BARRIER GRID STORAGE TUBE TYPE WL-7566
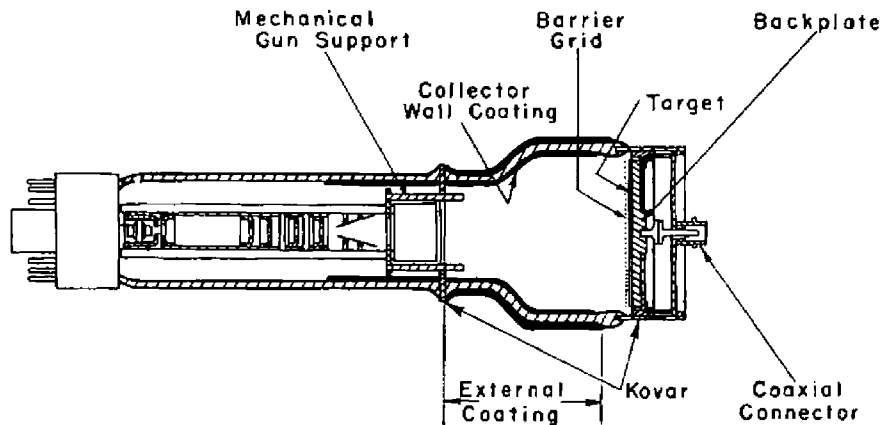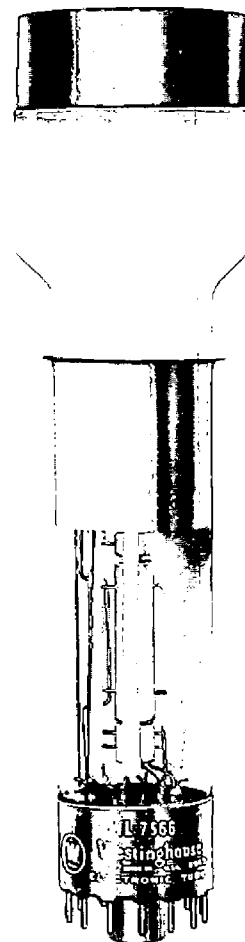## (RADECHON)

Rugged Construction   High Resolution   2.6" Useful Diameter Target
Shielded Target Assembly   Coaxial Connection for Signal Output

The WL-7566 is a 3" electrical write, electrical read, barrier-grid type storage tube. It is designed for service in digital or analog computer systems and pulse height analyzers.

The WL-7566 uses a single gun with electrostatic focus and deflection. The electron-optical design of this gun makes unnecessary any astigmatic correction in order to achieve a fine electron beam of high current density at all deflections. A high degree of mechanical strength is imparted to the 4-bead gun structure by making the collector terminal an integral part of the gun. The collector terminal is a thick Kovar ring sealed into the envelope of the tube and electrically connected to the collector wall coating and external conductive coating. Permanent axial alignment of the gun is thus ensured by mechanically securing both ends of the gun.

The mesh-target storage assembly of the WL-7566 is extremely rugged. The barrier-grid is a fine, woven stainless-steel mesh, treated to control secondary emission ratio to unity, stretched drum tight on a ring which is welded to the outer Kovar cylinder. The mica target is between, and in continuous contact with the barrier grid and back plate. The back plate is retained firmly against the target and a single heavy lead is brought out through a glass bead seal in the center of the Kovar end cup and terminated in the center conductor of a hermetically sealed BNC connector. Since the entire target assembly is surrounded by a Kovar cylinder, a high degree of shielding is obtained reducing the generation of spurious signals due to external fields.

The WL-7566 is designed to operate in existing systems. The use of a coaxial connector provides a quick and positive means of electrical connection with a shielded output. The increased resolution capability, uniformity of output and rugged construction results in an all round improvement in system performance.
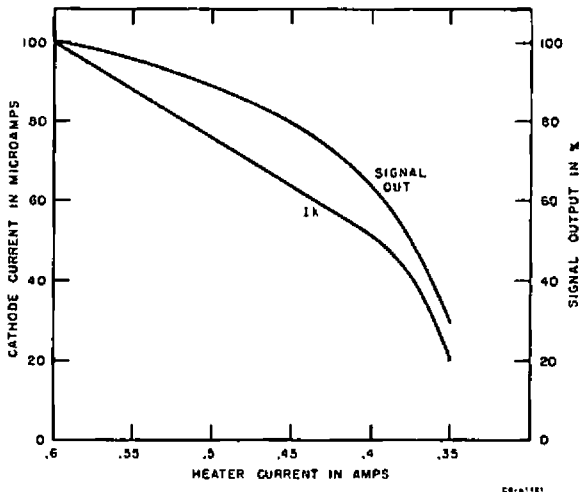

Mechanical Gun Support   Barrier Grid   Backplate   Collector Wall Coating   Target   External Coating   Kovar   Coaxial Connector

CE-A1419

from JEDEC release #2668, Dec. 21, 1959

ELECTRICAL:

Cathode		Coated Unipotential
Heater:		
Voltage	6.3	Volts
Current ♦	0.6	Ampere
Interelectrode Capacities:		
Cathode to all Other Electrodes	15	$\mu\mu f$
Grid 1 to all Other Electrodes	10	$\mu\mu f$
Grids 2 & 4 to all Other Electrodes	10	$\mu\mu f$
DJ1 to all Other Electrodes	8	$\mu\mu f$
DJ2 to all Other Electrodes	8	$\mu\mu f$
DJ3 to all Other Electrodes	7.5	$\mu\mu f$
DJ4 to all Other Electrodes	7.5	$\mu\mu f$
DJ1 to DJ2	1.5	$\mu\mu f$
DJ3 to DJ4	2	$\mu\mu f$
Barrier Grid to Backplate	1600±20%	$\mu\mu f$
Collector to Backplate	0.2	$\mu\mu f$
Barrier Grid to Collector	18	$\mu\mu f$
Collector to All Other Electrodes	22	$\mu\mu f$
Interelectrode Insulation:		
Cathode to all Other Electrodes	500 min.	Megohms
Heater to Cathode	50 min.	Megohms
Any one Deflection Plate to		
all Other Deflection Plates	500 min.	Megohms
Backplate to Barrier Grid	100 min.	Megohms
Grid 3 to all Other Electrodes	500 min.	Megohms
Grid 1 to all Other Electrodes	500 min.	Megohms
Focusing Method		Electrostatic
Deflecting Method		Electrostatic
Deflection Sensitivity:		
DJ1 and DJ2	110±7%	Volts/Inch/KV
DJ3 and DJ4	125±7%	Volts/Inch/KV
Spot Position ⊕	0.065	Inch

♦ Reasonable performance is obtained with a minimum of 0.45 amperes of heater current. The decrease in relative signal output and beam current resulting from a decrease in heater current is shown in CE-A1421.

⊕ Undeflected focused spot falls within 0.065" of the geometric center of the target.

MECHANICAL:

Mounting Position	Any
Maximum Diameter	3-1/8"
Maximum Overall Length	11-7/8"
Maximum Usable Target Diameter	2.6"
Base	Small Shell 14 Pin Base (JEDEC B14-45)
Signal Connector	Hermetically Sealed BNC Panel Jack JAN No. UG-657/U
Net Weight (approx.)	1 Pound
Shipping Weight (approx.)	4 Pounds

MAXIMUM RATINGS:

Absolute Maximum Values

|		
Cathode to Barrier Grid Voltage	-3300 max.	Volts
Grid 1 to Barrier Grid Voltage	-3000 max.	Volts
Grid 1 to Cathode Voltage	+3 max.	Volts
Grid 3 to Grids 2 & 4 Voltage	-3000 max.	Volts
Back Plate to Barrier Grid Voltage	+200 max.	Volts
Heater-Cathode Voltage	±100 max.	Volts

TYPICAL OPERATING CONDITIONS:

(With Barrier Grid Grounded)

Cathode Voltage	-1100	Volts
Grid 1 Cutoff Voltage	-1140	Volts
Grids 2 & 4 Voltage	+150	Volts
Grid 3 Voltage	-770±5%	Volts
Collector Voltage	+150	Volts
Back Plate Voltage:		
Reading Conditions	0	Volts
Writing Conditions	+40	Volts

MERIT FACTOR:

|	Min.	Bogey
Read Around Ratio using 70% of usable target diameter	800	3000

PRINCIPLES OF OPERATION

When an electron beam bombards an insulator, secondary electrons are emitted in proportion to the secondary emission ratio of the target material at the operating voltage. For the WL-7566 target, this ratio follows the general pattern in curve CE-A1509.

VARIATION OF SIGNAL OUTPUT WITH HEATER CURRENT


SECONDARY EMISSION CHARACTERISTIC
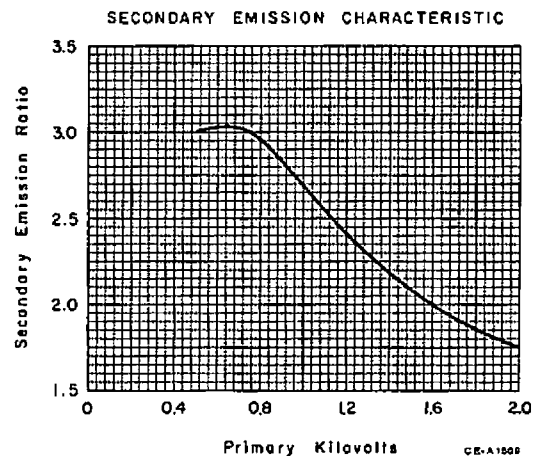
If a grounded grid is placed touching the target, and a positive potential applied to the backplate, a retarding electric field is formed which acts like a barrier to prevent the secondary electrons from escaping from the small areas formed by the spaces of the grid. If the back plate is returned to the potential of the barrier grid during scan, secondary electrons will be released. These secondary electrons are attracted to the collector maintained at a positive potential.

In the writing operation of the WL-7566 the backplate is pulsed 20 to 50 volts positive with respect to the barrier grid. A similar positive potential is initially induced on the target surface. The modulated electron beam is scanned across the target. The barrier grid prevents the escape or redistribution of secondary electrons and the information is stored on the target in the form of a pattern of negativly charged areas. This operation is illustrated in CE-A1418.

WRITING CONDITION
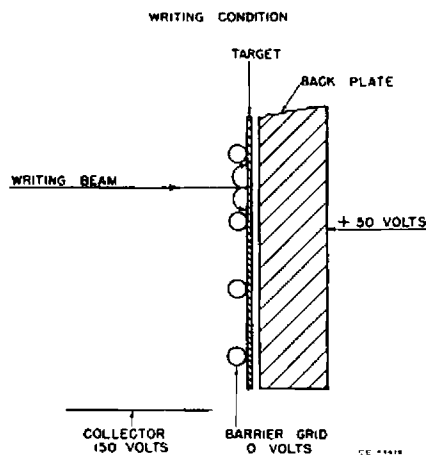
During the reading operation, the back plate is returned to the same potential as the barrier grid. The written areas of the target surface assume a negative potential with respect to the barrier grid. An unmodulated electron beam is scanned across the target. A burst of secondary electrons leaves the target as the reading beam enters each aperture in the barrier grid which contains a charged area. These electrons are attracted to the collector held at a potential of +150 volts with respect to the barrier grid. This operation is illustrated in CE-A1417.

READING CONDITION
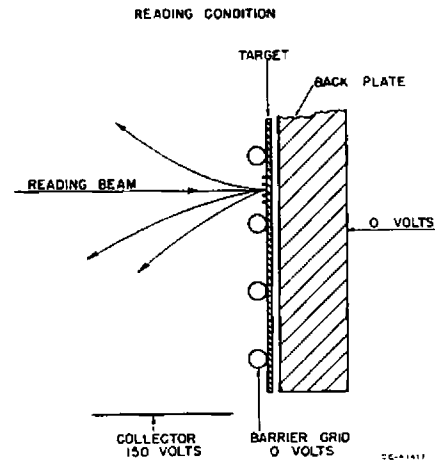
This current, or the displacement current flowing in the back plate, constitutes the output signal. This reading process discharges the target toward an equilibrium potential which is close to that of the barrier grid. A negligible disturbance signal is produced when the scanning beam strikes the mesh which is treated in such a manner that the secondary emission ratio is approximately unity. This close control of the secondary emission ratio of the barrier grid results in a very favorable signal to noise ratio.

PERFORMANCE

The WL-7566 is primarily designed for use in digital computers. In this application, a significant performance indicator is the Readaround Ratio capability. The Readaround Ratio Test is performed in the following manner:

Raster: A pattern of 4096 dots is made by arranging 16 square blocks of 16 × 16 each in the form shown in CE-A1508. An identical pattern interlaced results in a 8192 dot raster.

READAROUND TEST RASTER
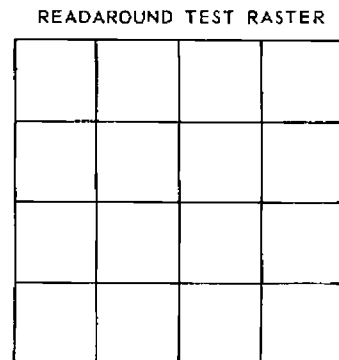
CE-A1508

Writing: Writing is achieved by switching the backplate to either +15 volts to write a "1" or -15 volts to write a "0". In each case the beam duration is sufficient to bring the spot to equilibrium. The Radechon grid drive is adjusted to provide a "1" read signal of a predetermined size at the output of the gain stabilized read amplifier; this is arranged to correspond to a beam current of approximately 1 μa.

Reading: The output from the read amplifier drives a discriminator having a triggering threshold of one quarter of the nominal "1" signal amplitude. Any signal triggering the discriminator is interpreted as a "1", all others as "0" 's. The test is performed with an ultor voltage of 1100 volts and a well focused spot.

The Readaround Ratio Test: An interlaced pattern of 8192 "0" 's or "1" 's is stored on the target. The regeneration cycle is set at 1 microsecond "read", 3 microsecond "rewrite" and 6 microsecond "deflect". Next, an equally spaced pattern of one-eighth of the total dot pattern (1024) is written to the opposite polarity of the previously written pattern. In turn, each of the 1024 locations is addressed N consecutive times. (An address is a read followed by a rewrite). The addressing of a spot in this manner, degrades the charge stored at adjacent spots. When the degradation of charge at any spot is such that its "readout" signal crosses the discriminator threshold, a "readaround failure" is said to have occurred. This procedure is then repeated for a pattern of dots written to the oppo-

TRANSFER CURVES

WL 7225
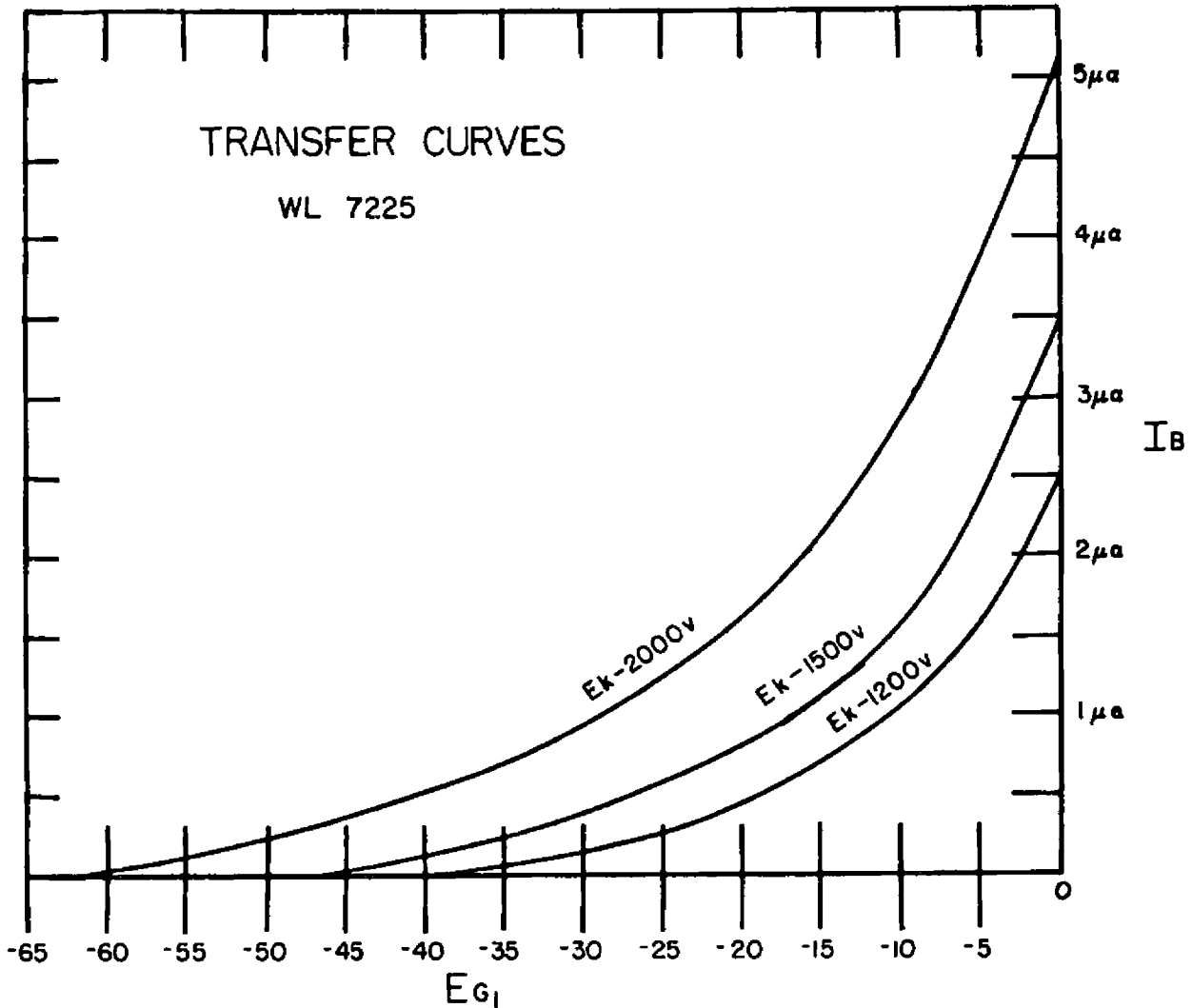
CE-A1416

site polarity. The entire pattern is examined in this way such that every nearest neighbor of every spot is consulted N consecutive times, and the smallest value N for which a readaround failure occurs is called the readaround ratio of the tube.

Results: When the WL-7566 is tested this way, the readaround ratio is approximately 3000 with a minimum of 800. This test, however, only uses approximately 70% of the usable target area. If the full usable target diameter is used, a much higher readaround ratio will-be obtained. For high resolution applications, up to 40,000 dots can be stored with corresponding lower readaround ratios.

Information may be written and stored for many hours, if desired, before being read out. The uniformity of output is such that for a constant signal applied the ratio of the maximum to minimum signal obtained from the target does not exceed 2 to 1 with a cathode voltage of -1100 volts. The signal output actually is much more uniform than this ratio indicates. The wide latitude given includes highly localized disturbances on the target surface.

For further information on the use of Radechons in a digital storage application see:

Greenwood and Staehler
Bell System Technical Journal
September 1958 Page 1195
and
C.F. Ault
Bell System Technical Journal
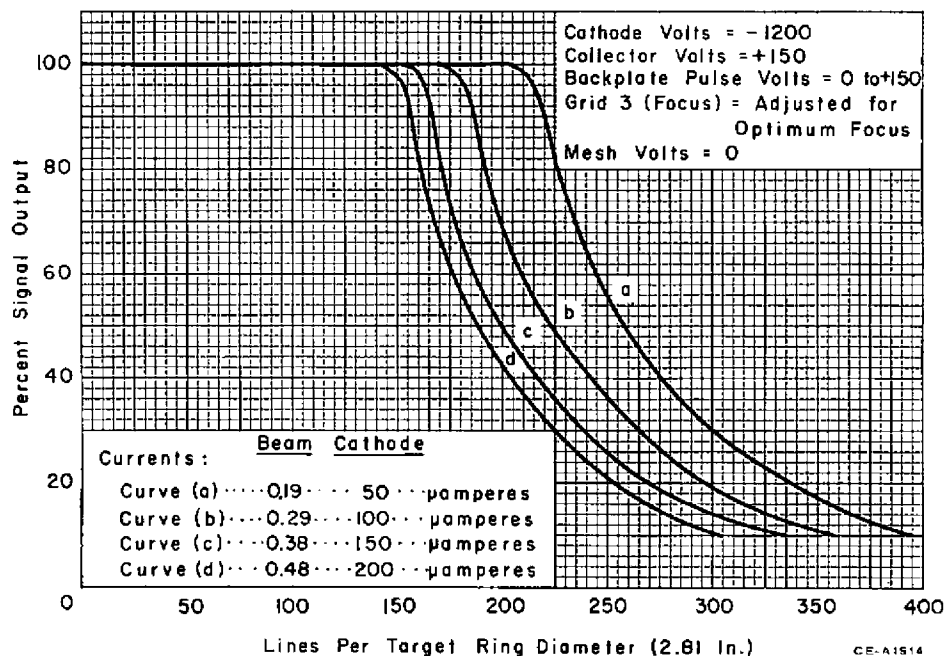March 1959 Page 445

Target Life: Under conditions of intensive bombardment of one spot, the signal output will fall, approaching a final value of 70% of its original value.
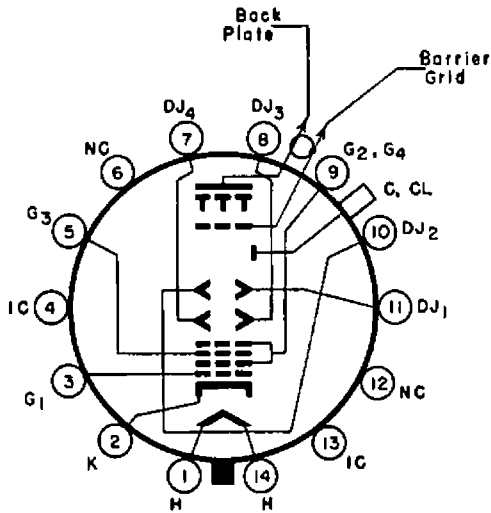
When a 50% duty cycle is used, this decrease in signal will not occur within the first four hours.

The normal operating conditions of digital computers are such that noticeable signal decrease is unlikely to occur for at least 1000 hours.

Resolution: The WL-7566 may also be used in applications employing a conventional raster. The tube characteristic of value in this application is its resolution. The resolution of the WL-7566 may be expressed in lines per target diameter when the target is scanned with a conventional raster. The difference in resolution with four values of beam current is shown inCE-A1514.

RESOLUTION CHARACTERISTICS

Cathode Volts = -1200
Collector Volts = +150
Backplate Pulse Volts = 0 to+150
Grid 3 (Focus) = Adjusted for Optimum Focus
Mesh Volts = 0

Currents:	Beam	Cathode	
Curve (a)	0.19	50	µamperes
Curve (b)	0.29	100	µamperes
Curve (c)	0.38	150	µamperes
Curve (d)	0.48	200	µamperes

Percent Signal Output vs Lines Per Target Ring Diameter (2.81 In.)

CE-A1514

Westinghouse®

CE-A1423

Socket Connections
(Bottom View)

Pin No.	Element
1	Heater
2	Cathode
3	Grid 1
4	Internal Connection (Do Not Use)
5	Grid 3
6	No Connection
7	Deflecting Electrode 4
8	Deflecting Electrode 3
9	Grids 2 & 4
10	Deflecting Electrode 2
11	Deflecting Electrode 1
12	No Connection
13	Internal Connection (Do Not Use)
14	Heater

Bulb Terminals

Neck Flange: External Conductive Coating (C),
Internal Shield, Collector (CL)

Coaxial Connector
Center Electrode: Back Plate
Outside Electrode: Barrier Grid, End Cylinder

SMALL SHELL DIHEPTAL
14 PIN BASE
JETEC NO. B14-45

CE-A1422