Pulsed Fiber Laser

YDFLP-CL2-200-1/5-A
YDFLP-CL2-300-1/5/10-A

USER MANUAL

Version 0.1

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SHENZHEN JPT OPTO-ELECTRONICS CO., LTD.

Safety Information

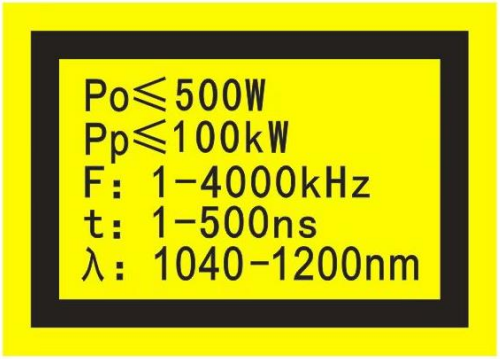
Please read this manual carefully before operating the YDFLP fiber lasers.

In order to ensure the safe operation and optimal performance of the product, please strictly follow the safety notification below.

- Make sure that the 48V DC power supply is connected in the correct way. Inappropriate connection might damage the product.
- To prevent electrical shock, please do not remove the laser cover. Warranty will be invalid if warranty label is removed.
- Please wear appropriate laser safety goggle (see below Fig.1.) before emitting the laser. We recommend OD4+ goggle or better. This laser module carries a Class 4 laser rating, which emits invisible 1064nm wavelength laser radiation with average output power over 200 W and peak power over 10kW. Both direct beam and reflected beam will cause permanent damage to the eyes, skin, and might cause fire.
- Caution: Even at 0% power emitting, the average output laser power is still around 100mW.

Figure 1 Laser Safety Goggle

Table 1 Safety Labels and Labeling Locations

Symbols	Information
	Laser Warning Triangle -Label of laser emission (Attached on the cover plate, near the output fiber）
	Compliance Label (Attached on the cover plate)
	Parameter Information (Located on the laser cover plate)

Contents

1. Product Introduction

1.1 Product Description

JPT pulsed fiber laser adopts master oscillator power amplifier (MOPA) structure, in which the master oscillator uses semiconductor laser as the seed source, and the power amplification is realized by traveling wave fiber amplifier. MOPA structure pulse fiber laser is used to output pulse beam by directly modulating single-mode semiconductor laser. Its pulse width is adjustable, its waveform can be edited, it has continuous mode, and its frequency range is wide, and its peak power is high. The pulse timing can be precisely controlled with the later stage pump. The controllable parameters are many, which greatly expands the application range of related pulse laser, and provides an ideal light source for industrial laser marking and other applications.

The Series fiber laser control with standard DB25 interface and powered with 48V DC,which makes it a good compatibility. Compared with similar products, the Jet pulsed fiber laser can adjust the pulse width and frequency within a certain range, and can maintain a stable peak power output. CL series lasers adopt lightweight design for the laser output part, which is particularly prominent in applications such as laser cleaning.

Photograph of typical YDFLP-CL2-200-1/5-A&YDFLP-CL2-300-1/5/10-A fiber lasers is shown in Fig.2 (For the specific appearance, please refer to the actual product shipped):

Figure 2. YDFLP-CL2-200-1/5-A&YDFLP-CL2-300-1/5/10-A

1.2 Packing List

Please refer to the packing list according to table 2.

Table 2. Packing List of YDFLP

Item	Quantity
Fiber Laser	1
Power supply cable	1
Collimator dust cap (installed on collimator output part)	1
Testing Report	1
Laser Usage Notes	1
Product List	1

1.3 Operation Conditions and Safety Instructions

Please read the following instructions carefully. Product reliability and lifetime probably be affected if not following the user manual.

1) Make sure that the 48V DC power supply is connected in the correct way. Wrong connection or input voltage might damage the product.

2) Make sure that the bending diameter of the fiber cable is larger than 15cm in anytime. Otherwise power will decrease or the laser may even be damaged.

3) The speed of the fan is adjustable according to ambient temperature. Make sure that minimum 10cm air gaps behind and in front of the fiber laser. And the air flow direction of the system should be the same as the laser. Short ventilation distance and wrong air flow direction will lead to the laser temperature rises.

4) The required running ambient temperature range is 0~40℃. Laser will get internal alarm if out of this range. It is recommended that the operating temperature range of the laser is 10-30℃. Good heat dissipation is helpful to prolong the working life of the laser.

5) Due to the "thermal lens effect" of ordinary K9 glass optical lens in medium and high power range application, the phenomenon of focus drift, spot size inconsistency or light output

instability might occur during material processing if using K9 glass optical field lens. Fused silica lens is recommended.

6) Please keep the fiber laser source clean especially the laser output window. Please remember to cover the output window when it's exposed to the open environment. Dust on the window will cause heat and damage the lens, which results in output power decrease even laser damage.

7) Please make sure that the power is off before installing and uninstalling.

8) Please **do not** look at the output window anytime when power on, and wear laser safety goggle when operating the fiber laser.

9) YDFLP-CL2-200-1/5-A&YDFLP-CL2-300-1/5/10-A contains 12 wave-forms: 13ns, 20ns, 30ns, 45ns, 60ns, 80ns, 100ns, 150ns, 200ns, 250ns, 350ns, 500ns.Other pulse width is available for customization request.

1.4 YDFLP CL Series Product Naming Convention

Table 3. Naming Convention for Pulsed Fiber Laser

YDFLP – XX – XX – XX – X – X
1 2 3 4 5 6

1. Product Name：Ytterbium Doped Fiber Laser Pulse (YDFLP)
2. Product type：CL: Cleaning Series 1 CL2: Cleaning Series 2, usually an upgraded version of CL
3. Average Output power
4. Fiber characteristic:
   Numbers such as 1, 5, 10, 15, 50, and 100 represent different types of fiber characteristics
5. Thermal Solution:
   A：Air-cooled
   W：Water-cooled

1.5 Technical Specifications

Table 4. Specifications of the CL Series Pulsed Fiber Laser

Characteristic\ Laser Type		YDFLP-CL2-200-1	YDFLP-CL2-300-1	YDFLP-CL2-200-5	YDFLP-CL2-300-5	YDFLP-CL2-300-10
M^2(typical)		1.5		5		12
Delivery Cable Length	m	5				
Average Output Power	W	>200	>300	>200	>300	>300
Maximum Pulse Energy	mJ	2		5		15
Pulse Repetition Rate Range	kHz	1-3000				
Pulse Width	ns	13-500				
Output Power Instability	%	<5				
Cooling Method		Air-cooled				
Power Supply Voltage (DC)	V	48V				
Power Consumption	W	<700	<1000	<700	<1000	<1000
Power supply current requirement	A	>14.6	>20.8	>14.6	>20.8	>20.8
Central Wavelength	nm	1064				
Emission Bandwidth@3dB	nm	<15				
Polarization		Random				
Anti-Reflection Protection		Yes				
Output Beam Diameter	mm	6±1	6±1	7±1	7±1	7±1
Output Power Tuning Range	%	0～100				
Ambient Temperature Rang	℃	0～40				
Storage Temperature Range	℃	-10～60				
Dimensions	mm	340*265*100				
QCS Size		153*Ø17				
Weight	Kg	Net weight:8.9 Gross weight:10.3				

Table5. Fiber Laser Cut-off Frequency Value（kHz）

Pulse Width (ns)	Cut-off frequency（kHz）					Max frequency (kHz)
	YDFLP-CL2-200-1	YDFLP-CL2-300-1	YDFLP-CL2-200-5	YDFLP-CL2-300-5	YDFLP-CL2-300-10	
1(CW)	-					
13	1200	1800	700	900	250	3000
20	900	1350	460	630	170	
30	650	975	330	460	120	
45	400	600	210	280	80	2000
60	360	540	180	250	70	
80	280	420	140	200	55	
100	260	390	110	190	50	1000
150	180	270	75	120	34	
200	150	225	64	96	30	
250	130	195	55	82	25	900
350	110	165	45	68	22	600
500	100	150	40	60	20	500

* The laser will have expected output power when working above the cut-off frequency. When working below the cut-off frequency, the power will drop accordingly to maintain the output peak power. Below chart shows the relationship between frequency and output power:

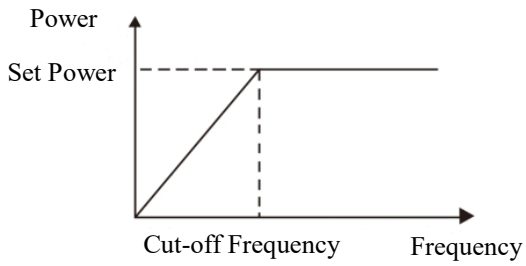


Figure3. Cut-off Frequency & Output Power Relationship Charts

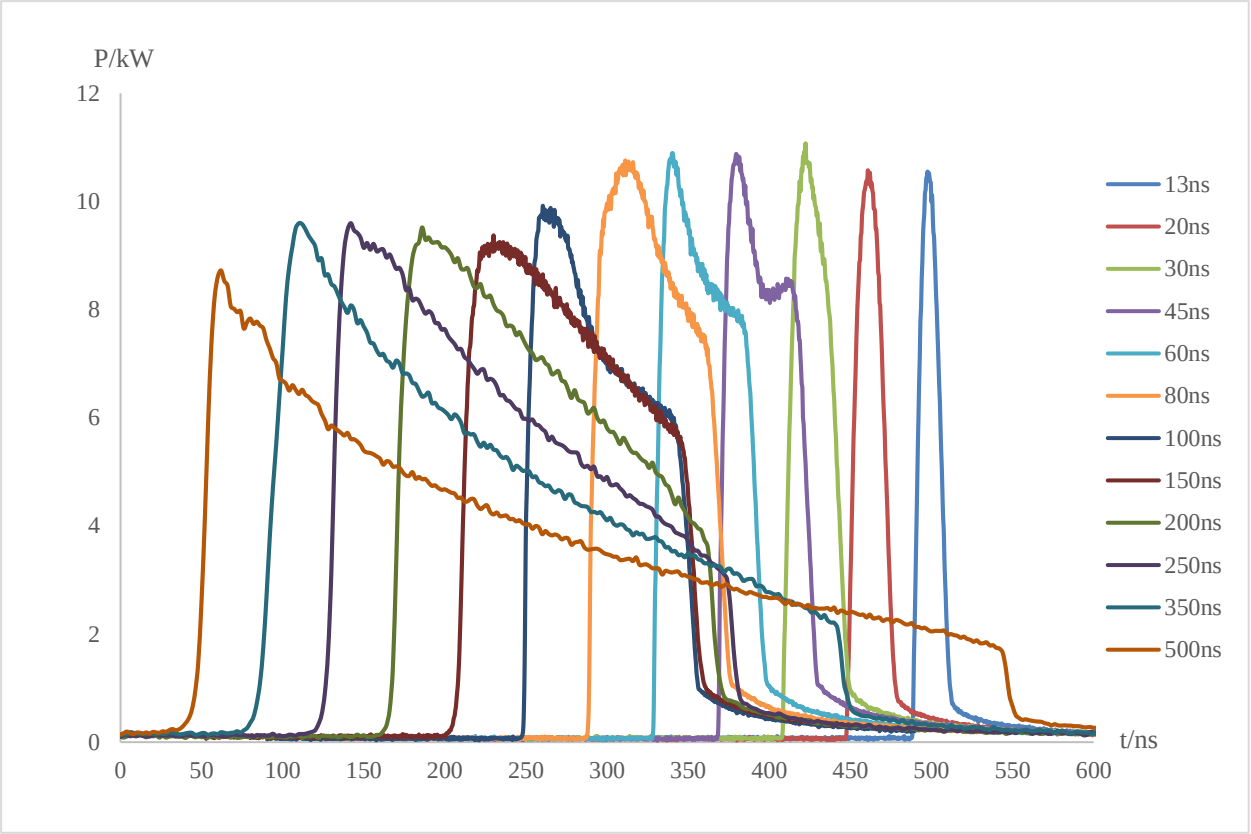


Figure4.1 YDFLP-CL2-200/300-1-A Output Waveform Graph

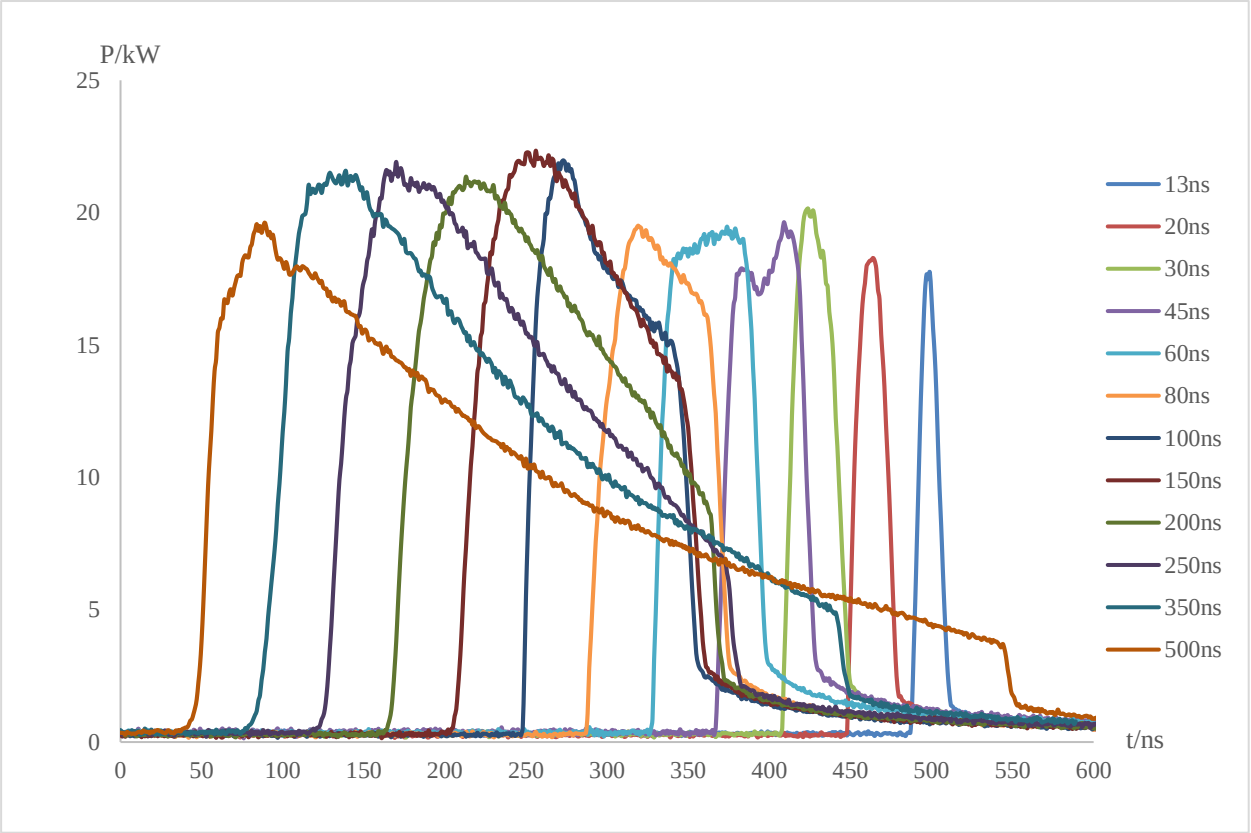


Figure4.2 YDFLP-CL2-200/300-5-A Output Waveform Graph

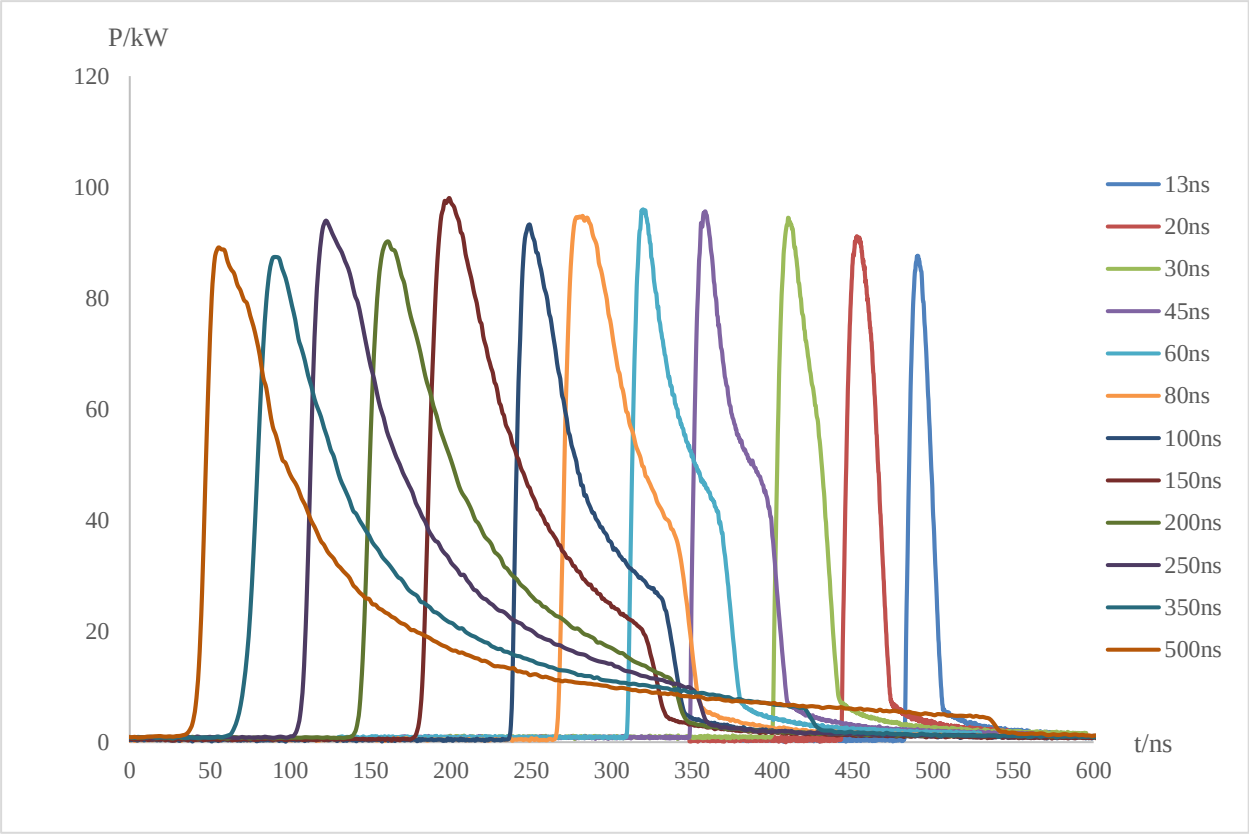


Figure4.3 YDFLP-CL2-300-10-A Output Waveform Graph

1.6 Installation

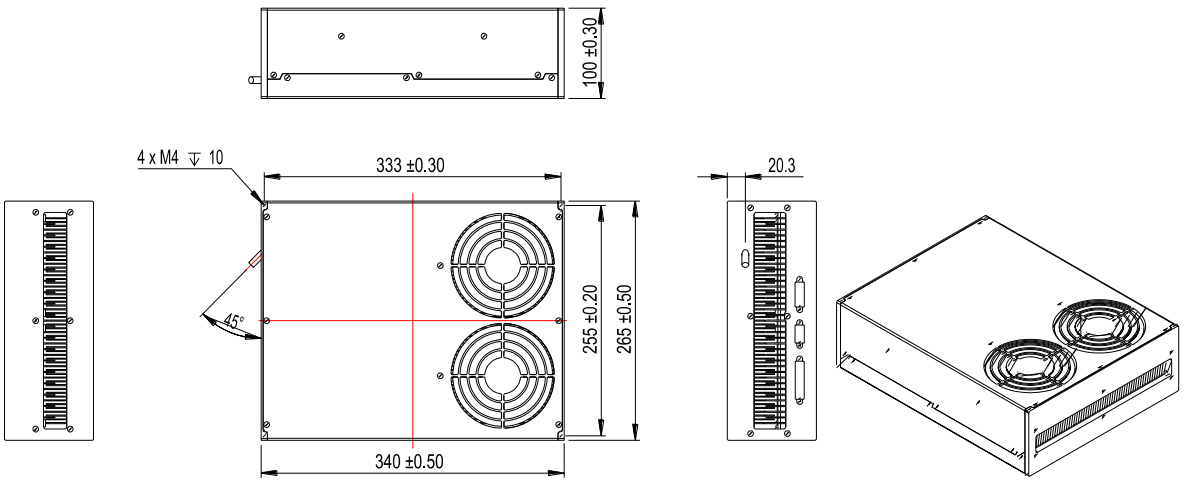


Figure 5. YDFLP-CL2-200-1/5-A&YDFLP-CL2-300-1/5/10-A Laser Module Dimensions (Unit: mm)

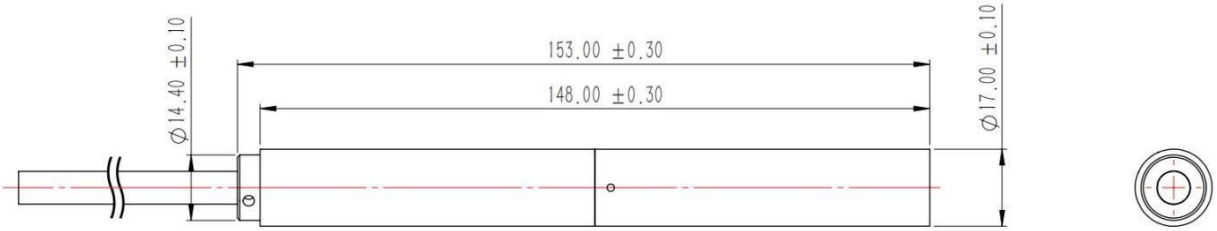


Figure 6. YDFLP-CL2-200-1/5-A&YDFLP-CL2-300-1/5/10-A Dimension of the Output section （Unit:mm）

∗ The Output section is only for reference. Please be subject to the actual product.

2. Laser port definition

2.1 Power cord and interface installation

1) Fix the laser module onto the mounting panel, make sure enough air gap around the laser module for sufficient air flow.

2) To connect the power supply cable to the 48V DC power supply, and make sure that the DC power supply can provide enough output power. Please note the polarity of the cable. Power supply cable “+” is DC positive and “-” is DC negative and GND is ground wire. Below figure8 is shown the power supply cable.

3) Ensure that the control interface of the external controller can match the laser,and then connect the control cable to the laser and fix it.

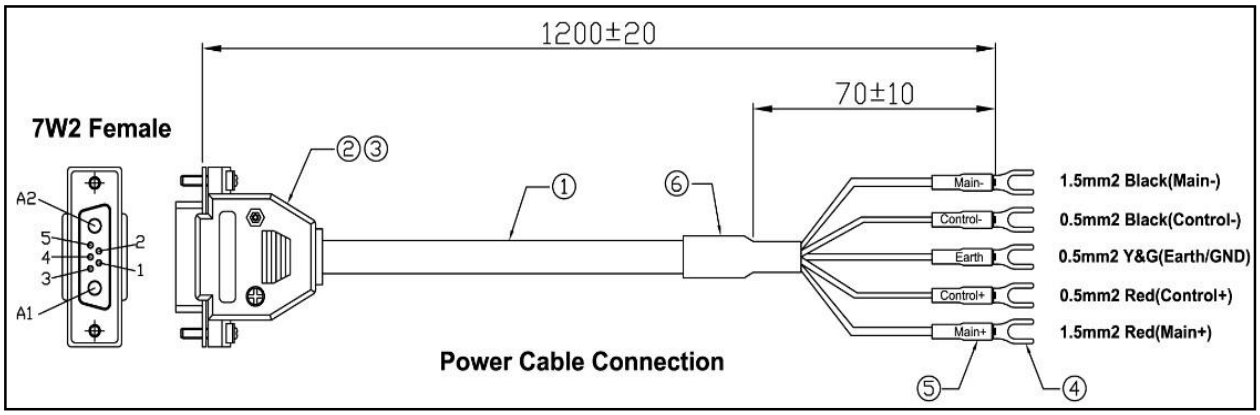


Figure 7. YDFLP-CL2-200-1/5-A&YDFLP-CL2-300-1/5/10-A Schematic diagram of laser power supply line

Table6. Laser power supply line pin definition

PIN	Describe
PE	Casing grounding wire
Main+	48VDC positive pole, laser main power supply
Main-	48VDC negative pole, laser main power supply
Control+	48VDC positive, control circuit power supply
Control-	48VDC negative, control circuit power supply

*If the independent power supply function is not required, control+and Mian+can be connected in parallel to the 48VDC positive pole, and control - and Mian - can be connected in parallel to the 48VDC negative pole.

2.2 RS-232 Connector

RS-232 connector is available for connecting PC or the Red Control card. Customer can monitor and control laser by GUI software, serial commands or red card after connected. Pins definition is shown in below Figure8 & Table 7:

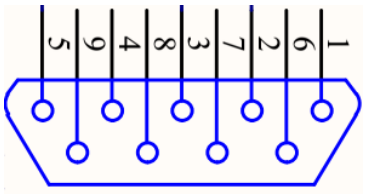


Figure 8 RS232 Connector DB9

Table 7. RS-232 Interface Definition

PIN#	Description
1，4，6-9	No need to connect
2	RxD
3	TxD
5	GND

2.3 Control Interface

DB25 is the interface usually used to connect the marking control system. The Pins are defined as shown in Figure 9 and Table 8.

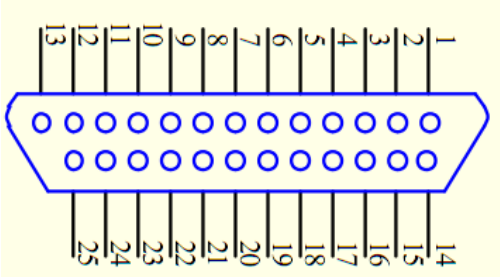


Figure 9. DB25 Connector

Table 8. DB25 Interface Definition

DB25 PIN*	Definition
1-8	IP0-IP7 Power Control
9	Latches power setting of the laser (effective during rising edge)
10,12,13,14,15	GND Description: PIN10-15 have connected to the ground inside the fiber laser, only need to connect control card GND with one of the Pins.
11	Low level, 1K resistance to GND
16,21	Warning signal Description:16 low level,21 high level: Normal 16 low level,21 low level: temperature alarm
19	Emission Modulation input (PA) HIGH= Emission ON LOW=Emission OFF
20	Frequency Modulation (TTL)
23	Emergency Stop signal High level: Normal; Low level: Emergency Stop (this function can be selected in GUI) Emergency stop signal is from low to high, need to detect the rising edge of MO firstly, then the laser can be re-emitted.
22	Red beam ENABLE (Red Beam is preferred when Laser and Red Beam are mutually exclusive. * refer to note2) Pulse width adjustment ENABLE (Please refer to the following pulse width control section for specific control mode). High Level: Red Beam On Low Level: Red Beam Off
18	MO signal for turn on/off HIGH: ON LOW: OFF
17,24,25	No need to connect

Note 1: 4.6-5.4V will be recognized as TTL high; 0-0.5V will be recognized as TTL low.

Note 2: Red beam Pin22 signal has higher priority than MO and PA signal. When Pin22 signal is high, MO and PA signal will be shut down internally. The laser can be emitted by restarting MO and PA after Pin22 signal is low, Priority mode can be set in GUI software.

PIN 1-8 power control

Please set the current of pump laser diode which is the output power through a combination of TTL signals of PIN1~8. The encoding can be set within the range of 0~255 which is corresponding to the 0~100% power output power (the actual optical power output may not be a linear relationship with these settings). Please refer to the description in table 9:

Table 9. Current Setting (example)

	Setting 1	Setting 2	Setting 3	Setting 4
PIN 1	0	0	0	0
PIN 2	0	0	0	0
PIN 3	0	0	0	0
PIN 4	0	0	0	0
PIN 5	0	0	0	1
PIN 6	0	0	1	1
PIN 7	0	1	1	1
PIN 8	1	1	1	1
Current	~50 %	~75 %	~87.5 %	~93.75%

The following is DB25 Control Time Sequence:

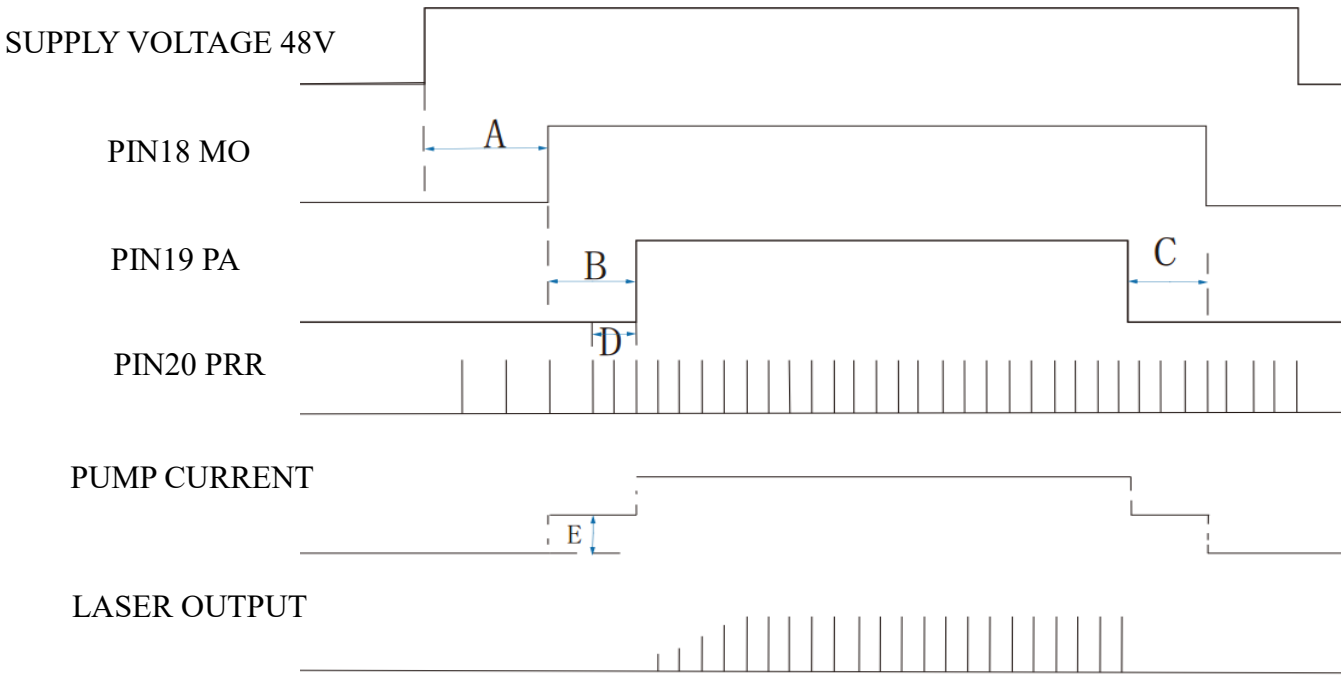


Figure 10. Diagram of DB25 Control Time Sequence

- A: 12 seconds System initialization time
- B: MO and PA signal delay time: range(8ms-35ms), recommend 8ms.
- C: Switching off PA should be earlier than MO or at the same time.
- D: Frequency sampling time under internal frequency mode, at least 1 complete frequency period before turning on the laser (PA).
- E: SIMMER value. The first pulse energy can be adjusted via GUI software.

Fiber laser control system self-locking:

If fiber laser is on abnormal status (high temperature, low power supply etc.), it will stop working to protect the whole system. Please restart the fiber laser.

Pulse Width Control

PIN2, PIN3 and PIN22 pins of DB25 control interface are not only used for basic control of laser, but also for pulse width control. Table 10 shows the pulse width control pin and signal description of laser.

Table 10. Pulse Width Control Pin and Signal Description of CL Series Laser

PIN. #	Item	Description
2	Serial Input	When fiber laser is serial input, setting data bits synchronize with the rising edge of serial clock.
3	Serial Clock	Serial digital clock, 8kHz≦Clock Frequency≦10kHz, 10KHZ is recommended.
22	Enable	Pulse width control function: High: Enable, Pin2 and Pin3 to control the pulse width Low or Not connection: Disable

1) Pulse Width Control Instruction Structure

- Send instruction to Pin2 of DB25 connector and send clock signal to Pin3 at the same time. The instruction description will be transmitted in binary form, with its most significant bit transmitted first.

- The instruction structure transmitted by the user to the laser is as follows:

0xA	Instruction

- 0xA5 (A5h) is the active pulse width control byte. 0xA5 and all subsequent data bytes are input to Pin2 serial input.
- Data length of input laser is 4-bit bytes.
- The first byte of instruction code is 0x01.
- The Pin22 signal needs to be turned on 10us in advance before sending Pin2 and Pin3 signals. After finished pulse width adjustment, Pin2 and Pin3 signals need ⩾10us delay before turning off Pin22 signal (as shown in Figure 13).
- All instruction design starts with byte 0xA5.
- Set Pin19 low before using pulse width control function.

2) Pulse Width Control Instruction Code

Table 11. Pulse Width Control Instruction Code

Instruction	Instruction Code	Description
Set-up pulse width	0x01	Set-up pulse width (ns)

It takes less than 50ms to finish the fiber laser pulse width initialization.

Remarks: If Instruction code transmit 3 * 0x01 instruction, it will not be accepted by the laser.

3) Pulse Width Time Sequence

- The following figure is an example to illustrate the sampling series diagram with a pulse width of 200ns. The series of 0x01 bytes of instructions is as follows:

Example: 0xa5 → 0x01 → 0x00 → 0xc8

0xa5: for activating pulse width control instruction

0x01: for setting pulse width instruction

0x00 and 0xc8: set the pulse width to 200ns.

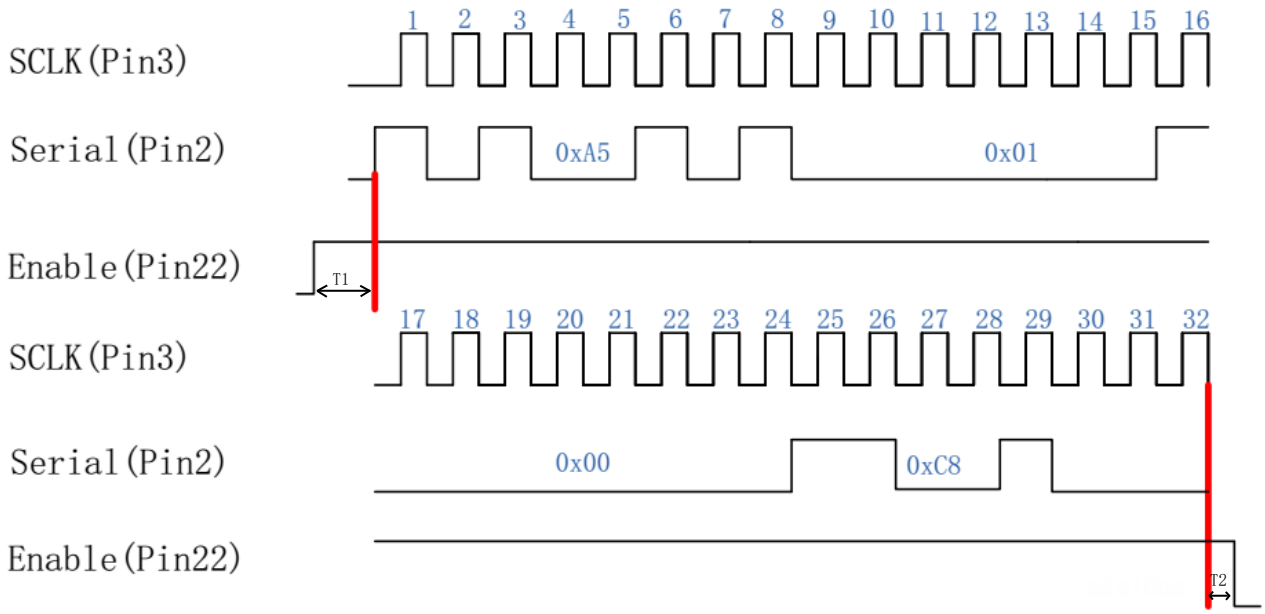


Figure 13. Diagram of 200ns Pulse Width Control Sequence

T1: the duration is 10us, and the enabling signal of pulse width adjustment needs to be turned on 10us in advance before adjusting the serial input and the serial clock signal.

T2: the duration is 10us. After pulse width adjustment, it needs to delay 10us before closing.

- If the user sets 350ns pulse width, the input instruction is: 0xa5 → 0x01 → 0x01 → 0x5e, where 0x01 and 0x5e represent the pulse width value 350.
- The parameter of this instruction is the binary value of pulse width.
- The user can compile any pulse width, but the laser only accepts the specified pulse width (refer to the specifications of various versions for specific pulse width). If the given pulse width is out of the range, the laser will output with the close pulse width value.

3. JPT GUI Testing Software

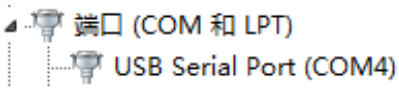
TypeE is designed for YDFLP-E series laser. It has multiple functions including laser control, setting the default parameters, setting the control mode, alarm monitoring, DB25 interface monitoring, internal parameters monitoring etc. TypeE also records error events which caused system self-locking.

3.1 Introduction to software connection and control

3.1.1 Connecting method

Using USB TO RS232 cable to connect PC's USB to the Laser's RS-232 connector.

After connecting the data line, check the serial port number: my computer → properties → hardware → device manager →



Click and open the Serial Com Number as follow:

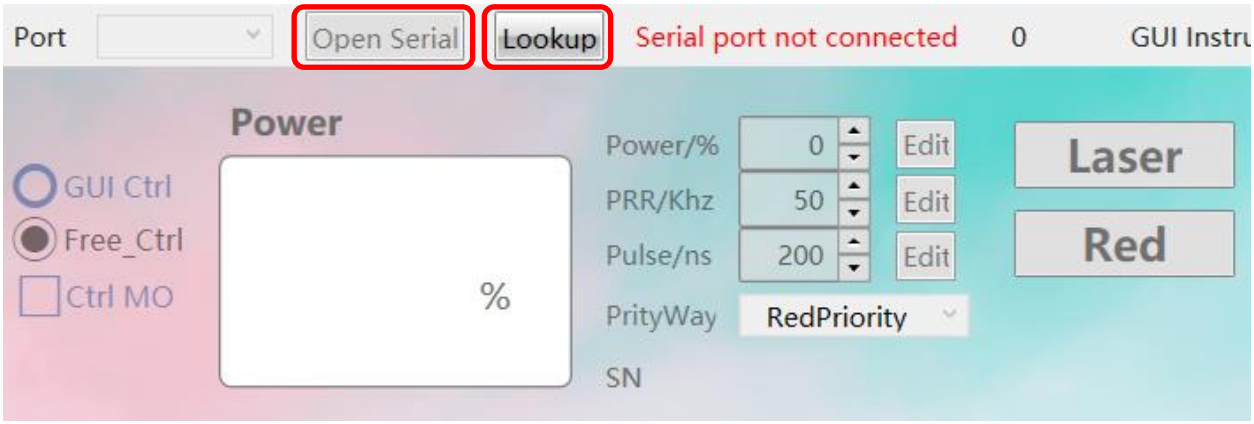


Figure 12. The Selection of GUI Serial Port Connection

3.1.2 Connecting State

Figure 13. GUI Disconnected State

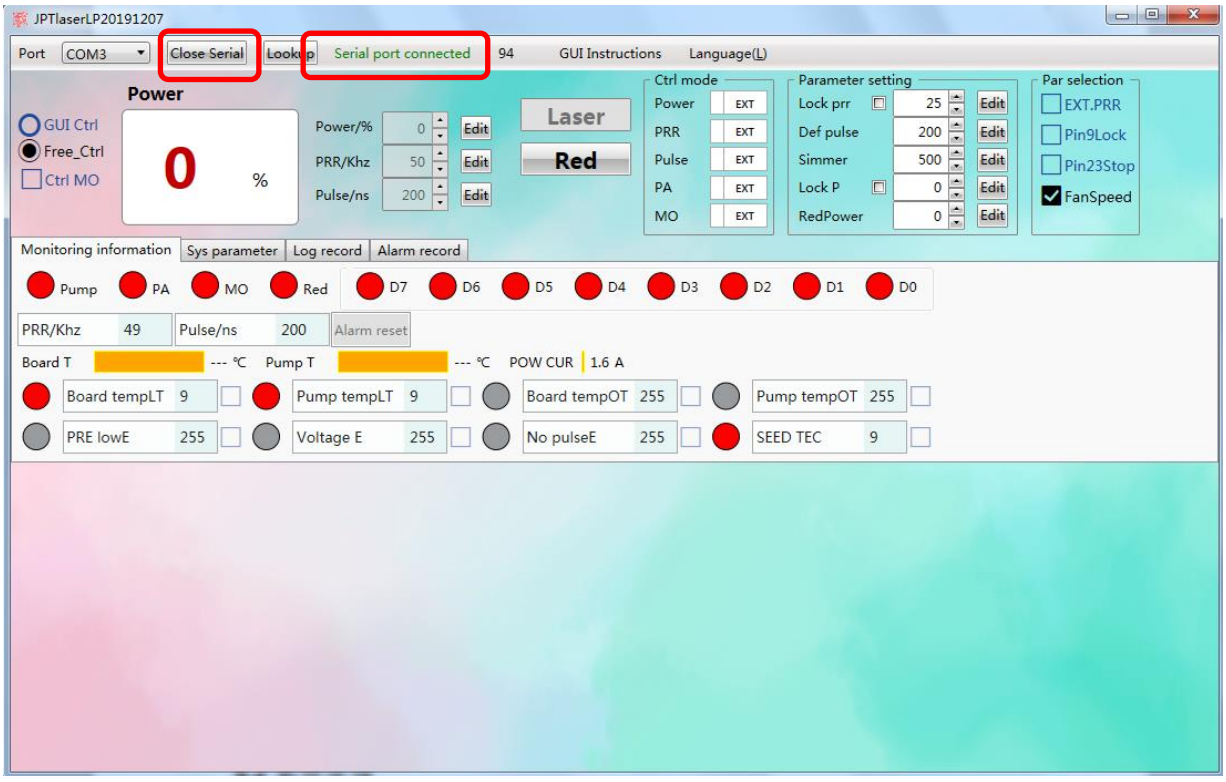


Figure 14. GUI Connected State

3.2 GUI control function

3.2.1 GUI control the emission

1) Choose the GUI control Mode

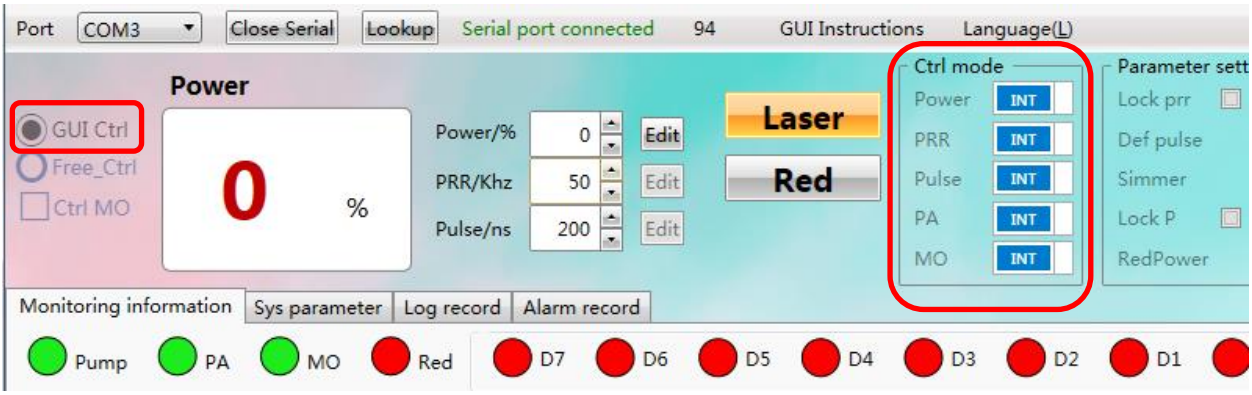


Figure 15. GUI Full Ctrl mode

GUI Full Control mode(GUI Ctrl)：When selecting the GUI full Control mode, all the parameters of Internal/External Control mode (EG. power, frequency, pulse width, PA, MO) will change to Internal Control mode. This mode will not be preserved after power off. It will change to “Free Ctrl” mode after serial port closed, and all the parameters of Internal/External Control mode will be changed to the previous free control mode setting. User can select this mode to test the emission of laser temporarily.

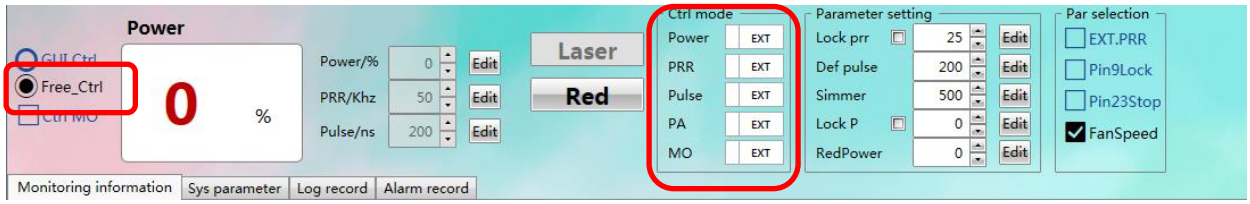


Figure 16. Free Ctrl mode

Free Control Mode (Free Ctrl): When selecting free Control mode, user can choose parameter control mode individually. In this mode, all the settings will be preserved after power off. EG. User can select this mode to lock a specific frequency or output power individually when don't want to control it by external signal.

2) Set parameters and emitting

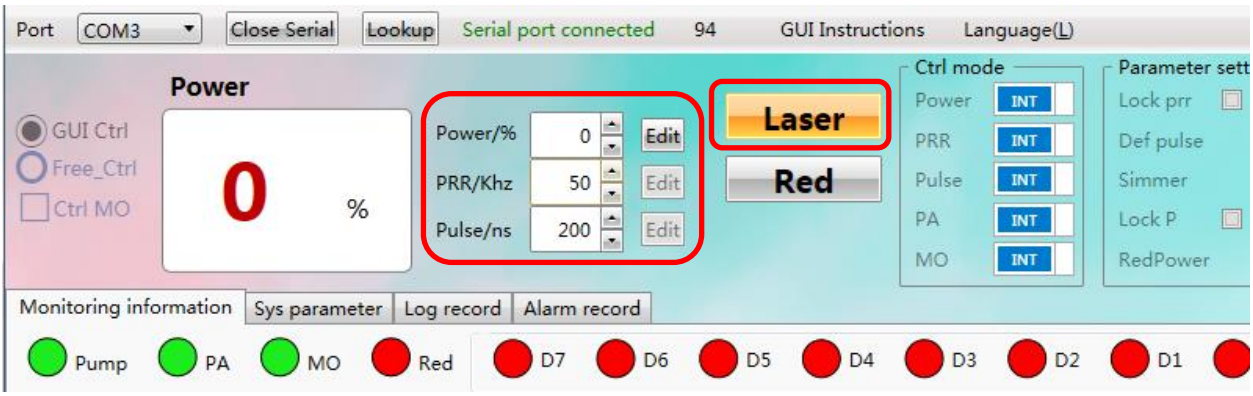


Figure 17. Setting parameters and emitting

After selecting full control mode, user can set power, frequency, pulse width and then press “edit” button to confirm. User can switch on/off emission when clicking “Laser” button.

Note: All the parameters except power can’t be modified during emission.

3) Control MO signal

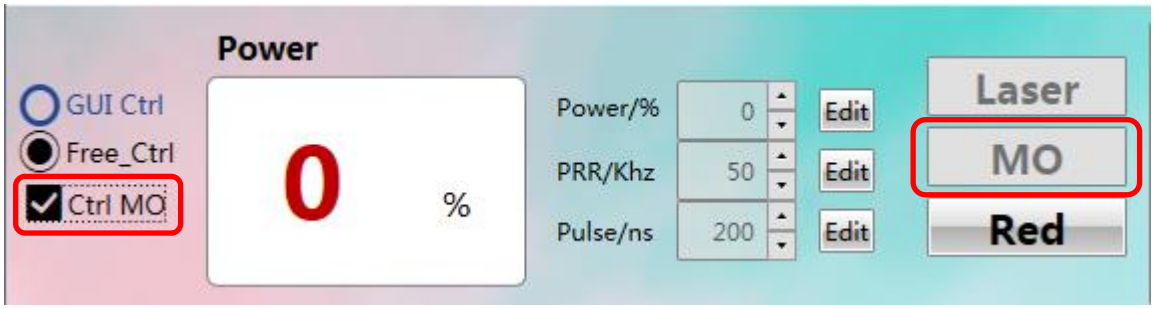


Figure 18. GUI control MO state

Ctrl MO: The “MO” button will be appeared on the interface after selecting Ctrl MO. User can control the switching of MO signal while clicking this button. This setting will not be preserved after power off.

3.2.2 Default parameter setting and selection

E type software can modify laser default parameter setting and selection in the option of "Parameter setting" and “Parameter selection”. The parameter settings take effect immediately and save automatically after power down.

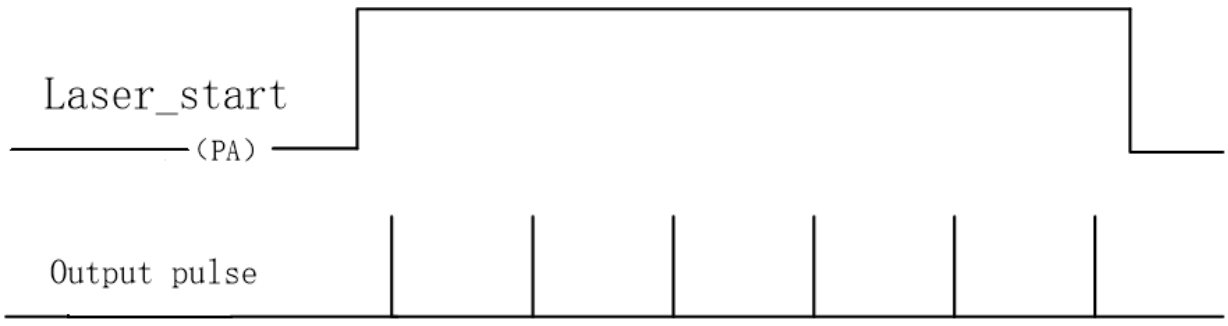
Figure 19. Default parameter settings and selection

Lock PRR: Laser will lock to GUI setting frequency.

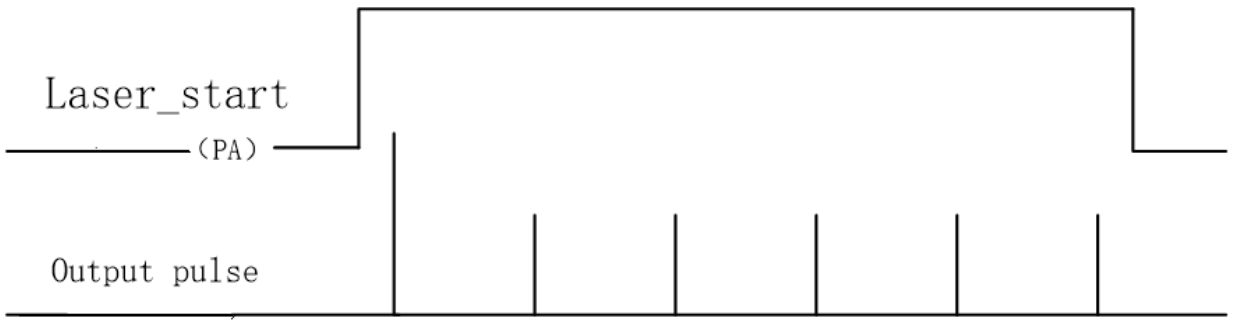
Default pulse: The laser will use GUI default pulse when no pulse width control command received.

Simmer： Can be used for controlling the height of the first pulse, the higher the value, the larger the first pulse. Setting range: 0-1000

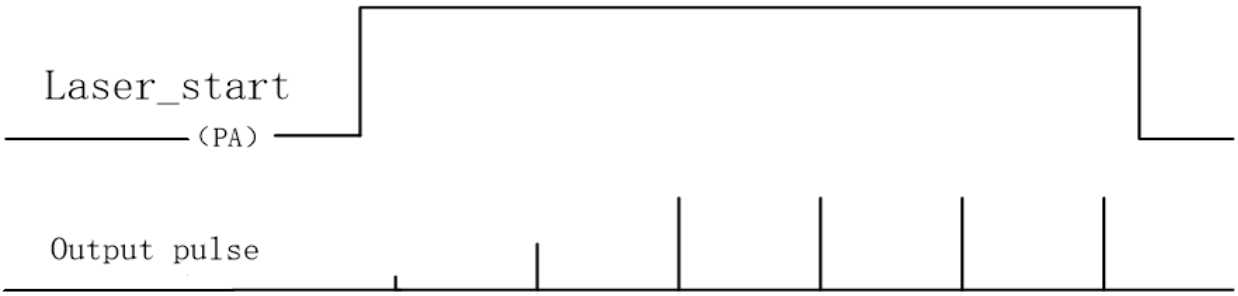
Simmer setting examples:



[Appropriate Simmer]



[High Simmer]



[Low Simmer]

Default pulse width: If the external control fails to provide the pulse width signal, the laser will work according to the default pulse width window setting value.

Default frequency: If the external control fails to provide frequency signal, the laser will work according to the default frequency window setting value.

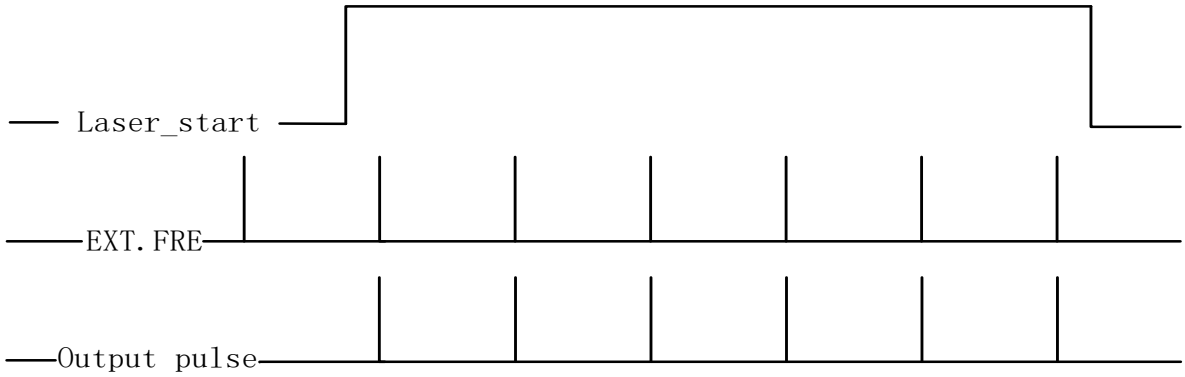
Pin9Lock： Power latch function is enabled if selected, the value of Pin1 to Pin8 is latched during the rising edge. Default setting is not selected.

Pin23Stop： Emergency stop function is enabled if selected. Low level is effective. Default setting is not selected.

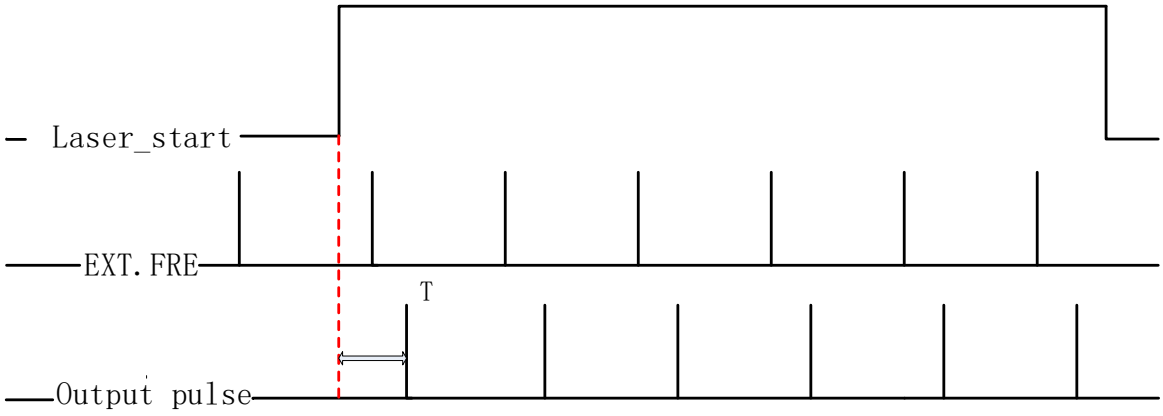
External frequency: When selecting external frequency mode, the laser output pulse will be synchronized with external frequency signal. If the control card has optimized the external frequency signal, this mode can be used.

When this option is not selected, the laser will use with internal frequency mode. And the laser will calculate external frequency signal in MO and PA delay time. Default setting is internal frequency mode.

External frequency and internal frequency setting examples:



[External Frequency]



[Internal Frequency]

*T=Duration of pulse period, maximum duration ≤ reduction frequency period

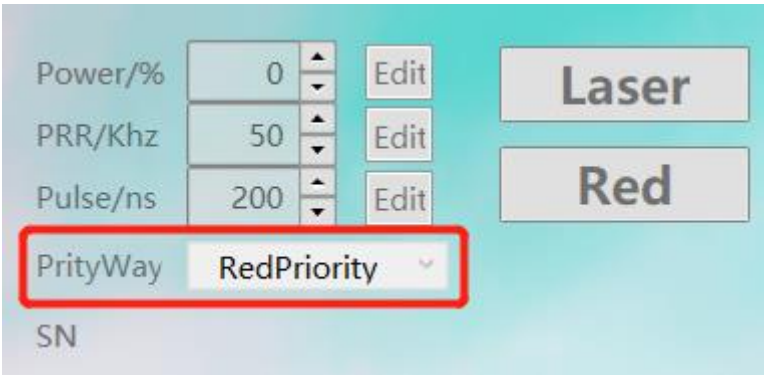


Figure 20. Red light/laser priority function option

Prity Way: Select red light/laser priority function mode

3.3 Laser Monitoring Function

The monitoring function of TypeE software can observe some operation parameters and alarm conditions. The laser will send the number of alarms saved in the system to the GUI software each time when it is turned on.

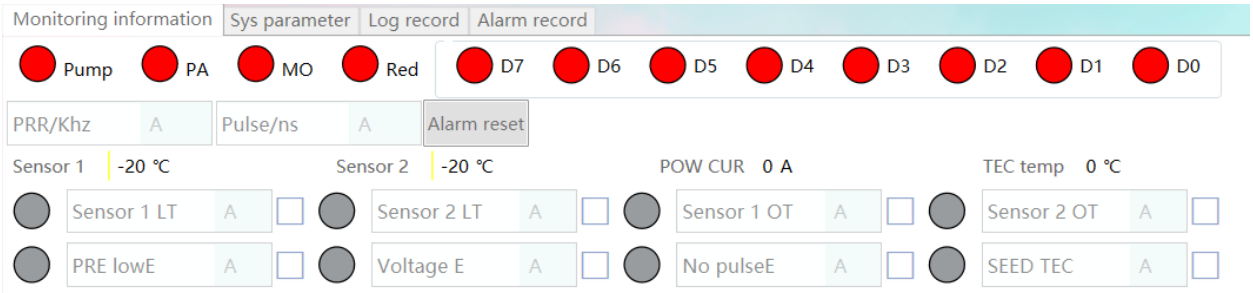


Figure 21. Laser Running Status Monitoring

1) Status Monitoring

Pump: monitors whether the laser pump is in normal working condition. It is green under normal conditions, and it will be red in case of abnormal alarm.

PA, MO and Red: monitor whether the laser currently receives the control signal. The green light is the status of received signal, and the red light is the status of not received signal.

D7-D0: monitor the current power signal of the laser, corresponding to the 8-bit binary mode. D0 is the lowest bit, D7 is the highest bit, and the green light is the status of the received signal of this bit.

Pulse width: monitor the working pulse width parameter of the current laser.

Frequency: monitor the current laser operating frequency parameter.

Sensor 1: monitors the temperature of the optical path module of the current laser.

Sensor 2: monitors the current output isolator temperature.

POW CUR: monitors the working power of a group of pump sources inside the current laser.

TEC temp: monitor the current laser seed source TEC temperature

Sys parameter: the manufacturer's internal system parameter setting interface (only for internal use of JPT).

Log record: record the laser setting and alarm information.

Alarm record: record the first 10 laser alarm records in sequence.

2) Alarm monitoring description

Sensor 1 LT: light path module temperature is lower than the set temperature alarm.

Sensor 1 OT: optical path module temperature is higher than the set temperature alarm.

Sensor 2 LT: output isolator temperature is lower than the set temperature alarm.

Sensor 2 OT: output isolator temperature is higher than the set temperature alarm.

PRE lowE: abnormal alarm for low primary current.

Voltage E: the laser detects that the power supply voltage is too low or too high.

No pulse E: alarm when no seed source backlight signal detected or backlight signal frequency less than 1kHz.

SEED TEC: seed source temperature abnormal alarm.

3) Description of the performance of the red light indicator in the alarm state

In addition to viewing the alarm condition of the laser under abnormal conditions in the GUI monitoring status bar, the alarm condition can also be visually reflected through the irregular flashing of the indicator light (Table 10).

Table 12 Laser red light indication alarm information

Red light flashing	alarm information
Fast alternating flashing	sensor 1 alarm
Slow alternating flashing	sensor 2 alarm
Flashing according to the rule of long, short and short	No pulse E
Flashing according to the rule of short, long and short	PRE lowE
Flashing according to the rule of short, long and long	SEED TEC
Flashing according to the rule of long, short and long	Voltage E

Alarm reset: the alarm of sensor 1 and sensor 2 is self-recovery alarm, that is, when the temperature recovers from the alarm temperature to the normal temperature range, the laser will release the alarm state, but the laser needs to re-receive the optical signal to continue to emit light. Except for sensor 1 and sensor 2 alarms, all other alarms need to restart the laser to remove the alarm status.

4. Faults and handling measures

NO.	fault problems	Main causes and treatment measures
1	The laser fan does not turn and cannot be powered on	（1）Check the positive and negative wiring of the laser power supply; （2）Check the laser power supply and test whether the power supply meets the laser power supply requirements; （3）By default, the laser is cooled by fan speed regulation. When the ambient temperature is low, the laser is powered on. The fan runs at full speed first, and then stops rotating. This is normal. When the temperature rises, the fan will rotate; （4）If the laser still does not power on after replacing the power supply that meets the requirements, please contact our technical personnel as soon as possible.
2	Laser alarm	（1）Check whether the laser output has red light flashing. If the red light flashing alarm is given, refer to the "Alarm red light flashing instruction" （2）Other alarms can be monitored and checked in combination with GUI internal control software.
3	The power supply is normal and there is no alarm, but there is no light	（1）Check the DB25 wiring, and connect it correctly according to the laser definition (refer to Table 7 Laser DB25 control interface definition), in which Pin18 and Pin19 signals control the laser on; （2）Check the power supply and software settings of the marking card; （3）Check the status of the indicator red light signal. Due to the principle of red light priority, the indicator red light signal is in the high level (Pin22 pin is high level) state, and the laser has priority to output red light without laser.
4	Low laser output power	（1）Check the power supply of the laser. The rated output current of the power supply should be greater than the required current of the laser; （2）Check the output lens of the laser, and check other lenses passing through the laser optical path such as the red light beam combining mirror, galvanometer, field mirror, etc. If there is dirt, wipe it gently with absolute alcohol dipped in a cotton swab. Please be careful not to scratch the coating layer of the lens; （3）Check whether the laser output spot is blocked, and ensure that

		the laser output port is coaxial with the galvanometer input port during installation; （4）Check the focus position and confirm that the parameters used are set to the best state of the laser; （5）After the laser is used, the laser power will have a power attenuation of less than 8%/year, which is normal.
5	Laser output is intermittent	（1）Check whether the laser and the power supply are grounded correctly and whether there is strong current or strong magnetic interference around the laser. If there is interference, it is recommended to use the signal line with shielding function. The strong current and weak current are routed separately. Based on the principle of red light priority, if the interference causes the trigger of red light, the laser will not be emitted; （2）Check that the parameters and configurations used are consistent with the characteristics of the processed materials. For materials with high reflectivity or high damage threshold (such as ceramics), high peak power parameters and strong energy density parameters are required for processing. Poor use parameters and configurations will also cause intermittent light emission.

5. Maintenance and service

5.1 General warranty

After the delivery of all products manufactured according to the order or specifications, Jeep will guarantee the products with defects in materials and technology within the warranty period of the contract, and ensure that they meet the specifications under normal use. Jept has the right to selectively repair or replace any products with problems in materials or technology during the warranty period, and provide repair or replacement services for products with faults caused by materials or production processes. Jept reserves the right to collect payment for products with problems under normal use.

5.2 Warranty limitations

(1) It is artificially tampered, disassembled or transformed by personnel other than Jeep;

(2) Damage caused by improper use, negligence or accident;

(3) Used outside the scope of product specifications and technical requirements;

(4) Laser damage is indirectly caused by failure of user software or interface;

(5) It is used under improper installation, maintenance or other abnormal operating conditions not included in this manual;

(6) Accessories are not covered by the warranty.

The above are the instructions for the use of the products of the company for users' reference only. The formal service and warranty contents are subject to the agreement in the contract and after-sales service commitment letter. Thank you for your support.