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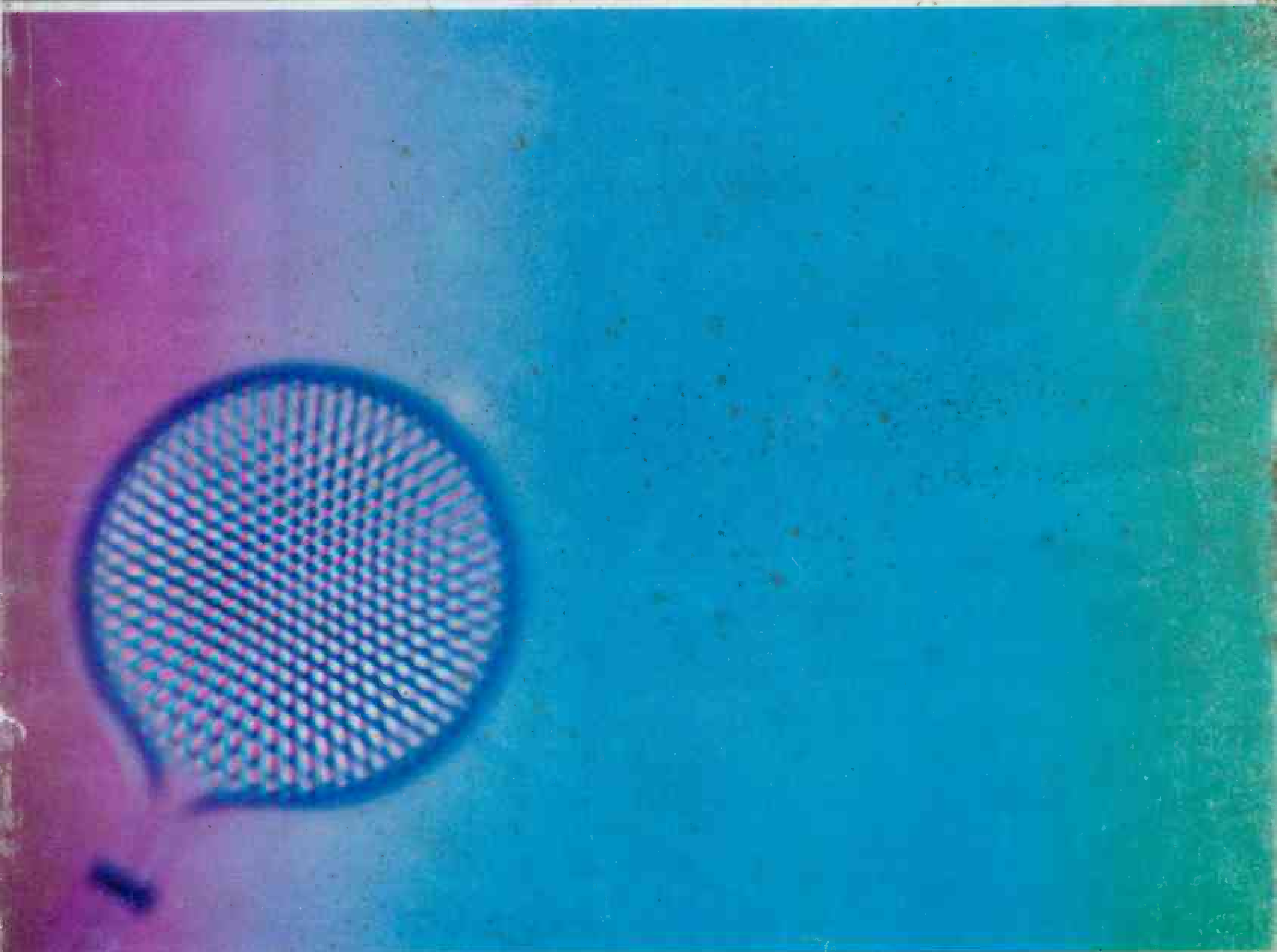
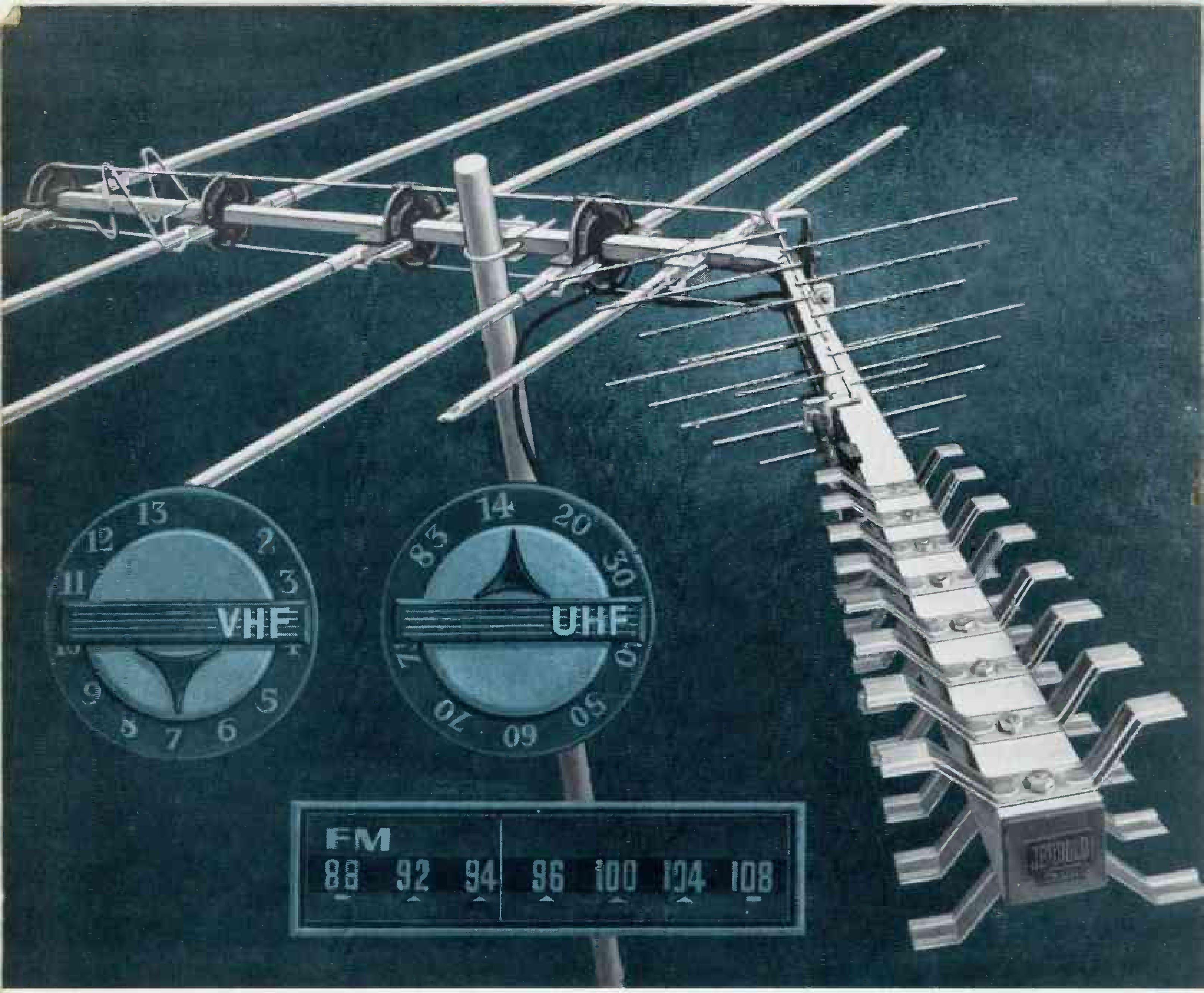


SPECIAL COLOR-TV ISSUE

- Know Your '66 Color Circuits
- Guideposts to Color Servicing
- Overall Alignment in Color Receivers
- Making Color Servicing Big Business
- Plus many more



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..KNOW YOUR '66 COLOR CIRCUITS

by Norman D. Tanner

The boom is on in color television. Sales in the past four months have increased beyond the most optimistic expectations. The fall viewing season finds the three major networks devoting a majority of their prime time to color telecasts. What does this mean to you? It means a greater necessity for technicians qualified to service color receivers. These pages will bring you up-to-date on new circuits in the 1966 models, and also review briefly some of the circuits that have been retained from previous models. First, though, let's have a look at some of the picture sizes.

CRT Sizes

The new year finds Admiral offering 21″, 23″, and 25″ models. Airline, DuMont, and Emerson all have 21″ and 25″ receivers. Electrohome (a Canadian manufacturer) is offering its 25″ rectangular set in the U.S. General Electric's new CB chassis is used in 21″ models, and this company also has a 12″ portable to be released soon. A 21″ round tube is used in the Magnavox T45 series, and both 23″ and 25″ rectangular tubes are found in sets using the T904 chassis. Motorola has 23″ and 25″ rectangular sets in its 1966 lines. Packard Bell has three screen sizes to choose from—a 21″, 23″, and 25″, and in the new Philco receivers you'll find 19″, 21″, and 25″ sets. Setchell Carlson's U802 chassis is used with both 23″ and 25″ tubes—both are rectangular. Sylvania features a round 21″ tube along with rectangular 19″ and 25″ tubes. RCA has three CRT sizes—a 19″ rectangular, a 21″ round, and a 25″ rectangular. Rounding out the new models are Zenith's 21″ and 25″ sets.

Luminance Channels

There have been some refinements—and in at least one case a major overhaul—of the circuits handling the luminance, or Y, signal. Here's what the various manufacturers have done.

The circuits are basically unchanged in the new Admiral receivers; however, some new tube types appear. The G11 chassis uses the pentode section of a 6BN11 (compactron) as the first video amplifier; the second video-amplifier stage uses the pentode section of a 10-pin decal-type tube, a 6Y9. Chassis G12 also has two video-amplifier stages, a 6EJ7 in the first stage and a 6HB6 in the second.

The circuit shown in Fig. 1 is used in Electrohome's 27P125 chassis. During a monochrome telecast, the video information is simply applied to the grid of the second video stage, amplified, and coupled to the third stage. During color reception, the signal on the grid of the bandpass amplifier causes it to conduct, and its plate current flows through R1 and R2. This lowers the potential at the junction of R1 and R2 and allows the neon light to fire, indicating color is being received. When the color-indicator light fires, the diode becomes forward biased, and the 3.58-mc signal components are shunted to B+ through the diode and series trap C1-L1. These frequency components are thus prevented from appearing in the output of amplifier V1.

Two tubes and one transistor are used in the video-amplifier stages of General Electric's CB chassis. The first stage uses the triode portion of a 6AU8A. The NPN transistor used in the second stage provides a low impedance that allows matching its collector output to the low input impedance of the delay line. Output of the delay line is fed to a 12GH7 used as the video output.

Magnavox, Motorola, Packard Bell, Setchell Carlson, and Sears are using circuits almost identical to those found in the '65 models.

The biggest news in the luminance-channel circuits is in Philco's 19″ and 25″ receivers. In these sets, the VHF and UHF tuners, video IF strip, video driver, and AGC stages are all transistorized. These circuits, with the exception of the video driver, are similar in operation to those found in black-and-white receivers. The video-driver stage, however, requires a closer look.

The first and second stages are shown in Fig. 2. The output of the video detector is applied to the grid of the first stage, and the amplified signal at the plate is divided for application to the noise inverter,

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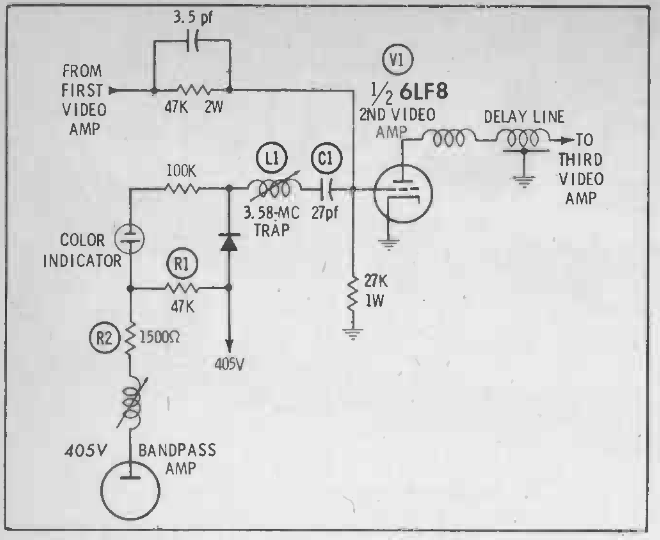

Fig. 1. Color indicator light is controlled by bandpass amp.

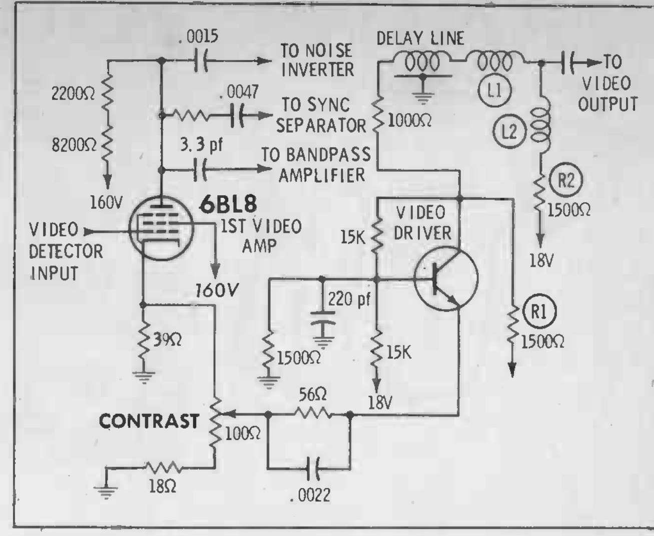

Fig. 2. Transistor serves as video driver in Philco's set.

sync separator, and bandpass amplifier. The luminance signal is taken from the first-stage cathode. Its amplitude is adjusted by the setting of the contrast control, and it is then applied to the emitter of the video-driver transistor. This stage is a common-base amplifier, and the bias is controlled mainly by the divider resistors in the base circuit. With the 1500-ohm collector load resistor (R1), the output of the stage is matched to the delay line. L1 and L2 are peaking coils which affect primarily the high-frequency signal components. Additional high-frequency peaking is provided by the low value (220 pf) of the base bypass capacitor. Output termination of the delay line is provided by R2.

The most notable change in Sylvania's receivers is the two-stage video-IF strip used in the D03 chassis. A 5JL6 and a 5KL6 are used as the first and second video-IF amplifiers, respectively. The other two chassis in the '66 line both use a conventional three-stage IF.

RCA's CTC16X, CTC17X, and CTC19 use basically the same luminance-channel cricuits as those found a year ago. In the CTC17X chassis, more complete blanking of the picture tube during vertical retrace is accomplished by using a transistor in the vertical-blanking stage. This transistor is actually a switch that causes increased conduction of the second video-amplifier stage during vertical retrace. Increased conduction causes a more positive signal to be applied to the CRT cathodes, insuring cutoff of the picture tube. When signal tracing in the second or third video-amplifier stages, remember that the composite video waveform, especially the vertical-sync portion, is altered somewhat.

The '66 Zenith receivers also incorporate improved blanking circuits. This year, both horizontal- and vertical-blanking signals are injected into the grid of the "Y" amplifier.

This covers what has happened since a year ago to the design of circuits handling luminance information. Now we move along to the chroma stages.

Bandpass Amplifiers

A two-stage bandpass amplifier circuit is used in all three of Admiral's new chassis. The schematic

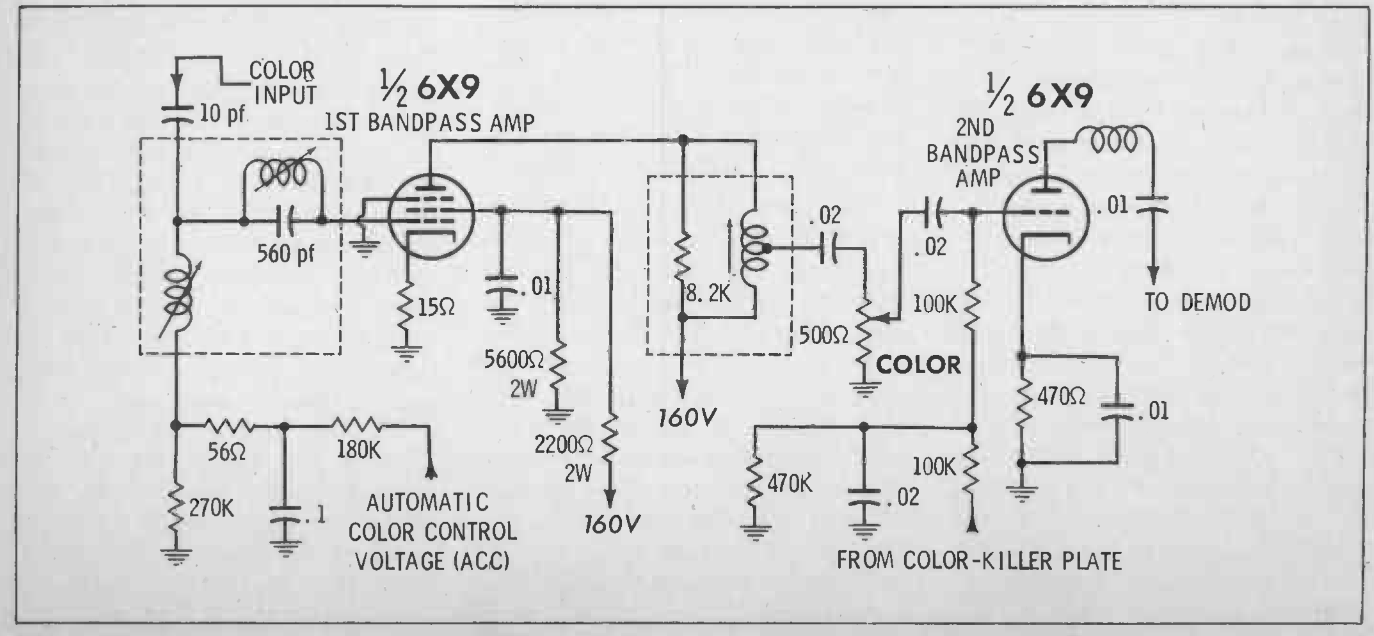

Fig. 3. 6X9 operates in both bandpass amplifier stages in the new Admiral receivers—ACC controls first section.

in Fig. 3 shows the design used in the G11 and G13 chassis. The G12 has a similar circuit but uses a 6GH8 and 6LM8 instead of the 6X9 decal 10-pin. Notice in Fig. 3 that the gain of the first bandpass stage is controlled by the automatic-color-control voltage. (We'll go more deeply into how this is accomplished a little later.) When color isn't being transmitted, the second bandpass stage is cut off by a negative voltage applied to the grid from the color-killer plate.

Bandpass-amplifier stages in General Electric, Magnavox, Motorola, Packard Bell, RCA, Sears and Setchell Carlson are all the same as those used in earlier models.

Automatic color control (ACC) seems to be popular in the new chassis. Fig. 4 shows the circuit used by Philco. The automatic-color-control detector operates in the same manner as the killer detector used in earlier models, but the ACC controls the bandpass amplifier as well as the color killer.

Here is how the ACC voltage is developed and how it affects the conduction of the bandpass amplifier. When a burst signal is applied to the primary of T1, signals of opposite phase are present on the anode of X1 and the cathode of X2. A sample of the 3.58-mc oscillator signal is applied to opposite sides of these diodes. The positive half-cycle on the anode of X1 causes it to conduct, since the oscillator signal on the cathode is 180° out of phase. When X1 conducts, current passes through R1, the common grid resistor for the color killer and bandpass amplifier. X2 will not conduct as long as a relatively strong burst signal is present, because nearly the same potential is maintained on both the cathode and anode. When the amplitude of the burst signal decreases, conduction through X1 decreases; the voltage drop across R1 is lowered, and in turn the bandpass-amplifier bias decreases. This causes increased conduction in the bandpass stage when a weak color signal is being received. When no burst signal is present, diodes X1 and X2 conduct on opposite half-cycles of the oscillator signal, and equal but opposite current pulses pass through R1. The result is zero DC voltage across R1-

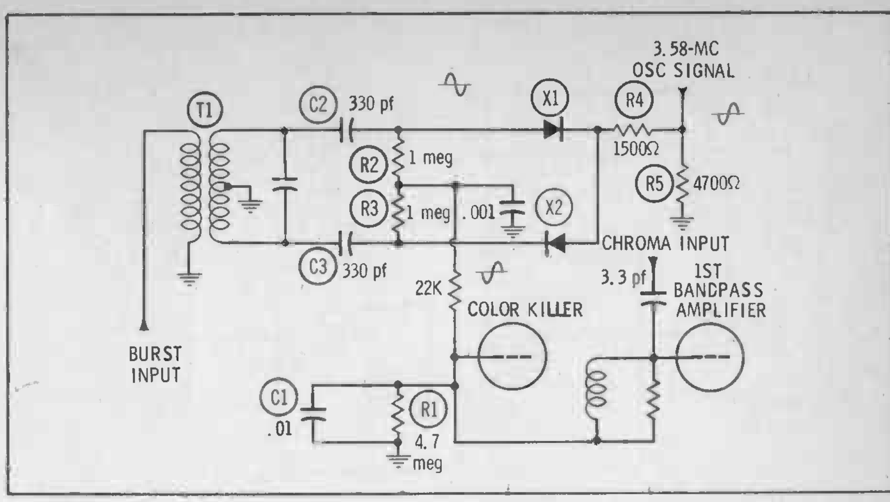

Fig. 4. ACC voltage governs gain of bandpass amplifier in this Philco design.

C1 and on the grid of the color killer. When the color-killer tube conducts, it cuts off the second bandpass-amplifier stage.

Sylvania's D01 and D02 chassis also have an automatic chroma-level-control circuit. Although a 6JU8 is used as the killer detector, the circuit operation is similar to that just described.

Fig. 5 shows the color-killer and ACC circuit used in Zenith Chassis 24NC31. During monochrome reception, the second bandpass amplifier is cut off by a negative voltage derived from the grid of the horizontal oscillator. When a color signal is received, an ACC voltage is developed and causes a more negative voltage to be present on the grid of the first bandpass amplifier. This increased negative voltage causes the first-stage screen voltage to increase considerably. This increase is reflected through R1 and the color-killer control to the grid of the second bandpass stage, where it overcomes the cutoff bias and allows the tube to conduct. Diode X1 prevents the grid of the second bandpass stage from becoming positive, because it conducts if its anode is more positive than its cathode.

Color-Sync Stages

The color-sync stages in Admiral's G12 chassis (25") and G13 chassis (23") are almost identical to those in earlier-model color sets by this manufacturer. However, Chassis G11 does have a refined color-sync circuit; it is shown in Fig. 6. The 3.58-mc signal is developed by an injection-lock type of oscillator. This oscillator functions whether or not a color program is being received, but during color reception, it is synchronized with the burst signal coupled through transformer L1. Bias voltage for the color killer and color-control voltage for the first bandpass-amplifier stage are developed by diode X1. This diode is connected in the grid circuit of the reference oscil-

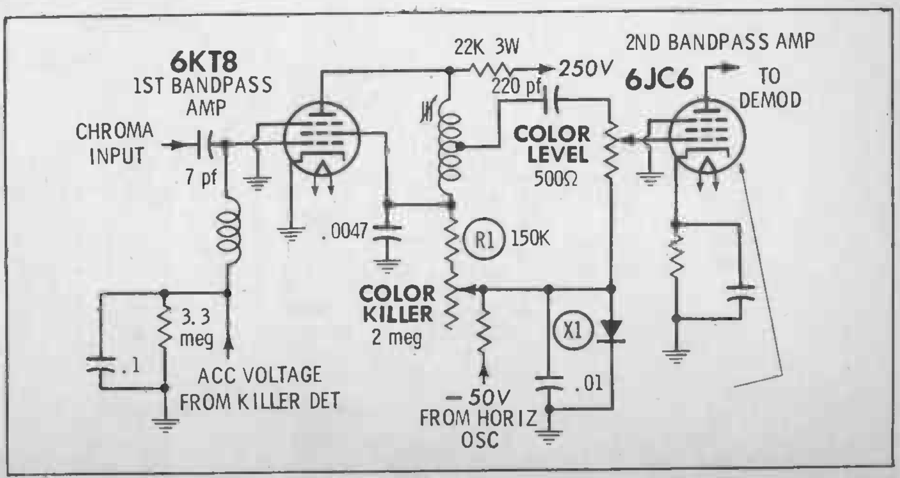

Fig. 5. Zenith derives voltage from horizontal oscillator to cut off bandpass.

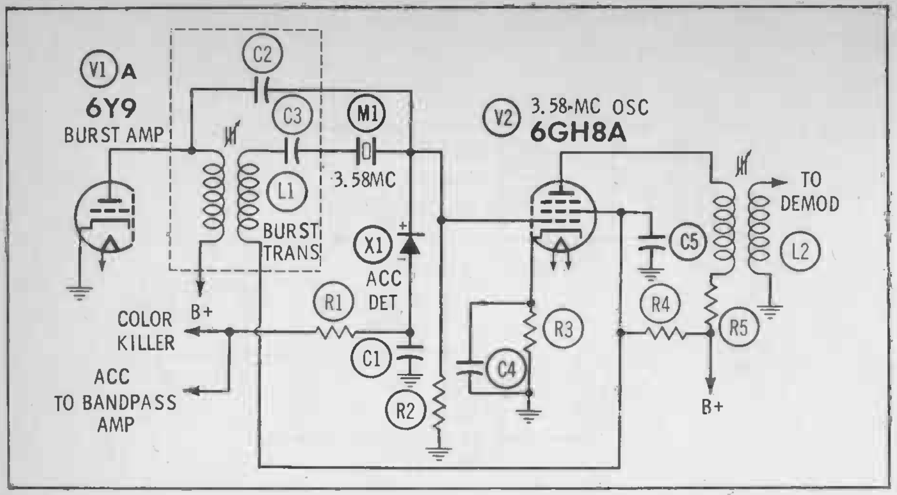

Fig. 6. 3.58-mc oscillator in Admiral G11 chassis operates without burst present.

lator and rectifies the 3.58-mc signal. When a burst signal is present, the diode increases conduction, and the negative DC voltage at the junction of R1 and C1 also increases. This increased voltage biases off the color killer and controls conduction of the first bandpass-amplifier stage in accordance with the strength of the incoming color signal. In other words, the weaker the burst signal is, the harder the bandpass stage is allowed to conduct.

The color-sync circuit shown in Fig. 7 is used in General Electric's CB chassis. In this circuit, the familiar oscillator tube has been omitted—the 3.58-mc signal is developed by a ringing circuit consisting of L3 and X1. Here's how this is accomplished. With no input, the tube is cut off, and L2 and C3 act as a series-resonant trap holding the grid at ground potential for 3.58 mc and reducing plate-cathode capacitive coupling at this frequency. When a positive pulse from the horizontal-output transformer is applied to the resonant circuit composed of L1 and C1, this circuit produces a damped train of oscillations at approximately 90 kc. The first positive half-cycle in this train is the only one of sufficient amplitude to fire neon bulb M1. When this bulb fires, a square wave is developed across R1 and causes the burst gate to conduct. During this period of conduction, the burst signal from the bandpass amplifier is applied to the cathode of the burst gate. This signal, when amplified and applied to the high-Q resonant circuit consisting of L3, X1, and C6, causes it to ring at 3.58 mc. Since the tuned circuit is excited only during horizontal-retrace time, the 3.58-mc signal decays in amplitude during trace time. The amplitude of the signal applied to the grid of the subcarrier amplifier is adjusted by L4. The tube functions as a limiter to maintain constant amplitude of the 3.58-mc signal applied to the demodulator circuits.

Magnavox, Motorola, Packard Bell, Sears, Setchell Carlson, Sylvania, and Zenith have simply carried over their color-sync circuits from previous models.

Philco has a basically unchanged circuit in its 16QT85 and 17KT50 series. The minor modifications include making the Z-demodulator phasing coil tunable, changing the chroma phase detector and killer to a pair of diodes, and changing the burst amplifier from a 6EW6 to a 6GH8A.

Only minor color-sync changes have been incorporated in RCA's new receivers. The CTC16X uses a frame-grid 6JC6 in the burst amplifier stage (Fig. 8)—last year's CTC16 used a 6EW6. The new tube has considerably more gain than the old and provides better lock-in of the reference oscillator both in strong-signal and fringe areas. Notice in Fig. 8 that the screen grid is now tied directly to the 270-volt source. This same circuit and tube type are used in the 25" CTC17X chassis.

Demodulators

The circuit shown in Fig. 9 is used in Admiral's G11 and G13 chassis. The single demodulator tube feeds the red, blue, and green grids of the CRT. The chroma signal is applied to pin 9 and the 3.58-mc cw signal to pins 2 and 7 of the demodulator tube. There are actu-

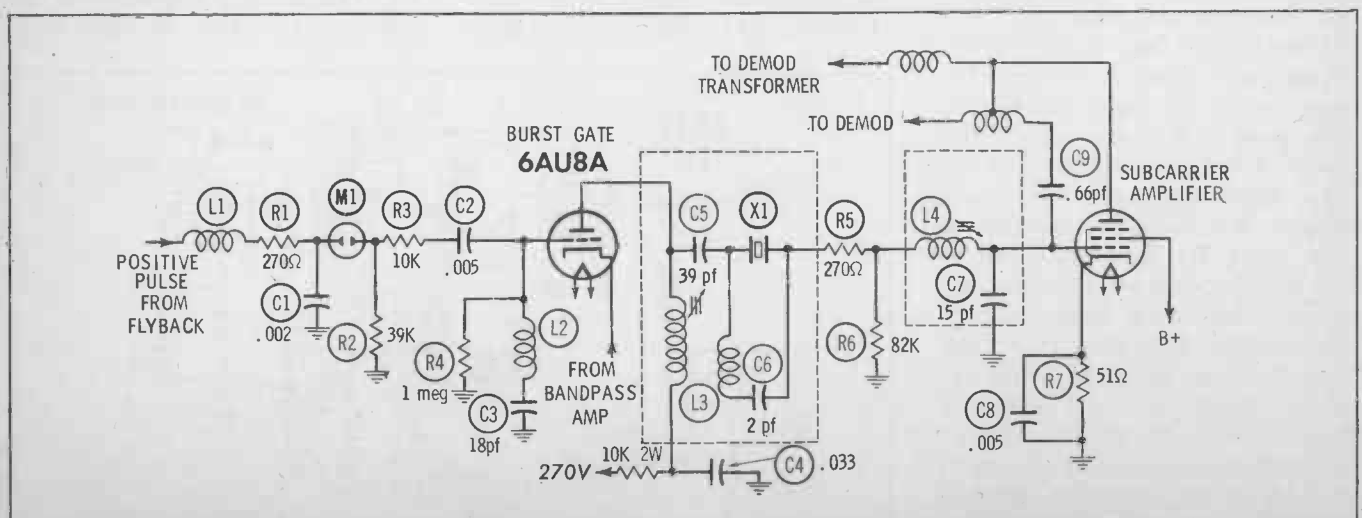

Fig. 7. General Electric's CB chassis uses ringing circuit and a subcarrier amplifier to develop 3.58-mc signal.

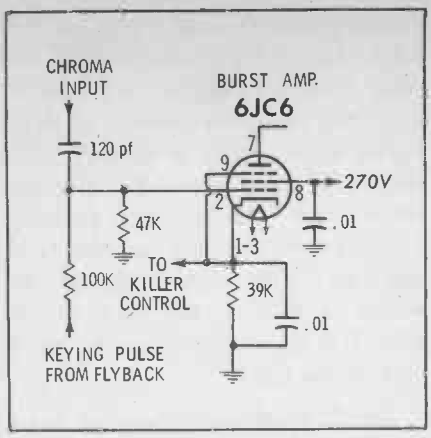

Fig. 8. Burst amp is frame-grid tube.

ally three separate tubes inside this single envelope; all have a common cathode and control grid. In Fig. 9, the left-hand section of the tube is the B-Y demodulator, the right-hand section is the R-Y demodulator, and the second grid functions as the plate of the G-Y demodulator. The network between pins 2 and 7 shifts the phase of the reference-oscillator signal about 90°. Since the control grid is common to both halves of the tube, the phase of the chroma signal is the same for both sections. The electrons in the two sections are acted upon so that the B-Y signal is reproduced at pin 6 and the R-Y appears at pin 1.

Development of the G-Y output is somewhat involved; it depends on the fact that a −(G-Y) signal can be produced by mixing R-Y and B-Y signals in the proper proportions. There are two factors involved in the operation of this circuit. First, the signal at the screen terminal depends on plate-circuit conduction—when fewer electrons go to the plates, more go to the screen. Since this grid is common to both sections of the tube, the signal at pin 8 is affected by changes in conduction to both plates; if both sections are cut off, screen conduction is maximum, and if either section is at maximum conduction the screen conducts least. In addition to this action, portions of the R-Y and B-Y outputs are matrixed (by R3 and R4) and fed back to the control grid. Both actions combine to produce the G-Y signal at pin 8.

Don't look for the demodulator tubes in General Electric's CB chassis, because there aren't any. The diagram in Fig. 10 shows a balanced-diode synchronous-detector network. Except for the phase of the injected

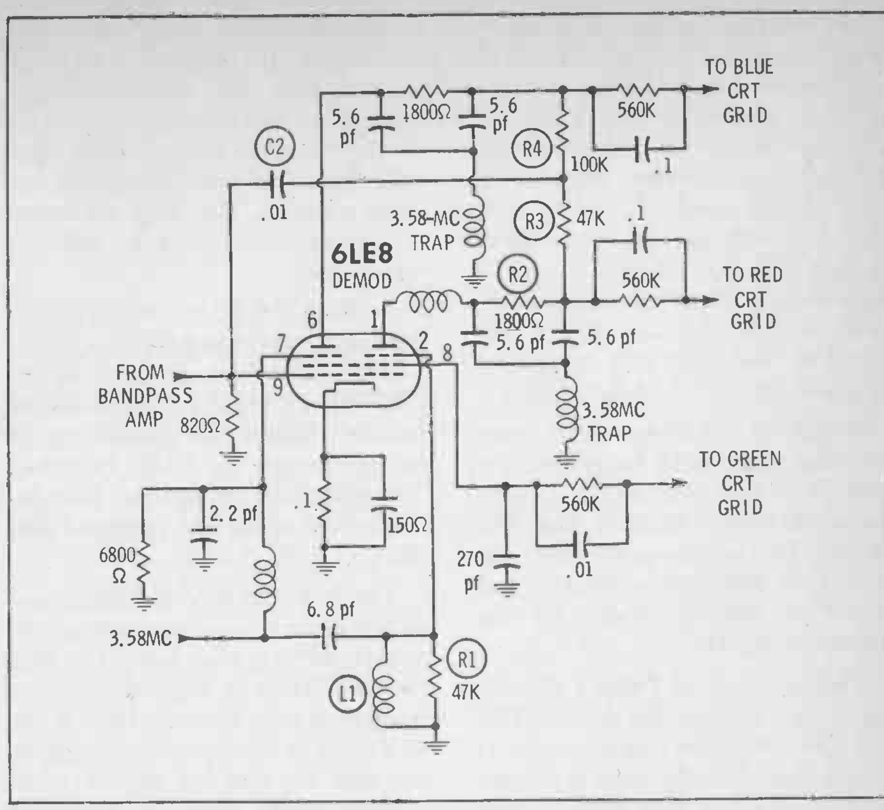

Fig. 9. Single demodulator tube develops difference signals in the Admiral G11.

3.58-mc signal, each of the detectors functions in the same manner, so a look at how the B-Y signal is developed will explain all three.

Notice that the chroma signal applied to the anode of X1 and the cathode of X2 is of exactly the same phase. However, the 3.58-mc signals at the cathode of X1 and the anode of X2 are 180° out of phase because of the center-tapped secondary of L1A. During every other half-cycle

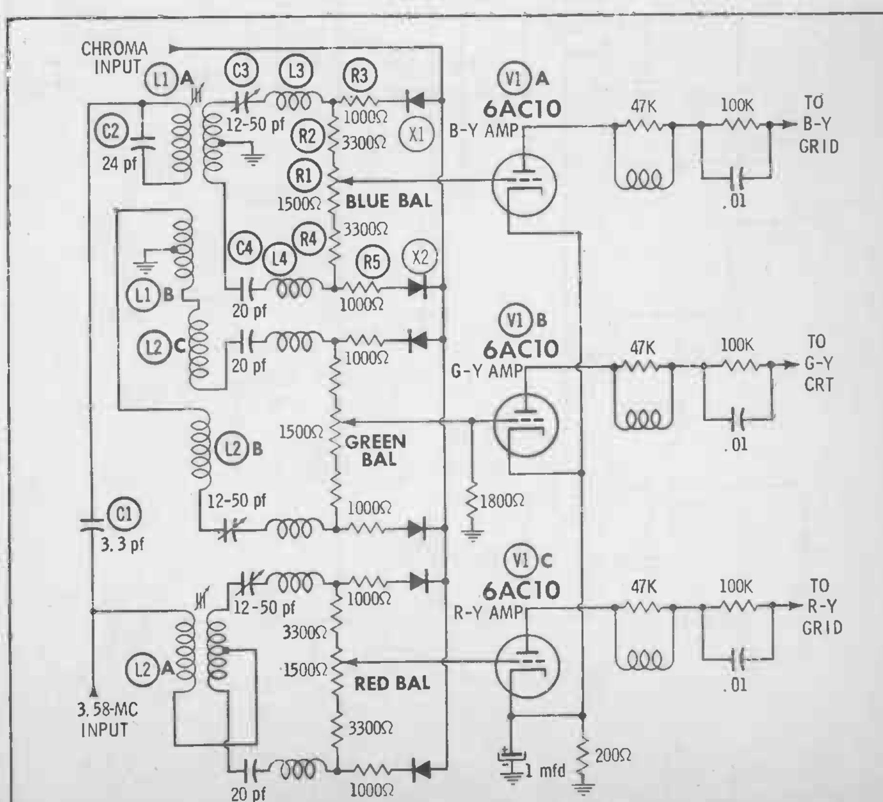

Fig. 10. Demodulator tube(s) is replaced by diodes in new General Electric receiver.

of the 3.58-mc voltage, a negative signal is applied to the cathode of X1, and, at the same time, positive signal is applied to the anode of X2; the diodes are switched into conduction and connect the chroma input to the amplifier grid in synchronism with the 3.58-mc signal. In this way, the chroma signal is demodulated. The balanced arrangement of R1, R2, and R4 is adjusted to keep the grid at ground potential for the 3.58-mc signal.

Magnavox and Motorola are using the same circuits in recovering the R-Y, B-Y, and G-Y signals as they did a year ago. Packard Bell and Setchell Carlson are again using the familiar X and Z demodulators and individual amplifier stages for the difference signals.

The operation of Philco's demodulator circuit (used in the 16QT85 and 17KT50 series) is the same as before, but different tube types are used. A 6BL8 is now used in both stages. 6BL8's are also used in the difference-amplifier stages, but the circuit operation remains virtually unchanged. In fact, it's interesting to note that only two tube types (6BL8 and 6GH8A) are used in all of the chroma stages. Only nine tube types are used throughout the entire receiver, including the tuners —last year there were 21 different types in use.

In RCA's CTC16, 6GY6's were used in the color demodulator stages —these have been replaced in the CTC16X by 6HZ6's. This new tube further reduces the possibility of snivets caused by UHF radiation. The same tube change has been incorporated in the 25" receivers with the CTC17X chassis.

The B-Y and R-Y difference amplifiers have been eliminated in Sylvania's 19" receiver using the D03 chassis. This was made possible by using high-level demodulation in the R-Y and B-Y demodulator stages. As can be seen in Fig. 11, the chroma signal from the bandpass amplifiers is applied to the cathodes of these tubes, and the 3.58-mc reference signal is fed to the control grids. The grid-circuit clamping diodes prevent changes in control-grid bias from occurring when a strong color signal is present. The outputs of the B-Y and R-Y demodulators are matrixed to produce −(G-Y) at the grid of the G-Y amplifier. This signal appears inverted to G-Y at the plate of the tube; it is then coupled to the green grid of the CRT.

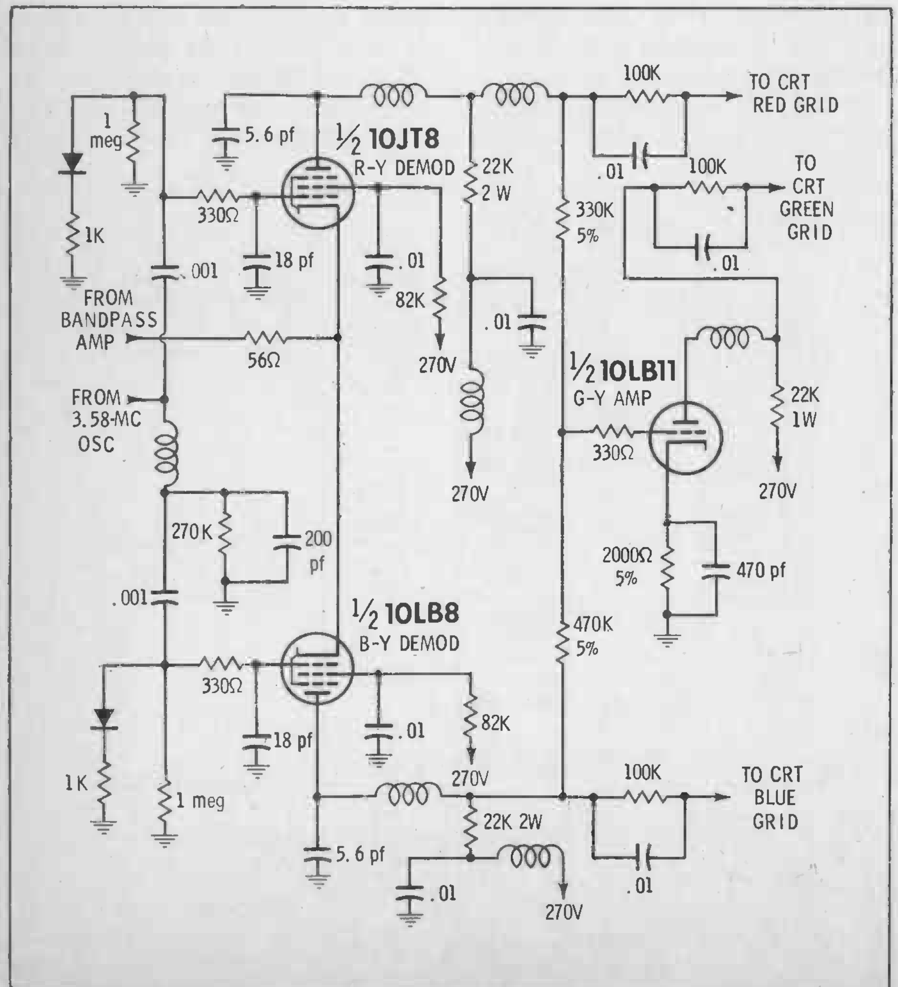

Fig. 11. Sylvania D03 chassis has high-level demodulation and separate G-Y amp.

Zenith continues to use the same high-level demodulation system that they have had for several years. Special-purpose, high-gain tubes are used in the demodulator stages, and difference amplifiers aren't required.

Horizontal Sweep and High Voltage

Many of the circuits used in the horizontal-output and high-voltage stages have undergone modifications since a year ago. One exception, however, is Admiral's G12 chassis —it remains the same as in 1965. However, this company's other two chassis, G11 and G13, have been revised. A pair of 6JM6's are now used in the horizontal-output stage, and the high-voltage regulator has been replaced by the diode shown in Fig. 12. The purpose of this diode is to maintain current regulation in the output stage when the load varies because of increased or decreased brightness. A positive pulse from the flyback transformer determines the amount of bias voltage developed by X1 for the output stage. When the feedback pulse is reduced in amplitude, because of an increased load on the output transformer, less bias voltage is applied to the horizontal-output tubes. The tubes then conduct harder, and the decrease in output is opposed. If the load on the horizontal-output transformer is lessened, more bias voltage is developed, and the output tubes conduct less.

General Electric, Magnavox, and Sears have primarily the same circuits as they did a year ago.

Motorola Chassis ETS908 and TS917 also remain unchanged, but their TS914 chassis has several modifications. The high-voltage rectifier, focus supply, and automatic-degaussing stages shown in Fig. 13 are used in the TS914. The focus

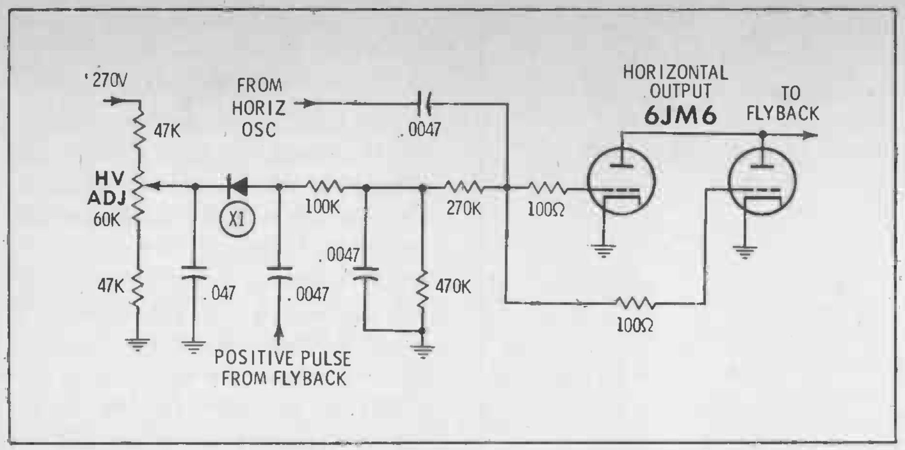

Fig. 12. High-voltage regulator tube has been replaced by diode in Admiral's G11.

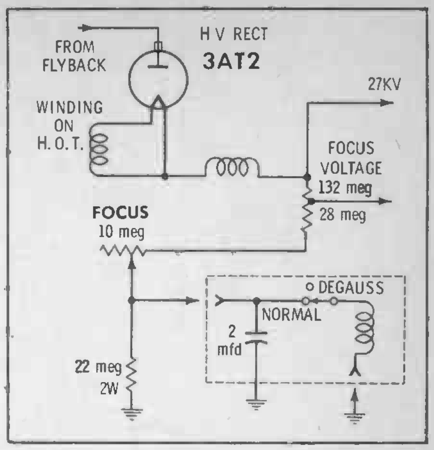

Fig. 13. Degaussing is in HV circuit.

voltage divider consists of a special high-voltage resistor (160 meg) and a control. The special resistor is constructed from 34 individual 4.7-meg resistors connected in series.

A color CRT normally requires approximately 20% of the second-anode voltage for focusing. If the anode voltage changes, the focus voltage must also change to maintain proper focus. In this chassis, the focus voltage is taken from the second-anode voltage source and is always the correct percentage of the high voltage.

The CRT can be automatically degaussed by operating a spring-loaded switch on the rear of the cabinet. When the switch is pushed to the degauss position, the 2-mfd capacitor becomes charged from the high-voltage source. When the switch is released, the capacitor discharges through the coil, setting up a magnetic field that degausses the picture tube. When the switch is in the normal position, the capacitor cannot charge because it is shunted by the low resistance (1 ohm) of the degaussing coil.

Chassis TS914 employs sweep rather than high-voltage regulation to maintain convergence at different brightness settings. The circuit is shown in Fig. 14. A pulse from the flyback transformer is rectified by diode X1 to supply bias for the horizontal-output tube. When the brightness is increased, the load on the output stage is increased, and the feedback pulse is reduced. This reduction causes a decrease in horizontal-output grid bias and an increase in output power to the flyback; nearly contant raster size is maintained with various brightness-control settings. This system does not compensate for resistance losses in the high-voltage winding and rectifier tube; these losses are insignificant as long as the proper focus is maintained.

Packard Bell's 98C9 and 99C1 chassis are using the same circuits as were found in comparable 1965 models. Chassis 98C10 embodies some slight changes. The boosted-boost rectifier is gone, and the focus rectifier is a 2AV2 instead of the familiar 1V2.

Philco's hybrid receivers have all new tubes in the horizontal and high-voltage sections. The reactance and oscillator stages use a 6BL8, the horizontal output is a 6DK6, a 3AT2 serves as the high-voltage rectifier, and a new tube, type 6CG3, functions as the damper.

A 6JE6A is used in the horizontal-output stage in Setchell Carlson's U802 chassis. This tube has construction that eliminates the need for additional circuitry to suppress snivets from UHF radiation.

A couple of tube changes are about the only difference between the horizontal and high-voltage sections of this year's RCA sets and those of 1965. In the CTC16X chassis, the 1V2 focus rectifier has been replaced by a 2AV2, and the high-voltage rectifier has been changed to a 3CA3. The substitution of these new tubes makes it unnecessary to use filament-dropping resistors.

The horizontal-regulator circuit shown in Fig. 15 is the biggest news from Sylvania. It is found in their D03 chassis; Chassis D01 and D02 have circuits similar to last year's. When the positive pulse from the flyback transformer is reduced, conduction of the regulator triode is also reduced. The plate voltage on the regulator tube rises and causes the horizontal-output tube to conduct harder. The neon tube in the cathode circuit of the horizontal

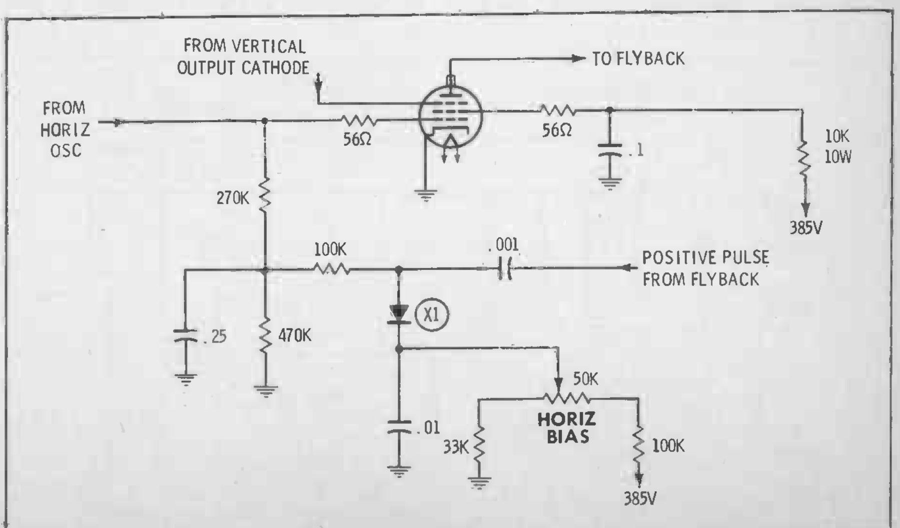

Fig. 14. Motorola TS914 uses sweep regulation instead of high-voltage regulator.

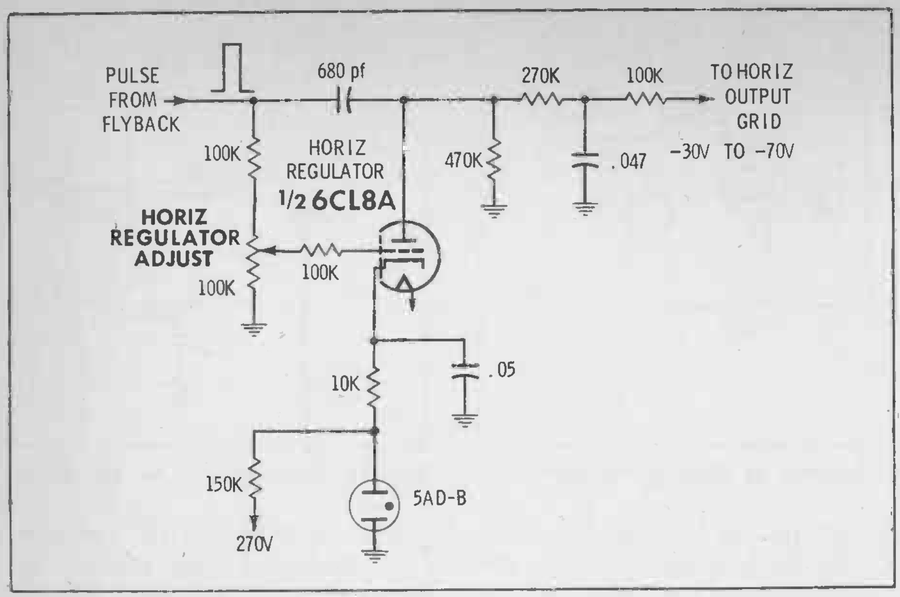

Fig. 15. Sylvania has triode section of a 6CL8A operating as horizontal regulator.

regulator provides a reference voltage to maintain a constant output even with changes in line voltage.

The horizontal-output and high-voltage stages used in Zenith receivers haven't undergone any changes for the new model year.

Pincushion Circuits

All manufacturers offering rectangular picture tubes have incorporated a circuit to correct for pincushioning at the top, bottom, and sides of the raster. The exact procedure depends on the manufacturer. Briefly, here are some of the methods you'll find being used.

Admiral doesn't use a pincushion corrector tube. Instead, a horizontal pulse is applied to a correction transformer and a current injected in series with the vertical-yoke coils to prevent distortion of the horizontal lines at the top and bottom of the screen. Correction to the horizontal yoke coils prevents added distortion at the raster edges.

Magnavox uses a 12AX7 as its pincushion amplifier. Pulses 180° out of phase are applied to the grids of the triode sections of this tube, as can be seen in Fig. 16. The bias is such that the tube conducts only on the positive half-cycles of the grid waveform. The horizontal signal is coupled from one side of the horizontal yoke windings to the grid of the first section and the cathode of the second section of the 12AX7. The resultant output signal shown in Fig. 16 applies maximum correction voltage when the vertical sweep is at the top and bottom of the screen.

Basically, the pincushion circuit in Motorola's TS914 chassis is unchanged from last year. The tube has been replaced by a transistor, but operation is basically the same.

The circuit used in Philco receivers is essentially the same as that described for Admiral. Setchell-Carlson uses a 6GK6 as a pincushion corrector tube. Sylvania has a 6GH8A serving this purpose. RCA has eliminated the adjustable side pincushioning control; it is replaced by fixed-value components in the CTC17X, but otherwise the operation is the same as in the CTC17. Zenith's pincushion circuit was described in detail in the May 1965 PF REPORTER.

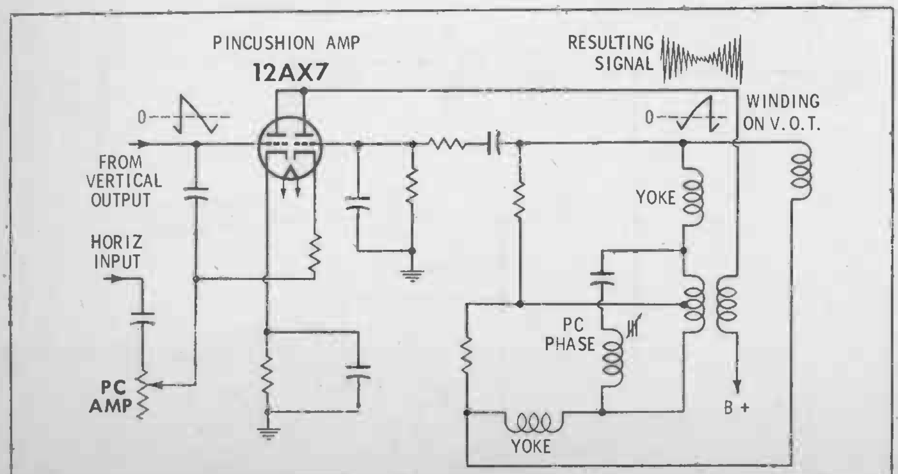

Fig. 16. Magnavox method of obtaining pincushion correction for rectangular tube.

Power Supplies

This year's low-voltage power-supply circuits are much the same as those used in earlier years. In practically all 1966 lines, you will find either two silicon rectifiers connected in a fullwave or halfwave voltage-doubler arrangement or four silicons operating in a bridge-rectifier network. Sylvania's D03 chassis was designed using tubes that operate from a lowered B+ voltage; the output of the low-voltage rectifier in these sets is only 270 volts.

Automatic degaussing is incorporated in practically all the new models, regardless of the manufacturer. Degaussing methods were described in the September 1965 PF REPORTER.

Conclusion

Many of the circuits used in 1966 color receivers will be familiar; other circuits have only minor changes. Still others have undergone a major overhaul, and there are a few that are being used for the first time.

Color servicing is going to snowball in the not-too-distant future. The best way to be sure that you get your share of this increased business is to be prepared to service the sets more quickly. One of the necessities in preparing yourself is to keep abreast of changes as they occur. By doing this, you won't be in the dark when asked to service a new chassis for the first time.

That's the picture for 1966—but we'll be back again next year to report the changes that are now on the drawing boards. ▲

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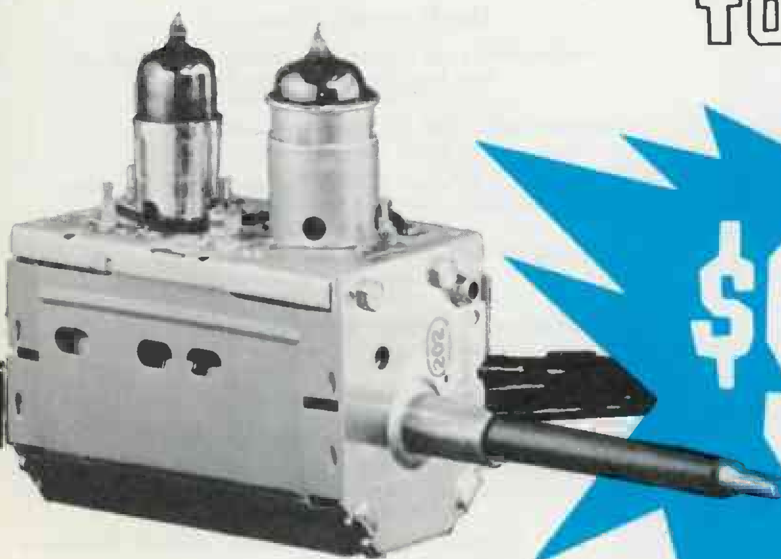

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PF Reporter™
PHOTOFACT

the magazine of electronic servicing

VOLUME 15, No. 11 — NOVEMBER, 1965

CONTENTS

ABOUT THE COVER

This, our fourth Annual Color-TV Issue, is the largest PF REPORTER ever published—128 pages. On our cover, the magnified dot structure of a color CRT exemplifies the depth and concentration we devote to color servicing the year around. Articles that show you how to understand and repair color receivers begin on page 1, with the special 8-page section, and continue throughout the entire issue.

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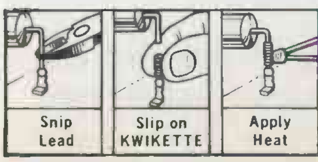

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Letters to the Editor

Dear Editor:

I've never written an editor before, so I thought it was about time I did, to let you know how much I appreciate everything you are doing to help us guys who try to turn out a good job on every piece of equipment that comes into the shop. It sure beats me how the men who write your articles can so expertly arrive at the cause of a TV ailment and immediately correct it. I really have to dig in to find most of my solutions to TV problems.

I just thought I'd tell you for myself and the rest of the guys I know: We really appreciate what you do for us in PF REPORTER and in answering our letters for help. I can't understand how The Troubleshooter keeps so much knowledge in his head. . . . Well, I'd better stop; I see the old RCA that is my headache for today is beginning to act up again. Thanks.

NAME WITHHELD

City Withheld, Too.

Thanks to you, N. W. There really isn't any secret to the rapid troubleshooting you read about in PF REPORTER *articles; it's quicker to read about it than it is to run down the trouble. However, the successes of The Troubleshooter and any other competent technician are the result of these rules: (1) Learn to understand the fundamentals of circuit operation; (2) Learn to recognize the locality of a trouble from its*

"Could you use a promising technician? I promise anything!"

symptom; (3) Have the proper equipment and know how to use it; (4) Use logical, step-by-step servicing procedures instead of haphazard hit-or-miss testing. Those four points will make a tough-dog expert out of any technician. If they require extra study, better take the time to do it. Electronic gear is getting more complex, not simpler; there's no time to waste.—Ed.

Dear Editor:

In the August 1965 issue, The Troubleshooter should have advised Mr. Waters (page 64) to modify the circuit by merely clipping out the 220-ohm resistor. The transistors will bias themselves and work perfectly. We have had to do this to all first-run Bendix 2TBO, 3TBD, and 3TBO models (covered in the PHOTOFACT AR-19 Auto Radio Manual).

WEBSTER H. FOULON
Cheney, Wash.

As The Troubleshooter pointed out, Bendix modified the circuit themselves to overcome the problem. However, we see nothing to prevent using your method, except possible shortening of transistor life by altered biasing.—Ed.

Dear Editor:

In your July 1965 issue, Jack Beever's article on "Phasing Multiple Antenna Systems" (page 24) suggests the use of a hybrid splitter mixer. Would you please explain what this is? Is there a way to avoid the 3.5-db loss in these splitters, which wastes signal we need in our installation?

L. LATOUR MURPHY
Tacoma, Wash.

Author Beever answers this and other letters: Your problem with the 3.5-db "loss" is one which has puzzled many men. The primary use of such splitters, as indicated by the name, is as RF power splitters, and their specs refer to them as such.

If you split (divide) a given power in half, each half you get will be 3 db less than the original amount. This, in effect, says that under these circumstances you have no loss; it's just like changing a half dollar into quarters—you still have 50 cents.

Consider the splitter as a transformer with one primary and two secondaries. If you put one watt into the primary, you can get one-half watt at each secondary, less the small transformer losses. But these devices work both ways. If you put a half-watt into each of the secondaries, you can draw a watt from the primary, so long as the currents are in phase.

This is exactly what a hybrid splitter is, just a fancy variety of two-secondary transform. The extra .5 db is the real loss, and this is the maximum loss of the worst sample at its worst frequency. They really average only about 3.2-db splitting loss.

In actual practice, if you stack a pair of antennas with hybrid splitters, and the antennas are evenly illuminated, both getting the same signal, you will see very close to twice the power of one—a 3-db increase. This is not twice the voltage; it's only about 1.4 times the voltage. Twice voltage is four times power, and you couldn't get four times the power of one antenna from two antennas—it ain't natural!—J.B. ▲

"Hey, Sarge, the TV is on the blink. How about having one of the boys arrest a repair guy?"

TECHNICIAN'S HOLIDAY

I worked all day
to fix each set;

Was bushed
and I'm not jokin'.

Sat down that night
to watch TV,

And found
MY set was broken!

—Phyllis Barlow

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The Electronic Scanner

news of the servicing industry

Bedside Manner

A few years ago, Charles Golenpaul, vice president of **Aerovox Corporation** spoke before the Philadelphia Service Men's Association about "bedside manners." Drawing an analogy to the doctor who comes into the home to examine a patient, diagnose his ills, and effect a cure, Mr. Golenpaul pointed out that "bedside manner" was a highly important part of the cure because it gave the patient confidence in the doctor and therefore in getting well.

Much the same was true for the television repairman then, and it remains so today. Personal appearance and personal mannerisms go a very long way toward building a business. It should be too obvious to bear repeating here, but the fact remains that there are hundreds, if not thousands, of TV servicemen who just never get a grip on the idea.

Says the Aerovox executive: "Oh, I don't imagine there are very many around in really dirty clothes spouting uncouth language and insulting the patient's (customer's) intelligence with a cryptic and unexplained 'it's gotta go to the shop' and similar statements. People have become a little too sophisticated for that kind of line.

"But, TV servicing is a competitive business, and too few servicemen realize the sales value, the promotional effect, of that extra measure of effort. A thing as simple as a neat, clean, and crisp uniform can make a world of difference—makes you look like a professional, and that makes the customer think of you as a professional. And if you're any kind of a real serviceman, you can diagnose the problem on the spot—at least nearly enough to give the customer a simple explanation of what's probably wrong and why that particular problem must be attended to in the shop. (And for gosh sakes, stop and think about how you talk to people; if you're not sure you use fairly decent grammar and the like, check into a local adult education class for speech improvement. After all, you're in a business that demands you talk to people every day. Do you want to sound like a clown? Will those people stay customers for long if you do?) And another thought on explaining circuit problems and failures to people: Try to keep it at a level they'll understand, but don't worry if it goes a little over their heads. People like to be flattered, and most are when you imply a little more knowledge than they really have.

"So give a little thought to your bedside manner. It can include a lot of things I've not touched on here, but your imagination and good sense will point them out to you. Remember the old adage about word of mouth being the best advertising? Well, customer confidence based on a good bedside manner is the best way to create word-of-mouth advertising."

Color-TV News

Production of color television receivers so far this year is nearly double that of the same period in 1964, while output of black-and-white sets remained just about at last year's level.

An expansion program at **RCA** is designed to more than double RCA's color-TV production capacity within two years. "This $50-million expenditure is being made in response to the explosive increase in consumer demand which has made color television the fastest growing industry in the world today. Approximately 2000 new jobs will be created at RCA's color TV plants."

An RCA executive predicts that annual color receiver sales will grow from more than 2.3 million sets in 1965 to well over 5 million sets in 1970, at which time color will have achieved at least a 40% saturation of the nation's television homes. Color will account for 25% of all TV sets sold in 1965, and the total dollar volume of color-set sales at the retail

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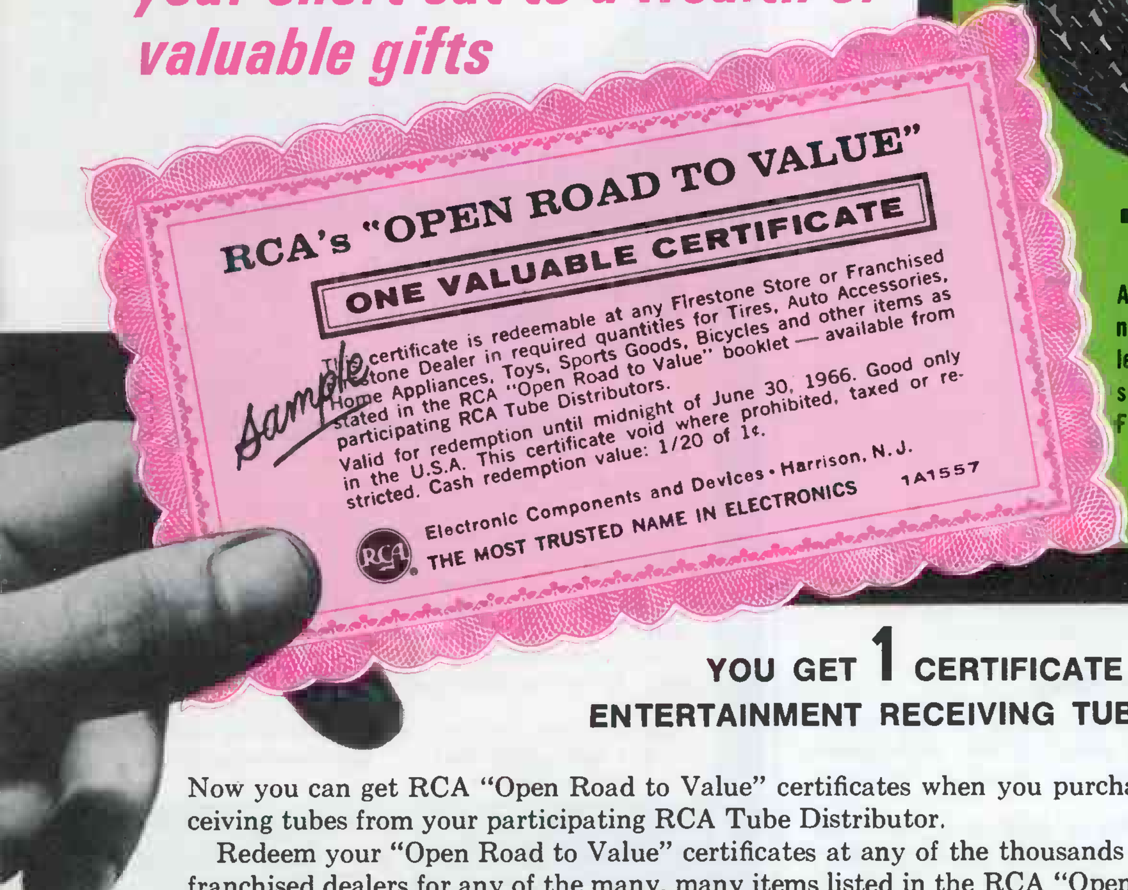

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level will exceed that of black-and-white for the first time ever — rising to a record $1.2 billion.

It appears that the supply of color picture tubes is the limiting factor in color-TV sales this year. On the strength of current demand, dealers probably would be able to sell anywhere from 300,000 to 500,000 more sets this year if enough tubes were available.

At least two manufacturers will be including 21" rectangular color picture tubes in their 1966 line.

A flat-faced, square-cornered 21" tube for **Admiral Corporation** will be maunfactured by **National Video Corporation.** Sets incorporating this new tube will be shown to Admiral distributors in December, with deliveries scheduled in the second quarter of 1966. In addition, Admiral is building a modern color-tube development and production center in Chicago. Pilot production of the newest-type 25" rectangular color tube will begin shortly. The plant is expected to have an annual production capacity of 600,000 tubes by the end of 1966.

Pilot production of its 21" color picture tube began in October at **Motorola, Inc.** The tube went on the drawing board in January of this year, and for several months Motorola and **Owens Illinois, Inc.,** supplier of glass for the tube, have been working together on the project. Volume production on the new picture tube is scheduled to start in March of 1966, with sets expected to be available in quantity to Motorola wholesale distributors with introduction of the company's June line. The 21" rectangular tube will be produced in the $10 million color TV tube manufacturing plant, now nearing completion at Motorola's Franklin Park complex.

Sylvania Electric Products, Inc. announced plans to increase its 1966 production of color picture tubes 100% over the 1965 level by building a multimillion-dollar manufacturing facility in Ottawa, Ohio. The new plant will be a 158,000-square-foot addition to the present 322,000-square-foot plant where the company is now producing black-and-white picture tubes. The expansion will create 700 new jobs.

Part of Sylvania's program began several months ago at their color-tube plant in Seneca Falls, N.Y. At that time, 150,000 square feet of additional manufacturing space was devoted to color-tube production.

Sylvania is producing color tubes in three sizes, the 21" round 70°, 25" rectangular 90°, and the recently introduced 19" rectangular 90° tube. All Sylvania color tubes use the rare earth phosphor.

Color television CRT's manufactured in the United States today use a **CBS Laboratories** patent which covers the curved shadow mask. This patent is considered to cover the essential part of the modern color picture tube. The first licensee was Radio Corporation of America, which acquired the rights on November 30, 1964, to manufacture and sell tubes using the CBS invention.

CBS Laboratories is now making its patent available to the industry both here and abroad. Agreements permitting three leading Japanese television manufacturers to produce the tube have been approved. They are **Hitachi, Ltd., Tokyo Shibaura Electric Co., Ltd.,** and **Nippon Electric Co., Ltd.**

Mergers and Acquisitions

PACE Communications Corp., Gardena, California, manufacturer of Citizens-band two-way radios, has merged with **WEMS, Inc.,** Hawthorne, California, supplier of welded electronic circuit modules and systems. Under the merger agreement, PACE becomes a wholly-owned subsidiary of WEMS, and will continue to market their products under their name. The present product line includes base station, mobile, and portable 5-watt radio equipment and accessories.

Eby Sales of New York has acquired the physical assets of **Excellex Electronics, Inc.,** manufacturers of terminal blocks recorder either plays the pictures directly through the scan converter to a TV receiver or is used to drive a lathe that cuts a master phonograph record.

Exhibit Van Tours U. S. and Canada

"Innovations in Technology" exhibit van has begun a 16,000-mile tour across the U. S. and Canada. The van will travel from Southern California to the Northeast and Canada, to the Middle Atlantic states and the Southeast, and then to the Southwest and Middle West.

The 8′ x 13′ x 50′ "InnoVan," largest self-contained mobile technology exhibit ever constructed, will feature some 55 running feet of exhibits and demonstrations of **Texas Instruments** products. Products on exhibit include digital and linear integrated circuits, silicon and germanium transistors, diodes, rectifiers, SCR's, optoelectronic devices, recorder equipment, semiconductor test systems, pulse generators, A/D converters, controls, and metallurgical and clad-metal products. The air-conditioned exhibit room is equipped with conference area, radiotelephone, and a 35,000-piece product literature library. In addition to its schedule of plant visits, the "Innovations in Technology" exhibit van will be open to the technical community throughout the U.S. and Canada at sessions hosted by authorized TI distributors.

More Service Clinics

The number of SENCORE Service Clinics to be presented this fall has been doubled. These clinics for servicemen include demonstrations with the **SENCORE** test equipment on a color-TV set and an FM- stereo receiver, and the engineers presenting the program will give helpful hints in servicing. Two station wagons will each be equipped with the test equipment, a color-TV set, an FM receiver, and two field engineers. Don Multerer and Don Nelson will cover the eastern half of the nation, and Jim Smith and Dick Reed the western half. ▲

and barrier strips. Eby will now manufacture and sell the complete line of blocks and barrier strips at Jamaica, N.Y.

TV Record-Playback System

There is now a system for recording and viewing still pictures and sound on a television screen with an ordinary home tape machine or phonograph. The system, developed by **Westinghouse Electric Corporation** and called "Phonovid" displays the taped pictures on a conventional television receiver. Or, in the exact way that hi-fi records are made, the taped pictures can be transferred to the grooves of a disc and played back from there.

Some 1200 pictures, with accompanying voice and music, can be stored on a standard 7″ reel (1200′) of ordinary audio tape. On discs, 400 still pictures and sound can be put on the two sides of a standard 12″ 33 1/3-rpm record — called a Videodisc. The pictures can be line drawings, charts, printed text, or photographs.

The complete "Phonovid" record-playback system was demonstrated by Westinghouse recently. As it was used in the demonstration, the system consists of four components: a slow-scan television camera for picking up the pictures; an audio tape machine for recording pictures and sound; a converter to turn the taped pictures into standard television signals; and a conventional television receiver to display the pictures and reproduce the sound. To store the pictures and sound on a phonograph record instead of tape, a standard 33 1/3-rpm turntable and long-play recorder are used.

The key to the recording of "Phonovid" pictures lies in the slow-scan TV camera. The camera uses a special television pickup tube, a type of vidicon that can store an image as an electrical charge for several minutes. A shutter snaps the pictures similar to the way an ordinary camera snaps photographs. An electron beam in the camera tube reads out the stored picture and passes it along as electrical signals to the tape machine, where it is magnetically recorded. The tape

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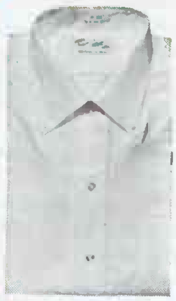

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GENERAL ELECTRIC

WINEGARD'S FALL COLOR SPECTACULAR

SPECTACULAR

Know how many color TV sets will be sold before the end of the year? Close to 2 million! There's no telling how many more will be sold during 1966. But the figure will be way up in the millions —and we'd like every single one of those sets to be hooked-up to a new Winegard made-for-color antenna. Impossible? Maybe. But we're sure going to try. And here's how we plan to do it. We're going to tell more people than ever before (and more often than ever before) that they do need a special antenna for color TV reception. Then we're going to tell them how very special Winegard made-for-color antennas are . . .

- They effectively reduce snow, ghosts and distortion in all reception areas—metropolitan, suburban and deep fringe!
- They make color TV brighter, sharper and more brilliantly alive!
- They make all-channel black & white reception better than ever!
- And they make expensive new color sets (black & white sets, too) worth every penny!

We're going to tell them on television, in magazines and via in-store merchandising aids. And the nice thing about advertising is, if you have an outstanding product, a truthful story and sensible prices—and if you tell people often enough, they'll buy. We call it our Fall Color Spectacular. Winegard dealers will call it the best thing that ever happened to antenna and accessory sales. Better call your Winegard distributor or write for complete information about Winegard's Fall Color Spectacular. It's here now!

Spectacular WINEGARD Made-For-Color TV Commercials . . . thousands of them!

Winegard has actually scheduled more than 2,000 minute and 30-second commercials to run before the end of the year. They'll be seen from coast to coast and in color as well as black & white. And here's the best part. They're more than commercials. They're station testimonials! That's right. Station engineers throughout the country have tested Winegard made-for-color antennas and found them to be everything we say they are and more. Wait 'til color TV prospects (and owners) hear these commercials. And they'll start hearing them in October!

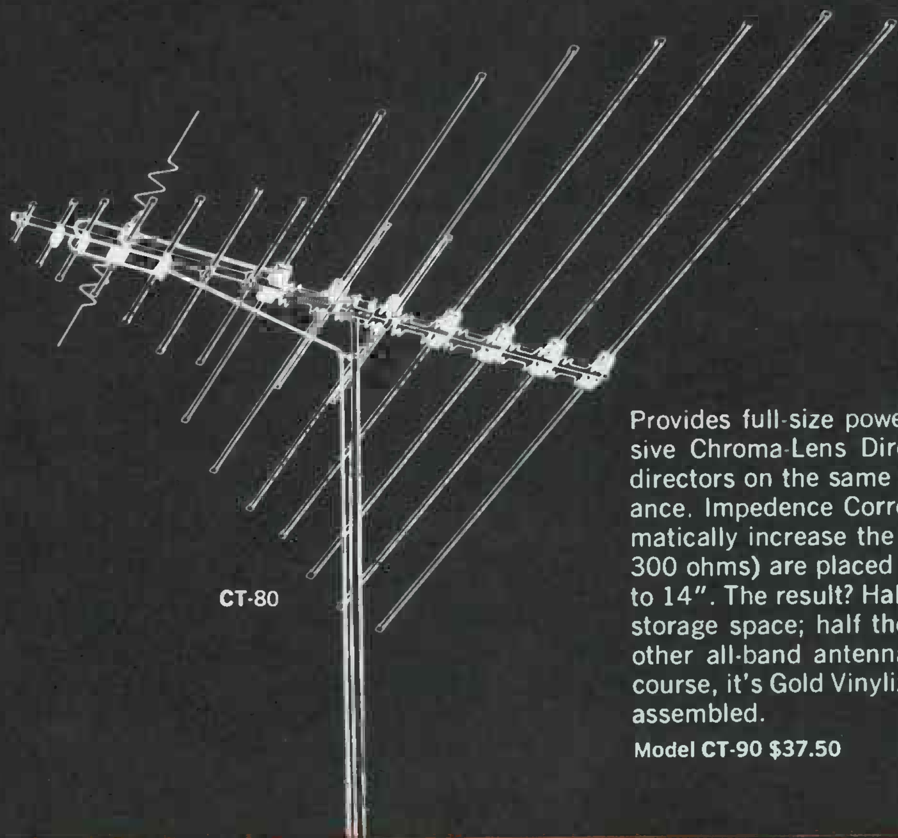
Spectacular WINEGARD Made-For-Color Ads in * LIFE * PARADE * SUNSET

They're the powerful, hard-selling publications that are read, believed and used as a buyers' guide by families (more than 6 million of them) now in the market for color television sets. They're your prospects and they'll soon read about Winegard made-for-color antennas . . . believe in them . . . and buy!

WINEGARD CO.

Circle 12 on literature card

MADE-FOR-COLOR ANTENNAS



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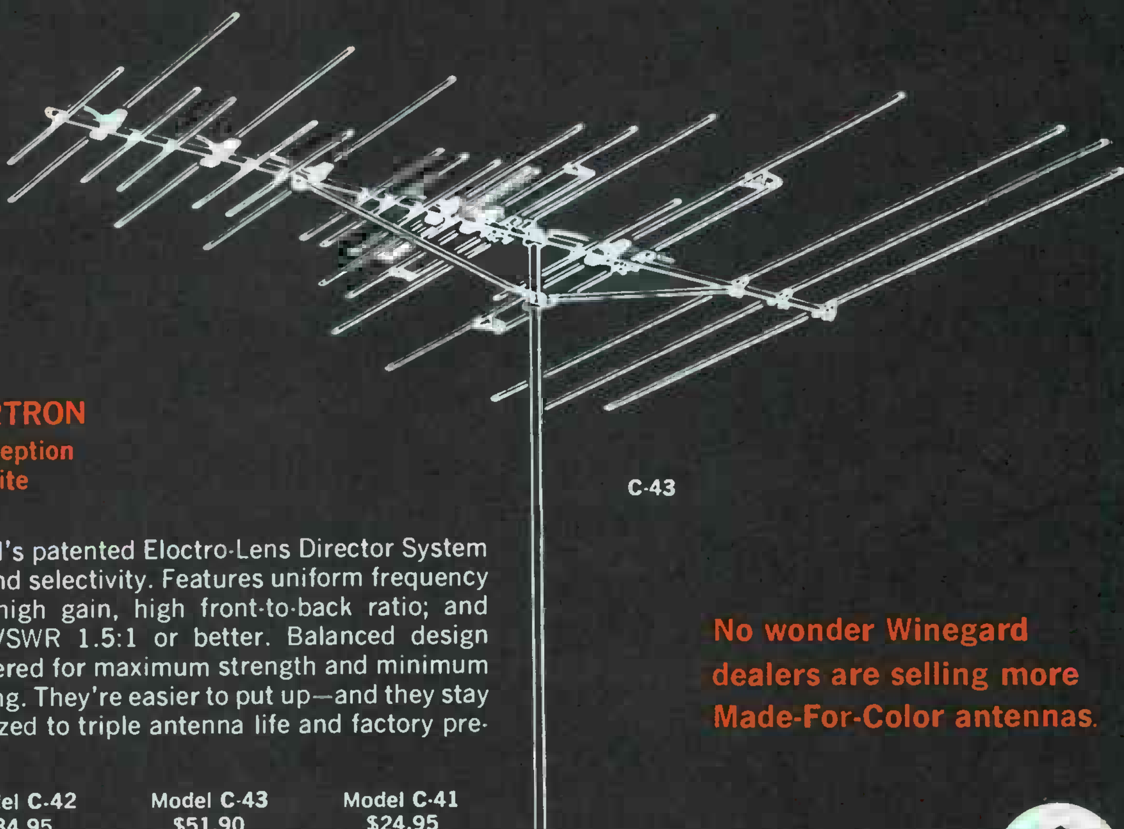

WINEGARD COLORTRON

. . . for the best VHF reception in color and black & white

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Model C-44	Model C-42	Model C-43	Model C-41
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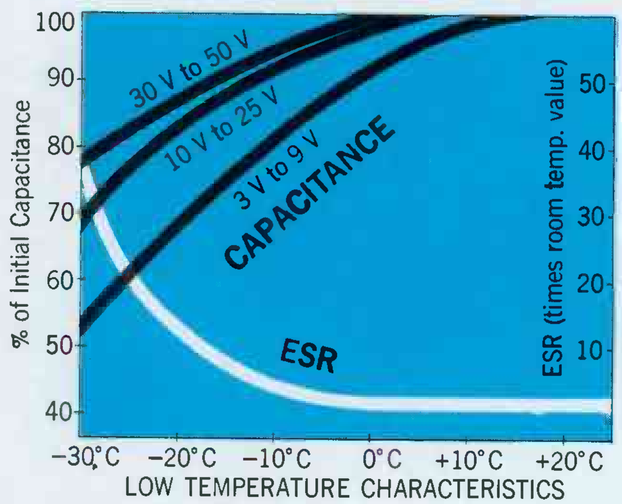
No wonder Winegard dealers are selling more Made-For-Color antennas.

ANTENNA SYSTEMS 3000 KIRKWOOD, BURLINGTON, IOWA

MALLORY **Tips for Technicians**

Meet a new kind of Capacitor



Standard MTA Values Available			
	Case Size	Volts WVDC	MFD
D	5/16" x 3/4"	3 to 50	60-8
E	3/8" x 1"	3 to 50	175-20
F	1/2" x 1 3/8"	3 to 50	600-80

Once in a while something new comes along that seems almost too good to be true. We've just come up with one of these. It's the Mallory MTA molded electrolytic capacitor. And it not only has good quality and good performance but its price is so low that it doesn't seem possible it could be made by a reputable U. S. manufacturer. But it's made by Mallory in our new Glasgow, Kentucky plant. So you know you can rely on it for famous Mallory quality.

What makes it unusual is a different kind of construction, worked out by Mallory capacitor specialists. Its moisture-proof plastic case is molded *in one piece* around the capacitor element. There are no seals or gaskets. Moisture can't get in, electrolyte can't leak out—no matter how much mechanical abuse and thermal cycling you give it.

The result: life, reliability, and temperature stability are far superior to cardboard case capacitors and other plastic-case types. Consistently better than imported types. And even better than many metal case tubular capacitors which cost one-third more! Look at the temperature stability test chart, for instance. This is excellent performance for a low-cost miniature electrolytic. So good, in fact, that we have now rated the MTA for −30°C to +85°C.

As for reliability, here are some figures from our test lab that should reassure anyone who worries about consistent quality (and who doesn't?). In over one million piece-hours of life test at 85°C, there hasn't been a single failure. At 65°C, we've had only *one* failure in 2½ million piece-hours.

You'll recognize the MTA by its bright white plastic case. Your Mallory distributor has them in stock for your use in replacement work and in experimental circuits, in handy two-pack blister cards. Mallory Distributor Products Company, a division of P. R. Mallory & Co. Inc., P. O. Box 1558, Indianapolis, Indiana 46206.

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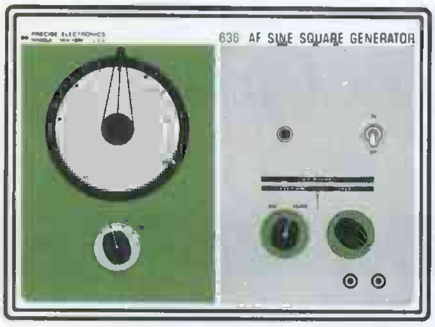

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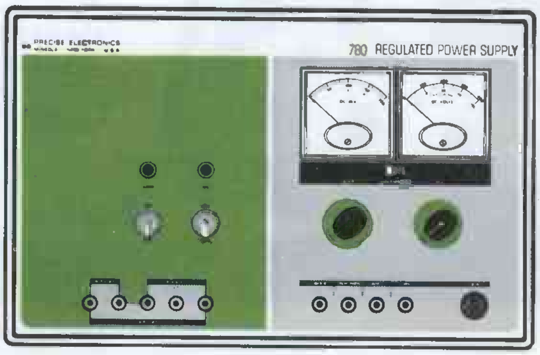
Kit: $45.95 Net Wired: $61.95 Net



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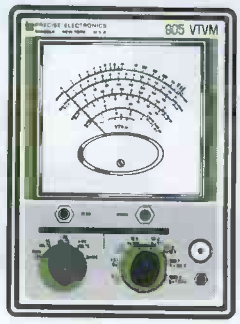

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Get this compact, convertible tool set free with your purchase of any PRECISE instrument (except probes and decade boxes). Included are nutdrivers, screwdrivers and a handy tote case. Available only during our Green Line introduction. Supplies are limited, so make tracks to your PRECISE distributor and get this free gift now!

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EICO's complete new color TV lab for the pro

A. Model 380 (DELIVERY EARLY IN 1966) B. Model 369 C. Model 435

Color TV servicing is a job for professionals—and **Eico's new color TV test equipment** is designed to their requirements. Professional service engineers can't afford to waste time on apparent set troubles caused by makeshift, inaccurate test signals, or on test equipment that is inherently difficult to use or incapable of fast, accurate determinations. Critical professionals know they can depend on EICO for accuracy, reliability, and laboratory standard performance. Moreover, EICO has now successfully reduced equipment size while improving performance, to permit convenient on-location servicing. No wonder the pros choose EICO!

PROFESSIONAL PERFORMANCE IN COLOR TV TEST INSTRUMENTS/ (A) MODEL 380 SOLID STATE N.T.S.C. STANDARD COLOR SIGNAL & DOT-BAR GENERATOR (PAT. PEND.) Entirely unique in both providing completely standard 100% fully saturated N.T.S.C. color signals, including both chrominance and luminance signals exactly as specified, and in being **completely transistorized.** Color burst is precisely gated and delayed according to N.T.S.C. standards, and phase angles are permanently established by taps on a linearly distributed delay line, so that no adjustments are ever required. Use of saturated transistor for switching and delay provides square "clean" waveforms without significant overshoots or ringing for excellent signal definition. The design of the 380 is an absolute protection against obsolescence, and assures the professional service engineer that apparent set trouble is not caused by a non-standard test signal. In addition to **generating 11 different color signals, one at a time,** for hue and demodulator adjustments, the Model 380 generates dots, crosshatch, horizontal lines, and vertical lines for convergence and linearity adjustments. Both video and RF outputs are provided, with gain controls. Three crystal-controlled oscillators are employed for color burst and color information, convergence and sync signals, and RF output on TV channel 3 **no drift or waiting for warm-up. Entirely stable** and inherently rugged by solid state design, the Model 380 is also outstandingly compact and weighs only 4 lbs. SIZE (HWD): 8½ x 5¾ x 6⅜ inches. Kit Wired **$149.95**

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(C) MODEL 435 DC WIDEBAND 3" OSCILLOSCOPE You'll be able to complete many more color or B&W TV service calls on location if you can take your 'scope with you. EICO's 435 is **really portable** (⅓ the size of conventional 5" scopes) and fully equipped to do the job. Quality equal to or better than the finest 5" TV service scopes is achieved with a **far sharper, brighter trace** on a flat-face CRT. Direct-coupled, push-pull V amplifier, with 4-pos. frequency-compensated decade attenuator has no low frequency phase shift, and **is flat from DC—4.5mc** (+1, —3db). Far more accurate p-p voltage measurements than ever before with a **Zener diode-controlled square wave calibrating voltage,** and an **edge-lit calibration grid.** Easier to use for TV servicing with pre-set TV-V and TV-H positions in addition to 4 sweep ranges, **automatic sync** limiter and amplifier, and **full retrace blanking.** Amazingly easy to build because of professional interior packaging that has eliminated crowding and permits easy access to any component. SIZE (HWD): 8½ x 5¾ x 12⅝ inches. Kit **$99.95.** Wired **$149.95.**

ONE MORE MATCHING INSTRUMENT EQUIPS YOU FOR FM STEREO SERVICING MODEL 342 FM MULTIPLEX SIGNAL GENERATOR. The EICO Model 342 is a compact, efficient instrument essential for test or alignment of the multiplex circuits of FM Multiplex Stereo tuners, receivers, and radios. FM Stereo is a field as fast-growing as color TV, and a multiplex generator is an absolute must for getting a share of the increasingly important and profitable service business. The circuitry of the Model 342 is of the design lab quality needed for restoring original performance quality to the costliest equipment, but the controls have been simplified for fast, uncomplicated operation. With it, you can quickly measure and adjust channel separation and balance, or the input level needed for synchronization or switch-over to stereo operation. The Model 342 provides signals as perfect as those available from generators costing many hundreds of dollars. It provides both a controlled amplitude composite audio output for direct signal injection beyond the detector into a multiplex section, and the same signal modulating an FM RF carrier at about 100mc (adjustable) with controlled deviation ± 75kc (100% modulation) for connection directly to the antenna terminals. Either a built-in 1kc oscillator (below 0.3% distortion) or an external audio oscillator may be used to provide the left only, right only, difference, or sum signals. **The 19kc pilot signal is crystal controlled** and may be switched on or off independently of the composite signal. The signal may be obtained without audio information and only the 19kc pilot injected. An oscilloscope sync output is provided, with a choice of either 19kc sync or internal 1kc/external oscillator sync. In addition, an input is provided for connecting an external audio oscillator to provide an SCA signal when required. Another important and valuable feature of the Model 342 is **dual inputs and amplifiers for a stereo source to permit FM MULTIPLEX STEREO demonstrations to customers when there are no stereo programs being broadcast.** Modern compactron tubes are used to obtain a lightweight, compact package that is easily portable. SIZE (HWD): 8½ x 5¾ x 12½ inches. Kit Wired **$149.95**

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Guideposts to Color Servicing

Follow this trail to faster repairs.

by Carl Babcoke

Precise receiver performance has not been easy to check on service calls because of the lack of proper equipment and the uncertainty of signal conditions at each location. In a well-equipped service shop it is comparatively easy to determine whether or not a color receiver meets the standards of alignment of a monochrome or color picture. When sweep and marker generators, scope, and video-sweep instruments are used correctly, receiver condition can be a matter of proof instead of guesswork.

Have you had customers tell you: "The picture is not as sharp as it should be. Closeups are okay but distance shots are all blurred"? Did you weakly mutter something about ghosts, or say, "Lady, it looks fine to me"? This type of answer may satisfy some customers, but color set owners expect more. Did you wonder if your diagnosis was really right? Or did you lug the heavy machine to the shop for comprehensive tests or to view it under familiar signal conditions? Would you like to know how you can be absolutely sure whether displaced colors, ghosts, or smeared pictures are caused by the receiver itself or by the station or network?

An Analysis Method

The method sounds deceptively simple: Check receiver performance accurately without the station or the antenna. If the receiver proves to be normal on both b-w and color, the trouble must be elsewhere. The equipment needed for this important job is not fancy or expensive, but merely what you should have already: a dot-bar generator and your eyes, which are connected to that organic computer sometimes called a brain.

Two factors make this type of analysis practical. (1) The bar-generator signal is always the same, and you connect it directly to the receiver. This eliminates the influence of the station signal and the receiving antenna. (2) You can form an accurate judgment, even though the standard of comparison is remembered only from past experience, if enough checkpoints or guideposts are provided.

Various makes and models of dot-bar generators give slightly different patterns, so you must know what *your generator* pattern looks like. The same model of bar generator must be used each time, under the same conditions. The instrument should have a sharp crosshatch pattern, keyed-rainbow color bars, a sound carrier, and RF output so the generator can be fed to the receiver at the antenna terminals. (A generator that feeds only the video or chroma stages can't be used with this method. The receiver must be checked from the antenna terminals to picture tube, for the test to be definitive.)

You have no doubt used your dot-bar generator to converge sets or to verify the presence or stability of color bars, but in these tests you must notice the *quality* of the crosshatch bars. This is meaningful only if you operate both the receiver and generator under the same set of conditions each time. The method of analysis involves a comparison of the pattern on the receiver in question with that you've seen on a set in good condition.

How To Do It

On a program with normal brightness and contrast, adjust focus for sharpest picture detail (not necessarily sharpest raster lines), then turn the color control down. Disconnect the antenna (this is important for some antennas will cause ghosts or ringing when used with the generator) and connect the generator to the antenna terminals. Set the generator for crosshatch. The sound carrier should be on, so the receiver can be fine-tuned accurately to the proper frequency.

Adjust the fine tuning toward the sound, until "beading" of the vertical bars is seen as in Fig. 1. Reverse the fine tuning enough to

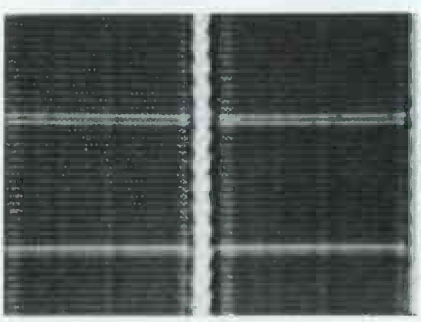

Fig. 1. Crosshatch when the fine tuning is near "sound"; see "beads."

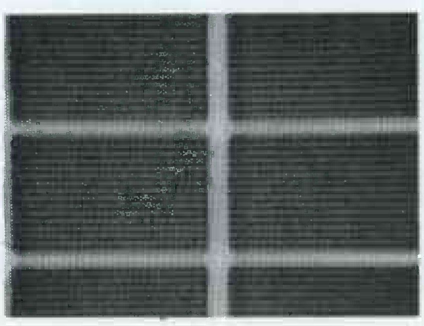

Fig. 2. Correct tuning, normal contrast and brightness. Notice the faint raster.

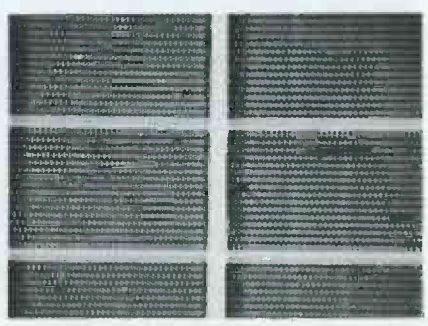

Fig. 3. Peaking control has been set for maximum. Sharpness is exaggerated.

barely free the bars from beading. Adjust brightness and contrast until the vertical white bars are not defocused and a faint raster can be seen between the bars (Fig. 2). If convergence is poor, turn down two of the screen controls to leave just one color, preferably green. Set any peaking controls to medium or "normal" position.

Now you are ready to analyze the vertical bars. They should be sharp, of course, but more important are the black lines on the left and right of the "white" bars. The left black line doesn't give much indication of picture clearness, so devote most of your attention to the one on the right side.

Compare Fig. 2 with Fig. 3, where the peaking control has been set for sharpest picture, or with Fig. 4, where faulty fine tuning has caused the detail to blur. It is easy to imagine the effect this would have on station pictures.

Notice that the horizontal bars show little change. This explains why we ignore them. Horizontal bars are affected by faults that alter low-frequency response in the IF and video chain. Low-frequency changes are less noticeable in most pictures than are high-frequency losses or ringing, so devote most of your attention to the vertical lines, which show effects on response at the high-frequency end of the video passband.

These first four illustrations show bar conditions of a normal set with good alignment and detail; the different views represent various conditions of operation you might encounter during adjustment.

Fig. 5 shows one type of "ringing" which can occur if alignment is bad or the IF's are close to oscillation. This particular condition was caused by an out-of-adjustment trap. Note the sharp white and dark vertical lines just to the right of the generator bar; these are typical of ringing. Ringing caused by misalignment will ordinarily vary with the fine tuning. The unwanted vertical lines will also appear differently for other types of misalignment. Disregard the very faint white lines between the bars; these are traces from pulses that lock the divider chains in the generator. You can see normal ones in Fig. 2.

Why can't this method be used to evaluate monochrome receivers, too? The answer is: it can, with only one small precaution. Fig. 6 shows the ringing which may result from certain contrast-control settings in some models, particularly in sets that have a high-level control in the plate circuit of the video amplifier. Disregard this ringing if it leaves when you reduce the contrast setting slightly, since this will not happen on the station signal.

Testing For Color

If the receiver under test passed the visual examination in good shape, you can be certain the set is normal on that channel. Tuner misalignment can cause trouble on other channels, of course. You have analyzed the receiver from the antenna terminals, through the IF's and video stages, all the way to the picture-tube screen. This monochrome test, however, is no assurance of good color, for you have not checked the chroma circuit at all. Trouble there can still prevent good color reception.

Overall color performance is analyzed in much the same way as in the b-w test, by observing the quality of color bars on the screen. Not only do you look for sharpness of the bars, but you also watch for unevenness of color across the total width of each bar and for edge-fringing of other tints.

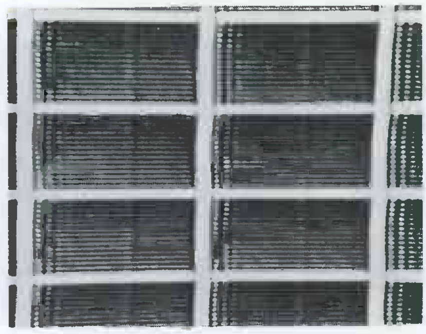

Fig. 6. Ringing in certain b-w sets with high-level video pot. Tuning is no help.

Reset the gray-scale tracking, if you changed it during the b-w analysis. The generator should be set for color bars of normal or 100% intensity and the sound carrier should be on. Tune in the generator as you would a colorcast from a station—by turning the color control up halfway, setting the fine tuning toward where the 920-kc beat (clothlike pattern—see Fig. 7) is seen in the bars, then reversing the fine tuning enough to eliminate the beat.

Set the tint or hue control so the third bar from left is maximum red. Adjust brightness and color controls until the bars have good color saturation without defocusing on the bright bars and until the background screen color can be seen easily between the bars. This background condition is important, for you are interested not only in the bars but in the spaces between them where ringing, fringing, or smearing may be seen. Convergence should be good or you will notice color fringes from that source.

You can obtain the most information from a bar composed of more than one primary color, so watch the fourth bar from the left —the one that is supposed to be

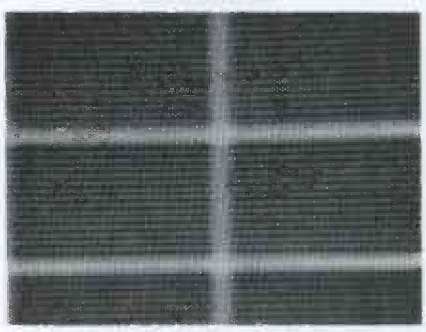

Fig. 4. Dullness in this pattern results from misadjustment of fine-tuning.

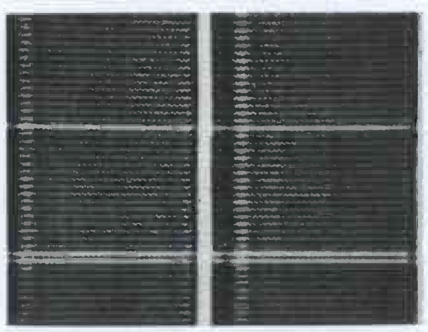

Fig. 5. Right of main bar, black-white-gray ringing caused by misalignment.

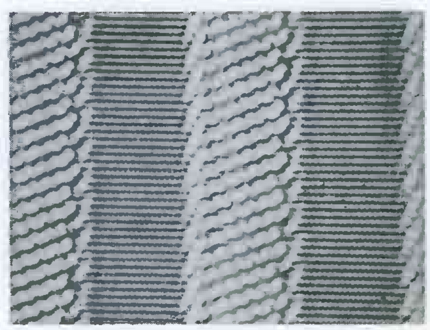

Fig. 7. Effect seen in keyed-rainbow pattern with fine tuning at "sound" end.

Fig. 8. Fourth rainbow bar should be magenta; dark bars are "off" period.

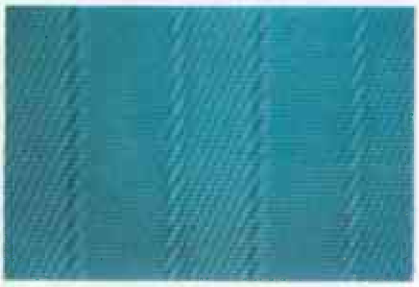

Fig. 9. With chroma control turned off, only luminance information is visible.

magenta or purple. Fig. 8 shows this bar on a normal receiver. Notice the bar is fairly even on color intensity and tint from edge to edge. The border on its right edge is caused partly by the generator and partly by slight video ringing

Fig. 10. Trap causes ringing in video, creates changes in chroma channel.

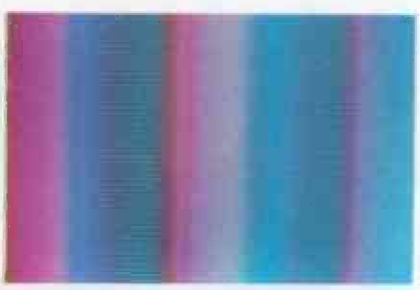

Fig. 11. Misalignment ringing that can also be caused by incorrect fine tuning.

in the receiver; this border is normal, so notice its width and intensity for future reference.

Fig. 9 shows the monochrome (luminance) component of the bars with the color control turned down. (The bluish-green cast is color distortion in the camera taking the photos. The same discoloring is visible between color bars in Fig. 8. On the color-set screen, these "off" or blanked portions of the display appear considerably darker.) To check chroma register (how well the b-w and color pictures fit each other), turn the color control up and then down while you notice how well the color component superimposes on the video. If the colors are sharp but displaced considerably to the right, suspect a shorted delay line. If the colors are displaced and smeared, however, then the alignment is off or bandwidth is poor from some other cause, such as component defect.

Fig. 10 shows the effect of a trap that has shifted its resonant point into the IF bandpass curve. This is the same condition that produced ringing on the crosshatch in Fig. 5, but the effect is much more noticeable on color bars. Notice the magenta bar is now two-tone, and has a large smeary background border on the right. Remember that this type of change merely blurs the b-w picture but it causes wrong colors as well as smeared colors in a color program. This explains why correct alignment is so much more important in a color set.

Another type of misalignment, usually—but not necessarily—in the tuner, can create the pattern in Fig. 11. These bars can be caused by chroma or IF misalignment. Notice that the magenta hue contaminates the third and fifth bars, and that the fourth bar is only partially magenta. Make sure, before you condemn alignment, that the fine tuning is set properly, as incorrect tuning can also cause this faulty pattern to appear.

Fig. 12 shows a b-w photo of the pattern in Fig. 7, except that the sound carrier has been turned off at the generator. The 920-kc beat between the 3.58-mc subcarrier and the 4.5-mc sound carrier is missing in Fig. 12. The exact slant of the bars you see will vary with

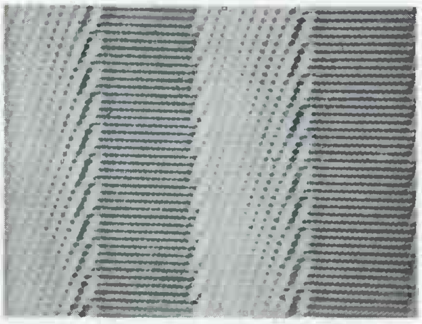

Fig. 12. Fine tuning near sound end, with 4.5-mc carrier off at generator.

the model of generator, so notice both patterns for later reference.

A Few Don't's

DON'T use any kind of gun-killer switches during these tests. Some of them smear the color only, others may smear both b-w and color pictures.

DON'T use extensions on the picture tube, for even a short one will cause smear on both b-w and color presentations.

DON'T have an antenna connected to the set at the same time as the generator. At best this will slightly blur the picture, and at worst may cause a double image on b-w and excessive phase shift in color bars.

You might wonder if you can use this analysis technique to touch up alignment in the field. DON'T! Never attempt alignment without full sweep-alignment equipment. (I still kick myself mentally over the time I tried to align out the effects of a delay line with an open ground. Or the time I attempted to touch up the IF's to eliminate the ringing that originated in a peaking coil.) This analysis method is valuable only in determining the condition of a color receiver, and is *not* to be used to correct bad alignment.

Conclusion

This analysis may sound involved or not very accurate, since it depends on remembering the optimum pattern. Yet it is surprising how accurately it will prove the total receiver performance, once you learn to use it. With only a little practice, you can look at the various patterns for only a few seconds each and be positive of receiver condition from the antenna right up to the picture tube. ▲

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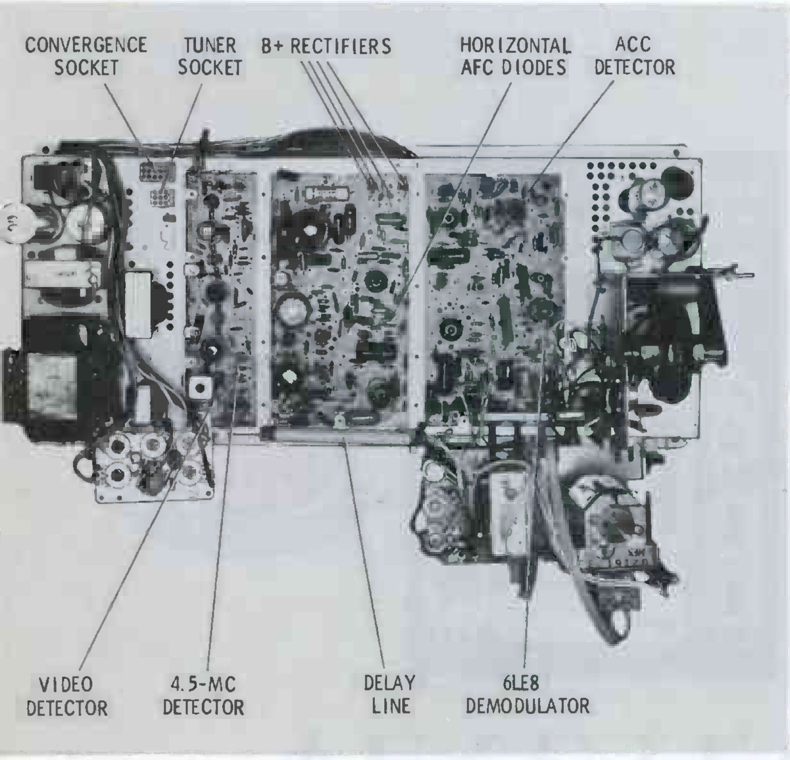
Circle 16 on literature card

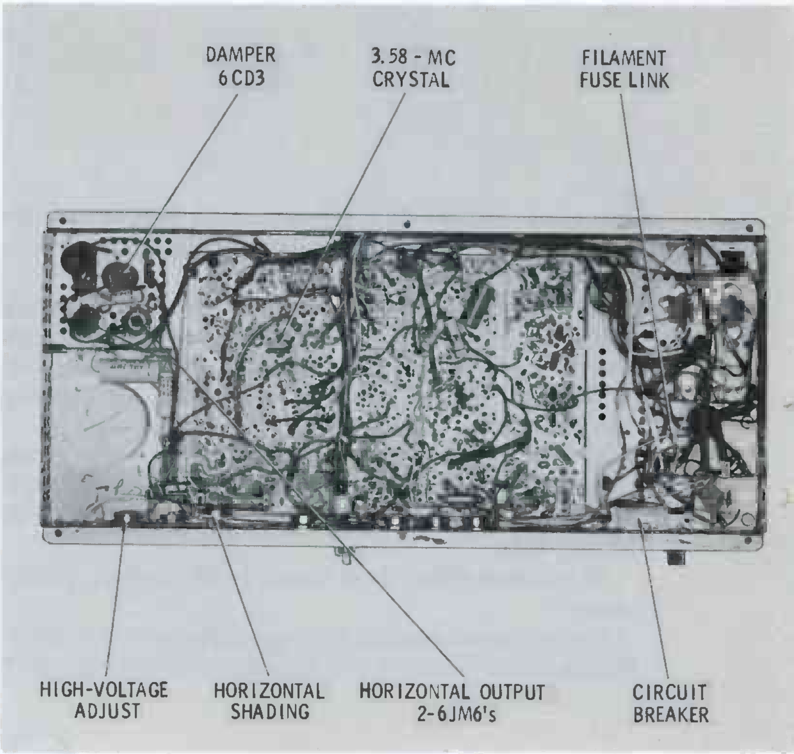
Guide to COLOR SET Chassis Layout

This guide shows the physical layout (top and bottom views) of chassis used in the latest color TV receivers. The photos cover eleven different chassis by nine different manufacturers. Most color receivers sold in the last three years use a chassis physically similar to one of those shown here.

The locations of such components as low-voltage (B+) rectifiers, filament fuse links, diodes, controls, and switches are plainly pointed out in this series of chassis pictures.

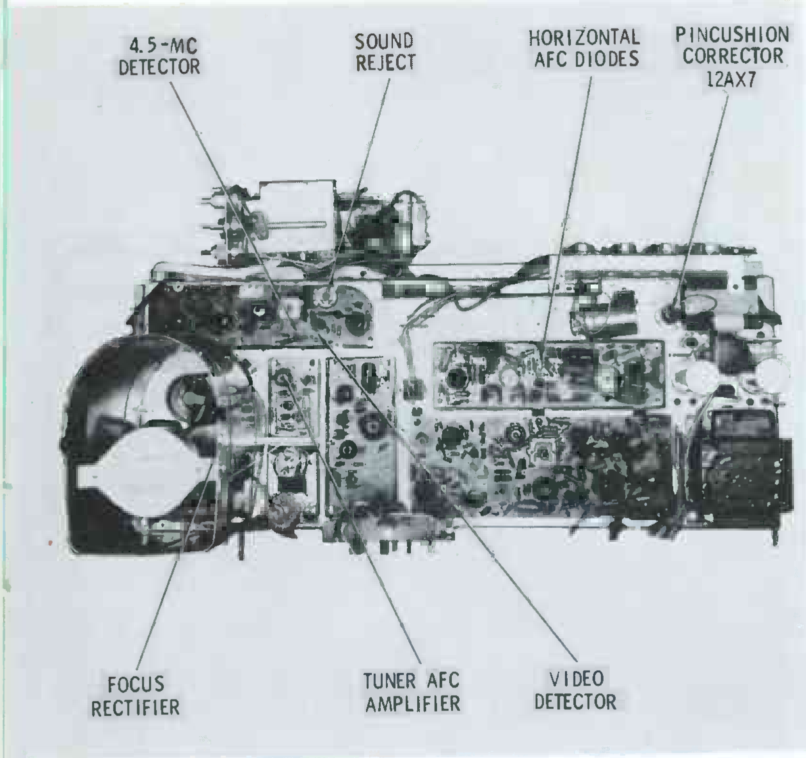


TOP VIEW

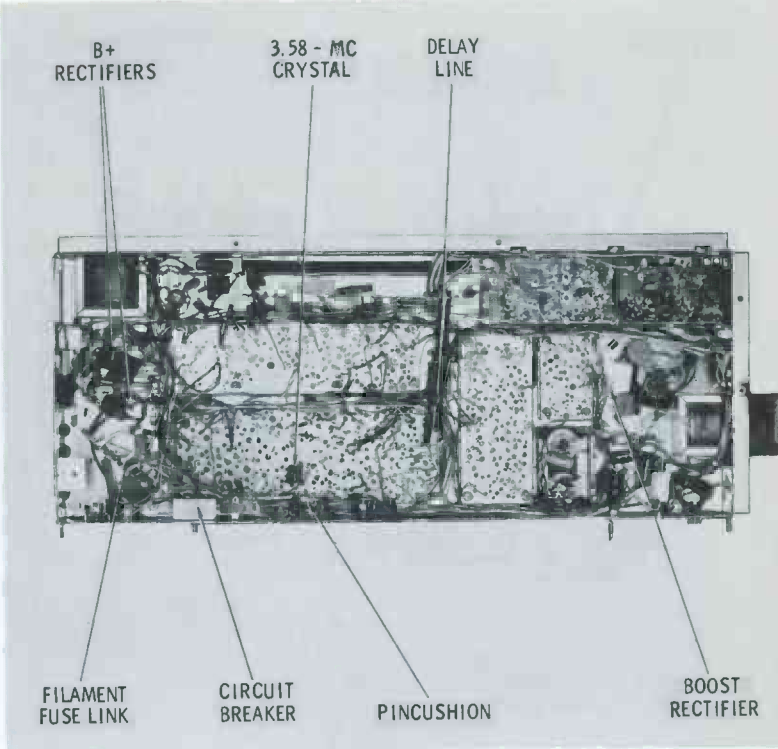


BOTTOM VIEW

ADMIRAL CHASSIS G11

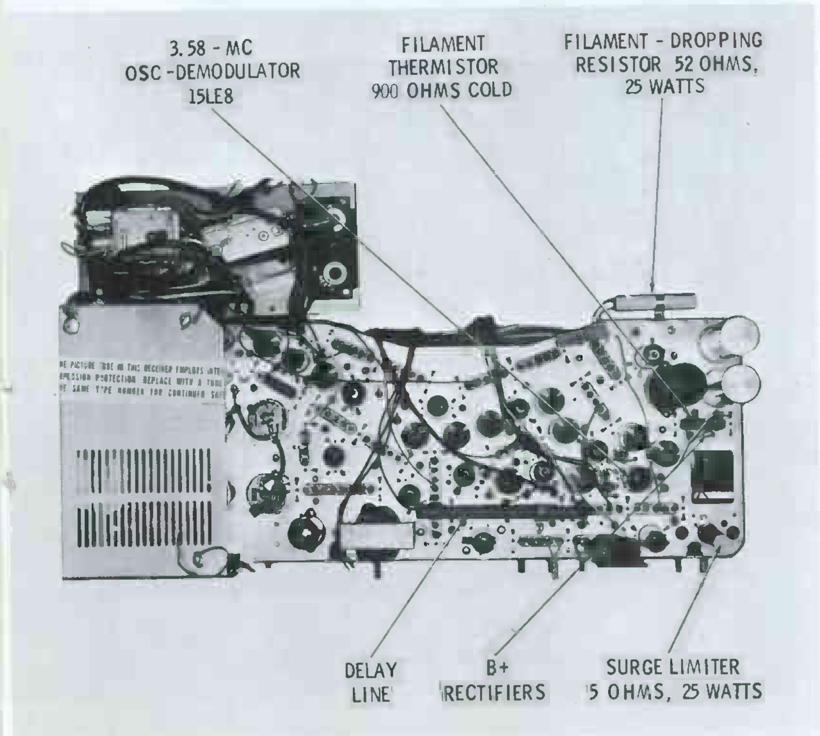


TOP VIEW

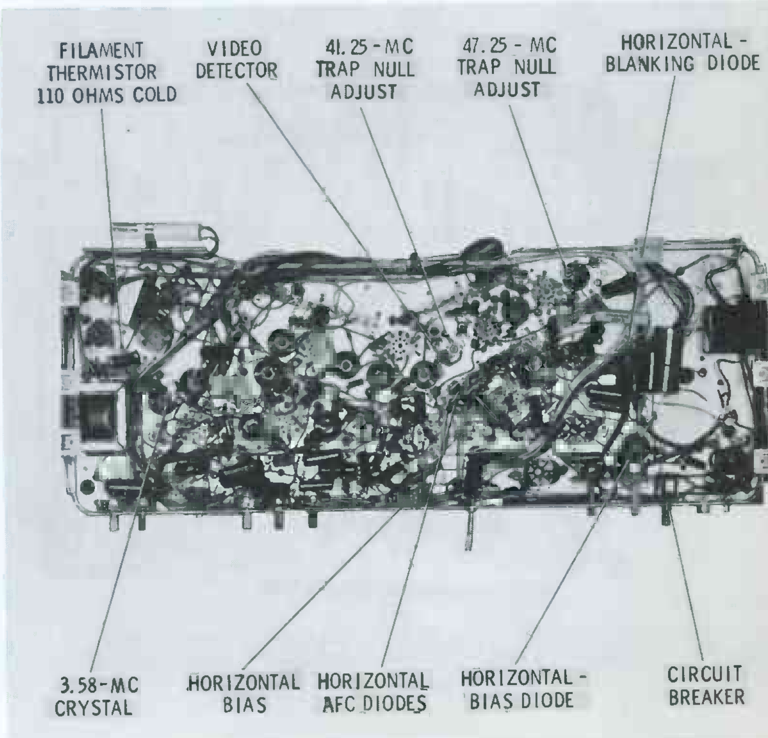


BOTTOM VIEW

MAGNAVOX CHASSIS T904

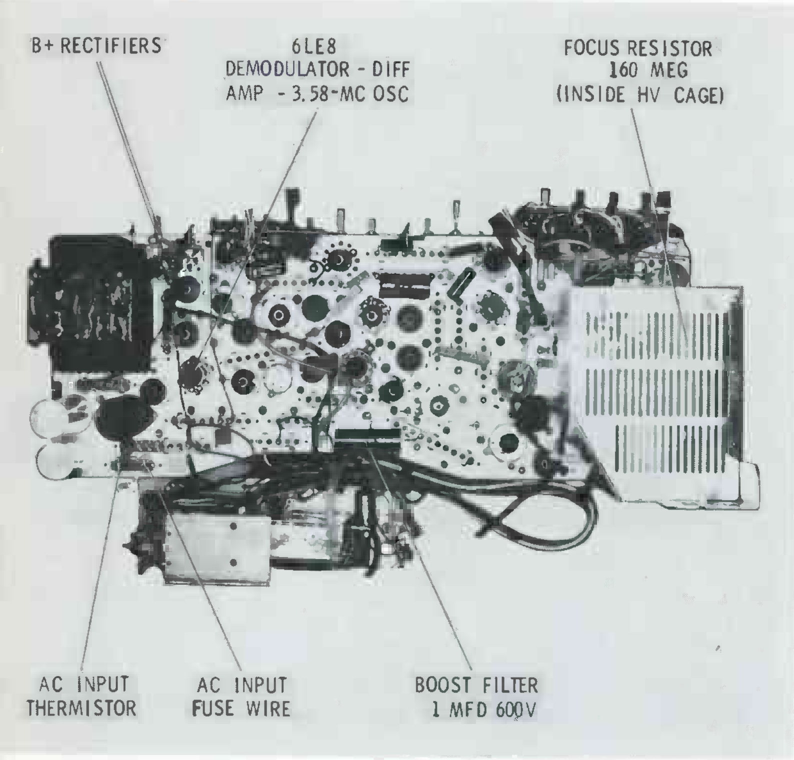


TOP VIEW

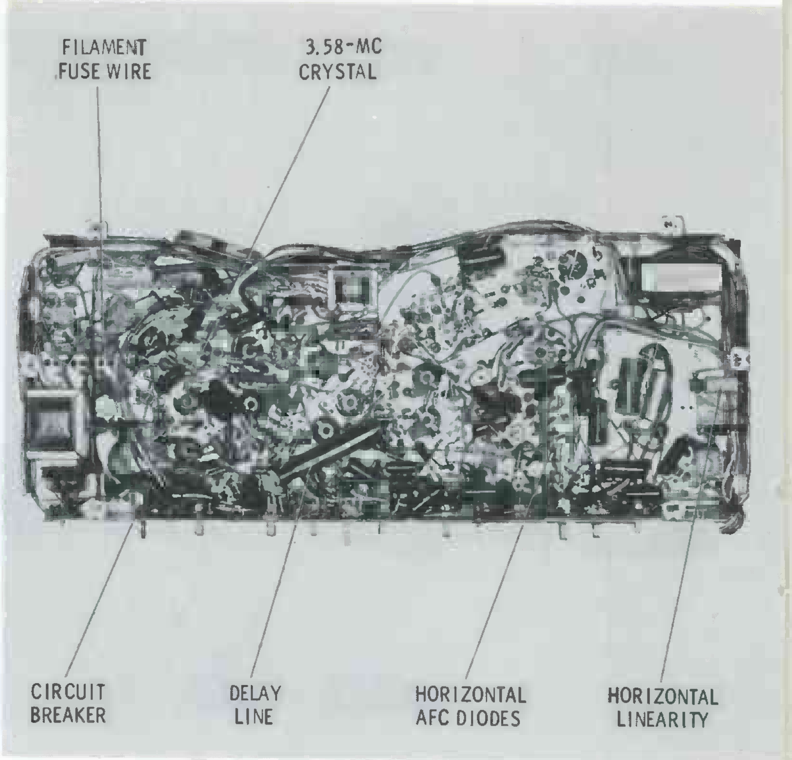


BOTTOM VIEW

MOTOROLA CHASSIS TS-912

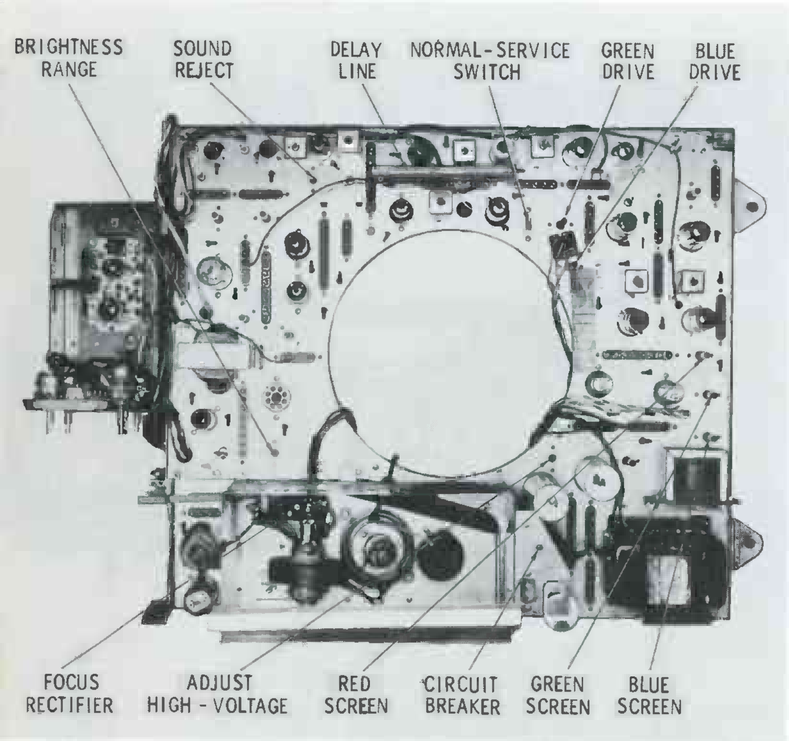


TOP VIEW

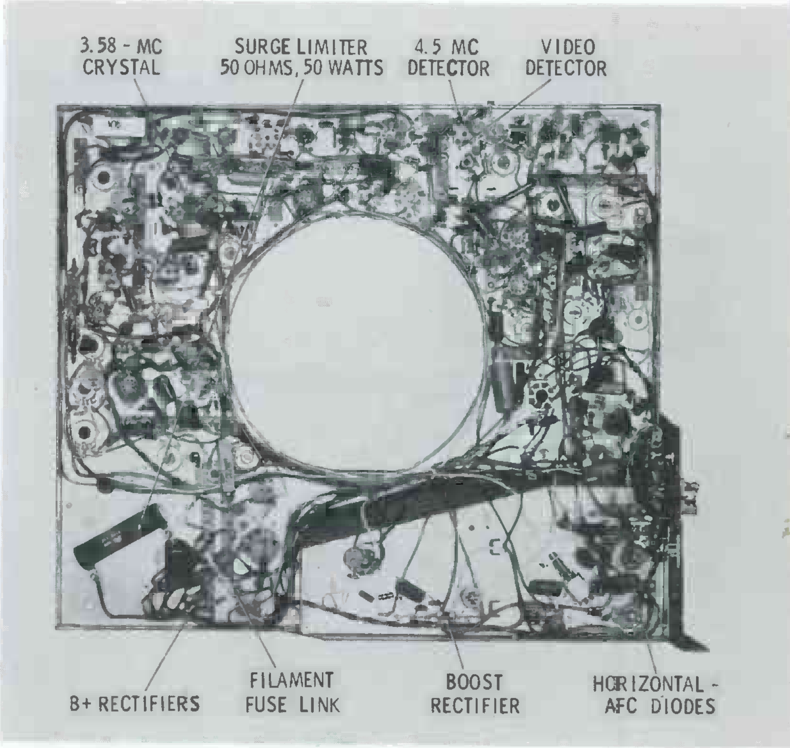


BOTTOM VIEW

MOTOROLA CHASSIS TS-914

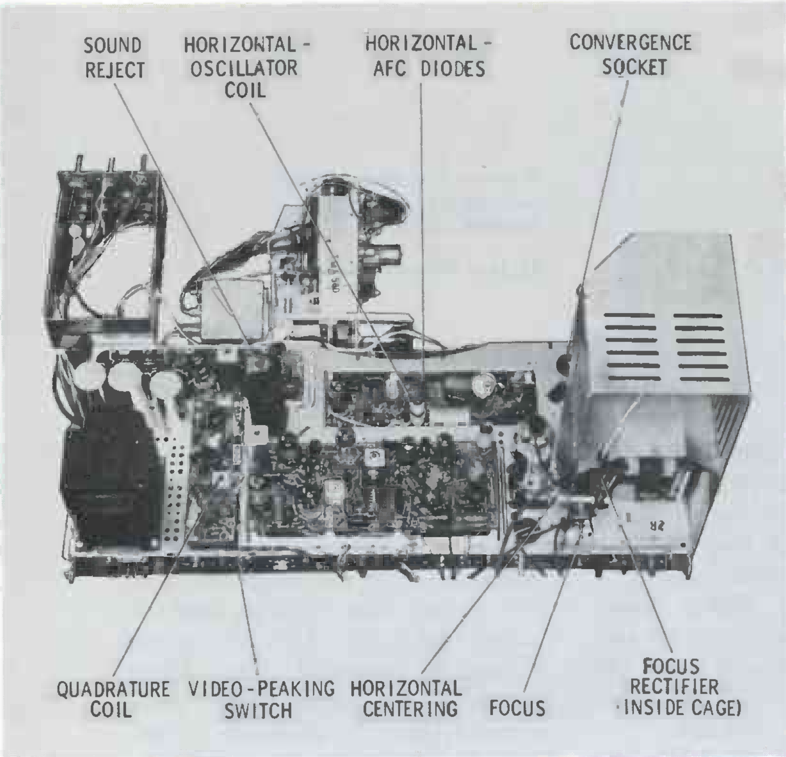


FRONT VIEW

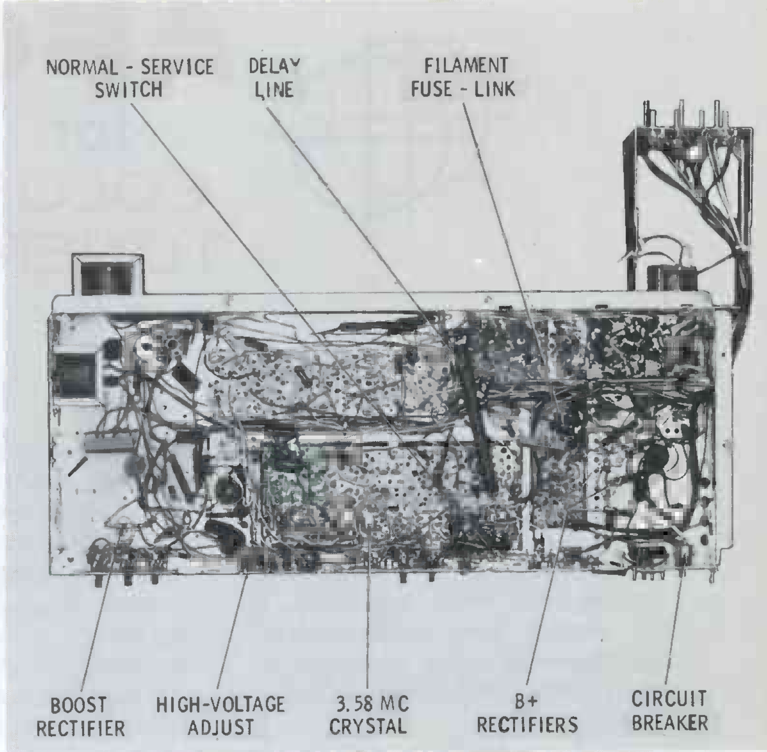


REAR VIEW

PACKARD BELL CHASSIS 98C8



TOP VIEW



BOTTOM VIEW

RCA CHASSIS CTC15

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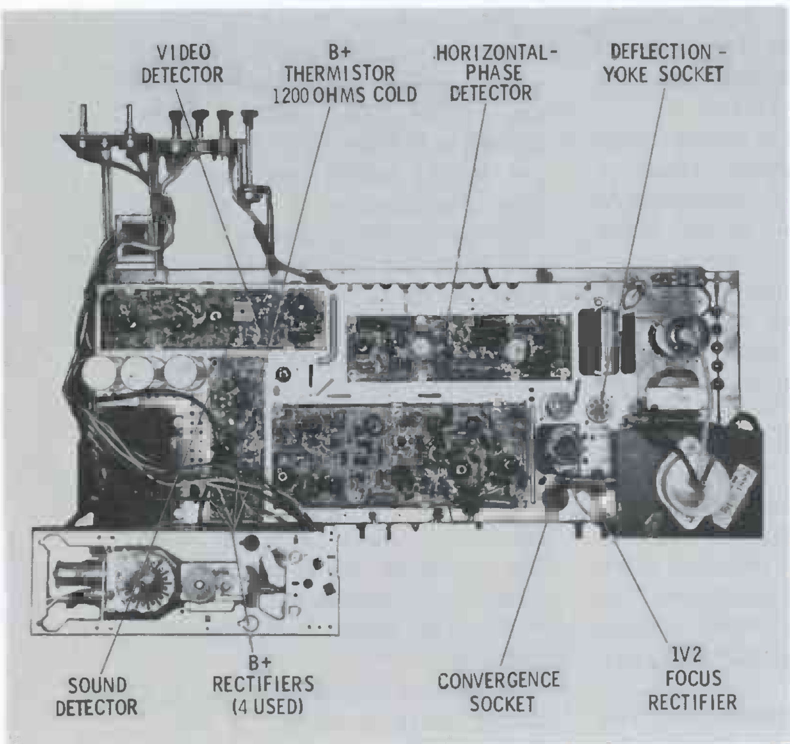
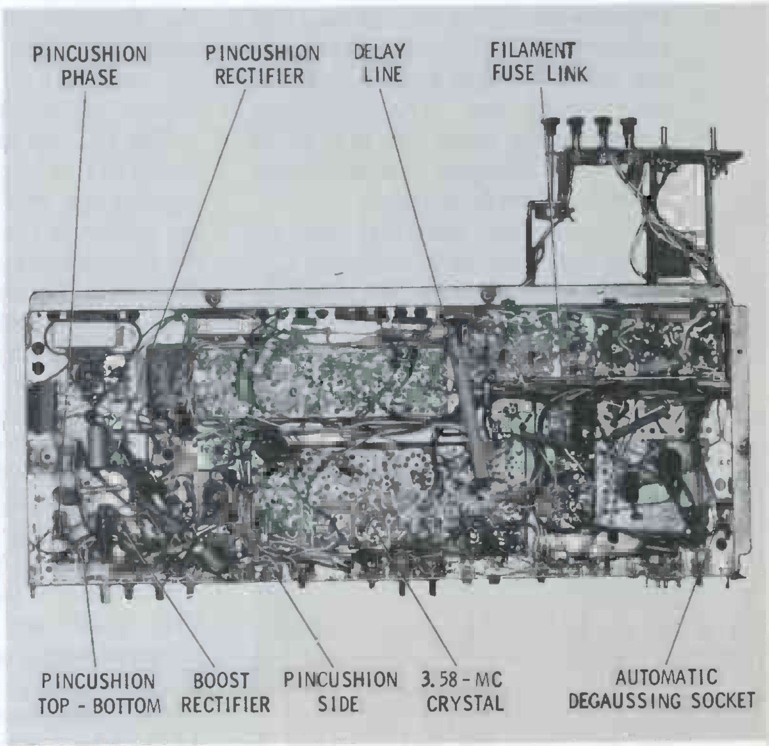


TOP VIEW



BOTTOM VIEW

RCA CHASSIS CTC17

AFC for COLOR TUNERS

This circuit automatically controls frequency in the VHF oscillator.

by Jack Gamble

Automatic frequency control (AFC) applied to a tuner is handy to correct small errors in fine tuning of a color television receiver, where tuning is very important. Perhaps even more significant, it will prevent tuner oscillator drift. On Magnavox color television receivers, this AFC circuit is called Automatic Color.

Fig. 1 is a block diagram of the AFC system. The video IF carrier is coupled from the third IF to an amplifier. A balanced discriminator stage, tuned to the video IF of 45.75 mc, develops a control voltage which affects the oscillator frequency in the VHF and UHF tuners. The discriminator has an "S" response curve like an ordinary FM detector, and will develop zero voltage when its input frequency is exactly 45.75 mc. The correction voltage to the tuner will thus be at zero when the local oscillator (fine tuning) is on-frequency.

Suppose, for example, the receiver is on channel 2; the video carrier going through the RF amplifier to the mixer is 55.25 mc. The correct oscillator frequency is 101.00 mc. Both signals combine in the mixer, and their difference is the correct IF carrier of 45.75 mc.

If the oscillator were incorrectly tuned to 101.25 mc, the resultant IF would be 46.00 mc. The AFC discriminator, receiving this higher IF carrier, would develop a positive correction voltage. If the oscillator drifted downward in frequency, or if the fine tuning were incorrectly set to a frequency slightly lower than normal, a lower video IF carrier would be generated, and the AFC discriminator would produce a negative correction voltage.

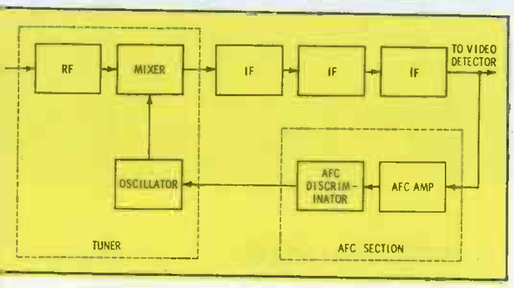


Fig. 1. AFC system is merely feedback loop for correcting oscillator drift.

The oscillators in the VHF and UHF tuners each have a diode connected across the oscillator tank. These special diodes are reverse-biased by a positive DC voltage on their cathodes, causing the diodes to behave as a capacitor. The diodes are, therefore, frequency-determining components of the oscillator. The diode capacitance, and thus the frequency of the oscillator, depends on the amount of reverse bias.

The DC correction voltage from the AFC discriminator (positive, negative, or zero) is connected to the anodes of the two diodes. When the discriminator voltage is positive, the anode of the tuner diodes is more positive, which decreases the reverse bias. The diode capacitor is then larger in value, and the increased capacitance across the tank will lower the oscillator frequency.

Fig. 2 shows the location of the *Varicap* diode in the transistorized UHF tuner. The *Varicap* connects to the terminal by the test probe and is above the transistor. The VHF tuner uses a "diode" formed of two elements of a transistor, and is shown in Fig. 3.

The usual installation uses two AFC-Defeat switches. One is located on the front of the turret-type tuner, and shorts the AFC correction voltage to ground while the "preset fine tuning" is adjusted—see Fig. 4. The "preset fine tuning" shaft pushes against a white nylon button connected to the metal contact of the switch.

The other defeat switch, a push-pull type, is on the brightness control. When the control shaft is pulled out, the AFC correction voltage is grounded. This defeat switch is for poor signal areas where it may be desirable to detune the set slightly for best black-and-white reception. Also, the brightness-control defeat switch can be pulled out when the owner is tuning a UHF station. However, after the station is tuned in, it is necessary to push in the brightness control to reactivate the AFC and prevent oscillator drift.

Fig. 5 shows the AFC circuit board in the Magnavox receiver. The amplifier is on the right of the picture. The shielded transformer at bottom right is at the input to the 6BA6 amplifier tube. The discriminator is in the rectangular shielded section on the left. Note the two tuned tank circuits, about ¾" apart; they are a loosely coupled primary and secondary tank. The primary, nearest the 6BA6 tube, requires a hexagonal alignment tool; the secondary needs a slotted alignment tool.

Fig. 6 shows the circuit board installed in a chassis, with the discriminator shield cover in place. The alignment tool is in the critical secondary adjustment. To the right of the AFC board is the high-voltage cage.

A detailed schematic of the AFC circuit board is shown in Fig. 7. Test-point B is located on the upper left-hand corner of the circuit board as it is shown in Fig. 5. The voltage at test-point B is zero when secondary L2B is at resonance. Consequently any adjustment or

Fig. 2. Tuning diode in this UHF tuner is mounted directly above transistor.

misadjustment of L2B will affect the fine tuning when the brightness control is pushed in (AFC functioning). L2B is the slotted adjustment.

There are two sources of signal voltage applied to the bridge. One source is across primary tank L2A, coupled to the diode circuit by C6 and C7. Both ends of the diode circuit receive voltage of the same phase from L2A. The other source of signal voltage is that developed across secondary coil L2B by inductive coupling from L2A. The voltages applied to the diodes from the secondary are 180° out of phase at either end of the bridge.

Current flow in either diode depends on the amplitude of signal voltage reaching it, and this amplitude is dependent on the phase relationship between the two signal sources. When the secondary is resonant, and fine tuning is correct, the phase difference between priary and secondary signals is 90°. The signals applied to each end of the diode circuits are equal. Equal current through each diode represents a balanced bridge, and test-point B measures zero volts.

When the IF video carrier frequency drifts above 45.75 mc, the tuned circuits are no longer resonant. This creates a phase shift in the signal voltage developed across the secondary. Consider the effect of this shift: The balanced signals coupled by C6 and C7 haven't changed at all; the signal voltage from the secondary has; therefore, the two sources of signal voltage for the diode circuits are no longer exactly 90° out of phase. Diode X1 receives a greater portion of the signal, unbalancing the bridge and developing a positive correction voltage at test-point B.

A tuning shift that causes the IF to swing below center frequency (45.75 mc) will cause the secondary signal voltage to shift phase in the other direction. The result is that the 90° balance is upset in the opposite direction, with a consequent negative correction from the bridge output test point.

The correction voltage at point B is sent to the tuners through decoupling resistor R8. A simplified schematic of the VHF oscillator is shown in Fig. 8. Resistors R5-R6 form a voltage-divider network that provides the positive voltage to keep AFC diode X1 at reverse bias. X1 is a part of the oscillator tuning network, and the correction voltage applied through R4 controls its capacitance, thus setting the oscillator frequency. The UHF-tuner oscillator operates essentially the same.

Troubleshooting

Hunting trouble in the tuner AFC system is no great problem. The usual resistor, capacitor, or diode faults can occur. The symptom almost invariably is a picture that shows off-frequency tuner operation when the AFC is active, but works okay when either defeat switch cuts out the AFC action. Of

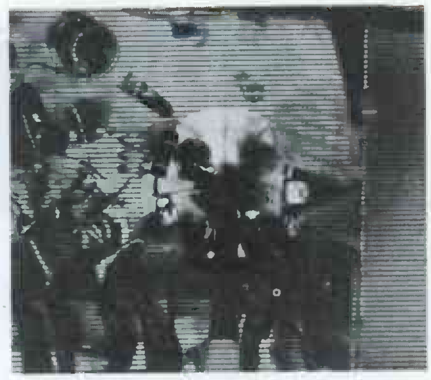


Fig. 3. Transistor in tuner acts as capacitor to set oscillator frequency.

course, the *Varicap* diode or its bias network can become faulty, but that's a tuner defect, and shows up as one.

One standard approach to troubleshooting the system can be adopted and followed through each time a symptom suggests tuner-AFC trouble. This step-by-step system will reveal any component fault that is likely to occur.

Tuner or AFC?

Start by pulling out the defeat switch on the brightness control. Then try to tune in a local station, particularly one that has a color program in progress. If you can tune it okay, the tuner is probably normal. If not, and the symptom is that of an off-frequency oscillator, the tuner may be at fault.

If tuning is poor, and there's no difference whether the defeat switch is on or off, leave the switch open and connect a jumper from point D (Fig. 8) to ground. If the tuning is okay with this jumper in place, AFC is at fault and the defeat switch isn't working. If tuning is still faulty, the cause probably isn't in the AFC section.

Tuner

Besides the usual tuner troubles

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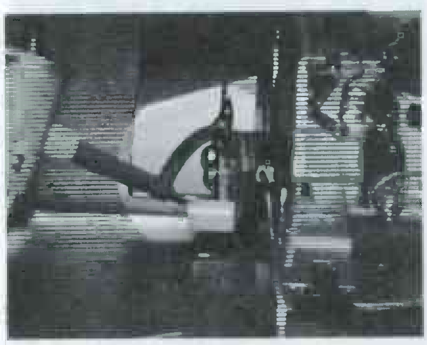


Fig. 4. Adjusting preset fine tuning is one way AFC is defeated momentarily.

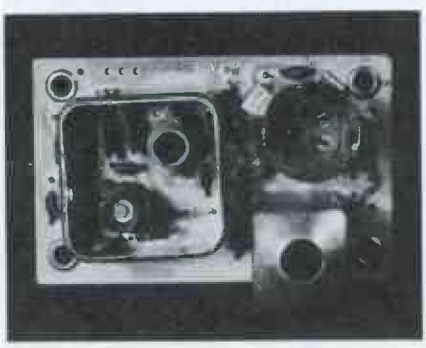


Fig. 5. Entire AFC section is mounted upon this single printed-circuit board.

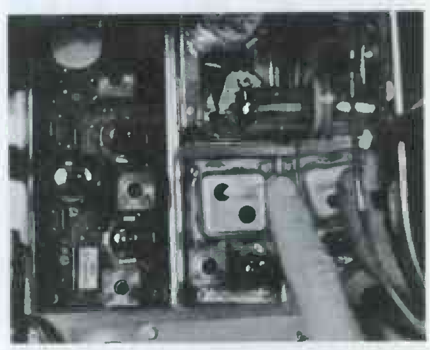
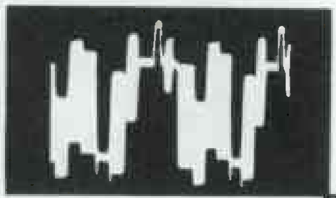


Fig. 6. AFC module is situated next to the high voltage cage, by video stages.



Analysis OF CHROMA WAVEFORMS

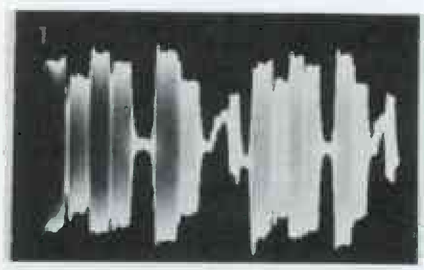
Scope traces can tell you a lot . . . .

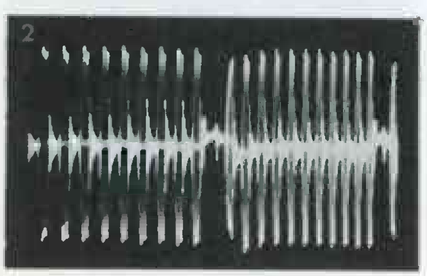
by Larry Allen

Scope displays are an absolute necessity for consistent trouble-shooting success in color receivers, but they are of little value unless you understand them. The wave-forms shown here are from important chroma circuits in different color sets. Although precise shapes and amplitudes vary from model to model, they are relatively the same in all similar circuits.

Study them carefully. Become familiar with them. Try to understand the characteristics peculiar to each; the knowledge will help you recognize abnormal displays when your scope sniffs them out.

In describing the waveforms in these photographs, a typical designation will be in parentheses and will look like this (LC, 7875, 250-300V, INT). The letters before the first comma indicate the type of probe used: LC = low-cap; DP = direct; DEM = demodulator. Preceding the second comma is the sweep-frequency setting of the scope: 7875 cps shows two 15,750-cps horizontal-rate cycles, and 30 cps shows two fields of 60-cps vertical-rate information. The numbers followed by a V give the peak-to-peak voltage of the waveform under normal conditions. The final designation indicates what type of signal is being fed to the color set: INT means the waveform has nothing to do with external signals, but is generated internally and will be the same regardless of RF signal input to the set's tuner; KR means the waveform is caused by a keyed rainbow signal; NT means an NTSC-type color signal is being fed to the set.





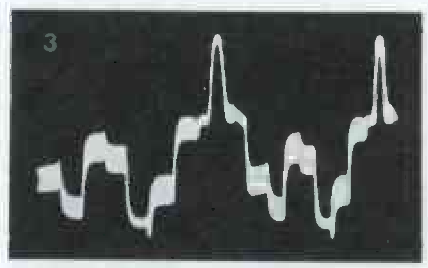
Chroma Bandpass Amps

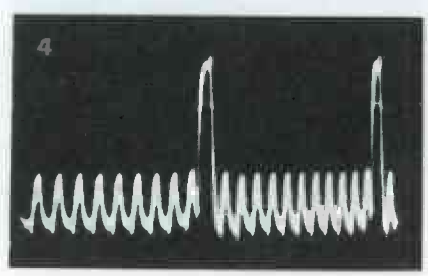
Waveforms in the chroma bandpass stages (called color IF's by Motorola) depend on the type of signal fed into the set. Those shown in photos 1 through 8 are taken from an RCA CTC-12 chassis with NTSC-type and keyed-rainbow signals, because they are the signals normally used for testing and troubleshooting; station signals are different from these in appearance, and the chroma information is changing so constantly that true evaluation would be difficult.

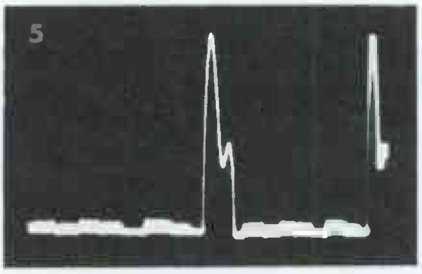
Photos 1 and 2 are the chroma-input waveforms taken at the secondary of the chroma takeoff coil. They are fed directly to the bandpass amplifier grid. Photo 1 (LC, 7875, 6.5V, NT) contains these bars of NTSC color information, starting at left: green bar, yellow bar, red bar, magenta bar, white bar (no color), cyan bar, blue bar, horizontal sync pulse (suppressed considerably), leading up to burst signal; then comes a very brief period of blanking, and the sequence starts over. Note that the scope has synchronized to the first predominantly positive-going signal following the period of low-level signals (suppressed horizontal pulse and burst). If the scope had synced somewhere else, the sequence would be the same but would start at some other color.

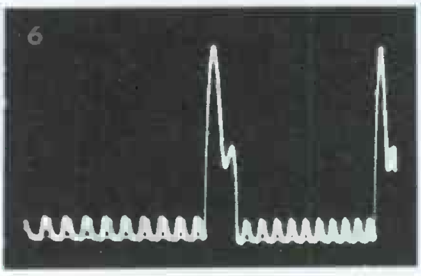
Photo 2 (LC, 7875, 6.5V, KR) shows keyed-rainbow bars fed into the bandpass-amplifier grid from the chroma-takeoff coil. The scope has synchronized on the first color bar; that's why one burst bar appears "left over" at the right end (on the TV screen, it's hidden by blanking). The sequence of colors

Note: This article is adapted, by popular demand, from the Howard W. Sams book "Color TV Guidebook," available for $1 at your distributor's.—Ed.









in photo 2 is: yellowish-orange, orange, red, magenta, reddish blue, blue, greenish blue, cyan, bluish green, green, a tiny trace of horizontal sync pulse that is leaking through, and burst (first large bar in second sequence).

Photos 3 and 4 (LC, 7875, 6V, NT and KR) are of the video (luminance) signals fed from the first video amplifier. In the photos, they are shown just as they come from the video stage; in the set, they are coupled through a small 18-pf capacitor which strips off the sync pulses that usually stick up so prominently above the video signals. Thus the signal actually applied to the bandpass-amp grid is video only, with little sync or blanking information (these pulses wouldn't blank, anyway; as you can see, they are positive-going and, being applied to the grid, would increase, not blank, the signal output pulse).

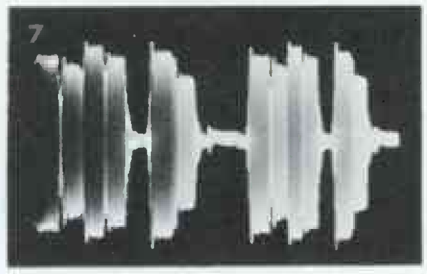
Compare the video-level steps in photo 3 with the chrominance-bar information in photo 1; you'll be able to count off the bars (each color) in the same sequence, and see the brightness (saturation) level of each. In photo 4, the keyed-rainbow luminance information shows about the same degree of brightness for every bar, which is normal for this type of pattern.

Photos 5 and 6 (LC, 7875, 25V, NT and KR) show a composite signal. Dominating the displays are blanking-signal pulses fed in from the blanker stage (usually taken from the blanker cathode, to provide an impedance match of sorts). Along the base line, you'll notice some of the mixed chrominance and luminance information that is applied to the grid; this appears at the cathode through normal cathode-follower action, although a small-value bypass capacitor (820 pf) reduces it to an insignificant level while allowing the 15,750-cps blanking pulses to remain. The strong positive pulses, applied to the cathode as they are, drive the bandpass-amplifier tube into cutoff during horizontal retrace time — thus keeping burst and sync from reaching the plate circuit.

Photos 7 and 8 (LC, 7875, 4-8V, NT and KR) show the result of all these signals being applied to the chroma bandpass amplifier tubes. Remember: Video (luminance) and color (chrominance) information go to the grid, and blanker pulses go to the cathode—result is pure, clean chroma signals that have no burst pulse and no sync pulse between the bars of color information. Note the clean blank space at zero-center between each color-bar sequence. This is the period of blanking, when there is no color in the chroma-bandpass output or reaching the CRT grids.

Color Sync

Synchronization of chroma information in the receiver with that in the station signal is the job of the color-sync section. The color-reference burst in the station signal must occur precisely at the beginning of each line — in fact, the burst is positioned (at the station) exactly on the "back porch" of the horizontal sync pedestal. Furthermore, the set's color-reference oscillator must be in precise phase with the few cycles of 3.58-mc information in the station signal. The entire job is accomplished by comparing — in some rather elaborate circuits — the CW signal from the 3.58-mc oscillator in the set, the incoming chroma signal, and a sample pulse from the horizontal output transformer. Photos 9 through 14 show the waveforms in the color-sync circuits of an RCA-type chassis of CTC-12 vintage, when a keyed-rainbow signal is used for receiver testing.



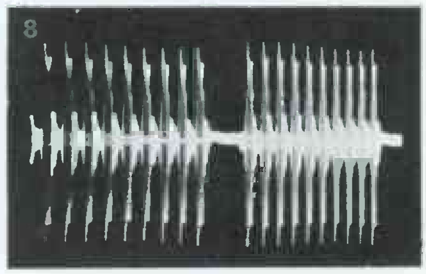


Photo 9 (LC, 7875, 60V, KR) is a video signal brought directly from the video amplifier. Photo 4 shows exactly the same signal. If you recall, the horizontal pulses are stripped off of photo 4's waveform by an 18-pf capacitor in series, before the signal is applied to the bandpass - amplifier grid; photo 10 (LC, 7875, 8V, KR) shows the video signal that is left after the 18-pf capacitor. You can see by comparing photos 9 and 10 that the 8-volt amplitude of 10 is about the same amplitude as the video information riding with the 60-volt pulse in 9. The chroma-and-video signal in photo 10 is applied to the grid of a burst amplifier in the color-sync section.

Photo 11 (LC, 7875, 90V, INT) is a slightly integrated (not sharply peaked) positive-going sample pulse from the flyback transformer. This sample pulse is applied, along

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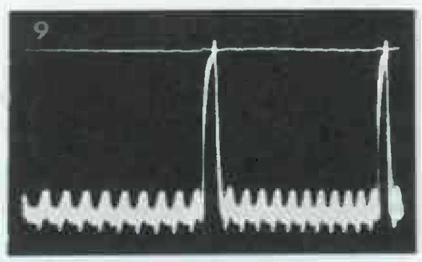
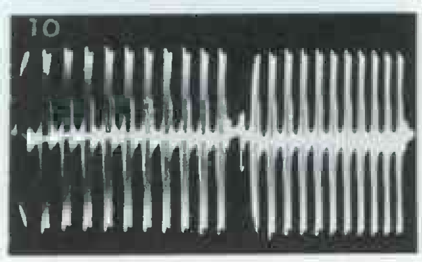




collection of COLOR TV CURES

The helps given here will save you time.

by Homer L. Davidson

Since color TV has been with some of us for eight or nine years, a technician who's been working at it has collected a lot of valuable information on color servicing. We soon forget the easy ones, but those troubles that recur time after time are always remembered. Repetition can be dull at times, but in color television it helps make some of the tough ones easy.

There are certain logical procedures you can follow in troubleshooting color sets, procedures which don't necessitate a lot of years of experience. To the old-timer, these trouble-hunting steps are the utmost of simplicity, but they should represent quick cures to the neophyte in color-TV servicing. And even you old hands may get an idea or two. Some specific case histories are thrown in to make the points in each troubleshooting instance.

Low-Voltage Stages

If there is no sound, no picture, no raster, and the tubes don't even light, a bad on-off switch, fuse, or power transformer is the most obvious cause. A surgistor in the primary circuit of the transformer can cause the same trouble. In the RCA CTC10 chassis, these surge limiters are of the disc type. They can become cracked or burned, their soldered ends can pull off, and their resistance may increase.

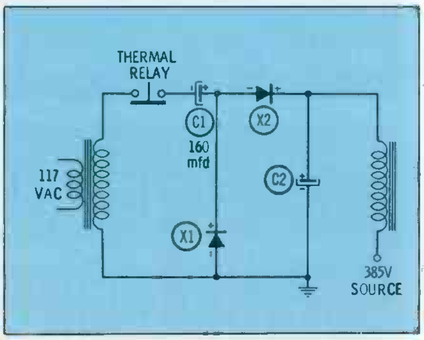


Fig. 1. Doubler circuit, thermal cutout.

An RCA CTC9 chassis was placed on the bench with no sound and no picture. The primary fuse was blown; indications were of a dead short somewhere in the power supply. The trouble was traced to a leaky 160-mfd 250-volt electrolytic voltage-doubling capacitor.

In the first color sets, the old faithful 5V4G was used as a low-voltage rectifier. Next came the selenium rectifier, and now the silicon diode has taken over.

An RCA CTC11B chassis had power-supply trouble. The thermal relay would kick out almost as soon as power was supplied. One side of each silicon rectifier (Fig. 1) was cut loose and checked. A good rectifier unit will measure 10 or 15 ohms one way and 1000 ohms or more with the ohmmeter leads reversed; a shorted one will show low or no resistance both ways. X1 was dead shorted.

In case of other damage, check associated components before a new silicon is soldered in place. In this set, C1 was in trouble because of the raw AC that had been applied to it momentarily. If the other silicon rectifier is in any doubt, replace it; it could cause the same trouble.

Sometimes a momentary arcover or overload on the B+ line will cause a silicon diode to blow. You may never find the short that caused it, but suspect power tubes such as audio, video, vertical, or horizontal output tubes.

In one set, the silicon diode had become open. Ohmmeter checks showed there was a short on the B+ line. By tracing through the maze of wires in the circuit, the troubleshooter found a shorted vertical centering control. When the color receiver was returned, the owner admitted adjusting the vertical centering control several times. Perhaps the screwdriver blade was too big!

It is well also to check voltage-divider resistors when trouble develops in the low-voltage power supply. They can become quite warm and crack in two or increase in resistance.

Vertical Troubles

The vertical-sweep section of a color receiver is no different than in a black-and-white set. Most of the troubles are tubes, capacitors, or resistance changes.

In the Admiral 25 series, such as the 25G6, 25H6, and 25J6 chassis, poor height and linearity are not uncommon. When adjusting the height control, the linearity will flatten down; then, when the linearity control is adjusted, the raster wants to pull up from the bottom.

If this happens, the 47-megohm resistor tied to the 1V2 focus rectifier tube is usually open. This results in improper voltages reaching the vertical oscillator circuit. The open resistor is a ribbon-wound type and should be replaced with the same type.

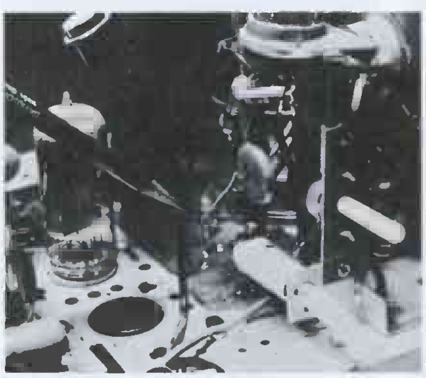
The most usual complaint is vertical rolling. In '58-'59 RCA and Admiral color receivers, a 2-mfd 350-volt screen-bypass capacitor commonly causes this symptom. Poor AGC action and sync faults can be caused by the same unit. It is wise to replace this capacitor whenever one of these chassis appears on your bench. The tubular unit lies close to the 6AW8 video amplifier tube, on top of the printed board, and can be replaced without removing the chassis.

Vertical rolling is also caused by poor vertical sync. Some color receivers can be helped in fringe-area reception by bridging one of the resistors in the vertical integration network — see Fig. 2. Also check all coupling capacitors for leakage. Voltage and resistance checks will help, but a scope is the fastest way to trace most vertical troubles.

Zenith 29JC20 chassis sometimes develop foldover at the bottom of the screen. A leaky C53 capacitor, the coupling from the plate of the oscillator to the grid of the output stage, is the usual culprit. Both oscillator and output stage are part of a dual-function 6EM7.

High Voltage and Focus

A lot of high-voltage troubles are visible: transformers that have arced over, burned linearity coils, and overheated resistors. Generally, the symptoms are no high voltage, insufficient width, or poor focusing of the picture.



An example of high-voltage arcing.

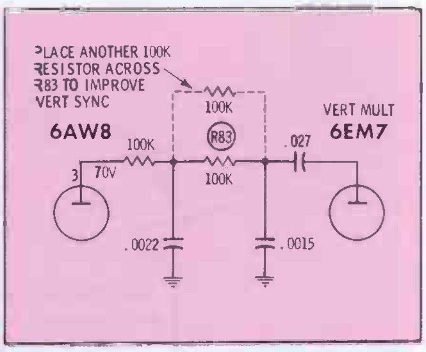


Fig. 2. Modification improves vert sync.

One trouble in the early Admiral receiver was excessive failure of 6BK4 tubes. The cause is a .0033-mfd ceramic disc capacitor, connected between cathode and grid, which either shorts or becomes leaky. The 6BK4 then gets so hot it cracks the glass envelope. Replace this capacitor with one having a 1000-volt rating.

In some RCA CTC9B chassis, the TV screen turns red, and the CRT screen-grid controls have no effect at all. The trouble is usually located in the focus rectifier circuit, where the 1-megohm resistor has increased in value.

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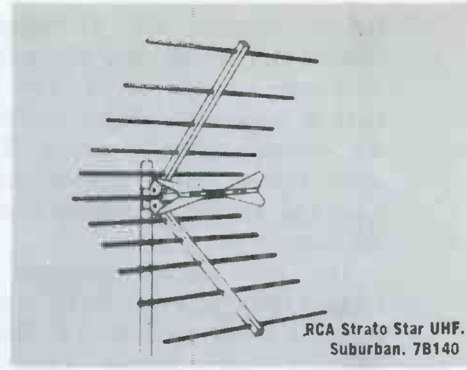
RCA Color Scan VHF/UHF/FM.
Urban. 10B1100
Kit Version: 10B1101

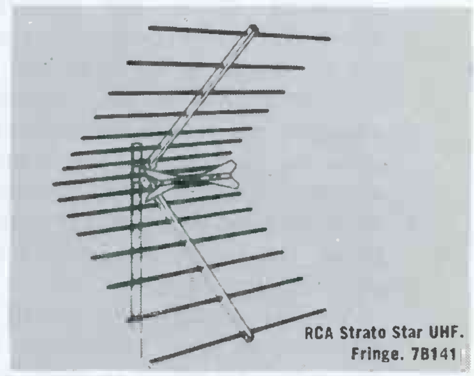
RCA Strato Beam VHF/FM.
Urban-Suburban. 10B1010
Kit Version: 10B1011



RCA Strato Star UHF.
Suburban. 7B140

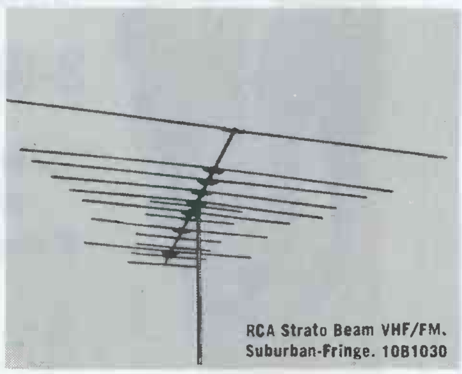
RCA Color Scan VHF/UHF/FM.
Urban-Suburban. 10B1110

RCA Strato Beam VHF/FM.
Suburban. 10B1020



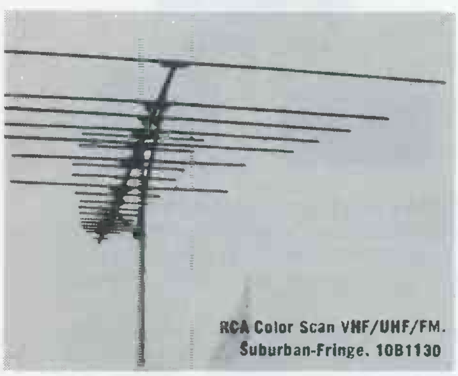
RCA Strato Star UHF.
Fringe. 7B141

RCA Color Scan VHF/UHF/FM.
Suburban 10B1120

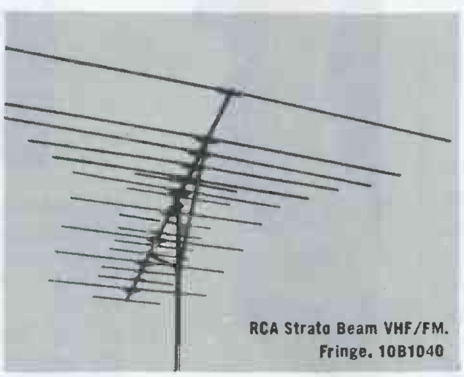


RCA Strato Beam VHF/FM.
Suburban-Fringe. 10B1030

RCA Strato Star UHF.
Urban. 7B150

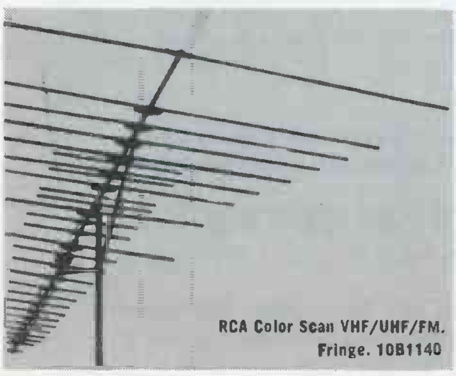


RCA Color Scan VHF/UHF/FM.
Suburban-Fringe. 10B1130

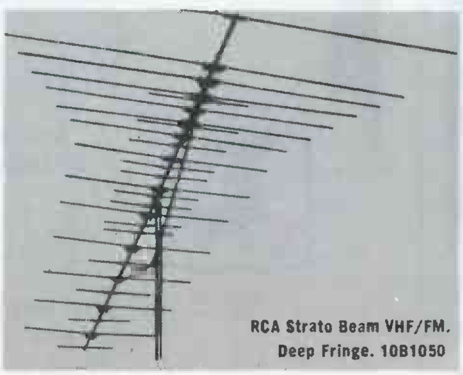


RCA Strato Beam VHF/FM.
Fringe. 10B1040

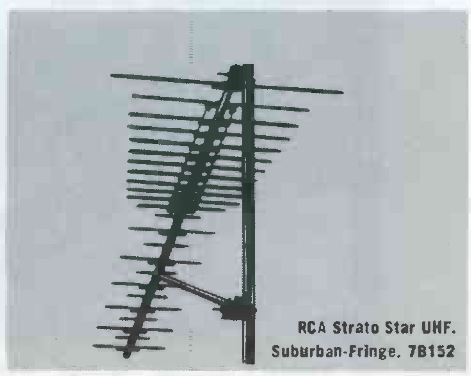
RCA Strato Star UHF.
Urban-Suburban. 7B151



RCA Color Scan VHF/UHF/FM.
Fringe. 10B1140

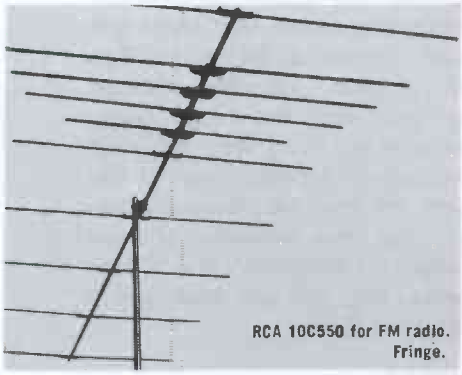


RCA Strato Beam VHF/FM.
Deep Fringe. 10B1050

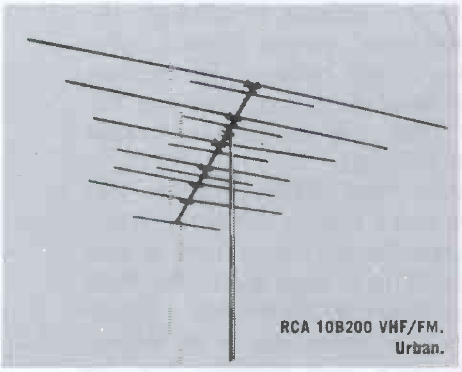


RCA Strato Star UHF.
Suburban-Fringe. 7B152

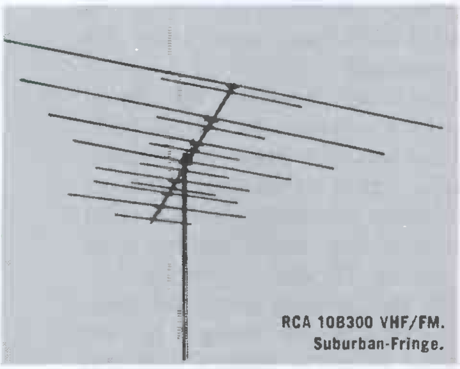
RCA 10C450 for FM radio. Suburban.



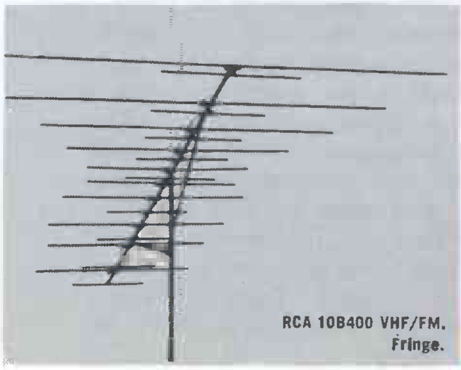
RCA 10C550 for FM radio. Fringe.



RCA 10B200 VHF/FM. Urban.



RCA 10B300 VHF/FM. Suburban-Fringe.



RCA 10B400 VHF/FM. Fringe.

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- **Rugged insulators** of high-impact polystyrene and linear polyethylene are used, the individual antenna model determining which is appropriate. Virtually unbreakable, these insulators provide excellent protection against the elements, preserving the high electrical characteristics and mechanical strength of the antenna.
- **Superior performance** assures customer satisfaction. Straight, in-line elements improve directivity by minimizing side pickup of noise, interference and spurious signals. In appropriate models, by combining directors, reflectors, and closely-spaced driven elements coupled with folded phasing lines, high uniform gain across all channels and superior front-to-back ratio are provided.
- **Highly efficient** due to extremely low VSWR.
- **Twice the gain** in a given antenna size is achieved in most of the models having a UHF capability since they employ a unique **double-length element.**
- **Built-in VHF-UHF coupler** on most UHF antennas permits installation with a single down-lead where separate VHF antenna is already installed.

Your customers are already sold on RCA. Remember this... next time you get an antenna order.

RCA PARTS AND ACCESSORIES, DEPTFORD, N. J.

The Most Trusted Name in Electronics

making Color Servicing BIG BUSINESS $

Mass repairs increase bank accounts.

by Forest H. Belt

Said a recent news release from TELEVISION DIGEST, reporting a survey they had conducted: "In the next five years, nearly half of America's television-equipped homes will convert to color." Open almost any magazine or newspaper and you'll read of astounding advances color TV is making—networks are pushing color programs, manufacturers are pushing color receivers, and furniture dealers are mouthing color-TV "bargains," especially in last year's models. In fact, dealers all over the country report that new color TV is now a seller's market; supply just isn't keeping up with the increasing demand.

Okay, so you've heard or read all of this; what does it mean to you? Just this: Every set that is sold should be installed and adjusted by someone familiar with the techniques of color servicing and convergence. An antenna assures best color reception, so there is outside work for someone; and every set that is sold will need servicing sooner or later.

Where's the Money

Let's delve into a few "dry" statistics, and see if we can liven them up for you, converting them into potential dollars and profits.

What are the dollar potentials right now for color-set service technicians? There are almost 5 million color sets in use already, and by January 1966 the figure should top that. (Experts say there would be even more in use except for a shortage of sets brought about by heavy demand and a scarcity of color picture tubes.) Imagine, 5 million sets!

Now, let's add another interesting statistic. Estimates indicate about 100,000 fulltime service technicians in the United States, either in business for themselves or employed fulltime. Of these, about 55% can service color receivers—about 55,000. Connect this with the number of color sets in operation and you can conclude that there are already about 100 sets for every technician capable of working on them. That means a set every 2½ working days or 2 sets per week, *if each receiver needs service only ONCE a year*.

Expand this a little further. Experience has shown that color sets require service a bit more than twice a year, on the average. You can see the implication: There's a set every day for each technician to service, even at the present low level of color-set saturation. Are you servicing at least one color set every day? If not, continue reading and see what you're missing in $$$$$.

The Dollars

It's not difficult to calculate the *approximate* service income generated if one color-set job reaches your shop every day. You can follow Table 1 if that makes it easier to understand.

More than 95% of color jobs start with a service call to the home. Charges for this range from as little as $6.00 to as high as $12.50. With an arbitrary $7.50 for our example (a survey shows this to be a popular rate), and allowing 5% for carry-ins, service calls bring in about $1750 each year. Okay for just a starter?

Remember, however, this figure is only for service calls. About 30% of these sets, if a really good maintenance job is to be done, will require shop servicing. So, we must also figure the service income from the almost 75 sets (including carry-ins) that actually reach the shop. (The service-call charge is left standing to cover pickup, delivery, and final adjustment in the home—a necessity with color.) A specific price for a shop repair job is more difficult to pin down. However, a well-equipped shop with a competent technician can do a thorough repair and preventive-maintenance job on a color receiver for about $25 (this, too, is a popular "round" figure all over the country, although actual charges fluctuate widely above and below this amount). So, add another $1825 of service in-

Table 1. Color Service Yearly Profit

Based on one set each work day

SERVICE					
$ 7.50/call	243 work days	$1750			
$25.00/bench job	73 sets	1825			
Total service income			$3575		
Color-service part of technician salary			2150		
Gross profit -- service				$1425	
PARTS					
$25/set	100 sets	2500			
Total parts income			2500		
Cost of parts			1500		
Gross profit -- parts				1000	
Total Gross Profit				2425	
Portion of expense & overhead				1825	
NET PROFIT					$600

come to the $1750 and you have: $3575 per color technician. If you service color, therefore, statistical chances are that you'll add nearly $3600 a year to your income.

But we're not finished yet.

Consider the parts used in servicing color receivers. Tubes and fuses on home calls; resistors, capacitors, coils, and transformers in the shop; sweep components; a picture tube every now and then: the charges for all these components are part of your gross income. Replacement parts for color sets, at list price, average about $25 per year per set over a 5-year span.

The Net-Profit Picture

To analyze profit, first develop some gross-profit figures.

Gross profit from service income is equal to total income minus salary (yours or your technician's). Of your $3575 service income, you may have paid your employee or yourself as much as 60% or $2150. Gross profit is thus $1425.

Gross profit from parts is found by subtracting their cost from total parts income. If your markup averages 40% (it's more on tubes and on a few other components if you buy wisely), your gross parts profit in this example will amount to $1000.

Total gross profit is $1425 plus $1000, which is $2425.

Naturally, this amount is reduced by overhead expense to find net profit, although your color-servicing activity should be charged only its fair share of overhead. A realistic portion shouldn't amount to more than 75% of gross profit, which leaves a net profit of $600 per year. That's $600 *profit*, mind you, over and above your (or employee's) salary; that's $2.50 *profit* every working day and more than $50 *profit* every month. Is it worth it? You decide.

The Outlook

So far, we've talked only about how you can make money servicing color right now. What is the future going to hold? To all appearances, the future of color is certainly bright. Present trends indicate there will be *25 million* color receivers in operation by 1970—only 5 short years from now! Consider this in terms of dollars and the net-profit picture, and it will be more meaningful.

In 1970, there will be five times as many color sets as there are today. Assume there will be the same number of color-television servicemen. Each man will have to repair an average of 5 sets every day to keep them all going. Better equipment will be necessary, along with faster ways to hunt trouble. Even if charges stay exactly the same (they're likely to rise as all other prices will), the total service income for a color technician will average $17,875. About $10,500 of that should go for salary, which incidentally means a competent color-TV technician can earn a good salary from color sets alone—fixing only 5 sets a day.

And what about net profits in 1970? Parts sales for the five-sets-per-day you're servicing then will produce a gross profit around $5,000. Total gross profit, then, will be $7375 for service and $5,000 for parts, a total of $12,375. It's likely that overhead costs will have risen along with other prices and will take a bigger bite out of gross profit. A $3000 net profit would be acceptable, and don't forget that's over and above whatever salary you pay yourself or your color technician.

Something else to keep in mind: all this means that 55,000 color-TV technicians will have to work practically fulltime to keep up. The few black-and-white sets that are left and the other electronic gadgets which will have been sold by 1970 will be taken care of by the remainder of the probably 100,000 technicians. Many of them will be specialists in their own type of electronic equipment. And of course color experts will be able to do other servicing, too.

Where's Your Share?

Yes, there is money to be made in color-television servicing. You can be having your share today. Apply yourself to the task, and you can take more than your 1/55,000 of the color-TV service work that's available; lots of service shops already have more than that. Specifically, here's how.

(1) Learn the basic operation of circuits in color chassis, even if you must spend much of your precious time in study, in school, in clinics, or in solitary evenings of reading, reading, reading about color television. You won't get your full share of today's servicing, let alone tomorrow's, unless you understand the sets.

(2) Learn the most modern and speedy troubleshooting techniques. Time wasted today may mean only that you don't make many dollars; in the future, it may mean you can't handle the load of sets you'll be asked to service, and the good wages will go to servicemen who have learned to do a thorough job quickly.

(3) Buy test equipment to do, in a reasonable time, the complete job your customer expects of you. You can't make money (profits) if you can't repair sets fast enough both to please the owner and to move several through in a day. Color sets require closer alignment, more thorough testing, and more careful servicing than monochrome receivers. Skimp on the job, and you'll soon get the reputation. Proper instruments, and knowledge of how to use them, are essential.

(4) Get experience as soon as possible. Don't wait until the work load is burying you (perhaps from your lack of skill). Work with an expert (even if he's younger than you). Learn by doing. Work on sets the cut-and-try way if you have to, but *do* it. Don't have time? You'll have less time later when more and more sets are demanding more and better technicians. Work on your own set. Work on your customers' sets. You gain experience only by working on sets. Now!

(5) Be sure you're charging enough—for your time and knowledge and for your investment in equipment and parts inventory. Don't forget your overhead expenses. If you don't ask enough for your specialized work on these complicated tinted sets, you'll discover that you can't afford the time- and labor-saving devices you'll need to handle the volume of sets you'll soon be asked to service. If you can't handle them properly, your customers will go somewhere else for service, and you would have far less than your fair share of this booming color-TV servicing market. ▲

Overall Alignment IN COLOR RECEIVERS

Adjusments to coils in the RF, IF, and chroma stages are sometimes related.

by Arnold E. Cly

Color is really on the move! According to most reports, by the end of this year five million color TV sets will be in use. This will represent an increase since January 1 of 2,140,000 units—the largest number of color receivers to be placed in American homes during any one year. It's easy to see that television technicians are going to have an increased amount of business in the color-TV field. To remain a keen competitor, the service shop must be ready to take care of many problems encountered in servicing color TV that are not found in black-and-white servicing.

RF, IF, and color-circuit alignment is one area that will be of great importance. The objective is the same as for a black-and-white set—the best possible picture definition on the CRT screen that the particular chassis can produce. The major difference is the exactness required in RF and IF alignment of color receivers; misalignment anywhere in the signal path through the receiver is more likely to cause poor performance in a color set than in a black-and-white set.

The Tuner

First, let's go through the fundamental alignment steps for a typical tuner, since this stage must pass a proper signal to the rest of the receiver. The tuner performs the same function in a color set as in a monochrome receiver; it selects transmitted RF signals, which are amplified and heterodyned with the signal from a local oscillator. The difference-frequency output that results is coupled to the video IF section. The tuner in a color receiver must provide uniform amplification at all required frequencies in the channel being received. In black-and-white reception, a good picture may be obtained even if the tuner bandwidth is somewhat narrow; however, this condition in a color receiver would result in poor or nonexistent color reception.

The normal response curve of the RF tuner in a color receiver (Fig. 1) provides proper bandwidth for color reception. By noting the markers on the curve, one can realize what would happen if the higher-frequency parts of the television signal were attenuated. The result would be the loss of part or all of the color information. This proves the importance of a proper alignment procedure which places the video- and audio-carrier markers at the positions shown, provides maximum gain with minimum tilt, and eliminates sag within the response curve.

Testing Requirements

The first requirement for any alignment job is proper equipment, and in color-TV service work it is especially important that this gear be stable and accurate. The generators and scope must be bonded together with short, direct grounding straps to eliminate standing waves on shielded leads and to prevent ground loops from being formed. These conditions will cause the response curve being viewed to vary in amplitude and shape if any part of the body approaches the test leads —this is very annoying and will prevent good alignment if not corrected.

The use of a marker adder will make alignment much easier and more accurate due to the absence of response-curve distortion caused by the marker. An adder places the frequency pip on the curve after the sweep

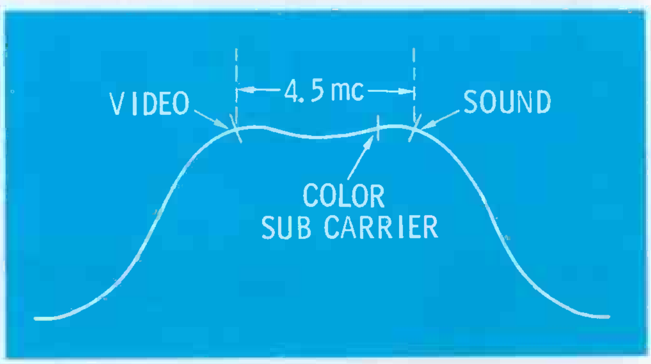


Fig. 1. The VHF-tuner response curve should look like this.

signal has passed through the receiver. If the marker signal passes through the same stages as the sweep signal, waveform distortion usually results—especially if the output of the marker generator is increased to make the pip visible.

Radiation from the horizontal-output stage will usually show up as *hash* on the response curve. This intereference may be eliminated by removing either the horizontal-output tube or the protective fuse for the horizontal-sweep circuit. Then, a 1500-ohm (some chassis may use 2000-ohm), 100-watt resistor is tied from the B+ source in the low-voltage supply circuit to ground. A word of caution! If the horizontal-output tube or fuse is removed, be sure all bias supplies are connected before the set is turned on. Some receivers use negative bias voltages from the horizontal-output-stage grid, and component failure may result if this voltage isn't present.

Alignment Procedure

Fig. 2. shows the connection points for the alignment apparatus and the components to be adjusted. The sweep and marker generators (and the marker adder, if one is used) should be permitted to warm up for at least 15 minutes before any checks are made.

The vertical input of an oscilloscope is connected to point U, and a variable negative bias supply is applied to point T. The sweep-generator output, with a 120-ohm resistor in each lead (to match the 50-ohm generator output to the receiver 300-ohm input), connects to the antenna terminals, and the tuner is set to channel 13. Adjust the sweep generator and scope to display the tuner response curve on the scope face. Set the bias-supply output to obtain a response curve that shows no indication of overloading; usually about −3 volts is needed. Adjust the marker generator so that first the video and then the audio carrier-frequency markers for channel 13 appear on the curve. Now adjust in sequence mixer-grid trimmer A201 and RF trimmers A202 and A203 to obtain maximum output; the response curve must be symmetrical with markers positioned as shown in Fig. 1.

Remove the oscilloscope from point U and reconnect it across the video-detector load resistor. Set the variable bias supply for −15 volts, and set the tuner and the generator to channel 10. Adjust RF neutralizing trimmer A204 for minimum amplitude of the output which appears on the scope screen. Return the scope connection to point U. Reduce the variable bias voltage to its previous setting, and switch the tuner selector and generator from channel 12 through channel 2. Observe the waveform on the scope for each channel, and (if it's necessary) make compromise adjustments of A201, A202, and A203 to obtain maximum gain and symmetrical response for all channels.

Video IF's Next

When the tuner is aligned and the proper frequencies are available for the video IF stages, you can proceed with the video-IF alignment. The connections to the tuner are removed, and the RF oscillator is disabled. This may be done by clipping off the grid pin of the oscillator section of the mixer-oscillator tube. Save this tube; it may be used in the same manner for other alignment jobs.

The first step in video-IF alignment is the connection of bias voltages to the proper points. These voltages and connection points vary from chassis to chassis; consequently, they must be obtained from the alignment instructions for the chassis concerned.

Basically there are two methods used for video-IF alignment. In the first procedure, the output of a crystal-calibrated RF signal generator is coupled to the tuner input. Usually the tuner local oscillator is disabled, and

• *Please turn to page 114*

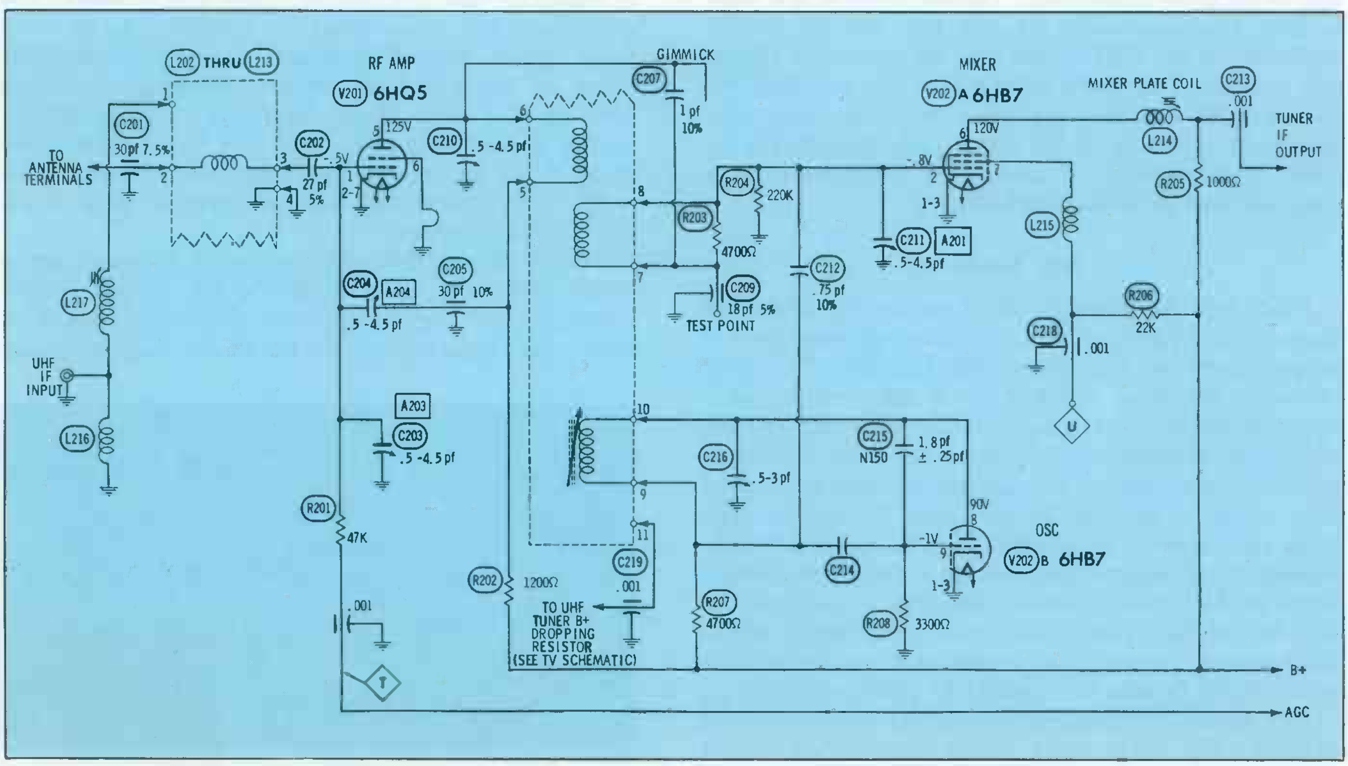
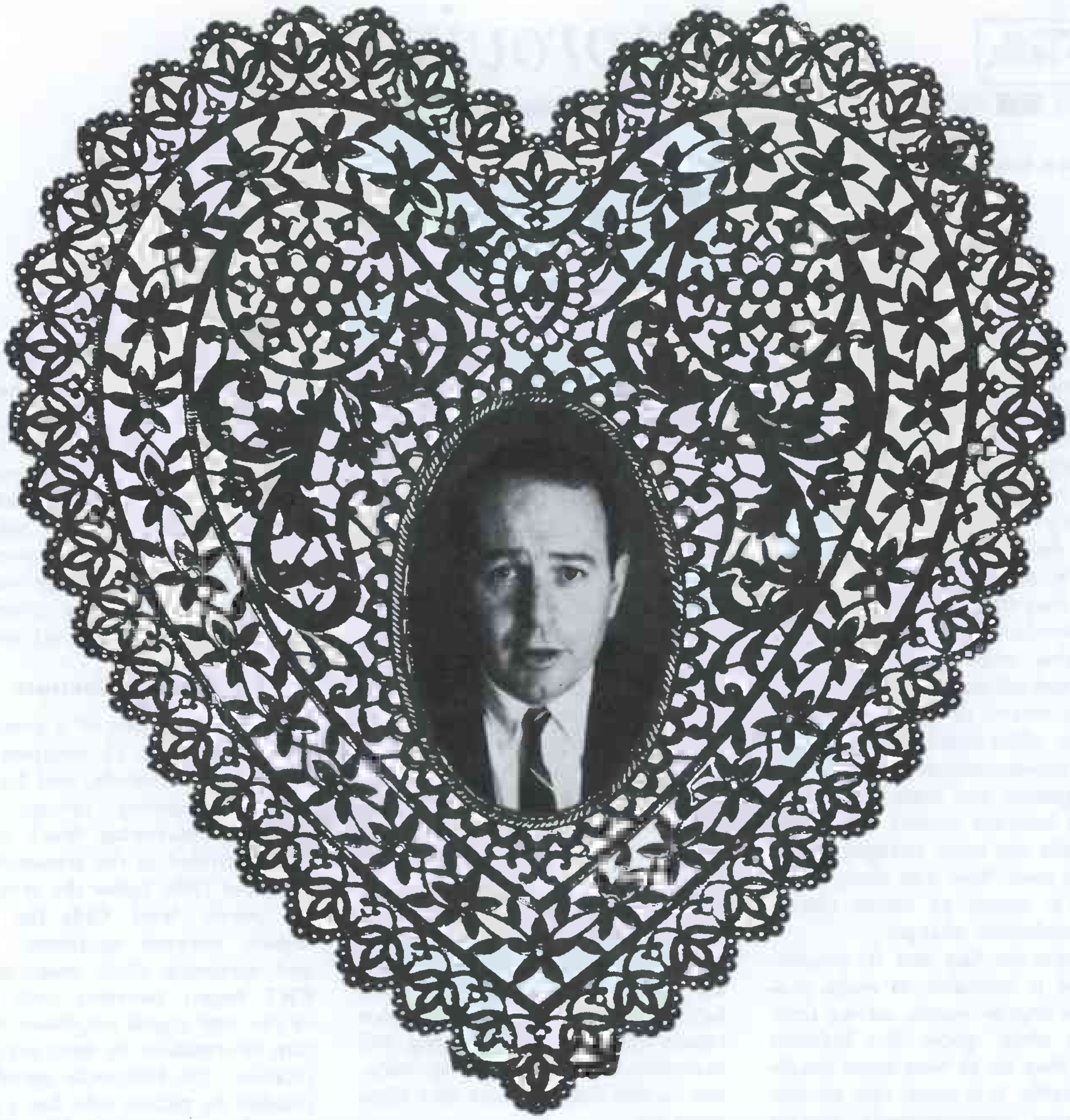


Fig. 2. Alignment adjustments in a typical color-set tuner are identified by "A" numbers.



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Shop Talk

Improving TV RECEIVERS

by Allan F. Kinckiner

Occasionally, minor modifications improve performance.

It is pretty well accepted that each succeeding line of TV receivers is in some way superior to previous lines. Improved performance generally results from combining newly developed tubes, circuits, and assembly techniques with established designs already proved reliable. Occasionally, however, a new model may not come up to expectation; shortcomings show up in the field that were not apparent in the design laboratory. In such cases, manufacturers develop production changes, often based on the findings and recommendations of field-service engineers, and issue production-change bulletins so that servicemen can make the same changes in sets already sold. Now and then, a new model is merely an earlier chassis with production changes.

Despite the fact that set producers find it advisable to make production improvements, service technicians often ignore the bulletins unless they tie in with some tough-dog trouble. It is ironic that servicemen who conscientiously replace "popped" bypasses with units of higher voltage ratings, or heat-damaged resistors with new ones of higher wattage, are the same fellows who won't change component values even when circumstances indicate that altered values would work better. This is not to suggest that part values be juggled indiscriminately, nor that circuit changes be made wholesale. But, in a great many sets, minor changes can produce exceptional improvements. In addition to restoring receiver operation, therefore, a technician can also improve a receiver's overall performance.

There is another consideration when changing parts or circuits: While changes made according to manufacturers' bulletins are helpful in late-model receivers, such changes in older sets may not help much because *all* the components are old. Change bulletins are rarely helpful when subpar performance results from accumulated aging, and manufacturers seldom issue bulletins on sets that are more than three years old.

Many of the changes mentioned in this article cover some pretty old chassis, models that have had no bulletins for years. The circuit changes described have been examined critically with test patterns and scope traces, to be positive that they introduce no detrimental side effects. Most of the improvements have been made in a large number of receivers, and have invariably been welcomed by the set owners.

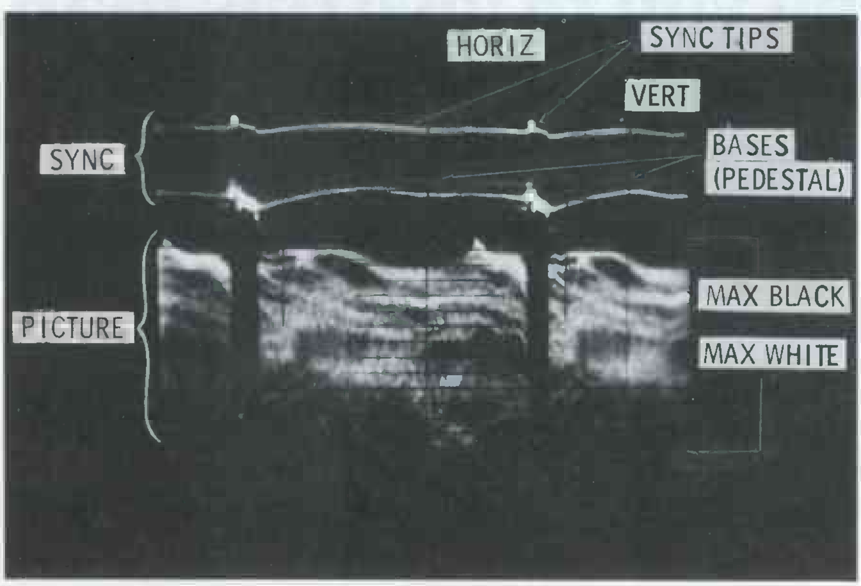

Fig. 1. Makeup of composite video waveform showing relative amplitude of sync.

Improving Contrast

The sync portion of a composite video signal (Fig. 1), occupies 25% of its total amplitude, and for normal programming (except commercials) maximum black signals are controlled at the transmitter to be about 10% below the sync base or "porch" level. Only the video signals between maximum white and maximum black modulate the CRT beam; therefore only 65% of the total signal amplitude is picture information. In most early TV receivers, the composite signal that reaches the picture tube has a peak-to-peak amplitude of 50 volts, so only about 33 volts is actual picture signal. This is hardly enough for a high-contrast picture and results in poor viewing in a lighted location.

Many very old receivers still found in some areas use a two-stage video amplifier circuit. Fig. 2 shows the second stage. In these receivers, the signal normally applied to the CRT is approximately 60 volts peak-to-peak with the contrast control at maximum. The signal on the plate of the video output stage is about 85 volts. By bridging the R4-C1 network, you can cause over 80 volts to reach the picture tube, improving contrast considerably. This change doesn't affect picture detail too much on sets this old.

• *Please turn to page 106*

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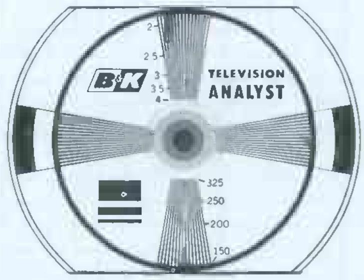

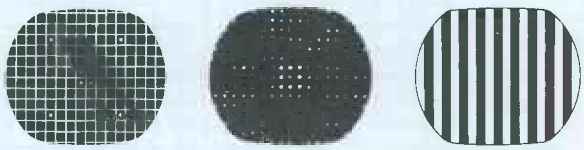

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REPORT ON COLOR

Transmission & Reception

Color has come into its own this past year.

by David Lachenbruch

In the 12 years of color television's commercial existence, 1965 has unquestionably been the most eventful and most successful. But 1965 has been only a beginning! There's little doubt that 1966 is going to eclipse the entire 12-year period in development, in production, and in sales of color television receivers.

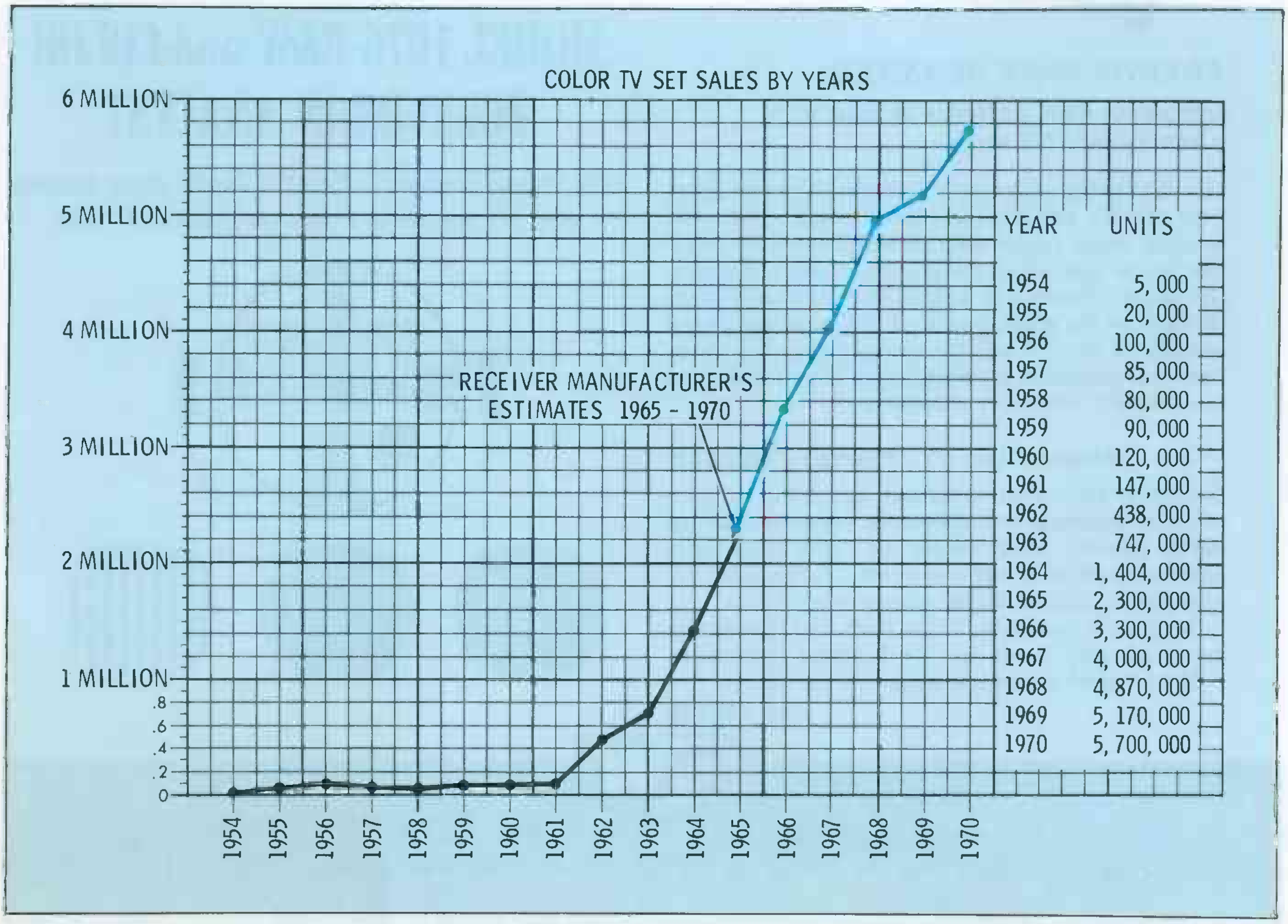
Color is now following almost precisely the explosive growth pattern that black-and-white television pursued during the early and middle 1950's—years of soaring sales, shortage of tubes and broadcast equipment, and proliferation of picture-tube sizes.

Industry Figures

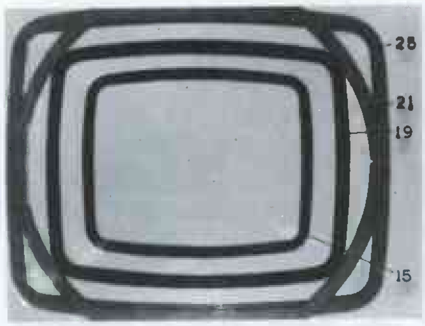
In 1964, there were only two color-TV screen sizes in the domestic market; for 1966, there will be at least six. In 1964, only one television network was broadcasting any significant amount of color; in 1966, all three are moving headlong toward full color programing. In 1964, fewer than 150 local TV stations were originating their own color shows; in 1966, the number will exceed 300.

Sales of color sets went over the million mark for the first time in 1964—totaling 1.4 million sets. For 1965, present trends suggest sales of nearly 2.4 million color sets, and few in the industry seriously question the probability that more than that could be sold by year's end if they were available. During 1965, about one color set was sold for every four black-and-white sets; in 1966, the ratio is expected to be one for two, with color accounting for 3.3 million units.

A recent survey of TV-set manufacturers showed that they expect



Color-set sales curves show yearly increases to date, with projected rises through 1970.

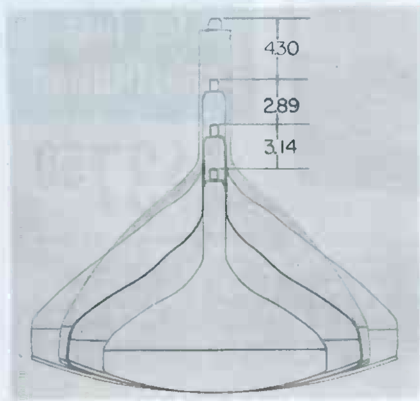


Relative sizes color-CRT viewing areas.

sales to continue rising at least through 1970, when 5.7 million sets will be sold to the public. According to these estimates, nearly 26 million American homes—or more than 44% of TV-equipped households—will have color sets by the end of 1970. This compares with 5 million, or 9%, today.

CRT Sizes

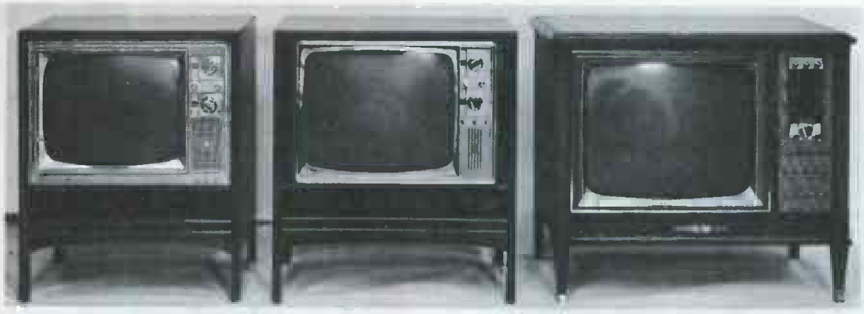
The most dramatic change in color sets themselves obviously has



Comparative lengths show reductions.

been the development of rectangular picture tubes. The bulky 21″ round tube which has been the industry standard for more than 10 years will be virtually out of production by mid-1965, except for replacement purposes. Until recently, it was believed that this tube would be succeeded by a mere two or three "standard" sizes; the fiercely competitive set-manufacturing industry has already announced a total of six rectangular sizes for 1966 production.

Already well established is the 23″ rectangular color tube developed jointly by Motorola and National Video Corp., which will appear in sets built by no less than 12 manufacturers in 1966. Because of its 92° deflection angle, the 23″



Left to right: sets with 19", 21" and 23" color picture tubes—all rectangular.

tube is more than 5" shorter than the 21" round 70° tube. Viewing area is 274 square inches, slightly more than the 265-square-inch screen area of the 21" round tube.

The 25" rectangular tube, after several false starts, is now in general distribution and is being used to a degree by virtually every set manufacturer, although it is in extremely short supply. With 90° deflection, the 25" CRT is still more than 4" shorter than the old 21" and provides a 295-square-inch picture viewing area.

Beginning to appear in a few sets is a new "industry standard" 19" rectangular color tube, with 90° deflection and a viewing area of 180 square inches. Its neck is almost 3" shorter than on the 25" rectangular tube.

Most manufacturers thought these three new rectangulars would be enough to launch a highly successful 1966 sales year. But already three more sizes are in advanced development stages and will probably see the light of the salesroom before 1966 ends.

General Electric, which achieved notable success in monochrome "tinyvision," has scheduled its 11" *Porta-Color* receiver, with a 60-square-inch picture, for sales before Christmas 1965 at $249.95. At press time, the company had released no technical details, but did verify that the set, which weighs less than 25 pounds, uses tubes and not transistors. The color picture tube is, according to GE, "an improved, simplified version of the standard three-gun aperture-mask type that is less costly to produce and install in the receiver." The little color set measures 11¾" high, 17" wide, and 16½" deep. This depth, in relation to screen size, suggests a deflection angle of 70°.

In a competitive answer to GE's 11" tube, Corning Glass Works has developed, in conjunction with several tube manufacturers, a glass bulb for a new 15" color tube. RCA has already announced it will manufacture the tube, to be available in limited quantities next fall. The new 15-incher will have a 102-square-inch viewing area and measure less than 15" from front to back.

RCA's small 15" color tube will

have several innovations. One is the "Einzel," or unipotential, lens focus system, which eliminates the need for a separate focus-voltage supply. Another is the use of a steel rim band for implosion protection—similar to modern black-and-white tubes—instead of bonded or external safety glass. RCA says the new tube and chassis could be housed in a cabinet about 15″ high, 18″ wide, and 12″ deep (with a 3″ "doghouse"), and the whole set should weight about 40 lb. The CRT is designed for operation at relatively low voltages with an eye to manufacturing economy, transistorization, or both.

Still another picture-tube size is on its way—this one a modern, rectangular version of the 21″. Developed jointly by Owens-Illinois Glass Co. and Motorola, this 90° rectangular will have 221 square inches of viewing area and will be about an inch longer than the 19″ rectangular. It should show up in new models of several brands about midyear or thereafter.

The Color Bottleneck

Picture-tube production continues to be the limiting factor in color-set sales. Despite unprecedented expansion of tube facilities (August 1965 PF Reporter, page 20), the supply isn't expected to equal demand until late 1966, at the earliest. One picture-tube maker estimates 1965 color-receiver production at 1,650,000 sets with 21″ round tubes, 600,000 with 23″ and 25″ rectangulars, 100,000 with 19″, and 25,000 with 11″ tubes. For next year, this same manufacturer predicts that the overwhelming majority of sets—2 million—will have 23″ and 25″ tubes, about 650,000 will have the old 21″ round, another 650,000 will have 19″, and a mere 150,000 will have 11″ and 15″ tubes. (These estimates were made before the announcement of the new 21″ rectangular.)

In addition to expansion among existing color-tube manufacturers, two set builders who are new to CRT manufacturing have added to the industry's total capacity by establishing color-tube plants. With Admiral and Motorola thus added to color-tube production, more manufacturers now make color tubes than make original-equipment monochrome tubes.

Another major 1965 development in color tubes has been the nearly universal acceptance of the new rare-earth phosphor described chemically as a europium-activated yttrium vanadate. Developed originally by Sylvania, this phosphor has made an important contribution to truer color rendition and greater brightness, in the opinion of most (not all) tube and set makers.

A less publicized issue within the TV industry is the question of brightness vs contrast. Some manufacturers—notably Zenith and Sylvania—are further utilizing the brightness of rare-earth tubes by using high-light-transmission filter glass for the CRT screen, which lets the viewer see about 70% of the light from the picture tube. RCA and others favor a more highly tinted face glass, which lets barely more than 50% of the light through but provides greater contrast. There's no end in sight to this difference of opinion, and both versions—along with etched and clear variations—are likely to be with us for a long time.

Beneath the Board

Because of the almost fantastic demand for color sets, there has been less emphasis this year on major technical innovation than on production. Some competitive features, such as automatic degaussing, first introduced by RCA in 1964, have now been universally adopted. Others, such as picture-peaking controls, tuner AFC, and color subcarrier pilot lights (which indicate when a color signal is being received) are touted by some manufacturers, shunned by others.

Some antenna and transmission-line manufacturers, led by Jerrold Electronics, have started campaigns for the use of coaxial cable in place of 300-ohm twin-lead, to improve color reception. General Electric has joined the drive by including connections for 75-ohm cable as well as 300-ohm lead-in on its 1966-model color sets. Others, spearheaded by JFD Electronics and Belden Manufacturing, denounce the high losses of coaxial lead (especially at UHF) and point out that a good-quality encapsulated twin-lead is better and less costly.

The trend to transistorization, now under way in black-and-white TV, undoubtedly will be felt in color in the next year or so. To date, Philco is the only manufacturer to use transistors extensively in color sets. Its 19" and 25" receivers boast a "solid-state signal system." UHF and VHF tuners, IF's, and AGC stages are transistorized, while tubes are used in the remainder of the chassis. Philco's *New Hybrid* color chassis contains 10 transistors.

1965 saw no radical departures from the standard method of decoding a color signal and displaying it. There's still only the three-gun shadow-mask picture tube and a fairly standardized demodulator and recombining arrangement.

The Cost Picture

Despite phenomenal business, competition inside the industry is

Least expensive color set—at $249.95.

so stiff that there's heavy pressure both to reduce costs and to come up with "something better." Therefore, new chassis that emphasize economy are expected to crop up with increasing regularity, while at the same time more and more manufacturers will begin transistorization during 1966 and 1967.

As for revolutionary new tubes and circuits, they're still nowhere in sight. But the pressure is heavy, and the rewards will be great for those manufacturers whose innovations and economies result in significant cost reduction in color sets.

Declines of color-set prices are best summarized in a study of starting or "leader" prices of 14 major color-TV brands. The usual price for a 21″ "leader" table model was $595.00 in September 1962, declining to $449.95 in September 1963, to $399.95 in September 1964, and to the $349.95 in September 1965. Typical starting prices of other set sizes, as of September 1965, were: 19″ table model, $399.95; 21″ (round) console, $410; 23″ console, $599.95; 25″ consoles, $675.

One of the latest color-TV cameras.

Color Telecasting

The color-set boom has accelerated the conversion of TV programs to color—which, in turn, is causing further escalation of the color-set boom. The programing escalator is expected to lead to virtually 100% color on the three networks by 1967, or maybe earlier.

Nearly all of the nation's 580 commercial television stations are now equipped to rebroadcast network color programs, and by the end of 1965, well over 200 stations will have cameras to originate their own film and/or live color programs. There would be far more, were it not for a sudden and serious shortage of equipment for color origination.

The rising interest in color broadcasting has spawned a new generation of color broadcast equipment. From the inception of tinted TV, live and film cameras have had three pickup tubes—one for each of the three primary colors. The new generation is using a four-tube approach—three vidicon tubes for color and a separate one for black-and-white or "luminance" information. The result is a crisper color picture, with no bleeding of colors, and a clear, sharp black-and-white image (for monochrome receivers) heretofore unobtainable with color cameras.

Both General Electric and RCA have four-vidicon film chains on the broadcast equipment market. GE has delivered more than 100 already this year, and RCA expects to have 200 installed by the end of the year. At midyear, RCA introduced a live camera working on the same principle, using three vidicons for color pickup and an image orthicon for the monochrome channel. Early in 1966, RCA will change from vidicons to a newly developed "Selenicon" pickup tube, which uses a selenium alloy in its photosensitive layer. RCA claims that color sensitivity of the Selenicon is more than double that of the vidicon. The company plans to deliver 300 live cameras of both the four-tube and three-tube types in the 12-month period ending in September 1966 (production has been resumed on the three-channel model because of demand).

Also attracting the attention of broadcasters is the Norelco live camera using Plumbicon (lead-oxide vidicon) tubes. This three-channel camera is praised for its compactness and accurate rendition of color details, particularly in deep shadows. Rumor says that Philips (Norelco) is at work on a four-tube "separate luminance" model.

The World Picture

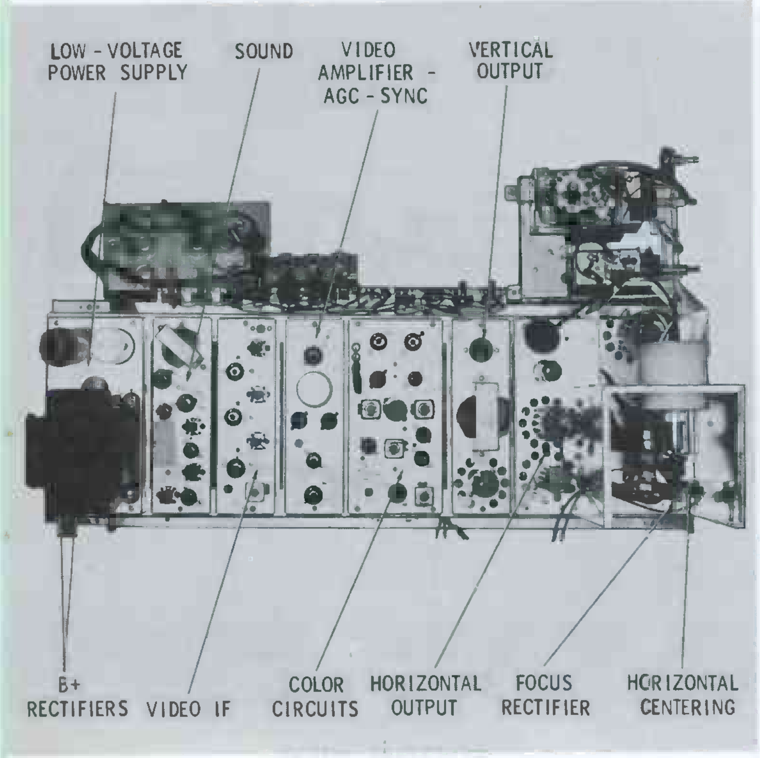
Color prosperity may be nationwide, but it isn't worldwide. Color broadcasting is available on a regular basis only in the United States and Japan. Canada has announced a January 1967 target date for inauguration of colorcasting.

Europe is stirring. Despite continuing efforts to choose a single color system for all of Europe, international communications groups are now virtually reconciled to the prospect of two or three different systems. The technical merits of the French SECAM system, the German PAL system, and the American NTSC method have been obscured by a smokescreen of international politicking.

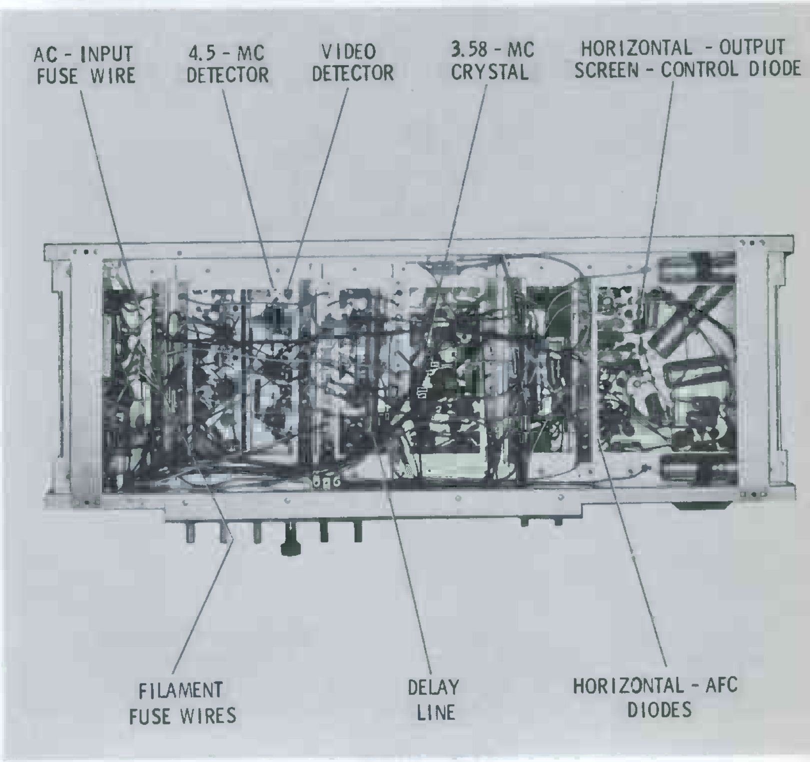
Any one of the systems can produce an acceptable color and black-and-white picture, and it will be unfortunate indeed if Europe doesn't agree on a single system for continent-wide networking. Most American TV engineers naturally favor the U.S. system, which has been proven by 12 years' use in 5 million receiver installations, and by a nationwide network of transmitting stations. It's particularly galling for U.S. engineers to hear some of their European colleagues claim that the NTSC system is "impractical" because it "cannot be transmitted satisfactorily by microwave relay."

The American color-TV system has been called impractical before—in this country. It couldn't succeed, said many . . . but it did! Nothing succeeds like success, and today the word *success* has become synonymous with color television. ▲

Color Sets
(Continued from page 35)



TOP VIEW



BOTTOM VIEW

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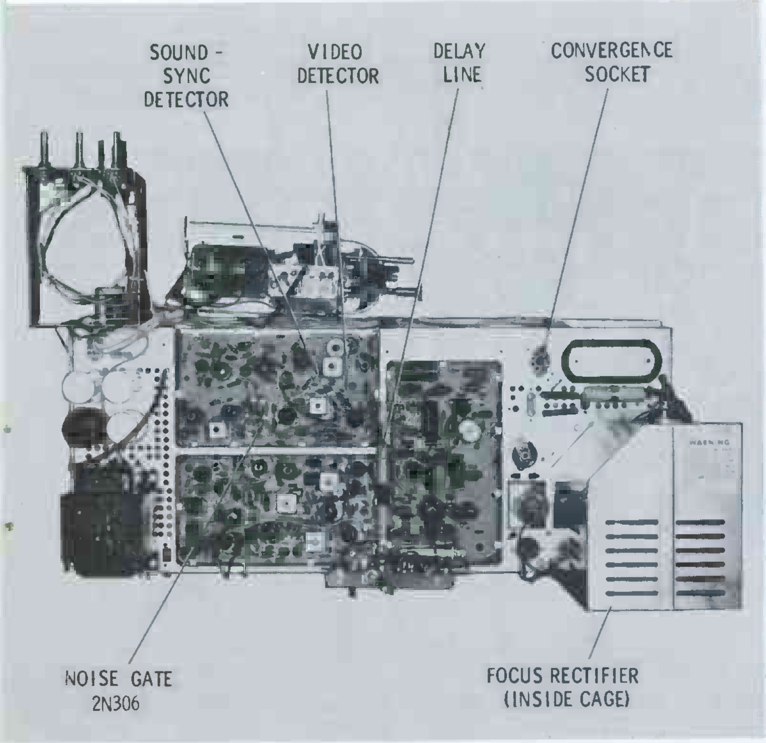

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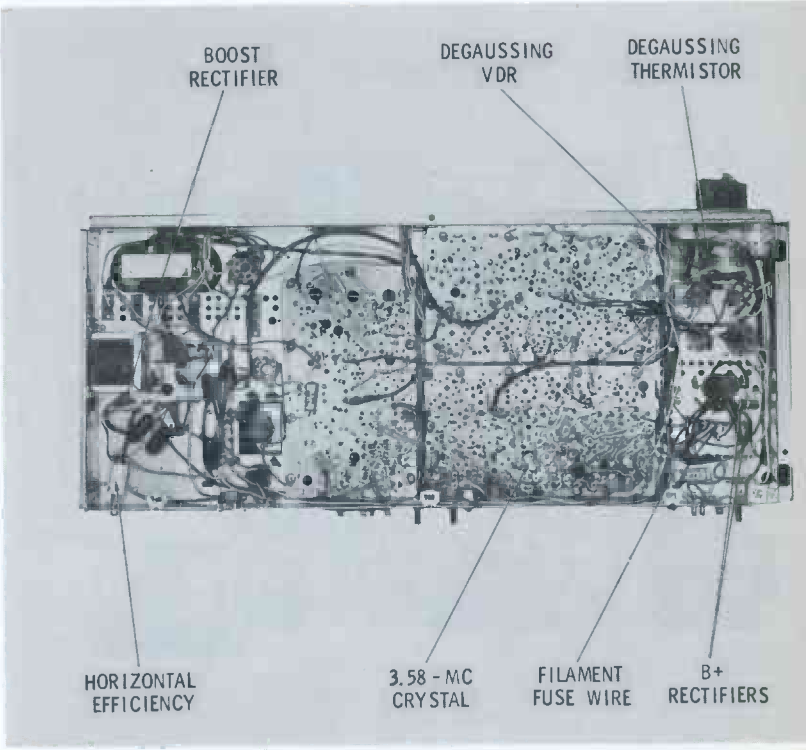
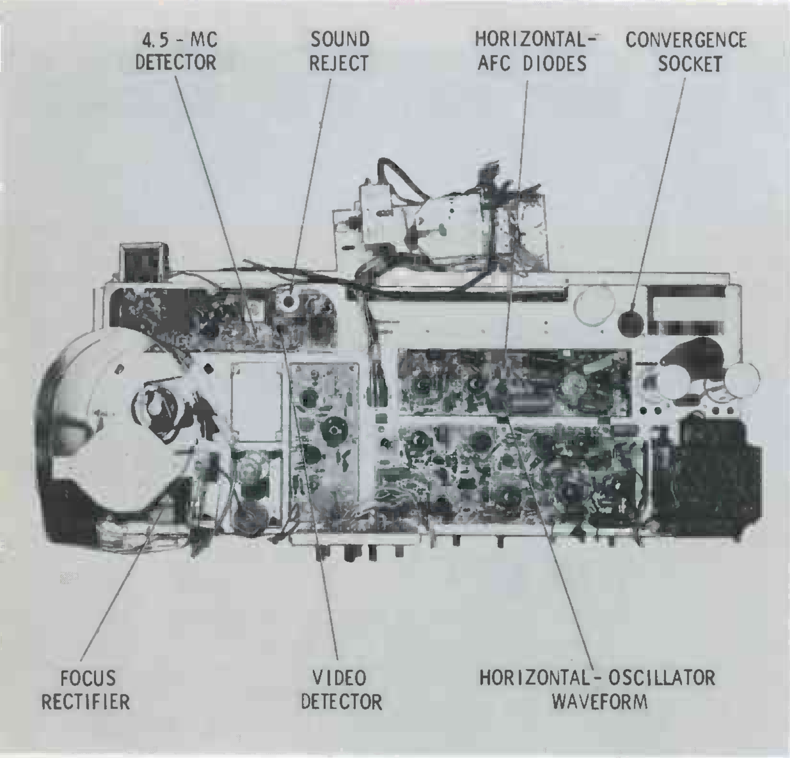


BOTTOM VIEW

SYLVANIA CHASSIS D01



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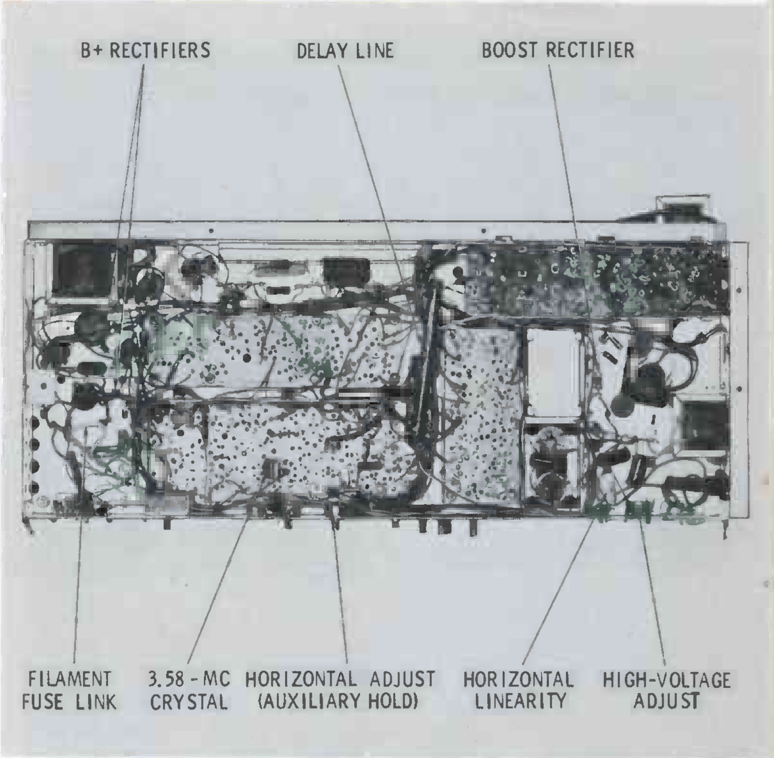
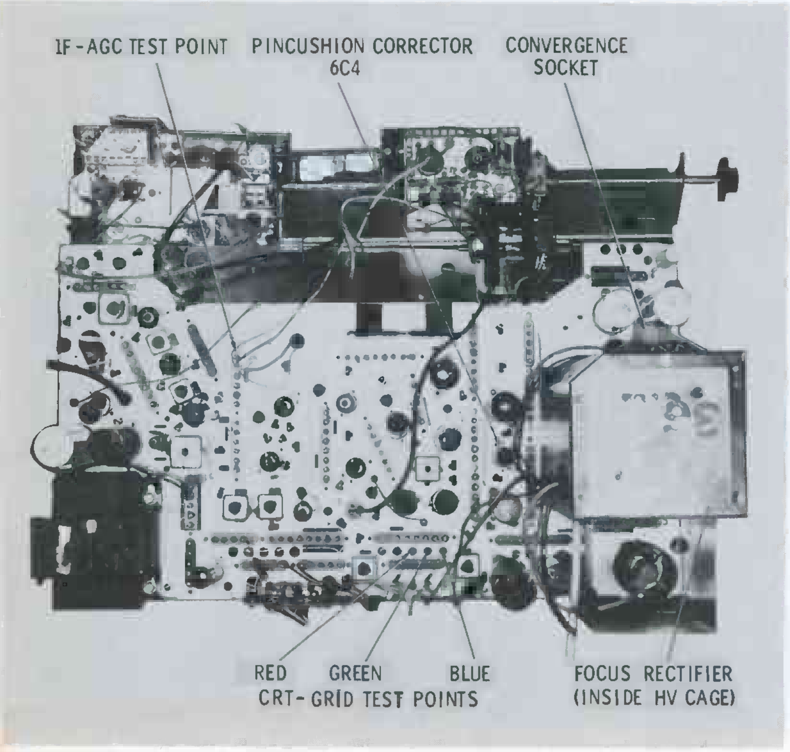


BOTTOM VIEW

WESTINGHOUSE CHASSIS V-2476-1



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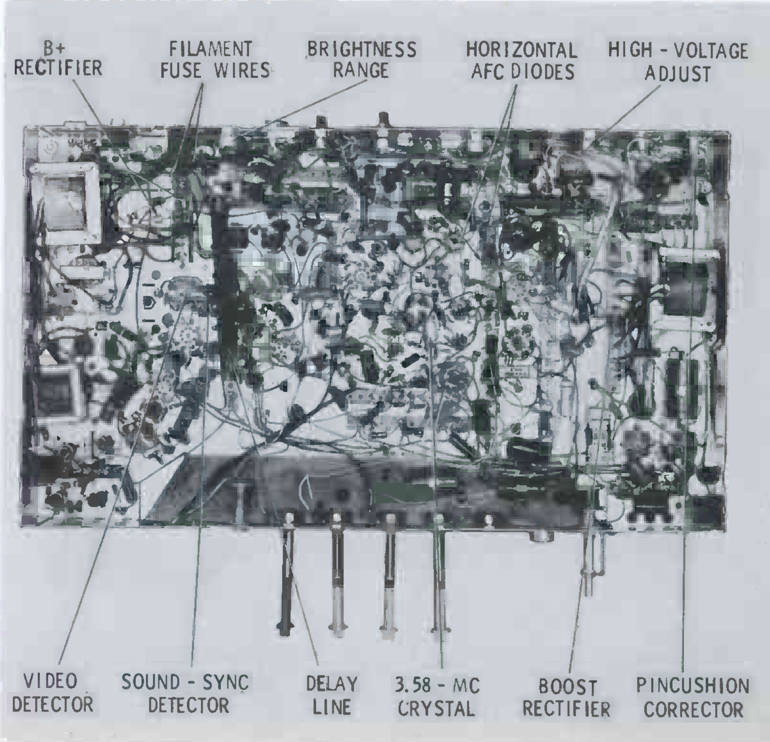

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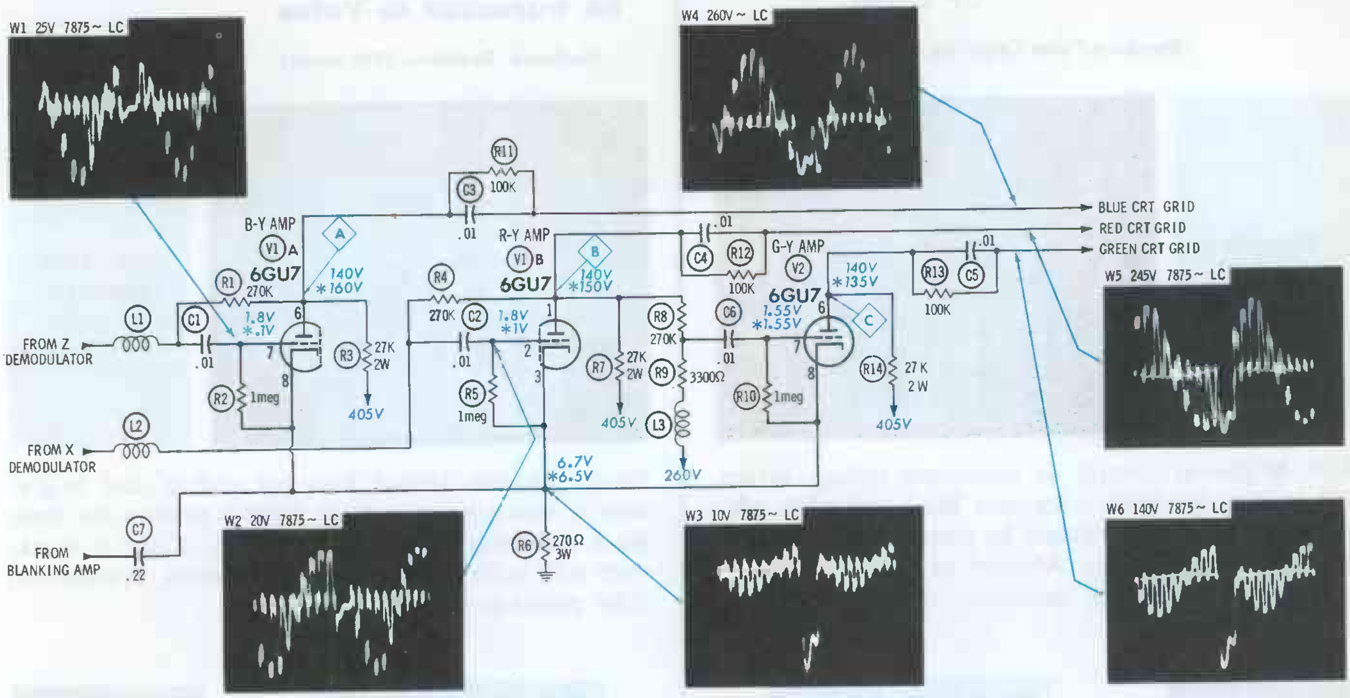


DC VOLTAGES taken with VTVM, on inactive channel; antenna terminals shorted. *Indicates voltages with signal present — see "Operating Variations."

WAVEFORMS taken with low-cap (LC) probe and wideband scope synced from blanking-amp cathode. All TV controls are set for normal color-bar pattern.

Normal Operation

Chroma-difference circuit amplifies outputs of X and Z demodulators, then feeds chroma-difference (B-Y, R-Y, and G-Y) signals to CRT grids; color mixing takes place in CRT. Y (luminance, or video) signal at CRT cathodes controls intensity of electron beams. Circuit shown here (from Truetone Model 2DC1655A) is used in majority of modern color re-receivers. Outputs of X and Z demodulators are fed to R-Y and B-Y amplifiers, respectively. (L1 and L2 block 3.58-mc reference signal from reaching V1 grids.) Signal currents in B-Y and R-Y amplifiers combine across common cathode resistor R6 to develop G-Y signal which is then coupled to cathode of G-Y amplifier. Small amount of R-Y signal from V1B plate, developed across R9-L3, is fed by C6 to G-Y amplifier grid and acts as slight degenerative feedback to assure correct phase and amplitude of G-Y signal. Negative 10-volt p-p pulse from horizontal-blanking amplifier is coupled to all three amplifiers by C7 and common cathode resistor R6. Resultant high negative pulse at difference-amplifier outputs biases off CRT beams during horizontal retrace. Since blanking pulse drives difference-amplifier cathodes negative with respect to grids, resulting grid current creates negative grid bias. Greater bias at R-Y and B-Y amplifier grids is also produced by grid current during chroma-signal peaks. RC networks (R11-C3, R12-C4, R13-C5) used for coupling compensate for grid-cathode capacitance of CRT and prevent loss of high frequencies.

Operating Variations

A, B With color signal present, DC plate voltages of V1A and V1B vary with setting of color control. At minimum setting, readings are 120 volts; at maximum, 175 volts. At normal setting, reading on V1A is 160 volts; on V1B, with normal setting, reading is 150 volts.

C With color signal present, voltage at V2 plate decreases as color control is advanced. Readings range from 140 volts with control at minimum to 130 volts with control at maximum—normal setting reads 135 volts.

PINS 2, 7 OF V1 DC voltages, with color signal present, range from 1.8 volts at both grids (color control at minimum) to −3 volts at pin 2 and −4 volts at pin 7 (color control at maximum). With control set for normal color, reading at pin 2 is 1 volt; at pin 7, reading is .1 volt.

WAVE-FORMS With signal strength adequate for color reception, W1 and W2 vary from 5-volt p-p blanking pulse (color control minimum) to 50 volts at W1 and 40 volts at W2 p-p chroma signals (color control maximum). W3 increases by 1 volt as color control is rotated from minimum to maximum. At minimum position of color control, p-p voltages are: W4, 120; W5, 110; and W6, 120. At maximum setting, p-p voltages are: W4, 300; W5, 300; and W6, 150.

Brightness Low

Green Missing

Symptom 1

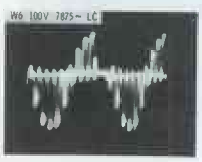
C7 Open

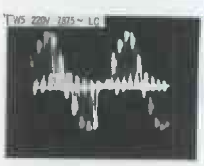
(Blanking-Pulse Coupling Capacitor—.22 mfd)

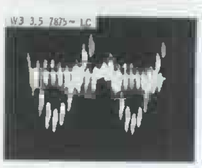
Symptom Analysis

With brightness control at maximum setting, screen still is dim for both color and black-and-white pictures. Bar at far right should be green; instead, is dark blue and barely visible. Absence of a color indicates trouble in chroma, not luminance, circuits.

Waveform Analysis

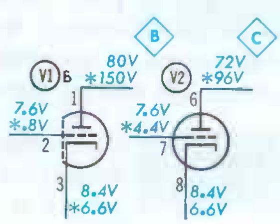






Waveform W6 at CRT green grid is significantly altered—now only 100 volts p-p and horizontal blanking pulse is missing. At red CRT grid, amplitude change of W5 isn't as significant as fact that blanking pulse is missing. Check of waveform W3 at common cathode junction proves that negative 10-volt p-p horizontal blanking pulse isn't reaching R6. Large negative pulse (not shown) at C7 input side spots open in PC board or C7.

Voltage and Component Analysis



Missing green results from low V2 plate voltage which almost cuts off electron beam from green cathode of CRT. Considered alone, voltage reading at grid of V2 (with signal) may be misleading — positive shift could result from leaky C6. Without signal, comparison shows both V1B and V2 grid voltages are similar; probability of two leaky capacitors is slim. Grid voltages are almost same as that of cathodes, indicating usual grid-current flow is absent. Missing blanking pulse can be cause. Scope is most useful here.

Best Bet: Scope finds trouble.

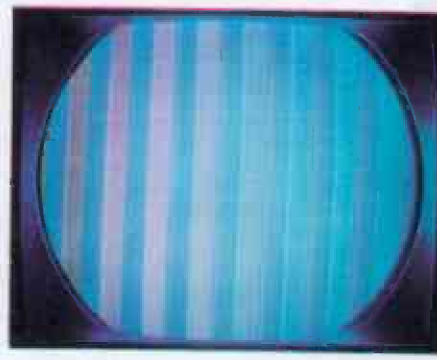
Color Washed Out

Brightness Excessive

Symptom 2

R6 Increased in Value

(Cathode Resistor—270 ohms)

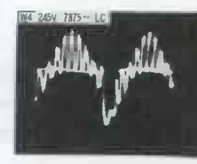


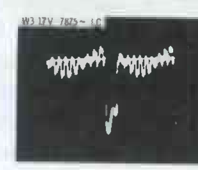
Symptom Analysis

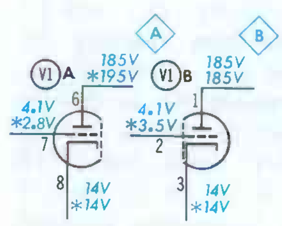
Picture blooms, retrace lines are visible, and brightness is excessive at normal control settings for both black-and-white and color reception. Color is weak, even with color control set for maximum. Washed-out color points to chroma-circuit defect.

Waveform Analysis

B-Y output waveform to CRT grid (W4) shows cause of color washout. P-P amplitude is correct at 245 volts; but, chroma amplitude is decreased and blanking-pulse amplitude is increased. In normal operation (see normal W4), first chroma peak following blanking pulse is same amplitude as blanking pulse; in abnormal W4, chroma peak is one-half blanking-pulse amplitude. W3 amplitude increase suggests change in R6 value.







Voltage and Component Analysis

Excessive brightness is caused by abnormally positive voltages at CRT grids, caused by voltage increases at plates of B-Y and R-Y amplifiers. Difference-amplifier grid voltages have increased approximately 3 volts; however, cathode voltages have increased more than 7 volts. Increased negative grid bias (by 4 volts) has decreased conduction and raised V1A and V1B plate voltages. High DC voltage at cathode is most significant symptom. Resistance test verifies R6 value increase to, in this case, 600 ohms.

Best Bet: Scope and resistance measurements.

Symptom 3

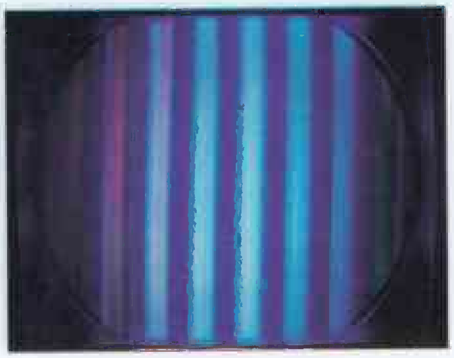
Red Colors Weak

Monochrome Pix Tinted Blue

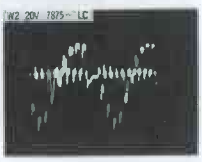
R7 Increased in Value

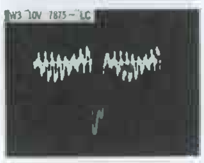
(V1B Plate Load Resistor—27K, 2 watt)

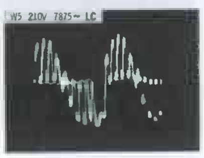
Symptom Analysis



Black-and-white picture is tinted blue. At normal position of tint control, flesh tones are green; with control fully counterclockwise, they are weak magenta. Color-bar pattern proves red output is weak indicating gray-scale misalignment or chroma-output trouble.



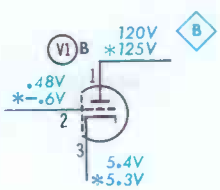




Waveform Analysis

Input to R-Y amplifier (W2) appears normal; amplitude is 20 volts p-p. No change is noted at common cathode junction (W3); waveshape and amplitude are okay. Amplitude at W5, output to red CRT grid, has dropped from normal 245 to 210 volts p-p. Decrease in amplitude doesn't seem great, but suggests that trouble is in that section. Although scope has helped isolate trouble area, voltage and resistance information is needed.

Voltage and Component Analysis



Findings from waveform checks are verified by 25-volt DC decrease at V1B plate. Grid and cathode voltages are lower; but grid-cathode bias is almost normal — 5 volts. Indications are that decreased voltage at red CRT grid is decreasing beam intensity, resulting in weak red output; as result, monochrome picture is tinted blue. Fact that both plate and cathode voltages are low usually suggests that plate load resistor has increased in value. Resistance checks verify that 27K resistor R7 has increased in value to 67K.

Best Bet: Voltage checks followed by ohmmeter verification.

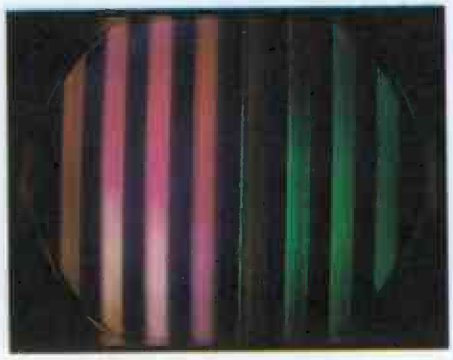
Symptom 4

Blue Missing

Monochrome Pix Green

C1 Open

(Coupling Capacitor—.01 mfd)

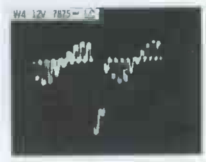


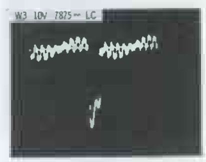
Symptom Analysis

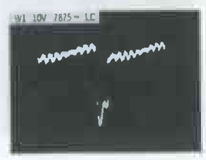
Monochrome picture is deep green or chartreuse. Tint and color controls do change intensity and position of color bars from generator; but blue bars are missing — only green and red visible. Chroma-output or CRT trouble is most likely.

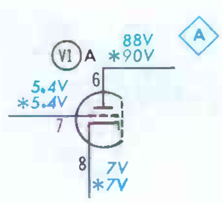
Waveform Analysis

Output to blue CRT grid (W4) has decreased to 12 volts p-p. W3, cathode-junction waveform is altered somewhat; but this gives little help. Big change is seen at B-Y amplifier grid (W1) — blanking pulse dominates waveform, suggests coupling-circuit path is open; R2 should isolate pulse from pin 7. L1 and C1 are prime suspects. Normal signal (not shown) at L1-C1-R1 junction indicates open C1 or PC board.









Voltage and Component Analysis

Less-negative grid-cathode voltage results in decreased plate voltage. Change from with- to without-signal condition doesn't significantly affect grid or plate voltage, suggests chroma signal is absent at grid, because lack of grid-current flow causes decrease in negative grid bias. Voltages offer clues, but scope actually proves C1 open. R2, C1, L1, and path via Z-demodulator form voltage divider for blanking pulse at V1A grid. With C1 open, grid and cathode pulses are of equal amplitude; grid current ceases.

Best Bet: Scope can pinpoint

Green Weak

Symptom 5

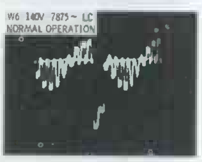
Monochrome Pix Tinted Magenta

R9 Increased in Value

(Coupling-Circuit Resistor—3300 ohms)

Symptom Analysis

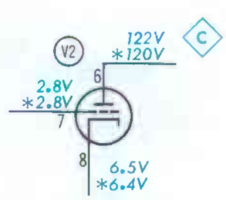
Green content of flesh tones is visible only with tint control fully clockwise; normal setting makes flesh magenta. Monochrome picture turns magenta at low brightness setting. Symptom indicates gray-scale misalignment or chroma-output circuit trouble.



Waveform Analysis

CRT green-grid input (W6) is reduced (compare to normal W6). Amplitude decrease is slight — 10 volts — but all chroma-information (bar) peaks have sharp instead of flat tops, suggesting differentiation. Relationship between chroma amplitude and blanking pulse amplitude has changed in way that seems contradictory with green decrease. W3 appears normal, suggests trouble in V2 plate or grid circuits.

Voltage and Component Analysis



G-Y amplifier plate voltage has decreased almost 20 volts, which causes lower green intensity. Cathode voltage is about normal, but grid voltage has nearly doubled — it is now 2.8 volts, not 1.55. Reduced grid-cathode bias is causing change at plate. Component checks in coupling circuit reveal that R9 has increased in value to 6600 ohms. Voltage divider R8-R9 determines signal amplitude fed to V2. Change in signal level upsets DC voltage at grid. Voltages gave help; component checks found trouble.

Best Bet: Voltage and component measurements.

Red Smeared

Monochrome Pix Normal

Symptom 6

C4 Open

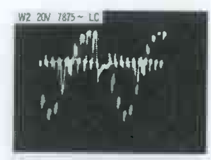
(Coupling-Network Capacitor—.01 mfd)

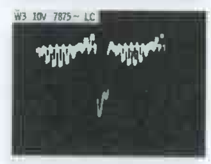
Symptom Analysis

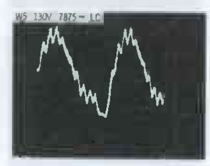
Red content of color picture is smeared and faded; fine-tuning control won't correct trouble. Black-and-white picture shows no evidence of smear or ringing. Color-bar pattern also shows red smear. Other colors are okay, clearing video-IF, chroma-bandpass circuits.

Waveform Analysis

Waveform at R-Y amplifier grid (W2) has normal shape and is of proper amplitude — 20 volts p-p. At common cathode junction (W3), no discrepancy can be found. Grid and cathode circuits appear to be operating normally. Waveform W5 is greatly changed; amplitude decreased from 245 to 130 volts p-p, and waveform is severely integrated. Waveform at B (not shown) looks like W5 should. C4 or R12 is at fault.







NO VOLTAGE CLUES

Voltage and Component Analysis

With and without signal, voltages at all points are normal and give no troubleshooting clues. Scope information showing integration (attenuation of high-frequency signal components) of W5 is most valuable clue. Normally, C4 has low impedance at high frequencies, so integration suggests it is open. With C4 open, input capacitance of CRT grid and R12 form integrating circuit which attenuates high-frequency components, causing red to smear. Bridging C4 with good unit corrects trouble.

Best Bet: Scope, then component check.

CASE BOOK For Color Techs

These job histories can teach many lessons.

These case histories cover a number of years of color-TV servicing. Emphasis has been placed on the newer models since there are a greater number of these in the home today, and they will be needing repair tomorrow. Some of these troubleshooting procedures may seem lengthy; however, an exposure to sure, systematic checks for finding the trouble has been considered most important. It would be ridiculous to assume that the specific steps described here are the *only* way to find these troubles. There are a number of equally valid approaches to any problem, but a consistent methodical manner is common to all good troubleshooting methods.

Dim Raster, Have Video

A low-brightness condition in a color receiver can often lead a merry chase—one of several different circuits can be at fault, and still the symptoms will be similar. Careful analysis of all available clues is necessary, if an expedient repair is expected. Here's the method we used to solve "dim raster" in an RCA CTC16 color receiver. A similar approach can be helpful in other color chassis, too.

Step 1: Check picture tube with checker.
Result: Good tube.
Decision: Dynamic check must be made in circuits associated with CRT brightness.
Step 2: Apply power, tune in station, observe raster.
Result: Video and sound are good, contrast control is operative, giving proper level of video. However, raster is dim, even at full setting of brightness control. Picture retains a normal gray tracking level. That is, the viewable screen (although dim) is *gray,* rather than some predominant *color hue*—an important point.
Decision: Definite clues have been established. Screen is gray, not some color, so defect has equal effect on all three guns in the tri-color tube. Trouble in individual screen or drive control circuits is ruled out—for the present. Video output stage(s) could cause low brightness. Video on screen is good, however, so stage(s) is passed at this time.
Step 3: Check high voltage to second anode, and to focus anode (using VTVM equipped with high-voltage probe).
Result: Normal 24KV at HV anode, and 5KV at focus anode is indicated.
Decision: High voltage is sufficient to produce normal raster on picture tube; 5KV focus voltage is sufficient. Does horizontal output stage supply other circuits connected with picture tube? Yes, screen grids are supplied by 1100-volt boosted-boost developed in flyback stage (Fig. 1).
Step 4: Check source voltage at point A.
Result: 800 volts is read at cathode of diode. This voltage is probably normal boost voltage present at point B. Boosted-boost diode is likely shorted. Ohmmeter check will confirm suspicion.
Afterthoughts: Note there was no definite clue to pinpoint defective HV stage as causing dim raster. In this instance, 800 volts, rather than 1100 volts to screen control circuits, lowered B+ available to CRT screen grids, reducing conduction of all three guns.

In addition to stages we cleared by analysis or dynamic checks—video, *individual* control grids, and screen grids — it may be necessary to troubleshoot other stages that could cause a dim raster. For example, the *blanker* supplies a pulse to all three color difference amplifiers, setting their average conduction and thus their plate voltage. These amplifiers have direct coup-

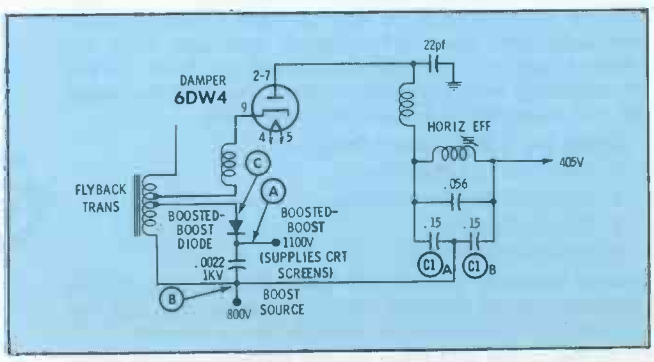


Fig. 1. Rectified positive flyback pulse is added to boost.

ling to the CRT control grids; any change in their plate voltage changes the CRT grid voltage. Under these conditions, picture tube conduction changes in direction relationship. The end result of blanker troubles can cause low or excessive conduction of the CRT.

One other point: An ocilloscope will locate a shorted boosted-boost diode. A 500-volt horizontal pulse is applied to the anode (C) of the diode. If the diode is shorted, the pulse will also be present on the cathode. Look for this type of trouble in other color receivers utilizing a boosted-boost circuit.

Gray-Scale Adjustment Impossible

Initially the problem was weak red and a blue-tinted black-and-white raster. The customer stated that the trouble in his Zenith color receiver (Chassis 24NC31) appeared suddenly one day after the set was turned on.

Usually, decreased emission from a particular CRT gun is gradual, so the possibility of circuit malfunction was suspected. However, gray-scale alignment was first tried; the procedure was as follows:

Step 1: Tune in black-and white signal; set color control to minimum. Turn CRT bias and all G2 controls to minimum. Move normal-setup switch to setup position. Then, advance G2 controls until each one produces a barely visible line on the screen.

Result: G2 control for green beam is first advanced until a thin green line appears; then, the G2 control for the blue beam is advanced until the blue line is just visible. As the G2 control for the red beam is rotated from minimum setting, the blue-green line disappears; the red line appears with the control set at almost maximum, but the blue and green lines are invisible.

Decision: Indications are abnormal. Possibly, by first advancing the G2 control for the red beam a gray-scale adjustment can be effected.

Step 2: Return all G2 controls to minimum. Advance G2 control for red beam until the line is barely visible. Advance the other G2 control until the blue and green lines just appear.

Result: With the blue and green lines visible the red line disappears. Advancing the G2 control for red extinguishes the blue-green line, and produces the red line; reducing it brings back the blue-green line and extinguishes the red line. It is impossible to get all three lines on screen. Finally the G2 control for the red beam is set at the point where the red line extinguishes and the blue-green line just appears.

Decision: Proper gray-scale adjustment is impossible; analysis of picture on the screen should be helpful.

Step 3: Return normal-service switch to normal and view black-and-white and color pictures on the screen.

Result: Black-and-white appears to be normal. Red content in the flesh tones is still weak; rotation of the tint control produces flesh tones that are more blue than magenta.

Decision: Since proper gray-scale adjustment is impossible and the red beam is weak, the CRT circuits are suspected.

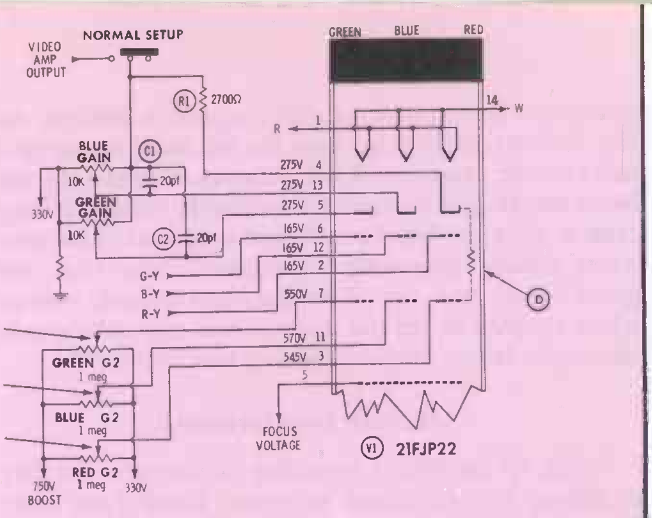


Fig. 2. Interelectrode leakage affects gray-scale adjustment.

Step 4: Check voltages at G2 controls (points A, B, and C, Fig. 2).

Result: Rotation of G2 controls for blue and green beams varies voltage at their wiper arms from 330 volts to 750 volts. Highest voltage at wiper arm of red G2 control (c) is 715 volts; low voltage is normal.

Decision: Lowered maximum voltage at G2 control doesn't seem normal; yet, this discrepancy could be caused by a small potentiometer defect. Also, when adjusted normally the controls are not set at maximum position; the red G2 control has sufficient range to match voltages from other controls.

Step 5: Monitor voltages at CRT control grids.

Result: All three voltages are normal.

Decision: The fact that voltages are normal here indicates the chroma demodulators are operating normally.

Step 6: Determine voltages at the CRT cathodes.

Result: In the setup position conditions are normal —275 volts at all cathodes.

Decision: As a last resort determine if there is any interaction between G2 voltages and cathode voltages.

Step 7: Rotate G2 controls and observe effect at CRT cathodes.

Result: G2 controls for blue and green beams have no noticeable effect on cathode voltages. Control for red beam causes 10-volt swing at all three CRT cathodes—shift follows G2 voltage.

Decision: Change in CRT current is usually not great enough to affect cathode voltage. Two of the G2 controls don't affect cathode voltage but the third does. Circuitry is identical; there must be a high-resistance path between the red beam G2 and the cathodes. Interelectrode leakage within CRT (D) is a possible cause of trouble.

Step 8: Check the condition of the CRT with a picture-tube tester.

Result: Reveals interelectrode leakage within CRT.

Decision: Replace the CRT. Installation of a new CRT solves the problem. Gray-scale adjustment is a snap. After all adjustments are made, flesh tones are normal.

Afterthoughts: Much time would have been saved had the CRT been immediately suspected when gray-scale adjustment proved impossible. However, the symptom was so unusual that the CRT was only suspected as a

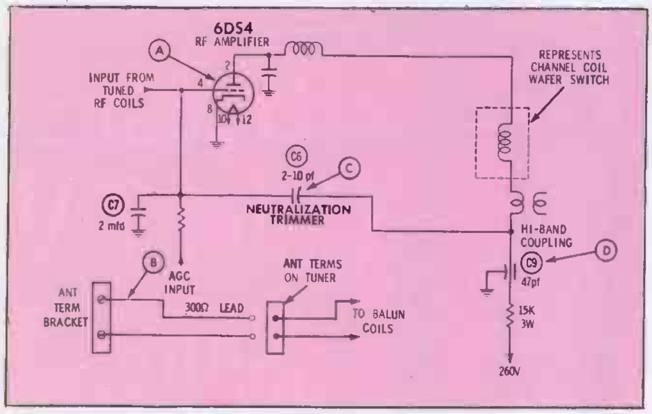


Fig. 3. Oscillation occurs with stage improperly neutralized.

last resort. Explanation for this symptom is difficult. As Fig. 2 shows, leakage between the red beam screen grid and cathode caused all three cathodes to follow the red beam screen-grid voltage. Grid-cathode voltage is very critical when the beam conduction is low, as is the case when making gray-scale adjustments. The blue and green beams were cut off by increased cathode voltage which resulted as the red beam screen-grid voltage was increased; hence, proper tracking was impossible.

Internal Interference

Often, RF oscillation occurring in television circuitry is difficult for servicemen to locate. Finding the exact stage causing the interference is relatively easy, if a few logical steps are followed. Locating the defective component may not be hard either, as demonstrated by the following case.

RCA color chassis, starting with the CTC11 series, use a *nuvistor* RF amplifier. Type 6CW4 is found in earlier chassis; type 6DS4 in later models. These *nuvistors* are triode types, requiring neutralization to prevent oscillation. Interference such as motorboating or a heavy herringbone pattern appears in the picture, if the RF amplifier (Fig. 3) starts oscillating. Let's examine one of the best ways to check for this type of trouble.

Step 1: Turn on receiver and tune to low-band channel that has medium signal strength.

Result: Receiver may operate normally, or interference may appear intermittently.

Decision: Let's see if interference remains constant on any channel.

Step 2: Tune to highest channel in area.

Result: Heavy bar pattern appears on picture tube screen; video from station may be completely lost.

Decision: Oscillation is more critical on high-channel operation. Fault is most likely caused by trouble in tuner.

Step 3: Touch fingers to 6DS4 case (A) and see if oscillation changes or disappears. In lieu of above test, run hand along 300-ohm lead-in from antenna terminal board to antenna terminals on tuner (B).

Result: Oscillation changes or stops completely.

Decision: RF amplifier is breaking into oscillation, especially on high channels. Stage needs neutralizing; perhaps slight readjustment of C6 trimmer will cure problem.

Step 4: Use an insulated tool (trimmer is connected to B+) and turn C6 1/8 to 1/4 turn counterclockwise. (C6 is accessible via hole in tuner shield.)
Result 1: Oscillation stops. Operation of receiver is normal on all channels.
Result 2: Slight adjustment of C6 fails to cure problem.
Decision: Defective C6 is possible, but most likely culprit is feed-through capacitor C9 (D). Replacement of C9 and/or C6 is in order.
Afterthoughts: Shorted C6 in this instance is unlikely, as other results would be evident—positive voltage on grid would cause damage to B+ resistors and RF amplifier. Open C6 would fail to respond to adjustment—causing no change in oscillation. Chances are C9 is causing trouble in this particular circuit. In this case channel-change (operation) check, coupled with "hand-capacity" check led to quick location of oscillating stage. Placing finger and/or metal object close to suspected area of oscillation is a good method to locate defective stage in other cases.

Often, a slight adjustment of C6 is necessary if oscillation starts after replacement of RF amplifier or mixer-oscillator tube.

Highlights Green, Lowlights Red

A severly tinted raster can indicate anything from CRT trouble to simple gray-scale misalignment (which can sometimes be caused by a knob-twisting customer). In this instance, the raster on a Zenith 24NC31 color chassis was orange with silvery-green highlights and brown lowlights. Also, the vertical blanking bar was red, not black. Here is the procedure that was used.
Step 1: Try gray-scale alignment.
Result: With CRT bias set at minimum, G2 control for CRT red beam will not extinguish line.
Decision: A defective CRT could be responsible for symptoms.
Step 2: Check the CRT with a tester.
Result: Continuity, interelectrode-leakage, and emission tests show tube isn't defective.
Decision: Trouble is in screen, control-grid, or cathode circuits of CRT. Voltage measurements are necessary in these parts of the set.
Step 3: Measure voltage ranges at CRT screen grids.
Result: All voltages range from 750 volts (boost voltage) down to 330 volts (B+ supply voltage).
Decision: Because voltage ranges seem normal and all three elements have identical reading, the CRT screen (G2) circuits are seen to be operating normally. Voltage at the control grids must now be checked.
Step 4: Determine voltages at the control grids.
Result: Voltage at the blue control grid is slightly low—170 volts—and slightly high at the green control grid—210 volts; however, of most interest is the excessive voltage at the red control grid—it measures 275 volts.
Decision: Normally CRT control-grid voltages are within 20 volts of each other. Since CRT control-grid voltage is determined by chroma-demodulator conduction, the increased voltage at the red control-grid points to R-Y demodulator trouble.
Step 5: Make voltage checks at R—Y demodulator (Fig. 4).
Result: At pin 8, point A, (the plate

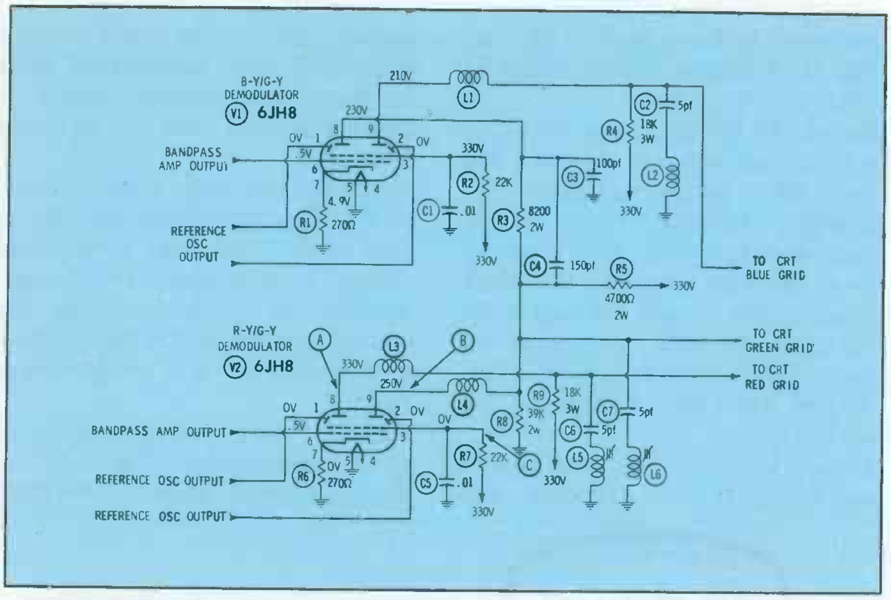


Fig. 4. Shorted C5 removes screen-grid voltage, tube and conduction ceases.

connection feeding the red grid of the CRT) 330 volts (B+ supply voltage) is read. Voltage is lower at the plate feeding the green CRT control grid, point B—250 volts—but there is a connection to the B−Y demodulator so this indication isn't really conclusive. Pin 3, the screen grid, reads 0 votls.

Decision: Absence of screen-grid voltage is cutting off the R−Y demodulator. Next, determine reason for loss of voltage on screen grid.

Step 6: Use VOM (or VTVM) for resistance checks at R−Y demodulator screen grid.

Result: C5, the screen-grid bypass, is shorted, and R7 has increased in value to 1 meg.

Afterthoughts: Close examination revealed R7 was discolored, but results of overheating weren't immediately noticeable. Often a shorted C5 causes this resistor to char, and visual inspection will find the trouble more rapidly. If this trouble has occurred in the B−Y demodulator, the raster would have been tinted blue with green highlights.

Visible Retrace Lines

On a few occasions, we've had a customer complain of vertical retrace lines in 21" color receivers; the symptom is worse when no video is transmitted from the station. Usually, the customers like to view a lighter-than-average screen; thus, they "run" the contrast control down, while advancing the brightness control slightly. With these particular control settings, vertical retrace lines may appear.

Fig. 5 shows the basic video output circuit employed in many color receivers used today. Positive vertical-blanking pulses, obtained via a divider network (R2-C1) from the vertical-output tube, are inserted and mixed at the plate of the video-output tube. Let's see

• *Please turn to page 78*

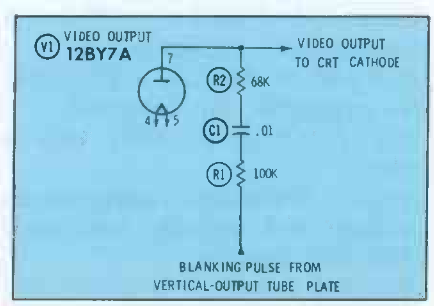
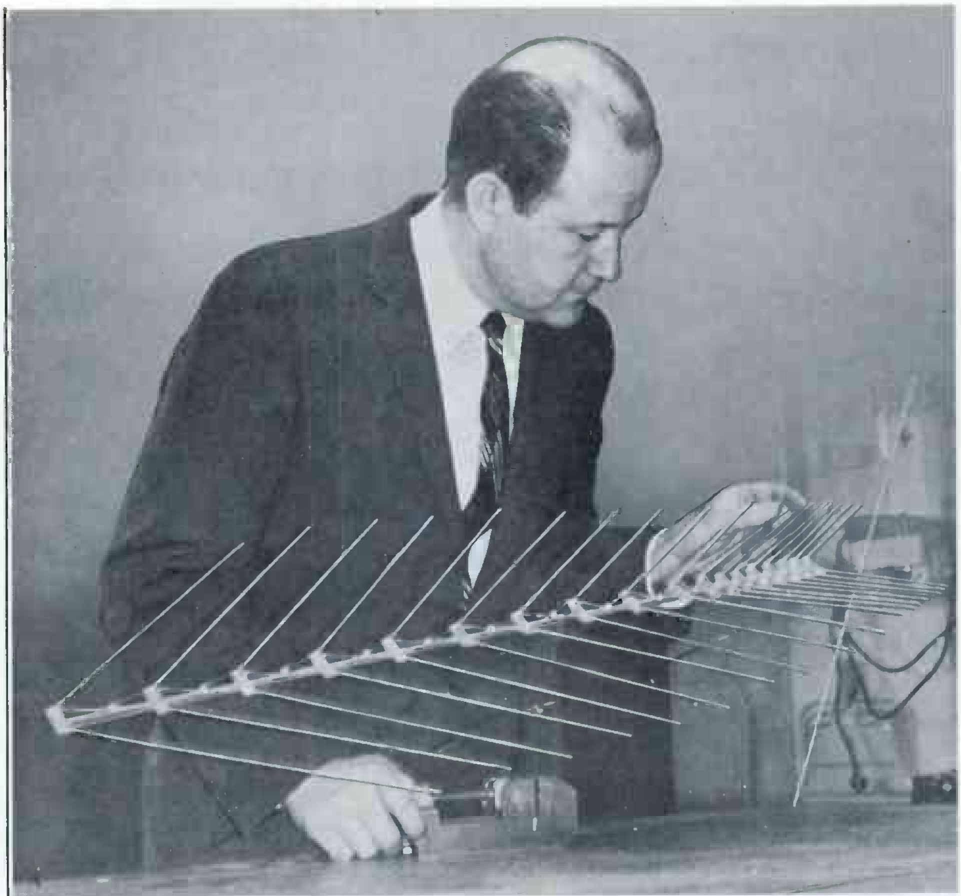


Fig. 5. Video-output tube plate is mixing point for vertical-blanking pulse.

REPRINTED FROM The News-Gazette Champaign Illinois THURSDAY, JULY 23, 1964 * *



News-Gazette Photo by Ian Ingalls

Dr. Paul E. Mayes inspects and checks out one of log-periodic family.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

UI's Mayes, Team Develop Better TV Antennas

By HANK HOKAMP
News-Gazette Staff Writer

Remember how you used to shake and pound your radios, trying to "get the darn things" playing again? That was then ... but how about now?

Yes, you've found a new culprit to cuss and perhaps shake . . . and to top things off, it's usually the most popular piece of furniture in the house ... the television set.

Thanks to the efforts of such men as Dr. Paul E. Mayes, professor of electrical engineering at the University of Illinois, and his associates, this situation may well become a rarity instead of commonplace.

"For many years no attempt was made to achieve a constant pattern regarding the development of VHF, UHF, VHF-UHF, and FM antennas," Dr. Mayes said. "Today there exisits a need for antennas which will cover a number of isolated frequency bands rather than covering continuously the entire spectrum between the lowest and highest frequencies of interest," he said.

Dr. Mayes and his colleagues have done just this .. developed a number of TV antennas which are presently being sold to the consumer public by electronic parts companies throughout the nation.

Another series of antennas, this time a family of four designed for FM Stereo radios, were released for production July 1. These antennas were developed by Mayes and Ron Grant, chief engineer at the JFD Antenna Laboratories located at 714 So. Randolph, C.

The JFD Electronics Corporation, Brooklyn, N.Y., manufactures these antennas and is licensed by the UI Foundation. JFD extends exclusive rights to the UI Foundation for its patented log - periodic - antenna concept.

Regarding the TV antennas developed by Mayes and his associates the largest log-periodic antenna in this family is the JFD Log-Periodic LPV antenna. This antenna can conquer the super fringe area up to 175 miles from a transmitter. It's considered to be the best for color and black and white reception regarding the capabilities of the "family."

The smallest LPV antenna reaches out to 50 miles from the transmitter. This is all one needs to attain local reception.

The second antenna in this family is the LPV-U, or the first UHF antenna design based upon the patented LPV formula by the laboratories at the UI. This antenna is used for high band performance on channels 14 to 83. Four models are now available and range up to 80 miles regarding reception.

No commercial antenna has had uniform high gain over the complete VHF television band. The log-periodic V, the third antenna available in this series, takes care of this unique situation. Out of various experiments led by Prof. V. H. Rumsey and Prof. J. D. Dyson, both members of the electrical engineering department at the UI, this log spiral antenna became available.

What is called the strongest antenna developed for UHF is the Zig-A-Log antenna, a new concept for local or long distance reception on channel 14 to 83.

This Zig-A-Log antenna is said to offer much less wind resistance, much less ice and snow loading area, and better directive gain.

Log-periodic or logarithmic antennas make-up a family that have a unique fundamental design. These designs have been developed by Mayes and his associates since 1954 at the UI and include the presence of a three-fold purpose.

These antennas have been and are presently being used for satellite tracking at missile range locations at points along the Atlantic and Pacific Oceans as well as at Cape Kennedy.

Secondly, the log-periodic antennas are used by communication networks of the Armed Forces. These new type designs can be made to cover any range of frequencies.

The third use of the antennas are found in commercial circles mentioned before. The TV log-periodic antennas have been developed since 1954 with the four FM Stereo antennas to be placed on the market in the near future.

Where does this antenna research take place? Largely at the JFD Laboratories where 12 undergraduate, graduate and post-graduate students are engaged in this basic research in log-periodic type antennas for television, FM, amateur and military application.

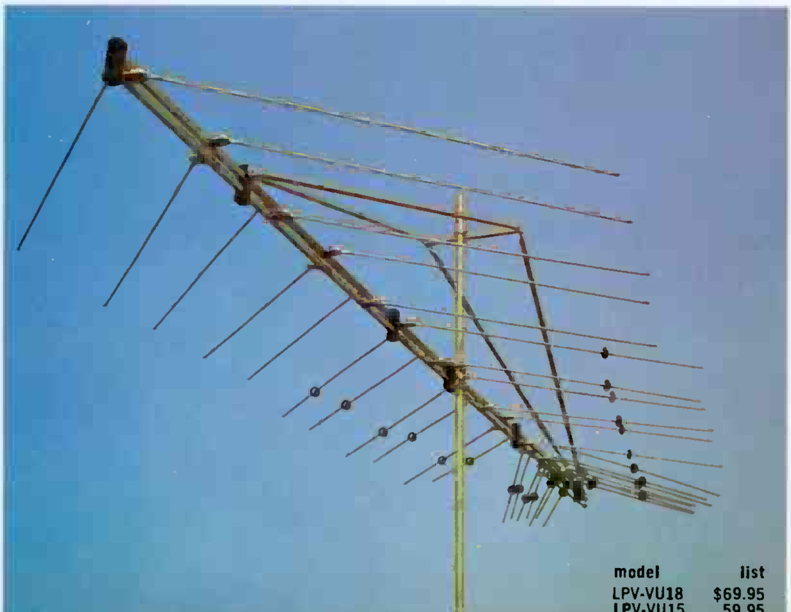
The new JFD Antenna Laboratory is located in the Interstate Research Park northwest of Champaign with the construction scheduled to be completed by Sept. 1. Operations at the new laboratory will not begin until Oct. 1. The facilities will be used for the development of new antenna designs for all-channel VHF and UHF reception.

According to a survey paper recently published by Profs. E. C. Jordan, G. A. Deschamps, J. D. Dyson and Mayes, it was noted that some of the earliest broadband antennas were long wire types designed to operate in the high frequency or short-wave band or perhaps in the low frequency band. Among these antennas the well - known rhombic or equilateral parallelogrammed shaped antenna has held a high place since the days of radio. The log-periodic antenna is a revolutionary development in design.

Other information gathered during the survey was presented for the express purpose of providing the nonspecialist with a basic understanding of the remarkable advances which have taken place over the past decade in the field of broadband antennas.

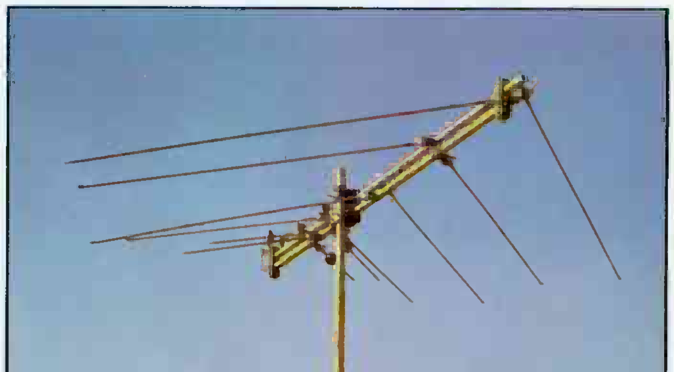
Since the law now requires all TV sets to come from the factory with a UHF "hook-up", perhaps this need for antennas to cover a number of isolated frequency bands could open more interesting doors to interested parties such as Dr. Mayes and his associates.

Don't Be 1/2 Set... With JFD LPV Log



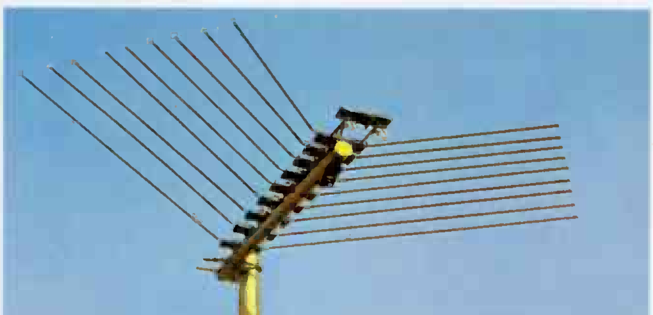
THE JFD LPV-VU WITH CAP ELECTRONIC DIPOLES THAT RECEIVES ALL CHANNELS 2-83 AND FM STEREO USING ONE DOWN-LEAD!

model	list
LPV-VU18	$69.95
LPV-VU15	59.95
LPV-VU12	49.95
LPV-VU9	39.95
LPV-VU6	27.50



NEW! LPV LOG PERIODIC WITH CAP-ELECTRONIC DIPOLE FOR VHF CHANNELS 2 TO 13

model	list
LPV-TV19	$69.95
LPV-TV16	59.95
LPV-TV13	49.95
LPV-TV10	39.95
LPV-TV7	29.95
LPV-TV5	21.95
LPV-TV3	14.95



UHF LOG-PERIODIC FOR CH. 14 TO 83 AND CH. 7 TO 13

model	list
LPV-U21	$27.95
LPV-U15	18.95
LPV-U9	12.50
LPV-U5	6.95

UHF ZIG-A-LOG ANTENNA FOR CHANNELS 14 TO 83

model	list
LPV-ZU20	$34.95
LPV-ZU10	15.95

Only JFD offers You LPV Log Periodics for VHF (Ch.2-13)...UHF

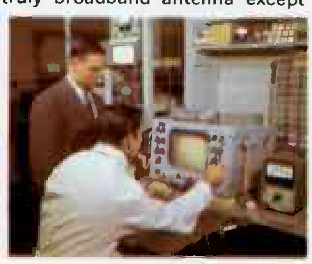
GET THE LION'S SHARE OF ANTENNA BUSINESS (FLATTEN CATV COMPETITION, TOO) BY FEATURING THE JFD LPV-VU LOG PERIODIC! THIS NEW GENERATION OF LOG PERIODIC ANTENNAS DELIVERS WHAT VIEWERS WANT—MANY MORE STATIONS...VHF CHANNELS 2 TO 13...UHF CHANNELS 14 TO 83...FM/STEREO. GIVES THE CLEAN, UNIFORM SIGNAL SETS NEED ESPECIALLY FOR VIVID COLOR RECEPTION.

Only the LPV follows the patented frequency independent Log Periodic antenna formula developed by the Antenna Research Laboratories of the University of Illinois. This new log periodic cellular concept provides you with a combination of gain, bandwidth, directivity and impedance match never before possible with conventional antenna designs.

You can actually see the difference in truer color purity, in greater contrast, in finer detail—not on just some of the channels but all of the channels! Small wonder more JFD Log Periodics were installed in the last 12 months than any other brand.

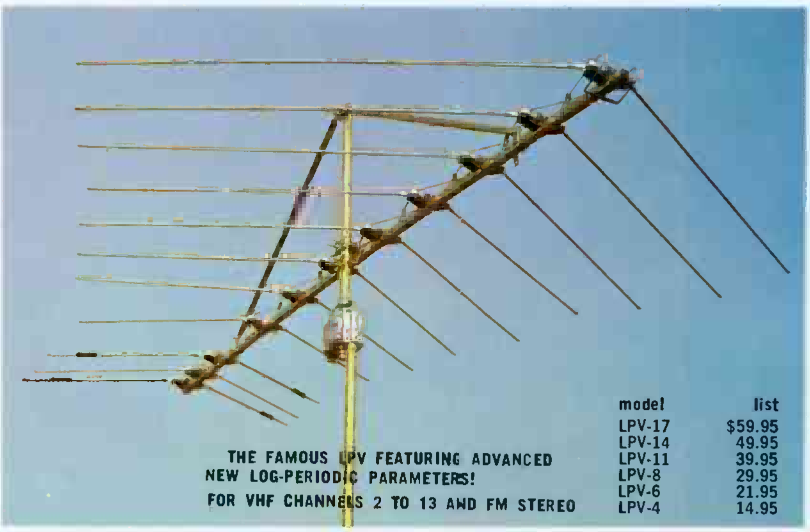
PREFERRED BY MORE N. Y. WORLD'S FAIR PAVILIONS . . . New York World's Fair exhibitors demand flawless color reception. That's why the House of Good Taste, Masonic Pavilion, Formica House, Eastman Kodak Exhibit, New York City Exhibit, House of Japan and other Fair showplaces chose the JFD LPV. This exclusive preference is pre-selling millions of Fairgoers—opening the door for more LPV sales by you.

WHY THE LOG PERIODIC IS THE MOST DRAMATIC BREAK WITH ANTENNA TRADITION SINCE DR. YAGI INVENTED THE YAGI . . . Up until the JFD Log Periodic, it was not possible to devise a truly broadband antenna except by "compromise" design that had to give up vital gain to get wider bandwidth . . . or had to degrade directivity for better impedance. Burdensome parasitics were piled on to try to compensate for gain "suck-outs", ghost-prone polar patterns, and inadequate bandwidth. This pyramided performance complications resulting in signal-sapping standing waves and impedance matches—and yet were only effective at the band edges.



Through the use of the revolutionary new logarithmic periodic formula, the entire frequency range is covered with dipole

Be *All* Set—
Periodic TV & FM Antennas



(Ch. 14-83)...FM/Stereo...VHF/UHF/FM-COLOR & Black/White

groups (cells) of overlapping resonances. These harmonically resonant V-dipoles result in a **frequency-independent performance. The LPV's inherently high gain, sharp directivity, 300 ohm impedance match and flat response are virtually constant across the entire band.**

AND ONLY THE JFD LPV HAS IT! . . . The JFD LPV is the product of the world's largest and newest antenna laboratories. Here, in the JFD Champaign, Illinois R & D Research Center, a team of scientists and engineers, under the direction of Dr. Paul E. Mayes, are revolutionizing the state of the antenna art.

MECHANICALLY SUPERIOR! . . . COMPARE CONSTRUCTION! . . . Life-time stainless-steel take-off terminals that can never corrode, "tank-turret" element brackets, tough heavy-wall Implex A acrylic insulators, twin U-bolts with 6 inch mast grip span; supple, permanently riveted aluminum drive line rod; electrically conductive gold alodizing; plus a host of other exclusive mechanical improvements.

FIGHT CATV WITH THE JFD LPV! Keep CATV out of your area with JFD Log Periodics (such as the 82-channel LPV-VU) which provide viewers with more channels—sharper reception—richer color—plus FM stereo. Don't install inferior antennas that open the door to CATV. Install the best to get the best performance—the LPV!

ADVERTISED IN LOOK, SUNSET . . . COMPARE ADVERTISING AND PROMOTION! . . . A versatile selection of indoor and outdoor sales helps . . . advertisements in LOOK, SUNSET and other national and local consumer publications . . . in newspapers . . . on television . . . sell your best prospects.

Now is the time and your JFD distributor is the place to stock up and step up into big-league LPV Log Periodic profits.

SEE WHY AT THE MOMENT OF TRUTH THE PICTURE IS THE PROOF THE JFD LPV LOG PERIODIC WORKS BEST!

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JFD

JFD ELECTRONICS CORPORATION
15th Avenue at 62nd Street, Brooklyn, N. Y. 11219
JFD Electronics-Southern Inc., Oxford, North Carolina
JFD International, 64-14 Woodside Ave., Woodside 77, N. Y.
JFD Canada, Ltd., 51 McCormack Street, Toronto, Ontario, Canada

Congress DIDN'T GO FAR ENOUGH!

PUBLIC LAW 87–529; 76 STAT. 150

[H. R. 8031]

An Act to amend the Communications Act of 1934 in order to give the Federal Communications Commission certain regulatory authority over television receiving apparatus.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That:

Section 303 of the Communications Act of 1934 (47 U.S.C. 303)[31] is amended by inserting at the end thereof the following:

"(s) Having authority to require that apparatus designed to receive television pictures broadcast simultaneously with sound be capable of adequately receiving all frequencies allocated by the Commission to television broadcasting when such apparatus is shipped in interstate commerce, or is imported from any foreign country into the United States, for sale or resale to the public."

Sec. 2. Part I of title III of the Communications Act of 1934 is amended by inserting at the end thereof a new section as follows:

THEY SHOULD HAVE ALSO REQUIRED...

"—that all 82-channel television receivers* must use an 82-channel television antenna."

Of course, you can't take the law into your own hands—but you *can* take advantage of today's ready-made opportunities to sell an 82-channel antenna with each 82-channel TV set.

Our Antenna Research Laboratories in Champaign, Illinois knew what they were doing when they teamed the acclaimed Log Periodic concept of the University of Illinois Antenna Research Laboratories with our new antenna design advance—the capacitor-coupled electronic dipole. Proof is the fact that the JFD LPV-VU is America's No. 1 82-channel TV/FM antenna!

Who says you can't have everything you want in a TV antenna—VHF?... UHF?... FM Stereo?—with a *single* down-lead to boot!

MOST EFFICIENT PERFORMANCE EVER ON VHF, UHF, FM/STEREO FROM *ONE* ANTENNA USING *ONE* DOWN-LEAD!

- *Cap-electronic* dipole design makes more elements resonate on channels 7 to 13 with a corresponding increase in gain.
- *Higher mode* operation in UHF band achieves higher gain on channels 14 to 83—and FM stereo.
- *Narrower* beamwidths . . . higher front-to-back ratios step up ghost rejection . . . intensify color.
- *Patented frequency independent* design maintains peak performance characteristics regardless of channel or band tuned.
- Includes 3-way splitter so single down-lead can be tied into individual VHF, UHF and FM system inputs.

REMEMBER – AN 82-CHANNEL TV SET IS NOT AN 82-CHANNEL TV RECEIVER UNLESS IT HAS AN 82-CHANNEL TV *ANTENNA!*

*Lest we forget—every *color* set is also an *82-channel* set requiring a color-perfect antenna. In fact, many color TV shows are broadcast on UHF channels.

JFD

SEE YOUR DISTRIBUTOR OR WRITE FOR BROCHURE 806

Model LPV-VU18 Model LPV-VU15 Model LPV-VU12 Model LPV-VU9 Model LPV-VU6

JFD LPV-VU LOG PERIODICS for channels 2 to 83 and FM/Stereo.

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JFD Electronics-Southern Inc.
Oxford, North Carolina
JFD International
64-14 Woodside Ave., Woodside 77, N.Y.
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Use this check list before you install a home TV distribution system

	COAXIAL VHF	TWINLEAD* VHF	COAXIAL UHF/VHF	TWINLEAD* UHF/VHF AND UHF ONLY
Channels received	2-13	2-13	2-83	2-83 (14-83 for UHF only)
Color reception when properly installed	Excellent	Excellent	Excellent	Excellent
Cable loss: @ channel 13 for VHF only @ channel 83 for UHF/VHF	4 db (foam filled) 6 db (solid)	1.8 db/100 ft. @ Channel 13	9 db (foam filled) 13 db (solid)	5.6 db/100 ft. @ Channel 83
Loss increase when wet	Nil	Negligible	Nil	Negligible
Reception when run near or through small metal areas	Excellent	Excellent when properly installed	Excellent	Excellent when properly installed
Reception when run near or through considerable amounts of metal	Excellent	Not recommended	Excellent	Not recommended
Ease of installation	More difficult	Easy	More difficult	Easy
Extra parts required	Connectors, matching transformers	None	Connectors, matching transformers	None
Performance in strong-signal areas	Excellent	Excellent—fair**	Excellent	Excellent—fair**
Performance in weak-signal areas	Excellent	Excellent	Excellent	Excellent
Cable pickup of interference (ignition, appliances, etc.)	None***	None—slight**	None***	None—slight**

*A high quality, low-loss foam encapsulated cable type **Depends upon local conditions ***Poorly designed accessories will pickup interference.

Once you know the facts—there is one best choice for your home system—Blonder-Tongue. Whether you prefer 300 ohm or a 75 ohm coax system, Blonder-Tongue has the products you'll need. There is only one way you can protect your home TV system against obsolescence when new UHF stations come on the air—that's with a Blonder-Tongue all-channel UHF/VHF system.

Blonder-Tongue products designed for all-channel home systems include: All-channel signal amplifiers (V/U-All-2 indoor and U/Vamp-2 mast mounted); all-channel couplers (A-102-U/V two-set and A-104-UV four-set). Rounding out the all-channel concept are UHF/VHF matching transformers (Cablematch U/V set mounted; MT-283 mast-mounted) and the TF-331-U/V flush-mounted feed-thru.

Take your pick. Blonder-Tongue makes them all—and all are "Color Approved". Buy the line with 15 years of quality leadership. Write for free booklet "How to Plan a Color-Approved Home TV System".

BLONDER-TONGUE

9 Alling Street, Newark, New Jersey 07102

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Circle 57 on literature card

how we can approach this circuit, and slightly modify it for better elimination of retrace lines.

Step 1: Apply power to receiver and tune in station. Slightly reduce contrast, while advancing brightness—don't bloom the raster.

Result: A few retrace lines are visible—more prominent in upper half of screen.

Decision: Use a scope to insure good blanking pulses are being received from vertical circuit.

Step 2: Check for vertical pulse at point A.

Result: Approximately 400-volt p-p vertical pulse is found here.

Decision: Normal pulse is available at this point.

Step 3: Check condition of R1 and R2 with ohmmeter.

Result: Value of both resistors is correct.

Decision: Install new C1 (.01 mfd).

Step 4: Recheck elimination of vertical retrace lines on picture tube.

Result: A few lines are still visible.

Decision: Vertical blanking divider network is okay. Slight circuit alteration is necessary to remove lines.

Step 5: Connect resistor substitution box in parallel with R2. Select lower resistance values while viewing screen. Watch finely detailed portions of the picture to insure that video-circuit frequency response does not change during this procedure.

Result: Retrace lines are sufficiently diminished; video response is not altered—definition is normal.

Decision: Install a fixed resistor of necessary value (68K parallel by selected resistor) for R2.

Step 6: Check operation at normal setting of contrast and brightness controls. Recheck screen during commercial or station break—when no video is transmitted.

Result: No visible retrace lines.

Decision: Repair is complete.

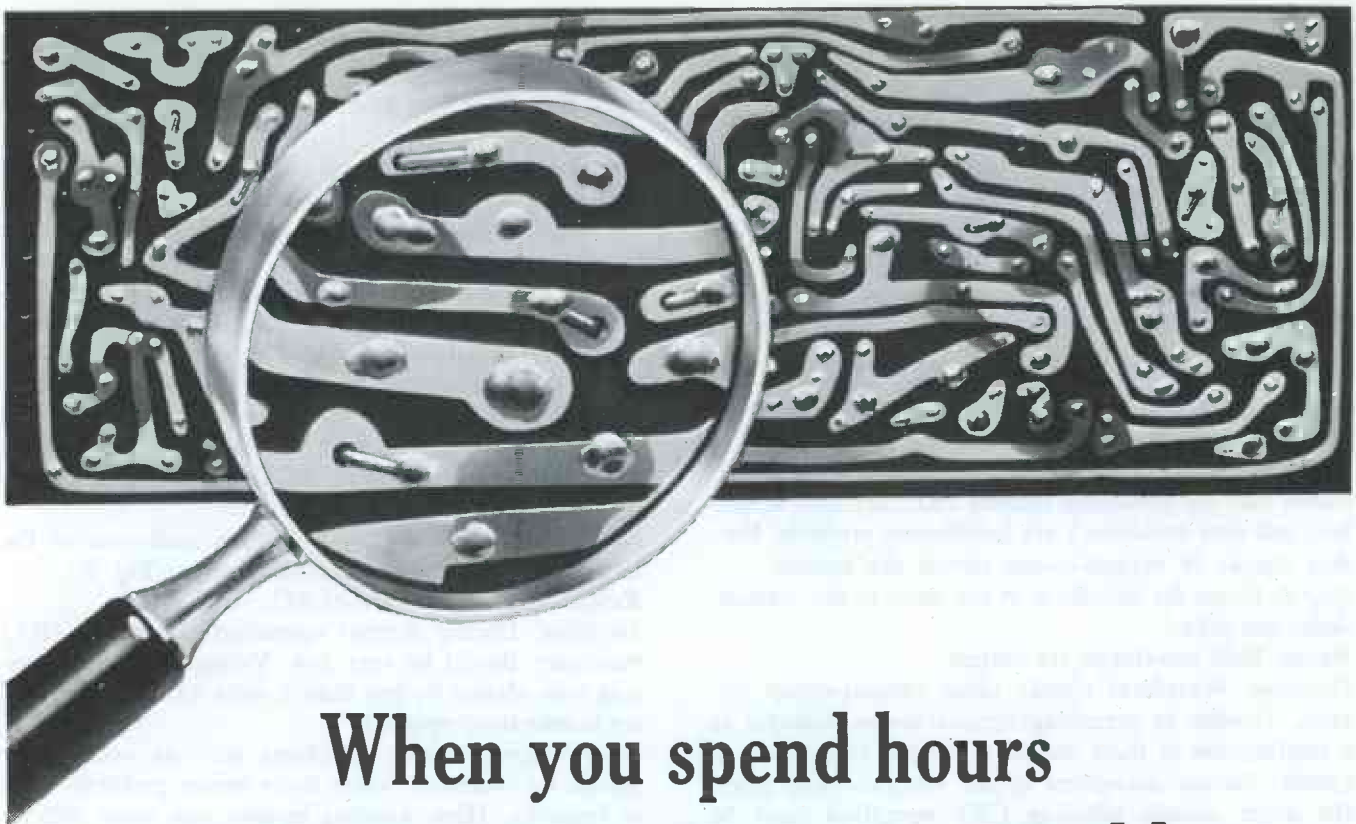
Afterthoughts: You'll notice we didn't give the value of resistor selected in this case. The exact value must be chosen for each particular chassis—that value which eliminates the retrace lines. A low value R2 may be necessary. However, make sure some resistance, say 4700 ohms, remains in the circuit. Otherwise, pulse amplitude at the video-output may be excessive, and radiation to surrounding stages will upset operation.

In some instances, replacement of R2 won't reduce the lines. If not, try reducing the screen-control settings slightly. In chassis equipped with a video peaking switch, try a different switch setting.

Vertical Jitter, Impurity

Usually the cause of horizontal or vertical jitter can be tied down to the sweep circuits, the B+ line, or the AGC circuit. However, here's one trouble which occurred in a Zenith 25MC33 color chassis that turned out to be a real stumper! The picture moved vertically at a slow regular rate; from all appearances, this was a form of vertical jitter. A second symptom, color impurity around the edges of the picture, was disregarded for the moment because it wasn't considered to be important. Let's follow the method used to locate the vertical jitter problem and subsequently the raster impurity.

Step 1: Check waveform at vertical-output tube grid.



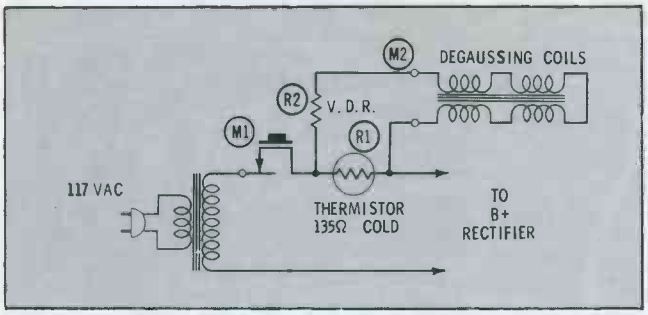


Fig. 6. Bad thermistor causes too much current in coils.

Result: Normal waveform with proper peak-to-peak amplitude is observed.

Decision: Proper waveform at this point is a good indication that the preceding circuits (RF, IF, sync amplifier, and sync separator) are functioning properly. Further checks of vertical-sweep circuit are needed.

Step 2: Scope the waveform at the input to the vertical-deflection yoke.

Result: Both waveforms are normal.

Decision: Waveform checks clear vertical-sweep circuits. Trouble in preceding circuits seems doubtful as a malfunction in them should affect the vertical-sweep circuit. Picture movement is not vertical-sweep jitter; the other circuits affecting CRT operation must be checked. Since the dynamic-convergence circuit is fed samples of both the horizontal- and vertical-sweep outputs, and it modifies the sweep, let's check it next.

Step 3: Check horizontal- and vertical-sweep inputs and all other waveforms, at dynamic-convergence circuit.

Result: All waveforms have normal shape and amplitude; no evidence of jitter or cause for jumping picture can be seen.

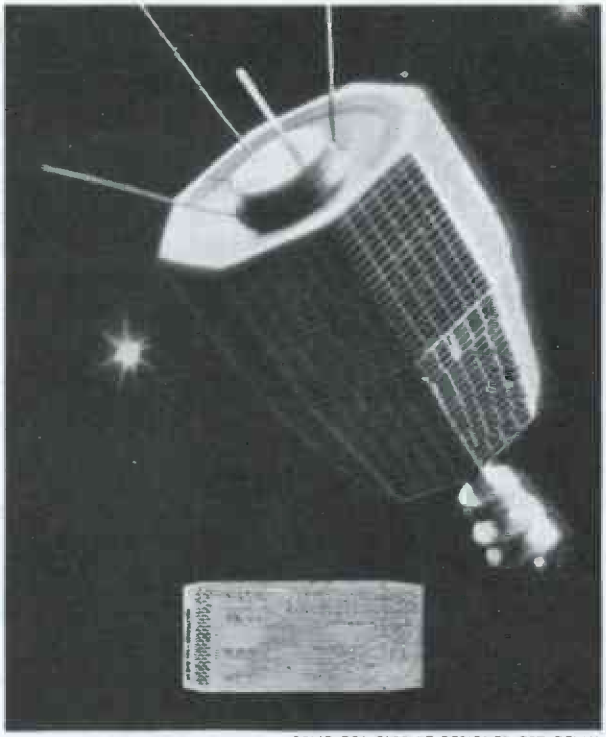
Decision: Normal waveforms indicate that neither the horizontal- and vertical-sweep circuits nor the dynamic-convergence circuit seems to be at fault. The picture shows no brightness variations; none of the inputs to the CRT are suspected. Trouble must be external to the sweep circuits. Maybe the color impurity and vertical jitter are related troubles. So now we follow the second clue—impurity. Automatic degaussing is incorporated in this chassis. Either it isn't operating when the set comes on, or it isn't shutting off during normal operation, which creates an AC field and thus produces impurity.

Step 4: Connect a VOM—AC volts scale—across the terminals to automatic-degaussing coils (Fig. 6).

Result: Meter reads 15 volts AC.

Decision: During normal operation thermistor (R1) resistance should be very low. Voltage fed to degaussing coils should be less than 2 volts AC. The thermistor is defective; replace it.

Afterthoughts: Major symptoms such as sweep jitter should be corrected before more minor problems such as impurity. Here, locating trouble was more difficult because similar symptoms hadn't been encountered before. (Automatic degaussing is a relatively new feature in color receivers.) The electromagnetic field created by 60-cps current through the degaussing coils inter-



SOLID RCA CIRCUIT DESIGNED FOR RELAY

RELAY uses Solid RCA Circuits.

CHROMA CIRCUIT DESIGNED FOR RCA VICTOR COLOR TV

RCA Victor Color TV uses RCA Solid Copper Circuits.

Why?

RCA Solid Copper Circuits won't come loose. Won't short circuit. Won't go haywire. They're the Space Age advance over old-fashioned "hand wiring."

"HIS MASTER'S VOICE"

The Most Trusted Name in Electronics

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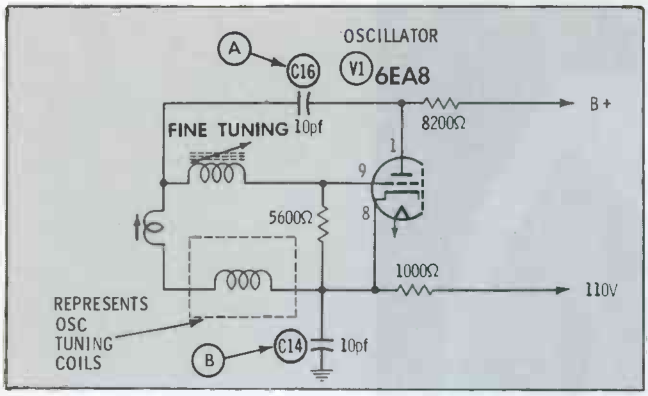

Fig. 7. Defective C16 changes VHF oscillator frequency.

fered with the 60-cps vertical-sweep field. Because the fields were out of phase, a form of jitter resulted.

Station on Wrong Channel

We've found the following trouble in several RCA CTC12, 15, and 16 color chassis. The trouble is usually attributed to the local oscillator in the VHF tuner. Various conditions of improper tracking may accompany the symptoms: picture wtihout sound; sound without picture; sound clear on one channel, station picture on another; or vice versa. In the following case, all stations were received one channel *lower* than normal. A simplified schematic of the VHF oscillator circuit is shown in Fig. 7.

Step 1: Apply power to receiver and run channel-change check on tuner.

Result: Sound and picture missing on assigned channel. Tuning *one* channel *lower* and adjusting fine tuning clears sound, but video is weak or missing.

Decision: Drastic change in oscillator frequency is evident — picture and sound can't be tracked together, even on lower channel. All channels are equally affected, so defective component is likely associated with overall oscillator operation, some component linked with all channels.

Step 2: Substitute several different oscillator tubes while rechecking operation.

Result: Conditions remain.

Decision: Dynamic checks inside tuner are necessary.

Step 3: Remove tuner shield, apply power to receiver. Perform visual checks inside tuner. Make voltage and resistance checks on 6EA8 and associated components.

Result: No abnormal readings.

Decision: Defect must be caused by poor connection or changed value of capacitor associated with RF oscillator stage.

Step 4: Check for poor connections by using insulated tool, pressing on and around components in oscillator stage (Fig. 7).

Result 1: Station signal is received on proper channel when pressure is applied to C16 (10 pf).

Decision 1: Intermittent connection at C16 leads is possible cause (see *Afterthoughts*).

Result 2: Stations still received one channel displaced.

Decision 2: Substitute for C16, keeping leads same size,

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WHY WAIT? YOU CAN MAKE MONEY NOW!

...IF YOU'RE EQUIPPED — AND A WIDE BAND SCOPE IS A MUST

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☆ 70% OF NBC PROGRAMMING* NOW IN COLOR

☆ OVER 3,000,000 NOW IN USE

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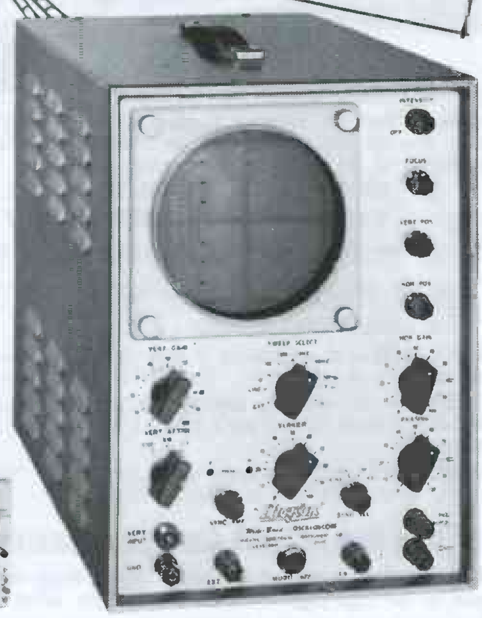
MODEL 677

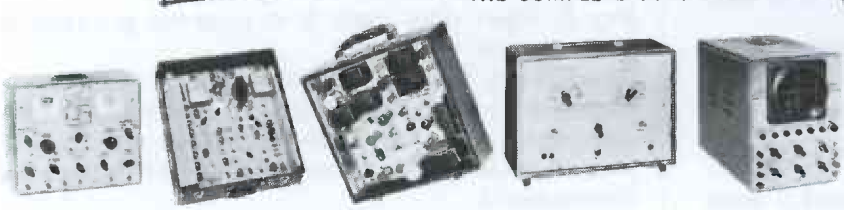
This Hickok-quality, full 5″, wide-band scope — factory assembled, wired and calibrated can put you in color TV service . . . for less than $200.00.

- Rise time—less than 0.08 usec.
- AC response—5 cycles to 4.5 MC within 3 db
- Vertical sensitivity—40 MV RMS/inch
- 5 times horizontal sweep expansion
- Sharp, bright (1600 volts anode potential) trace with full astigmatic correction

and, of course, it's . . .



THE COMPLETE COLOR LINE



MODEL 615 MODEL 656XC MODEL 660 MODEL 661 MODEL 675A

THE HICKOK ELECTRICAL INSTRUMENT CO.
10566 Dupont Avenue • Cleveland, Ohio 44108

Internationally by Hughes International, Culver City, California

Circle 45 on literature card

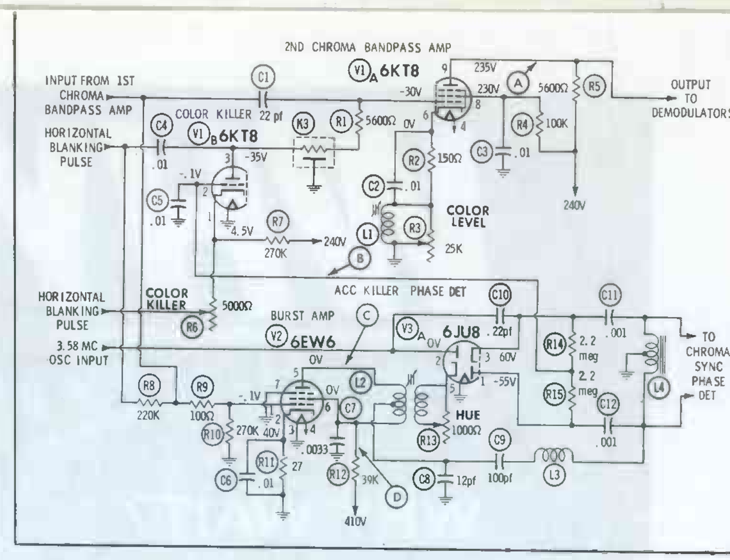


Fig. 8. Missing burst pulse caused killer to cut off bandpass.

and installing in same physical location.

Afterthoughts: Defective or intermittent C16 shifts oscillator frequency, affecting all channels. A poor solder joint, as in Decision 1, usually occurs at the junction of C16 and pin 1. A hot solder iron at this connection may solve the problem. However, it's wiser to replace C16 at this time, rather than depend on a solder repair job. C14, connected from grid to ground in this circuit, could cause similar operation.

Capacitors such as C16 and C14 are small and fragile, so take extreme care not to put undue strain on the leads or body.

Color Missing

The customer stated that originally the circuit breaker would trip occasionally. At times the color would lose sync, then disappear before the breaker tripped. Neither the fine-tuning, color, nor tint control produced any sign of color. Since the black-and-white picture was okay, trouble was suspected to be in the chroma circuits. Let's follow the steps used to find the trouble source in this Zenith 25MC30 color chassis.

Step 1: Apply RF output from color-bar generator to receiver antenna terminals.

Result: Gray bars are visible. Increased signal strength overloads receiver, indicating that loss of color is not due to low receiver sensitivity.

Decision: It is now definite that trouble is not external to the receiver. Video IF circuits appear to be okay; misalignment is possible although unlikely.

Step 2: Inject video signal from color-bar generator to video-detector test point.

Result: Gray bars appear on screen.

Decision: Trouble is definitely in chroma circuits—eliminating tuner and video-IF strip as possible suspects. A wide-band oscilloscope is needed to trace the chroma signal.

Step 3: Trace signal through bandpass amplifier stages.

Result: Waveform at the first chroma bandpass amplifier grid and plate is normal. At the grid of the second bandpass amplifier signal is normal but plate signal is missing (point A, Fig. 8).

Decision: Second chroma bandpass amplifier is not functioning properly.

Step 4: Check the voltages at the second chroma bandpass amplifier.

Result: Plate voltage equals supply voltage; grid voltage is —30 volts.

Decision: The color-killer circuit is cutting off the second chroma bandpass amplifier when color signal is being received.

Step 5: Read voltages at color-killer circuit.

Result: Voltages are normal for no-color-signal condition. Grid voltage is —.1 (point B).

Decision: Voltage at the color-killer grid is dependent upon action at the ACC-color killer phase detector.

Step 6: View waveforms at ACC-color killer phase detector.

Result: No color burst is visible.

Decision: Presence of color burst signal from burst amplifier causes voltage fed to the color killer to go negative. The negative voltage at the color killer grid cuts off the color killer, and its plate returns to almost 0 volts, which allows the second chroma bandpass amplifier to conduct. Absence of the burst signal at the phase detector thus prevents the chroma signal from reaching the demodulators.

Step 7: Use scope at burst amplifier.

Result: Grid signal is normal; plate signal is missing.

Decision: The burst amplifier is inoperative.

Step 8: Measure voltages in burst-amplifier circuit.

Result: Plate and screen-grid voltages are missing (points C and D).

Decision: Trouble source has been found; simple resistance checks should find the defective component or components.

Step 9: Make resistance checks at burst amplifier plate and screen-grid circuit.

Result: Plate and screen grid read 0 ohms to ground and infinite resistance to the B+ line.

Decision: Either C7 or C8 is shorted; R12 has opened (underside is charred). Further checks reveal C7 is the culprit.

Afterthoughts: Here, it really wasn't necessary to insert the chroma signal at the video detector, but this step does eliminate the RF and video IF circuits as any possible trouble source. Also, in this particular instance, time would have been saved had the waveforms at the burst amplifier and phase detector been checked immediately after checking the first bandpass amplifier. It could be argued that the signal path actually includes the burst amplifier, ACC-color killer, phase detector, and the color killer; if these stages do not function properly the second chroma bandpass amplifier will be cut off. However, the approach used here is generally more straightforward, methodical, quick, and easy.

Conclusion

As you service more color sets, you will undoubtedly develop your own methods and time-saving techniques. As has been said before, there are a number of approaches, and each has its advantages and disadvantages. All good approaches have one common characteristic—they are methodical. The whole idea can be summed in the phrase: It isn't as much *what* you do as the *way* that you do it. ▲

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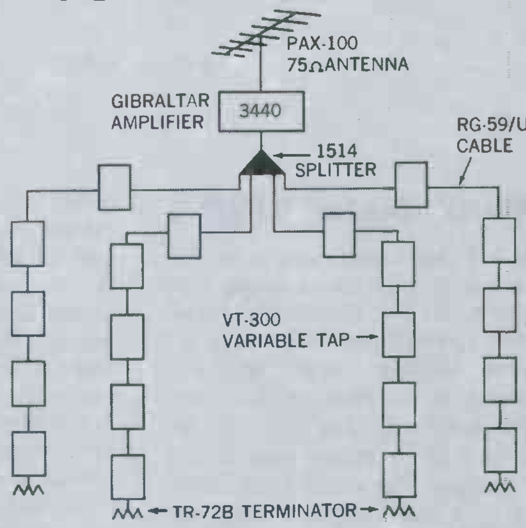

	Dealer Price
Model PAX-100 75-ohm antenna	$ 25.77
Model 3440 Gibraltar amplifier	53.70
Model 1514 4-way splitter	9.14
20 Model VT-300 Variable-Tap outlets @ $2.15	43.00
Miscellaneous (mast, mount, hardware, fittings, etc.)	20.00
Cable (500 ft. of RG-59/U)	20.00
Total Materials	$171.61
Labor (16 hours @ $5 per hour)	80.00
	$251.61
Suggested installed price to customer	350.00
YOUR PROFIT	**$98.39**

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Notes on Test Equipment

analysis of test instruments . . . operation . . . applications

by Arnold E. Cly

"Multi"-Meter VTVM

This VTVM incorporates some features not ordinarily found in this type of instrument. The Electronics Measurements Corp. Model 107A (Fig. 1) measures decibels, capacitance, and inductance in addition to the usual VTVM functions. The unit is enclosed in a black plastic case with a carrying strap. The meter front measures 4¼" x 5½" and is covered entirely by transparent plastic for visibility. This instrument may be purchased in kit form or factory wired.

Circuitry involved in checking values of capacitors and coils is shown in simplified form in Fig. 2. The component to be tested is placed between the input terminals, with the CIRCUIT SELECTOR switch set to the CAP position; 6.3 volts AC that powers the test circuit is taken from a tap on the secondary of the power transformer. The RANGE SELECTOR switch is an adjustable divider network that is placed in series with the component under test to form a resistive-reactive voltage divider. Voltage fed to the grid of the 12AU7 is determined by the reactance of the component connected across the input terminals; the greater the reactance (less capacitance or more inductance), the larger the voltage at pin 7. (The voltage is not determined by a simple ratio, however, because the voltages across the resistor and reactor are not in phase.)

A 60-cps signal is coupled from this section of the tube through C1 to pin 2 of the other section. Both grid and plate of V1B are tied together, and the 60-cps voltage from V1A is rectified and fed to the meter bridge circuit.

To evaluate a capacitor or coil, connect it across the input terminals, and set the CIRCUIT SELECTOR switch to the CAP position. The RANGE SELECTOR switch is adjusted to provide a readable indication on the CAP meter scale, which has divisional markings from .05 to 5 mfd. The reading obtained is multiplied or divided, whichever is indicated, by the factor shown at the range-switch setting. If the component tested is a capacitor, the result gives the capacitance value directly.

Should the component be a coil, the value on the CAP scale is applied to a chart in the operating manual. This chart lists in one column the values appearing on the CAP meter scale. Opposite each appears a value of inductance — 1.4 through 141 henrys. The multiplier (or divisor) read from the RANGE SELECTOR switch is then applied to the reading from the henry column to determine the actual value of the coil tested.

We used the instrument in our lab to determine the value of several coils and capacitors. Measuring coils we found the meter had an accuracy of 10% between 16 and 35 henrys; either side of these values the accuracy deteriorated. It is not recommended to measure coils with an inductance of less than 1.4 henrys; errors introduced in this range are large.

The meter maintained an accuracy of 20% in measuring capacitors from .001 to 300 mfd. Above and below these values, the percentage of error increased considerably. It was found that values below .001 mfd were critical to measure. Capacitance introduced by the meter leads greatly influenced the meter reading; test leads had to be spaced far apart and hands kept away. It was determined that if the small-value capacitors were connected as near as possible to the test terminals (using short clip leads) the accuracy of the meter was increased.

Zeroing of the meter must be maintained during coil and capacitor measurements. A false reading will result if this isn't observed. We found that changing the setting of the RANGE SELECTOR required the meter to be zeroed each time.

Fig. 1. VTVM provides multiple checks.

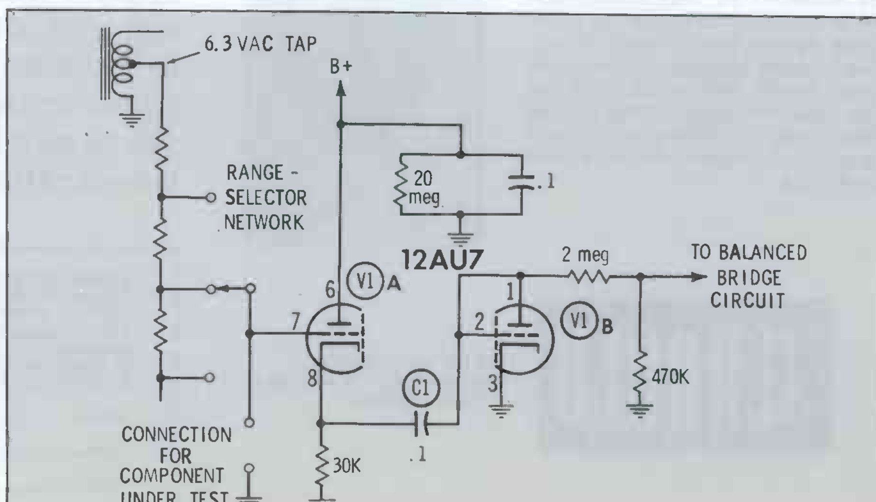

Fig. 2. Circuit arrangement to determine value of capacitors and coils.

EMC Model 107A Specifications

Meter Ranges:

1.5, 10, 30, 100, 300, 1000 volts full scale for DC, AC (rms), p-p, and db scales. C×1, ×10, ×1K, ÷10, ÷100, ÷1K ranges for capacitance measurement.
R×1, ×10, ×1K, ×10K, ×100K ×1 meg ranges for resistance.

Meter:

800-ua movement.

DC Input Resistance:

1⅔ megohms per volt on 1.5 DCV range; 16.5 megohms all other ranges.

AC Input Impedance:

1.5 megohms.

Circuit:

Balanced bridge (push-pull) using 12AU7; p-p rectification using ½ of 12AU7.

Accuracy:

DC ±3%, AC ±5% of full scale.

Frequency Response:

±1 db 25 cps to 1 mc.

Power Requirements:

105-125 volts, 50/60 cps, 8 watts; also includes 1.5-volt C and 1.5-volt penlite batteries.

Size: (HWD)

7⅜" x 8⅜" x 3".

Weight:

4¼ lb

Price:

Factory wired $51.40
Kit $36.50

A scale is provided on the meter for expressing voltages in terms of db based on a 0-db level of 6 mw in a 500-ohm line. This −8-db to +15-db scale is used as follows: If the RANGE SELECTOR switch is set on the 1.5 ACV range, subtract 16 db from the meter reading; for the 10 ACV range, add 0 db. The operating manual lists db values corresponding to all the ACV ranges. Also listed in the manual are correction factors for various line impedances from 5 to 1000 ohms, but all referenced to 6 mw. The standard used most often nowadays is the dbm—1 mw in 600 ohms; to express the reading in dbm, add +7 db.

The meter has a zero-center scale which permits a convenient method for measuring either plus or minus voltages, as in balancing discriminators. The need for switching the CIRCUIT SELECTOR switch between −DCV and +DCV is eliminated. Voltages of this type are also found in practically all transistor equipment.

Circle 160 on literature card

Monitors VHF, UHF

The Hickok Model 235A field-strength meter (Fig. 3) will determine the strength of television signals in both the VHF and UHF bands. The metallic-gray metal case has a removable hinged lid and a carrying strap.

Fig. 3. Portable field-strength meter.

The instrument input is designed for 75-ohm coaxial cable; however, the Hickok Type CM-1 Calimatch matching transformer, which is mounted inside the lid, permits measurements with a 300-ohm balanced lead. A short coaxial cable, supplied with the unit, connects the matching transformer to the instrument; two terminals on the transformer are for the antenna twin-lead.

On the front panel, a neon indicator is one of two safeguards that insure accuracy of the instrument. When the meter is switched to the "on" position, the neon lamp will glow continuously if the B battery has voltage sufficient to power the unit satisfactorily. Should the neon lamp fail to light, the battery must be replaced. The two 1½-volt A batteries should be replaced at the same time.

The second safeguard that will maintain calibration accuracy is a sensitivity adjustment to compensate for the tube aging or replacement and for any rough handling the unit may receive. The calibration adjustment is very easily made. The instrument is removed from its case, turned on, and tuned to channel 4. The ZERO ADJUST knob on the panel is set to the center of its range, and a coil is adjusted to zero the meter.

To measure the signal from a 300-ohm line, connect the short coaxial cable from the CM-1 to the 75-ohm input jack on the panel of the 235A. Be sure the neon lamp is illuminated. Set the main switch to the band that contains the television signal you intend to check. Adjust the tuning knob to the carrier—either picture or sound. Continue adjusting until maximum indication on the microammeter is reached; then detune toward the high side of the carrier until the meter reaches minimum deflection. Next, move the ZERO ADJUST knob until the meter needle is exactly on zero; then again readjust the tuning knob for a maximum reading on the panel meter. Apply the reading obtained from the meter scale to the correction chart printed on the inside of the lid. This figure is the signal strength of the carrier in microvolts. (The chart is used to compensate for the signal loss in the Calimatch.)

The setup procedure for measuring signal strength on a 75-ohm line is the same as for the 300-ohm, except for two differences: the signal to be measured is coupled directly to the 75-

Hickok Model 235A Specifications

Frequency Coverage:

54 to 88 mc for low band (LB) Channels 2 through 6; 174 to 216 mc for high band (HB) Channels 7 through 13. 450 to 900 mc includes UHF Channels 14 through 83. Two separate dials indicate either picture or sound carrier for the VHF band.

Sensitivity and Accuracy:

VHF bands 10 to 100,000 uv; +/−3 db with 75-ohm input. UHF band 30 to 50,000 uv; +6 db, −2 db with 75-ohm input.

Meter:

2⅜" × 4¼" (HW)
200-ua movement. Three scales; 1 LB, 1 HB — 10 to 100,000 uv; UHF 30 to 50,000 uv.

Power Required:

Self-contained supply consisting of two 1½-volt A batteries and one 90-volt B battery.

Size: (HWD)

10½" × 6¼" × 6".

Weight:

8¾ lb

Price:

$229.50.

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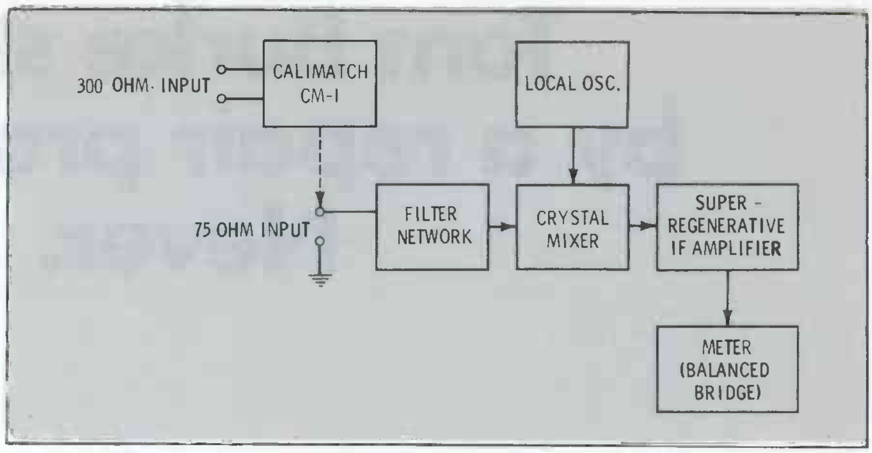

Fig. 4. This instrument may be adapted to either 75- or 300-ohm input.

ohm input jack; and the indication on the meter is the actual carrier strength (the correction chart is not used).

To combine sensitivity and accuracy with portability some compromising has been necessary which has mainly affected image-rejection capability. When you are measuring a certain carrier with the 235A, many frequencies other than those desired are also present. These unwanted signals may be noticed as spurious responses on the panel meter. Generally, these responses will not coincide with the carrier markers on the tuning dial, and may be disregarded. They may even derive from a band other than the one the field-strength meter is set for. This may be verified by merely moving the bandswitch to the next band and checking the image frequency; observe the movement of the meter needle. Should its deflection increase then you can be assured the interference is from the opposite band.

The selective filter input circuit was designed to provide 75-ohm input impedance plus image-rejection features. However, the principal objective was to match input impedance, especially in the UHF ranges where standing waves can easily cause inaccurate readings. Consequently, the filter's image-rejection abilities are limited, and in strong signal areas spurious responses from image frequencies will appear. However, as just explained, this poses no problem in detecting the desired carrier frequency.

A phone jack on the panel provides a way to help locate the carrier frequency with earphones. The earphones can also be used to help determine best orientation of an antenna if the signal is very weak. The antenna is positioned for minimum noise in the earphones. The phone-jack is designed to accommodate a high-impedance crystal type earphone; magnetic earphones will load the circuit and attenuate the sound, making it practically inaudible.

The circuit of the 235A is so designed that the local oscillator is variable from 92 to 188 mc. The oscillator tunes to the high side of the signal frequency on the low-band VHF channels and to the low side of the high-band channels. The heterodyning action produces a 40-mc IF frequency. For the UHF band, the local oscillator fifth harmonic is employed, tuned 40 mc higher than the carrier frequency to be measured.

The 40-mc signal is coupled to a regenerative IF amplifier, an amplifier in which the average plate current varies logarithmically with the instantaneous voltages on its grid. The plate current also affects a balanced bridge circuit which incorporates the indicating microammeter; see the block diagram in Fig. 4. Temperature compensation in the circuits insures accuracy under different climatic conditions.

The scales on the indicating meter are plotted in a logarithmic manner; thus, the first two-thirds of the scale (10 to 1000 uv) may be read more accurately. To restrict meter movement to this portion of the scales, the attenuator pads shown in Fig. 5 may be used in the connecting lead-in. The 20-db pad provides an attenuation ratio of 10 to 1; this means the readings are to be multiplied by 10. The 40-db attenuator has a 100 to 1 ratio, and the multiplier factor is 100.

The Model 235A is useful for determining signal strength when installing antennas and antenna-distri-

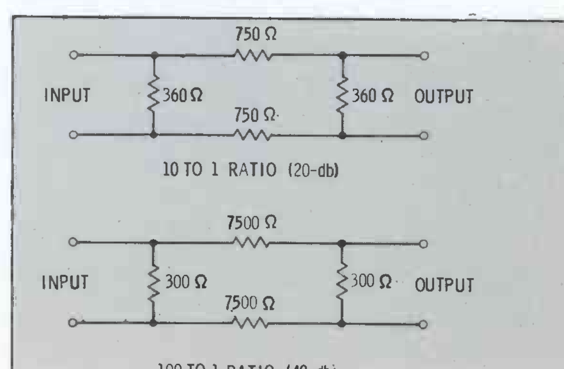

Fig. 5. Pads restrict meter movement.

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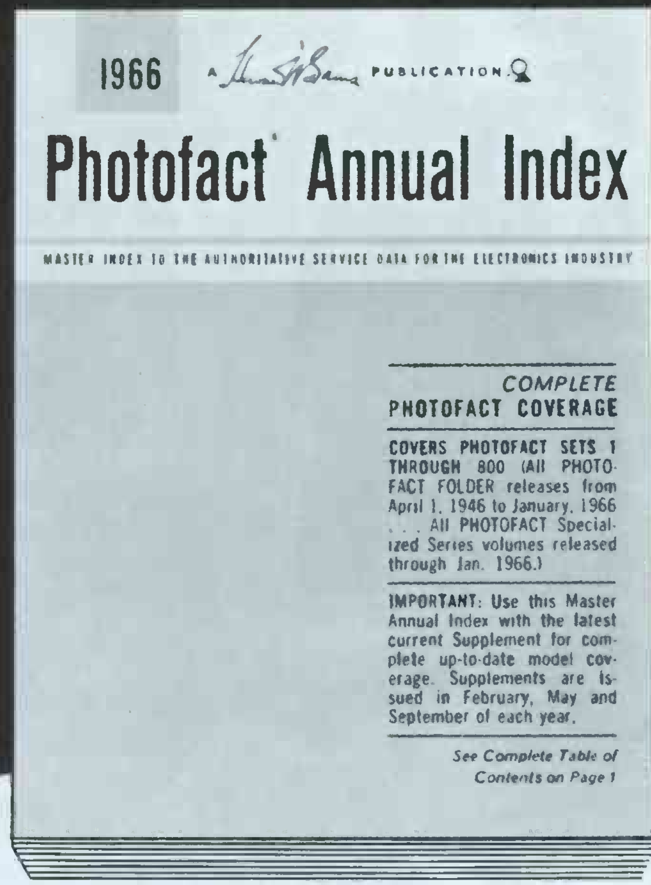

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For further information,
Circle 161 on literature card

Bench-Type Tube Checker

Here is a tube checker that will get a lot of use in any TV and radio service shop. The SENCORE TC131 (Fig. 6) is a "do-it-yourself" type of tester that can be used by the service technician as well as his nontechnical customer. Many people like to test the tubes from their own electronic equipment; if any are found defective,

Fig. 6. Checks both tubes and nuvistors.

the customer has the satisfaction of having "fixed" his own set.

The TC131 is housed in a black metal case. The instrument can be used to check nuvistors and tubes used in portable and auto radios, hi-fi sets, and television receivers. Tests are provided by the multiple-socket method. Mounted immediately below the test sockets are five pin-straightener sockets that accommodate nuvistors and the 7-, 9-, 10-, and 12-pin tube bases. The indicating meter, which measures 5¾" × 4¼", is located in the upper right corner of the panel. Directly above the meter are two concave compartments; these are used to separate the faulty tubes from those that test satisfactorily.

Only three setup controls are used; they are labeled FILAMENT, LOAD, and SHORTS. The proper settings of these switches for a particular tube are given in the chart accompanying the tester. (Up-to-date charts are available at regular intervals.)

In addition to the setup controls, there is a switch which is used to select QUALITY (cathode emission), LEAKAGE (grid leakage), and SHORTS (between elements) tests. As the switch is moved to each position, an indicating lamp (mounted beneath

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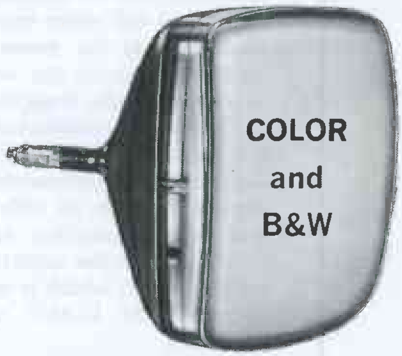

Zenith black-and-white replacement picture tubes are made only from new parts and material except for the envelope which prior to re-use, is inspected to the same standards as a new envelope. In color tubes the screen, aperture mask assembly and envelope are inspected and tested to meet Zenith's high quality standards prior to re-use. *All* electron guns are new.

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Specifications subject to change without notice.

Circle 55 on literature card

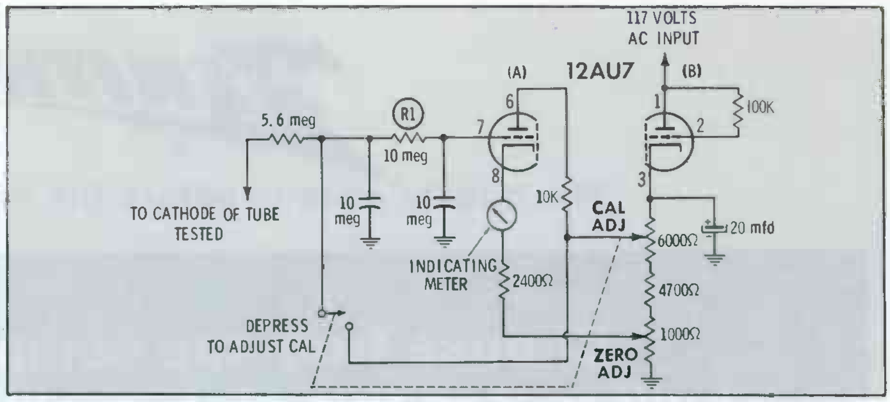

Fig. 7. Vacuum-tube-voltmeter reading will not exceed full scale.

the panel) glows at the left edge of the meter scale to be read. Many tube checkers indicate gas or shorts by a glowing lamp; however, the TC131 registers these conditions with the meter movement.

SENCORE Model TC131
Specifications

Tube-Socket Complement:
7-, 9-, and 10-pin miniature
8-pin loctal
8-pin octal
9-pin *novar*
12-pin compactron.

Tests Performed:
Cathode emission, grid leakage (sensitivity over 100 megohms), short between elements (up to 180K ohms).

Meter Ranges:
Quality—Bad/?/Good (0-130)
Leakage — Good/?/Bad
Shorts — Good/?/Bad

Test Settings:
Filament — 1 to 50 volts AC in 12 steps. Load-switch settings — cathode current levels.
A 50 ma or above
B 20-50-ma
C 15-30 ma
D 10-16 ma
E 6-12 ma
F 2-7 ma
G .7-2 ma
H .5-.8 ma
J .5 ma or less

Power Requirements:
105-125 volts AC, 50/60 cps, 7 watts.

Size: (HWD)
4½" × 22" × 21¼"

Weight:
21 lb

Price:
$129.50

The indicating circuit, shown in Fig. 7, is essentially a single-ended vacuum-tube voltmeter that employs one section of a 12AU7 as an amplifier and the other as a power-supply rectifier. With zero volts on the grid, the indicating meter reads less than .1 ma. As the voltage is gradually increased, the meter current rises until it approaches .75 ma with +5 volts on the grid. At this point the grid-cathode voltage reaches practically zero, and any additional voltage applied to the grid is dropped across R1 due to grid-current flow. An additional 35 volts is then required for maximum meter deflection (1 ma). A tube which has normal emission registers 100 (.78 ma) on the QUALITY scale of the meter. Should the emission be greater than normal, the meter deflection will be limited as just described and will never exceed full scale. This protects the meter even if the load setting is on the wrong position or a shorted tube is accidentally tested.

The meter is calibrated by means of a front-panel CAL control. When it is depressed, approximately 40 volts is applied through its slider arm to the grid of the amplifier section of the 12AU7. Then the control is turned to set the meter, which is in the cathode circuit of the 12AU7, for maximum deflection.

We tested several tube types from our lab tube stock. This inventory consists of tubes having a variety of symptoms: leakage, low emission—and a few tubes showing these conditions intermittently. The TC131 checked all these tubes for the proper trouble symptom.

The service manual supplied with the unit fully explains all tests and also includes a trouble chart for reference, should any malfunction appear. This instrument will allow several fast checks of many different tubes, and as previously mentioned will permit the "do-it-yourselfer" to test his own. The space it occupies on the service bench will be well used. ▲

For further information. circle 162 on literature card

COLOR BY KIT

What makes a color set tick? Build one and see!

by Alan James

This year has seen color television come to 5 million American homes. Word for the future is dawning clearly for the television servicing industry: "Learn to service color sets or take a back seat to those who can." Monochrome TV is being crowded out by color the same way radio was for television.

"Learn color" is on the lips of everyone connected with consumer electronics. How are you reacting? Are you attending the color-service clinics sponsored by distributors, set makers, and test equipment builders? Have you had a chance to attend a color-servicing school? Any of these is an excellent way to learn if you are situated where you can use them.

For those who can't attend formal classes, however, there are other ways to learn color servicing. One is to buy a color set and learn by experimenting with it. It can be a used set, a new set, or one you buy in kit form and build right in your own shop. If you're studying by correspondence, or learning from books and articles on the subject, having your own color set is next best to attending laboratory classes.

For many technicians, the idea of building a set holds a lot of interest. Many of you learned how test equipment works by building kit-type instruments. There's no reason why the same method, enlarged a little, can't familiarize you with color receivers.

Some technicians buy kit instruments to save money. Don't count on this with a kit-form color receiver, because the price is as great as for some wired sets. One justification is that the kit-form chassis isn't an economy design.

Fig. 1, the block diagram of a kit-form 21" color receiver, shows the stages that are included. The chassis is a pan-type, and the picture tube and chassis are together in a mounting that can be installed in a cabinet or fitted neatly into a wall. X-Z demodulation is used, followed by a separate minus-Y amplifier for each color. Video and chroma are picked from the video IF by a diode detector; a separate diode detects intercarrier sound and sync. Notice that sync is amplified along with the 4.5-mc sound. Then they are split up, with the sound sent through its demodulating and amplifying stages and the sync sent to its separator. The chroma section includes automatic color control (ACC) and horizontal blanking. In other words, this chassis contains a full complement of 25 tubes to assure a clean, stable color picture on the CRT screen.

More recent is a 25" color receiver with a vertical chassis mounted around the neck of the CRT. This type of chassis construction has become popular with manufacturers who want to slim down a cabinet; combined with the short neck-length of the new 90° rectangular-screen 25" CRT, vertical chassis (sometimes called wraparound) construction permits shallower mounting space than with most 21" sets. Transistor tuners and certain circuit advances are features of this newest receiver.

Getting the Most

Think of your time while you're considering whether to buy and

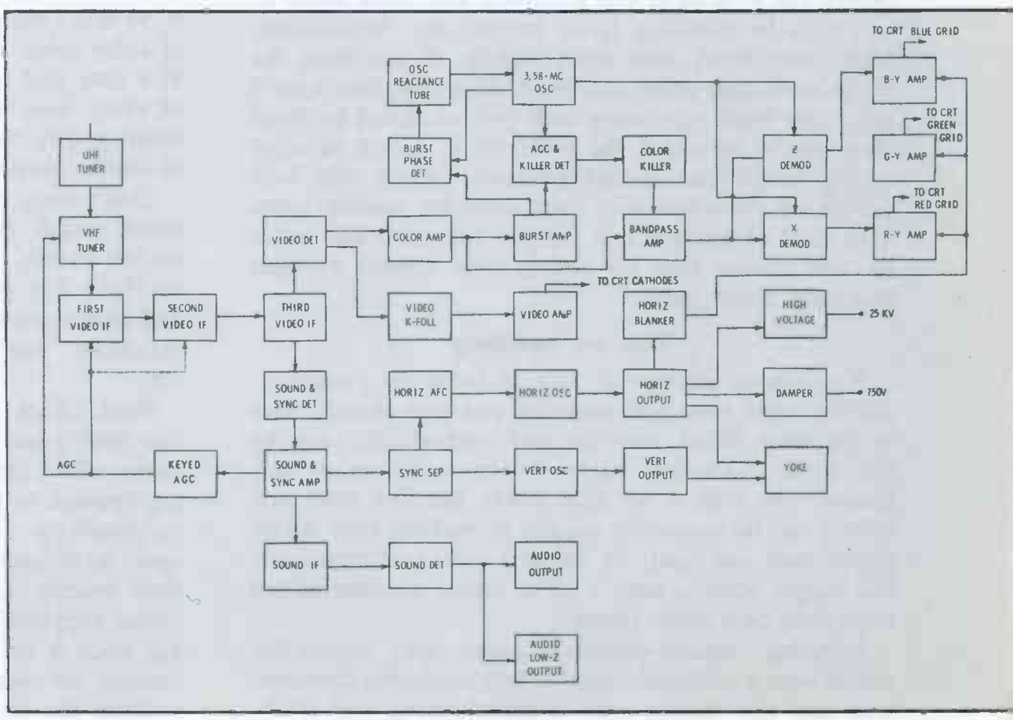

Fig. 1. Stage-by-stage layout of color-TV receivers, showing signal paths.

build a color receiver. An expert can assemble a color set from a kit of parts in three 8-hour days. For others, construction may take longer. If you allow a week, you'll have time for careful assembly, thorough rechecking, and precise final adjusting and alignment.

Since you're going to spend this much time and money to learn color servicing, you may as well gain everything you can from it. Slow down your building enough that you can do some studying right along with each part of the task. Of course, you'll have to add extra days to your planned construction time.

You'll want to learn several things from your project: How components look on a circuit board compared with how they appear on the schematic. Ways the parts are connected to each other by printed foil or wire lengths on the board, and represented by mere lines on the schematic. How parts and connections form circuits, how circuits and wire form stages, and how stages combine with other stages to form the whole receiver. Methods of bringing power to each stage and circuit. How circuits operate normally. How they operate abnormally. What troubles can make them malfunction. How circuit faults affect the picture on the screen, the voltages in the circuits, or the waveforms you see with your scope. How controls and adjustments ordinarily operate, how they are adjusted, what effects they have on other circuits and on each other. And many more. You can learn all these things if you study them as you progress through the steps of wiring the kit.

At each stage of construction, you'll find different factors easy to study. Pore over the schematics, block diagrams, and circuit descriptions for the set. Learn to recognize each part, circuit, stage, and section; this comes naturally as you mount the parts, wire the circuits and stages, and put the sections together. Make sure as you go along that you know exactly what you're doing with what part and to what circuit. You can't imagine how familiar you'll become with the entire set before you're done if you go slowly and think about it.

You'll be working from step-by-step instructions. Don't vary from them even slightly, if you want the set to work well when you finish. However, this doesn't keep you from examining each printed board in detail after you've mounted the parts on it. Learn to trace wiring, locate hard-to-find junctions (which may look simple on the schematic), and pinpoint specific parts. This kind of analysis can aid you immeasurably when the time comes later for you to trace missing voltages and hunt faulty parts.

Tips on Building

You'll need no special tools to build the receiver—just the hand tools and soldering gun you already have in the shop. Work carefully and methodically, and by the book. Avoiding hurry during construction will reward you with a set that works the first time you turn it on. Be especially careful in making your solder joints; they can easily be left too cold, and experience has taught what a pain it is to locate an intermittent rosin joint on a printed board.

Labeling chassis-mounted parts and connection points with a soft-lead pencil is helpful during construction and also during later troubleshooting and study. Be sure you label each correctly, for it is aggravating to wire up half a terminal board and then find it's the wrong one.

You'll first mount resistors, capacitors, and coils on the circuit boards. With resistors, and capacitors, you can save time by putting several in position at once and then soldering. Just push their leads through the correct holes in the board, and bend them slightly to prevent slipping out; after five or ten are in place flip the board over, solder all the leads well, then clip off the excess wire.

Next, you'll assemble controls and parts on the convergence subchassis, and then mount switches, terminal strips, small transformers, controls, etc. on the main chassis. This step is mechanical, but requires care in positioning parts correctly and placing proper screws and grounding lugs where they should be. After this, you'll bolt the printed-circuit boards in place on the main chassis.

Then comes the task of wiring the circuit boards and underchassis components together. A precut and prelaced cable simplifies much of this, and the remainder of wiring is done with lengths of colored hookup wire. As in all the wiring, well soldered joints are one key to saving time and trouble later—keep this in mind as you wire in the few small parts beneath the chassis. The final underchassis job is mounting the UHF and VHF tuners into their respective slots.

Lastly comes assembling the chassis to the picture-tube mountings, installing of the CRT, and mounting the convergence and deflection yokes on the CRT neck along with purity magnets, etc. You've just built a color television set!

Firing Up the Chassis

The instruction manual gives easy instructions for firing up the chassis and checking it out. But, remember, you've done all this work so far with the aim of learning more about color television. You've taken time to study each section carefully as you've built it, so don't rush now. You can add to your knowledge of color more at this point by firing up the set a little at a time and familiarizing yourself with the operation of every little bit of it. Yes, it'll take some time, but when you've finished you'll know this set (and a lot of similar models) like the palm of your hand.

Don't even put the tubes in their sockets, yet. Instead, install the fuses, plug in the power cord, turn on the switch, and use the AC range of your VTVM to check line power, voltage at transformer windings, and heater power at the proper pins of each tube socket. Naturally, you'll be using the schematic with every step.

Next, check the DC power supply. Trace each B+ line with your DC voltmeter. Before you're through, know where they all go. Make sure DC voltage is being applied to the plate and screen of every tube it's supposed to. (Two cautions: All voltages not developed in bleeder systems will be at the same level as their source, since no plate current is flowing. Also, points supplied by boosted B+ won't show boost voltage since it isn't developed until the horizontal sweep circuits are working.)

Since the tube heaters are in parallel, you can fire up some of the chassis section by section, checking

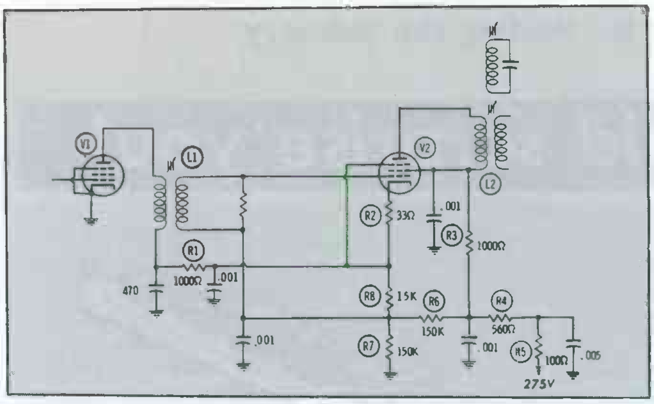

Fig. 2. First video-IF receives B+ from cathode of second.

each for proper operation as you go. Start with audio tubes. Use the audio and modulated portions of your signal generator as a signal injector to check operation. The sound detector, the sound IF, and the sound-and-sync detector are next in the logical order.

With this step-by-step fireup procedure, you learn a lot about layout and circuitry in each stage. Analyze operation. Check voltages at all the tube pins and make notes if they don't agree with those in the manual; these notes may be valuable for later troubleshooting experiments or in case you find a section that doesn't work properly as you fire it up.

You can't fire up all the sections this way. For example, the first and second IF stages are stacked across the B+ line (Fig. 2). If you fire up the IF section as a whole, however, this stacking will concern you only if you have to troubleshoot the section. As you proceed through the entire receiver, checking its operation as you go, you'll find other stages that depend on signals or voltages from other sections.

A valuable aid to you at this point in your "learn-by-building" program is the manual of instructions furnished with the kit. Circuit explanations tell how the entire receiver works. You can learn a lot by reading about each stage and trying to understand it as you go through the fireup steps.

Learning to Troubleshoot

This last is the easiest, but will take the most of your time. Don't try to learn it all at once. Concentrate on a section at a time. Learn exactly how that section operates normally by reading the manual; by using your VTVM to explore voltages, continuities, resistances; by disabling portions to note the effect on voltages, the picture on the screen, or the sound; by reading articles to widen your knowledge of how that section works; by studying schematics of other chassis to see how they resemble or differ from this one and doping out how the same job is done with other circuits; by considering how signals move and where DC voltages exist within the circuits, stages and sections; by verifying those signals and DC voltages with your test instruments; by imagining methods by which you could troubleshoot the section; by tracing circuitry on the schematic as well as in the chassis; by reading troubleshooting articles to see how others troubleshoot that section; by scoping so you'll always recognize normal waveforms. All of these steps can make you the master of this chassis—so familiar with it that others

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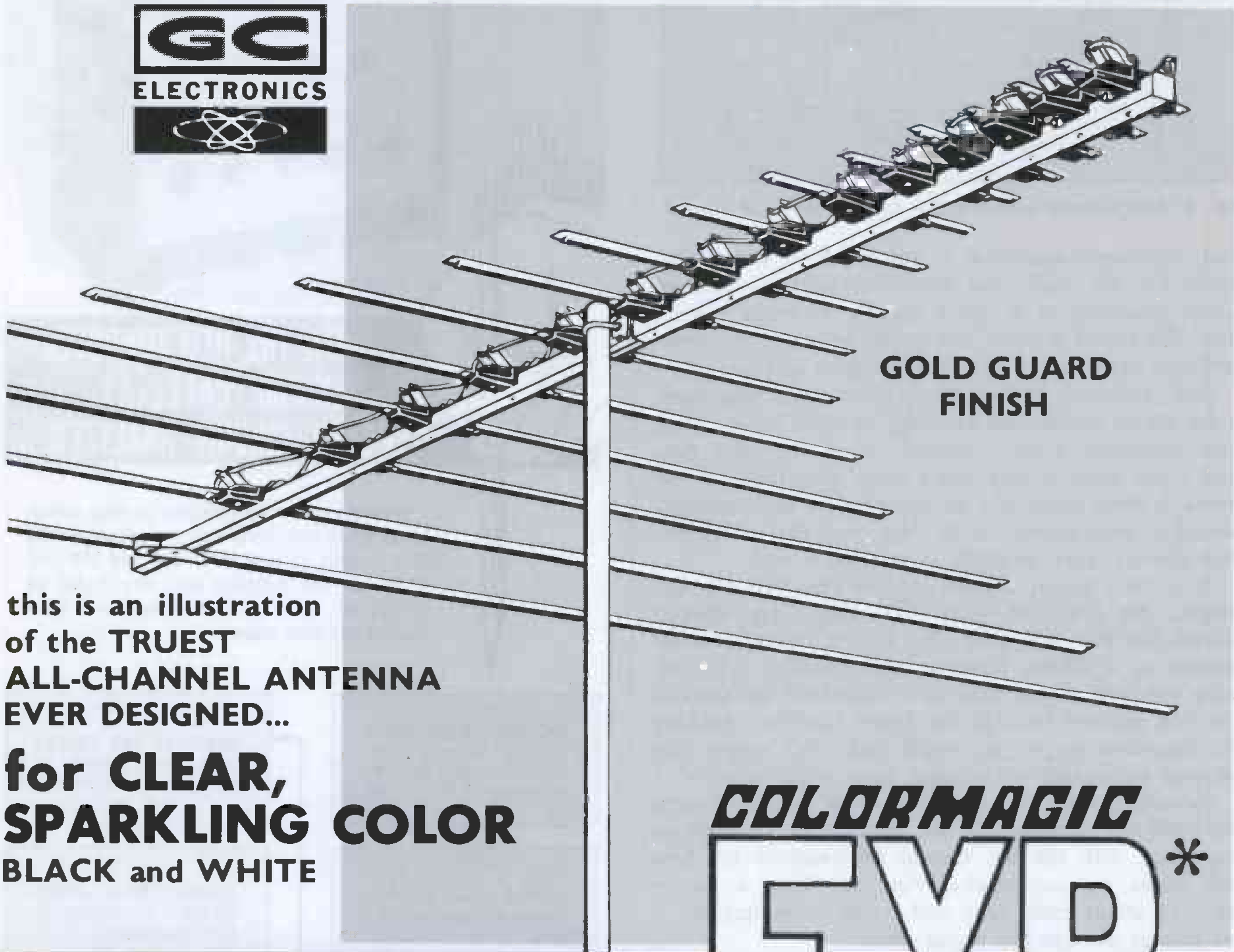

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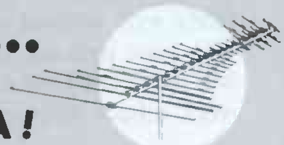
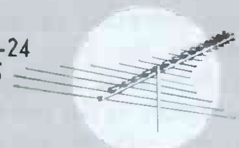
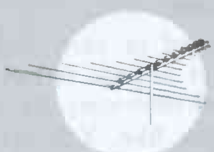


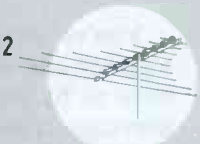
FAR-FRINGE
MODEL NO. CM-24
24 ELEMENTS
VHF - 175 miles
UHF - 75 miles
FM - 190 miles



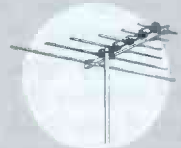
FRINGE AREA
MODEL NO. CM-15
15 ELEMENTS
VHF - 100 miles
UHF - 55 miles
FM - 110 miles



FAR SUBURBAN
MODEL NO. CM-12
12 ELEMENTS
VHF - 80 miles
UHF - 45 miles
FM - 90 miles

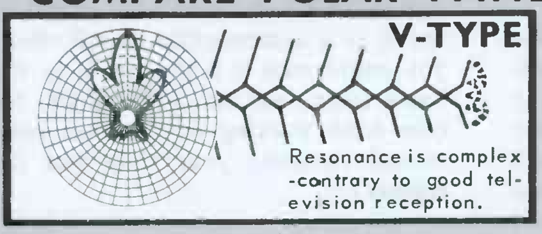


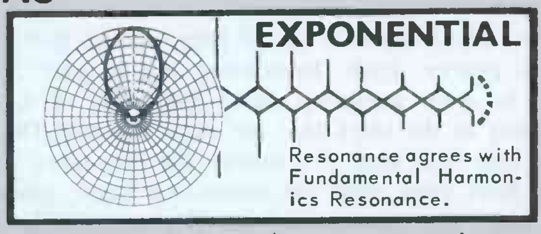
METROPOLITAN
MODEL NO. CM-9
9 ELEMENTS
VHF - 50 miles
UHF - 25 miles
FM - 70 miles



LOCAL AREA
MODEL NO. CM-6
6 ELEMENTS
VHF - 35 miles
UHF - 20 miles
FM - 50 miles

•COMPARE POLAR PATTERNS





V-TYPE: Antennas have polar patterns similar to that shown above. Notice the large side lobes on the polar graph. These lobes indicate distorted reception-the cause of impure color and ghosting.

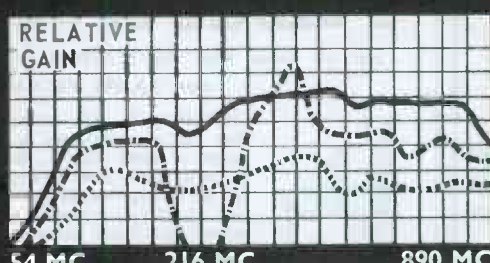
EXP-TYPE: Antennas have even pencil point polar patterns as seen in the typical EXP pattern shown above. This type of polar pattern is indicative of undistorted, high-quality reception.

•COMPARE V.S.W.R. RATIO

A perfect V.S.W.R. is a 1:1 ratio. This, however, exists in theory only. Up to the present, a V.S.W.R. of 1.5:1 was considered exceptional. Now, the EXP antennas have a unique V.S.W.R. of 1.2:1 - a technical advance in antenna design which insures the purest color and the sharpest black and white reception possible today.

•COMPARE GAIN-RESPONSE CURVES

KEY:
——— EXP ALL-CHANNEL
-.-.-. "X" TYPE ALL-CHANNEL
.... "Y" TYPE ALL-CHANNEL



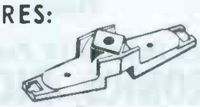
EXP All-Channel Antennas show a consistantly higher performance level on the gain response curve than comparable All-Channel Antenna models. Curves produced by comparable All-Channel antennas indicate a great deal of fluctuation in performance from band to band - usually falling off in one of the reception areas. EXP All-Channel Antennas graph consistantly high on ALL BANDS - showing EXP to be the truest, high-quality ALL CHANNEL Antenna.

COMPACT-RUGGED CONSTRUCTION

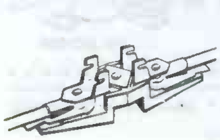
EXP Antennas are compact! The Exponential Curve Design allows elements to be more closely spaced. There's more antenna per square inch! Rugged construction completely protected by Gold-Guard Finish.

GOLD-GUARD FINISH

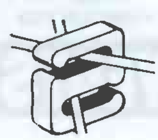
EXP FEATURES:



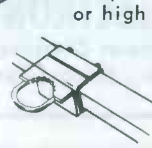
Super high-impact insulators that will not snap in cold weather or high winds.



Bridge type construction with rugged reinforcing sleeves add to element stability & antenna durability.



High impact plastic "S" type phasing bar insulators.



Thick walled, sturdy square boom with heavy-duty, reinforced boom clamp for added strength.

will seem familiar to you because of their similarities.

Finally, go through a complete alignment and convergence. You are a technician, and even if the kit manufacturer doesn't suggest overall alignment, you can use your set to familiarize you with the procedure. As a competent technician, you're already at home with RF and IF alignment procedures; they are the same as those for monochrome sets, only more exacting. Be precise and be careful; make the response curve as nearly ideal as possible. (If you've never learned to align a black-and-white chassis, better start now because alignment is far more important with color than with monochrome—a misaligned color set won't deliver balanced signals to the chroma stages.)

New to you, however, will be alignment of the chroma section. Just follow the steps carefully as outlined in the instruction manual. If you don't get the result you're supposed to, try again. Make it 100% right. Here, no customer will fuss if you miss, but you'll never learn to do it right if you slack off. Do it exactly like it ought to be. Don't stop until the set shows precisely the pitcure it should, in monochrome as well as in color.

And then—throw it out of kilter and go through the whole process again. Remember, this is your "schooling" in color servicing; make the most of it. Keep working at the steps that are hard for you. Do them over and over until you master the procedure so well you don't even need the instruction book. Once you can align your own experimental chassis easily, you'll be surprised how readily you adapt to the few changes that apply to other chassis.

Also new may be the techniques of setting up purity and convergence. Do it over and over until each step is second nature. Try convergence with only station signals—use scenes with little action and with lots of vertical and horizontal lines such as walls, porches, roofs, fences, and the like. Once you learn which portion of the screen and which lines are affected by each convergence control, you'll find you can converge a set fairly well without a bar pattern. But learn to do this with your own set; that way, if you foul it up (and you will more than once before you're an expert), you can work it back to normal without upsetting any customer.

School's Out

You've started with an armload of parts and put together one entire color receiver chassis. It can continue to be your own school and laboratory for color-television training as long as you like. You can use it to teach your technicians, or to check out any pet troubleshooting theories you develop. You might even decide, after you "graduate," to put it in a cabinet and use it as a demonstrator to sell other color sets; or—you might take it home, set it in the corner of your living room, and watch it (if you have any time left over from working on all those color sets that have started crowding your shop and jingling your cash register). ▲

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RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, NEW JERSEY

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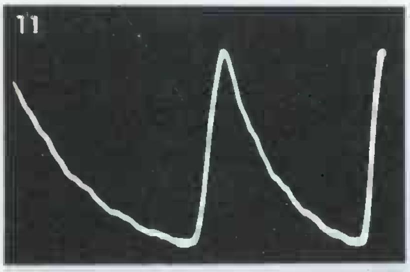
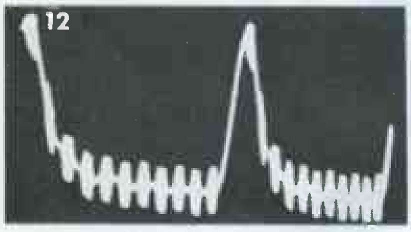
Waveform Analysis

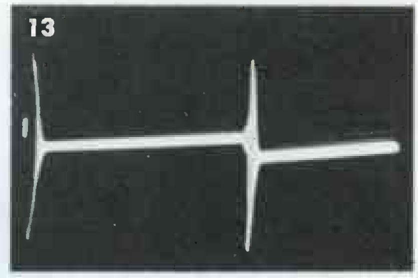
(Continued from page 39)

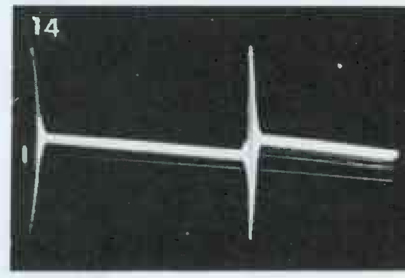




with the video-chroma signal (photo 10), to the grid of the burst amplifier tube.

The result, at that grid, is the combined waveform of photo 12 (LC, 7875, 60V, KR). If you'll examine this waveform carefully, you'll see that the 8-volt video signal is modulated on the sample pulse (which is reduced to 60 volts in a resistive divider). In fact, even more important, note that the 11 bars of color information (counting burst) that are visible in photo 10 are distributed along the trace-line of the pulse of photo 11. At the pulse tip, you can see the first bar, which is the burst portion of a keyed-rainbow signal. Farther down the slope is the first bar of actual color, and the remaining nine bars are spaced out at even intervals along the trace.





Photos 13 and 14 (LC, 7875, 90V, KR) are both phases of the burst signal that is developed in the plate circuit of the burst amplifier. Perhaps you wonder how an input signal like photo 12, with the entire 11 bars of color information, can produce a single burst like that in photo 13. The answer is simple, really: The burst amplifier tube is biased at about 40 volts. When the waveform of photo 12 is above that value, the tube conducts and amplifies whatever is appearing at the grid during that interval — in this case, the burst bar. The other bars, as we have already pointed out, are below the 40-volt point and therefore cannot appear in the output. Result — one burst of chroma-synchronizing information, ready to be applied to the phase detectors. A burst-amplifier transformer with center tap develops the two opposite phases of 90-volt burst in photos 13 and 14, which are shown as they are applied (through 330-pf capacitors) to the chroma-sync phase detector. The same signals are applied to the killer phase detector, also through 330-pf capacitors.

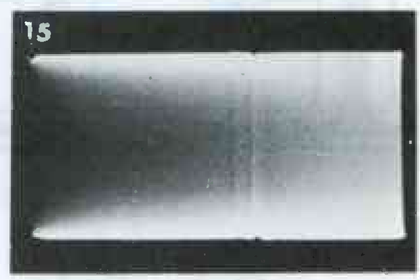


Photo 15 (LC, 7875, 20V, INT) shows the 3.58-mc CW sample signal from the chroma-reference oscillator. The slight blips that appear when the CW signal is synchronized to the 7875-cps scope rate are caused by stray feedthrough of burst pulses; their presence here is totally insignificant. The signal in photo 15 is at the opposite sides of the phase detector from the signals of 13 and 14, having been fed from the chroma-reference oscillator through a 10-pf capacitor. The purpose there of course is to compare phase of the signal burst and the 3.58-mc oscillator signal; if there is any slight variance, the phase detector develops a correction voltage for the oscillator control tube. ▲

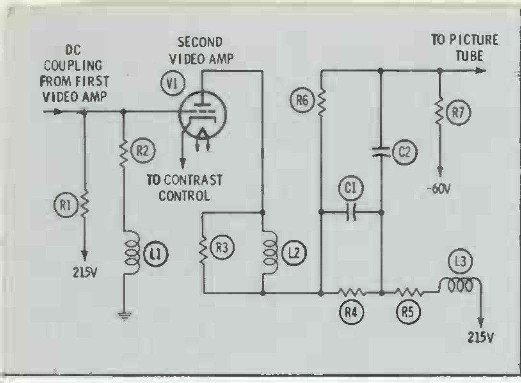


Fig. 2. Old-fashioned video amplifier.

A Dual Improvement

Another old line of chassis, still common because they were produced in great number, includes the RCA KCS 47, 48, 49, 60, and 62. Many of these receivers have two marginal defects: minor bending of vertical lines and critical horizontal sync at contrast settings less than maximum. Slightly increasing the capacitance of cathode bypass C2 (Fig. 3A) to .0047 mfd or .0068 mfd will eliminate these faults. Some designs had the alternate circuit shown in Fig. 3B, but the cure is identical: Add a .0047-mfd or .0068-mfd capacitor across 220-ohm resistor R2. Vertical lines are straightened by this modification, with no detrimental effects on picture resolution. Viewing a test pattern will aid in determining the exact capacitance; if C2 is increased too much, a low-frequency phase shift takes place, and black areas in the picture are trailed by intense whites.

Perhaps you wonder how a modification like this is developed. In

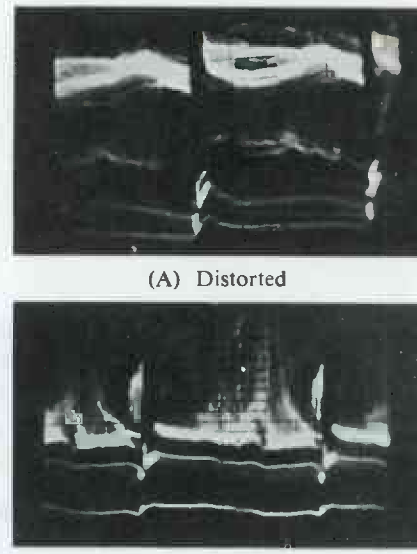
Improving TV

(Continued from page 50)

this case, we noted with a scope that the signal at the first video amplifier grid was excellent, with a peak-to-peak amplitude of about 5 volts. At the plate of the first stage and the grid of the second, the signal still looked good, and was about 20 volts peak to peak. The output of the second stage was about 80 volts, but the waveform had the sync compression and distortion you see in Fig. 4A. Obviously, the second stage was causing the problem, so every component was checked and eventually replaced, but without result. Finally, a .01-mfd capacitor was shunted across the cathode resistor of this stage, and the scope displayed the improved waveform in Fig. 4B; the picture also lost the bends. Early next morning, when a station test pattern was broadcast, the excessive phase shift (trailing whites) was noted, but reducing the value of capacitance took care of that.

An Improvement By Accident

While the scope has been instrumental in developing most of these modifications, one exceptional case began late one Saturday afternoon when a customer brought in his Philco Model TV-330. The complaint: poor sync, vertical hold touchy, and horizontal twisting. Two quick scope checks revealed a good signal at the separator input but a badly contaminated output



(A) Distorted

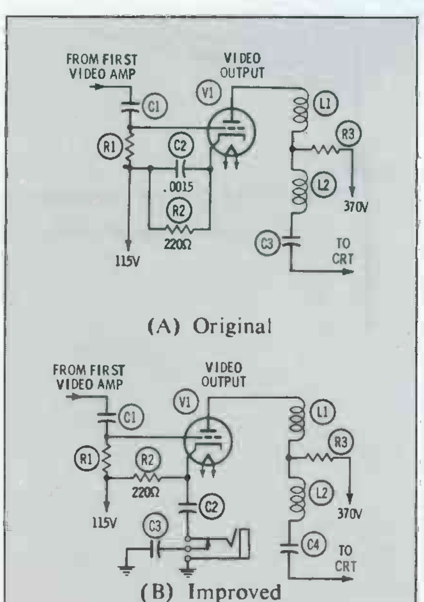
(B) Cleaned up

Fig. 4. Changes in video waveforms.

sync signal.

Elementary, my dear Watson; replace the sync separator tube! Not so easy, since we didn't have a 12BR7 in stock. The customer was anxious to have the set for the Sunday doubleheader, so I studied the circuit to see if something could be improvised. The pin arrangement of the triode in the 12BR7 was similar to that of one section of most double triodes (12AU7, etc.). So a 12AU7 was installed, with the thought that we could tack in a diode for horizontal AFC. Surprise! The horizontal locked in beautifully with the 12AU7.

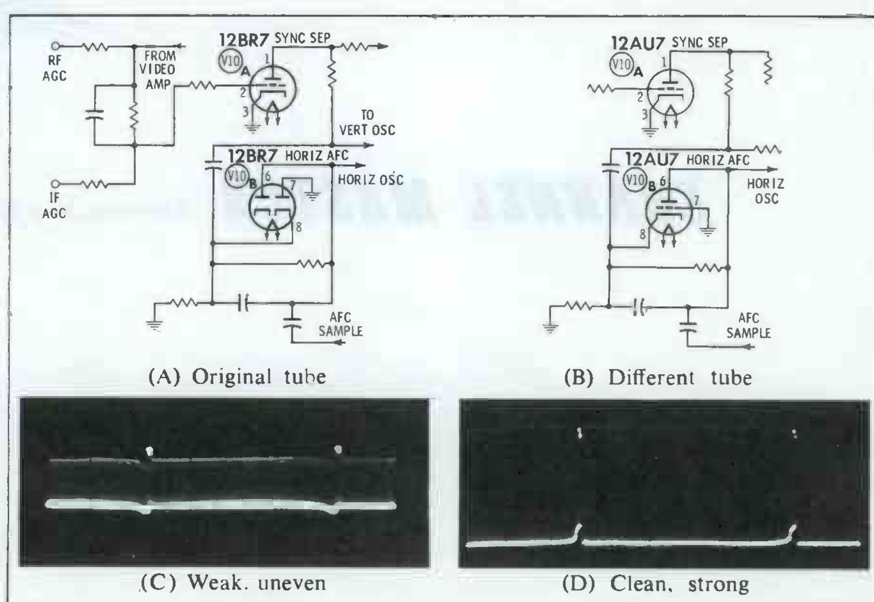
It was agreed the customer would bring back the 12AU7 the following week and exchange it for a 12BR7 I would pick up, but he



(A) Original

(B) Improved

Fig. 3. Modification improves contrast.



(A) Original tube

(B) Different tube

(C) Weak, uneven

(D) Clean, strong

Fig. 5. Circuits and waveforms show improvement brought on by tube change.

never stopped in. About three weeks later, I encountered him and reminded him about the tubes. His response was a question, "Will the tube that's in it hurt the set or will the set hurt the tube?" When he was told it wouldn't, he said, "The lines were never that straight before, nor has the picture ever held so well as it is with that tube. So let's forget about changing it."

About a month later, a similar Philco was in the shop, also using a 12BR7. After it was repaired, I decided to check its sync operation with a 12AU7. It definitely worked better. Next, the scope was used to help find out *why*. The circuits of the separator and AFC are shown in Fig. 5. The sync signal at the 12BR7 plate is clean (Fig. 5C), but with slightly ragged tips. With the 12AU7 in the socket, the signal has almost twice the amplitude and a decidedly crisp sync-tip level (Fig. 5D). The sync signal in Fig. 5D is almost equal to the clipped-tip sync obtained from 'BU8-type separators.

There's another oddity here: A tube manual reveals that the 12BR7 triode section is very similar to a 12AT7 triode in its characteristics, quite different from a 12AU7. It's strange, but a 12AT7 will not work as a substitute; only a 12AU7 will do.

Oh! Those Vertical Jitters

One of the most disagreeable complaints in all makes and vintages of receivers is vertical jitter. There is a wide variety of jitters. Sometimes they occur only during color reception. Often the condition is just severe enough to be eye-tiring, while at other times it is so bad it can't be tolerated.

Causes are equally diverse. Many times the trouble stems from a filter capacitor that allows an otherwise trivial amount of unwanted coupling between stages, even though the filter would seem quite isolated from the trouble. In some instances, intermittent jitters can be traced to 60-cps power-line energy entering the vertical sync section, from either filament wiring or B+-winding leads. Jitters can be found in sets where no defect can be detected; you could replace the entire video, sync, and vertical-oscillator sections

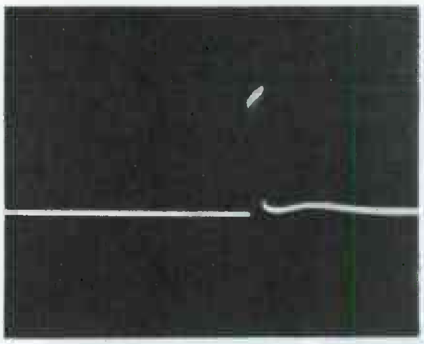


Fig. 6. Expanded vertical sync pulse.

without obtaining the slightest improvement.

Your scope will invariably be helpful in tracing the cause of vertical jitter. If the output sync signal is scoped at 60 cps (showing one cycle) and expanded, the individual pulses that form the vertical sync signal should be visible as in Fig. 6 (the vertical oscillator might have to be disabled). Sometimes the slant across the top of the equalizing pulses is to the right and occasionally there is no slant. The thing to look for is jittering at the leading edge of the group, which indicates the presence of unwanted signals. When the vertical-sync pulse group looks like Fig. 5, signal stages prior to the sync output are vindicated. This leaves the possibility of a defect in the vertical oscillator or deflection stages. Here again, however, many technicians have discovered that every component can sometimes be replaced without finding a satisfactory cure.

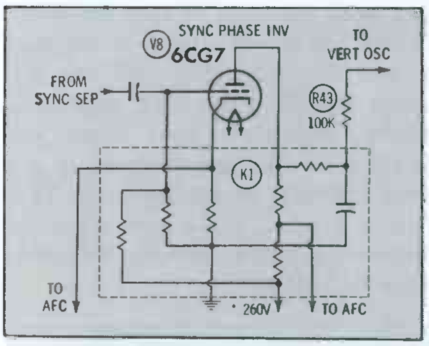


Fig. 7. Reducing series resistor here helps overcome a tendency to jitter.

In one Series-30 Magnavox chassis, vertical jitters can be cured by changing R43 from 100K (Fig. 7) to 50K. This discovery suggested a defective printed circuit K1, but replacing this unit was a waste of time, for only by reducing the value of R43 could acceptable vertical stability be achieved.

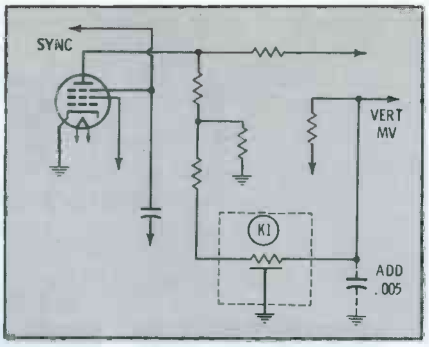
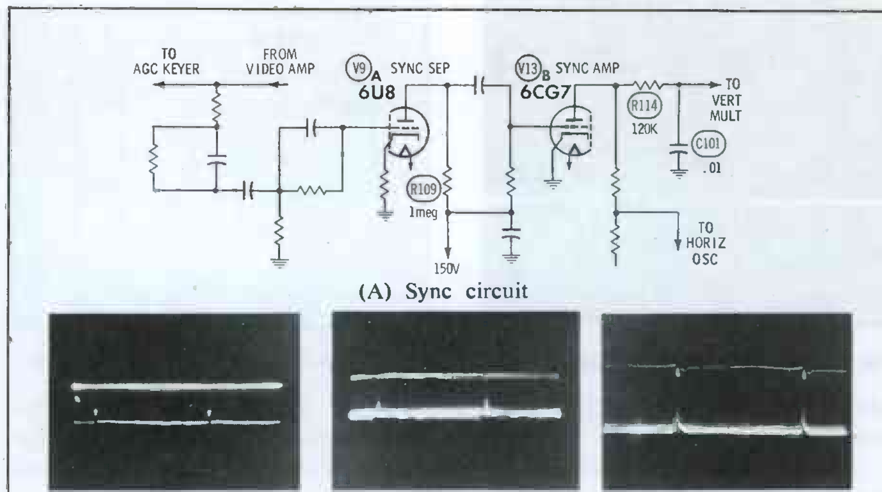


Fig. 8. Modification improves stability.

Many different Zenith models have been found to have either outright vertical jitters, an intermittent bar wandering through the picture, or extremely touchy vertical lock. Every one of these models uses a single-tube sync circuit, combining a 'BN6, 'BE6, 'CS6, or 'BU8 tube with a printed integrator unit. We'll use the 17A20 chassis as a specimen case.

Several years ago, we found that vertical lock-in could be improved considerably by shunting the printed circuit integrator (Fig. 8) with a 100K resistor connected from in-



(A) Sync circuit

(B) Weak sync (C) Weak, ragged (D) Strong, even

Fig. 9. Modifications in this color-set stage eliminate recurrent sync fault.

put to output. Later, it was found that a .01-mfd capacitor had the same effect as the 100K resistor. Subsequently, using scoped signals at the integrator output as a guide, we found that adding a .005-mfd capacitor across the output of K1 seemed to produce the best integrated sync signal. Noting the effects on the picture, we also found the last modification to produce the best "snap" in vertical sync action.

Touchy Vertical In Color

The RCA CTC4 and CTC5 color chassis have been cited for their touchy vertical sync, occasionally extending to outright vertical jitters. Sets worked on by "factory" technicians have R114 (Fig. 9A) shunted by a second 120K resistor and C101 replaced by a .005-mfd capacitor. The improvement thus obtained is minimal, so we decided to see if any additional improvement could be made.

First, we noted the low sync level (15 volts peak to peak— Fig. 9B) at the separator output; the shape and amplitude of this signal were compared with the signal in black-and-white models using the same tube type. In most cases, they provide a higher-amplitude sync signal. This was attributed at first to differences in input networks, but duplicating the monochrome circuit in the color chassis didn't help.

Next, resistor R109 was connected to a higher B+ voltage. This increased the sync signal to 30 volts peak to peak. Then we discovered that better results could be had by reducing R109 to 270K or 330K. With this last modification, the output from the plate of sync amplifier V13A increased from a ragged-tipped 40 volts (Fig. 9C) to the clean Fig. 9C trace with amplitude slightly above 55 volts. Most important was the improvement in actual stability of the picture. This last is natural; if the sync signal is improved, picture locking will likewise be better.

More For CTC5

Poor regulation of sweep and high voltage in the RCA CTC5 color receiver is seldom correctable by either adjustments or component replacement. The trouble can, however, be minimized by some minor circuit changes. When the brightness and contrast controls are advanced, 12BY7 video amplifier V8 draws considerable current. lowering the voltage on its plate and thus also lowering bias on the three picture-tube guns. If bias is reduced too far, picture-tube beam-current exceeds high-voltage and sweep-circuit limits. Poor regulation results in the picture shrinking horizontally and going out of focus whenever contrast or brightness controls are set a little high.

The cure is simple: Change the contrast-control circuit from a variable-bias circuit to a variable-degeneration circuit. The original circuit is shown in Fig. 10A, the revision in Fig. 10B. Remove and discard C66, C70, C71, and R72. Install a 390-pf capacitor in place of C70. Remove the wire that connects the cathode of V8 to the arm of the contrast control. Wire the 3900-pf and 68-ohm combination from V8 cathode to the contrast control terminal where C71 and R72 were previously connected. From this same terminal, connect a 1000-ohm, ½-watt resistor to ground. Ground the other end of the contrast control, and add a 50-mfd, 50-volt electrolytic from the arm of the contrast control to ground.

With this revision, picture-tube bias is not affected by the contrast control setting; the picture tube screen controls can thus be safely advanced a bit to afford better color saturation and white tracking. The new value of C70 improves picture crispness. The entire modification takes about 20 minutes.

Conclusion

Don't get the notion that altering circuits is the way to fix every tough dog you run into. You can do only harm by changing component values to mask defects in either that circuit or somewhere else. You would also be just begging for a callback, because the defect would likely develop further until the change could no longer cover it up.

To play it safe, changes on sets less than three years old should be limited to those suggested in bulletins from the manufacturer. On older sets, then, get out your scope and be very sure of the exact location of a problem before you start revising circuits or altering parts values.

Judicious modifications in older sets, if adequately researched and thought out, and then carefully tried and checked for possible side effects, can make you popular with the owners of those sets. Be sure you charge for your time in making these modifications; they're worth it in added viewing enjoyment. ▲

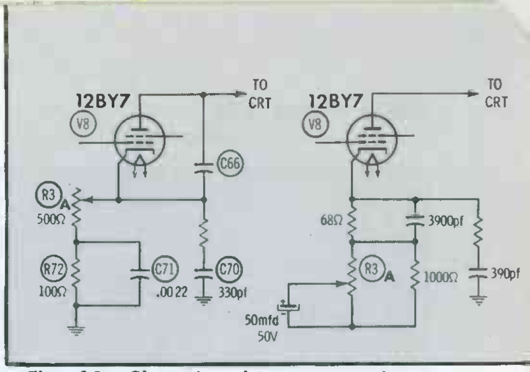


Fig. 10. Changing bias-operated contrast circuit to a variable-degeneration.

Color Tuner AFC

(Continued from page 37)

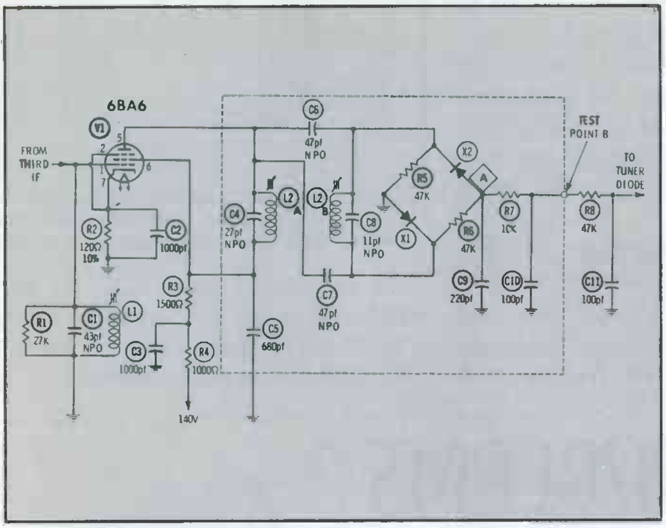


Fig. 7. Schematic of AFC section shows bridge discriminator.

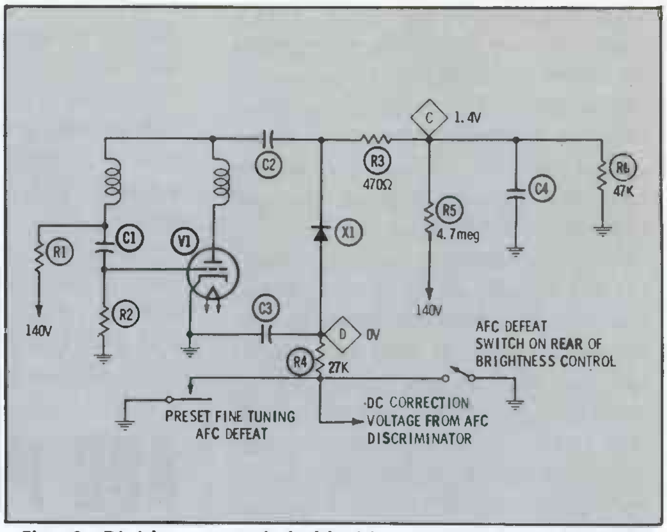


Fig. 8. Divider network holds bias potential on diode X1.

that affect its oscillator, either of these (UHF or VHF) tuners could have a bad diode X1 (Fig. 8) or a faulty resistor.

Voltage tests at points C and D will provide clues to the trouble source if it's caused by one of the extra AFC components. If point C measures greater than 1.4 volts, C2 has become leaky, R6 has increased in value, or R5 has decreased. If the voltage at C is low, X1 is leaky, C1 has developed leakage, or R5 has raised greatly in value; be sure the source voltage is at its full 140 volts.

The voltage (or lack of it) at point D is a significant clue. If there is any voltage there, with the defeat switch closed, it must be coming from a leaky X1. If the voltage at C was normal, only the very slightest trace of voltage should appear at D; a VTVM might reveal a tiny amount, but it should cause barely a needle-flicker. If the voltage at D were to reach more than 1.4 volts, suspect that C2 has shorted or developed leakage—but point C would also have a high voltage reading. If C2 shorts, replace diode X1 automatically as extra insurance against a callback.

AFC Discriminator

Leave the defeat switch closed, and with a low-range DC VTVM measure the voltage at test-point B (Fig. 7), while turning the fine-tuning control back and forth through its range. The voltage there should vary from positive through negative. If it registers in only one direction, the bridge is unbalanced either by faulty alignment or by a defective component in the bridge.

If there is no voltage at all at point B, move the VTVM probe to point A and again go through the preceding step. It's possible for R7 or R8 to open, or for C10 or C11 to short—although neither is very likely, because the voltages here are quite low.

It's best to check the diodes by unsoldering one end of each and measuring forward and backward resitance with an ohmmeter, in the usual manner for diodes. One important factor here, however, is that the two diodes should be very closely matched, especially in the forward (low-resistance) direction.

While the diodes are loose, check the two 47K resistors; they should match exactly. They can be checked with the diodes in place, too, if there's any reason. Merely connect the ohmmeter between point A and ground, then reverse the leads. Both readings will be exactly the same if (a) the resistors match and (b) the diodes are okay.

Amplifier

Checking the 6BA6 tube stage is no different from troubleshooting any other IF amplifier, for that's essentially what this stage is. Going through the alignment procedures stipulated by the manufacturer will usually reveal if this stage is at fault.

Conclusion

So far, only Magnavox has put this system to use. But its simplicity suggests that others will follow. The critical tuning of UHF tuners, especially for color programs, makes an AFC system quite desirable — particularly in UHF tuners that convert directly to the IF of the receiver instead of through a VHF channel. ▲

Overall Alignment

(Continued from page 48)

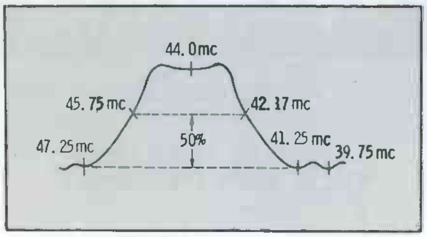


Fig. 3. Overall IF response curve.

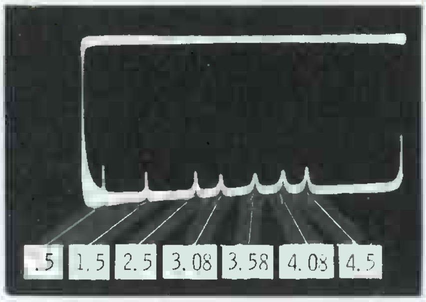


Fig. 4. Pips are represented on curve.

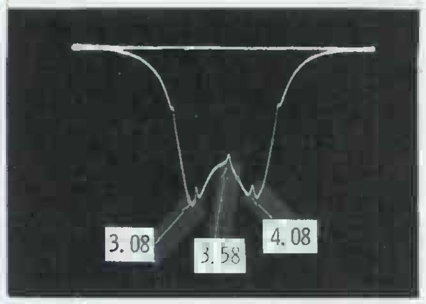


Fig. 6. Desired frequency response.

the signal is applied to the mixer control grid. A VTVM connected across the video-detector output is used as an indicator. Each IF transformer is peaked at a predetermined input frequency. Next, output from a sweep generator is added to the mixer control grid. (The RF signal generator is used for a marker generator.) A scope replaces the VTVM at the video detector. Each IF transformer is touched up to obtain an overall response curve similar to the one shown in Fig. 3.

In the second procedure the sweep and marker generators are first connected to the grid of the last video-IF tube. The last video IF transformer is adjusted so that its response corresponds to the curve shown in the alignment instructions for this step. Next, the output of the generators is coupled to the grid of the first video-IF tube. The transformers (usually two) between this stage and the last video-IF tube are adjusted to produce proper response curves for each step. The generator output cable is then shifted to the mixer-grid injection point on the tuner, and the first video-IF transformer and the mixer plate coil are adjusted to arrive at approximately the overall response of the complete IF strip. As the final step, all the IF transformers previously adjusted will need a slight touch-up to produce an overall response curve similar to the one shown in Fig. 3.

In both procedures, the traps (39.75-mc, 41.25-mc, and 45.75-mc) may be adjusted for minimum deflection using a VTVM as an indicator. Or, they may be checked when the scope is used to observe the overall IF response curve; touch-up adjustments may be made so that the appropriate trap notches are produced.

Video-Stage Alignment

Since a portion of the video signal goes to the chroma-bandpas amplifier, the detector-load and video-amplifier circuits cannot be ignored during color alignment. The RF/IF and chroma-bandpass stages could be aligned perfectly, but if the circuitry between the two is neglected, chances are there will be poor color reproduction on the CRT. A *video-sweep-modulated* (VSM) alignment should be applied to this portion of the receiver.

The VSM alignment is accomplished by amplitude-modulating an RF carrier with a video sweep signal approximately 3 mc wide and centered at 3.5 mc. The required signal is usually produced with an RF generator, a video sweep generator, and RF modulator, and a means of inserting accurate frequency markers. The sweep generator must be capable of sweeping the frequency range from .05 to 5 mc. Frequency markers are needed at 3.08, 3.58, and 4.08 mc. A typical marker-insertion unit has an absorption-type circuit which consists of seven traps tuned to .5, 1.5, 2.5, 3.08, 3.58, 4.08, and 4.5 mc. When the unit is connected to the output of the sweep generator, the traps produce seven reference marker pips on the response curve (see Fig. 4). Each coil has a lead connected to a small terminal on the outside of the case. Touching any particular terminal with a finger shorts the associated coil, and the corresponding marker disappears from the response curve. The unit also contains a switch; in the "off" position, this switch shorts all the coils, and all markers are removed from the curve.

If such a marker-insertion unit is not available, a crystal-controlled signal generator may be used; the desired frequency from the generator may be injected to a floating tube shield placed over the chroma-bandpass amplifier tube.

Before the test, all the equipment

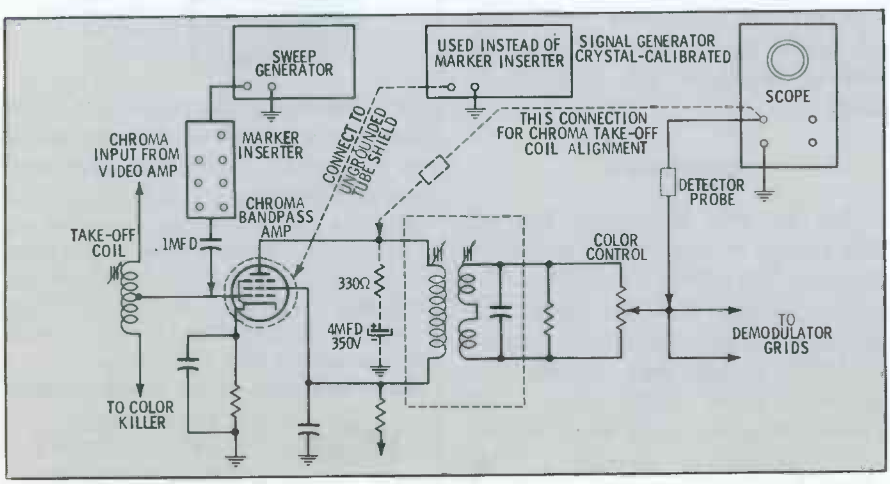


Fig. 5. Necessary test-equipment connections in chroma-bandpass circuit.

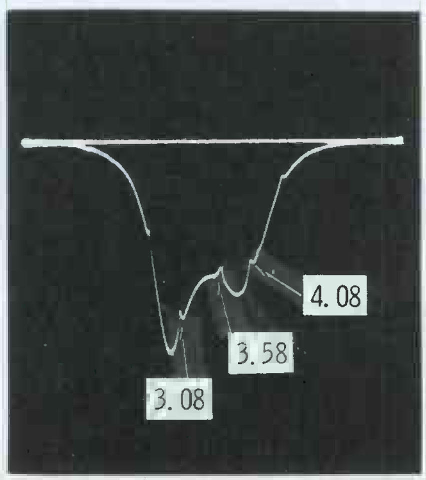


Fig. 7. High end of curve is attenuated.

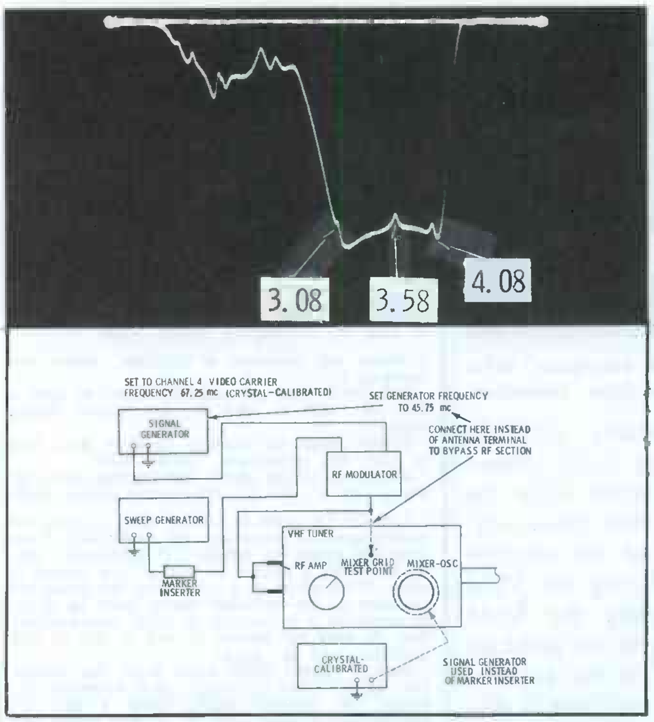


Fig. 8. Setup for video-sweep modulated (VSM) alignment.

must be bonded together as explained previously. The exact procedure to be followed is given in the alignment instructions for the set concerned.

Chroma-Bandpass Transformer Adjustment

Fig. 5 shows a typical chroma-bandpass circuit with the equipment properly set up to align the transformer. The output of the sweep generator is connected to the input of the marker unit, and its output is fed through a .1-mfd capacitor to the chroma-bandpass amplifier grid. The scope is coupled to the color-demodulator grids through a conventional demodulator probe unless the alignment instructions specify a different type. With the sweep generator set to produce a 3.5-mc center frequency and a 3- to 5-mc sweep width, alternately adjust the primary and secondary slugs of the bandpass-amplifier transformer to obtain a response curve similar to the one shown in Fig. 6. The 3.08- and 4.08-mc markers must appear at the same level on the peaks of the waveform; then, the 3.58-mc pip will be at the center of the sag. The curve in Fig. 7 shows the result of misaligning the transformer primary.

An extra 3.58-mc marker will appear on the response curve. This pip is due to radiation from the 3.58-mc reference oscillator in the receiver. If the marker is annoying, the oscillator tube may be removed; however, it affords a good check on the marker equipment being used, since both 3.58-mc pips should be at the same point on the curve.

Chroma Input Adjusted by VSM

The next step is to move to the tuner for signal injection and to use the VSM alignment procedure. Fig. 8 shows the equipment required and the proper connections. The tuner is set to the channel for which the RF modulator is set (usually 3, 4, or 5), and the sweep generator is adjusted in the same manner as it was for the previous step. Sweep-generator output is connected to the input of the marker unit, and the

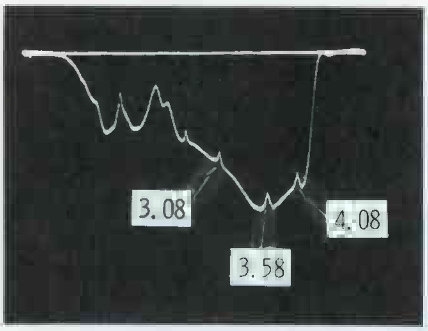


Fig. 9. Video markers should be of nearly equal height on response curve.

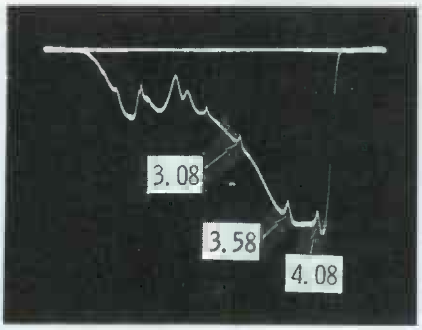


Fig. 10. Misadjusted bandpass take-off coil causes this type distortion.

marker output is then coupled to the video-sweep input of the RF modulator. (If a marker unit is not available, the required frequencies from a crystal-calibrated RF signal generator may be coupled to a floating tube shield over the mixer-oscillator tube on the tuner.) The signal generator provides a crystal-controlled input at the picture-carrier frequency for the RF input of the modulator. The modulator output is connected to the antenna terminals.

The fine-tuning control on the tuner must be adjusted so that the RF oscillator operates precisely 45.75 mc above the input picture carrier; this is important since the IF was aligned to this frequency.

The RF section of the receiver may be bypassed during the VSM alignment by coupling the VSM signal to the mixer-grid test point on the tuner instead of to the antenna terminals. The RF oscillator is disabled, and the carrier frequency is changed to 45.75 mc. This frequency must be accurate and should be obtained from a crystal-calibrated generator.

The oscilloscope is connected through a demodulator probe to the chroma-bandpass amplifier plate. If a special detector probe is not specified in the alignment instructions, the probe normally used with the scope may be employed. Connect the bandpass - amplifier plate to ground through a 330-ohm resistor in series with a 4-mfd, 350-volt electrolytic capacitor. (This will detune the plate circuit.) Tune the sweep generator to display a pattern on the scope, and adjust the chroma take-off coil in the grid circuit to place the 3.08- and 4.08-mc markers as near equal heights on the curve as possible (Fig. 9). Fig. 10 shows a waveform obtained with the takeoff coil slightly misadjusted to favor the high-frequency side of the response curve.

Place the scope probe on the grid of the color demodulators, and touch up the secondary of the bandpass-amplifier transformer to flatten the top of the response curve until it resembles the one shown in Fig. 8.

Conclusion

In the last two steps, the signals were fed through the entire video path. The color information that appears at the tuner antenna terminals will now reach the color-demodulator grids as it should. ▲

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B. Paid Circulation		
1. Sales through dealers and carriers, street vendors and counter sales	13,247	12.445
2. Mail Subscriptions	66,456	67,214
C. Total Paid Circulation	79,703	79,659
D. Free Distribution (including samples) by Mail, Carrier or other Means	3,828	3,931
E. Total Distribution (Sum of C and D	83,531	83,590
F. Office use, Left-over, Unaccounted, Spoiled After Printing	2,097	3,327
G. Total (Sum of E & F—should equal net press run shown in A)	85,628	86,917

I certify that the statements made by me above are correct and complete.

(Signature of editor, publisher, business manager, or owner)
FOREST H. BELT, Editor

Color Cures

(Continued from page 41)

Another trouble along this same line occurs in an RCA CTC16 chassis. The set goes out of focus

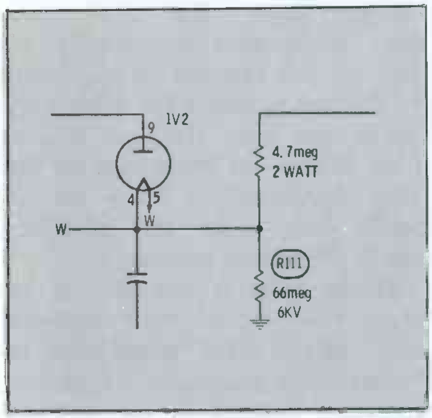
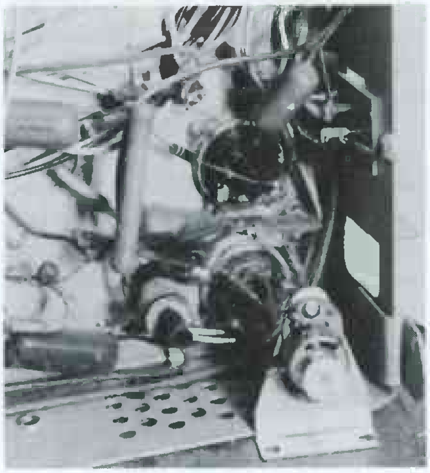


Fig. 3. Special resistor changes value.

every four or five days. At first the 1V2 was replaced; but the customer called again in four days. Again a new 1V2 was put in, and focus was restored. This time, the old tube was plugged back in, and it too was okay, so the tube obviously wasn't causing the trouble. The chassis was brought into the shop, where it was found that the 66-megohm resistor from pin 4 (cathode) to ground (Fig. 3) was changing value. This special-type 6-kv resistor was replaced, and the set hasn't changed focus since.



Focus control arcs, burns internally.

Many focus controls in CTC7 chassis have arced and burned inside. To prevent burning out the replacement control, insert a 56K resistor between the center arm and the plate cap of the 1V2.

Arcing and intermittent sizzling can usually be traced to the high-voltage stage. High-voltage cable has often been found arcing-through. Sometimes, a check inside the HV cage with the shop darkened will help pinpoint corona or arcing.

Horizontal Sweep and Sync

In the RCA CTC7 chassis, the horizontal sync is affected greatly by a 270K resistor at the grid of the horizontal oscillator. It increases in resistance, changing the bias voltage.

Horizontal sync in Admiral T1000 models is extremely critical. Try several 6BU8 tubes and leave in the one that works the best. The tube may check okay but just will not operate in a color receiver.

A Zenith 29JC20 color set had narrow width. The damper, horizontal oscillator, and horizontal output tube were replaced. Replacing the output tube helped a little, but width was still poor. After some checking, a partially open screen-bypass capacitor was found guilty. (Be sure to replace the cage over the high voltage section after replacing the capacitor; we have found two sets in which the service-

Circle 82 on literature card

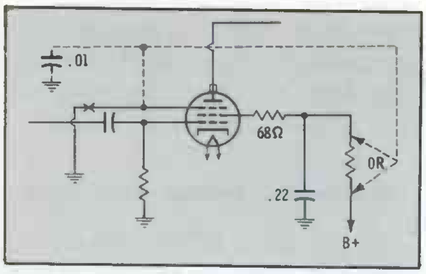


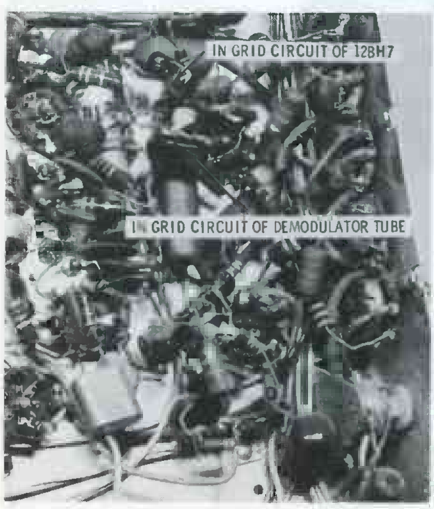
Fig. 4. Change connection of suppressor to eliminate Barkhausen lines.

man left the cage lying alongside the chassis. This is one way to lose a good TV customer — by death or by lawsuit.)

Since TV manufacturers are including UHF, Barkhausen oscillations again are showing up on TV screens (these annoying lines were common in early days of VHF TV). Change the horizontal output tube until you find one that doesn't develop these parasitic oscillations on your UHF station. If the Barkhausen effect is still there, change the suppressor-grid connection from ground to a B+ voltage, as shown in Fig. 4. Be sure to add the extra bypass at the suppressor grid.

Chroma Section

One RCA CTC7 chassis had a completely green screen, while another chassis showed a combination of magenta and cyan. Both of these troubles led to the .01-mfd coupling capacitor in the demodulator stages. This capacitor shorts or becomes leaky, causing the 12AU7 tubes to draw more current than normal. The heavy current burns the cathode resistor and also the plate-load resistor of the 12AZ7.



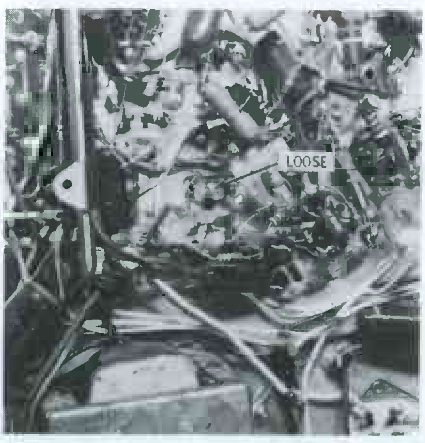
Two bothersome coupling capacitors.

Another quite similar case was found in a General Electric M940WMD. Green was missing entirely from the picture, and brightness was low. The trouble wasn't a capacitor, but the resistor common to the two demodulator tubes; the 560-ohm unit was burned badly.

Poor color in an Admiral 25VE6 chassis was traced to two neon bulbs which act as pulse regulators. Excessive brightness in the neons was the clue. Not only can these two neons cause poor color but they can also cause narrow width, low brightness, or poor focus. These neon lamps are also found in the RCA CTC10 and CTC11.

Miscellaneous

A change of resistance in the grid of a killer circuit can cause poor or no color. A defective burst-phase transformer results in weak color in RCA CTC7A chassis. Poor pictures on both color and black-and-white can result from a faulty



Loose connection on burst transformer.

picture tube; the CRT guns may not all grow weak at once.

Be sure the color killer is set correctly — just below the point where the color snow is produced on the TV screen. In extreme fringe areas, the color killer control may have to be set wide open. If this results in color snow on the black-and-white picture, the color control may have to be turned down for noncolor programs.

Most TV owners turn the color control on the front of the set too high; educate them to set the color knob for pleasant, easy color.

A weak 3.58-mc oscillator tube will result in no color. Substitute tubes in the chroma section rather than testing them, as they may be operating in a critical stage. Be sure all shields are in place on the IF, video, and chroma tubes.

Weak color may be caused by poor alignment of the IF and chroma stages. But don't turn these adjustments haphazardly, as they do not slip out of alignment by themselves unless the set is very old or has been slammed around a bit. If someone has fouled up the color alignment, put the set on the bench and follow the manufacturer's alignment procedure.

If the color is out of lock or phase, first plug in a new oscillator tube. Next, check adjustment of the reactance coil, using a color-bar generator hooked to the antenna terminals. Ground the test point, and adjust the coil until the color bars are almost stationary and in an upright position.

In the Admiral Model LDV2021, run 11, you'll often find a lot of hum when the volume control is turned down. The hum is picked up by the output transformer and speaker leads. This transformer is mounted under the chassis, right next to the degaussing relay. Move the output transformer to the top of the chassis and dress the speaker leads away from the degaussing coil leads. You can prove the cause of this hum by simply pulling the audio output tube from its socket; the hum remains.

The UHF tuner in an RCA chassis was snowy on the higher channels. The crystal diode was defective. Try switching polarity back and forth with the new diode to find which way gives the best picture.

Building Up Experience

This collection has been elementary and varied. The histories include troubles in almost every section of a TV chassis. The cures set forth are those that have been most common. Other cures will impress themselves in your mind as you build a store of experience from your work on color sets. They won't lick the tough dogs — only thorough analysis and intelligent testing can do that. But they'll help you speed up those run-of-the-mill jobs and make them more profitable. ▲

BOOK REVIEW

How To Service UHF TV; Allen Lytel; John F. Rider Publisher, Inc., New York, New York; 136 pages, 6" x 9". softbound; $3.50. Since 1964, all television receivers produced for interstate commerce have been required by Federal law to incorporate tuners capable of receiving all the UHF channels. UHF television is finally becoming important; in fact, today there are more than twice as many UHF stations as VHF stations under construction. In the immediate future, TV servicemen are going to spend an increasing amount of time installing UHF antennas, servicing all-channel tuners, and converting older sets for UHF reception. Although UHF television maintenance employs the same basic principles as VHF, there are new techniques which must be used for rapid and efficient servicing.

Mr. Lytel has written this book specifically for the service technician. Each subject is treated quite thoroughly, and the text moves smoothly from basic theory to service techniques. The first chapter introduces UHF television and discusses its transmission characteristics, conversion techniques for VHF receivers, antenna installation requirements, and servicing problems common only to UHF. Chapter 2 explains transmission-line fundamentals and introduces methods for their use in UHF tuning circuits.

Antenna theory and its applications to UHF television are discussed in the third chapter, and the fourth chapter explains physical construction, circuit theory, and design considerations for UHF converter and tuner circuits. Chapters 5, 6, and 7 cover service hints, alignment techniques, and theory of operation for the most common all-channel tuners, converters, tuner strips, and single-channel converters.

For the service technician who wishes to be really familiar with UHF servicing, this book should prove quite useful for developing a firm background in UHF theory and maintenance techniques. ▲

PFR Puzzler

Hidden Tools

The puzzle below contains the names of 30 tools used frequently by electronic technicians. The names of these tools are scattered throughout the puzzle, some interlocking with another word. They may be discovered by reading left-to-right, right-to-left, up, down, or diagonally.

See how many of these thirty tools you can locate. The answers and a score chart will appear in December PF REPORTER.

A	X	L	G	Q	O	F	T	I	L	J	R	A	Q	F	L	S	O	A	G	C	O	A	B	E	L	C	T
D	B	K	H	L	U	N	A	T	P	Y	R	M	C	H	A	S	S	I	S	P	U	N	C	H	Q	M	B
G	E	C	I	S	M	V	J	O	W	Q	F	H	O	L	Q	E	N	O	M	A	F	D	C	L	P	C	N
J	F	S	P	A	N	N	E	R	W	R	E	N	C	H	W	Ç	H	A	M	M	A	O	L	R	F	C	E
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Y	S	R	E	T	T	U	C	L	A	N	O	G	A	I	D	T	W	S	C	I	S	S	O	R	S	N	D
C	A	I	E	N	L	P	H	E	A	T	S	I	N	K	S	B	I	A	E	O	C	J	U	A	A	N	L
E	T	U	B	W	O	Y	A	B	C	T	P	L	I	E	R	S	R	F	A	R	R	G	U	S	H	L	E
S	V	A	B	X	Y	Z	E	C	I	O	L	A	T	S	E	U	M	T	W	E	E	Z	E	R	S	B	N
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X	A	S	C	R	M	P	L	S	R	I	N	Q	Z	S	M	A	W	Z	F	I	I	E	S	O	M	L	S
C	R	I	R	M	E	L	E	C	T	R	I	C	D	R	I	L	L	M	O	N	D	A	Y	T	O	S	E
D	P	O	E	V	I	S	C	L	Y	R	C	K	O	O	R	H	A	C	K	S	A	W	A	H	T	A	P
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F	C	P	R	O	B	C	I	F	O	V	I	S	E	S	B	E	X	E	R	A	M	E	E	L	A	T	E
B	O	M	I	T	T	B	Z	Z	E	R	C	R	C	O	M	P	S	R	T	I	R	S	O	E	S	T	R
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B	O	L	J	C	T	U	B	P	I	S	R	O	L	A	L	I	G	N	M	E	N	T	T	O	O	L	M
S	O	D	E	T	R	I	M	M	N	H	A	C	K	S	A	U	S	S	H	E	I	L	A	W	E	R	C
C	A	B	F	O	S	E	S	T	K	M	D	A	L	I	D	N	J	A	N	E	S	C	A	R	S	T	U

Product Report

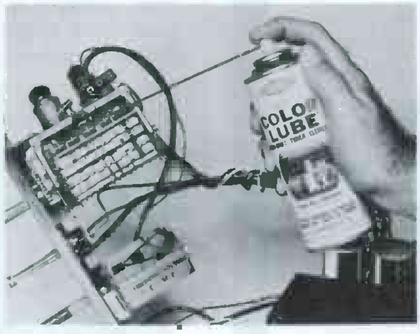
For further information on any of the following items, circle the associated number on the Catalog & Literature Card.

Color Picture Tube Free

(163)

A free 21" color-television test picture tube is being offered with each **RCA** WR-64B Color Bar Generator purchased between now and December 15, 1965. These 21" round 70° color-test tubes have minor mechanical (not electrical) defects but are adequate for testing purposes.

The color generator has a crystal-controlled RF oscillator and separate gun-killer switches. This instrument produces color bars, dots, and a crosshatch pattern. Optional distributor resale price is $189.50 (may be higher in Alaska, Hawaii, and the West).



Tuner Cleaner

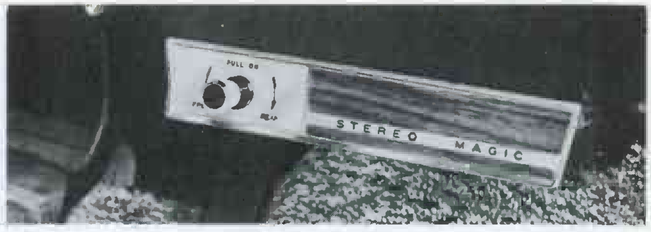
(164)

A new chemical product called "TC-5" is used in "Color Lube" tuner cleaner by **Chemtronics.** This manufacturer of service chemicals has been working with a large midwest distributor, who has used "Color Lube" successfully in set after set to clean and lubricate tuners without introducing frequency drift or detuning.

Rechargeable Battery

(165)

A self-contained full-wave rectifier which allows recharging from any 110-volt output is incorporated within this size-D cell. Made by **En-Power Company**, the all plastic-and-aluminum unit, with sealed nickel-cadmium cell, has a capacity of approximatey a full ampere hour at a 10-hour rate. The "Ready-charge" is intended for use in photoflash equipment, toys, flashlights, cordless clocks, portable radios, etc. An overnight connection to a 110-volt source will restore the battery to full power. The suggested retail price is $4.95.



Automobile Reverb Unit

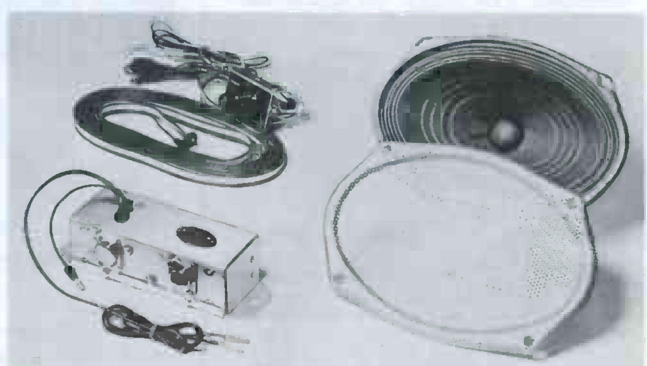
(166)

A new, improved automobile reverberation unit that measures 1⅝" x 9" x 4" may be mounted under the dash instead of in the car's trunk. The "Stereo-Magic," made by **Tenna Corporation,** connects to the car radio and rear-seat speaker. Its faceplate is of bright chrome and brushed aluminum, with walnut wood-grain inset.

A Decorative TV Antenna

(167)

This indoor TV antenna, encased in a ceramic vase. provides UHF as well as VHF reception. Each unit is hand-wired and has a 5½' lead which permits the unit to be placed on the TV set or on any object nearby. The vase enclosure measures 12" high and comes in three colors: white, amber, and aqua. Suggested retail price is $12.95. Other models, 14 in all, made by **Eagle International, Inc.,** include bowl planters, Madonna planters, floral vases, and a simulated tea pot; selling prices range from $14.95 to $24.95.



Reverberation Kit

(168)

The "Babe," an all transistor reverberation kit, is used with negative-ground 12-volt car radios. It reverberates and amplifies incoming sound, which is then fed to a separate speaker. The **Cleveland Electronics, Inc.** "Cletron 300" Series. has 4 watts output with a quiescent current drain of 250 ma. The unit measures 2" x 6" x 2½" and includes a fader control. Two kits are available: Model RU-304 does not include speaker or grille; Model RU-301 does.

new SAMS BOOKS

Color-TV Servicing Guide

by Robert G. Middleton. This great new book on color-TV troubleshooting follows the same picture-tube-and-trouble-symptom format made famous in the best-selling *TV Servicing Guide,* now used by more than 100,000 servicemen. Shows how to apply fast troubleshooting procedures, based on an analysis of trouble symptoms. Includes many full-color picture tube photos illustrating various operating troubles, accompanied by clear, concise explanations of probable causes and diagnosing procedures. Takes you through each section of the color-TV receiver, describing the symptoms for various types of troubles. A final chapter explains in detail how to test and service color-bar generators. If you service color-TV, this book is a gold-mine of help. 112 pages. 8½ x 11". Order **SGC-1**, *only* $3.95

OTHER SAMS COLOR-TV SERVICING BOOKS

Color TV Training Manual (new 2nd Edition), by Oliphant & Ray. Order **TVC-2**, *only* $5.95

Color TV Servicing Made Easy, by Wayne Lemons and Carl Babcoke. Order **CSL-1**, *only* $2.95

Know Your Color-TV Test Equipment, by Robert G. Middleton. Order **KOC-1**, *only* $2.50

Inventors Idea Book

by L. George Lawrence. Have you ever thought of inventing a laser defense against nuclear warheads, or a thawing device for water hydrants? These are just two of hundreds of ideas awaiting the attention of an inspired inventor. If you are an experimenter, technician, engineer, or student with imagination and initiative, this new book is for you. Contains more than 175 suggestions about specific needs of industry and technology; provides possible approaches toward their solution. Encompasses such varied areas as safety appliances for the home, devices for communications, metereology, aeronautics, transportation, medicine, and the conquest of space. This challenging book not only points up the vital need for original invention, but also stimulates creative thinking. 128 pages; 5½ x 8½". Order **IBL-1**, *only* $1.95

Know Your Square-Wave and Pulse Generators

by Robert G. Middleton. Square-wave and pulse generators are very useful in component testing, and for making amplifier performance checks with an oscilloscope. This book, another in the practical "know your test equipment" series, offers comprehensive information on the operating principles and applications of square-wave and pulse generators and tells how to determine their performance quality in terms of their rise (and fall) time. Begins with basic principles and proceeds to a step-by-step analysis of both service and laboratory-type generators. Mathematics is used only when absolutely necessary. This book provides technicians and technical institute and engineering students with a sound foundation for further study. 144 pages, 5½ x 8½". Order **KOP-1**, *only* $2.50

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by James Kyle. The only complete book available on etched-circuit construction for experimenters, hobbyists, and students. Unique, easy-to-use negatives are included right in the book; just clip them out and follow the simple instructions. You can build 30 fascinating projects; each is explained so that you gain a fuller understanding of the principles involved. One chapter also tells you how to design and photo-etch your own projects; a list of suppliers of materials required for photo-etching is included. The only book of its kind, packed with building fun and valuable instruction. 144 pages; 5½ x 8½". Order **TCK-1**, *only* $2.95

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NOVEMBER, 1965

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No. 42 of a series

Ray Love says, "We know we can always depend on Winegard Colortrons and Color-'Ceptors to overcome reception problems."

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You might say that Ray has confidence in the Winegard products he sells and the confidence rubs off on his customers. Ray adds that his selling job is made easier because the name "Winegard" appears to ring a bell with most of his prospects. "It seems that they've either read about Winegard antennas or heard about their reliability from friends—and that makes them easier to sell than any other brand."

The confidence Ray Love has in Winegard is the result of installing Winegard products and seeing them in action. He is one more important service man who knows Winegard's standards of excellence first hand.

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ANTENNAS & ACCESSORIES

101. *ALLIANCE* — Colorful 4-page brochure describing in detail all the features of *Tenna-Rotors.**

102. *ANTENNACRAFT*—Literature featuring 3 new 75-ohm, all-channel TV antennas available in factory-built or kit form.

103. *BLONDER-TONGUE* — Booklet titled How to Plan a Home TV System" containing information on required components and cable with diagrams of actual systems. Written for both homeowner and technician.*

104. *CORNELL-DUBILIER* — 8-page booklet featuring rotor systems and their applications.*

105. *FINNEY* — Catalog 20-337 covering U-Vert series UHF converters and catalog 20-338 on Model 65-1 distribution amplifier.*

106. *JFD*—Literature on complete line of log-periodic antennas for VHF, UHF, FM, and FM stereo. Brochure showing converters, amplifiers and accessories; also complete '64-'65 dealer catalog plus dealer wall chart of antenna selection by area.*

107. *STANDARD KOLLSMAN* — Catalog sheet on Model TA transistorized UHF converter and transistor converter kit.*

108. *TRIO*—Brochure on installation and materials for improving UHF translator reception.

109. *WINEGARD*—12-page brochure "Color Spectacular" featuring antenna products designed for color TV use.*

110. *WRIGHT*—Circular supplying specifications and packaging information on guy wire.

111. *ZENITH*—Information bulletins on antennas, rotors, batteries, tubes, power converters, record changers, picture tubes, wire, and cable.*

AUDIO & HI-FI

112. *ADMIRAL* — Folders describing line of equipment; includes black-and-white TV, color TV, radio, and stereo hi-fi.

113. *JENSEN*—Multicolored 24-page catalog 165-L featuring complete line of headphones, speaker systems, and speaker kits.*

114. *LAFAYETTE*—New 512-page 1966 catalog No. 660 listing electronics equipment for home, hobby, and industry.

115. *NUTONE*—Two full color booklets illustrating built-in stereo music systems and intercom-radio systems. Includes specifications, installing ideas, and prices.

116. *OAKTRON*—"The Blueprint to Better Sound," an 8-page catalog of loudspeakers and baffles giving detailed specifications and list prices.*

117. *OXFORD TRANSDUCER*—4-page catalog describing three lines of automobile rear-seat speaker kits.

118. *QUAM-NICHOLS* — Catalog 65 listing replacement speakers for public address systems, hi-fi, auto radio, and radio-TV applications.*

119. *ROBINS*—Form 851 featuring tape editing workshop and phono-record care kit.

120. *SAMPSON*—4-color catalog page illustrating entire line of Waltham transistor radios.

121. *TURNER*—Applications and specifications sheet plus full-color brochure describing transistorized microphone.

COMMUNICATIONS

122. *EICO*—Data sheet on Model 753 *Tri-band* transceiver and other ham gear, plus full-line catalog.*

123. *MOSLEY ELECTRONICS* — Catalog covering complete 1966 line of Citizens-band equipment.*

124. *PEARCE-SIMPSON* — Specification brochure on IBC 301 business-band two-way radio, *Companion II, Director, Escort II, Guardian* 23, and *Sentry* Citizens-band transceivers. "The Modern Approach to Business Communications" concerning land mobile radio service for businessman.

125. *SPRAGUE* — Circular M-853 describes SK-1, SK-10, SK-20, and SK-30 *Suppressikits* for vehicles with alternators or DC generators.*

126. *VIBRATROL* — 4-page brochure describing product line for Citizens-band, amateur-radio, and audio applications; includes compressor-amplifiers, test equipment, transistorized vibrators, and solid-state rectifier replacements.

COMPONENTS

127. *BUSSMANN*—Bulletin SHF-12 introducing shielded fuseholder designed to prevent radiation and reception of RF energy via the fuseholder.*

128. *GC ELECTRONICS* — Cross-reference FR-605-G for TV knob replacement. Catalog FR-66-TD listing TV antennas and accessories. Brochure FR-171-A and catalog FR-66-A covering audio accessories and solid-state modules. Wall chart FR-250-W providing cross-reference for tape and phono drives and belts. Wall chart FR-029-E listing test prods, plugs, and jacks.*

129. *MERIT* — Form 715 cross-referencing company's coils and transformers to those of other manufacturers'.

130. *MILWAUKEE RESISTOR*—Flyer sheets supplying photographs, dimensions, specifications, and charts for metal-case resistors

131. *ONEIDA*—New catalog pages listing line of hardware, switches, resistors, and other replacement components.

132. *SWITCHCRAFT*—New product bulletin No. 154 describing "TINI-D-JAX" molded two-conductor phone jack designed for PC-board and/or panel mounting.

SERVICE AIDS

133. *BAY PRODUCTS* — Full-color 40-page catalog featuring *CONVERTA-BENCH.*

134. *CASTLE*—How to get fast overhaul service on all makes and models of television tuners is described in leaflets. Shipping instructions, labels, and tags are also included.*

135. *EBY*—New catalog listing full line of service aids.

136. *ELECTRONIC CHEMICAL* — Catalog sheet describing aerosol cleaners for electrical contacts, volume controls, and tape heads.

137. *PRECISION TUNER*—Literature supplying information on complete low-cost repair and alignment services for any TV tuner.*

138. *YEATS*—The new "back-saving" appliance dolly Model 7 is featured in a four-page booklet describing feather-weight-aluminum construction.*

SPECIAL EQUIPMENT

139. *GREYHOUND* — The complete story of the speed, convenience, and special ervice provided by the Greyhound Package Express routes.

140. *TERADO*—Brochures covering complete line of inverters and portable power supplies.*

141. *WINDSOR ELECTRONICS*—"The Open Door to TV Profits" booklet describing a process by which TV servicemen can rebuild regular and bonded CRT's.*

TECHNICAL PUBLICATIONS

142. *CLEVELAND INSTITUTE OF ELECTRONICS*—Free illustrated brochure describes electronic slide rule and four lesson Instruction Course and grading service.*

143. *HAYDEN*—72-page catalog listing books for the electronics service technician, student, and hobbyist.

144. *HOWARD W. SAMS* — Literature describing popular and informative publications on radio and TV servicing, communications, audio, hi-fi, and industrial electronics, including special new 1965 catalog of technical books on every phase of electronics.*

145. *RCA INSTITUTES* — 64 - page book, "Your Career in Electronics" detailing home study courses in telecommunications, industrial electronics, TV servicing, solid-state electronics, and drafting. Preparation for FCC license, and courses in mobile communications and computer programming also available.*

TEST EQUIPMENT

146. *B & K*—New 1966 catalog featuring test equipment for color TV, auto radio, and transistor radio servicing, including tube testers designed for testing latest receiving tube types.*

147. *HICKOK*—New 1965-66 short form catalog listing test equipment for radio and TV servicing.*

148. *JACKSON*—New 8½" x 11" catalog listing full line of test equipment.*

149. *LECTROTECH* — Flyer sheet detailing specifications and applications for Model U-75 VHF to UHF translator.*

150. *MERCURY*—Folder supplying information on complete line of test equipment.*

151. *SECO*—New colorful folder describing 20 test instruments including tube testers.*

152. *SENCORE*—Latest information on TC-136 tube tester and SS137 sweep-circuit analyzer.*

153. *SIMPSON* — Complete 16-page brochure on entire line of electronic test equipment; also, catalog on line of panel meters.*

154. *TRIPLETT*—Catalog covering entire line of test equipment and accessories.*

TOOLS

155. *ARROW*—Catalog sheet describing uses, prices, and construction features for staple guns.

156. *BERNS*—Data on unique 3-in-1 picture-tube repair tools, on *Audio Pin-Play Crimper* that enables technician to make solderless plug and ground connections, also for color and other picture tubes. Model AV-2 for RCA type phono plugs, along with C rings for shielded braided wire ground connections and LC-3 for 5/32" pin diameter.

157. *ENTERPRISE DEVELOPMENT*—Time-saving techniques in brochure from Endeco demonstrate improved desoldering and resoldering techniques for speeding and simplifying operations on PC boards.*

158. *GREENLEE*—New 8-page catalog No. E-730-3 depicting line of standard and special chassis punches for radio, TV, and electrical work.

159. *WASSCO GLO-MELT* — "Principles of Resistance Soldering" 16-page primer describing controlled-heat soldering method. Catalogs covering: conduction- and resistance-type soldering equipment, and thermal wire-stripping equipment.

TUBES & TRANSISTORS

160. *WORKMAN* — Cross-reference for entainment-type transistor replacement, and reference list for picture-tube brightener application.*

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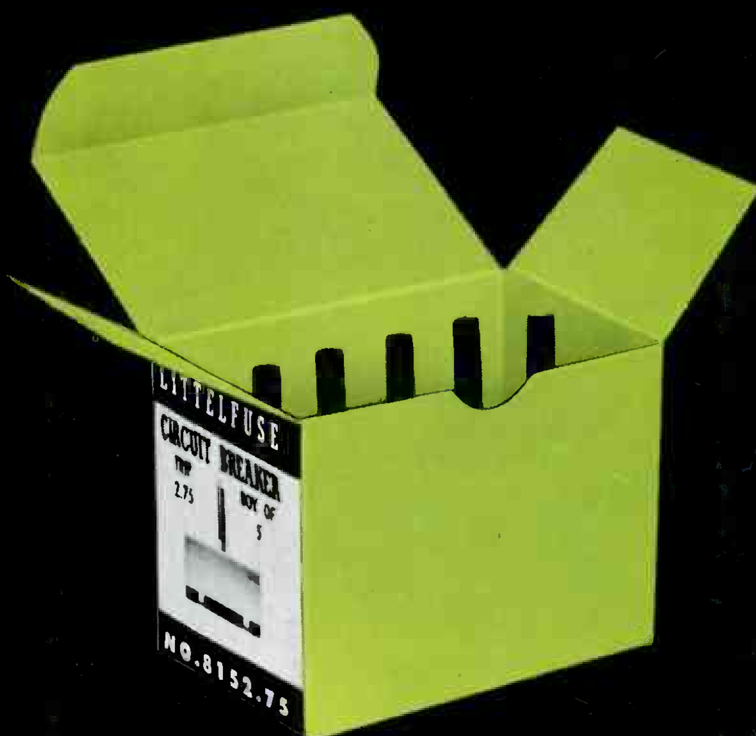

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