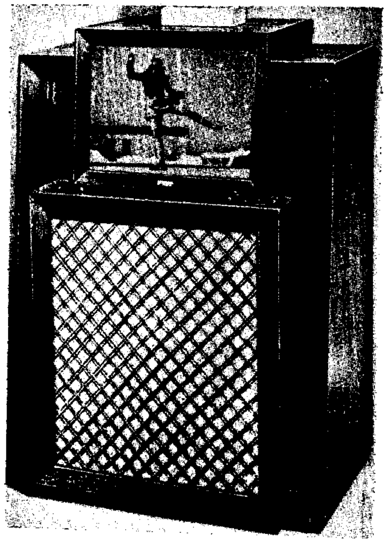
MODEL 880



Model 880 is a projection-viewing console model Television Receiver. Thirty-six tubes . . . 29 working tubes, Kinescope tube and six Rectifiers. The receiver is complete in one unit and is operated by the use of eight front-panel controls. Features of the receiver include: Full twelve channel coverage; F-M sound system; Improved picture brilliance; A-F-C horizontal hold; Stabilized vertical hold; Two stages of video amplification; Noise saturation circuits; Three stage sync separator and clipper; 4.5 Mc. band width for picture channel; Reduced hazard 25KV high voltage supply; Automatic electronic H.V. cut-off circuit.

ELECTRICAL AND MECHANICAL SPECIFICATIONS

Cabinet Dimensions

Base	31" wide x 22" deep
Height	45"
Screen	Tilted back at five degrees.

Picture Size — 12"x16"—Square corner—192 sq. in.

R-F Frequency Ranges

Channel Number	Channel Freq. Mc.	Picture Carrier Freq. Mc.	Sound Carrier Freq. Mc.	Receiver R-F Osc. Freq. Mc.
2	54-60	55.25	59.75	81
3	60-66	61.25	65.75	87
4	66-72	67.25	71.75	93
5	76-82	77.25	81.75	103
6	82-88	83.25	87.75	109
7	174-180	175.25	179.75	201
8	180-186	181.25	185.75	207
9	186-192	187.25	191.75	213
10	192-198	193.25	197.75	219
11	198-204	199.25	203.75	225
12	204-210	205.25	209.75	231
13	210-216	211.25	215.75	237

Fine Tuning Range adequate for oscillator adjustment.

Power Supply Rating — 117 volts, 60 cycles, 350 watts

Receiver Antenna Input Impedance—300 ohms balanced

Audio Power Output Rating

Undistorted Power Output ..... 3.5 Watts.
Maximum Power Output ..... 4 Watts.

Loudspeaker

Type ..... 10" Permanent Magnet.
Voice Coil Impedance ..... 3.2 ohms at 400 cycles.

Weight

Chassis with Tubes in Cabinet ..... 165 lbs.
Shipping Weight ..... 225 lbs.

TUBE COMPLEMENT

Tube Used	Function
6J6	R-F Amplifier
6J6	R-F Oscillator
6J6	Convertor
6BA6	1st. Sound I-F Amplifier
6BA6	2nd. Sound I-F Amplifier
6AU6	3rd. Sound I-F Amplifier
6AL5	Sound Discriminator
6AT6	1st. Audio Amplifier
6K6GT	Audio Output
6AG5	1st. Picture I-F Amplifier
6AG5	2nd. Picture I-F Amplifier
6AG5	3rd. Picture I-F Amplifier
6AG5	4th. Picture I-F Amplifier
6AL5	Picture 2nd. Detector and D-C Restorer
6AU6	1st. Video Amplifier
6V6GT	2nd. Video Amplifier
6SK7	1st. Sync Amplifier
6SH7	Sync Separator
6SN7GT	2nd. Sync Amplifier and Horizontal Discharge
6SN7GT	H. V. Cut-Off Tube
6J5	Vertical Sweep Oscillator and Discharge
6K6GT	Vertical Sweep. Output
6AL5	Horizontal Sync Discriminator
6K6GT	Horizontal Sweep Oscillator
6AC7	Horizontal Sweep Oscillator Control
6BG6G	Horizontal Sweep Output
6BG6G	H. V. Driver Tube
5V4G	Horizontal Reaction Scanning
5Y3GT	Aux. Power Supply Rectifier
5U4G	Power Supply Rectifiers (2 tubes)
3NP4	Kinescope
EY51	Special H.V. Rectifiers (3 tubes in sealed unit)
6SR7	Blocking oscillator-diode

Picture Carrier Frequency ..... 25.75 Mc.
Adjacent Channel Sound Trap ..... 27.25 Mc.
Accompanying Sound Trap ..... 21.25 Mc.
Adjacent Channel Picture Carrier Trap ..... 19.75 Mc.

SOUND I-F FREQUENCIES

Sound Carrier Frequency ..... 21.25 Mc.
Sound Discriminator Band Width (between peaks) 350 Kc.
VIDEO RESPONSE ..... To 4.5 Mc.
FOCUS ..... Magnetic
SWEEP DEFLECTION ..... Magnetic
SCANNING ..... Interlaced, 525 line
HORIZONTAL SCANNING FREQUENCY ..... 15,750 cps
VERTICAL SCANNING FREQUENCY ..... 60 cps
FRAME FREQUENCY (Picture Repetition Rate) ..... 30 cps

OPERATING CONTROLS (front panel)

Channel Selector, Fine Tuning	Dual Control Knobs
Picture, Sound Volume and On-Off Switch	Dual Control Knobs
Picture Horizontal Hold, Picture Vertical Hold	Dual Control Knobs
Brightness, Focus	Dual Control Knobs

NON-OPERATING CONTROLS (not including r-f and i-f adjustments)

Horizontal Centering	rear chassis adjustment
Vertical Centering	rear chassis adjustment
Width	rear chassis screwdriver adjustment
Height	rear chassis adjustment
Horizontal Linearity	top chassis screwdriver adjustment
Vertical Linearity	rear chassis adjustment
Horizontal Drive	rear chassis adjustment
Horizontal Oscillator Frequency	rear chassis adjustment
Horizontal Oscillator Phase	bottom chassis adjustment
Focus (Mechanical)	optical assembly adjustments
Deflection Coil	optical assembly adjustment
Horizontal Optical Centering	optical assembly adjustment
Vertical Optical Centering	optical assembly adjustment
High Voltage Driver Frequency	driver unit screwdriver adjustment

RECEIVER OPERATING INSTRUCTIONS

The following adjustments are necessary when turning the receiver on for the first time:

1. Turn the receiver "ON" and advance the SOUND VOLUME control to approximately mid-position.
2. Set the STATION SELECTOR to the desired channel.
3. Turn the PICTURE control fully counterclockwise.
4. Turn the BRIGHTNESS control clockwise, until a glow appears on the screen, then counterclockwise until the glow just disappears.
5. Turn the PICTURE control clockwise until a glow or pattern appears on the screen.
6. Adjust the FINE TUNING control for best sound fidelity and SOUND VOLUME for suitable volume.
7. Adjust the VERTICAL hold control until the pattern stops vertical movement.
8. Adjust the HORIZONTAL hold control until a picture is obtained and centered.
9. Adjust the PICTURE control for suitable picture contrast.
10. Adjust the FOCUS control until picture shows sharpest detail or definition.
11. After the receiver has been on for some time it may be necessary to readjust the FINE TUNING control slightly for improved sound fidelity.
12. In switching from one station to another, it may be necessary to repeat steps number 6, 9, and 10.
13. When the set is turned on again after an idle period it should not be necessary to repeat the adjustments if the positions of the controls have not been changed. If any adjustment is necessary, steps number 6, 9 and 10 are generally sufficient.
14. If the positions of the controls have been changed, it may be necessary to repeat steps number 1 through 10.

NOTE: If any difficulty is experienced with steps number 7 or 8, turn the PICTURE control 1/4 turn counterclockwise and repeat those adjustments.

Explanation of Controls

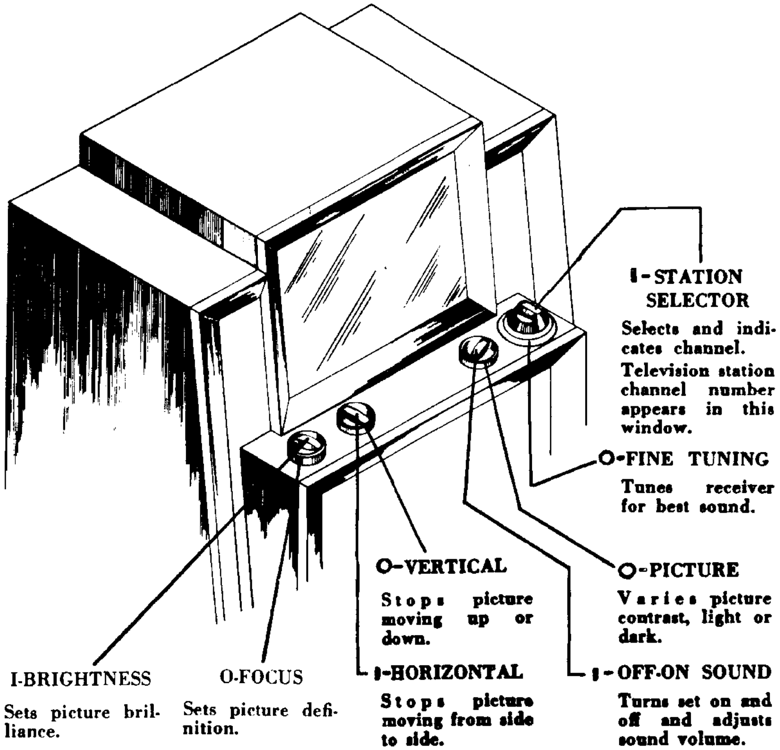


FIGURE 1.

INSTALLATION INSTRUCTION TABLE

The following table is provided as a check-off list for use when installing the receivers.

Step No.	Proceed as indicated
1.	Select location of receiver in room.
2.	Remove front of shipping crate.
3.	Slide cabinet out of crate.
4.	Remove all packing inserts and packing materials.
5.	Lay insert on floor and open cabinet front.
6.	Unpack tube and mirror.
7.	Push aside dust cover and remove cardboard cover over corrector lens.
8.	Remove top, install front surface mirror.
9.	Install kinescope and connect socket.
10.	Check all interconnecting cables.
11.	Make sure all tubes are firmly seated in their sockets.
12.	Connect receiver to an AC line and antenna.
13.	Turn receiver on.
14.	Tune in station per Operating Instructions, steps 2 through 10.
15.	Make optical alignment adjustment, electrical.
16.	Make optical alignment adjustment, mechanical.
17.	Adjust height, vertical linearity and vertical centering controls.
18.	Adjust width, horizontal drive, linearity and horizontal centering controls.
19.	MAKE SURE ALL OPTICAL ADJUSTMENT LOCKS ARE TIGHT.
20.	Replace optical barrel dust cover and tie drawstring.
21.	Check r-f oscillator frequency on all available channels.
22.	Adjust antenna traps.
23.	Check picture and sound on all available channels.
24.	Replace top cover.
25.	Close and lock cabinet front.
26.	Wipe off cabinet.

I. GENERAL DESCRIPTION

The Fada Model 880 Projection Television Receiver introduces to the public a combination of all the proven features of superior receiver performance, plus many innovations to assure the brightest picture, widest viewing angle, and longest-life operation.

An automatic High Voltage cut-off circuit is provided which automatically "shuts off" the picture illumination should failure occur in the sweep circuit sections. Failures such as these would otherwise result in the burning of lines on the tube face, necessitating costly replacement.

The receiver consists of the following major components:

1. Cabinet
2. Receiver Chassis
3. Projection Unit
4. Projection cathode-ray tube
5. High voltage supply
6. Auxiliary power supply
7. Speaker
8. Front Surface Mirror
9. Viewing Screen

The receiver weighs 165 lbs. complete; 225 lbs. when crated.

In picking a location for the television receiver in a room, the following general precautions should be followed:

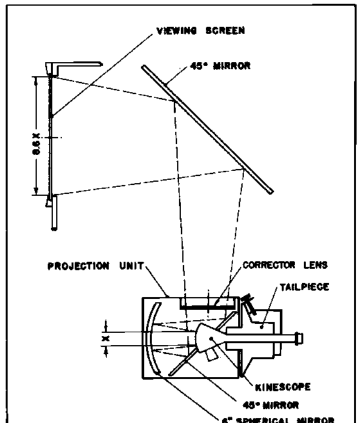
(1)—Do not place the instrument in such a position that direct illumination, such as light from a window, falls directly on the face of the screen. A certain amount of background illumination is desirable when viewing over long periods of time to reduce eyestrain.

(2)—Do not place the cabinet directly against a wall. Leave a two-inch air space in the back so that adequate ventilation will be assured. Do not obstruct any of the ventilation slots on the bottom or back of the cabinet. The receiver must be installed a sufficient distance from any heating device such as heating radiators, sun lamps, etc., as the effect of excessive heat will impair the operation or damage the receiver.

(3)—It is desirable to locate the receiver as far as possible away from sparking or gaseous discharge electrical devices such as may be found in public places. Such devices are neon display signs, electrically operated cash registers, etc.

1. PROJECTION UNIT — Description

The projection unit consists of two major parts: the optical assembly, and the mounting and alignment assembly, which are mounted together with four thumb-screws.



OPTICAL SYSTEM
MODEL 880
FIGURE 2. 102,252

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

The reflective optical system employs a Schmidt type spherical lens and is employed to project the image from the kinescope to the viewing screen. The system consists of the kinescope mounted on the axis of, and facing, a front surface spherical mirror. The spherical mirror reflects the light to a 45° mirror which bends the light beam at right angles to project it vertically through the corrector lens to another 45° mirror which again bends the light beam at a right angle to project the image horizontally on to the rear of the viewing screen.

The center section of the spherical mirror is painted black so that the illumination which falls on this sector will not be reflected back on to the face of kinescope to thus reduce the picture contrast by illuminating dark areas of the picture.

A spherical mirror will not by itself produce an in-focus image. The corrector lens is employed to bring the image into focus at all points on the viewing screen.

All reflecting surfaces are silvered on the front or first side to prevent ghosts which would occur from reflections at the surface of the glass of a rear surface mirror.

The mounting and alignment assembly contains the focusing coil, the deflection yoke with its associated wire-wound shield, the cathode-ray tube mounting assembly, and the mechanical focusing adjustments.

Adjustments are described under ALIGNMENT PROCEDURE.

2. PROJECTION CATHODE-RAY TUBE—Description

The projection cathode-ray kinescope is a type 3NP4 triode. It is packed in a special carton and should not be unpacked until ready for installation.

Due to the extremely high light intensity produced on the tube face, a protective circuit is incorporated in the receiver chassis to prevent line burns on the phosphor screen in the event of sweep circuit failure.

The raster size is 1.4 x 1.86 inches and is linearly magnified approximately 8.6 times to produce a final image 12 x 16 inches on the viewing screen. The tube operates at approximately 24.5 KV and employs magnetic deflection and magnetic focusing. The kinescope screen is backed by a microscopic aluminum film. This coating is porous to the electron stream. However, it is opaque to light and prevents radiation at the back of the screen from reducing picture contrast by illuminating dark areas of the picture with scattered light. The coating instead reflects the light out the front of the screen thus increasing the picture brilliance by approximately two to one. The aluminum film also prevents a negative charge from building up on the screen. Such a charge tends to repel the electron beam thus reducing the velocity with which the beam strikes the screen with consequent reduction of light output. The coating also provides some protection against screen burns produced by ions in the electron stream.

3. HIGH VOLTAGE SUPPLY (DRIVER UNIT) — Description

The high voltage supply is a compact, self-contained, reduced hazard pulse type, high-voltage unit supplying the 25 KV required for the operation of the 3NP4 cathode-ray tube.

It is mounted on the projection shelf to the right of the projection unit.

The high voltage rectifier tubes are enclosed, with associated components, in an oil-filled hermetically sealed can. If failure occurs, the entire container must be replaced. No adjustments should be required before operation.

Warning

This high-voltage supply is a reduced hazard pulse-type unit whose power output capabilities are limited to the requirements of the 3NP4 tube. Nevertheless, extreme care should be excercised while working on this unit.

Description of Circuit

The schematic diagram of this high-voltage supply is shown in the back of the manual.

.. AUXILIARY POWER SUPPLY — Description

The auxiliary power supply furnishes the DC power for the High Voltage Supply (Driver Unit), the DC power for the electromagnetic focus circuit, and the high-voltage cut-off tube V-131.

The auxiliary power supply chassis is mounted in a vertical position on the rear panel of the cabinet and is located just above the High Voltage Supply Driver Unit.
This supply is fused. The fuse is in the output (DC) circuit. It is a ¼ amp, 250 volt delay type "slo-blo" fuse. It is located in a holder beneath the chassis. If this fuse opens, there will be no high voltage output; hence no illumination on the screen. It is necessary to remove the four machine nuts supporting the chassis in order to replace this fuse.
No adjustments should be required before operation.

5. FRONT SURFACE MIRROR—Description

The front surface mirror provides maximum efficiency in the optical system to produce a picture of maximum brightness and contrast with a minimum loss of diffused light that would reduce brightness and contrast.
This mirror is mounted at a 45° angle in the top of the cabinet behind the viewing screen. Its dimensions are 14½ x 16⅞.
It is packed separately when shipped and the instructions for unpacking, handling and installation should be carefully observed.

6. VIEWING SCREEN — Description

The molded plastic screen, part No. 92.225, is a new development for a large screen projection type television receiver. This screen is of the refracting type, comprising many minute lens elements. The culmulative effect of these lenses is to produce a brighter and clearer picture. The viewing angles are sufficient to permit large groups of people to view the picture to full advantage whether seated or standing.
The focusing effect of the multiple lens elements increases the brightness some five times over that of the non-directional type screen, resulting in a bright picture with ample contrast. Average room lighting does not affect the picture on the screen to the extent that it is necessary to dim room lights for effective television picture presentations. This type of screen has an exceptionally high efficiency in that nearly all of the light striking the screen is passed through to the viewer.

FRONT SURFACE MIRROR.

In unpacking, be extremely careful not to scratch the mirror surface since in this type mirror the silvered front surface is completely exposed. Finger marks deposit organic matter that is difficult to remove. If necessary to clean this mirror surface, follow carefully the instructions under installation.

CATHODE-RAY TUBE. 3NP4

It is necessary only to point out that due care should be exercised in opening the tube carton and in handling the tube as it is fragile and therefore dangerous, as any kinescope tube, if broken.

III. INSTALLATION PROCEDURE

1. INSTALLATION OF FRONT SURFACE MIRROR

Remove the two wood screws at the top rear of the cabinet. Lift the back of the top lid and pull toward the rear to disengage the mortised joint. Remove the stop-strip, anchored on the 45° ledge with two wood-screws. Very carefully unpack the mirror and slide into the slotted grooves, FRONT SURFACE FACING DOWN, and seat carefully, but firmly, into position. It is very important to take every precaution to prevent scratching or smudging of the front surface while installing. Replace the stop-strip.
To determine the front surface of the mirror, lay it flat on a smooth surface and carefully approach the surface with an opaque object such as the edge of a coin or point of a pencil. The front surface is that side on which it can be observed that the coin or pencil point comes into contact with the mirror image. On the reverse side of the mirror it will be observed that there is a spacing of approximately ¼ inch (representing the thickness of the glass) between the object and its image. Moreover, there will usually be found a label on the rear side of the mirror.
Be very careful not to smudge the front surface with the fingers. Organic material is thus deposited which is difficult to remove without some damage to the mirror surface.
If the front silvered surface is accidently smudged or smeared, extreme care is required to re-clean the surface. One good method is to use alcohol on absorbent cotton to take up the smudges, followed by dry absorbent cotton to remove the last traces.
Where dirty from dust collection and free deposits from the atmosphere, the mirror can be cleaned with any normal glass cleaning procedure, provided abrasives are avoided. Cleaning with absorbent cotton and a liquid solution of the Windex type is recommended. Soap and water and a clean, soft cloth are satisfactory. Mirrors should NOT be cleaned with Bon Ami, Lava Soap or similar abrasives. Soft cloths must be **clean.**

2. INSTALLATION OF CATHODE RAY TUBE

The unit is shipped with the tailpiece yoke assembly (92.231) in place. See diagram of Projection Unit. Loosen the four thumbscrews marked "M" on the diagram. Rotate the assembly counterclockwise a few degrees and carefully withdraw it straight back. Lay the assembly on the shelf. Loosen the two tube clamp screws marked "T" about one turn each. Loosen the screw marked "C" to open the tube neck clamp. Unpack the kinescope tube from its box. Attach the "light shield" as shown in the diagram, securing it in position with the rubber band.
Carefully insert the tube into the yoke mold and seat very carefully, but firmly, so that the tapered neck portion rests snugly in the yoke mold, and, with the second anode cup at six o'clock (straight down when in mounted position). The two ground wire contacts must rest securely against the sides of the tube and not interfere with the shield.
Be sure the tube neck is properly centered in the hole in the triangular tail plate and then tighten the two screws "T". Then, holding the tube firmly seated, tighten the tube neck clamp screw "C". Although some care is required in tightening this clamp, a firm tightening may be successfully obtained, since the clamp flange would be deformed before the tube would be imploded.

Remove the insulated high voltage cable clamp on the mounting plate and fasten the second anode cable through the clamp. Insert the fitting into the second anode cup, being certain that positive contact is made. Pull the cable back through the clamp so the cable and coupling will clear the lip of the optical barrel when the units are assembled. Anchor the cable by tightening the cable clamp screws. Be sure that the cup remains in the straight down position. Carefully insert the tube into the barrel opening and into the opening in the 45° flat mirror. Care is required so as not to knock off the light shield. Slight difficulty might be experienced in getting the second anode cable to clear the lip of the opening. Seat the yoke, rotate clockwise slightly and tighten the four thumbscrews marked "M."

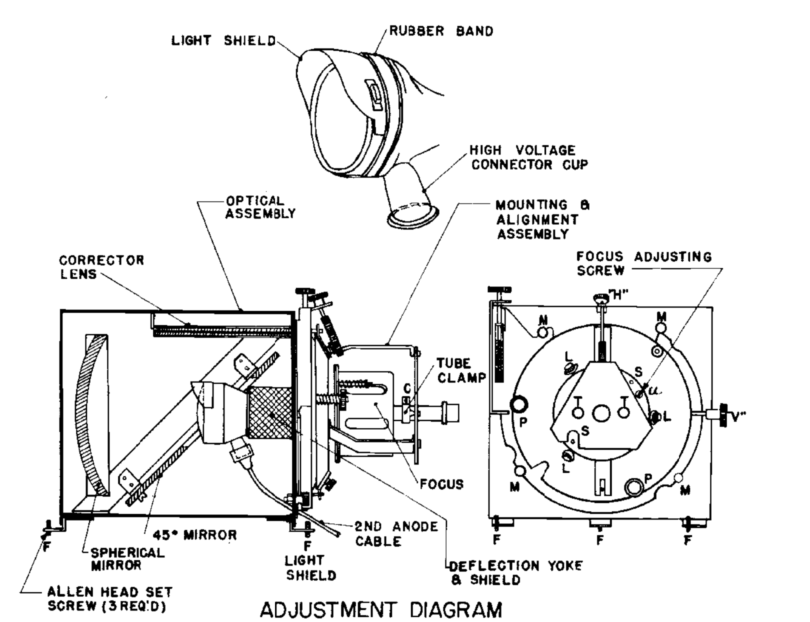
Attach the tube socket. The optical assembly is now ready for electrical and mechanical adjustment as described under the "Alignment Procedure" section.
Discoloration of the kinescope tube face may be found after a period of use. A brown discoloration, the shape of the picture raster, is characteristic in normal use and deterioration and is not detrimental to the character, quality or brightness of the picture. The discoloration in result is a partial change in composition of the glass tube face caused by soft x-ray bombardments, over a long period of use. X-rays are emitted from the aluminum tube face backing when it is bombarded by the stream of picture forming electrons at a sufficiently high velocity. However, at 25KV only a low order of excitation may be expected. Secondary x-rays are emitted from the tube face which is in turn receiving the primary x-ray radiation. The magnitude of this radiation is extremely low and may be considered quite harmless. Moreover, when the tube is enclosed in the optical projection unit, complete insulation is effected. Lastly, x-rays are not reflected in the light beam and are therefore **not** present in the viewing screen's illumination. No measureable x-ray radiation is to be found outside the cabinet.

3. RECEIVER CHASSIS

The receiver chassis is mounted on the front grilled panel. Examine carefully to see that all tubes are securely in their sockets and that the wires and cables are connected. All connectors are designed so that each is different, preventing erroneous connections.
Access to the underside of the receiver chassis is provided in this Model such that the majority of under chassis adjustments or repairs can be made without removing the chassis from the cabinet.
With the front panel open and lying on the floor as described under "Cabinet" above, fourteen wood screws are found spaced around the edges of the receiver chassis mounting board. These screws anchor the front grille frame. Remove the screws. Lift the front closed, leaving the front frame, screen and grille lying on the floor. Set the frame aside. The underside of the chassis and the speaker cone are exposed.

4. INSTALLATION OR REPLACEMENT OF VEIWING SCREEN

The viewing screen is mounted in a rectangular frame. For cleaning or replacement, the top side of the frame can be removed and the viewing screen slid up and out of its frame.
To remove the screen, first remove the top of the cabinet as described under "Installation of Front Surface Mirror". Three woodscrews anchor the top edge of the viewing screen frame. Remove these screws. Then, lift the piece up to disengage the mortised joints. The screen is then slid up and out of the frame.
If necessary, this screen can be washed with mild soap and warm water applied with a soft cloth. Rinse and dry thoroughly. Avoid any abrasive soaps or cloths that might scratch either side.
In replacing the screen, be certain the circular cerations face the back.



ADJUSTMENT DIAGRAM
PROJECTION UNIT
MODEL 880

FIGURE 3.

102.251

5. AUXILIARY POWER SUPPLY

The auxiliary power supply is mounted in a vertical position on the right hand side of the rear panel and directly above the high voltage supply. Examine to see the following:

1. 5Y3 GT tube secure in socket
2. Red B lead connected in socket
3. Octal connector from high voltage supply connected securely.
4. AC plug is connected to socket on cord coming from receiver chassis.

6. BRAIDED GROUND BUS

The ¼" tinned braid ground bus must be connected to the auxiliary power supply, the high voltage supply, the projection assembly, and to the receiver chassis.

IT IS IMPERATIVE THAT THIS BRAID BE SECURELY SOLDERED TO THESE FOUR POINTS BEFORE ATTEMPTING TO OPERATE THE RECEIVER.

ANTENNAS

1. General

The finest television receiver built may be said to be only as good as the antenna design and installation. It is therefore extremely important to use a correctly designed antenna, and to use care in its installation.

The customer sees only the results of an installation in the picture and sound qualities for the stations available in that area. If an antenna is poorly installed and improperly oriented and coupled to the receiver, the customer may tend to criticize the receiver, since the receiver is where the results are observed, rather than criticize the antenna installation which may be the actual cause of poor reception. In short, a television receiving antenna and its installation must conform to much higher standards than an antenna for reception of International Short Wave and Standard Broadcast signals.

2. Reflections

Multiple images, sometimes called echoes or ghosts, are caused by the signal arriving at the antenna by two or more routes. The second or subsequent image occurs when a signal arrives at the antenna later than the original direct signal, after being reflected off a building, a hill, or other object which may serve as a reflecting "mirror" to the signal. In severe cases of reflections, even the sound may be distorted. In less severe cases, reflections may occur that are not noticeable as reflections but that will instead cause a loss of definition in the picture.

Depending upon the circumstances, it may be reasonably possible to eliminate the reflections by rotating the antenna or by moving it to a new location. In some cases, it may be impossible to eliminate the reflection, or at least to do so at reasonable cost.

Under certain extremely unusual conditions, it may be possible to rotate or position the antenna so that it receives the cleanest picture over a reflected path. If such is the case, the antenna should be so positioned. However, such a position may give variable results as the nature of the reflecting surfaces may vary with weather conditions. Wet surfaces have been known to have different reflecting characteristics than dry surfaces.

3. Interferences

The various types of interferences are described and discussed in the Operation Instruction Manual, with descriptive illustrations.

IV. RECEIVER ALIGNMENT TEST EQUIPMENT

To properly service this receiver, it is recommended that the following test equipment be available.

R. F. SWEEP GENERATOR meeting the following requirements:

(a) Frequency ranges
- 18 to 30 mc., 1 mc. sweep width
- 40 to 90 mc., 10 mc. sweep width
- 170 to 225 mc., 10 mc. sweep width

(b) Output adjustable with at least 1 volt maximum
(c) Output constant on all ranges
(d) "Flat" output on all attenuator positions.

CATHODE-RAY OSCILLOSCOPE preferably one with a wide band vertical deflection, an input calibrating source, and a low capacity probe.

SIGNAL GENERATOR to cover I.F. frequencies of from 19.75 mc. to 27.25 mc.,

ELECTRONIC VOLTMETER of Junior "Voltohmyst" type.

HIGH VOLTAGE METER for measuring 2nd anode potentials. A 50 or 100 microamp movement is recommended with a 1000 megohm probe, well insulated and fitted with an insulated handle at least 12 inches long.

V. RECEIVER ALIGNMENT PROCEDURE

To align the instrument, the various Receiver Chassis Adjustments (1) must be accomplished first. Then, in order, make the Electrical Adjustments (2) as these affect the optical assembly and finish by making the Mechanical Adjustments (3).

After these are done, normal operating procedures for tuning all stations are all that should be required for optimum performance, using only the controls on the front panel shelf.

1. RECEIVER CHASSIS ADJUSTMENTS (other than R.F. & I.F.)

Trial adjustments of electrical controls should be made first to insure all are working. The picture may be defocused and/or tilted. This will be corrected under "Projection System" adjustments.

(a) Picture Adjustments: It will now be necessary to obtain a test pattern picture in order to make further adjustments. See steps 2 through 10 and the note in the receiver operating instructions   Turn the horizontal hold control to the extreme counter-clockwise position. The picture should remain in horizontal sync. Momentarily remove the signal by turning the picture control fully counter-clockwise and then returning it to the operating position. Normally the picture will pull into sync. Turn the horizontal hold control to the extreme clockwise position. The picture should remain in sync. Momentarily remove the signal. Again the picture should normally pull into sync.

If the receiver passes the above checks and the picture is normal and stable, the horizontal oscillator is properly aligned. Skip "Alignment of Horizontal Oscillator".

(b) Alignment of Horizontal Oscillator: If, in the above check, the receiver failed to hold sync, with the hold control at either extreme, or failed to pull into sync, after momentary removals of the signal, make the adjustments under "Slight Retouching Adjustments". If, after making these retouching adjustments, the receiver fails to pass the above checks, or, if the horizontal oscillator is completely out of adjustment, then make the adjustments under "Complete Realignment".

Slight retouching adjustments: Tune in a Television Station and adjust the fine tuning control for best sound quality. Sync the picture and adjust the picture control for slightly less than normal contrast. Turn the horizontal hold control to the extreme position in which the oscillator fails to hold or to pull in. Momentarily remove the signal. Turn the T108 frequency adjustment on the chassis rear apron until the oscillator pulls into sync. Check hold and pull-in for the other extreme position of the hold control.

Complete realignment: Tune in a Television Station and adjust the fine tuning control for best sound quality.

Turn the T108 frequency (on rear apron) until the picture is synchronized. (If the picture is not synchronized vertically, adjust the vertical hold.) Adjust the picture control so that the picture is somewhat below average contrast level. Turn the T108 phase adjustment screw (under chassis) until the blanking bar, which may appear in the picture, moves to the right and off the raster. The range of this adjustment is such that it is possible to hit an unstable condition (ripples in the raster). The screw must be turned clockwise from the unstable position. The length of stud beyond the bushing, in its correct position, is usually about ½ inch. Turn horizontal hold to extreme counter-clockwise position. Turn T108 frequency adjustment clockwise until the picture falls out of sync. Then turn it slowly counterclockwise to the point where the picture falls in sync again.

Readjust T108 phase adjustment so that the left side of the picture is close to the right side of the raster, but does not begin to fold over.

Turn horizontal hold to extreme clockwise. The right side of the picture should be close to the right side of the raster, but should not begin to fold over. If it does, readjust the phase. Momentarily remove the signal. When the signal is restored, the picture should fall into sync. If it doesn't, turn T108 frequency adjustment counter-clockwise until the picture falls into sync.

Turn horizontal hold to extreme counter-clockwise position. Remove the signal momentarily. When the signal is restored, the picture should fall into sync.

NOTE: If the picture does not pull into sync, after momentary removals of signal in both extreme positions of horizontal hold, the pull-in range may be inadequate, though not necessarily. A pull-in through ¾ of the hold control range may still be satisfactory.

There is a difference between the pull-in range and hold-in range of frequencies. Once in sync, the circuit will hold about 50% to 100% more variation in frequency than it can pull in. The range of the horizontal hold control is only approximately equal to the pull-in range. Considerable variation may be found due to variations in the cut-off characteristics of the horizontal oscillator control tube, V124. Excessive pull-in is objectionable because the higher sensitivity of the control circuits means also greater susceptibility to noise, and to the vertical sync and equalizing pulses which tend to cause a bend in the upper part of the raster. This effect is more noticeable when the sync link is in the 1-2 position.

(c) Height and Vertical Linearity Adjustment: Adjust the height control (R169 on chassis rear apron) until the picture fills the screen vertically (12 inches). Adjust vertical linearity (R178 on rear apron) until the test pattern is symmetrical from top to bottom. Adjustment of either control will require a readjustment of the other. Adjust vertical centering to align the picture with the screen.

(d) Width and Horizontal Linearity Adjustments: Turn the horizontal drive (R187 on rear apron) clockwise as far as possible, without causing crowding of the right of the picture. This position provides maximum high voltage to the Kinescope second anode. Adjust the width control (L196 on rear chassis) until the picture just fills the screen horizontally (16 inches). Adjust the horizontal linearity control L201 until the test pattern is symmetrical left to right. A slight readjustment of the horizontal drive control may be necessary when the linearity control is used. Adjust horizontal centering to align the picture with the mask.

If repeated adjustments of drive width and linearity fail to give proper linearity, it may be necessary to move the tap on R209, which is located in the high voltage compartment. Adjustments of drive, width and linearity, must then be repeated.

(e) Sync Link: If any phase modulation is present, in the transmitted sync, a faster response to fluctuations in the sync phase is needed. The sync discriminator will demodulate sync phase variation quite faithfully. However, the filter resistor R193 together with the capacity attenuator C167 and C170, is just as effective in removing this information as it is with respect to the noise disturbances for which it is intended. Removal of this information will produce a horizontal displacement of portions of the picture. It may be necessary in some instances to sacrifice some noise immunity to compensate for phase modulation in the transmitted sync. By switching the link provided for this purpose, the speed of response is increased several times. Therefore, the link on J102 should be connected between terminals 1 and 2 whenever this condition exists.

(f) Antenna Trap: In some instances interference may be encountered from FM stations that are on the image frequency of a television station. In other instances, interference between two television stations may be observed.

Assume that two television stations in a city are operating on channels 6 and 10. When the receiver is tuned to channel 6, a small amount of the oscillator voltage (109 mc) is present on the r-f amplifier grid. This (109 mc) voltage beats with the channel 10 picture carrier and produces an 84.25 mc. signal. This signal falls within the channel 6 range and interference with the reception of channel 6. A similar case occurs between channels 5 and 7.

A series resonant trap across the r-f amplifier grid circuit will remove the oscillator voltage from the grids and will eliminate this type of interference. In production, this trap is adjusted to reject the channel 6-10 interference. However, in the field, it may be necessary to retouch the adjustment or to readjust the trap for channel 5-7 or FM image interference.

To adjust the trap in the field, tune in the station on which the interference is observed. Tune both cores of the trap for minimum interference in the picture. Keep both cores approximately the same by visual inspection. Then, turn one core ½ turn from the original position and repeat the second for maximum rejection. Repeat this process until the best rejection is obtained.

2. PROJECTION SYSTEM — ELECTRICAL ADJUSTMENTS

After checking to ascertain that all connections are complete turn receiver on. To make adjustments, it is recommended that a transmitted test pattern be used. If a test pattern is not available, retrace and scanning lines should be used. Untie drawstring of dust cover and lift bottom of cover aside to permit viewing of the unit through the corrector lens as follows:

Look down into the optical assembly through the corrector lens and observe, in the 45° mirror, the picture reflected from the tube face. Be careful not to touch lens.

Adjust the electrical controls of the receiver to center a normal, focused linear pattern on the tube face. Adjust the raster or picture size so that the four corners of the rectangular raster or picture just touch the edge of the circular tube face. All four corners cannot be seen from one position; each corner must be examined separately for final electrical positioning by moving the eye form side to side.

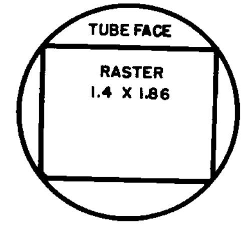


FIGURE 4.

3. PROJECTION SYSTEM — MECHANICAL 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 thumbscrew adjustments are provided for this purpose. The principal adjustment "O" (see adjustment diagram Figure 3.) 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, "V", and horizontally, "H", with the center of the tube face plate as the center of rotation. These adjustments determine the positions 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.

First, loosen the five blocking nuts marked "L" and "P", about one turn each.

(a) Adjust the overall focusing thumbscrew "O" until the center portion of the picture is properly focused, on the screen.

(b) Adjust the thumbscrew marked "H" until the center of each side of the picture is equally focused.

(c) Adjust the thumbscrew marked "V" until the center portion of the top and bottom of the picture are equally focused.

(d) After each slight adjustment of the "H" and "V", the overall focusing adjustment "O" should be rechecked. By carefully manipulating these adjustments, it is possible to bring the entire picture into satisfactory focus.

(e) When the focusing procedure has been completed, turn the five locking nuts "L" and "P" clockwise until they are snug.

With this completed, the picture may be off-center on the front viewing screen so that the picture does not properly fill the frame of the viewing screen.

(f) **Centering Picture on Viewing Screen:** Examine the tube face again at this point to ascertain the electrical centering of the image as described under "Electrical Adjustments" above. If the picture is centered on the **tube face** and optically focused on the screen, but off-center on the screen, the following further adjustment is required. Do not attempt to recenter the picture on the screen by electrical adjustment alone.

With no picture signal, increase raster brightness (with scanning lines in focus) so as to observe uniformity of illumination on the tube face. If one corner or side is dark, or becomes dark unevenly as brightness is gradually decreased, the focus coil may be out of adjustment. This is corrected by movement of one adjustment screw with screwdriver slot, "U". This adjustment will also cause overall displacement of the raster and **should not** be used for that purpose, but only to obtain uniform illumination of the tube face. The total raster displacement which is coincident is readjusted for with the horizontal and vertical electrical centering controls.

The optical assembly is anchored to the shelf at three points "F" with wingnuts. Reach under the shelf and loosen the wingnuts 3 or 4 turns each. Then tilt the assembly by hand to correct the picture location on the viewing screen, noting which foot or feet "F" must be shimmed or raised. Then, holding assembly free of shelf at leg "F" being adjusted, turn allen-head set-screw stud clockwise, "jacking" the assembly into position. Then retighten the three wing-nuts under shelf to anchor the assembly in the desired position. Repeat the mechanical adjustments for focus if necessary as described above.

After these adjustments are accomplished, the picture may be **electrically** readjusted for critical linearity, focus, size, and centering as in normal operation, using the same as for the direct-view type of receiver.

Replace the dust cover over the optical assembly and tie the drawstring.

Lift closed the hinged front section and latch the two anchoring catches, completing the assembly and adjustment of the receiver.

4. HIGH VOLTAGE SUPPLY—OSCILLATOR ADJUSTMENT

The triode section of the 6SR7 tube, operates as a conventional blocking oscillator, whose frequency is 1000 $\pm$ 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/s, each 1000 cycle pulse will start a damped train of high voltage transient oscillations whose frequency is 25 kc/s 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 $\pm$ 70 cycles. A trimmer condenser C-1 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 generated by 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 through the action of C6, C8, and R8, and then applied to the driver grid circuit across resistor R6. The use of this method of automatic voltage control of the driver tube provides a regulation characteristic which is substantially flat within the desired control 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.**

The high voltage supply oscillator is factory adjusted. In normal installation, further adjustment should NOT be required. A transformer hum may also be audible with the cabinet front open. This, too, is normal.

The frequency of the blocking oscillator in the high-voltage supply must be maintained at 1000 $\pm$ 70 cycles. Adjustment should not be necessary unless a frequency determining element has been replaced or altered. This frequency should be checked when the 6SR7 tube or any of its associated components is replaced. 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 C-228 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 the H.V. supply side of the resistor. **Be sure to remove this resistor when the frequency is set.**

With the 1000 cycle signal from the generator applied to the horizontal sweep amplifier of the oscilloscope, adjust C-228 until a single stable Lissajou figure is obtained.

High-Voltage Supply Service Hints

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 high voltage supply schematic shows the normal operating voltages obtained with a vacuum tube voltmeter. These 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. Check, in addition to voltage, the 6SR7 and 6BG6G tubes.

VI. ADJUSTMENTS REQUIRED FOR R-F, PICTURE I-F AND SOUND I-F

Normally, only the R.F. oscillator line will require the attention of the service technician. All other circuits are either broad or very stable and hence will seldom require re-adjustment.

Due to the high frequencies at which the receiver operates, the R.F. oscillator line adjustment is critical and may be affected by a tube change. The line can be adjusted to proper frequency on channel 13 with practically any 6J6 tube in the socket. However, it may not then be possible to adjust the line to frequency on all of channels 7, 8, 9, 10, 11 and 12. To be satisfactory as an oscillator tube, it should be possible to adjust the line to proper frequency with the fine tuning control in the middle third of its range. It may therefore be necessary to select a tube for the oscillator socket. In replacing, if the old tube can be matched for frequency by trying several new ones, this practice is recommended. At best, however, it will probably be necessary to completely realign the oscillator line when changing the tube.

Tubes which cannot be used as oscillator will work satisfactorily as R.F. amplifier or converter.

ORDER OF ALIGNMENT

When a complete receiver alignment is necessary, it can be most conveniently performed in the following order:—

Picture i-f traps	R-F oscillator line
Picture i-f transformers	Converter grid trap
Sound discriminator	Retouch picture i-f transformers
Sound i-f transformers	Antenna Trap Alignment
R-F and converter lines	Sensitivity check

PICTURE I-F TRAP ADJUSTMENT

Set the voltage on the i-f bias buss to approximately —3 volts.

Set the channel switch to channel 9.

Connect the VoltOhmyst across the picture second detector load resistor R137.

Connect the output of the signal generator to the junction of C14 and R6. This connection is available on a terminal lug through a hole in the side apron of the chassis beside the r-f unit.

Set the generator to each of the following frequencies and tune the specified adjustment for minimum indication on the voltohmyst. In each instance the generator should be checked against a crystal calibrator to insure that the generator is exactly on frequency.

19.75 mc. — T104 (top)
21.25 mc. — T2 (top)
21.25 mc. — T105 (top)
27.25 mc. — T103 (top)

PICTURE I-F TRANSFORMER ADJUSTMENTS

Set the signal generator to each of the following frequencies and peak the specified adjustment for maximum indication on the voltohmyst.

21.8 mc. — T2 (bottom)
25.3 mc. — T103 (bottom)
22.3 mc. — T104 (bottom)
25.2 mc. — L183 (top of chassis)
23.4 mc. — L185 (top of chassis)

if T104 (bottom) required adjustment, it will be necessary to reset T104 (top) for minimum response at 19.75 mc.

PICTURE I-F OSCILLATION

If the receiver is badly misaligned and two or more of the i-f transformers are tuned to the same frequency, the receiver may fall into i-f oscillation. I-F oscillation shows up as a voltage in excess of 3 volts at the picture detector load resistor. This voltage is unaffected by the r-f signal input and sometimes is independent of picture control setting.

If such a condition is encountered, it is sometimes possible to stop oscillation by adjusting the transformers approximately to frequency by setting the adjustment stud extensions of T2, T103, T104, T105, L183, and L185 to be approximately equal to those of another receiver known to be in proper alignment. If this does not have the desired effect, it may now be possible to stop oscillation by increasing the grid bias with the picture control. If so, it should then be possible to align the transformers by the usual method. Once aligned in this manner, the i-f should be stable with reduced bias.

If the oscillation cannot be stopped in the above manner, shunt the grids of the first three i-f amplifiers to ground with 1000 mmf. capacitors.

Connect the signal generator to the fourth i-f grid and adjust L185 to frequency.

Remove the shunting capacitor from the third i-f grid, connect the signal generator to this grid and align L183.

Remove the shunting capacitor from the second i-f grid, connect the signal generator and align T104.

Remove the shunting capacitor from the first i-f grid, connect the signal generator and align T103.

Connect the signal generator to the junction of L80 and R6 and align T2 to frequency.

If this does not stop the oscillation, the difficulty is not due to i-f misalignment as the i-f section is very stable when properly aligned. Check all i-f by-pass condensers, transformer shunting resistors, tubes, socket voltages, etc.

SOUND DISCRIMINATOR ALIGNMENT

Set the signal generator for approximately 1 volt output at 21.25 mc. and connect it to the third sound i-f grid.

Detune T113 secondary (bottom).

Set the VoltOhmyst on the 10 volt scale.

Connect the meter in series with a one megohm resistor to the junction of diode resistors R219 and R220. Do not remove the discriminator shield to make connections to R219 and R220. Connections can be easily made by fashioning a hook on the 1 meg resistor lead and making connection to the transformer lug "C" through the hole provided for the adjusting tool.

Adjust the primary of T113 (top) for maximum output on the meter.

Connect the Volt-Ohmyst to the junction of R236 and C205.

Adjust T113 secondary (bottom). It will be found that it is possible to produce a positive or negative voltage on the meter dependent upon this adjustment. Obviously to pass from a positive to a negative voltage, the voltage must go through zero. T113 (bottom) should be adjusted so that the meter indicates zero output as the voltage swings from positive to negative. This point will be called the discriminator zero output.

Connect the sweep oscillator to the grid of the third sound i-f amplifier.

Adjust the sweep band width to approximately 1 mc. with the center frequency at approximately 21.25 and with an output of approximately 1 volt.

Connect the oscilloscope between R236 and C205.

The pattern obtained should be similar to that shown in Figure 9A. If it is not, adjust the T113 (top) until the wave form is symmetrical.

The peak to peak bandwidth of the discriminator should be approximately 350 kc and it should be linear from 21.175 mc. to 21.325 mc.

SOUND I-F ALIGNMENT

Connect the sweep oscillator to the second sound i-f amplifier grid.

Connect the oscilloscope to the third sound i-f grid return (terminal A T112) in series with a 33,000 ohm isolating resistor.

Insert a 21.25 mc. marker signal from the signal generator into the second sound i-f grid.

Adjust T112 (top and bottom) for maximum gain and symmetry about the 21.25 mc. marker. The pattern obtained should be similar to that shown in Figure 9B. The output level from the sweep should be set to produce approximately .3 volt peak-to-peak at the third sound i-f grid return when the final touches on the above adjustment are made. It is necessary that the sweep output voltage should not exceed the specified values otherwise the response curve will be broadened, permitting slight misadjustment to pass unnoticed and possibly causing distortion on weak signals.

Connect the sweep and signal generator to the top end of the trap winding of T2 (on top of chassis).

Adjust T111 (top and bottom) for maximum gain and symmetry at 21.25 mc.

Reduce the sweep output for the final adjustments so that approximately .3 volt peak-to-peak is present at the third sound i-f grid return.

The band width at 70% response from the first sound i-f grid to the third i-f grid should be approximately 200 kc.

R-F AND CONVERTER LINE ADJUSTMENT

Connect the r-f sweep oscillator to the receiver antenna terminals J103. If the sweep oscillator has a 50 ohm single-ended output, it will be necessary to obtain balanced output by properly terminating the sweep output cable and connecting a 120 ohm non-inductive resistor in series between the sweep output cable and each receiver antenna terminal as shown in Figure 5.

Connect the oscilloscope to the junction of C14 and R6 (in the r-f tuning unit) through a 10,000 ohm resistor. This connection is available on a terminal lug through a hole in the side apron of the chassis, beside the r-f unit. This hole is normally down when the chassis is in the recommended position. Connection can be easily made, however, by allowing the receiver to hang over the edge of the test bench a few inches.

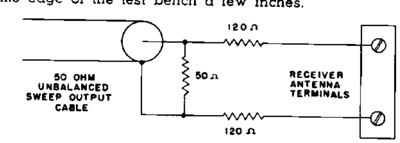


FIGURE 5—UNBALANCED SWEEP CABLE TERMINATION

By-pass the first picture i-f grid to ground through a 1000 mmf. capacitor. Keep the leads to this by-pass as short as possible. If this is not done, lead resonance may fall in the r-f range and cause an incorrect picture of the r-f response.

Set the picture control for approximately —1.5 volts bias on the r-f stage. (For convenience check this voltage at the diodes of V108, pins 5 and 6.)

Connect the signal generator loosely to the receiver antenna terminals.

Since channel 7 has the narrowest response of any of the high frequency channels, it should be adjusted first.
Set the receiver channel switch to channel 7.
Set the sweep oscillator to cover channel 7.
Insert markers of channel 7 picture carrier and sound carrier 175.25 mc. and 179.75.
Adjust L25, L26, L51 and L52 (see Figures 7 and 11), for an approximately flat topped response curve located symmetrically between the markers. Normally this curve appears somewhat overcoupled or double humped with a 10 or 15% peak to valley excursion and the markers occur at approximately 90% response. See Figure 11, channel 7. In making these adjustments, the stud extension of all cores should be kept approximately equal.
Check the response of channels 8 through 13 by switching the receiver channel switch, sweep oscillator and marker oscillator to each of these channels and observe the response obtained. See Figure 11, for typical response curves. It should be found that all these channels have the proper shaped response with the markers above 70% response. If the markers do not fall within this requirement on one or more high frequency channels, since there are no individual channel adjustments, it will be necessary to readjust L25, L26, L51 and L52, and possibly compromise some channel slightly in order to get the markers up on other channels. Normally however, no difficulty of this type should be experienced since the higher frequency channels become comparatively broad and the markers easily fall within the required range.
Channel 6 is next aligned in the same manner.
Set the receiver to channel 6.
Set the sweep oscillator to cover channel 6.
Set the marker oscillator to channel 6 picture and sound carrier frequencies.
Adjust L11, L12, L37 and L38, for an approximately flat-topped response curve located symmetrically between the markers.
Check channels 5 down through channel 1 by switching the receiver, sweep oscillator, and marker oscillator to each channel and observing the response obtained. In all cases, the markers should be above the 70% response point. If this is not the case, L11, L12, L37 and L38 should be retouched. On final adjustment, all channels must be within the 70% specification.
Coupling between r-f and converter lines is augmented by a link between L12 and L37. This link is adjusted in the factory and should not require adjustment in the field. On channel 6 with the link in the minimum coupling position, the response is slightly overcoupled with approximately 10% excursion from peak-to-valley. With the coupling at maximum, the response is somewhat broader, and the peak-to-valley excursion is approximately 40%. The amount of coupling permissible is limited by the peak-to-valley excursion which should not be greater than 30% on any channel.

R-F OSCILLATOR LINE ADJUSTMENT

The r-f oscillator line may be aligned by adjusting it to beat with a crystal calibrated heterodyne frequency meter, or by feeding a signal into the receiver at the r-f sound carrier frequency and adjusting the oscillator for zero output from the sound discriminator. In this latter case, the sound discriminator must first have been aligned to exact frequency. Either method of adjustment will produce the same results. The method used will depend upon the type of test equipment available.
The heterodyne frequency meter is the more universal method since it is applicable to all types of receivers. However, it requires a great many calibration points since receivers with different i-f frequencies employ different oscillator frequencies, and hence different calibration points in the frequency meter. This may result in confusion and errors in adjustment.
Since all sets must receive the same stations, the r-f sound carrier frequencies remain the same, regardless of i-f frequency. By use of this method, only one set of calibrating points is necessary. If these frequencies are crystal controlled, this method of alignment becomes very fast and with a minimum chance of error. However this method is applicable only on receivers that use a sound discriminator or other type of sound detector that has a definite and measurable characteristic at center frequency. This method cannot be easily employed on receivers that employ a slope type detector. Regardless of which method of oscillator alignment is used the frequency standard must be crystal controlled or calibrated.

If the receiver oscillator is to be adjusted by the heterodyne frequency meter method, the r-f oscillator frequencies must be established for the 880.
If the receiver oscillator is adjusted by feeding in the r-f sound carrier frequency, the sound carrier frequencies must be available.
If the heterodyne frequency method is used, couple the meter probe loosely to the receiver oscillator.
If the r-f sound carrier method is used, connect the voltohmyst to the sound discriminator output (junction of R236 and C205).
Connect the signal generator to the receiver antenna terminals.
The order of alignment remains the same regardless of which method is used.
Since lower frequencies are obtained by adding steps of inductance, it is necessary to align channel 13 first and continue in reverse numerical order.
Set the receiver channel switch to channel 13.
Adjust the frequency standard to the correct frequency (237 mc. for heterodyne frequency or 215.75 for the signal generator.)
Set the fine tuning control to the middle of its range while making the adjustment.
Adjust L77 and L78 for an audible beat on the heterodyne frequency meter or zero voltage from sound discriminator. The core stud extensions should be maintained equal by visual inspection except as discussed in the following paragraph entitled oscillator pulling.
Switch the receiver to channel 12.
Set the frequency standard to the proper frequency as listed in the alignment table.
Adjust L76 for indications as above.
Adjust the oscillator to frequency on all channels by switching the receiver and the frequency standard to each channel and adjusting the appropriate oscillator trimmer for the specified indication. It should be possible to adjust the oscillator to the correct frequency on all channels with the fine tuning control in the middle third of its range.
After the oscillator has been set on all channels, start back at channel 13 and recheck to make sure that all adjustments are correct.
Oscillator Pulling—If in setting the low frequency channels, the high frequency channels are pulled noticeably off frequency, or it is impossible to set channels 10, 11 or 12 within the range of their respective trimmers, it may be due to interaction between sections of the line. A quick check can be made to determine if this is the case.
The shorting section of the r-f oscillator channel switch, (rotor) should be at ground r-f potential. If this is not the case due to dissymmetry in the circuit, the shorting section may be somewhat above ground. Since at these high frequencies, even the length of the shorting bar represents an appreciable portion of a wave length, the lower frequency section is effectively tapped up on the high frequency section and reflects reactance into it. This reactance varies with low frequency channel oscillator adjustments thus causing a shift in oscillator frequency on the upper channels. One way to cure this difficulty is to adjust the shorting switch to ground potential. This can be accomplished by staggering L77 and L78 until this condition is achieved.
To find if dissymmetry exists, remove the bottom cover from the r-f unit.
Set the channel switch to channel 10.
Disconnect any input from the receiver.
Connect the voltohmyst to R6 through the hole in the side of chassis, and measure the oscillator injection into the converter grid.
Take an insulated metal prod and touch the center of the oscillator rotor shorting bar. If the meter readings changes, it indicates that the bar is not at r-f ground.
To balance the line, switch to channel 13 and stagger the cores for one or more turns (usually L78 out and L77 in). The final adjustment must leave the oscillator on correct channel 13 frequency.
Switch back to channel 10 and touch the switch rotor as before. As before, meter movement indicates unbalance.
For fine balancing touch the switch contacts for channel 10. When balanced, the meter will show equal reduction for both contacts. Continue staggering the cores until balance is obtained.
Repeat the oscillator adjustments for all channels.

CONVERTER GRID TRAP ADJUSTMENT

Connect the sweep generator to the receiver antenna terminals.
Observe the precaution for single-ended output generators mentioned in the r-f alignment section.
Connect the oscilloscope to R6 through 10,000 ohms.
Shunt the first picture i-f grid to ground with a 1,000 mmf. capacitor, keeping the leads as short as possible.
Couple the signal generator loosely to the receiver antenna terminals.
Switch the channel switch and signal generator through the low frequency channels and observe the response on each range.
Select a channel which is essentially flat over the operating range with the sound and picture carrier markers at 90% or higher on the response curve.
Remove the capacitor from the first picture i-f grid and shunt it from the second picture i-f grid to ground.
Check to assure that proper converter operation is obtained.

RETOUCHING OF PICTURE I-F ADJUSTMENTS

The picture i-f response curve varies somewhat with change of bias and for this reason it should be aligned with approximately the same signal input as it will receive in operation.
If the receiver is located at the edge of the service area, it should be aligned with the picture control at the maximum gain position. However, for normal conditions, (signals of 800 microvolts or greater), it is recommended that the picture i-f be aligned with a grid bias of —3 volts.
Connect the sweep generator to the receiver antenna terminals.
Connect the signal generator to the antenna terminals and feed in the 25.75 mc. i-f picture carrier marker and a 22.3 mc. marker.
Connect the oscilloscope across the picture detector load resistor.
Remove the shunting capacitor from the second picture i-f grid.
Set the i-f grid bias to —3 volts.
Set the sweep output to produce approximately 3 volt peak-to-peak across the picture detector load resistor.
Observe and analyze the response curve obtained. The response will not be ideal and the i-f adjustments must be retouched in order to obtain the desired curve. See Figure 12.
If for example the response is peaked in the middle, and the picture carrier is low on the response curve slope, then the high Q transformer T103, (which is peaked at 25.3 mc.—near the picture carrier, 25.75 mc.), should be retouched to bring the picture carrier response up to approximately 40%.
It will then probably be found that the response is generally high on the low frequency end of the curve. If this is the case, adjust L183, (25.2 mc. and fairly broad), to bring the high frequency end response up. The picture carrier is thus brought still further up the slope and an approximately flat topped response curve is obtained.
If T104 (bottom) required any adjustment, it will be necessary to reset T104 (top) for minimum response at 19.75 mc.
On final adjustment the picture carrier marker must be at approximately 60% response. The curve must be approximately flat topped and with the 22.3 mc. marker at approximately 100% response.
The most important consideration in making the i-f adjustment is to get the picture carrier at the 60% response point. If the picture carrier operates too low on the response curve, loss of low frequency video response, of picture brilliance, of blanking, and of sync may occur. If the picture carrier operates too high on the response curve, the picture definition is impaired by loss of high frequency video response.
The above example is used to show the line of reasoning involved in making the retouching adjustments. Since there are five transformers each aligned to a different frequency, it is obvious that many different conditions can exist, however, similar reasoning will apply to each case. With some experience in making these adjustments, it will be found that the desired response can be readily obtained. In making these adjustments, care should be taken that no two transformers are tuned to the same frequency as i-f oscillation may result.

ANTENNA TRAP ALIGNMENT

When the receiver is aligned in the shop, the antenna trap should be adjusted to reject the type of interference which might be encountered at the customer's home. It can be adjusted by actual observation of the interference on the air or by the use of a signal generator. Two methods of adjustment are possible if a signal generator is employed. Select the type of interference and method to suit the test equipment involved.
Method 1 for channel 6-10 interference. Set the "Volt-Ohmyst" on the 3 volt scale and connect it to the junction of L188 and R137. Turn the picture control to the maximum clockwise position. Connect the signal generator to the antenna terminals through balancing network as shown in Figure 5. Tune the receiver oscillator to 109 mc. with the fine tuning control as determined by the method employed in the previous section on r-f oscillator line adjustment. Feed in the channel 10 picture carrier (193.25 mc.) from the signal generator. Adjust L81 and L82 for minimum reading on the "Volt-Ohmyst", keeping both cores about the same. For final touches, adjust L81 one-half turn clockwise and readjust L82 for minimum on the meter. If this minimum is lower than the previous, repeat until the lowest minimum is obtained. If the minimum was higher, adjust L81 one-half turn counterclockwise and readjust L82. Repeat for the lowest minimum.
Method 2 for channel 6-10 interference. With the same set-up as above, switch the receiver to channel 3 and tune the receiver oscillator to 87 mc. Feed in a signal of 109 mc. from the signal generator and adjust the trap as above.
Method 1 for channel 5-7 interference. With the same set-up as above, switch the receiver to channel 5 and tune the receiver oscillator to 103 mc. Feed in the picture 7 sound carrier (179.75 mc.) from the signal generator and adjust the trap as above.
Method 2 for channel 5-7 interference. With the same set-up as above, switch the receiver to channel 2 and tune the receiver oscillator to 81 mc. Feed in a 103 mc. signal from the generator and adjust the trap as above.
Method for FM image interference. With the same set-up as above, switch the receiver to channel 2 and tune the receiver oscillator to 81 mc. Feed in a signal of the frequency of the interfering FM station and adjust the trap as before.
To adjust the trap by observation of the picture under actual operating conditions, connect an antenna to the receiver and tune in the station on which the interference is observed. Adjust the trap as above for minimum interference in the picture. Since the customer's antenna will affect these adjustments slightly, in cases of severe interference, it may be necessary to retouch the trap adjustment when the receiver is installed in the customer's home.

SENSITIVITY CHECK

A comparative sensitivity check can be made operating the receiver on a weak signal from a television station and comparing the picture and sound obtained to that obtained on other receivers under the same conditions.
This weak signal can be obtained by connecting the shop antenna to the receiver through an attenuator pad of the type shown in Figure 6. The number of stages in the pad depends upon the signal strength available at the antenna. A sufficient number of stages should be inserted so that a somewhat less than normal contrast picture is obtained, when the picture control is at the maximum clockwise position.

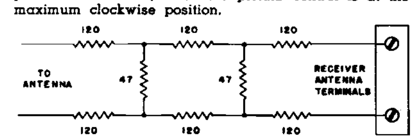


FIGURE 6—ATTENUATOR PAD

Only carbon type resistors should be used to construct the attenuator pad. Since many of the low value molded resistors generally available are of wire wound construction, it is advisable to break and examine one of each type of resistor used in order to determine its construction.

ALIGNMENT TABLE

Both methods of oscillator alignment are presented in the alignment table. The service technician may thereby choose the method to suit his test equipment. If it is found that the dual listing is confusing, the unwanted listing can be easily erased.

ALIGNMENT TABLE

THE DETAILED ALIGNMENT PROCEDURE SHOULD BE READ BEFORE ALIGNMENT BY USE OF THE TABLE IS ATTEMPTED.

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT SWEEP GENERATOR TO	SWEEP GEN. FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
	DISCRIMINATOR AND SOUND I-F ALIGNMENT								
1	3rd sound i-f grid (pin 1, V106)	21.25 .1 volt output	Not used		Not used	In series with 1 meg. to junction of R219 & R220		Detune T113 (bottom). Adjust T113 (top) for max. on meter	Fig. 8 Fig. 7 Fig. 6
2	"	"	"		"	Junct of R236 & C205	Meter on 3 volt scale	T113 (bottom) for zero on meter	Fig. 8 Fig. 7
3	" "	"	3rd sound i-f grid (pin 1, V106)	21.25 center 1 mc. wide .1 v. out	Junction of R236 & C205	Not used	Check for symmetrical response waveform (positive & negative). If not equal adjust T113 (top) until they are equal		Fig. 8 Fig. 10 A
4	2nd sound i-f grid (pin 1, V105)	21.25 reduced output	2nd sound i-f grid	21.25 reduced output	Terminal A, T112 in series with 33,000 ohms	"	Sweep output reduced to provide .3 volt p-to-p on scope	T112 (top & bottom) for max. gain and symmetry at 21.25 mc.	Fig. 8 Fig. 6 Fig. 7 Fig. 10 B
5	Trap winding on T2 (top of chassis)	21.25 reduced output	Trap winding on T2	21.25 reduced output	"	"	"	T111 (top & bottom) for max. gain and symmetry at 21.25 mc.	Fig. 6 Fig. 7 Fig. 8 Fig. 10 B
	PICTURE I-F AND TRAP ADJUSTMENT								
6	Not used		Not used		Not used	Junction of R189 & R190		Picture control for −3 volts on meter	Fig. 8
7	Junction C14 and R6	21.25	"		"	Junction of L188 & R137	Meter on 3 volt scale. Receiver on channel 13	T105 (top) for min.	Fig. 6
8	"	21.25	"		"	"	"	T2 (top) for min.	Fig. 8 Fig. 6
9	"	27.25	"		"	"	"	T103 (top) for min.	"
10	"	19.75	"		"	"	"	T104 (top) for min. on meter	Fig. 6
11	"	21.8	"		"	"	"	T2 (bottom) for max.	Fig. 7
12	"	25.3	"		"	"	"	T103 (bottom) for max.	"
13	"	22.3	"		"	"	"	T104 (bottom) for max.	"
14	"	25.2	"		"	"	"	L183 (top chassis) for max.	Fig. 6
15	"	23.4	"		"	"	"	L185 (top chassis) for max.	"
16	If T104 (bottom) required adjustment in step 13, repeat step 10.								
	R-F AND CONVERTER LINE ALIGNMENT								
17	Not used		Not used		Not used	Pin 5 or 6 V108		Picture control for −1.5 volts on meter	Fig. 8 Fig. 7
18	Antenna terminal (loosely)	175.25 & 179.75	Antenna terminals (see text for precaution)	Sweeping channel 7	Junction C14 and R6 through 10,000 ohm series resistor	Not used	1st i-f grid bypass to gnd. with 1000 mmf. Receiver on channel 7	L25, L26, L51 & L52 for approx. flat top response between markers. Markers above 70%	Fig. 8 Fig. 7 Fig. 11
19	"	181.25 185.75	"	channel 8	"	"	Receiver on channel 8	Check to see that response is as above	Fig. 11
20	"	187.25 191.75	"	channel 9	"	"	Receiver on channel 9	"	Fig. 11.
21	"	193.25 197.75	"	channel 10	"	"	Receiver on channel 10	"	Fig. 11
22	"	199.25 203.75	"	channel 11	"	"	Receiver on channel 11	"	Fig. 11
23	"	205.25 209.75	"	channel 12	"	"	Receiver on channel 12	"	Fig. 11
24	"	211.25 215.75	"	channel 13	"	"	Receiver on channel 13	"	Fig. 11
25	If the response on any channel (steps 19 through 24) is below 70% at either marker, switch to that channel and adjust L25, L26, L51, & L52 to pull response up on that channel. Then recheck steps 18 through 24.								

ALIGNMENT TABLE

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT SWEEP GENERATOR TO	SWEEP GEN. FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
	R-F AND CONVERTER LINE ALIGNMENT (Cont'd)								
26	Antenna terminals (loosely)	83.25 87.75	Antenna terminals (see text for precaution)	Sweeping channel 6	Junction C14 and R6 through 10,000 ohm series resistor	Not used	Receiver on channel 6	L11, L12, L37 & L38 for response as above	Fig. 11
27	"	77.25 81.75	"	channel 5	"	"	Receiver on channel 5	Check to see that response is as above	Fig. 11
28	"	67.25 71.75	"	channel 4	"	"	Receiver on channel 4	"	Fig. 11
29	"	61.25 65.75	"	channel 3	"	"	Receiver on channel 3	"	Fig. 11
30	"	55.25 59.75	"	channel 2	"	"	Receiver on channel 2	"	
31	If the response on any channel (steps 27 through 30) is below 70% at either marker, switch to that channel and adjust L11, L12, L37 & L38 to pull response up on that channel. Then recheck steps 26 through 31.								

R-F OSCILLATOR ALIGNMENT

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT HETERODYNE FREQ. METER TO	HET. METER FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
33	Antenna terminals	215.75	Loosely coupled to r-f osc.	237	Not used	Junction of R236 & C205 for sig. gen. method only	Fine tuning centered for all adjustments Receiver on channel 13	L77 & L78 for zero on meter or beat on het. feq. meter	Fig. 8 Fig. 7
34	"	209.75	"	231	"	"	Rec. on chan. 12	L76 as above	Fig. 9
35	"	203.75	"	225	"	"	Rec. on chan. 11	L74 as above	"
36	"	197.75	"	219	"	"	Rec. on chan. 10	L72 as above	"
37	"	191.75	"	213	"	"	Rec. on chan. 9	L70 as above	"
38	"	185.75	"	207	"	"	Rec. on chan. 8	L68 as above	"
39	"	179.75	"	201	"	"	Rec. on chan. 7	L66 as above	"
40	"	87.75	"	109	"	"	Rec. on chan. 6	L33 & L64 as above	Fig. 7
41	"	81.75	"	103	"	"	Rec. on chan. 5	L62 as above	Fig. 9
42	"	71.75	"	93	"	"	Rec. on chan. 4	L60 as above	"
43	"	65.75	"	87	"	"	Rec. on chan. 3	L58 as above	"
44	"	59.75	"	81	"	"	Rec. on chan. 2	L56 as above	"
45	Repeat steps 33 through 44 as a check.								
	RETOUCHING PICTURE I-F TRANSFORMERS								
47			Not used		Not used	Junction of R189 & R190	Receiver & sweep on a channel between 2 and 6 known to have good r-f response	Picture control for −3 volts on meter	Fig.
48	Antenna terminals (loosely)	22.3 25.75	"		Junction L188 and R137	Not used	Retouch pix i-f adjustments (T2, T103, T104 bottoms L183 & L185) as necessary to provide proper response		Fig. 8 Fig. 7 Fig. 12
49	If T104 (bottom) was adjusted in step 48, repeat step 10 and step 48.								
	ANTENNA TRAP ADJUSTMENT								
	Select 1 of the 6 steps below for suitable method for type of interference encountered.								
50-1	Antenna terminals through termination	193.25	Loosely coupled to r-f osc.	109	Not used	Junction of L188 & R137	Rec. on chan. 6	L81 & L82 for min. on meter	Fig. 8 Fig. 6
50-2	"	109	"	87	"	"	Rec. on chan. 3	"	"
50-3	"	179.75	"	103	"	"	Rec. on chan. 5	"	"
50-4	"	103	"	81	"	"	Rec. on chan. 2	"	"
50-5	"	FM Sta. Freq.	"	81	"	"	"	"	"
50-6	Not used		Not used		Not used	Not used	Rec. on interfered channel	L81 & L82 for min. interference	"
	SENSITIVITY CHECK								
51	Connect antenna to receiver through attenuator pad to provide weak signal. Compare picture and sound obtained to that obtained on other receivers under the same conditions.								

ALIGNMENT DATA

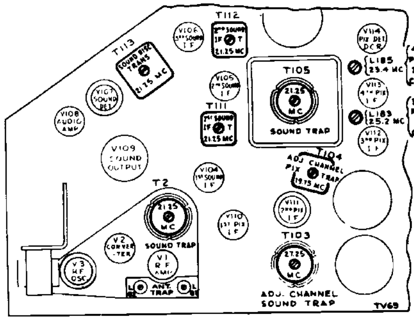


Figure 6 —Top Chassis Adjustments

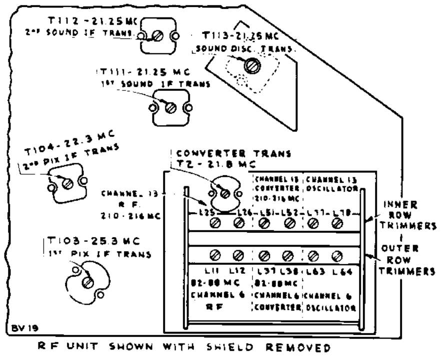


Figure 7 —Bottom Chassis Adjustments

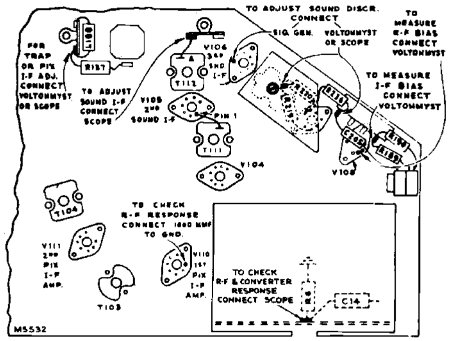


Figure 8 —Test Connection Points

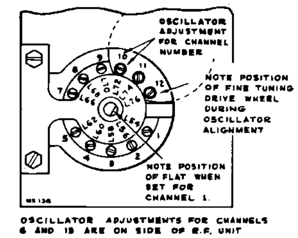


Figure 9 —R-F Oscillator Adjustments

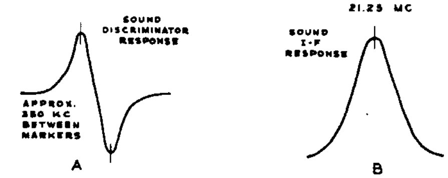


Figure 10 —Sound Discriminator and I-F Response

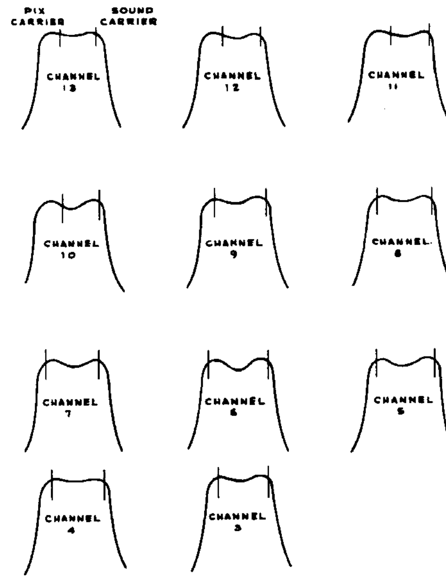


Figure 11 —R-F Response

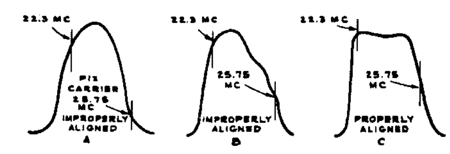
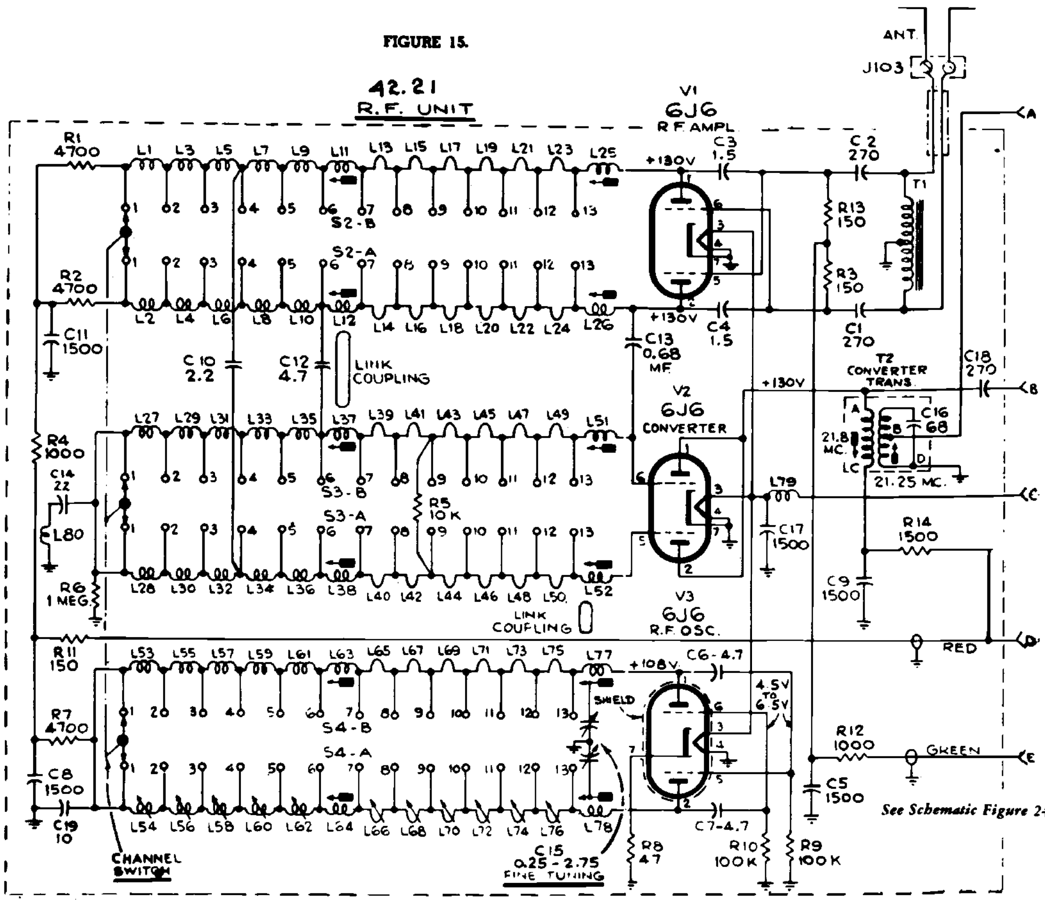


Figure 12 —Overall Response

FIGURE 15.



See Schematic Figure 24 for Connections.

MODEL 880

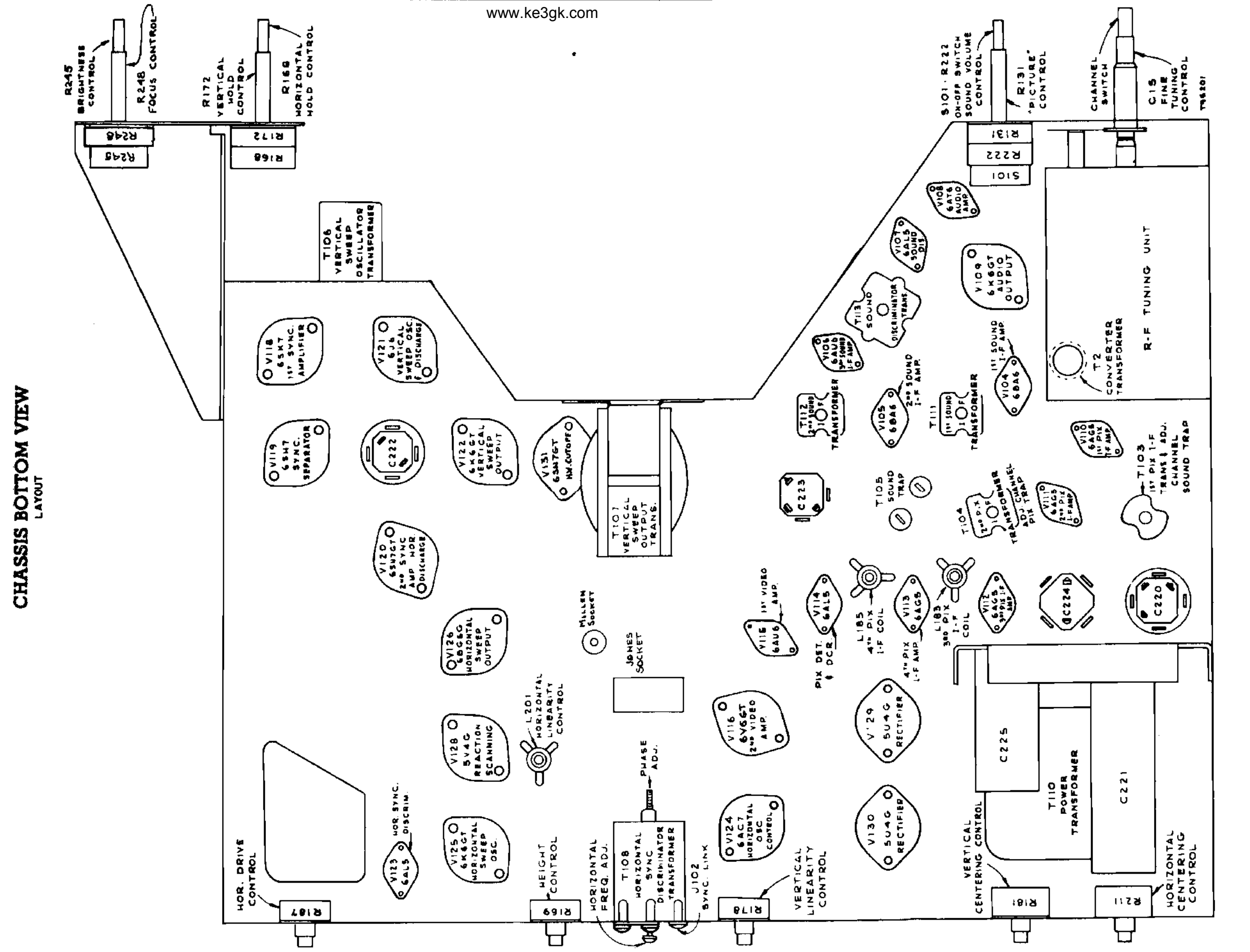


Figure 14.—Chassis Bottom View

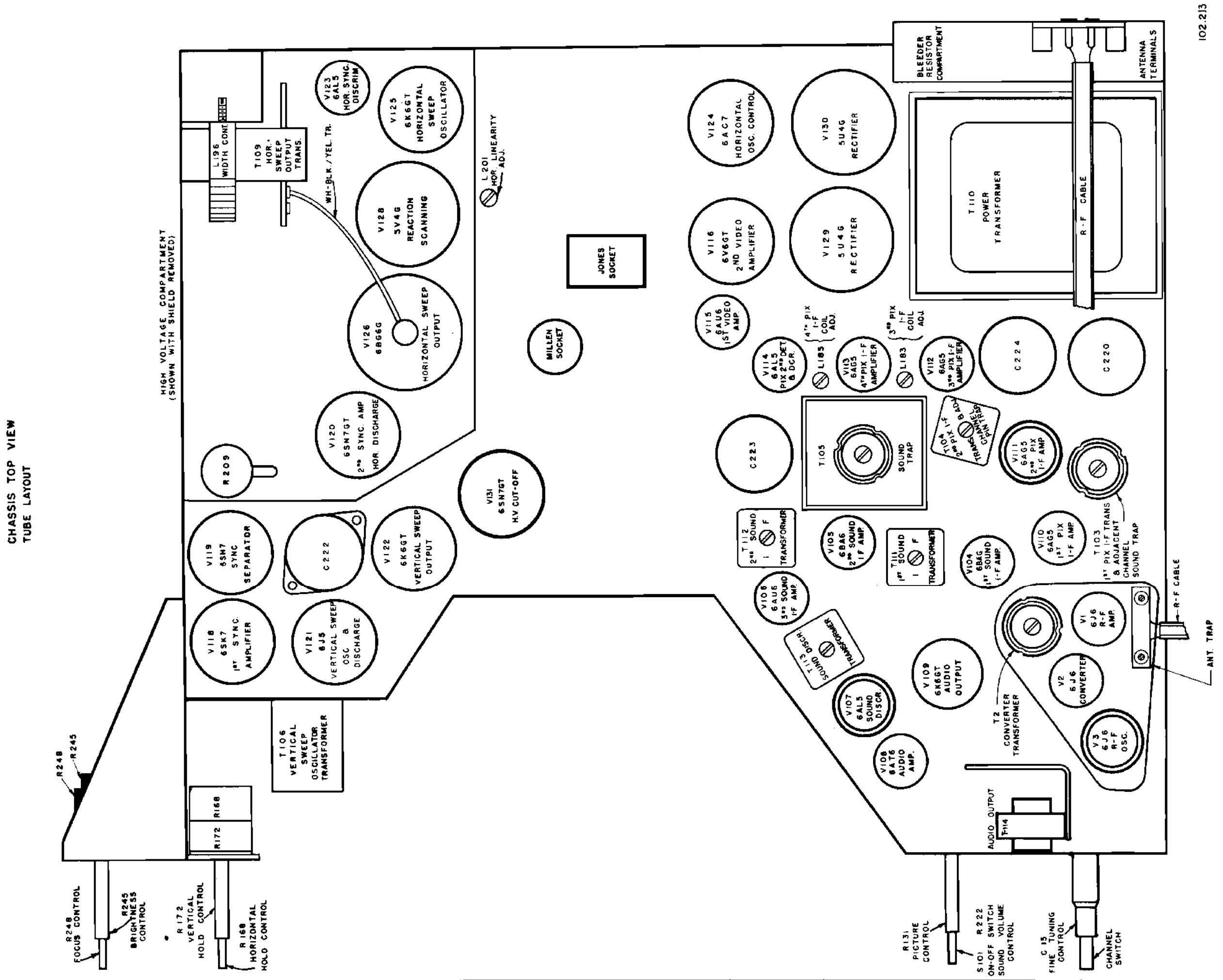
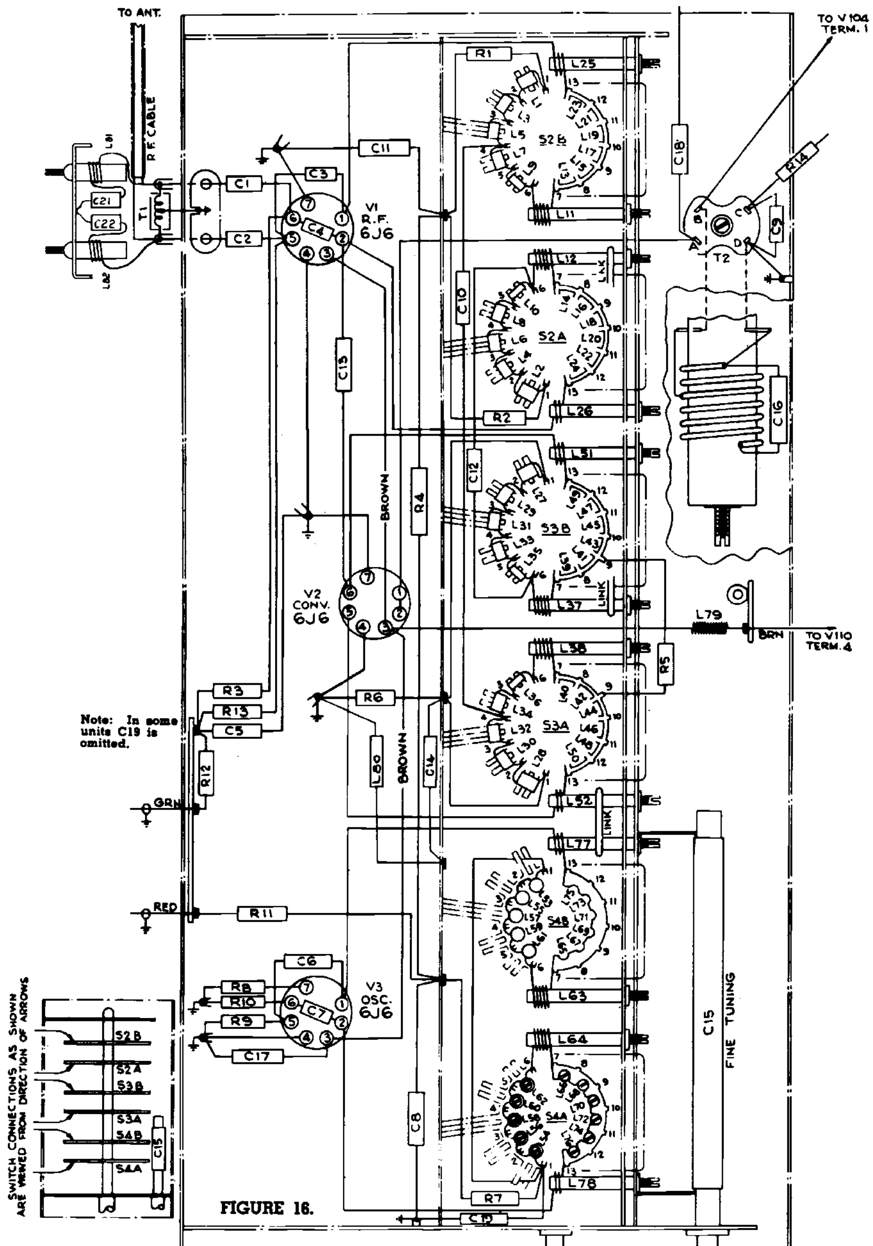


FIGURE 13.

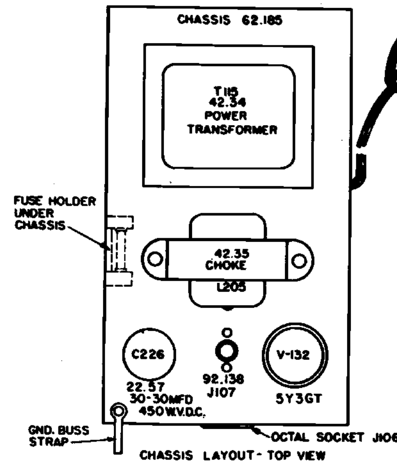
102,213

R-F UNIT WIRING DIAGRAM



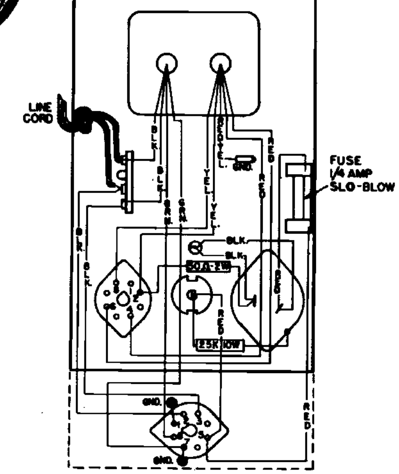
Note: In some units C19 is omitted.

FIGURE 16.



CHASSIS LAYOUT- TOP VIEW
AUXILIARY POWER SUPPLY
MODEL 880
FIGURE 17.

CHASSIS LAYOUT-BOTTOM VIEW
FIGURE 18.



MODEL 880
PROJECTION TV RECEIVER
HIGH VOLTAGE DRIVER UNIT

TOP

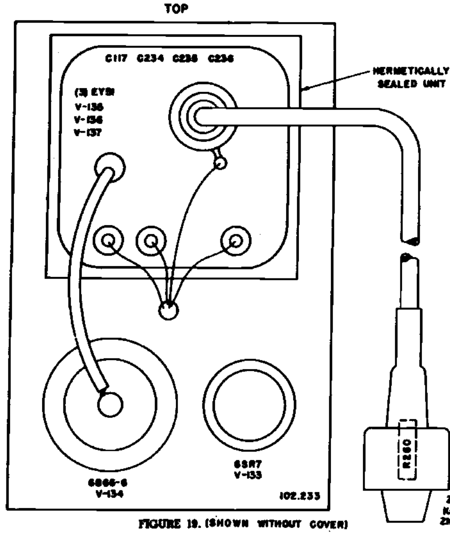


FIGURE 19. (SHOWN WITHOUT COVER)

BOTTOM

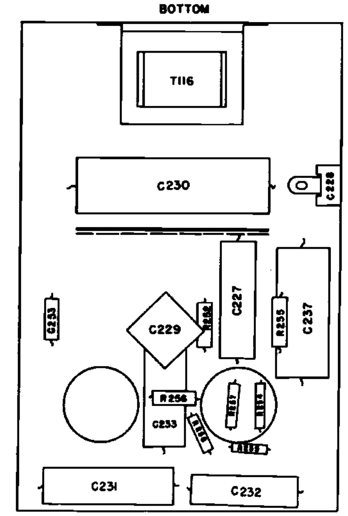


FIGURE 20.

VOLTAGE CHART

Measurements made with receiver operating on 117 volts 60 cycles a-c and with no signal input except where otherwise indicated. Voltages shown are as read with Jr. VoltOhmyst between indicated terminal and chassis ground except where otherwise noted. Symbol < means "less than."

Tube No.	Tube Type	Function	Operating Condition **	E. Plate Pin No.	E. Plate Volts	E. Screen Pin No.	E. Screen Volts	E. Cathode Pin No.	E. Cathode Volts	E. Grid Pin No.	E. Grid Volts	I Plate (ma.)	I Screen (ma.)	Notes on Measurements
V1	6J6	R-F Amplifier	Pictr. Min.	1 & 2	130	—	—	7	0	5 & 6	-9.2	<.1*	—	*Per Plate
			Pictr. Max.	1 & 2	55	—	—	7	0	5 & 6	+.05	7.0*	—	*Per Plate
V2	6J6	Converter	Pictr. Min.	1 & 2	125	—	—	7	0	5 & 6	-3 to -6.	.5 to 4*	—	*Per Plate
			Pictr. Max.	1 & 2	100	—	—	7	0	5 & 6	-2 to -5.	.2 to 3*	—	*Per Plate
V3	6J6	R-F Oscillator	Pictr. Min.	1 & 2	108	—	—	7	.25	5 & 6	-4.5 to -6.5	2.5	—	
			Pictr. Max.	1 & 2	90	—	—	7	.15	5 & 6	-3.5 to -5.	1.7	—	
V104	6BA6	1st Sound I-F Amplifier	Pictr. Min.	5	120	6	120	7	1.9	1	0	12.0	5.0	
			Pictr. Max.	5	110	6	110	7	1.6	1	0	10.5	4.5	
V105	6BA6	2d Sound I-F Amplifier	Pictr. Min.	5	122	6	118	7	1.9	1	0	12.5	4.9	
			Pictr. Max.	5	113	6	108	7	1.6	1	0	10.5	4.2	
V106	6AU6	3d Sound I-F Amplifier	Pictr. Min.	5	48	6	48	7	0	1	-.5	3.3	1.4	
			Pictr. Max.	5	41	6	41	7	0	1	-.5	2.8	1.2	
V107	6AL5	Sound Discrim.	Pictr. Min.	2 & 7	-.35	—	—	4 & 5	—	—	—	—	—	
			Pictr. Max.	2 & 7	-.45	—	—	4 & 5	—	—	—	—	—	
V108	6AT6	1st Audio Amplifier	Pictr. Min.	7	80	—	—	2	0	1	-.75	.5	—	
V109	6K6-GT	Audio Output	Pictr. Min.	3	233	4	245	8	0	5	-18	27.5	4.0	
V110	6AG5	1st Pix. I-F Amplifier	Pictr. Min.	5	135	6	135	2 & 7	0	1	-5.0	<.1	<.1	
			Pictr. Max.	5	109	6	109	2 & 7	.26	1	-1.0	5.5	.9	
V111	6AG5	2d Pix. I-F Amplifier	Pictr. Min.	5	135	6	135	2 & 7	0	1	-5.0	<.1	<.1	
			Pictr. Max.	5	113	6	113	2 & 7	.26	1	-1.0	5.6	.9	
V112	6AG5	3d Pix. I-F Amplifier	Pictr. Min.	5	135	6	135	2 & 7	0	1	-5.0	<.1	<.1	
			Pictr. Max.	5	98	6	117	2 & 7	.26	1	-1.0	5.7	.9	
V113	6AG5	4th Pix. I-F Amplifier	Pictr. Min.	5	99	6	127	2 & 7	1.2	1	0	6.8	1.7	
			Pictr. Max.	5	89	6	117	2 & 7	1.1	1	0	6.8	1.7	
V114-A	6AL5	Picture 2d Det.	Pictr. Min.	7	-.1	—	—	1	0	—	—	—	—	
V114-B	6AL5	DC Restorer	Brightness Min.	2	-100	—	—	5	-90	—	—	—	—	
			Brightness Max.	2	-1	—	—	5	-.9	—	—	—	—	
V115	6AU6	1st Video Amplifier	Pictr. Min.	5	240	6	135	7	0	1	-2.15	4.0	1.55	
			Pictr. Max.	5	255	6	125	7	0	1	-2.2	2.8	1.05	
V116	6V6-GT	2d Video Amplifier	Pictr. Min.	3	180	4	270	8	9.8	5	-7.5	40	5	
			Pictr. Max.	3	175	4	260	8	9.2	5	-7.1	38	3	

** Where separate readings are not listed for max. and min. gain settings of the picture control, the effect of the control is slight and readings are given for "Picture Min."

VOLTAGE CHART

Tube No.	Tube Type	Function	Operating Condition **	E. Plate Pin No.	E. Plate Volts	E. Screen Pin No.	E. Screen Volts	E. Cathode Pin No.	E. Cathode Volts	E. Grid Pin No.	E. Grid Volts	I Plate (ma.)	I Screen (ma.)	Notes on Measurements
V118	6SK7	1st Sync. Amplifier	Pictr. Min.	8	163	6	129	5	0	4	-4.3	11.5	3.8	
			Pictr. Max.	8	185	6	115	5	0	4	-4.4	9.2	2.9	
V119	6SH7	Sync. Separator	Pictr. Min.	8	134	6	135	5	0	4	-5.2	.1	.05	
			Pictr. Max.	8	123	6	125	5	0	4	-9*	.3	.1	*Depends on noise
V120-A	6SN7 GT	2d Sync. Amplifier	Pictr. Min.	2	88	—	—	3	0	1	-5	9.0	—	
			Pictr. Max.	2	80	—	—	3	0	1	-9*	7.9	—	*Depends on noise
V120-B	6SN7 GT	Horizontal Discharge	Pictr. Min.	5	-37	—	—	6	-100	4	-140	.5	—	
V121	6J5	Vertical Oscillator	Pictr. Min.	3	'70*	—	—	8	-100	5	-150	.15	—	*Height, linearity and hold affect readings 2 to 1
V122	6K6-GT	Vertical Output	Pictr. Min.	3	180	4	180*	8	-70	5	-100	9.0	*	*Screen connected to plate
V123	6AL5	Horizontal Sync. Discr.	Pictr. Min.	2 & 7	-6.5	—	—	1 & 5	-2.1	—	—	—	—	
V124	6AC7	Horizontal Osc. Control	Pictr. Min.	8	194	6	105	5	.05	4	-2.0	3.8	1.1	
V125	6K6-GT	Horizontal Oscillator	Hold Max. Resistance	3	190	4	208	8	0	5	-30	17.0	6.7	
			Hold Min. Resistance	3	180	4	194	8	0	5	-23.5	19.5	8.2	
V126	6BG6-G	Horizontal Output	Pictr. Min.	Cap	Do not Meas.*	8	134	3	-91	5	-113	77.0	11.5	* 6000 volt pulse present
			Brightness Max.	Cap	*	—	—	2 & 7	6700	—	—	.7	—	*9200 volt pulse present
V128	5V4G	Reaction Scanning	Pictr. Min.	4 & 6	Do not Meas.*	—	—	8	350	—	—	90	—	* 1200 volt pulse present
V129	5U4G	Rectifier	Pictr. Min.	4 & 6	390*	—	—	2 & 8	300	—	—	146	—	*A-C measured from plate to trans center tap
V130	5U4G	Rectifier	Pictr. Min.	4 & 6	390*	—	—	2 & 8	300	—	—	146	—	
V131	6SN7 GT	Hi-Voltage cut-off	Pictr. Min.	2	275	—	—	3	12	1	-25	.7*	—	*6 MA with B+ Short or sweep failure
			Pictr. Min.	5	275	—	—	6	12	4	-25	.7*	—	
V132	5Y3G	Rectifier	Brightness Min.	4	370*	—	—	2	380	—	—	24	—	*AC measured from plate to trans. center tap.
				6	370*	—	—	8	380	—	—	24	—	
V133	6SR7	Blocking Oscillator	Pictr. Min.	6	350	—	—	3	90	2	-50	1.5	—	4+5 Diodes -100
V134	6BG 6G	H.V. Driver	Pictr. Min.	Cap	Do not Meas.*	8	350	3	16	5	-85	23	40	* H.V. Pulse Present
V135	EY51	H.V. Rectifier				INSIDE OF SEALED CAN ASSEMBLY								
V136	EY51	H.V. Rectifier				INSIDE OF SEALED CAN ASSEMBLY								
V137	EY51	H.V. Rectifier				INSIDE OF SEALED CAN ASSEMBLY								
V138	3NP4	Kinescope	Brightness Min.	Cup	25.KV*	—	—	5	-12	1	-90	—	—	*Use High VOLTAGE METER, Described under Section IV.
			Brightness Max.	Cup	24.6KV	—	—	5	-15	1	-4	175, ua to 250, ua	—	
			Brightness Average	Cup	24.8KV	—	—	5	-14	1	-35	90, ua	—	

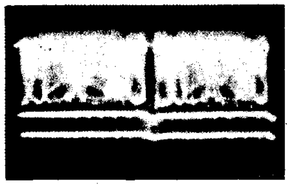
** Where separate readings are not listed for max. and min. gain settings of the picture control, the effect of the control is slight and readings are given for "Picture Min."

Following readings taken with video signal applied through video amplifiers to produce 55 volts peaks to peak on Kinescope grid.

Tube No.	Tube Type	Function	Operating Condition	E. Plate Pin No.	E. Plate Volts	E. Screen Pin No.	E. Screen Volts	E. Cathode Pin No.	E. Cathode Volts	E. Grid Pin No.	E. Grid Volts	I Plate (ma.)	I Screen (ma.)	Notes on Measurements
V114-B	6AL5	DC Restorer	Pictr. Min.	2	-41	—	—	5	-27	—	—	—	—	
V119	6SH7	Sync. Separator	Pictr. Min.	8	136	6	142	5	0	4	-21.5	.9	.8	
V120-A	6SN-7GT	2d Sync. Amplifier	Pictr. Min.	2	88	—	—	3	0	1	-5.4	9.0	—	
V123	6AL5	Horizontal Sync. Discr.	Pictr. Min.	2 & 7	-20	—	—	1 & 5	K, * K, -2.1	—	—	—	—	*See grid voltage of V124
V124	6AC7	Horizontal Osc. Control	Pull-in*	8	200(a)	6	100(b)	5	<.1	4	-1.5 to -3	<8.	<2.5	*Varying Hor. Osc. tuning
			Hold*	8	200(c)	6	100(d)	5	<.1	4	(e)	<8.	<2.5	

(a) Pull-in range varies with tubes from 110-210 to 195-270.
(b) Pull-in range varies with tubes from 80-100 to 100-115.
(c) Hold range varies with tubes from 110-270 to 140-270.
(d) Hold range varies with tubes from 80-115 to 90-115.
(e) Hold range varies with tubes from 1.5-7.0 to 1.-4.5.

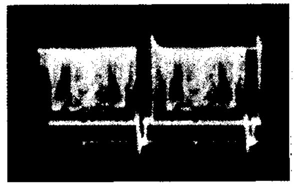
WAVEFORM PHOTOGRAPHS

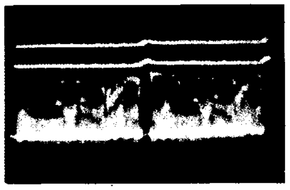


Video Signal Input to 1st Video Amplifier (Junction of L187, R136, L188 and C138)

Vertical (Oscilloscope Synced to ½ of Vertical Sweep Rate) (1.5 Volts PP) ←

Horizontal (Oscilloscope Synced to ½ of Horizontal Sweep Rate) (1.5 Volts PP) →

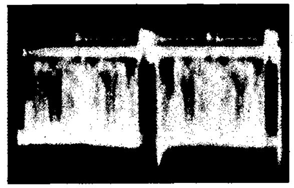




Output of 1st Video Amplifier (Junction of L189, R139, L190 and C140)

Vertical (10 Volts PP) ←

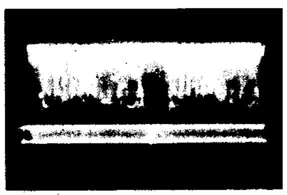
Horizontal (10 volts PP) →



Input to Kinescope Grid (Junction of C141, R148 and Green Lead to Kinescope)

Vertical (60 Volts PP) ←

Horizontal (60 Volts PP) →



Cathode of D-C Resistor (Pin 5 of V114-B) (6AL5)

-Vertical (58 Volts PP) ←

-Horizontal (58 Volts PP) →

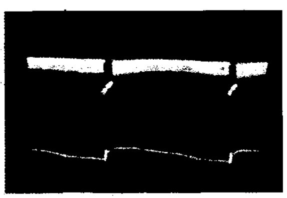
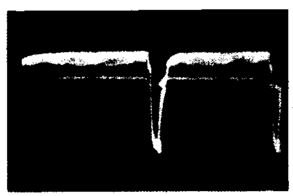


Plate of D-C Restorer (Pin 2 of V114-B) (6AL5)

-Vertical (14 Volts PP) ←

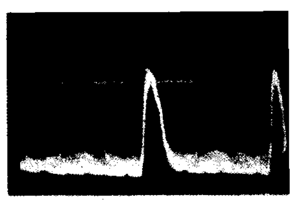
-Horizontal (14 Volts PP) →



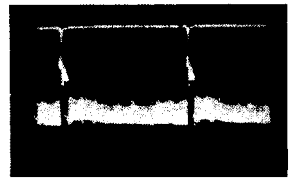
Output of 1st Sync. Amplifier (Pin 8 of V118) (6SK7)

-Vertical (70 Volts PP) ←

-Horizontal (52 Volts PP) →



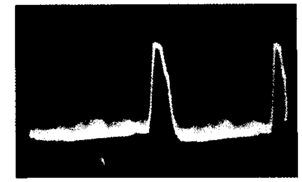
WAVEFORM PHOTOGRAPHS

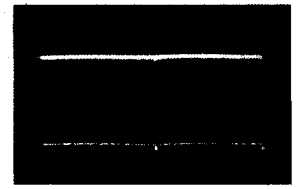


Input to Sync. Separator (Pin 4 of V119) (6SH7)

Vertical (35 Volts PP) ←

Horizontal (35 Volts PP) →

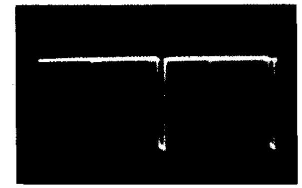


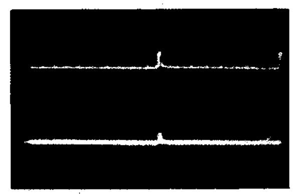


Output of Sync. Separator (Pin 8 of V119) (6SH7)

Vertical (75 Volts PP) ←

Horizontal (75 Volts PP) →

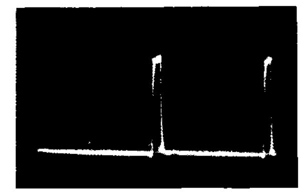


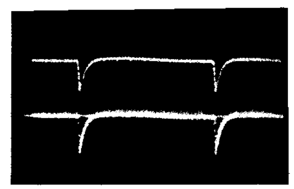


Output of 2nd Sync. Amplifier (Pin 2 of V120-A) (6SN7GT)

Vertical (35 Volts PP) ←

Horizontal (29 Volts PP) →

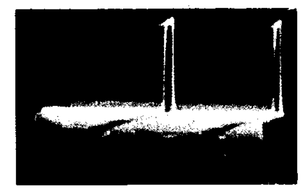


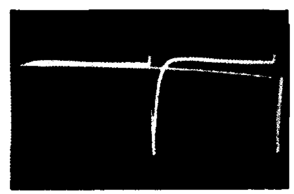


Input to Integrating Network (Junction of C149, R162 and R163)

Vertical (45 Volts PP) ←

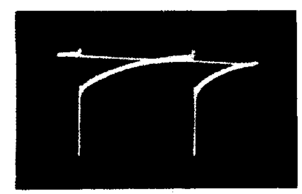
Horizontal (30 Volts PP) →





Output of Integrating Network (Junction of R165, C153 and Yellow Lead of T106). Vertical (32 Volts PP) ←

Grid of Vertical Osc. (350 Volts PP) (Pin 5 of V121) (6J5) →



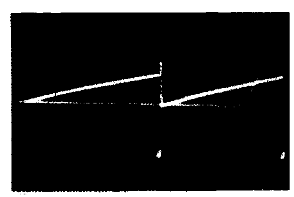
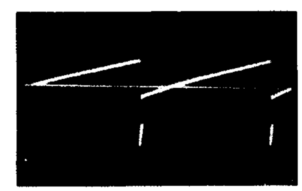
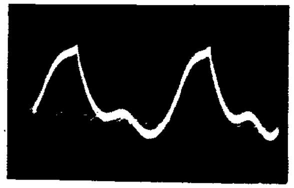


Plate of Vertical Osc. (140 Volts PP) (Pin 3 of V121) (6J5) ←

Input Coupling of Vertical Output (125 Volts PP) (Junction of C157, C158, R170 and Red Lead of T106) →

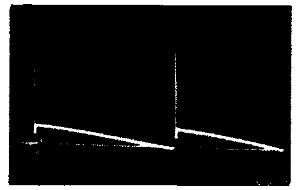


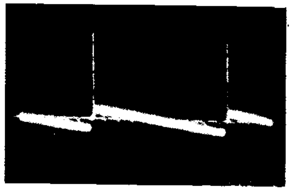
WAVEFORM PHOTOGRAPHS



Cathode of Vertical Output (.75 Volt PP) (Pin 8 of V122) (6K6GT)
←

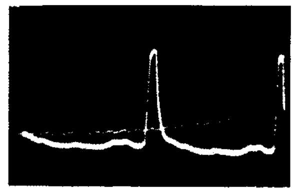
Plate of Vertical Output (700 Volts PP) (Pin 3 of V122) (6K6GT)
→

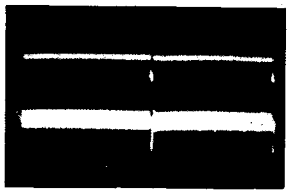




Input to Vertical Deflection Coils (60 Volts PP) (Junction of Green Lead of T107 and Green Lead of Yoke)
←

Vertical Boost of 1st Sync. Amplifier (16 Volts PP) (Junction of R154, R155 and C146)
→

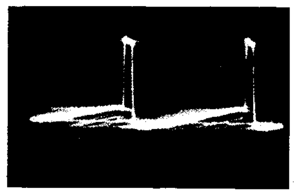


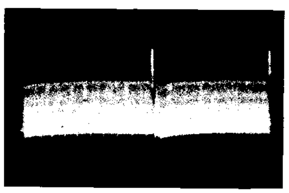


Terminal "E" of Sync Discriminator Transformer (T108)

Vertical (16 Volts PP)
←

Horizontal (13 Volts PP)
→

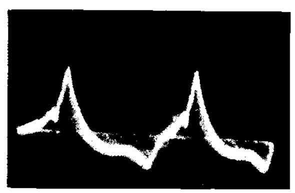


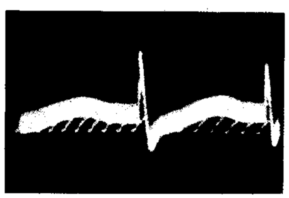


Junction of R191 and R192 (Cathode Resistors of Horizontal Sync. Discriminator)

Vertical (3 Volts PP)
←

Horizontal (1.7 Volts PP)
→

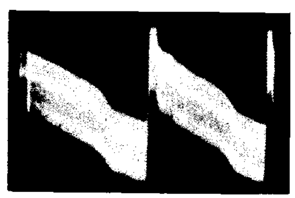




Cathode of Hor. Sync. Discriminator (Pin 1 of V123) (6AL5)

Vertical (.8 Volt PP)
←

Horizontal (.15 Volt PP)
→



Cathode of Hor. Sync. Discr. (Pin 5 of V123) (6AL5) Horizontal (.19 Volt PP)
←

Plate of Hor. Sync. Discr. (Pin 7 of V123) (6AL5) Horizontal (23 Volts PP)
→

WAVEFORM PHOTOGRAPHS

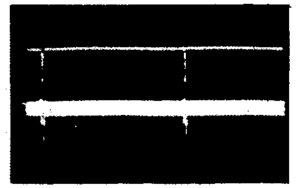
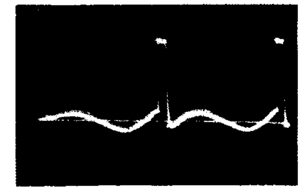
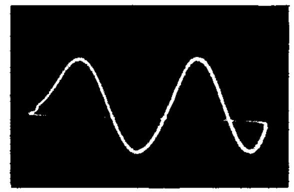


Plate of Hor. Sync. Discr. (Pin 2 of V123) (6AL5)

Vertical (21 Volts PP)
←

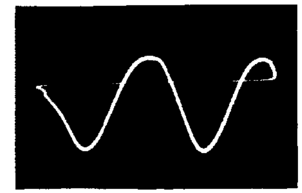
Horizontal (21 Volts PP)
→





Horizontal (95 Volts PP) Terminal "A" of Sync. Discriminator Transformer (T108)
←

Cathode of Horizontal Oscillator Control (1.5 Volts PP) (Pin 5 of V124) (6AC7)
→



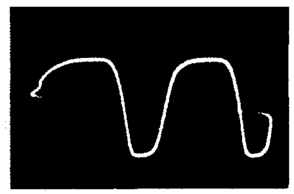
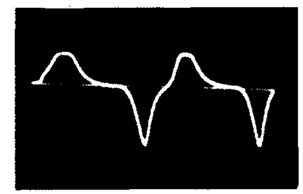


Plate of Horizontal Oscillator (225 Volts PP) (Pin 3 of V125) (6K6GT)
←

Input of Horiz. Discharge (100 Volts PP) (Junction of C176, C177 and R202)
→



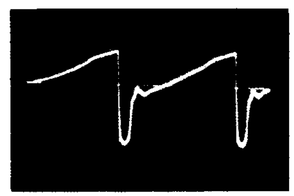
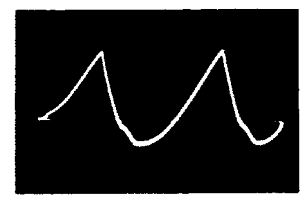
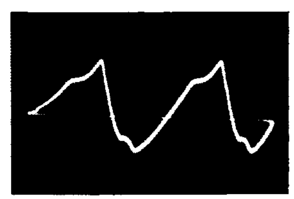


Plate of Hor. Discharge (78 Volts PP) (Pin 5 of V120-B) (6SN7GT)
←

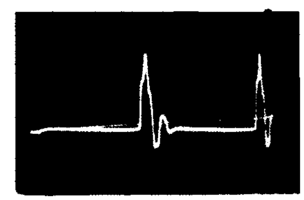
Cathode of Hor. Output (11.5 Volts PP) (Pin 3 of V126) (6BG6-G)
→

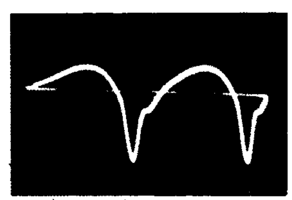




Screen of Hor. Output (9 Volts PP) (Pin 8 of V126) (6BG6-G)
←

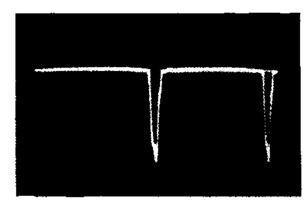
Plate of Horizontal Output (Approx. 6000 Volts PP) (Measured Through a Capacity Voltage Divider Connected from Top Cap of V126 to Ground)





Cathode of Reaction Scanning (60 Volts PP) (Pin 8 of V128) (5V4G)
→

Input to Horizontal Deflection Coils (1325 Volts PP) (Pin 4 of V128) (5V4G)
→



SERVICE SUGGESTIONS

Following is a list of symptoms of possible failures and an indication of some of the possible faults.

NO RASTER ON KINESCOPE OR SCREEN

(1) Fuse blown in aux. power supply.
(2) P-105, P-106, P-107 or kinescope socket disconnected.
(3) Sweep circuit failure (horizontal or vertical) actuating high-voltage cut-off tube V-131 (6SN7GT).
To expedite checking, the following procedure is offered which may be used at the discretion, and on the responsibility, of the serviceman. The procedure requires extreme caution since excessive beam current (or brightness) will permanently score the kinescope tube face and the kinescope tube is not replaceable for sweep burns.
With receiver turned on, turn the brightness control fully off (counter-clockwise). Then, remove the 6SN7GT (V-131) high voltage cut-off tube from the chassis. Carefully watch the screen and very slowly advance the brightness control until the screen is just illuminated, or, until brightness control is in full clockwise position. If there is no illumination with brightness fully on, there is no high voltage, the kinescope is defective, the driver unit is defective, or, the auxiliary power supply is defective.
If either a vertical or horizontal line appears on the screen, deflection trouble is indicated in the opposite plane, i.e., if a vertical line appears, the horizontal deflection, or sweep, is inoperative and vice versa.
(4) High voltage driver unit operative; no audible hum. Check V-133, V-134 and chassis voltages per schematic.
(5) Auxiliary power supply; 1/4 amp fuse, V-132 defective, filter capacitor, choke or R-251 shorted or open.
(6) Defective kinescope.
(7) R-152 open (terminal 3 of brightness control to gnd.)
(8) No receiver plate voltage; filter capacitor or filter choke shorted; negative bleeder or filter choke open.

NO HIGH VOLTAGE: Complete Failure*

(1) No H.V. output
(2) No picture sweeps working; 6SN7 cut-off tube V-131 removed.
(3) Excessive input current (70 to 90 MA). Check blocking oscillator for bias of approx. minus 50 volts on 6SR7 grid.
(4) Normal, no-load input current (approx. 30 MA).

LOW HIGH VOLTAGE: Partial Failure of Sealed Unit*

(1) Low H.V. output on the order of 10 to 17KV.
(2) Reduced picture brightness
(3) Excessive sweep width and height ("blooming").
(4) Very poor H.V. regulation requiring readjustment of the focus control for otherwise normal changes in brightness level of the picture, or complete inability to focus picture electrically.

*Replacement of whole sealed can unit required when any part therein is defective.

NO VERTICAL DEFLECTION:

(1) V121 or V122 inoperative. Check voltage and wave forms on grids and plates.
(2) T107 open.
(3) Vertical deflection coils open.

NO HORIZONTAL DEFLECTION:

(1) V125, V120B, V126 or V128 inoperative—check voltage and wave forms on grids and plate.
(2) T109 open.
(3) Horizontal deflection coil open.

SMALL RASTER:

(1) Low Plus B or low line voltage.
(2) Defective kickback coil.

POOR VERTICAL LINEARITY:

(1) If adjustments cannot correct, change V122.
(2) Vertical output transformer defective.
(3) V121 inoperative—check voltage and wave forms on grid and plate.
(4) R174, C158, C221-C or C222-B defective.
(5) Low bias or plate voltage—check rectifiers and capacitors in supply circuits.

POOR HORIZONTAL LINEARITY:

(1) If adjustments do not correct, change V128 or V126.
(2) T109 or L201 defective.
(3) C186 or C188 or R209 defective.
(4) C179, R187 or R210 defective.

WRINKLES ON LEFT SIDE OF RASTER:

(1) R180, R201 or C181 defective.
(2) Defective yoke.

PICTURE OUT OF PHASE HORIZONTALLY:

(1) T108 winding D to F incorrectly tuned or connected in reverse.
(2) R200 or R202 defective.

TRAPEZOIDAL OR NON-SYMMETRICAL RASTER:

(1) Improper adjustment of focus coil or ion trap magnet.
(2) Defective yoke.

RASTER & SIGNAL ON KINESCOPE BUT NO SOUND:

(1) R-F oscillator off frequency.
(2) Sound i-f, discriminator or audio amplifier inoperative—check V104, V105, V106, V107, V108, V109 and their socket voltages.
(3) T114 or C209 defective.
(4) Speaker defective.

SIGNAL AT KINESCOPE GRID BUT NO SYNC:

(1) Picture control advanced too far.
(2) V114-B, V118, V119, or V120-A inoperative. Check voltage and waveforms at their grids and plates.
(3) C142 defective.

SIGNAL ON KINESCOPE GRID BUT NO VERTICAL SYNC:

(1) Check V121 and associated circuit C154, T106, etc.
(2) Integrating network inoperative Check C149, C151, C152, C153, R162, R163, R164 and R165.

SIGNAL ON KINESCOPE GRID BUT NO HORIZONTAL SYNC:

(1) T108 misadjusted readjust as instructed
(2) V123 or V124 inoperative check socket voltages and waveforms.
(3) T108 defective.
(4) C166, C167, C170 or C171 defective.
(5) If horizontal speed is completely off and cannot be adjusted check C168, C169, R168 and R196.

SOUND & RASTER BUT NO PICTURE OR SYNC:

(1) Picture i-f, detector or video amplifier inoperative—check V110, V111, V112, V113, V114, V115 and V116—check socket voltages.
(2) Bad contact to kinescope grid.

PICTURE STABLE BUT POOR RESOLUTION:

(1) V114, V115 or V116 defective.
(2) Peaking coils defective—check for specified resistance.
(3) C138, C140, C141 or C142 defective.
(4) Make sure that the focus control operates on both sides of proper focus.
(5) R-F and I-F circuits misaligned.

SERVICE SUGGESTIONS

PICTURE SMEAR:

(1) Video amplifier overloaded by excessive input—reduce picture control setting.
(2) Insufficient bias on V115 and V116 resulting in grid current on video signal. Check bias and possible grid current.
(3) Defective coupling condenser or grid load resistor—check C138, C140, C141, C223B, R138, R142, R143, R148, etc.
(4) This trouble can originate at the transmitter—check on another station.

PICTURE JITTER:

(1) Picture control operated at excessive level.
(2) If regular sections at the left picture are displaced change V126.
(3) Vertical instability may be due to loose connections or noise.
(4) Horizontal instability may be due to unstable transmitted sync.

RASTER BUT NO SOUND, PICTURE OR SYNC:

(1) Defective antenna or transmission line.
(2) R-F oscillator off frequency.
(3) R-F unit inoperative—Check V1, V2, V3 and their socket voltages.

DARK VERTICAL LINE ON LEFT OF PICTURE:

(1) Reduce horizontal drive and readjust width and horizontal linearity.
(2) Replace V126.

LIGHT VERTICAL LINE ON LEFT OF PICTURE:

(1) C181 defective.
(2) V128 defective.
(3) Change tap on R209.

PICTURE I-F RESPONSE—At times it may be desirable to observe the individual i-f stage response. This can be achieved by the following method.

Select a channel with a flat r-f response as outlined in the R-F and Converter Line adjustment section of the alignment procedure.

Shunt all i-f transformers and coils with a 330 ohm carbon resistor except the one whose response is to be observed.

Connect the oscilloscope across the picture detector load resistor and observe the overall response. The response obtained will be essentially that of the unshunted stage. The effects of the various traps are also visible on the stage response.

Figures *A* through *E* show the response of the various stages obtained in the above manner. The curves shown are typical although some variation between receivers can be expected. Relative stage gain is not shown.

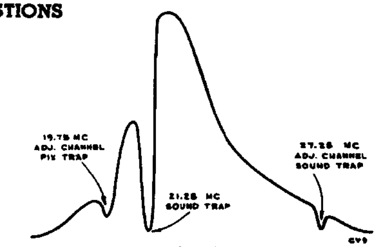


Figure A—T2 Response

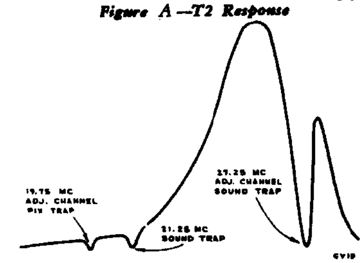


Figure B—T103 Response

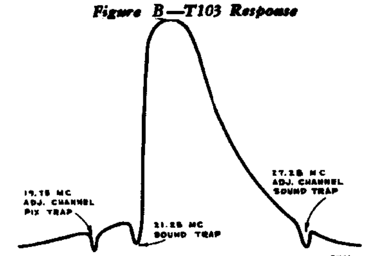


Figure C—T104 Response

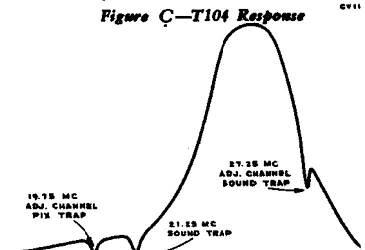


Figure D—L183 Response

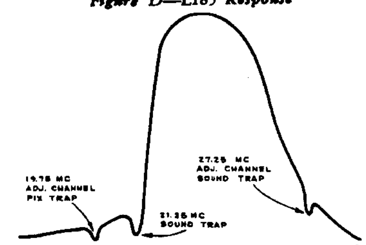
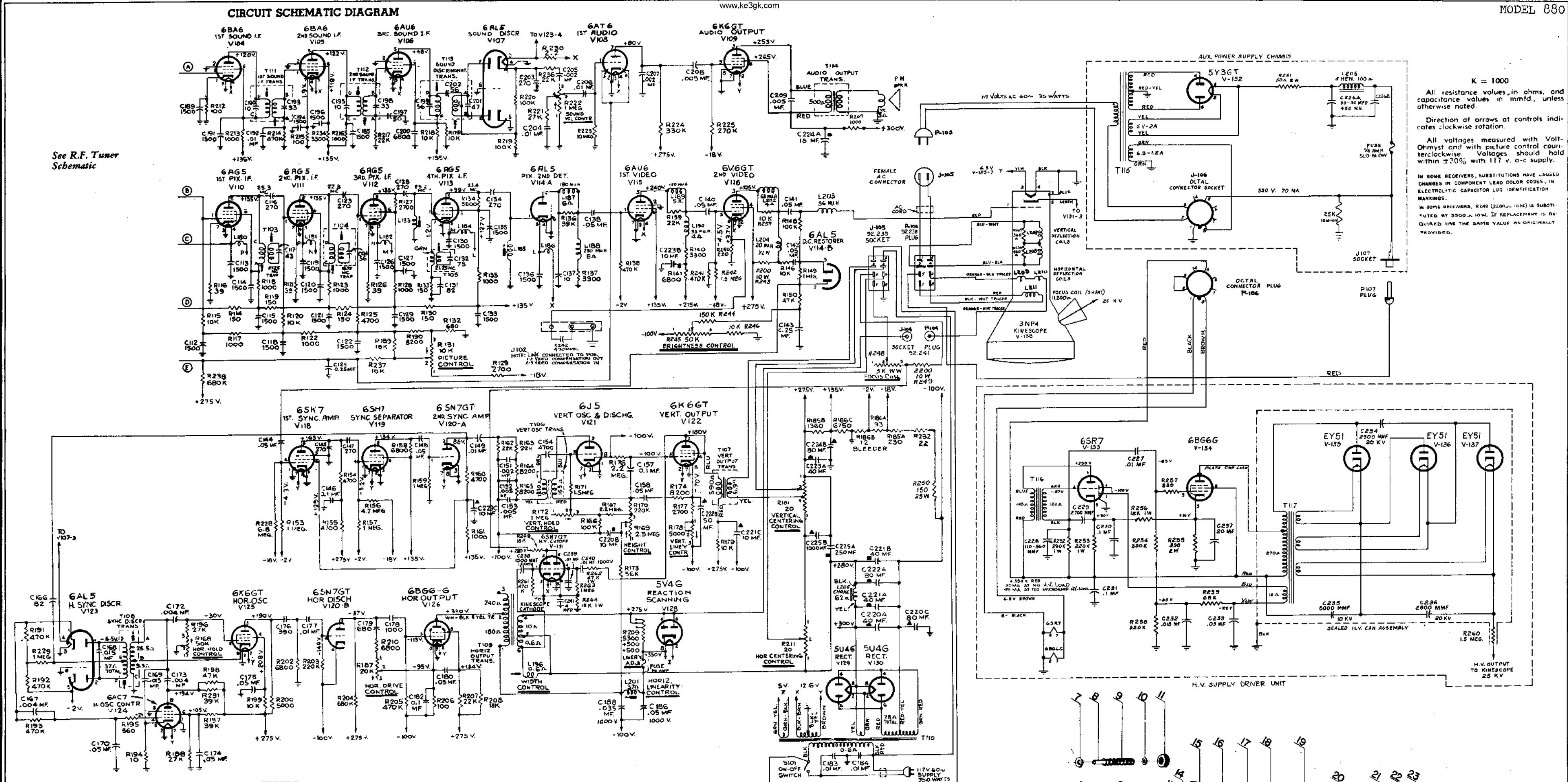


Figure E—L185 Response

CIRCUIT SCHEMATIC DIAGRAM



K = 1000

All resistance values, in ohms, and capacitance values in mmfd., unless otherwise noted.

Direction of arrows at controls indicates clockwise rotation.

All voltages measured with Volt-Ohmyst and with picture control counterclockwise. Voltages should hold within ±20% with 117 v. a-c supply.

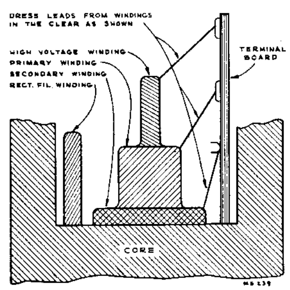
IN SOME RECEIVERS, SUBSTITUTIONS HAVE CAUSED CHANGES IN COMPONENT LEAD COLOR CODES, IN ELECTROLYTIC CAPACITOR LUG IDENTIFICATION MARKINGS.

IN SOME RECEIVERS, R240 (2200Ω, 10W) IS SUBSTITUTED BY 3300Ω, 10W. IF REPLACEMENT IS REQUIRED USE THE SAME VALUE AS ORIGINALLY PROVIDED.

CRITICAL LEAD DRESS:

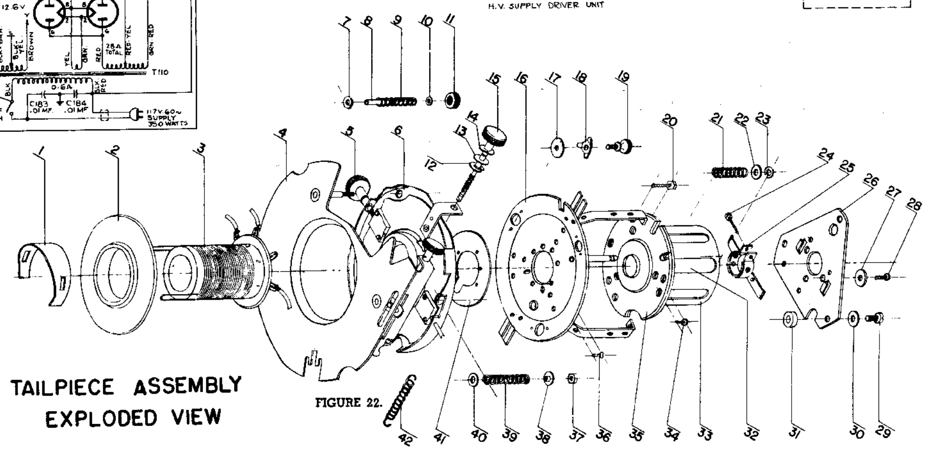
1. Dress spaghetti-covered leads from A and B on discriminator transformer T113 to pin 7 and 2 on V107 tube socket approximately 3/16" above chassis.
2. Dress video capacitors C-138, C-140 and C-141 up and away from chassis.
3. Dress video peaking coils L-187, L-188, L-189, L-190, L-191 and L-192 up and away from chassis.
4. Contact between the r-f oscillator frequency adjustment screws and the oscillator coils or channel switch eyelets must be avoided.
5. Dress leads from L196 (width control coil) away from the lead to the cap of V127 (h-v rectifier). Contact between these leads will cause arcing and fire.
6. Dress T109 winding leads as shown in Figure 21.

FIGURE 24.



T109 Lead Dress FIGURE 21.

NOTE: THE NUMBERS ON THIS EXPLODED VIEW SHOULD BE ORDERED AS DASH NUMBER OF PART # 92.231 EXAMPLE: 92.231-32



TAILPIECE ASSEMBLY EXPLODED VIEW

FIGURE 22.

CHASSIS WIRING DIAGRAM

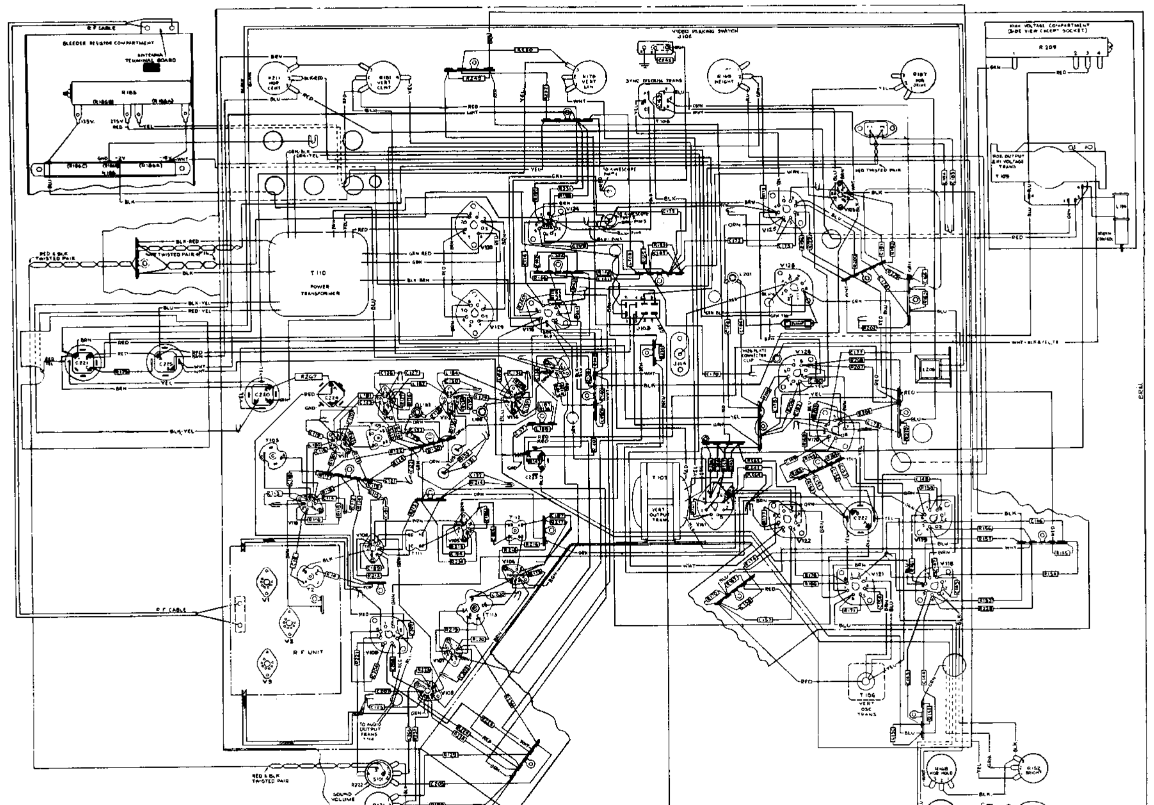


Figure 23.—Chassis Wiring Diagram

R.F. UNIT No. 42.21

STOCK No.	DESCRIPTION	SCHEMATIC
17.68	Capacitor — Ceramic, 0.68 mmf	C-13
17.67	Capacitor — Ceramic, 1.5 mmf	C-3, C-4
17.59	Capacitor — Ceramic, 2.2 mmf	C-10
17.79	Capacitor — Ceramic, 4.7 mmf	C-6, C-7, C-12
17.60	Capacitor — Ceramic, 22 mmf	C-14
17.57	Capacitor — Ceramic, 270 mmf	C-1, C-2
17.9	Capacitor — Mica, 270 mmf	C-18
17.45	Capacitor — Ceramic, 1500 mmf	C-5, C-8, C-9, C-11, C17
Note:	Coils — R.F., plate, and oscillator coils not individually replaceable.	
32.139	Resistor — 47 ohms, ½ watt	R-8
32.4	Resistor — 150 ohms, ½ watt	R-3, R-11, R-13
32.8	Resistor — 1000 ohms, ½ watt	R-4, R-12, R-14
32.75	Resistor — 4700 ohms, ½ watt	R-1, R-2, R-7
32.80	Resistor — 1000 ohms, ½ watt	R-5
32.89	Resistor — 100,000 ohms, ½ watt	R-9, R-10
32.33	Resistor — 1 Megohm, ½ watt	R-6
37.89	Coil — Heater Choke Coil (coils not individually replaceable.)	L-79
37.208	Wave Trap Assembly	
87.296	Screw #4-40 x ¼" binder head screw, adjusting	L-66, 68, 70, 72, 74, 76
87.297	Screw #4-40 x 15/32" adjusting	L-54, 56, 58, 60, 62
92.263	Indent shaft, complete with flanges	
92.264	Shield — Lead tube shield for V-3.	
92.265	Shield retainer spring for V-3.	

REPLACEMENT PARTS LIST
RECEIVER CHASSIS

STOCK No.	DESCRIPTION	SCHEMATIC
12.34	Capacitor — tubular .001 mfd 400 V	C178
12.59	Capacitor — tubular .0015 mfd 1000 V	C238
12.2	Capacitor — tubular .002 mfd 600 V	C151, 205, 207
12.35	Capacitor — tubular .004 mfd 400 V	C167, 172, 173
12.19	Capacitor — tubular .005 mfd 400 V	C152, 153, 208, 209
12.6	Capacitor — tubular .01 mfd 400 V	C149, 177, 192, 204, 206 239
12.58	Capacitor — tubular .01 mfd 1000 V	C240
12.36	Capacitor — tubular .015 mfd 400 V	C168, 169
12.53	Capacitor — tubuar .035 mfd 1000 V	C188
12.12	Capacitor — tubular .05 mfd 400 V	C138, 144, 148, 170
12.38	Capacitor — tubular .05 mfd 600 V	C140, 141, 142, 158, 174, 175, 180
12.55	Capacitor — tubular .05 mfd 1000 V	C186
12.15	Capacitor — tubular .1 mfd 400 V	C146
12.14	Capacitor — tubular .1 mfd 200 V	C157, 182
12.16	Capacitor — tubular .25 mfd 200 V	C125
12.17	Capacitor — tubular .25 mfd 400 V	C143
12.22	Capacitor — Tobe molded .01 mfd 400 V	C183, 184
17.33	Capacitor — ceramic 10 mmf — 20%	C137, 190, 195
17.18	Capacitor — ceramic 50 mmf — 10%	C197
17.45	Capacitor — ceramic 1500 mmf — 20% 350 V	C112, 113, 114, 115, 118, 119, 120, 121, 122, 126, 127, 129, 130, 133, 135, 136, 185, 189, 191, 194, 196.
17.35	Capacitor — ceramic 6800 mmf 20% 350 V	C200
17.88	Capacitor — Mica 33 mmf 5%	C193, 198
17.87	Capacitor — Mica 43 mmf 5%	C117
17.89	Capacitor — Mica 47 mmf 5%	C201
17.36	Capacitor — Mica 56 mmf 5%	C124, 199, 202
17.4	Capacitor — Mica 75 mmf 10%	C132
17.37	Capacitor — Mica 82 mmf 10%	C131, 166
17.9	Capacitor — Mica 270 mmf 10%	C116, 123, 128, 134, 145, 147, 203
17.38	Capacitor — Mica 390 mmf 10%	C176
17.96	Capacitor — Mica 470 mmf 10%	C242

REPLACEMENT PARTS LIST

STOCK No.	DESCRIPTION	SCHEMATIC
17.39	Capacitor — Mica 680 mmf 10%	C179
17.40	Capacitor — Mica .0047 mmf 10%	C154
22.22	Capacitor — Electrolytic 40-450, 10-450, 80-150	C220A, 220B, 220C
22.23	Capacitor — Electrolytic 40-450, 40-450, 10-450	C221A, 221B, 221C
22.24	Caapcitor — Electrolytic 80-450, 50-50	C222A, 222B
22.25	Capacitor — Electrolytic 40-450, 10-450, 10-350	C223A, 223B, 223C
22.26	Capacitor — Electrolytic 18-450, 80-350	C224A, 224B
22.27	Capacitor — Electrolytic 250-10, 1000-6	C225A, 225B
22.58	Capacitor — Electrolytic 4-150	C241
32.61	Resistor — 2.2 ohms 5% 1 Watt	R230
32.63	Resistor — 10 ohms 5% ½ Watt	R194
32.123	Resistor — 22 ohms 10% 2 Watt	R232
32.64	Resistor — 39 ohms 10% ½ Watt	R116, 121, 126
32.53	Resistor — 100 ohms 10% 1 Watt	R206
32.2	Resistor — 100 ohms 10% ½ Watt	R212, 215
32.4	Resistor — 150 ohms 10% ½ Watt	R114, 119, 124, 130, 133
32.159	Resistor — 220 ohms 10% 1 Watt	R240
32.68	Resistor — 560 ohms 10% ½ Watt	R195, 265, 266
32.31	Resistor — 680 ohms 10% ½ Watt	R132
32.8	Resistor — 1 K ohms 10% ½ Watt	R117, 118, 122, 123, 128, 135, 161, 213, 216
32.71	Resistor — 2.7 K ohms 5% ½ Watt	R177
32.57	Resistor — 2.7 K ohms 10% ½ Watt	R127, 129
32.32	Resistor — 3.3 K ohms 10% ½ Watt	R140, 234
32.73	Resistor — 3.9 K ohms 5% ½ Watt	R137
32.74	Resistor — 4.7 K ohms 10% 1 Watt	R154, 155, 160
32.75	Resistor — 4.7 K ohms 5% ½ Watt	R125
32.76	Resistor — 5.6 K ohms 5% ½ Watt	R134
32.10	Resistor — 6.8 K ohms 10% ½ Watt	R141, 158, 202, 210
32.77	Resistor — 8.2 K ohms 10% ½ Watt	R164, 165, 190
32.78	Resistor — 8.2 K ohms 5% ½ Watt	R174
32.79	Resistor — 10 K ohms 10% 1 Watt	R179, 199, 218
32.80	Resistor — 10 K ohms 5% ½ Watt	R115, 120
32.11	Resistor — 10 K ohms 10% ½ Watt	R146, 175, 237, 246
32.81	Resistor — 18 K ohms 10% ½ Watt	R189, 269
32.82	Resistor — 18 K ohms 10% 1 Watt	R208, 264
32.13	Resistor — 22 K ohms 10% ½ Watt	R162, 163, 217, 236
32.83	Resistor — 22 K ohms 10% 1 Watt	R207
32.84	Resistor — 27 K ohms 10% 1 Watt	R188
32.85	Resistor — 27 K ohms 10% ½ Watt	R196, 221
32.86	Resistor — 39 K ohms 5% 1 Watt	R197, 231
32.15	Resistor — 47 K ohms 10% 1 Watt	R198
32.87	Resistor — 47 K ohms 5% 1 Watt	R150, 262
32.88	Resistor — 56 K ohms 20% ½ Watt	R173
32.89	Resistor — 100 K ohms 10% ½ Watt	R148, 166, 219, 220
32.90	Resistor — 150 K ohms 10% ½ Watt	R244
32.91	Resistor — 220 K ohms 10% ½ Watt	R170, 203
32.44	Resistor — 270 K ohms 10% ½ Watt	R225
32.19	Resistor — 330 K ohms 20% ½ Watt	R224
32.92	Resistor — 470 K ohms 10% ½ Watt	R138, 191, 192, 193, 205, 214, 241, 261
32.93	Resistor — 680 K ohms 5% ½ Watt	R204, 238
32.33	Resistor — 1 Meg ohm, 10% ½ Watt	R149, 153, 157, 159, 229, 263
32.97	Resistor — 1.5 Meg ohms 5% ½ Watt	R171, 242
32.34	Resistor — 2.2 Meg ohm 10% ½ Watt	R167, 176
32.98	Resistor — 4.7 Meg ohm 10% ½ Watt	R156
32.46	Resistor — 6.8 Meg ohm 10% ½ Watt	R228
32.99	Resistor — 10 Meg ohm 20% ½ Watt	R223
37.89	Coil — Filament Choke Coil	L180, 181, 182, 184, 186
37.90	Coil — Peaking Coil	L187, R136
37.91	Coil — Choke Coil	L188
37.92	Coil — Peaking Coil	L189, R139
37.93	Coil — Choke Coil	L190
37.209	Coil — Choke Coil	L203

REPLACEMENT PARTS LIST

STOCK No.	DESCRIPTION	SCHEMATIC
37.210	Coil — Choke Coil	L204
37.211	Coil — Peaking Coil	L202, R239
37.94	Transformer — Sound I.F. Transformer	T-111, 112
37.95	Transformer — Sound Discriminator Transformer	T-113
37.96	Coil — 1st. Video I.F. Coil	T-103
37.97	Coil — 2nd. I.F. Coil	T-104
37.98	Trap — Pix. I.F. Cathode Sound Trap	T-105
37.99	Coil — Video I.F. Coil	L-183, 185
37.104	Transformer — Synchrolok Transformer	T-108
37.105	Coil — Horizontal Linearity Coil	L-201
37.106	Coil — Horizontal Width Coil	L-196
42.12	Transformer — Main Power Transformer	T-110
42.13	Transformer — Horizontal Deflection Output Trans.	T-109
42.14	Transformer — Vertical Deflection Transformer	T-107
42.15-1	Transformer — Vertical Oscillator Transformer	T-106
42.16	Transformer — Audio Output Transformer	T-114
42.28	Choke — Filter Choke	L-206
42.21	R. F. Unit (RCA)	
52.21	Control — Vertical & Horiz. Hold Control	R-168, 172
52.22	Control — Contrast & Volume Control	R-131, 222
52.23	Control — Horizontal Drive Control	R-187
52.24	Control — Height Control	R-169
52.25	Control — Vertical Linearity Control	R-178
52.26	Control — Vertical Centering Control	R-181
52.50	Control — Brightness & Focus Control	R-245,248
52.52	Control — Horizontal Centering Control	R-211
72.26	Tinned Copper Ground Braid ¼"	
72.46	Antenna Lead-In 300 ohm	
72.72	Power Cord & Male Plug 10 ft. long	
72.74	Power Cord & Female Plug 36" long	J-105
82.4	Shield for Miniature Tube	
87.199	Wing Nut #8-32	
92.114	Escutcheon Spring	
92.117	Ground Contact Spring-Tuner	
92.122	Escutcheon Plate	
92.143	Rubber Grommet	
92.110	Insulator, Lead-In	
92.111	Bearing Shaft Support	
92.113	Fibre Shield — Brightness	
92.118	Insulator Plate — H.V. Shield Cover	
92.119	Insulator Plate — H.V. Shield	
92.155	Twin Lead Holder	
92.183	Knob Springs, 142.40, 142.42	
92.184	Knob Springs, 142.41	
92.185	Knob Spring, 142.43	
92.138	Plug — Aux. power supply B Connector	P-107
92.224	Baffle — Masonite Speaker Baffle	
92.225	Screen — Viewing Screen	
92.226	Mirror — Front Surface Mirror	
92.227	Screen — Front Grille Screen	
92.243	Cloth — Front Grille Cloth	
92.229	Optical system — optical projection unit	
92.231	Yoke — Focus Coil & Deflection Yoke Tailpiece	L-207, 208, 209, 210, 211 R-265, 266
92.232	High Voltage Driver Unit	
92.233	Hinge, Cabinet Front	
92.254	Catch — Draw Pull Catch (front)	
92.255	Strike — Strike for Catch (front)	
92.238	Plug — Jones Type	P-103
92.239	Socket — Jones Type	J-103
92.241	High Voltage Connector — Millen type	J-104, P-104
92.251	CR Tube Socket & 36" Cable	
97.205	Dust Cover	
97.208	Cabinet	
102.215	Instruction Manual — Operation	
102.163	Decalcomania — Brightness, Horizontal, Vertical	
102.164	Decalcomania — Off-On, Sound, Picture	
102.169	Decalcomania — FADA	
102.210	Decalcomania — Focus	
107.43	Speaker — 10" PM Speaker	
117.19	Resistor — 5300-500-500 ohm, 50 W. & mtg. hdwe.	R-209
117.20	Resistor — 1360-230 ohm, 50 W. & mtg. hdwe.	R-185A & B
117.21	Resistor — 6750-12-93 ohm	R-186A, B, & C
117.40	Resistor — 150 ohm 25 Watt	R-250
117.27	Resistor — 1000 ohm 5 Watt	R-267
117.41	Resistor — 2200 ohm 10 Watt	R-243, 249*
117.18	Resistor — 5000 ohm 10 Watt & mtg. hdwe.	R-200
122.22	Fuse—¼ Amp. Type 3AG	
142.40	Knob, Station Selector	
142.41	Knob, Fine Tuning	
142.42	Knob, Outside Shaft	
142.43	Knob, Inside Shaft	
152.27	Antenna Terminal Strip	
152.28	Link Connector Strip & Link	

*In some units, R249 may be 3300 ohms, 10 W. instead of 2200 ohms, 10 Watts. When ordering, specify which.

REPLACEMENT PARTS LISTS
AUXILIARY POWER SUPPLY

STOCK No.	DESCRIPTION	SCHEMATIC
22.57	Capacitor, Electrolytic 30-450; 30-450	C-226A, 226B
42.34	Transformer — Power Transformer	T-115
42.35	Choke — Filter Choke	L-205
67.3	Socket — Octal Molded Connector, female	J-106
72.73	Plug — Line Cord with AC Male Plug	P-105
92.139	Socket — Single female connector	J-107
117.38	Resistor — 50 ohm 2 Watt	R-251
117.45	Resistor — 25000 ohm 10 Watt	R-268
122.21	Fuse Holder	
122.29	Fuse, ¼ amp. type 3AG slo-blo.	
152.50	Terminal Post, — Tie strip.	

REPLACEMENT PARTS LIST
HIGH VOLTAGE DRIVER UNIT #92.232

STOCK No.	DESCRIPTION	SCHEMATIC
12.7	Capacitor, tubular .01 mfd. 600 V	C-227
12.36	Capacitor, tubular .015 mfd 400 V	C-232
12.9	Capacitor, tubular .03 mfd 400 V	C-233
12.15	Capacitor, tubular .1 mfd 400V	C-230
12.60	Capacitor, tubular .1 mfd 600 V	C-231
17.92	Capacitor — Mica 2700 mmf 5%	C-229
17.93	Capacitor — High Voltage 5000 mmf 10 KV (enclosed in sealed can)	C-235
17.94	Capacitor — High Voltage 2500 mmf 20 KV (enclosed in sealed can)	C-234, 236
22.59	Capacitor — Electrolytic 20 mfd 50 V	C-237
132.13	Capacitor — Trimmer 110-560 mmf	C-228
32.67	Resistor — 330 ohm 20% ½ Watt	R-257
32.16	Resistor — 68 K ohm 5% ½ Watt	R-259
32.91	Resistor — 220 K ohm 5% ½ Watt	R-258
32.19	Resistor — 330 ohm 10% ½ Watt	R-254
32.82	Resistor — 18 K ohm 10% 1 Watt	R-256
32.160	Resistor — 220 K ohm 10% 1 Watt	R-253
32.161	Resistor — 390 K ohm 5% 1 Watt	R-252
32.162	Resistor — 1.5 Megohm 1 Watt	R-260
32.163	Resistor — 390 ohm 10% 2 Watt	R-255
42.41	Transformer — Oscillator Transformer	T-116
42.42	Transformer — High Voltage Tripler Transf. (enclosed in sealed can assy')	T-117
92.234	Plug — Octal Male Plug Connector	P-106

ALIGNMENT ASSEMBLY PART No. 92.231
SEE EXPLODED VIEW.

STOCK No.	DESCRIPTION
92.231—1	Projection Tube Light-Shield
92.231—2	Dust Ring — Neoprene
92.231—3	Deflection Yoke Assembly
92.231—4	Mounting and overall adj. plate assy'.
92.231—5	Vertical adjustment screw assembly
92.231—6	Vertical adjustment plate assembly
92.231—7	Washer
92.231—8	Locking sleeve
92.231—9	Spring
92.231—10	Washer
92.231—11	Thumb Nut
92.231—12	Snap Ring
92.231—13	Washer
92.231—14	Spring Washer
92.231—15	Horizontal adjustment screw
92.231—16	Coil mounting plate assembly
92.231—17	Washer
92.231—18	Spring Washer
92.231—19	Thumb Screw
92.231—20	Focusing Coil adjustment screw
92.231—21	Spring
92.231—22	Washer
92.231—23	Snap Ring
92.231—24	Screw
92.231—25	Tube Clamp
92.231—26	Tube Clamp Plate
92.231—27	Washer
92.231—28	Screw 5-40
92.231—29	Screw 8-32
92.231—30	Washer
92.231—31	Tube clamp plate spacer
92.231—32	Focusing coil and housing assem. 11,000 ohm, complete
92.231—33	Focusing coil housing
92.231—34	Screw 5-40
92.231—35	Focusing coil housing cover
92.231—36	Yoke mounting screw
92.231—37	Nut, hexagon, 8-32
92.231—38	Spring bushing
92.231—39	Spring
92.231—40	Washer
92.231—41	Deflection-yoke insulating spacer
92.231—42	Spring