DIRECT DIODE LASER

ML-5020BW

OPERATION MANUAL

AMADA®

OM1208535
ML-5020BW-E09-202307

How to Use This Document

Thank you for purchasing our product.

This operation manual explains its method of operation and precautions for use.

Before using, read this operation manual carefully; after reading, save it in a proper place for your future reference.

This document is composed of the 4 parts of "Introduction Part", "Installation and Preparation Part", "Operating Part", and "Maintenance Part", and "Appendixes."

We recommend inexperienced users to read through the whole contents starting from "Introduction Part."

This document allows the user to understand the whole equipment image, basic configuration, and how to use the laser.

Experienced users can refer to the desired page from the table of contents.

Organization of This Document and Its Contents

Introduction Part:	Explains the outline and functions of the laser. Regarding the Direct Diode Laser, this part explains the basic configuration and functional outline of this product including options so that the user can know the configuration of the laser and equipment composition, and also the name and function of each component section.
Installation and Preparation Part:	Explains the installation of the laser and preparatory operations such as connections of its respective sections.
Operating Part:	Explains how to operate the laser processing. First, this part explains how to perform each setting and how to operate the laser. Two types of control (Control by the control panel and control by external input/output signals) are explained in the operating method for laser processing.
Maintenance Part:	Explains how to perform maintenance and how to handle trouble.
Appendixes:	For reference materials, specifications, dimensional outline drawing, timing chart, and list of terminology are available. In the output schedule data entry table, the user can enter registered laser output schedule data for use.

Contents

For Use in Safety

Safety Precautions

Before using, read "Safety Precautions" carefully to understand the correct method of use.

These precautions are shown for safe use of our products and for prevention of damage or injury to operators or others. Be sure to read each of them, since all of them are important for safety.

A meaning of a figure sign

DANGER	Denotes operations and practices that may imminently result in serious injury or loss of life if not correctly followed.
WARNING	Denotes operations and practices that may result in serious injury or loss of life if not correctly followed.
CAUTION	Denotes operations and practices that may result in personal injury or damage to the equipment if not correctly followed.
	Denote "prohibition." They are warnings about actions out of the scope of the warranty of the product.
	Denote actions which operators must take.
	Denotes caution for electrical shock.

DANGER

Do not touch the inside of the Laser unnecessarily.
Since source voltage of or single-phase 100 V to 220 V AC is applied to the Laser, high voltages are applied to its inside. Do not touch the inside of the Laser unnecessarily with the power turned ON.

Never disassemble, repair or modify the Laser.
These actions can cause electric shock and fire. Do not do anything other than the maintenance described in the operation manual.

Do not look at or touch the beam.
Both direct laser beams and scattered laser beams are highly dangerous. If the beam enters the eye directly, it can cause blindness.

Never burn, destroy, cut, crush or chemically decompose the Laser.
This product incorporates parts containing gallium arsenide (GaAs).

Do not look into or reach into the light path while the LD is turned on.
Fluorescence emission can cause burn or blindness.
Wear protective glasses while the LD is turned on.

WARNING

Wear protective glasses.
Be sure to wear protective glasses having an optical density of at least 7 while using the Laser. Even if you wear them, you may lose your sight if the laser beam enters your eyes directly through protective glasses. Protective glasses attenuates the laser beam, but does not block it.

Do not expose your skin to the laser beam.
Your skin may be severely burnt.

Do not touch any processed workpiece during and just after processing finished.
The processed workpieces are very hot.

Use only specified cables.
Use of a cable of insufficient capacity or loose connection can cause electric shock fire.

Do not damage the power cable or connecting cables.
Do not tread on, twist or tense any cable. The power cable and connecting cables may be broken, and that can cause electric shock and fire. If any part needs to be repaired, consult us or your distributor.

Stop the operation if any trouble occurs.
Continuous operation after occurrence of a trouble such as burning smell, abnormal sound, abnormal heat, smoke, etc. can cause electric shock and fire. If such a trouble occurs, immediately consult us or your distributor.

Ground the Laser.
If the Laser is not grounded, you may get an electric shock when there is trouble or electricity leaks.

Use a stopper.
The laser beam is dangerous to human bodies. Prevent emission through the air by using a stopper (a heat-resistant, laser beam-absorbing, -scattering material).

Persons with pacemakers must stay clear of the Laser.
Those who use a pacemaker must not approach the Laser or walk around the processing shop while the Laser is in operation, without being permitted by his/her medical doctor. The Laser generates a magnetic field and has effects on the operation of the pacemaker while it is turned ON.

CAUTION

Do not splash water on the Laser.

Water splashed over the electric parts, can cause electric shock and short circuits.

Use proper tools (wire strippers, pressure wire connectors, etc.) for termination of the connecting cables.

Do not cut the wire conductor. A fire or electric shock will occur.

Install the Laser on a firm and level surface.

If the Laser falls or drops, injury may result.

Do not place a water container on the Laser.

If water spills, insulation of the Laser will deteriorate, and that can cause electric leaks and fire.

Keep combustible matter away from the Laser.

Surface flash and expulsion can ignite combustible matter. If it is impossible to remove all combustible matter, cover it with non-combustible material.

Do not apply the laser beam to combustible materials.

To avoid risk of fire never apply the laser beam to flammable or combustible materials.

Do not cover the Laser with a blanket, cloth, etc.

Do not cover the Laser with a blanket, cloth, etc. while you are using it. The cover may be overheated and burn.

Do not use this Laser for purposes other than metal processing.

Use of the Laser in a manner other than specified can cause electric shock and fire.

Protective gear must be worn.

Put on protective gear such as protective gloves, long-sleeve jacket, leather apron, etc. Surface flash and expulsion can burn the skin if they touch the skin.

Keep a fire extinguisher nearby.

Keep a fire extinguisher in the processing shop in case of fire.

Maintain and inspect the Laser periodically.

Maintain and inspect the Laser periodically, and repair any damage before starting operation.

Precautions for Handling

Laser Safety Supervisor

⇒ Appoint a safety supervisor for all laser work.
The appointed safety supervisor must have sufficient knowledge and experience regarding both lasers and laser work.

⇒ The supervisor must control the keyswitch of the Laser, and must be responsible for instructing operators in safety aspects of the Laser as well as directing the laser work.

⇒ Establish and control a laser operation area.
The responsible person must isolate the laser operation area from other areas and control it by fences and display signs indicating that the area is off-limits to unauthorized personnel.

Routine Handling

⇒ Perform inspection periodically referring to the Maintenance Part, Chapter 1 "1. Cleaning the Cover Hole" on page 64.

⇒ If the outside of the Laser is stained, wipe it with a dry cloth or a moistened cloth. If it is badly stained, use neutral detergent or alcohol to clean it. Do not use paint thinner, benzine, etc. which can discolor or deform the parts.

⇒ Do not put screws, coins, etc. in the Laser, since they can cause a malfunction.

⇒ Operate the switches and buttons carefully by hand. If they are operated roughly or with the tip of a screwdriver, a pen, etc. they may be broken.

⇒ Operate the switches and buttons one at a time. If two or more of them are operated at a time, the Laser may have trouble or may be broken.

⇒ To restart the Laser, ensure that the Laser stops before turning ON the MAIN switch.

⇒ To prevent damage, do not bend the optical fiber beyond its minimum bending radius (fixed part: 35 mm, movable part: 50 mm) or apply any forms of shock to it.

⇒ When a supervisor or operator enters the area where the laser is used, protective measures not to exceed the MPE* level must be taken.

* MPE: The maximum level of permissible exposure of the eyes or skin to laser beams. Abbreviation of Maximum Permissible Exposure.

⇒ Use the product in a place where the ambient temperature is 20 to 30ºC and the ambient humidity is 20 to 85% RH and yet a sudden temperature change does not occur.

* For other information on managing laser equipment or the MPE level, refer to the following standards.

Japanese Industrial Standards JIS C 6802 “Safety of Laser Products”

Notification by the Ministry of Labor No. 0325002 “Laser Damage Prevention Measures”

For Transportation

When transporting the laser, observe the following precautions to avoid hazards.

⇒ Package the Laser when transporting it.

⇒ The worker must wear a helmet, safety shoes and gloves for safety. (Leather gloves are recommended.)

⇒ When transporting the Laser, use a lift truck, pallet truck, etc., of at least 30 kg allowable load.

Precautions for transportation

⇒ Transport it using a dedicated package to prevent a fall, damage due to vibration.

For Packaging

Precautions for packaging

⇒ The worker must wear a helmet, safety shoes and gloves for safety. (Leather gloves are recommended.)

For Disposal

This product incorporates parts containing gallium arsenide (GaAs). At the time of disposal, separate it from general industrial waste or domestic waste and carry out the disposal in accordance with applicable laws and regulations.

Cautions for Export

The product described in this Operation Manual falls into a controlled item specified in the Foreign Exchange and Foreign Trade Law.

When exporting the product from Japan, you need approval based on the said law.

For details, please visit the Security Export Control's website or contact the Security Export Licensing Division, Ministry of Economy, Trade and Industry directly.

Security Export Control's website of Ministry of Economy, Trade and Industry

http://www.meti.go.jp/policy/anpo/index.html

Security Export Licensing Division, Ministry of Economy, Trade and Industry

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Introduction Part

Introduction Part

Chapter 1

Overview of the Direct Diode Laser

1. Direct Diode Laser

Laser means the equipment to generate powerful light by amplifying light (electromagnetic wave) or means this light itself. In direct diode laser, diode laser (LD) can be applied to the heat processing directly without passing through a crystaline body such as YAG and YVO_4.

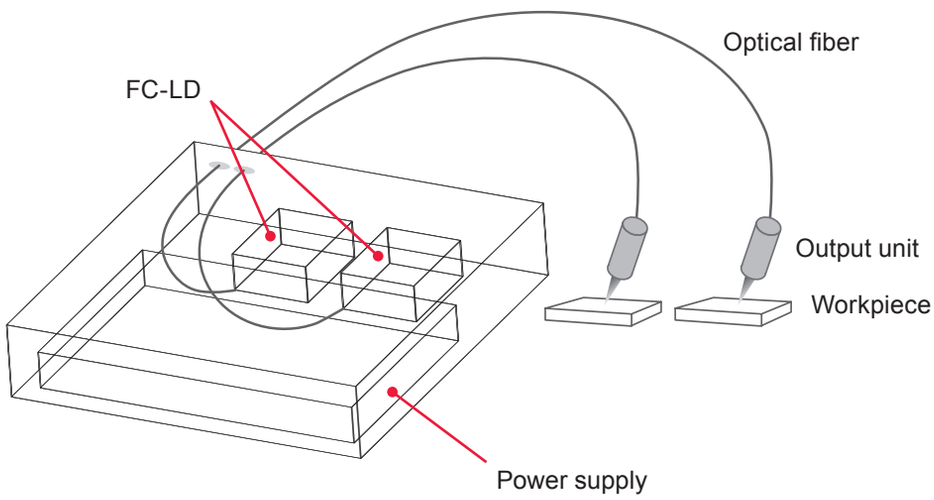
The laser wavelength generated in this laser equipment is 915 nm of near infrared rays that are invisible to the human eye. Most of laser equipment for laser processing belongs to class 4 laser that is the most hazardous in the classification of laser products specified in JIS. When the laser light greets the eye, it is focused by crystalline lens and reaches the retina, thereby inviting a loss of eyesight. Do not look at the laser light in any case. Because both beams and scattered light are hazardous, do not touch or look at them.

To check where invisible laser is irradiated on the workpiece, red guide light is generally mounted in the laser equipment. When the output unit is provided with a CCD camera, cross lines are generally displayed on the monitor and the cross point of these cross lines is an irradiation point. In this laser, a red point appears on the workpiece when guide light is output.

2. Mechanism of the Direct Diode Laser

The direct diode laser consists of a power supply, light source, optical fiber, output unit, etc. Laser light can be transferred to a place remote from the main unit by optical fiber, so that only the optical fiber and output unit can be mounted in the manufacturing line for processing.

Direct Diode Laser Configuration



3. Functions of the ML-5020BW

⇒ Direct diode laser oscillation function

- The laser is capable of processing workpieces under a small spot diameter.
- The laser employs an LD, which significantly reduces the number of required maintenance operations.
- The laser provides high energy efficiency for lower power consumption.

⇒ Simple operations and maintenance

- Fully air-cooled-no coolant or coolant filters needed.

⇒ Active heat control function

- This function varies the laser output while detecting the temperature of the processing part coaxially with the laser light to control heat input.

⇒ The factory environment can be improved by space saving.

- The laser power supply and laser light source are integrated into a single piece for easy transport and installation of the Laser.

⇒ The Laser conforms to JIS C 6802 and Notification by the Ministry of Labor No. 0325002.

4. Product Composition

Packaging

The main unit and accessories are packed together. The dimensions and mass are as follows.

Dimensions	Mass (including packaged products)
Approx. 400 (H) × 500 (W) × 600 (D) mm	Approx. 25 kg

Checking the Packaged Products

Make sure that all the packaged products are included.

⇒ The model numbers of accessories are subject to change without notice. Depending on the part to be changed, the mounting screw shape may change and a necessary tool may be different. For the latest parts information, contact a nearest sales office.

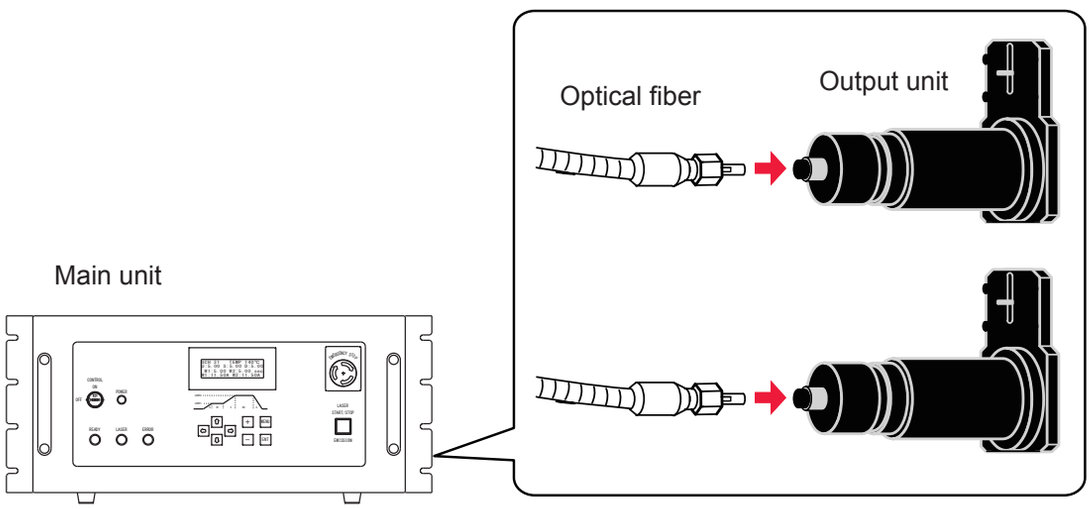
Product name		Model No.	Q'ty
Direcr Diode Laser		ML-5020BW	1
Cable with a round-type connector (2 m) *1		AS1178984	1
Protective glasses		CE YL-717S	1
Operation manual		AS1208267(OM1208268+OM1208269)	1
Connector	Assembly	A-03376-001	1
	Plug	HDCB-37P(05)	1
	Case	HDC-CTH(10)	1

*1: The cable with a round-type connector is included in the laser main unit.

Main Unit and Output Unit

This product is used in combination with the output unit as shown below.

Main unit x 1 + Output unit x 2



Main unit

Provided with optical fibers.

Model	Specification	Length of optical fiber
ML-5020BW	Simultaneous output to 2 fibers	5 m

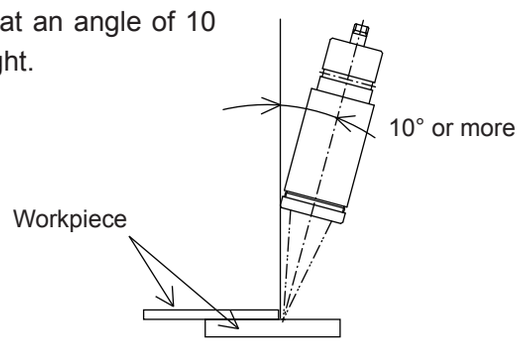
Output unit

The output unit with the specification that you selected at the time of purchase is connected to the main unit.

Cylinder type	With CCD camera	With CCD camera and active heat control function
-	FOCH-30C-□□□	FOCH-30C-□□□-AHC

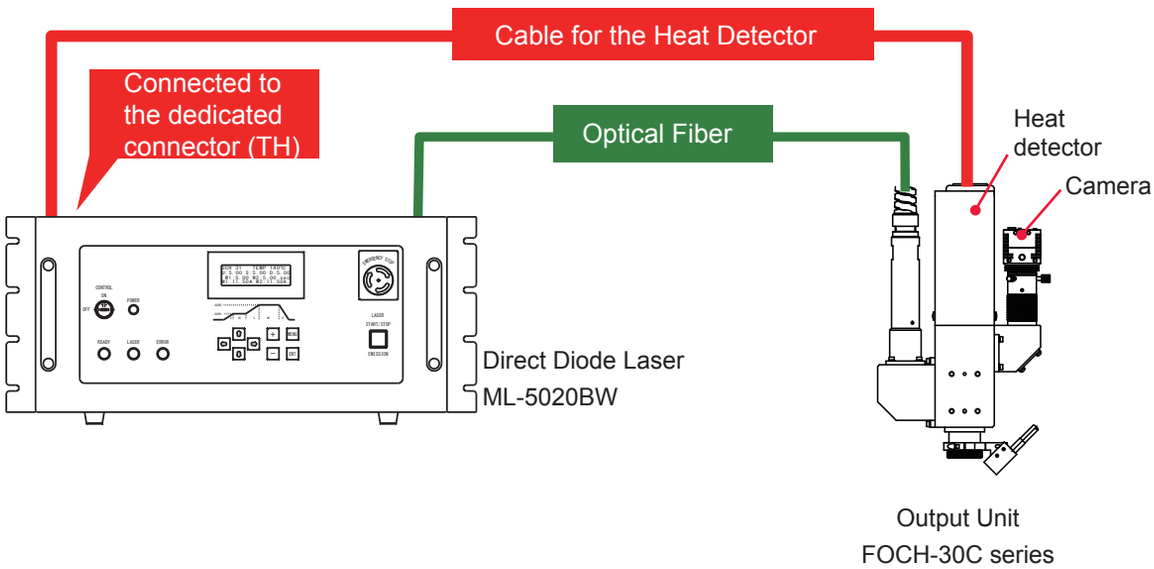
⇒ As the spot diameter is bigger, the visibility of guide light becomes lower.

⇒ When using a laser,tilt the output unit at an angle of 10 degrees or more to prevent reflected light.



⇒ Mechanism of the Active Heat Control

This function controls the laser output while detecting the temperature of the processing part coaxially with the laser light to keep heat input constant.



Introduction Part

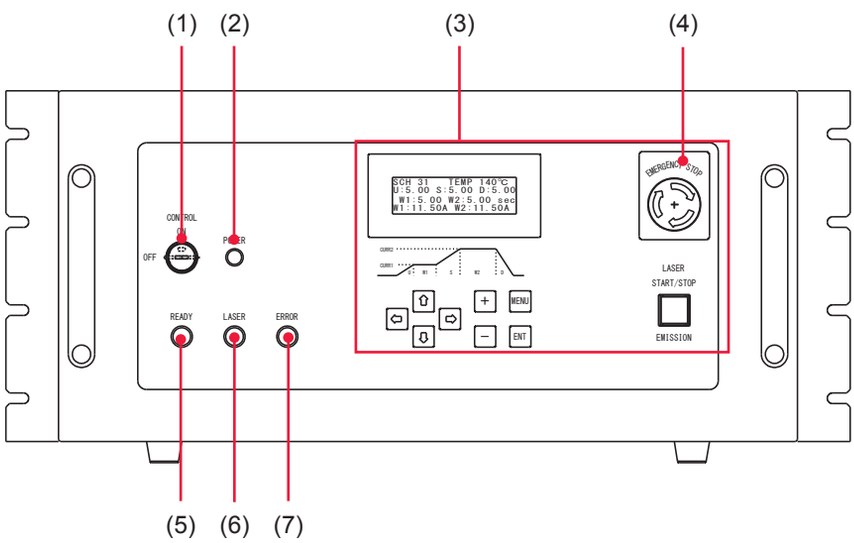
Chapter 2

Name and Functions of Each Section

1. Name and Function of Each Section on the Front Side

Front Cover Section

This section explains each section of the front cover of the main unit.



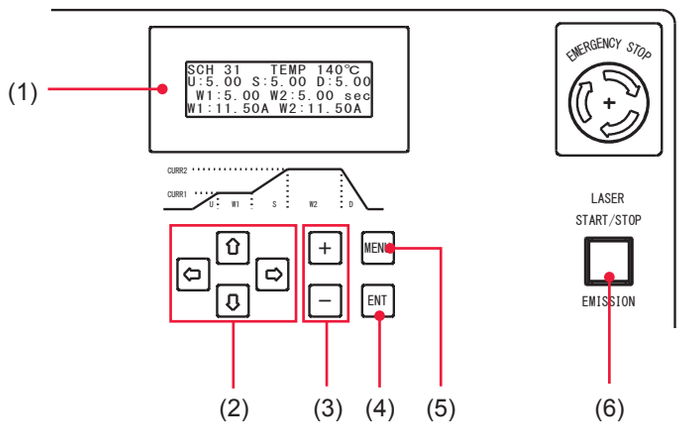
Function of Each Section on the Front Cover

(1) CONTROL Keyswitch	When the CONTROL keyswitch is turned ON, the laser equipment becomes operable. Aldo, when the CONTROL keyswitch is turned OFF after abnormality processing, an abnormal display is cleared and the screen is reset.
(2) POWER Lamp	When the CONTROL keyswitch is turned ON, the POWER lamp comes on.
(3) Control Panel	This controller sets processing conditions and operates the laser equipment. Setting items and set values are displayed on the touch panel type liquid crystal display.
(4) EMERGENCY STOP Button	With this button pressed, the laser output is stopped. When the pressed button is turned in the direction of RESET (clockwise), the button is reset to the initial state.
(5) READY Lamp	Lights up when laser is ready for outputting.
(6) LASER Lamp	Indicates that laser is being output.
(7) ERROR Lamp	Indicates that an error occurs.

Control Panel

In the following, the buttons and keys on the control panel are explained.

On the control panel, the operator can set welding schedules and perform laser light output operations.

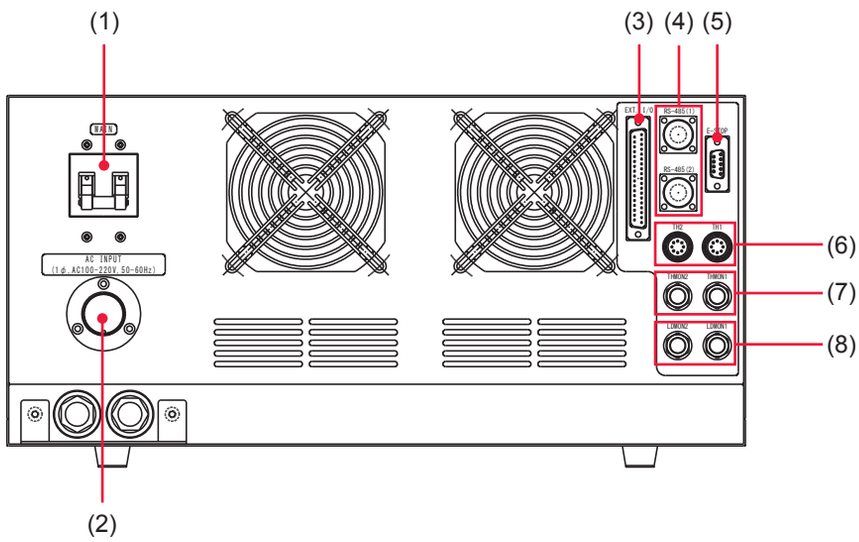


Function of Each Section on the Control Panel

(1) Liquid Crystal Display	Displays the setting conditions and monitor data in 20 characters x 4 lines.
(2) CURSOR Key	This key moves the cursor (■) in the upward/downward or left/right direction on the screen.
(3) + / - Key	This key changes the numeric value or alphabet at the cursor position.
(4) ENT Key	This key definitively sets the changed value. When moving the cursor without pressing the ENT key, the changed value is invalid.
(5) MENU Key	This switches the screen of the liquid crystal display.
(6) LASER START/STOP (Button)	If you press the button while the READY lamp is lighting up, laser light is output. If the button is pressed again while laser light is output, the output is stopped.
EMISSION (Lamp)	When the LD is turned on, the EMISSION lamp comes on.

2. Name and Function of Each Section on the Rear Side

This section explains each section on the rear side.



Function of Each Section on the Rear Side

(1) MAIN Switch	Turns ON and OFF the power supply.
(2) Power Input Connector	Connect the attached cable to a single-phase power supply of 100 V to 220 V AC, and the grounding conductor.
(3) EXT. I/O Connector	Used to output signals, e.g., alarm signals and monitor judgment signals; and to input signals, e.g., start signal and schedule signals. For details, refer to the Operating Part, Chapter 4 “3. Connector Functions” on page 53.
(4) RS-485 Connector	Not used.
(5) E-STOP Connector	Used to connect to the Remote Interlock for emergency stop or input/output Emergency signals. For details, refer to the Operating Part, Chapter 4 “3. Connector Functions” on page 53.
(6) TH Connector	Connects the connector of the heat detector. When using a heat detector, connect the output unit with the heat detector to the fiber 1 and connect the connector of the heat detector to TH1. When using two heat detectors, connect the heat detector of the output unit connected to the fiber 1 to TH1 and that of the output unit connected to the fiber 2 to TH2.
(7) THMON Connector	Outputs an analog signal input to the TH connector between 0 to 5 V. (BNC)
(8) LDMON Connector	BNC connector used to output an analog signal representing the LD current waveform. When viewing the current waveform, connect to an oscilloscope. (1 A = 0.33 V)

Installation and Preparation Part

Installation and Preparation Part

Chapter 1

Installation

This chapter explains where to install the laser equipment, and how to fix it.

1. Installation Place

The space required for installing the laser equipment and the environment suitable for the installation are explained below.

Install laser equipment in a sure place at a level with the ground surface. If the product is operated in inclined or fallen form, a failure will occur.

When installing the laser equipment in the rack, be sure to support it by the rubber foot or the right and left parts of the bottom. The main unit cannot be supported only by the rack mounting bracket on the front.

⇒ For the power supply side, we earnestly recommend using a leakage breaker with the rated current of 5 A or more, which is applicable to harmonics and surges.

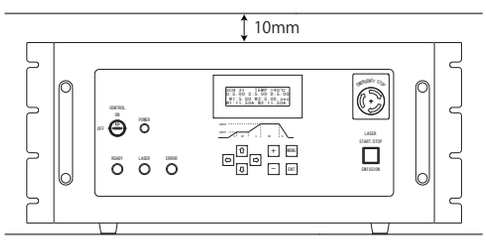
⇒ Perform class D grounding work (Ministry of Economy, Trade and Industry "Technical Standards for Electric Equipment").

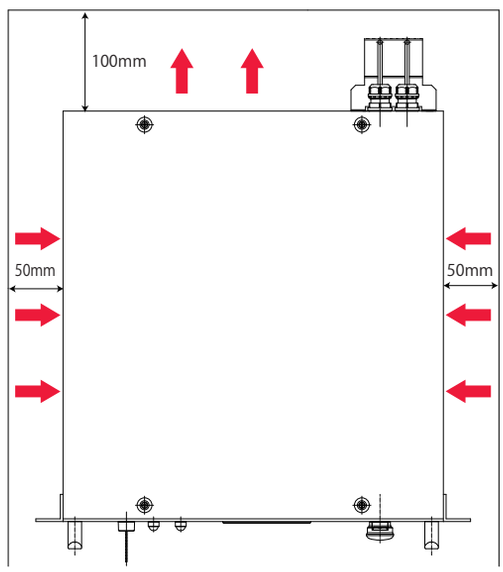
Space Required for Installation

In the installation place of this product, a space is required in the surroundings.
Install the product in a place remote from the wall as shown in the following figure.

⇒ Air flows in the direction of the red arrow shown in the following figure. Install the product so as not to interrupt the air flow.

⇒ When installing this product in a closed space, secure a space more than double the following dimensions.





Environment Suitable for Installation and Precautions

⇒ In laser processing, dust and fumes are generated from workpiece. Depending on the kind of workpiece, they may adversely affect a human body. Also, dust and fumes from workpiece may cause staining and burning of optical parts and lower the laser output. Furthermore, if conductive dust enters the laser equipment, a short circuit accident may occur to cause malfunction. Therefore, in laser processing, be sure to install an exhaust device such as dust collector and blower in a proper position to keep a clean environment.

⇒ Use the product in a place where the ambient temperature is 20 to 30ºC and the ambient humidity is 20 to 85% RH and yet a sudden temperature change does not occur.

⇒ Avoid operating the product in the following places because a failure may occur.

- Place where there is considerable dirt, dust, or oil mist,
- where the Laser may be subjected to vibration or impact,
- where the Laser may be exposed to chemicals,
- where there is a nearby high noise source,
- where moisture may be condensed on the surface of the Laser,
- where the concentration of CO_2, NOx or SOx is high.

⇒ When a sudden temperature change occurs, for example, at a start of heating, condensation will be caused to the surface of the lens or the mirror, thereby sticking dust there. Avoid such a sudden temperature change if possible. When there is a possibility of condensation, turn ON the power supply of the laser. In about 2 hours, start to operate the laser.

2. Fixing the Laser Equipment

This section explains how to fix the laser equipment in the rack.

Item required

Phillips screwdriver

Operating Procedure

(1) Install the L-shaped rail or the floor panel on the rack.

(2) When installing on the floor panel, remove the rubber foot at the bottom of the laser main unit.

(3) Place the laser main unit on the rack.

(4) Fix the laser main unit on the rack with the L-shaped bracket at the right and left sides of the front of the laser main unit.

⇒ The L-shaped bracket at the right and left sides of the front of the laser main unit is for preventing displacement. The laser main unit cannot be supported with the L-shaped bracket only. Be sure to install the L-shaped bracket or the floor panel to receive.

Installation and Preparation Part

Chapter 2

Connections and Preparations of Each Section

1. Connecting the Power Supply

⚠ CAUTION

Your qualified electrician must carry out the electrical connection to main power supply. (Also follow your local accident prevention regulations, such as the German Regulation, BGVA2.)

⚠ CAUTION

For the power supply side, we earnestly recommend using a leakage breaker with the rated current of 5 A or more, which is applicable to harmonics and surges.

Item required

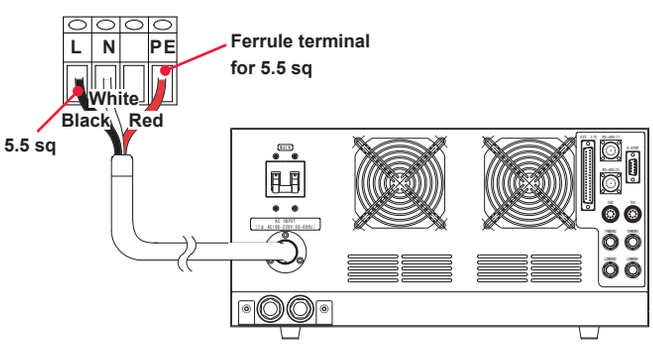
Phillips screwdriver

Operating Procedure

(1) Connect the attached cable with a round-type connector to the rear of the main unit.

(2) Perform the terminal processing of the cable and connect it to the distribution board or the leakage breaker on the factory side.

Cable insulation color	Destination
Black	L
White	N
Red	PE



2. Connecting the Optical Fiber

This section explains the method of connecting the optical fiber on the laser beam output unit side.

⚠ WARNING

- **Be sure to receive education for this work from our engineer.**
- **Before starting work, be sure to turn OFF the power supply.**

Before Connection

Before making a connection, check the end face of the optical fiber. If it is stained or dust is attached, blow it off by air blow or wipe it out with lens cleaning paper.

⇒ For a check for stain, use the optional end face checker.

⇒ Use such an air blow dedicated to cameras as shown at right. If rubber is deteriorated, dust may enter the optical fiber. Use a clean air blow.

Precautions during Operation

⇒ During operation, take care not to give shocks to the optical fiber or bend it below the minimum bending radius (fixed part: 35 mm, movable part: 50 mm).

⇒ Do not tighten the nut of fiber plug too firmly; otherwise the incident laser beam may be dislocated. Tighten the nut by hand without using a tool.

Item required

Air blow

Operation Procedure

(1) Remove the cap at the end of the optical fiber and blow off dust by using the air blow.

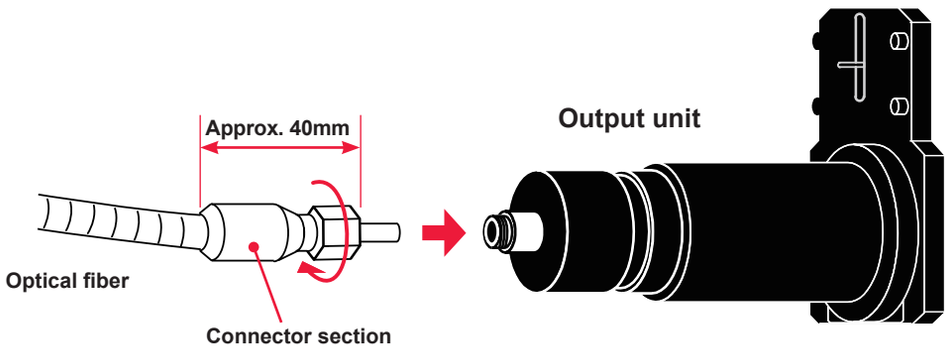
⇒ Use such an air blow dedicated to cameras as shown at right. If rubber is deteriorated, dust may enter the optical fiber. Use a clean air blow.

(2) Insert the optical fiber plug.

(3) Turn the outer-side nut of the plug in the direction of the arrow to fix the optical fiber.

⇒ Tighten the nut by hand without using a tool.

⇒ The connector section cannot be bent. Take care not to give excessive force to this section.



⇒ Keep the recover cap in a clean place in custody. If a dirty cap is mounted again, this will cause seizure.

3. Connecting the Cable for the Heat Detector

To use the output unit FOCH-30C series, connect the cable for the heat detector attached to the output unit.

Item required

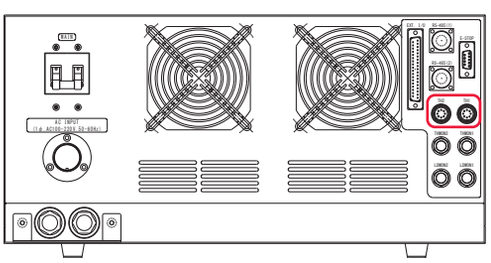
Cable for the heat detector

Operating Procedure

(1) Confirm that the MAIN switch is turned OFF.

(2) Connect the cable for the heat detector to the TH connector on the rear of the main unit.

⇒ Connect the cable for the heat detector of the output unit connected to the fiber 1 to TH1 and that of the output unit connected to the fiber 2 to TH2.



Operating Part

Operating Part

Chapter 1

Control Method, and Start and Stop

1. Control Method

This section explains the control method for the laser.

The following 2 control methods are available, namely, control from the control panel (PANEL) and control by external input/output signals connecting the PLC (*) to the laser (EXT).

Select one of these 2 control methods according to the processing work. The selected control method is displayed on the liquid crystal display.

*: PLC: Programmable Logic Controller which is a unit to perform sequence control by executing the programmed contents of control in sequence. This unit is often called sequencer (product name of Mitsubishi Electric Corporation).

Switching the Control Method

Control by Control Panel (PANEL)

When the laser is used independently or when the power supply of the PLC or personal computer connected to the laser is OFF, the laser is under control by control panel.

⇒ To switch the control by external input/output signals over to the control by control panel, set CTRL to PANEL on the SYSTEM screen.

Control by External Input/Output Signals (EXT)

When the PLC or the like is connected to the main unit and CTRL on the SYSTEM screen is set to EXT, the control by external input/output signals (EXT) is selected.

2. Start and Stop

This section explains the methods of starting and stopping the laser.

How to Start the Laser

Operating Procedure

(1) Turn ON the MAIN switch.

(2) Turn ON the CONTROL keyswitch.

(3) Turn ON the LD.

(4) Select a control method as required and perform laser processing.

⇒ For the control by control panel, set the output schedules by operating the buttons while watching the liquid crystal screen display, and press the LASER START/STOP button to output laser light.

⇒ For the control by external input/output signals, execute the program by PLC, select output schedules, and exert laser start/stop to output laser light.

How to Stop the Laser

Operating Procedure

(1) Turn OFF the LD.

(2) Turn OFF the CONTROL keyswitch and pull out the key.

(3) Turn OFF the MAIN switch.

⇒ The laser safety supervisor takes charge of the key of the CONTROL keyswitch.

Operating Part

Chapter 2

Various Settings

1. Setting Welding Schedules

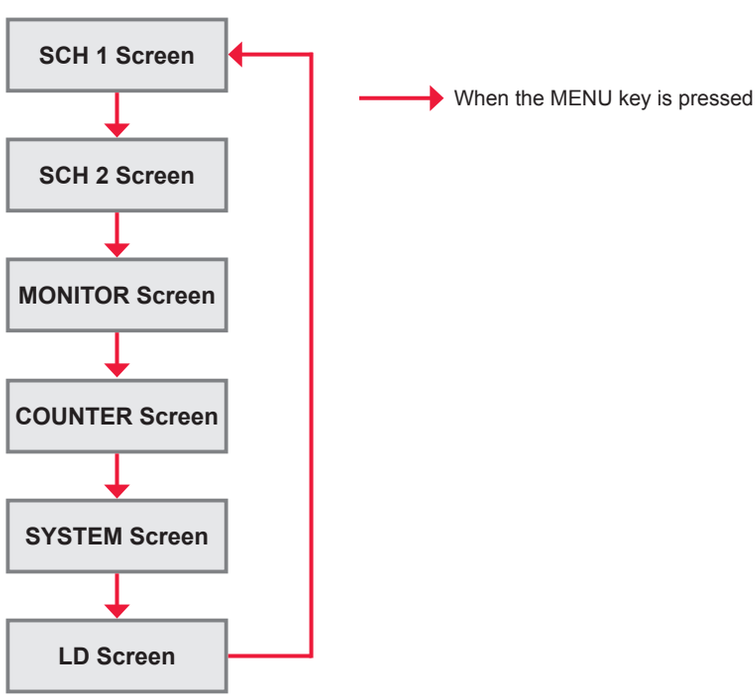
This section explains the method of setting various laser processing schedules by using the control panel.

Welding Schedule Setting Screen

How to see the SCH, MONITOR, COUNTER, SYSTEM, and LD screens to set welding schedules is explained below.

The following 7 screens that are displayed on the control panel are available. While watching these screens, perform various settings by operating keys provided on the control panel.

Pressing the MENU key switches the screen on the control panel over to the SCH screen, MONITOR screen, COUNTER screen, SYSTEM screen, and LD screen in this order.



SCH 1 Screen

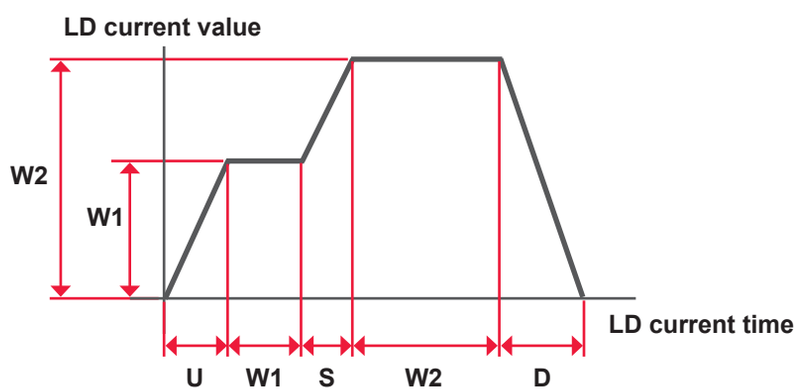
On the SCH 1 screen, the laser light output schedules are set and registered by giving SCHEDULE numbers. If a registered SCHEDULE number is entered, the corresponding output schedules can be called.

```
SCH 00   TEMP 200°C
U:0.00 S:0.00 D:0.00
 W1:0.30 W2:0.00 sec
W1:01.70A W2:01.00A
```

How to see the displayed items

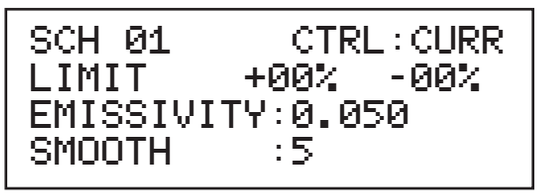
: Settable item

SCH	Sets the SCHEDULE number of laser light. The 32 numbers of 00 to 31 and output schedules can be set.
TEMP	Sets the temperature level for turning ON/OFF of laser output in the range of 50°C to 600°C. This is displayed as the relative value and may change depending on the workpiece material or the surface state. The measurement temperature of 120°C or lower is not warranted because the influence of the disturbance light becomes remarkable.
	Sets the LD current time. The time unit can be changed on the SYSTEM screen.
U	Sets the up-sloping (the laser output becomes gradually stronger) time to W1.
W1	Sets the weld time 1.
S	Sets the up-sloping or down-sloping (the laser output becomes gradually stronger or weaker) to W2.
W2	Sets the weld time 2.
D	Sets the down-sloping (the laser output becomes gradually weaker) for the last FLASH.
W1	Sets the LD current value for W1 in the range of 00.75 to 11.50 A.
W2	Sets the LD current value for W2 in the range of 00.75 to 11.50 A.



SCH 2 Screen

On the SCH 2 screen, the temperature control function can be set.



How to see the displayed items

: Settable item

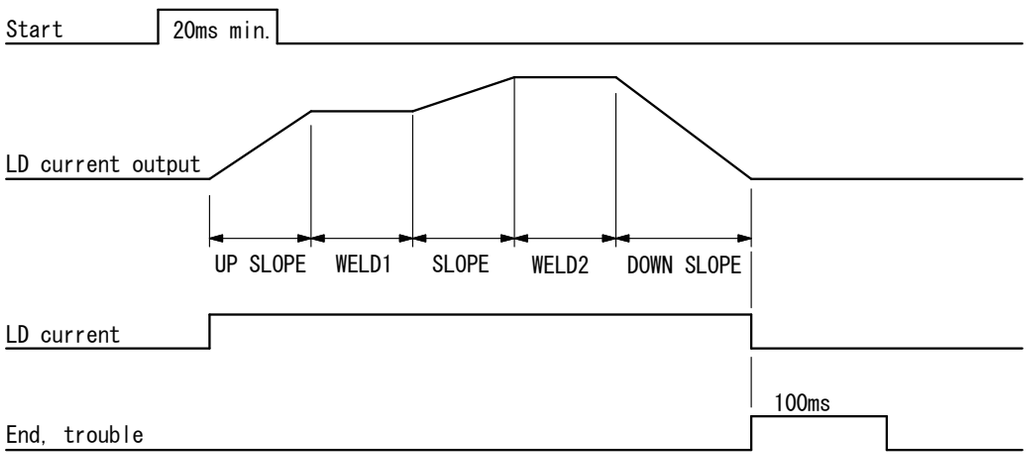
SCH	Sets the SCHEDULE number of laser light. The 32 numbers of 00 to 31 and output schedules can be set.
CTRL	Sets the temperature control method. For details, refer to "Temperature control method" on the next page. CURR: No temperature level control (current control only) KEEP: Controls the output current ON/OFF with the temperature level set in TEMP on the SCH 1 screen (whole area). STOP: Stops output to the LD when the output current ON/OFF with the temperature level set in TEMP on the SCH 1 screen is reached. Set PEAK for DISP on the MONITOR screen since NOW does not function. W2KP: Controls the output current ON/OFF with the temperature level set in TEMP on the SCH 1 screen for W2 (weld time 2) only.
LIMIT	Sets the upper and lower limit judgment value for current in the range of 00 to 99%. The judgment period of the upper and lower limit is within the WELD set time. Effective only when CURR (no temperature level control) is set. +**%: Upper limit judgment value -**%: Lower limit judgment value
EMISSIVITY	Sets the emissivity of workpiece in the range of 0.050 to 1.000.
SMOOTH	Sets the moving average time of the measured temperature in the range of 0 to 9. When the temperature change is large and hard to read, increase the setting to smooth the variation.

Setting	Moving average time	Setting	Moving average time
0	0.001 s	5	0.05 s
1	0.002 s	6	0.1 s
2	0.005 s	7	0.2 s
3	0.01 s	8	0.5 s
4	0.02 s	9	1.0 s

Temperature control method

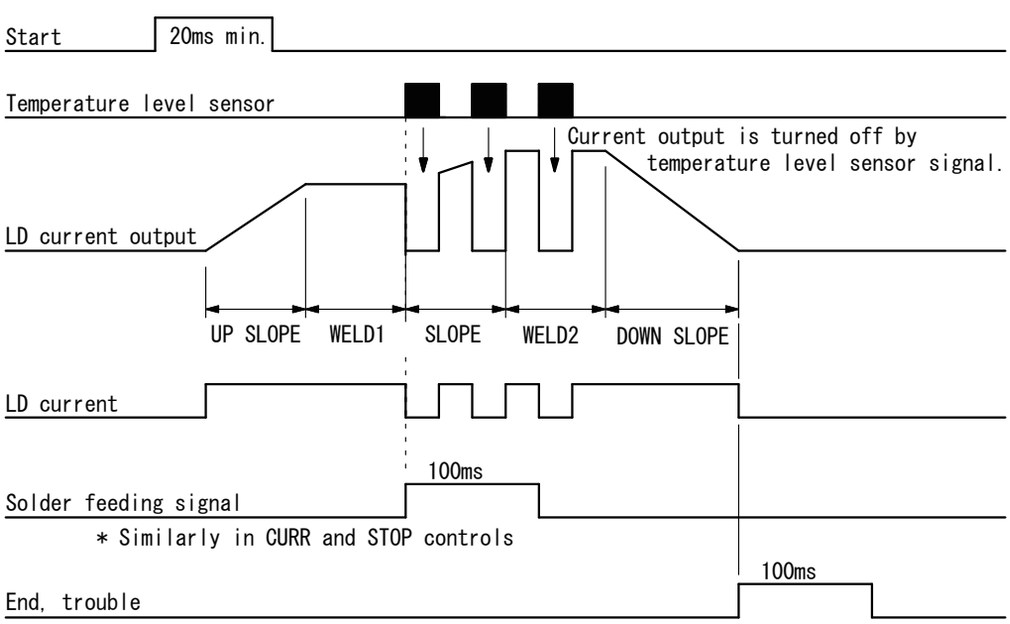
CURR (No temperature level control)

Controls the LD current output with the LD current and time of the set waveform.



KEEP

Controls the LD current output with the LD current and time of the set waveform and the set temperature level.

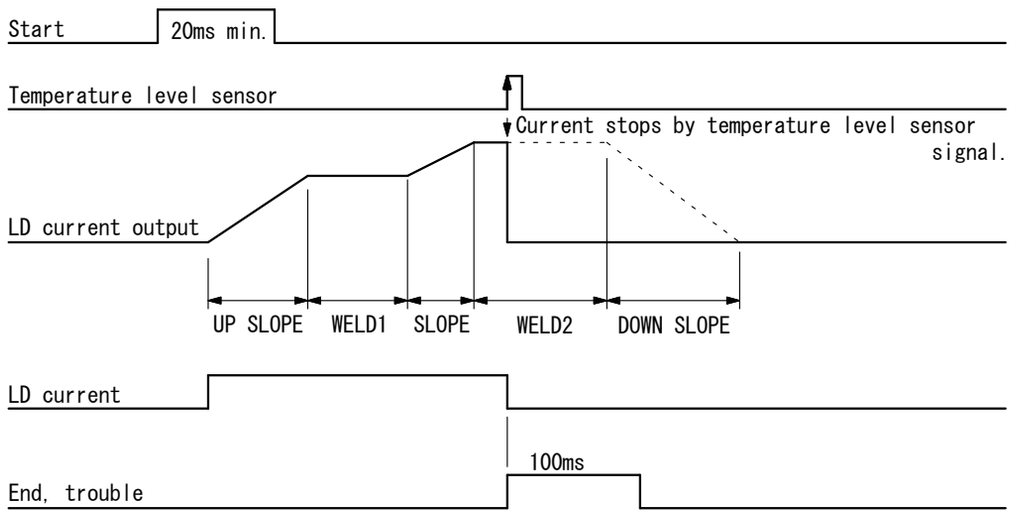


⇒ The time between the start signal and the LD current output is about 80 ms. However, it becomes 130 ms at the first shot after the power supply is turned on or after the sensor setting is changed.

STOP

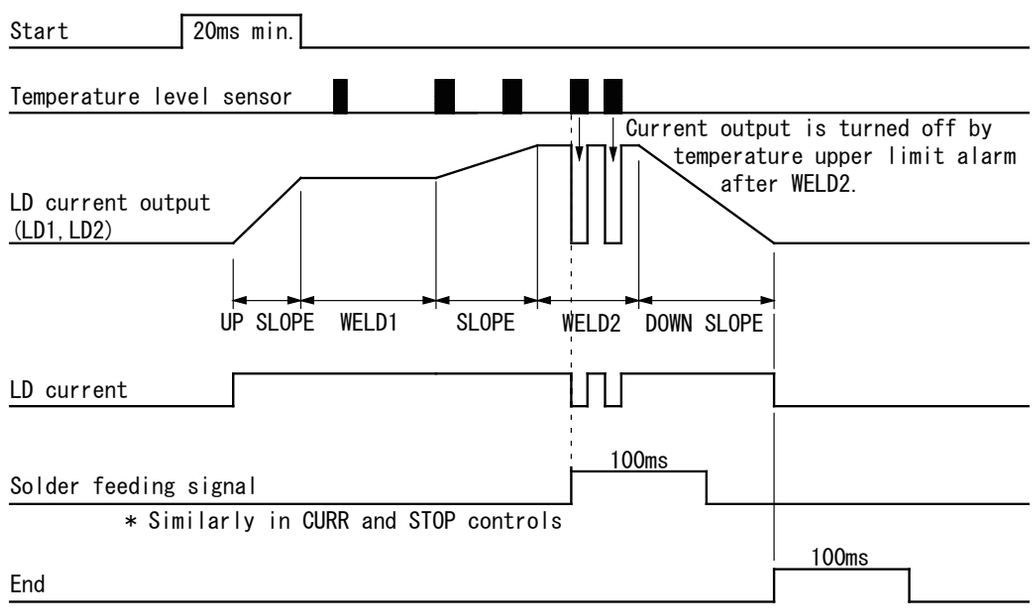
Stops the LD current output when the set temperature level is reached.

When two temperature level sensors are connected, the LD current output is stopped with the earlier signal.



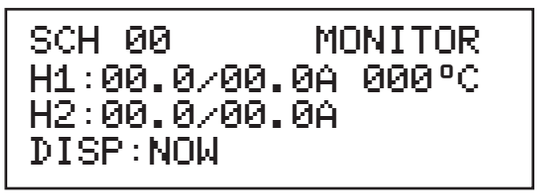
W2KP

Controls the LD current output with the set temperature level for W2 (weld time 2) only.



MONITOR Screen

On the MONITOR screen, the average current of the LD is displayed.

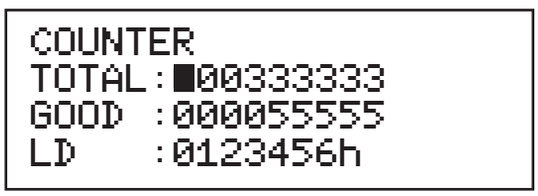


How to see the displayed items : Settable item

SCH	Sets the SCHEDULE number of laser light. The 32 numbers of 00 to 31 and output schedules can be set.
H1/H2	Displays the current value and the temperature level of W1/W2 of the output unit 1 (fiber 1) and the output unit 2 (fiber 2). The temperature level is displayed when the number of heat detectors is set in SENSOR on the SYSTEM screen.
DISP	Switches the temperature displayed in H1/H2. NOW: Present temperature level. Do not set this since this does not function when STOP is set for CTRL on the SCH 2 screen. PEAK: Maximum temperature level

COUNTER Screen

On the COUNTER screen, the total and appropriate number of laser light outputs can be checked.



How to see the displayed items : Settable item

TOTAL	Displays the total number of laser light outputs. Move the cursor to the beginning of the value and press the + key for 3 seconds to reset the value.
GOOD	Displays the appropriate number of laser light outputs. Move the cursor to the beginning of the value and press the + key for 3 seconds to reset the value.
LD	Displays the accumulated emission time of LD.

SYSTEM Screen

On the SYSTEM screen, the laser control method can be checked and the LD power supply to output laser light is set.

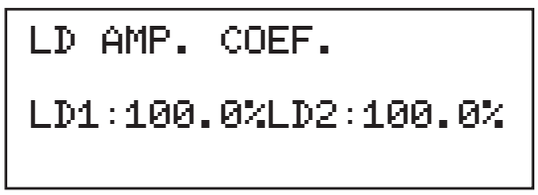
How to see the displayed items

: Settable item

PRE	Sets the laser output preparation. (Effective only in the PANEL control) ON: Turns on the LD power supply to enable laser light output. OFF: Turns off the LD power supply to disable laser light output.
CTRL	Switches the control method. PANEL (internal control): Control is exerted by control panel. Control by the EXT. I/O cannot be exerted. EXT (external control): Control is exerted by the PLC connected to the EXT. I/O connector. Laser start and stop by control panel cannot be exerted.
SENSOR	Sets the number of heat detectors used for the temperature control. 0: No heat detector Used when adjusting or setting to CURR (no temperature level control). Remove the connector of the heat detector. 1: Synchronized feedback control Controls two LD power supplies with a heat detector simultaneously. Be sure to connect the heat detector to TH1. 2: Independent feedback control Controls a LD power supply with each heat detector. Be sure to connect the heat detectors to both TH1 and TH2.
TIME	Switches the time unit on the SCH 1 screen. sec: second ms: millisecond
LD	Switches the LD which laser can be output from. 1: LD1 only 2: LD2 only 1&2: LD1 and LD2 (can be changed by Pins 7 and 9 on the EXT. I/O connector. Refer to page 53.) 1or2: LD2 in the external control (Refer to page 54.)
GID1/GID2	Sets the guide light of LD1/LD2 to ON or OFF. When laser light is output with guide light ON, guide light is turned off automatically.

LD Screen

On the LD screen, the correction value can be set.



How to see the displayed items

: Settable item

LD1/LD2	When there is a difference between LD1 and LD2 of the laser output (W) at the end of the output unit, multiply a higher one by the value (50.0 to 100.0%*) to adjust the output. * The lower limit should be more than 0.75 A. To measure the later output, install the power meter at the end of the output.

Operation depending on the CTRL, SENSOR and LD settings

Operation depending on the CTRL, SENSOR and LD settings is as follows. When SENSOR is set to “0”, remove the connector of the heat detector.

CTRL	SENSOR	LD	Operation	Thermal monitor
CURR	0	1	CURR operation	-
		2	CURR operation	-
		1&2	CURR operation	-
		1or2	CURR operation	-
	1	1	OK when the heat detector is connected to LD1, E12 when connected to LD2	LD1
		2	OK when the heat detector is connected to LD2, E13 when connected to LD1	LD2
		1&2	OK when the heat detector is connected to LD1 (synchronous control), E12 when connected to LD2	LD1
		1or2	Occurrence of an error for LD to which the heat detector is not connected, E12 when both LD1 and LD2 are connected	-
	2	1	CURR operation	LD1
		2	CURR operation	LD2
		1&2	CURR operation	LD1, LD2
		1or2	CURR operation	LD1, LD2
STOP	0	1	CURR operation	-
		2	CURR operation	-
		1&2	CURR operation	-
		1or2	CURR operation	-
	1	1	OK when the heat detector is connected to LD1, E12 when connected to LD2	LD1
		2	OK when the heat detector is connected to LD2, E13 when connected to LD1	LD2
		1&2	OK when the heat detector is connected to LD1 (synchronous control), E12 when connected to LD2	LD1
		1or2	Occurrence of an error for LD to which the heat detector is not connected, E12 when both LDs are connected	-
	2	1	OK	LD1
		2	OK	LD2
		1&2	Stopping laser outputs from both LDs when either of the heat detector 1 and 2 reaches the target temperature	LD1, LD2
		1or2	OK, stopping laser outputs from both LDs when either of the heat detector 1 and 2 reaches the target temperature	LD1, LD2
KEEP	0	1	CURR operation	-
		2	CURR operation	-
		1&2	CURR operation	-
		1or2	CURR operation	-

CTRL	SENSOR	LD	Operation	Thermal monitor
KEEP	1	1	OK when the heat detector is connected to LD1, E12 when connected to LD2	LD1
		2	OK when the heat detector is connected to LD2, E13 when connected to LD1	LD2
		1&2	OK when the heat detector is connected to LD1 (synchronous control), E12 when connected to LD2	LD1
		1or2	Occurrence of an error for LD to which the heat detector is not connected, E12 when both LDs are connected	-
	2	1	OK	LD1
		2	OK	LD2
		1&2	OK (independent control)	LD1, LD2
		1or2	OK, independent control when LD1 and LD2 are simultaneously used	LD1, LD2
W2KP	0	1	CURR operation	-
		2	CURR operation	-
		1&2	CURR operation	-
		1or2	CURR operation	-
	1	1	OK when the heat detector is connected to LD1, E12 when connected to LD2	LD1
		2	OK when the heat detector is connected to LD2, E13 when connected to LD1	LD2
		1&2	OK when the heat detector is connected to LD1 (synchronous control), E12 when connected to LD2	LD1
		1or2	Occurrence of an error for LD to which the heat detector is not connected, E12 when both LDs are connected	-
	2	1	OK	LD1
		2	OK	LD2
		1&2	OK (independent control)	LD1, LD2
		1or2	OK, independent control when LD1 and LD2 are simultaneously used	LD1, LD2

Operating Part

Chapter 3

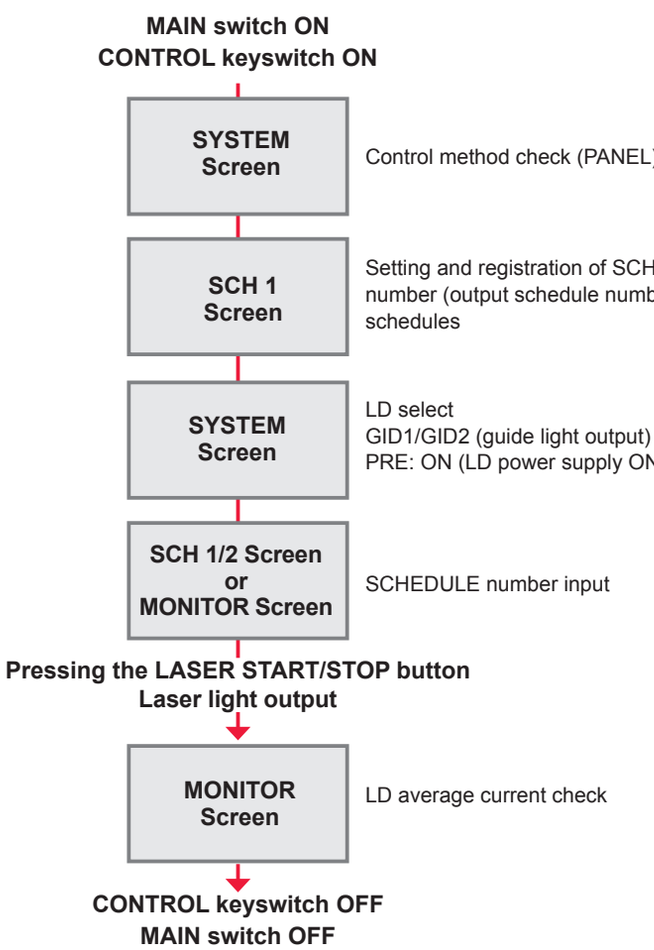
Laser Processing by Control Panel (PANEL)

1. Operation Flow

This section explains a laser processing operation flow by control panel.

The following methods for laser processing operations are available: control from the control panel (PANEL) and control by external input/output signals from the connected PLC (Programmable Logic Controller) (EXT).

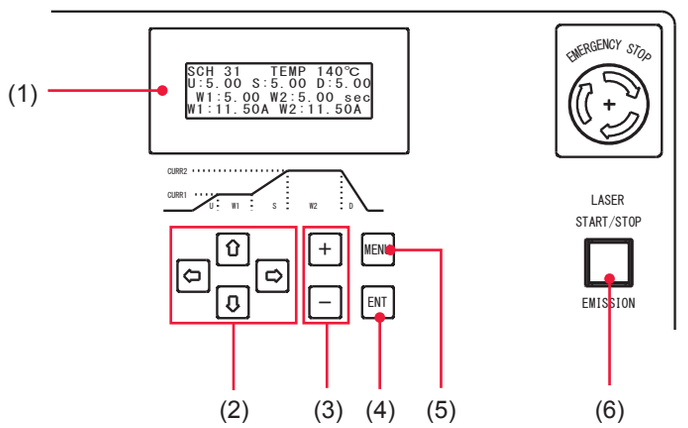
At PANEL, processing schedules are set by using the control panel and laser light is output.



2. Control Panel Functions

This section explains the functions of the control panel.

At PANEL, processing schedules are set by using the control panel keys and laser light is output by pressing the LASER START/STOP button. After the output, you can check the LD average current on the MONITOR screen.



Function of Each Section on the Control Panel

(1) Liquid Crystal Display	Displays the setting conditions and monitor data in 20 characters x 4 lines.
(2) CURSOR Key	This key moves the cursor (■) in the upward/downward or left/right direction on the screen.
(3) + / - Key	This key changes the numeric value or alphabet at the cursor position.
(4) ENT Key	This key definitively sets the changed value. When moving the cursor without pressing the ENT key, the changed value is invalid.
(5) MENU Key	This switches the screen of the liquid crystal display.
(6) LASER START/STOP (Button)	If you press the button while the READY lamp is lighting up, laser light is output. If the button is pressed again while laser light is output, the output is stopped.
EMISSION (Lamp)	When the LD is turned on, the EMISSION lamp comes on.

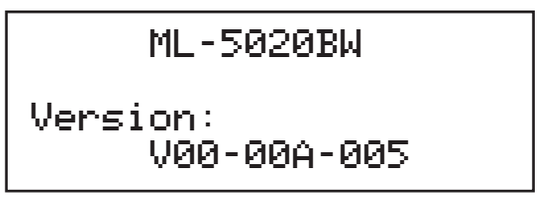
3. Operating Procedure

This section explains the operating procedure for laser processing to be controlled from the control panel.

1 Starting the Laser

(1) Turn ON the MAIN switch at the rear of the main unit.
The power supply is turned ON and the POWER lamp comes on.
The memory and power supply unit are automatically checked. When no error is found, the start screen is displayed.

(2) Turn ON the CONTROL keyswitch.

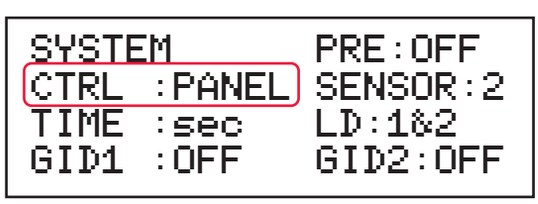


After 2 seconds, the screen displayed at the previous completion appears.

2 Setting the Control Method

(1) Press the MENU key to display the SYSTEM screen.

(2) Move the cursor to "CTRL" and press the + or - key to set the control method.
In this example, set PANEL.



3 Setting Output Schedules

⇒ It is convenient if you enter the set output schedules in the Appendix “Output Schedule Data Entry Table” in advance.
⇒ For the details of setting items, refer to “Welding Schedule Setting Screen” on page 37.
⇒ The unit of time setting depends on the setting of “TIME” on the SYSTEM screen.

As an example, the procedure for setting SCHEDULE No. 00, temperature level 200°C, W1: 0.5 s/1.7 A, S: 0.8 s, W2: 1.2 s/3.0 A, up-slope: 1.0 s, down-slope: 1.5 s is explained below.

(1) Press the MENU key to display the SCH 1 screen.

(2) Move the cursor to "SCH" and press the + or - key to set the SCHEDULE number.
In this example, set 00.

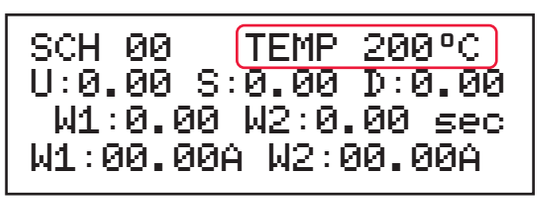
⇒ As the SCHEDULE number, it is possible to set 32 schedules of 00 to 31.

⇒ When the registered SCHEDULE number is entered, the set output schedules are displayed.

(3) Move the cursor to "TEMP" and press the + or - key to set the temperature level (°C) for turning ON/OFF of the laser output.
In this example, set 200°C.

<Note>

The settable temperature level is 50 to 600°C. It is displayed as the relative value and may change depending on the workpiece material or the surface state.

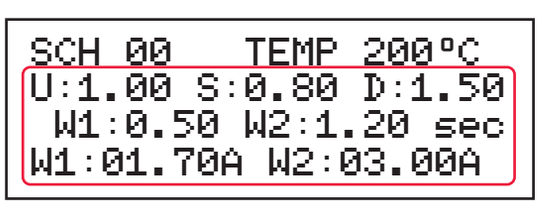


(4) Move the cursor to "U" to "S" and press the + or - key to set the laser output time (ms or sec).

⇒ Set the laser output time in the range of 000 to 999 ms or 0.00 to 5.00 s.

(5) Move the cursor to "W1" to "W2" at the bottom and press the + or - key to set the LD current value (A).

⇒ Set the LD current value in the range of 0.75 to 11.5 A.



(6) Press the ENT key to establish the set value.

<Note>

The set welding schedule is not established until ENT key is presssed. When completing setting, be sure to press the ENT key.

4 Outputting Laser Light

⚠ WARNING

Be sure to put on specified protective glasses during laser light output operation. Even if you wear them, you may lose your sight if the laser beam enters your eyes directly through protective glasses.

(1) Adjust the workpiece and output unit positions to set an appropriate work distance (distance between the workpiece and the output position).

(2) Press the MENU key to display the SYSTEM screen.

(3) Move the cursor to "LD" and press the + or - key to select the LD to be used.
In this example, set 1.

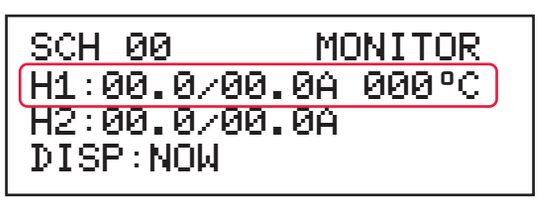
(4) Move the cursor to "GID1" and press the + or - key to set it to ON to output guide light.
A red dot of guide light appears at the laser light injecting position. Laser light is injected to the red-dot position.

(5) Check the laser light irradiation position.
If the point to be worked deviates from the red point of guide light, adjust the position by moving the output unit or workpiece.

(6) Move the cursor to "PRE" and press the + or - key to set it to ON.
The READY lamp comes on.

(7) Press the LASER START/STOP button.
Laser light is output. Guide light stops automatically.

(8) Press the MENU key to display the MONITOR screen, and check the LD average current value (A) of the output laser light.



5 Stopping Laser Processing

(1) Move the cursor to "PRE" and press the + or - key to set it to OFF.
The LD is turned OFF.

(2) Turn OFF the CONTROL keyswitch.
The key can be pulled out.

(3) Turn OFF the MAIN switch.
The power supply is turned OFF and the POWER lamp goes out.

⇒ Return the key of the CONTROL keyswitch to the laser safety supervisor so that it can be kept in custody.

Operating Part

Chapter 4

Laser Processing by External Input/ Output Signals (EXT)

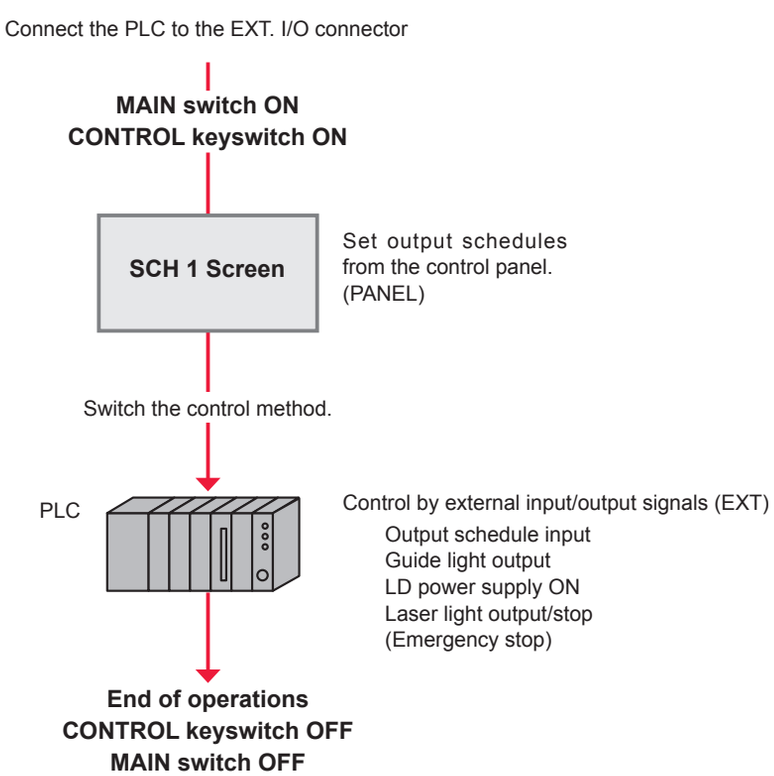
1. Operation Flow

This section explains an operation flow of laser processing external input/output signals (EXT).

The following methods for laser processing operations are available: control from the control panel (PANEL) and control by external input/output signals from the PLC (Programmable Logic Controller) connected to the connector (EXT).

At the control by external input/output signals (EXT), output schedules are set by another method (PANEL) in advance. After that, such control as schedule selection, laser light output, and emergency stop is exerted.

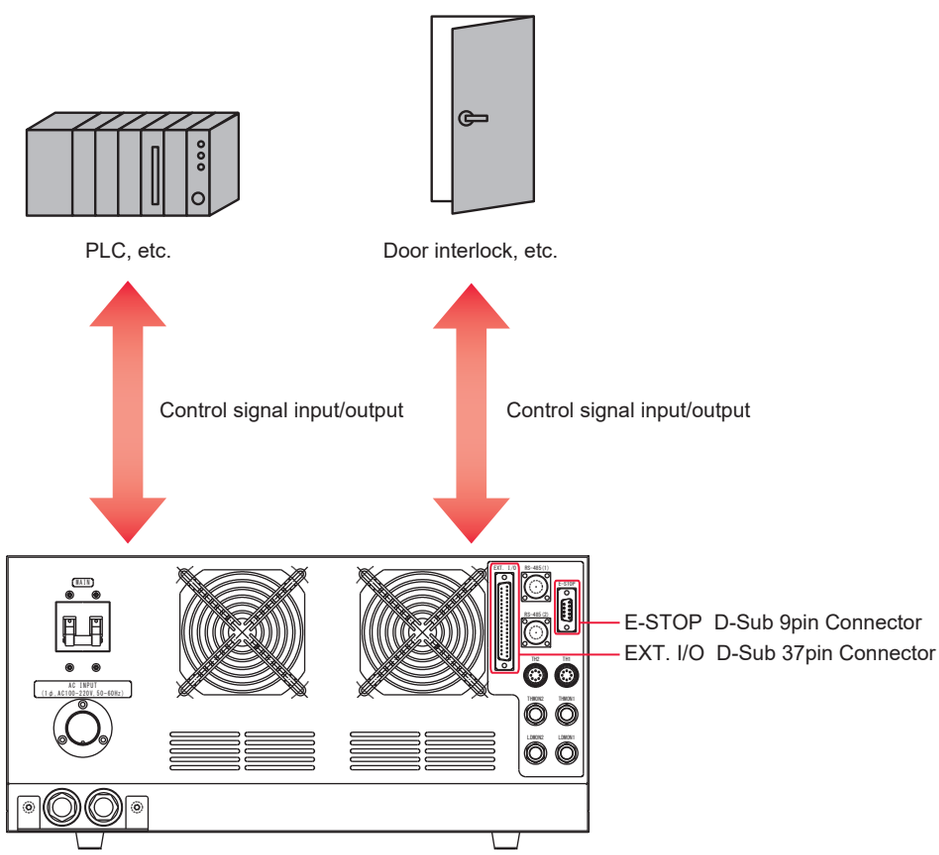
* PLC: Programmable Logic Controller This unit exerts sequence control by executing the programmed contents of control in sequence. This is often called Sequencer (product name of Mitsubishi Electric Corporation).



2. Preparations for Operations

This section explains the devices and connectors required for laser processing by external input/output signals (EXT).

Connect the PLC to the EXT. I/O and E-STOP connectors provided at the rear of the main unit to control the main unit by executing the program from the outside. The E-STOP connector plays a role to cut off the power supply of the laser equipment when an error occurs in another unit on the production line or an emergency stop signal is received from the PLC.



Rear of the main unit

The plug and case models of connectors are as follows.

Connector	Plug	Case	Manufacturer
EXT. I/O	HDCB-37P(05)	HDC-CTH(10)	HIROSE ELECTRIC CO., LTD.
E-STOP	A-03376-001		-

⇒ Prepare a program and its development environment for laser control on the customer side.

⇒ Do not connect the shielded portion to FG (frame ground) inside the laser equipment when using the shielded cable.

3. Connector Functions

Pin Arrangement and Functions

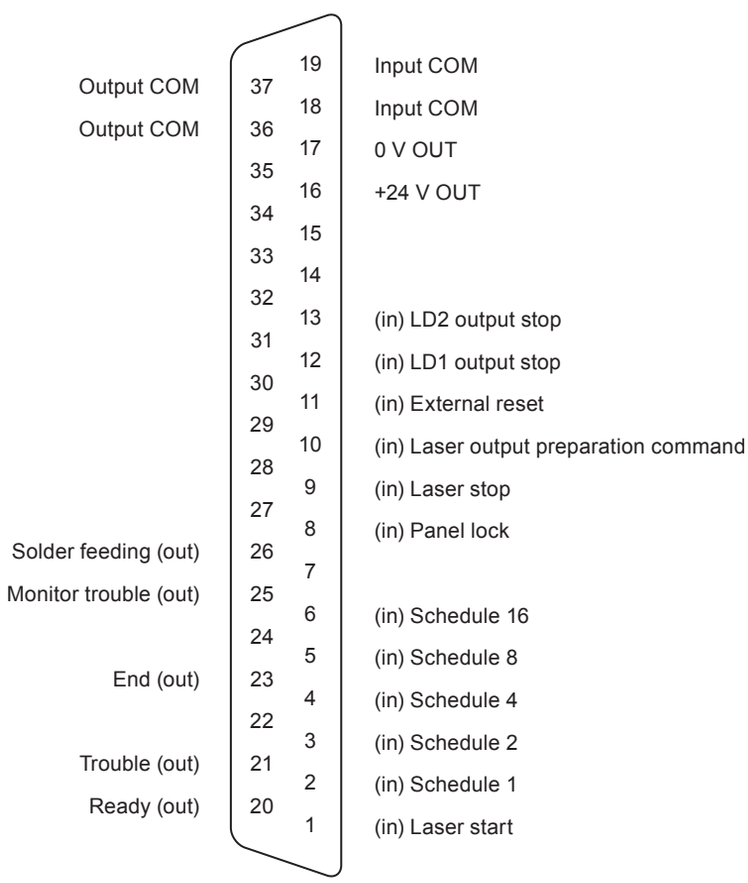
There are 2 connectors to be connected for the control by external input/output. This section explains the arrangement and functions of the respective pins.

EXT. I/O Connector (D-Sub 37 pin)

The EXT. I/O connector inputs or outputs processing schedules and the start signal of laser light.

⇒ Use the following product out of the attached connectors.

Plug	Case	Manufacturer
HDCB-37P(05)	HDC-CTH(10)	HIROSE ELECTRIC CO., LTD.



Input Pins of EXT. I/O Connector

⇒ To control by external input signals, set CTRL on the SYSTEM screen to EXT.

Pin No.	Description	
1	Laser start When this pin is connected to the input COM, the laser output starts. Normally, this pin is connected to a contact or an open-collector signal. Input it for at least 20 ms.	
2	Schedule 1	When this pin is connected to the input COM, the selected schedule number is input. The start signal is turned ON, the schedule number is read. Establish the schedule number before the start signal is turned ON. For example, when outputting laser with SCH 07, connect schedule select signals 1, 2 and 4 to the input COM. Binary signal of negative logic. Normally, this pin is connected to a contact or an open-collector signal.
3	Schedule 2	
4	Schedule 4	
5	Schedule 8	
6	Schedule 16	
7	Unused Do not connect anything.	
8	Panel lock When this pin is connected to the input COM, the setting by the front panel is disabled.	
9	Laser stop When this pin is connected to the input COM, the laser output stops.	
10	Laser output preparation command At ON, the laser equipment is brought to a laser output preparation state and the ready output is turned ON. At OFF, the laser is not output even when the start signal is turned ON.	
11	External reset When this pin is connected to the input COM, the error is reset. Also, the laser output preparation command signal is turned OFF. It is necessary to turn it ON again.	
12	LD1 output stop When LD is set to “1or2” and this pin is connected to the input COM during laser stop, laser is not output from the LD1. Laser does not stop even if the connected during laser output. This functions only when LD is set to “1or2.”	
13	LD2 output stop When LD is set to “1or2” and this pin is connected to the input COM during laser stop, laser is not output from the LD2. Laser does not stop even if the connected during laser output. This functions only when LD is set to “1or2.”	
14	Unused Do not connect anything.	
15	Unused Do not connect anything.	
16	+24 V OUT Power supply for input signals. When using the internal power source, connect this power source to 0 V (pin No.17).	
17	0 V OUT When using the internal power source, connect it to +24 V OUT (pin No.16). When using the external power source, connect it to +24 V.	
18	Input COM	
19	Input COM	

SCHEDULE Number Selection

Set "SCH" by combining pin No.2 to pin No.6 (schedule signals 1, 2, 4, 8, and 16) inputs.

Input / SCH	SCH 16	SCH 8	SCH 4	SCH 2	SCH 1
00					
01					●
02				●	
03				●	●
04			●		
05			●		●
06			●	●	
07			●	●	●
08		●			
09		●			●
10		●		●	
11		●		●	●
12		●	●		
13		●	●		●
14		●	●	●	
15		●	●	●	●
16	●				
17	●				●
18	●			●	
19	●			●	●
20	●		●		
21	●		●		●
22	●		●	●	
23	●		●	●	●
24	●	●			
25	●	●			●
26	●	●		●	
27	●	●		●	●
28	●	●	●		
29	●	●	●		●
30	●	●	●	●	
31	●	●	●	●	●

●: Input-pin-COM circuit closed.
Blank: Input-pin-COM circuit opened.

Output Pins of EXT. I/O Connector

Pin No.	Description
20	Ready When the laser output preparation command signal is turned ON, the ready signal is turned ON. In the memory error, TROUBLE and EMSTOP, the ready signal is turned OFF even when the laser output preparation command signal is turned ON.
21	Trouble If trouble such as LD overheat arises, this pin is turned ON. This can be reset by ON/OFF of the CONTROL keyswitch.
22	Unused Do not connect anything.
23	End Output at the completion of laser output. The signal is an open-collector type and ON at the time of output. After the laser is output, this pin is output for 100 ms.
24	Unused Do not connect anything.
25	Monitor trouble Output when the value is outside the range of the monitor upper/lower limit set value. The signal is an open-collector type and ON at the time of output. After the laser is output, this pin is closed internally for 100 ms.
26	Solder feeding Output for 100 ms when the measured temperature of the heat detector reaches the set value (only at the first time). The signal is an open-collector type and ON at the time of output. Output signal form: Photo relay, Output capacity: 30 V DC and 300 mA
27	Unused Do not connect anything.
28	Unused Do not connect anything.
29	Unused Do not connect anything.
30	Unused Do not connect anything.
31	Unused Do not connect anything.
32	Unused Do not connect anything.
33	Unused Do not connect anything.
34	Unused Do not connect anything.
35	Unused Do not connect anything.
36	Output COM
37	Output COM

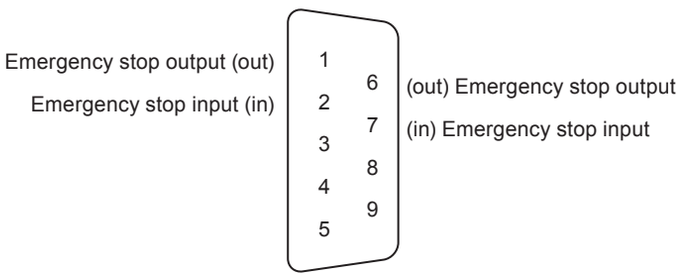
Type of output: Photo MOS relay output
Rating of output: 24 V DC, 20 mA max.

E-STOP Connector (D-Sub 9 pin)

The E-STOP connector inputs and outputs an emergency stop signal for the laser.

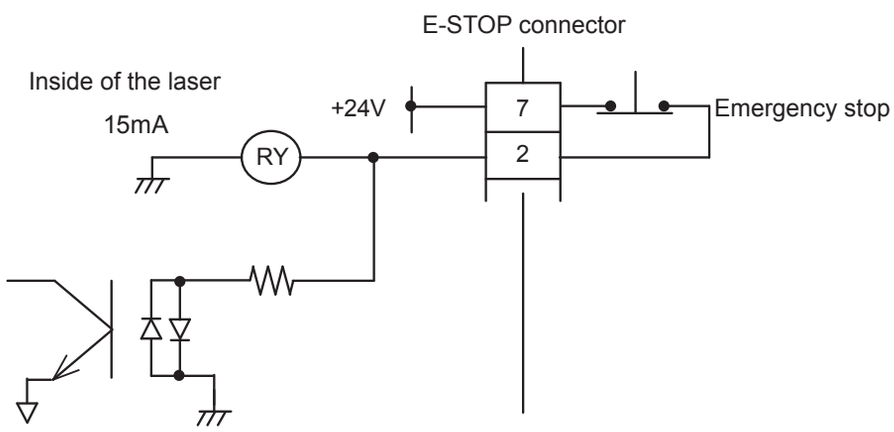
⇒ Use the following product out of the attached connectors.

Model	Manufacturer
A-03376-001	-



Pin No.	Description
1	When the laser is put in an emergency stop, the section between pin No.1 and pin No.6 is put in an open circuit.
2	When the section between Pin No.2 and Pin No.7 is put in an open circuit, the power supply of the laser is cut off.
6	When the laser is put in an emergency stop, the section between pin No.1 and pin No.6 is put in an open circuit.
7	When the section between Pin No.2 and Pin No.7 is put in an open circuit, the power supply of the laser is cut off.

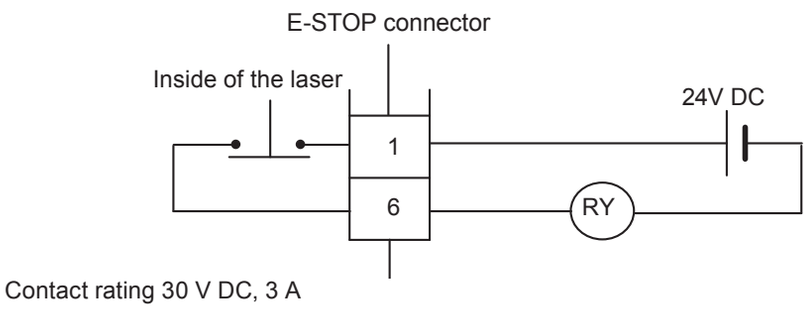
⇒ When the section between pin No.2 (emergency stop input) and pin No.7 (emergency stop input) is put in an open circuit, the laser is put in an emergency stop status and the power supply of the laser is cut off.



At occurrence of an emergency stop, the section between pin No.1 (emergency stop output) and pin No.6 (emergency stop output) is put in an open circuit and the emergency stop output status shown in the following figure is provided.

⚠ CAUTION

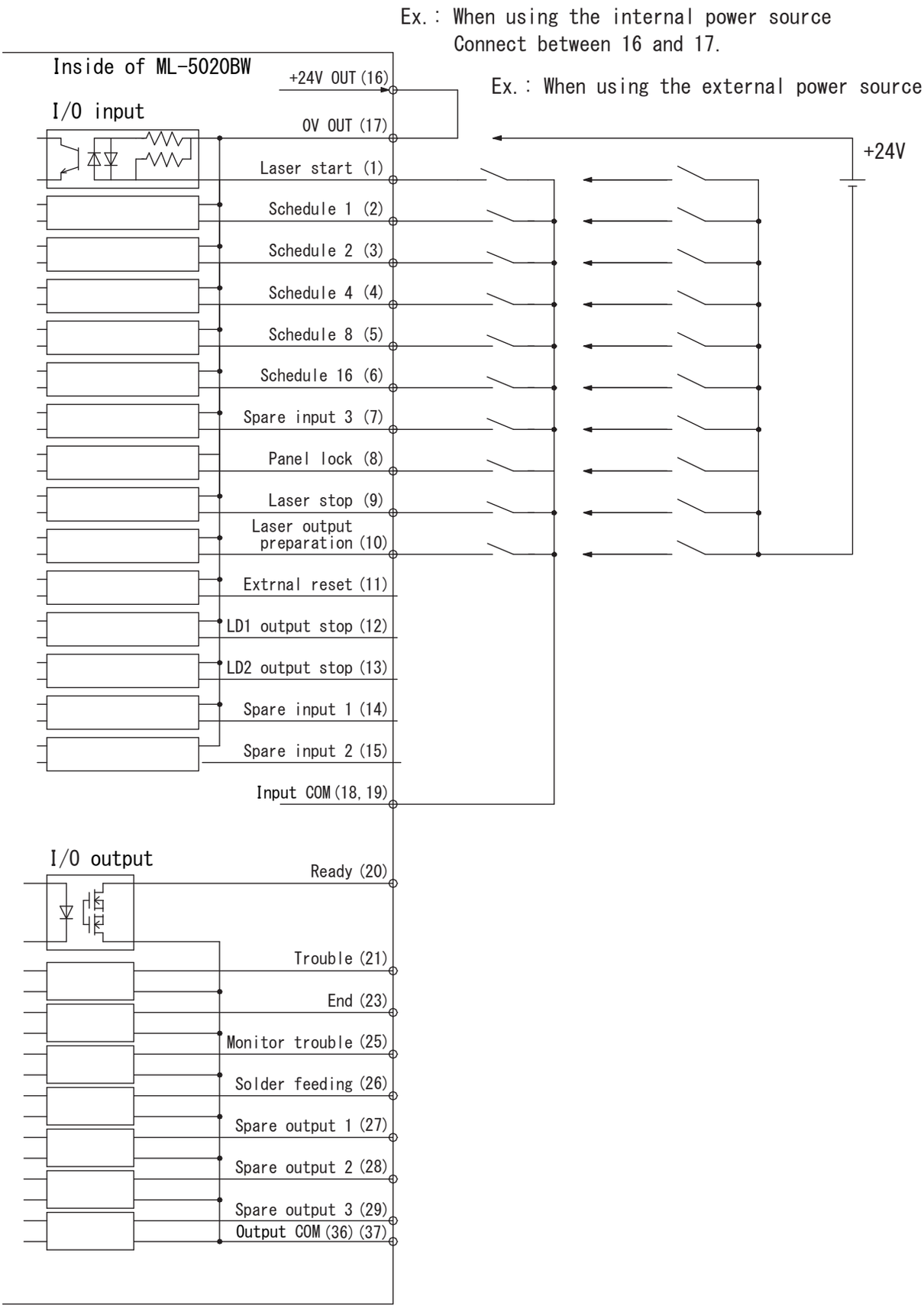
The section between pin No.2 and pin No.7 of the attached connector is short-circuited by soldering before shipment. Be sure to mount the connector even when not using the emergency stop input.



Contact rating 30 V DC, 3 A

Example Connections of External Input/Output Signals

An example of external input/output signal connections is explained below.



Maintenance Part

Chapter 1

How to Perform Maintenance

NOTE

Simple user maintenance tasks are described in this chapter. For optimal performance, we recommend regular inspections. Contact us for further details.

Before starting maintenance, read the following items and take extreme care.

⚠ WARNING

- **Before starting maintenance operations, be sure to turn OFF the power supply.**
- **Turning ON the power supply for a operation check during maintenance puts the laser in oscillation. Take extreme care about it.**
- **The operator and those who may receive laser light during maintenance must put on protective glasses.**

1. Maintenance Parts and Standard Intervals of Inspection/Replacement

Service parts may deteriorate and require repair or replacement. Refer to the table below and Check it regularly.

⇒ The model numbers of maintenance parts are subject to change without notice. For the latest parts information, contact a nearest sales office.

Part name	Maintenance Cycle (*1)	Maintenance content(*2)	model number
LD module (*3)	End of life	replacement	PZ1211513
LD cooling fan for ML-5020AW/BW	4.5 year	replacement	LP1214233
LCD display for ML-5020AW/BW	5 year	replacement	LP1214234
LD driver for ML-5020AW	5 year	replacement	LP1214235
LD driver for ML-5020BW	5 year	replacement	LP1214237
Controller board for ML-5020AW	End of life	replacement	LP1214386
Controller board for ML-5020BW	End of life	replacement	LP1214236
LD driver cooling fan for ML-5020AW	4.5 year	replacement	LP1214164
LD driver cooling fan for ML-5020BW	4.5 year	replacement	LP1214850

For the hatched portion, our engineer takes charge of maintenance work.

*1: The Maintenance cycle is a guideline when the equipment is operated for 8 hours a day.

*2: Replacement is performed at the end of life, when burnout occurs, or when a defect is discovered.

*3: About the definition of lifespan

If the problem persists even after adjusting the optics and cleaning the optical system, increase the LD current setting.

The maximum setting value of LD current is 11.50A

If there is no improvement even if the setting is set to the maximum value, the life of the LD has come to an end. Inspection of the LD module is required. Please contact us.

2. Cleaning the Cover Hole

The air inlet and outlet are provided at the cover on the main unit. Perform cleaning every month.

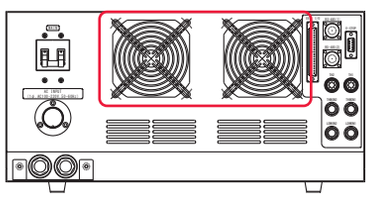
<Note>

Not performing cleaning of the cover hole decreases the cooling capacity and affects the service life of parts such as LD. To give normal performance of the laser equipment, perform cleaning periodically.

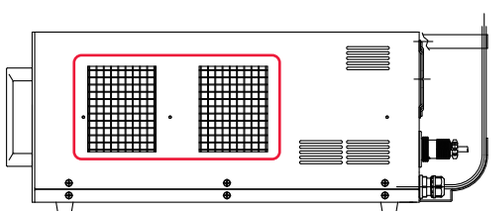
Operating Procedure

(1) When dust is attached on four air inlets on both sides of the main unit and two air outlets on the rear, remove it by a cleaner.

Rear



Side (similarly also on the opposite side)



Maintenance Part

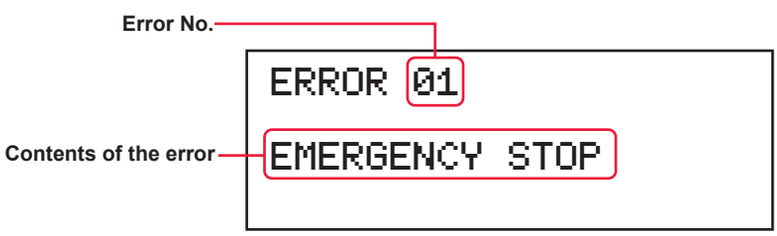
Chapter 2

Inspection and Measure To Be Taken at Occurrence of an Error

1. Error Display and How to Take a Measure

When an error occurs in the laser, the contents of the error are displayed on the control panel screen as shown below. In the following, how to take a measure is explained in the order of Error No. At occurrence of an error, read this chapter carefully and perform inspection of the laser and take a proper measure.

* If you have any unclear point, contact the distributor or us for information.



LD "-": State of LD doesn't change even if an error/fault occurs.
LD "OFF": LD is turned off automatically if an error/fault occurs.
Alarm output "-": Error/Fault signal is not output if an error/fault occurs.
Alarm output "ON": Error/Fault signal is output if an error/fault occurs.

No.	Contents of error	LD	Alarm output	Measures
01	EMERGENCY STOP	OFF	ON	An emergency stop signal is input. Release the emergency stop by turning the EMERGENCY STOP button on the front panel clockwise, and then turn off the CONTROL keyswitch and turn it on again to reset. Check that the emergency stop input (Pins 2-7) of the E-STOP connector (D-Sub, 9 pin) on the rear is shorted. If the trouble will continue even after the above measures, write down the error No. and consult us.
02	LD OVER HEAT	OFF	ON	The thermostat of the LD unit is actuated. Turn off the CONTROL keyswitch and turn it on again to reset. If the trouble will continue even after the above measures, write down the error No. and consult us.

No.	Contents of error	LD	Alarm output	Measures
03	LD FAN STOP	OFF	ON	The fan of the LD unit stops and the rotation sensor of the fan is turned off. Turn off the CONTROL keyswitch and turn it on again to reset. If the trouble will continue even after the above measures, write down the error No. and consult us.
04	LDPS1 OVER HEAT	OFF	ON	The thermostat of the LD power supply 1 is actuated. Turn off the CONTROL keyswitch and turn it on again to reset. If the trouble will continue even after the above measures, write down the error No. and consult us.
05	LDPS1 OVER CURR	OFF	ON	The current of the LD power supply 1 is 13.5 A or more. Turn off the CONTROL keyswitch and turn it on again to reset. If the trouble will continue even after the above measures, write down the error No. and consult us.
06	LDPS1 OUTPUT OPEN	OFF	ON	The output voltage of the LD power supply 1 is 7 V or more. Turn off the CONTROL keyswitch and turn it on again to reset. If the trouble will continue even after the above measures, write down the error No. and consult us.
07	LDPS1 OUTPUT SHORT	OFF	ON	The output voltage of the LD power supply 1 is 1.8 V or less. Turn off the CONTROL keyswitch and turn it on again to reset. If the trouble will continue even after the above measures, write down the error No. and consult us.
08	LDPS2 OVER HEAT	OFF	ON	The thermostat of the LD power supply 2 is actuated. Turn off the CONTROL keyswitch and turn it on again to reset. If the trouble will continue even after the above measures, write down the error No. and consult us.
09	LDPS2 OVER CURR	OFF	ON	The current of the LD power supply 2 is 13.5 A or more. Turn off the CONTROL keyswitch and turn it on again to reset. If the trouble will continue even after the above measures, write down the error No. and consult us.
10	LDPS2 OUTPUT OPEN	OFF	ON	The output voltage of the LD power supply 2 is 7 V or more. Turn off the CONTROL keyswitch and turn it on again to reset. If the trouble will continue even after the above measures, write down the error No. and consult us.

No.	Contents of error	LD	Alarm output	Measures
11	LDPS2 OUTPUT SHORT	OFF	ON	The output voltage of the LD power supply 2 is 1.8 V or less. Turn off the CONTROL keyswitch and turn it on again to reset. If the trouble will continue even after the above measures, write down the error No. and consult us.
12	THERMO SENSOR1 ERROR	OFF	ON	The error signal of the heat detector 1 is turned on. Turn off the CONTROL keyswitch and turn it on again to reset. If the trouble will continue even after the above measures, write down the error No. and consult us.
13	THERMO SENSOR2 ERROR	OFF	ON	The error signal of the heat detector 2 is turned on. Turn off the CONTROL keyswitch and turn it on again to reset. If the trouble will continue even after the above measures, write down the error No. and consult us.

2. Troubles not Displaying Fault Code

States of Laser	Measures
Laser output increases though monitor displays normal value. (When processing spot is not clean or spatter increases.)	Adjust the LD current value and output time. If the laser does not improve though the setting is adjusted, optical axis of resonator may have been dislocated. For adjusting the axis, consult us.
Laser output decreases though monitor displays normal value. (When processing is not performed or weld strength is not enough.)	

Appendixes

Specifications

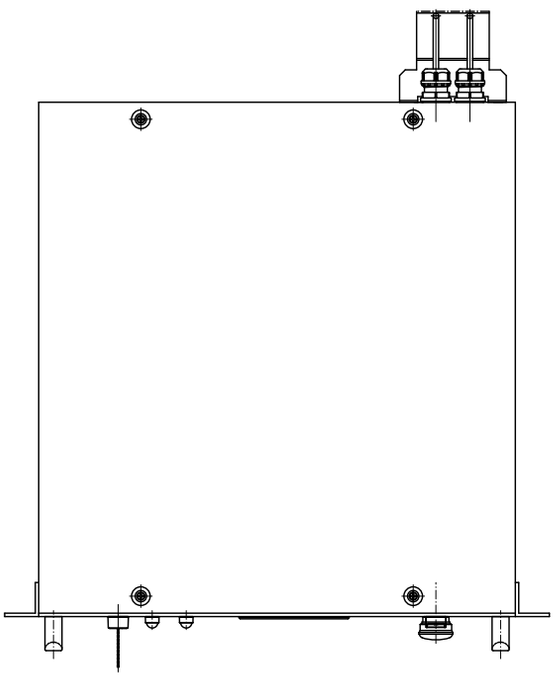
Oscillator	Maximum rated output (from output unit end)		20 W × 2
	Pulse width		000–999 ms (1ms step) 0.00–5.00 s (0.01s steps) ***<Note>***UP SLOPE(U),WELD1(W1),SLOPE(S),WELD2(W2),DOWN SLOPE(D) It can be set up to 5s each (maximum 25s). For details of each item, refer to Chapter 2 1. Setting Welding schedules.
	Oscillation wavelength		915 ± 20 nm
	Positioning guide beam		Built-in visible laser (red)
	Output stability		±3% or less @ 2 W or more (within ambient temperature ±5°C)
Power Supply	Power supply	Input power supply	Single-phase, 100 V to 220 V AC (±10%)
		Frequency	50/60 Hz
	Max. input current		3.0 A (100 V), 1.5 A (200 V), 1.4 A (220 V)
	Max. apparent power		300 VA
	Power consumption	Maximum	300 W
		Standby	40 W
	Breaker rated current (to be supplied by customers)		For the power supply side, we earnestly recommend using a leakage breaker with the rated current of 5 A or more, which is applicable to harmonics and surges.
	Ground		Class D (ground resistance: 100 Ω max.)
Control Panel	Number of schedules		32
	Schedule setting		Laser output waveform
	Measurement function		Average value of the LD-applied current (A)
	Counter		Displays the total number of outputs (9 digits) Displays the number of acceptable outputs (9 digits) Displays the total LD ON time (7 digits)
	Active heat control function		Laser output control by detecting the temperature of the processing part ***<Note>*** Effective only when using with the output unit FOCH-30C series.
Operating Environment	Ambient temperature		20 to 30°C
	Ambient humidity		20% to 85% RH (non-condensing)
	Temperature during transport or storage		-10 to 50°C
	Humidity during transport or storage		20% to 90% RH
	Vibration during transport		4.9 m/s^2 (0.5 G) max.
	Impact during transport		49 m/s^2 (5 G) max.
	Vibration during operations		10 to 60 Hz: 0.98 m/s^2 (0.1 G) max.
	Intermittent vibration during operations		Less than 2 Hz: 4.9 m/s^2 (0.5 G) max.

Others	Mass		22 kg
	Dimensions		With rubber foot and rack mounting plate: 211 (H) × 480 (W) × 563 (D) mm Without rubber foot and rack mounting plate: 199 (H) × 420 (W) × 563 (D) mm
	Noise level	A; Weighted equivalent continuous sound pressure level	75 dB (A) max.
		C; Sound pressure level	0.3 Pa max.

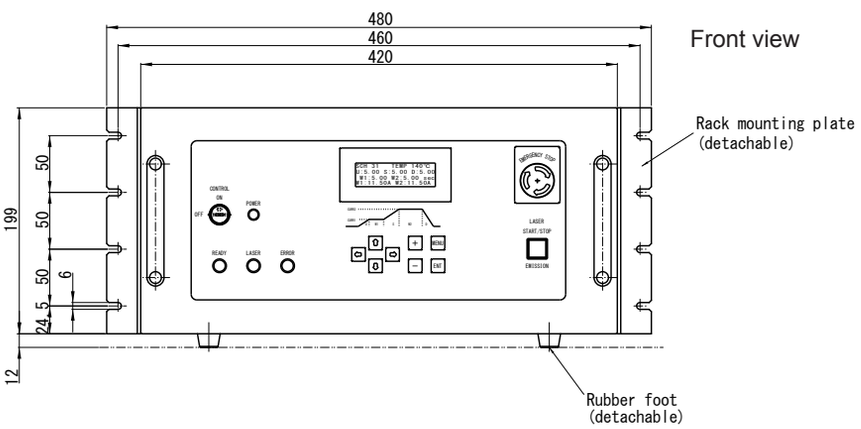
Dimensional Outline Drawings

Unit: mm

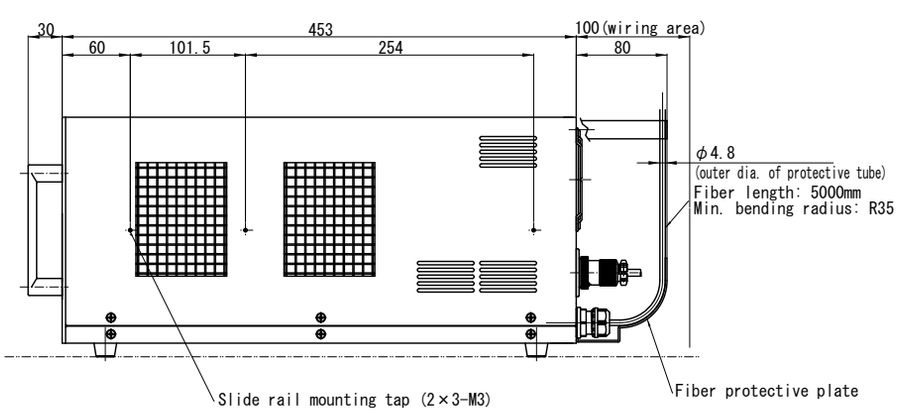
Top view



Front view



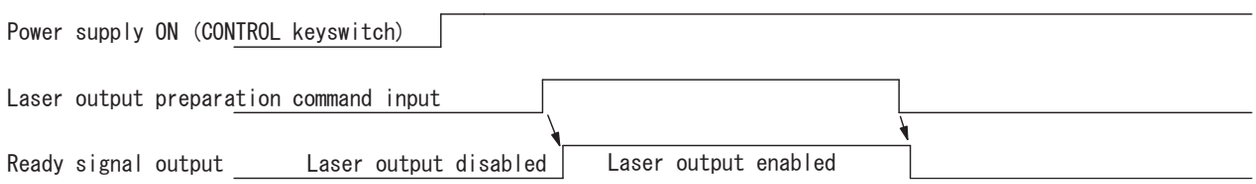
Right side view



Timing Chart

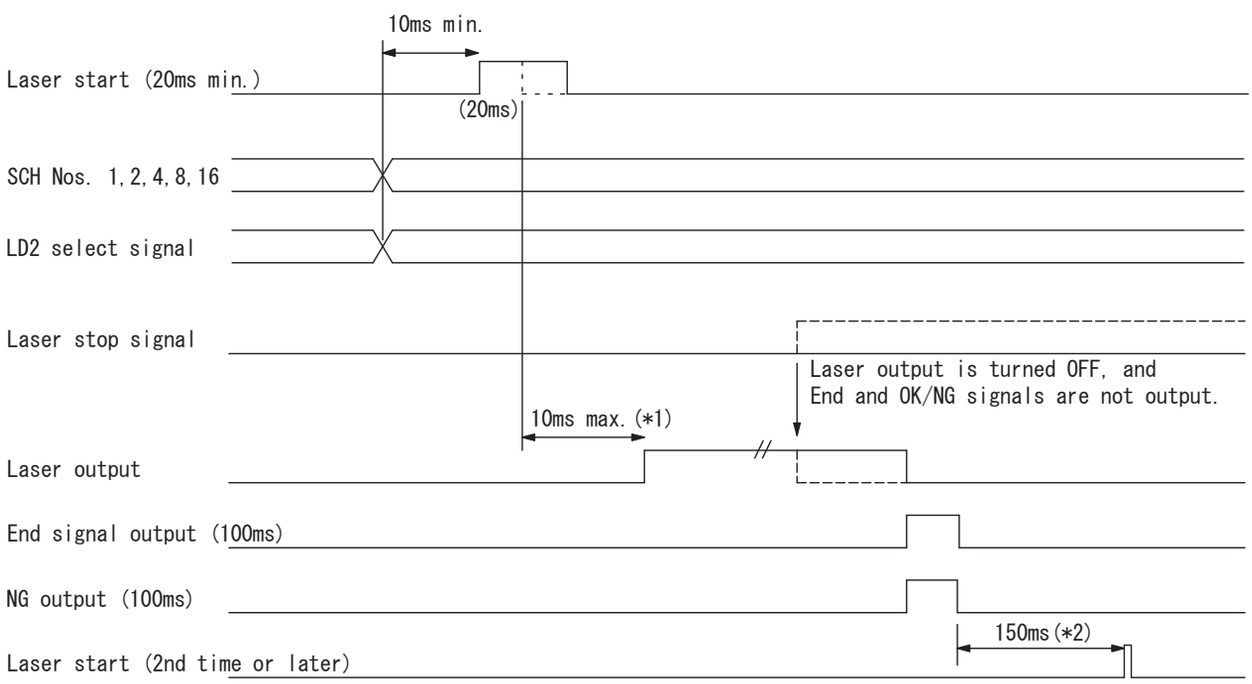
An example of timing chart for the case where the LD power supply is turned on and laser light is output up to a monitor output is shown below. The equipment operation is represented on the axis of ordinates and the lapse of time is represented on the axis of abscissas to show the change status based on changes with the lapse of time at each operation and the time required for a certain operation.

Ready Signal



*1: The ready signal is turned on at rising edge of the laser output preparation command. When the laser output preparation command is turned on at start-up, turn it off and turn it on again.

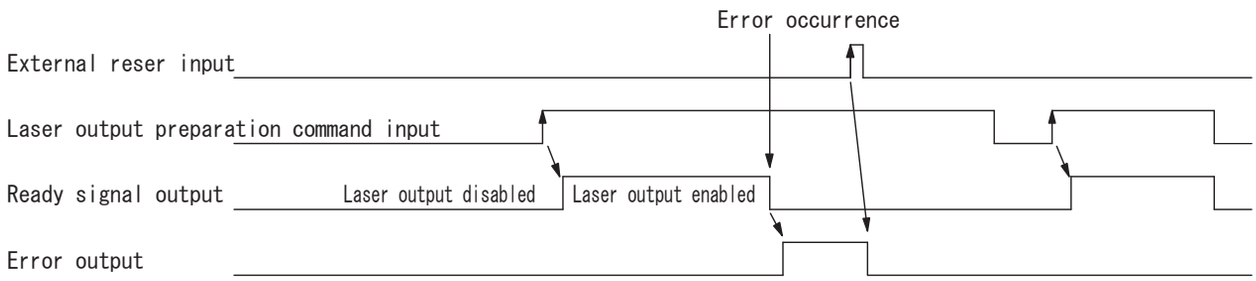
Laser Output



*1: At start-up of laser or when the setting related to temperature is changed: approx. 300 ms

*2: 150 ms or more of the irradiation time. The next laser start is disabled during this period.

Error Occurrence



Explanation of Terminology

The following table explains the terminology related to laser processing. General terms and the terms peculiar to this laser are included. When there is any related page in this Operation Manual, the reference page is shown.

C	
COM (Common)	Common line. This means a connecting point where the multiple points are connected to the same common point. The electric circuit includes an A contact, B contact, and Common. The common contact is connected to the A contact and B contact commonly. Abbreviation of Common.
Common	Common line. This means a connecting point where multiple points are commonly connected to the same point in the circuit or wiring. The electric circuit includes an A contact, B contact, and Common. The common contact is connected to the A contact and B contact commonly. This is abbreviated as COM.
D	
Diode laser	Package that mounts the LD bar in a heat sink.
E	
Excitation	Phenomenon in which the electrons around an atom proceed from the ground status to a one-upper status. In the case of laser, excitation means that the atoms or molecules in the laser medium proceed from a low energy status to a high energy status when energy is given from the outside.
F	
FC-LD	Unit that permits diode laser light to be emitted from the fiber by using a special optical system. Abbreviation of Fiber Coupling Laser Diode.
G	
Grounding	Electrical connection between an electric device and the ground. This is also called earth or ground.
Grounding work	Specified in Article 18 "Interpretation of Technical Standard of Electric Equipment." The grounding work for device connected to a low-voltage circuit of 300 V or less is performed in compliance with class D, and that of more than 300 V is performed in compliance with class C. → P.25
Guide light	Auxiliary light to check the laser light irradiating position and make a positional adjustment. Light with a wavelength of 380 nm to 780 nm that can be seen by man. This is also called visible laser. In this laser, diode laser for guide light is output. → P.43
H	
Harmonic	Waveform having 3 to 40 times of frequency of the basic frequency (50/60 Hz). → P.29
I	
Interlock	Circuit to prevent hazards, which stops the machine operation when a material comes close to a place where a hazardous unit or equipment is provided.
L	
L	Line terminal. This is a terminal to be connected to a line conductor of the external circuit. Abbreviation of Live. → P.29
Laser	LASER is an abbreviation of Light Amplification by Stimulated Emission of Radiation, which is light artificially generated by laser oscillator. Laser is classified into solid laser, liquid laser, and gas laser by medium.

Laser light	Light artificially generated by laser oscillator. This laser light is widely used for electronic devices, optical communication, medial treatment, metal working, and other fields. As a matter of feature, laser light goes straight, its wavelength is fixed and the phase (wave peak and hollow) is the same, so high energy can be obtained by concentrating light to one point.
Laser safety supervisor	Person who is responsible for laser safety management, having an enough knowledge to execute laser hazard assessment and safety management. For the facilities or places where a laser product exceeding Class 3B in JIS C 6802 "Safety Standards for Laser Products", it is necessary to appoint a laser safety supervisor and provide a management area. Since most laser equipment comes under class 4 of the highest hazard, the laser safety supervisor must be appointed. → P.8
LD	General term for diode laser and FC-LD.
LD chip	Semiconductor laser device.
Leakage breaker	Safety device to shut off the circuit at detection of a leakage current that flows from the power supply to the ground.
N	
N	Neutral point terminal. This is a terminal to be connected a neutral point of the circuit. Abbreviation of Neutral. → P.29
O	
Optical fiber	Cable to transmit light that is made of quarts glass or thin plastic fiber. This cable consists of a core of the center and a clad covering the surroundings, and light is propagated in the core. The mode is classified into 2 types, namely, multi mode and single mode by the number of light propagation modes, and the multi-mode optical fiber is divided into step index (SI) and graded index (GI) by refractive index distribution of the core.
Oscillator	In the laser equipment, the oscillator means a unit to amplify and oscillate laser light. This unit consists of a laser medium, excitation source, amplifier, etc. Laser is amplified and oscillated when the laser medium is excited by excitation source.
Output unit	Unit to output the laser light transmitted by optical fiber to the workpiece. The optical fiber connected to the branch unit is connected. → P.17 and P.30
P	
PE	Protective earthing terminal. This is a terminal that is provided to ground a device. Abbreviation of Protective Earth. → P.29
PLC	Device that exerts sequence control by executing the programmed contents of control in sequence. This is often called Sequencer (product name of Mitsubishi Electric Corporation). Abbreviation of Programmable Logic Controller.
Protective glasses	Protective glasses that the operator puts on to protect the eyes from laser light. The protective glasses are divided into some types by wavelength of laser light.
Pulse width	Time during which laser light is irradiated.
R	
Rated current	Maximum effective current value when a current can be continuously output. This value indicates that it is prohibited to cause a current to continuously flow exceeding this level.
Remote interlock	Interlock function to shut off the laser output in an emergency as a means for using the laser device safely. In this laser, the E-STOP connector is connected to the door of the room so that laser light may be shut off when the door is opened. → P.57
Resistivity	Electric resistance generally used as a scale to indicate the hardness of current flow for a material. Its unit is ohm (Ω). The value that indicates this resistance by unit volume (1 cm x 1 cm x 1 cm) is volume resistivity and its unit is ohm centimeter (Ωcm).

S	
SCH	This word means a laser light output schedule in this laser. 256 types of SCHEDULE can be set and each schedule can be registered with a SCHEDULE number. → P.38, P.39 and P.42
Sequencer	A type of PLC (Programmable Logic Controller) that exerts sequence control by executing the programmed contents of control, being a product name of Mitsubishi Electric Corporation.
Single phase	Electric current whose magnitude and direction change periodically, having the same phase. This single phase is used as a 100 V power supply for electric lamps and plug sockets.
Surge	Abnormal overvoltage or overcurrent applied momentarily to the electric circuit. → P.29
W	
Work distance	Distance from the laser light output position to the target workpiece for laser processing.

Output Schedule Data Entry Table

Screen	ITEM		SETTING RANGE	No. / UNIT	SCH (Enter No. optionally.)															
SCH 1	TEMP		050 - 600	°C																
	U		000 - 999 0.00 - 5.00	ms s																
	W1		000 - 999 0.00 - 5.00	ms s																
	S		000 - 999 0.00 - 5.00	ms s																
	W2		000 - 999 0.00 - 5.00	ms s																
	D		000 - 999 0.00 - 5.00	ms s																
	W1		00.75 - 11.50	A																
	W2		00.75 - 11.50	A																
SCH 2	LIMIT	+	00 - 99	%																
		-	00 - 99	%																
	EMISSIVITY		0.050 - 1.000																	
	SMOOTH		0 - 9																	

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