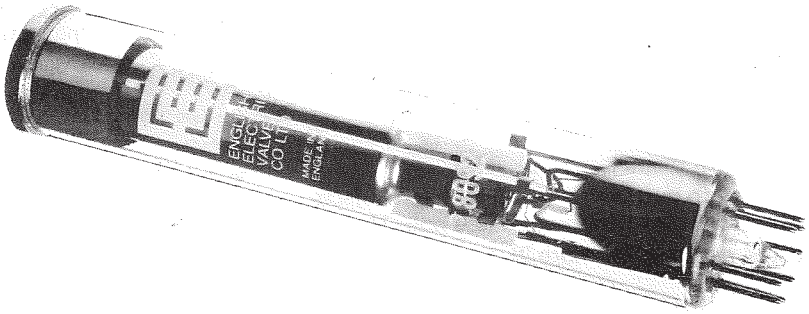
P8092

PEVICON INFRARED PYROELECTRIC VIDICON

INTRODUCTION

The P8092 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.

With a suitable optical system and a low-noise amplifier the P8092 will resolve temperature steps smaller than 0.2 °C.



The range of spectral sensitivity of the P8092 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 with temperature produces a distribution of surface charges proportional to the

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quantity 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 high pedestal current to maintain the scanned surface above cathode potential. In the P8092 the pedestal current, generated by ionization of inert gas within the tube, is exceptionally uniform. 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)	>4	μA/W
Spectral response (see note 2)		see page 7

Mechanical

Dimensions	see outline on page 9
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	15 to 35	°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. The tube must 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	—	150	V
positive bias value	—	0	V
Blanking voltage, peak to peak:			
when applied to grid 1 (negative pulses)	40	—	V
when applied to cathode (positive pulses)	10	—	V
Peak heater to cathode voltage:			
heater negative with respect to cathode	—	125	V
heater positive with respect to cathode	—	10	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	40	°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	
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	V
Grid 4 (mesh) voltage (see notes 6 and 11)	240	V
Grid 3 voltage	200	V
Grid 2 (accelerator) voltage	200	V
Grid 1 (modulator) voltage (see note 7)	−10 to −70	V
Blanking voltage, peak to peak, applied to cathode	20	V
Pedestal current (see note 8):		
instantaneous	90	nA
mean	40	nA
Grid 4 current (see notes 7 and 9)	15	μA
Grid 3 current	10	μA
Grid 2 current	23	μA
Grid 1 current	<0.1	μA
Cathode current	48	μA
Field strength at centre of focusing coil (see note 10)	3.2 ± 0.5	mT
Alignment field (see note 11)	0 to 0.4	mT

For poling procedure, see note 12.

TYPICAL PERFORMANCE

Responsivity	>4	μA/W
Gamma		unity
Signal (panned) (with f/1 germanium lens giving 0.5 W/m²/°C)	0.9 nA/°C in scene	
Signal uniformity (see note 13)	±20	%
Pedestal uniformity (see note 13)	±5	%
Lag (see note 14)	0.20	
Resolution, panned mode	see note 15 and page 8	

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 accidental 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 undesired signals outside the target area.
6. The grid 4 voltage must not be allowed to fall below the voltage on grid 3.
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 pedestal current maintains a positive bias on the scanned side of the target to ensure efficient readout. The recommended instantaneous pedestal current is 90 nA. The mean pedestal current can be measured in the signal lead if the target potential is pulsed negatively to prevent electrons landing. For normal overscan (see note 5) the instantaneous pedestal current is 2.25 times the mean pedestal current.
9. The recommended value for grid 4 current is that which gives 90 nA instantaneous pedestal current. Preferably a lower beam, a grid 4

current of 4 μA, is used for readout during forward scan. The beam is then pulsed up during line flyback to generate the required pedestal. Cathode blanking ensures that only positive ions, but no electrons, reach the target during flyback.

After several hundred hours of use more current is needed to maintain the pedestal. In the EEV P4200 camera, this regulation of the pedestal level is automatic.

10. Adjust the current in the focus coil to obtain optimum beam focus.

11. 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.

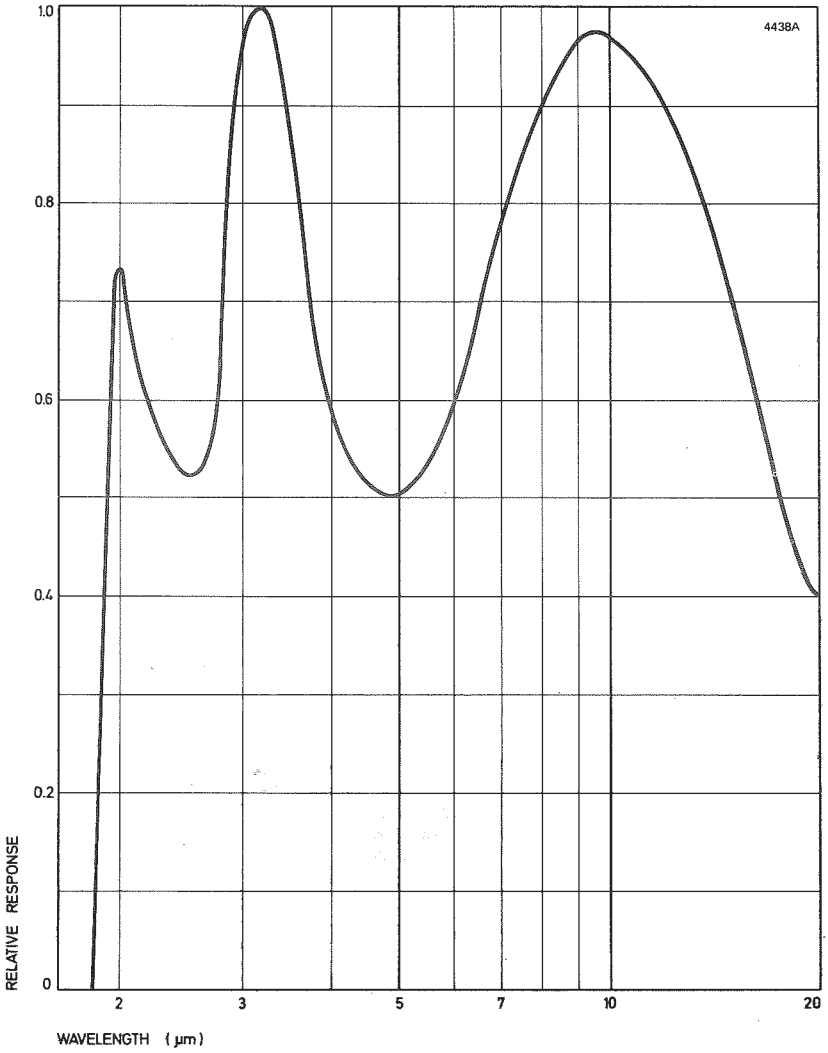
12. Before use, the target is poled by a bias field. Line-flyback pedestal generation is suppressed during this process. With the beam off, the target potential, V_T, is set 75 to 100 volts below grid 4 potential, V_{g4}. Then the beam is set to give a grid 4 current, I_{g4}, between 10 and 15 μA for 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.

13. Uniformity is measured over an area covering 80% of the target diameter.

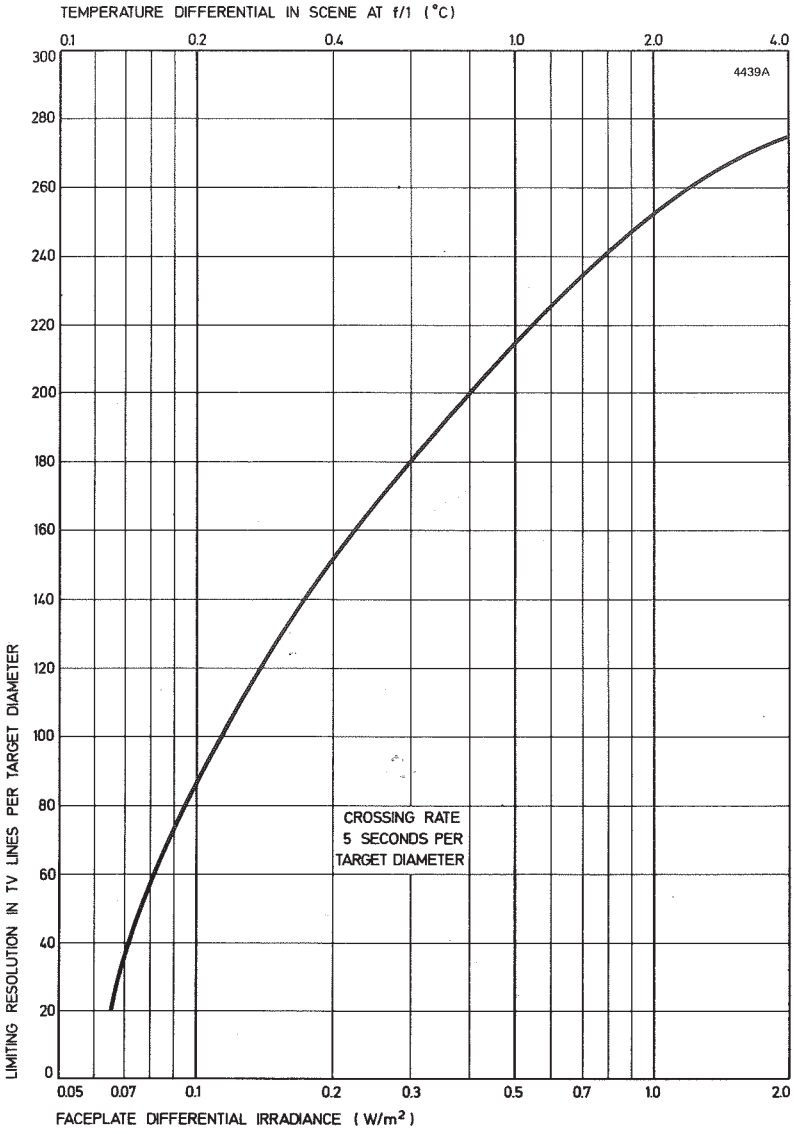
14. The lag is calculated as the ratio of the transient current flowing in the second field to that in the first field 40 ms and 20 ms respectively after a step input.

15. The characteristic on page 8 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.

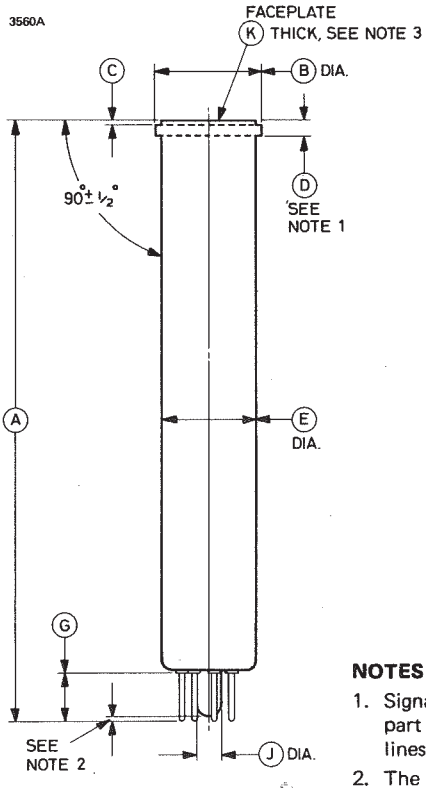
TYPICAL RESPONSE CHARACTERISTIC

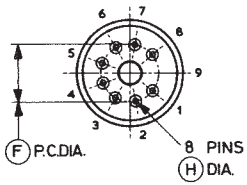


TYPICAL RESOLUTION, PANNED MODE (See Notes 1 and 15)



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	J	0.265 max	6.73 max
E	$1.020^{+0.030}_{-0.035}$	$25.91^{+0.76}_{-0.89}$	K	0.080 ± 0.005	2.03 ± 0.13

Millimetre dimensions have been derived from inches.

POSSIBLE APPLICATIONS OF EEV P8092

- CO_2 laser interferometry (pulsed and c.w.).
- CO_2, HCN and H_2O etc. laser alignment.
- 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.

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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