BROADCAST AND TELEVISION EQUIPMENT

RCA

# Instructions

RADIO CORPORATION OF AMERICA, Industrial Electronic Products

# TM-21D Color Monitor

MI-40226-D



IB-36309-2

INSTRUCTIONS

# TM-21D Color Monitor

## MI-40226-D

RADIO CORPORATION OF AMERICA
BROADCAST AND COMMUNICATIONS PRODUCTS, CAMDEN, N. J.

IB-36309-2

PRINTED IN U.S.A.
PP 692

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# TECHNICAL DATA

### Power Required

117 v, a-c, 60 cps, 900 watts, nominal operating voltage 105-125 v, a-c, 60 cps, selection provided by transformer taps

### Input Signals

Composite Video, .3 to 1.25 v black-to-white
External Sync, 2.5 to 6 v peak-to-peak

### Picture Size

Normal Scan, Standard 21 inch display
Under Scan, 12.5 inches by 16 inches

### Input Impedance

Video, 1 meg, 5 uuf
Sync, 1 meg

### Height and Weight

Length, 28 inches
Height, *31⅝ inches
Width, 27 inches
Weight, 213 lbs., approximately

* When the adjustable glide feet are attached, the height is increased a minimum of one inch to a maximum of two inches depending on the setting of the adjustable glide feet.

# TUBE COMPLEMENT

| *Symbol* | *RCA Type* | *Function* | *Symbol* | *RCA Type* | *Function* |
|---|---|---|---|---|---|
| | | 3 CHANNEL VIDEO AMPLIFIER | | | |
| 1V1A | ½ 6AU8 | Video Amplifier | 1V7 | 6197 | Video Amplifier |
| 1V1B | ½ 6AU8 | Video Amplifier | 1V8 | 6197 | Video Amplifier |
| 1V2A | ½ 6BQ7A | Video Amplifier | 1V9A | ½ 12AX7 | Error Detector |
| 1V2B | ½ 6BQ7A | Sync Amplifier | 1V9B | ½ 12AX7 | Pulse Rectifier |
| 1V3 | 6AU8 | Video Amplifier | 1V10A | ½ 12AX7 | Error Detector |
| 1V4A | ½ 6BQ7A | Video Amplifier | 1V10B | ½ 12AX7 | Pulse Rectifier |
| 1V4B | ½ 6BQ7A | Sync Amplifier | 1V11A | ½ 12AX7 | Error Detector |
| 1V5A | ½ 6AU8 | Video Amplifier | 1V11B | ½ 12AX7 | Pulse Rectifier |
| 1V5B | ½ 6AU8 | Video Amplifier | 1V12A | ½ 6BQ7A | Sync Amplifier |
| 1V6 | 6197 | Video Amplifier | 1V12B | ½ 6BQ7A | Sync Amplifier |
| | | DECODER | | | |
| 2V1 | 6AL5 | Burst Phase Detector | 2V11B | ½ 12AT7 | Red Output |
| 2V2A | ½ 6AN8 | Reactance Tube | 2V12A | 6AW8 | Sync Amplifier |
| 2V2B | ½ 6AN8 | Subcarrier Oscillator | 2V12B | 6AW8 | Sync Clipper Driver |
| 2V3A | ½ 6AW8 | Color Killer Amplifier | 2V13A | ½ 6AU8 | Sync Separator |
| 2V3B | ½ 6AW8 | Color Killer Detector | 2V13B | ½ 6AU8 | Pulse Inverter |
| 2V4A | ½ 6AW8 | Monochrome Inverter Adder | 2V14 | 6197 | Chroma Monochrome Driver |
| 2V4B | ½ 6AW8 | Aperture Inverter | 2V15 | 6AL5 | Q Demodulator |
| 2V5A | ½ 6AW8 | Aperture Adder | 2V16A | ½ 12AT7 | Green Output |
| 2V5B | ½ 6AW8 | Monochrome Matrix Driver | 2V16B | ½ 12AT7 | Blue Output |
| 2V6A | ½ 12AT7 | Q Amplifier | 2V17 | 6197 | Chroma Monochrome Driver |
| 2V6B | ½ 12AT7 | Q Matrix Driver | 2V18A | ½ 6BQ7A | Sync Out Driver |
| 2V7 | OA2 | Voltage Regulator +150 | 2V18B | ½ 6BQ7A | Ext. Sync Amplifier |
| 2V8A | ½ 6BQ7A | Brightness Pulse Adder | 2V20 | 6AL5 | I Demodulator |
| 2V8B | ½ 6BQ7A | Burst Keyer and Feedback Gate | 2V21A | ½ 6AW8 | I Amplifier |
| 2V9A | ½ 6AW8 | Subcarrier Amplifier | 2V21B | ½ 6AW8 | I Delay Driver |

# TUBE COMPLEMENT (Continued)

| *Symbol* | *RCA Type* | *Function* | *Symbol* | *RCA Type* | *Function* |
|---|---|---|---|---|---|
| | | DECODER (continued) | | | |
| 2V9B | ½ 6AW8 | Spare | 2V23 | 6688 | 1st Video Input Amplifier |
| 2V10A | ½ 6AW8 | Matrix B-Y Inverter | 2V24 | 7119 | 2nd Video Amplifier |
| 2V10B | ½ 6AW8 | B-Y Matrix Driver | | | |
| 2V11A | ½ 12AT7 | I Matrix Driver | | | |
| | | DEFLECTION AND HV | | | |
| 3V1A | ½ 6AL5 | HV Protection Pulse Detector | 3V8A | ½ 12AT7 | Sync Amplifier |
| 3V1B | ½ 6AL5 | HV Protection Pulse Detector | 3V8B | ½ 12AT7 | Vertical Oscillator |
| 3V2A | ⅓ 6BC7 | Kine Protection Bias | 3V9 | 6CD6-GA | Driver |
| 3V2B | ⅓ 6BC7 | Kine Protection Pulse Detector | 3V10 | 6CD6-GA | Driver |
| 3V2C | ⅓ 6BC7 | Kine Blanking Clipper | 3V11 | 3B2 | High Voltage Rectifier |
| 3V3A | ½ 12AT7 | Vertical Discharge | 3V12 | — | Not used |
| 3V3B | ½ 12AT7 | Cathode Follower | 3V13 | 6AU4GTA | Damper |
| 3V4A | 6W6 | Vertical Output Amplifier | 3V14 | 6AU4GTA | Damper |
| 3V5A | ½ 6CG7 | Horizontal Oscillator | 3V15 | — | Not used |
| 3V5B | ½ 6CG7 | Horizontal Control | 3V16 | 1X2B | Focus Rectifier |
| 3V6A | ½ 12AT7 | Kinescope Overload Protection | 3V17 | 6BK4 | High Voltage Regulator |
| 3V6B | ½ 12AU7 | Sawtooth Generator | 3V18 | 6BK4 | High Voltage Regulator |
| 3V7A | ½ 12AT7 | Pulse Gate Protection | 6V2 | 21FJP22 | Color Kinescope |
| 3V7B | ½ 12AT7 | Pulse Gate Protection | | | |
| | | POWER SUPPLY | | | |
| 4V1 | 6X4 | Full Wave Rectifier | 4V7A | 12AX7 | DC Amplifier |
| 4V2 | 6080 | Current Regulator | 4V7B | 12AX7 | DC Amplifier |
| 4V3 | 6080 | Current Regulator | 4V8A | 12AX7 | DC Amplifier |
| 4V4 | 6080 | Current Regulator | 4V8B | 12AX7 | DC Amplifier |
| 4V5 | 6080 | Current Regulator | 4V9 | 5651 | Voltage Regulator |
| 4V6A | 12AX7 | DC Amplifier | 4V10A | ½ 12AT7 | Time Delay Amplifier |
| 4V6B | 12AX7 | DC Amplifier | 4V10B | ½ 12AT7 | Protection Amplifier |
| | | CONVERGENCE | | | |
| | | No tubes required. | | | |

# RECOMMENDED TEST EQUIPMENT

Tektronix 524-D Oscilloscope with low capacity probe

RCA Type WV-97A VoltOhmyst

RCA Type WA-21B Video Sweep Generator

RCA Type WA-7C Linearity Checker

RCA MI-21200-C1 Plate Current Meter

Electrostatic Voltmeter 0-30KV

*205-W1 Degaussing Coil or equivalent

*Refer to Monitor Set-Up Procedure for Degaussing Coil Construction Instructions.


118966

Figure 1. TM-21D Color Monitor

# DESCRIPTION

## General

The RCA TM-21D Color Monitor, shown in Figure 1, is a color display device designed to produce high fidelity color and monochrome pictures. The extraordinary stability of the TM-210 assures stable monitoring over long periods of time without the need of adjustments, along with the ability to withstand rigorous operating conditions.

The TM-21D may be used as a monitor in control rooms, transmitter monitoring points, or in prestige locations such as clients' rooms or reception rooms.

When used as a control room monitor, the TM-21D offers the following immediate advantages:

1. It provides a better check of registration during actual programming than the black-and-white master monitor.

2. Because of its own excellent deflection linearity (within 1% in both directions), a good check of camera deflection linearity is possible.

3. Provision for underscanning, to show the corners of the picture, permits better checking of camera framing, camera lens aberrations, and camera deflection transients. Underscanning also makes cue marks in the picture corners readily visible.

4. A highly stabilized method of black-level setting permits better evaluation of camera shading characteristics and clearly indicates the effects of camera pedestal adjustments.

5. Precision decoder circuits and highly linear output amplifiers produce a picture of improved color fidelity, so that camera color fidelity can be more accurately evaluated.

6. The improved picture sharpness facilitates checking of camera focus.

7. Ease of setup and circuit stability reduce operating cost, because very little operator time is required to keep the monitor operating.

8. Excellent accessibility for servicing reduces both the maintenance cost and down-time in the event of tube or component failures.

9. Kinescope filament voltage regulated to insure good color temperature stability when variations in a-c line voltage occur.

For monitoring purposes at master control or transmitter points, where the color picture must serve as a final indication of the quality of the signals being received or transmitted, the stability of the monitor is particularly significant. Here operating personnel must be certain whether observed picture faults are

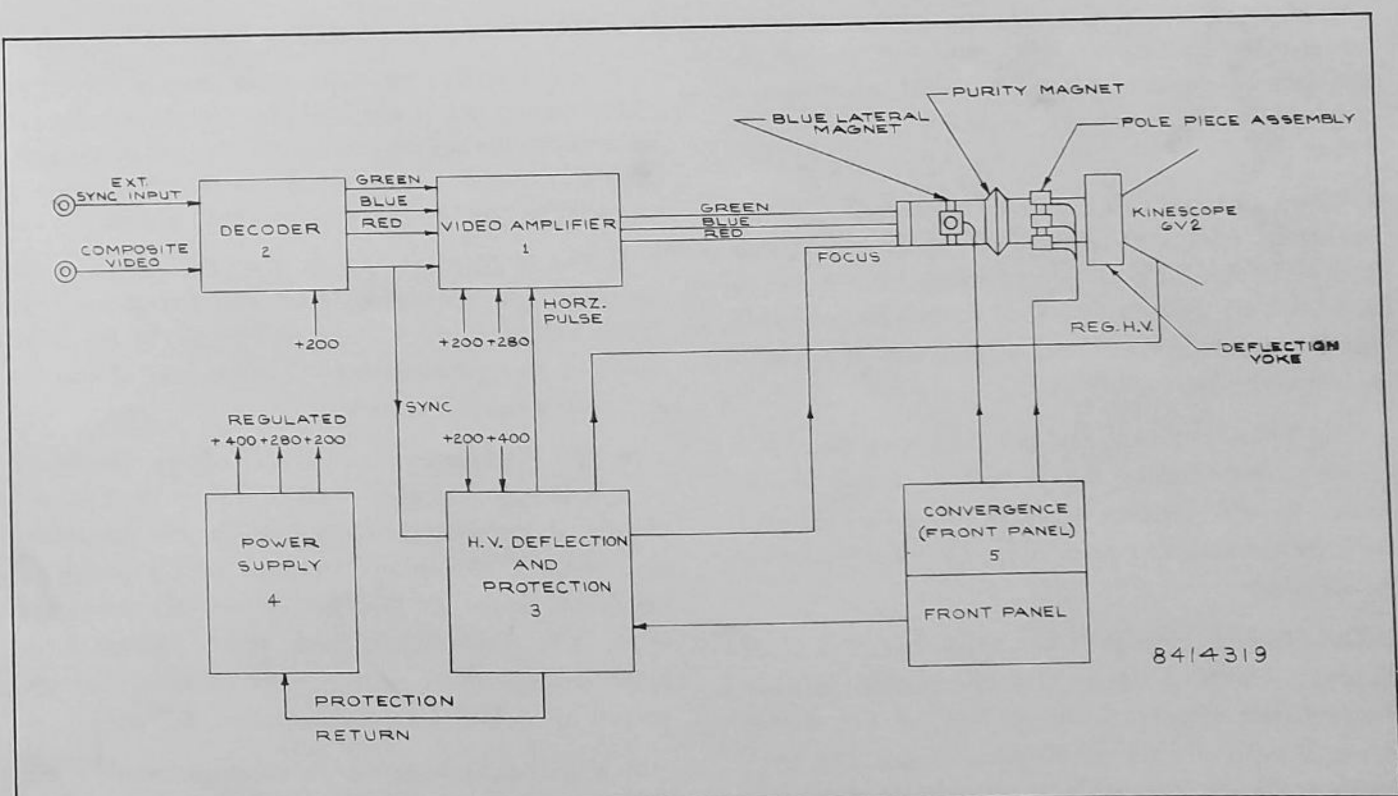


**Figure 2. Block Diagram, TM-21D Color Monitor**

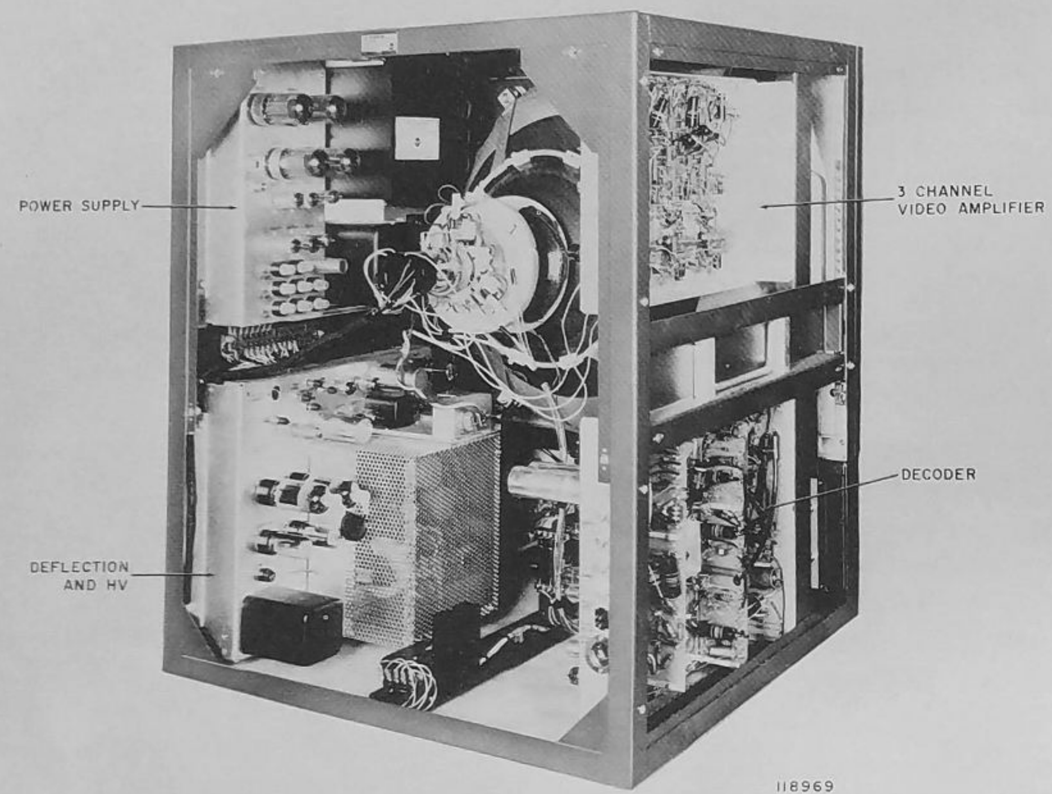


***Figure 3. Rear Quarter View, TM-21D Color Monitor Top and Side Cover Panels Removed***

due to the Monitor or are caused by defects in the signal. Because of the outstanding ability of the Monitor to detect substandard signal conditions, a quick, effective course of corrective action can be taken.

When switched from color to black and white the horizontal resolution limit of 275 lines is overcome in the TM-21D by cross connecting the sub-carrier trap with the color killer. This enables monochrome pictures to be displayed with a resolution of approximately 450 lines.

The TM-21D Color Monitor will serve both as a color picture display device and as a test instrument. It will produce pictures which are limited only by transmission standards and color kinescope capabilities.

The Monitor consists of five main chassis. A block diagram, Figure 2, shows the relationship between these chassis. Figure 3 shows four of the chassis mounted vertically on the Monitor frame. The Convergence chassis not visible, is mounted in the center of the control panel (see Figure 13).

A brief description of the five chassis follows:

1. The Decoder processes the composite color signal to derive red, green, and blue signals suitable for controlling the color kinescope. It also contains a sync separator and a sync interlock circuit which permits optional use of external synchronizing pulses.

2. The 3 Channel Video Amplifier increases the amplitude of the signals from the Decoder to the levels needed to drive the electron guns of the kinescope. It also provides for the restoration of the d-c components of the signals.

3. The Deflection and High-Voltage chassis is controlled by composite sync from the Decoder chassis. It provides sawtooth currents for the deflection yoke of the color kinescope, plus a source of regulated power at 23 kilovolts for the kinescope ultor. The protection circuits, which prevent kinescope damage from certain types of failure or improper operation, are located within this unit.

4. The Convergence chassis develops second-order deflection currents, which are applied to the convergence yoke on the color kinescope for the purpose

of adjusting the shapes of the red, green, and blue rasters so that they may be properly registered in all parts of the picture.

5. The Power Supply provides regulated +B power for the other chassis.

By mounting the four chassis vertically on the monitor frame, maximum accessibility is achieved for maintenance and service. It is possible to replace any tube from the rear of the Monitor, and with the top and side covers removed (Figure 3) all components on the wire side of the chassis are accessible.

The Convergence chassis consists of passive networks and may be removed for servicing by unscrewing the captive screws used to mount it in the front panel.

# GENERAL DECODER THEORY

### Primary Decoder Function

The primary function of the Decoder is to take a composite color video signal and process it to obtain the separate red, green, and blue signals. To do this, the Decoder must separate the luminance and chrominance information contained in the signal. The chrominance signal portion is then demodulated with resulting color difference signals are matrixed with the filtered luminance signal to produce the desired red, green, and blue outputs.

NOTE: Figure 4 is a block diagram of the general decoder theory. The blocks are labeled with letters and titles and will be referred to, by letter, in the text as the various functions or stages are discussed.

### Composite Signal Amplifier

Because of the multiple signal paths, the gain stability of the luminance and chroma channels must be high to insure long term, constant luminance to chroma ratio. This is accomplished by amplifying the composite signal to a high level before separation.

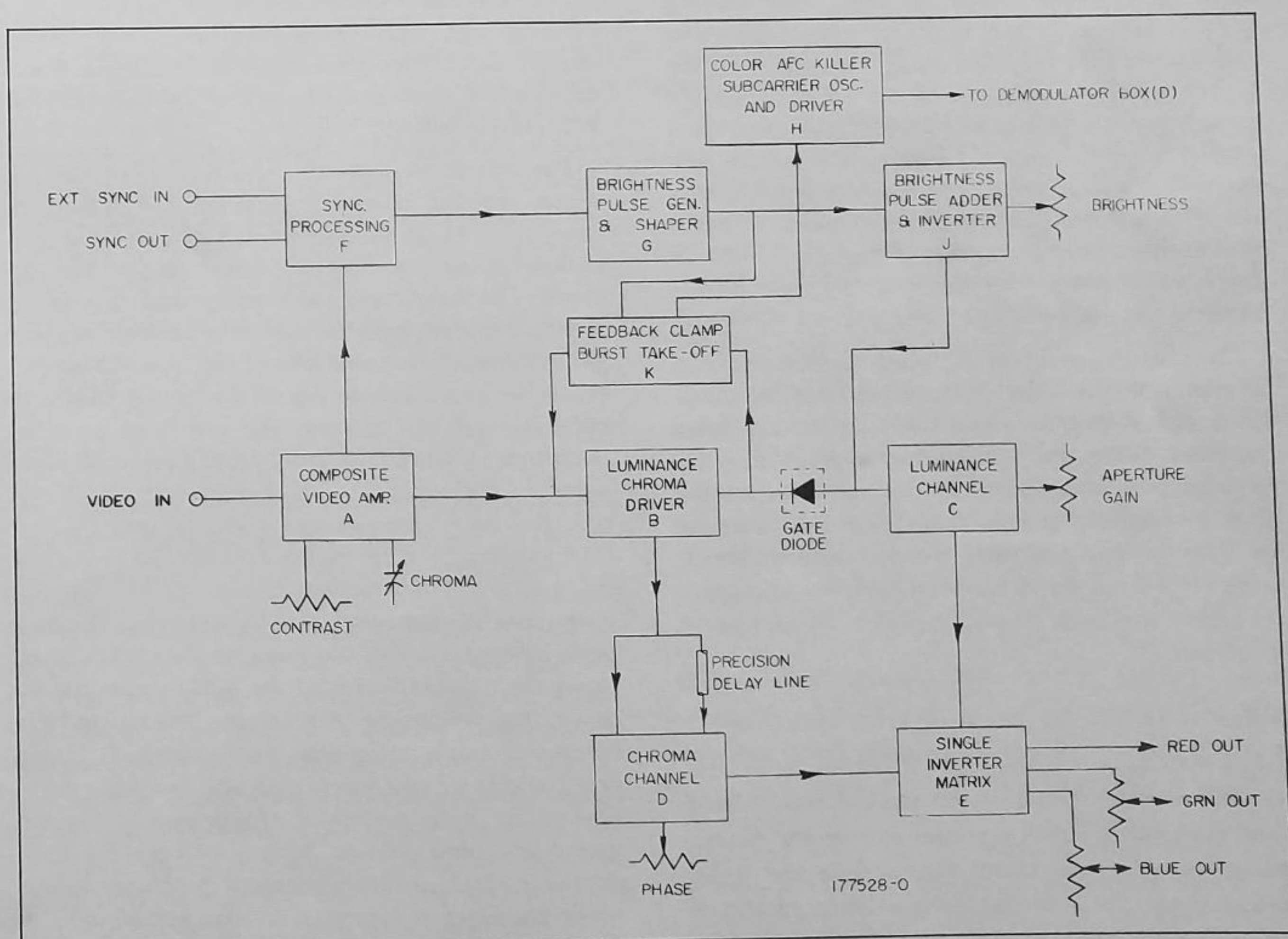


**Figure 4. Block Diagram, General Decoder Theory**

(Refer to A and B.) In the luminance chroma driver stage, the luminance and chroma outputs are taken from plate and cathode respectively. This insures a constant ratio of the two throughout normal tube life. The remaining circuits C, D, and E, for both the luminance and the chroma paths, are highly degenerative and therefore stable. In A, the luminance to chroma (m/c) ratio is constant as long as the frequency response is constant. Therefore, varying the video response in the subcarrier region is the only method of varying the ratio m/c. Hence, if the response is fixed flat, the m/c is unity and the Decoder, assuming correct phase adjustment, will give a true presentation of the input signal conditions. Occasionally it may be desirable to "dress up" a picture, therefore a variable chroma control is available and can be switched in. The contrast control varies the overall gain of A and does not effect the m/c ratio.

### Luminance Channel

The luminance output of B drives the Luminance Channel C which includes a 3.58 mc trap, an aperture corrector and switching circuits operated by the color killer relay system. When no color synchronizing burst is present on the incoming signal, the killer both removes the trap and changes the aperture frequency. Thus, the response of the entire luminance channel is made wide band with variable symmetrical peaking (aperture control) making the system suitable for wide band monochrome monitoring. The output of C drives the matrix, E, to combine with the chrominance information when present.

### Chroma Channel

The chroma output of B, which can be switched off and on by the killer, drives a precision delay line which has 90 degrees phase delay at the subcarrier frequency. Thus the quadrature is fixed for the demodulation of the *I* and *Q* signal which takes place in diode-clamp type demodulators. D contains the demodulators and the *I* and *Q* amplifiers which drive the matrix. As stated previously, the amplifiers are highly stabilized; therefore no *I* or *Q* gain control is necessary.

### Matrix

The matrix, E, is a highly stabilized single inverter type that receives the luminance and the demodulated *I* and *Q* signals which it processes to form the desired red, green, and blue video signals. Blue and green gain controls are included to provide a means of controlling the ratio of red to green to blue, which is different for each kinescope.

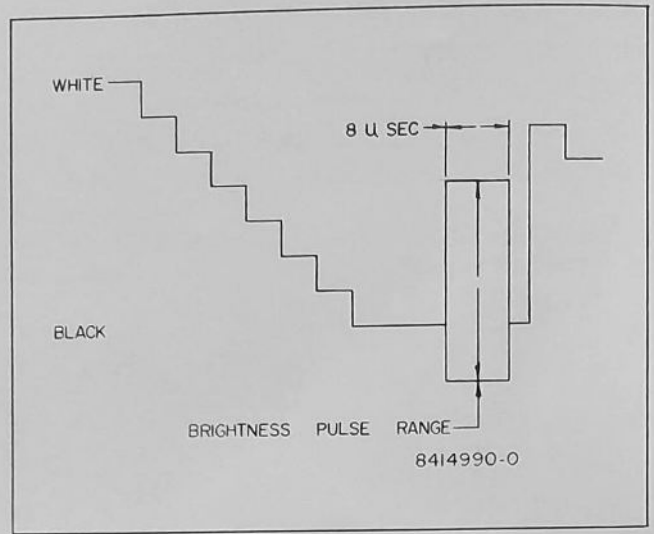


**Figure 5. Functional Diagram, Brightness Pulse**

### Sync Processing and Brightness Pulse

A also drives the sync processing section, F. Here the sync is either separated from the video signal or amplified from an external sync source. The processed sync is used in the Deflection and the 3 Channel Video Amplifier circuits and in the formation of a pulse voltage which is approximately eight microseconds long. This pulse is generated in G and is called a brightness pulse because of its main function, as explained below.

The brightness pulse drives a feedback clamp, K, which sets the operating point of the luminance-chroma driver. In this process it applies a fixed level positive going pulse on the driver side of the gate diode. The brightness pulse adder and inverter, J, which is driven from G, applies a variable negative going pulse to the other side of the gate diode. This causes the gate diode to cut off during the brightness pulse interval and remove sync and burst from the luminance channel. The pulse from J is variable and therefore the input to C is a composite signal with sync and burst removed and a variable pulse added. (See Figure 5.) This variable pulse appears at the red, green, and blue outputs. Because the d-c restorers in the kine drivers are clamped during the brightness pulse interval, varying this pulse amplitude effectively varies the d-c component of the video signal thereby controlling brightness. Adding the brightness pulse before the matrix makes possible the automatic brightness tracking of red, green, and blue because a variation in the pulse amplitude effects equally the red, green, and blue outputs. This eliminates the background controls ordinarily needed to obtain brightness tracking of red, green, and blue because a variation in the pulse amplitude affects equally the red, green, and blue outputs.

### Color AFC

In the feedback clamp, K, burst is keyed out and applied to the pulse discriminator which applies a d-c control voltage to a reactance tube which in turn controls the frequency of a crystal controlled oscillator. (Refer to H.) The subcarrier output is variable in phase and drives the diode-clamp demodulators in D.

### Test Switch Functions

The test switch has a variety of functions in the Decoder proper, but the reason for these functions extends into the 3 Channel Video Amplifier and kine characteristics. A brief description of each position follows.

Position 1. SCRN RED. Not used in TM-21D.

Position 2. SCRN BAL. In this position all decoder controls are made inoperative and the decoder has zero signal output. The three channel amplifier output to the kinescope clamps at black level, and therefore in this position, the red, green and blue screen controls are set for raster cutoff. For accurate tracking the three guns must cut off simultaneously. In order to insure accuracy of the cutoff setting, the vertical deflection is collapsed in order to concentrate the scan in a smaller area.

Position 3. MONO. In this position, only the chroma channel is disabled and a monochrome picture is allowed to pass. Hence the blue and green gain controls can be set to give proper drive to the kine grids for gray scale tracking. With this adjustment, the white balance procedure is complete.

Position 4. CHROMA UNITY. In this position, the response of A is fixed flat thereby giving the unity luminance to chroma ratio discussed earlier. Also the phase control is to be set for proper colors.

Position 5. CHROMA VAR. In this position, the video response in the subcarrier region of A is made variable thereby making the luminance to chroma ratio variable

## DECODER CIRCUIT DETAILED DESCRIPTION

The primary function of the decoder circuit is to process a composite color signal and produce desired red, green, and blue video information for driving a color kinescope. Additional functions include sync separation, aperture peaking, adding a variable pulse to the signal which replaces the sync portion, and providing a wideband monochrome signal when color sync information is not present.

The tube side of the Decoder is shown in Figure 6. Figure 50 is a block diagram and Figure 51 the schematic.

### Video Preamplifier

The video preamplifier is a feedback amplifier, consisting of tubes V23 and V24, which drives the CONTRAST control 2R197. The variable output video signal from this control drives the luminance-chrominance driver stage, tubes 2V17 and 2V14. The cathode circuit of tube V23 contains the peaking capacitor 2C103 which serve to adjust for proper high frequency response by adjusting the frequency characteristics of the amplifier feedback circuit. Capacitor 2C103 is made variable so that proper response for the unity chroma condition can be obtained. This is necessary for the gain tolerances in the monochrome and chroma channels. For the variable chroma conditions, a front panel controlled variable capacitor 2C31 replaces 2C103 to manually adjust the frequency response in the color subcarrier region.

### Luminance-Chrominance Driver and Feed Back Clamp

The luminance-chrominance driver stage consists of two parallel 6197 tubes, 2V17 and 2V14. The cathode circuit of this stage supplies drive to the chrominance channel while the plate circuit drives the luminance channel. The screen grids are bypassed to the cathode making the cathode and plate signal currents equal, thus maintaining a constant plate to cathode signal ratio for long term stability.

The cathode circuit consists of a simple all-pass constant resistive impedance network 2L8, 2L9, 2C34, 2C35, 2R67, 2R149 or delay line, which preserves flat response to the plate. The LC combinations in the network are tuned to the color subcarrier frequency, providing a maximum output across 2R149 or delay line at the subcarrier frequency. This is the chrominance take-off point.

### Driven Feed Back Clamp

The luminance chrominance driver works in conjunction with a feedback clamp circuit which is driven by a pulse shaped from sync. This pulse is called a brightness pulse because of its function, which is explained later. The feedback clamp sets a precise voltage level at the plates of the drivers during the pulse interval. Feedback makes this clamped voltage independent of the driver characteristics and operates as follows:

Tied to the plate of the drivers is the cathode of the feedback gate tube, 2V8B. This tube is held to cut-off during the normal video interval by the d-c setting action of diode 2CR3 in the grid of 2V8B which is driven by a positive pulse from the plate of pulse inverter 2V13B. When this pulse occurs, 2V8B is made to conduct which raises the potential on the plates of the driver and an inverted pulse appears at the plate of 2V8B. If the driver plate voltage should tend to change due to a change in duty cycle or tube drift, the grid voltage necessary to turn on 2V8B is changed. This appears as a change in inverted pulse amplitude in the plate of 2V8B. This inverted pulse is used as the error signal and is fed to the feedback rectifier, diode 2CR11 and diode 2CR5. Here the d-c of the error pulse is compared with a fixed d-c reference set by divider 2R58 and 2R59. The resulting grid voltage for 2V17 and 2V14 is that necessary to obtain the desired precise clamp level in the plate, regardless of tube characteristics or duty cycle. The gain of the feedback loop is such that the clamp level is equal to the grid voltage of the feedback gate tube during the pulse interval.

## Luminance Channel

### *Brightness Pulse Addition*

A positive pulse from the brightness pulse generator is applied to the grid of the pulse adder, 2V8A, and a d-c voltage is applied to the grid by diode 2CR7. This d-c voltage is made variable by the brightness control 2R71. During video time, 2V8A is cut off and the setting of the brightness control 2R71 determines the time of conduction when the pulse occurs and thus the amplitude of the inverted (negative going) pulse in the plate circuit. This variable pulse is fed through resistor 2R68 and applied to the plate side of the gate diode 2CR6. During video, 2CR6 is conducting and passing the video signal. During the pulse interval the fixed positive clamped pulse at the chroma-monochrome driver plates (2V17, 2V14) cuts

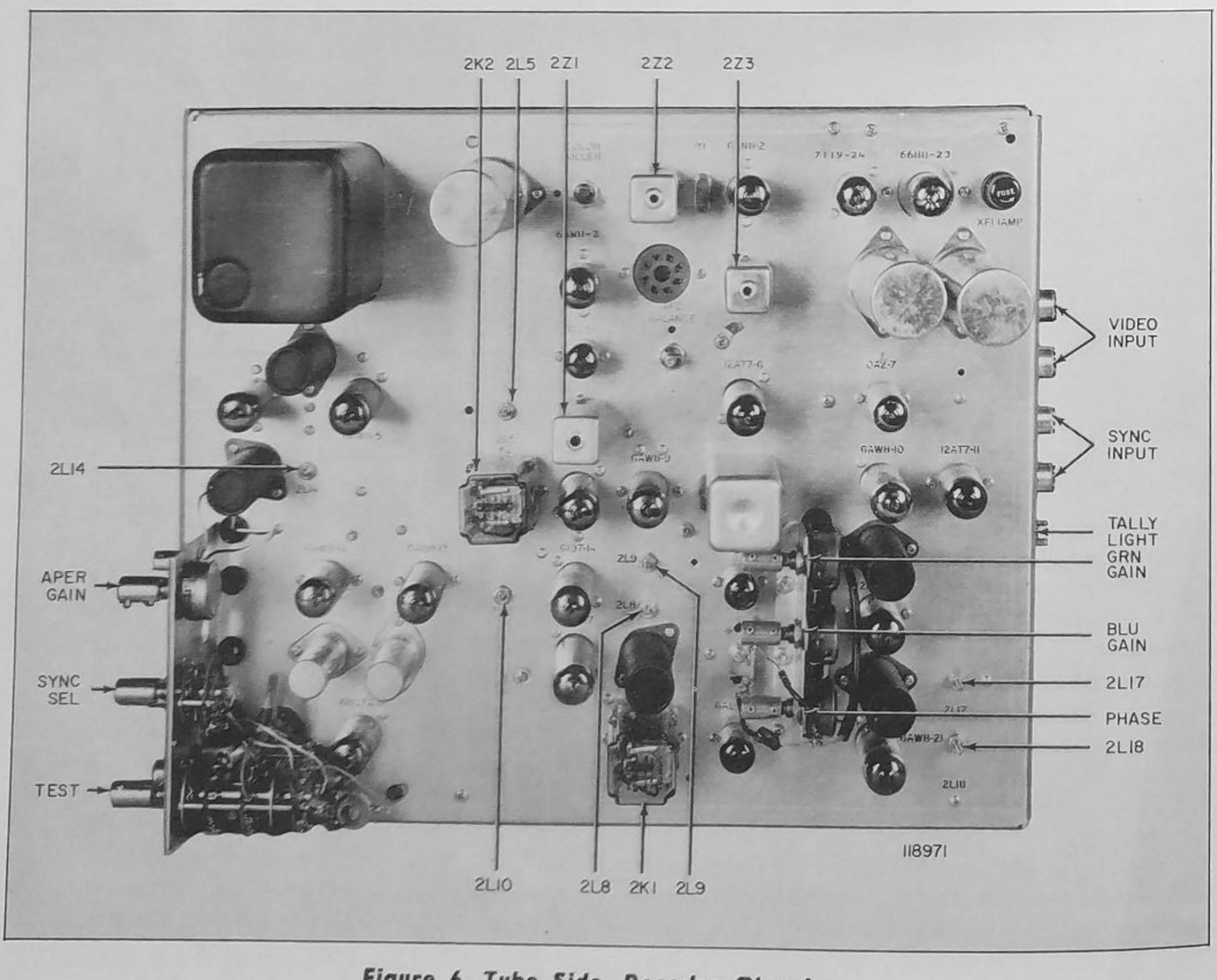


**Figure 6. Tube Side, Decoder Chassis**

2CR6 off and prevents the passage of sync and burst information to the remainder of the luminance channel. With 2CR6 cut off, the variable pulse is all that will be fed to the remainder of the luminance channel during this interval; the result is a video signal with sync and burst removed and a variable pulse added.

## Trap, Aperture Amplifier and Matrix Driver

The video signal with brightness pulse is fed first to a simple series trap 2L10 and 2C38 which removes the color subcarrier information leaving only luminance information. This trap is switched out by the color killer relay 2K2 when no color sync burst is present on the incoming signal, thus providing wide band operation for monochrome monitoring. (See Color Killer description.) The filtered luminance then passes through a linear phase high peaking circuit called an aperture compensator. This circuit effectively increases the rise time of transitions to compensate for kinescope spot size and the necessarily narrowband color signal. The aperture compensator functions in the following manner.

The luminance signal drives two series-connected, terminated delay lines $DL_2$ and $DL_3$ each having a 180° phase shift at approximately the desired max-boost frequency. The output of the second line $DL_3$ is added back to the input of the first line $DL_2$ by resistors 2R74 and 2R83. The resultant video signal has a peak response at the max-boost frequency and is inverted by the aperture inverter 2V4B. At the junction of $DL_2$ and $DL_3$, an undistorted video signal is taken and applied to the grid of the monochrome adder, 2V4A. This signal appears at the cathode of 2V4A and is added through 2R144 to the inverted peaked signal at the plate of 2V4B and it is proportioned so that complete cancellation of the low-frequency components occurs. Remaining is only the high frequency (aperture) components of the video signal which are applied to the grid of the aperture adder 2V5A.

The gain of 2V5A is varied by the aperture gain control 2R145 in its cathode. 2V5A inverts the aperture signal and adds it to the inverted but undistorted video signal at the plate of 2V4A. The result is a video signal applied to the grid of the monochrome matrix driver, 2V5B, which has variable high frequency boost.

The use of terminated delay lines for band shaping results in a linear phase characteristic. 2V5B is a cathode follower amplifier which provides a low impedance drive source for the matrix.

## Chrominance Channel

*Chroma Take Off*

As stated before, the chrominance component is taken from a network in the cathode for the chroma-monochrome driver stage 2V14 and 2V17. For color operation, the chrominance signal drives the *Q* and *I* demodulators.

## Demodulators

Briefly the demodulators operate as follows: (Refer to Figure 7.) The constant subcarrier voltage $E_{SC}$ is applied around the series path C, R, $D_1$, and $D_2$ charging C so that the diodes conduct simultaneously only on the tips of the subcarrier signal (Figure 8). During each conducting interval, point A, Figure 7, is effectively switched to ground potential. Thus the diodes act as fast acting switches or clamps which open and close at a 3.58 megacycle rate. Consider a chrominance signal $E_{IN}$ of constant peak to peak amplitude, but with the phase changing as indicated in Figure 8, applied to point B, Figure 7. This signal will couple through $C_1$ and appear at point A, Figure 7. However, as stated before, and as shown in Figure 8, during the diode conducting interval point A, Figure 7, is switched to ground potential; therefore $C_1$ must assume a charge dependent on the phase of $E_{IN}$ as shown by the dotted line in Figure 8C.

With reference in Figure 8 when $E_{SC}$ and $E_{IN}$ are in phase, or 180 degrees out of phase the average $E_{OUT}$ is maximum. At 45 or 135 degrees phase difference,

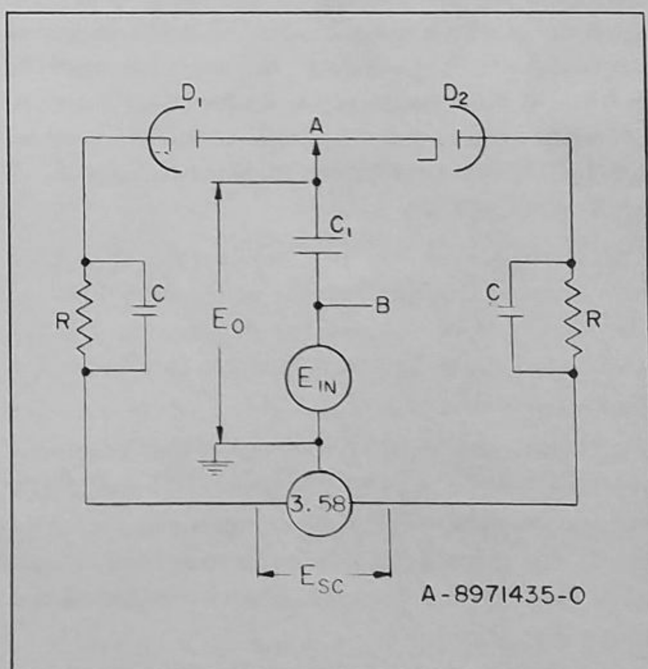


**Figure 7. Simplifed Schematc Diagram, Decoder Demodulators**

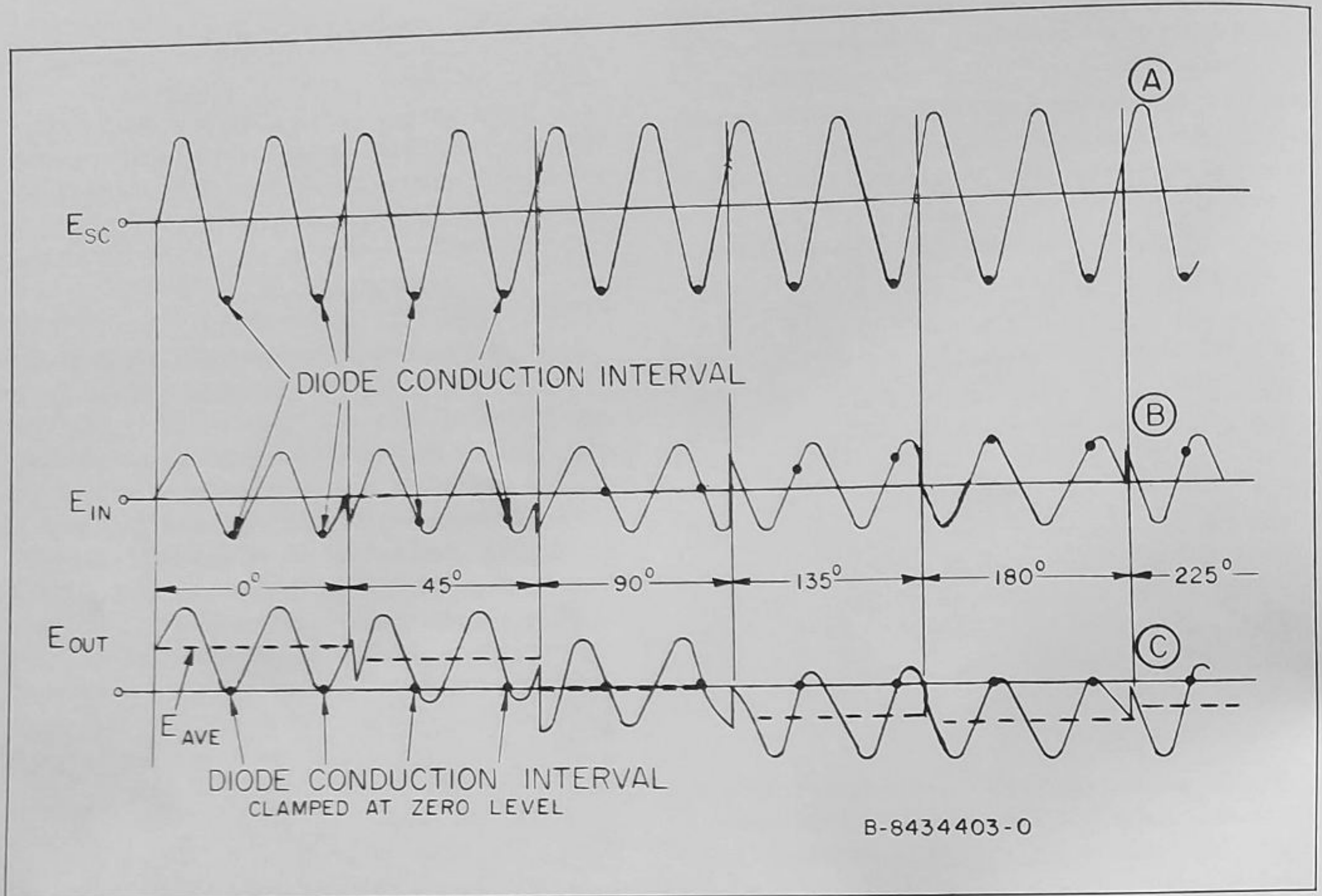


***Figure 8. Waveforms, Decoder Demodulators***

the output is 70% of the maximum. At 90 degrees, the $E_{IN}$ is passing through zero at the same instant the diodes are switching (point A, Figure 7) to zero, resulting in zero average output. Thus the output is proportional to the cosine of the angle between $E_{SC}$ and $E_{IN}$ which is necessary for synchronous detection. Of course, the output amplitude is directly proportional to the input amplitude; therefore the demodulation requirements are complete.

Since the diodes act only as switches, they have little effect on the gain stability of the demodulators. The amplitude of $E_{SC}$ also has no effect on the demodulator gain as long as it is larger then $E_{IN}$ under any conditions.

In the decoder, the subcarrier drives the Q demodulator from transformer 3T3 through 2C56 and 2R110 to the series diodes, 2V15. The chroma signal component is fed through 2C58. The demodulated Q output is then coupled through 2C59 to the grid of the Q amplifier, 2V6A.

The chrominance signal is also passed through a precision lumped constant delay line and through 2C47 to the I demodulator. The precision delay line shifts the phase of the chrominance signal 90 degrees for the necessary stable quadrature. Subcarrier for the I demodulator is applied from 3T3 through 2C48, 2R102, and the series diodes, 2V20. The demodulated −I signal is fed through 2C50 to the grid of the I amplifier, 2V21A.

## Q Channel

The +Q signal from the demodulator drives the Q amplifier and inverter, 2V6A. This stage is gain stabilized by its high cathode degeneration. The plate circuit contains the Q filter for the necessary band pass shaping and drives the Q matrix driver, 2V6B, a cathode follower which provides a low impedance drive source for −Q to the matrix.

## I Channel

The demodulated −I signal drives the gain stabilized 2V21A I amplifier and inverter. Its plate circuit shapes the band pass of the +I signal and drives a cathode follower delay driver, 2V21B, which drives the I delay line 2DL5. The delayed I output drives the I matrix driver cathode follower, 2V11A, which provides a low impedance drive source for +I to the matrix.

### Matrix

The $-Q$ and $+I$ signals derived above are added through 2R121 and 2R122, respectively, in the proper proportion to produce a $-$B-Y signal which is applied to the gain stabilized B-Y amplifier, 2V10A. The +B-Y at the plate of 2V10A drives the B-Y matrix driver cathode follower, 2V10B. From this point the +B-Y signal is added back to the input $-Q$ signal by the simple resistance adder, 2R129 and 2R130, to make G-Y. Also the +B-Y signal is added back to the $+Q$ by 2R132 and 2R133 to make R-Y. Thus, the three necessary color difference signals have been made. The luminance Y signal which comes from the cathode of 2V5B (monochrome matrix driver) is fed to the matrix through 2R134, 2R135 and 2R136. These signals are added to the R-Y, B-Y, and G-Y signals, respectively, to produce the desired red, green, and blue video signals, which are fed to their respective cathode followers 2V11B, 2V16A, and 2V16B for application to the three channel video amplifier. The inputs to the green and blue output cathode followers may be varied by the blue and green gain controls, 2R139 and 2R141, respectively.

### Color AFC, Color Killer, Burst Channel and Phase Detector

Referring to the composite signal path theory, it was stated that during the brightness pulse interval, the burst keyer and feedback gate 2V8B, conducts. Since the cathode of 2V8B contains the video information, burst will appear at its plate during this interval for color operation. Therefore part of the plate load of 2V8B is made selective to 3.58 mc by inserting the primary of a tuned transformer 2Z1 in series with the plate load resistor 2R18. This is the burst take-off point. The burst components from the feed back pulse are removed by 2C75 and 2L5 across 2R18. The burst is amplified by 2V8B and is coupled to the secondary of 2Z1 which drives the phase detector, 2V1.

The subcarrier input to the phase detector comes from the demodulator driver transformer, 3T3. Subcarrier phase to the detector is made variable by the phase shifting networks 2R103, 2R104, and 2C49. The arm of the phase control 2R104 has an output with variable phase and constant amplitude. The d-c output of the phase detector controls the reactance tube, 2V2A, which in turn controls the crystal controlled subcarrier oscillator, 2V2B. The output signal from the oscillator is taken from its cathode circuit and drives the subcarrier amplifier, 2V9. The plate of this amplifier drives the transformer, 3T2, with the necessary "locked in" subcarrier to drive the demodulators.

From 2Z1, the burst transformer, the burst is coupled through 2C7 to the killer detector, 2V3B, the grid of which sets up a negative d-c voltage dependent on the burst amplitude. As the burst increases from zero, the grid of 2V3B becomes increasingly negative; consequently, its plate goes more positive. At some point, depending upon the setting of the killer control, 2R127, the killer amplifier, 2V3A, will conduct sufficiently to energize the killer relay, 2K2. This relay when energized switches in the 3.58 megacycle trap in the luminance channel, increases the aperture boost slightly, and energizes 2K1 when the test switch 2S2 is in positions 4 or 5. Relay 2K1 switches the chroma signal to the demodulators. (The complete test switch 2S2 functions are discussed later.) With insufficient or with no burst present, 2K2 is deenergized and the 3.58 mc is switched out. This makes the monitor suitable for high quality wide band monochrome monitoring.

### Sync Channel

*Internal Sync Operation*

For internal sync operation, the sync selector switch, 2S1, returns the sync amplifier, 2V12A, cathode to ground. It also grounds the mid-point of the divider network, 2R171 and 2R177, which otherwise sets the operating grid voltage for the external sync amplifier, 2V18B. As a result, 2V12A conducts and 2V18B is cut off.

Composite video with negative sync is applied from the junction of the CONTRAST control resistors, 2R197 and 2R198, through resistor 2R154 and capacitor 2C97 to the grid of tube 2V12A. The amplified, inverted output of 2V12A drives the sync clipper driver, 2V12B, which is a cathode follower. The output of 2V12B drives the noise clipper diodes, 2CR8 and 2CR9. Diode 2CR8 sets the positive going sync tips to the positive DC voltage developed across 2R176. During the sync interval, this positive voltage containing the noise to be clipped is passed through the clipper network consisting of 2R174 and 2CR9. Diode 2CR9 conducts for all positive going voltages, attenuating the noise by the ratio of diode forward resistance to the resistance of 2R174. The remainder of the signal occurs when 2CR9 is not conducting, resulting in negligible signal loss during this time.

The output of the clipper drives the sync separator stage 2V13A and it is sufficient to drive 2V13A to cut-off during the video interval.

Stripped sync is taken from the screen grid of 2V13A. During the video interval, diode 2CR10 clips the signal in the screen circuit. This results in clean sync driving the sync output driver, 2V18A. From the cathode of 2V18A, sync is coupled through 2C91 to appropriate points throughout the Monitor.

*External Sync Operation*

When the sync selector switch, 2S1, is in the external position, the cathode circuit of 2V12A is open and the tube is cut off. At the same time, divider 2R171 and 2R177 raises the grid voltage of the external sync amplifier, 2V18B, so that now it conducts. Until this time, 2V18B was prevented from conducting by divider 2R170 and 2R7, in the cathode circuit.

External sync is connected to 2J11 and from there is fed to the grid of 2V18B. The output from the plate of 2V18B is coupled through 2R6, 2R3, and 2C88 to drive the sync clipper driver, 2V12B. From this point, external sync operation is identical to internal sync operation.

*Remote Sync Operation*

When the sync selector switch is in remote position, grounding and ungrounding for internal or external sync operation may be done at a remote location. Relay control of sync selection is also possible by removing the jumper wire connected to pins 1 and 7 of relay socket 2XK3.

## Brightness Pulse Channel

*Pulse Generator and Shaper*

The plate circuit of the sync separator, 2V13A, is used for the original shaping of the sync pulse for use as a brightness pulse. Here the amplified sync is integrated by capacitor 2C92 and clipped by diode 2CR2, resulting in a pulse width greater than sync. This pulse, which is negative, is applied to the grid of the pulse inverter, 2V13B, with sufficient amplitude to drive it far beyond cut-off. The resulting clipped pulse appears at the plate of 2V13B. This second clipping action completes the brightness pulse shaping.

From the plate of 2V13B the pulse is coupled directly to the grid of the feedback gate tube, 2V8B. Here 2CR3 sets a precise voltage level during the pulse interval for the proper operation of the feedback clamp discussed earlier. The pulse is also coupled to the brightness pulse adder 2V8A grid, which was discussed earlier.

## Setup Switch 2S2 Function

In this discussion, the function of each switch section for each switch position will be given, followed by a brief statement on the resulting output of the decoder. The use of these outputs are discussed both in the General Decoder Theory and the Setup Procedure.

Position One—Not Used

Position Two—Screen Balance

2S2A—Monochrome matrix driver 2V5B disconnected from matrix and the monochrome input point to matrix grounded through capacitor 2C66A.

2S2B—Brightness control 2R71 switched in.

2S2B—DC voltage to 2K1 disconnected (color channel off).

2S2C—Grounds grid of monochrome — chroma drivers 2V17 and 2V14.

2S2C—Opens video output from CONTRAST control 2R197 to grids of 2V17 and 2V14.

The result is zero signal from the decoder on the red, green, and blue outputs.

Position Three—Gain Balance—Monochrome

2S2A—Monochrome matrix driver 2V5B connected to R, G, and B cathode follower outputs.

2S2B—Brightness control 2R71 connected.

2S2B—DC voltage to relay 2K1 disconnected (color channel off).

2S2C—Connects video drive from CONTRAST control to 2V17 and 2V14.

2S2C—Connects pulsing capacitor 2C103 from first video input amplifier 2V23 cathode to ground.

The result is a monochrome signal only, at R, G, and B outputs. The output will be wide or narrow band depending on whether or not there is burst on the incoming signal. (Refer to Color Killer Theory.)

Position Four—Chroma Unity

2S2A—Same as position three.

2S2B—Brightness control 2R71 connected.

2S2B—Relay 2K1 switched to contacts of Killer relay 2K2.

2S2C—Same as position three.

The result is dependent on whether or not burst is present. With no burst, the result is identical to position three with no burst because killer relay 2K2 is deenergized and prevents 2K1 from energizing (color channel off). With burst present, however, 2K2, is energized thereby energizing relay 2K1 to turn on the color channel providing red, green, and blue signal outputs.

Position Five—Chroma Variable

2S2A—Same as position three.

2S2B—Same as position three.

2S2C—Variable capacitor 2C31 (Chroma Gain) switched in place of 2C103.

The result differs from position four only in that the video response in the color subcarrier region is made variable by the chroma gain control 2C31.

# 3 CHANNEL VIDEO AMPLIFIER DESCRIPTION

The 3 Channel Video Amplifier receives the simultaneous red, green, and blue video signals from the decoder and amplifies them to a suitable level for application to their respective kinescope guns. The three amplifiers are identical and therefore only the green amplifier is referred to in the following text.

Figure 9 shows the tube side of the 3 Channel Video Amplifier. Figure 48 is a block diagram and Figure 49 the schematic.

The video signal is applied to the grid of the first video amplifier, 1V2A, where it is inverted and a-c coupled to the grid of the second amplifier 1V1A. Again it is inverted and d-c coupled to the third video amplifier 1V1B, which is a cathode follower whose output is a-c coupled to the final video amplifier 1V6.

The cathode of the video output and input stages are coupled together providing feedback stabilization. The plate of the output stage 1V6 drives the kinescope cathode and is outside the video feedback loop. However, the plate contains a driven feedback clamp circuit which acts to precisely set the voltage during the blanking interval.

The clamp is driven with sync amplified by amplifiers, 1V4B and 1V12B. The amplified negative sync drives the sync amplifier, 1V12A, to cut off during the sync interval. Thus the inverted positive tip of sync in the plate circuit is set by the voltage at the junction of 1R28, 1R19 and 1R26 and is applied to the error detector (1V9A) grid. During video time, the error detector is held at cut-off by the sync signal. When it starts to conduct will depend on the instantaneous difference between the kinescope driver plate voltage and the fixed amplified sync voltage. This difference is a function of drive characteristics and input duty cycle. The error signal in the error detector plate is rectified by 1V9B and fed back to the grid of the driver. The rectified grid voltage sets the necessary grid bias so that the voltage level during the clamp interval is maintained constantly regardless of the duty cycle or the driver characteristics. The loop has been designed so that the clamp level is equal to the voltage at the divider 1R28, 1R19 and

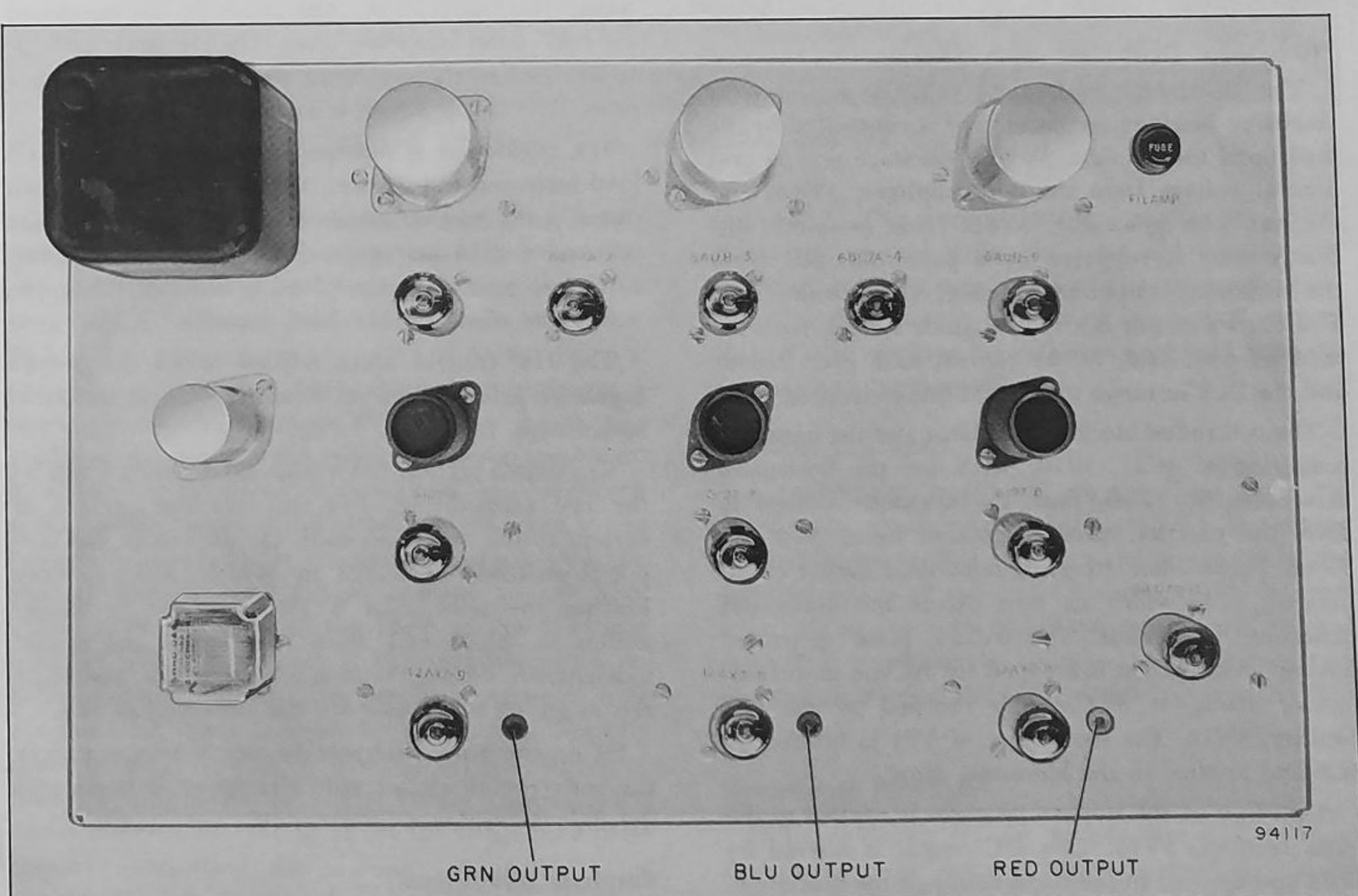


**Figure 9. Tube Side, 3 Channel Video Amplfier Chassis**

1R26. The divider 1R28, 1R19 and 1R26 is also used to control the red and blue amplifiers, insuring an equal d-c setting on each gun.

From the decoder description it is seen that clamping takes place during a brightness pulse interval and that this pulse is variable in amplitude. Thus, as this pulse is varied, the overall level during video time will shift while the clamp remains fixed resulting in a change in brightness.

Added to the sync in the grid of the sync amplifier, 1V12B, is a horizontal pulse from the transformer, 3T1, in the deflection chassis. This pulse drives the feedback clamp in the event of loss of sync and maintains proper free running brightness conditions.

# DEFLECTION AND HIGH VOLTAGE CIRCUIT DESCRIPTION

The Deflection and High Voltage chassis, which is controlled by composite sync from the decoder, provides sawtooth currents for the deflection yoke of the color kinescope, plus a source of regulated 23 kilovolts for the kinescope ultor. The protection circuits are also in this chassis.

Figure 10 shows the tube side of the Deflection and High Voltage chassis. Figure 52 is a block diagram and Figure 53 the schematic.

### Sync Amplifier

Sync, obtained from the decoder chassis, is applied to the sync amplifier and inverter 3V8A. The plate of this stage drives the horizontal control circuit through 3C2 and the vertical integrating networks 3PC1.

### Horizontal Deflection and HV

The horizontal oscillator, 3V5, is a sine-wave stabilized blocking oscillator, and is controlled by the horizontal control tube, 3V5B. This stage gets its grid control voltage from the sync amplifier, 3V8A, and the sawtooth generator, 3V6B. This sawtooth discharge tube is triggered by a pulse obtained from the horizontal output transformer, 3T1, terminal U3. The control circuit is a synchroguide system, with the hold control, 6R5, in the control tube plate circuit and the lock in range control, 3C9A, in its grid.

The controlled blocking oscillator and the networks consisting of 3R11, 3R10, 3C13 and the horizontal drive control, 3C9B, form the sawtooth voltage to drive the parallel horizontal output tubes, 3V9 and 3V10. These tubes drive the horizontal output transformer, 3T1, which in turn drives the horizontal deflection yoke coils. The flyback pulse generated during retrace time is stepped up by the autotransformer action of 3T1 and is rectified by the HV rectifier, 3V11. The d-c output of 3V1 is filtered by 3C8 and applied to the kinescope ultor.

A portion of the stepped up pulse is applied to the focus rectifier, 3V16. This DC output is filtered by 3C24 and applied to the focus anode of the kinescope. The pulse input to the plate of 3V16 is made variable by 3R23 and thus a variable focus voltage is obtained.

Damping is obtained by the parallel diodes, 3V13 and 3V14, which also serve as a d-c return for the horizontal outputs, 3V9 and 3V10. The shape of the damping current waveform is controlled by the horizontal tuning coil, 3L8, in the damper plate circuit. Since this damper current is used for sweep current, the tuning coil, 3L8, serves as a linearity control. Also, a portion of the damping energy is used to generate a d-c voltage across 3C25 which, when added to the regulated +400 volts, gives a boosted B voltage of approximately 800 V.

This boosted B voltage serves two functions. First it supplies the necessary kinescope screen voltage, and second it is divided down by divider 3R39 and 3R40 and applied to the grids of the parallel HV regulator tubes, 3V17 and 3V18. The plates of the regulators are tied to the kinescope ultor. The regulator cathode is returned to the regulated 400 V supply through a protection circuit which is explained later.

HV regulation is obtained as follows. As the HV load increases, transformer 3T1 is loaded more which causes a decrease in the boosted B. This lowers the regulators' grid voltage and the regulators take less current to return the total load to normal. The opposite is true when the HV load decreases.

The HV control 3R41 is used to set the proper regulator grid voltage to obtain 23 KV at the kinescope ultor.

Size switch section 3S1A and 3S1B selects a tap on the HV transformer, 3T1, to vary the amount of current to the deflection coils. On underscan, the output is switched from W1 to W2. In order to keep loading the same, 3L4 is also switched in during underscan. 3R25 and 3R26 load down the system momentarily during the switching transient, and 3C21 acts as an arc suppressor for the switching of 3L4.

U4 on the horizontal transformer is used to supply the convergence circuit with the required horizontal dynamic convergence information.

### Vertical Deflection

The output of the sync amplifier, 3V8A, drives the vertical integrating network, 3PC1. The integrated

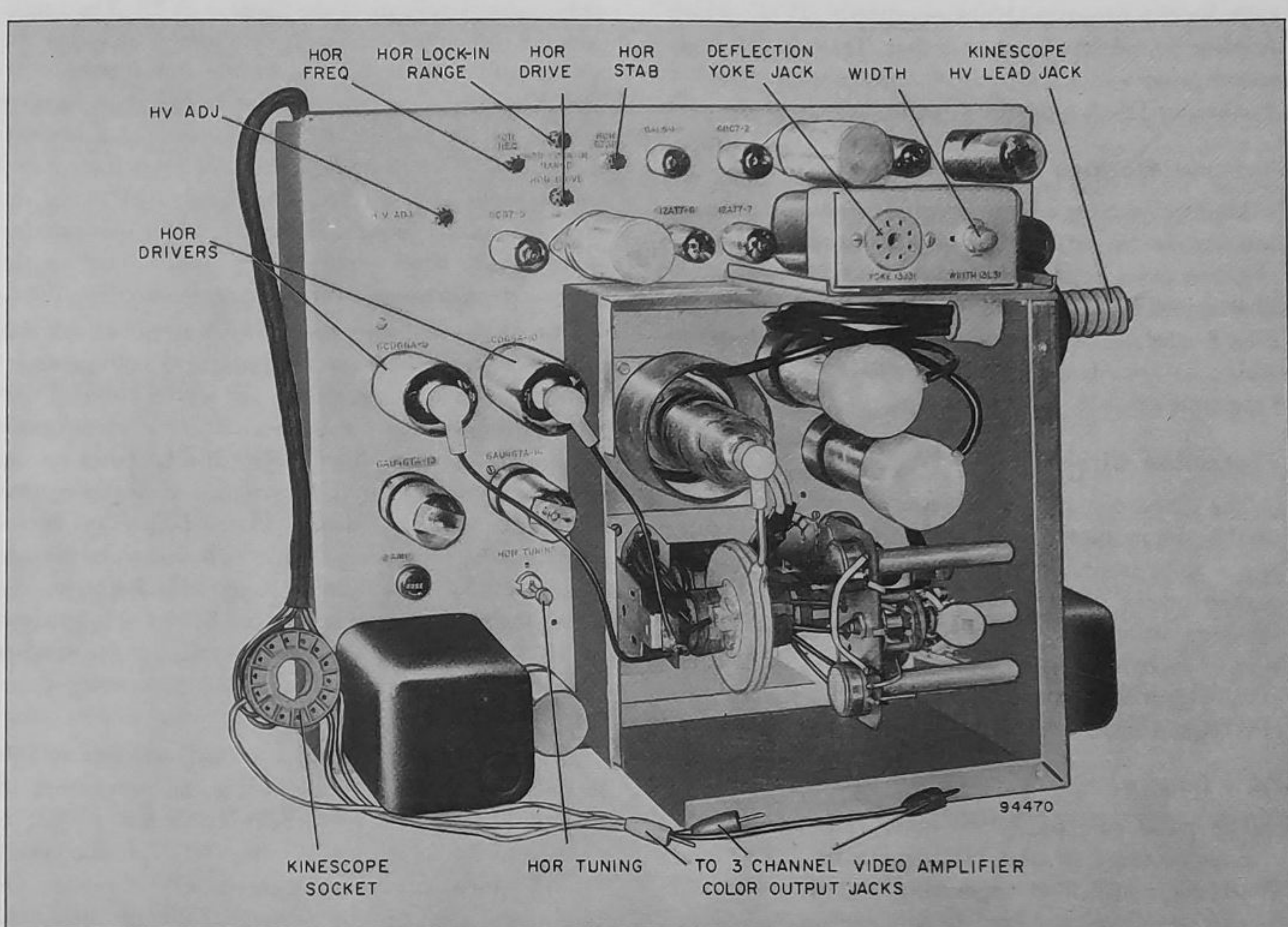


***Figure 10. Tube Side, Deflection and HV Chassis***

vertical sync triggers the vertical blocking oscillator, 3V8B. A positive going pulse is taken from the cathode of 3V8B and shaped by network 3R36 and 3C41 after which it drives the vertical discharged tube, 3V3A. The output from the plate of 3V3A drives a network which charges slowly during sweep time, and discharges rapidly through 3V3 during the trigger (retrace) to generate the required vertical sawtooth. The discharging circuit is contained in a feedback system which begins at the plate of 3V3A, then to the cathode follower, 3V3B, the vertical output, 3V4, the vertical linearity and height control system 3T6, 3C44, 3R99 and back to the plate of the discharge tube, 3V3A. The feedback is degenerative which results in high stability. The feedback network time constants are made variable by the vertical linearity controls, 6R25 and 6R4, making a high degree of linearity control possible. The height control, 6R1, varies the positive voltage at the discharge tube plate thereby controlling the sawtooth amplitude. This voltage is switched by the size switch, 6S5. On "under" size position the +B is taken from the divider, 6R10 and 6R17. The vertical output transformer, 3T6, drives the vertical deflection yoke and supplies the sawtooth voltages necessary for the convergence circuit. The signal at the cathode of the vertical output, 3V4, is used to drive the convergence circuit with the required parabolic waveform.

### Vertical Collapse

A pushbutton switch 6S7 on the front panel reduces to a great extent the plus (+) B voltage applied to the vertical sawtooth charge circuit by the dividing action of resistors 6R10 and 6R29. A great reduction in sawtooth amplitude results, and vertical deflection is effectively collapsed to approximately one-half inch when the SIZE switch 6Sg is in NORM position.

### Horizontal Blanking

Utility winding U2 on transformer 3T1 supplies a negative pulse voltage which is applied through 3C52 and 3R108 to the kinescope grids and serves as the blanking signal. D-c level is set during sweep time by the kinescope blanking clipper, 3V2C, which is made to conduct between pulses. This sets the kinescope grids to the desired d-c voltage as determined by divider 3R76 and 3R77.

### Vertical Blanking

During retrace a negative high voltage pulse is induced in the vertical output transformer, 3T6. This negative pulse appears during the vertical retrace time at terminal V on 3T1. The sawtooth is filtered out by 3R105 and 3C54 leaving only the negative pulse which is added to the horizontal blanking at the kinescope grids.

### Protection Circuit

The functions of the protection circuit are: first, disable the monitor in case of failure in the high voltage supply; second, prevent overdriving the kinescope with excessive video level. In the first case, failure in the high voltage supply would cause excessive reduction or complete loss of flyback pulses. In the second case, overdriving the kinescope results in very low HV regulator current.

*Pulse Gate*

The pulse gate protection tube, 3V7A, senses the cathode voltage of the HV regulators, 3V17 and 3V18. Normally it is conducting and drawing grid current; however, conduction will decrease as regulator current decreases because of the voltage developed across 3R42 of divider 3R43 and 3R42. Plate voltage for the series connected 3V7A and 3V7B is provided by the negative pulse from terminal U1 of transformer 3T1. Because of the series conduction of 3V7A and 3V7B, control of the current in 3V7A changes the current in 3V7B. As a result, a negative pulse voltage appears at the plate of 3V7B. The amplitude of this pulse voltage is determined by either the 3V7A grid-cathode voltage or the input pulse voltage. This negative output pulse is fed to a rectifier system, 3V1A and 3V1B, which generates a positive d-c at the 3V1A cathode. This positive voltage is fed to the main power relay control tube, 4V10, in the power supply. The pulse is also fed to the bias rectifier tube, 3V2A, which feeds a negative voltage to the grid of the kinescope overload protection tube, 3V6A.

During normal operation, 3V6A is cut off by this voltage since it overcomes the negative voltage on its cathode. The cathode voltage is set by diode 3V2B which peak rectifies the horizontal flyback pulse from U2 on 3T1. When cut off, 3V6A has no effect on the kinescope grid circuit. The system is arranged so that when the regulator current drops below 75 microamperes, the pulse output of 3V7B decreases enough to allow 3V6 to conduct. When this happens, the kinescope grid voltage is lowered by the voltage drop in 3R78. Increasing the drive results in the further lowering of this grid voltage thus preventing overload.

If a circuit failure causes a drastic reduction or loss in pulse amplitude, the d-c voltage at the cathode of 3V1A decreases sharply. This reduction in d-c is applied to the relay control tube, 4V10B, in the power supply which shuts off the monitor +B power. Of course, a failure in the protection circuit itself will shut down the monitor. This makes it a fail-safe device.

A manual a-c reset button, 6S3, is provided which overrides the protection d-c voltage to turn the monitor back on. However, upon release of the switch, the monitor will shut down unless the cause of failure has been remedied.

## POWER SUPPLY DESCRIPTION

The Power Supply operates from a 117 a-c volt source and performs three functions. First, it supplies three regulated d-c voltages: +400, +280, and +200 volts. Secondly, it contains a time delay circuit which allows filament warm up before application of plate voltage. Thirdly, it contains a protection tube which receives its information from the deflection chassis and shuts down the monitor in case of failure.

Figure 11 shows the tube side of the Power Supply. Figure 54 is a block diagram and Figure 55 the schematic.

### Regulated DC Generation

Under normal operating conditions, the main power transformer 4T1 is energized by the input 117 volts a-c. Its secondary contains the rectifier system for generating the three regulated voltages. On the one voltage swing, 4CR1 is made to conduct thus charging 4C4, 4C5, 4C6, 4C7, and 4C8 to the peak voltage across 4T1. This d-c voltage is applied to the plate of the series regulators 4V5 for the 200 v supply. On the opposite a-c voltage swing 4CR3 is made to conduct charging 4C2 and 4C3 to the peak voltage between terminals 5 and 6 of 4T1. This voltage is added to the original voltage across capacitors 4C4 to 4C8 and is applied to the series regulator combination 4V4 and 4V3 for the 280 v supply. Also, on this opposite a-c voltage swing, 4CR2 conducts charging 4C1 to the peak voltage between terminals 6 and 7 of 4T1. This new voltage is added to the two previous d-c voltages and applied to the series regulators 4V2 and 4V3 for the 400 v supply.

## 200 V Regulator

The discussion of the regulators will begin with the 200 v supply because the adjustment of this supply is used also to set the 280 and 400 v regulators. Across the 200 v output point is tied a resistor, 4R70, in series with a gas regulator tube 4V9. Across this tube is a constant d-c voltage to be used in the setting of the 200 v regulator feedback loop. A portion of this constant voltage, which is adjustable by the 200 v adjust control, 4R67, is used to set the grid for the operating point of the first d-c amplifier, 4V8A, in the 200 v regulated feedback loop. The cathode of this amplifier is set by the divider 4R64 and 4R68 which gets its voltage from the 200 v output. The amplifier is feedback stabilized by the high cathode degeneration. The plate of this stage is d-c coupled through the precision divider 4R62 and 4R63 to the grid of the second d-c amplifier 4V8B. This is also a feedback stabilized amplifier whose plate drives the grid of the series regulator 4V5. Regulation is obtained as follows.

An increase in the 200 v load would tend to reduce the voltage of the output and therefore at the cathode of the regulator 4V5. This reduction is sensed by the first d-c amplifier (4V8A) cathode through the precision divider 4R64 and 4R68, resulting in a drop at its plate. This causes a drop at the grid of the second d-c amplifier (4V8B) grid which causes a corresponding rise in its plate. This voltage rise appears at the regulator grid and thus at its cathode and the 200 v output to make up for the original attempted drop. The opposite is true for a decrease in the 200 v load. A-c coupling by 4C20 and 4C19 form a ripple cancellation system in a similar manner.

## 280 V Regulator

This regulator circuit operates identically to the 200 v regulator. Its first d-c amplifier, 4V7A, gets its grid voltage setting from the same point as the 200 v first d-c amplifier. The second d-c amplifier, 4V7B, gets its cathode reference from the cathode of the +200 v second d-c amplifier. The system is designed so that adjusting the 200 volts automatically sets the 280 v output.

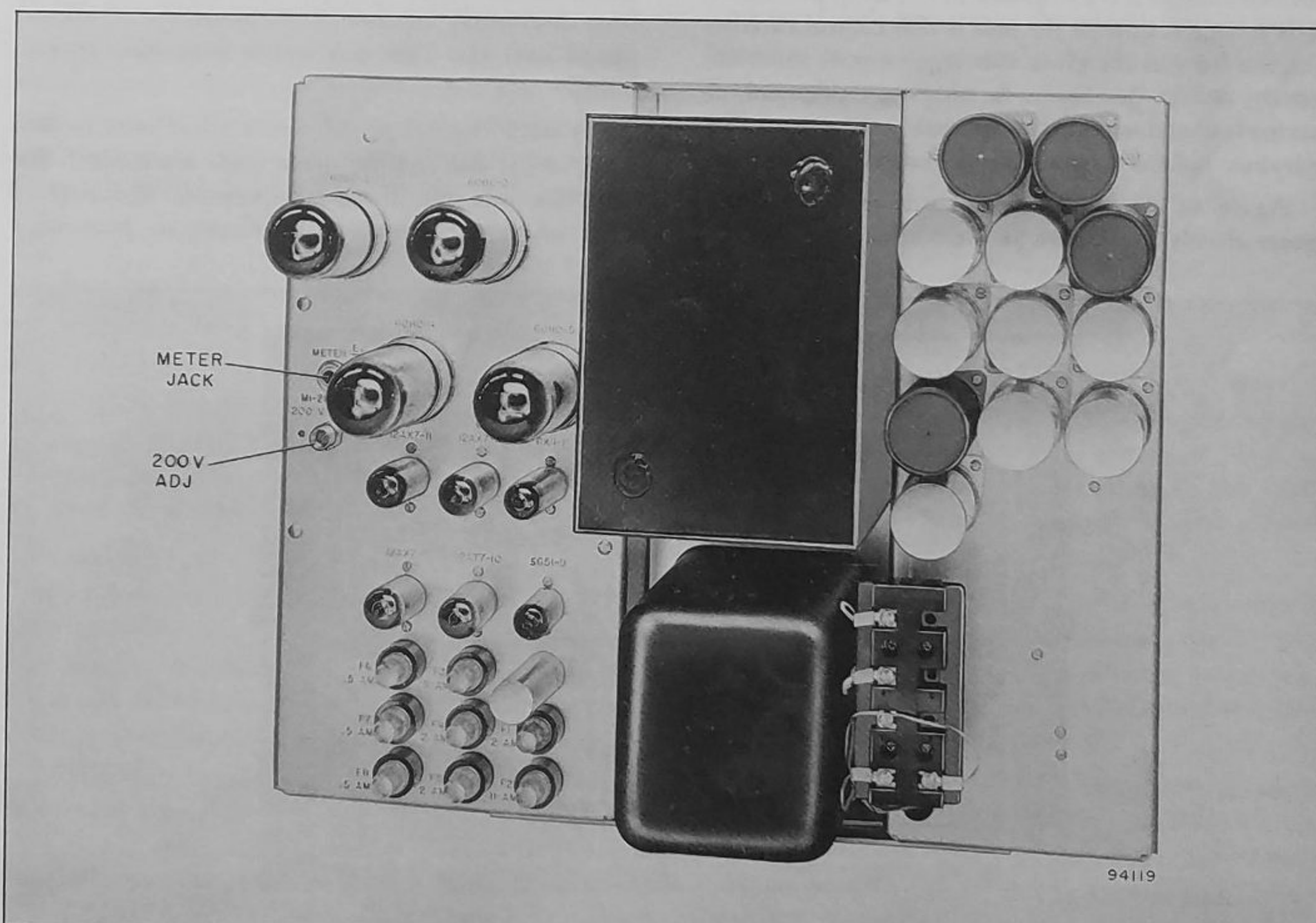


***Figure 11. Tube Side, Power Supply Chassis***

### 400 V Regulator

As does the 280 v supply, the 400 v regulator also operates identically to the 200 v supply. However, the grid operating point of the first d-c amplifier, 4V6A, and the cathode operating point of the second d-c amplifier, 4V6B, is the regulated 200 volts. As with the other two supplies, the 400 volt is automatically set by the 200 v adjustment.

### Time Delay

When a-c power is first applied to the Monitor, relay 4K1 is deenergized and the main power transformer 4T1 primary is open. However, 4T2 is energized and thus the filaments are immediately energized, after which 4V1 will rectify and produce a d-c voltage at the junction of its filter, 4C18B and 4R53. As soon as this voltage builds, 4C13 begins to charge through 4R29 in the grid of the time delay amplifier, 4V10A. This puts a positive voltage on the grids and, when the filaments have warmed up sufficiently, 4V10A will conduct and energize 4K1 to turn on the main power transformer.

The time delay is governed by filament warm up time. From a cold start, this delay is from 10 to 15 seconds. At this time the protection voltage amplifier (4V10B) grid voltage is zero. It is kept cut off by the divider 4R30 and 4R31. When the regulated 400 volts build up, 4C14 begins to charge to keep 4V10A conducting. This allows extra time for the kinescope HV rectifier filaments to warm up. As 4C13 and 4C14 approach their final charge, the voltage across 4V29 approaches zero and divider 4R30 and 4R31 will ultimately cut off 4V10A. Before this happens, however, a positive d-c voltage generated in the deflection protection circuit will be applied to the grid of 4V10B causing it to conduct and keep 4K1 energized. The circuit will now operate normally, as long as there is a protection voltage at the grid of 4V10B.

## CONVERGENCE DESCRIPTION

The Convergence circuit is purely passive and its control functions are discussed in the setup procedure. The unique feature of the unit is that control currents for the red and the green convergence coils simultaneously deflect the beams in either a horizontal or vertical direction relative to each other, both for dynamic and static (position) convergence.

Figure 12 shows the control side of the Convergence chassis and Figure 56 the schematic.

Blue is controlled vertically (both dynamic and static) by the blue convergence pole piece assembly. Blue horizontal motion is obtained by a magnet placed over the blue gun and is a position control only.

For both the horizontal and vertical relative motions of the red and the green there are controls for size, linearity, tilt, bow, and position. Working in conjunction with the position controls are permanent


**Figure 12. Control Side, Convergence Chassis**

magnets which are mounted on the convergence pole piece assembly on the kinescope neck. These magnets are used to set approximate convergence of the red gun and the blue bars at the center of the raster. This circuit matrixes the control voltages to perform these functions for correction at both horizontal and vertical scan rates. The horizontal dynamic waveforms are clamped by diodes 5SR1A, 5SR1B, and 5SR1C at the center of each horizontal scan. Therefore, the center of the raster is unaffected as the horizontal dynamic controls are adjusted to correct convergence at the left and right side of the raster.

Diode clamping is not used in the vertical dynamic correction, but a system equivalent to a clamp is used. This system employs a d-c cancellation method which simultaneously adds the correct amount of position (d-c) adjustment to maintain center convergence as the vertical dynamic controls are adjusted. The sawtooth for the vertical dynamic correction is obtained from the vertical output transformer, 3T6; the parabolic waveform for the vertical dynamic correction is obtained from the cathode of the vertical output tube, 3V4, in the deflection circuit. The horizontal dynamic correction wave shapes are formed from a utility pulse from the flyback transformer in the deflection circuit. DC for the position controls is obtained from the cathode of the horizontal deflection output tubes 3V9 and 3V10.

## KINESCOPE FILAMENT REGULATOR CIRCUIT DESCRIPTION

The purpose of the kinescope filament voltage regulator circuit is to stabilize the filament voltage, counteracting the effect of variations in the input line voltage. The circuit is shown schematically in Figure 53 as part of the Deflection Schematic.

Regulation is obtained by double clipping the sine wave applied to the kinescope filaments. The clipping level is set by the zener diodes 6CR1 and 6CR2 and the amount of clipping is set by the voltage at the secondary of transformer 6T1 and the series resistors 6R30, 6R31 and 6R32. The values have been chosen such that with a transformer 6T1 secondary voltage of 12.6 volts rms the filament voltage developed across the zener diodes is 6.0 volts rms, regulated. This is 0.3 volt lower than the nominal rating but is necessary to aid in protecting the kinescope filaments if the regulating diodes should fail. A failure (open) will cause the filament voltage to increase to an amount determined by the input voltage and the series resistors.

## INSTALLATION

*CAUTION: Do not attempt to apply power to the monitor after removal from its shipping carton until the following instructions have been complied with.*

1. Remove both side cover panels by loosening the four Camlock fasteners on each panel. Remove the cover from the high voltage compartment.

2. Remove the cords binding the extension shafts, which are between the back of the front panel and both the Decoder and the Deflection and HV chassis.

3. The front panel fuses 6F1 and 6F2 and their caps are in a small bag attached to the Deflection and HV chassis shaft extensions. Remove the bag and insert the fuses in their receptacles.

4. Make certain that all extension shafts are now free of cord and that the blade extension shaft actuates the switch inside the high voltage compartment when the SIZE switch on the front panel is operated. Make certain that the tubes in the high voltage compartment are seated firmly in their sockets before replacing the compartment cover.

5. Before replacing the side cover panels, inspect each chassis. In particular check that the 27 pin Jones connector, 3P2, which connects the cable from the back of the front panel to the Deflection and HV chassis, is firmly in its socket.

6. Remove the four screws holding the plywood panel on the bottom of the frame. Insert the four adjustable glide feet into the four holes from which the screws were removed and bolt them securely to the frame. Adjust the glide feet as required to level the Monitor.

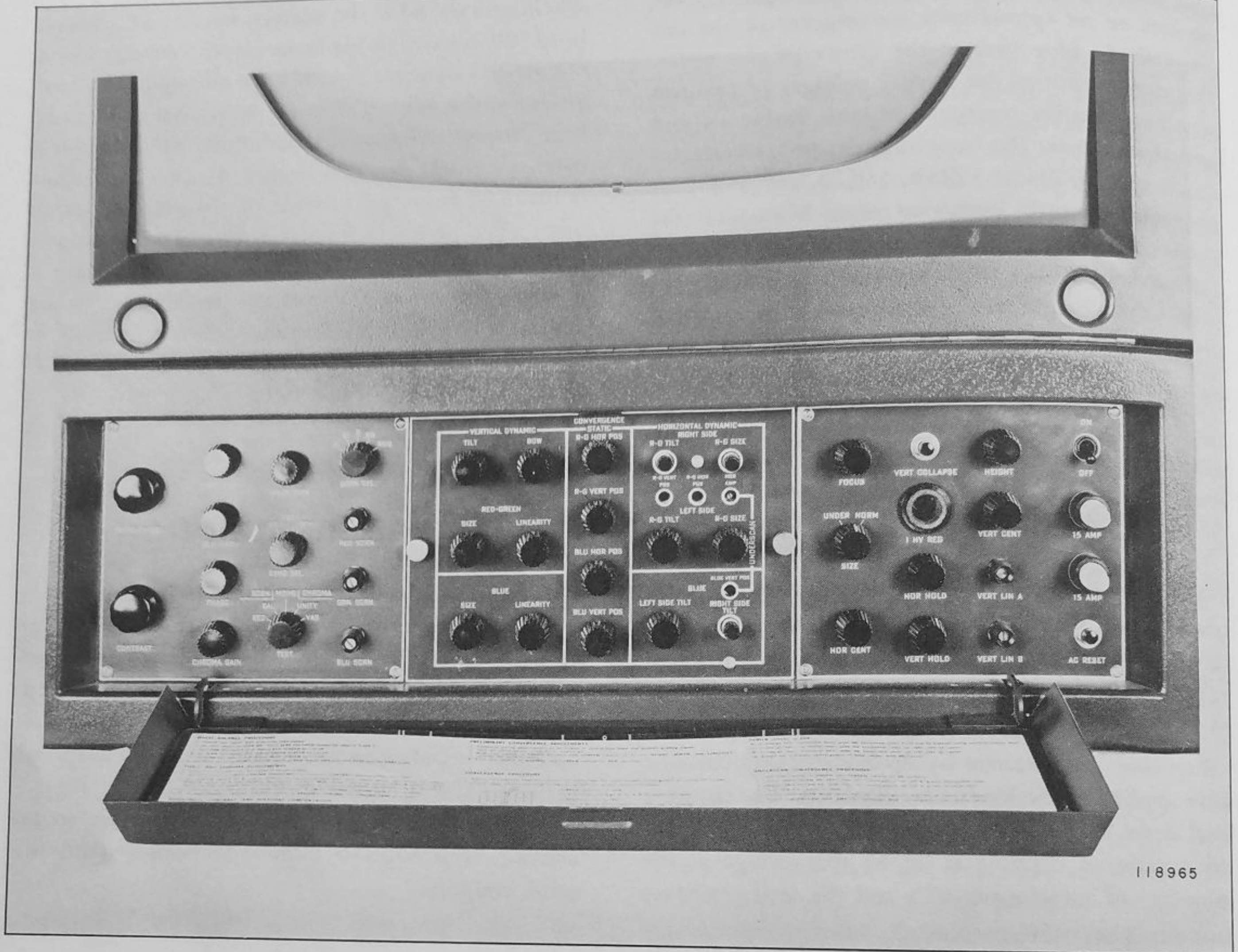


**Figure 13. Front Panel Control Section and Convergence Chassis**

## TABLE 1. FRONT PANEL CONTROLS

| *Control* | *Function* | *Control* | *Function* |
|---|---|---|---|
| BRIGHTNESS | Adjusts the black background of the picture. | SCRN SEL | |
| CONTRAST | Varies the video drive to the kinescope. | R | Red kinescope operation only. |
| GRN GAIN | Adjusts the gain of the green video signal. | G | Green kinescope operation only. |
| BLU GAIN | Adjusts the gain of the blue video signal. | B | Blue kinescope operation only. |
| PHASE | Adjusts the subcarrier phase to the demodulators. | RG | Red and green kinescope operation only. |
| CHROMA GAIN | Varies the chroma signal amplitude by adjusting the video response in the subcarrier region. | RGB | Full operation. |
| APERT GAIN | Increases the gain of the high frequency information of the luminance channel. | RED SCRN | Varies the luminance of the red screen only. |
| | | GRN SCRN | Varies the luminance of the green screen only. |
| | | BLU SCRN | Varies the luminance of the blue screen only. |

## TABLE 1. FRONT PANEL CONTROLS (Continued)

| *Control* | *Function* |
|---|---|
| SYNC SEL | |
| INT | Internal sync operation. |
| EXT | External sync operation. |
| REM | Remote sync operation. |
| TEST | |
| SCRN RED | Not used. |
| SCRN BAL | Supplies a reference black level for the setting of cut-off with the red, green, and blue screen controls. |
| MONO | Luminance signal setup for the blue and green gain controls for gray scale tracking. |
| CHROMA UNITY | Selects a fixed, flat response video signal for a unity chroma to luminance ratio with no chroma control. |
| CHROMA VAR | Inserts chroma control to adjust the gain of the chroma signal relative to the luminance signal. |
| BLU HOR POS | Adjusts the horizontal centering of the blue raster. |
| BLU VERT POS | Adjusts the vertical centering of the blue raster. |
| HORIZONTAL DYNAMIC | |
| RIGHT SIDE | |
| R-G TILT | Adjusts the relative red and green tilt on the right side of the raster. |
| R-G SIZE | Adjusts the relative red and green size on the right side of the raster. |
| LEFT SIDE | |
| R-G TILT | Adjusts the realtive red and green tilt on the left side of the raster. |
| R-G SIZE | Adjusts the relative red and green size on the left side of the raster. |
| BLUE | |
| LEFT SIDE | |
| TILT | Adjusts the relative blue tilt on the left side of the raster. |
| RIGHT SIDE | |
| TILT | Adjusts the relative blue tilt on the right side of the raster. |
| UNDERSCAN | |
| R-G VERT POS | Adjusts the centering of the red and green raster in opposition vertically for under size display. |
| R-G HOR POS | Adjusts the centering of the red and green raster in opposition horizontally for under size display. |
| BLUE VERT POS | Adjusts the vertical centering of the blue raster for under size display. |
| VERTICAL DYNAMIC | |
| RED-GREEN | |
| TILT | Adjusts the relative tilt of the red and green raster from top to bottom. |
| SIZE | Adjusts the relative size of the red and green raster from top to bottom. |
| BOW | Adjusts the relative bow of the red and green raster from top to bottom. |
| LINEARITY | Adjusts the relative linearity of the red and green raster from top to bottom. |
| BLUE | |
| SIZE | Adjusts the relative size of the blue raster from top to bottom. |
| LINEARITY | Adjusts the relative linearity of the blue raster top to bottom. |
| STATIC | |
| R-G HOR POS | Adjusts the centering of the red and green raster in opposition horizontally. |
| R-G VERT POS | Adjusts the centering of the red and green raster in opposition vertically. |
| HOR AMP | Adjusts the overall horizontal dynamic correction for underscan. |
| FOCUS | Adjusts the focus electrode potential so that the beams from each gun come to focus at the viewing screen. |
| SIZE | |
| UNDER | Reduces the size of the raster. |
| NORM | Normal full size raster. |
| HOR CENT | A variable adjustment for centering the raster in the horizontal direction. |
| VERT COLLAPSE | Reduces vertical size of raster to approximately ½ inch to aid in setting kinescope cut-off. |
| HOR HOLD | Horizontal picture lock-in control. |
| VERT HOLD | Vertical picture lock-in control. |
| HEIGHT | Controls the size of the raster. |
| VERT CENT | A variable adjustment for centering the raster in the vertical direction. |
| VERT LIN A | Adjust the vertical linearity at the top of the raster. |
| VERT LIN B | Adjust the vertical linearity at the top and bottom of the raster. |
| ON OFF | Main a-c power switch. |
| AC RESET | Reactivates the main power supply by activation of relay 4K1. |

# MONITOR SETUP PROCEDURE

Two preliminary procedures are given as part of the Monitor Setup Instructions. Normally, preliminary procedure 2 will be sufficient before continuing with the remainder of the Setup Instructions beginning with the SIZE AND LINEARITY ADJUSTMENTS. Preliminary procedure 1 is to be used when the kinescope has been replaced or, as happens in some cases, after it ages, thus making it necessary to re-position the jumpers across the kinescope screen resistors.

### Recommended Test Equipment

Tektronix Type 524-D Oscilloscope
RCA MI-21200-C1 Meter
205-W1 Degaussing Coil or equivalent which may be constructed according to the following instructions:

Wind 425 turns (approximately 1335 feet) of #20 enamel covered copper wire to form a coil 12 inches in diameter. Bind all turns together with several layers of insulating tape and connect an 8-foot a-c line cord to the end wires of the coil.

*Electro-static Voltmeter.

### Initial Conditions

Adjust or place the following front panel controls as indicated:

(a) POWER—OFF
(b) BRIGHTNESS—Fully CW
(c) CONTRAST—Fully CCW
(d) GRN GAIN—Fully CW
(e) BLU GAIN—Fully CW
(f) SYNC SEL—INT
(g) TEST—SCRN BAL
(h) SCRN SEL—B
(i) RED SCRN—Fully CCW
(j) GRN SCRN—Fully CCW
(k) BLU SCRN—Fully CCW
(l) CONVERGENCE—Mid-range CONTROLS
(m) SIZE—UNDER

### Initial Setup

1. Connect the jumpers across the RED, GRN and BLU screen range selector resistors, located on the Deflection and HV chassis, in full shunt position (see Figure 53).

2. Make certain that the kinescope and its associated accessories (deflection yoke, convergence yoke, purity magnets and blue lateral magnet) are installed correctly. For detailed instructions, refer to *Replacement and Installation of Kinescope and Associated Components.*

3. Slide the center convergence magnets maximum distance from the kinescope neck.

4. Move the deflection yoke as far as possible toward the bell of the kinescope; then back the yoke off approximately a ½ inch.

5. Insert the MI-21200-C1 meter into jack 6J7 on the Front Panel Control Section.

6. Apply a cross hatch signal to the video input jack 2J13, on the Decoder chassis.

7. Switch the Monitor POWER ON.

8. If necessary, adjust the BLU SCRN control for a low intensity raster.

9. Turn the TEST switch to MONO and, if necessary, turn the CONTRAST control CW to obtain a cross hatch on the screen.

10. Make preliminary adjustments of the HOLD, HEIGHT, CENTERING, LINEARITY, and FOCUS controls.

11. Place the SIZE switch to NORM.

NOTE: If the HOR HOLD control does not lock-in the raster, refer to the Deflection and HV Alignment and make the adjustments described under the heading "Horizontal Deflection and HV Procedure."

12. If necessary, adjust the 200 v potentiometer on the Power Supply chassis to obtain 200 v as measured on the MI-21200-C1 meter.

13. Remove the kinescope blue output cathode lead from the 3 Channel Video Amplifier chassis.

14. Using an electro-static voltmeter, adjust the HV ADJ control on the Deflection and HV chassis for a reading of 23 KV. If an electrostaticc voltmeter is not available, steps 15 through 19 of Deflection and HV alignment procedure must be performed to insure proper high voltage alignment.

### Purity and Screen Adjustment

1. Connect the degaussing coil to an a-c power line and hold the coil approximately 1 inch from the kinescope face plate. Then move the coil in a circular motion in a plane parallel to the glass for about 30 seconds. Then slowly withdraw the coil to a distance of approximately 6 feet and remove it from the a-c power source.

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* By using an electro-static voltmeter, the HV Adjustment may be made quickly and accurately. However, an alternate method of adjusting the HV that does not require the use of this type of meter is described in the Deflection and HV Alignment Procedure, steps 15 through 19.

2. Turn the CONTRAST control fully CCW (minimum). Place the SCR SEL switch to R and G in turn and, if necessary, adjust the screen controls to obtain a raster. Adjust each screen for low intensity.

3. Turn the TEST switch to MONO and SCRN switch to RG. If necessary, adjust the CONTRAST control to obtain a red-green grating pattern of normal intensity. Adjust the FOCUS control for normal viewing and maintain it throughout the remainder of the Setup Procedure.

4. Adjust the red and green convergence magnets on the neck of the kinescope to obtain approximate convergence of the red and green raster at the center of the screen.

5. Turn the SCRN SEL to RGB; adjust the blue convergence magnet on the neck of the kinescope to converge with the red and green in a vertical direction at the center of the screen.

6. With the BLUE HOR POS control, converge the blue horizontally with the red and green at the center of the screen. Disregard cross talk with the red and green since, at this point, only approximate convergence is necessary. Readjust the focus if necessary.

NOTE: It may also be necessary after installing a replacement kinescope to change the connection on the BLU HOR POS potentiometer, 5R12, to increase the convergence range. This, if required, will be evident during the Setup Procedure when making the blue convergence adjustment. The BLU HOR POS control adjustments are indicated in the following steps: step 6 above, and under the heading "Convergence," steps 5 and 6. If the conditions described in any of these steps cannot be met because of the inadequate range of the BLU HOR POS control, the center tap connection on 5R12 must be changed.

The connection shown on the Convergence chassis schematic diagram, figure 56 (with a blue colored lead connected to 5R12 opposite the potentiometer center arm) usually provides sufficient convergence range. To increase this range, disconnect the lead from the center tap, and connect it to either end of 5R12 as required to obtain proper convergence.

7. Place the TEST switch in SCRN RED and the SCRN SEL switch in RED. Adjust the RED SCRN control for a medium-bright raster. Maintain focus during this adjustment.

NOTE: If red brightness cannot be increased sufficiently to properly set purity, connect a 39K ohm resistor across resistor 3R76 (cathode of 3V2C). This applies also for the subsequent checking of the green and blue purity.

8. Move the yoke as far as possible towards the kinescope base, being careful not to disturb the position of the pole piece assembly.

Use care to prevent the convergence coil assembly terminals from shorting to the back of the deflection yoke.

9. Rotate the purity magnet around the neck of the kinescope and, at the same time, vary the spacing between the tabs (Figure 14) on the purity magnet to obtain a uniform red screen area at the center of the kinescope.

10. Move the yoke forward, and adjust for best overall red screen purity without neck shadow. Do not adjust the edge purity magnets at this time.

11. Select the green and blue screens in turn and observe the purity of each. If necessary, repeat the procedure just described, beginning with step 7 and continuing through to include this step until minimum contamination is obtained on the three screens. Maintain a level raster throughout these adjustments. Remove the 39K ohm resistor which was connected across resistor 3R76 according to the instructions in the note between steps 7 and 8.

12. Set the TEST switch in the SCRN BAL position and the SCRN switch to R.

13. Depress the VERT COLLAPSE switch. Maintain vertical collapse for steps 14, 15 and 16.

14. Check that the R SCRN control can adjust the raster *through* cutoff. If cutoff does not occur move the jumper on the screen range selector resistors 3R84 to 3R86 back step by step until the proper screen range is obtained.

15. Set the SCRN switch at G and check that the SCRN control can adjust the raster through cutoff. If cutoff does not occur, move the jumper on the screen range selector resistors 3R89 to 3R91 back step by step until proper screen range is obtained.

16. Set the SCRN switch at B and check that the B SCRN control can adjust the raster through cutoff. If cutoff does not occur, move the jumper on the screen range selector resistors 3R94 to 3R96 back step by step until proper screen range is obtained.

17. Switch the Monitor POWER OFF and tighten the yoke clamp.

### Size and Linearity Adjustments

1. Turn the Monitor POWER ON. Place the TEST switch to SCRN BAL, the SCRN SEL to B, and the SIZE switch to UNDER. Adjust the BLU SCRN control for a low level raster.

2. Turn the TEST switch to MONO, and adjust the BRIGHTNESS and CONTRAST controls for a normal cross hatch pattern.

3. Adjust the WIDTH control, 3L3, located on the Deflection and HV chassis next to the deflection yoke socket, for a raster 16 inches wide.

4. Adjust the HEIGHT control and the VERT LIN A and VERT LIN B controls for a raster 12.5 inches high. VERT LIN A control mainly affects the overall (top to bottom) linearity of the raster. Horizontal linearity is adjusted during the Deflection and HV alignment with the Horizontal Tuning Coil, 3L5.

5. Turn the SIZE switch to NORM. Linearity should track.

### Convergence

*Normal Size Display Adjustments*

1. Turn the SCRN SEL to RG. Check that the R-G HOR POS and the R-G VERT POS controls are in the center of their range.

2. Observe the center convergence. If either the horizontal or vertical red and green lines are separated by 3/16 of an inch or more, bring them into approximate convergence by adjusting the red and green convergence magnets on the neck of the kinescope.

3. Turn the SCRN SEL to RGB. Check that the BLU VERT POS control is at mid-range.

4. Observe the center convergence. If the blue is vertically displaced from the red and green at the center of the raster by 3/16 of an inch or more, bring the blue into approximate convergence vertically by using the blue convergence magnet on the neck of the kinescope.

5. Move the blue horizontally into convergence with the red and green at the center of the raster with the BLUE HOR POS control. Neglect cross talk with the red and green at this point. This completes the adjustments to the convergence magnets on the kinescope neck.

6. Using the R-G VERT POS, R-G HOR POS, BLU VERT POS and BLU HOR POS controls, set the red, green, and blue for precise convergence at the center of the screen.

7. Turn the SCRN SEL to RG. Simultaneously adjust the VERTICAL RED-GREEN, TILT and BOW controls for convergence of the red and green vertical centerline, from top to bottom. It may be necessary to readjust the R-G HOR POS control slightly.

8. Simultaneously adjust the VERTICAL RED-GREEN, SIZE and LINEARITY controls for convergence of the red and green horizontal lines where they intersect the vertical centerline, from top to bottom. It may be necessary to readjust R-G VERT POS control.

9. Using the RIGHT SIDE R-G SIZE control, converge the red and green vertical lines on the right side of the raster.

10. Using the RIGHT SIDE R-G TILT control, converge the red and green horizontal lines on the right side of the raster.

11. Using the LEFT SIDE R-G SIZE control, converge the red and green vertical lines on the left side of the raster. It may be necessary to readjust the RIGHT SIDE R-G SIZE slightly.

12. Using the LEFT SIDE R-G TILT control, converge the red and green horizontal lines on the left side of the raster. It may be necessary to readjust the RIGHT SIDE R-G TILT control slightly.

13. Turn the SCRN SEL to RGB. If necessary, converge the blue with the red and green at the center of the raster using the BLU VERT POS control and BLU HOR POS control.

14. Using the VERTICAL BLUE, SIZE and LINEARITY controls, converge the blue horizontal lines with the red and green horizontal lines from top to bottom, along the vertical centerline. Readjust the BLUE VERT POS control if necessary.

15. Using the BLUE, RIGHT SIDE TILT control, converge the blue horizontal lines at the right side of the raster.

16. Using the BLUE, LEFT SIDE TILT control, converge the horizontal blue lines on the left side of the raster with the red and green horizontal lines.

This completes the normal size display convergence procedure. If optimum convergence is in doubt, it is suggested that steps 6 through 16 be repeated to obtain improved convergence, since normal scan convergence must be correct before proceeding with the Underscan Convergence which follows.

*Under Size Convergence Adjustments*

1. Turn SCRN SEL to RG and SIZE switch to UNDER. (Maintain focus.)

2. Using the UNDERSCAN R-G VERT POS control, converge the red and green horizontal lines at the center of the raster

3. Using the UNDERSCAN R-G HOR POS control, converge the red and green vertical lines at the center of the raster.

4. Turn the SCR SEL to RGB.

5. Using the UNDERSCAN, BLUE VERT POS control, converge the blue in the center of the screen. A slight readjustment of the UNDERSCAN R-G POS controls may be necessary.

6. Adjust the UNDERSCAN HOR AMP control for optimum RGB convergence over the entire raster.

7. When switching from UNDERSCAN to NORMAL SCAN or vice versa, proper convergence tracking should be sustained.

## Gray Scale and Color Balance

*Test Switch Operation*

1. Connect a composite colorplexed color bar signal with sync to the video input. Place the SCRN SEL to R and the SIZE switch to NORM.

2. RED SCREEN TEST (Position 1): No longer used.

3. SCREEN BAL (Position 2):

a. Turn the SCRN SEL switch to R. Depress the VERT COLLAPSE switch and adjust the RED SCRN control to raster cutoff.

b. Turn the SCRN SEL switch to G. Depress the VERT COLLAPSE switch and adjust the GRN SCRN control to raster cutoff.

c. Turn the SCRN SEL switch to B. Depress the VERT COLLAPSE switch and adjust the BLU SCRN control to raster cutoff.

4. MONOCHROME (Position 3): Adjust the BRIGHTNESS and CONTRAST controls for normal picture viewing. Then adjust the GRN and BLU GAIN controls for proper black to white gray scale tracking.

5. UNITY CHROMA (Position 4): Place the SCRN SEL to B. Adjust the PHASE control for blue bars of equal intensity. Adjust the BRIGHTNESS control until the area between the blue bars is just cut off. Select the red and green screens and check that the bar patterns displayed are correct. Then place the SCRN SEL to RGB to view the complete color bar pattern.

6. VARIABLE CHROMA (Position 5): Vary the CHROMA GAIN control to change the chroma above and below the level of that obtained with the Test Switch in position 4 (Unity Chroma).

7. Return the Test Switch to UNITY CHROMA (Position 4). This position is the standard for viewing color presentations and, as such, is normally used during program operation.

*Hor Hold Control*

1. The presentation should remain in sync while varying the HOR HOLD control through its full range.

NOTE: If loss of sync occurs, refer to the Deflection alignment and readjust the HOR HOLD control according to the instructions outlined in the Horizontal Deflection Procedure.

*Tally Light and Panel Light Operation*

1. Apply 24 volts d-c between pin 1 and pin 3 of 2J10, on the Decoder Chassis, to energize the tally light relay to change the tally lights from "Standby" (White) to "On Air" (Red).

2. The control panel lights are turned on by opening the control panel door, which in turn operates a micro-switch to close the panel light circuit.

*Remote and External Sync Operation*

1. Turn the SYNC SEL switch to REM to cause loss of sync, then ground pin 2 of 2J10, on the Decoder chassis, to restore sync.

2. Return the SYNC SEL switch to INT.

3. Connect a sync signal to the EXT SYNC jack and place the SYNC SEL switch to EXT. The Monitor should remain in sync.

*Monoscope Resolution and Picture Appearance*

1. Connect a monoscope picture to the video input and a source of separate sync to EXT SYNC input. Turn the SYNC SEL switch to EXT and the SIZE switch to NORM.

2. Turn the TEST switch to CHROMA UNITY. Adjust the BRIGHTNESS and CONTRAST controls for a picture of normal intensity.

3. The horizontal and vertical resolution should be at least 380 lines in the center of the raster.

NOTE: If the picture does not switch to wide band operation, refer to the Decoder Alignment and follow the instructions outlined in steps 43 through 45 for adjusting the color killer control.

4. Disconnect the monoscope picture signal from the video input.

*Color Picture and Bar Appearance*

1. Connect a composite color bar signal to the video input, and place the SYNC SEL switch to INT.

2. Check that the color bars are correct. If not, readjust according to the TEST SWITCH OPERATION previously outlined.

3. Turn the CONTRAST control through its range and observe that there is constancy of color phase. Reset for normal presentation, taking care not to overdrive.

NOTE: If proper tracking is not obtained, refer to the Decoder Alignment, Sweep and Video Procedure, and make the adjustments as instructed in steps 36 through 43.

# OPERATION

The RCA TM-21D Color Monitor requires no operation in the sense that "riding" gain controls or making frequent adjustments to levels is necessary. After the Monitor Setup has been completed, and with signal and power applied, it is only necessary to adjust the BRIGHTNESS and CONTRAST controls for the desired level and to place the TEST switch to CHROMA UNITY.

Video, Sync, Tally-Light and Sync Interlock and 117 v, a-c, inputs are on the side of the Decoder facing the back of the Monitor.

If desired, a rapid check of the various Monitor adjustments may be made by following the procedure on the Instruction Card, which is attached to the inside of the control cover panel.

# KINESCOPE

### Cleaning Kinescope Face Plate

To clean the kinescope face plate proceed as follows:

1. Use a soft, clean, lint-free cloth to wipe off any accumulation of dust or dirt from the kinescope face plate.

### Replacement and Installation of Kinescope and Associated Components

*CAUTION: Use extreme care at all times in handling the kinescope or when positioning or placing associated components about the neck of the kinescope. Never apply more than finger pressure, nor use any sidewise or up and down force to adjust or replace accessories on the kinescope neck. Protective goggles should be worn by personnel handling the kinescope.*

*Kinescope Installation*

1. Turn the monitor POWER OFF and disconnect the a-c line cord.

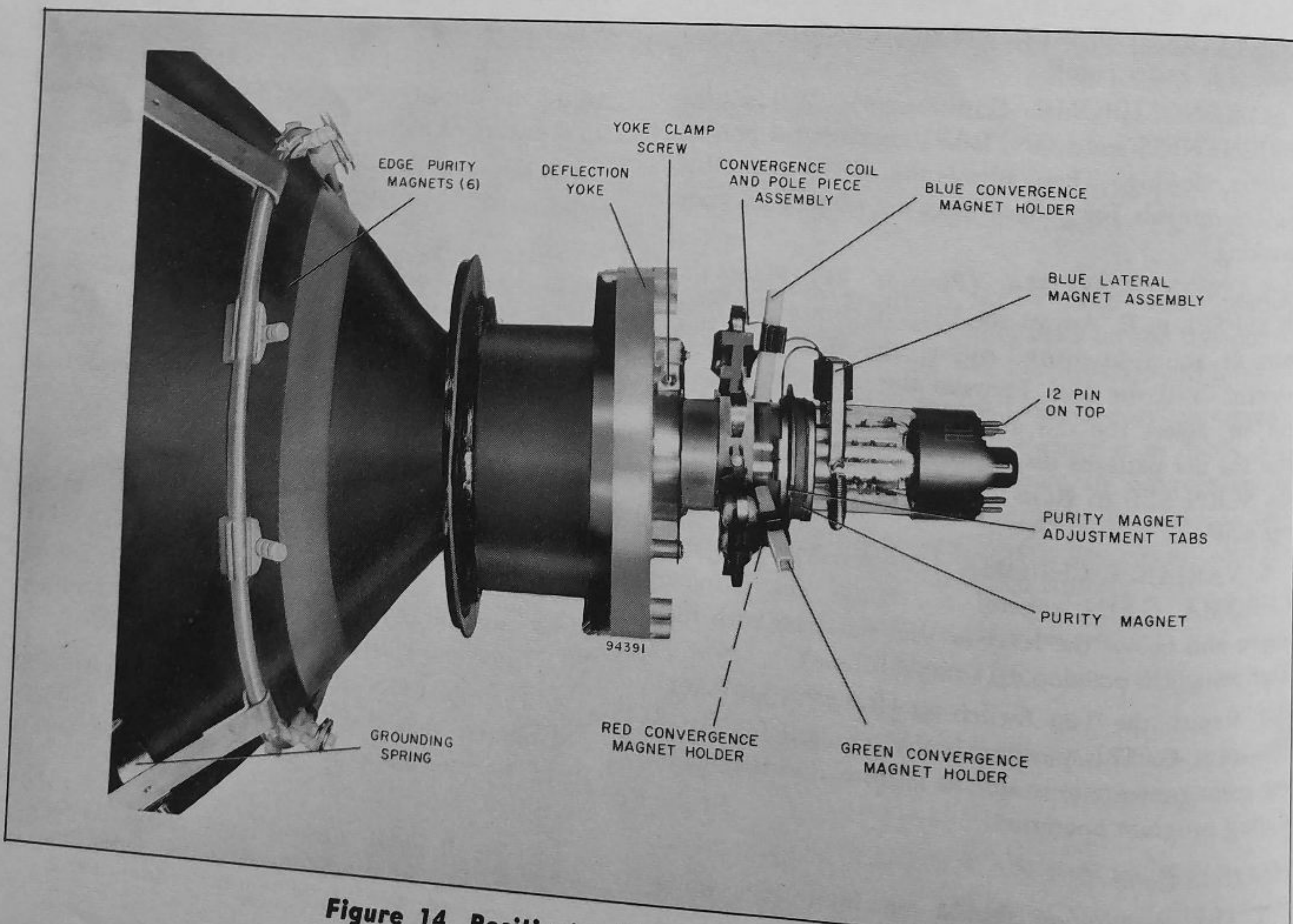



**Figure 14. Positioning Kinescope Accessories**

2. Remove the top cover panel by unfastening the camlock screws located on top corners of the cover, and the back cover panel by loosening the camlock fastener located in each corner of the cover.

3. Remove the kinescope socket, the R, G, and B gun leads from the 3 Channel Video Amplifier chassis, the deflection yoke plug from the Deflection and HV chassis, the convergence yoke plug and the blue lateral magnet plug from the Convergence chassis.

4. Loosen the deflection yoke clamp screw (see Figure 14) and then remove all the accessories from the neck of the kinescope.

5. Remove the bezel framing the kinescope by loosening the camlock fastener located in each corner on the bottom front of the bezel, and then lift the bezel upward and outward to free it at the top of the frame.

6. Remove the three screws in each of the upper right and left corners of the frame (two screws are on the top of the frame and one is in the front) and the two screws that are on each side of the front panel near the center. Now lower the loosened kinescope section of the front frame to the limit of its anchor chains. (See Figure 15.)

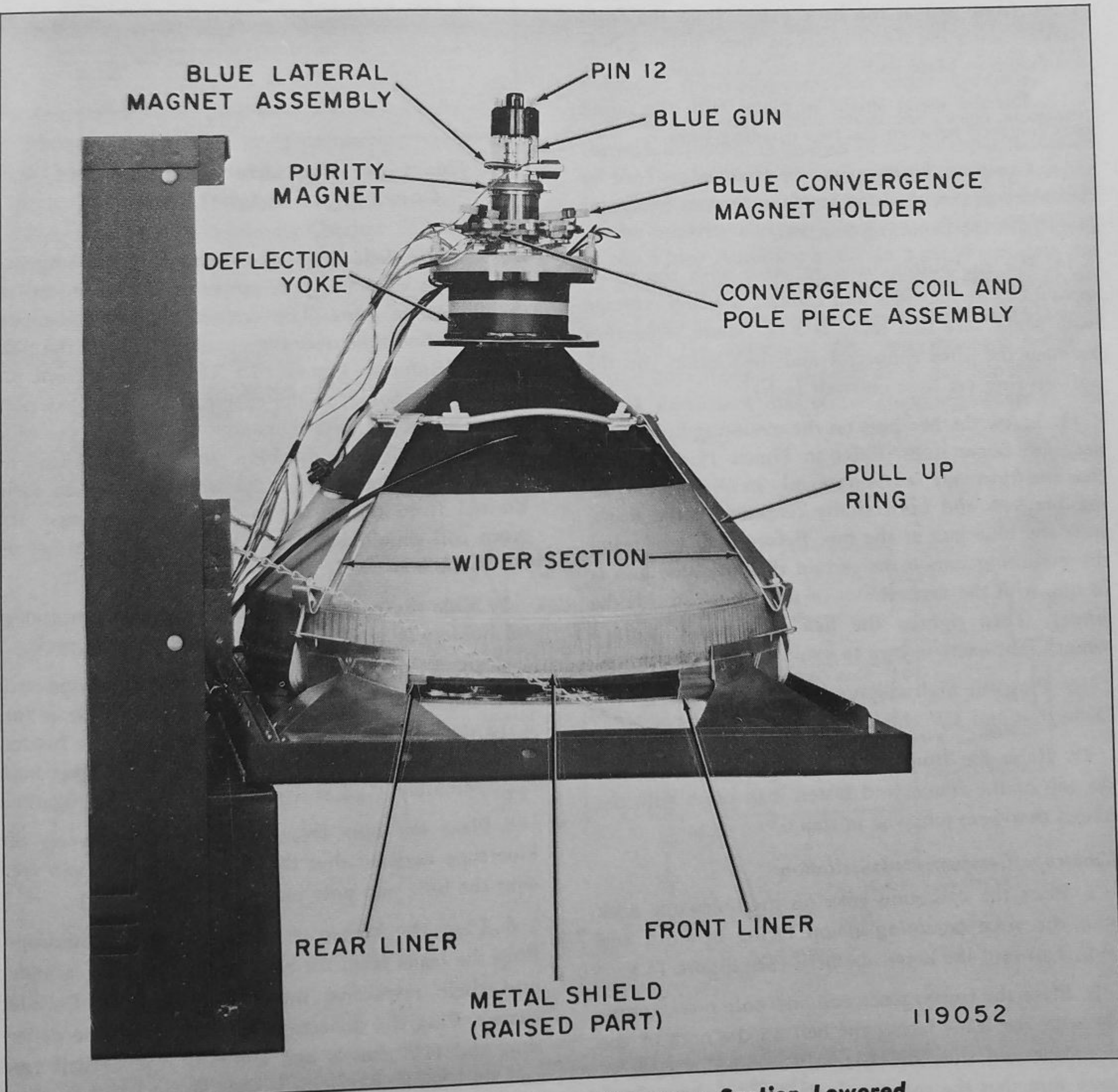



**Figure 15. Front Quarter View, Kinescope Section Lowered**

7. Remove the high voltage anode lead from the Deflection and HV chassis.

8. Remove the four hex nuts from the bolts holding the pull up ring assembly to the kinescope mounting brackets, see Figure 15, and lift the pull up ring assembly off the kinescope.

9. Lift the kinescope from the mounting brackets and place it on a soft, padded surface.

10. Remove the metal shield and shield liners from the bell of the kinescope. Disconnect the high voltage lead from the kinescope.

11. With the blue gun, at the top of the kinescope, in front (pin 12, see Figure 15) mark the kinescope at the front and at the back (180° from the front mark). Center the shield liners on these dividing lines and fasten in place with black electrical tape.

12. Put the metal shield in place, with the raised part centered between the two dividing lines.

13. Grasp the kinescope at the front edges (not by the neck) so that the blue gun is at the top front and place it in the mounting brackets.

14. Put the pull-up ring in place with the wider separations at the sides and connect the high voltage lead. Make sure that there is a maximum separation between the ultor connector and the "bump" on the pull-up ring (at least one-half inch).

15. Screw the hex nuts on the mounting bolts until they are finger tight. Refer to Figure 15 and check that the kinescope is resting firmly in all four mounting brackets and horizontally centered in the mask, with the blue gun at the top. Before finally securing the mounting nuts make certain that the blue gun is in line with the vertical axis of the tube (towards the front). Then tighten the hex nuts firmly with a wrench, but exercise care to avoid excessive tightness.

16. Plug the high voltage lead into its jack on the Deflection and HV chassis.

17. Raise the front panel, closing it securely over the top of the frame, and fasten it in place with the screws that were removed in step 6.

*Kinescope Components Installation*

1. Place the deflection yoke on the kinescope neck with the yoke mounting clamp facing upward, and slide it toward the kinescope bell. (See Figure 14.)

2. Place the convergence coil and pole piece assembly with the leads facing the bell on the neck of the kinescope and slide the assembly forward. Check to make sure that the coil terminals do not short to the

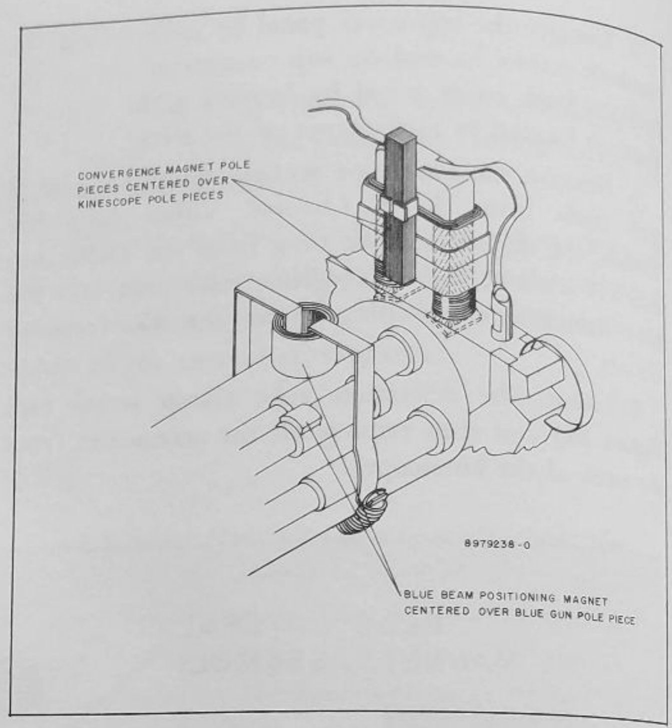



**Figure 16. Blue Lateral Magnet and Convergence Magnet Locations**

back of the deflection yoke. Center the convergence pole pieces over the pole pieces in the front end of the kinescope guns. The opening between the two magnets should be over the opening between the pole pieces. (Refer to Figure 16.) The distance from the convergence holder to the center of the blue gun pole piece should be approximately 1⅜", with the blue coil positioned over the blue gun. The coils may be identified by the color of the wires fastened to each. Viewed from the socket end of the kinescope, the green coil should be on the left and the red coil on the right.

3. Slide the red, green, and blue convergence magnet holders in until they touch the kinescope neck.

4. Place the purity magnet over the kinescope neck with the small tabs facing the bell, and slide it forward until it touches the center convergence holder. (See Figure 14.) Then slide the purity magnet back approximately 1/16" and move the red tabs together.

5 Place the blue lateral magnet assembly on the kinescope neck so that the magnet's pole is centered over the blue gun pole piece. (See Figure 16.)

6. Plug the kinescope socket into the kinescope. Plug the leads from the red, green, and blue cathodes into their respective input jacks on the Decoder chassis. Plug the deflection yoke lead into the deflection and HV chassis and the convergence coil lead and the blue lateral magnet lead into the Convergence chassis.

# ALIGNMENT

The TM-21D Color Monitor is completely aligned at the factory and requires no further adjustments of this nature before operating. However, complete alignment procedures are given should it become necessary to replace components affecting alignment. Normally, alignment of the stage or band pass circuit in which the component has been replaced will suffice.

## 3 Channel Video Amplifier Alignment

NOTE: Two alignment procedures follow. The first method is the preferred; the second method may be used when no horizontal drive signal is available. The test equipment used is the same for both. Figures 17 and 18 are block diagrams showing the test equipment setup for each alignment procedure.

*Recommended Test Equipment and Accessories*

Tektronix Type 524-D Oscilloscope with low capacity probe

RCA Type WA-21B Video Sweep Generator

RCA Type WA-7C Linearity Checker

1000 ohm, ½ w resistor

75 ohm terminations, 2

Clip leads, short length

*Procedure (Preferred Method)*

1. Connect horizontal drive to the linearity checker and to the EXT SYNC jack 2J11-2J12 on the Decoder Chassis.

2. Turn the SYNC SEL switch, on the control panel of the monitor, to EXT and if necessary "lock in" the raster with the HOR HOLD control.

3. Adjust the linearity checker and the video sweep generator for gated sweep output with no sync or blanking.

4. Remove the GREEN, BLUE, and RED output plugs to the kinescope. Remove 2V11 and 2V16 in the Decoder.

5. Connect the GREEN, BLUE and RED input terminals of the video amplifier together, using short leads.

6. Terminate the video output of the linearity checker with 75 ohms, then connect the gated sweep output to the Video Amplifier input terminals.

7. Connect the marker from the sweep generator through a 1000 ohm resistor to the r-f input terminals of the linearity checker. Connect the sweep output from the sweep generator to the r-f input terminal of the linearity checker. Check that the sweep signal to the Video Amplifier is flat to 8 mc. Terminate the r-f input terminal of the linearity checker in 75 ohms.

8. Connect the scope with probe to the RED output jack, 1J5 and adjust the sweep envelope for 40 v +0 −20 volts peak-to-peak at .5 mc. Set the scope on d-c and check that center clamping occurs at 180 volts.

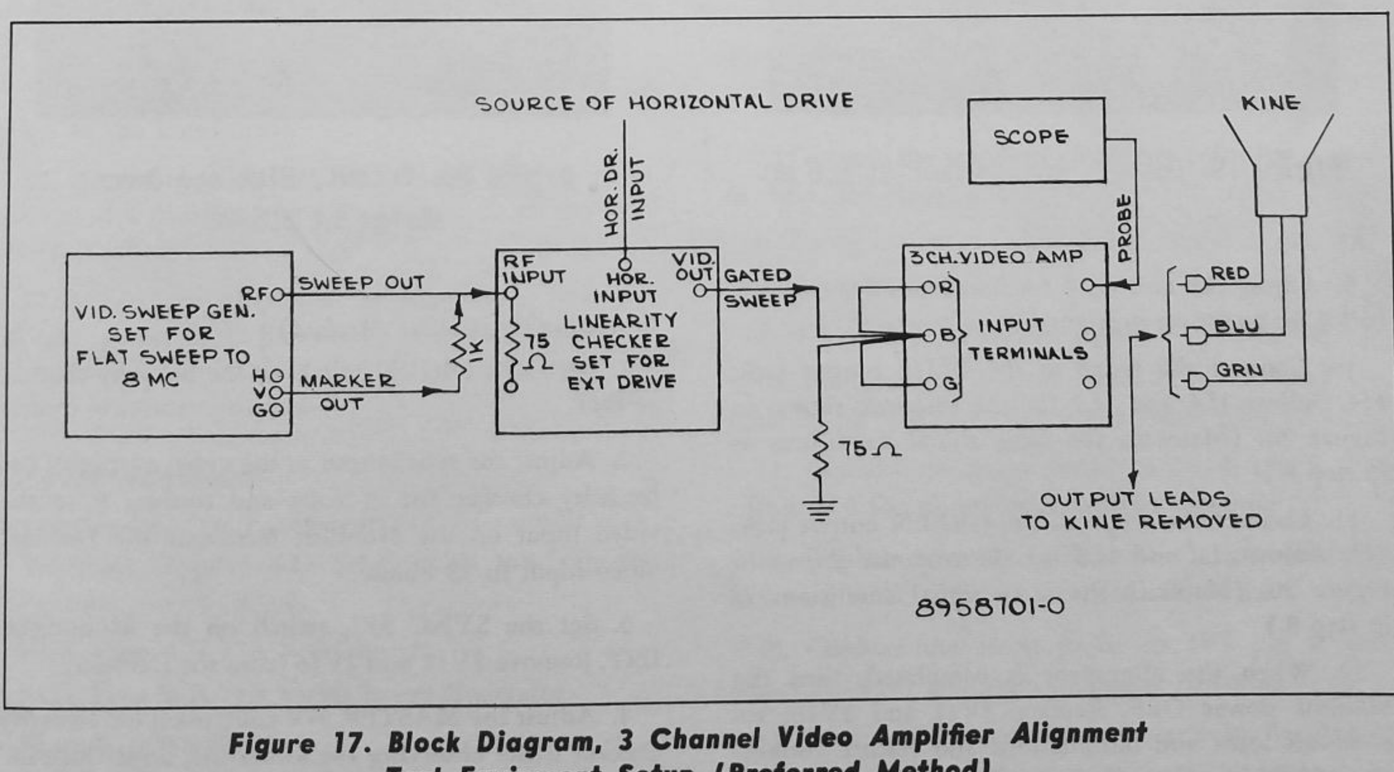



**Figure 17. Block Diagram, 3 Channel Video Amplifier Alignment Test Equipment Setup (Preferred Method)**

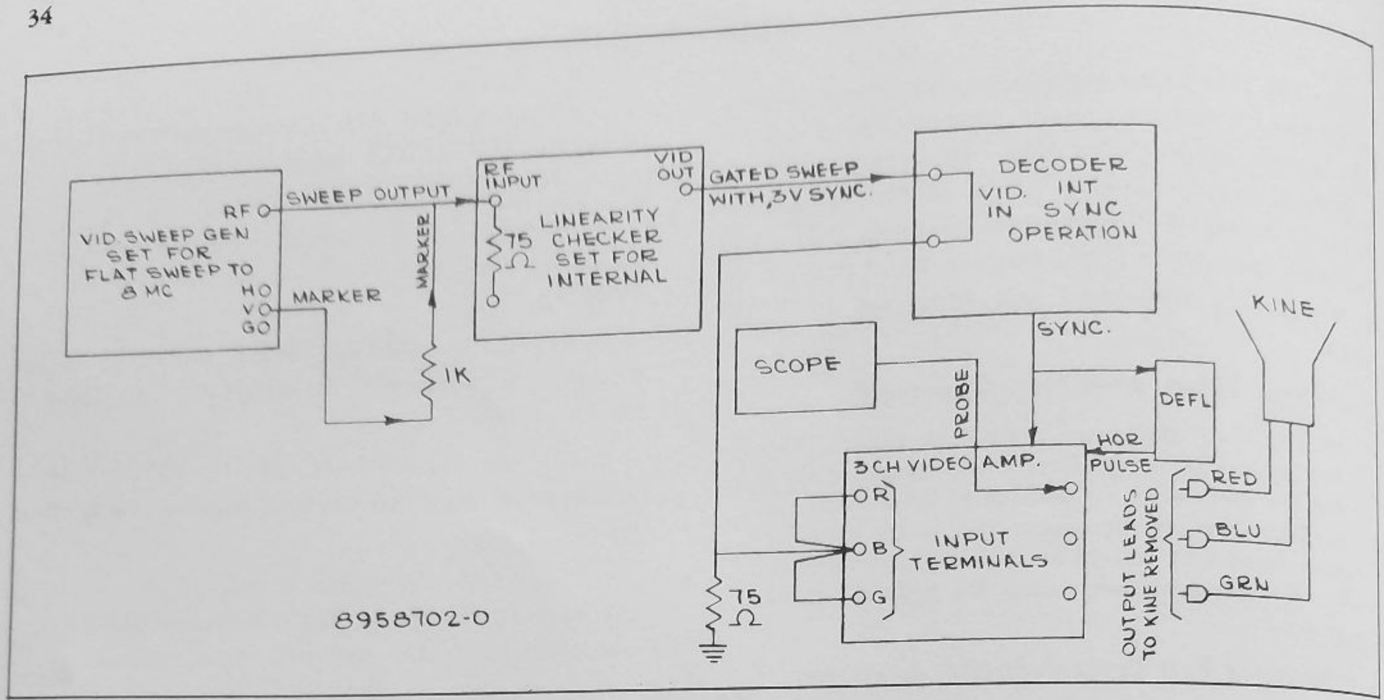



**Figure 18. Block Diagram, 3 Channel Video Amplifier Alignment Test Equipment Setup (Alternate Method)**

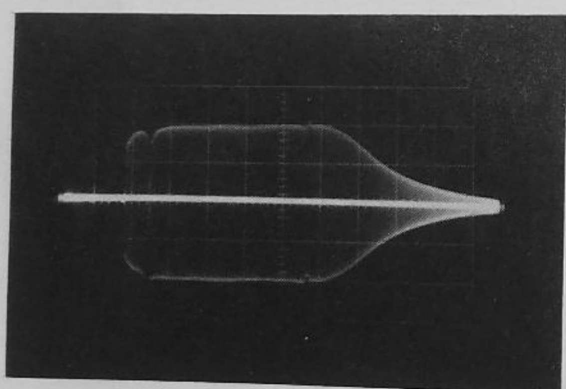


Figure 19. Output, Red, Marker at 5.5 MC

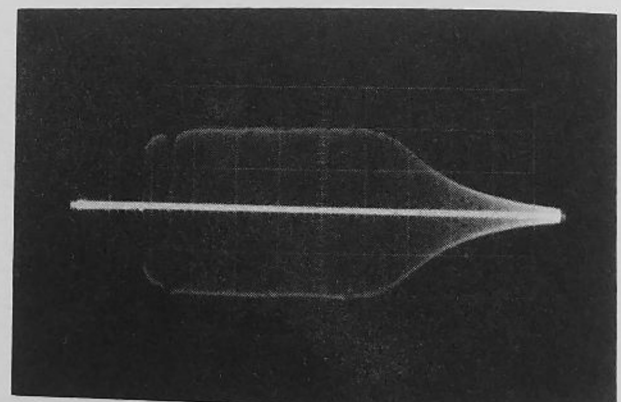


Figure 20. Output, Blue and Green, Marker at 5.5 MC

9. Adjust 1L9 and 1L10 for maximum flat response to 5.5 mc as shown in Figure 19.

10. Connect the scope to the BLUE output jack, 1J4. Adjust 1L6 and 1L7 for the response shown in Figure 20. (Maintain the same signal conditions as in step 8.)

11. Connect the scope to the GREEN output jack, 1J3. Adjust 1L2 and 1L3 for the response shown in Figure 20. (Maintain the same signal conditions as in step 8.)

12. When the alignment is completed, turn the Monitor power OFF. Replace 2V11 and 2V16; remove all leads and terminations and restore connections for normal monitor operation.

*Procedure (Alternate Method)*

1. Set HOR DRIVE switch on the linearity checker at INT.

2. Adjust the sync output at the video output of the linearity checker for .3 volts and connect it to the video input on the Monitor; terminate the Decoder video input in 75 ohms.

3. Set the SYNC SEL switch on the Monitor at INT. Remove 2V11 and 2V16 from the Decoder.

4. Adjust the MASTER MV control on the linearity checker while observing the kinescope, until "lock-in" is obtained.

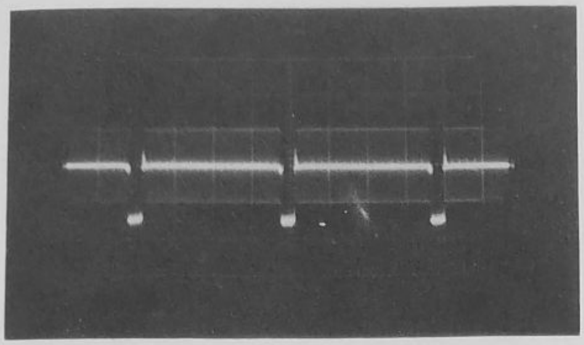


Figure 21. Output, Linearity Checker, 4V Sweep P-P, .3V Sync. Horizontal Sweep Rate

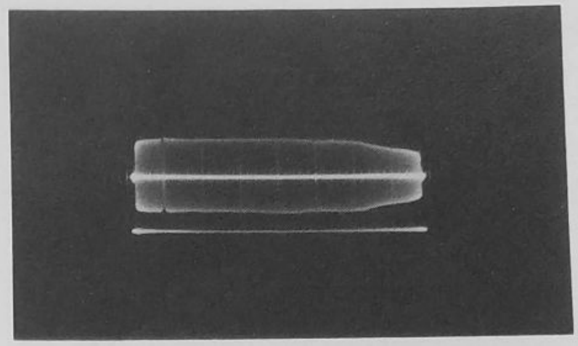


Figure 22. Output, Linearity Checker, .3V Sync. Marker at 8 mc. 60 Cycle Sweep Rate

5. Set the linearity checker for gated sweep output. The gated sweep output will now contain sync, as shown in Figures 21 and 22.

6. Connect the GREEN, BLUE, and RED input terminals on the Video Amplifier together, using short leads.

7. Remove the 75 ohm termination from the Decoder video input.

8. Bridge the output of the linearity checker through the Decoder video input and from the Decoder, using coaxial cable, to the Video Amplifier. Terminate the Video Amplifier terminals in 75 ohms.

9. Connect the marker from the video sweep generator, through a 1K resistor to the r-f input of the linearity checker. Terminate with 75 ohms. Check that the sweep signal to the Video Amplifier is flat to 8 mc. (See Figure 22.)

10. Remove the GREEN, BLUE, and RED output plugs to the kinescope.

11. Adjust the GREEN, BLUE, and RED peaking coils as described in steps 9 through 11 of the Preferred Method.

12. When the alignment is completed, turn the Monitor power OFF. Replace 2V11 and 2V16, remove all leads and terminations and restore connections for normal Monitor operation.

## Decoder Alignment

*Recommended Test Equipment and Accessories*

Tektronix Type 524-D Scope with low capacity probe

RCA Type WV-97A VoltOhmyst

RCA Type WA-21B Video Sweep Generator

75 ohm termination

Dummy 6BQ7A (one heater pin removed)

100 ohm ½ watt resistor, ½ meg resistor, clip leads

Source of standard composite color bar signal

*Sweep and Video Procedure*

1. Turn the monitor power OFF.

2. Short crystal 2Y1 to ground. Ground the junction of 2R53 and 2R75 (located at 2V5 grid). Connect a ½ meg resistor from the junction of 2C30 and 2R62 to ground. Ground 2C34 on the side connected to relay 2K1.

3. Remove 2CR6 and replace with a 100 ohm ½ watt resistor (short leads). Remove 2V8 and replace with dummy 6BQ7A.

4. Place TEST switch in CHROMA UNITY, position 4. Place SYNC SEL switch in EXT.

5. Turn the APERT GAIN control fully CCW. Turn 2C22 to maximum capacity.

6. Turn the Monitor power ON.

7. Connect the standard composite color bar signal to the video input jack, 2J13.

8. Using a low capacity probe on the scope, connect the scope probe to 2V14, pin 1.

9. Adjust 2L8 for minimum subcarrier response.

10. Remove the ground from 2C34. Ground the junction of 2L9 and 2R67 and remove relay 2K1.

11. Connect the scope probe to 2V14, pin 6, and adjust 2L9 for minimum subcarrier response

12. Replace relay 2K1. Remove the ground from 2L9 and 2R67. Ground pin 6 of relay 2K2.

13. Connect the scope probe to 2V5 pin 1, and adjust 2L10 for minimum subcarrier response.

14. Remove the standard composite color bar signal. Connect the sweep generator, properly terminated, to

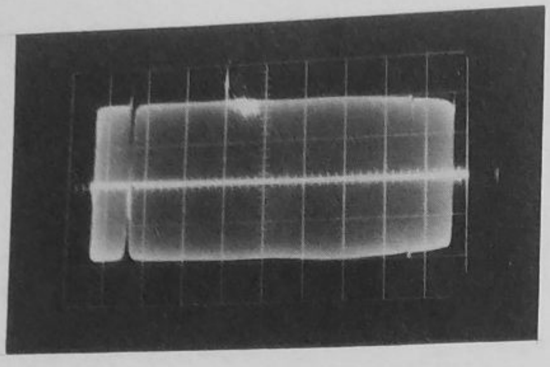


Figure 23. Input at Junction of 2R60,2R62,and 2R63. Output at 2V14, Pin1. Marker on 6 mc.

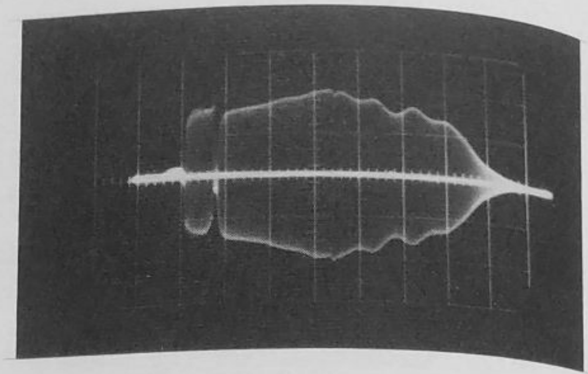


Figure 26. Input, Video Input 2J13. Output at Junction of 2R134,2R135, and 2R136. Marker on 2.5 mc.

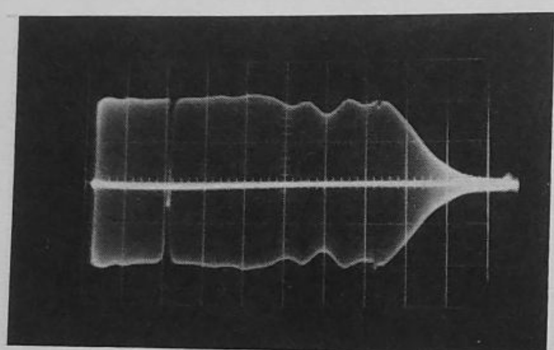


Figure 24. Input at Junction of 2R60,2R62, and 2R63. Output at Junction of 2R134,2R135, and 2R136. Marker on 5 mc.

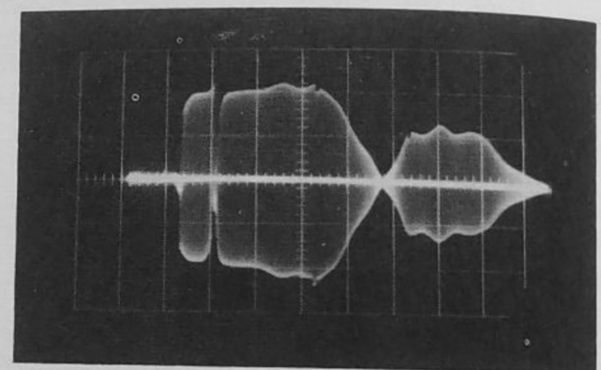


Figure 27. Input, Video Input 2J13. Output at Junction of 2R134,2R135, and 2R136. Marker on 2 mc.

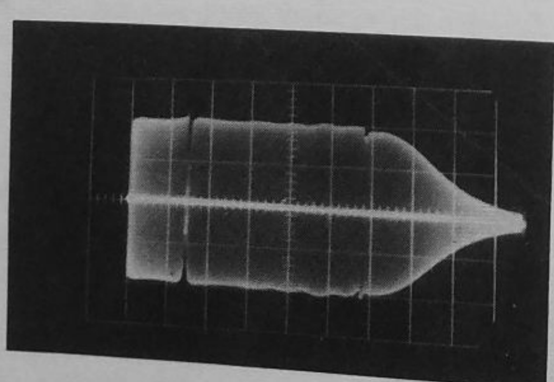


Figure 25. Input, Video Input 2J13. Output, 2V14, Pin 1. Marker on 6 mc.

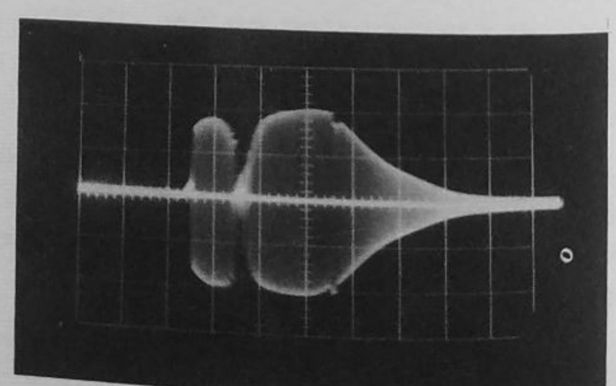


Figure 28. Input, 2V15, Pin 1. Output, 2V6, Pin 8. Marker on .5 mc.

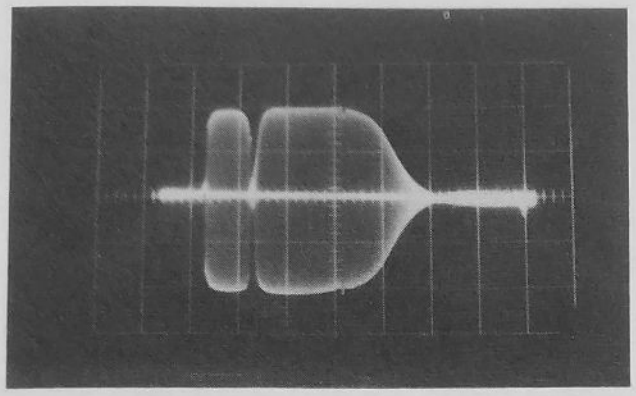


Figure 29. Input, 2V20, Pin 1. Output, 2V11, Pin 3. Marker on 1.25 mc.

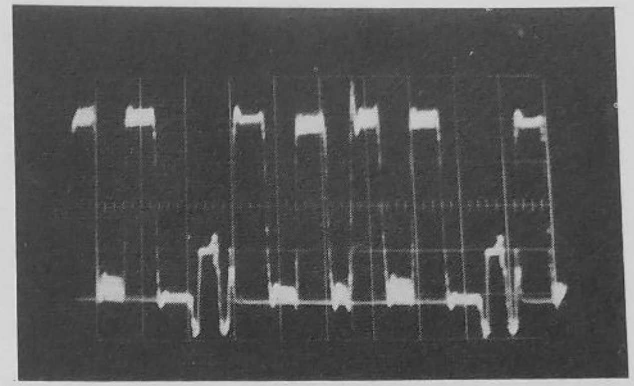


Figure 31. Input, Video Input 2J13. Output Blue Output, 0.6V B-W. Set Brightness control at 1/3 rotation.

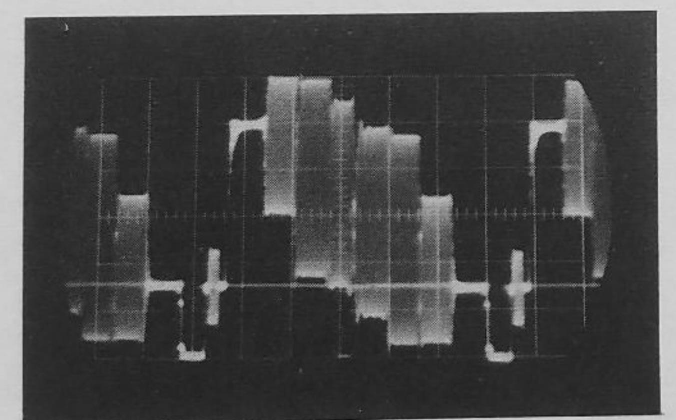


Figure 30. Input, Video Input 2J13,0.7V B-W. Output, Video Input 2J13.

the junction of 2R60, 2R62 and 2R63. Remove the ground from pin 6 of 2K2.

15. Turn the color killer control, 2R27, full CCW. (Directional rotation of 2R27 is viewed from tube side of chassis.)

16. Connect the scope probe to 2V14, pin 1. Adjust the sweep generator output for approximately 0.5 v at 2V14, pin 1. Set the marker on 6 mc. If necessary, readjust 2L8 and 2L9 for a flat response with reference to 1 mc response. (See Figure 23.)

17. Connect the scope probe to the junction of 2R134, 2R135, and 2R136.

18. Adjust the sweep generator output to obtain approximately 1 volt. Set the marker on 5 mc.

19. Adjust 2L14 for the response shown in Figure 24.

NOTE: Ringing observed is due to delay line characteristics.

20. Connect the sweep generator output to the video input jack, 2J13 and set the marker on 6 mc. Set the scope probe on 2V14, pin 1. Set the CONTRAST control to mid-range position.

21. Adjust 2C103 for a flat response to 5 mc. (See Figure 25.)

22. Turn the TEST switch to CHROMA VAR, position 5. Vary the CHROMA GAIN control. This should cause the high frequency response to vary above and below that shown in Figure 25.

23. Turn the TEST switch to CHROMA UNITY, position 4. Connect scope probe to junction of 2R134, 2R135, and 2R136. Set the marker on 2.5 mc. Remove the ground from 2R53 and 2R75. The overall luminance channel response will be as shown in Figure 26. Adjust 2C22 to obtain approximately 160% response at 2.5 mc.

24. Turn the TEST switch to MONO, position 3. Turn the color killer control, 2R27, fully CW and set the marker on 2 mc.

25. The response will be narrow band as shown in Figure 27. (Notch at 3.58 mc.)

26. Connect the sweep generator output to 2V15, pin 1. Set the marker on 0.5 mc. Connect the scope probe to 2V6, pin 8.

27. The response should be as shown in Figure 28.

28. Connect the sweep generator output to 2V20, pin 1. Set the marker on 1.25 mc. Connect the scope probe to 2V11, pin 3.

29. Adjust 2L17 and 2L18 to obtain a flat response to 1.25 mc as shown in Figure 29.

30. Turn the TEST switch to MONO, position 3. Turn the color killer control, 2R27, fully CW. Turn the SYNC SEL switch to EXT.

31. Turn the Monitor power OFF.

32. Remove the 100 ohm resistor and replace diode 2CR6. Remove the dummy 2V8 and replace with a 6BQ7A. Remove the ½ meg resistor from the junction of 2C30 and 2C62 and the short from crystal 2Y1.

33. Turn the TEST switch to CHROMA UNITY, position 4. Set the CONTRAST and PHASE controls at mid-range.

34. Turn the Monitor power ON.

35. Apply a 0.7 v, black to white composite color bar signal to the video input. Place PHASE control in mid-range. Place TEST switch to CHROMA VAR, position 5. (See Figure 30.)

36. Connect the scope probe to the blue output. Adjust the CONTRAST control to obtain 0.6 v black to white output.

37. Adjust the PHASE and CHROMA GAIN controls to obtain a proper blue bar pattern. (See Figure 31.)

38. Turn the TEST switch to CHROMA UNITY, position 4. If the pattern slopes up or down, adjust 2C103 slightly to eliminate the slope.

39. Check Phase tracking by varying the CONTRAST control to change the blue output from 0.2 volt P-P to 0.6 volt P-P. If mis-tracking occurs, the *Burst Control Oscillator Adjustment* must be made.

40. Connect the scope probe to the red output. This pattern should be the same as shown in Figure 32.

41. Connect the scope probe to the green output. This pattern should be the same as shown in Figure 33.

42. Turn the TEST switch to CHROMA VAR, position 5. Connect the scope probe to the blue output. The slope of the blue bars will now be controlled by the CHROMA GAIN control.

43. Turn the TEST switch to MONO, position 3. Reduce the burst amplitude output of the Colorplexer to ¼ of normal amplitude. Connect the scope probe to the red output.

44. While varying the CONTRAST control, adjust the color killer control, 2R27, so that relay 2K2 switches to wide band operation (wide band is recognizable when the subcarrier bursts come through) as the signal amplitude falls below 0.6 volt. (See Figure 34.)

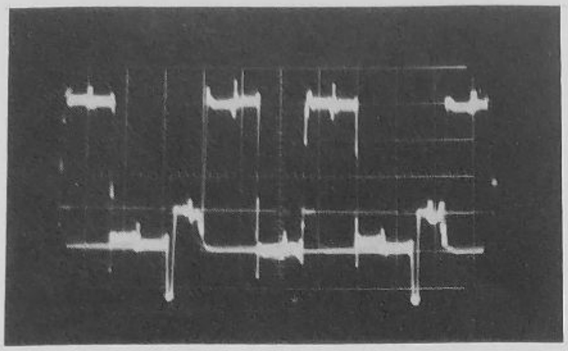


Figure 32. Input, Video Input 2J13. Output, Red Output. Set Brightness Control at 1/3 Rotation.

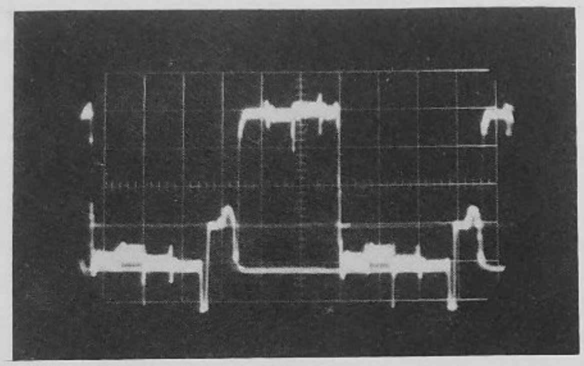


Figure 33. Input, Video Input 2J13. Output, Green Output. Set Brightness Control at 1/3 Rotation.

45. Increasing the CONTRAST control from 0.5 volt output will cause 2K2 to switch to color at approximately 0.65 volt to 0.8 volt output, with no subcarrier bursts present.

*Burst Control Oscillator Adjustment*

NOTE: Following this adjustment, the color killer control, 2R27, should be reset according to the procedure outlined in steps 43 and 45 of Decoder Alignment, Sweep and Video Procedure.

1. Short crystal 2Y1 to ground. Turn the COLOR KILLER control, 2R27, fully CW. Place SYNC SEL switch to INT and the PHASE control in midrange.

2. Apply the standard colorplexed color bar signal to the video input, 2J13. Check that the burst is 1 to 2 cycles from the trailing edge of the sync on the standard colorplexed signal. Turn the BLU GAIN control fully CW and adjust the CONTRAST control to obtain 0.6 volt at the BLU output.

3. Connect the scope probe to 2V1, pin 5. Turn the core stud of 2L5 out approximately ½ inch.

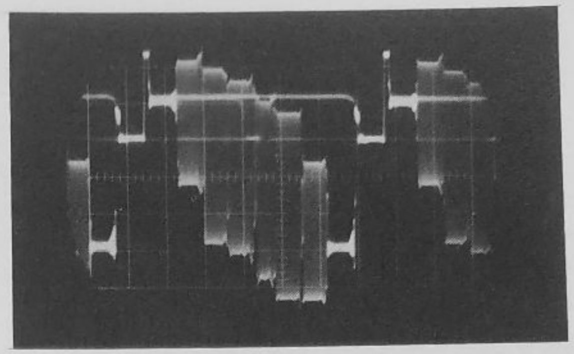


Figure 34. Input, Video Input 2J13. Output, Red Output, 0.7V B-W with Killer Fully CCW. Set Brightness Control at 1/3 Rotation.

4. Turn 2Z1 core all the way out and then turn it CW for maximum burst signal.

5. Connect the scope probe to 2V19, pin 1, and adjust 2L5 for minimum subcarrier on the pulse observed.

6. Connect the voltohmyst to the arm of the balance pot, 2R23, and adjust the pot for zero voltage.

7. Remove the short from the crystal 2Y1. Connect the scope probe to 2V9, pin 7, and adjust 2Z3 for 15 volts; then reduce the voltage to approximately 5 volts P-P.

8. Ground the junction of 2L1, and 2R32, and connect the scope probe to the red output.

9. Adjust 2Z2 for minimum "crankshaft" motion (zero beat).

NOTE: Other patterns may be obtained, but the correct one has a distinctive "crankshaft" appearance.

10. Connect the scope probe to 2V9, pin 7, and adjust 2Z3 for approximately 5.0 volts P-P. If necessary, readjust 2Z2 for minimum crankshaft motion. Maintain 5.0 volts P-P at pin 7 of 2V9.

11. Connect the scope probe to the junction of 2R102 and 2R110 (or D of 2T3), and adjust 2C71 for maximum amplitude. Recheck that the voltage at pin 7 of 2V9 is still 5.0 volts P-P.

12. Remove the ground from 2L1, 2R32. "Lock-in" should occur. Short the crystal momentarily and note that recovery is positive.

13. Connect the scope probe to the blue output. Adjust 2Z1 for proper blue bars (Figure 31). Repeat step 39 of the Sweep and Video Procedure.

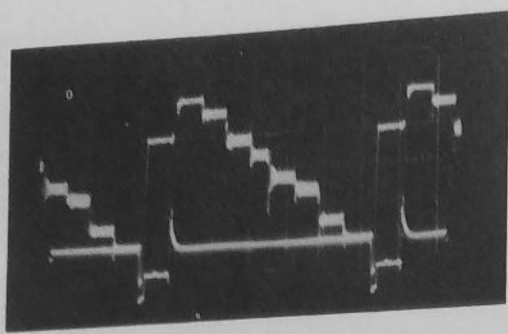


Figure 35. Input, Video Input 2J13. Output, Red Output, 0.7V B-W Variable Brightness Pulse.

*Decoder Operation Test*

1. Apply a 0.7 volt white, 0.3 volt sync, 0.3 volt burst, colorplexed bar signal to the video input, 2J13.

2. Place TEST switch in SCRN BAL, position 2. Zero signal output should be obtained.

3. Place TEST switch in MONO, position 3. Use the low capacity probe on the scope and connect it to the red output. A colorplexed signal with subcarrier, burst, and sync signals removed, but with a brightness pulse present during blanking should be obtained. Adjust the CONTRAST control for a 0.7 volt black to white bar amplitude. Turn the BRIGHTNESS control through its range. This will cause the brightness pulse to vary in the positive and negative direction from black level. (See Figure 35.)

NOTE: Readjust 3L10 for minimum subcarrier on steps.

**Deflection and HV Alignment**

*Recommended Test Equipment and Accessories*

Tektronix Type 524-D Oscilloscope with low capacity probe

RCA Type WV-97A VoltOhmyst

RCA MI-21200-C1 Plate Current Meter

Electrostatic Voltmeter, 0-30 KV

Series network consisting of a 0.01 mfd 400 v capacitor and a 100 K ½ watt resistor

1500 ohm 100 W wire wound resistor, to be used in case the Power Supply goes out of regulation with 3V9 and 3V10 removed.

Short clip lead.

Source of standard sync signal.

*Horizontal Deflection and HV Procedure*

1. Turn the Monitor power OFF.

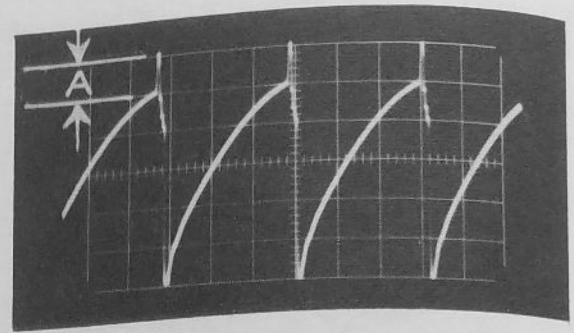



Figure 36. Output, 3V5, Pin 7, 37V P-P.

2. Turn the SIZE switch to NORM; turn the HOR HOLD the HOR CENT, and the HOR DRIVE (HOR DRIVE is located on Deflection and HV chassis) controls to midrange.

3. Turn the HOR FREQ, the HOR STAB, and the HOR LOCK-IN RANGE controls fully CCW; turn the HV ADJ control to midrange.

4. Remove the Horizontal Driver Tubes (6CD6) 3V9 and 3V10. Connect a short jumper across the HOR STAB (sine wave stab) coil, 3L2. Connect the 0.01 capacitor —100K resistor network from the "hot" side of the HOR DRIVE capacitor, 3C9B, to the "hot" side of the HOR LOCK-IN capacitor, 3C9A. Connect a jumper across the AC RESET switch. Connect the oscilloscope probe to pin 7 of 3V5. If necessary, for stable operation, connect the 1500-ohm 100-watt resistor from the tube cap of 3V9 to ground.

5. Turn the Monitor power ON and allow it 15 minutes to warm up.

6. Turn the SYNC SEL switch to EXT and apply a sync signal from an external source to the EXT SYNC input, 2J12, on the Decoder chassis.

7. Adjust the HOR FREQ coil, 3L1 for lock-in as shown in Figure 36. (Both 3L1 and 3L2 were sealed with glyptol in the final factory tests, so that it may be difficult to adjust these coils.) Disregard any spurious signal that might come from vertical serrations.

8. Connect the oscilloscope probe to the junction of 3L1, 3L2, and 3R12. Remove the jumper from the HOR STAB coil, 3L2, and then adjust the HOR STAB for a waveform such as shown in Figure 37.

9. Return the oscilloscope probe to pin 7 of 3V5. Refer to Figure 36 and turn the HOR FREQ coil, 3L1, adjustment CW for maximum amplitude of "A". If the 3L1 adjustment is turned too far clockwise, loss of lock-in will occur. If this happens, turn it CCW for lock-in and then CW again for maximum amplitude of "A".

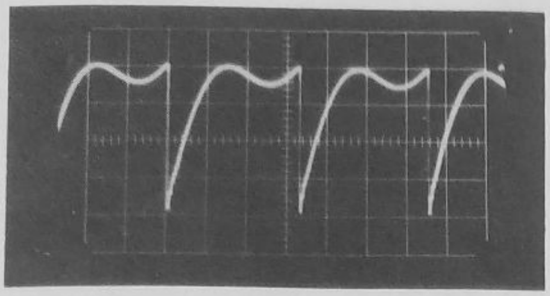


Figure 37. Output, at Junction of 3L1, 3L2, and 3R12, 120V P-P.

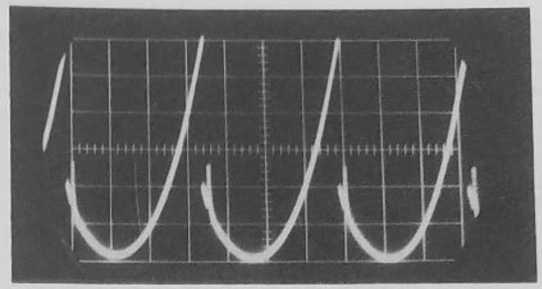


Figure 38. Output, 3V4, Pin 8, Approximately 7V P-P.

10. After "A" has been adjusted for maximum amplitude, reduce the amplitude 10 per cent by slowly rotating 3L1 adjustment CCW. Do not exceed 10 per cent.

11. Turn the Monitor power OFF.

12. Replace 3V9 and 3V10. Remove the capacitor-resistor network from 3C9 (A and B) and the jumper across the AC RESET switch. Also remove the 1500 ohm 100 watt resistor, if used.

13. Turn the Monitor power ON and allow it 10 minutes to warm up.

14. If necessary, lock-in with the HOR HOLD control, and then repeat the adjustments described in step 8.

15. Connect the VoltOhmyst to pin 3 of 3V9 or 3V10, and adjust the HOR TUNING coil, 3L5, for minimum DC voltage.

NOTE: Lock-in is to be maintained and the kinescope set at cut-off (turn down BRIGHTNESS control) throughout the remainder of this procedure.

16. Connect the oscilloscope probe to the junction of 3L1, 3L2, and 3R12. Turn the HOR DRIVE control fully CCW.

17. Insert the MI-21200-C1 meter into the HV REG CURRENT jack, 6J8. Set the HV ADJ control for a reading of 1.25 ma of regulator current. Then turn the HOR DRIVE control CW until the meter reads 1.2 ma, or until the HOR DRIVE control is at midrange, whichever condition occurs first. If necessary, readjust the HOR STAB coil, 3L2, according to the instructions in step 8; then readjust the HV ADJ control to obtain 1.2 ma.

18. Remove the oscilloscope probe. The regulator current will now increase to approximately 1.205 ma.

19. If an electrostatic voltmeter is used to check the high voltage level, a reading of 23KV + 2KV − 3KV should be obtained. The high voltage should then be adjusted to 23KV by the HIGH VOLTAGE ADJ (3R41) as indicated on the electrostatic voltmeter.

*Vertical Deflection Procedure*

1. Place the SIZE switch to UNDER.

2. Adjust the VERT HOLD control for "lock-in."

3. Set the VERT LIN controls (A and B) and the HEIGHT control for a normal, linear raster picture.

4. Place the SIZE switch to NORM and connect the scope probe to 3V4, pin 8. Figure 38 shows the correct waveform.

# MAINTENANCE

The RCA TM-21D Color Monitor is designed for long periods of continuous operation with a minimum of maintenance. Normal, routine station equipment inspection and maintenance will insure trouble-free operation of the Monitor.

Chassis that might require tube replacement from time to time are readily accessible from the rear of the Monitor. Virtually all components, along with tube pin sides of the tube sockets, are visible and within easy reach when the side cover panels are removed. This enables trouble shooting quickly and facilitates signal tracing or component replacement.

The Convergence chassis contains passive networks, therefore little or no servicing is required. However, should component replacement become necessary, the Convergence chassis may be removed from the Monitor by unfastening the two captive screws holding it to the front panel.

## TABLE 2. FUSE DATA

| *Fuse Symbol* | *Rating* | *Chassis* | *Location* |
|---|---|---|---|
| 1F1 | 1 Amp | 3 Channel Video Amp. | 117 v, ac, input to 1T1 primary |
| 2F1 | 1 Amp | Decoder | 117 v, ac, input to 2T2 primary |
| 3F1 | 2 Amp | Deflection and HV | 117 v, ac, input to 3T5 primary |
| 4F1 | 2 Amp | Power Supply | 117 v, ac, input to 4T2 primary |
| 4F2 | 8 Amp | Power Supply | 117 v, ac, input to 4T1 primary |
| 4F3 | 5 Amp | Power Supply | Input of rectifier 4CR1 |
| 4F4 | 2 Amp | Power Supply | Input of rectifier 4CR2 |
| 4F5 | 2 Amp | Power Supply | Input of rectifier 4CR3 |
| 4F6 | ½ Amp | Power Supply | Output of rectifier 4CR1 |
| 4F7 | ½ Amp | Power Supply | Output of rectifier 4CR2 |
| 4F8 | ½ Amp | Power Supply | Output of rectifier 4CR3 |
| 6F1 | 10 Amp | — | Monitor Control Panel, power line input |
| 6F2 | 10 Amp | — | Monitor Control Panel, power line input |
| 6F3 | 1.0 Amp | Filament Reg Chassis | Rear of Monitor on heat sink mounting chassis |

NOTE 1: The fuses in the Power Supply and the Monitor front panel are the neon glow tube type which will give immediate visual indication in the event a fuse blows.

NOTE 2: The convergence chassis does not require fuses.

## TABLE 3. DC VOLTAGES*
## 3 CHANNEL VIDEO AMPLIFIER TUBE SOCKETS

| *Tube* | *Type* | *Function* | *Pin Numbers* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1V1 | 6AU8 | Video Amplifier | 115 | 112 | 280 | 27 | 27 | 9.5 | 4 | 200 | 110 |
| 1V2 | 6BQ7A | Video Amplifier | 110 | −.03 | .8 | 27 | 27 | 110 | −.03 | .75 | 0 |
| 1V3 | 6AU8 | Video Amplifier | 125 | 123 | 280 | 27 | 27 | 9.5 | 4 | 200 | 123 |
| 1V4 | 6BQ7A | Video Amplifier | 115 | −.01 | .8 | 27 | 27 | 280 | 120 | 145 | 0 |
| 1V5 | 6AU8 | Video Amplifier | 110 | 110 | 280 | 27 | 27 | 9.5 | 3.7 | 200 | 110 |
| 1V6 | 6197 | Video Amplifier | .8 | −3.3 | 160 | 27 | 27 | 150 | 0 | 160 | −3.3 |
| 1V7 | 6197 | Video Amplifier | .75 | −3.8 | 160 | 27 | 27 | 150 | 0 | 160 | −3.8 |
| 1V8 | 6197 | Video Amplifier | .82 | −4 | 160 | 27 | 27 | 150 | 0 | 160 | −4 |
| 1V9 | 12AX7 | Error Detector and Pulse Rectifier | −3.3 | −3.3 | 11 | 27 | 27 | 280 | 50 | 150 | 27 |
| 1V10 | 12AX7 | Error Detector and Pulse Rectifier | −4 | −4 | 11 | 27 | 27 | 280 | 50 | 150 | 27 |
| 1V11 | 12AX7 | Error Detector and Pulse Rectifier | −4 | −4 | 11 | 27 | 27 | 280 | 50 | 150 | 27 |
| 1V12 | 6BQ7A | Sync Amplifier | 270 | 140 | 160 | 27 | 27 | 180 | −1.5 | 0 | 0 |

* These measurements were taken using the same input signal level and control settings given in the first set of conditions under Decoder-Typical Waveforms.

## TABLE 4. DC VOLTAGES*
## DECODER TUBE SOCKETS

| Tube | Type | Function | Pin Numbers | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 2V1 | 6AL5 | Burst Phase Detector | 0 | 0 | 48 | 48 | 5.4 | 0 | −4.1 | — | — |
| 2V2 | 6AN8 | Reactance Tube and Subcarrier Oscillator | 102 | −7.2 | 0 | 48 | 48 | 278 | 85 | .23 | 2.5 |
| 2V3 | 6AW8 | Color Killer Amplifier and Color Killer Detector | 0 | −3.4 | 144 | 48 | 48 | 155 | 155 | 195 | 172 |
| 2V4 | 6AW8 | Mono. Inverter Adder and Aperture Inverter | 15.5 | 14.5 | 136 | 48 | 48 | 18.3 | 15 | 162 | 230 |
| 2V5 | 6AW8 | Aperture Adder and Mono. Matrix Divider | 135 | 129 | 280 | 48 | 48 | 6.3 | 2.8 | 176 | 230 |
| 2V6 | 12AT7 | Q Ampilfier and Q Matrix Driver | 136 | 47 | 48.5 | 48 | 48 | 280 | 124 | 135 | 48 |
| 2V7 | OA2 | Voltage Regulator +150 | 155 | 2.7 | 10.2 | 2.7 | 155 | 4.4 | 2.7 | — | — |
| 2V8 | 6BQ7A | Bright, Pulse Adder and Burst Keyer and Feedback Gate | 144 | −44 | 17 | 48 | 48 | 278 | 94 | 146 | — |
| 2V9 | 6AW8 | Subcarrier Amplifier | — | — | — | 48 | 48 | 2.6 | 0 | 111 | 110 |
| 2V10 | 6AW8 | Matrix B-Y Inverter and B-Y Matrix Driver | 135 | 124 | 280 | 48 | 48 | 18 | 14.5 | 119 | 192 |
| 2V11 | 12AT7 | I Matrix Driver and Red Output | 280 | 124 | 136 | 48 | 48 | 280 | 136 | 137 | 48 |
| 2V12 | 6AW8 | Sync Amplifier and Sync Clipper Driver | 54 | 44.5 | 280 | 48 | 48 | 3.5 | 1.2 | 108 | 68 |
| 2V13 | 6AU8 | Sync Separator and Pulse Inverter | 0 | 11.2 | 94 | 48 | 48 | 0 | −22.5 | 81 | 144 |
| 2V14 | 6197 | Chroma Monochrome Driver | 6.2 | 4.6 | 114 | 48 | 48 | 146 | 0 | 114 | 4.6 |
| 2V15 | 6AL5 | Q Demodulator | −7.7 | −7.7 | 48 | 48 | 0 | 0 | −15.5 | — | — |
| 2V16 | 12AT7 | Green Output, Blue Output | 280 | 135 | 136 | 48 | 48 | 280 | 135 | 136 | 48 |
| 2V17 | 6197 | Chroma Monochrome Driver | 6.2 | 4.6 | 114 | 48 | 48 | 146 | 0 | 114 | 4.6 |
| 2V18 | 6BQ7A | Sync Output, 2nd Video Ext Sync Amp | 190 | 0 | 26 | 48 | 48 | 280 | 81 | 85 | 0 |
| 2V19 | | Not Used | | | | | | | | | |
| 2V20 | 6AL5 | I Demodulator | 7.7 | 7.7 | 48 | 48 | 15.5 | 0 | 0 | — | — |
| 2V21 | 6AW8 | I Amplifier and I Delay Driver | 30 | 27 | 155 | 48 | 48 | 18.5 | 14.4 | 113 | 165 |
| 2V23 | 6688 | 1st Video Input Amp | — | — | — | — | — | — | — | — | — |
| 2V24 | 7119 | 2nd Video Amp | — | — | — | — | — | — | — | — | — |

* These measurements were taken using the same input signal level and control settings given in the first set of conditions under Decoder-Typical Waveforms.

# TABLE 5. DC VOLTAGES*
## DEFLECTION AND HV TUBE SOCKETS

| *Tube* | *Type* | *Function* | *Pin Numbers* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 3V1 | 6AL5 | HV Protection Pulse Detector | 94 | 0 | 110 | 110 | 90 | — | 90 | — | — |
| 3V2 | 6BC7 | Kine Protection Bias and Kine Protection Pulse Detector and Kine Blanking Clipper | 80 | 70 | — | 110 | 110 | −60 | 0 | −120 | −28 |
| 3V3 | 12AT7 | Vertical Discharge and Cathode Follower | 95 | −12 | 0 | 110 | 110 | 400 | 95 | 100 | — |
| 3V4 | 6W6 | Vertical Output Amplifier | — | 110 | 370 | 260 | 110 | — | 110 | 100 | — |
| 3V5 | 6CG7 | Horizontal Oscillator and Horizontal Control | 180 | −70 | 0 | 110 | 110 | 165 | −24 | 3 | 0 |
| 3V6 | 12AT7 | Kine Overload Protection and Sawtooth Generator | 70 | −120 | −59 | 110 | 110 | 50 | −47 | 0 | 110 |
| 3V7 | 6201 | Pulse Gate Protection | 385 | 400 | 400 | 400 | 400 | 395 | 270 | 385 | 400 |
| 3V8 | 12AT7 | Sync Amplifier and Vertical Oscillator | 150 | 0 | 0 | 110 | 110 | 240 | −85 | .5 | 110 |
| 3V9 | 6CD6GA | Driver | — | 0 | 9 | — | −30 | — | 0 | 160 | — |
| 3V10 | 6CD6GA | Driver | — | 0 | 9 | — | −30 | — | 0 | 160 | — |
| 3V11 | 3B2 | HV Rectifier | — | — | — | — | — | — | — | — | — |
| 3V12 | — | Not Used | — | — | — | — | — | — | — | — | — |
| 3V13 | 6AU4 | Damper | — | — | — | — | 400 | — | 400 | 400 | — |
| 3V14 | 6AU4 | Damper | — | — | — | — | 400 | — | 400 | 400 | — |
| 3V15 | — | Not Used | — | — | — | — | — | — | — | — | — |
| 3V16 | 1X2B | Focus Rectifier | — | — | — | — | — | — | — | — | — |
| 3V17 | 6BK4 | HV Regulator | 400 | 400 | — | — | 375 | — | 400 | — | — |
| 3V18 | 6BK4 | HV Regulator | 400 | 400 | — | — | 375 | — | 400 | — | — |

* These measurements were taken using the same input level and control settings given in the first set of conditions under Decoder-Typical Waveforms.

## TABLE 6. DC VOLTAGES*
## POWER SUPPLY TUBE SOCKETS

| *Tube* | *Type* | *Function* | *Pin Numbers* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* |
| 4V1 | 6X4 | Full Wave Rectifier | — | — | 70 | 70 | — | — | 300 | — | — |
| 4V2 | 6080 | Current Regulator | 390 | 500 | 420 | 380 | 500 | 400 | 200 | 200 | — |
| 4V3 | 6080 | Current Regulator | 390 | 500 | 420 | 270 | 390 | 300 | 210 | 210 | — |
| 4V4 | 6080 | Current Regulator | 270 | 390 | 300 | 270 | 390 | 300 | 85 | 85 | — |
| 4V5 | 6080 | Current Regulator | 180 | 295 | 200 | 180 | 290 | 220 | 84 | 84 | — |
| 4V6 | 12AX7 | DC Amplifier | 300 | 200 | 200 | 210 | 210 | 390 | 195 | 200 | 210 |
| 4V7 | 12AX7 | DC Amplifier | 150 | 80 | 80 | 85 | 85 | 270 | 48 | 50 | 85 |
| 4V8 | 12AX7 | DC Amplifier | 150 | 80 | 82 | 85 | 85 | 180 | 50 | 50 | 85 |
| 4V9 | 5651 | Voltage Regulator | 85 | 0 | — | — | 85 | — | 0 | — | — |
| 4V10 | 12AT7 | Time Delay Amplifier and Protection Voltage Amp. | 140 | 0 | 16 | 85 | 85 | 140 | 16 | 16 | 85 |

* These measurements were taken using the same input signal level and control settings given in the first set of conditions under Decoder-Typical Waveforms.

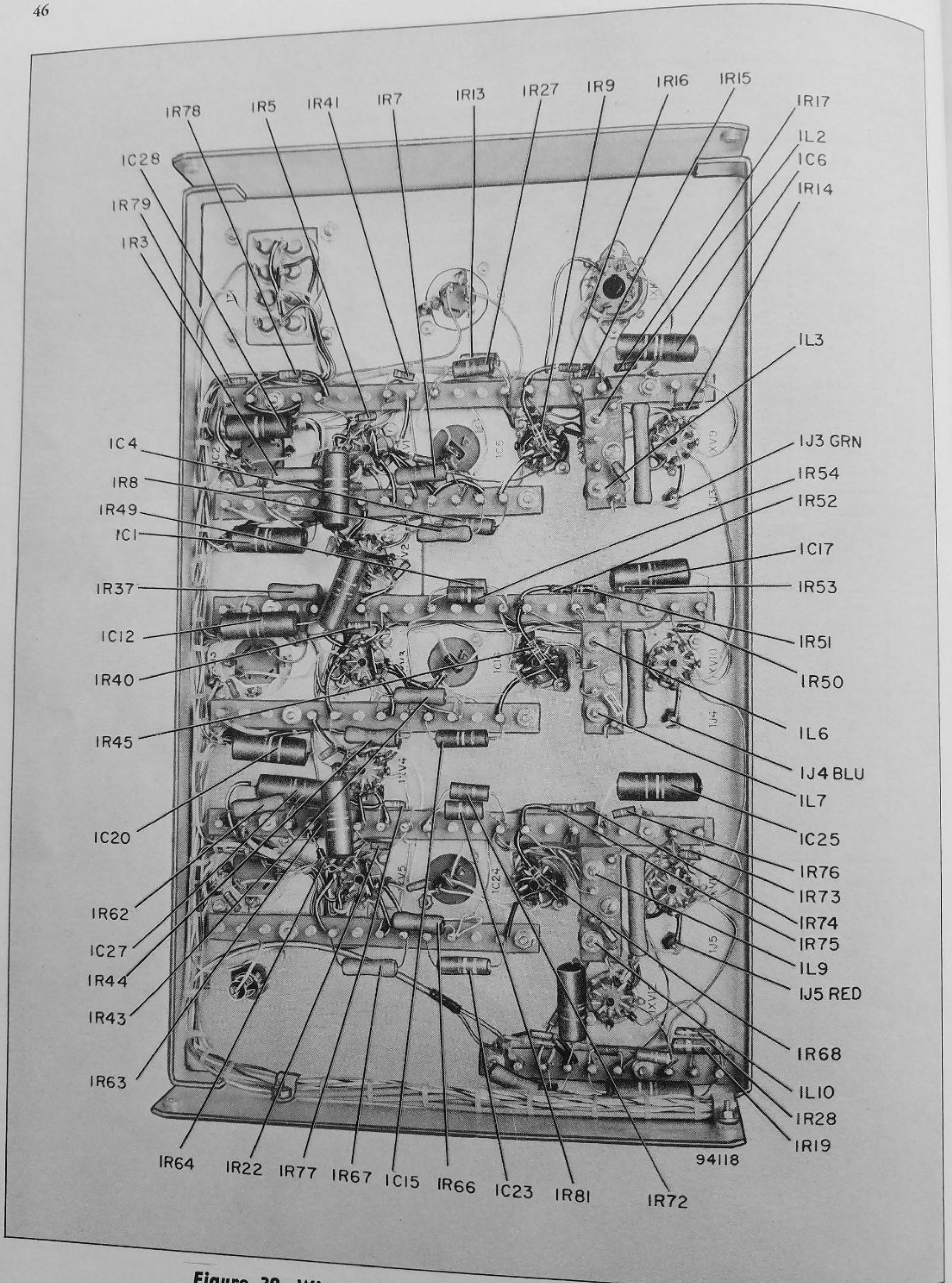
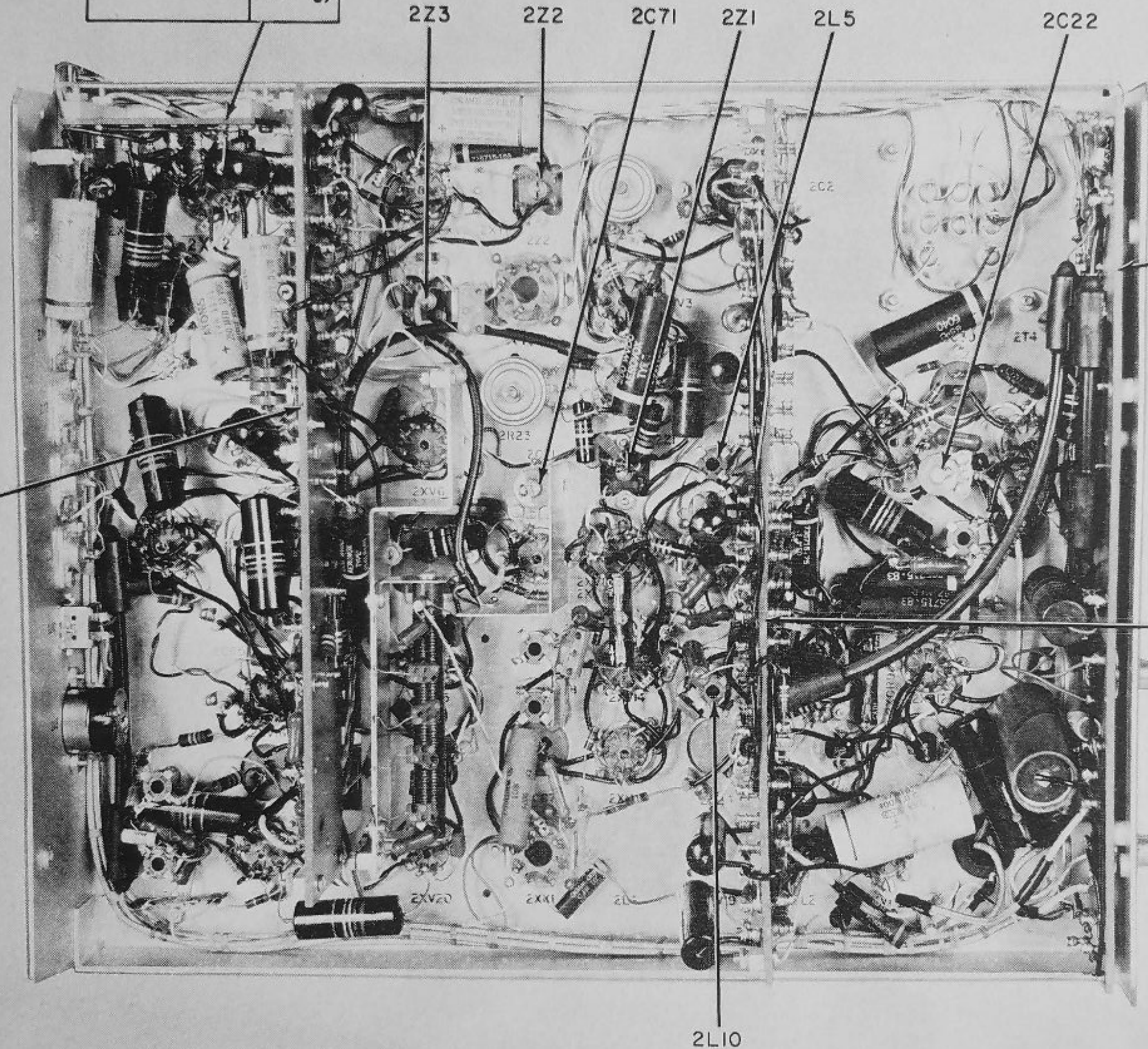



**Figure 39. Wire Side, 3 Channel Video Amplifier Chassis**

| COMPONENTS ON TB TOP TO BOTTOM |
|---|
| 2C27 |
| 2R190 |
| 2R191 |
| 2R186 |
| 2R187 |
| 2R189 |




| COMPONENTS ON TB TOP TO BOTTOM | |
|---|---|
| LEFT SIDE | RIGHT SIDE |
| 2R97 | 2R119 |
| 2R96 | 2R128 |
| 2R95 | 2R120 |
| 2R94 | 2R112 |
| 2R93 | 2C37 |
| 2R92 | 2C21 |
| 2R99 | 2R105 |
| 2R100 | 2R40 |
| 2L15 | 2R35 |
| 2C72 | 2R38 |
| 2C60 | 2C17 |
| 2R157 | 2R37 |
| 2L16 | 2C16 |
| 2R114 | 2R36 |
| 2C61 | 2C11 |
| 2R115 | 2R32 |
| 2R124 | 2R33 |
| 2C64 | 2L1 |
| 2R127 | 2C12 |
| 2C63 | 2C13 |
| 2R123 | |
| 2R122 | |
| 2R121 | |
| 2R129 | |
| 2R130 | |
| 2R131 | |
| 2R132 | |
| 2R133 | |
| 2R136 | |
| 2R135 | |
| 2R134 | |

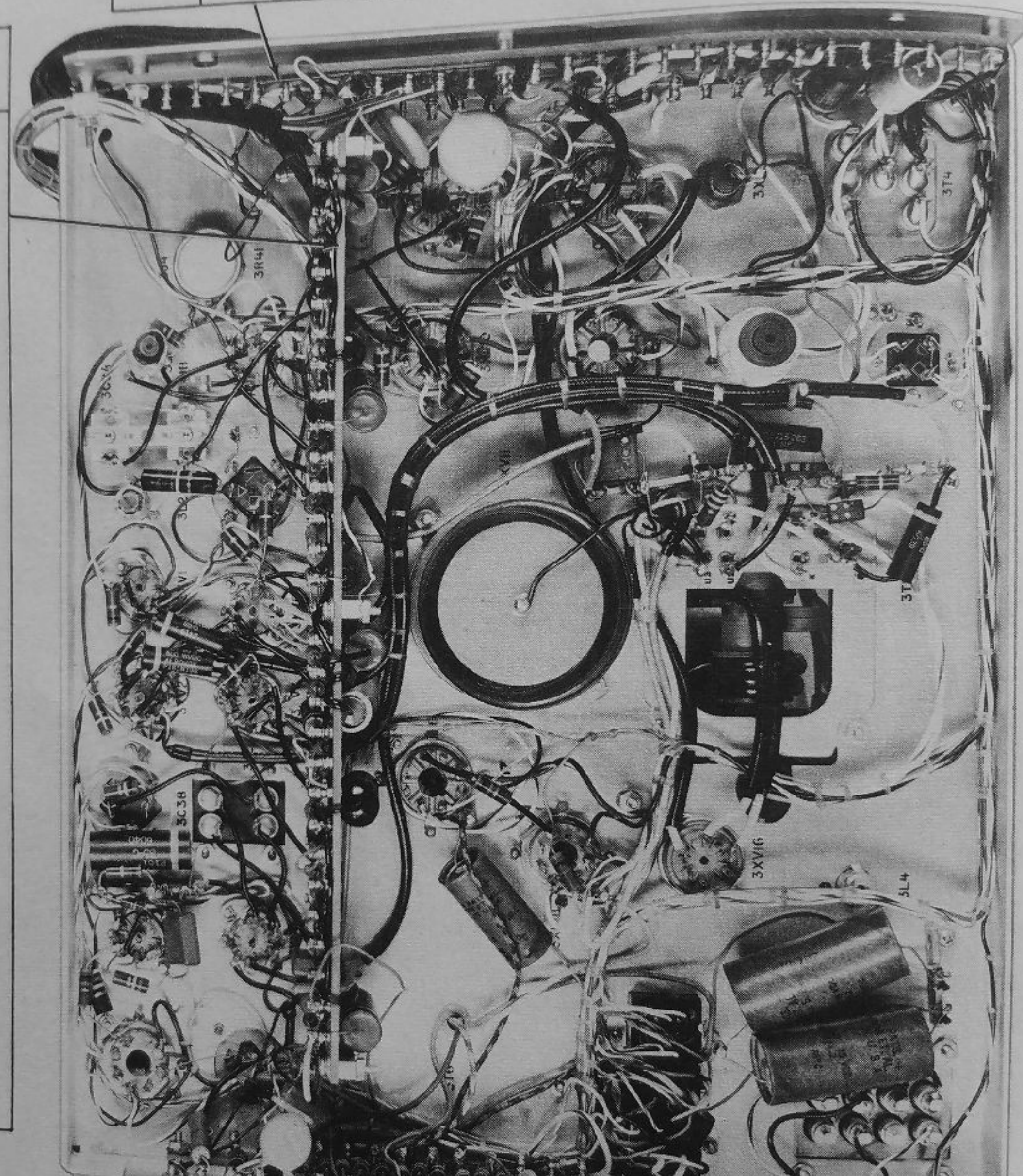
| COMPONENTS ON TB TOP TO BOTTOM | |
|---|---|
| LEFT SIDE | RIGHT SIDE |
| 2R20 | 2R26 |
| 2R30 | 2C6 |
| 2R59 | 2R54 |
| 2C29 | 2R16 |
| 2R58 | 2R78 |
| 2R70 | 2R91 |
| 2R52 | 2R77 |
| 2C18 | 2L20 |
| 2R15 | 2R176 |
| 2C74 | 2R175 |
| 2CR7 | 2C90 |
| 2CR3 | 2R179 |
| 2R18 | 2R14 |
| 2C33 | 2C4 |
| 2CR5 | 2R180 |
| 2R160 | 2R11 |
| 2L13 | 2CR10 |
| 2R65 | 2R172 |
| 2CR11 | 2R173 |
| 2R147 | 2R3 |
| 2R178 | 2C88 |
| 2C92 | 2R6 |
| 2CR2 | 2R168 |
| 2C91 | 2R167 |
| 2R181 | 2R7 |
| 2C28 | 2R31 |

| COMPONENTS ON TB TOP TO BOTTOM |
|---|
| 2R79 |
| 2R73 |
| 2R72 |
| 2L11 |
| 2R82 |
| 2R146 |
| 2R74 |
| 2R83 |
| 2L12 |
| 2DL3 |
| 2C43 |
| 2DL2 |
| 2DL1 |
| 2R84 |
| 2C42 |
| 2R152 |
| 2R80 |
| 2R171 |
| 2R71 |
| 2C87 |
| 2R169 |
| 2R182 |
| 2C94 |
| 2R1 |
| 2R197 |
| 2R154 |
| 2R198 |
| 2R137 |

**Figure 40. Wire Side, Decoder Chassis**

| COMPONENTS ON TB TOP TO BOTTOM | |
|---|---|
| 3R70 | 3R106 |
| 3R71 | 3R107 |
| 3C14 | |
| 3C15 | 3C4 |
| 3C13 | |
| 3R11 | |
| 3R10 | |
| 3C7 | 3C8 |
| 3R8 | |
| 3R6 | |
| 3R9 | |
| 3R7 | 3C5 |
| 3R5 | |
| 3R4 | 3C11 |
| 3C3 | |
| 3C2 | |
| 3R3 | 3C51 |
| 3R76 | 3C50 |
| 3R77 | 3C48 |
| 3R74 | 3C32 |
| 3R75 | 3C1 |
| 3C49 | |
| 3R50 | |
| 3R51 | |
| 3R49 | |
| 3R48 | |
| 3R44 | |
| 3C29 | |
| 3R45 | |
| 3R42 | |
| 3R43 | |
| 3R58 | |
| 3R56 | |
| 3C39 | |
| 3PC1 | |
| 3R19 | |
| 3R1 | |

| COMPONENTS ON TB TOP TO BOTTOM |
|---|
| 3C35 |
| 3C33 |
| 3C34 |
| 3R54 |
| 3R52 |
| 3R53 |
| 3R78 |
| 3C27 |
| 3R40 |
| 3R39 |
| 3C24 |
| 3R34 |
| 3R33 |
| 3R30 |
| 3R31 |
| 3R32 |
| 3C25 |
| 3R69 |
| 3C26 |




| COMPONENTS ON TB TOP TO BOTTOM |
|---|
| 3R102 |
| 3R64 |
| 3R99 |
| 3C44 |
| 3C43 |
| 3R103 |
| 3R86 |
| 3R85 |
| 3R84 |
| 3R91 |
| 3R90 |
| 3R89 |
| 3R96 |
| 3R95 |
| 3R94 |
| 3R109 |
| 3CR5 |
| 3CR4 |
| 3CR3 |

**Figure 41. Wire Side, Deflection and HV Chassis**

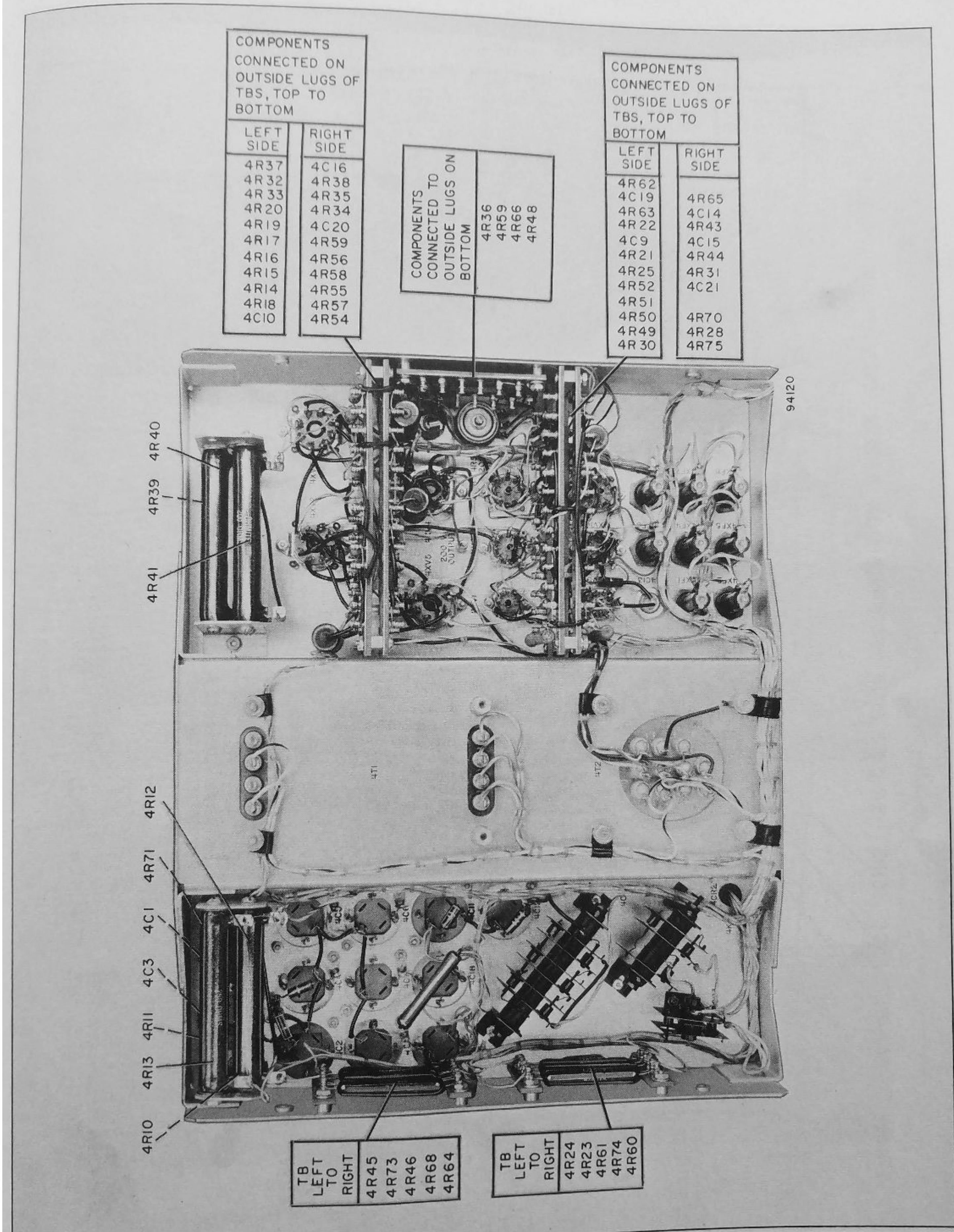



**Figure 42. Wire Side, Power Supply Chassis**

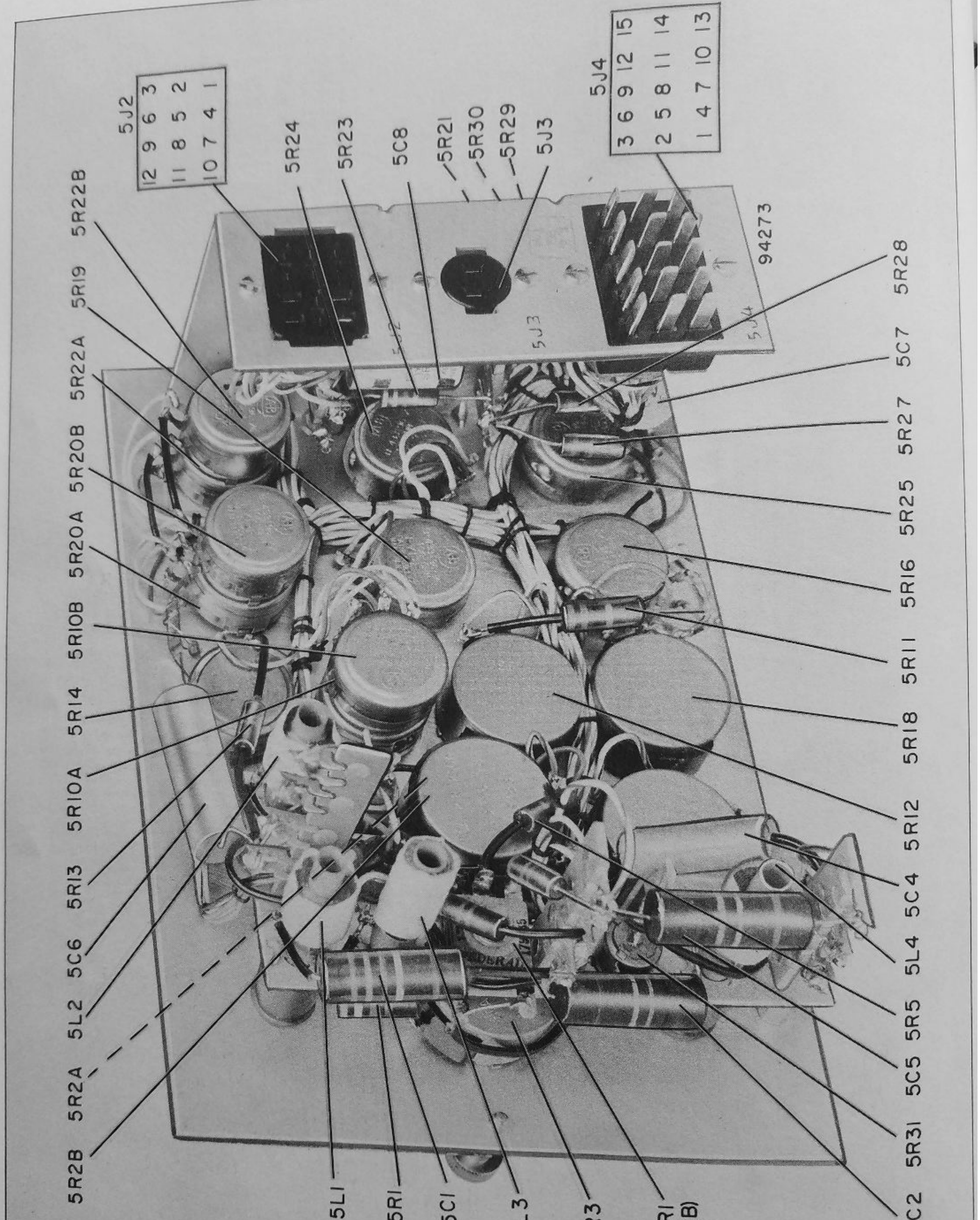
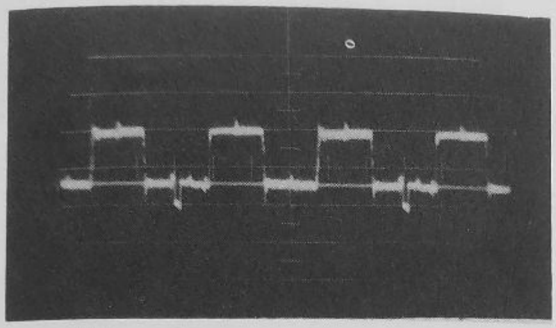



**Figure 43. Wire Side, Convergence Chassis**

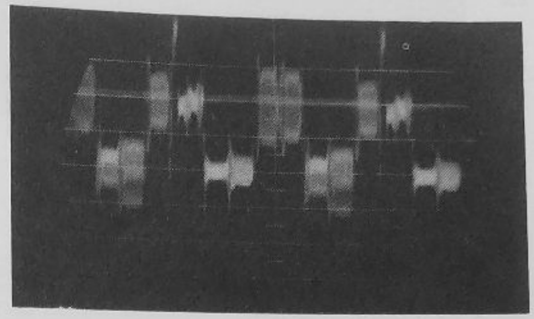
# 3 CHANNEL VIDEO AMPLIFIER
## TYPICAL WAVEFORMS

Conditions for waveform pictures 1P1 through 1P11

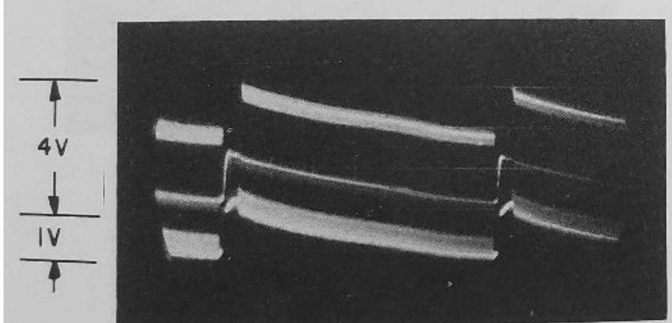
Input: 0.5 V B-W at Red Input
Sync: 20 V, approximately



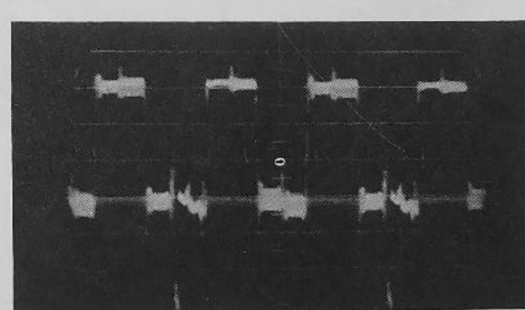
IP1 - IV4, pin 2, 0.5 V B-W



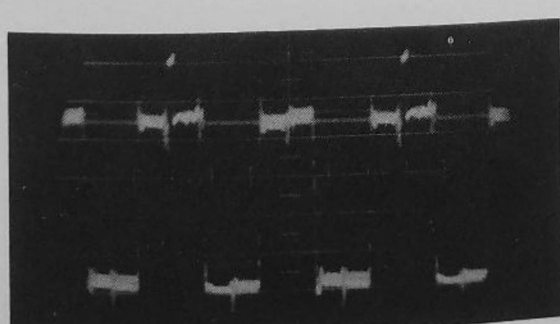
IP2 - IV5, pin 7, .05 V B-W



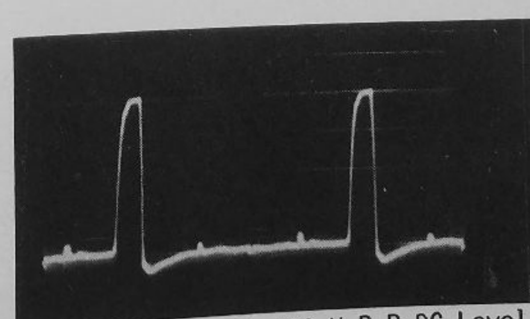

IP3 - IV5, pin 2, 5 V P-P



IP4 - Junction IC23, IL8, IR68, 3.5 V B-W

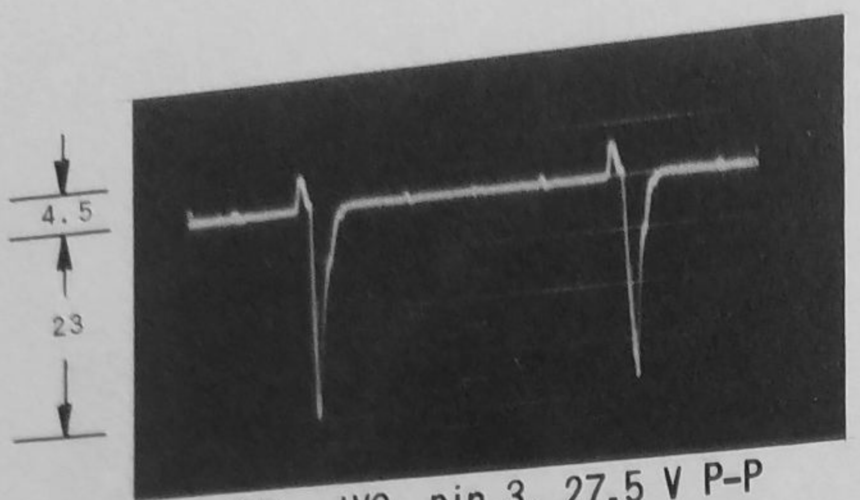


IP5 - Red Output 45 V B-W DC Level
180 V at Black

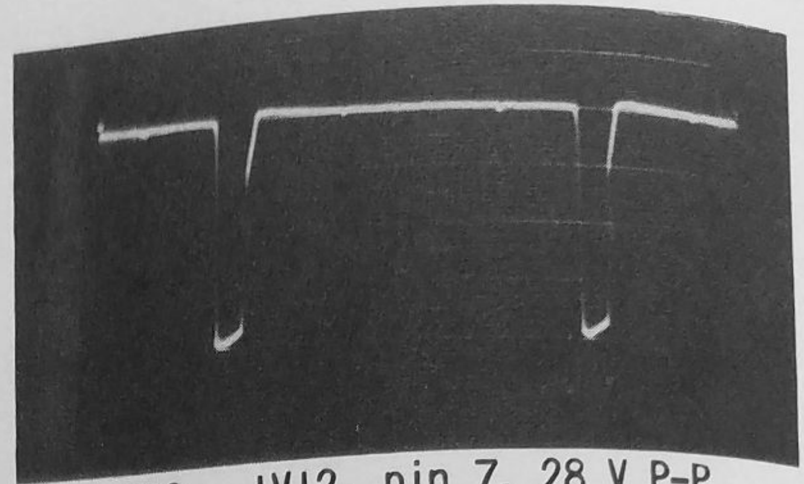


IP6 - IV9, pin 7, 120 V P-P DC Level
180 V at Tip

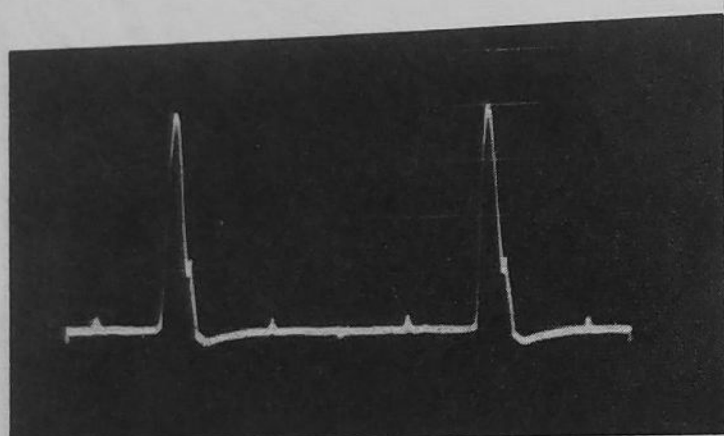
**Figure 44. Typical Waveforms, 3 Channel Video Amplifier (Sheet 1 of 2)**



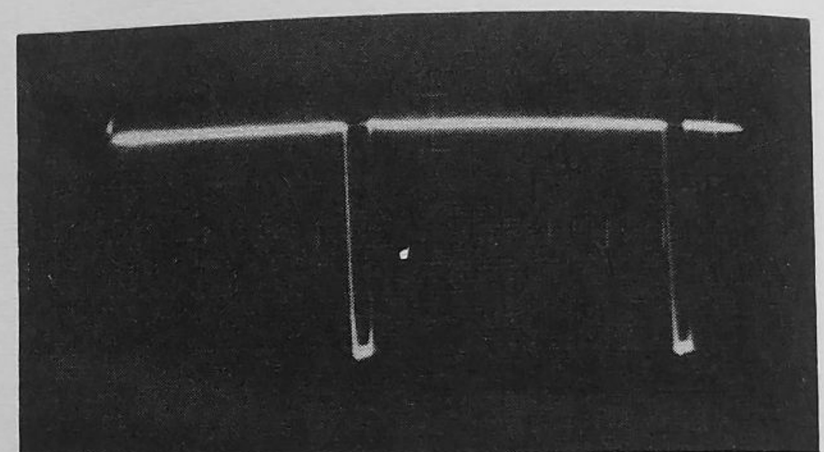

1P7 - 1V9, pin 3, 27.5 V P-P



1P8 - 1V12, pin 7, 28 V P-P



1P9 - 1V12, pin 2, 5 V P-P



1P10 - Junction 1C27, 6TB1-10
15 to 40 V P-P

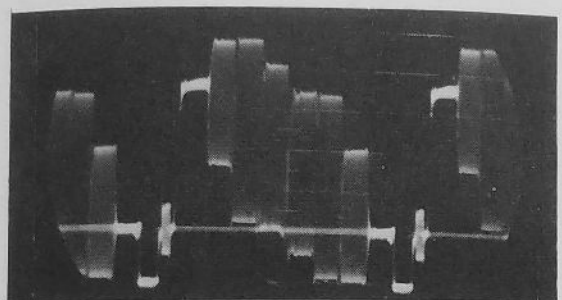
# DECODER – TYPICAL WAVEFORMS

1. Conditions for waveform pictures 2P1 through 2P31

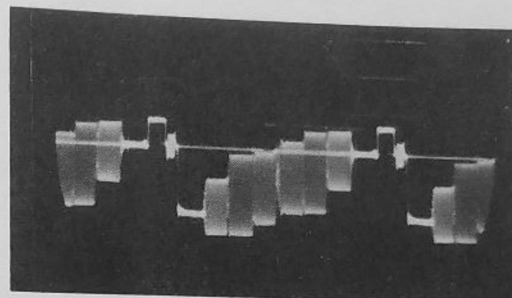
   Input: 0.7 V B-W Composite Color Bar
   Contrast: 0.5 V B-W at Red Output
   Brightness: Top of brightness pulse at black level
   Sync Sel: Internal
   Aperture Gain: Maximum
   Test Switch: Chroma Unity
   Blue and Green Gain: Set for proper balance

2. Conditions for waveform pictures 2P34 through 2P38

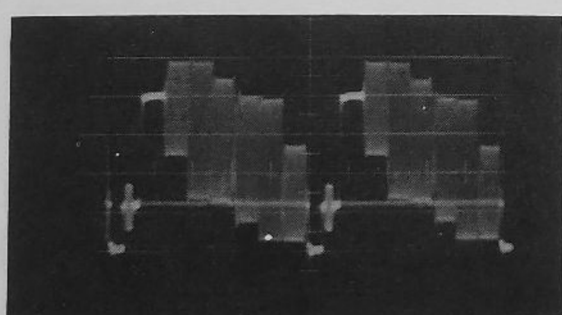
   Test Switch: Scrn Red; other conditions same as above



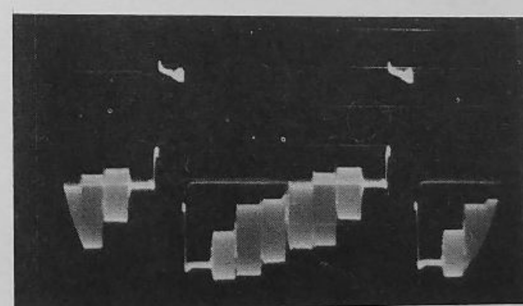
2P1 - 2J13, 0.7 V B-W



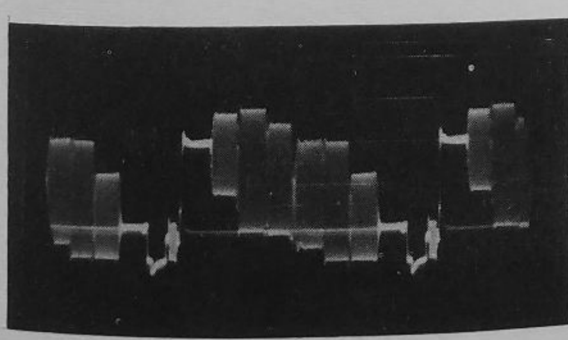
2P2 - 2V24, pin 2, 1 V B-W



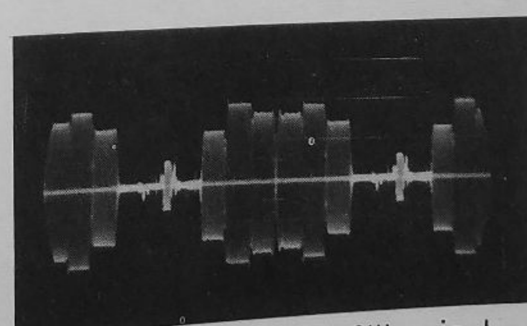
2P3 - 2V17, pin 9, 1.25 V B-W



2P4 - 2V17, pin 6, 12.5 V B-W
DC Level at Pulse Tip 155 V

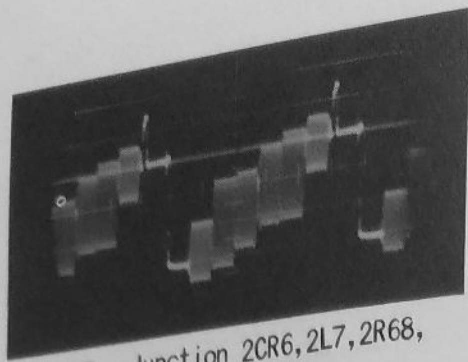


2P5 - 2V14, pin 1, 0.85 V B-W

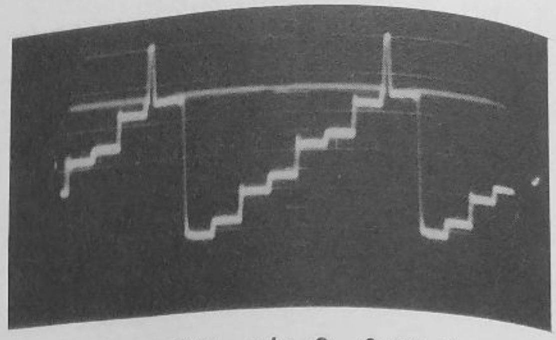


2P6 - Junction 2C34,2K1, pin 1, 1.2 V P-P

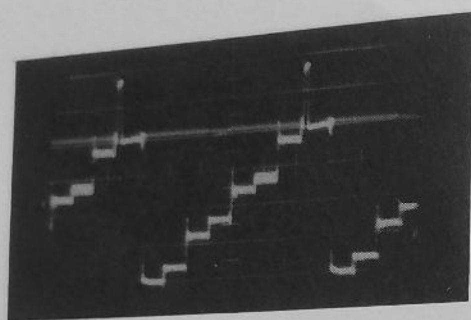
**Figure 45. Typical Waveforms, Decoder (Sheet 1 of 5)**



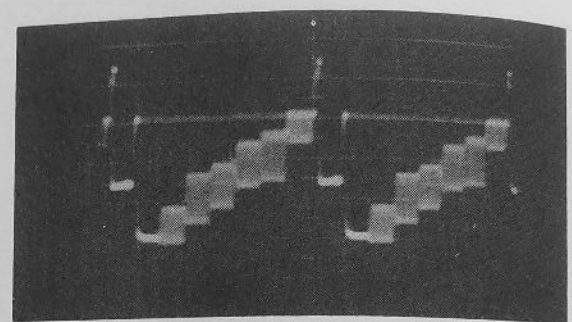
2P7 - Junction 2CR6,2L7,2R68, 12.2 V B-W



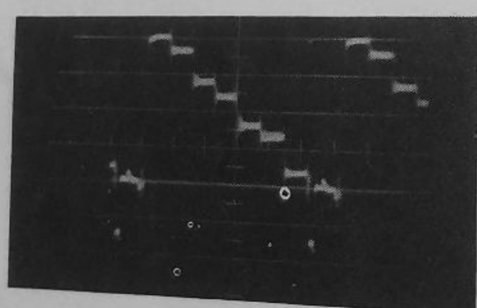
2P8 - 2V4, pin 2, 0.75 V B-W



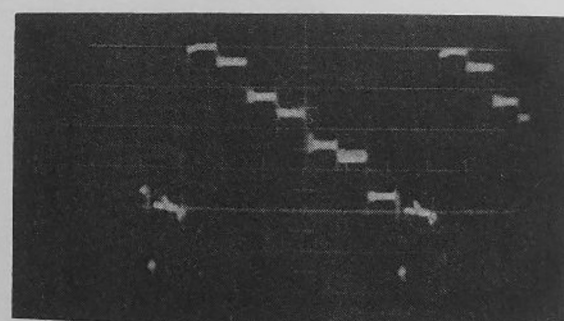
2P9 - 2V4, pin 7, 3 V B-W



2P10 - 2V8, pin 1, 5.0 V per CM

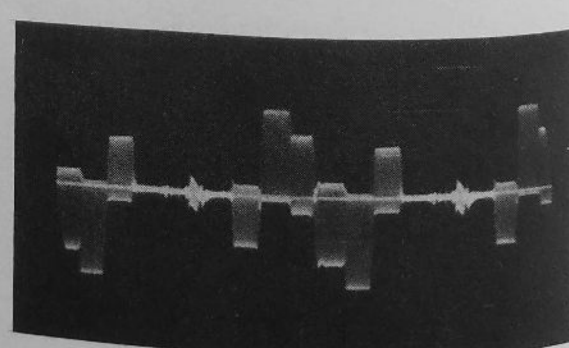


2P11 - 2V5, pin 2, 5.1 V B-W



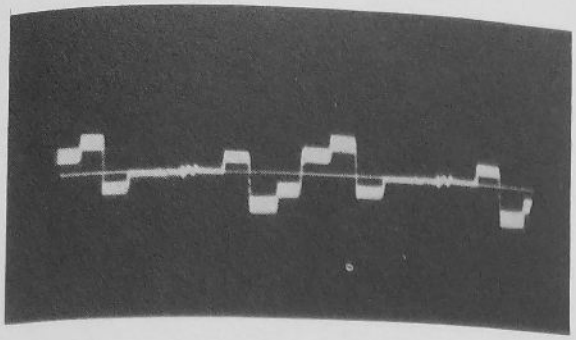
2P12 - 2V5, pin 1, 5 V B-W

2P13 - 2T3, pin D, 18 V P-P

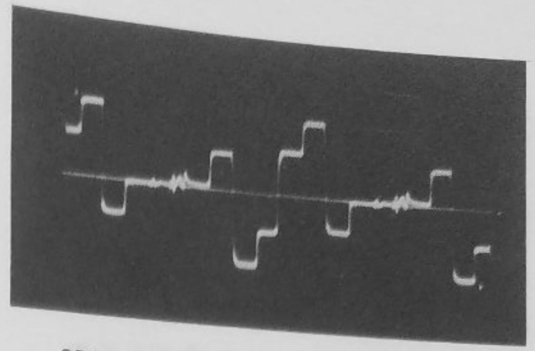


2P14 - 2V21, pin 7, 1.5 V P-P

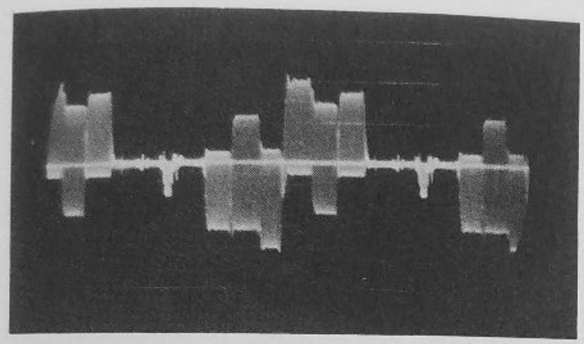
**Figure 45. Typical Waveforms, Decoder (Sheet 2 of 5)**



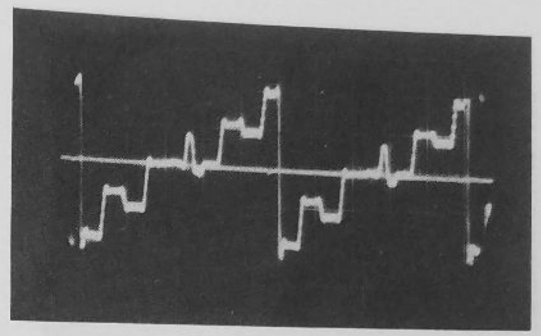
2P15 - 2V21, pin 1, 2.6 V P-P



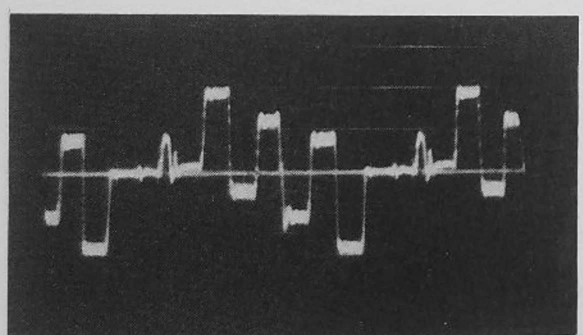
2P16 - 2V11, pin 3, 1.22 V P-P



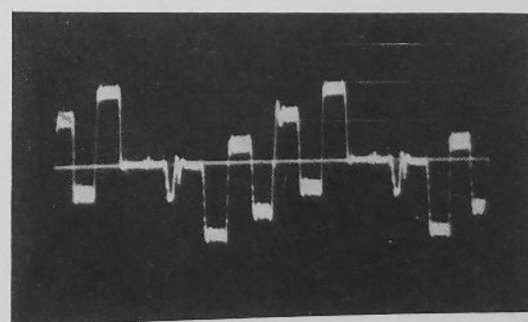
2P17 - 2V6, pin 2, 1.3 V P-P



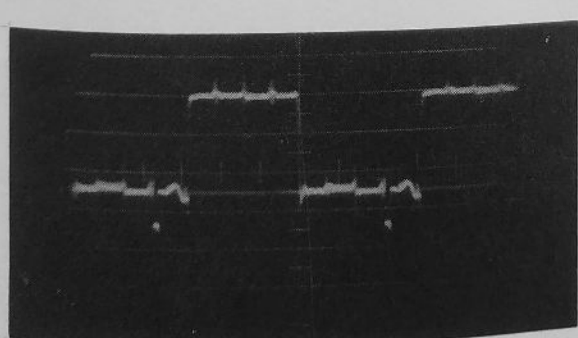
2P18 -2V6, pin 8, 0.9 V P-P



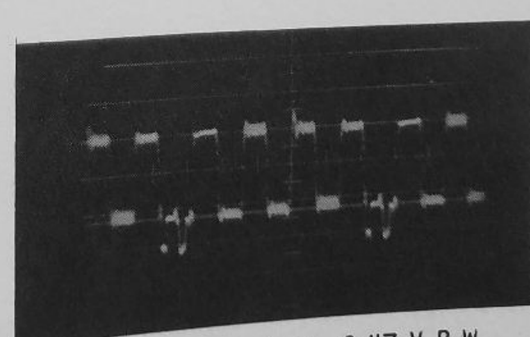
2P19 - 2V10, pin 7, 0.65 V P-P



2P20 - 2V10, pin 1, 1.02 V P-P

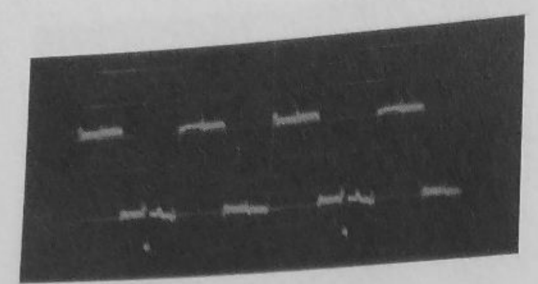


2P21 - 2V16, pin 3, 0.5 V B-W
(GRN OUTPUT)

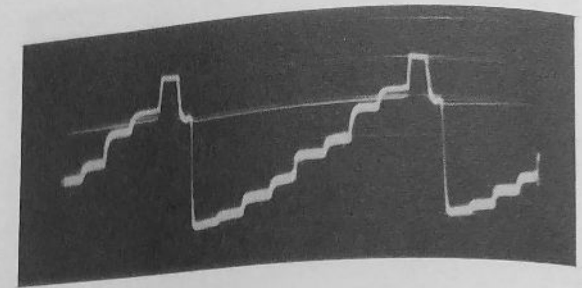


2P22 - 2V16, pin 8, 0.47 V B-W
(BLU OUTPUT)

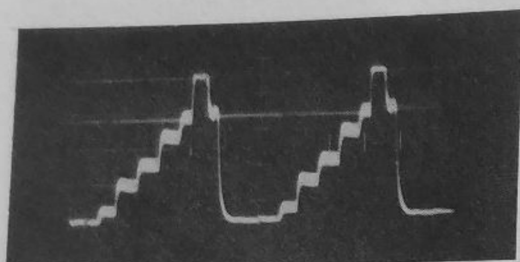
***Figure 45. Typical Waveforms, Decoder (Sheet 3 of 5)***



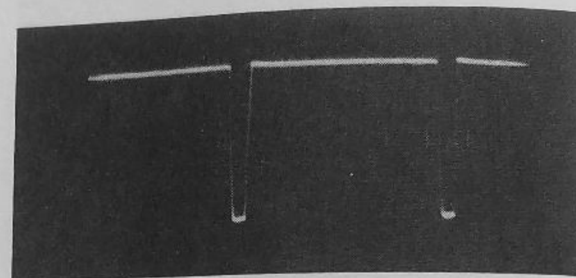
2P23 - 2V11, pin 8, 0.5 V B-W
(RED OUTPUT)



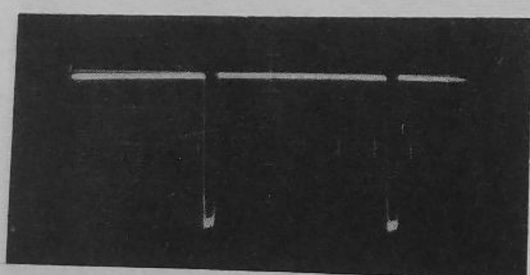
2P24 - 2V12, pin 9, 90 V P-P



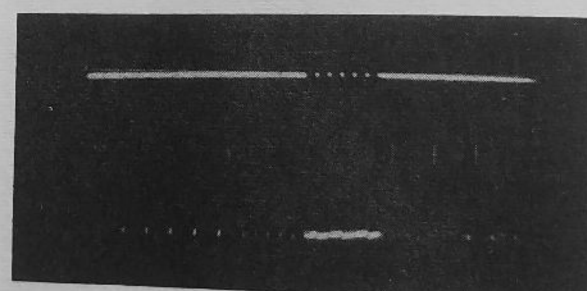
2P25 - 2V13, pin 7, 35 V P-P 0 DC on
Sync Tips, Hor. Sweep Rate



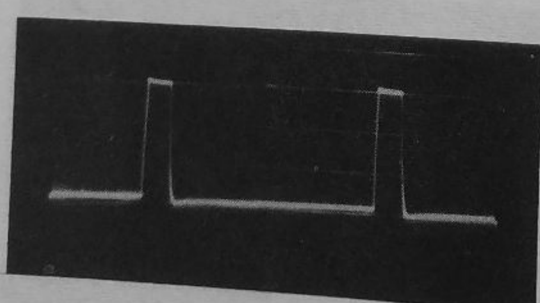
2P26 - 2V13, pin 9, 135 V P-P
Horiz. Sweep Rate



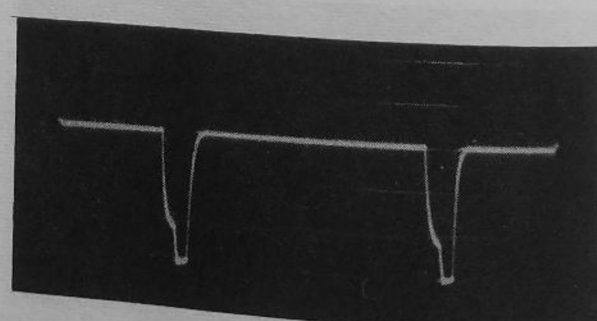
2P27 - 2V18, pin 8, 15 to 40 V P-P
Sync at Hor. Sweep Rate



2P28 - 2V18, pin 8, 15 to 40 V P-P
Sync Output, Vert. Sync Interval

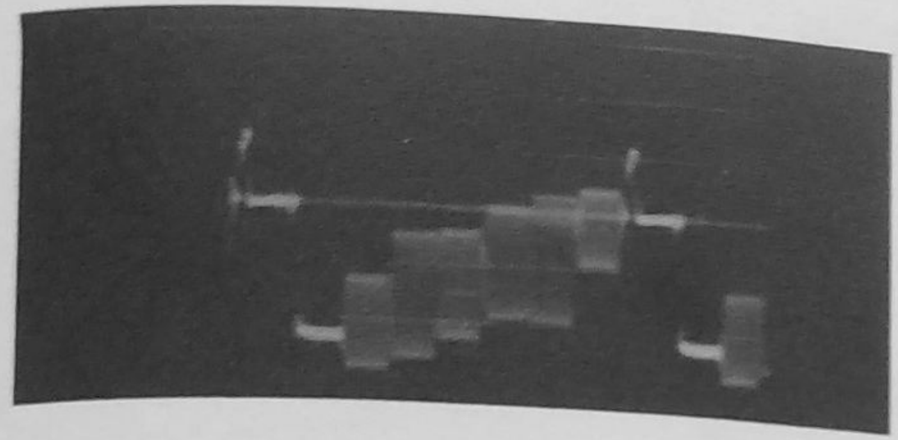


2P29 - 2V8, pin 7, 80 V P-P

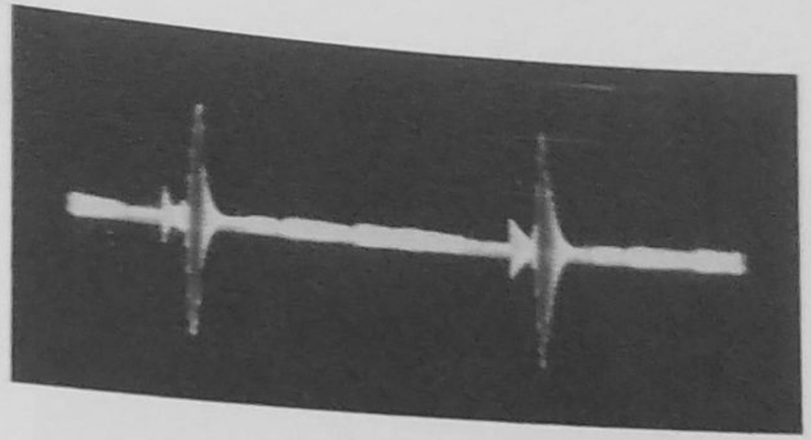


2P30 - At Anode of 2CR5, 32 V P-P
DC Level 32 V (Video Interval)

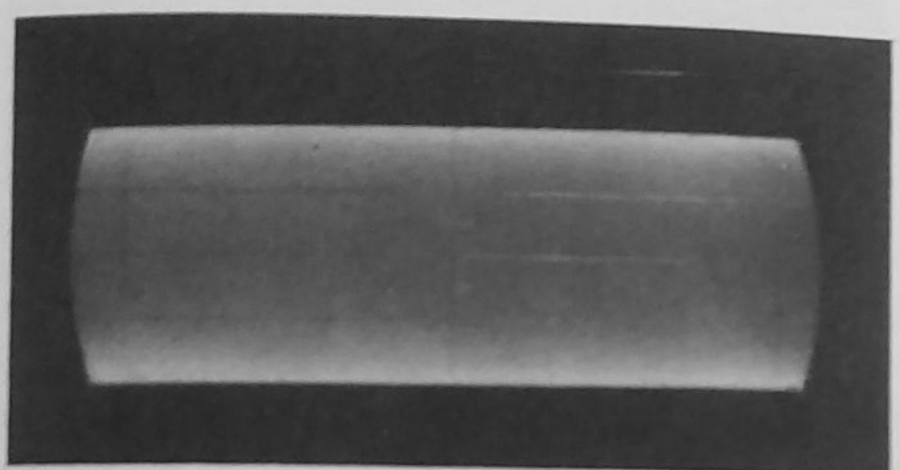
**Figure 45. Typical Waveforms, Decoder (Sheet 4 of 5)**



2P31 - Junction 2CR6,2L7,2R68
12.0 V B-W



2P32 - 2V1, pin 5, 14 V P-P



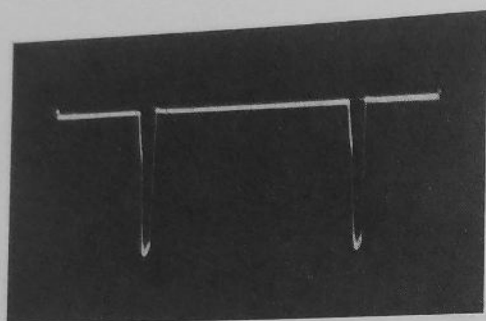
2P33 - 2V9, pin 7, 5.0 V P-P

## DEFLECTION AND H V TYPICAL WAVEFORMS

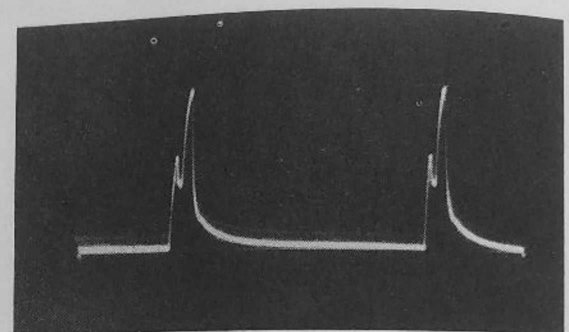
Conditions for waveform pictures 3P1 through 3P12

| | |
|---|---|
| Scan: | Normal |
| Linearity: | Normal Picture |
| Size: | Normal Picture |

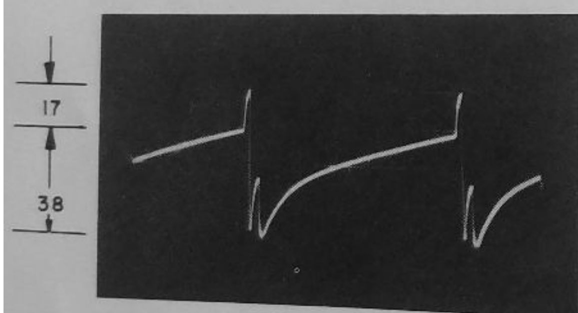
NOTE: DC Level also shown on 3P12



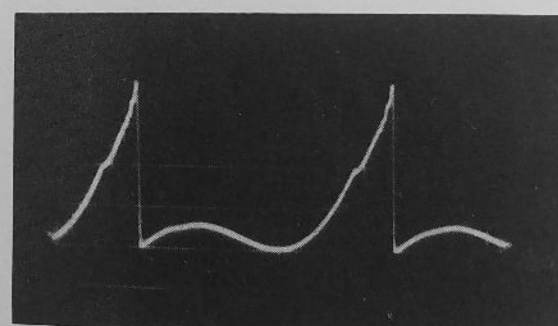
3P1 - 3V8, pin 2, 30 V,
Sync at Hor. Sweep Rate



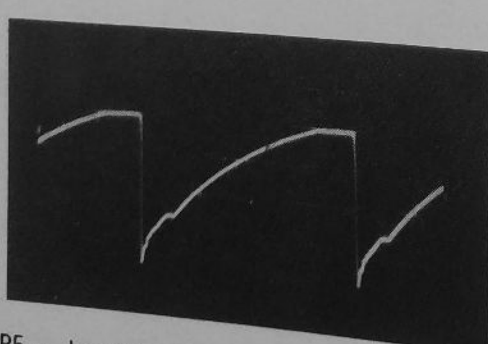
3P2 - 3V8, pin 1, 50 V P-P



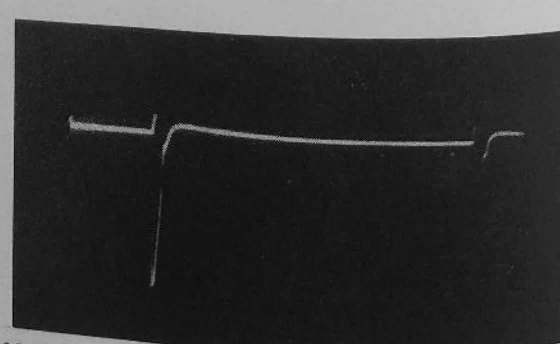

3P3 - 3V5, pin 7, 55 V P-P



3P4 - Junction 3L1,3L2,3C12,3R12,
120 V P-P

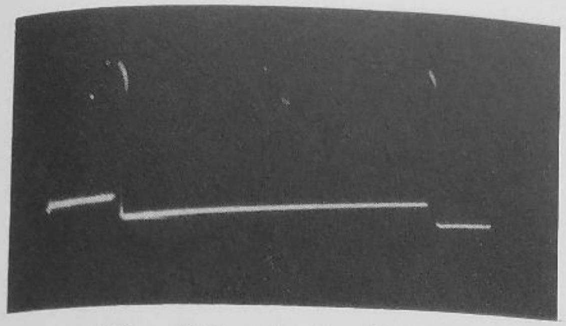


3P5 - Junction 3C13,3C14,3C15,120 V P-P

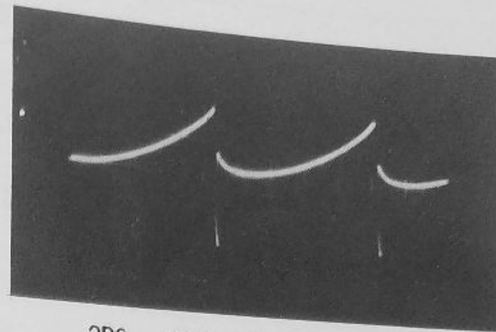


3P6 - Junction 3C39,3R56,3PC1,80 V P-P
(Viewed at Vert. Pulse Rate)

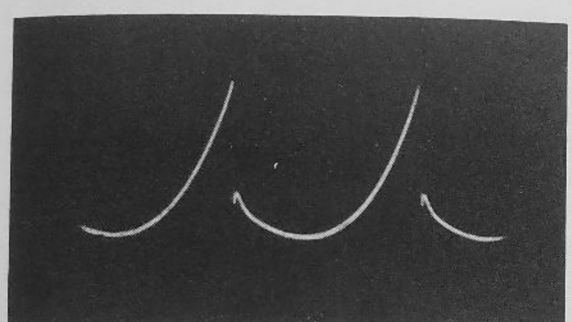
**Figure 46. Typical Waveforms, Deflection and HV (Sheet 1 of 2)**



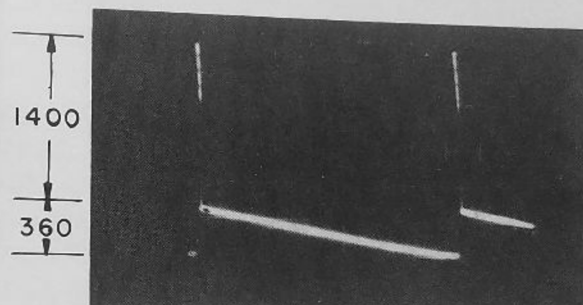
3P7 - 3V3, pin 2, 13 V P-P
(Vert. Sweep Rate)



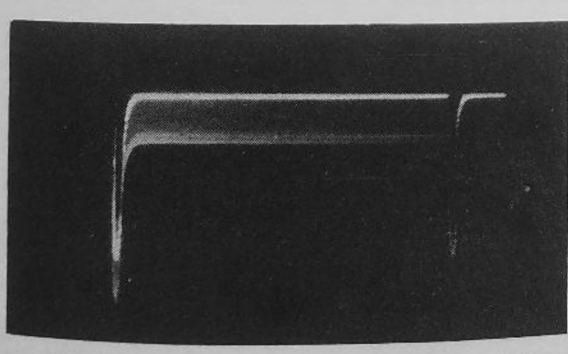
3P8 - 3V4, pin 5, 30 V P-P
(Vert. Sweep Rate)



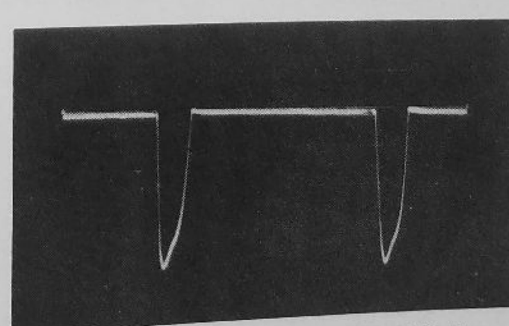
3P9 - 3V4, pin 8, 7 V P-P
(Vert. Sweep Rate)




3P10 - 3V4, pin 3, 1760 V P-P
Sawtooth 360 V; Pulse 1400



3P11 - Junction 3V6, pin 1, 3R78,
110 V P-P (Vert. Sweep Rate)



3P12 - 3V6, pin 1, 38 V P-P
DC Level 72 V Hor. Sweep Rate

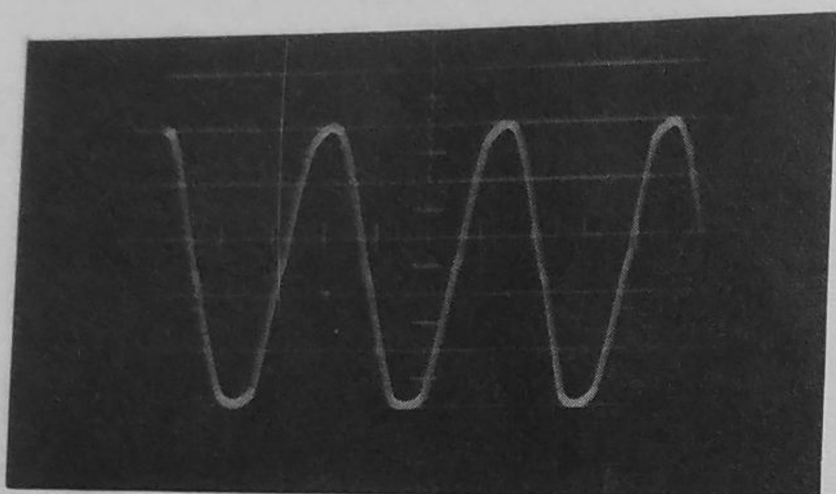
***Figure 46. Typical Waveforms, Deflection and HV (Sheet 2 of 2)***

# KINESCOPE VOLTAGE REGULATION

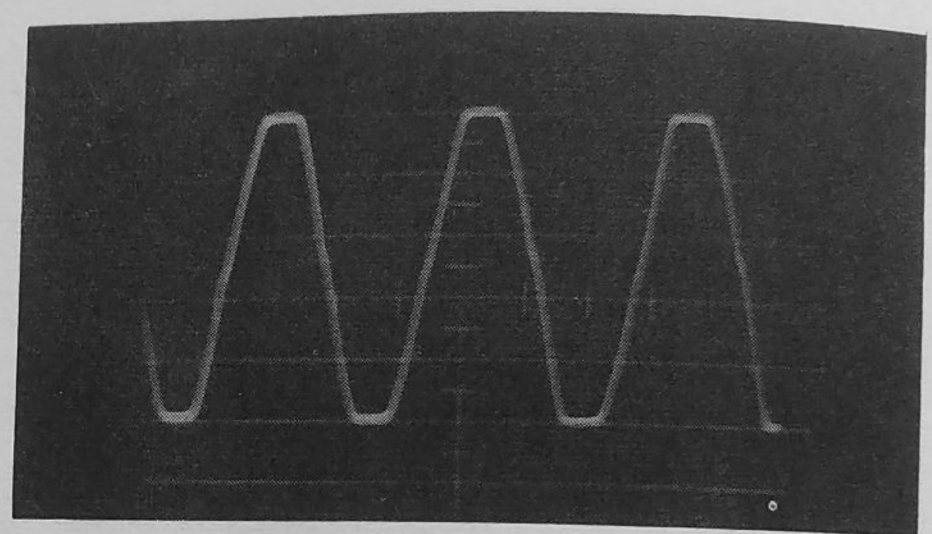
## WAVEFORMS

Conditions for waveform pictures 6PI and 6P2

Input: 117 V. AC



6PI - Transformer - 6TI - Secondary, 36 V P-P



6P2 - 6CRI and 6CR2 Cathodes, 15 V P-P

# PARTS LIST
## TM-21D COLOR MONITOR, MI-40226-D

| Symbol No. | Stock No. | Description |
|---|---|---|
| | | **3 CHANNEL VIDEO AMPLIFIER CHASSIS** |
| | | *CAPACITORS:* |
| 1C1 | | Paper, 0.1 μf, ± 10%, 400 v |
| 1C 2A/B | 214852 | Electrolytic, 50/100 μf, +50% -10%, +100% -10%, 450/50 v |
| 1C3 | | Paper, 0.1 μf, ±10%, 400 v |
| 1C4 | | Paper, 0.01 μf, ±10%, 400 v |
| 1C5 | 99133 | Electrolytic, 10 μf, +50% -10%, 450 v |
| 1C6 to 1C8 | | Paper, 0.1 μf, ±10%, 400 v |
| 1C9 to 1C11 | | Not Used |
| 1C12 | | Paper, 0.1 μf, ±10%, 400 v |
| 1C13A/B | 214852 | Electrolytic, 50/100 μf, ±50% -10%, ±100% -10%, 450/50 v |
| 1C14 | | Paper, 0.1 μf, ±10%, 400 v |
| 1C15 | | Paper, 0.01 μf, ±10%, 400 v |
| 1C16 | 99133 | Electrolytic, 10 μf, +50%, -10%, 450 v |
| 1C17 | | Paper, 0.1 μf, ±10%, 400 v |
| 1C18, 1C19 | | Not Used |
| 1C20, 1C21 | | Paper, 0.1 μf, ±10%, 400 v |
| 1C22A/B | 214852 | Electrolytic, 50/100 μf, +50% -10%, +100% -10%, 450/50 v |
| 1C23 | | Paper, 0.01 μf, ±10%, 400 v |
| 1C24 | 99133 | Electrolytic, 10 μf, +50% -10%, 450 v |
| 1C25 | | Paper, 0.1 μf, ±10%, 400 v |
| 1C26A/B | 99295 | Electrolytic, 20/20 μf, 450 v |
| 1C27 | | Paper, 0.1 μf, ±10%, 400 v |
| 1C28 | | Paper, 0.1 μf, ±10%, 200 v |
| 1C29 | 95320 | Mica, 47 μμf, ±5%, 500 v |
| 1CR1 | 59395 | Rectifier: crystal diode (1N34A) |
| 1F1 | 14133 | Fuse: 1.0 amp. |
| 1J1, 1J2 | | Not Used |
| 1J3 | 210359 | Connector: female, green tip jack |
| 1J4 | 210358 | Connector: female, blue tip jack |
| 1J5 | 203532 | Connector: female, red tip jack |
| 1K1 | 206744 | Relay: DPDT |
| 1L1 | 209846 | Coil: peaking |
| 1L2 | 205845 | Coil: peaking |
| 1L3 | 94876 | Coil: peaking |
| 1L4, 1L5 | 209846 | Coil: peaking |
| 1L6 | 205845 | Coil: peaking |
| 1L7 | 94876 | Coil: peaking |
| 1L8 | 209846 | Coil: peaking |
| 1L9 | 205845 | Coil: peaking |
| 1L10 | 94876 | Coil: peaking |
| 1P1, 1P2 | | Not Used |
| 1P3 | | Connector: green tip jack |
| 1P4 | 213495 | Connector: blue tip jack |
| 1P5 | 213493 | Connector: red tip jack |

| Symbol No. | Stock No. | Description |
|---|---|---|
| | | *RESISTORS:* *Fixed, Composition, Unless otherwise specified* |
| 1R1 | | Not Used |
| 1R2 | | 470,000 ohm, ±10%, ½ w |
| 1R3 | 213757 | 15,000 ohm, ±5%, 3 w |
| 1R4 | | 270 ohm, ±5%, ½ w |
| 1R5 | | 470,000 ohm, ±10%, ½ w |
| 1R6 | | 910 ohm, ±5%, ½ w |
| 1R7 | 213758 | 20,000 ohm, ±5%, 3 w |
| 1R8 | 213756 | 10,000 ohm, ±5%, 3 w |
| 1R9 | | 10,000 ohm, ±10%, ½ w |
| 1R10 | 213759 | 2200 ohm, ±5%, 5 w |
| 1R11 | | 8200 ohm, ±5%, ½ w |
| 1R12 | | 20 ohm, ±5%, ½ w |
| 1R13 | | 8200 ohm, ±5%, 2 w |
| 1R14 | | 22,000 ohm, ±5%, ½ w |
| 1R15 | | 3.9 meg ohm, ±5%, ½ w |
| 1R16 | | 8.2 meg ohm, ±10%, ½ w |
| 1R17 | | 220,000 ohm, ±5%, ½ w |
| 1R18 | | Not Used |
| 1R19 | | 22,000 ohm, ±5%, 2 w |
| 1R20 | | 1 meg ohm, ±10%, ½ w |
| 1R21 | | 2200 ohm, ±5%, ½ w |
| 1R22 | | 150 ohm, ±5%, ½ w |
| 1R23 | 213756 | 10,000 ohm, ±5%, 3 w |
| 1R24 | | 470,000 ohm, ±10%, ½ w |
| 1R25 | | Not Used |
| 1R26 | | 91,000 ohm, ±5%, 1 w |
| 1R27 | | 15,000 ohm, ±5%, 2 w |
| 1R28, 1R29 | | 13,000 ohm, ±5% 2 w |
| 1R30 to 1R35 | | Not Used |
| 1R36 | | 470,000 ohm, ±10%, ½ w |
| 1R37 | 213757 | 15,000 ohm, ±5%, 3 w |
| 1R38 | | 270 ohm, ±5%, ½ w |
| 1R39 | | 270,000 ohm, ±5%, ½ w |
| 1R40 | | 470,000 ohm, ±10%, ½ w |
| 1R41 | | 3900 ohm, ±5%, ½ w |
| 1R42 | | 910 ohm, ±5%, ½ w |
| 1R43 | 213758 | 20,000 ohm, ±5%, 3 w |
| 1R44 | 213756 | 10,000 ohm, ±5%, 3 w |
| 1R45 | | 10,000 ohm, ±10%, ½ w |
| 1R46 | 213759 | 2200 ohm, ±5%, 5 w |
| 1R47 | | 8200 ohm, ±5%, ½ w |
| 1R48 | | 20 ohm, ±5%, ½ w |
| 1R49 | | 8200 ohm, ±5%, 2 w |
| 1R50 | | 22,000 ohm, ±5%, ½ w |
| 1R51 | | 3.9 meg ohm, ±5%, ½ w |

| Symbol No. | Stock No. | Description |
|---|---|---|
| 1R52 | | 8.2 meg ohm, ± 10%, ½ w |
| 1R53 | | 220,000 ohm, ± 5%, ½ w |
| 1R54 | | 15,000 ohm, ± 5%, 2 w |
| 1R55 to 1R60 | | Not Used |
| 1R61 | | 470,000 ohm, ± 10%, ½ w |
| 1R62 | 213757 | 15,000 ohm, ± 5%, 3 w |
| 1R63 | | 270 ohm, ± 5%, ½ w |
| 1R64 | 213757 | 470,000 ohm, ± 10%, ½ w |
| 1R65 | | 910 ohm, ± 5%, ½ w |
| 1R66 | 213758 | 20,000 ohm, ± 5%, 3 w |
| 1R67 | 213756 | 10,000 ohm, ± 5%, 3 w |
| 1R68 | | 10,000 ohm, ± 10%, ½ w |
| 1R69 | 213759 | 2200 ohm, ± 5%, 5 w |
| 1R70 | | 8200 ohm, ± 5%, ½ w |
| 1R71 | | 20 ohm, ± 5%, ½ w |
| 1R72 | | 8200 ohm, ± 5%, 2 w |
| 1R73 | | 22,000 ohm, ± 5%, ½ w |
| 1R74 | | 3.9 meg ohm, ± 5%, ½ w |
| 1R75 | | 8.2 meg ohm, ± 10%, ½ w |
| 1R76 | | 220,000 ohm, ± 5%, ½ w |
| 1R77, 1R78 | | 470,000 ohm, ± 10%, ½ w |
| 1R79 | | 47,000 ohm, ± 10%, ½ w |
| 1R80 | | 10,000 ohm, ± 10%, ½ w |
| 1R81 | | 15,000 ohm, ± 5%, 2 w |
| 1T1 | 58619 | Transformer: filament |
| XF1 | 48894 | Holder: fuse |
| 1XK1 | 68590 | Socket: relay, 8 contacts |
| 1XV1 to 1XV12 | 94926 | Socket: tube, 9 contacts |
| | | *Miscellaneous* |
| | 207974 | Cover: insulating, capacitor cover |
| | 19820 | Plate: insulating, capacitor mtg. |
| **DECODER CHASSIS** | | |
| | | *CAPACITOR* |
| 2C1 | | Paper, 0.1 μf, ± 10%, 200 v |
| 2C2A/D | 214851 | Electrolytic, 80/10/40/30 + 50% - 10%, 450 v, + 100%, - 10%, 300 v |
| 2C3 | | Not Used |
| 2C4 | | Paper, 0.01 μf, + 10%, 400 v |
| 2C5 | | Not Used |
| 2C6 | | Paper, 0.01 μf, ± 10%, 400 v |
| 2C7 | | Paper, 0.22 μf, ± 10%, 200 v |
| 2C8 | | Mica, 10 μμf, ± 10%, 500 v |
| 2C9 to 2C12 | 59905 | Paper, 0.0047 μf ± 10%, 600 v |
| 2C13 | | Paper, 0.22 μf, ± 10%, 400 v |
| 2C14 | | Paper, 0.01 μf, ± 10%, 400 v |
| 2C15 | 206225 | Fixed, ceramic, 2 μμf, 500 v |

| Symbol No. | Stock No. | Description |
|---|---|---|
| 2C16, 2C17 | | Paper, 0.01 µf, ±10%, 400 v |
| 2C18 | | Paper, 0.1 µf, ±10%, 200 v |
| 2C19 | | Paper, 0.01 µf, ±10%, 400 v |
| 2C20 | 206225 | Fixed, ceramic, 2 µµf, 500 v |
| 2C21 | | Paper, 0.01 µf, ±10%, 400 v |
| 2C22 | 57602 | Variable, ceramic, 5-25 µµf |
| 2C23 | 99613 | Fixed, mica, 680 µµf ±10%, 300 v |
| 2C24 | | Paper, 0.22 µf, ±10%, 400 v |
| 2C25, 2C26 | | Not Used |
| 2C27 | | Paper, 0.22 µf, ±10%, 400 v |
| 2C28 | | 0.22 µf, ±10%, 100 v |
| 2C29 | | Paper, 0.1 µf, ±10%, 200 v |
| 2C30 | | Not Used |
| 2C31 | 214636 | Variable air, 7-102 µµf |
| 2C32 | | Not Used |
| 2C33 | | Paper, 0.22 µf, ±10%, 400 v |
| 2C34, 2C35 | 39644 | Mica, 470 µµf, ±5%, 500 v |
| 2C36 | | Not Used |
| 2C37 | | Paper, 0.1 µf, ±10%, 200 v |
| 2C38 | 59307 | Fixed, mica, 33 µµf, ±10%, 500 v |
| 2C39 | 99133 | Electrolytic, 10 µf, -10% ±50%, 450 v |
| 2C40 | | Paper, 0.47 µf, ±10%, 200 v |
| 2C41 | 99133 | Electrolytic, 10 µf, +50%, -10%, 450 v |
| 2C42 | | Paper, 0.47 µf, ±10%, 200 v |
| 2C43 | | Paper, 0.1 µf, ±10%, 400 v |
| 2C44 | 99133 | Electrolytic, 10 µf, -10% +50%, 450 v |
| 2C45 | | Paper, 0.22 µf, ±10%, 400 v |
| 2C46A/B | 214840 | Electrolytic, 50/80 µf, -10%, +50%, 475 v |
| 2C47 | 214875 | Fixed mica, 120 µµf, ±1%, 500 v |
| 2C48 | | Paper, 0.01 µf, ±10%, 400 v |
| 2C49 | 98422 | Fixed mica, 100 µµf, ±10%, 500 v |
| 2C50 | | Paper, 0.22 µf, ±10%, 400 v |
| 2C51 | | Paper, 0.047 µf, ±10%, 400 v |
| 2C52 | 99133 | Electrolytic, 10 µf, -10%, +50%, 450 v |
| 2C53 | 101200 | Ceramic, 3.0 µµf, ±5%, 500 v |
| 2C54 | 54598 | Ceramic, 12 µµf, ±5%, 500 v |
| 2C55 | 102646 | Ceramic, 18 µµf, ±5%, 500 v |
| 2C56 | | Paper, 0.01 µf ±10%, 400 v |
| 2C57 | | Paper, 0.22 µf ±10%, 400 v |
| 2C58 | 214875 | Fixed mica, 120 µµf, ±1%, 500 v |
| 2C59 | | Paper, 0.22 µf, ±10%, 400 v |
| 2C60 | 99582 | Fixed ceramic, 5.0 µµf, ±5%, 500 v |
| 2C61 to 2C64 | | Paper, 0.22 µf, ±10%, 400 v |
| 2C65 | 99133 | Electrolytic, 10 µf, -10%, +50%, 450 v |
| 2C66A/B | 214850 | Electrolytic, 150/150 µf, -10% +100%, 250 v |
| 2C67 | 99133 | Electrolytic, 10 µf, -10% +50%, 450 v |
| 2C68 | | No Used |

| Symbol No. | Stock No. | Description |
|---|---|---|
| 2C69 | | Not Used |
| 2C70 | 98409 | Fixed mica, 27 μμf, ±10%, 500 v |
| 2C71 | 57602 | Variable ceramic, 5-25 μμf |
| 2C72 | 99689 | Ceramic, 2.0 μμf, 500 v |
| 2C73 | | Paper, 0.47 μf, ±10%, 200 v |
| 2C74 | | Paper, 0.1 μf, ±10%, 400 v |
| 2C75 | 97793 | Mica, 82 μμf, ±10%, 500 v |
| 2C76 | 102646 | Ceramic, 18 μμf, ±5%, 500 v |
| 2C77 | | Not Used |
| 2C78 | | Paper, 0.1 μf, ±10%, 200 v |
| 2C79 | 214874 | Mica, 82 μμf, ±1%, 500 v |
| 2C80 to 2C82 | 98416 | Mica, 180 μμf, ±1%, 500 v |
| 2C83 | 206324 | Mica, 68 μμf, ±1%, 500 v |
| 2C84 | | Not Used |
| 2C85 | 99133 | Electrolytic, 10 μf, -10% +50%, 450 v |
| 2C86 | | Paper, 0.47 μf, ±10%, 400 v |
| 2C87 | | Paper, 0.033 μf, ±10%, 400 v |
| 2C88 | | Paper, 0.1 μf, ±10%, 400 v |
| 2C89 | | Paper, 0.47 μf, ±10%, 200 v |
| 2C90 | | Paper, 0.022 μf, ±10%, 400 v |
| 2C91 | | Paper, 0.22 μf, ±10%, 400 v |
| 2C92 | 99160 | Mica, 120 μμf, ±5%, 500 v |
| 2C93 | | Paper, 0.47 μf, ±10%, 200 v |
| 2C94 | 214737 | Electrolytic, 1000 μμf, -10%, +250%, 15 v |
| 2C95 | 98409 | Mica, 27 μμf, ±5%, 500 v |
| 2C96 | | Not Used |
| 2C97 | | Paper, 0.33 μf, ±5%, 400 v |
| 2C98 | | Not Used |
| 2C99 | | Electrolytic, 25 μf, 150 v |
| 2C100 | | Electrolytic, 250 μf, 25 v |
| 2C101 | | Electrolytic, 40 μf, 150 v |
| 2C102 | | Electrolytic, 250 μf, 12 v |
| 2C103 | | Ceramic, 5-50 μμf |
| 2CR1 | | Not Used |
| 2CR2, 2CR3 | 98509 | Rectifier: crystal diode (1N58A) |
| 2CR4 | | Not Used |
| 2CR5, 2CR6 | 59395 | Rectifier: crystal diode, (1N34A) |
| 2CR7 | 98509 | Rectifier: crystal diode, (1N58A) |
| 2CR8 | 99483 | Rectifier: crystal diode, (1N54) |
| 2CR9 | 99483 | Rectifier: crystal diode, (1N54) |
| 2CR10 | 98509 | Rectifier: crystal diode, (1N58A) |
| 2CR11 | 207403 | Diode, (1N100) |
| 2DL1 | 214942 | Delay Line: "M" delay |
| 2DL2, 2DL3 | 214943 | Delay Line: APT delay |
| 2DL4 | | Not Used |
| 2DL5 | 214994 | Delay Line: "I" delay |
| 2F1 | 205121 | Fuse: 1.0 amp |

| Symbol No. | Stock No. | Description |
|---|---|---|
| 2J1 to 2J8 | | Not Used |
| 2J9 | 32660 | Connector: male, 2 contact |
| 2J10 | 98258 | Connector: male, 4 contact |
| 2J11 to 2J14 | 51800 | Connector: female, coaxial |
| 2K1, 2K2 | 215302 | Relay: DPDT |
| 2K3 | 213979 | Relay: sync interlock |
| 2L1 | 205518 | Coil: RF Choke |
| 2L2 to 2L4 | | Not Used |
| 2L5 | 210531 | Coil: peaking |
| 2L6 | 204681 | Coil: RF choke |
| 2L7 | 203437 | Coil: video |
| 2L8, 2L9 | 214858 | Coil: peaking |
| 2L10 | 213198 | Coil: peaking |
| 2L11 | 205518 | Coil: RF choke |
| 2L12 | 202911 | Coil: RF choke |
| 2L13 | 214924 | Coil: RF choke |
| 2L14 | 214859 | Coil: peaking |
| 2L15 | 204755 | Coil: peaking |
| 2L16 | 204754 | Coil: peaking |
| 2L17 | 214860 | Coil: peaking |
| 2L18 | 214861 | Coil: peaking |
| 2L19 | 214945 | Coil: delay line |
| 2L20 | 202911 | Coil: RF choke |
| 2L21 | | Not Used |
| | | *RESISTORS:* |
| | | *Fixed composition unless otherwise specified* |
| 2R1 | | 1 meg, ohm ±10%, ½ w |
| 2R2 | | Not Used |
| 2R3 | | 1 meg, ohm ±10%, ½ w |
| 2R4, 2R5 | | Not Used |
| 2R6, 2R7 | 214941 | ww, 20,000 ohm ±5%, 5 w |
| 2R8 to 2R10 | | Not Used |
| 2R11 | | 27,000 ohm, ±10%, ½ w |
| 2R12 | | 47,000 ohm, ±10%, 1 w |
| 2R13 | | Not Used |
| 2R14 | | 1 meg, ohm ±10%, ½ w |
| 2R15 | | 39,000 ohm ±10%, 2 w |
| 2R16 | | 470,000 ohms ±10%, ½ w |
| 2R17 | | Not Used |
| 2R18 | | 5600 ohm ±5%, 2 w |
| 2R19 | | 1 meg, ohm ±10%, ½ w |
| 2R20 | | 18,000 ohm ±10%, 1 w |
| 2R21 | | 15,000 ohm ±10%, ½ w |
| 2R22 | | 1 meg, ±5%, ½ w |
| 2R23 | 214847 | Variable, 250,000 ohm ±10%, 2 w |
| 2R24 | | 1 meg, ohm ±5%, ½ w |
| 2R25 | | 390,000 ohm ±10%, ½ w |

| Symbol No. | Stock No. | Description |
|---|---|---|
| 2R26 | | 100,000 ohm ±10%, ½ w |
| 2R27 | 214847 | Variable, 250,000 ohm ±10%, 2 w |
| 2R28 | | 1 meg, ohm ±10%, ½ w |
| 2R29 | | 270,000 ohm ±10%, ½ w |
| 2R30 | | 6800 ohm ±10%, 2 w |
| 2R31 | | 36,000 ohm ±5%, 2 w |
| 2R32 | | 10,000 ohm ±10%, ½ w |
| 2R33 | | 33,000 ohm ±10%, ½ w |
| 2R34 | | 1000 ohm ±10%, ½ w |
| 2R35 | | 2200 ohm ±5%, ½ w |
| 2R36 | | 330 ohm ±10%, ½ w |
| 2R37 | | 12,000 ohm ±10%, ½ w |
| 2R38 | | 27,000 ohm ±10%, 1 w |
| 2R39 | | 150,000 ohm ±10%, ½ w |
| 2R40 | | 39,000 ohm ±10%, 2 w |
| 2R41 | | Not Used |
| 2R42 to 2R47 | | Not Used |
| 2R48 to 2R51 | | Not Used |
| 2R52 | | 100,000 ohm ±10%, ½ w |
| 2R53 | | 100 ohm ±10%, ½ w |
| 2R54 | | 100,000 ohm ±10%, ½ w |
| 2R55 to 2R57 | | Not Used |
| 2R58 | | 110,000 ohm ±5%, 1 w |
| 2R59 | | 15,000 ohm ±5%, ½ w |
| 2R60 | | 10,000 ohm ±10%, ½ w |
| 2R61 | | Not Used |
| 2R62, 2R63 | | 100 ohm ±10%, ½ w |
| 2R64 | | 39,000 ohm ±10%, 1 w |
| 2R65 | 214937 | ww, 3000 ohm ±1%, 10 w |
| 2R66 | | 1 meg ohm ±10%, ½ w |
| 2R67 | 214902 | 100 ohm ±1%, 1 w |
| 2R68 | | 4700 ohm ±10%, ½ w |
| 2R69 | | 6800 ohm ±5%, ½ w |
| 2R70 | | 100,000 ohm ±5%, ½ w |
| 2R71 | 205550 | Variable, 50,000 ohm ±10%, 2 w |
| 2R72 | 214884 | 2320 ohm ±1%, ½ w |
| 2R73 | 214896 | 13,300 ohm ±1%, ½ w |
| 2R74 | 214898 | 24,900 ohm ±1%, ½ w |
| 2R75 | | 1000 ohm ±10%, ½ w |
| 2R76 | | 470 ohm ±10%, ½ w |
| 2R77 | | 1000 ohm ±10%, ½ w |
| 2R78 | | 43,000 ohm ±5%, 1 w |
| 2R79 | 214894 | 8870 ohm ±1%, ½ w |
| 2R80 | | 680,000 ohm ±10%, ½ w |
| 2R81 | 214903 | 1740 ohm ±1%, 1 w |
| 2R82 | 214889 | 3320 ohm ±1%, ½ w |
| 2R83 | 214898 | 24,900 ohm ±1%, ½ w |

| Symbol No. | Stock No. | Description |
|---|---|---|
| 2R84 | | 680,000 ohm ±10%, ½ w |
| 2R85 | | 27,000 ohm ±10%, 1 w |
| 2R86 | 214886 | 2940 ohm ±1%, ½ w |
| 2R87 | | 39,000 ohm ±10%, 1 w |
| 2R88 | | ww 2700 ohm ±1%, 5 w |
| 2R89 | | 15,000 ohm ±5%, ½ w |
| 2R90 | | 470,000 ohm ±10%, ½ w |
| 2R91 | | 27,000 ohm ±10%, 1 w |
| 2R92 | | 10,000 ohm ±5%, ½ w |
| 2R93 | | 39,000 ohm ±5%, ½ w |
| 2R94 | | 6800 ohm ±5%, ½ w |
| 2R95, 2R96 | | 6200 ohm ±5%, ½ w |
| 2R97 | | 7500 ohm ±5%, ½ w |
| 2R98 | | 100 ohm ±10%, ½ w |
| 2R99 | | 180 ohm ±10%, ½ w |
| 2R100 | 78907 | ww, 4000 ohm ±5%, 5 w |
| 2R101 | 214882 | 100 ohm ±1%, ½ w |
| 2R102 | | 20,000 ohm ±5%, ½ w |
| 2R103 | | 470 ohm ±10%, ½ w |
| 2R104 | 206913 | Variable, 1000 ohm ±10%, 2 w |
| 2R105 | 214940 | ww, 14,000 ohm ±5%, 5 w |
| 2R106 | | 1 meg ohm ±10%, ½ w |
| 2R107 | 216311 | 5110 ohm ±1%, 1 w |
| 2R108 | | 100,000 ohm ±10%, ½ w |
| 2R109 | 214883 | 1430 ohm ±1%, ½ w |
| 2R110 | | 20,000 ohm ±5%, ½ w |
| 2R111, 2R112 | | 1 meg ohm ±10%, ½ w |
| 2R113 | 214885 | 2740 ohm ±1%, ½ w |
| 2R114 | 214906 | 18,200 ohm ±1%, 1 w |
| 2R115 | 214895 | 11,000 ohm ±1%, ½ w |
| 2R116 | 214887 | 3010 ohm ±1%, ½ w |
| 2R117, 2R118 | | 1 meg ohm ±10%, ½ w |
| 2R119, 2R120 | | 27,000 ohm ±10%, 1 w |
| 2R121 | 216899 | 5490 ohm ±1%, ½ w |
| 2R122 | 214886 | 2940 ohm ±1%, ½ w |
| 2R123 | | 1 meg ohm ±10%, ½ w |
| 2R124 | 214904 | 3010 ohm ±1%, 1 w |
| 2R125 | 214883 | 1430 ohm ±1%, ½ w |
| 2R126 | | 39,000 ohm ±10%, 1 w |
| 2R127 | | 1 meg ohm ±10%, ½ w |
| 2R128 | | 27,000 ohm ±10%, 1 w |
| 2R129 | 214892 | 4420 ohm ±1%, ½ w |
| 2R130 | 214896 | 13,300 ohm ±1%, ½ w |
| 2R131 | 214891 | 3480 ohm ±1%, ½ w |
| 2R132 | 214893 | 6980 ohm ±1%, ½ w |
| 2R133 | 214888 | 3090 ohm ±1%, ½ w |
| 2R134 | 214897 | 19,100 ohm ±1%, ½ w |

| Symbol No. | Stock No. | Description |
|---|---|---|
| 2R135 | 214898 | 24,900 ohm ±1%, ½ w |
| 2R136 | 214899 | 26,100 ohm ±1%, ½ w |
| 2R137 | | Not Used |
| 2R138 | | 27,000 ohm ±10%, 1 w |
| 2R139 | 52443 | Variable, 20,000 ohm ±10%, 2 w |
| 2R140 | | Not Used |
| 2R141 | 52443 | 20,000 ohm ±10%, 2 w, variable |
| 2R142, 2R143 | | 27,000 ohm ±10%, 1 w |
| 2R144 | 214895 | 11,000 ohm ±1%, ½ w |
| 2R145 | 52598 | 200 ohm ±10%, 2 w |
| 2R146 | 214892 | 4420 ohm ±1%, ½ w |
| 2R147 | | 8.2 meg, ohm ±10%, 2 w |
| 2R148 | | Not Used |
| 2R149 | 214882 | 100 ohm ±1%, ½ w |
| 2R150 | | Not Used |
| 2R151 | | 16,000 ohm ±5%, ½ w |
| 2R152, 2R153 | | 100 ohm ±10%, ½ w |
| 2R154 | | 4700 ohm ±10%, ½ w |
| 2R155 | | 100 ohm ±10%, ½ w |
| 2R156 | | 220 ohm ±10%, ½ w |
| 2R157 | | 100,000 ohm ±10%, ½ w |
| 2R158 | | 100 ohm ±10%, ½ w |
| 2R159, 2R160 | 214894 | 8870 ohm ±1%, ½ w |
| 2R161 | 214884 | 2320 ohm ±1%, ½ w |
| 2R162 to 2R164 | | Not Used |
| 2R165 | | 2000 ohm ±5%, 2 w |
| 2R166 | | 1.5 meg ohm ±5%, ½ w |
| 2R167 | | 10,000 ohm ±5%, 2 w |
| 2R168 | | 4700 ohm ±5%, 2 w |
| 2R169 | | 39 ohm ±5%, ½ w |
| 2R170 | | 2000 ohm ±5%, 1 w |
| 2R171 | | 2 meg, ±5%, ½ w |
| 2R172 | | 91,000 ohm ±5%, 2 w |
| 2R173 | | 2.4 meg ±5%, ½ w |
| 2R174 | | 8200 ohm ±5%, ½ w |
| 2R175 | | 56,000 ohm ±5%, 2 w |
| 2R176 | | 270 ohm ±5%, ½ w |
| 2R177 | | 200,000 ohm ±5%, ½ w |
| 2R178 | | 33,000 ohm ±5%, 2 w |
| 2R179 | | 56 ohm ±5%, ½ w |
| 2R180 | | 91,000 ohm ±5%, ½ w |
| 2R181 | | 13,000 ohm ±5%, 2 w |
| 2R182 | | 430 ohm ±5%, ½ w |
| 2R183 | | 56,000 ohm ±5%, ½ w |
| 2R184 | | 18,000 ohms ±5%, ½ w |
| 2R185 | 214895 | Film, 11,000 ohm ±1%, ½ w |
| 2R186 | | Film, 1.0 meg ohm ±5%, ½ w |

| Symbol No. | Stock No. | Description |
|---|---|---|
| 2R187 | | Film, 470 ohm ±5%, ½ w |
| 2R188 | | Film, 510 ohm ±5%, ½ w |
| 2R189 | | Film, 1.0 meg ohm ±5%, ½ w |
| 2R190 | | Film, 2000 ohm ±5%, ½ w |
| 2R191 | | Film, 13,000 ohm ±5%, 2 w |
| 2R192 | | Film, 27,000 ohm ±5%, 2 w |
| 2R193 | | Film, 430 ohm ±5%, 1 w |
| 2R194 | | Film, 2700 ohm ±5%, ½ w |
| 2R195 | | Film, 160 ohm ±10%, 1 w |
| 2R196 | | Film, 220 ohm ±5%, ½ w |
| 24197 | 52598 | Variable, 200 ohm ±10%, 2 w |
| 2R198 | | Variable, 47 ohm ±5%, ½ w |
| 2R199 | | ww, 8000 ohm ±5%, 5 w |
| 2R200 | | ww, 6000 ohm ±5%, 10 w |
| 2R201 | | ww, 68,000 ohm ±5%, 1 w |
| 2S1 | 214411 | Switch: rotary, 1 section, 3 position |
| 2S2 | 214413 | Switch: rotary, 3 section, 5 position |
| 2T1, 2T2 | | Not Used |
| 2T3 | 98985 | Transformer: RF |
| 2T4 | 95539 | Transformer: filament |
| 2XCR6 | 95470 | Holder: crystal |
| 2XCR7 | | Not Used |
| 2XCR8, 2XCR9 | 95470 | Holder: crystal |
| 2XF1 | 99218 | Holder: fuse |
| 2XF1 to 2XK3 | 68590 | Socket: relay, 8 contacts |
| 2XV1 | 94925 | Socket: tube 7 contacts |
| 2XV2 to 2XV6 | 94926 | Socket: tube 9 contacts |
| 2XV7 | 94925 | Socket: tube 7 contacts |
| 2XV8 to 2XV14 | 94926 | Socket: tube 9 contact |
| 2XV15 | 94925 | Socket: tube 7 contact |
| 2XV16 to 2XV18 | 94926 | Socket: tube 9 contact |
| 2XV19 & 2XV22 | | Not Used |
| 2XV20 | 94925 | Socket: tube 7 contact |
| 2XV21 | 94926 | Socket: tube 9 contact |
| 2XV23 | 94926 | Socket: tube 9 contacts |
| 2XV24 | 94926 | Socket: tube 9 contacts |
| 2XY1 | 205062 | Socket: crystal |
| 2Y1 | 78896 | Crystal: 3.579545 |
| 2Z1 | 78886 | Transformer: video |
| 2Z2 | 213840 | Transformer: RF |
| 2Z3 | 213839 | Transformer: oscillator |
| | | *Miscellaneous* |
| | 19820 | Plate: insulating, capacitor mtg. |
| | 97745 | Terminal: stand-off |

| Symbol No. | Stock No. | Description |
|---|---|---|
| **DEFLECTION AND HV CHASSIS** | | |
| | | *CAPACITORS:* |
| 3C1 | | Paper, 0.47 μf, ±10%, 200 v |
| 3C2 | 98948 | Mica, 270 μμf, ±5%, 500 v |
| 3C3 | 79191 | Mica, 330 μμf, ±5%, 500 v |
| 3C4 | | Paper, 0.1 μf, ±10%, 400 v |
| 3C5 | | Paper, 0.047 μf, ±10%, 400 v |
| 3C6 | 214871 | Mica, 8200 μμf, ±10%, 300 v |
| 3C7 | | Paper, 0.1 μf, ±10%, 400 v |
| 3C8 | | Paper, 0.47 μf, ±10%, 200 v |
| 3C9A/B | 204815 | Electrolytic, 10/169 μμf, +250% -10%, 500 v |
| 3C10 | 98948 | Mica, 270 μμf, ±5%, 500 v |
| 3C11 | | Paper, 0.01 μf, ±10%, 600 v |
| 3C12 | | Paper, 0.01 μf, ±10%, 600 v |
| 3C13 | 39650 | Mica, 820 μμf, ±5%, 500 v |
| 3C14, 3C15 | | Paper, 0.047 μf, ±10%, 400 v |
| 3C16A to 3C16D | 206276 | Electrolytic, 20/10/10/10 μf, +50% -10%, 450 |
| 3C17 | | Not Used |
| 3C18 | 100398 | Ceramic, 2500 μμf, +50% -20%, 30 KV |
| 3C19, 3C20 | | Paper, 0.47 μf, ±10%, 200 v |
| 3C21 | | Ceramic, 5000 μμf min, 3000 v |
| 3C22, 3C23 | | Not Used |
| 3C24 | 100446 | Ceramic, 1000 μμf, +100% -0%, 5 KV |
| 3C25 | | Paper, 0.1 μf, ±10%, 600 v |
| 3C26 | | Paper, 0.15 μf, ±10%, 400 v |
| 3C27 | | 5000 μμf min, 3000 v |
| 3C28 to 3C31 | | Paper, 0.01 μf, ±10%, 600 v |
| 3C32 | | Paper, 0.22 μf, ±10%, 400 v |
| 3C33 to 3C35 | | 5000 μμf min, 3000 v |
| 3C36, 3C37 | | Not Used |
| 3C38A/B/C | 211768 | Electrolytic, 40/40/10 μf, +50%, -10%, 450 v |
| 3C39 | | Mica, 8200 μμf, ±2%, 300 v |
| 3C40 | | Paper, 0.1 μf, ±10%, 600 v |
| 3C41 | 215083 | Ceramic, 0.001 μf, ±10%, 1000 v |
| 3C42 | | Not Used |
| 3C43 | | 5000 μμf min, 3000 v |
| 3C44 | | Paper, 0.01 μf, ±10%, 1000 v |
| 3C45 | 206732 | Electrolytic, 100 μf, +50% -10%, 150 v |
| 3C46 | 214737 | Electrolytic, 1000 μf, +250% -10%, 15 v |
| 3C47 | | Not Used |
| 3C48 | 205887 | Paper, 1.0 μf, ±10%, 100 v |
| 3C49, 3C50 | | Paper, 0.01 μf, ±10%, 600 v |
| 3C51 | | Paper, 0.47 μf, ±10%, 200 v |
| 3C52 | 76992 | Mica, 470 μμf, 5%, 500 v |
| 3C53 | | Not Used |
| 3C54 | | Paper, 0.01 μf, ±10%, 600 v |

| Symbol No. | Stock No. | Description |
|---|---|---|
| 3C55 | | Not Used |
| 3C56 | | Not Used |
| 3C57A/B/C | 211768 | Electrolytic, 40/40/10 μf, +50% -10%, 450 v |
| 3C58 | | 470 μμf, 3000 v |
| 3C59 | 214737 | Electrolytic, 1000 μf, +250% -10%, 15 v |
| 3C60, 3C61 | | Not Used |
| 3C62 | 214871 | Mica, 8200 μμf, ±10%, 300 v |
| 3C63 | 214854 | Electrolytic, 500 μf, +250% -10%, 6 v |
| 3CR3 | 226504 | Diode, 1N978 |
| 3CR4 | 226504 | Diode, 1N978 |
| 3CR5 | 226504 | Diode, 1N978 |
| 3F1 | 93939 | Fuse: 2 amp Slo-Blo |
| 3J1 | | Not Used |
| 3J2 | 202949 | Connector: female, 27 contacts |
| 3J3 | 208505 | Connector: yoke |
| 3J4 | 7903 | Not Used |
| 3J5 | 213998 | Connector: hi-voltage |
| 3L1 | 213754 | Coil: hor. osc. |
| 3L2 | 213755 | Coil: sine wave stab. |
| 3L3 | 214912 | Coil: width adj. |
| 3L4 | 214913 | Coil: width fixed |
| 3L5 | 214914 | Coil: hor. tuning |
| 1P3 | 213494 | Connector: male, green |
| 1P4 | 213495 | Connector: male, blue |
| 1P5 | 213493 | Connector: male, red |
| 3PC1 | 79246 | Integrator |
| | | *RESISTORS:* |
| | | *Fixed composition unless otherwise specified* |
| 3R1 | | 1 meg ohm, ±5%, 1 w |
| 3R2 | | 2.2 meg ohm, ±10%, 1 w |
| 3R3 | | 12,000 ohm, ±5%, 1 w |
| 3R4 | | 330,000 ohm, ±5%, 1 w |
| 3R5 | | 820,000 ohm, ±5%, 1 w |
| 3R6 | | 82,000 ohm, ±5%, 1 w |
| 3R7 | | 150,000 ohm, ±5%, 1 w |
| 3R8 | | 3900 ohm, ±5%, 1 w |
| 3R9 | | 100,000 ohm, ±5%, 1 w |
| 3R10 | | 150,000 ohm, ±5%, 1 w |
| 3R11, 3R12 | | 68,000 ohm, ±5%, 1 w |
| 3R13 | | 470,000 ohm, ±5%, 1 w |
| 3R14 | | Not Used |
| 3R15 | | 470 ohm, ±10%, 2 w |
| 3R16 | | Not Used |
| 3R17 | | 470 ohm, ±10%, ½ w |
| 3R18 | | 470, 000 ohm, ±5%, 1 w |
| 3R19 | | 47,000 ohm, ±5%, 2 w |
| 3R20 | | Not Used |

| Symbol No. | Stock No. | Description |
|---|---|---|
| 3R21 | | 470 ohm, ±10%, 2 w |
| 3R22 | | 470 ohm, ±10%, ½ w |
| 3R23 | 215079 | Variable, 250,000 ohm, ±10%, 2 w |
| 3R24 | 214625 | Variable, 100 ohm, ±10%, 2 w |
| 3R25, 3R26 | | 100 ohm, ±5%, 1 w |
| 3R27 | | 1.5 meg ohm, ±5%, 1 w |
| 3R28, 3R29 | | Not Used |
| 3R30 to 3R32 | | 10 meg ohm, ±5%, 2 w |
| 3R33, 3R34 | | 1 meg ohm, ±5%, 1 w |
| 3R35 | | Not Used |
| 3R36 | | 22,000 ohm, ±5%, ½ w |
| 3R37 | | 100 meg ohm, ±20%, 1 w |
| 3R38 | | 100 ohm, ±5%, 1 w |
| 3R39 | | 1.8 meg ohm, ±5%, 1 w |
| 3R40 | | 1.5 meg ohm, ±5%, 1 w |
| 3R41 | 95246 | Variable, 500,000 ohm, ±10%, 2 w |
| 3R42 | | 22,000 ohm, ±5%, 1 w |
| 3R43 | | 8.2 meg ohm, ±5%, ½ w |
| 3R44 | | 300,000 ohm, ±5%, 1 w |
| 3R45 | | 100,000 ohm, ±5%, 1 w |
| 3R46 | | 10,000 ohm, ±5%, 1 w |
| 3R47, 3R48 | | 1 meg ohm, ±5%, 1 w |
| 3R49 | | 470,000 ohm, ±5%, 1 w |
| 3R50 | | 3.3 meg ohm, ±5%, 1 w |
| 3R51 to 3R54 | | 1 meg ohm, ±5%, 1 w |
| 3R55 | | Not Used |
| 3R56 | | 15,000 ohm, ±5%, 1 w |
| 3R57 | | 200,000 ohm, ±5%, 1 w |
| 3R58 | | 510,000 ohm, ±5%, 1 w |
| 3R59 | | 1 meg ohm, ±5%, 1 w |
| 3R60 | | Not Used |
| 3R61, 3R62 | | Not Used |
| 3R63, 3R64 | | 47,000 ohm, ±5%, 2 w |
| 3R65 to 3R69 | | Not Used |
| 3R70 | | 390,000 ohm, ±5%, 1 w |
| 3R71 | | 150,000 ohm, ±5%, 1 w |
| 3R72 | | Not Used |
| 3R73, 3R74 | | 1 meg ohm, ±5%, 1 w |
| 3R75 | | 22,000 ohm, ±5%, 1 w |
| 3R76 | | 39,000 ohm, ±5%, 1 w |
| 3R77 | | 24,000 ohm, ±5%, 1 w |
| 3R78 | | 680,000 ohm, ±5%, 1 w |
| 3R79 | | 10 ohm, ±5%, 1 w |
| 3R80 | | 220,000 ohm, ±5%, 1 w |
| 3R81 | | 12,000 ohm, ±5%, 1 w |
| 3R82 | | Not Used |
| 3R83 | | Not Used |

| Symbol No. | Stock No. | Description |
|---|---|---|
| 3R84 | | 300,000 ohm, ±5%, 1 w |
| 3R85 | | 360,000 ohm, ±5%, 1 w |
| 3R86 | | 390,000 ohm, ±5%, 1 w |
| 3R87 | | Not Used |
| 3R88 | | Not Used |
| 3R89 | | 300,000 ohm, ±5%, 1 w |
| 3R90 | | 360,000 ohm, ±5%, 1 w |
| 3R91 | | 390,000 ohm, ±5%, 1 w |
| 3R92, 3R93 | | Not Used |
| 3R94 | | 300,000 ohm, ±5%, 1 w |
| 3R95 | | 360,000 ohm, ±5%, 1 w |
| 3R96 | | 390,000 ohm, ±5%, 1 w |
| 3R97, 3R98 | | Not Used |
| 3R99 | | 180,000 ohm, ±5%, 1 w |
| 3R100 | | 510 ohm, ±5%, ½ w |
| 3R101 | | 51,000 ohm, ±5%, 1 w |
| 3R102 | 217237 | 2400 ohm, ±5%, 7 w |
| 3R103 | | 30,000 ohm, ±5%, 1 w |
| 3R104 | | 100 ohm, ±5%, 1 w |
| 3R105 | | 33,000 ohm, ±5%, 1 w |
| 3R106, 3R107 | 96214 | 15,000 ohm, ±5%, 10 w |
| 3R108 | | 5600 ohm, ±10%, 1 w |
| 3R109 | 217268 | 221,000 ohm, ±1%, ½ w |
| 3S1 | 214415 | Swtich: rotary, size |
| 3T1 | 214870 | Transformer: hi-voltage |
| 3T2 | 51936 | Transformer: vert. pulse |
| 3T3 | | Not Used |
| 3T4 | 95539 | Transformer: filament |
| 3T5 | 58619 | Transformer: filament |
| 3T6 | 105193 | Transformer: vert. defl. |
| 3XF1 | 48894 | Holder: fuse |
| 3XV1 | 94925 | Socket: tube, 7 contacts |
| 3XV2, 3XV3 | 94926 | Socket: tube, 9 contacts |
| 3XV4 | 68590 | Socket: tube, 8 contacts |
| 3XV5 to 3XV8 | 94926 | Socket: tube, 9 contacts |
| 3XV9, 3XV10 | 208505 | Socket: tube, 8 contacts |
| 3XV11 | 102166 | Socket: tube, hi-voltage, 8 contacts |
| 3XV12 to 3XV15 | | Not Used |
| 3XV16 | 100373 | Socket: tube, 9 contacts |
| 3XV17 | 208505 | Socket: tube, 8 contacts |
| 3XV18 | 208505 | Socket: tube, 8 contacts |
| 6XV2 | 214868 | Socket: tube, kine |
| | | *Miscellaneous:* |
| | 207990 | Cover: insulating, capacitor, 3C45 |
| | 100399 | Insulator: high voltage (3B2) |
| | 94878 | Knob: rubber |

| Symbol No. | Stock No. | Description |
|---|---|---|
| | 28452 | Plate: capacitor mtg. 3C45 |
| | 97745 | Terminal: stand-off, 15/16'' ht, 4/40 tap |
| | | **POWER SUPPLY CHASSIS** |
| | | *CAPACITORS:* |
| 4C1 | 214853 | Electrolytic, 250 $\mu$f, -10%, +100%, 200 v |
| 4C2, 4C3 | 214848 | Electrolytic, 200$\mu$f, -10%, +100%, 200 v |
| 4C4 to 4C8 | 99123 | Electrolytic, 80 $\mu$f, -10%, +100%, 400 v |
| 4C9 | | Paper, 0.1 $\mu$f, ±10%, 400 v |
| 4C10 | | Paper, P.22 $\mu$f, ±10%, 400 v |
| 4C11, 4C12 | 214849 | Electrolytic, 100 $\mu$f, -10%, +100%, 350 v |
| 4C13 | 214735 | Paper, 1.0 $\mu$f, ±10%, 400 v |
| 4C14 | | Paper, 0.1 $\mu$f, ±10%, 600 v |
| 4C15 | | Paper, 0.1 $\mu$f, ±10%, 400 v |
| 4C16 | | Paper, 0.22 $\mu$f, ±10%, 400 v |
| 4C17A/B, 18A/B | 204731 | Electrolytic, 40/40 $\mu$f, -10% +50%, 450 v |
| 4C19 | | Paper, 0.1 $\mu$f, ±10%, 400 v |
| 4C20 | | Paper, 0.22 $\mu$f, ±10%, 400 v |
| 4C21 | | Paper, 0.1 $\mu$f, ±10%, 400 v |
| 4C22 | | Not Used |
| 4CR1 | 214918 | Rectifier: germanium |
| 4CR2 | 214021 | Rectifier: germanium |
| 4CR3 | 214919 | Rectifier: germanium |
| 4F1 | 211405 | Fuse: 2.0 amp |
| 4F2 | 214876 | Fuse: 8.0 amp |
| 4F3 | 214926 | Fuse: 5.0 amp |
| 4F4, 4F5 | 211405 | Fuse: 2.0 amp |
| 4F6 to 4F8 | 211413 | Fuse: ½ amp. |
| 4I1 | | Part of 4XF1 (lamp) |
| 4I2 | | Lamp: part of 4XF2 |
| 4I3 | | Lamp: part of 4XF3 |
| 4I4 | | Lamp: part of 4XF4 |
| 4I5 | | Lamp: indicating part of 4XF5 |
| 4I6 | | Lamp: part of 4XF6 |
| 4I7 | | Lamp: part of 4XF7 |
| 4I8 | | Lamp: part of 4XF8 |
| 4J1 | | Not Used |
| 4J2 | 53401 | Connector: jack type |
| 4K1 | 213659 | Relay |
| 4R1 to 4R8 | | 220,000 ohm ±5%, ½ w |
| 4R9 | | 1.0 meg ±10%, 1 w |
| 4R10 to 4R13 | | WW, 250 ohm 50 w |
| 4R14 | 214862 | 470 ohm ±10%, 1 w |
| 4R15, 4R16 | | ww, 200 ohm ±5%, 5 w |
| 4R17 | 214923 | 470 ohm ±10%, 1 w |
| 4R18 | | 470,000 ohm ±10%, 1 w |

| *Symbol No.* | *Stock No.* | *Description* |
|---|---|---|
| 4R19 | | 470 ohm ±10%, 1 w |
| 4R20 | 214923 | ww, 200 ohm ±5%, 5 w |
| 4R21 | | 2.0 meg ±5%, ½ w |
| 4R22 | | 1.0 meg ohm ±5%, ½ w |
| 4R23, 4R24 | 214911 | 40,200 ohm ±1%, 2 w |
| 4R25 | 208038 | 499,000 ohm ±1%, ½ w |
| 4R26, 4R27 | | 470,000 ohm ±10%, 1 w |
| 4R28 | 214877 | 13,000 ohm ±5%, 3 w |
| 4R29 | | 6.8 meg ohm ±10%, 1 w |
| 4R30 | 214881 | 20,000 ohm ±5%, 7 w |
| 4R31 | | 510 ohm ±5%, 1 w |
| 4R32 | 214923 | ww, 200 ohm ±5%, 5 w |
| 4R33 | | 470 ohm ±10%, 1 w |
| 4R34 | | 470,000 ohm ±10%, 1 w |
| 4R35 | | 470 ohm ±10%, 1 w |
| 4R36, 4R37 | 214923 | ww, 200 ohm ±5%, 5 w |
| 4R38 | | 470 ohm ±10%, 1 w |
| 4R39 to 4R41 | 56880 | ww, 200 ohm 50 w |
| 4R42 | | Not Used |
| 4R43 | 216898 | 1.05 meg ohm ±1%, ½ w |
| 4R44 | 208038 | 499,000 ohm ±1%, ½ w |
| 4R45 | 214911 | 40,200 ohm ±1%, 2 w |
| 4R46 | 214907 | 8060 ohm ±1%, 2 w |
| 4R47 | 214901 | 649,000 ohm ±1%, ½ w |
| 4R48 | | 27,000 ohm ±5%, 1 w |
| 4R49 | | 200,000 ohm ±5%, 1 w |
| 4R50 | | 82,000 ohm ±5%, 1 w |
| 4R51 | | 62,000 ohm ±5%, 1 w |
| 4R52 | | 220,000 ohm ±5%, 1 w |
| 4R53 | 214879 | 1000 ohm ±5%, 7 w |
| 4R54 | | 470 ohm ±10%, 1 w |
| 4R55, 4R56 | 214923 | ww, 200 ohm ±5%, 5 w |
| 4R57 | | 470 ohm ±10%, 1 w |
| 4R58 | | 470,000 ohm ±10%, 1 w |
| 4R59 | 56085A | 200,000 ohm ±1%, 1 w |
| 4R60 | 214905 | 4990 ohm ±1%, 1 w |
| 4R61 | 214910 | 30,100 ohm ±1%, 2 w |
| 4R62 | 208022 | 1.0 meg ohm ±1%, ½ w |
| 4R63 | 206018 | 475,000 ohm ±1%, ½ w |
| 4R64 | 214909 | 13,000 ohm ±1%, 2 w |
| 4R65 | 214900 | 249,000 ohm ±1%, ½ w |
| 4R66 | | 27,000 ohm ±5%, 1 w |
| 4R67 | 212472 | Variable, 25,000 ohm ±10%, 2 w |
| 4R68 | 214908 | 8870 ohm ±1%, 2 w |
| 4R69 | | 120,000 ohm ±5%, 1 w |
| 4R70 | | 39,000 ohm ±5%, 2 w |

| Symbol No. | Stock No. | Description |
|---|---|---|
| 4R71, 4R72 | | 1.0 meg ± 10%, 1 w |
| 4R73 | 214911 | 40,200 ohm ± 1%, 2 w |
| 4R74 | 214910 | 30,100 ohm ± 1%, 2 w |
| 4R75 | 214881 | 20,000 ohm ± 5%, 7 w |
| 4T1 | 213987 | Transformer |
| 4T2 | 206125 | Transformer |
| 4XF1 to 4XF8 | 211618 | Holder: fuse, indicating |
| 4XV1 | 94925 | Socket: tube, 7 contact |
| 4XV2 to 4XV5 | 68590 | Socket: tube, 8 contact |
| 4XV6 to 5XV8 | 94926 | Socket: tube, 9 contact |
| 4XV9 | 94925 | Socket: tube, 7 contact |
| 4XV10 | 94926 | Socket: tube, 9 contact |
| | | *Miscellaneous:* |
| | 72772 | Cover: capacitor, 2-3/4'' high |
| | 75556 | Cover: capacitor, 3-1/4'' high |
| | 18469 | Cover: insulating, capacitor mtg. |
| **CONVERGENCE CHASSIS** | | |
| | | *CAPACITORS:* |
| 5C1 | | Paper, 0.068 μf, 200 v |
| 5C2 to 5C5 | | Paper, 0.1 μf, ± 10%, 200 v |
| 5C6, 5C7 | 210001 | Electrolytic, 250 μf, 6 v |
| 5C8 | 100447 | Electrolytic: 5 μf, 25 v |
| 5J1 | | Not Used |
| 5J2 | 56078 | Connector: female, 12 contact |
| 5J3 | 202962 | Connector: female, 2 contact |
| 5J4 | 95562 | Connector: male, 15 contact |
| 5L1 | 217240 | Coil: R.S. R-G size |
| 5L2 | 217241 | Coil: R.S. Tilt R.G. |
| 5L3 | 217239 | Coil: Unders. H.A. |
| 5L4 | 217240 | Coil: R.S. blu tilt |
| 5P1 | | Not Used |
| 5P2 | 32057 | Connector: Male, 12 contact |
| 5P3 | 215819 | Connector: male, 2 contact |
| 5P4 | 44177 | Connector: female, 15 contact |
| | | *RESISTORS:* |
| | | *Fixed composition unless otherwise specified* |
| 5R1 | | 390 ohm ± 5%, 2 w |
| 5R2A/B | 217236 | Variable ww, 250/250 ohm ± 10%, 2 w |
| 5R3 | 214835 | Variable 100 ohm ± 10%, 2 w |
| 5R4, 5R5 | | 100 ohm ± 5%, 1 w |
| 5R6 | | Variable, 200 ohm ± 10%, 2 w |
| 5R7 | | 100 ohm ± 5%, 1 w |
| 5R8 | | 33 ohm ± 5%, 1 w |
| 5R9 | 217242 | Variable, 100 ohm ± 20%, ½ w |

| Symbol No. | Stock No. | Description |
|---|---|---|
| 5R10A/B | 214838 | Variable, 100/100 ohm ±10%, 2 w |
| 5R11 | | 68 ohm ±10%, 2 w |
| 5R12 | 214834 | Variable, 20 ohm ±10%, 2 w |
| 5R13 | | 100 ohm ±5%, 1 w |
| 5R14 | 214625 | Variable, 100 ohm ±10%, 2 w |
| 5R15 | | 27 ohm ±5%, 1 w |
| 5R16 | 214625 | Variable, 100 ohm ±10%, 2 w |
| 5R17 | | 27 ohm ±5%, 1 w |
| 5R18 | 214834 | Variable, 20 ohm ±10%, 2 w |
| 5R19 | 214625 | Variable, 100 ohm ±10%, 2 w |
| 5R20A/B | 214838 | Variable, 100/100 ohm ±10%, 2 w |
| 5R21 | | 200 ohm ±10%, 2 w |
| 5R22 | 214837 | Variable, 50/50 ohm ±10%, 2 w |
| 5R23 | | 430 ohm ±5%, 1 w |
| 4R24 | 214836 | Variable, 50 ohm ±10%, 2 w |
| 5R25 | 214625 | Variable, 100 ohm ±10%, 2 w |
| 5R26 | | 33 ohm ±5%, 1 w |
| 5R27, 5R28 | | 51 ohm ±5%, 1 w |
| 5R29 | | 100 ohm ±5%, 1 w |
| 5R30 | 90 | 51 ohm ±5%, 1 w |
| 5R31 | 217244 | Variable, 500 ohm ±20%, ½ w |
| 5R32 | | 100 ohm ±5%, 1 w |
| 5R33 | 217243 | 250 ohm ±20%, ½ w |
| 5R34 | | 51 ohm ±5%, 1 w |
| 5SR1A/C | 105064 | Rectifier |
| | | *Miscellaneous* |
| | 79533 | Knob: coil, 5L1, 5L2, 5L4 |
| | 214863 | Knob: control, maroon with white groove |
| | 214927 | Screw: thumb, panel locking |
| | 100372 | Washer: spring coil knob |

## MAIN ASSEMBLY

| | | |
|---|---|---|
| | | *CAPACITORS:* |
| 6C1, 6C2 | | Paper, 0.01 µf, ±10%, 600 v |
| 6CR1 | 226497 | Diode, 1N2970 |
| 6CR2 | 226497 | Diode, 1N2970 |
| 6C3 | | Paper, 0.1 µf, ±10%, 600 v |
| 6F1, 6F2 | 215321 | Fuse: 10 amp |
| 6F3 | 205121 | Fuse: 1.0 amp |
| 6I1 | 216209 | Lamp: 6.3 v. on-air |
| 6I2 to 6I4 | | Lamp: indicator, standby type #44 |
| 6J8 | 7903 | Connector: meter jack |
| | 32661 | Connector: female, 2 contact |
| | 216896 | Connector: female, 4 contacts |
| 3P5 | 213999 | Connector: HV |
| 6L1, 6L2 | | Not Used |

| Symbol No. | Stock No. | Description |
|---|---|---|
| 6L3 | 216900 | Blue lateral assembly |
| | 216901 | Spring: blue lateral assembly |
| 6L4 | 217810 | Yoke: deflection |
| 6L5 | | Yoke: covergence assembly |
| | 32057 | Connector: female, 12 contacts |
| | | *Pole Piece Exciter* |
| | 105023 | Holder: coil, nylon |
| | 102296A | Spring: magnet holder retaining |
| | 102297A | Spring: magnet holder retaining |
| | 105415 | Slider: convergence coil & core, nylon |
| | 105024 | Magnet: exciter |
| 5P4 | 44177 | Connector: female |
| 3P2 | 215799 | Connector: male, 27 contact |
| | | *RESISTORS:* |
| 6R1 | 214839 | Variable, 2.5 meg ±20%, 2 w |
| 6R2 | 214834 | Variable, ww, 20 ohm ±10%, 2 w |
| 6R3 | | Not Used |
| 6R4 | 214842 | Variable, 1.0 meg ±10%, 2 w |
| 6R5 | 214843 | Variable, 50,000 ohm ±10%, 2 w |
| 6R6 | 214844 | Variable, 250,000 ohm ±10%, 2 w |
| 6R7 to 6R9 | 214845 | Variable, 2.5 meg ±20%, 2 w |
| 6R10 | | 100,000 ohm ±5%, 1 w |
| 6R11 | | 1.5 meg ±5%, 1 w |
| 6R12 | | 120,000 ohm ±5%, 1 w |
| 6R13 | | 130,000 ohm ±5%, 1 w |
| 6R14 | | 330,000 ohm ±5%, 1 w |
| 6R15, 6R16 | | Not Used |
| 6R17 | | 360,000 ohm ±5%, 1 w |
| 6R18 | | Not Used |
| 6R19, 6R20 | | 1.5 meg ±5%, 1 w |
| 6R21, 6R23 | | 620,000 ohm ±5%, 1 w |
| 6R24 | | 130 ohm ±5%, 1 w |
| 6R25 | 96675 | Variable, 100,000 ohm ±10%, 2 w |
| 6R26 | | 200,000 ohm ±5%, 1 w |
| 6R27 | | 1.8 meg ±5%, 1 w |
| 6R28 | | Not Used |
| 6R29 | | 3300 ohm ±5%, 1 w |
| 6R30 | 56991 | Wire wound, 1.0 ohm ±10%, 10 w |
| 6R31 | 56991 | Wire wound, 1.0 ohm ±10%, 10 w |
| 6R32 | 56991 | Wire wound, 1.0 ohm ±10%, 10 w |
| 6S1 | 214846 | Switch: toggle, DPDT (power) |
| 6S2 | | Not Used |
| 6S3 | | Switch: push (reset) |
| 6S4 | 214412 | Switch: rotary, wafer 3 section, 5 position (Scr. Selec.) |
| 6S5 | 217238 | Switch: (size) |
| 6S6 | 213350 | Switch: (panel lite) |

| Symbol No. | Stock No. | Description |
|---|---|---|
| 6S7 | | Switch, push (Vert collapse) |
| 6T1 | 58619 | Transformer |
| 6XF1, 6XF2 | 211618 | Holder: fuse |
| 6XF3 | 48894 | Holder: fuse |
| 6XI1, 6XI2 | 95633 | Socket: lamp |
| 6XI3, 6XI4 | 216897 | Socket: lamp |
| 6XV1 | | Not Used |
| 6XV2 | 214868 | Socket: kinescope |
| | 214863 | Knob: control maroon, phenolic, plain |
| | 214864 | Knob: control maroon, phenolic, with white groove |
| | 206281 | Knob: black, 1-1/16'' dia., pointer type |
| | | *Miscellaneous* |
| | 51209 | Connector: male |
| | 105030 | Holder: color equalizer |
| | 223799 | Lead: H.V. Lead, complete assembly |
| | 223799 | Connector: Anode |
| | 223679 | Glide: (foot 4), cabinet |
| | 79604 | Ring: purity |

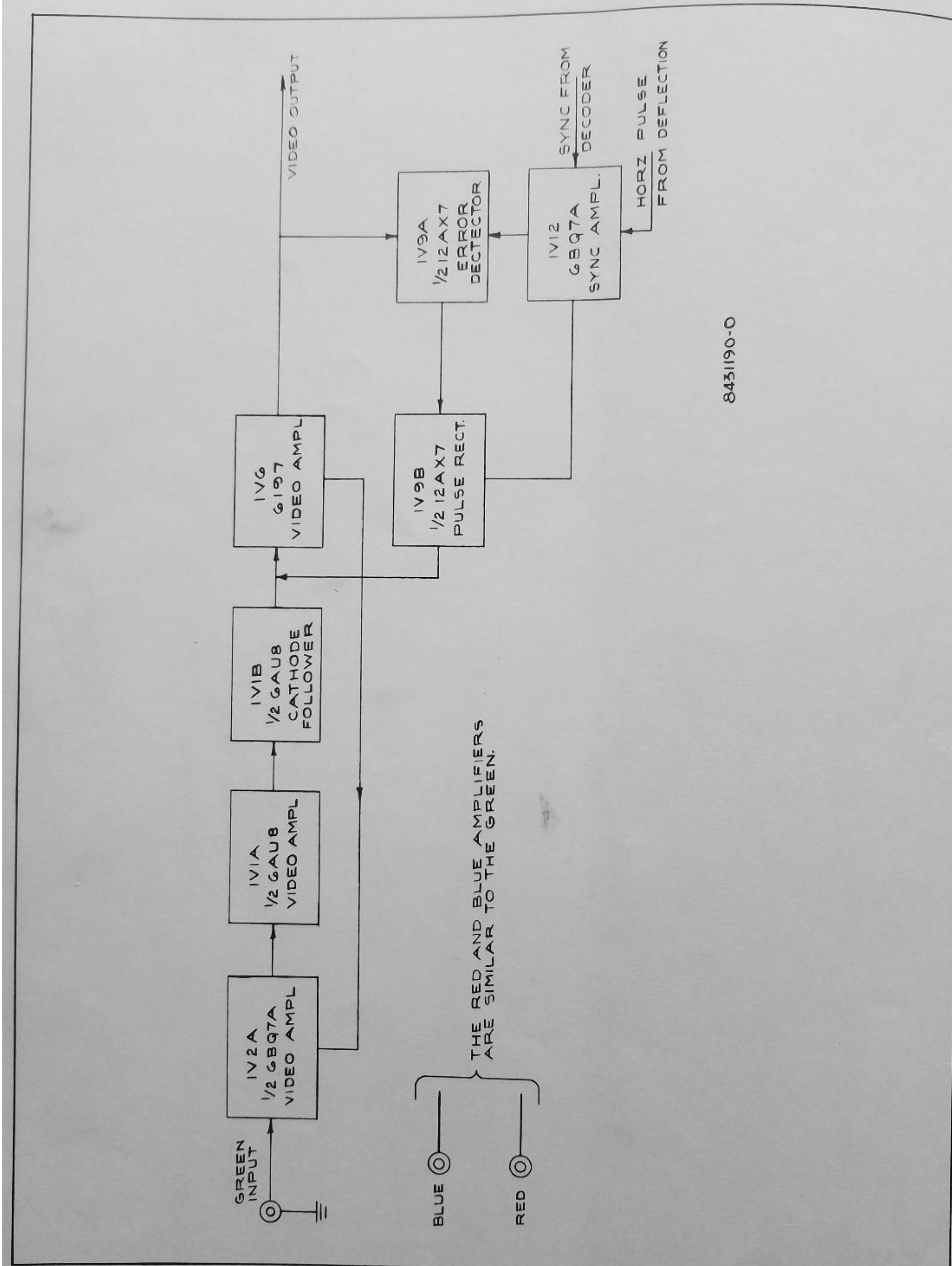
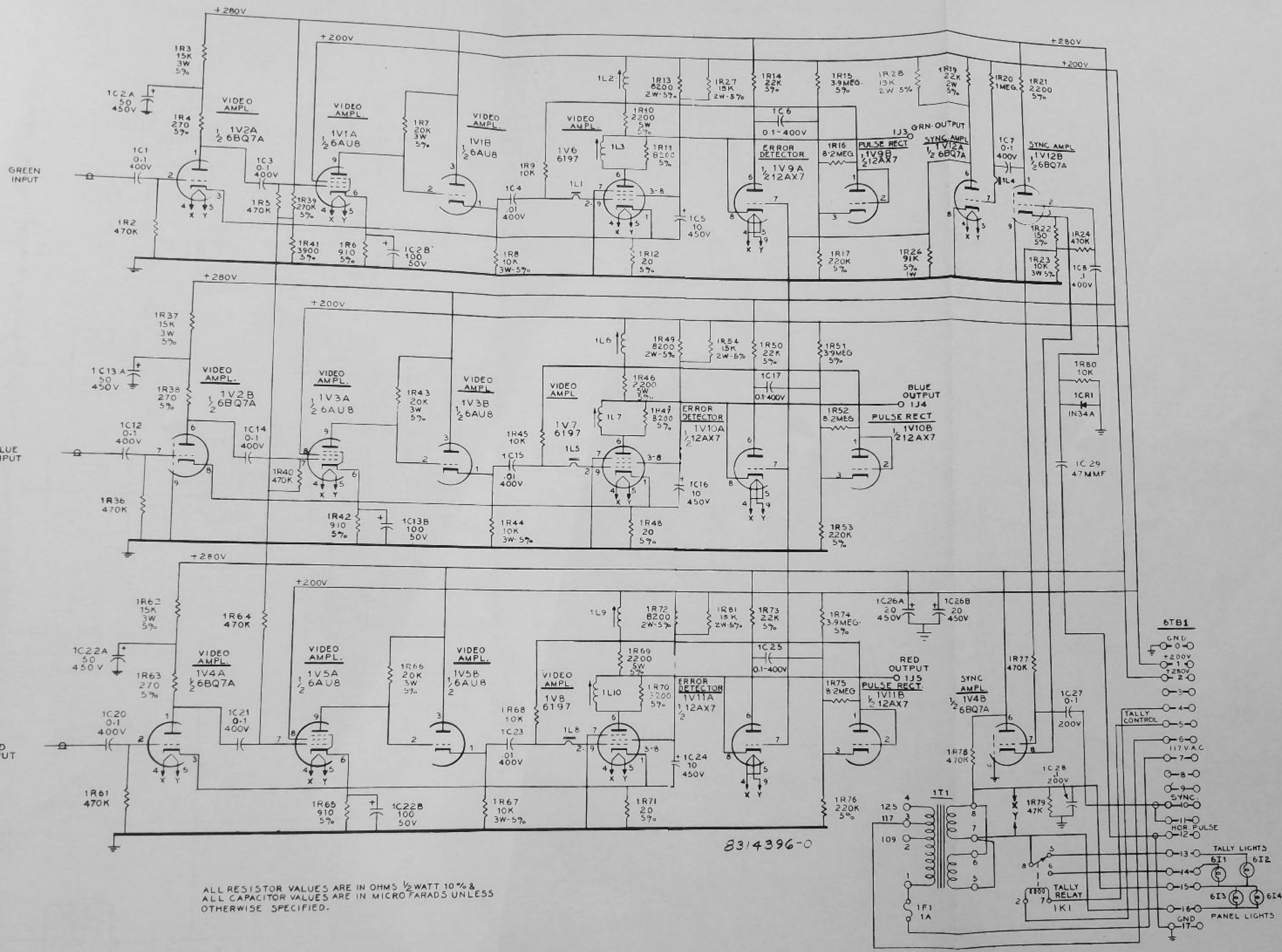



**Figure 48. Block Diagram, 3 Channel Video Amplifier**




ALL RESISTOR VALUES ARE IN OHMS 1/2 WATT 10% & ALL CAPACITOR VALUES ARE IN MICRO FARADS UNLESS OTHERWISE SPECIFIED.

**Figure 49. Schematic Diagram, 3 Channel Video Amplifier**

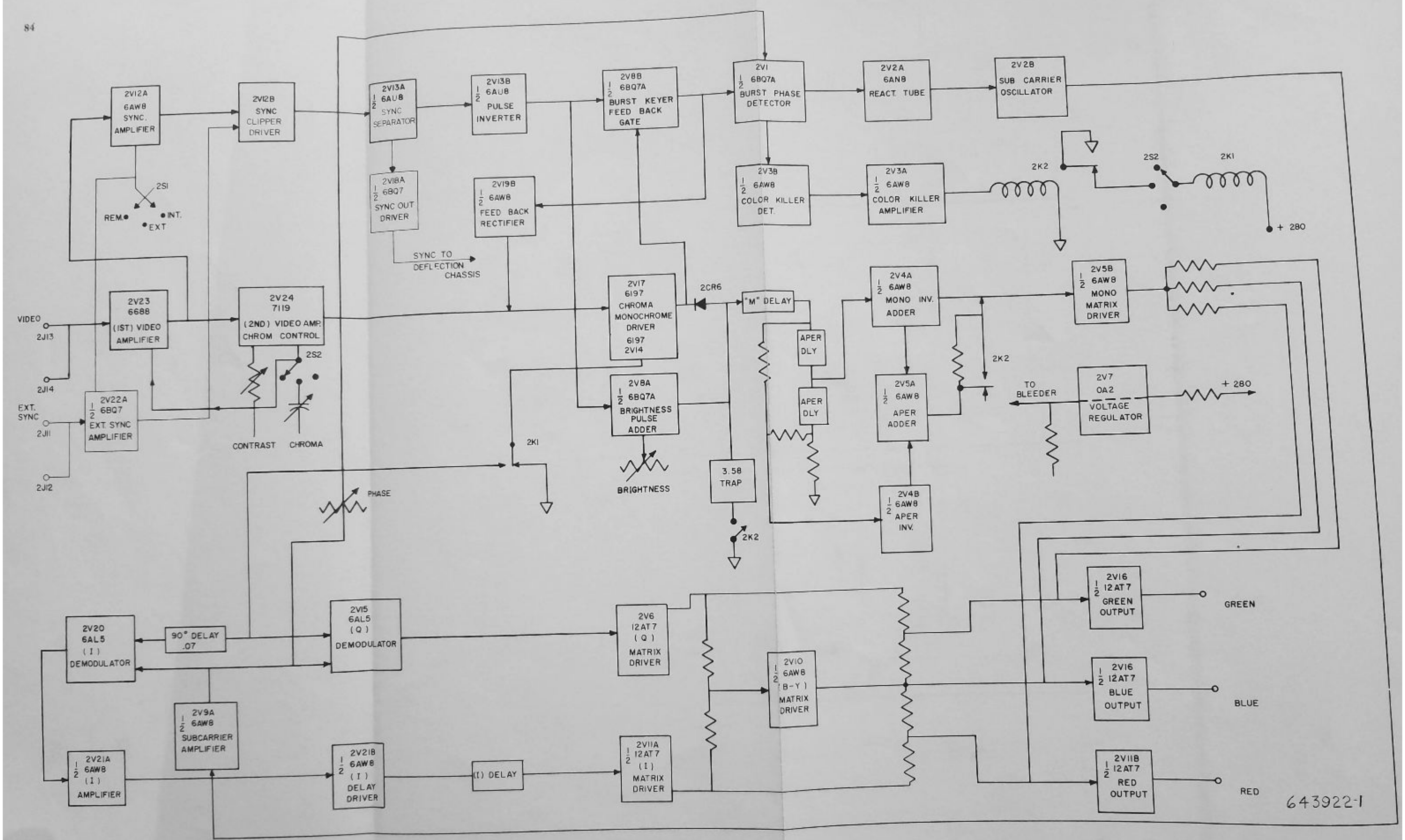



***Figure 50. Block Diagram, Decoder***

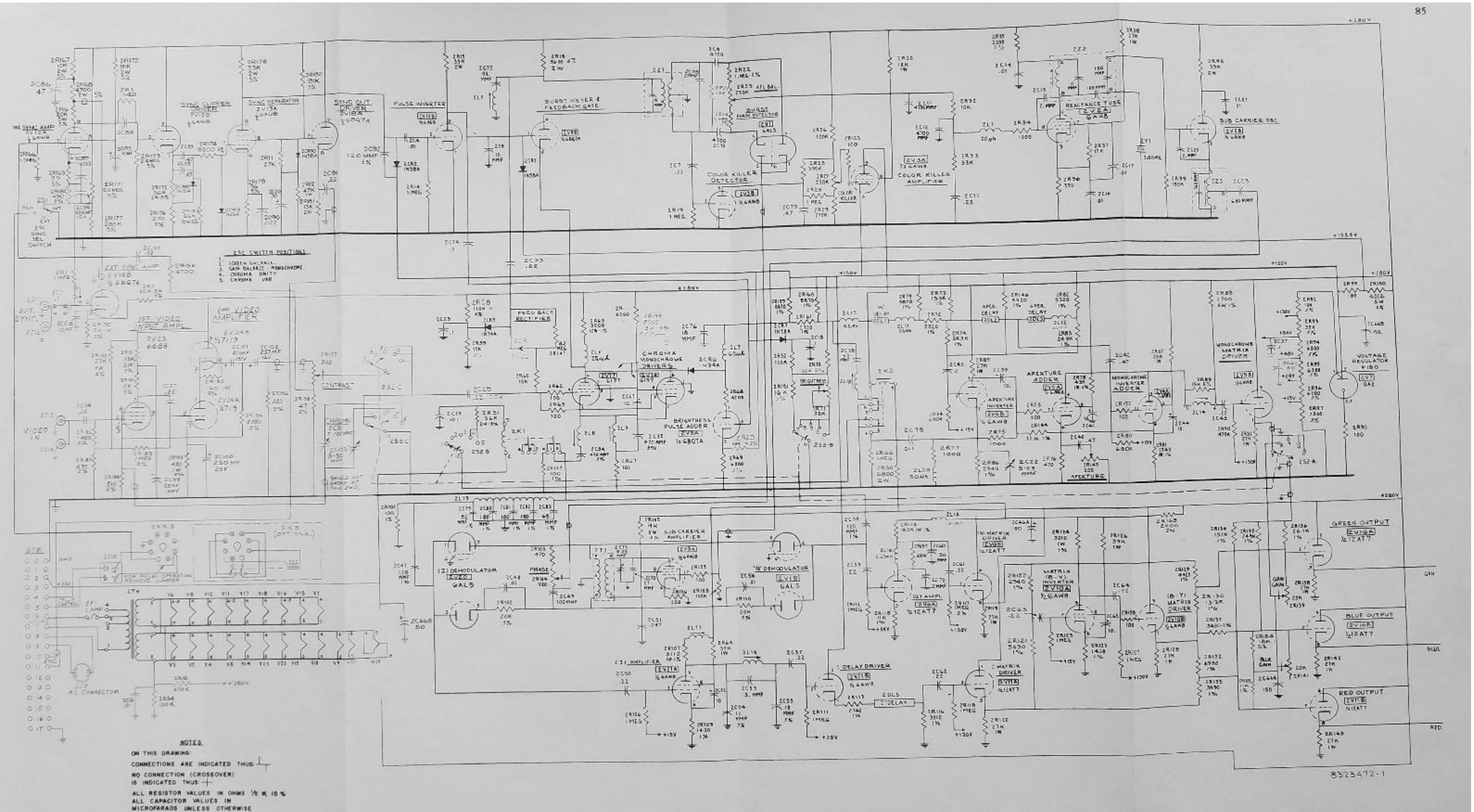



**Figure 51. Schematic Diagram, Decoder**

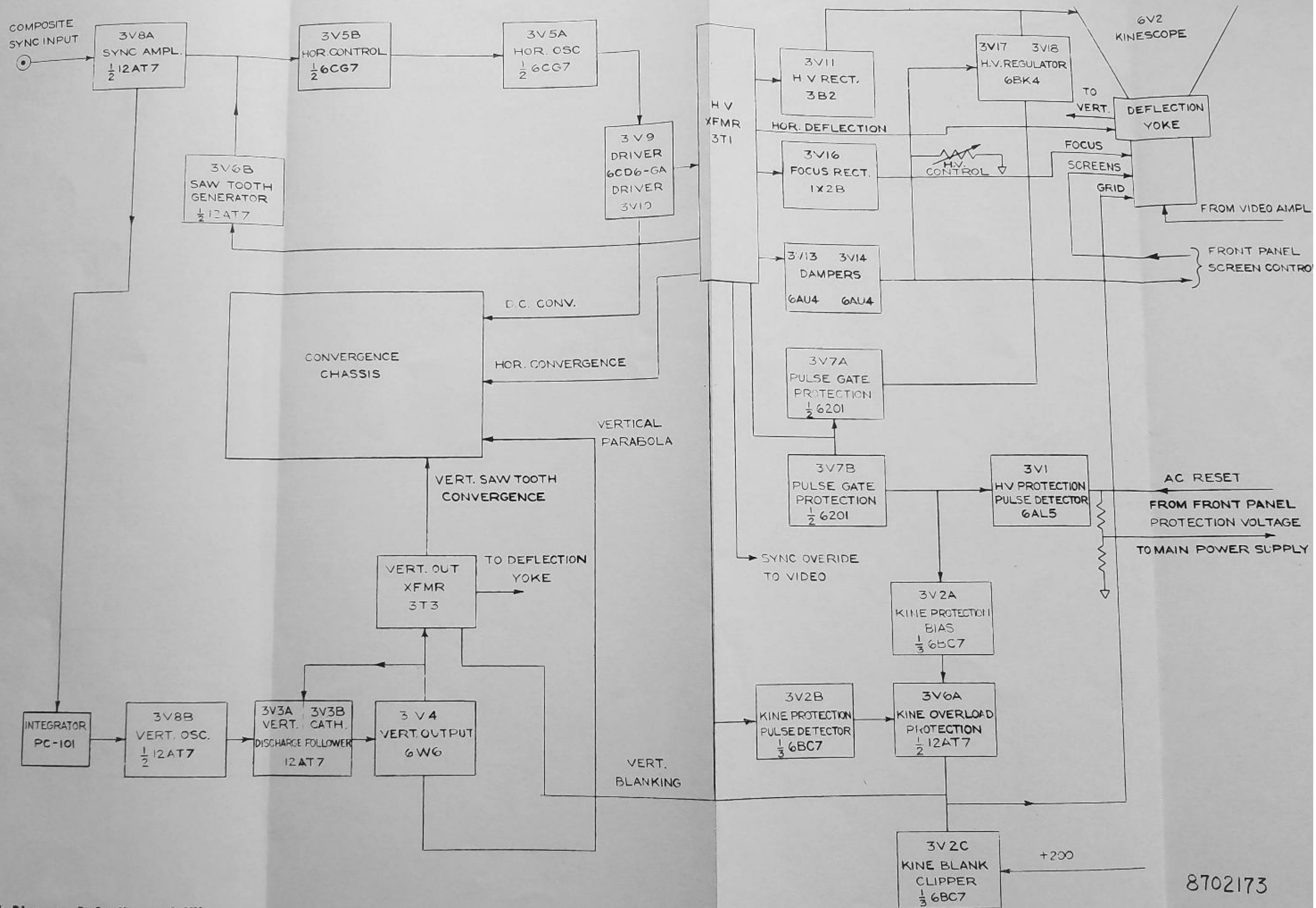



***Figure 52. Block Diagram, Deflection and HV***

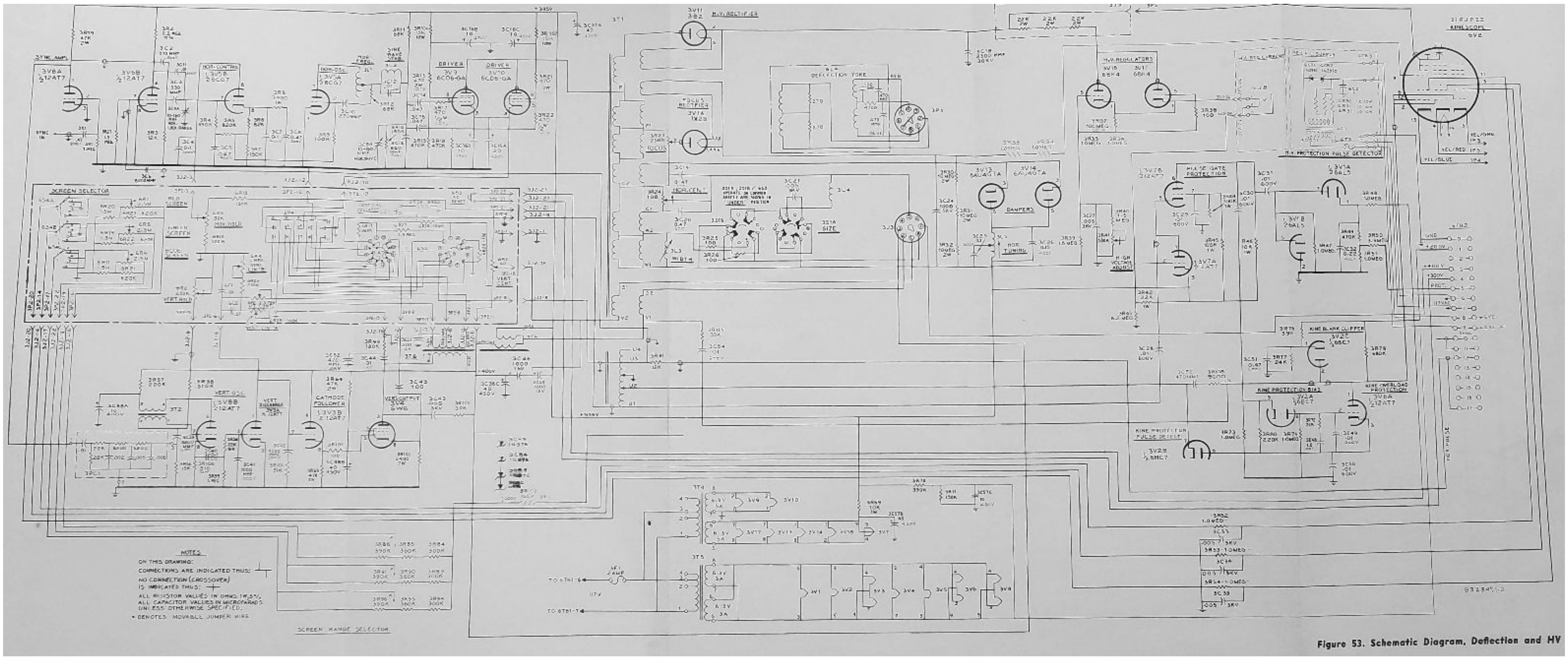



Figure 53. Schematic Diagram, Deflection and HV

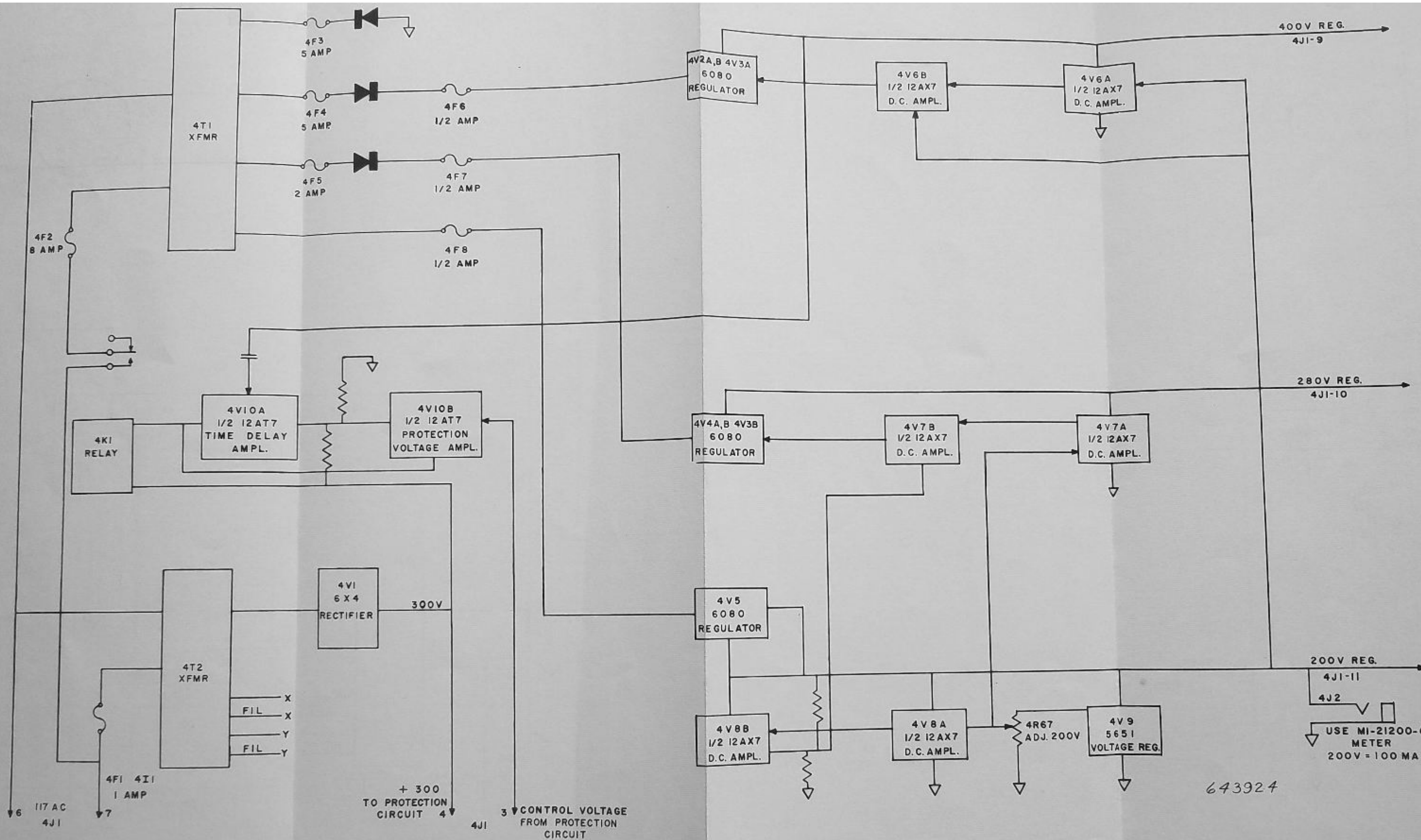



Figure 54. Block Diagram, Power Supply

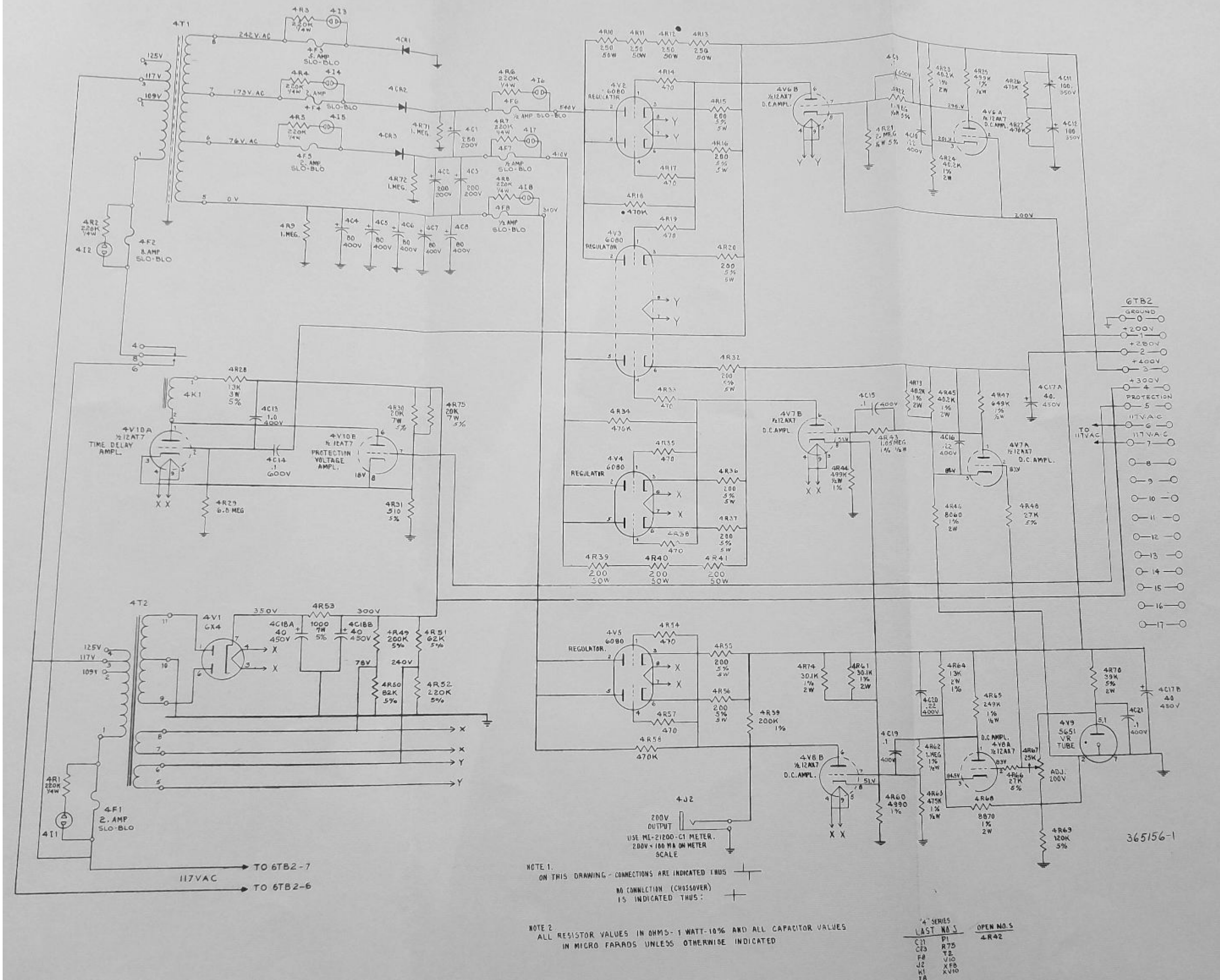



**Figure 55. Schematic Diagram, Power Supp**

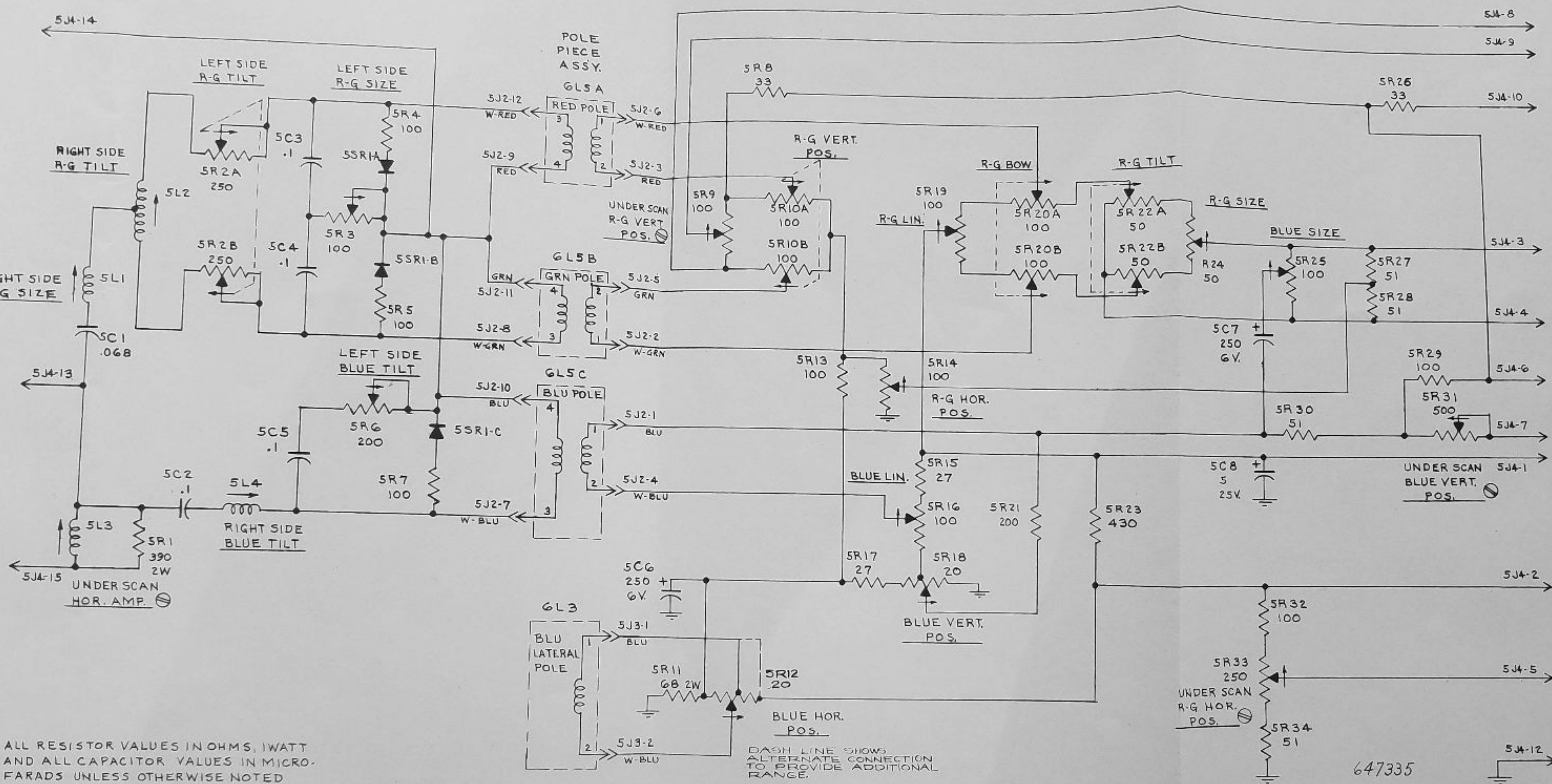
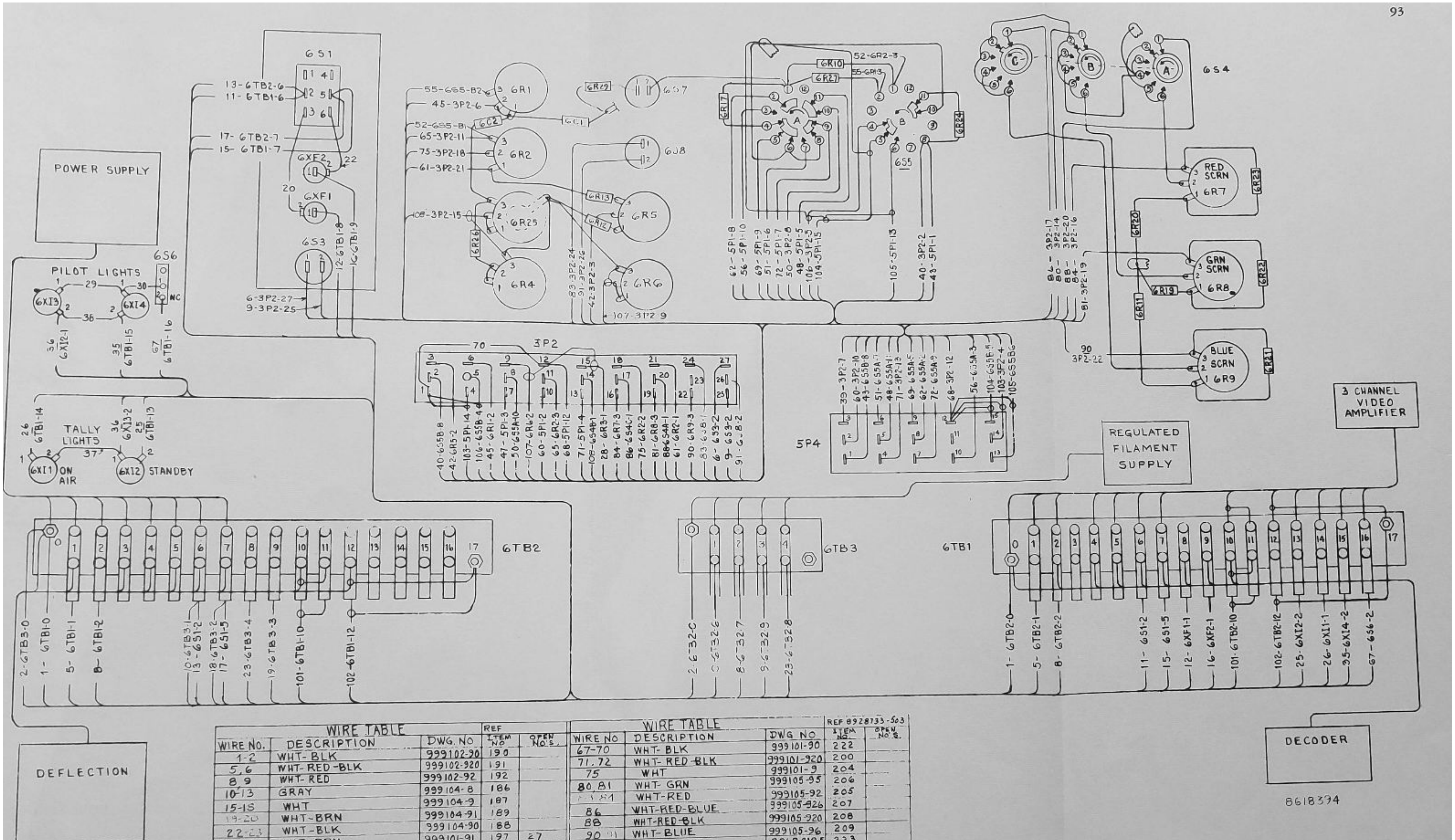



**Figure 56. Schematic Diagram, Convergence**




| WIRE TABLE | | | REF | |
|---|---|---|---|---|
| WIRE No. | DESCRIPTION | DWG. NO | ITEM NO | OPEN NO'S. |
| 1-2 | WHT-BLK | 999102-90 | 190 | |
| 5,6 | WHT-RED-BLK | 999102-920 | 191 | |
| 8 9 | WHT-RED | 999102-92 | 192 | |
| 10-13 | GRAY | 999104-8 | 186 | |
| 15-15 | WHT | 999104-9 | 187 | |
| 19-20 | WHT-BRN | 999104-91 | 189 | |
| 22-23 | WHT-BLK | 999104-90 | 188 | |
| 25-30 | WHT-BRN | 999101-91 | 197 | 27 |
| 35-39 | WHT-BRN-BLK | 999101-910 | 203 | |
| 40 | WHT-ORN | 999101-93 | 195 | |
| 42,43 | WHT-BLUE | 999101-96 | 194 | |
| 45 | WHT-YEL-BLK | 999101-940 | 202 | |
| 47,48 | WHT-RED-GRN | 999101-925 | 199 | |
| 50,52 | WHT-GRN-BLK | 999101-950 | 201 | |
| 55,56 | WHT-GRN | 999101-95 | 196 | |
| 60-62 | WHT-YEL | 999101-94 | 198 | |
| 65 | WHT-RED | 999101-92 | 193 | |

| WIRE TABLE | | | REF 8928733-503 | |
|---|---|---|---|---|
| WIRE NO | DESCRIPTION | DWG NO | ITEM NO. | OPEN NO'S. |
| 67-70 | WHT-BLK | 999101-90 | 222 | |
| 71,72 | WHT-RED-BLK | 999101-920 | 200 | |
| 75 | WHT | 999101-9 | 204 | |
| 80,81 | WHT-GRN | 999105-95 | 206 | |
| 83,84 | WHT-RED | 999105-92 | 205 | |
| 86 | WHT-RED-BLUE | 999105-926 | 207 | |
| 88 | WHT-RED-BLK | 999105-920 | 208 | |
| 90 91 | WHT-BLUE | 999105-96 | 209 | |
| 101-108 | COAX CABLE | 8868319-5 | 223 | |

**Figure 57. Interconnection Diagram**

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