SERVICE DATA

For

PR990, VR630, PR994 and PR998

PROJECTION TELEVISION RECEIVERS

Model PR990

Model PR998

WALL PROJECTION

Model PR994

Model VR630

MODELS PR990 and VR630
GENERAL INFORMATION

These models are console models incorporating a television receiver of the projection type, utilizing a complement of 30 tubes (including the picture tube).

Features of the television receiver include the Protelegram Television Projection System; a 2½" aluminized screen picture tube utilizing electromagnetic focusing and deflection; a 12 channel selector; a.g.c. and automatic frequency control for stabilization of the horizontal deflection circuits; a protective tube circuit to safeguard the picture tube; a high fidelity f.m. audio system for television sound reproduction.

The PR990 Receiver uses the Model 170B High Voltage Driver Unit.

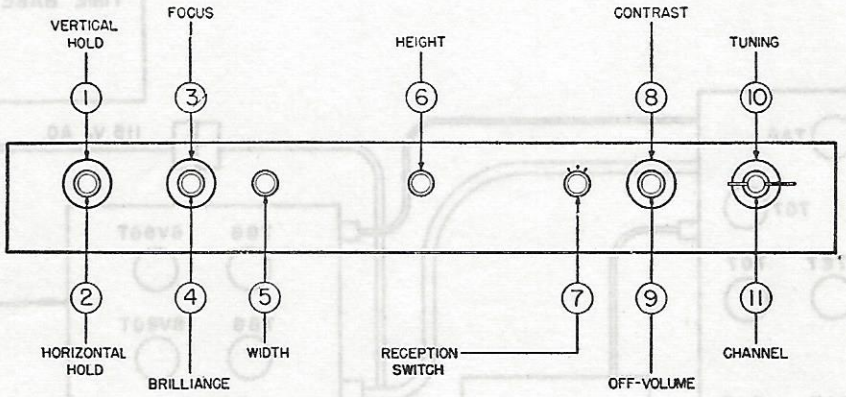
The VR630 Receiver uses the Model 160B High Voltage Driver Unit.

MODEL PR994

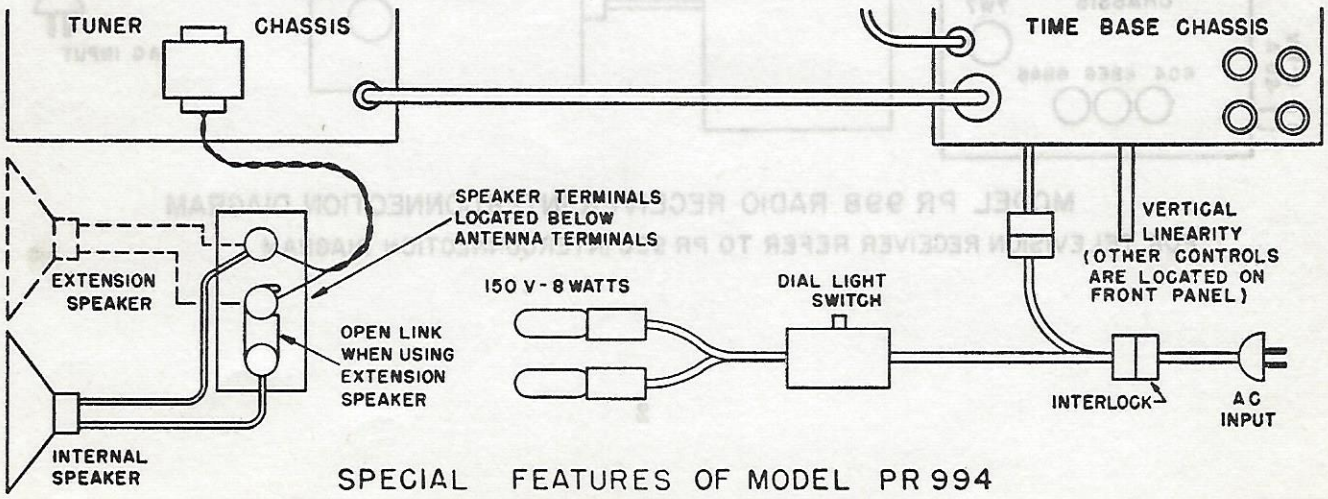
Model 994 is a television receiver of the wall projection type. It uses the same chassis as the PR990 with modifications. The definition switch, vertical size control and horizontal size control have been moved from the rear of the chassis to a bracket on the front of the chassis. Provision is made on the rear of the receiver to use an external speaker having a voice coil impedance of not less than 5 ohms. The PR994 projects a picture on a 3 x 4 foot screen therefore it does not incorporate a built in projection screen. A semi-beaded screen of the home motion-picture roll up type is advised. The distance from the center of the screen to the face of the optical box should be 90 inches.

The Model PR994 uses the Model 170B High Voltage Driver Unit.

Service replacement parts peculiar to the Model PR994 receiver are listed on page 33 of this manual.



OPERATING CONTROLS



SPECIAL FEATURES OF MODEL PR 994
OTHERWISE SAME AS PR 990

MODEL PR998

Model PR998 is a combination radio-phonograph and television receiver. The television section of the PR998 is identical to the television receiver of the PR990.

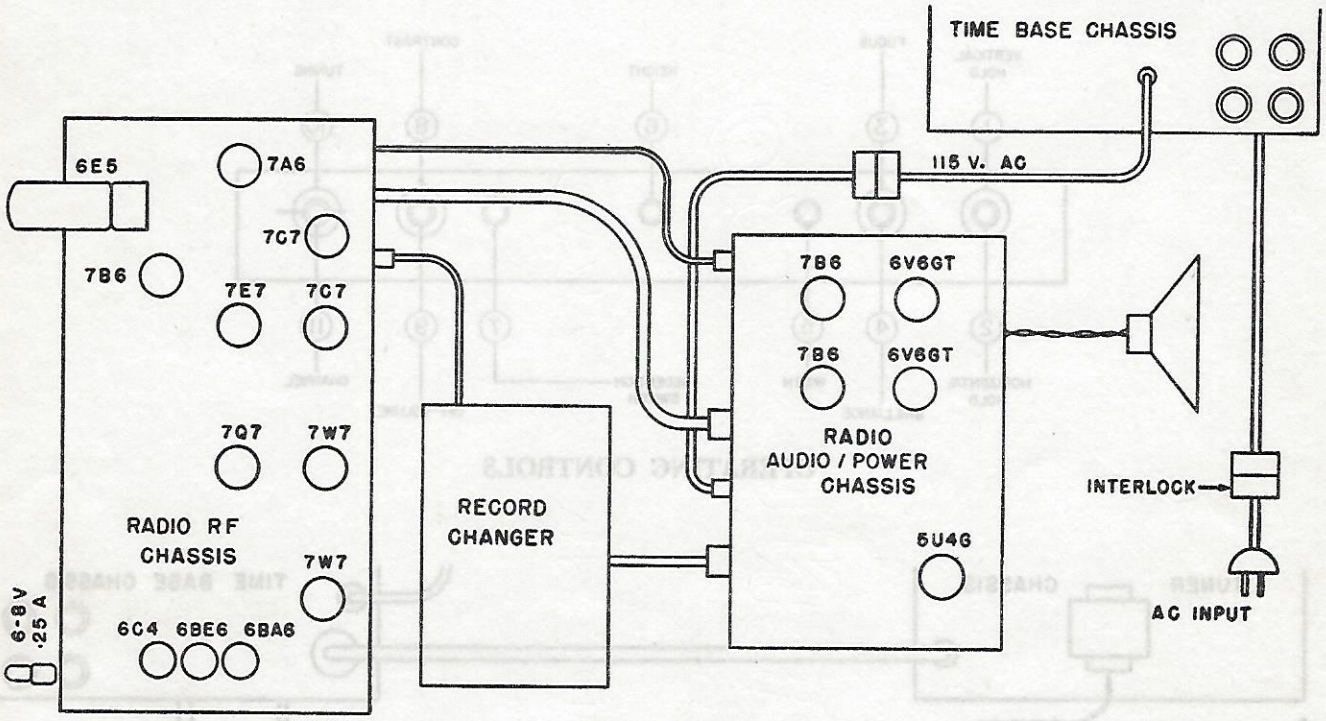
The radio section of the PR998 covers the standard broadcast band, two short wave bands and the f.m. band. The radio receiver is composed of two units, an RF and an audio power unit. For all servicing information on the radio receiver refer to the Philips CM100A Radio Receiver Service Manual.

The record player is a Webster Model 100, three speed automatic changer using an Astatic Crystal Turnover Cartridge No. LQD1M. For servicing information on the changer refer to the Webster Record Changer Model 100 Service Manual.

As the phonograph motor is frequency sensitive, this model is designed in both a 25 cycle and a 60 cycle version.

The Model PR998 uses the Model 160B High Voltage Driver Unit.

Service replacement parts peculiar to the Model PR998 receiver are listed on page 33 of this manual.



MODEL PR 998 RADIO RECEIVER INTERCONNECTION DIAGRAM

FOR TELEVISION RECEIVER REFER TO PR 990 INTERCONNECTION DIAGRAM

SPECIFICATIONS OF TELEVISION RECEIVER

POWER SUPPLY RATING: 25 or 60 cycles, 115 volts, 2 amperes.

ANTENNA CONNECTION: A two terminal antenna strip at the rear of the receiver is used for connecting the 300 ohm transmission line from the antenna.

INTERMEDIATE FREQUENCIES: Video, 26.1 Mc; Sound, 21.6 Mc.

AUDIO POWER OUTPUT: 3 watts for 10% distortion (nominal value).

STAGGER-TUNED AND TRAP FREQUENCIES:

Coil Assembly	Slug Location	Freq. Mc.	FUNCTION
1st—L20	Top	20.1	Adjacent Channel Video Trap
1st—L22	Top	22.65	1st Video I.F. Tuned Circuit
2nd—C172	Top	27.6	Adjacent Channel Sound Trap
2nd—T7	Bottom	25.65	2nd Video I.F. Tuned Circuit
3rd—C175	Top	21.6	Sound Trap and Sound Take-off
3rd—T9	Bottom	22.15	3rd Video I.F. Tuned Circuit
4th—C178	Top	27.6	Adjacent Channel Sound Trap
4th—T11	Bottom	25.55	4th Video I.F. Tuned Circuit
5th—C181	Top	20.1	Adjacent Channel Video Trap
5th—T13	Bottom	23.75	5th Video I.F. Tuned Circuit

TUBE COMPLEMENT

V1.	6AG5	R.F. Amplifier
V2.	6J6	Converter—Oscillator
V4.	6AG5	1st Video I.F. Amplifier
V5.	6AG5	2nd Video I.F. Amplifier
V6.	6AG5	3rd Video I.F. Amplifier
V7.	6AG5	4th Video I.F. Amplifier
V8.	6AL5	Video Detector and AGC Detector
V9.	6AG5	Video Amplifier
V10.	6V6	Video Output
V11.	6AU6	1st Clipper
V12.	6AT6	AGC Amplifier
V13.	6AL5	D.C. Restorer
V14.	6BA6	1st Sound I.F. Amplifier
V15.	6AU6	Sound Limiter
V16.	6AL5	Sound Discriminator
V17.	12SQ7	1st Audio Amplifier
V18.	25L6	Audio Output
V19.	12SC7	2nd Clipper
V20.	12SN7	Horizontal Multivibrator
V21.	19BG6G	Horizontal Output
V22.	IT4	C.R.T. Protective Tube
V23.	25W4GT	Booster-Damper-Diode
V24.	12SC7	Vertical Blocking Oscillator
V25.	25L6GT	Vertical Sweep Output
V26.	3NP4	Picture Tube
V27.	6SR7	H.V. Blocking Oscillator
V28.	6BG6G	H.V. Driver Amplifier
V29.	EY51	H.V. Rectifier
V30.	EY51	H.V. Rectifier
V31.	EY51	H.V. Rectifier

V27A—6L6G, V28A—6V6GT, V29A—1B3GT, V30A—1B3GT

RADIO FREQUENCY RANGE

Channel Selector Position No.	Frequency Range Mc.	Picture Carrier Frequency Mc.	Sound Carrier Frequency Mc.	Receiver R.F. Oscillator Freq. Mc.
2	54-60	55.25	59.75	81.35
3	60-66	61.25	65.75	87.35
4	66-72	67.25	71.75	93.35
5	76-82	77.25	81.75	103.35
6	82-88	83.25	87.75	109.35
7	174-180	175.25	179.75	201.35
8	180-186	181.25	185.75	207.35
9	186-192	187.25	191.75	213.35
10	192-198	193.25	197.75	219.35
11	198-204	199.25	203.75	225.35
12	204-210	205.25	209.75	231.35
13	210-216	211.25	215.75	237.35

CONTROLS

Symbol	Function	Location	Description
R114	Vertical Hold	Front Panel	Outer Knob } Dual
R96	Horizontal Hold	" "	Inner Knob }
R123	Focus	" "	Outer Knob } Dual
R89	Brilliance	" "	Inner Knob }
R72	Contrast	" "	Outer Knob } Dual
R13-14	On-Off and Volume	" "	Inner Knob }
L15-19	Channel	" "	Outer Pointer } Dual
C136	Tuning	" "	Knob }
R116	Vertical Size	Rear of Time Base Chassis	Knurled Knob
R118	Vertical Linearity	Rear of Time Base Chassis	Slotted Stud
R87	Horizontal Size	Rear of Time Base Chassis	Knurled Knob
L3	Horizontal Hold Adj.	Centre Edge of Time Base Chassis	Slotted Core
S1	Definition Switch	Rear of Tuner Chassis	Knurled Knob

HIGH VOLTAGE WARNING

Operation of this receiver outside its cabinet or with covers removed, involves a shock hazard from the power supplies. Regular B+ only voltages used are in some cases higher than ordinarily encountered in standard radio equipment.

The 25,000 volts from the high voltage driver unit to the anode of the picture tube, while normally capable of only low current, upon accidental contact, could result in injury due to involuntary movement or other secondary reaction. Only personnel thoroughly familiar with the handling of high voltage equipment should attempt work on the receiver.

PICTURE TUBE HANDLING AND OPERATING PRECAUTIONS

TUBE BREAKAGE:

Extreme care must be used in handling these tubes. Although this size tube is less dangerous to handle than the larger ones used in Direct-View receivers, it must always be borne in mind that they are subjected to considerable pressure by the surrounding atmosphere and mis-handling could cause them to shatter.

Gloves should be worn to protect the hands and shatter-proof goggles to protect the eyes during installation or removal of the tube. Do not strike or scratch the tube, nor attempt to force it into the tailpiece assembly if it fails to slide in easily.

INSTALLATION INSTRUCTIONS

CAUTION:

Under no circumstances should any connection be made from the chassis to ground. However, a grounded antenna connected to the antenna terminals will cause no damage.

The line cord should be connected to a 115 volt a-c source. The frequency may be either 25 or 60 cycles. The receiver will not operate on direct current.

The current consumption of the receiver is approximately 2 amperes at 115 volts.

ANTENNA REQUIREMENTS:

To service this receiver satisfactorily a good antenna installation is needed. Make certain the transmission line is as short as possible, has 300 ohms impedance and is kept clear of all surrounding objects including the antenna mast itself by at least 6 inches. Unless the signal strength in the area of operation is several hundred microvolts, it is advisable to use a transmission line having very low attenuation.

The antenna itself should be designed to afford a good match to the 300 ohm transmission line, either directly or by transformer coupling.

For lightning protection, the antenna mast should be connected to a good ground, and the transmission line connected to an approved type of lightning arrestor, one terminal of which is grounded.

All electrical joints must be carefully made. A coating of glyptal on each joint exposed to the weather will assist in maintaining trouble-free performance over a long period of time.

LOCATION OF RECEIVER:

A location should be chosen convenient to an electrical outlet supplying 115 volts, 25 or 60 cycles, and to the antenna lead-in.

Consideration should be given to convenient seating for proper viewing.

Avoid placement where direct sunlight or lamp illumination will fall upon the screen. Moderate room lighting, or a shaded lamp placed several feet to either side of the receiver, is recommended for best viewing. A completely darkened room is undesirable.

Adequate ventilation is provided by openings in the cabinet back and bottom, and care should be taken to keep these openings uncovered and free from obstructions. Maintain a space of a few inches between the cabinet back and the wall.

SETTING UP THE RECEIVER

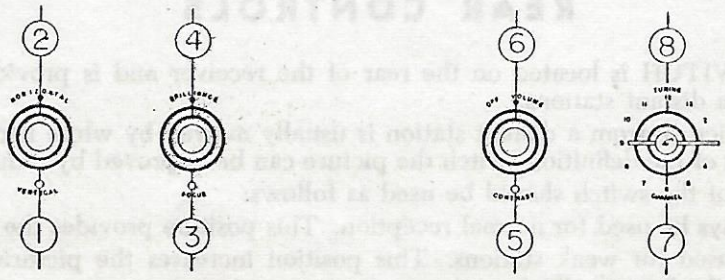
After removing the receiver from the packing case and taking off the shipping skids:

1. Remove the cabinet back cover.
2. Remove the tape and the corrugated packing pad from the top of the optical box assembly.
3. Remove the felt packing block located at the rear of the focus coil assembly.
4. Remove the two red brackets clamping the deflection coil assembly to the optical box.
5. Remove any accumulated dust from the underside surface of the large mirror, using only a camel's-hair brush as this is a front surfaced mirror. (Refer to section "Servicing the optical box and Mirrors" if dirt other than loose dust is to be removed.)
6. See that all the tubes are properly seated in their sockets.
7. Release the speaker baffle board by unscrewing the four wing nuts that hold it in position, so that adjustments to the optical system may be made from the front of the receiver.
8. Replace the receiver back cover.
9. Connect antenna transmission line lead-in to the receiver antenna terminals.
10. Insert the power cord plug into an electrical outlet. (115 volts, 25 or 60 cycles.)
11. Proceed to tune the receiver as outlined under "OPERATING INSTRUCTIONS."
12. Set all controls and adjustments for correct operating positions as detailed under "INSTALLATION AND SERVICE ADJUSTMENTS AND INSTALLATION OF 3NP4 TUBE AND OPTICAL ADJUSTMENTS."
13. Disconnect the antenna transmission line lead-in and remove back cover of the receiver.
14. Replace speaker baffle.
15. Replace receiver back cover and antenna.

OPERATING INSTRUCTIONS

FRONT PANEL CONTROLS:

There are four dual controls on the front panel, making a total of eight operating controls. The function of each control is indicated by markings on the front panel. The "Circle" indicates the round outer knob, the "dot" indicates the inner knob.



HOW TO OPERATE THE TELEVISION RECEIVER

1. Turn the BRILLIANCE control to the full counter-clockwise position.
2. Turn the CONTRAST control to the full counter-clockwise position.
3. Turn the OFF-VOLUME control from its "OFF" position to the right. After the click of the switch is heard, continue to turn the control to approximately the middle of its range. Allow about a minute for the tubes of the receiver to warm up.
4. Turn the CHANNEL selector to the channel number of the desired station.
5. Adjust the TUNING control for the best sound. If the sound becomes to loud during tuning, turn the OFF-VOLUME control counter-clockwise until the sound is at a low level, then adjust the TUNING

control for the best sound and minimum noise. The best picture quality will coincide with this setting of the TUNING control, with freedom from moving shadow bars (sound bars) in the picture.

6. Turn the BRILLIANCE control clockwise until light becomes just visable on the screen.
7. Advance the CONTRAST control clockwise until a picture or activity is seen on the screen.
8. Adjust the HORIZONTAL HOLD control until a picture appears that is free of diagonal dark lines and horizontal movement.
9. Adjust the VERTICAL HOLD control until the picture is stationary. The most satisfactory position of the VERTICAL HOLD control is obtained by turning the control slowly counter-clockwise until the picture moves slowly downwards. Then turn the control clockwise to a point slightly beyond the position at which picture becomes stationary.
10. If the picture appears to be unsteady after correctly adjusting the VERTICLE HOLD control, it will be necessary to readjust carefully the HORIZONTAL HOLD control to remedy this horizontal movement.
11. Adjust the FOCUS control for sharpest detail. Either side of the correct setting will result in a blurring of the picture. The fine horizontal lines of the "raster" should be clearly visible over the picture area.

As the BRILLIANCE control and CONTRAST control both function for the best picture quality, it may be possible to improve the picture by a slight readjustment of them. A suitable setting for the BRILLIANCE control is where some illumination is just visible on the screen, when the CONTRAST control is off. The best setting for the CONTRAST control is the position giving the correct shade graduations from white to light gray, medium gray, and black.

Too low a setting may permit the picture to be unsteady; too high a setting may cause the picture to twist out of shape, and also have a black and fuzzy appearance.

After the receiver has been in operation for some time it may be necessary to readjust the TUNING control for best sound quality.

To turn the receiver "OFF" rotate the OFF-VOLUME control to the extreme counter-clockwise position until the switch clicks "OFF." No other controls need be touched.

TO RESUME OPERATION ON THE SAME OR A DIFFERENT CHANNEL

1. Turn the OFF-VOLUME control to the right to the middle of its range.
2. Select a different number on CHANNEL control if desired.
3. Adjust TUNING control for best sound quality.
4. Adjust CONTRAST control for best picture quality.
5. Check FOCUS control for best setting.
6. Reset OFF-VOLUME control for desired sound level.

REAR CONTROLS

A DEFINITION SWITCH is located on the rear of the receiver and is provided for the purpose of improving reception from distant stations.

The quality of the picture from a distant station is usually marred by white flecks (snow) in the background. Through the use of the definition switch the picture can be improved by reducing the "snow" effect.

The three positions of the switch should be used as follows:

Position 1: Should always be used for normal reception. This position provides the best picture definition.

Position 2: Should be used for weak stations. This position increases the picture sensitivity with some rejection of the "snow" effect.

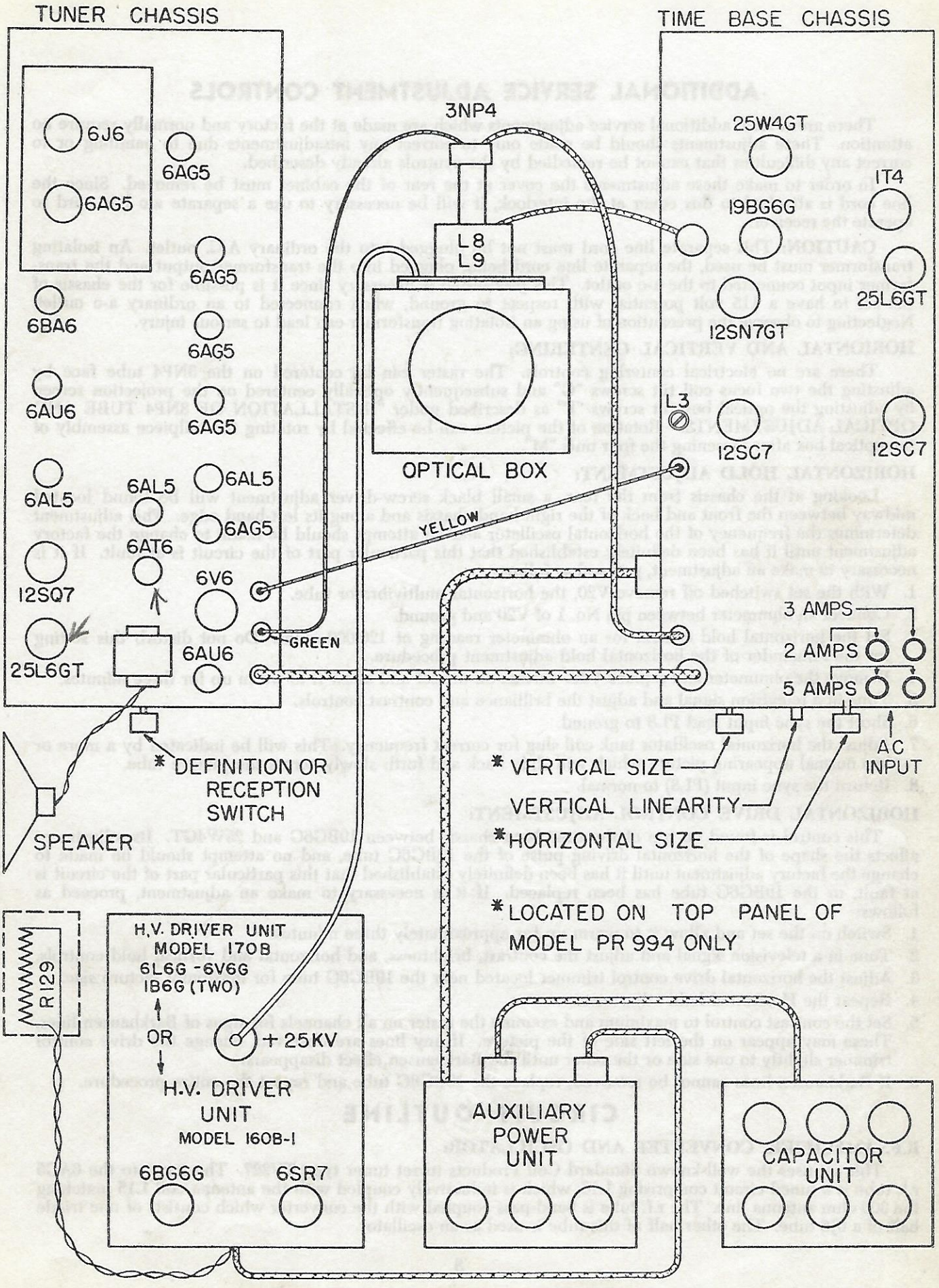
Position 3: Should be used for weak stations. This position greatly increases the picture sensitivity with a larger reduction in the "snow" effect.

Position 3 should not be used for normal reception, or the quality of the picture will be impaired.

The HORIZONTAL SIZE CONTROL is used to control the size of the picture in a horizontal direction. Clockwise rotation of the knob increases the picture width.

The VERTICAL SIZE CONTROL is used to control the size of the picture in a vertical direction. Clockwise rotation of the knob increases the verticle size of the picture.

The VERTICAL LINEARITY CONTROL is used to adjust the linearity of the picture. Adjustments should be made when receiving a test pattern from a Television station. Counter-clockwise rotation of the knob compresses the bottom and stretches the top of the picture. Clockwise rotation of the knob compresses the top and stretches the bottom.



TUBE LOCATION AND INTERCONNECTION DIAGRAM

ADDITIONAL SERVICE ADJUSTMENT CONTROLS

There are several additional service adjustments which are made at the factory and normally require no attention. These adjustments should be made only to correct any misadjustments due to handling or to correct any difficulties that cannot be remedied by the controls already described.

In order to make these adjustments the cover at the rear of the cabinet must be removed. Since the line cord is attached to this cover at the interlock, it will be necessary to use a separate a-c line cord to operate the receiver.

CAUTION: This separate line cord must not be plugged into the ordinary A.C. outlet. An isolating transformer must be used, the separate line cord being plugged into the transformer output and the transformer input connected to the a-c outlet. This precaution is necessary since it is possible for the chassis of the set to have a 115 volt potential with respect to ground, when connected to an ordinary a-c outlet. Neglecting to observe the precaution of using an isolating transformer can lead to serious injury.

HORIONTAL AND VERTICAL CENTERING:

There are no electrical centering controls. The raster can be centered on the 3NP4 tube face by adjusting the two focus coil tilt screws "G" and subsequently optically centered on the projection screen by adjusting the optical box tilt screws "F" as described under "INSTALLATION OF 3NP4 TUBE AND OPTICAL ADJUSTMENTS." Rotation of the picture can be effected by rotating the tailpiece assembly of the optical box after loosening the four nuts "M".

HORIZONTAL HOLD ADJUSTMENT:

Looking at the chassis from the rear, a small black screw-driver adjustment will be found located midway between the front and back of the right-hand chassis and along its left-hand edge. This adjustment determines the frequency of the horizontal oscillator and no attempt should be made to change the factory adjustment until it has been definitely established that this particular part of the circuit is at fault. If it is necessary to make an adjustment, proceed as follows:

1. With the set switched off remove V20, the horizontal multivibrator tube.
2. Connect an ohmmeter between pin No. 1 of V20 and ground.
3. Set the horizontal hold control for an ohmmeter reading of 120,000 ohms. Do not disturb this setting for the remainder of the horizontal hold adjustment procedure.
4. Remove the ohmmeter and replace V20. Switch on the set and allow it to warm up for three minutes.
5. Tune in a television signal and adjust the brilliance and contrast controls.
6. Short the sync input lead PL8 to ground.
7. Adjust the horizontal oscillator tank coil slug for correct frequency. This will be indicated by a more or less normal appearing picture which will slide back and forth slowly across the picture tube.
8. Return the sync input (PL8) to normal.

HORIZONTAL DRIVE CONTROL ADJUSTMENT:

This control is found on top of the time base chassis between 19BG6G and 25W4GT. Its adjustment affects the shape of the horizontal driving pulse of the 19BG6G tube, and no attempt should be made to change the factory adjustment until it has been definitely established that this particular part of the circuit is at fault, or the 19BG6G tube has been replaced. If it is necessary to make an adjustment, proceed as follows:

1. Switch on the set and allow it to warm up for approximately three minutes.
2. Tune in a television signal and adjust the contrast, brightness, and horizontal and vertical hold controls.
3. Adjust the horizontal drive control trimmer located near the 19BG6G tube for maximum picture size.
4. Repeat the Horizontal hold adjustment.
5. Set the contrast control to maximum and examine the raster on all channels for signs of Barkhausen lines. These may appear on the left side of the picture. If any lines are observed, change the drive control trimmer slightly to one side or the other until the Barkhausen effect disappears.
6. If Barkhausen lines cannot be removed, replace the 19BG6G tube and repeat the entire procedure.

CIRCUIT OUTLINE

R.F. AMPLIFIER, CONVERTER AND OSCILLATOR:

This set uses the well-known Standard Coil Products turret tuner type TV227. The input to the 6AG5 r.f. tube is a tuned circuit comprising L16, which is inductively coupled with the antenna coil L15 matching the 300 ohm antenna line. The r.f. tube is band-pass coupled with the converter which consists of one triode half of a 6J6 tube. The other half of this tube is used as an oscillator.

The input coils L15 L16, the interstage band-pass coils L17 L18 and the oscillator coil L19 form one clipped-in mechanical unit on the tuner turret. Twelve different units, aligned for optimum reception of each of the twelve Television Channels, can be switched into the tuner circuit by rotating the CHANNEL SELECTOR knob.

All circuit components and in addition the 1st video i.f. transformer with adjacent channel video trap, are incorporated in the R.F. TUNER UNIT sub-chassis, which in turn is mounted in the TUNER CHASSIS.

VIDEO CHANNEL:

The 26.1 Mc video i.f. signal is amplified by four stages utilizing 6AG5 tubes in staggered tuned circuits. Five trap coils are used, tuned respectively to adjacent video, adjacent sound, accompanying sound, adjacent sound and adjacent video frequencies. A 6AL5 tube functions as video detector and a.g.c. detector. The detected video signal is amplified by the 6AG5 and 6V6 video amplifiers, and injected at the cathode of the 3NP4 cathode ray tube.

AUTOMATIC GAIN CONTROL:

The detected a.g.c. voltage is amplified by a 6AT6 tube and applied to the R.F. amplifier and the 1st and 3rd Video I.F. Amplifiers. A.G.C. voltage to the I.F. stages is limited to the desired value by a selenium diode X6.

SOUND CHANNEL:

A tap on the accompanying sound trap, incorporated in the 3rd video i.f. transformer, serves as a take-off point for the 21.6 Mc sound i.f. signal. This signal is then amplified and limited by two band-pass coupled i.f. stages using a 6BA6 tube and a 6AU6 tube respectively. The demodulator is a conventional discriminator using a 6AL5 tube and having a peak-to-peak bandwidth of approximately 200 kc. The triode section of a 12SQ7 tube functions as 1st a.f. amplifier, and a 25L6 tube as audio output to the p-m type dynamic speaker.

SYNC CLIPPERS:

The 1st Sync Clipper (6AU6) receives on its grid the composite video signal with the sync pulses in the positive direction. Grid current develops a sufficient bias for this tube to cut off the video information, and the stripped sync pulses are fed to the Time Base Chassis via SK2 where they are applied to a double triode (12SC7). The first half of this tube amplifies and clips the sync pulses again, and from its anode the signal is fed into the vertical integrating network, from which the vertical sync pulse reaches the grid of the Vertical Oscillator Tube (12SC7). The second half of the 2nd Sync Clipper amplifies and clips the sync signal for the 3rd time and feeds it into the Horizontal Discriminator Transformer.

VERTICAL SWEEP CIRCUITS:

A 12SC7 tube functions as the Vertical Blocking Oscillator, whose grid is triggered by the Vertical Sync pulses. The oscillator provides a peaked saw-tooth voltage which is applied to a 25L6GT Vertical Output Tube. A relatively large amount of negative feed-back is used in the Vertical Output Stage. A variable resistor in the feed-back network is used to adjust the Vertical Linearity, whereas the Vertical Size can be adjusted by varying the B+ supply voltage to the Vertical Oscillator.

The Vertical Output Tube is matched to the Vertical Deflection Coils by means of the Vertical Output Transformer.

HORIZONTAL SWEEP CIRCUITS:

The horizontal saw-tooth is generated by a 12SN7 Horizontal Oscillator tube in an l.c. stabilized multivibrator circuit. Synchronization is accomplished by phase comparison of the Horizontal Sync pulses from the secondary of the Horizontal Discriminator Transformer, with a saw-tooth voltage derived from the deflection current.

A matched pair of 1N34 germanium diodes is used in the Horizontal Phase Discriminator.

The Horizontal Output tube (19BG6G) is driven by a peaked saw-tooth derived from the Horizontal Oscillator. The width of the negative peaking pulse can be adjusted with the Drive Control trimmer.

The Horizontal Deflection Coils are matched to the Horizontal Output Tube by the Horizontal Output Transformer, which is also part of a Booster-Damper circuit incorporating a 25W4GT tube.

This tube controls the damping-out of the oscillations immediately after the retrace and feeds back the excess energy to the plate circuit of the Horizontal Output Tube, thus boosting its efficiency.

HIGH VOLTAGE DRIVER CIRCUIT (TYPE 160B-1):

The triode section of the 6SR7 tube operates as a conventional blocking oscillator, whose frequency is 1,000 ± 70 cycles. The saw-tooth voltage which it generates, is applied between the control grid and cathode of the 6BG6G driver tube, which is biased beyond cut-off. The driver tube plate-current flows through a portion of the primary of the high-voltage transformer, in pulses corresponding to the saw-tooth peaks of the

input signal. The top end of the primary is connected to the voltage tripler circuit. The peak voltage across the high-voltage winding is approximately 8.5 kv. Three indirectly heated rectifier tubes, which have been developed for pulse operation, are used in the voltage multiplier circuit. The heating power is derived from individual windings on the high-voltage transformer. Because the transformer is self-resonant to approximately 25 kc, each 1,000 cycles pulse will start a damped train of high voltage transient oscillations whose frequency is 25 kc and whose initial peak amplitude is approximately 8.5 kv. The amount of power supplied to the heaters of the rectifier tubes is a function of the frequency. Therefore, in order to maintain the proper operating temperature on the rectifier heaters, the blocking oscillator frequency must be held to 1000 ± 70 cycles. A trimmer condenser C304 which is accessible through a hole in the side of the chassis serves to adjust this frequency.

Automatic control of the driver tube bias, by means of a control voltage derived from the voltage peaks across the resonant circuit provides a most effective method of obtaining high power efficiency and good regulation. The control voltage is obtained from a separate winding on the high voltage tripler transformer and is rectified by the diode sections of the 6SR7 tube. The rectified control voltage is filtered by the network consisting of C308, C307, and R308, and then applied to the driver grid circuit across resistor R307. The use of this method of automatic voltage control of the driver tube provides a regulation characteristic which is substantially flat within the desired operating range. The output voltage falls off very rapidly beyond this range. This is a very desirable feature from the viewpoint of protection against external short circuits. It also reduces the accidental shock hazard. Despite this, USE EXTREME CARE WHEN WORKING ON THE HIGH VOLTAGE CIRCUITS. (Refer to High Voltage Driver Schematic Diagram.)

PICTURE TUBE PROTECTION CIRCUIT, D.C. RESTORATION

Since a special high-voltage unit is incorporated which does not depend in any way upon the sweep circuit operation, a permanent burn on the face of the cathode-ray-tube could occur in the event of any sweep failure for a period of a few seconds. The failure of a vacuum tube, resistor, or condenser, etc., could therefore induce a cathode-ray tube failure, requiring a relatively expensive replacement.

For this reason a C.R.T. Protective Tube (1T4) is used in combination with the 6AL5 D.C. Restorer. This circuit functions as follows:

The D.C. Restorer Tube cathode will attain a positive potential which approximately equals that of the peaks of the (positively oriented) sync pulses applied to the C.R.T. cathode.

This intelligence is supplied to the top of the Brilliance control via pin No. 6 of PL4 and SK4 after passing through the 1T4 Protective Tube. If the Protective Tube is conductive the voltage supplied by the D.C. Restorer will provide the right amount of variation of the C.R.T. grid voltage required to maintain a satisfactory brightness level with varying picture content and signal strength.

The Protective Tube heater is energized from the secondary of the Vertical Output Transformer. The tube is made intermittently conductive by pulses on its grid which are derived from the horizontal deflection coil. In the event that one or both of the scanning signals disappear, the Protective Tube becomes non-conductive and the grid voltage drops to —100V which is the potential at the lower side of the Brilliance Control, thereby effectively cutting off the C.R.T. beam current. For the same reason the beam will be cut off in case of failure of the Protective Tube itself.

VIDEO A.G.C. CIRCUIT:

The A.G.C. Detector rectifies the video i.f. signal coupled to it from the 4th video i.f. stage. The positive potential developed at the Detector cathode is applied to the 6AT6 diodes, which function as clippers to reduce any noise peaks that may be present. This voltage is fed to the grid of the 6AT6 triode. This triode functions as a controlled d.c. amplifier of which the negative d.c. voltage output is applied to the r.f. and i.f. stages as "automatic gain control" bias voltage. The operating bias of this triode determined by the setting of the front panel Contrast control is likewise amplified and added to the a.g.c. bias voltage. In this manner the Contrast control serves as a manual gain control.

This triode amplifier supplies two separate a.g.c. outputs, one to the r.f. stage, and the other to the i.f. stages. The a.g.c. voltage applied to the i.f. amplifier is initially higher than that to the r.f. amplifier and increases with increasing signal up to approximately 3 volts negative, after which the r.f. a.g.c. voltage is progressively higher. The reason for this crossover is that the a.g.c. limiter diode (X6) shunting the i.f. a.g.c. circuit starts to conduct at 3 volts negative and loads down the i.f. a.g.c. circuit. Thus at lower signal strengths the r.f. amplifier operates at higher gain for better signal-to-noise ratio and at higher signal strengths the r.f. amplifier is biased sufficiently to prevent overload.

SERVICING THE CHASSIS

Before attempting to perform any service work on this receiver, the following precautions must be taken:

1. Whenever the back cover is removed, always use an isolating transformer to supply power to the receiver.

2. Never remove a tube from the chassis, or remove the socket from the picture tube while the power is on. Since the filaments are in series-parallel, the removal of one tube will cause abnormally high voltage in other parts of the filament circuit causing tube filaments to burn out. Ordinarily, the chassis cannot be operated with the picture tube removed unless provision is made for bridging the filament leads to the picture tube with the proper resistor.
3. If service work on the High Voltage Driver chassis or Optical Box Assembly is required, give careful consideration to the "PICTURE TUBE HANDLING AND OPERATING INSTRUCTIONS" as described on Page 4 and to the WARNING given under "SERVICING THE HIGH VOLTAGE DRIVER UNIT."

CIRCUIT ALIGNMENT

SEQUENCE: Complete alignment of the receiver tuned circuits, or alignment of one or more sections, can be performed as required. The following sequence is suggested for complete alignment:

1. Video I.F. Trap.
2. Sound I.F. Alignment.
3. Sound Discriminator.
4. Overall Video.
5. R.F. Oscillator.
6. Sensitivity Check.

Detailed description of the alignment procedure should be followed carefully, and the alignment table used only as a guide, or after becoming thoroughly familiar with the various operations through practice.

Test Equipment: The following test equipment is recommended for proper alignment and testing of the receiver:

1. R.F. Sweep Generator capable of constant output of not less than .1 volt maximum, and with dependable attenuator, covering the ranges of—
   (a) Video I.F. 20-30 Mc.
   (b) Sound I.F. 21-22 Mc.
   (c) R.F. channels from No. 2 to No. 13 inclusive with 300 ohms output impedance.
2. R.F. Signal Generator having good frequency stability and accurate dial calibration for the following frequencies—
   (a) Pictures and Sound Carrier Frequencies for all channels—No. 2 to No. 13 inclusive.
   (b) Picture and Sound Intermediate Frequencies and Trap Frequencies ranging from 20.1 Mc to 27.6 Mc. (See detailed lists under ELECTRICAL AND MECHANICAL SPECIFICATIONS.)
3. Heterodyne Frequency Meter or Crystal Calibrator with which to check calibration points on the R.F. Signal Generator.
4. Cathode-Ray Oscilloscope with a wide-band frequency response on vertical deflection. (This feature is required when analyzing the waveform patterns shown on Pages 19 and 20.
5. Vacuum Tube Voltmeter, one range of which will read not more than 3 volts at full scale, and preferably 1 volt full scale.

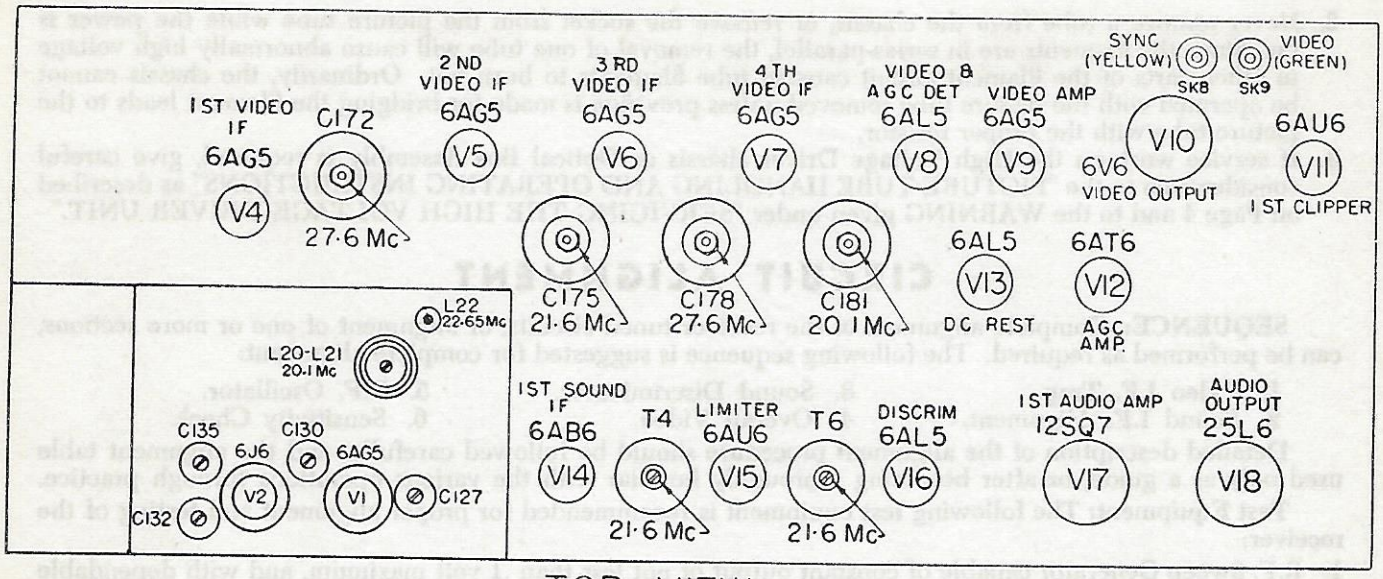
ALIGNMENT SET-UP

Use of these recommended accessories and observance of the outlined precautions preparatory to and throughout alignment of the tuner chassis will assure satisfactory and trouble-free results.

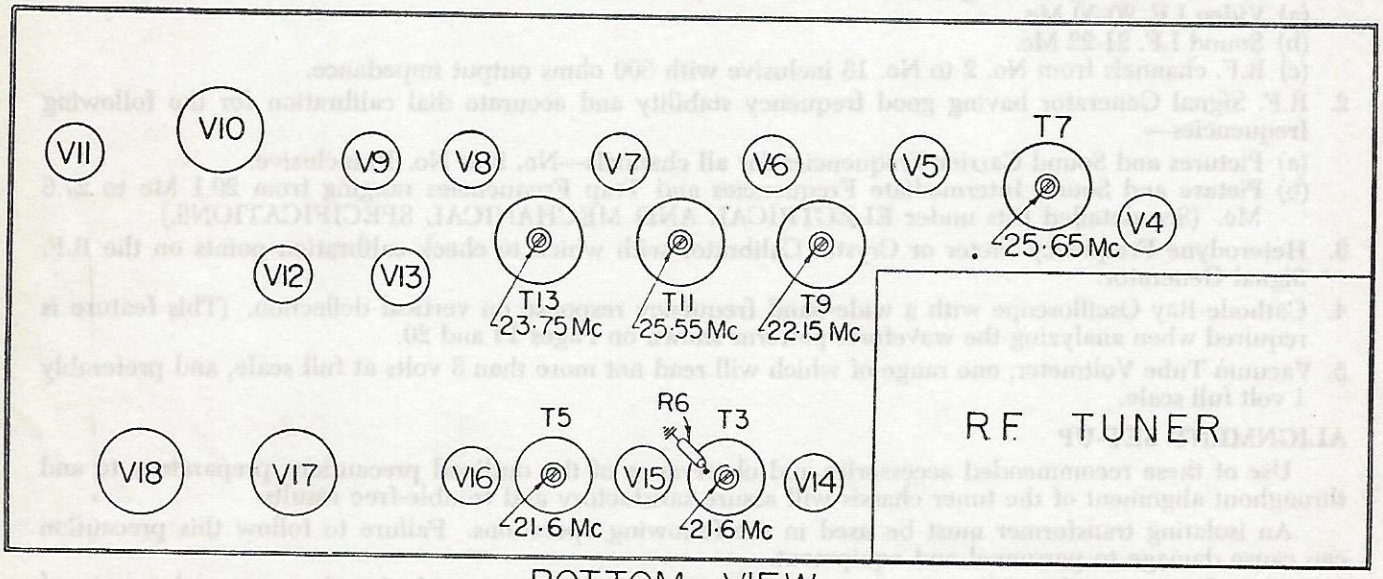
An isolating transformer must be used in the following operations. Failure to follow this precaution can cause damage to personnel and equipment.

Note: Great care should be taken to avoid contact with other points of high voltage, e.g., plate caps of the 6BG6G tube and associated leads. Very severe burns may result if these points are touched.

1. Place a plate of sheet copper upon the top of the bench and group the test equipment around the end and back edges, binding each piece of equipment to the plate by means of a short piece of copper strap or braid. Group signal generating equipment at one side and indicating equipment at the opposite side to reduce the possibility of coupling due to input and output lead crossings, etc.
2. Stand the chassis on edge with the bottom facing the operator. A convenient position is with the chassis edge making contact with the plate, and the R.F. tuner at the bottom. If the chassis is supported in any other way, be certain to connect the chassis to the metal plate.
3. A convenient place of feeding in the signal for I.F. alignment is between the tube shield of V_2 and the R.F. tuner chassis. Disconnect tube shield from chassis.
4. Use a simple de-coupling network between the desired output point and the oscilloscope probe, or the meter lead, to reduce the possibility of undesired R.F. coupling. Connect a 10,000 ohm composition type resistor and a 1,000 mmf mica or ceramic capacitor in series and connect the resistor lead to the desired output point and the capacitor lead to the chassis. The scope or meter may now be connected from the junction of the resistor and capacitor to chassis.
5. Three alignment tools are required, a screwdriver consisting of an insulated rod with a small metal blade, preferably with a sleeve around the tip, to adjust the Video I.F. slugs, a small fibre or plastic screwdriver to adjust the sound I.F. slugs and an insulated hex socket wrench or piece of stiff ¼" diameter spaghetti for traps.



TOP VIEW



BOTTOM VIEW

SOUND I.F. AND DISCRIMINATOR ALIGNMENT

Step No.	SIGNAL GENERATOR (1 Mc. SWEEP)		SIGNAL GENERATOR (MARKER)		OSCILLOSCOPE	Adjust	Remarks
	Connect Between	Freq.	Connect Across	Freq.	Connect Across		
1	Tube Shield V_2 and chassis	21.6 Mc.	Tube shield V_2 and chassis	21.6 Mc.	Limiter grid resistor R6	T4-T3	Maximum amplitude symmetrical to marker
2	Tube Shield V_2 and chassis	21.6 Mc.	Tube shield V_2 and chassis	21.6 Mc.	Limiter grid resistor R6	T6-T5	Same as above
3	Tube Shield V_2 and chassis	21.6 Mc.	Tube shield V_2 and chassis	21.6 Mc.	Volume control R13-R14	T5-T6	For symmetrical "S" curve

Conditions: A. A.C. Line Voltage: 117 volts
B. Select Channel No. 3
C. Disconnect shield of V_2 from R.F. tuner chassis.

VIDEO I.F. AND TRAPS ALIGNMENT

Step No.	SIGNAL GENERATOR		CATHODE RAY OSCILLOSCOPE		Remarks
	Connect Between	Freq.	Connect To	Adjust	
1	Between tube shield of V_2 and chassis	20.1 Mc.	Video detector output pin 5 of 6AL5 (V8A)	L20-C181	Tune for minimum amplitude (first dip)
2	Between tube shield of V_2 and chassis	27.6 Mc.	Video detector output pin 5 of 6AL5 (V8A)	C172-C178	Tune for minimum amplitude (first dip)
3	Between tube shield of V_2 and chassis	21.6 Mc.	Video detector output pin 5 of 6AL5 (V8A)	C175	Tune for minimum amplitude (first dip)
4	Between tube shield of V_2 and chassis	22.65 Mc.	Video detector output pin 5 of 6AL5 (V8A)	L22	Tune for maximum amplitude (first peak)
5	Between tube shield of V_2 and chassis	25.65 Mc.	Video detector output pin 5 of 6AL5 (V8A)	T7	Tune for maximum amplitude (first peak)
6	Between tube shield of V_2 and chassis	22.15 Mc.	Video detector output pin 5 of 6AL5 (V8A)	T9	Tune for maximum amplitude (first peak)
7	Between tube shield of V_2 and chassis	22.55 Mc.	Video detector output pin 5 of 6AL5 (V8A)	T11	Tune for maximum amplitude (first peak)
8	Between tube shield of V_2 and chassis	23.75 Mc.	Video detector output pin 5 of 6AL5 (V8A)	T13	Tune for maximum amplitude (first peak)

Upon completion of Operation 8, repeat Operations 1, 2 and 3.

Conditions:

A. A.C. Line Voltage: 117 volts

B. Select channel No. 3

C. Disconnect shield of V_2 from R.F. tuner chassis

D. Apply —3 volts bias to the I.F., A.G.C. bias (+ Red side of X6 rectifier)

E. Adjust contrast control to maximum

F. Turn all coil slugs and trimmers full out before starting alignment

ALIGNMENT PROCEDURE

1. Set Channel Selector to Channel No. 3.
2. Apply 3-volts fixed battery bias to the I.F., A.G.C. bias, at the red (+) side of the A.G.C. limiting rectifier, or the junction of R74 and R75 or the ungrounded side of C33. Set contrast control to maximum.
3. Disconnect tube shield of V_2 from chassis. The I.F. fixed frequency or swept frequency signal is applied between this tube shield and R.F. tuner chassis.
4. Video I.F. and trap alignment. Note: (See chassis sketch for location of adjustments.) Use minimum strength of signal throughout this alignment. Adjust oscilloscope gain and R.F. signals so that pattern observed is just clear of noise level. Connect oscilloscope to 6V6 video output at SK3 (green).
5. Using R.F. signal generator, with 50-100%, 400 cycle modulation, applied at converter tube shield align trap condensers and stagger tuning slugs, as indicated:
   (a) — at 20.1 Mc. adjust L20 and C181 traps for minimum.
   (b) — at 27.6 Mc. adjust C172 and C178 traps for minimum.
   (c) — at 21.6 Mc. adjust C175 trap for minimum.
   (d) — at 22.65 Mc. adjust L22 I.F. for maximum.
   (e) — at 25.65 Mc. adjust T7 I.F. for maximum.
   (f) — at 22.15 Mc. adjust T9 I.F. for maximum.
   (g) — at 25.55 Mc. adjust T11 I.F. for maximum.
   (h) — at 23.75 Mc. adjust T13 I.F. for maximum.
6. Recheck all trap adjustments. Since trap rejection ratio is very high, and traps tune very sharply, care must be exercised to avoid false dips due to overloading.
7. Apply the sound I.F. sweep signal (21.6 Mc. centre) between tube shield V_2 and ground, and align the sound I.F. transformers in succession starting at T8, for maximum response at 21.6 Mc. with symmetry, at 21.5 Mc. and 21.7 Mc. markers. For this alignment, the oscilloscope is connected across the limiter grid resistor R6. Use a signal just large enough to give a clean trace on the oscilloscope, free of background set noise.

8. Remove the oscilloscope and reconnect it to the upper or "hot" end of volume control. At this point, observe the discriminator "S" curve. Align the primary T5 and secondary T6 of the discriminator transformer for maximum response with the zero crossover at 21.6 Mc. The "S" curve should be symmetrical. Recheck (7) if necessary to correct lack of symmetry. Check "S" curve for horizontal vibration due to filament hum, if present, change 6AL5 discriminator tube and repeat 8.

9. Apply the video I.F. Sweep Signal (20-30 Mc.) to test adapter and connect oscilloscope to 6V6 video output at SK3. Examine the overall I.F. selectivity curve. If the curve varies from the selectivity limits curve, corrections may be made by adjusting the 5th I.F. transformer tuning and, if necessary, the 3rd and 4th as well, in order stated.
If more than two turns are needed on any coil trimmers, recheck and readjust, if necessary, the associated trap tuning.

   The selectivity curve must conform to the following specifications:
   (a) Video carrier must be within the range of 50% to 60% of the average response at the top of the curve.
   (b) The dip in the middle of the top of the response curve must not be less than 66% of the top of the curve for the I.F. response curve
   (c) The response at 22.4 Mc. must not be less than 90% of the average of the top of the curve.

10. Replace tube shield of V_2. Apply the R.F. sweep signal to the antenna terminal on the tuner assembly and observe the overall selectivity curves. Check the tuner vernier on each channel to see that the vernier will tune the "own sound" rejection dip through the sound marker. If it does not, adjust the tuner oscillator slug for the channel in question.

11. Check selectivity curves on R.F. on each channel on each band applying the R.F. sweep signal to the antenna terminals. The selectivity curve must conform to the following specifications:
   (a) Same as in Section No. 9.
   (b) Same as in Section No. 9.
   (c) The video passband as measured between the video carrier and the 90% response point on the 90% end must be greater than 3.8 Mc.

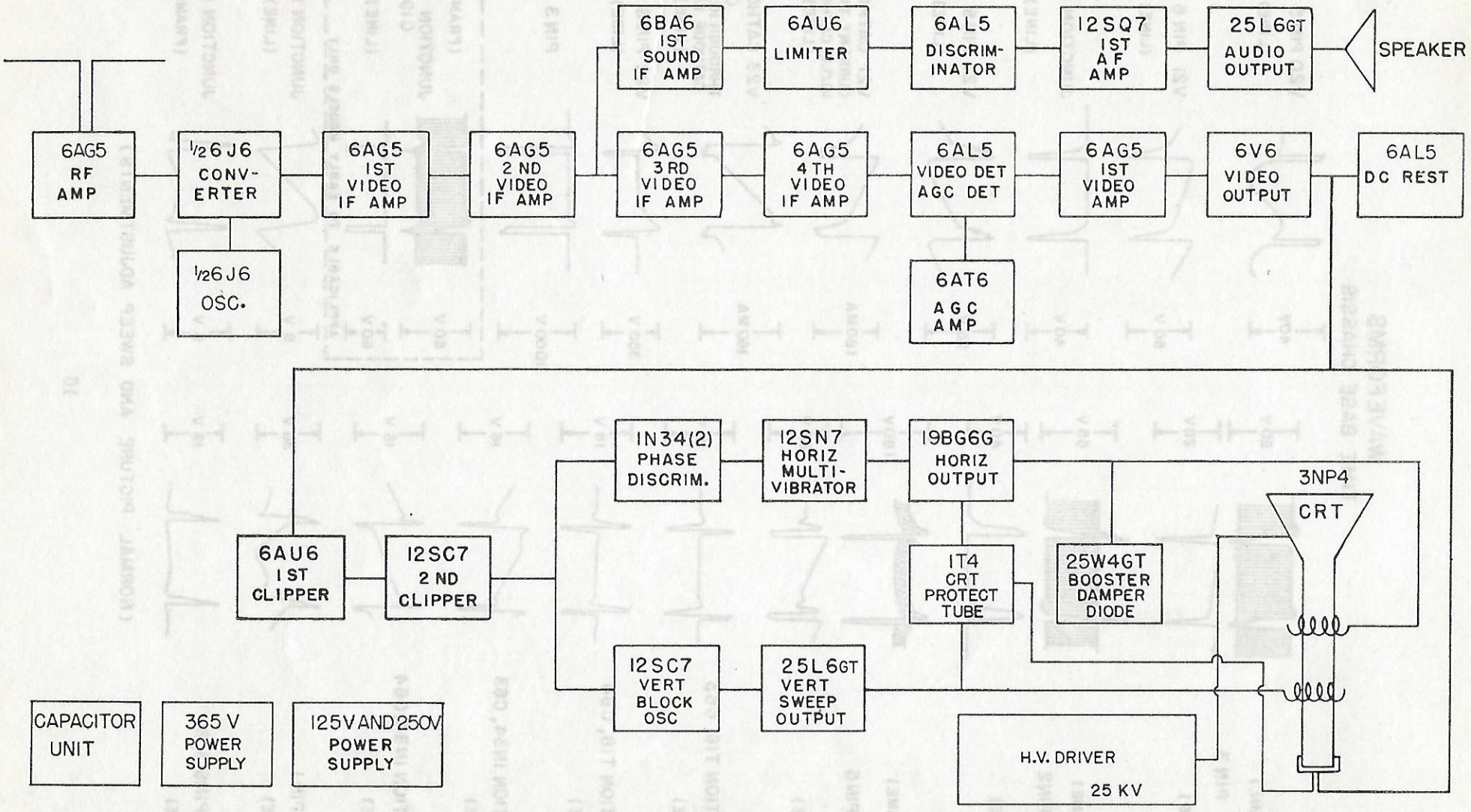
12. Seal all iron cores with soft wax.

SENSITIVITY CHECK (Remove fixed bias)

(a) **Video Channel** — Connect the AC voltmeter through a decoupling filter (as in Step 4 or alignment set-up, page 11), to the video output at the pin jack SK3 and ground. Set contrast control to maximum. Apply the R.F. signal 30% 400 cycle modulation to the antenna terminals and tune for maximum AC voltmeter reading, using a signal of about 25-50 microvolts. Adjust signal generator output for 3.0 volts R.M.S. output.
Limits: 50 uv maximum on all channels.

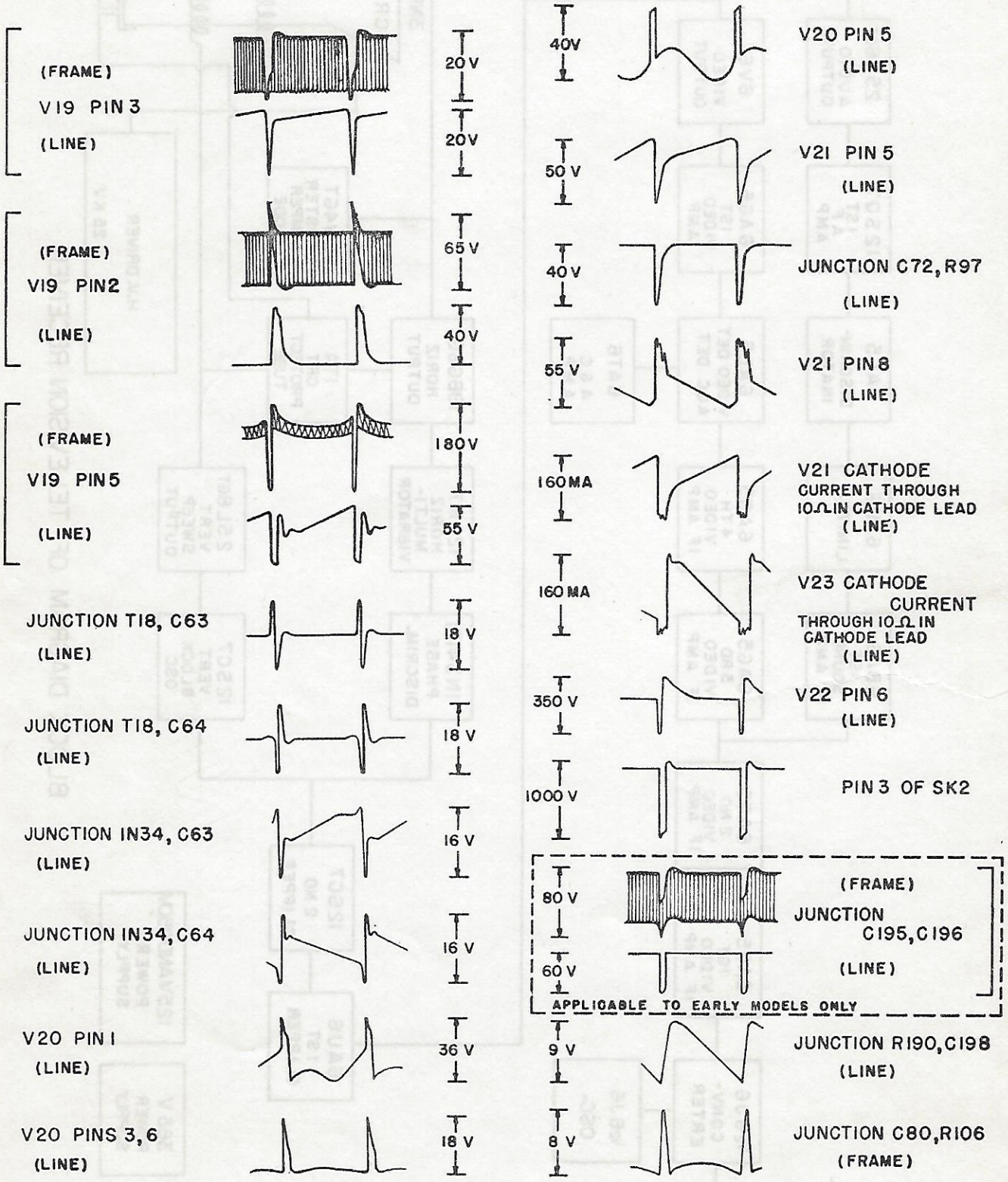
(b) **Video Output** — Connect an oscilloscope to the video output in addition to the AC voltmeter. Adjust R.F. signal for 100,000 uv, 50% 400 cycle modulation on any one channel. The video output must not be less than 75 volts peak to peak, or 40 volts R.M.S. with no distortion as viewed on the oscilloscope when the receiver is tuned to receive the R.F. signal on the flat or average part of the curve.

(c) **Sound Channel** — Connect F.M. signal generator to antenna terminals of set (balanced 300 ohm input) and connect output meter, set at 4 ohms impedance, in place of speaker. Set generator at sound carrier frequency of the desired channel and use frequency modulation of 30% (7½ kc deviation) at 400 C. Set Volume and Contrast controls fully clockwise. Adjust Tuning Control for maximum output. Input should not exceed 150 uv for channels No. 2 through No. 6 and 300 uv for channels No. 7 through No. 13, for 500 mw output (1.4 Volts across 4 ohm resistor).



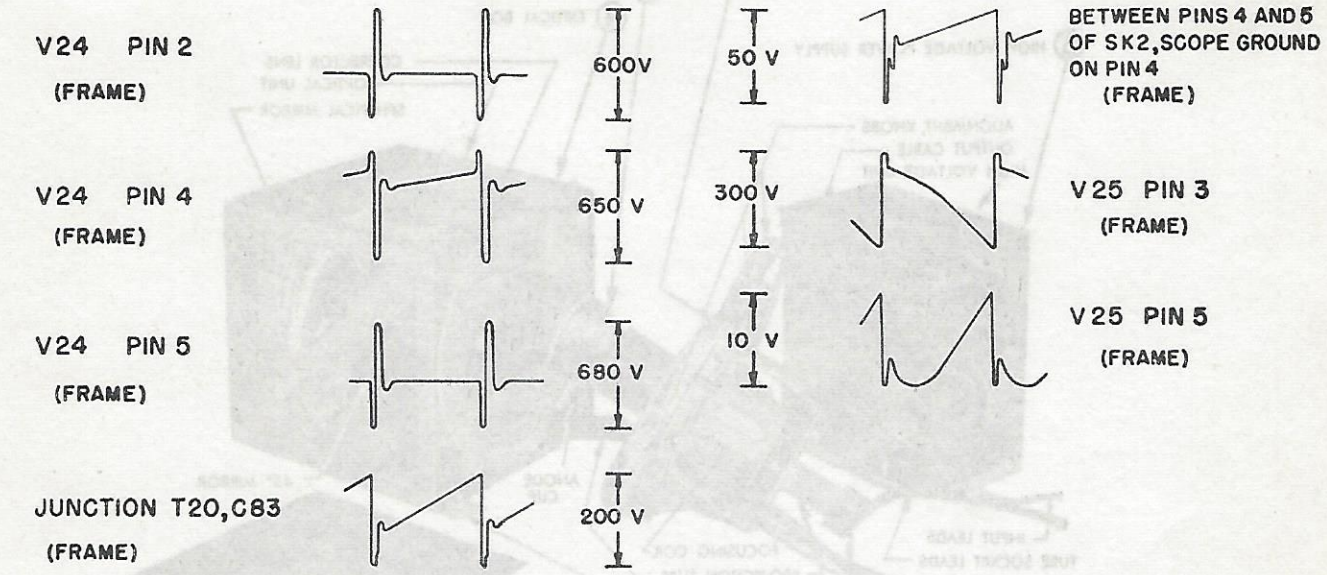
BLOCK DIAGRAM OF TELEVISION RECEIVER

WAVEFORMS
TIME BASE CHASSIS



(NORMAL PICTURE AND SWEEP ADJUSTMENTS)

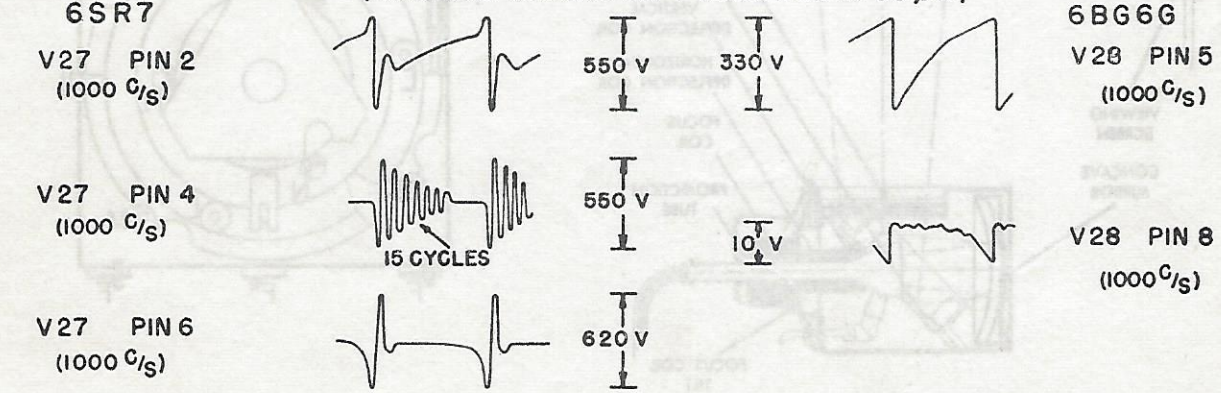
WAVEFORMS (CONTINUED)

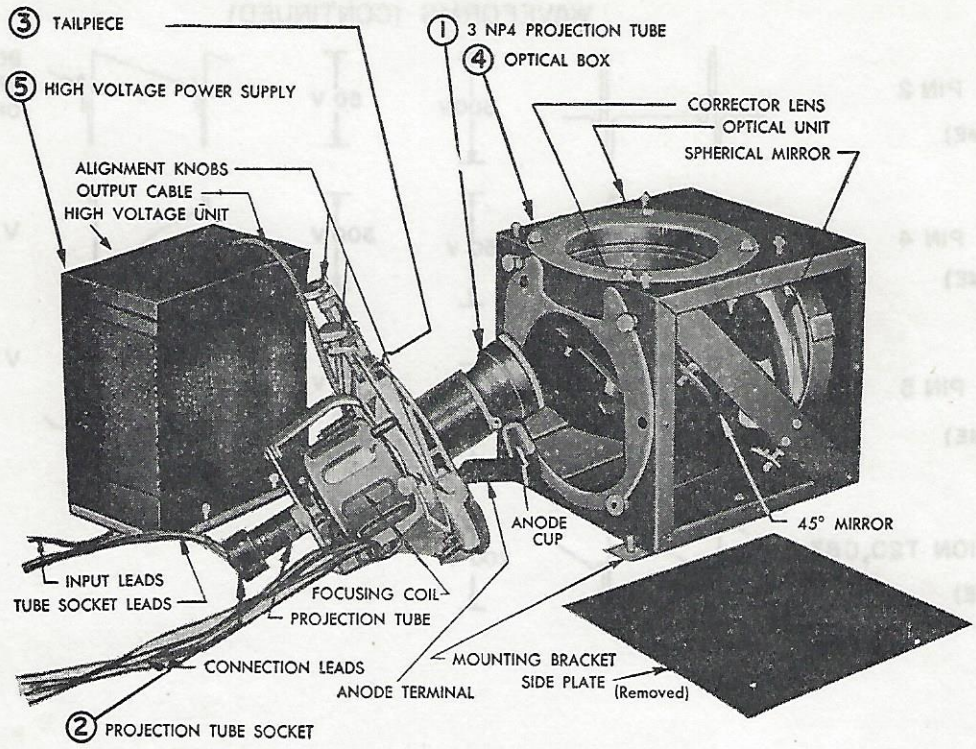


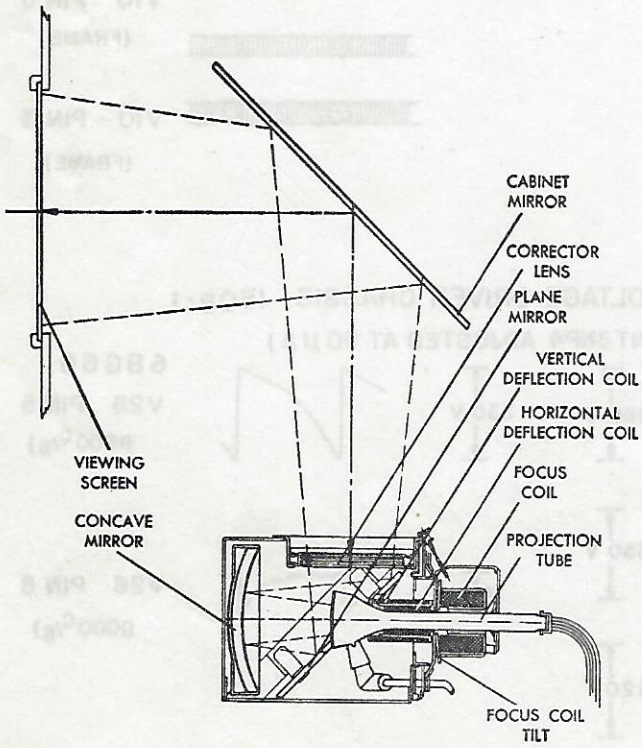
WAVEFORMS VIDEO CHASSIS

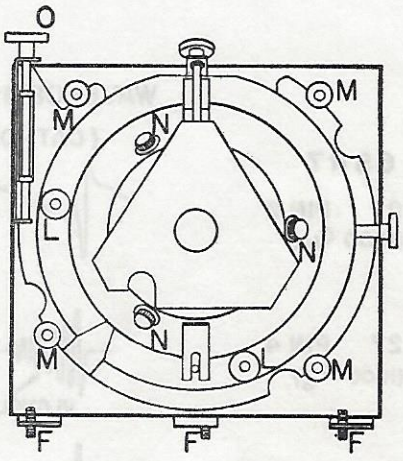
WAVEFORMS HIGH VOLTAGE DRIVER CHASSIS 160B-1

(CATHODE CURRENT 3NP4 ADJUSTED AT 90 μA)




3 TAILPIECE
1 3 NP4 PROJECTION TUBE
4 OPTICAL BOX
5 HIGH VOLTAGE POWER SUPPLY
CORRECTOR LENS
OPTICAL UNIT
SPHERICAL MIRROR
ALIGNMENT KNOBS
OUTPUT CABLE
HIGH VOLTAGE UNIT
ANODE CUP
45° MIRROR
INPUT LEADS
TUBE SOCKET LEADS
FOCUSING COIL
PROJECTION TUBE
CONNECTION LEADS
MOUNTING BRACKET
ANODE TERMINAL
SIDE PLATE (Removed)
2 PROJECTION TUBE SOCKET


CABINET MIRROR
CORRECTOR LENS
PLANE MIRROR
VERTICAL DEFLECTION COIL
HORIZONTAL DEFLECTION COIL
FOCUS COIL
PROJECTION TUBE
VIEWING SCREEN
CONCAVE MIRROR
FOCUS COIL TILT


O
M
N
L
F

INSTALLATION OF 3NP4 TUBE AND OPTICAL ADJUSTMENTS

Note: Provision has been made to permit the adjustments outlined below to be made from the front of the receiver cabinet. This is accomplished by removing the 4 wing nuts holding the speaker baffle in place and taking the baffle out from the front. The necessary controls can be reached through the opening.

(A) 1. Loosen the 4 nuts "M" which hold the tailpiece to the optical box.
2. Rotate the tailpiece to the left and
3. Pull out tailpiece.

Note: This operation should be done with care to prevent the tube from hitting the 45° plane mirror.

(B) 1. Loosen the screw on the tube clamp and the 2 screws which center the tube neck in the hole in the triangular endplate.
2. A light shield and rubber band are packed with the tube. Place light shield over top of tube locating it over the 2 projecting lugs on the tube and hold it in place with the rubber band.
3. Insert the tube through the deflection yoke, keeping the anode cup "down." The 2 springs "S" must make good contact with the aquadag (black coating) on the outside of the tube. Therefore, the springs must be kept clear of the light shield or under it.
4. Tighten the screw in the tube-clamp at the same time keeping the tube held firmly in the deflection yoke. To avoid breaking the neck of the tube, do not tighten the screw with undue force. Then tighten the 2 screws on the face of the triangular end-plate keeping the neck of the tube in the centre of the hole.

Caution: In this operation or in any subsequent operations, do not hold the tailpiece assembly by grasping the deflection yoke.

(C) 1. Place h.v. connector at end of h.v. cable in anode cup of tube, with the connector making contact to the metal button.
2. Loosen 2 screws holding h.v. cable clamp and insert cable through hole in plastic strip. Push clamp inward and tighten 2 screws.

Note: At this point it will be more convenient to centre the raster on the face of the 3NP4 as described in the next section under Electrical Adjustments, because it is difficult to see the face of the tube after it has been installed in the optical box.

3. Carefully insert tailpiece in optical box. Be sure that the position of the light shield is not disturbed and that the tube clears the opening in the 45° plane mirror. It is essential that the position of the tube in the tailpiece is not disturbed. The tube must be kept back snugly in the deflection yoke.
4. Rotate tailpiece to the right until the slots in the tailpiece engage under the 4 nuts "M." Keep the bottom of the triangular endplate parallel to the bottom of the optical box and hand tighten the 4 nuts "M."
5. Place tube socket over end of tube. Hold neck of tube so as to avoid pushing the tube in.

(D) ELECTRICAL ADJUSTMENTS

Warning: Bombardment of the face plate of the tube by a 25 kv electron beam produces soft X-rays which are well absorbed by the projection unit when the tube is in its normal position. Without this shielding, free radiation will result, prolonged exposure to which could prove harmful to personnel. As a consequence, it is recommended that the tube be operated outside the projection unit only as little as is required for test purposes, then **face the tube away from the operator, and view the tube face by means of a mirror.**

Caution: The image seen in the projection box is extremely brilliant. Set the "Brilliance" control for minimum required for a clear picture, and use care when looking into the projection unit. If desired, dark glasses may be used to protect the eyes.

1. Plug in line-cord and tune receiver to a transmitted test pattern. Look down into the optical box at the pattern reflected from the 45° plane mirror.
2. Adjust the electrical controls of the receiver as described under "How to Operate the Television Receiver."
3. Set Horizontal Hold Control in the middle of the range over which synchronism is maintained.
4. Adjust two screws "G" tilting focus coil to place pattern on the centre of the tube.
5. Adjust Horizontal and Vertical Size Controls so that each corner of the pattern just touches the edge of the tube face. If necessary repeat (4).

(E) 1. Now look at viewing screen. Loosen two nuts "L" which lock the overall adjustment "O." Bring the centre of the picture in focus on the viewing screen by adjusting the knob "O." Then lock the two nuts "L."
2. Adjust the three tilt screws "F" to centre the pattern on the viewing screen.
3. If the pattern appears on the screen at an angle, rotate the tailpiece slightly. To do this loosen 4 screws "M" and tighten after proper positioning of the tailpiece.
4. Increase Horizontal and Vertical Size until the pattern overlaps the screen by about ½ inch.

(F) Look at the viewing screen while making the following adjustments. (Turn down contrast control on receiver and look at lines on the raster.)

1. Slightly loosen 2 nuts "L" and 3 nuts "N."
2. Adjust overall focus "O" and focus centre of raster only.
3. Adjust horizontal focus "H" so that both sides of raster focus equally well.
4. Adjust vertical focus "V" so that top and bottom of raster focus equally well.
5. Re-check overall adjustment "O."
6. Repeat steps 2, 3, 4 and 5 if necessary.
7. Hand-tighten 2 nuts "L" and 3 nuts "N."
8. Wipe off any dust accumulation on the corrector lens with a soft cloth.

DESCRIPTION OF MECHANICAL OPERATION OF OPTICAL ADJUSTMENTS

The 3NP4 cathode-ray tube face plate is part of an accurately defined spherical surface. It is the first lens in the projection system and must be precisely located within the fixed optical triangle (concave mirror, 45° mirror, and corrector lens) to obtain satisfactory optical resolution on the viewing screen. Three thumb-screw adjustments are provided for this purpose. The principal adjustment moves the tube in a longitudinal direction, towards and away from the concave mirror, and provides an overall focusing control. The other two adjustments rotate the tube vertically and horizontally with the centre of the tube face plate as the centre of rotation. These adjustments determine the position of the outer edges of the face plate so that every part of it may be precisely located in relation to the rest of the optical system. Five locking screws are provided to secure the alignment assembly after the adjustments have been made. No attempt should be made to replace or adjust the concave mirror, the 45° mirror or the aspherical corrector lens. Should any of these parts require replacement or realignment, ship the projection unit to the factory. An easy method of checking the alignment of the parts comprising the optical triangle in the projection unit is as follows:

1. Place the optical unit beneath a light source, with the corrector lens facing the light. Tailpiece should be removed.
2. Moulded in the centre of the aspherical corrector lens is a small "v" mark.
3. Look down into the unit from a little to the tailpiece side through the corrector lens. Place the eye for a line of vision from the "v" mark to a place on 45° mirror slightly below elliptical hole. A reflected and inverted "v" will be observed. When this combines with the moulded "v" to form an "X," the optical triangle is perfectly aligned. The reflected "v" may be seen more readily if light enters the box from a direction nearly the same as the line of sight.

SERVICING THE OPTICAL BOX AND MIRRORS

The optical box contains the concave mirror, the 45° plane mirror and the aspherical corrector lens. These are optically aligned at the factory and no adjustments should be attempted under any circumstances. Optical parts must be replaced at the factory.

This is a sealed unit and the side plates should not be removed except in those cases when the mirrors require cleaning. As a rule, this is not required. However, the unit may be used in places where dirt or grease accumulation may be unusually severe. In such cases, the mirror will require cleaning.

To clean the mirrors in the optical box and in the receiver cabinet, first remove dust with a camel's-hair brush and then polish with lens tissue, such as is used for polishing camera lenses. Where discoloration or dirt is excessive, apply a spray such as "Windex."

The top of the corrector lens should be cleaned with a soft cloth.

SERVICING THE TAILPIECE

The tailpiece includes the focus coil, the deflection yoke and its associated wire-wound shield, the tube clamp assembly and the optical focusing adjustments.

SPECIFICATIONS

WIRING COLOUR CODE

Horizontal Deflection Coil — Orange with white tracer, orange with black tracer.
Vertical Deflection Coil — Blue with white tracer, blue with black tracer.
Focus Coil — Red, black with white tracer.
Ground — Black provides a low resistance connection to all other grounded chassis in system.

FOCUS COIL

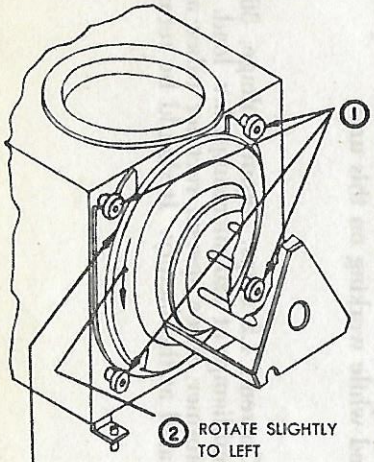
1000 Ampere turns: D—C resistance 11,000 ohms ±10%; Current 20 milliamps (nominal).

DEFLECTION YOKE

Horizontal: Inductance 8.3 millihenries ±10% at 1000 c.; D—C resistance, 15 ohms (approx.).
Vertical: Inductance 45 millihenries ±10% at 1000 c.; D—C resistance, 68 ohms ±10%.

PROTELGRAM TUBE INSTALLATION AND ADJUSTMENTS

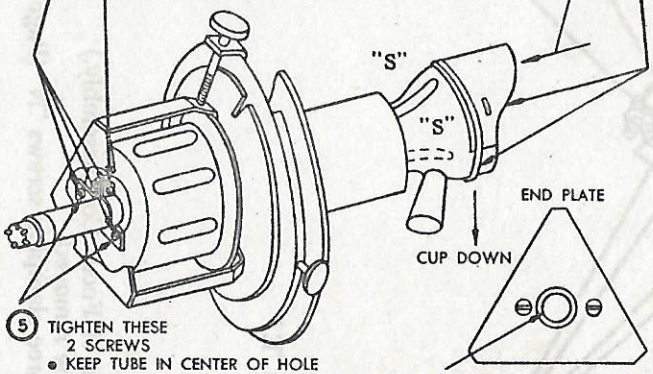
A



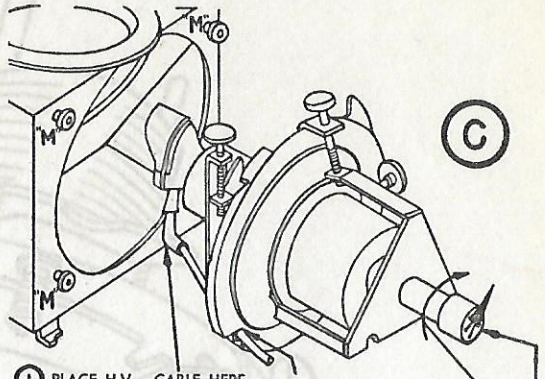
1. LOOSEN THESE 4 NUTS
2. ROTATE SLIGHTLY TO LEFT
3. PULL OUT COMPLETE ASSEMBLY

B

1. PUT ON LIGHT-SHIELD AND RUBBER BAND
2. LOOSEN THESE 3 SCREWS
3. PUSH TUBE "IN"
   - 2 SPRINGS "S" MUST PRESS AGAINST TUBE AND BE CLEAR OF LIGHT-SHIELD OR UNDER IT
4. TIGHTEN THIS SCREW FIRST
   - KEEP TUBE "IN"
5. TIGHTEN THESE 2 SCREWS
   - KEEP TUBE IN CENTER OF HOLE



C



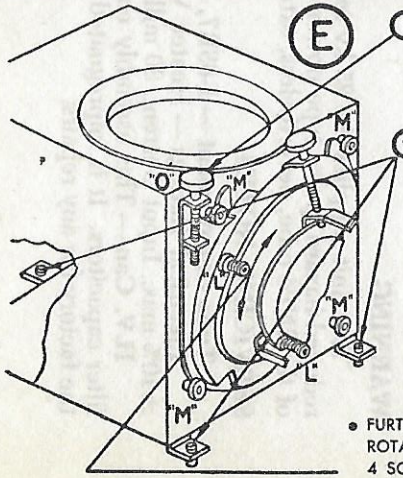
1. PLACE H.V. CABLE HERE
2. PLACE H.V. TERMINAL HERE
3. INSERT COMPLETE ASSEMBLY GENTLY IN BOX
   - WATCH CLEARANCE BETWEEN LIGHT-SHIELD AND INSIDE MIRROR
   - KEEP TUBE AND L'T-SHIELD IN PLACE
   - ROTATE ASS'Y TO RIGHT UNTIL BOTTOM OF ENDPLATE IS PARALLEL TO BOTTOM OF BOX
   - TIGHTEN 4 SCREWS "M"
4. PLACE TUBE SOCKET OVER END OF TUBE

D

ELECTRICAL ADJUSTMENTS

1. PROPERLY TUNE RECEIVER TO TRANSMITTED TEST PATTERN LOOK DOWN INTO BOX AT PATTERN REFLECTED FROM 45° MIRROR
2. ADJUST ELECTRICAL CONTROLS OF RECEIVER TO OBTAIN NORMAL AND PROPERLY FOCUSED PATTERN ON TUBE FACE AS DESCRIBED IN SERVICE NOTES
3. ADJUST SIZE OF PATTERN AND CENTER SO THAT EACH CORNER JUST TOUCHES EDGE OF TUBE FACE

E

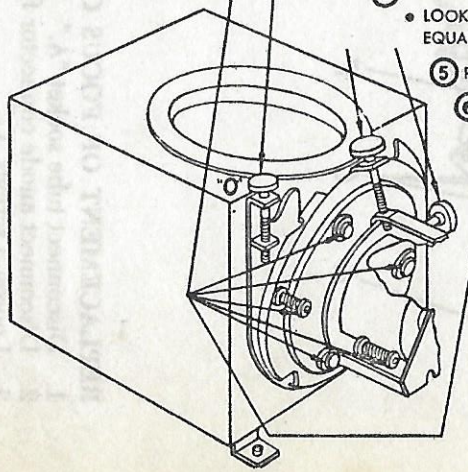


1. LOOK AT VIEWING SCREEN
   - LOOSEN 2 LOCK-NUTS "L" ADJUST OVER-ALL FOCUS "0" AND BRING CENTER OF PICTURE IN FOCUS
2. ADJUST 3 TILT SCREWS AND CENTER PATTERN ON VIEWING SCREEN
   - PATTERN SHOULD OVERLAP SCREEN BY ¼" TO ½"

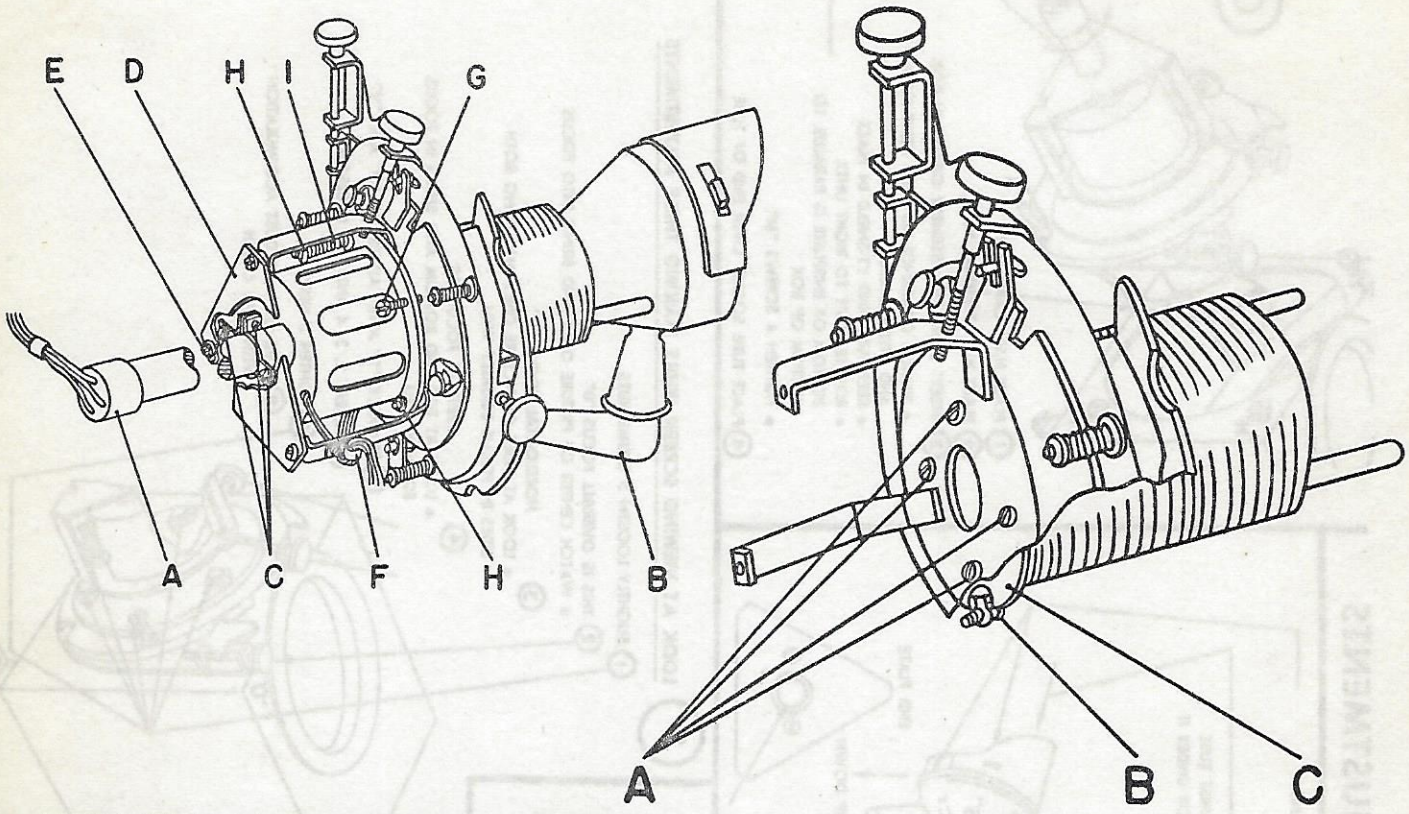
- FURTHER ADJUSTMENT MAY BE MADE BY ROTATING ASSEMBLY AFTER LOOSENING 4 SCREWS "M"

F

LOOK AT VIEWING SCREEN WHILE MAKING THESE ADJUSTMENTS



1. SLIGHTLY LOOSEN 5 THUMB-NUTS
2. THIS IS *OVERALL* FOCUS "0"
   - WATCH CENTER OF PICTURE ONLY AND BRING INTO FOCUS
3. *HORIZONTAL* FOCUS "H"
   - LOOK AT SIDES OF PICTURE ONLY AND BRING BOTH SIDES IN FOCUS EQUALLY WELL
4. *VERTICAL* FOCUS "V"
   - LOOK AT TOP AND BOTTOM AND BRING IN FOCUS EQUALLY WELL
5. RE-CHECK "0" AFTER ADJUSTING "H" AND "V"
6. REPEAT 2, 3, 4 AND 5 IF NECESSARY
7. TIGHTEN 5 NUTS
8. WIPE OFF ANY DUST ACCUMULATION WITH SOFT CLOTH



REPLACEMENT OF FOCUS COIL ASSEMBLY:

1. Disconnect tube socket "A."
2. Disconnect anode connector from tube cup "B."
3. Loosen 3 screws "C."
4. Gently remove 3NP4 tube.
5. Remove triangular plate "D" by unscrewing 3 screws "E."
6. Loosen cable clamp "F."
7. Loosen 2 adjustment screws "G."
8. Remove 2 snap washers "I" and spring "H."
9. Remove focus coil and replace with new one.

REPLACEMENT OF DEFLECTION YOKE:

1. Remove 3NP4 tube and focus coil. (See Replacement of Focus Coil Assembly.)
2. Carefully note the mounting position of the yoke to be removed.
3. Remove the rear spherical plate "C" by taking out three clamping screws "N" (Page 21) and the vertical optical focus adjusting screw "V."
4. Unscrew 4 screws "A."
5. From opposite side remove the ground lug screw "B."
6. Remove deflection yoke and replace with new one.

HIGH VOLTAGE DRIVER UNIT
Type 160B-1

WARNING

This unit supplies the 25 kv required for the operation of the 3NP4 cathode-ray tube. Although it is a reduced-hazard, pulse type power supply, whose power output capabilities are limited to the requirements of the 3NP4 tube, nevertheless, extreme care should be exercised while working on this unit.

SERVICING NOTES:

Tube Complement — 1-6SR7, 1-6BG6G.

Electrical Ratings — Heater Voltage, 6.3 volts. Heater Current, 1.2 amps. Input Voltage, 365 volts ±10% max. Input Current, 30 milliamps at zero h.v. load. 45 milliamps at 120 microamps h.v. load.

H.V. Can — This assembly contains the h.v. tripler transformer, three special rectifier tubes and h.v. filter capacitors. It is impregnated under high vacuum and sealed at the factory. It should be returned to the factory for any repairs.

SERVICING NOTES:

In the interests of safety, testing of this unit should be conducted, as much as possible, with the power supply turned off. If the defective component cannot be located in this manner, an operating voltage check should prove helpful. The check points are all accessible by removing the bottom cover of the unit where, under normal circumstances, no voltages in excess of those externally applied are present.

If failure occurs, first check the 6SR7 and the 6BG6G tubes by replacing them. If this does not correct the difficulty, check to see that the blocking oscillator is functioning as evidenced by a bias of approximately —50 volts, on the grid of the 6SR7 tube.

When replacing the 6BG6G tube, care must be taken to dress the 6BG6G plate lead away from all other connections and grounds. This lead should clear all objects by at least ¼" to prevent corona discharge, as some radio interference may result.

When placing the cover on the high-voltage unit, make certain that it is not reversed. The 25 kv lead must go directly up through the cover and not cross over inside the box. Severe arcing and sparking may result if the cover is reversed.

The following conditions could indicate failure of the sealed h.v. can:

Reduced picture brightness.

Excessive sweep width and height.

No picture.

Note: "No picture" can also indicate action of the 1T4 protective tube or a defective 1T4 tube. Check whether this tube gets grid drive from the horizontal transformer and its heater voltage from the vertical output transformer. If both are normal, check 1T4 protective tube. If this tube is defective no pictures will appear.

REPLACEMENT OF SEALED CAN:

Remove bottom of chassis by removing 4 screws. Unsolder 3 leads from terminal strip on underside of chassis and black lead from chassis.

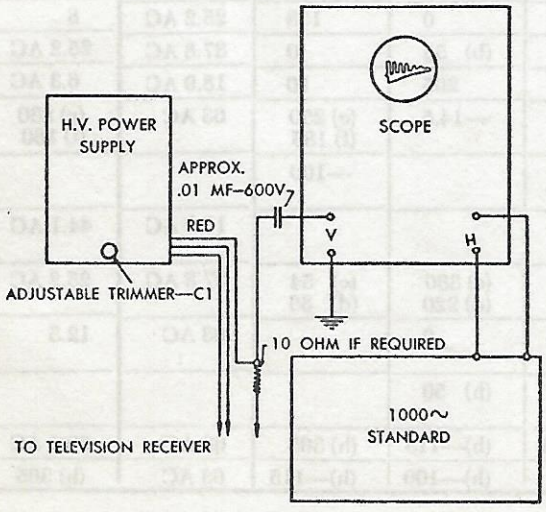
Do not unsolder leads from top of can. Do not unscrew gland (anode lead) at top of can.

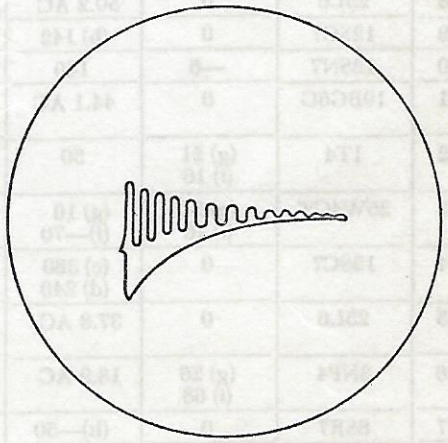
Loosen 2 nuts on underside of chassis thus releasing the 2 clamps. Replace new can by inserting 4 leads through holes in top of chassis. Tighten nuts on underside of chassis holding the 2 clamps. Solder 3 leads to terminal strip on underside of chassis and solder black lead to chassis.

OSCILLATOR ADJUSTMENT:

The frequency of the blocking oscillator in the high-voltage supply must be maintained at 1000 ±70 cycles. Adjustment should not be necessary unless a frequency determining element such as the blocking oscillator transformer has been replaced or altered. The 1000 cycle adjustment has negligible effect on either the output voltage or current regulation and should not be tampered with in an attempt to rectify failure. Its only function is to provide the proper frequency which determines just the proper amount of power to the heaters of the three high-voltage rectifier tubes inside the sealed can, to assure maximum life of these tubes.

Adjust C304 with an oscilloscope and a dependable 1000 cycle generator. Sufficient blocking oscillator voltage can usually be obtained from the B+ red lead to operate the vertical amplifier of the oscilloscope. If sufficient voltage cannot be obtained from the red lead to produce a signal on the oscilloscope, a resistor of about 10 ohms should be soldered in series with the red lead. An increased oscillator signal can be obtained from h.v. driver side of the resistor. Be sure to remove this resistor after the frequency is set. With the 1000 cycle signal from the generator applied to the horizontal sweep amplifier of the oscilloscope, adjust C until a single stable lissajou figure is obtained.





LISSAJOU FIGURE FOR 1000 CYCLE ADJUSTMENT

VOLTAGE CHART

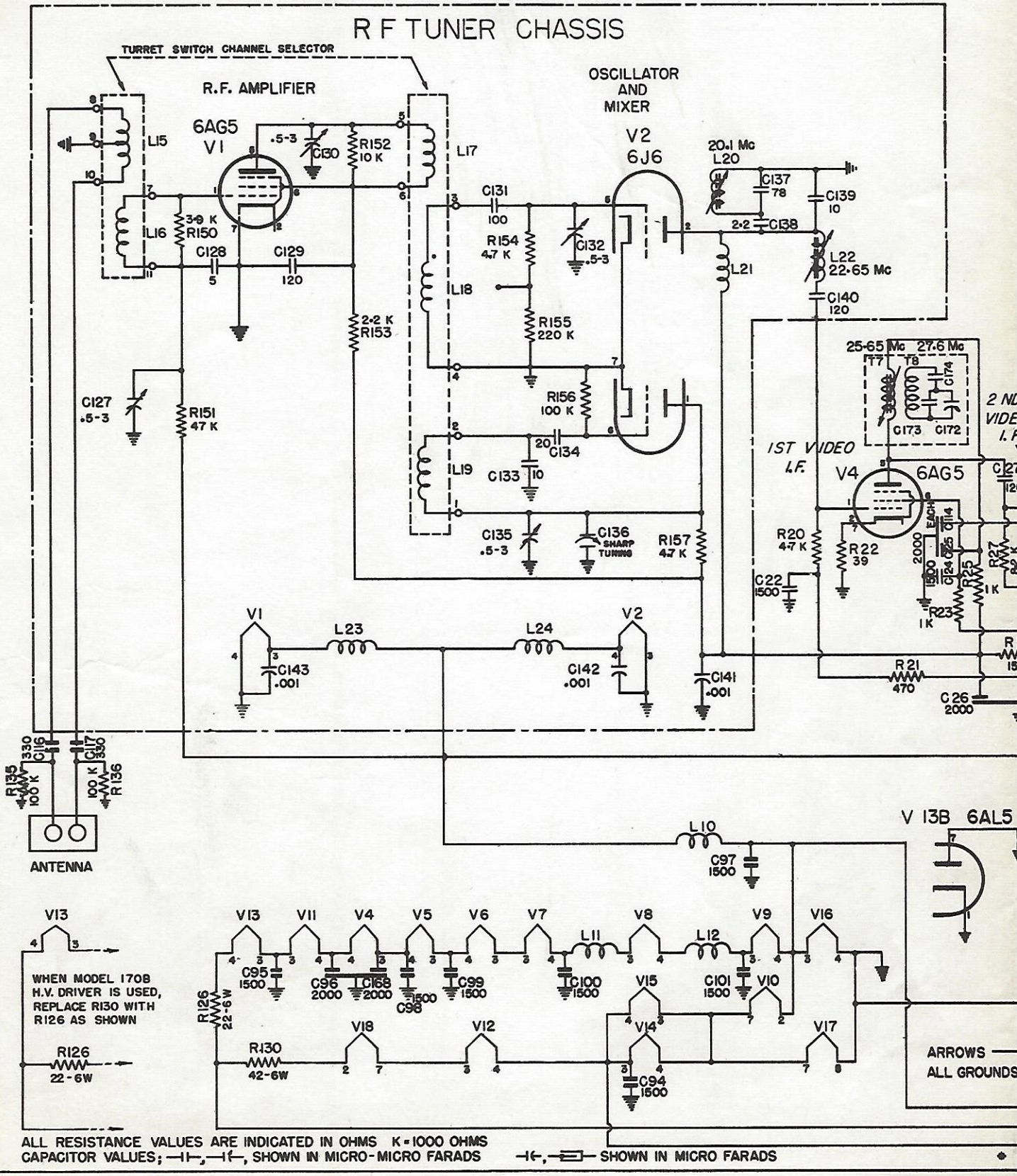
MEASUREMENT CONDITIONS

(1) Line voltage, 117 volts.
(2) Antenna terminals short circuited.
(3) All readings taken from socket terminal to chassis and positive except where noted.
(4) All readings taken with V.T.V.M.
(5) Horizontal and vertical frequencies adjusted at 15.750 c. and 60 c. respectively.
The position of controls, other than those indicated below, should have no effect on the voltage readings.
(a) Contrast Control at maximum setting.
(b) Contrast Control at minimum setting.
(c) Height Control at maximum setting.
(d) Height Control at minimum setting.
(e) Width Control at maximum setting.
(f) Width Control at minimum setting.
(g) Brilliance Control at maximum setting.
(h) Brilliance Control adjusted for 90 ua cathode current of V26 (CRT).
(i) Brilliance Control at minimum setting.

All readings shown may be considered good on 25 cycle or 60 cycle within the limits of ±20%.

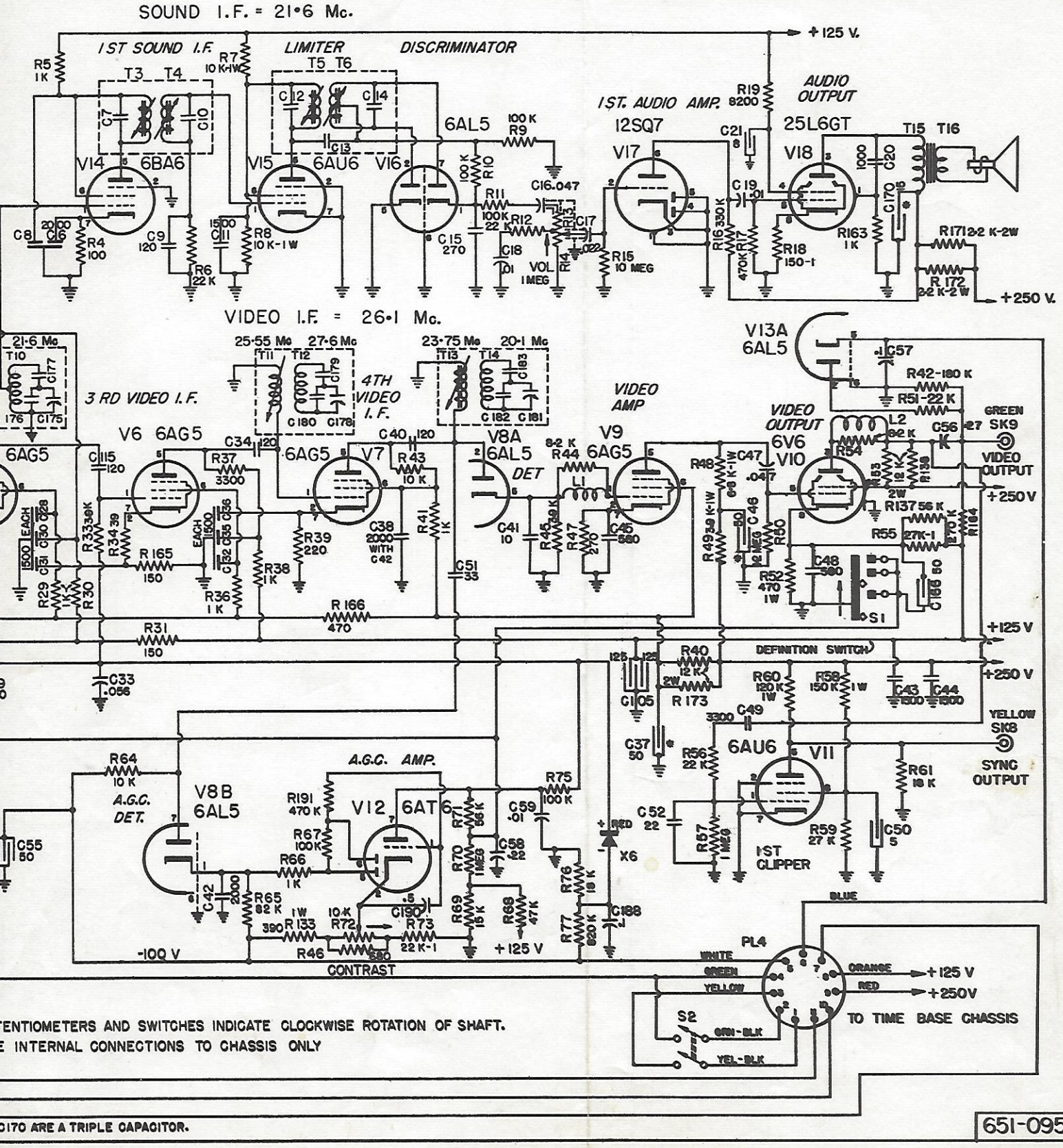
TUBE		PIN NUMBERS							
NO.	TYPE	1	2	3	4	5	6	7	8
1	6AG5	(a) 0 (b)—13	0	6.3 AC	0	(a) 90 (b) 132	(a) 90 (b) 132	0	
2	6J6	(a) 95 (b) 100	(a) 120 (b) 135	0	6.3 AC			0	
4	6AG5	(a) .22 (b)—5.4	(a) .6 (b) 0	37.8 AC	44.1 AC	(a) 110 (b) 130	(a) 140 (b) 170	(a) .6 (b) 0	
5	6AG5	0	(a) 1.5 (b) 1.8	31.5 AC	37.8 AC	(a) 120 (b) 125	(a) 140 (b) 165	(a) 1.5 (b) 1.8	
6	6AG5	(a) 1.3 (b)—5.4	(a) 1.5 (b) 0	25.2 AC	31.5 AC	(a) 110 (b) 140	(a) 140 (b) 170	(a) 1.5 (b) 0	
7	6AG5	0	(a) 1.65 (b) 1.9	25.2 AC	18.9 AC	(a) 90 (b) 100	(a) 140 (b) 165	(a) 1.65 (b) 1.9	
8	6AL5	—94	0	18.9 AC	12.6 AC			—94	
9	6AG5		(b) 2.2	12.6 AC	6.3 AC	(b) 180	(a) 145 (b) 170	(b) 2.2	
10	6V6		6.3 AC	120	250		138	12.6 AC	15.5
11	6AU6		0	50.4 AC	44.1 AC	(b) 19	(b) 30	0	
12	6AT6	—94	—94	25.2 AC	18.9 AC	—94	—94	(a) .8 (b)—29	
13	6AL5	97 AC	(i) 42	50.4 AC	56.7 AC	(i) 42	0	—118	
14	6BA6	0	0	18.9 AC	12.6 AC	120	120	1.6	
15	6AU6	0	0	12.6 AC	18.9 AC	50	50	0	
16	6AL5			6.3 AC	0	0	0		
17	12SQ7	0		0	0	0	96	12.6 AC	0
18	25L6	0	50.2 AC	185	125	0	138	25.2 AC	8
19	12SC7	0	(b) 142			(b) 58	0	37.8 AC	25.2 AC
20	12SN7	—6	140	10		205	10	18.9 AC	6.3 AC
21	19BG6G	0	44.1 AC	0	—14.5	—14.5	(e) 250 (f) 185	63 AC	(e) 230 (f) 180
22	1T4	(g) 21 (i) 16	50	50			—100		
23	25W4GT	(g) 21 (i) 16	(g) 10 (i)—70	(e) 440 (f) 380				18.9 AC	44.1 AC
24	12SC7	0	(c) 380 (d) 240	(c) 35 (d) 22	(c)—34 (d)—20	(c) 380 (d) 220	(c) 54 (d) 33	37.8 AC	25.2 AC
25	25L6	0	37.8 AC	(c) 160 (d) 150	(c) 125 (d) 125	0		63 AC	12.5
26	3NP4	(g) 26 (i) 68	18.9 AC		25.2 AC	(h) 50			
27	6SR7	0	(h)—50	(h) 90	(h)—115	(h)—115	(h) 365	63 AC	69.3 AC
28	6BG6G	(h)—100	69.3 AC	(h) 18	(h) 18	(h)—100	(h)—115	63 AC	(h) 365

T+L	L15, L16	L23	L17, L18, L19,	L24, L11,	L10, L12,	L20, L21,	L22, T7, T8
C	128	129, 130	131	132		137, 139, 140	
C	127	143	133, 134, 135, 136, 141, 142,		22	26, 29, 172, 173, 174, 115, 24	
C	116, 117	95, 96, 168, 98, 99		100, 94	97, 101		
R	150	152, 153	154, 155				
R	151		156	157	20	22	121, 23, 25, 26,
R	135, 136	126, 130					



ALL RESISTANCE VALUES ARE INDICATED IN OHMS K=1000 OHMS
CAPACITOR VALUES; —⊣⊢—, —⊣(—, SHOWN IN MICRO-MICRO FARADS —⊣(—, —⊣⊢— SHOWN IN MICRO FARADS

T10	T3, T4	T11, T12, T5, T6	T13, T14	L1	L2	T15, T16	T+L
8, 6, 7, 9, 10,	11,	12, 13, 14,	15, 16, 17, 18,	19,21	170, 20		C
27, 28, 30,31, 175,176,177,	33,34,35, 36, 32, 180,179,178,38,40,	120, 51, 41,	181, 182, 183, 145,	46, 47, 48	57,56,	166	C
42		190	58, 59	105, 37, 52, 49	50,43,	44	C
5	4	6, 7, 8	10, 9, 11, 12, 13, 14, 15	16, 17, 18,	163,	171, 172	R
29, 30,	33, 34, 31, 165,	36, 37, 38, 39, 166,	43, 41	44,45, 47,	40,48, 49, 50, 52,	53,54, 55, 42, 51, 137, 138, 164	R
64		65, 66, 67, 191,	133,46, 72, 69, 70, 71,73, 68,	75, 76, 77,	56, 57, 173, 58, 59, 60,	61	R



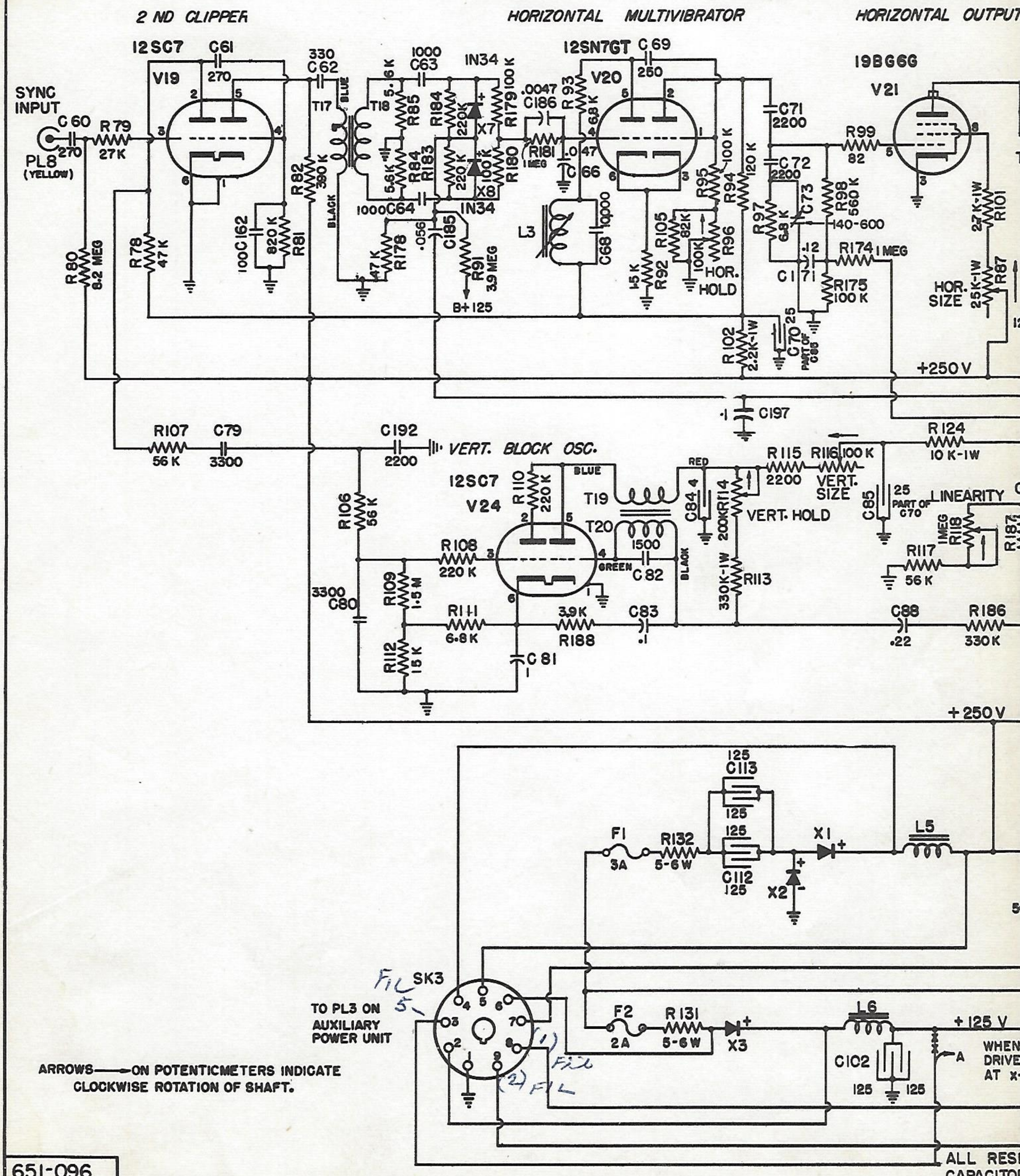
TENTIOMETERS AND SWITCHES INDICATE CLOCKWISE ROTATION OF SHAFT.
E INTERNAL CONNECTIONS TO CHASSIS ONLY

C170 ARE A TRIPLE CAPACITOR.

651-095

ING — VIDEO CHASSIS

L&T		T17	T18	L3	T19, T20	L6	L5
C	60	79,61,162, 80,62,	192,64,63,185	81,186,84,66,68,69,83,82,	171,70,71, 72, 73, 113, 112, 102, 106, 85,		
R	80, 79, 78, 107	81, 82, 178,	84,85,184,183,179,	180, 181, 91, 93, 92, 105, 94, 95, 96, 97, 102, 98, 99, 174, 175	87,		
R		106,109,	112, 108,111, 110,188	132, 131	114,113,115,116,	118, 124, 117, 18	



651-096

SCHEMATIC DRAWING — TI

L5	T23, T25, T26	T21, T22		L7	L8	L9	L,T
3, 113, 112, 102, 106, 85, 88, 89, 78, 89, 189, 191, 198	111, 90, 93,	54, 92	86, 87	91	167	193	C
99, 174, 175	87, 101	189, 190	196,	185		123, 192, 194, 193	R
118, 124, 117, 186, 187, 121, 119, 122, 120		170, 63, 89, 169	62	168,	167		R

HORIZONTAL OUTPUT

9BG6G

V21

PL 9

VIDEO INPUT (GREEN)

+25 KV FROM H.V. DRIVER UNIT

CRT BASE

CRT SOCKET

BLK.

BLUE

YEL.

GREEN

25W4GT

V23

T23

T25

T26

BOOSTER DAMPER DIODE

HOR. SIZE

27 K-1W R101

25K-1W R87

1 MEG

12-5

C78

+250 V

R189 3.9 K-1W

C191

C198 400

R190 18-2W

R124 10 K-1W

FOCUS COIL

HOR. R192 3.9K-1W

VERT.

390 C193

L9

R193

L8

L7

V26 3NP4

RED

WHITE-BLK.

ORANGE-BLK.

BLACK

BLUE WH.

R194 680

OR. WH.

BLUE

SK2

PL2

100 K R185

R123 FOCUS 6000-4W

CRT PROTECTIVE TUBE

VERTICAL OUTPUT

LINEARITY

C189

V25 - 25L6GT

PART OF C70

1 MEG R188

R187 680 K

R117 56 K

BLUE

GREEN

RED

BLACK

T21 T22

C92

C91 .056

R168 100

C167 33

1T4

V22

C88 .22

R186 330 K

R119 6.8 K

R122 2.2K-1W

R121 560-1W

100 C89

50 50 40

22 K R196

C86 .056

C87 .056

R167 100 K

C111 C90 C93

+250 V

R170 220 K

680 K

R 89

R169 100 K

-100 V BRILLIANCE

SK4

L5

C106 50 50

115 V A.C.

TO VIDEO CHASSIS

47 K R63

X9

R62 1200

C54 40-150 V

+365

115 V. A.C.

V21 V23

V25 V24

V26 X, SKT, Y

V20

V19

F3 5A

F4 5A

PL 5

+125 V

125

A

WHEN MODEL 170B H.V. DRIVER IS USED, DISCONNECT AT x-x AND JOIN "A" TO "B".

B

INTERLOCK ON BACK COVER

SK5

115 VOLTS 25/60 CYCLES

ALL RESISTANCE VALUES ARE INDICATED IN OHMS K=1000 OHMS M=1MEGOHM

CAPACITOR VALUES; —|—, —||—, SHOWN IN MICRO-MICRO FARADS —|(—, —▭—, SHOWN IN MICRO FARADS

RAWING — TIME BASE CHASSIS

REPLACEMENT PARTS LIST

For dependable repairs, use only genuine Philips Replacement Parts. When ordering always give model number of receiver and description, and part number of parts required.

CAPACITORS

Symbol	Value	Rating	Description	Part No.
C6	2000 mmf	500V	Dual Ceramic	514-013
C7		Fixed	Part of T3	
C8	2000 mmf	500V	Dual Ceramic	514-013
C9	120 mmf°	500V	Ceramic	514-317
C10		Fixed	Part of T4	
C11	1500 mmf°	500V	Ceramic	514-330
C12		Fixed	Part of T5	
C13		Fixed	Part of T5-T6	
C14		Fixed	Part of T6	
C15	270 mmf°	500V	Ceramic	514-321
C16	.047 mf	400V	Tubular	515-521
C17	.022 mf	200V	Tubular	515-467
C18	.01 mf	200V	Tubular	515-463
C19	.01 mf	400V	Tubular	515-513
C20	1000 mmf°	500V	Mica	512-437
C21	8 mf	150V	Electrolytic	516-006
C22	1500 mmf°	500V	Ceramic	514-330
C24	1500 mmf°	500V	Ceramic	514-380
C25	2000 mmf	500V	Dual Ceramic	514-013
C26	2000 mmf	500V	Dual Ceramic	514-013
C27	120 mmf°	500V	Ceramic	514-317
C28	1500 mmf	500V	Triple Ceramic	514-014
C29	2000 mmf	500V	Dual Ceramic	514-013
C30	1500 mmf	500V	Triple Ceramic	514-014
C31	1500 mmf	500V	Triple Ceramic	514-014
C32	1500 mmf	500V	Triple Ceramic	514-014
C33	.056 mf	150V	Tubular	515-472
C34	120 mmf°	500V	Ceramic	514-317
C35	1500 mmf	500V	Triple Ceramic	514-014
C36	1500 mmf	500V	Triple Ceramic	514-014
C37	50 mf	350V	Triple Electrolytic	Part of 516-530
C38	2000 mmf	500V	Dual Ceramic	514-013
C40	120 mmf°	500V	Ceramic	514-317
C41	10 mmf	500V	Ceramic G.P.	514-354
C42	2000 mmf	500V	Dual Ceramic	514-013
C43	1500 mmf	500V	Ceramic	514-330
C44	1500 mmf	500V	Ceramic	514-330
C45	560 mmf°	500V	Ceramic	514-325
C46	50 mf	350V	Triple Electrolytic	Part of 516-530
C47	.047 mf	400V	Tubular	515-521
C48	560 mmf°	500V	Ceramic	514-325
C49	3300 mmf°	500V	Ceramic	514-334
C50	5 mf	150V	Electrolytic	516-040
C51	33 mmf	500V	Ceramic G.P.	514-360
C52	22 mmf	500V	Ceramic	514-358
C54	40 mf	150V	Electrolytic	516-049
C55	50+50 mf	355V	Electrolytic, Dual	516-528
C56	.27 mf	200V	Tubular	515-480
C57	.1 mf	150V	Tubular	515-009
C58	.22 mf	200V	Tubular	515-479
C59	.01 mf	200V	Tubular	515-463
C60	270 mmf°	500V	Ceramic	514-321
C61	270 mmf°	500V	Ceramic	514-321
C62	330 mmf	500V	Ceramic	514-372
C63	1000 mmf	500V	Ceramic	514-378
C64	1000 mmf	500V	Ceramic	514-378
C66	.047 mf	200V	Tubular	515-471
C68	.01 mf°	500V	Mica	512-449
C69	250 mmf°	500V	Mica	512-515
C70	25 mf	500V	Dual Electrolytic	Part of 516-526
C71	2200 mmf	500V	Ceramic	514-382
C72	2200 mmf	500V	Ceramic	514-382
C73	140-600 mmf		Trimmer	511-041
C78	12.5+12.5 mmf	355V	Dual Electrolytic	516-525
C79	3300 mmf	500V	Ceramic	514-384
C80	3300 mmf	500V	Ceramic	514-384
C81	1 mf	150V	Tubular	515-007
C82	1500 mmf	500V	Ceramic	514-380
C83	.1 mf°	400V	Tubular	515-413
C84	4 mf	450V	Electrolytic	516-042
C85	25 mf	500V	Dual Electrolytic	Part of 516-526
C86	.056 mf	200V	Tubular	515-472
C87	.056 mf	200V	Tubular	515-472
C88	.22 mf	200V	Tubular	515-479
C89	100 mf	25V	Electrolytic	516-045
C90	50 mf	355V	Dual Electrolytic	Part of 516-528
C91	.056 mf	400V	Tubular	515-522
C92	.1 mf	150V	Tubular	515-009
C93	40 mf	150V	Electrolytic	516-047
C94	1500 mmf°	500V	Ceramic	514-330
C95	1500 mmf°	500V	Ceramic	514-330
C96	2000 mmf	500V	Dual Ceramic	514-013
C97	1500 mmf°	500V	Ceramic	514-330
C98	1500 mmf°	500V	Ceramic	514-330
C99	1500 mmf°	500V	Ceramic	514-330
C100	1500 mmf°	500V	Ceramic	514-330
C101	1500 mmf°	500V	Ceramic	514-330
C102	125+125 mf	150V	Dual Electrolytic	516-527
C103	125+125 mf	150V	Dual Electrolytic	516-527
C104	125+125 mf	150V	Dual Electrolytic	516-527
C105	125+125 mf	150V	Dual Electrolytic	516-527
C106	50+50 mf	355V	Dual Electrolytic	516-528
C107	50+50 mf	355V	Dual Electrolytic	516-528
C108	50+50 mf	355V	Dual Electrolytic	516-528
C109	50+50 mf	355V	Dual Electrolytic	516-528
C110	50+50 mf	355V	Dual Electrolytic	516-528
C111	50 mf	355V	Dual Electrolytic	Part of 516-528
C112	125+125 mf	150V	Dual Electrolytic	516-527
C113	125+125 mf	150V	Dual Electrolytic	516-527
C114	2000 mmf	500V	Dual Ceramic	514-013
C115	120 mmf°	500V	Ceramic	514-317
C116	330 mmf°	500V	Mica	512-431
C117	330 mmf°	500V	Mica	512-431
C127	.5-3 mmf		Trimmer	Part of R.F. Tuner Unit
C128	5 mmf	500V	Ceramic	
C129	120 mmf	500V	Ceramic	
C130	.5-3 mmf		Trimmer	
C131	100 mmf	500V	Ceramic	
C132	.5-3 mmf		Trimmer	
C133	10 mmf	500V	Ceramic	
C134	20 mmf	500V	Ceramic	
C135	.5-3 mmf		Trimmer	
C136			Sharp Tuning	
C137	78 mmf	500V	Ceramic	
C138	2.2 mmf	500V	Ceramic	
C139	10 mmf	500V	Ceramic	
C140	120 mmf	500V	Ceramic	
C141	.001 mf	400V	Tubular	
C142	.001 mf	200V	Tubular	
C143	.001 mf	200V	Tubular	
C162	.01 mf	500V	Ceramic	514-316
C166	50 mf	50V	Electrolytic	516-041
C167	33 mf°	500V	Mica	512-419
C168	2000 mmf	500V	Dual Ceramic	514-013
C170	15 mf	350V	Triple Electrolytic	Part of 516-530
C171	.12 mf	200V	Tubular	515-676
C172	30 mf		Adjustable Trimmer	Part of T7-T8
C173	22 mmf		Ceramic	
C174	22 mmf		Ceramic	
C175	30 mmf		Adjustable Trimmer	Part of T9-T10
C176	22 mmf		Ceramic	
C177	22 mmf		Ceramic	
C178	30 mmf		Adjustable Trimmer	Part of T11-T12
C179	22 mmf		Ceramic	
C180	22 mmf		Ceramic	
C181	30 mmf		Adjustable Trimmer	Part of T13-T14
C182	22 mmf		Ceramic	
C183	22 mmf		Ceramic	
C185	.056 mf	200V	Tubular	515-472
C186	.0047 mf	200V	Tubular	515-569
C188	.1 mf	150V	Tubular	515-009
C189	.1 mf	400V	Tubular	515-525
C190	.5 mf	150V	Tubular	515-006
C191	400 mmf°	500V	Mica	512-518
C192	2200 mmf	500V	Ceramic	514-382
C193	390 mmf°	500V	Ceramic	514-323
C197	.1 mf	200V	Tubular	515-475
C198	400 mmf°	500V	Mica	512-518
C200	.01 mf	600V	Tubular (PR994 only)	
C201	50+50 mf	355V	Dual Electrolytic	516-528
C202	40+40 mf	450V	Dual Electrolytic	516-512
C203	40+40 mf	450V	Dual Electrolytic	516-512
C301	2700 mmf	500V	Ceramic	Part of H.V. Driver Unit 160B-1 120-608
C302	8 mf	250V	Electrolytic	
C303	.1 mf	600V	Tubular	
C304	110-560 mmf		Trimmer	
C305	.01 mf	600V	Tubular	
C306	20 mf	50V	Electrolytic	
C307	.015 mf	400V	Tubular	
C308	.03 mf	400V	Tubular	
C309	5000 mmf	10,000V	H.V.	
C310	2500 mmf	20,000V	H.V.	
C311	2500 mmf	20,000V	H.V.	
C312	100 mmf	500V	Mica	

• Tolerance ±10%

REPLACEMENT PARTS LIST — Continued

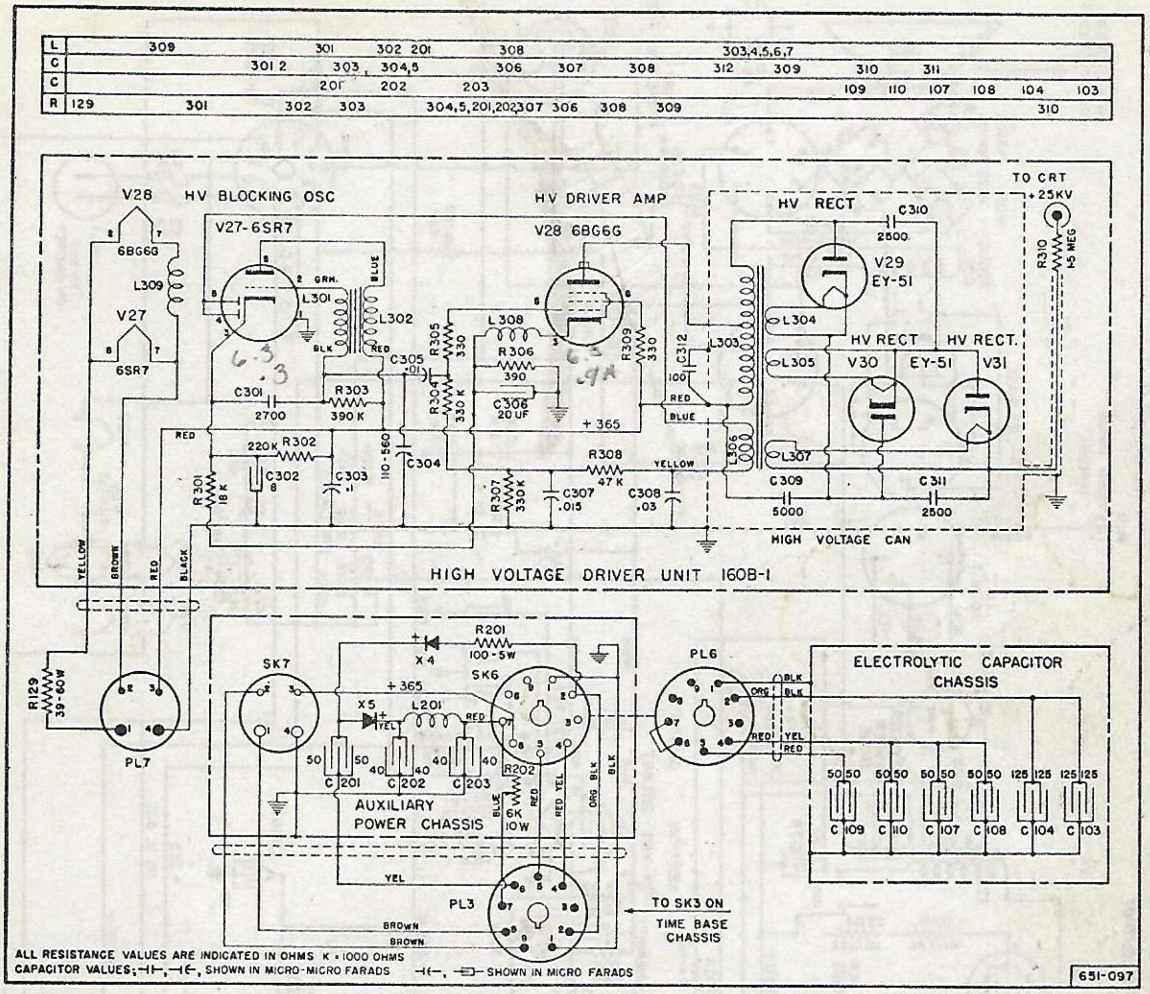
RESISTORS

Symbol	Value	Rating	Description	Part No.
R4	100 ohms°	½ w	Carbon	501-613
R5	1000 ohms°	½ w		501-125
R6	22,000 ohms°	½ w		501-141
R7	10,000 ohms°	1 w	Carbon	502-637
R8	10,000 ohms°	1 w	Carbon	502-637
R9	100,000 ohms°	½ w		501-149
R10	100,000 ohms°	½ w		501-149
R11	100,000 ohms°	½ w		501-149
R12	22,000 ohms°	½ w		501-141
R13	750,000 ohms }		Volume Control	Part of 506-018
R14	250,000 ohms }			
R15	10 Megohms°	½ w		501-173
R16	330,000 ohms°	½ w		501-155
R17	470,000 ohms°	½ w		501-157
R18	150 ohms°	1 w	Carbon	502-615
R19	8200 ohms°	½ w		501-136
R20	4700 ohms°	½ w		501-133
R21	470 ohms°	½ w		501-121
R22	39 ohms°	½ w	Carbon	501-608
R23	1000 ohms°	½ w		501-125
R25	1000 ohms°	½ w		501-125
R26	150 ohms°	½ w	Carbon	501-615
R27	8200 ohms°	½ w		501-136
R28	150 ohms°	½ w	Carbon	501-615
R29	1000 ohms°	½ w		501-125
R30	1000 ohms°	½ w		501-125
R31	150 ohms°	½ w	Carbon	501-615
R33	3900 ohms°	½ w		501-632
R34	39 ohms°	½ w	Carbon	501-608
R36	1000 ohms°	½ w		501-125
R37	3300 ohms°	½ w		501-131
R38	1000 ohms°	½ w		501-125
R39	220 ohms°	½ w		501-117
R40	12,000 ohms°	½ w	Carbon	503-338
R41	1000 ohms°	½ w		501-125
R42	180 k°	½ w		501-152
R43	10,000 ohms°	½ w		501-137
R44	8200 ohms°	½ w	Part of L1	501-636
R45	3900 ohms°	½ w		501-132
R46	680 ohms°	½ w		501-623
R47	270 ohms°	½ w		501-118
R48	6800 ohms°	1 w	Carbon	502-635
R49	3900 ohms°	1 w	Carbon	502-632
R50	1.2 Megohms°	½ w		501-162
R51	22,000 ohms°	½ w		501-141
R52	470 ohms°	1 w		502-121
R53	12000 ohms°	2 w	Carbon	503-338
R54	8200 ohms°	½ w	Part of L2	501-636
R55	27,000 ohms°	1 w	Carbon	502-642
R56	22,000 ohms°	½ w		501-141
R57	1 Megohm°	½ w		501-161
R58	150,000 ohms°	1 w	Carbon	502-651
R59	27,000 ohms°	½ w		501-142
R60	120,000 ohms°	1 w	Carbon	502-650
R61	18,000 ohms°	½ w		501-140
R62	1200 ohms°	½ w		501-126
R63	4700 ohms°	½ w		501-133
R64	10,000 ohms°	½ w		501-137
R65	82,000 ohms°	½ w		501-148
R66	1000 ohms°	½ w		501-125
R67	100,000 ohms°	½ w		501-149
R68	47,000 ohms°	½ w		501-145
R69	15,000 ohms°	½ w		501-139
R70	1 Megohm°	½ w		501-161
R71	56,000 ohms°	½ w		501-146
R72	10,000 ohms		Contrast Control	Part of 506-018
R73	22,000 ohms°	1 w	Carbon	502-641
R75	100,000 ohms°	½ w		501-149
R76	18,000 ohms°	½ w		501-140
R77	820,000 ohms°	½ w		501-160
R78	47,000 ohms°	½ w		501-145
R79	27,000 ohms°	½ w		501-142
R80	8.2 Megohms°	1 w		502-672
R81	820,000 ohms°	½ w		501-160
R82	390,000 ohms°	½ w		501-156
R84	5600 ohms°	½ w		501-134
R85	5600 ohms°	½ w		501-134
R87	25k°	1 w	Horizontal Size Control	505-044
R89	680,000 ohms°		Brightness Control	Part of 506-021
R91	3.9 Megohms°	½ w		501-823
R92	1500 ohms°	½ w		501-127
R93	6800 ohms°	½ w		501-135
R94	120,000 ohms°	½ w		501-150
R95	100,000 ohms ±5%	½ w		501-882
R96	100,000 ohms		Horizontal Hold Con.	Pt. of 506-019

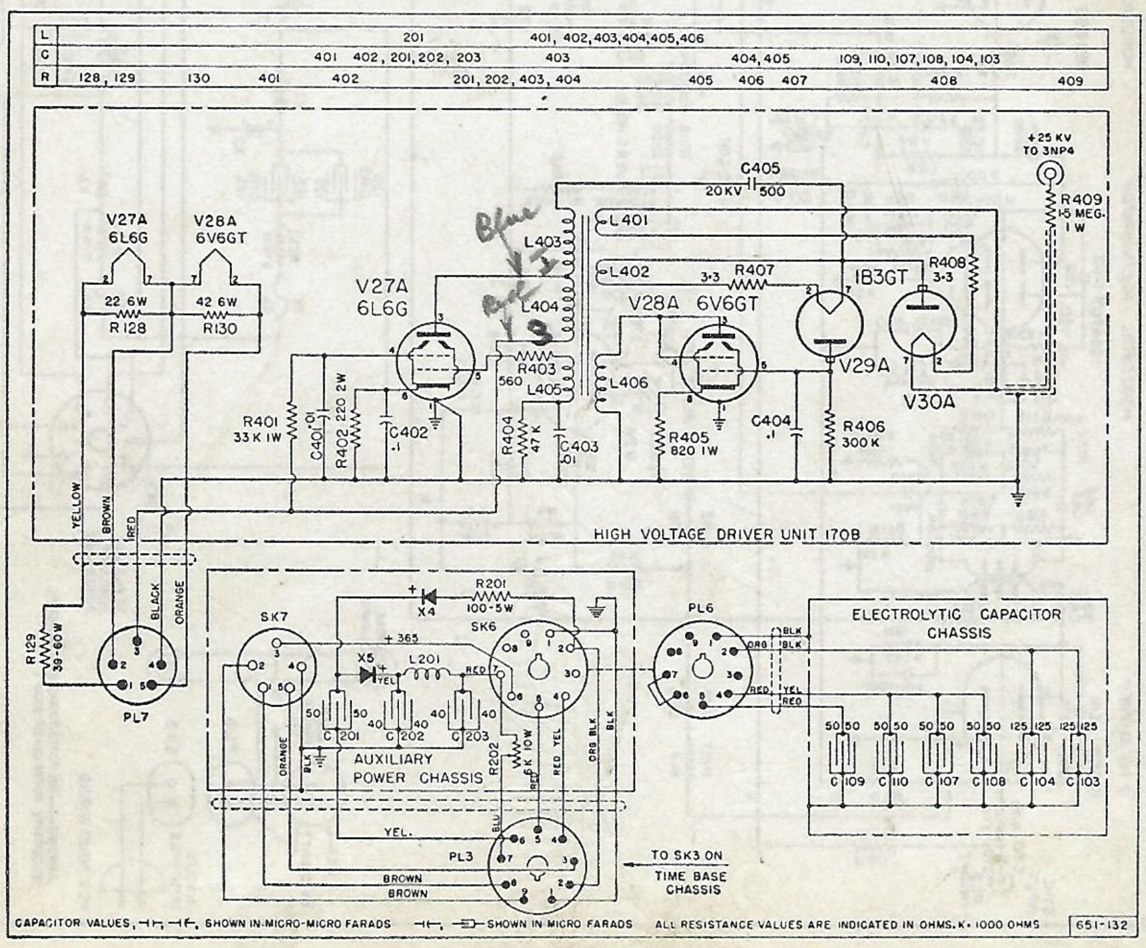
Symbol	Value	Rating	Description	Part No.
R97	6800 ohms°	½ w		501-135
R98	560,000 ohms°	½ w		501-158
R99	82 ohms°	½ w	Carbon	501-612
R101	2700 ohms°	1 w	Carbon	502-630
R102	2200 ohms°	1 w	Carbon	502-629
R105	82,000 ohms°	½ w		501-148
R106	56,000 ohms°	½ w		501-146
R107	56,000 ohms°	½ w		501-146
R108	220,000 ohms°	½ w		501-153
R109	1.5 Megohms°	½ w		501-163
R110	220,000 ohms°	½ w		501-153
R111	6800 ohms°	½ w		501-135
R112	15,000 ohms°	½ w		501-139
R113	330,000 ohms°	1 w	Carbon	502-655
R114	200,000 ohms		Vertical Hold Control	Part of 506-019
R115	2200 ohms°	½ w		501-129
R116	100,000 ohms		Vertical Size Control	505-032
R117	56,000 ohms°	½ w		501-146
R118	1 Megohm		Vertical Linearity Control	505-033
R119	6800 ohms°	½ w		501-135
R120	2200 ohms°	1 w		502-629
R121	560 ohms°	1 w	Carbon	502-622
R122	2200 ohms°	1 w	Carbon	502-629
R123	6000 ohms	4 w	Focus Control	Part of 506-021
R124	10,000 ohms°	1 w		502-137
R126	22 ohms°	6 w	W.W.	504-024
R128	22 ohms ±5%	5 w		504-053
R129	39 ohms°	60 w	W.W.	504-035
R130	42 ohms	6 w	W.W.	504-046
R131	5 ohms	6 w	W.W.	504-023
R132	5 ohms	6 w	W.W.	504-023
R133	390 ohms°	1 w		502-620
R135	100,000 ohms°	½ w		501-149
R136	100,000 ohms°	½ w		501-149
R137	56,000 ohms°	½ w		501-146
R138	12,000 ohms°	2 w		503-338
R150	3.3 k°	½ w	Part of R.F. Tuner	130-063
R151	47 k°	½ w		
R152	10,000 ohms°	½ w		
R153	2.2 k°	½ w		
R154	4.7 k°	½ w		
R155	220 k ohms°	½ w		
R156	100 k ohms°	½ w		
R157	4.7 k ohms°	½ w		
R163	1000 ohms°	½ w		501-125
R164	270 k ohms	½ w		501-154
R165	150 ohms°	½ w	Carbon	501-615
R166	470 ohms°	½ w		501-121
R167	100 k ohms°	½ w		501-149
R168	100 ohms°	½ w		501-613
R169	100,000 ohms°	½ w		501-149
R170	220,000 ohms°	½ w		501-153
R171	2200 ohms°	2 w	Carbon	503-329
R172	2200 ohms°	2 w	Carbon	503-329
R173	12,000 ohms°	2 w	Carbon	503-338
R174	1 Megohm°	½ w		501-161
R175	100,000 ohms°	½ w		501-149
R178	47,000 ohms°	½ w		501-145
R179	100,000 ohms°	½ w		501-149
R180	100,000 ohms°	½ w		501-149
R181	1 Megohm°	½ w		501-161
R183	220,000 ohms°	½ w		501-153
R184	220,000 ohms°	½ w		501-153
R185	100 k ohms°	½ w		501-149
R186	330,000 ohms°	½ w		501-155
R187	560,000 ohms°	½ w		501-158
R188	3900 ohms°	½ w		501-132
R189	3900 ohms°	1 w	Carbon	502-632
R190	18 ohms°	2 w		503-304
R191	470,000 ohms°	½ w		501-157
R192	3900 ohms°	1 w		502-632
R193	560 ohms°	½ w		501-122
R194	560 ohms°	½ w		501-122
R196	22,000 ohms°	½ w		501-641
R200	470 k ohms°	½ w	(PR994 only)	501-157
R201	100 ohms°	5 w	W.W.	504-001
R202	6000 ohms	10 w	W.W. Adjustable	504-040
R301	18 k ohms°	1 w	Part of H.V. Driver Unit 160B-1	120-608
R302	220 k ohms°	1 w		
R303	390 k ohms ±5%	1 w		
R304	330 k ohms°	½ w		
R305	330 ohms°	½ w		
R306	390 ohms°	2 w		
R307	330 k ohms°	½ w		
R308	47 k ohms°	½ w		
R309	330 ohms°	½ w		
R310	1.5 Megohms°	1 w		

° Tolerance ±10%

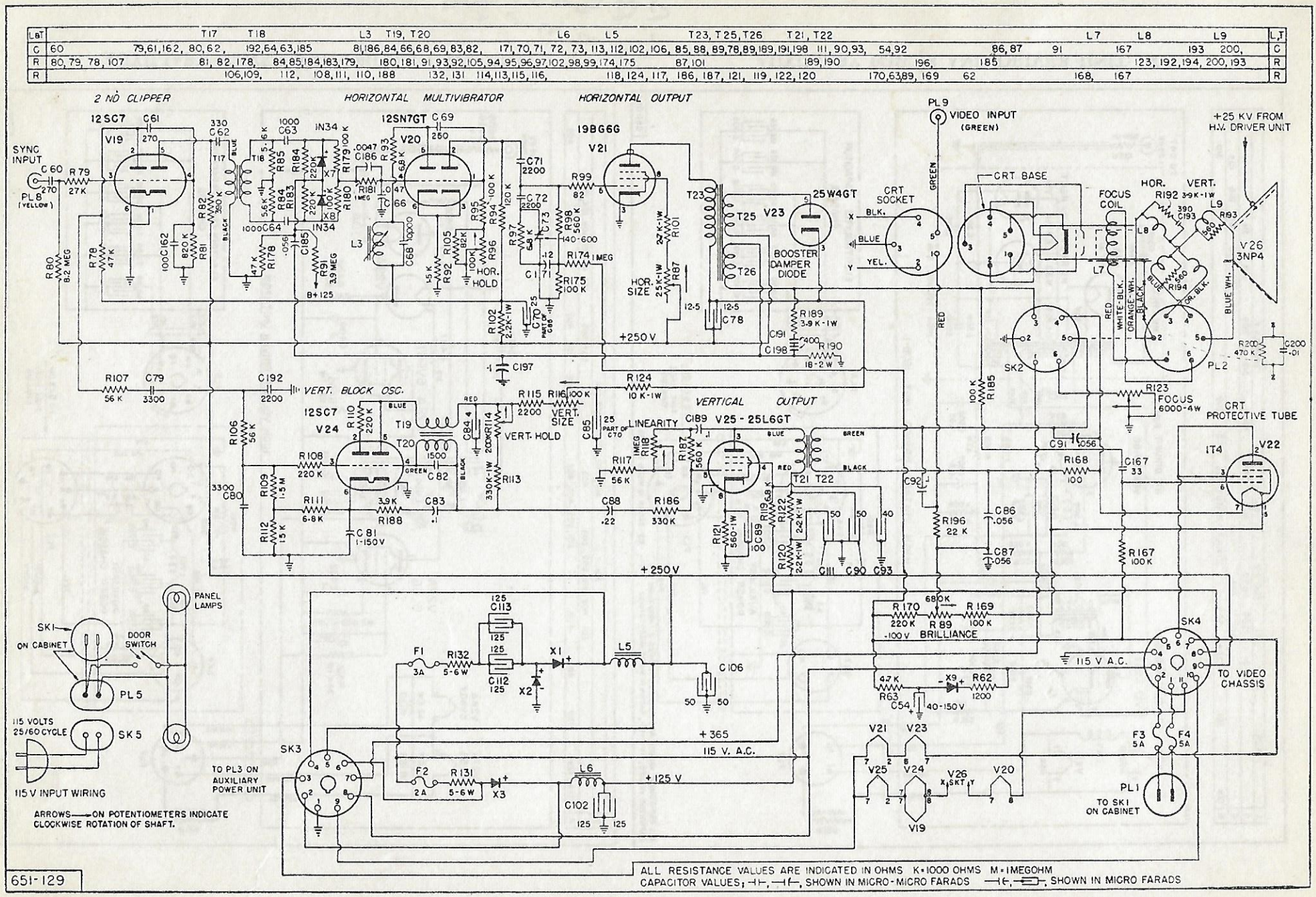
AUXILIARY POWER AND DRIVER UNIT 160B



AUXILIARY POWER AND DRIVER UNIT 170B



1 - Blue
2 Black
3 Red
5 yellow
6 Green
7 yellow



MODEL PR994 TIME BASE CHASSIS

REPLACEMENT PARTS LIST — Continued

COILS

L1	Detector Peaking Coil 165 uh	070-153
L2	Video Peaking Coil	070-153
L3	Horizontal Hold Coil Assembly	060-098
L5	Filter Choke	050-141
L6	Filter Choke	050-141
L7, L8, L9	Focus Coil Assembly; Horizontal Deflect on Coil Assembly; Vertical Deflection Coil Assembly	Part of 120-613
L10	Heater Choke	050-143
L11	Heater Choke	050-143
L12	Heater Choke	050-143
L15, L16, L17, L18, L19, L20, L21, L22, L23, L24	Antenna Coil Assembly; Oscillator Coil Assembly; Plate Trap Assembly; Series Plate Coil; Heater Choke; Heater Choke	Part of R.F. Tuner 130-063
L201	Filter Choke	050-148
L301, L302, L303, L304, L305, L306, L307, L308, L309	Oscillator Blocking Transformer; H.V. Transformer Part of H.V. Can; Cathode Choke; Filament Choke	Part of H.V. Driver 160B-1 120-608

TRANSFORMERS

T3-T4	1st Sound I-F Transformer	060-082
T5-T6	Sound I-F and Discriminator Transformer	060-083
T7-T8	2nd Video I-F Transformer	060-084
T9-T10	3rd Video I-F Transformer	060-085
T11-T12	4th Video I-F Transformer	060-086
T13-T14	5th Video I-F Transformer	060-087
T15-T16	Audio Power Output Transformer	050-142
T17-T18	Horizontal Discriminator Transformer	060-090
T19-T20	Vertical Blocking Transformer	050-129
T21-T22	Vertical Output Transformer	050-130
T23		
T25-T26	Horizontal Output Transformer	053-097

ADDENDA PARTS LIST OF HIGH VOLTAGE DRIVER UNIT 170B

Used on Models PR990 and PR994

CAPACITORS

Symbol	Value	Rating	Description	Part No.
C401	.01 mf	600V	Tubular	515-563
C402	.1 mf	400V	Tubular	515-525
C403	.01 mf	400V	Tubular	515-513
C404	.1 mf	400V	Tubular	515-525
C405 *	500 mmf	20,000V	High Voltage	519-021

TRANSFORMER

L401 to L406	H.V. Transformer	050-179

RESISTORS

Symbol	Value	Rating	Description	Part No.
R401	33,000 ohms ±10%	1 w		502-643
R402	220 ohms ±10%	2 w		503-317
R403	560 ohms ±10%	½ w		501-622
R404	47,000 ohms ±10%	½ w		501-645
R405	820 ohms ±5%	1 w		502-020
R406	300,000 ohms ±5%	½ w		501-825
R407	3.3 ohms ±10%	½ w		501-824
R408	3.3 ohms ±10%	½ w		501-824
R409	1.5 Megohm ±10%	1 w		502-663

MISCELLANEOUS PARTS

Part No.	Description
120-522	Antenna Terminal Panel Assembly
303-178	Antenna Line Support
100-545	Cable Connector, 2-conductor shielded
120-863	Cable Assembly with 9-prong plug
120-583	Cable Assembly with 11-prong plug
120-665	CRT Socket and Cable Assembly
540-513	Electrolytic Capacitor Washer
503-186	Electrolytic Capacitor Insulated Washer
531-020	Electrolytic Capacitor Mounting Nut
050-150	Focus Coil Assembly
646-012	Fuse, 2 amp. 3AG, 250V
646-001	Fuse, 3 amp. 3AG, 250V
646-013	Fuse, 5 amp. 3AG, 250V
571-188	Fuse Holder
120-360	H.V. Can for 160B-1
120-608	H.V. Driver Assembly 160B-1
120-920	H.V. Driver Assembly 170B
120-711	H.V. Anode Connector and Lead Assembly, 19BG6G
572-087	Knob, Small Gold
572-120	Knob and Pointer Assembly, Brass
572-086	Knob, Large, Fine Tuning
572-083	Knob, Small
572-071	Knob, Large
572-073	Knob, Single (Rear Controls)
100-003	Line Cord and Plug
571-197	Line Cord Interlock Plug
571-198	Line Cord Interlock Socket
332-610	Mirror, Reflector
120 613	Optical Box and Cable Assembly
130-068	Optical Box Assembly
120-520	Pin Jack and Lead Assembly, Yellow
120-674	Pin Jack and Lead Assembly, Green
120-675	Pin Jack and Lead Assembly, Black
571-195	Plug, Single Prong Male, Yellow
571-194	Plug, Single Prong Male, Green
571-197	Plug, 2-contact
571-214	Plug, 4-contact
571-187	Plug, 6-contact
571-177	Plug, 9-contact with cover
571-180	Plug, 11-contact
642-003	Rectifier, Selenium Diode
120-616	Rectifier, Matched Pair Germanium Crystal
130-062	Rectifier, Selenium, 400 MA
332-645	Screen, Reflector
313-024	Shaft, Extension ¼" x 8¼"
310-169	Shaft, Coupling for ¼" shaft
571-186	Socket, Single Contact (Yellow)
571-185	Socket, Single Contact (Green)
544-010	Socket, Retainer Ring for above
570-014	Socket, 6-prong
570-008	Socket, 7-prong
570-015	Socket, 9-prong
570-016	Socket, 11-prong
570-001	Socket, Tube Octal
570-021	Socket, Miniature 7-prong

Part No.	Description
080-100	Switch, Definition
130-063	Tuner Chassis Assembly (Standard)
632-009	Tuner Chassis Mounting Grommets
542-022	Washer (Resistor Insulating)

MISCELLANEOUS PARTS FOR MODEL PR990 ONLY

120-671	Back Cover and Interlock Assembly
303-215	Back Cover Only
030-158	Cabinet Consoleviewer, Walnut
030-177	Cabinet Consoleviewer, Blonde
350-066	Door Pull
332-606	Escutcheon, Knob Function
041-096	Speaker 10" PM (Impedance 3.2 ohms)
041-055	Speaker Cone and Voice Coil Assembly
627-096	Speaker Grille Cloth 23" x 18"
350-063	Speaker Grille, Ornamental Plastic

MISCELLANEOUS PARTS FOR MODEL PR994 ONLY

120-761	Antenna and Terminal Strip Assembly
030-231	Cabinet Wall Projection, Walnut
030-232	Cabinet Wall Projection, Mahogany
030-233	Cabinet Wall Projection, Blonde
350-092	Cabinet Base Bar (foot)
643-001	Dial Lamp, 150V Clear
120-787	Dial Lamp Harness and Interlock Assembly
332-630	Escutcheon Knob Function
572-124	Knob, Small with dot
120-786	Optical Box Assembly
301-147	Projection Shield
310-216	Shaft, Extension
313-028	Shaft, Phenolic ¼" x 10"
120-784	Socket and Cable Assembly CR Tube 23"
041-079	Speaker, 8" PM (Impedance 3.2 ohms)
041-080	Speaker Cone and Voice Coil Assembly
627-044	Speaker Grille Cloth 10" x 20½"
350-096	Speaker Grille, Metal, Ornamental
120-785	Speaker Leads and Pin Terminal Assembly

MISCELLANEOUS PARTS FOR MODEL PR998 ONLY

120-757	Back Cover and Interlock Assembly
120-783	Back Cover Riveted Assembly
030-216	Cabinet Console Viewer, Walnut
030-217	Cabinet Console Viewer, Mahogany
030-218	Cabinet Console Viewer, Blonde
350-089	Door Pull, large
350-091	Door Pull, small
332-628	Escutcheon Knob Function
041-118	Speaker, 10" PM (Impedance 3.2 ohms)
041-119	Speaker Cone and Voice Coil Assembly
627-030	Speaker Grille Cloth 16½" x 22"
350-093	Speaker Grille, Metal, Ornamental
332-633	Screen, Projector
332-556	Radio Dial Scale
572-048	Radio Knob
572-049	Radio Knob with dot
100-041	Radio Power Cable, 18"
100-042	Radio Line Cord and Plug, 17"
100-561	Phono Shielded Cable Assembly
090-151	Phono Record Changer Model 100, 25 cycle
090-152	Phono Record Changer Model 100, 60 cycle
090-144	Phono Cartridge, Type LQDIM with bracket
090-127	Phono Needle (.003") Standard
090-128	Phono Needle (.001") Micro

Refer to CM100A Service Manual for radio components