Panasonic®

Laser Welding System

Safety Instructions Manual

VL-W1

EN-EU-VLW1-SAFETY-5.1

2022.02 | https://laser.panasonic.eu

Preface

Thank you for purchasing this product.

Read this manual carefully to make full use of the product and to ensure its safe and proper operation.

The English version of this instruction manual is the original version. All other languages are translations that are based on the original documentation.

This product has been strictly checked and tested prior to packaging. However, make sure that the product has not been damaged during transportation and operates properly before using it. If the product was damaged or does not operate as specified in this manual, contact our service center or sales office.

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Please direct support matters and technical questions to your local Panasonic representative.

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Disclaimer

The applications described in the manual are intended as examples only. The purchase of our products described in the manual shall not be regarded as granting of a license to use our products in the described applications. We do not warrant that we have obtained some intellectual properties, such as patent rights, with respect to such applications, or that the described application may not infringe any intellectual property rights, such as patent rights, of a third party.

Important symbols

One or more of the following symbols may be used in this documentation.

The following symbols are used to indicate the type of hazard.

⚠ DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

Notice

Indicates a property damage message.

The following symbols are used to indicate the type of instructions to be observed.



Indicates an operating procedure which must not be performed.



Indicates an operating procedure which must be followed to operate the unit safely.



Indicates an operating procedure which must be performed carefully.

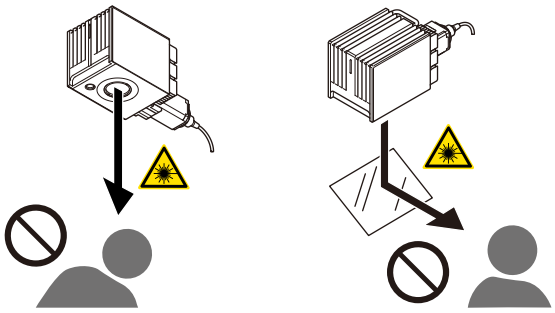
General safety precautions

Always follow these important safety precautions!

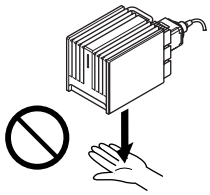
This product falls into laser class 4 according to IEC 60825-1 "Safety of laser products". By definition, class 4 laser devices are "laser products for which intrabeam viewing and skin exposure is hazardous and for which the viewing of diffuse reflections may be hazardous. These lasers also often represent a fire hazard". Laser class 4 devices require a safety system compliant with ISO 13849-1 and ISO 11553-1. To protect the operator from being exposed to a laser beam, be sure to follow the instructions in this manual and observe the safety regulations of your country.

⚠ DANGER

Never look at the direct laser beam, neither directly nor through a lens or any other optical components. Laser radiation into the eye causes blindness or serious damage to the eye. A specularly reflected laser beam is also dangerous.



Never expose your skin, clothing or any other flammable object to the laser radiation. Your skin will be severely burned and there is a risk of fire.



Build a protective enclosure with proper reflectance, durability and thermal resistance to enclose the laser radiation range without leakage. The laser is highly collimated and the power density is high even at distance.

⚠ WARNING

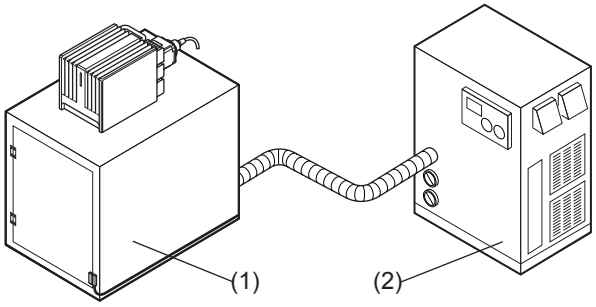
Do not use this product near flammable gas or objects (organic solvents such as thinner or gasoline), in a dusty place or anywhere where fire is strictly prohibited. There is a risk of fire.

Do not install this product in wet places except for water-resistant parts. Never conduct wiring or maintenance work with wet hands or when the product surface is wet. Otherwise, there is a risk of an electrical shock or malfunction.

⚠ WARNING	
	Do not open or disassemble this product. Otherwise, there is a risk of exposure to laser radiation or of electrical shock.
	Do not insert hands or objects in the gaps of the cooling air inlet or outlet. This may result in injuries, electrical shock, or failure of this product.
	Make sure that the fiber cable is not put under mechanical stress or squeezed during installation. Do not install the product into systems that impose excessive load on the fiber cable such as head movement units. If the fiber cable is damaged, there is a risk of exposure to laser radiation.
	Take laser protection measures required to use class 4 laser products subject to the local laws and regulations of the country or region in which this laser product is used.
	Wear laser protective goggles against laser radiation within the laser controlled area. Never look into the direct or specularly reflected laser beam even when you are wearing the protective goggles. The protective goggles are designed to protect your eyes from diffuse reflection only. 
	Construct an interlock system, e.g. to stop laser radiation when the access panel of the protective enclosure is opened.
	After you turn off the power supply of this product, the laser safety officer must remove the key and keep it.
	Be sure to connect a laser head and a controller which have the same model number. Otherwise there is a risk of exposure to laser radiation or failure.
	Read all safety instructions and manuals thoroughly, and do not operate, install and connect this product with any other methods except the instructions provided in the manuals. Otherwise the safety protection and functions provided by the device may be affected and may cause injury, electrical shock or exposure to the laser beam.
	Turn off the power of this product before you conduct wiring, connection, or maintenance work. Wiring and maintenance should be done by an expert engineer or a qualified electrician. Otherwise, there is a risk of an electrical shock or fire.
	When connecting the power supply, be sure to ground this product properly. Otherwise, there is a risk of malfunction and electrical shock in case of a failure or leakage current.
	Perform regular maintenance (cleaning, parts replacement) on this product. Do not use this product if it is visibly soiled with dust or dirt. Otherwise, there is a risk of an electrical shock or fire.

⚠ WARNING

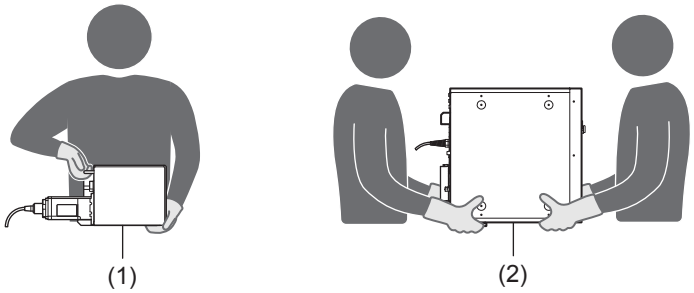
Remove the dust and gas with a dust collector or exhauster. Depending on the material of the workpiece, dust or gas, which can be harmful for the human body and this product, may be generated.



(1) Protective enclosure
(2) Dust collector

When using an assist gas for laser processing, take safety measures to protect operators from exposure, ignition, toxic effects, excess or lack of oxygen.

To carry this product, wear non-slip gloves and safety shoes. Hold the laser head as shown below. Do not transport this product by holding the cables or connectors. Carry the controller with two persons. In case it falls down, it may cause injury.



(1) Laser head
(2) Controller

Install this product in a stable place without vibration and shock. In case the unit falls down, it may cause injury.

Applicable standards

All models of this product comply with the following standards. This product does not comply with standards or countries which are not listed.

When you export the product by itself or integrated into a machine or device, check the regulations and standards of the importing country or region.



Laser class 4 devices require a safety system compliant with ISO 13849-1 and ISO 11553-1.

- EN Standards (CE Marking)

  2014/30/EU: "EMC Directive" (EN 55011, EN 61000-6-2)

  2014/35/EU: "Low Voltage Directive" (EN 60204-1, EN 60825-1)

  2011/65/EU as amended by (EU)2015/863 "RoHS Directive" (EN IEC 63000, EN 62321-1, EN 62321-2, EN 62321-3-1, EN 62321-3-2, EN 62321-4, EN 62321-5, EN 62321-6, EN 62321-7-1, EN 62321-7-2, EN 62321-8)

  Contact for CE: Panasonic Marketing Europe GmbH, Panasonic Testing Center, Winsbergring 15, 22525 Hamburg, Germany

- JIS (Japanese Industrial Standards)

  JIS C 6802

- FDA (Food and Drug Administration, US regulations)

  21 CFR1040.10 and 1040.11 (except for conformance with IEC 60825-1 Ed. 3, as described in Laser Notice No. 56 dated May 8, 2019)

- GB (Chinese National Standard)

  GB 7247.1-2012 (IDT IEC 60825-1)

For more details regarding the applicable standards, refer to the “Setup and Maintenance Guide”.

Product models

This manual covers the product models listed in the table.

Multiple models may be described collectively. Therefore, illustrations and screenshots may slightly vary, depending on the model. Different settings or technical data, however, are specified in the text.

Model	Collective name
VL-W1500	VL-W1 series
VL-W1506	
VL-W1A00	
VL-W1A06	

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1 Radiation information

1.1 Precautions

Make sure that all protective measures are in place before using the system.

You have acquired a product with components of laser class 4 (laser for processing) and laser class 2 (guide laser). The laser classifications are defined in the standard IEC 60825-1 "Safety of laser products".

Related topics

Protective measures (page 19)

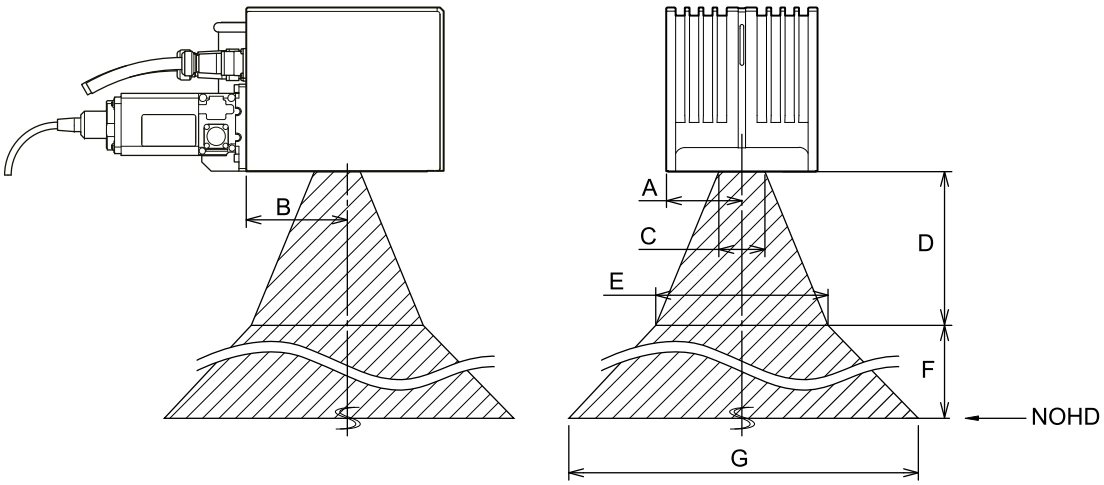
1.2 Laser for processing (laser class 4)

Laser class 4 refers to “laser products for which intrabeam viewing and skin exposure is hazardous and for which the viewing of diffuse reflections may be hazardous. These lasers also often represent a fire hazard”.

Specifications	
Wavelength	1070nm (invisible beam)
Laser medium	Yb: Fiber laser
Maximum output	VL-W1500, VL-W1506: ≈110W VL-W1A00, VL-W1A06: ≈160W This is the maximum value that can be output from the laser oscillator. This value is used to define the relevant laser class. For the specification under normal operation, refer to the “Setup and Maintenance Guide”.
Oscillation method	Continuous wave
Laser class	4 (IEC 60825-1)
NOHD (nominal ocular hazard distance)	VL-W1500: ≈1461m, VL-W1506: ≈4020m VL-W1A00: ≈1761m, VL-W1A06: ≈4860m NOHD is the distance from the source at which the amount of beam irradiance or radiant exposure equals the maximum permissible exposure to eyes (MPE).

Specifications	
MPE (maximum permissible exposure)	50W/m^2 for an exposure time of 10s.
NHZ (nominal hazard zone)	Varies depending on the reflectance or surface conditions and should be calculated based on the actual working environment. NHZ represents the area where the amount of beam irradiance or radiant exposure exceeds the maximum permissible exposure to eyes. The maximum value is equal to the NOHD value.

Radiation range



A Center position of laser emission port: 81.5mm
B Center position of laser emission port: 109mm
C Diameter of laser emission port: Ø62mm
D Work distance (base position):
VL-W1500, VL-W1A00: 300mm
VL-W1506, VL-W1A06: 670mm
E Laser radiation range at work distance:
VL-W1500, VL-W1A00: Ø283mm
VL-W1506, VL-W1A06: Ø566mm
F NOHD:
VL-W1500: 1461m, VL-W1A00: 1761m
VL-W1506: 4020m, VL-W1A06: 4860m
G Laser radiation range at NOHD:
VL-W1500: Ø1670m, VL-W1A00: Ø2013m
VL-W1506: Ø4596m, VL-W1A06: Ø5556m

1.3 Guide laser and pointer (laser class 2)

By definition, class 2 lasers devices are "laser products that emit visible radiation in the wavelength range from 400 to 700nm that are safe for momentary exposures but can be hazardous for deliberate staring into the beam."

Specifications	
Wavelength	655nm (visible beam)
Laser medium	Semiconductor laser
Maximum output	1mW Sum of the values for guide laser and pointer.
Oscillation method	Continuous wave
Laser class	2 (IEC 60825-1)

2 Safety functions

2.1 Overview

This product offers the following safety functions. Use these functions properly to ensure safe operation of this product.

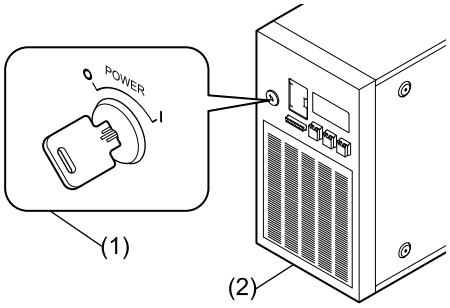
- Key switch (page 13)
- Shutter (page 13)
- Manual alarm reset (page 14)
- Laser status display (page 14)
- Behavior of the safety functions under fault condition (page 16)
- Warning labels (page 17)

2.2 Key switch

The key switch is used to turn the main power of this product on or off.

To prevent unauthorized operation of this product, the laser safety officer must remove the key and keep it in a safe place. The key can only be removed when in OFF (O) position.

Key switch on the controller:



(1) Key switch
(2) Controller

2.3 Shutter

The shutter is located inside the laser head. By closing the shutter, the emission of the laser beam is blocked.

To monitor the shutter status, the controller of the laser welding system is equipped with two independent signal outputs SHUTTER CLOSE 1 OUT and SHUTTER CLOSE 2 OUT.

Connect the shutter closed outputs to a safety relay unit or the relay outputs of a safety PLC to ensure safe operation of the laser system.

2.4 Manual alarm reset

If the interlock input or another input for safety devices is opened, or if a failure of this product occurs, an alarm signal is output.

Alarm status

- Shutter closes.
- Laser pumping turns off.
- ALARM OUT (Y13) turns OFF.
- The controller emits a beeping sound.
- The display panel on the controller shows the error code.

Alarm reset

When an alarm occurs, remove the cause of the alarm and reset the system by one of the following methods:

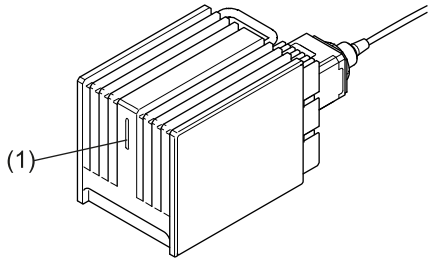
- Push the alarm reset switch on the controller.
- Set the alarm reset input (X13) on the I/O terminal block to ON.
- Turn off the key switch once and turn it on again after 5 seconds.

2.5 Laser status display

To indicate the status of the laser emission and of the laser welding system, LED indicators located on the displays of both laser head and controller light up.

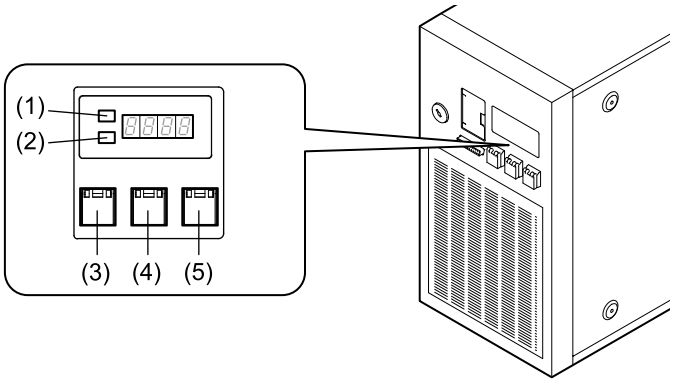
⚠ WARNING
If the laser head LED display is placed out of sight of operators, install an external signal lamp that is clearly visible.

Laser head



(1) Laser status display on the laser head
Orange: Laser emission in progress
Green: Shutter open/Laser pumping completed (Flashes: Laser pumping in progress)
White: Shutter closed/Laser pumping completed (Flashes: Laser pumping in progress)
Off: Laser in non-pumped status

Controller



(1) MAIN (green)
On: System start-up completed
Flashes: System start-up in progress

(2) LASING (orange)
On: Laser emission in progress

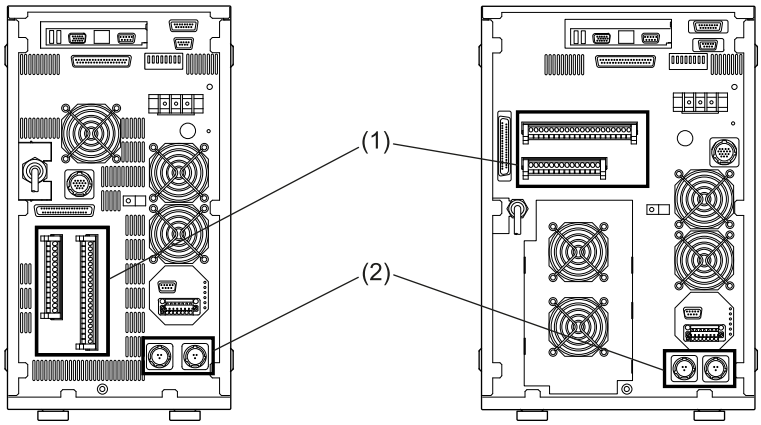
(3) LASER SUPPLY (Laser pumping switch, white)
On: Laser pumping completed
Flashes: Laser pumping in progress

(4) REMOTE (Remote mode switch, white)
On: Operation in remote mode to enable control by external devices

(5) ALARM RESET (Alarm reset switch, blue)
On: There is an alarm

2.6 Behavior of the safety functions under fault condition

The TERMINAL connector on the rear of the controller is equipped with several inputs to construct a safety system. They can be connected to an external safeguard such as an emergency stop button or the safety switch of an access panel.



VL-W1500, VL-W1506 VL-W1A00, VL-W1A06

(1) I/O terminal block at the rear side of the controller
(2) Two interlock connectors

Interlock connectors

The connection of the interlock inputs must be closed to enable laser radiation. If it is opened, laser radiation and laser pumping are stopped.

By using interlock input 1 and 2 together with a safety relay unit, you can design a dual-channel safety system.

Laser stop inputs (I/O terminal block)

The connection to the laser stop 1 and laser stop 2 inputs must be closed. If it is opened, laser radiation is disabled in the way described below.

- If one of the laser stop 1 inputs is opened while the laser is NOT radiating, the shutter closes.
- If one of the laser stop 1 inputs is opened while the laser is radiating, the shutter closes and laser pumping turns off.
- If one of the laser stop 2 inputs is opened, the shutter closes and laser pumping turns off.

  The laser stop 2 inputs can be used as the remote interlock connector required by IEC 60825-1.

Safety function	Operation	Release method
INTERLOCK 1: OPEN or INTERLOCK 2 : OPEN	• Laser pumping turns off • Shutter closes • Alarm is activated (E260)[1)]	Close the interlock input and reset the alarm.
LASER STOP 1A IN: OPEN or LASER STOP 1B IN: OPEN	Laser is radiating: • Laser pumping turns off • Shutter closes • Alarm is activated (E011)	Close the laser stop input and reset the alarm.
	Laser is not radiating, shutter is open: • Laser pumping remains active • Shutter closes • Warning is activated (E811)	Close the laser stop input.
LASER STOP 2A IN: OPEN or LASER STOP 2B IN: OPEN	• Laser pumping turns off • Shutter closes • Alarm is activated (E004)[1)]	Close the laser stop input and reset the alarm.

1) There is no alarm when the laser welding system is operated by PC configuration software and the shutter is closed (no laser radiation).

Note

We recommend that you connect external safeguards such as an emergency stop button or access panel to the interlock connectors to physically shut off laser radiation. Use the laser stop 1 inputs to disable laser radiation temporarily, and leave the laser stop 2 inputs short-circuited.

For details about control by I/O signals and wiring, refer to the “Setup and Maintenance Guide”.

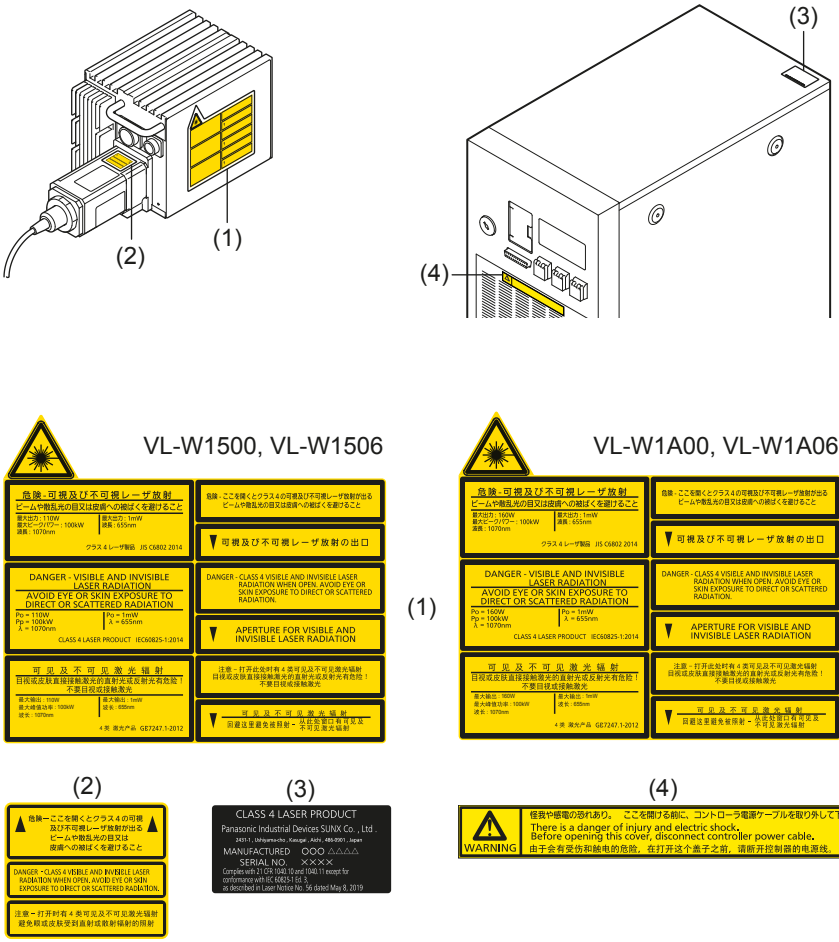
Related topics

Construction of an interlock system (page 20)

2.7 Warning labels

The following labels are attached to the product. Do not peel them off!

If the laser head is placed out of sight of the operators, attach the supplied labels on the system so that they are immediately visible.



(1) Warning label/Explanatory label/Aperture label
The symbols on the explanatory label represent the following radiation output information:

Po= Maximum output
Pp= Maximum peak power
λ = Wavelength

(2) Protective housing label

(3) Certification and identification label

(4) Warning label for maintenance

Note

It is the responsibility of the customer to ensure proper labeling in a language understood by the users of the laser welding system.

3 Protective measures

3.1 Overview

This product is a system component and designed for welding plastic materials during the manufacturing or assembly process, in which a protection according to laser class 4 is prescribed (IEC 60825-1). Therefore the system designer must take appropriate protective measures in order to use the device.

Please follow the national laws and regulations of the country or region in which this laser product is used.

Perform the following protective measures before using this product.

- Appoint a laser safety officer (page 19)
- Control access by key (page 20)
- Provide laser protective goggles (page 20)
- Construct an interlock system (page 20)
- Build a protective enclosure (page 22)
- Apply other safety measures (page 22):
  - Construct a manual recovery system for power failures
  - Control the laser beam path
  - Terminate the laser beam path
  - Install lighting
  - Provide protective clothing

3.2 Laser safety officer

In some countries, you may be required to appoint a laser safety officer to ensure safe operation of laser devices. This person must be competent to evaluate laser hazards and to put effective protective measures in place.

Tasks and responsibilities of the laser safety officer include:

- Implement protective measures against injuries by laser radiation
- Set up and maintain the laser use area
- Manage the laser device, the system and the key
- Inspect and maintain the laser device and storage of records
- Inspect, maintain, and check the use of protective equipment
- Execute the safety training for users of this product

3.3 Key control

To prevent unauthorized operation of this product, the laser safety officer must remove the key and keep it in a safe place.

⚠ WARNING

According to IEC/FDA/JIS standards, laser products shall incorporate a key-actuated master control. This product is basically started by the key switch located on the front of the controller. However, when this product is operated as part of a larger system, the key switch is permanently in ON position and the power is supplied. In this case, you have to make sure that the external system which controls this product is equipped with a key-actuated master control.

3.4 Laser protective googles

Wear laser protective goggles against laser radiation within the laser controlled area. Never look into the direct or specularly reflected laser beam even when you are wearing the protective goggles. The protective goggles are designed to protect your eyes from diffuse reflection only.

Use ANSI Z136 and CE certified protective goggles applicable for a wavelength of 1.07μm.

Ensure that the laser status display is clearly visible through the goggles.

3.5 Construction of an interlock system

To operate this product, construct a protective enclosure with an interlock system to avoid that human beings and surrounding objects are exposed to laser radiation.

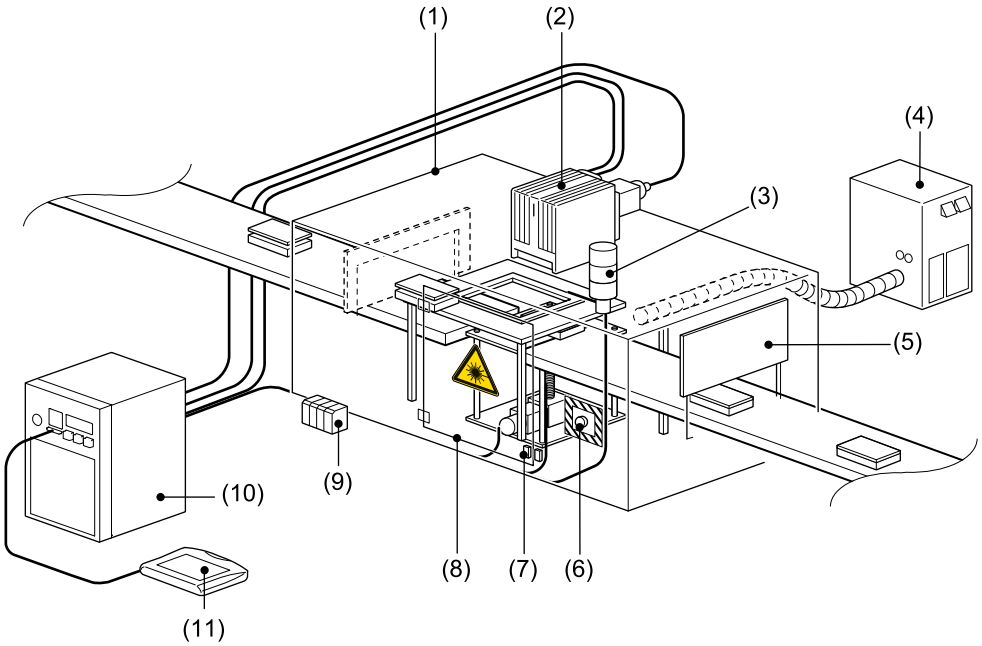
When constructing a system compliant with ISO 11553-1/ISO 13849-1, use the following functions to design a dual-channel safety system for turning off the power supply.

- Connect the interlock inputs INTERLOCK 1 and 2 to a safety PLC or safety relay unit to design a redundant interlock system.
- Connect the shutter closed outputs SHUTTER CLOSE 1 and 2 to a safety PLC or safety relay unit to design a redundant monitoring system.

Notice

The interlock inputs are connected to the operating coils of safety relays inside the controller. Connect INTERLOCK 1 and 2 to INTERLOCK 1 COM. and INTERLOCK 2 COM. and then to a non-voltage contact, e.g. a relay or switch. Do not connect any voltage contact, e.g. a transistor (semiconductor).

Installation example with protective enclosure and interlock system:



(1) Protective enclosure
(2) Laser head
(3) Laser emission signal lamp
(4) Dust collector
(5) Laser shield plate
(6) Emergency stop button
(7) Safety switch
(8) Access panel
(9) Safety relay unit, safety PLC, etc.
(10) Controller
(11) Touch panel

Installation notes

To indicate the status of this product, connect the signal outputs, e.g. ALARM OUT, LASER SUPPLY OUT or LASING OUT, to the laser emission signal lamp (3).

Place the suction nozzle of the dust collector (4) as close as possible to the workpiece.

Construct a safety system to interrupt laser radiation or turn off laser pumping when the laser shield plate (5) is open for feed/discharge of workpieces.

Construct a safety system to turn off laser pumping when the emergency stop button (6) or safety switch (7) is actuated or the access panel (8) is opened.

Connect the safeguards (5) to (8) via a safety relay unit or the relay outputs of a safety PLC (9) to interlock input 1 and 2 (or to the laser stop inputs or shutter closed outputs) of this product.

Connect a touch panel (11) for configuration and monitoring.

Related topics

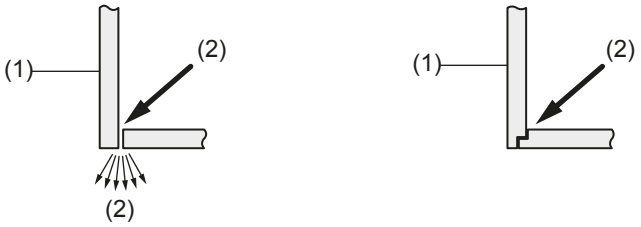
Behavior of the safety functions under fault condition (page 16)

3.6 Protective enclosure

In order to prevent exposure to laser beams accidentally reflected from the workpiece or from surrounding areas, construct a protective enclosure. It should enclose this product in the laser radiation range.

Use materials with proper reflectance, durability and thermal resistance which do not transmit a wavelength of 1070nm (1.07µm). Recommended materials are metals such as iron, aluminum, or stainless steel.

Design the protective enclosure so that the laser beam does not pass through joint parts:



(1) Protective enclosure
(2) Laser radiation

3.7 Other protective measures

Before using this product, also perform the following important protective measures.

- Power failure recovery

  In case of a power failure, re-pumping of this product will be necessary. For safety reasons, construct a laser re-pumping system which must be operated by hand.

- Control of radiation direction

  In addition to building a protective enclosure, take measures to make the direction of laser radiation visible to operators and others. Warning labels are attached to the system before shipment. Do not peel them off.

  Control the laser beam path, so that the eyes of the workers sitting and standing are not met.

- Termination of laser beam

  In the event that no workpiece is present, terminate the laser beam within the laser radiation range with a flame-resistant object. Do not use objects with a specular surface.

- Illumination

  Brightly illuminate the area surrounding this product. Since the pupils are contracted in well-lit places, your eyes will be better protected.

- Protective clothing

  Exposure of the skin and clothing to laser radiation will cause burning. Wear flame-resistant clothing to protect your skin.

4 Record of changes

EN-EU-VLW1-SAFETY-5.1, 2022.02

European edition based on MJEC-VLW1-SAFETY-5 No.9000-0068-77V

- Updated section "Warning labels"

EN-EU-VLW1-SAFETY-5, 2021.09

European edition based on MJEC-VLW1-SAFETY-5 No.9000-0068-77V

- Updated sections "General safety precautions" and "Applicable standards"
- Replaced section "Interlock and laser stop inputs" by section "Behavior of the safety functions under fault condition"

ME-VLW1-SM-V1-EU, 2017.09

European edition based on MJEC-VLW1-SAFETY-3

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