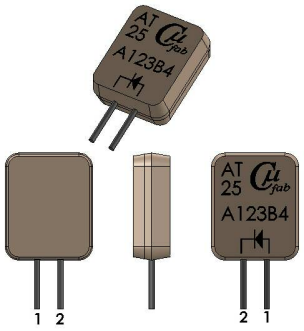
CAMBRIDGE MICROFAB LIMITED

Thermal Neutron Sensor

AT-25



PRODUCT DESCRIPTION

The AT-25 thermal neutron sensor is designed for neutron metrology. It is a 25 mm^2 active area heterojunction diode in a 2 pin package, with excellent neutron specificity.

In use the sensor produces 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.

Close connection of the AT-25 sensor to a high gain, charge sensitive preamplifier will give optimal signal to noise ratio. We can supply suitable pre-amplifiers, housings and power supplies or work with customers on specific application requirements.

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

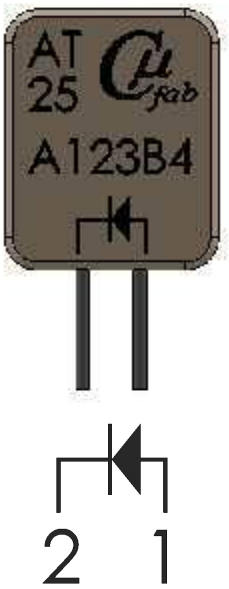
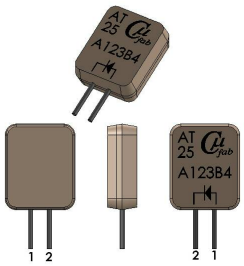


Fig. 1 Pin Configuration



P lead pitch	2.54	mm
W width	9.5	mm
H Height	11.5	mm
T thickness	4.0	mm
Active area	25	mm^2

Fig. 2 Dimensions

SPECIFICATIONS

Symbol	Description	Max	Min	Typ	Unit
V_{rb}	Reverse bias voltage	10*	0	4	V
I_f	Forward Current	5*			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
W_{idth}	Package width			9.5	mm
H_{eight}	Package height			11.5	mm
T_{hick}	Package thickness	4.5	3.2	4.0	mm
A_{act}	Device active area			25	mm^2
A_{neu}	Thermal neutron cross sectional area.			4.06	mm^2
C_{min}	Fully depleted capacitance			140	pF
C_{max}	Maximum unbiased capacitance			1600	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 Cambridge Microfab AT Mk 3 Thermal Neutron Sensor Kit. This kit comprises:

- AT-25 Sensor and low noise, high gain, charge sensitive, inverting 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-25 is light-sensitive and should be operated in a light-tight enclosure.
- Isolation from mechanical vibration is desirable.
- The AT-25 requires a preamplifier to give a useful signal level.
- The AT-25, the preamplifier and the cables should be electrically screened.
- The AT-25 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-25 is connected to the preamplifier input.
- Typically Pin 2 of the AT-25 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-25 should NOT be forward biased. Passing forward current in excess of 5 mA may cause permanent damage.
- A feedback network comprising ~20 MΩ resistor in parallel with ~2 pF capacitor is appropriate.

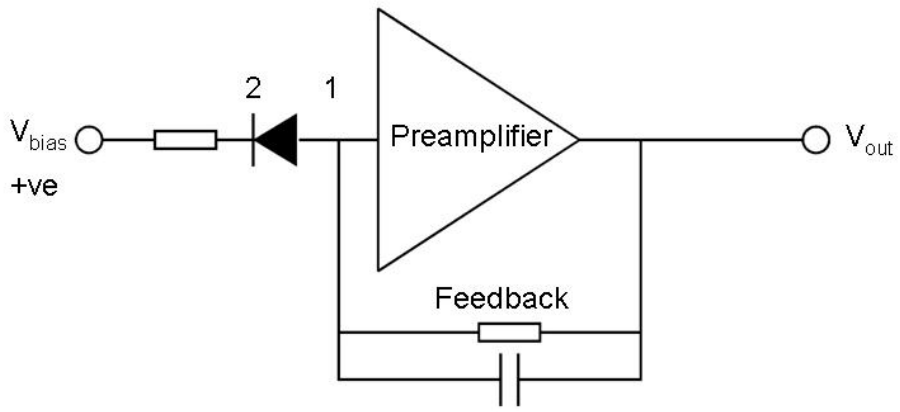

Fig. 3 Biasing and Readout

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NEUTRON DETECTION

Figures 4 and 5 are oscilloscope traces showing neutron detection events from an AT-25 sensor. Neutron detection events are indicated by a sharp negative edge with exponential recovery based on the feedback loop time constant. They have been obtained using a Cambridge Microfab AT Mk3 Thermal Neutron Sensor Kit feeding an AC coupled oscilloscope. The Cambridge Microfab Preamplifier has inverting gain and is DC coupled. This gives a negative going pulse superimposed on a negative DC level. AC coupling to the oscilloscope removes the negative DC level from the trace.

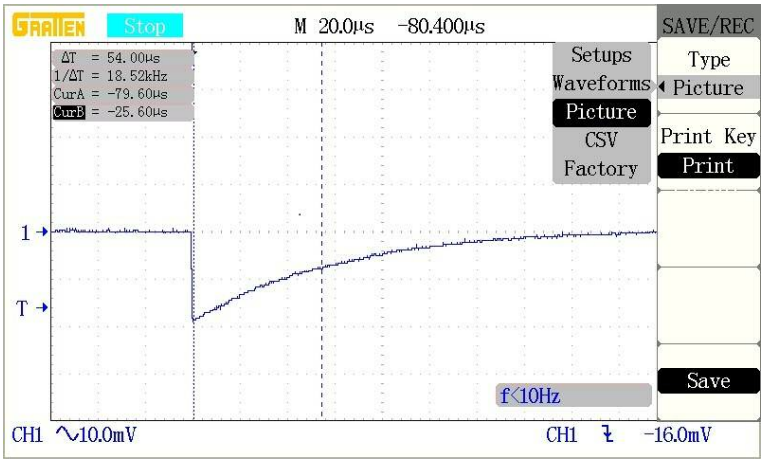

Fig. 4 ~20mV neutron event

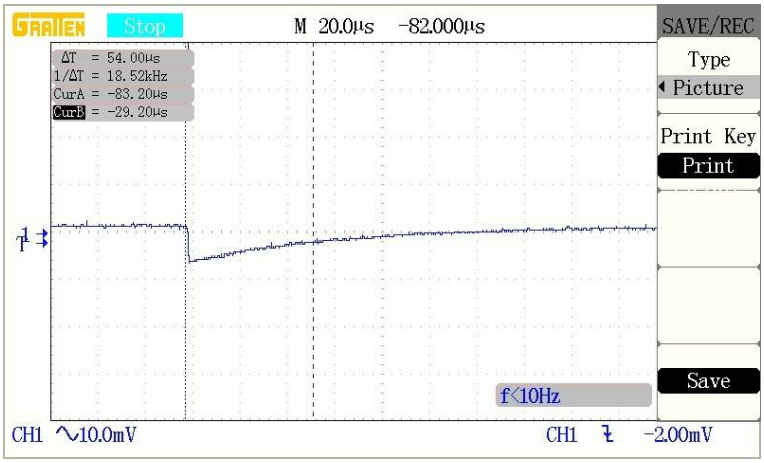

Fig. 5 Lower amplitude neutron event

NEUTRON COUNTING

Neutron counting with AT-25 sensors can be implemented in many different ways. A classic approach is to take the preamplifier output, apply further gain, filter the signal using a shaping amplifier, and then to use a comparator and logic to generate a logic level pulse from each negative edge at the preamplifier output.

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