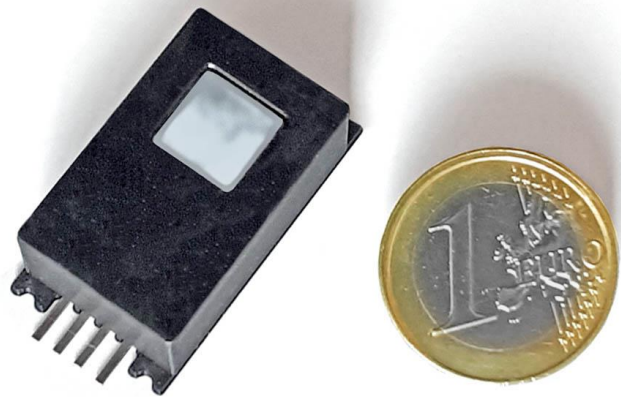




Alpha Sensor AL54

- Detects alpha particles, electrons and photons
- Detects decay products of radon
- Works in daylight (no darkroom conditions required)

Features and benefits

- Detects alpha, beta and gamma
- Analog and digital output signal
- Very low power consumption (25 μ A)
- Sensitivity of the detector: 5 cpm/ μ Sv/h
- High immunity to RF and electrostatic fields
- Linear response over a wide temperature range (-30 °C to 60 °C)
- Manufactured in Switzerland

Fields of application

- Radon experiments (detection of the decay products ^{218}Po and ^{214}Po)
- Instruments for the detection of radioactivity in the medical environment
- Radiation monitors for nuclear surveillance and safety
- Detection of illegal substances
- Scientific courses and practical laboratory experiments

Description of the sensor

The heart of the AL54 radiation sensor is a custom PIN diode covered with a thin aluminum foil to make it insensitive to light. Electrons (beta) and photons (gamma) easily penetrate the aluminum foil. Alpha particles which interact with the aluminum foil generate electrons and photons that can be detected by the PIN diode.

The analog output of the pulse charge amplifier can be connected to an energy spectrum analyzer to detect radon decay products such as ^{218}Po and ^{214}Po .

An integrated pulse discriminator with temperature compensated threshold provides a true TTL signal output for alpha particles, electrons and photons. The performance of the AL54 solid-state sensor combined with its extremely low power consumption makes it an excellent choice for physics lab experiments as well as cutting-edge designs.

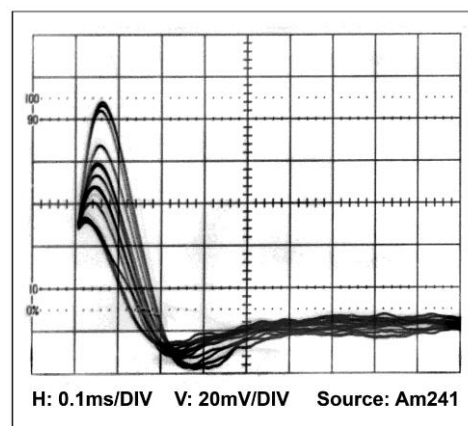
Absolute maximum ratings

Supply voltage, V_{CC} to GND	18.0 V
Output short-circuit current	continuous
Storage temperature range	-65 °C to 100 °C

Electrical characteristics

Unless otherwise indicated specified at:
 $V_{CC} = 5.0 \text{ V}$, $T_A = 25 \text{ °C}$

Measurement range of dose rate	0.1 $\mu\text{Sv/h}$ to 100 mSv/h
Pulse Rate vs. Radiation Rate	5 cpm $\pm$ 15% for 1 $\mu\text{Sv/h}$
Energy response	70 keV to 10 MeV
Analog output signal	80mV typical for Am241
Analog output pulse width	100 μs typical for Am241
Digital output pulse level	Equal to supply voltage (positive going)
Digital output pulse width	50 μs to 200 μs (LOW→HIGH→LOW)
Supply voltage range	2.5 V to 10.0 V (5.0 V recommended)
Supply current, I_S	25 μA TYP
Operating temperature range	-30 °C to 60 °C



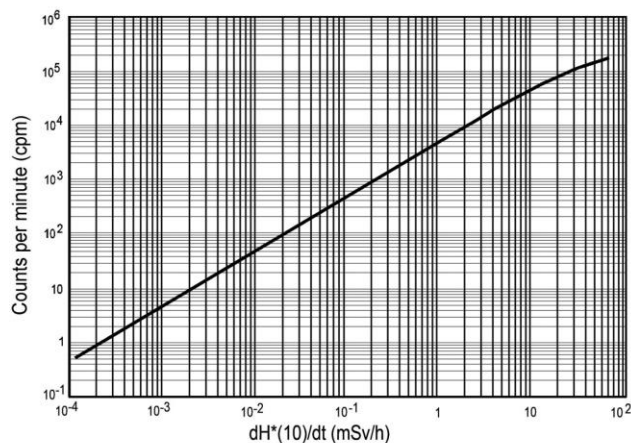
Typical analog output signal for Am241

Sensor characteristics

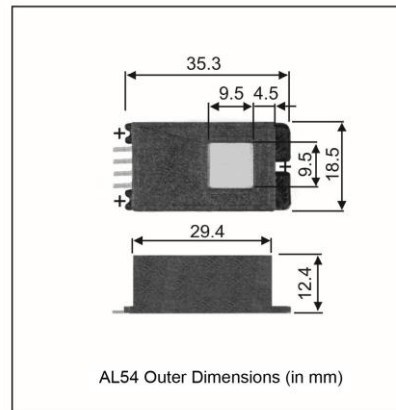
PIN diode active area	13 mm ²
Window	Aluminum 9.5 x 9.5 x 0.01 mm

AL54 sensor linearity

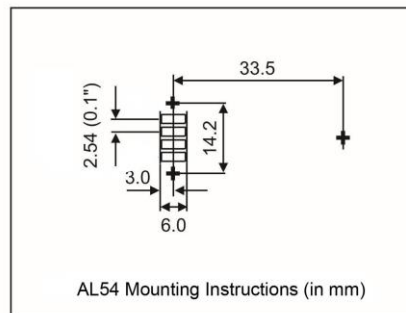
$dH^*(10) / dt$ = Radiation dose equivalent rate for Cs-137 and Co-60 (mSv/h)



AL54 outline dimensions



AL54 footprint



AL54 connecting description



AL54 handling and soldering recommendations

- **CAUTION!** The window must not be touched or cleaned! A scratched or damaged window can impair the function of the PIN diode or even destroy it.
- **Preventing detection of undesired pulses**
<https://www.teviso.com/file/pdf/bg51-preventing-undesired-pulses.pdf>
- **AL54 soldering recommendations**
Hand soldering is recommended. Maximum temperature: 360°C, maximum duration: 5 seconds.

Detecting alpha particles with the AL54

What happens when alpha particles hit an aluminum foil?

When alpha particles hit an aluminum foil, they can undergo a variety of interactions, including

Elastic scattering: This is the most common type of interaction, where the alpha particle bounces off the aluminum core without losing energy. This is because the alpha particle is so much smaller than the aluminum nucleus that it does not have enough energy to penetrate the nucleus.

Inelastic scattering: This is a more energetic interaction in which the alpha particle gives up some of its energy to the aluminum nucleus. This can happen when the alpha particle transfers some of its energy to an electron in the aluminum atom, causing the electron to be ejected from the atom. The alpha particle can also lose energy by colliding with the nucleus itself.

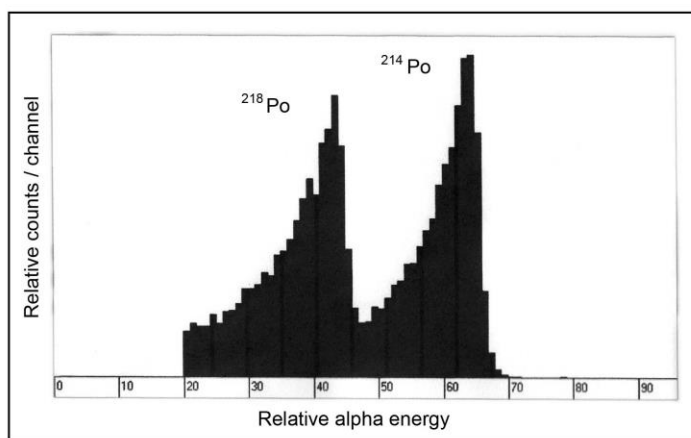
Capture: This is the rarest type of interaction and occurs when the alpha particle is absorbed by the aluminum nucleus. This can only happen if the alpha particle has enough energy to overcome the Coulomb barrier, i.e. the electrical repulsion between the alpha particle and the positively charged nucleus.

It is important to know that the extent of these interactions depends on the energy of the alpha particles, the thickness of the aluminum foil and the angle at which the particles hit the foil. These interactions are often used in experiments and detectors to study alpha particles or to shield their radiation in various applications.

Experiments to measure radon with the AL54 sensor

Electrostatic collection of the decay products of radon is a precise and reliable method to obtain a representative measure of the radon concentration in the environment to be monitored.

A typical energy spectrum alpha spectrum of radon decay products, electrostatically deposited on the detector surface, was recorded in the TEVISO R&D Lab with a *PRA multi-channel analyzer* (1). The energy resolution of the detector AL54 is sufficient to clearly identify the alpha energies of the radon decay products ^{218}Po and ^{214}Po .



Typical energy spectrum of the radon decay products ^{218}Po and ^{214}Po . Recorded with *PRA multi-channel analyzer* (1)

(1)

PRA is an intelligent software that turns the PC sound card into a powerful multi-channel analyzer for alpha spectrometry. PRA was developed by Marek Dolleiser at the University of Sydney as a tool for teaching physics students about atomic theory. [\[Download more about PRA\]](#)

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