

ELECTRONIC TUBE REFERENCE

CONSOLIDATED TECHNICAL DATA
1 SECTION
CONSTRUCTION
CATHODERAY

15HP22

Specialized - Cathode Ray electronic tube

P22 cathode-ray picture tube documented by CBS-Hytron; available extracted manufacturer data is too sparse to support additional specialized characteristics.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	—
NOMINAL HEATER	— / —	PARALLEL HEATER	— / —
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION1 Cathode Ray
No fixed ratings recorded.
Color television CRT display system.

15HP22 — Tri-Color Picture Tube

The **15HP22** (also designated as the CBS-Colortron Type 15HP22) is an aluminized, direct-view, tri-color picture tube designed for use in color-television receivers. It features electromagnetic deflection and electrostatic focusing, providing a deflection angle of approximately 45 degrees. The tube is capable of displaying either full-color or black-and-white pictures on a screen area of approximately 116 square inches.

Mechanical Construction and Screen Assembly

The 15HP22 utilizes an all-glass construction with a unique curved mask-and-screen assembly designed to simplify manufacturing and improve operational stability.

Phosphor Screen

The tri-color, phosphor-dot screen is processed directly onto the inside surface of the spherical glass face plate. This direct application minimizes dynamic focusing and convergence requirements, resulting in sharper, brighter images. The screen uses the JETEC P22 phosphor designation, which exhibits medium persistence across all three primary colors:

- **Red:** Red fluorescence and red phosphorescence.
- **Blue:** Blue fluorescence and blue phosphorescence.
- **Green:** Green fluorescence and green phosphorescence.

The screen contains approximately 250,000 phosphor dots of each primary color, which calculates to a total of 750,000 individual phosphor dots (250,000 groups multiplied by 3 colors equals 750,000 dots). These dots are arranged in 250,000 triangular groups, or triads, each containing one red, one blue, and one green dot.

Aperture Mask and Kinematic Mounting

A thin, arched aperture mask is positioned approximately 0.4 inch behind the phosphor screen, situated between the screen and the electron-gun assembly. The mask contains approximately 250,000 round holes, with each hole precisely aligned with a corresponding phosphor triad on the screen.

The mask assembly is mounted using a kinematic design to prevent misregistration caused by thermal expansion. It is held in place by spring clips on three glass hemispheres molded directly around the edge of the face plate, outside the active picture area. The mask features three "V"-shaped surfaces that rest over these hemispheres. Because the mask is unstressed, it is free to expand and contract during operation without causing color misregistration.

Electron Gun and Basing Configuration

The tube incorporates an electron-gun assembly containing three matched, electrostatic-focus electron guns. Each gun is structurally similar to the gun used in the [5TP4](#) projection-type black-and-white tube.

Gun Arrangement

The three guns are arranged in a triangular configuration, aligned parallel to and equidistant from the central axis of the tube. Each gun is angularly displaced from the others by 120 degrees in a plane perpendicular to the tube axis.

The heaters of the three guns are electrically connected in parallel within the tube. The overall heater requirements are:

- **Heater Voltage:** 6.3 V
- **Heater Current:** 1.8 A
- **Heating Method:** Indirectly heated unipotential cathodes

Basing and Pin Connections

The 15HP22 uses a small-shell bidecal 14-pin base (JETEC No. B14-103) and is designed to fit a Cinch No. 57C17902 socket or equivalent. The pin connections, viewed from the bottom of the base, are assigned as follows:

Pin	Connection
1	Heater
2	Cathode of red gun
3	Grid No. 1 of red gun
4	Grid No. 2 of red gun
5	No connection
6	Grids No. 3 (internally tied)
7	Cathode of green gun
8	Grid No. 1 of green gun
9	Grid No. 2 of green gun
13	Grid No. 4 (common convergence electrode)
17	Grid No. 2 of blue gun
18	Grid No. 1 of blue gun
19	Cathode of blue gun
20	Heater
Metal Flange	Anode

Electrical Characteristics and Capacitances

The direct interelectrode capacitances of the 15HP22 are measured as approximate values:

- **Grid No. 1 of any gun to all other electrodes** (except the Grid No. 1 electrodes of the other two guns): 7.5 uuf
- **Three cathodes externally tied together to all other electrodes:** 17.5 uuf
- **Grid No. 3 (all three internally tied) to all other electrodes:** 12.0 uuf
- **Grid No. 4 (common to all three guns) to all other electrodes:** 7.0 uuf
- **External conductive coating:** 1500 uuf minimum, 2500 uuf maximum

Operating Conditions and Maximum Ratings

The operating potentials of the 15HP22 must be carefully regulated to maintain proper color registration and focus. The maximum ratings are based on the Design-Center system.

Maximum Ratings

- **Anode Voltage:** 20,000 V d-c
- **Grid-No. 4 (Convergence) Voltage:** 11,000 V
- **Grid-No. 3 (Focus) Voltage:** 5,000 V
- **Grid-No. 2 (Accelerating) Voltage (each gun):** 500 V d-c
- **Grid-No. 1 (Control) Voltage (each gun):**
 - *Negative-bias value:* 200 V d-c
 - *Positive-bias value:* 0 V d-c
 - *Positive-peak value:* 2 V
- **Peak Heater-Cathode Voltage (each gun):**
 - *Heater negative with respect to cathode (during warm-up, ≤ 15 seconds):* 410 V
 - *Heater negative with respect to cathode (after warm-up):* 180 V
 - *Heater positive with respect to cathode:* 180 V

Typical Operating Conditions

Under typical operating conditions, the electrodes are biased as follows:

- **Anode Voltage:** 20,000 V
- **Grid-No. 4 (Convergence) Voltage (approximate):** 9,300 V
- **Grid-No. 3 (Focus) Voltage (approximate):** 3,100 V
- **Grid-No. 1 Voltage (each gun, for visual extinction of focused raster):** -45 V to -100 V (with Grid-No. 2 at 200 V)
- **Grid-No. 2 Voltage (each gun):** 240 V (with Grid-No. 1 at -75 V)
- **Maximum Grid-No. 4 Current:** 5 microamperes
- **Maximum Peak Grid-No. 3 Current:** 300 microamperes

Circuit and System Requirements

High-Voltage Regulation

To prevent misregistration of the three color images, the regulation of both the anode and convergence voltages must be maintained within two percent. These high voltages are typically derived from the full winding of a tapped autotransformer in a flyback-type deflection system. A separate tap on the same autotransformer supplies the focus rectifier tube. To achieve the required two-percent regulation, a shunt regulator or a corona discharge tube must be employed in the circuit. Focus and convergence adjustments are made using potentiometers in a high-voltage divider network.

Dynamic Convergence and Focus

Because the distance from the electron guns to the screen varies as the beams scan across the spherical face plate, dynamic voltages must be superimposed on the static convergence and focus potentials:

- **Horizontal-dynamic-convergence voltage:** approximately 550 V peak-to-peak
- **Vertical-dynamic-convergence voltage:** approximately 200 V peak-to-peak
- **Dynamic-focus voltage:** approximately 150 V peak-to-peak

Scanning Failure Protection

If scanning should cease during operation, the intense, stationary electron beams can cause permanent damage to the screen-and-mask assembly. To prevent this, receivers must incorporate an electronic switch activated by the horizontal and vertical deflection voltages. A recommended method is to derive the Grid-No. 2 voltages from the boost voltage of the horizontal scanning circuit (which also powers the vertical deflection system). If scanning fails, the boost voltage drops, removing the Grid-No. 2 potential and cutting off all beam current.

Shielding and Safety

- **Magnetic Shielding:** A magnetic shield made of MuMetal or an equivalent high-permeability material must be placed snugly over the cone of the glass bulb to shield the electron beams from the earth's magnetic field and stray fields.
- **X-Ray Protection:** Because the tube operates at voltages up to 20,000 V, X-ray shielding may be necessary if operating voltages exceed 16,000 V. Adequate shielding is typically provided by the safety glass mounted in front of the television cabinet.

External Components and Alignment

Proper operation of the 15HP22 requires several external magnetic components mounted on the neck of the tube:

1. **Beam-Positioning Magnets:** A combination of three small, moveable permanent magnets mounted on a non-ferrous ring, located approximately 1-1/2 inches from the tube axis in the Grid-No. 2 region. Each magnet has a field strength of approximately 8 gauss (Sickles No. 17086-1 or equivalent). These magnets adjust the individual beams so they are properly aligned before entering the convergence lens.
2. **Color-Purifying Coil:** Located on the neck in the region of grids 2 and 3 (Sickles No. 17086-1 or equivalent). It produces a transverse magnetic field perpendicular to the tube axis. It requires a current source of 0 to 200 mA. Rotating and sliding this coil adjusts the common axis of the three beams to achieve optimum color purity.
3. **Deflection Yoke:** A yoke consisting of four electromagnetic coils operating in pairs (Sickles No. 17080-1 or equivalent). It must provide highly uniform magnetic fields to deflect all three beams simultaneously. To allow for color purity adjustments, the yoke must be capable of being moved 2 inches back from the glass funnel toward the tube base.

Installation and Adjustment Procedure

A systematic procedure must be followed to minimize setup time and ensure proper alignment:

1. Purity Adjustment

- Pull the deflection yoke back from the glass funnel by approximately 2 inches.
- Turn the Grid-No. 2 controls to zero and Grid-No. 1 controls to maximum negative bias.
- Apply operating voltages and deflection power.
- Slowly increase the Grid-No. 2 voltage of the red gun and reduce its Grid-No. 1 bias until the screen is illuminated.
- Energize the color-purifying coil. Move and rotate the coil along the neck, and vary its current, until a pure red field is centered on the screen (surrounded by radial blue and green fields).
- Slide the deflection yoke forward toward the face plate until a uniform red field covers the entire screen.
- Verify the purity of the blue and green fields individually.

2. Convergence Adjustment

- **Static Convergence:** Use a spot generator to project a grid of spots on the screen. Adjust the static convergence voltage and the external beam-positioning magnets until the red, blue, and green components of the spots in the center of the screen are perfectly superimposed.
- **Dynamic Convergence:** Adjust the amplitude and waveform of the horizontal-dynamic-convergence voltage to converge the horizontal rows of spots near the center. Then, adjust the vertical-dynamic-convergence voltage to converge the vertical rows. Repeat these adjustments alternately to account for control interaction.

3. Color Balancing (Grey-Scale Adjustment)

Because the phosphors have different luminescence efficiencies, the gun transfer characteristics must be balanced to produce a neutral grey scale:

- Set all Grid-No. 2 voltages to the same initial value.
- Adjust Grid-No. 1 voltages to produce a low-level grey field.
- Increase the brightness using a master control or by simultaneously varying the signal on all No. 1 grids.
- Identify the dominant color at high brightness, return to low brightness, and reduce the Grid-No. 2 voltage of the gun corresponding to that dominant color.
- Repeat this process until the field remains neutral grey across the entire brightness range.

Technical Summary

The **15HP22** is an all-glass, 45-degree, tri-color picture tube utilizing three matched electrostatic-focus guns and a shared 6.3 V, 1.8 A parallel heater. It features a spherical face plate with a directly deposited 750,000-dot phosphor screen (JETEC P22) and an unstressed, kinematically mounted curved aperture

mask. Operating at an anode potential of 20,000 V, it requires precise high-voltage regulation (within 2%), dynamic convergence voltages, and specialized external magnetic components (beam-positioning magnets, color-purifying coil, and a high-uniformity deflection yoke) to achieve optimum color purity, convergence, and grey-scale balance.