SYLVANIA NEWS

Technical Editor
R. A. Humphreys

TECHNICAL SECTION
July 1968 VOL. 35 — ISSUE 3

CHROMA AMPLIFIERS

by

R. F. Bergdahl

Most service technicians have a good understanding of monochrome television and can, without reference to a schematic, state what the waveforms generally should be throughout the circuit. In a color receiver, the signals from the antenna to the video output, including sync and AGC, are identical to a monochrome receiver. The information which must be processed to provide color is contained in the composite video signal.

Therefore, processing of the color information contained in the detected video signal is the essential difference between monochrome and color TV receivers. The color signal contained in the composite video is located in a narrow bandwidth of 1.0 Mhz which is centered on a suppressed subcarrier of 3.58 Mhz. This color information or chroma signal is removed from the video by a take-off circuit tuned to 3.58 Mhz. Amplification, demodulation and matrixing are the three processing stages required to provide color signals at the grids of the three guns in a color picture tube. Our concern here will be with the amplification of the chroma signal and the effects of control voltages supplied to the chroma stages.

Chroma amplifiers, or bandpass amplifiers, as used in present day television receivers can be classified into two general types. Let's call them simply the "One-Stage" and "Two-Stage" amplifier systems. Block diagrams are shown in Figure 1 with the chroma portions enclosed in dotted lines for comparison.

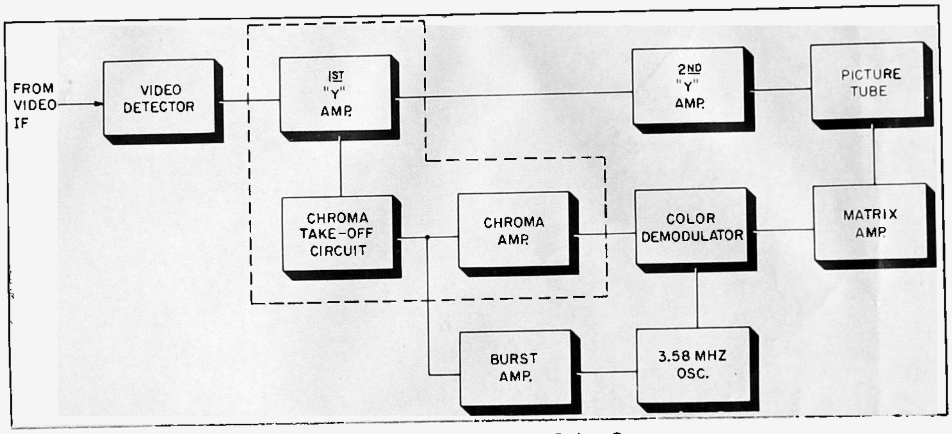

Figure 1A. "One Stage" Color System.

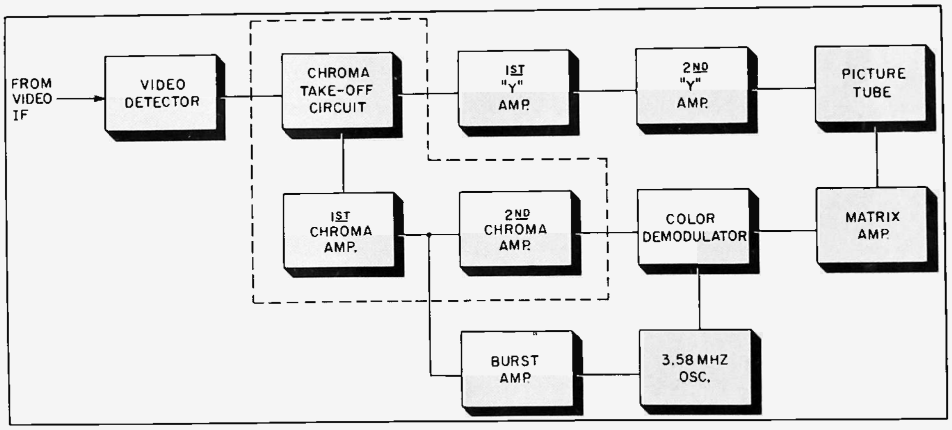

Figure 1B. "Two Stage" Color System.

One-Stage System

A typical "One-Stage" amplifier circuit with corresponding oscilloscope waveforms is shown in Figure 2. In this arrangement, the 1st video amplifier stage also serves as a chroma amplifier by providing an amplified chroma signal output. The chroma signal is removed from the video by a 3.58 Mhz series tuned circuit at the plate. This chroma signal is then used to drive both the burst amplifier grid and the chroma amplifier grid. Notice that the chroma control grid circuit is returned to the killer bias source. This permits the chroma amplifier tube to be cut off with a negative killer voltage when a burst signal is not present or to operate normally when the killer voltage is removed with the presence of a burst signal. Cut-off of the chroma amplifier prevents the display of colored snow when no color signal is received.

The output of the chroma amplifier stage generally ranges from ten to thirty volts peak-to-peak

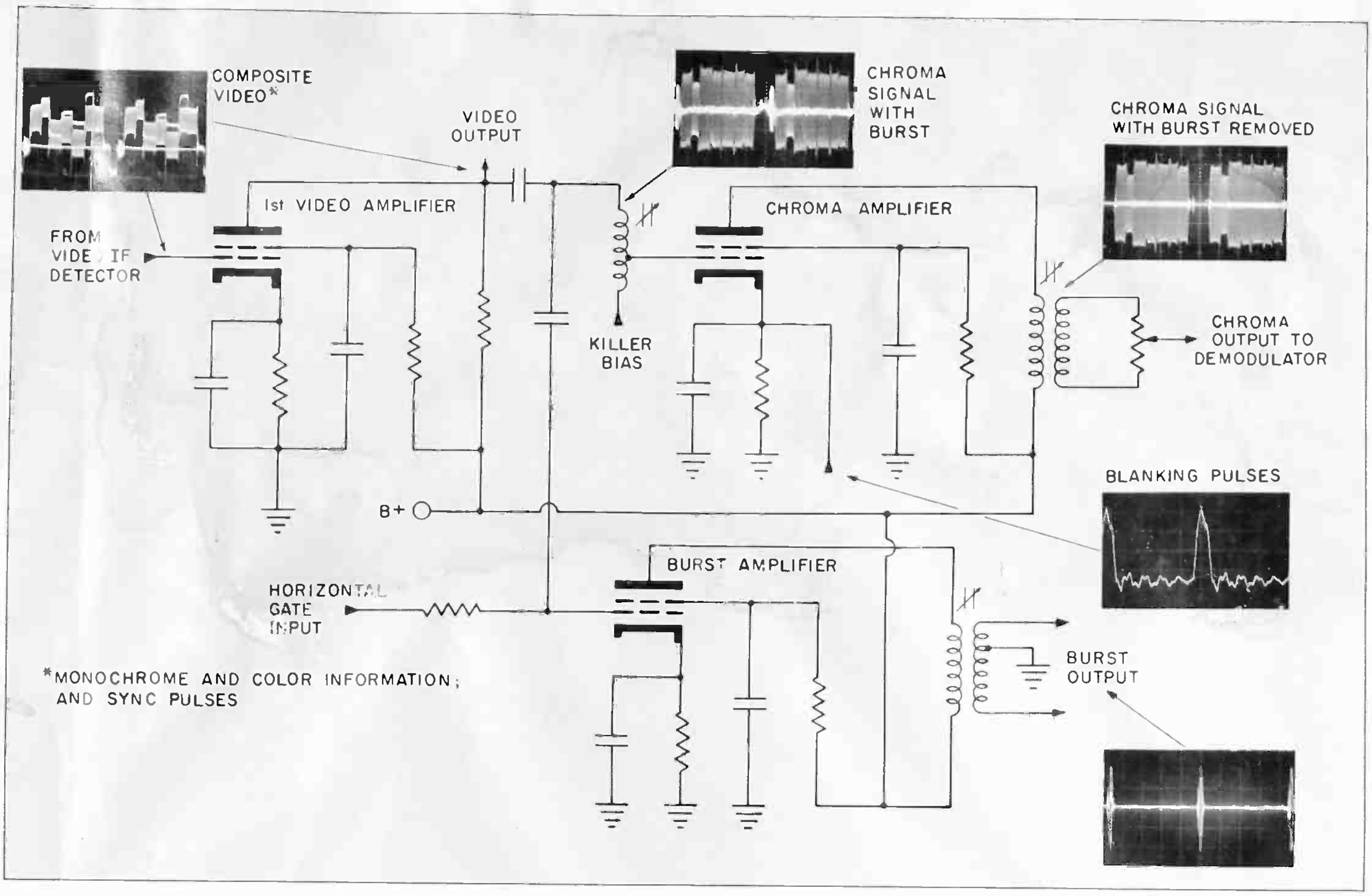

Figure 2. Chroma "Bootstrap" Amplifier Circuit.

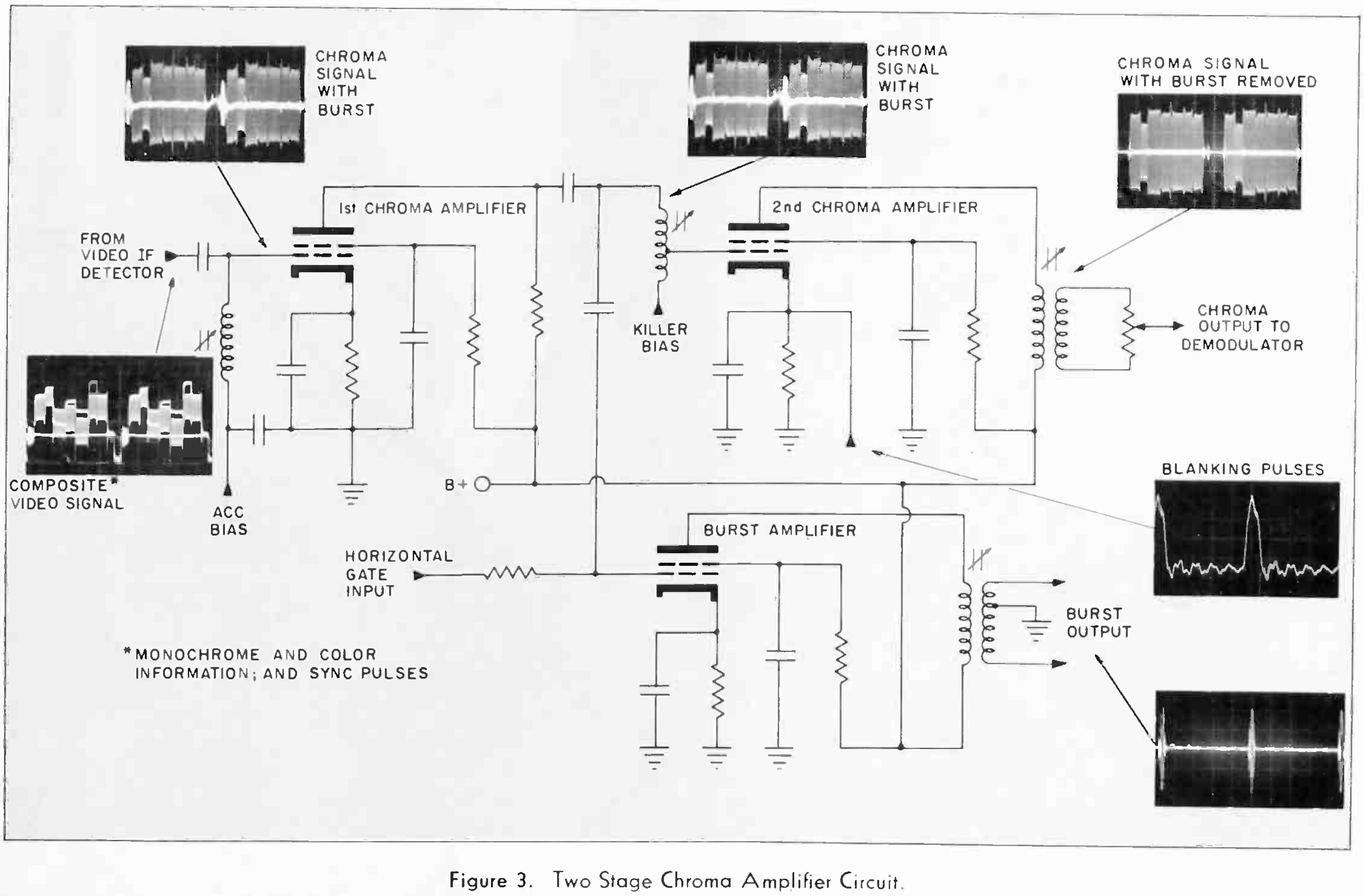

Figure 3. Two Stage Chroma Amplifier Circuit.

depending on the demodulator drive requirements, but in all cases, is from a low impedance output circuit of approximately 500 ohms. The low output impedance is necessary to prevent interaction between the chroma signal applied to the demodulator tube and the carrier signal from the 3.58 Mhz oscillator also supplied to the demodulator tube. The output signal from the chroma amplifier stage would normally contain the burst pulse that is part of the chroma signal. Since the burst signal is of sufficient amplitude, and occurs during horizontal retrace time, a brightening of the retrace lines on the CRT screen results. To prevent this, a positive blanking pulse is applied to the grid of the chroma amplifier tube, thereby removing the burst from the chroma signal driving the demodulator control grid.

chroma amplifier stages. The control grid of the 2nd chroma amplifier tube is returned to a killer bias source which provides a high negative voltage to the grid, cutting the tube off when a signal with no color burst is received. The presence of a color burst signal removes the bias from the 2nd chroma amplifier grid permitting normal amplification of the chroma signal. The output of this tube ranges from 10 to 30 volts and is a low impedance suitable for driving the demodulator tubes.

The color gain control for either the "One-Stage" or "Two-Stage" circuit can be a variable resistance in the cathode of the chroma output tube, a potentiometer in the grid circuit of the chroma output tube or a potentiometer across the secondary winding of the chroma output transformer, the latter being the most commonly used method.

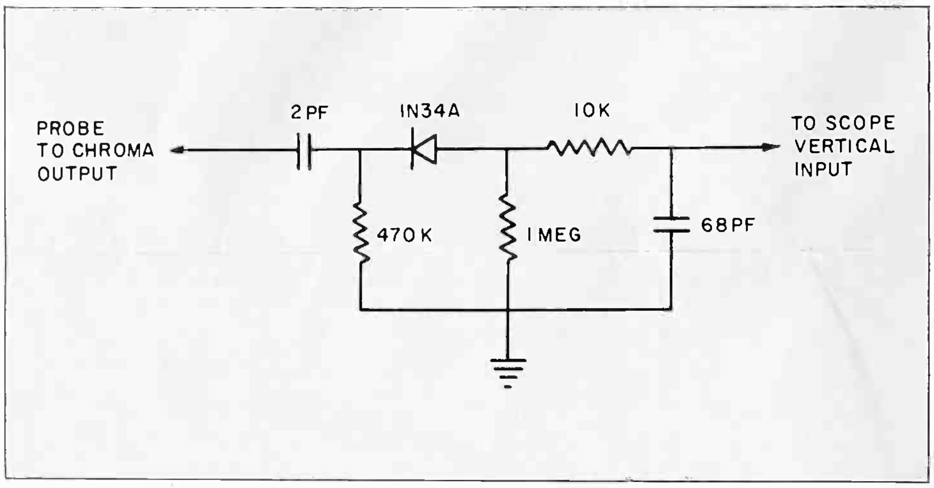

Figure 4. Oscilloscope Demodulator Probe.

Two-Stage System

A typical "Two-Stage" amplifier circuit with associated oscilloscope waveforms is shown in Figure 3. In this circuit, the chroma input signal has been trapped from the detected video signal and applied to the grid of the first chroma amplifier. Since this tube is used exclusively for chroma signals, an automatic color control bias (ACC) can also be applied to the grid to stabilize the burst and chroma output level. This ACC voltage regulates the chroma signal level in the same way that the AGC regulates the audio signal level in a radio.

The output of the 1st chroma amplifier then drives both the burst amplifier and the 2nd

Trouble-Shooting

When trouble-shooting chroma circuits, there are several checks that can help in your analyses and perhaps pin-point the trouble faster. First, be sure the problem is actually in the chroma circuits. Proper setting of the channel fine tuning is necessary to receive the color signal. Correct tuning can be achieved by adjusting the fine tuning control towards the sound bars, then backing off slightly to obtain a sharp color picture.

The color killer circuit can be misadjusted so as to cause intermittent color or a complete loss of color. The color killer control is usually adjusted with the receiver tuned to a snowy signal or a blank channel. The control is set to cause confetti or colored snow, then backed off to eliminate the confetti.

Ghosts which would not be noticed on black and white can cause severe shifts in colors. Antennas and lead-in's should be checked for broken lines or corroded connections. Improper matching of lines feeding two or more TV receivers can cause interference and reflections which may prevent color reception on some channels.

Locating a problem within the receiver with an oscilloscope can save time if certain precautions are taken. Tuned circuits at the input to the first chroma amplifier and burst amplifier are generally critically tuned and scope probe capacitances can cause severe detuning or loading. Do not expect the same receiver performance with probes attached; they

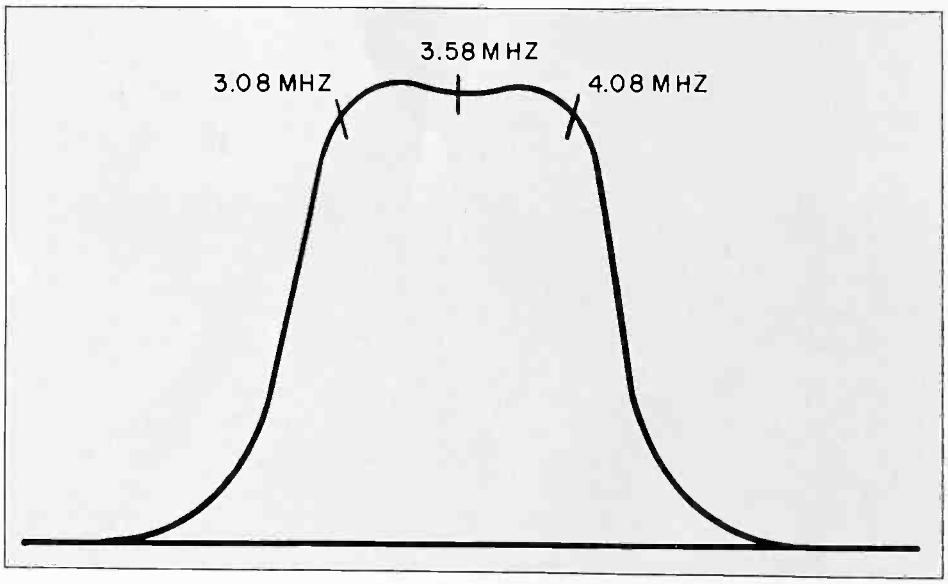

Figure 5. Overall Chroma Response Curve.

will, however, indicate the presence of the chroma or burst signals. The additional capacity of a probe may cause reduced color gain or shifts in color hue. Measurements of DC voltages on the grids of the chroma amplifier tubes isolate chroma amplifier problems from burst and color killer problems. With a color signal being received, the chroma amplifier grids should be near zero voltage or slightly negative. Negative voltages in excess of 3 to 4 volts usually indicates malfunction of the color killer.

The alignment of chroma amplifiers is straightforward. The same sweep and marker equipment used for video IF alignment will usually handle the chroma frequency of 3.58 Mhz. The only possible additional item needed would be a demodulator scope probe if you do not already have one. A demodulator probe circuit is shown in Figure 4. This particular probe has a low input capacitance to minimize circuit loading.

The sweep and marker generators are generally tied in ahead of the chroma circuit just after the video IF detector. The demodulator probe is attached to the secondary of the chroma output transformer.

The typical chroma response curve is shown in Figure 5. It has a bandwidth of 1.0 Mhz with a center frequency of 3.58 Mhz. Generally, the chroma take-off coil is adjusted to peak at 3.58 Mhz while the chroma plate transformer is tuned to peak at 3.08 Mhz and 4.08 Mhz with the top and bottom core adjustments. When alignment is required, the receiver manufacturers' procedures should be followed for best results.

To summarize the operation of chroma amplifiers, regardless of the circuit used, they are narrow band rf amplifiers operating at 3.58 Mhz. They operate with input signals as low as two volts to provide 10 to 30 volts output across an impedance of approximately 500 ohms. Voltages influencing the operation of chroma amplifiers are: The input chroma level, the ACC grid bias, the horizontal blanking pulse, the color killer bias and the adjustment of the color level control. The output signals provided by the chroma amplifiers are: A chroma signal with burst which is fed to the burst amplifier and a chroma signal without burst which feeds the color demodulator tubes. In some circuit applications, the burst is removed from the chroma signal with a blanking pulse at the color demodulator tubes. Other circuits apply the blanking pulse to the chroma amplifier tubes to remove the burst. The presence of burst in the color signal applied to the picture tube grid causes a brightening of the retrace lines during burst time.

Take care to avoid the pitfalls of circuit loading with test probes; problems with associated circuits changing the voltages to the chroma amplifiers; check for color and burst signals at the control grid of the chroma amplifier; and finally, follow the receiver manufacturers' recommended procedures for the servicing and alignment.

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TECHNICAL SECTION

April 1968 VOL. 35 — ISSUE 2

X-Radiation and the service technician

by H. C. Pleak, Manager Commercial Engineering Department Electronic Tube Division

As much has been said about X-radiation during the past year . . . this article presents a brief discussion of X-rays and what they may mean to the man that services a color TV receiver. Included also is what Sylvania has been and is doing about X-radiation from tubes.

Introduction

A German physicist, working with a Crook's gas discharge tube, discovered in 1895 that some type of unknown rays, given off by the operating tube were fogging up his photographic plates. Since they were unknown rays, the physicist used the algebraic X (for unknown) and called them X-rays. The world remembered the physicist by naming the unit of X-ray dosage after him—the Roentgen (pronounced Rentgen). The X-ray dosage rates we shall be discussing are in the range of one or a few thousandths of Roentgens (milli Roentgens) per hour, abbreviated to mR/hr.

Since Roentgen's discovery, almost three quarters of a century ago, there has been an immense amount of knowledge accumulated upon the theory of generation, application, detection, and the dangers associated with X-rays. Let's talk a little about each one of these items.

How X-rays are generated

Without going into a lot of complexities . . . When high speed electrons are stopped suddenly by hitting atoms or elements (such as in a metallic surface), the energy of the electrons is converted to electromagnetic radiation. A portion of this electromagnetic radiation is known as general X-radiation. Speaking in generalities, detectable X-rays caused by abrupt deceleration or breaking of the electron beams are only generated by electron beams which have been accelerated at voltages in excess of 15,000 volts. Each species of chemical element also gives off X-rays characterized by unique wave lengths with the higher atomic weight materials giving off short wave lengths and the lighter materials longer wave lengths. All X-rays are capable of passing through some material with a transmission which is inversely proportional to the density of the material being penetrated. This characteristic makes X-rays most useful in the field of diagnosis, particularly medical, but also in such diverse fields as pipe line weld quality and mechanical part fit.

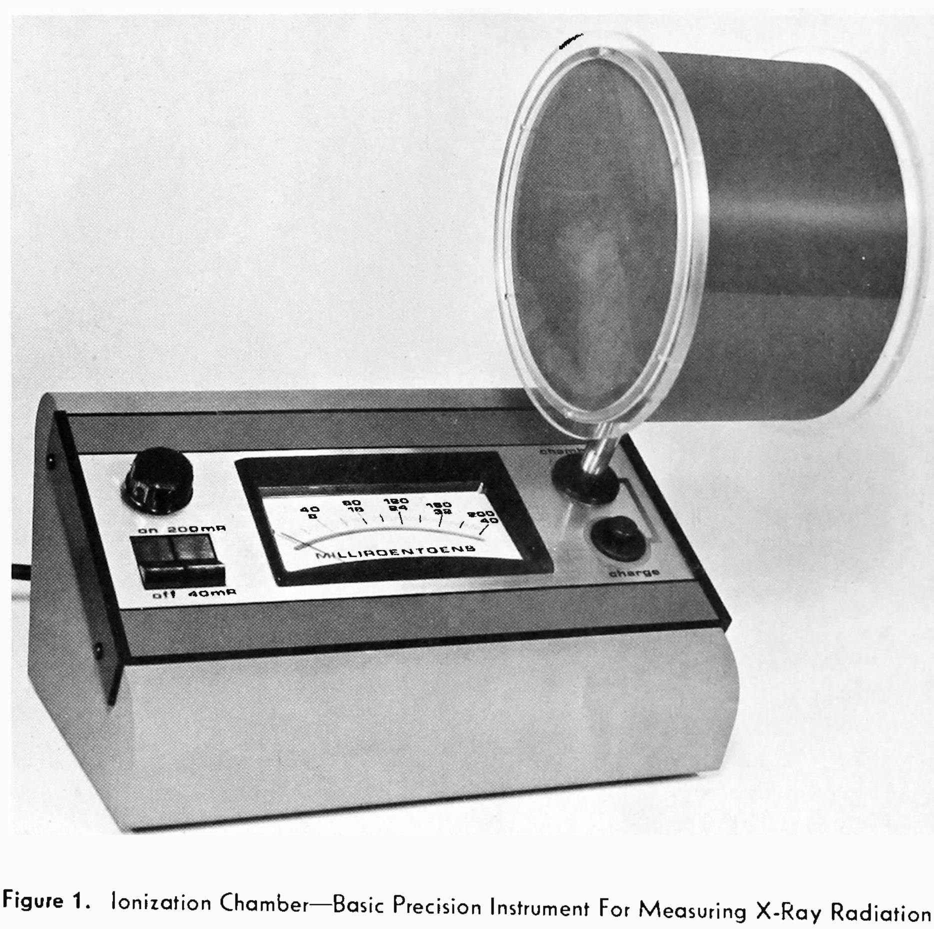


Figure 1. Ionization Chamber—Basic Precision Instrument For Measuring X-Ray Radiation.

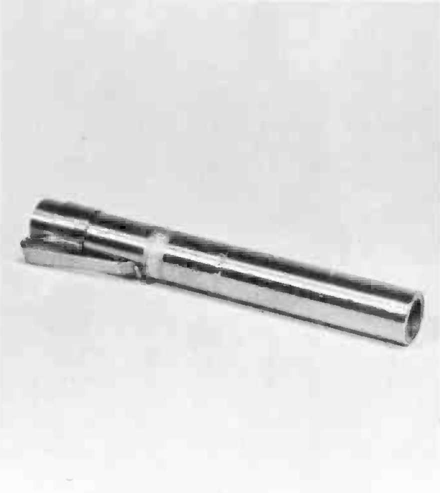


Figure 2. Dosimeter—Personnel Type Dosage Indicator Is Worn On Person.

X-rays are usually described as being "hard" or "soft". Comparative hardness is determined by the speed (accelerating potential) of the electrons which caused the X-rays. The accelerating potential in the case of dental X-rays may be in the 50 kilovolt to 75 kilovolt region, while medical X-rays for X-ray plates or treatment may be in the 75 kilovolt to 150 kilovolt region. Industrial X-ray equipment for analyzing welds and machinery may use accelerating potentials exceeding a million volts. In terms of comparative hardness, the dental X-ray is the least hard, or relatively soft of the well known X-ray sources. The maximum potential capable of causing generation of X-rays in a properly operating TV receiver is approximately 25 kilovolts. So in comparison with dental and medical X-rays, this is, indeed, a very soft X-ray source—with very low penetration capability.

As explained previously, in order to generate X-rays, we must have a stream of electrons accelerated at fairly high potentials and stop these electrons abruptly. There are three locations in a color receiver where these conditions for X-ray generation can be met; the high voltage rectifier, the high voltage shunt regulator, and the picture tube.

X-ray detection

In order to determine the presence of X-rays, we need a means of detecting and measuring them. X-rays ionize air in their path causing electrical conduction, so one means of detecting X-rays is to use a form of condenser with air as a dielectric. In use, the condenser is charged and placed in the path of the radiation where the ionized particles discharge the condenser. The amount of discharge is proportional to the amount of X-ray radiation received for a given length of time. The unit is called an ionization chamber and is considered to be the basic precision measurement instrument for X-ray radiation, Figure 1. In comparison, however, with other X-ray radiation measuring devices they are somewhat bulky and require skilled personnel to handle.

A second, personnel, type of dosage indicator (called a dosimeter) is a film badge. Exposure to X-radiation sensitizes the photographic film. Upon developing, the degree of darkening of the film is a measure of the X-ray dose received. The film calibration and development is a skilled and highly specialized procedure.

Pocket dosimeters working on the ionization chamber principle are also available for monitoring of personnel dosage in such places

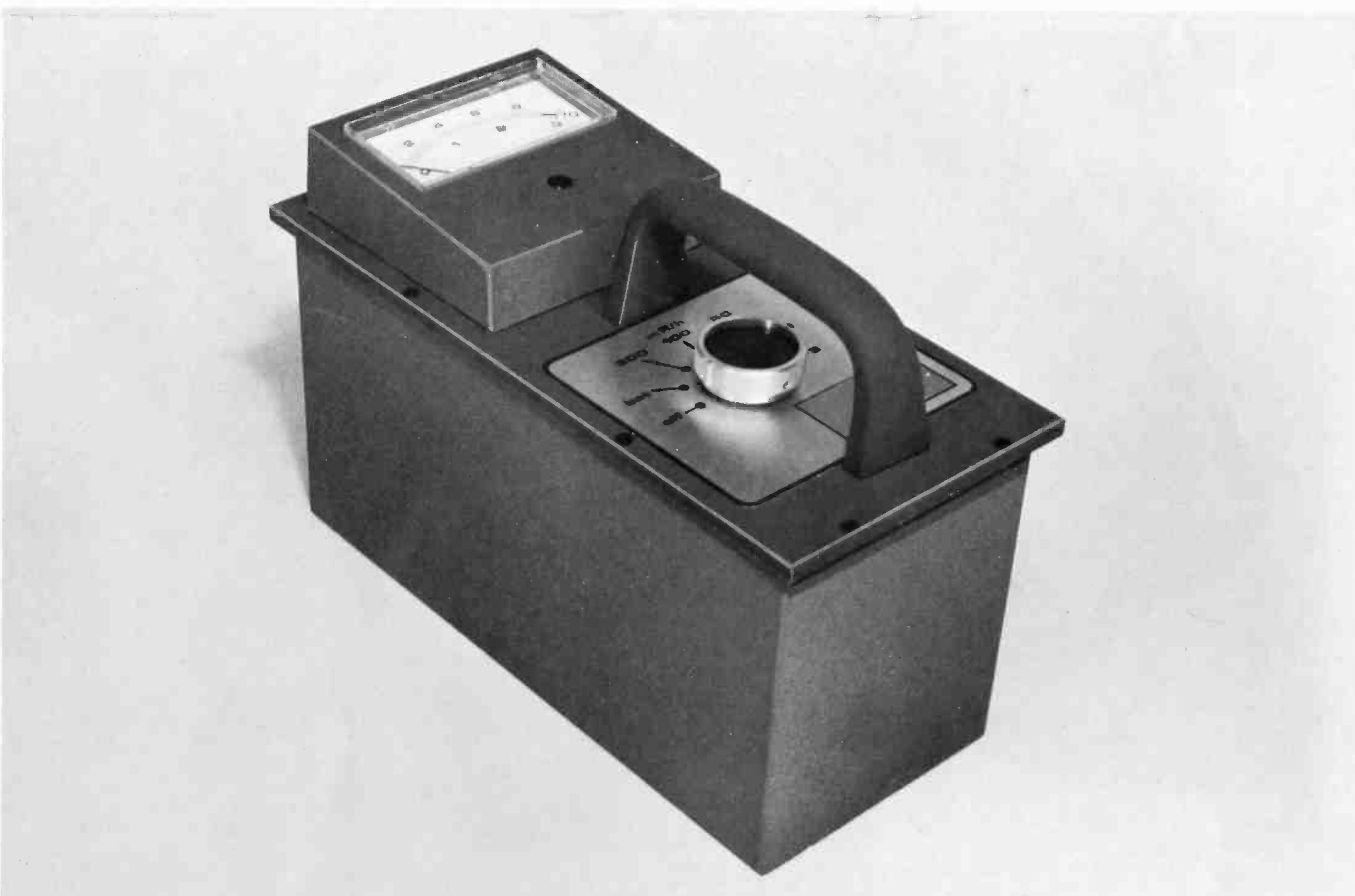


Figure 3. Survey Meter—Reads Dose Rate Per Hour of An X-Ray Field.

SYLVANIA NEWS

Editor
D. James McCue

PROMOTION SECTION

April 1968 VOL. 35 — ISSUE 2

Sylvania Scores Again BRIGHT ON TARGET!

Featuring The Sensational Sylvania Dealer Sweepstake!

Sylvania has done it again with a big, brand new award program—the most exciting and imaginative in the industry!

Your Sylvania distributor will award you one "On Target" check for every 50 Sylvania receiving tubes purchased—**regardless of type**. These checks will be redeemable for fabulous gifts to suit your every mood and pleasure.

Here is the smart way to increase your profits, capture a greater share of the market in your area and, by selling quality Sylvania receiving tubes, increase your customer loyalty—all while piling up those valuable "On Target" award checks!

Everyone a Winner

Check your Sylvania distributor—you may have already won! In addition to all the spectacular "On Target" prizes offered, you have an opportunity to win one of the 1,017 major sweepstake prizes—including a 1968 Dodge service van, a 1968 Dodge Coronet 440, a great variety of color TV servicing equipment and much, much more!

Every listed Service Dealer will receive a Sweepstake announcement with a "Dealer Sweepstake Award Check" enclosed. Rush this check to your Sylvania distributor where you will find a listing of all the winning numbers—check this list, if your number appears—you're a winner—it's that simple! There is no purchase required—void where prohibited by law.

Even if you don't win one of the big prizes, you may still redeem your sweepstake check for one of the thousands of glamorous "Bright On Target" prizes, when combined with dealer "On

Target" award checks issued on your Sylvania tube purchases. So you see, Sylvania has come up with a program that makes **every participating dealer a winner!**

Dealers not receiving a copy of the Sweepstake announcement may obtain entries by writing to: Sylvania Dealer Sweepstake Headquarters, P.O. Box 7020, St. Louis, Mo. 63177.

IN THIS SECTION

Sylvania Sponsors the Most Exciting Program in TV Guide . . . "MAN IN MOTION" STARRING YOU!

Yes, **you** can star in TV Guide throughout the year—billed as an expert in color TV service and repair!

You still can be featured in three big issues; June 8, September 21 and November 16 as the "Man In Motion"—a dealer on the move who uses Sylvania quality products. Each ad will list your name, city and phone number.

Along with your TV Guide listing, you will receive a complete, business building promotional package that includes a three dimensional clock sign and window display spotlighting **you** as the "Man In Motion"—the man kept busy doing expert TV repairs and servicing.

This total program was designed to bring you greater profit and recognition—what better way than a listing under the Sylvania trademark in America's most widely read TV magazine?

Your Sylvania distributor can tell you how you can still become a part of this program in time for the next listing. So—**get in motion!**

Easy On/Off Magnetic Vinyl Sign

You can now transform your family car into an advertising vehicle for use during your working hours. Just use this new, bright yellow, red, black and white sign to identify you and your services to potential customers in your area.

This 8½″ x 11″ sign easily adheres to any metal surface—files, counters, trucks and cars. When you're using your car for pleasure—just remove the sign—no trouble or fuss! This is an extremely inexpensive way to convert your business/family car into a vehicle advertising your services. ET-1849—$3.50 each.

Sylvania Announces The Brightest Color Picture Tube Ever Made!

Sylvania recently emphasized its position as the industry leader by introducing the brightest picture tube in the history of color television! This was achieved through a series of coordinated developments involving major components to the tube. The new picture tube is 23% **brighter than its nearest competitor** and delivers a more vivid, more realistic picture than heretofore possible!

This new picture tube represents the second major advance in color TV brightness in less than four years. Sylvania also led the industry in 1964 with the development of a europium "rare earth" red phosphor which enabled the consumer to view the picture in a normally lighted room.

40 Million Picture Tubes

Sylvania entered into 1968 with the production of its 40 millionth picture tube. Our Silver Screen 85 is a quality leader in the Black and White television market and we have continued those quality objectives with the manufacture of color picture tubes.

With the introduction of this new **color bright 85®** picture tube, Sylvania has once again dramatically reaffirmed its leadership by developing the most advanced color picture tubes available in the industry today.

As always, Sylvania is "**Bright On Target!**"

A Sylvania engineer is shown measuring the new tube's brightness (lower set) with a photoelectric cell. The brightness level is displayed on the monitor (upper set) via closed circuit TV.

Identify Yourself As An Expert In TV Servicing

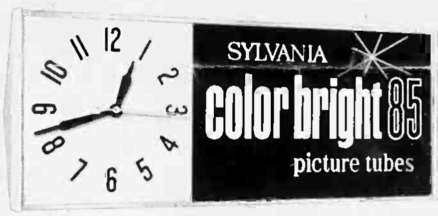
The colorful, new dealer decals highlight you as an expert in color TV servicing and identify you as the person to contact for top quality Sylvania **color bright** 85® and Silver Screen 85® picture tubes.

It adheres firmly and easily to any smooth surface: windows, counters and trucks . . . **no water required.** When placed on your window, the 7½" x 10" double face sells your services inside and out.

Made of weather and fade resistant material, this decal will last for years.

Order your supply today. ET-1921—25 cents each.

Light Up A Winner!



When you carry an outstanding picture tube you should let it be known with an outstanding sign! The Sylvania **color bright** 85® clock sign was awarded a top prize as a superior Point-of-Purchase item in a recent national competition. Another professional recognition of Sylvania's winning form in consumer attracting signs and displays!

At $24.95, the **color bright** 85® clock sign is also a winner price wise—Order one from your Sylvania distributor. ET-1915.

New Types Added By Sylvania

Type	Description
3CB6/3CF6	Pentode for use as IF amplifier in TV receivers. Replaces 3CB6 and 3CF6.
6LH6A	Beam triode for use as a shunt regulator in the high voltage power supply of color TV receivers. Used by GE.
6LJ6	Low current, high voltage beam triode for use as a shunt regulator in high voltage power supply of color TV receivers. Used by GE.

Sylvania Has The Best Ideas!

Since its introduction slightly over two years ago, the Electronic Components color motion picture IDEAS has been viewed by an audience in excess of 60,000 people in almost 2,000 different locations. Recognition from the film industry reads like a Who's Who of Awards in movie making: The Columbus Film Festival, the American Film Festival in New York and the CINE '67 Award among others, have all accorded recognition in the industrial film category to IDEAS.

The interest that has been exhibited in the IDEAS film and the story of our contribution to electronics has further helped identify Sylvania as an industry leader. The content and message is as current today as it was on its initial showing.

If your group would like to have the opportunity to view this excellent film, it is available by writing to: Sterling Movies, 43 W. 61 St., New York, N. Y. 10023 or 309 W. Jackson Boulevard, Chicago, Illinois 60606.

Years Ago In Sylvania News: 1948

Eight of Ten 1947 Passenger Cars Radio Equipped

"Firm demand for new passenger automobiles now being produced at the 1941 rate, and the increasing number of new car buyers taking a radio as original equipment will provide a good market for auto radios during 1948, according to the director of sales research for Sylvania."

(Yesterday, A Sylvania radio in every car -- tomorrow, a **color bright 85®** picture tube in every home!)

ORDER COUPON

Order any item from your Sylvania distributor or mail this order form to:
Sylvania Electric Products Inc., 1100 Main Street, Buffalo, New York 14209

Quantity	Description	Price	Total
....	ET-1921—Dealer Decal	@ $ .25 ea.	....
....	ET-1849—Magnetic Vinyl Sign	@ $ 3.50 ea.	....
....	ET-1915—color bright 85® Clock Sign	@ $24.95 ea.	....
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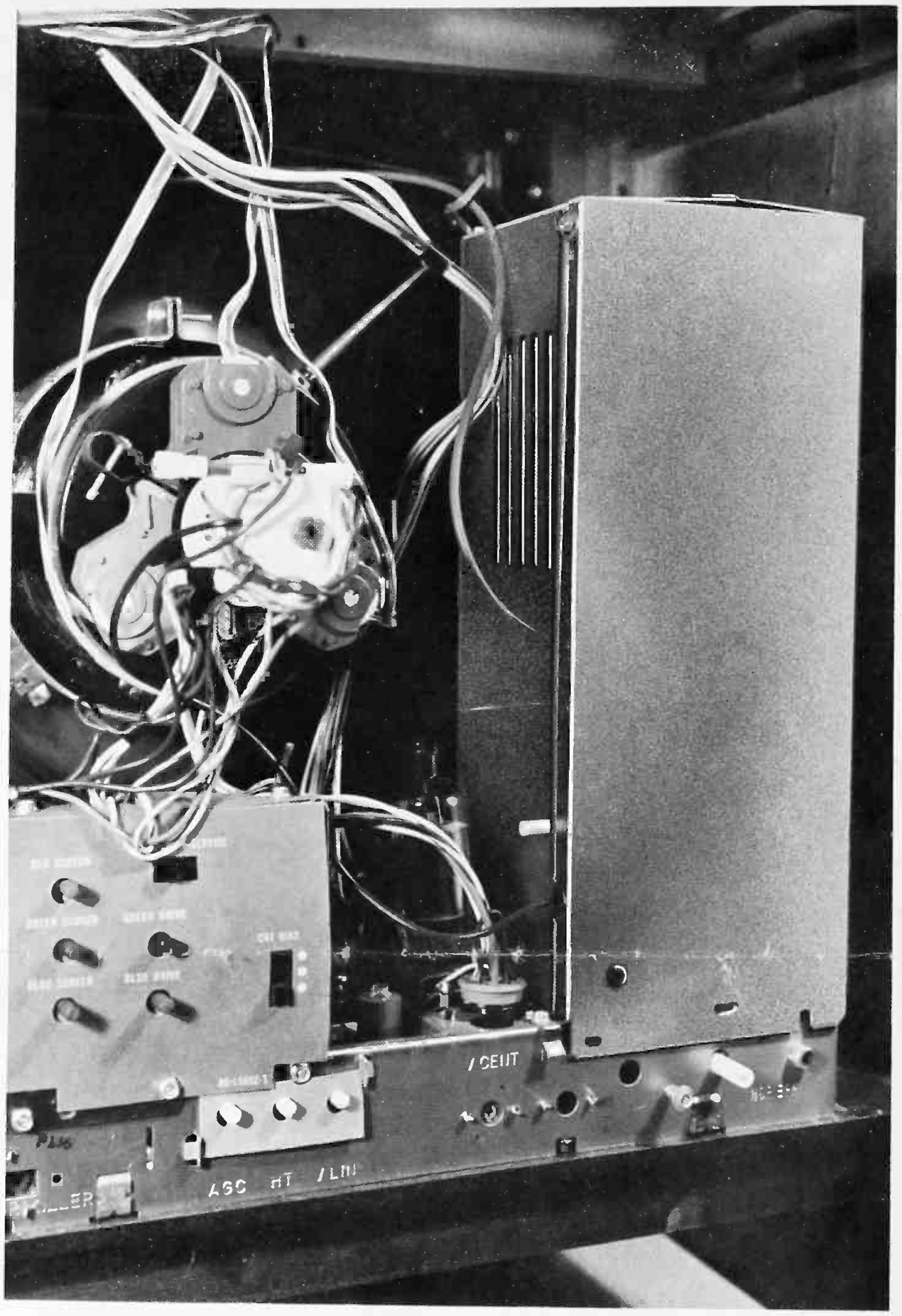

Figure 4. Steel of Proper Thickness is An Effective X-Ray Shield.
HV Rectifier and Shunt Regulator in Well Designed Receiver Are Housed in Steel Enclosures.

as the vicinity of atomic reactors, Figure 2. They read a value of received dose which may be a milli Roentgen in 1 hour (1mR per hour); or perhaps a Roentgen in 20 days of continuous 10 hour per day use or 5mR per hour; or in other words, the total dose received in any measured length of time.

A different type of instrument used to continuously indicate **dose** rate is called a survey meter, Figure 3. It reads the dose rate per hour of an X-ray field. Sometimes the survey meter is called a counting rate meter since it counts the rate of discharges of a Geiger-Mueller tube . . . whose discharges are proportional to the intensity of the X-ray radiation. A prospector's Geiger counter falls in this category as do various other counting rate meters of superior precision and stability for laboratory radiation survey work.

All of these devices indicate the presence of X-ray radiation, but their use for absolute measurements is not for amateurs or the unskilled. For example, ionization chambers can be affected by corona discharges. Some instruments are seriously affected, and indeed worthless, in a pulsed RF field such as developed by a horizontal flyback transformer. While the ionization chambers are not completely directional, low levels of radiation will be detected in a directional mode. Prospector's Geiger counters are very sensitive and can indicate presence of X-radiation, but unfortunately, the indication is most probably incorrect by extremely large factors. This is due to the output variation of the Geiger-Muller tube at various X-ray energy levels, and extreme calibration inaccuracies in the low energy (about 25 KV) region. Further, Geiger counters are extremely directional and an inordinate amount of experience and knowledge is required to probe an X-ray field and obtain meaningful results. X-ray intensity from a point source drops off as the square of the distance from the source. But, since Geiger counters pick up those rays emanating from a surface, it is possible to obtain higher measurements farther from the source. This is because the detection probe sees a larger source of X-rays, all of which can be most confusing and meaningless to the uninitiated.

Intensity

X-radiation increases with voltage and current. A high voltage increase accompanied by an electron current increase vastly increases the amount of X-ray radiation. Shielding material which was adequate at one voltage and current level may not necessarily be adequate for a higher level. This is similar to a flashlight behind an opaque glass panel. You can't see the flashlight, but if a powerful arc light is used, the light shines right through the supposedly opaque panel. Generally as an X-ray beam gets harder and harder, the effective efficiency of the shielding material is reduced.

Shielding

The soft X-rays developed by a color TV set can be partially attenuated by many materials, such as wood, pressed board, cardboard, glass, etc. **All** reputable American manufacturers use a glass containing a high percentage of the chemical element lead (high atomic weight and high density) for the envelope of high voltage rectifiers and dc shunt regulators. Lead, of course, is an effective shielding material.

Shielding of soft X-rays can be

accomplished by any of the heavy materials (high atomic weight). For example, the high voltage rectifier and shunt regulator in well designed receivers are shielded by steel enclosures approximately .010 to .015″ thick, Figure 4.

The real and implied dangers of X-radiation to the viewing public and to the service technician have been bandied around, cussed, and discussed ad infinitum. Manufacturers always will meet, or better, state or government requirement . . . but legislation may be no protection against problems which can develop at the service bench.

Sylvania and X-rays

Sylvania has, of course, always been most conscious of the X-ray safety problems associated with high voltage devices. With television sets operating at high voltages over 15 Kv and set manufacturers desiring even higher voltages, it has long been a Sylvania directive that "no tubes intended for use at or above 15 Kv should be made with envelopes other than lead glass." Continuous laboratory evaluation of the X-radiation from the Type 6BK4 shunt regulator resulted in a product control specification to be written coincident with volume production. The manufacturing techniques and processes, as well as metallurgical developments and designs which produced the high reliability Sylvania high voltage rectifiers for color TV were also instrumental in maintaining the low levels of X-radiation found in these tubes. Engineering and production groups are, of course, continuously working to reduce X-radiation even lower.

Precautions

The TV technician can and should take precautions when performing service work on color receivers. Even though well designed receivers have more than adequate shielding around those tubes capable of developing X-rays, the service technician must often "trouble shoot" with the shielding removed. A malfunctioning tube can yield high volumes of soft X-rays for short intervals, and these are the types of trouble the service technician is hunting. The service technician should always remember that his eyes are one of the most seriously affected part of the body where X-rays are concerned. He must, for his own safety's sake, be alert to malfunctions (arcs, shorts, red anodes, and glowing particles) and kill the set power immediately. Of course, he must observe normal high voltage safety precautions.

A few do's and dont's can be helpful:

1. The receiver manufacturer has furnished straightforward set-up instrumentions for his receiver. Follow these in detail.
2. After set-up, check out the receiver's high voltage performance with an accurate high voltage meter. Insure that the high voltage stays within the recommended range with various adjustments of the front controls, and over expected line voltage variations.
3. Do not routinely remove protective shielding in preparation for servicing.
4. Develop troubleshooting techniques that circumvent operating the set with the high voltage compartment open.
5. Don't get closer to high voltage sections than is dictated by safe high voltage practice.
6. Do not attempt X-ray surveys with Geiger counters—they are not intended for this work!
7. Don't examine at close distances malfunctioning high voltage components. Wear safety goggles if you do not wear eye glasses.
8. Treat both high voltage and X-ray sources with respect.

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