

# SPECIFICATIONS

**POWER SUPPLY**  
105-125 Volts — 60 Cycle A.C.

**POWER CONSUMPTION**  
195 Watts

**POWER OUTPUT (AUDIO)**  
2.5 Watts (Undistorted)

**INPUT IMPEDANCE**  
300 Ohms

| Model #   | PICTURE TUBE SIZE |
|-----------|-------------------|
| 17c — 17T | 17" RECTANGULAR   |
| 20C — 20T | 20" RECTANGULAR   |
| 21H20     | 21" RECTANGULAR   |
| 2420      | 24" ROUND         |

Equipped with highly sensitive Super Cascode front end turret type tuner.

Can be adapted for hi-frequency stations.

A 20-tube power chassis to give you a clear, clean, living picture.

# TUBE COMPLEMENT

|    |       |                                      |
|----|-------|--------------------------------------|
| 1  | 6BK6  | Cascode RF Amplifier                 |
| 2  | 6J6   | Oscillator-Mixer                     |
| 3  | 6CB6  | 1st Video IF Amplifier               |
| 4  | 6CB6  | 2nd Video IF Amplifier               |
| 5  | 6AL5  | Video Detector AGC                   |
| 6  | 6CB6  | Final Video Amplifier                |
| 7  | 6AU6  | Ratio Detector Driver                |
| 8  | 6AL5  | Sound Detector                       |
| 9  | 6AV6  | 1st Audio Amplifier                  |
| 10 | 6V6   | Final Audio Amplifier                |
| 11 | 12AU7 | DC Restorer Sync. Inverter Amplifier |
| 12 | 12AU7 | Sync. Splitter & Clamper Amplifier   |
| 13 | 6AL5  | Horizontal Phase Detector            |
| 14 | 12BH7 | Vertical Sweep Oscillator & Output   |
| 15 | 6SN7  | Horizontal Sweep Oscillator          |
| 16 | 6BQ6  | Horizontal Sweep Output              |
| 17 | 1X2A  | Hi-Voltage Rectifier                 |
| 18 | 6W4   | Horizontal Dampner                   |
| 19 | 5U4   | Power Rectifier                      |
| 20 | ---   | Picture Tube                         |

# FREQUENCY CHART

IF FREQ. — SOUND 21.6 — PICTURE — 26.1

| CHANNEL | FREQUENCY | PIX FREQUENCY | SOUND  | OSCILLATOR |
|---------|-----------|---------------|--------|------------|
| 2       | 54-60     | 55.25         | 59.75  | 81.35      |
| 3       | 60-66     | 61.25         | 65.75  | 87.35      |
| 4       | 66-72     | 67.25         | 71.75  | 93.35      |
| 5       | 76-82     | 77.25         | 81.75  | 103.35     |
| 6       | 82-88     | 83.25         | 87.75  | 109.35     |
| 7       | 174-180   | 175.25        | 179.75 | 201.35     |
| 8       | 170-186   | 181.25        | 185.75 | 207.35     |
| 9       | 186-192   | 187.25        | 191.75 | 213.35     |
| 10      | 192-198   | 193.25        | 197.75 | 219.35     |
| 11      | 198-204   | 199.25        | 203.75 | 225.35     |
| 12      | 204-210   | 205.25        | 209.75 | 231.35     |
| 13      | 210-216   | 211.25        | 215.75 | 237.35     |

# INSTALLATION

## WARNING

This receiver is designed for use on 105 to 125 Volt 60 cycle AC only. Do NOT connect to Direct Current (DC) power supply. If in doubt, check with your local Power Supply Company.

# CONTROL FUNCTIONS

## RECEIVER FRONT PANEL CONTROLS

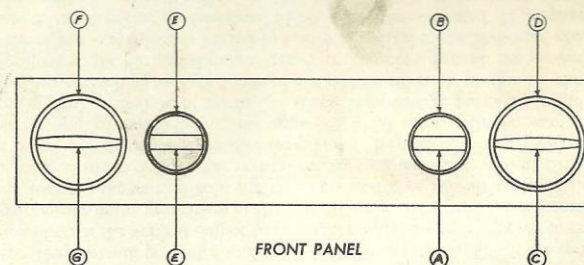


FIG. 1

- A) **VOLUME ON-OFF:** A slight clockwise rotation of this control turns the receiver on. Further clockwise rotation will increase sound volume.
- B) **CONTRAST:** This control varies the relative intensity between black and white in the picture.
- C) **STATION SELECTOR:** This control is used to select desired channel.
- D) **FINE TUNING:** This control is used to adjust for best picture quality, and is not used to adjust for best sound. Turn fine tuning control clockwise until fine grain structure or horizontal bars appear in picture. Then turn counter clockwise until fine grain just disappears. This is point of best picture quality.
- E) **BRIGHTNESS:** Turning this clockwise will increase brightness of picture. This should be set at a point where bright lines over face of picture disappear.
- F) **HORIZONTAL HOLD:** This control is to keep the picture stationary in horizontal direction. If lines appear sloping down to left, control should be turned clockwise. The receiver is so designed and adjusted this this control need not be touched once it is set.
- G) **VERTICAL HOLD:** This control keeps picture stationary vertically. When turned clockwise, picture will move downward. Counter-clockwise, upward. This control need not be manipulated once set.

MODELS 17C, 17T, 20C, 20T, 21H20, 24H20, Ch. Series 20, Codes 88, 90, 91, 9



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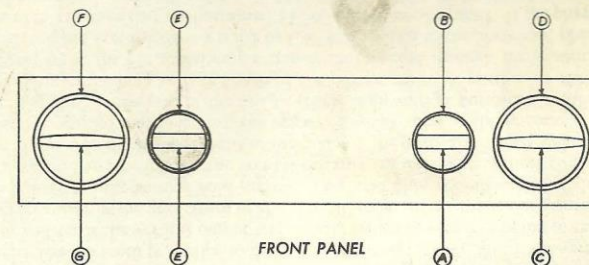


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## REAR PRE-SET CONTROLS

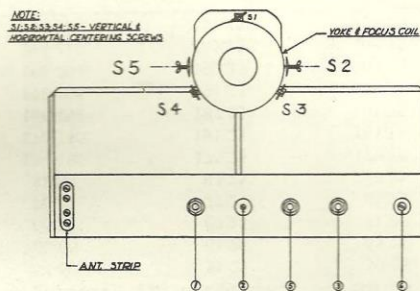


FIG. 2

- 1) FOCUS: This control should be adjusted so that the lines that compose the television picture are clearly distinguishable. (See above.)
- 2) HORIZONTAL FREQUENCY CONTROL: This is a slug control which stabilizes the horizontal frequency of the sweep circuit. To adjust, turn the contrast to minimum and front inset control marked horizontal hold, to its center position. Adjust slug till picture locks in and further adjust the slug till picture is centered. There should be no evidence of fold over on either side of the picture.
- 3) VERTICAL LINEARITY: This control affects principally the size of the upper portion of the picture, and to some extent the size of the entire picture.
- 4) 5" speaker on table model. 8" speaker on console.
- 5) VERTICAL SIZE: This control affects the total vertical size of the picture, but must be used in conjunction with the vertical linearity control adjustment.
- 6) HORIZONTAL DRIVE: This trimmer affects the high voltage and the size of the picture left of center. To adjust this control, turn contrast to medium (a picture is not necessary). Adjust brightness to a nominal value. Turn trimmer out till one or two white vertical lines appear on face of tube left of center. Turn trimmer in till these lines are no longer visible.
- 7) HORIZONTAL LINEARITY CONTROL: This control is used for obtaining symmetry about the center of the picture.
- 8) FRINGE SWITCH: This switch can be set to fringe position to increase gain in weak areas.

## DESCRIPTION OF CIRCUIT

**RF TUNER:** The Tuner employs a 6BK7 RF amplifier in a Cascode Circuit, and a 6J6 RF oscillator and mixer. The tuned circuit in the plate of the mixer is slug tuned to peak at 23.4 Mc.

**VIDEO IF:** The Video IF consists of a link coupled input which is coupled to the output of the converter which is low impedance link output. This stage employs a 6CB6 amplifier tube, and is coupled to a bi-filar coil which is coupled to the 2nd 6CB6 IF amplifier. The 2-stage picture IF amplifier is stagger tuned to 25.3 Mc and 23 megacycles. The link coil is tuned to 23 megacycles. The band width of the IF response is such that it will also pass the sound IF carrier, though at a very small percentage of the peak IF response. No sound traps are employed. Video IF carrier and sound IF carrier (which are maintained at a 4.5 Mc apart at the transmitter) are heterodyned in the video detector and yield a 4.5 beat which contains all the FM sound information transmitted.

**VIDEO AMPLIFIER:** The detected video information, as well as the 4.5 Mc FM signal, is direct coupled to the grid of the 6CB6 video amplifier through a high frequency compensating network. The plate of the video amplifier contains in addition to the high frequency compensation network feeding the kinescope grid, the primary of a RF transformer tuned to 4.5 megacycle. The primary of this transformer behaves as a trap for the 4.5 Mc at the kinescope grid, thus reducing the negligible proportions 4.5 megacycles in the picture. At the same time it allows the video amplifier to have very high gain at 4.5 megacycle, thus greatly amplifying the sound information which up to the plate of this tube has been received at a very low level.

**AGC AND CONTRAST:** The AGC Diode, which is fed from the 2nd video IF, has its cathode connected to the contrast control. The small positive voltage existing at the cathode of the AGC rectifier acts as a delay, thus preventing the AGC voltage from being developed until the peak video IF voltage exceeds the bias at this cathode of the AGC rectifier. AGC voltage is applied to the RF amplifier and the first IF amplifier. The contrast control and AGC delay are so designed that when the contrast setting is greatest, the delay on the AGC rectifier is greatest. This makes possible a greater overall picture control action.

**SYNC CIRCUIT:** One-half of the 12AU7 acts as the SYNC inverter and DC restorer. The SYNC pulses taken from this network is fed through the other half of the 12AU7 which acts as a linear amplifier, from there it is fed through a low pass filter to another 12AU7, the first half being a SYNC clamper, which then feeds into the other half of the 12AU7 SYNC splitter. A pulse is taken from the cathode and from the junction of the 2 plate restorers are fed to the 6AL5 horizontal phase detector. The output of this phase detector is a direct voltage which is applied to the control grid of the 6SN7 horizontal sweep oscillator. The pulse is taken from the plate of the phase splitter and fed to an integrating network which separates vertical pulses from the horizontal pulses, and applies the vertical pulses to the grid of  $\frac{1}{2}$  of the 12BH7. This section is the vertical oscillator.

**SWEEP CIRCUITS:** One-half of the 12BH7 acts as a blocking oscillator which generates the sawtooth for the vertical sweep. The sawtooth is applied to the 2nd half of the 12BH7. This is the vertical output section of the sweep circuit, and feeds the vertical output transformer which in turn is coupled to the deflection yoke. The 1 megohm potentiometer in the grid circuit of the vertical sweep oscillator which controls the frequency of the vertical sweep is termed the vertical hold control. The 5000 ohm potentiometer in the cathode of the output section of the vertical sweep circuit is the vertical linearity control. The vertical size control is a 2.5 megohm potentiometer located in the B-supply lead to the plate of the vertical sweep oscillator. The 6SN7 tube is a stabilized cathode coupled multi-vibrator, the output of which supplies the horizontal sawtooth sweep voltage. This voltage is applied to the grid of the 6BQ6. These high voltage pulses are rectified by the 1X2A and the output is fed through the high voltage anode of the picture tube. A portion of the sawtooth current which flows in the primary of the horizontal output transformer is bled through the ground through C64 and R62. The voltage developed across R62 is shaped by C65 and applied to the horizontal phase detector as a sawtooth voltage. It is to this voltage that the horizontal SYNC pulses are compared. If the phase of the horizontal pulses differ from the reference sawtooth pulses, an AFC voltage (DC) is developed across the control grid of the horizontal oscillator in such a direction as to correct the frequency of the oscillator. This brings horizontal pulses and reference pulses back in phase and maintains the picture stationary in a horizontal direction.

In the event that the sufficient AFC voltage is not developed to bring the pulses into phase, the proper adjustment of the 50,000 ohm potentiometer (20-28) in the grid circuit of the 6SN7 will correct the horizontal sweep frequency. This control is called the Horizontal Hold Control. Trimmer capacity, C67, acts as an AC divider with C62, and regulates the amount of sawtooth applied to the grid and consequently the energy delivered to the deflection yoke. This trimmer is called the Horizontal Drive Control, (30-16), in the Cathode circuit of the damper tube (6W4) is the Horizontal Linearity Control. This coil controls the phase of the ripple voltage on the high B (boost) which is applied to the plate of the 6BQ6 through the primary of the flyback transformer. This changes the shape of the horizontal deflection yoke current slightly and affects the horizontal size of the picture from slightly left of center to the right. The horizontal deflection yoke is very carefully matched to the secondary of the flyback transformer, so that no width coil is necessary. However, in low line voltage operation, a .05 MFD condenser placed across connections 5 and 6 will increase width.



**SOUND SECTION:** The 4.5 megacycle FM signal from the secondary of the take-off transformer (30-46) is fed to the grid circuit of the ratio detector, a 6AU6 tube. The output from this driver tube feed the primary of the ratio detector transformer (30-47) which is tuned to 4.5 megacycles. The double dialled section of the 6AL5 is used as the ratio detector. The resultant audio signal developed is fed to the grid of the first audio amplifier (6AT6) through the volume control network. The output of the first audio amplifier is R-C coupled to the grid of a 6V6 tube, which is the audio output amplifier. The audio signal output from this stage is fed to the audio output transformer (140-13) and then to the speaker.

**POWER SUPPLY AND VOLTAGE REGULATION:** The low voltage power supply provides 400 volts positive and a 2.5 volt negative bias supply. The 5U4 is used as the rectifier for this low voltage supply. The filter incorporates the focus coil (140-120) and a resistive filter. The RF and IF sections use 140 volts as the supply voltage with the Cathodes returned to ground. The Cathodes of the sound section (I.E.) 6V6 and the 6AU6 are returned to the 140 volt line. Their plates and screens being fed directly from the 400 volt supply. The 140 volt line may be considered as a tap in a voltage divider across the 400 volt supply, the voltage divider being the 6V6 in series with the RF amplifier maintained at the constant voltage of plus 127 volts by another voltage divider network composed of resistors R15 and R13. Since the Cathode is at the plus 140 volt line potential, the grid to Cathode bias is 13 volts. The grids of the RF amplifier and IF strip are controlled by the AGC voltage which is variable depending on the signal strength of the received signal. As the AGC bias increases, the RF and IF tubes draw less current and effectively look like a large resistance in the lower half of the voltage divider. This raises the 140 volt line to a higher voltage. But as the 140 volt line is raised in voltage, the grid bias on the 6V6 increases. This causes the 6V6 to draw less current making it look like a higher resistance in the top half of the voltage divider, thus causing the 140 volt line to adjust itself to its proper voltage once more. This system thus tends to maintain a constant voltage divider action because both sections of the divider tend to increase or decrease in resistance in proper proportion.

### IF ALIGNMENT PROCEDURE

1. Remove RF tube (6BK7) from tuner.
2. Place a VTVM with a 47K ohm isolating resistor in series with it across the video detector load. Make sure that the ground end of the meter is connected to a 2½ volt bias supply.
3. Set meter to 3 volts full scale.
4. Connect an outside 3 volt bias to AGC strip.
5. Spray IF signal through 6J6 tube (remove shield slightly above ground) and align first and third IF transformers for maximum signal at 25.6 Mc and then align the 2nd and 4th IF for maximum signal at 25.7 Mc.

### VISUAL IF ALIGNMENT

1. Connect sweep generator at antenna terminal.
2. Set sweep generator to cover 10 Mc. at approximately 23 Mc. center.
3. Connect generator scope sweep to horizontal amplifier terminal of the oscilloscope, and set oscilloscope to external sweep.
4. Set scope for 2 volts total vertical deflection.
5. Connect oscilloscope across detector load through a 47K isolating resistor. Oscilloscope grounding terminal should be connected to chassis.
6. Set contrast to minimum.
7. Upon centering response pattern on oscilloscope screen, adjust generator until vertical total vertical deflection is 2 volts.
8. Loosely couple a signal generator to output of sweep generator. This will provide a means of obtaining a marker on response curve.

9. The response curve should appear as shown below:

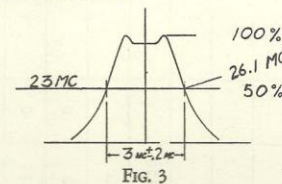


FIG. 3

NOTE: 30% variation in amplitude between peaks and from peak to valley is permissible.

### SOUND TAKE-OFF AND RATIO DETECTOR ALIGNMENT

1. Place marker signal generator at junction R43 and P121 of GCB6 video amplifier and to ground and set to 4.5 Mc.
2. Place a VTVM (DC scale) or a 20,000 ohm/voltmeter across C17 in the output of the ratio detector circuit. With the ground side of the meter on the 140 volt line, the voltages read across C17 should be negative. Set voltage scale to read 30 volts maximum.
3. Adjust core of primary of ratio detector transformer (underneath chassis) for peak response on meter.
4. Adjust primary and secondary of sound take-off transformer also for maximum indication on meter.
5. Remove negative lead of output meter to junction R18 and R19; move positive lead to junction C16, R89 and C23.
6. Tune secondary of ratio detector transformer (top side of chassis) for rapid swing of meter from positive to negative, and set to zero and center of rapid swing.
7. Repeat steps 2, 3, 4, 5, 6, and 7, making certain a generator output is set so that meter voltage does not exceed 30 volts.

### SERVICE NOTES

1. No raster: check 6SN7 and 6BQ6 tubes, fuse which is mounted on flyback transformer, check flyback transformer, check associated condensers and resistors on horizontal oscillator circuits, check 6W4 tube. Also check ion trap setting if high voltage is available at anode lead.
2. Raster, but no picture—no sound: check speaker connections plug to ascertain correct position, check tubes in the IF section, check tubes in the video output section, check tubes in the sound section.
3. Raster, sound—no picture: check kinescope grid lead for continuity from chassis to socket, check picture tube.
4. Picture—no sound: check all sound tubes (6AT6, 6V6, and the 6AU6 ratio detector driver and the 6AL5 ratio detector tube), check continuity of sound take-off coils and ratio detector coils.
5. No horizontal or vertical sync: check 12AU7 (both) and 6AL5 in the balance sync circuit.
6. No horizontal sync: check horizontal frequency control coil, check 6AL5 horizontal phase detector and also analyse associated circuits, check 6SN7 tube.
7. No vertical sync: check 12BH7 and 12AU7's.
8. Insufficient height: check 12BH7, check yoke.

NOTE: Entire audio circuit is at a potential of 140 volts above ground and grids are hot. Also 6V6 must be in set at all times for all operational checks to insure proper operation, since it determines the voltage to various circuits.



## NO SIGNAL VOLTAGE MEASUREMENTS (Ant. terminals shorted and connected to ground)

- Where readings may vary according to control settings, min. & max. readings are given.
- Measurements are from socket pin to chassis, unless otherwise stated.
- All measurements taken with line voltage maintained at 117 A.C.

| TUBE  | APPLICATION                   | PIN 1     | PIN 2 | PIN 3    | PIN 4    | PIN 5    | PIN 6    | PIN 7    | PIN 8     | PIN 9 | REMARKS |
|-------|-------------------------------|-----------|-------|----------|----------|----------|----------|----------|-----------|-------|---------|
| 6CB6  | 1st I. F. AMP.                | -8.2      | +8    | 0        | 6.3 A.C. | +128     | +126     | 0        | —         | —     | —       |
| 6CB6  | 2nd I. F. AMP.                | 0         | +1.92 | 0        | 6.3 A.C. | +130     | +128     | 0        |           |       |         |
| 6AL5  | VIDEO DETECTOR, AGC RECTIFIER | 0 to +2.2 | -2.8  | 6.3 A.C. | 0        | -2.4     | 0        | -4       |           |       |         |
| 6CB6  | VIDEO AMP.                    | -2.4      | +1.16 | 0        | 6.3 A.C. | +320     | +147     | 0        |           |       |         |
| 6AU6  | SOUND I. F. AMP.              | +130      | +132  | +130     | +130     | +350     | +160     | +132     |           |       |         |
| 6AL5  | RATIO DET.                    | +130      | +128  | +128     | +128     | +128     | +128     | +128     |           |       |         |
| 6V6   | AUDIO OUTPUT                  | Grd.      | +128  | +320     | +325     | +110     | +115     | +128     | +128      |       |         |
| 6AV6  | 1st AUDIO AMPLIFIER           | +122      | +128  | +128     | +128     | N.C.     | N.C.     | +250     | —         |       |         |
| 12AU7 | D. C. RESTORER & INV. AMP.    | 0         | 0     | +1.1     | 6.3 A.C. | 6.3 A.C. | +76      | -7.5     | 0         | 0     |         |
| 12AU7 | SYNC. SPLITTER & AMP.         | +125      | -1.3  | 0        | 6.3 A.C. | 6.3 A.C. | +92      | +12.5    | +15       | 0     |         |
| 6AL5  | HORIZ. PHASE DET.             | 0         | 0     | 6.3 A.C. | 0        | +9.0     | 0        | -1.5     | —         |       |         |
| 6SN7  | HORIZ. OSC.                   | +3.4      | +320  | +14      | -11      | +135     | +14      | 6.3 A.C. | 0         |       |         |
| 6BQ6  | HORIZ. OUTPUT                 | N.C.      | 0     | N.C.     | +125     | -16.     | +255     | 6.3 A.C. | +6.8      |       |         |
| 6W4   | DAMPER                        | N.C.      | +250  | +565     | N.C.     | 242      | N.C.     | +565     | +565      |       |         |
| 12BH7 | VERTICAL OSC.—VERTICAL OUTPUT | +365      | Pulse | +18      | 6.3 A.C. | 6.3 A.C. | +120     | -55      | 0         | 0     |         |
| 5U4   | LOW VOLTAGE RECT.             | —         |       | —        | 390 A.C. | —        | 390 A.C. |          | +400 D.C. |       |         |
| 1X2A  | HI-VOLTAGE RECT.              |           |       |          |          |          |          |          |           |       |         |

\* Reading taken from pin socket with + 140 as Common Negative reference. Measurements taken with RCA Advanced Volt Ohmmtr.  
All readings taken from pin socket to ground.

## D.C. RESISTANCE MEASUREMENTS

|                            |                     |                      |                      |                      |                     |  |  |  |  |  |                            |
|----------------------------|---------------------|----------------------|----------------------|----------------------|---------------------|--|--|--|--|--|----------------------------|
| Horizontal A.F.C. Coil     | 57 ohms             |                      |                      |                      |                     |  |  |  |  |  |                            |
| Vert. Blocking Osc. Trans. | 190 ohms            | 1000 ohms            |                      |                      |                     |  |  |  |  |  |                            |
| Horiz. Output Trans.       | $R_{1,2} = 78$ ohms | $R_{1,3} = 420$ ohms | $R_{3,4} = 6.5$ ohms | $R_{5,7} = 0.6$ ohms | $R_{6,9} = 10$ ohms |  |  |  |  |  |                            |
| Vert. Output Trans.        | 720 ohms            | 8 ohms               |                      |                      |                     |  |  |  |  |  |                            |
| Deflection Yoke Horiz.     | 10 ohms             |                      |                      |                      |                     |  |  |  |  |  |                            |
| Deflection Yoke Vert.      | 55 ohms             |                      |                      |                      |                     |  |  |  |  |  |                            |
| Focus Coil                 | 370 ohms            |                      |                      |                      |                     |  |  |  |  |  |                            |
| Audio Output Trans.        | 340 ohms            | 0.6 ohms             |                      |                      |                     |  |  |  |  |  |                            |
| Yellow dot peaking coil    | 7 ohms              | 120 mh               |                      |                      |                     |  |  |  |  |  |                            |
| Green dot peaking coil     | 11 ohms             | 240 mh               |                      |                      |                     |  |  |  |  |  | Wound on 18K ohms resistor |
| Blue dot peaking coil      | 15 ohms             | 380 mh               |                      |                      |                     |  |  |  |  |  |                            |
| Red dot peaking coil       | 19 ohms             | 600 mh               |                      |                      |                     |  |  |  |  |  |                            |
| Sound take-off coil        | 1.6 ohms            | 1.4 ohms             |                      |                      |                     |  |  |  |  |  |                            |
| Ratio Det.                 | 6.5 ohms            | 2. ohms              |                      |                      |                     |  |  |  |  |  |                            |
| Horiz. Lin. coil           | 28 ohms             |                      |                      |                      |                     |  |  |  |  |  |                            |
| Horiz. size coil           | 0.6 ohms            |                      |                      |                      |                     |  |  |  |  |  |                            |



## RESISTORS

| Symbol No. | Description                               |
|------------|---|
| R10        | 4700Ω 10% 1/2w, carbon                    |
| R11        | 56Ω 10% 1/2w, carbon                      |
| R12        | 100Ω 10% 1/2w, carbon                     |
| R13        | 330Ω 5% 1/2w, carbon                      |
| R14        | 8200Ω 10% 1/2w, carbon                    |
| R15        | 180Ω 5% 1/2w, carbon                      |
| R16        | 100Ω 10% 1/2w, carbon                     |
| R17        | 680KΩ 10% 1/2w, carbon                    |
| R18        | 680KΩ 10% 1/2w, carbon                    |
| R19        | 39KΩ 10% 1w, carbon                       |
| R20        | 3300Ω 10% 1/2w, carbon                    |
| R21        | 8.2KΩ 10% 1/2w, carbon                    |
| R22        | 1KΩ 10% 1/2w, carbon                      |
| R23        | 120Ω 10% 1/2w, carbon                     |
| R24        | 220Ω 10% 1/2w, carbon                     |
| R25        | 1.5KΩ 10% 1/2w, carbon                    |
| R26        | 3.9KΩ 10% 1w, carbon                      |
| R27        | 8200Ω 10% 2w, carbon                      |
| R27        | 5KΩ 10%, 1/2w, carbon (Codes 88, 90, 91)  |
| R28        | 39KΩ 10%, 2w, carbon                      |
| R28        | 68KΩ 10% 1/2w, carbon (Codes 88, 90, 91)  |
| R29        | 10KΩ 10% 1/2w, carbon                     |
| R30        | 820KΩ 10% 1/2w, carbon                    |
| R31        | 10KΩ 10% 1/2w, carbon                     |
| R31        | 4700Ω 10% 1/2w, carbon (Codes 88, 90, 91) |
| R32        | 470KΩ 10% 1/2w, carbon                    |
| R32        | 56Ω 10% 1/2w, carbon (Codes 88, 90, 91)   |
| R33        | 100KΩ 10% 1/2w, carbon                    |
| R33        | 8200Ω 10% 1/2w, carbon (Codes 88, 90, 91) |
| R34        | 1 meg 10% 1/2w, carbon                    |
| R34        | 180Ω 10% 1/2w, carbon (Codes 88, 90, 91)  |
| R35        | 680KΩ 10% 1/2w, carbon                    |
| R36        | 470KΩ 10% 1/2w, carbon                    |
| R37        | 3.3KΩ 10% 1/2w, carbon                    |
| R38        | 100KΩ 10% 1/2w, carbon                    |
| R39        | 100KΩ 10% 1/2w, carbon                    |
| R40        | 4.7 meg 10% 1/2w, carbon                  |
| R41        | 470KΩ 10% 1/2w, carbon                    |
| R42        | 390Ω 10% 1/2w, carbon                     |
| R43        | 3.9KΩ 10% 1/2w, carbon                    |
| R44        | 5.6KΩ 10% 1/2w, carbon                    |
| R45        | 220KΩ 10% 1/2w, carbon                    |
| R46        | 27KΩ 10% 1/2w, carbon                     |
| R47        | 47KΩ 10% 1/2w, carbon                     |
| R48        | 1KΩ 10% 1/2w, carbon                      |
| R49        | 100KΩ 10% 1/2w, carbon                    |
| R50        | 1KΩ 10% 1/2w, carbon                      |
| R51        | 22KΩ 10% 1/2w, carbon                     |
| R52        | 22KΩ 10% 1/2w, carbon                     |
| R53        | 15KΩ 10% 1/2w, carbon                     |
| R54        | 560Ω 10% 1w, carbon                       |
| R55        | 3KΩ 5% 5w, w.w.                           |
| R61        | 100Ω 5% 10w, w.w.                         |
| R62        | 2700Ω 10% 2w, carbon                      |
| R63        | 270Ω 10% 2w, carbon                       |
| R64        | 500Ω 5% 20w, w.w.                         |
| R64        | 220KΩ 10% 1w, carbon (Codes 88, 90, 91)   |
| R65        | 2500Ω 5% 20w, w.w.                        |
| R66        | 68KΩ 10% 2w, carbon                       |
| R66        | 1KΩ 10% 1/2w, carbon (Codes 88, 90, 91)   |
| R67        | 15Ω 5% 2w, w.w.                           |
| R68        | 6.8 meg 10% 1/2w, carbon                  |
| R69        | 100KΩ 10% 1/2w, carbon                    |
| R70        | 1 meg 10% 1/2w, carbon                    |
| R71        | 820KΩ 10% 1/2w, carbon                    |

|      |   |
|------|---|
| R72  | 2.2 meg 10% 1/2w, carbon                  |
| R73  | 5.6 meg 10% 1/2w, carbon                  |
| R74  | 240Ω 10%, w.w.                            |
| R75  | 1000Ω 10% 1w, carbon                      |
| R75  | 5.6KΩ 10% 1/2w, carbon (Codes 88, 90, 91) |
| R76  | 3.9KΩ 10% 1/2w, carbon                    |
| R77  | 1.5KΩ 10% 1/2w, carbon                    |
| R78  | 47KΩ 10% 1/2w, carbon                     |
| R79  | 180KΩ 10% 1/2w, carbon                    |
| R80  | 470KΩ 10% 1w, carbon                      |
| R81  | 100KΩ 10% 1w, carbon                      |
| R82  | 120Ω 10% 1/2w, carbon                     |
| R83  | 270KΩ 10% 1/2w, carbon                    |
| R84  | 470KΩ 10% 1/2w, carbon                    |
| R85  | 82Ω 10% 2w, carbon                        |
| R86  | 22KΩ 5% 10w, w.w.                         |
| R87  | 5.6Ω 10% 1/2w, w.w. (Part #70-117)        |
| R88  | 1 meg 10% 1w, carbon                      |
| R99  | 600Ω 10% 2w, carbon (Codes 88, 90, 91)    |
| R107 | 2.7KΩ 10% 1/2w, carbon (Codes 88, 90, 91) |

## CAPACITORS

| Symbol  | No.      | Part No. | Description                                 |
|---------|----------|----------|---|
| C1      |          |          | .005mf, disc ceramic                        |
| C2      |          |          | .005mf, disc ceramic                        |
| C10A, B | T-55-139 |          | 2000mmf 500V dual ceramic                   |
| C11     |          |          | 40mf 400V electrolytic                      |
| C12     | T-55-24  |          | 5000mmf 500V, dual ceramic                  |
| C12     |          |          | 50mf 200V, electrolytic (Codes 88, 90, 91)  |
| C13A, B | T-55-139 |          | 2000mmf 500V, dual ceramic                  |
| C14A, B | T-55-139 |          | 2000mmf 500V, dual ceramic                  |
| C15     |          |          | 0.1mf 400V, paper                           |
| C16     | T-55-18  |          | 120mmf 500V, mica                           |
| C17     | T-55-24  |          | 5000mmf 500V, dual ceramic                  |
| C17     |          |          | 1mf 50V, electrolytic (Codes 88, 90, 91)    |
| C18     | T-55-13  |          | 5mmf 500V 10%, ceramic                      |
| C19     |          |          | 0.01mf 400V, paper                          |
| C20     |          |          | 0.1mf 400V, paper                           |
| C21     | T-55-5   |          | 680mmf 500V 10%, ceramic                    |
| C22     | T-55-7   |          | 470mmf 500V 10%, ceramic                    |
| C23     |          |          | 0.02mf 600V, molded tubular                 |
| C24     | T-55-19  |          | 330mmf 500V, silver mica                    |
| C25     |          |          | 0.1mf 600V, paper                           |
| C30     | T-55-61  |          | 1000mmf 500V, ceramic                       |
| C31     | T-55-61  |          | 1000mmf 500V, ceramic                       |
| C32     | T-55-24  |          | 0.005mf 500V, dual ceramic                  |
| C33     | T-55-24  |          | 0.005mf 500V, dual ceramic                  |
| C34     |          |          | 0.01mf 400V, tubular                        |
| C35     | T-55-137 |          | 500mmf 20KV, ceramic                        |
| C36     | T-55-1   |          | 56mmf 500V 10%, mica                        |
| C37     |          |          | 0.25mf 600V, paper                          |
| C38     |          |          | 0.1mf 1000V, paper                          |
| C39     |          |          | 0.035mf 1KV, paper                          |
| C40     |          |          | 0.25mf, 600V, paper                         |
| C41     |          |          | 0.05mf 600V, molded tubular                 |
| C42     | T-55-4   |          | 390mmf 500V 10%, mica                       |
| C43     | T-55-131 |          | 270mmf 500V 10%, mica                       |
| C44     | T-55-19  |          | 330mmf 500V 10%, mica                       |
| C44A, B |          |          |   |
| C, D    |          |          | 10mf, 450V, electrolytic (Codes 88, 90, 91) |
| C45     |          |          | 0.05mf 600V, paper                          |
| C46     | T-55-25  |          | 3900mmf 500V, 10%, mica                     |
| C47     |          |          | 0.1mf 200V, paper                           |
| C47*    |          |          | .002mf 450V, ceramic (Codes 88, 90, 91)     |

\*C47 is a vertical integrator capacitor. Some models use 50-138 complete couplate instead of separate items.

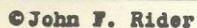
|         |          |  |
|---------|----------|--|
| C48     |          | 0.25mf 200V; paper                         |
| C49     | T-55-23  | 4700mmf 500V 5%, mica                      |
| C50     |          | 0.01mf 400V, paper                         |
| C51     |          | 0.01mf 400V, paper                         |
| C52A, B |          | 40mf 500V, electrolytic (Codes 88, 90, 91) |
| C53     |          | 40mf 450V, electrolytic (Codes 88, 90, 91) |
| C54     |          | 500mf 5V, electrolytic (Codes 88, 90, 91)  |
| C56     |          | 100mf 25V, electrolytic (Codes 88, 90, 91) |
| C60     |          | 0.005mf 600V, paper                        |
| C61     | T-55-138 | 3900mmf 500V 5%, silver mica               |
| C62     | T-55-61  | 1000mmf 500V 10%, ceramic                  |
| C63     |          | 0.02mf 600V, molded tubular                |
| C63     |          | 180mmf 10%, mica (Codes 88, 90, 91)        |
| C64     |          | 5000mmf 1000V, paper                       |
| C65     | T-55-16  | 39mmf 500V 10%, ceramic                    |
| C66     |          | 0.02mf 600V, molded tubular                |
| C67     |          | 0.1mf 600V 10%, paper                      |
| C68     |          | 0.1mf 600V 10%, paper                      |
| 60-127  |          | 40 x 40 x 10mf 450V, electrolytic          |
| 60-125  |          | 12mf 50V, electrolytic                     |
| 60-7    |          | 1mf, electrolytic                          |
| 60-8    |          | 40 x 40mf 450V, electrolytic               |
| 60-9    |          | 100mf 25V, electrolytic                    |
| 60-11   |          | 10 x 10 x 10 x 20mf, electrolytic          |
| 15-142  |          | Audio couplate                             |
| 50-138  |          | Vertical integrator                        |

## TRANSFORMERS

| Part No. | Description   |
|----------|---|
| 30-42    | Ratio detector transformer                                  |
| 30-46    | 4.5 mc sound take-off transformer                           |
| 30-47    | Ratio detector transformer (Codes 88, 90, 91)               |
| 30-217   | 1st IF transformer 23 mc                                    |
| 30-216   | 2nd IF transformer 25.3 mc                                  |
| 30-216   | 3rd IF transformer 23 mc                                    |
| 140-2    | Audio output transformer                                    |
| 140-8A   | Vert. osc. transformer                                      |
| 140-9    | Vert. output transformer (Codes 88, 90, 91)                 |
| 140-12   | Power transformer (Codes 88, 90, 91)                        |
| 140-13   | Audio output transformer (Codes 88, 90, 91)                 |
| 140-121  | Hor. output transformer & HV transformer (Codes 88, 90, 91) |
| 140-123A | Vert. output transformer                                    |
| 140-126  | Hor. output & HV transformer                                |
| 140-134  | Power transformer   |
| COILS    |   |
| 30-11    | Filter choke  |
| 30-16A   | Hor. linearity coil   |
| 30-26    | Hor. osc. ringing coil                                      |
| 30-28    | Peaking coil 600μh gray dot                                 |
| 30-30    | Peaking coil 380μh purple dot                               |
| 30-54    | Peaking coil 180μh orange dot                               |
| 30-55    | Peaking coil 160μh yellow dot                               |
| 30-213   | Deflection yoke   |
| 140-120C | Focus coil  |
| 140-130  | Filter choke (Codes 88, 90, 91)                             |

|          |   |
|----------|---|
| 110-126  | Speaker PM 5"                           |
| 110-116  | Speaker PM 8"                           |
| CONTROLS |   |
| 20-2A    | Horiz. speed control, 50KΩ              |
| 20-2A    | Vert. speed control, 1MΩ                |
| 20-9A    | Audio taper, 250KΩ (Volume control)     |
| 20-9A    | Contrast control 750Ω tap at 250        |
| 20-10    | Brightness control, 100KΩ               |
| 20-5     | Vert. size, 2.5MΩ                       |
| 20-121   | Vert. linearity, 2KΩ                    |
| T-20-8   | Focus control, 1.5KΩ (Codes 88, 90, 91) |
| T-40-1   | Horiz. drive, 25-280mmf trimmer         |

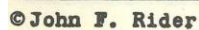






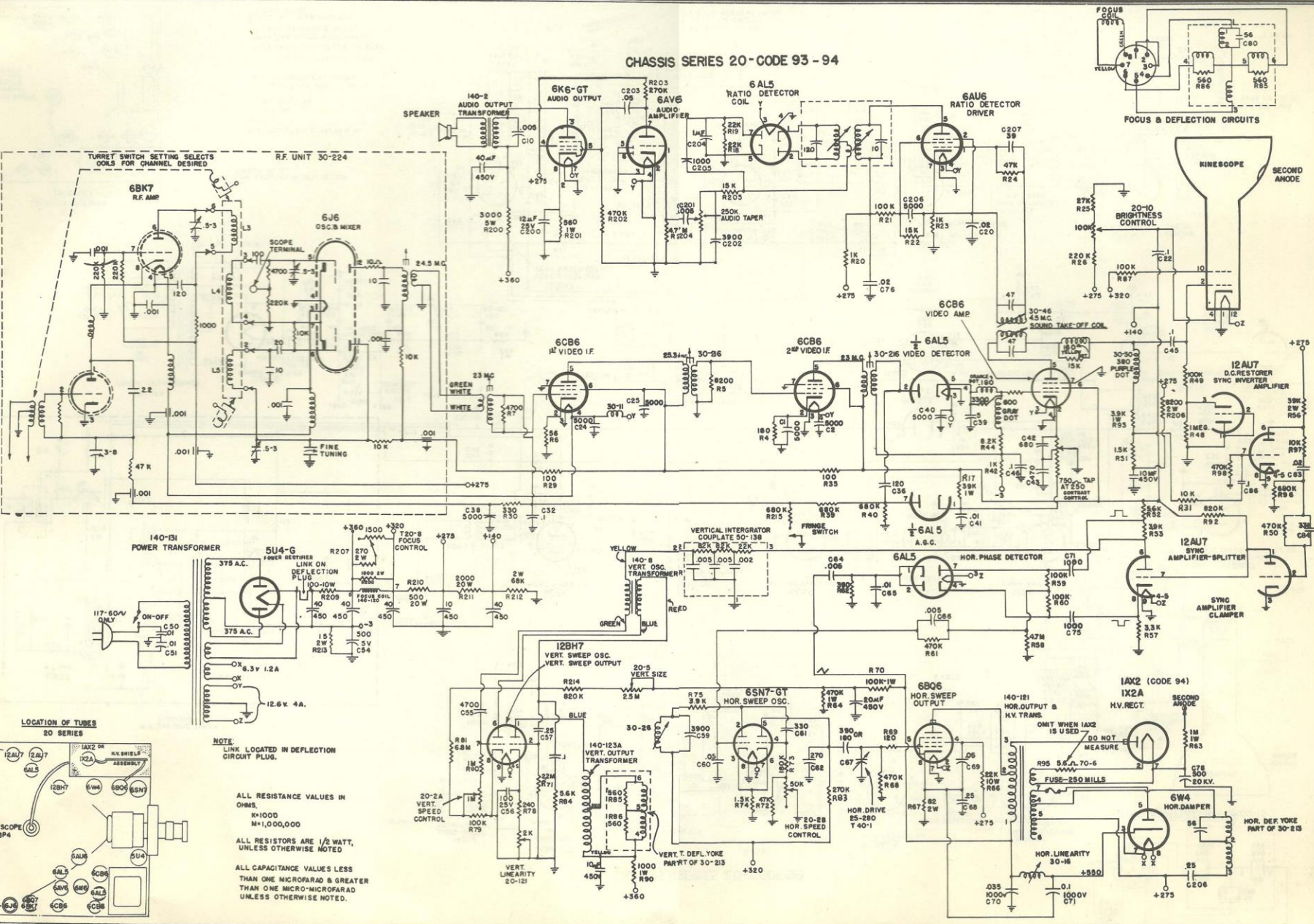








# CHASSIS SERIES 20-CODE 93-94





### FOCUS & DEFLECTION CIRCUITS

