Pevicon® High Resolution Infrared Pyroelectric Vidicon

P8226

EEV

INTRODUCTION

The P8226 produces television pictures of good industrial quality by converting thermal radiation from the scene into electrical signals. The tube is mechanically similar to standard separate mesh 1-inch vidicons and can be used in standard yokes. It operates at normal ambient temperatures without cooling.

The P8226 has a reticulated target which reduces thermal diffusion, increasing the resolution obtainable to 400 TV lines/target diameter.

With a suitable optical system and a low-noise amplifier the P8226 will resolve temperature steps smaller than 0.2 °C.

The range of spectral sensitivity of the P8226 is determined by the transparency of its window. The standard germanium faceplate is bloomed to give optimum sensitivity in the 8 to 14 micron band in which there is maximum radiant power from objects at temperatures close to ambient.

Tubes incorporating alternative faceplates, designed to respond to selected bands between ultraviolet and sub-millimetre wavelengths, can be made to special order.

Operation of the tube depends on the pyroelectric effect in a thin slice of polar crystal. Variation of the electrical polarisation of the target with temperature produces a distribution of surface charges proportional to the quantity of heat absorbed. The neutralisation of the charges by the scanning electron beam gives rise to the signal current.

High readout efficiency is ensured by using a high pedestal current to maintain the scanned surface above cathode potential. In the P8226 the pedestal current is generated by secondary emission from the target. The combination of low lag and uniform background enables almost flicker-free pictures to be obtained with the highest possible chopping rate and with minimal signal processing.

POSSIBLE APPLICATIONS

EEV Pevicons being of uncooled, compact design coupled with excellent resolution characteristics provide unequalled opportunities for equipment development plans. With a growing need for thermal analysis, EEV Pevicons are ideally suited to a wealth of applications, examples of which are:

- Vehicle recognition in darkness.
- Power line, transformer and switchgear inspection.
- Industrial process control for manufacture of glass, paper, steel, chemicals etc.
- Studies in aerospace technology, heat balancing, wind tunnel experiments.
- Detection of thermal waste, polluted waters, heat agitated air.
- Industrial and prison security.
- Fault diagnosis in weapon systems, jet engines.
- Medical thermography.
- Examination of tyre temperatures under dynamic loads.
- Detection of insulation leakage in refrigerated systems, buildings etc.
- Inspection of railway overhead power lines, axle boxes etc.
- Inspection of kiln and furnace linings.
- Investigations of bearing and braking systems under load.
- 'O' band radiation detection.
- CO_2 laser interferometry and alignment.

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GENERAL DATA

Electrical

Cathode	indirectly heated, oxide coated
Heater voltage	6.3 V
Heater current	95 mA
Inter-electrode capacitance, signal electrode to all other electrodes	6.0 pF
Focusing method	magnetic
Deflection method	magnetic

Optical

Useful target diameter	18 mm
Sensitivity to excess radiant power from objects above ambient temperature (see note 1)	>6 μA/W
Spectral response (see note 2)	see page 4

Mechanical

Dimensions	see Outline
Net weight	65 g approx
Mounting position	any
Base	small button ditetrar 8-pin (JEDEC no. E8-11)
Mating socket	type 13398-11-015 by United Carr Fasteners Ltd (or equivalent)
Focus, deflection and alignment coil assembly	EEV MA517A or equivalent

Storage

Recommended store temperature	−40 to +60 °C

WARNING

When operating the tube the following precautions must be observed:-

1. The temperature of the tube must be within its permitted range.
2. A surge limiting device is necessary to ensure that the heater current does not exceed 150 mA when switching on or at any other time.
3. Protection must be provided against scan failure and blanking failure.
4. It is recommended that the tube be operated for at least one hour every month to maintain satisfactory performance.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

No individual rating to be exceeded.
(All potentials are referred to cathode).

	Min	Max	
Heater voltage	5.7	6.9	V
Signal electrode (target) voltage	-	300	V
Grid 4 (mesh) voltage	-	500	V
Grid 3 voltage	-	400	V
Grid 2 (accelerator) voltage	-	300	V
Grid 1 (modulator) voltage:			
negative bias value	-	220	V
positive bias value	-	0	V
Cathode voltage (negative in line flyback)	-	125	V
Field blanking voltage, applied to grid 1	80	-	V
Peak heater to cathode voltage	-	125	V
Signal electrode current (when poling)	-	30	μA
Grid 4 current	-	100	μA
Grid 3 current	-	70	μA
Grid 2 current	-	150	μA
Grid 1 current	-	0.1	μA
Cathode current	-	320	μA
Operating temperature (ambient)	0	50	°C
Faceplate temperature (in camera)	0	50	°C
Target excess irradiance (see notes 3 and 4)	-	50	W/m^2

TYPICAL OPERATION

Operating Conditions (All potentials are referred to cathode)

The following values are for general guidance and may vary from tube to tube. Recommended values are given with a test report for each tube.

Scanned area (see note 5)	18 mm x 24 mm
Video amplifier bandwidth	4 MHz at 3 dB
Faceplate temperature	30 to 40 °C
Signal electrode (target) voltage	0 V
Grid 4 (mesh) voltage (see notes 6 and 7)	300 V
Grid 3 voltage	260 V
Grid 2 (accelerator) voltage	250 V
Grid 1 (modulator) voltage (see note 8)	−10 to −70 V
Cathode voltage:	
forward scan	0 V
line flyback	−100 V
Field blanking voltage, peak to peak, applied to grid 1	−220 V
Pedestal current (see note 9):	
instantaneous	90 nA
mean	40 nA
Grid 4 current (see notes 8 and 10)	15 μA
Grid 3 current	10 μA
Grid 2 current	23 μA
Grid 1 current	<0.1 μA
Cathode current	48 μA

For poling procedure, see note 7.

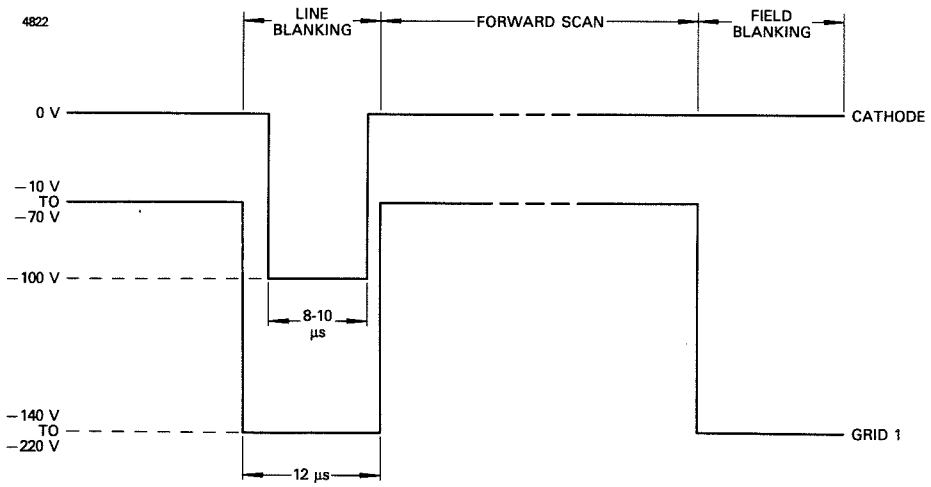
TYPICAL PERFORMANCE

Responsivity	6 μA/W
Gamma	unity
Signal (panned) (with f/1 germanium lens giving 0.5 W/m²/°C)	0.9 nA/°C in scene
Pedestal uniformity (see note 11)	±10 %
Lag (see note 12)	0.25
Resolution, panned mode	see note 13 and page 6

NOTES

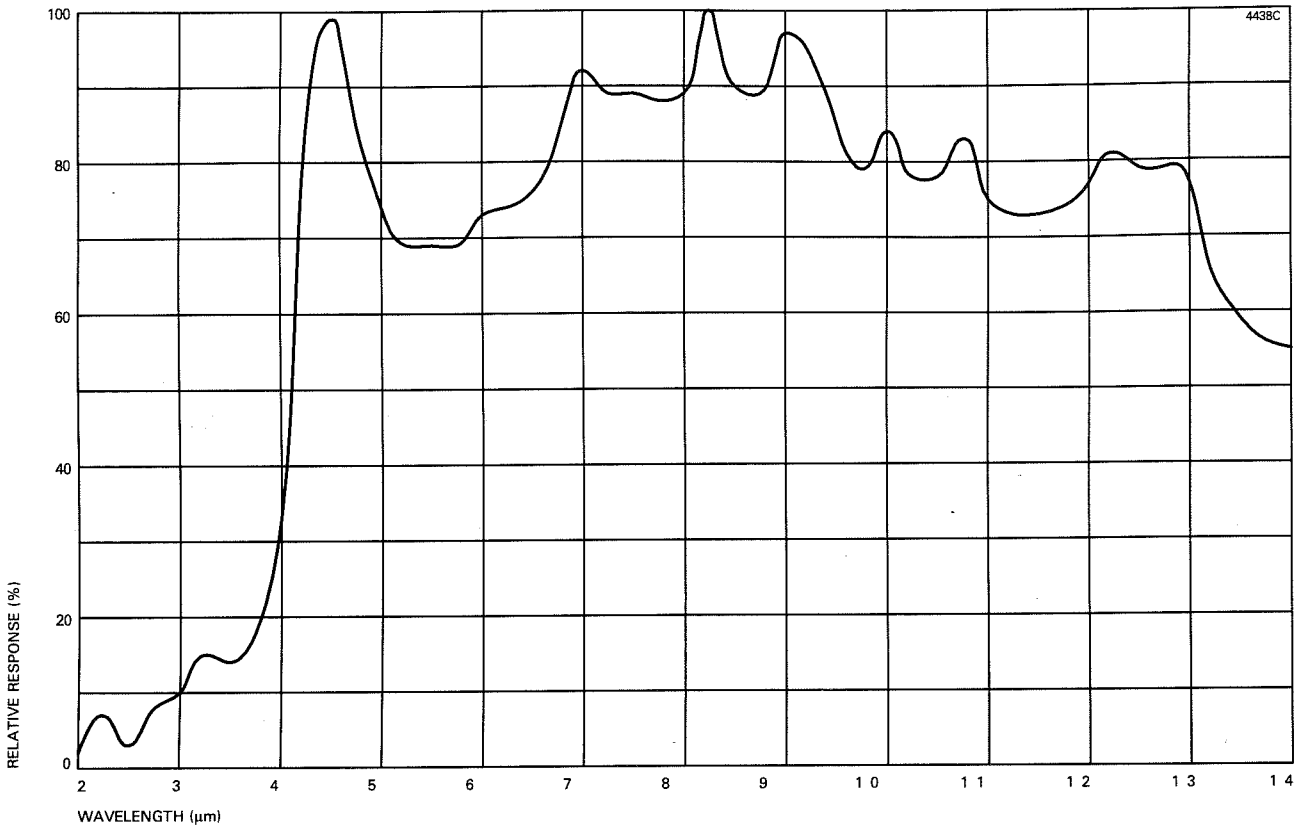
1. The signal is proportional to the rate of change of the temperature of the pyroelectric target and decays within 10 seconds of exposure. To obtain a continuous signal from a stationary object, either a chopper is used to obscure the incoming radiation at a frequency of up to 25 Hz, or the camera is panned so that the image crosses the target at a few millimetres per second.
2. The spectral response is optimised between 8 and 14 microns. The camera lens must therefore be designed for this band.
3. This irradiance is equivalent to that given by a typical germanium lens at f/1 focusing the radiation from a black body 70 °C above ambient (e.g. body at 90 °C in 20 °C ambient).
4. To avoid damaging exposure to excess irradiance, e.g. from the sun or a furnace, the lens must be capped while setting the camera in position. Prior to viewing scenes in which there are objects at high temperature, ensure that the radiation is modulated, either by panning or chopping, and that the lens is stopped down, before uncapping.
5. To ensure stable operation the entire area of the target must be scanned by the electron beam. A virtual raster size of 18 mm x 24 mm is recommended. Electronic circular blanking may be used to mask unwanted signals outside the target area.
6. Adjust the current in the alignment coils so that the shading appears symmetrical about the centre of the target. Grid 4 voltage is set to minimise radial shading. Uniformity is observed with the lens capped.
7. The P8226 is despatched with the pyroelectric target poled and should not require polarization before use. However, should depolarisation occur the following procedure should be used.
   The target voltage V_t should be set to −70 V with respect to cathode, with all other electrode voltages set as for normal operation. A long poling time is desirable. A minimum of 10 minutes is recommended.
   When poling is complete, restore the target slowly to 0 V; at least 5 seconds should elapse between V_t = 70 V and V_t = 0 V.
8. The beam current is controlled by the potential on grid 1. Its level is determined by measuring the current drawn by grid 4 (the mesh).
9. The recommeded instantaneous pedestal current is 90 nA; this is the difference between the currents flowing in the signal lead when the electron beam scans the target area and when it scans the passivating ring at the periphery of the target. These currents may be determined from the pre-amplifier output voltage measured on an oscilloscope. For normal overscan (see note 5) the instantaneous pedestal current is 2.25 times the mean pedestal current.
10. The recommended grid 4 current for readout during forward scan is 5 μA. During line flyback the cathode is pulsed to a negative value; the voltage on grid 1 is pulsed to a variable negative value providing pedestal current control. The pulses applied to the cathode and grid 1 are shown below.
11. Uniformity is measured over an area covering 80% of the target diameter.
12. The lag is calculated as the ratio of the transient current flowing in the second field to that in the first field 40 ms and 20 ms respectively after a step input.
13. The characteristic on page 6 shows the differential irradiance necessary in the image of a bar pattern in order that the bars be distinguishable on a picture monitor. The corresponding temperature differences in the scene assume the use of a well-corrected f/1 germanium lens producing a modulation in the image equal to 0.5 W/m² for a 1 °C temperature step at the object. In the chopped mode, the required differential irradiance will be approximately doubled.

CATHODE AND GRID 1 PULSES (TYPICAL)



Notes 1. These blanking times are not mandatory. Longer periods may be used if preferred.
2. Line flyback falls within the cathode pulse.

TUBE RESPONSE CHARACTERISTIC (Standard faceplate)

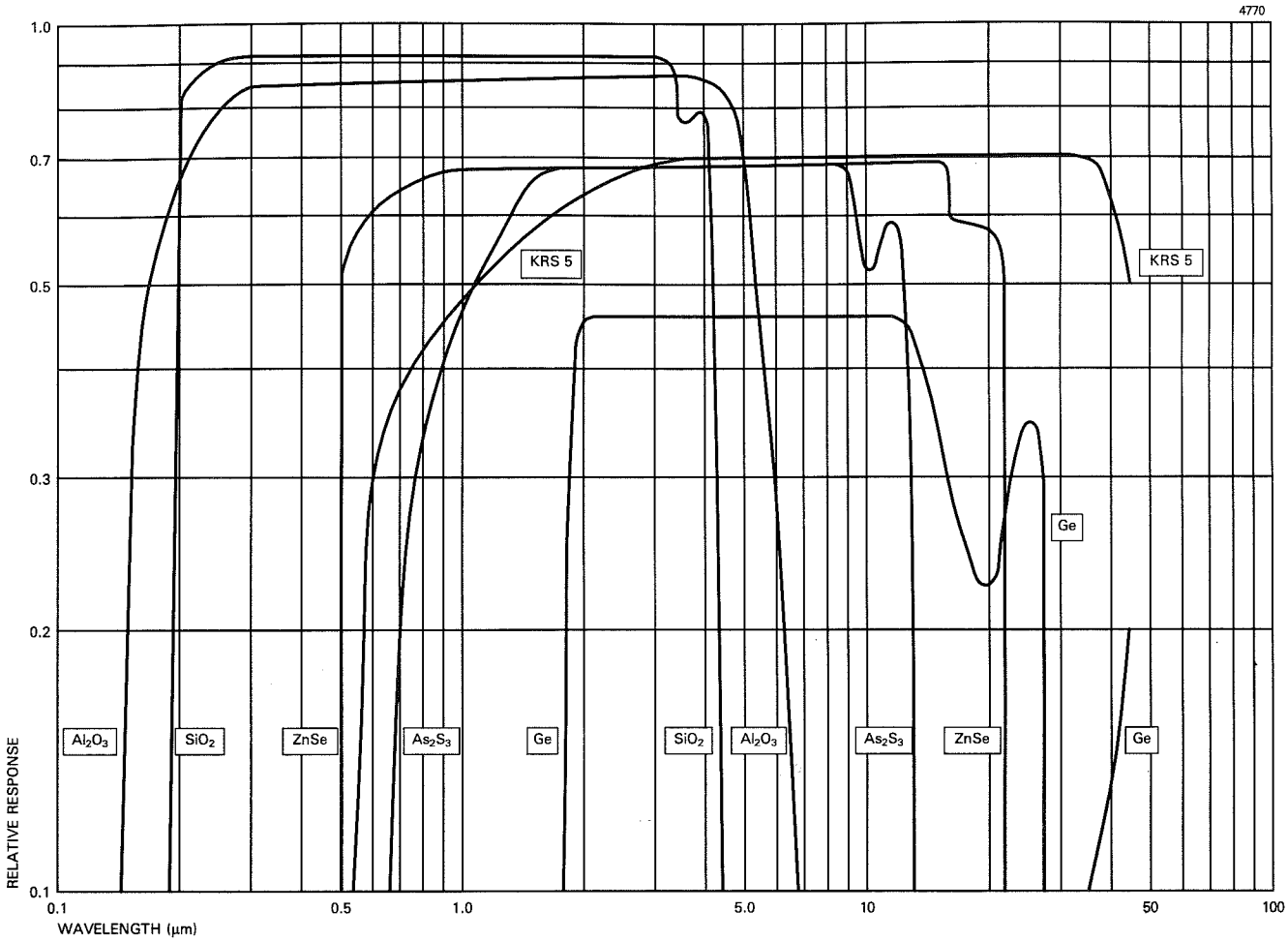


SPECIAL FACEPLATES

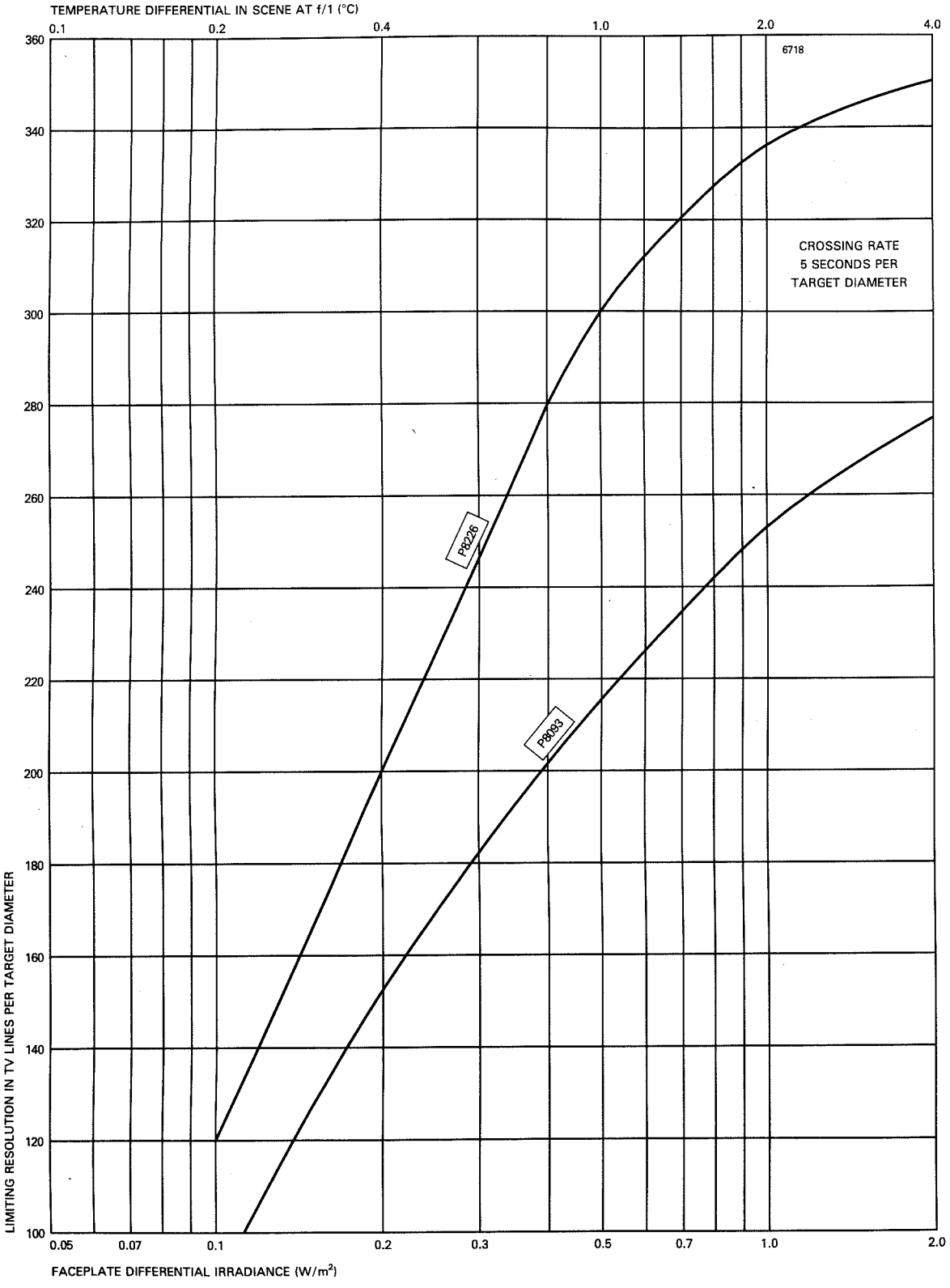
The P8226 pyroelectric vidicon can be supplied to order with a variety of special faceplate materials. The table below shows the range of wavelengths transmitted by each material; the spectral response of a tube can be optimised, for a specific wavelength within the range shown, by anti-reflection coatings.

			Wavelength limits (μm)	
Type	Faceplate material		Min	Max
P8226A	Arsenic Trisulphide	As_2S_3	0.7	13
P8226G	Germanium	Ge	1.8	27+
P8226K	KRS5		0.6	40+
P8226Q	Fused Quartz	SiO_2	0.2	4.5
P8226S	Sapphire	Al_2O_3	0.15	6.5
P8226Z	Zinc Selenide	ZnSe	0.5	22
P8226C	Crown Glass		0.35	2.7

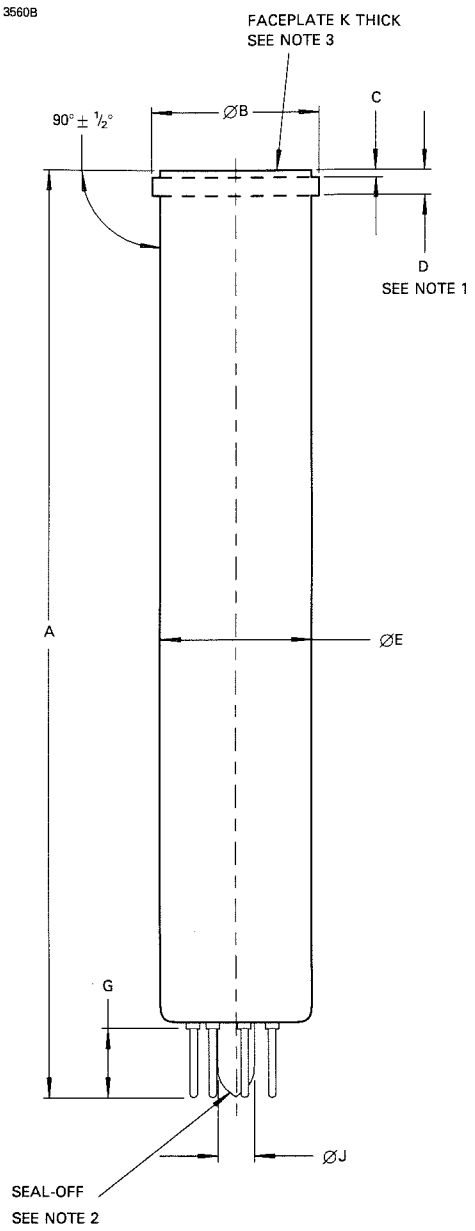
Special Faceplate Transmission Characteristics

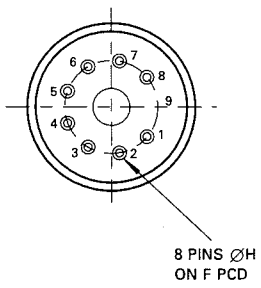


TYPICAL RESOLUTION, PANNED MODE (See notes 1 and 13)



OUTLINE





Ref	Inches	Millimetres
A	6.300 ± 0.125	160.0 ± 3.2
B	1.125 ± 0.010	28.58 ± 0.25
C	0.050 max	1.27 max
D	0.175	4.45
E	1.020 $^{+\ 0.030}_{-\ 0.035}$	25.91 $^{+\ 0.76}_{-\ 0.89}$
F	0.600	15.24
G	0.503 max	12.78 max
H	0.050 $^{+\ 0.002}_{-\ 0.004}$	1.270 $^{+\ 0.051}_{-\ 0.102}$
J	0.265 max	6.73 max
K	0.080 ± 0.005	2.03 ± 0.13

Millimetre dimensions have been derived from inches.

Outline Notes

1. Signal electrode flange may be located in any part of or all of the space between the dashed lines.
2. The seal-off will not project beyond the pins.
3. The refractive index of the standard faceplate is 4.0. The target plane is 0.035 ± 0.015 inch (0.89 ± 0.38 mm) behind the inside of the faceplate.

Connections

Pin	Element
1	Heater
2	Grid 1
3	Grid 4 (mesh)
4	Internal connection
5	Grid 2
6	Grid 3
7	Cathode
8	Heater
9	Key pin position, blank
Flange	Signal electrode

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