RADIATION SENSOR
BT70I

USER'S GUIDE

CENTRE FOR MICROCOMPUTER APPLICATIONS

http://www.cma-science.nl

Short description

The Radiation sensor BT70i senses alpha, beta and gamma radiation.
Alpha, beta, gamma rays ionize material they strike or pass through. The amount of radiation is generally determined by measuring the resulting ionization. The Radiation sensor uses a Geiger-Müller tube to detect this radiation. The GM tube consists of an anode (positive electrode) positioned in the center of a tubular cathode (negative electrode) filled with a mixture of argon, neon, and halogen. The cathode is a thin-walled metallic cylinder sealed at each end with an insulating disk to contain the gas. The anode is a wire that extends into the cylinder. A high voltage is applied to the electrodes to create an electrical field within the chamber. When radiation passes through the chamber and ionizes the gas, it generates a pulse of current. The sensor electronically processes these pulses to display the radiation level in counts per minute. A clicking sound is emitted for each radiation event detected (for each count).
The end of the GM tube has a thin mica window. It allows alpha particles to reach the GM tube and be detected. The mica window will also sense low energy beta particles and gamma radiation that cannot penetrate the plastic case or the side of the tube.
For the short amount of time the GM tube is detecting one particle, if another radioactive particle enters the tube it will not be detected. This is called dead time. The maximum dead time for the GM tube is 90 microseconds (or 90 µs).
To detect radiation point the sensor toward the source of radiation. To detect Alpha radiation put the sensor close to the sources, this is because Alpha particles do not travel far through air.
The Radiation sensor can be directly connected to the analog BT inputs of the CMA interfaces.

Sensor recognition

The Radiation sensor BT70i has a memory chip (EEPROM) with information about the sensor: its name, measured quantity, unit and calibration. Through a simple protocol this information is read by the CMA interfaces and the sensor is automatically recognized when it is connected to these interfaces. If your Radiation sensor is not automatically detected by an interface you have to manually set up your sensor by selecting it from the Coach Sensor Library.

Calibration

The CMA Radiation sensor BT70i is calibrated as counter, the pulses generated by the sensor are counted.
The Coach software allows selecting the calibration supplied by the sensor memory (EEPROM) or the calibration stored in the Coach Sensor Library.

Suggested experiments

- Monitoring background radiation
  If the radiation sensor is set up far away from any radioactive source, it still detects pulses occasionally. This is due to the background radiation that is a result of radiation that occurs naturally from cosmic radiation, geophysical radiation, inherent material radiation, etc. Normal background radiation levels vary at different locations, according to altitude and other factors, such as types of minerals in the ground. The level of background radiation is usually very low. Since the background radiation is present in all experiments, it should be measured and subtracted from the experimental readings for these to be reliable.
- Monitoring radiation of common radioactive materials
  Here the natural source of radiation such as potassium salts or lantern mantels can be used. In such experiment the random nature of the radiation can be presented.
- Radioactive decay and half-life determination
  The radiation sensor gives the possibility to measure radioactive decay rate and half-life time. In such experiments isotope generators, Protactinium generator (half-life time of 72 seconds) or Ba137m generator (half-life time of 153 seconds) are ideal radioactive materials for this experiment.
- Radiation level versus shielding
  In this experiment the radiation level is recorded when an absorber of different thickness is placed between the sensor and radiation source. As absorber aluminum sheet(s) for beta radiation or a lead sheet(s) for gamma radiation can be used. In this experiment you can also compare the effect of different types of materials to shield alpha, beta or gamma radiation.
- Monitor radiation from an radiation source as a function of the distance between the source and the radiation sensor
  In this experiment the radiation level is recorded when a sensor is placed at different distances from the radiation source.

Technical Specifications

Sensitive to	Alpha, beta, gamma radiation
Range	0 .. 1000 cps (counts per second)
Pulse height	5 V
Pulse length	0.26 ms
Gamma sensitivity	18 cps / (mR/hr) (for Cs^{137})
Minimum energy (gamma)	6 keV (for Cs^{137})
Dead time	Effective dead time equal to pulse length (GM tube dead time < sensor pulse length)
GM tube operating voltage	450 .. 650 V, fixed to about 500 V
Gas filling	Neon – halogen quenched
Cathode material	Fe – Cr (446 stainless steel)
Cathode wall thickness	0.25 mm
Mica window active diameter	9 mm
Mica window density	1.5 .. 2.0 mg/cm^2
GM tube active length	39 mm
Dimensions	138 x 58 x 33 mm^3
Operating temperature	0 .. 50 °C
Connection	Sensor cable attached to the sensor.

Warranty:

The Radiation sensor BT70i is warranted to be free from defects in materials and workmanship for a period of 24 months from the date of purchase provided that it has been used under normal laboratory conditions. This warranty does not apply if the sensor has been damaged by accident or misuse.

Note: *This product is to be used for educational purposes only. It is not appropriate for industrial, medical, research, or commercial applications.*

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