

# Mini-spectrometers

This document describes general precautions for using Hamamatsu mini-spectrometers.

If the product comes with special precautions on the delivery specification sheet, then be sure to strictly comply with those instructions.

## 1. All models

- Mini-spectrometers (hereafter “the product”) are high precision optical components. Do not apply excessive vibration and shock to the product. Avoid operating and storing it in dusty locations or in areas exposed to water, high temperature or high humidity.
- When cleaning the enclosure, wipe it with a clean, soft, dry cloth. Do not use organic solvents such as thinner and acetone.
- Do not apply excessive force to the connector. Doing so may cause a poor connection or damage the connector.
- Use the product at incident light levels that do not cause the A/D count of each pixel to become saturated. Correct measurement may not be possible when some pixels become saturated. Set a shorter integration time if the A/D count is saturated. If the integration time cannot be shortened, we recommend you use a neutral density filter.
- Even when no light is input, the product generates an output consisting of an offset component and dark signal. The offset component is not dependent on integration time, but the dark signal is dependent on it.
- Coefficients for converting image sensor pixel numbers into wavelengths are described in the final inspection sheet that comes with each product. For module types, those coefficients are also written into the EEPROM in the mini-spectrometer. However, we do not provide coefficients for converting the output value of each pixel to a value proportional to the incident light level.

## 2. Module type

- The optical connector is exposed to outside air, so when not using the product for extended periods, place a cap on the optical connector or connect the input optical fiber to the connector. When connecting the optical fiber, clean the ferrule on the optical fiber as needed.
- Power supplied through a USB port from a PC is limited to 5 V/500 mA per port due to USB specifications. So power exceeding this limit cannot be supplied to the product. If connecting two or more products to one USB port via a hub, use a hub with a power supply.
- Evaluation software differs according to the product model. Be sure to install the evaluation software that supports the product you will be using.

- Never connect the product to the PC before installing the evaluation software into the PC. This might prevent correctly installing the evaluation software.
- The supported OS is Microsoft® Windows®. Refer to the datasheet or operation manual for details on versions and platforms.
- Depending on the PC model, the power-saving mode or screensaver might interrupt power supplied from the USB port. Interruption of power supplied from the USB port will also stop the product operation and might cause problems when power is later resupplied from the PC after recovering from power-saving or screensaver mode. If the PC causes this problem, then please disable the power-saving mode and screensaver. (See the PC operation manual to find PC functions and settings.)

(1) TG-CCD/TM-CCD series

An external power supply is required to operate the internal image sensor. Use the AC adapter that comes supplied with the product.

(2) TG-cooled series

- An external power supply is required to operate the internal thermoelectric cooler and cooling fan. Please prepare a low noise power supply and connect it to the product using the connector that came supplied with it. Use caution when turning on the power supply because an inrush current flows at that time. Table 1 shows the maximum current in steady state and typical inrush current.

[Table 1] Maximum current in steady state and typical inrush current (TG-cooled series)

Power supply	Mini-spectrometer type	Supply voltage (V)	Maximum current in steady state (A)	Typical inrush current (A)
For thermoelectric cooler	C9913GC	5	1.8	5
	C9914GB		2.8	
	C11118GA			
For cooling fan	All models	12	0.2	0.4

[Power supply examples]

Multi-output power supply: PW18-1.3ATS (Texio Technology Corporation)

Unit type power supply (+5 V): GT2.5-5-T (Cosel Co., Ltd.)

(+12 V): PBA10F12-N (Cosel Co., Ltd.)

- When the cooling fan filter becomes dirty, replace it by following the procedure described in the product operation manual.
- Do not block the air intake and exhaust ports for the cooling fan during use. If the temperature inside the product rises too high, the internal safety circuit acts to stop product operation. However, high temperatures may cause a malfunction. If product operation stopped due to the safety circuit, then immediately turn off the external power supply and disconnect this product from the USB port of the PC. Then, check and eliminate the cause of the problem. Resume operation after making sure that the product temperature has dropped to room temperature.

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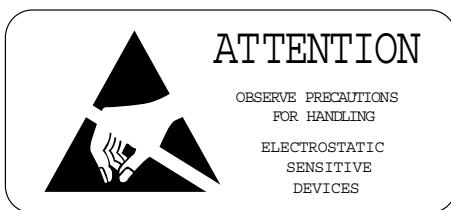
## 3. Head type

The electrical terminals of the head type are connected to the internal image sensor signal terminals. Take the following precautions on static electricity management, circuit board design, and handling, etc.

### 3-1. Static electricity management

Electrostatic sensitive products come with an electrostatic warning label on the product packing. Handling of the product requires taking precautions on the following points to avoid product damage and deterioration due to static electricity.

【Figure 1】 Electrostatic warning label



#### (1) Workplace and facilities, etc.

- Lay a conductive mat (750 k $\Omega$  to 1 G $\Omega$ ) on the surface of the workbench and ground it.
- Use conductive flooring material or lay a conductive mat on the workplace floor and ground it.
- Ground all manufacturing equipment and inspection devices.
- Keep moisture at approximately 50%. Low humidity tends to cause static electricity and high humidity is prone to moisture absorption.

#### (2) Handling

- Using an ionizer or similar item to eliminate electrical charges is recommended when handling the product.
- Wear anti-static clothing and conductive shoes (100 k $\Omega$  to 100 M $\Omega$ ).
- Attach a wrist strap (having protective resistance of 750 k $\Omega$  to 35 M $\Omega$ ) directly to the skin, and ground the strap. If the wrist strap does not include protective resistance, there is a risk of electric shock hazard due to electric leak. Also wear conductive finger sacks or gloves.
- Tools such as tweezers used to handle the product may sometimes become electrically charged. Connect a ground line as needed.
- Use a soldering iron with an insulation resistance of 10 M $\Omega$  or higher. The soldering iron tip should be grounded.
- If the product is induction-charged and contacts with a metal, excessive current may flow due to electrostatic discharge causing damage to the product. To prevent induction charging, keep objects (insulators such as plastic and vinyl, PC display monitors and keyboards, etc. that may possibly be electrically charged) away from the product. The product may be induction-charged even by just bringing such objects close to the product. If keeping such objects near the product is unavoidable, then use an ionizer, etc. to remove electrostatic charges from the objects that are apt to be electrostatically charged.
- Friction on the product causes electrostatic charges. If such friction is unavoidable, then remove the electrostatic charges using an ionizer, etc.

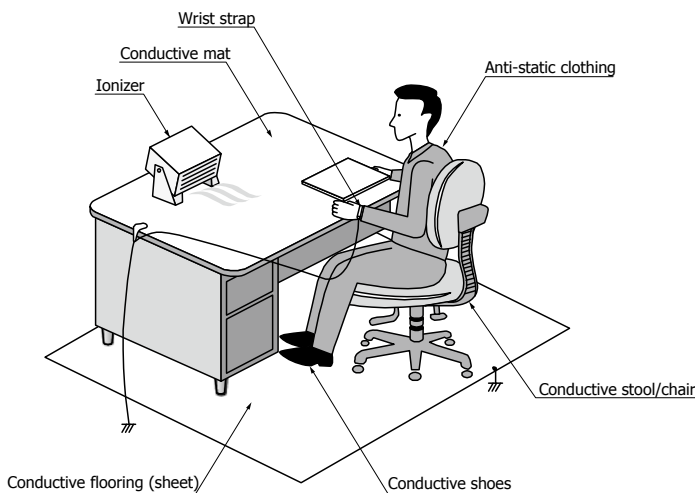
- Peripheral devices must be properly grounded so that no surges are applied to the product by a leakage voltage. Do not allow a voltage exceeding the absolute maximum ratings to be applied to the product from the measurement instrument, etc. (This tends to occur during ON/OFF switching of power sources, so use caution.) If there is the possibility of a surge voltage, insert a filter (made up of a resistor and capacitor) to protect the product. During operation do not attach or detach any connector, etc. that are connected to the power supply line or output line.

(3) Carrying, storage and packing

- Place the MS series and micro-spectrometers in a conductive case by inserting the leads into the conductive mat (for shorting leads). For the RC series (head type), put the product in a conductive case. The PC board to mount the head type should also be put in a conductive case. Avoid using plastic or styrofoam as they may generate static electricity by vibration during shipping, etc. causing breakdown or deterioration of the head type.
- Use a conductive carrying case and storage shelf.
- Avoid storing the product near equipment that may generate high voltage or high electromagnetic fields.
- When packing the product, short the leads so that they are at the same electrical potential, and use conductive packing materials.

Note: It is not always necessary to provide all the anti-electrostatic measures stated above. Implement these measures according to the extent of deterioration or damage that may occur.

【Figure 2】 Electrostatic countermeasure example



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### 3-2. Precautions for designing the circuit board

Driver circuits for mini-spectrometers are unique in that they contain a light input section and both digital and analog circuits, so take the following precautions when designing the circuit board.

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(1) Circuit board surface to mount a mini-spectrometer

- The circuit board surface to mount a mini-spectrometer should be inside an optical system that blocks external light. So, attaching variable resistors, etc. to the back side of the circuit board surface makes it easier to adjust them.

(2) Circuit board

- The mounting holes for equipment in the circuit board should be made slightly larger than the screw diameter in order to allow making fine adjustments of the photosensitive area position. Additionally, use a circuit board that will hardly warp due to temperature variations in order to prevent the focus position from shifting.

(3) Circuit components

- Changes in mini-spectrometer temperature will also cause changes in characteristics such as the sensitivity and dark current. Using circuit components that emit as little heat as possible is recommended to suppress a temperature rise in the mini-spectrometer. Besides keeping the product away from heat-emitting circuit components, please take other measures for heat dissipation.

(4) Grounds

- To prevent digital circuit section noise from intruding into the analog circuit section through the ground, isolate the digital section ground from the analog section ground, and use a thicker ground line to lower its resistance.

(5) Digital signals

- The input clock pulse line causes voltage fluctuations, so separate it as far as possible from the video signal line and voltage supply line. Apply the input clock pulses at the specific timing and voltage to the product connection terminals on the circuit board. Additionally, extra caution is needed during high-speed operation.

(6) Analog signals

- Keep the wiring width and wiring distance between the video output terminal and amplifier as short as possible. For the product with the active video and dummy video, set the same wiring width and wiring distance for both the active video and dummy video side signal lines so that they have the same capacitance as much as possible. To prevent noise intrusion into the output signal, keep the video signal line away from digital signal lines such as clock lines that are subject to voltage fluctuations, and also make sure that the video signal lines and digital signal lines do not cross each other on the front or back of the circuit board. This reduces clock feed-through.

(7) Supply voltage

- Fluctuations in mini-spectrometer supply voltage will cause unstable output characteristics. To avoid this, use a power supply having minimal voltage fluctuations, and ensure that the mini-spectrometer supply voltage is not affected by external voltage fluctuations. Do not allow voltage fluctuations on the power supply lines caused by circuit board component operation to change the product supply voltage. Separate the power supply lines to the product as far away as possible from digital signal lines such as clock lines where the voltage changes.

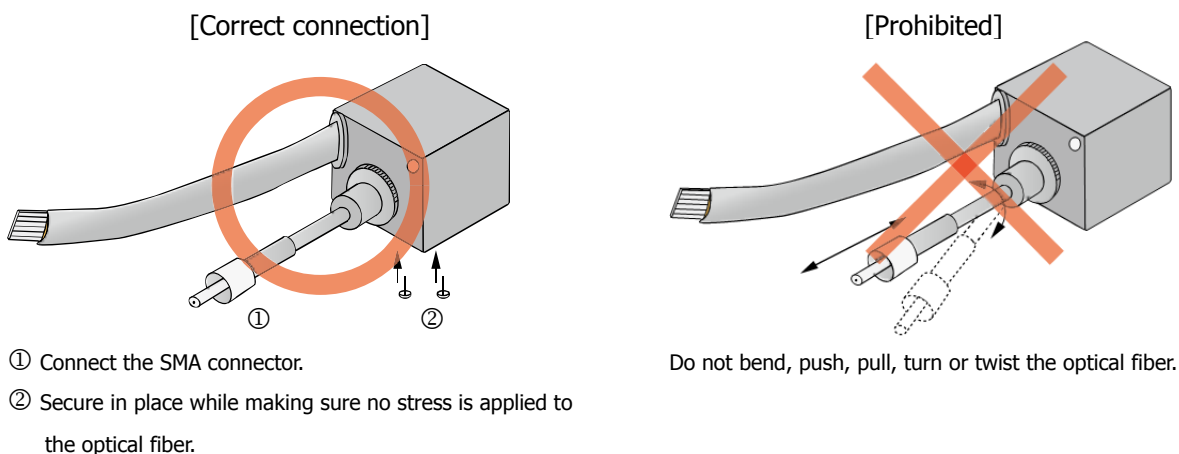
## (8) Others

- Noise generated from mechanically driven sections, etc. in equipment, into which the product and circuit board are incorporated, may enter the output signal. Perform the circuit board shielding securely.
- Characteristics may deteriorate during operation at high temperature. Take heat dissipation measures as required.

### RC series

- Avoid excessive or repeated bending and stretching of the flexible board, which may cause an open-circuit fault. Do not bend the flexible board to the point where folds or creases occur.
- Avoid pulling, twisting or excessive bending of the optical fiber, which may damage the optical components in the mini-spectrometer or the optical fiber itself. To prevent applying stress to the optical fiber, provide slotted mounting holes in the equipment enclosure where the head-type mini-spectrometer is to be installed. Make sure these slotted holes are aligned along the same direction as the optical fiber. When installing the mini-spectrometer, first clamp the optical fiber SMA connector and then use the slotted holes to secure the mini-spectrometer at a position where the optical fiber is free from stress.

[Figure 3] Precautions when connecting input optical fiber



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### MS series, Micro-spectrometer

#### Handling

##### (1) Window material

- Do not rub the window surface hard or do not apply strong pressure to the window to prevent scratches or cracks. Do not allow the window surface to come in contact with a sharp or hard object.
- If dust is adhering to the window, blow it away with a blow gun. Use an ionizer along with the blow gun to remove static electricity. When handling ESDS (electro-static charge sensitive) products, use an ionizer to remove static electricity.
- If oil or grease adheres to the window, then gently wipe it away with cotton swabs, etc. moistened with ethyl alcohol so that the window is not scratched. Rubbing strongly or wiping the same section over and over may decrease the electrical and optical characteristics, or the reliability.

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- Take precautions to protect the window from contamination or scratches when packing or shipping equipment in which the product is installed.

#### (2) Precautions when mounting

- The product is a precision optical component, so placing excessive loads on the package may cause problems such as package warping or damage, chip peeling, wire breakage, damage to thermoelectric cooler, or poor optical characteristics. Take full precautions when mounting the product on the board, inserting the product into the socket, or installing the heatsink.
- Never handle the product in the following ways since this may cause the package to break.
  - apply repeated stress to the leads.
  - suddenly cool or suddenly heat the product.
- Check the pin connection positions when mounting the product in the socket. Installing the product reversely or in the wrong position may damage the product. Be sure to turn on the power after the product has been properly installed.
- Be aware that inserting the product reversely, inserting it incorrectly, or causing short-circuit between terminals may lead to malfunctions.
- If external force is repeatedly applied to the leads, this may damage the leads. When installing this product in locations subject to vibration, secure it with resin or a holder, etc.

#### (3) Precautions for designing the circuit board

- The packaging of the micro-spectrometer is electrically conductive, so be careful when designing the circuit to avoid short circuit caused by contact with a circuit pattern.

### Soldering

#### (1) Precautions during soldering

- Take sufficient care to make sure that the soldering iron tip temperature and soldering time are correct. Do not attempt soldering at high temperatures or for long periods. Soldering at high temperatures or for long periods may cause the package to crack or the window material to separate from the package.
- It is recommended that the MS series be soldered within 3 seconds at 370 °C or less and the micro-spectrometers within 3.5 seconds at 350 °C or less when soldering by hand, and both be soldered within 10 seconds at 260 °C or less when using reflow soldering.
- Take measures to prevent solder or flux from flying outward and sticking to the light input window, contaminating it.

#### (2) Flux

- Use non-cleaning solder or rosin type flux. Using flux with relatively strong acid or alkali levels or inorganic flux may cause corrosion on the leads.

#### (3) When using a soldering iron

- Set the soldering iron tip temperature by referring to the recommended soldering condition. If you cannot provide these conditions, then grip the root of the lead you are soldering with tweezers or a similar tool to prevent heat from conducting to the product package.

- Do not let the soldering iron directly contact the package section of the product. Direct contact with the soldering iron may cause mechanical or optical damage.

#### Storage

- Avoid exposure to direct sunlight, harmful gases, or dust, or storage in a place with sudden temperature changes.
- Do not lay a heavy object or load on the product or the bag. Also avoid stacking the products or bags when storing them.
- When storing the product for a long period of time, seal it in a moisture-proof package containing silica gel or keep it in a low-humidity desiccator.

## 4. Input optical fibers (option)

- When connecting the input optical fiber, clean the ferrule on the optical fiber as needed.
- Do not bend the HAMAMATSU input optical fibers to a radius smaller than that shown in Table 2. Doing so may break the optical fiber.

[Table 2] Minimum bend radius of input optical fiber

Product name	Type no.	Core diameter ( $\mu\text{m}$ )	Minimum bend radius (mm)
Fiber for UV/visible range (resistance to UV)	A9762-01	600	75
	A9762-02	800	100
	A9762-05	400	50
Fiber for visible/near infrared range	A9763-01	600	66
	A9763-02	800	88
	A9763-05	400	44