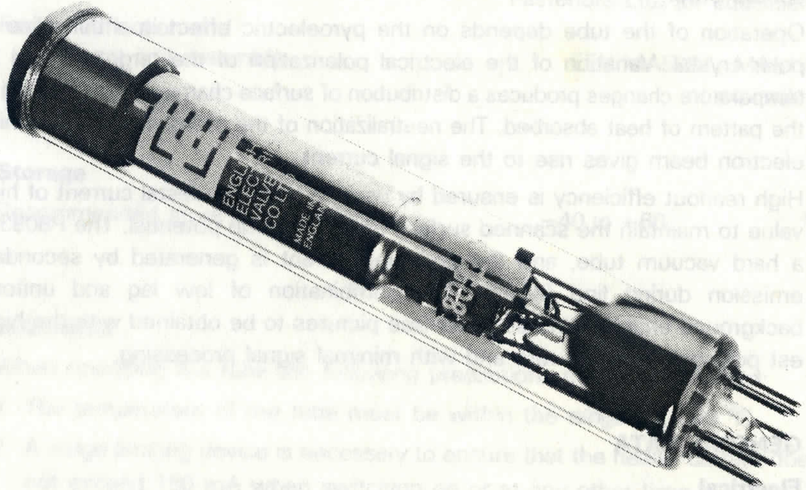
P8093

PEVICON®
HIGH SENSITIVITY INFRARED
PYROELECTRIC VIDICON

FEATURES OF EEV PEVICONS

- Improved target material giving extended operational temperature range.
- Similar construction to 1-inch Vidicons.
- Electromagnetic focus and deflection.
- No cooling required.
- Sensitive to very small temperature differentials.
- Choice of spectral range available.



SPECIAL FEATURES OF P8093

- Hard vacuum operation giving longer life.
- Increase in sensitivity over 8 – 14 µm spectral range.
- Elimination of interference effects when viewing coherent radiation sources.

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INTRODUCTION

The P8093 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, but requires special camera circuitry. It operates at normal ambient temperatures without cooling.

With a suitable optical system and a low-noise amplifier the P8093 will resolve temperature steps smaller than 0.2 °C.

The range of spectral sensitivity of the P8093 is determined by the transparency of its window. The 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 submillimetre 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 polarization of the target caused by temperature changes produces a distribution of surface charges corresponding to the pattern of heat absorbed. The neutralization of the charges by the scanning electron beam gives rise to the signal current.

High readout efficiency is ensured by using a target pedestal current of high value to maintain the scanned surface above cathode potential. The P8093 is a hard vacuum tube, and the pedestal current is generated by secondary emission during line flyback. 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.

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 9	

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 MA509A, 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 the range 0 to 50 °C.
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.

	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 (negative)	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/m²

TYPICAL OPERATION

Operating Conditions

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	
Scanning standard	625 lines 50 Hz	
Video amplifier bandwidth	4 MHz at 3 dB	
Faceplate temperature	30 to 40	°C
Signal electrode (target) voltage	0 to −10	V
Grid 4 (mesh) voltage (see note 6)	300	V
Grid 3 voltage	260	V
Grid 2 (accelerator) voltage	250	V
Grid 1 (modulator) voltage (see note 7):		
forward scan, adjust for I_{g4} = 3 μA	−10 to −70	V
flyback, adjust for mean pedestal current = 40 nA	−140 to −220	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 8):		
instantaneous	90	nA
mean	40	nA
Grid 4 current (see notes 7 and 9)	4 to 5	μA
Grid 3 current	2.0	μA
Grid 2 current	30	μA
Grid 1 current	<0.1	μA
Cathode current	35	μA
Field strength at centre of focusing coil (see note 10)	3.2 ± 0.5	mT
Alignment field (see note 6)	0 to 0.4	mT

For poling procedure, see note 11.

TYPICAL PERFORMANCE

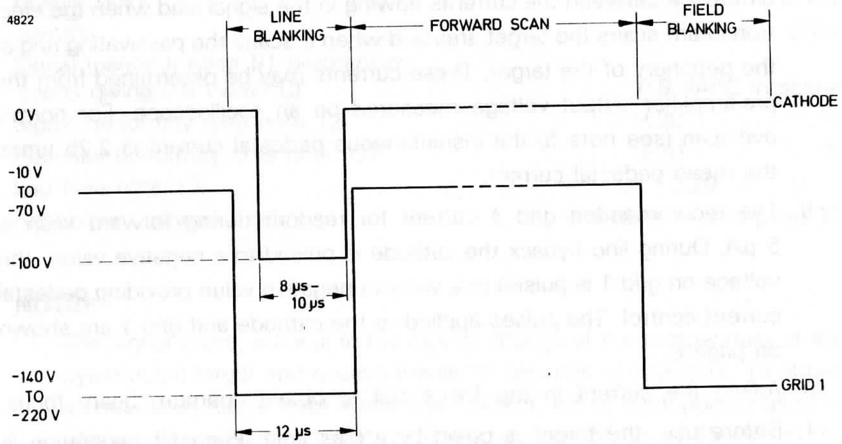
Responsivity	7.0	μA/W
Gamma		unity
Signal (panned) (with f/1 germanium lens giving 0.5 $W/m^2/°C$)	0.9	nA/°C in scene
Signal uniformity (see note 12)	±20	%
Pedestal uniformity (see note 12)	±10	%
Lag (see note 13)	0.20	
Resolution, panned mode	see note 14 and page 10	

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 optimized 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 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 minimize radial shading. Uniformity is observed with the lens capped.
7. 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).

8. The recommended 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.
9. 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 on page 8.
10. Adjust the current in the focus coil to obtain optimum beam focus.
11. Before use, the target is poled by a bias field. Pedestal generation is suppressed during this process. With the beam off, the target potential, V_T, is set 75 to 100 volts below grid 4 potential, V_{g4}. The beam is then set to give a grid 4 current, I_{g4}, between 10 and 15 μA for 30 seconds. I_{g4} is then reduced to between 1 and 2 μA, prior to V_T being raised to between 10 and 15 volts below V_{g4}. Following a delay of at least 2 seconds, the beam is turned off. V_T is reset to cathode potential before restoring the beam.
12. Uniformity is measured over an area covering 80% of the target diameter.
13. 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.
14. The characteristic on page 10 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/m^2 for a 1 °C temperature step at the object. In the chopped mode, the required differential irradiance will be approximately doubled.

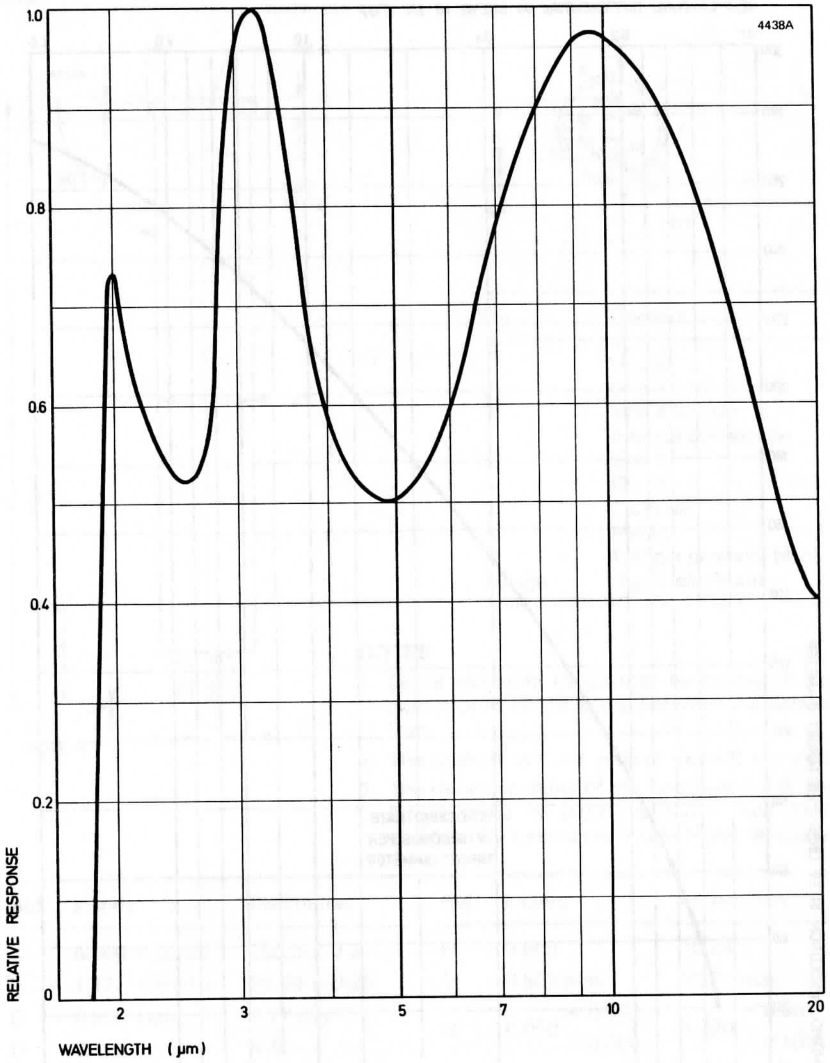
CATHODE AND GRID 1 PULSES (TYPICAL)



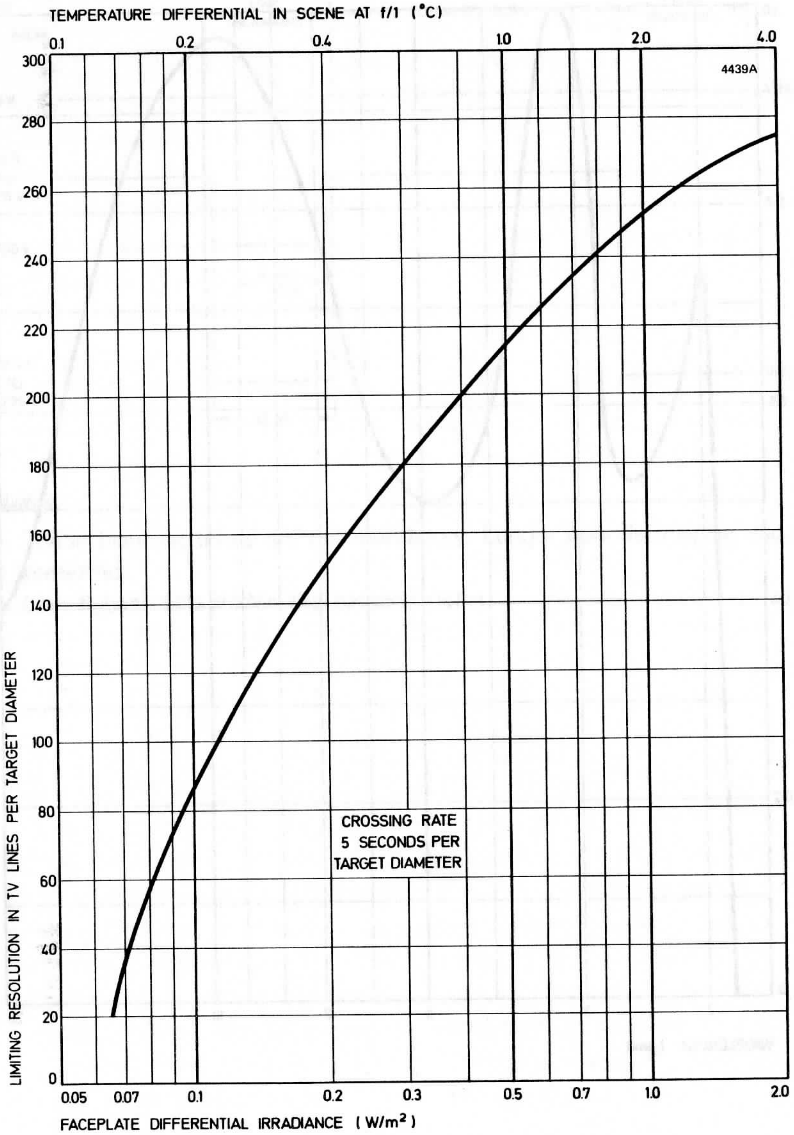
Notes

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

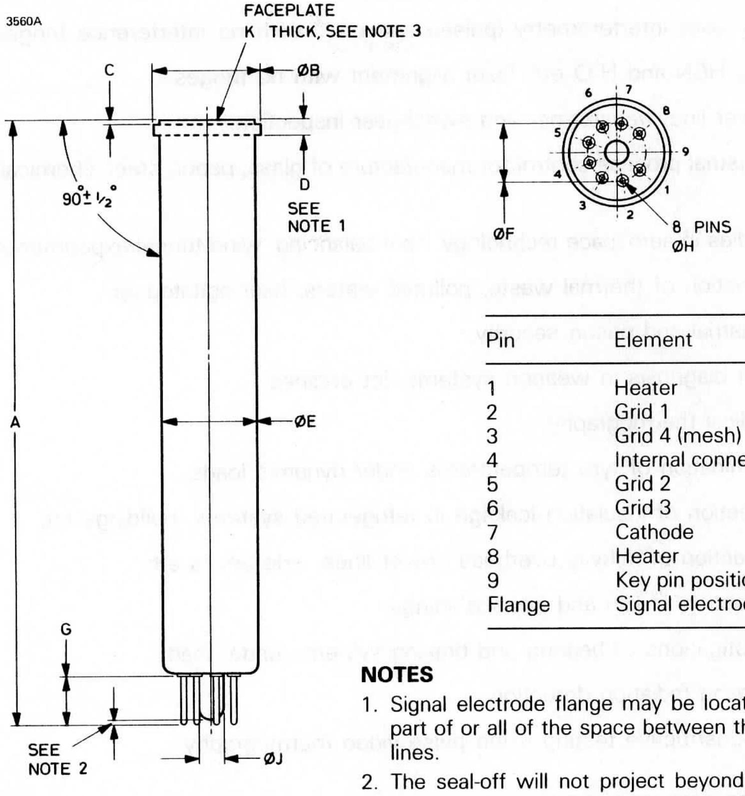
TYPICAL RESPONSE CHARACTERISTIC



TYPICAL RESOLUTION, PANNED MODE (See Notes 1 and 14)



OUTLINE (All dimensions without limits are nominal)



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

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 faceplate is 4.0. The target plane is 0.035 ± 0.015 inch (0.89 ± 0.38 mm) behind the inside of the faceplate.

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

Millimetre dimensions have been derived from inches.

POSSIBLE APPLICATIONS OF EEV P8093

- CO_2 laser interferometry (pulsed and c.w.) with no interference fringes.
- CO_2, HCN and H_2O etc. laser alignment with no fringes.
- 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.
- Non-destructive testing using pulse video thermography.

SYSTEM ADVANTAGES

- No cooling required.
- Capable of being built into a compact, easily portable system.
- Can view pulse-irradiated scenes.
- Standard television signal processing techniques applicable e.g. video tape recording, transmission etc.
- 300 TV lines/target diameter resolution obtainable.

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