ELECTRON TUBES

RCA Application Note

AN - 149
March 1, 1951

# Application of Transformer RCA-225T1 in Deflection System for Wide-Angle Large-Screen Kinescopes

A deflection system using the new ferrite-core transformer, RCA-225T1, has been developed to supply adequate horizontal deflection and an anode voltage of 16 kilovolts for kinescopes such as the RCA-17CP4 and RCA-20CP4 having horizontal-deflection angles of about 66 degrees. The tubes required for the horizontal-deflection-and-high-voltage circuit are one 6BQ6-GT or 6AU5-GT beam power amplifier, one 6W4-GT damper diode, and one 1B3-GT high-voltage rectifier. Transformer RCA-225T1 is so designed that the power for the vertical-deflection circuit may be obtained from the boosted B-voltage supply. The power input required for the horizontal-deflection-and-high-voltage and vertical-deflection circuits totals approximately 29 watts from a 280-volt B-supply when a 6BQ6-GT is used, or 31 watts from a 300-volt B-supply when a 6AU5-GT is used.

General circuit design considerations for the use of the RCA-225T1 are the same as those for the RCA-224T1 and are described at some length in RCA Application Note AN 148. The deflecting yoke, RCA-209D1; the linearity control, RCA-209R1; and the vertical-deflection circuits for the RCA-225T1 are the same as those used with the RCA-224T1. The recommended horizontal-deflection circuit for the 225T1 shown in Fig.1 is essentially the same as the circuit for the 224T1. Special considerations in the use of the 225T1 are discussed below.

## Width Control

An inductive width control may be used, connected to terminals 1 and 3 of the 225T1. When this control has the recommended inductance range (1.5 to 13 millihenries), the maximum width reduction is approximately 12 per cent and the corresponding high-voltage reduction is approximately 400 volts.

The deflection circuit is well suited to methods of width control in which power input to the circuit is varied. One such method is to insert an unbypassed variable resistor in series with the B-supply lead



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to the deflection circuits. Another is to add a variable resistor in series with the screen-grid resistor, $R_{15}$. A disadvantage of these methods is that the high-voltage is reduced; an advantage is that appreciably less current is required by the deflection circuits. For example, with any of the power-control methods the no-load kinescope anode voltage at normal width setting is approximately 14.5 kilovolts and the cathode current of the horizontal-output tube is approximately 80 milliamperes (the corresponding figures with an inductive width control are 16 kilovolts and 95 milliamperes). By adjustment of the power control, variations in line voltage and components can be compensated for, so that for normal picture width the no-load high voltage and the cathode current of the horizontal-output tube are maintained substantially constant at the above figures.

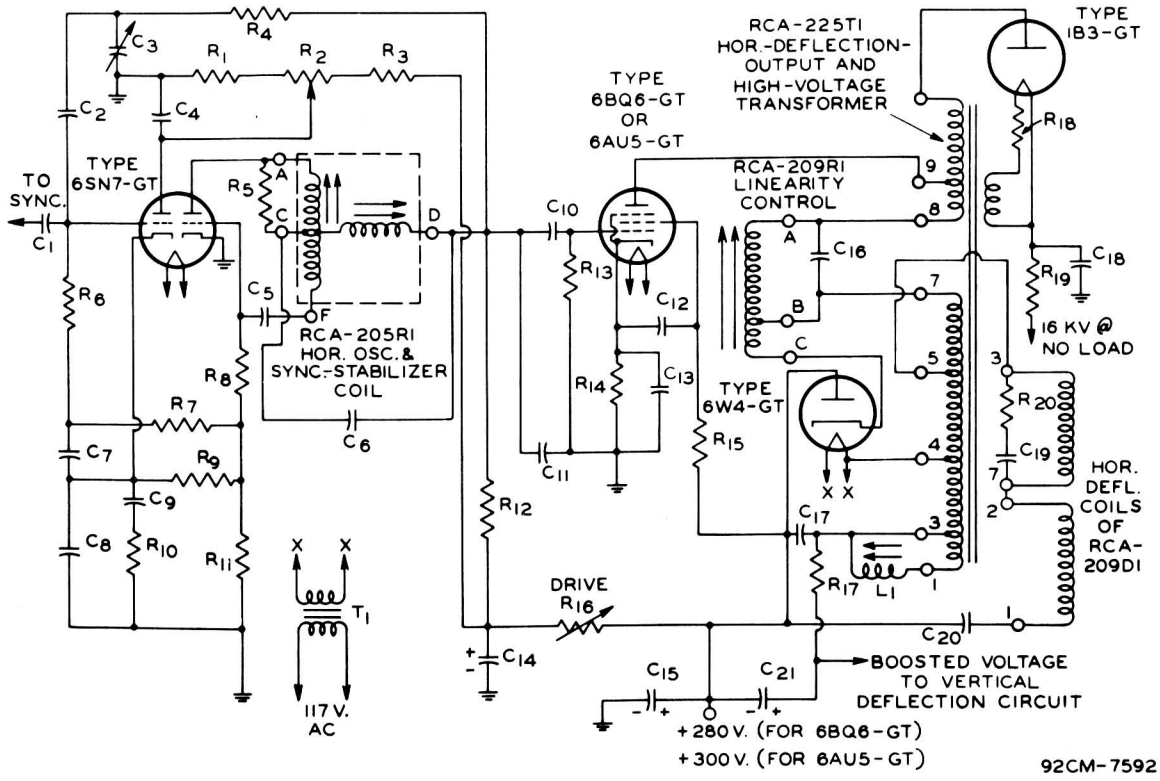
**Lead Dress**

The step-up ratio of the 225T1 transformer is such that a kinescope anode voltage of 16 kilovolts may be obtained. Because of this step-up ratio any capacitance between the 1B3-GT plate and the chassis has a 30 times greater effective value at the yoke. If this effective capacitance is excessive, horizontal-retrace time is increased and the high voltage is decreased. Consequently, it is important to keep the 1B3-GT plate lead short and to mount the 1B3-GT in such a manner that stray capacitance from plate to chassis is minimized.

**Drive Requirements**

To obtain adequate deflection and high-voltage output from any horizontal-deflection circuit without excessive power input and excessive dissipation in the horizontal-output tube, a sawtooth voltage of proper amplitude and waveform must be applied to the grid of the horizontal-output tube. The proper amplitude is that which results in near class B operation. Insufficient sawtooth voltage yields more nearly class A operation, and therefore results in reduced efficiency and a consequent reduction in the deflection voltage and high-voltage output. Excessive sawtooth voltage produces class C operation, which causes a localized cramping and a resultant white line near the center of the raster. The desired sawtooth amplitude may be determined by adjusting the drive control to increase the amplitude until a white line appears near the center of the raster and then reducing the drive until the white line just disappears.

The waveform of the driving sawtooth voltage is determined in the design of the horizontal-oscillator circuit and no service adjustment is needed. The criterion for proper sawtooth waveform is circuit efficiency. If the designer uses a horizontal-oscillator circuit other than that shown in Fig.1, he should try various component values in the horizontal-oscillator circuit until the combination is found which produces the most high-voltage output with the least cathode current in the horizontal-output tube. The data in Table I indicate the efficiency which can be obtained. The shape of the sawtooth voltage waveform on an oscilloscope is not a satisfactory criterion for waveform adjustment. Significant changes in circuit efficiency can be obtained with such subtle changes in sawtooth waveform that the effects on the oscilloscope waveform are not readily perceptible.




C1 C2: 82 $\mu\mu$f, 500 v., mica
C3: Locking range control, 8–70 $\mu\mu$f, mica trimmer
C4: 0.05 $\mu$f, 400 v.
C5: 330 $\mu\mu$f, 500 v., mica
C6: 0.01 $\mu$f, 600 v., oil-filled
C7: 0.05 $\mu$f, 400 v.
C8: 0.02 $\mu$f, 400 v.
C9: 0.5 $\mu$f, 400 v.
C10: 0.003 $\mu$f, 600 v.
C11: 820 $\mu\mu$f, 500 v., mica
C12: 0.1 $\mu$f, 400 v.
C13: 0.5 $\mu$f, 200 v.
C14: 10 $\mu$f, 300 v., electrolytic
C15: 20 $\mu$f, 300 v., electrolytic
C16: 0.04 $\mu$f, 400 v.
C17: 0.03 $\mu$f, 600 v.
C18: 500 $\mu\mu$f, 20 kv.
C19: 56 $\mu\mu$f ± 5%, 800 v.
C20: 0.1 $\mu$f, 400 v.
C21: 10 $\mu$f, 250 v., type DEE or equivalent
R1: 0.12 megohm, 1 watt
R2: Hold Control, 50000-ohm potentiometer, 2 watts
R3: 47000 ohms, 1 watt
R4 R8: 0.15 megohm, 1 watt
R5: 8200 ohms, 0.5 watt
R6: 0.33 megonm, 0.5 watt
R7: 0.82 megohm, 0.5 watt
R9: 82000 ohms, 1 watt
R10: 3900 ohms, 0.5 watt
R11: 0.33 megohm, 1 watt
R12: 68000 ohms, 1 watt
R13: 0.47 megohm, 0.5 watt
R14: 150 ohms, 2 watts
R15: 8200 ohms approx., 2 watts
R16: Drive control, 25000-ohm potentiometer, 2 watts
R17: 1000 ohms, 1 watt
R18: 3.9 ohms, 0.5 watt
R19: 50000 ohms min., 1 watt
R20: 10000 ohms, 0.5 watt
T1: Heater transformer insulated for 1.5 kv peak
L1: Width control, min. inductance, 1.5 mh, ferrite core

NOTE: Terminals A, B, and C of the RCA-209R1 Linearity Control can be identified by resistance measurements. The resistance between terminals A and B is approximately 4 ohms and the resistance between terminals B and C is approximately 1.5 ohms.

*Fig. 1 - Horizontal-Deflection and High-Voltage Circuit.*

## Vertical Deflection

The vertical-deflection circuits may be operated from the boosted B-supply, provided the current drain is not more than 12 milliamperes. Any larger current drain reduces the scanning amplitude and the high-voltage output. The relatively high boosted voltage permits the design of a vertical-deflection circuit of good efficiency. When a 6S4 vertical-output tube, a 209D1 yoke, and a vertical-output transformer having an 18:1 turns ratio are used, adequate vertical deflection is obtained with a 6S4 plate current of approximately 11 milliamperes.

## Typical Operation

Table I shows typical operating conditions for the circuit of Fig.1 with an average 6BQ6-GT, a line voltage of 117 volts, and with maximum width adjustment. For purposes of evaluating circuit performance, the following values should be measured: the B-voltage, the 6BQ6-GT cathode current, the 6BQ6-GT screen current, the 6BQ6-GT screen voltage, the current drawn from the boosted-voltage supply, and the voltage of the high-voltage supply.

Table I - Typical Operation of Circuit in Fig.1*

| | | |
|---|---|---|
| B-Voltage | 280 | volts |
| High Voltage: | | |
| At Zero Beam Current | 16 | kilovolts |
| At 140 μa Beam Current | 14.8 | kilovolts |
| Boosted Voltage● | 520 | volts |
| Current from Boosted Voltage Supply | 11 | milliamperes |
| Retrace Time | 8.3 | microseconds |
| **6BQ6-GT** | | |
| Cathode Current | 93.7 | milliamperes |
| Plate Current | 80.0 | milliamperes |
| Grid-No.2 Current | 13.7 | milliamperes |
| Grid-No.2 Voltage | 146 | volts |
| Grid-No.2 Input | 2.0 | watts |
| Grid-No.1 Voltage▲ | -32 | volts |
| Peak Plate Voltage | 4350 | volts |
| **6W4-GT** | | |
| Plate Current | 91 | milliamperes |
| Peak Inverse Plate Voltage | 2400 | volts |
| Peak Heater-to-Cathode Voltage | 1600 | volts |
| **1B3-GT** | | |
| Peak Inverse Plate Voltage | 18.7 | kilovolts |

* At a line voltage of 117 volts with maximum width adjustment. All values are at zero kinescope beam current unless otherwise noted.

● Measured at terminal 3 of RCA-225T1.

▲ Composed of 14 volts cathode bias and 18 volts grid-resistor bias.

When a 6AU5-GT is used, the no-load value of the high voltage is 16 kilovolts for the following 6AU5-GT operating conditions: B-voltage, 300 volts; screen voltage, 195 volts; screen current, 10.5 milliamperes; and cathode current, 91 milliamperes.

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# ERRATUM NOTICE

for

Application Note AN-149 'Application of Transformer RCA-225T1 in Deflection System for Wide-Angle Large-Screen Kinescopes.'

Page 3, Fig. 1 - Horizontal-Deflection and High-Voltage Circuit. The value shown in the parts list for resistor R20 is incorrectly given as 10000 ohms, 0.5 watt; the correct value of R20 is 1000 ohms, 0.5 watt.



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