Laser Weld Monitor

MML SERIES

MM-L400A

OPERATION MANUAL

AMADA

LAV0904(LAV0901)
MML SERIES-E06-202604

Thank you for your purchase our product.
Please read this manual carefully to ensure correct use. Keep the manual handy after reading for future reference.

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1. Special Notes

(1) Safety Precautions

Before using the equipment, please read through the Safety Precautions carefully to ensure proper use.

- The precautions listed here are designed to ensure safe use and proactively prevent risks and damage to the user and other people. All precautions are critical for safety. Please read them all.
- The hazard signs have the following meanings:

DANGER	Mishandling will cause imminent risk of death or serious injury.
WARNING	Mishandling may cause risk of death or serious injury.
CAUTION	Mishandling may cause risk of injury and physical damage. It may also cause property damage.
	These signs represent “DON’Ts.” They warn of actions not covered by the product warranty. The concrete contents of prohibition are shown in illustrated form or in writing inside or near the symbol.
	These signs represent “DOs" which must be observed by the product user. The concrete contents of instructions are shown in illustrated form or in writing inside or near the symbol.
	A sign within a triangular border indicates that a hazard (danger, warning or caution) is present. The concrete contents of instructions are shown in illustrated form or in writing inside or near the symbol.

⚠ DANGER



DO NOT touch anything inside the equipment.
High voltage is present internally. Do not touch anything inside the equipment with the power on.



NEVER ATTEMPT to disassemble, repair or modify the equipment.
Failure to observe this will result in an electric shock or fire.
Do not perform maintenance other than that detailed in the Operation Manual.



DO NOT look directly at the beam, and do not allow any part of the body to enter the beam.
Both direct and scattered beams are hazardous.
Direct eye exposure to a laser beam will cause blindness.



NEVER burn, destroy, cut, crush or chemically decompose the equipment.
This product incorporates parts containing arsenide (As).

⚠ WARNING



ALWAYS wear protective goggles.
Always wear protective goggles where the equipment is used.
Even if you wear them, you may lose your sight if the laser beam enters your eyes directly through protective goggles. Protective goggles attenuates the laser beam, but does not block it.



AVOID skin exposure to a processing or welding laser beam.
This product monitors the near-infrared light from the processing point.
Exposure to a laser beam will cause burns. Never expose any part of the body to a laser.



DO NOT touch the workpiece during or immediately after laser working.
The workpiece may be extremely hot.



USE the specified cables and connect them securely.
Using cables with an insufficient capacity or improper connection may result in a fire or electric shock.



KEEP the power and connection cables free of damage.
Do not walk on, twist, or tug the cables.
Damaged cable may result in an electric shock, short circuit, or fire
For repair or replacement, contact your dealer or us.



In the event of an anomaly, STOP the operation.
Continuing the operation with anomalies such as a generation of fumes, a burning odor, strange noise, or overheating unattended may result in an electric shock or fire. In the event of the above or other anomaly, immediately contact your dealer or us.



GROUND the equipment.
If not grounded, the equipment may cause an electric shock in the event of malfunction or ground fault.



STAY AWAY from the equipment if you have a pacemaker.
If you have a pacemaker, do not approach a welding machine in operation or the immediate area unless your doctor has given consent.
Welding machines generate a magnetic field which interferes with the operation of a pacemaker.

⚠ CAUTION



DO NOT splash water.
Electrical parts may cause an electric shock or short circuit if they become wet.



USE proper tools (e.g., wire stripper, pressure wire connectors) for termination of connection cables.
Failure to do so may damage the internal wires, leading to possibility of fire and electric shock.



PLACE the equipment on a firm surface.
Injury or equipment damage/malfunction may result if equipment topples over or falls from the installed location.



DO NOT place any drinks, etc. on the equipment.
Any liquid split onto the equipment may cause insulation failure, resulting in ground fault or fire.



DO NOT place flammable objects near the equipment.
Surface flash and expulsion (spatter) generated during welding may ignite flammable objects, resulting in a fire.
If work involves use of flammable items, place a non-flammable cover on such items.



DO NOT cover the equipment with a blanket or cloth.
During operation, do not cover the equipment with a blanket or cloth. This may lead to the equipment overheating and catching fire.



DO NOT use the equipment for applications other than metal working.
Using it otherwise may result in an electric shock or fire.



DO NOT use with the equipment other than the YAG or fiber laser equipment which oscillates a waveform of 1.0 µm band.
Using it otherwise may result in malfunction to the equipment.



ALWAYS wear appropriate work clothing.
Wear protective gear such as gloves, a long-sleeved top and leather apron.
Surface flash and expulsion (spatter) can cause burns if it contacts the skin.



PROVIDE fire extinguishers.
Provide fire extinguishers at the welding site as a precautionary measure.



PERFORM maintenance and inspection on a regular basis.
Perform maintenance and inspection regularly.
For repair or replacement, contact your dealer or us.

(2) Handling Precautions

- Designate a person with sufficient knowledge and experience in handling laser beams and laser equipment as a laser safety administrator.
- The laser safety administrator must take charge of the control keyswitch for the laser device. Further, the administrator must share safety knowledge with laser workers and take command of the work.
- Partition all areas that may be exposed to laser beams with a fence or other means. Further, the administrator must take charge of such areas, and post a sign in a clearly visible manner to keep them off limits for unauthorized personnel.
- Place the product on a firm surface, and keep it level with the ground when in use. Using it in a tilted position may result in malfunction.
- For the **MM-L400A**, install in a location with an ambient temperature range of 5 to 40ºC, ambient humidity of 85% RH or less and free from abrupt temperature changes. Further, avoid the following locations.
  - Dirty or dusty location or location with oil mist present
  - Location often exposed to vibration or shock
  - Location where chemical substances, etc. are handled
  - Location near a high noise generating source
  - Location where condensation occurs
- Perform warming-up operation for at least 10 minutes after turning on the power supply. When the ambient temperature is low, it is recommended that the time is increased.
- Keep the exterior clean with a soft cloth or cloth lightly dampened with water. For stains, clean them off using a diluted neutral detergent or alcohol. Do not use thinner or benzene as they may cause discoloration or deformation.
- To prevent malfunction, do not allow any foreign objects such as screws or coins to enter the equipment.
- Operate the switches and buttons with care. Rough operation or the use of a tool or pen tip may result in damage or malfunction.
- Subjecting cables to strong impact may damage it. Further, mount them securely until the connector is locked
- To prevent malfunction, be sure to turn off the power supply in advance when installing and removing cables that are connected on the rear side of the product.
- To prevent damage, do not bend the optical fiber beyond its minimum bending radius or apply any forms of shock to it.

Type	Minimum bending radius
Fiber unit	100 mm
Scanner receiving unit Optical fiber	60 mm

- When an administrator or an operator enters an area containing a laser radiation hazard, safety measures to ensure compliance with MPE* limits are required.

  *MPE: Maximum Permissible Exposure of the laser radiation limit permissible for human eye and skin exposure.

  * For more information about laser radiation regulations and MPE values, see the standard referenced below.

  Japanese Industrial Standard JIS C 6802 “Safety of laser products”

Notification from Ministry of Health, Labor and Welfare No. 0325002 “Prevention measures plan concerning laser hazards”

(3) Disposal

The **MM-L400A** incorporate parts containing arsenide (As).

Dust or vapor of gallium arsenide (GaAs) is harmful; handle the product with care.

・At the time of disposal, the below process is recommended:

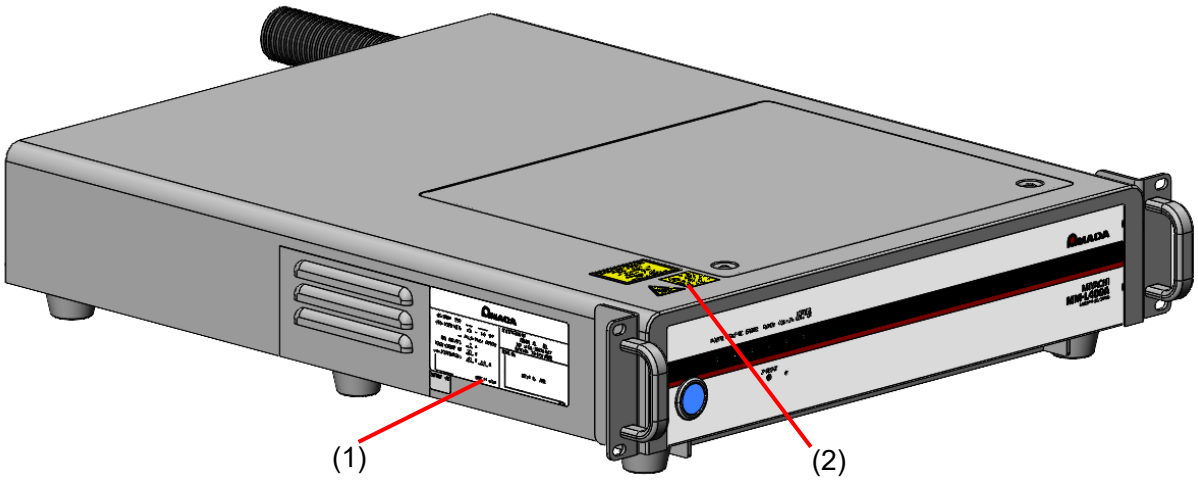
1. The disposal work shall be subcontracted to a waste disposal specialist who is qualified for collection, transportation, and disposal of industrial waste that includes materials containing arsenic.
2. This material shall be separated from general industrial waste or domestic waste, and controlled through to its final stage as specially-controlled industrial waste.

・No combustion, cutting, crushing of the product. Avoid chemical decomposition.

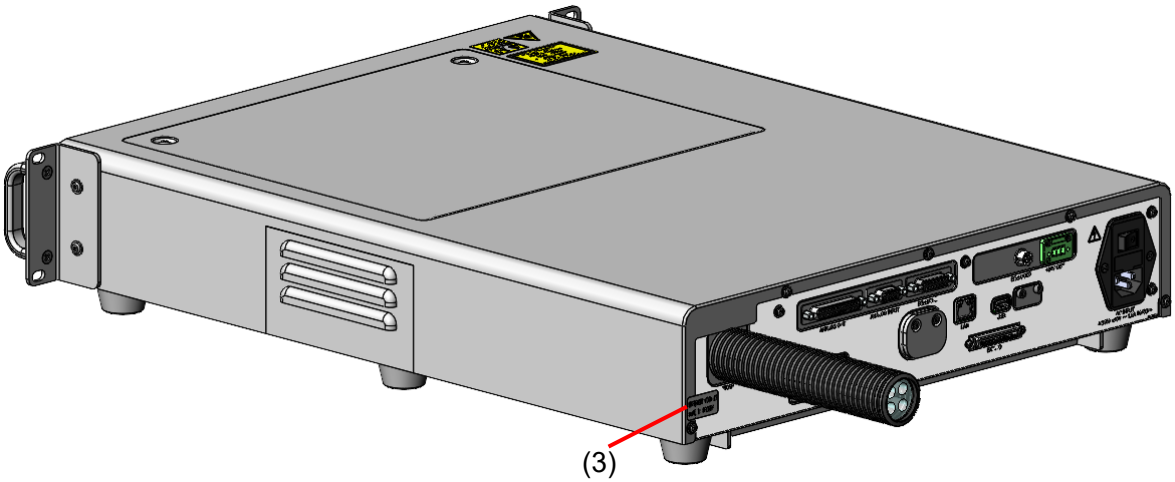
(4) Sticking Warning/Danger Labels

Warning/danger labels are struck on the product. Read the precautions provided on each label for correct use.

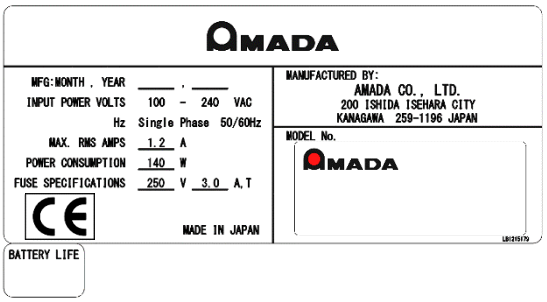
- **MM-L400A** (Front)



- **MM-L400A** (Rear)



(1)



(2)







(3)



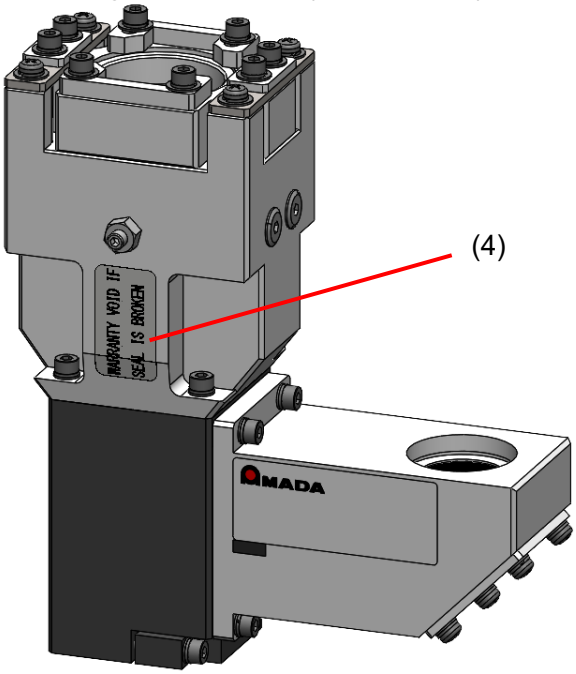
Tearing off the seal will void the warranty.

- MM-L400A Accessories



The product has a Laser Aperture warning label included.
Attach this label to the product or place it near to where the Fiber Unit and Scanner receiver unit is connected.
For details, see 5 (3) “Attaching the Laser Aperture Warning label.”

- Coaxial light receive unit (**MM-L400A**)

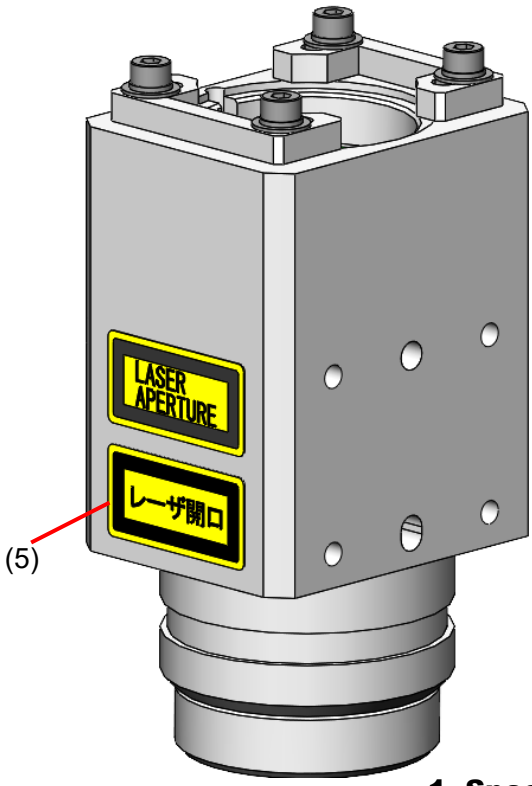


(4)

WARRANTY VOID IF
SEAL IS BROKEN

Tearing off the seal will void the warranty.

- External light-receiving unit



(5)



2. Features

The Laser Weld Monitor **MM-L400A** detects the light generated from the processing point and monitors the welding status. The **MM-L400A** offers the following features:

- At laser welding, the welding status can be monitored by detecting the light generated from the processing point.
- Transmits the light generated from the processing point to the incorporated sensor for measurement using optical fibers.
- Setting conditions and displaying waveforms can be easily done with **MS-Viewer**, the dedicated software.
- Produces an alarm signal output upon detection of an output waveform outside the tolerance range by setting upper and lower tolerance widths for the output waveform. Also, the output waveform which detects the light generated from the processing point can be displayed on the PC screen.
- The **MM-L400A** allows external devices to be connected including an output unit and galvanometer scanner. Also, the output unit (output unit model series fitted with a CCD camera)*1 can be used by mounting coaxially with an optional coaxial light receive unit adapter.
- A power supply in the range of 100 V AC to 240 V AC can be used.
- Turning on the guide light*2 enables confirmation of the measurement position.

NOTE:
The **MM-L400A** is equipment to monitor the light generated from the processing point but not equipment to directly judge whether the laser welding status is good or bad. The customer should optionally use a judging function considering the relation between the laser processing quality and the monitored output waveform.

*1: Coaxial mounting is available only for selected output unit products. For details, contact us.

*2: The guide light of the **MM-L400A** is Class 3R of JIS C 6802 “Safety standards for laser products.”

3. Unpacking

(1) Container

⚠ CAUTION

- At least two persons are required to remove the **MM-L400A** from its packing container.

Dimensions	Mass (including contents)	Remarks
Approx. 315 (H) x 1120 (W) x 621 (D) mm	Approx. 35 kg	Common to the **MM-L400A**

(2) Checking the Contents of Container

Check the contents of container. If you find any defect, contact us.

(1) Products

Product Series	Model Name	Qty
MML Series	MM-L400A[*1]	1

(2) Accessories

Product name	Model	Qty
PC software: MS-Viewer	AS1215744	1
Operation Manual	-	1
LAN CABLE	LD-TWST/BM50	1
Ferrite clamp[*2]	NFT-8	1
Laser aperture label	LB1201367	1
METALLIC-CONNECTOR	HDEB-9P(05)	1
Plug	HDAB-15P(05)	1
Plug	HDBB-25P(05)	1
Plug	DF02P050F22A1	1
METALLIC-CONNECTOR	HR10A-7P-4P(73)	1
Case	HDA-CTH(10)	1
CONNECTOR-ACC	HDB-CTH(10)	1
CONNECTOR-ACC	HDE-CTH(10)	1
Food	DF02D050A11	1

(3) Option (Power Cord)

Product name	Model	Qty
250 V for use in Japan or China	KP244 VCTF3×1.25 KS16D 3m	1*3
250 V for use in Europe	CEE3P-W-1.8	
125 V max.	KP-35 KS-16A SVT#18x3 B-TYPE	

(4) Option (Fiber Unit)

Product name	Model	Qty
Fiber Unit (5m)	LP1215333	1*3
Fiber Unit (10m)	LP1215334	
Fiber Unit (20m)	LP1215335	

(5) Option (Receive unit)

Product name	Model	Qty
Coax Light Receive Unit*4	LP1214881	1*3
Coax Light Receive Unit(SET)*4, 5	LP1215369	
GWM-K Coax Light Receive Unit	LP1213922	
External light receiving unit	LP1214900	

(6) Option (Scanner Light Receiving Unit)

Product name	Model	Qty
Scanner Light Receiving Unit	LP1216476	1*3
Light Receiving Unit Plate*6	LP1211191	
Light Receiving Unit Plate *6	LP1216428	

(7) Option (Others)

Product name	Model	Qty
Optical Attenuation Filter Unit※7	AS1213648	1*3
PC	-*8	
Hard Disk	-*8	
19-inch Rack	-*8	

*1 This product is available in both 3-channel and 6-channel configurations.

*2 Used for LAN cable. For mounting, see 5. (6) Mounting the Ferrite Clamp.

*3 Depends on the customer's selection.

*4 Used when measuring coaxially with the output unit with a CCD camera. Our engineer takes charge of mounting work.

*5 When the coaxially mounting adapter **(MM-L400A)** is shipped with being mounted on our output unit, the model number is changed into LP1215369. The shipping form is different, but there is no difference between LP1214881 and LP1215369 in performance.

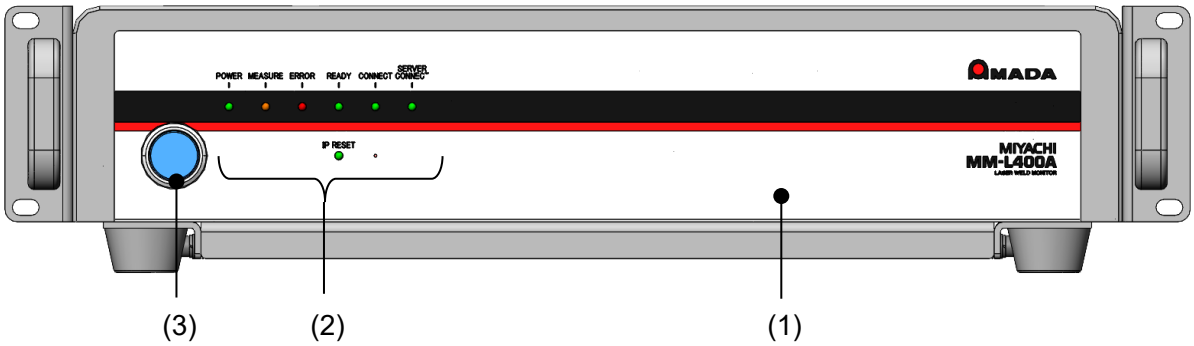
*6 This is used when installing the scanner light receiving unit. The installation work will be carried out by our service personnel.

*7 Mainly used to attenuate excessive light intensity emitted from the processing point.

*8 PC is necessary to configure the settings of the **MM-L400A**. A PC and peripheral devices can be also prepared by the customers. For the PC specifications, refer to the Application Manual of the **MS-Viewer.**

4. Name and Function of Each Part

(1) Front



(1) Display panel:

Shows the status of the **MM-L400A**.

(2) Status indicating LEDs:

Indicate the current status of the **MM-L400A**. All of the LEDs turn on soon after startup, and as the startup process continues, each LED flashes and turns off in sequence from the right. After startup completes, the LEDs operate as follows:

POWER:

Lit in green when the power supply is turned on. Flashes during the shutdown process.

MEASURE:

Lit in orange from the measurement start to the end. There are two ways to start measurement; the internal trigger by monitor signal level and the external trigger of external input.

ERROR:

Lit in red when a device error occurs. Flashes at the warning status.

READY:

Lit in green when the preparation for measurement is completed and no device error occurs.

CONNECT:

Lit in green during the measurement data transmission between the equipment and the PC.

SERVER CONNECT

Lit in green when the equipment and the PC (database server) are online.

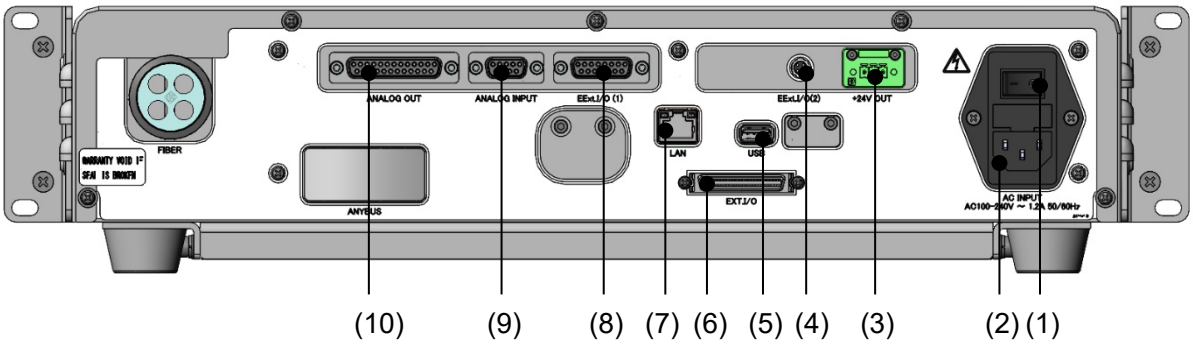
IP RESET

Lit in green when the switch on the right is pressed to reset the IP address to the factory status (192.168.1.40). This resetting operation is invalid during measurement. To press the switch, use a sharp-pointed tool.

(3) Controller Power Switch

Used to turn on/off the power. To turn off the power, press the switch for 0.5 seconds or more.

(2) Rear



(1) Power switch:
Turns on/off the power. When turning off the power switch, be sure to confirm that the controller power is off (POWER of the status indicating LEDs at the front).

(2) AC INPUT
Used to connect the attached power cord to supply power.

(3) +24V OUT
Outputs 24V to the external device.

(4) EExt.I/O(2)
Do not connect anything to this port.

(5) USB
Do not connect anything to this port.

(6) Ext.I/O
Connector for input and output with the external device.

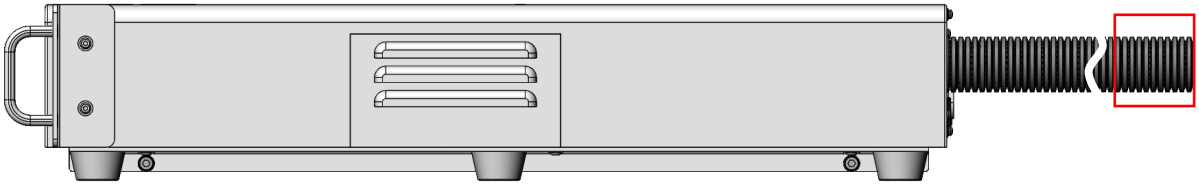
(7) LAN
Used to connect to the personal computer with the attached LAN cable.

(8) EExt.I/O (1)
Do not connect anything to this port.

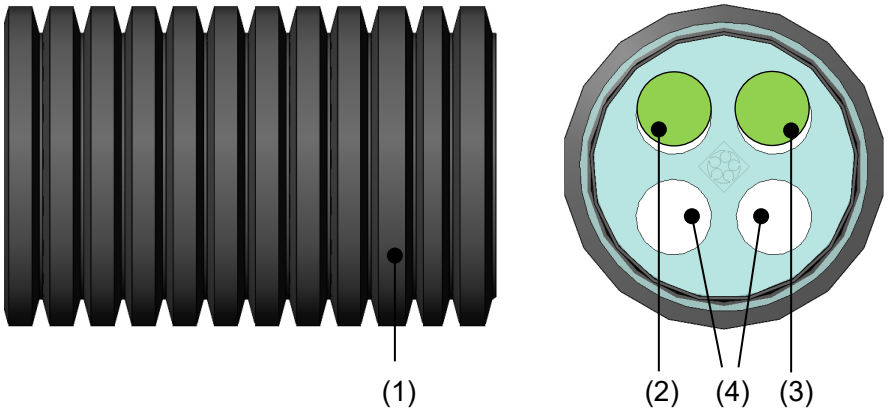
(9) ANALOG INPUT
Connector for input from the external device.

(10) ANALOG OUT
Outputs the **MM-L400A** detection with the analog signal. It can be observed with an oscilloscope, etc.

(3) Optical Fiber Mounting Part



End of corrugated tube



(1) Corrugated tube:
Used to protect the optical fibers.

(2) Fiber unit ch1:
The fiber unit connected from ch1 to ch3 of the sensor in the **MM-L400A** controller.

(3) Fiber unit ch2:
The **MM-L400A** controller's sensors connected to channels 5 through 7 are fiber units or scanner receiver units. If the product configuration is 3-channel, these parts will remain empty.

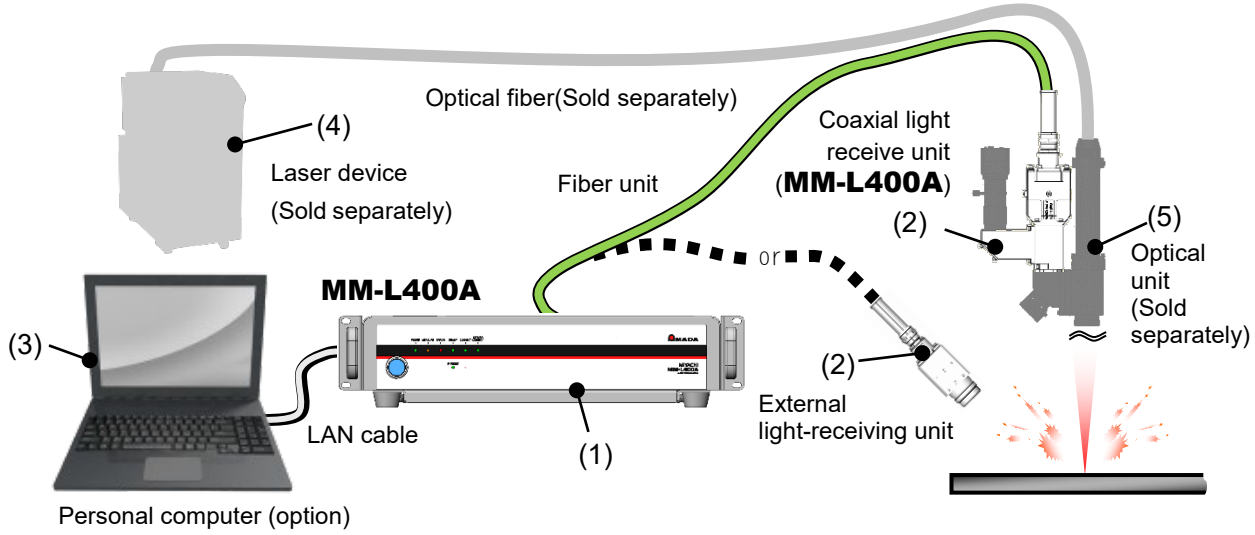
(4) Empty conduits
These conduits are empty.

5. Connecting Equipment

(1) Typical Equipment Connection

The typical equipment connection of the **MM-L400A** is shown below.

The **MM-L400A** monitors the light generated from the processing point by mounting the coaxial light receive unit (**MM-L400A**) coaxially with the output unit and galvanometer scanner, or by mounting the external light-receiving unit.



(1) **MM-L400A**:
Judges the upper/lower limit for obtaining waveforms, records measured data, etc.

(2) Coaxial light receive unit (**MM-L400A**)/External light-receiving unit:
Receives light necessary for the measurement from the processing point.

(3) Personal computer (option):
With **MS-Viewer** installed, sets conditions of the **MM-L400A**, displays waveforms and saves the waveform data, etc. For installation, refer to the Application Manual of the **MS-Viewer**.

(4) Laser device (separately available):
Oscillates the laser light.
Be sure to read the operation manual for the laser device.

(5) Output unit (separately available):
Condenses laser light and performs processing and welding. For the use with **MM-L400A**, mount either the external light-receiving unit, the scanner light receiving unit (to be externally mounted) or the coaxial light receive unit (**MM-L400A**) (to be coaxially mounted).

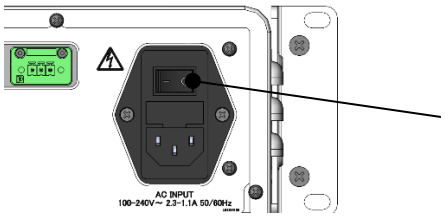
(2) Startup, Shutdown, and Power Off

This explains the sequence from starting up the **MM-L400A**, shutting it down, to powering it off. Additionally, we provide information about the UPS (Uninterruptible Power Supply) that prevents data loss in the event of power troubles.

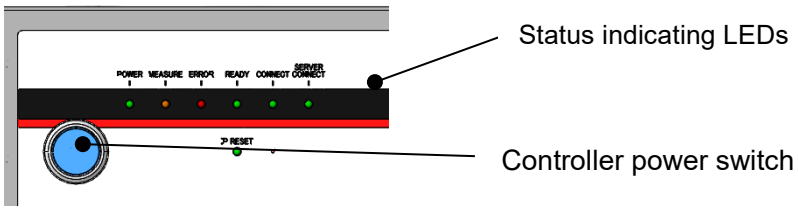
> **⚠ CAUTION**
>
> - When the **MM-L400A** is not properly shut down, it can damage the parameter data in the equipment or result in malfunction.

Startup

1) To start up the **MM-L400A**, turn on the AC power switch on the rear panel.

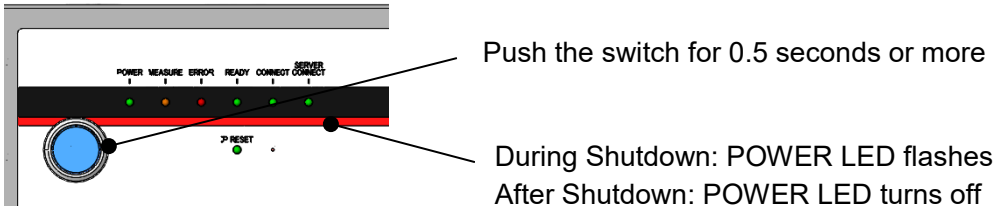


2) Push the controller power switch on the **MM-L400A** front panel. Startup operation starts, and the status indicating LEDs turn on in order. After the startup operation, the POWER LED turns on.

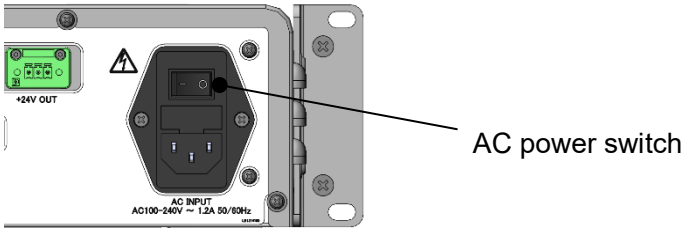


Shutdown, Power off

1) To shut down the **MM-L400A**, push the controller power switch for 0.5 seconds or more. During the shutdown operation, the POWER LED of the status indicating LEDs flashes. After the shutdown operation, the POWER LED turns off.



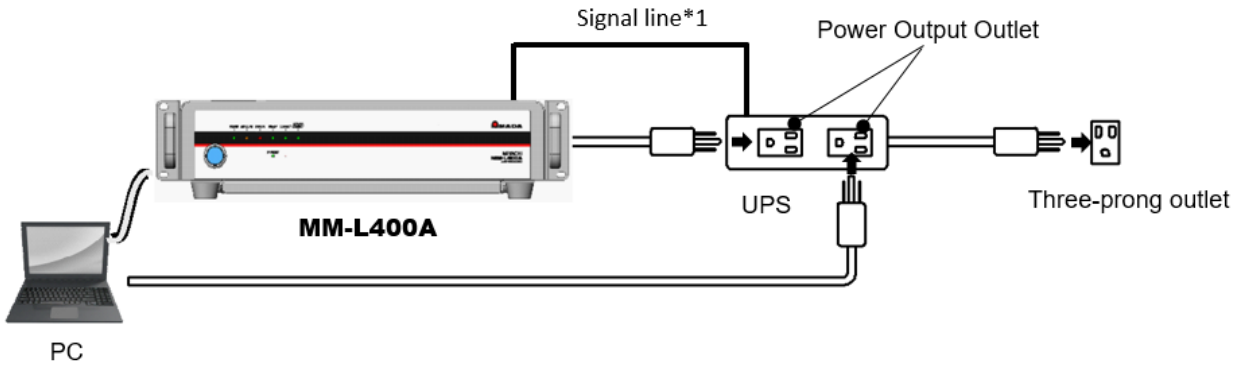
2) Confirm that the **MM-L400A** status indicator LEDs are off, and then turn off the AC power switch on the rear panel.



About UPS

A UPS (Uninterruptible Power Supply) is a device that supplies power from an internal battery during power outages or momentary voltage drops, preventing data loss or damage to connected devices. This allows for safe shutdowns or continued operation of systems for a certain period.

With this product, using the OMRON "BY50FW" and referring to the wiring example diagram below, it is possible to ensure safe shutdown operations by sending a shutdown signal to a computer during power loss or to the EXT. I/O PIN number B17 of the **MM-L400A**.



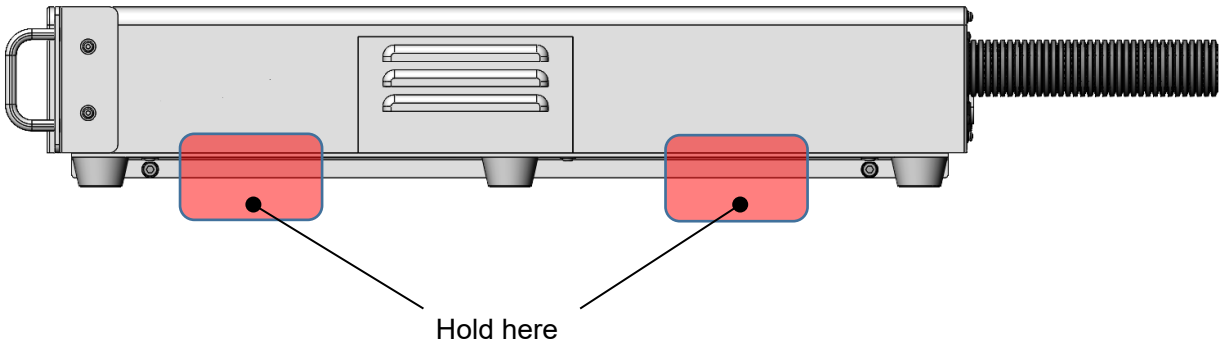
*1 Please prepare the signal line to connect the **MM-L400A** and the UPS by yourself.

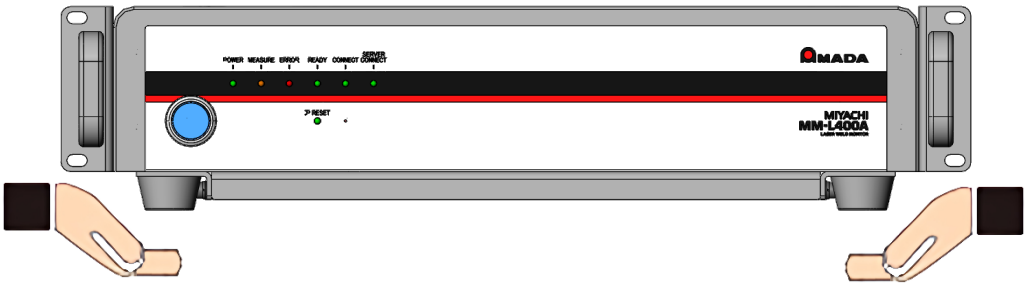
(3) Transportation and Installation

This section describes precautions for transportation and installation of the **MM-L400A**.

> **⚠ CAUTION**
>
> - Before starting the operation, be sure to turn off the power of the **MM-L400A**.
> - During the operation, avoid excessive force applied to the optical fibers.
> - Perform install or transport operations always by two or more persons.

To transport or install the **MM-L400A**, hold the parts at the both sides of the equipment as shown below.





(4) Mounting 19” Rack

This section describes how to mount the **MM-L400A** to a 19” rack.

⚠CAUTION

- Before starting the operation, be sure to turn off the power of the **MM-L400A**.
- During the operation, avoid excessive force applied to the optical fibers.
- Be sure to use only the specified screws. Otherwise, it may damage the product.

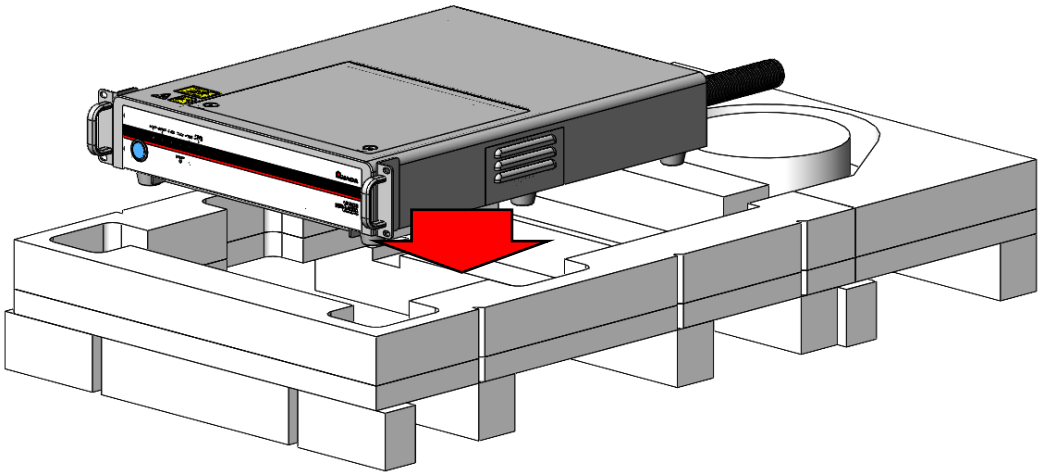
To mount the **MM-L400A** to a commercially-available 19” rack, the parts on the bottom need to be removed. The required specifications for a 19” rack are as follows:

・Size: 2U, effective internal dimensions Depth: 700 mm or more

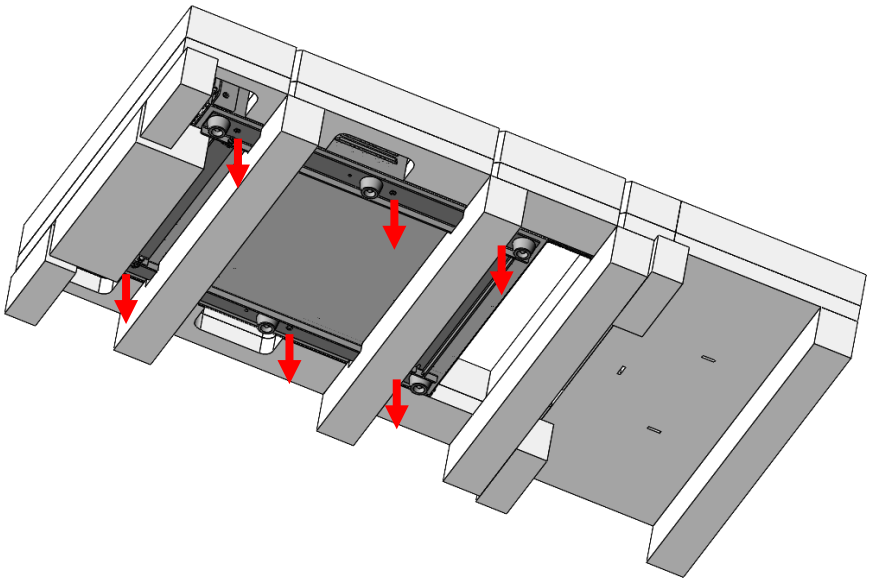
・Equipped with a top panel supporting the **MM-L400A** (maximum weight of approx. 22 kg)

・Equipped with a screw hole securing the front

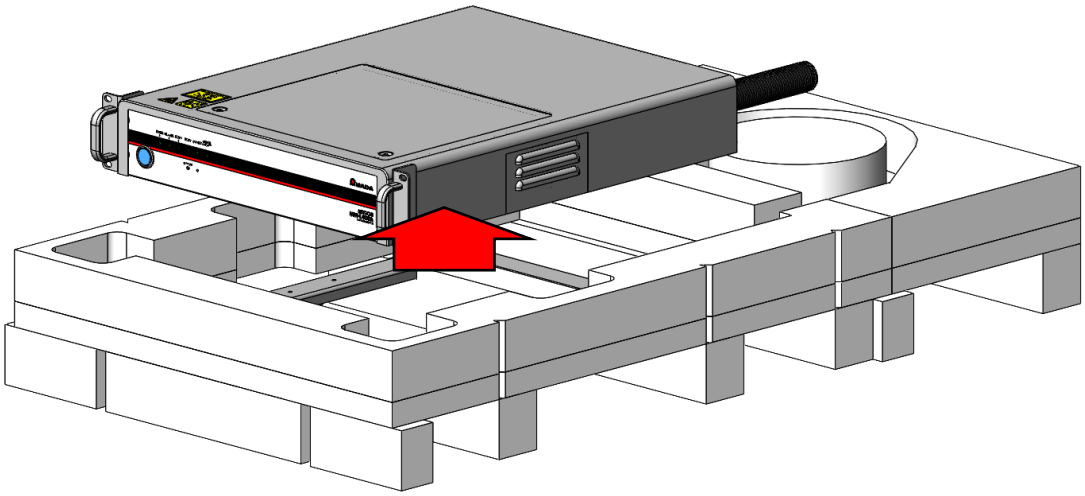
1) Place the lower pad in the package box of the **MM-L400A** on a stable base such as a table, and then place the **MM-L400A** on the lower pad.



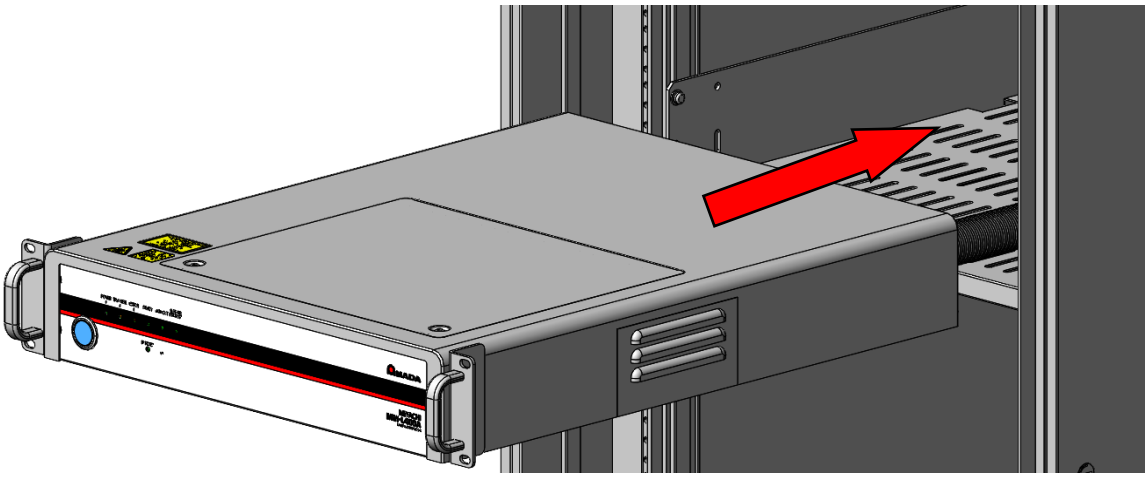
2) Remove the target M4 screws (six positions) by using a tool. This enables to remove the part on the bottom from the **MM-L400A.**



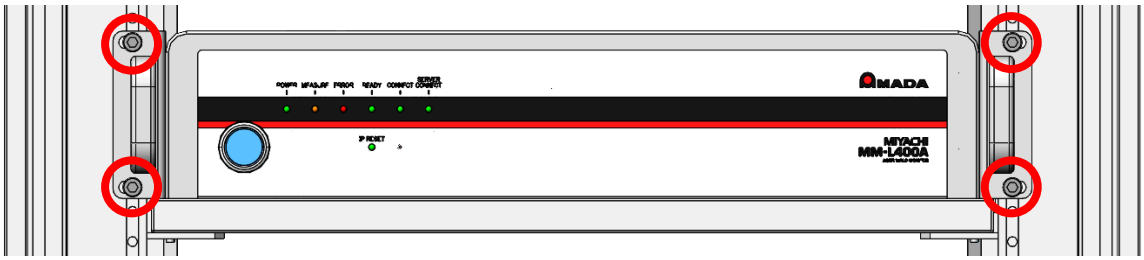
3) Take out the **MM-L400A** from the lower pad. At this time, confirm that the bottom part is separated from the **MM-L400A** and remained on the lower pad.



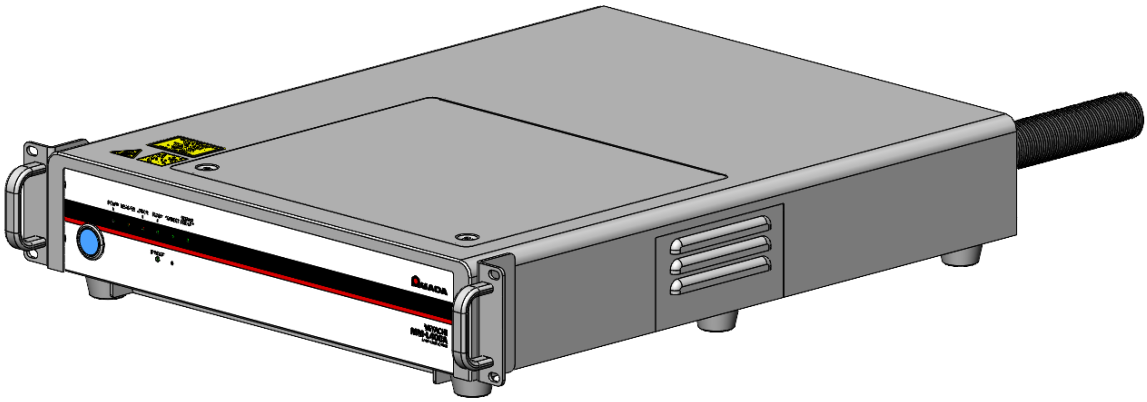
4) Store the **MM-L400A** into the 19” rack by pushing from the front. At this time, pay attention not to apply forces to the optical fibers.



5) Secure the **MM-L400A** from the front. The slotted hole for the **MM-L400A** handle is large enough to accept up to M6 screws.



6) To return to the delivered status, perform the steps 1) to 3) in the reversed order, and secure the bottom part by using the removed M4 screws (six positions).
(Recommended tightening torque: 1.27N・m)



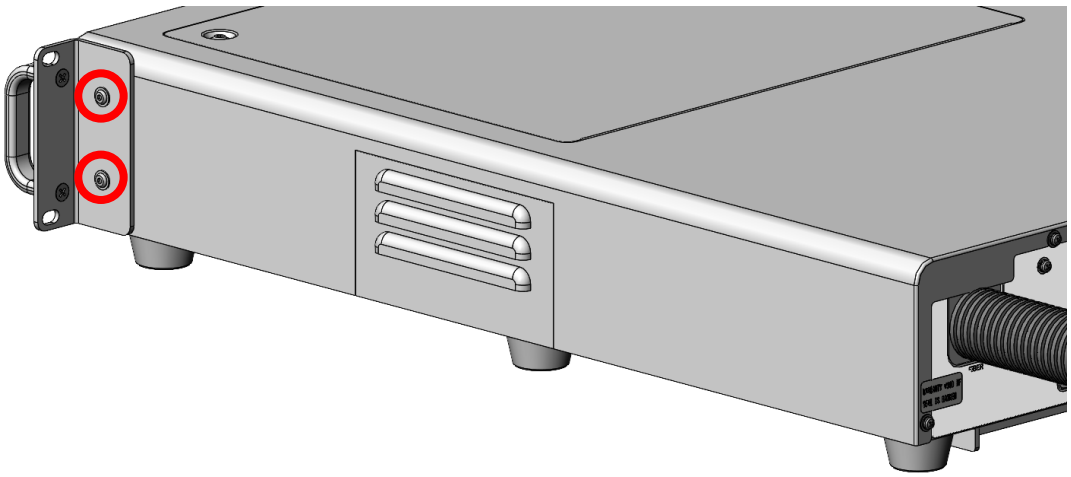
(5) Removing/Mounting Handles

This section describes how to remove/mount the **MM-L400A** handles.

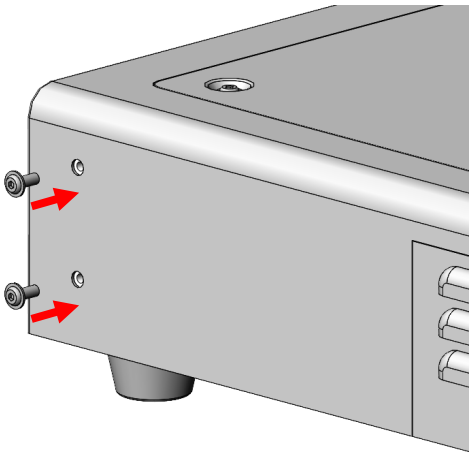
> **⚠CAUTION**
>
> - Before starting the operation, be sure to turn off the power of **MM-L400A**.
> - Be sure to use only the specified screws. Otherwise, it may damage the product.
> - During the operation, avoid load to be applied to the cover on the **MM-L400A**. Otherwise, the sealing sticker on the rear of the equipment may be peeled off, which will be out of the warranty coverage.

The handles on the both sides of the **MM-L400A** are removable.

1) Remove the M4 screws (2 positions) securing the handle by using a tool.



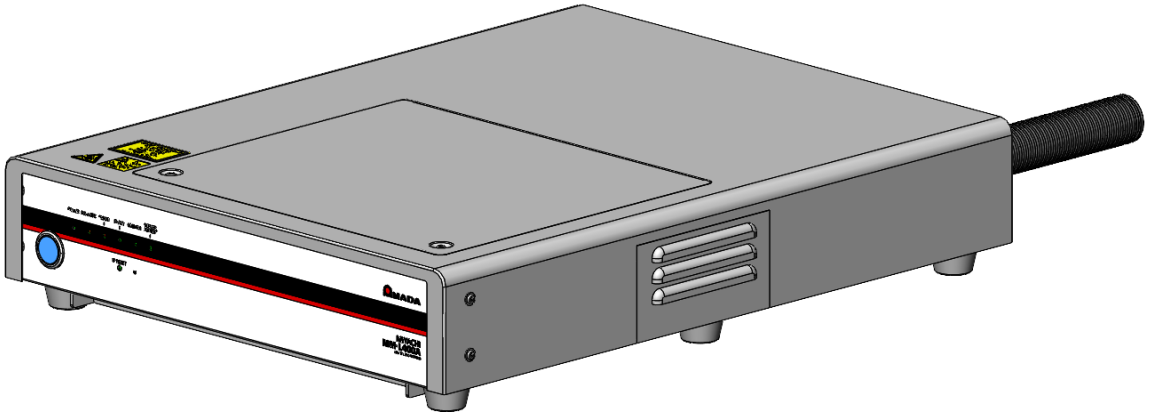
2) The handle co-tightened with the M4 screws can be removed. After removing the handle, attach the M4 screws (two positions) to the original positions by using a tool. (Recommended tightening torque value: 1.27N・m)



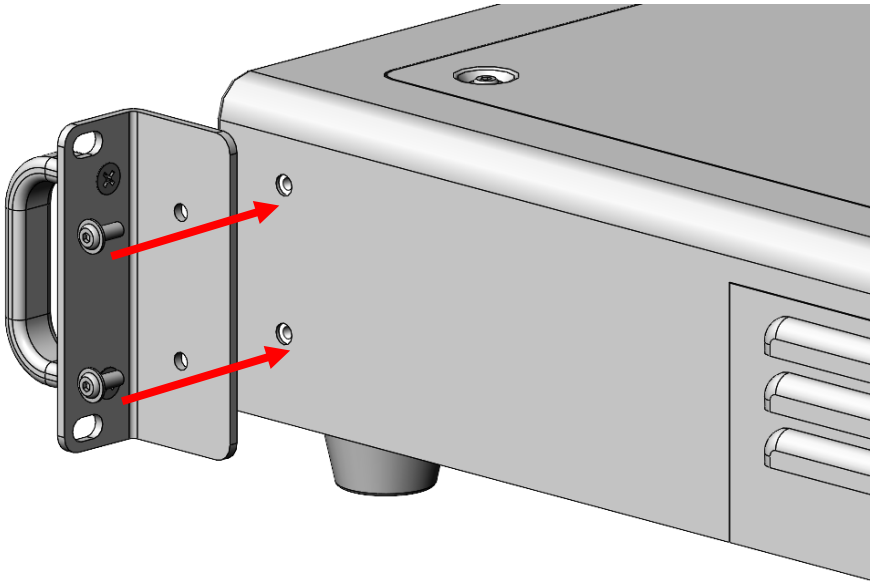
Removed handle



3) Repeat the steps 1 and 2 to remove the handle in the opposite side.



4) To secure the handles back in the places, repeat the steps 1 and 2, and use the M4 screws to co-tighten with the handle. (Recommended tightening torque: 1.27N・m)



(6) Mounting Ferrite Clamp

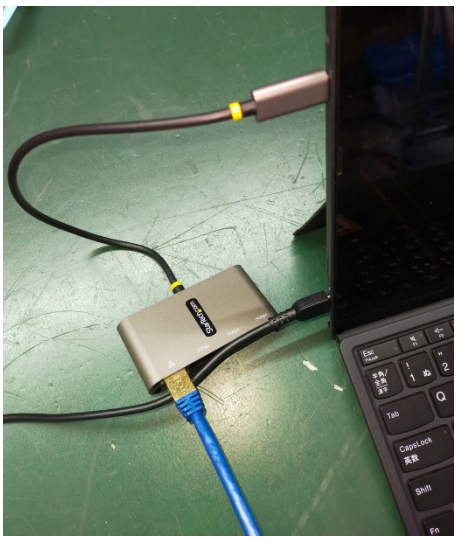
This section describes how to mount the attached ferrite clamp to the LAN cable.

⚠CAUTION

- If you connect or disconnect the AC cord when the power supply of the MM-L400A is on, a failure may occur. Accordingly, turn off the power supply of the MM-L400A when mounting the ferrite clamp.
- If the ferrite clamp is not mounted or is mounted at the place not specified, the waveform could contain noise, and correct waveforms may not be obtained. Be sure to mount the noise filter as specified.

Mount the attached ferrite clamp at the **MM-L400A** side of the LAN cable with one turn. Connect the other side of the LAN cable to the personal computer.





(7) Sticking Laser Aperture Label

This section describes how to stick the attached laser aperture label.

⚠CAUTION

- Before the operation, be sure to turn off the power of the laser device.

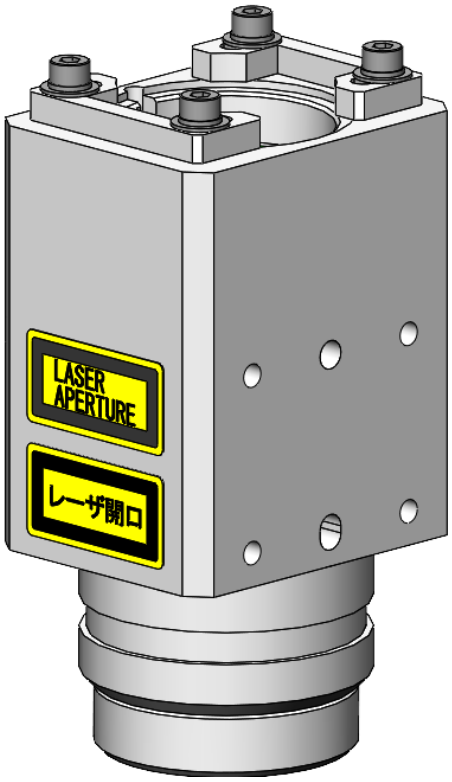
The **MM-L400A** is equipped with a guide light function to confirm the measurement position.
The guide light of the **MM-L400A** is Class 3R of JIS C 6802 “Safety of laser products”.

Stick the laser aperture label near the laser aperture of the laser product as well as the product to which the fiber unit is mounted.
The external light-receiving unit which is an optional product is already sticked with the laser aperture label, and need no label to be sticked.

Laser aperture label (accessory)



External ligh-receiving unit (optional)



(8) Coaxial light receive unit (MM-L400A)

This section describes the coaxial light receive unit (**MM-L400A**) which allows to coaxially use the **MM-L400A** for measurement.

⚠CAUTION

- Coaxial mounting is applicable to a part of our output units. For the details of applicable units, contact us.
- For the combination outline drawing of each output unit and the coaxial light receive unit (**MM-L400A**), contact us.
- When a strong shock is applied to the coaxial light receive unit (**MM-L400A**), the measurement light path is shifted, influencing the measurement values. Proper handling is required to use the adapter.

The **MM-L400A** can be fixed coaxially with the output unit by coaxial light receive unit (**MM-L400A**) to our output unit with CCD camera.
Since measurement can be performed coaxially, the measurement position of the **MM-L400A** follows even when the output unit moves.

The mounting and the adjustment of the coaxial light receive unit (**MM-L400A**) is only available by our qualified service personnel.

Since the coaxial light receive unit (**MM-L400A**) is mounted to a position where the camera unit has been mounted, the mounting requires removal of the assembled camera unit.
The camera image of the output unit may change slightly. Therefore, if you are using the image processing function, be sure to perform an operational check after installing the coaxial light receiving unit (**MM-L400A**).

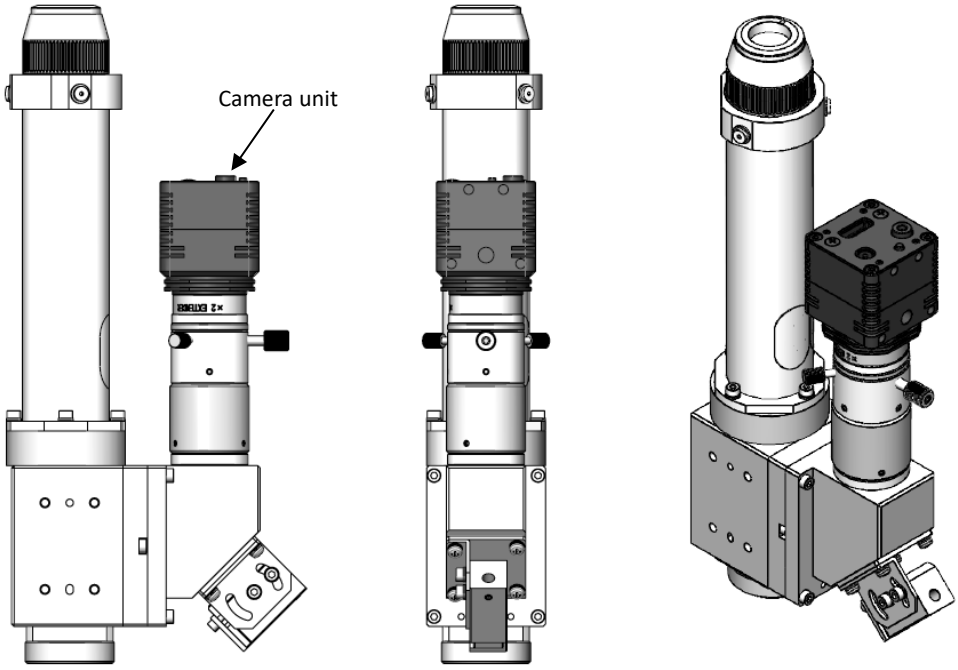
For the appearance and installation dimensions of the Coaxial Light Receiving Unit (**MM-L400A**), please refer to section 10.(2) "Coaxial Light Receiving Unit (**MM-L400A**) (optional)."
For an example of the installation with the Coaxial Light Receiving Unit (**MM-L400A**) attached, please refer to the representative installation example on the next page.

Typical Mounting Example

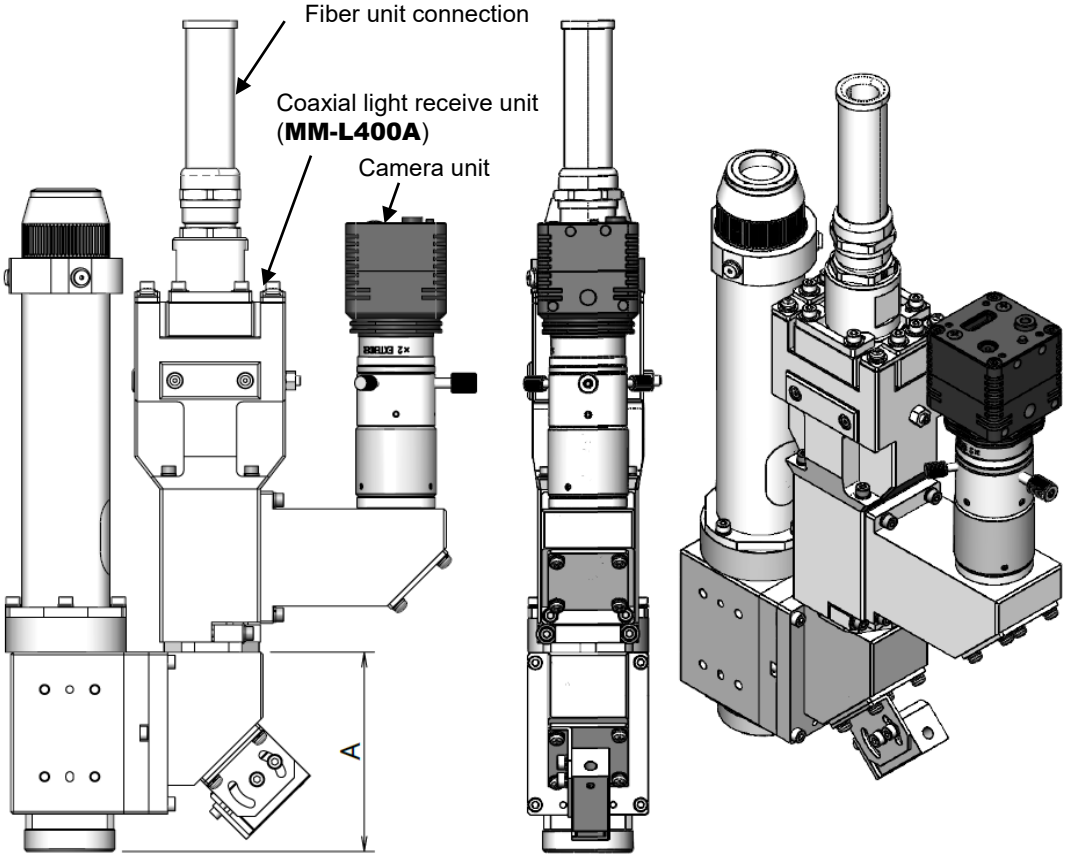
Output unit which the laser light is not turned

The coaxial light receive unit (**MM-L400A**) is fixed at the position where the laser light is turned by the output.

Example) Before being mounted



Example) After being mounted (The section above dimension A is rotatable by 360 degree as long as it interferes with nothing)



(9) Mounting External Light-Receiving Unit and Measures against Reflected Light

This section describes how to use the light-receiving unit for external measurement and measures against the reflected light.

⚠CAUTION

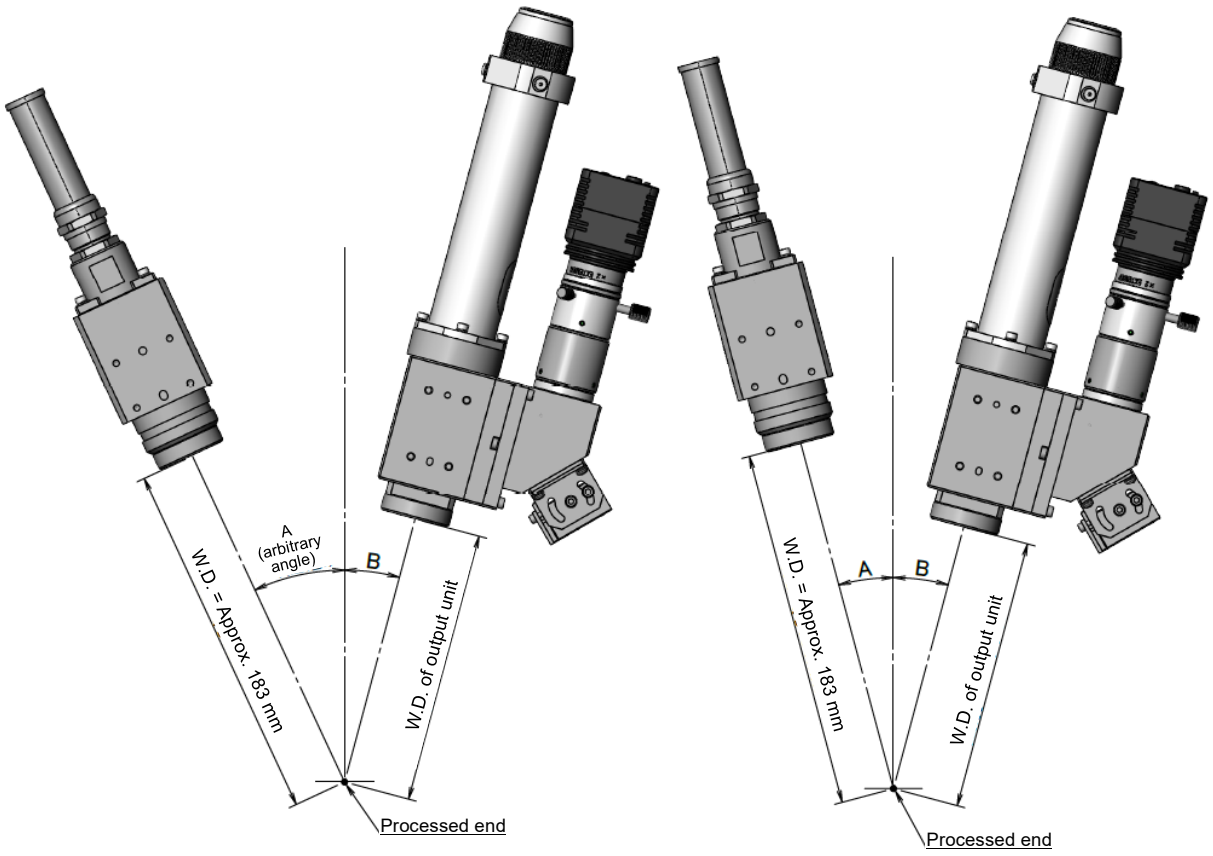
- Especially for processing and welding at high output for a long time, the external light-receiving unit (for fixing) may be overheated by reflected light or diffusion reflected light. In such a case, you need to take cooling measures such as water-cooled jacket. Consult us.

1) Turn on the **MM-L400A** power and start up the PC software **MS-Viewer**.
Turn on the guide light of the corresponding sensor, and confirm that the guide light is irradiated from the external light-receiving unit.

2) Determine the position of the external light-receiving unit so that the guide light correctly illuminates the laser processing point according to the guide light W.D. (approx. 183 mm), and then fix the position.
Angle A should be an arbitrary angle according to a purpose. However, do not install at a position where much reflected light is returned (refer to the figure below).

3) Perform laser welding and monitor the amount of reflected light.
Ensure that the measured reflected light value does not reach its maximum (saturates) under analog gain 1 throughout the laser irradiation process.
If the measured value reaches its maximum (saturates), it indicates that the amount of reflected light is too high, so please adjust the mounting position accordingly.

(Good example) (Bad example)



Angle A = arbitrary angle°(not A ≒ B)

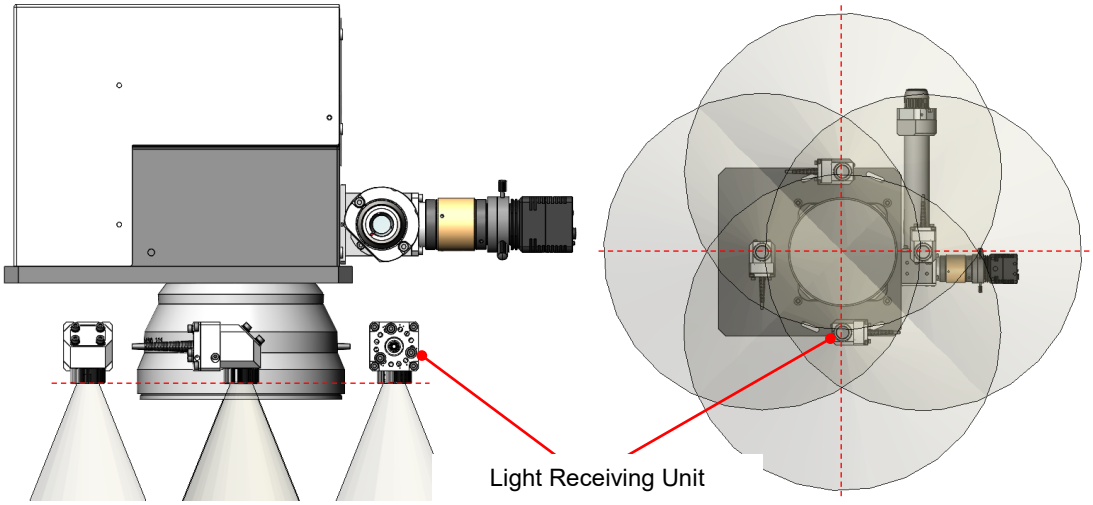
(10) External Mounting Method for the Scanner Light Receiving Unit

This is a method of using the Scanner Light Receiving Unit, an optional product that allows the **MM-L400A** to be measured externally, by attaching it to a customer-provided fixture.

⚠CAUTION

- Do not bend, apply strong shocks, or contaminate the terminals of the Scanner Light Receiving Unit's optical fiber.
- Do not bend the Scanner Light Receiving Unit's optical fiber to a radius smaller than the minimum bending radius (60mm).
- Adjustment of the angle for the light receiving unit will be performed by our service personnel. For further details, please contact our service department.
- Especially during long processing or welding operations with high output, the Scanner Light Receiving Unit may overheat due to reflected light. In such cases, appropriate cooling measures, such as the use of a water-cooling jacket, will be required. Please contact us for assistance.

1) Consider the placement of four light receiving units to be evenly distributed around the galvanometer scanner or similar equipment as described below. When doing so, please ensure that the optical fiber length and bending radius of the Scanner Light Receiving Unit, as well as the height of each light receiving unit, are uniform during installation.



2) 10.(4) Confirm the "Measurement Range of the Light Receiving Unit" of the scanner light receiving unit, and ensure that the desired measurement range is covered based on the design calculations before securing the unit. Please take extra care when handling the optical fibers of the scanner light receiving unit during installation. Additionally, measurement intensity tends to increase under the following conditions:

・The closer the light receiving unit is to the processing point, the higher the measurement intensity becomes.

・The closer the processing point is to the center of the measurement area, the higher the measurement intensity becomes.

* The measurement area is determined by design specifications. While measurements outside the area are possible under certain conditions, the measurement intensity will significantly decrease.

* The distance to the processing point is discretionary.

(11) Installation method using a mounting plate for the scanner light receiving unit

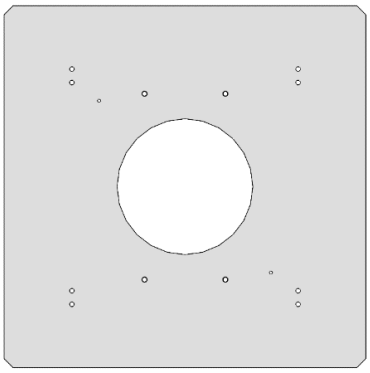
This is the method for installing the scanner light receiving unit using the mounting plate (optional).

⚠CAUTION

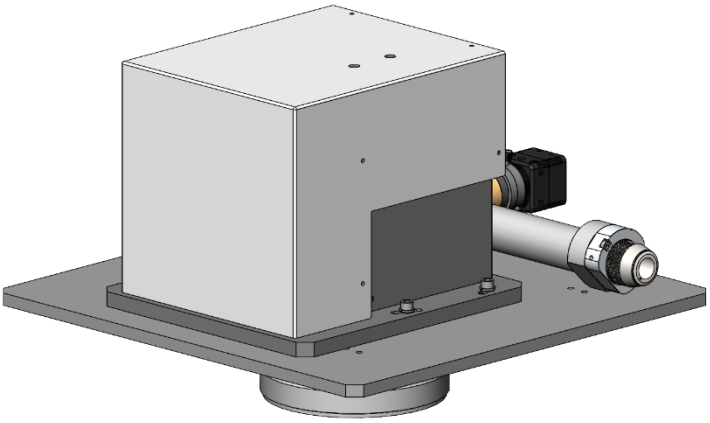
- Do not bend, apply strong force, or contaminate the terminals of the scanner light receiving unit optical fibers.
- Do not bend the scanner light receiving unit optical fibers below the minimum bending radius of 60 mm.
- Adjustment of the light receiving unit's angle will be done by our service personnel. For details, please contact our service department.
- Particularly in cases of high-power, long-duration machining or welding, reflected light may cause the scanner light receiving unit to overheat. In such cases, cooling measures, such as using a water-cooling jacket, will be required. Please contact us for further assistance.

(1) Preparation Before Installing the Mounting Plate for the Scanner Light Receiving Unit

1) Prepare a base for fixing the galvanometer scanner with eight M6 screw holes, as indicated in the external view diagram titled "Recommended Dimensions for Mounting Plate of Scanner Light Receiving Unit."



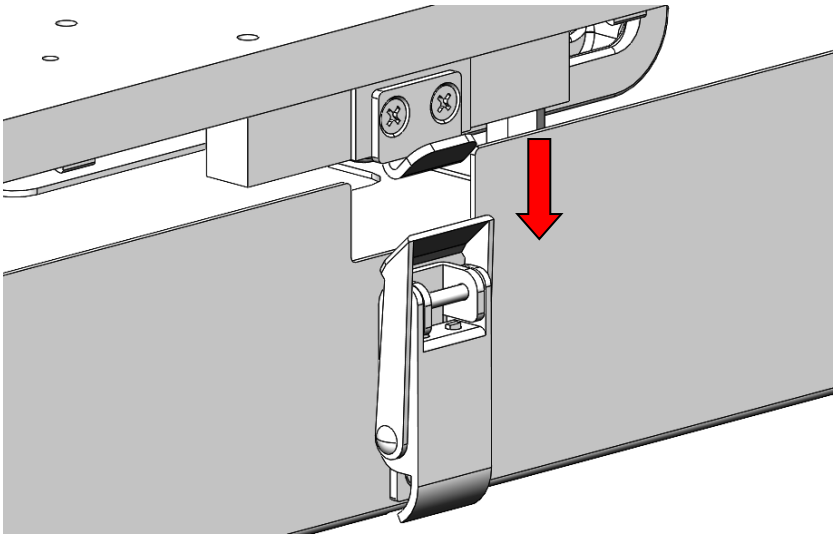
2) Fix the galvanometer scanner onto the prepared base.



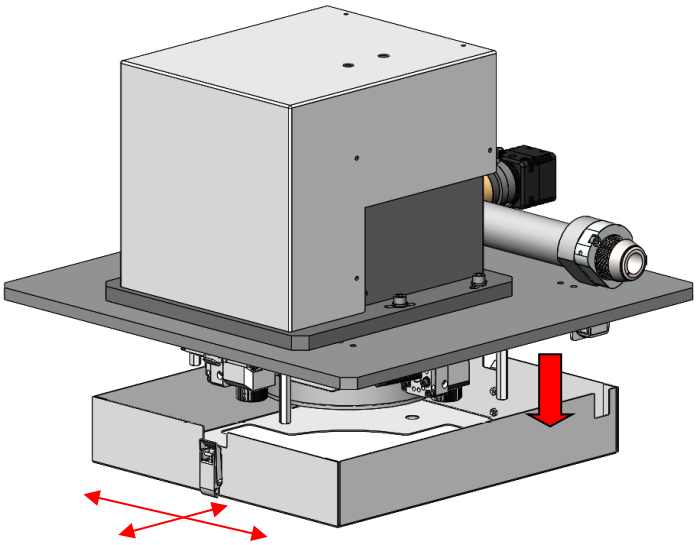
- The distance to the processing point is optional (can be set freely).

(2) How to Remove the Cover of the Mounting Plate for the Scanner Light Receiving Unit

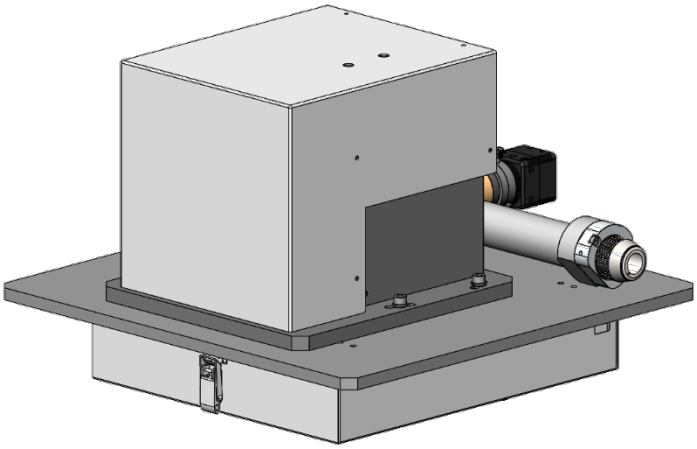
1) While holding the cover securely with both hands, release the two spring catches located on the sides of the mounting plate for the scanner light receiving unit. Be cautious during this process, as removing the spring catches will release the cover, causing it to drop. Ensure careful handling to avoid accidents.



2) Lower the cover approximately 70mm before removal. This will allow the cover to move freely in all directions (front, back, left, and right).



3) After completing tasks such as cleaning the protective glass, secure the cover again by following the above procedures in reverse order.



(12) Regarding countermeasures for reflected light in the scanner light receiving unit.

This document provides an explanation regarding countermeasures for reflected light in the scanner light receiving unit.

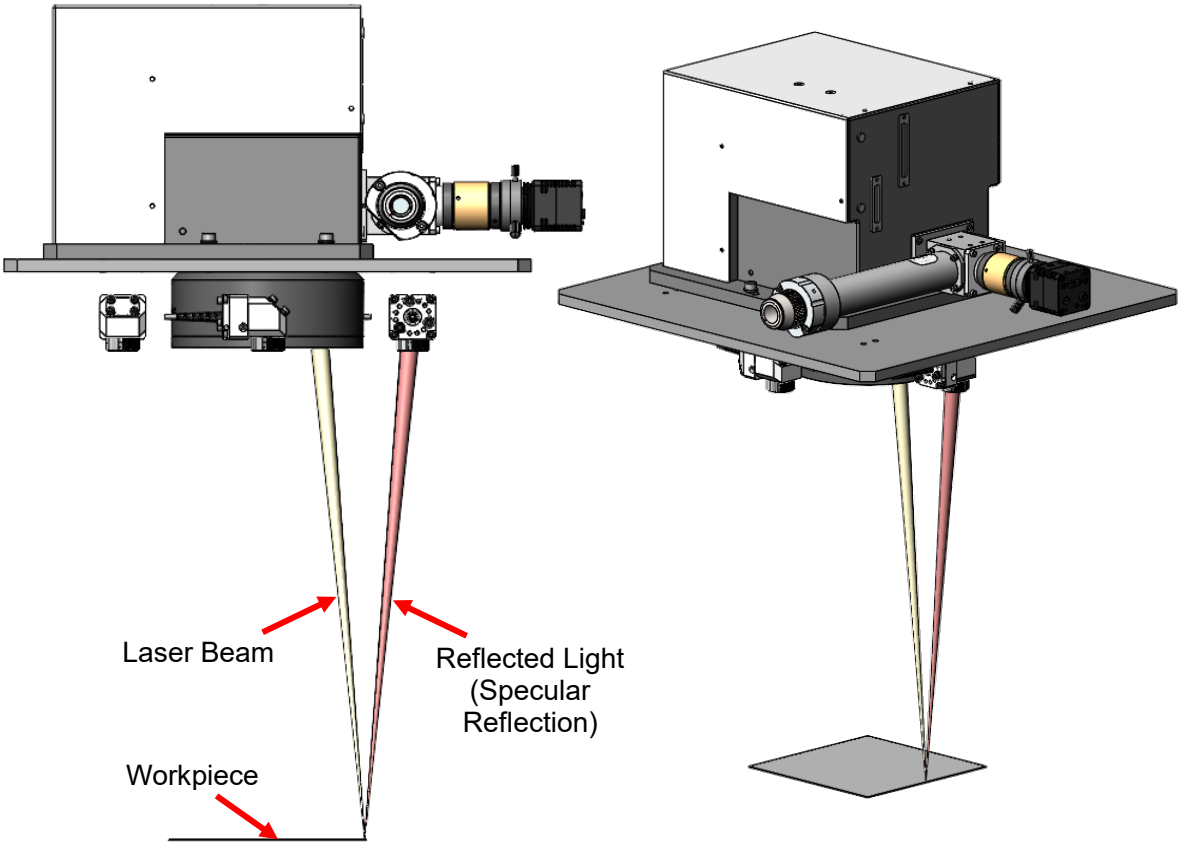
⚠CAUTION

- If damage due to heat accumulation or component burns are anticipated, please measure the output of reflected light in advance using a power meter.
- Especially during high-power, long-duration processing or welding, reflected light or diffuse reflected light may cause overheating of the light receiving unit or the mounting plate cover. In such cases, it is necessary to implement cooling measures such as a water-cooled jacket. For further assistance, please contact our company.

Due to the design specifications of the scanner light receiving unit, there are areas where laser-reflected light from laser welding directly hits the light receiving unit at the specular reflection position.
When the light receiving unit is installed on the X-axis or Y-axis of the galvanometer scanner, the specular reflection position exists on either the X-axis or Y-axis.

There is a risk of heat accumulation damage or component burns caused by laser-reflected light.
In particular, the following laser welding system configurations create conditions with especially high reflected light output.

- Single-mode laser welding configuration.
- Configuration with a collimator lens having a short focal length (f).



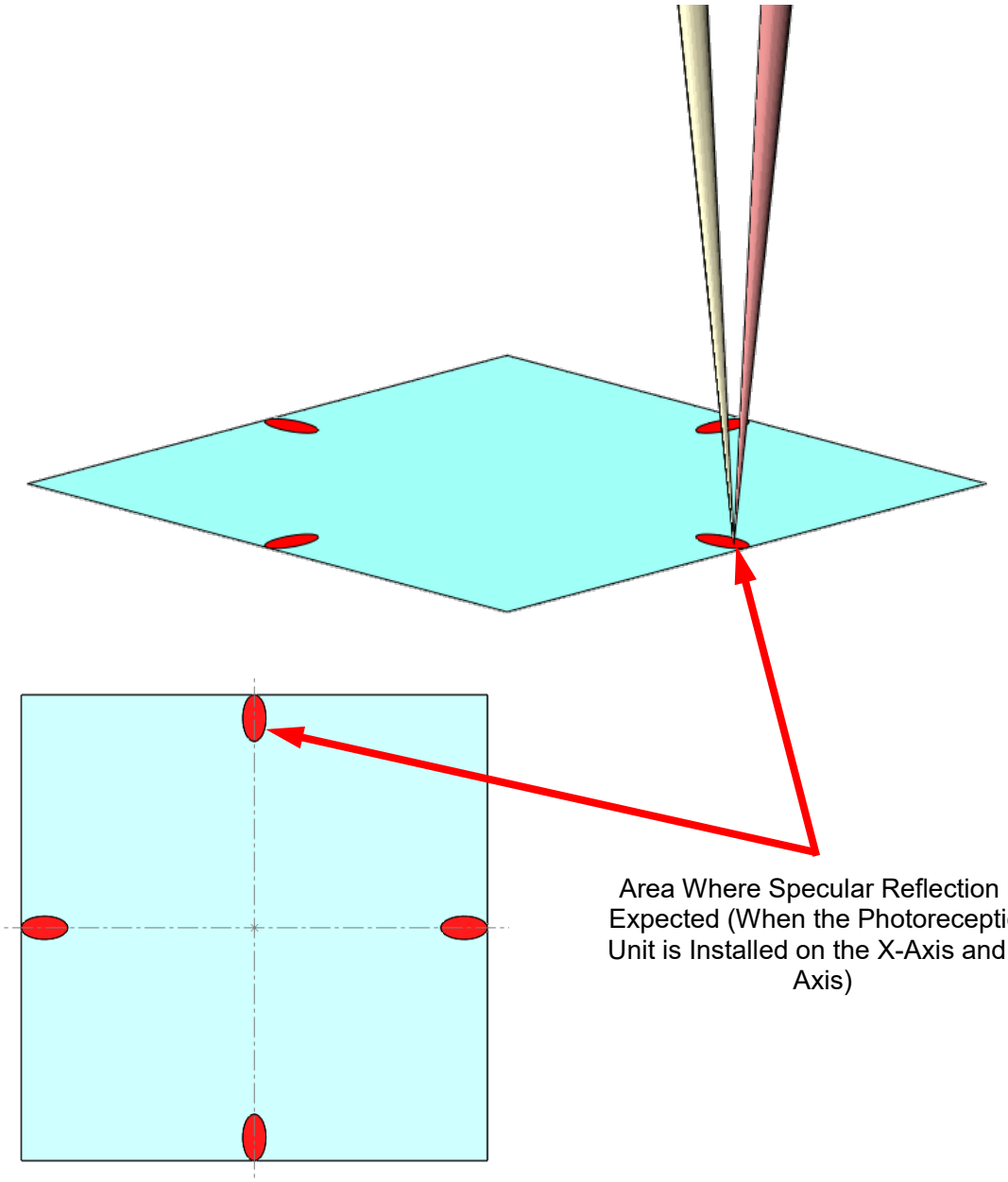
Laser Beam and Reflected Light Path Diagram

Please consider the laser welding layout conditions to prevent situations such as the following from occurring. For more details, please contact our service department.

- Continuous laser irradiation near the position where the photoreception unit receives direct reflection.

※Please check whether the reflected light measurement value is not exceeding the range even while the laser is being irradiated, with an analog gain set to 1x.

- Laser irradiation under conditions where the workpiece does not melt due to workpiece installation errors, etc.



Area Where Specular Reflection is Expected (When the Photoreception Unit is Installed on the X-Axis and Y-Axis)

Processing Layout (Illustrative Diagram)

(13) Removing/Mounting Light Attenuation Filter Unit

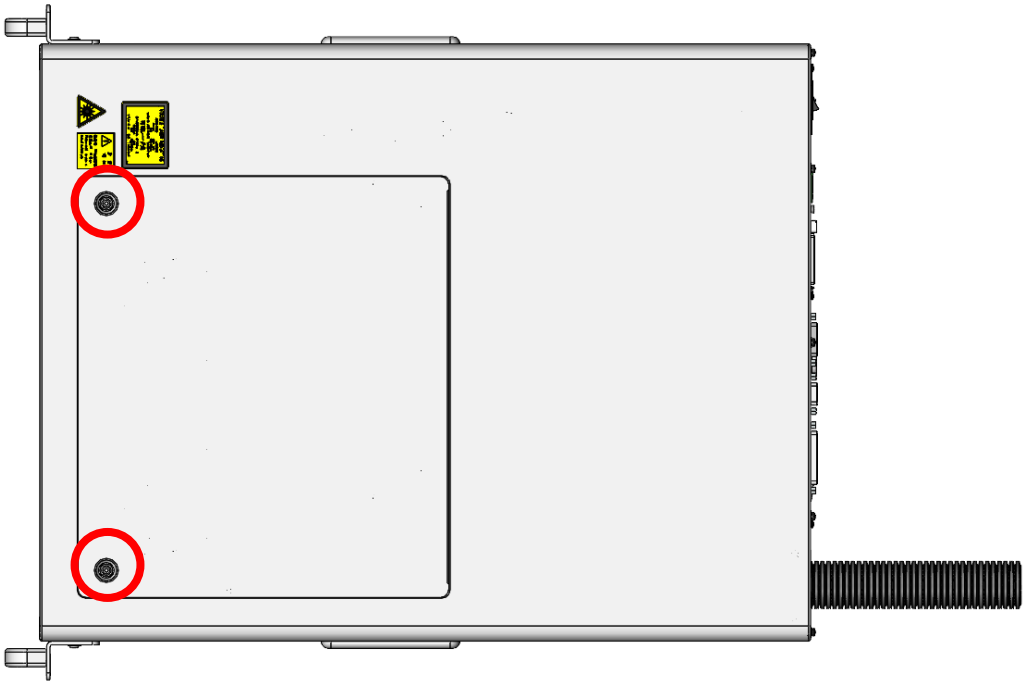
This section describes how to remove/mount the light attenuation filter unit, which is an optional unit to optically attenuate the measured light volume of the **MM-L400A**.

⚠CAUTION

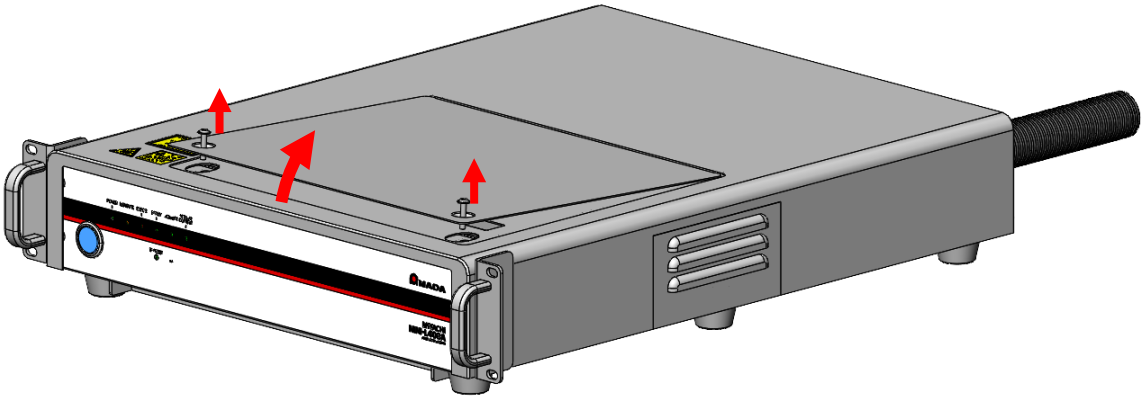
- Before starting the operation, be sure to turn off the power of the **MM-L400A**.
- Before mounting the optical attenuation filter unit, remove the dusts properly. Mounting the unit with dusts could cause dusts dropped in the measurement light path, resulting in fluctuation of the measurement values.
- Replace the optical attenuation filter unit (steps 6 and 7) in a short time. If dusts enter within the measurement light path, the measurement values could fluctuate.

1) Move the **MM-L400A** to a space for the operation. Replacing the optical attenuation filter unit requires a space of 120 mm or more from the top surface.

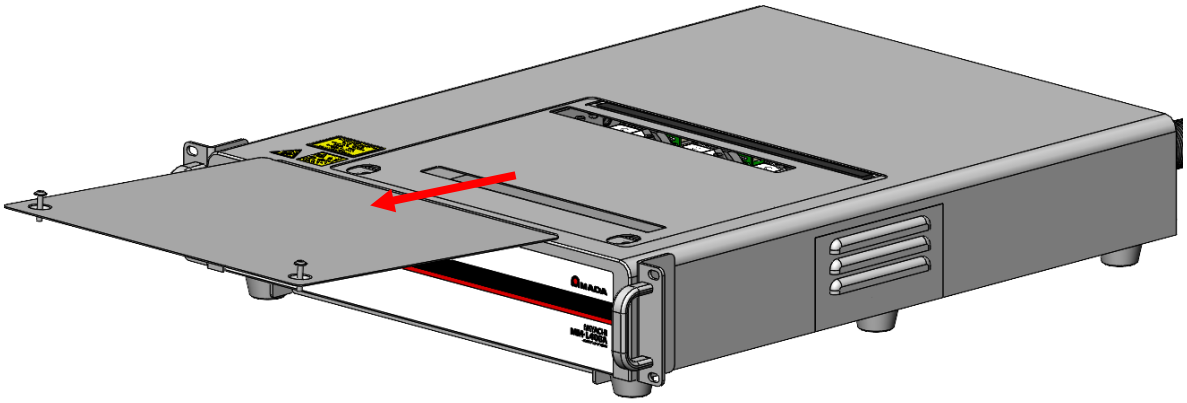
2) Loosen the M4 screws (two positions) on the **MM-L400A**. These screws are captive screws, which do not fall out even after being loosened.



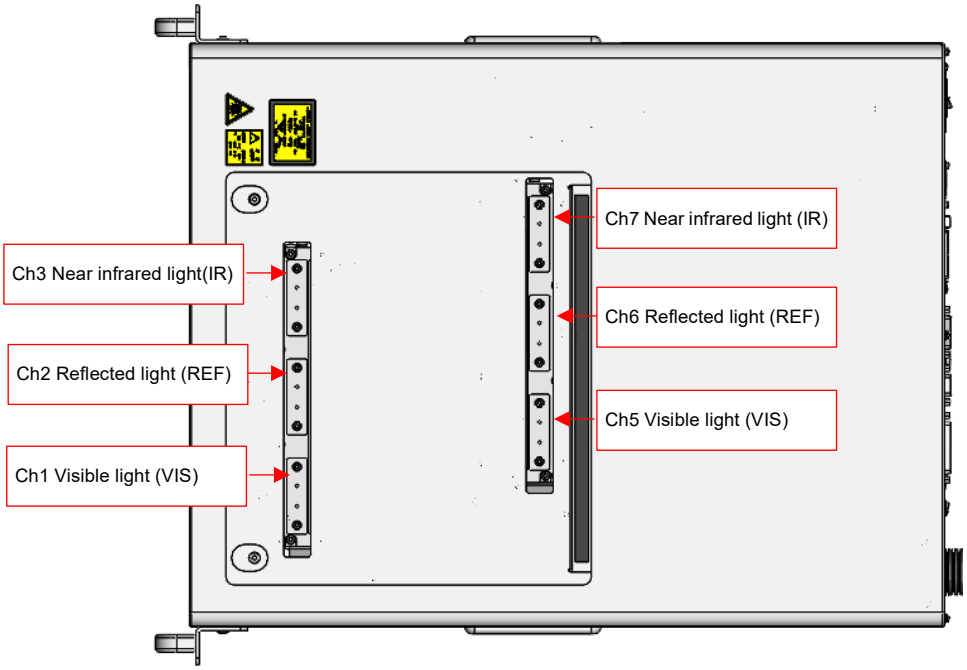
3) Hold the loosened two M4 screws, and lift them up in approximately 12 mm. As necessary, lift them up while pulling them to the front side. This can easily remove the cover plate.



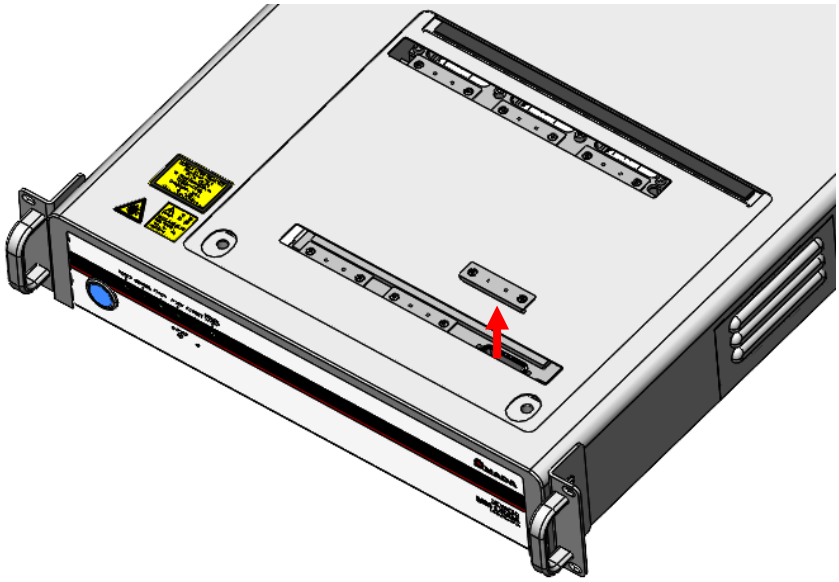
4) Pull the cover plate that has been lifted to the front to remove it.



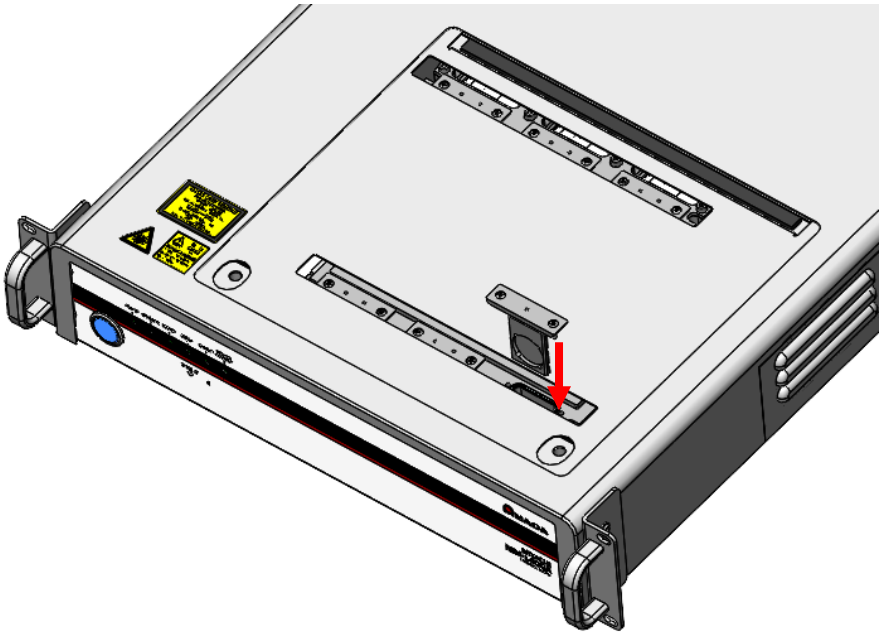
5) Please check the parts where you want to reduce the light intensity. Loosen the two M3 screws on the respective section and remove the cover. The M3 screws will not fall off. If the product configuration is 3-channel, there will be no sensors for channels 5 to 7.



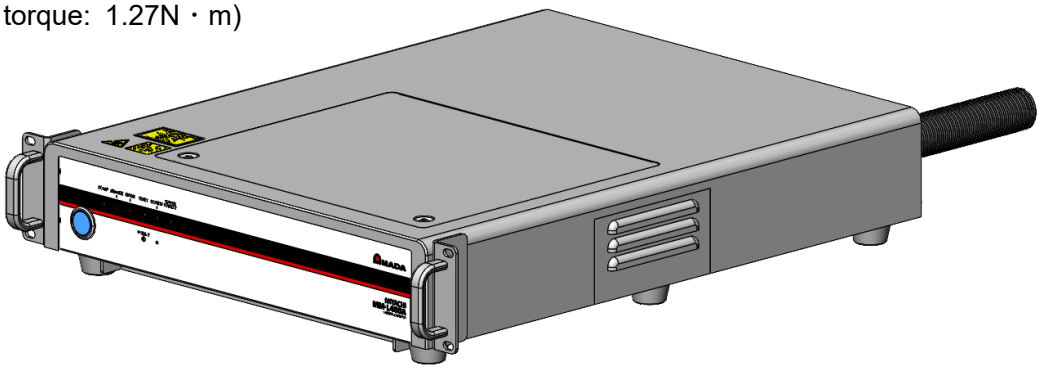
6) Loosen the M3 screws (two positions) of the target part, and remove the lid. Note that these M3 screws do not fall out.



7) Insert the optical attenuation filter unit to the removed part, and secure it by using two M3 screws. (Recommended tightening torque: 0.69N・m)



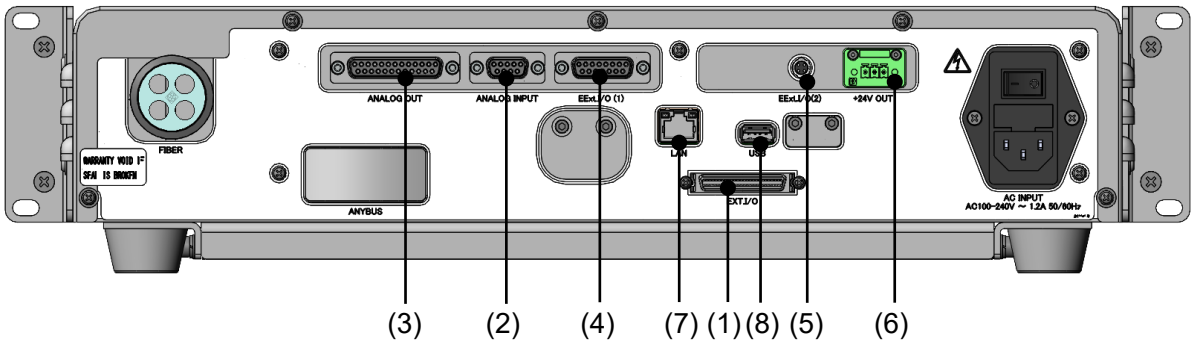
8) Perform the steps 2 to 4 in the reversed order, return the cover of the **MM-L400A** back in place, and secure it by using two M4 screws. (Recommended tightening torque: 1.27N・m)



6. Interface

(1) Inputs/Outputs

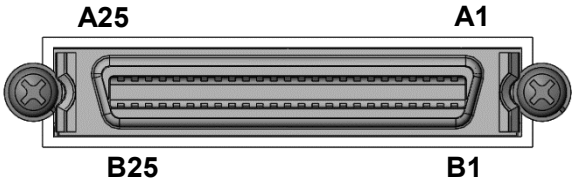
No	Connector name	Connected device	Remarks
(1)	EXT. I/O	Device to control the welding process	1.27mm pitch 50 pin Female
(2)	ANALOG INPUT	Sensor, etc.	D-Sub 9pin Female
(3)	ANALOG OUT	Oscilloscope, etc.	D-Sub 25pin Female
(4)	EExt. I/O (1)	Oscilloscope, etc.	D-Sub 15pin Female
(5)	EExt. I/O (2)	Not used	-
(6)	24V OUT	Trigger unit, etc.	3.81mm pitch 3 pin Female
(7)	LAN	Personal computer	Category 7 or higher
(8)	USB	Not used	-



(2) Connectors

(1) EXT. I/O

This is an interface connector (1.27 mm in pitch, 50-pin) to make connection with the external control unit. For pulse signal inputs, input should be continued for at least 1 ms.

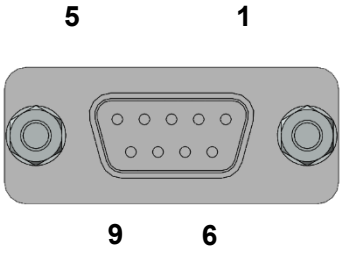


Pin No.	Signal name	Description
A1	+24V OUT	Power supply for external input/output (user I/O). Maximum output current is 0.1A.
A2	+24V OUT	
A3	OUT COM	Common signal for output signals.
A4	Recipe No. Select	Output of recipe No. in selection (binary code:128)
A5		Output of recipe No. in selection (binary code:64)
A6		Output of recipe No. in selection (binary code:32)
A7		Output of recipe No. in selection (binary code:16)
A8		Output of recipe No. in selection (binary code: 8)
A9		Output of recipe No. in selection (binary code:4)
A10		Output of recipe No. in selection (binary code:2)
A11		Output of recipe No. in selection (binary code:1)
A12	OK signal	When the judgment result is OK, the circuit is closed (on).
A13	Not used	Do not connect anything.
A14	NG signal	When the judgment result is NG, the circuit is closed (on).
A15	External Control Enable	When the external control is enabled, the circuit is closed (on).
A16	Recipe No. Determined	When the layout No. is determined, the circuit is closed (on).
A17	In-Shutdown	The circuit is closed (on) during shutdown.
A18	Ready	When the trigger is acceptable, the circuit is closed (on).
A19	In-Measurement	The circuit is closed (on) during measurement.
A20	Device Error	The circuit is open (B-contact) at error status.
A21	Not used	Do not connect anything.
A22	Not used	
A23	Not used	
A24	0V OUT	GND for external I/O. Do not use for any other purpose.
A25	0V OUT	

Pin No.	Signal name	Description
B1	External Trigger Input	With closed circuit input during READY, the measurement starts. It works regardless of whether external control is enabled or disabled.
B2	External Control Enable	With closed circuit input, the mode is switched to the external control mode.
B3	Not used	Do not connect anything.
B4	Not used	
B5	Device Error Reset	With closed circuit input, the abnormal output is released. Functions when the external control is enabled.
B6	Counter Reset	With closed circuit input, the relative counter is reset. Functions when the external control is enabled.
B7	Recipe No. Select	Input of recipe No. in selection (binary code:128)
B8		Input of recipe No. in selection (binary code:64)
B9		Input of recipe No. in selection (binary code:32)
B10		Input of recipe No. in selection (binary code:16)
B11		Input of recipe No. in selection (binary code: 8)
B12		Input of recipe No. in selection (binary code:4)
B13		Input of recipe No. in selection (binary code:2)
B14		Input of recipe No. in selection (binary code:1)
B15	Recipe No. Determined Strobe	Determines the recipe No. Functions when the external control is enabled.
B16	Judgment Reset	With closed circuit input, the judgment result held is reset.
B17	Shutdown Start	With closed input, the shutdown operation starts. Functions when the external control is enabled.
B18	Not used	Do not connect anything.
B19	Not used	
B20	Not used	
B21	IN COM	Common terminal for input signals.
B22	Not used	Do not connect anything.
B23	Not used	
B24	Not used	
B25	Not used	

(2) ANALOG INPUT

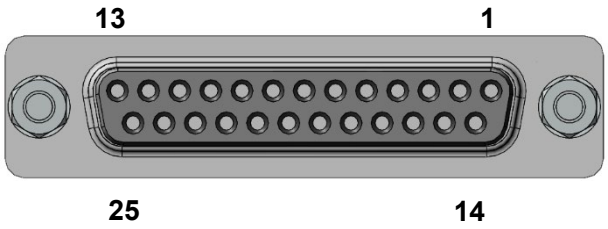
Transmits the signals detected by the external sensors or other devices to the **MM-L400A.**



Pin No.	Signal name	Description
1	Analog IN 1 (General-purpose)	By using a general-purpose analog input terminal, you can input a voltage of 0–10V (0–100%), which can be displayed on the **MS-Viewer**.
2	Analog GND	Common analog ground. Wire with the adjacent analog signals by using coaxial or twisted pair.
3	Analog IN 2 (General-purpose)	Using a general-purpose analog input terminal, you can input a voltage of 0–10V (representing 0–100%), which can then be displayed in **MS-Viewer**.
4	Analog GND	Common analog ground. Wire with the adjacent analog signals by using coaxial or twisted pair.
5	Reserved	Do not connect anything.
6	Reserved	
7	Reserved	
8	Reserved	
9	Not used	

(3) ANALOG OUT

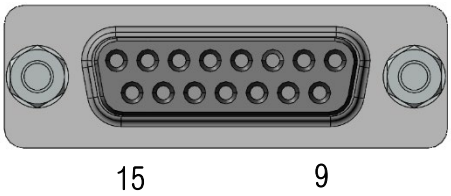
Transmits signals from the **MM-L400** to the external sensors or other devices.



Pin No.	Signal name	Description
1	Reserved	Do not connect anything.
2	Reserved	
3	Reserved	
4	Reserved	
5	Reserved	
6	Reserved	
7	Reserved	
8	Reserved	
9	Not used	
10	Not used	
11	Not used	
12	Not used	
13	Not used	
14	Not used	
15	Not used	
16	Not used	
17	Analog IN 1 (General-purpose)	General purpose analog input 1 is then output.
18	Analog GND	Common analog GND. Wire with the adjacent analog signals by using coaxial or twisted pair.
19	Analog IN 2 (General-purpose)	General purpose analog input 2 is then output.
20	Analog GND	Common analog GND. Wire with the adjacent analog signals by using coaxial or twisted pair.
21	Reserved	Do not connect anything.
22	Reserved	
23	Reserved	
24	Reserved	
25	Reserved	

(4)EExt.I/O (1)

You can transmit signals from the **MM-L400A** to external sensors and other devices.

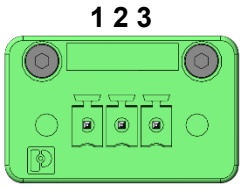


Pin No.	Signal name	Description
1	Reserved	Do not connect anything.
2	Reserved	
3	Reserved	
4	Reserved	
5	Reserved	
6	analog ground	common analog ground.
7	Reserved	Do not connect anything.
8	analog ground	common analog ground.
9	Selectable sensor output 1	It can output an analog signal of the incident light set by the PC software. It is a voltage output of 0-10V (0-100%). [Filter setting *1] Analog gain: Reflected. Moving average, low/high pass filter: Not reflected.
10	analog ground	common analog ground. Use coaxial cable or twisted pair cable to wire to nearby analog signals.
11	Selectable sensor output 2	It can output an analog signal of the incident light set by the PC software. It is a voltage output of 0-10V (0-100%). [Filter setting *1] Analog gain: Reflected. Moving average, low/high pass filter: Not reflected.
12	analog ground	common analog ground. Use coaxial cable or twisted pair cable to wire to nearby analog signals.
13	Reserved	Do not connect anything.
14	Reserved	
15	Not used	

*1：You can set it from the recipe.

(5) 24V OUT

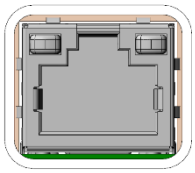
A connector for power output.



Pin No.	Signal name	Description
1	24V	Output terminal for 24V/1.5A
2	GND	Ground terminal
3	FG	Frame ground terminal with the same electrical potential with that of the housing.

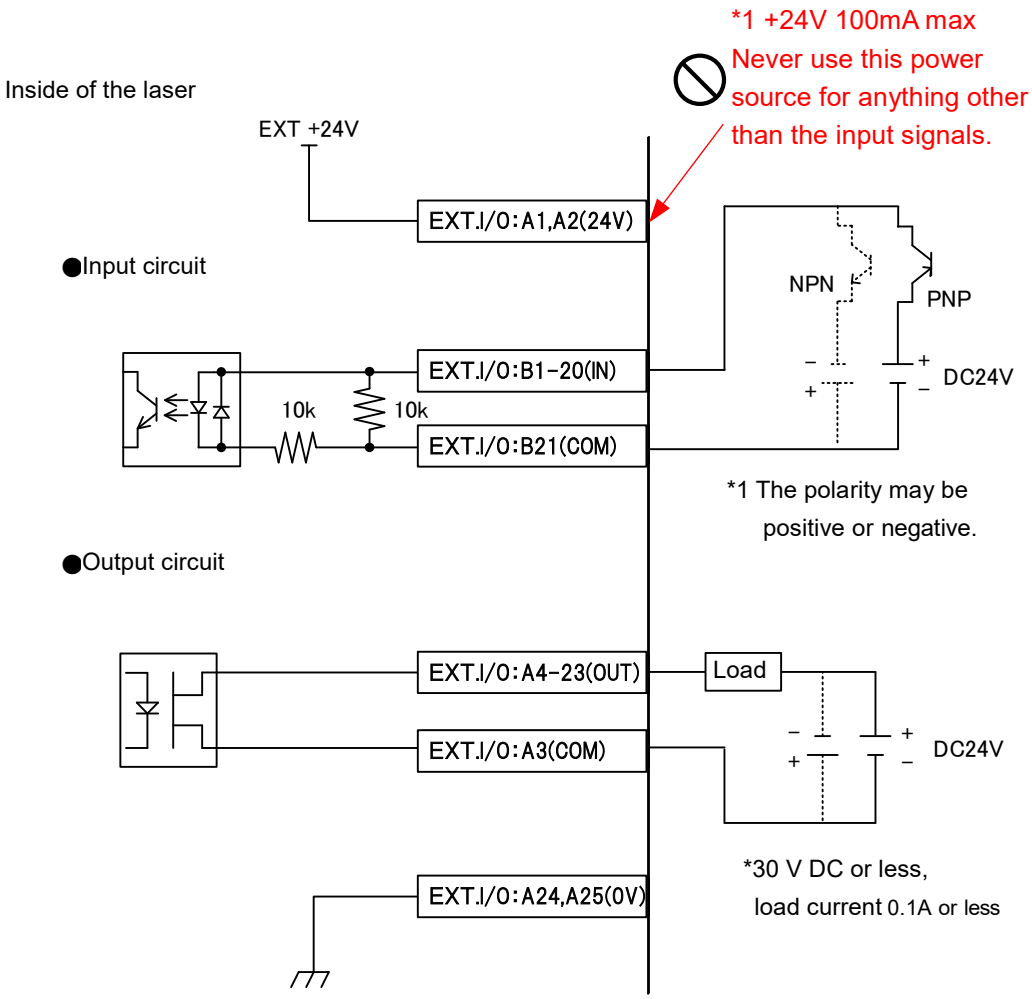
(6) LAN

A connector to connect with a personal computer.
Used for various settings and for transmission of measurement data.

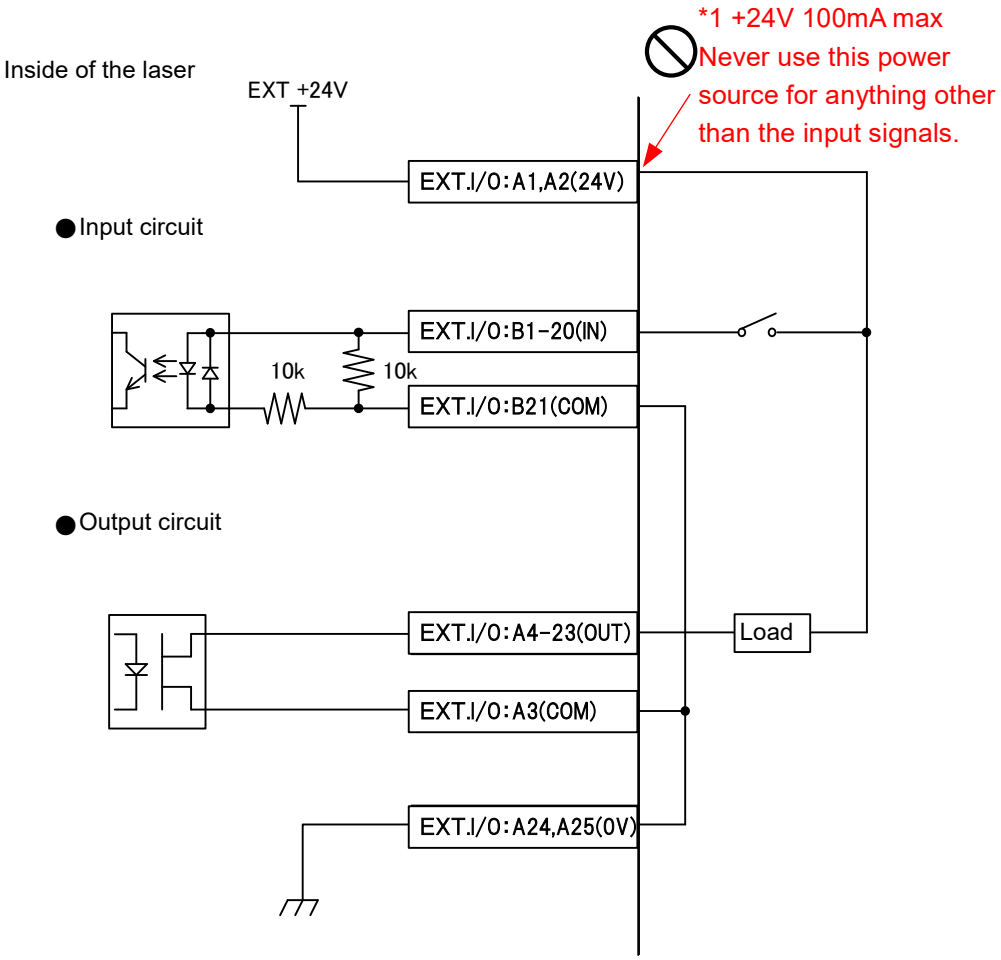


(3) Example Connections of External Input/Output Signals

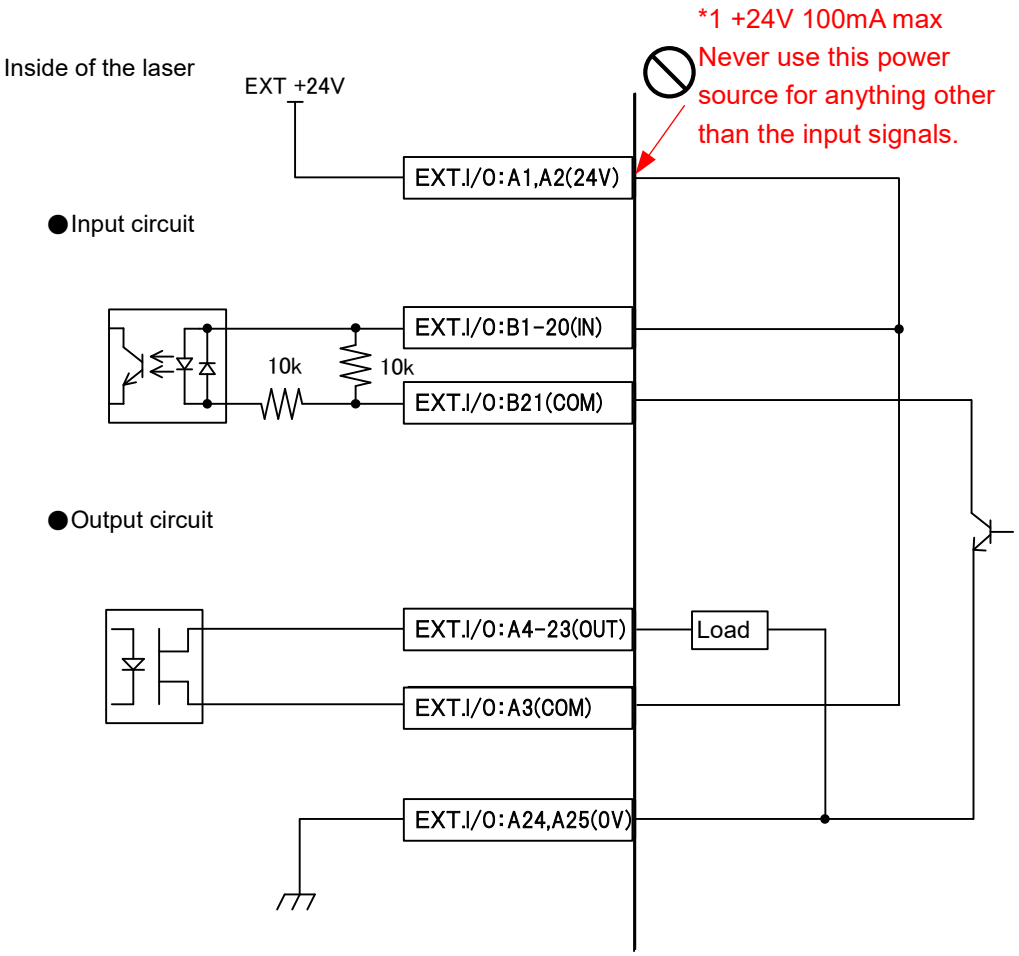
(1) When connected to an external power source



(2) When using a contact signal



(3) When connected to an internal power source and using an open-collector signal



(4) Timing Chart

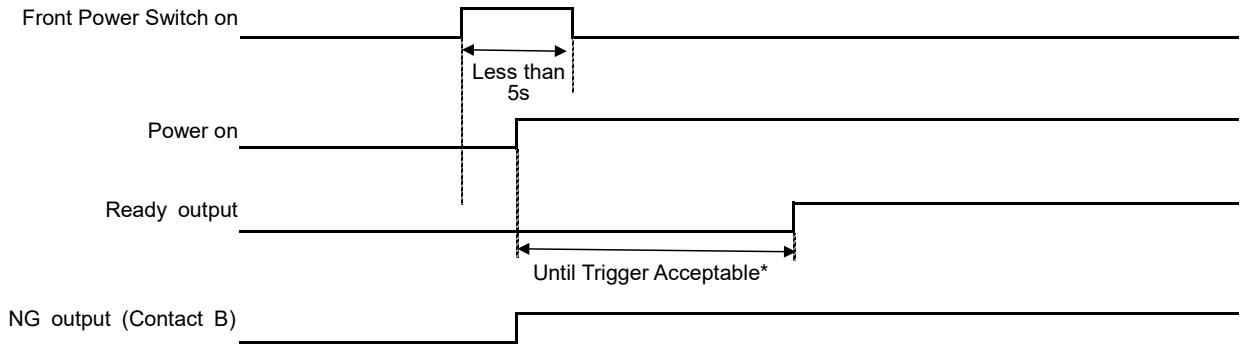
Examples of timing chart are shown below for the case where the power supply of the **MM-L400A** is turned on, measurement by laser processing is performed and judgment is made.

Each timing chart, with the equipment operation represented on the vertical axis and the lapse of time represented on the horizontal axis, shows the change status based on changes with the lapse of time at each operation and the time required for a certain operation.

(1) From turning on the power supply to the ready status

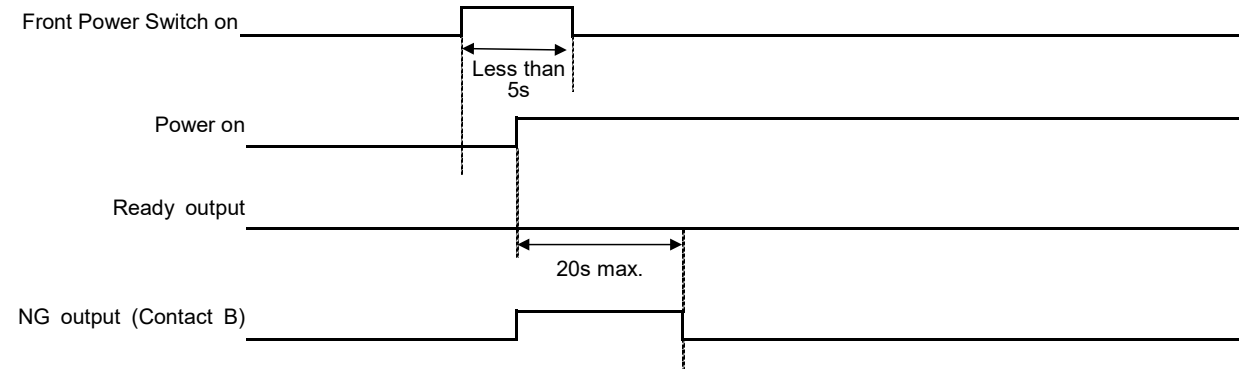
The following diagram shows the lapse of time in the case where the power supply of the **MM-L400A** is turned on and measurement becomes ready.

<Normal>



*Trigger Acceptable: initial setting completed, sensor ready, and measurement data transmittable (connection established with save destination such as a personal computer)

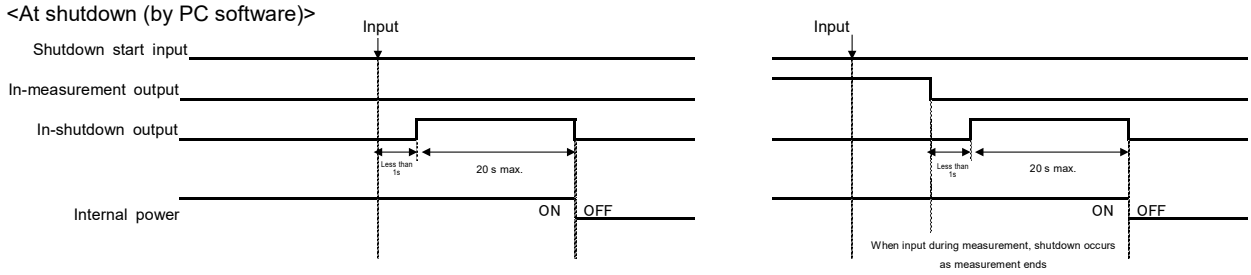
<When error occurs>



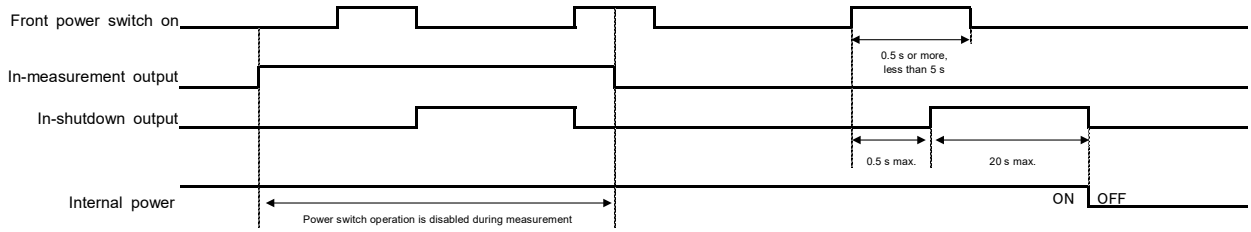
(2) To power off

The following diagram shows the lapse of time in the case where the internal power of the **MM-L400A** is turned off.

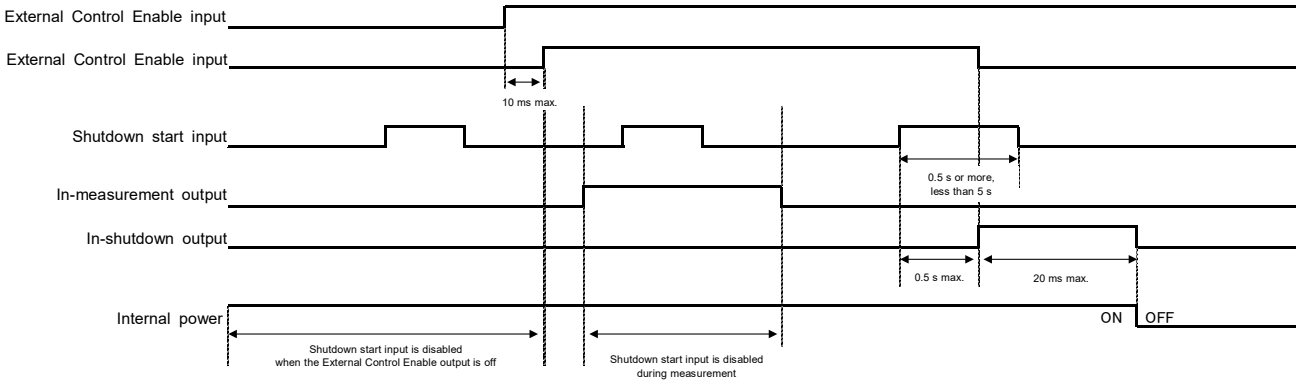
<At shutdown (by PC software)>



<At shutdown (by front power switch)>



<At shutdown (by EXT. I/O)>



The internal power can be turned off either by using a personal computer, the front power switch of the equipment, or the EXT. I/O operation of the Shutdown Start input (B17).

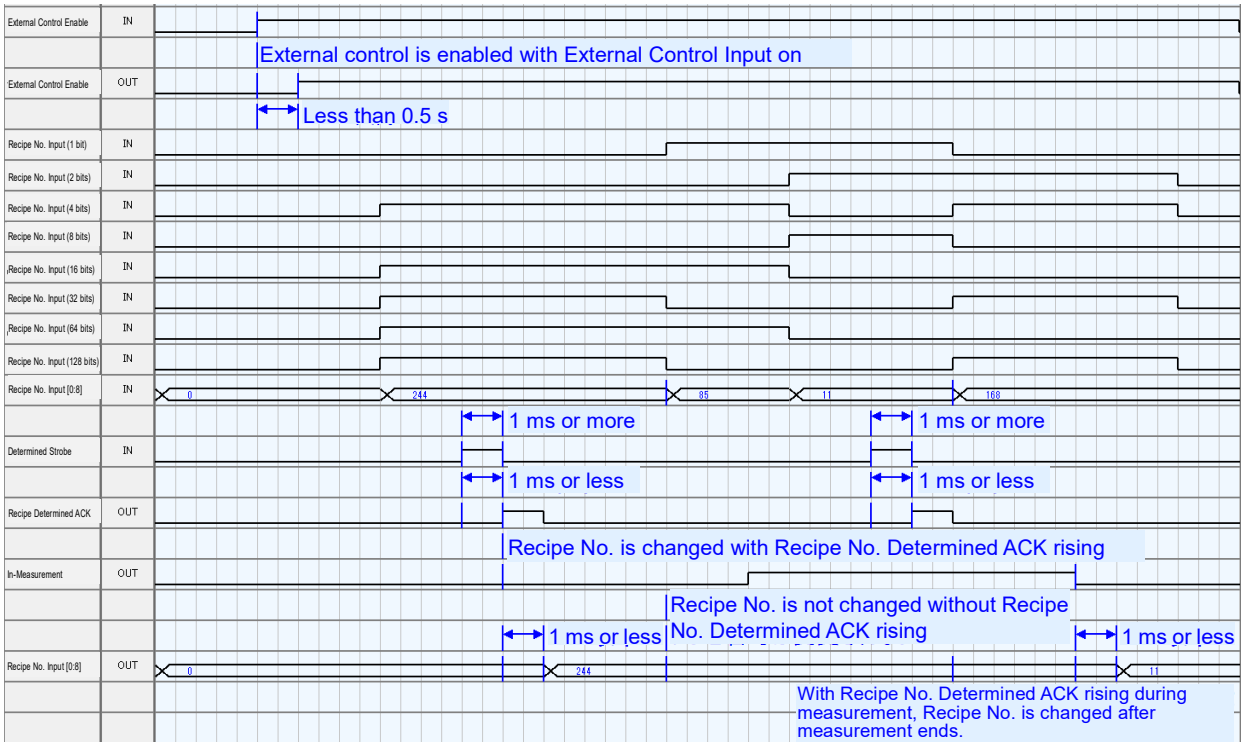
During measurement, the internal power cannot be turned off. When using a personal computer, the internal power turns off after the measurement ends. When using the front power switch and EXT. I/O, input during measurement is invalid. The operation of Ext. I/O is enabled when External Control Enable is on.

During the internal power off operation, the In-Shutdown output (A17) is on. Turning off the AC power switch on the rear of the equipment during the shutdown operation can damage the setting data. Be sure to wait until the In-Shutdown output is off before turning off the AC power switch on the rear of the equipment

While the In-Shutdown output is on, the POWER lamp of the status indicator LEDs on the front of the equipment flashes.

(3) To switch conditions

An example of timing chart is shown below for the case where the condition No. is switched by using Ext. I/O.



When External Control Enable is on, the measurement condition No. can be switched by using Ext. I/O.

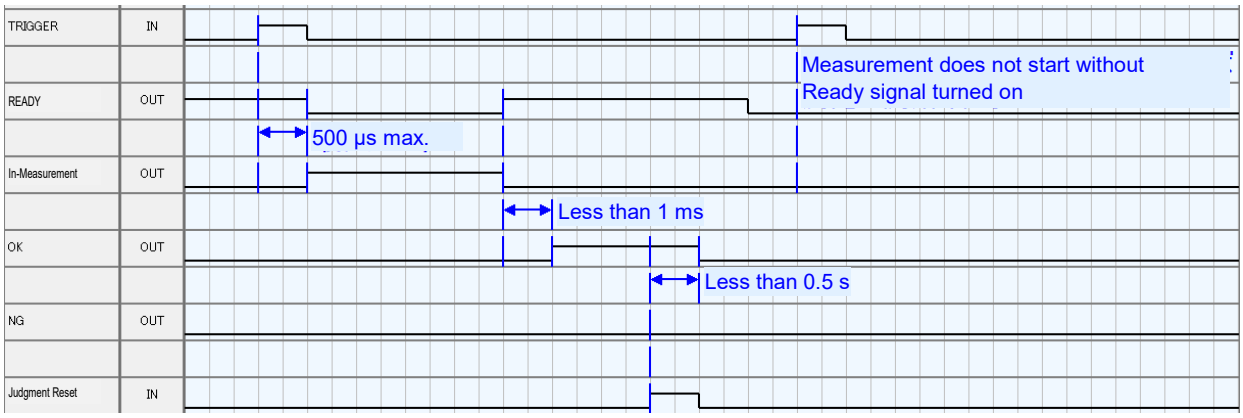
When External Control Enable is on, with the Recipe No. Determined Strobe input (B15) triggered (rising), the status changes to the condition of Recipe No. Select (B7 to B14). However, if the input is triggered during measurement, the status only changes after the measurement ends (the measurement continues with the condition that existed before the change until it ends).

The Recipe No. Determined output (A16) is on when it accepts the Recipe No. Determined Strobe input (B15). It is off when the Recipe No. Determined Strobe input (B15) is off. When changing the condition No., turn off the Recipe No. Determined Strobe input (B15) after the Recipe No. Determined output (A16) is on.

The Recipe No. Select outputs (A4 to A11) output the current condition No.

(4) From trigger input to measurement

An example of timing chart is shown below for the case where the measurement is performed by the **MM-L400A**.



The following signal is triggered based on the setting of trigger conditions.

Trigger channel	Trigger
External trigger	Measurement starts with External trigger input of Ext. I/O (B1) and waveform rising
Other than External trigger	Measurement starts when the selected output exceeds the set trigger level.

Measurement starts when the trigger is turned ON while the READY state is ON.
When the set measurement time has elapsed, the measurement ends.
(If an error occurs during the measurement, the measurement will end at the time the error occurs.)

If the READY state is OFF, the measurement will not start even if the trigger is turned ON.

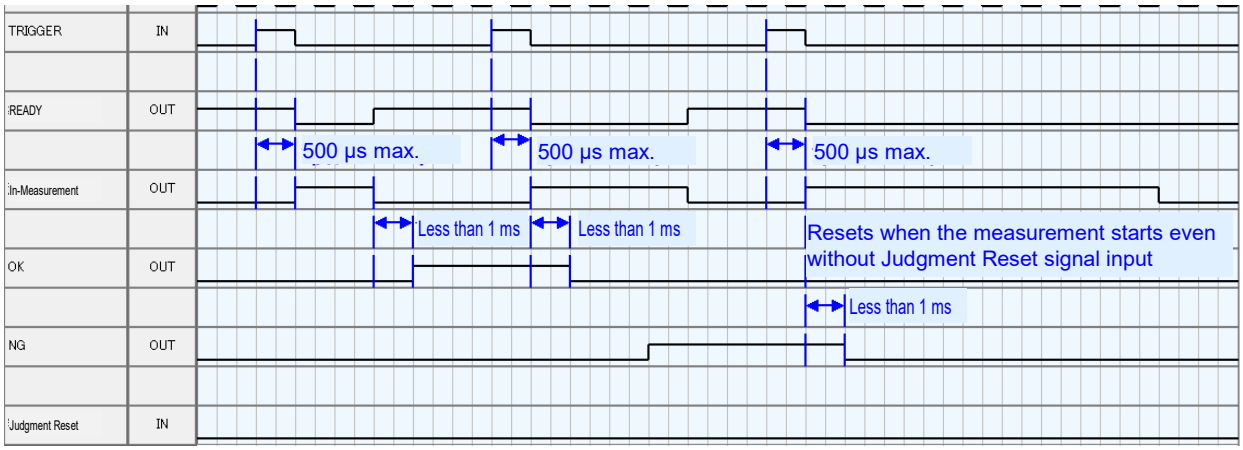
If the waveform rise cannot be observed due to the delay in the external trigger signal, set the pre-trigger.

The READY state of the **MM-L400A** corresponds to the ON state of READY.

(5) From trigger input to measurement (Judgment Reset)

An example of timing chart is shown below for the time elapsed from the measurement start using the **MM-L400A** to the output of a judgment result (OK or NG signals), as well as the reset of the judgment result output.

<When the Judgment Reset input(B16) is not used>



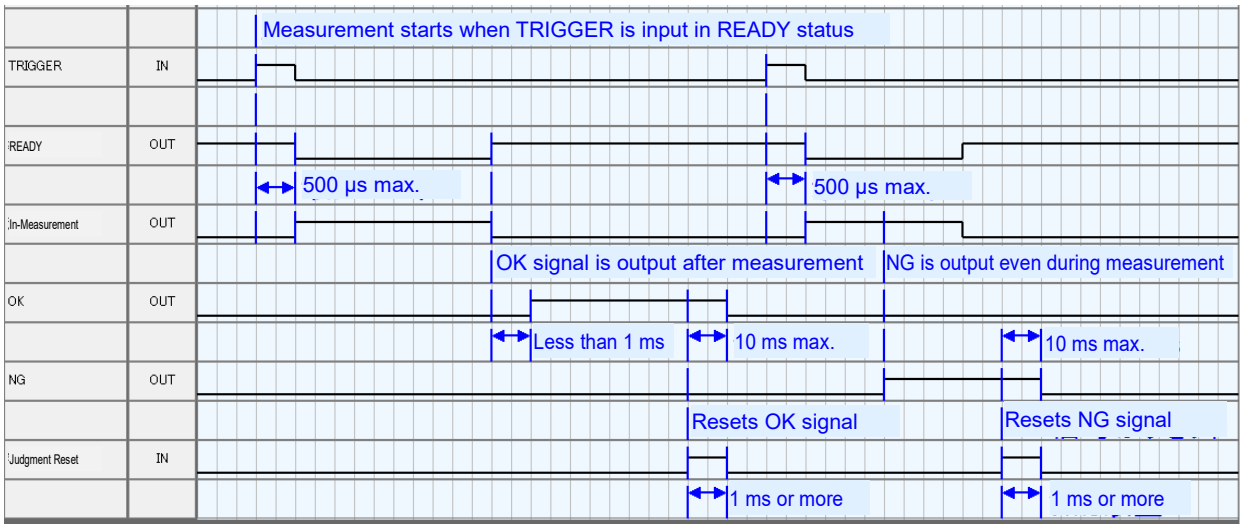
The OK signal of Ext. I/O (A12) is on when there is no NG in the judgment result at the measurement end.

The NG signal (A14) rises as shown in the table below when the judgment becomes NG during measurement.

NG Judgment Details	Rise Specifications
Envelope	Output within 1µs upon NG detection (under conditions including assist function)
Integral Value (Upper Limit)	Output within 1µs after detecting values exceeding the set threshold
Integral Value (Lower Limit)	Output within 1µs after waveform measurement is complete

Both the OK signals and NG signals are off when the measurement starts. (Judgment results of the previous measurement are maintained until the next measurement starts.)

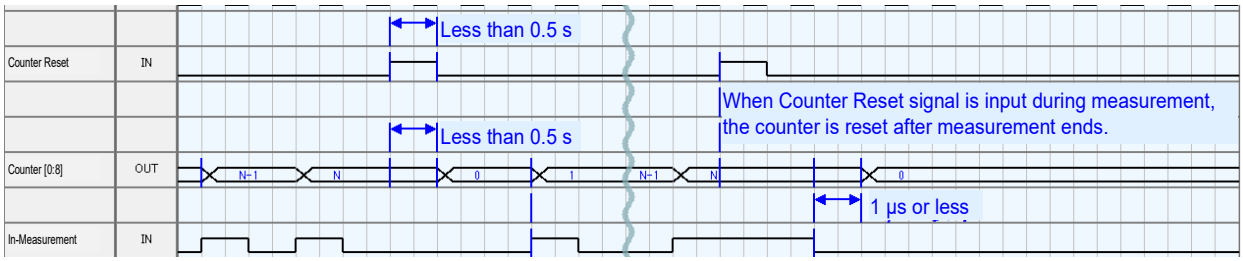
<When the Judgment Reset input(B16) is used>



In the measurement stop state, when the Ext. I/O judgment reset (B16) input is activated, the OK signal (A12) and NG signal (A14) are turned OFF.

(6) Counter reset

An example of timing chart is shown below for the change in counter (the values of Total and NG in the PC software **MS-Viewer**) as well as the time elapsed from when the counter is reset by Ext. I/O.



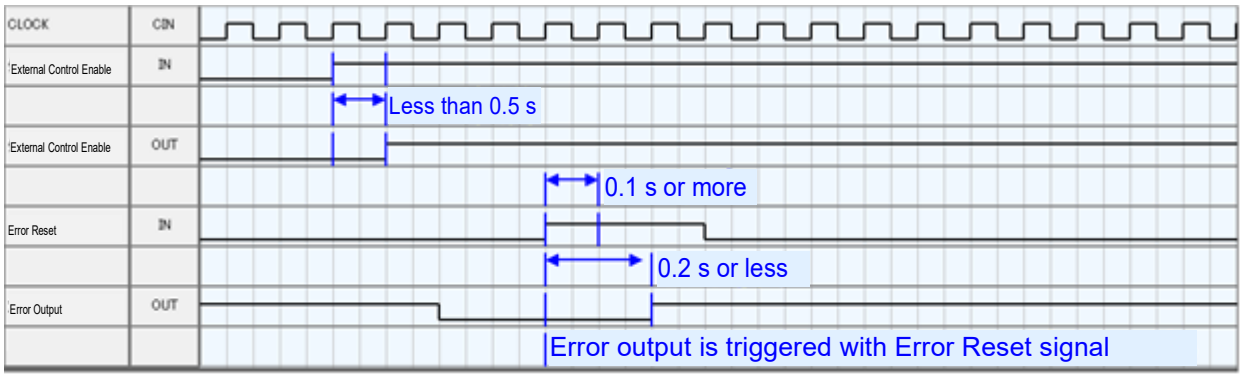
The counter increments when the measurement starts. (The NG value increments when the first NG is judged during a measurement.) In the **MS-Viewer**, however, the display is reset when each measurement ends (with the measurement data updated), the counter display changes when the measurement ends.

The Ext. I/O Counter Reset (B6) is enabled when the External Control Enable is on.

In the external control enabled state, the counter is reset to 0 by inputting the counter reset (B6). However, if the input is received during measurement, the counter will be reset to 0 at the end of the measurement.

(7) Error Reset

An example of timing chart is shown below for the time elapsed from when the Ext. I/O is used to reset errors.



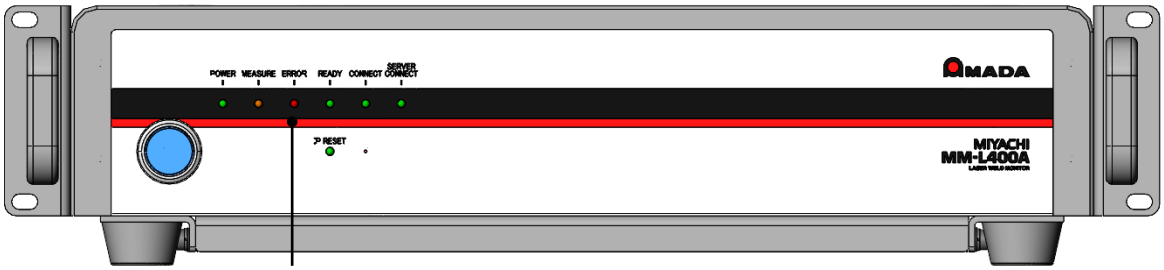
The Ext. I/O Error Reset (B5) is enabled when the External Control Enable is on.

In the error state, when the external control is enabled (ON), the error can be cleared by inputting the error reset (B5).

7. Maintenance

(1) Troubleshooting

When an error occurs in the **MM-L400A**, the ERROR lamp on the display panel lights up in red.



ERROR lamp

Here describes the symptoms, confirmation item and measures to take.

Phenomenon possibly occurring until online

Symptom	Confirmation item	Measures
The power supply is not turned on.	Is the AC cable connected?	Connect the AC cable.
	Is a current applied to the switchboard (power supply)?	Turn on the circuit breaker in a switchboard.
	Is the power supply voltage normal?	Use with a voltage of 100 to 240 V AC.
	Are cables normal (free from disconnection, etc.)?	Use the normal cable.
	Is the fuse normal (free from malfunction or breakage)?	Replace the malfunctioned or the broken fuse. (See 7.(3) Replacing the Fuse)
State does not change to on-line.	Is the IP address of the personal computer different from that of the **MM-L400A**?	Set a different IP address than MM-L400A. (Refer to the MS-Viewer user manual for instructions.)
	Is the IP address of the **MM-L400A** set to [192.168.1.40] when connecting it for the first time after purchase?	Press the IP address reset switch. This sets the IP address to [192.168.1.40].
	Is the LAN cable connected?	Connect the LAN cable.
	Is the power supply of the **MM-L400A** turned on?	Turn on the power supply.

Symptom	Confirmation item	Measures
The software cannot be installed.	Doesn't the installer start automatically?	Start automatically. (Refer to the Application Manual of the **MS-Viewer**.)
	Is the .NET Framework installed?	Install it from Microsoft. For installation, the network connection is required.
The **MM-L400A** is not become READY.	Is the ERROR lamp at the front of the **MM-L400A** lit?	Check the ERROR information. (Refer to the Application Manual of the **MS-Viewer**.)
	Is the **MM-L400A** is not in shutdown mode, is it?	Please restart the **MM-L400A** after it has been shut down.
	Are you connected to the database server and online?	Please check the connection status with the database server.
	Are you not in the process of switching measurement conditions?	Please stop switching the measurement conditions.

Symptoms that occur until waveforms are obtained

Symptom	Confirmation item	Measures
The guide light cannot be turned on.	Is the [Guide] button clicked on the Main Window?	Click the [Guide] button. (In the case of the scanner light receiving unit, the guide light is designed not to illuminate.)
Waveforms cannot be obtained. / The intensity of waveform is low or high.	Is the monitoring point of the **MM-L400A** aligned with the processing point?	Align the monitoring point of the **MM-L400A** with the laser processing point.
	Is the gain adjustment proper?	Adjust the gain so that the waveforms can be obtained.
	Are the settings of external trigger and internal trigger proper?	Change them on the Recipe Window.
	Isn't the trigger setting too high?	Lower the set value of the trigger.
	Is the external trigger input?	Check Ext. I/O. (See 6. Interface.)
	Is the specification of the optical filter proper?	Use a filter for the **MM-L400A** with a proper specification.[*1]
	Are you performing laser welding within the measurable range of the scanner's light-receiving unit?	Please perform laser welding within the measurable range of the scanner's light-receiving unit.

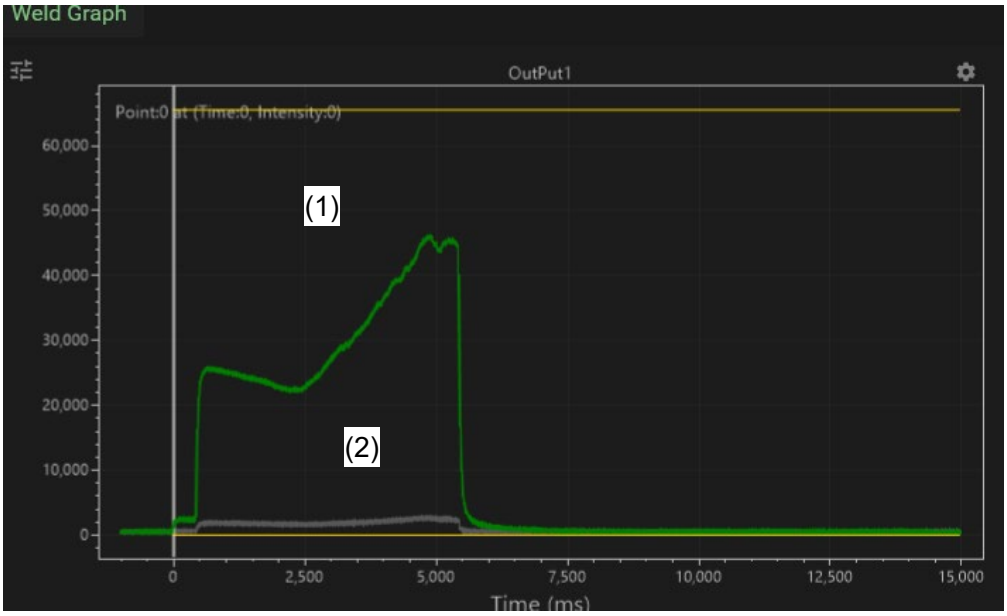
Symptoms that occur after waveforms are obtained

Symptom	Confirmation item	Measures
Quality judgment cannot be performed.	Is the envelope detection setting appropriate?	Change the setting.
	Is the integration detection setting appropriate?	Check the setting.
Disturbance of waveform	Are the installation methods for the external light receiving unit, coaxial light receiving unit, scanner light receiving unit, and optical fiber appropriate?	Please ensure that it is installed in a way that avoids vibrations.
	Is the environment under high noise?	Take proper measures against noise. As necessary, increase the setting value of the moving average.
EXT. I/O and TRIGGER signals cannot be input or output correctly.	Is the wiring proper?	Check the connection and disconnection of the connector.
	Is the timing chart proper?	Check the timing chart in the Operation Manual again to confirm the proper setting.

*1: For the profiles of the optical filters for the **MM-L400A**, see (4) Options in 3.(2). When performing measurement with the same setting condition, the measurement intensity is different as shown below.

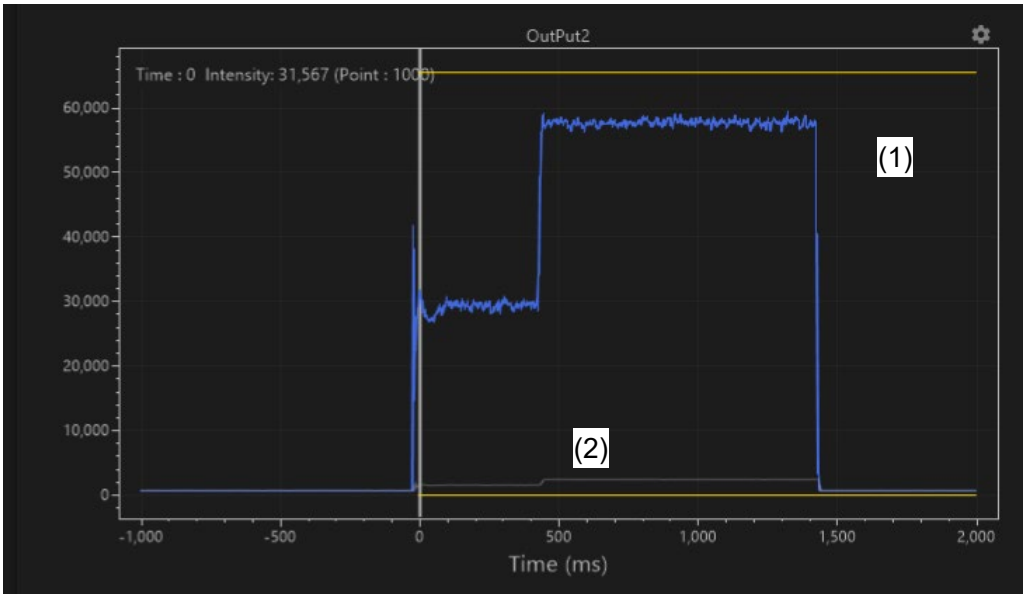
Visual lights

No.	Line color	Optical attenuation filter unit
(1)	Green	Without optical attenuation filter unit
(2)	Gray	With optical attenuation filter unit (AS1213648)



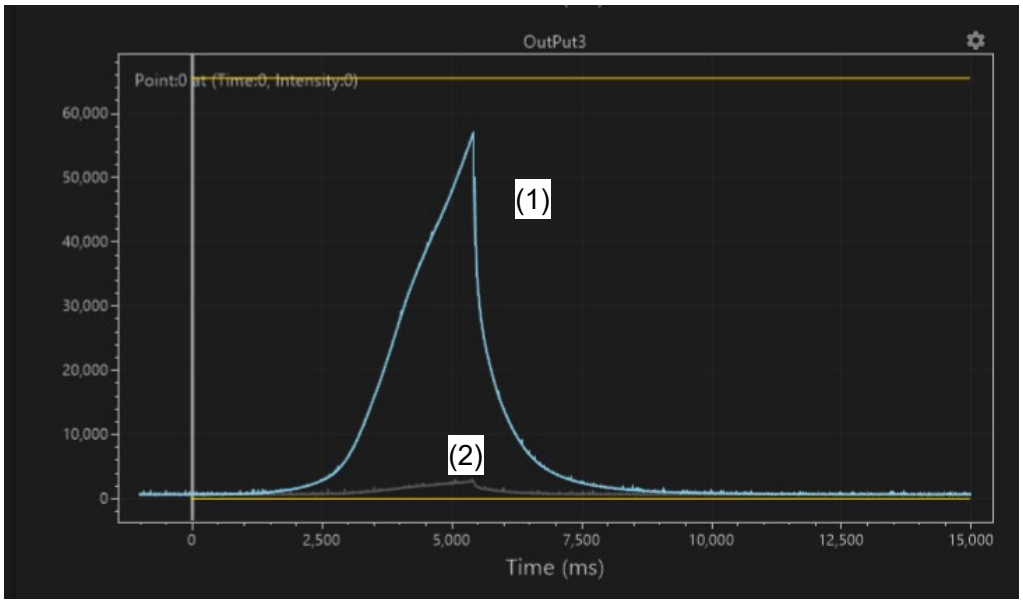
Reflective light

No.	Line color	Optical attenuation filter unit
(1)	Blue	Without optical attenuation filter unit
(2)	Gray	With optical attenuation filter unit (AS1213648)



Near-infrared light

No.	Line color	Optical attenuation filter unit
(1)	Light blue	Without optical attenuation filter unit
(2)	Gray	With optical attenuation filter unit (AS1213648)



(2) Cleaning/Replacing Protective Glass

The optional external light receiving unit and scanner light receiving unit are equipped with protective glass.
The protective glass prevents the lens from becoming dirty due to dust in the air or sputter from the workpiece.

If the protective glass gets dirty, it will no longer be possible to obtain accurate waveforms. Therefore, regular cleaning or replacement is required.

⚠ CAUTION

- If the protective glass holder is not properly tightened, there is a risk of dust and debris entering the external light receiving unit or scanner light receiving unit.
- Do not touch the surface of the protective glass and the optical filter.
- The protective glass may stick to the protective glass holder through the intermediary of the O-ring. In such a case, gently press the protective glass with a finger from above the lens cleaning paper to remove it.

(1)Necessary items

- Lens cleaning paper
- Ethanol
- Air blow
- Gloves (made of latex for clean room)

(2)Maintenance parts

For external light receiving unit

Item	Model No.
Protection Glass dia29.8_1t *1	KU-0037
O ring *1	D9270 SG-26

*1 Replace the protective glass and the O-ring together.

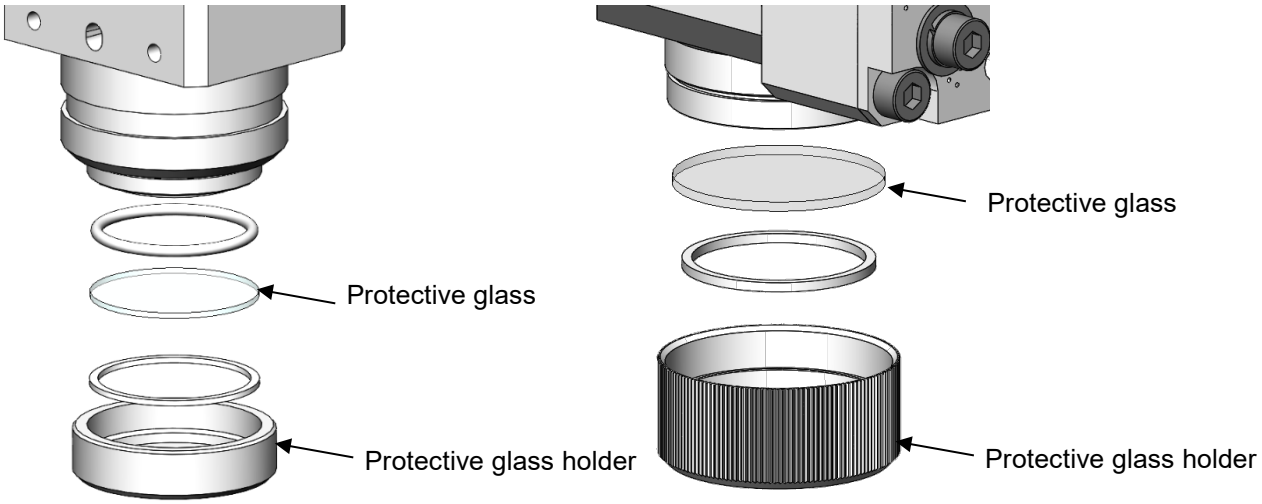
Item	Model No.
Protection Glass dia22x1t(No AR)	PO1216091
O_ring(Clear) *2	OR VMQ-50 AS568-017 Clear

*2 If the O-ring is damaged, please replace it.

(3) Cleaning/replacement procedure

1) Turn off the power for the laser device and the power for the **MM-L400A**.

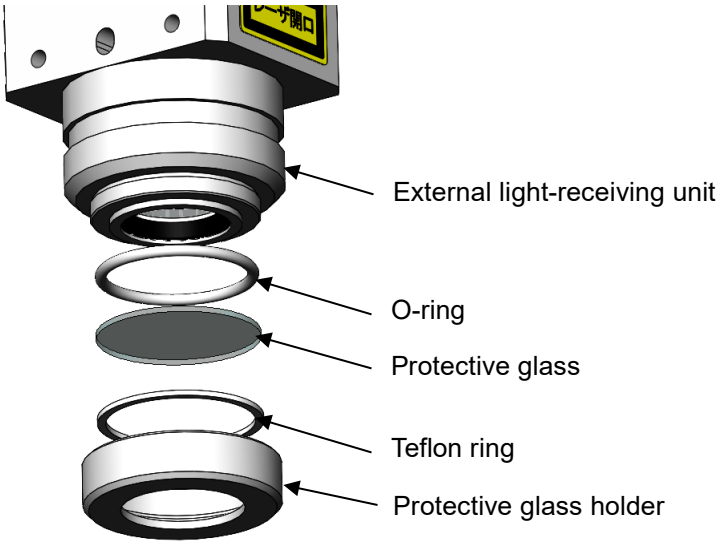
2) Rotate the protective glass holder of the external light receiving unit or the scanner light receiving unit tip, and remove the protective glass holder of the external light receiving unit.
Take out the protective glass inside the protective glass holder.



3) Place several drops of ethanol on the lens cleaning paper, make a wet part contact with the protective glass, and slowly pull it from left to right.
If the dirt cannot be cleaned off, replace the protective glass with a new one.

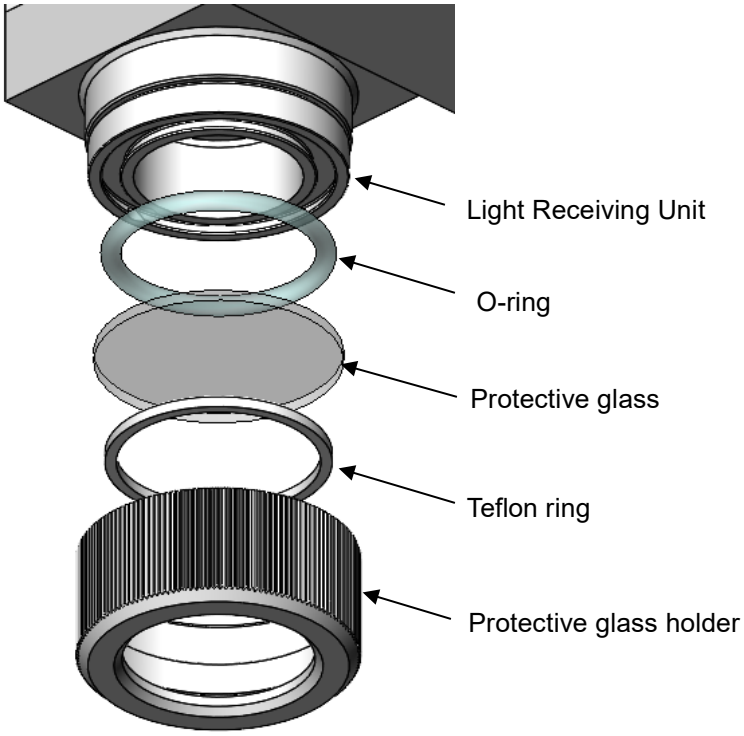


4) Fit the Teflon ring in the protective glass holder, and then fit a clean (or new) protective glass. The glass orientation is not important.
After that, fit the O-ring on the protective glass.
Turn the protective glass holder until the protective glass is securely tightened.



For the scanner light receiving unit:
Check that the O-ring attached to the light receiving unit is not damaged. If it is damaged, replace the O-ring.
Since the O-ring is embedded in the groove, use a tool to remove the O-ring.
When attaching the O-ring, press it into the groove to install it.

Insert a cleaned (or new) protective glass into the protective glass holder. The orientation does not matter.
After that, rotate the protective glass holder until the protective glass is secured and does not move.



(3) Replacing Fuse

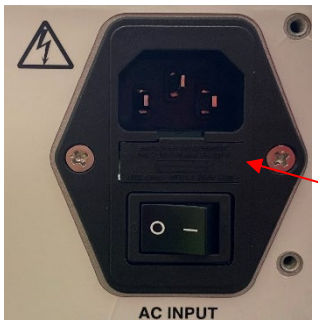
A fuse will be blown out if the rated voltage is exceeded (or overvoltage is applied). When this occurs, replace the fuse according to the following procedure:

(1) Maintenance parts

Item	Model No.
Fuse	02153.15MXP

(2) Replacement procedure

1) Open the cover on the AC inlet.



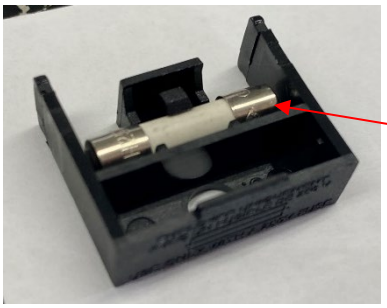
Cover

2) Pull out the fuse box.



Fuse box

3) Take out the fuse with the blown element, and replace it.



Fuse

(4) About MM-L400A

The **MM-L400A** does not guarantee the absolute value.
The output intensity of the **MM-L400A** can be used for comparison to the relative value.

It assumes that the waveform data can be always obtained with the same intensity under the determined conditions (laser output, profile, workpiece, and surface state are the same).

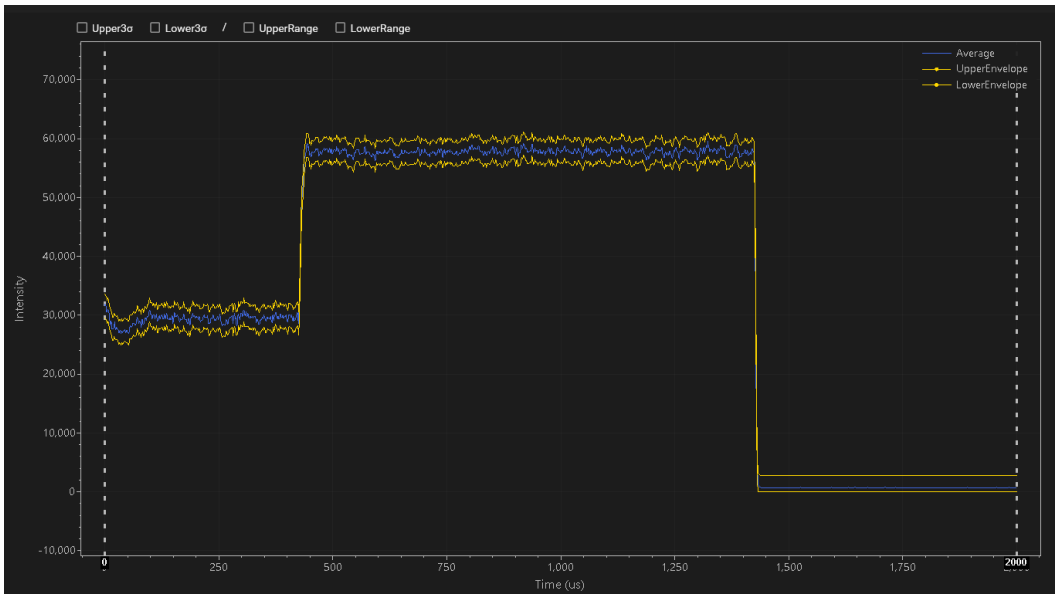
Since the detection intensity also changes when the setting state changes, in order to check that the **MM-L400A** is normal, as shown in Fig. a, obtain waveforms at any determined conditions by welding on reference workpieces.

Fig. a



For the obtained waveform, as shown in Fig. b, make the upper/lower limit setting in an extremely narrow range. On the basis of this condition, confirm that the value always falls within a range.

Fig. b



For the sensitivity check and readjustment, see 8. Sensitivity Check and Readjustment.

8. Sensitivity Check, Readjustment

To maintain the performance of the laser weld monitor **MM-L400A,** periodical sensitivity check is mandatory. Due to the product specifications, calibration is not possible for the equipment. Accordingly, sensitivity check is required to see if the equipment is in the same status with the default status at the shipment. When any gap is admitted, readjustment needs to be performed to readjust the measurement sensitivity to the default status.

The sensitivity check and readjustment can be performed at the customer site.
The following environment is required for the readjustment:

- Provide a space for moving and working on the **MM-L400A** (500 mm x 700 mm or more). As necessary, the **MM-L400A** needs to be moved to the work space for internal adjustment.
- At readjustment, the **MM-L400A** can be under the influence of the customer environment. When in the readjustment works, it is recommended to stabilize the ambient temperature/humidity as well as to stop the surrounding devices (to avoid disturbance noises).
- The readjustment of the **MM-L400A** should be performed by using the PC of our service personnel.

Contact us for the details of the sensitivity check and readjustment.

9. Specifications

Controller	Dimensions	486(W) x 597(D) x 109(H) mm (with handle and rubber feet mounted, excluding fiber bending radius)
	Maximum mass	Approx. 22 kg
	Input supply voltage	Single-phase 100 to 240 V AC (-10%, +4%), 50/60 Hz
	Power consumption	110 W or less
	Detection wavelength	Visible light: 400 to 800 nm Reflective light: 1060 to 1080 nm Near-infrared light: 1300 to 1700 nm
	Guide light wavelength	645 to 660 nm *3、4
	Guide light laser class	3R
	Input channel	Max. 8 channels + 2 channels from external analog input
	Repeatability	±4%*5
	Minimum measuring time resolution	1 μs
	Measuring time setting range	1 ms to 400 sec
	Judging function	Envelope (upper/lower limit judgment), integral judgment
	Grounding class	Class D grounding
Fiber unit	Minimum bending radius	R100 mm
	Mounting method	Fixed mounting *4, 5
Scanner Light Receiving Unit	Light Receiving Unit Dimensions	55(W) × 35(D) × 44(H) mm (excluding sensor fiber)
	Measurement Spot Diameter	Refer to the external view diagram
	Laser Welding Layout Conditions	The layout conditions designed to avoid the risk of damage caused by reflected light. *8
	Factors Affecting Minimum Bending Radius	R 60 mm
	Common Mounting Methods	Fixed type (excluding installation on robots and similar devices) (*6, *7)

Analog input	Input channel	2 channels
	Analog input voltage	0 to 10 V (resolution: 10 bits)
	Absolute maximum input	-0.3 to 11.2 V
	Input impedance	Approx. 1 MΩ
Analog output (General-purpose monitor)	Output channel	2 channels
	Output voltage	0 to 10 V
	Output impedance	Approx. 26 Ω
24V output (3-pin connector)	Output voltage	23 to 25 V
	Maximum output current	1.5 A
24V output (IO connector)	Output voltage	23.5 to 24.5 V
	Maximum output current	0.1 A
Use environment	Ambient operating temperature	5 to 40 ºC (without condensation)
	Ambient operating humidity	85% RH or less (without condensation)
	Cooling method	Natural air-cooled*6
	Vibration when in use	JEITA IT-1004A Class S
	Dust, oil mist	IP3X (Controller Only)
	Temperature during transport or storage	-10 to 60 ºC (without condensation)
	Humidity during transport or storage	85% RH or less
	Vibration during transport	ASTM D 4728 Level2
	Impact during transport	ASTM D 4169-05 Level2
	Overvoltage category	II
	Altitude	2000 m max.
	CE marking	applicable

*1: Use this product in the environment without conductive dust. If conductive dust enters in the product, this may result in a failure, electric shock, or fire. When using this product in this environment make contact with us.

*2: It is recommended to use in the environment where the temperature change is small.

*3: Measurement cannot be performed when the guide light is ON.

*4: The guide light cannot be used with the scanner receiver unit.

*5: The repeatability is effective when the following conditions are satisfied:

- Ambient temperature change: 1ºC or less
- Warm-up time: 10 minutes or more
- Analog gain x 1
- Intensity of 6000 or more
- With a certain level of light volume entered (without the light accuracy)

*6: When the fiber unit is mounted to the movable part such as a robot arm, the fiber damage is out of the warranty scope. Use the unit by taking the minimum bending radius or bending times into account.

*7: When mounted to the movable part such as a robot arm, the fiber unit may influence the measurement value depending on the operation conditions. It is recommended to evaluate the operation beforehand. For details, contact us.

*8: Laser reflected light may cause accumulation of heat, leading to damage or burning of components. For details, refer to section 5.(12) "Countermeasures for Reflected Light on the Scanner Receiver Unit."

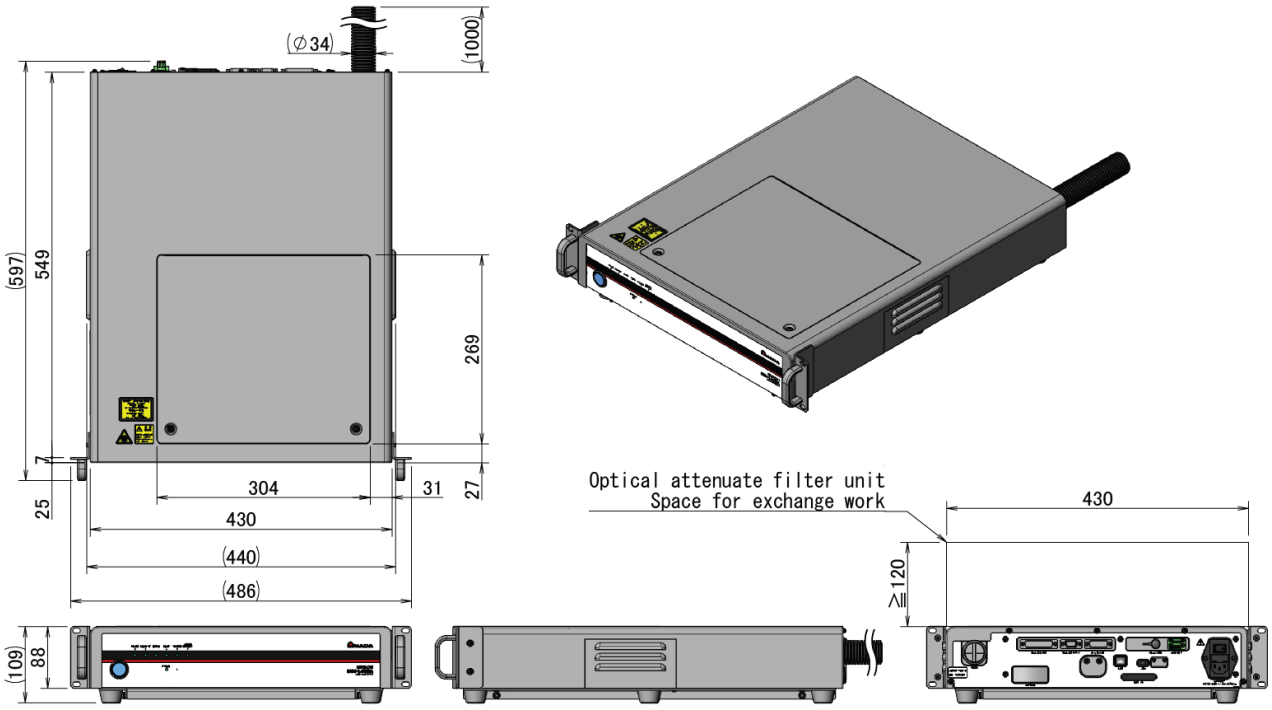
*9: If the external receiver unit or other components accumulate heat due to diffuse reflected light from the workpiece, it is necessary for the customer to implement cooling measures, such as using a water-cooling jacket, or to address the reflected light. For details, refer to sections 5.(9) to (12).

10. Outline Drawing

(1) MM-L400A Laser Weld Monitor

Maximum mass: approx. 22 kg
(Excluding the fiber unit)

(Unit: mm)

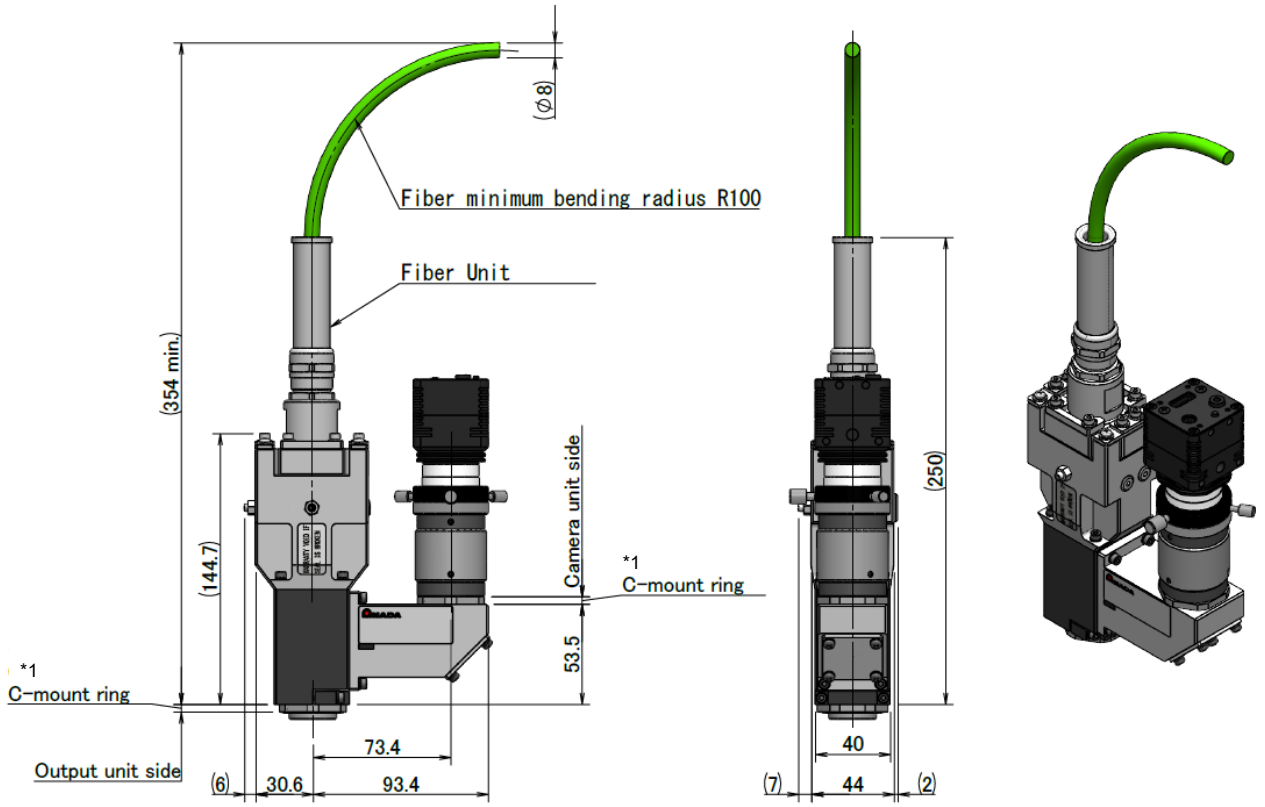


*1 When the bottom parts are removed, the product height is 88 mm.
Please refer to Section 5.(4) for the installation method
of the 19-inch rack.

(2) Coaxial light receive unit (MM-L400A) (Optional)

Maximum mass: approx. 0.9 kg
(Excluding the fiber unit and the camera unit, including the accessories to mount)

(Unit: mm)

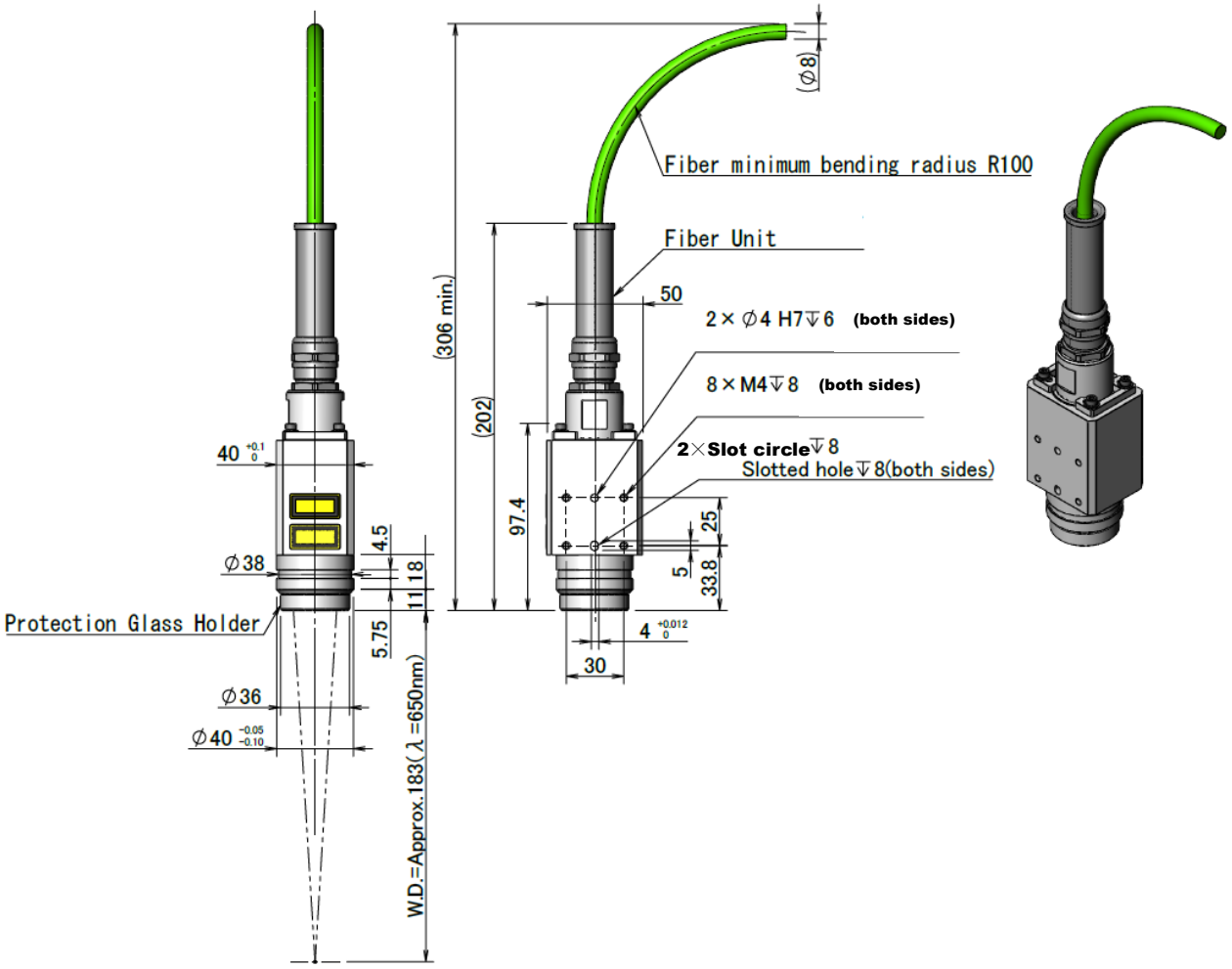


*1 Use the C-mount ring (height: 4 mm) to either of the two locations.
*2 The space required for mounting the output unit is within this dimension.

(3) External Light-Receiving Unit (Optional)

Mass: approx. 0.4 kg
(Excluding the fiber unit)

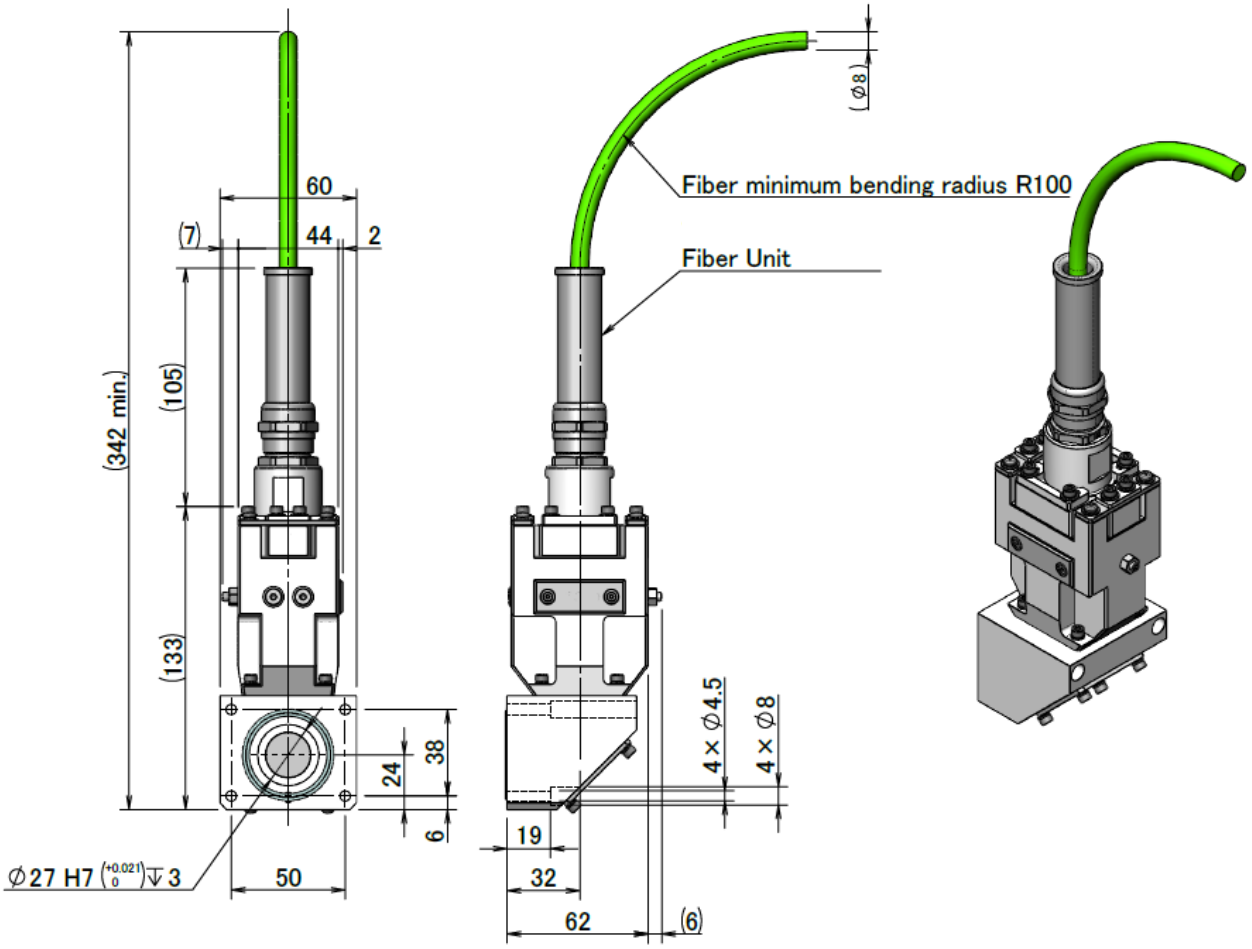
(Unit: mm)



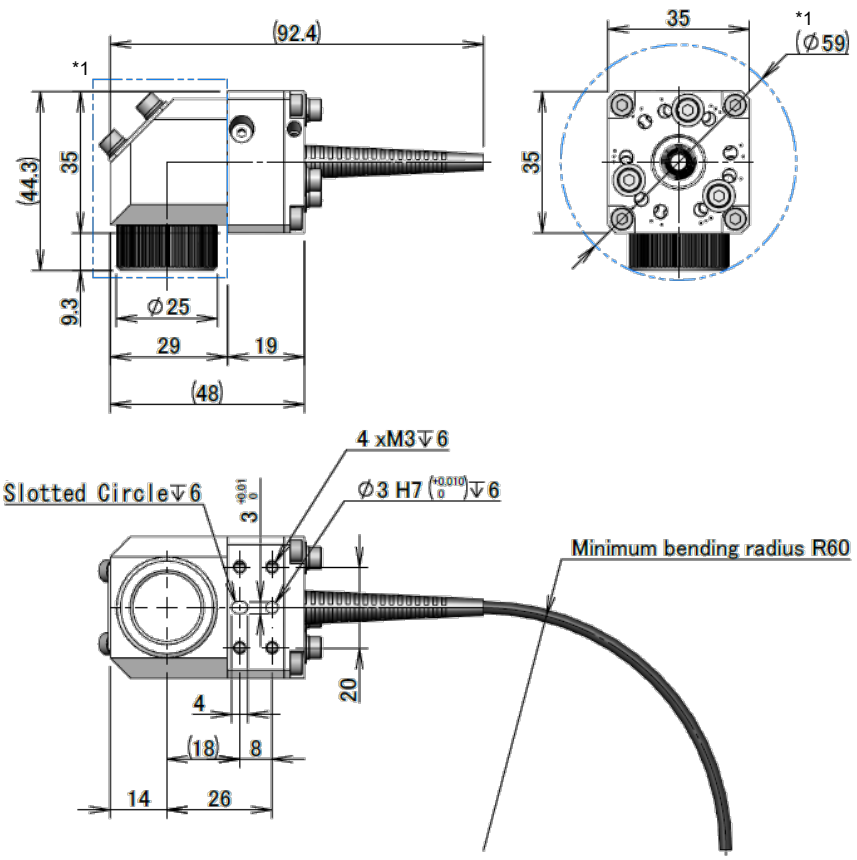
(4) GWM-K Coaxial Receiving Unit (MM-L400A) (Optional)

Mass: approx. 0.4 kg
(Excluding the fiber unit)

(Unit: mm)



(5) Scanner Receiving Unit (Optional)

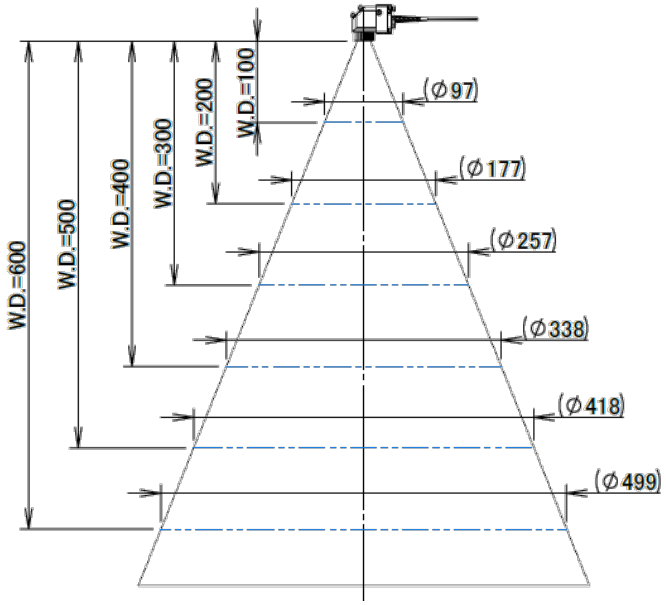


Mass: approx. 130 g
(Excluding the fiber unit)

(Unit: mm)

*1 By adjusting the angle of the receiving unit, the square area can move within a range of φ59mm.

Optical Path Diagram of Measurement Range for Scanner Receiving Unit



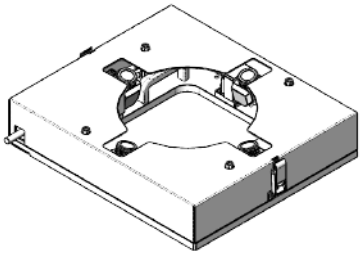
*2 As the WD (Working Distance) increases, the measurement range expands, but the measurement sensitivity detected by the MM-L400A decreases.

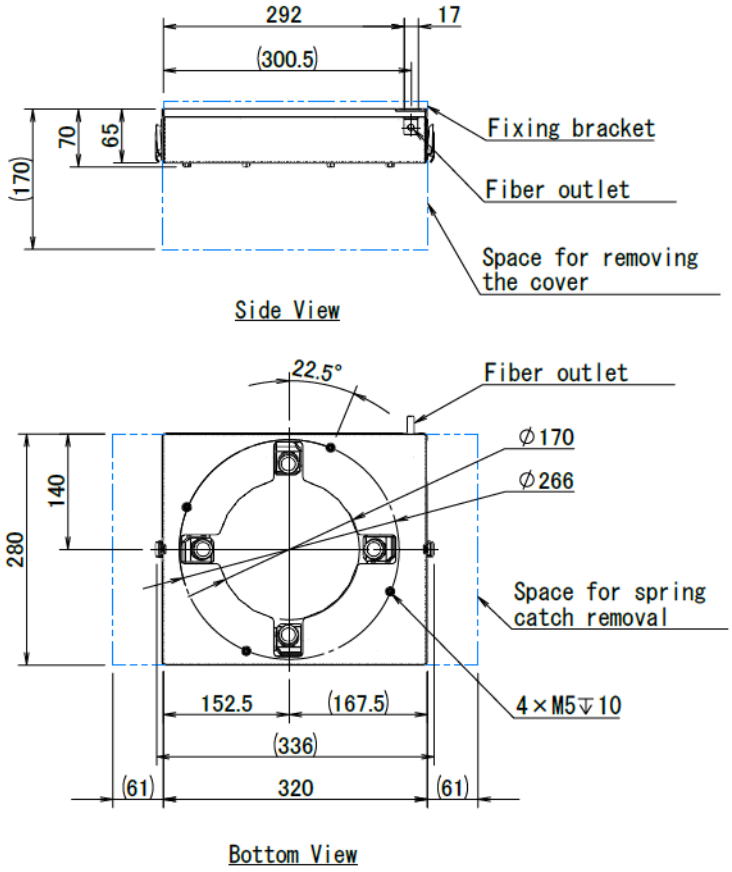
*3 The scanner receiving unit's four receiving sections all share the same measurement optical path.
The above-mentioned measurement optical path is calculated based on theoretical values.
*4 The scanner receiving unit does not have a guide light function.
*5 If the receiving unit is tilted during use, the measurement optical path will form an elliptical shape.

(6) Mounting Plate for Scanner Receiving Unit (Optional)

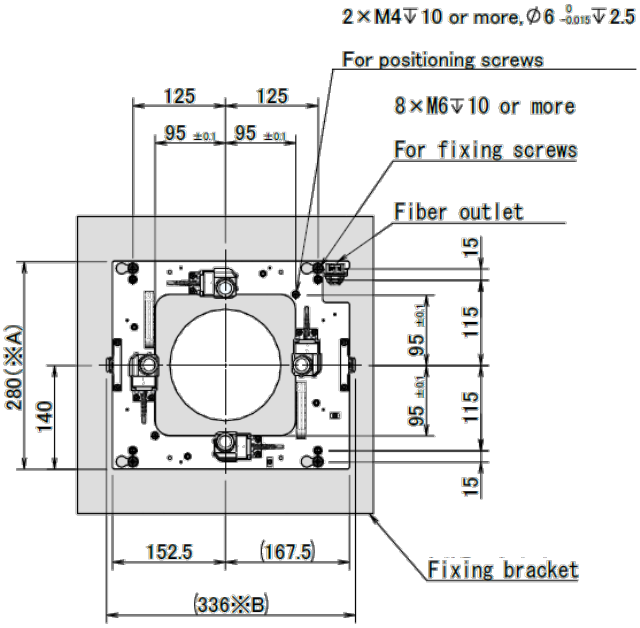
Mass: approx. 2.5 kg
(Excluding the fiber unit)

(Unit: mm)





Mounting Bracket Screw Hole Specification Diagram for Scanner Receiving Unit Mounting Plate (Recommended Plate Thickness: 10 mm or more)



*1 A and B represent the depth and width dimensions of the mounting plate for the scanner receiving unit.

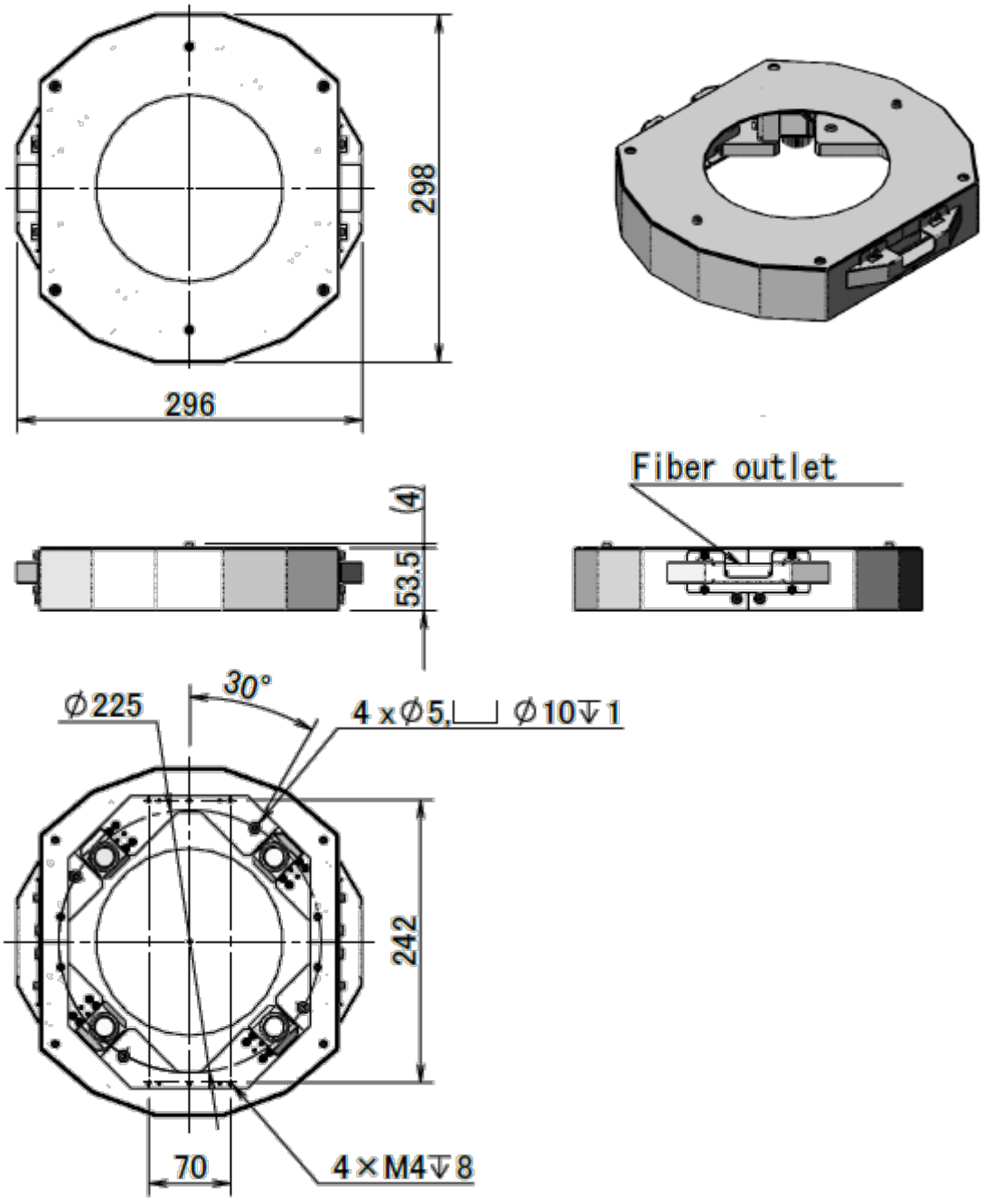
*2 The dimensions for securing the galvanometer scanner should be referenced in each galvanometer scanner's instruction manual.

*3 If the thickness of the mounting bracket is less than 10 mm, there is a risk that the screw depth will be insufficient, leading to reduced strength or the possibility of the fixing/positioning screws protruding.

(7) Mounting Plate for Scanner Receiving Unit (GWM-K) (Optional)

Mass: approx. 0.4 kg
(Excluding the fiber unit)

(Unit: mm)



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