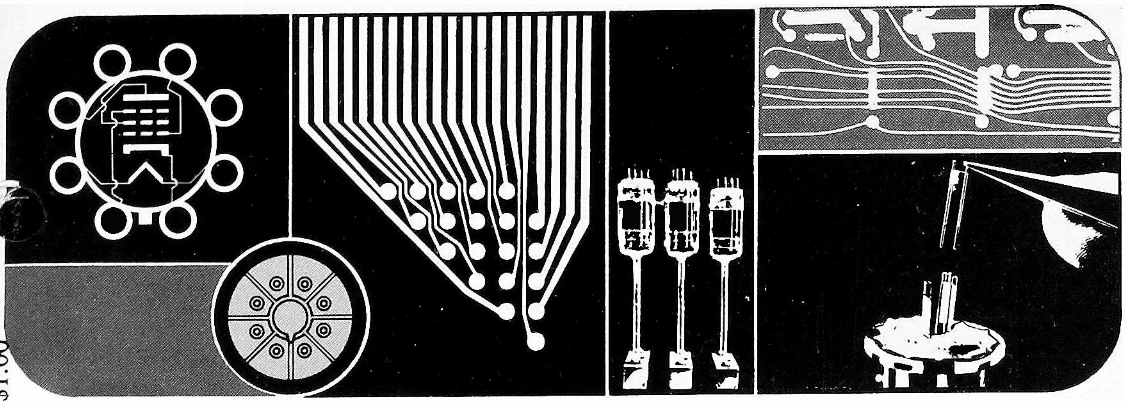


SYLVANIA NEWS
Technical Section
Spring 1964 ☐ VOL. 31, NO. 1
R. A. HUMPHREYS, TECHNICAL EDITOR

TIPS ON COLOR TV PICTURE TUBE ALIGNMENT

By D. G. MACKEY — Color Tube Design and Development

The majority of color TV receivers now on the market use a 21″, 70°, all glass shadow-mask picture tube. The three tube types in general use are the 21FBP22, 21FJP22, and 21FKP22. The 21FBP22 is the basic color tube. It requires a separate safety shield while both the 21FJP22 and the 21FKP22 have bonded safety shields. The bonded shield on the 21FJP22 is anti-reflection treated.

The serviceman confronted with a current color receiver notices immediately that there are fewer picture tube accessories than on early models. No longer needed are the field neutralizing coil and rim magnets. This simplification is the result of improvements in the design and production of the color picture tube which have made it possible to obtain better picture quality without these items.

The color picture tube in current sets is also less tedious to align or set up and the end result much more satisfactory. Properly aligned, the color tube will display a uniform white field at all levels of brightness. Alignment procedure is still all important and obtaining a good monochrome picture can be the biggest problem. The following step-by-step procedure makes alignment easy.

Step 1—Degaussing. The picture tube should be degaussed in the position in which it will be operated. Degaussing removes or "*bucks*" out any external magnetic fields that would influence the electron beam landing on the phosphor dot screen. Commercial degaussing coils are available or one may be made by winding 425 turns of No. 20 enameled wire on a 12-inch diameter form about ¾-inch wide. Degaussing is accomplished by moving the coil, while it is connected to a 120 volt, 60 cycle source, over the faceplate of the tube. After thirty seconds the coil should be slowly moved straight back approximately ten feet from the tube before the power is turned off. A variac type control turned slowly to zero can be used in place of moving back ten feet from the tube.

Step 2—Color Purity. The deflection yoke should be moved back on the neck toward the convergence assembly until neck shadow appears. At this point it is necessary to have only the red gun operating. The green and blue guns can be biased off by shunting 100,000 ohms between the No. 1 grids of the picture tube and the chassis. Figure 1 shows a suitable switching circuit that can be used to control any gun.

For good purity it is necessary for the red, green and blue beams to land in the center of their respective dots. In general, when the red beam lands correctly, the green and blue beams are also landing correctly. The red field is used for purity setup since it shows up incorrect beam landing better than either the green or blue field.

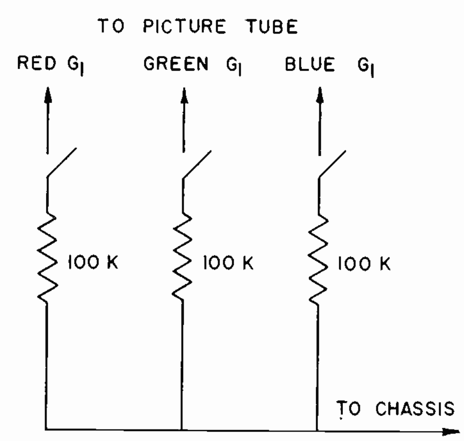


Figure 1—Simple switching circuit for control of electron guns.

The purity magnet, located between the convergence assembly and the blue lateral magnet, functions on a color tube exactly like the picture centering magnet on a monochrome tube. The strength of the purity field is changed by separating the tabs on the two flat rings. The direction of of the field can be changed by rotating the two rings together. The action

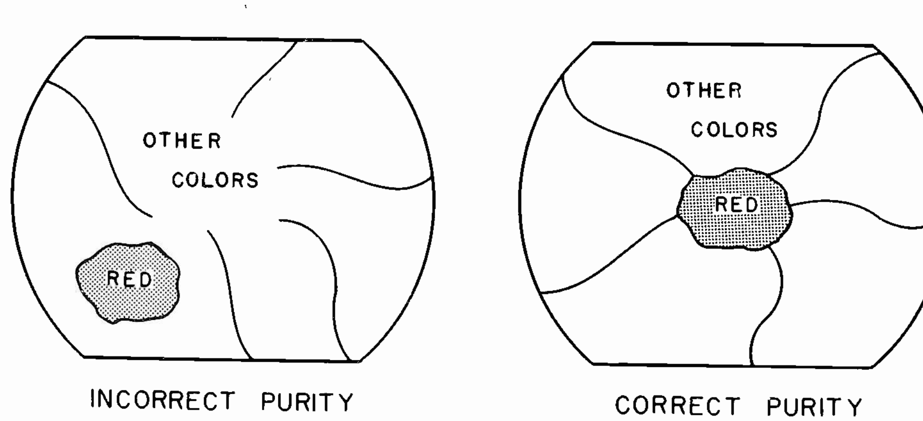


Figure 2—Purity is correctly adjusted when red area is centered.

of the purity magnet is followed more easily if the two rings are rotated together.

The purity magnet centers the beams correctly as they pass through the center of deflection of the yoke. The beams are then deflected and pass through the aperture mask at the angle necessary to land at the center of the correct dots.

The red beam is landing correctly when the uniform red area is moved to the center of the picture tube screen as shown in Figure 2.

Step 3—Static Convergence. The three beams, red, green and blue, should now be statically converged. The green and blue guns should be turned on and the dot signal from a dot-and-bar generator applied. Commercial dot-and-bar generators that provide an RF output that may be connected to the antenna terminals of the receiver are available.

Static convergence of the three beams in the center of the tube is obtained by the combined adjustment of the red, green and blue convergence magnets and the blue lateral magnet shown in Figure 3. The recommended location of these components is shown in Figure 4.

The beam travel caused by the static convergence magnets and the blue lateral magnet is shown in Figure 5. The amount of beam travel can be increased by rotating the plastic magnet holder 180°. The blue lateral magnet must be removed from its holder and the opposite end reinserted to increase its range of adjustment on beam travel.

Once the three beams have been statically converged in the center of the picture tube, it is necessary to recheck the purity of the red field since large changes in static convergence affect the purity and vice-versa.

With the blue and green guns turned off it is very easy to see and adjust, if necessary, the purity. Since the yoke is still pulled back on the neck, this only requires moving the uniform red area to the center of the screen.

If a large purity change is required it will be necessary to recheck the static convergence again. Generally no more than two compensating adjustments are required.

Step 4—Yoke Adjustment. At this point, with the red area in the center of the screen and the three beams statically converged, the deflection yoke is moved forward until the entire screen is a pure red field.

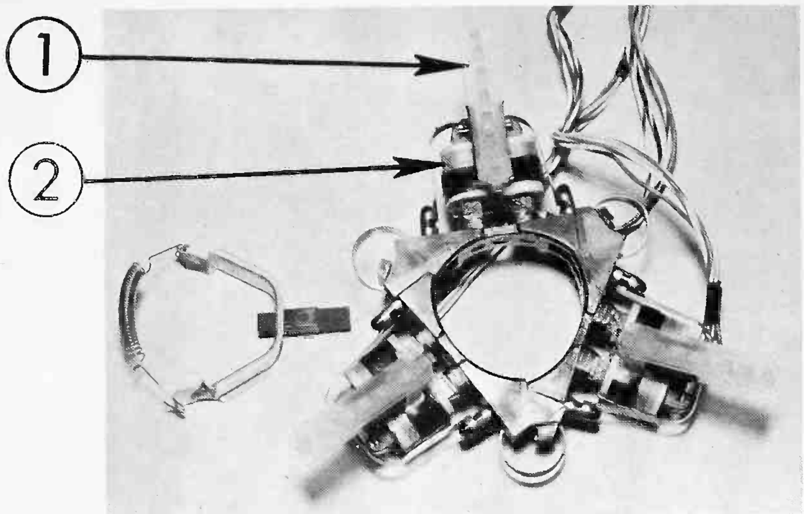


Figure 3—Left, blue lateral magnet; right, convergence assembly—(1) static convergence adjustment, (2) dynamic convergence coil.

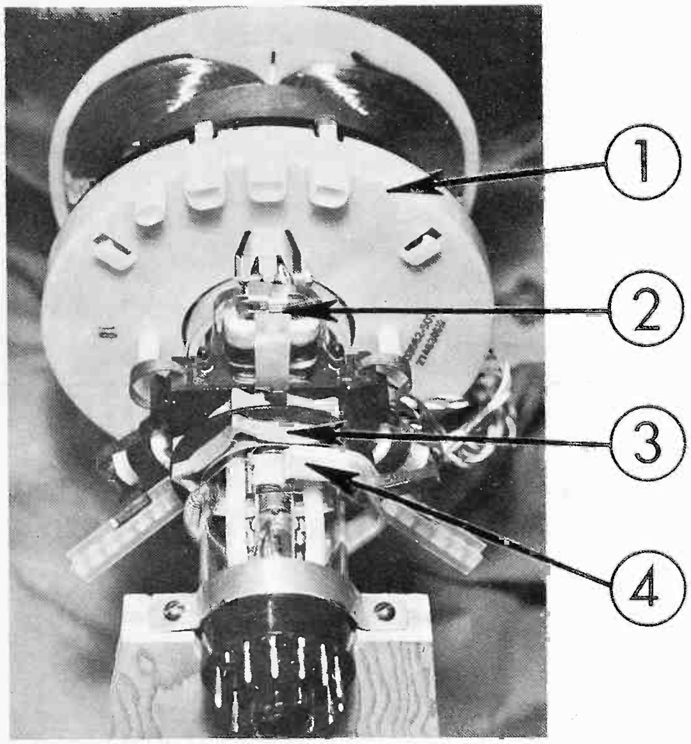


Figure 4—Proper relative position of accessories: (1) yoke, (2) convergence assembly, (3) purity magnet, (4) blue lateral magnet. The back edge of the convergence assembly should be located 1⅛ inches ahead of the front edge of the internal blue lateral pole piece.

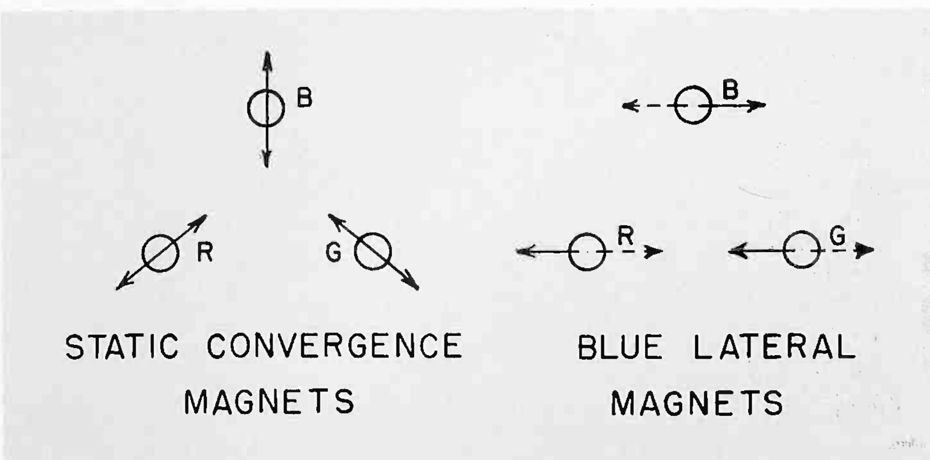


Figure 5—Beam movement produced by adjustment of static convergence magnets and blue lateral magnet.

SYLVANIA NEWS

Dealer Section

Spring 1964 □ VOL. 31, NO. 1

DICK DE SALVO, EDITOR, Published For the Professional Radio-TV Service Dealer

At Participating Sylvania Distributors

"DEALER'S CHOICE"

YOUR CHOICE OF OVER 400 WONDERFUL GIFTS!

Climb aboard and get off to a flying start in Sylvania's spring Receiving Tube promotion—the first for 1964! Now through the end of May you can win handsome gifts simply by making it a point to install famous-quality Sylvania Receiving Tubes at every opportunity. *It's that easy!*

Dealer's Choice is a program that's designed to make every one of you a happy, satisfied winner. You select from over *400* valuable prizes in Sylvania's VAL-U-BUY catalog—thirty pages of portable TV's, home appliances, cameras, toys, sporting goods, even a mink stole, and MANY MORE!

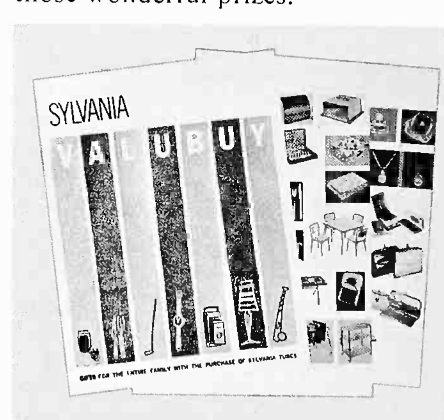
As we said, *everyone* can be a winner . . . *even* if you're the smallest dealer in town. Of the more than 400 gifts in the catalog, over 275 require but average purchases on your part for the three-month period. And, of course, extra-added purchases mean extra-special awards.

Here's How Dealer's Choice Works!

For every 10 red and yellow Sylvania Receiving Tubes you buy from your Sylvania Distributor, you'll receive a "check" worth 12 points. Save all the checks you collect during March, April, and May; then "cash in" the total for the gift or gifts of your choice. It's as simple as it sounds!

Start today by calling on your participating Sylvania Distributor. While you're there, browse through his VAL-U-BUY catalog, and select the gifts you'd like to win. Realize your prize by purchasing Sylvania Receiving Tubes, the best tubes your money can buy. *AND* the tubes that satisfy your customers best.

Remember! You can *collect* points through May 30, and you have until September 1 to redeem them for those wonderful prizes.



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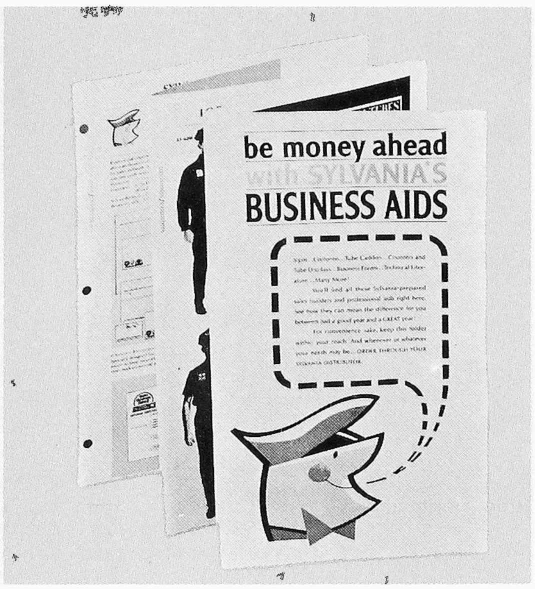
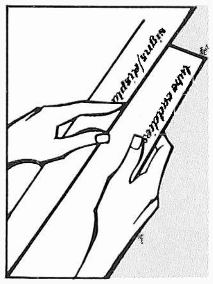


When you find yourself in want of a brilliant outdoor sign that will identify your store blocks away . . . or an eye-catching window display that will stop passers-by and sell them on your expert service . . . or a new uniform that will add handsomely to your professional stature, then pick up your copy of Sylvania's new dealer aids folder.

You'll find everything you need to make yours a more professional, more profitable business. This colorful, attractively illustrated brochure unfolds to show you a large selection of Signs . . . Uniforms . . . Tube Caddies . . . Business Forms . . . Technical Literature . . . Many More!

It's tabbed *by subject* on its outer-flaps, so you can flip—from either side—right to the promotional aids you're interested in. (*See cut*).

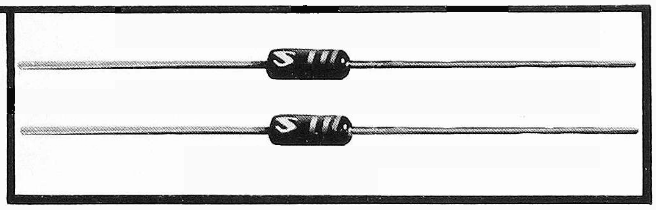
And for safe-keeping—it's punched to fit a 3-ring binder! Keep it at your bench for convenience sake, and whenever or whatever your needs . . . ORDER THROUGH YOUR SYLVANIA DISTRIBUTOR!



Since the supply of the "Be Money Ahead . . ." brochure is limited, assure yourself of your FREE copy by mailing the coupon above . . . TODAY!

THIS IS THE 1N4093

Sylvania's New Silicon Diode Pair

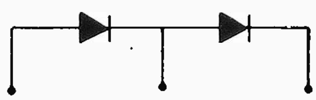
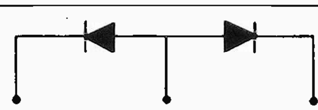


Practically every existing TV set has a potted pair of selenium diodes that is used as the horizontal phase discriminator or phase detector. These units are known to have a particularly high failure rate, and are usually one of the first sources of trouble TV servicemen look for.

Now a recently-registered Sylvania silicon diode pair should make the pair of selenium diodes obsolete. This new Sylvania type 1N4093 has been tested and proved superior, and is already being employed in the manufacture of new television receivers.

The three schematics here illustrate the three different types of connections that the 1N4093 will replace—in all, some 80 different replacement types. In effect this means that the 1N4093 can replace the potted pair of selenium diodes in virtually every set.

So . . . the next time you're at your Sylvania Distributor, or being called on by one of his salesmen, inquire about Sylvania's 1N4093. The replacement market is virtually endless. And installing Sylvania's 1N4093 is one more way you can demonstrate your expert repair service, and make customers fully satisfied.

CONNECTION		SCHEMATIC
A	Common Anode	
B	Series	
C	Common Cathode	

18 NEW TYPES ADDED TO SILVER SCREEN 85 LINE

Note: Silver Screen 85 picture tubes are made only from new parts and materials except for the envelopes, which prior to reuse, are inspected and tested to the same standard as new envelopes.

TYPE	DESCRIPTION, USAGE
16BAP4	A 114° deflection, aluminized, Bonded Shield tube employing a 6.3 volt, .600 amp heater. Used in Admiral receivers.
16BRP4	A 114° deflection, aluminized, Bonded Rim tube employing a 6.3 volt, .600 amp heater. Used in Admiral receivers.
17EHP4	A 110° deflection, aluminized, non-ion trap tube employing a 6.3 volt, .600 amp heater. Used in Admiral receivers.
19BRP4	A 114° deflection, aluminized, Bonded Shield tube employing a 6.3 volt, .600 amp heater. Used in Motorola receivers.
19DAP4	A 114° deflection, aluminized, Bonded Shield tube employing a 6.3 volt, .450 heater. Used in Warwick and Pacific Mercury receivers.
19DWP4	A 114° deflection, aluminized, Bonded Rim tube employing a 6.3 volt, .450 amp heater. Used in Sylvania receivers.
27YP4	A 90° deflection, aluminized, Bonded Shield tube employing a 6.3 volt, .600 amp heater. Used in Admiral receivers.
16ANP4	A 114° deflection, aluminized, Bonded Shield tube employing a 6.3 volt, .600 amp heater. Used in Emerson receivers.
19DKP4	A 114° deflection, aluminized, Bonded Shield tube employing a 6.3 volt, .600 amp heater. Used in Emerson receivers.
23DLP4	A 92° deflection, aluminized, Bonded Rim tube employing a 6.3 volt, .600 amp heater. Used in Curtis Mathes receivers.
23EWP4	A 114° deflection, aluminized, Bonded Rim tube employing a 6.3 volt, .450 amp heater. Used in Warwick and Pacific Mercury receivers.
19CZP4	A 114° deflection, aluminized, Bonded Shield tube employing a 6.3 volt, .450 amp heater. Used in Warwick and Pacific Mercury receivers.
23DNP4	A 92° deflection, aluminized, Bonded Shield tube employing a 6.3 volt, .600 amp heater. Used in Zenith receivers.
19CXP4	A 114° deflection, aluminized, non-ion trap tube employing a 6.3 volt, .600 amp heater. Used in Zenith receivers.
16BCP4	A 114° deflection, aluminized, Bonded Shield tube employing a 6.3 volt, .450 amp heater. Used in Zenith receivers.
19DBP4	A 114° deflection, aluminized, Bonded Shield tube employing a 6.3 volt, .450 amp heater. Used in Zenith receivers.
23ECP4	A 92° deflection, aluminized, Bonded Shield tube employing a 6.3 volt, .600 amp heater. Used in Zenith receivers.
23EDP4	A 92° deflection, aluminized, Bonded Shield tube employing a 6.3 volt, .600 amp heater. Used in Zenith receivers.

In recent months Sylvania Electric Products Inc. has announced the addition of *18* new picture tube types to the famous-quality Silver Screen 85 line. In these new types, 5 screen sizes are represented—16″, 17″, 19″, 23″ and 27″.

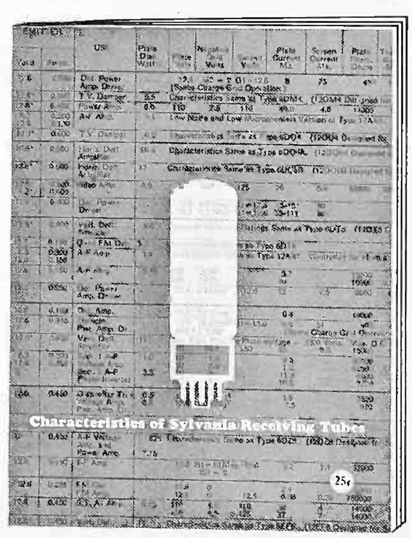
Be sure to familiarize yourself with their descriptions . . . and when you need to replace one of these newer types, be sure you do the job with a Silver Screen 85. Your customers will enjoy the clearest, brightest, sharpest reception when you do.

(To become familiar with these new types and their usage, **cut out this chart** and place it prominently in your shop.)

NEW EDITION JUST PRINTED!

"CHARACTERISTICS OF SYLVANIA RECEIVING TUBES"

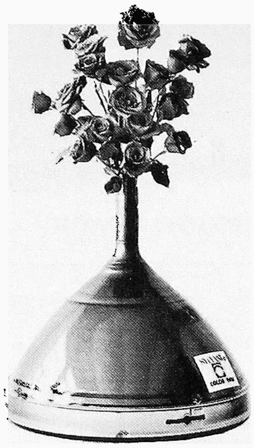
. . . here are the most up-to-date facts on receiving tubes.



For your complete reference source on receiving tubes, consult the most current book available on the subject—"Characteristics of Sylvania Receiving Tubes." It's a *must* booklet for every practicing Radio-TV service dealer.

Sixty-six pages provide detailed technical data for over 1700 tube types—their characteristics, ratings and basing diagrams. And it's yours for two-bits, one thin quarter—25 cents.

Add to your professional know-how! Be sure you have this booklet *at your fingertips* when you need it. Order your copy from your Sylvania Distributor, or write Sylvania Electric Products Inc., 1100 Main Street, Buffalo, New York 14209. (Please enclose remittance.) ET-1350 25¢



This eye-catching photograph served as the illustration in a recent General Telephone & Electronics advertisement that appeared in *The Wall Street Journal*, and several other financial periodicals.

The ad sold the business world on the progress taking place at GT&E, of which Sylvania is a subsidiary.

It's easy to guess the ad painted a rosy picture for Sylvania color tubes. And well it should, for Sylvania has made giant strides in the perfection of color TV to achieve industry leadership.

Next time you have to replace a color picture tube, replace it with a Sylvania Color Screen 85. You'll find it's the way to satisfy customers, as well as assure yourself of fewer, time-consuming callbacks for readjustments.

SPOTLIGHT SYLVANIA'S NEW DEALER DISPLAY IN YOUR SHOP

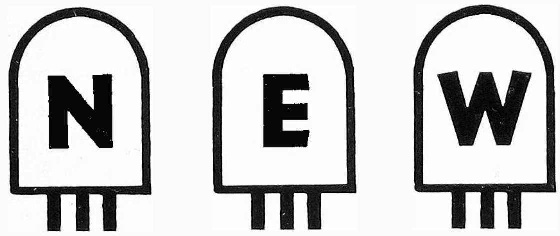
Wanna know how you can have crowds gathered around your shop? Well, you might try giving money away. (It's a real crowd pleaser.) *OR* you might put Sylvania's new "EXPERT TV SERVICE" display in your window, or on your counter. You'll be amazed at the amount of attention this 4-color sign attracts.

First of all, it boasts everything that makes a sign successful—it's big, bold, and bright. But this particular display goes even one step further; it has *reader identification*. Six big illustrations depicting symptoms of picture tube failure allow customers to readily identify their TV problems . . . and remedy them with the famous-quality Silver Screen 85, of course.

The top "EXPERT TV SERVICE" panel easily affixes to the two sides so you have a panoramic display that's standin' tall *and* stationary—*in seconds.*

Its tough cardboard construction will endure the humidity of summer, the steam heat of winter . . . an effective display to serve you the year 'round.

No doubt about it, this is one of the most eye-catching displays Sylvania has ever prepared for service shops. So . . . don't delay, put one in your window *today!* With all those customers coming your way, the display can't help but win your whole-hearted approval. ET-1983 36″ x 46″ Price: $1.98.



Keep an up-to-the-minute inventory with these *9* new additions in Sylvania's top quality Receiving Tube line . . . and help yourself to bigger profits in 1964.

TYPE	DESCRIPTION
6GQ7	Triple diodes in 9 pin miniature construction. For AM detector and FM ratio detector or discriminator applications. Used in Zenith FM multiplex receivers.
6KZ8	9 pin miniature tube containing a medium mu triode and a sharp cutoff pentode. Oscillator mixer. Used in RCA and GE TV receivers.
6LC8	High mu triode plus sharp cutoff pentode. Sync-separator and noise-immune gated-AGC-amplifier circuit. For use in RCA TV receivers.
10GN8	High mu triode plus sharp cutoff pentode. Sync-separator or voltage amplifier and video amplifier. Used in Westinghouse TV receivers.
12AL11	T-9 Compactron containing a sharp-cutoff, dual control pentode and a power pentode for FM detector and AF output amplifier. Used in Admiral TV receivers.
17AX3	Heater-cathode type diode. Damping diode in horizontal deflection circuit. Used in GE TV receivers.
17JB6	T-12 Novar beam power pentode for horizontal deflection amplifier circuits. Used in RCA TV receivers.
19GQ7	Triple diodes in 9 pin miniature construction. For AM detector and FM ratio detector or discriminator applications. Used in Zenith FM multiplex receivers.
50HK6	Miniature power pentode for AF power output. Used in GE and Arvin Radios.

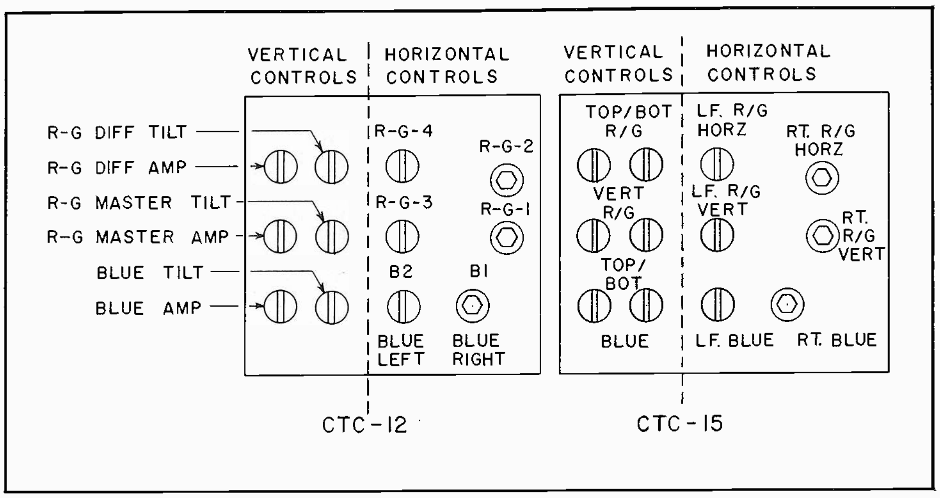


Figure 6—Dynamic convergence controls for CTC-12 and CTC-15 chassis. The CTC-15 controls have been rearranged for easier set-up.

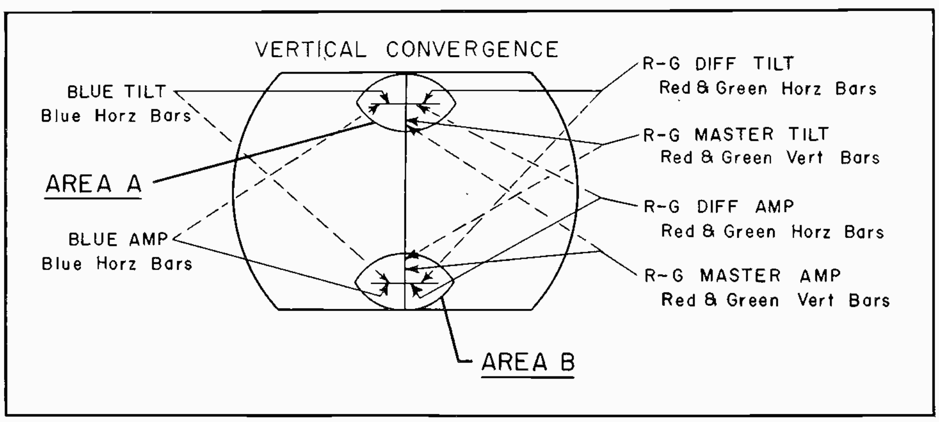


Figure 7—Areas of screen controlled by vertical dynamic convergence controls.

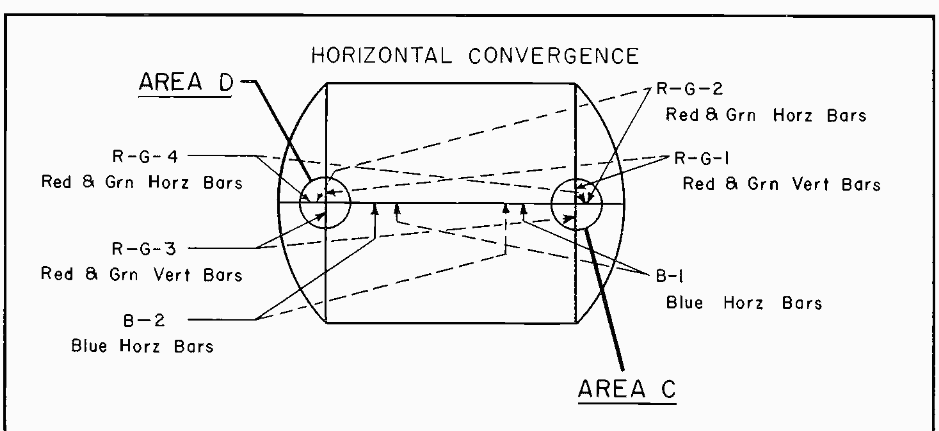


Figure 8—Areas of screen controlled by horizontal dynamic convergence controls.

This can be judged visually, but, if it is felt necessary, a low power (10X) microscope can be used to insure proper beam landing over the entire screen.

Step 5—White Uniformity. Normally when the red field is pure, the green and blue fields will be pure. The next step is to turn on the green and blue guns and inspect the white uniformity. If the white uniformity is not acceptable, the green and blue fields should be checked separately. Slight adjustments to the deflection yoke position and/or the purity magnet should be made to compromise the beam landings.

Step 6—Dynamic Convergence. With the purity and static convergence set, it is time to adjust the dynamic convergence. The dynamic convergence boards used on current color receivers are all quite similar in appearance and operation. Figure 6 shows the control arrangement on the dynamic convergence board of the CTC-12 and CTC-15 chassis. Figure 7 shows the areas of the screen controlled by the vertical convergence controls. Figure 8 shows the areas of the screen controlled by the horizontal convergence controls.

The dynamic convergence controls are needed to make the three beams converge at the aperture mask over the entire screen area. Dynamic convergence adjustments should be made with a white crosshatch pattern. Dynamic convergence setup will become easy if, while working on the first few receivers, you become familiar with the areas of the screen affected by the various controls. The receiver manufacturer's specified setup procedure should be followed although the following procedure applies to most current receivers:

1. Be sure horizontal size and centering, vertical size and centering, purity and center static convergence are set up properly.
2. Apply white crosshatch pattern to the receiver.
3. Turn off blue gun.
4. Adjust R-G MASTER TILT to bring the red and green vertical bars together at the top of the center vertical line. (Area A in Figure 7).
5. Adjust R-G MASTER AMP to bring the red and green vertical bars together at the bottom of the center vertical line. (Area B in Figure 7.)
6. Because of the interaction between the controls it is necessary to touch up both controls to get the optimum red-green convergence along this vertical center line.
7. Adjust R-G DIFF. TILT to bring the red and green horizontal bars together at the top center of the screen. (Area A in Figure 7.)
8. Adjust R-G DIFF. AMP to bring the red and green horizontal bars together at the bottom center of the screen. (Area B in Figure 7.)
9. Because of the interaction between the controls it is necessary to touch up both controls for optimum convergence of the top and bottom horizontal center bars.
10. Turn on the blue gun.
11. Adjust BLUE TILT to converge the horizontal blue line with the red and green horizontal lines at the top center of the screen. (Area A in Figure 7.)
12. Adjust BLUE AMP to converge the horizontal blue line with the red and green horizontal lines at the bottom center of the screen. (Area B in Figure 7.)
13. Recheck center static convergence and adjust if necessary.
14. Adjust B-1 to make a straight horizontal blue line from the center to the right side of the screen, Figure 8.
15. Adjust B-2 to make straight horizontal line from the center to the left side of the screen, Figure 8.
16. Turn off the blue gun.
17. Adjust R-G-1 to bring the red and green vertical bars together at the

center of the right side of the screen. (Area C in Figure 8.)

18. Adjust R-G-2 to bring the red and green horizontal bars together at the center of the right side of the screen. (Area C in Figure 8.)
19. Adjust R-G-3 to bring the red and green vertical bars together at the center of the left side of the screen. (Area D in Figure 8.)
20. Adjust R-G-4 to bring the red and green horizontal bars together at the center of the left side of the screen. (Area D in Figure 8.)
21. Because of the interaction between controls it is necessary to touch up R-G-1, R-G-3, and R-G-2, R-G-4 for the optimum convergence of the vertical and horizontal red-green lines on both sides of the screen.
22. Turn on the blue gun.
23. Touch up B-1 and B-2 to make the blue line converge with the horizontal red-green line through the center of the screen.
    In general, it is possible to get good convergence to within 1½ inches of the screen edges on current receivers. If it should become necessary to leave one beam misconverged in order to compromise the convergence over the largest possible area of the screen, let it be the blue beam. Misconvergence of the blue beam is not as noticeable, from the normal viewing distance, as is the red or green beam.

Step 7—Gray Scale Tracking. The last step will be to set up the *Gray Scale* tracking on the picture tube. With the *Gray Scale* tracking set properly a black and white picture will show no color tinting throughout the usable range of the brightness control. Here again the receiver manufacturers' specified procedure should be followed. A general procedure for receivers that have three separate SCREEN controls, blue and green VIDEO DRIVE controls, SERVICE SWITCH and KINE BIAS switch, is as follows:

1. Set KINE BIAS switch in the top position.
2. Turn the green and blue VIDEO DRIVE controls to midrange.
3. Turn red, green and blue SCREEN CONTROLS full counter-clockwise.
4. Move SERVICE SWITCH to the *service* position.
5. Adjust the three SCREEN controls to the point where they just extinguish their respective horizontal line.
6. If a line cannot be made visible, move the KINE BIAS switch to the middle or bottom position and reset all three SCREEN controls.
7. With all three lines just cut off, move the SERVICE SWITCH to the normal position.
8. Adjust the brightness and contrast controls to approximately three-fourths of the maximum brightness level.
9. Adjust the green and blue VIDEO DRIVE controls to give an acceptable white color. A black-and-white tube might be used as a standard.
10. Reduce the brightness level to its lowest usable point and observe the raster for any color tinting. If color tinting is evident, a slight readjustment of the screen controls will correct this. For example, if there is too much green in the picture, the green screen control should be rotated counter-clockwise.

With the completion of this last step, the color picture tube is now capable of providing the viewer with hours of enjoyable color and black-and-white viewing.

SYLVANIA ELECTRIC
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1100 MAIN ST.
BUFFALO, N.Y.
SYLVANIA NEWS
SPRING 1964

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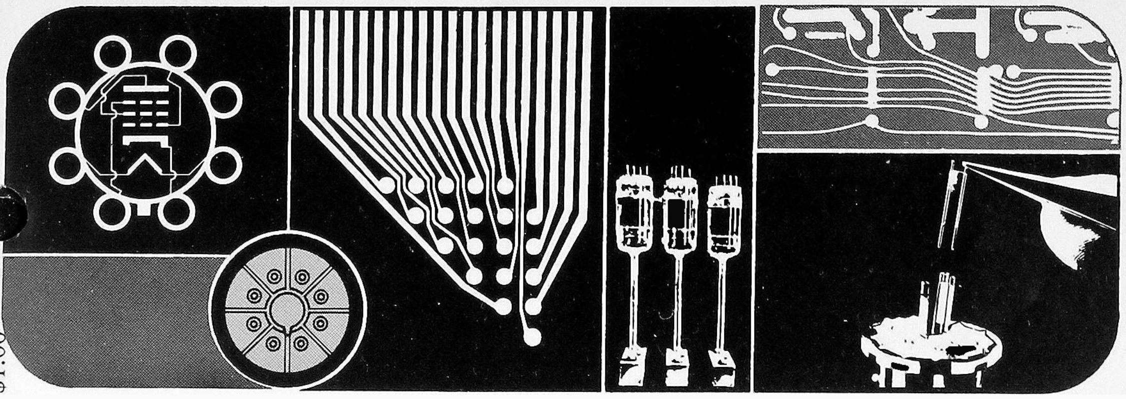

SYLVANIA NEWS
Technical Section
Summer 1964 ☐ VOL. 31, NO. 2

R. A. HUMPHREYS, TECHNICAL EDITOR

UHF TV TUNERS AND CONVERTERS

A complete UHF-VHF tuner in the television receiver, capable of covering any of the channels in either band, is the most compact and convenient method for all-channel reception. Converters and selectors that are additions to the television receiver are only modifications to existing equipment.

UHF has some special problems of its own; because of the small wavelengths an indoor antenna for UHF can be designed with much more gain than its counterpart in the VHF range. An outdoor antenna for the same reason can be quite small and still produce very high gain. But with a UHF indoor antenna, movements are critical. As little as two inches can mean the difference between a strong clear picture and no usable signal at all which is one disadvantage.

Transmission line loss is a major factor in the UHF spectrum; channel 14, for example, has almost twice the line attenuation loss as has channel 13. Wet or dirty lead-in cable increases this loss factor up to six times. Ribbon type 300 ohm lead-in cable cannot be used outdoors for UHF. The round poly-foam filled cables give best results; the foam type filling not only helps prevent loss due to dampness, but also the added stiffening helps keep the cable from being shifted by the wind.

It is also necessary for the lead-in to be dressed away from all metal objects. Radiated interference is not a problem in UHF, but even such things as the leaves on trees can cause a reception problem. Buildings and hills sometimes create problems that even the best antenna orientation cannot overcome completely.

Most sets manufactured in the past few years can be field converted with a specially made UHF adaption kit. External converters for UHF are another popular solution for those sets where space, or other requirements preclude a tuner. Converter units are manufactured both with and without RF or IF amplifier stage or stages. For primary signal areas, within 20 miles of the station, a simple one-tube converter may be used.

But where the receiver is not in the primary signal area, the converter should have at least one stage of amplification and an outdoor type antenna.

A converter with a stage of amplification is shown in Figure 1 where a 6DS4 is used to increase the converter's output before it is fed to the VHF antenna terminals of the TV receiver.

TUNED CIRCUITS

Electrically, UHF converters for TV are all units that employ a local oscillator and mixer to convert the UHF signal into a VHF signal. The tuned circuits are usually of the transmission line type.

UHF circuits are different than those at VHF since, in the UHF TV band, some factors that are not important at lower frequencies become significant. Consider a common piece of wire 4 inches long with a diameter of 0.04 inch has an inductance of 0.1 μh. At a frequency of 1 mc this represents an inductive reactance of 0.63 ohm. But at 500 mc the reactance of the wire rises to a value of 315 ohms and the wire becomes, in effect, an r-f choke.

Another critical factor at UHF is the distributed capacitance of the coil. The capacitance between turns of a coil represents an appreciable reactance, although this is relatively negligible at low frequencies. At UHF, the leads of a capacitor may have enough inductive reactance to cancel some or all of the capacitance

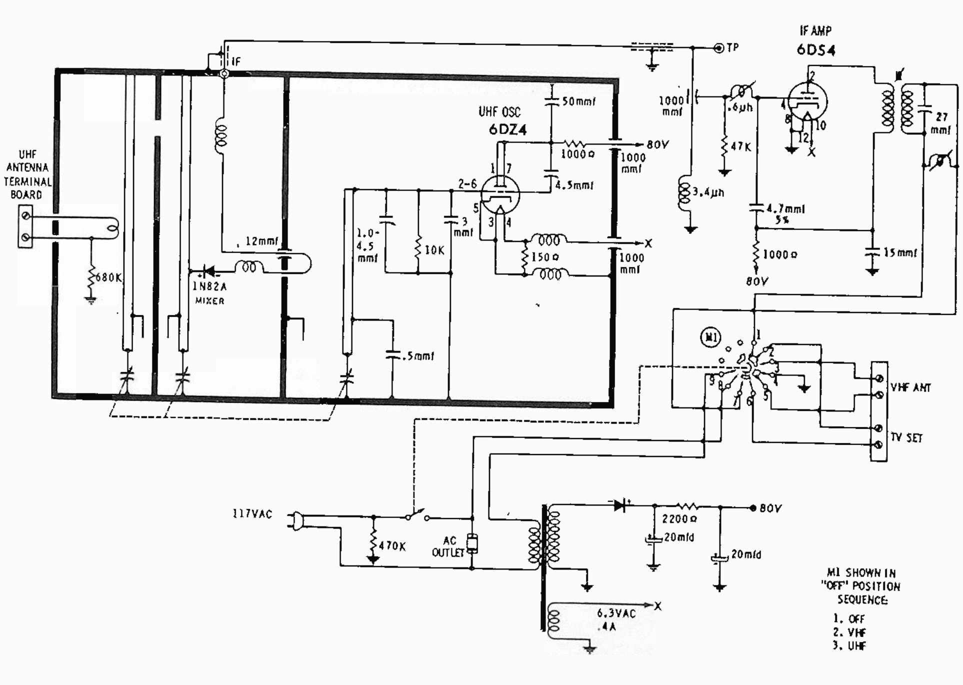

Figure 1—Typical UHF Converter

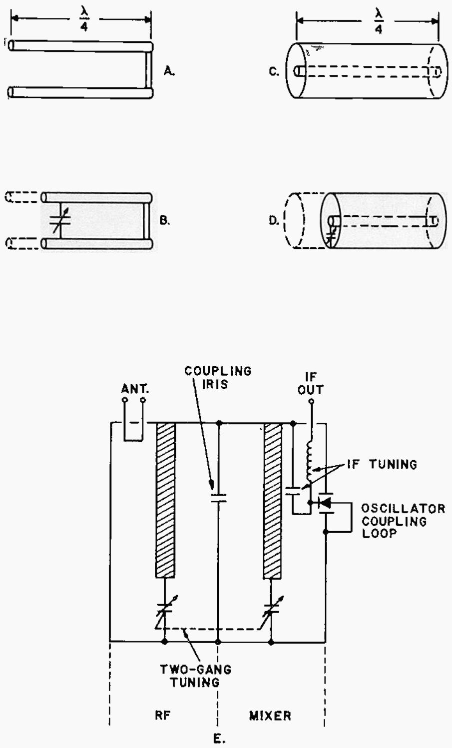

Figure 2—Tuning Circuit Development

UHF circuits are carefully designed to provide a single ground point for each circuit section in which there are UHF currents, so that there will be little current flowing in the chassis itself.

Oscillator stability is an important factor in UHF converters. The local oscillator of a UHF converter operates at a higher frequency than the oscillator of a VHF receiver. But since the TV channel width is the same as at VHF, the drift, in terms of cycles per second, must be just as low.

The use of a section of transmission line as a tuned (resonant) circuit is common, a quarter-wave line with a short-circuit termination is equivalent to a parallel-resonant circuit. The frequency at which the quarter-wave line section is resonant is that frequency at which the line is a quarter-wave length long. Similarly, the frequency of resonance can be adjusted over a range by varying the effective length of the line.

The shorted quarter-wave line may be visualized as a shorted eighth-wave line section and an open eighth-wave line section connected in parallel. The former supplies the inductance and the latter the capacitance. Sometimes a line which is less than a quarter-wave long is used for the inductance of the circuit, while the capacitance is supplied by a variable capacitor.

Tuning circuits may be seen from Figure 2 which shows their development. A is a quarter-wave shorted line which has a high impedance at only one frequency hence it appears as a parallel resonant circuit. (A quarter-wave line is the shortest length of line that acts as a resonant circuit.)

In B a capacitor replaces a part of the line, hence the line is physically shorter than in A, but it is still a resonant circuit. Because of the variable capacitor this line can be tuned over a band of frequencies. C shows a coaxial line just like A in its action; D is a capacitive loading on such a line to shorten its physical length and allow tuning.

E shows, in simplified form the use of such lines in a tuner; a coaxial line is a self-shielded device so there is little external radiation. Two lines are shown with magnetic coupling via an opening or iris. R-f from the antenna is coupled to this coaxial circuit; output, which is frequency selective, is coupled to the mixer. By means of a coupling loop the local oscillator signal also appears in this mixer tank circuit. Because of mixing action the IF appears as the output.

The local oscillator is located in a similar coaxial tuned circuit and it is supplied with heater and plate power.

of the component.

At a frequency at which the inductive reactance of the leads equals the capacitive reactance, the component actually becomes a series-resonant circuit. At the ultra-highs, special capacitors (without leads) are used to prevent this.

These are feed-through capacitors in which there is an inner conductor, an insulating sleeve, and an outer conductor. The outer conductor is forced into a hole in the chassis and makes a direct ground without leads; the capacity exists between the inner and outer conductor. The inner lead becomes a part of the wiring circuit and this device is a very effective by-pass or filter capacitor.

A resistor may also be affected at UHF because the leads have an inductive effect and, in addition, result in the creation of a certain amount of capacitance between the ends of the resistor.

A metal chassis can ordinarily be considered at ground potential, however, at UHF the chassis metal actually has enough inductance and resistance to offer appreciable impedance to signal currents.

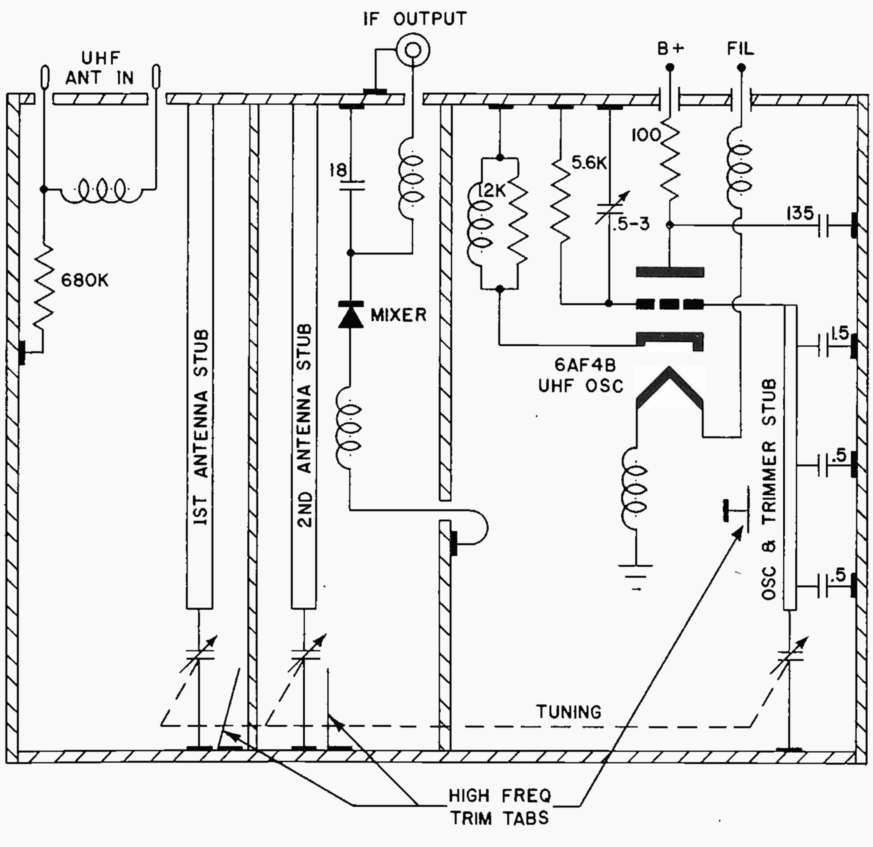

Figure 3—Circuit of Typical UHF Tuner

TUNER CIRCUITS

A UHF tuner using coaxial circuits is shown in Figure 3; it uses a 6AF4 local oscillator, crystal diode mixer combination. Plate and filament voltages of the UHF tuner are obtained by interconnecting leads between the UHF tuner and VHF tuner. The converter shown in Figure 1 uses these same tuned circuits.

The circuit and mechanical construction of these UHF tuners is relatively simple, very little trouble should be encountered with the tuner, other than a defective tube or mixer crystal. But, the high frequencies make it necessary that extreme care be exercised when servicing. When replacing components, it is imperative that they be replaced with others of identical electrical characteristics and physical size.

UHF TUNER ALIGNMENT

A representative UHF Tuner Kit is shown in Figure 4. It consists of a continuously variable UHF tuner with an IF amplifier assembled to the tuner.

The UHF tuner and amplifier assembly employs three tubes and a crystal mixer. A single control provides continuously variable tuning, covering all 70 UHF channels. Picture IF is 45.75 mc and sound IF is 41.25 mc. The tuner output or the VHF output is fed to the receiver's IF amplifier through P101.

To properly perform alignment of the tuner/amplifier unit, the following test equipment should be available:

1. **Bias Supply.**
2. **Cathode Ray Oscilloscope.**
3. **VTVM**—A 1.5 volt dc scale is required.
4. **Input Head**—As in Figure 5.
5. **Oscilloscope Preamplifier**— Required for alignment of UHF tuner.
6. **VHF Heterodyne Frequency Meter**—With crystal calibrator if the signal geneator is not crystal controlled.
7. **VHF Signal Generator**—To provide the following frequencies with crystal accuracy:
   (a) Intermediate frequencies, 39.25 mc to 47.25 mc.
   (b) Output should be adjustable and at least 0.1 volt maximum.
8. **VHF Sweep Generator**—Meeting the following requirements:
   (a) Frequency range 35 to 50 mc, 1 mc to 12 mc sweep width.
   (b) Output adjustable with at least 0.1 volt maximum.
   (c) Output constant.
   (d) Flat output on all attenuator positions.
9. **UHF Sweep Generator**—With a frequency range of 470 mc to 890 mc.
10. **UHF Signal Generator** — To provide frequencies between 461 mc and 931 mc with crystal accuracy.
11. **Sweep Attenuator Pads**—As in Figure 6.

This test equipment or its equivalent, is essential to properly perform the alignment procedures. A warm-up period of at least 15 minutes should be allowed for proper stabilization of such equipment as Signal and Sweep Generators. It is essential that the bias values as specified are maintained during alignment to insure the proper results.

The input head is designed for correct matching of the equipment to the circuits involved and improper matching will result in responses which cannot be depended upon as representing true operation. All unshielded leads at the end of the test equipment cables should be as short as possible, less than one inch long if possible.

A small ceramic capacitor of about 1000 pf connected from the oscilloscope probe to ground usually will eliminate stray pick-up of unwanted signals. Make sure the capacitor does not affect the shape of the response being observed.

Use of excessive signal from the sweep generator can cause overloading of the circuits. It is possible to determine that this condition is not present and that the response is a true representation by turning the sweep generator output to zero. Next, gradually increase the output until a response is obtained, a further increase of the sweep output should

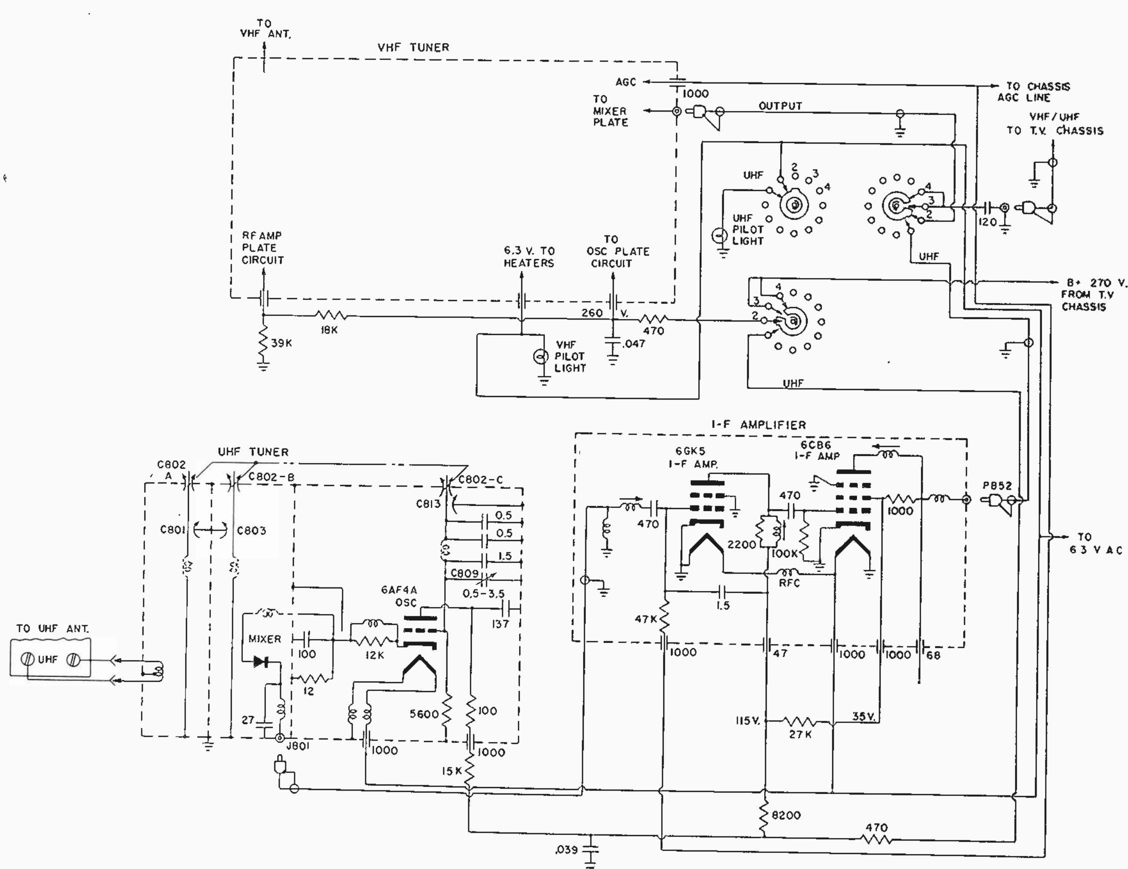

Figure 4—Representative Tuner Kit

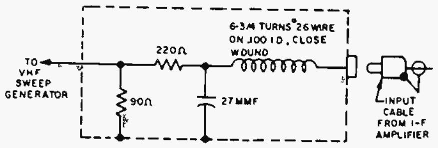

Figure 5—IF Amplifier Input Head

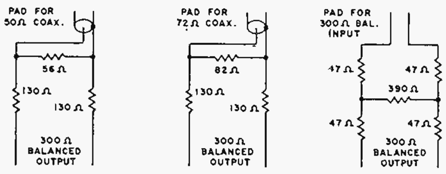

Figure 6—Sweep Attenuator Pads

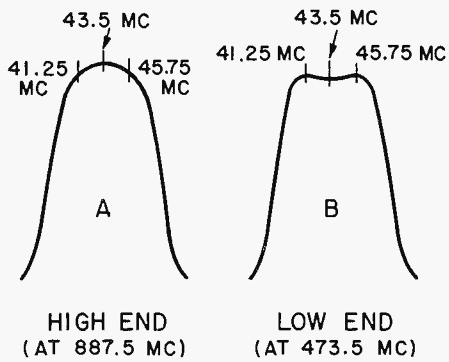

Figure 7—Tuner Response Curves.

not change the configuration of the response, except in amplitude. But where the response does change in shape (flattening at the top or dropping below the base line at bottom for example) decrease the sweep output to restore the proper shape. The oscilloscope gain should be run as high as possible to maintain a usable pattern with the peak-to-peak values specified, which requires a lower output from the sweep generator with less chance of overload.

TABLE II—TUNER ALIGNMENT PROCEDURE

Step	UHF Sweep and Signal Generators	VHF Signal Generator	Adjust
1. Adjust osc. tab at high freq. end	887.5 mc center freq. Chan. 83	41.25 mc 43.5 mc 45.75 mc	Gang at 172° point. Knife C801 and C803 for response "A" (Figure 7) centered at 887.5 mc.
2. Adjust osc. tab at high freq. end	887.5 mc center freq. Chan. 83	43.5 mc	Adjust C813 so 43.5 mc marker and 887.5 mc marker coincide. See response "A".
3. Adjust osc. trimmer at low freq. end	473.5 mc center freq. Chan. 14	43.5 mc	Gang at 5° point. Adjust C809 so 43.5 mc marker and 473.5 mc marker coincide. See response "B" (Figure 7).
Repeat Steps 1, 2 and 3 for proper response. Tune entire range from high freq. to low freq. end and check response to be within limits. Mistracking to the extent that carriers do not fall lower than 70% down the sides of response is permissible. If tracking is outside limits proceed with Step 4.			
4. Knife R-F plates from high to low end	Downward from high to low end for Chan. being observed	41.25 mc 43.5 mc 45.75 mc	Knife segments of C802A and B from high to low end. Knife equally on each side at point closest to mesh with stator. Do not reknife preceding section. Always knife going lower in freq.
5. Tune entire range and observe reading on VTVM. A reading of at least + .08 volts should be obtained with 60 volts at UHF tuner B+ terminal. If not, the fault probably lies in the 6AF4 or the LD128 crystal. If the crystal is replaced make sure the polarity is correct as will be indicated by a positive voltage (with respect to ground) across the 100 ohm resistor.			

Insertion of markers from the signal generator should not cause distortion of the response. The markers should be kept as small as possible and still remain visible. Loose coupling of the generator cable to the sweep cable will usually provide ample marker information without distortion of the response.

TEST EQUIPMENT CONNECTIONS

1. Connect a 100 ohm resistor from center conductor of J801 to ground.
2. Connect the scope using preamplifier to center conductor of J801 at the 100 ohm resistor.
3. Connect the VTVM to the center conductor of J801.
4. Connect the VHF Signal Generator in series with 1000 ohms to the center conductor of J801.
5. Connect the UHF Sweep Generator to antenna terminals using 300 ohm pad, set for full sweep width.
6. Couple the UHF Signal Generator loosely to the sweep cable if sweep does not have internal markers.

Fashion a test dial to fit over split gear on tuning gang. Mark 0°, 5°, and 172° on test dial. Establish 0° with tuner gang shaft fully counter-clockwise with gang fully meshed. Where the kit has been installed in a set, turn the VHF channel selector knob to the UHF position (between channels 2 and 13) which supplies the necessary B+ voltages to the UHF tuner for alignment purposes. If the UHF tuner is aligned independently from the TV chassis, the filament and DC voltages must be supplied from an external power supply source.

Alignment steps are given in Table II. Response curves referred to in Table II are shown in Figure 7.

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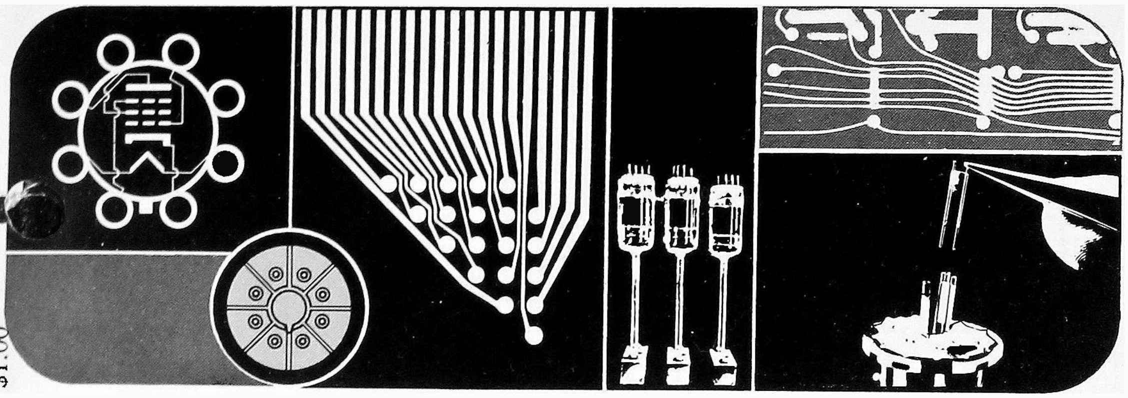

SYLVANIA NEWS
Technical Section
Fall 1964 ☐ VOL. 31, NO. 3
R. A. HUMPHREYS, TECHNICAL EDITOR This information in Sylvania News is furnished without assuming any obligations.

RECEIVING TUBE RELIABILITY IN TV RECEIVERS

By **G. V. Herrold**
Electronic Tube Division
Sylvania Electric Products Inc.
Emporium, Pennsylvania

Figure 1—TV Life Test Area at Electronic Tube Division Plant at Emporium, Pennsylvania.

A COMPREHENSIVE EVALUATION of receiving tube reliability in various makes and models of TV receivers is a program of analysis conducted by Sylvania which still continues today, after 14 years, **Figure 1**. The receivers are operated at 130-volts line, instead of at normal line voltage to accelerate results. The tests are continued for 1500 hours of operation and cycled 50 minutes **on** and 10 minutes **off**.

The degree of acceleration produced by the increased line voltage is determined periodically by operating a control group of sets at 117-volts line. The ratio of the proportion of tube failures at 130 volts to the proportion at 117 volts is the acceleration ratio. This ratio is approximately 4.0. That is, the number of failures at 130-volts line is four times greater than at 117 volts at the completion of 1500 hours.

Since July 1954, approximately 33,000 Sylvania tubes have been tested in more than 2000 TV receivers produced by all major American manufacturers.

During that time, yearly average tube failure rates have been decreased from five per cent per 1000 hours to 0.9 per cent per 1000 hours at 130-volt line. The pattern of significant improvement is shown by **Figure 2.**

Five TV circuit applications have generally been most subject to failure. These are horizontal deflection amplifier, vertical deflection amplifier, damper, VHF amplifier, and UHF oscillator. Yearly average failure rates since 1954 for these critical sockets are displayed by **Figure 3.**

During the past four years the total number of circuits in which failures were noted receded from 14 to 7. The per cent tube failure through 1500 hours for each of these circuits for each year is shown by **Figure 4.**

During the 1962-63 testing period, the use of a nickel additive to the cathode coating for damper types was introduced to inhibit arcing. This was largely responsible for the reduction in damper failure rate down to 2.9 per cent per 1000 hours. About one-half of the tests during this period had the nickel additive, therefore further improvement is expected.

During this same period, failure of the long-troublesome UHF oscillator was reduced to zero. This significant

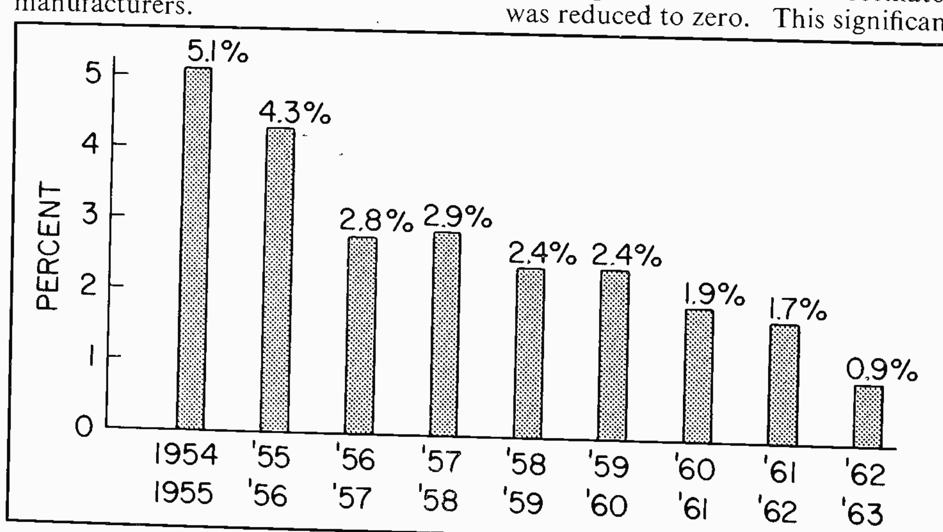

Figure 2—Average Tube Failure Rate—% Per 1000 Hours at 130-V Line July to July.

stride was due to the use of a powdered nickel alloy cathode developed by Sylvania and now being used in most tube types. The powdered metal cathode, which is formed from material produced by cold-rolling a powdered metal blend of base materials, exhibits distinct advantage in controlling sublimation and insulation resistance. The precise control of the mixing, that is achieved in the powdered state and subsequent cold processing, assures more uniform characteristics and excludes impurities to a degree never before achieved.

REASONS FOR FAILURE

Only four causes for failure have consistently been responsible for 50 per cent to 80 per cent of the total failures. These are open heaters, shorts, arcing and gas. However, the per cent tube failure for each of these major causes has shown important improvement. Percent tube failure by cause and year is shown by **Figure 5.**

It has been found that the open heater problem can be greatly reduced by the use of rhenium-tungsten wire. This material is much more ductile than ordinary tungsten and has a higher recrystallization temperature. It also has a higher internal resistance which allows the use of a larger diameter thus adding substantially to mechanical strength.

Open heaters can also be reduced by applying a dark overcoating to the white aluminum oxide first—layer that insulates the heater wire electrically. This makes for more efficient heat transfer to the cathode thus permitting the use of a lower heater operating temperature.

The use of these materials is not reflected in any of the open heater failures shown in **Figure 5**, but will begin to appear in the 1963-64 data.

A continuing test of five types with rhenium-tungsten (250 tubes) and five types with dark heaters (250 tubes) has reached 2800 hours in TV receivers operated at 130-volts line with only one open heater to date. This is equivalent to a failure rate of only 0.07 per cent per 1000 hours. This one failure was not due to embrittlement.

Other extensive data, obtained under various stress conditions, strongly indicate that the use of rhenium-tungsten alloy and/or dark overcoating will virtually eliminate heater failures due to embrittlement.

CIRCUIT	1954 1955	'55 '56	'56 '57	'57 '58	'58 '59	'59 '60	'60 '61	'61 '62	'62 '63
Horiz. Defl. Amp.	17	23	11	6.7	6.5	3.3	2.0	1.3	0.2
Vert. Defl. Amp.	17	19	11	2.0	3.3	4.0	4.0	4.7	0.6
Damper	22	11	6.0	10	6.0	10	6.0	4.7	2.9
VHF Amp.	15	12	4.7	8.0	6.7	3.3	1.3	0.0	0.0
UHF Osc.	—	—	—	10	4.7	8.0	8.7	1.3	0.0

Figure 3—Average Tube Failure Rate—% Per 1000 Hrs. at 130-V Line by TV Circuit Application July to July.

CIRCUIT	FAILURE RATE PER 1000 HOURS			
	1959 1960	1960 1961	1961 1962	1962 1963
Vert. Defl. Amp.	4.0%	4.0%	4.7%	.6%
Damper	10.0	6.0	4.7	2.9
Low Voltage Rect.	3.2	3.3	4.2	.0
Osc. Mixer	2.5	4.1	3.3	5.1
Hi Voltage Rect.	2.4	1.7	2.6	.4
Horiz. Defl. Amp.	3.3	2.0	1.3	.2
UHF Osc.	8.0	8.7	1.3	.0
AGC	.0	.0	1.2	.0
IF Amp.	.6	.2	.6	1.0
Sound Disc.	.7	.0	.0	.8
Sound Output	.7	.5	.0	.0
RF Amp.	3.6	1.2	.0	.0
Sound Det.	1.0	.0	.0	.0
Video Amp.	2.7	.0	.0	.0
VHF Amp.	3.3	1.3	.0	.0

Figure 4—TV Circuits Having Tube Failures at 130-V Line thru 1500 Hours.

CAUSE	JULY TO JULY TEST								
	1954 1955	1955 1956	1956 1957	1957 1958	1958 1959	1959 1960	1960 1961	1961 1962	1962 1963
Open Heater	1.86	1.78	1.03	1.17	.73	.72	.19	.47	.32
Shorts	2.02	1.17	1.19	.94	1.08	.83	1.05	.55	.32
Arcing	—	.72	.22	.56	.34	.76	.29	.55	.19
Gas	1.50	.82	.29	.14	0	0	.10	0	0
Others	1.35	1.37	1.20	1.50	1.45	1.30	1.29	.90	.56

Figure 5—Percent Tube Failure by Cause and Year thru 1500 Hours at 130-V Line.

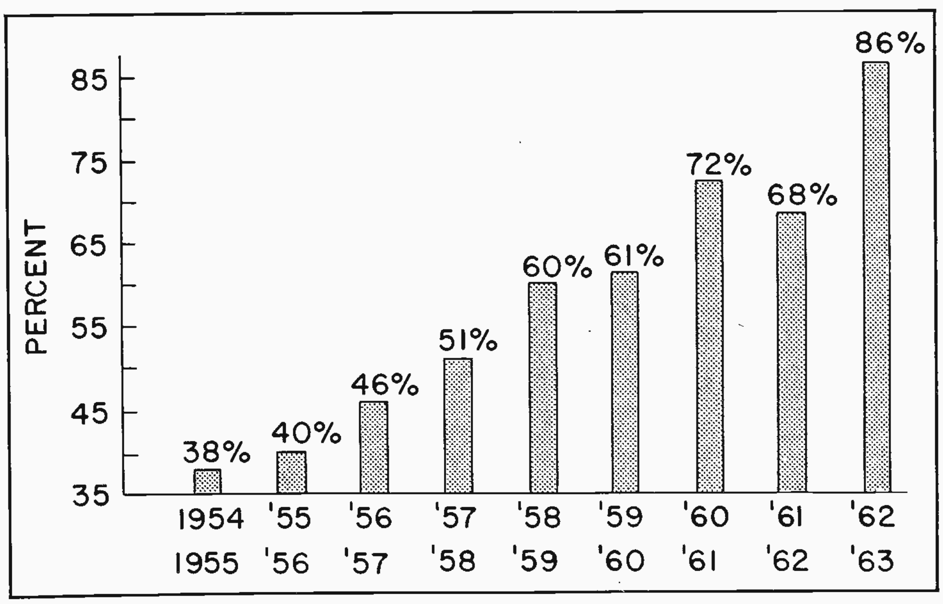

Figure 6—Percent of Sylvania Tube Types with Zero Failures thru 1500 Hours at 130-Volt Line.

SYLVANIA NEWS

Dealer Section

Fall 1964 □ VOL. 31, NO. 3

DICK DE SALVO, EDITOR, Published for the Professional Radio-TV Service Dealer.

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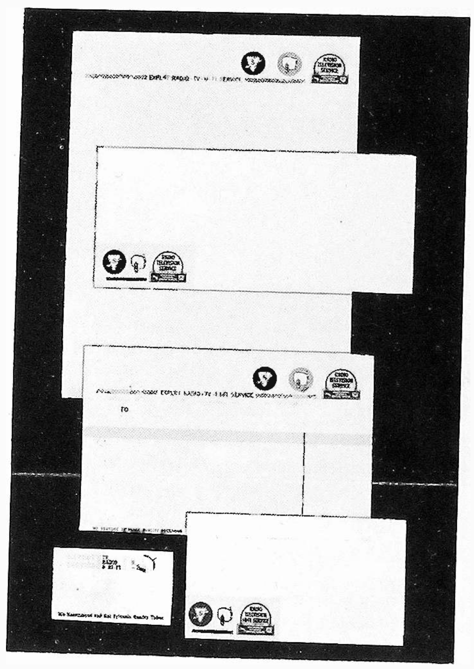

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THE "RECOGNIZED QUALITY" OF THE

The Sylvania screen . . . there's a new one in every Silver Screen 85. And every one, from beginning to end, is characterized by Sylvania craftsmanship throughout.

To begin with, the phosphors that are so important to screen brightness are rigorously controlled during their manufacture. And to assure the highest quality, these phosphors undergo more extensive testing upon arrival at Sylvania's picture tube plant. Absolute testing controls over these critical phosphors are the first of many steps taken to insure the brightest screens possible for the Silver Screen 85.

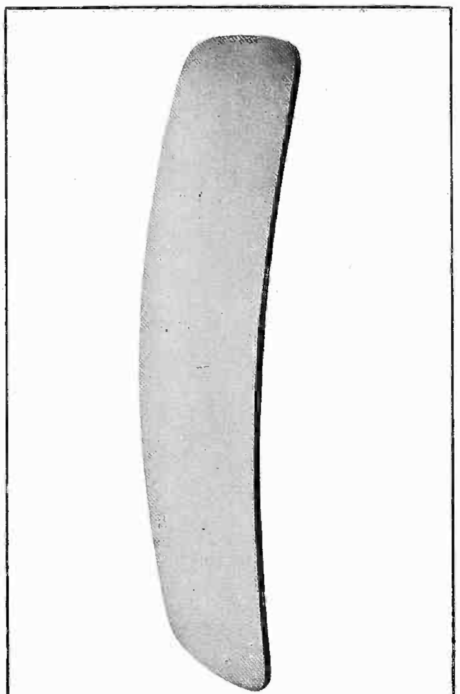
Sylvania also takes extra precautions during the screening process in the preparation and storage of the screen solution. The solution is actually stored in a tile-lined room, and is filtered through large stainless steel filters before it is allowed to flow out of the solution room. This protects the solution from impurities that could cause spots, holes, or dirt specks on the screen.

Special safeguards are also taken to guarantee a consistent uniform screen for each and every bulb. Transparent plastic reservoirs are filled automatically by electrically controlled devices and supply each Silver Screen 85 with exactly the right amount of solution.

To eliminate the possibility of a slight change in temperature destroying the edge-to-edge color of the screen, or producing dark centers, Sylvania rigidly maintains atmospheric conditions. This is accomplished through air filters and air conditioners that eliminate any dust in the air during the screen-settling process. Also the warm air that is used to dry and set each screen has, itself, been carefully pre-dried to remove moisture.

These steps are *only* the measures Sylvania takes during the processing of every Sylvania *screen*. Add to these the many, many extra precautions that are taken during the complete production of the Silver Screen 85.

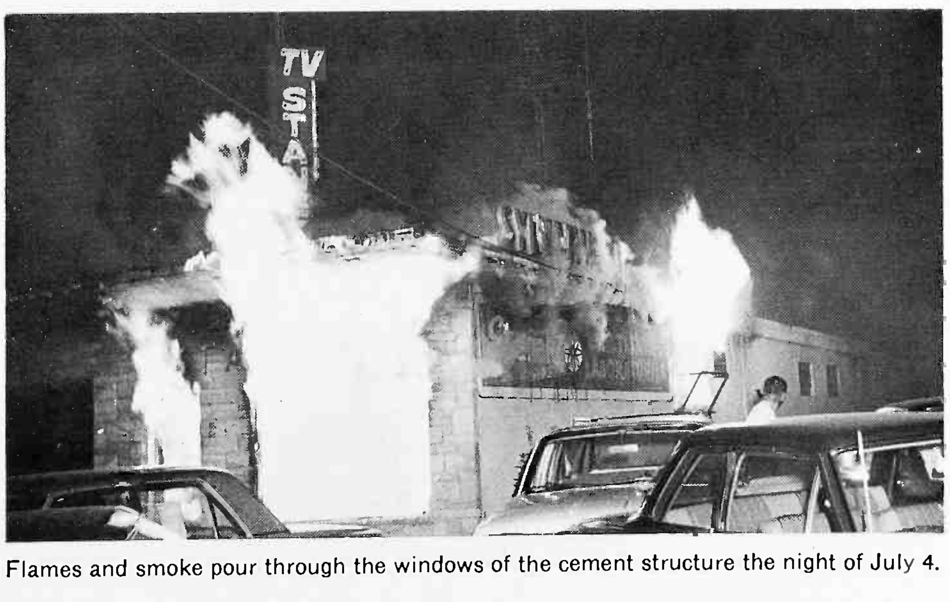
It is doing "something more than is required" that distinguishes the manufacture of the Silver Screen 85 throughout. That's why you can install Sylvania picture tubes with utmost confidence. And that's why your customers are satisfied with the brightest, clearest, sharpest reception from any picture tube available.



The Sylvania Screen

Note: Silver Screen 85 picture tubes are made only from new parts and materials except for the envelopes, which prior to reuse, are inspected and tested to the same standard as new envelopes.

SYLVANIA DEALER REBUILDS AFTER FIRE DESTROYS STORE



Flames and smoke pour through the windows of the cement structure the night of July 4.

William Stanek, Sylvania dealer in Manchester, Connecticut, saw his dreams go up in smoke the night of July 4 when a fire gutted the interior of his radio-television sales and service store. Damages were estimated to run as high as $100,000, but fortunately a large part of the loss was covered by insurance.

What to do? Well, Bill's a man of stern stuff. He decided right then and there that he would carry on in the business he knew best. A "crash" building program at 277 Broad Street started to reconstruct what was, and still is Stanek Electronics Laboratories.

It took just three short months to the day. Saturday, October 4, Mr. Stanek and his personnel held Open House for the general public.

Congratulations, Bill! It is men like you, who bounce back from misfortune, who do our industry proud.

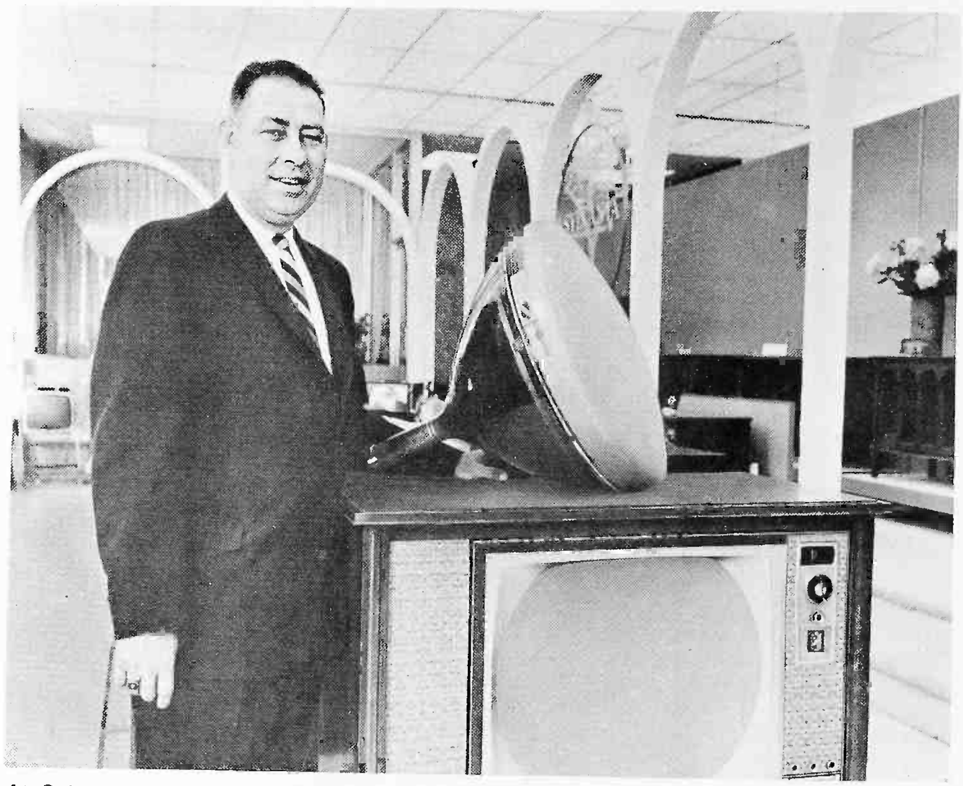
SYLVANIA PRODUCES 30 MILLIONTH PICTURE TUBE

Sylvania's color tube operations in Seneca Falls, New York recently announced that the 30 millionth picture tube manufactured by Sylvania had been lifted from the assembly line.

The news in itself isn't startling. Nevertheless to Sylvanians and to our dealers across the country, it represents an important milestone of great significance.

Much of that significance is represented by this particular 30 millionth tube—a Color Bright 85. Development of this revolutionary color picture tube has brought us Europium Red, the truest, most vivid red known to television today. And with this new, true red, *all* colors in the television spectrum are more natural, more vibrant. In monochrome brightness, too, the tube's performance is far superior to the industry average.

But before Color Bright 85, there were hundreds of thousands of other tubes—millions—that were manufactured to Sylvania's exacting, demanding specifications. Every one of those 30 million tubes was a product of the cumulative experience and knowledge in design, engineering, research, manufacturing and testing that go into the world's finest picture tubes.



At Sylvania's Home Entertainment Showroom in New York City, Merle W. Kremer, Senior Vice-President—Electronic Tubes, shows off a **Color Bright** 85—30 millionth Sylvania-produced picture tube.

To you, as an independent service dealer, this means the utmost confidence in every Silver Screen 85 installation. For your customers, it means the sharpest, brightest, most dependable performance from any picture tube on the market.

As good as new. Stanek Electronic Laboratories just before the October 4 reopening.

Modern interior of new Stanek store provides attractive setting for full line of Sylvania entertainment products.

Keep Your Picture Tube Comparison Chart Up-To-Date With These New Additions

Because new picture tube types are constantly being added to the line, Sylvania's latest editions of the Picture Tube Comparison wall chart and pocket guide already need updating.

To keep you abreast of the changes and your references current, the information below lists Sylvania's latest types in production and their characteristics. Attach it to your charts so that you'll have the information where you want it, when you want it.

If you have yet to obtain your copies of these two popular reference pieces, you can do so from your Sylvania Distributor, or by writing CADD, 1100 Main Street, Buffalo, New York 14209. When writing, order by number: Wall Chart (ET-1050); Pocket Guide (ET-1051). Enclose 10¢ for each requested.

LATEST ADDITIONS TO PICTURE TUBE WALL CHART & POCKET GUIDE

NOTE: Because every new type listed is rectangular, tinted and aluminized, the "FACE" column on your Picture Tube Comparison references does not appear in the chart below.

Type	Heater EF/IF Volts Amps	Metal or Glass	Ext. Coating Capacitance	Focus	Defl. Angle	Anode Volts KV Max.	Basing	Neck Length	Ion Trap Mag.	Nominal Length (In.)
11DP4	6.3/.45	G	500- 750	Lo Es**	110	15	8HR	4¼	N	8 15/16
11EP4	6.3/.60	G	300- 500	Lo Es	114	14	8HR	4⅛	N	8 15/32
11FP4	6.3/.45	G	300- 500	Lo Es	114	14	8HR	4⅛	N	8 15/32
11GP4	6.3/.45	G, BF	400- 600	Lo Es**	110	15	8HR	4¼	N	8 15/16
16BFP4	6.3/.45	G	800-1500	Lo Es	114	15.4	8HR	4	N	10 1/16
16BMP4	6.3/.45	G	800-1500	Lo Es	114	15.4	8HR	4¼	N	10 1/16
16RP4B	6.3/.60	G	750-1500	Mag	70	17.6	12N	7½	N	18¾
17BP4D	6.3/.60	G	750-1500	Mag	70	17.6	12N	7½	N	19 3/16
19DBP4	6.3/.45	G, BP	1400-1900	Lo Es**	114	19.8	7FA	4⅜	N	11 13/16
19DQP4	6.3/.45	G, BR	1000-1500	Lo Es	114	23	8HR	4⅛	N	11⅜
19DSP4	6.3/.60	G, BR	1000-1500	Lo Es**	114	20	8HR	4⅜	N	11⅝
19DUP4	6.3/.45	G, BR	1150-1550	Lo Es**	114	22	8HR	4½	N	11¾
19DVP4	6.3/.45	G	1000-1500	Lo Es**	114	20	8HR	4½	N	11¾
19DYP4	6.3/.45	G, BC	1700-2100	Lo Es**	114	23	8HR	4⅛	N	11⅝
19DZP4	6.3/.45	G	1000-1500	Lo Es**	114	18	8HR	4½	N	11¾
19EBP4	6.3/.60	G, BF	1000-1500	Lo Es	114	23	8HR	4⅜	N	11⅝
19ECP4	6.3/.45	G, BR	1000-1500	Lo Es**	114	20	8HR	4½	N	11¾
19EFP4	6.3/.60	G, BR	1000-1500	Lo Es**	114	20	8HR	4⅜	N	11⅝
19EGP4	6.3/.45	G, BF	1000-1500	Lo Es**	114	21	8HR	4⅜	N	11⅝
21AVP4C	6.3/.60	G	2000-2500	Lo Es	72	22	12L	7½	N	23 1/32
21AWP4A	6.3/.60	G	2000-2500	Mag	72	19.8	12N	7½	N	23 1/32
21WP4B	6.3/.60	G†	500- 750	Mag	70	19.8	12N	7½	N	22 7/16
23CGP4	6.3/.45	G	1700-2500	Lo Es	92	22	12L	5½	N	18
23DLP4A	6.3/.60	G, BR	1700-2500	Lo Es**	92	22	12L	5½	N	18
23DVP4A	6.3/.60	G, BR	1700-2500	Lo Es	114	22	8HR	5⅛	N	14 7/16
23EKP4	6.3/.45	G, BR	1700-2500	Lo Es	92	25	12L	5½	N	18
23ENP4	6.3/.60	G, BR	1700-2500	Lo Es**	92	25	12L	5⅝	N	18⅛
23EQP4	6.3/.45	G, BR	1700-2500	Lo Es	114	23	8HR	5⅛	N	14 17/32
23ETP4	6.3/.60	G, BR	1700-2500	Lo Es	110	23	8HR	5⅛	N	14⅞
23FBP4	6.3/.60	G, BR	1700-2500	Lo Es**	92	25	12L	5⅝	N	18⅛
23FCP4	6.3/.45	G, BR	1700-2500	Lo Es**	110	22	8HR	5⅛	N	14⅞
23FDP4	6.3/.45	G, BR	1700-2500	Lo Es**	110	23	8HR	5⅛	N	14⅞
23FMP4	6.3/.45	G, BR	1700-2500	Lo Es	110	23	8HR	5⅛	N	14⅞
23FRP4	6.3/.45	G, BF	1700-2500	Lo Es**	110	23	8HR	4½	N	14¼
23FSP4	6.3/.60	G, BF	1700-2500	Lo Es	110	23	8HR	5⅛	N	14⅞
23FWP4	6.3/.45	G, BR	1700-2500	Lo Es**	92	22	12L	5½	N	18
23FWP4A	6.3/.45	G, BR	1700-2500	Lo Es**	92	22	12L	5½	N	18
23GBP4	6.3/.45	G, BR	1700-2500	Lo Es	110	23	8HR	5⅛	N	14⅞

Mag.—Magnetic • Es—Electrostatic • Lo Es—Low Voltage Electrostatic • **—Low Grid No. 2 Voltage • †—Bulb Varies in Dimensions from Normal • BC—Bonded Shield Glass Cap • BP—Bonded Glass Plate • BL—Bonded Laminated Plastic Shield • BR—Bonded Metal Rim plus Tension Band and Fiber Glass Cone Cover • BF—Bonded Metal Frame.

TUBE RELIABILITY INCREASES

Another measure of progress in tube reliability has been the proportion of total types life tested which showed zero failures through 1500 hours. This proportion increased from 38 per cent in 1954 to 86 per cent for the most recent year. The year-by-year pattern is shown by **Figure 6.**

During the most recent testing year there was a total of 12 tube types which exhibited failures. These occurred in seven circuits. There were 32 tube types used in these same circuits which had zero failures. A total of 39 additional tube types used in other circuits had zero failures. This is displayed by **Figure 7.**

1500 HOURS AT 130 V—1962-1963

CIRCUIT	No. of Types With Failures	No. of Types Without Failures
Vert. Defl. Amp.	1	4
Damper	3	4
Osc. Mixer	2	3
Hi Volt Rect.	1	2
Horiz. Defl. Amp.	1	9
IF Amp.	3	8
Sound Disc.	1	2
All Other Circuits	0	39
Total	12	71
Total types tested	83	
Total types with failures	12	
% of types WITHOUT failures	86%	

Figure 7—Number of Tube Failures by Circuit.

Over the past two years tube reliability has been examined in TV receivers operated under normal usage conditions at 117-volts line for a period of time equivalent to several years of use in the home. (This test is not to be confused with the 117-volt control test conducted to establish the acceleration ratio for 130-volt tests.) Two groups of 25 receivers were tested for 8000 hours at one time and were cycled 5½ hours **on** and ½ **off**. These tests were carried out sequentially and represented two different models of TV receivers.

(Continued on following page)

NEW TUBE TEST DATA SERVICE

SYLVANIA AUTHORIZES PRECISION APPARATUS

We are pleased to announce that the Precision Apparatus Company of Glendale, New York has been authorized by Sylvania to take over our tube test data service. They will continue to supply all tube test data for all Sylvania tube tester models of the serviceman's type.

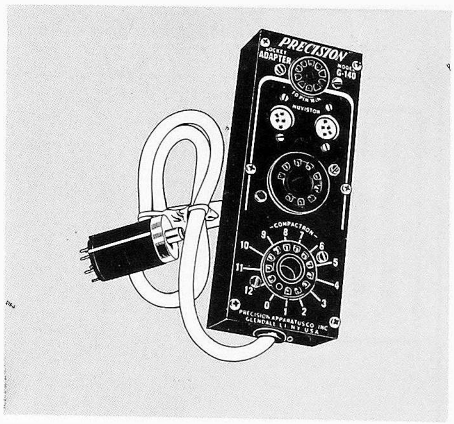
As you know, new engineering developments continue to make possible advancements in tube manufacturing. In order for servicemen to keep abreast of these improvements, and the introduction of new tube types, Precision Apparatus offers a special annual subscription service at a nominal cost.

At periodic intervals during the year, valuable new tube test data will be published and sent automatically to those who subscribe to the service. As a subscriber you will no longer be burdened with the necessity of "writing in" for information on new types that have been introduced.

Your total cost for the service is only $3.00 for a one-year subscription, which includes a minimum of four mailings on new tube data. Also available is a two-year subscription for $5.00. For those who do not choose to subscribe to the service on a yearly basis, test data will be available on request for $2.00.

To accommodate all the new special types (e.g. nuvistors, compactrons, novars, etc.), Precision Apparatus will supply the Model G-140 Adapter which *simply* and *easily* plugs into the nine-pin socket of the tube tester. NO WIRING CHANGES OR ADDITIONS TO THE CIRCUIT ARE NECESSARY. The adapter is priced at $12.95 and an order entitles you to a $2.00 allowance towards the cost of new tube test data.

Subscribe now . . . use the handy coupon below to bring you up-to-the-minute test tube data and/or the Model G-140 Adapter.



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IMPROVED PICTURE TUBE REPLACES TYPE 21EVP4

The Type 21FDP4 is now being recommended as the replacement for Type 21EVP4 used in Philco receivers. Previously, the 21FDP4 was offered only as a replacement for Type 21EAP4. The 21FDP4 features longer life through improved design characteristics, thus reducing servicemen's call backs and in-warranty replacements.

The 21EVP4 employs a 2.68 volt, 450 ma heater; Type 21FDP4 a 6.3 volt, 600 ma heater.

Because of this difference, minor circuitry modifications are required in certain Philco receivers employing the 21EVP4, in order to effect replacement with the 21FDP4:

Philco 10L41, 10L42, 10L43, — These chassis have conventional (parallel) heater wiring with a separate 2.68 volt winding tap for the 21EVP4 picture tube. The picture tube heater lead going to the 2.68 volt tap on the transformer must be disconnected and reconnected to the 6.3 volt winding of the power transformer. This winding can be located by tracing back any of the 6.3 volt filament leads going to other receiving tubes on the printed circuit board.

Instructions for making modifications and a conversion warning label are packaged with each 21FDP4 picture tube.

The last step in making the 21FDP4 replacement, is to affix the warning label to the TV set near the serial number and tube layout diagram. The label notifies future servicemen, that "This TV receiver has been modified for use with a Type 21FDP4 cathode ray tube."

Receiving Tube Reliability In TV Receivers

(*Continued from preceding page*)

One group disclosed an average tube failure rate of 0.3 per cent per 1000 hours and the other 0.2 per cent per 1000 hours of operation. These results, translated into terms of TV receiver reliability are equivalent to approximately 96 per cent through 1000 hours.

The average failure rate for all types under the 130 volts accelerated condition for 1500 hours was approximately 1.2 per cent per 1000 hours. This is the weighted average failure rate.

With strong evidence of further tube failure rate improvement now at hand, it is estimated that the average failure rate, at 130-volt line, for the current testing period, will not exceed 0.5 per cent per 1000 hours. This is equivalent to approximately 0.15 per cent per 1000 hours at 117-volt line.

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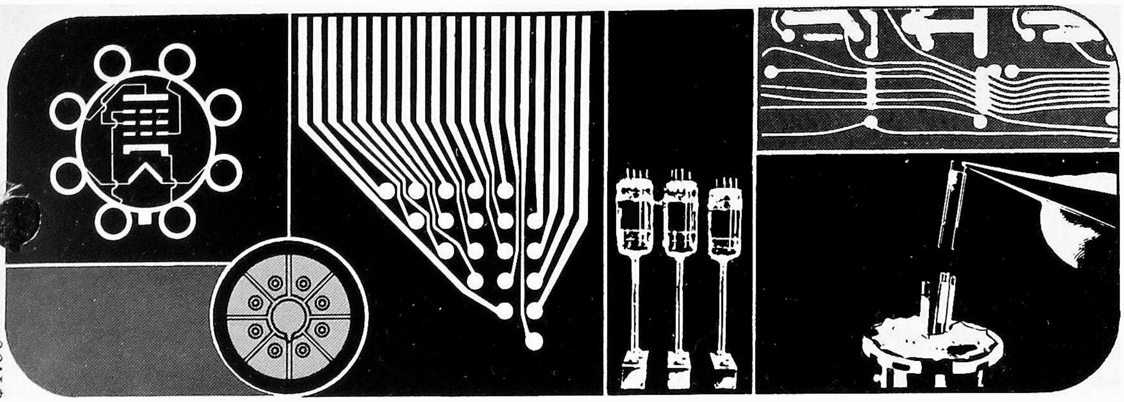

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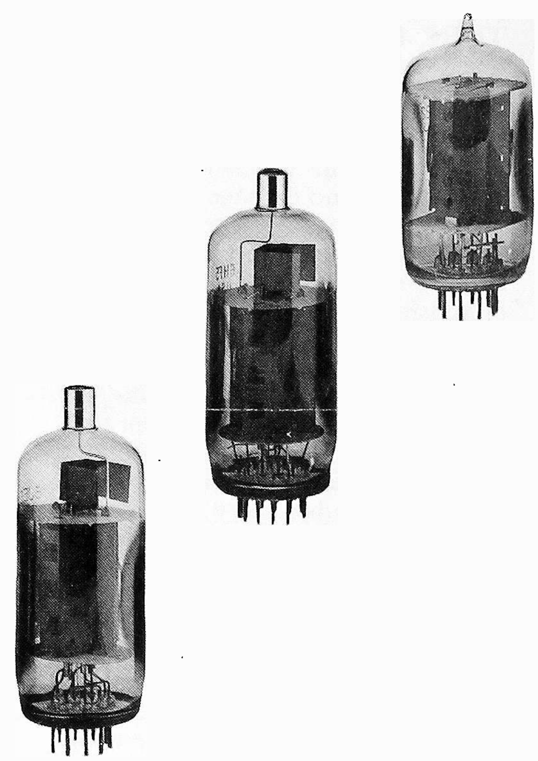
HORIZONTAL DEFLECTION TUBES AS RF POWER AMPLIFIERS

By
W. D. Murphy



The limited choice of RF power amplifier tube types in the 50-watt category and their relatively high cost has caused designers of amateur and industrial communications gear to seek out acceptable commercial receiving tubes for use in this field.

Modern horizontal deflection amplifier tubes, while not originally designed for RF applications have several attractive characteristics. They are capable of high peak currents, an important factor in single sideband applications. Further, these high currents are attainable at low plate voltages which can result in power supply economy. Widespread usage in television applications contributes to low cost and general availability.

Since deflection tubes are designed and controlled in manufacture only for deflection amplifier service, manufacturers ordinarily do not publish data specifically showing operating conditions or capabilities in the various types of RF service. In the interest of providing a benchmark for the equipment designer, Sylvania's Engineering Laboratory has measured and tabulated actual performance of several tube types operating in both Class AB1 and Class C at a frequency of 30 Mc.

Deflection tubes can be divided into two general categories, those designed for black-and-white television, and having a plate dissipation rating of about 17 watts, and larger 25-30-watt tubes designed for color applications. Variations occur in basing, internal connections, and certain electrical characteristics to satisfy specific application requirements.

Four types of low power B&W tubes and two color TV types which appeared suitable for RF service were selected for evaluation:

B & W—6GJ5—6JB6—6JM6—6JG6
Color—6HF5—6JE6

The Types 6JB6 and 6GJ5 differ only in that the former has separate pin connections for the beam forming plates, while in the 6GJ5 the beam plates are internally connected to the cathode. Both have 9-pin novar bases. The Type 6JM6 has a 12-pin base, and slightly lower peak current capabilities than the other types. The Type 6JG6 is a single ended tube designed specifically for "Low B+" television applications.

The Types 6JE6 and 6HF5 have plate dissipations of 24 and 28 watts respectively in color TV deflection service. The 6JE6 has a 9-pin novar base and the 6HF5 a 12-pin base.

The performance, operating conditions, and power levels are shown in Tables I and II. The Class AB1 operation is particularly applicable to single sideband linear amplifier service, while Class C operation applies to CW and narrow band FM operation.

TABLE I
CLASS C OPERATION
ICAS—30 MC

Type	(1) Ecc1 Vdc	(1) Ecc2 Vdc	(1) Ebb Vdc	Peak Ec1 V RF	(1) Ic1 Ma dc	Ic2 Ma dc	Ib Ma dc	Grid 1 Driving Power (Approxi.) Watts	Grid 2 Dissi-pation Watts	Plate Input Power Watts	Power Output Watts RF	Efficiency %	Plate Dissi-pation Watts	(2) Circuit Loss Watts
6GJ5	–75	200	500	61	5.0	14.9	180	.43	2.99	90.0	62.7	69.5	22.0	5.3
6HF5	–85	140	500	67	8.0	12.5	232	.76	1.75	116.0	77.0	66.0	35.0	4.0
6JB6	–75	200	500	61	5.0	13.3	180	.43	2.66	90.0	62.7	69.5	22.0	5.3
6JE6	–85	125	500	72	8.0	17.2	222	.82	2.15	111.0	76.3	69.0	30.0	4.7
6JM6	–75	200	500	57	4.0	13.7	180	.32	2.72	90.0	61.1	67.9	22.0	6.9
6JG6	–80	150	450	67	8.0	20.0	202	.75	3.0	91.0	63.0	69.3	21.0	7.0

(1) Selected as Optimum Operating Conditions as Outlined in Text.
(2) Calculated Power Lost in Tank Circuit.

TABLE II

CLASS AB1 OPERATION
ICAS—30 MC

Type	(1) Ecc1 Vdc	(2) Ecc2 Vdc	(2) Ebb Vdc	(1) Ib 0 Signal Ma dc	Ic2 Ma dc	Ib Ma dc	Plate Power 0 Signal Watts	Grid 2 Dissi-pation Watts	Plate Input Power Watts	Power Output RF Watts	Peak Envelope Power (P.E.P.) Watts	Effi-ciency %	Plate Dissi-pation Watts	(3) Cir-cuit Loss Watts
6GJ5	−43	200	500	30	3.8	85	15	.76	42.5	17.5	35.0	41.5	22.0	3.0
6HF5	−46	140	500	40	4.5	133	20	.63	66.5	28.8	57.6	43.0	35.0	2.7
6JB6	−42	200	500	30	4.2	85	15	.84	42.5	17.5	35.0	41.5	22.0	3.0
6JE6	−44	125	500	40	3.9	110	20	.49	55.0	23.4	46.8	42.6	30.0	2.6
6JM6	−42	200	500	30	4.4	85	15	.88	42.5	18.3	36.6	43.1	22.0	2.2
6JG6	−35	150	450	30	4.5	98	13.5	.67	44.0	18.9	37.8	43.0	21.0	4.1

(1) Ec1 Adjusted to Indicated Ib (Zero Signal).
(2) Optimum Conditions for Providing Best Linearity and Efficiency.
(3) Calculated Power Loss in Tank Circuit.

TUBE RATINGS

The plate dissipation rating of a particular tube type is established only after extensive life testing, and is set at a value which will result in long life, and no damage to the tube. Deflection tubes are rated for continuous duty, and therefore, must be capable of operating continuously at established dissipation levels. Intermittent operation, such as might be encountered in two-way communication equipment, allows one to operate a tube at higher power than would be permissible on a continuous basis. For this type of service, many transmitting tubes carry Intermittent Commercial and Amateur Service ratings, as well as Continuous Commercial Service ratings. The ICAS plate dissipation rating is 25% higher than the CCS rating of the same tube. The same 25% increase over published values was used to establish the maximum plate dissipations for the several deflection tubes evaluated at 30 Mc.

TEST CIRCUITS AND MEASUREMENTS

To measure a particular tube's capabilities, several amplifiers were constructed for the various tube types with circuitry similar to that found in high frequency transmitters. Figure 1 shows the typical 30 Mc test circuit. Pi network output circuits allowed considerable adjustment of the tuning, loading, and circuit "Q". All supply voltages were adjustable to permit determination of optimum operating conditions.

Figures 2 and 3 show the complete test set-up. Grid drive was obtained from a commercial sideband exciter. CW input at 30 Mc was required for Class C studies, while Class AB1 operation utilized a "two-tone" input. The "two-tone" signal varies from zero to its maximum value at about 1000 times per second, and tests the Class AB1 linear amplifier over its entire operating range. Observation of the output with a wideband oscilloscope provides an accurate indication of linearity.

The point at which power output no longer increases linearly with increasing grid drive is determined by a tube's basic design. Driving the tube beyond this point results in "flat-topping" and distortion. The maximum undistorted output is referred to as Peak Envelope Power, or P.E.P., and is a measure of a particular tube's capability as a linear amplifier. Linearity is of utmost importance in single sideband applications. Any nonlinearity represents distortion which produces spurious signals that result in excessive bandwidth.

Class C operation was established at the condition of minimum grid drive necessary to provide plate saturation and best overall efficiency.

Following is a summary of conditions under which the tubes were operated:

A ICAS maximum plate dissipation capabilities for Class C and AB1 linear service were established at 1.25 times the rated plate dissipation for deflection service.

B ICAS maximum screen dissipation limitations for all types were kept identical to the rated screen dissipation for deflection service.

C Class C operating conditions were established at the point where conditions in (A) and (B) were not exceeded. In general, maximum plate dissipation was the limiting factor.

D Class AB1 operating conditions were established at the point where the two-tone signal did not exceed the predetermined ICAS suggested ratings in (A) and (B); linearity and efficiency were optimized. The wave shape of the two-tone input signal was monitored to insure that no "flat-topping" occurred during Class AB1 operation.

E Various combinations of plate, screen, and grid bias voltages as well as grid drive, plate current, tank circuit "Q", loading, etc. were used to determine an optimum operating condition consistent with the suggested ICAS plate and screen dissipations.

Power output was determined with a calorimetric wattmeter, which operates on the principle of measuring the temperature rise in an RF load resistance.

Plate dissipation for each tube was accurately measured by use of recently developed laboratory type infrared temperature measuring equipment. Any object gives off infrared radiation whose intensity varies in proportion to the temperature. The measuring equipment consists of an optical system for focusing the infrared radiation on a suitable detector, an amplifier, and indicator system. The optics are designed so that only a small area is observed. If for example, a tube plate is observed, the detector will

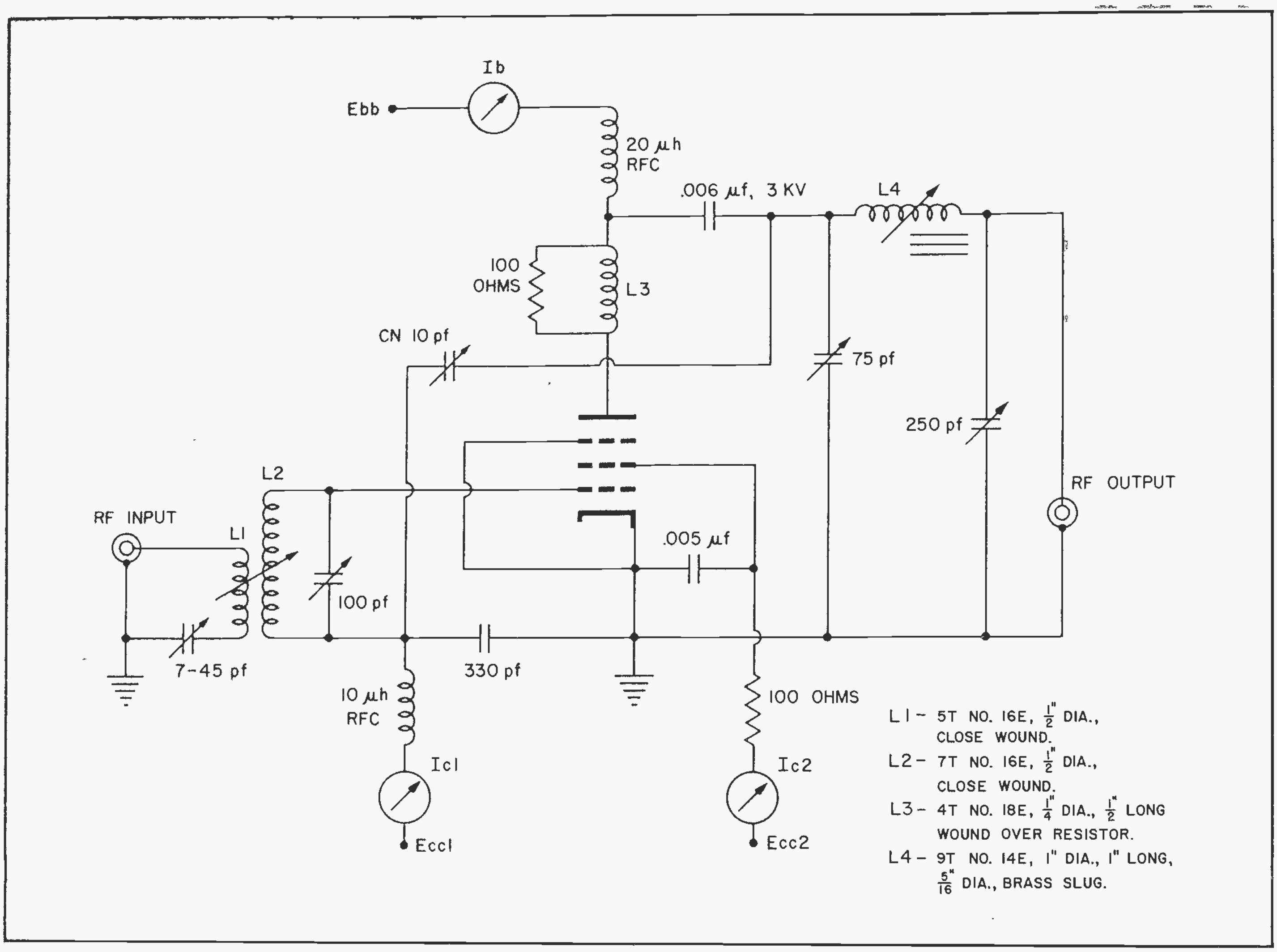


Figure 1—30 Mc Test Circuit.

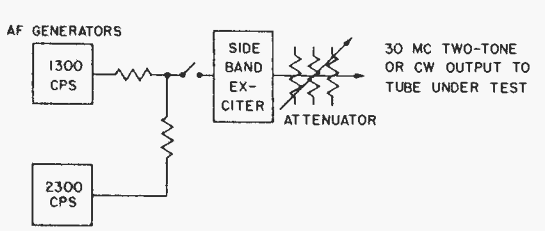


Figure 2—Driver Set-up to Obtain Two-tone Signal for AB1 Linear Operation or CW for Class C Operation.

indirectly show the power being dissipated by the plate. Accurate determination of infrared detector reading vs. power can be made by actually "calibrating" the tube under test. A known plate voltage and current are applied to the tube, with no drive or load, and a curve of temperature reading vs. DC power to the plate is plotted. Then, with the tube operating normally in its test circuit, plate temperature be-

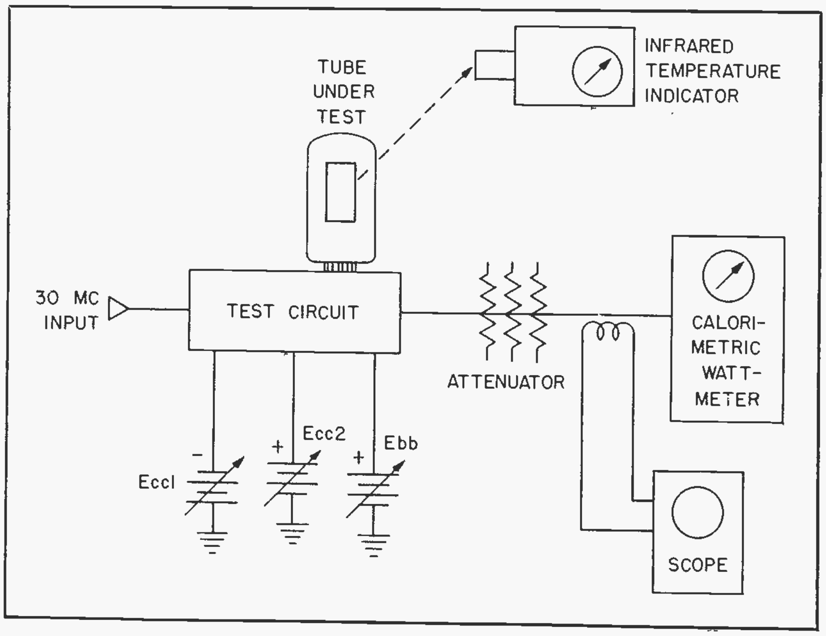


Figure 3—Test Set-up for Measuring Power output, Plate Dissipation and Checking Linearity of Tube Under Test.

comes a precise measure of plate dissipation within the tube.

FREQUENCY LIMITATIONS

The physical construction of a tube is important in determining its high frequency performance. Since horizontal deflection circuits operate at a low frequency, considerations which determine tube lead length, interelectrode capacitance, basing, etc. are not the same as for high frequency tubes. These factors place a limit on high frequency performance. A high output capacitance, for example, would shunt the RF plate current to ground, resulting in excessive currents within the tube. The same is true of the input circuits. Lead inductance resonates with the tube capacitance at some high frequency, further increasing stray currents.

A comparative evaluation of tubes was obtained by measuring resonant frequencies, input and output capacitance. This is shown in Table III.

TABLE III

UPPER FREQUENCY LIMIT

Type	C Input (pf)	Input Resonant Frequency (MC)	C Output (pf)	Output Resonant Frequency (MC)	Probable *** Upper Frequency Limit of Operation (MC)
6GJ5	19.1	190	10.0	190	150
6HF5*	25.5	86	16.3	141	60
6HF5**	26.7	100	16.3	141	75
6JB6	19.1	190	10.5	200	145
6JE6	24.3	82	14.5	152	60
6JM6	17.2	200	10.3	194	150
6JG6	22.9	187	14.7	226	150

*One Grid Connection
**Two Grid Connections
***75% of Self-Resonant Frequency

The effect of lead inductance is evident from the Type 6HF5 input circuit measurements. With only one grid connection, the tube was resonant at 86 Mc. With both grid leads connected in parallel, capacitance increased, but the resonant frequency also increased to 100 Mc.

In conclusion, it should be kept in mind that the operating conditions and limiting values presented in this article are only suggested. They do not constitute formal ratings such as those established for the various tube types in their intended application of horizontal deflection amplifier.

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