Laser Soldering Unit STAR GATE-E
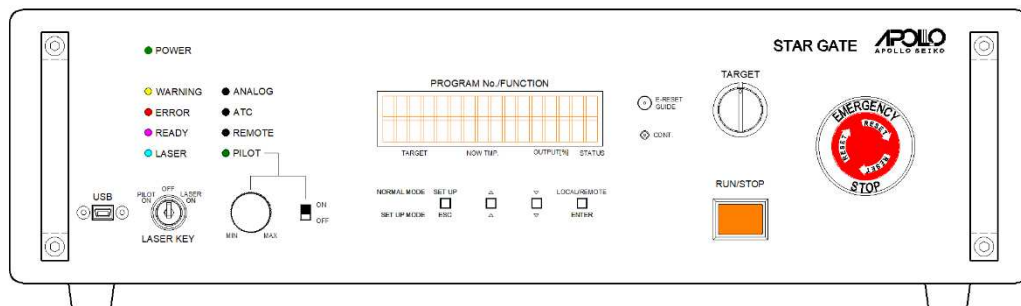
STG925-8020TNR-E（without temperature control）

STG925-8020TCR-E（with temperature control）

Instruction Manual

<Laser Controller>

Rev. 2.00

Apollo Seiko Ltd.

Index

1.   For Your Safety

This section describes the particularly important notes to ensure safety.

Use the device correctly according to the methods which are described in this manual.

If this device is used by a method which is not described in this manual, the protection which is provided by this device may be impaired.

1) Warning: Warning to prevent a risk of serious injury or death.

2) Caution: Caution to prevent the possibility of injury, unit breakdown, or handling which is the cause of the malfunction.

＊Be sure to follow the " Warning" and "Caution" in this manual to prevent an accident.

 Warning

1) **Do Not perform control and adjustment by procedures otherwise than the procedure in this manual.**

・It may cause danger laser exposure.

2) **Stop operations if anything unusual occurs, such as smoke, unusual noise, or smell.**

・Continuing to use the robot without addressing the problem causes electric shock, fire, or unit breakdown.

3) **Do Not put something heavy on the power cable or bring it close to the heating equipment**

・The power cable gets damaged and it causes fire or electric shock.

4) **Make sure to power the unit within its rated current range.**

・Failure to do so causes electric shocks, fires, or unit breakdown.

5) **Do Not give any damage to the fiber cable / Do not bend the cable excessively.**

・Optical fiber is glassware.

・Do not put something heavy on the fiber cable and do not bend the cable excessively.

・Do not stick any dirt or dust to the irradiating port of the fiber cable end. Do not give any damage to it.

・Be sure to remove the protective cap of the fiber end before irradiating the laser. If it is irradiated without removing the cap, the fiber and module get damaged.

6) **Do Not disassemble or modify.**

・When inspecting the internal, adjustment, or repair, contact us.

7) **Do Not put foreign matter inside of the device.**

・Do not insert or drop something such as a metal or flammable foreign matter

through the crack. It may cause electric shocks or fires.

8) **Do Not allow water to come in contact with the unit.**

・Do not use the device in the installation environment where water comes in contact with the unit.

9) **Set a beam terminator or attenuator when constructing laser system.**

・To protect from bodily radiation exposure by laser beam, set a beam terminator, attenuator or mechanical shutter in laser system.

⚠ Caution

1) **Do Not touch the device and power cable with wet hands.**

   ・It may cause electric shocks.

2) **Do Not remove/insert the cables in the ON state of the electric source.**

   ・There is a possibility that the internal circuit will be broken.

3) **Caution when connecting the power cable.**

   ・Be sure to connect the power cable properly to the AC plug which can supply enough electric power or switchboard with a power source blocking mechanism.

   ・Do Not connect the power cable in the method that it is difficult to remove it from the inlet in emergency.

   ・Make sure the device is grounded by a protective earth. Improper grounding causes an electric shock.

4) **Caution of installation place.**

   ・Do not put the device in a place where there is a lot of humidity, dust, oil Smoke, or steam.

   ・Use the unit in an environment that is not exposed to direct sunlight. Do not install it near heating equipment.

   ・Install the device so that the bottom face is directed downwards and use it in a horizontal position.

5) **Do Not put something heavy on the device.**

   ・It may cause injury by falling down the device.
     There is a possibility of breakdown due to the weight.

6) **Do Not drop or give impact the unit during transport and/or installation.**

   ・Because it is a piece of precision equipment, do not drop give an impact on the unit. It gives serious damage.

7) **Usage / Storage environment**

   ・Use the device within the range of "5-2. Setting / Storage / Operation Environment" under the proper usage/storage environment.

   ・Do not put the device vertically. Store it as the bottom face of the device is directed downwards.

8) **Caution while maintenance or when the device is not in use for long periods.**

   ・Be sure to unplug the power cable from the power outlet and cut off the power supply to secure safety.

   ・Wipe the device with a clean and soft cloth to eliminate dirt. In the case, the dirt is heavy, wipe off dirt with diluted neutral detergent or alcohol.

   ・Do not use thinner or benzene. It may cause discoloration or deformation.

2. Handling Precautions

2-1. Laser Safety Management

⚠	This machine is classified as a **CLASS 4 LASER**. ・There are risks of disorders if laser synchrotron radiation or scattered light exposure to your eyes or skin. ・Pay enough attention to safety management.
⚠	During laser irradiation, strong laser light is irradiated from a fiber end. ・Perform the safety measures that are described in IS C6802(2014). ・Put on laser protection glasses or use a laser shielding plate etc. that conforms to the laser output specification. 　　Adaptive wavelength　　　　915±15nm（near infrared light） 　　OD value（optical density）　5 or more recommended
⚠	Manage the area where are risks of laser exposure by setting up a safety guard etc. Only a responsible person can manage the area. Install a warning sign not to enter the area except for the person concerned.
⚠	Only a person who has enough knowledge and experience in handling the laser beam/laser system can be a laser safety manager.
⚠	The laser safety manager should manage the laser key of this device, inform the safety knowledge laser operators, and directs the work.

＊Refer to the following standards about the details of other laser management.

　IEC 60825-1: 2014

　"Safety of laser products – part1: Equipment classification and requirements"

Model name plate label

Laser warning label
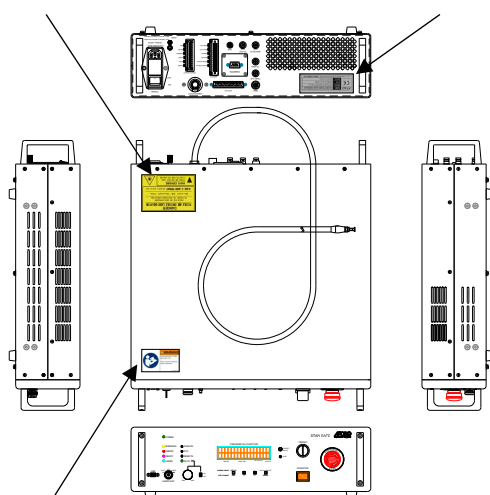
Device operation warning label

Figure2-1. Attachment position of warning label & manufacturing name plate

2-2． Daily Management

⚠	Wipe the device with a soft cloth or cloth containing a little water to eliminate dirt on the exterior. In the case, the dirt is heavy, wipe off dirt with diluted neutral detergent or alcohol. Do not use thinner or benzene. It may cause discoloration or deformation. If you wipe the surface strongly, the coating may be taken off or get damaged.
⚠	Do not put in a foreign matter such as a screw inside of the device. It becomes a cause of failure.
⚠	Press the switches or buttons carefully. Rough operation or operation by a tool or pen becomes a cause of failure or damage.
⚠	Operation of switch or button must be done individually. If plural switches or buttons are operated at the same time, it becomes a cause of failure or damage.
⚠	When turning off the power switch and turning on it again, take an interval time of more than 10 seconds.
⚠	Do not bend the optical fiber less than the minimum bending radius (R100) or give a strong shock to it. Because the optical fiber is made of glass, it will be broken.
⚠	Do not touch the end of the fiber directly or bring it into contact with something. It can be damaged easily. If the fiber got damaged, stop to use it immediately and contact us.
⚠	Use this device in a state where the bottom face of the device is directed downwards and in a horizontal state. Do not use, store or move it in a vertical state.

3. Before Using

Thank you for purchasing the STAR GATE-E.

The instruction manual consists of **<Laser Controller>** part (this manual) and **<Monitoring Software>** part.

＜Laser Controller＞ part explains the installation and operation method of the device, and the <Monitoring software> part describes the monitor display under the controlled condition, the various setting, and irradiation program editing method, etc.

Read these manuals thoroughly for proper use before you use the device.

After reading these manuals, store them in a safe place that can be easily accessed at any time by an operator.

3-1. Check

Before using the device, check that there is not any abnormality or damage caused by the transportation.

If there is any damage or it does not work according to the specifications, contact us.

3-2. Accessories

Check that all the following are there.

1) Delivery specification : PDF data in USB memory

2) Shipping inspection certification : PDF data in USB memory

3) Instruction manual <Laser controller> (this manual) : PDF data in USB memory

4) Instruction manual <Monitoring software> : PDF data in USB memory

5) Monitoring software "SGMonitor": in USB memory

[*1] 6) AC cable (AC125V/15A, 3m) ×1

7) Conversion plug from 3P to 2P for AC cable ×1

8) USB cable (A type－mini B type, 2m）×1 [ELECOM:U2C-MF20BK]

9）Laser switch key ×2

10) Fiber end protection cap ×1 (It is attached to the fiber end when shipping)

11）Glass tube fuse 10A/250V ×1 (It is inserted into the fuse holder when shipping)

12）Glass tube fuse 5A/250V ×1

(It is stored in the fuse holder / Fuse for exchange when using AC200V power source)

13）Connector cap (Those are attached when shipping)

AUX×1, D-SUB9×1, D-SUB37×1, Temperature sensor [TEMP]×1

14) D-SUB37 connector(female / socket)＋hood(M2.6mm screw) ×1

[OMRON: connector XM3D-3721/ hood XM2S-3711]

15) 12 pin pluggable terminal block ×1（Rear panel terminal block [STATUS-OUT] for attachment） [Phoenix Contact:1851339] (It is attached when shipping)

16) 14 pin pluggable terminal block ×1（Rear panel terminal block [SAFETY] for attachment） [Phoenix Contact:1851335] (It is attached when shipping)

17) Short jumper wire x4 (When shipping: 14 pin 1851355　It is attached to the connector)

LASER STOP (Blue), INTER LOCK (White), EMG1 (Red), EMG2 (Yellow)

[1] : When using AC200V, prepare an AC cable meeting the specification of the power supply side by customer.

For example, the following AC200V cables are available on the market.

・Model：EE-CESS-3 (5)　　10A,250V／Plug attachment side: cutting off／3m(5m)
・Model：BSP-E-BSSS-2　　10A,250V／Plug shape BS1363（BF TYPE）／2m
・Model：ASP-G-ASSS-2　　10A,250V／Plug shape O-3／2m
・Model：CEE3P-MS -3　　10A,250V／Plug shape CEE7(SE-TYPE)／3m

4. Product Summary

This equipment is a laser controller that uses an IR semiconductor laser and there are two models, "Standard model (TNR)" and "Temperature control model (TCR)".

"Temperature control model" measures a temperature of a laser irradiation point of processing objects and keep a temperature of an irradiation point at a fixed temperature, and it can automatically control the laser irradiation level.

When each device, such as a laser head, etc., is connected (refer to figure 4-1. Equipment configuration example), this device can be used in various fine processing such as soldering, welding, fusing, cutting, and so on.
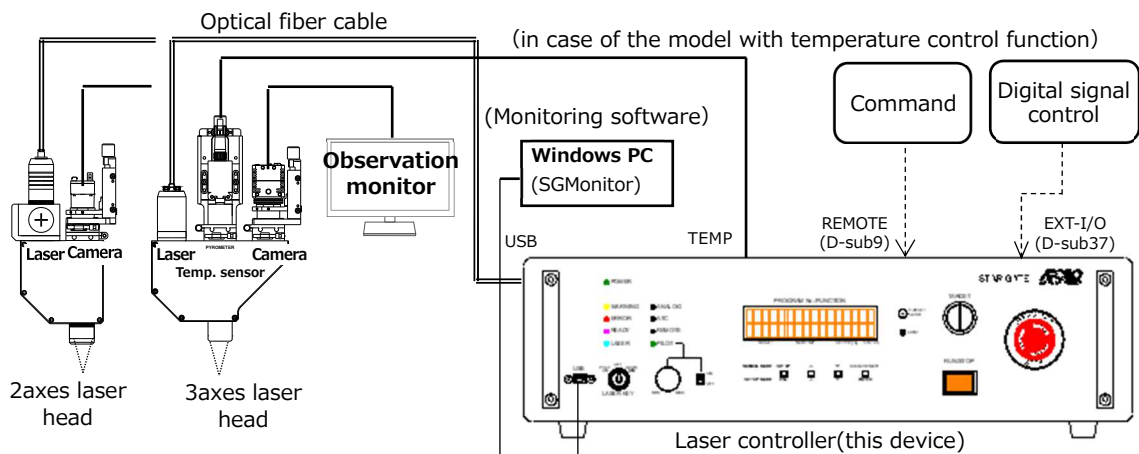
Figure 4-1. Equipment configuration example

There are two management methods for laser irradiation level, "output volume" control and "temperature" control. It is possible to switch when using.

【Output volume control】 ＊It specifies the laser output level when outputting.

・ Specify laser irradiation level between 0～100%(0.1% unit).

＊The display of LCD is 1% unit.

・ It can register 32 irradiation programs to this equipment.

【Temperature control】 ＊It controls the laser output level automatically.

・ It controls the laser irradiation level automatically to keep a target temperature by connecting an temperature sensor which is coaxially incorporated in the laser head to this equipment and measuring the temperature of the laser irradiation point of the processing target.
(In case of the model with temperature control:)

・ Specify the target temperature of the laser irradiation point of the processing target between 200～1800℃(0.1℃ unit).

・ It can register and edit 4 patterns of control parameters through the monitoring software.

・ 32 programs can be registered in this equipment.

The irradiation level of output amount control and temperature control can be specified by any of the following methods.

・Attached software：＜Monitoring software＞「SGMonitor」
・Front panel ：＜TARGET knob＞

・Rear panel　：＜REMOTE connector (D-sub9)＞ command
　　　　　　　　　＜BNC connector＞ analog signal

The irradiation start/stop can be performed by any of the following methods.
　・Front panel　：＜RUN/STOP switch＞
　・Rear panel　：＜REMOTE connector (D-sub9)＞ command
　　　　　　　　　＜EXT-I/O connector (D-sub37)＞ digital signal control

Any irradiation waveform or pattern can be created from the Windows PC screen which has been installed in the monitoring software.
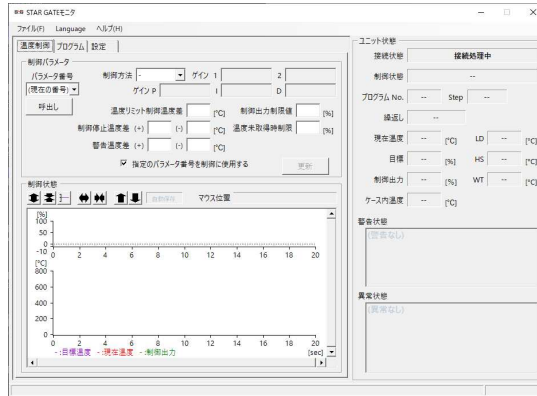
It can also save the created program and call the program from the front panel, REMOTE connector, or EXT-I/O and execute it.

5. Specifications

5-1. Standard Specification

Item	Specification	Remarks
Power source voltage	AC100V～120V ±10% AC200V～240V ±10%	Single-phase 50Hz or 60Hz
Power consumption	900VA or less	Apparent electric power
Power source fuse capacity	AC100V：10A AC200V： 5A	Φ5×20mm、Slow Blow
Insulation resistance	100MΩ or more	
LD cooling method	Compulsion air Peltier cooling method	Housing dispersion radiation structure
Temperature of housing surface	45℃ or less	Maximum output when continuous operation
Noise level	75dB or less	Main unit front surface 1m/ height 1.2-1.5m
Housing structure	Non-dustproof, Non-waterproof	A5052P, Coating
Dimensions	W448×D504×H132 (mm)	Including projection
Weight	Approx. 14kg	

5-2. Setting / Storage / Operation Environment

Item	Specification	Remarks
Location of Use	Indoor use only	
Pollution Degree	2	Office environment
Elevation	2,000m or less	
Operation temp.	+15℃ ～ +35℃	Non-dew condensation
Humidity	85%RH or less	Non-dew condensation
Storage temp.	0 ～ +60℃	Store horizontally to face the main unit bottom surface to the bottom

5-3．Laser Output Specification

Item	Specification	Remarks
Laser oscillation wavelength	915±15nm (Near infrared light)	
Output	0～80W	Fiber end
LD drive maximum electrical current	9～15A	
LD drive voltage	12～17V	When maximum output
Output fluctuation [100%output]	Within 1.0%	Measuring between 4min ~2h after started output
[50%output]	Within 1.0%	
[10%output]	Within 2.0%	
Variable output level	1% unit	
Output time width （minimum）	1mSec ±0.3mS	Time setting unit：1mSec
Others	Make sure that eyes and skins are not exposed to laser irradiation light from the fiber end.	

5-4．Pilot Light Output Specification

Item	Specification	Remarks
Pilot light wavelength	650±10nm (Visible light: red)	
Output	0～0.3mW	Fiber end Adjusting the light by PILOT knob

5-5．Laser Transmission Fiber Specification

Item	Specification	Remarks
Type	Multi-mode	
Core diameter	Φ105μm ／ Φ200μm ／ Others	Standard Specification ／ Depending on the selected model
Numerical aperture (NA)	0.22	
Maximum permissible exposure (MPE)	28.18 W/m^2	
Nominal ocular hazard distance (NOHD)	10 m	
Fiber cable length	3±0.3m／5±0.3m	depending on the selected model

Fiber end connector	SMA905	With protection cap
Fiber minimum bending radius	100mm	
Fiber external diameter (Protective covering diameter)	φ7～11mm	depending on the selected model

5-6．Control I/F Specification

Interface	Specification	Remarks
REMOTE I/F	RS232C: D-sub 9pin	Control by command telegram
EXT-I/O	Digital signal: D-sub 37pin	Control by digital signal
ANALOG IN	DC voltage: BNC	Control the laser irradiation level
PD-OUT	DC voltage: BNC	Monitor the laser irradiation level
Registerable number of control parameters	4	
Registerable number of control programs	32	

5-7．Dimensions

・Laser controller   W:448mm x D:504mm x H:132mm

L=3±0.3m
or 5±0.3m

R100≦

56
302
62

44
504
420
40

78
15   32
264
78

2x4-M5 x 深さL8max(対面同)

STAR GATE

132
120

36   376   36
448
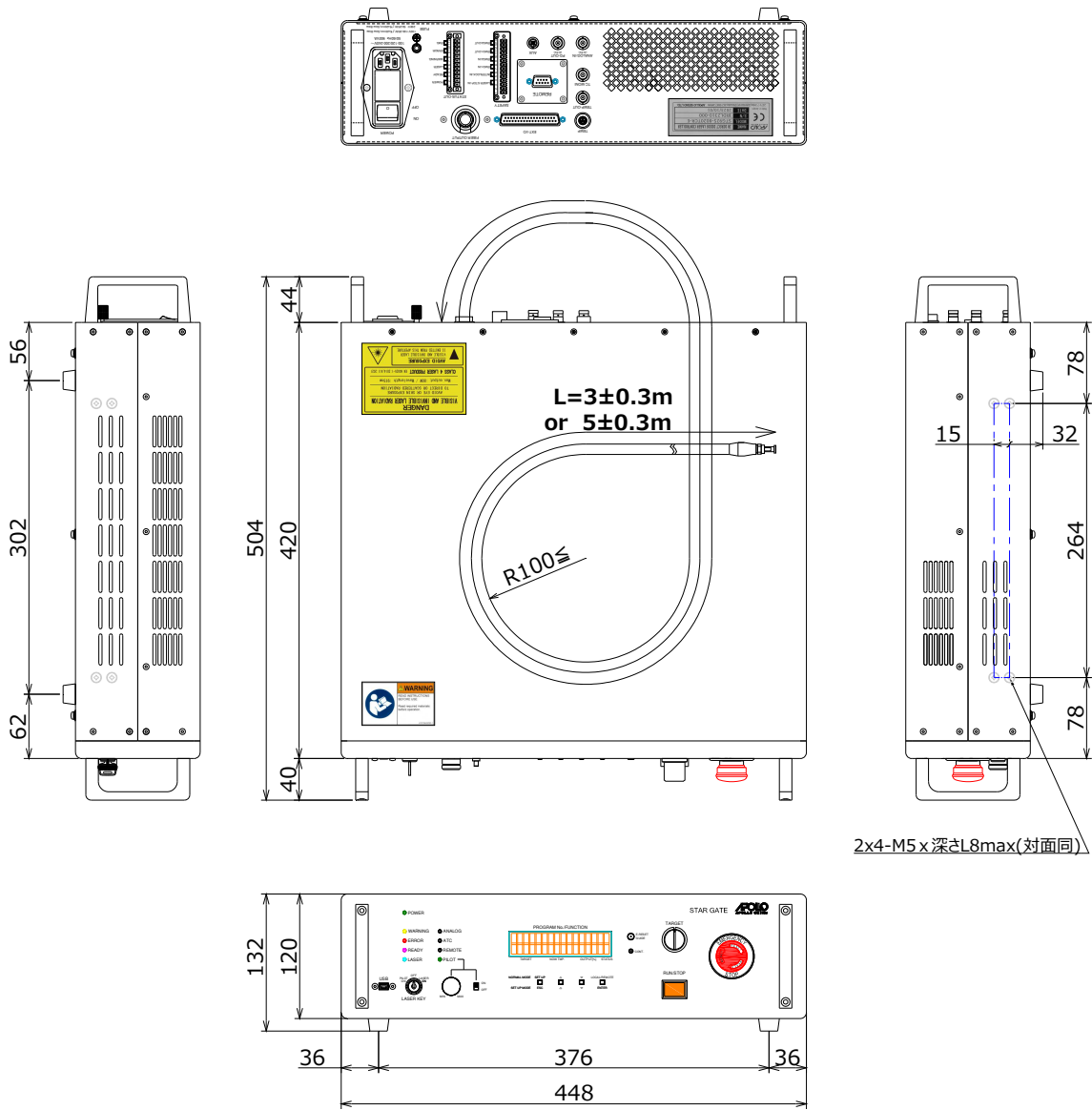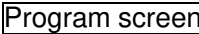
Figure 5-1. Dimensions of Laser Controller

5-8．Main Functions

1) Laser Irradiation waveform pattern program setting number

    ・Incorporated memory：32

    (program capacity which can be saved in this device memory)

    ・PC for control： It can store the program in any folder within the range of the memory

    capacity of the PC.

2) Laser Irradiation Control

    ・Control by the front panel：

    After selecting the function or program number by △ ▽ button on the front
    The panel starts or stops irradiation with the RUN/STOP button.
    It monitors the control states on the screen of the attached "Monitoring
    software".
    Connect the PC which installed "Monitoring software" to the USB on the front
    panel.

    ・Control by command telegram：

    It controls by command telegram from the remote equipment which connects
    to REMOTE the connector on the rear panel.

    ・Control by digital signal：

    It controls by a digital signal from the hand controller etc. which connects to
    the EXT-I/O connector (D-sub37) on the rear panel.

3) Setting of Laser Irradiation Output Level / Selection of Irradiation Pattern Program

    ・Set by the front panel：

    After registering the irradiation output level in steps of 0.1% or the target
    the temperature in steps of 0.1℃ from the Program screen by monitoring software,
    select the number by the button on the front panel and execute it.

    ・Set by command telegram：

    It sets program selection, laser irradiation output level, and target temperature
    by command telegram from the external equipment which connects to
    REMOTE connector on the rear panel.

    ・Set by digital signal：

    It sets the start/stop of the program which has been registered by monitoring
    the software beforehand by a digital signal from the hand equipment which
    connects to the EXT I/O connector on the rear panel.

    ・Set by analog signal：

    It inputs an analog voltage signal from the BNC connector on the rear panel
    and sets the irradiation output level or irradiation point target temperature.

        ＊ It can change the irradiation output level or irradiation point target
          temperature continuously by applying 0~5V to ANALOG-IN on the rear panel
          when the analog mode is available.

                                    （applied voltage resolution＝0.00244V）

        ・in output level: irradiation output level[%]＝applied voltage／5 (V)

         ・The voltage conversion value of the target temperature is specified
          by a setting value separately.

4) Waveform Creation of Laser Irradiation Output Pattern

・It can create the output waveform (program) by monitoring software. Refer to the instruction manual < monitoring software> for details.

5) LD Driving Current "Minimum (threshold current) / Maximum Current Value"

・It is set an optimal minimum / maximum current value for each LD individually when shipping to exhibit the maximum performance.

＊The set minimum (threshold) / maximum current value is described in the shipping inspection record.

⚠ It cannot change the LD module driving current by the customer.

6) LD Module Temperature Alarm

・It alarms when the temperature of the internal module increases and the LD module reaches 35℃.

・It sets when shipping not to damage the module for any contingency.

＊Alarm temperature:35℃

＊It stops laser irradiation when it reaches the alarm temperature.

・LD module temperature

＊When idling： Environmental temperature ～ around 25℃

＊When irradiation： Environmental temperature ～ around 28℃ (depending on irradiation level)

＊When maximum output continuous irradiation for a long time： It keeps 25±0.5℃ (after irradiation 90 sec.)

⚠ When it is above 30℃ for a long time, there is a possibility a malfunction of the cooling system occurs. Please contact us.

7) Monitor Function

・Laser irradiation output level monitor

＊It can check the output level while irradiation in BNC connector PD-OUT on the rear panel.
It converts the PD (photodiode) current value of the laser module into the voltage, amplifies the voltage, and outputs it from the BNC connector.

Voltage output example： （The output value of this equipment is described in the inspection report.）

- Irradiation output level   :
   0% → 0.00V（PD-OUT output value）

         100% → 5.00V（PD-OUT output value）

・Laser irradiation integration time monitor

＊It can check on the monitoring software. It can also check through REMOTE connector.

8) Temperature Control of Laser Irradiation Point

・It acquires the temperature information from the temperature sensor which is provided on the same axis with laser light and incorporated in the laser head and controls laser output. Then it keeps the irradiation point temperature of the processing object constant.

6. Description and Function

6-1. Front Panel
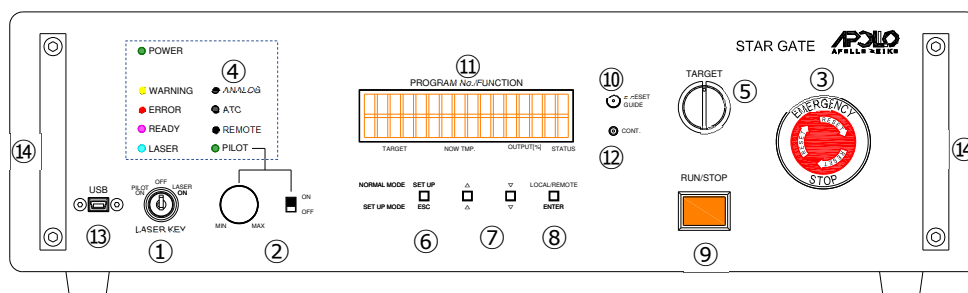
Figure 6-1. Description and function of the front panel

No.	Name	Function
①	LASER KEY (Switch key insertion port)	LASER ON： Laser / Pilot light irradiation is possible (when there are no INTERLOCK and errors) OFF： Laser / Pilot light irradiation is impossible **Turn off the laser excitation and stop laser irradiation.** PILOT ON：Pilot light irradiation is possible (when there are no errors)
②	PILOT VR （Adjusting knob）	MIN： Pilot light is minimum MAX： Pilot light is maximum
	PILOT ON / OFF （slide switch）	ON：④PILOT LED turns on （Light control can be performed by PILOT adjusting knob） OFF：④PILOT LED turns off
③	EMERGENCY STOP (press button)	PUSH： Emergency stop **It turns the power for laser driving off forcibly and stops laser irradiation.** PULL： Emergency stop releasing （Turn the press-button to the right） ＊Release the emergency button and turn the laser key off and on again to recovery
④	POWER （Yellow-green）	Lighting： Equipment power ON Lights-out： Equipment power OFF
	WARNING （Orange）	Lighting： Occurrence of warning (*Refer to 14-2. Warning list for details） Lights-out： No warning
	ERROR （Red）	Lighting： Error occurrence state (*Refer to 14-1. Error list for details） Lights-out： Normal operation (No error)
	READY （Pale orange）	Lighting： Laser output preparation completion Lights-out： Laser output is impossible
	LASER （Blue）	Lighting： Laser is outputting (during irradiation program operation) Lights-out： The laser is not outputting
	ANALOG （White）	Lighting： Analog input is enabled Lights-out： Analog input is disabled

No.	Name	Function
④	ATC (White)	Lighting ： Temperature control mode Lights-out ： Output amount control mode
	REMOTE (White)	Lighting ： Remote operation 　　　　　　(REMOTE / EXT-I/O connection) Lights-out ： Local operation
	PILOT (Green)	Lighting ： Pilot light is irradiating Lights-out ： Pilot light turns off
⑤	TARGET (knob)	It specifies the target temperature of the irradiation point when temperature control and specifies the laser output amount when output amount control.
⑥	SETUP ESC	Normal ： When pressing and holding it for 2 seconds in the standby state, it becomes the "Other setting" state.※1 When setting ： Return to the previous state
⑦	△ ▽	Normal ： It selects an executing function/program. When setting ： Change the setting item or setting value.
⑧	LOCAL/REMOTE ENTER	Normal ： It switches the control by this device and control by a remote device (external host). When setting ： Decide the setting item or setting value.
⑨	RUN/STOP	Normal ： It executes or stops a function that is selected by △▽ button. The button lights on while executing. When setting ： (It does not function) *The trigger of this button is when releasing the button after pressing it.
⑩	E-RESET GUIDE	Normal ： Temperature It turns the pilot light of the sensor ON / OFF. Pressing and holding in normal state ： It resets an error.※2 When setting ： (It does not function)
⑪	LCD monitor	(See the next page)
⑫	CONT.	Adjust the contrast of the LCD (Rotation to the left　MIN－MAX Rotation to the right)
⑬	USB connector	When it operates by monitor software, it connects an USB cable (Type A~mini B / 2m) between a PC that is installed with the monitor software and this device.
⑭	Front guard	*It can be removed.

※1：Refer to 13.2 Setting item list for details of "other setting".

※2：Refer to 14.1 Error list for details of errors.

※：" When setting" is the function while executing the above "Other setting".

⚠ It cannot select function and program(△▽ button operation) while controlling the remote device (external host).

1)　Display of LCD Monitor

⑪　LCD monitor is displayed as follows in normal condition.

Program No./Function

```
Temp. Control
 320   ℃    (LOW)
35.0R
```

　　　Target　　　　　　Now TMP.　　　　Output[%]
　Status
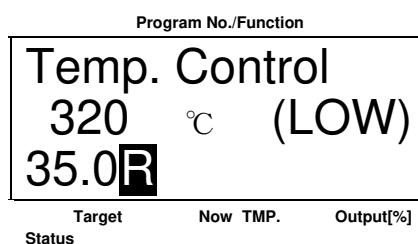
LCD monitor example

Display Position	Contents
Upper row	Control contents ・" **Temp. Control**" :　Temperature control ・" **Direct Output**" :　Output amount control ・" **TempCtrl by Ext.** " :　Temperature control 　　　　　　　　　　　　　　(External analog) ・" **DirctOut by Ext**" :　Output amount control 　　　　　　　　　　　　　(External analog) ・" **No.xx:yyyy** "　　　 : Program control 　(xx: program number yyyy: comment)
Left of the bottom row (Target)	Target temperature or output amount ・Temperature control：Temperature by knob[℃] ・Output amount control：　Output amount by knob[%] ・Program control：First target temperature[℃] 　　　　　　　　　　　　　or output amount[%] ・Remote control：Target temperature [℃] or output 　　　　　　　　　amount [%]　by an external remote 　　　　　　　　　device
Middle of bottom row (Now TMP.)	Temperature sensor measuring temperature ・"**(LOW)**" :　The measuring temperature is less than the lower limit ・"**(ERR)**" :　It detects an error in the　temperature sensor ・"---" :　The temperature sensor is not connected
Right of bottom row (Output[%])	Laser output command (% unit) 　(When it is not outputting, it displays "-----")
The right end of the bottom row (Status)	**R** :　While remote controlling 　　When using an external remote device (console which is connected with REMOTE, EXT-I/O)

When an abnormality occurs, it displays the error content, and the above content alternately.

Refer to 14. Error display for the error content.

2) Operation at the Front Panel

   The control operation at the front panel is performed by the following procedures.

① Irradiate the pilot light before laser irradiation to confirm the laser irradiation point as needed.

   Procedure of pilot light irradiation：

   ・Set LASER KEY switch to the position of PILOT ON

   ・Set PILOT adjusting knob to MIN and turn PILOT switch on.

   ・Adjust the pilot light by PILOT adjusting knob.

② Select the control content to be executed by using △ ▽ button and display it on the first row of the LCD.

Control	LCD monitor display (First row)
Program control	**No.xx:yyyy** 　　xx= program number 　　yyyy= comment of program
Temperature control	**Temp. Control**
Output amount control	**Direct Output**
Temperature control (External analog)	**TempCtrl by Ext.**
Output amount control (External analog)	**DirctOut by Ext.**

③ When temperature control or output amount control, adjust the target temperature or output amount control by TARGET knob on the front panel. (It displays on the second row of the LCD monitor)

④ After the preparation of laser irradiation is completed, set the LASER KEY switch to the position of LASER ON and press the RUN/STOP button on the front panel. Laser light is irradiated.

⑤ It can change the target temperature or output amount control by the TARGET adjusting knob while temperature control or output amount control. Change or adjust it as necessary.

⑥ When stopping the laser, press the RUN/STOP button again.

   *Press EMERGENCY STOP button in an emergency. Laser irradiation is stopped.

6-2． Rear Panel
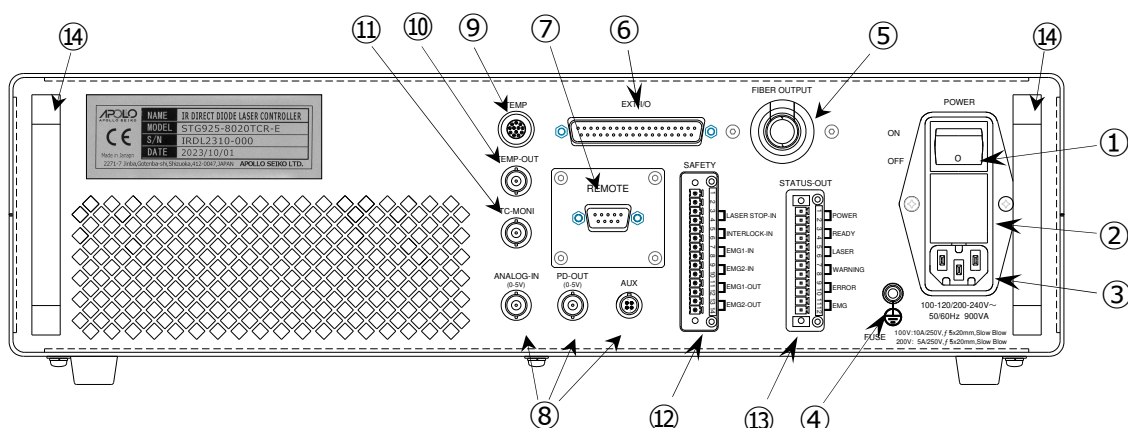
Figure 6-2. Description and function of the rear panel

No.	Name	Function etc.	Condition explanation／Remarks
①	Power Switch	Power ON/OFF ※1	I: Equipment power source ON O: Equipment power source OFF
②	Fuse Holder	Power fuse x 2 pcs.	Fuse outer shape:Φ5×20mm Fuse capacity 　　　　　:10A／AC100-120V input 　　　　　 5A／AC200-240V input Fusing characteristics 　　　　　: Slow Blow
③	Inlet	Inlet plug connection port	Single phase AC100-120V /AC200-240V
④	PE Terminal	The ground wire connecting terminal	Make sure ground it with a thick ground wire certainly.
⑤	FIBER OUTPUT	Optical fiber cable outlet	Fiber cable bending radius: 100mm or more
⑥	EXT-I/O	External operation device connection port （Digital signal control）	D-sub 37pin(male) Connector fitting fixing screw：M2.6mm screw
⑦	REMOTE	Remote device connection port （Command telegram control）	D-sub 9pin(male) Connector fitting fixing screw：#4-40 inch screw
⑧	ANALOG-IN	Temperature control by external analog ・Target of output amount control	0-5V linear voltage input※2

No.	Name	Function etc.	Condition explanation／Remarks
⑧	PD-OUT	Laser irradiation output level Monitor signal	0-5V voltage output (Output that PD was I-V converted) ＊The linearity and correlation accuracy is a guide.
	AUX	＊Not used	＊Not used
⑨	TEMP	Temperature sensor connecting port	
⑩	TEMP-OUT	Temperature sensor monitor output	0-5V voltage output (℃/mV when shipping)
⑪	TC-MONI	Temperature control monitor output	0-5V voltage output (0-100%)
⑫	SAFETY-IN	Plug-in terminal block_14 poles	Model：1829455_Phoenix Contact 14 poles terminal block plug：1851355 is attached （Pitch :3.81mm, 26-16 AWG)
	3-4p	LASER-STOP-IN ：Forced stop of laser irradiation	Short ： Normal operation possible Open ： Laser irradiation forced stopping **Laser excitation is turned OFF, laser irradiation is stopped.** ＊Short setting when shipping
	5-6p	INTER LOCK-IN ：Laser irradiation possible／ Stop	Short ： Laser irradiation possible Open ： Laser irradiation impossible **Laser excitation is turned OFF, laser irradiation is impossible.** ＊Short setting when shipping
	7-8p 9-10p	EMG1-IN EMG2-IN ：Emergency stop	Short ：Normal operation possible Open ：Operation impossible / Laser irradiation stop / Irradiation impossible **Laser driving power is turned off forcibly and laser irradiation is stopped.** ＊Short setting when shipping
	11-12p 13-14p	EMG1-OUT EMG2-OUT	Contact output when pressing emergency stop button on the front panel Short ： When normal operation Open ： When pressing emergency stop button
⑬	STATUS-OUT	Plug-in terminal block 12 poles	Model：1829439_Phoenix Contact 12 poles terminal block plug：1851339 is attached （Pitch:3.81mm, 26-16 AWG）
	1-2p	POWER	Device power source ON: Status output
	3-4p	READY	Laser irradiation is ready: Status output
	5-6p	LASER	During laser irradiation: Status output
	7-8p	WARNING	Warning is occurring: Status output
	9-10p	ERROR	Error is occurring: Status output

	11-12p	EMG	During emergency stop: Status output ＊It interlocks and outputs with the front panel emergency stop button and rear panel plug-in terminal block SAFETY-EMG1,2.
⑭	Rear Guard	Guard ・ knob	

⚠️

※1：When turning off the switch and turning on it again, make an interval of
10 seconds or more.

※2：The conversion of input voltage of ANALOG-IN and the target value is as follows:

・Output amount control：0-5V = 0 - 100%

・Temperature control：0-5V = Control minimum value – Control temperature
 （Refer to 13-2. about setting value）

※Caution： It will not stop output amount controlling only by making the application
 voltage of ANALOG-IN (BNC connector) 0V.
 ANALOG LED on the rear panel keeps lighting on.

6-3. Status Change Chart of Emergency Stop, RUN / STOP Button, Reset Operation and SAFETY, STATUS-OUT Terminal
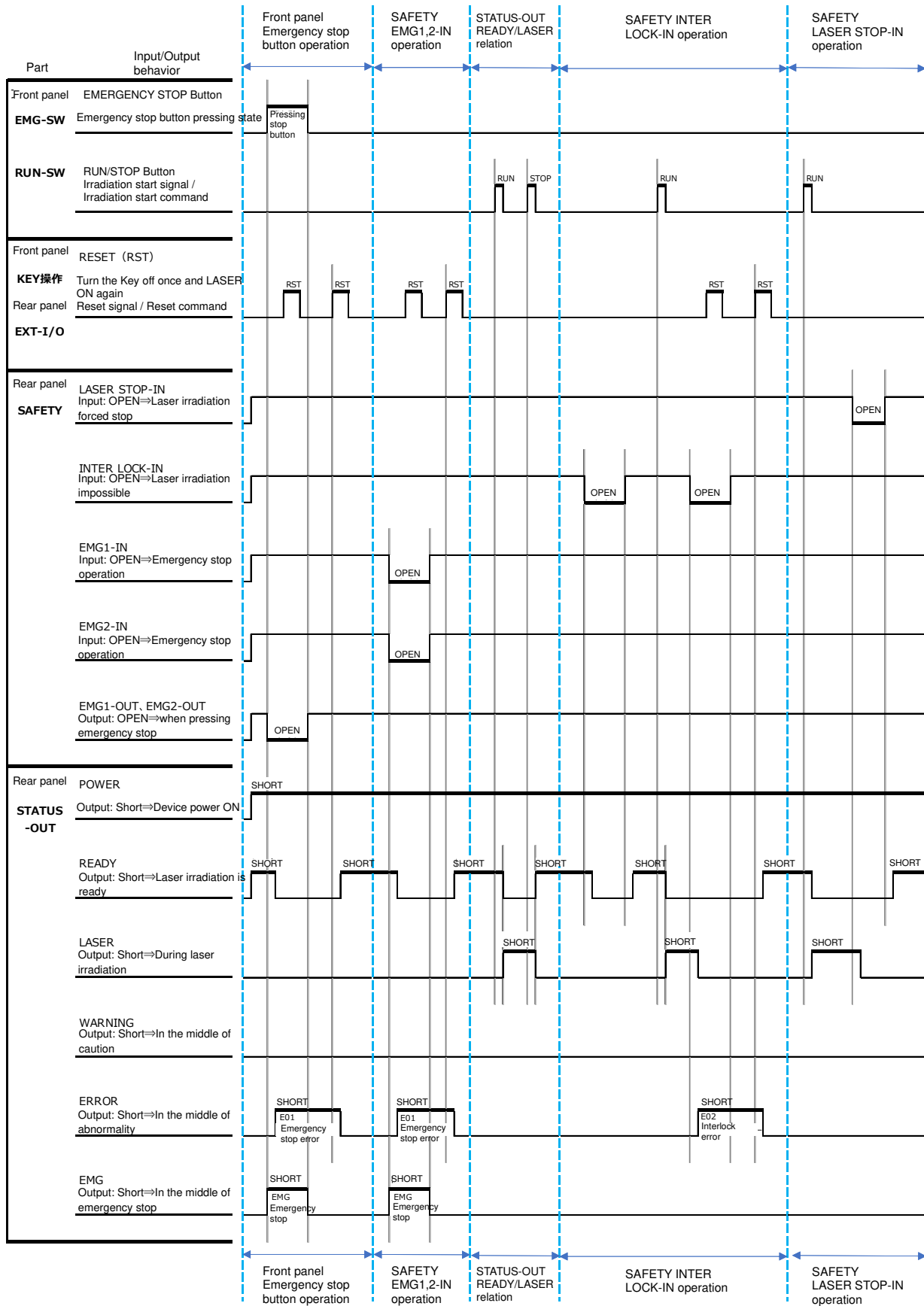
Chart Explanation

Relation of status changes of the front panel emergency stop button, RUN/STOP button, reset operation and SAFETY terminal and STATUS-OUT terminal.
It explains how the status of SAFETY terminal and STATUS-OUT terminal (short / open) will be when each operation.

【Front Panel Emergency Stop Button Operation】

Operation：Turning LASER KEY-SW to LASER ON → Irradiation is ready (READY)

Status Change：STATUS-OUT READY：Open → Short

Operation：Pressing emergency stop button → Error[E01] display

Status Change：SAFETY EMG1,2-OUT：Short → Open

Status Change：STATUS-OUT EMG   ：Open → Short

Status Change：STATUS-OUT ERROR：Open → Short

Operation：Return the emergency stop button to the original status → Error[01]（No change）

Status Change：SAFETY EMG1,2-OUT：Open → Short

Status Change：STATUS-OUT EMG   ：Short → Open

Operation：Reset → Error[01] release

Status Change：STATUS-OUT ERROR：Short → Open

【SAFETY EMG1,2-IN Operation】

Operation：Turning LASER KEY-SW to LASER ON → Irradiation is ready(READY)

Status Change：STATUS-OUT READY：Open → Short

Operation：SAFETY EMG1,2-IN Open → Error[01] display

Status Change：SAFETY EMG1,2-OUT：Short → Short（No change）

Status Change：STATUS-OUT EMG   ：Open → Short

Status Change：STATUS-OUT ERROR：Open → Short

Operation：Reset after SAFETY EMG1,2-IN is shorted → Error[01] release

Status Change：SAFETY EMG1,2-OUT：Short → Short（No change）

Status Change：STATUS-OUT EMG   ：Short → Open

Operation：Reset → Error[01] release

Status Change：STATUS-OUT ERROR：Short → Open

【STATSU-OUT READY/LASER の関係】

Operation：Turning LASER KEY-SW to LASER ON → Irradiation is ready

Status Change：STATUS-OUT READY：Open → Short

Operation：Pressing RUN/STOP button → Laser irradiation

Status Change：STATUS-OUT READY：Short → Open

Status Change：STATUS-OUT LASER：Open → Short

Operation：Pressing RUN/STOP button → Laser irradiation stop

Status Change：STATUS-OUT READY：Open → Short

Status Change：STATUS-OUT LASER：Short → Open

【SAFETY INTER LOCK-IN Operation】 ＊Irradiation is ready (READY status)

Operation：SAFTY INTER LOCK-IN Open

Status Change：STATUS-OUT READY： Short → Open

Operation：SAFTY INTER LOCK-IN Short

Status Change：STATUS-OUT READY： Open → Short

【SAFETY INTER LOCK-IN Operation】 ＊During laser irradiation

Operation：SAFTY INTER LOCK-IN Open → Laser irradiation stop Error[E02] display

Status Change：STATUS-OUT ERROR： Open → Short

Status Change：STATUS-OUT LASER： Open → Short

Status Change：STATUS-OUT READY： Open → Open (No change)

Operation：SAFTY INTER LOCK-IN Short → Laser stop continuation Error[E02] display continuation

Status Change：STATUS-OUT ERROR： Short → Short (No change)

Status Change：STATUS-OUT LASER： Open → Open (No change)

Status Change：STATUS-OUT READY： Open → Open (No change)

Operation：Reset → Error[02] release

Status Change：STATUS-OUT ERROR： Short → Open

Status Change：STATUS-OUT LASER： Open → Open (No change)

Status Change：STATUS-OUT READY： Open → Short (When LASER KEY is LASER ON)

【SAFETY LASER STOP-IN Operation】 ＊During laser irradiation

Operation：Pressing RUN/STOP button → Laser irradiation

Status Change：STATUS-OUT READY：Short → Open

Status Change：STATUS-OUT LASER：Open → Short

Operation：SAFTY LASER STOP-IN Open → Laser irradiation stop

Status Change：STATUS-OUT LASER： Short → Open

Status Change：STATUS-OUT READY： Open → Open (No change)

Operation：SAFTY LASER STOP-IN Short → Laser irradiation stop continuation

Status Change：STATUS-OUT LASER： Open → Open (No change)

Status Change：STATUS-OUT READY： Open → Short (Irradiation is ready）

7. Installation Specification

7-1. Intake & Exhaust Area / Insertion & Extraction of Power Cable
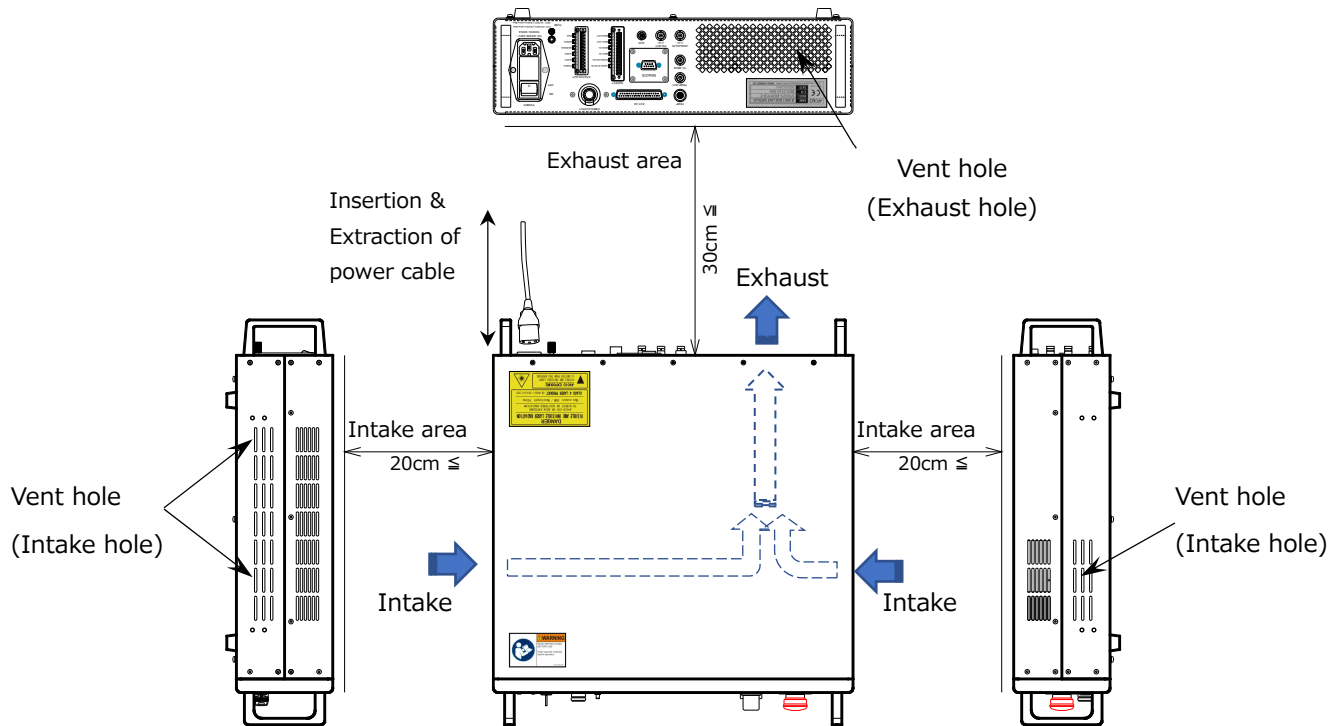
⚠ Caution

1) Do Not connect the power cable in the method that it is difficult to remove it from the inlet in emergency.

2) Do not put anything within 20cm from intake holes.

3) Do not prevent air flow. Especially, keep the space of 30cm or more from the exhaust area on the rear side. If the cooling power decreases, the internal part becomes high temperature and it causes damage.

4) Do not put anything which is lightweight such as paper which can stick easier around intake/exhaust holes. The cooling fan in the device rotates with a high speed and the intake / exhaust power may become stronger.

5) Do not insert or drop any metals or flammable foreign substances inside. It causes a fire or electric shock.

7-2. Cooling Method

1) This device radiates the heat of the laser driver exclusive power, control circuit, and laser module is radiated using the whole casing by forced air cooling (cooling fan) and housing dispersion radiation structure. The housing surface temperature increases especially when high output continuous operation, but it is not a malfunction.

2) The forced air-cooling Peltier method is adopted to cool the module, it realizes stable laser light output even if the state of high-output and continuous operation by reliable cooling and management of laser module temperature.

The laser module in this equipment generates heat when laser irradiation and becomes extremely hot.

The module temperature is cooling-controlled to keep stable output even in continuous high-output irradiation.

The Peltier element absorbs the module heating and move the heat to the heatsink forcibly. It controls the rotation of high-performance fans and the heat of the heatsink is exhausted from the equipment efficiently. When the laser irradiation output is low, it rotates at a low speed and when it starts up and the output is high, it rotates at a high speed. It monitors the heatsink temperature and controls the fan rotation.

7-3. Top Side / Bottom Side

Vent hole
(Intake hole)

Top side   Bottom side
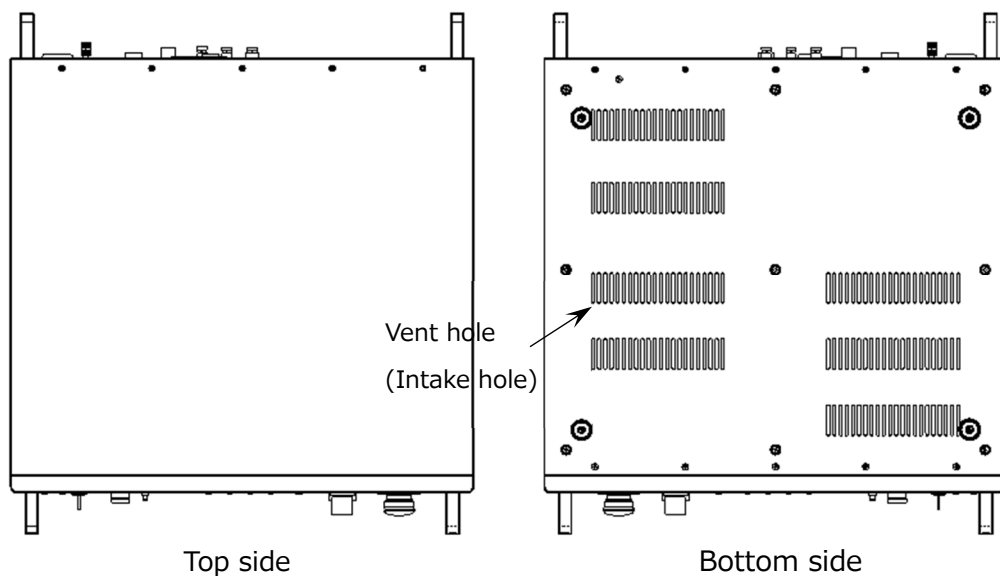
⚠ Caution

1) Do not put any something heavy weight or apply a load on the top side of the device (top side cover).

2) Be careful with the bottom surface which becomes high in temperature.

3) Do not block the air holes for cooling on the bottom cover.

4) Use the device without removing the rubber legs.

5) Because it causes a fire or electric shock, do not insert or drop any metals or flammable foreign substances inside.

8. AC Power Supply Specification

Single phase AC power supply：AC100V～120V±10%　or　AC200V～240V±10%
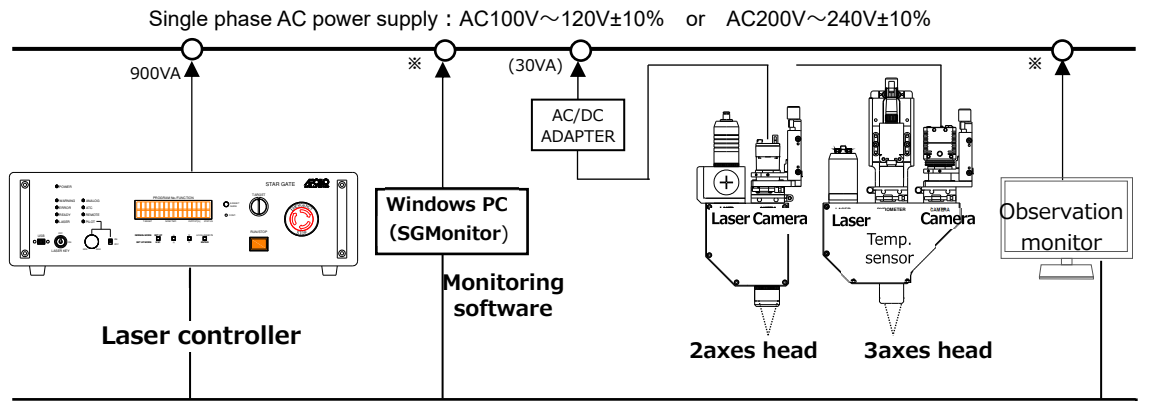
*Confirm the device specification about the power supply to Windows PC and observation monitor.

⚠ Caution

1) Connect PE terminal of this laser controller to ground certainly.

2) Make sure to connect the power cable to an AC outlet which can supply enough electricity or a wiring board which has power source blocking mechanism.

3) When using with AC200V, prepare an AC cable which suits to the connection specification of power supply side by customer.

4) When shipping, a fuse of 10A is mounted. When using with AC200V, replace it to a fuse of 5A.

Fuse capacity＿when connecting to AC100～120V：10A Slow Blow
when connecting to AC200～240V： 5A Slow Blow

9. Connection of External Device

9-1. Terminal Block for Safety Operation Control (SAFETY)

For safety use of the laser controller, connect the remote interlock switch, emergency stop switch and laser irradiation stop switch to the rear panel terminal block SAFETY-IN.

To operate safely and normally, **do not control interlock or emergency stop by signal from host device** which operates / controls this laser controller.
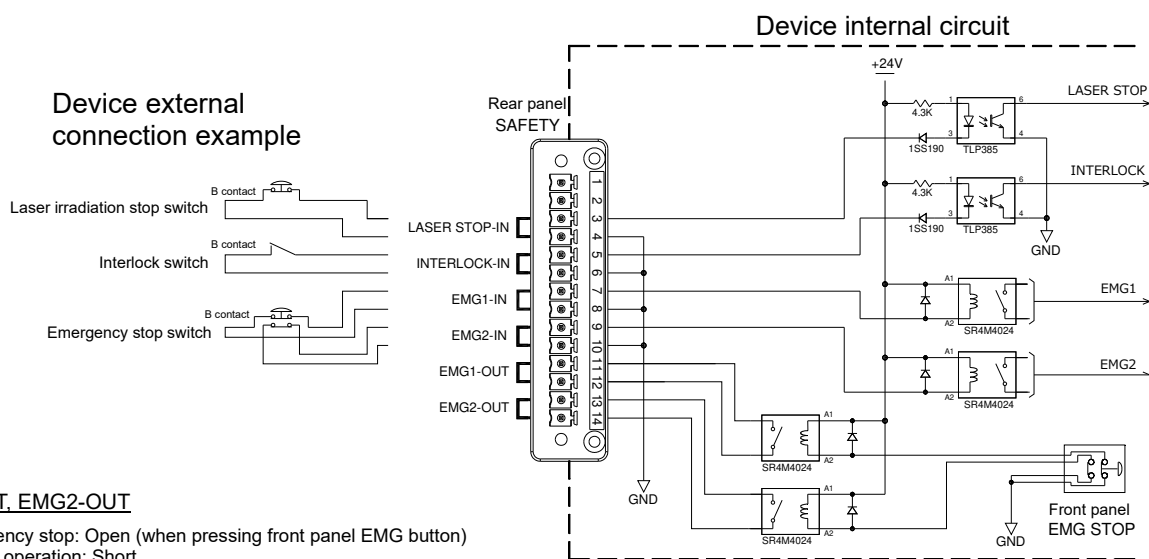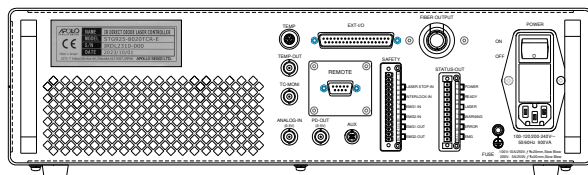
Device external connection example

Device internal circuit
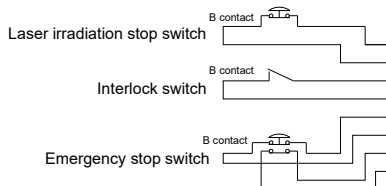
*EMG1-OUT, EMG2-OUT

When emergency stop: Open (when pressing front panel EMG button)
When normal operation: Short
Contact type: Relay contact / relay model number: SR4M4024(TE)
Contact specification: DC24V/2A (MAX)

*EMG1,2-IN and EMG1,2-OUT are not interlocked.

⚠ Caution

1) Do not operate interlock, emergency stop or laser irradiation stop by signal from a host device which operates / controls the laser controller. There is a possibility that it does not work normally.

2) Use mechanical contact switch alone.

3) Make ON resistance of connected switch 100Ω or less.

4) Make sure perform connection in the condition that the power of the device is turned OFF. Attach the protective cover of the terminal block, and then turn the power ON.

Remote switch	Laser irradiation stop switch	Interlock switch	External emergency stop switch
Connecting port	SAFETY 3,4 LASER STOP-IN	SAFETY 5,6 INTERLOCK-IN	SAFETY 7,8 / 9,10 EMG1-IN / EMG2-IN
Operation	・Short：Laser irradiation is possible ・Open：Laser irradiation stopping **Laser excitation is turned OFF and laser irradiation is stopped.**	・Short：Laser irradiation is possible ・Open：Laser irradiation stopping **Laser excitation is turned OFF and laser irradiation is stopped.**	・Short：Laser irradiation is possible ・Open：Laser irradiation stopping **Laser driving power is turned OFF forcibly and laser irradiation is stopped.**
Remarks	a) It is short-circuit connected via an accessory connector when shipping. b) Use the b contact (normal close) type switch which is to be connected.*		

*Contact us if it is necessary to perform control of interlock or emergency stop by signal from a host device.

9-2．Connection of Radiation Warning Device（STATUS-OUT）

Connect a radiation warning device such as revolving light.

Device internal circuit

STATUS-OUT
1829439_Phoenix Contact

TLP176AM contact specification
VDD: 48V(MAX)
Ion: 700mA(MAX)
RON: 2Ω(MAX)

TLP176AM photo relay contact output

Conduction = Device power on — POWER

Conduction = Irradiation is ready — READY

Conduction = During laser irradiating — LASER

Conduction = Warning is occurring — WARNING

Conduction = Error is occurring — ERROR

Conduction = During emergency stop — EMG

SR4M4024

STATUS-OUT
EMG output type：Relay contact（SR4M4024）
Contact specification：DC24V/2A（MAX）

＊When pressing front panel EMG button and output which is interlocked with EMG1,2-IN

⚠️ **Warning**

When the laser opening is set in the place 2 meter or more from this device, make sure to mount a radiation warning device to be able to see or hear it clearly from people who are near the laser opening.

9-3． Connection of PC for Monitor Software Control

*Use a USB cable Type A～mini-B(2m) which comes with this device.

①Connect the mini B side of the attached USB cable to the USB port on the front panel.

②Connect the USB-A side to the USB port of the PC which you prepared.
   (Device driver is not needed.)

③Install the monitor software "SGMonitor" from the attached USB media to the PC. Refer to "Instruction manual <Monitoring software>" about setting and operation.

Laser controller

Monitoring software
SGMonitor.exe
Install

Windows PC

Mini B-USB port

USB A－mini B cable（2m）
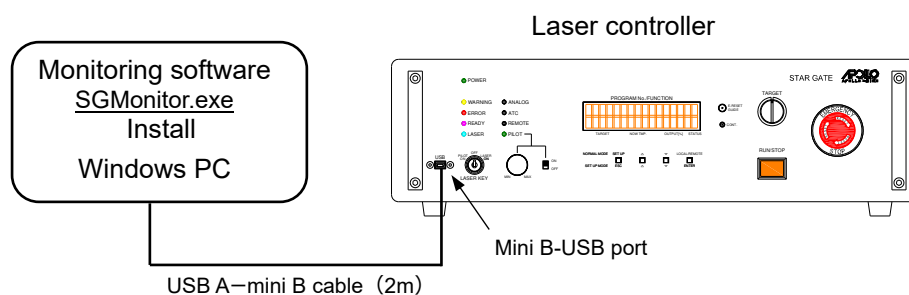
9-4． Connection of Remote Device

The following is the explanation of the connection example of REMOTE I/F.

① Connect a remote device and the REMOTE connector (RS-232C) on the rear panel by using a USB-RS232C conversion cable or RS-232C straight cable which is sold at a market.

＊When connecting directly by RS-232C straight cable, use a cable that is a shield type of good quality and shorter than 20m.

② Operate this equipment by command from the remote device.

＊Refer to "10. REMOTE Interface" about the operation commands.

*In the case of the model with temperature control

Fiber cable

Remote device
(Robot, equipment etc.)
(Command)

Monitor

Laser Temperature Camera
sensor

USB-RS232C conversion cable (straight type)
RS-232C cable (straight type) etc.

Single phase AC
power source
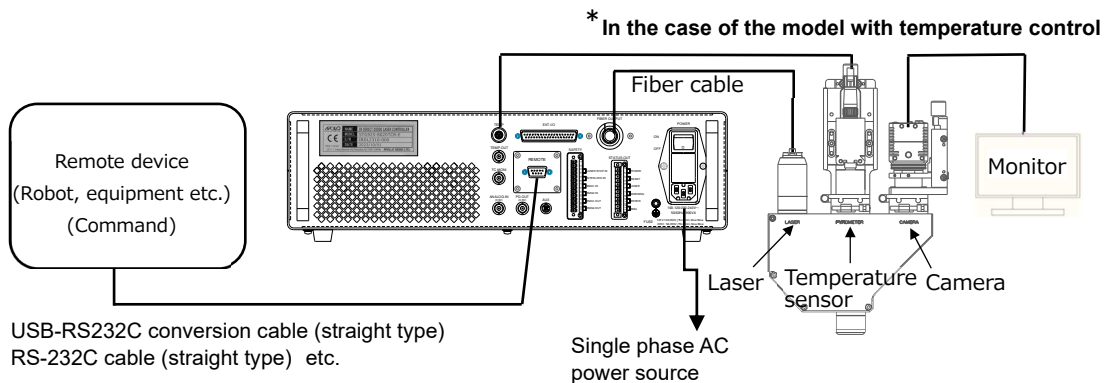
⚠ **Caution**

＊When using a USB-RS232C conversion cable which is sold at a market by
   extending it, use a USB active extension cable or an RS-232C extension
   cable which is sold at a market.

＊It has been confirmed that the following extension cables which are sold
   at a market work normally.

   ・USB active extension cable ： made by Sanwa "500-USB007" 20m
     extending

   ・RS-232C extension cable ： made by Sanwa "KRS-443FM4K" 4m×5=20m
     extending

＊Use a good quality cable when using an extension cable that is sold at
   a market.

9-5． Connection of External Control Equipment

①Connect between an external control equipment and EXT-I/O connector (D-sub 37pins)
   on the rear panel by using a good quality shield-type cable (shorter than 20m).

 ＊Refer to "11.EXT-I/O Interface" about the Interface specification of EXT-I/O.

D-sub 37pin straight cable

External control
equipment

Single phase
AC power source
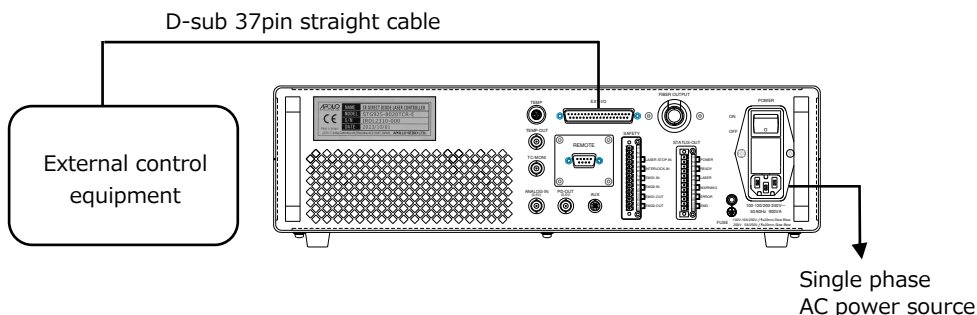
9-6． Specifying the Irradiation Output Level by Analog Voltage

①Connect the voltage generator and BNC connector ANALOG-IN on the rear panel by
   a coaxial cable.

Voltage generator
etc. (0～5V)

Coaxial cable
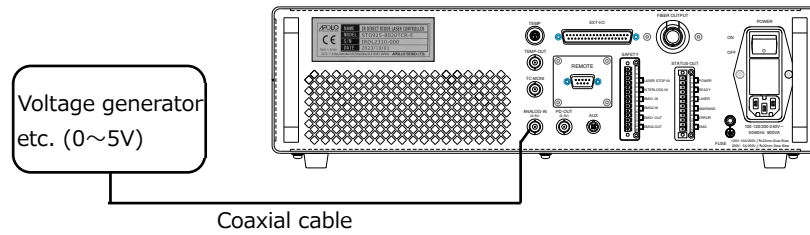
⚠ *Do not apply more than 5V to ANALOG-IN.
（Maximum standard value=7Vmax. If it exceeds this value, the internal circuit
will get damaged.）

9-7．Monitor of Irradiation Output Level (Confirmation)

①Connect the voltmeter for the monitor to the BNC connector PD-OUT on the rear
panel.
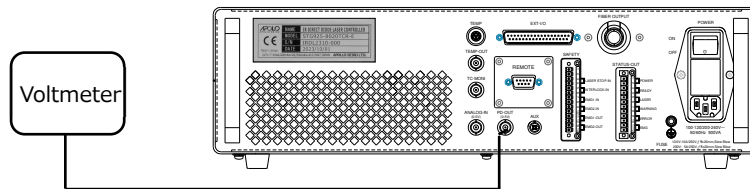
Voltmeter

Voltage output example： （The output value of this equipment is described in the
inspection record.）

Voltage output 0.00V → Irradiation output level 0%

5.00V → Irradiation output level 100%

⚠ * Because the correlation between the voltage value and irradiation level is not corrected,
it is just a guide. (It converts the voltage of PD electric current and outputs.)

10. REMOTE Interface (RS-232C)

10-1．Electric Specifications (RS-232C)

REMOTE connector (D-sub 9pins / male) on the rear panel conforms to RS-232C standard.

Connect the REMOTE connector and remote device by using RS232C straight cable which is sold at a market and perform command communication control.

10-2．Connector Pin Assignment (RS-232C)

Pin assignment of RS-232C I/F (D-sub 9pins / male)

Pin Number	Signal Name	in/out	Explanation
1	(NC)	−	
2	TxD	out	Transmission data
3	RxD	in	Received data
4		−	Connecting to 6-pin internally
5	GND	−	
6		−	Connecting to 4-pin internally
7		−	Connecting to 8-pin internally
8		−	Connecting to 7-pin internally
9	(NC)	−	

⚠ Caution

※4 - 6 (DSR-DTR) and 7 - 8 (CTS-RTS) are connected internally.

※2 and 3 are reversed to the standard because this equipment is connected as DCE equipment (equivalent to modem).

10-3．Communication Specifications

Communication condition (RS-232C)：

Communication speed=38,400bps, Data bit＝8, Stop bit=1, Parity=None, Flow control=None

Command telegram (Reception)：

Command string (ASCII)	Terminating string (LF=0x0a)

Response telegram (Transmission)：

Response string (ASCII)	Terminating string (CR=0x0d)+(LF=0x0a)

10-4． Communication Telegram Format

Content	Command telegram	Response telegram
Temperature sensor guide light ON	**P1**(LF)	Normal ： **A** (CR)(LF) Error ： **N** (CR)(LF)
Temperature sensor guide light OFF	**P0**(LF)	Normal ： **A**(CR)(LF) Error ： **N** (CR)(LF)
Parameter number setting ※1	**Cx**(LF) **x:** Parameter number [1-4]	Normal ： **A**(CR)(LF) Error ： **N** (CR)(LF)
Parameter number inquiry ※1	**CQ**(LF)	Normal ： **Cx**(CR)(LF) **x**: Parameter number[1-4] Error ： **N**(CR)(LF)
Output amount control setting / start	**Oxxx,yyy**(LF) **Oxxx**(LF) **xxx**: Output amount specifying [0.1%] **yyy**: Shift time [0.1sec] (Default 0sec)	Normal ： **A**(CR)(LF) Error ： **N**(CR)(LF) After finishing shift time ： **Rx** **x**: Number of setting [1-]
Temperature control Setting / start	**Txxx,yyy, zzz**(LF) **Txxx**(LF) **Txxx,yyy**(LF) **Txxx,,zzz**(LF) **xxx**: Temperature specifying[0.1℃] **yyy**: Shift time from previous temperature [0.1sec] (Default 0.5sec) **zzz**: Arrival determination temperature [0.1℃] (Default 20℃)	Normal ： **A**(CR)(LF) Error ： **N**(CR)(LF) When it reaches the specified temperature range during holding control after finishing shift time ： **Rx** **x**: Number of setting [1-]
External input control start	**Ux**(LF) **x:0=**Output amount control **0-5V=**0-100% **x:1=**Temperature control **0-5V**→control range Minimum temperature – Maximum temperature	Normal ： **A**(CR)(LF) Error ： **N**(CR)(LF)
Program control start	**Wxx(LF)** **xx: Program number [1-32]**	Normal start ： **A**(CR)(LF) Normal end ： **A**(CR)(LF) Error ： **N**(CR)(LF) When it reaches the specified temperature range during holding control after finishing shift time ： **Rx** **x**: Step number[1-50]

Content	Command telegram	Response telegram
Output amount limit stop Temperature control stop Program control stop	**Z**(LF)	Normal　　**:** **A**(CR)(LF) Error　　　**:** **N**(CR)(LF)
Program number inquiry	**WQ**(LF)	Normal　　**:** **Wxx**(CR)(LF) 　　　**xx**: Program number 　　　　　[1-32] Error **:** **N**(CR)(LF)
Condition inquiry	**SQ**(LF)	Controllable **:** **R**(CR)(LF) While controlling **:** **I**(CR)(LF) Key-SW OFF: **K**(CR)(LF) Error occurrence: **E**(CR)(LF) Maintenance **:** **M**(CR)(LF) Error **:** **N**(CR)(LF) Local state **:** **L**(CR)(LF) Interlock stop : **T**(CR)(LF) LASER STOP signal : **S**(CR)(LF)[※2]
Output amount inquiry	**OQ**(LF)	Normal　　**:** **O**xxx(CR)(LF) 　**xxx**: Output amount [0.1%] Error **:** **N**(CR)(LF)
Target temperature inquiry	**TQ**(LF)	Normal　　**:** **Txxx**(CR)(LF) 　　　**xxx**: Target temperature 　　　　　[0.1℃] Error **:** **N**(CR)(LF)
Error content inquiry	**EQ**(LF)	Normal　　**:** **Eyyyy**(CR)(LF) **yyyy**: Error content[※2][※3]
Error reset	**ER**(LF)	Normal　　**:** **A**(CR)(LF) Error　　　**:** **N**(CR)(LF) [※5]
Laser irradiation integrating time inquiry	**LQ(LF)**	Normal　　**:** **LQxxx**(CR)(LF) **xxx**: Irradiation integrating 　　　time[sec] Error　　　**:** **N**(CR)(LF)
Model name and version inquiry	**VQ(LF)**	Normal　　**:** **STAR GATE xxx**(CR)(LF) 　　　**xxx**: Version string Error　　　**:** **N**(CR)(LF)

※1 **:** When setting the parameter number while temperature controlling or program controlling, it becomes valid next when temperature control or program control is executed. The response to the inquiry becomes the number that is set last.

※2 **:** Between LASER STOP terminal block of "SAFETY-IN" terminal block on the rear panel is opened.

※3：An error content corresponds to low-order 24 bits of the maximum 8-digit hex

value of OR of bit for each item. Refer to 14-1 about the bit value of error for

each item.

（e.g.：When detecting an error at emergency stop button detection of this

equipment and LD power source： **E 1 1**(CR)(LF))

※4：An error content includes a warning state. An error content corresponds to high-order 7

bits. Refer to 14-2 about the bit value of the warning for each item.

（e.g.：When LD life time warning occurs：**E400 0000**(CR)(LF))

※5：It also becomes an error response when it detects emergency stop switch was pressed

or detects interlock.

10-5．Confirmation of Communication Port Channel (D-sub 9pin)

【When communicating by connecting the WINDOWS-PC and prepared USB-RS232C

conversion cable】

Use a USB-RS232C conversion cable of the "**Straight**" type. It cannot communicate by

Cross-type.

After connecting the conversion cable to the using PC, it needs to confirm

The communication port number (COM) and perform the communication software

setting that was installed on the using PC. (COM port/baud rate/parity etc.)

To confirm the communication port number (COM), confirm "Port (COM & LPT)" from the device

manager of the PC.

e.g.："Prolific USB-to-Serial Comm Port(COM3)"

The above example represents communication port 3 (COM3).

Recognize this number to the using software.

※When connecting the prepared USB-RS232C conversion cable to the PC, Windows

standard driver will be installed automatically. When it did not install or some

malfunction of the driver occurred, download the driver from the driver disc (CD, etc.)

which is attached to the cable or website of the cable maker, and install it again.

10-6．Communication Cable （RS-232C）

＊When using a USB-RS232C conversion cable by extending, use a USB active extension

cable or RS-232C extension cable which is sold at a market.

＊It has been confirmed that the following extension cables which are sold at a market

work normally.

・USB active extension cable： made by Sanwa "500-USB007" 20m extending

・RS-232C extension cable： made by Sanwa "KRS-443FM4K" 4m×5=20m extending

＊Use a good quality cable when using an extension cable that is sold at a market.

＊When connecting this equipment and host equipment (RS-232C direct connection), use a straight cable.

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11. EXT-I/O Interface

11-1. Pin Assignment, Electric Specifications

Connect the EXT-I/O on the rear panel and an external control equipment, perform the setting of the irradiation program number to be executed, and control to start/stop laser irradiation, etc.

⚠ ＊EXT-I/O INPUT is the control input of "irradiation program No.1~32". There is no correlation with "Direct Output" or "Temp. Control" by operating on the front panel.
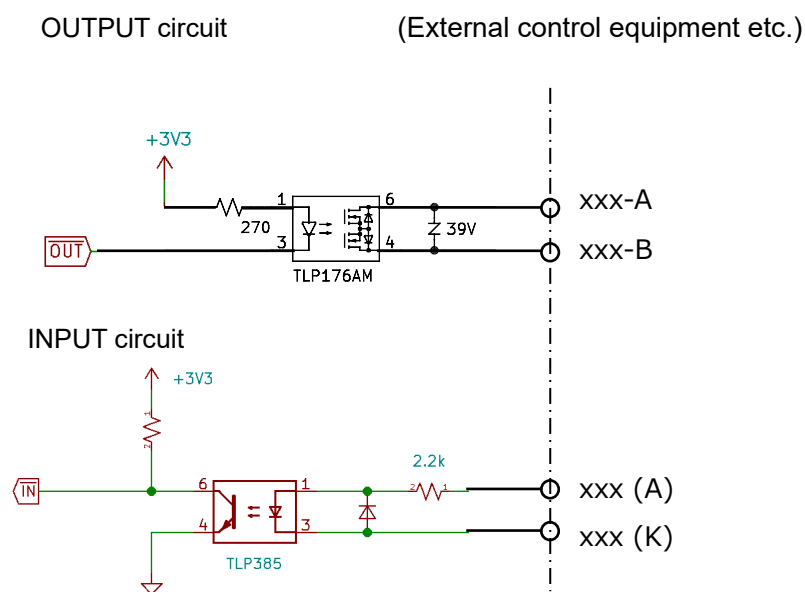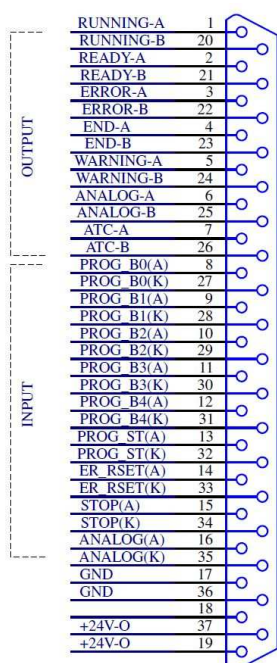
＊Input signal must be signal without chattering.

Main rating of input / output circuit element

TLP176AM（photo relay）

Item	Mark	Min.	Standard	Max.	Unit	Measurement condition
Usage voltage	V_{DD}	—	—	48	V	
On electrical current	I_{ON}	—	—	700	mA	
On resistance	R_{ON}	—	0.15	2	Ω	$I_{ON}=700mA$

TLP385 （infrared LED＋phototransistor）

Item	Mark	Min.	Standard	Max.	Unit	Measurement condition
Input order electrical current	I_F			50*	mA	*Absolute max. rating
Input order voltage	V_F	1.1	1.25	1.4	V	$I_F=10mA$
Input reverse Electrical current	I_R	—	—	5	μA	$V_R=5V$

＜Connection example of external control equipment＞

－OUTPUT circuit－

1

6

+24V

3

4

TLP176AM

2.2kΩ,
1/2w

≒10mA

0V

－INPUT circuit－

+24V

2.2kΩ

TLP385

Input

※When a mechanical
switch is connected,
take measures against
electric noise.

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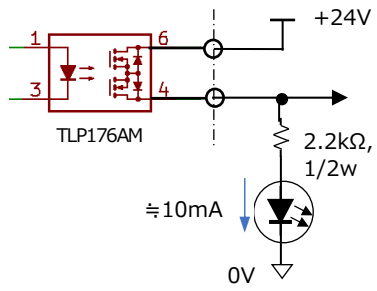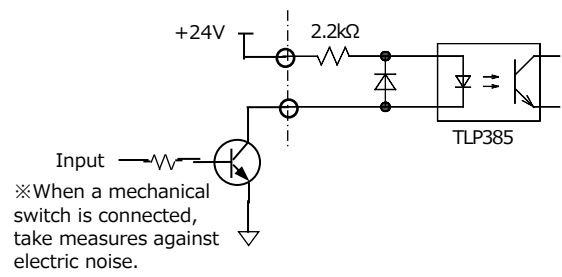
EXT- I/O Pin Number Assignment

Pin No.		Signal name	IN/OUT	Function	Active ON states
1		RUNNING-A	OUTPUT	During program operation (During irradiation output)	ON between A-B (Conductive state)
	20	〃 -B			
2		READY -A	OUTPUT	Program execution preparation is ready	Same as above
	21	〃 -B			
3		ERROR-A	OUTPUT	Error occurred	Same as above
	22	〃 -B			
4		END -A	OUTPUT	Program operation has been completed	Same as above
	23	〃 -B			
5		WARNING -A	OUTPUT	Warning occurred	Same as above
	24	〃 -B			
6		ANALOG -A	OUTPUT	Analog input mode	Same as above
	25	〃 -B			
7		ATC -A	OUTPUT	(Reserve)	Same as above
	26	〃 -B			
8		PROG_B0 (A)	INPUT	Program № bit0 (LSB)	A-K energization
	27	〃 (K)			
9		PROG_B1 (A)	INPUT	Program № bit1	Same as above
	28	〃 (K)			
10		PROG_B2 (A)	INPUT	Program № bit2	Same as above
	29	〃 (K)			
11		PROG_B3 (A)	INPUT	Program № bit3	Same as above
	30	〃 (K)			
12		PROG_B4 (A)	INPUT	Program № bit4 (MSB)	Same as above
	31	〃 (K)			
13		PROG_ST (A)	INPUT	Program start	Same as above
	32	〃 (K)			
14		ER_RSET (A)	INPUT	Error reset	Same as above
	33	〃 (K)			
15		STOP (A)	INPUT	Program stop	Same as above
	34	〃 (K)			
16		ANALOG (A)	INPUT	Analog input mode switching	Same as above
	35	〃 (K)			
17		GND	------	GND for DC24V	
	36	GND			
18		－ －		－ － Not used(NC)	
	37	+24V-O	OUTPUT	DC 24V	500mA (max)
19		+24V-O			

11-2. How to Set the Irradiation Program to be Executed

Select one of the irradiation program No.1~32 that created by "monitoring software" with 5-bit combination of "PROG_B4~B0" of EXT I/O (D-sub37) connector.

Irradiation program №. \ Signal name	PROG B4	PROG B3	PROG B2	PROG B1	PROG B0
1					
2					●
3				●	
4				●	●
5			●		
6			●		●
7			●	●	
8			●	●	●
⋮	⋮	⋮	⋮	⋮	⋮
25	●	●			
26	●	●			●
27	●	●		●	
28	●	●		●	●
29	●	●	●		
30	●	●	●		●
31	●	●	●	●	
32	●	●	●	●	●

＊「●」shows ON state (energization state) between A (anode) ~ K(cathode) of "IN (input) circuit".

11-3. EXT-I/O Program Control Timing Specification
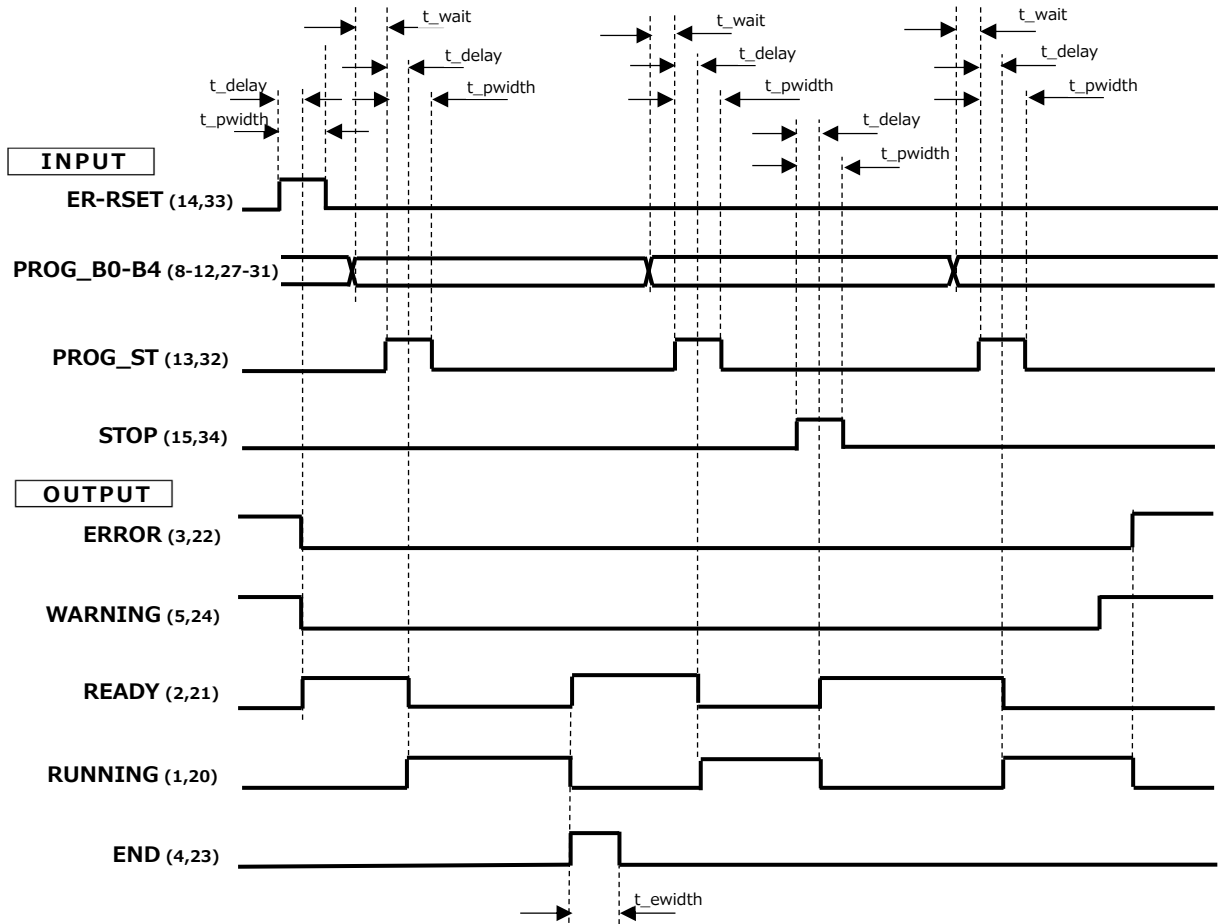
Name	Contents	Minimum	Maximum
t_pwidth	Input signal pulse width	5msec	-
t_wait	Wait time from program number change until start	2msec	-
t_delay	Delay from input pulse rising until operation reflection	-	5msec
t_ewidth	END signal pulse width	1sec	1sec

11-4．Operation Method by EXT-I/O

・If ERROR signal is ON when program starts, E-RESET signal turns ON for 5msec or more. When an error is solved, READY signal becomes ON.

・Specify a program number to be executed by PROG_B0~4 signal. Wait 5msec or more until recognition by this device after setting this signal.

・When turning START signal ON for 5msec or more while READY signal is ON, the program that was specified number by PROG_B0~4 starts and RUN signal becomes ON. When the program has finished normally, RUN signal becomes OFF and END signal becomes ON for a second.

・When a program does not start even if START signal becomes ON due to abnormality of program date etc., RUN signal does not become ON, it continues OFF, READY signal becomes OFF and ERROR signal becomes ON. In this case, END signal does not become ON.

・When STOP signal becomes ON for 5msec or more during execution of the program, the program is interrupted, RUN signal becomes OFF and READY signal becomes ON. In this case, END signal and ERROR signal does not become ON.

・When a warning occurred in this device (refer to 14-2.), WARNING signal becomes ON. It does not affect execution of the program.

・When an error occurred in this device (refer to 14-1.), if it is during execution of a program, it is interrupted, ERROR signal becomes ON, RUN signal and READY signal become OFF. When the program was interrupted, END signal does not become ON.

⚠ Caution

EXT-I/O controls the irradiation program 1~32 was programed by monitoring software. In operation on the front panel, **when START signal becomes ON from EXT-I/O in the state that display of the LCD is "Direct Output" or "Temp.Control", the set irradiation program starts. Be careful because it starts irradiation** according to the content of the set program.

12. Irradiation Thermometer Interface

It can execute temperature control by connecting the temperature sensor to the interface for temperature control on the rear panel (the below drawing).

(*This function applies in the model "TCR-type" with temperature control.)
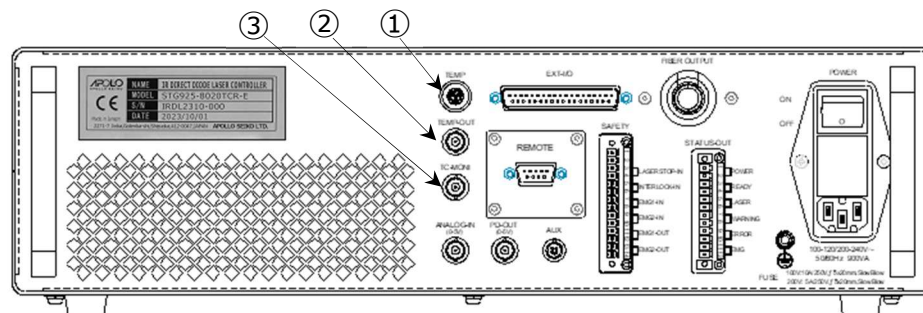
12-1. Temperature Sensor Connection Connector（TEMP）

(1) Connector Specification

① TEMP connector

LF10WBR-12S_HIROSE

Cable side connector

F10WBP-12P(31)

(2) Assignment of Pin Number

Pin №	Signal Name	IN/OUT	Function
1	DC+5V	OUT	Temperature sensor power（＋ side）
2	TxD	IN	RS232C reception data
3	DC GND	–	Power GND（－ side）
4	RxD	OUT	RS232C transmission data
5	Temp_GUIDE	OUT	Sighting lamp lighting
6	Temp AD	IN	Measuring temperature（Analog data）
7	Analog GND-1	–	GND for analog output
8	Analog GND-2	–	GND for analog output
9	(NC)		
10	(NC)		
11	(NC)		
12	(NC)		

⚠ **Caution**

※ When temperature control is executed in the state that the temperature sensor is not connected, "Temperature sensor error" occurs.

※ Use the temperature sensor and connecting cable which are specified by us. Contact us for details.

12-2． Temperature Sensor Monitor Output（TEMP-OUT）

(1) Connector specification

② BNC connector
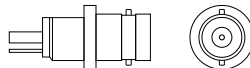
(2) Signal specification

Function　Temperature sensor monitor output

Specification　　0-5V

➢ It is possible to set voltage conversion factor. Refer to 13-2.

12-3． Temperature Control Monitor Output（TC-MONI）

(1) Connector specification

③ BNC connector
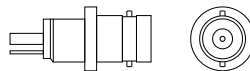
(2) Signal specification

Function　Temperature control monitor output

Specification　　0-5V

➢ The control amount of temperature control 0-100% is 0-5V (When control amount is 50%, it is 2.5V output). When output amount control, it outputs in the same way.

13. Operation Setting Value

13-1．Setting Method on the Front Panel

Follow the below procedures to edit the setting value on the front panel.

1. Press "**SET UP**" button② for 2 seconds. "**Min.Target Temp.**" is displayed in the first line of LCD① with blinking cursor, and the present setting value (200℃ etc.) in the second line.

2. Select the setting item by "△" "▽" button③. Press "**ESC**" button② to finish or stop editing operation. The original screen is displayed.

3. After item name to be set is displayed, press "**ENTER**" button④. When it is editable setting item, cursor blinking display moves to the setting value in the second line.

4. Change the value by "△" "▽" button③. Press "**ESC**" button② to stop. It returns to the item select state (1.).

5. Press "**ENTER**" button④ once the value is decided. The setting value is saved in this device and LCD monitor display returns to the item select state (1.).

Figure 13-1. Front panel LCD monitor and Operation Button

13-2. Setting Item List

There are following setting items.

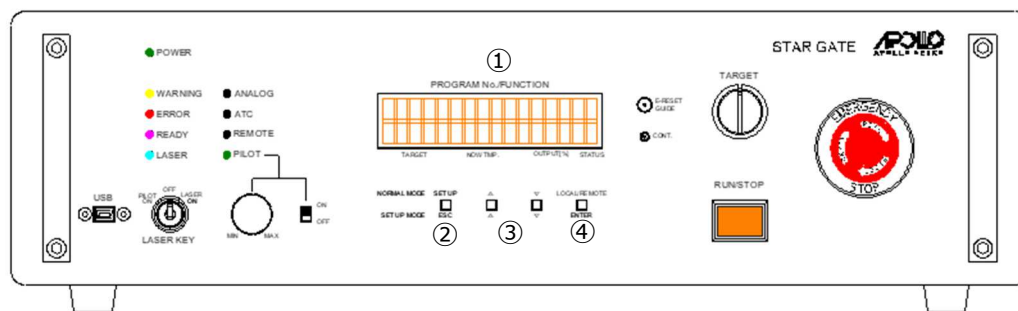| ① **LCD Display** - Monitoring software display -	Content
Min.Target Temp. - Target temperature minimum value [℃] -	Minimum temperature of control target
Max.Target Temp. - Target temperature maximum value [℃] -	Maximum temperature of control target
Ctrl Parameter -Control parameter number [1-4] -	Parameter number that is used in temperature control
Max LD Temp. - LD module effective temperature maximum value [℃] -	When internal LD module exceeds this temperature, an alarm is generated (unchangeable)
Laser Life Time - Laser irradiation integration time [hour] -	It is irradiation time integration value of laser. It updates per call (unchangeable)
Ls. LifeTimeLmt. - Laser irradiation integration time limit value [hour] -	When laser irradiation time integration value exceeds this set value, a warning message is displayed.
TempSens Low End - Temperature sensor effective temperature minimum value [℃] -	Minimum value of temperature that can be measured by usage temperature sensor
Temp Of CtrlFail - Temperature difference that regards as temperature control failure [℃] -	When the state that the difference between temperature sensor measuring value and target value exceeds the set value continues for specified time, it becomes temperature control failure error and control is stopped.
Time Of CtrlFail - Time that regards as temperature control failure [sec 0: No check] -	
Temp. out at 5V - Temperature output conversion value : temperature when 5V [℃] -	Voltage conversion value of measured temperature that outputs to TEMP-OUT terminal on the rear panel
Ethernet DHCP - DHCP is used in Ethernet communication [0:Invalid 1:Valid] -	When using Ethernet while REMOTE communication, it specifies valid / invalid of address setting by DHCP.
Ethernet Address - Address for Ethernet communication -	Address of this device when using Ethernet while REMOTE communication (unchangeable when using DHCP)
Ethernet Mask - Netmask for Ethernet communication -	Netmask of this device when using Ethernet while REMOTE communication (unchangeable when using DHCP)
Ethernet Port - Port number for Ethernet communication -	Port number of this device when using Ethernet while REMOTE communication
Buzzer by Warn. - Buzzer sounding when warning occurs [0:Invalid 1:Valid] -	When detecting a warning while "Valid" setting, the buzzer sounds intermittently.
Buzzer by Error - Buzzer sounding when error occurs [0:Invalid 1:Valid] -	When detecting an error while "Valid" setting, the buzzer sounds intermittently.
Buzzer by Button - Buzzer sounding when pressing button [0:Invalid 1:Valid] -	When pressing a button of this device while "Valid" setting, the buzzer sounds briefly.

LCD Display ‑ Monitoring software display ‑	Content
TempSens:Emissiv ‑ Emissivity (0.050〜1.000) ‑	It is setting of temperature sensor. Refer to the manual of temperature Sensor for details.
TempSens: Smooth ‑ Smoothing time [sec] ‑	Same as above
TempSens: Indoor ‑ Room temperature reflection correction [0:Invalid 1:Valid] ‑	Same as above
TempSens:Emissiv Ref. Corr. ‑ Emissivity reflection correction value (-1999 〜 9999) ‑	Same as above
TempSens: Aiming Intensity ‑ Light quantity of sighting light (0 〜 4095) ‑	Same as above
TempSens: Firmware Version ‑ (None) ‑	Firmware version number of temperature sensor (unchangeable)
Unit Name ‑ (None) ‑	Product name（unchangeable）
Type Name ‑ (None) ‑	Part number（unchangeable）
Unit Firmware Ver. ‑ (None) ‑	Firmware version number of this device (unchangeable)

14. Error / Warning Display and Countermeasure

The message, cause and countermeasure that is displayed on LCD of the front panel or monitoring software are as followings. When an error message displays, temperature control, output amount control and program control stop immediately, and laser output becomes 0[%] output. When it is warning, it displays only and each control continues.

Even if an error cause is solved after stopped each control due to error generation, the error display is continued and each control does not restart automatically. Perform reset operation (refer to 14-3.), then perform operation to start.

"Error bit" in each item is a response to error question (**EQ**) in external host control. If there are several causes, each logical sum (OR) becomes response.

14-1. Error List

          ＜LCD monitor display＞   ＜Monitoring software display＞ ＜Error bit＞

1) **E01:EMG STOP detected.**   **Emergency stop detection**   **0000 0001**

    Cause : EMERGENCY STOP button is depressed or between EMG STOP terminals on the rear panel becomes open state.

    Countermeasure : Eliminate the stop factor, rotate the emergency stop button clockwise to recover and connect between EMG STOP terminals on the rear panel at the same time.

2) **E02:Inter Lock detected.**   **Interlock stop detection**   **0000 0002**

    Cause : It is the open state between INTER LOCK terminals on the rear panel.

    Countermeasure : After eliminate the stop factor, connect between INTER LOCK terminals on the rear panel.

3) **E03:KEY-SW OFF detected.**   **KEY-SW OFF**   **0000 0004**

    Cause : When laser irradiation starts, LASER-KEY on the front panel is in the OFF position.

    Countermeasure : Turn LASER-KEY ON.

4) **E04:LDD ERROR detected.**   **LD error**   **0000 0008**

    Cause : LD driver is abnormality (LD driver initialize error etc.).

    Countermeasure : Contact us.

5) **E05:LDD ALARM detected.**   **LD power error**   **0000 0010**

    Cause : LD driver power source is abnormality.

    Countermeasure : Contact us.

6) **E06:Temp Sensor error detected.**   **Temperature sensor error**   **0000 0020**

    Cause : The temperature sensor is not connected when temperature control starts, or the response is abnormality.

Countermeasure：After checking the connection of the temperature sensor, consider the influence of noise to the cables. If it does not improve, contact us.

7) **E07:Temp of Ctrl PCB detected.**   **Main control board temp. error**   **0000 0040**

Cause：It detects temperature error of the control board.

Countermeasure：Contact us.

8) **E08:No data Cooling unit.**   **Communication error between cooling unit**   **0000 0080**

Cause：There is not any response from the cooling unit.

Countermeasure：Contact us.

9) **E09:COOL:LD Temp detected.**   **LD module temp. error**   **0000 0100**

Cause：It detects temperature error of DM.

Countermeasure：Contact us.

10) **E10:COOL:HS Temp detected.**   **Cooling Heat sink temp. error**   **0000 0200**

Cause：It detects that Heat sink is in the overheat condition.

Countermeasure：Refer to 13.「Maintenance」, confirm the heating factor and remove it. If it does not improve, contact us.

11) **E12:COOL:Pelt Power detected.**   **Power source for cooling error**   **0000 0800**

Cause：It detects an error of cooling unit peltier drive power.

Countermeasure：Contact us.

12) **E13:COOL:All FAN Stopped.**   **All cooling fan rotation stop error**   **0000 1000**

Cause：It detects an error of all cooling fan rotation stop.

Countermeasure：Contact us.

13) **E16:COOL:PCB Tmp detected.**   **Cooling control board temp. error**   **0000 8000**

Cause：It detects temperature error of cooling control board.

Countermeasure：Contact us.

14) **E17:COOL:EEPROM detected.**   **Cooling control board ROM error**   **0001 0000**

Cause：It detects an error in EEPROM of the cooling control board.

Countermeasure：Contact us.

15) **E18:COOL:CPU err detected.**   **Cooling control board SPI error**   **0002 0000**

Cause：CPU operation of the cooling control board is abnormality.

Countermeasure：Contact us.

16) **E19:COOL:Unknown detected.**   **Cooling unit (undefined)**   **0004 0000**

Cause：It detects an undefined error in the cooling control board.

Countermeasure：Contact us.

17) **E20:TEMP.Ctrl Failed.**   **Temperature control failure**   **0008 0000**

Cause：The temperature difference between the target temperature and current temperature exceeded the specified range continuously more than specified

number.

Countermeasure：・Expand "temperature difference [0.1℃] that regards as
temperature control error" in the setting value.

・Increase "the number that regards as temperature control error" in the setting
value.

*When "the number that regards as temperature control error" is 0, this
error does not occur.

18) **E21:TEMP.Ctrl Out of Range.**   **Temp. range deviation (Control stop)**   **0010 0000**

Cause：The difference between measuring temperature and target temperature exceeds
the specified value during temperature control.

Countermeasure：After error reset operation, confirm the laser irradiation object and
temperature sensor sight, and readjust the control parameter etc.

19) **E22:Program Data error detected.**   **Program data error**   **0020 0000**

Cause：There is an error in the setting content of the program that was tried to execute.

Countermeasure：After performing error reset, reconfirm the setting content of the
program by monitoring software.

20) **E23:TuningFailed detected.**   **Tuning failure**   **0040 0000**

Cause：This is an error for adding a function in future. It does not occur normally.

Countermeasure：Contact us.

21) **E24:Internal Dev error detected.**   **Internal device error**   **0080 0000**

Cause：There is an error in an internal device.

Countermeasure：Contact us.

22) **E25:Undefined error detected.**   **Undefined error**   **0100 0000**

Cause：There is an undefined error.

Countermeasure：Contact us.

14-2.Warning List

1) **W01:Temp Ctrl Out of Range. Temp. range deviation (Warning)   0200 0000**

   Cause：The difference between measuring temperature and target temperature exceeds the specified value during temperature control.

   Countermeasure：After error reset operation, confirm the laser irradiation object and temperature sensor sight, and readjust the control parameter etc.

2) **W02:LDM Life Time Expired.   LDM lifetime   0400 0000**

   Cause：Irradiation integration time of LDM exceeded the guarantee range.

   Countermeasure：When it continues to use it, set a setting value of the integration time which is larger than the current value.

   When it continues to use and reach the set value (time), it shows a warning display [W02] again.

   Contact us about any unclear points.

3) **W03:COOL:Fan Stopped.   Cooling fan rotation stop warning   0800 0000**

   Cause：It detects rotation stop of one of cooling fans.

   Countermeasure：The fan may be broken. Contact us.

4) **W06:COOL:Target tmp of LD ERROR.   Out of LDM temp. setting range   4000 0000**

   Cause：It sets the temperature that is out of LDM setting temperature range.

   ⚠ ＊This is the content for initial setting or maintenance, and it does not display Warning Display [W06] normally. If it displays, contact us.

14-3.Error Reset

Errors which were detected in this device do not recovery automatically. Reset operation
is needed to recovery, but some errors need to turn power on again.

The following errors need to turn the power on again.

        E04: LDD ERROR detected. (14-1-4)

        E05: LDD ALARM detected. (14-1-5)

Reset Procedures

    ・Set LASER KEY on the front panel OFF once, and set it to LASER ON or PILOT ON.

    ・Press E-RESET button on the front panel for 2 seconds or more.

    ・Send communication telegram "Error reset command" from the remote device (external host).

    ・Turn "ER_RSET" signal ON for a certain time from the external control equipment (external host). (Refer to 11-3)

When it turned the power on again but it detects an error, the factor of error is not removed.
Contact us.

15. INTERLOCK／LASER KEY Operation and State Transition by Control Command

LASER KEY

PILOT ON   OFF   LASER ON

I N T E R L O C K

Open (Door: open)

E02
Inter Lock detected
[ERROR] Lighting Alarm ringing

Open (Door: open)

Pilot light irradiation *1 — PILOT KEY off → Irradiation stop ⇄ (LASER KEY on / LASER KEY off) ⇄ Irradiation stop

LASER KEY off

Laser output command

Short (Door: close)

INTERLOCK Open/Short

Pilot light irradiation READY — PILOT KEY on ← / PILOT KEY off → Irradiation stop — LASER KEY on → / LASER KEY off ← Pilot light irradiation READY

INTERLOCK Short / INTERLOCK open

INTERLOCK Short / INTERLOCK open

Pilot light output command

Short (Door: close)

Pilot light output command / Irradiation stop command

PILOT KEY off

Pilot light irradiation *1

Irradiation stop command / Laser output command

Pilot light output command

Laser irradiation

Pilot light output command

※ Pilot light output / stop command
    ・Front panel　　: PILOT ON/OFF switch

※ Laser output／stop command
    ・Front panel　　: RUN/STOP button
    ・REMOTE I/F　: Communication telegram
    ・EXT-I/O I/F　　: PROG_ST signal／STOP signal

*1 Pilot light irradiation: When no errors

16. Preparation for Use

Connect this device and a PC that installed monitoring software by USB cable, turn the power on to start using it.

＊Refer to the instruction manual <monitoring software> about the monitoring software such as installation of monitoring software.

16-1. Connection of this Device

※The following is the connection when using 3-axis laser irradiation head (with temperature sensor).

When 2-axis laser irradiation head is used, it does not connect to the temperature sensor.

※It explains that AC100V power plug as power supply source.

① Remove the protection cap of the fiber cable end (irradiation port), and connect the fiber cable and laser irradiation head. Fasten the SMA connector tightly.

＊Be careful not to touch the irradiation port of the fiber end.
- If it performs laser irradiation in the state there is dust, foreign substance or damage, it generates heat by hear absorption and the fiber end melts.
  And if the irradiation port has damage, the semiconductor laser light source (LDM) may be destroyed by return light of light reflection.
- Perform attaching / removing of the irradiation port in environment correspond to clean room for preventing adhesion of foreign object.

② Connect "TEMP" connector on the rear panel and temperature sensor by a connection cable for the irradiation thermometer sensor.

③ Confirm the using power source voltage and it has enough power source capacity for supply.

＊In Supply power source capacity, it needs more than 10A in AC100V and more than 5A in AC200V.

④ Replace the fuse according to the using power source voltage.

＊10A (Slow Blow) fuse for AC100V is inserted when shipping.
＊Replace it to 5A (Slow Blow) fuse when using AC200V power source.

⑤ Confirm that the power source switch is OFF, and connect the attached AC cable (for AC100V) to the inlet and plug.
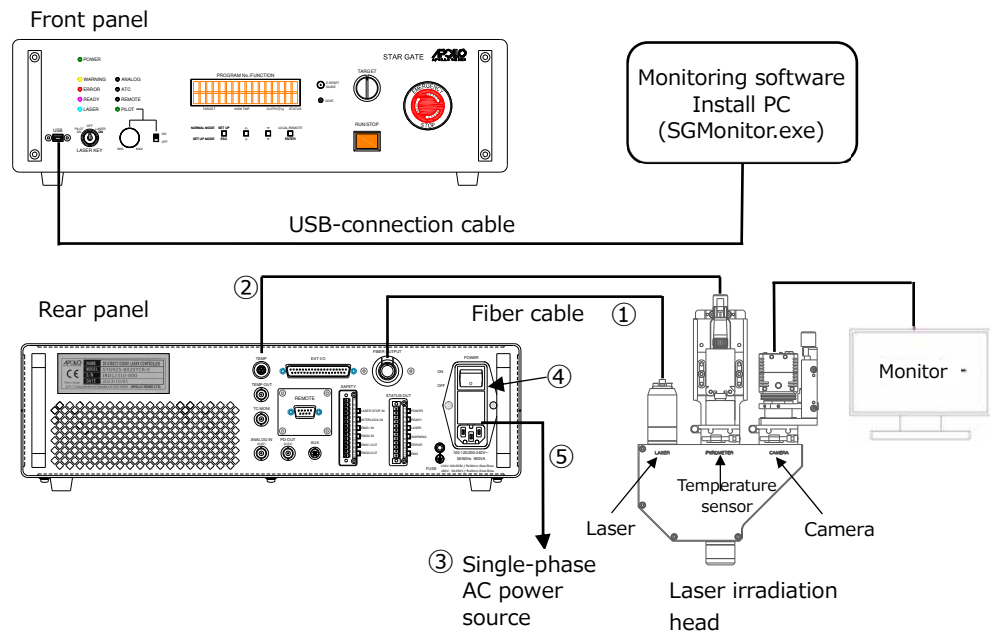
＊Confirm each connection state etc. again before turning power on.

Figure 16-1. 3-axis laser head connection example

16-2. How to Replace Fuse

① Appearance of fuse holder

Fuse holder

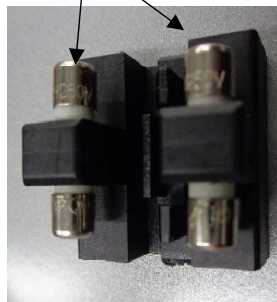②Pull out the fuse holder-1

Insert a driver from the bottom
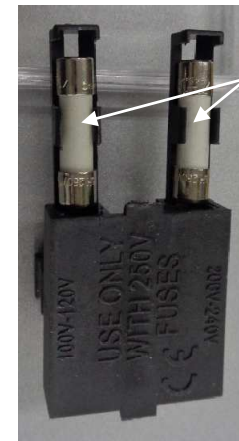

③Pull out the fuse holder-2

Pull out forward

④State the fuse holder is pulled out

Replace it to the fuse of input voltage specification
・for 100V：T10H250V
・for 200V：T 5H250V

⑤Replace the fuse

Spare fuse is stored

⑥Spare fuse

200V-240V   100V-120V
USE ONLY WITH 250V FUSES
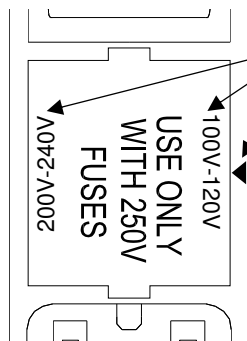
Confirm that the side of marked the voltage which is the same as the mounted fuse value in the holder are facing to ◄ mark, and mount the fuse holder.

⑦ Attach the fuse holder

Figure16-2.   Fuse replacement procedures

16-3．Laser Irradiation Confirmation

(1) Confirmation before laser irradiation

⚠️

a. When Interlock, emergency stop or laser stop switch are used, confirm to connection with rear panel terminal block "SAFETY-IN". (9-1.)

b. Enclose around irradiation point by proper laser protection filter plate not to leak the irradiation light. (2-1. Laser safety management)

c. Make sure to use laser protection glasses etc. and take a safety measure when laser irradiation. (2-1. Laser safety management)

d. Do not touch the fiber irradiation end face. (16-1. ①)

e. Receive light by a thermal power meter in laser irradiation test. (Power meter: it recommends 100W or more)

f. When confirming the output level (W) of this device unit, measure at the fiber end in the state not through the irradiation head.

g. Do not make to contact the power meter receiving light part and fiber end face.

h. Have distance between the receiving light part and fiber end face, irradiate the laser at angle of approx. 15 degrees. (It depends on the type of power meter or area of the receiving light part.)
   If it irradiates from short distance at right angle, it causes damage to fiber end face or module by reflecting light.

J. The measuring amount changes according to the type of the power meter (method), distance of the power meter receiving light part and fiber end, irradiation position or range of the receiving light surface or the surrounding environment or characteristic of the power meter. Thus, the value of the setting output level and the power meter may be slightly different from the value in the inspection sheet.
   The each value in the inspection sheet is the value that inspected and confirmed in our standard and the inspection environment (measuring device and environmental temperature).

k. When measuring the correct output level, measure it by using a calibrated power meter under the same condition as the condition that performed calibration.

m. After getting used to operation and handling by performing irradiation tests, start to use for experiments or processes.

(2) Confirmation of laser irradiation

① Turn LASER KEY switch OFF.

② Turn the power of this device (POWER-SW) ON.

③ Set the display of the LCD monitor to "Direct Output".

④ Turn TARGET knob to left and set the irradiation output level to 0%.

⑤ Set LASER KEY switch to LASER ON.

⑥ Press RUN/STOP button.

Check that the output amount etc. is displayed on the LCD monitor and irradiation was started. (Refer to 6-1.)

＊"LASER" LED lights even if the irradiation output is 0%.

⑦ After irradiation is started, turn TARGET knob to right little by little to increase the irradiation level, and confirm that it irradiates laser by a power meter.

⑧ To stop laser irradiation, press RUN/STOP button again.

⑨ Turn LASER KEY switch OFF until next irradiation to secure safety.

＊Press EMERGENCY button in an emergency situation. Laser irradiation stops.

＊Refer to the instruction manual "monitoring" or another item in this manual about another laser irradiation method and temperature control. Contact us if there are any unclear points.

17. Maintenance

17-1．Before Daily Use

＊Clogging of intake / exhaust fan or vent hole causes increase in internal temperature. Confirm that there is not clogging or the vent hole does not be stopped before using.

＊Confirm that the bending radius exceeds the specified value and there is no dust, damage or signs of melting.

＊Use chargeable inspection service.
For continuous use with safety and security, it is recommended to perform regular inspection at our company per one year when using in usual environment or per 3 years when using in clean room. (Chargeable)

17-2．Attached USB Memory

The content of the attached USB memory is following configuration.
Drive letter of "D:¥" differs depending on the using PC.

There are "Installer" and "Doc" folder in USB memory.

```
D:¥
└──[Installer]」
│       SGMonitor.msi
│
└──[Doc]
          ＊Instruction manuals
          ＊Others
```

Monitoring software (SGMonitor) is in "installer" folder.
The software can be download by clicking SGMonitor.
＊Read the instruction manual <Monitoring software> for details.

The instruction manuals, inspection sheet and related documents are stored in "Doc" folder.
＊The stored contents differ depending on the model.

18. Service Life

It is estimated that the product service life is 8 years in the case all the maintenance and service requirement described in this manual are satisfied and the use is suited to the purpose.

It is estimated that the product service life is prolonged more when the product is handled with care and maintenance is performed properly.

The average service life also becomes shorter when extreme or improper use.

The estimate of average service life of these products by us does not provide additional guarantee.

19. Product Guarantee

Guarantee period : one year after the delivery of this product

＊Except for laser module

(1) When it is used properly on the basis of this manual but an unexpected malfunction which our company bear responsibility occurs within the guarantee period, we repair it free of charge.

About laser module, we repair it free of charge or replace it if a malfunction occurs in one year after the delivery or until the laser irradiation integration time reaches 5000 hours, whether is earlier.

But about guarantee of laser module, we will repair it free of charge or replace it when laser maximum output (W) is less than 70% compared to the value which is described in the inspection sheet.

(2) Any repair has to be paid in the following cases even if in the guarantee period.

・When it performs disassembling, alteration or repair which our company do not allow.

・When a malfunction occurs from carelessness or improper handling.

・Any malfunction or damage from fall, moving or transportation etc. after delivery.

・When there is a cause of malfunction except for this product.

・Any malfunction from mistake when using or wrong operation etc.

・Nature disaster such as fire, earthquake, flood damage, thunderbolt or so on.

・Any malfunction or damage from pollution, abnormal voltage or external factors.

・When the cause is an accident which our company do not bear responsibility.

・When nature deterioration of consumable parts.

・Any malfunction or damage by neglecting maintenance inspection.

(3) Any repair after completing the guarantee period has to be paid.

(4) We do not take any responsibility on claim for direct / indirect damage and loss of profit caused by usage of this device or malfunction.

20. Disposal

Comply with laws and regulations of each area about disposal and recycle of the product and package.

Apollo Seiko Ltd.