6499

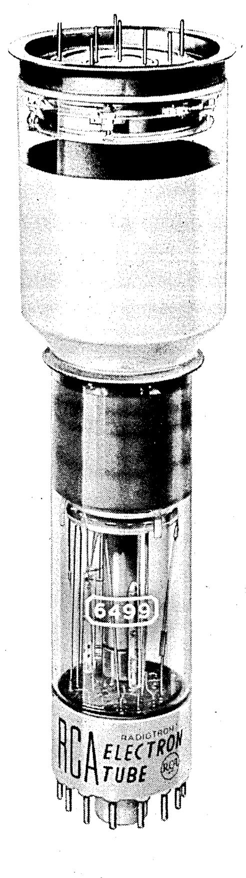
RADECHON

Electrostatic Deflection
Electrostatic Focus

Charge Storage Tube
Single-Beam, Barrier-Grid Type
Non-Equilibrium Writing and
Capacitance-Discharge Reading
TENTATIVE DATA

12-7/32" Max. Length
3.35" Max. Diameter

RCA-6499 is a charge storage tube of the barrier-grid type intended for use in a variety of information-processing systems. Information in digital or analogue form may be introduced to the active elements of the tube, stored for a period of time controllable from microseconds to minutes, and then extracted at a rate the same as or different from the writing rate.



The 6499 may be operated so that (1) the output signal is linearly related in amplitude to the input signal, or (2) the output signal is proportional to the duration of an input-signal pulse or to several input-signal pulses occurring within a given time interval, or (3) the output signal is proportional to the difference between two successive input signals.

Design features of the 6499 include an electron gun capable of providing an electron beam having high current density and relatively small cross-sectional area at the focus plane, and a storage surface having uniform secondary emission to provide a uniform output signal. Electrostatic deflection of the beam is utilized to permit the design of deflection circuitry having relatively low power consumption and providing high speed of response.

PRINCIPLES OF OPERATION

The 6499 contains an electron gun of the electrostatic-focus and electrostatic-deflection type, a barrier grid (grid No.5), a dielectric layer, a backing-electrode, and a collector, as shown in Fig.1. The barrier grid consists of a fine mesh screen very closely spaced to or in contact with the gun side of the dielectric layer. On the opposite side of the layer and in contact with it is placed the backing-electrode which consists of a metal disc. The dielectric layer has high insulating qualities and a maximum secondary-emission ratio greater than unity. The barrier grid, the dielectric layer, and the backing-electrode are collectively referred to as the "target" for convenience in explaining the operating principles of the 6499. The collector is a conductive coating on the inside wall of the large part of the tube. This part of the tube also has an external conductive coating which is connected at the seal flange to the collector and internal shield.

By adjustment of the voltage applied to the focusing electrode (grid No.3), the electron beam may be focused in the plane coinciding with the exposed surface of the dielectric layer. This surface on which charge storage occurs is known as the storage surface. Adjustment of the control-grid (grid-No.1) voltage controls the intensity of the beam current impinging on the storage surface. The control grid may be modulated in accord with system requirements. The area of the storage surface bombarded by the electron beam is determined for any specific application by the magnitude of the voltages applied to the deflecting electrodes.

The effect of storage-surface potential in determining the action of the target is illustrated in Figs.2, 3, and 4. In Fig.2 the storage surface is instantaneously some tens of volts positive with respect to the barrier grid. When the primary-beam electrons, produced by the electron gun, go through the barrier grid and impinge on the storage surface, they release secondary electrons from the storage surface. The number released depends on the energy of the impinging electrons. The energy of the secondary electrons is not sufficient to overcome the negative gradient existing between the barrier-grid plane and the storage surface. Consequently, after a transit time of a small fraction of a microsecond, the secondary electrons return to the vicinity from which they were released. Under these conditions, a net electron current flows into the target from the beam. This current has a value equal to that of the beam current multiplied by the effective transmission of the barrier grid. Because the barrier grid is treated so that it has a secondary-emission ratio of very nearly unity, it contributes nothing to the net electron current flowing into the target.

In Fig.3, the storage surface is instantaneously some tens of volts negative with respect to the barrier grid. When the primary-beam electrons go through the barrier grid and impinge on the storage surface, they release secondary electrons from the storage surface, as in the case of Fig.2. However, unlike the case of Fig.2, the secondary electrons are accelerated from the storage surface, pass through the plane of the barrier grid, and go into the space beyond it. These secondaries together with those released from the barrier grid are then accelerated to the collector which is operated at a positive dc potential. Actually, the barrier grid collects some of the secondaries from the storage surface

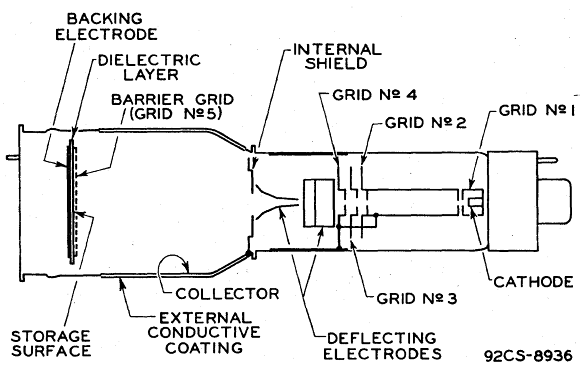


Fig.1 - Schematic Arrangement of Type 6499.

but these may be neglected in considering first-order effects without introducing appreciable inaccuracy. Under the conditions shown in Fig.3, the net electron current flows away from the target. This current has a value equal to that of the beam current multiplied by the effective transmission ratio of the barrier grid and by the difference between the secondary-emission ratio of the storage surface and unity.

Because the secondary electrons which are liberated from the storage surface have initial energies in the range from 0 to more than 10 electron volts, the transition between the case of Fig.2 and that of Fig.3 is gradual. The exact percentage of the secondaries which escape from the target depends on the magnitude of the potential gradient between the storage surface and the barrier grid.

The magnitude and shape of the transition between the case of Fig.2 and that of Fig.3 is illustrated by the typical target characteristic curves shown in Fig.10.

In Fig.4, the storage surface is several volts positive with respect to the barrier grid. In this case, the escaping secondaries exactly balance those primary-beam electrons arriving at the storage

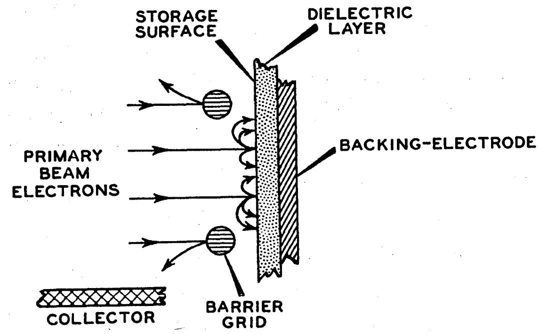


Fig.2 - Storage Surface Instantaneously Positive With Respect to Barrier Grid.

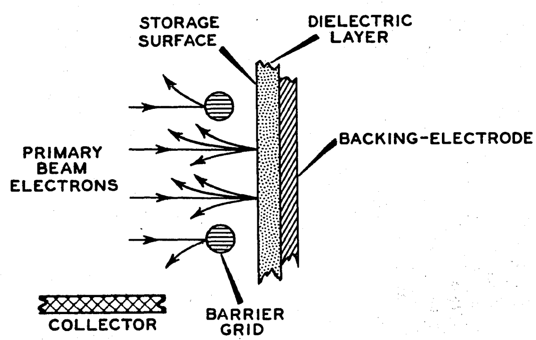


Fig.3 - Storage Surface Instantaneously Negative With Respect to Barrier Grid.

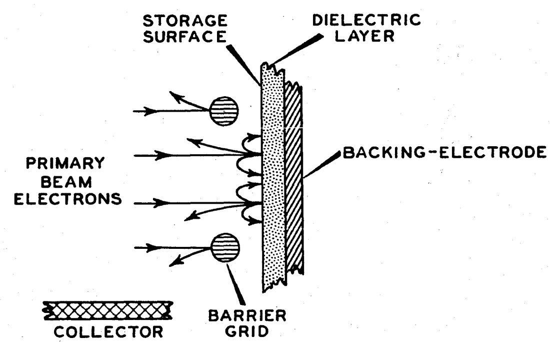


Fig.4 - Storage Surface at Equilibrium Potential.

surface. Under these conditions, the net target current is zero, and the potential of the storage surface is known as the *equilibrium potential.*

The condition shown in Fig.2 is unstable because charge neutrality can not be maintained within the dielectric layer. In order that charge neutrality be maintained within the dielectric as the beam deposits electrons on the storage surface, it is necessary that a displacement current flow in the storage-surface backing-electrode. As a result of this flow, a voltage gradient is built up across the dielectric. The potential of the storage surface on which the electrons (negative charges) land, becomes more and more negative, assuming that the bombardment is not affected by modulation or deflection of the beam, until the condition shown in Fig.4 is attained.

Similarly, the condition in Fig.3 is unstable. However, in this case, the process of charging to the equilibrium potential is in a positive direction.

It is this process of charging, called *writing*, by means of which the storage of information is effected. A term indicative of the speed of writing is known as *discharge factor*. It may be defined as the ratio of the shift in potential with respect to equilibrium potential of a given element of the storage surface during a single exposure to the beam, to the potential of the storage surface with respect to equilibrium potential at the beginning of exposure. The concept of discharge factor is usually applied to cases where the storage surface is scanned by the beam. A single exposure is usually interpreted as meaning a single scan of an element of the storage surface. A typical discharge-factor curve for the 6499 is shown in Fig.11.

An example of a simple writing sequence is as follows: Assume that the storage surface is at equilibrium potential, and that zero potential exists between the backing-electrode and the barrier grid (grid No.5). A step-function voltage of, say, +50 volts with respect to grid No.5 is applied to the backing-electrode. Because of the relatively high capacitance between the backing electrode and the barrier grid, practically all of the step-function voltage appears between the storage surface and the barrier grid. The undeflected beam is now turned on and that part of the storage surface bombarded by it commences to charge negatively toward equilibrium. Assume that bombardment continues until the storage-surface potential, in relation to equilibrium potential, has changed from the +50 volts to +40 volts, whereupon the beam is turned off. A charge sufficient to develop a gradient of 10 volts has now been stored in the dielectric layer. For these conditions, the discharge factor is (50-40)/50 = 0.2. If the step-function voltage is now removed, the storage surface becomes 10 volts more negative than the equilibrium value.

This stored information may now be extracted by a discharging process known as *reading*. During reading, the backing-electrode is held at the same potential as the barrier grid. When the beam is turned on, the resulting target-current flow is that for the storage surface at -10 volts with respect to the equilibrium potential, and may be determined by reference to a target characteristic curve for the appropriate operating conditions.

Since reading is accomplished by the removal of electrons from the storage surface and its consequent discharge toward equilibrium potential, reading is likewise an *erasing* process. If the discharge factor during reading is sufficiently high, further erasing is unnecessary. However, in critical applications, a second or possibly more subsequent reading processes at high discharge factor may be necessary to restore the storage surface to equilibrium potential prior to the next writing process. A discharge factor of 1.0 represents complete erasure.

DATA

General,

Heater, for Unipotential Cathode:		
Voltage (AC or DC)	6.3 ± 5%	volts
Current	0.6	amp
Direct Interelectrode Capacitances (Approx.):		
Grid No.1 to all other electrodes	9	μμf
Deflecting electrode DJ_1 to all other electrodes	13	μμf
Deflecting electrode DJ_2 to all other electrodes	13	μμf
Deflecting electrode DJ_3 to all other electrodes	11.5	μμf
Deflecting electrode DJ_4 to all other electrodes	11.5	μμf
DJ_1 to DJ_2	3	μμf
DJ_3 to DJ_4	3	μμf
Grid No.5 to backing-electrode	800	μμf
Grid No.5 and backing-electrode to collector	4	μμf
Collector to all other electrodes & external cylindrical shield	See Fig.5	
Focusing Method	Electrostatic	
Deflection Method	Electrostatic	
Overall Length	11-27/32" ± 3/8"	
Greatest Diameter of Tube	3.30" ± 0.05"	
Minimum Useful Storage-Surface Diameter	2-1/4"	
Base:		
On large end of tube	Small-Button Twentyninar 8-Pin (JETEC No.E8-19)	
On small end of tube	Small-Shell Diheptal 14-Pin (JETEC No.B14-45)	
Mounting Position	Any except those positions where the diheptal base is up and the tube axis is at an angle of less than 60° from the vertical.	
Weight (Approx.)	1	lb.

All voltages are with respect to cathode unless otherwise specified

Maximum Ratings, *Absolute Values***:**

BACKING-ELECTRODE-TO-GRID-No.5 (BARRIER-GRID) VOLTAGE:		
Backing-electrode positive with respect to grid No.5	100 max.	volts
Backing-electrode negative with respect to grid No.5	100 max.	volts
COLLECTOR-TO-GRID-No.5 VOLTAGE:		
Positive value	100 max.	volts
Negative value	0 max.	volts
ULTOR● VOLTAGE	1500 max.	volts
GRID-No.3 VOLTAGE	500 max.	volts
GRID-No.1 VOLTAGE:		
Negative bias value	200 max.	volts
Positive bias value	0 max.	volts
Positive peak value	2 max.	volts

PEAK HEATER-CATHODE VOLTAGE:

Heater negative with respect to cathode	125 max.	volts
Heater positive with respect to cathode	10 max.	volts

Equipment Design Ranges:

*For anyultor voltage (E_{c4}) between 1000 and 1500 volts**

Back-Electrode-to-Grid-No.5 Voltage	See Note 1	
Collector-to-Grid-No.5 Voltage.	0 to 50	volts
Grid-No.3 Voltage for Focus with grid-No.1 volts = 0 . . .	14% to 26% of E_{c4}	volts
Grid-No.1 Voltage for collector-current cutoff	-2.5% to -4.7% of E_{c4}	volts
Collector Current for grid-No.1 volts = 0	20 to 50	μamp
Max. Cathode Current for grid-No.1 volts = 0	See Fig.6	
Deflection Factors:		
DJ_1 and DJ_2	85 to 105 v dc/in./kv of E_{c4}	
DJ_3 and DJ_4	78 to 96 v dc/in./kv of E_{c4}	
Spot Position	See Note 2	
Signal-Uniformity Ratio.	See Note 3	

Examples of Use of Design Ranges:

For ultor voltage of	*1000*	*volts*
Grid-No.3 Voltage for Focus with grid-No.1 volts = 0 . . .	140 to 260	volts
Grid-No.1 Voltage for collector-current cutoff	-25 to -47	volts
Deflection Factors:		
DJ_1 and DJ_2.	85 to 105	v dc/in.
DJ_3 and DJ_4.	78 to 96	v dc/in.

Maximum Circuit Values:

Grid-No.1-Circuit Resistance	1.5 max.	megohms
Resistance in Any Deflecting-Electrode Circuit#	1.0 max.	megohm

● The "ultor" in a storage tube is the electrode to which is applied the highest dc voltage for accelerating the electrons in the beam prior to its deflection. In the 6499, the ultor function is performed by grid No.4. Since grid No.4 and grid No.2 are connected together within the 6499, they are collectively referred to simply as "ultor" for presenting data.

* In general, the recommended minimum ultor voltage should not be less than 1000 volts. Signal output and resolution decrease with decreasing ultor voltage. Secondary-emission characteristics of the dielectric layer limit the maximum ultor voltage to 1500 volts.

\# It is recommended that all deflecting-electrode-circuit resistances be approximately equal.

Note 1: The backing-electrode, grid No.5, and ultor are usually operated at the same dc potential. During the writing cycle, the backing-electrode may be pulsed to ± 60 volts with respect to grid No.5.

Note 2: The undeflected focused spot will fall within a circle having a diameter equal to 10% of the minimum storage-surface diameter and having its center coincident with the center of the storage surface.

Spot position is calculated as follows: With heater voltage of 6.3 volts, ultor voltage of 1000 volts, grid-No.5 voltage of 1000 volts, collector voltage of 1050 volts, grid-No.3 voltage adjusted to give focus, grid-No.1 voltage adjusted for 15 microamperes peak collector current, each deflecting electrode connected through a 1-megohm resistor to ultor, and the tube shielded from all extraneous fields, the voltages required to displace the beam from its undeflected position to the edge of the storage surface in the direction of each deflecting electrode are recorded as *a* for DJ_1, *b* for DJ_2, *c* for DJ_3, and *d* for DJ_4.

Spot Position in % of Storage-Surface Diameter

$$= 1/2\sqrt{\left(\frac{b-a}{b+a}\right)^2 + \left(\frac{d-c}{d+c}\right)^2} \times 100$$

Note 3: With voltages as specified in Note 2, and with a signal written into storage by applying a series of well-formed symmetrical square waves to grid No.1 such that a series of 25 equally spaced stored elements are written across a single line scan, the ratio of the maximum to minimum signal amplitude observed as the single line scan is moved across the storage surface will not exceed 1.35.

OPERATING CONSIDERATIONS

Handling. The 6499 should always be handled and transported with the large end (twentyninar-base end) up in order to prevent possible damage

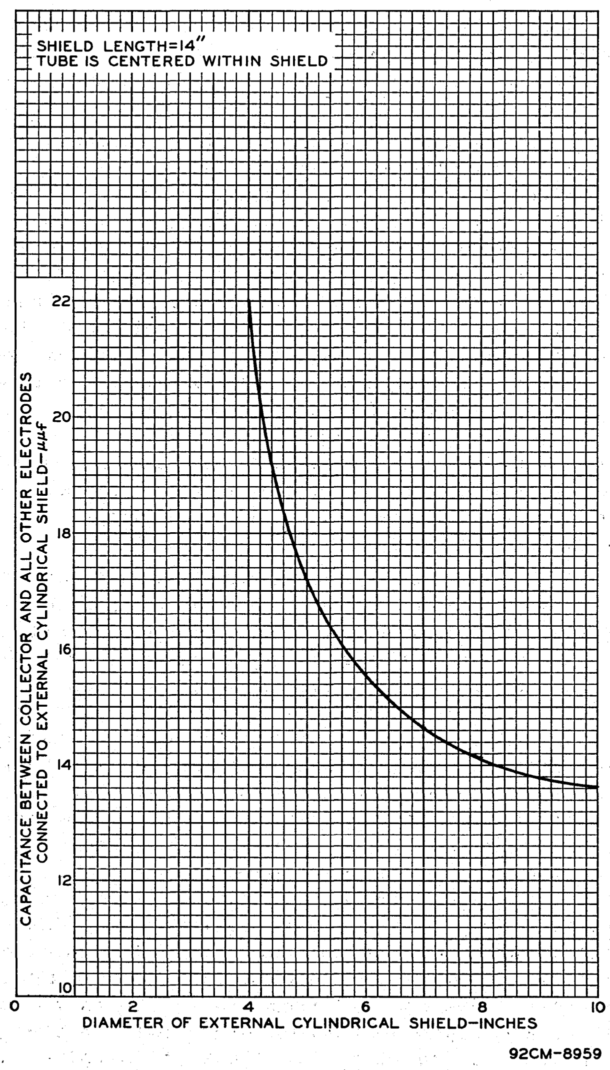


Fig.5 - Curve Showing Indicated Capacitance vs. Shield Diameter.

to the storage surface caused by any loose particles striking the target and adhering to it.

The *maximum ratings* shown in the tabulated data are limiting values above which the serviceability of the 6499 may be impaired from the viewpoint of life and satisfactory performance. Therefore, in order not to exceed these absolute ratings, the equipment designer has the responsibility of determining an average design value for each rating below the absolute value of that rating by an amount such that the absolute values will never be exceeded under any usual condition of supply-voltage variation, load variation, or manufacturing variation in the equipment itself.

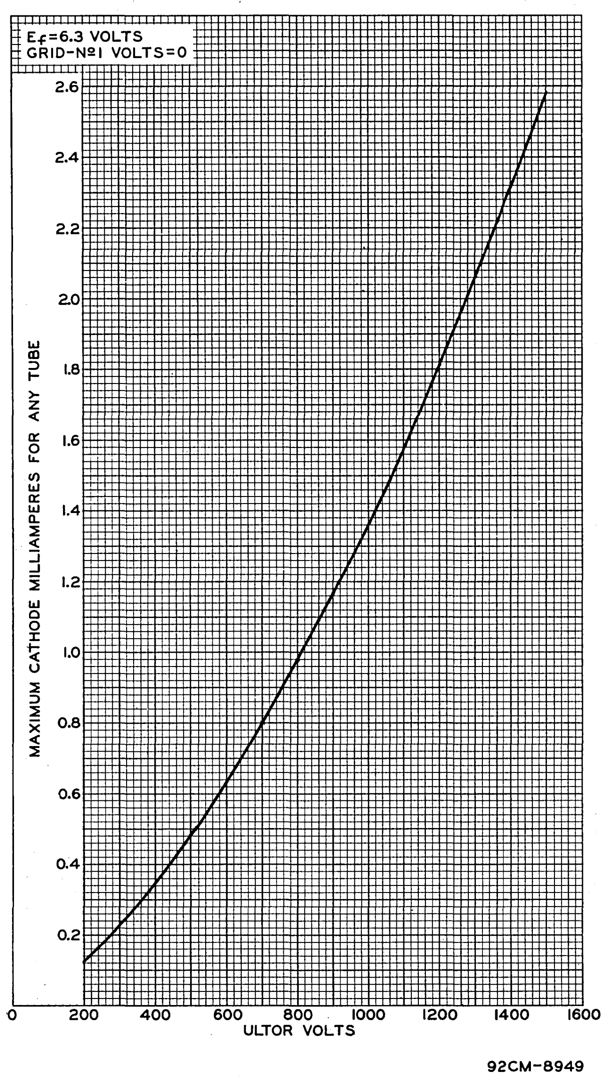


Fig.6 - Maximum Cathode Current for Any Type 6499 With Zero Grid-No.1 Voltage.

Support for the 6499 within the external magnetic shield may be provided by any convenient method. A suggested method is shown in Fig.7.

The *base pins* on the small end of the 6499 fit the small diheptal 14-contact socket. A socket for the twentyninar-base pins at the large end of the tube is unnecessary. Connection to the grid-No 5 base pin and to any one of the five backing-electrode base pins may be made by a flexible lead soldered to a socket contact clip, such as Cinch Experimental No.8023-A, or equivalent.

Shielding. The use of a magnetic shield of high-permeability material surrounding the tube is recommended. This shield prevents the effect of stray fields in causing unwanted deflection of the electron beam.

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. If the circuit design is such as to cause a high voltage between heater winding and ground, the heater transformer should be adequately insulated to withstand the high voltage.

Although maximum values of peak heater-cathode voltage are specified in the tabulated data, it is recommended that the mid-tap or one side of the heater winding be connected directly to the cathode to minimize the possibility of damage to the tube produced by arcing between heater and cathode when a possible momentary internal arc causes the voltage between heater and cathode to exceed the maximum heater-cathode ratings. When, in some circuit designs, the heater is not connected directly to the cathode, precautions must be taken to hold the peak heater-cathode voltage to the maximum values shown in the tabulated data.

Grid No.2, connected within the tube to grid No.4 and operated at grid-No.4 potential, is incorporated in the electron-gun design so that the beam current and grid-No.1 cutoff voltage will not be affected by focusing adjustment. Because of the effect of grid No.2, and the negligible current taken by grid No.3, the beam can be sharply focused on the storage surface and remains sharp when beam current is varied over a wide range.

Grid No.3, the focusing electrode, is so designed that it takes negligible current. This

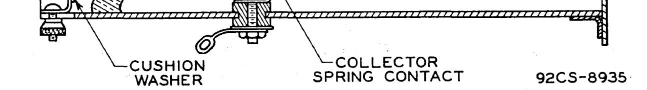


Fig.7 - Suggested Arrangement for Supporting Type 6499 Within External Magnetic Shield.

feature makes possible the use of a low-current voltage-divider system. Focusing of the beam is controlled by adjustment of the ratio of grid-No.3 voltage to grid-No.4 voltage. Ordinarily, the ratio is adjusted by variation of grid-No.3 voltage. For this purpose, a potentiometer adequately insulated is required in the voltage-divider circuit; the necessary range of adjustment is indicated under *Equipment Design Ranges* and *Examples* in the tabulated data.

The *external conductive coating* serves as a convenient connection to the collector and internal shield. If the coating becomes oxidized, it may be cleaned with a silverware cleaner.

end of the tube. This shield is in addition to that recommended under *Shielding.*

Two pairs of *electrostatic deflecting electrodes*, producing fields approximately at right angles to each other, are located within the bulb neck to provide for deflection of the electron beam in the directions of the respective fields.

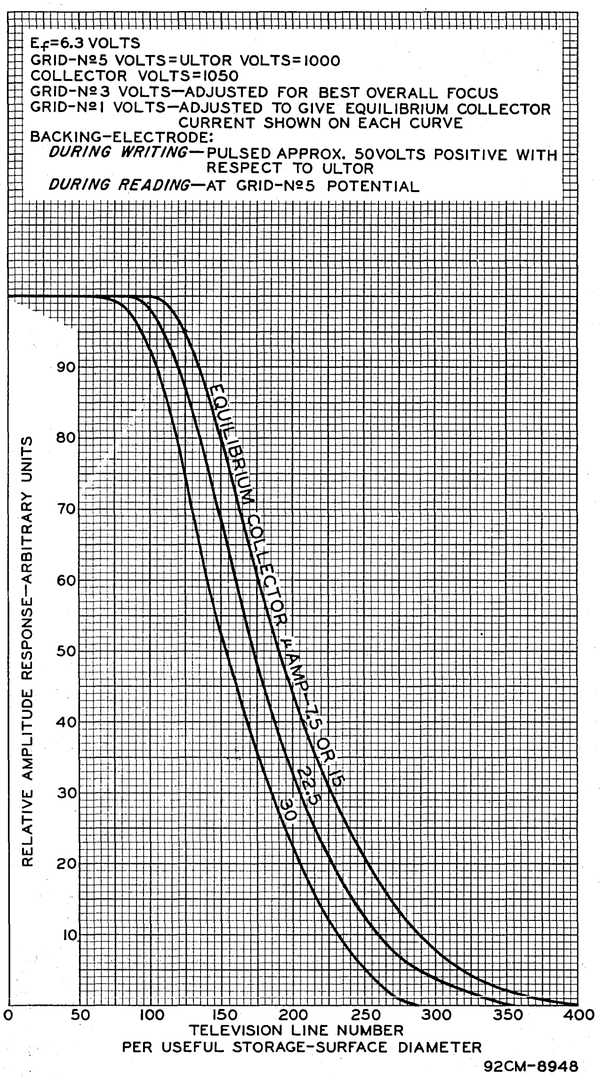


Fig.8 - Resolution Characteristics of Type 6499.

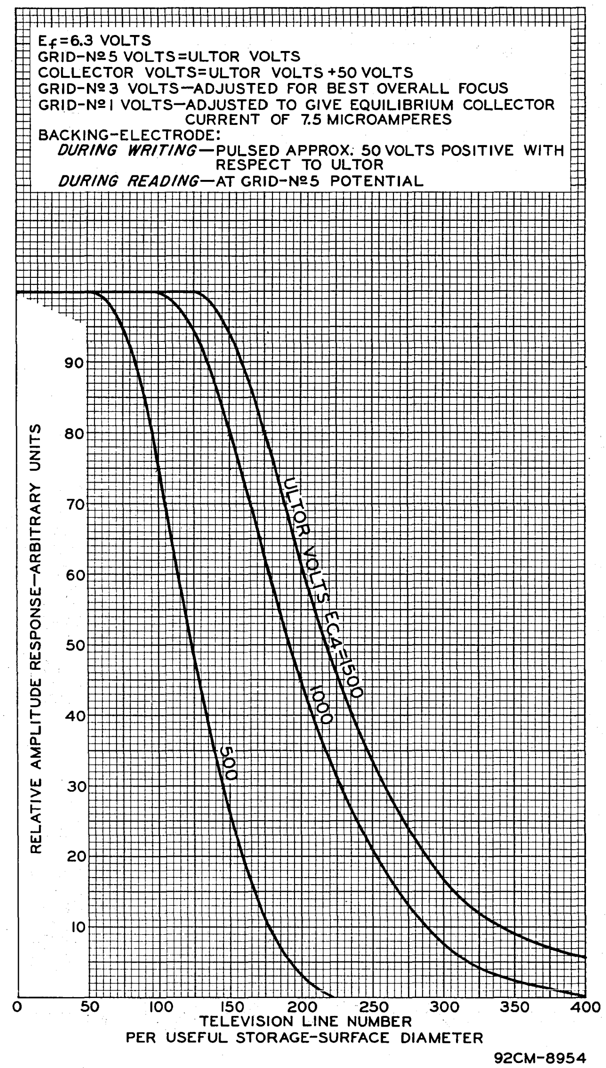


Fig.9 -Resolution Characteristics of Type 6499.

Under no conditions should the rubber supports shown in Fig.7 come in contact with the coating. Connection is normally made to this coating by a spring contact which may be incorporated as a part of the tube support. In applications utilizing rf signal separation, in which rf is applied to grid No.1 or cathode, the coating may be used as an effective rf ground to minimize coupling of the rf signal into the target area. Under such conditions, connection to the coating should be made by spring fingers at one end of a cylindrical shield extending from the coating contact area to beyond the base, thus enclosing the gun

Each pair of deflecting electrodes is normally operated at an average potential the same as that of grid No.4. The grid-No.4 voltage may be adjusted with respect to the average deflecting-electrode potential to provide control of astigmatism. The resistance in the dc path to each of the deflecting electrodes should not exceed 1 megohm.

The *dc voltages* for grid No.1, grid No.3, and ultor should be obtained from an extremely well-regulated power supply essentially free of ripple. It is recommended that the power supply be obtained from the ac-supply line with a suitable rectifier and filter. When the 6499 is operated with an ultor voltage near the maximum value of 1500 volts, the dc power supply should be capable of providing the operating value within ± 1 per cent over a current range of 0 to 3 milliamperes (see Fig.6). To insure adequate regulation of the various electrode voltages, the current through the voltage-divider should be at least 30 milliamperes.

operator from coming in contact with the high voltages. Safety 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 desired. In most applications, it is recommended that the ultor terminal be grounded rather than the cathode terminal. With this method, which places the heater and cathode at high negative potential with respect to ground, the dangerous voltages can more easily be made inaccessible.

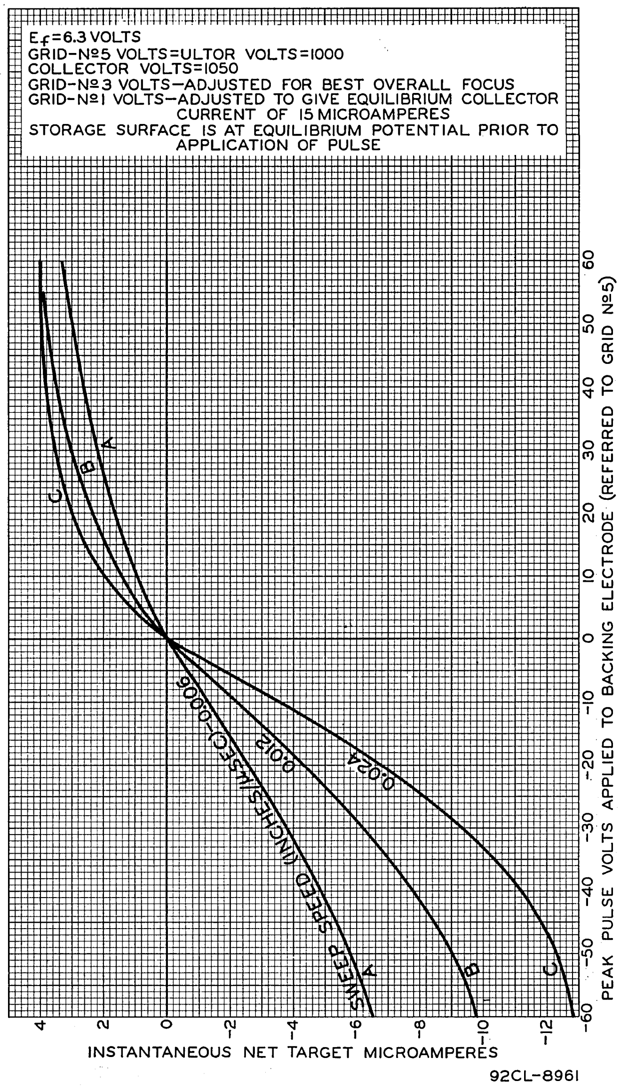


Fig. 10 - Typical Target Characteristics of Type 6499.

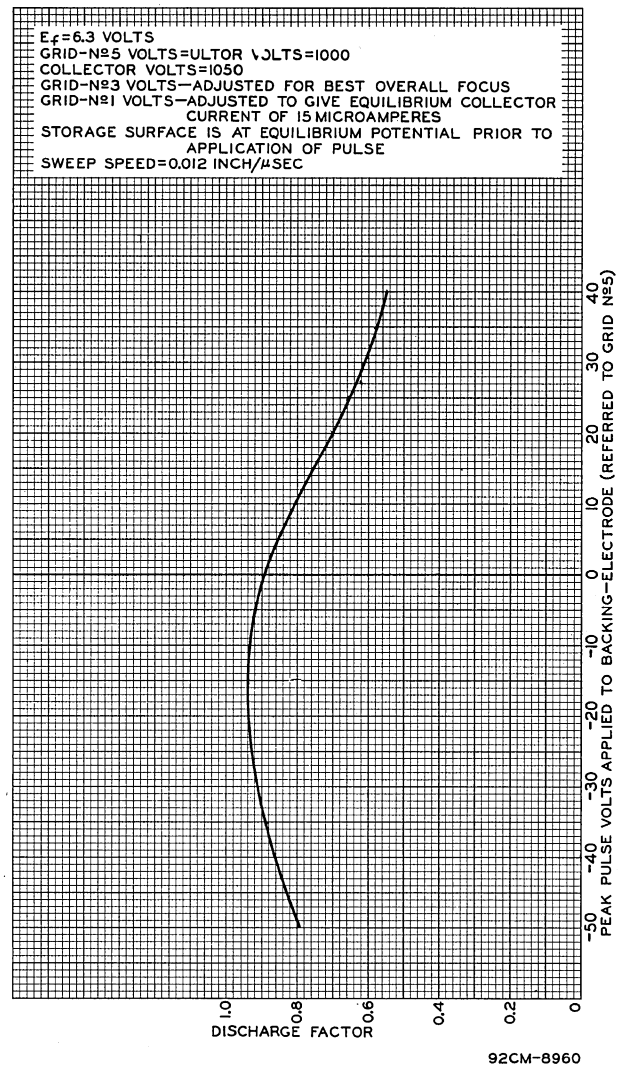


Fig. 11 - Approximate Discharge-Factor Curve of Type 6499.

In most applications, it is recommended that the ultor (grids No.2 and No.4) be grounded in order that the deflecting electrodes may be operated at essentially ground potential. With this method, the cathode and heater are at high negative potential with respect to ground.

The high voltages at which this tube is operated may be very dangerous. Great care should be taken in the design of apparatus to prevent the

In the use of high-voltage tubes, it should always be remembered that high voltages may appear at normally low-potential points in the circuit as a result of capacitor breakdown or 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 capacitors grounded.

The *undeflected focused beam* is normally close to the geometric center of the storage surface. However, to compensate for variation from tube to tube, designers may desire to provide an adjustable and reversible supply of at

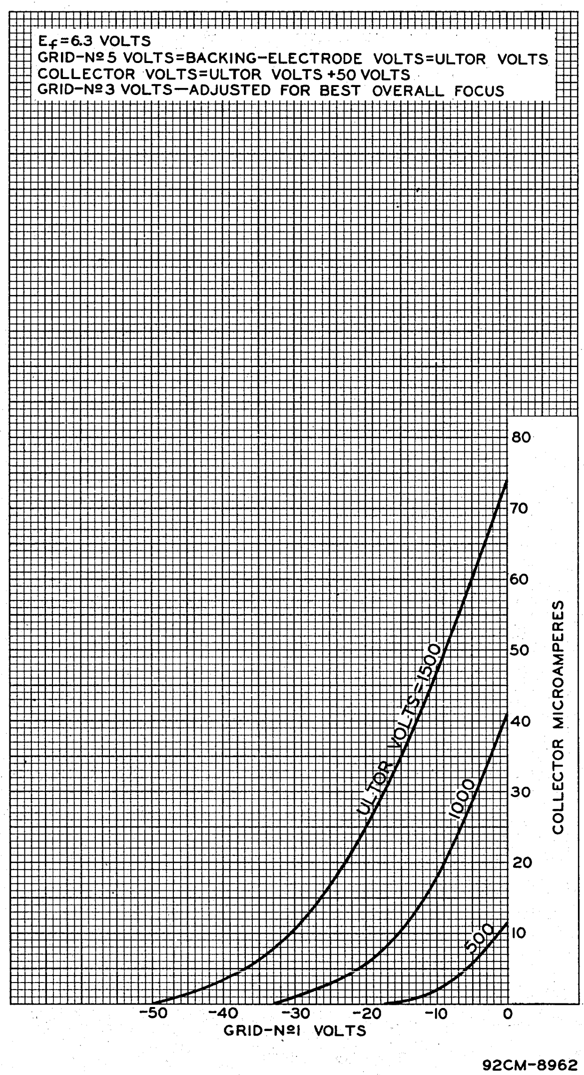


Fig. 12 - Average Transfer Characteristics of Type 6499.

least 13 volts dc per kilovolt of ultor voltage (balanced to ultor) for application between the two deflecting electrodes of each pair. By adjustment of this dc voltage on each pair of the deflecting electrodes, the beam may be centered.

Do not operate the 6499 continuously for more than a few minutes with an undeflected focused beam or with a stationary single-line scan. Such operation may cause damage to the storage surface.

The *resolution capability* of the 6499 is dependent upon the beam current and the beam accelerating voltage used in a particular application, as shown in Figs. 8 and 9, respectively.

The resolution of the 6499 may be measured by writing-in a signal consisting of a sequence of square waves, by observing the amplitude of the ac component of the reading-output, and by plotting relative output as a function of the number of half-cycles (TV lines) stored across the minimum useful diameter of the storage surface.

The shape of the resolution curve is related in a complex manner to the cross-sectional diameter of the focused beam and the current-density distribution within the beam. As an approximation, it may be assumed that the beam density has a Gaussian distribution. For the conditions shown by the upper curve in Fig. 8, the width of the Gaussian distribution curve at half amplitude is about 0.010 inch.

The use of 1000 volts as the ultor voltage (beam accelerating voltage) is often a good compromise between resolution and secondary-emission ratio of the storage surface. Within the operating range of the 6499, the secondary emission ratio decreases with increase in ultor voltage.

Typical target-characteristic curves for the 6499 are shown in Fig. 10. For an individual tube, the shape of these curves is dependent on ultor voltage, beam current, beam focus, and scanning speed.

The *discharge-factor curve* for the same operating conditions as used for the middle curve in Fig. 10 is shown in Fig. 11.

Average transfer characteristic curves for the 6499 are shown in Fig. 12. For the conditions indicated, the collector current is identical to the beam current.

The *circuit arrangement* used with the 6499 will depend on the requirements of the storage application. A discussion of various circuits is given in References 3 and 4.

The *sequence of adjustments* in operating the 6499 is as follows:

1. With the tube inserted in the equipment, apply rated heater power.

2. Next apply deflecting-electrode voltages and make certain that the deflecting circuits are functioning properly to scan the storage surface.

3. Apply other electrode voltages as indicated under *Equipment Design Ranges*.

4. Adjust grid-No. 1 voltage to operate the tube on the proper portion of its transfer characteristic as required by the application.

5. Adjust grid-No. 3 voltage for best focus.

REFERENCES

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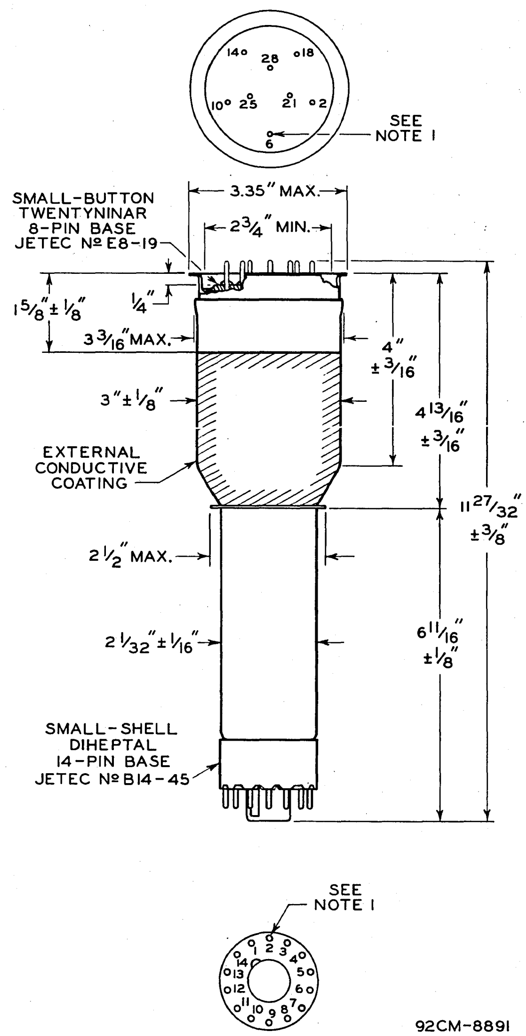
4. M. E. Hines, M. Chruney, and J. A. McCarthy, *"Digital Memory in Barrier-Grid Storage Tubes"*, Bell System Technical Journal, Vol. XXXIV, No.6, pp. 1241 - 1264, November, 1955.
5. M. Knoll and B. Kazan, *"Storage Tubes and Their Basis Principles"*, John Wiley & Sons, Inc., New York (1952).

DIMENSIONAL OUTLINE

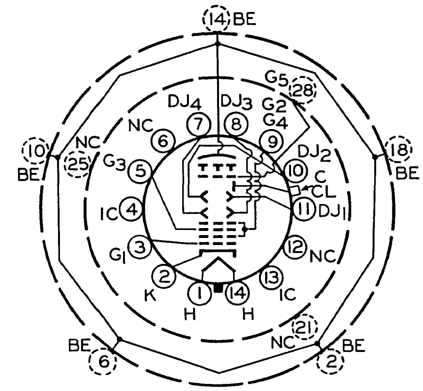


NOTE 1: THE ANGLE BETWEEN PLANE THROUGH PIN No. 6 OF TWENTYNINAR BASE AND TUBE AXIS, AND PLANE THROUGH PIN No. 2 OF DIHEPTAL BASE AND TUBE AXIS WILL NOT EXCEED 10°. THE INDICATED PINS ARE BOTH ON THE SAME SIDE OF THE TUBE.

NOTE 2: DEFLECTING ELECTRODES DJ_1 & DJ_2 ARE NEARER THE TARGET. DEFLECTING ELECTRODES DJ_3 AND DJ_4 ARE NEARER THE DIHEPTAL BASE.

NOTE 3: ANGLE BETWEEN DJ_1 & DJ_2 DEFLECTION PATH AND DJ_3 & DJ_4 DEFLECTION PATH IS $90° \pm 3°$.

SOCKET CONNECTIONS
Bottom View



SOLID-LINE CIRCLES DEPICT DIHEPTAL BASE
BROKEN-LINE CIRCLES DEPICT TWENTYNINAR BASE

SMALL-SHELL DIHEPTAL 14-PIN BASE

View of Diheptal-Base End of Tube

PIN 1: HEATER
PIN 2: CATHODE
PIN 3: GRID No.1
PIN 4: INTERNAL CONNECTION--DO NOT USE
PIN 5: GRID No.3
PIN 6: NO CONNECTION
PIN 7: DEFLECTING ELECTRODE DJ_4
PIN 8: DEFLECTING ELECTRODE DJ_3
PIN 9: ULTOR (Grids No.2 & No.4)
PIN 10: DEFLECTING ELECTRODE DJ_2
PIN 11: DEFLECTING ELECTRODE DJ_1
PIN 12: NO CONNECTION
PIN 13: INTERNAL CONNECTION--DO NOT USE
PIN 14: HEATER
C, CL: EXTERNAL CONDUCTIVE COATING, COLLECTOR, INTERNAL SHIELD, FLANGE BETWEEN NECK AND LARGE PART OF TUBE

SMALL-BUTTON TWENTYNINAR 8-PIN BASE

View of Twentyninar-Base End of Tube

Pins 2, 6, 10, 14, 18: On 1-7/8" Dia. Pin Circle
Pins 21, 25, 28: On 7/8" Dia. Pin Circle

PIN 2, PIN 6, PIN 10, PIN 14, PIN 18: MULTIPLE CONNECTIONS TO BACKING-ELECTRODE. ONLY ONE NEED BE USED
PIN 21: NO CONNECTION
PIN 25: NO CONNECTION
PIN 28: GRID No.5

RCA