5HP1-A

CATHODE-RAY TUBE

Electrostatic Focus
Electrostatic Deflection

Medium-Persistence Screen

16-3/4 Inches Long
5-1/4-Inch Bulb

RCA-5HP1-A is a cathode-ray tube of the electrostatic deflection and electrostatic focus type. It has a medium-persistence screen, four and one-half inches in diameter, which produces a brilliant luminous spot suitable for the observation and photography of transient and recurrent phenomena. The 5HP1-A is like the 5BP1-A except that the 5HP1-A is equipped with a Micanol base and, therefore, is less easily damaged by repeated base-pin flashovers which may occur when the tube is used at low atmospheric pressure.

The 5HP1-A employs an improved electron gun for projecting the electron beam onto the fluorescent screen. The improved gun provides sharper focus of the beam and is designed so that its anode No.1 takes essentially no current. This feature permits the use of a bleeder system requiring very little current and, consequently, a smaller filter capacitance. As a result of the extremely small anode No.1 current, variation in focus which may otherwise take place with change in beam current is minimized.

RCA-5HP1-A supersedes RCA-5HP1.

DATA

General:

Heater, for Unipotential Cathode:			
Voltage (AC or DC)	6.3	±10%	Volts
Current	0.6		Ampere
Direct Interelectrode Capacitances (Approx.):			
Grid No.1 to All Other Electrodes	8.0		μμf
DJ1 to DJ2	1.3		μμf
DJ3 to DJ4	1.2		μμf
DJ1 to All Other Electrodes	9.5		μμf
DJ3 to All Other Electrodes	12.0		μμf
DJ1 to All Other Electrodes except DJ2	8.0		μμf
DJ2 to All Other Electrodes except DJ1	7.5		μμf
DJ3 to All Other Electrodes except DJ4	10.0		μμf
DJ4 to All Other Electrodes except DJ3	7.5		μμf
Phosphor			No.1
Fluorescence			Green
Persistence			Medium
Focusing Method			Electrostatic
Deflection Method			Electrostatic
Deflecting-Electrode Arrangement			See *Outline Drawing*
Overall Length			16-3/4" ± 3/8"
Greatest Diameter of Bulb	5-1/4"	+1/16" -3/32"	
Minimum Useful Screen Diameter			4-1/2"
Base	Medium Shell Magnal 11-Pin, Micanol		
Mounting Position			Any

Maximum Ratings, *Absolute Values*:

ANODE-NO.2 & GRID-NO.2 VOLTAGE	2200 max.	Volts
ANODE-NO.1 VOLTAGE	1100 max.	Volts
GRID-NO.1 (CONTROL ELECTRODE) VOLTAGE:		
Negative Value	125 max.	Volts
Positive Value	0 max.	Volts
PEAK VOLTAGE BETWEEN ANODE NO.2 and ANY DEFLECTING ELECTRODE	550 max.	Volts

Typical Operation:

Anode-No.2 & Grid-No.2 voltage*	1500	2000	Volts
Anode No.1 Voltage for Focus at 75% of Grid-No.1 Voltage for Cutoff**	337	450	Volts
Grid-No.1 Voltage for Visual Cutoff#	-30	-40	Volts
Max. Anode-No.1 Current Range▲	Between -50 and +10 μamp.		
Deflection Sensitivity:			
DJ1 and DJ2	0.404	0.303	mm/volt dc
DJ3 and DJ4	0.446	0.334	mm/volt dc
Deflection Factor:##			
DJ1 and DJ2	63	84	volts dc/in.
DJ3 and DJ4	57	76	volts dc/in.

* Brilliance and definition decrease with decreasing anode-No.2 voltage. In general, anode-No.2 voltage should not be less than 1500 volts.

** Individual tubes may require between +25% and -30% of the values shown with grid-No.1 voltages between zero and cutoff.

\# Visual extinction of stationary focused spot. Supply should be adjustable to ±50% of these values

\#\# Individual tubes may vary from these values by ±17%.

▲ See curve for average values.

Spot Position:

The undeflected focused spot will fall within a 15-mm square centered at the geometric center of the tube face and having one side parallel to the trace produced by DJ1 and DJ2. Suitable test conditions are: anode-No.2 volts, 1500; anode-No.1 volts, adjusted for focus; deflecting-electrode resistors, one megohm each, connected to anode No.2; the tube shielded from all extraneous fields. To avoid damage to the tube, grid-No.1 voltage should be near cutoff before application of anode voltages.

Maximum Circuit Values:

Grid-No.1-Circuit Resistance	1.5 max. Megohms
Impedance of Any Deflecting-Electrode Circuit at Heater-Supply Frequency	1.0 max. Megohm
Resistance in Any Deflecting-Electrode Circuit□	5.0 max. Megohms

□ It is recommended that the deflecting-electrode circuit resistances be approximately equal.

INSTALLATION and APPLICATION

The *base* pins of the 5HP1-A fit the magnal 11-pin socket which may be installed to hold the tube in any position. The socket alone, however, should not be used to support the tube. Other support, such as a yoke or saddle arrangement should be used near the screen end of the tube. The socket should be made of good insulating material; a type having insulating baffles between contacts provides an additional factor of safety.

The *bulb* should be enclosed in a grounded shield made of high permeability metal having low residual magnetism in order to minimize the effects of extraneous magnetic fields. When a grounded metal shield is used around the tube, it may be necessary to insulate the tube from the shield to avoid the effects of corona or leakage currents.

The *heater* is designed to be operated at 6.3 volts. The transformer winding supplying the heater power should be designed to operate the heater at the rated voltage under average line-voltage conditions.

The *cathode* is connected to base pin 11 to which the grid and anode circuit returns should be made. Heater and cathode are connected internally.

RCA VICTOR DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

5HP1-A-5-45
Photolithographed in U.S.A.

The *fluorescent screen* employs phosphor No.1 which fluoresces to produce a medium-persistence green luminescence.

The *dc voltages* for the grid and the two anodes may be obtained conveniently from a high-voltage vacuum-tube rectifier. Since a cathode-ray tube requires very little current, the rectifier system can be of either the half-wave or the voltage-doubler type. Likewise, the filter requirements are simple. A capacitor of about 0.1 μf will ordinarily provide sufficient filtering. If this is inadequate, a two-section filter is recommended. If the electrode voltages are obtained from a bleeder circuit, a bleeder current of about 0.2 milliampere usually is satisfactory. Considerably higher values may require the use of more filtering than that provided by a single capacitor shunted across the dc supply. In most applications, it is recommended that anode No.2 be grounded in order that the deflecting electrodes may be operated at or near ground potential. With this method, the cathode and heater are at high negative potential with respect to ground.

The high voltages at which the tube is operated are very dangerous. Great care should be taken in the design of apparatus to prevent the operator from coming in contact with the high voltages. Precautions include the enclosing of high-potential terminals and the use of interlocking switches to break the primary circuit of the power supply when access to the equipment is required. In most applications, it is recommended that the anode No.2 terminal be grounded rather than the cathode terminal. With this method, which places the cathode and heater at high negative potential with respect to ground, the dangerous voltages can more easily be made inaccessible.

In the use of cathode-ray tubes, it should always be remembered that high voltages may appear at normally low-potential points in the circuit due to capacitor breakdown or to incorrect circuit connections. Therefore, before any part of the circuit is touched, the power-supply switch should be turned off and both terminals of any charged capacitors grounded.

Focusing of the fluorescent spot produced by the electron beam is controlled by adjustment of the ratio of anode No.2 voltage to anode No.1 voltage. Ordinarily, the ratio is adjusted by variation of anode No.1 voltage. For this purpose, a potentiometer is required in the bleeder circuit; the necessary range of adjustment is indicated under TYPICAL OPERATION.

Regulation of spot brilliance can be accomplished by varying the current to anode No.2. This current can be increased by decreasing the bias voltage applied to the control electrode. An increase in the current increases the spot size and the quantity of light. To obtain the smallest spot, a slight readjustment of focus may be necessary. An increase in the voltage applied to anode No.2 increases the beam current and the sharpness of focus and, therefore, the spot brilliance.

In applications involving extremely accurate measurements, the anode No.2 current should be reduced to the minimum consistent with the desired brilliance of the pattern. In cases where high brilliance is an important consideration, the voltage applied to the high-voltage electrode may be increased to the maximum rated value with due consideration to the line-voltage variations. This procedure, however, is not always desirable since it results in reduced deflection sensitivity.

It is important to note that a high-intensity spot will burn the fluorescent screen if the spot is allowed to remain stationary. To prevent this possibility, it is recommended that the spot be kept in motion over a reasonably large area or the beam current should be reduced.

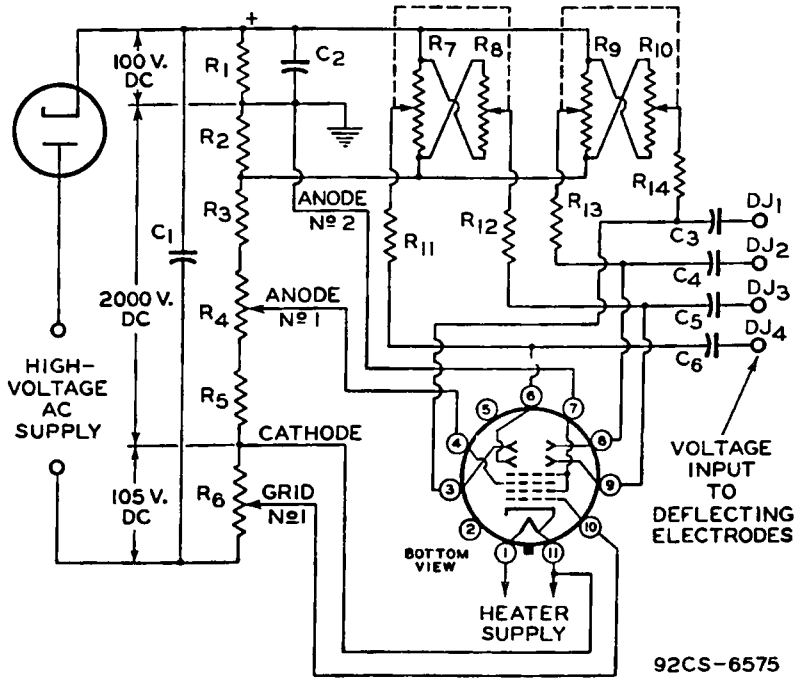
Two pairs of *electrostatic electrodes*, producing fields at right angles, are located within the bulb neck to provide for deflection of the electron beam. The electrostatic field of each pair of deflecting electrodes causes deflection of the beam in the direction of the gradient lines of the field and perpendicular to the plane of the deflecting electrodes; therefore, the deflections caused by the two fields are at right angles. Each set of deflecting electrodes should be maintained essentially at the dc potential of anode No.2. To do this, each electrode of each set should be connected through a resistor of not more than 5 megohms to the anode No.2 tube terminal (ordinarily at ground potential). This arrangement permits a choice of resistor values such that the electron beam is not distorted by dc potentials built up on the deflecting electrodes. If, during operation, the zero axes should shift, it usually is because the beam current is too high for the resistor value used. When it is necessary to use a high value of beam current, as when photographs are taken, the value of the deflecting-electrode resistors should be reduced to minimize the shift of the zero axes.

The deflection sensitivities and the deflection factors for each pair of deflecting electrodes for typical anode-No.2 voltages are given under TYPICAL OPERATION.

Photographs of the phenomena appearing on the viewing screen can be made with an ordinary camera. The photographing is done preferably in complete darkness in order to obtain as much contrast as possible between the fluorescent pattern and the screen. The time of exposure will depend on the speed of the camera lens, the kind of film or plate emulsion used, and the brightness of the pattern. Where transients are to be photographed, maximum brightness may be required because of the short duration of the

phenomena; where recurrent wave forms are to be photographed, patterns having low brightness can be compensated for by longer exposure. The use of emulsions having high green sensitivity is recommended; orthochromatic types of film and high-speed films have been found to give excellent results.

For high-speed photographic work involving non-recurrent phenomena, it is permissible to increase the trace brightness, for the short interval required to make the exposure, above that required for visual observation. The extent to which the anode current may be increased without harming the screen is proportional to the velocity of beam travel and pattern size, and an inverse function of the duration of the phenomena. Short-interval operation at increased current can be obtained by means of a temporary decrease in the grid-No.1 voltage. A switching arrangement should be provided to switch the grid-No.1 voltage rapidly between a negative and a less negative value. The exposure is made while the grid-No.1 voltage is at the less negative value.

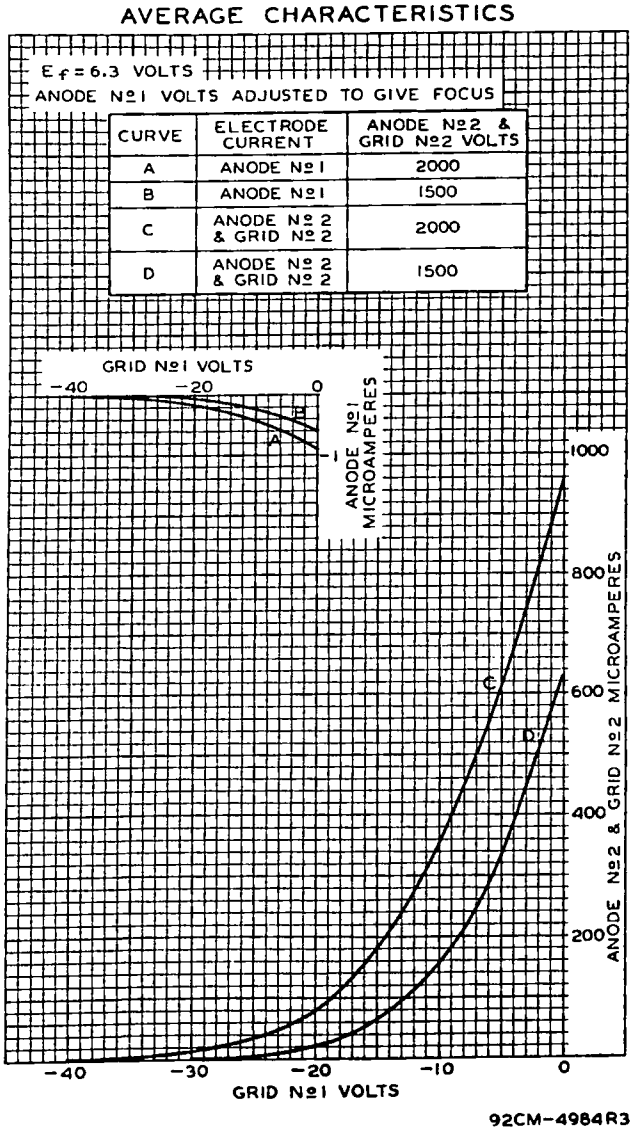


C1: 0.1 μf
C2: 1.0 μf
C3 C4 C5 C6: 0.05-μf Blocking Capacitors*
R1 R2: 2 Megohms
R3: 6 Megohms
R4: 2-Megohm Potentiometer
R5: 1.0 Megohm
R6: 0.5-Megohm Potentiometer
R7 R8: Dual 5-Megohm Potentiometer
R9 R10: Dual 5-Megohm Potentiometer
R11 R12 R13 R14: 2 Megohms

* When cathode is grounded, capacitors should have high voltage rating; when anode No.2 is grounded, they may have low voltage rating. For dc amplifier service, deflecting electrodes should be connected direct to amplifier output. In this service, it is preferable usually to remove deflecting-electrode resistors to minimize loading effect on amplifier. In order to minimize spot defocusing, it is essential that anode No.2 be returned to a point in the amplifier system which will give the lowest possible potential difference between anode No.2 and the deflecting electrodes.

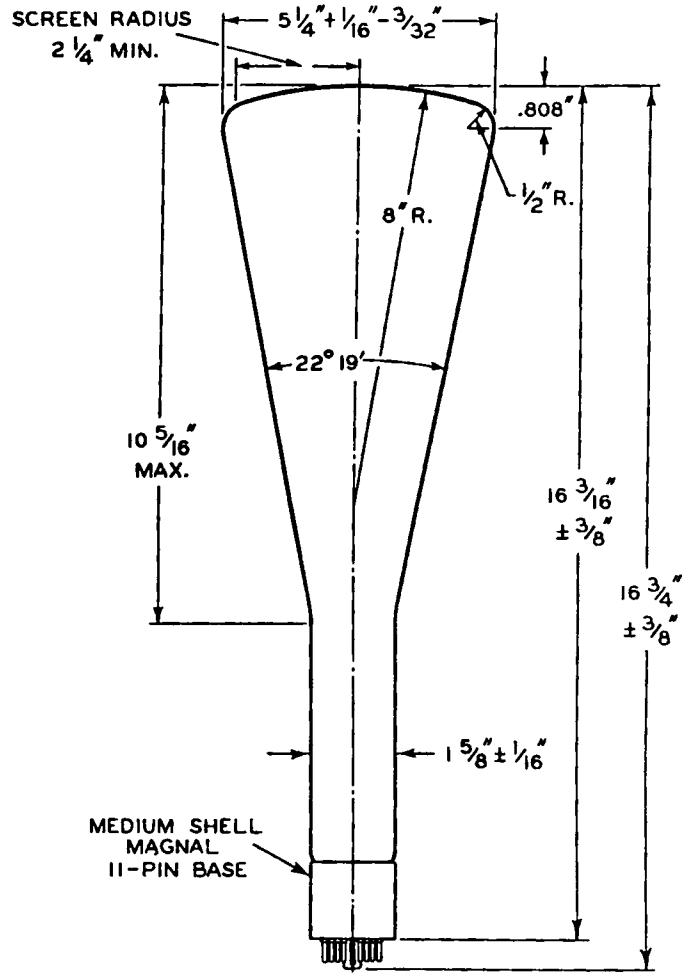
Typical Oscillograph Circuit

AVERAGE CHARACTERISTICS



CURVE	ELECTRODE CURRENT	ANODE No2 & GRID No2 VOLTS
A	ANODE No1	2000
B	ANODE No1	1500
C	ANODE No 2 & GRID No 2	2000
D	ANODE No 2 & GRID No 2	1500

92CM-4984R3



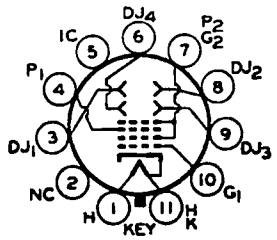
92CM-4976R2

℄ of bulb will not deviate more than 2° in any direction from perpendicular erected at center of bottom of base.

The plane through the tube axis and pin 1 may vary from the trace produced by DJ3 and DJ4 by an angular tolerance (measured about the tube axis) of 10°. Angle between DJ1-DJ2 trace and DJ3-DJ4 trace is 90° ± 3°.

With DJ1 positive with respect to DJ2, the spot will be deflected toward pin 4; likewise, with DJ3 positive with respect to DJ4, the spot will be deflected toward pin 1.

Bottom View of Socket Connections



11N

PIN 1: HEATER
PIN 2: NO CONNECTION
PIN 3: DEFLECTING ELECTRODE DJ1
PIN 4: ANODE NO.1
PIN 5: INTERNAL CONNECTION - DO NOT USE
PIN 6: DEFLECTING ELECTRODE DJ4
PIN 7: ANODE NO.2 and GRID NO.2
PIN 8: DEFLECTING ELECTRODE DJ2
PIN 9: DEFLECTING ELECTRODE DJ3
PIN 10: GRID NO.1
PIN 11: HEATER and CATHODE