

Mini-spectrometer [SMD series] C14384MA-01

# World's Smallest Grating Type Spectrometer is Expanding the Future of Spectrophotometry



Spectrophotometry, which examines the light spectrum emitted or absorbed by materials and analyzes their composition, is used in a wide variety of fields including food, agriculture and medicine. Up until now, spectrophotometry was typically performed in a chemical laboratory using large benchtop spectrometers.

For many years, Hamamatsu has been developing compact spectrometers to meet the needs for performing measurements on-site using portable instruments. The newly released SMD series C14384MA-01 represents a culmination of years of work designing and improving our past compact spectrometers. The result is the world's smallest near infrared spectrometer (according to our research).

This SMD series spectrometer is expected to be used in hand-held instruments with limitations to their size or weight, simultaneous multipoint measurements, and other applications.

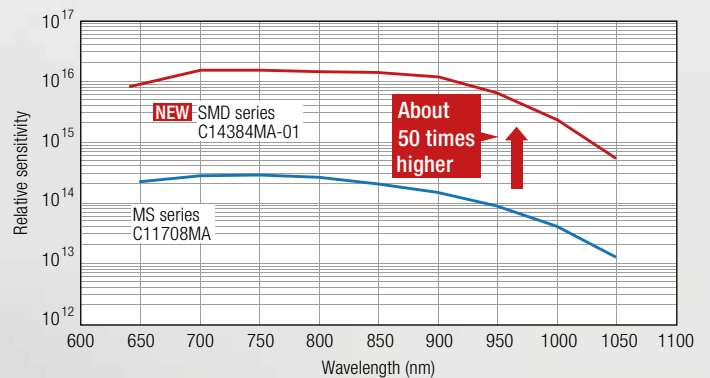
### Remarkably compact next-generation grating type spectrometer

The most distinctive feature of the SMD series is that while the volume has been reduced 40 to 1 and the weight 30 to 1 as compared to the previous mini-spectrometer MS series, the sensitivity in the near infrared region has been increased about 50 times by employing the latest high-sensitivity image sensor.

This makes it easier to mount the device in portable spectrophotometers quadcopters and drones, with limitations for size and weight. It also allows the device to be used in various other applications such as making multipoint measurements by using several units of this device in parallel and making observations by attaching the device directly to a living body.

Moreover, because this spectrometer combines a grating and an image sensor, it can acquire changes in the light intensity for each wavelength as continuous data to be used in more advanced analysis methods.

Furthermore, a flexible cable connection has been employed to improve the usability of the device whilst also offering high levels of freedom in mountability.



Sensitivity comparison (typical example)



# In Focus

## High sensitivity to near infrared light, suitable for food and agricultural inspection

In recent years, there has been a growing global concern for safety and productivity in the food and agriculture fields and there are high expectations for spectrophotometry, which is an easy and efficient inspection method.

The SMD series provides high sensitivity to near infrared light in the range of 640 nm to 1,050 nm, which allows measurements of moisture, sugar, organic acids and other components derived from organisms. This makes them suitable not just for food and agricultural applications, but for many other fields and applications such as medical and pharmaceutical.

## Hamamatsu Photonics technologies applied to world's smallest devices

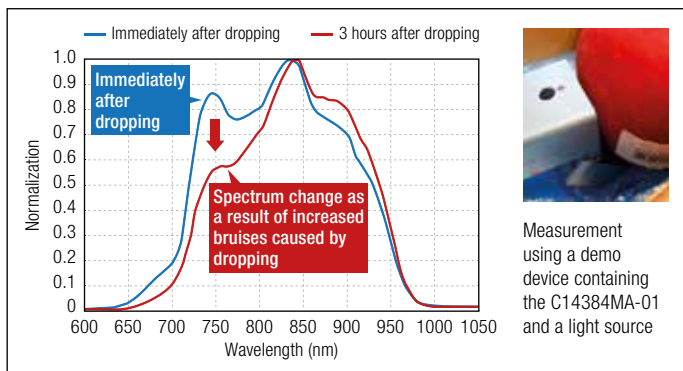
The world's smallest grating type spectrometer was made possible through the integration of the unique optical design technologies developed by Hamamatsu Photonics and the MOEMS technology that achieves high quality in mass production.

In a grating type spectrometer, the positional relationship is important between the slit passing the light in, the grating separating the light into each wavelength, and the sensor. However, the process of micro-machining gratings was approaching its limits using the previous structure for minimizing the number of reflections in order to achieve the needed accuracy.

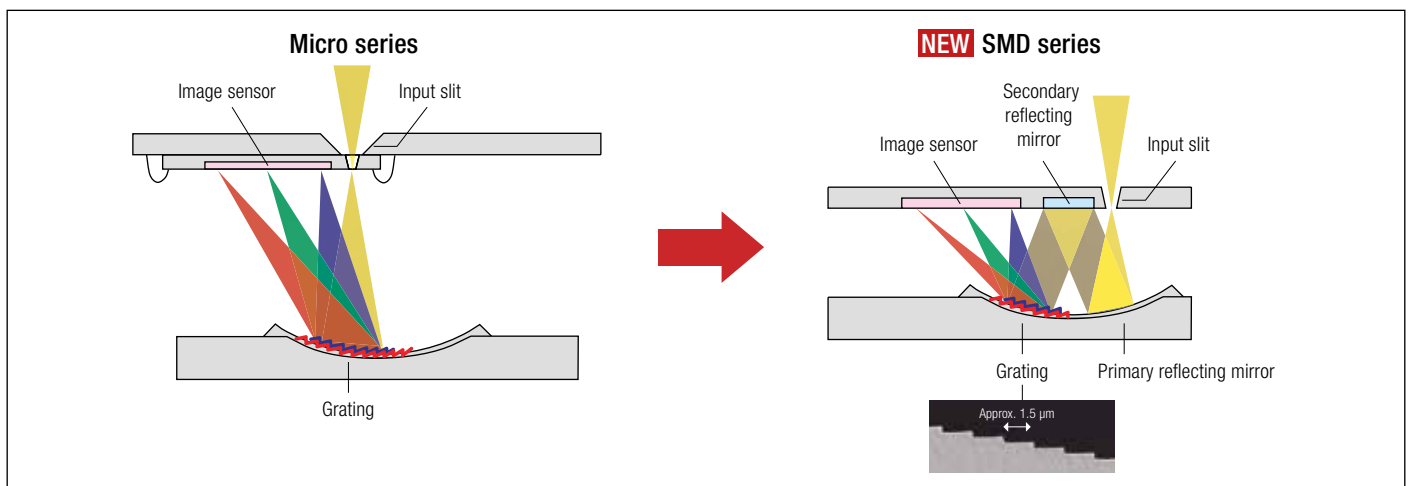
To overcome this limitation, the SMD series was developed with a completely new approach. Ultra-miniaturization was accomplished by employing optics using multiplex reflection that utilizes MOEMS technologies such as replication technology that replicates sub-micron-level shapes through nanoimprints and high-added-value CMOS sensor technology that integrates a slit and mirror.

In addition, the latest high-sensitivity image sensor has successfully increased the sensitivity even further. Low cost is another feature achieved by consolidating the input slit, secondary reflecting mirror, and image sensor all on a single chip to reduce the number of components.

Example: spectral measurement of apple (observation of bruises caused by dropping)



## Optical system layouts



# Mini-spectrometer SMD Series C14384MA-01

## Ultra-compact grating type spectrometer with high sensitivity in the near infrared

The C14384MA-01 is an ultra-compact grating type spectrometer that provides high sensitivity in the near infrared region. With the employment of Hamamatsu's unique optical design and latest high-sensitivity image sensor, the sensitivity in the near infrared region has been increased by about 50 times while the volume has been reduced by about 40 times as compared to the previous mini-spectrometer MS series.

### Features

- Ultra-compact: 11.7 x 4.0 x 3.1 mm
- Ultra-lightweight: 0.3 g
- Spectral response range: 640 to 1,050 nm
- High sensitivity: 50 times ( $\lambda = 1,000$  nm) the previous product (C11708MA)
- Flexible cable included



C14384MA-01

### Specifications

Parameter	Specification	Unit
Spectral response range	640 to 1,050	nm
Spectral resolution (FWHM)	640 to 800 nm	25 max.
	800 to 1,050 nm	20 max.
Wavelength reproducibility	$\pm 0.5$	nm
Wavelength temperature dependence	$\pm 0.1$	nm/deg. C.
Spectral stray light	-23 max.	dB
Slit size (H x V)	15 x 300	$\mu\text{m}$
Numerical aperture	0.22	—
Video rate	5	MHz
Dimensions (W x D x H)	11.7 x 4.0 x 3.1*	mm
Weight	0.3	g

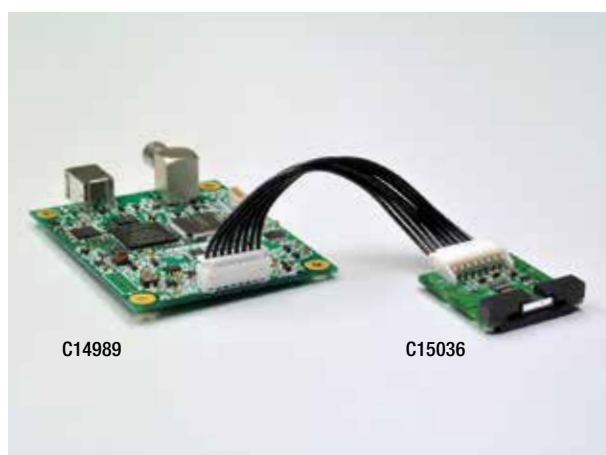
\* Flexible cable not included

### Evaluation kit (C14989 + C15036)

This evaluation kit can be used to easily evaluate the characteristics of the SMD series C14384MA-01. The C14989 is an evaluation circuit (with evaluation software and connection cable). The C15036 is a circuit with a mini-spectrometer head (C14384MA-01 built in). By connecting the evaluation kit to a PC through a USB cable, you can easily evaluate the characteristics of the C14384MA-01 using the dedicated software.

### Features

- Initial evaluation circuit for the C14384MA-01 mini-spectrometer
- The wavelength conversion factor of the mini-spectrometer can be entered from a PC
- High A/D resolution (16-bit)
- Operated only with USB power supply



C14989

C15036