RCA-913
CATHODE-RAY TUBE
High-Vacuum, Low-Voltage Electrostatic Type

The RCA-913 is a high-vacuum cathode-ray tube utilizing the all-metal construction and having a viewing screen approximately one inch in diameter. This tube, designed for operation with an anode voltage as low as 250 volts, is provided with two sets of electrostatic plates for deflection of the electron beam. The 913 produces a brilliant, luminous spot of greenish hue. Admirably suited for use in portable oscillographs, this new type greatly enlarges the field for practical applications of the cathode-ray tube.

CHARACTERISTICS

HEATER VOLTAGE (A.C. or D.C.)	6.3 Volts
HEATER CURRENT	0.6 Ampere
FLUORESCENT-SCREEN MATERIAL	Phosphor No. 1
PATTERN COLOR	Greenish
DIRECT INTERELECTRODE CAPACITANCES:	
Control Electrode to All Other Electrodes	10.5 *max.* μμf
Deflecting Plate D_1 to Deflecting Plate D_2	3.6 *max.* μμf
Deflecting Plate D_3 to Deflecting Plate D_4	4.3 *max.* μμf
MAXIMUM OVERALL LENGTH	4-3/4"
MAXIMUM DIAMETER	1-23/32"
BASE (For connections, see page 121)	Octal 8-Pin

MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS

HIGH-VOLTAGE ELECTRODE (Anode No.2) VOLTAGE		500 *max.*	Volts
FOCUSING ELECTRODE (Anode No.1) VOLTAGE		125 *max.*	Volts
CONTROL ELECTRODE (Grid) VOLTAGE		Never Positive	
GRID VOLTAGE FOR CURRENT CUT-OFF *		-90 *approx.*	Volts
PEAK VOLTAGE BETWEEN ANODE NO.2 AND ANY DEFLECTING PLATE		250 *max.*	Volts
FLUORESCENT-SCREEN INPUT POWER PER SQ CM		5 *max.*	Milliwatts
TYPICAL OPERATION:			
Heater Voltage	6.3	6.3	Volts
Anode No.2 Voltage	250	500	Volts
Anode No.1 Voltage (Approx.)	50	100	Volts
Grid Voltage	Adjusted to give suitable luminous spot		
Deflection Sensitivity:			
Plates D_1 and D_2	0.15	0.07	Mm/Volt D.C.
Plates D_3 and D_4	0.21	0.10	Mm/Volt D.C.

* With maximum voltage applied to anode No.1 and anode No.2.

INSTALLATION

The *base* pins of the 913 fit the universal eight-contact octal socket, which may be installed to hold the tube in any position.

The *metal shell* of the 913 is connected to anode No.2 within the tube. In circuits where it is desirable to operate the shell at a positive potential with respect to chassis ground, the shell should be completely encased in a cylindrical tube of good insulating material. Bakelite or fibre tubing is suitable for this purpose. The front rim of the metal shell should also be made inaccessible by means of a clear celluloid or glass plate mounted in front of the viewing screen. Where a separate d-c power supply is used for the electrode voltages (see circuit on page 120), it is recommended that the shell be grounded, rather than the cathode terminal. With this method, which places the cathode and heater at a high negative potential with respect to ground, the shell need not be insulated from the chassis and the high voltage can more easily be made inaccessible. If the shell of the 913 can not be connected to the chassis, as is the case where the anode No.2 voltage is obtained from the power supply of a receiver or other equipment, d-c blocking condensers must be inserted in all signal-input leads to the deflecting plates, so that the anode voltage supply can not be shorted by the signal circuit.

The *heater* is designed to operate at 6.3 volts. For *heater operation* and *d-c voltage supply* considerations, refer to CATHODE-RAY TUBE INSTALLATION on page 5.

The *cathode* is connected within the tube to one side of the heater. The terminal for this common connection is base pin No.2, to which grid and anode returns should be made.

The *fluorescent screen* employed in the 913 is of the phosphor No.1 (medium persistence) type. It has good visual and photographic properties as well as high luminous efficiency.

Two sets of *electrostatic plates*, producing fields at right angles, provide for deflection of the electron beam. The electrostatic field of each pair of deflecting plates deflects the beam parallel to the axis of the field; therefore, the deflections produced by the two fields are at right angles. One deflecting plate of one set is connected within the tube to one plate of the other set, to anode No.2, and to the metal shell. The free deflecting plate of each set should be connected through a resistor of one to ten megohms to the anode No.2 socket terminal. For additional information on the deflecting system, refer to CATHODE-RAY TUBE INSTALLATION on page 5.

The *deflection sensitivity* for each set of plates for typical anode No.2 voltages is given under MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS.

The voltages at which the 913 is operated may be dangerous. Care should be taken in the design of apparatus to prevent the operator from coming in contact with these voltages. It is recommended that the protective measures given on page 7 be employed in the design and application of cathode-ray-tube equipment. In circuits where the shell can not be connected directly to the chassis, the shell should be *completely insulated*, as described in the second paragraph under INSTALLATION.

APPLICATION

Due to the relatively low cost of the 913 and its associated apparatus, to the low voltages at which it can be operated, and to the small size and portability of equipment in which it is employed, this tube should find very general use by engineers, radio servicemen, radio amateurs, and school laboratories.

A *cathode-ray oscillograph*, reduced to its simplest form, can be designed to use only the cathode-ray tube and a voltage divider; such a circuit, employing an RCA-906, is shown on page 50. A more elaborate circuit, using the 913, is shown on page 120. Two a-f amplifiers and a linear time-sweep oscillator are employed. One amplifier can be used to amplify the vertical deflecting-plate voltage; the other, to amplify the time-sweep voltage from the 885 saw-tooth oscillator. In many applications the a-f amplifiers and the linear time-sweep oscillator are not required.

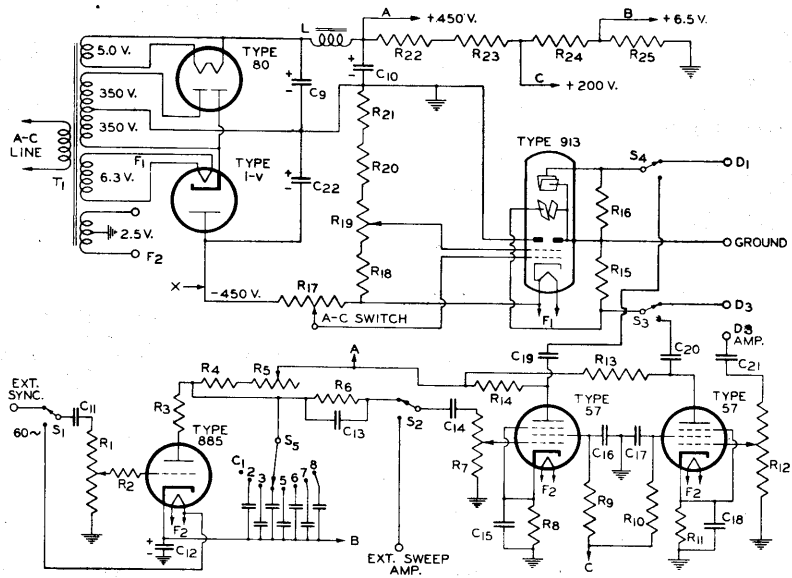
The 913 is capable of producing a fluorescent spot of high intensity. This capability helps in obtaining high brightness of patterns covering considerable area but must be used with caution when the spot traverses slowly any portion of a large pattern or when the pattern size is small. To reduce the possibility that the screen material may be damaged by an excessively brilliant spot, it is recommended that the beam be kept in motion by the application of an a-c voltage to the deflecting system or that the pattern brilliancy be reduced by adjustment of the grid bias voltage. A more complete discussion of this subject is given on pages 8 and 9.

For information on *focusing* of the spot and regulation of its *size* and *intensity*, refer to page 8 under CATHODE-RAY TUBE APPLICATION. Other data on the application of the 913 are also included in that section.

A photographic record of many types of phenomena can be made with an ordinary camera. A discussion of the photography of cathode-ray tube patterns is given on page 86 et seq.

NOTE: *Under some conditions of operation, especially with a low anode-supply voltage, a portion of the 913 viewing screen may not fluoresce. This effect, due to a negative charge built up on the screen when the velocity of the electrons in the beam is too low, can be prevented easily by means of a switch at point "X" in the circuit diagram. The cathode of the rectifier should always be allowed to reach operating temperature before the supply voltage is applied to the bleeder circuit by means of this switch. The charging effect can also be avoided if the control-grid bias is set for beam-current cut-off (maximum-bias position of R_{17}) until the anode-supply voltage has risen to its full value. The bias control may then be advanced for focusing in the usual manner.*

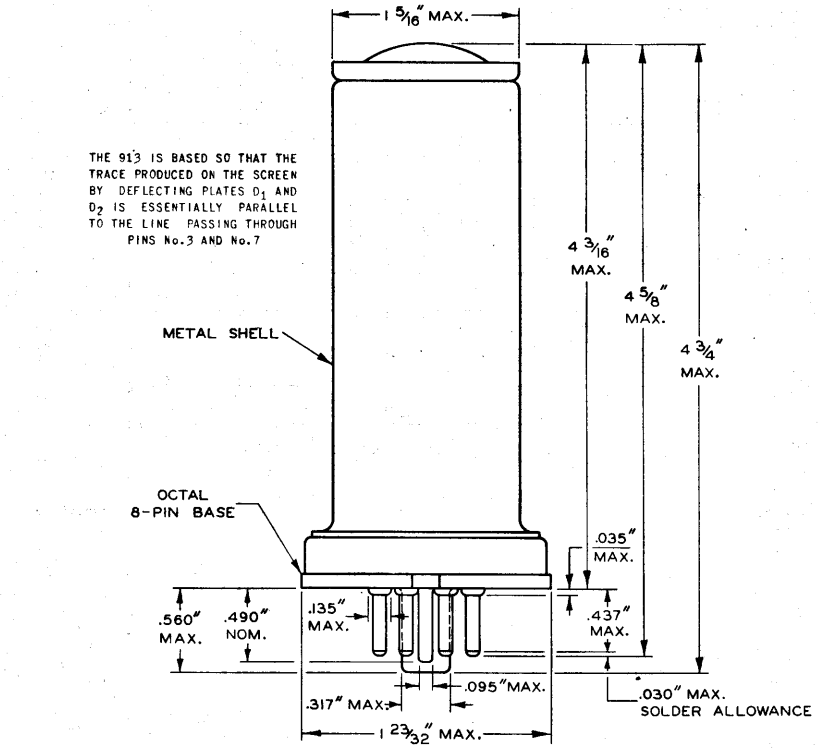
OSCILLOGRAPH CIRCUIT WITH LINEAR SWEEP AND AMPLIFIERS

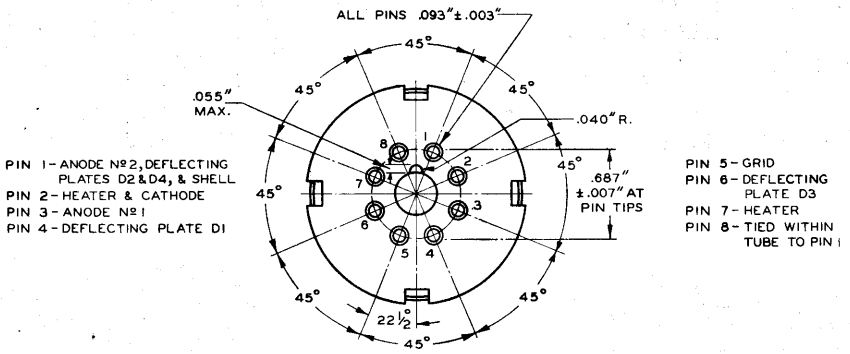


C_1 = Stray Circuit Capacity
C_2 = 0.0008 μf, 500 V.
C_3 = 0.002 μf, 500 V.
C_4 = 0.005 μf, 500 V.
C_5 = 0.015 μf, 500 V.
C_6 = 0.05 μf, 500 V.
C_7 = 0.10 μf, 500 V.
C_8 = 0.25 μf, 500 V.
C_9 C_{10} C_{22} = 8 μf, 475 V. (Working)
C_{11} C_{16} C_{17} = 0.25 μf, 250 V.
C_{12} = 25 μf, 15 V.
C_{13} = 25 μμf, 500 V.
C_{14} C_{21} = 0.5 μf, 500 V.
C_{15} C_{18} = 0.003 μf
C_{19} C_{20} = 0.25 μf, 500 V.
L = 30 Henries, 10 ma.
T_1 = Power Transformer

R_1 = 250000-ohm Potentiometer
R_2 = 25000 ohms, 0.5 watt
R_3 = 500 ohms, 0.5 watt
R_4 = 300000 ohms, 0.5 watt
R_5 = 1.0-megohm Potentiometer
R_6 = 1.0 megohm, 0.5 watt
R_7 R_{12} = 0.5-megohm Potentiometer
R_8 R_{11} = 1000 ohms, 0.5 watt
R_9 R_{10} = 200000 ohms, 0.5 watt
R_{13} R_{14} = 100000 ohms, 1 watt
R_{15} R_{16} = 2.0 megohms, 0.5 watt
R_{17} = 15000-ohm Potentiometer
R_{18} = 15000 ohms, 0.5 watt
R_{19} = 25000-ohm Potentiometer
R_{20} R_{24} = 50000 ohms, 1 watt
R_{21} = 40000 ohms, 1 watt
R_{22} R_{23} = 30000 ohms, 1 watt
R_{25} = 1600 ohms, 0.5 watt

OUTLINE DRAWING





BOTTOM VIEW OF BASE

AVERAGE CHARACTERISTICS