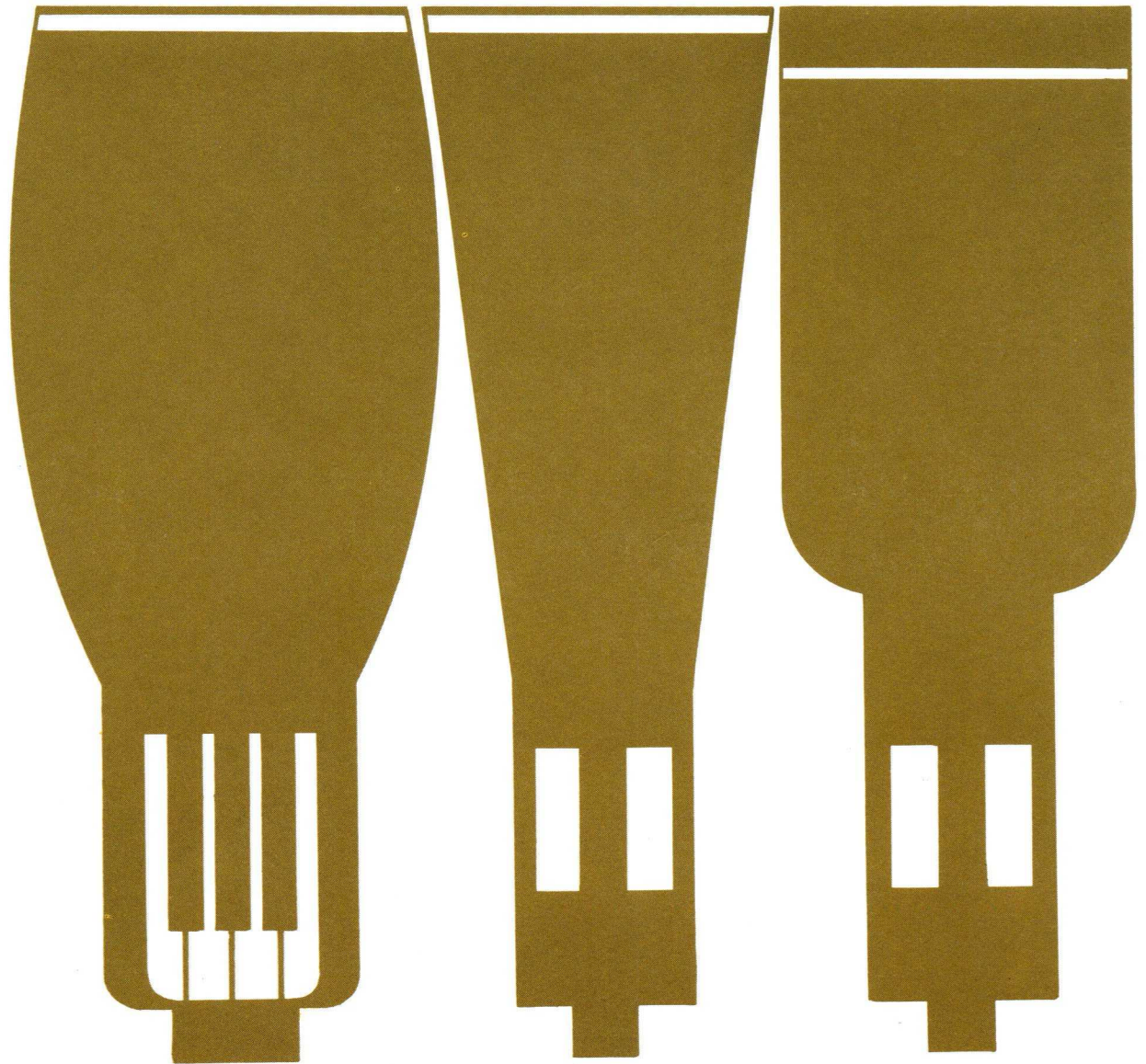
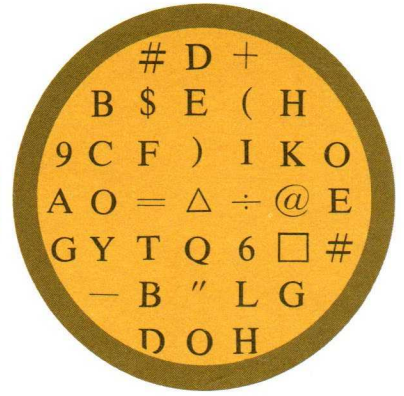
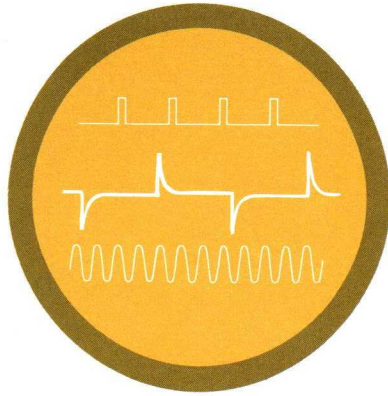


SYSTEM DESIGNERS HANDBOOK OF SYLVANIA INDUSTRIAL & MILITARY CRT'S



MULTI-GUN TUBES/HIGH RESOLUTION TUBES/DOUBLE DEFLECTION TUBES

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INTRODUCTION

This brochure contains information helpful to the Design Engineer considering the display portion of a system. Three types of cathode ray tubes with characteristics useful in today's complex systems are discussed, along with a new plug-in assembly that greatly facilitates the use of high resolution tubes in certain applications:

1/Multi-Gun Tubes present simultaneous displays from different inputs.

2/High Resolution Tubes give extremely fine line displays useful in film recording, reconnaissance, and similar applications.

3/High Resolution Assemblies offer plug-in operation without alignment or adjustment.

4/Double Deflection Tubes display characters in a simpler, less expensive manner than do other character display tubes.

Since 1932, Sylvania has designed and produced nearly 30 million cathode ray tubes. Many of these have been specialized industrial and military types. The INDUSTRIAL & MILITARY CRT design group has thus acquired exceptional experience in virtually every display application.

Today Sylvania offers a truly broad range of INDUSTRIAL & MILITARY CRT's. They are presently being used in such diverse systems as high altitude reconnaissance aircraft, specialized radar applications and industrial addressing machines.

Sylvania's experience in glass handling and glass technology related to electronics extends back to the beginning of the industry. Currently, manufacturing facilities exist for any quantity from a few of the very specialized types to very large numbers of the more common types. Further, Sylvania is the only manufacturer of cathode ray tubes with complete facilities for fabricating all tube components (except glass) from raw material. This permits the highest quality control throughout all stages of manufacture.

With the accumulated experience of these years of designing and manufacturing cathode ray tubes, Sylvania tube engineers are eminently qualified to design any CRT needed for your system.

CUSTOM ENGINEERING

The needs of modern systems require advanced, highly specialized cathode ray tubes. Today's systems, because they are unique, usually necessitate the concurrent development of a new CRT.

For some, a modification of an existing CRT meets the system's needs. For others, entirely new designs are needed. This brochure discusses two areas important to the system designer:

1/How CRT performance is affected by factors in the system, such as available space, operating voltages, environmental characteristics, etc.

2/The information a tube designer must know to adequately design or modify a CRT.

Because system characteristics affect CRT performance the design of the CRT should be given attention during the early stages of planning the system. The parameters of a completed system do not always allow the design and manufacture of the most economical or efficient CRT. With an early dialogue between the tube engineer and system's designer, the tube engineer can often suggest the best approach based on his accumulated experience and existing tool parts, glassware and special processing.

The brochure also contains detailed data on representative tubes that have been designed and manufactured by Sylvania. They are not shown as the limits of a product line but rather to exhibit capability. They were custom engineered for particular systems. Others with similar or identical characteristics can be designed for your systems.

MULTI-GUN TUBES

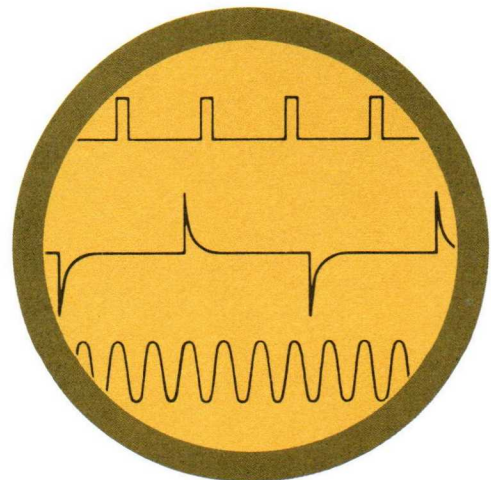
Multi-Gun tubes are used where:

- 1 / There is a need for simultaneous displays.
- 2 / Time sharing of the single beam is not feasible.
- 3 / Space is limited, and parallel stacked tubes cannot be used.
- 4 / There is a need for superimposing spots as in tracking applications.
- 5 / A larger display area is needed, as in spectrum analyzing where the trace length can be increased by using more than one gun, each covering a part of the screen.

Theoretically, there is no limit of the number of guns that can be put in a single tube. Multi-Gun tubes have been manufactured with face diameters from 3" to 16" and length from 8" to 36". In designing a multi-gun tube it is important to know: optimum bulb size, usable screen area, the number of guns, and the area of the screen to be covered by each gun. For some applications it is necessary to have all the guns scanning the same screen area. In others, each gun may be required to scan individual zones.

Tracking

Tracking is the ability of a multi-gun tube to superimpose simultaneously information from each gun. Tracking error is the maximum allowable distance between the displays of any two guns. For maximum tracking accuracy, the tube design should incorporate low deflection angles and monoaccelerator operations, i.e., without post deflection acceleration, with its somewhat reduced light output and sensitivity.



Electrostatic Deflection & Focus

The basic formula for beam deflection is:

$$y_d = \frac{Lb}{2a} \frac{V_d}{V_o}$$

Where:

y_d = distance the beam is deflected from the axis

L = distance from deflection plate to phosphor screen

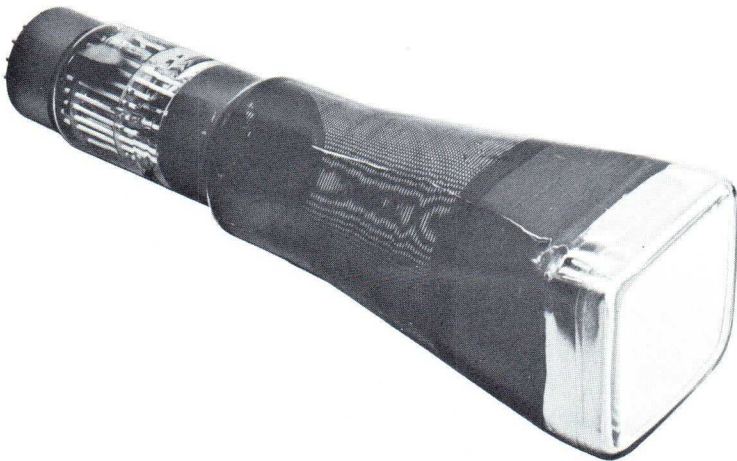
b = length of deflection plate

V_d = voltage on deflection plate

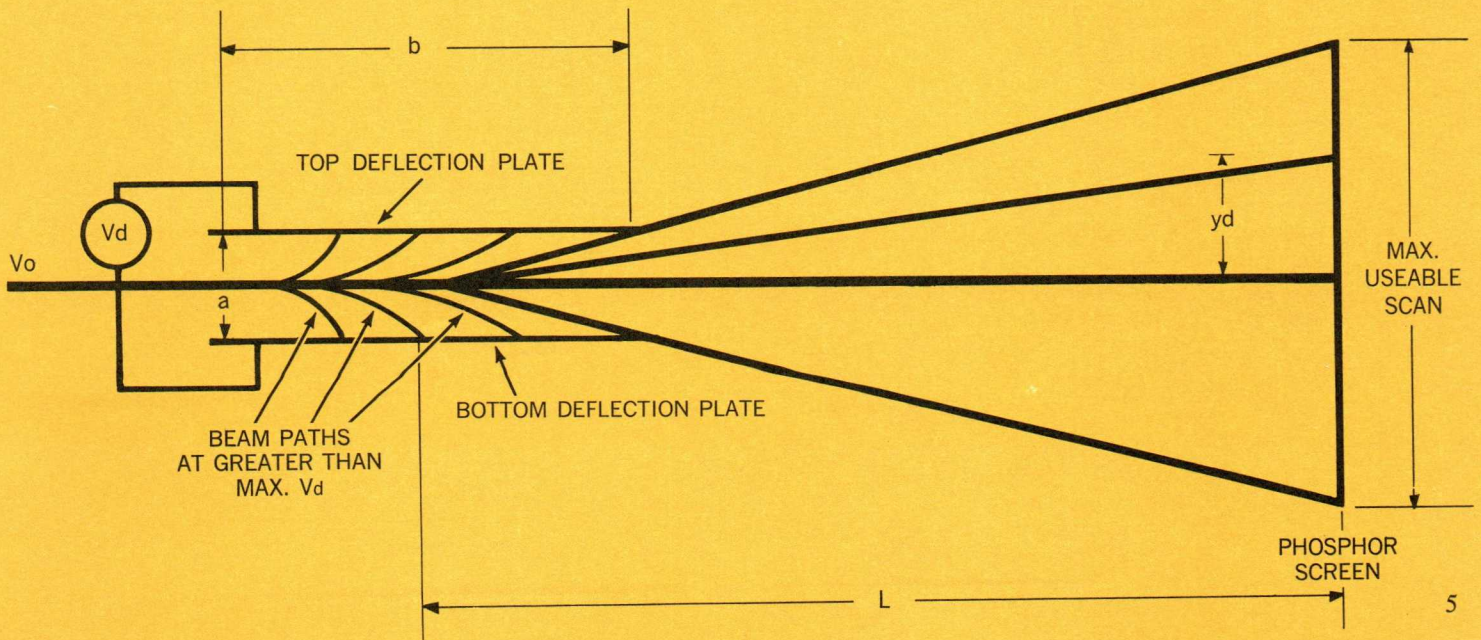
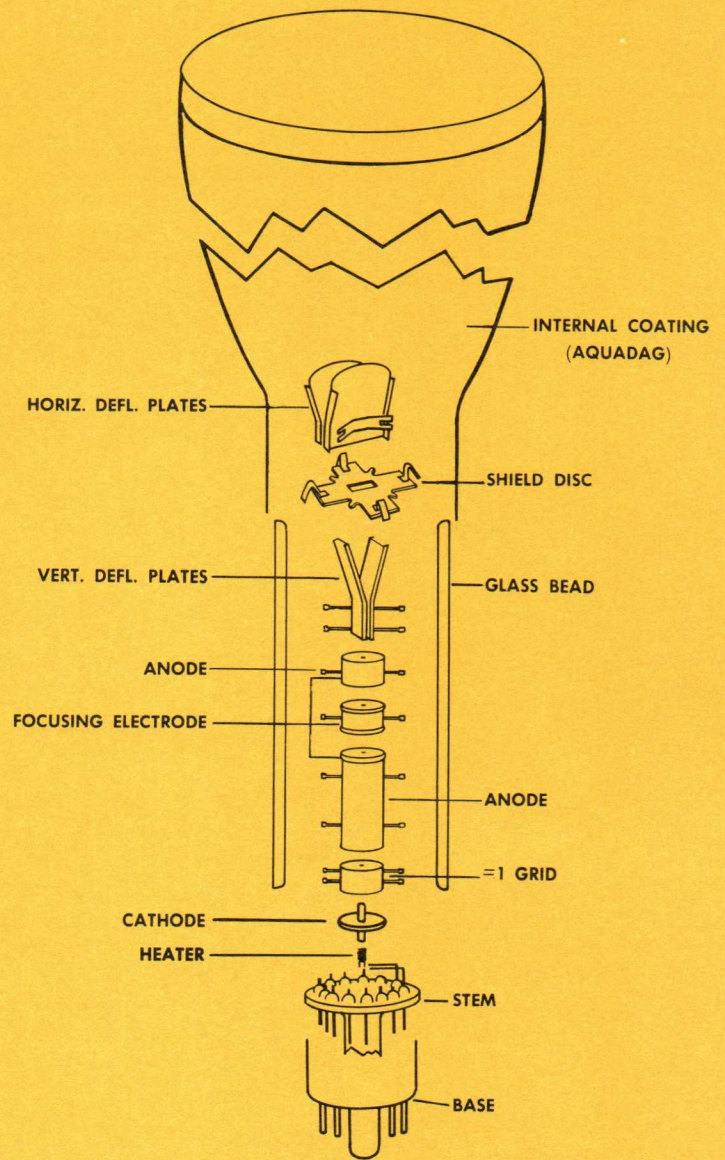
a = spacing between deflection plates

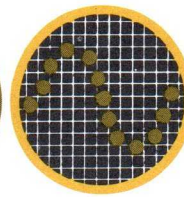
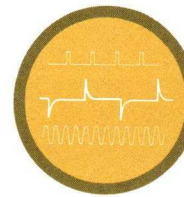
V_o = anode voltage.

For maximum sensitivity, the terms in the numerator should be large and those in the denominator small. This says that tubes should be long, have long, closely spaced deflection plates, and operate at low anode voltage. Notice that the terms “L” and “Vo” for this application are in direct opposition for applications where resolution is a prime requirement. For the maximum resolution (minimum line width), “Vo” must be high and tube length short. There is no term in this formula which determines scan size. If “a” (the spacing between plates) is made too small the beam will be deflected into the plates and the tube will exhibit plate shadow on the screen. If increased scan is required, the plates must be separated sufficiently for the beam to pass through the plate region. For any given set of parameters, the smaller the scan size, the closer the plates can be and the greater the deflection sensitivity.



EXPLODED VIEW OF CRT (ELECTROSTATIC DEFLECTION)





DESCRIPTION

The Sylvania SC-3061 is a 3 gun, electrostatically focused and deflected cathode-ray tube, 10 inches in diameter, for displaying simultaneously, 3 independently controlled traces. It features monoaccelerator design for maximum pattern linearity and deflection factor uniformity. All deflection plate leads are brought through the neck. In addition to high vertical deflection sensitivity, an independent astigmatism electrode connection is provided, also brought through the neck, so that maximum resolution can be attained by the use of dynamic control of both focus and astigmatism voltages.

CHARACTERISTICS

GENERAL DATA¹

Focusing Method	Electrostatic			
Deflection Method	Electrostatic			
Types*	SC-3061 P1	SC-3061 P2	SC-3061 P7	SC-3061 P11
Fluorescence	Green	Blue-Green	Blue	Blue
Phosphorescence	—	Green	Yellow	—
Persistence	Medium	Long	Long	Short

*In addition to the types shown, the SC-3061P- can be supplied with several other screen phosphors.

ELECTRICAL DATA

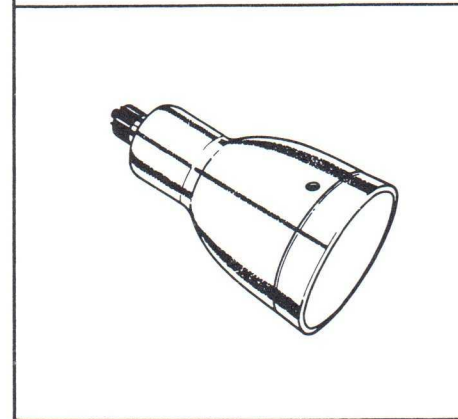
Heater Voltage	6.3 Volts
Heater Current (3 Guns in Parallel)	1.50 to 1.98 Amperes
Direct Interelectrode Capacitances (Approx.)	Each Gun
Cathode to All	5.5 $\mu\mu\text{f}$
Grid No. 1 to All*	6.5 $\mu\mu\text{f}$
D1 to D2	2.5 $\mu\mu\text{f}$
D3 to D4	1.5 $\mu\mu\text{f}$
D1 to All Other Electrodes	7.5 $\mu\mu\text{f}$
D2 to All Other Electrodes	7.5 $\mu\mu\text{f}$
D3 to All Other Electrodes	4.5 $\mu\mu\text{f}$
D4 to All Other Electrodes	4.5 $\mu\mu\text{f}$
*Value for B Gun Only:	10 $\mu\mu\text{f}$

MECHANICAL DATA

Overall Length	$20\frac{1}{2} \pm \frac{1}{2}$ Inches
Minimum Useful Screen Diameter	9 Inches
Bulb Contact (Recessed Small Ball Cap)	J1-22
Basing	See Diagram
Base and Contact Alignment	See Diagram
Positive Voltage on D1 (Gun B) Deflects the Beam Toward Base Key	± 10 Degrees
Positive Voltage on D3 Deflects the Beam Approximately Toward Pin No. 11	
Bulb Contact (J1-22), is Oriented $45^\circ \pm$ 10° from D1-D2 Trace (Gun B) and is Aligned Approximately with Base Pin Position No. 6	
For Deflection Plate Lead Alignment with the Base and Bulb Contact—See Diagram	
Trace Alignment	
D1-D2 Trace Aligns with D3-D4 Trace (Each Gun)	90 ± 1 Degree
D1-D2 Traces of the 3 Guns are Parallel	± 1 Degree

QUICK REFERENCE DATA

- Three Independent Guns
- 10" Direct Viewed
- Oscilloscope Tube
- Round Glass Type
- Electrostatic Focus
- Electrostatic Deflection
- Monoaccelerator Design
- All Deflection Plate Leads Brought Through the Neck Wall



MAXIMUM RATINGS (Absolute Maximum Values)

Anode Voltage	5500 Volts	dc
Focus Electrode Voltage	3000 Volts	dc
Grid No. 1 Voltage		
Negative Bias Value	220 Volts	dc
Positive Bias Value	0 Volts	dc
Positive Peak Value	2 Volts	dc
Peak Heater to Cathode Voltage		
Heater Negative with Respect to Cathode	200 Volts	
Heater Positive with Respect to Cathode	200 Volts	
Peak Voltage Between Anode and Astigmatism Electrode, or Any Deflecting Plate	750 Volts	

TYPICAL OPERATING CONDITIONS

Anode Voltage	5000 Volts	dc
Astigmatism Electrode Voltage	5000 Volts	dc
Focus Electrode Voltage	1500—2500 Volts	dc
Grid No. 1 Voltage ²	-100 to -175 Volts	dc
Line Width "A" ³016 Inches	Max.
Deflection Factors		
D1-D2	120 to 140 Volts Per Inch	
D3-D4	62 to 76 Volts Per Inch	
Deflection Factor Uniformity ⁴	1½ Percent	Max.
Undelected Spot Positions ⁵	Within 1 Inch Square	
Useful Scan ⁶		
D1-D2	±4½ Inches	
D3-D4	±1½ Inches	
Interaction Factor ⁷	6 x 10 ⁻⁵ In./Volts	Max.
Pattern Distortion ⁸		

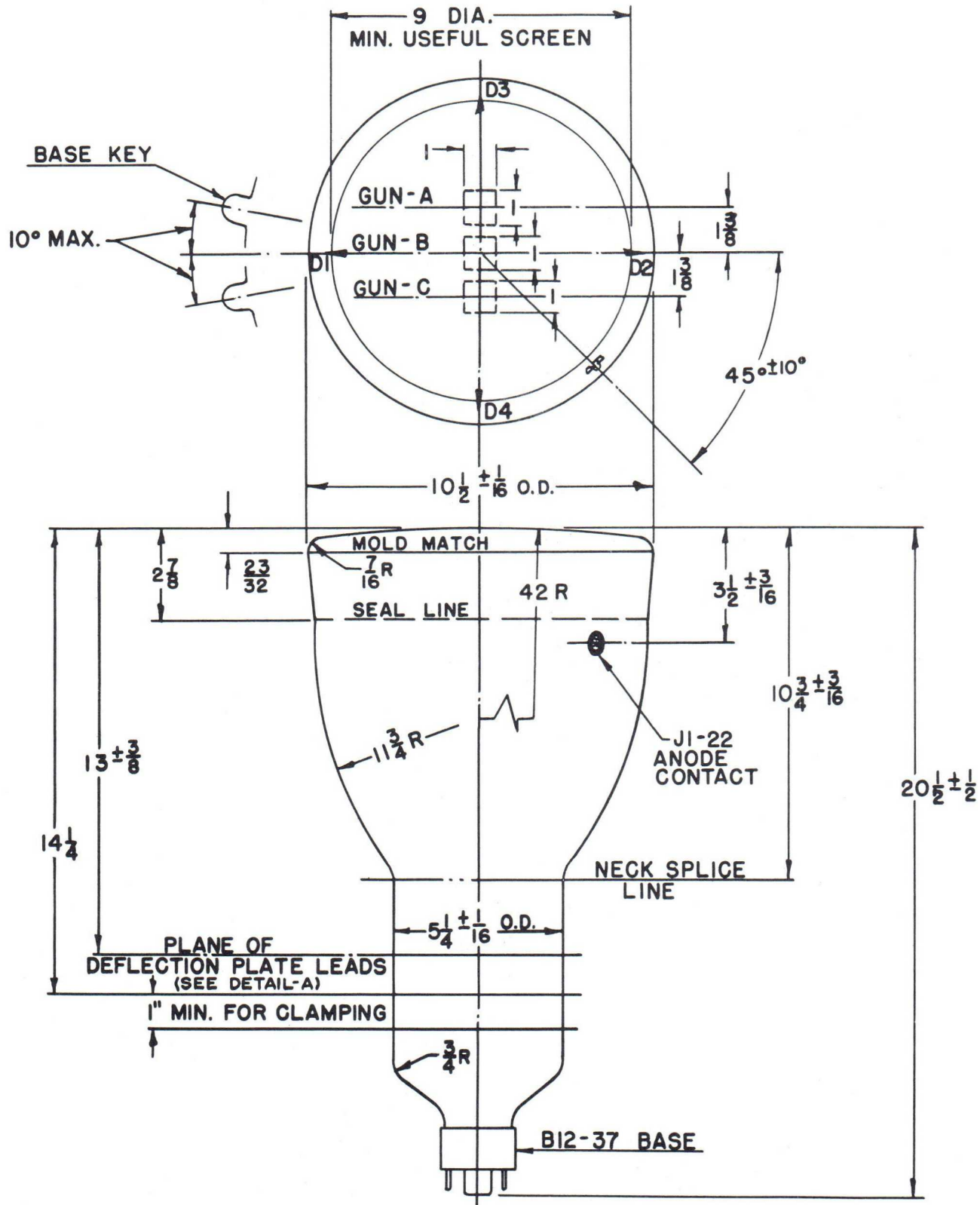
CIRCUIT VALUES

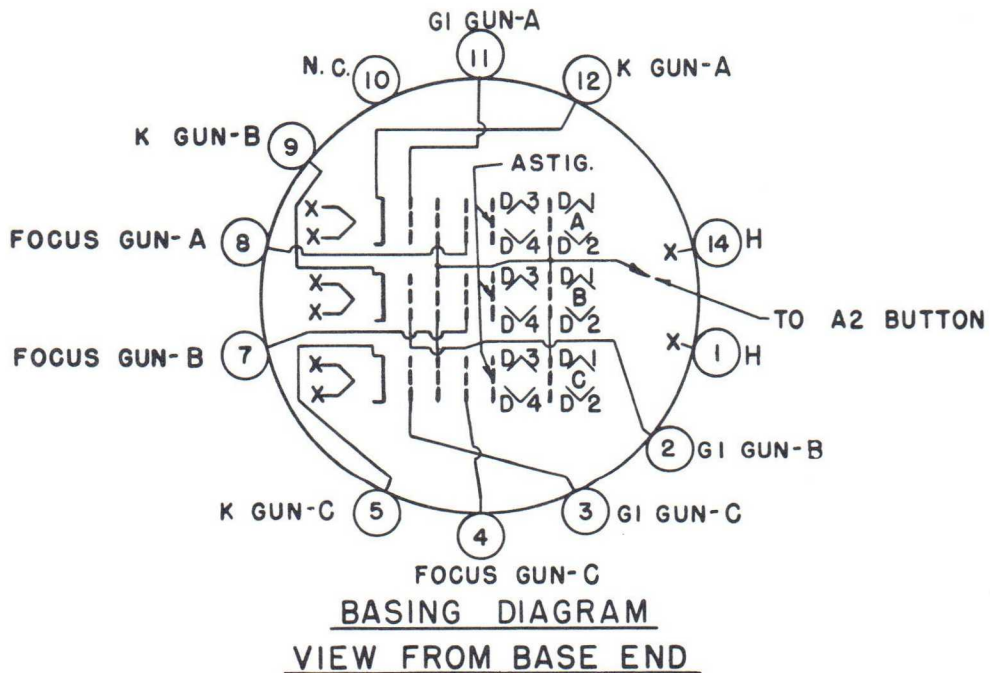
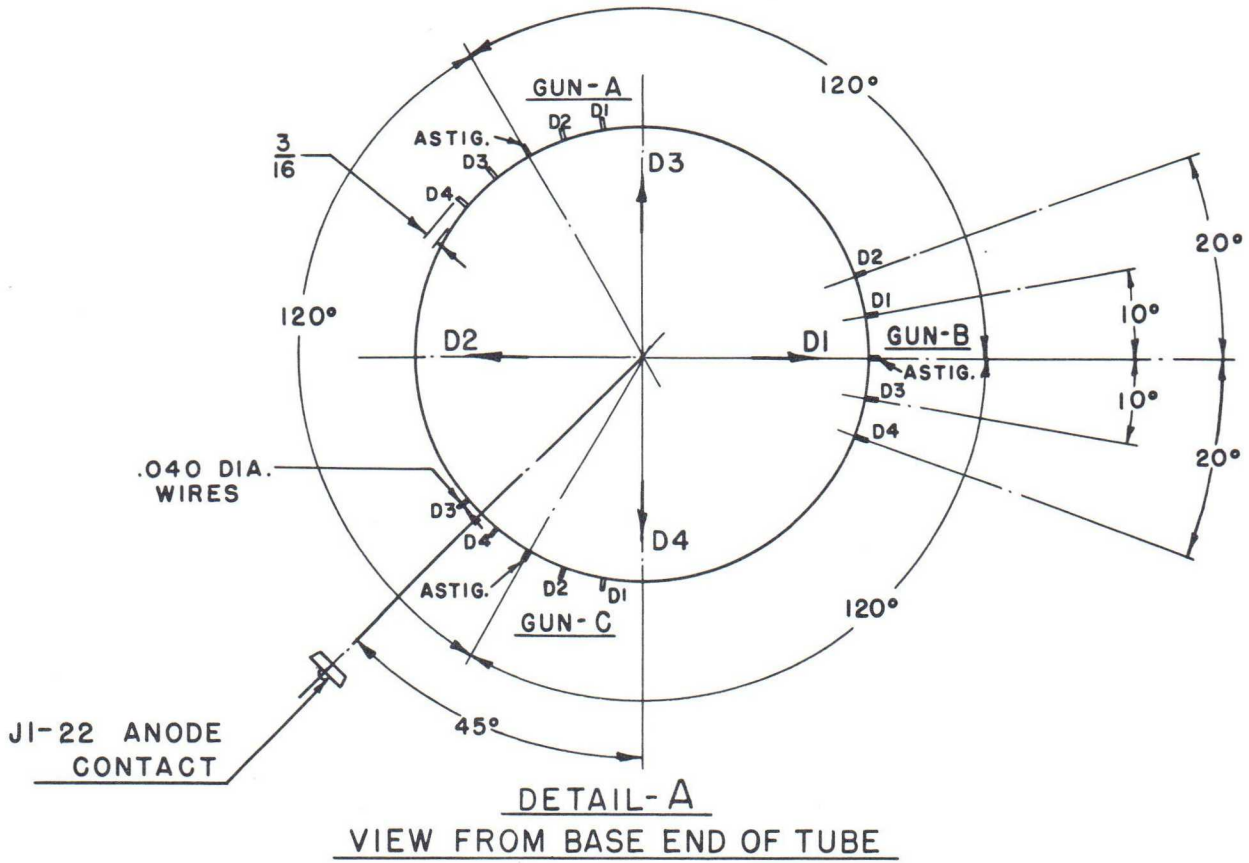
Grid No. 1 Circuit Resistance	1.5 Megohm	Max.
Deflection Circuit Resistance	1.0 Megohm	Max.

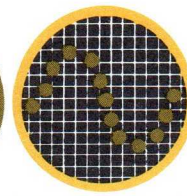
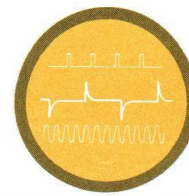
NOTES:

1. Values are for each gun unless otherwise specified.
2. Visual extinction of undeflected focused spot.
3. Per MIL-E-1 and at a control grid voltage of 25 volts above spot cutoff.
4. The deflection factor (for both D1-D2 and D3-D4 plate pairs separately) for a deflection of 75% of the minimum useful scan will not differ from the deflection factor at 25% of the minimum useful scan by more than the indicated value.
5. (See Diagram) With the tube shielded, D3-D4 traces vertical, and base Pin No. 11 at top, the three spot positions shall be within three 1 inch squares, each square centered along the vertical centerline of the tube face. The middle square (Gun B) centered on the tube face center, the top square (Gun A) centered 1¾ inches above the tube face center, and the bottom square (Gun C) centered 1¾ inches below the tube face center. The slides of the 3 square shall be parallel to the deflection axes.
6. Useful scan shall be measured from the center of the square as specified in Note 5 for spot centering.
7. The deflection of one beam when balanced dc voltages are applied to the deflection electrodes of either of the other two guns shall be less than the specified value.
8. The total horizontal movement of the left or right end of an 8" horizontal trace, produced by any of the three guns, when deflected vertically ¾ inches above or below its normal position, shall not exceed .060 inches.
The total vertical movement of the upper or lower end of a 1½ inch vertical trace produced by any of the three guns, when any one or all beams are deflected horizontally for the full 8 inches of sweep, shall be less than .075 inches.

OUTLINE







ADVANCE DATA

DESCRIPTION

The Sylvania SC-3561 is a 3 gun, electrostatically focused and deflected cathode-ray tube, for displaying simultaneously, 3 independently controlled traces. It features mono-accelerator design for maximum pattern linearity and deflection factor uniformity. All deflection plate leads are brought through the neck. In addition to high vertical deflection sensitivity, an independent astigmatism electrode connection is provided, also brought through the neck, so that maximum resolution can be attained by the use of dynamic control of both focus and astigmatism voltages.

QUICK REFERENCE DATA

Three Independent Guns
 $6\frac{1}{32}'' \times 4\frac{1}{32}''$ Direct Viewed
 Oscilloscope Tube
 Round Glass Type
 Electrostatic Focus
 Electrostatic Deflection
 Monaccelerator Design
 All Deflection Plate Leads
 Brought Through the Neck Wall

CHARACTERISTICS

GENERAL DATA¹

Focusing Method	Electrostatic				
Deflection Method	Electrostatic				
Phosphor*	P1	P2	P7	P11	
Fluorescence	Green	Blue-Green	Blue	Blue	Blue
Phosphorescence	—	Green	Yellow	—	
Persistence	Medium	Long	Long	Short	

*In addition to the types shown, the SC-3561P- can be supplied with several other screen phosphors.

ELECTRICAL DATA

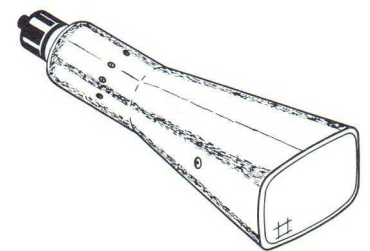
Heater Voltage	6.3 Volts
Heater Current (3 Guns in Parallel)	1.62 to 1.98 Amperes
Direct Interelectrode Capacitances (Approx.)	Each Gun
Cathode to All	5.5 pf
Grid No. 1 to All*	6.5 pf
D1 to D2	2.5 pf
D3 to D4	1.5 pf
D1 to All Other Electrodes	7.5 pf
D2 to All Other Electrodes	7.5 pf
D3 to All Other Electrodes	4.5 pf
D4 to All Other Electrodes	4.5 pf
*Value for B Gun Only	10 pf

MECHANICAL DATA

Overall Length	$18\frac{1}{2} \pm \frac{3}{8}$ Inches
Minimum Useful Screen Diameter	$3\frac{1}{4} \times 5\frac{1}{4}$ Inches
Bulb Contact (Recessed Small Ball Cap)	J1-22
Basing	See Diagram
Base and Contact Alignment	See Diagram
Trace Alignment	
D1-D2 Trace Aligns with D3-D4 Trace (Each Gun)	90 ± 1 Degree
D1-D2 Traces of the 3 Guns are Parallel	± 1 Degree

MAXIMUM RATINGS (Absolute Maximum Values)

Anode Voltage	5500 Volts	dc
Focus Electrode Voltage	3000 Volts	dc
Grid No. 1 Voltage		
Negative Bias Value	220 Volts	dc
Positive Bias Value	0 Volt	dc
Positive Peak Value	2 Volts	dc
Peak Heater to Cathode Voltage		
Heater Negative with Respect to Cathode	200 Volts	
Heater Positive with Respect to Cathode	200 Volts	
Peak Voltage Between Anode and Astigmatism Electrode, or Any Deflecting Plate	750 Volts	



TYPICAL OPERATING CONDITIONS

Anode Voltage	5000 Volts	dc
Astigmatism Electrode Voltage	5000 Volts	dc
Focus Electrode Voltage	1500-2500 Volts	dc
Grid No. 1 Voltage ²	-50 to -90 Volts	dc
Line Width "A" ³016 Inch	Max.
Deflection Factors		
D1-D2	120-150 Volts Per Inch	
D3-D4	65 to 85 Volts Per Inch	
Deflection Factor Uniformity ⁴	1 1/2 Percent	Max.
Undelected Spot Positions ⁵	Within 1/2 Inch Square	
Useful Scan ⁶		
D1-D2	Full Screen	
D3-D4	±1 1/2 Inches	
Interaction Factor ⁷	6 x 10 ⁻⁵ In./Volts	Max.
Pattern Distortion ⁸		

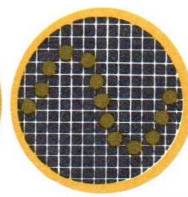
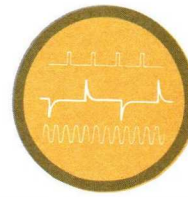
CIRCUIT VALUES

Grid No. 1 Circuit Resistance	1.5 Megohms	Max.
Deflection Circuit Resistance	1.0 Megohms	Max.

NOTES:

1. Values are for each gun unless otherwise specified.
2. Visual extinction of undeflected focused spot.
3. Per MIL-E-1 and at a control grid voltage of 15 volts above spot cutoff.
4. The deflection factor (for both D1-D2 and D3-D4 plate pairs separately) for a deflection of 75 % of the minimum useful scan will not differ from the deflection factor at 25 % of the minimum useful scan be more than the indicated value.
5. Guns will be on parallel axes. Spot centering as follows:
 One gun on horizontal center line 5/8" to left
 One gun 3/4" above horizontal center line 5/8" to right
 One gun 3/4" below horizontal center line 5/8" to right
6. Useful scan shall be measured from the center of the square as specified in Note 5 for spot centering.
7. The deflection of one beam when balanced dc voltages are applied to the deflection electrodes of either of the other two guns shall be less than the specified value.
8. The total horizontal movement of the left or right end of a 5" horizontal trace, produced by any of the three guns, when deflected vertically 3/4 inches above or below its normal position, shall not exceed .050 inches.

 The total vertical movement of the upper or lower end of a 1 1/2 inch vertical trace produced by any of the three guns, when any one or all beams are deflected horizontally for the full 5 inches of sweep, shall be less than .075 inches.



DESCRIPTION

The SC-3814 is an electrostatically focused and deflected cathode ray tube designed for zoned display applications. The tube features provision for six simultaneous independently controlled zoned traces, and uses a 10" x 12" rectangular glass bulb with large radius of curvature faceplate. Deflection plate leads are brought out through the neck wall to reduce inter-electrode capacitance and a monoaccelerator design is employed to provide maximum pattern linearity and deflection factor uniformity.

The tube is encapsulated in an integral mu metal shield for protection against stray magnetic and electric fields and breakdown at high altitudes. Color coded leads are brought out of the encapsulation to make connection to associated circuitry.

CHARACTERISTICS

GENERAL DATA

Heater Voltage	6.3 Volts
Heater Current	1.8 Amp
Overall Length (Approx.)	21 1/2 Inches
Phosphor*	P7

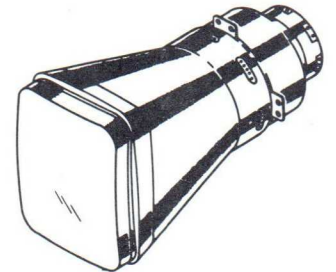
*The SC-3814 can be supplied with several other screen phosphors.

TYPICAL OPERATING CONDITIONS

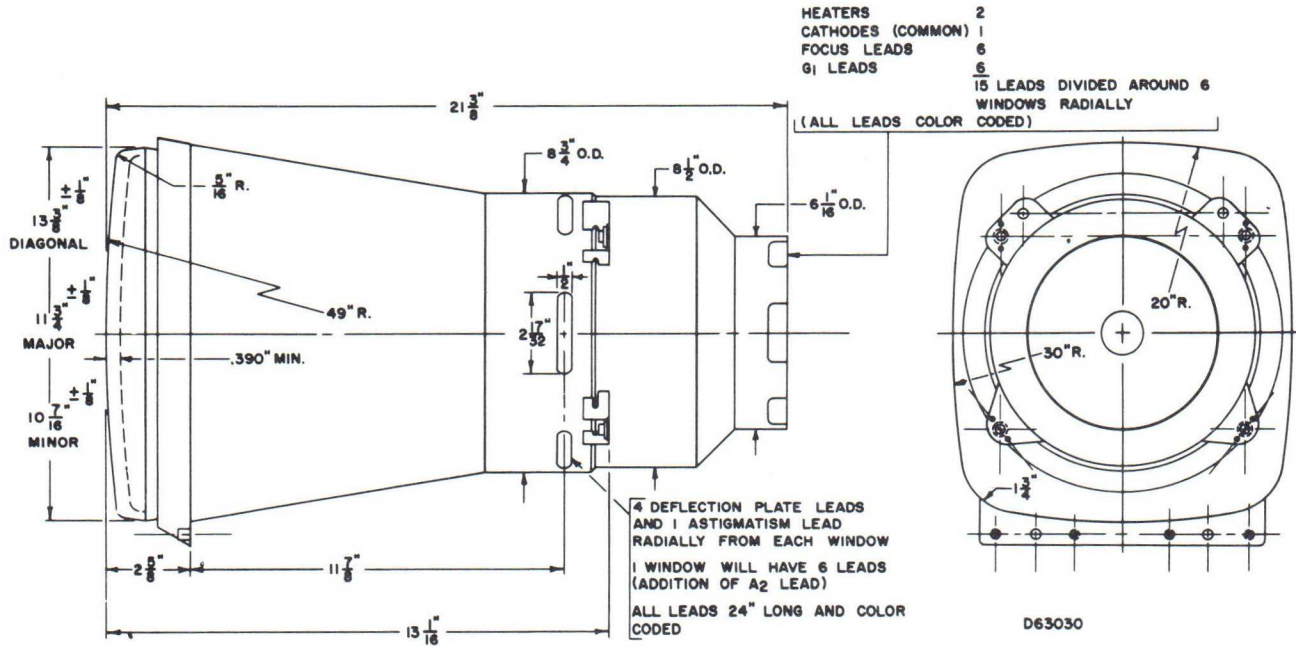
Anode Voltage	4000 Volts dc
EA1 for Focus	900-1300 Volts dc
Grid No. 1 Voltage for Cutoff	-70 to -120 Volts dc
Deflection Factors	
1D2	80-100 Volts dc Per Inch
3D4	38-52 Volts dc Per Inch
Useful Scan	
D1-D2 (Horizontal)	9 Inches
3D4 (Vertical)	2 1/2 Inches
(Major axis of the bulb is vertical)	
Parallelism of all Horizontal Traces	0.55 ° Max.

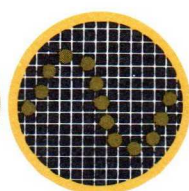
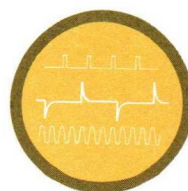
QUICK REFERENCE DATA

**Six Independent Guns
Zoned Displays
10 x 12 Inch Direct Viewed
Electrostatic Focus
Electrostatic Deflection
Monoaccelerator Design
Encapsulated in mu Metal Shield
Color Coded Leads are Brought
Out Through the Encapsula-
tion**



OUTLINE





ADVANCE DATA

DESCRIPTION

The Sylvania SC-3892P1 is a 5 gun, electrostatically focused and deflected cathode-ray tube, 16 inches in diameter, for displaying simultaneously, 5 independently controlled traces. It features monoaccelerator design for maximum pattern linearity and deflection factor uniformity. The tube is potted in a mu-metal shield with all tube connections being color coded flying leads.

QUICK REFERENCE DATA

5 Gun Design
 Electrostatic Focus
 Electrostatic Deflection
 16" Diameter
 Monoaccelerator Design
 Potted in Mu-Metal
 Color Coded Leads

CHARACTERISTICS

GENERAL DATA

Focusing Method Electrostatic
 Deflection Method Electrostatic
 In addition to P1, the SC-3892 can be supplied with several other screen phosphors.

ELECTRICAL DATA

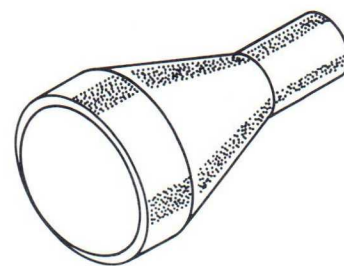
Heater Voltage 6.3 Volts
 Heater Current (600 ma per Gun) $3.0 \pm 10\%$ Amperes
 Direct Interelectrode Capacitances (Approx.) Each Gun
 Cathode to All To Be Determined
 Grid No. 1 to All To Be Determined
 D1 to D2 To Be Determined
 D3 to D4 To Be Determined
 D1 to All Other Electrodes To Be Determined
 D2 to All Other Electrodes To Be Determined
 D3 to All Other Electrodes To Be Determined
 D4 to All Other Electrodes To Be Determined

MECHANICAL DATA

Overall Length $26\frac{1}{2} \pm \frac{3}{8}$ Inches
 Minimum Useful Screen Diameter 15 Inches
 Basing Color Coded Leads
 Trace Alignment
 D1-D2 Trace Aligns with D3-D4 Trace (Each Gun) 90 ± 1 Degree
 D1-D2 Traces of All Guns are Parallel ± 1 Degree

MAXIMUM RATINGS (Absolute Maximum Values)

Anode No. 2 Voltage 5500 Volts
 Astigmatism Electrode Voltage 5500 Volts
 Focus Electrode Voltage 3000 Volts
 Grid No. 1 Voltage
 Negative Bias Value 220 Volts
 Positive Bias Value 0 Volt
 Positive Peak Value 2 Volts
 Peak Heater to Cathode Voltage
 Heater Negative with Respect to Cathode 200 Volts
 Heater Positive with Respect to Cathode 200 Volts
 Peak Voltage Between Anode and Astigmatism
 Electrode or Any Deflecting Plate 1500 Volts



TYPICAL OPERATING CONDITIONS

Anode No. 2 Voltage	3000 Volts	dc
Astigmatism Electrode Voltage	2900-3100 Volts	dc
Focus Electrode Voltage	850 to -1500 Volts	dc
Grid No. 1 Voltage ²	-50 to -100 Volts	dc
Line Width "A" ³	0.035 Inches	Max.
Deflection Factors		
D1-D2	80 V/in.	Max.
D3-D4	80 V/in.	Max.
Deflection Factor Uniformity ⁴	1½ Percent	Max.
Undelected Spot Position (All Guns)	Within 1 Inch Square	at Geometric Center of Face
Useful Scan		
D1-D2	±7½ Inches	
D3-D4	±7½ Inches	
Interaction Factor ⁵	6 x 10 ⁻⁵ In./Volts	Max.

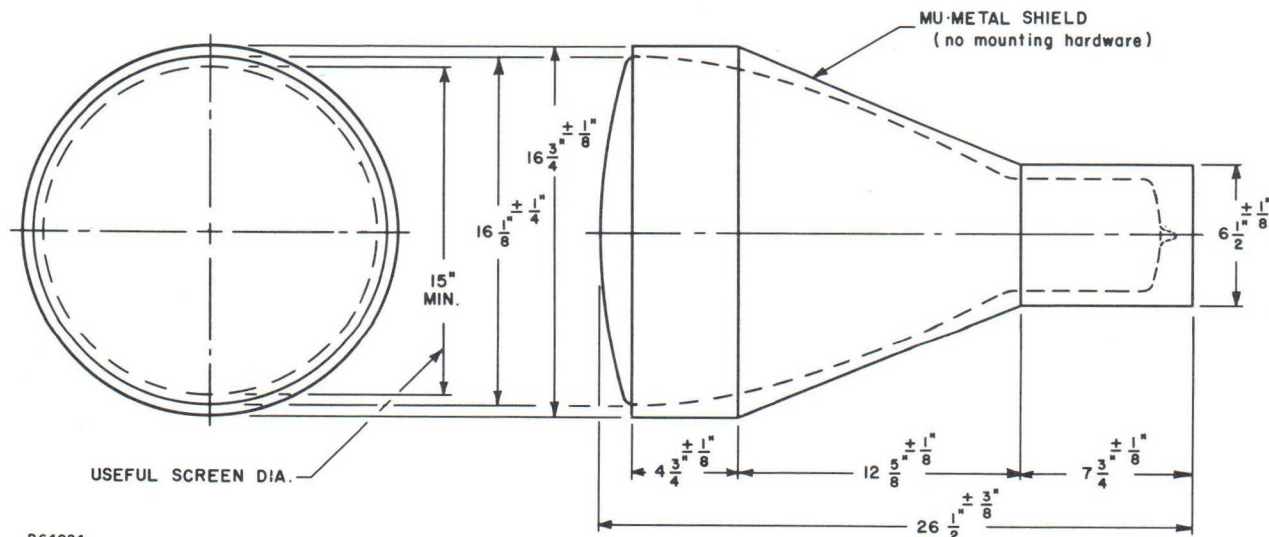
CIRCUIT VALUES

Grid No. 1 Circuit Resistance	1.5 Megohms Max.
Deflection Circuit Resistance	1.0 Megohm Max.

NOTES:

1. Values are for each gun unless otherwise specified.
2. Visual extinction of undeflected focused spot.
3. Per MIL-E-1 and at a control grid voltage of 25 volts above spot cutoff.
4. The deflection factor (for both D1-D2 and D3-D4 plate pairs separately) for a deflection of 75 % of the minimum useful scan will not differ from the deflection factor at 25 % of the minimum useful scan by more than the indicated value.
5. The deflection on one beam when balanced dc voltages are applied to the deflection electrodes of either of the other two guns shall be less than the specified value.

OUTLINE

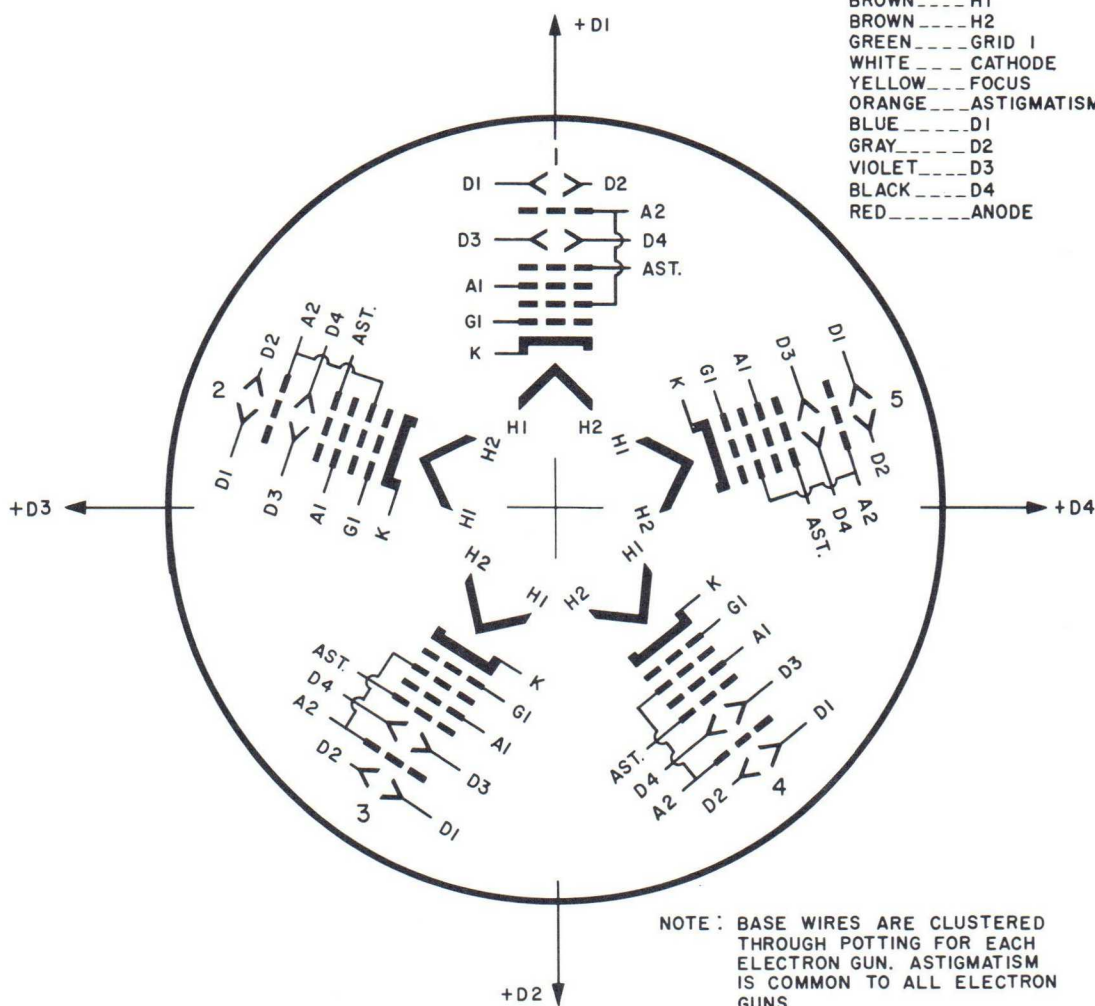


D64024

BASING DIAGRAM

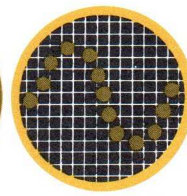
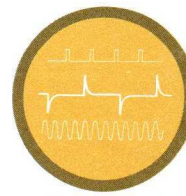
Color Coded Base Wires
(MIN. LENGTH 18 INCHES)

- BROWN-----H1
- BROWN-----H2
- GREEN-----GRID 1
- WHITE-----CATHODE
- YELLOW-----FOCUS
- ORANGE-----ASTIGMATISM
- BLUE-----D1
- GRAY-----D2
- VIOLET-----D3
- BLACK-----D4
- RED-----ANODE



D64028

VIEW FROM BASE END OF TUBE



ADVANCE DATA

DESCRIPTION

The SC-4014 is a 7" flat face, 2 gun cathode ray tube with electrostatic deflection and focus. It features linear post deflection acceleration for maximum pattern linearity and deflection factor uniformity. It is intended for applications where line widths less than 0.020 inches are required. The SC-4014 can be supplied with a variety of phosphors. The screen is aluminized for high brightness. This tube is potted in its mu-metal shield and is provided with color coded leads for all connections.

CHARACTERISTICS

GENERAL DATA

Focusing Method	Electrostatic
Deflection Method	Electrostatic
Faceplate	Clear

ELECTRICAL DATA

Heater Voltage	6.3 Volts
Heater Current (2 Guns in Parallel)	0.60 ± 10 % Ampere

MECHANICAL DATA

Overall Tube Length	20 ⁷ / ₈ ± 1/4 Inches
Minimum Useful Screen Diameter	6 ¹ / ₈ Inches
Basing	Color Coded Leads
Angle Between D1-D2 and D3-D4 Traces of Each Gun	90 ± 1 Degree
Angle Between D1-D2 and D3-D4 Traces of the 2 Guns are Parallel	±1 Degree

MAXIMUM RATINGS (Absolute Maximum Values)

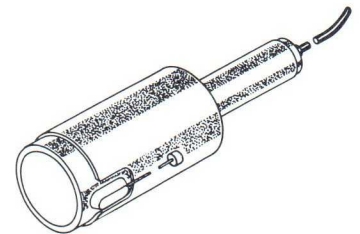
Anode No. 3 Voltage	15,000 Volts	dc
Anode No. 2 Voltage	4500 Volts	dc
Anode No. 1 (Focus Electrode) Voltage	1550 Volts	dc
Grid No. 1 Voltage		
Negative Bias Value	220 Volts	dc
Positive Bias Value	0 Volt	dc
Positive Peak Value	2 Volts	
Peak Voltage Anode No. 2 to Any Deflecting Plate	±550 Volts	
Peak Heater-Cathode Voltage		
Heater Negative with Respect to Cathode	200 Volts	
Heater Positive with Respect to Cathode	200 Volts	
Modulation (Anode 3 Current = 25 μa)	36 Volts	Max.

TYPICAL OPERATING CONDITIONS

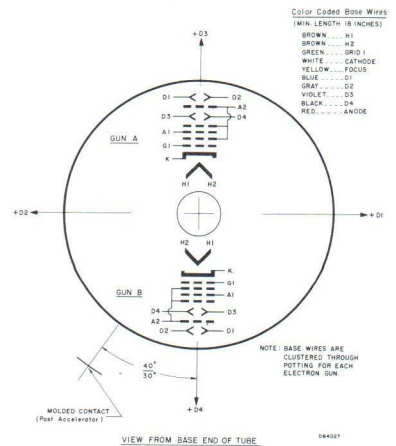
Anode No. 3 Voltage	12,400 Volts	dc
Anode No. 2 Voltage	2900 Volts	dc
Grid No. 1 Voltage (For Spot Cutoff)	-35 to -65 Volts	dc
Anode No. 1 Voltage (For Focus) ¹	750-1050 Volts	dc
Deflection Factors		
D1-D2	116 to 134 Volts/in.	
D3-D4	116 to 134 Volts/in.	
Line Width "A" ²	0.020 Inches	Max.
Useful Scan ³		
D1-D2	2 ⁵ / ₈ Inches	Min.
D3-D4	2 ⁵ / ₈ Inches	Min.
Spot Position ⁴	—	
Maximum Ib3 at Cutoff	60 μa	dc
Interaction Factor ⁵	5 x 10 ⁻⁵ Inches/V	dc
Gun to Gun Tracking ⁶	—	
Pattern Distortion ⁷	—	

QUICK REFERENCE DATA

2 Gun Design
7" Flat Face
Electrostatic Focus
Electrostatic Deflection
Linear Post Acceleration
Aluminized Screen
Potted in Mu-Metal
Color Coded Leads



BASING DIAGRAM



NOTES:

1. Focus voltage at cutoff ($I_{b3} = 0$) not to exceed maximum value specified.
2. Per MIL-E-1 and at $I_{b3} = 25 \mu a$ (this current shall be in addition to the value of I_{b3} read at cutoff).
3. Measured from geometric center of the face.
4. The shielded undeflected focused spot of each gun shall fall within a $\frac{5}{8}$ inch square whose sides are parallel to the deflection axes. The center of this square will lie on the geometric center of the face.
5. The deflection of one beam when balanced dc voltages are applied to the deflection electrodes of the other, shall not be greater than the specified value.
6. Display a spot with gun "A" and a 0.120 inch high by 0.130 inch wide rectangle with gun "B". After appropriate centering and scale factor corrections have been made, the guns shall track such that the spot of gun "A" will stay within the rectangle of gun "B" at all points within a rectangle 4.50 inches high by 3.75 inches wide centered on the tube face.
7. Guns "A" and "B". With a 4.50 inch high (+D3 is top) by 3.75 inch wide rectangular raster centered on the face of the tube, the raster edges shall not deviate from straight parallel lines by more than 0.080 inch total on the upper and lower edges, and 0.080 on the right and left edges.

OUTLINE

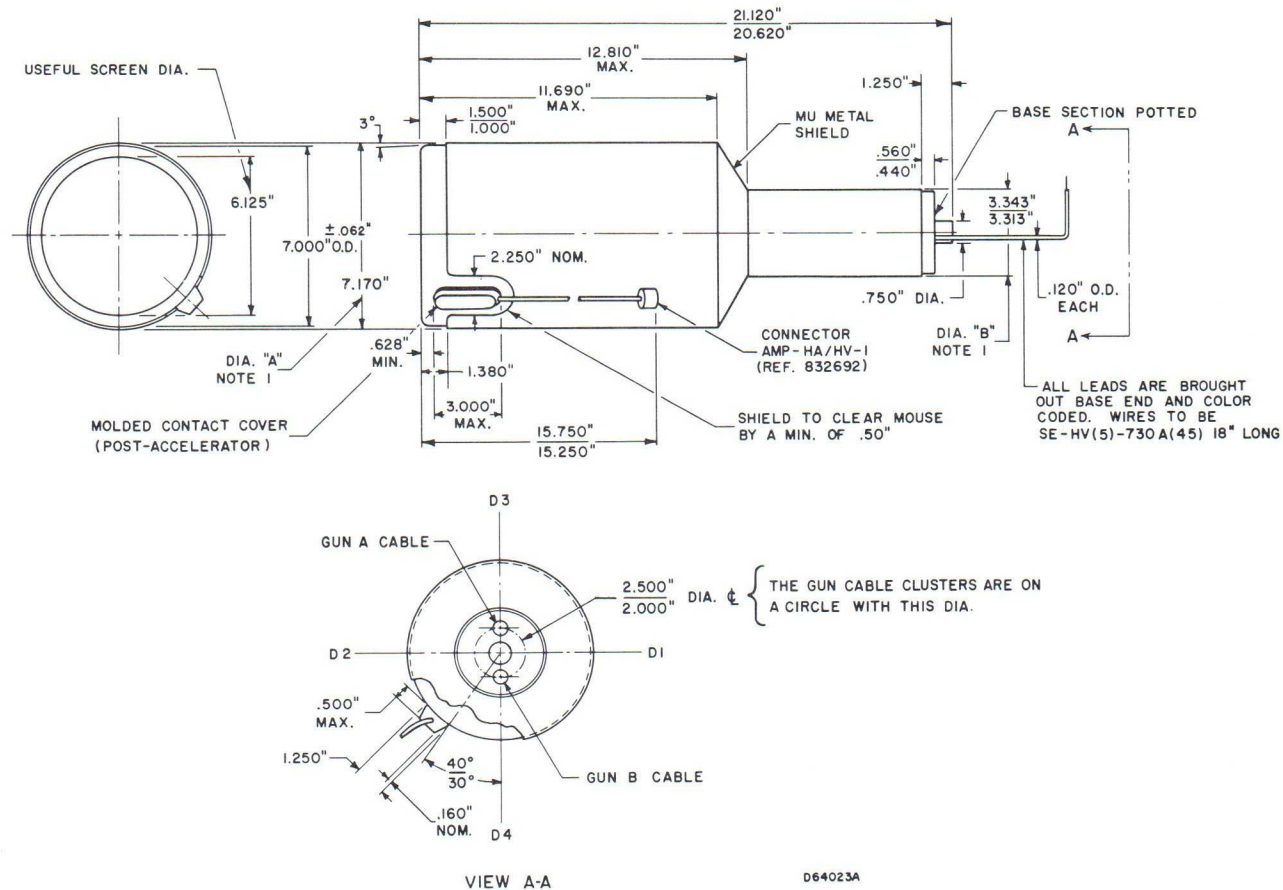


DIAGRAM NOTE:

1. Diameter "A" to be concentric with Diameter "B" within 0.120 T.I.R.

HIGH RESOLUTION TUBES

Photo recording, flying spot scanning and reconnaissance systems are but a few of the applications where fine line, high resolution cathode ray tubes are used. Sylvania high resolution cathode ray tubes provide displays with line widths as small as .0008". Tubes of this quality use optical quality faceplates, fine grain phosphor, and very tight tolerances on screen blemishes. Sylvania engineers can recommend, on the basis of past experience, the line width, necessary for a particular application. The information needed is:

- 1/ The desired line width
- 2/ The method and speed of scan
- 3/ The deflection angle
- 4/ The minimum useful screen area
- 5/ Maximum overall length of the tube.

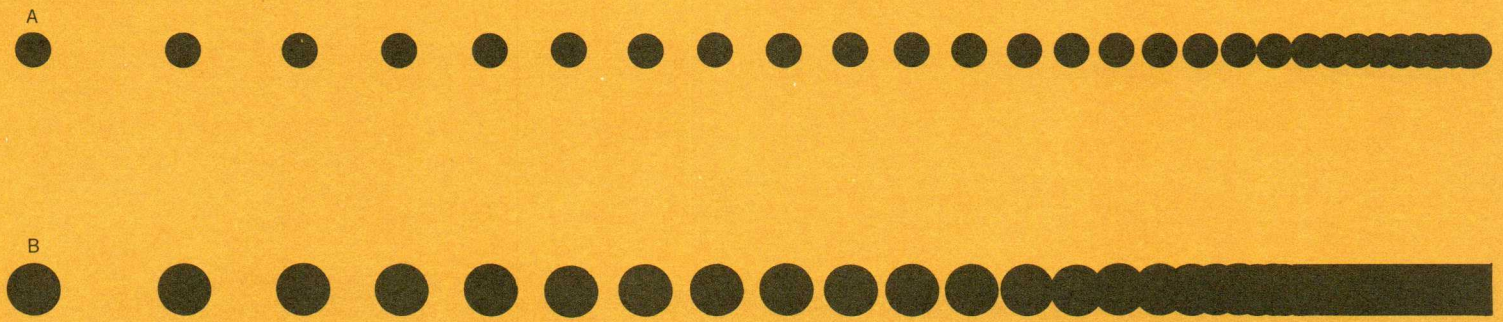
Line Width Determinants

Line width, the critical factor in high resolution tubes, is affected in many ways. As in physical optics, where the image (Q) and object (P) distances determine the magnification (M), the analogous electron optics situation holds true in the cathode ray tube. The spot on the phosphor screen is a focused image of the cross-over point in the electron beam in the general area of the control grid. In the magnetic focus design, the image distance is dependent on the bulb shape, deflection angle, and yoke length. To maintain low magnification, the object distance must be long; therefore, neck length on high resolution magnetic deflection and focus tubes is made long. With other factors being unchanged the line width is increased as the deflection angle is decreased. However, the lower the deflection angle, the better center-to-edge uniformity of the spot.

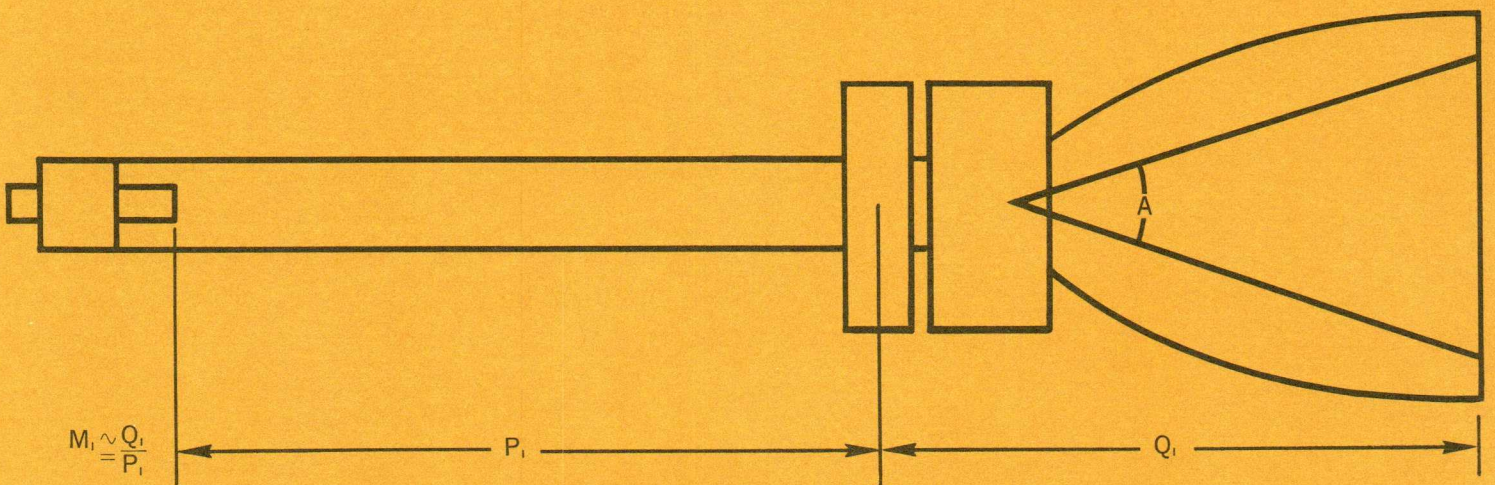
For the ultimate in high quality presentations, dynamic focusing is necessary. This is a dynamic variation of focus current, with respect to spot position on the face; or in some cases, the variation of focus current with variations in beam current.

Available voltage is very important to the proper performance of high resolution tubes. Anode and G_2 voltages should be high. Up to 1,000 volts are needed for the G_2 and 15,000 to 20,000 volts for the anode voltages. As the anode voltage decreases, brightness decreases; and, as the beam current is increased, the beam cross-over size increases, thereby reducing resolution.





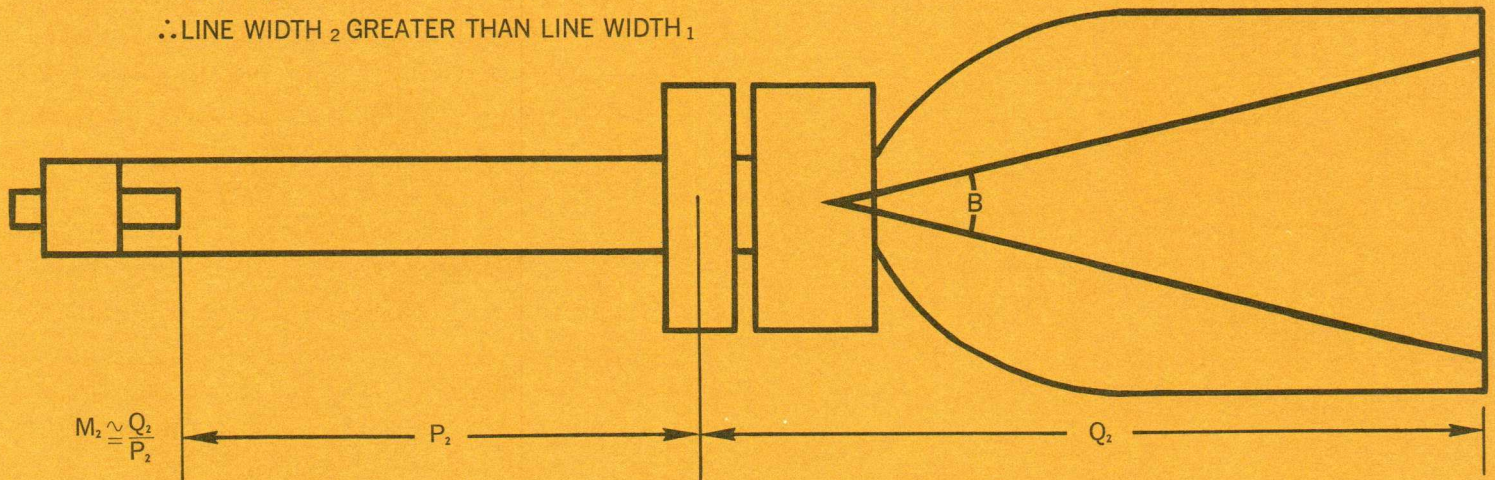
A graphical illustration of resolution is shown between a conventional cathode ray tube (Line B) and a high resolution tube (Line A). It represents an intensity modulated display in decreasing increments of time. Notice that the information presented on the high resolution tube is useable for the full length of the trace, where the information on a conventional tube is lost after $\frac{2}{3}$ of the sweep. Sylvania's SC-2809P11 and SC-2782P11 CRT's can produce this improvement for you.



$$M_2 > M_1$$

∴ LINE WIDTH₂ GREATER THAN LINE WIDTH₁

$$d > B$$



Magnetic focusing provides the best resolution at the center, but the greater amount of deflection defocusing. Low voltage electrostatic focus designs have less resolution potential, but center-to-edge focus is better than in the magnetic design.

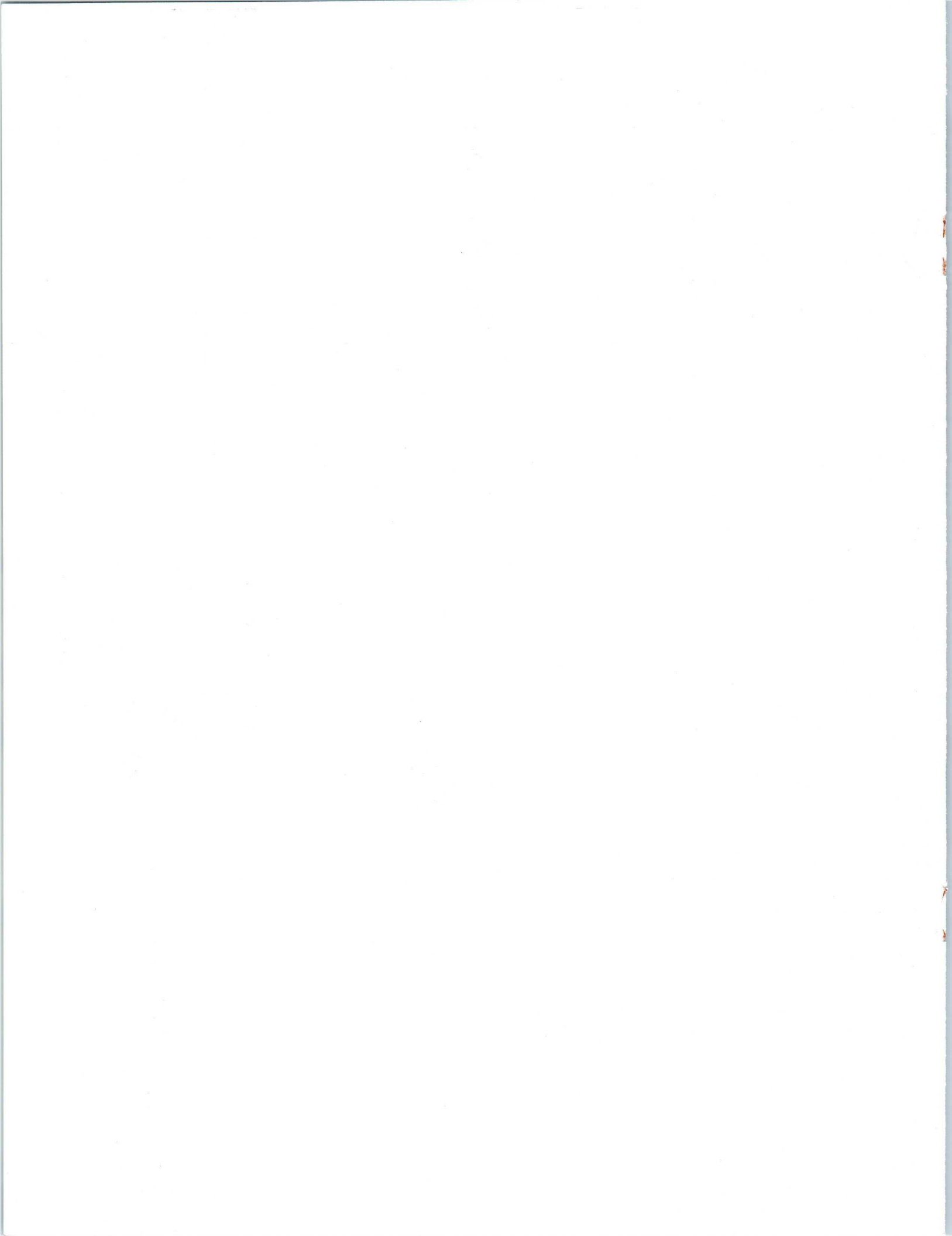
Line Width Measurements

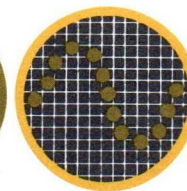
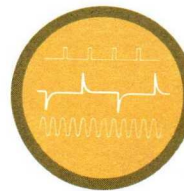
The light output variations across the width of a trace resembles the gaussian distribution with maximum intensity at the center and decreasing towards the edges of the trace. The most commonly used measurement of line width is the merged raster method. A known number of scan lines are displayed on the tube. The raster height is reduced until the individual scan lines are merged. The number of scan lines is divided into the raster height and the quotient is the line width. For good correlation in the use of this method, much care is needed with regard to well regulated supplies, vertical and horizontal retrace blanking, and good horizontal and vertical linearity. The merged raster method assumes that the measurement is at the 50% brightness point of the distribution curve of the trace width.

Another technique for measuring line width is a method known as double slit analysis. In this technique, the image of the cathode ray tube spot, slowly scanning a single line, is focused on a pair of very narrow slits, oriented perpendicular to the scanned line and in front of a highly sensitive photomultiplier tube. The output of the photomultiplier when displayed on an oscilloscope will show two trace envelopes which represent the light output profile of the cathode ray tube spot. Since separation of the slits is known exactly, the calibration of the scope is simplified and any degree of magnification may be used for extremely accurate readings. With other techniques, jitter, linearity and stray field pickup interfere with accurate, repeatable line width measurements. As the double slit analysis utilizes a slow, single line sweep, the effect of these conditions is greatly reduced. Applying this technique and the merged raster method in testing tubes, excellent correlation is obtained if the light output profile is read at the 60% amplitude point. The double slit analysis technique is particularly applicable to measuring line width on high resolution tubes where the phosphor output is primarily in the ultraviolet portion of the spectrum, such as P16, and visual measurements are difficult to make.



Double slit analysis method for measuring line width.





DESCRIPTION

The Sylvania Types 5CEP11 and 5CEP16 are 5-inch diameter Cathode Ray Tubes designed for high resolution photographic recording and high resolution flying spot scanning applications respectively. They have electrostatic focus, magnetic deflection, and are capable of producing a line width of 0.0015 inch. The tubes have flat, neutral gray, non-browning optical glass faceplates for optimum photographic quality. Both types have aluminized phosphors to increase display brightness. An integral encapsulated high voltage connector is utilized to minimize corona at high altitude.

CHARACTERISTICS

GENERAL DATA

Focusing Method	Electrostatic
Deflection Method	Magnetic
Deflection Angle (Approx.)	42 Degrees
Phosphor*	5CEP16 P16 5CEP11 Fine Grain P11, Aluminized Blue
Fluorescence	Violet and Near Ultra-Violet
Persistence	Extremely Short
Faceplate	Gray, Non-Browning Optical Glass

*In addition to the types shown, the 5CEP can be supplied with several other screen phosphors.

ELECTRICAL DATA

Heater Voltage	6.3 Volts
Heater Current	0.6 ± 10 % Ampere
Direct Interelectrode Capacitances (Approx.)	
Grid No. 1 to All Other Electrodes	9 pf
Grid No. 2 to All Other Electrodes	7 pf
Cathode to All Other Electrodes	7 pf

MECHANICAL DATA

Minimum Useful Screen Diameter	4 1/4 Inches
Overall Length	13 ± 1/2 Inches
Bulb Diameter	5 1/4 ± 1/16 Inches
Anode Terminal	16" HV Cable, Corona Protected
Base	B6-63
Basing	12Q

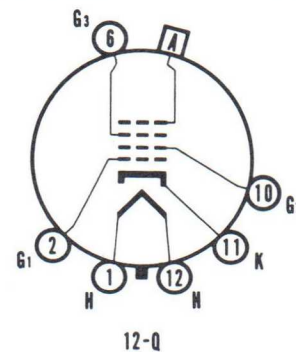
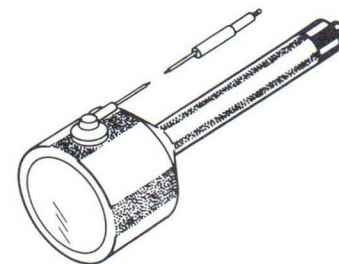
RATINGS

MAXIMUM RATINGS (Absolute Maximum Values)

Anode Voltage	22,000 Volts dc
Grid No. 3 (Focus) Voltage	5000 Volts dc
Grid No. 2 Voltage	600 Volts dc
Grid No. 1 Voltage	
Negative Bias Value	180 Volts dc
Positive Bias Value	0 Volt
Positive Peak Value	0 Volt
Peak Heater Cathode Voltage	
Heater Negative with Respect to Cathode	
During Warm-up Period Not to Exceed 15 Seconds	450 Volts
After Equipment Warm-up Period	180 Volts
Heater Positive with Respect to Cathode	180 Volts

QUICK REFERENCE DATA

High Resolution Tube
 .0015" Line Width
 5-Inch, Flat, Optical Glass Faceplate
 Clear Non-Browning Faceplate
 Extremely Fine Grain Screen
 Aluminized Screen
 Magnetic Deflection
 Electrostatic Focus
 No Ion Trap



TYPICAL OPERATING CONDITIONS

Anode Voltage	10,000	20,000 Volts
Grid No. 3 (Focus) Voltage ¹	2070-2370	4140-4740 Volts
Grid No. 2 Voltage	300	300 Volts
Grid No. 1 Cutoff Voltage ²	-40 to -65	-40 to -65 Volts
Line Width ³	0.0015	0.0015 Inch

CIRCUIT VALUES

Grid No. 1 Circuit Resistance 1.5 Megohms Max.

NOTES:

1. The Grid No. 3 focus supply should be capable of 250 μ a average current. Due to the extreme fineness of the line, it is recommended that focus modulation (dynamic focus) be used.
2. Visual extinction of undeflected focused spot.
3. Line width measured at 5 μ a by the shrinking raster method.

WARNING:

X-ray radiation shielding may be necessary to protect against possible danger of personal injury from prolonged exposure at close range if this tube is operated at higher than the manufacturer's Maximum Rated Anode Voltage of 16,000 volts, whichever is less.

OUTLINE

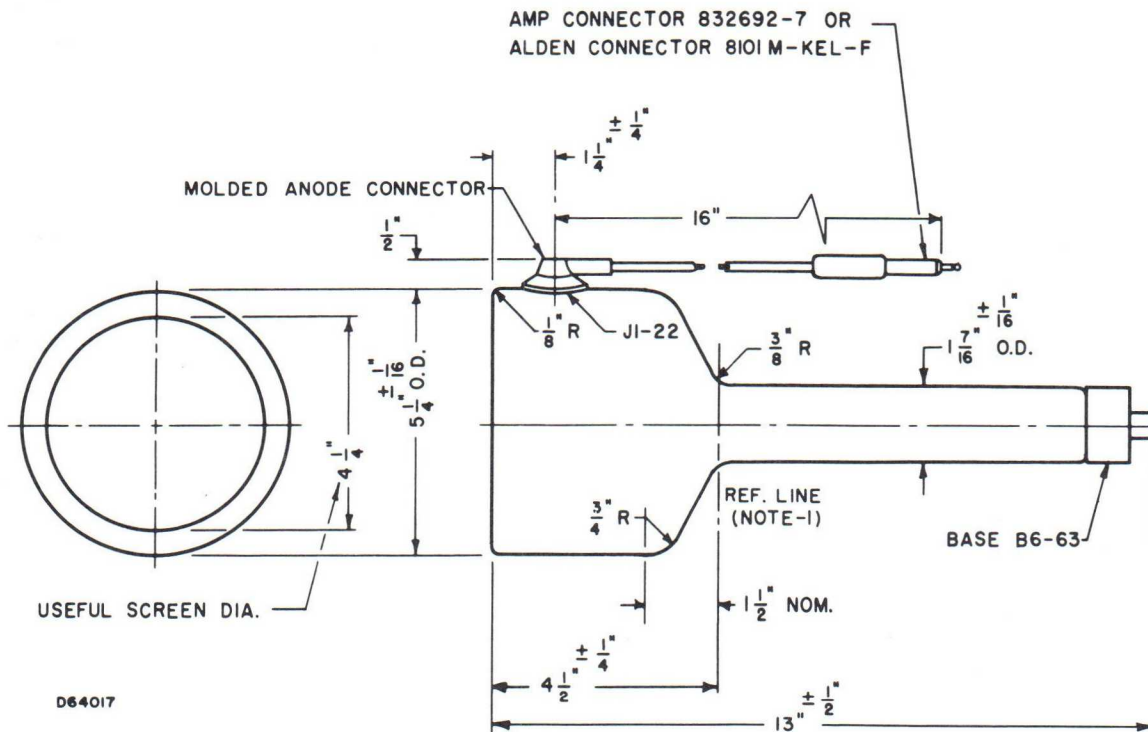
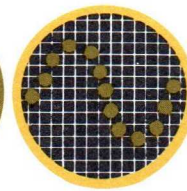
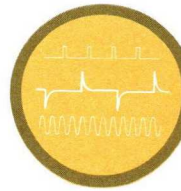


DIAGRAM NOTES:

1. Yoke Reference Line is the plane where a 1.500" + 0.003", -0.000" I.D. Ring Gage will stop.
2. Molded Anode Connector alignment with vacant pin Position No. 3 has angular tolerance of $\pm 10^\circ$ measured about the tube axis.



CHARACTERISTICS

GENERAL DATA

Focusing Method	Electrostatic
Deflection Method	Magnetic
Deflection Angle (approx.)	50°
Types*	5WP11 5WP15
Fluorescence	Blue Blue-Green
Persistence	Short Extremely Short
Screen	Aluminized
Faceplate	Flat, Clear

*In addition to the types shown, the 5WP- can be supplied with several other screen phosphors.

ELECTRICAL DATA

Heater Voltage	6.3 Volts
Heater Current	0.6 ± 10% Ampere
Direct Interelectrode Capacitances	
Cathode to All Other Electrodes	5 μμf
Grid No. 1 to All Other Electrodes	7.5 μμf Max.
External Conductive Neck Coating to Anode No. 2 ¹	500 μμf Max.
	100 μμf Min.

MECHANICAL DATA

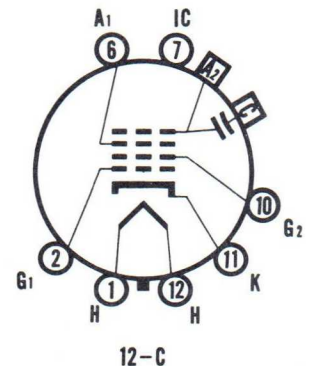
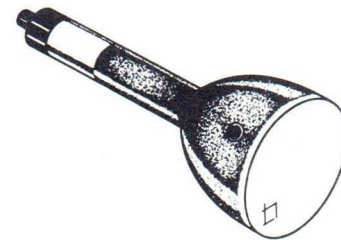
Minimum Useful Screen Diameter	4 1/4 Inches
Bulb Contact (Recessed Small Cavity Cap)	J1-21
Base (Small Shell Duodecal 7-Pin)	B7-51
Basing	12C
Bulb	C40 Exp. 14 or Equivalent

MAXIMUM RATINGS (Absolute Maximum Values)

Anode No. 2 Voltage	30,000 Volts dc
Anode No. 1 Voltage (Focusing Electrode)	6,600 Volts dc
Grid No. 2 Voltage	385 Volts dc
Grid No. 1 Voltage	
Negative Bias Value	165 Volts dc
Positive Bias Value	0 Volts dc
Positive Peak Value	2 Volts
Peak Heater-Cathode Voltage	
Heater Negative with Respect to Cathode	
During Warm-up Period	
Not to Exceed 15 Seconds	450 Volts
After Equipment Warm-up Period	140 Volts
Heater Positive with Respect to Cathode	140 Volts

QUICK REFERENCE DATA

- 5WP11—Video Recorder
- 5WP15—Flying Spot Scanner
- 5" Round Glass Type
- Flat, Clear Faceplate
- Magnetic Deflection
- Acceleration Type
- Electrostatic Focus
- No Ion Trap
- External Conductive Coating on Neck
- External Insulating Coating on Bulb
- Aluminized Screen



SYLVANIA
5WP11
5WP-*

TYPICAL OPERATING CONDITIONS

Anode No. 2 Voltage ²	27,000	Volts	dc
Anode No. 1 Voltage for Focus	4200 to 5400	Volts	dc
Grid No. 2 Voltage ³	200	Volts	dc
Grid No. 1 Voltage Required for Cutoff ⁴	-42 to -98	Volts	dc
Anode No. 2 Current			
5WP11	20	μ a	dc
5WP15	100	μ a	dc
Max. Anode No 1. Current			
5WP11	25	μ a	dc
5WP15	150	μ a	dc
Grid No. 2 Current	-15 to +15	μ a	dc

CIRCUIT VALUES

Grid No. 1 Circuit Resistance	1.5	Megohms	Max.
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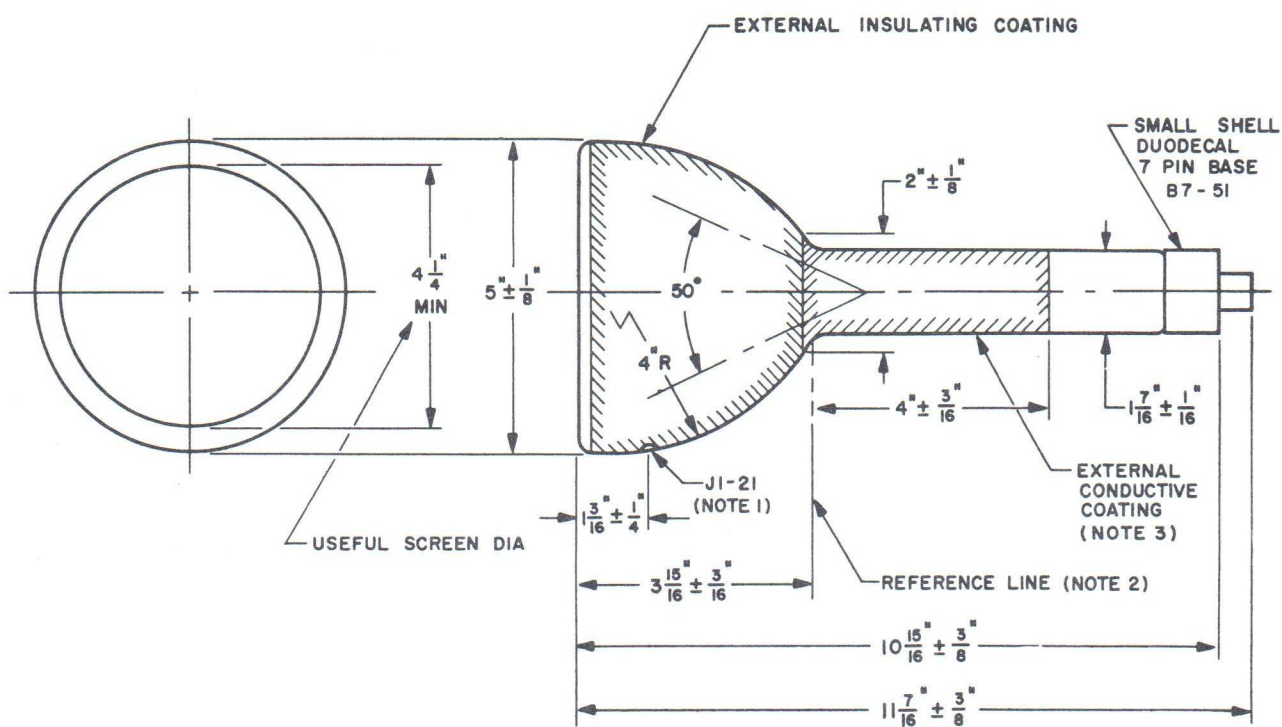
NOTES:

1. *External conductive neck coating must be grounded.*
2. *Brilliance and definition decrease with decreasing anode voltage. In general, the anode voltage should not be less than 15,000 volts.*
3. *Subject to variation of $\pm 40\%$ when Grid No. 1 Voltage cutoff is desired at the average cutoff value of -70 volts.*
4. *Visual extinction of undeflected focused spot.*

WARNING:

X-ray radiation shielding may be necessary to protect against possible danger of personal injury from prolonged exposure at close range if this tube is operated at higher than the manufacturer's Maximum Rated Anode Voltage or 16,000 volts, whichever is less.

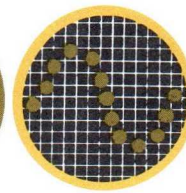
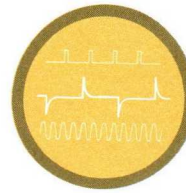
OUTLINE



558065

DIAGRAM NOTES:

1. The plane through the tube axis and vacant pin position No. 3 may vary from the plane through the axis and Anode No. 2 terminal by an angular tolerance (measured about the tube axis) of $\pm 10^\circ$.
 Anode No. 2 terminal is on same side as vacant pin position No. 3.
2. Reference line is determined by the plane C-C' of the reference line gauge (JEDEC No. G112) when the gauge is seated on the glass cone.
3. External conductive coating must be grounded.



CHARACTERISTICS

GENERAL DATA

Focusing Method	Electrostatic
Deflection Method	Magnetic
Deflection Angle (approx.)	40 Degrees
Types*	

	5ZP15	5ZP16	5ZP24
Fluorescence	Blue-Green	Violet & Near Ultraviolet	Blue-Green
Persistence	Extremely Short	Extremely Short	Extremely Short
Screen Faceplate		Aluminized	Clear, Non-Browning

*In addition to the types shown, the 5ZP- can be supplied with several other screen phosphors.

ELECTRICAL DATA

Heater Voltage	6.3 Volts	
Heater Current	0.6 ± 10% Ampere	
Direct Interelectrode Capacitances (approx.)		
Cathode to All Other Electrodes	8 μμf	
Grid No. 1 to All Other Electrodes	5 μμf	
External Conductive Neck Coating to Anode ¹	500 μμf	Max.
	100 μμf	Min.

MECHANICAL DATA

Minimum Useful Screen Diameter	4 1/4 Inches
Bulb Contact (Recessed Small Cavity Cap)	J1-21
Base (Small Shell Duodecal 7-Pin)	B7-51
Basing	12C
Bulb Contact Aligns with Vacant Pin	
Position No. 3	±10 Degrees

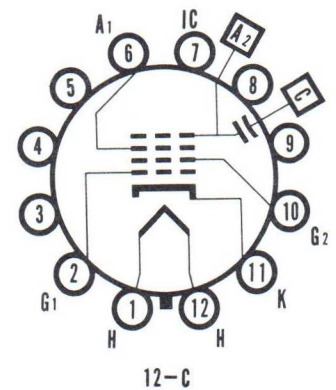
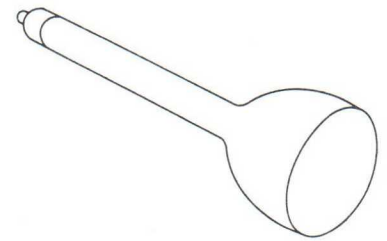
RATINGS

MAXIMUM RATINGS (Absolute Maximum Values)

Anode No. 2 Voltage	30,000 Volts	dc
Anode No. 1 Voltage (Focusing Electrode)	7,700 Volts	dc
Grid No. 2 Voltage	385 Volts	dc
Grid No. 1 Voltage		
Negative Bias Value	165 Volts	dc
Positive Bias Value	0 Volts	dc
Positive Peak Value	2 Volts	
Peak Heater-Cathode Voltage		
Heater Negative with Respect to Cathode		
During Warm-up Period		
Not to Exceed 15 Seconds	450 Volts	
After Equipment Warm-up Period	165 Volts	
Heater Positive with Respect to Cathode	165 Volts	

QUICK REFERENCE DATA

- Flying Spot Scanner Tube
- 5" Round Glass Type
- Flat Faceplate
- Clear Non-Browning Faceplate
- Magnetic Deflection
- Acceleration Type Electrostatic
- Focus
- No Ion Trap
- External Conductive Coating on Neck
- External Insulating Coating on Bulb
- Aluminized Screen



TYPICAL OPERATING CONDITIONS

Anode Voltage ²	27,000 Volts	dc
Anode No. 1 Voltage for Focus at $I_b = 15 \mu a$	5550 to 7050 Volts	dc
Grid No. 2 Voltage	200 Volts	dc
Grid No. 1 Voltage Required for Cutoff ³	-42 to -98 Volts	dc
Anode Current	15 μa	dc
Maximum Anode No. 1 Current at $I_b = 15 \mu a$	25 μa	dc
Grid No. 2 Current	-15 to +15 μa	dc

CIRCUIT VALUES

Grid No. 1 Circuit Resistance 1.5 Megohms Max.

NOTES:

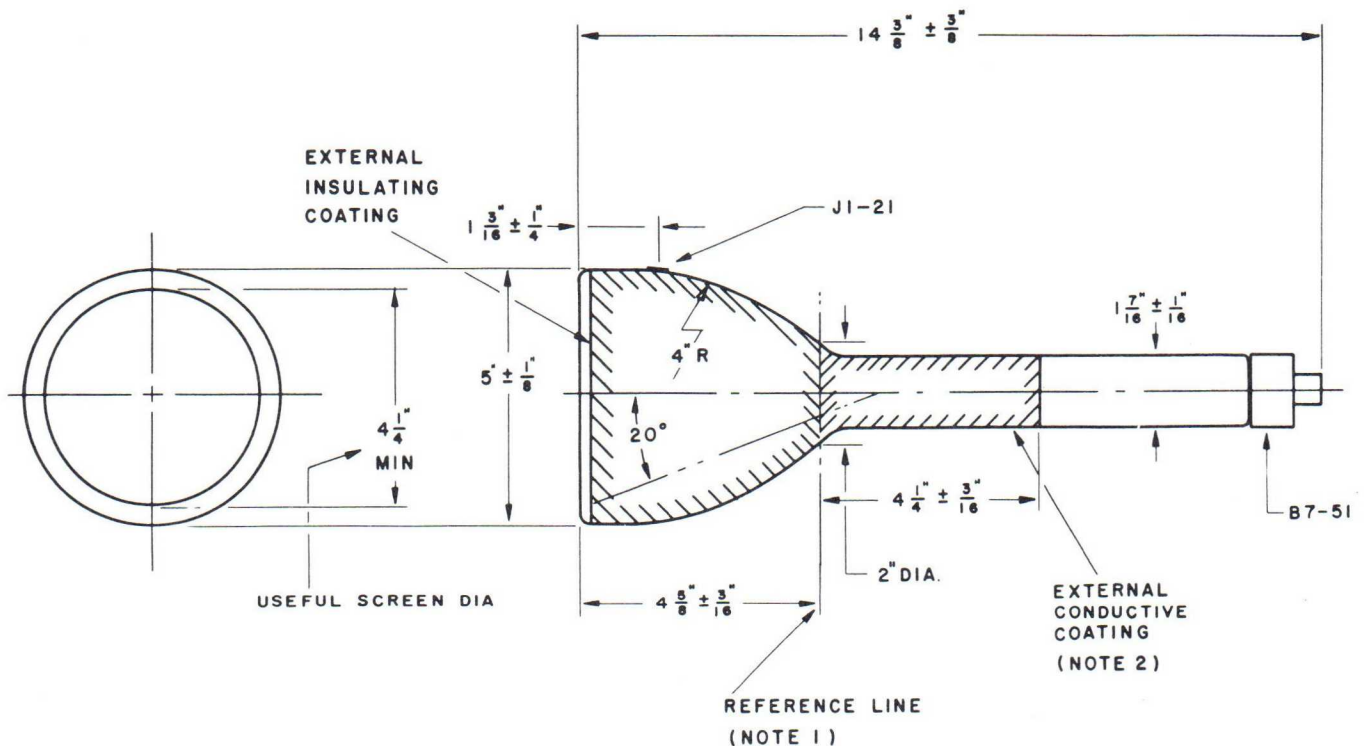
1. External conductive neck coating must be grounded.
2. Brilliance and definition decrease with decreasing anode voltage. In general, the anode voltage should not be less than 20,000 volts.
3. Visual extinction of undeflected focused spot.

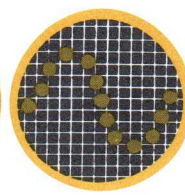
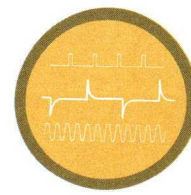
DIAGRAM NOTES:

1. Reference line is determined by the plane C-C' of the reference line gauge (JETEC No. 110) when the gauge is resting on the glass cone.
2. External conductive coating must be grounded.

WARNING:

X-ray radiation shielding may be necessary to protect against possible danger of personal injury from prolonged exposure at close range if this tube is operated at higher than the manufacturer's Maximum Rated Anode Voltage or 16,000 volts, whichever is less.





DESCRIPTION

Sylvania Type SC-2782 is a 5-inch diameter Cathode-Ray Tube designed for high resolution photographic recording. Its electron-optical system and fine grain screen achieve very fine trace width with conventional focusing and deflection units and a simple beam-centering magnet. The tube has a flat, clear, non-browning optical glass faceplate for optimum photographic quality. An integral encapsulated high voltage connector is utilized to minimize corona at high altitude.

CHARACTERISTICS

GENERAL DATA

Focusing Method	Magnetic
Deflection Method	Magnetic
Deflection Angle (approx.)	50 Degrees
Type*	SC-2782
Phosphor	Fine Grain P11, Aluminized
Fluorescence	Blue
Persistence	Short
Faceplate	Clear, Non-Browning Optical Glass

*In addition to the type shown, the SC-2782 can be supplied with several other screen phosphors.

ELECTRICAL DATA

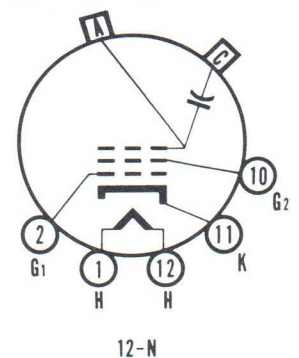
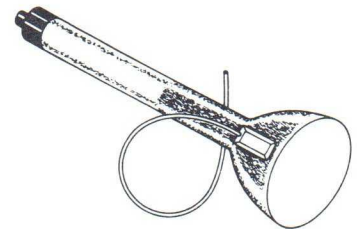
Heater Voltage	6.3 Volts
Heater Current	0.6 ± 10% Ampere
Direct Interelectrode Capacitances (approx.)	
Grid No. 1 to all Other Electrodes	9 μμf
Cathode to all Other Electrodes	4.3 μμf
External Conductive Coating to Anode	500 μμf Max. 100 μμf Min.

MECHANICAL DATA

Minimum Useful Screen Diameter	4 1/4 Inches
Overall Length	16 ± 3/8 Inches
Bulb	C40 Exp. 14 or Equivalent
Anode Terminal	16", HV Cable, Corona Protected
Base (Small Shell Duodecal 5-Pin)	B5-57
Basing	12N

QUICK REFERENCE DATA

- High Resolution Tube
- .001" Line Width
- 5-Inch, Flat, Optical Glass Faceplate
- Clear Non-Browning Faceplate
- Extremely Fine Grain Screen
- Aluminized Screen
- Magnetic Deflection
- Magnetic Focus
- No Ion Trap
- External Conductive Coating on Neck
- External Insulating Coating on Bulb



MAXIMUM RATINGS (Absolute Maximum Values)

Anode Voltage	25,000	Volts	dc
Grid No. 2 Voltage	2,500	Volts	dc
Grid No. 1 Voltage			
Negative Bias Value	150	Volts	dc
Positive Bias Value	0	Volts	dc
Positive Peak Value	0	Volts	
Peak Heater Cathode Voltage			
Heater Negative with Respect to Cathode			
During Warm-up Period Not to Exceed 15 Seconds	450	Volts	
After Equipment Warm-up	165	Volts	
Heater Positive with Respect to Cathode	165	Volts	

TYPICAL OPERATING CONDITIONS

Anode Voltage	20,000	Volts	dc
Grid No. 2 Voltage	2,000	Volts	dc
Grid No. 1 Voltage Required for Cutoff ¹	-33 to -77	Volts	dc
Focusing Coil Current (approx.) ²	100	Ma	
Line Width ³	0.001	Inch	

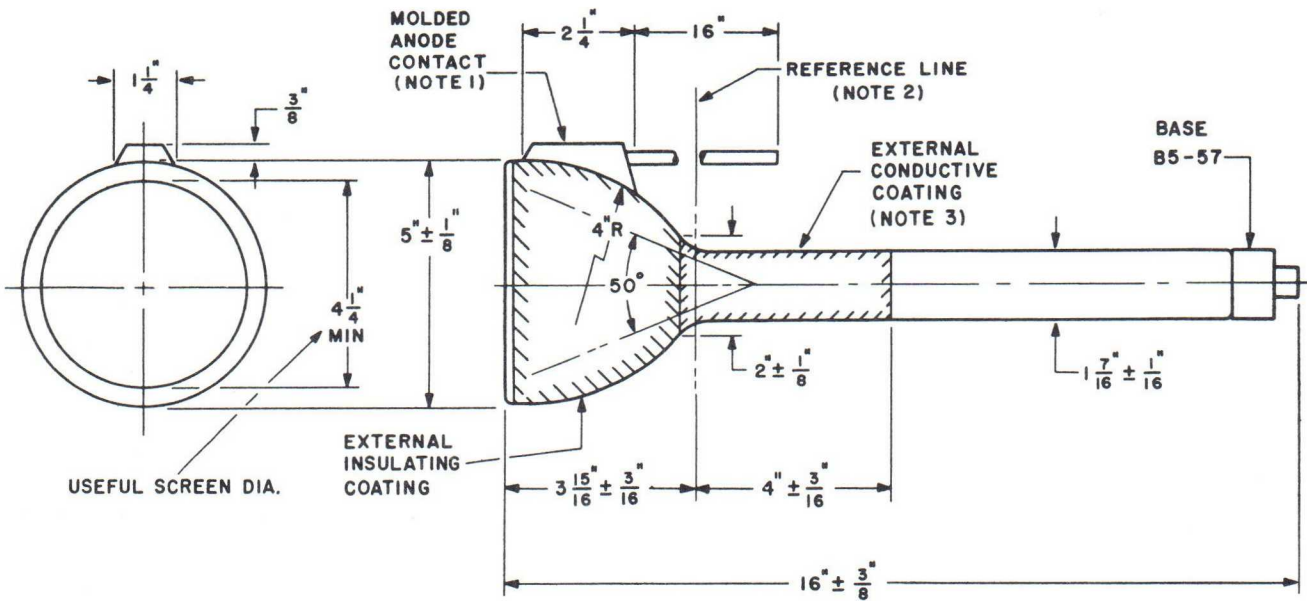
CIRCUIT VALUES

Grid No. 1 Circuit Resistance	1.5	Megohms	Max.
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NOTES:

1. Visual extinction of undeflected focused spot.
2. For JEDEC focusing coil 106 or equivalent 2 1/2" from reference line.
3. Line width measured at 5 μ a by the shrinking raster method. Variable strength (0-10 gauss) beam centering magnet must be used for optimum line width.

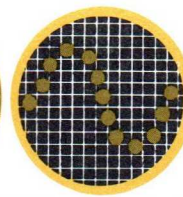
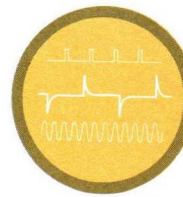
OUTLINE



D59023

DIAGRAM NOTES:

1. The plane through the tube axis and vacant pin position No. 3 may vary from the plane through the axis and centerline of molded anode contact by an angular tolerance (measured about the tube axis) of $\pm 30^\circ$. Molded anode contact is on same side as vacant pin No. 3.
2. Reference line is determined by the plane C-C' of reference line gauge (JEDEC No. G112), when gauge is seated on the glass cone.
3. External conductive coating must be grounded.



DESCRIPTION

Sylvania Type SC-2809 is a 5-inch diameter Cathode-Ray Tube designed for high resolution photographic recording. Its electron-optical system and fine grain screen achieve very fine trace width with conventional focusing and deflection units and a simple beam-centering magnet. The tube has a flat, clear, non-browning optical glass faceplate for optimum photographic quality. An integral encapsulated high voltage connector is utilized to minimize corona at high altitude.

CHARACTERISTICS

GENERAL DATA

Focusing Method	Magnetic
Deflection Method	Magnetic
Deflection Angle (Approx.)	50 Degrees
Type*	SC-2809
Phosphor	Aluminized, Fine Grain P11
Fluorescence	Blue
Persistence	Short
Faceplate	Clear, Non-Browning Optical Glass

*In addition to the type shown the SC-2809 can be supplied with several other screen phosphors.

ELECTRICAL DATA

Heater Voltage	6.3 Volts	
Heater Current	0.6 ± 10% Ampere	
Direct Interelectrode Capacitances (Approx.)		
Grid No. 1 to All Other Electrodes	10 μμf	
Cathode to All Other Electrodes	5.5 μμf	
External Conductive Coating to Anode	500 μμf	Max.
	100 μμf	Min.

MECHANICAL DATA

Minimum Useful Screen Diameter	4 1/4 Inches
Overall Length	16 3/8 ± 3/8 Inches
Bulb	C40 Exp. 14 or Equivalent
Anode Terminal	16", HV Cable, Corona Protected
Base (Small Shell Duodecal 5-Pin)	B5-57
Basing	12N

MAXIMUM RATINGS (Absolute Maximum Values)

Anode Voltage	25,000 Volts	dc
Anode Current (Egl = 0 Volts)	3.0 μa	dc
Grid No. 2 Voltage	2500 Volts	dc
Grid No. 2 Current (Egl = 0 Volts)	2000 μa	dc
Grid No. 1 Voltage		
Negative Bias Value	150 Volts	dc
Positive Bias Value	0 Volts	dc
Positive Peak Value	0 Volts	
Peak Heater-Cathode Voltage		
Heater Negative with Respect to Cathode		
During Warm-up Period not to Exceed 15 Seconds	450 Volts	
After Equipment Warm-up	165 Volts	
Heater Positive with Respect to Cathode	165 Volts	

TYPICAL OPERATING CONDITIONS

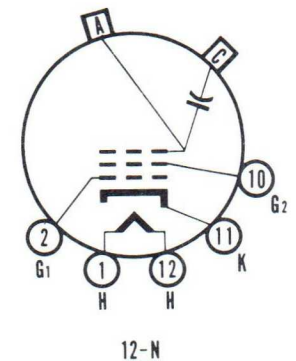
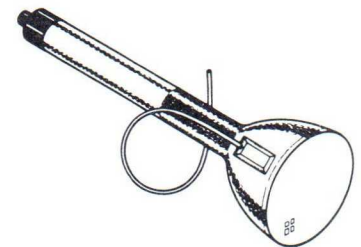
Anode Voltage	20,000 Volts	dc
Grid No. 2 Voltage	2000 Volts	dc
Grid No. 1 Voltage Required for Cutoff ¹	-33 to -77 Volts	dc
Focusing Coil Current (Approx.) ²	100 Ma	
Line Width ³	0.0008 Inch	

CIRCUIT VALUES

Grid No. 1 Circuit Resistance	1.5 Megohms Max.
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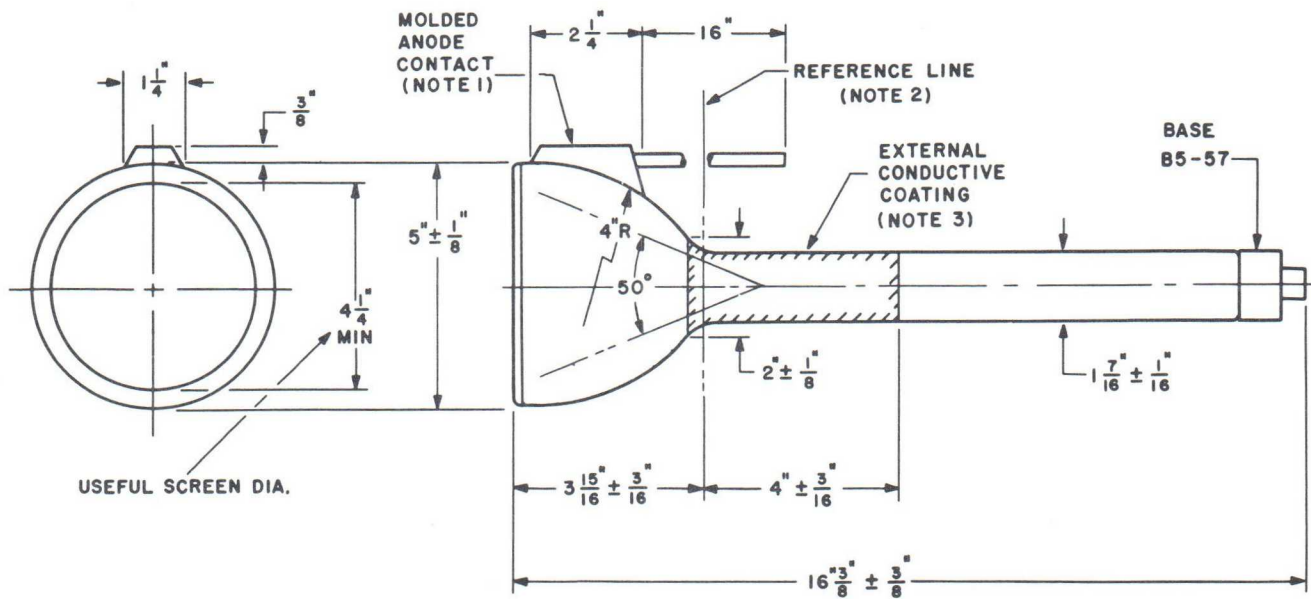
QUICK REFERENCE DATA

- High Resolution Tube
- 0.0008" Line Width
- 5-Inch, Flat, Optical Glass Faceplate
- Clear Non-Browning Faceplate
- Extremely Fine Grain Screen
- Aluminized Screen
- Magnetic Deflection
- Magnetic Focus
- No Ion Trap
- External Conductive Coating on Neck



NOTES:

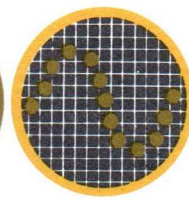
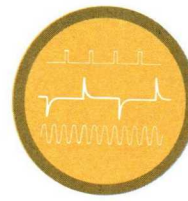
1. Visual extinction of undeflected focused spot.
2. For JEDEC focusing coil 106 or equivalent $2\frac{1}{2}$ " from reference line.
3. Line width measured at $2\ \mu\text{a}$ anode current by the shrinking raster method. Variable strength (0-10 gauss) beam centering magnet must be used for optimum line width.



D59023

DIAGRAM NOTES:

1. The plane through the tube axis and vacant pin position No. 3 may vary from the plane through the axis and centerline of molded anode contact by an angular tolerance (measured about the tube axis) of $\pm 30^\circ$. Molded anode contact is on same side as vacant pin No. 3.
2. Reference line is determined by the plane C-C' of reference line gauge (JEDEC No. G112), when gauge is seated on the glass cone.
3. External conductive coating must be grounded.



ADVANCE DATA

DESCRIPTION

Sylvania Type SC-3168 is a 5-inch diameter cathode-ray tube designed for high resolution photographic recording. Its electron-optical system, very low deflection angle, and fine grain screen achieve very fine trace width with conventional focusing and deflection units and a simple beam-centering magnet. The tube has a flat, clear, non-browning optical glass faceplate for optimum photographic quality. An integral encapsulated high voltage connector is utilized to minimize corona at high altitude.

CHARACTERISTICS

GENERAL DATA

Focusing Method	Magnetic
Deflection Method	Magnetic
Deflection Angle (Approx.)	16 Degrees
Phosphor*	Fine Grain P11, Aluminized
Fluorescence	Blue
Persistence	Short
Faceplate	Clear, Non-Browning Optical Glass

*In addition to the type shown, the SC-3168 can be supplied with several other screen phosphors.

ELECTRICAL DATA

Heater Voltage	6.3 Volts	
Heater Current	0.6 ± 10 % Ampere	
Direct Interelectrode Capacitances (Approx.)		
Grid No. 1 to All Other Electrodes	9 pf	
Cathode to All Other Electrodes	4.3 pf	
External Conductive Coating to Anode	500 pf	Max.
	100 pf	Min.

MECHANICAL DATA

Minimum Useful Screen Diameter	4 1/4 Inches
Overall Length	26 ± 3/8 Inches
Bulb	See Outline Drawing
Anode Terminal	16", HV Cable, Corona Protected
Base (Small Shell Duodecal 5-Pin)	B5-57
Basing	12N

MAXIMUM RATINGS (Absolute Maximum Values)

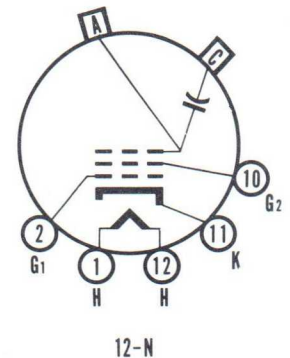
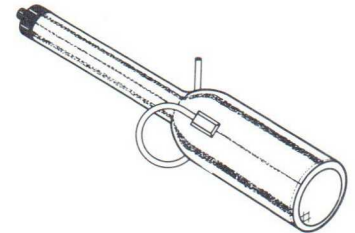
Anode Voltage	25,000 Volts	dc
Grid No. 2 Voltage	2500 Volts	dc
Grid No. 1 Voltage		
Negative Bias Value	150 Volts	dc
Positive Bias Value	0 Volts	dc
Positive Peak Value	0 Volts	
Peak Heater Cathode Voltage		
Heater Negative with Respect to Cathode		
During Warm-up Period Not to Exceed		
15 Seconds	450 Volts	
After Equipment Warm-up Period	165 Volts	
Heater Positive with Respect to Cathode	165 Volts	

TYPICAL OPERATING CONDITIONS

Anode Voltage	20,000 Volts	dc
Grid No. 2 Voltage	2000 Volts	dc
Grid No. 1 Voltage Required for Cutoff ¹	-33 to -77 Volts	dc
Focusing Coil Current (Approx.) ²	80 Ma	
Line Width ³	0.002 Inch	

QUICK REFERENCE DATA

- High Resolution Tube
- .002" Line Width
- 5-Inch, Flat, Optical Glass Faceplate
- Clear Non-Browning Faceplate
- Extremely Fine Grain Screen
- Aluminized Screen
- Magnetic Deflection
- Magnetic Focus
- No Ion Trap
- External Conductive Coating on Neck



CIRCUIT VALUES

Grid No. 1 Circuit Resistance 1.5 Megohms Max.

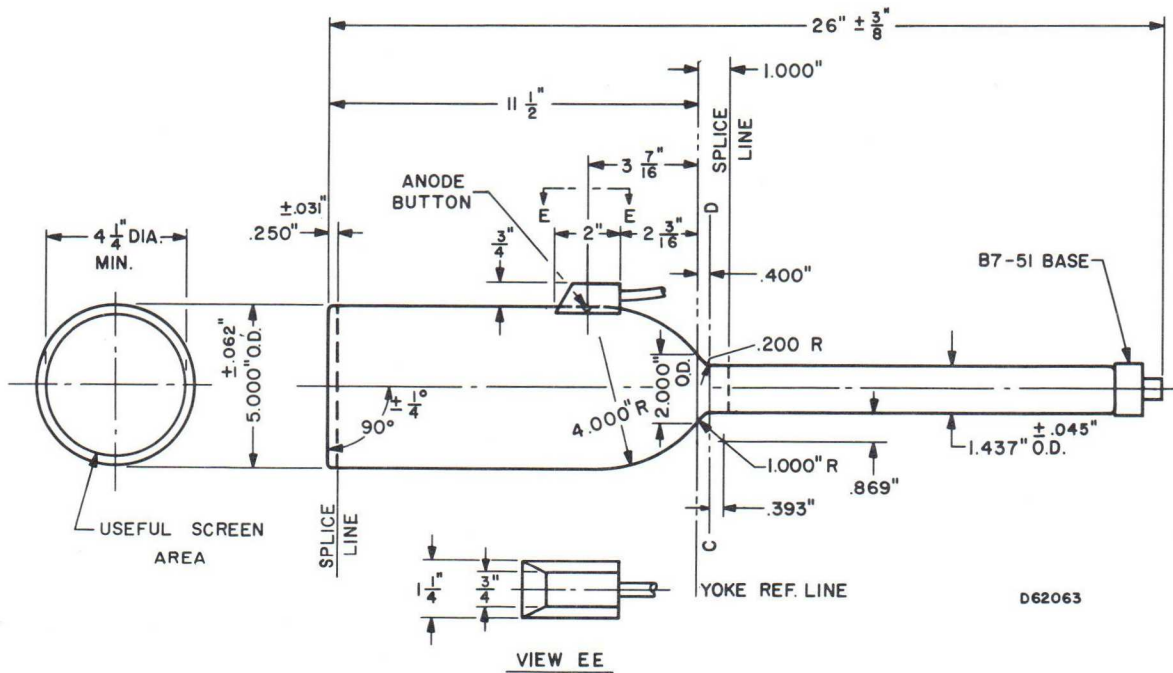
NOTES:

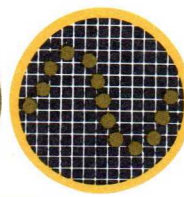
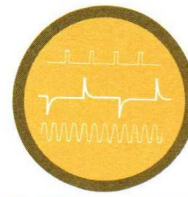
1. Visual extinction of undeflected focused spot.
2. For JEDEC focusing coil 106 or equivalent 2 1/2" from reference line.
3. Line width measured at 5 μa by the shrinking raster method. Variable strength (0-10 gauss) beam centering magnet must be used for optimum line width.

WARNING:

X-ray radiation shielding may be necessary to protect against possible danger of personal injury from prolonged exposure at close range if this tube is operated at higher than the manufacturer's Maximum Rated Anode Voltage of 16,000 volts, whichever is less.

OUTLINE





DESCRIPTION

The Sylvania Type SC-3890 is a 10-inch diameter Cathode Ray Tube designed for high resolution photographic recording. Its electron-optical system and fine grain screen achieve very fine trace width with conventional focusing and deflection units and a simple beam-centering magnet. The tube has a flat, clear, non-browning optical glass faceplate for optimum photographic quality.

CHARACTERISTICS

GENERAL DATA

Focusing Method	Magnetic
Deflection Method	Magnetic
Deflection Angle (Approx.)	50 Degrees
Phosphor	P11
Fluorescence	Blue
Phosphorescence	Blue
Persistence	Short
Faceplate	Flat, Non Browning Optical Glass

ELECTRICAL DATA

Heater Voltage	6.3 Volts
Heater Current	0.6 ± 10 % Ampere
Direct Interelectrode Capacitance (Approx.)	
Cathode to All Other Electrodes	5 pf
Grid No. 1 to All Other Electrodes	6 pf

MECHANICAL DATA

Minimum Useful Screen Diameter	9 Inches
Bulb Contact (Recessed Small Cavity Cap)	J1-21
Base (Small Shell Duodecal 6-Pin)	B5-57
Basing	12N
Bulb Contact Aligns with Vacant Pin	
Position No. 3	±10 Degrees

RATINGS

MAXIMUM RATINGS (Absolute Maximum Values)

Anode Voltage	25,000 Volts dc
Grid No. 2 Voltage	2500 Volts dc
Grid No. 1 Voltage	
Negative Bias Value	150 Volts dc
Positive Bias Value ¹	0 Volt
Positive Peak Value	0 Volt
Peak Heater-Cathode Voltage	
Heater Negative with Respect to Cathode	200 Volts dc
Heater Positive with Respect to Cathode	200 Volts dc

TYPICAL OPERATING CONDITIONS

Anode Voltage	20,000 Volts dc
Grid No. 2 Voltage	2000 Volts dc
Grid No. 1 Voltage for Cutoff ²	-33 to -77 Volts dc
Line Width at $I_b = 5 \mu a$	0.002 Inch

CIRCUIT VALUES

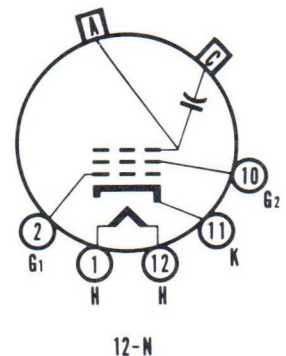
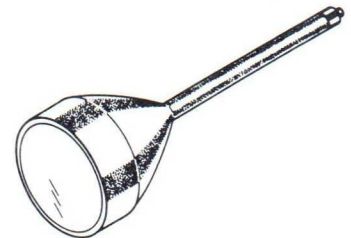
Grid No. 1 Circuit Resistance	1.5 Megohms Max.
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NOTES:

1. At or near this rating, the effective resistance of the anode supply should be adequate to limit the anode input power to 6 watts. To prevent burning, minimum beam current densities should be employed.
2. Visual extinction of undeflected focused spot.

QUICK REFERENCE DATA

High Resolution Tube
0.002" Line Width
10-Inch, Flat, Optical Glass
Faceplate
Clear Non-Browning Faceplate
Extremely Fine Grain Screen
Magnetic Deflection
Magnetic Focus
No Ion Trap



WARNING:

X-ray radiation shielding may be necessary to protect against possible danger of personal injury from prolonged exposure at close range if this tube is operated at higher than the manufacturer's Maximum Rated Anode Voltage or 16,000 volts, whichever is less.

OUTLINE

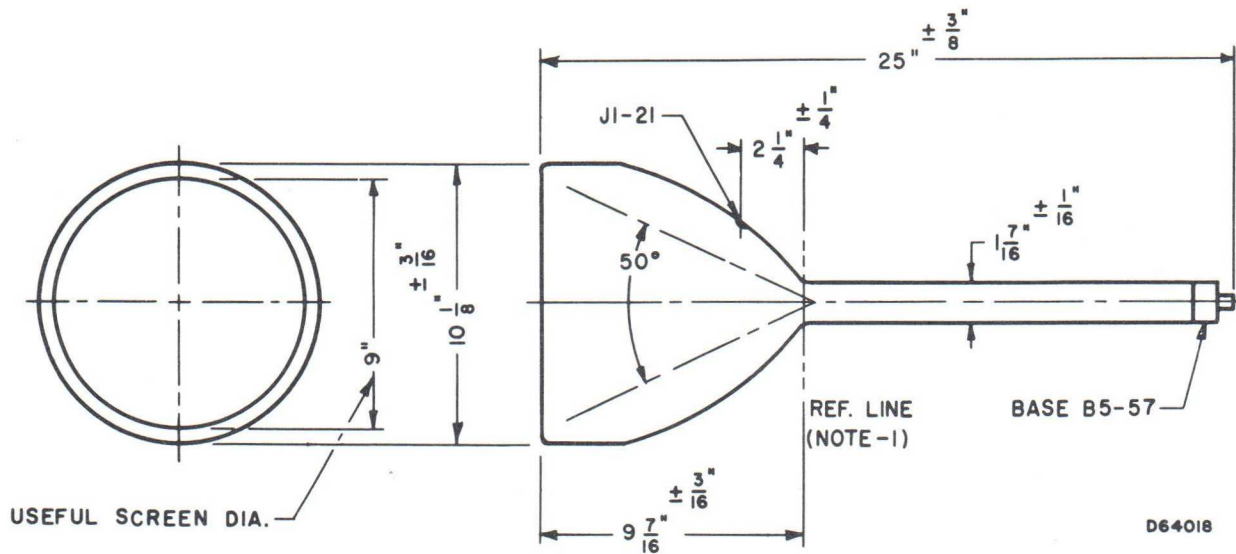


DIAGRAM NOTE:

1. Reference Line is the point where a $1.500'' + 0.003'' - 0.000''$ diameter ring gauge 2'' long will stop against the bulb.

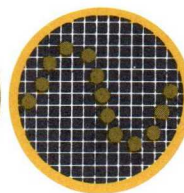
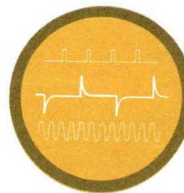
HIGH RESOLUTION ASSEMBLIES

These Sylvania High Resolution CRT Assemblies are completely preadjusted and prealigned plug-in "packages." They offer the utmost in ease of installation and flexibility of application in high resolution photographic recording and flying spot scanning.

The AT-SK-5053* is supplied with any of five high resolution tube types. These assemblies are individually engineered and built to the requirements of a specific system, so cannot be stocked as off-the-shelf items. It is advisable, therefore, to check the nearest Sylvania representative (see back cover) for delivery information.

**Prefix which specifies hardware only—full designation also includes suffix which specifies tube. For example: AT-SK-5053/SC-2809.*





DESCRIPTION

Sylvania type AT-SK-5053 is an assembly consisting of a high-resolution tube, deflection coil, focusing coil, alignment magnets, mu metal shield, and supporting hardware. It is designed to be a complete, plug-in "package" for your display system.

With only slight modifications, the AT-SK-5053 can be furnished for use with any high-resolution cathode ray tube, such as:

- SC-2782 (5")
- SC-2809 (5")
- SC-3168 (5")
- 5CEP (5")
- SC-3890 (10")

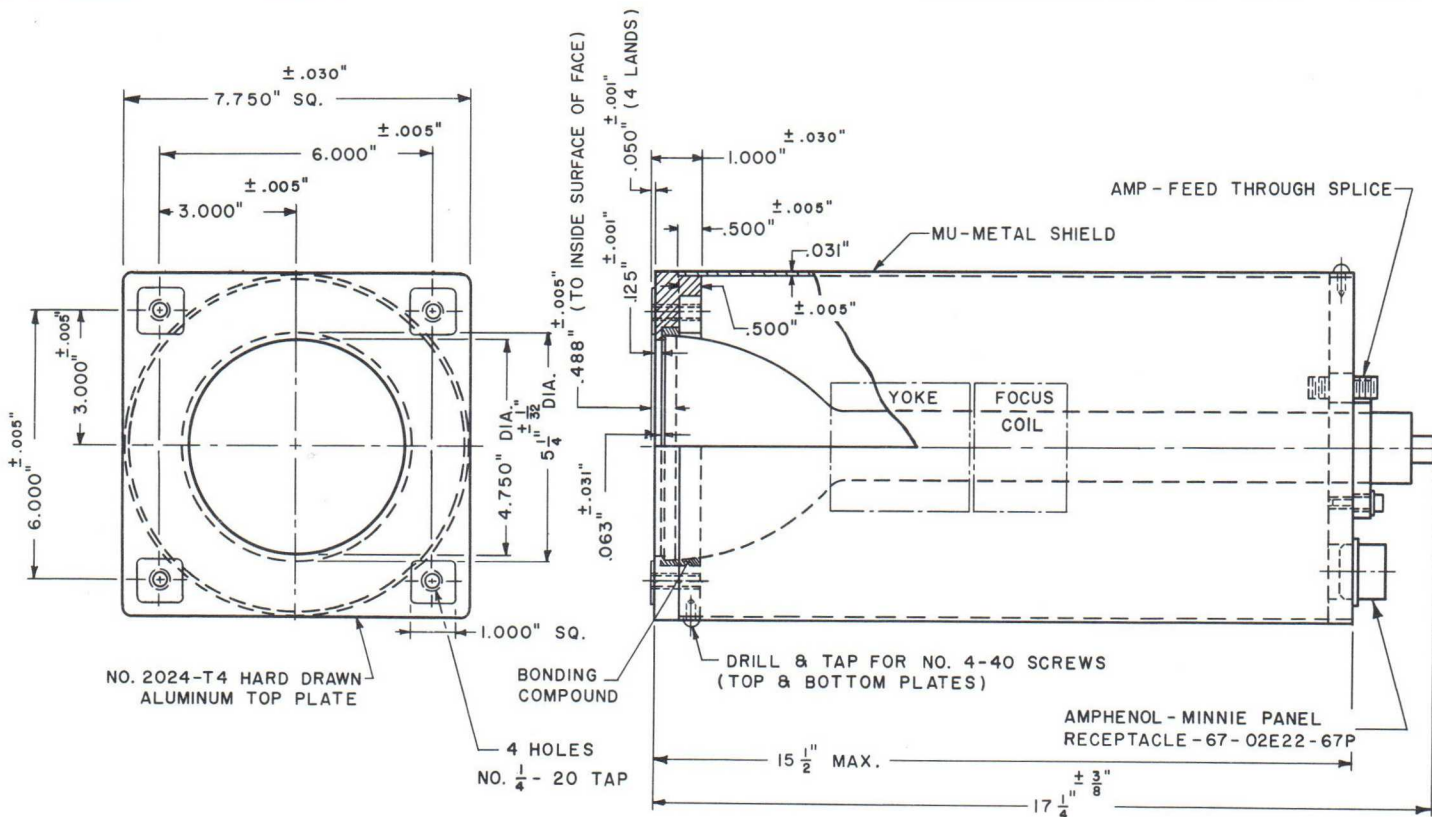
Also, the front end mounting plate can be supplied to your specifications.

APPLICATIONS

The AT-SK-5053 is designed as a plug-in unit for any application requiring high-resolution, flying spot scanning or photographic recording.

FEATURES

- Prealigned components for optimum resolution
- "Plug-in" operation with no further alignment/adjustments required
- Ease of service—quick disconnect and replacement of entire package
- Can be installed by nontechnical personnel
- Saves engineering costs and time



Type AT-SK-5053/SC-2809

DOUBLE DEFLECTION TUBES

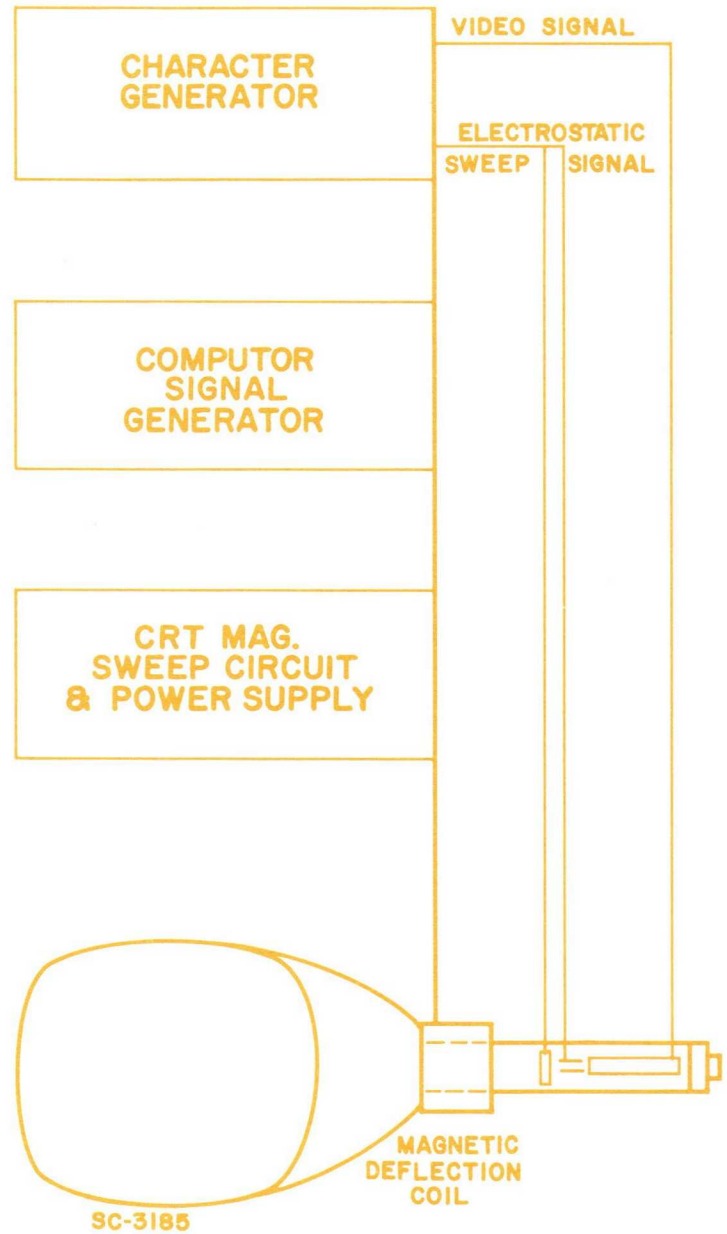
Sylvania double deflection tubes utilize separate magnetic and electrostatic deflection to form symbols and characters at far lower cost than other character producing cathode ray tubes. Electrostatic plates are used to “write” externally generated characters while magnetic deflection provides for character positioning. Any magnetically deflected tube with a $1\frac{7}{16}$ -inch neck diameter can be supplied in a character writing design.

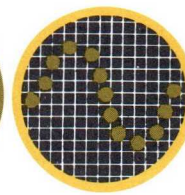
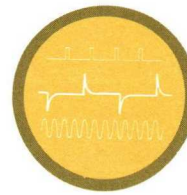
One approach to a double deflection system is to employ a Sylvania SC-3093 monoscope tube for character generation and a Sylvania SC-3185 for character writing and display. This system provides several important advantages over other character writing and data display systems: high speed writing and simplified circuitry; lower cost of complete system; and higher brightness on display tube.

The Sylvania SC-3093 is a compact, 3-inch monoscope tube designed for use with high-speed electrostatic printing equipment. It features a useful target area of approximately 2 x 2 inches, on which any pattern of up to 64 alphanumeric characters can be furnished.

The Sylvania SC-3185 is a 21-inch rectangular cathode ray tube for character writing and data display applications. It employs two pairs of electrostatic deflection plates having high sensitivity and limited scan, for writing alphanumeric characters and symbols, and uses 72° magnetic deflection for positioning the characters for full-screen scanning.

In operation, the monoscope (SC-3093) tube and associated circuitry serve as the character generator. Information to select the proper character and position it on the display-tube face is fed from the computer network. Accordingly, the monoscope scans a selected character on the target. The difference in secondary emission of the character, usually printed on the target plate with a carbon ink, and the background of the target, usually aluminum, produces an output signal which when amplified becomes the video signal which is fed to the control grid of the character writing tube (SC-3185). Sweep signals synchronized with the scan signals in the monoscope are supplied to the deflection plates of the character writing tube (SC-3185), while character-positioning signals are fed to the magnetic deflection system.





ADVANCE DATA

DESCRIPTION

Sylvania Type SC-3185 is a 21-inch rectangular cathode-ray tube for character writing and television display applications. It has two pairs of electrostatic deflection plates having high sensitivity and limited scan, for writing alpha-numeric characters and symbols, and uses 72 degree magnetic deflection for positioning the characters and for full-screen scanning.

CHARACTERISTICS

GENERAL DATA

Focusing Method	Electrostatic
Character Writing	Electrostatic
Deflection Method	Magnetic
Deflection Angles (Approx.)	
Vertical	53 Degrees
Horizontal	67 Degrees
Diagonal	72 Degrees
Phosphor*	P4
Fluorescence	White
Persistence	Short to Medium
Faceplate	Gray Filter Glass
Light Transmittance (Approx.)	75 Percent

*In addition to the type shown, the SC-3185 can be supplied with several other phosphors.

ELECTRICAL DATA

Heater Voltage	6.3 Volts
Heater Current	0.6 ± 5 % Ampere
Direct Interelectrode Capacitances (Approx.)	
Cathode to All Other Electrodes	5 pf
Grid No. 1 to All Other Electrodes	6.5 pf
D1 to D2	2 pf
D3 to D4	2.5 pf

MECHANICAL DATA

Minimum Useful Screen Dimensions	19 ¹ / ₁₆ x 15 ¹ / ₁₆ Inches
Minimum Useful Screen Area	262 Sq. Inches
Bulb	J171B or J171F
Bulb Contact (Recessed Small Cavity. Cap)	J1-21
Neck Contacts (5)	J1-25
Base (Short Small Shell Duodecal 6-Pin)	B6-203
Basing	See Diagram

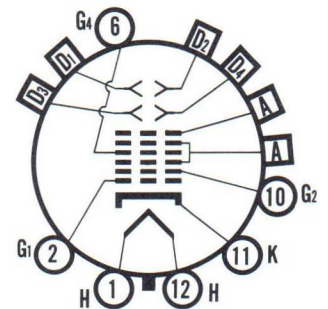
RATINGS

MAXIMUM RATINGS (Absolute Maximum Values)

Anode Voltage ¹	22,000 Volts	dc
Grid No. 4 (Focusing Electrode) Voltage	-550 to +1100 Volts	dc
Grid No. 2 Voltage	700 Volts	dc
Grid No. 1 Voltage		
Negative Bias Value	180 Volts	dc
Negative Peak Value	220 Volts	
Positive Bias Value	0 Volts	dc
Positive Peak Value	2 Volts	
Peak Heater-Cathode Voltage		
Heater Negative with Respect to Cathode		
During Warm-up Period Not to Exceed		
15 Seconds	450 Volts	
After Equipment Warm-up Period	200 Volts	
Heater Positive with Respect to Cathode	200 Volts	
Peak Voltage Between Anode and Any Deflection Plate	550 Volts	

QUICK REFERENCE DATA

Character Writing Tube
 21" Direct Viewed
 Rectangular Glass Type
 Spherical Faceplate
 Gray Filter Glass
 Low Voltage Electrostatic Focus
 Electrostatic Character Writing
 Magnetic Deflection
 No Ion Trap
 Aluminized Screen



TYPICAL OPERATING CONDITIONS (Grid Drive Service)

Anode Voltage ¹	15,000 Volts	dc
Grid No. 4 Voltage for Focus	0 to +400 Volts	dc
Grid No. 2 Voltage	300 Volts	dc
Grid No. 1 Voltage Required for Cutoff ²	-35 to -72 Volts	dc
Deflection Factors (Approx.) ³		
D1-D2	170 Volts	dc/In.
D3-D4	185 Volts	dc/In.

CIRCUIT VALUES

Grid No. 1 Circuit Resistance	1.5 Megohms Max.
Deflection Circuit Resistance	5 Megohms Max.

NOTES:

1. Connect both bulb and neck anode contacts to anode supply.
2. Visual extinction of focused raster. Extinction of the stationary focused spot will require that these values be about 5 volts more negative,
3. Useful electrostatic deflection is limited to ± 1 inch on each axis.

WARNING:

X-ray radiation shielding may be necessary to protect against possible danger of personal injury from prolonged exposure at close range if this tube is operated at higher than the manufacturer's Maximum Rated Anode Voltage or 16,000 volts, whichever is less.

OUTLINE

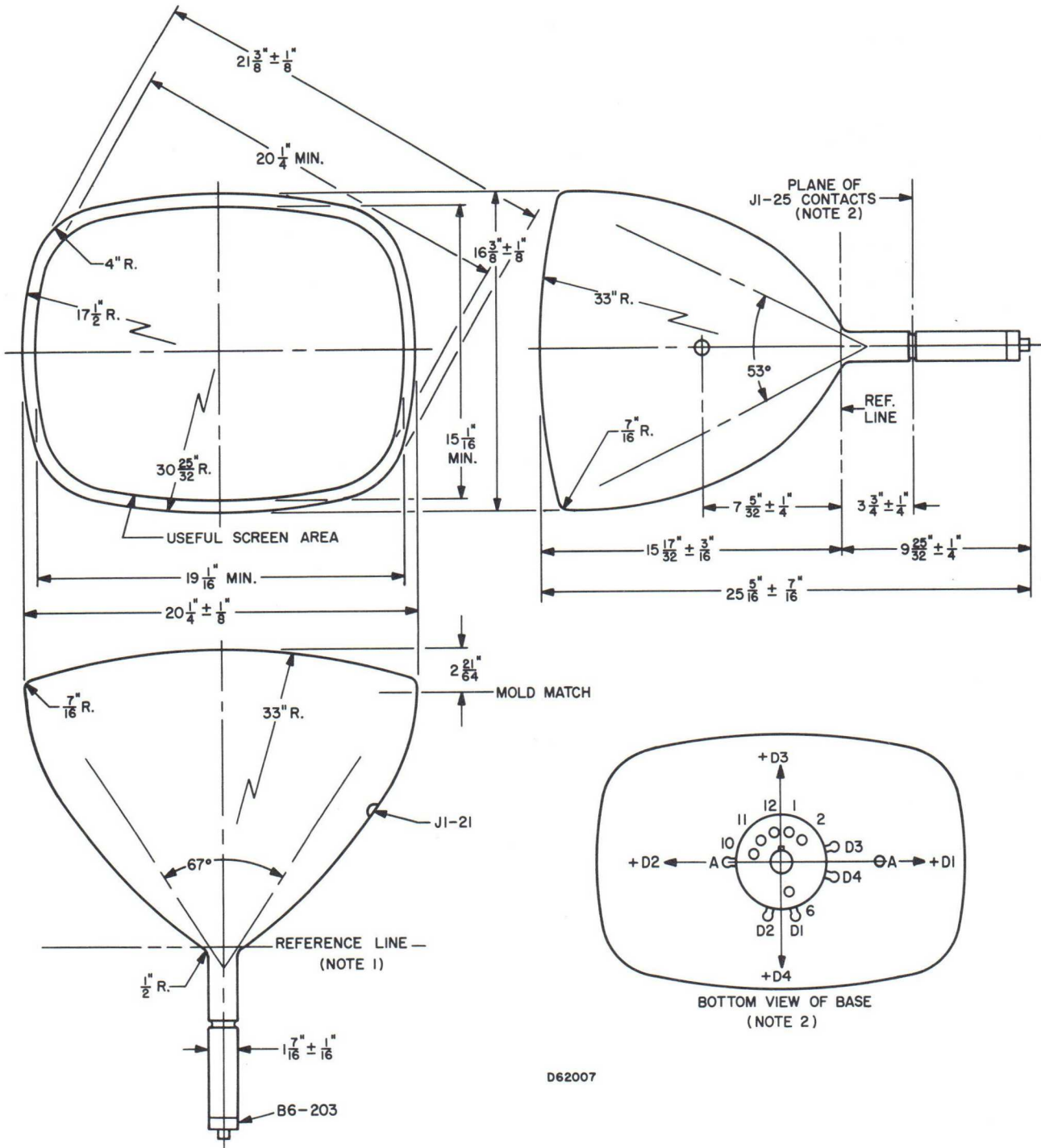
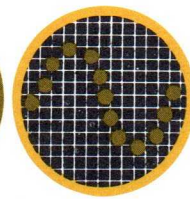
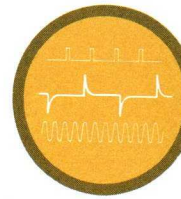


DIAGRAM NOTES:

1. With the tube neck inserted through the flared end of Reference-Line Gauge (JEDEC No. 110) and with the tube seated in the gauge, the reference line is determined by the intersection of the Plane C-C' (face of the flared end) of the gauge with the glass funnel.
2. Deflection plates and anode are connected to J1-25 contacts which are recessed into neck. Alignment of contacts and orientation of deflection plates are shown at lower right.



ADVANCE DATA

DESCRIPTION

The Sylvania SC-3369 is a 16" diameter, all glass cathode ray tube for character writing applications. Two pairs of electrostatic deflection plates are provided for character generation while character positioning is by means of magnetic deflection. The tube is electrostatically focused and has an aluminized screen.

CHARACTERISTICS

GENERAL DATA

Focusing Method	Electrostatic
Deflecting Method ¹	Electrostatic and Magnetic
Bulb	J127B
Phosphor Number	P7
Fluorescent Color	Blue
Phosphorescent Color	Yellow
Persistence	Long

ELECTRICAL DATA

Heater Voltage	6.3 Volts
Heater Current at 6.3 Volts	0.6 ± 10 % Ampere
Direct Interelectrode Capacitances (Approx.)	
Cathode to All Other Electrodes	3.8 pf
Grid No. 1 to All Other Electrodes	7.5 pf
D1 to D2	1.0 pf
D3 to D4	1.0 pf
D1 to All Other Electrodes	2.8 pf
D2 to All Other Electrodes	2.8 pf
D3 to All Other Electrodes	3.1 pf
D4 to All Other Electrodes	2.8 pf

RATINGS (Design Center Values)

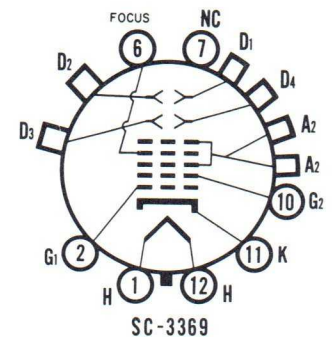
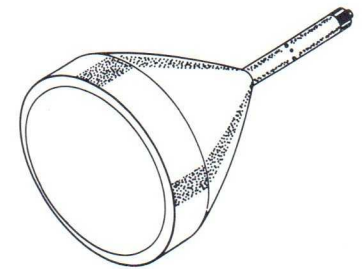
Accelerator Voltage	15,000 Volts dc	Max.
Accelerator Input	8 Watts	Max.
Focusing Electrode Voltage	5600 Volts dc	Max.
Grid No. 2 Voltage	700 Volts dc	Max.
Grid No. 1 Voltage		
Negative Bias Value	300 Volts dc	Max.
Positive Bias Value	0 Volt dc	Max.
Positive Peak Value	0 Volt	Max.
Peak Heater-Cathode Voltage		
Heater Negative with Respect to Cathode		
During Warm-up Period Not to Exceed		
15 Seconds	410 Volts	Max.
After Equipment Warm-up Period	180 Volts	Max.
Heater Positive with Respect to Cathode	180 Volts	Max.
Peak Voltage Between Accelerator and		
Any Deflection Electrode	500 Volts	Max.

TYPICAL OPERATING CONDITIONS

Accelerator Voltage	12,000 Volts dc	
Focusing Electrode Voltage	3000 to 4400 Volts dc	
Grid No. 2 Voltage	400 Volts dc	
Grid No. 1 Voltage ³	-35 to -70 Volts dc	
Modulation ²	30 Volts	Max.
Line Width "A" ²	0.012 Inch	Max.
Deflection Factors		
D1 and D2	315 to 385 Volts dc/Inch	
D3 and D4	330 to 410 Volts dc/Inch	
Focusing Electrode Current For Any Operating Condition	-10 to +5 μA	
Spot Position (Focused and Undelected) ⁴	Within a 25 mm Square	
Maximum Grid No. 2 Current For Any Operating Position	5 μA	

QUICK REFERENCE DATA

Character Writing Tube
16" Diameter
Electrostatic and Magnetic
Deflection
Electrostatic Focus
Aluminized Screen



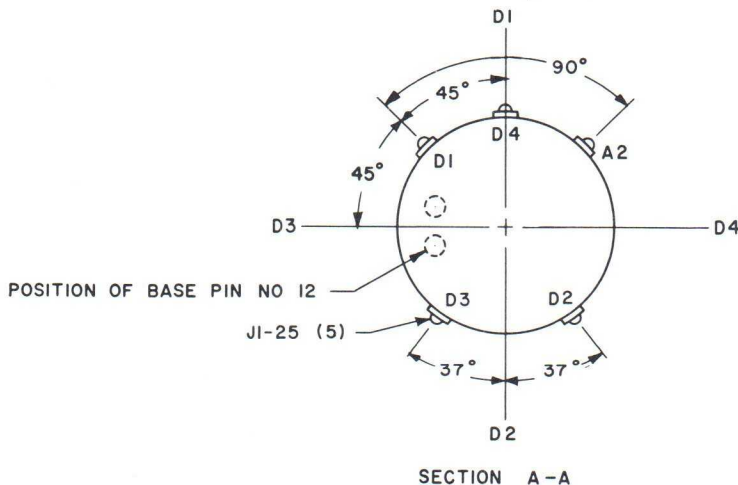
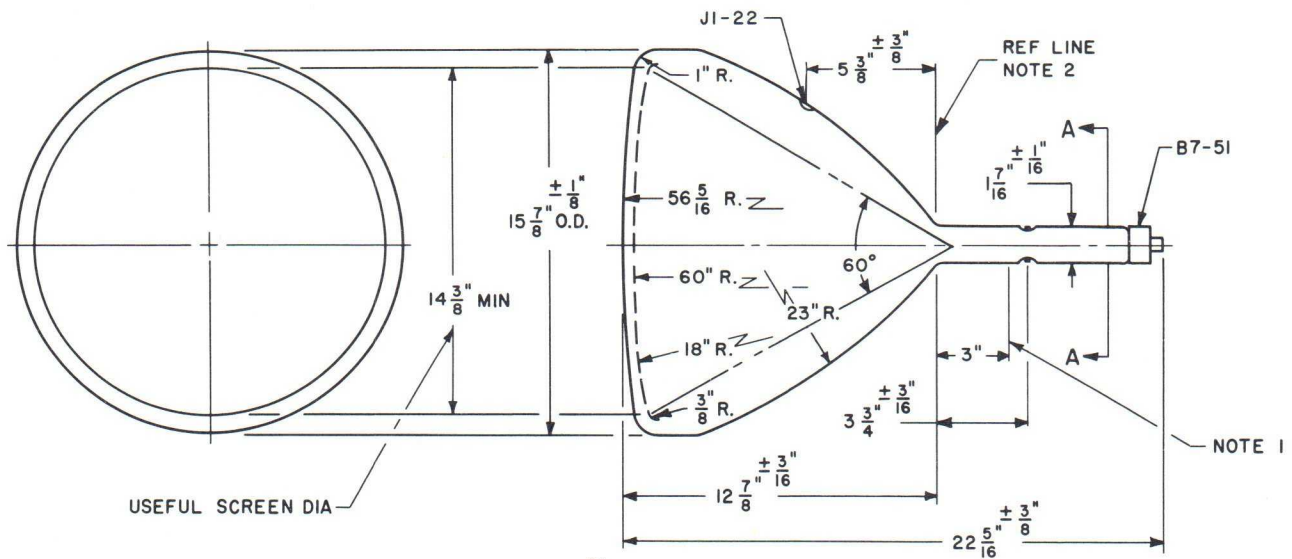
MAXIMUM CIRCUIT VALUES

Grid No. 1 Circuit Resistance	1.5 Megohms Max.
Resistance in Any Deflecting-Electrode Circuit ⁷	5.0 Megohms Max.

NOTES:

1. The electrostatic deflection plates are designed to form a 1/2 inch square raster which can be deflected to any portion of the screen by the magnetic deflection yoke. Larger rasters may be used with a corresponding decrease in magnetic deflection area.
2. Measured in accordance with MIL-E-1 specifications, with $I_b = 25 \mu A$.
3. Visual extinction of the undeflected focused spot.
4. Connect deflecting electrodes to accelerator.
5. It is recommended that the deflecting electrode-circuit resistances be approximately equal.

OUTLINE



D64025

DIAGRAM NOTES:

1. The magnetic deflection field should not extend below this line.
2. Point where JEDEC G-112 reference line gauge will stop.

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