LB-925

R. C. A. DEVELOPMENTAL COLOR TELEVISION RECEIVER

RADIO CORPORATION OF AMERICA

RCA LABORATORIES DIVISION

INDUSTRY SERVICE LABORATORY

LB-925
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RCA Developmental Color Television Receiver

Approved

Stuart W. Seeley

Contents

This bulletin contains the following three sections:

Scanner's note: The 97 page Section III (Constructional Data on Transformers and Coils) has been omitted. Its content is similar to that in the LB-825A addendum.

- John Atwood, 180622

Introduction

A circuit diagram of an RCA developmental color television receiver was shown in *LB-918*. Industry interest in a receiver operating on the present NTSC color signal was such that in order to expedite distribution of the circuit no discussion or constructional information was included. The purpose of this bulletin is to describe that receiver and its circuits together with their construction and adjustment.

Since this is a developmental receiver the performance characteristics included in this bulletin may not represent design center conditions. Further optimization of circuit parameters will be necessary for a production design based on this information. The information is given to assist in the understanding of the circuit operation and to illustrate the design considerations involved.

General Receiver Features

The RCA developmental color receiver is shown schematically in Fig. 1. This circuit is the same as that shown in *LB-918* except for certain minor circuit corrections. The receiver provides for all functions necessary for the reception of NTSC color signals. The 45-Mc picture i-f amplifier has characteristics that meet the requirements of color signals. The picture second detector is operated at high level to provide for maximum linearity. Precautions are taken in the picture i-f amplifier to minimize cross modulation between the sound and color carriers. A separate second detector is provided for a 4.5-Mc intercarrier sound system. The color outputs are obtained by medium level I-Q demodulation. A quartz crystal a-f-c color synchronization circuit is used with an associated color "killer" circuit to disable the color channel during monochrome transmissions. A regulated high-voltage supply of the horizontal pulse type is employed. Both static and dynamic focus and convergence voltages are provided for the RCA tricolor kinescope. Circuits that are common to high quality monochrome receivers include: VHF-UHF tuner, keyed a.g.c., noise inversion sync separation, stabilized horizontal a.f.c., and kinescope grid drive with d-c restoration.

Photographs of the top and bottom of the receiver chassis are shown in Fig. 2a and b.

RF Tuner

The KRK-12 television r-f tuner is a three-tube, sixteen-position, turret-type tuner covering both the VHF and UHF television channels, and providing a 40-Mc i-f output. A 1N82 silicon crystal is used in the mixer circuit for both VHF and UHF. In the VHF range a low noise r-f amplifier is used ahead of the crystal mixer, which in turn is followed by another low noise stage operating at i.f. For the UHF range, the arrangement is similar except that there is no r-f amplifier ahead of the crystal mixer.

Picture IF Amplifer

A. General

The picture i-f amplifier is designed for a 45.75-Mc picture carrier, 42:17-Mc color sub-carrier, and a 41.25-Mc sound carrier. The amplifier consists of six stages, using one stage which is included in the tuner, four 6CB6 stages, and one 6CL6 stage. The second detector uses a 1N60 crystal and is operated at 5 volts peak output level in the interests of linearity. Fig. 3 shows the overall rf-if response characteristic for channel 4.

B. Individual IF Stages

Tuner:

The noise factor of the tuner on UHF depends primarily on the noise contributed by the first i-f amplifier and the conversion loss in the crystal mixer circuit. Therefore, a low-noise stage is used for the i-f amplifier. It is fed from the crystal mixer by means of a single-tuned circuit. The output network is a link-coupled, bridged-T, circuit with a trap tuned for rejection of the accompanying sound frequency (41.25 Mc). In order to reduce cross modulation, the sound carrier is attenuated as soon as possible in the i-f amplifier.

First IF:

The first picture i.f. (6CB6) employs a bridged-T, m-derived, bandpass circuit with the rejection traps tuned for adjacent picture (39.75 Mc) and adjacent sound (47.25 Mc).

Second, Third, and Fourth IF:

The second (6CB6), third (6CB6), and fourth (6CB6) picture i-f stages form a staggered triple with the second and third stages tuned, respectively, to the high and low frequency side of the pass band.

The staggered triple provides a means of compensating for production variations in the overall amplifier, since each stage will affect a different portion of the pass band.

The fourth stage is tuned to approximately the center of the band. A low "Q" absorption trap is loosely coupled to the second stage to shape the high-frequency corner of the m-derived circuit in the first picture i-f stage.

Fifth IF:

The fifth picture i.f. (6CL6) uses a bridged-T, m-derived, bandpass circuit and a mutually coupled absorption trap. The bridged trap is tuned to the accompanying sound frequency (41.25 Mc), and the absorption trap to the adjacent sound frequency (47.25 Mc).

C. Alignment

The alignment of the picture i-f amplifier should be done with approximately 8 volts of bias on the a-g-c bus and 5 volts of detected output across the second detector load resistor, R190.

The general alignment procedure requires the individual adjustment of the fifth i-f plate circuit T112 and T113, the first i-f plate circuit T107 and T108 and the first i-f grid circuit T106. The overall response of Fig. 3 is then produced by adjustment of the staggered triple comprising the second, third and fourth i-f stages.

The adjustment of the fifth i-f plate circuit and the first i-f plate circuit requires initial alignment of the traps to their specified frequencies and then adjustment of the primary and secondary coils for the respective responses of Fig. 4a for the fifth i.f. and Fig. 4b for the first.

The alignment of the first i-f grid circuit requires adjustment of the sound trap and sound control for maximum attenuation at the sound carrier frequency, 41.25 Mc. The alignment of the grid coil to produce the response of Fig. 4c is then done. Following this adjustment the sound control R158 is rotated so as to increase its resistance, to reduce the sound carrier attenuation of this circuit to 30 to 1 with respect to its response at the picture carrier frequency.

The overall response of Fig. 3 is obtained by adjusting the staggered triple. The second i.f. is tuned in the vicinity of the picture carrier (45.75 Mc) with the trap slug set such that the trap is tuned to its highest frequency. The third i.f. is tuned to approximately 41.65 Mc, and the fourth to the center of the pass band. The adjustment of the second i.f. determines the high-frequency portion of the pass band, the third i.f. the low-frequency portion and the fourth i.f. the tilt of the amplitude response. The trap on the second i.f.

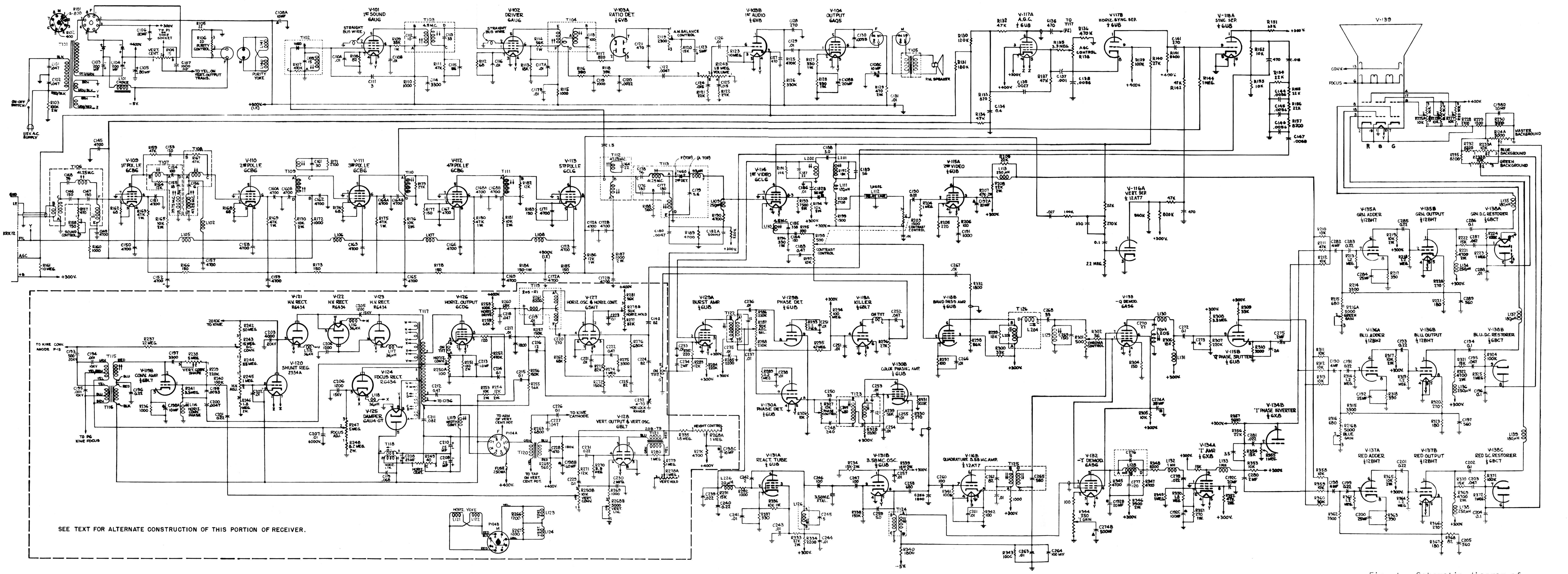


Fig. 1 – Schematic diagram of RCA developmental color television receiver.

is adjusted to shape the high-frequency corner to conform to the specified response.

Sound IF and Audio

In most monochrome intercarrier sound receivers the sound take-off follows the second detector. In order to minimize the possibility of a 920-kc beat between sound carrier and color subcarrier it is desirable to have relatively high attenuation of the sound carrier at the second detector. To obtain maximum sound gain it is desirable to take off sound information as late as possible in the i-f system; in this case the plate of the fifth picture i-f tube. The additionally needed sound rejection for video is then obtained by bridging the m-derived, bandpass circuit for maximum sound rejection.

The 4.5-Mc intercarrier sound information taken off at the plate of the fifth picture i-f amplifier is detected by a 1N60 crystal diode feeding a single-tuned circuit in the grid of the sound i-f amplifier (6AU6). The output circuit is a high-impedance, double-tuned, bandpass transformer. Following is the driver (6AU6) for the ratio detector, which is operated with low screen voltage and grid-leak bias in order to improve AM rejection. The ratio detector circuit uses a 6V8, the triode half of which serves as the first audio amplifier. In order to achieve maximum AM rejection in the ratio detector a variable resistance is placed in series with one of the diodes.

The audio channel is single ended with two-tap compensation on the volume control. The audio output stage is a 6AQ5 and feeds an 8-inch PM speaker. The maximum audio power output is approximately 3.0 watts.

Video Section

The video system contains a luminance channel, a chrominance channel, and the matrix.

The luminance channel serves a purpose substantially similar to that performed in standard monochrome receivers, that of amplifying the luminance information to a level satisfactory for application to the kinescope.

The chrominance channel serves to recover the color difference information contained in in the color subcarrier and its accompanying side bands. By the process of synchronous detection in phase quadrature two independent signals are recovered from the color subcarrier. These signals are called I and Q. Both the I and Q channels are band limited. The Q channel passes information up to approximately 0.5 Mc and the I channel to approximately 1.5 Mc. While band limiting of these channels prevents cross talk, it necessitates equalization of signal delay time since the channels have different bandwidth characteristics. Similar equalization is also required in the luminance channel.

The tricolor kinescope requires simultaneous excitation with red, blue and green signals as derived from the composite signal. The matrix combines the chrominance and luminance signals in the proper proportions to obtain the simultaneous red, blue and green signals. A block diagram of the video section is shown in Fig. 5.

Luminance Channel

The first video amplifier stage, a 6CL6, V114, provides both polarities of the composite wide-band video signal. Positive video at the plate provides the luminance channel signal as well as the sync, a-g-c, and burst signals. The luminance signal is fed to the Y delay line which provides a time delay of approximately 1.0 microsecond, thereby effecting time coincidence with the chrominance signals arriving at the matrix input. The Y delay line is electrically terminated by a potentiometer which is one section of a two-section contrast control. The other potentiometer is in the cathode of V114 and controls the amount of video fed to the chrominance channel. These two potentiometers comprise the contrast control and have their shafts mechanically ganged. Thus, proper relationship between the luminance channel and chrominance channel signals for all contrast settings is maintained.

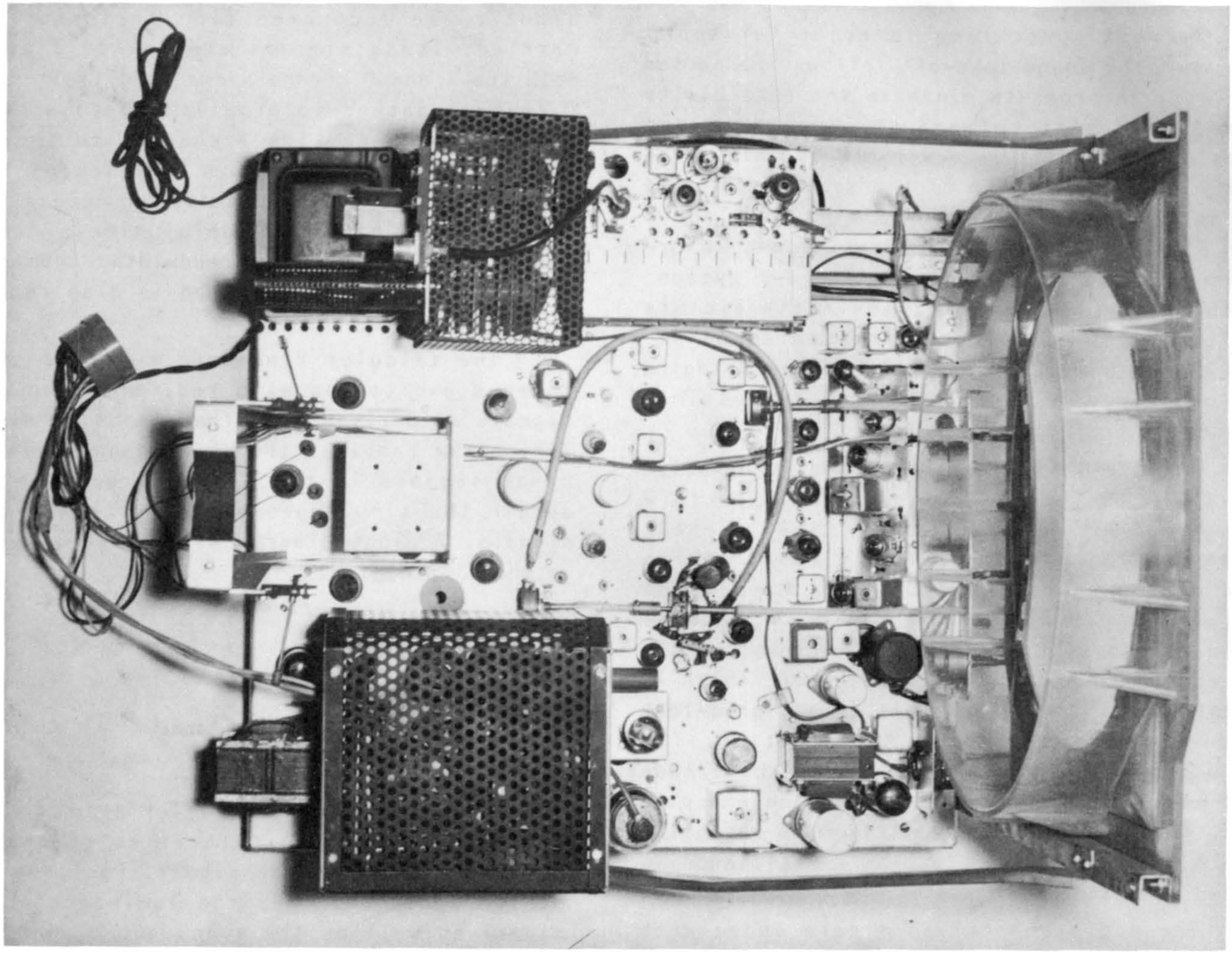


Fig. 2a - Photograph of top of the receiver chassis.

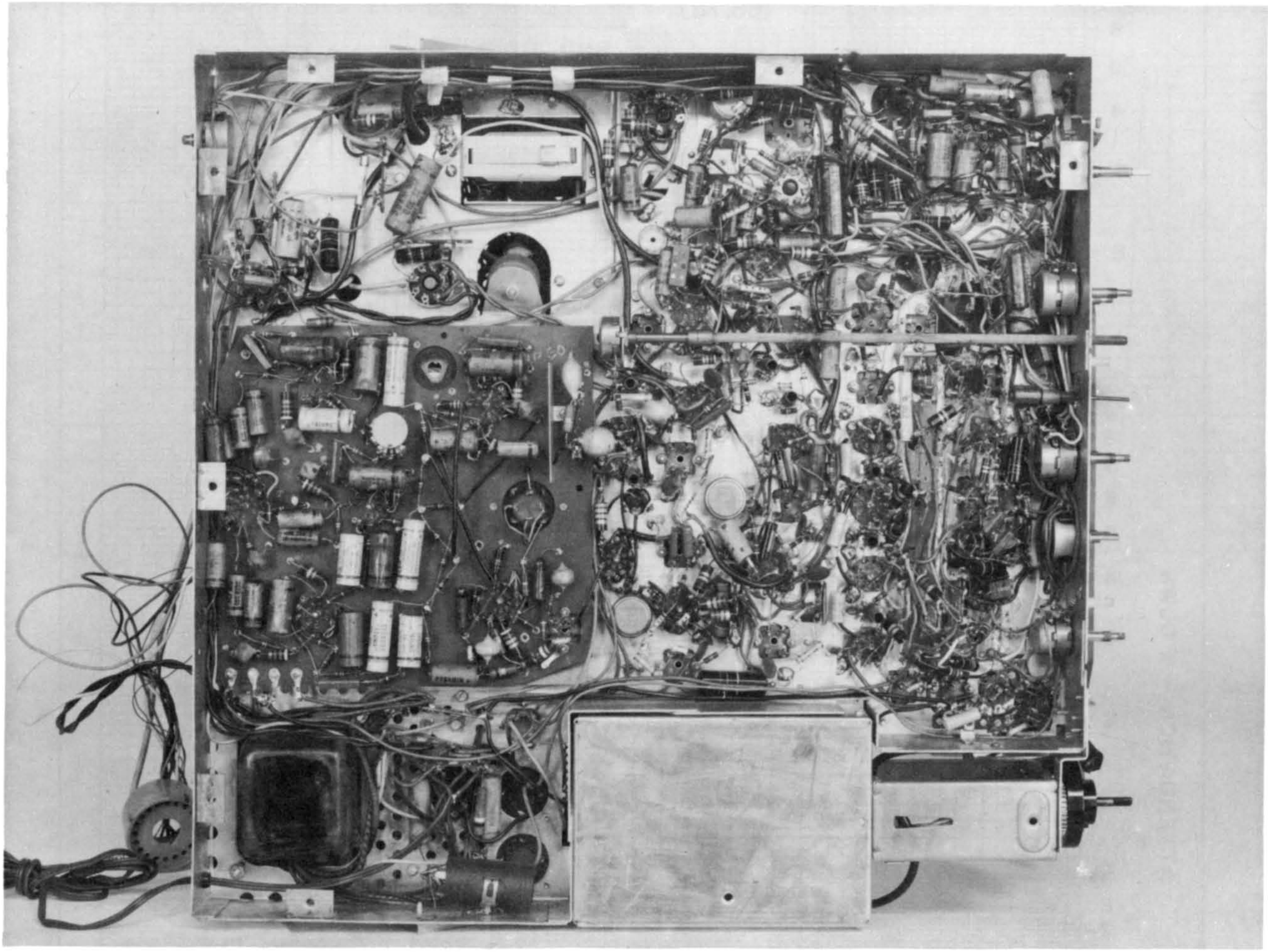


Fig. 2b - Photograph of bottom of the receiver chassis.

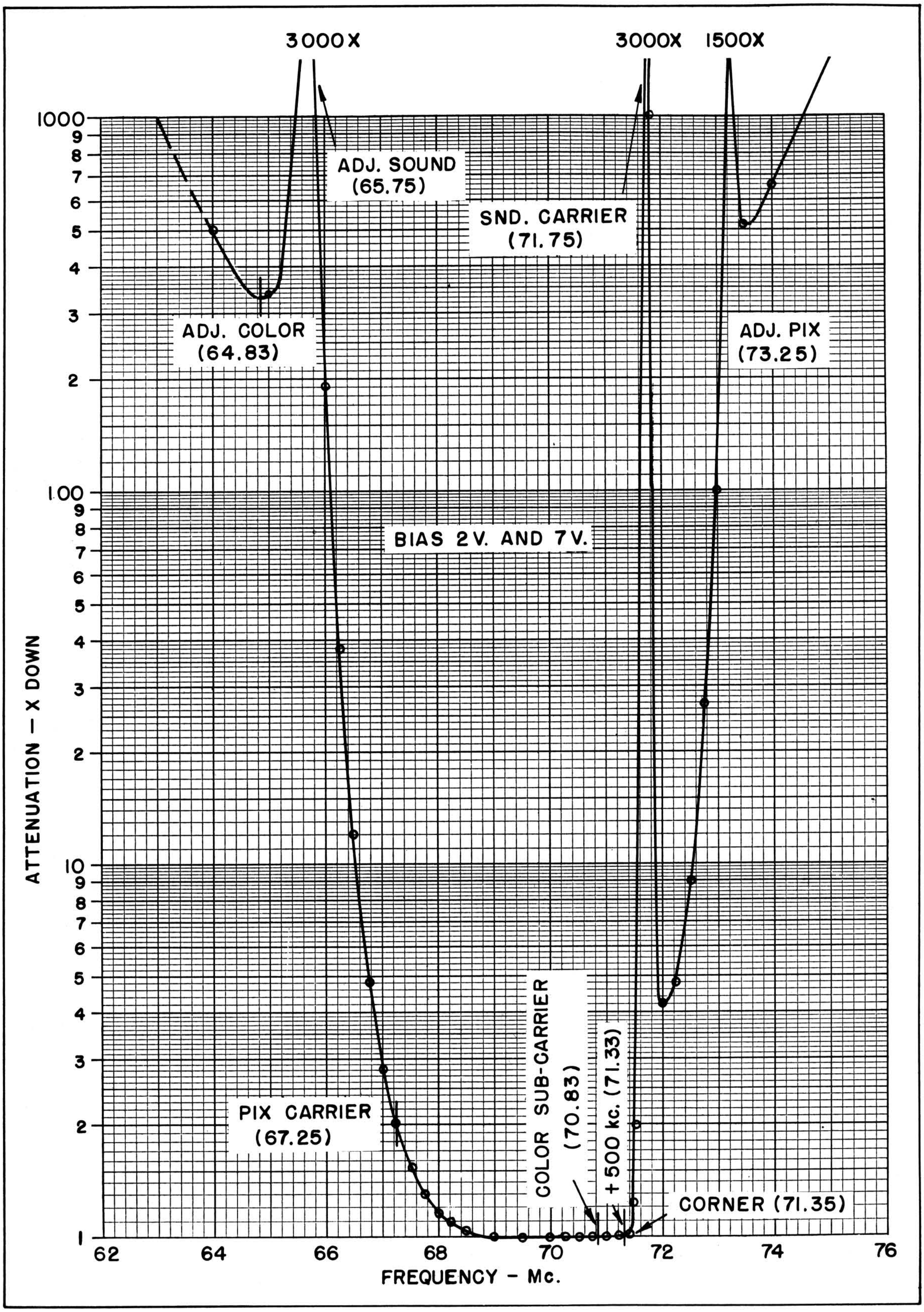
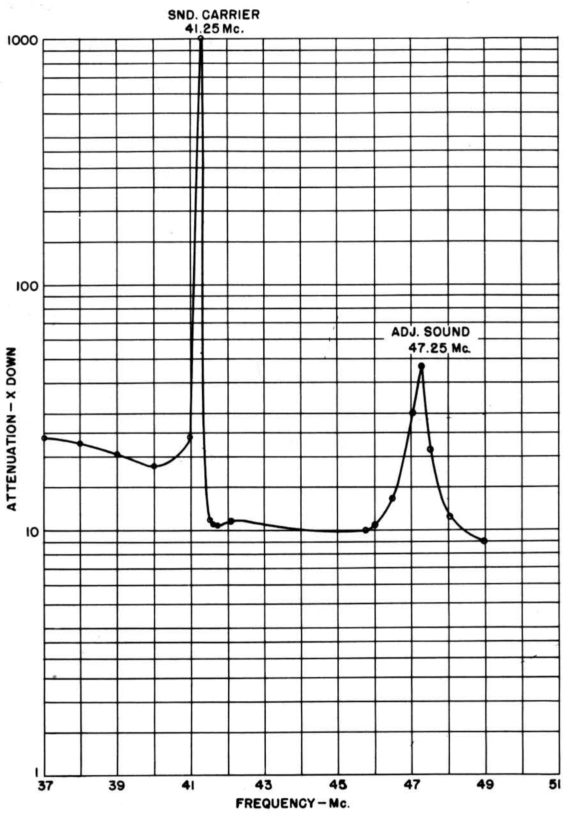
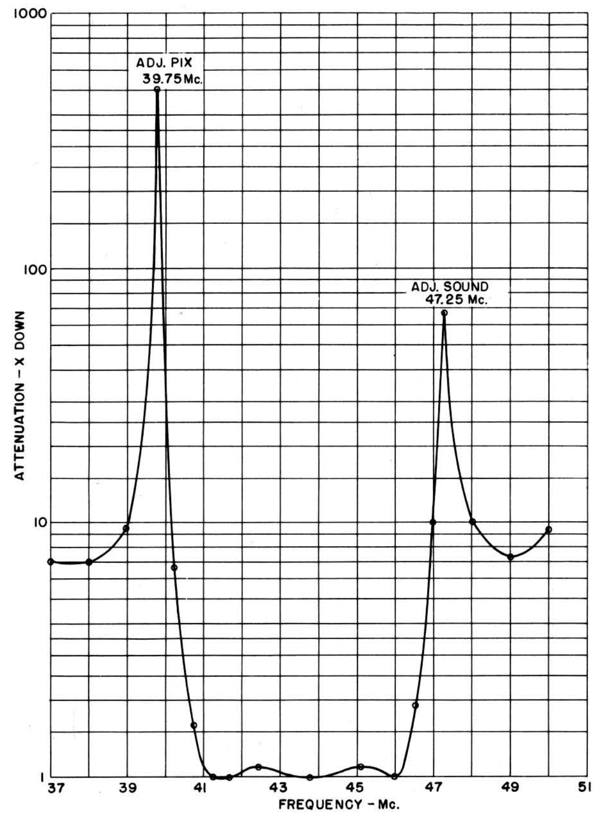


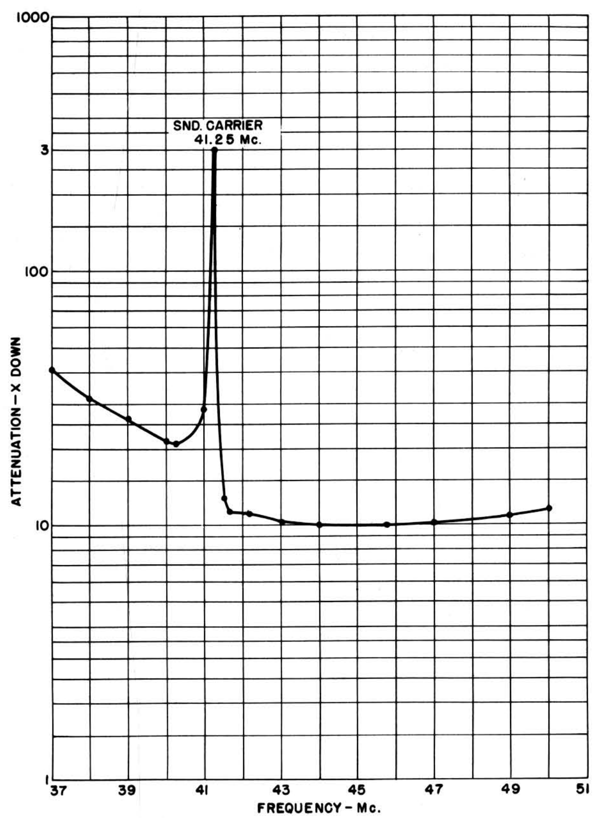
Fig. 3 - Overall r.f.-i.f. response, channel #4.



(a)-Response, fifth picture i.f.



(b)-Response, first picture i.f.



(c)-Response, first i-f input.

Fig. 4 - IF responses.

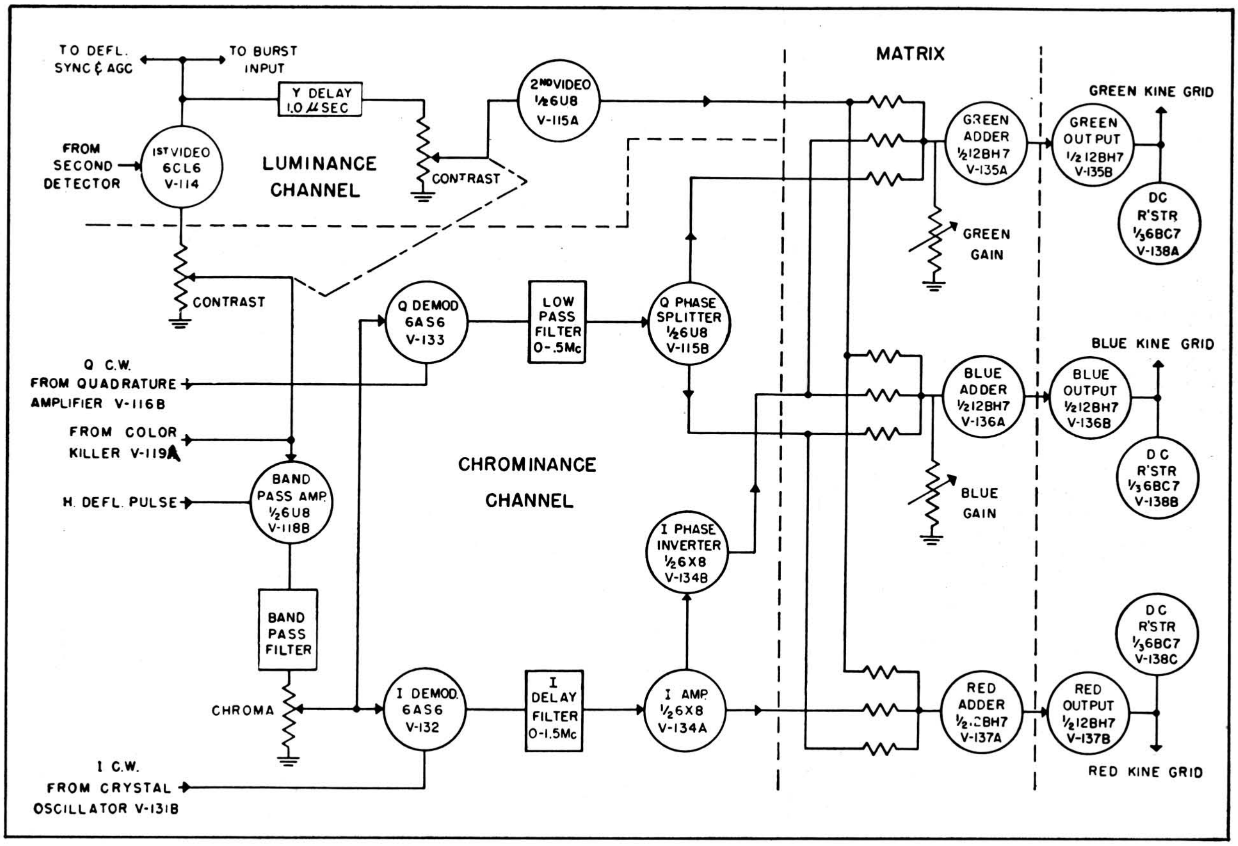


Fig. 5 - Video section block diagram.

Further amplification of the luminance signal is the second video amplifier stage, pentode section of a 6U8, V115A, brings the signal to a level suitable for application to the matrix. The frequency response at this point is essentially similar to that encountered in standard monochrome receivers with some additional attenuation at the subcarrier frequency.

The video second detector operates at a signal level of about 5 volts peak-to-peak. With this signal amplitude at the grid of V114, the first video amplifier, a signal of approximately 6 volts peak-to-peak is developed across R203, the terminating resistor of the delay line, L112. Under average operating conditions the master contrast control is generally set to give about 20 volts peak-to-peak signal at the plate of V115A, which is the luminance signal input to the three resistive matrix networks. When the appropriate color difference signals are added to the luminance signal in the matrix networks, three simultaneous primary-color signals are obtained. These are amplified in the three feedback amplifiers, V135, V136 and V137. The amplitudes of the signals at the outputs of these amplifiers, which are applied to the tricolor kinescope grids, are about 70 volts peak-to-peak for the blue and green guns and about 100 volts peak-to-peak for the red gun.

The data on the 4.5-Mc trap and L201 and L202, all associated with V114, are shown in Table I.

Chrominance Channel

The chrominance signal from the cathode of the first video amplifier is fed to the bandpass amplifier, pentode section of a 6U8, V118B. The plate circuit of this stage contains the bandpass filter which passes the color subcarrier and its sidebands. This filter has a bandwidth of approximately 2.4 to 5.0 Mc and is terminated by a potentiometer which serves as the chroma control.

During each burst interval the bandpass amplifier is keyed off by applying a negative

Table I

VIDEO SECTION COIL DATA

NUMBER	NOMINAL OR CENTER VALUE INDUCTANCE	Q	DISTR. CAP.	REMARKS
L110	5.8 µh	85 @ 4.5 Mc		Center tapped, slug tuned.
L126	106 µh	87 @ 1.6 Mc		Single layer solenoid, 9/32" O.D., 170 turns #36, slug tuned.
L128 AB	0.86 mh			2-pie, 9/32" O.D., fixed slug.
BD	0.86 mh			
AD	2.46 mh	75 @ 5 Mc		
L130	6.7 mh		1.6 µµf	3-pie, .18" O.D., no slug, low distributed capacitance desirable
L131	1.9 mh		6 to 8 µµf	1-pie, .18" O.D., no slug, indicated distributed capacitance needed
L132 & L133	1 mh			2-pie, .18" O.D., no slug, self resonant about 3.58 Mc
L201 & L202	58 µh			Close wound, #36, 9/32" O.D., slug tuned

COLOR SYNC TRANSFORMER DATA

NUMBER	PRIMARY		SECONDARY		REMARKS
	turns	wire	turns	wire	
T122	120	#36 spaced 110TPI	18 bifilar 36 total 55TPI	#36	Primary 9/32" O.D., Secondary concentric bifilar, slug tuned
T123	150	#38 close	8 bifilar 16 total 35TPI	#34 spaced	Critical coupling or less, two slugs, 9/32" O.D., secondary concentric bifilar
T124	20	#34 spaced 55TPI	40 80TPI	#34 close	Secondary 9/32" O.D., Primary concentric, slug tuned
T125	55	#34 close	18 70TPI	#34 spaced	9/32"O.D., two slugs, primary and secondary end to end with 1/8" separation, critical coupling

BAND PASS FILTER

NUMBER	REMARKS
L203 BA	3-pie, tapped between bottom two pies, slug advanced through top pies, low distributed capacitance desirable, 9/32" O.D.
L204 DC	58 µh, 9/32" O.D., #38 close wound, slug tuned
(L203 and L204 together: T126)	
L129	13.6 µh, Q @ 3 Mc is 80, 9/32" O.D., slug tuned

pulse derived from horizontal deflection to the screen of the tube. Keying out the burst in this manner avoids color kinescope background unbalance due to the d-c restorers clamping on demodulated burst rather than on tips of sync.

The grid circuit of the bandpass amplifier operates in conjunction with the color killer tube, triode section of a 6BL7, V119A. The killer stage is held at cutoff by a negative d-c voltage developed by the burst phase detector. In the absence of burst, that is, a standard monochrome transmission, the killer stage conducts and biases the bandpass amplifier to cutoff, thereby assuring that no signal information passes to the demodulator grids via the bandpass filter.

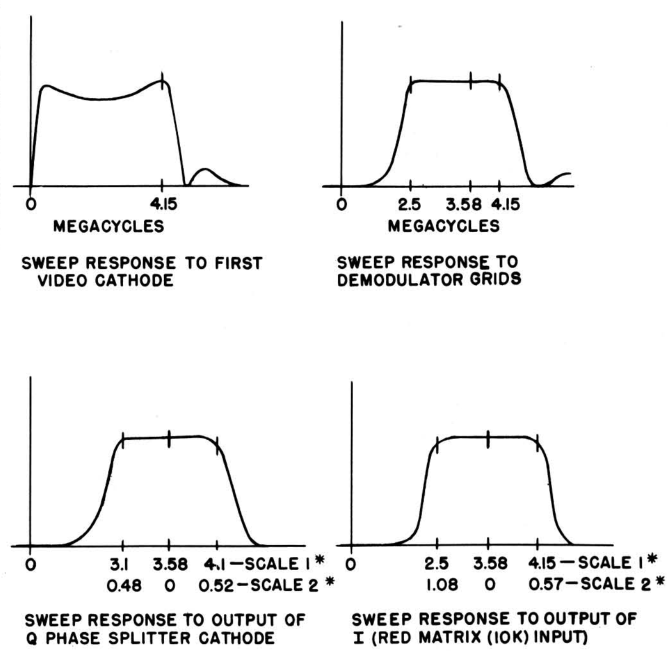
Demodulation of the chroma signal is accomplished by a pair of 6AS6 synchronous detectors operating in quadrature. Color subcarrier voltages of about 25 to 30 volts peak-to-peak are applied to the number 3 grids. The chroma signals from the arm of the bandpass filter terminating potentiometer is applied to the number 1 grids.

The detected Q signal appears at the plate of the Q demodulator and is band limited by a 0.5-Mc low pass type filter. This signal is fed to the Q phase splitter whose outputs provide the positive and negative Q signals necessary for matrixing.

The detected I signal appearing at the plate of the I demodulator is fed to a bridged negative mutual type filter which is coupled to the grid of the I amplifier, V134A, by a series-peaking circuit. The plate of this amplifier is coupled to the grid of the I phase inverter V134B and the matrix through another series-peaking circuit. The combined phase and amplitude characteristics of the filter and series peaking circuits provide a uniform time delay approximating the delay of the Q channel, and proper I channel bandwidth. The positive I signal necessary for matrixing is derived from the plate circuit of V134A, while the negative I signal necessary for matrixing is derived from the plate of the I phase inverter, V134B.

The chrominance channel section of the master contrast control has available a maximum of about 3 volts peak-to-peak of composite video signal. Although the available peak-to-peak signal at the output of the bandpass filter is about 6 volts with both chroma and master contrast controls at maximum, only about 2 volts peak-to-peak is used under average operating conditions to drive the signal grids of the two demodulators, V133 and V132. The maximum available peak-to-peak signal (color oscillator out-of-lock in order to produce demodulated signals corresponding to all possible phases of chrominance information) at the plate of the Q demodulator, V133, is about 20 volts peak-to-peak. The signal at the plate of the I demodulator under these same conditions is about 3 volts peak-to-peak. The Q phase splitter produces both polarities of the Q signal and has a gain of about 0.75 to the cathode and about 2 to the plate. The I amplifier, V134A, has a gain of about 11. The I phase inverter, V134B, has a gain of about unity.

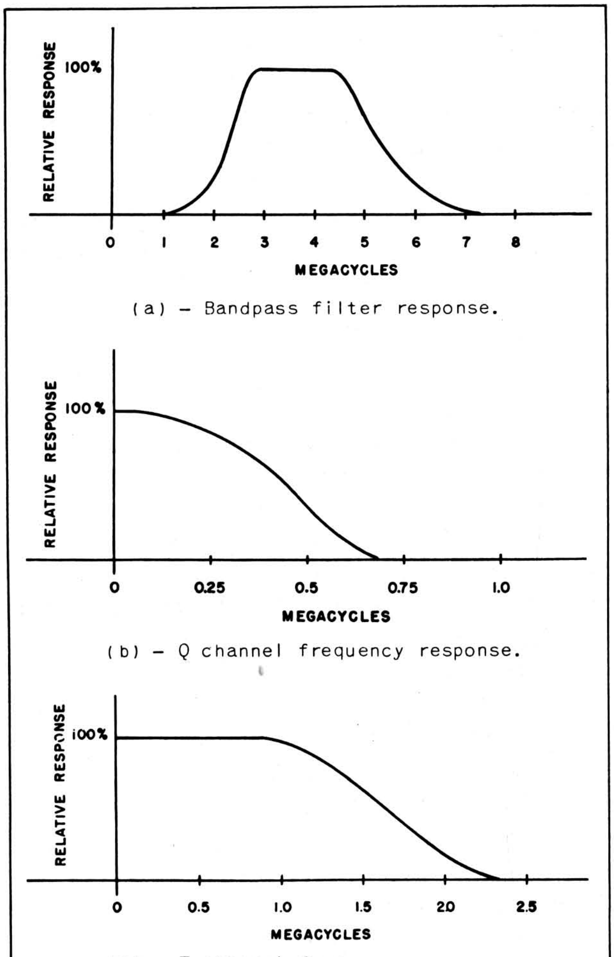
Data on the coils used in the bandpass network are given in Table I. The data on the coils used in the I and Q low pass networks are also given in Table I. The low pass network in the Q demodulator is a linear-phase type of peaking circuit. The distributed capacitance of L128, a part of the I demodulator filter network, is of importance.



*Scale 1 relates the indicated amplitude response to particular video frequencies. Scale 2 relates the same amplitude response to demodulated color frequencies. This shows the manner in which the upper and lower side bands of the color subcarrier are treated.

Fig. 6 - Overall chrominance swept responses.

Fig. 6 shows the amplitude response at various points in the chrominance section of the receiver. These responses were taken by applying a sweep oscillator to the video input terminals of an r-f television signal generator. Therefore each response characteristic is the result of all circuits between the sweep generator and the point at which measurement is made in the receiver. Fig. 7 shows the individual amplitude responses of the bandpass filter, and I and Q low-pass networks.



(a) – Bandpass filter response.

(b) – Q channel frequency response.

(c) – T channel frequency response.

Fig. 7 – Chrominance channel responses.

Matrix Section

In order to synthesize the red, green and blue drive signals, required by the kinescope, from the Y, I and Q signals, a fixed resistive mixing type of feedback amplifier is employed. Using one triode section of a 12BH7 in conjunction with three fixed matrix resistors for the red, green, and blue adder stages respectively, linear addition of Y with the proper amplitude and polarity of I and Q is accomplished with approximately unity gain.

The added luminance and chrominance signals are then amplified by the output amplifier stages, second half of the twin triode 12BH7, to a level suitable for application to the respective kinescope grids. Unequal kinescope drive signals are required because of the unequal phosphor efficiencies of the tricolor kinescope, and the requirement for producing a desired color temperature. The red gun requires approximately 50 per cent more drive than do the blue and green guns. Overall gain controls for the green and blue channels are provided.

DC restoration is applied to the red, blue and green output signals by a 6BC7, V138, a triple diode tube. The plate return circuits for these three restorers are arranged in a bridge circuit which is adjusted to maintain tracking of the three kinescope grid bias values proportional to the video drives throughout the range of the master brightness control.

Kinescope and Video Adjustments

Saturated color bar patterns with stepped gray scales are the most desirable signals to use for set-up of the color circuits. The kinescope d-c potentials should be adjusted first. With the chroma and contrast controls at a minimum and the master brightness control at a maximum, the red, green and blue screen controls are set for a low-brightness gray. Using the gray bar pattern, normal highlights may be introduced by advancing the master contrast control. The highlights should be adjusted for neutral hue through the use of the green and blue gain controls. By dropping the brightness level, a gray scale is maintained by adjusting the green and blue background controls. The saturated color bar pattern is used to adjust the chrominance channel. The following adjustments can be made only with the I and Q demodulator phases properly adjusted as explained in a succeeding section under the heading "Color Synchronization". The chroma and I gain controls are advanced until rectangular pulses corresponding only to the particular color bars are observed with an oscilloscope at three kinescope grids.

Delay Adjustments

Best reproduction of color transitions requires that the overall time delay for the luminance channel, I chrominance channel and Q chrominance channel be identical. The broad band luminance channel has negligible delay of its own. Both chrominance channels have the delay of the bandpass stage and their respective low-pass stages with the 0.5-Mc Q channel having the greatest delay possibility. Equalization of the I and Q delays is accomplished by choosing a filter for the I channel having proper bandwidth and a time delay equal to that of the Q channel. Additional delay is added between the first and second video amplifiers to equalize the luminance channel. One technique for adjusting delays requires an r-f signal modulated with the color bar pattern of the test signal generator described in LB-819, *A Color Television Test-Signal Generator*. An oscilloscope with an expanded sweep at line frequency is connected to a kinescope grid. The sweep is adjusted to allow examination of the color transition appropriate to the grid under observation. The delay is adjusted to provide symmetrical transients or "spikes" around the transitions.

Color Synchronization

In order to recover the color information contained in an NTSC type signal, it is necessary to generate a local subcarrier of proper frequency and phase. To accomplish this, phase reference information is transmitted as a component of the composite color video signal. The color synchronizing information is transmitted in the form of a "burst" of approximately 8 cycles of the color subcarrier frequency and appears immediately following each horizontal synchronizing pulse in the composite signal.

This "burst" is separated from the composite video signal and is used in establishing two continuous-wave signals of color subcarrier frequency having a 90-degree phase displacement with respect to each other. These signals, called I c.w. and Q c.w., are generated by a quartz crystal oscillator which is locked in phase and frequency by a reactance tube. The reactance tube derives its control information from an error signal proportional to the difference in phase between the transmitted "burst" and the local crystal oscillator output.

The color synchronizing channel shown in Fig. 8 includes a keyed burst amplifier stage, phase detector, 3.579-Mc driver and color phasing amplifier, crystal oscillator, reactance tube, and quadrature 3.579-Mc amplifier.

The burst amplifier stage, pentode section of a 6U8, V129A, is driven from a tuned coil capacity coupled to a 3.579-Mc trap in the first video amplifier plate. The burst signal at the grid of the burst amplifier is about 10 volts peak-to-peak. Specifications for L201 and L202 are given in Table I. The burst amplifier cathode is keyed by a partially integrated negative pulse of about 37 volts peak-to-peak derived from horizontal deflection. About 40 volts of partially fixed cathode bias is provided for this stage. The discriminator transformer in the plate circuit of the burst amplifier V129A has a high-impedance primary and a bifilar secondary tightly coupled to the primary. Specifications for this transformer, T122, are given in Table I. The output is approximately 60 volts peak-to-peak of burst signal on either side of the secondary center tap.

The phase detector uses the triode sections of two 6U8's, V129B, V130A, connected as grid-cathode diodes with the plates acting as shields. The phase detector compares the phase of the incoming burst signal with the phase of the locally generated c-w signal. The color-phasing amplifier, V130B, provides 25 to 35 volts peak-to-peak of this signal at the reference voltage input to the phase detector, pin 8 of V130A and pin 9 of V129B. The specifications for the plate transformer of this amplifier, T123, are given in Table I. The output of the phase detector controls the reactance tube. The color-phasing amplifier, pentode section of a 6U8, V130B, serves the additional function of an overall phase control. The phase-control po-

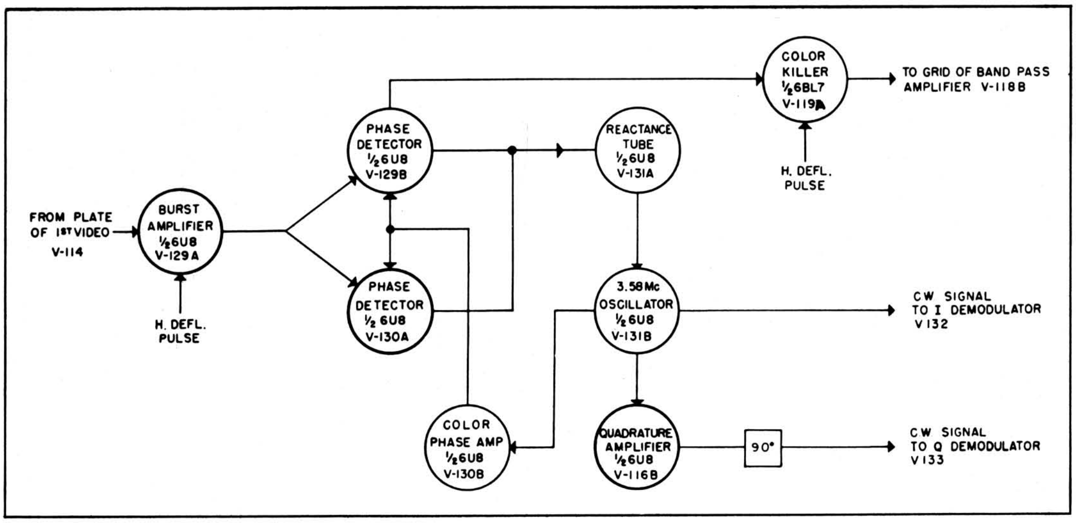


Fig. 8 - Color synchronization channel block diagram.

tentiometer associated with this circuit permits manual adjustment of the phase of the local oscillator over 150 degrees.

The reactance tube stage, pentode section of a 6U8, V131A, is of the capacitive type. It has a total equivalent incremental capacity of about 7 μμf over its range. The control sensitivity in the center of its characteristic is about 175 cycles per volt. Specifications for the reactance tube plate coil, L126, are given in Table I.

Operating the oscillator, (triode section of V131B), as a cathode-tuned type eliminates the possibility of spurious oscillations due to the reactance tube plate coil. This occurs because operation of an oscillator as a cathode follower requires the cathode tank to be tuned below 3.579 Mc. It falls between the tuning points of the crystal and the reactance tube plate coil. The oscillator cathode transformer has its secondary tightly coupled to the primary. The low side of the secondary is directly connected to the demodulator bias source, while the high side is connected to the I demodulator number 3 grid through a shielded lead. The I c-w signal required for synchronous detection is taken off directly from this point. Specifications for the cathode transformer, T124, are given in Table I.

The quadrature 3.579-Mc amplifier, triode section of a 6U8, V116B, is driven from the oscillator. A coupled transformer in the plate circuit yields a 3.579-Mc voltage having a 90-degree phase displacement with respect to the phase of the oscillator voltage. This is the Q c-w signal required for synchronous detection. Both signals are of 25 to 30 volts peak-to-peak amplitude at the demodulators.

Color Sync Alignment

The color synchronization circuits may be aligned as follows:

1. Tune the oscillator cathode transformer T124 for maximum drive to the grid pin 2, V130B, of the color phasing amplifier, then increase its inductance until this drive drops to about 5 volts peak-to-peak.

2. With the control grid, pin 2, V129A, of the burst amplifier shorted to ground, tune the primary and secondary of T123 for maximum negative voltage at the grid, pin 9 of V130A. The secondary of T123 should then be adjusted for minimum output voltage variation (indicated by the d-c voltage at pin 9 of V130A) over the range of the phasing control R327.

3. With the d-c return of the grid of the reactance tube V131A shorted to ground by shorting C239, adjust L126 for the correct crystal oscillator frequency. The correct frequency is indicated by observing color synchronism of the color bars on the kinescope or at the output of either the I or Q demodulators by use of an oscilloscope.

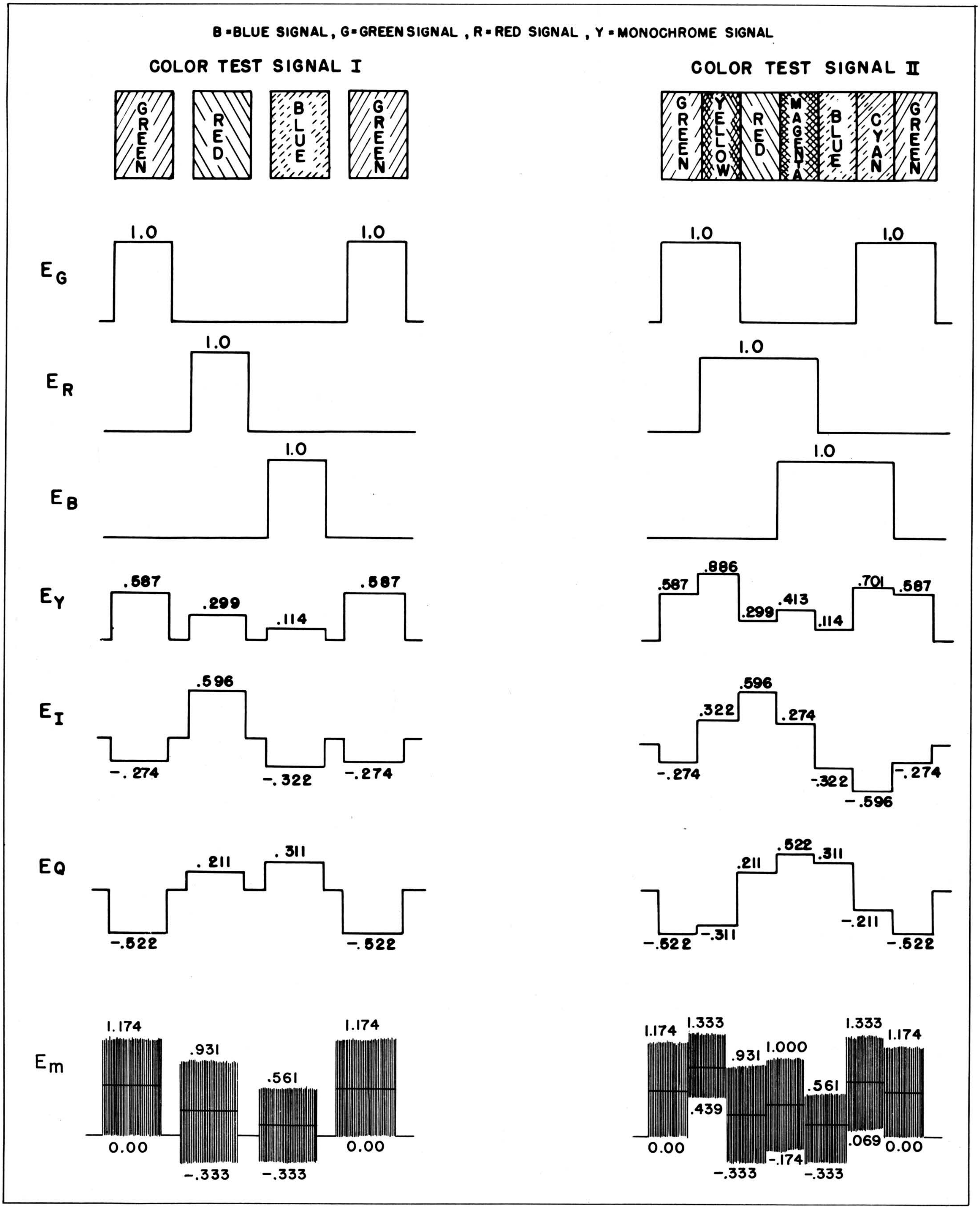


Fig. 9 – Monochrome, color difference and color signals in a television receiver supplied with an NTSC color signal (Feb. 2, 1953) modulated by the indicated test patterns.

4. With pin 2, grid of V130B shorted to ground, tune L201, L202 and T122 for maximum negative voltage at pin 9, grid of V130A.

5. With the burst and c-w inputs to the phase detector and oscillator detuned by adding about 10 μμf across the crystal so that the oscillator is out of synchronization, adjust R287, the a-f-c balance control for zero d-c voltage across C239 which is the grid return of V131A.

6. With the I signal turned off adjust R237, the phase control, for zero video output from the I demodulator.

7. With the Q signal turned off, and the phase control left undisturbed, tune T125 for zero video output from the Q demodulator.

If an off-the-air color bar pattern signal is used, steps 6 and 7 can be accomplished by adjusting the phase controls until the required I and Q outputs from the demodulators are obtained as shown in Fig. 9.

Color Circuit Radiation

A color television receiver, operating on the NTSC color signals, includes circuits that can cause interference to other services operating near the color subcarrier frequency or its harmonics unless proper precautions are taken in the design of the color receiver.

In this receiver the 3.579-Mc c-w signals on the demodulators and the color phasing amplifier are kept at the minimum levels consistant with reasonable efficiency. Also, those tubes which are potential radiators are shielded. All 3.579 c-w circuits are placed in shield cans as indicated on the diagram.

To minimize interference from the color demodulator circuits, peaking coils L132 and L133 in the I channel are made self resonant at 3.579 Mc. In the Q channel, a series resonant 3.579 trap and a low distributed capacity peaking coil are used in the demodulator output.

A bottom cover is used to provide additional shielding for the radiating circuits and to reduce possible radiation from outside sources into the color receiver.

Deflection Synchronization

Approximately 40 volts peak-to-peak of composite video signal is fed into the vertical and horizontal sync separators, from the plate of V114. The vertical sync separator is a grid-leak-biased type employing a double time constant and developing about 50 volts peak-to-peak of sync at its plate. The horizontal sync separator is cathode biased, developing about 25 volts peak-to-peak of sync at its plate. The outputs of both sync separators are fed to the sync amplifier (V118A) which feeds about 20 volts peak-to-peak to the horizontal a-f-c system and about 40 volts peak-to-peak to the vertical integrating network.

When the final i-f amplifier (V113) is overloaded by noise, negative pulses are developed at its screen. These are fed to the input of the vertical sync separator to cut it off for the duration of each noise pulse.

Automatic Gain Control

Automatic gain control is derived from the rectified voltage at the cathode of V118A, the horizontal sync separator. This voltage is amplified and referenced to ground by means of V117A, a keyed pentode. The pulse voltage on the plate is about 600 volts and is obtained from tap No. 2 on the transformer primary. To vary the operating levels, the grid of the a-g-c amplifier is connected to a potentiometer in a divider between the cathode of V118 and ground. To keep the r-f bias low on weak signals, current is bled into the r-f a-g-c bus from a +300 volt point through a 10-megohm resistor. The diode of V103B is used as a clamp to prevent this bias from going excessively positive.

Horizontal Deflection and High Voltage

The horizontal deflection system supplies the high-voltage potentials along with the horizontal scan. This stage is preceded by a dual triode 6SN7GT horizontal oscillator and a.f.c. which is similar to that system used in many monochrome receivers. In order to produce the regulated 20-kv high-voltage output, the transformer is designed to store the amount of energy required for this purpose. The yoke is a-c coupled from the output transformer and is shunted by a variable inductance width control which supplies the d-c path for electrical centering.

High voltage is obtained by means of a diode-coupled pulse doubler rectifying the boosted retrace pulse. Regulation is achieved by using a d-c grid-controlled shunt regulator tube, which maintains a constant load on the high-voltage system.

A variable tap on the high-voltage bleeder is used to provide approximately 10 kv for the convergence electrode of the tricolor kinescope. A separate rectifier is used for the focus supply and a variable tap on the focus voltage bleeder provides approximately 4 kv to the focus electrode.

The horizontal blocking oscillator and a.f.c. uses a stabilized type of transformer T119. The alignment procedure is the same as that in black-and-white receivers employing this transformer. The amplitude of the sawtooth applied to the grid of the horizontal output tube is controlled by means of potentiometer R258 which varies the plate potential of the blocking oscillator. The timing of the sawtooth relative to the horizontal sync pulse received with the incoming signal is controlled by the horizontal a.f.c. This timing directly affects the relative position of the received color burst in the flyback pulse period. Stable adjustment of the a.f.c. is particularly important because the output transformer supplies keying pulses to several other circuits. These are the burst amplifier V129A, the a-g-c amplifier V117A, the color burst killer V119B and the bandpass amplifier V118B.

As shown, the receiver was built with a metal tricolor kinescope. The deflection, high-voltage, and convergence circuits enclosed within the dotted line on the circuit diagram shown in Fig. 1 used experimental laboratory type tubes and components. The metal shell tricolor kinescope has since been replaced with the developmental No. C73599 glass-envelope kinescope. A new complement of components directly associated with this picture tube together with certain new developmental tube types have been made available by the RCA Tube Department. These new components and tubes are described in the accompanying material, "RCA Developmental Tri-Color Kinescope, Associated Tubes, Components and Circuits" together with circuit modifications.

Power Supply

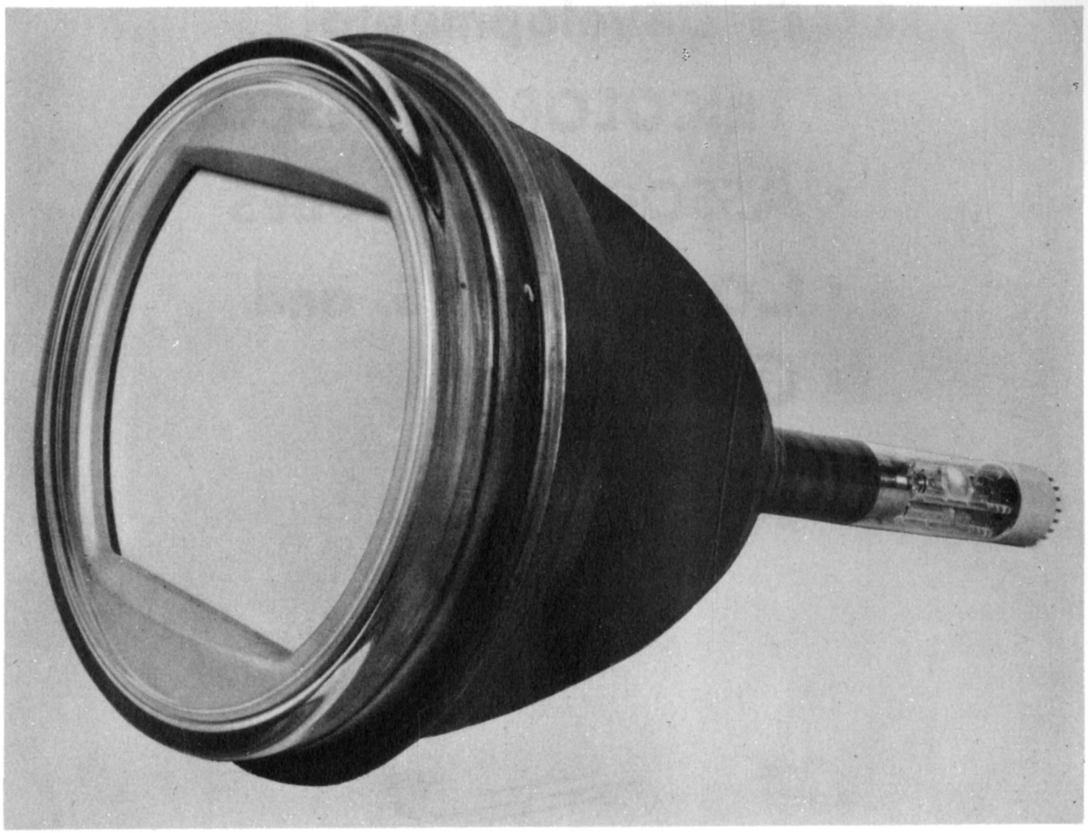
The power supply is included on the chassis. Power input is about 500 watts. The power transformer and full-wave selenium rectifier provide 400 volts d.c. at approximately 600 ma. The filter choke, L101, has an impedance of 175 ohms at 60 cycles with 600 ma, d.c. Its resistance is 30 ohms.

RCA Developmental

- **Tricolor Kinescope**
- **Associated Tubes**
- **Components and**
- **Circuits**

TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

10-53
Photolithographed in U.S.A.



RCA Glass-Envelope Tricolor Kinescope

DEVELOPMENTAL № C-73599

Contents

Preliminary and Tentative Data on Following RCA Developmental Tube Types

* Each of these developmental numbers identify a particular laboratory design, but the number and identifying data are subject to change.

Preliminary and Tentative Data on RCA Developmental

Three-Gun Tricolor Kinescope

Developmental No. C-73599

RCA Developmental Type C-73599 is a directly viewed picture tube of the glass-envelope type for use in color television receivers. It is capable of producing either a full-color or a black-and-white picture 11-1/2" x 8-5/8" with rounded sides.

The C-73599 utilizes three electrostatic focus guns spaced 120° apart with axes parallel to the tube axis, and an assembly consisting of a shadow mask and a plane, tricolor, Filterglass phosphor-dot (screen) plate located between the shadow mask and a clear-glass faceplate.

The tricolor, phosphor-dot plate, which serves as the directly viewed screen, carries an orderly array of small, closely spaced, phosphor dots arranged in triangular groups (trios). Each trio consists of a green-emitting dot, a red-emitting dot, and a blue-emitting dot. The phosphor-dot plate has approximately 195,000 dot trios or 585,000 dots and is metalized after application of the phosphor dots to give increased light output and contrast as well as to prevent ion-spot blemish.

The metal shadow mask, interposed between the electron gun structure and the phosphor-dot plate, contains round holes equal in number to and centered with respect to the dot trios.

DATA

General:

Electron Guns, Three	Blue, Green, Red	
Heater, for Unipotential Cathode of Each Gun, Paralleled with Each of the Other Two Heaters within Tube:		
Voltage (AC or DC)	6.3	volts
Current	1.8	amp
Direct Interelectrode Capacitances (Approx.):		
Grid No.1 of Any Gun to All Other Electrodes Except the No.1 Grids of the Other Two Guns	7.5	μμf
Cathode of Blue Gun + Cathode of Green Gun + Cathode of Red Gun to All Other Electrodes	17.5	μμf
Grid No.3 (Of Each Gun Tied within Tube to No.3 Grids of Other Two Guns) to All Other Electrodes	12	μμf
Grid No.4 (Common to the Three Guns) to All Other Electrodes	7	μμf
External Conductive Coating to Ultor●	2500 max. 1500 min.	μμf μμf
Faceplate, Spherical	Clear Glass	
Screen, Flat:		
Type	Metal-Backed, Tricolor, Phosphor-Dot	
Plate	Filterglass	
Light Transmission (Approx.)	70%	
Size (Rounded Sides—See *Dimensional Outline*)	11-1/2" x 8-5/8"	
Area	88.5 sq. in.	
Phosphor (Three Separate Phosphors, collectively)	P22	
Fluorescence and Phosphorescence of Separate Phosphors, respectively	Blue, Green, Red	
Persistence of Group Phosphorescence	Medium	
Dot Arrangement	Approx. 195,000 triangular groups, each consisting of blue dot, green dot, and red dot (total of 585,000 dots)	
Focusing Method	Electrostatic	
Convergence Method	Electrostatic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Horizontal	45°	
Vertical	35°	
Tube Dimensions:		
Maximum Overall Length	26-1/8"	
Greatest Diameter:		
At faceplate	14-5/8" ± 5/32"	
At metal flange	15-3/4" max.	
Ultor● Terminal	Metal Flange	
Base	Small-Shell Bidecal 14-Pin (JETEC No.B14-103)	
Socket	Cinch Developmental No.57C17902, or equivalent	
Mounting Position	Any	
Weight (Approx.)	25 lbs	

Maximum Ratings, *Design-Center Values*:

ULTOR● VOLTAGE	20000 max.	volts
ULTOR INPUT	15# max.	watts
GRID-No.4 VOLTAGE	11000 max.	volts
GRID-No.3 VOLTAGE	5000 max.	volts
GRID-No.2 VOLTAGE (Each Gun)	500 max.	volts
GRID-No.1 VOLTAGE (Each Gun):		
Negative bias value	200 max.	volts
Positive bias value	0 max.	volts
Positive peak value	2 max.	volts
PEAK HEATER-CATHODE VOLTAGE (Each Gun):		
Heater negative with respect to cathode:		
During equipment warm-up period not exceeding 15 seconds	410 max.	volts
After equipment warm-up period	180 max.	volts
Heater positive with respect to cathode	180 max.	volts

Characteristics Range Values for the Design of Experimental Receivers:

For ultor voltage (E_{c5}) of 18000 to 20000 volts and ultor input of 15 watts

Grid-No.4 (Converging Electrode) Voltage†	42.5% to 51% of E_{c5}	volts
Grid-No.3 (Focusing Electrode) Voltage	12% to 19% of E_{c5}	volts
Grid-No.2 Voltage (Each Gun) when circuit design utilizes grid-No.1 voltage (E_{c1}) at fixed value for raster cutoff (each gun)	2 to 4.5 times E_{c1}	volts
Grid-No.1 Voltage for Visual Extinction of Focused Raster (Each Gun) when circuit design utilizes grid-No.2 voltage (E_{c2}) at fixed value (each gun)	22.5% to 50% of E_{c2}	volts
Grid-No.4 Current	-5 to +5	μamp
Maximum Grid-No.3 Current	300	μamp
Grid-No.2 Current	-15 to +15	μamp
Beam-Current Ratio to Produce Illuminant-C White (6500°K):		
Red Gun to Green Gun	4:1 to 1:1	
Blue Gun to Green Gun	1.5:1 to 0.5:1	
Maximum Raster Shift in Any Direction from Screen Center□	1-1/4	inches

Examples of Use of Range Values:

For ultor voltage of 20000 volts

Grid-No.4 (Converging Electrode) Voltage†. . .	8500 to 10200	volts
Grid-No.3 (Focusing Electrode) Voltage. .	2400 to 3800	volts
Grid-No.2 Voltage (Each Gun) when circuit design utilizes grid-No.1 voltage of -70 volts (each gun)	140 to 315	volts
Grid-No.1 Voltage for Visual Extinction of Focused Raster (Each Gun) when circuit design utilizes grid-No.2 voltage of 200 volts (each gun)	-45 to -100	volts

Circuit Values:

Grid-No.1-Circuit Resistance (Each Gun).	1.5 max.	megohms
Dynamic Converging Voltage (Approx.)**.	900	volts
Dynamic Focusing Voltage (Approx.)** .	225	volts

● The "ultor" in a cathode-ray tube is the electrode to which is applied the highest dc voltage for accelerating the electrons in the beam prior to its deflection. In the C-73599, the ultor function is performed by grid No.5. Since grid No.5, grid No.6, and collector are connected together within the C-73599, they are collectively referred to simply as "ultor" for convenience in presenting data and curves.

This value is the product of ultor voltage and average current measured at the ultor terminal with a dc ammeter.

† This range does not include the dc component of the dynamic converging voltage.

□ Centering of the raster on the screen is accomplished by passing direct current of the required value through each pair of deflecting coils to compensate for the raster shift resulting from optimum adjustments for convergence, color purity, and concentricity.

** Peak-to-peak value. This ac voltage having essentially parabolic waveform is synchronized with scanning and does not include any voltage developed during the blanking time.

GENERAL CONSIDERATIONS

The *maximum ratings* in the tabulated data for the C-73599 are working design-center maximums established according to the standard design-center system of rating electron tubes. Tubes so rated will give satisfactory performance in equipment designed so that these maximum ratings will not be exceeded when the equipment is operated from ac or dc power-line supplies whose normal voltage including normal variations falls within ± 10 per cent of line-center voltage value of 117 volts.

X-Rays. As may occur in conventional black-and-white kinescopes, x-ray radiation is present at the face of the C-73599 when it is operated at its normal ultor voltage. Simple shielding should prove adequate to provide protection against personal injury from prolonged exposure at close range.

Tube Handling. Grasp the tube (1) with both hands by placing the thumb of each hand on the flange and the fingers on the faceplate or vice versa without touching the insulating coating on the glass; or (2) with one hand on the faceplate and the other on the cone section in the region of the conductive coating. Never handle the tube by the neck alone. Contamination of the insulating coating with finger prints or dust may cause electrical breakdown during humid weather. Do not strike or scratch the tube, or subject it to more than moderate pressure when installing in or removing from equipment. Such treatment may result in immediate or delayed cracking of the bulb. The same safety precautions against breakage should be employed for the C-73599 as are employed with similar-size glass picture tubes of the black-and-white type.

Metal Flange. The metal flange operates at high voltage and, as a safety measure, should be covered with a suitable insulator* having adequate insulation to prevent the possibility of electrical leakage including corona between the flange and any grounded element in the receiver. It is recommended that the shape and width of the insulator be chosen so that the leakage path between the metal flange and the nearest grounded element shall be not less than 4 inches. Always ground the metal flange before touching after the

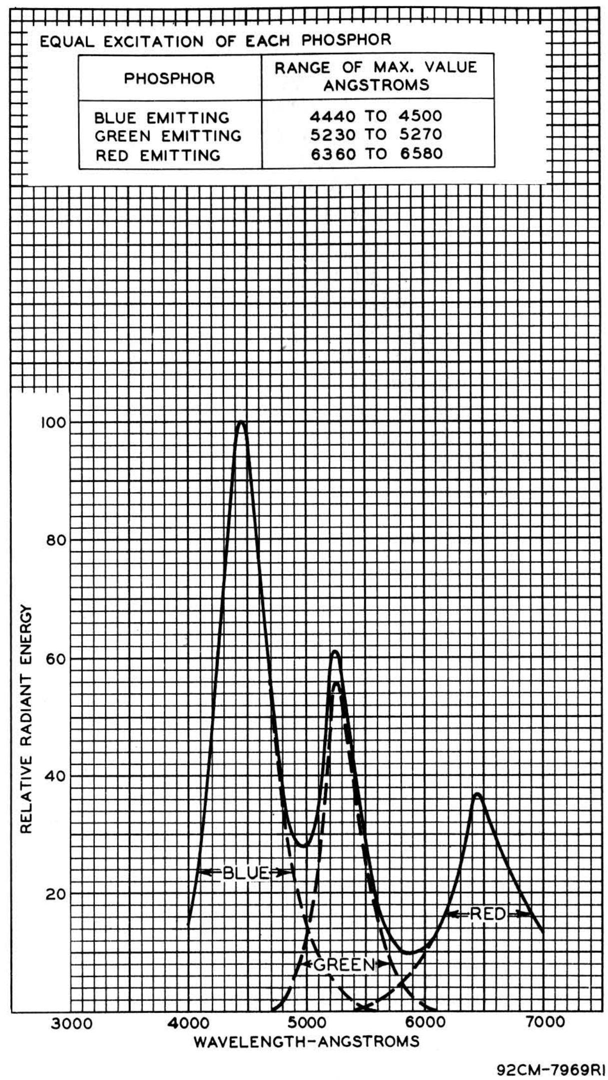


Fig. 1 - Spectral-Energy Emission Characteristic of Group Phosphor P22.

* Such an insulator having the manufacturer's designation Insulator Part No.15GCA1 may be obtained from Anchor Industrial Co., 36-36 36th St., Long Island City 6, N.Y.

power is turned off. The flange should not be scraped nor be allowed to bear against any sharp edge. Do not allow the metal flange to come in contact with a magnet and thus become permanently magnetized. A magnetized flange may produce localized color impurity.

Insulating Material for External Mask. The external mask should be made only of material providing insulation adequate for one half of the applied ultor voltage in order to minimize leakage across the surface of the glass between the metal flange and the external mask which is at ground potential. Mask material having the specified qualities can bear directly against the faceplate.

Shatter-Proof Cover Over The Tube Face. Following conventional kinescope practice, it is recommended that the cabinet be provided with a shatter-proof, clear glass or plastic cover over the face of the C-73599 to protect it from being struck accidentally and to protect against possible damage resulting from tube implosion under some abnormal condition.

External Shielding. External magnetic shielding is required for the C-73599 to prevent external magnetic fields from affecting tube performance. Further information on shielding considerations is given in the discussion of Mounting, Shielding, and Related Components on page 33.

Support. The C-73599 should be supported by any properly insulated arrangement at the face-plate end and by a suitable mechanism engaging the cone section of the envelope in the support region indicated on the Dimensional Outline. The tube should not be supported by the neck or by the base. It is also to be noted that support for the tube should not be provided, in accord with conventional practice for picture tubes, by the deflecting yoke because the latter must have flexibility of adjustment on the neck.

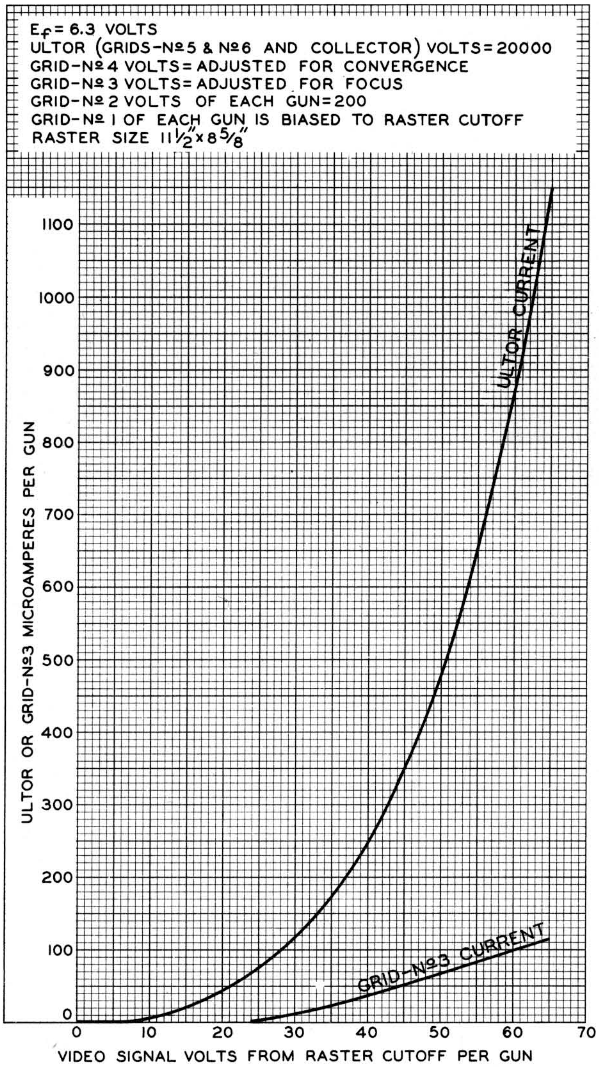


Fig. 2 - Typical Drive Characteristic of Dev. Type C-73599.

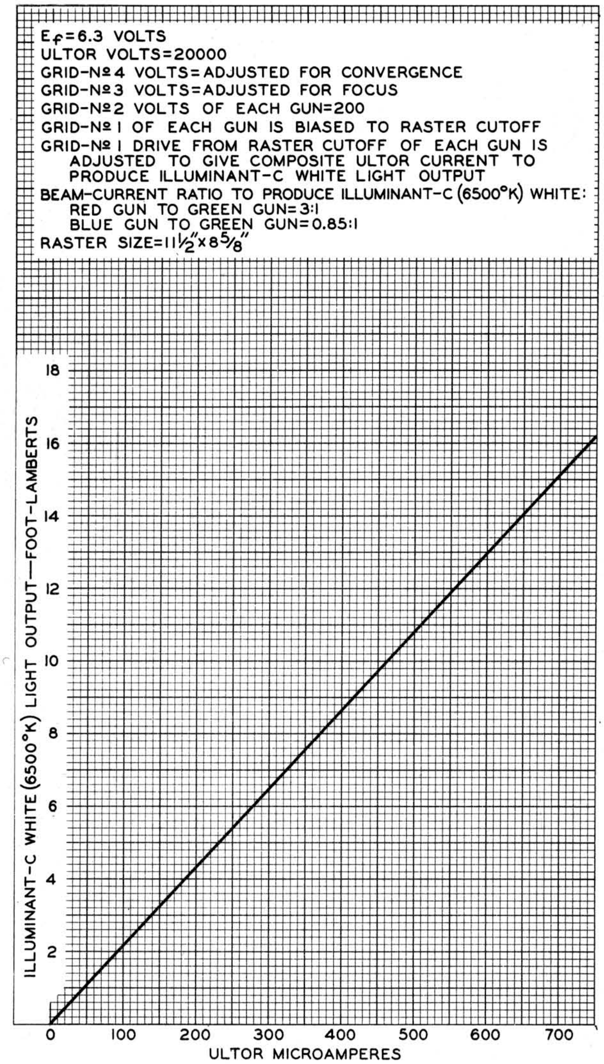


Fig. 3 - Typical Light-Output Characteristic of Dev. Type C-73599.

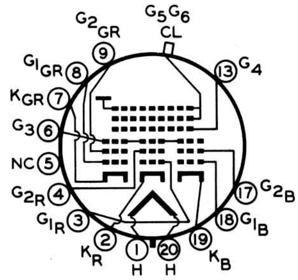
High Voltages. The high voltages at which cathode-ray tubes are operated may be very dangerous. Great care should be taken in the design of apparatus to prevent the operator from coming in contact with the high voltages. Precautions include the enclosing of high-potential terminals and the use of interlocking switches to break the primary circuit of the power supply when access to the equipment is required.

In the case of cathode-ray tubes, it should always be remembered that high voltages may appear at normally low-potential points in the circuit because of capacitor breakdown or to incorrect circuit connections. Therefore, before any part of the circuit is touched, the power-supply switch should be turned off and both terminals of any capacitors should be grounded.

REFERENCE

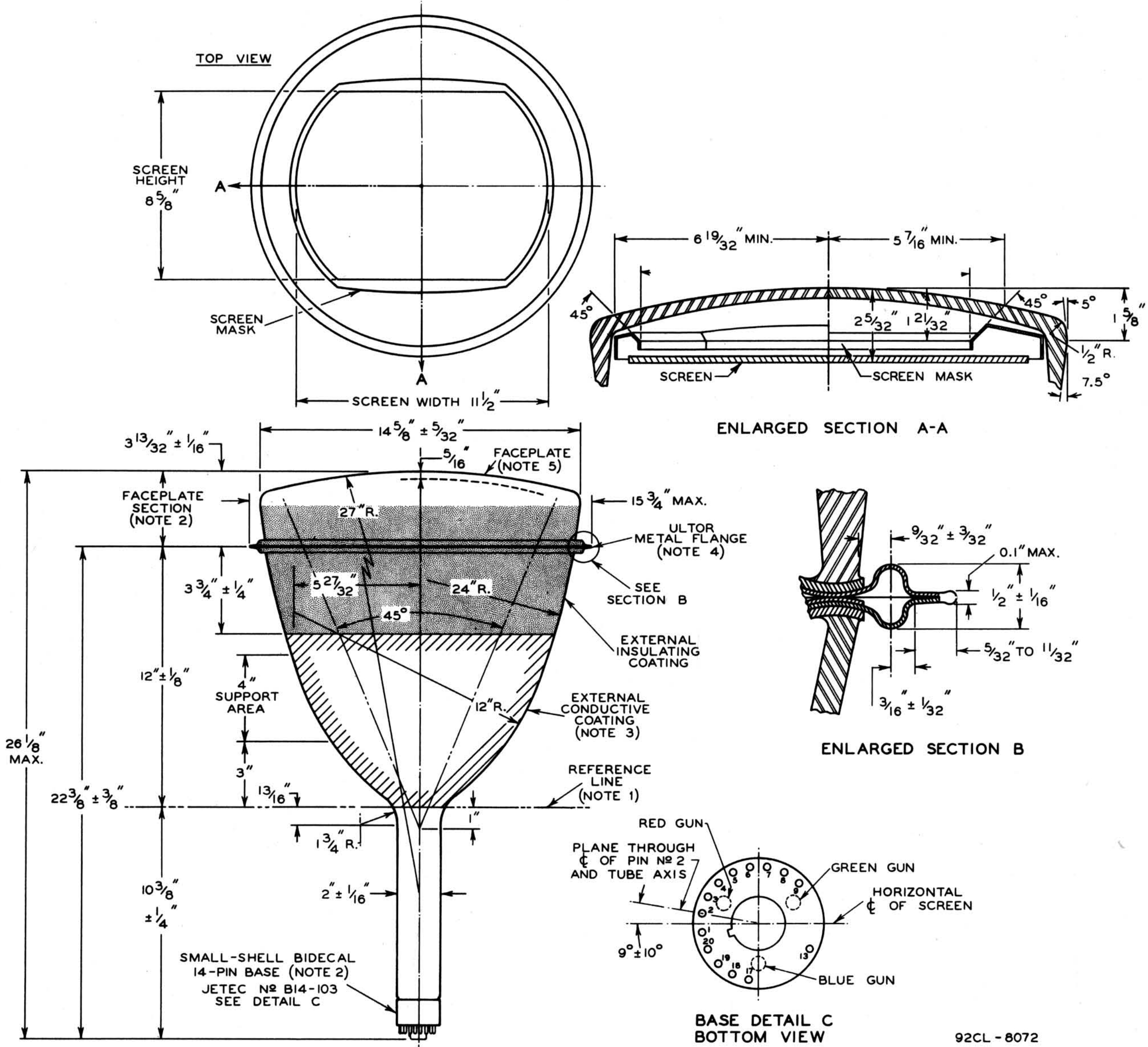
IES Handbook (Second Edition), 1952, Section 3-3. Illuminating Engineering Society, 1860 Broadway, New York 23, N.Y.

SOCKET CONNECTIONS
Bottom View



PIN 1: HEATER
PIN 2: CATHODE OF RED GUN
PIN 3: GRID No.1 OF RED GUN
PIN 4: GRID No.2 OF RED GUN
PIN 5: NO CONNECTION
PIN 6: GRIDS No.3
PIN 7: CATHODE OF GREEN GUN
PIN 8: GRID No.1 OF GREEN GUN
PIN 9: GRID No.2 OF GREEN GUN
PIN 13: GRID No.4
PIN 17: GRID No.2 OF BLUE GUN
PIN 18: GRID No.1 OF BLUE GUN
PIN 19: CATHODE OF BLUE GUN
PIN 20: HEATER
METAL FLANGE: ULTOR (Grid No.5, Grid No.6, Collector)

DIMENSIONAL OUTLINE



NOTE 1: REFERENCE LINE IS DETERMINED BY POSITION WHERE A CYLINDRICAL GAUGE 2.400" ± 0.001" I.D. WHICH IS HELD CONCENTRIC WITH TUBE NECK AXIS WILL REST ON FUNNEL.

NOTE 2: SOCKET FOR THIS BASE SHOULD NOT BE RIGIDLY MOUNTED; IT SHOULD HAVE FLEXIBLE LEADS AND BE ALLOWED TO MOVE FREELY. BOTTOM CIRCUMFERENCE OF BASE SHELL WILL FALL WITHIN A CIRCLE CONCENTRIC WITH FACEPLATE-SECTION AXIS AND HAVING A DIAMETER OF 3".

NOTE 3: EXTERNAL CONDUCTIVE COATING MUST BE GROUNDED.

NOTE 4: METAL FLANGE OPERATES AT HIGH VOLTAGE. ADEQUATE INSULATION MUST BE PROVIDED BETWEEN THE FLANGE AND ANY GROUNDED ELEMENT IN THE RECEIVER TO PREVENT THE POSSIBILITY OF ELECTRICAL LEAKAGE INCLUDING CORONA.

NOTE 5: MASK MATERIAL BEARING ON THE FACEPLATE MUST HAVE INSULATING QUALITIES ADEQUATE FOR ONE HALF THE APPLIED ULTOR VOLTAGE TO MINIMIZE SURFACE LEAKAGE BETWEEN METAL FLANGE AND MASK.

Preliminary and Tentative Data
on RCA Developmental

Sharp-Cutoff Beam Triode

High-Voltage, Low-Current, Regulator Type

Developmental No. A-2334-C

RCA Developmental Type A-2334-C is a low-current beam triode of the sharp-cutoff type designed specifically for the voltage regulation of high-voltage, low-current dc power supplies such as the power supply used with the RCA Developmental Tricolor Kinescope C-73599. It has a maximum dc plate-voltage rating of 20000 volts, a maximum dc plate-current rating of 1.5 milliamperes, and a maximum plate-dissipation rating of 20 watts.

The high-voltage insulation in the A-2334-C for its intended service is obtained by the use of a double-ended structure utilizing a suitably designed electron gun which consists of a thermionic cathode and one grid. The plate connection is made to a small cap at the end of the bulb.

GENERAL DATA

Electrical:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)	6.3	volts
Current	0.6	amp
Direct Interelectrode Capacitances:		
Grid to Plate	1.0	μμf
Grid to Cathode	2.8	μμf
Plate to Cathode	0.01	μμf
Amplification Factor	1650	

Mechanical:

Mounting Position	Any
Maximum Overall Length	5-1/8"
Seated Length	4-1/2" ± 1/8"
Maximum Diameter	1-23/32"
Bulb	T-12
Cap	Small (JETEC No.C1-1)
Base	Short Jumbo-Shell Octal 6-Pin (JETEC No.B6-73)
Weight (Approx.)	2.7 oz

VOLTAGE-CONTROL SERVICE

Maximum Ratings, *Design-Center Values*:

DC PLATE VOLTAGE	20000 max.	volts
UNREGULATED DC SUPPLY VOLTAGE	40000 max.	volts
GRID VOLTAGE:		
DC value	-125 max.	volts
Peak value	-550 max.	volts
DC PLATE CURRENT	1.5 max.	ma
PLATE DISSIPATION	20 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	180 max.	volts
Heater positive with respect to cathode	180 max.	volts

Typical Operation As Shunt Voltage-Regulator Tube in Accompanying Circuit:

Unregulated Supply:		
DC voltage	29800	volts
Equivalent Resistance	8	megohms
Voltage Divider Values:		
R_1 (5 watts)	120	megohms
R_2 (2 watts)	1	megohm
R_3 (1/2 watt)	2	megohms
Reference Voltage Supply:		
DC value	500	volts
Equivalent Resistance	1000	ohms
Effective Grid-Plate Transconductance	138	μmhos
DC Plate Current:		
For load current of 0 ma	1055	μamp
For load current of 1 ma	100	μamp
Regulated DC Output Voltage:		
For load current of 0 ma	20000	volts
For load current of 1 ma	19700	volts

Maximum Circuit Values:

Grid-Circuit Resistance:		
With unregulated supply having an equivalent resistance of at least 8 megohms	3 max.	megohms
With unregulated supply having an equivalent resistance less than 8 megohms	See Curve in Fig.1	

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	*Min.*	*Max.*	
Heater Current	1	0.54	0.66	amp
Grid Voltage (1)	1,2	-2	-	volts
Grid Voltage (2)	1,3	-	-25	volts
Grid-Voltage Change	1,4	-	8	volts

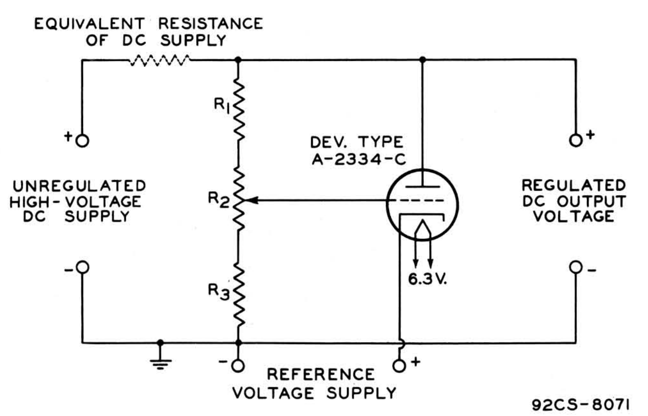
Note 1: With heater voltage of 6.3 volts ac or dc.

Note 2: With dc plate voltage of 20000 volts and dc plate current of 1 ma.

Note 3: With dc plate voltage of 20000 volts and dc plate current of 0.1 ma.

Note 4: Difference between grid voltage (1) and grid voltage (2).

SHUNT VOLTAGE-REGULATOR CIRCUIT



Typical performance data for this basic circuit with certain characteristics of the unregulated dc supply and related voltage-divider values are given in the above tabulated data. Other combinations are feasible within the maximum ratings and the maximum circuit values for the A-2334-C.

OPERATING CONSIDERATIONS

The *maximum ratings* in the tabulated data are working design-center maximums established according to the standard design-center system of rating electron tubes. Tubes so rated will give satisfactory performance in equipment designed so that these maximum ratings will not be exceeded when the equipment is operated from ac or dc power-line supplies whose normal voltage including normal variations falls within ± 10 per cent of line-center voltage value of 117 volts.

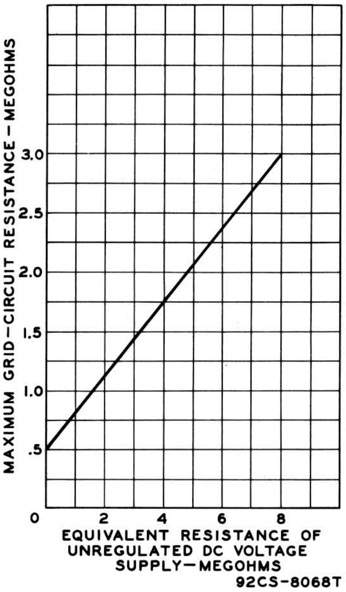


Fig. 1 - Maximum Grid-Circuit Resistance for Dev. Type A-2334-C as a Function of Un-Regulated DC Voltage Supply Resistance.

The high dc voltages at which the A-2334-C is operated may be extremely dangerous to the user. Great care should be taken during the adjustment of circuits. The tube and its associated apparatus, especially all parts which may be at high potential above ground, should be housed in a protective enclosure. The protective housing should be designed with interlocks so that personnel cannot possibly come in contact with any high-potential point in the electrical system. The interlock devices should function to break the primary circuit of the high-voltage supply when any gate or door on the protective housing is opened, and should prevent the closing of this primary circuit until the door is again locked.

It should always be remembered that high voltages may appear at normally low-potential points in the circuit because of capacitor breakdown or to incorrect circuit connections. Therefore, before any part of the circuit is touched, the power-supply switch should be turned off and both terminals of any capacitors should be grounded.

The *bulb* becomes hot during operation. To insure adequate cooling, it is essential that free circulation of air be provided around the A-2334-C.

The *plate* shows a dull red color when the A-2334-C is operated at maximum plate dissipation. Connection to the plate cap should be made by a suitable connector with flexible lead to prevent any strain on the seal at the cap.

Operation of the A-2334-C with a plate voltage above approximately 16000 volts (absolute value) results in the production of x-rays which can constitute a health hazard on prolonged exposure at close range unless the tube is adequately shielded. Relatively simple shielding should prove adequate, but the need for this precaution should be considered in equipment design (see *References 1 and 2*).

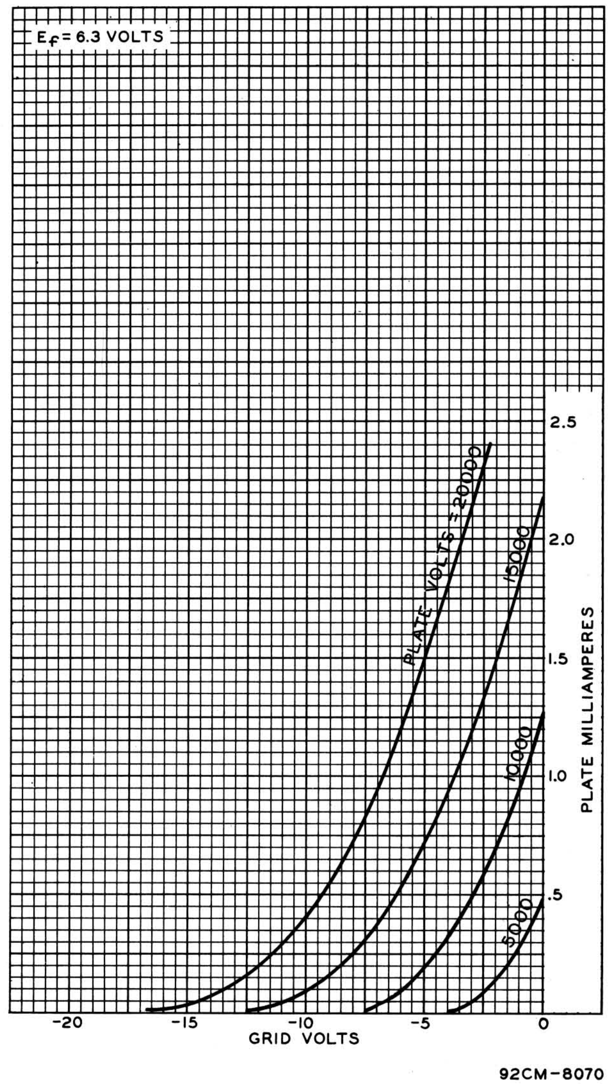


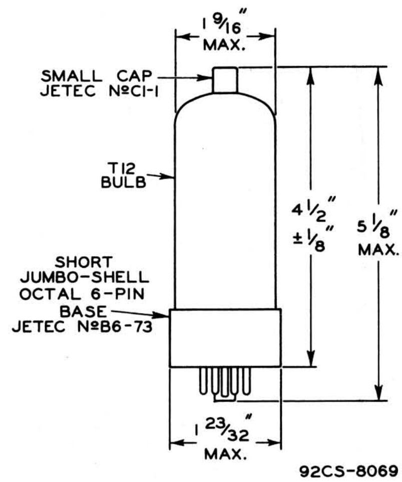
Fig. 2 - Average Transfer Characteristics of Dev. Type A-2334-C.

The A-2334-C may exhibit a blue glow on the upper half of the inner surface of the bulb wall under normal operating conditions. This effect is caused by fluorescence and is not to be mistaken for gas.

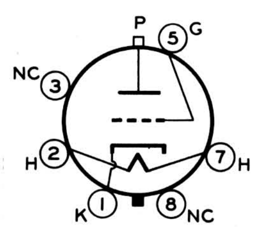
REFERENCES

1. *"Medical X-ray Protection Up to Two Million Volts,"* National Bureau of Standards Handbook H41.
2. *"Safety Code for Industrial Use of X-rays,"* American Standards Association, ASA Code Z54.1-1946.

DIMENSIONAL OUTLINE



SOCKET CONNECTIONS
Bottom View



PIN 1: CATHODE
PIN 2: HEATER
PIN 3: NO CONNECTION
PIN 5: GRID
PIN 7: HEATER
PIN 8: NO CONNECTION
CAP: PLATE

Preliminary and Tentative Data on RCA Developmental

Half-Wave Vacuum Rectifier

(Equivalent to Commercial Type 6AU4-GT)

Developmental No. R-6424-A

RCA Developmental Type R-6424-A is a half-wave vacuum rectifier tube of the glass-octal type. It is particularly suited for use as a damper diode in color television circuits utilizing the RCA tricolor kinescope developmental No. C-73599.

Rated to withstand a maximum peak inverse plate voltage of 4500 volts (absolute), the R-6424-A can supply a maximum peak plate current of 1050 milliamperes and a maximum dc plate current of 175 milliamperes. Furthermore, negative peak pulses between heater and cathode of as much as 4500 volts with a dc component of as much as 900 volts may be used when the heater is operated negative with respect to cathode.

GENERAL DATA

Electrical:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)	6.3	volts
Current	1.8	amp
Direct Interelectrode Capacitances (Approx.):°		
Plate to Heater and Cathode . . .	8.5	μμf
Cathode to Heater and Plate . . .	11.5	μμf
Heater to Cathode	4.0	μμf

Mechanical:

Mounting Position	Any
Maximum Overall Length	3-13/16"
Maximum Seated Length	3-1/4"
Maximum Diameter	1-9/32"
Bulb	T-9
Base	Short Intermediate-Shell Octal 5- or 6-Pin with External Barriers (JETEC Nos. B5-85 or B6-60)

DAMPER SERVICE

Maximum Ratings, *Design-Center Values Except as Noted:*

For operation in a 525-line, 30-frame system▲

PEAK INVERSE PLATE VOLTAGE (Absolute Maximum)# . .	4500●	max.	volts
PEAK PLATE CURRENT	1050	max.	ma
DC PLATE CURRENT	175	max.	ma
PLATE DISSIPATION	6.0	max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode (Absolute Maximum). .	4500●*	max.	volts
Heater positive with respect to cathode	300†	max.	volts

° With no external shield.

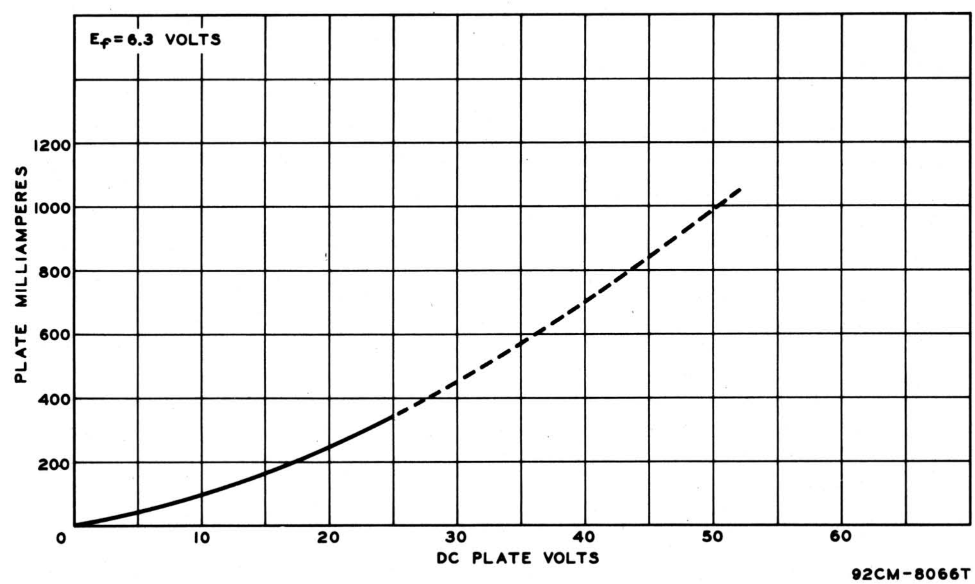
▲ As described in "Standards of Good Engineering Practice Concerning Television Broadcast Stations," Federal Communications Commission.

This rating is applicable where the duty cycle of the voltage pulse does not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30-frame system, 15 per cent of one horizontal scanning cycle is 10 microseconds.

● Under no circumstances should this absolute value be exceeded.

* The dc component must not exceed 900 volts.

† The dc component must not exceed 100 volts.



Average Plate Characteristic of Developmental Type R-6424-A

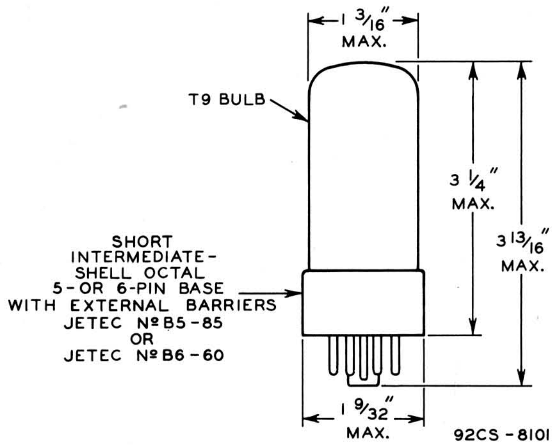
OPERATING CONSIDERATIONS

The *maximum ratings* shown in the tabulated data for peak plate current, dc plate current, plate dissipation, and peak heater-cathode voltage with the heater positive with respect to cathode are working design-center maximums established according to the standard design-center system of rating electron tubes. Tubes so rated will give satisfactory performance in equipment designed so that these maximum ratings will not be exceeded when the equipment is operated from ac or dc power-line supplies whose normal voltage including normal variations falls within ± 10 per cent of line-center voltage value of 117 volts.

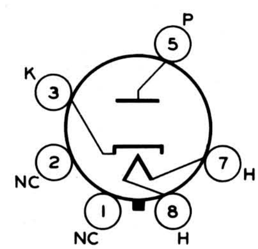
The *maximum ratings* shown in the tabulated data for peak inverse plate voltage and peak heater-cathode voltage with the heater negative with respect to cathode are limiting values above which the serviceability of the R-6424-A may be impaired from the viewpoint of life and satisfactory performance. Therefore, in order not to exceed these absolute ratings, the equipment designer has the responsibility of determining an average design value for each rating below the absolute value of that rating by an amount such that the absolute values will never be exceeded under any usual condition of supply-voltage variation, load variation, or manufacturing variation in the equipment itself.

The *base pins* of the R-6424-A fit the standard octal socket. Socket terminals for pins 1, 2, 4, and 6 should not be used for tie points. It is also recommended that socket clips for these pins be removed to reduce the possibility of arc-over and to minimize leakage.

DIMENSIONAL OUTLINE



SOCKET CONNECTIONS
Bottom View



PIN 1: NO CONNECTION— DO NOT USE; OR OMITTED
PIN 2: NO CONNECTION— DO NOT USE
PIN 3: CATHODE
PIN 5: PLATE
PIN 7: HEATER
PIN 8: HEATER

Preliminary and Tentative Data on RCA Developmental

Half-Wave Vacuum Rectifier

Development No.R-6433-B

RCA Developmental Type R-6433-B is a half-wave vacuum rectifier tube of the glass-octal type designed for use in high-voltage, pulse-operated rectifying systems of color television receivers. In such systems it is particularly suitable as a rectifier of high-voltage pulses produced in the scanning system for the kinescope.

GENERAL DATA

Electrical:

Heater, for Unipotential Cathode:		
Voltage (AC)	3.15	volts
Current	0.22	amp
Direct Interelectrode Capacitance (Approx.):●		
Plate to Heater, Cathode, and Internal Shield	1.5	$\mu\mu$f

Mechanical:

Mounting Position	Any
Maximum Overall Length	4-1/16"
Seated Length	3-5/16" ± 3/16"
Maximum Diameter	1-9/32"
Bulb	T-9
Cap	Small (JETEC No.C1-1)
Base	Intermediate-Shell Octal 6-Pin (JETEC No.B6-8)

PULSED-RECTIFIER SERVICE

Maximum Ratings, *Design-Center Values:*

For operation in a 525-line, 30-frame system▲

PEAK INVERSE PLATE VOLTAGE	30000 max.	volts
PEAK PLATE CURRENT	80 max.	ma
AVERAGE PLATE CURRENT	1.5 max.	ma
VOLTAGE PULSE DURATION♦	10 max.	μsec

● With no external shield.

▲ As described in "Standards of Good Engineering Practice Concerning Television Broadcast Stations," Federal Communications Commission.

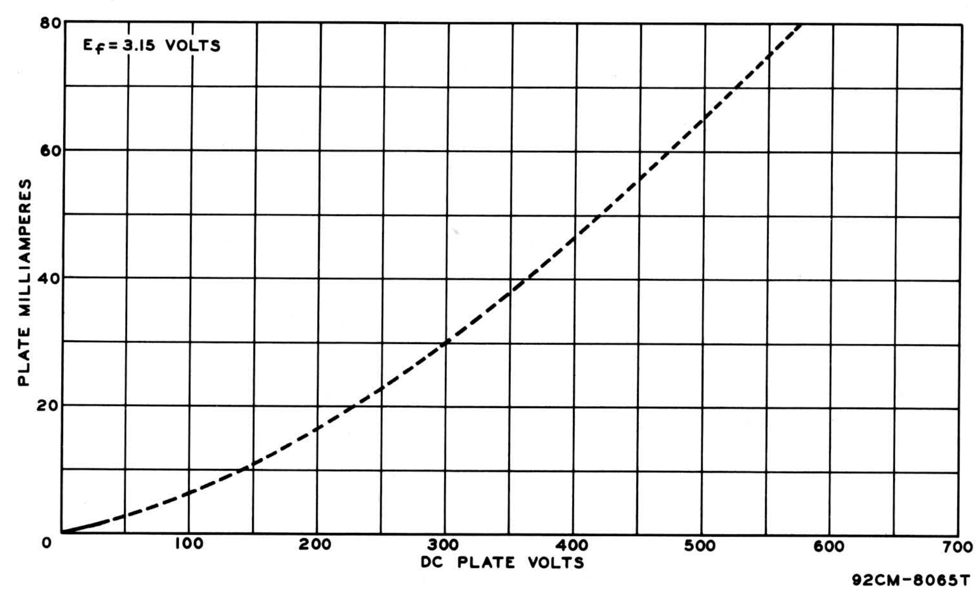
♦ The duration of the voltage pulse must not exceed 15 per cent of one horizontal scanning cycle. In a 525-line, 30 frame system, 15 per cent of one horizontal scanning cycle is the specified maximum value.

OPERATING CONSIDERATIONS

The *maximum ratings* in the tabulated data for the R-6433-B are working design-center maximums established according to the standard design-center system of rating electron tubes. Tubes so rated will give satisfactory performance in equipment designed so that these maximum ratings will not be exceeded when the equipment is operated from ac or dc power-line supplies whose normal voltage including normal variations falls within ± 10 per cent of line-center voltage value of 117 volts.

The *base pins* of the R-6433-B fit the standard octal socket. The socket terminals for pins 1,3,5, and 8 may be connected to the terminal for pin 7, but if not, they should not be used as tie points because tube performance may be adversely affected.

The *heater* of the R-6433-B is designed for operation at 3.15 volts. The heater windings on the pulse transformer should be adjusted to provide the rated voltage under average line-voltage conditions. When the heater voltage is measured,

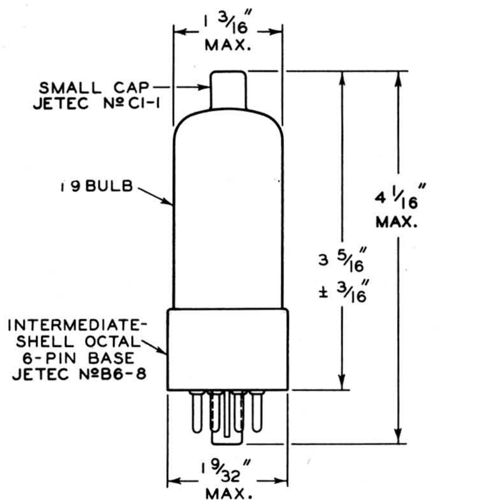


Average Plate Characteristic of Developmental Type R-6433-B it is recommended that a voltmeter of the thermocouple type calibrated in rms volts be used. The meter and its leads must be insulated to withstand 20000 volts and the stray capacitances to ground should be minimized.

The high voltages at which the R-6433-B is operated are very dangerous. Great care should be taken in the design of apparatus to prevent the operator from coming in contact with these high voltages. Particular care against fatal shock should be taken in measuring the heater voltage. Under any circumstances, all circuit parts which may be at high potentials should be enclosed or adequately insulated.

The voltages employed in some television receivers and other high-voltage equipment is sufficiently high that high-voltage rectifier tubes may produce x-rays which can constitute a health hazard unless such tubes are adequately shielded. Relatively simple shielding should prove adequate, but the need for this precaution should be considered in equipment design.

DIMENSIONAL OUTLINE



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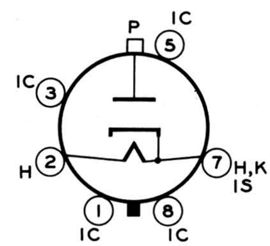
SOCKET CONNECTIONS
Bottom View



PIN 1: INTERNAL CONNECTION DO NOT USE
PIN 2: HEATER
PIN 3: INTERNAL CONNECTION DO NOT USE
PIN 5: INTERNAL CONNECTION DO NOT USE
PIN 7: HEATER, CATHODE, INTERNAL SHIELD
PIN 8: INTERNAL CONNECTION DO NOT USE
CAP: PLATE

Preliminary and Tentative Data on RCA Developmental Components for Use with RCA Developmental Tricolor Kinescope Dev. No. C-73599

* Each of these developmental numbers identify a particular laboratory design, but the number and identifying data are subject to change.

\# Identifies RCA commercial item.

Preliminary and Tentative Data
on RCA Developmental

Horizontal-Dynamic-Convergence Phase Control

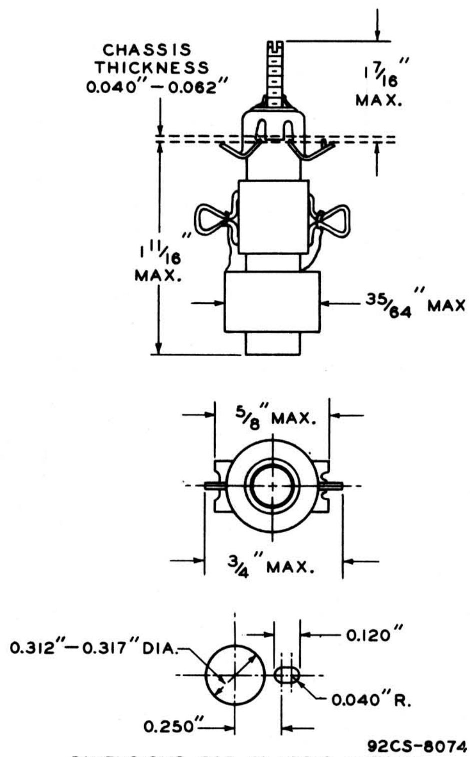
Developmental No. XL-582-C

XL-582-C is a developmental variable inductor for use as a phasing control of the horizontal-dynamic voltage waveform applied to the converging electrode (grid No. 4) of the RCA Tricolor Kinescope Developmental No. C-73599. Utilizing a ferrite core for high efficiency, this control is intended for operation in circuits using the Developmental No. XT-7648-F Horizontal Dynamic-Converging and Dynamic-Focusing Transformer.

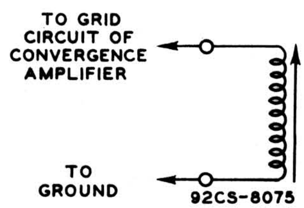
DATA

Maximum Ratings:		
Coil Temperature	90 max.	°C
Characteristics:		
Inductance:		
With Core Adjusted for Least Inductance	5.7 max.	mh
With Core Adjusted for Greatest Inductance	32.5 min.	mh
DC Resistance.	33 approx.	ohms

DIMENSIONAL OUTLINE



DIMENSIONS FOR CHASSIS CUTOUT



Terminal Connections for Developmental No. XL-582-C.

Preliminary and Tentative Data
on RCA Developmental

Horizontal-Linearity Control

Developmental No. XL-693-A

XL-693-A is a developmental bifilar-wound variable-inductance transformer designed for adjusting the linearity of the horizontal-scanning beams in the RCA Tricolor Kinescope Developmental No. C-73599. It utilizes a ferrite core for high efficiency and is intended for use with Developmental No. XD-2165-J Horizontal-output and High-voltage Transformer and the Developmental No. XD-2071-D Deflecting Yoke.

The coefficient of coupling is approximately unity with the core adjusted for maximum inductance and it is more than 0.95 with core adjusted for minimum inductance. The individual coils have approximately the same range of inductance.

DATA

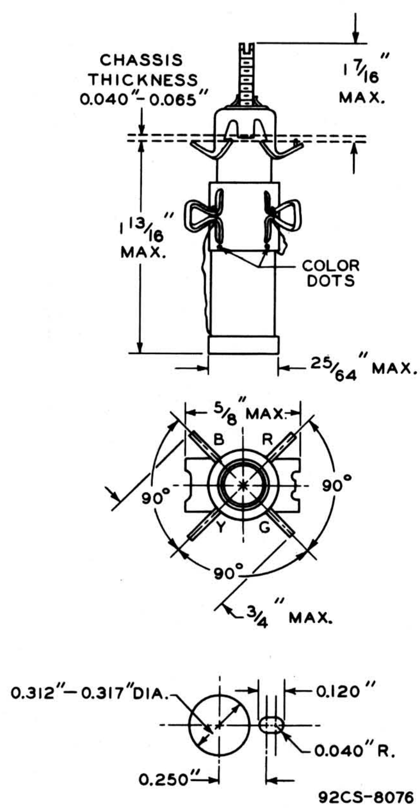
Ratings:

Coil Temperature	90 max.	°C

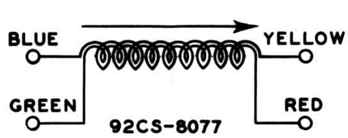
Characteristics:

Inductance:		
With Core Adjusted for Least Inductance (Core Out) and Windings Connected Series Aiding.	0.48 max.	mh
With Core Adjusted for Greatest Inductance (Core In) and Windings Connected Series Aiding.	2.9 min.	mh
DC Resistance (Coils connected in series).	7.6 approx.	ohms

DIMENSIONAL OUTLINE



DIMENSIONS FOR CHASSIS CUTOUT



Terminal Connections for Developmental No. XL-693-A.

Preliminary and Tentative Data
on RCA Developmental

Width Control

Developmental No. XL-696-A

XL-696-A is a developmental variable inductor with a ferrite core for adjusting the picture width on the RCA Tricolor Kinescope Developmental No. C-73599. It is intended for operation with the Developmental No. XD-2165-J Horizontal-Output and High-Voltage Transformer and the Developmental No. XD-2071-D Deflecting Yoke.

DATA

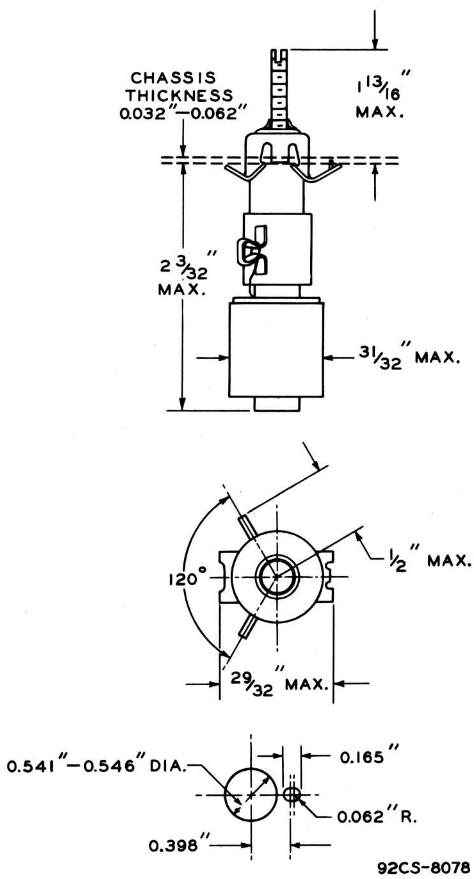
Ratings:

Coil Temperature	90 max.	°C

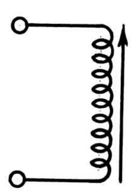
Characteristics:

Inductance:		
With Core Adjusted for Least Inductance (Core Out).	18.5 max.	mh
With Core Adjusted for Greatest Inductance (Core In)	68.9 min.	mh
DC Resistance.	31.8 approx.	ohms

DIMENSIONAL OUTLINE



DIMENSIONS FOR CHASSIS CUTOUT



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Terminal Connections for Developmental No. XL-696-A.

Preliminary and Tentative Data on RCA Developmental

Deflecting Yoke

Developmental No. XD-2071-D

XD-2071-D is a developmental deflecting yoke for use with the RCA Tricolor Kinescope Developmental No.C-73599 having a horizontal deflection angle of 45°. It is designed to operate efficiently with the developmental No.XD-2165-J Horizontal-Output and High-Voltage Transformer and to provide full deflection, good uniformity of focus, optimum convergence, and high deflection sensitivity.

The horizontal and vertical coils of this yoke are especially wound to produce proper magnetic fields for simultaneous deflection of the three beams and, in addition, are flared widely at the end of the yoke placed nearest the tube funnel to provide the desired flux distribution for optimum convergence. High deflection sensitivity and good field symmetry are achieved by the use of a precision-shaped ferrite core having unique design characteristics. The core consists of 8 separate ferrite sections fitted to form a single unit having a chamfered front which corresponds with the shape of the funnel-to-neck section of the kinescope.

A flame-retardant polyethlyene liner is used to provide adequate insulation between the yoke coils and the grounded coating.

The yoke should not be used for supporting the kinescope-neck section since optimum performance requires three adjustments; (1) centering the yoke on the axis common to the three beams, (2) moving the yoke along the neck of the kinescope, and (3) moving the yoke rotationally about the neck. Further information on yoke adjustments is presented on Pages 43 and 44.

DATA

General:

Outside Diameter	7-13/16 max.	inches
Inside Diameter.	2.22 min.	inches

Performance:

Percentage tolerances indicate deviation of characteristics from corresponding characteristics of a specimen yoke established as a standard and operating in a circuit with an RCA Tricolor Kinescope Developmental No.C-73599 to provide an 11-3/4 inch by 8-7/8 inch raster.

Horizontal Deflection.	+5 / −5	per cent / per cent
Vertical Deflection.	+5 / −3	per cent / per cent
Departure from Linearity* (Vertical or Horizontal) . . .	±10	per cent
Pincushion or Barrel†	±2	per cent
Trapezoid (Horizontal or Vertical Departure from Rectangularity)† .	±2	per cent

Maximum Ratings:♦

Peak Voltage Between Horizontal and Vertical Coils, for maximum duration of 8 microseconds⊕ . . .	3500 max.	volts
Ambient Temperature.	50 max.	°C
Horizontal Coils (Series Connected):		
Peak-to-Peak Sawtooth Current⊕ . .	1100 max.	ma
Peak Pulse Voltage, for maximum duration of 8 microseconds⊕ . . .	3000 max.	volts
Vertical Coils (Series Connected):		
Peak-to-Peak Sawtooth Current° . .	300 max.	ma
Peak Voltage, for maximum duration of 650 microseconds°	800 max.	volts

Characteristics:

Horizontal Coils (Series Connected):		
Inductance at 1000 cps	11.8 approx.	mh
DC Resistance at 25°C	7.3 approx.	ohms
Vertical Coils (Series Connected):		
Inductance at 1000 cps	125 approx.	mh
DC Resistance at 25°C	54 approx.	ohms

---

* With non-linearity equally distributed about the center of the screen by means of circuit adjustments.

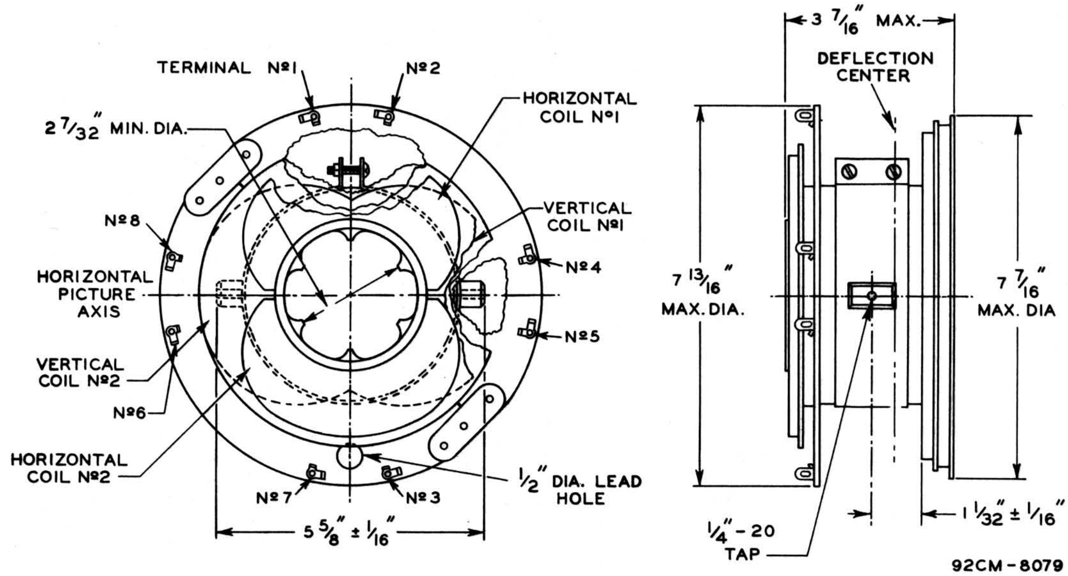
† With raster distortion equally distributed about the center of the screen by circuit adjustments.

♦ These maximum ratings are limiting values above which the serviceability of the yoke may be impaired from the viewpoint of life and satisfactory performance. Therefore, in order not to exceed these maximum ratings, the equipment designer has the responsibility of determining an average design value for each rating below the maximum value of that rating by an amount such that the maximum values will never be exceeded under any usual condition of supply-voltage variation, load variation, or manufacturing variations in the equipment itself.

⊕ At 15750-cps scanning rate.

° At 60-cps scanning rate.

DIMENSIONAL OUTLINE



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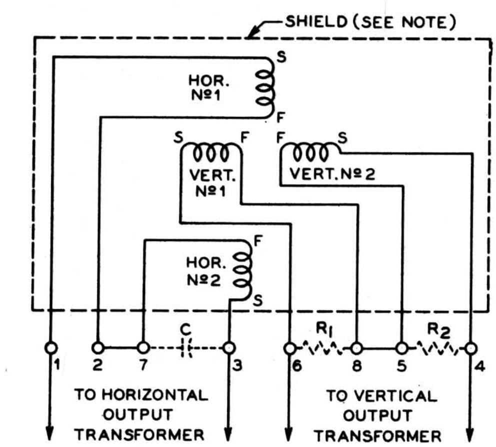


92CS-8081

NOTE: PROVISION SHOULD BE MADE FOR GROUNDING THE SHIELD WHICH IS INTERNALLY CONNECTED TO THE MOUNTING LUGS. RESISTORS AND CAPACITOR SHOWN ARE TYPICAL VALUES AND ARE NOT SUPPLIED WITH THE XD-2071-D. C1 = 250 TO 300 $\mu\mu f$, 1800 VOLTS. R1, R2 = 1000 OHMS ± 10%, 0.5 WATT.

Terminal Connections for Developmental No. XD-2071-D.

Preliminary and Tentative Data
on RCA Developmental

Horizontal-Output and High-Voltage Transformer

Developmental No.XD-2165-J

XD-2165-J is a developmental horizontal-output and high-voltage transformer for use with the Developmental No.XD-2071-D Deflecting Yoke in circuits employing the RCA Tricolor Kinescope Developmental No.C-73599.

This transformer has an auto-transformer winding and seven isolated windings. The auto-transformer winding is tapped to provide deflecting-yoke, damper-tube, driver-tube, and width-control connections. Other taps on the winding supply voltage pulses for keyed AGC and voltage for the rectifier tube supplying the dc voltage to the focusing electrode of the kinescope. Voltage for the converging electrode of the kinescope is obtained from a bleeder resistor in the high-voltage supply. The isolated windings supply filament power to the high-voltage and focusing-voltage rectifiers as well as voltage pulses for the color-synchronizing circuit and a peaking voltage pulse for the horizontal-driver circuit.

When used in a regulated, diode-coupled voltage-doubler circuit, the XD-2165-J can supply up to 20 kilovolts at 750 microamperes to the ultor of the kinescope, up to 4.75 kilovolts to the focusing electrode, and up to 10 kilovolts to the converging electrode. Such a circuit, utilizing the Developmental No.A-2334-C Beam Triode Tube as a shunt regulator, is capable of maintaining regulation within ± 2% from full load to no load and is shown in Fig.3, Page 36.

A ferrite core is used in the construction of the XD-2165-J to provide high efficiency. The coils are impregnated to assure high resistance to moisture absorption.

DATA

Characteristics:

DC Resistance (Approx.) at 25°C:

Between term. #1 and #2 . .	1.0	ohm
Between term. #2 and T . .	less than 1.0	ohm
Between term. T and #3 . .	1.7	ohms
Between term. #3 and #4 . .	less than 1.0	ohm
Between term. #4 and #5 . .	2.7	ohms
Between term. #5 and #7 . .	2.0	ohms
Between term. #7 and HV Lead▲ . .	27.3	ohms
Between term. A and B . .	less than 1.0	ohm
Between term. C and D . .	less than 1.0	ohm
Between term. E and F . .	less than 1.0	ohm
Between term. F and G . .	less than 1.0	ohm

Typical Operation:

Operating Temperature●	100 max.	°C
High-Voltage DC Output at 750-ua . .	20	kv
Focusing-Voltage DC Output at 0-ua .	4.7	kv
Peak Pulse Voltage for Keyed AGC:		
Between term. #2 and ground . . .	800 approx.	volts
Peak Pulse Voltage for Horizontal-Driver Circuit:		
Between terminals A and B (with terminal B grounded) . .	-60 approx.	volts
Peak Pulse Voltage for Color-Synchronizing Circuit:		
Between terminals C and D (with terminal C grounded) . .	114 approx.	volts
Between terminals E and G (with terminal G grounded) . .	-230 approx.	volts
Between terminals F and G (with terminal G grounded) . .	-55 approx.	volts

Test Conditions:

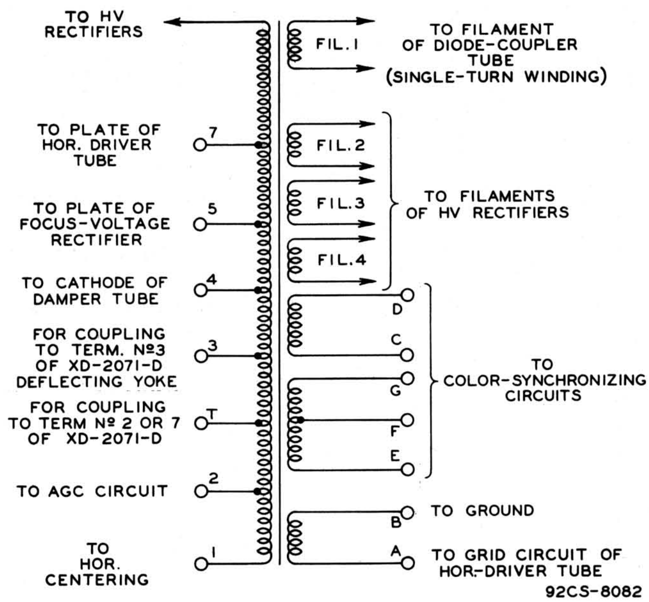
High Voltage (60 cps) Applied Between Each Winding and Core°	2.0 rms	kv
Induced Output Voltage	*	

▲ The high-voltage lead and the lead from terminal No.7 should be dressed away from each other, the chassis, and other wiring.

● Includes effects of ambient temperature and temperature rise of the winding measured by the resistance method (A.I.E.E. Rule No.13-207) during Underwriters Laboratory, Inc. type of heat run in a complete receiver.

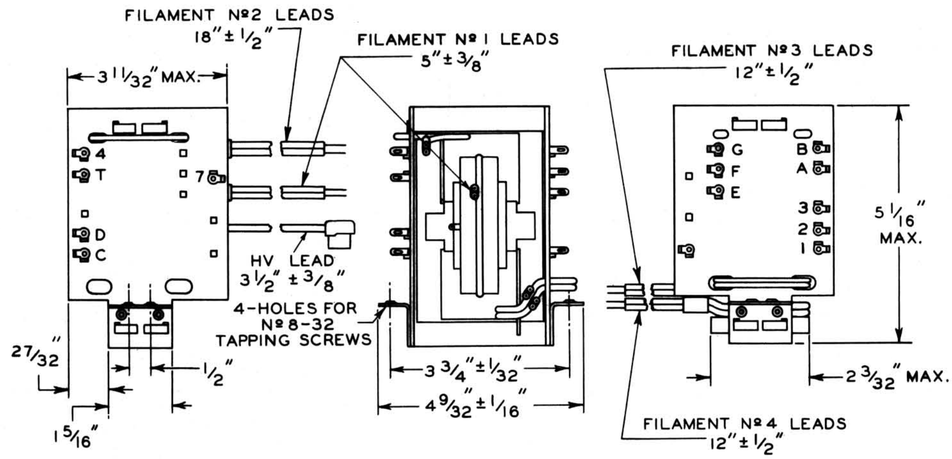
* Transformer will withstand voltage overload produced by overdriving its deflection circuit to develop a dc voltage of 36 kilovolts (at zero beam current) measured at the output of the high-voltage rectifier circuit.

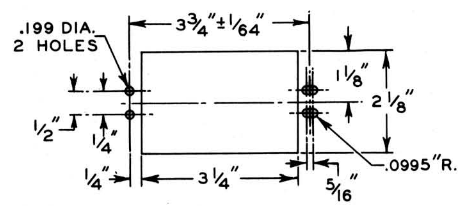
° Windings not under test should not be grounded.



Terminal Connections for Developmental No.XD-2165-J

DIMENSIONAL OUTLINE





DIMENSIONS FOR CHASSIS CUTOUT

92CS-8081

Preliminary and Tentative Data
on RCA Developmental

Purifying Coil, Beam-Positioning Magnets, and Neck-Shield Assembly

Developmental No. XD-2233-C

XD-2233-C is a developmental assembly consisting of a purifying coil for obtaining multi-beam alignment, three magnets for positioning the individual beams, and a magnetic shield. It is designed for mounting on the neck section of the RCA Tricolor Kinescope Developmental No. C-73599 and is equipped with a clamp for attaching the assembly to the kinescope neck.

The purifying coil of the XD-2233-C assembly produces a transverse magnetic field which can be adjusted by rotation of the coil and by change of current in the coil to provide accurate alignment of the common axis of the beams so that the common axis coincides with the axis of the kinescope. As a result, when the beams are focused, converged, and deflected they approach each hole in the shadow mask at the proper angle to strike the centers of their appropriate color dots thus producing color purity.

The beam-positioning magnets of the XD-2233-C assembly are supported by the shield of the XD-2233-C and are spaced at 120° intervals to correspond with the positions of the kinescope guns. They provide accurate positioning of their associated beams in a direction perpendicular to the change in beam direction produced by the electrostatic convergence lens.

The magnets are threaded and are slotted at both ends to provide ease and accuracy of adjustment. A red dot identifies the north pole of each magnet; effect of magnet on beam position is reversible by inserting the opposite end of the magnet into the shield.

The shield section of the XD-2233-C assembly is a Nicaloi magnetic shield for isolating the beams passing at low velocity through the neck section of the tricolor kinescope from effects of extraneous magnetic fields.

Information on adjustment procedure for the purifying coil and the beam-positioning magnets is given on Pages 43 and 44 of the Application Material.

DATA

Purifying Coil:

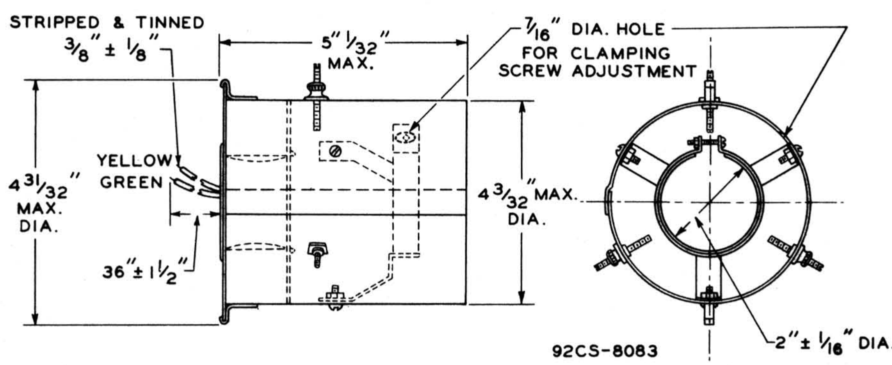
Ratings:

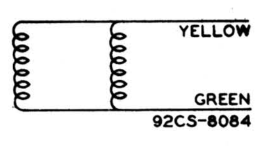
DC Current	200 max.	ma
DC Voltage (Coil to Shield).	500 max.	volts

Characteristics:

DC Resistance at 25°C.	17.5 ± 10%	ohms

DIMENSIONAL OUTLINE





Terminal Connections for Developmental No. XD-2233-C.

Preliminary and Tentative Data on RCA Developmental

Field-Neutralizing Coil

Developmental No.XD-2315-A

XD-2315-A is a developmental field-neutralizing coil designed to be placed around the faceplate end of the RCA Tricolor Kinescope Developmental No.C-73599. Its function is to produce a uniform magnetic field which can be adjusted to neutralize extraneous magnetic fields causing tangential displacement of the beams from their color centers as explained on Page 35 of the Application Material.

Correction of the direction of beam displacement is accomplished by adjusting the direction of current flow in the coil; correction of the magnitude of beam displacement is accomplished by adjusting the current value. A convenient means of adjusting both the current value and the direction of current flow is to use the coil in conjunction with a center-tapped potentiometer in a centering-supply circuit.

The XD-2315-A has an inside diameter large enough to facilitate mounting at the faceplate end of the kinescope and the insulating of the kinescope's flange section.

DATA

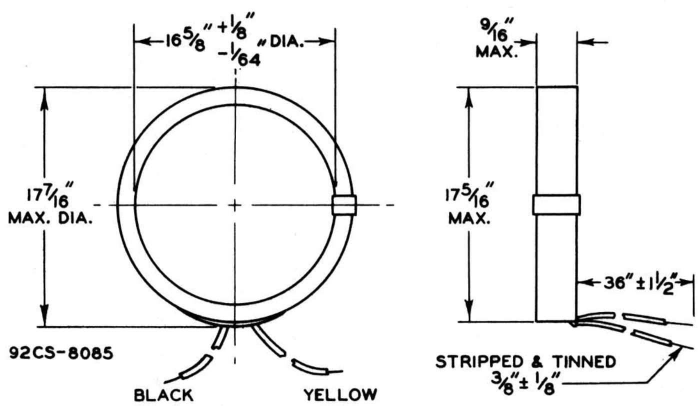
Ratings:

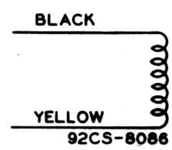
DC Current	150 max.	ma

Characteristics:

DC Resistance at 25°C	28.5 ± 10%	ohms

DIMENSIONAL OUTLINE





Terminal Connections for Developmental No.XD-2315-A.

Preliminary and Tentative Data on RCA Developmental

Vertical Dynamic-Converging and Dynamic-Focusing Transformer

Developmental No. 5XT-7610-C

5XT-7610-C is a developmental vertical dynamic-converging and dynamic-focusing transformer with a tapped secondary winding for coupling the vertical-dynamic output of the convergence amplifier to both the converging electrode (grid No.4) and the focusing electrode (grid No.3) of the RCA Tricolor Kinescope Developmental No.C-73599.

This transformer supplies vertical dynamic-correcting voltages for combining with the dynamic-correcting voltages supplied by the Developmental No.XT-7648-F Horizontal Dynamic-Converging and Dynamic-Focusing Transformer. These combined dynamic-correcting voltages are superimposed on the dc voltages for grid Nos.3 and 4 to provide changing electrostatic fields which maintain proper focus and convergence of the beams as they traverse the flat shadow mask of the tricolor kinescope.

This transformer employs a potted type of construction which provides quiet operation and high resistance to moisture absorption.

DATA

Ratings:

DC Primary Current	18 max.	ma
Ambient Temperature.	50 max.	°C

Characteristics:

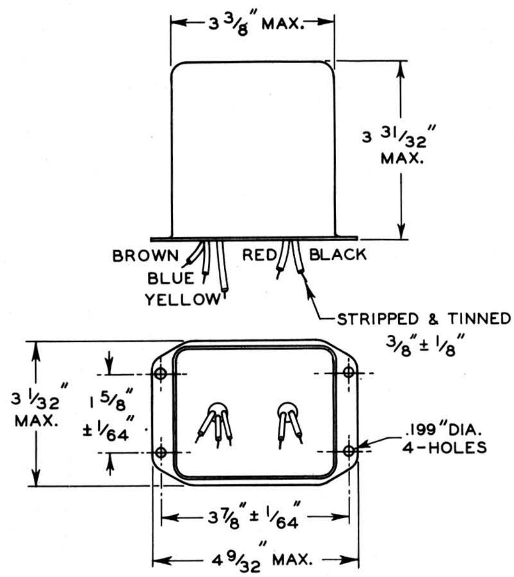
Turns Ratio of Primary to Secondary (Between brown and yellow leads) . .	1:10 ± 5%	
Turns Ratio of Primary to Secondary (Between brown and blue leads). . .	1:3.3 ± 5%	
Primary Impedance (With 10-volt, 60-cps signal superimposed on dc current of 18 ma)	5000 min.	ohms
Leakage Inductance (With 1-volt, 1000-cps signal on primary and with secondary shorted).	500 max.	mh
DC Resistance at 25°C:		
Primary Winding.	1145 approx.	ohms
Secondary Winding.	29200 approx.	ohms

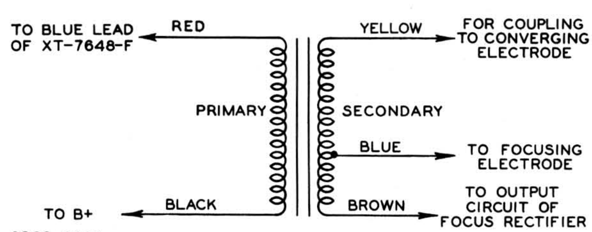
Test Conditions:

High-Voltage Test:		
Between Primary Winding and Core . .	1500 rms	volts
Between Secondary Winding and Core .	5000 rms	volts
Induced Voltage Test	*	

* This transformer will withstand the effects of 5500 dc volts on the secondary winding plus an rms voltage induced on the secondary winding by applying 170 volts at 800 cps to the primary winding. The red lead of the primary winding is grounded during the test.

DIMENSIONAL OUTLINE





Terminal Connections for Developmental No. 5XT-7610-C.

Preliminary and Tentative Data
on RCA Developmental

Horizontal Dynamic-Converging and Dynamic-Focusing Transformer

Developmental No. XT-7648-F

XT-7648-F is a developmental variable-inductance transformer with a tapped secondary winding for coupling the horizontal-dynamic output of the convergence amplifier to both the converging electrode (grid No.4) and the focusing electrode (grid No.3) of the RCA Tricolor Kinescope Developmental No.C-73599.

This transformer can be adjusted to supply horizontal dynamic-correcting voltages for combining with the dynamic-correcting voltages supplied by the Developmental No.5XT-7610-C Vertical Dynamic-Converging and Dynamic-Focusing Transformer. These combined dynamic-correcting voltages are superimposed on the dc voltages for grid Nos.3 and 4 to provide changing electrostatic fields which maintain proper focus and convergence of the beams as they traverse the flat shadow mask of the kinescope.

Designed for operation at the horizontal-scanning frequency of 15750 cycles per second, the XT-7648-F utilizes an adjustable ferrite core to permit tuning the transformer to the scanning frequency. The output of the XT-7648-F, as observed on an oscilloscope, is tuned to maximum by adjusting the ferrite core. The oscilloscope probe should be connected to the insulation of the green lead of the transformer and the adjusting is done with the transformer installed in the circuit given in Fig.6, Page 41.

DATA

Ratings:

DC Primary Current	18 max.	ma
Ambient Temperature.	50 max.	°C

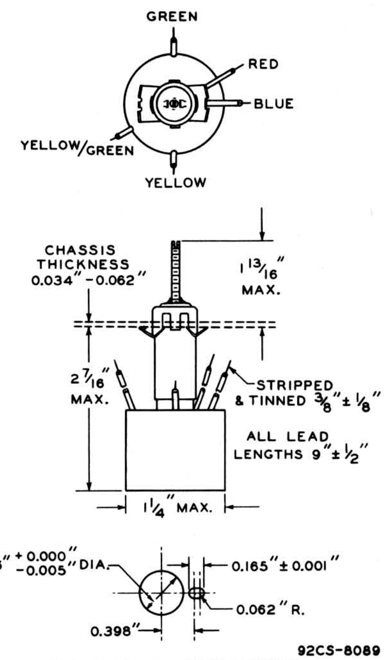
Characteristics:

Turns Ratio of Primary to Secondary (green and yellow leads)	1:9.4 ± 5%	
Turns Ratio of Primary to Secondary (yellow/green and yellow leads) .	1:3 ± 5%	
Primary Inductance (With 1-volt, 1000-cps signal and no dc):		
With Core In	10.7 approx.	mh
With Core Out.	2.3 approx.	mh
Secondary Inductance (With 1-volt, 1000-cps signal and no dc):		
With Core In	900 approx.	mh
With Core Out.	352 approx.	mh
DC Resistance at 25°C:		
Primary (Between blue and red leads) .	94 approx.	ohms
Secondary (Between green and yellow leads)	2070 approx.	ohms

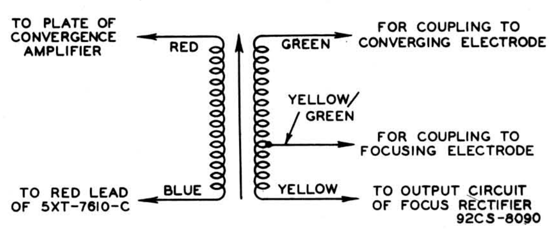
Test Conditions:

High-Voltage Test:		
Between Primary Winding and Core. .	2500 rms	volts
Between Primary and Secondary Winding	7500 rms	volts
Between Secondary Winding and Core.	7500 rms	volts

DIMENSIONAL OUTLINE



DIMENSIONS FOR CHASSIS CUTOUT



Terminal Connections for Developmental No. XT-7648-F.

Preliminary and Tentative Data
on RCA Developmental

Vertical-Deflection-Output Transformer

Developmental No. XT-7898-A

XT-7898-A is a developmental vertical-deflection-output transformer for use with the Developmental No. XD-2071-D Deflecting Yoke in TV receivers employing the RCA Tricolor Kinescope Developmental No. C-73599. Designed to operate with one-half of a 6BL7-GT as the driver tube, this transformer provides good sweep linearity, ample deflection, and efficient coupling between the driver tube and the vertical coils of the deflecting yoke.

The XT-7898-A is carefully constructed to provide long life under adverse humidity conditions and the coils are vacuum impregnated in varnish and wax to insure quiet operation, and resistance to moisture.

DATA

Ratings:

DC Primary Current (Limited by Iron Saturation).	19 max.	ma
Ambient Temperature.	60 max.	^{o}C

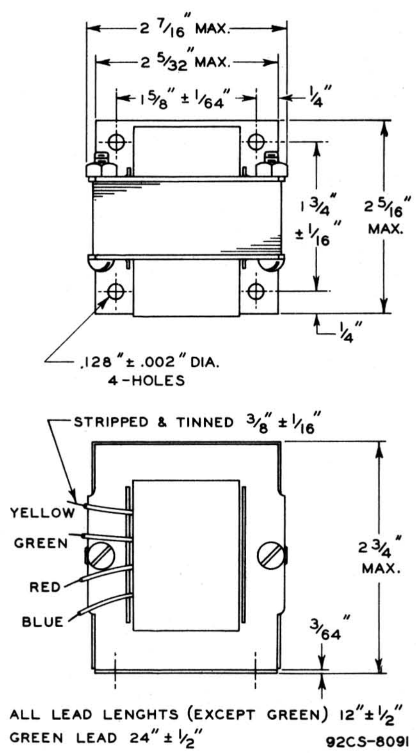
Characteristics:

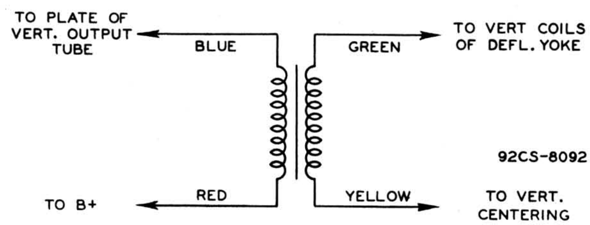
Turns Ratio of Primary to Secondary. .	9:1 ± 5%	
Primary Impedance (With 30-volt, 60-cps signal superimposed on dc current of 19 ma). .	15000 min.	ohms
DC Resistance at 25°C:		
Primary Winding.	555 approx.	ohms
Secondary Winding.	15.7 approx.	ohms

Test Conditions:

Between Windings and Core.	2500 rms	volts

DIMENSIONAL OUTLINE





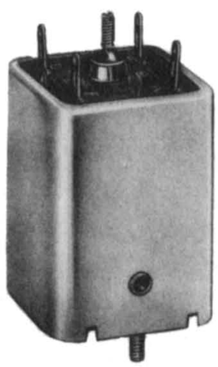
Terminal Connections for Developmental No. XT-7898-A.

205R1

HORIZONTAL-OSCILLATOR AND SYNC-STABILIZER COIL

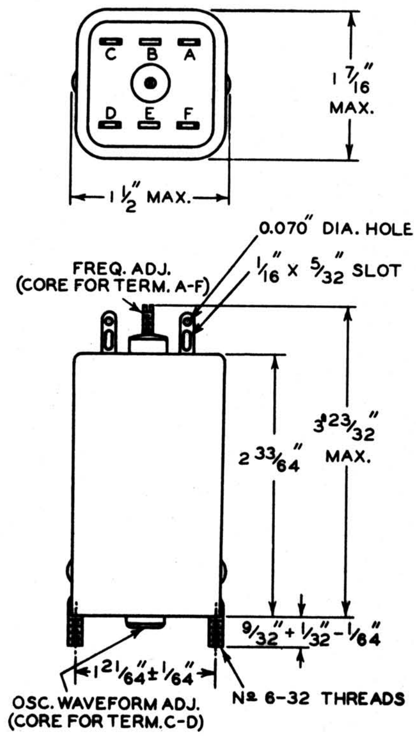
TENTATIVE DATA

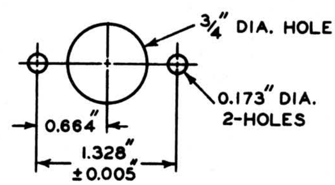
RCA-205R1 consists of a horizontal-blocking oscillator coil and a shock-excited frequency-stabilizing coil for use in television receivers employing a 6SN7-GT as a combination horizontal blocking-oscillator and synchronizing-control tube.



When the low-capacitance probe of an oscilloscope is connected at terminal C in a typical circuit such as that shown in Fig.3, Page 36, the oscillator waveform adjustment should be set so that the wide and narrow peaks of the waveform observed are of the same height.

DIMENSIONAL OUTLINE





92CS-7236R1

Dimensions for Chassis Cutout for Type 205R1.

DATA

Characteristics:

	Term. A-F	*Term. C-D*
DC Resistance (Approx.)	81 ohms	47 ohms
Coil Inductance	13.5▲ max. mh to 33● min. mh	7.75▲ max. mh to 11.0● min. mh
	With Core For Term. A-F Set For 33.0 mh At 1000 cps	*With Core For Term. A-F Set For 13.5 mh At 1000 cps*
Ratio of Inductance of Winding (Term. A-F) to Inductance of Winding (Term. A-C) at 1000 cps	7.81 ± 3%	10.28 ± 3%
Coefficient of Coupling Between Sections (Term. A-C & Term. C-F)	89.2 ± 2%	76.9 ± 2%
Q of Winding at 50 Kc (Term. A-F)	55 ± 10%	35 ± 10%
Distributed Capacitance of Winding (Term. A-F)	14.9 ± 2.5 μμf	17.3 ± 2.5 μμf
	With Core For Term. C-D Set For 7.75 mh At 1000 cps	*With Core For Term. C-D Set For 11.0 mh At 1000 cps*
Q of Winding (Term. C-D) Tuned with 0.01-μf Capacitor	17.5 ± 10%	20 ± 10%

▲ With core adjusted for least inductance.
● With core adjusted for greatest inductance.

208T9

VERTICAL-BLOCKING-OSCILLATOR TRANSFORMER

Quiet Operation

Moisture Resistant

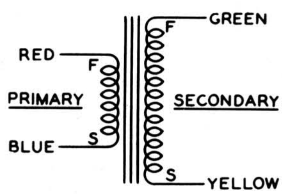
TENTATIVE DATA

The RCA-208T9 is a vertical-blocking-oscillator transformer for television receiver circuits. It is used in typical blocking-oscillator circuits which generate pulses for driving the grids of the vertical-discharge tubes. It employs a potted type of construction which provides quiet operation and resistance to moisture absorption.

DATA

Characteristics:

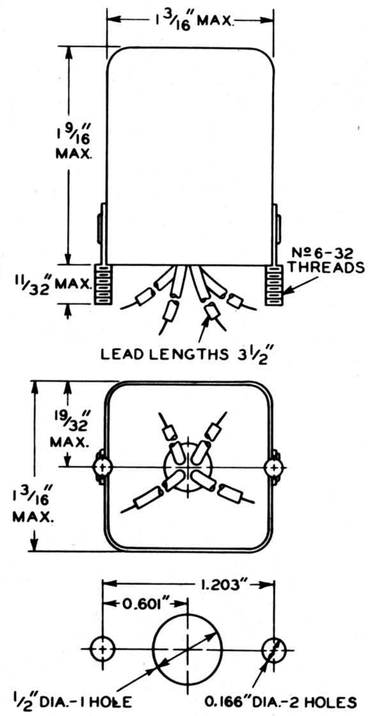
Turns Ratio of Primary to Secondary. . .	1:4.2 ± 5%	
Primary Inductance (with 3-volt, 1000-cps signal & no dc current). . .	1.15 ± 20%	henries
Leakage Inductance (with 1-volt, 1000-cps signal on primary and with secondary shorted). . .	0.008 + 25% − 15%	henry
DC Resistance at 25°C:		
Primary	165	approx. ohms
Secondary	1310	approx. ohms



92CS-7026

Polarity is additive with red connected to yellow. Insulation on leads designed to withstand continuous operation at 75°C.

DIMENSIONAL OUTLINE



92CS-7027

Application of RCA Developmental Tricolor Kinescope Dev. No. C-73599 and Associated Tubes and Components

This material discusses the operation and adjustment of components for the RCA Developmental Tricolor Kinescope Dev. No.C-73599. Included is information on (1) mounting, shielding, and related components; (2) deflection, high-voltage, and dynamic-focus and convergence circuits; and (3) kinescope component adjustment procedure. Obviously, the circuits given are not the only ones that can be used, but are suggested as a starting point in experimental designs because they do not require unusual circuit arrangements.

1. MOUNTING, SHIELDING, AND RELATED COMPONENTS

The glass tricolor kinescope Developmental No.C-73599 can be supported by any of numerous methods, but certain precautions should be taken into consideration when the mounting for this kinescope is designed. The front end of the kinescope should be supported in the region between the metal flange and the faceplate in such a manner that no pressure is exerted directly on the flange. The front support should be cushioned with shock-absorbing material. A high-voltage insulator* should be used to insulate the metal flange, which is the ultor terminal, from the magnetic shield and other grounded elements.

The rear support of the kinescope can consist of the grounded magnetic shield supporting the kinescope in the cone area indicated in Fig. 1 or on the dimensional outline drawing in the tube bulletin (page 9). Neither the neck nor the base should be used to support the tube. The magnetic shield may be supported from the chassis or the receiver cabinet. Pads of neoprene-base rubber or similar material should be provided between the magnetic shield and the glass envelope.

The deflecting yoke should not be used for supporting the kinescope because it should be centered on the neck and free to move along the neck for a distance of approximately one inch for adjustment purposes. The yoke mount should also provide for a small amount of rotational adjustment. An assembly consisting of the purifying coil, beam-positioning magnets, and neck shield is preferably supported by the neck of the kinescope.

Shielding and Extraneous-Field Neutralization

Proper operation of the tricolor kinescope requires shielding of the electron beams from the earth's magnetic field and other extraneous magnetic fields. Shielding and effective neutralization of external magnetic

* A suitable insulator having the manufacturer's designation Insulator Part No. 15GCA1 may be obtained from Anchor Industrial Co., 36-36 36th St., Long Island City 6, N.Y.

fields may be accomplished by the use of two shields and two coils. One shield, which may be used as part of the rear support of the kinescope, is located on the conical section of the kinescope envelope. The other shield is located on the tube neck. One coil is located around the periphery of the faceplate; the other coil is located on the tube neck.

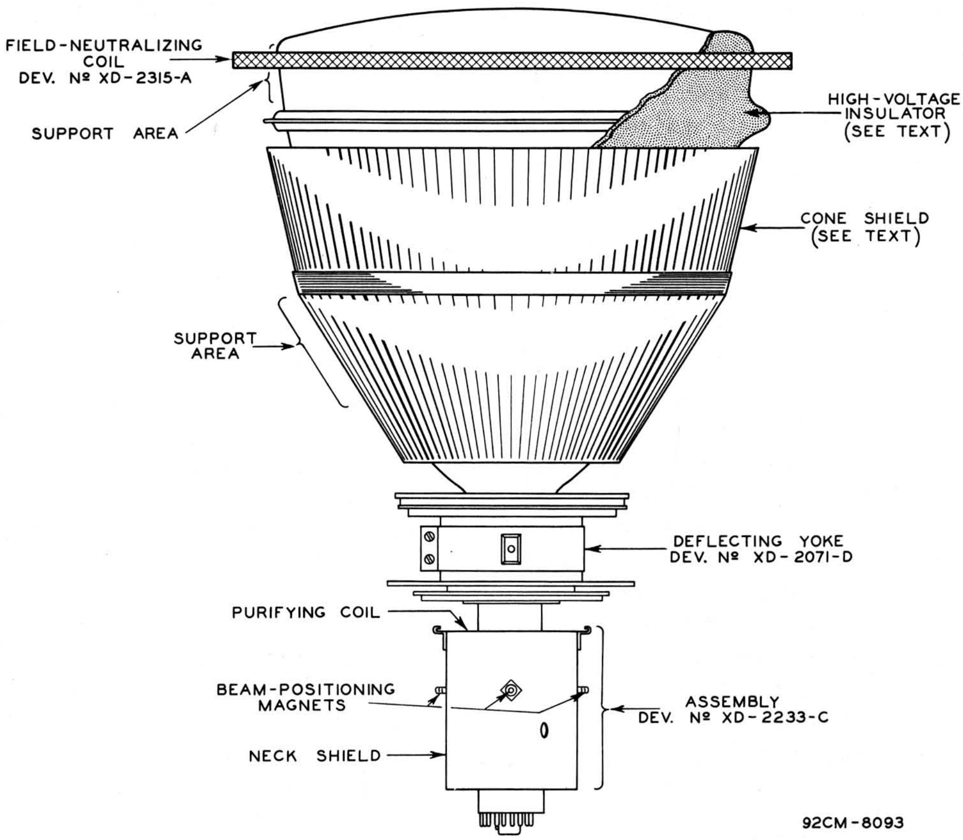


Fig. 1 - Sketch showing the relative placement of components and the support regions on faceplate section and cone area.

For the conical section, the magnetic shield● may be made of Mumetal. Fig. 2 is a dimensional outline for a typical cone shield made of this material. Although effective shielding is provided with high-nickel alloys such as Mumetal, Nicaloi, or equivalents, lower-cost shielding can be obtained with the use of multiple shields of 3.5 to 4 per cent annealed silicon steel. The most effective shielding is provided by the use of annealed material having high permeability and low coercive force.

Properties of materials suitable for shields are:

Material	*Permeability at 10 Gauss (approx.)*	*Coercive Force (Hc)*
Mumetal	>10000	0.05 - 0.07
Nicaloi	4000 - 5000	0.1
3.5% - 4.0% Silicon Steel	1000	0.5

● A suitable cone shield having the manufacturer's designation Sketch No. SO-333 (HYMU 80) may be obtained from the Magnetic Metals Co., Hayes Avenue at 21st St., Camden 1, N.J.

In addition to rubber pads for cushioning, the shield may be conveniently equipped with a spring of beryllium-copper or other suitable material to provide the electrical contact for grounding the external conductive coating on the kinescope.

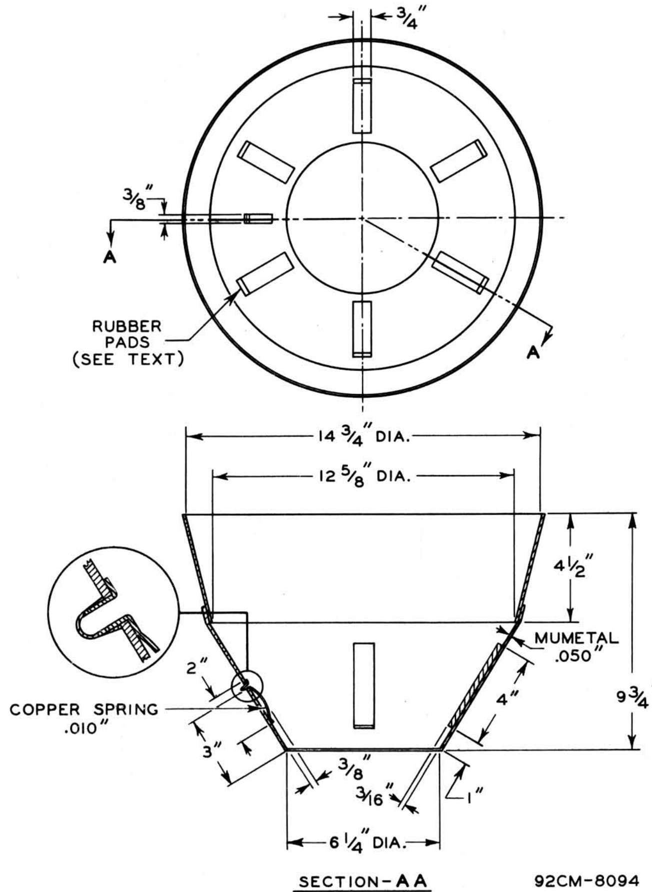


Fig. 2 - Dimensional outline of typical cone shield made of Mumetal.

Field-Neutralizing Coil

For producing an adjustable magnetic field to neutralize the effects of extraneous fields the use of a coil around the faceplate section of the kinescope is recommended. Such a coil is the Field-Neutralizing Coil RCA Developmental No. XD-2315-A. This coil is positioned around the periphery of the faceplate as shown in Fig. 1. It may be supported in any convenient manner. The field of this coil is controlled in both amplitude and direction by adjustment of the current through it. It is recommended that the current be adjusted by a center-tapped potentiometer so that easy reversal of the direction of the current may be obtained. This control should provide a minimum of 100 milliamperes in either direction through the coil. This current value will produce approximately 15 ampere turns. Adequate high-voltage insulation between this coil and the metal flange of the kinescope is provided by the high-voltage insulator previously mentioned.

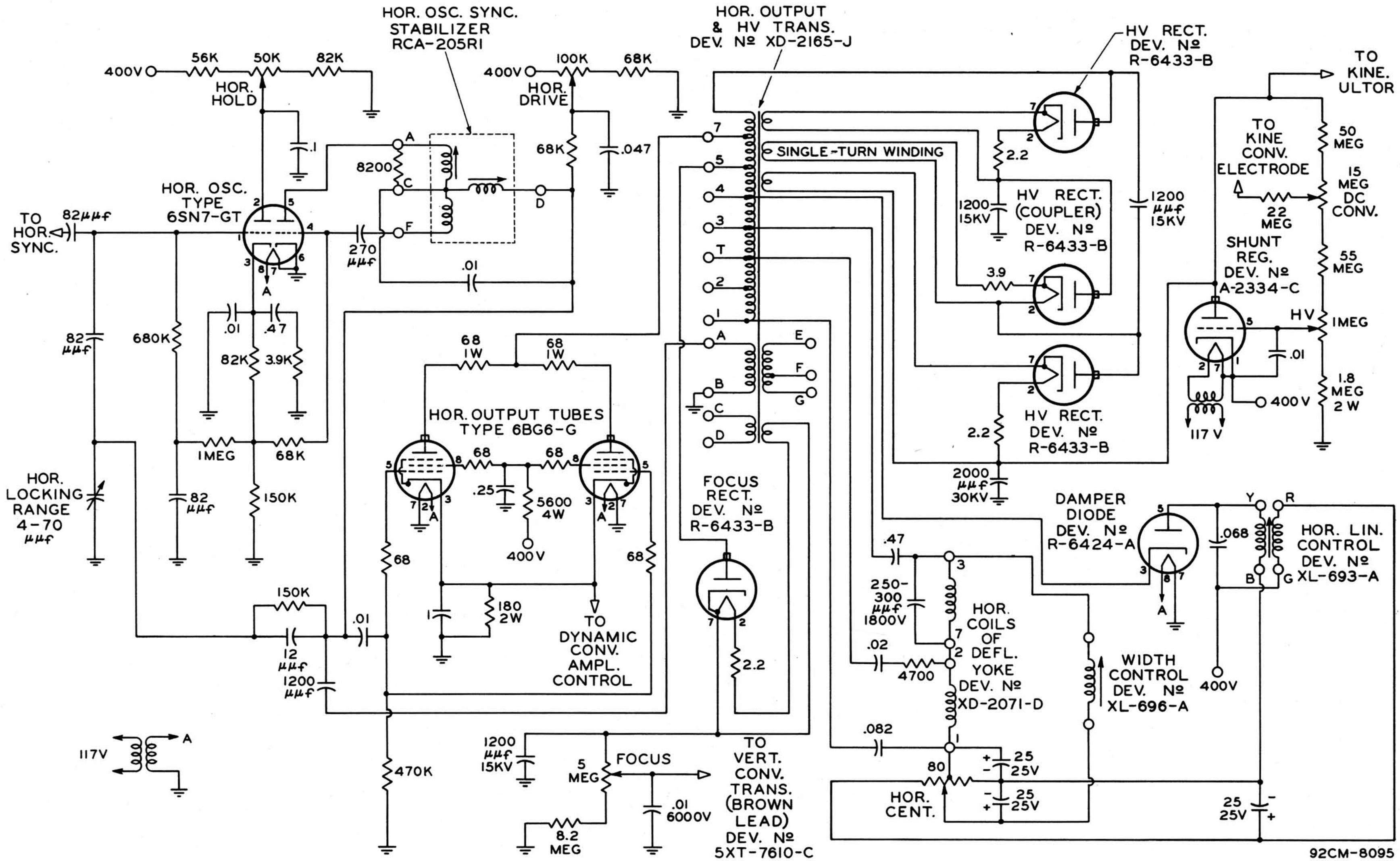


Fig. 3 - Horizontal-deflection and high-voltage circuit for RCA Developmental Tricolor Kinescope Dev. No. C-73599. Capacitor values are in microfarads, resistor values in ohms, and resistor rating is 0.5 watt, unless otherwise indicated. K = 1000 ohms.

Purifying Coil, Beam-Positioning Magnets, and Neck-Shield Assembly

The neck shield may be part of an assembly including the purifying coil and the beam-positioning magnets. Such an assembly is the Purifying Coil, Beam-Positioning Magnets, and Neck-Shield Assembly, RCA Developmental No. XD-2233-C. The purifying coil provides for proper alignment of the three beams with respect to the phosphor-dot plate and the shadow mask; the neck shield shields the low-velocity section of the beams from stray magnetic fields; the three beam-positioning magnets help to provide proper alignment of each of the three beams with respect to the others.

This assembly is mounted on the kinescope neck with the purifying coil at the end away from the base. The three threaded magnets are spaced at 120-degree intervals to correspond to the three positions of the three electron guns of the tricolor kinescope. The clamp of the assembly should be tightened around the kinescope neck. Each positioning magnet provides deflection of its associated beam in a direction perpendicular to the change in beam direction produced by the electrostatic convergence lens. The direction of deflection can be reversed by reversing the magnet and threading its other end into the assembly. Proper convergence in the center of the raster is obtained by adjusting the position of the magnets in or out and by adjusting the voltage on the convergence electrode as required.

The adjustment for color purity is made by simultaneously rotating the purifying coil and adjusting the current through it as required. Rotation of the coil affects the direction of the field; adjustment of current affects the magnitude of the field. A minimum of 150 milliamperes through the purifying coil should be provided at the maximum setting of the current control.

2. DEFLECTION, HIGH-VOLTAGE, FOCUS, AND CONVERGENCE CIRCUITS

Deflection and High-Voltage Circuit

A schematic diagram of a suggested horizontal-deflection and high-voltage circuit is given in Fig. 3. Correct operation of this circuit can be obtained with a conventional oscillator-discharge circuit, such as the one shown, which is capable of delivering a driving voltage of the amplitude and waveform shown in Fig. 4. Two RCA-6BG6's in parallel

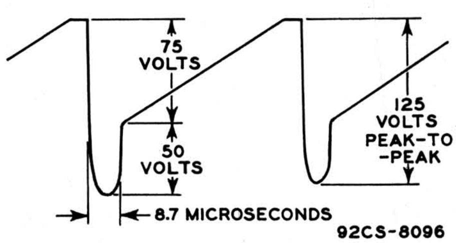


Fig. 4 - Typical waveform of input to grid-No. 1 circuit of horizontal-deflection-output tubes type 6BG6-G measured across 470,000-ohm grid resistor.

are used as horizontal-output tubes. In order that circuit efficiency be maintained, the output tubes must be cut off rapidly at the end of each scanning cycle and kept cut off during the entire retrace interval. To assure complete cutoff, it is desirable to add a negative peaking pulse to the sawtooth driving voltage during retrace. The winding between terminals A and B of the Horizontal-Output Transformer RCA Developmental No.XD-2165-J may be used to provide the necessary peaking pulse. A method of using this winding for peaking is shown in Fig.3.

Width Control and Linearity Control

An inductive Width Control, RCA Developmental No.XL-696-A, is connected in parallel with the horizontal windings of the Deflecting Yoke RCA Developmental No.XD-2071-D. This type of width control is best suited for this circuit because it does not entail a serious loss in ultor power.

Horizontal-Linearity Control RCA Developmental No.XL-693-A is used to provide for linearity adjustment. Electrical centering is provided by an 80-ohm center-tapped potentiometer which controls the dc current through the horizontal coils of the deflecting yoke.

Plate Pulse Voltage

During the retrace interval, a positive voltage pulse of 5500 volts appears on the plate of the horizontal-output tube. A portion of this pulse is fed back to the control grid through the grid-plate capacitance of the tube and the associated wiring. This pulse opposes the action of the peaking pulse and, if it is too large, will prevent the maintenance of plate-current cutoff during the retrace interval. In order that the effect of this feedback pulse be kept at a minimum, the wiring must be dressed to reduce as much as possible the grid-plate capacitance in the external circuit.

If the insulation or spacing of the plate-circuit components of the 6BG6-G's is inadequate, the 5500-volt pulse on the tube plate during retrace may cause corona or arc-over. To minimize the possibility of corona and arc-over, soldered joints should be smooth and free from projecting points, and adequate spacing should be provided between the plate circuit components and the chassis or other grounded components.

Damper-Tube Considerations

The developmental type No.R-6424-A is used as the damper diode. The cathode of the diode receives a positive peak voltage of approximately 3200 volts during the retrace interval. Because this value is within the 4500-volt peak-pulse heater-cathode rating, the heater may be grounded at either of its terminals. It is important that the socket also be capable of withstanding this 3200-volt pulse without breakdown or leakage.

Deflecting-Yoke Considerations

A neutralizing capacitor of 250 to 300 micromicrofarads for the yoke is shown on the diagram of the deflection circuit, Fig.3. As with conventional yokes, improper neutralization causes the appearance of vertical bands on the left side of the raster, together with an uneven vertical displacement of the scanning lines. In the yoke for the tricolor kinescope, however, the effect of improper neutralization will be more severe because each beam may be displaced a different amount and it will therefore be impossible to obtain proper beam convergence on the left side of the picture. Tying the center tap of the horizontal winding of the deflecting yoke back to the horizontal-output transformer by the network (4700 ohms and 0.02 microfarads) also helps to improve the neutralization.

High-Voltage Power Supply

The high-voltage output required for the kinescope ultor is supplied by a diode-coupled voltage-doubling circuit using three RCA developmental tubes Developmental No.R-6433-B. A shunt-regulator tube RCA Developmental No.A-2334-C is used to regulate the ultor voltage supply at 20 kilovolts. This voltage is maintained with loading up to approximately 750 microamperes. The high-voltage lead of the output transformer and the leads of the 1200-micromicrofarad coupling capacitor in the plate circuit of the two high-voltage rectifiers should be kept as short as possible and away from the chassis to maintain optimum efficiency. The single-turn heater winding around the high-voltage winding of the horizontal-output transformer should be used for the coupling diode; the heater leads should be kept as short as possible and away from the chassis. Part of the 4000-micromicrofarad output capacitance may consist of the 2000-micromicrofarad capacitor formed by the kinescope ultor and the grounded coating. Because the cathode of the shunt regulator tube Developmental No.A-2334-C is tied to B+ (400 volts), a value which is greater than the heater-cathode rating of ±180 volts, a separate heater winding should be used for this tube.

The dc convergence-voltage control may be part of the regulator bleeder as shown in Fig.3 because the current collected by the converging electrode is only leakage current. Special precautions should be taken to minimize leakage currents in this bleeder circuit.

The dc focus voltage is obtained from a tap (terminal 5) on the horizontal-output transformer. A diode RCA Developmental No.R-6433-B is used as the focus rectifier. Adjustment of the focusing voltage is provided by means of a 5-megohm potentiometer in a voltage-divider network.

Adjustment of Horizontal-Deflection and High-Voltage Circuit

Adjustment of the horizontal-deflection and high-voltage circuit is conventional. The first step is the adjustment of the horizontal-oscillator-discharge circuit. When this adjustment is completed, the horizontal drive should be adjusted for efficient operation of the output circuit. The appearance of a bright vertical bar near the center of the raster is an indication that the driving voltage is more than sufficient. It is important that this condition be attainable because the most efficient operation is usually obtained just before this overdrive indication appears. The high-voltage adjustment should now be made to provide 20 kilovolts at the kinescope ultor terminal. Width and linearity should be adjusted for approximately a one-fourth inch over-scan on each side. After these adjustments have been completed, the horizontal-drive adjustment should be repeated.

Vertical-Deflection Circuit

Vertical-deflection power is provided by the circuit shown in Fig. 5. The signal from the combined vertical-oscillator and discharge circuit is sufficient to drive the output stage. One-half of an RCA-6BL7-GT is used in the output stage with the Vertical-Deflection Output Transformer

RCA Developmental No.XT-7898-A. Electrical centering is provided by a center-tapped potentiometer which should provide a minimum of 50 milliamperes in either direction through the vertical winding of the yoke.

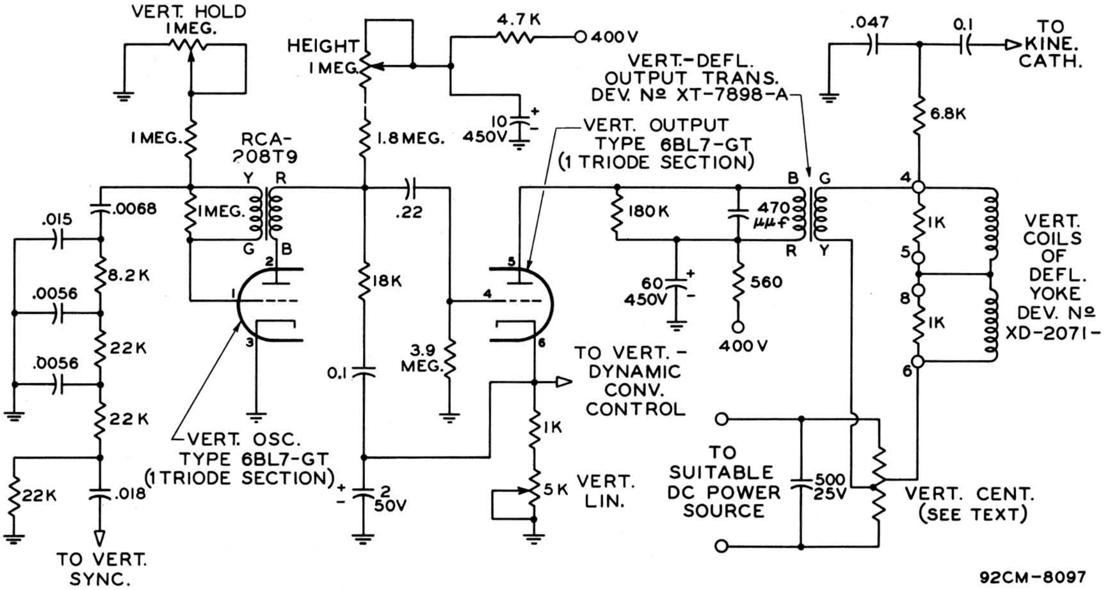


Fig.5 - Vertical-deflection circuit for RCA Developmental Tricolor Kinescope Dev. No. C-73599. Capacitor values are in microfarads, resistor values in ohms, and resistor rating is 0.5 watt, unless otherwise indicated. K = 1000 ohms.

Dynamic-Convergence-and-Dynamic-Focus Circuit

In addition to the approximately 3000-volt dc focus voltage and 9000-volt dc convergence voltage obtained from the high-voltage supply, dynamic-focus and convergence voltages are superimposed on the dc components to maintain uniform focus and convergence over the entire raster. A diagram of the dynamic-convergence-and-dynamic-focus circuit is given in Fig.6.

For the horizontal-dynamic-focus-and-convergence circuit, a voltage, having the approximate waveform shown in Fig.7a, is taken from the cathode circuit of the horizontal-output tube and applied through an amplitude control and the Horizontal-Dynamic-Convergence Phase Control, RCA Developmental No.XL-582-C to the grid of the convergence amplifier RCA-6BL7-GT. For the vertical-dynamic-focus-and-convergence circuit, a voltage as shown in Fig.7b is taken from the cathode circuit of the vertical-output tube and applied through an amplitude control to the grid of the convergence amplifier tube. The shape of the waveform of the vertical-dynamic-convergence-and-focus voltage is adjusted by means of the vertical-convergence-phase control. The Horizontal Dynamic-Converging and Dynamic-Focusing Transformer, RCA Developmental No.XT-7648-F, in the plate circuit of the RCA-6BL7-GT is tuned by means of the adjustable core to give maximum output at the horizontal-scanning frequency. Although this adjustment results in rounding off the sharp peaks of the parabolic wave, which becomes almost sinusoidal in appearance, the resultant distortion does not adversely affect performance because the sharp peaks occur during horizontal blanking. The secondary of the transformer is tapped to provide the proper ratio of dynamic-focus voltage to dynamic-convergence voltage.

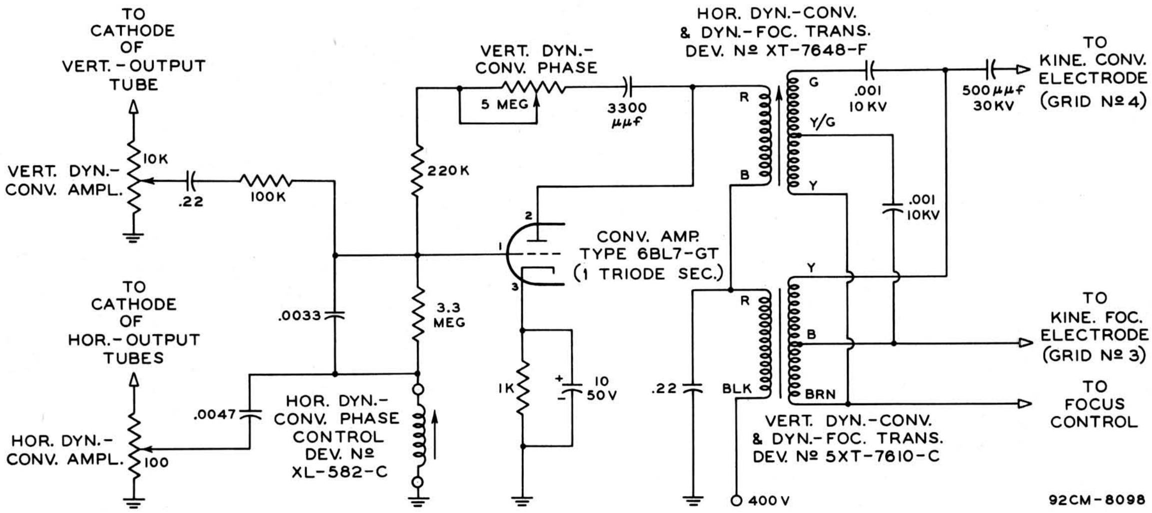


Fig.6 - Dynamic-convergence-and-focus circuits for RCA Developmental Tricolor Kinescope Dev. No.C-73599. Capacitor values are in microfarads, resistor values in ohms, and resistor rating is 0.5 watt, unless otherwise indicated. K = 1000 ohms.

The Vertical Dynamic-Converging and Dynamic-Focusing Transformer, RCA Developmental No.5XT-7610-C has its primary connected in series with the primary of the horizontal dynamic-converging-and-focusing transformer in the plate circuit of the RCA-6BL7-GT. The secondary of the vertical-

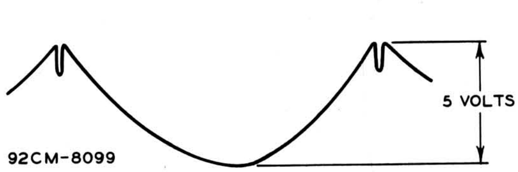


Fig.7a - Waveform of voltage at cathode of horizontal output tube.

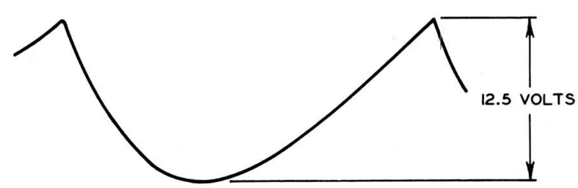


Fig.7b - Waveform of voltage at cathode of vertical output tube.

transformer is tapped to provide the proper ratio of dynamic-focus voltage to dynamic-convergence voltage. The dynamic-convergence voltages are coupled by a capacitor to the converging electrode and added to the dc convergence voltage; the dynamic-focus voltages are series fed to the focusing electrode and added to the dc focus voltage.

Table I: Typical Operating Values for the Deflection and High-Voltage Circuits Given in Figs.3,5, and 6.

B Voltage	400	volts
High Voltage (Regulated)	20	kilovolts
Beam Current	0-750	microamperes
Boosted B Voltage▲	610	volts
6BG6-G Horizontal Output Tubes (Values are for both tubes):		
Peak Positive-Pulse Plate Voltage	5500	volts
Grid-No.2 Voltage	290	volts
Grid-No.1 Voltage●	-36	volts
Plate Current	160	milliamperes
Grid-No.2 Current	15	milliamperes
Cathode Current	175	milliamperes
Grid-No.2 Input	4.5	watts
Dev. No. R-6424-A Damper Tube:		
Peak Inverse Plate Voltage	2800	volts
Plate Current	160	milliamperes
Peak Heater-Cathode Voltage	3200	volts
Dev. No. XD-2165-J Horizontal-Output and High-Voltage Transformer:		
Pulse Voltage at Terminals (Measured to Ground)□		
Terminal T	1770	volts
Terminal 2	1400	volts
Terminal 3	2800	volts
Terminal 5	4700	volts
6BL7-GT Vertical Output Tube:		
Plate Supply Voltage	400	volts
Plate Voltage	360	volts
Peak Positive-Pulse Plate Voltage	1300	volts
Grid Voltage	-21	volts
Cathode Current	13	milliamperes
6BL7-GT Convergence Amplifier:		
Plate Supply Voltage	400	volts
Plate Voltage	360	volts
Grid Voltage	-20	volts
Cathode Current	19	milliamperes

▲ Measured at terminal 1 of horizontal-output and high-voltage transformer Dev. No.XD-2165-J, to ground.

● Consists of 11 volts cathode bias and 25 volts grid-resistor bias.

□ Consists of positive voltage pulse having a dc component equal to the boosted B voltage.

3. KINESCOPE COMPONENT ADJUSTMENT PROCEDURE

This section gives a suggested procedure for the adjustment of the kinescope components to provide color purity and optimum convergence of the three beams over the entire area of the screen. Once the preliminary adjustments have been made, final "touch-up" becomes a matter of experience not requiring a set procedure, but rather an understanding of the effects of particular corrections.

Neither a complete color receiver nor a color signal is required for the alignment of the kinescope components. In fact, the best indication of the quality of kinescope alignment is the ability of the kinescope to produce a good-quality black-and-white picture. A conventional test pattern is useful in making the initial adjustments. Some other pattern, however, is preferable for the final "touching-up" operations. A pattern of horizontal and vertical bars is particularly suitable and can be helpful in linearity adjustments as well. If a flying-spot scanner is available, an excellent convergence test pattern can be made with a slide of opaque material having 15 or more uniformly distributed holes. Commercial dot-pattern generators are available which are very useful for both convergence adjustments and linearity adjustments.

Proper adjustment requires that each of the three beams be focused and that all three beams properly converge so that their axes intersect in the plane of the shadow mask. It is important to distinguish between these two operations. Each of the beams is brought to a focus by a separate electrostatic lens in the appropriate gun. All of these focusing lenses are adjusted by the voltage applied to the focusing electrodes through base pin No. 6. The three beams are adjusted to proper convergence by the use of an electrostatic lens common to all three guns. Proper convergence is established when the three color images produced by the application of the same video signal to all three guns appear superimposed on one another.

Placement of Components

After the kinescope is mounted with the blue gun uppermost (i.e. base pin 17 on top), the first step is placement of the components on the kinescope neck as shown in Fig. 1. The Deflecting Yoke Developmental No. XD-2071-D should be centered radially on the neck of the kinescope and placed near its most forward position, with its insulating liner about 3/8 of an inch from contact with the funnel of the tube. The Purifying Coil, Beam-Positioning Magnets, and Neck-Shield Assembly Developmental No. XD-2233-C should be clamped on the neck of the kinescope so that any one of the beam-positioning magnets is located vertically above the blue gun. It is advisable to ground this assembly. The beam-positioning magnets should be unscrewed so that they have a minimum effect on the beams.

The Field-Neutralizing Coil Developmental No. XD-2315-A should be placed around the kinescope faceplate section. The inside diameter of this coil is about two inches greater than the outside diameter of the tube at the faceplate to facilitate the mounting of the kinescope at the faceplate section and the insulation of the metal flange. The socket may now be placed on the kinescope.

Initial Adjustments

Before the application of deflection power and high voltage to the kinescope, the kinescope bias control (background or brightness) should be adjusted for maximum bias. The dynamic-convergence adjustments (amplitude and phase controls) should be at their mid positions, and the controls for the purifying coil and for the field-neutralizing coil set so that no current is flowing through either. After deflection power and high voltage are applied, the beam currents should be increased gradually to minimize the possibility of tube damage in the event of circuit trouble. In addition, it is important that the high-voltage input (product of ultor voltage and ultor current) be kept within the tube rating of 15 watts. If color changes in bright areas of the test pattern are observed, the ultor current is too high and should be reduced immediately to prevent permanent damage to the shadow mask. The high-voltage adjustment should be made to provide approximately 20 kilovolts to the ultor. With the application of a test signal, initial adjustment of focus and convergence should be made. At this point it is convenient to adjust the horizontal oscillator and make the conventional adjustments of height, vertical linearity, horizontal linearity, width, drive, and electrical centering.

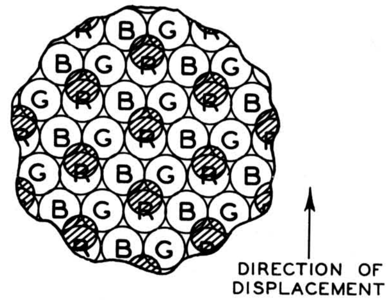
Color-Purity Adjustments

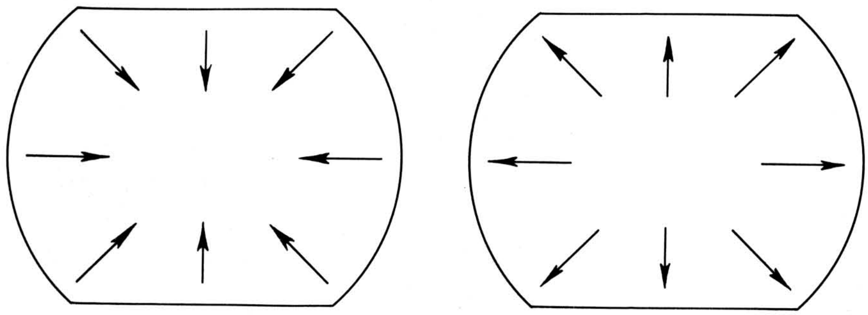
Adjustment for color purity is the next step. The normal sequence of adjustments involves first the purifying coil, then the axial position of the deflecting yoke, and last the field-neutralizing coil. Any color dilution may be best seen with the blue and green beams cut off. With a beam current of approximately 100 microamperes from the red gun and with no video signal applied, the purifying coil should be rotated on the tube neck simultaneously while the current through it is varied until a uniform red field appears in the center of the screen.

Adjust edge purity first by sliding the deflecting yoke axially on its mount and then by varying the amplitude and direction of the current in the field-neutralizing coil in such a way as to produce the most uniform red field. The blue and green fields should now be checked separately. If the field purity is not acceptable on either or both of these two fields, a compromise in adjustment settings must be reached to give the best simultaneous red, blue, and green field purity. After these adjustments, it may be necessary to recenter the raster by means of the electrical centering adjustments.

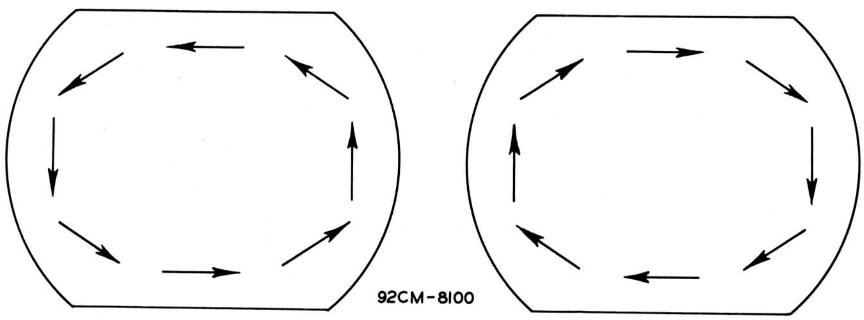
If difficulty is encountered in obtaining purity by means of the adjustments outlined in the foregoing paragraph, the use of a wide-field microscope having a magnification of approximately 20 can be very helpful. Purity errors can be analyzed by observing with a microscope the excited areas of the red phosphor dots while the red field only is turned on. The relative displacements of the centers of the excited area with respect to the centers of the phosphor dots should be noted in the center of the viewing screen. These displacements as observed with the microscope are shown in Fig. 8a. The arrow indicates the direction of displacement. If there is any displacement, such as shown in Fig. 8a, a readjustment of the position of the purifying coil and the current through it should be made until the excited area is in the center of the phosphor dots in the center of the screen. Adjustment of the position of the coil affects the direction the excited area will move when the coil current is changed.

a - Magnified view of screen showing uniform displacement of red beam. Arrow indicates direction of displacement.





b - Radial displacements



c - Tangential displacements

Fig. 8 - Purity displacement diagrams.

The relative displacements should then be observed along the periphery of the viewing screen. If the displacements have radial components as indicated by the arrows in Fig. 8b, the yoke should be readjusted axially until the excited area of the phosphor dots along the periphery are centered or have only a tangential displacement component as shown in Fig. 8c. At the center of the left and right edges of the screen, for example, the excited areas of the phosphor dots should either be centered or have only a vertical component. If the displacements are essentially tangential, a readjustment of the current in the field-neutralizing coil should be made. If difficulty in obtaining purity is still encountered, a compromise adjustment of these components after the convergence adjustments have been made will possibly be helpful in providing optimum purity.

Adjustment of Beam-Positioning Magnets

After the adjustments for color purity, the beam-positioning magnets should be adjusted. The kinescope control should be set to adjust the raster brightness just below visibility, and a video dot-pattern signal applied and adjusted so that each color is of approximately the same intensity. The dc convergence voltage should be adjusted so that the three color spots are visible separately in the center of the screen. The magnets should then be adjusted so that the three color spots form a small equilateral triangle, the ends of the base being formed by the red and green spots as shown in Fig. 9. Although each magnet has its major effect on one beam, the other beams are also affected slightly. When this equilateral triangle is obtained, complete convergence in the center of the screen (as indicated by the superposition of the three color spots to form a white spot) can usually be achieved by adjustment of the dc convergence control.

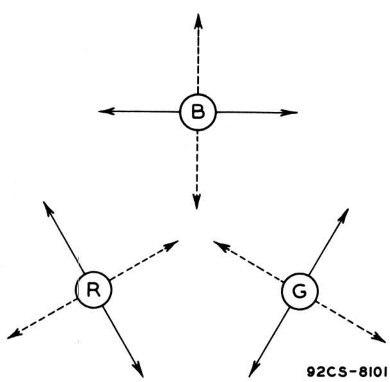


Fig. 9 - Equilateral triangle formed by three color spots when beam-positioning magnets are properly adjusted. Triangle may be as much as one quarter inch on each side. Dashed lines show direction of color-spot movement produced by action of electrostatic convergence lens. When the dc convergence voltage is decreased, for example, all three beams converge. Solid lines show direction of movement of each color spot produced by adjustment of its associated beam-positioning magnet.

Dynamic-Convergence Considerations

The dynamic-convergence adjustments should be made next. Although the same amplifier applies both dynamic-focus and dynamic-convergence voltages, the adjustment criterion should be convergence. When the dynamic-convergence adjustment is correct, the uniformity of dynamic focus is satisfactory also. Because focus and convergence are interdependent, a dc focus adjustment should be made each time a dc convergence adjustment is made.

In the adjustment of dynamic convergence, a technique which will be found very helpful is that of frequently varying the dc convergence control and noting its position for optimum convergence at various parts of the screen. With a particular setting of the beam-positioning magnets, optimum convergence can be obtained at any point on the screen simply by adjusting the dc convergence voltage. The purpose of the dynamic-convergence voltages is to establish the voltage of the converging electrode at each instant so that, for each point on the picture area, no improvement could be made by further adjustment of the dc convergence voltage.

The criterion for dynamic-convergence adjustment is that optimum convergence is achieved at all points on the picture area with a single setting of the dc convergence control. If optimum convergence at particular areas of the picture is obtained at different settings of the dc convergence control, the nature of the correction of dynamic-convergence voltage is indicated by the direction of rotation of the dc convergence control required to change from the optimum value at the center of the picture to the optimum value at another point. If the dc convergence voltage is set for optimum convergence at the center of the picture area and the convergence at the right and left edges of the screen is improved by increasing (or decreasing) the dc convergence voltage, the horizontal-dynamic-convergence amplitude control should be adjusted to increase (or decrease) the horizontal-dynamic-convergence voltage.

Horizontal-Dynamic-Convergence Adjustment

The first step in the dynamic-convergence adjustment is to set the horizontal-dynamic-convergence amplitude control at approximately mid position. The horizontal-dynamic-convergence phase control should then be adjusted. Slight adjustment of the phase control should be made until, as the dc convergence voltage is adjusted, the left edge and right edge of the picture pass through optimum convergence simultaneously. After this adjustment is completed, the amplitude of the horizontal-dynamic-convergence voltage should be adjusted. Varying the dc convergence voltage provides a good indication of the proper adjustment of dynamic convergence. Optimum convergence at the center and sides of the picture should occur at the same setting of the dc convergence voltage control.

Vertical-Dynamic-Convergence Adjustment

The amplitude of the vertical-dynamic-convergence voltage may be adjusted by the method suggested above for the adjustment of the horizontal-dynamic-convergence voltage. If in some cases the region just above the center of the screen does not reach optimum convergence at the same dc convergence voltage as the center and top and bottom, correction may be made with the phase control. Adjustment of the phase control usually requires readjustment of the amplitude control.

Final Adjustments

Because the dynamic-convergence adjustments require adjustment of the dc convergence voltage, readjustment of the focusing voltage is also required. The focus and convergence adjustments are somewhat inter-dependent and several successive trials are usually required.

After these adjustments, convergence and focus should be optimum at all areas of the screen. The application of the dynamic convergence and focus voltages, however, may have affected purity. If necessary, compromise adjustments of the purifying coil, the field-neutralizing coil, and the axial position of the deflecting yoke should be made to provide optimum purity of all color fields.

Although considerable time and patience may be required initially to adjust the kinescope components properly, the techniques are straight-forward and, as a result, skill is not difficult to acquire.

RADIO CORPORATION OF AMERICA
RCA LABORATORIES DIVISION
INDUSTRY SERVICE LABORATORY

LB-925A

(Please attach this Supplement to LB-925)

Supplemental Information on

RCA Developmental Color Television Receiver

Approved

Stuart Wm Seeley

Introduction

This supplement to *LB-925* contains additional information on the RCA developmental color television receiver. Included are the following items:

1. Supplementary coil data including core data, coil form sizes, and shield can cross-sectional sizes.
2. Wire-wound potentiometer and resistor dissipation ratings.
3. Quartz crystal data for color reference oscillator.
4. Errata
5. New drawings for T109.
6. Drawing for L130.

Supplementary Coil Data

Coil	Core Type	Coil Form Dia. (in inches)	Can Cross Section (in inches)
T102	4	0.283 O.D. 0.253 I.D.	7/8 Sq.
T103	4	0.283 O.D. 0.253 I.D.	7/8 Sq.
T104	3	0.283 O.D. 0.253 I.D. 0.342 O.D. } sleeve 0.312 I.D. }	1-1/8 Sq.
T106	3 L_1 and L_2 L_3 and Link	{ 0.283 O.D. { 0.253 I.D. { 0.187 O.D. Molded { 0.288 I.D. } sleeve { 0.423 O.D. }	1-1/8 Sq.
T107	3 top coil 2 bottom coil	0.283 O.D. 0.253 I.D.	7/8 Sq.
T108	3 top coil 2 bottom coil	0.283 O.D. 0.253 I.D.	7/8 Sq.
T109	5	0.283 O.D. 0.253 I.D.	None
T110	4	0.283 O.D. 0.253 I.D.	None
T111	5	0.283 O.D. 0.253 I.D.	None
T112	3	0.283 O.D. 0.253 I.D. 0.423 O.D. sleeve 0.288 I.D.	7/8 Sq.
T113	3	0.283 O.D. 0.253 I.D. 0.423 O.D. } sleeve 0.288 I.D. }	1-1/8 Sq.

Coil	Core Type	Coil Form Dia. (in inches)	Can Cross Section. (in inches)
T122	1	0.283 O.D. 0.253 I.D. 0.342 O.D.} sleeve 0.312 I.D.}	7/8 Sq.
T123	5	0.283 O.D. 0.253 I.D. 0.312 O.D.} sleeve 0.288 I.D.}	7/8 Sq.
T124	4	0.283 O.D. 0.253 I.D.	7/8 Sq.
T125	5	0.283 O.D. 0.253 I.D.	7/8 Sq.
T126	6	0.283 O.D. 0.253 I.D. 0.318 O.D.} sleeve 0.288 I.D.}	7/8 Sq.
L102	None	0.156 O.D. Molded Bakelite	None
L110	4	0.283 O.D. 0.253 I.D.	None
L126	4	0.283 O.D. 0.253 I.D.	7/8 Sq.
L128	4	0.283 O.D. 0.253 I.D.	7/8 Sq.
L129	4	0.283 O.D. 0.253 I.D.	None
L130	None	0.225 O.D. 0.195 I.D. 0.187 O.D. Molded Bakelite	None
L201, 202	4	0.283 O.D. 0.253 I.D.	None

The varnished impregnated paper tubing is dimpled whenever threaded-type cores are used. Threaded and brass stud types of various materials may be described briefly as follows:

Type 1 – Molded Ferrite with threaded brass stud.

Type 2 – Molded Carbonyl "E" iron with brass stud.

Type 3 – Molded Carbonyl "TH" iron with brass stud.

Type 4 – Molded and threaded Carbonyl "E" iron core.

Type 5 – Molded and threaded Carbonyl "TH" iron core.

Type 6 – Molded and threaded IRN No. 2 iron core.

Core lengths in all cases are as long or slightly longer than the winding, except L128 which is one inch long and L201 and L202 which are one-half inch long.

Wire-Wound Potentiometer and Resistor Dissipation Ratings

The following list shows the rated dissipation of the wire-wound potentiometers and wire-wound resistors used in the screen, cathode, and grid return circuits of the tricolor kinescope of the developmental color television receiver shown in Fig. 1 of *LB-925*.

Resistor	Value (in ohms)	Dissipation Rating (watts)
R225A	10K	2
R225B	10K	2
R227	10K	2
R124A	5K	2
R233A	10K	2
R234B	10K	2
R228	2700	10

R229	1200	4
R230	3000	4
R232	8200	2
R235	8200	2

Matrix and Video 5 per cent Tolerance Resistors

The following resistors in the I and Q channels, matrix and video output circuits on Fig. 1 of *LB-925* were 5 per cent tolerance. R306, R309, R310, R210, R211, R212, R214, R217, R219, R220, R221, R311, R312, R313, R315, R317, R318, R320, R322, R323, R358, R359, R360, R362, R363, R365, R366, R367, R369, R345, R347, R353, R354, R356, R357. Plate resistor in I amplifier plate, V134A, 15K.

Quartz Crystal Data for Color Reference Oscillator

1. The crystal is a metal-plated quartz plate wire-mounted in a metal holder and operates in antiresonance at 3.579545 Mc into a load capacitance of 12±0.5 μμf on the fundamental thickness shear of the quartz plate.

2. The capacitance of the crystal and holder (pin to pin) should not exceed 7 μμf.

3. The tolerance on the nominal frequency of the crystal is ±0.003 per cent over the range of +20° to +65°C.

4. Operating the crystal in an oscillator circuit similar to that shown in *LB-925*, the oscillator output should be 5 volts (p-p) or greater across the 1800-μμf section of the cathode tank capacitor. With a crystal load capacitance change of 7 μμf (maximum range of reactance tube) and the reactance tube plate coil adjusted for symmetrical deviation about the nominal frequency of 3.579545 Mc, the deviation should be between ±400 cycles and ±600 cycles.

Errata (Reference Fig. 1, LB-925)

C288 should be 0.1 μf.

R302 is connected between grid 1 of the Q demodulator and grid 1 of the I demodulator instead of between the arm of the chroma control R301 and grid of the Q demodulator. A 0.1-μf capacitor is used to couple the plate *circuit* of the vertical sync separator, V116A, to the grid of V118A.

T109 and L130 Drawings

The following drawings for T109 supersede those shown in *LB-925*. The drawing marked T109 in *LB-925* should therefore be deleted.

A drawing for L130 is also included.

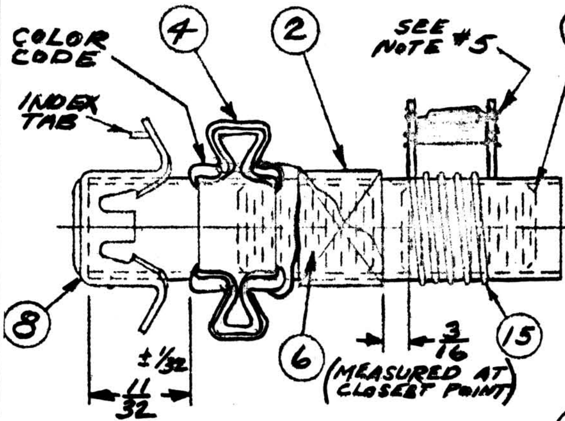
T-109

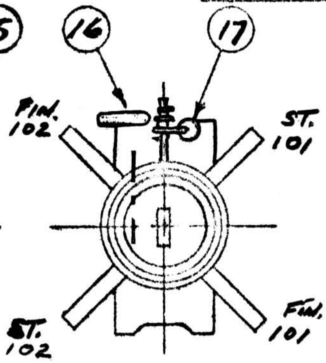
SHEET 1 ON SHEET 11

ITEM		DESCRIPTION	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518
1	SHEET-11	ASSEMBLY	X																	
2	SHEET-21	COIL ASSEMBLY	1																	
3																				
4		TUBE & STAPLE ASS'Y	1																	
5	TYPE #5	IRON CORE (THREADED)	1																	
6	TYPE #5	IRON CORE (THREADED)	1																	
7		COIL FORM (.283 O.D.)	AS REQ																	
8		COIL TUBE FASTENER	1																	
9		CEMENT	1/SET																	
10		SOLDER	1/SET																	
11	SHEET-31	TEST SPECS	X																	
12		MINERAL WAX	1/SET																	
13	SYNTHETIC RESIN COATED MAGNET WIRE. (SINGLE COATING)	WIRE (RED)	AS REQ																	
14		WIRE (GREEN)	AS REQ																	
15	SHEET-41	COIL (SPRING WOUND)	1																	
16		CAPACITOR 56 MMF ±5%	1																	
17		RESISTOR 2700 Ω ±5%	1																	
18		CLEAR COIL LACQUER	1/SET																	

DIMENSIONS ARE IN INCHES, AND INCLUDE THICKNESS OF PLATING, DO NOT SCALE DRAWING. ALL EXTERNAL THREADS TO BE CLASS 2A (AM. STD.), ALL INTERNAL THREADS TO BE CLASS 2B (AM. STD.), UNLESS OTHERWISE SPECIFIED.

T-109 SHEET 11 CONT'D ON SHEET 21





GRP. NO.	NOTES	COLOR CODE	
50L	1,2,3,4,5	RED	

Ⓣ 501

NOTES:-

1.-CEMENT P-4 SECURELY IN POSITION SHOWN USING P-9.

2. EYES OF STAPLES MUST ADMIT 5 PIECES OF .025 BUS.

3.-ANCHOR P-15 SECURELY TO P-2 AT POSITION SHOWN, USING P-18, AFTER ASS'Y OF P-15, TURNS PER INCH MUST BE 14±1.

4.-BEFORE ASSEMBLING PTS. 5,6,8,16 & 17, BAKE COIL FOR 30 MIN. @ 290°F & TREAT WITH CERESE 'A-A' WAX IMMEDIATELY AFTER BAKE, COVER WINDINGS (101 & 102) COMPLETELY WITH P-12.

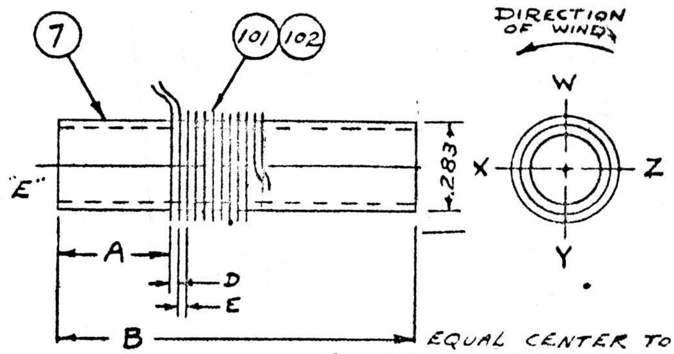
5.-WRAP & SOLDER LEADS OF PTS. 16 & 17 SECURELY.

DIMENSIONS ARE IN INCHES, AND INCLUDE THICKNESS OF PLATING. DO NOT SCALE DRAWING. ALL EXTERNAL THREADS TO BE CLASS 2A (AM. STD.), ALL INTERNAL THREADS TO BE CLASS 2B (AM. STD.), UNLESS OTHERWISE SPECIFIED.

T-109

SHEET 21 CONT'D ON SHEET 31

GP. No.	PT. No.	WINDING PART No.'S	DIMENSION A	B	C	COLOR CODE	NOTES
			TOLERANCE ± 1/32				
501	2.	101 & 102	±1/32 23/32	2 1/8			1,2,3



EQUAL CENTER TO CENTER SPACING BETWEEN WIRES & BETWEEN TURNS.

GP. No.	DIMENSION D	E
501	.0167	.0167

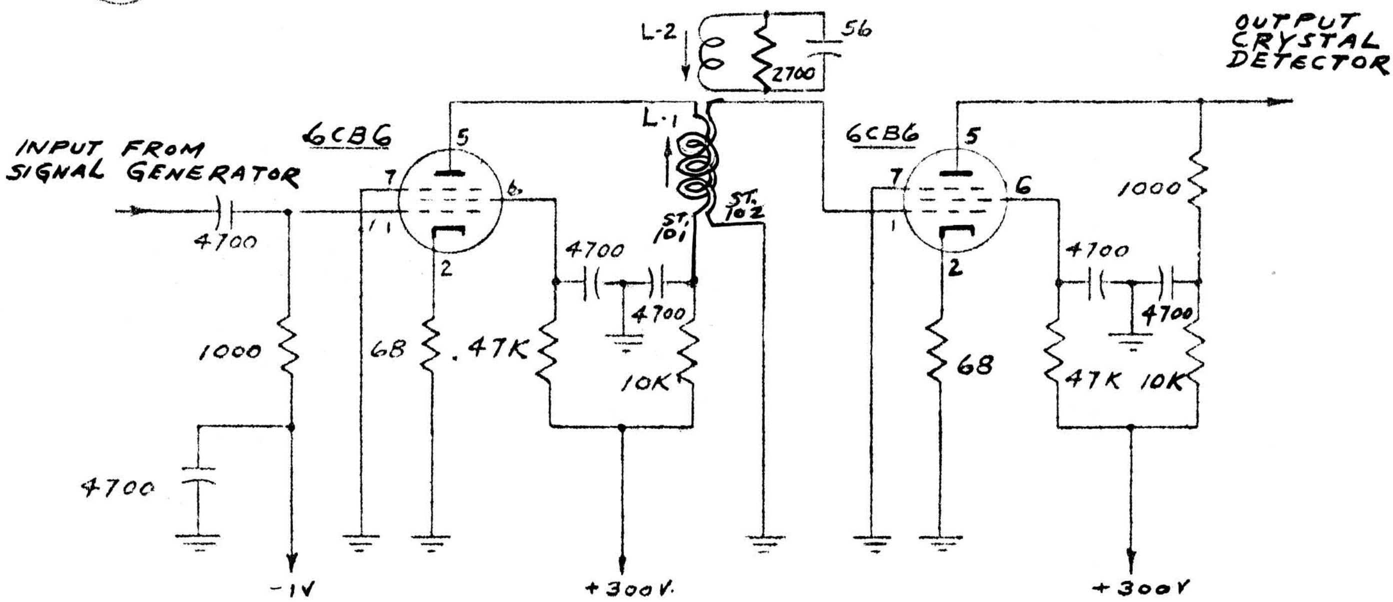
WINDING.

PT. NO.	CONDUCTOR P. S. NO.	ST'NDS	BARE WIRE	LBS./1000 COILS	METHOD OF WINDING	CAM	TURNS PER SEC.	TURNS TO TAP	NO. OF SEC	O.D. ± .015	LEAD EXTENSIONS START POS'N.	START L'GTH.	TAP POS'N.	TAP L'GTH.	FINISH POS'N.	FINISH L'GTH.
101	SEE NOTE 2	1	.010		BIFILAR 30T/IN (SEE NOTE)		11 1/4		1		W	SEE NOTE 1			X	SEE NOTE 1
102	SEE NOTE 3	1	.010				11 1/4		1		W	↓			X	↓

NOTES:-

1.- ALL LEADS TO EXTEND 1/2" BEYOND "E" END OF COIL FORM.
2.- P-101 MAKE FROM P-13,
3.-P-102 MAKE FROM P-14.

(11) RESISTANCE VALUE IN OHMS AND CAPACITANCE IN MMF UNLESS OTHERWISE NOTED

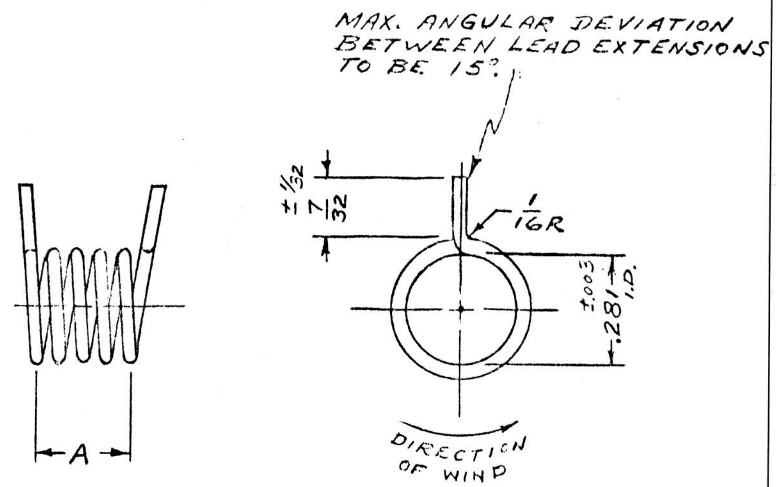


TEST CIRCUIT

SUB NUMBER	
AP. BY	O
AP. MFG.	

ALL SCREW THREADS TO BE CLASS 2 FIT (AM. STD.) UNLESS OTHERWISE SPECIFIED. DIMENSIONS ARE IN INCHES AND INCLUDE THICKNESS OF PLATING. DO NOT SCALE DRAWING.

T-109 SHEET 41 FINAL



PT. NO.	CONDUCTOR				METHOD OF WINDING	NO. TURNS	"A" DIM.	
	P.S. NO.	ST'NDS	BARE WIRE	LBS/1000 COILS				
1	SEE NOTE 3	1	.0508	4.8	14T/IN	5	.284 ±.014	

NOTES:-

1.- UNITS MUST BE FREE FROM DIRT PARTICLES, OIL & GREASE.

2.- SPACING OF INDIVIDUAL TURNS TO BE .071 ±.010, BUT "A" DIMENSION MUST BE WITHIN TABULATED TOLERANCE.

3.- SOFT OR ANNEALED ROUND COPPER WIRE (TINNED).

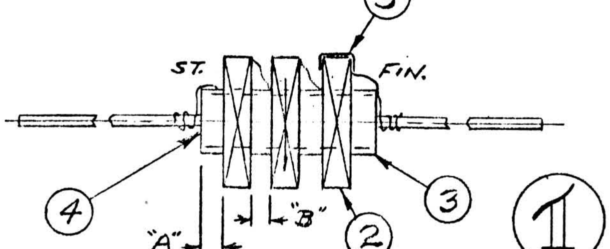
TITLE			L-130
DRAWN BY	CHECKED BY		
FIRST MADE FOR	USED ON	COLOR TV	

ITEM		DESCRIPTION	MATERIAL	501	502	503	504	505	506
1		ASSEMBLY		X					
2	SEE TABLE	COIL ASSEMBLY		1					
3		TUBING (COIL) (.195 I.D. x .225 O.D.)		1					
4		FORM, COIL (.187 O.D.)	MOLDED BAKELITE	1					
5		TAPE (1/4 x 1/8 LG.)		1					
6		CEMENT		1/SET					
7		SOLDER		1/SET					
8		PACKING MAT'L LIST		1					

TEST DATA:—
100% TEST: NATURAL RESONANT FREQ. TO BE 1600 KC ±160 KC.
SPOT CHECK: 1000 ~ INDUCTANCE TO BE 6.67 MH. ±5%

PT. NO.	CONDUCTOR STNDS	BARE WIRE	P.S. NO.	LBS/1000 COILS	METHOD OF WINDING	TURNS PER SEC	NO. OF SEC.	CAM	"A" DIM.	"B" DIM.	O.D. ±.015
2	1	.004	NOTE #5	6.22	UNIV. 2 x/T	440	3	.125	3/32	3/32	.600

NOTE 5.-
SYNTHETIC RESIN
COATED COPPER WIRE
(SINGLE NYLON)



NOTES:-
1.- WIND COIL (P-2) ON TUBING (P-3) THEN CEMENT P-2 CENTRALLY ON P-4 USING P-6.
2.- ANCHOR FIN. OF P-2 SECURELY BY APPLYING P-5 TO FINAL COIL SECTION ONLY.
3.- WRAP & SOLDER ENDS OF WINDING TO LEAD WIRES WITHIN 1/8" OF COIL FORM BODY.
4. TREAT FINAL ASS'Y WITH CERESE 'A-A' WAX

DIMENSIONS ARE IN INCHES, AND INCLUDE THICKNESS OF PLATING. DO NOT SCALE DRAWING. ALL EXTERNAL THREADS TO BE CLASS 2A BEFORE PLATING AND CLASS 2 AFTER PLATING; ALL INTERNAL THREADS TO BE CLASS 2B, UNLESS OTHERWISE SPECIFIED.