英诺激光 INNO LASER Advanced Optowave

This instruction is applicable to Fairy.

V1.1

Table of Contents

1 Laser safety instructions

1.1 Laser safety Level

The laser is a Class IV High Power Laser. Extreme care should be taken when operating. The laser beam is a fire and safety hazard. Only personnel who are trained with the safety precautions listed in this manual should be allowed to operate the laser system. Precautions must be taken to prevent accidental exposures to direct or reflected laser beam. Both diffuse and specula reflections can cause severe skin or eye damages. Proper eye protection must be worn at all times. Direct eye contact with the output beam from the laser will cause serious damage and even blindness.

1.2 Laser Safety Responsibilities

Lasers are engineered industrially and undergo rigorous tests to ensure that they are safe and reliable under reasonable using conditions. If operators do not operate in accordance with the correct safety guidelines, it will be extremely dangerous to both their body and property. Especially when the output wavelength of the laser is in an invisible range, the danger also increases accordingly. If operators do not use the lasers in accordance with the normal use guidelines of our company, our company will not bear any legal liability for all personal injuries resulting therefrom.

1.3 Laser Safety Operation Guide

Danger!

Before using the laser, operators must read this manual and strictly follow the operating procedures in this user manual. Precautions must be taken to prevent accidental injuries caused by direct or reflected light beams. Non-operators must be evacuated outside the laser radiation hazard area.

The greatest danger is the direct exposure to the main laser beam when using a laser. In addition to the main beam, a few smaller weaker power beams may exit at different angles near the laser system. The weaker beams may still be sufficiently intense to cause eye damage.

Laser light is powerful enough to burn skin, clothing or paint. They can ignite volatile substances such as solvents even at some distance. The laser beam can damage light sensors in video cameras and photo diodes. The user is advised to follow the precautions below and in this manual.

- Only qualified users who are familiar with standard laser safety practices and who are aware of the dangers involved should be allowed to have the access the laser.
- Don’t look at the output beam directly. Specula and diffuse reflections are hazardous.
- Avoid wearing jewelry or any reflective items when operating the laser.
- Use protective eye wear that is right for the laser wavelength, that is, always use optical protective goggles during laser operations. Consult your organization's Laser Safety Officer in accordance with your laser safety procedures.
- Use a suitable wavelength fluorescence card to verify that the laser beam is off for safety.
- Be sure to use non-reflective beam stops to block the laser beam.

- Set up the laser beam so that it is not at eye level, the beam should be above or below eye level both at a seated position and a standing position.
- Post highly visible warning-signs near the laser operation area for Class IV laser products.
- Set up a dangerous zone around the laser, use safety interlocks to prevent non-experienced personnel from entering into the working area.
- Laser light is very bright and intense compared with conventional light sources. It poses a significant safety hazard. All laser users, and everyone near the laser system, should be aware of the dangers of using a class IV laser such as the laser system.
- Observe and follow all safety precautions in this manual.
- Extreme cautions should be taken when using volatile substances in the laser area.
- Never direct exposure to the laser beam. The intensity of the beam can easily cause flesh burns or ignite clothing.

Danger！Visible light, invisible light, and ultraviolet radiation.

Laser produces both visible and invisible radiation. The invisible radiation has a wavelength of 1064nm which corresponds to the infrared (IR) optical region and 355-351nm which corresponds to the Ultra Violet (UV) optical region. The visible radiation is 532-527nm which corresponds to the Green (GR) optical region. All these radiations can easily cause permanent damage to the retina.

1.4 Warning and Safety Signs

<table>
<tr><td>LASER RADIATION WARNING LABEL</td><td>  </td><td>ENERGY & WAVELENGTH LABEL（Sample）</td><td> 
</td></tr>
<tr><td>APERTURE LABEL</td><td> 
</td><td>CLASS 4 LASER PRODUCT LABEL</td><td> 
</td></tr>
<tr><td>MANUFACTURING IDENTIFICATION LABEL（Sample）</td><td colspan="3">英诺激光 INNO LASER
Model No. FAIRY-355-2-30-A
Serial No. J12210010
Manufactured 2025-3-24
THIS EQUIPMENT CONFORMS TO PROVISIONS OF US 21 CFR 1040.10&1040.11-US PATENTS PENDING
MADE IN CHINA</td></tr>
</table>

1.5 Laser Safety Characteristics

- External Interlock Connector: A detachable interlock connector is provided at the back of the laser control unit, which has two pins inside that can be connected to an external interlock switch. When the two pins are disconnected, the laser will stop working, displaying an alarm for the disconnection of the external interlock device. At the same time, the buzzer will sound an alarm sound. When the fault is resolved (such as the interlock switch being reconnected), clearing the fault alarm or power off and restarting the laser will restore normal operation.
- Key switch control: The laser cannot be turned on when the key is turned off.
- Laser emission warning light: The on and off of the LED light on the laser can also indicate whether the laser is on or off. However, users cannot rely solely on this function to determine whether the laser is on or off. When using the laser, you need to be very careful at all times.

1.6 Laser Safety Commitment

The laser itself is safe, but protection must be taken when using it. Both equipment manufacturers and end users should abide by the safety requirements of lasers. This is the basis for ensuring safe production. They should commit to installing laser protection devices that can isolate, block, and protect in the use scenario, even when the laser is not turned off. Laser safety requirements are included in IEC 60825-1:2014& CAN/CSA-E60825-1:15, GB 7247.1-2012.

2 Laser Interface Description And Packing List

2.1 Interlock Pins

Pins	Signal Function	Comment
1	GATE	Internal trigger（5V TTL level trigger）
2	Trigger	External trigger (PWM signal trigger)
3	FPS Input	First pulse suppression signal
4	GNDiso	
5	RS232 RXO	RS232 Signal Receiver
6	Interlock	Interlock, short with any GNDiso
7	Alarm Out	Alarm output，5V output
8	Laser Ready	Laser self-start completion signal（5v）
9	RS232 TXO	RS232 Signal Transmitter

2.2 Packing list

Physical Objects	
Interlock Connector	1
Power Cord	1
Laser Test Report	1

3 Laser System Environmental Requirements

3.1 Electrical Requirements

Parameter	Requirements
power supply voltage	DC-12V
Rated Power	200W
Suggested power supply	350W

3.2 Environmental Requirements

Parameter	Requirements
Ambient Operating Temperature	15℃ to 35℃
Relative Humidity	5% to 90%(non-condensing)
Vibration	Keep away from Vibrations
Altitude	Sea level to 3000m

3.3 Operating Precautions

- The laser controller power line has two reserved connectors: +V and GND. Please correctly connect them to a switching power supply that meets the power requirements.
- The laser needs to be installed horizontally on the platform. If you need to install it in other directions, please consult Inno technical support personnel.
- The laser should be equipped with a chiller that meets the requirements. Excessive water pressure will squeeze the cavity and cause power attenuation.
- The water coolant should be replaced at least once every two months. It is recommended to use automotive antifreeze to prevent water blockage and extend the water replacement cycle.
- Install the chiller in a convenient and well-ventilated spot. The chiller will draw cool air in

from the front of the unit and will exhaust warm air through the rear of the unit. Caution should be taken to ensure that the chiller can draw and expel air freely and that it will not recirculate its exhaust warm air as this will prevent the chiller from maintaining a stable water temperature.

- The optical path behind the laser window mirror needs to be sealed. It is recommended to use a beam expander directly installed on the window mirror, which can effectively extend the service life of the window mirror.

Note: The window mirror is a consumable and is not covered by the warranty.

4 AOC NANO Laser Controller Software

4.1 Software List and System Requirements

The laser control software does not need to be installed. It can be downloaded directly from our official website or official account. Double click to open it.

- Software Name: NANO GUI
- Please install Microsoft .NET Framework 4.5.1 or a higher version software on the computer to support software operation.

4.2 Installation and Operating Problem Solutions

- Please use RS232 direct connection (2, 3, 5-pin direct connection), or use a USB to serial communication cable. If you choose a serial to USB data cable as the RS232 communication cable, please install the corresponding driver. Some systems may require a PC restart after installation.
- If the software is unable to start or error, please confirm whether the installation software version and the Microsoft .net framework software is correct. If there are multiple .net framework software versions, please unload them all and reinstall one.
- When unable to find the serial port, please check if the serial port driver has been installed. You can open the device manager to check if the com port is not enabled.
- The software running interface displays "Searching for laser……Please make sure the port connection is good", which means the com port is wrong, please change to the correct com port.
- The software running interface displays "Error! Unable to switch to remote state", please check if there is any alarm sound in the communication cable and laser. If there is an alarm, please first troubleshoot the laser problem and then restart the laser controller.

5 New Graphical User Interface --- GUI

5.1 Operator Page Introduction

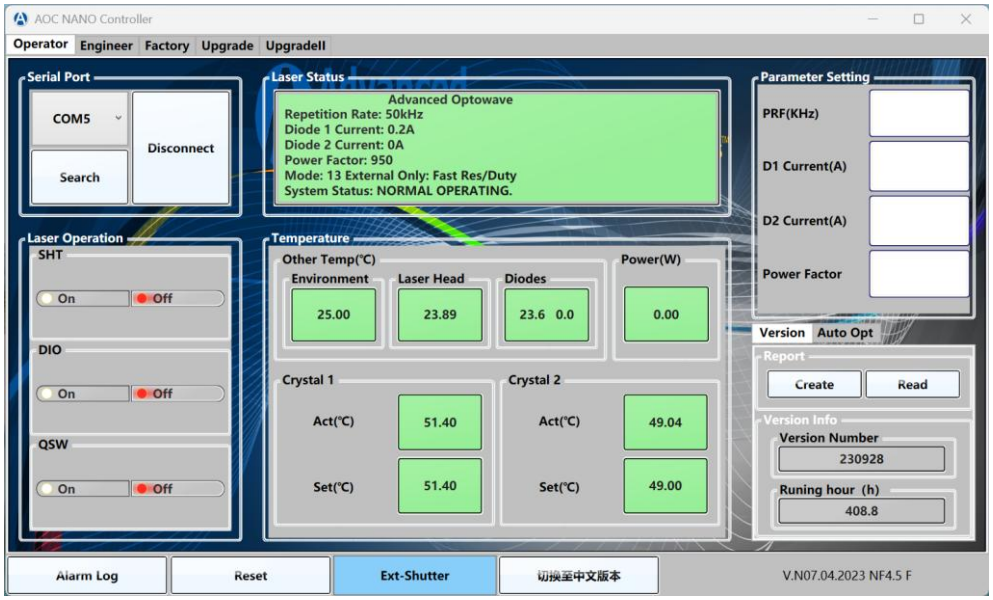


Figure 1: Operator Screen

Connect the computer and the laser with the serial communication cable, launch the GUI on your computer.

The connectable serial port might not be displayed in the “Serial Port” drop down menu. Please click "Search" button. Then, the system will automatically search and display the connectable serial port. Then click "connect", the system will be automatically connected and enter the initialization stage.

(Note: It is necessary to select the correct serial port by yourself if multiple serials are connected in the computer, otherwise the system will display an error message. Please select the port again.)

- Laser Status Section

Laser Status displays the operating status of the laser system. After the laser is initialized normally, the status bar will display various parameters, especially the power factor and working mode code.

- Temperature Section

Environment: The ambient temperature at the installation location of the laser.

Laser Head: The shell temperature of the laser resonator.

Diodes: The current temperature of the laser diode.

Crystal 1: The actual temperature and the set temperature of the SHG crystal.

Crystal 2: The actual temperature and the set temperature of the THG crystal.

- Parameter Setting Section

PRF: Sets the working frequency of the laser.

D1 current: Sets the current of pump diode 1 (Note: Refer to the factory test report).

D2 current: Sets the current of pump diode 2 (Note: Refer to the factory test report, do not set any value if there is no such parameter).

Power Factor: Sets the laser output power value (PWF function, 50 - 950 adjustable, the higher the value, the higher the output power).

- Laser Operation Section

SHT: Turns on or off the laser shutter.

DIO: Turns on or off the laser pump diode.

QSW: Turns on or off the laser Q-switch.

- Other

Reset: The button to eliminate alarms. The alarm can be eliminated by pressing this button when the malfunction is resolved.

Report (Create): The button for generating the report for the internal laser parameters. When the laser system fails, the user can create a report and send it to the INNO's engineer for quick analysis and solution for the problem.

(Note: By default setting, the laser works in "13" external control mode. If the interface shows that the laser works in "01" internal control mode, the laser outputs at low level, so please set up a power meter or shielding device for protection.)

5.2 Engineer Page Introduction

Click the "Engineer" and enter the password "AOC" (in capital letters), shown in Figure 2 and 3.

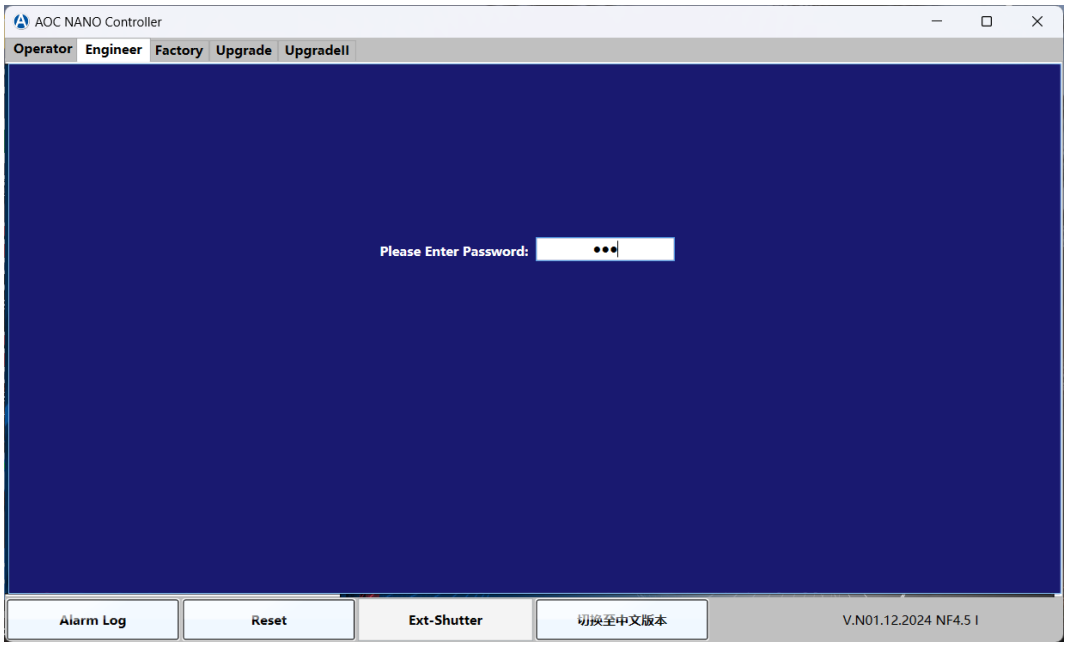


Figure 2: Password AOC

Figure 3: Engineer screen

Parameter setting section/Laser operation section/Temperature section are the same as the functions of the operator screen.

- Opera Level Section

Gate: Switch between high-level triggering and low-level triggering.

PWM: Switch between rising-edge triggering and falling-edge triggering.

- FPS Mode Section

This section is used to switch the laser control mode.

- Command Box Section

The window is used to input serial port communication instructions.

5.3 The Working Modes of The Laser

There are two commonly used modes for the lasers, namely Mode 01 and Mode 13, as shown in Figure 4.

For Mode 01, please connect "Gate In" with high and low level TTL signal.

For Mode 13, please connect "Trig in" with a PWM signal.

Turn off "QSW" before changing the laser working mode, then select the desired laser working mode from the drop-down menu and click the "Change" button. Please don't open the "QSW" until "Present Mode" displays the selected mode.

(Note: For the customer's request for high-level output, it can be switched through the command: GTR=0/1 to change the high and low-level control output. By default, the laser system is set to low-level output)

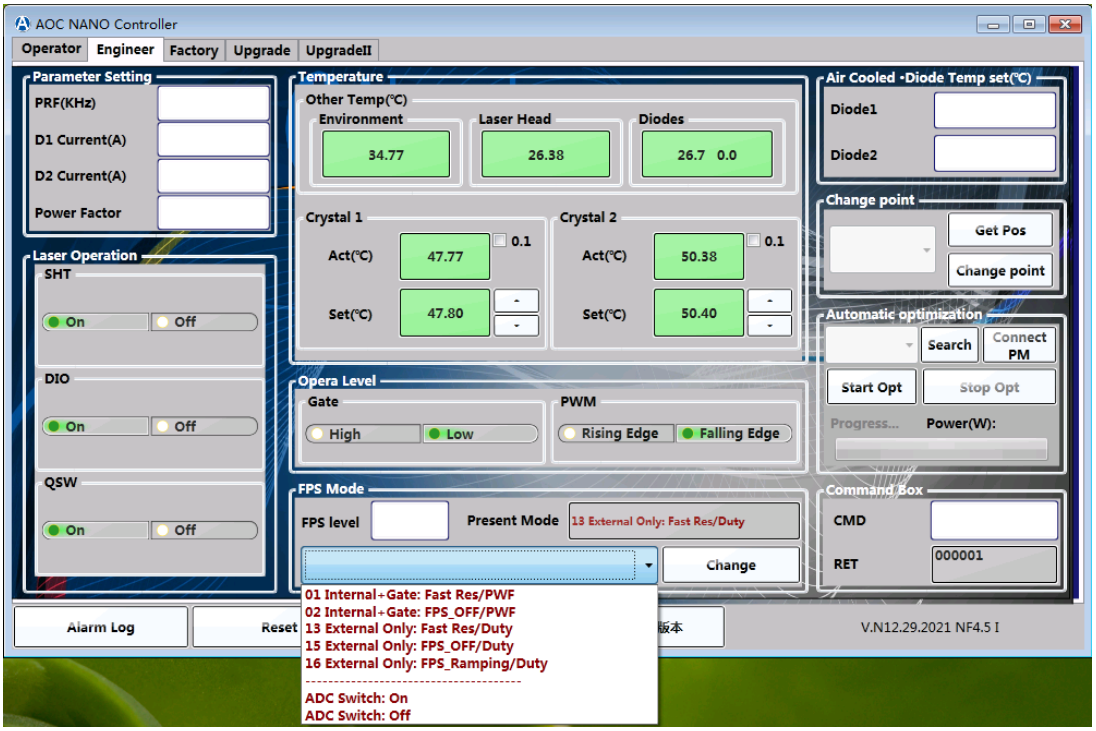


Figure 4: Laser working mode

6 Laser Basic Operations

6.1 Laser Start-up Procedure

- Connect the laser to the computer with RS232, turn on the laser power, and turn on the laser key switch. Warm up the machine for 5-8 minutes, or until the cooling system reaches the set temperature value and stabilizes if there is chiller.
- Launch the AOC GUI on your computer. Click “Search” button, select the serial port you are using. On the GUI click “Connect” button to connect the computer to the laser controller. The status showing in the system.

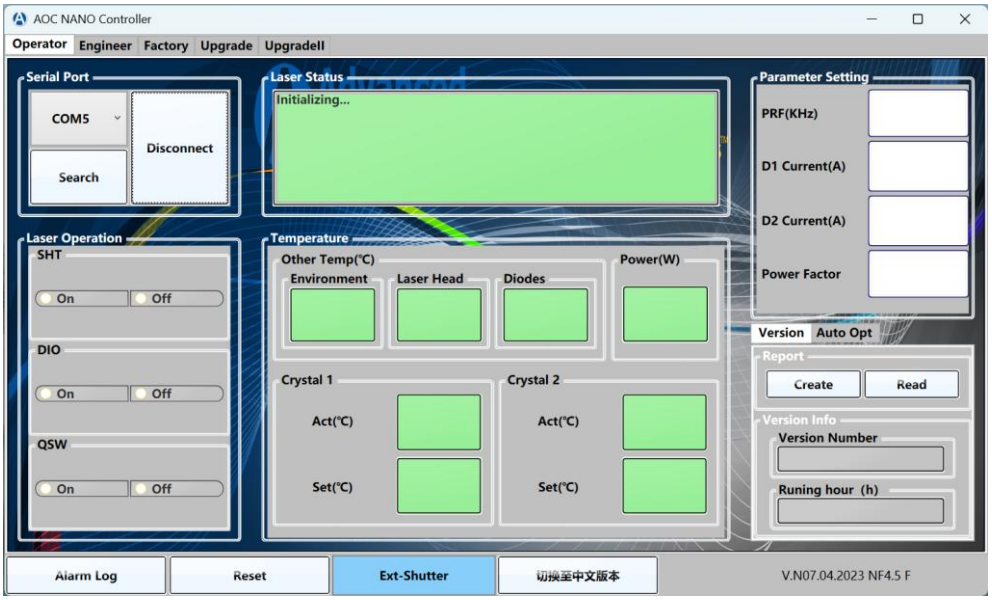


Figure 5: Laser initializing

- After 2 minutes, the following interface appears, indicating that the software has been correctly connected.
- Open in sequence “SHT-ON” “DIO-ON” (When turning on the pump source, wait for the current to rise until the system status bar displays the correct current value), finally turn on “QSW-ON”.

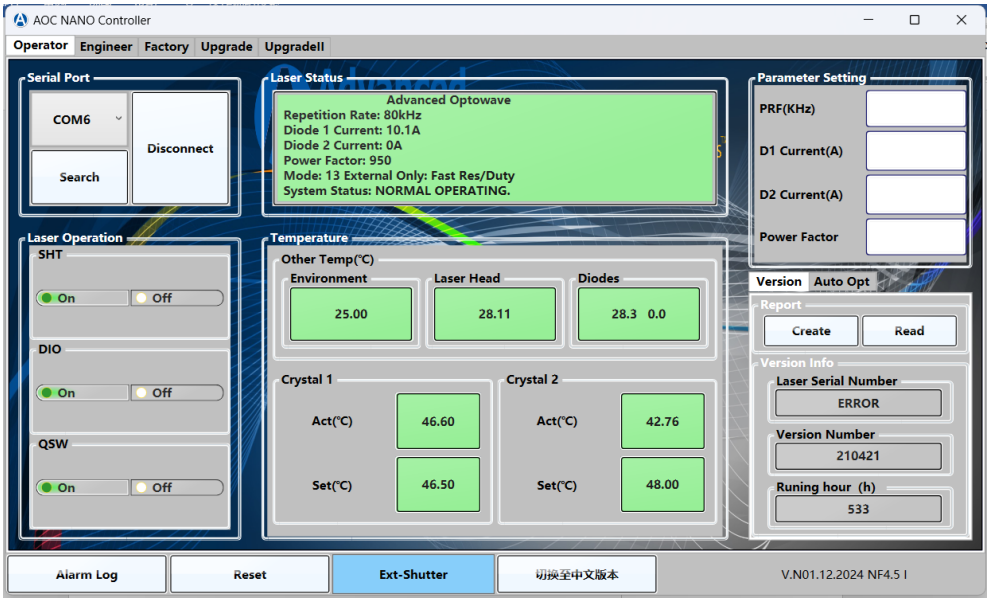


Figure 6: Laser startup completed interface

- Wait for 3-5 minutes for the machine to warm up, then you can adjust the optical path and set the power meter based on the CW light at this time.

Note: It is important that the system is allowed to thermally stabilize for 20 minutes when power is first applied to the system. The system will maintain a stable harmonic temperature.

6.2 Laser Shutdown Procedure

- Turn off the "QSW", turn off the "DIO" (wait for the current to reach 0A), and finally turn off the "SHT".
- Click "Disconnect" button, disconnect from the laser.
- Turn off the power.

Note: After shutting down the laser system, it is recommended to keep the main power switch of the controller turned on to ensure the power supply of the controller, because the crystal temperature control module of the laser controller is still in working condition at this time, which can reduce the warm-up time when the laser system is restarted and extend the working lifetime of the crystal.

6.3 Enable The Automatic Start-up Function of The Laser

Note: To determine whether the laser version supports one-key startup, please contact our engineer to confirm before setting it up yourself. Laser power less than 10W can use this function.

- Click the "Engineer" and enter the password "AOC" (in capital letters).

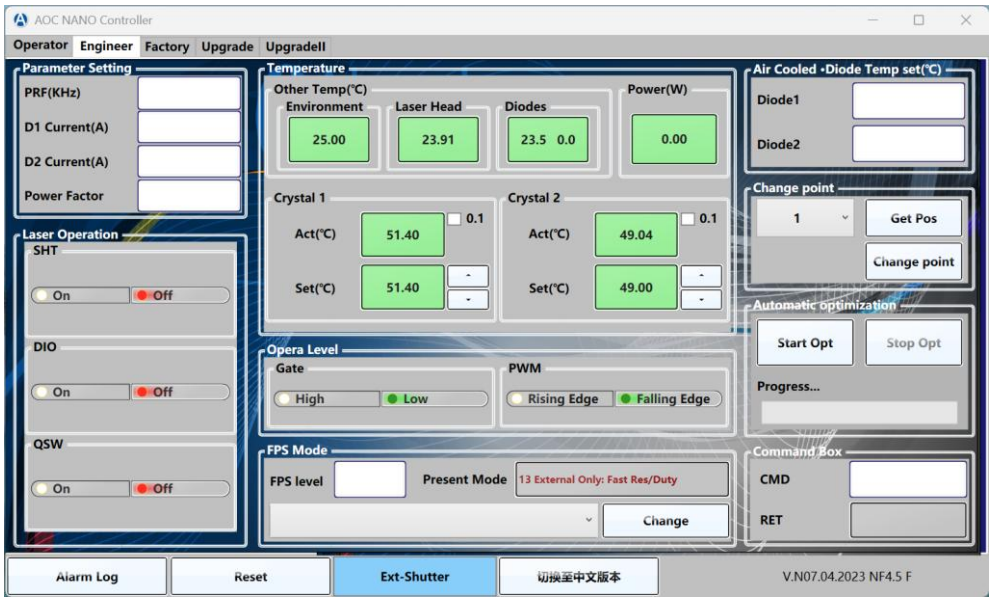


Figure 7

- Selecting "ADC Switch: on", click the "Change" button. the automatic start-up setting is completed.

Figure 8

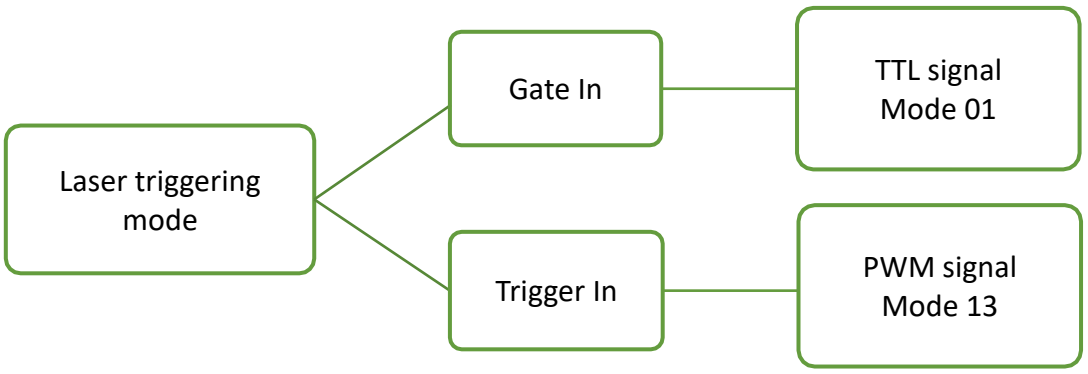
After the automatic startup setting is completed, when the laser is powered on next time, it will automatically complete the startup steps without opening the laser control software again.

If you want to turn off the automatic startup program, select "ADC Switch: off".

Note: The entire startup process lasts about 1.5 minutes. Please do not perform other operations before seeing the laser indicator light to complete the startup, to avoid laser shutdown.

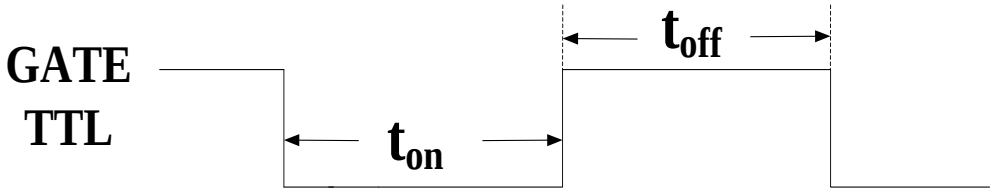
7 Laser Triggering Methods

7.1 Introduction



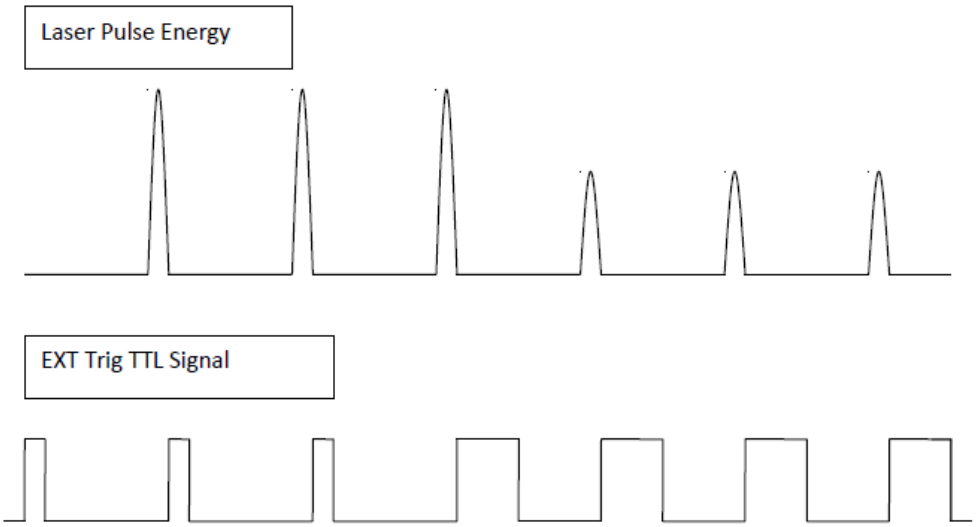
- Gate In:

Provides the user with another option to control the lasers ON/OFF function for their application. During the low portion of a TTL signal (0~0.4V) the laser will be enabled (laser on). During the high portion of the signal (3.7~5V) the laser will be disabled (laser off).



- Trigger In:

Provides the user to control the laser frequency as desired. The input signal must be +5V TTL, with a negative pulse width of no less than 1us.



7.2 The Connection of The Laser and The Marking Card

- EzCad

Gate In:

EzCad CON2(DB25)	Interlock Pins
PIN 12 (LASER-)	PIN1 (GATE)
PIN 3/6/7/8/10/11/19 (GND)	PIN 4 (GNDiso)

Trigger In:

EzCad CON2(DB25)	Interlock Pins
PIN 22 (PWMTTL)	PIN2 (TRIGGER)
PIN 3/6/7/8/10/11/19 (GND)	PIN 4 (GNDiso)

Note: The signal line must be a coaxial cable with shielding.

- MarkingMate PMC2

Gate In:

Markingmate P2 (DB15)	Interlock Pins
PIN 6 (LO_Laser On/Off)	PIN1 (GATE)
PIN 3/15 (GND)	PIN 4 (GNDiso)

Trigger In:

Markingmate P2 (DB15)	Interlock Pins
PIN 4 (Laser1_PWM)	PIN2 (TRIGGER)
PIN 3/15 (GND)	PIN 4 (GNDiso)

Note: The signal line must be a coaxial cable with shielding.

- RTC4

Gate In:

RTC4 (DB9)	Interlock Pins
PIN 2 (LASER ON)	PIN1 (GATE)
PIN 6/7 (GND2)	PIN 4 (GNDiso)

Trigger In:

RTC4 (DB9)	Interlock Pins
PIN 1 (LASER1)	PIN2 (TRIGGER)
PIN 6/7 (GND2)	PIN 4 (GNDiso)

Note: The signal line must be a coaxial cable with shielding.

- SAMLight

Gate In:

SAMLight (DB37)	Interlock Pins
PIN 31 (LASER_GATE)	PIN1 (GATE)
PIN 14/15/24 (GND)	PIN 4 (GNDiso)

Trigger In:

SAMLight (DB37)	Interlock Pins
PIN 13 (Laser_A)	PIN2 (TRIGGER)
PIN 14/15/24 (GND)	PIN 4 (GNDiso)

Note: The signal line must be a coaxial cable with shielding.

8 Maintenance

8.1 Maintenance Schedule

Frequency	Detail
Monthly	Check and optimize the maximum power of the laser
Every 2 Months	Check the laser output window for damage
Every 3 Months	Check the chiller coolant level (if applicable)
Every 6 Months	Replace the chiller coolant
Every 12 Months	Clean the chiller and the controller's fans of dust

- Optimize the maximum power of the laser

Regular measurement and optimization of laser power can improve the stability and reliability of product usage, and it is also beneficial to the lifespan of the laser.

The UV laser is equipped with two (2) harmonic crystals. GR laser only has crystal 1. Below are the steps to optimizing Crystal 2's temperature. The same steps are also applicable to optimizing crystal 1.

✧ While in Operator GUI please hit the Engineer Tab and then the password AOC when prompted. Once the Engineer GUI is opened located the Crystal 2 Temperature Adjustment Section, see figure 9.

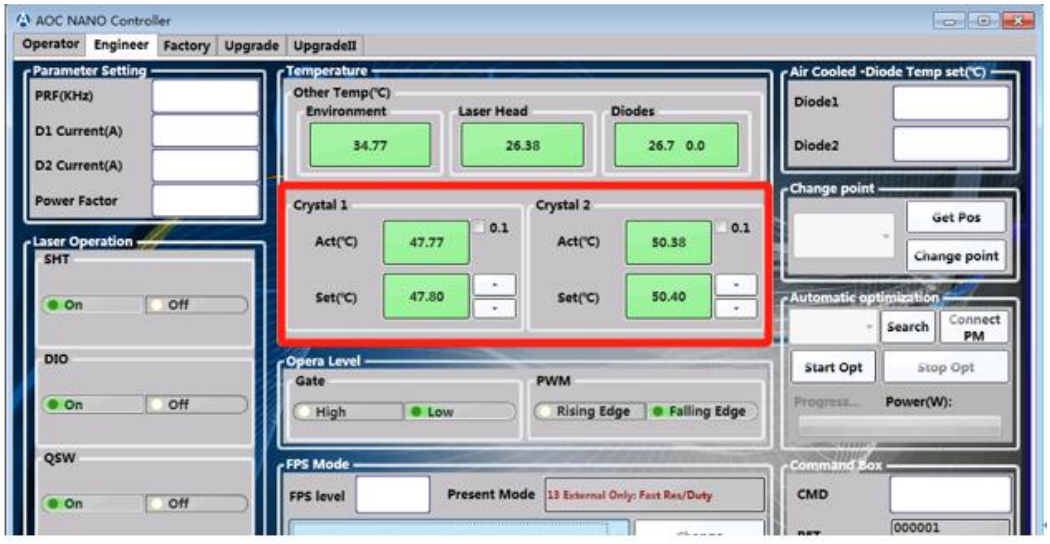


Figure 9

✧ During this procedure, please make sure that there is a power meter in front of the laser and that you are monitoring the power as you make the following adjustments.

✧ Using the "UP" arrow located to the right of the set temperature make small 0.5°C (this can be done by checking the 0.1box) changed to the set temperature. It will take a few seconds for the crystal to respond to the change.

✧ If the power on the power meter showed an increase in power, continue to make 0.5°C adjustments until you see the output power decrease, at this point you have past the

optimal crystal temperature.

- ✧ Once the maxima temperature has passed, please start lowering the set temperature in 0.2°C steps, until the laser has reached its peak performance.

Once the fine tuning is completed, please click the Operator Tab and return to Operator GUI.

- Check the laser output window for damage

It is recommended that the laser output window be checked for damage approximately every 2 months. This can be done by looking at the area around the main output beam. An excessive amount of beam scatter may be the result of a damaged output window. One side of the laser window is exposed to the environment so it can be damaged if dust or contamination settles on the surface. If an excessive amount of scatter is found the laser window can be replaced by removing the screws that hold it in place, pull out the window, insert a new window and secure using the original screws. Please note the orientation of the Brewster window and make sure that the replacement window is installed in the same orientation.

- Check the chiller coolant level (if applicable)

Some laser models require the use of an external chiller unit. This chiller unit provides chiller liquid coolant to the laser head and the controller to regulate their temperatures to a set level. The coolant level of the chiller unit should be checked every 3 months to ensure that it is at its maximum capacity.

- Replace the chiller coolant

The regular coolant replacement ensures that the system is free of contamination and that the coolants anti corrosive properties are not depleted. To drain the system the chiller must be in the OFF position and the AC cord unplugged. Remove the VENT plug and remove the rubber fill plug. Locate the female water connecter that is next to the coolant. Remove one of the water hoses from the system. Insert one end into the plug labeled DRAIN. Press in the male connector of the other end of the water hose and coolant should flow out. The reason why you must press the tip of the male water connector is because the water fittings are self-sealing, and they are designed to prevent unwanted coolant leakages. Pressing the tip of the fitting will open the seal and allow coolant to flow. When the coolant stops flowing disconnect the water hoes from the DRAIN fitting and fill the clear plastic tube with fresh coolant so that it reached the MAX fill line. Turn on the system and allow the coolant to circulate. The coolant level will drop as the coolant fills the cavity of the laser and the coolant lines. Add coolant as necessary.

- Clean the chiller and the laser's fans of dust

During the long-term use of the cooling fan of the laser, dust will accumulate on it, resulting in a decline in heat dissipation performance. Compressed gas can be used to clean the fan and the heat sink. Pay attention to protecting the window mirror and other lenses during the cleaning process.

8.2 Special Response from Laser

Special case	Response from laser is always 6 digits (each digit is between 0-9)	Comments
Any error message: wrong message, wrong message ending (0xD, 0xA), or incorrect value range.	ERROR	Need to check the message, the ending and value. If it is caused by RS232 bit error rate, PC needs to resend message
PC tries to send message to laser driver when it is busy with other high priority task.	BUSY	Wait for laser driver to finish its task
When laser alarms any command sent to laser driver will be ignored and get a return of “ALARM”, followed by the alarm condition code.	Example: ALARM 000007	Indicates laser is alarming because of interlock open
When alarm condition cleared, laser will require user to press RESET button by GUI. Before the button is pressed any commands to laser will be ignored and get a return “RESET”	RESET	RESET by user required

8.3 Laser alarm promotion and solutions

Code	Malfunction Description	Solutions
000001	Diode Temperature High	Check whether the laser's heat dissipation is good; Check whether the fans are working.
000002	Diode Temperature Low	Check whether the environment temperature is too low. Turn on the air conditional if the indoor temperature is too low.
000003	Laser Head Temperature High	Check if the heat sink under the fan of the laser head is blocked and if the fan is working. Check the ventilation status of the laser head.
000004	Laser Head Temperature Low	Check whether the temperature sensor connector is loose. Check whether the environment temperature is too low. Turn on the air conditional if the indoor temperature is too low.
000005	Environment Temperature High	Check the indoor temperature, please turn on the air conditional if it's too high. Check whether the air inlet and outlet of the laser controller are blocked.
000006	Environment Temperature Low	Check if the temperature sensor plus is loose. Check whether the indoor temperature is too low (15C or below), Turn on the air conditional if it is too low.
000007	Interlock Open	Check whether the interlock connector is loose. Check whether the connections is shorted
000009	Crystal 1 Temperature High	Restart the laser by cutting off the power and then turning it on again. Ensure that the ambient temperature is within the operating range.
000010	Crystal 1 Temperature Low	
000011	Crystal 2 Temperature High	
000012	Crystal 2 Temperature Low	

8.4 Laser common malfunction troubleshooting

Malfunction Description	Solutions
Beam quality degrades	Check whether the laser current value is consistent with the factory report Check whether the external optical components are dirty or damaged, such as the f-theta, beam expander, reflector, and finally the laser window.
No beam output	no indicator light, no strong light： 1. Check whether the laser alarms. 2. Check whether the Diode voltage and current are normal. 3. Check whether the optical fiber is damaged or burned out. With indicator light without no strong light: 1. Check whether the Diode current is normal. 2. Check if the crystal temperature is normal. 3. Check whether the water temperature of the chiller and the Diode temperature is normal.
Power attenuation	1. Check whether the laser current, chiller temperature, PRF and PWF are set correctly. 2. Confirm whether the control signal voltage is normal. 3. Check whether the laser window is broken. 4. Check whether the temperature of the laser is abnormal. If all the above items are correct and the power is still weak, then the crystal temperature needs to be optimized. Crystal optimization method: 1. Switch the laser working mode to 01 internal control mode. 2. Put the power meter in front of the laser window. 3. Click Enable on the Engineer interface of the laser control software. 4. Refer to the power meter, adjust the temperature of crystal 2 first, just click the arrow icon below Crystal 2. If the power rises when the temperature of crystal 2 is increased, continue to increase the temperature, otherwise reduce it until the crystal temperature does not change or decay any more. 3. Adjust the temperature of Crystal 1 with same method and optimize the temperature of Crystal 2 again after completion

Wherever you are, the instant service will be provided for you.

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