September 1, 1960

DIRECT VIEW STORAGE TUBE TYPE 7268

Two Writing Guns
Viewing Gun
Integral Tube and Shield Assembly

4" Display Diameter

5-1/4" Overall Diameter Including Shield
15-3/4" Overall Length
25 Pin Two-Tier Base

The 7268 is a direct-view storage tube incorporating two writing guns and a viewing gun system capable of producing a bright, non-flickering, uniform display over a four inch diameter viewing area. The two electrostatically focused and deflected writing guns permit independent and simultaneous writing of two signals.

Performance characteristics of the tube include a brightness of up to 2500 foot-lamberts with 10,000 volts applied to the phosphor, good resolution of half-tone displays, and excellent display uniformity. The writing speed of 36,000 inches per second is sufficient to "freeze" high frequency transients, and storage time is long enough to allow adequate examination and recording of the display.

The 7268 is particularly useful for such applications as airborne fire control radar, weather radar, transient studies, data transmission including half-tone storage, telemetering, facsimile, and visual displays requiring steady, narrow-bandwidth transmission over telephone lines.

The 7268 is designed to operate under military environmental conditions. It may be operated unpressurized at high altitudes. The pin connections have been grouped according to operating potentials within a Westinghouse designed Two-Tier 25 Pin Base (JEDEC B25-216) which features unusually long external leakage paths between pin circles. In addition, the base is potted to eliminate internal leakage.

The entire tube is potted within its magnetic shield with a synthetic silicone-rubber material providing protection against mechanical shock, vibration, humidity, and leakage between bulb terminals. The magnetic shield is resistant to salt spray.

The integral tube-and-shield assembly together with the improved base design greatly simplify tube installation procedure.

ELECTRICAL:

Storage:

Type	Half-Tone or Line
Mode	Control of Transmission
Type of Erasure	Overall

Writing Guns: (Each Gun)

Cathode				Coated Unipotential
Heater:	Min.	Bogey	Max.	
Voltage (ac or dc)	5.67	6.3	6.93	Volts
Current	0.50	0.60	0.70	Amperes
Focusing Method				Electrostatic
Deflection Method				Electrostatic
Number of Writing Guns				Two

Viewing Gun:

Cathode				Coated Unipotential
Heater:	Min.	Bogey	Max.	
Voltage	5.67	6.3	6.93	Volts
Current	0.50	0.60	0.70	Ampere
Warm-up Time before Applying High Voltages	30	--	--	Seconds
Focus and Deflection	Undeflected, Collimated "Flood" Gun			

Direct Interelectrode Capacitances:

External Integral Shield Grounded

Writing Gun Cathode to All Internal Elements	7 max.	μμf
Viewing Gun Cathode to All Internal Elements	10 max.	μμf
Writing Gun Grid 1 to All Internal Elements	10 max.	μμf
Viewing Gun Grid 1 to All Internal Elements	18 max.	μμf
Deflection Electrode 1 to Deflection Electrode 2	3 max.	μμf
Deflection Electrode 3 to Deflection Electrode 4	2 max.	μμf
Deflection Electrode 1 to All Internal Elements	8 max.	μμf
Deflection Electrode 2 to All Internal Elements	8 max.	μμf
Deflection Electrode 3 to All Internal Elements	8 max.	μμf
Deflection Electrode 4 to All Internal Elements	8 max.	μμf
Backing Electrode to All Internal Elements	110 max.	μμf

OPTICAL:

Phosphor:

Type	High Visual Efficiency, Aluminized P20
Fluorescence	Yellow-Green
Phosphorescence	Yellow-Green
Persistence	Short
Faceplate	Optical Glass, Ground and Polished Flat

MECHANICAL:

Minimum Useful Viewing Diameter	4"
Maximum Overall Length	16"
Maximum Seated Length	14-1/4"
Greatest Shield Diameter	5-1/4" ± 1/16"
Viewing Screen Terminal	Flexible Cable
Caps on Large End of Bulb	
Backing Electrode	Recessed Small Ball (JEDEC J1-22)
Collecting Electrode	Recessed Small Ball (JEDEC J1-22)
Collimating Electrode	Recessed Small Ball (JEDEC J1-22)
Base	25 pin Two Tier Deci-Quindecimal (JEDEC B25-216)
Mounting Position	Any

MAXIMUM RATINGS:

Absolute Maximum Values

Writing Gun:

(Reference Voltage is Writing Gun Cathode)

Grids 2 & 4 Voltage♦	3000 max.	Volts
With Respect to Viewing Gun Cathode	200 max.	Volts
Grid 3 Voltage (Focus)	2000 max.	Volts
Negative with Respect to Viewing Gun Cathode	2600 max.	Volts
Grid 1 Voltage:		
Negative Bias Value	200 max.	Volts
Positive Bias Value	0 max.	Volts
Positive Peak Value	2 max.	Volts
Cathode Voltage Negative with Respect to Viewing Gun Cathode	2800 max.	Volts
Voltage Between any Deflection Electrode and Grids 2 & 4:♦		
Positive or Negative Peak Value	500 max.	Volts
Peak Heater-Cathode Voltage:		
Heater Positive or Negative with Respect to Cathode	125 max.	Volts

Viewing Gun:

(Reference Voltage is Viewing Gun Cathode)

Viewing Screen Voltage	11000 max.	Volts
Grid 5 Voltage (Backing Electrode)	35 max.	Volts
Grid 4 Voltage (Collecting Electrode)	300 max.	Volts
Grid 3 Voltage (Collimating Electrode)	300 max.	Volts
Grid 2 Voltage (Accelerating Electrode)♦	200 max.	Volts
Grid 1 Voltage:		
Negative Bias Value	150 max.	Volts
Positive Bias Value	0 max.	Volts
Peak Heater-Cathode Voltage Heater Positive or Negative with Respect to Cathode	125 max.	Volts

LIMITING CIRCUIT VALUES

Viewing Screen Series Current-Limiting Resistance	1.0 min.	Megohm
Backing Electrode Circuit Resistance	5000 max.	Ohms
Collecting Electrode Unbypassed Series Current-Limiting Resistance	22000 min.	Ohms
Grid 1 Circuit Resistance	1.0 max.	Megohm
Resistance in Any Deflecting Electrode Circuit⊕	0.1 max.	Megohm

ENVIRONMENTAL LIMITS

Atmospheric Pressure	60 max.	P.S.I.
Altitude (Non-pressurized)	60,000 max.	Feet
Temperature:		
Operating	0 to 50	°C
Non-Operating	-60 to 80	°C
Relative Humidity (Non-Operating)	95	Percent

Vibration .... Sinusoidal Vibration from 10 to 50 cycles per second with a total excursion of 0.015 inches and from 50 to 500 cycles per second with 2 g acceleration will not damage the tube.

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

Note: *Damage to the ♦ 7268 ♦ may occur if the Writing-Gun beam is turned on before the Viewing-Gun-beam current has reached normal operating value or if the Viewing-Gun beam is turned off before the Writing-Gun beam.*

Reference Point for DC Voltages is Ground

Writing Guns:			
Grids 2 & 4 Voltage♦		50 to 125	Volts
Grid 3 Voltage (Focus)		-1975 to -2150	Volts
Grid 1 Voltage to Writing Gun Cathode		0 to -100	Volts
Cathode Voltage		-2400	Volts
Grids 2 & 4 Current♦		100	μampere
Grid 3 Current (per gun)		-10 to 5	μampere
Cathode Current		See CE-A 1472	
Deflection Factors			
Deflecting Electrodes 1 and 2♦		80 to 100	V dc/In.
Deflecting Electrodes 3 and 4♦		80 to 100	V dc/In.
Focused Beam Position †			0.5 Inch
Viewing Gun:	Range	Typical	
Viewing Screen Voltage	8000 to 11000	10000	Volts
Grid 5 Voltage (Backing Electrode)	0 to 10	2	Volts
Grid 4 Voltage (Collecting Electrode)	175 to 300	265	Volts
Grid 3 Voltage (Collimating Electrode)	5 to 150	75	Volts
Grid 2 Voltage♦	50 to 125	90	Volts
Grid 1 Voltage	0 to -50	0	Volts
Cathode			Grounded
Viewing Screen Current		250	μamperes
Grid 5 Current (Backing Electrode)		2	μamperes
Grid 4 Current (Collecting Electrode)		1.5	Ma.
Grid 3 Current (Collimating Electrode)		200	μamperes
Cathode Current		2	Ma.

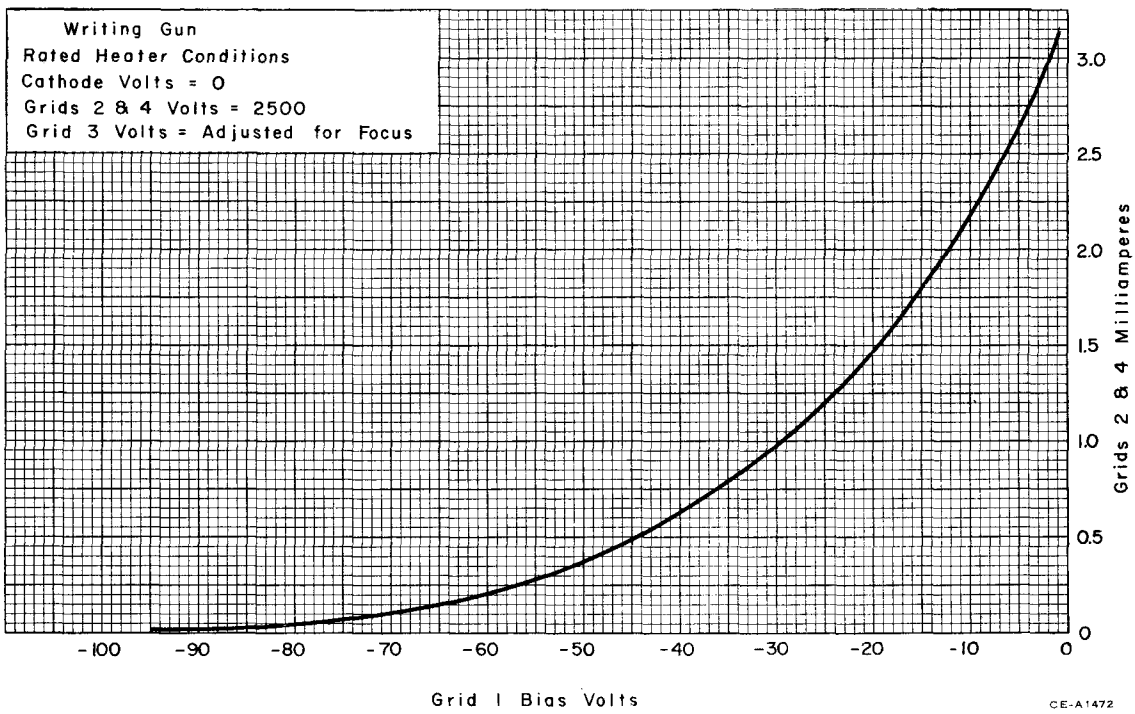
♦ Grids 2 & 4 of both Writing Guns are internally connected together and to Grid 2 of the Viewing Gun.

♦ For other values of cathode to Grids 2 & 4 Voltages, the deflection factor is approximately 32 to 40 V dc/In./KV of cathode to Grids 2 & 4 Voltage.

† With all deflecting electrodes tied to Grids 2 & 4, and erasure at a convenient value the undeflected, focused spots will fall within a circle of 0.5 inch radius, centered on the tube faceplate.

⊕ Approximately equal resistances should be used in each deflecting-electrode circuit.

AVERAGE WRITING GUN ANODE TRANSFER CHARACTERISTIC



PERFORMANCE DATA

Viewing Time	5	Seconds
Erasing Time	50	Milliseconds
Display Uniformity (Δep min.)	1	Volt
Writing Speed	36,000	Inches/Second
Half Tones	5	
Brightness (Screen Voltage = 10 KV)	2500	Ft-Lamberts
Contrast Ratio	5	
Resolution	50	Lines/Inch
Grid Drive	20	Volts

Methods of Measuring Tube Performance

Viewing Time: A standard raster is written to saturated brightness with overlapping lines. The brightness level near the center of the viewing screen is then measured with a spot photometer. For this measurement, the color response of the measuring device is unimportant, as only relative brightness readings are required. The complete raster is then erased to visual extinction and the erase pulse removed. The screen is allowed to increase in brightness, and the time interval required for the brightness level at the center of the screen to increase to 10% of the initial brightness level is taken as the viewing time.

Erasing Time: Erasure is produced by positive rectangular pulses applied to the backing electrode. With an erase pulse amplitude adjustable from 2 to 10 volts peak-to-peak, complete erasure may be accomplished in 50 milliseconds from the start of the pulse, or when the sum of the duration of the pulses is 50 milliseconds. Note that by adjustment of pulse amplitude, shape, duration, and pulse repetition frequency it is possible to adjust total time for erasure as desired.

The erasing time under stated erasing conditions is taken as the time required for the flood beam to reduce the output luminence from 90% of its saturated value to 10% of that value. A rectangular raster covering the entire viewing area is written to 90% of saturated brightness and the raster is erased by pulsing the backing electrode for a known length of time. The process is repeated and the length of the erase pulse is changed until the desired degree of erasure is obtained.

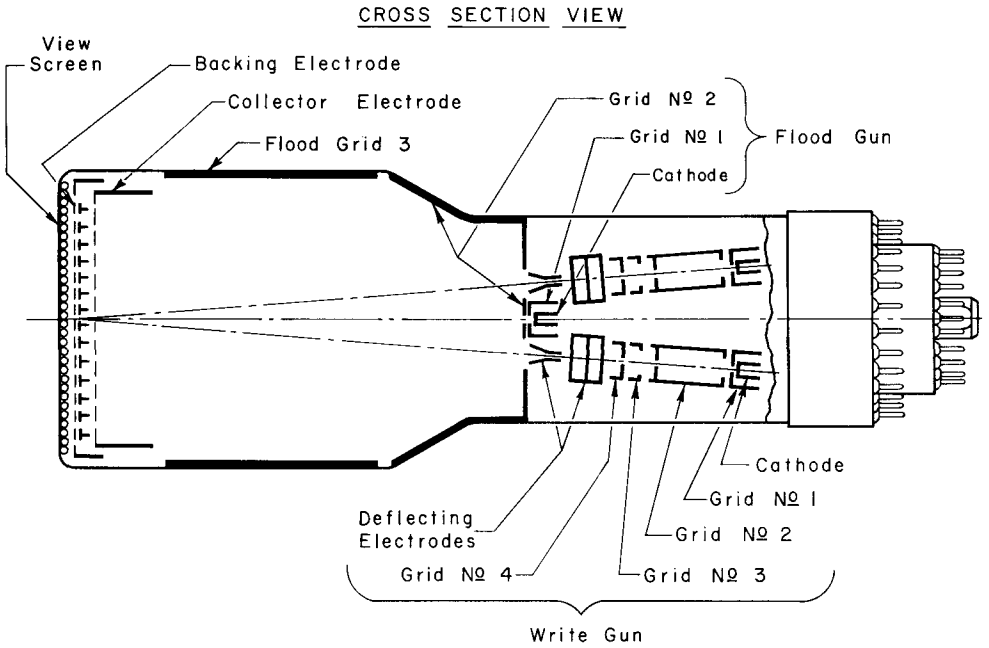
Display Uniformity (Δ ep min.): The difference between the amplitude of an erase pulse required to brighten any area of an unwritten screen, and the amplitude of an erase pulse required to completely illuminate the screen is described as the display uniformity, (Δ ep-min.). The erase pulses used for this measurement are positive rectangular pulses adjusted from 2 to 10 volts peak to peak to produce complete erasure in 50 milliseconds.

Writing Speed: This is the maximum scanning speed at which a raster can be written to a specified brightness in one frame time at a writing gun cathode current below a specified value. A raster is applied having frequencies and trace length necessary to produce the specified scanning speed. The focus electrode is adjusted for best focus at the center of the raster. The tube is erased to cutoff and with a rectangular drive pulse of adjustable amplitude a single raster is written. This step is repeated, moving the lines progressively closer together until the individual lines in the raster cannot be discerned visually. As the lines approach the merging condition, the control grid pulse ampitude is adjusted to give a written raster with brightness of 2500 foot lamberts. When this brightness is achieved and the lines cannot be discerned visually, the condition of visually limited contrast ratio exists and it is under this condition that the cathode current is to be read. The cathode current measured with an oscilloscope is less than one milliampere.

Contrast Ratio: A trace is written to saturation brightness while continuously writing and erasing. Using positive rectangular erase pulses variable from 2 to 10 volts peak-to-peak, the persistence (time required for a written area to be reduced to 10% of saturated brightness) is adjusted to 2 seconds. The ratio of brightnesses in the written and unwritten areas is defined as the contrast ratio. This measurement is made with a maximum ambient brightness of 10 foot-lamberts.

Resolution: Erasure is adjusted to a convenient value. A 60 cps sawtooth voltage is applied to the horizontal deflection electrodes and 2100 to 6300 cps sawtooth voltage to the vertical deflection electrodes. The light level is set at 1000 ± 5% foot-lamberts with a vertical trace length of 3-1/2 inches. The raster is expanded horizontally so that the number of lines can be counted. Adjustment is made for best focus at center of raster. The raster is compressed horizontally until lines merge or just overlap at center of screen. The width of this compressed pattern perpendicular to the line structure is measured. Resolution is the number of lines in the compressed pattern divided by its width. The scanning voltages are interchanged and the resolution is measured as before at points on the center vertical axis 1½ inches above and below the center of the tube face.

Grid Drive: This is the drive required for writing to 90% of saturated brightness with a writing speed of 36,000 inches per second in 1 scan. Note the writing gun drive characteristic. In the useful region, writing speed is proportional to writing current.



CE-B1456 R1

Principles of Operation

The WL-7268 contains, in addition to a phosphor screen and writing guns similar to those of conventional cathode-ray tubes, a storage surface, a secondary-electron collimating system, all of which can be seen in Cross Section View.

The storage surface is a dielectric material deposited on a fine metallic mesh called the backing electrode. Initially this surface is charged to a uniform potential near the viewing gun cathode voltage. Either or both of the writing guns scan the storage surface and create a charge pattern by secondary emission from the dielectric material. Because this dielectric material is an excellent insulator, the charge pattern does not leak away, but remains for a period of time, as long as a week under non-operating conditions. The secondary electrons liberated from the storage surface are attracted to a collecting mesh.

The reading or viewing gun does not scan the screen, but produces a wide-angle beam of electrons which "floods" the entire storage mesh and penetrates through its holes to bombard the phosphor screen. The charge pattern written upon the storage surface controls the viewing gun beam in a manner similar to the control of plate current by the signal applied to the control grid of a triode. In this way the signals applied to the two writing guns are converted to patterns on the storage surface, and these produce corresponding patterns on the phosphor screen. The penetration of electrons through the storage mesh is proportional to the charge written upon it, hence, intermediate shades of gray or half-tones may be reproduced. Because of the high current density of the viewing beam, the high accelerating potential on the screen, and simultaneous bombardment of all portions of the viewing screen, the display is extremely bright.

The Viewing Section

The viewing section consists of the following elements: a cathode, control grid, accelerating grid, collimating electrode, collecting electrode, backing electrode, and viewing screen.

The cathode is oxide coated and indirectly heated. Grids 1 and 2 are conventional aperture grids and the collimating electrode grid 3 is a conductive coating applied to the bulb wall. The collecting electrode is a fine metallic mesh mounted slightly toward the cathode from the backing electrode.

The backing electrode is an extremely fine metallic mesh upon which the dielectric or storage material is

deposited. This material is on the cathode side of the mesh as shown in Cross Section View.

The viewing screen is an aluminized P20 phosphor having short persistence and high visual efficiency. The Spectral Response Curves show that the peak radiation from this phosphor coincides with the peak sensitivity of the human eye.

The Viewing Operation

The viewing gun produces a wide angle, low energy, high density electron stream which continuously floods the storage surface. The electrons are highly divergent as they emerge from the aperture of the accelerating grid no. 2, but by proper adjustment of grids no. 2, 3, and 4, the electron stream is collimated to provide uniform, normal flooding of the backing electrode. It is necessary that all of the electrons of the viewing beam approach the storage surface in paths normal to the backing electrode in order that they will have equal energy components in this direction. Only under this operating condition will equal charges at various points on the storage surface have equal control of the flood beam. Thus, collimation is necessary for uniformity of display.

The functions of the collecting electrode are several. In addition to its effect upon collimation, it serves to accelerate electrons in the beam; it repels positive ions produced by collisions of electrons with gas molecules in the region between cathode and collector, thus preventing destruction of the stored pattern by ions; it collects secondary electrons produced when the writing beams impinge upon the storage surface; and it collects viewing beam electrons turned back near the storage surface when its potential is negative.

When the viewing section voltages are applied, some of the viewing beam electrons are intercepted by the collector mesh, and others are decelerated to near zero velocity at the storage grid. Their velocity is so low at this point that fewer secondary electrons are emitted than strike the storage surface. Thus electrons accumulate until the potential is approximately the same as the viewing gun cathode, or zero potential.

At this time when the collimated viewing beam approaches the storage mesh, electrons cannot land upon the storage mesh, but will either return to the more positive collecting electrode or penetrate through the holes of the backing electrode to be accelerated to the phosphor viewing screen producing a bright display. The brightness of the screen under this condition is designated as "saturated brightness". A condition of equilibrium exists, and the storage surface remains charged to approximately zero potential. If the storage surface is made positive by a writing gun or other means, the surface will be immediately restored to zero potential by the viewing gun beam. If, now the backing electrode is suddenly made more positive by several volts, the storage surface will also become positive momentarily because of the very close capacitive coupling between the backing electrode and storage surface, but again the viewing beam will restore the storage surface to zero potential. If next the backing electrode is returned to its original value, the storage surface potential will drop by an equal amount to a negative potential and will retain this charge since viewing beam electrons cannot land. If this negative voltage is great enough, it will cut off the viewing beam electrons preventing them from reaching the phosphor and resulting in a dark screen.

The writing guns are used to produce a charge pattern upon the storage surface varying in potential from the storage surface cutoff value to zero potential. Since these potentials are at or below viewing gun cathode potential, no viewing beam electrons may land upon the storage surface to destroy the written pattern and it will remain until erased or degraded by positive ions produced by collision of electrons in the viewing beam with residual traces of gas between the viewing screen and collecting electrode.

Without altering its own form the stored charge pattern in thus able to control the electrons impinging upon the screen, producing a bright stored image with full tone range from visual extinction to saturated brightness.

The Writing Guns

The two writing guns are of identical design and are similar to those found in electrostatically focused and deflected oscilloscope tubes. They are capable of forming a well defined beam having high current-density resulting in excellent resolution and high writing speed.

Both guns are shown in Cross Section View and each consists of an oxide coated, indirectly heated cathode, a control grid 1, first and second anodes (grids 2 & 4) which are internally connected, a focusing grid 3, and horizontal and vertical deflection plates.

The Writing Operation

The writing guns are generally operated with the cathode at -2400 volts with respect to the viewing-gun cathode. At this potential the electrons from the

writing beam have sufficient energy to cause the secondary emission ratio at the storage surface to be greater than unity. Thus, since more electrons are leaving the storage surface than are arriving. the surface assumes a less-negative potential whenever the beam strikes, Since the secondaries are attracted to the positive collecting electrode it would appear that the writing beam could charge the storage surface to collecting electrode potential, but in practice the viewing beam lands upon the surface whenever it tends to become positive and returns it to approximately viewing-gun cathode potential.

The writing beam electrons striking the storage surface can then result in potentials varying from storage-grid-cutoff voltage to approximately zero potential. The storage surface potential is controlled over this range by the amplitude and duration of the writing beam current which is determined by the signal applied to the control grid.

As was described previously, the potential at any point on the storage surface determines the number of viewing beam electrons passing through the storage mesh holes in that immediate vicinity. When any point is sufficiently positive to allow passage of electrons, they will be accelerated by the high viewing screen potential and strike the phosphor directly opposite that point. The result is a bright spot on the viewing screen having a size only slightly larger than that of the corresponding point where the writing gun beam struck the storage surface. The brightness of this spot is directly proportional to the density and velocity of the electrons landing on the element, the density being determined by the elemental charges of the storage surface, and the velocity by the potential of the viewing screen.

The image brightness may be varied by adjusting the screen potential, but because the screen is aluminized, the light output decreases rapidly below 5000 volts. Operation below this value is not recommended.

The Erasing Operation

A method of preparing the storage surface for the writing operation has already been described under The Viewing Operation. This technique, which involves charging the storage surface to a negative value by the momentary application of a positive potential to the backing electrode, is actually an erasing method known as static erasure.

During the application of the positive potential to the backing electrode, viewing-beam electrons land on the storage surface and drive it uniformly to cathode potential thus erasing any stored information.

A disadvantage of this method is that during erasure and subsequent re-writing no information or only incomplete information is displayed. Also the entire screen is illuminated to the saturation brightness level or higher during erasure.

In most applications it is desirable to present a display which gradually decays after a given interval of time. This type of operation may be obtained by applying a continuous series of positive pulses to the backing electrode at a rate sufficiently fast to prevent visible phosphor flicker. The technique of applying a series of pulses to the backing electrode is known as dynamic erasure.

The amount of charge erased during each erase pulse depends upon pulse duration, shape and amplitude. These factors together with erasing-pulse repetition frequency determine the rate at which the observed display decays.

If the erasing pulses are smaller in amplitude than the viewing-beam cutoff voltage, erasure will not be complete, whereas if the pulses are greater than cutoff they will eventually drive the storage surface below cutoff or "blacker than black". Therefore it is not advisable to use erase pulse amplitude as a means of adjusting erasing time.

When a rectangular erasing pulse is used, all portions of the storage surface will simultaneously become positive with respect to the viewing-gun cathode and viewing-beam electrons will be deposited at nearly the same rate over the entire surface regardless of initial charge. Thus charges representing the brighter elements will remain after other elements have been erased and the brighter areas will be visible for a longer period than the darker areas.

If a positive-going sawtooth erasing pulse is used, the least-negative storage elements will reach cathode potential before the remaining elements, thus allowing viewing-beam electrons to land on elements representing brighter areas for a longer period than on those representing darker areas. With this type of proportional erasure, half-tones will persist as long as bright areas.

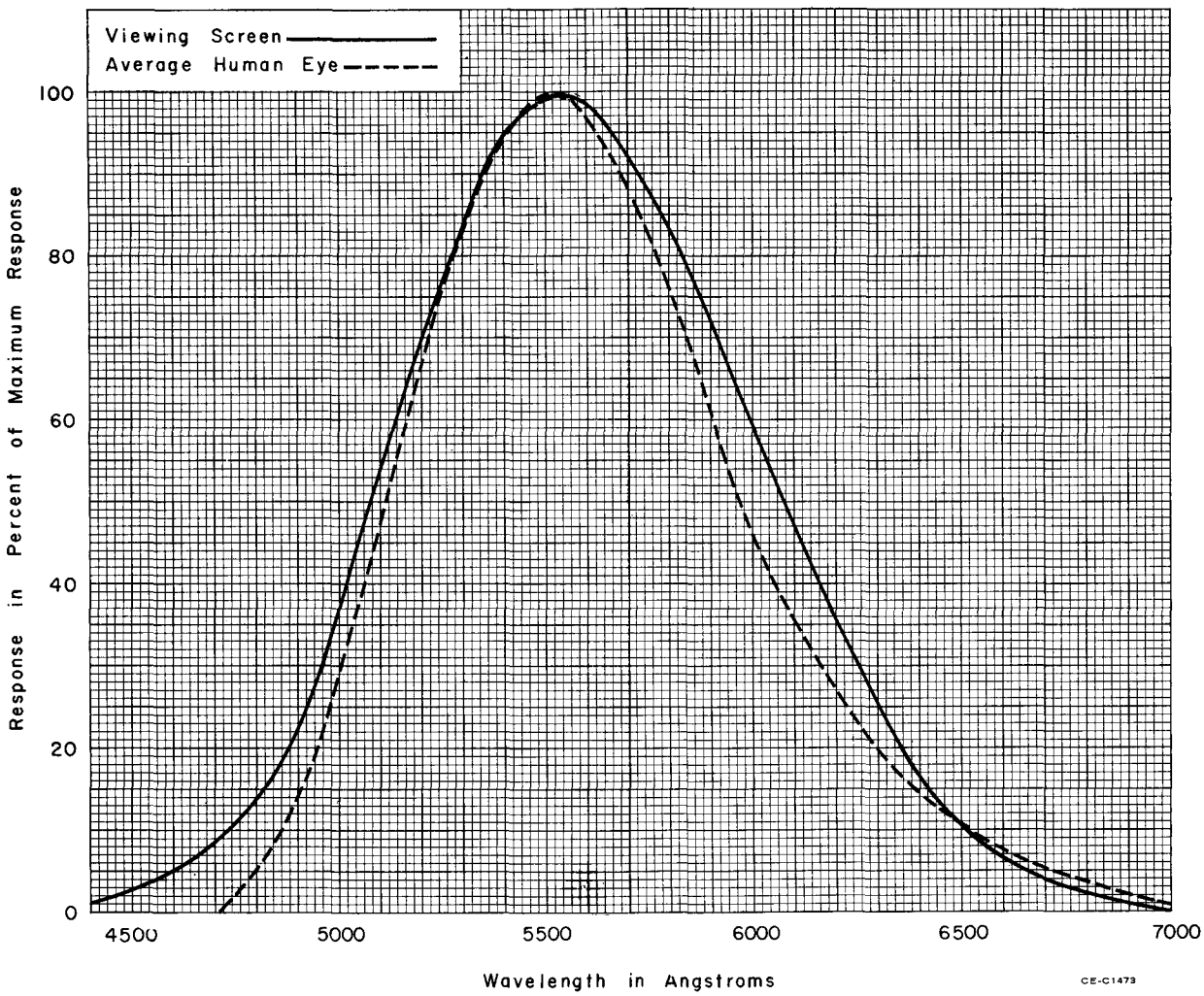
For applications involving half-tone display, the rectangular erase pulses should be adjusted in amplitude so that the storage surface is charged to exactly cutoff potential by the erasing operation.

For applications such as radar, where noise must be

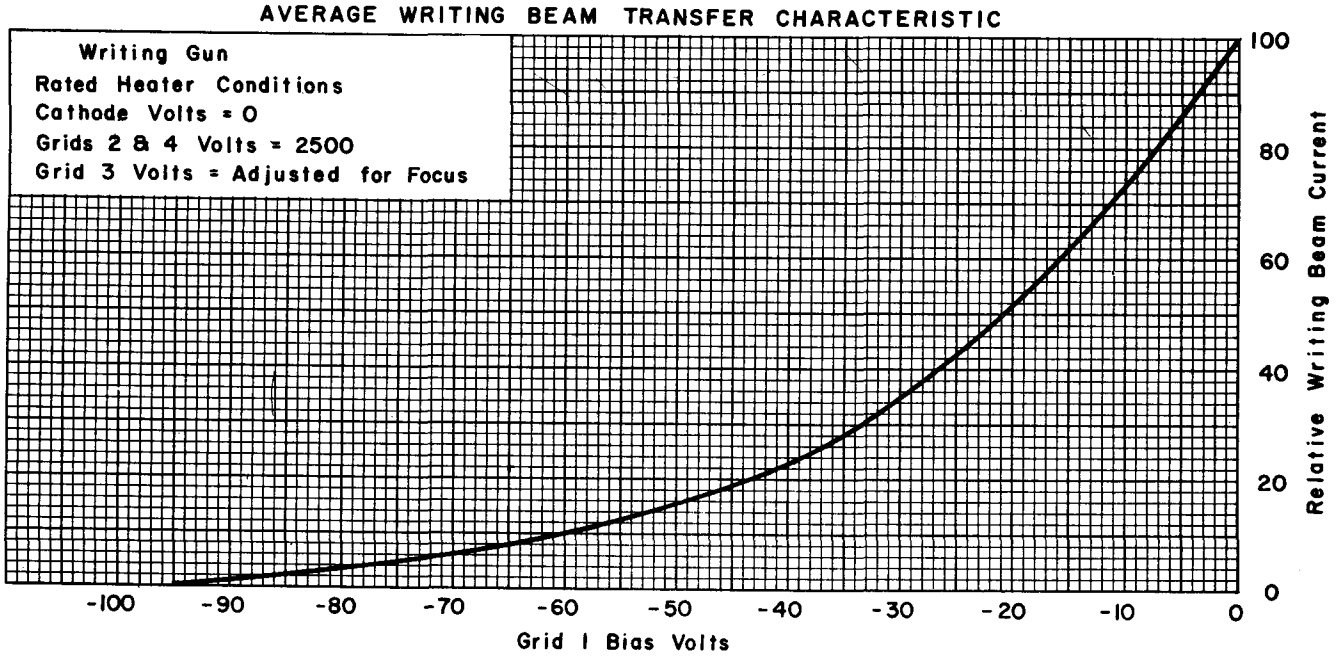
suppressed, a more positive erase pulse may be used to drive the storage surface several volts below cutoff. The writing beam must then scan the surface several times to bring the written elements above cutoff.

If possible the erase-pulse amplitude should be adjusted so that the noise component of the writing gun signal is just sufficient to bring the storage surface to cutoff. The signal above this level will then allow viewing-beam electrons to produce a display representing that signal without any noise background.

SPECTRAL RESPONSE CHARACTERISTICS



AVERAGE WRITING BEAM TRANSFER CHARACTERISTIC



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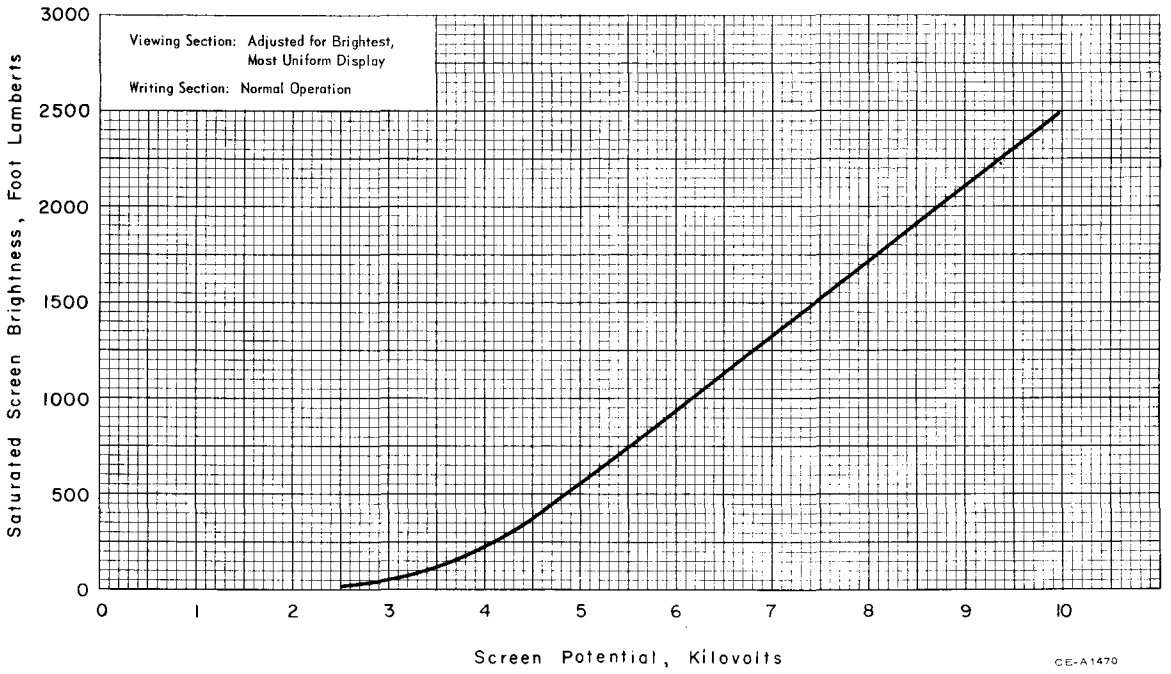
SCREEN BRIGHTNESS AS A FUNCTION OF SCREEN POTENTIAL



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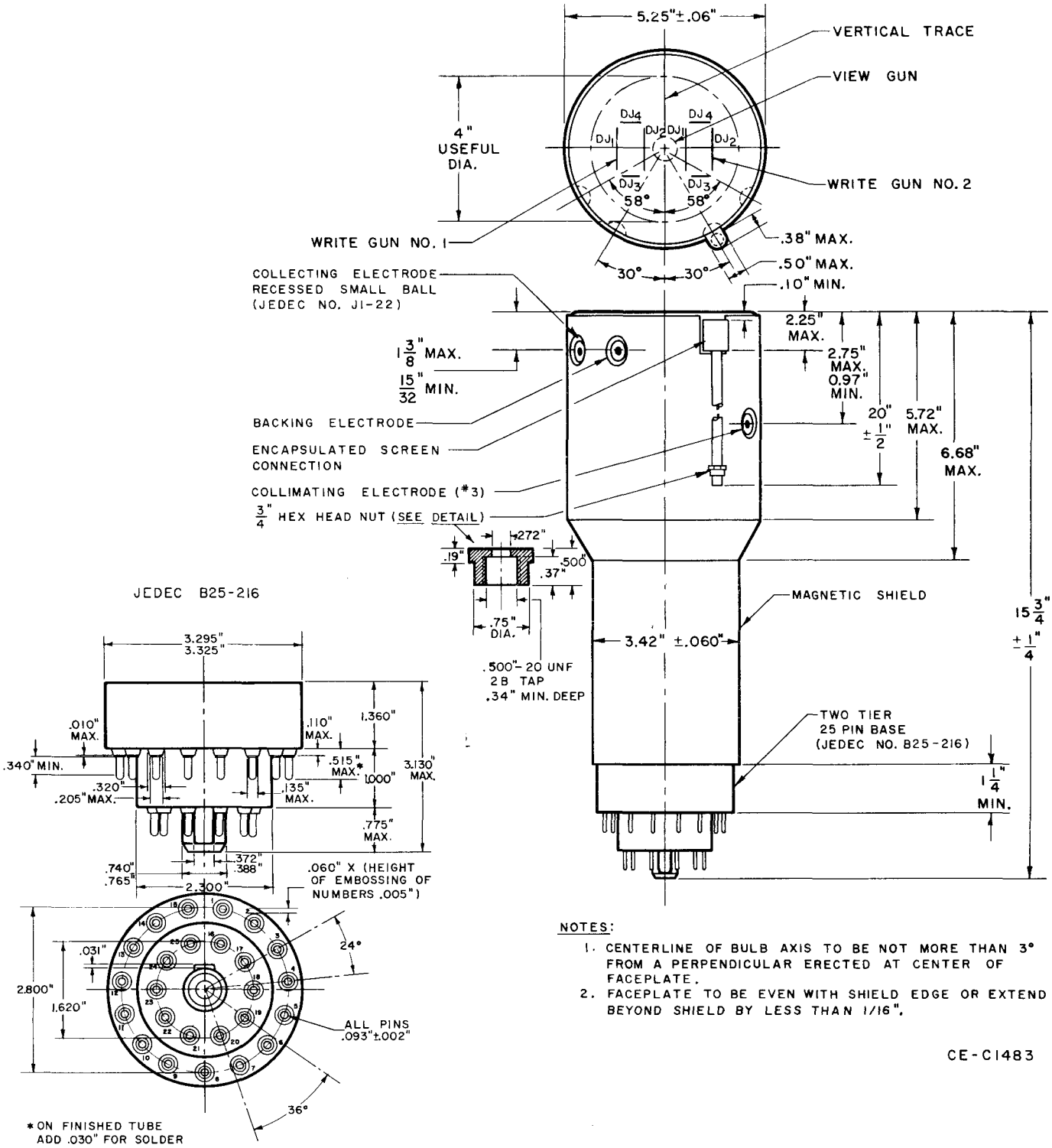
COMMERCIAL OUTLINE



NOTES:

1. CENTERLINE OF BULB AXIS TO BE NOT MORE THAN 3° FROM A PERPENDICULAR ERECTED AT CENTER OF FACEPLATE.
2. FACEPLATE TO BE EVEN WITH SHIELD EDGE OR EXTEND BEYOND SHIELD BY LESS THAN 1/16".

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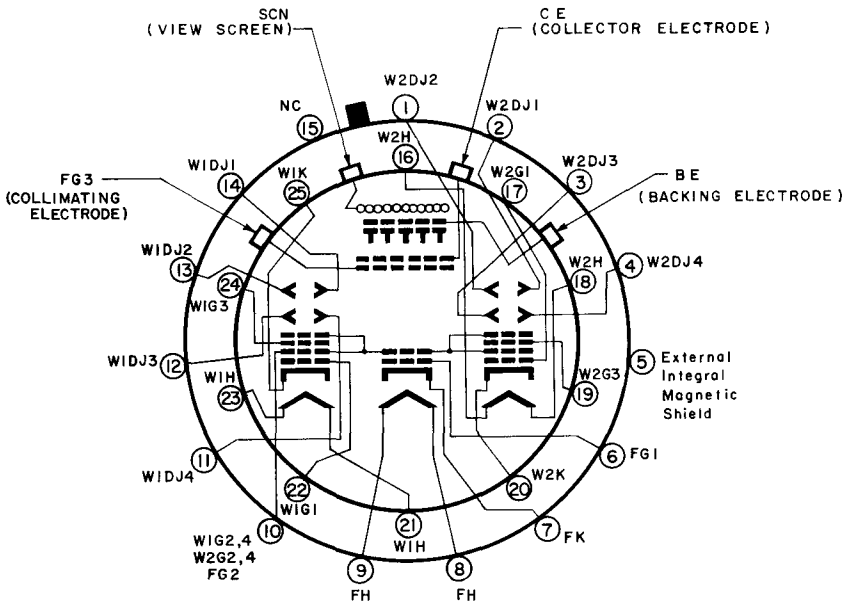


BOTTOM VIEW

CE-A1399 R2

INDEX OF TERMINALS

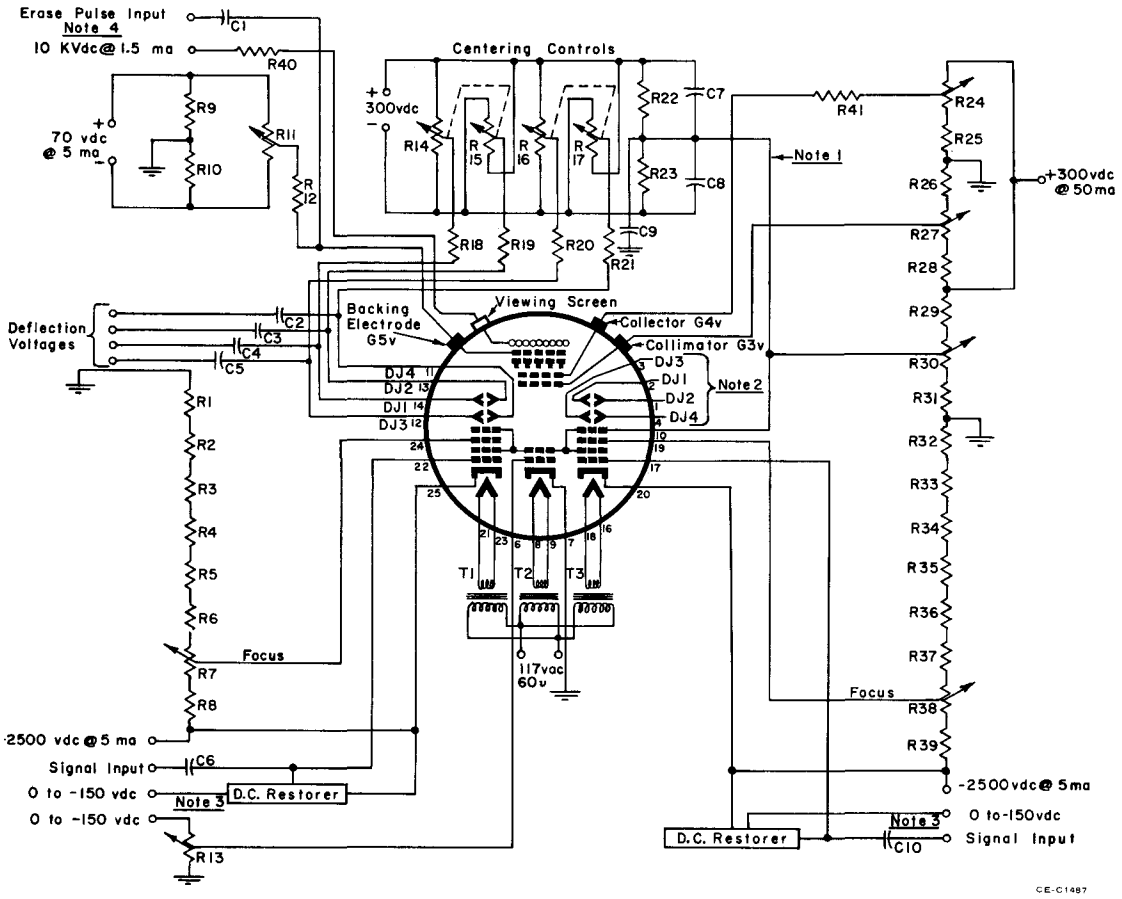
BASE PINS

Pin No.	Gun	Element
1	Write (2)	Deflection Electrode 2
2	Write (2)	Deflection Electrode 1
3	Write (2)	Deflection Electrode 3
4	Write (2)	Deflection Electrode 4
5	External Integral Magnetic Shield	
6	Flood	Grid 1
7	Flood	Cathode
8	Flood	Heater
9	Flood	Heater
10	Write (1)	Grids 2 & 4
	Write (2)	Grids 2 & 4
	Flood	Grid 2
11	Write (1)	Deflection Electrode 4
12	Write (1)	Deflection Electrode 3
13	Write (1)	Deflection Electrode 2
14	Write (1)	Deflection Electrode 1
15	NO CONNECTION (DO NOT USE)	
16	Write (2)	Heater
17	Write (2)	Grid 1
18	Write (2)	Heater
19	Write (2)	Grid 3
20	Write (2)	Cathode
21	Write (1)	Heater
22	Write (1)	Grid 1
23	Write (1)	Heater
24	Write (1)	Grid 3
25	Write (1)	Cathode

CAPS ON LARGE END OF BULB

Gun	Element
Flood	Collimating Electrode
Flood	View Screen
Flood	Collect or Electrode
Flood	Backing Electrode

TYPICAL POWER SUPPLY REQUIREMENTS



Note 1: The mean deflection potential is referred to the writing gun final anode potential to prevent astigmatism.
Note 2: Centering and deflection circuitry for Writing Gun 2 is similar to that shown for Writing Gun 1.
Note 3: Voltages are with respect to each writing gun cathode. Entire supply must be insulated from ground for 4000 volts.
Note 4: Erase Pulse Characteristics, Amplitude: 0 to 10 volts peak-to-peak, Width: 2 to 10 microseconds, Frequency: 0 to 1000 pulses per second

C_1: 0.1 μf, 200 volts

C_2, C_3, C_4, C_5: Value depends on deflection-voltage frequency and waveform

C_6, C_{10}: Value depends on signal-voltage frequency and waveform, 4000 volts

C_7, C_8: 0.05 μf, 600 volts

C_9: 0.5 μf, 600 volts

R_1, R_{32}: 91,000 ohms, 1 watt

R_2, R_{25}, R_{29}, R_{33}: 100,000 ohms, 1 watt

R_3, R_4, R_5, R_6, R_{34}, R_{35}, R_{36}, R_{37}: 470,000 ohms, 2 watts

R_7: Write Gun 1 Focus Control, 250,000-ohm potentiometer, 2 watts

R_8, R_{39}: 180,000 ohm, 1 watt

R_9, R_{10}, R_{22}, R_{23}: 1 megohm, 0.5 watt

R_{11}: Backing Electrode Control 100,000-ohm potentiometer, 2 watts

R_{12}: 5,000 ohm, 1 watt

R_{13}: View Gun Grid 1 Control, 250,000-ohm potentiometer 2 watts

R_{14}, R_{15}: Write Gun 1 DJ_1 & DJ_2 Centering Controls Dual 1 megohm potentiometers, 2 watts

R_{16}, R_{17}: Write Gun 1 DJ_3 & DJ_4 Centering Controls Dual 1 megohm potentiometers, 2 watts

R_{18}, R_{19}, R_{20}, R_{21}: 100,000 ohm, 0.5 watt

R_{24}: Collector Control, 200,000-ohm potentiometer, 2 watts

R_{26}, R_{28}, R_{31}: 51,000 ohm, 1 watt

R_{27}: Collimator Control, 200,000-ohm potentiometer, 2 watts

R_{30}: Accelerating Anode Control, 150,000 ohm potenti- 2 watts

R_{38}: Write Gun 2 Focus Control, 250,000-ohm potentiometer, 2 watts

R_{40}: 1 megohm, 5 watts

R_{41}: 22,000 ohm, 1 watt

T_1, T_3: Filament Transformer Primary 117 volts, Secondary 6.3 volts @ 1 ampere Insulated for 4000 volts

T_2: Filament Transformer Primary 117 volts, Secondary 6.3 volts @ 1 ampere.

The information contained herein is furnished without assuming any obligations. The description and illustration of circuits herein does not convey to the purchaser of tubes any license for circuits under the patent claims of Westinghouse Electric Corporation or others.