

# CBS-COLORTRON "205"

## RETMA TYPE 19VP22

### Data and Application Notes

19VP22  
THE  
CBS-COLORTRON  
"205"

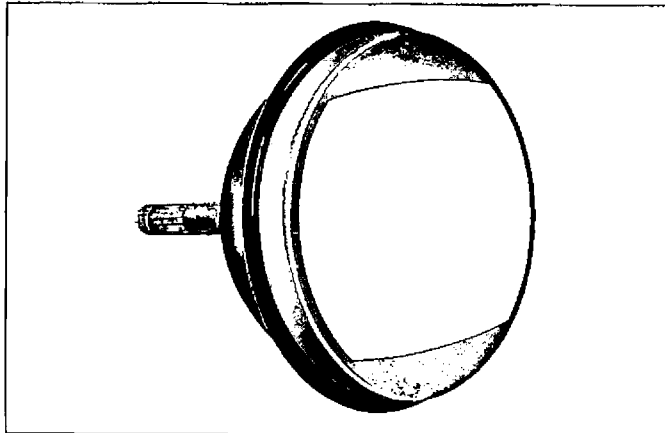


Fig. 1. The CBS-Colortron "205"

The CBS-Colortron "205" is a 19-inch, aluminized, glass-envelope, tri-color picture tube designed for use in color television receivers. By utilizing the CBS-Hytron method of applying the phosphor dots to the inner surface of the face plate, the "205" provides truly large-screen color television. The actual useful screen area of this 19-inch CBS-Colortron is 205 square inches. In addition to the large-screen surface, the CBS-Colortron "205" incorporates an electromagnetic convergence system that eliminates the high-voltage problems associated with electrostatic convergence. This convergence system and other features are described in detail in later sections of this bulletin.

The electrostatically-focused and magnetically-deflected CBS-Colortron "205", in short, provides: 205 square inches of useful viewing surface . . . electromagnetic convergence . . . wide-angle 62° deflection and 26 7/16-inch over-all length for cabinet economy . . . and the unique CBS-Hytron mask-and-screen assembly that facilitates the use of low-cost mass production techniques.

#### ELECTRON-GUN ASSEMBLY

The electron-gun assembly of the "205" contains three matched electron beam sources arranged in a triangular configuration. Each of the three beam sources is tilted toward the common tube axis. This tilted structure provides proper convergence of the beams at the center of the screen. The electron-gun assembly of the "205" contains three pairs of pole pieces mounted 120° apart above the anode.

#### PHOSPHOR SCREEN AND SHADOW MASK

By a new method of screen processing, the tri-color, phosphor-dot screen is placed directly on the inside surface of the spherical face plate of the CBS-Colortron. In addition to achieving simple construction and high-quality reproduction, many electrical and structural advantages are realized, because of this advanced design. Dynamic convergence requirements are reduced; sharper, brighter pictures result; adjustment time is reduced to a minimum; and a simple, stable over-all tube construction is attained.

The phosphor screen of the CBS-Colortron contains some 300,000 phosphor dots of each primary color, a total of 900,000 phosphor dots. These dots are arranged in 300,000 triangular groups, or triads. Each triad contains one red, one blue, and one green phosphor dot.

Another component of the CBS-Colortron is the shadow mask. See Figure 2. This thin, arched mask is located between the phosphor screen and the electron-gun assembly. It contains approximately 300,000 uniform-size, round holes, one for each triad on the screen. Since the position of these holes relative to the triads is of paramount importance for proper tube operation, the mask is accurately positioned with relation to the triads and is approximately 0.4 inch behind the phosphor screen.

#### MASK-AND-SCREEN ASSEMBLY

As can be seen in Figure 2, the entire mask assembly is exceedingly simple. It consists of the curved mask with spring clips to hold it in place. This assembly is mounted on three

hemispheres, which are raised points of glass molded around the edge of the face plate, beyond the picture area.

The mask contains three "V"-shaped surfaces which rest over the hemispheres and make use of the kinematic principle of precise location. Since the mask is unstressed, it is free to expand and contract. This combination of a curved face plate and a curved, unstressed mask automatically permits expansion and contraction without misregistration.

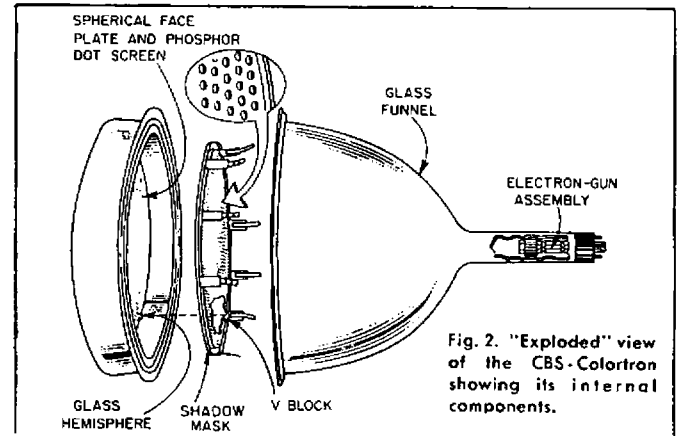


Fig. 2. "Exploded" view of the CBS-Colortron showing its internal components.

#### PRINCIPLES OF TUBE OPERATION

A logical starting point to discuss tube operation is the electron-gun assembly made up of three identical electron beam sources arranged in a triangular configuration. The resultant beams are also in the same triangular arrangement relative to the tube axis.

Each of these beams is individually modulated by a composite voltage that consists of color and brightness information. By utilizing a separate composite signal for each beam source, the individual beams are modulated in accordance with the transmitted signal, and are of the proper intensities for their respective colors.

The modulated beams are also focused by their respective beam sources. This focusing, similar to that in conventional black-and-white tubes, is accomplished by the electrostatic lens formed by grids 2 and 3. Since the focusing electrodes (grid 3 of each of the three beam sources) are internally connected together, a common focusing voltage may be used. This feature simplifies the associated circuitry.

The three electron beams are then acted upon by the magnetic fields created by three external electromagnets mounted on the tube neck. The electron-gun assembly contains three sets of pole pieces mounted above the anode. Magnetic fields, created by three electromagnets on the tube neck, are induced in these three sets of pole pieces and provide dynamic convergence control of each of the three electron beams. Small d-c fields may also be induced in these pole pieces to compensate for slight manufacturing variations that might otherwise impair proper mechanical static convergence.

These electromagnets provide radial adjustment of each of the three beams. Since it may not always be possible to converge properly the three beams by radial adjustment only, an external blue-beam positioning magnet is used to provide tangential movement of the blue beam. The combination of the three external electromagnets and the blue-beam positioning magnet insures the realization of center convergence.

The dynamic convergence produced by the electromagnetic fields varies the point of convergence in accordance with the position of the beams as they scan the phosphor screen. The spherical shape of the mask and screen of the CBS-Colortron reduces the dynamic-convergence requirements and facilitates easy convergence adjustment in the receiver. A suggested circuit for the derivation of the convergence currents is shown in Figure 3.

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**CBS-HYTRON**

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In the ideal case, the three beams leave the magnetic convergence fields so aligned that, when deflected, they approach the shadow mask at the correct angles properly converged. In the practical case, however, this is not always true. For this reason, it is necessary to employ external components to align properly the three beams.

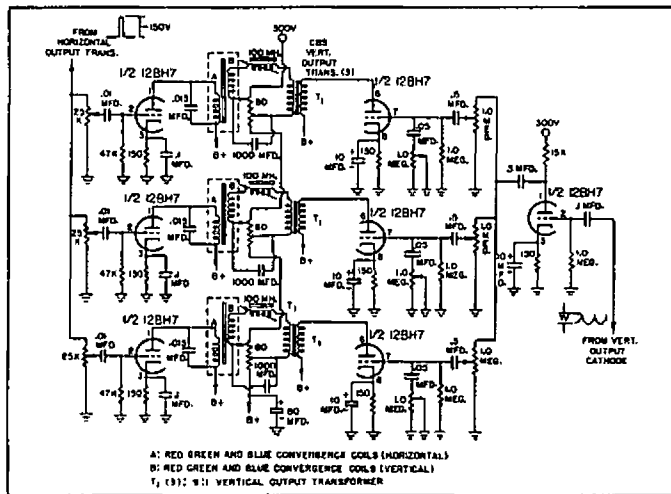


Fig. 3. Suggested circuit for the derivation of convergence currents.

Two of these external components, the blue-beam positioning magnet and the magnetic convergence coils, have already been described. The other external component necessary for proper beam alignment is the color-purifying coil. The magnetic field produced by this coil is perpendicular to the tube axis. This field acts upon the three beams simultaneously and, by proper adjustment of its strength, and its axial and rotational position, the common axis of three beams can be positioned to achieve optimum color purity. The coil is located on the neck of the tube in the region of grids 2 and 3. The construction of the coil should allow it to be rotated and moved along the neck of the tube.

After the beams have been acted upon by the alignment components and the magnetic convergence fields, they enter the deflection area. Here, the deflection yoke provides the required uniform magnetic fields that simultaneously deflect the three beams.

As in black-and-white tubes, the deflection yoke consists of four electromagnet coils. These coils function in pairs, each coil of a pair located diametrically opposite the other. Since this deflection yoke acts simultaneously on three beams, the electromagnetic field requirements are more stringent than those in black-and-white tubes. In particular, a more uniform field is required for deflection in the tri-color tube.

The electron beams travel in straight line paths from the deflection area to the screen. Between the phosphor screen and the deflection area is the shadow mask. This mask is positioned so that, when viewed from the deflection point of any of the beams, only the dots of a single color can be seen through the perforations in the mask. Figure 4 illustrates this condition.

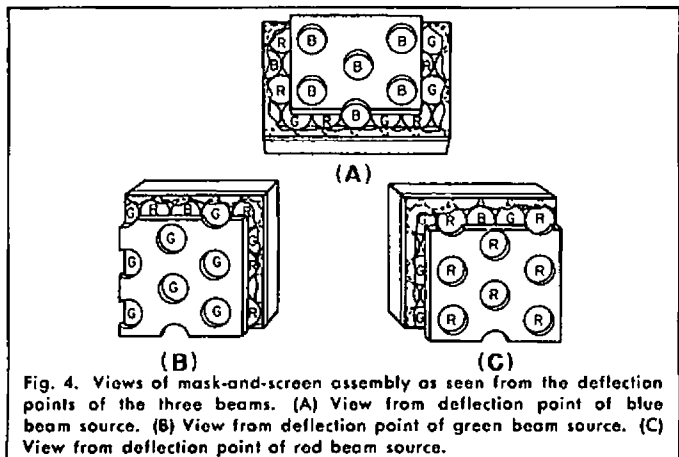


Fig. 4. Views of mask-and-screen assembly as seen from the deflection points of the three beams. (A) View from deflection point of blue beam source. (B) View from deflection point of green beam source. (C) View from deflection point of red beam source.

With the mask in the position described above, one beam will strike only the red dots, another beam will strike only blue dots, and the third beam will strike only green dots. This mask, conse-

quently, allows the three beams to reproduce the exact hue present in each portion of the televised scene.

## APPLICATION CONSIDERATIONS

### TUBE HANDLING

The CBS-Colortron should never be lifted by its neck alone. It is recommended that the tube be lifted by the glass bulb and neck, or by the bulb alone. Special care should be taken to avoid striking or otherwise damaging the metal flange near the face plate of the tube.

### COVER FOR FACE PLATE

A safety glass should be mounted in front of the tube when installed in a television cabinet to provide protection against accidental striking of the face plate and possible tube implosion. This precaution is similar to conventional black-and-white tube requirements.

### SUPPORT

Supports for the CBS-Colortron, which weighs approximately 31 pounds, should be in the form of an insulated support at the large end of the tube and another near the small end of the bulb. Support for this tube should never be provided at the neck of the tube. Since the deflection yoke must be free to move in an axial and transverse direction, tube supports in this area are also not advisable.

### HIGH-VOLTAGE REQUIREMENTS

Briefly stated, the high-voltage requirements of the CBS-Colortron "205" are: anode, 25,000 volts with a maximum peak current of 3,000 microamperes; focus electrode, 8,000 volts with a maximum current drain of 300 microamperes. In addition, it is desirable that the regulation of the anode voltage be maintained within two percent.

The regulated voltage for the anode may be derived from a fly-back-type deflection system that employs a tapped autotransformer. This voltage is obtained by using a pulse doubler rectifier system from the tertiary winding of the autotransformer. A separate tap of the same autotransformer supplies the voltage to the focus rectifier tube.

Since two-percent regulation is desirable for the anode voltage supply, a shunt regulator tube should be employed, such as the CBS-Hytron 6BD4A.

Adjustment of the focus potential can be achieved by the use of a potentiometer in the high-voltage divider network.

### MAGNETIC CONVERGENCE COILS

The function of the three magnetic convergence coils has been described in a preceding section. The approximate position of the unit containing these coils is shown in Figure 5. The three individual electromagnets are positioned 120° apart around the circumference of this unit and over the internal pole pieces. Rola Type CC600 magnetic-convergence-coil unit is recommended for use with the CBS-Colortron "205".

### COLOR-PURIFYING COIL

The function of this coil has been described in a preceding section. The approximate position of the coil on the neck of the tube is shown in Figure 5. By rotating the coil around the neck of the tube, the transverse magnetic field will move the beams in different directions. The current through the coil determines the magnitude of the movement. A typical coil (Rola CP600) requires a current source capable of supplying from 0 to 200 milliamperes.

### FIELD NEUTRALIZING COIL

In order to reduce the effect of axial stray fields, a D.C. field neutralizing coil located around the periphery of the "205" face plate is required. It should be approximately 21 inches in diameter and capable of producing about 15 ampere-turns (150 turns of No. 24 wire and a current source with a range from +100 milliamperes to -100 milliamperes). Adjustment of this component is described in the INSTALLATION AND ADJUSTMENT PROCEDURE Section of this bulletin.

### BLUE-BEAM POSITIONING MAGNET

The function of this unit has also been described in a preceding section. Figure 5 illustrates the position of this magnet on the neck of the tube. The magnet is mounted to provide for reversal of its polarity and the position of the magnet controls the magnitude of the correction.

### DEFLECTION YOKE

The deflection yoke recommended for use with the "205" is Rola Type CY600 or equivalent. To permit adjustment for color purity, the deflection yoke, when placed against the glass funnel, should be capable of being moved two inches toward the tube base.

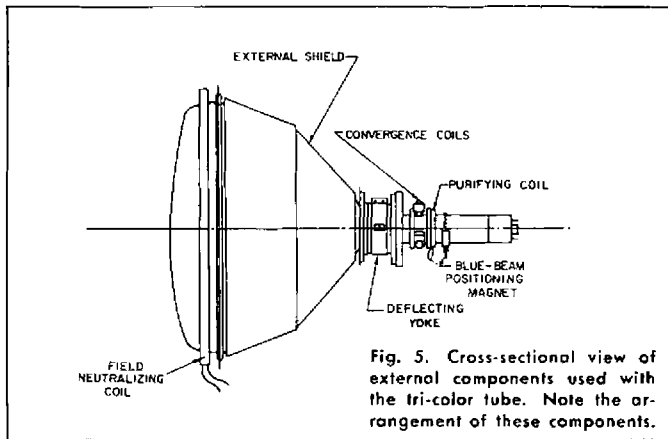


Fig. 5. Cross-sectional view of external components used with the tri-color tube. Note the arrangement of these components.

## GRID NO. 1 DRIVE CHARACTERISTICS AND REQUIREMENTS

The three electron beam sources of the CBS-Colortron have similar transfer characteristics. Due to the differences in phosphor luminescence efficiencies, however, the grid-No. 1 and grid-No. 2 voltages of each beam source must be adjusted to produce equal phosphor brightness or color balance. If color balance is not maintained when the tube is reproducing black-and-white pictures, for instance, color tinting of the gray scale will result. It is recommended that individual grid-No. 2 voltage controls and grid-No. 1 drive controls be provided. The grid-No. 2 controls should allow voltage adjustment from 100 to 450 volts.

## PROTECTION AGAINST SCANNING FAILURE

Permanent damage may be done to the screen-and-mask assembly if scanning should cease during tube operation. For this reason, an electronic switch activated by the horizontal and vertical deflection voltages should be provided. The circuit should be arranged so that, in case of scanning failure, all beam current will be cut off.

A convenient method of achieving this protection is by obtaining the grid-No. 2 voltages from the boost voltage of the horizontal scanning circuit. This boost voltage also serves to power the vertical deflection system. Any failure of scanning, consequently, would remove the voltage from the No. 2 grids, and all beam current would cease.

## MAGNETIC SHIELDING

Optimum performance of the CBS-Colortron necessitates proper shielding against the effects of the earth's magnetic field and stray fields around the picture tube. A magnetic shield of MuMetal or equivalent material should be placed over the bulb portion of the tube. Placement of magnetic components of the receiver so that the effect of their fields on the picture tube is minimized will result in improved tube performance. A typical shield is shown on page 4.

## INSTALLATION AND ADJUSTMENT PROCEDURE

By following a systematic adjustment procedure, adjustment time of the CBS-Colortron can be reduced to a minimum. Such a procedure is described in this section. In addition to the procedural steps, screen patterns that will be observed during each step are described.

When the CBS-Colortron is removed from its carton, it should be handled by the bulb and not by the neck of the tube. Care should be taken to prevent damage to the metal flange near the face plate of the tube. The tube should be mounted securely in the manner described in the SUPPORT Section of this bulletin.

After mounting, the color-purity coil, convergence magnets, and deflection yoke should be placed on the neck of the tube. The approximate position of each of these components is described in the APPLICATION CONSIDERATIONS Section of this bulletin. Also, refer to Figure 5 for a graphic illustration of these external components. Once these components are positioned on the neck of the tube, the socket and high-voltage connections may be made.

Before applying voltages to the tube, turn the grid-No. 2 controls to zero and the grid-No. 1 controls to their maximum negative positions. Then, apply the proper potentials to the electrodes of the tube, and sweep power to the deflection yoke. Initially, some arcing or sputtering may be observed. This is a normal reaction.

After allowing sufficient time for the various supplies to stabilize, slowly increase the grid-No. 2 voltage of the red beam source, simultaneously reducing the grid-No. 1 bias until the screen is illuminated.

The next step is to adjust the purity coil. This adjustment should be made in the following steps:

1. Pull the deflection yoke back from the funnel of the tube approximately 2 inches.
2. Energize the color-purity coil.
3. Move the purity coil along the neck of the tube, while simultaneously rotating it and varying the current through it, until the purest red field is obtained in the center of the screen. It will be noted that the pattern on the screen also contains alternate blue and green fields extending radially out from this red center.
4. Slide the deflection yoke in the direction of the face plate until the most uniform red field is obtained over the entire screen.
5. Adjust the magnitude and direction of the current through the field neutralizing coil for optimum edge purity.

Once the most uniform red field is obtained, slight readjustment of the color purity coil may be required to achieve optimum color purity. The adjustment may be made by varying the current through the purity coil or by additional movement of the coil.

After obtaining optimum purity of the red field, the blue and green fields should be separately checked. No further adjustment of the color purity coil should be necessary.

Convergence is the next characteristic to be adjusted. Convergence adjustment is facilitated by use of a spot generator. This spot generator should be capable of producing equally spaced horizontal and vertical rows of spots on the phosphor screen. Each of these spots contains individual red, blue, and green components. Proper convergence is attained when the three color components are superimposed.

Initially, red and green static convergence is adjusted by varying the d-c current through the red and green magnetic convergence coils until the red and green dots at the center of the raster overlap. The blue static convergence is then adjusted by varying the d-c current through the blue magnetic convergence coil and by adjusting the blue-beam positioning magnet until the blue dot at the center of the raster overlaps the red and green dots.

Dynamic convergence can be optimized after static convergence is attained. Horizontal dynamic convergence is obtained by adjustment of the amplitude of the parabolic horizontal current wave applied to the three external convergence electromagnets. This current should be varied until each triad in the horizontal row that passes through the center of the screen is the same size. Then the d-c current through the three electromagnets should be adjusted to bring all the triangles of this horizontal row into proper convergence.

Vertical dynamic convergence is attained by varying the magnitude of the parabolic vertical current wave applied to the external electromagnets until each triad of the vertical row that passes through the center of the screen is the same size. The dots of each triangle can be converged by the readjustment of the d-c current through the electromagnets. Because of the interaction between the horizontal- and vertical-convergence adjustments, it is recommended that these adjustments be performed alternately until optimum convergence is attained.

The final adjustment of the CBS-Colortron is the setting of the color balance. As was previously stated, the transfer characteristics and bias voltages of the three beam sources must be adjusted to produce a grey scale with no color tinting.

The following steps should be taken to achieve color balance.

1. Set each grid-No. 2 voltage at the same value.
2. Set each grid-No. 1 voltage so that a low-level grey field is obtained on the screen.
3. Increase the brightness level of the composite field on the screen. This may be done by varying a master brightness control, or by varying a signal voltage simultaneously applied to all No. 1 grids.
4. As the brightness is increased during Step 3, observe which color becomes dominant.
5. Reduce the brightness of the field to the level in Step 2.
6. Reduce the grid-No. 2 voltage of the beam source controlling the dominant color.
7. Repeat steps 3 through 6 until no color tinting is observed over the required brightness range.

This color-balancing procedure can be simplified by the use of a combination of a density wedge and flying-spot scanner.

The foregoing adjustment procedure represents the method that achieves the fastest alignment consistent with optimum operational quality. After these steps have been completed, further adjustment should not be required. But further adjustment of the various components can be made to overcome any undesirable characteristics that may result from improper initial adjustment.

# DATA ON THE "205"

## GENERAL CHARACTERISTICS

### Electrical Data

Heater for unipotential cathode each beam source\*:

Voltage	6.3 volts
Current	1.8 amperes

Focusing method ..... Electrostatic  
 Convergence method ..... Electromagnetic  
 Deflection method ..... Magnetic  
 Deflection angle (approximate) ..... 62 degrees  
 Electron beam sources ..... Red, Blue, Green

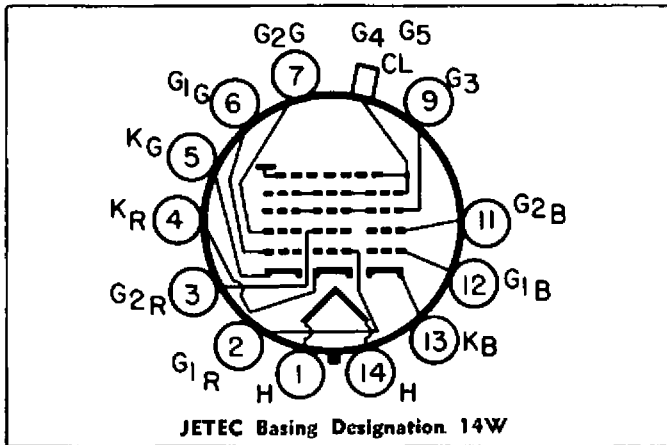
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Fluorescence	Red	Blue	Green
Phosphorescence	Red	Blue	Green
Persistence	Medium	Medium	Medium

Direct interelectrode capacitances (approximate):

Grid No. 1 of any beam source to all other electrodes except No. 1 grid of other two beam sources	7.0 uuf
Three cathodes externally tied together to all other electrodes	10.0 uuf
Grid No. 3 (all three No. 3 grids tied together internally) to all other electrodes	6.0 uuf
EXTERNAL conductive coating	1500 uuf min. 3000 uuf max.

Screen ..... Metal-backed, tri-color, phosphor-dot type  
 Face plate light transmission (neutral density filter) approx. .... 75%  
 Phosphor-dot arrangement . . . Approximately 300,000 triangular groups each containing a blue, red, and green dot (a total of 900,000 dots).



**Basing Diagram**

- |  |  |
|--|--|
| Pin 1: Heater                          | Pin 7: Grid No. 2 of green beam source |
| Pin 2: Grid No. 1 of red beam source   | Pin 9: Grids No. 3                     |
| Pin 3: Grid No. 2 of red beam source   | Pin 11: Grid No. 2 of blue beam source |
| Pin 4: Cathode of red beam source      | Pin 12: Grid No. 1 of blue beam source |
| Pin 5: Cathode of green beam source    | Pin 13: Cathode of blue beam source    |
| Pin 6: Grid No. 1 of green beam source | Pin 14: Heater                         |
- Metal Flange: Anode

### Mechanical Data

Approximate weight	31 pounds
Maximum over-all length	26 7/16 inches
Maximum face-plate diameter	19 1/2 inches
Maximum metal-flange diameter	20 27/32 inches
Screen size (14 x 3 aspect ratio)	17 1/2 x 13 3/8 inches
Screen area	205 square inches
Bulb contact	Metal-flange seal
Base	Small shell diheptal 12-pin (JETEC B12-105)

Mounting position ..... Blue Gun Down  
 Deflection yoke ..... Rola Type CY600  
 Horizontal output transformer ..... Rola Type CF600  
 Magnetic convergence coils ..... Rola Type CC600  
 Color purifying coil ..... Rola Type CP600

### MAXIMUM RATINGS — Design-Center Values

Anode voltage	27,000 volts
Anode input	20 watts
Peak anode current to not more than 25 square inches of picture area (with 205 square inch scan)	3,000 uamps
Grid-No. 3 voltage	9,000 volts
Grid-No. 2 voltage (each beam source)	500 volts
Grid-No. 1 voltage (each beam source):	
Negative-bias value	200 volts
Positive-bias value	0 volts
Positive-peak value	2 volts
Peak heater-cathode voltage (each beam source):	
Heater negative with respect to cathode:	
During warm-up period not to exceed 15 seconds	410 volts
After warm-up	180 volts
Heater positive with respect to cathode	180 volts

### TYPICAL OPERATING CONDITIONS

Anode voltage	25,000 volts
Convergence**	
Grid-No. 3 (focus) voltage	6,500 to 8,000 volts
With 200 volts on No. 2-grids, grid-No. 1 voltage***	—45 to —100 volts
With —75 volts on No. 1-grids, grid-No. 2 voltage	150 to 330 volts
Maximum peak grid-No. 3 current	225 uamps
Grid-No. 2 current	—15 to +15 uamps

### CIRCUIT VALUES

Maximum grid-No. 1 circuit resistance ..... 1.5 megohms  
 \*Heaters electrically paralleled within the tube.

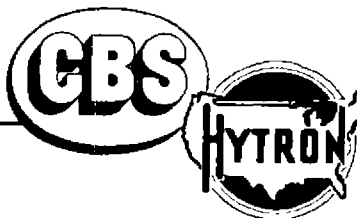
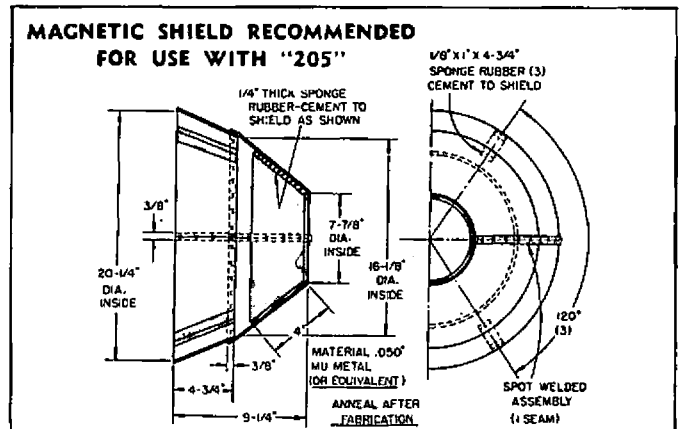
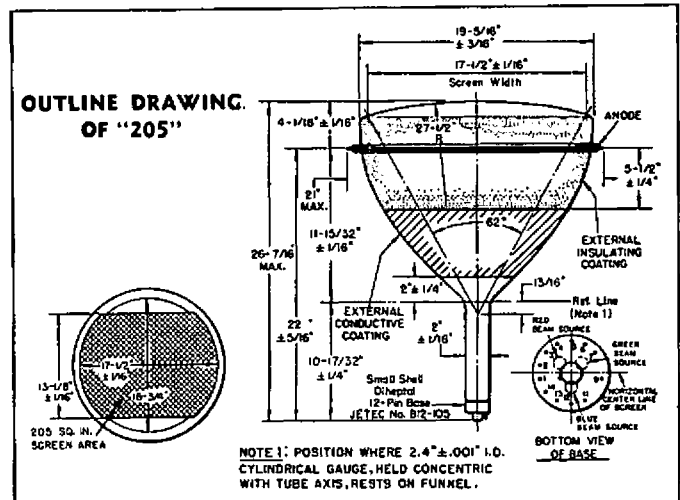
\*\*Convergence is accomplished by a combination of mechanical position of the three electron beam sources during tube fabrication and by the adjustment of the shape and amplitude of current through the magnetic convergence coil assembly. Details on circuitry for the derivation of these currents are shown elsewhere in this bulletin.

\*\*\*For visual extinction of focused raster.

To reduce the effects of stray magnetic fields on color purity, a magnetic shield is recommended. This shield should fit snugly around the cone of the glass bulb. Outline drawing of a recommended shield is shown elsewhere in this bulletin.

### CAUTION

Because the rating of this tube permits operation at voltages as high as 27,000 volts, shielding of the tube for X-ray radiation may be necessary whenever operating conditions involve voltages in excess of 16,000 volts. Sufficient shielding is usually provided by the safety glass in front of the tube.



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