RCA VICTOR

TELEVISION SERVICE CLINIC

SERVICING COLOR TELEVISION RECEIVERS

THE 21CT660U SERIES

PREPARED BY THE COMMERCIAL SERVICE SECTION
RCA SERVICE COMPANY, INC., CAMDEN 8, N. J.

A Service of Radio Corporation of America

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INTRODUCTION

The RCA Television Service Clinic is a means by which all servicemen can keep abreast of the ever increasing field of television servicing.

The success of our Clinic Program is attributed to the meeting of a demand for comprehensive coverage of television service and installation practices. This demand has been met through the presentation of a series of Service Clinic Lectures, beginning with basic television principles and progressing through UHF and color television.

Included in the lecture series is service and technical information on RCA Victor television chassis, and up-to-date descriptions of the latest developments in VHF, UHF and color television.

Following is a list of the lectures in the Television Service Clinic Series:

The lectures numbered 1 through 9 have been compiled to form Television Clinic Lectures—Volume I.

No. 1: *Basic Circuit Description of an RCA Victor Television Receiver.*

No. 2: *Servicing the RCA Victor Television Receiver—The R-F Unit, Picture I-F and Sound Channel.*

No. 3: *Servicing the RCA Victor Television Receiver—The Video and Sync Circuits.*

No. 4: *Servicing the RCA Victor Television Receiver—Deflection Circuits and Power Supplies.*

No. 5: *Servicing the RCA Victor Television Receiver—Troubles Other Than Component Failures.*

No. 6: *Practical Antenna and Transmission Line Considerations and RCA Victor Television Receiver Installation Techniques.*

No. 7: *Technical Features of the New RCA Victor "Million Proof" Television Chassis.*

No. 8: *Technical Features of the RCA Victor KCS66-68 Intercarrier-Sound Television Chassis.*

No. 9: *Introduction to UHF Television*

The lectures listed below are printed in individual booklet form.

No. 10: *Technical Features and Simplified Alignment of the RCA Victor KCS72-72A Television Chassis.*

No. 11: *Technical Aspects of RCA Victor UHF Receiving Equipment.*

No. 12: *Principles of Color Television and Technical Features of the RCA Victor Model CT-100 Color Television Receiver.*

No. 13: *Technical Features of the RCA Victor Model 21CT55 Color Television Receiver.*

No. 14: *Technical Features of the RCA Victor KCS93 Television Chassis.*

No. 15: *Technical Features of the RCA Victor Model 21CT662U Color Television Receiver.*

The Volume and current Clinic Lectures are available, at a nominal charge, from the RCA Service Company, Inc., Commercial Service Section, Camden, N. J.

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FOREWORD

The purpose of this booklet is to provide a handy reference and a guide to enable the television service technician to locate and make the necessary adjustments or repairs where service is required for the RCA Victor Color Television Instruments, 21CT660U series.

Previous RCA Victor Television Service Clinic Lectures covering color television receivers have stressed theory, technical descriptions of circuitry, practical step-by-step installation, set-up procedures and service hints.

This booklet is intended to be a practical service aid to the technician who is familiar with the theory, circuitry, set-up and installation but who may not have had actual practical experience in servicing the receiver.

As such an aid it will be of value to him in accumulating sufficient background to consider servicing color television receivers as routine, rather than an unusual occurrence.

It is designed as a practical work-book. Large headings are printed at the top of each page to facilitate location of the circuit or section of the receiver for which information is desired. Data is grouped according to a logical plan. First — test equipment — the tools the technician needs in order to perform an efficient, professional job. Next — how to approach service from the viewpoint of the field service technician who is required to perform service in the customer's home or place of business. Then — for the bench technician — what to look for when the receiver is brought into the service shop.

The booklet is designed for use in the field and at the service bench to supplement the service data and previous Television Service Clinic Lectures in providing practical data for the working technician.

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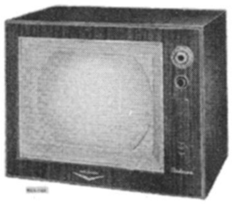
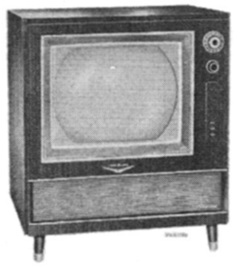


Model 21CT660U
"Haviland 21"



Model 21CT662U
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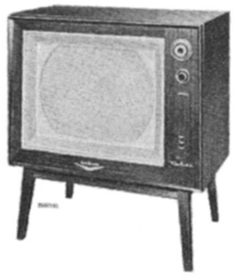

Model 21CT661U
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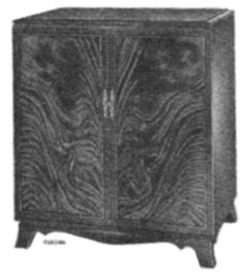


Model 21CT663U
"Cheltenham 21"

Fig. 1—RCA Victor Color Television Receivers, 21CT660U Series

INTRODUCTION

Color television has come of age.

The popularity engendered by the miracle of the addition of color to the magic of television has created a demand by the public for ownership of color television receivers.

RCA Victor is proud to be the leader in helping to satisfy this demand. A complete new line of RCA Victor color television receivers is being accepted by the public as another forward step by RCA in making available to the public the fruits of the research laboratory.

The increase in color television receiver ownership in turn creates a demand for rapid, efficient service for these instruments. This demand will be met by the progressive service technician who has had opportunity to observe, at special training meetings, or during the course of his daily business, the differences between the servicing techniques required for black-and-white television receivers, and those required for color television receivers.

The demand for service, however, will continue to increase. Eventually, more and more technicians will be required to become familiar with color television receivers. Many service technicians are today studying, and experimenting when possible, with actual receivers. Texts concerning theory, and service data for the instruments are available from many sources to further this training.

It has been expressed that color television receivers can be serviced just as easily as the black-and-white models. The technician will need, however, along with a background of the theory in color television and basic colorimetry, actual experience in working with the color receivers before he can become proficient in color television receiver servicing. To that end, as part of the Television Service Clinic program, a great many "workshop" meetings have been held under the joint sponsorship of the RCA Victor Television Division and RCA Victor distributors throughout the country.

As a result of this program, many service technicians have become familiar with installation and set-up adjustments.

This booklet is provided by RCA Victor and RCA Victor distributors as a further aid to technicians in the television service industry.

It contains valuable service information for the RCA Victor 21CT660U, 21CT661U, 21CT662U, 21CT663U and 21CT664U color television receivers. These receivers are referred to herein as the 21CT660U series.

The booklet describes the tools required for efficient color receiver servicing; tells how to use these tools; discusses procedures for determining specific needs for service; shows representative waveforms obtainable with an oscilloscope at various points in the receiver; and gives practical information useful in the field, or at the service bench, for localizing the source of improper operation of the receiver.

TEST EQUIPMENT

GENERAL CONSIDERATIONS

To service color television receivers efficiently, the progressive technician should have certain special color test equipment in addition to the equipment normally required to service black-and-white television receivers.

A Dot-Bar Generator, Color Bar Generator, Degaussing Coil, high voltage measuring device and a milliammeter, in addition to standard test equipment may be considered as essential "tools." An oscilloscope is also very useful, preferably a wide-band model capable of faithfully reproducing the 3.58 mc. color burst signal and the extended video range required in the color television receivers.

The equipment mentioned above does not include alignment equipment. Alignment of the color television receiver is not too often necessary. To align a color receiver properly it is necessary to have special alignment equipment in addition to the equipment normally employed to align black-and-white receivers. The equipment (or its equivalent) described in the following paragraphs will enable the technician to make all required adjustments and tests accurately and thus obtain the best possible performance from the color television receiver.

Dot-Bar Generator

A Dot-Bar Generator is required to facilitate scanning adjustments made on the red, green and blue beams in the tricolor kinescope. These adjustments are referred to as *static* and *dynamic* convergence adjustments. The three beams must be made to scan the entire screen of the kinescope simultaneously, without causing color fringing.

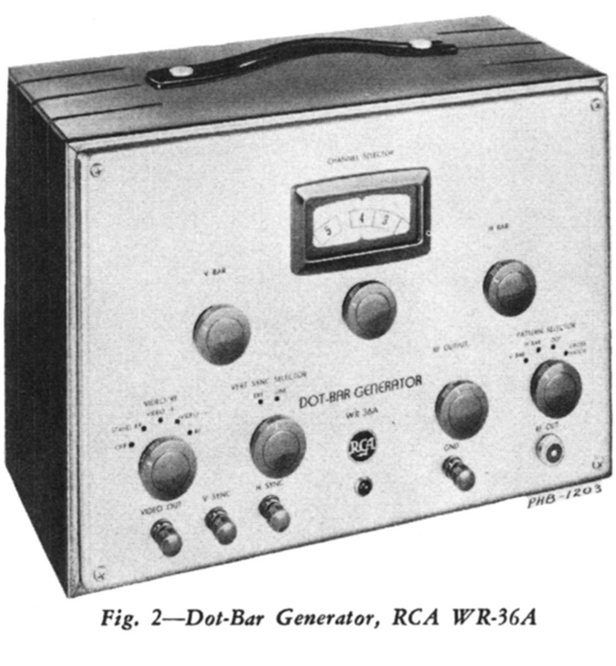


Fig. 2—Dot-Bar Generator, RCA WR-36A

The RCA WR-36A Dot-Bar Generator, shown in figure 2, provides a pattern of small dots, or fine line cross-hatch patterns, ideal for convergence adjustments in large-screen color receivers. It also provides horizontal and vertical bars which are also useful for precise adjustment of linearity in both color and black-and-white receivers.

The R-F output of the Dot-Bar Generator is normally fed into the receiver antenna terminals as shown in figure 3.

An adapter, WG-305A, that allows the video output signal of the Dot-Bar Generator to be fed directly into the second video amplifier of the receiver, may be obtained from RCA Distributors. The adapter offers a means of obtaining convergence patterns totally free of background interference. It also provides a means of making convergence adjustments on any channel including UHF.

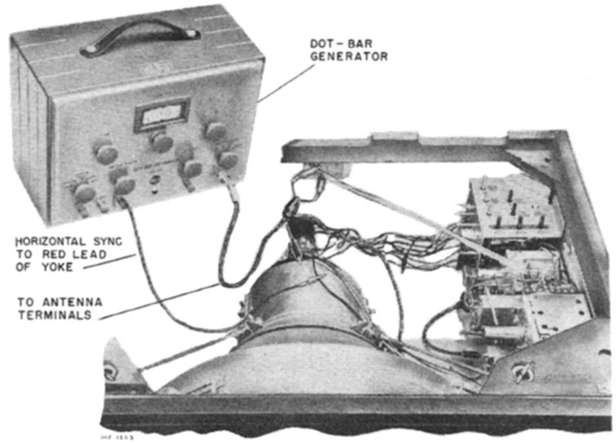


Fig. 3—Dot Bar Generator Connections

When performing convergence adjustments, make certain that the receiver is properly synchronized with a station signal. Adjust the fine-tuning control to the best counter-clockwise position so that the picture carrier is high on the I-F slope, to insure maximum picture sync. The pattern can generally be stabilized without the need for an external source of vertical sync. If vertical sync difficulty is encountered, connect a lead from the "V Sync" terminal of the generator to terminal #1 of the Green Vertical Tilt control on the receiver. External horizontal sync is always required and can be obtained from the receiver horizontal sweep circuits by clipping a lead from the "H Sync" terminal of the generator to the insulation of the red lead of the deflection yoke. Since the station sync on the receiver has been previously locked-in, a stable dot or bar pattern can now be obtained by adjustment of the "V Bar" or "H Bar" controls of the generator.

Color Bar Generator

A color bar generator is necessary to facilitate checking and adjusting all color functions in color television receivers, including:

1. Demodulator phasing adjustments.

2. Matrixing.

3. Color AFC.

4. Check of color sync action for normal and weak color-sync-burst signals.

5. Registration of luminance and chrominance signals.

6. Overall R-F, I-F and video acceptance of color signals.

7. Sound rejection, and beat interference between the color subcarrier and the sound carrier.

8. Non-linear amplitude characteristics in the receiver that might affect color reproduction.

The RCA WR-61A Color-Bar Generator, shown in figure 4, generates 10 different color bars simultaneously, including bars corresponding to R-Y, B-Y, G-Y, and I and Q Signals. The color-bar generator is an efficient instrument for checking all color signal circuitry in a color television receiver.

Fig. 4—Color-Bar Generator, RCA WR-61A

The R-F output of the Color Bar generator is normally fed into the receiver antenna terminals as shown in figure 5.

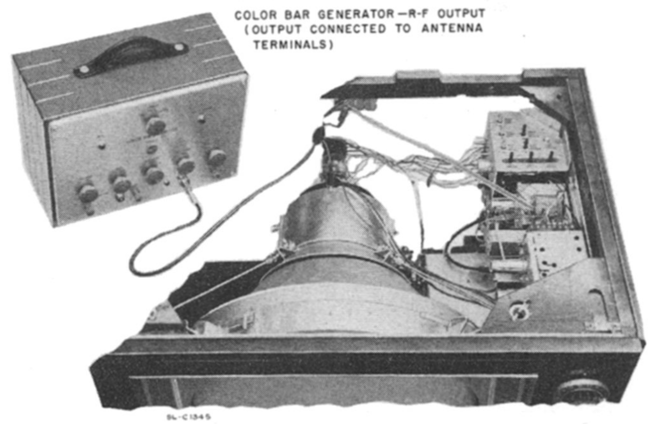


Fig. 5—Color-Bar Generator Connections

High Voltage Probe

The voltage applied to the ultor of the kinescope in color receivers ranges up to 30,000 volts. An incorrect value of high voltage affects convergence, focus, color, purity, and high-light and low-light tracking. It is, therefore, essential that the high voltage applied to the ultor of the tricolor kinescope be accurately adjusted in accordance with the receiver design requirements.

To measure the high voltage accurately it is necessary to employ a suitable high-voltage probe in conjunction with an accurate voltmeter. The voltmeter should have a sensitivity of at least 20,000 ohms per volt.

The high-voltage probe, WG-289, shown in figure 6, used in conjunction with the RCA Senior "Volt-Ohmyst" WV98A, shown in figure 7, satisfies these conditions.

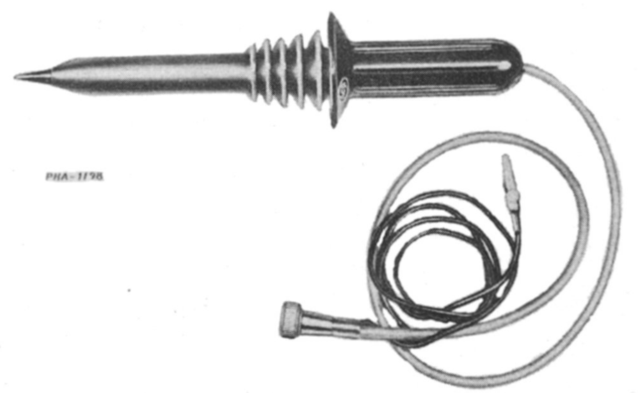


Fig. 6—High-Voltage Probe, RCA WG-289

For 20,000 ohm-per-volt meters having phone-tip connectors and a 5,000 volt range, use the RCA High Voltage Probe WG-290, and WG-210 multiplier resistor. This combination extends the range of the meter and permits measurement of high voltage up to 50,000 volts.

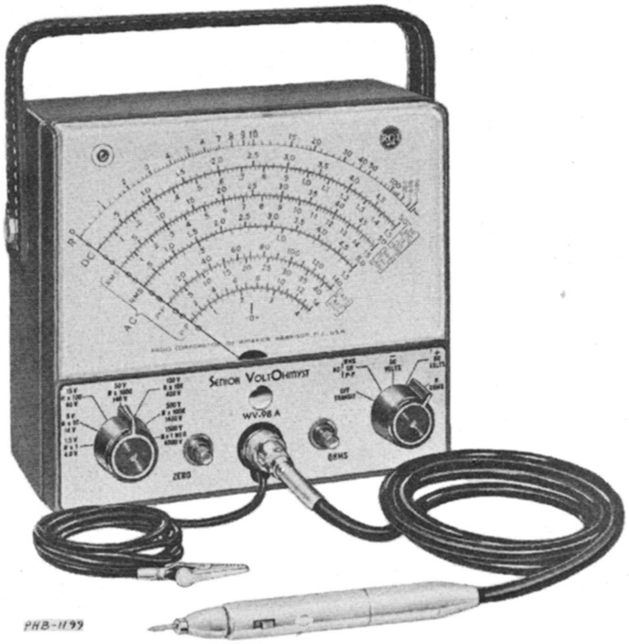


Fig. 7—Senior "VoltOhmyst", RCA WV89A

Degaussing Coil

Color kinescopes may become magnetized when subjected to magnetic fields of a steady or alternating nature. This may occur when the instrument is transported from one location to another.

A degaussing coil is required to demagnetize the television chassis and tricolor kinescope. This procedure is important because undesired magnetic influences anywhere about the chassis or kinescope will noticeably impair the purity and convergence of the receiver.

Every kinescope should be degaussed with the receiver located in its final operating position before attempting purity and convergence adjustments. With the kinescope properly degaussed, a minimum of magnetic field neutralization is necessary to obtain white uniformity.

A degaussing coil, shown in figure 8, may be constructed of 425 turns (approximately 1335 ft.) of number 20 enamel-covered copper wire, 12 inches in diameter. All turns should be bound together with several layers of insulating tape. The ends of the wire should be connected to an eight foot AC line cord.

Fig. 8—Degaussing Coil

To use the degaussing coil, first withdraw all of the color equalizing magnets around the rim of the kinescope into their housings. Then, plug in the AC cord of the coil, taking care that the coil is at least six feet from the receiver. Move the coil slowly over the front and sides of the cabinet as well as inside the cabinet near the top and sides of the kinescope. After about a minute or two, withdraw the coil from the receiver very slowly to a distance of at least six feet and then disconnect the AC plug.

CAUTION

When using the degaussing coil, avoid passing the coil over the neck of the kinescope since it can demagnetize the purity magnets, convergence pole piece magnets, and/or the blue-lateral beam-positioning magnet.
Also be careful not to have any meters within five feet of the coil when it is energized. Permanent damage to the meter may result if this precaution is not observed.

Milliammeter

It is important that the horizontal tuning transformer be tuned to resonance at the horizontal sweep frequency so that optimum high-voltage may be maintained. This adjustment also provides linear operation of the horizontal deflection circuits and maximum efficiency of the related circuitry.

A meter with a 0-500 ma. range should be used when making this adjustment. Many 20,000 ohms-per-volt volt-ohm-milliammeters have this feature.

Oscilloscope

An oscilloscope having a response essentially flat to 500 kc. is satisfactory for the majority of applications in servicing color television receivers. It may be employed in R-F—I-F alignment, checking sync and deflection circuits, dynamic convergence circuits, etc. However, for applications such as measurement of the 3.58 mc. signals or observing the overall video response, a wide-band oscilloscope having a response flat to 4.5 mc. should be employed.

The RCA WO-78A Oscilloscope, shown in figure 9, has dual band-width. In the wide-band position, the response is flat, within —1 db., from 3 cycles to 4.5 mc., with direct sensitivity of 0.1 volt peak-to-peak per inch. In the narrow band position, the response is flat, within

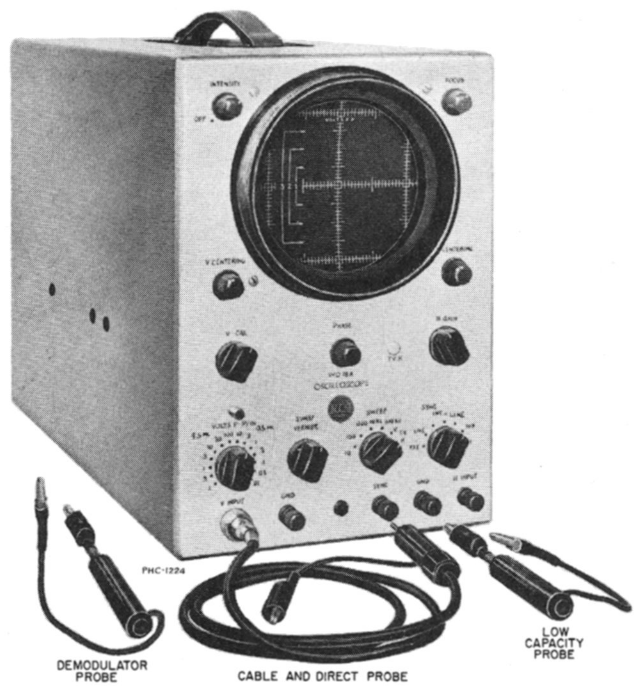


Fig. 9—Dual-Bandwidth Oscilloscope, RCA WO-78A

3 db., from 3 cycles to 500 kc. with sensitivity of .01 volt peak-to-peak per inch. The RCA WO-91A oscilloscope is also excellent for these applications.

Microscope

A low power microscope, see figure 10, is optional and is necessary only when good white uniformity cannot be obtained. It can be used to advantage as a service aid when doubtful as to whether the yoke or kinescope is at fault when improper purity is encountered.

The microscope enables the technician to observe individual phosphor dots to determine on which portion of the dot the electron beam is landing, and make the proper adjustments to achieve the best possible purity over the greatest area. (Centers of all phosphor dots illuminated.)

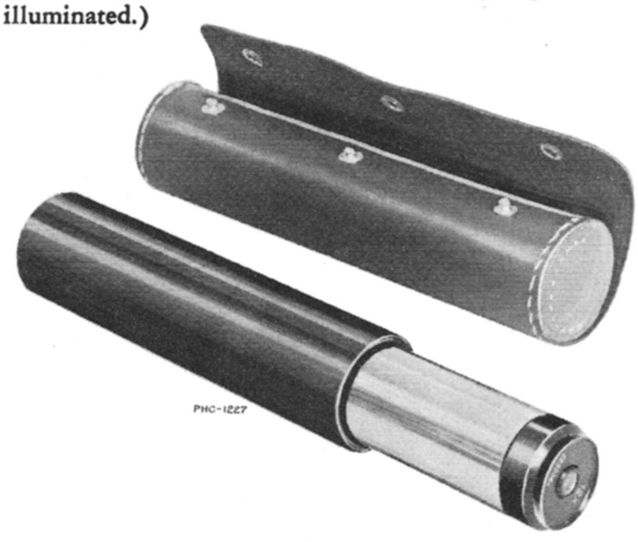


Fig. 10—Low-Power Microscope

Mirror

A large mirror can be extremely useful when making purity adjustments. It should be of sufficient size so that when it is placed approximately four feet in front of the receiver the technician can easily view the entire area of the kinescope screen when he is working at the rear of the receiver.

A mirror mounted on a portable tripod, as shown in figure 11, is ideal for this purpose.

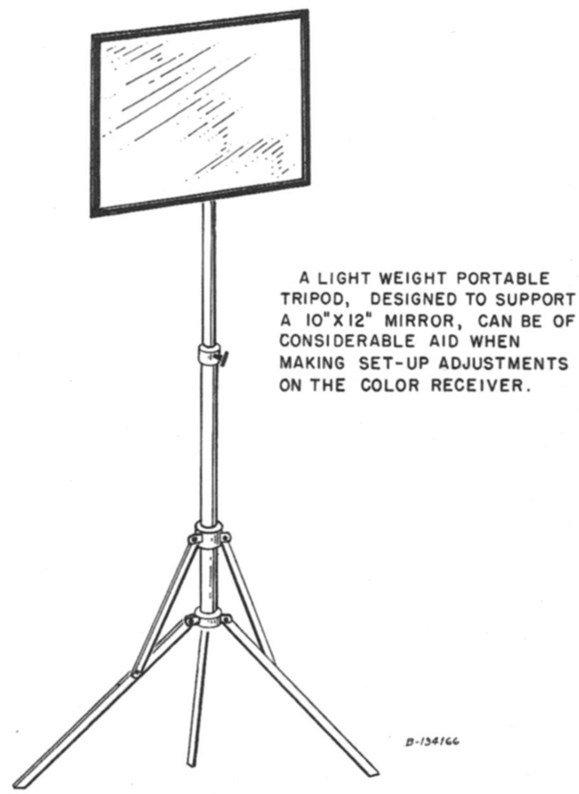


Fig. 11—Portable Mirror and Tripod

Kinescope Control Grid Switch

A switch box for connecting a 100K resistor from each of the tricolor kinescope control grids individually to ground, at will, is useful when making convergence and matrix adjustments in the field. An illustration of such a switch box and a schematic diagram is shown in figure 12.

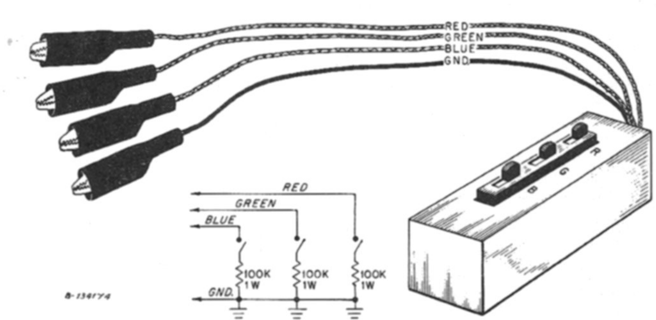


Fig. 12—Kinescope Control Grid Switch Box

High Voltage Interlock

The high voltage interlock plug for the 21CT660U series color receivers is attached to the rear cover of the receiver cabinet. In order to service the chassis with the rear cover removed, an interlock plug must be inserted in the high voltage interlock receptacle. Neglecting to insert the high voltage interlock plug when the rear cover is removed will result in failure of the high voltage fuse, F-101, when the receiver is turned on. This item, shown in figure 13, may be obtained from RCA Distributors under part number 206P1.

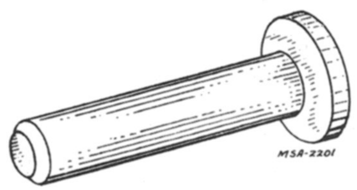


Fig. 13—High Voltage Interlock Plug

If this is not available, or temporarily out of stock, a high voltage interlock plug can be constructed, as shown in figure 14, using plexiglas or lucite tubing. It

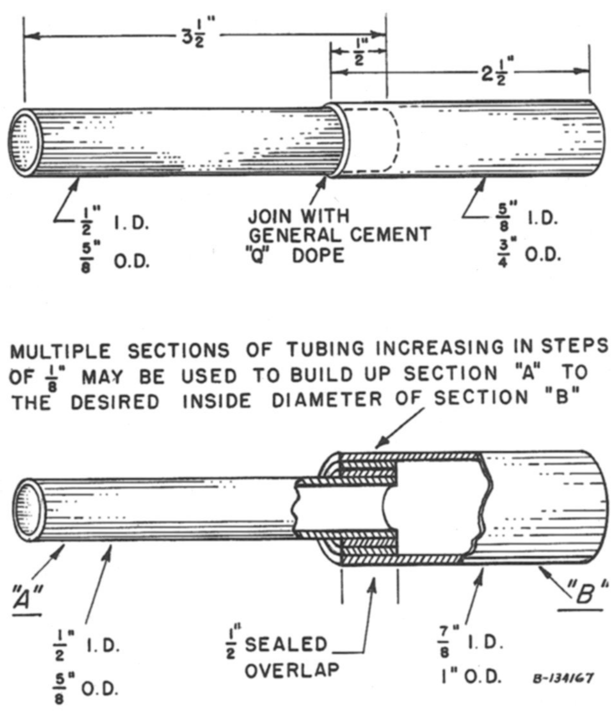


Fig. 14—Interlock Plug for Use with High Voltage Probe

is important that the two tubes be overlapped exactly one-half inch and that General Cement "Q" Dope, or equivalent, be used to join the tubes together. The use of a hollow insulating tube of this type permits the insertion of a high voltage probe at the interlock to conveniently measure the high voltage. The diameter of the tube used for the outer section may be made larger, if desired, by building up multiple layers of tubing across the one-half inch overlapped portion as shown in the illustration. In this manner the inside diameter may be made large enough to accommodate various types of high voltage probes.

Extension Cables

The 21CT660U series receivers may be operated with the chassis removed from the cabinet by employing a set of extension cables for the yoke, high voltage, convergence and kinescope leads. Such cables facilitate servicing components located on the wiring side of the chassis. The cables required may be constructed as shown in figures 15, 16, 17, 18, and 19.

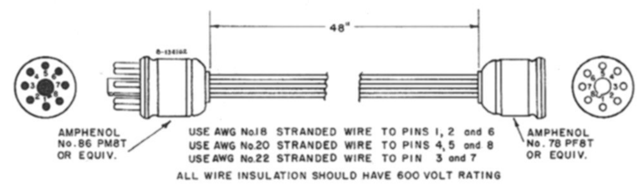


Fig. 15—Deflection Yoke Extension Cable

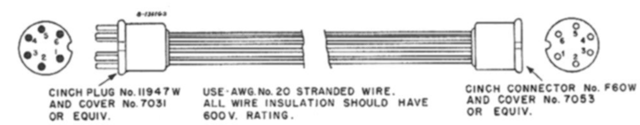


Fig. 16—Convergence Yoke Extension Cable

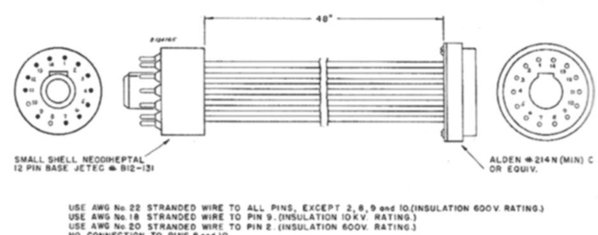


Fig. 17—Kinescope Extension Cable

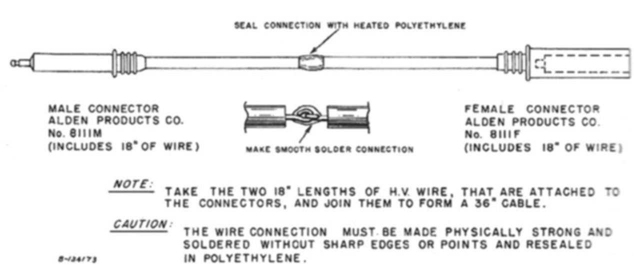


Fig. 18—High-Voltage Extension Cable

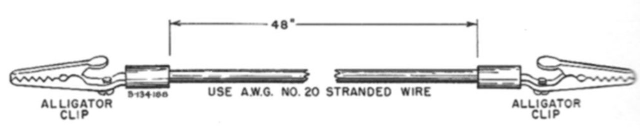


Fig. 19—Kinescope Shield Grounding Cable

Tricolor Kinescope Test Jig

A kinescope test jig designed to properly enclose, support and protect a tricolor kinescope is a valuable piece of shop equipment. Such a jig may be used to accommodate a kinescope brought in from the field for test purposes. If desired, it can be permanently equipped with a tricolor kinescope and used for color television chassis test purposes, thereby making it unnecessary to remove kinescopes from cabinets in the field and transport them to the shop.

Details for the construction of a test jig suitable for the 21AXP22 tricolor kinescope are shown in figures 20, 21, 22 and 23.

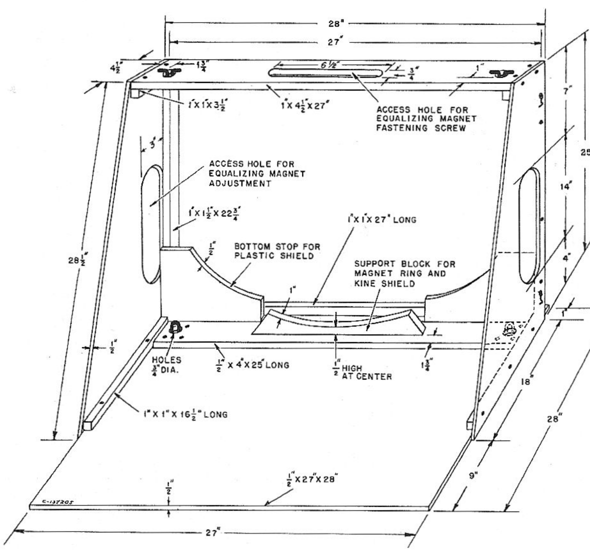
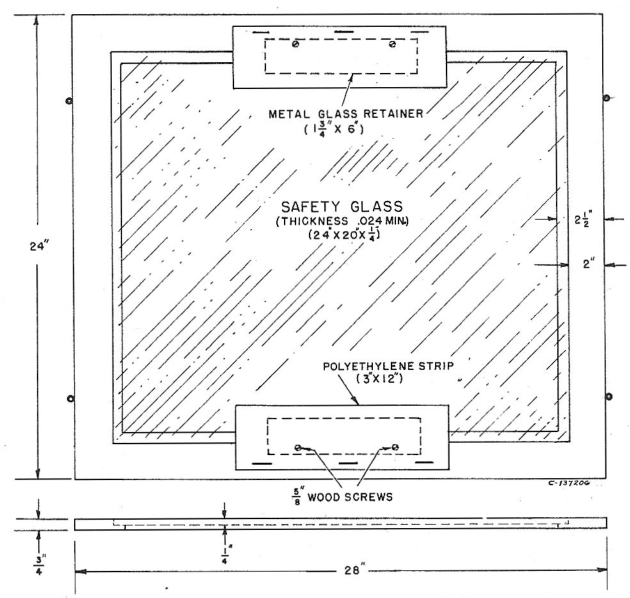


Fig. 20—Rear View—21AXP22 Tri-Color Kinescope Test Jig



NOTE: POLYETHYLENE STRIPS MUST BE PLACED OVER METAL GLASS RETAINER TO PREVENT HIGH VOLTAGE ARC TO THE FRONT PANEL.

Fig. 22—Front Panel Assembly—21AXP22 Tri-Color Kinescope Test Jig

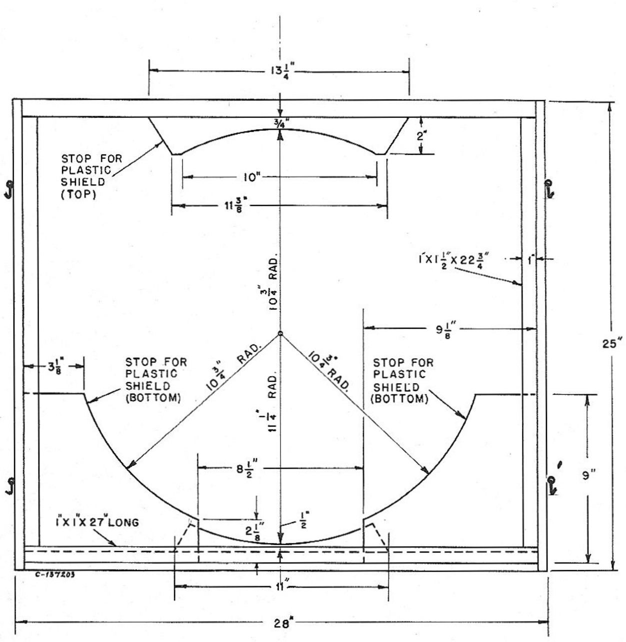


Fig. 21—Front View—21AXP22 Tri-Color Kinescope Test Jig

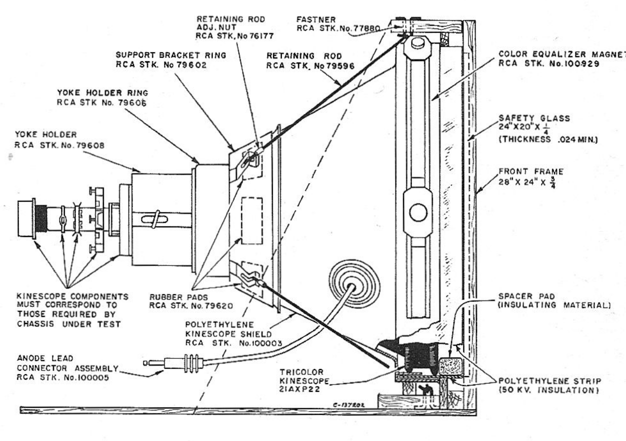


Fig. 23—21AXP22 Tri-Color Kinescope Test Jig—Assembly

ALIGNMENT EQUIPMENT

Conventional black-and-white television receiver alignment equipment may be employed when aligning color receivers. Accurate alignment equipment and methods assume even greater importance when working with color receivers because of the necessity for precise alignment of R-F, I-F, and video amplifiers. *Before attempting alignment of a color receiver, it is important to determine whether alignment is actually required.* Defective components or tubes may produce symptoms which resemble those due to misalignment. If it is determined that alignment is required, the alignment procedure outlined on page 70 should be followed.

The equipment required to properly align a color television receiver is briefly described in the following paragraphs.

Signal Generator

A signal generator is needed to provide the necessary R-F or I-F signals. It must have crystal accuracy and satisfy the following requirements:

(a) Frequency Ranges.
4.5 mc. output.
19 mc. to 260 mc. output.

(b) Output should be adjustable and at least .1 volt maximum.

The RCA WR-89A Crystal Calibrator, shown in figure 24, is well suited for color receiver alignment, because it insures the accuracy required in locating the shoulder of the overall R-F - I-F response curve, the position of the picture carrier, color sub-carrier and the exact frequencies for I-F traps, etc.

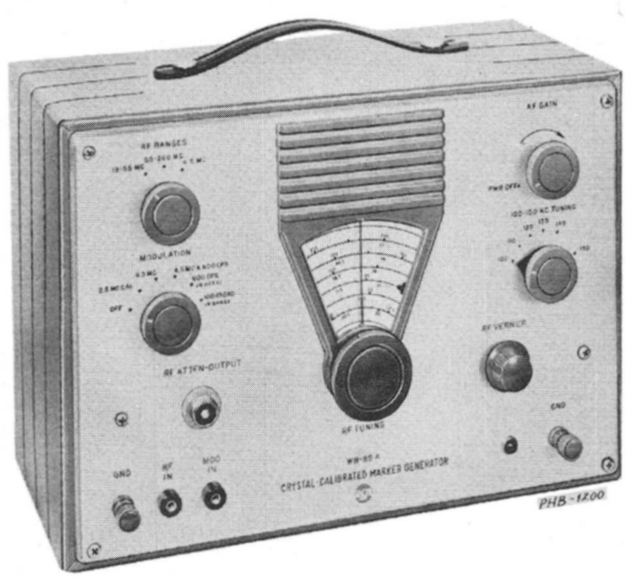


Fig. 24—Crystal Calibrated Marker Generator, RCA WR-89A

Sweep Generator

To align a color television receiver it is also essential to have a sweep generator meeting the following requirements:

(a) Frequency Ranges.

Video Sweep output of 50 kc. to 5 mc., or better.

35 mc. to 90 mc. output with 12 mc. sweep width.

170 mc. to 225 mc. output with 12 mc. sweep width.

(b) Output adjustable with at least .1 volt maximum.

(c) Output constant on all ranges.

(d) "Flat" output on all attenuator positions.

The RCA WR-59C Sweep Generator, shown in figure 25, is ideally suited for color television receiver alignment because it satisfies all requirements listed above.

Fig. 25—Television Sweep Generator, RCA WR-59C

Black-and-white television receivers do not require video sweep during alignment. There is a very definite need, however, for a video sweep when servicing color receivers since the Video Amplifier, Band-pass Amplifier and Demodulator circuits must be aligned. To accomplish this, the video sweep signal from the Sweep Generator is used to modulate a picture-carrier signal from a Signal Generator.

Video "MultiMarker"

When using the video-frequency range of a sweep generator to check the response of a video amplifier, or to align the chrominance channels in a color receiver, it is necessary to provide markers to identify specific frequencies on the response curves.

It is possible to use a CW oscillator as a marker, but this method makes it difficult to identify the desired point and also makes it difficult to inject the signal without loading the circuit. For video-frequency work, it is preferable to use an absorption-type marker, consisting of a tuned circuit loosely coupled to the output of the sweep generator.

The RCA WG-295A Video "MultiMarker," shown in figure 26, is suitable for this purpose. Each of the marker frequencies may be quickly identified on the

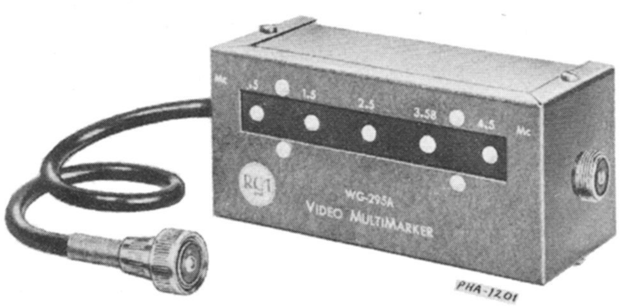


Fig. 26—Video Multi-Marker, RCA WG-295A

response curves simply by touching the corresponding contact on the "MultiMarker"; this has the effect of reducing the amplitude and shifting the position of the particular marker notch. At present the markers are adjusted to: 4.5 mc., 3.58 mc., 2.5 mc., 1.5 mc., and 0.5 mc. For use in alignment of the 21CT660U series receivers the 3.58 mc. and 2.5 mc. marker traps should be changed to 4.1 mc. and 3.0 mc. respectively. The 3.58 mc. and 2.5 mc. coils may be re-tuned to 4.1 mc. and 3.0 mc. In some cases it may be necessary to remove one turn from each of the respective coils.

R-F Modulator

To properly align color receivers in which the falling off of picture I-F response in the region of the color subcarrier is compensated for by a rising characteristic in the video amplifier, a picture carrier signal modulated with video sweep is required.

The RCA WG-304A R-F Modulator, shown in figure 27, provides an efficient means of modulating an R-F carrier from a signal generator by a signal from a sweep generator.

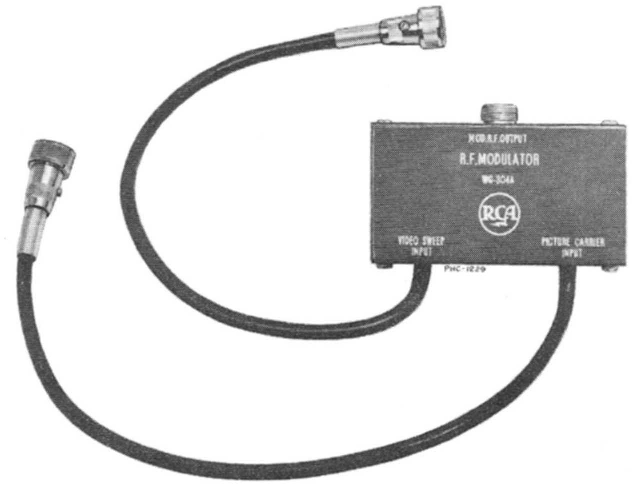


Fig. 27—R-F Modulator, RCA WG-304A

Bias Supplies

It is important to employ proper bias voltages, when and where necessary, during the alignment of black-and-white and color television receivers.

Each particular bias supply can be made using combinations of batteries, a switch and a potentiometer. The batteries must deliver adequate bias voltage and should be capable of withstanding appreciable current drain.

A battery-bias supply which can be used in the alignment of the 21CT660U series receivers is shown in the diagram in figure 28.

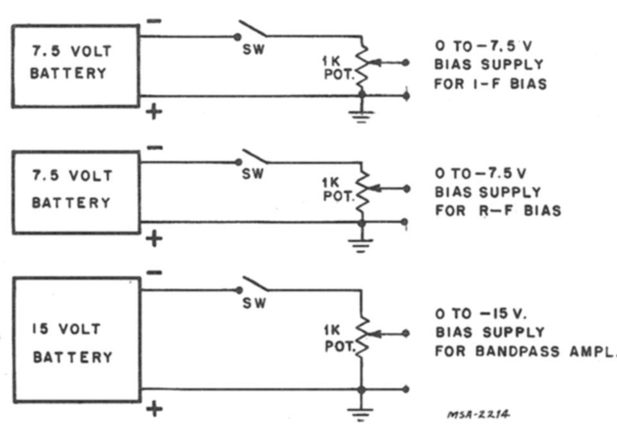


Fig. 28—Battery-Bias Supply

A 3-way bias supply may be constructed to make use of the available negative supply within the color receiver. An illustration and schematic diagram of this supply is shown in figure 29.

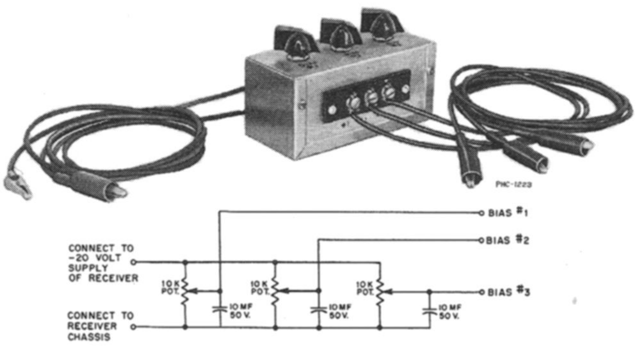


Fig. 29—3-Way Bias Supply

I-F Test Block

To observe the frequency response of the mixer plate circuit, it is necessary to load the plates of the second and third picture I-F amplifiers and detect the response at the plate of the first picture I-F amplifier. An I-F test block, shown in figure 30, can be constructed and used to facilitate this step in the alignment of the receiver.

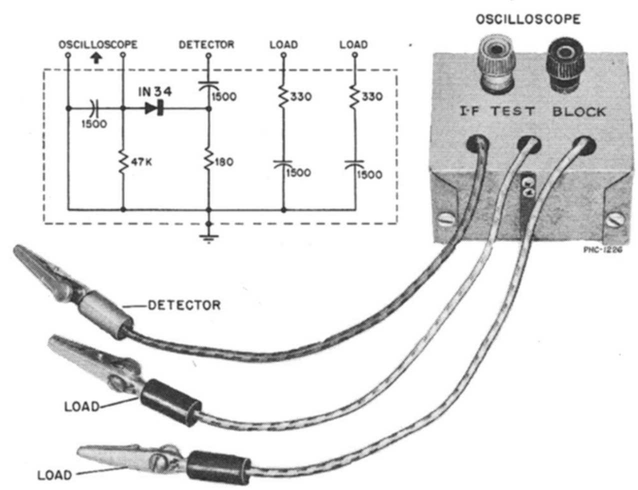


Fig. 30—I-F Test Block

Dummy Load

When aligning the 21CT660U series color receivers, the horizontal deflection circuits must be disabled to prevent horizontal pulse interference on the oscilloscope. A load equivalent to the horizontal deflection circuits should be connected across the output of the power supply so that the proper operating voltages are maintained on the circuits being aligned.

A 1500 ohm 100 watt resistor, or four 25 watt light bulbs connected in series, as shown in figure 31, provides an adequate "dummy load" for the 21CT660U series receivers. This load should be connected between the plus 380 volt supply source and the minus 20 volt supply source.

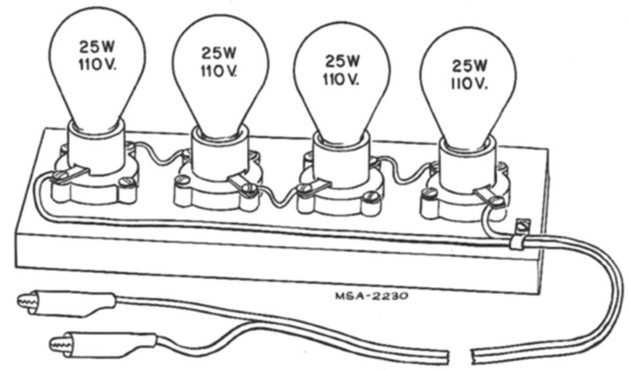


Fig. 31—Light Bulbs used as Dummy Load

Another method of compensating for the change in voltages, when the horizontal deflection circuits are made inoperative by removing F101, is to disconnect one side of F104 (4.5 amp. pigtail fuse) and connect a 7.5 ohm, 5 watt resistor across the terminals to which F104 was fastened. This resistor lowers the supply voltage to a normal value when fuse F101 is removed.

Sweep Attenuator Pad

A sweep attenuator pad should be employed when using a signal from a sweep generator to align the receiver. The attenuator pad will prevent coupling reaction, between the receiver antenna matching unit and the sweep generator cable. This reaction may affect the alignment of the receiver. A schematic diagram of an attenuator pad suited to each type of sweep generator output cable is shown in figure 32.

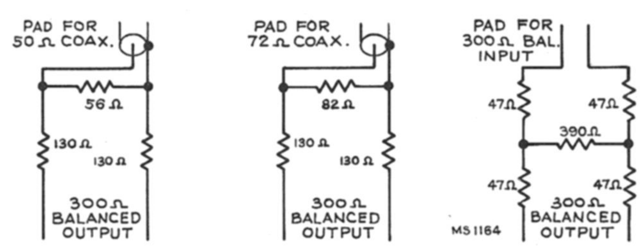


Fig. 32—Attenuator Pads

Other Measuring and Indicating Equipment

It is essential to employ accurate measuring and indicating equipment to insure effective results in receiver alignment. An accurate meter, such as the "VoltOhmyst," and a wide-band cathode-ray oscilloscope, having a sensitivity of .01 volts per inch deflection, and a diode demodulator probe should be used. (Refer to figures 7 and 9.)

It is important to keep in mind that accuracy in the alignment of a television receiver depends upon the accuracy of the equipment used to make the alignment.

FIELD SERVICE

The majority of service performed on color television receivers will be in the customer's home or place of business. It is therefore essential to develop and follow a logical pattern of service techniques that can be readily employed in the field. The techniques will naturally reflect the patterns previously developed in the practice of servicing black-and-white receivers.

A reasonable knowledge of the circuitry of the particular color receiver to be serviced, is of course required, as well as the use of the proper equipment. The equipment recommended to efficiently perform set-up adjustments and service for a color receiver in the field is as follows:

Dot-Bar Generator.

Color Bar Generator.

Voltmeter and High Voltage Probe.

Milliammeter.

Degaussing Coil.

Mirror.

Extension Cables.

Kinescope Control Grid Switch.

High Voltage Interlock.

Standard Black-and-White Servicing Tools.

Proper Complement of Tubes.

Servicing techniques used for black-and-white receivers apply equally to color receivers. However, in addition to techniques proven effective in servicing black-and-white receivers, the application of *new* techniques peculiar to color receivers must be employed. These techniques will be reviewed in the following paragraphs.

Preliminary Investigation

Before proceeding to service a color television receiver in the field, make every attempt to obtain and organize all information pertaining to the operating condition of the receiver to be serviced. For instance, when contacting the customer, learn all you can about the difficulties being encountered with the receiver so that the proper course of analysis may be quickly determined. If possible, before entering the establishment housing the receiver to be serviced, take a quick look at the antenna and the lead-in. Note its condition, age, type and approximate orientation since these factors may have a bearing on the performance of the receiver requiring service.

Check the operating controls of the receiver to determine which are, or are not, re-acting properly. *Do not change the adjustment of the set-up controls until a diagnosis of the receiver performance has been made since changing these adjustments may hide symptoms that are of value in diagnosing malfunction of circuits in the receiver.*

When attempting to isolate the source of improper operation in a color receiver it is of value to keep in mind that the receiver is basically a reproducer of black-and-white pictures, and that certain additional circuits are devoted entirely to color. Therefore, the first logical step toward analyzing improper operation of a color receiver is to observe the reception of a black-and-white transmission.

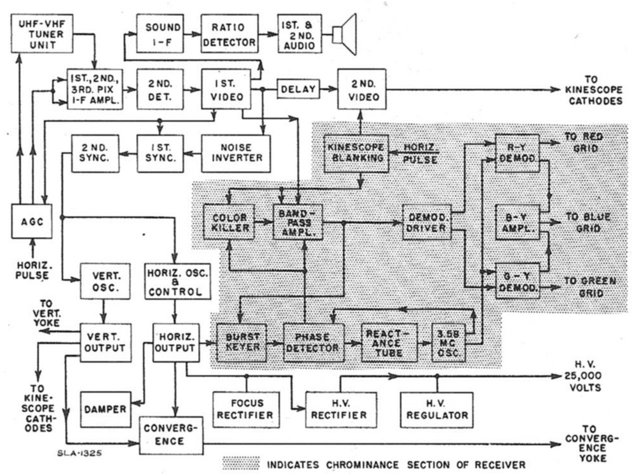
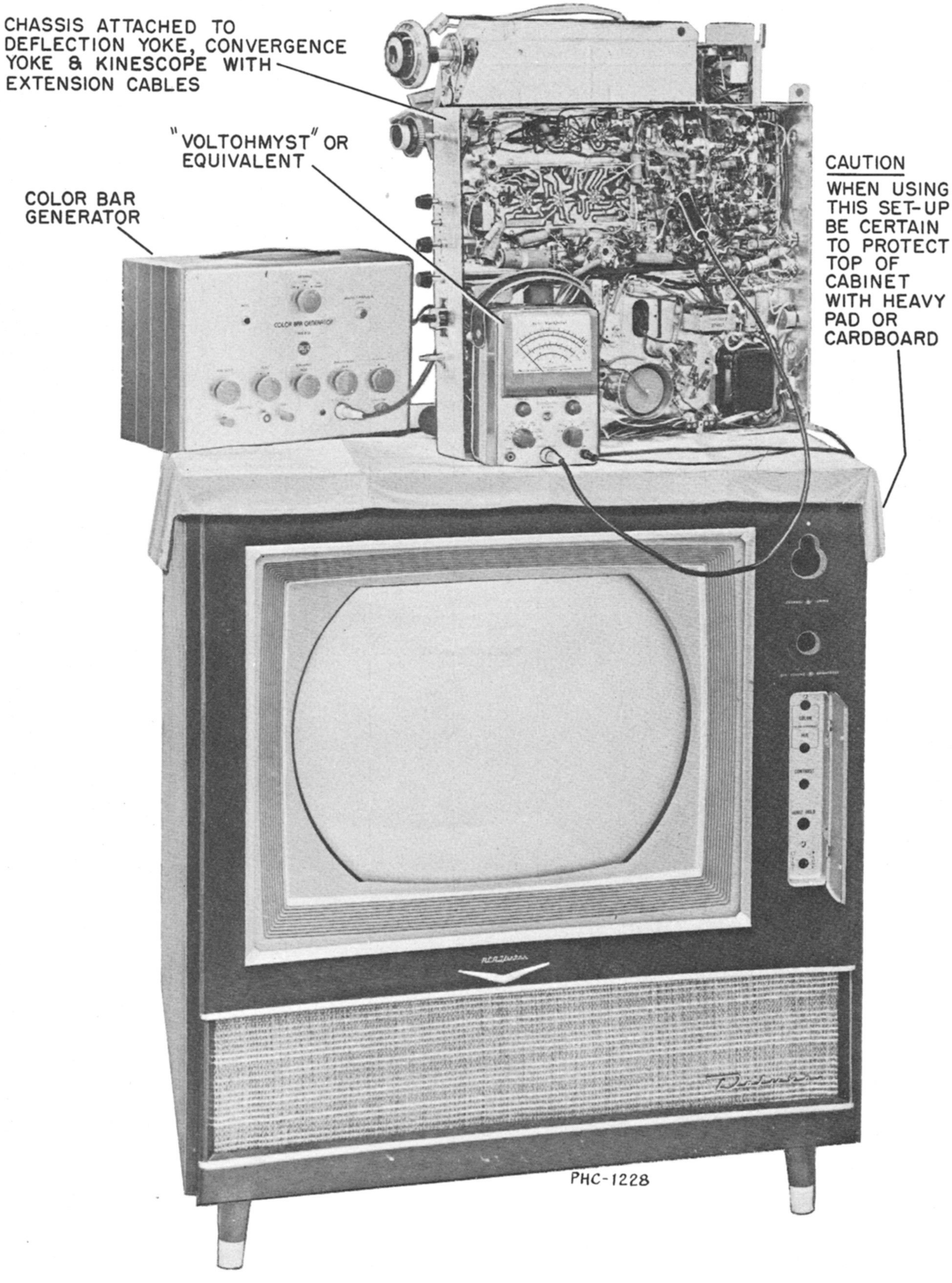


Fig. 33—Block Diagram—21CT660U Series Color Television Receivers

The block diagram figure 33, shows, in the shaded portions, the commonly designated "color circuits" of the receiver.

The unshaded blocks may be considered the "black-and-white" circuits. Defects or improper operation in the black-and-white circuits can be localized *without* a color signal.

Since the major portion of the receiver circuitry concerns functions familiar in black-and-white television receivers, most of the service that may be required can be quickly and efficiently performed by applying service techniques used to service black-and-white receivers.



RCA Victor 21CT662U Color Television Receiver—Set up for Circuit Analysis in the Field

CHECKING BLACK-AND-WHITE OPERATION

CAUTION

Operation of these receivers outside the cabinet or with the covers removed involves a shock hazard from the receiver power supplies. Work on the receivers should not be attempted by anyone not familiar with the precautions necessary when working under these conditions. Make certain the H.V. interlock plug (on rear cover of the receiver) is removed from the interlock jack, thereby shorting the high voltage, before touching this circuit. Also remember to replace the interlock plug into the interlock jack before turning on the receiver. Neglecting to do so will result in failure of the H.V. fuse F101.

Effects observed in black-and-white reception will expose malfunction of circuits that are common to both color and black-and-white operation of a color receiver. For example:

1. General operating defects such as, no picture; no brightness; no sync; distorted picture; no sound, etc., reveal faults common to both black-and-white and color reception.
2. When video and color demodulator circuits are DC coupled to the kinescope, as in the 21CT660U series color receivers, they can cause a condition of no brightness and should be checked if such a condition exists.
3. Color fringing on a black-and-white picture indicates primarily, improper operation of the convergence circuits.
4. Color shading in sections of the background of an otherwise normal black-and-white picture indicates impurity in the primary color fields.
5. A primary color cast over the entire background of the picture indicates improper color balance which can be caused by faults in the kinescope circuitry, faults in the matrix circuits and faults in the color demodulator circuits.

If normal black-and-white pictures can be produced it is a good indication that the following circuits are in proper working order:

Low voltage power supply
High-voltage power supply
Horizontal and vertical sync
Sound I-F and audio circuits
2nd Video amplifier
AGC circuits
Convergence circuits
Color Killer
Horizontal Blanking Amplifier
Horizontal and vertical deflection
Kinescope and controls

The Antenna Tuner unit, Picture I-F circuits and 1st Video Amplifier might also be added to this list but there are occasions when they could affect color reception without noticeable effect on black-and-white reception. This condition could occur when the R-F, I-F and 1st video circuits are mis-aligned to the extent that the chrominance information is greatly attenuated. Improper antenna characteristics or orientation can also cause poor reception of color signals.

In the 21CT660U series color receivers a good black-and-white picture also indicates that the 3.58 mc. oscillator and the color demodulator circuits are most likely functioning normally.

CHECK OF CIRCUITS AFFECTING BOTH BLACK-AND-WHITE AND COLOR RECEPTION

Color Purity

Receiver faults causing impurity of the primary color fields are confined to the deflection yoke, kinescope, and kinescope accessories. Color impurity resulting from defects in these components or circuits can be located by following the procedure for obtaining color purity, as described in the set-up procedure for the receiver. See page 26. Do not forget that good purity is dependent upon good convergence and proper demagnetization of unwanted magnetic fields about the tricolor kinescope. External magnetic fields which cannot be compensated for in the receiver, may be in the vicinity of the receiver and may affect color purity.

Beam Convergence and Focus

It is necessary to have both good convergence and focus of the red, blue and green beams in the tricolor kinescope for either black-and-white or color reception.

If static convergence is normal, the beams will converge at the center of the screen when the beam positioning magnets are adjusted.

The horizontal dynamic convergence controls will affect the convergence of the three beams at the sides of the picture, and the vertical dynamic convergence controls will affect the convergence of the beams on the top and bottom of the picture.

If color fringing exists and cannot be corrected by following the dynamic convergence set-up procedure (see page 26), the operation of the convergence circuits of the receiver must be checked. (See page 67, in the SHOP SERVICE section of this booklet.)

Remember, it is imperative that the kinescope focus, convergence and purity be adjusted with great care if a good black-and-white or color picture is to be obtained. These adjustments have inter-related effects. This therefore, must be taken into consideration when making these adjustments.

Gray Scale

To insure that no color tint appears in the highlights or lowlights in a black-and-white picture, and that proper colors are represented in highlights and lowlights of a color picture, the receiver gray scale tracking must be properly adjusted.

Poor gray scale tracking should be checked on black-and-white reception. When improper tracking is detected, the "Tracking" adjustments on page 28 should be performed. If tracking cannot be attained, all kinescope control and matrix voltages should be checked.

Unbalanced color demodulator stages can also cause this condition.

It is important to remember that before a color receiver can be expected to produce a good color picture, it must first be able to produce a good black-and-white picture.

SERVICING THE CHROMINANCE CHANNELS

A color receiver may respond beautifully to all signals required to reproduce a good black-and-white picture but fail to respond, as it should, to color signal information. When this condition exists, the receiver produces black-and-white pictures even when tuned to a station transmitting a color program. Color signal deficiencies may be placed in three classifications.

1. No color reproduction
2. No color lock (Synchronization)
3. Improper color rendition

These can be quickly localized since the responsible circuits are few in number and not difficult to analyze.

No Color

Chrominance Channel Check — Tubes and Adjustments

When a receiver fails to reproduce color, even though it is properly tuned to a station transmitting a color program, it is necessary to determine first whether the fault lies in the receiver itself or is due to the antenna. A rough test that indicates whether the receiver is passing color information may be made as follows:

Set the COLOR control to its maximum position (fully clockwise) and the color killer threshold control to its maximum counter-clockwise position. Rotate the FINE TUNING control through its range. If the receiver is capable of passing color signals a color beat disturbance will be seen on the screen of the kinescope and an antenna check is in order. In most cases, a portable type antenna will prove of value in roughchecking color signal reception when a faulty antenna or transmission line is suspected. If the above test indicates that the antenna or transmission line is at fault both antenna and transmission line should be checked.

Antenna Considerations

Partial or complete loss of the chroma portion of the color television signal can sometimes result from an unsuitable antenna installation. Some of the causes for this condition are:

Multi-path signal reception due to reflection from an object or the ground plane.

Multi-path reception due to transmission line or power line signal pickup.

Antenna or transmission line impedance mis-match. Critical transmission line length when associated with impedance mis-match.

Reaction of one receiver on another when both are connected to a common transmission line from the antenna.

Selective absorption at certain frequencies in some commercial antennas.

Frequency dependent reception patterns of highly directional antennas.

The following remedies may eliminate most of the causes of loss of chroma signal due to the antenna installation.

Use of an antenna rotator so that optimum orientation can be obtained. Or, in the case where a fixed antenna is required, optimum orientation for reception from stations transmitting color programs.

Broad-band antennas should be used where possible, in preference to high-gain types, since high-gain antennas are likely to have limited bandwidth. Elevator or balun impedance transformers should be used at the receiver antenna input where coaxial cable transmission lines are used. Where more than one television receiver is installed in the same location, unless attached to a well designed central distribution system, separate antenna installations will be of benefit for the reception obtained by the color receiver.

If separate antennas are not practical, or permissible, low capacitance switches may be used in the lead-in to switch from one receiver to the other.

A resistive isolation pad at the input to each receiver may also help to eliminate the condition of loss of chroma due to the antenna or lead-in.

Mis-match due to lead-in receiver-input impedance differences may be reduced by the installation of a non-inductive resistance load (300 to 1000 ohms) across the tuner input terminals.

In instances when extremely high signal levels are present, attenuation pads should be installed at the tuner "Antenna input" terminals.

Figure 34 shows schematic diagrams and values of the carbon resistors needed to construct pads that will produce respectively, ten-to-one, three-to-one and two-to-one reduction in signal strength.

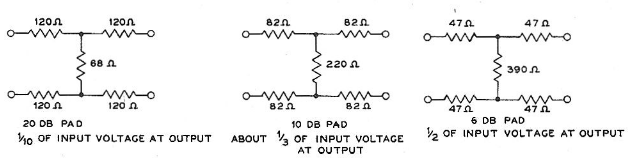


Fig. 34—Resistive Attenuating Pads

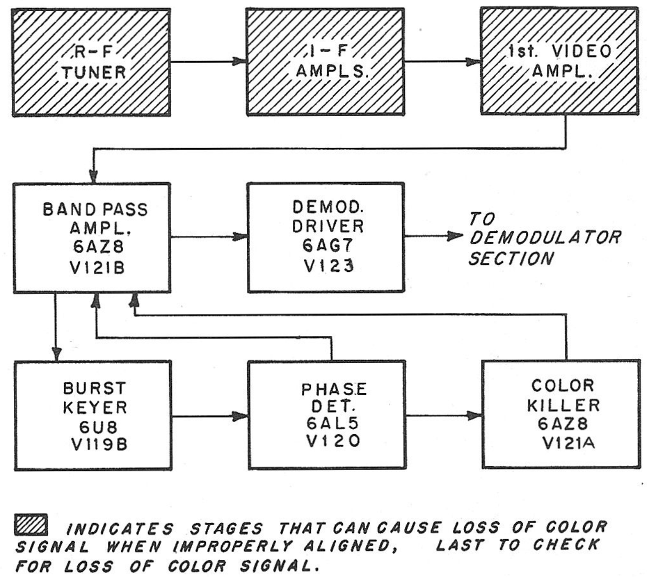


Fig. 35—Block Diagram—Stages to Check for Loss of Color

A similar overload condition may exist in receivers connected to a multiple-outlet system or a community cable system where the received signal is amplified before it is distributed to the receivers. In this case, reducing the signal at the antenna input of the receiver will correct the overload condition. However, if the amplifiers of the community system are being overloaded by the signals they are receiving, then padding the antenna input to a receiver will not correct the overload condition. The signal handling capabilities of the amplifier should be increased or the signal applied to the amplifier should be decreased.

Receiver Considerations

If color is not indicated when the Color control is set to its maximum position (clockwise), the Color Killer Threshold control at maximum counter-clockwise position, and the Fine Tuning control rotated, the color circuits in the receiver should be checked.

Certain checks can be made if a color stripe or program is being transmitted by the television station to which the set is tuned, but a color bar generator is the most applicable piece of test equipment for color signal circuit analysis and should be used whenever possible.

Localizing Faults Resulting in No Color Reproduction

The circuits that can cause the loss of color reproduction in the 21CT660U series receivers are shown in block diagram form in figure 35. The R-F, I-F and 1st Video stages are the least likely to be at fault if a good black-and-white picture is being produced, however if these circuits are not aligned properly they can attenuate or cancel the color signals. This can be seen by noting the effect the Fine Tuning control has on the picture reproduction. Before checking tubes for loss of color be certain that the Color control is set fully clockwise and the Color Killer Threshold control is in its fully counter-clockwise position.

Defects in the Bandpass Amplifier V121B, Demodulator Driver V123, Burst Keyer V119B, the Phase Detector V120 and the Color Killer V121A, are most likely to cause a chrominance signal interruption in the receiver. The Burst Keyer, Phase Detector and Color Killer do not pass the chrominance signal within themselves but act to *control* the passage of the chrominance signal through the Band Pass Amplifier. The 3.58 mc. *burst* signal must pass through the Burst Keyer and Phase Detector if the Color Killer is to be biased off and allow passage of color through the Band Pass Amplifier. The tubes in this section of the receiver (see figure 36) are the first to be checked when no color reproduction is experienced. The respective circuitry must be checked if the tubes in the circuits listed above are not found to be at fault.

Localizing Faults Causing No Color Lock (Sync)

This condition is revealed by bands of color moving vertically or diagonally across the screen.

When such a condition exists, the Reactance Tube V122B, the Phase Detector V120, and the 3.58 mc. CW oscillator, V124A, see figure 37, should be checked. At this point it is already known that the Burst Keyer is operating, since if it were not functioning, the Color Killer would conduct and the Band Pass Amplifier would be cut-off, resulting in no color. If checking the Reactance, Phase Detector, and 3.58 mc. oscillator tubes does not correct the condition, a check of their circuits is in order.

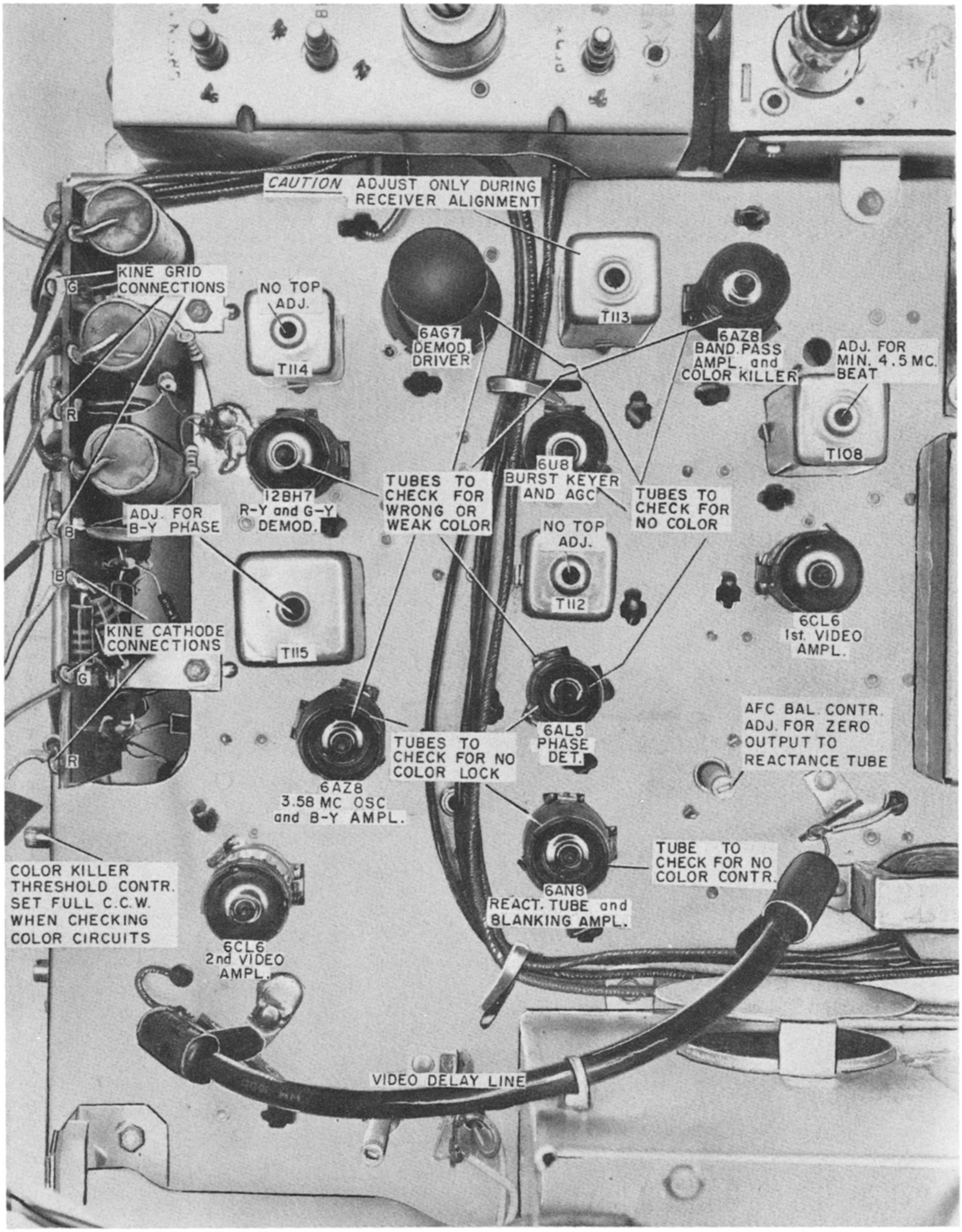


Fig. 36—Chrominance Section of the Receiver

Localizing Faults Causing Wrong Color Rendition

Since color involves hue, saturation and brightness a change in any one of these characteristics will cause improper color rendition. As explained previously, black-and-white reproduction of the picture should be normal before attempting to service the chrominance channels. This indicates that the brightness component of the signal is normal. Hue and saturation are then the other characteristics to be considered.

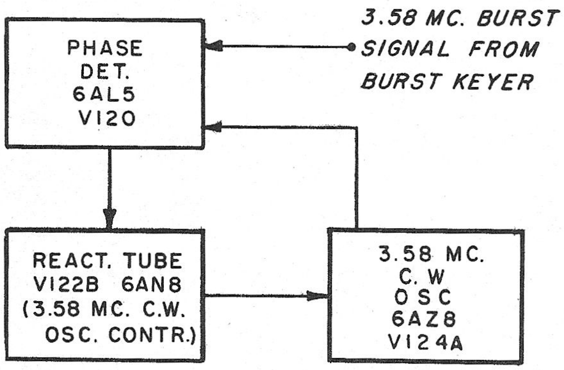


Fig. 37—Block Diagram—Stages to Check for Loss of Color-Lock

The circuits that affect hues, in the sense of the phase relationships, are shown in block diagram form in figure 38.

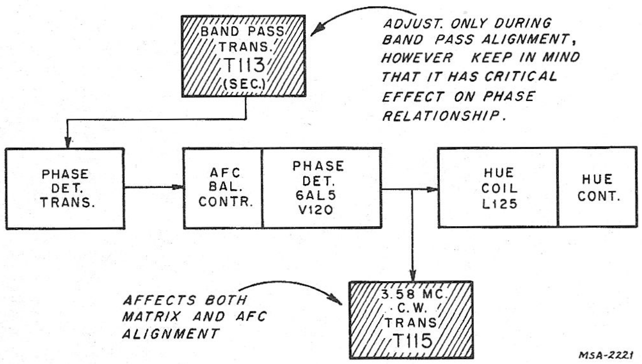


Fig. 38—Block Diagram—Circuits Affecting Hue (Phase)

When all hues are present but show improperly throughout the picture, the phase relationship between burst and the 3.58 mc. reference signal is incorrect. This condition usually results from improper operation in the AFC or Demodulator circuits, and the cause can be readily located by checking the AFC and matrix alignment of the receiver as explained on page 22.

NOTE

Before trying to localize the source of this condition, check the HUE control and determine the amount of correction required. In many cases only slight adjustment of the hue coil, L125, may be all that is required.

Improper colors due to color saturation difficulties, when luminance is normal, may be observed as weak color, color too strong, or no control of color. Improper operation of the circuits controlling the amplitude of the color signal may cause this condition. Assuming the receiver is aligned properly and that black-and-white reproduction is normal, the Band Pass Amplifier V121B, the Burst Keyer, V119B, the Phase Detector, V120, and the Demodulator Driver V123 should first be checked if a weak color condition exists. Refer to figure 36. The Blanking Amplifier, V122A, Burst Keyer, V119B, Phase Detector, V120 and Color Killer, V121A, should be checked if the condition is insufficient control of color, or no control of color. The 3.58 mc. CW oscillator, V124A, and the demodulator tubes, V125 and V124B have some effect on color saturation and should also be checked. However, if defective, these tubes will normally cause a lack of color balance during black-and-white picture reproductions. Chrominance circuits that affect color saturation are shown in block diagram form in figure 39. If a check of the respective tubes and related set-up controls does not reveal the fault, an analysis of waveforms or voltages in these circuits must be made.

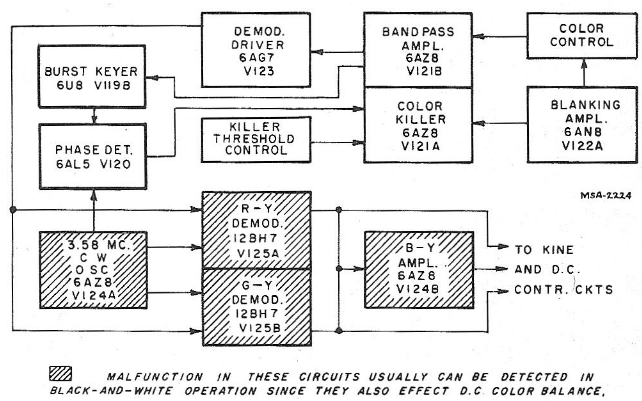


Fig. 39—Block Diagram—Circuits Affecting Color Saturation

Circuit and Component Analysis of the Chrominance Channels

If, after all tubes and associated controls in the appropriate sections of the chrominance channels have been checked, the faulty condition persists, the receiver must be analyzed for defective components and wiring. To accomplish this, the chassis must be removed from the cabinet. If the top of the receiver cabinet is adequately protected with a heavy pad, or other suitable protective covering, it provides a convenient place to set the chassis. Refer to page 16. In this position the chassis may be easily connected to the kinescope and its components by means of extension cables. This arrangement provides a convenient set-up for performing circuit analysis.

CAUTION

Make sure that the chassis and the exposed metal fittings of the kinescope mounting are connected by a jumper. Failure to make this connection may result in a shock hazard from the metal fittings of the kinescope mounting.

The AFC alignment procedure provides a systematic method of analyzing the operation of the chrominance circuits.

The chrominance channels of the receiver may be checked very effectively by simply following the step-by-step procedure for AFC alignment, see figure 40, and noting when and where circuits fail to respond to adjustment.

The procedure serves to detect the presence and status of all signals involved in the various sections of the chrominance circuitry. It provides a quick and systematic method of tracking down any malfunctioning circuit in the chrominance channels.

A color bar generator should be used as a color signal source when making these checks because it provides a stable signal having known characteristics and constant output. The color bar signals should be fed into the antenna terminals of the receiver and a "VoltOhmyst" (or a voltmeter having at least 20,000 ohms per volt sensitivity) should be used for signal detection.

AFC Alignment Used For Chrominance Circuit Analysis

See figure 40.

Connect a color bar generator to the receiver input terminals. Adjust the generator and receiver for reception of black-and-white bar signals on the kinescope. Proceed with the AFC alignment as described below. Circuits functioning improperly will fail to respond to alignment.

1. Remove Band Pass Amplifier tube V121, or short terminal "C" of T-113 to ground. This prevents the color signals from entering the chrominance channels and permits detection of the 3.58 mc. CW reference signal at pin 7 of the phase detector.

2. Connect the "VoltOhmyst" to Pin 7 of the Phase Detector, V120. The Phase Detector at this point of AFC alignment serves to detect the presence and amplitude of the 3.58 mc. CW reference signal.

3. Adjust T-115 (bottom) for maximum DC reading on the "VoltOhmyst."

(a) A peaking response to this adjustment indicates the 3.58 mc. CW oscillator is functioning and T-115 is passing the 3.58 mc. signal.

(b) If no response to this adjustment is indicated on the "VoltOhmyst," check pins 2 and 7 on the R—Y and G—Y demodulators, V125. If the 3.58 mc. signal is passing through T-115, a negative voltage (approximately —20 volts) should be present at these points.

(c) If incorrect voltage or no voltage is indicated on pins 2 and 7 of V125, in step (b) connect the "VoltOhmyst" to pin 6 of V124 the 3.58 mc. CW oscillator grid. If the oscillator is functioning, approximately —10 volts should be indicated here. Note: A vacuum tube voltmeter must be used when measurement is made.

4. Set the HUE control to its mid-position and adjust L-125, hue coil, for maximum DC reading on the "VoltOhmyst."

Response to this adjustment indicates the hue coil is functioning.

5. Replace Band Pass Amplifier tube, V121, or remove short from terminal "C" of T-113, whichever applies.

This admits the color signal information to the chrominance channels of the receiver.

6. Adjust T-112 (bottom) for maximum DC reading on the "VoltOhmyst."

Response to this adjustment indicates color burst is passing through the Burst Keyer tube, V119B, and T-112 is coupling the color burst signal to the Phase Detector.

7. Ground the junction of R241 and L126 in the grid circuit of the reactance tube.

This removes the AFC control voltage from the reactance tube and permits the 3.58 mc. CW oscillator to become free-running.

8. Adjust L127, the reactance coil, for zero-beat between the 3.58 mc. color burst and reference signal as indicated at pin #7 of the Phase Detector by the "VoltOhmyst" or, by stationary or slowly drifting color bars on the screen of the kinescope when color is visible.

Response to this adjustment indicates the reactance coil, L127, is functioning properly and the free running frequency of the 3.58 mc. CW oscillator is correct.

9. Remove the short, which grounds the junction of R241 and L126 and disable the 3.58 mc. CW oscillator by connecting a piece of wire about one foot long to the grid of the oscillator tube, (pin #6 V124A).

This removes the 3.58 mc. locally generated reference signal from the phase detector, V120, and allows only the 3.58 mc. color burst signal from the color bar generator to pass through the phase detector circuit.

10. Disconnect the "VoltOhmyst" from pin #7 of V120 and connect it to the junction of R241, L126.

The "VoltOhmyst" reading at this point will reveal the state of balance between the two sections of the phase detector tube, V120.

11. Adjust the AFC Balance Control for zero reading as indicated on the "VoltOhmyst."

Proper response to this adjustment indicates the phase detector circuit is working properly.

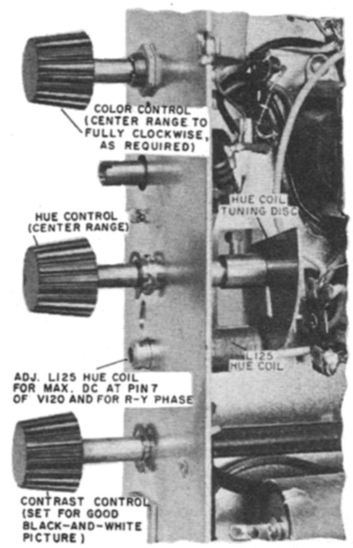
12. Remove all test equipment applied to the receiver circuits.

The Demodulator Driver circuit is not covered in AFC alignment and should be carefully checked when all the circuits involved in AFC alignment appear to be functioning normally and color does not appear on the kinescope.

The R—Y, G—Y demodulators and the B—Y amplifier affect color balance and therefore malfunction in these circuits can normally be detected in the black-and-white signal reproduction of the receiver.

AFC ADJUSTMENTS

1. Remove Bandpass Ampl.
2. Connect "VoltOhmyst" to Pin 7 of Phase Detector.
3. Adjust T-115 (bot.) for max. on "VoltOhmyst".
4. Center HUE control and Adjust L-125 for max. on "VoltOhmyst".
5. Replace Bandpass Ampl.
6. Adjust T-112 (bot.) for max. on "VoltOhmyst".
7. Ground Junction of R-241/L-126.
8. Adjust L-127 for zero beat between Burst and Reference signals.
9. Remove ground from junction of R-241/L-126 and disable 3.58 mc. CW osc.
10. Connect "VoltOhmyst" to junction of R-241/L-126.
11. Adjust AFC control for zero reading on "VoltOhmyst".
12. Remove all test equipment formerly applied to AFC circuits.



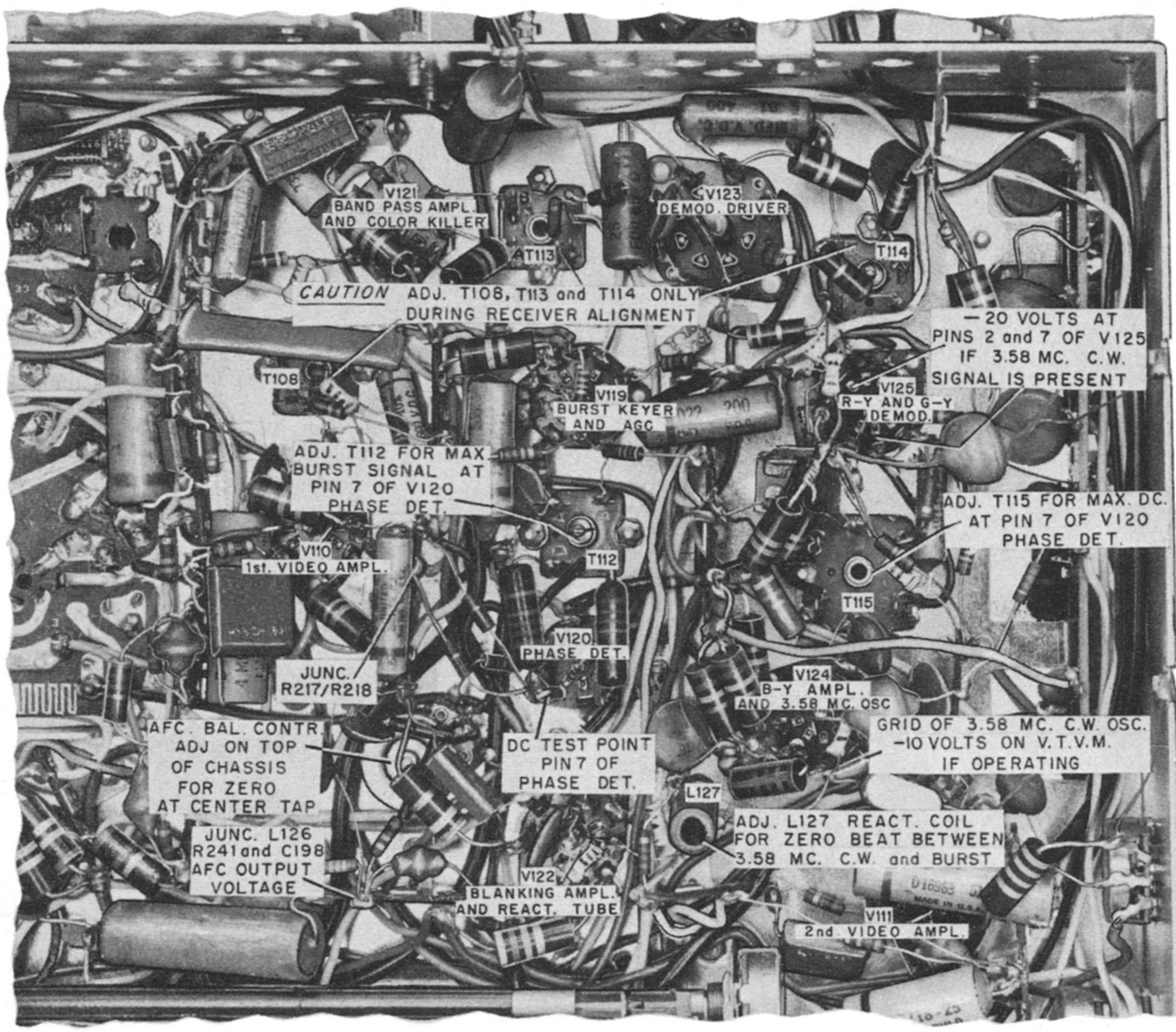


Fig. 40—Color AFC Alignment Procedure

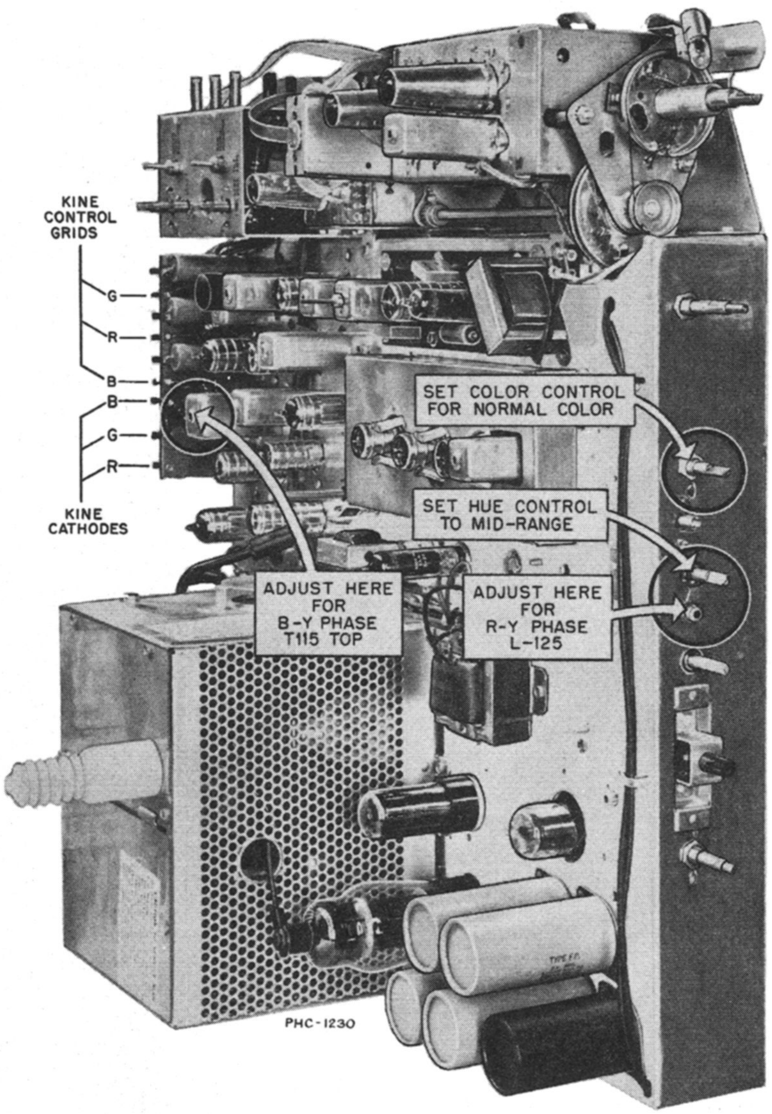


Fig. 41—Demodulator Phasing Adjustment

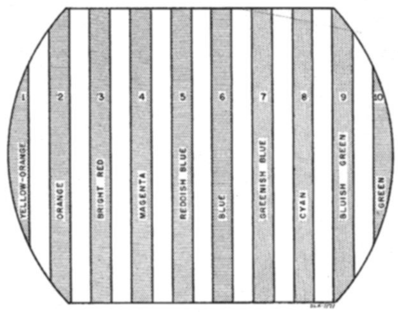


Fig. 41(a)—Color Bar Pattern

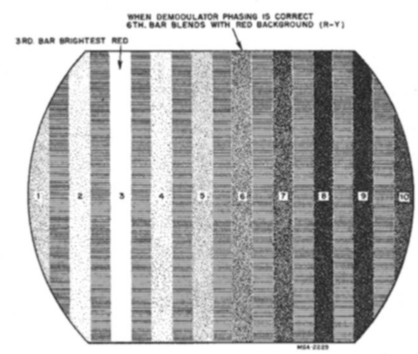


Fig. 41(b)—Color Bar Pattern—Blue and Green Removed

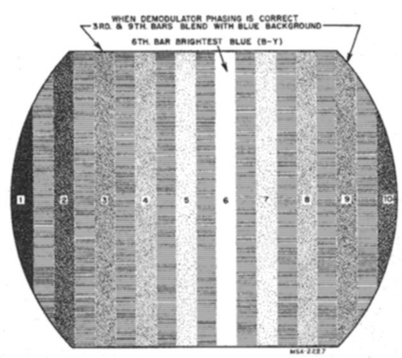


Fig. 41(c)—Color Bar Pattern—Red and Green Removed

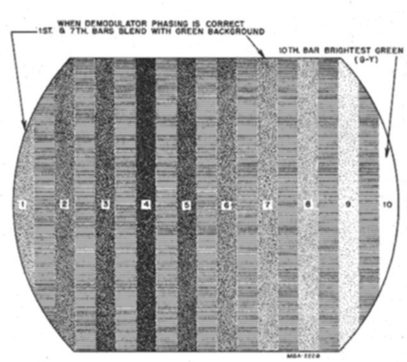


Fig. 41(d)—Color Bar Pattern—Red and Blue Removed

DEMODULATOR PHASING ADJUSTMENTS

1. Short green and blue control grids to ground through 100K resistors.

2. Adjust L-125 until sixth bar blends with background.

3. Remove 100K resistor from red control grid and connect between green control grid and ground.

4. Adjust T-115 (top) until third and ninth bars blend with background.

5. Remove the 100K resistors from red and green control grid.

Demodulator Phasing and Matrixing Check

When the color bars are present on the screen of the kinescope, and the HUE control is in the center of its range, the hues should appear in the order shown in figure 41 (a). If they do not, and the AFC alignment has been checked as described in the previous paragraphs, the demodulator phasing must be checked. This can be done easily in the field by checking the bar pattern of each of the individual primary colors separately on the screen of the kinescope.

To do this proceed as follows:

1. Short the grids of the green and blue guns to ground through a 100,000 ohm resistor. See figure 41 for location of connection points.

2. Observe the pattern of the red color bars (R—Y). The sixth bar should be the same color as the background. See figure 41(b). If necessary, adjust L125 to obtain this condition.

3. Remove the 100,000 ohm resistor from the grid of the blue gun and connect it between the grid of the red gun and ground.

4. Observe the pattern of blue color bars (B—Y). The third and ninth bars should be the same color as the background. See figure 41(c). If necessary adjust T-115 (top) to obtain this condition.

5. Remove the resistor from the green grid and connect it between the blue grid and ground. The first and seventh bars should have the same brightness as the background as shown in figure 41(d).

6. Remove the 100,000 ohm resistors employed in making these adjustments. The color bar pattern should now appear as illustrated in figure 41(a).

The R—Y, B—Y and G—Y color bar patterns may also be observed by viewing the color bar pattern through respective Red, Blue or Green filters. This method works nicely and eliminates the need for applying 100,000 ohm resistors between the kinescope grids and ground.

FUSE DATA

There are four fuses in the 21CT660U series color receivers. See figure 42. The following list gives the function of each fuse, and the effect upon the receiver when the fuse is open.

Symbol	*Function*
F101	No brightness (No High Voltage) sound normal.
F102	No vertical deflection, no sound.
F103	No brightness (No High Voltage), sound normal.
F104	No brightness, no sound, no B plus.

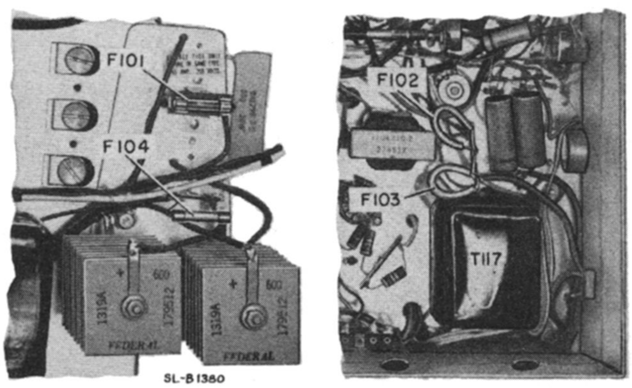


Fig. 42—Fuse Locations

SET-UP PROCEDURE FOR THE 21CT660 SERIES RECEIVERS

SET-UP

In the event that the kinescope is replaced or it is evident that dynamic convergence or color purity adjustments are required, it may be advisable to perform the complete set-up procedure.

CAUTION

Removal of the rear cabinet cover actuates the HV interlock, grounding the high voltage capacitor. Do not turn on the receiver with the HV interlock plug removed. To do so will result in failure of the HV fuse, F101.

High Voltage and Horizontal Tuning Adjustments

1. Remove the HV fuse (F101) and insert a 0-500 milliammeter across the fuse clips.

2. Adjust the HORIZONTAL TUNING (L-117) for minimum current. (This should occur between 180 ma. and 220 ma.)

3. Set HORIZONTAL DRIVE clockwise as far as possible without causing white overdrive line.

4. Turn BRIGHTNESS control to minimum and connect a voltmeter for measuring high voltage.

5. Adjust HV ADJUSTMENT control for 2000 volts less than the maximum high voltage indicated. It should not be less than 23,000 volts. Recheck Horizontal Drive.

Purity Adjustments

1. Retract all magnetic-field equalizer magnets into their housings.

2. Demagnetize the kinescope with a degaussing coil.

3. Using a dot pattern from a dot generator, converge the center of the picture using static convergence magnets only.

4. Set CHANNEL SELECTOR for no signal input. Turn CONTRAST and COLOR controls to minimum.

5. Turn RED SCREEN control to maximum; the BLUE SCREEN to minimum; and the GREEN SCREEN to minimum.

6. Turn all dynamic convergence amplitude controls to maximum counter-clockwise position. Set the tilt controls to mid-range.

7. Loosen and pull yoke toward the rear of the cabinet.

8. Adjust the purity magnet for a pure red field in only the center area of the kinescope.

9. Push the yoke forward to obtain a pure red field over the entire viewing area of the kinescope.

10. Check green and blue fields. In some cases, a compromise may be made for best overall red, green and blue fields.

11. Adjust Red, Green and Blue Screen controls for white screen. Check center convergence with aid of Dot-Bar Generator. If adjustment of convergence magnets is necessary re-check purity.

NOTE

Best purity can only be obtained when the receiver has good center convergence.

Convergence Adjustments

1. Tune in black-and-white picture.

2. Connect Dot-Bar generator to the receiver.

3. Tune Dot-Bar generator for stable vertical and horizontal bars (crosshatch pattern). Adjust brightness, contrast and Dot-Bar generator output for a clear bar pattern without station interference, but also make certain that the receiver is being synchronized by station sync. In order to obtain correct horizontal dynamic convergence, it is necessary to perform dynamic convergence adjustments while the receiver is being scanned at the station rate.

4. Set Dot-Bar generator for vertical bars. If necessary, separate the red and green bars from the blue with static convergence magnets. Using the blue bar at the center of the screen as a reference, adjust the red and green vertical amplitude and tilt controls (see figure 43A), for parallel red, green and blue bars, as shown in figure 43B. (The position of the *vertical* blue bar cannot be altered by vertical dynamic convergence controls.)

5. Set the Dot-Bar generator for horizontal bars. Set the red horizontal amplitude to maximum and the blue and green horizontal amplitudes to minimum. Adjust the red horizontal phasing to produce a bow in the center of the red horizontal bars. Return red horizontal amplitude to minimum and turn up green, then blue, making the same adjustments. See figure 43C.

6. Retaining the horizontal bar setting on the Dot-Bar generator, adjust the blue vertical amplitude and tilt until the blue horizontal bars are all equally displaced from each respective set of red and green horizontal bars as shown in figure 43D.

7. Set the Dot-Bar generator to produce a stable dot pattern. Eliminate the blue dot by connecting a 100,000 ohm resistor from the blue kinescope grid to ground. Adjust green and red horizontal amplitude and phasing slightly, for the *same amount* of fringing on the *same side* of the horizontal row of dots across the center of the screen, using the dot at the extreme left of the screen, the center dot, and the dot at the extreme right of the screen for reference. See figure 43E. Converge to a row of yellow dots. Check fringing on the center dots and the dots at the extreme left and right edges of the screen. Advance horizontal amplitude controls and re-adjust phasing slightly, if necessary, for the same amount of fringing, then converge the center of the screen with the static convergence magnets.

8. Remove the 100,000 ohm resistor from the blue grid and adjust blue horizontal amplitude and phasing for same fringing of the dots at the center, and left and right extremes of the screen.

9. With the static convergence magnets converge the dots to form white dots as shown in figure 43F. Remove Dot-Bar generator.

NOTE

The late production receivers do not have a blue vertical amplitude control. Instead there is a vertical amplitude control that affects all three color fields. In these receivers be certain to set this control to the center of its range before proceeding with the convergence adjustments. After making the required adjustments with the (red and green) vertical amplitude and tilt controls, set the vertical amplitude control in the clockwise direction until best results are attained. If necessary, readjust the red and green amplitude and tilt controls. Best results will be obtained with the vertical amplitude control adjusted as close to its maximum clockwise position as good vertical convergence will permit.

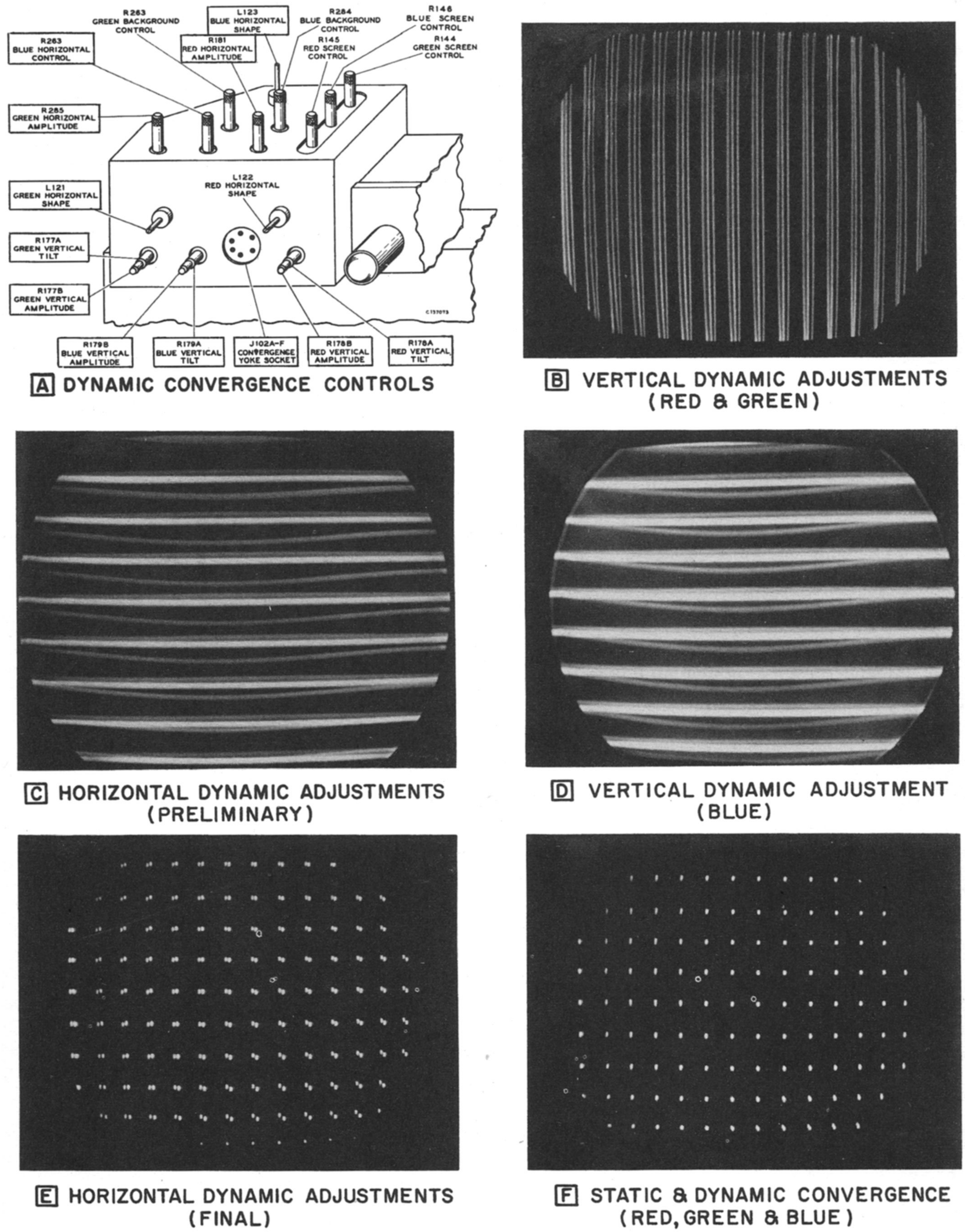


Fig. 43—Convergence Adjustments

Screen Adjustments

1. With no signal applied to the receiver, and the contrast and color controls at minimum, turn Green and Blue Screens "off" and Red Screen "on." Set the Green and Blue Background controls 30% from the maximum counter-clockwise position.

2. Measure the bias on the red gun of the kinescope, between grid and cathode, using a vacuum tube voltmeter. Adjust the Brightness control for —70 volts with no signal input. Adjust Red Screen control for just barely visible red screen.

After setting the Red Screen control, this control should not be readjusted.

3. Turn up the brightness control and adjust the green and blue screen controls for a high-level bluish-white (8200° Kelvin) raster, without blooming.

4. If color contamination exists around the edges of the screen, adjust the magnetic-field equalizer magnets.

Tracking Adjustments

1. Tune in a black-and-white picture.

2. Adjust brightness tracking, if necessary, by restoring the low-lights with the screen controls and the high-lights with the background controls. DO NOT adjust the red screen control.

3. Repeat step 2 until proper color tracking (no change from black, grey and white) is obtained as the contrast and brightness controls are varied over their useful ranges.

Servicing procedures requiring additional test equipment and a more involved analysis than can be done practically in the field should be done in the shop.

The following section of this booklet contains information of great value when servicing the color receiver in the shop.

NOTE

The major portion of service is accomplished in the customer's home or place of business.

The information in the FIELD SERVICE section of this booklet has been compiled to facilitate all of the tests and checks practical in the field.

The procedures have been listed in logical order so that the technician can quickly localize the source of improper operation without the need for removing the chassis to the service shop.

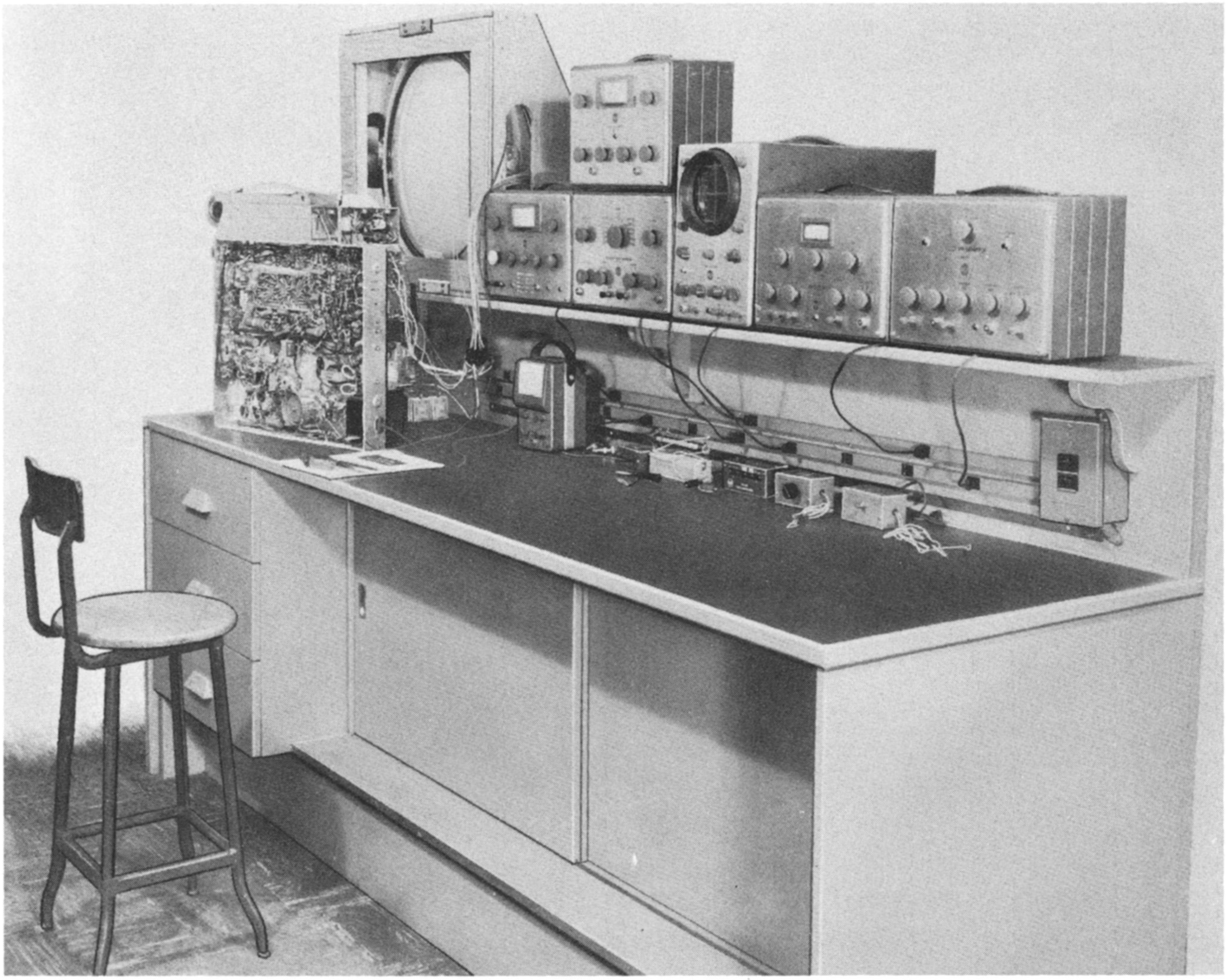
Field service checks, however, are not limited to service required in the field but include procedures applicable wherever service is performed.

Although the following section of the booklet is titled "Shop Service" the procedures and data included should not be considered as limited to service performed only in the service shop. It contains *additional* information listed to provide a quick reference for either the technician assigned to field service work, or the technician at the service bench.

All of the data in this booklet is practical information, to be consulted whenever required.

The data is intended to be a *further* aid to the service technician but does not preclude the use of procedures or other service aids in the RCA Victor Service Data and other publications.

SHOP SERVICE



Typical Service Shop Bench Set-Up

INTRODUCTION

It is assumed that the technician assigned to bench repair work or receiver analysis in the service shop, has had considerable experience with alignment and set-up procedures, and is familiar with the operation of circuits in black-and-white television receivers.

With allowances for minor differences in circuit operation, and taking into consideration the basic idea that three colors are used for reproducing either a full-color picture or a black-and-white picture in the color receiver, the color receiver should prove as easy to service as a black-and-white receiver.

As mentioned previously in this booklet, theory and circuit analysis have been discussed in other publications. Thus, only the practical aspects of servicing the 21CT660U series color television receivers will be considered here.

OSCILLOSCOPE WAVEFORMS AS SERVICE AIDS

The oscilloscope is a valuable aid for quickly tracing discrepancies in circuit operation.

Once the proper waveshape at a given point in the circuit is known, and the oscilloscope is applied to that point, the waveform observed can be compared with the known waveform.

It is an easy matter to localize any cause of improper operation of a circuit, if a systematic procedure is followed, and waveforms are compared, circuit-by-circuit.

The data in the following pages progresses stage-by-stage through the receiver and shows waveforms taken at various points within the circuits. For convenience in locating the check points, circuit schematic diagrams are shown along with photographs of the section of the chassis where the circuit is located.

UHF-VHF TUNER UNIT

The KRK37 UHF-VHF tuner unit is serviced in the same manner as comparable type tuners used in black-and-white television receivers. The schematic diagram for this tuner is shown in figure 44.

Extreme care should be exercised when making repairs or adjustments to this tuner, so that lead lengths and component positions are maintained.

All adjustments should be made carefully. For example, if care is not taken, it is possible to tune the FM trap so that reception of channel 6 or even channel 5, may be seriously impaired. See figure 45 for adjustment locations.

A detailed illustration of the mechanical assembly and the dial cord stringing diagrams of the tuner unit are shown in figure 46. For convenience in identification, RCA stock numbers are indicated where replacement parts may be required.

Tuner unit alignment is seldom required, however, when alignment seems necessary refer to the ALIGNMENT section of this booklet.

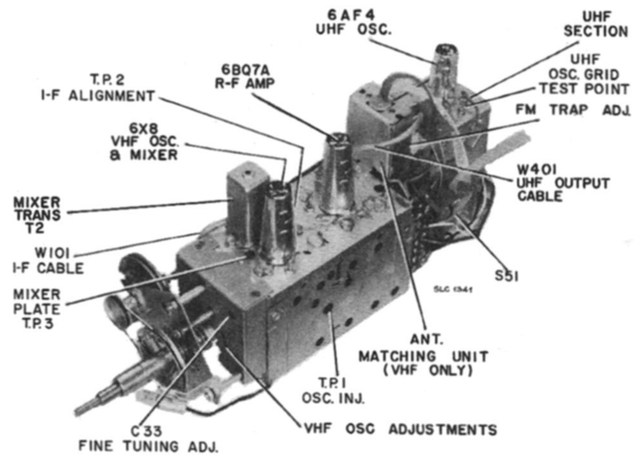


Fig. 45—KRK-37 UHF-VHF Tuner Unit—Adjustment Locations

Since it is not convenient to make voltage measurements in the tuner unit when the unit is operating in the receiver, a suitable check can be made by removing the tubes and measuring at the tube socket pin connections of each tube.

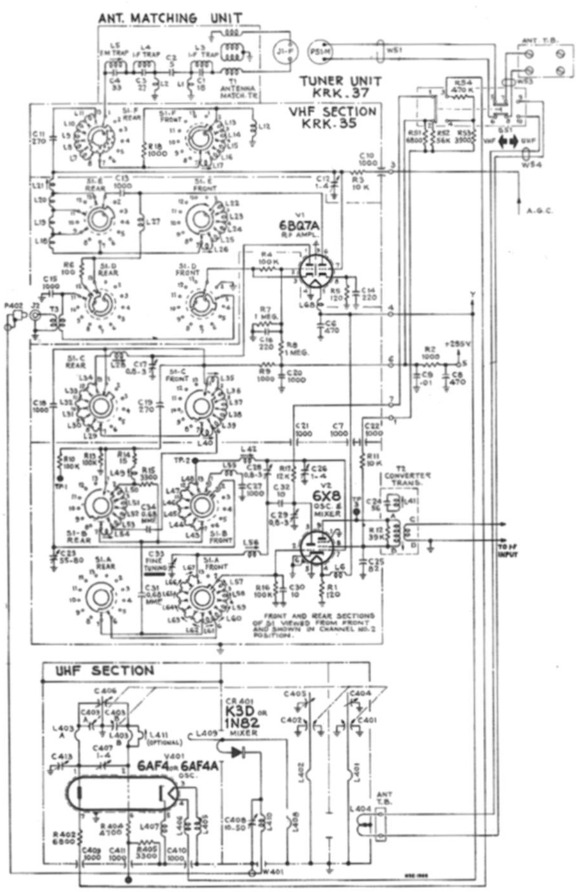


Fig. 44—Schematic Diagram—KRK37 UHF-VHF Tuner Unit

SERVICE SUGGESTIONS

UHF-VHF Tuner

Symptoms	*Possible Causes*
No picture.	6BQ7A R-F Amplifier.
No picture.	R2 open.
No picture on high channels.	C32 intermittent.
No picture.	C30 open.
No picture.	6X8 R-F oscillator defective.

Fig. 46—KRK-37 UHF-VHF Tuner Unit Mechanical Assembly →

When reassembling, locate 79403 between stop lugs of 79404 as shown.

To assemble cords, rotate drive shaft to a full counter-clockwise position against stop on front plate. Fasten pulley assembly 79407 as shown, with set screw in vertical position. Place flat on dial pulley in horizontal position and assemble cord. Before engaging gear 79406, position opening in intermediate gear (79373) to coincide with opening in front plate, then mesh gears and tighten set screw. (Provide .010 inch clearance between gear and plate.)

Position pulley 79402 with notch in vertical position and assemble cord.

Before assembling gear 79399 maintain counter-clockwise position of drive shaft then rotate scissors gear (79576) on UHF tuner pulley clockwise to stop. Advance the free riding gear one tooth clockwise, mesh gears and tighten set screw.

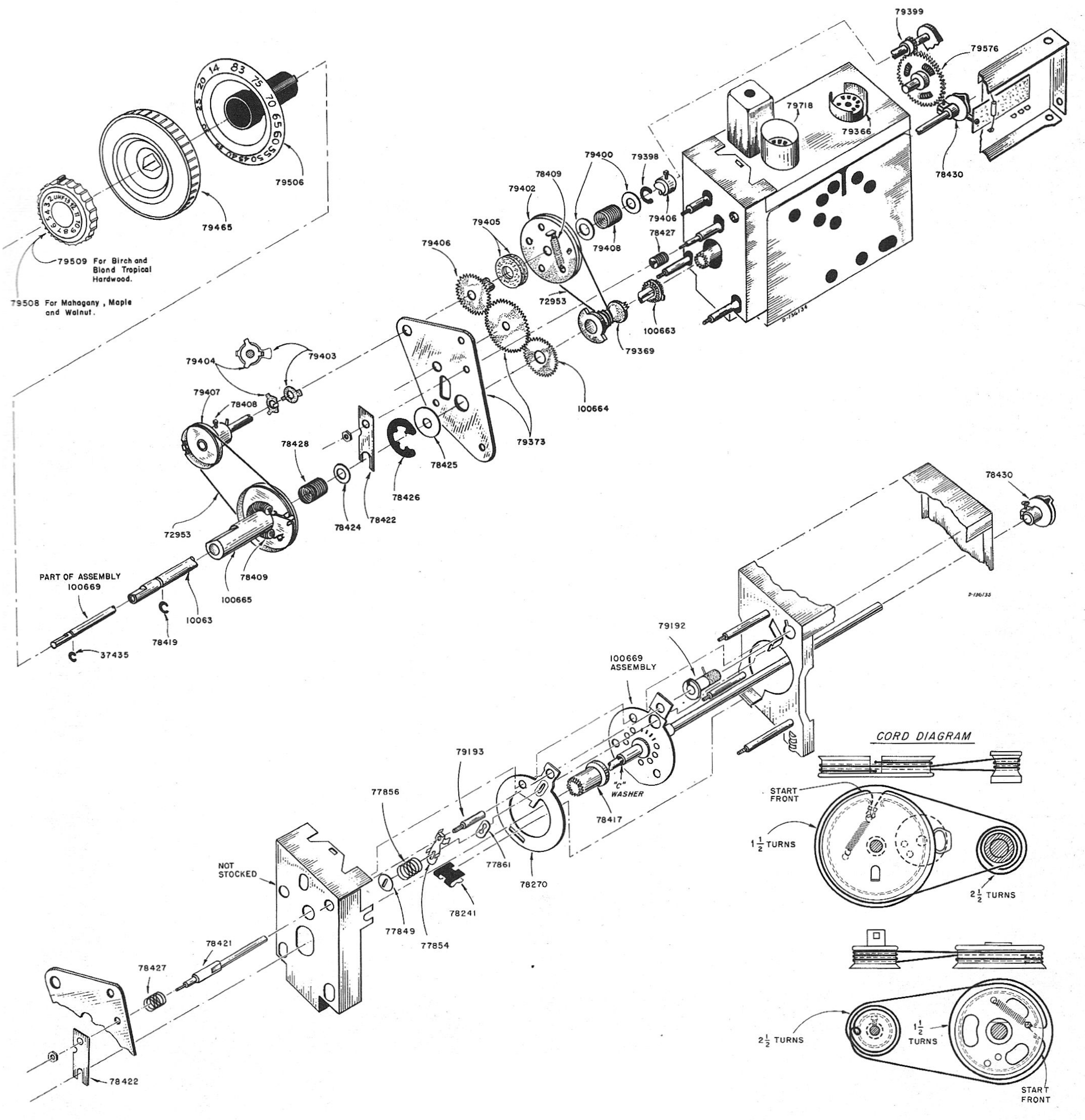


Fig. 46—KRK-37 UHF-VHF Tuner Unit—Assembly Detail

PICTURE I-F

The picture I-F stages are similar to conventional stagger-tuned I-F systems found in black-and-white receivers. A schematic diagram of these circuits is shown in figure 47. The picture I-F circuits utilize the printed circuit board type of construction. A detailed view of the wiring side of the printed circuit board is shown in figure 48.

A shield cover over the component side of the picture I-F printed circuit board is easily detachable by removing the four hex-nuts securing it to the chassis. The component side of the printed circuit board is shown in figure 49.

The wiring is conveniently accessible since the board is mounted flush with the receiver chassis with the entire underside of the board exposed, as shown in figure 50.

Dual purpose tubes are used in the picture I-F stages. This permits the 1st and 2nd sync amplifiers and the vertical sweep oscillator to utilize the same printed circuit board for their circuitry since the tubes for these circuits of the receiver are the triode sections of the picture I-F tubes.

It is important to remember that plate voltage for the 3rd picture I-F stage is supplied from the cathode of the 6AQ5 audio output tube, thus, failure of the audio output tube would result in not only loss of sound, but also loss of the picture.

The type 6AZ8 tubes used in the 1st and 2nd picture I-F amplifier stages are not interchangeable with the type 6AN8 used in other circuits in the receiver because of tube characteristics and the internal connections to the base pins.

It is important that the I-F response be maintained. As with the tuner unit, degradation or complete loss of color may result when the color subcarrier does not appear at the proper point on the I-F response curve.

I-F Alignment is covered in a following section of this booklet, see page 70.

NOTE

See page 37 before attempting repair of the printed circuit board or replacement of components mounted on the printed circuit boards.

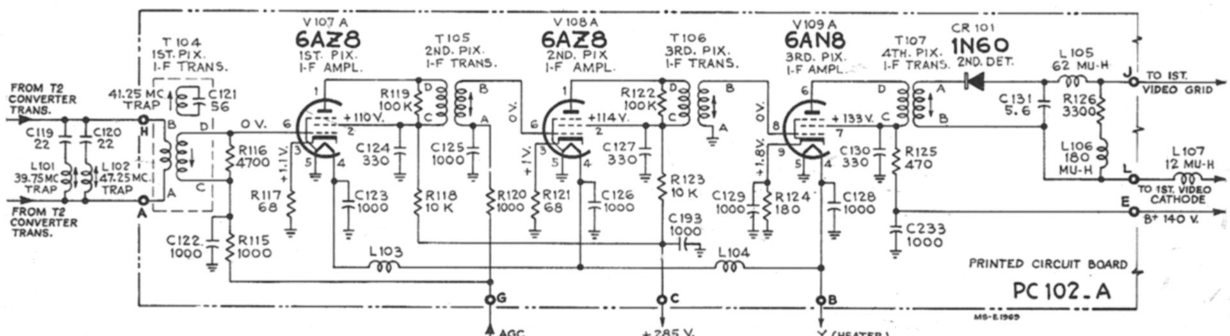


Fig. 47—Schematic Diagram—Picture I-F—2nd Detector

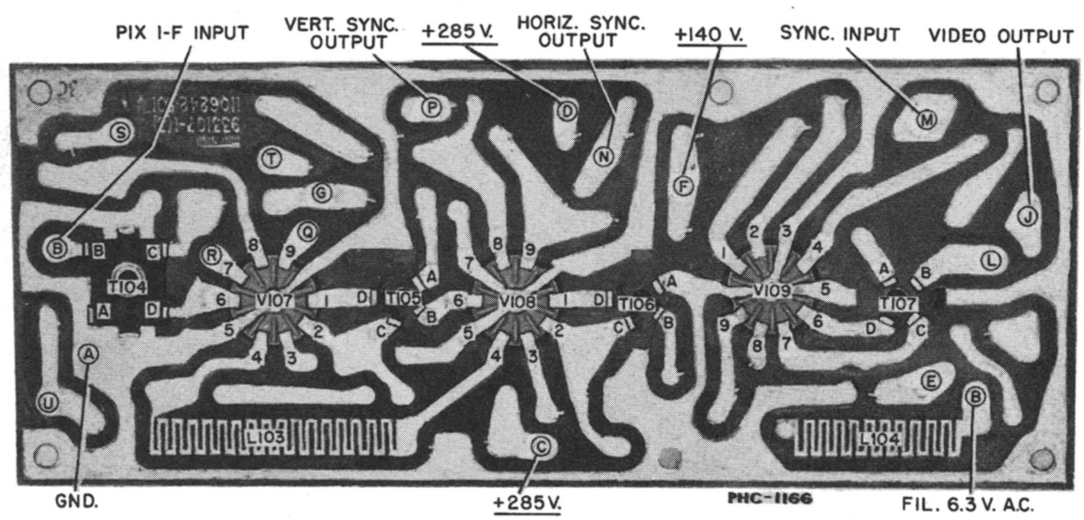


Fig. 48—Picture I-F Printed Circuit Board—Wiring Side

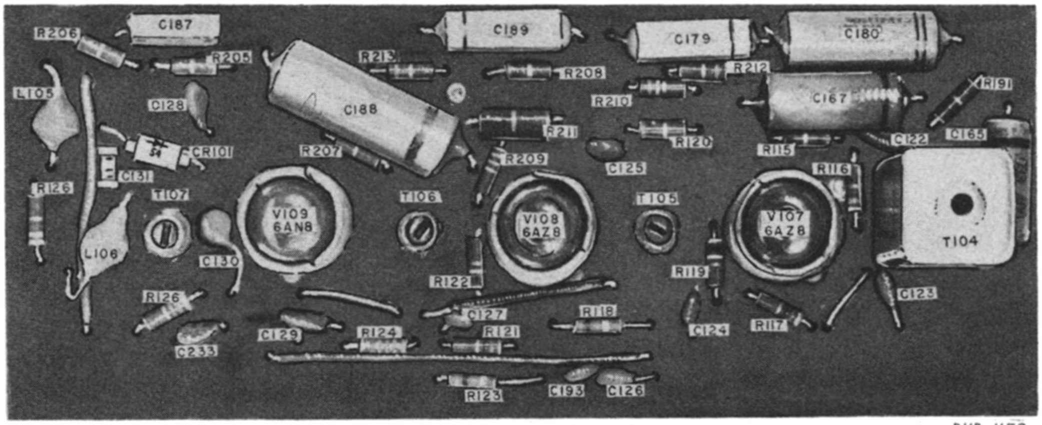


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Fig. 49—Picture I-F Printed Circuit Board—Component Side

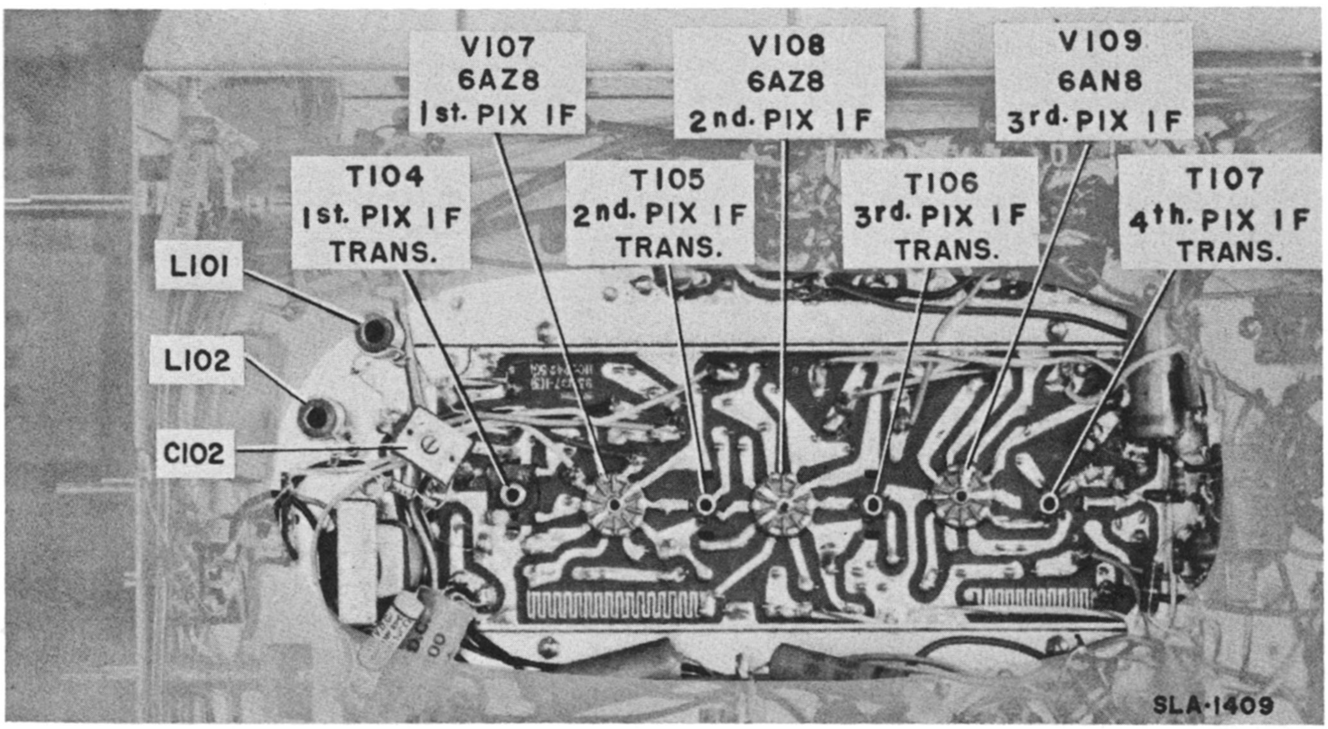


Fig. 50—Chassis Location of Picture I-F Circuit

VOLTAGE CHART

Picture I-F

Tube	*Pin No.*	*Voltage Too High*	*Voltage Too Low*	*No Voltage*
V107A	1	R-117 open V107A open heater	C-193 leaky R-118 high in value. T-105 open	C-193 shorted C-124 shorted
	2	6AZ8(V107) open heater	C-124 shorted	R-118 open
	3	V107A gassy	C-127 shorted. High grid bias	V107A inoperative
V108A	1	R-121 open V108A open heater	R-123 high in value C-193 leaky. T-106 open	R-123 open C-127 shorted
	2	R-121 open	C-127 leaky	C-127 shorted
	3	R-121 open	C-193 leaky High grid bias	R-123 open V108A inoperative
V109A	6	R-124 open	B-plus 140 V. low	V103 open heater. T-107 open
	7	R-124 open	C-130 leaky. C-233 leaky	C-130 shorted. R-125 open
	9	V109 gassy	B-plus low	C-129 shorted

SOUND I-F AND AUDIO

The sound I-F and audio system consists of one stage of sound I-F amplification, a ratio detector, the first stage of audio amplification and the audio output stage. A dual purpose tube (6U8) is used in the sound I-F. The triode section of this tube is utilized as the Noise Inverter stage. The 6T8 tube performs three separate functions. These are: the ratio detector; the 1st audio amplifier; and the bias clamp diode for the R-F tuner unit bias.

As mentioned previously, the 6AQ5 audio output tube operates with its cathode 140 volts above ground potential and in this manner provides B-plus voltage for the sound I-F and other circuits in the receiver.

The sound I-F and audio circuits also utilize the printed circuit board type of construction. Figure 51 shows the locations of the sound I-F and audio circuits in the receiver chassis.

A schematic diagram of these circuits is shown in figure 52.

The printed wiring side of the board is shown in figure 53.

Figure 54 shows the component side of the sound I-F and audio printed circuit boards with each component identified.

For alignment of Sound I-F and ratio detector refer to the ALIGNMENT section of this booklet, page 75.

NOTE

See Page 37 before attempting repair of printed circuit boards.

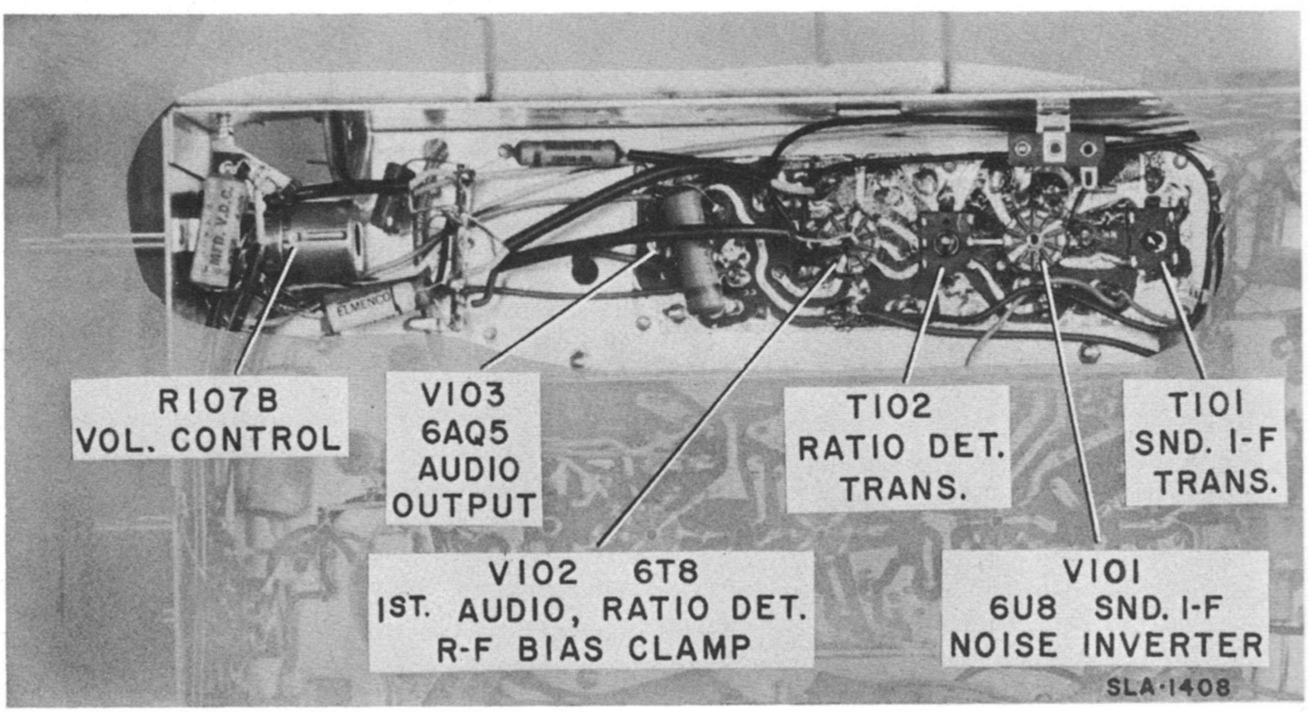


Fig. 51—Location of Sound I-F and Audio Circuits

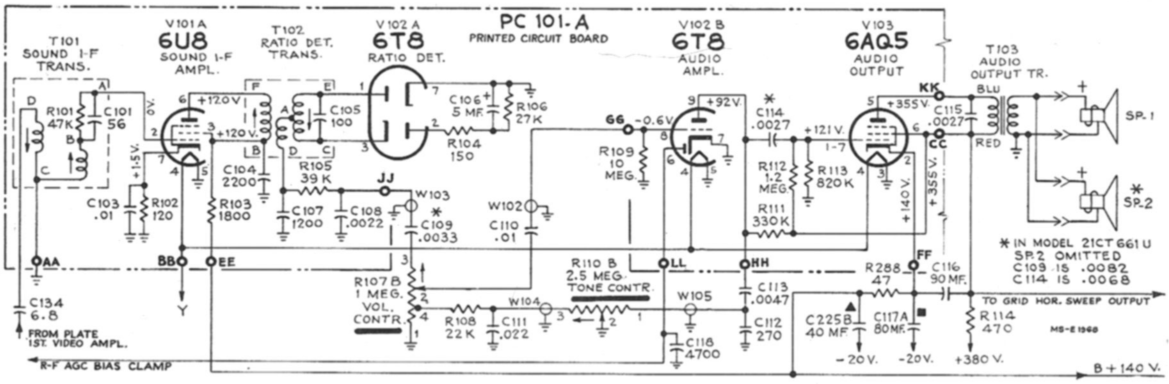


Fig. 52—Schematic Diagram—Sound I-F and Audio

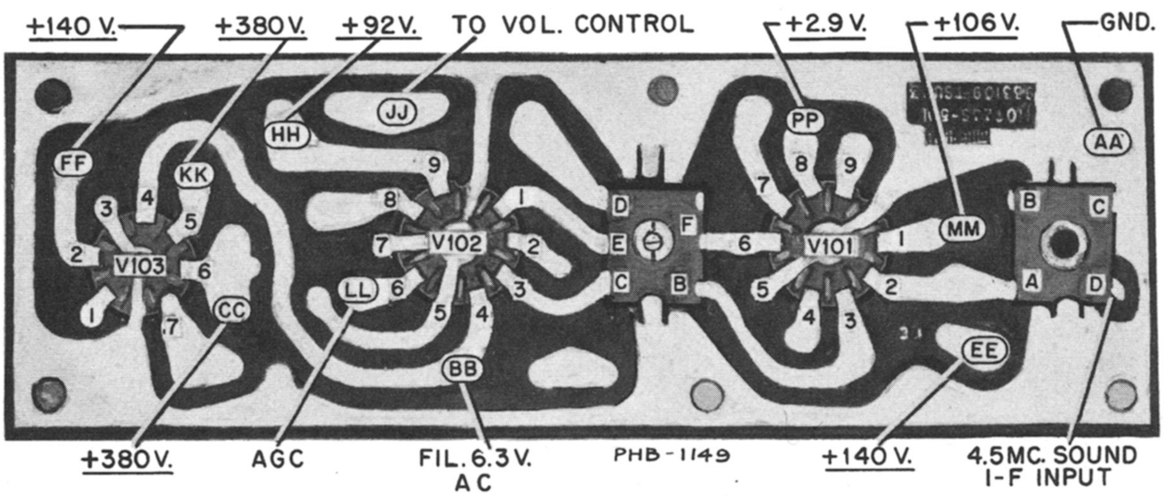


Fig. 53—Sound I-F and Audio Printed Circuit Board—Wiring Side

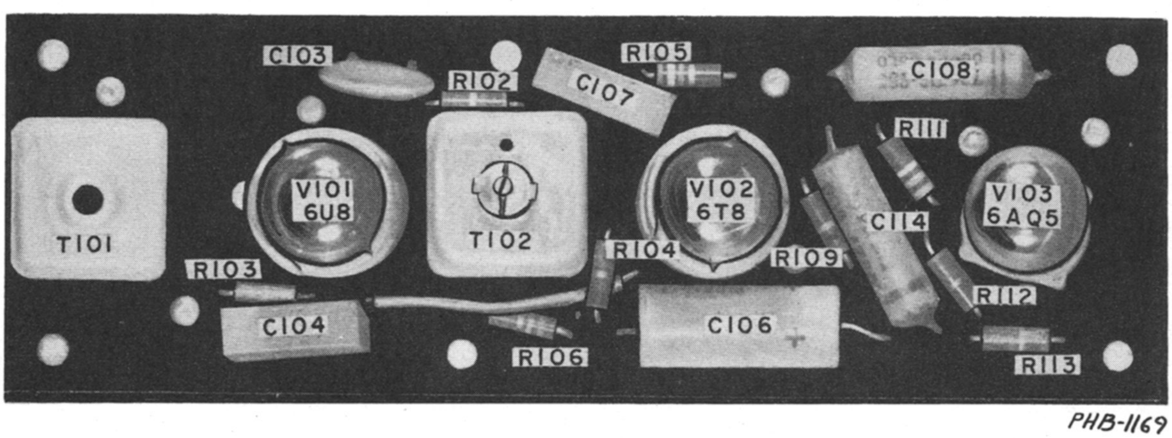


Fig. 54—Sound I-F and Audio Printed Circuit Board—Component Side

SERVICE SUGGESTIONS

Sound I-F—Audio

Symptoms	*Possible Cause*
Audio howls at various degrees above normal sound volume.	Ratio detector transformer.
No low frequency response in sound.	Speakers — leads reversed.
No brill; no sound.	C117—Filter capacitor shorted (cathode of 6AQ5 audio output)
No sound.	Unsoldered connection on terminal board; audio output transformer.
No picture; no sound; hum in raster.	6AQ5 audio output tube, heater to cathode short.
Intermittent AGC overload.	6AQ5 audio output tube, poor contact at socket.
Buzz in sound.	Ground lead from volume control to terminal board not connected.
Hum in sound and critical tuning.	6U8 sound I-F tube.
Distorted sound.	6U8 sound I-F tube.
No sound, no picture.	6AQ5 audio output, open heater.
No sound, no picture.	6U8 AGC amplifier defective; C225B shorted.

VOLTAGE CHART

Sound I-F—Audio

Tube	*Pin No.*	*Voltage Too High*	*Voltage Too Low*	*No Voltage*
V101A	6	R-102 open	6U8 defective C-104 leaky 140 V. B-plus low	T-102 open C-104 shorted R-103 open 6AQ5 (V103), open heater
	3	T-102 open, R-102 open	C-104 leaky 140 V. B-plus low 6U8 defective R-103 high in value	R-103 open 6AQ5 (V103), open heater
	7	6U8 shorted Plate and screen voltage high	C-103 leaky 6U8 weak	C-103 shorted 6U8 open heater R-102 open
V102A	2		C-106 leaky	V102 open heater
	3		C-107 shorted	C-106 shorted
V102B	9	C-113 leaky	R-111 high in value 6T8, open heater B-plus low	R-111 open C-113 shorted
V103	1-7	B-plus high	C-114 shorted	R-112 open
	2	6AQ5 gassy	C-117A leaky C-225B leaky Short on +140 buss	6AQ5 open heater
	5	6U8(V101A) open heater 6AZ8(V121B) open heater	6AQ5 defective C-116 leaky B-plus low	T-103 open
	6	6U8(V101A) open heater 6AZ8(V121B) open heater	6AQ5 gassy C-116 leaky B-plus low	

SERVICING THE PRINTED CIRCUIT BOARDS

Replacement of Components on Printed Circuit Boards

The individual components mounted on printed circuit boards may be easily replaced when the proper technique is used. *Only extensive damage to the printed connecting strips, or breakage of the board, should necessitate replacement of the complete board.*

Tools Required to Service Printed Circuit Boards

There are no special tools required when servicing printed circuit boards. The complement of tools normally employed by the television service technician are all that are necessary. However, the soldering iron used when working on the printed circuit board should not exceed 100 watts, since excessive heat can readily damage the board.

Checking Intermittent Circuitry

The technique employed in the construction of printed circuits minimizes the possibility of intermittent circuit conditions. If an intermittent condition does exist it may be localized by a slight flexing of the board and probing of the component leads. Caution should be exercised in excessive flexing of the boards, since although the board is sturdy in construction it may crack or break if proper care is not taken when servicing.

When an intermittent point or area is localized it usually can be corrected by simply heating the leads of the components, at that point or area, with a soldering iron. This will fuse the intermittent point, forming a secure connection.

If the printed circuit board has been removed from the receiver chassis for reasons other than component replacement, the parts may be removed simply by applying heat to the point on the connecting strip where the leads come through the board, bending the leads upright with a soldering aid, and lifting the part from the board. In the process of removing the solder, caution must be taken to prevent excessive heating. Use a small wire brush if necessary to quickly brush away the excessive solder from the connection. Do not leave the soldering iron on the connection when brushing away the solder. Melt the solder, remove the iron and quickly brush away the solder. It may require more than one heating and brushing process to completely remove the solder. The new part can then be mounted in place of the part that has been removed and secured in the original manner.

Replacement of Components

To replace capacitors or resistors on printed circuit boards without removing the boards from the chassis proceed as follows: (see figure 55.)

1. Cut the component in half with a pair of diagonal cutting pliers. (Fig. 55(a).)

2. Remove the body of the component from the connecting wires leaving as much wire as possible for connecting purposes. (Fig. 55(b).)

3. Prepare connecting points for the replacement component by cutting the wire, leaving one-fourth inch to five-sixteenth inch, and form a connecting loop as shown in figure 55(c).

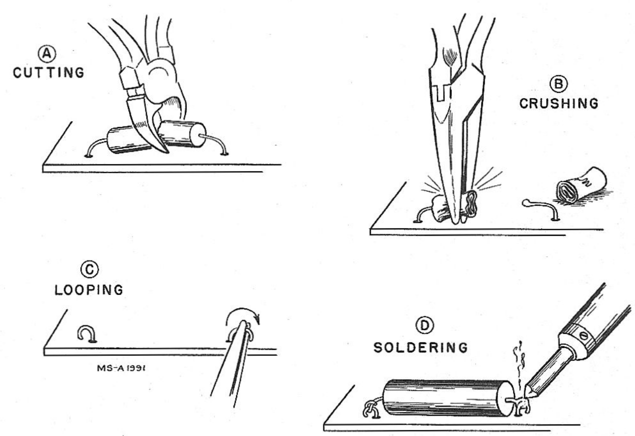


Fig. 55—Procedure Used to Replace Components in Printed Circuit Boards

4. Thread the leads of the replacement component through the loops of wire, bend component leads to form a good connection and then solder. Cut off excess wire from component leads.

Figure 56 shows the method used to replace a tube socket on the printed circuit boards.

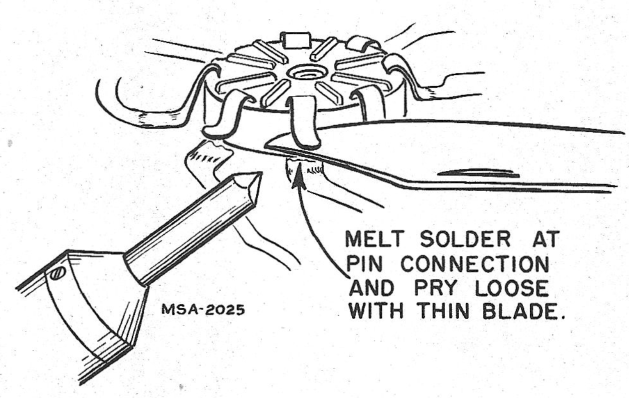


Fig. 56—Method of Replacing Tube Socket in Printed Circuit Boards

VIDEO

Luminance Channel

There are two stages of luminance signal (brightness) amplification in the 21CT660 series receivers. The first video amplifier uses a type 6CL6 tube. It supplies from its plate circuit; color signal information (which is removed through the color take-off transformer, T-108, and fed to the bandpass amplifier), sync, AGC and Sound information for their respective circuits. The drive for the second video amplifier stage is obtained from the cathode circuit of the 1st video amplifier.

The delay line between the 1st and 2nd video amplifiers compensates for the difference in bandwidth between the chrominance and the luminance channels. A defective delay line may cause mis-registration between the luminance and the color presentation on the face of the kinescope.

Figure 57 shows the location of the 1st and 2nd video amplifier stages on the receiver chassis.

The schematic diagram shown in figure 58, and also in the 1st edition of the RCA Victor Service Data for

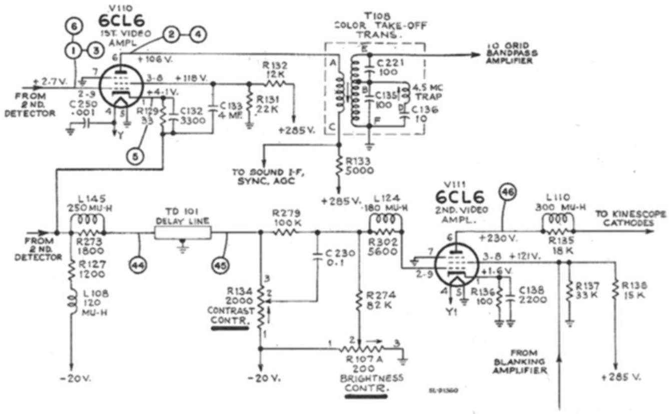


Fig. 58—Schematic Diagram—1st and 2nd Video Amplifiers. Circled numbers refer to waveform photographs.

this receiver (1955 — T5), shows the lettered terminals "B" and "D" of T-108, the color take-off transformer, connected to the components within the transformer. In some receivers the components are wired as shown in the schematic diagram, except that the terminals "B"

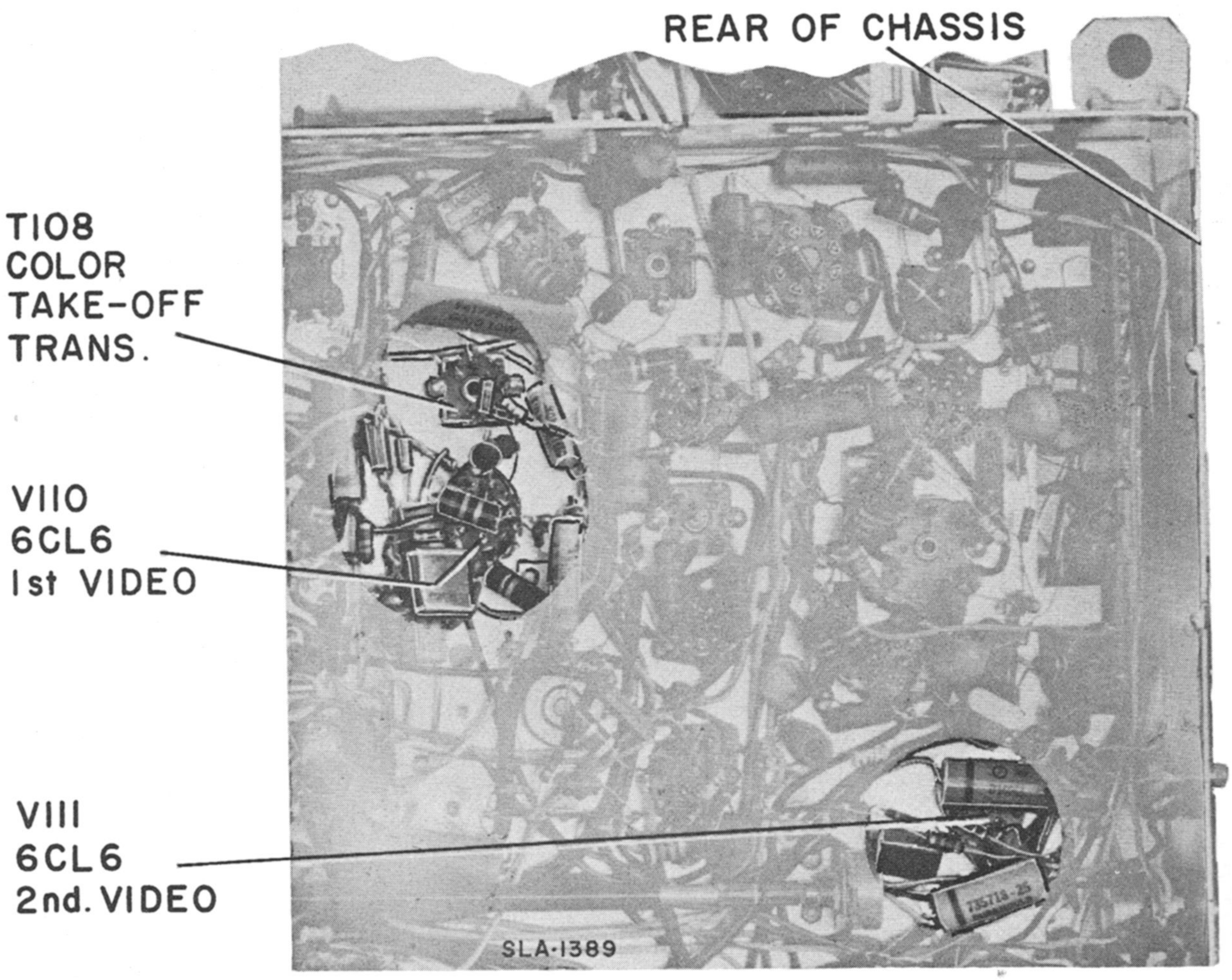


Fig. 57—Upper Right Rear Corner of Chassis Showing Location of 1st and 2nd Video Amplifier Stages. Rear of Chassis at Right.

and "D" are not used as tie points and are not connected to any components.

There should not be a center tap connection on the secondary winding of T-108. This should be kept in mind when making continuity checks on the color take-off transformer.

The waveforms shown in figures 59, 60 and 61 are photographs of the waveforms obtained from an RCA Victor model 21CT662U color television receiver under actual operating conditions. Since picture content varies widely it is not important to note the shape of the video information appearing above or below the base line. It is important, however, when making comparisons, that the polarities be consistent and to observe the relationship between the sync peaks and video peaks.

Figures 62, 63, 64 and 67 show the waveforms obtained using the standard 10 bar color signal from the RCA color bar generator as a signal source. Figures 65 and 66 show waveforms obtained at each end of the delay line.

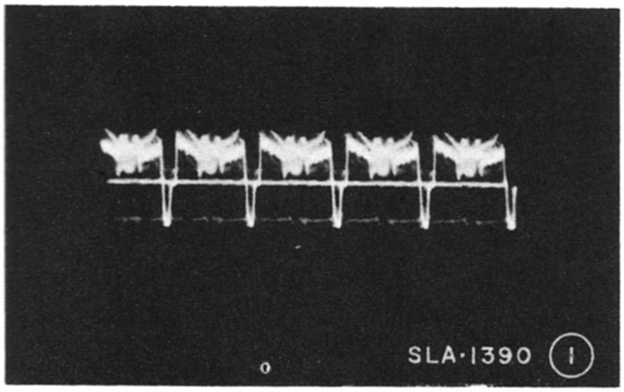


Fig. 59—Waveform at Grid of 1st Video Amplifier (Pin #2). Black-and-white Picture. Contrast Control Adjusted for Normal Reception. Color Control at Minimum.

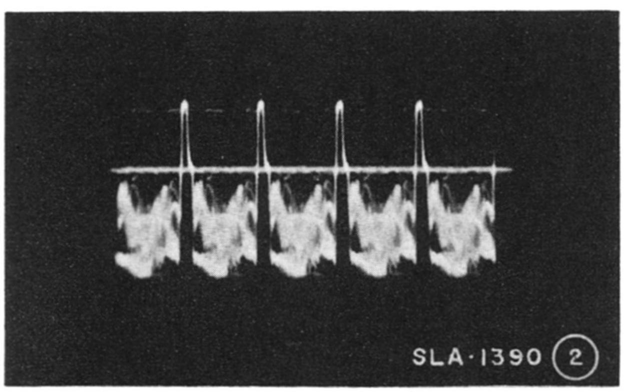


Fig. 60—Waveform at Plate of 1st Video Amplifier (Pin #6). Black-and-white Picture. Contrast Control Adjusted for Normal Reception. Color Control at Minimum.

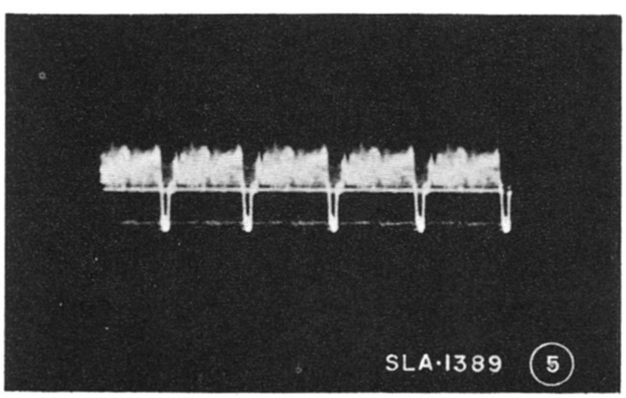


Fig. 61—Waveform at Cathode of 1st Video Amplifier (Pin #1). Black-and-white Picture. Contrast Control Adjusted for Normal Reception. Color Control at Minimum.

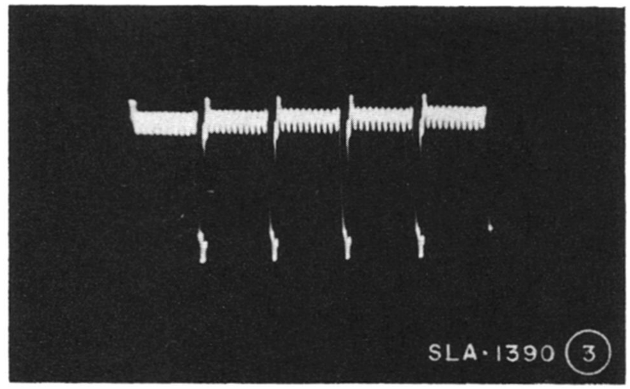


Fig. 62—Waveform at Grid of 1st Video Amplifier (Pin #2). Signal from RCA Color Bar Generator. Color Control at Maximum. Contrast Control at Maximum.

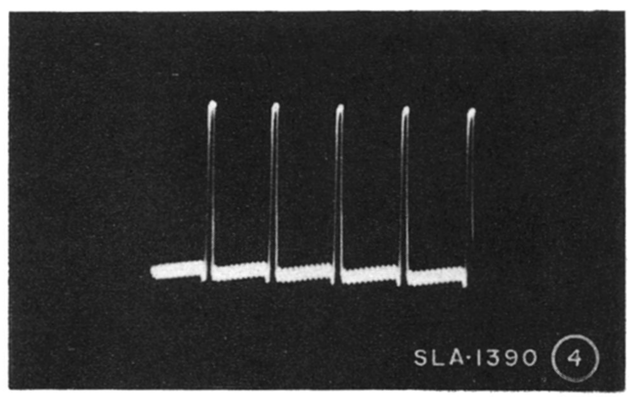


Fig. 63—Waveform at Grid of 1st Video Amplified (Pin #6). Signal from RCA Color Bar Generator. Color Control at Maximum. Contrast Control at Maximum.

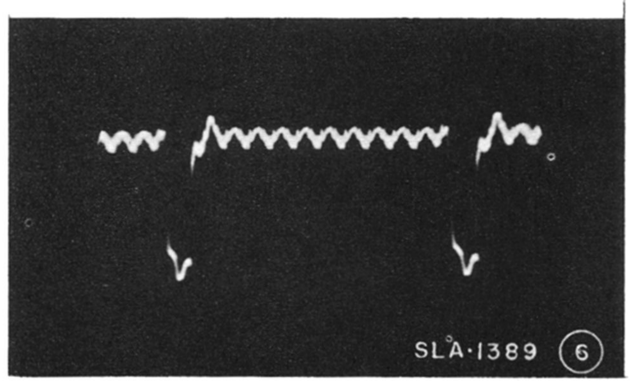


Fig. 64—Waveform at Grid of 1st Video Amplifier (Pin #2). Signal from RCA Color Bar Generator. Color Control at Maximum. Contrast Control at Maximum. Waveform same as Figure 62, Expanded to Show the 10 Color Bars.

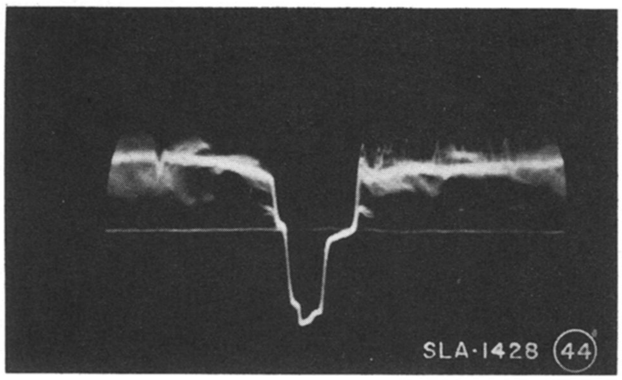


Fig. 65—Waveform at L-145 End of Delay Line—Horizontal Sync

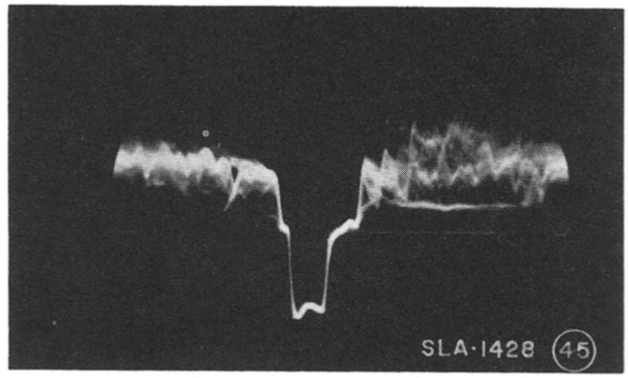


Fig. 66—Waveform at R-134 End of Delay Line—Horizontal Sync

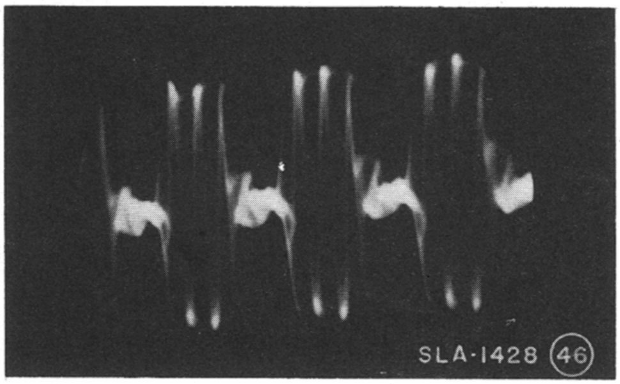


Fig. 67—Waveform at Plate of 2nd Video—Color Bars—Expanded—Wideband Position of Oscilloscope.

SERVICE SUGGESTIONS

Video - Luminance

Symptoms	*Possible Cause*
No brilliance.	6CL6 1st Video.
No brilliance.	6CL6 2nd Video.
No picture, no brilliance.	6CL6 1st Video — short at cathode.
Flashing in picture.	6CL6 1st Video.
Flashing in picture.	Intermittent brightness control, R-107A.
Picture overload.	6CL6 2nd Video.
Oscillation in picture.	6CL6 2nd Video.

VOLTAGE CHART

Video - Luminance

Tube	*Pin No.*	*Voltage Too High*	*Voltage Too Low*	*No Voltage*
V110	1	R-129 high in value R-129 open	C-132 shorted	
	3-8	R-129 open R-131 open	C-133 shorted R-132 high in value	R-132 open
	6	V110 open heater	R-133 high in value	T-108 open R-133 open
	2-9	C-132 shorted	V101 inoperative	
V111	1	V111 gassy R-136 open	C-256 shorted	C-138 shorted
	3-8	R-137 open R-136 open	R-138 high in value	R-138 open
	6	R-135 open	L-110 open V111 gassy	L-112 open
	2-9	C-130 shorted (contrast min.)	Varies with Brightness control	

CHROMINANCE CHANNEL

Bandpass Amplifier

The chrominance channel includes the bandpass amplifier, demodulator driver, the R—Y and G—Y demodulators and the B—Y amplifier. A schematic diagram of the bandpass amplifier circuit is shown in figure 68.

The function of the bandpass amplifier is to amplify only the frequencies near the region of the color subcarrier. If this stage were operating incorrectly, degradation or complete loss of color might result.

Amplification in this stage is controlled by a variable grid bias voltage from the phase detector and color killer circuits.

Figures 69, 70, 71 and 72 show oscilloscope waveforms useful in checking this circuit. For instance, with only a black-and-white picture, comparing the waveforms of figure 70 and figure 72 and rotating the color control will give an indication of the operation of the control and the circuits providing the control voltage.

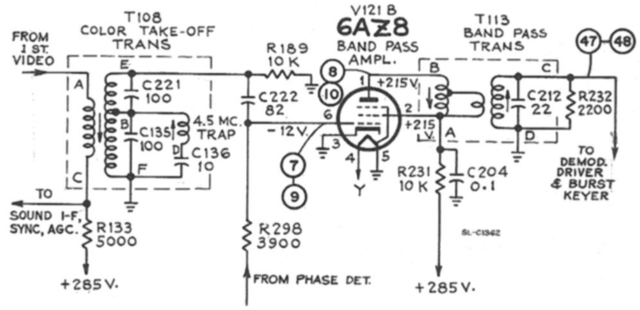


Fig. 68—Schematic Diagram Bandpass Amplifier. Circled numbers refer to waveform photographs.

Figures 73 and 74 show waveforms obtained at terminal "C" T-113, the bandpass transformer. Alignment of the Bandpass amplifier is covered on page 73.

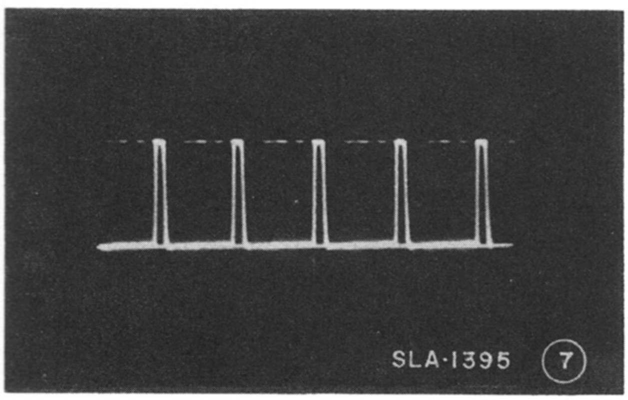


Fig. 69—Waveform at Grid (Pin #6) of 6AZ8 Bandpass Amplifier. Black-and-white Picture. Picture Control Adjusted for Normal Picture. Color Control at Minimum.

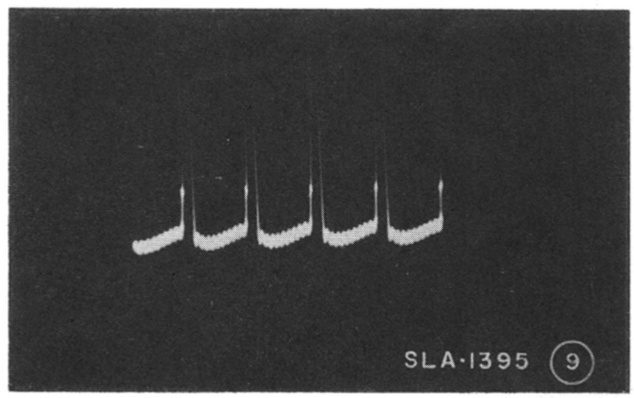


Fig. 71—Waveform at Grid (Pin #6) of 6AZ8 Bandpass Amplifier. Signal from Color Bar Generator. Picture Control at Maximum. Color Control at Maximum.

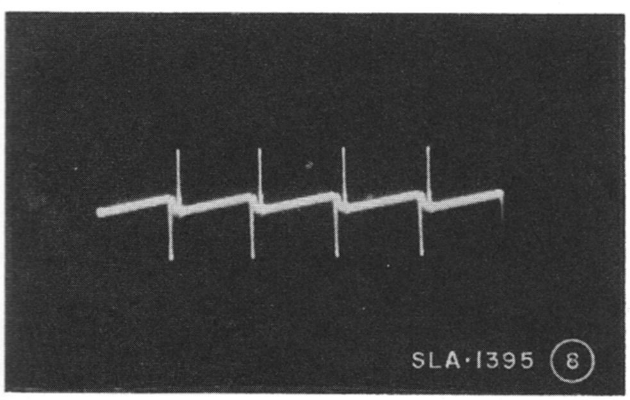


Fig. 70—Waveform at Plate (Pin #1) of 6AZ8 Bandpass Amplifier. Black-and-white Picture. Picture Control Adjusted for Normal Picture. Color Control at Minimum.

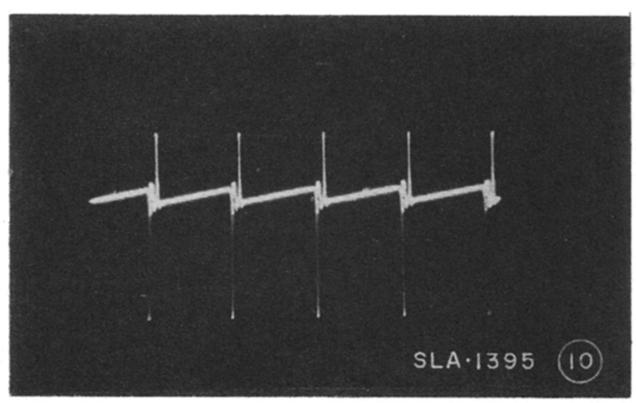


Fig. 72—Waveform at Plate (Pin #1) of 6AZ8 Bandpass Amplifier. Black-and-white Picture. Color Control at Maximum.

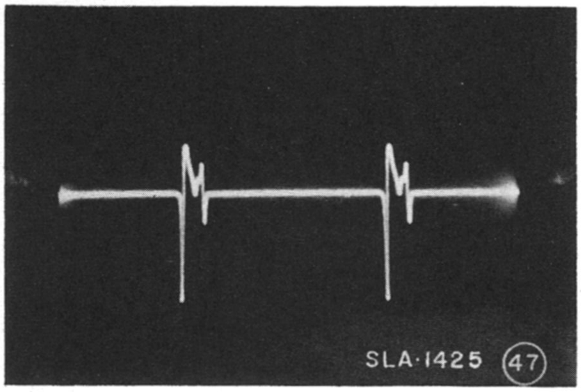


Fig. 73—Waveform at Terminal "C"—T-113. Black-and-white Picture. Color Control at Minimum.

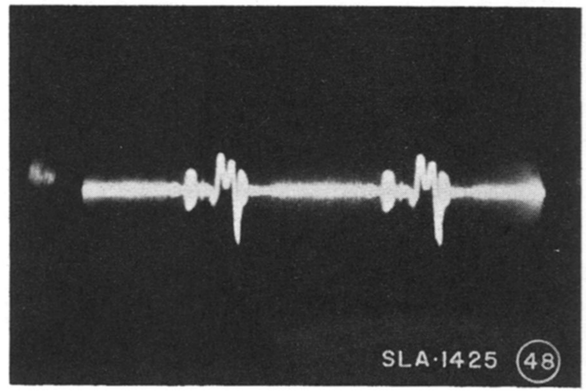


Fig. 74—Waveform at Terminal "C"—T-113. Black-and-white Picture with Color Stripe. Color Control Maximum.

VOLTAGE CHART

Chrominance Channel — Bandpass Amplifier

Tube	*Pin No.*	*Voltage Too High*	*Voltage Too Low*	*No Voltage*
V121B	1	Bias voltage high	C-222 shorted C-204 leaky	T-113 open C-204 shorted R-231 open
	2	B-plus 140 V. high	B-plus 140 V. low	V103 open heater
	6		C-196 open	V120 defective

Demodulator Driver

The demodulator driver stage uses a type 6AG7 metal-envelope tube. The function of the demodulator driver is to further amplify the signal information fed from the bandpass amplifier. A schematic diagram of the demodulator driver stage is shown in figure 75.

The chrominance information, after amplification in the 6AG7, is transformer-coupled to the plates of the R—Y and G—Y demodulator tubes.

Failure of the demodulator driver would result in the absence of color during a color program.

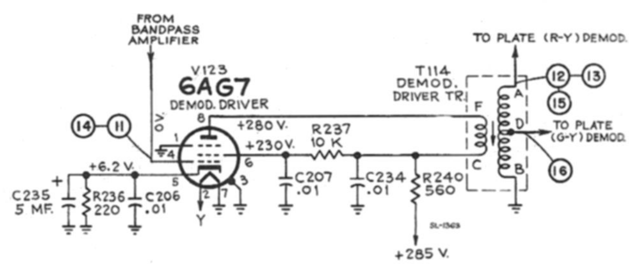


Fig. 75—Schematic Diagram Demodulator Driver. Circled numbers refer to waveform photographs.

Figures 76 through 81 show waveforms useful in checking the operation of this circuit.

Adjustment of the demodulator driver transformer is covered on page 75.

VOLTAGE CHART

Chrominance Channel — Demodulator Driver

Tube	*Pin No.*	*Voltage Too High*	*Voltage Too Low*	*No Voltage*
V123	5	R-236 open	C-235 leaky	C-206 shorted
	6	R-236 open	R-240 high in value	C-234 shorted
	8	R-236 open	C-234 leaky	T-114 open

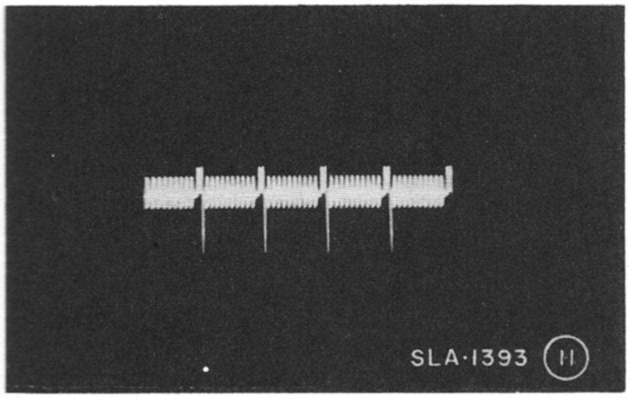


Fig. 76—Waveform at Grid (Pin #4) of Demodulator Driver. Signal from Color Bar Generator. Picture Control Adjusted for Normal Contrast. Color Control at Maximum.

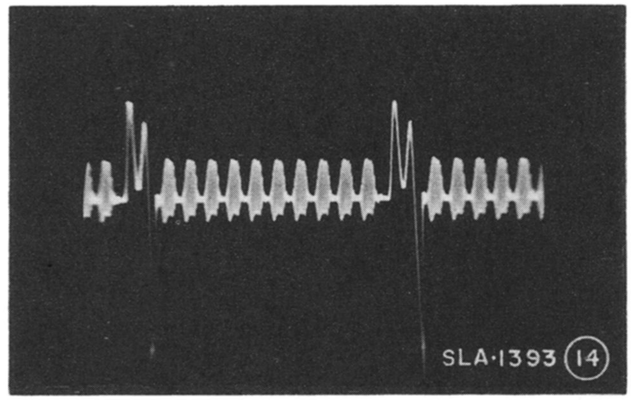


Fig. 79—Waveform at Grid (Pin #4) of Demodulator Driver. Signal from Color Bar Generator. Picture Control Adjusted for Normal Contrast. Color Control at Maximum. Waveform Expanded to Show Detail. Compare with Figure 76.

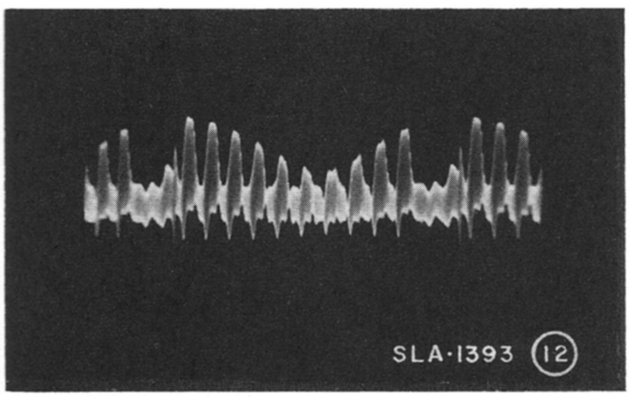


Fig. 77—Waveform at Terminal "A" T-114, Demodulator Driver Transformer. Signal from Color Bar Generator. Picture Control Adjusted for Normal Contrast. Color Control at Maximum. Hue Control Incorrectly Adjusted. Waveform Expanded to Show Detail.

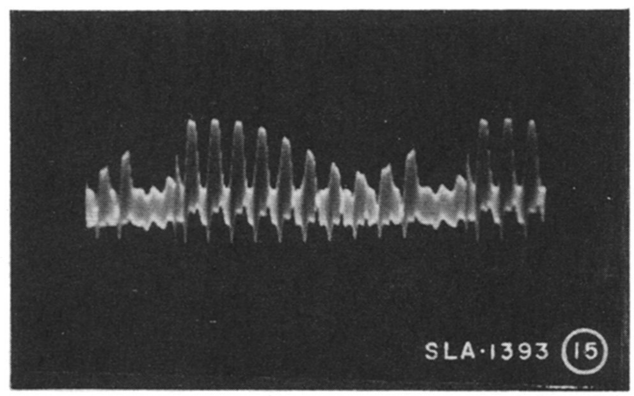


Fig. 80—Waveform at Terminal "A" T-114, Demodulator Driver Transformer. Signal from Color Bar Generator. Picture Control Adjusted for Normal Contrast. Color Control at Maximum. Hue Control Adjusted Correctly. Compare with Figure 77.

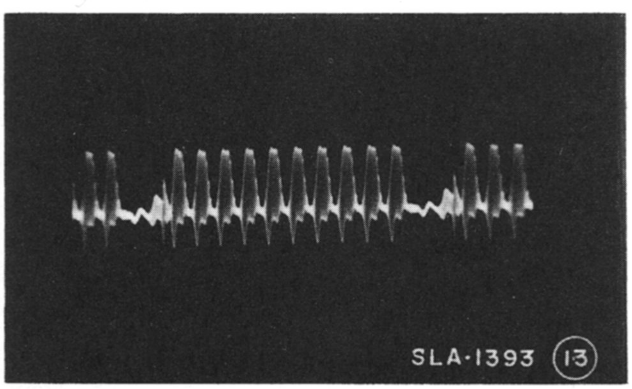


Fig. 78—Waveform at Terminal "A" T-114, Demodulator Driver Transformer. Signal from Color Bar Generator. Picture Control Adjusted for Normal Contrast. Color Control at Maximum. Hue Control Incorrectly Adjusted. 3.58 mc. Oscillator Operating Normally.

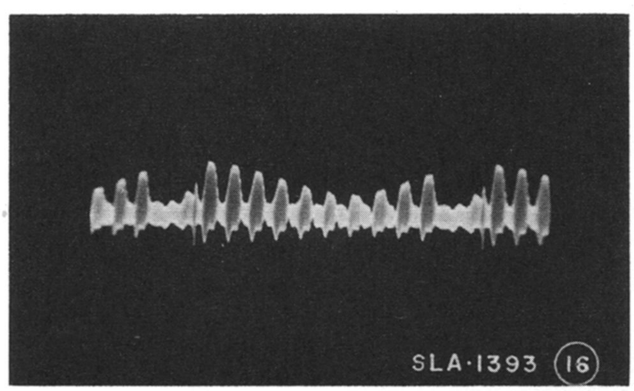


Fig. 81—Waveform at Terminal "D" T-114, Demodulator Driver Transformer. Signal from Color Bar Generator. Picture Control Adjusted for Normal Contrast. Color Control at Maximum. Hue Control Misadjusted. Note Difference in Amplitude when Compared with Figure 77.

Demodulators

The demodulator stages use both halves of a type 12BH7 dual triode. One of the triode sections is used as the R—Y demodulator and the other is used as the G—Y demodulator. A schematic diagram of the demodulator stages is shown in figure 82.

Figures 83 through 87 show waveforms useful in checking operation of these circuits.

The function of the demodulators is to convert the color signal, passed through the bandpass amplifier and the demodulator driver, into a varying DC voltage, suitable in polarity and amplitude, to overcome the bias at the grid of the kinescope electron gun to which the demodulator is connected.

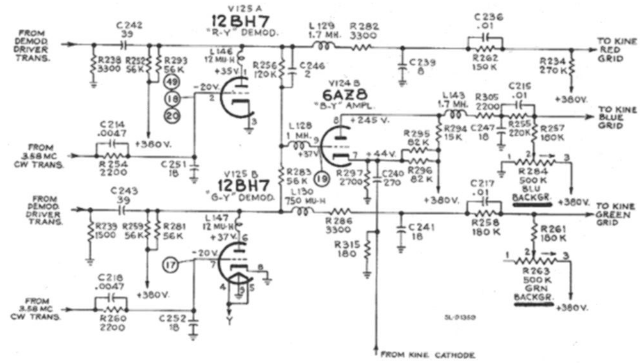


Fig. 82—Schematic Diagram. Chrominance Demodulator Circuits. Circled numbers refer to waveform photographs.

For example, a section of the picture which is to appear red should have voltage applied to the red gun grid in amplitude sufficient to overcome the fixed grid bias maintained between the grid and cathode.

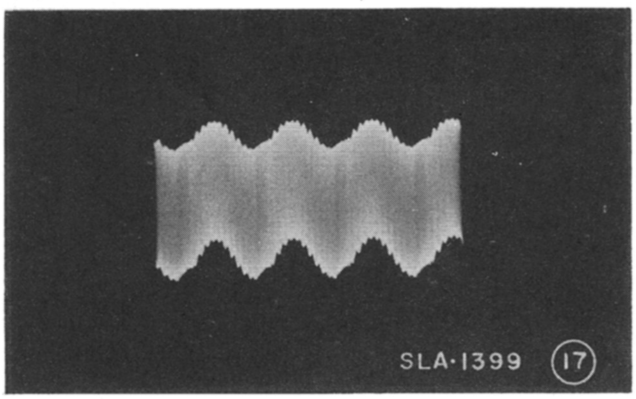


Fig. 83—Waveform at Grid (Pin #7) of G—Y Demodulator. Signal from Color Bar Generator. Picture Control Adjusted for Normal Contrast. Color Control at Maximum.

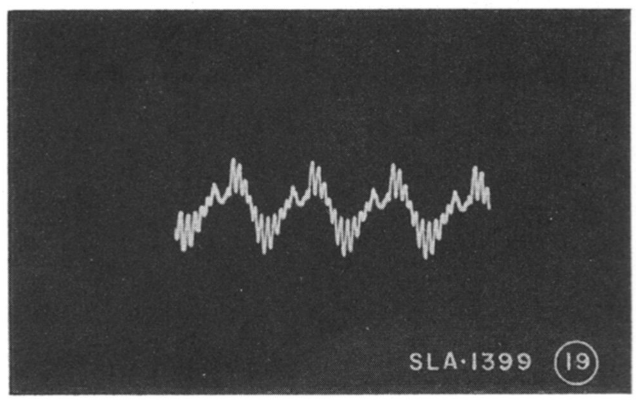


Fig. 85—Waveform at Grid (Pin #9) of B—Y Amplifier. Signal from Color Bar Generator. Picture Control Adjusted for Normal Contrast. Color Control at Maximum. Note that Signal has been Demodulated.

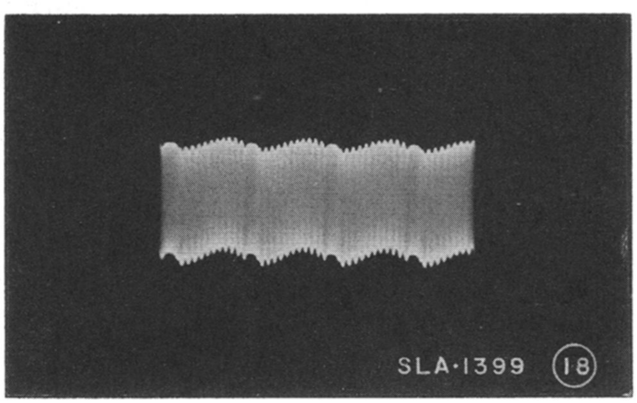


Fig. 84—Waveform at Grid (Pin #2) of R—Y Demodulator. Signal from Color Bar Generator. Picture Control Adjusted for Normal Contrast. Color Control at Maximum.

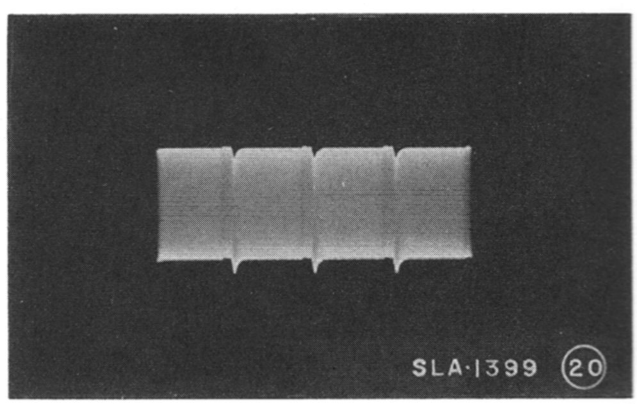


Fig. 86—Waveform at Grid (Pin #2) of R—Y Demodulator. Signal from Color Bar Generator. Picture Control Adjusted for Normal Contrast. Color Control at Minimum. Compare with Figure 84.

The higher the voltage from the R—Y demodulator, the more intense the red area on the screen will become, since the positive voltage applied to the grid, in opposition to the negative bias, will cause the grid to become less negative with respect to the cathode (e.g. from —70 to —50 volts) thus permitting the passage of more electrons from the cathode to the anode. This results in a higher current flow (higher beam current) and thus, since the phosphors of the red dots on the face of the kinescope will be struck with more electrons, more light will be emitted.

It can be seen from this explanation that weakness in either section of the 12BH7 will result in improper color rendition or, if complete failure of the tube occurs, loss of colors will result.

As mentioned above R—Y and G—Y (the red and green color difference signals) are developed in the color demodulators. B—Y (the blue color difference signal) is obtained by mixing a portion of the output of each of the two demodulators. Thus, if the demodulators are not operating properly, B—Y (blue) will also be improperly reproduced.

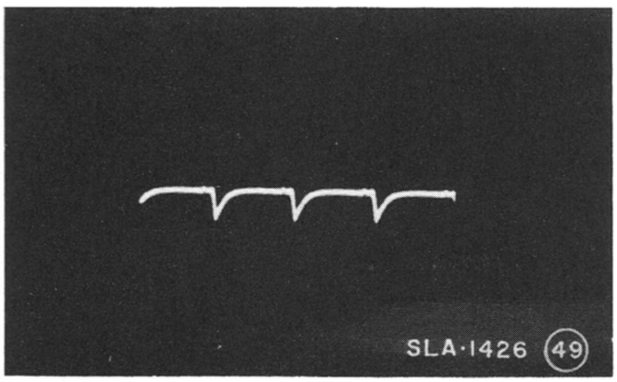


Fig. 87—Waveform at Grid (Pin #2) of R—Y Demodulator. Signal from Color Bar Generator. Picture Control Adjusted for Normal Contrast. 3.58 mc. Oscillator not Operating.

SERVICE SUGGESTIONS

Demodulators

Symptoms	*Possible Causes*
Green picture.	R-259, R-281 changed in value (replace with 3-82K 2 watt resistors in parallel).
Intermittent green picture.	12BH7 G—Y and R—Y demodulator defective.
No green screen.	C-241, high resistance short to ground.
No green screen.	C-217 leaky.
	If R-252, R-293 change in value, replace also with 3-82K 2 watt resistors in parallel.

VOLTAGE CHART

Chrominance — Demodulators

Tube	*Pin No.*	*Voltage Too High*	*Voltage Too Low*	*No Voltage*
V125A	1	High grid bias	C-251 shorted	L-146 open
	2	T-115 defective	C-251 leaky	V124A inoperative
V125B	6	High grid bias	C-241 shorted	C-243 shorted L-147 open
	7	T-115 defective	C-252 leaky	V124A inoperative
V124B	7	R-297 open	C-240 shorted	
	8	R-297 open	C-247 shorted	
	9	C-247 shorted		L-128 open

COLOR SYNC

The color synchronizing section of the receiver consists of the Burst Keyer, the Phase Detector, Color Killer, the 3.58 mc. CW Oscillator and the Reactance control tube.

Figure 88 shows the schematic diagram for the color sync circuits.

The purpose of the color sync section of the receiver is to insure that the correct colors appear at the proper instant on the viewing screen of the kinescope.

The function of the burst keyer tube is to permit the burst portion of the composite color video signal, when present, to pass to the phase detector and the color killer.

The phase detector provides during a color program, a correction voltage proportional to the difference in phase between burst and the locally generated 3.58 mc. CW signal. The correction voltage is applied to the reactance tube, which changes the frequency and/or phase of the 3.58 mc. oscillator. The 3.58 mc. CW oscillator in turn, feeds a portion of its output back to the phase detector. When the phase of this signal coincides with the phase of burst, the signal will be in "color-lock" and the proper colors will appear at the proper places in the picture.

The location of these circuits on the receiver chassis is shown in figure 89.

Figures 90 through 95 show waveforms useful in checking operation of the keyer and killer circuits.

The color killer, as its name implies, prevents color from appearing in the picture when only a black-and-white picture is being received. This is accomplished by applying a bias (developed by the color killer) to the grid of the bandpass amplifier. This prevents the chrominance circuits from receiving any video information.

When a color picture is being received, the color killer is biased off by a voltage developed from the burst signal passing through the phase detector circuit. This permits the bandpass amplifier to operate and pass chrominance information to the chrominance channels.

One of the characteristics of this series of receivers is that *in order to produce a black-and-white picture, the color demodulation section must operate properly.*

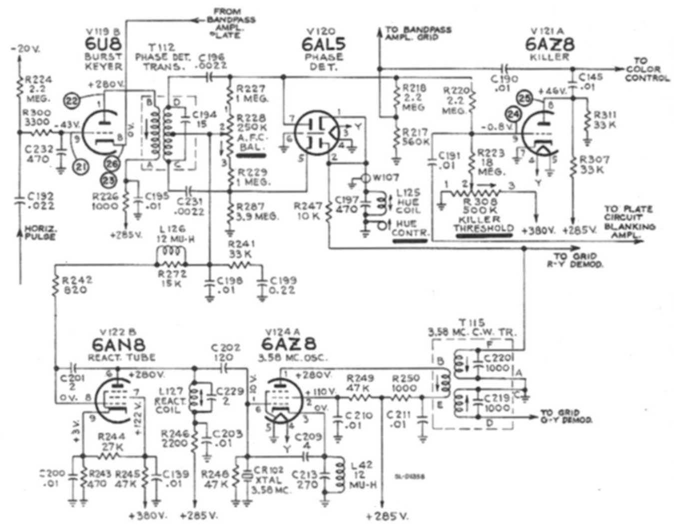


Fig. 88—Schematic Diagram—Color Sync Circuits. Circled numbers refer to waveform photographs.

If the 3.58 mc. subcarrier oscillator does not operate and provide adequate bias voltage to the grids of the G—Y and R—Y demodulators, a picture having an overall yellow-green cast will result.

If this condition exists, the 3.58 mc. oscillator tube and associated components should be checked.

Check:

Plate, cathode, screen voltages of Reactance Tube, V122B.

Plate, screen, grid voltages of 3.58 mc. oscillator, V124A.

Grid voltage at pin #12 of kinescope (measure with no signal input).

A similar condition can result from a short-circuit in the blue grid circuit of the kinescope.

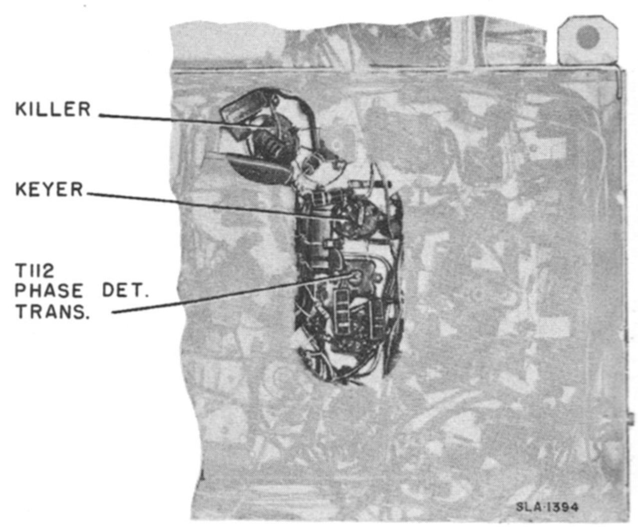


Fig. 89—Chassis Location—Killer and Keyer Circuits.

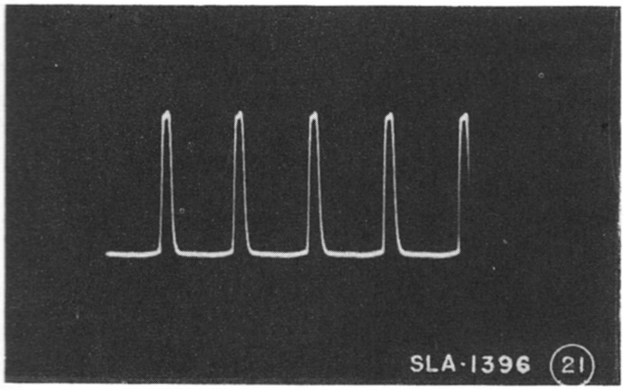


Fig. 90—Waveform at Grid (Pin #9) of Burst Keyer. Black-and-white Picture. Contrast and Brightness Controls Adjusted for Normal Picture Reception. Color Control at Minimum.

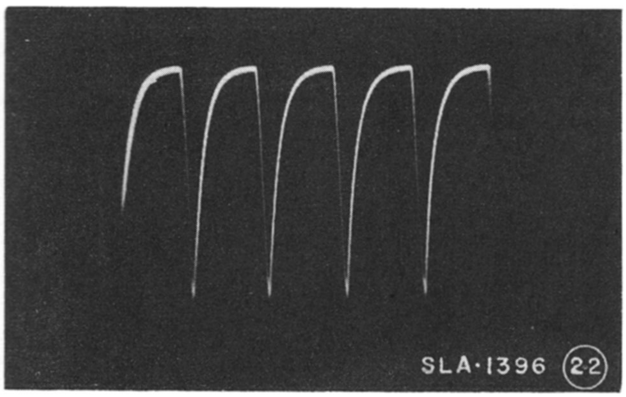


Fig. 91—Waveform at Plate (Pin #1) of Burst Keyer. Black-and-white Picture. Contrast and Brightness Controls Adjusted for Normal Picture Reception. Color Control at Minimum.

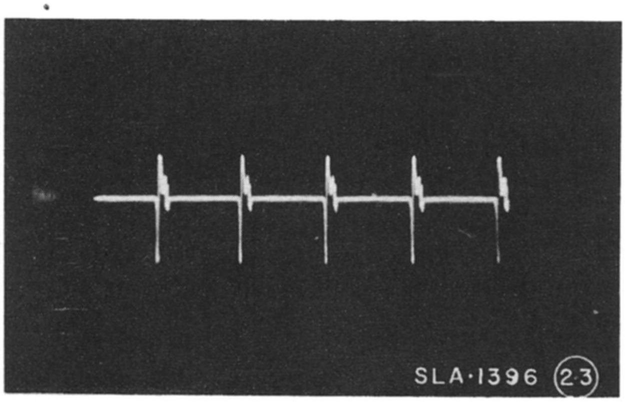


Fig. 92—Waveform at Cathode (Pin #8) of Burst Keyer. Black-and-white Picture. Contrast and Brightness Controls Adjusted for Normal Picture Reception. Color Control at Minimum.

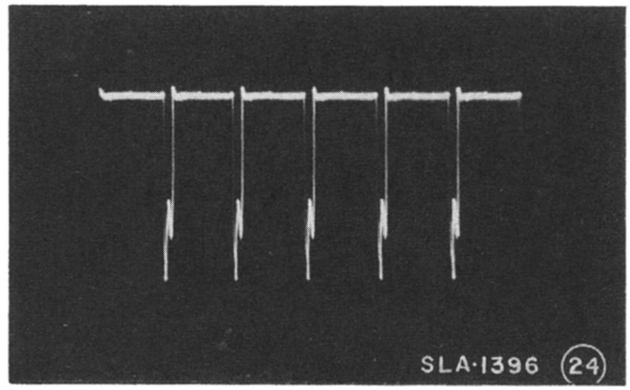


Fig. 93—Waveform at Grid (Pin #9) of Killer. Black-and-white Picture. Contrast and Brightness Controls Adjusted for Normal Picture Reception. Color Control at Minimum.

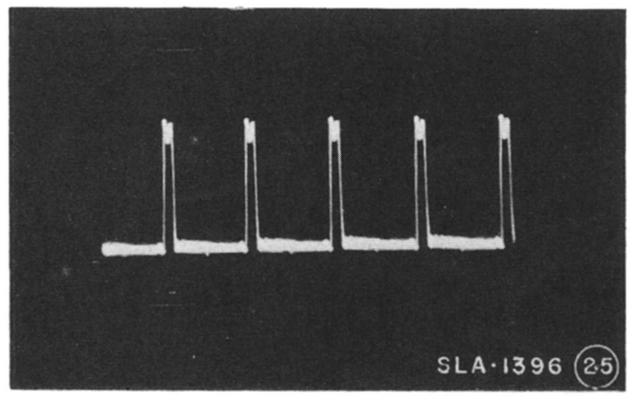


Fig. 94—Waveform at Plate (Pin #8) of Killer. Black-and-white Picture. Contrast and Brightness Controls Adjusted for Normal Picture Reception. Color Control at Minimum.

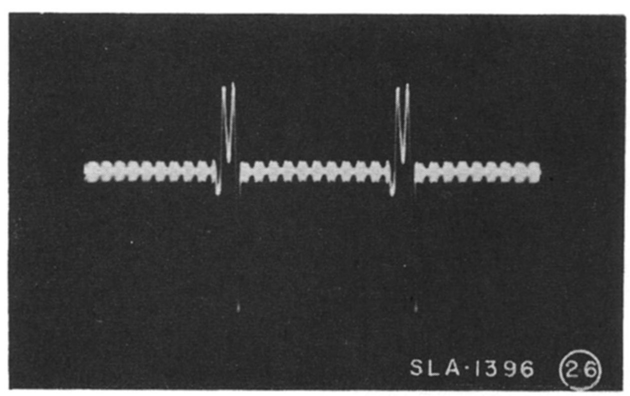


Fig. 95—Waveform at Cathode (Pin #8) of Keyer. Signal from RCA Color Bar Generator. Contrast and Brightness Controls Adjusted for Normal Picture Reception. Color Control at Maximum. Expanded to Show Color Bars. Compare with Figure 92.

SERVICE SUGGESTIONS

Color Sync

Symptoms	*Possible Causes*
No color, not enough burst to bias color killer.	Readjust T-112 and L-125.
No color.	6U8 burst keyer.
No color sync.	Readjust L-127.
AC hum in picture, triggers color.	6U8 burst keyer.
No brightness.	R-250 open, short to ground at term "B" T-115.
No brightness, no sound.	C-234 shorted, defective R-240 in screen of demod. driver.
No color sync.	6AN8 reactance tube.

3.58 mc. Oscillator

Symptoms	*Possible Causes*
Picture Yellow-Green.	Defective 3.58 mc. crystal. Replace crystal.
Insufficient feedback to make crystal oscillate.	Increase C-209 to 6.8 mmfd. Wrong value L-129 or L-130.
Feedback from the demodulator outputs to the 3.58 mc. oscillator grid through the B—Y amplifier, or direct.	Dress L-143 away from oscillator section of V-124.
Tendency of reactance tank coil, L-127, and oscillator, to parasitic oscillation.	Remove C-229.

VOLTAGE CHART

Color Sync

Tube	*Pin No.*	*Voltage Too High*	*Voltage Too Low*	*No Voltage*
V119B	1		C-195 leaky R-226 high in value Bias low	T-112 open C-195 shorted
	9		C-232 leaky C-192 shorted	C-232 shorted
V120	5		C-231 shorted	
	7		C-196 shorted	
V121A	8	R-311 open	C-145 shorted	R-307 open
	9	C-191 shorted		
V122B	7	R-243 open	C-200 shorted	C-139 shorted
	9	R-243 open	C-203 leaky	C-200 shorted
	6	R-243 open	C-202 shorted	L-127 open C-203 shorted
V124A	1	L-142 open	Crystal defective C-202 shorted	C-211 shorted T-115 open
	2	L-142 open	C-210 leaky C-202 leaky	C-210 shorted C-211 shorted
	6	C-202 shorted (high B+.)	Weak crystal C-202 leaky	Crystal defective

Demodulator Phase Adjustment

In addition to the method shown under "FIELD SERVICE," the demodulator phase adjustments can be easily made using the color bar generator and the oscilloscope. Figure 96 shows how to interpret the waveforms obtained at the kinescope grids from the color bar signal. The procedure for adjustment to obtain the correct waveforms with the proper hue control setting is shown in figures 97 through 101. The correct waveforms which should be seen at each kinescope grid are shown in figures 102, 103 and 104.

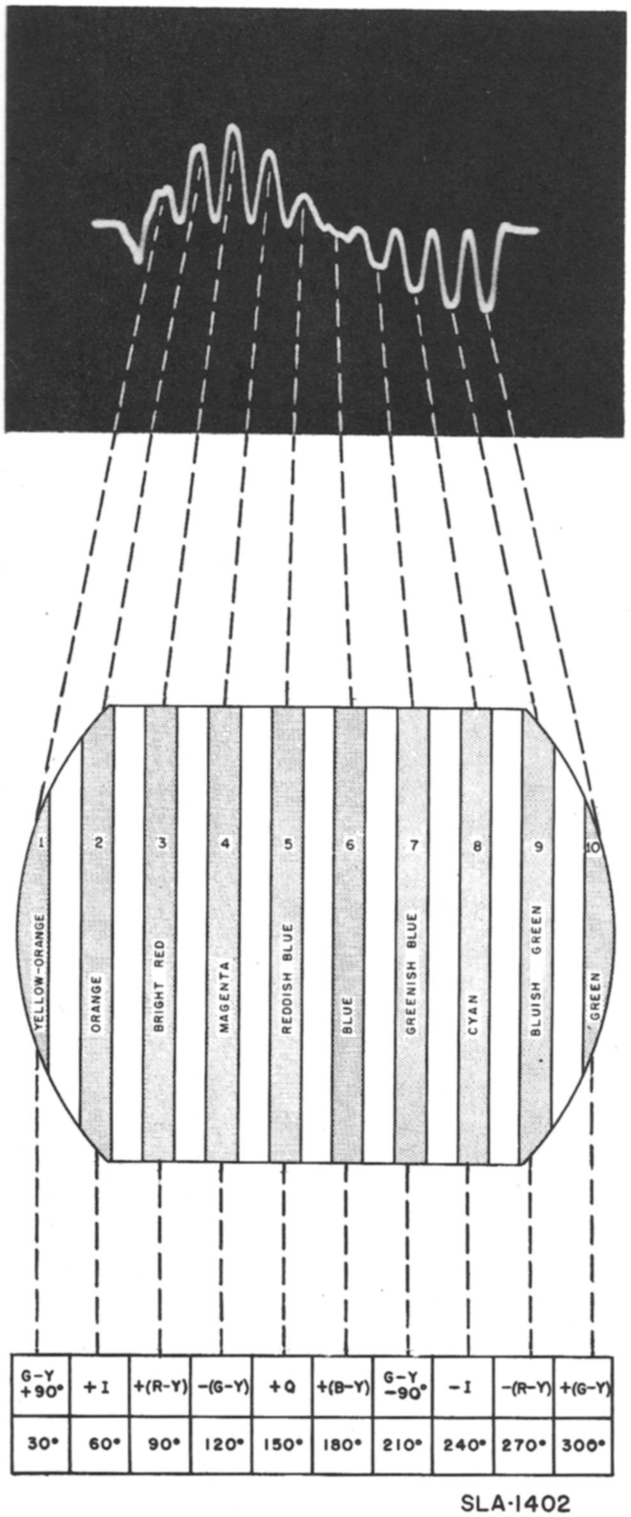


Fig. 96—How to Interpret Color Bar Signal Waveforms.

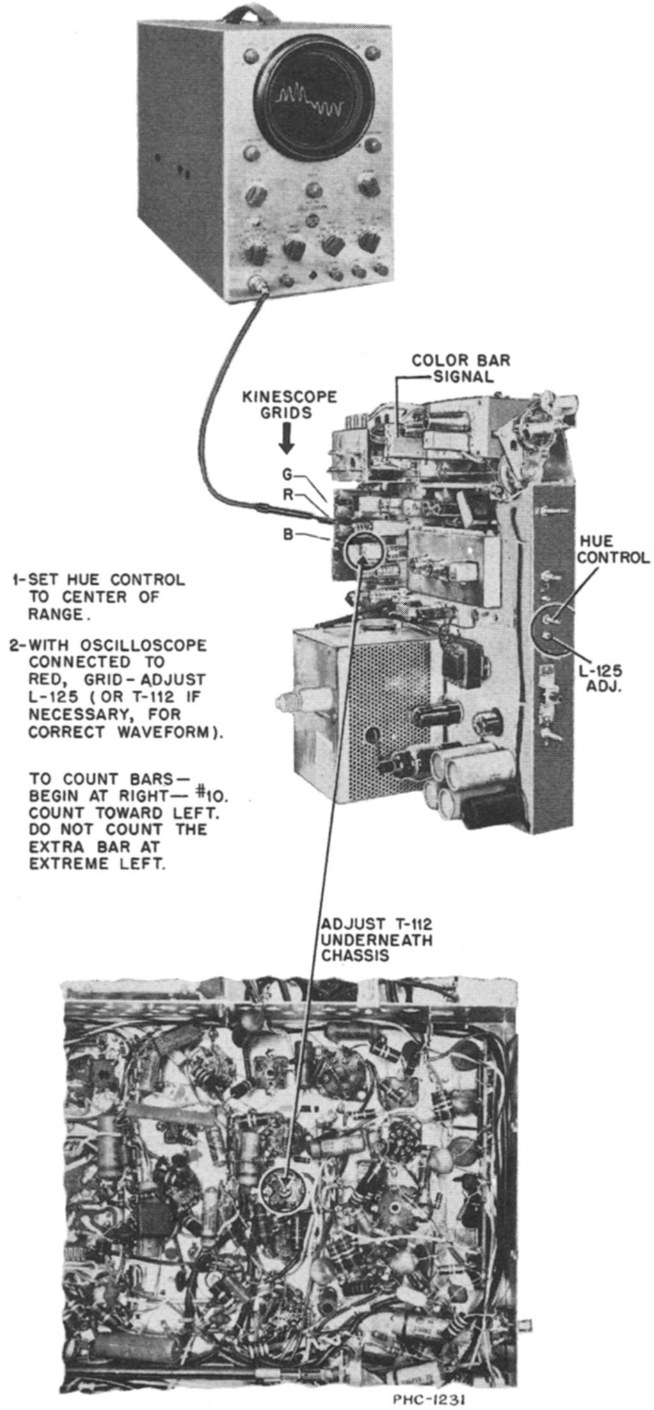


Fig. 97—How to Adjust for Correct Range of Hue Control. (See Field Procedure, page 24.)

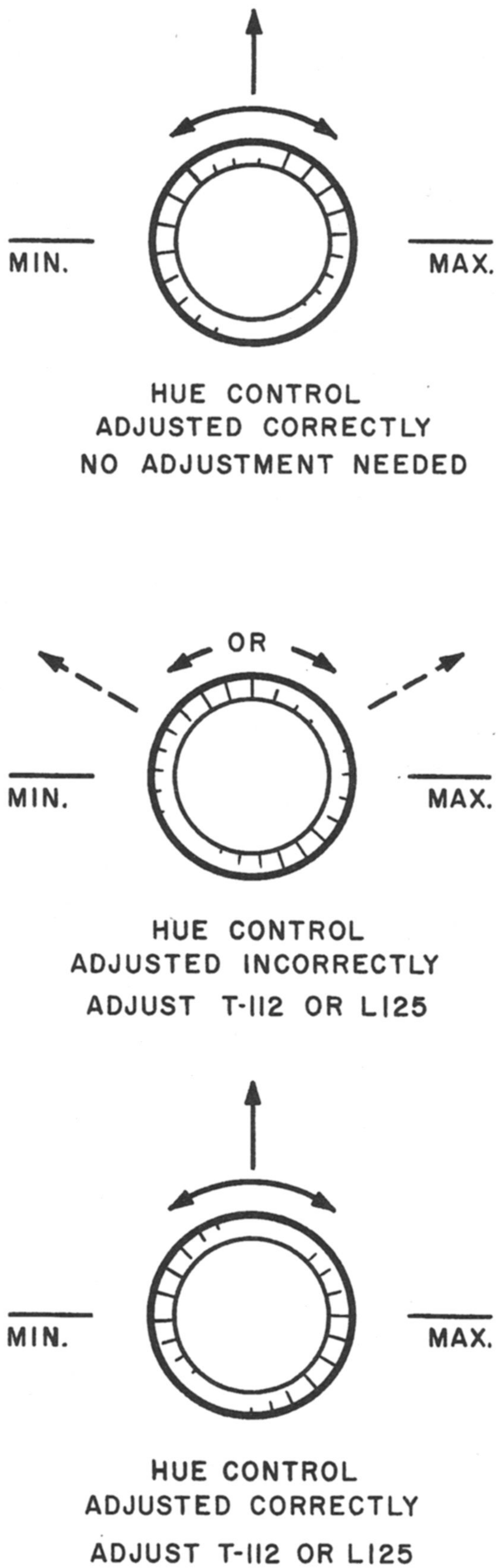


Fig. 98—Hue Control Settings

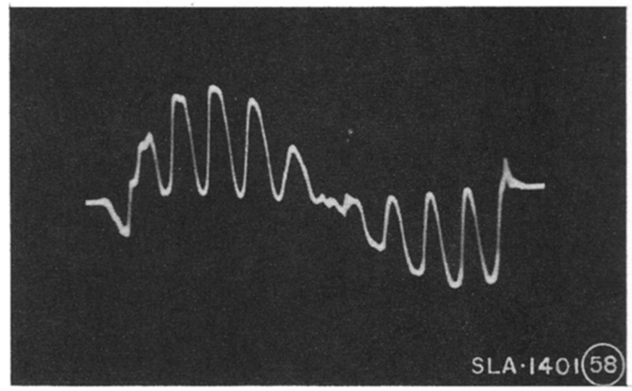


Fig. 99—Correct Waveform at Red Grid of Kinescope

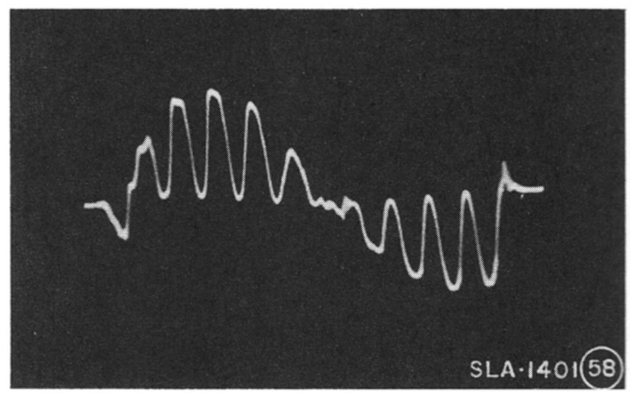


Fig. 100—Correct Waveform at Red Grid of Kinescope

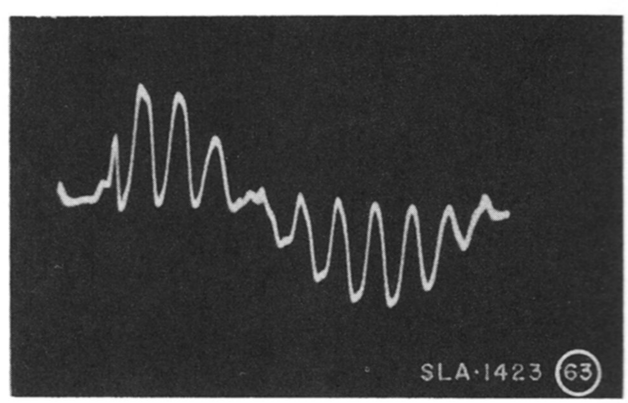


Fig. 101—Incorrect Waveform at Red Grid of Kinescope

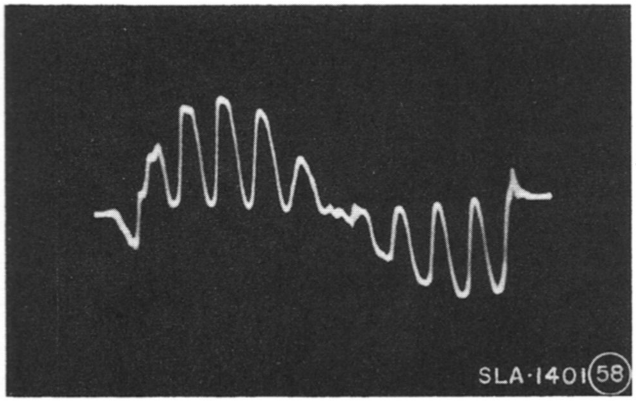


Fig. 102—Waveform at Kinescope Red Grid—Color Bar Signal. Hue Correctly Adjusted. 6th Bar at Zero. 3rd Bar at Maximum. Center of 6th Bar on Base Line.

Correct waveform for red hue. When hue control and color sync circuits are operating normally, 6th bar is at zero. 3rd bar at maximum. 6th bar is partly above and partly below base line.

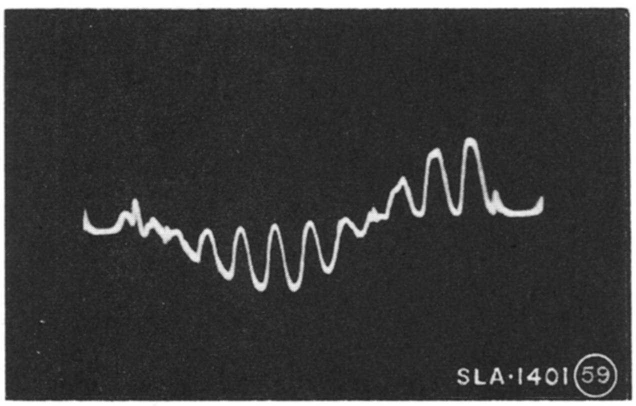


Fig. 103—Waveform at Kinescope Green Grid—Color Bar Signal. Hue Correctly Adjusted. 7th Bar at Minimum. 10th Bar at Maximum. Center of 7th Bar on Base Line.

Correct waveform for green hue. 7th bar at minimum. 10th bar at maximum. Center of 7th bar is on base line.

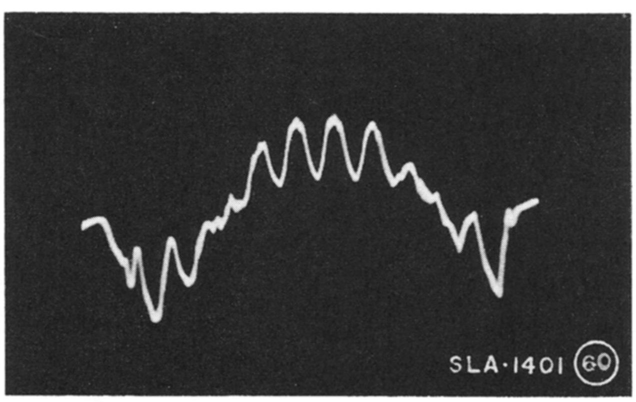


Fig. 104—Waveform at Kinescope Blue Grid—Color Bar Signal. Hue Correctly Adjusted. 3rd and 9th Bars at Minimum.

Correct adjustment of blue hue. 3rd and 9th bars at minimum. Waveform distorted because of difference in bandwidth of B—Y video channel. (If necessary, adjust top of T-115 for correct waveform.)

NOTE: *Late production receivers will show waveform having base line similar to figures 102 and 103.*

DEFLECTION SYNC

Sync Amplifiers

Horizontal and vertical deflection sync is derived from the composite video signal present at the output of the 1st Video amplifier and is fed to two sync amplifier stages. These consist of the triode sections of the 6AN8 3rd Picture I-F amplifier and the 6AZ8 2nd Picture I-F amplifier. A schematic diagram of the 1st and 2nd Sync Amplifier Circuits is shown in figure 105. The circuit wiring and components are mounted on the same printed circuit board as the Picture I-F stages. Refer to figures 48 and 49. Signal is also fed to the sync amplifiers from the noise inverter stage. Waveforms useful in checking operation of the sync amplifier stages appear in figures 106 to 110.

NOTE

The plate supply voltage for these stages is taken from the cathode of the audio output tube, consequently a current drain caused by a short circuit, or other malfunction in the sync amplifier stages, may affect operation of the 3rd picture I-F amplifier and sound output.

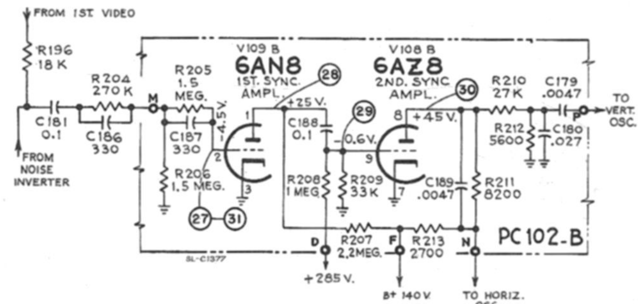


Fig. 105—Schematic Diagram—1st and 2nd Sync Amplifier Circuits. Circled numbers refer to waveform photographs.

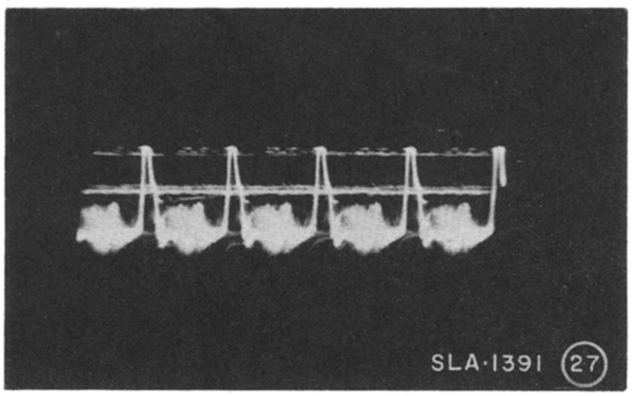


Fig. 106—Waveform at Grid (Pin #2) of 1st Sync Amplifier. Black-and-white Picture. Contrast and Brightness Controls Adjusted for Normal Picture. Color Control at Minimum.

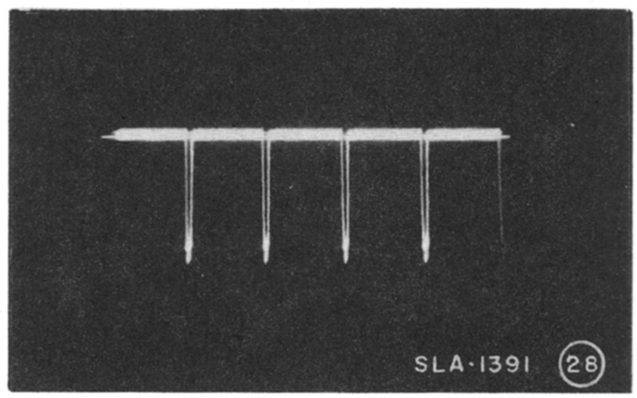


Fig. 107—Waveform at Plate (Pin #1) of 1st Sync Amplifier. Black-and-white Picture. Contrast and Brightness Controls Adjusted for Normal Picture. Color Control at Minimum.

VOLTAGE CHART

Deflection Sync — Sync Ampl.

Tube	*Pin No.*	*Voltage Too High*	*Voltage Too Low*	*No Voltage*
V109B	1	B-plus 140 V. high V109B open heater	C-181 shorted R-207 high in value	R-207 open V103 open heater
	2		C-181 leaky	
V108B	8	C-189 shorted	R-213 high in value R-211 high in value C-188 shorted	R-211 open V103 open heater
	9		C-188 leaky	

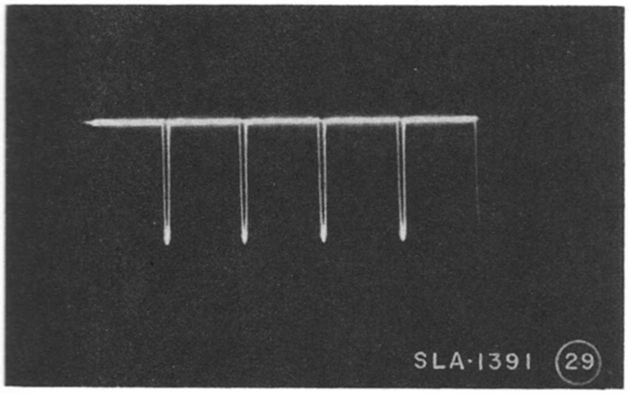


Fig. 108—Waveform at Grid (Pin #9) of 2nd Sync Amplifier. Black-and-white Picture. Contrast and Brightness Controls Adjusted for Normal Picture. Color Control at Minimum.

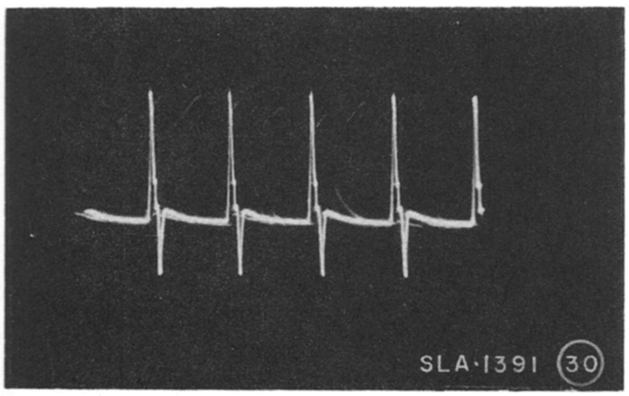


Fig. 109—Waveform at Plate (Pin #8) of 2nd Sync Amplifier. Black-and-white Picture. Contrast and Brightness Controls Adjusted for Normal Picture. Color Control at Minimum.

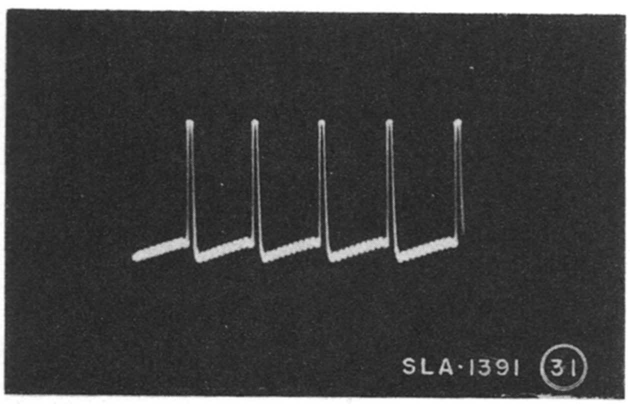


Fig. 110—Waveform at Grid (Pin #2) of 1st Sync Amplifier. Signal from Color Bar Generator. Contrast and Brightness Controls Adjusted for Normal Picture. Color Control at Maximum.

AGC

The AGC amplifier uses the pentode section of the 6U8 Burst Keyer. Figure 111 shows the schematic diagram for this circuit. Sync, from the 1st Video amplifier output is fed to the grid.

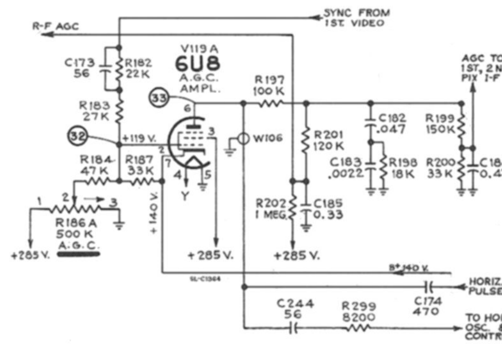


Fig. 111—Schematic Diagram—AGC Amplifier. Circled numbers refer to waveform photographs.

A horizontal pulse, taken from the horizontal output transformer, keys the tube into conduction.

When the tube is keyed into conduction, a voltage is developed in its plate circuit and fed to the R-F and I-F stages as the AGC control voltage.

The cathode of the AGC amplifier is connected to the 140 volt B-plus circuit whose source is the cathode of the audio output tube, thus, failure in this circuit may affect AGC voltages.

If the resistances R202, R201, R197, R199 and R200 should change in value, proper AGC voltage distribution between R-F and I-F circuits will not be maintained and will result in a degraded or snowy picture. R202, 1 megohm, should be checked for proper value if AGC voltage unbalance is suspected. Figures 112 and 113 show waveforms useful in checking proper operation of this circuit.

The AGC control should be adjusted with the strongest station signal available. The control is turned counter-clockwise until the picture can be synchronized and appears normal.

NOTE

AGC adjustment should be made in conjunction with the Noise Threshold Control.

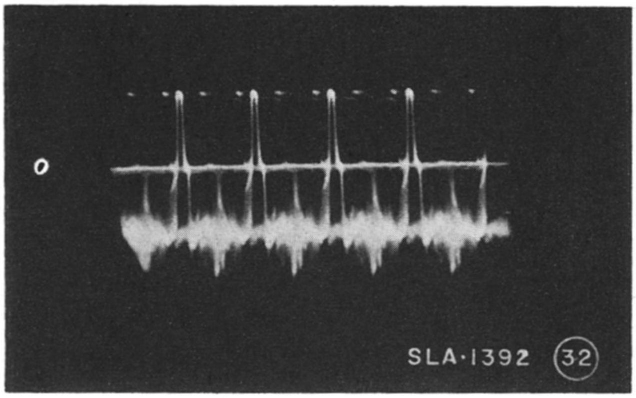


Fig. 112—Waveform at Grid (Pin #2) of AGC Amplifier. Black-and-white Picture. Picture and Brightness Controls Adjusted for Normal Picture. Color Control at Minimum.

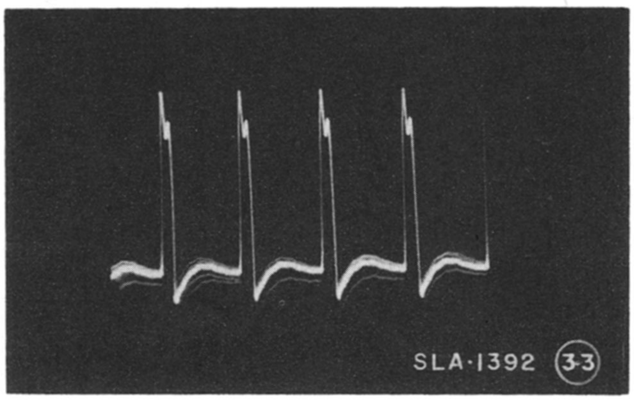


Fig. 113—Waveform at Plate (Pin #6) of AGC Amplifier. Black-and-white Picture. Picture and Brightness Controls Adjusted for Normal Picture. Color Control at Minimum.

SERVICE SUGGESTIONS

AGC

Symptoms	*Possible Causes*
Picture overload.	6U8 AGC amplifier.
Picture only with brightness control at max.	6U8 AGC amplifier.
Picture overload.	Adjust AGC control.
Picture overload and snowy.	6U8 AGC amplifier.
Low color saturation.	Adjust AGC.
Hum in picture.	6U8 AGC amplifier.
Intermittent picture overload.	6U8 AGC amplifier.
No sync.	AGC misadjusted.
Snow or interference in picture.	AGC amplifier, V-119A inoperative. R-202 changed value.

VOLTAGE CHART

AGC

Tube	*Pin No.*	*Voltage Too High*	*Voltage Too Low*	*No Voltage*
V119A	2	V110 open heater	R-133 high in value	R-133 open
	3	B-plus high V119A open heater	C-257 leaky R-325 high in value	C-257 shorted R-325 open
	7	B-plus 140 V. high	V103 defective	V103 open heater

NOISE INVERTER

The triode section of the 6U8 sound I-F amplifier tube is used in the noise cancellation circuit. Figure 114 shows the schematic diagram of the noise cancellation circuit. The printed circuit board on which the sound I-F and audio sections of the receiver are constructed, also includes the noise inverter stage. Refer to figures 53 and 54, page 35.

Noise occurring in the video signal will appear in the plate circuit of the 1st Video Amplifier stage. The same noise also appears, in opposite polarity, at the

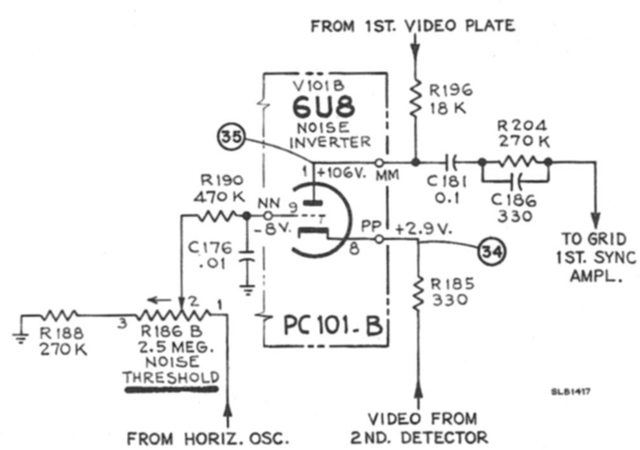


Fig. 114—Schematic Diagram—Noise Inverter Circuit

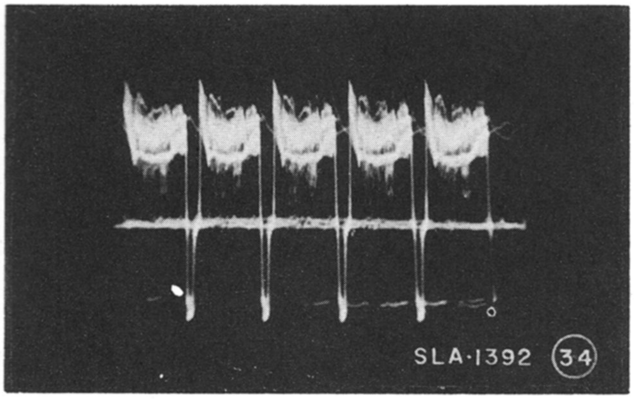


Fig. 115—Waveform at Cathode (Pin #8) of Noise Inverter. Black-and-white Picture. Picture and Brightness Controls Adjusted for Normal Picture. Color Control at Minimum.

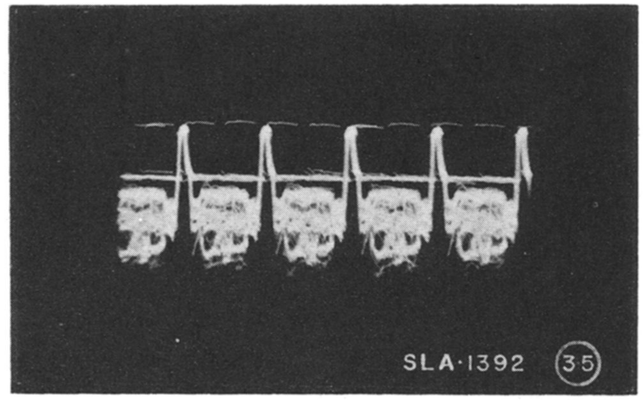


Fig. 116—Waveform at Plate (Pin #1) of Noise Inverter. Black-and-white Picture. Picture and Brightness Controls Adjusted for Normal Picture. Color Control at Minimum.

cathode of the 1st video stage. The noise which appears at the cathode of the noise inverter tube is amplified without being inverted (cathode and plate have same signal polarity). The amplified noise which appears at the plate of the noise inverter is applied to the grid of the 1st sync amplifier stage. The grid of the 1st sync amplifier stage receives noise of positive polarity from the plate of the 1st video stage and noise of negative polarity from the noise inverter stage. Since the two noise pulses are of opposite polarity, cancellation of the noise pulses occurs and noise does not appear in the sync stages.

Figures 115 and 116 show waveforms useful in checking proper operation of this circuit.

The Noise Threshold control varies the grid bias of the noise inverter stage and sets the level at which the tube operates. It is adjusted in conjunction with the AGC control. For proper adjustment, turn the Noise Threshold control R-186B, on the chassis rear apron, fully counter-clockwise. Select the channel with the strongest signal and turn the AGC control counter-clockwise until the receiver operates normally and the picture can be synchronized.

Switch the receiver to the weakest signal to be received.

Turn the Noise Threshold control clockwise until the best signal-to-noise ratio is obtained.

Select the strongest signal once again and check to see that adjustment of the Noise Threshold control did not cause overload. The Noise Threshold control should be set for best signal-to-noise without causing overload on strong signals.

SERVICE SUGGESTIONS

Noise Inverter

Symptoms	*Possible Causes*
Smear in picture.	6U8 noise inverter.
Intermittent hum in picture; hum in sound and very low contrast; no color sync.	6U8 noise inverter.
Low contrast.	6U8 noise inverter.
No sync.	Noise threshold control misadjusted.

VOLTAGE CHART

Noise Inverter

Tube	*Pin No.*	*Voltage Too High*	*Voltage Too Low*	*No Voltage*
V101B	1	B-plus 140 V. high Bias voltage high	V103 defective No bias (V117 defective)	R-196 open V103 open heater
	9	R-188 open	V117 defective	R-186B open
	8	C-176 shorted R-185 open	V110 inoperative (negative voltage)	

VERTICAL DEFLECTION

The vertical sync circuits consist of two stages. The vertical oscillator uses the triode section of the 6AZ8 1st Picture I-F Amplifier. The vertical output stage uses a 6AQ5. A schematic diagram of these circuits is shown in figure 117.

The vertical oscillator circuit components are mounted on the Picture I-F printed circuit board. Refer to pages 32 and 33.

It is important that the vertical sweep circuits operate correctly since, aside from the normal function of supplying vertical sync, the vertical output transformer, T-110 supplies the vertical dynamic convergence circuits with operating voltages.

Figure 118 shows the location of the vertical sync components on the receiver chassis.

Waveforms useful in checking operation of the vertical circuits are shown in figures 119, 120, 121 and 122.

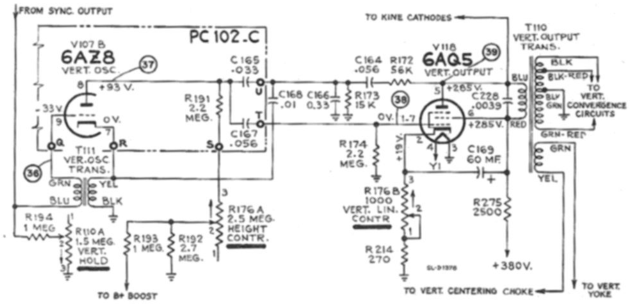


Fig. 117—Schematic Diagram—Vertical Oscillator and Output Circuit. Circled numbers refer to waveform photographs.

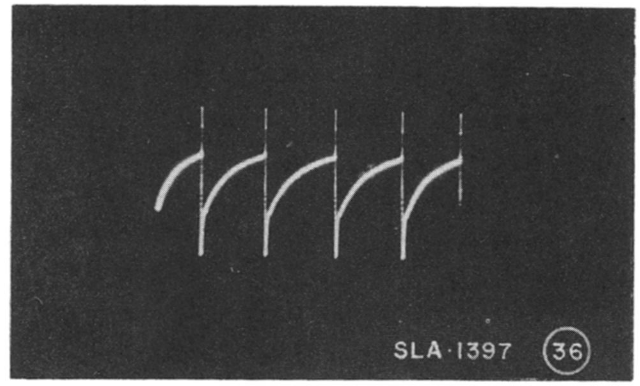


Fig. 119—Waveform at Grid (Pin #9) of Vertical Oscillator. Black-and-white Picture. Picture and Brightness Controls Adjusted for Normal Picture. Color Control at Minimum.

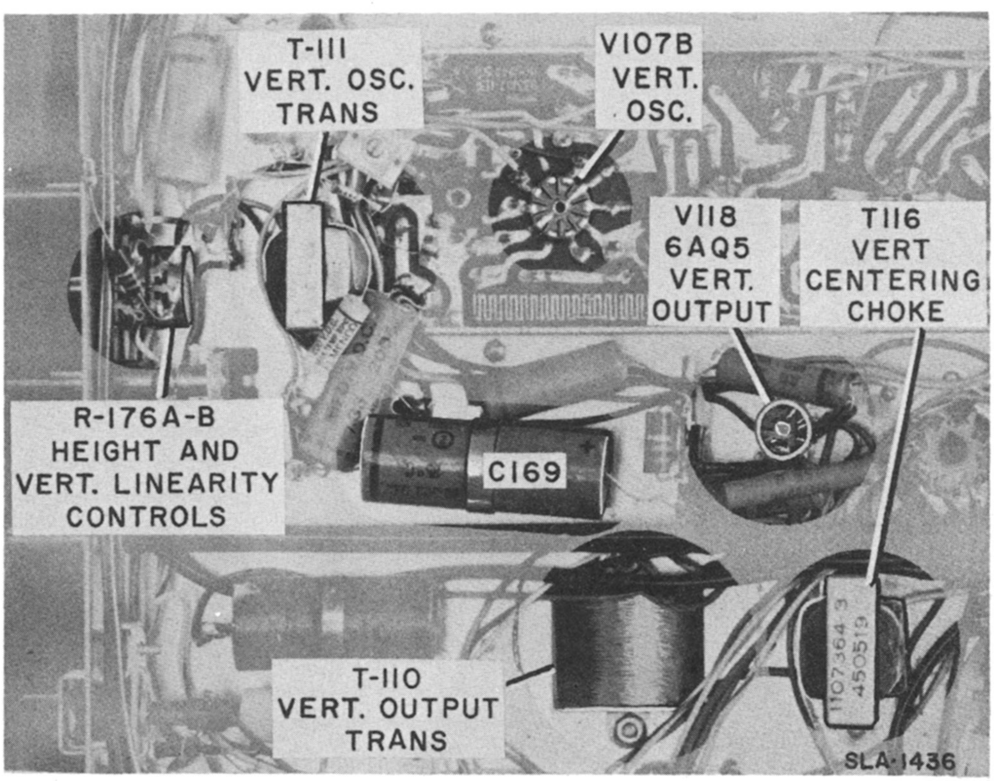


Fig. 118—Chassis Location of Vertical Oscillator and Output Circuits

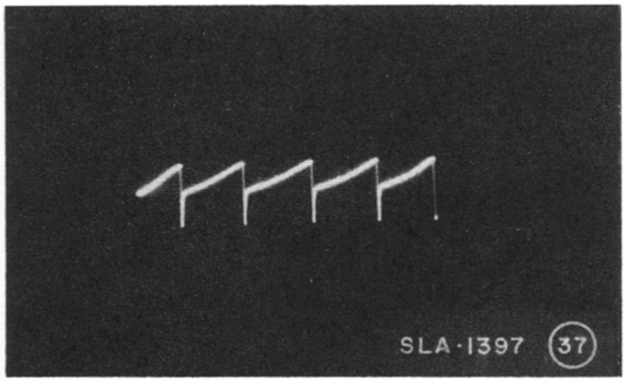


Fig. 120—Waveform at Plate (Pin #8) of Vertical Oscillator. Black-and-white Picture. Picture and Brightness Controls Adjusted for Normal Picture. Color Control at Minimum.

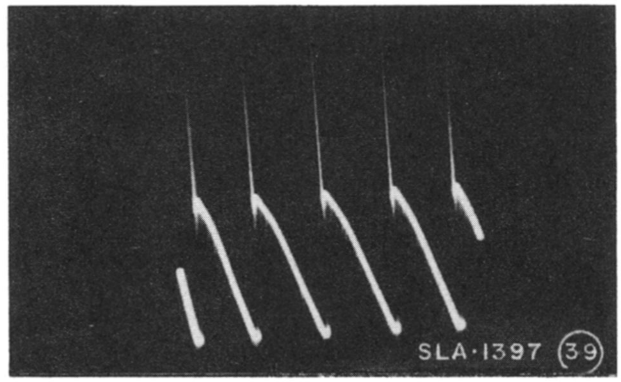


Fig. 122—Waveform at Plate (Pin #5) of Vertical Output. Black-and-white Picture. Picture and Brightness Controls Adjusted for Normal Picture. Color Control at Minimum.

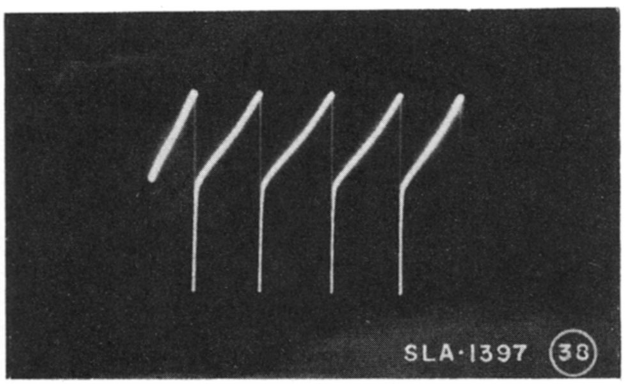


Fig. 121—Waveform at Grid (Pin #1) of Vertical Output. Black-and-white Picture. Picture and Brightness Controls Adjusted for Normal Picture. Color Control at Minimum.

SERVICE SUGGESTIONS

Vertical Deflection

Symptoms	*Possible Causes*
No vertical deflection.	6AZ8 vertical osc.
No vertical deflection.	Vertical osc. transformer winding open.
No vertical deflection.	6AZ8 vertical osc.
Loud buzz.	Vertical output transformer.
No vertical deflection.	C-169 shorted, R214 open.
Vertical roll.	6AZ8 vertical osc.
Picture shrinks vertically.	6AZ8 vertical osc.

VOLTAGE CHART

Vertical Deflection

Tube	*Pin No.*	*Voltage Too High*	*Voltage Too Low*	*No Voltage*
V107B	8	High grid bias	R-193 high in value V115 defective	R-176A open
	9		V107 defective	T-111 open
	7	T-111 open		
V118	5	R-176B open	C-169 leaky	T-110 open
	6	R-176B open	R-275 high in value	C-169 shorted
	7	C-167 shorted		

HORIZONTAL OSCILLATOR AND OUTPUT

The horizontal oscillator and control consists of a modified "synchroguide" circuit using a type 6SN7GTB tube to drive the 6CB5 horizontal output tube. These circuits, shown in the schematic diagram, figure 123, operate in a manner similar to the "synchroguide" used in many black-and-white television receivers.

Figure 124 shows the location of components, and adjustments for this section of the receiver.

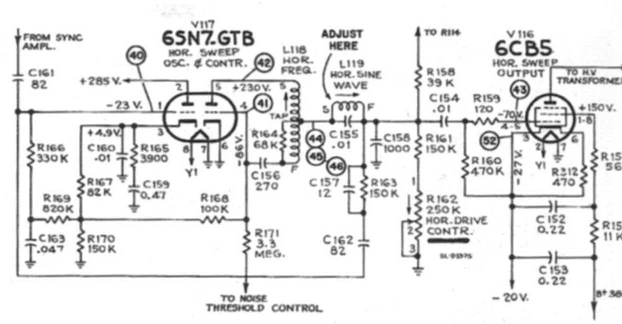


Fig. 123—Schematic Diagram—Horizontal Oscillator, Control and Horizontal Output Circuits. Circled numbers refer to waveform photographs.

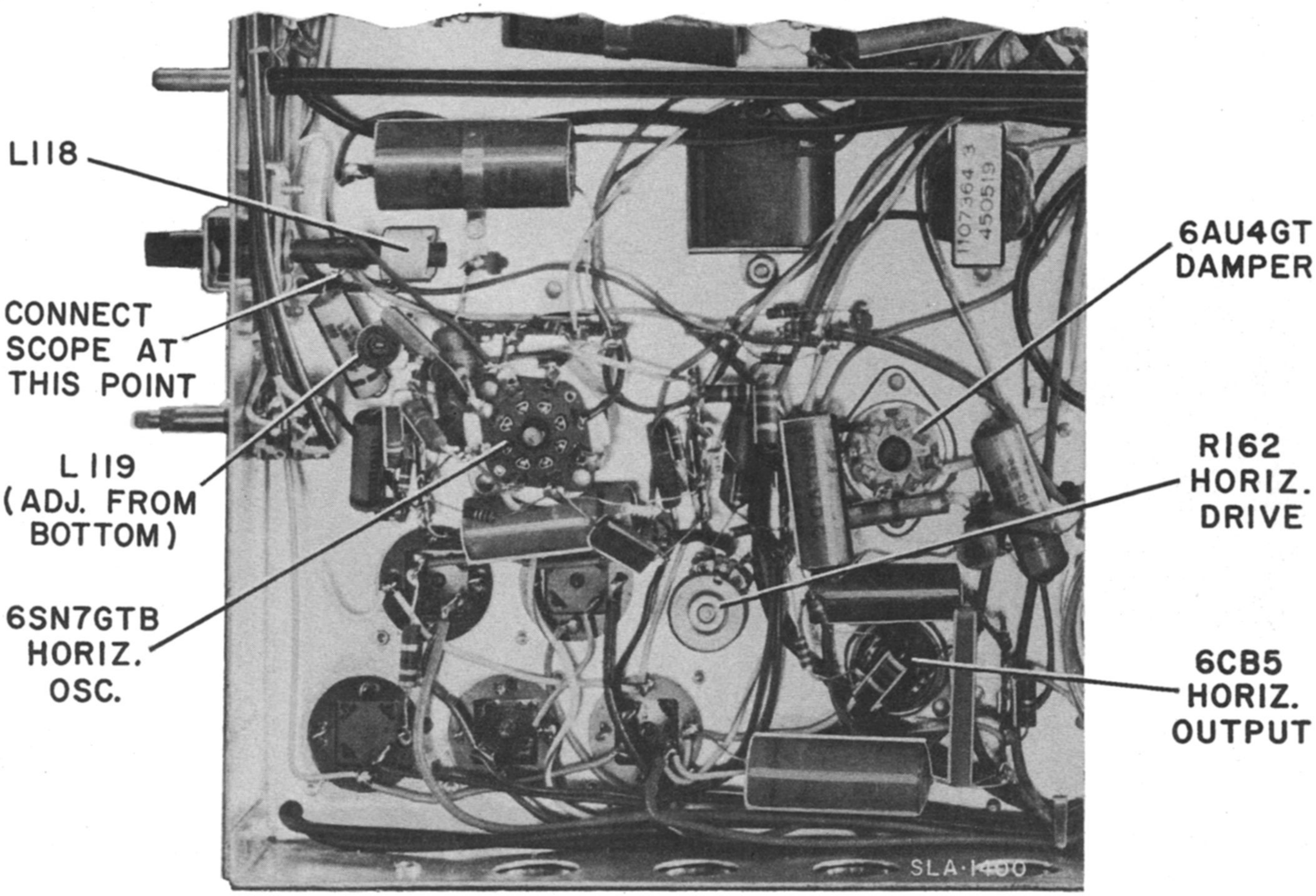


Fig. 124—Location of Horizontal Oscillator and Output Circuits on Receiver Chassis.

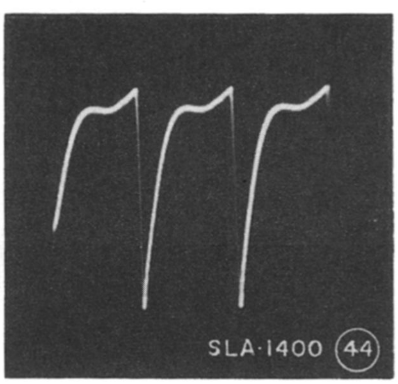


Fig. 125—Waveform at Junction of L-118, L-119 and R-164. Incorrectly Adjusted.

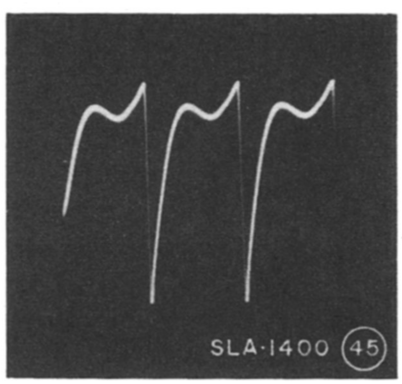


Fig. 126—Waveform at Junction of L-118, L-119 and R-164. Incorrectly Adjusted

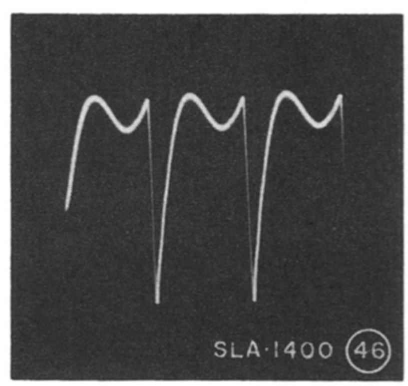


Fig. 127—Waveform at Junction of L-118, L-119 and R-164. Adjusted to Obtain Correct Waveform.

Waveforms useful in checking operation of these circuits are shown in figures 128 to 132. The waveforms shown in figures 125, 126 and 127 are useful for comparison purposes when adjusting the synchroguide circuit for proper operation. Since many receiver circuit functions depend upon proper operation of the horizontal output circuit, it is important that the adjustment be made correctly.

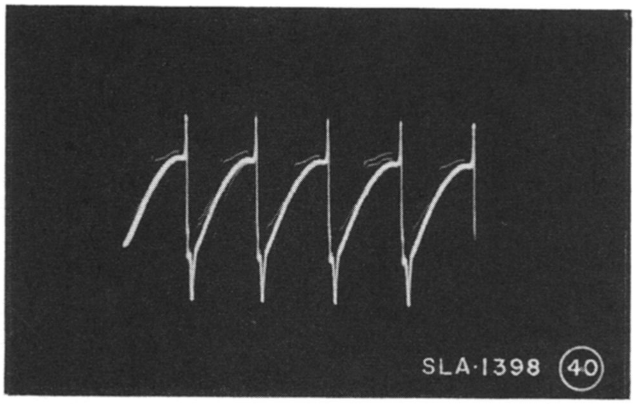


Fig. 128—Waveform at Grid (Pin #1) of Horizontal Oscillator Control Tube. Black-and-white Picture. Contrast and Brightness Controls Adjusted for Normal Picture. Color Control at Minimum.

HORIZONTAL OSCILLATOR ADJUSTMENT:

1. Adjust "Horizontal Drive" fully clockwise.
2. Set WIDTH switch (rear of chassis) to center position.
3. Adjust L-118 to sync picture.
4. Connect oscilloscope to junction of L-118, L-119 and R-164.
5. Adjust L-119 to obtain waveform shown in figure 127.
6. Picture should remain in sync for at least 3 full clockwise turns of L-118.

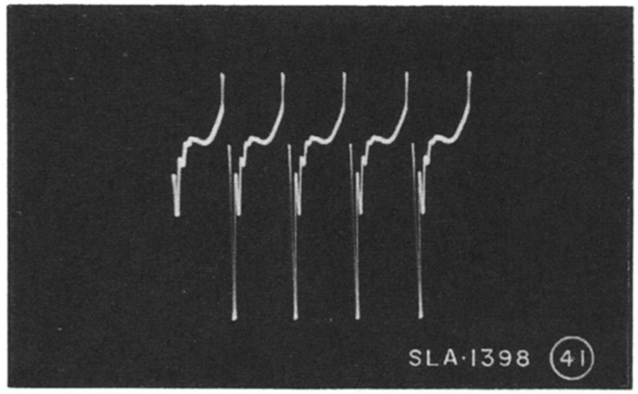


Fig. 129—Waveform at Grid (Pin #4) of Horizontal Oscillator. Black-and-white Picture. Contrast and Brightness Controls Adjusted for Normal Picture. Color Control at Minimum.

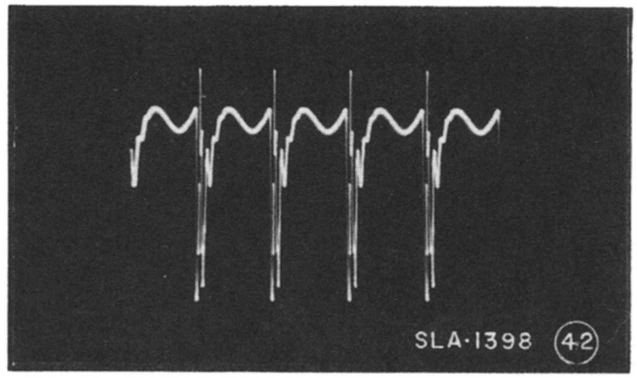


Fig. 130—Waveform at Plate (Pin #5) of Horizontal Oscillator. Black-and-white Picture. Contrast and Brightness Controls Adjusted for Normal Picture. Color Control at Minimum.

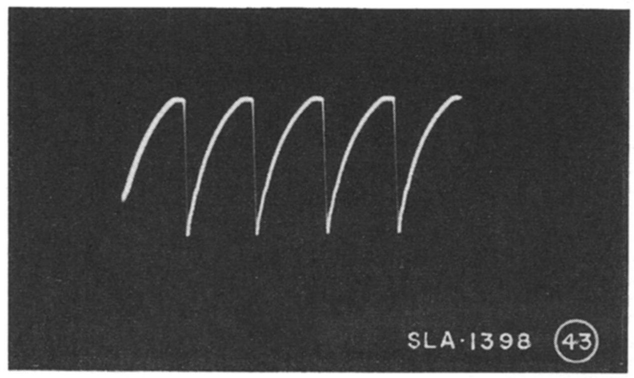


Fig. 131—Waveform at Grid (Pins 4-5) of 6CB5 Horizontal Output Tube. Black-and-white Picture. Contrast and Brightness Controls Adjusted for Normal Picture. Color Control at Minimum.

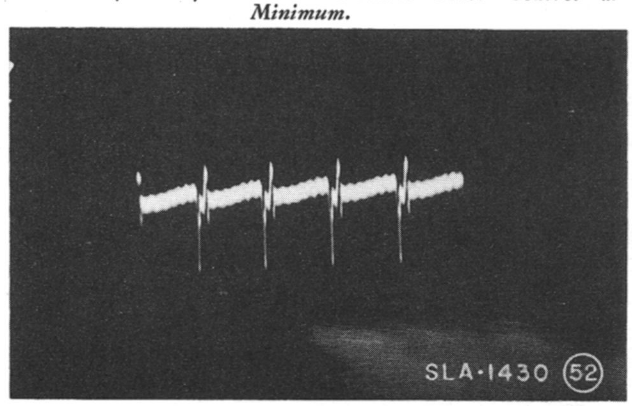


Fig. 132—Waveform at Cathode—Horizontal Output

VOLTAGE CHART

Horizontal Oscillator and Output

Tube	*Pin No.*	*Voltage Too High*	*Voltage Too Low*	*No Voltage*
V117	1	C-161 shorted (High positive voltage)	V117 weak L-118 misadjusted	L-118 open C-156 shorted
	2	High grid bias	Low grid bias	No B-plus
	3	C-161 shorted	C-159 shorted	C-160 shorted
	4		V117 weak C-156 leaky	C-156 shorted
	5		C-156 leaky	L-18 open
V116	1-8	R-157 high in value	C-152 leaky	C-152 shorted C-153 shorted
	3		C-117C leaky	C-117C shorted
	4-5		V117 weak C-154 leaky	V117 defective

HORIZONTAL DEFLECTION AND HIGH VOLTAGE

The high voltage section of the receiver is the source for voltages which perform a number of functions in addition to those normally thought of in conjunction with horizontal deflection and high voltage. A schematic diagram of the high voltage supply in these receivers is shown in figure 133.

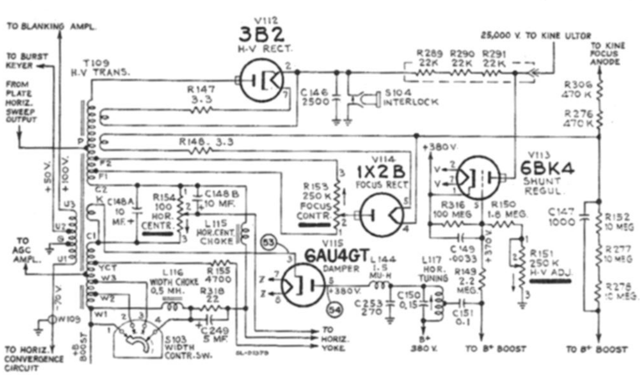


Fig. 133—Schematic Diagram—Horizontal Output and High Voltage Circuits. Circled numbers refer to waveform photographs.

The high voltage transformer provides high voltage, through the 3B2 high voltage rectifier, to the kinescope ultor; focus voltage for the focus anode, through the 1X2B focus rectifier; horizontal pulses to operate the Burst Keyer, and the Blanking Amplifier; a pulse for the AGC amplifier; horizontal voltage for the convergence circuits; deflection current for the horizontal deflection yoke; and, B-plus "boost" voltage. The diagram, figure 134, illustrates the circuits to which T-109 furnishes supply and control voltages.

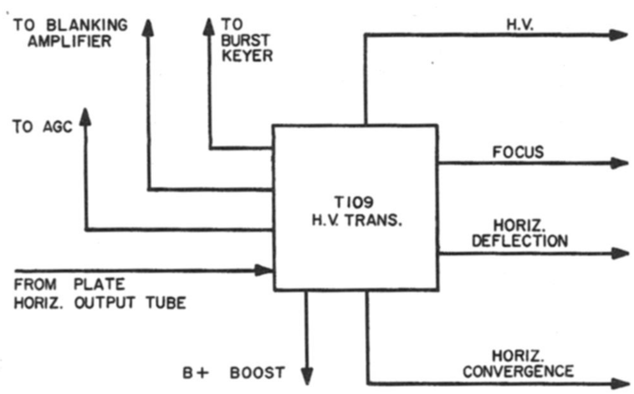


Fig. 134—Circuits Using High Voltage Transformer, T-109, as Supply Source.

Failure of components in the high voltage section may not always result in a "no picture" condition. As an example, should the focus control become intermittent, when the proper focus point is reached during adjustment, a flickering or rapid in-and-out-of-focus condition may result. The remedy is to replace the Focus Control.

NOTE

When replacing this control, the 470K resistors, R-306 and R-276, should be replaced with 1 megohm resistors having the same wattage rating (2 watts). This will limit the focus current and prevent re-occurrence. In an emergency, and for temporary use only if a correct replacement focus control is not immediately available and the control is not too badly damaged, a 33,000 ohm, 1/2 watt resistor may be connected in series with one end of the existing focus control. This will move the point of correct focus away from the charrred area on the resistance element of the control.

A new control, part number 100396, should be installed as soon as available. The 33,000 ohm resistor should then be removed. R-276 and R-306 should be replaced with 1 megohm resistors in any case where the focus circuit requires service. Late models have had the 1 megohm resistors installed at the factory.

A defective shunt regulator may result in excessive "blooming" in the picture due to the inability of the 6BK6 shunt regulator tube to properly control the high voltage.

Figure 135 shows the location of the High Voltage circuits on the receiver chassis. The components in the high voltage section are subjected to considerable heat and are designed for maximum service under all normally encountered operating conditions, however improper initial adjustment of the high voltage circuits may cause excessive heating and consequent extended overloads in these circuits. It is important to follow the adjustment procedure, as shown in the set-up instructions in this booklet, the service data, service tips and previous Television Service Clinics, to insure optimum operating life of tubes and components in these circuits.

HV Transformer Notes:

1. Should it be required to open the high voltage compartment cover and replace or check tubes or components within the compartment, special care should be taken that proper lead dress is maintained to the high voltage transformer. In particular, the lead from the high voltage rectifier socket, and the lead from the regulator tube should not be permitted to remain in contact with the transformer or its leads or connections. These leads should be fastened to the side of the cage to prevent their touching the transformer, softening at the point of contact and arcing through to the coil of the transformer thus causing the transformer to become defective.

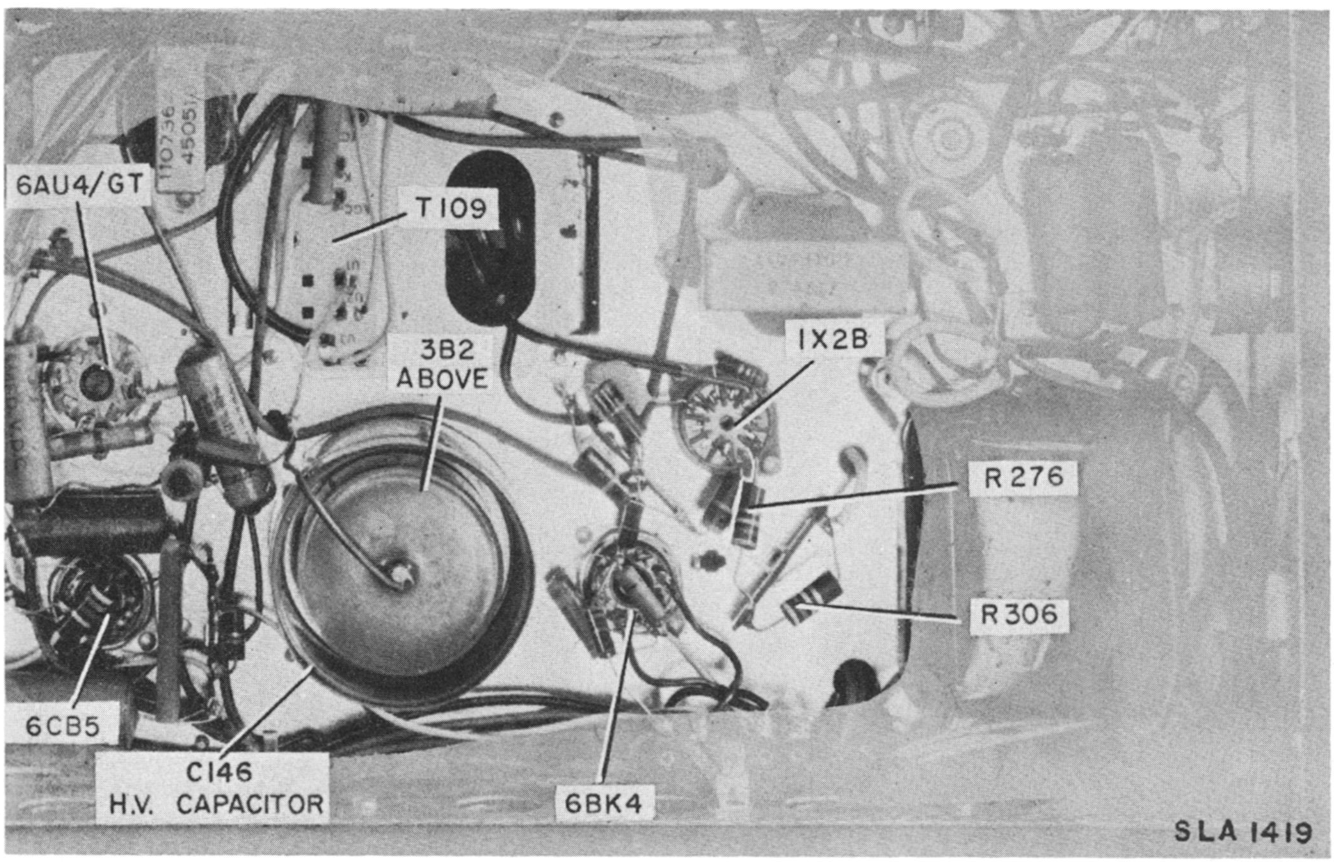


Fig. 135—Chassis Location of High Voltage Circuits. Bottom View of Chassis.

2. If replacement of the high voltage transformer is required, the correct replacement part number is 100409. Transformers marked 100409A are *not* direct replacements for the units installed in early production receivers. (Serial numbers prior to B-8075000.)

As an emergency measure, the 100409A (or 101959) transformers may be used, *but the following wiring changes must be made in the receiver:*

1. Ground terminal #1 of each Horizontal Amplitude Control (R-181, R-235, R-180). Refer to schematic diagram page 67.

2. Exchange the connections on terminal 2 of each Vertical Amplitude control (R-177B, R-178B, R-179B) with the connections on terminal 2 of each Vertical Tilt control (R-177A, R-178A, R-179A).

3. Refer to the rear view of J102-F Convergence yoke *socket.* Interchange the connections:

GA with GT

BA with BT

RA with RT

These modifications are required when using the 100409A or 101959 transformers in early production receivers because the U-1 terminal on these transformers provides a *positive* 35 volts (P-P) pulse instead of the *negative* 70 volts (P-P) pulse at terminal U-1 of the 100409 transformer. This causes the horizontal convergence waveform polarity to be reversed. The modification causes convergence waveform polarity reversals which result in the same waveforms obtained in the original circuit.

NOTE

If these modifications are made, the receiver chassis should be tagged or otherwise identified so that future servicing can be performed with the modification taken into consideration.

If for any reason the ground lead at the center of the high voltage filter capacitor, C-146, is disconnected, make sure that it is resoldered in place, (ground to center of capacitor) before turning the receiver on or reassembling in the cabinet.

Horizontal Centering Control

In case of failure of the Horizontal Centering Control, R-154, capacitors C148A and C148B should be replaced when the control is replaced. This dual capacitor, listed in early service data as part number 79786 has been superseded by two separate 20 mfd. capacitors now listed as part number 79380. Note that *two* capacitors should be ordered for replacement.

NOTE

This precautionary measure should also be taken if replacement of horizontal centering controls is required in the model CT-100 and 21CT55 receivers.

The waveforms shown in figures 137 and 138 are useful for checking operation of the damper circuit.

Figure 136 shows an interior view of the high voltage compartment.

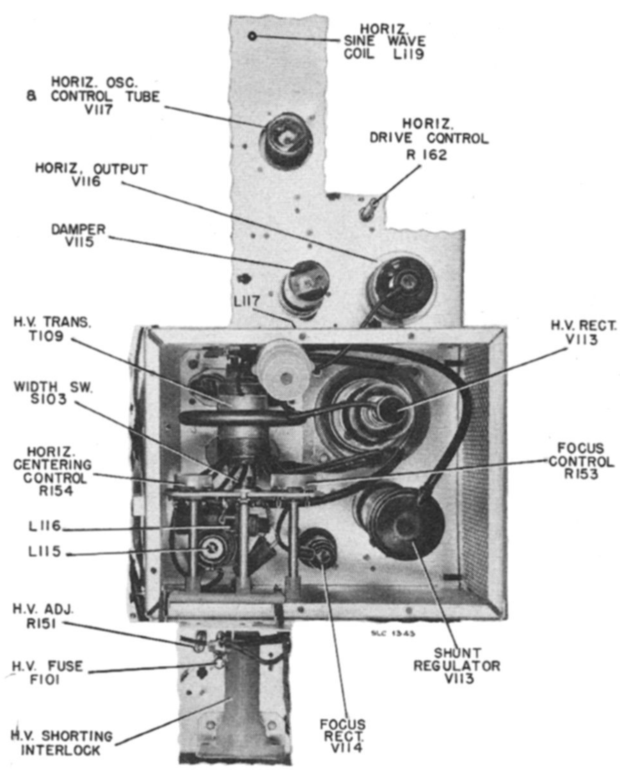


Fig. 136—High Voltage Compartment—Top View

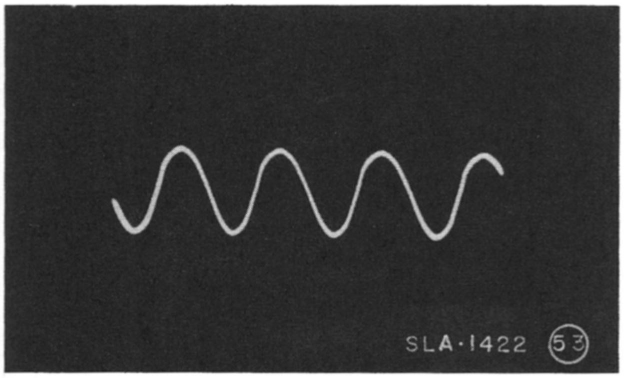


Fig. 137—Waveform at Cathode (Pin #3) of Damper Tube. Black-and-white Picture. Contrast and Brightness. Controls Adjusted for Normal Picture. Color Control at Minimum.

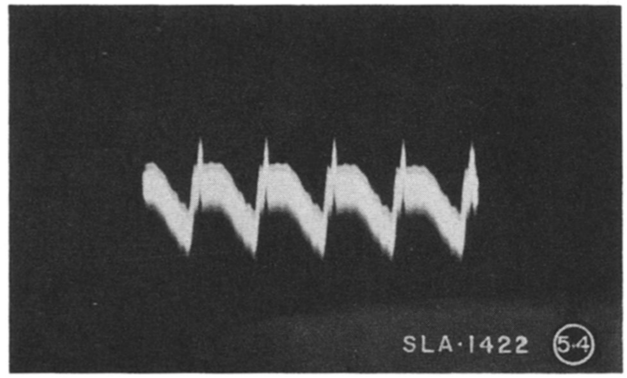


Fig. 138—Waveform at Plate (Pin #5) of Damper Tube. Black-and-white Picture. Contrast and Brightness Controls Adjusted for Normal Picture. Color Control at Minimum.

SERVICE SUGGESTIONS

High Voltage Section

Symptoms	*Possible Causes*
Voltage present on controls and front panel control cover.	Grounding spring to control cover case not making proper contact to chassis.
Arcing in picture.	Ultor lead not making good connection at high voltage connection to chassis.
No brightness.	Yoke not plugged in.
No brightness or low brightness.	1X2B focus rectifier.
No brightness, buzz in sound.	3B2 high voltage rectifier.
No brightness.	6CB5 horizontal output.
Arcing in high voltage.	High voltage transformer arcing where lead from plate cap of 6CB5 attaches to transformer.
No brightness.	Fuse—F104 open.
No brightness.	Fuse—F101 open.
Intermittent brightness.	6AU4GTA damper.
Poor focus.	Focus control open.
Arcing in High Voltage.	High voltage transformer, lead from plate cap 3B2 high voltage rectifier arcs to top of high voltage caps.
Unstable focus — focus changes.	Focus control arcs at proper focus point — burned focus control.
No brightness.	6BK4 HV regulator.

Symptoms	*Possible Causes*
No brightness.	Horizontal centering control open.
No brightness.	Arcing in HV transformer.
Intermittent arcing in pix.	High voltage lead making poor contact at kinescope.
Picture arcing.	Horizontal centering control burned, C148A open, C148B shorted.
Picture blooming.	Open filament V124, V125. Low cathode voltages on kinescope. Defective shunt regulator, V-113.
No brightness, no high voltage.	Horizontal oscillator inoperative; horizontal output inoperative. Open winding on T-109 high voltage transformer. Damper tube V-115 inoperative.
Picture blooming.	Incorrect high voltage adjustment. Incorrect adjustment of screen controls.
HV does not reach 25,000 volts.	Check for corona discharge—Causes high voltage to drop as much as 5,000 volts.
Arcing in picture.	Check high voltage connector at kinescope bell—Spring contact may be weak or broken.

HORIZONTAL BLANKING AMPLIFIER

The Horizontal Blanking Amplifier prevents video information from being presented during horizontal retrace time.

A schematic diagram of the blanking amplifier is shown in figure 139.

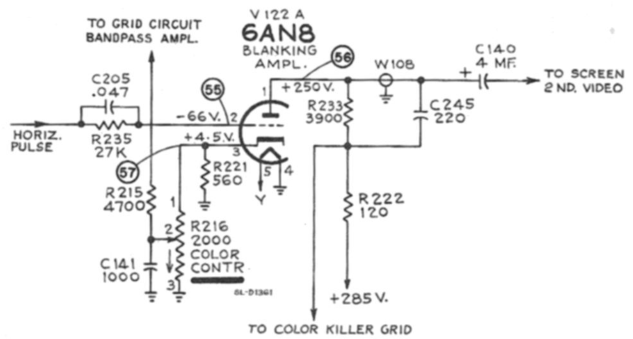


Fig. 139—Schematic Diagram—Horizontal Blanking Amplifier. Circled numbers refer to waveform photographs.

Since burst is demodulated during retrace time, if the kinescope were permitted to present video information during retrace, a yellow stripe (yellow is the hue of burst) would appear on the screen.

A positive horizontal pulse, obtained from the horizontal output transformer, is fed to the grid of the Horizontal Blanking Amplifier. The pulse is inverted during amplification and is applied to the screen of the 2nd Video Amplifier. Since the 2nd Video Amplifier is coupled to the cathodes of the kinescope, the high positive pulse causes the kinescope to cut-off and show no video information during horizontal retrace time.

The cathode of the Blanking Amplifier is also used as a supply source of voltage which, applied through the color control, varies the gain of the bandpass amplifier and thus controls color saturation.

Figures 140, 141 and 142 show waveforms useful for checking proper operation of this circuit.

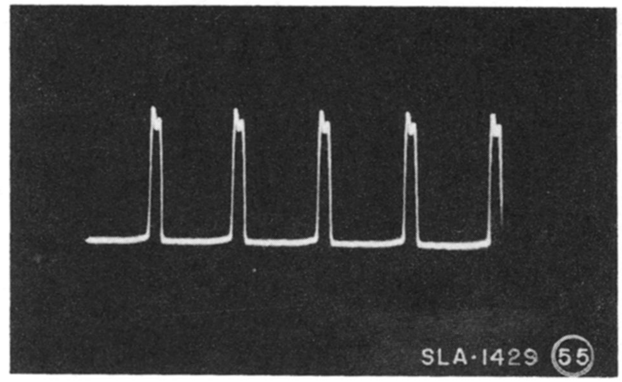


Fig. 140—Waveform at Grid (Pin #2) of Blanking Amplifier. Black-and-white Picture. Contrast and Brightness Controls Adjusted for Normal Picture. Color Control at Minimum.

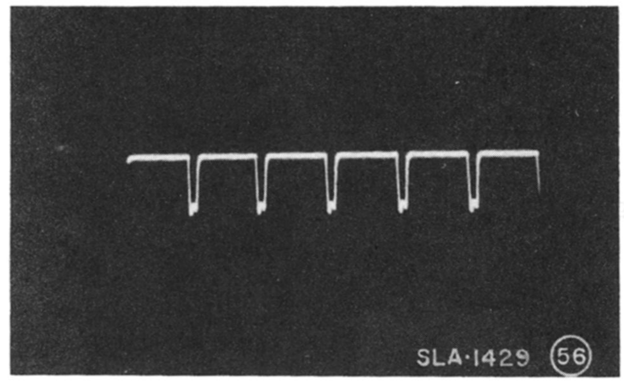


Fig. 141—Waveform at Plate (Pin #1) of Blanking Amplifier. Black-and-white Picture. Contrast and Brightness Controls Adjusted for Normal Picture. Color Control at Minimum.

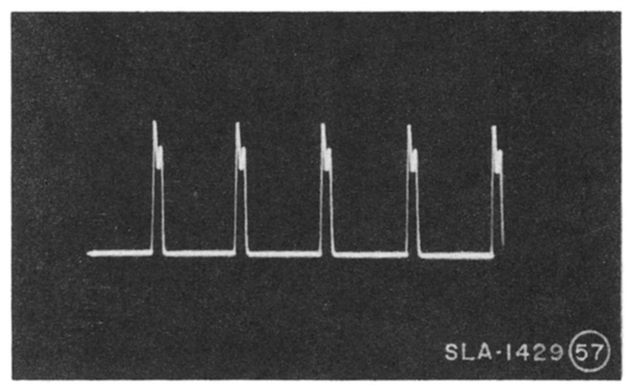


Fig. 142—Waveform at Cathode (Pin #3) of Blanking Amplifier. Black-and-white Picture. Contrast and Brightness Controls Adjusted for Normal Picture. Color Control at Minimum.

VOLTAGE CHART

Horizontal Blanking Amplifier

Tube	*Pin No.*	*Voltage Too High*	*Voltage Too Low*	*No Voltage*
V122A	1	C-245 shorted	Low grid bias	R-222 open
	2		T-109 defective	V116 defective
	3	Color control open	C-141 shorted	V122 inoperative

KINESCOPE CIRCUIT

The kinescope circuit includes the kinescope and the controls directly connected to the tube elements. A schematic diagram of the kinescope circuit is shown in figure 143. The brightness or luminance signal is supplied to the three cathodes from a single source, the 2nd Video Amplifier. A voltage dividing network, R-304, R-139 and R-140, provides the necessary difference in drive voltages to the individual cathodes.

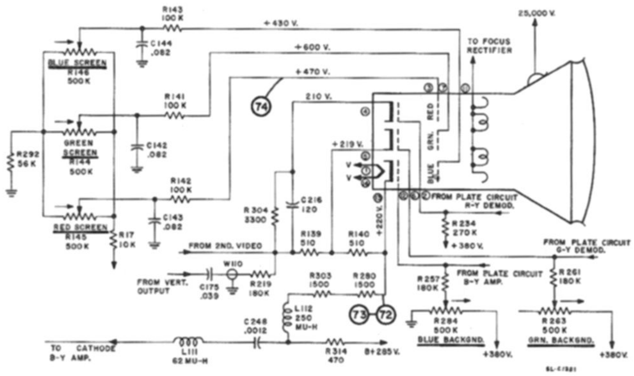


Fig. 143—Schematic Diagram—Kinescope Circuit. Large circled numbers refer to waveform photographs.

The Red Screen control (R-145), Blue Screen control (R-146), and Green Screen control (R-144), vary the voltages applied to the individual screen grids of the electron guns and thus the output from each gun can be limited without regard to the input voltage to the control grid and cathode. The screen controls are adjusted to produce the white screen which appears when no picture is present. Defective screen controls should be replaced with part No. 101821 instead of 100391 as shown in the service data parts list.

The Blue Background control (R-284) and the Green Background control (R-263) are used to adjust the highlights in the picture. Then, the Screen controls are used to adjust the lowlights. Before making this adjustment the voltage between the red grid and red cathode should be adjusted to minus 70. This adjustment is made with the Brightness control. After the red screen control is set, the Brightness control setting can be changed but the red screen control should not be changed when making tracking adjustments with the Screen and Background controls.

A vertical pulse, obtained from the vertical output transformer, is applied to the cathodes of the kinescope for vertical retrace blanking.

Figures 144 and 145 show the location of the kinescope circuit components on the receiver chassis.

Waveforms useful in checking the kinescope circuit are shown in figures 146, 147 and 148.

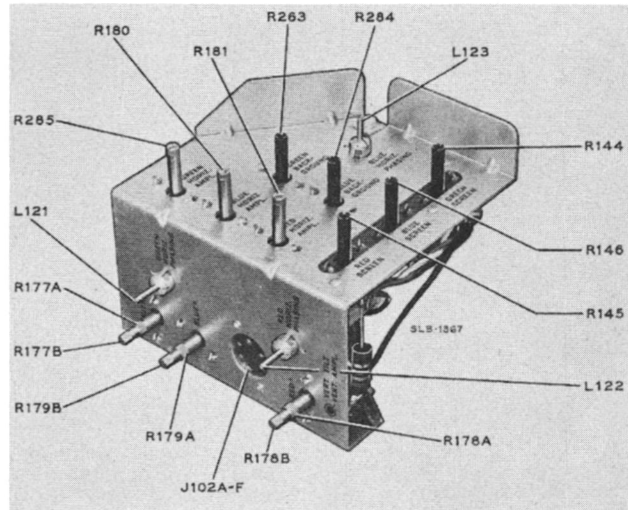


Fig. 144—Chassis Location of Screen and Background Controls

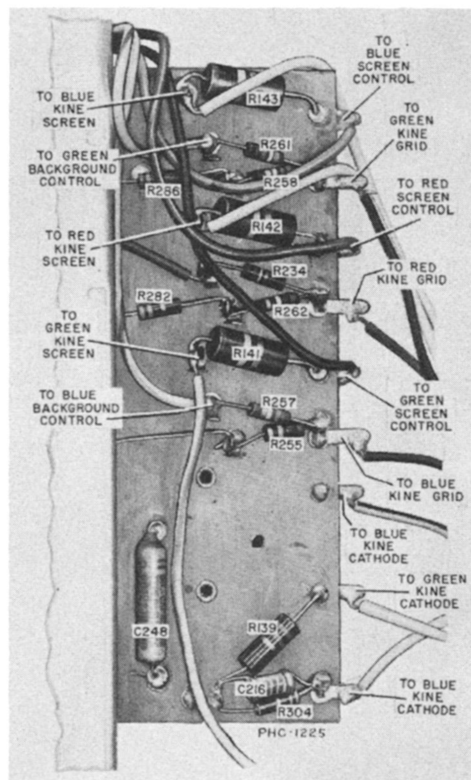


Fig. 145—Chassis Location of Kinescope Circuit Components

Other waveforms useful in checking operation of the kinescope circuits are shown on page 51.

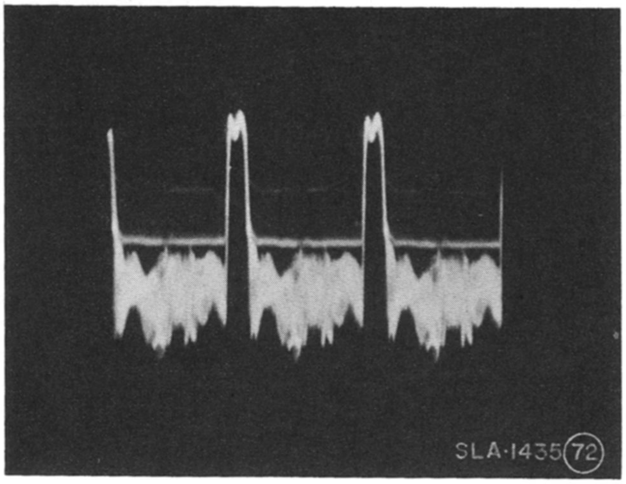


Fig. 146—Waveform at Kinescope Cathodes. Black-and-white Picture

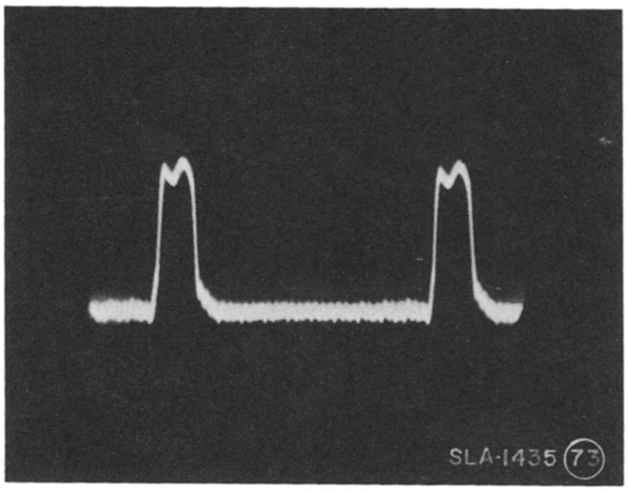


Fig. 147—Waveform at Kinescope Cathodes. Color Bar Signal

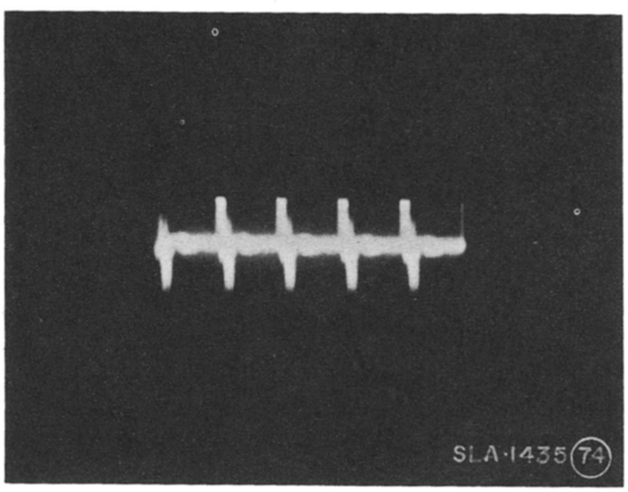


Fig. 148—Waveform at Red Grid. Black-and-white Picture

SERVICE SUGGESTIONS

Kinescope Circuit

Symptoms	*Possible Causes*
No brightness.	Red screen control defective. Blue screen control defective. (R-317 and R-292 changed value)
Yellow screen — blue background control has no effect.	Grid to screen short in kine.
No brightness — arcing in kinescope gun.	Defective kinescope.
Yellow screen.	Blue screen control open.
Red screen.	Grid to Cathode short in kine.
Green screen.	Grid to Cathode short in kine.
No brightness.	Heaters in kinescope open.
Constant red screen at low brightness setting.	Poor pin contact, red grid pin in kinescope socket.
No focus, no control of brightness.	Short circuit between focus and green screen grid.
No brightness, buzz in sound.	Red screen control defective. R-317 changed to lower value.
No brightness, buzz in sound.	Blue screen control defective.
No brightness, buzz in sound.	Green screen control defective. R-292 and R-317 open.
Blue screen.	Grid to cathode short, blue gun in kinescope.
Red screen, constant brightness.	Red grid lead intermittent due to poor contact kine socket to kine base.
Yellowish-green screen.	3.58 mc. crystal defective.
Yellow screen.	B—Y amplifier V-124 defective.
Color fringing (all colors).	Mis-convergence.
Color fringing (one color).	Low emission from one gun of kinescope.

CONVERGENCE CIRCUITS

The convergence circuits include the convergence yoke and the controls for adjusting the currents through each of the three convergence coil and magnet assemblies in the yoke.

The function of the convergence circuits is to continuously compensate for the convergence error existing when the three beams are moved horizontally and vertically from the same deflection center during sweep deflection.

A schematic diagram of the convergence circuits is shown in figure 149.

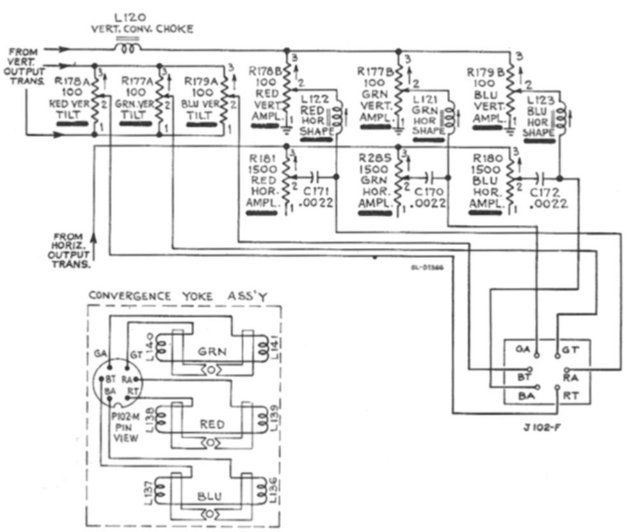


Fig. 149—Schematic Diagram—Convergence Circuits

The Red, Green and Blue Horizontal Amplitude controls, R-181, R-285 and R-180 vary the amplitude of the horizontal sweep current through the coils in the individual assemblies in the convergence yoke. The Red, Green and Blue Horizontal Shape controls, L-122, L-121 and L-123 vary the shape (position) of the horizontal sweep current through the individual coils in the convergence yoke.

Horizontal Sweep current is supplied to the horizontal dynamic convergence circuits from a tap on T-109, the horizontal output (high voltage) transformer.

The Red, Green and Blue Vertical Amplitude controls, R-178B, R-177B and R-179B, vary the amplitude of the vertical convergence current through the individual coils in the convergence yoke. The Red, Green and Blue Vertical Tilt controls vary the tilt (phase or position), of the vertical convergence current through the yoke and magnet assemblies. The vertical dynamic convergence voltages are obtained from the vertical output transformer, T-110.

In addition to the coils in the convergence yoke assembly, small cylindrical magnets, having knurled knob adjustments, provide a *static,* or fixed, convergence adjustment. The electromagnetic convergence action (dynamic convergence) is applied in addition to static convergence. Static convergence adjustments are made mainly to obtain convergence at the center of the screen while dynamic convergence adjustments are for obtaining edge and top and bottom convergence.

Figure 150 shows the location of the convergence yoke. directly behind the deflection yoke on the neck of the kinescope. Careful adjustment of the cylindrical magnets is required because they are fragile and may break off at the knurled adjustment knob. In cases where adjustment of an individual static convergence magnet seems to have little or no effect on the movement of the beam

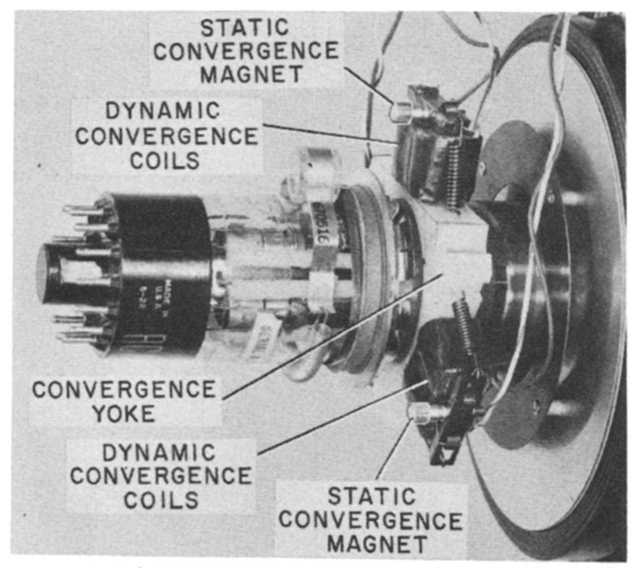


Fig. 150—Location of Convergence Yoke and Static Convergence Adjustments.

involved, the magnet should be inspected, since it is possible that it has become demagnetized. It is held in place by spring action and can easily be removed. The direction of movement of the beams, when the individual static magnets are rotated, is shown in figure 151.

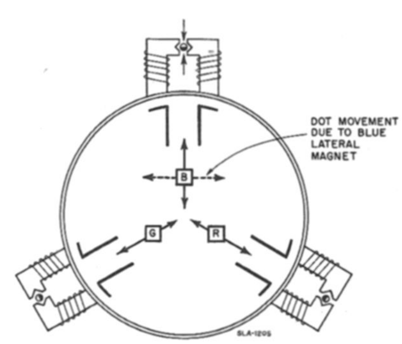


Fig. 151—Movement of Electron Beams due to Rotation of Static Convergence Magnets.

Lack of proper action of the beams during dynamic convergence adjustments would indicate that either the source, vertical or horizontal output, is not supplying the correct voltage; component failure has occurred, or: improper connections exist.

The dynamic convergence controls are grouped together at the rear of the chassis, see figure 152, and are conveniently accessible for making convergence adjustments when the top of the cabinet is removed.

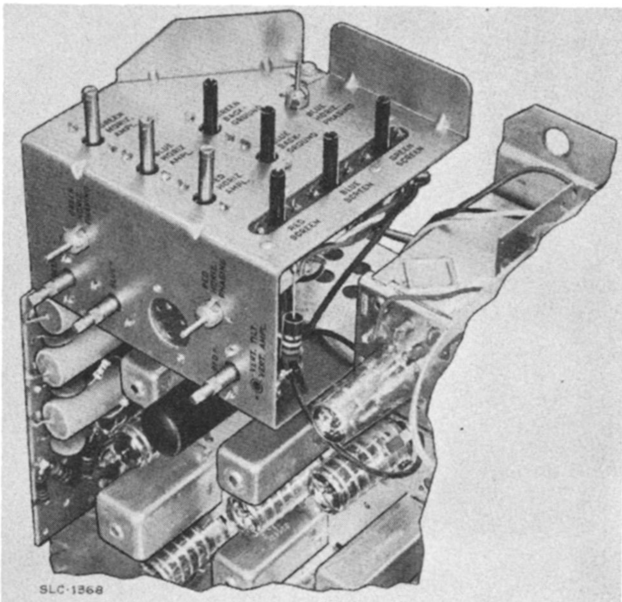


Fig. 152—Location of Dynamic Convergence Controls

NOTE

If the high voltage transformer has been replaced and it is not possible to properly converge the beams, check the high voltage transformer. It is possible that the incorrect transformer has been installed as a replacement. *Refer to page 61.*

If it becomes necessary to make resistance measurements of the dynamic convergence controls it is best to disconnect one of the leads from the control being checked. This procedure, since the controls and inductances are in parallel circuits, will insure measurement of the resistance of only the particular control, or continuity of the particular inductance under examination.

Figures 153 through 160 show the effect of convergence controls have over the individual beams. When all three beams are being observed, interaction occurs among the three beams. As a result, when convergence adjustments are made to one beam, the other two beams will be slightly affected. This is a variable factor and should be taken into consideration when making convergence adjustments.

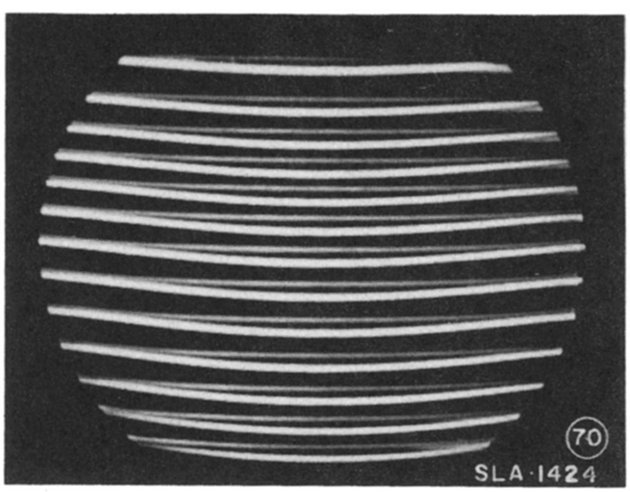


Fig. 153—Horizontal Amplitude Control at Maximum. Other Dynamic Convergence Controls at Minimum. Causes Bow in Horizontal Line.

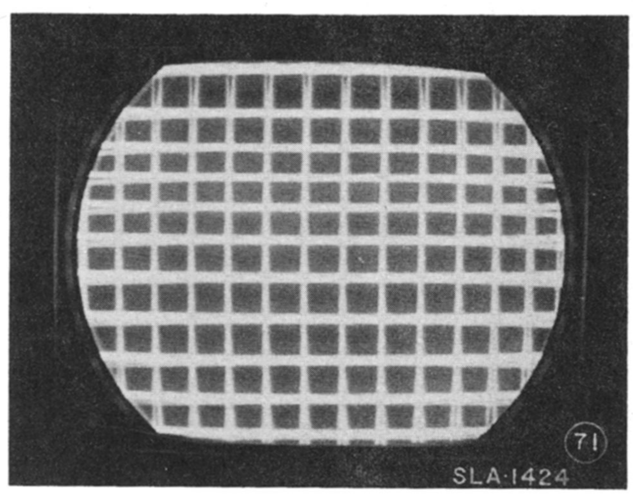


Fig. 154—Center of Screen Statically Converged. Convergence Yoke Disconnected. All Edges of Screen Show Separation of Bars.

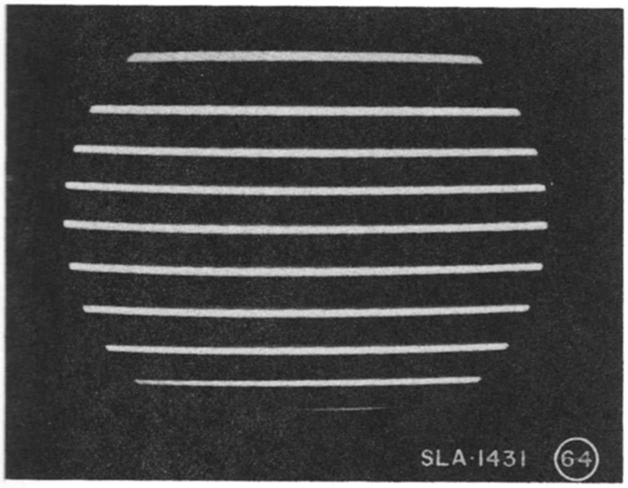


Fig. 155—Blue Vertical Amplitude Control at Maximum Clockwise Position. All other Dynamic Convergence Controls at Minimum. Bars are spread apart near the top of screen.

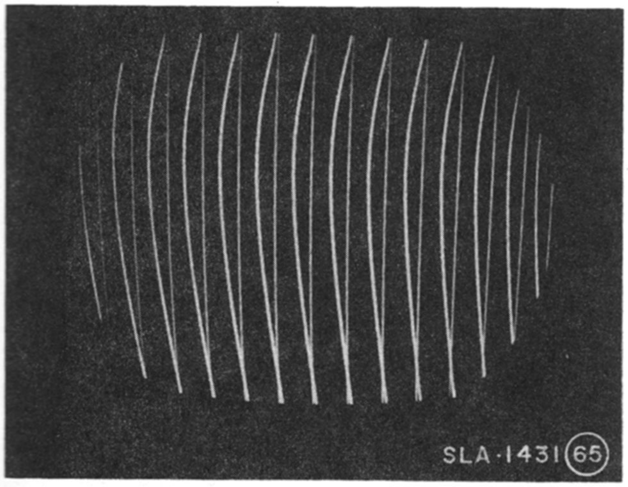


Fig. 156—Green Vertical Amplitude Control at Maximum Clockwise Position. All other Dynamic Convergence Controls at Minimum. Green Bar bows to left. Vertical reference is Blue Bar.

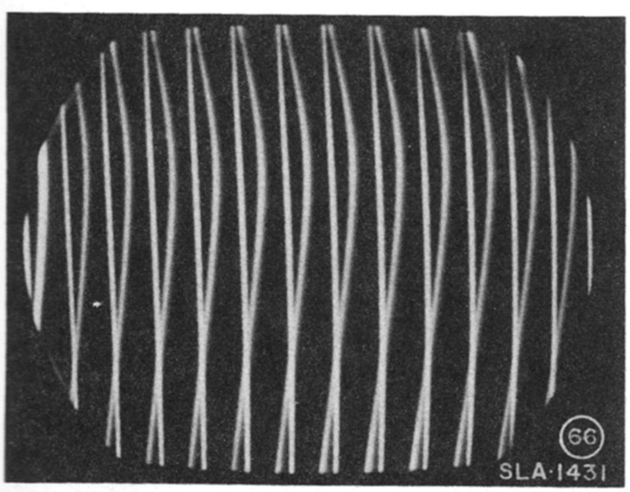


Fig. 157—Red Vertical Amplitude Control at Maximum Clockwise Position. All other Dynamic Convergence Controls at Minimum. Red Bar bows to right. Vertical Reference is Green or Blue Bar.

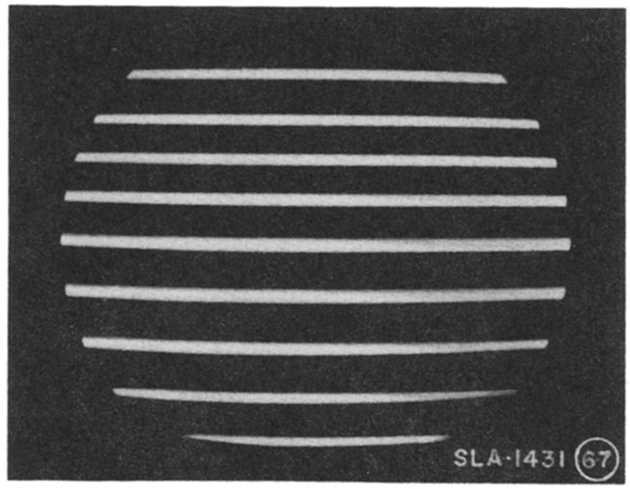


Fig. 158—Blue Vertical Tilt Control at Maximum Clockwise Position. All other Dynamic Convergence Controls at Minimum. Blue Vertical Tilt Control varies distance between Blue Bars.

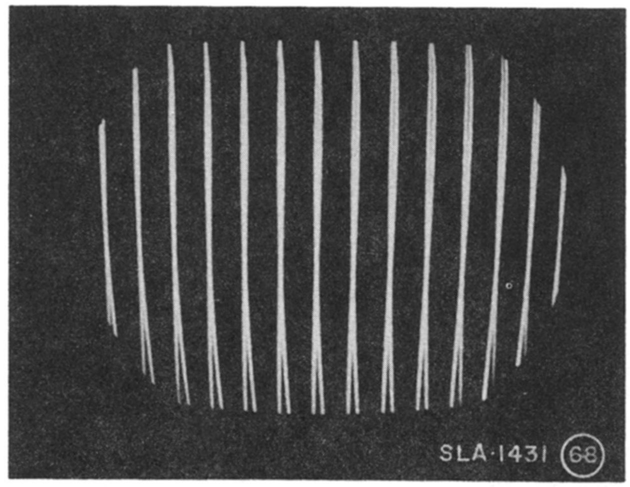


Fig. 159—Green Vertical Tilt Control at Maximum Clockwise Position. All other Dynamic Convergence Controls at Minimum. Green Bar crosses over Vertical Blue Reference Bar at Center of Screen.

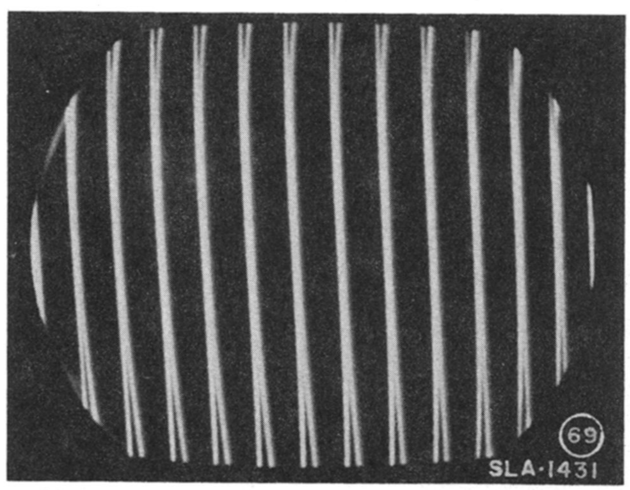


Fig. 160—Red Vertical Tilt Control at Maximum Clockwise Position. All other Dynamic Convergence Controls at Minimum. Red Bar Crosses to the right at Bottom of Screen. Green or Blue Bar as Vertical Reference.

LOW VOLTAGE POWER SUPPLY

The low voltage power supply provides a source for the 380 volt and 285 volt B-plus requirements and also supplies negative 20 volts. A schematic diagram of the low voltage power supply is shown in figure 161.

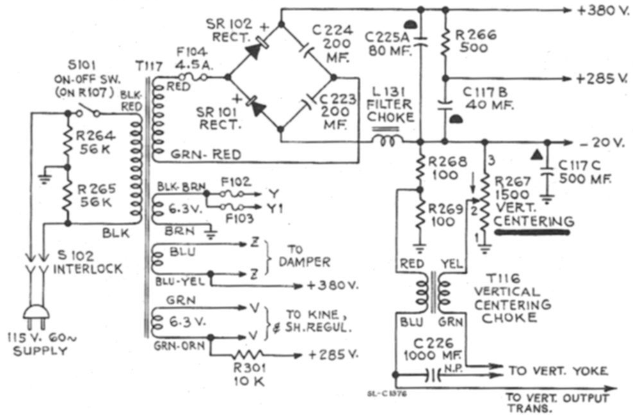


Fig. 161—Schematic Diagram—Low Voltage Power Supply

Two selenium rectifiers operate in a full wave voltage doubling circuit from the power transformer.

The total power input to the receiver is 375 watts. Fuse protection is provided in the power transformer secondary circuit, the horizontal deflection circuit B-plus supply and the heater supply circuits (except the kinescope, damper and high voltage regulator tubes). The kinescope and the high voltage regulator tube receive heater voltage from a separate winding on the power transformer. The damper tube is also supplied from another independent heater winding.

The cathode of the audio output tube is operated at 140 volts above ground. This is used as a B-plus source for the sound I-F, 3rd picture I-F, 1st and 2nd sync amplifier stages. Because of this method of providing B-plus for the above stages, if the 6AQ5 audio output tube becomes inoperative and causes a "no sound" condition, a "no picture" condition may also result. A simplified schematic diagram of this B-plus circuit is shown in figure 162.

Fuse data for these receivers is shown on page 25.

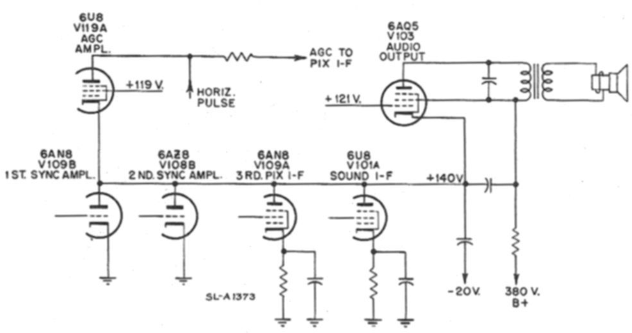


Fig. 162—Simplified Schematic Diagram—140 volt B-plus Circuit.

ALIGNMENT PROCEDURE FOR 21CT660 SERIES RECEIVERS

Equipment Required

The following equipment, (or its equivalent) is recommended for use in aligning these receivers:

VHF Sweep Generator	— RCA WR-59C
VHF Signal Generator	— RCA WR-89A
Oscilloscope	— RCA WO-78A or RCA WO-91A
Demodulator Probe	— RCA WG-291
Video Marker Box	— RCA WG-295A
R-F Modulator	— RCA WG-304A
Voltmeter	— RCA WV-98A ("VoltOhmyst")

Accessories:

1. *Bias source* with three adjustable voltages; two of 0 to —7.5 V or better, and one of 0 to —15 V or better.

2. *Dummy load* (1500 ohm, 100 Watt Resistor).

3. *Attenuator Pad* (300 ohms balanced).

4. Special tuning tool for adjustment of T-2 cores (WALSCO 2526, or equivalent).

5. *Isolation capacitor* (2 or 3 mmfd.).

General

In most instances the alignment of a television receiver involves only a small amount of re-tuning. It therefore may be considered good practice to check the overall R-F — I-F response at the picture detector before proceeding with more individualized steps in the alignment of these circuits. The proper overall R-F — I-F response ,see figure 163, can usually be obtained by adjusting the picture I-F transformers T-105, T-106 and T-107. See figure 165. To accomplish this, set-up the test equipment as shown in the block diagram, figure 164.

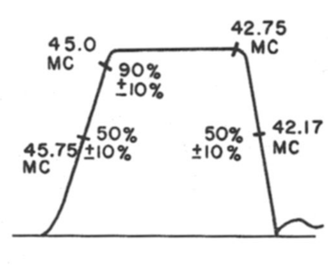


Fig. 163—Picture R-F — I-F, Overall Response

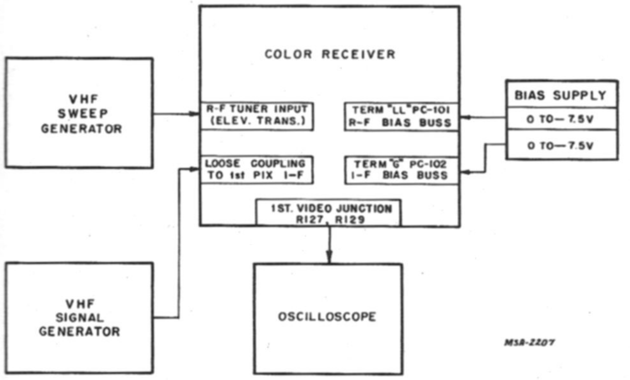


Fig. 164—R-F — I-F Sweep Alignment Test Set-Up

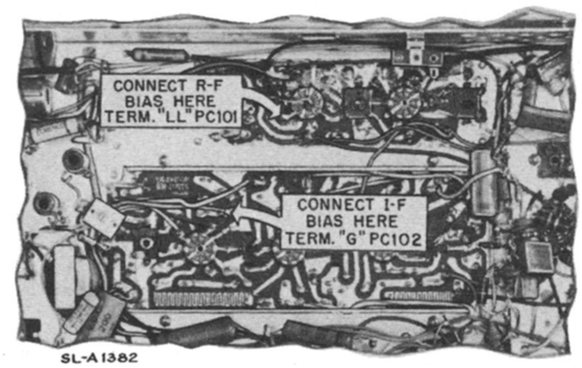


Fig. 166—R-F — I-F Bias Connections

1. Connect a VHF sweep generator through a balanced 300-ohm pad to the input of the R-F tuner at the elevator transformer.

2. Clip the output cable of the VHF signal generator over the insulation of the blue or yellow wire at the point where they pass T-104, the first picture I-F transformer, see figure 165.

NOTE

By dressing the lead, the strength of the marker signal can be varied.

3. Connect one lead from the bias source to the R-F AGC buss, and one lead to the picture I-F AGC buss, and one lead to the junction of R-217/R-218, for the bandpass amplifier bias, see figures 166 and 174.

4. Remove fuse F-101 (HV fuse) and connect a 100 watt 1500-ohm resistor between the 380 volt B-plus and the negative 20 volt sources in the power supply.

5. Connect an oscilloscope, using a direct probe, to the junction of R-127/R-129, located at the end of the picture I-F strip, refer to figure 165.

6. Adjust the R-F bias to —2 volts, the picture I-F bias to —7 volts, and the bandpass amplier to between —10 and —15 volts.

7. Adjust the output of the sweep generator to obtain an 8 volt peak-to-peak signal on the oscilloscope.

8. Set the Fine Tuning control of the receiver so that the R-F oscillator frequency is correct for the channel being swept. If a TV signal of 3 millivolts or more is available from the antenna, sweep this channel and couple the antenna loosely around the 300-ohm balanced pad until the TV station signal appears as a marker on the response curve. Set the calibrator frequency to 45.75 mc., and adjust its output until its marker appears on the response curve. Adjust the Fine Tuning control until the two markers coincide and a low frequency ripple is observed in the base line of the scope trace. This method also has the advantage of providing a stationary picture carrier marker on the response curve and the VHF signal generator marker may be used to check the response at other frequencies.

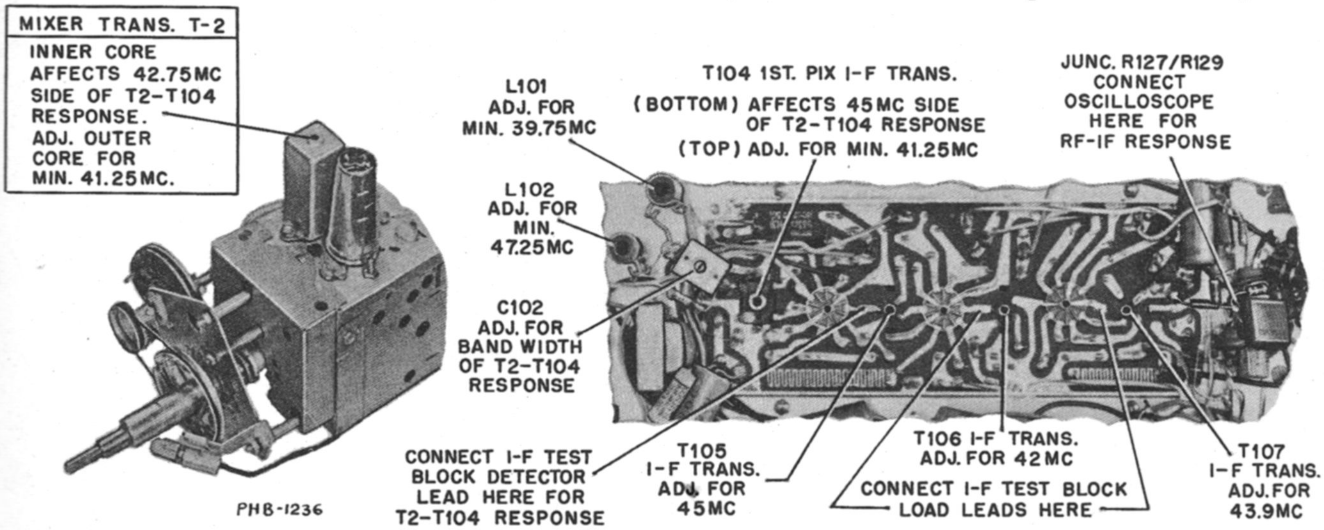


Fig. 165—Overall R-F — I-F Alignment Adjustments

9. Check the trap frequencies by increasing the output of the sweep generator until the trap notches are readily seen on the response curve, and then check each trap frequency with the VHF signal generator.

10. Reduce the output of the sweep generator to produce an 8 volt peak-to-peak response curve on the oscilloscope. The response curve should be similar to that shown in figure 163. If it is not, adjust T-105, T-106 and T-107, picture I-F transformers, to make it conform. T-105 affects the picture carrier slope, T-106 affects the color subcarrier slope and T-107 affects the tilt.

If the proper response cannot be obtained by adjusting T-105, T-106 and T-107, it will be necessary to make small adjustments to T-104, C-102, and the bottom core of T-2. The 1st pix I-F transformer, T-104, affects the shoulder of the curve around 45 mc.; T-2, the bottom of the converter transformer, affects the shoulder of the curve around 42.75 mc.; C-102 adjusts the bandwidth of the R-F — I-F response. When the proper curve is obtained, check the response on each channel in use by switching the sweep and receiver simultaneously. Tilts in response of 10% in either direction are not detrimental, however a tilt of 20% may degrade the color reception on a specific channel. If the response is proper, proceed to the Video and Bandpass Alignment.

Tuner Sweep Alignment

11. Connect the oscilloscope to TP-1 on the tuner unit, see figure 167. Set the oscilloscope to maximum gain. Figure 168 shows, in block diagram form, the test equipment set-up for these tests.

12. Ground the R-F AGC.

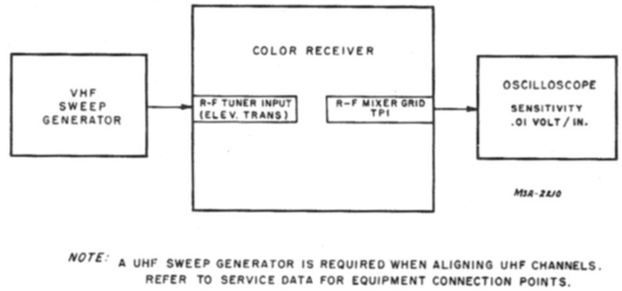


Fig. 168—Block Diagram—Sweep Alignment Tuner Unit

13. Set the sweep generator to channel thirteen and the receiver Channel Selector to channel thirteen. Use the least amount of input signal possible to produce a usable pattern on the oscilloscope.

NOTE

Excessive input can change oscillator injection during alignment and produce consequent misalignment even though the response as seen on the oscilloscope may look normal. Use a VHF signal generator to provide the necessary marker signals.

14. Touch-up L-28, C-23 and L-42 if necessary, see figure 167, to produce a response curve similar to that shown in figure 169.

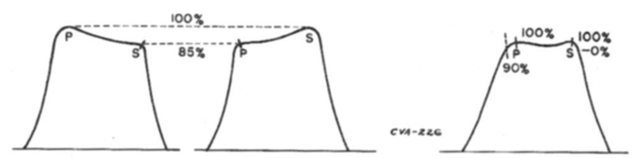


Fig. 169—Tuner Unit Response Curves

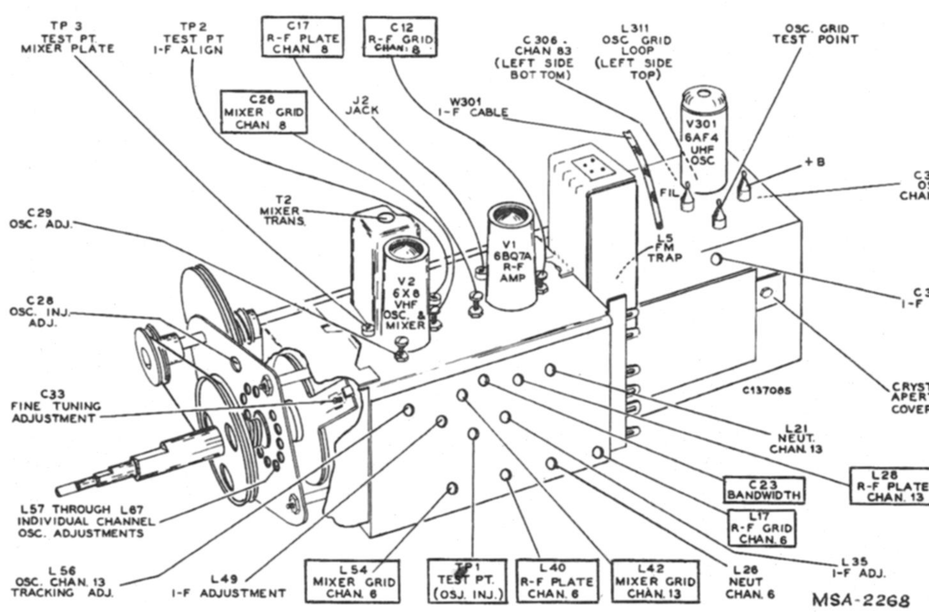


Fig. 167—Tuner Unit Alignment Adjustments

15. Set the sweep generator to channel eight and touch-up C-12, C-17 and C-26 to obtain a response curve similar to that shown in figure 169.

16. Set the sweep generator to channel six and touch-up L-17, L-40 and L-54 to obtain a response curve similar to that shown in figure 169.

Steps 11 through 16, above, should correct any moderate tuner misalignment and should only be employed when an R-F — I-F sweep check of the receiver indicates that these steps are necessary. If the above R-F tuner sweep alignment procedure does not result in satisfactory response curves, or if alignment of the UHF section of the tuner is required, follow the R-F tuner alignment procedure described in the 21CT660 series service data.

17. Re-connect the oscilloscope to the junction of R-127/R-129 and check the overall R-F — I-F response curve. If a response curve similar to that shown in figure 163 cannot be obtained by retouching T-105, T-106 and T-107, check the T-2 — T-104 response as outlined in steps 18, 19 and 20.

If the response can be obtained, proceed with the overall R-F — I-F, Video — Bandpass alignment.

T-2 — T-104 Alignment

18. Connect the detector lead of the I-F test block (see figures 170 and 171) to Pin 1, V-107A, the 1st pix I-F amplifier plate, and connect one of the load leads to Pin 1, V-108A, the 2nd pix I-F amplifier plate, refer to figure 165.

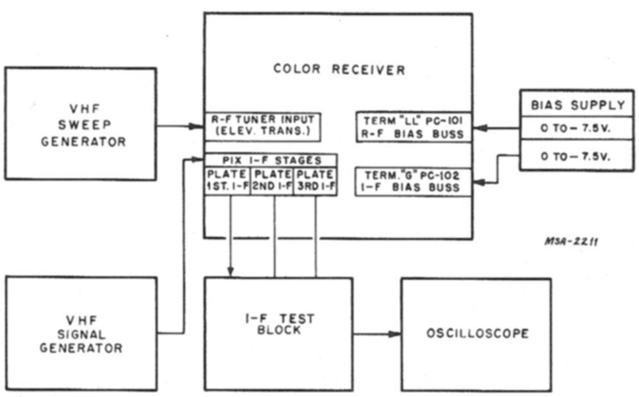


Fig. 170—Block Diagram T-2—T-104 Alignment Equipment Set-up.

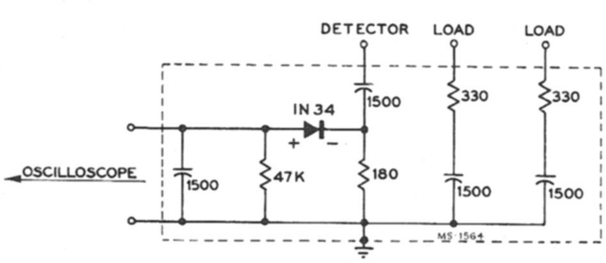


Fig. 171—Schematic Diagram I-F Test Block

19. Remove the oscilloscope probe from R-127 and R-129 and connect to the oscilloscope terminals of the I-F test block. Increase the oscilloscope gain to maximum and increase the sweep output, if necessary, to secure a usable response. Adjust T-2 bottom, C-102, and T-104 to obtain response shown in figure 172.

20. After the correct T-2 — T-104 response is obtained, repeat Steps 5 through 10.

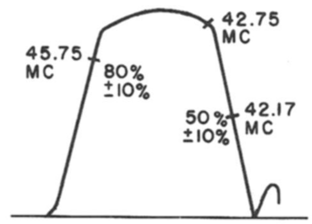


Fig. 172—T-2—T-104 Response

Overall R-F — I-F, Video and Bandpass Alignment

To align the video and bandpass circuits, set up the equipment as indicated in the block diagram, figure 173.

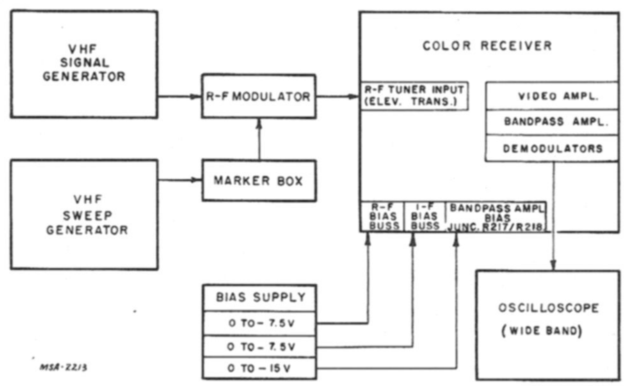


Fig. 173—Block Diagram—Video and Bandpass Amplifier Alignment.

1. Connect the oscilloscope, using the direct probe, to junction R-127/R-129 of the receiver, see figure 174.

2. Set the VHF sweep generator for 50 kc. —5 mc. sweep output and connect the Video Marker (WG-295A) between the sweep output and the R-F Modulator (WG-304A) sweep input. See figure 173.

3. Set the VHF signal generator to the picture carrier of the channel to which the set is tuned. Connect the signal generator to the R-F Modulator and set the calibrator output to maximum.

NOTE

If the Fine Tuning control of the receiver has been moved it will be necessary to re-calibrate the oscillator frequency. To do this, loosely couple a short lead from the receiver oscillator to the R-F input terminal of a VHF signal generator, and, using the heterodyne beat *method, adjust the Fine-Tuning control on the receiver for zero beat at the proper receiver oscillator frequency for the channel being used.*

Do not change the fine tuning control during the remainder of the alignment.

4. Remove the balanced 300 ohm pad that was previously attached to the elevator transformer and insert a plug having short connecting leads. Connect the R-F Modulator output to this point.

5. The bias connections remain unchanged. It may be necessary to reduce the picture I-F bias to get an 8 volt peak-to-peak response. Avoid I-F overload by keeping the I-F bias as high as possible, consistent with adequate circuit response.

6. Adjust the VHF sweep generator output, VHF signal generator output and picture I-F bias to obtain a symmetrical response curve similar to that shown in figure 175.

Adjust the sweep width and center frequency for a single trace display on the face of the oscilloscope.

7. Connect the Diode Demodulator Probe to the oscilloscope and fasten a 2 or 3 mmfd. capacitor to the tip of the probe for circuit isolation. *This capacitor should remain connected for the balance of the alignment.* Check the response curve at junction R-127/R-129. It should appear similar to that shown for point "2" of figure 174.

8. Remove the R—Y and G—Y demodulator tube, V-125, from its socket.

9. Connect the oscilloscope to pin #6 of the Bandpass Amplifier, V-121B, and check the position of the 4.5 mc. trap "suck-out," top core of T-108.

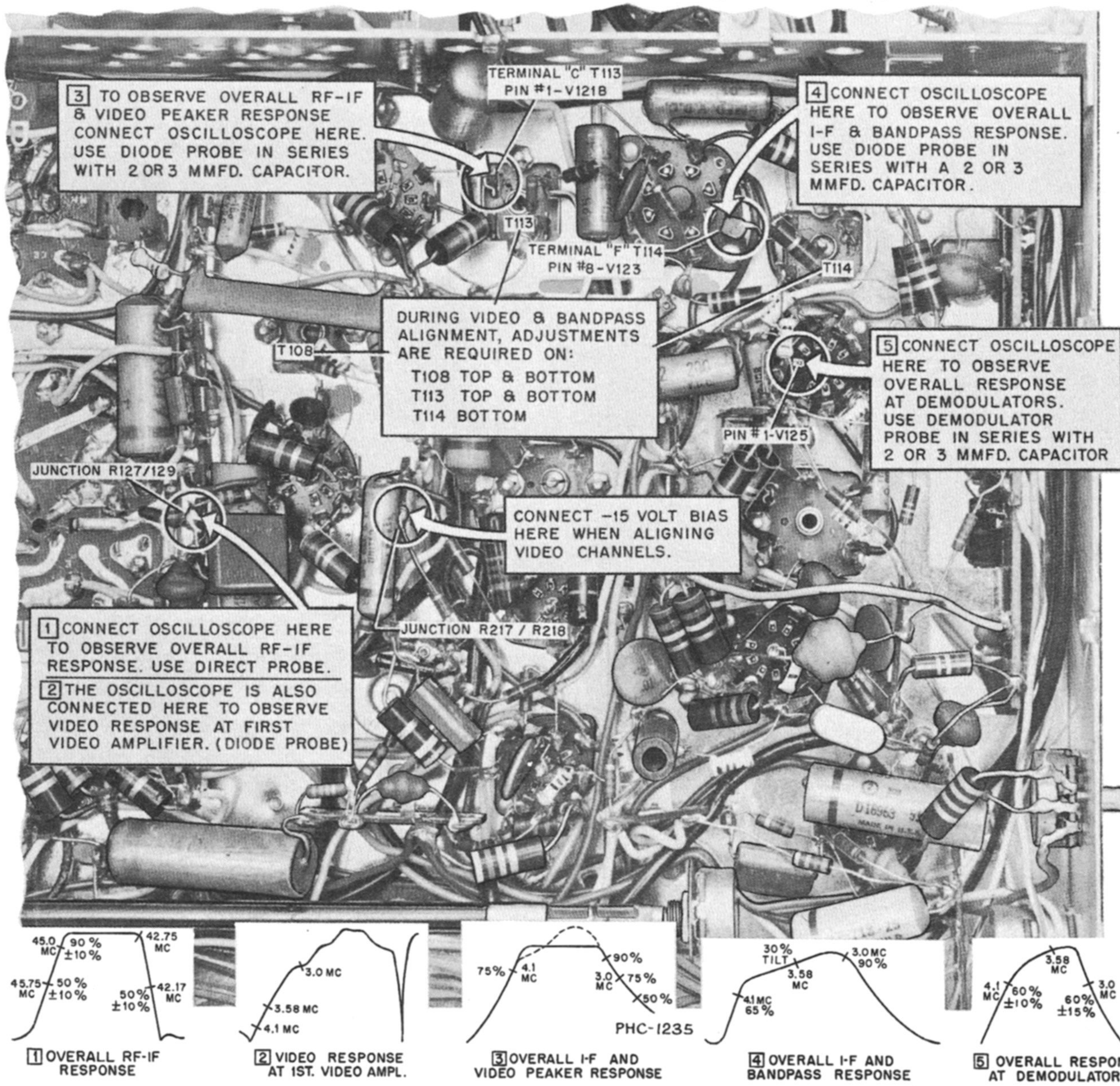


Fig. 174—Test Points and Procedure, Equipment Set-up. Overall R-F — I-F, Video and Bandpass Amplifier Alignment

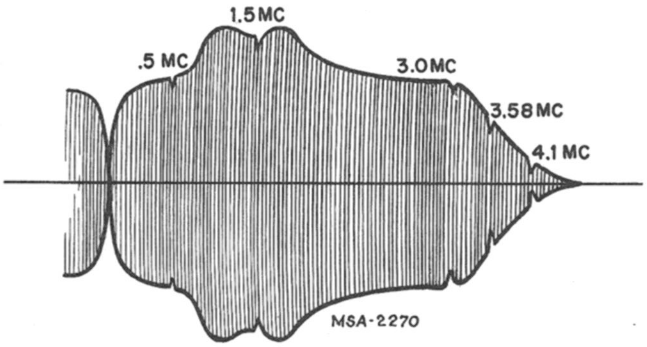


Fig. 175—Overall R-F — I-F, 2nd Detector Envelope

10. Connect the oscilloscope to terminal "F" of T-114 the demodulator driver transformer (refer to figure 174 and adjust the bottom core of T-108, and the top and bottom cores of T-113 for the response shown for point "4" of figure 174.

NOTE

It will be necessary to reduce the sweep width and center frequency of the sweep signal to get a reasonable trace width on the screen of the oscilloscope.

11. Connect the oscilloscope probe to pin 1 or 6 of the R—Y and B—Y demodulator socket, V-125. Adjust T-114, if necessary, for maximum amplitude of the response curve shown for point "5" of figure 174. If, during the alignment of the bandpass amplifier, the response curve cannot be made to look like that shown for points "4" and "5" of figure 174 check the following circuit components:

R-231 should be 5600 ohms 2 watts
R-232 should be 2700 ohms ½ watt
R-323 should be installed (18 meg. ½ w.)

These component values correspond to the wiring of the bandpass amplifier circuit shown in the schematic diagram of the second edition of the service data for this receiver and the circuit schematic diagram shown as "Late Production" at the back of this book. These changes must be made if the bandpass amplifier is to be aligned properly.

SOUND I-F ALIGNMENT

Connect test equipment as shown in the block diagram figure 176 and refer to figure 177 for test points and adjustments.

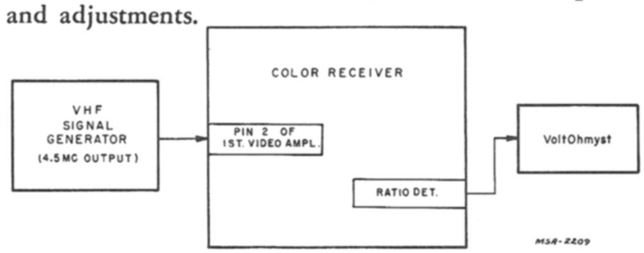


Fig. 176—Block Diagram—Test Equipment Set-Up for Sound I-F Alignment.

1. Connect the VHF signal generator to pin 2 of V-110, the first video amplifier, and set the generator for 4.5 mc. output.

2. Ground pin 8 of V-109A, third picture I-F amplifier, with a short jumper.

3. Connect a voltmeter between junction R-104/R-106 and ground. See figure 177.

4. Adjust T-102 (top), ratio detector transformer for maximum indication on the voltmeter, and adjust the generator for —15 volts indication on the voltmeter. This is the operating level of the ratio detector for average signals.

5. Connect two matched 100K resistors in series, between the junction of R-104/R-106 and ground. Then connect the voltmeter to the junction of the two 100K resistors and Terminal "JJ" of PC101, see figure 177.

6. Adjust T-102 (bottom), ratio detector secondary, for zero DC on the voltmeter.

7. Repeat steps 3, 4, 5 and 6 making final adjustments.

8. Reconnect the voltmeter to the junction of R-104/R-106 and adjust T-101 (top and bottom), for maximum indication on the voltmeter. Maintain approximately —15 volt meter reading by adjusting the generator output while making these adjustments.

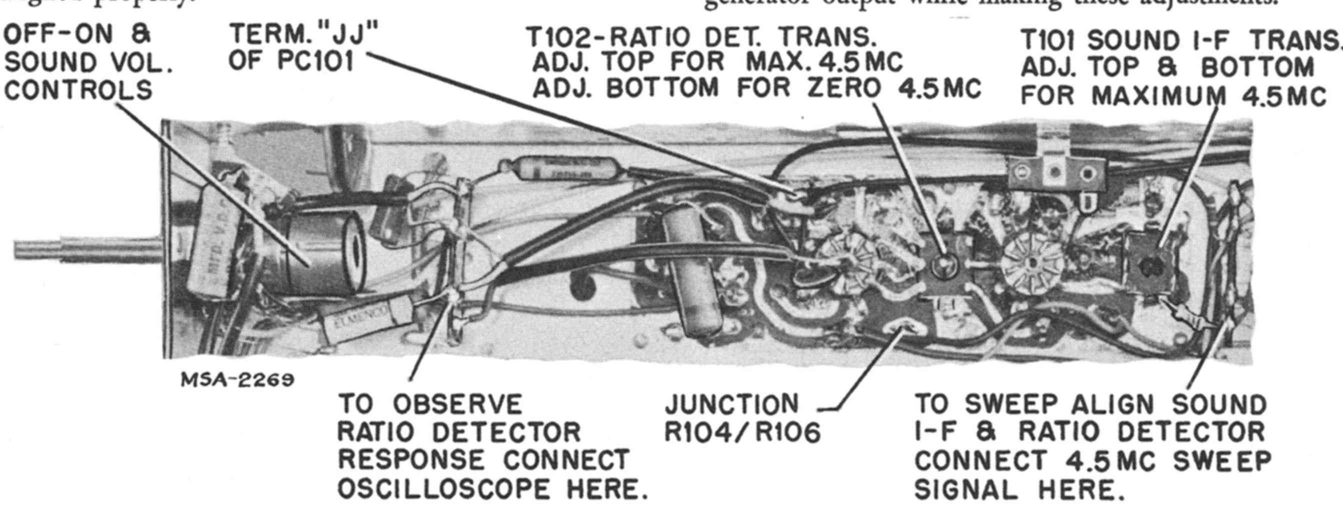


Fig. 177—Sound I-F Alignment, Test Points and Adjustments

INTERFERENCE

Beat Frequency Interference

A beat interference pattern may appear in some receivers on any channel being received in either black-and-white, or color. Usually the beat pattern is not very strong and may not be visible at viewing distances further than eight feet from the receivers.

This interference is caused by the 13th harmonic of the 3.58 mc. oscillator, approximately 46.5 mc., beating with the picture carrier at 45.75 mc.

The 46.5 mc. harmonic couples to the picture I-F circuits by the shielded cable which runs from C-175, at the plate of the vertical output tube, to R-219, at the kinescope terminal board.

The shield of this cable is grounded to the chassis at one side of the 3.58 mc. oscillator socket.

To remedy this condition, cut the shield off ground at this end, and ground the shield at the other end of the cable near the terminal strip to which the center conductor is attached. This grounding point is not critical.

Color Stripe Interference

Some television stations transmit a vertical stripe at the edge of the picture during a black-and-white transmission in order to provide service technicians with a test signal that can be reproduced as a colored stripe on color television receivers. Reception of black-and-white programs on a color television receiver may be marred by the appearance of this stripe in color. Since it is not normally synchronized, it may appear as a red, green and blue "barber pole."

Normally, this condition is prevented by the action of the color killer. However, certain conditions can disable the color killer:

1. Improper setting of the color killer threshold control.

2. Signals about the frequency of 3.58 mc. A strong signal may overload the R-F amplifier and produce this condition. The remedy is to pad the input to the receiver. See page 19.

3. Noise or other pulses during burst time. Reflections (ghosts) of horizontal sync could cause this.

4. Abnormally high bias voltage at the phase detector.

5. Transmission of color stripe too close to blanking. If the station places the stripe too close to blanking it might be accepted by the receiver circuits and produce the stripe in color.

Adjustment of the color killer threshold control will remedy this condition in the 21CT660U series receivers.

Channel 8 Interference

In areas served by a television station on Channel 8, a beat interference may be noticed on color television reception. The effects may vary, depending on the amount of signal received. The interference is caused by the 4th harmonic of the picture I-F carrier generated in the picture detector circuit, and is picked up by the 300 ohm lead associated with the UHF/VHF switch. The frequency of the interference is approximately 183 mc., depending on the position of the fine tuning control.

To suppress the interference, install a 22 mmf. capacitor between Terminals "B" and "C" of T-107 the 4th Picture I-F transformer. If this change does not reduce the interference sufficiently, re-route the Tuner Unit supply leads as follows:

1. Remove the brown heater lead from PC101-Terminal "B", re-route through hole in chassis side apron between V121 and T-113, and connect to V121-4. Refer to page 35 for printed circuit board connections.

2. Remove the black lead which connects the AGC terminal board with Terminal "LL", PC101, from the Terminal "LL" end. Route it through same hole specified above, and connect to tuner AGC terminal.

3. Remove tuner end of black lead connecting Terminal "LL", PC101, and tuner AGC terminal. Route through hole in chassis side apron nearest to Terminal "LL", and reconnect to tuner AGC terminal.

4. Remove the terminal board end of red-white lead which connects PC102-Terminal "D" to B-plus 280. Refer to pages 32 and 33 for printed circuit board connections. Re-route the lead through the hole in the chassis lip nearest to Terminal "D". An orange wire runs through this hole from PC101 to PC102. Then route the red-white lead on the sound I-F side of the chassis lip, between V121 and T108. Connect to B-plus 280 buss at the same terminal to which R231 is connected.

Other Types of Interference

When using a color television receiver to receive a color telecast, the Fine Tuning control must be adjusted to reduce the sound beat to a minimum if the best color picture is to be received. This relatively restricted range of fine tuning makes it difficult to use the fine tuning control to minimize interfering signals — as is the practice in black and white television reception.

If the frequency of the interfering signal is within the channel being received, and not more than 3 mc. removed from the picture carrier, the interference is passed through the luminance channel and is visible if the color saturation control is turned off. If the frequency of the interfering signal is within .75 mc. of the color sub-carrier frequency, it will appear as a red, blue, and green beat pattern, and will disappear if the color saturation control is turned off. For example, oscillator radiation from another receiver, not visible on black-and-white reception, might appear as red, green, and blue stripes on the color picture.

Another type of interference pickup occurs when the interfering signal is within the I-F passband and very strong, so that direct I-F pickup may take place. Since the chassis is shielded, the interference is usually picked up by wiring above the chassis or by the house wiring, and fed into the chassis via the AC line cord. Bypassing, or providing series resonant traps at points where wires enter the chassis, may reduce or eliminate such pickup.

Improper alignment can be responsible for sound beat in the case of the low picture carrier, or for weak sound and color in the case of the high picture carrier. The latter condition will usually show a smeary picture. Replacement of the 1st Picture I-F Amplifier (6AZ8) may cause the picture I-F carrier position to shift on the response curve. It is a good practice to check operation of the Fine Tuning control after replacing tubes in this stage. If the picture is seriously degraded, and the operation of the fine tuning control is abnormal, check the tubes, the tuner unit, supply voltages, and the antenna lead. If these appear normal, realignment is indicated.

MODIFICATIONS

LATE PRODUCTION CHASSIS

Early production receivers, models 21CT661U and 21CT662U only, were manufactured in accordance with the schematic diagrams shown throughout the preceding sections of this book.

Later production receivers (21CT661U and 21CT-662U) have had some, or all, of the modifications shown in this section incorporated during production.

Model 21CT661U and 21CT662U receivers chassis bearing serial numbers higher than B-8075000, or any chassis serial number beginning with "A", incorporate all of the changes shown in the schematic diagrams following.

Models 21CT660U, 21CT663U and 21CT664U are manufactured only with all of the modifications incorporated at the factory. These receiver chassis bear serial numbers higher than B-8075000, or a chassis serial number beginning with "A".

Complete schematic diagrams of the chassis appear at the back of this booklet. The diagram marked "Early Production" shows the circuitry of the early production receivers. The schematic diagram marked "Late Production" shows the circuitry revised to include all changes effected in chassis bearing serial numbers higher than B-8075000, or any chassis serial number beginning with "A".

NOTE

If it is desired to incorporate, in early production receivers, any or all of these modifications, the chassis should be identified or marked to avoid confusion in the event future adjustments, or service, is required.

In order to clarify the circuit differences between early and late production chassis, schematic diagrams of the original circuits in which changes were made are shown side-by-side with the later circuits. The modifications made are clearly identified by the shaded portions of the diagrams.

Schematic Diagrams—EARLY PRODUCTION

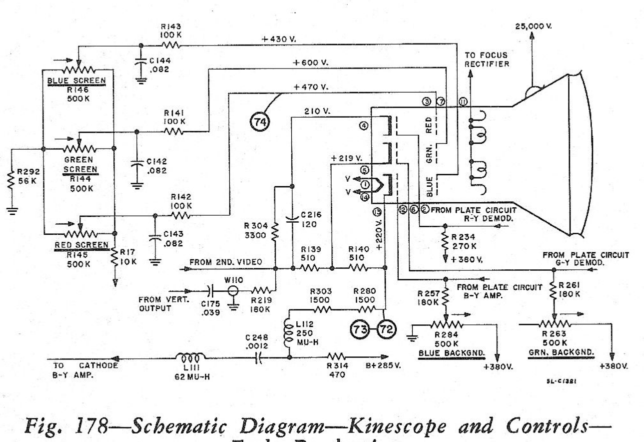


Fig. 178—Schematic Diagram—Kinescope and Controls—Early Production.

Schematic Diagrams—LATE PRODUCTION

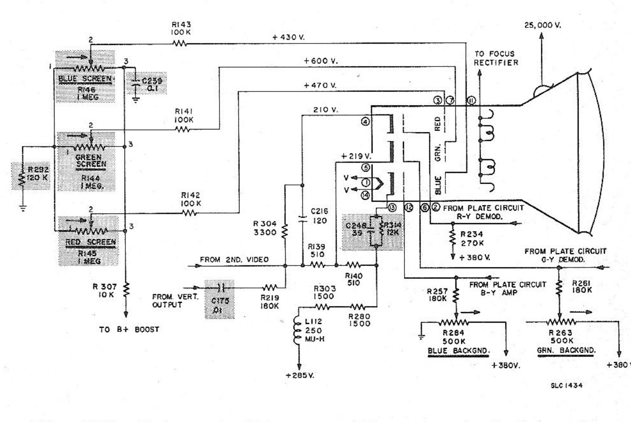


Fig. 179—Schematic Diagram—Kinescope and Controls—Late Production.

Schematic Diagrams in this column are for EARLY PRODUCTION receivers

Schematic Diagrams in this column are for LATE PRODUCTION receivers

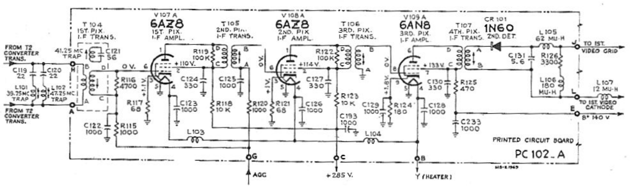


Fig. 180—Schematic Diagram—1st, 2nd, 3rd Picture I-F, Picture Detector—Early Production.

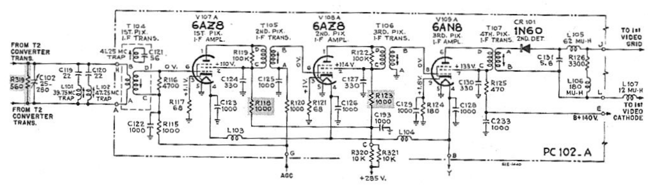


Fig. 181—Schematic Diagram—1st, 2nd, 3rd Picture I-F, Picture Detector—Late Production

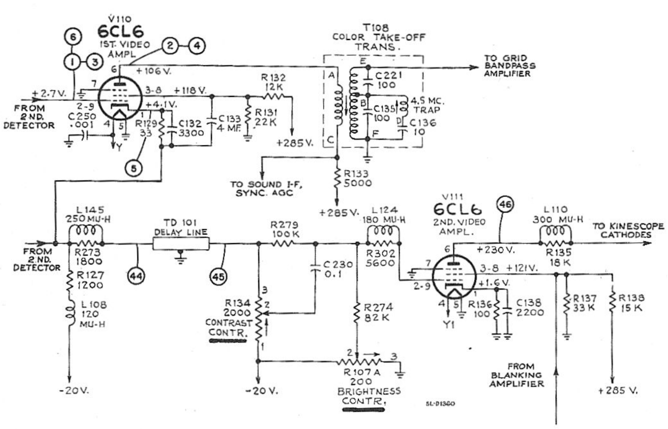


Fig. 182—Schematic Diagram—1st and 2nd Video Amplifier—Early Production.

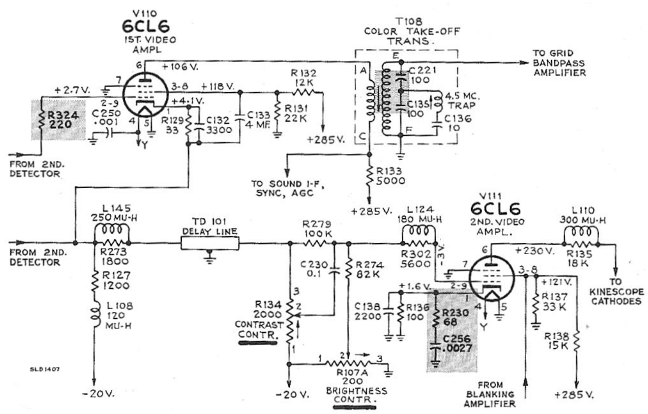


Fig. 183—Schematic Diagram—1st and 2nd Video Amplifier—Late Production.

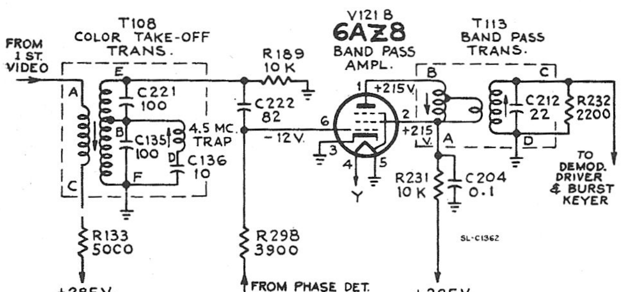


Fig. 184—Schematic Diagram—Bandpass Amplifier—Early Production.

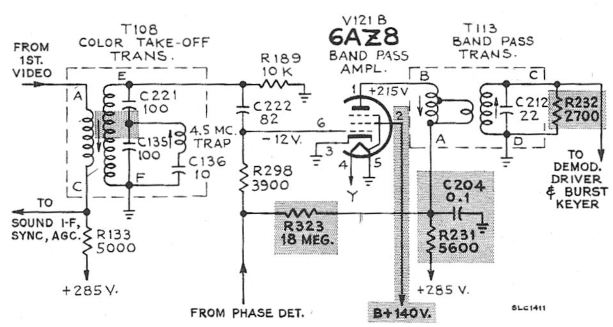


Fig. 185—Schematic Diagram—Bandpass Amplifier—Late Production.

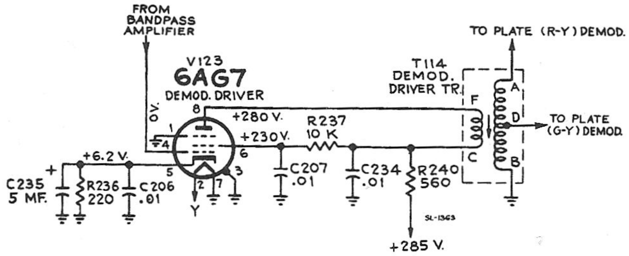


Fig. 186—Schematic Diagram—Demodulator Driver—Early Production.

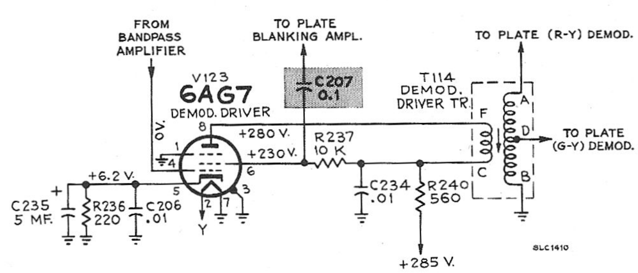


Fig. 187—Schematic Diagram—Demodulator Driver—Late Production.

EARLY PRODUCTION

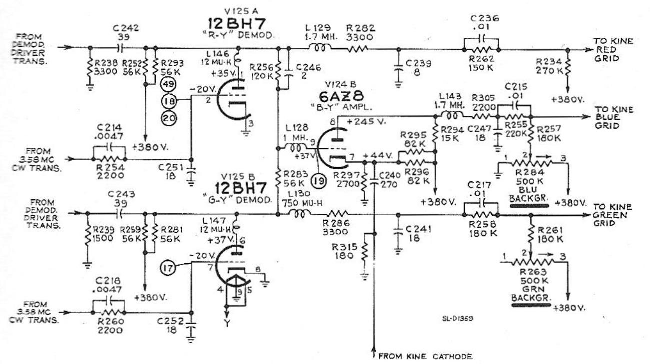


Fig. 188—Schematic Diagram—Color Demodulators—Early Production.

LATE PRODUCTION

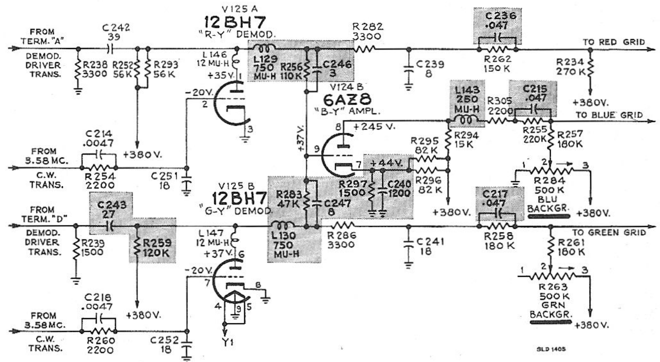


Fig. 189—Schematic Diagram—Color Demodulators—Late Production.

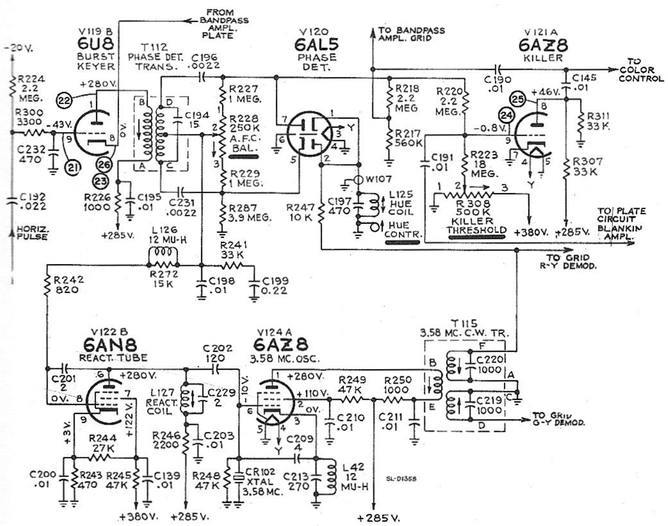


Fig. 190—Schematic Diagram—Color Sync Circuits—Early Production.

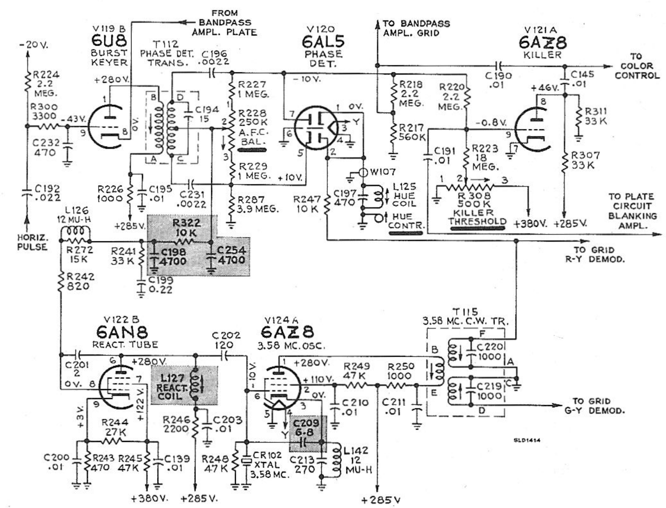


Fig. 191—Schematic Diagram—Color Sync Circuits—Late Production.

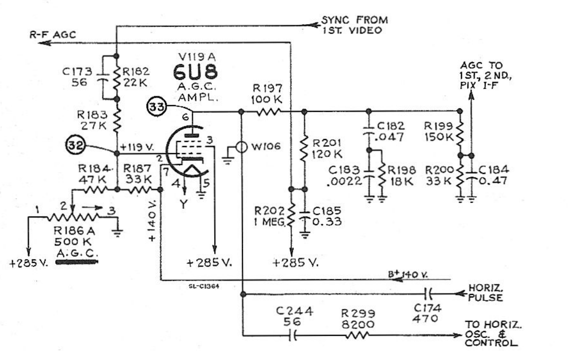


Fig. 192—Schematic Diagram—AGC Amplifier—Early Production.

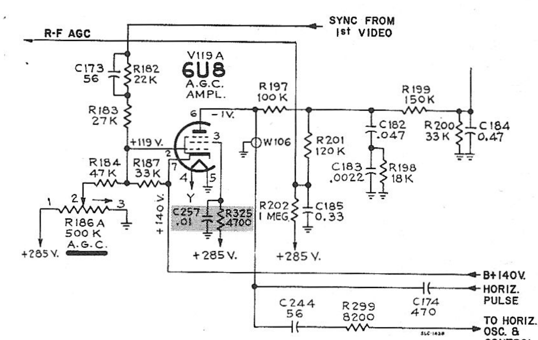


Fig. 193—Schematic Diagram—AGC Amplifier—Late Production.

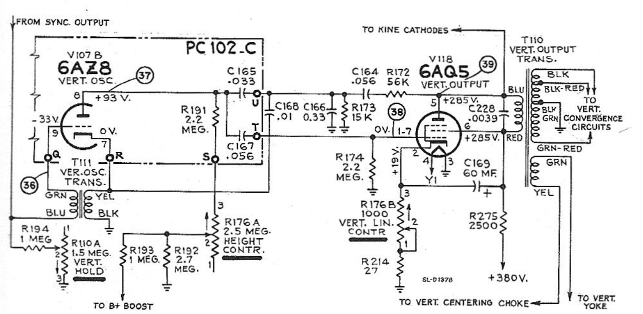


Fig. 194—Schematic Diagram—Vertical Oscillator and Output—Early Production.

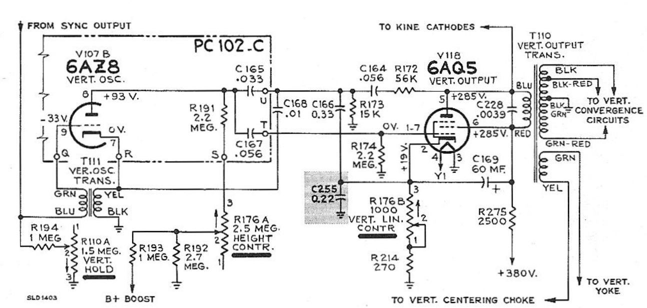


Fig. 195—Schematic Diagram—Vertical Oscillator and Output—Late Production.

EARLY PRODUCTION

LATE PRODUCTION

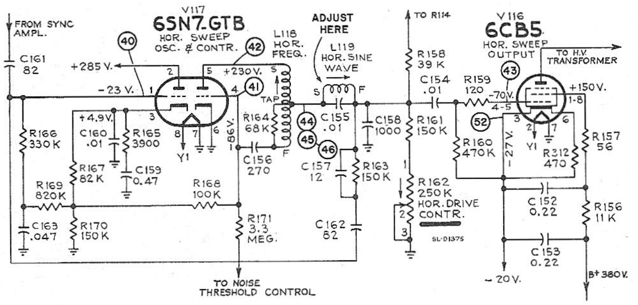


Fig. 196—Schematic Diagram—Horizontal Oscillator, Control and Horizontal Output—Early Production.

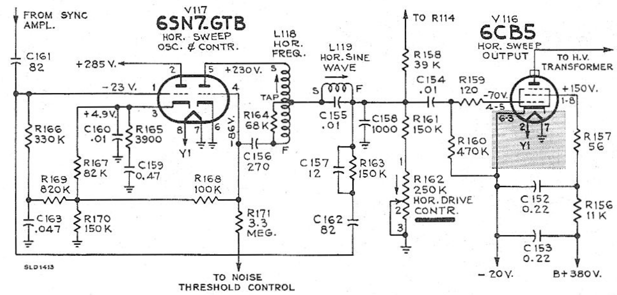


Fig. 197—Schematic Diagram—Horizontal Oscillator, Control and Horizontal Output—Late Production.

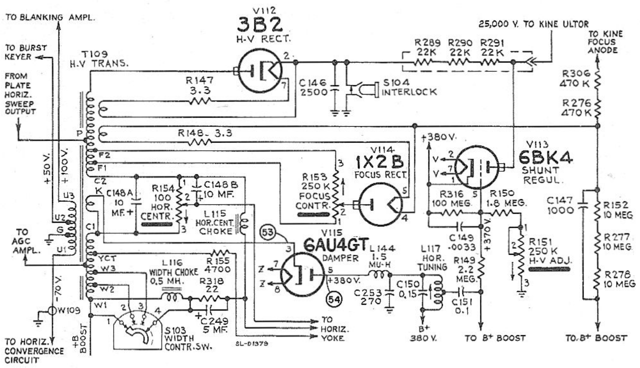


Fig. 198—Schematic Diagram—Horizontal Output and High Voltage Circuits—Early Production.

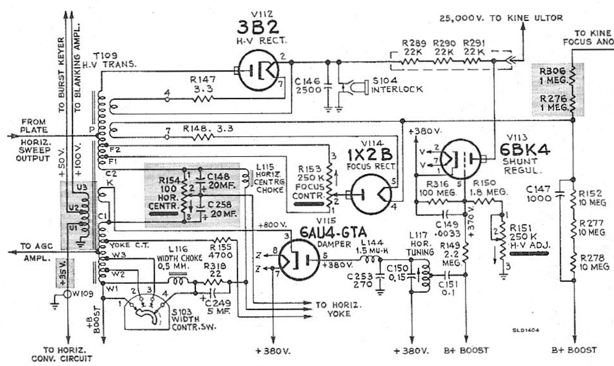


Fig. 199—Schematic Diagram—Horizontal Output and High Voltage Circuits—Late Production.

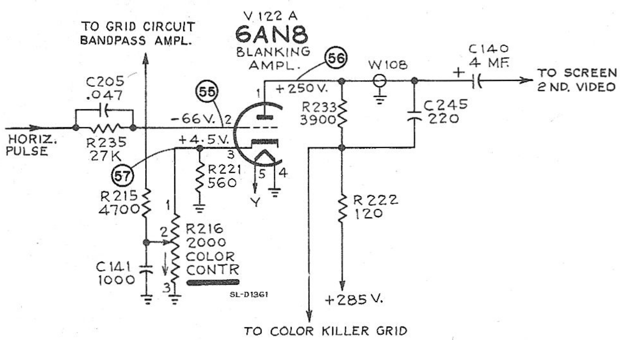


Fig. 200—Schematic Diagram—Blanking Amplifier—Early Production.

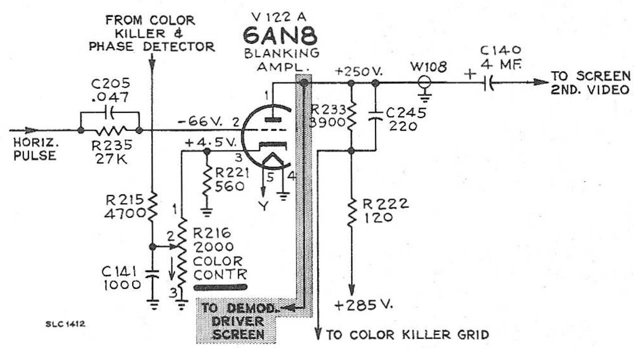


Fig. 201—Schematic Diagram—Blanking Amplifier—Late Production.

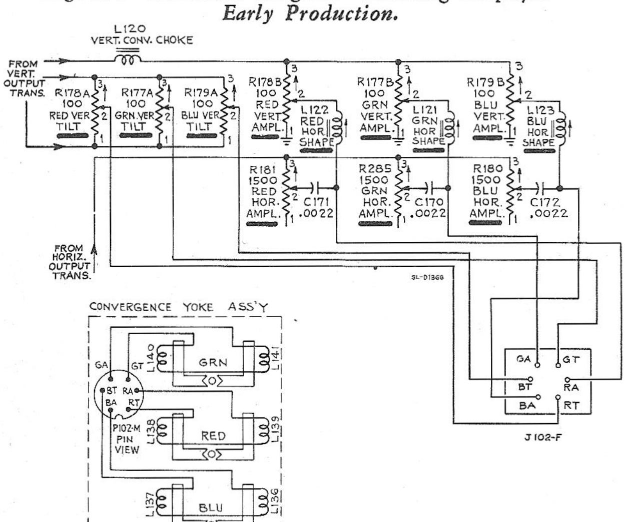


Fig. 202—Schematic Diagram—Convergence Circuits—Early Production.

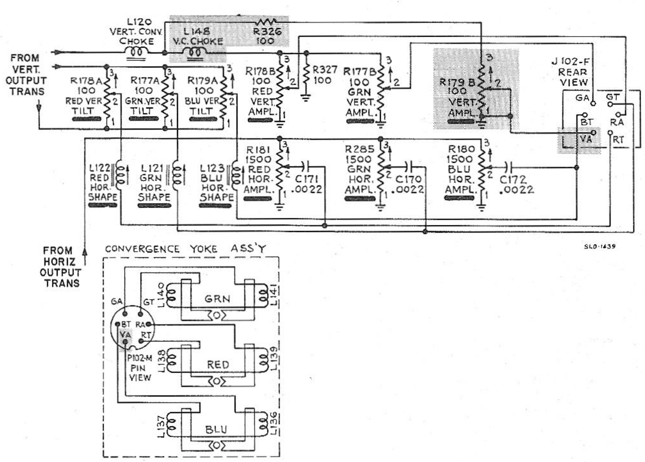


Fig. 203—Schematic Diagram—Convergence Circuits—Late Production.

SERVICE REFERENCES

Symptoms	*Possible Cause*	*Circuit Location*	*Refer to Page*
No picture.	6CL6 1st Video — short at cathode.	Video	38
	6BQ7A R-F Amplifier.	Tuner	30
	R2 open.	Tuner	30
	6X8 R-F oscillator defective.	Tuner	30
	Short, term 1 to 2, tuner unit terminal board.	Tuner	30
	C30 open.	Tuner	30
No picture on high channels.	C32 intermittent.	Tuner	30
Picture only with brightness control at max.	6U8 AGC amplifier.	AGC	53
Oscillation in picture.	6CL6 2nd Video.	Video	38
No picture, no sound.	T105 shorted.	Pix I-F	32
No picture, no sound, hum in raster.	6AQ5 audio output tube, heater to cathode short.	Audio	34
No picture, no sound.	6AQ5 audio output, open heater.	Audio	34
	6U8 AGC amplifier defective.	AGC	53
	C225B shorted.	Audio	34
Smear in picture.	6U8 noise inverter.	Noise Inv.	54
Low contrast.	6U8 noise inverter.	Noise Inv.	54
Picture overload.	6U8 AGC amplifier.	AGC	53
	Adjust AGC control.	AGC	53
	6CL6 2nd Video.	Video	38
Intermittent AGC overload.	6AQ5 audio output tube, poor contact at socket.	AGC Audio Output	53 34
Poor horizontal linearity.	Horizontal drive, Width and Hor. Tuning misadjusted.	HV	60
	T109 defective.	HV	60
	L117 defective.	HV	60
Voltage on controls and control cover.	Grounding spring to control cover not making proper contact.	Chassis	—
Color "ghosts" in picture.	Misconvergence.	Convergence	67
	Low emission from one of the guns of the kinescope.	Kine.	65
	Reflections in signal.	Ant.	18

SERVICE REFERENCES

Symptoms	*Possible Cause*	*Circuit Location*	*Refer to Page*
Colored snow in picture.	Killer Threshold misadjusted.	Color Sync	19 46
Picture arcing.	Horizontal centering control burned, C-148A open, C-148B shorted.	HV	60
Arcing in kinescope gun.	Defective kinescope.	Kine.	65
Arcing in High Voltage.	High voltage transformer, lead from plate cap 3B2 high voltage rectifier arcs to top of high voltage caps.	HV	60
	High voltage transformer arcing where lead from plate cap of 6CB5 attaches to transformer.	HV	60
Picture blooming.	High voltage adjustment incorrect.	HV	60
	Contrast and/or brightness control misadjusted.	Video	38
	Screen controls misadjusted.	Kine.	65
	Shunt regulator V113 defective.	HV	60
	Demodulator tubes inoperative.	Demod.	18 44 49
Flashing in picture.	6CL 1st Video.	Video	38
	Intermittent brill control R107A.	Video	38
Hum in picture.	6U8 AGC amplifier.	AGC	53
Intermittent hum in picture; hum in sound and very low contrast; no color sync.	6U8 noise inverter.	Noise Inv.	54
No sound.	Unsoldered connection on terminal board; audio output transformer.	Audio	34
	6AQ5 audio ou put tube shorted caused R-114 and L-131 (filter choke) to overheat.	Audio	34
Loud buzz.	Vertical output transformer.	Vert Sync	56
Poor vertical linearity.	Height and/or linearity control misadjusted.	Vert. Sync	56
	Vertical output transformer T-110 defective.	Vert Sync	56
	Vertical oscillator V107B defective.	Vert Sync	56
	C164, C166 or C167 defective.	Vert Sync	56

SERVICE REFERENCES

Symptoms	*Possible Cause*	*Circuit Location*	*Refer to Page*
No sync.	Sync amplifier tubes V108 or V109.	Sync Ampl.	52
	C188 open.	Sync Ampl.	52
	C189 shorted.	Sync Ampl.	52
	AGC misadjusted.	AGC	53
	Noise Threshold misadjusted.	Noise Inv.	54
Wrong color(s).	Hue coil or control misadjusted.	Color Sync	19 46
	Demodulator tube (V124 or V125) defective.	Demod.	18 44 49
	Poor purity.	Adj.	26
	Magnetized kinescope.	Adj.	8
No vertical deflection.	6AZ8 vertical osc. V107B.	Vert. Sync	56
	Vertical osc. transformer winding open.	Vert. Sync	56
	C-165 not soldered at terminal "U" PC102C.	Vert. Sync	56
	C-169 shorted, R214 open.	Vert. Sync	56
	6AQ5 vertical output V118.	Vert. Sync	56
	Vertical coils in yoke open.	Vert. Sync	56
Vertical roll.	6AZ8 vert. osc.	Vert. Sync	56
	C179 or C180 defective.	Sync Ampl.	52
Picture shrinks vertically.	6AZ vert. oscillator.	Vert. Osc.	56
Buzz in sound.	Ground lead from volume control to terminal board not connected.	Audio	34
Hum in sound and critical tuning.	6U8 sound I-F tube.	Sound I-F	34
Distorted sound.	6U8 sound I-F tube.	Sound I-F	34
Audio howls at various degrees above normal sound volume.	Ratio detector transformer.	Sound I-F	34
No low frequency response in sound.	Speakers — leads reversed.	Audio	34
Low color saturation.	RF-IF or Bandpass circuits misaligned.	R-F — I-F Bandpass Ampl.	70 41
	Adjust AGC.	AGC	53
	Weak signal from antenna.	Ant.	18

SERVICE REFERENCES

Symptoms	*Possible Cause*	*Circuit Location*	*Refer to Page*
Low color saturation. (Continued)	Bandpass Amplifier tube weak.	Bandpass Ampl.	41
	Demodulator driver tube weak.	Demod.	18 44 49
No color.	Fine tuning or color control misadjusted.	Adjust.	—
	Demodulator Driver (V123) inoperative.	Demod.	18 44 49
	Bandpass Ampl. (V121B) inoperative.	Bandpass Ampl.	41
	Burst Keyer (V119B) inoperative.	Color Sync	19 46
	Phase Det. (V120) inoperative.	Color Sync	19 46
	Antenna system attenuating color information.	Ant.	18
Intermittent brightness.	6AU4GTA damper.	HV	60
No brightness.	Heaters in kinescope open.	Kine	65
	6CL6 1st Video (check AGC 6U8).	Video	38
	6CL6 2nd Video.	Video	38
	Horizontal centering control open.	HV	60
	T109 HV transformer defective.	HV	60
	Arcing in HV transformer.	HV	60
	Yoke not plugged in.	HV	60
	Damper (V115) defective.	HV	60
	1X2B focus rectifier.	HV	60
	3B2 high voltage rectifier.	HV	60
	6SN7 horizontal oscillator.	Horiz. osc.	58
	6CB5 horizontal output.	Horiz. osc.	58
	Fuse — F104 open.	LV Pwr.	25 70
	Fuse — F101 open.	HV	25
	6BL4 HV regulator.	HV	60
Poor focus.	Focus control open.	HV	60
Unstable focus — focus changes.	Focus control arcs at proper focus point — burned focus control.	HV	60
No focus, no control of brightness.	Short circuit between focus and green screen grid.	HV	60
Insufficient width.	Ultor lead arcing — causes corona.	HV	60
Arcing in picture.	Ultor lead not making good connection inside high voltage insulator on chassis.	HV	60
	High voltage lead making poor contact at kinescope.	HV	60

SERVICE REFERENCES

Symptoms	*Possible Cause*	*Circuit Location*	*Refer to Page*
No color lock.	Phase Det. (V120) defective.	Color Sync	19 46
	Reactance tube (V122B) defective.	Color Sync	19 46
	3.58 mc. oscillator (V124B) off frequency.	Color Sync	19 46
Red screen, constant brightness.	Red grid lead intermittent due to poor contact kinescope socket to kinescope base.	Kine.	65
Red screen.	Short in kinescope.	Kine.	65
Red screen.	Cathode to grid short in kinescope.	Kine.	65
Constant red screen at low brightness setting.	Poor pin contact, red grid pin in kinescope socket.	Kine.	65
Yellow screen — blue background control has no effect.	Grid to screen short in kinescope.	Kine.	65
Yellow screen.	Blue screen control open.	Kine.	65
	B—Y amplifier, V124, defective.	Demod.	18 44 49
Green screen.	Cathode to grid short in kinescope.	Kine.	65
	3.58 mc. crystal defective.	Color sync.	19 46
	R-259, R-281 changed in value.	Demod.	18 44 49
	Short from grid to ground, kinescope.	Kine.	65
	12BH7, R-259.	Demod.	18 44 49
Intermittent green picture.	12BH7 G—Y and R—Y demod.	Demod.	18 44 49
No green screen.	C-241 high resistance short to ground.	Demod.	18 44 49
	C-217 leaky.	Demod.	18 44 49
Blue screen.	Grid to cathode short, blue gun in kinescope.	Kine.	65
No brightness, buzz in sound.	Red screen control defective.	Kine.	65
	R317 changed to lower value.	Kine.	65
	Blue screen control defective.	Kine.	65
	Green screen control defective.	Kine.	65
	R-292 and R-317 open.	Kine.	65
No brightness, no sound.	C-117 — Filter capacitor shorted cathode of 6AQ5 audio output.	Audio	34

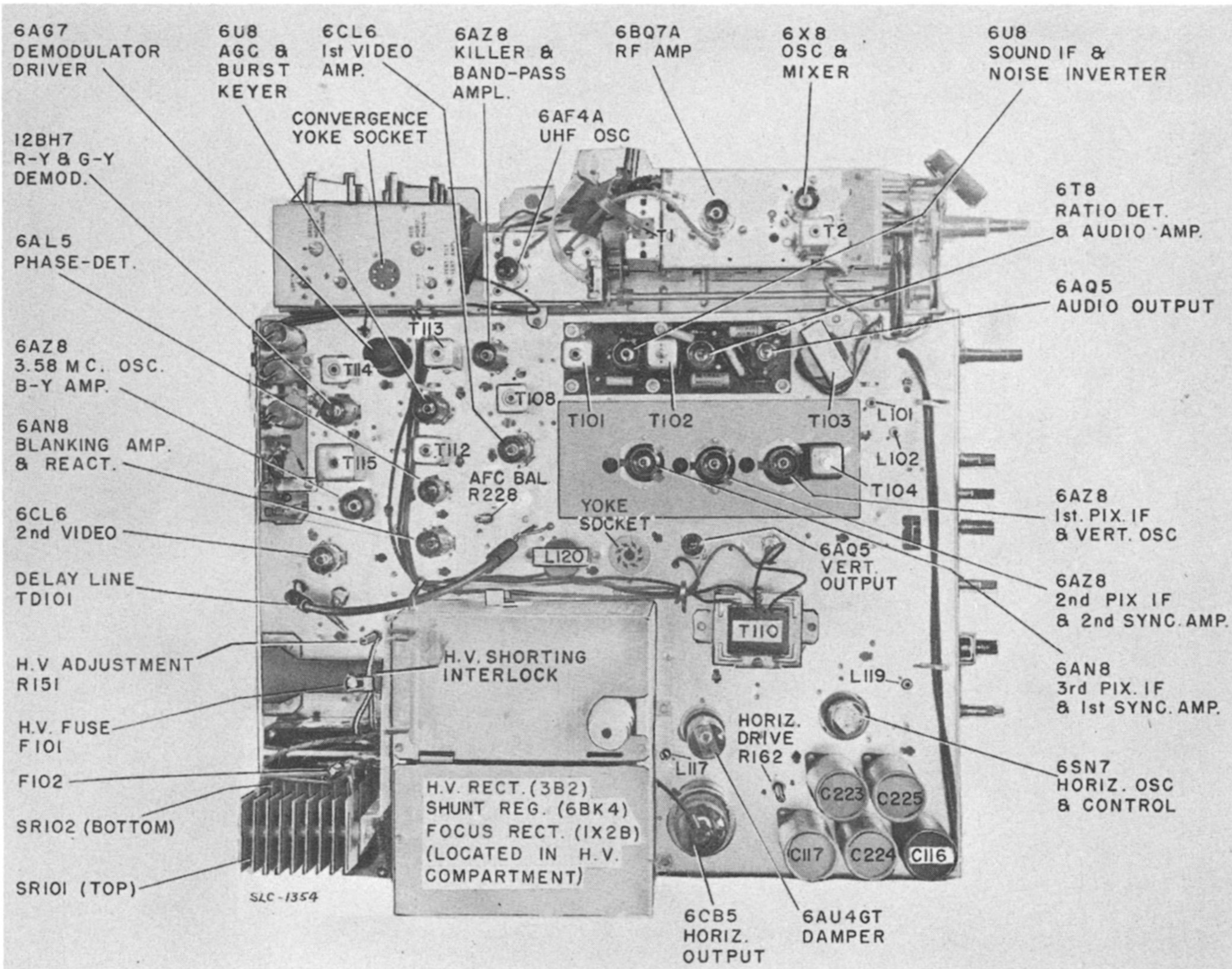


Fig. 204—Top View—21CT662U Color Television Receiver Chassis

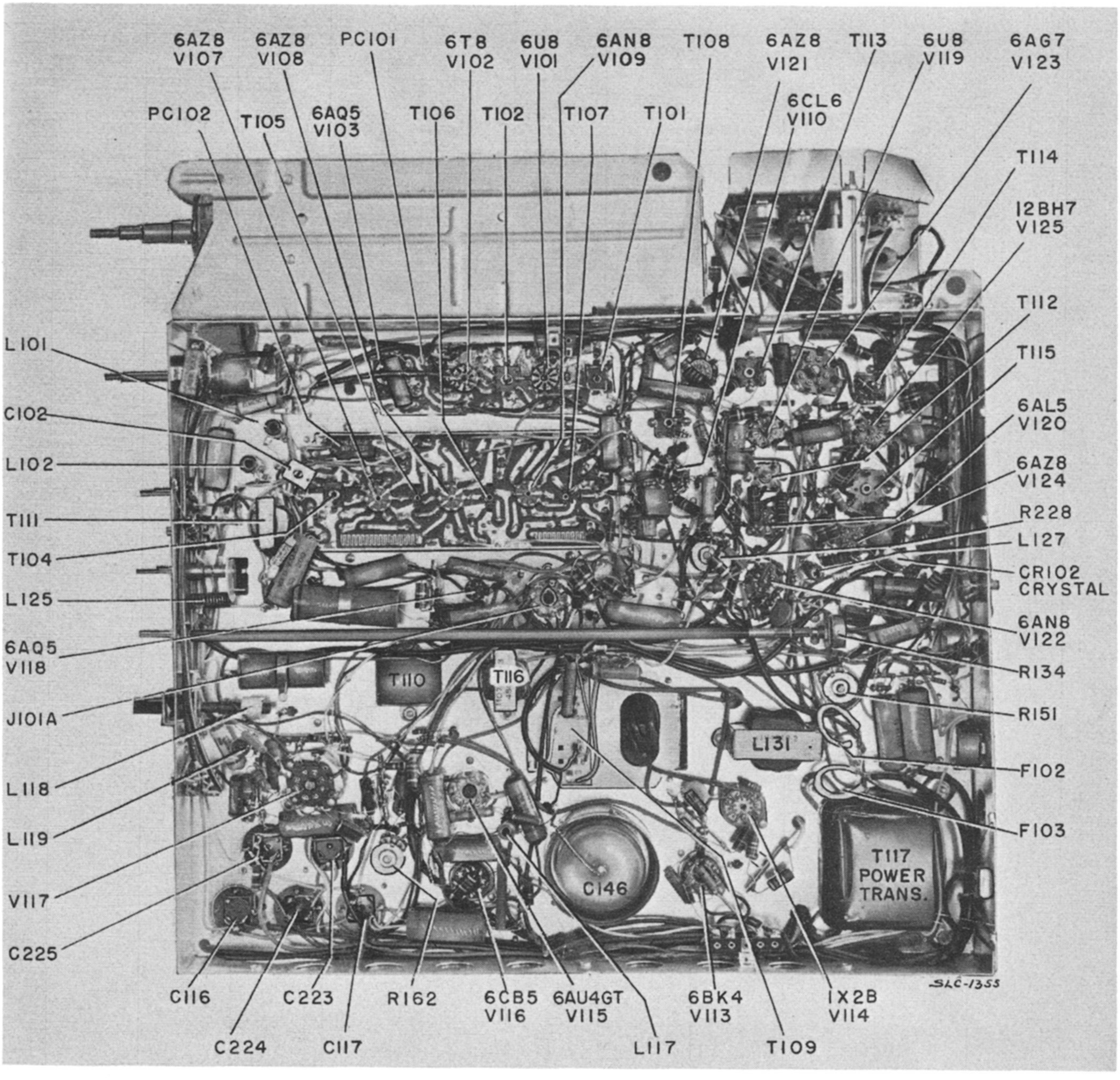


Fig. 205—Bottom View—21CT662U Color Television Receiver Chassis

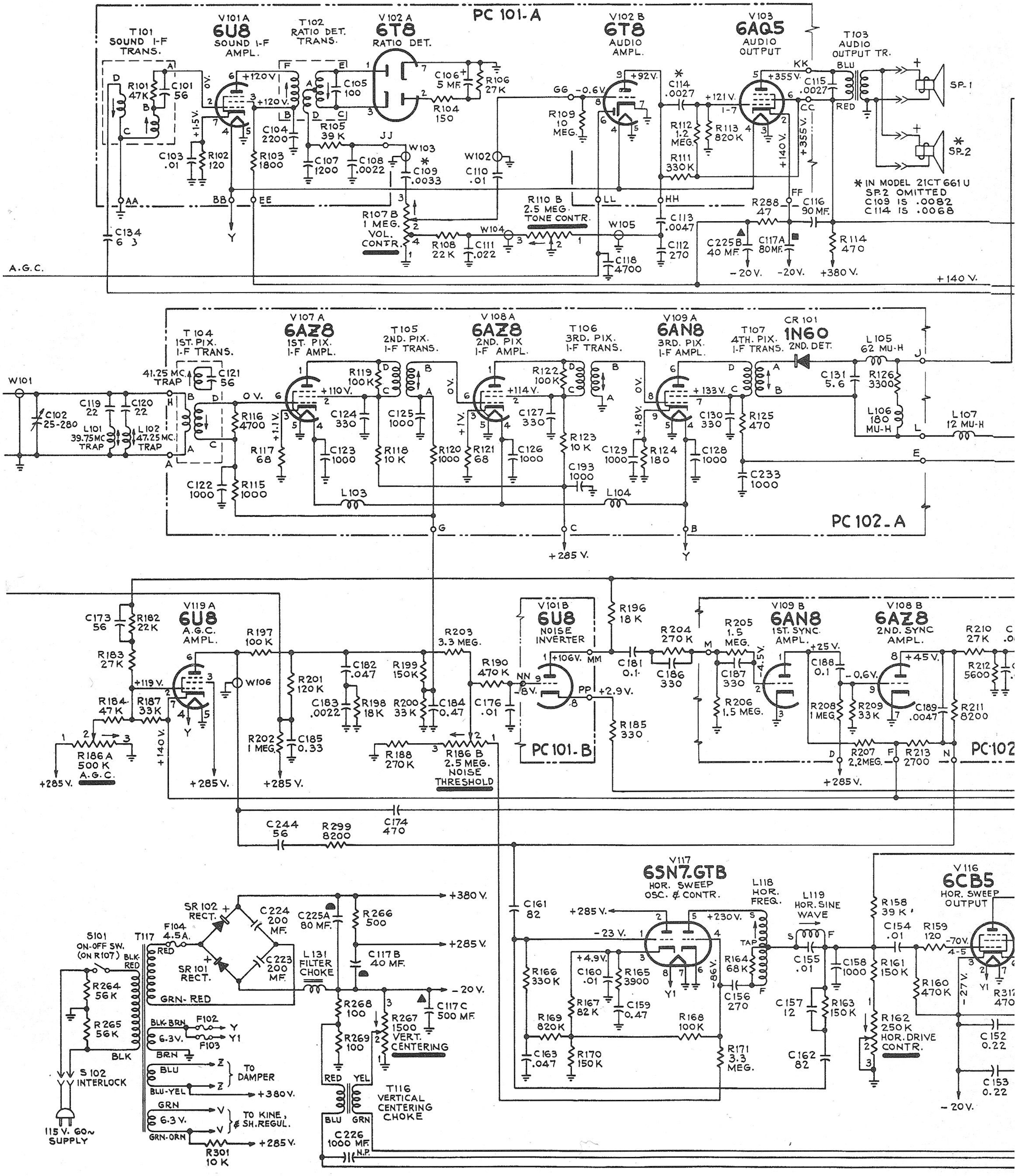


Fig. 206—Schematic Diagram—21CT661U - 21CT662U— Early Production.

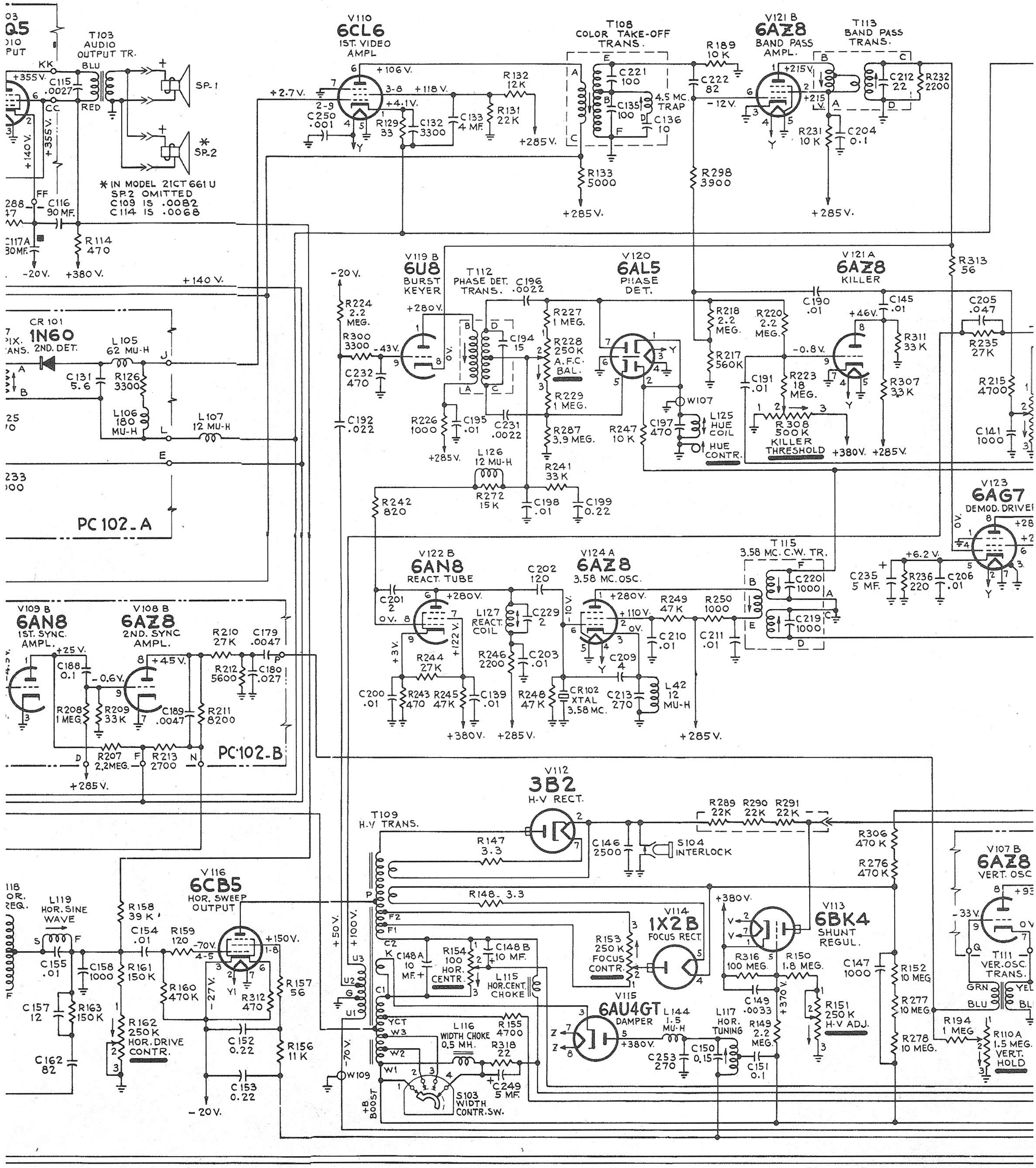


Fig. 206—Schematic Diagram—21CT661U - 21CT662U—
Early Production.

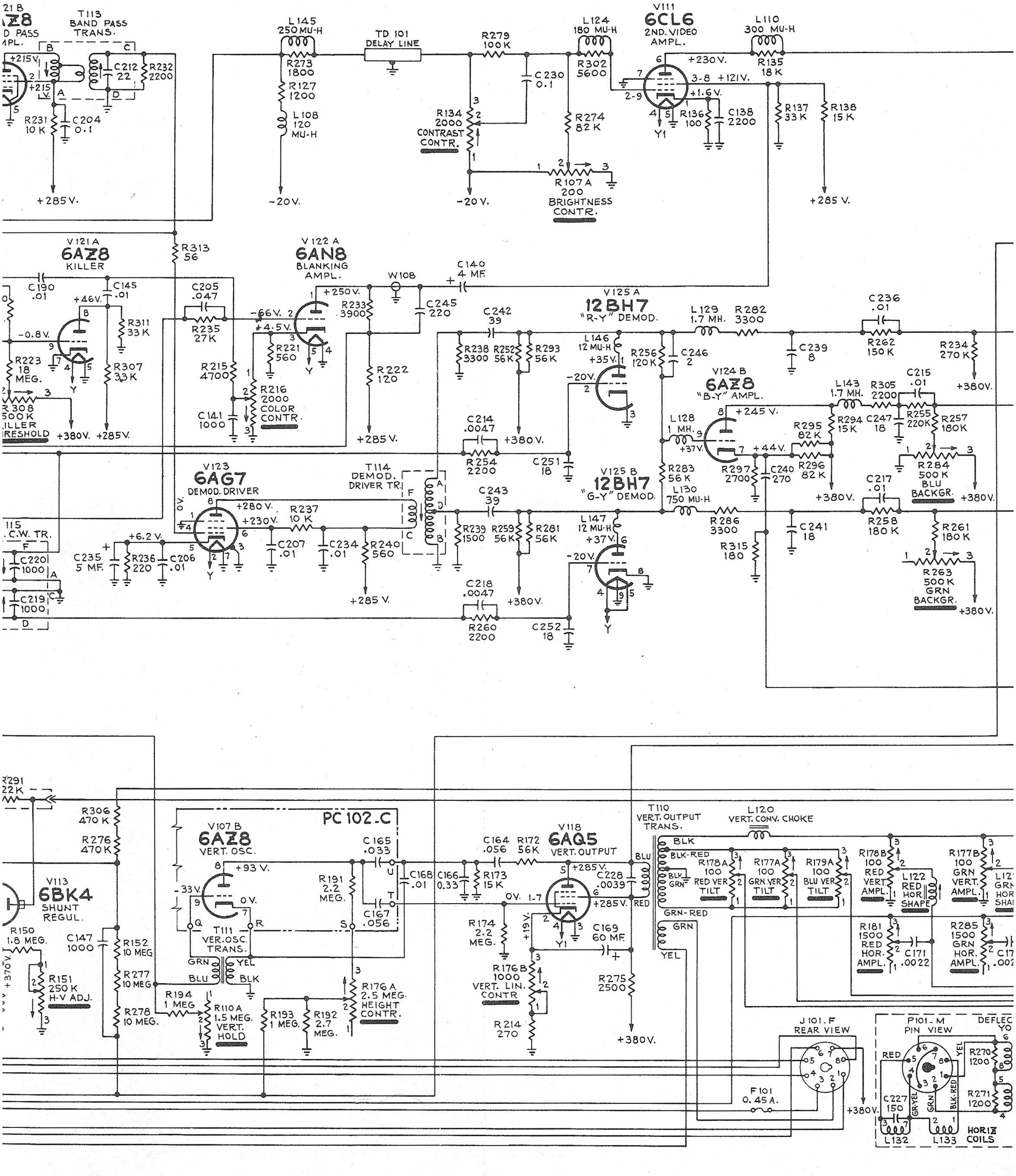


Fig. 206—Schematic Diagram—21CT661U - 21CT662U—
Early Production.

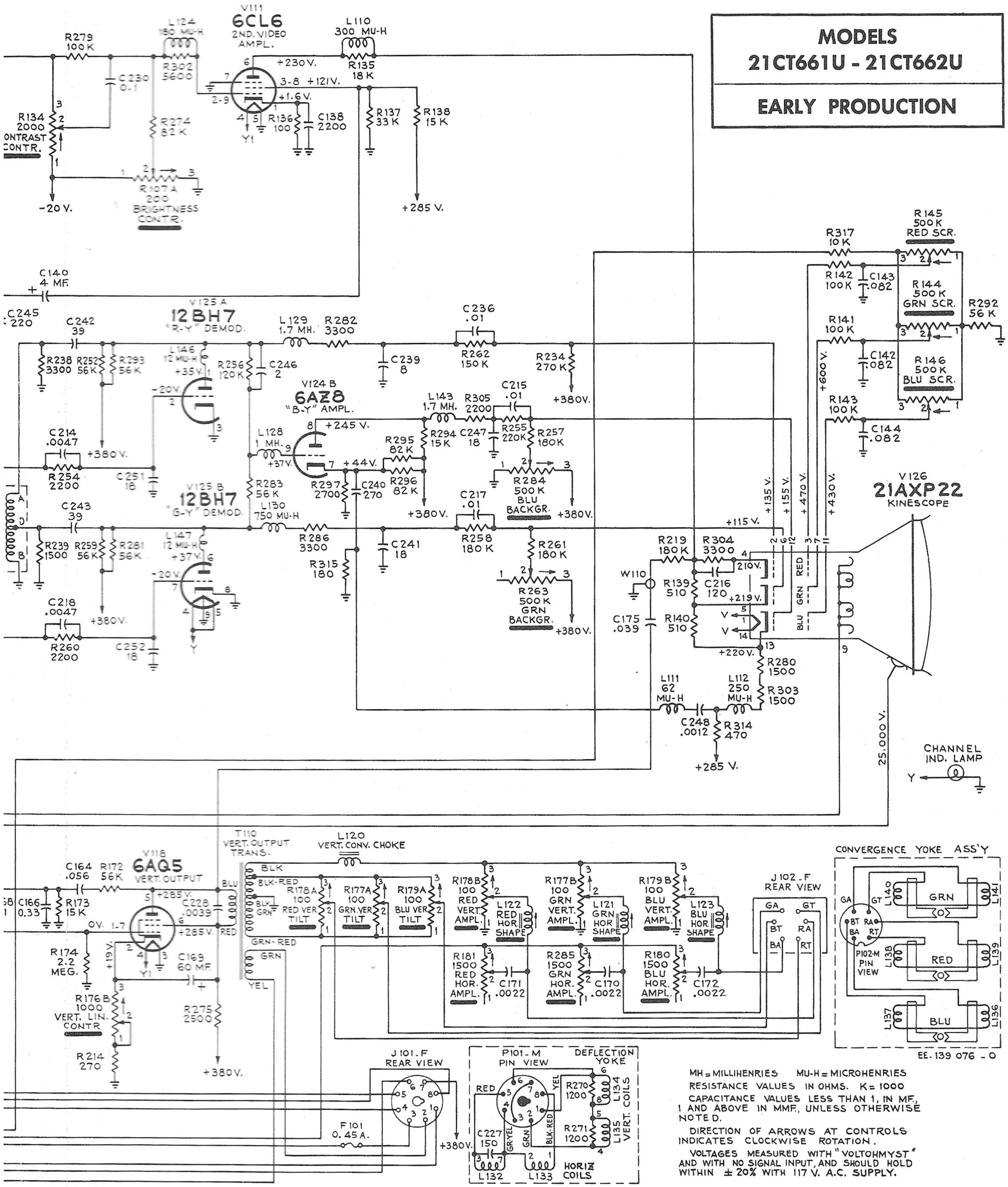


Fig. 206—Schematic Diagram—21CT661U - 21CT662U—Early Production.

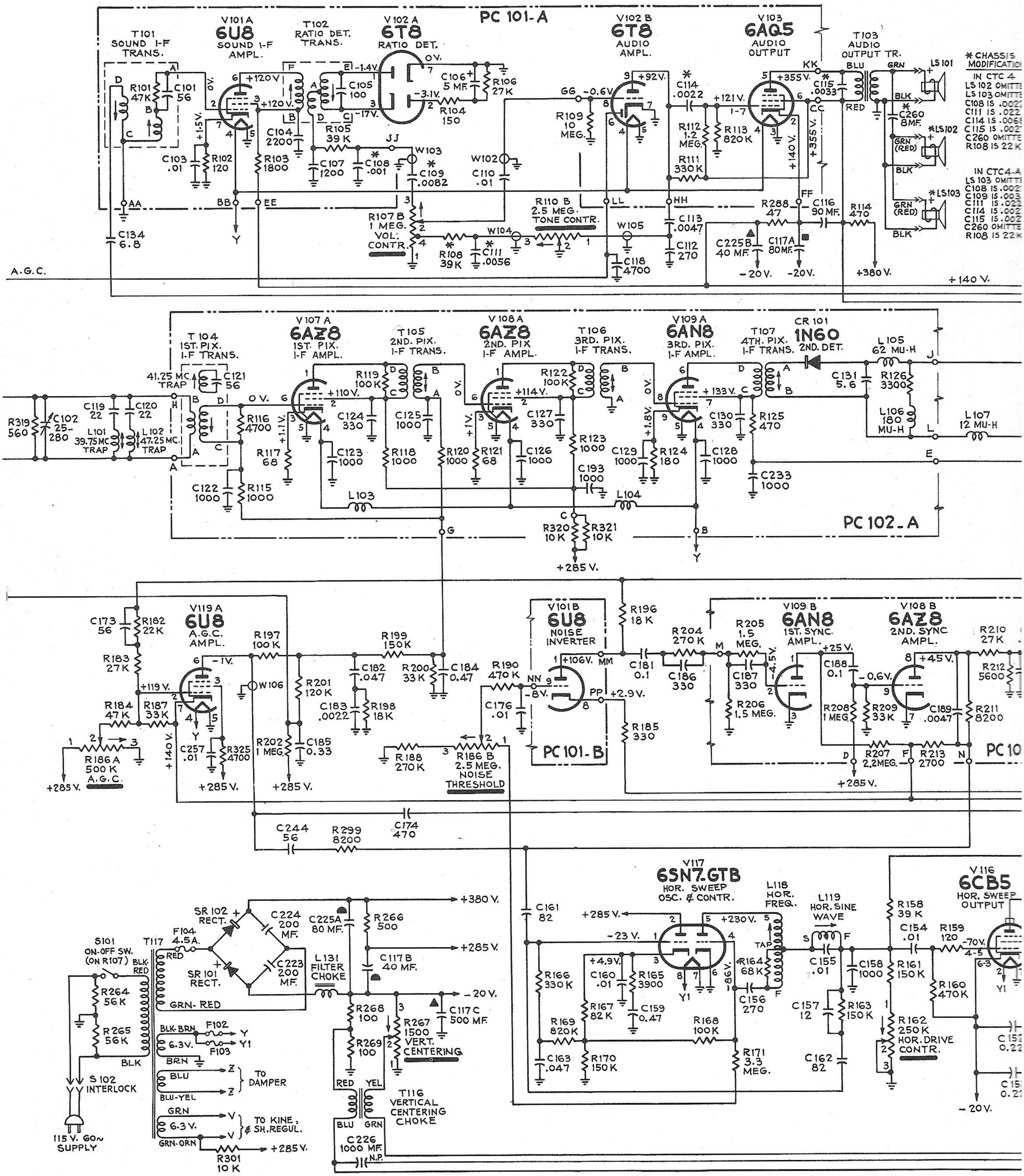


Fig. 207—Schematic Diagram—21CT660U Series—Late Production.

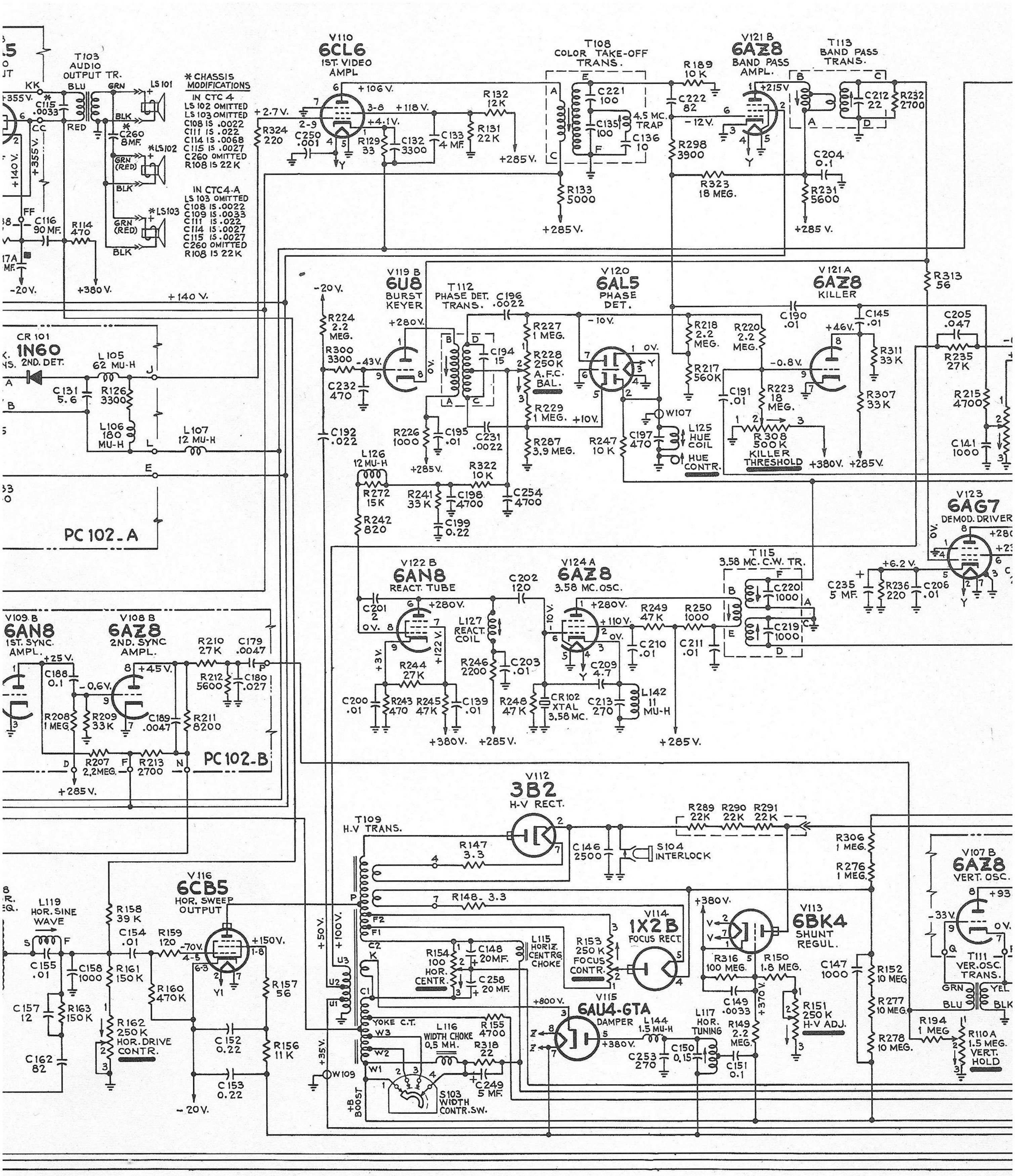


Fig. 207—Schematic Diagram—21CT660U Series—
Late Production.

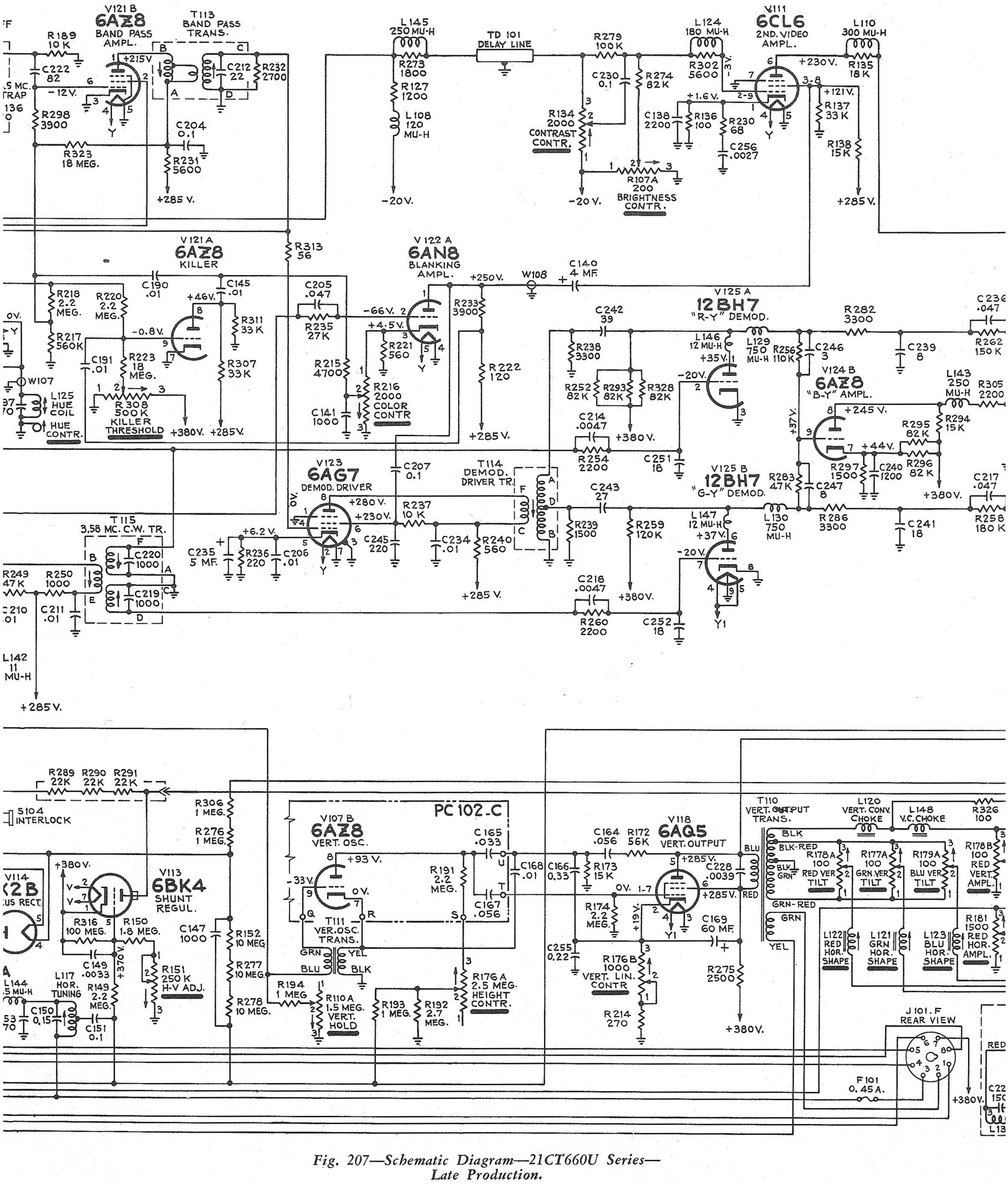
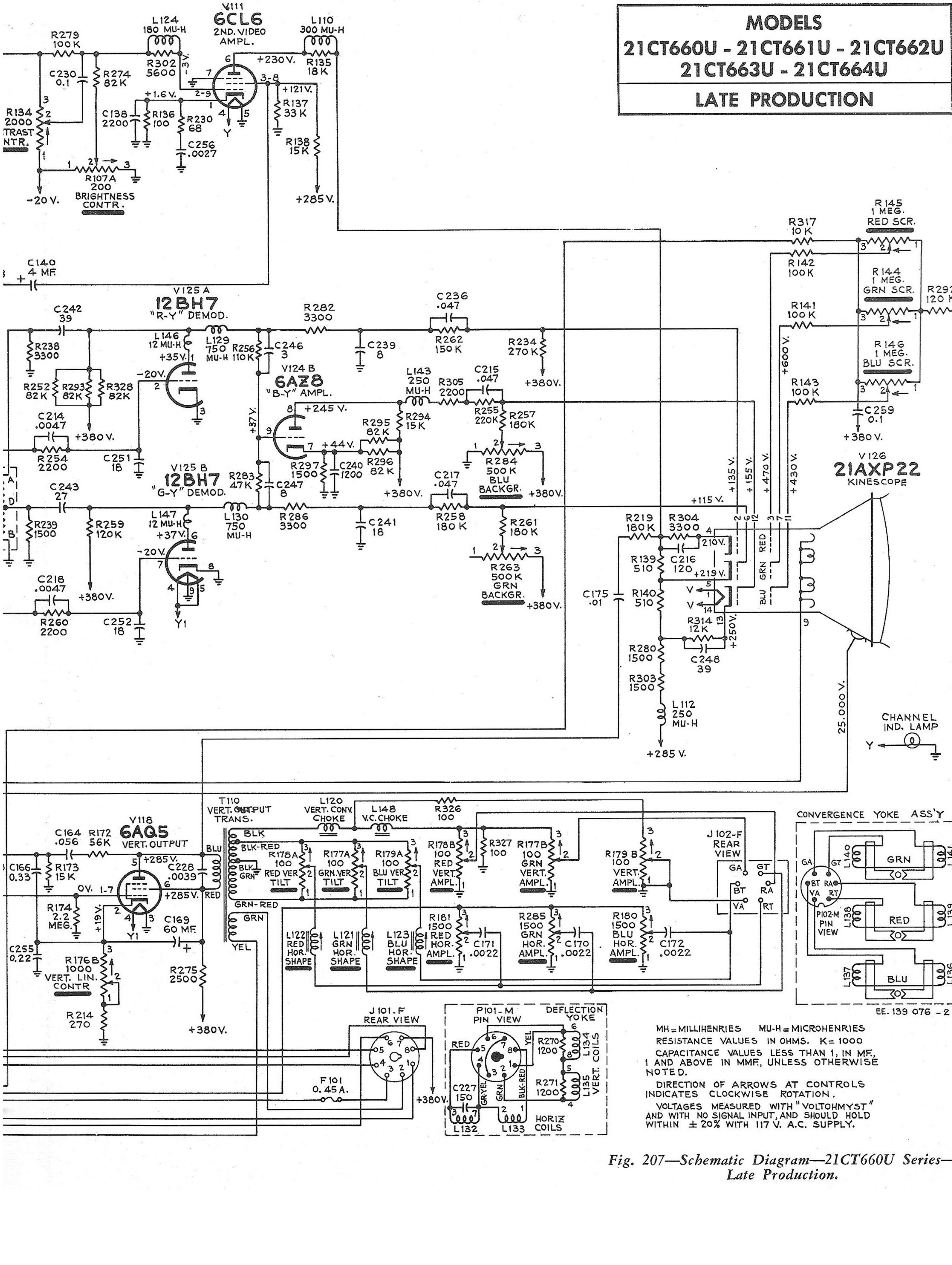


Fig. 207—Schematic Diagram—21CT660U Series—Late Production.

MODELS
21CT660U - 21CT661U - 21CT662U 21CT663U - 21CT664U
LATE PRODUCTION



MH = MILLIHENRIES MU-H = MICROHENRIES

RESISTANCE VALUES IN OHMS. K = 1000

CAPACITANCE VALUES LESS THAN 1, IN MF., 1 AND ABOVE IN MMF., UNLESS OTHERWISE NOTED.

DIRECTION OF ARROWS AT CONTROLS INDICATES CLOCKWISE ROTATION.

VOLTAGES MEASURED WITH "VOLTOHMYST" AND WITH NO SIGNAL INPUT, AND SHOULD HOLD WITHIN ± 20% WITH 117 V. A.C. SUPPLY.

Fig. 207—Schematic Diagram—21CT660U Series—Late Production.