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Radiation detection modules

These modules incorporate a scintillator and MPPC (multi-pixel photon counter) and are designed to detect gamma-rays from ^{137}Cs (cesium 137) and the like. The incident gamma-rays are converted into visible light using the scintillator, and the MPPC detects extremely low-level light to measure low-energy gamma-rays with high accuracy. The signal processing circuit and A/D converter are housed in a compact case. And, the module provides a USB interface. The product includes sample software with functions for setting measurement conditions, acquiring and saving data, drawing graphs, etc.

1 Features

- Includes an ultra-high sensitivity MPPC semiconductor detector
- Includes a CsI(Tl) scintillator
- Gamma-ray energy discrimination
- Easy integration in devices
- Compact and lightweight
- Built-in temperature compensation circuit

[Figure 1] Radiation detection modules

A total of eight types in four different sizes and two interfaces (USB, RS-232C) are available that you can choose from according to your application. The characteristics are the same between the USB type and RS-232C type (the software specifications are different).

[Table 1] Hamamatsu radiation detection modules

Parameter	Condition	C12137	C12137-01	C12137-08	C12137-10	C12137-00D	C12137-01D	C12137-08D	C12137-10D	Unit
Dimensions (W × D × H)		110 × 55 × 27	71 × 55 × 60.5	112 × 94 × 53.3	122 × 122 × 53.3	110 × 55 × 27	71 × 55 × 60.5	112 × 94 × 55.6	122 × 122 × 55.6	mm
Detector		MPPC								-
Scintillator		CsI(Tl)								-
Scintillator size		13 × 13 × 20	38 × 38 × 25	80 × 80 × 25	ϕ110 × 25	13 × 13 × 20	38 × 38 × 25	80 × 80 × 25	ϕ110 × 25	mm
Counting efficiency min.	^{137}Cs, 0.01 µSv/h	40	400	2000		40	400	2000		cpm
Energy range		0.03 to 2		0.06 to 2		0.03 to 2		0.06 to 2		keV
Energy resolution	^{137}Cs, 662 keV	8	8.5	9	10	8	8.5	9	10	%
Measurement range	^{137}Cs, 662 keV The lower limit depends on the environmental radiation.	0.01 to 100	0.001 to 10	*		0.01 to 100	0.001 to 10	*		µSv/h
Measurement error	Excludes attenuation (caused by the shield) and counting fluctuations.	±20		*		±20		*		%
Interface		USB 2.0 (Full Speed)				RS-232C				-
Power supply		USB bus power				+5 V				-
Operating temperature		-10 to +50	0 to +40	0 to +40		-10 to +50	0 to +40	0 to +40		°C

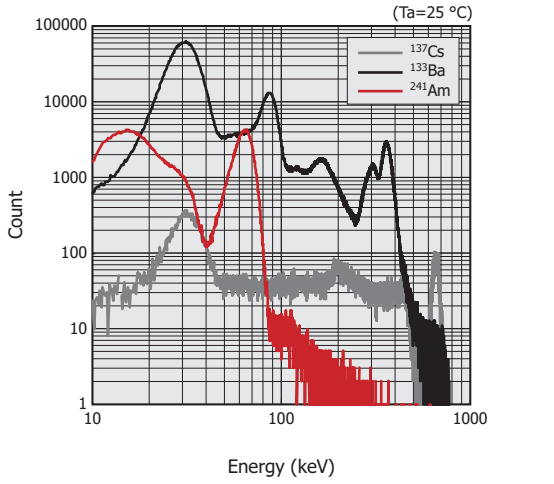
* The C12137-08/-08D/-10/-10D do not perform conversion into dose equivalent rate using the G(E) function.

2 Structure and characteristics

The C12137 series radiation detection modules can acquire energy spectra and therefore can perform energy discrimination. It is known that when ^{137}Cs disintegrates, gamma-rays with energies near 662 keV and 32 keV are emitted. Whether gamma-rays are from ^{137}Cs can be determined by acquiring the energy spectrum from the low-energy gamma-rays at around 30 keV. As the gamma-rays become lower in energy, the level of light emitted by the scintillator weakens. However, the C12137 series, which uses a high sensitivity MPPC, is able to detect gamma-rays over a wide range from a low energy region around 30 keV to 2 MeV. The low-light-level detection performance of high gain MPPCs also contributes greatly to reducing the measurement time. To reduce the measurement time, the scintillator capacity must be increased to improve the detection efficiency. However, as the scintillator capacity is increased, the level of light that reaches the photosensor is attenuated inside the scintillator, and the lower limit of detection degrades accordingly. This means that the detection of low-energy gamma-rays will become more difficult. The MPPC offers higher gain than the PIN photodiode or APD and makes low-light-level detection possible. Even when it is combined with a large capacity scintillator, low-energy gamma-rays can still be measured.

Note: The lower limit of the energy range of the C12137-08/10 is 60 keV.

[Figure 2] Radiation measurement examples (C12137)



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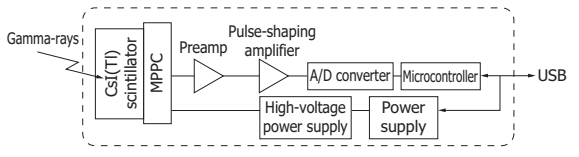
[Figure 3] Block diagram



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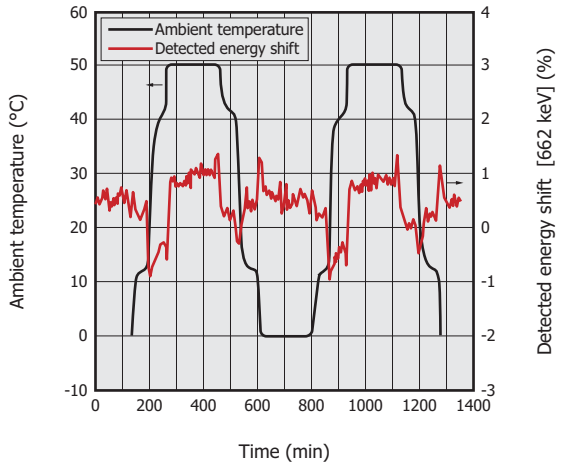
Superb temperature stability

The level of emitted light by the scintillator due to incident gamma-rays and the photosensor sensitivity are temperature dependent. This temperature dependence causes a shift in the detection energy when the ambient temperature changes even when gamma-rays with the same energy are incident and leads to measurement errors and hindrance to radionuclide identification. The C12137 series' gamma-ray detector unit employs a structure with high temperature stability as well as a temperature-compensation circuit. Figure 4 illustrates its excellent temperature stability performance against drastic temperature changes. The temperature stability of the radiation detector module is ±5% max. in the ambient temperature range of 0 to +50 °C.

[Figure 4] Ambient temperature and detected energy shift (typical example)



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Easy integration in devices

Figure 5 shows the cross section of the C12137-01 radiation detection module.

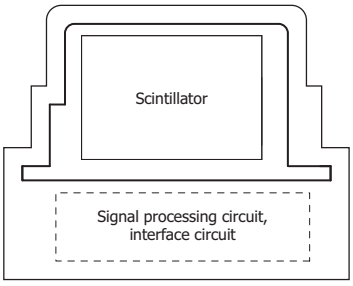
Since the radiation detection module includes a scintillator, photosensor (MPPC), signal processing circuit, interface circuit, and the like in a small case, it can easily be incorporated into portable measuring instruments and in-line measuring instruments.

In the C12137 series, the photosensor MPPC is a small, thin type. The amount of space it takes up is relatively small. The amount of space taken up by the scintillator is predominant. This shows that even though the radiation detection module is small, it can provide high detection efficiency.

Because the radiation detection module is compact, it is advantageous in applications where the radiation dose from the object under measurement is minute. Such applications include inspection of food, beverages, and seafood. In these types applications, the periphery of the detector must be covered with lead to eliminate the

effects of environmental radiation. Because the radiation detection module is compact, the amount of used lead can be reduced, which in turn reduces the volume and weight of the entire device.

[Figure 5] Cross section diagram (C12137-01)



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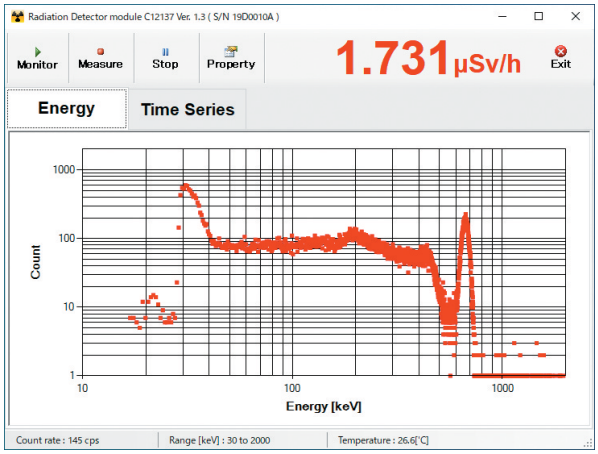
3 How to use

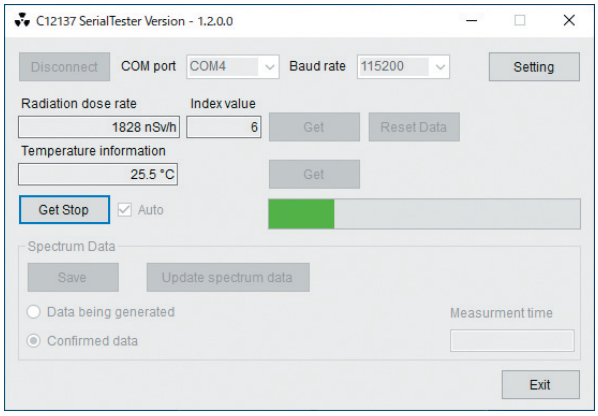
The C12137 series can be connected to a PC via USB or RS-232C. The USB type runs on the bus power.
The sample software provides functions for setting measurement conditions, acquiring and saving data, drawing graphs (USB type only), etc. To help you develop your own application software, function specifications and sample software source code are provided.

[Figure 6] Screen examples of the sample software

(a) USB type



(b) RS-232C type



4 Applications

- Environmental monitoring and mapping
- Screening such as incoming and shipment inspections at the production site
- Incorporation into portable, high sensitivity detectors

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www.hamamatsu.com

HAMAMATSU PHOTONICS K.K., Solid State Division
1126-1 Ichino-cho, Higashi-ku, Hamamatsu City, 435-8558 Japan, Telephone: (81)53-434-3311, Fax: (81)53-434-5184
U.S.A.: Hamamatsu Corporation: 360 Foothill Road, Bridgewater, N.J. 08807, U.S.A., Telephone: (1)908-231-0960, Fax: (1)908-231-1218, E-mail: usa@hamamatsu.com
Germany: Hamamatsu Photonics Deutschland GmbH: Arzbergerstr. 10, D-82211 Herrsching am Ammersee, Germany, Telephone: (49)8152-375-0, Fax: (49)8152-265-8, E-mail: info@hamamatsu.de
France: Hamamatsu Photonics France S.A.R.L.: 19, Rue du Saule Trapu, Parc du Moulin de Massy, 91882 Massy Cedex, France, Telephone: (33)1 69 53 71 00, Fax: (33)1 69 53 71 10, E-mail: infos@hamamatsu.fr
United Kingdom: Hamamatsu Photonics UK Limited: 2 Howard Court, 10 Tewin Road, Welwyn Garden City, Hertfordshire AL7 1BW, United Kingdom, Telephone: (44)1707-294888, Fax: (44)1707-325777, E-mail: info@hamamatsu.co.uk
North Europe: Hamamatsu Photonics Norden AB: Torshamnsgatan 35 16440 Kista, Sweden, Telephone: (46)8-509 031 00, Fax: (46)8-509 031 01, E-mail: info@hamamatsu.se
Italy: Hamamatsu Photonics Italia S.r.l.: Strada della Moia, 1 int. 6, 20020 Arese (Milano), Italy, Telephone: (39)02-93 58 17 33, Fax: (39)02-93 58 17 41, E-mail: info@hamamatsu.it
China: Hamamatsu Photonics (China) Co., Ltd.: B1201, Jiaming Center, No.27 Dongsanhuan Beilu, Chaoyang District, 100020 Beijing, P.R.China, Telephone: (86)10-6586-6006, Fax: (86)10-6586-2866, E-mail: hpc@hamamatsu.com.cn
Taiwan: Hamamatsu Photonics Taiwan Co., Ltd.: 8F-3, No. 158, Section2, Gongdao 5th Road, East District, Hsinchu, 300, Taiwan R.O.C. Telephone: (886)3-659-0080, Fax: (886)3-659-0081, E-mail: info@hamamatsu.com.tw

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