

# Compound opto-semiconductors (photosensors, light emitters)

This document describes general precautions for using Hamamatsu compound opto-semiconductors (hereafter called "the product"). Read this along with the "Safety consideration". For image sensors, surface mount type products, and unsealed products (opto-semiconductors whose chip is exposed), refer also to the precautions provided with the corresponding products.

If the precautions are described in the delivery specification sheet, instruction manual, or the like, be sure to strictly comply with those instructions.

## 1. Handling

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

### (1) Basic precautions

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

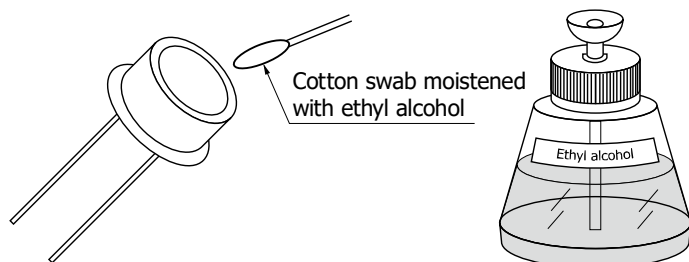
### (2) Window material

- Electrical and optical characteristics may deteriorate if dust, stain, or scratches are on the window material. Dust, stain, or scratches on the window material can degrade light transmittance and sensitivity. In the case of ultraviolet light detection, oil from the fingers can cause a 30% drop in sensitivity. Also, if a very small light spot is detected, scratches on the window material may be the problem.
- To prevent scratches and cracks on the window material, do not apply strong friction, shock, or pressure. Avoid sharp or hard objects from making contact with the window material. In particular, plastic-package and resin-sealed types are prone to scratches, so extra precautions must be taken.
- Use an air blower to remove dust adhering to the window material. For electrostatic sensitive devices, use an ionizer to remove static electricity.
- If oil, grease, or other substances that cannot be removed with an air blower adheres to the window material, gently wipe it away with a cotton swab moistened with ethyl alcohol and the like to prevent the window from being scratched. Rubbing strongly or wiping the same section over and over will cause scratches and degrade the electrical and optical characteristics or the reliability.
- Do not rub the window material with a dry cloth or cotton swab. Doing so may cause scratches or static electricity, resulting in malfunctions.
- Take precautions to protect the window material from stain or scratches when packing or shipping equipment, in which the product is installed.

### (3) Vibration, shock, and stress

- If long-term vibration or frequent or strong shock is applied to the product, the package may break causing the characteristics to be impaired.
- Using the product under external stress may damage the inside of the product or connected parts.
- On some products with optical filters, the filter may fall out if excessive force or continuous vibration is applied to the filter section.

[Figure 1] Gently wipe stain off from the window material using a cotton swab moistened with ethyl alcohol or the like.



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### (4) Cleaning

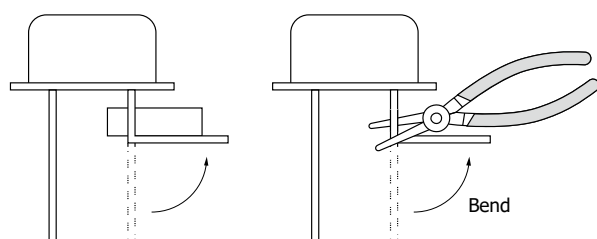
Avoid cleaning with solvent as much as possible. If you must, note the following points.

- Use alcohol solvents such as ethyl alcohol. Particularly with plastic packages, some solvents may cause package erosion or swelling.
- Check that there is no problem with the cleaning method by experimenting in advance.
- Do not use ultrasonic cleaning or steam cleaning as it may cause critical damage to the product. Dip washing is recommended.
- If you use non-cleaning solder to mount the product, do not clean the flux. If you do, leakage or other problems may occur between terminals, which can lead to operation errors.

### (5) Handling leads

- Do not touch leads with bare hands. If stain adheres to the leads, it may cause problems with solder wettability, leakage between terminals, or plating corrosion.
- Design the lead insertion hole spacing of the printed circuit board to match the lead spacing of the product. If the insertion hole spacing of the printed circuit board does not match the lead spacing of the product, do not forcibly insert the product.
- Form or cut leads before soldering. Form or cut leads by holding the root of the leads in place to prevent mechanical stress from being applied to the leads inside the package. Forming the leads from their roots may crack or damage the package. If cutting leads after soldering is unavoidable, do it after the soldered section has solidified.

[Figure 2] Lead forming



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(6) Temperature and humidity

- On some products with optical filters, the light transmittance may degrade due to moisture absorption.
- On plastic-package and resin-sealed types, extended exposure to high temperatures may cause the resin to turn yellow and degrade the transmittance of short-wavelength light.

(7) High power light irradiation

- When high power light is irradiated on a plastic-package or resin-sealed type, the resin may be damaged by the heat.
- High power light irradiation may cause the element temperature to rise, so measures such as heat dissipation are necessary.
- Strong background light or light incident from outside the light input window may affect the product output. Take these into consideration when designing the optical system.

(8) Ultraviolet (UV) light and X-ray irradiation

- Long-term exposure to the UV light or X-ray irradiation will cause product characteristics to deteriorate. Avoid exposing the product to any unnecessary UV light or X-ray irradiation. The product usage environment may require countermeasures to block unnecessary UV light or X-rays.

(9) Electrical connection

- Depending on the power supply, a surge (a phenomenon in which an extremely high voltage is generated instantaneously) may occur at power-on, causing damage to the product. Select an appropriate power supply.
- On some products that require multiple biases to be applied, the order in which the biases need to be applied is defined.
- The light emitter is instantly destroyed by the addition of overvoltage, overcurrent, and reverse voltage. When driving the product, be careful not to exceed the maximum rating for even a moment. Do the following to prevent surges.
  - The drive power supply should incorporate protective circuits such as resistors and diodes to prevent overvoltage, overcurrent, and reverse voltage, and capacitors to prevent surge voltages.
  - Always connect the product to the drive power supply with the drive power supply switch turned OFF.

(10) External noise

- Using the product in an environment with high level of electrical external noise may cause the product to operate erroneously. Take measures against peripheral equipment noise.

(11) Various types of stresses

- The product life can be extended (failure rate can be reduced) by reducing (derating) the stress (temperature, humidity, voltage, current, power, etc.) applied to the product. We recommend using values less than the absolute maximum ratings written on the datasheet to reduce the possibility of failure. In addition, avoid unnecessary high level of stress.

## 2. Storage

Be sure to strictly comply with the storage conditions described in the delivery specification sheet, instruction manual, or the like.

- Avoid wetting, exposure to direct sunlight, harmful gas, or dirt, or storage in a place with sudden temperature changes.
- For products packaged in moisture-proof bags, do not open the bag until immediately before using the product so as to prevent oxidation or contamination of leads or moisture absorption of the package. Even in the unopened moisture-proof package state, avoid wetting, exposure to the direct sunlight, harmful gas, or dirt, storage in a place with sudden temperature changes, and humidity increase by stopping the air-conditioner during night or the like.
- Do not lay a heavy object or load on the product or the package. Do not store by stacking the products or packages.
- When storing the products after transferring them into another case, use a case that is difficult to be charged with static electricity. When storing electrostatic sensitive devices, be sure to put them in a conductive case.
- If the product is stored in a poor environment (conditions exceeding the recommended storage conditions [Table 1]), the solderability may lower, leads may be rusted, or electrical characteristics may decrease. When the storage conditions are described in the datasheet, delivery specification sheet, or the like, be sure to comply with them.
- For products packaged in moisture-proof bags, if the sealing of the moisture-proof package is faulty, the silica gel discolours from navy blue to red by moisture absorption. Check the silica gel for discoloration when unpacking the products. If any fault is found, contact Hamamatsu.
- For tape packing products, tape unwound from a reel must not be left in that state for long periods. Also, do not bend the tape more than necessary.
- For products that have moisture sensitivity level (MSL) indicated in the datasheet, delivery specification sheet, or the like, follow Table 2.

[Table 1] Recommended storage conditions

Parameter		Storage conditions	Note
Product not packed in moisture-proof bag		Temperature: 15 °C to 35 °C Humidity: 45% to 75%	
Product packed in moisture-proof bag	Unopened product	Temperature: 15 °C to 35 °C Humidity: 75% or less Period: within 12 months	Be aware that the moisture-proof package gets a hole if a sharp object is in contact with it.
	Opened product	Temperature: 15 °C to 35 °C Storage period in a low-humidity desiccator: within 3 months	

[Table 2] Moisture sensitivity level and storage conditions

Moisture sensitivity level (MSL)	Storage period	Storage temperature and humidity
1	Unlimited	30 °C or less, 85 % or less
2	1 year	30 °C or less, 60 % or less
2a	4 weeks	
3	168 hours	
4	72 hours	
5	48 hours	
5a	24 hours	

### 3. Soldering

The correct soldering temperature, time, and method may differ depending on the type of package. Further, effects on the product vary depending on the circuit board, soldering iron, flow bath, reflow oven, and so on that are used. When setting the soldering conditions such as the soldering temperature and time, check that problems do not occur in the product by testing out the conditions in advance by referring to the recommended soldering conditions [Table 3]. When the soldering conditions are described in the datasheet, delivery specification sheet, or the like, be sure to comply with them.

[Table 3] Recommended soldering condition examples

Package	Soldering temperature	Soldering time	Note
Metal	260 °C or less	10 s or less	
Ceramic	260 °C or less	5 s or less	Solder at a point at least 1.5 mm away from the package body. [Figure 3]
Plastic	230 °C or less	5 s or less	Solder at a point at least 1 mm away from the package body.

#### (1) Points requiring special caution

- Consider carefully the soldering iron tip temperature and soldering time, and do not solder at high temperatures or for long periods. If soldering is performed at high temperatures or for long periods, package cracks or window material peeling may occur.
- Take measures to prevent solder or flux from flying outward, sticking to the window material, and contaminating it.

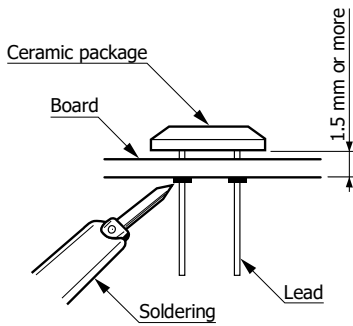
#### (2) Flux

- 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

- To prevent effects from electrostatic charges, use a grounded soldering iron whose insulation resistance is 10 MΩ or more.
- Set the soldering iron tip temperature by referring to the recommended soldering condition examples [Table 3]. If you cannot provide these conditions, then grip the root of the leads you are soldering with tweezers or a similar tool to prevent heat from conducting to the product package [Figure 3].
- 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.
- Perform the soldering so that no stress is applied to the package section of the product. Soldering in a state where stress is applied will cause residual stress after the soldering that tends to cause deterioration.

[Figure 3] Soldering ceramic package



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#### (4) Flow (dip) soldering

- In flow soldering, dip only the lead section in the solder bath. Do not dip the package section in the solder bath. If you do, mechanical or optical damage may result.
- Perform flow soldering by making sure that external force is not applied to the leads or package. Flow soldering in a state where external force is applied will cause residual stress that tends to cause deterioration.

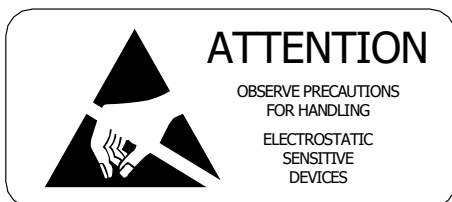
#### (5) Soldering of reflow compatible products

- For details on soldering reflow compatible products, see "3. Soldering" in "Surface mount type products" listed under "Precautions".

## 4. Static electricity management

The solid state division product or packing comes with an electrostatic warning label [Figure 4]. Handling of the products requires taking precautions on the following points to avoid damage and product deterioration due to static electricity.

[Figure 4] Electrostatic warning label (example)



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### (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 humidity at approximately 50%. Low humidity tends to cause static electricity and high humidity is prone to moisture absorption.

### (2) Handling

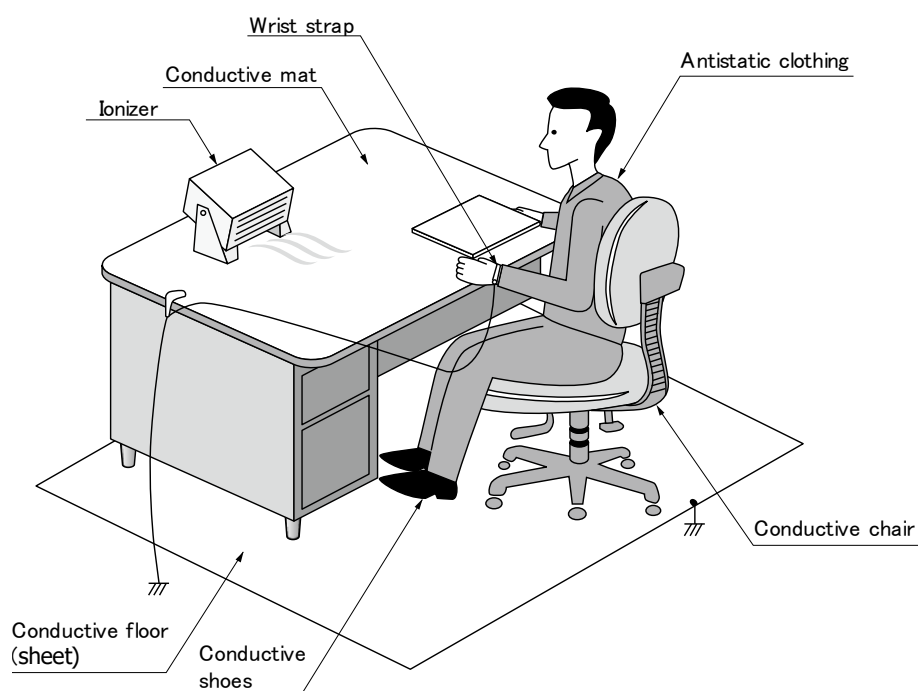
- Using an ionizer or similar item to eliminate electrical charges is recommended when handling the product.
- Wear anti-static clothing and conductive shoes (100 k $\Omega$  to 100 M $\Omega$ ).
- Attach a wrist strap (having protective resistance of 750 k $\Omega$  to 35 M $\Omega$ ) directly to the 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. (particularly during ON/OFF switching of power sources). If there is the possibility of a surge voltage, insert a filter (made up of a resistor and capacitor) to protect the product. Do not attach or detach any connector that is connected to the power supply line or output line during operation.

### (3) Carrying, storage, and packing

- Place the product on a conductive foam by inserting the leads into the foam (for shorting leads), and then put it in a conductive case. The PC board to mount the product on 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 product.
- Use a conductive carrying case and storage shelf.
- Avoid storing the product near equipment that may generate high voltage or high electromagnetic field.

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 5] Electrostatic countermeasure example

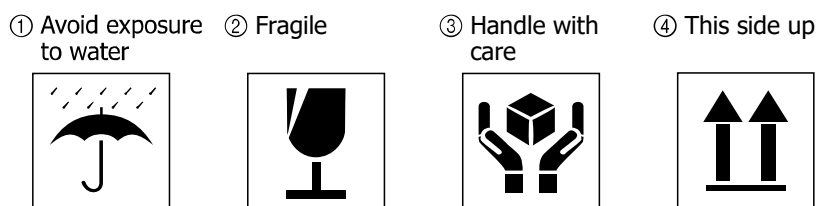


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## 5. Handling of cardboard boxes

The product comes shipped in cardboard boxes. When handling the cardboard boxes, comply with warning labels displayed on the cardboard box.

[Figure 6] Warning displays on cardboard box



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## 6. Hazardous Substances

The product's chips (compound semiconductors) include In (indium), as well as GaAs (gallium arsenide) compounds that contain As (arsenic), which is extremely harmful to the human body. In particular, please note the following.

- Never remove the chip and place it in your mouth, break it into pieces, pulverize it, heat it to melt it, or vaporize it.
- Avoid touching it with bare hands in any case.
- When disposing of hazardous substances, be sure to entrust the processing to a specialist processor capable of intermediate and final processing of hazardous substances in accordance with applicable laws and local regulations.

## 7. Precautions by product

### TE-cooled products

TE-cooled type products are cooled or kept at a constant temperature by thermoelectric coolers.

- Use a heatsink with small thermal resistance (for mounting the metal base surface). If heat dissipation is insufficient, the detector may break.
- Make the thermal resistance between the package and heat sink as small as possible. In addition, use silicone grease or the like to improve thermal coupling. If the thermal resistance is large, heat dissipation will be insufficient and may damage the product.
- When attaching to a heatsink, do not apply excessive force to prevent distorting the package. If the air tightness of the package is lost such as due to a cracked window material, the product's characteristics and cooling capacity will degrade.
- In the case of lasers, the cooling effect can be confirmed by the wavelength. If the wavelength is shifted to the long wavelength side, cooling may not be sufficient. Check the cooling condition.
- Because the current supplied to the thermoelectric coolers is greater than the allowable current of the detector or thermistor, if this current is applied even for an instant to the detector or thermistor, it will be destroyed. Be careful not to miswiring.
- Do not reverse the positive and negative terminals of the thermoelectric cooler. Reversing the polarity may damage the product.
- If there is a thermistor, be careful not to exceed the power dissipation of the thermistor.
- Running a current exceeding the allowable current of the thermoelectric cooler may damage the product. Do not run a current exceeding the allowable current of the thermoelectric cooler. We recommend suppressing the applied current as much as possible to use the product stably for a long time.
- If a temperature controller is to be used, take into full consideration the cooling capacity, and set the temperature according to the ambient temperature conditions. In addition, be careful not to run a current exceeding the allowable current of the thermoelectric cooler.
- Handle the thermoelectric cooler carefully as it may be damaged from shock such as due to dropping.

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#### Metal dewar type detectors

- Be careful not to apply external force to the metal dewar as it is easily damaged due to dropping, shock, vibration, and so on.
- If you are pouring liquid nitrogen ( $-196\text{ }^{\circ}\text{C}$ ), be sure to remove moisture completely from inside the metal dewar. If there is moisture remaining, it may freeze, and the metal dewar may be damaged.
- If liquid nitrogen is poured rapidly when the metal dewar body is not cooled, liquid nitrogen may spout. This is dangerous. As such, pour liquid nitrogen according to the following procedure. First, pour 20 to 30 cm<sup>3</sup> of liquid nitrogen. Immediately after pouring, you will see white smoke (cold air from boiling liquid nitrogen) from the inlet. Wait until the white smoke disappears (about 1 minute). After the white smoke disappears, pour an additional 20 to 30 cm<sup>3</sup> of liquid nitrogen, and wait a moment (about 3 minutes). Then, add more liquid nitrogen making sure it does not overflow.
- When using dry ice ( $-77\text{ }^{\circ}\text{C}$ ) as a coolant, first place dry ice in another container, and slowly pour ethyl alcohol into it. Mix to form a gel, and then pour it into the metal dewar.
- If the coolant overflows and adheres to the outside of the metal dewar, moisture in the air may condense. Wipe this condensation with a soft cloth. Normally, condensation will stop after a while. If the condensation does not stop, the metal dewar vacuum level may be degraded.
- Do not completely seal the lid after filling the metal dewar with coolant (simply plug the lid into the inlet). Sealing the lid will increase the internal pressure, and this is dangerous. Vaporized gas must be able to leak through the gap.
- The metal dewar vacuum level will degrade over time. We recommend re-evacuating the dewar periodically once every 1.5 to 2 years. Contact us to have the dewar be re-evacuated.

#### LED

- When running power through the LED, make sure that no surge current or the like is applied.
- When an LED is used for a long time, it will degrade due to the heat generated in the emitter as a result of conduction. Degradation usually appears as a decrease in optical output or variations in the forward voltage. Degradation is also caused by external stress. If the LED chip is driven when external stress is applied, it will show significant degradation. External stress may be due to a mechanical distortion in the package. When mounting the LED, make sure not to distort the package.
- Sufficiently dissipate the heat from the LED. Insufficient heat dissipation may degrade the LED more quickly.

#### Lasers (LD)

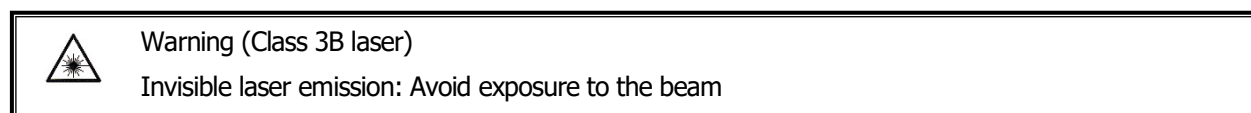
- The LD will be destroyed if it is irradiated with laser light, such as by regular reflection. Be careful not to expose the LD to reflected light.

#### ◆ Notice regarding laser light exposure

Be careful not to let the laser light enter your eyes directly or by reflection from mirror bodies.

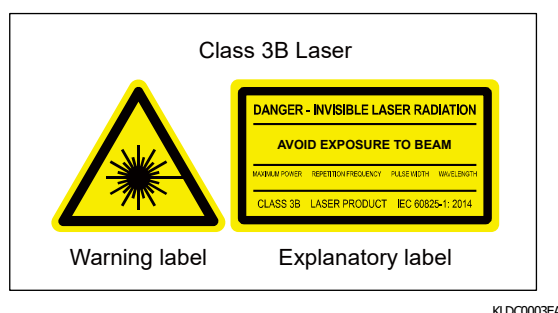
Use according to the precautions listed on the instruction manual or the label, such as the following.

#### ▪ Class 3B example



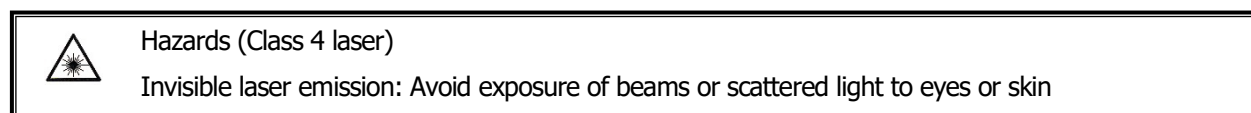
This product falls under the "Class 3B laser" in the classification of laser products according to IEC 60825-01. The laser light emitted by this product is an invisible laser light that cannot be seen by the naked eye. Observing the laser light directly is dangerous, and you should also avoid direct exposure to the skin. In addition, some conditions may cause skin damage or flammable substances to ignite. When using equipment incorporating this product, please classify it according to IEC 60825-01.

[Figure 7] Class 3B laser warning label example



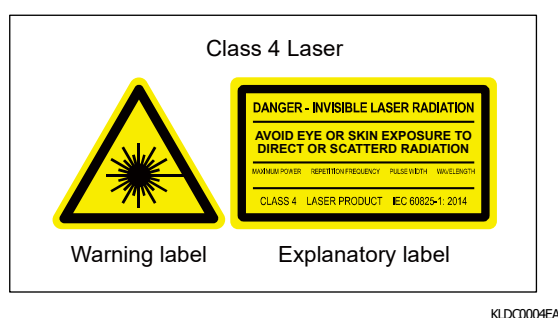
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#### ▪ Class 4 example



This product falls under the "Class 4 laser" in the classification of laser products according to IEC 60825-01. The laser light emitted by this product is an invisible laser light that cannot be seen by the naked eye. Observation of laser light and exposure to the skin are very dangerous. Scattered light can also cause serious damage. In addition, there is a risk of fire, so be careful. When using equipment incorporating this product, please classify it according to IEC 60825-01.

[Figure 8] Class 4 laser warning label example

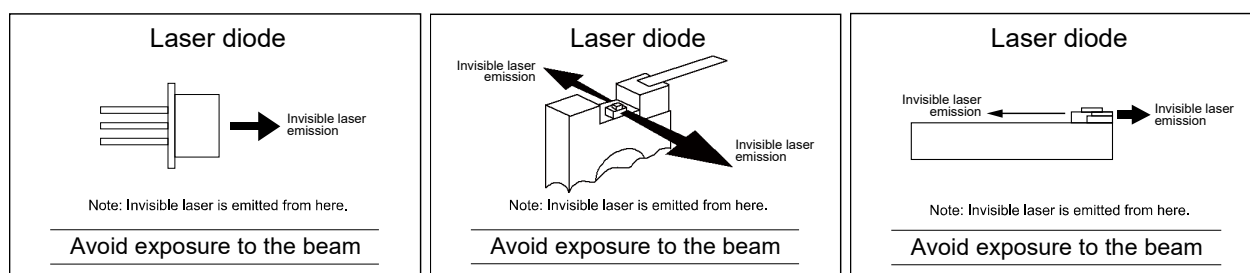


#### ◆ Laser safety measures (common across classes)

When using, take safety measures for each laser class. For example, laser safety measures are shown below.

- Installation of remote interlock
- Control by key
- Installation of a laser light shield or attenuator
- Installation of emission warning device
- Installation of warning signs
- Termination of laser optical path
- Prevention of unexpected specular reflections
- Protecting the eye against laser light (wearing protective glasses, installing light-shielding windows, etc.)
- Wearing protective clothing for laser light
- Implementation of laser safety education and training for employees

See IEC60825-01: 2014 for more details concerning the above countermeasures.



Note: For overseas operation, please follow the latest national laws and standards.