ELECTRON TUBES

RCA Application Note

AN-167

Color-Purity and White-Uniformity Adjustment Procedure for the RCA-21AXP22-A Color Kinescope

This Application Note describes the correct procedure for color-purity and white-uniformity adjustments in equipment employing the RCA-21AXP22-A color kinescope. Although the specific components involved and methods of control may vary with the design of the equipment, the steps of the procedure should always follow the order indicated. This procedure is also applicable for equipment employing the RCA-21AXP22.

When the highest possible degree of color purity is desired, it may be necessary to check the effects of certain adjustments with a hand microscope. No special skill or training in microscope technique is required, however, and the entire procedure may readily be carried out by non-engineering personnel.

GENERAL CONSIDERATIONS

The adjustments described are required in all initial (factory) setups of color-television receivers and monitors. They should be made after the equipment has been completely assembled, and after ultor-voltage, focus, size, linearity, and centering adjustments have been completed. Once purity adjustments have been properly made, it will not usually be necessary to repeat the entire procedure when the equipment is moved to a new location, unless the kinescope neck components (see Fig.1) and their adjustments have been disturbed, or the equipment has been subjected to strong magnetic fields. The kinescope must always be degaussed in the manner described, however, after the equipment is installed in the desired operating position, and after each change in location or orientation. In some instances, minor readjustments may also be necessary in order to reestablish optimum conditions.

EQUIPMENT REQUIREMENTS

The following equipment is required for making color-purity and white-uniformity adjustments, including the static and dynamic convergence adjustments which are part of the procedure:

(a) A signal source supplying a cross-hatch or dot-pattern video test signal, such as the RCA WR-36A Dot/Bar and WG-46A Dot/Crosshatch Generators.

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(b) A simple hand microscope having a magnification of approximately 20X. The microscope is a valuable aid in obtaining optimum color purity because it permits direct observation of "register"--i.e., the areas of the phosphor dots excited by the electron beams--at any portion of the screen. Microscopes which have been found satisfactory for this purpose include the Gaertner[1] Model M101A, equipped with Model M250-240 eyepiece adapter, M247 eyepiece, and M225 objective (providing a total magnification of 24X), and the Edmund[2] "Color-TV Tube Scope", Stock No. 50,099 (20X), or Stock No.50,100 (27X). These microscopes are inverting types.

(Note: Because personal-safety considerations require that neither the operator nor any piece of equipment come in contact with the kinescope faceplate during setup adjustments, microscope observations of register should always be made through a safety-glass or similar protective shield. The optical combinations described above were chosen to provide focus at the screen edge at normal spacing between safety shield and kinescope. When precise focusing at the center of the screen is also desired, it may be necessary to fit the objective end of the microscope with an adjustable extension barrel.)

(c) A flashlight or other portable, low-power light source, used in conjunction with the microscope for observation of the phosphor-dot pattern.

(d) A light source producing white light of approximately 8500 degrees Kelvin, used as a color reference in white-field adjustments. One such source consists of a 4-watt "daylight" fluorescent lamp, a Wratten type 87C color-correcting filter, a 40-per-cent-transmission steel-wire mesh, and two sections of No.7138 Opal Lucite. This combination provides a diffused white-light output comparable to the maximum output of the 21AXP22-A at an ultor voltage of 25 kilovolts.

(e) An RCA Type 205W1 Degaussing Coil, or equivalent.

A useful adjunct for these adjustments as well as for others necessary in color-television equipment is the simple switching arrangement shown in Fig.2. This arrangement permits any of the three beams to be switched on or off without disturbance to the settings of the associated beam controls.

ADJUSTMENT PROCEDURE

COLOR-PURITY ADJUSTMENTS

1. After the equipment has been completely assembled and installed in its production-line setup, test, or final operating position, turn the equipment on, and

   (a) adjust the magnets of the magnetic-field-equalizer assembly (see Fig.1) for minimum field strength. If the assembly uses permanent magnets, withdraw the magnets fully inside their housings; if it uses electromagnets, set the appropriate circuit controls at their "minimum field-strength" positions. (Note: In subsequent degaussing, such as that required each time the equipment is moved to a new location or reoriented, the existing positions or electrical adjustments for the field-equalizer magnets should not be disturbed.)

   (b) place the degaussing coil symmetrically against the kinescope faceplate shield, and plug the coil into a 117-volt, 60-cycle supply output. Move the coil slowly over the area of the faceplate for about 10 seconds, and then slowly withdraw it to a distance of not less than 6 feet from the faceplate and disconnect the coil from the ac line.

2. Apply a video test-pattern signal to the equipment and adjust the appropriate controls for the radial-converging-magnet assembly and lateral-converging magnet until static convergence is obtained at the center of the kinescope screen.

3. Remove the video test-pattern signal, and switch or bias off the blue and green beams. Adjust the red intensity control for a red field of medium brightness, and move the deflecting yoke back (towards the kinescope base) as far as possible. (Caution: Use care not to change the position of the radial-converging-magnet assembly during this adjustment.)

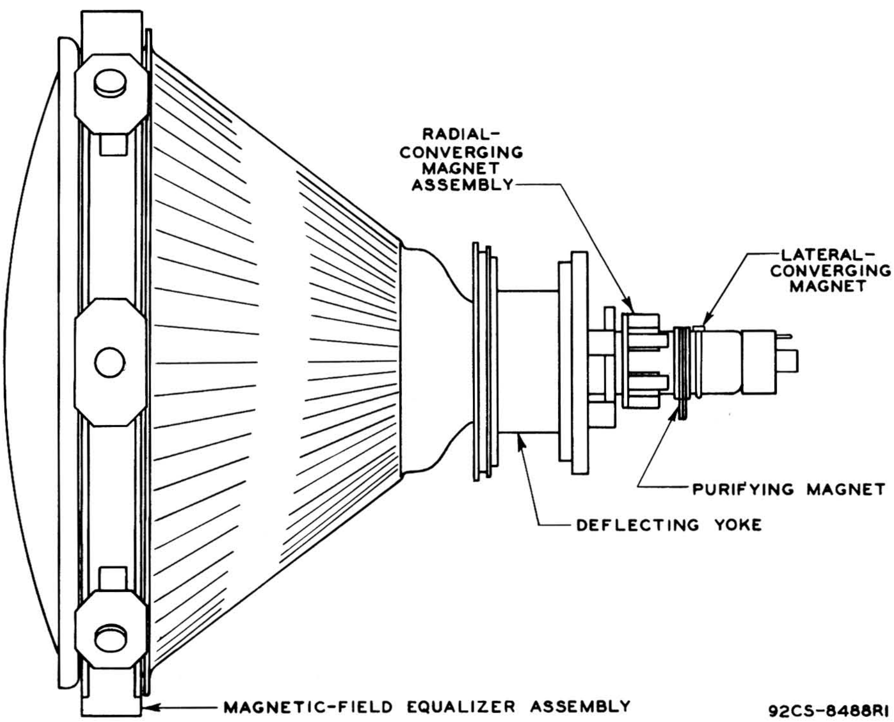

Fig.1 - Relative positions of envelope and neck components involved in color-purity adjustments.

4. Rotate the purifying magnet on the kinescope neck, and/or vary the strength of the magnet until the red field is centered in the kinescope screen.

5. Move the yoke forward and position it to produce the most uniform red field.

6. Repeat steps 2, 4, and 5 until the most uniform red field is obtained. Check the green and blue fields separately for color purity, and, if necessary, make compromise adjustments of the purifying magnet so that any impurities present are concentrated in the outer regions of

the screen. Center convergence should be checked, and, if necessary, reestablished, after each change in the strength or rotational position of the purifying magnet.

ADJUSTMENTS WITH MICROSCOPE

7. Optimum color-purity adjustments, using the microscope if required, should be made at this time in the following manner:

(a) Remove the video test-pattern signal, and, using the hand microscope, examine the beam-landing pattern at the center of the kinescope screen. The arrangement of a phosphor-dot trio as seen through an inverting microscope is shown in Fig.3. (This inverted arrangement is used in all subsequent figures.) Typical landing patterns obtained as a result of the initial purity adjustments described in steps 2 through 6 are shown in Fig.4.

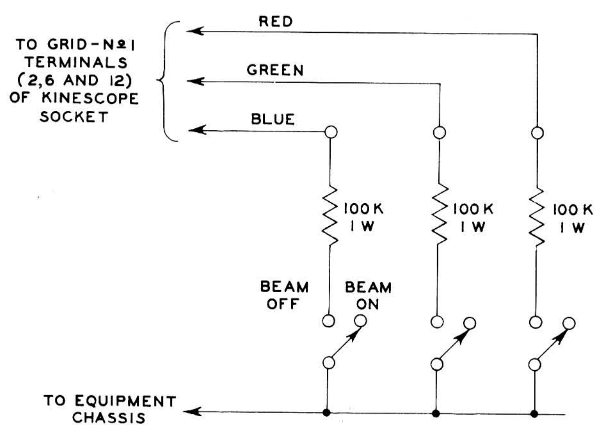

Fig.2 - Auxiliary circuit permitting independent on-off switching of any beam without affecting beam adjustments.

(b) If necessary, readjust the purifying magnet until the beam-landing pattern in the center of the screen is as nearly as possible like that shown in Fig.4a. (When the purifying magnet is adjusted for a given strength, rotation of the entire magnet causes the electron-beam trio to move in a circular path, as shown in Fig.5. The size of the circle described by the beam trio under these conditions is determined by the strength of the purifying magnet. A change in the strength of the magnet causes the electron-beam trio to move in a straight line, as shown in Fig.6. The direction of this straight-line movement is determined by the rotational position of the purifying magnet on the kinescope neck).

(c) Using the video test-pattern signal, check, and, if necessary, reestablish static convergence.

(d) Remove the video test-pattern signal, and using the microscope, again check the electron-beam landing pattern at the center of the screen. If necessary, repeat steps 7a, b, and c until optimum register (as shown in Fig.4a) is obtained in this area.

(e) Using the microscope, check the electron-beam landing patterns at the top and bottom of the scanned area. Move the yoke along the neck of the tube until the electron beam trios are *radially* centered on the phosphor-dot trios at the top and bottom of the scanned area. Typical landing patterns which may be observed in these areas, including examples of tangential and radial landing errors, are shown in Fig.7. A tangential error or movement is any displacement of the electron-beam trio from its proper position in a direction normal to the screen radius pass-

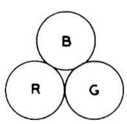

Fig.3 - Relative positions of the dots in a color trio as seen through an inverting microscope.

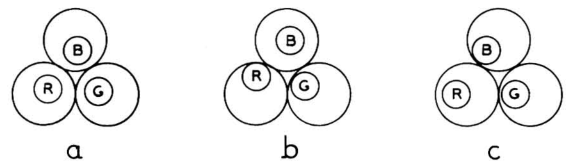

Fig.4 - Typical register patterns at the center of the kinescope screen after initial color-purity adjustments.

ing through the center of the associated phosphor-dot trio (see Fig.8a). A radial error or movement is any displacement of the electron-beam trio from its proper position along the screen radius passing through the center of the associated phosphor-dot trio (see Fig.8b). Movement of the yoke toward the base of the tube will cause the electron-beam trios to move radially outward toward the edge of the screen; movement of the yoke toward the face of the tube will cause them to move radially inward towards the center of the screen.

Tangential landing errors cannot be corrected by yoke adjustments; the magnetic-field-equalizer assembly (see Fig.1) is used to correct these errors in the manner described subsequently.

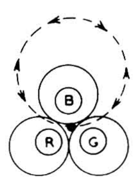

Fig.5 - Circular movement of electron-beam dot trio produced by rotation of purifying magnet assembly (see Fig.6).

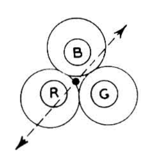

Fig.6 - Straight-line movement of electron-beam dot trio produced by change in strength of purifying magnet assembly.

8. Make final raster-centering adjustments. (Any subsequent changes in raster position may affect the convergence adjustments which follow.)

9. Using a light source producing white light of approximately 8500 degrees K as a color reference, adjust the bias for each electron gun to obtain a white raster.

10. Again apply the video test-pattern signal, and make static and dynamic convergence adjustments, following the procedures recommended for the convergence circuit and components used.

INITIAL MAGNETIC-FIELD-EQUALIZER ADJUSTMENTS

The magnetic-field-equalizer assembly is used to correct beam-landing errors at the edges of the scanned area. When the field of an equalizer magnet is rotated, an electron-beam trio entering the field is shifted along an elliptical path, as shown in Fig.9. The direction in which the electron-beam trio is shifted depends upon the rotational position of the field. The distance the beam is shifted in a given direction depends upon the strength of the field. Consequently, the fields of the individual equalizer magnets can be used to correct both tangential landing errors and nonuniform radial landing errors which have not been corrected by yoke adjustments.

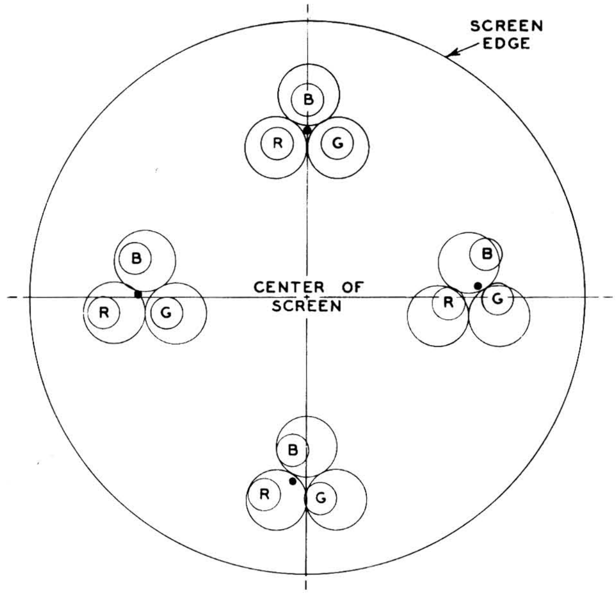

Fig. 7 - Typical beam-landing patterns at screen edge before final yoke and field-equalizer-magnet adjustments: Top - ideal landing (centers of electron-beam trio and phosphor-dot trio coincide); Left - radial error (centers of electron-beam trio and phosphor-dot trio lie on same radius but do not coincide); Bottom - tangential error (centers of electron-beam trio and phosphor-dot trio are equidistant from center of screen but do not coincide); Right - radial and tangentail errors (centers of electron-beam trio and phosphor-dot trio do not lie on the same screen radius and are not equidistant from the center of the screen).

11. Switch or bias off the blue and green beams, and, using a red field of medium brightness, adjust the fields of the individual field-equalizer magnets until the highest possible degree of color purity is obtained over the entire screen.

12. Switch or bias off the red beam, and, using a blue field of medium brightness, repeat step 11 for the blue field.

13. Switch or bias off the blue beam, and, using a green field of medium brightness, repeat step 11 for the green field.

14. Switch on all three beams, and make any minor readjustments of the equalizer-magnet fields necessary to obtain the best possible white field.

15. Reexamine the individual fields for possible loss of purity as a result of step 14. Make a compromise adjustment, if necessary, to obtain optimum white uniformity and purity.

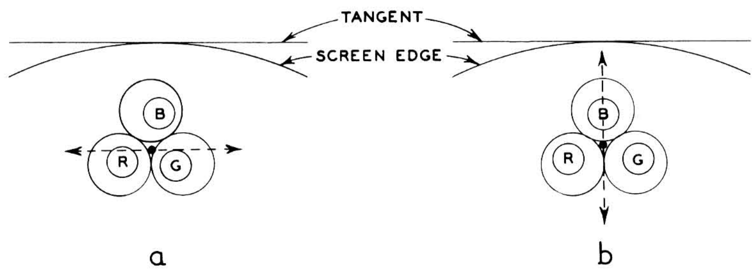

Fig. 8 - Landing errors which can be corrected by proper purity adjustments: a - tangential, b - radial. Tangential errors are corrected by field-equalizer adjustments only; radial errors by yoke and field-equalizer adjustments.

OPTIMUM MAGNETIC-FIELD-EQUALIZER ADJUSTMENTS

16. Using the microscope to observe the beam-landing pattern, readjust the individual equalizer fields until register is obtained at the edges of the scanned area. If care has been used in the preceding steps, it should be possible by means of this adjustment to position the electron-beam trios so that they land completely on the proper phosphor-dot trios.

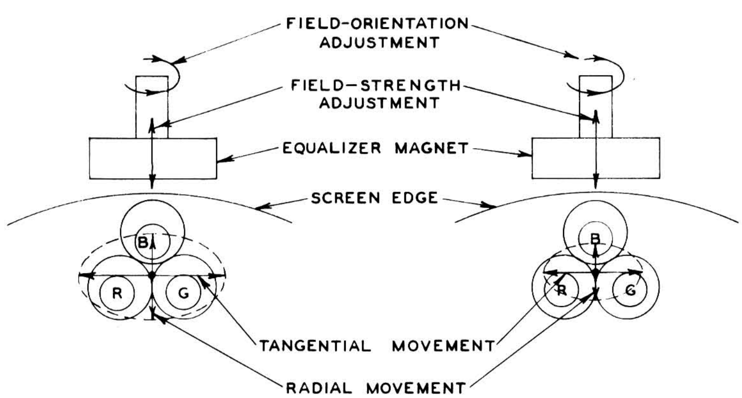

Fig. 9 - Effect of equalizer-magnet field strength on shift in path of electron-beam trio (a PM equalizer magnet is shown): a - maximum field strength; b - less than maximum field strength. Direction of shift is determined by orientation of magnet poles.

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[2] Edmund Scientific Company, 101 E. Gloucester Pike, Barrington, N. J.