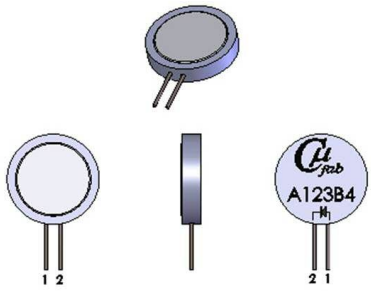
CAMBRIDGE MICROFAB LIMITED

Thermal Neutron Sensor

AT-50



PRODUCT DESCRIPTION

The AT-50 thermal neutron sensor is designed for neutron metrology. It is a 50 mm^2 active area heterojunction diode in a 2 pin package, with excellent neutron specificity.

In use the sensor will produce a current pulse coinciding with each single neutron interaction. The pulse rise time at ambient temperature is under 100 nS. The decay time is dependent on readout electronics but an exponential decay with $t^{1/2}$ of ~ 25 µS is typical.

We can supply suitable pre-amplifiers, housings and power supplies or work with customers on specific application requirements. The device can operate with some standard radiation diode preamplifiers and is therefore compatible with standard NIM radiation measurement electronics.

BENEFITS

- Excellent thermal Neutron specificity
- Very low Gamma sensitivity
- High thermal neutron detection efficiency
- Detects single Neutron interactions
- Compact
- Low power requirement
- Intrinsically safe operating voltage range

APPLICATIONS

- Field survey
- Environmental monitoring
- Security screening
- Radiological safety
- Nuclear decommissioning and cleanup
- Neutron flux guide metrics
- Nuclear physics instrumentation
- Nuclear reactor diagnostics

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TECHNICAL DATA

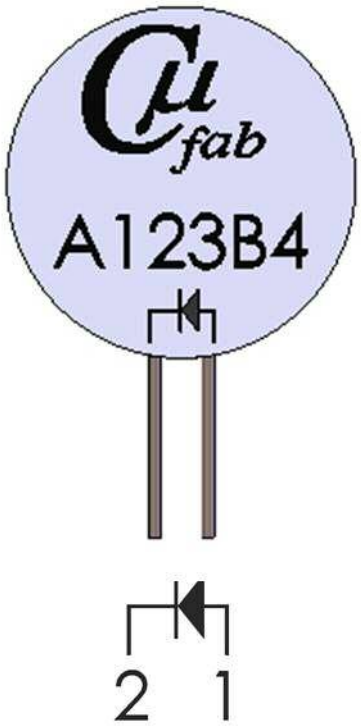
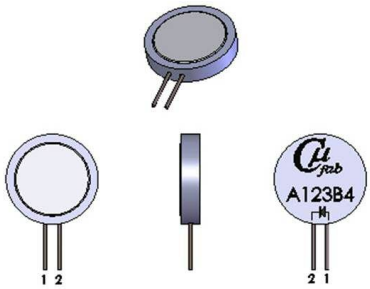


Fig. 1 Pin Configuration



P lead pitch	2.54	mm
D diameter	16.5	mm
T thickness	4.0	mm
Active area	50	mm^2

Fig. 2 Dimensions

SPECIFICATIONS

Symbol	Description	Max	Min	Typ	Unit
V_{rb}	Reverse bias voltage	20*	0	4	V
I_f	Forward Current	10*			mA
I_l	Leakage current at 5Volts reverse bias at 20ºC	40	2	20	nA
T_{sto}	Storage temperature	55	0	20	ºC
T_{op}	Operating temperature	55	10	20	ºC
P_{itch}	Lead pitch			2.54	mm
D_{iam}	Package diameter			16.5	mm
T_{hic}	Package thickness	4.5	3.2	4.0	mm
A_{act}	Device active area			50	mm^2
A_{neu}	Thermal neutron cross sectional area.			8.12	mm^2
C_{min}	Fully depleted capacitance			280	pF
C_{max}	Maximum unbiased capacitance			3200	pF
N_{eff}	Thermal neutron detection efficiency	8.0	5	7	%
G_{eff}	Gamma detection efficiency at 59.5keV			0.019	%

*** Do Not Exceed**

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OPERATING GUIDELINES

Simplest operation is achieved using a Microfab AT50 Mk 3 Thermal Neutron Sensor Kit. This kit comprises:

- AT-50 Sensor and preamplifier in a light-tight aluminium enclosure with power and signal connectors
- power supply
- power and signal cables
- 12V mains adaptor
- carry case

For users requiring integration with their own or 3rd party equipment we offer the following guidelines:

- The AT-50 is light-sensitive and should be operated in a light-tight enclosure.
- Isolation from mechanical vibration is desirable.
- The AT-50 requires a preamplifier to give a useful signal level.
- The AT-50, the preamplifier and the cables should be electrically screened.
- The AT-50 should be directly connected to a low noise, high gain, charge sensitive preamplifier using a very short copper track.
- Typically Pin 1 of the AT-50 is connected to the preamplifier input.
- Typically Pin 2 of the AT-50 is connected to a stabilised current limited bias voltage in the range +4 V to +10 V.
- Reverse bias gives improved signal-to-noise ratio, faster signal rise time and reduces the device capacitance.
- The AT-50 should NOT be forward biased. Passing forward current in excess of 10 mA may cause permanent damage.
- A feedback network comprising ~20 MΩ resistor in parallel with ~2 pF capacitor is appropriate.

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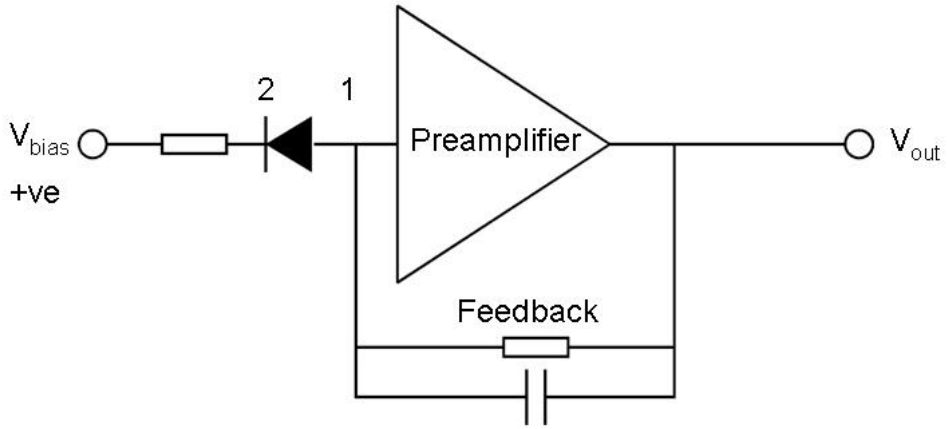

Fig. 3 Biasing and Readout

Neutron detection events are indicated by a sharp negative pulse from the output of the Microfab preamplifier, as shown in Figure 4, with exponential recovery based on the feedback loop time constant. The Cambridge Microfab preamplifier is DC coupled and gives a negative going pulse superimposed on a DC level. Other preamplifiers may operate differently. Figure 4 shows the Cambridge Microfab preamplifier output feeding an AC coupled oscilloscope input.

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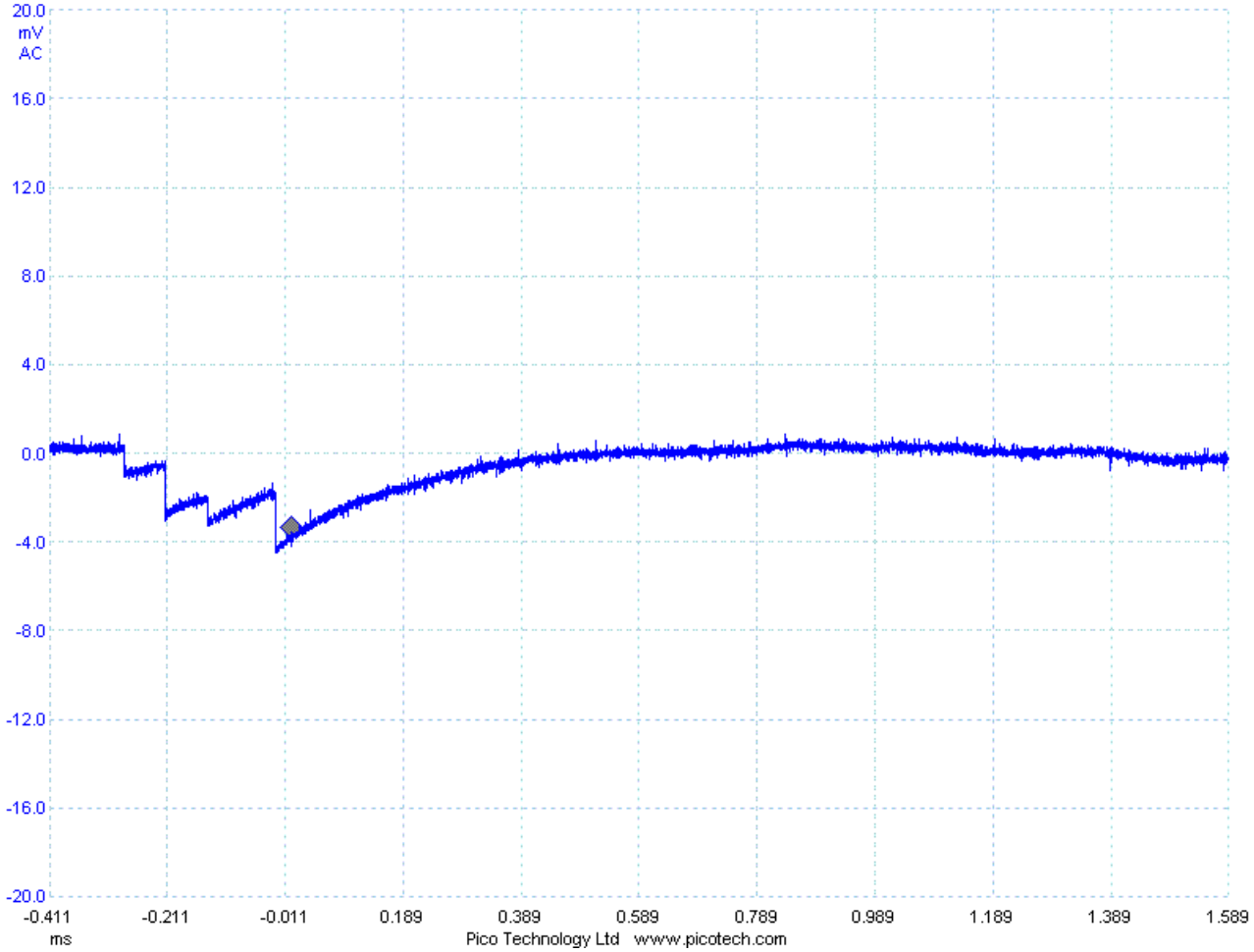

Fig. 4 Four separate events arising from neutron interaction giving rise to a temporary level offset

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Neutron counting with AT-50 sensors can be implemented using a preamplifier circuit followed by a high pass filter, comparator and logic. Figure 5 shows conversion of the low voltage level preamplifier output to high level logic pulses. Each pulse represents a single neutron capture event.

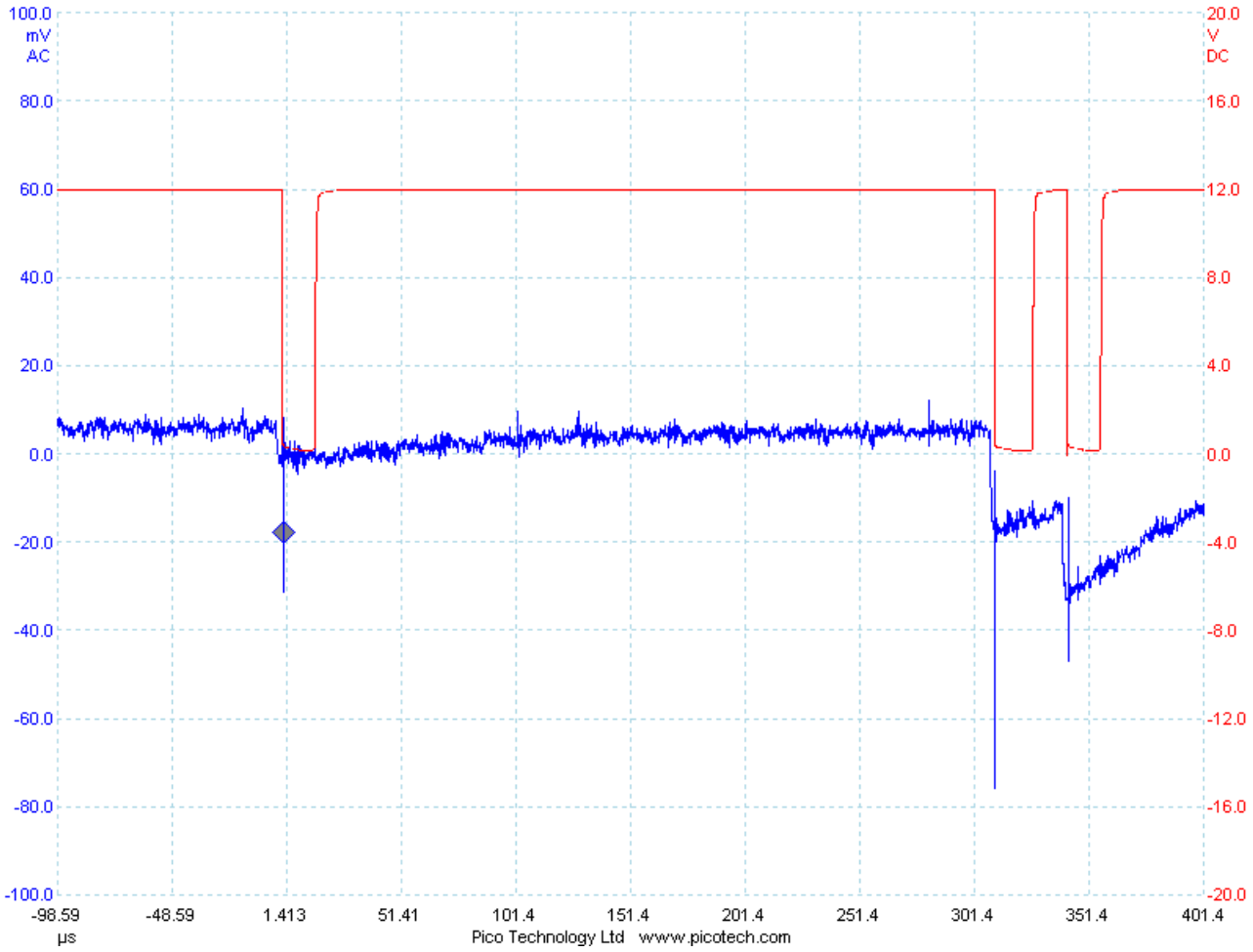

Fig. 5 The red trace shows output pulses extracted from event edges at the preamplifier and demonstrates a method which generates a pulse from each transient edge at the preamplifier

(NOTE : The measurements in Figures 4 and 5 have been obtained at ambient temperature)

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