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NEW

MEMS-FPI spectrum sensor

C13272-01

Ultra-compact near infrared spectrum sensor that integrates MEMS tunable filter and photo-sensor

The MEMS-FPI spectrum sensor is a ultra-compact sensor that houses a MEMS-FPI (Fabry-Perot Interferometer) tunable filter that can vary its transmission wavelength depending on the applied voltage and InGaAs PIN photodiode in a single package. The spectral response range is 1550 to 1850 nm. It is suitable for installation in compact devices for identifying materials in plastic and solutions and other similar applications.

Features

- **Built-in Hamamatsu InGaAs PIN photodiode single element chip**
- **Spectral response range: 1550 to 1850 nm**
- **Ultra-compact: TO-5 package**
- **Ultra light: 1 g**
- **Hermetically sealed package: high reliability under high humidity**
- **Built-in thermistor**

Applications

- **Screening of plastic, solutions, and the like**
- **Gas detection**
- **Installation into mobile measuring devices**
- **Use in combination with portable devices such as smartphones and tablets.**

Absolute maximum ratings (Ta=25 °C, unless otherwise noted)

Parameter	Value	Unit
Filter control voltage*1	$V_{\lambda 1550nm}$ + 0.5	V
Photosensor reverse voltage	1	V
Photosensor forward current	10	mA
Operating temperature*2	-40 to +85	°C
Storage temperature*2	-40 to +125	°C
Recommended soldering conditions	260 °C or less, within 10 s	-

*1: Applying a voltage that is +0.5 V or higher than $V_{\lambda 1550nm}$ (filter control voltage to transmit light at λ=1550 nm) at a specific temperature may damage the MEMS-FPI tunable filter. For $V_{\lambda 1550nm}$ of individual products at Ta=25°C, see the final inspection sheet.

*2: No condensation
When there is a temperature difference between a product and the surrounding area in high humidity environment, dew condensation may occur on the product surface. Dew condensation on the product may cause deterioration in characteristics and reliability.

Note: Exceeding the absolute maximum ratings even momentarily may cause a drop in product quality. Always be sure to use the product within the absolute maximum ratings.

Electrical and optical characteristics of MEMS-FPI spectrum sensor (Ta=25 °C, unless otherwise noted)

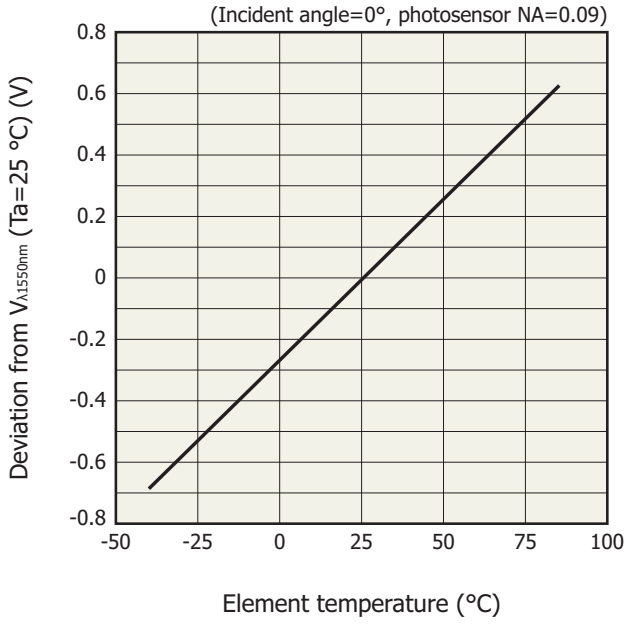
Parameter	Symbol	Min.	Typ.	Max.	Unit
Spectral response range*3	λ	-	1550 to 1850	-	nm
Spectral resolution (FWHM)*4	-	-	-	20	nm
Wavelength temperature dependence*5	-	-	-	0.9	nm/°C
Wavelength reproducibility*6	-	-	±2	-	nm
Settling time (0 V→Vλ1550nm)*7	-	-	1	-	ms
Dark current*8	ID	-	4	40	nA
Thermistor resistance	-	9.6	-	10.4	kΩ

*3: Use a band-pass filter that cuts wavelength outside the spectral response range.
*4: Incident angle=0°, photosensor NA=0.09
*5: λ=1550 nm
*6: When filter control voltage, incident light condition, and usage environment, etc. are constant
*7: Time for the output signal to reach 99% of the stable signal level when the control voltage of the MEMS-FPI tunable filter is varied from 0 V to Vλ1550nm
*8: VR=0.5 V

Electrical and optical characteristics of built-in InGaAs PIN photodiode (Ta=25 °C, unless otherwise noted)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Photosensitive area	A			ϕ0.1		mm
Spectral response range	λ			900 to 2100		nm
Peak sensitivity wavelength	λp		1800	1950	2050	nm
Photosensitivity	S	λ=λp	1.0	1.2	-	A/W
Detectivity	D*	λ=λp	9×10^{10}	2.5×10^{11}	-	cm·Hz$^{1/2}$/W
Noise equivalent power	NEP	λ=λp	-	4×10^{-14}	9×10^{-14}	W/Hz$^{1/2}$
Terminal capacitance	Ct	VR=0 V, f=1 MHz	-	8	20	pF

Filter control voltage vs. element temperature (typical example)



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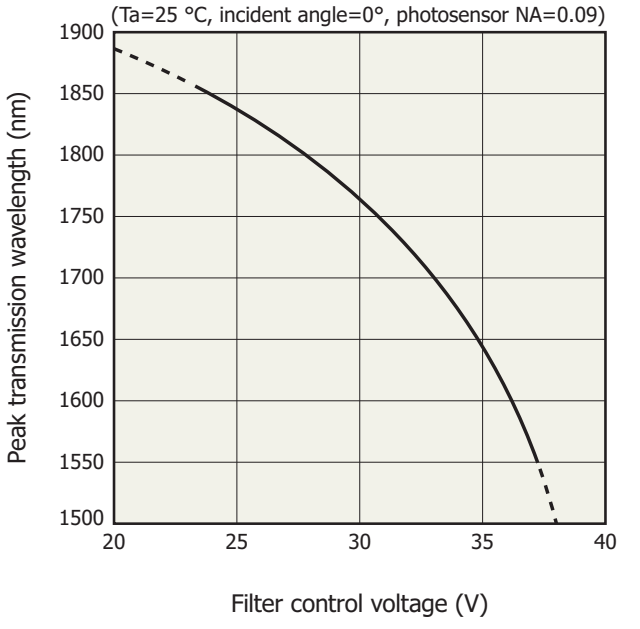
Peak transmisson wavelength vs. filter control voltage (typical example)



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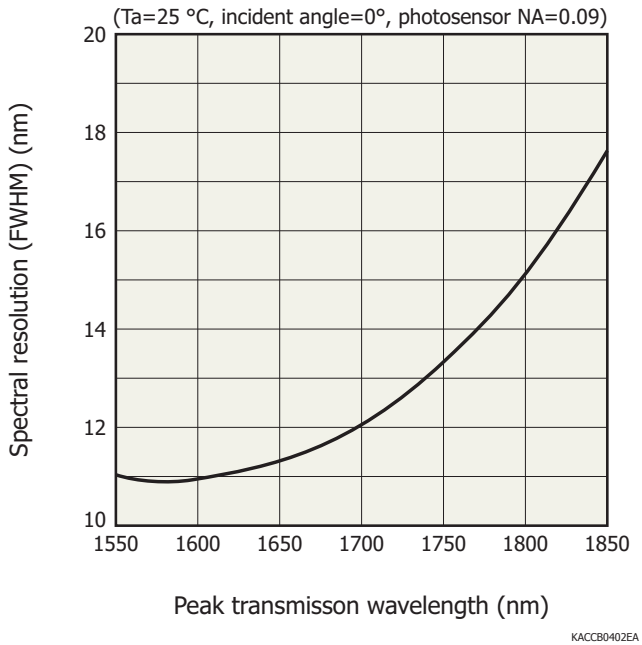
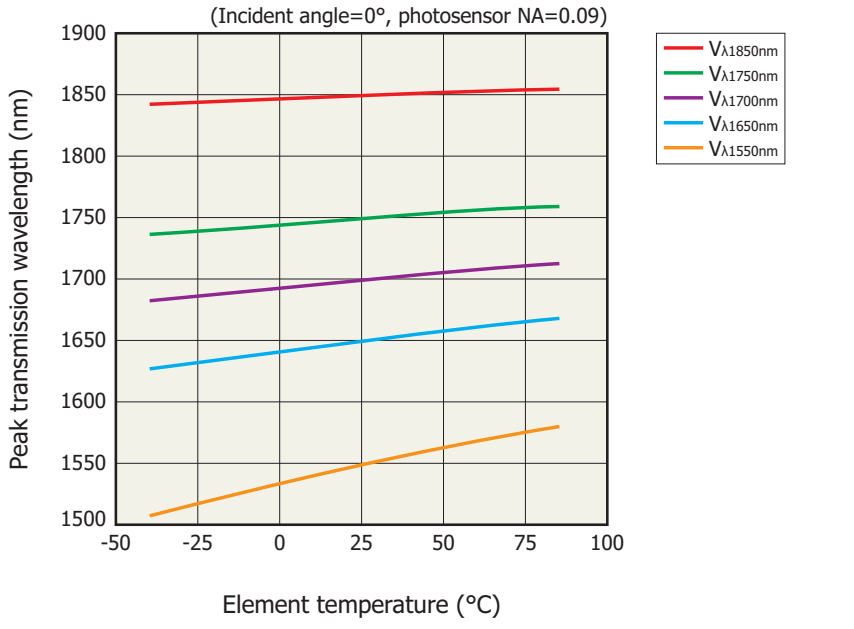
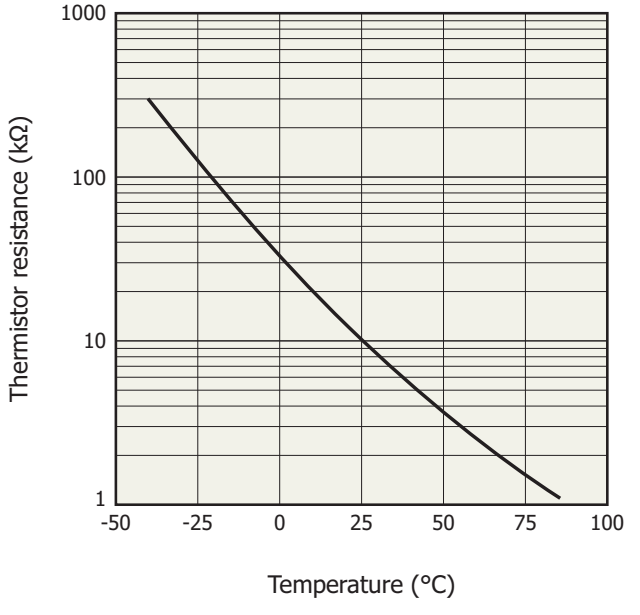
Spectral resolution vs. peak transmisson wavelength (typical example)



Peak transmission wavelength vs. element temperature (typical example)



Thermistor resistance vs. temperature (typical example)



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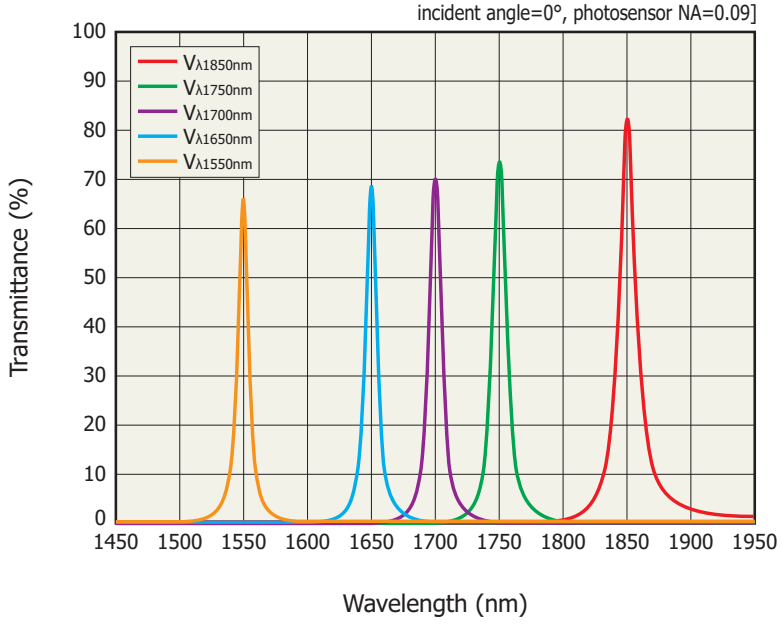
Transmittance of MEMS-FPI tunable filter vs. wavelength (typical example)

[Ta=25 °C, input line spectrum, line spectrum resolution (FWMH)= 3 nm max., incident angle=0°, photosensor NA=0.09]



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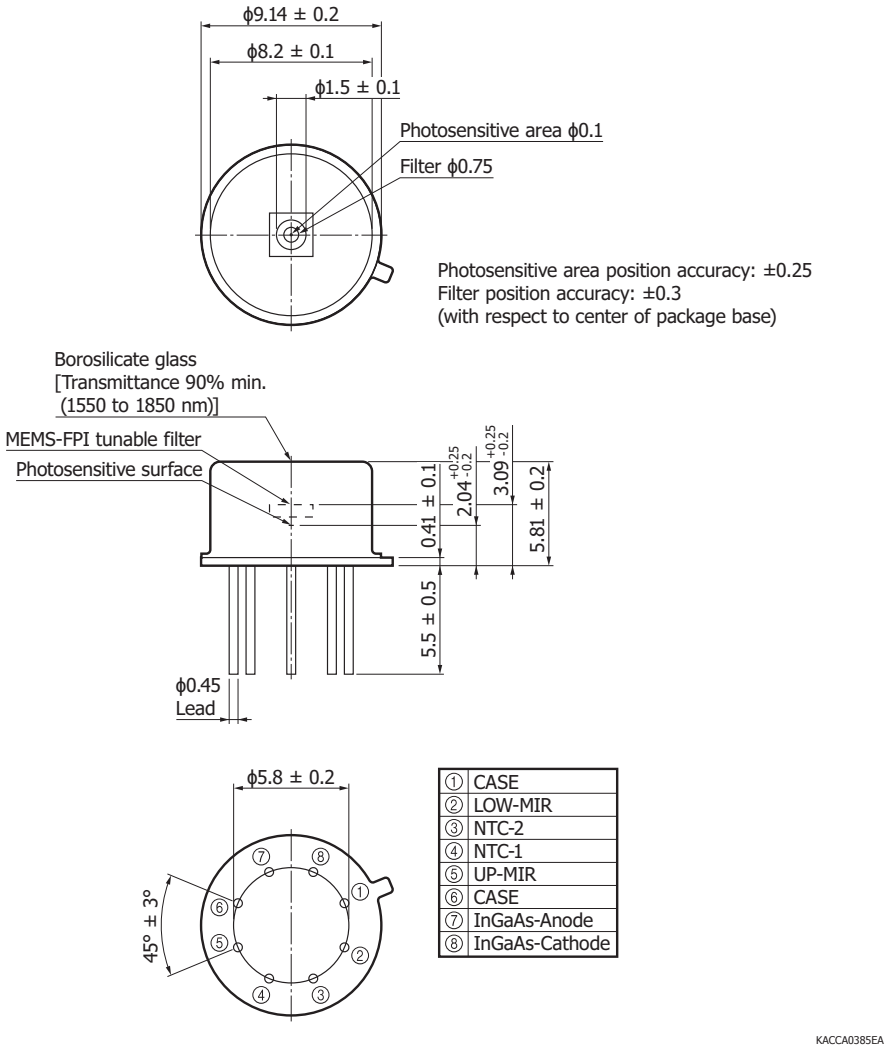
- Unwanted transmission in a range outside the spectral response range may occur due to higher order mode and the like as a MEMS-FPI tunable filter's feature. Use of a band-pass filter is recommended for removing this effect if a white light is taken for a source.
- There is tolerance in filter control voltage for arbitrary peak transmission wavelength from unit to unit. The individual data for $V_{\lambda 1850nm}$ and $V_{\lambda 1550nm}$ at Ta=25 °C is to be described in an inspection sheet attached with a product on delivery.

Dimensional outline (unit: mm)



Pin connections

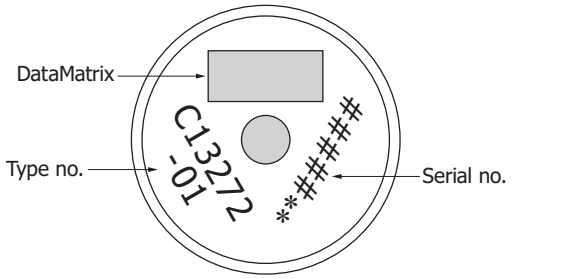
Pin no.	Name	Input/Output	Description
1	CASE	-	Case connection
2	LOW-MIR	Input	MEMS-FPI tunable filter lower electrode
3	NTC-2	Output	For thermistor
4	NTC-1	Output	For thermistor
5	UP-MIR	Input	MEMS-FPI tunable filter upper electrode
6	CASE	-	Case connection
7	InGaAs-Anode	Output	
8	InGaAs-Cathode	Output	

Marking information

Marking item	Description
DataMatrix	Shape: rectangle Cell size: 0.14 × 0.14 mm Symbol size: 12 × 26 cell Input information: C13272-01, **###### ("Type no." + "," + "Serial no.")
C13272-01	Type no.
******	Serial no. **: information on year and month #####: number of five digits (number of individual product)

Note: KEYENCE 2-D code reader SR-1000 is recommended for reading the DataMatrix.

■ Marking on cap



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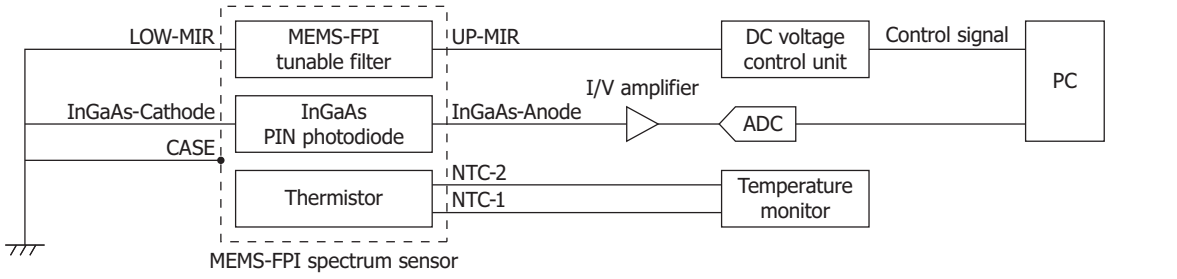
Connection example



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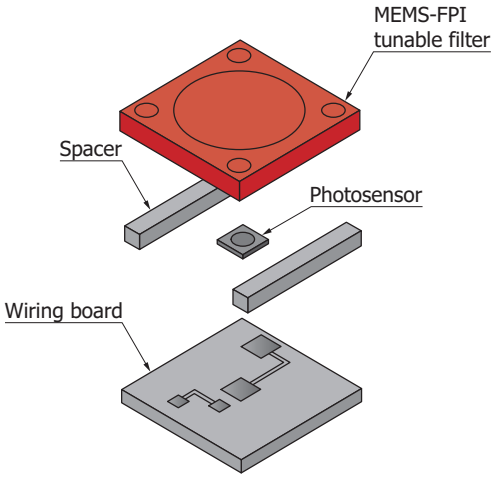
MEMS-FPI spectrum sensor structure

The MEMS-FPI spectrum sensor is composed of a MEMS-FPI tunable filter, photosensor (photodiode), and the like. It has a simple structure in which a MEMS-FPI tunable filter and photosensor is arranged on the same axis as the direction of the incident light. Though this product is a spectrum sensor, it uses a single-element photosensor and does not require an expensive multichannel photosensor.

Internal structure



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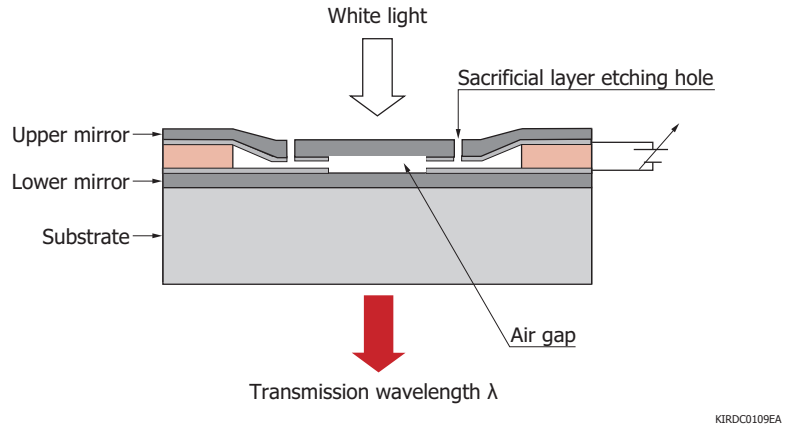
MEMS-FPI tunable filter

The MEMS-FPI tunable filter has an upper mirror and a lower mirror that are placed opposite each other with an air gap in between them. When a voltage is applied across the mirrors, an electrostatic attractive force is produced to adjust the air gap. To facilitate this action, the upper mirror has a membrane (thin film) structure. If the air gap is mλ/2 (m: integer), it functions as a filter that allows wavelengths near λ to pass through. When the filter control voltage is increased, the air gap is narrowed by the electrostatic attractive force, and the transmission peak wavelength shifts to the short-wavelength side.

MEMS-FPI tunable filter cross section



Precautions

Note the following when handling the product and also after installing into a device.

■ Handling
· When touching the product, it is recommended to wear gloves or use tweezers. Touching the product with bare hands may cause degradation in characteristics and plating corrosion and may lead to problems with solder wettability.
· Perform work in a clean place.

■ Filter control voltage
· Apply filter control voltage as defined by the absolute maximum ratings. Applying a filter control voltage exceeding the absolute maximum ratings may damage the MEMS-FPI tunable filter.

■ Static electricity
· The MEMS-FPI spectrum sensor is an electrostatic sensitive device. When handling the product, precautions need to be taken to avoid damage and deterioration due to static electricity.

Related information

www.hamamatsu.com/sp/ssd/doc_en.html

■ Precautions
· Disclaimer
· Safety consideration

■ Technical information
· MEMS-FPI spectrum sensor/Q&A
· Infrared detectors

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