Pulsed Fiber Laser

YDFLP-E-80&100-M7-M-R

USER MANUAL

Version V00

深圳市杰普特光电股份有限公司
SHENZHEN JPT OPTO-ELECTRONICS CO., LTD.

Safety Information

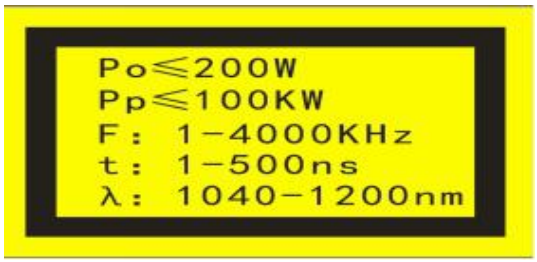
Please read this manual carefully before operating the YDFLP fiber lasers.

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 laser.
- 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 60W 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)
	Product Rating Information (Attached on the cover plate)

Contents

1. Product Introduction

1.1 Product Description

JPT E-M7 Series fiber laser control with standard DB25 interface and powered with 48V DC. It is designed for high-speed and precise marking application. The pulse response and performance are much better comparing to similar products. Significantly compact size is ideal for small marking system.

Photographs of typical E-M7 type fiber lasers are shown in Fig.2 and Fig.3 (For the specific appearance, please refer to the appearance of the product shipped):

Figure 2 YDFLP-E-80&100-M7-M-R

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
Testing Report	1
Power Cable	1
Dust Cap for Laser Isolator	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 48VDC 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 minimum10cm 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 default running ambient temperature range is 0~40℃. **Enable the "Performance Mode" by GUI, the average output power can be increased by 20% under this mode when at the same cut-off frequency. The operational temperature range 5-35℃ is recommended at this point. The sensor might be alarm if temperature beyond 5-35℃ and continuous emitting the laser under the high energy. (Please refer to the introduction of monitoring function and alarms in Chapter 3.2.)** 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-E-80&100-M7-M-R contains 17 wave-forms: CW, 2ns, 4ns, 6ns, 9ns, 13ns, 20ns, 30ns, 45ns, 60ns, 80ns, 100ns, 150ns, 200ns, 250ns, 350ns, 500ns.

Other pulse width is available for customization request.

1.4 YDFLP Product Naming Convention

Table 3 Naming Convention for Pulsed Fiber Laser

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

1. Product Name: Ytterbium Doped Fiber Laser Pulse (YDFLP)
2. Product type
3. Average Output power
4. Pulse Characteristics:
M7 series - adjustable pulse width
LP series - fixed pulse width
5. Optical Fiber attributes:
M: Near single mode, M^2＜1.4
L: Low mode, M^2＜1.8
H: High mode, M^2＞2.5
6. Additional function: **R: Built-in red pilot laser**

Examples:

YDFLP-E-50-LP-L: Type E LP, using low mode type of optical fiber with nominal output power 50W.

YDFLP-80-M7-M-R: M7, using near single mode type of optical fiber with the nominal output power 80W, built-in red pilot laser.

1.5 Technical Specifications

Table 4 Specifications of the E-M7 Series Pulsed Fiber Laser

Characteristic\ Laser Type		YDFLP-E-80-M7-M-R	YDFLP-E-100-M7-M-R
M^2		<1.6	
Delivery Cable Length	m	3	
Average Output Power	W	>80	>100
Maximum Pulse Energy	mJ	1.5	
Pulse Repetition Rate Range	kHz	1-4000	
Pulse Width	ns	2-500	
Output Power Instability	%	<5	
Cooling Method		Air-cooled	
Power Supply Voltage (DC)	V	48V	
Power Consumption	W	< 400	<450
Power supply current requirement	A	>8	>9
Central Wavelength	nm	1064	
Emission Bandwidth@3dB	nm	<15	
Polarization		Random	
Anti-Reflection Protection		Yes	
Built-in Red Beam		Yes	
Output Beam Diameter	mm	7.0±0.5	
Output Power Tuning Range	%	0～100	
Ambient Temperature Rang	℃	0～40	
Storage Temperature Range	℃	-10～60	
Dimensions	mm	280*336.5*112	
Package Size	mm	455*365*245	
Weight	Kg	Net: 11 Gross: 12.2	

Table5 E-M7 Series Fiber Laser Cut-off Frequency Value（kHz）

YDFLP-E-80&100-M7-M-R			
Pulse Width (ns)	Cut-off frequency（kHz）		Max pulse frequency（kHz）
	YDFLP-E-80-M7-M-R	YDFLP-E-100-M7-M-R	
1 (CW)	-	-	-
2	2600	2960	4000
4	1800	2160	4000
6	1300	1400	4000
9	800	960	4000
13	550	680	3000
20	330	420	3000
30	250	300	3000
45	200	250	2000
60	180	200	2000
80	150	180	2000
100	140	160	1000
150	76	95	1000
200	60	75	1000
250	56	70	900
350	53	67	600
500	53	67	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:

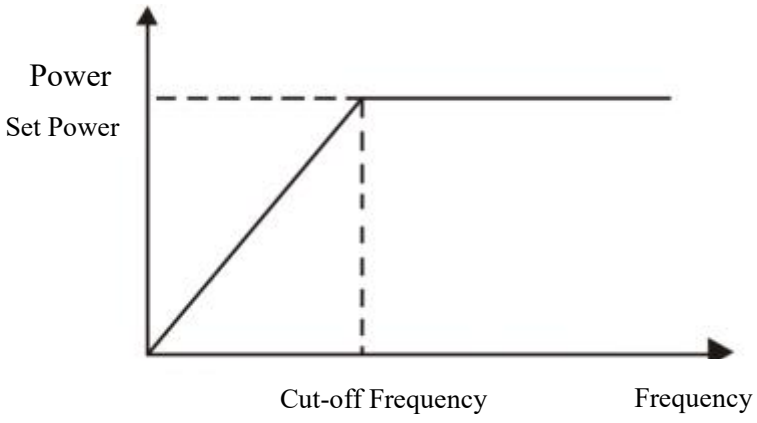


Figure 3 Cut-off Frequency & Output Power Relationship Charts

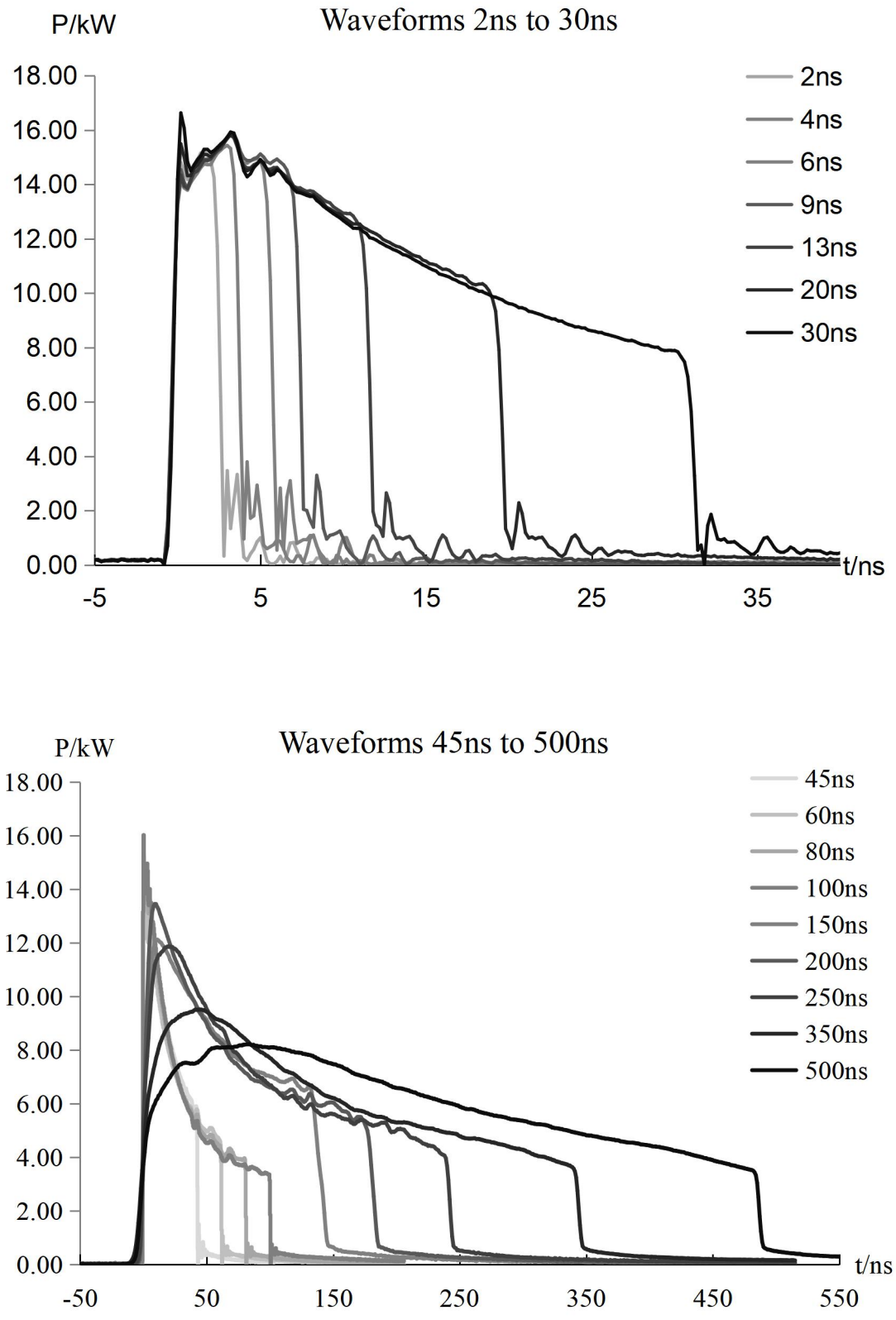


Figure 4 YDFLP-E-80&100-M7-M-R Output Waveform Graph.

1.6 Installation Dimensions

1. YDFLP-E-80&100-M7-M-R Laser Dimensions

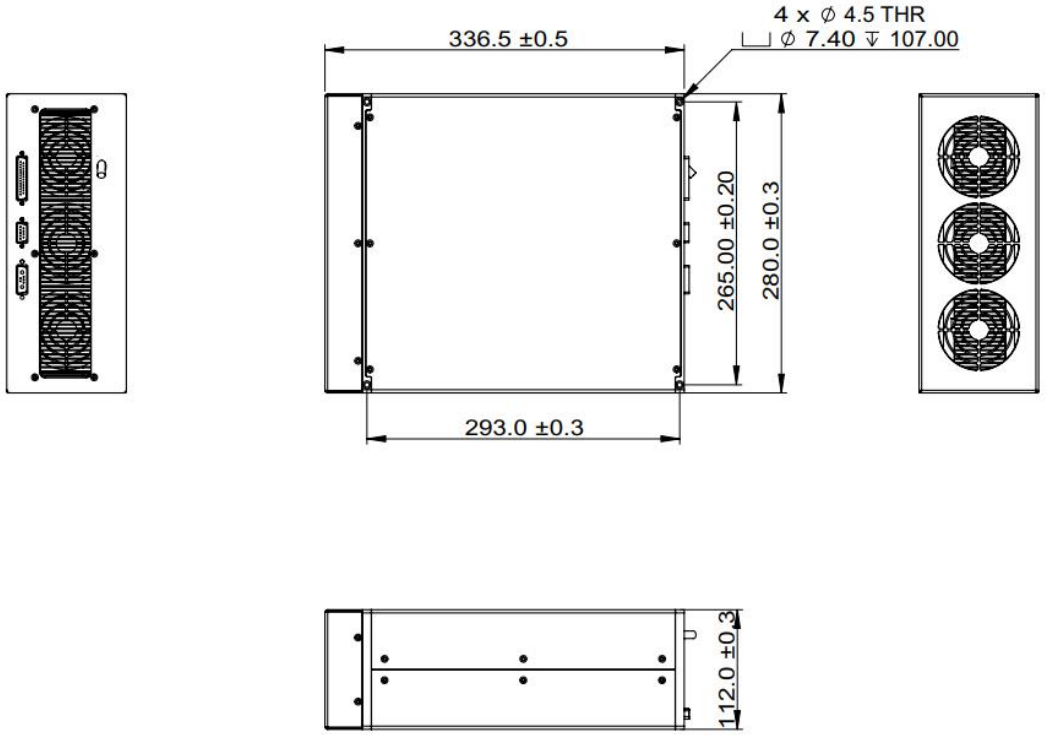


Figure 5 YDFLP-E-80&100-M7-M-R Laser Module Dimensions (Unit: mm)

2. YDFLP-E-80&100-M7-M-R Laser Dimensions

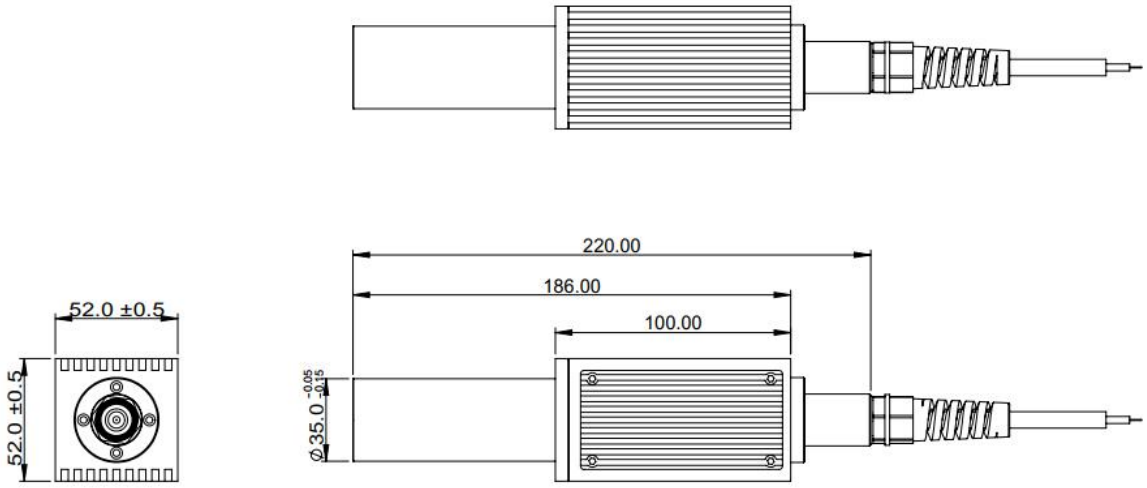


Figure 6 YDFLP-E-80&100-M7-M-R Standard Output Head Dimensions (Unit: mm)

∗ The isolator head is only for reference. Please be subject to the actual product.

2. Laser Interface

2.1 Power Supply Connector

Please refer to Figure7 & Table 6 in below to install the power cable to the 48V DC power supply, and ensure the DC power supply can provide sufficient output power. Please also note the polarity of the cable when connecting. The “main+” and “control+” at the end of the power cable are 48V DC positive, “main-” and “control-” are 48V DC negative, “Earth” is the ground wire.

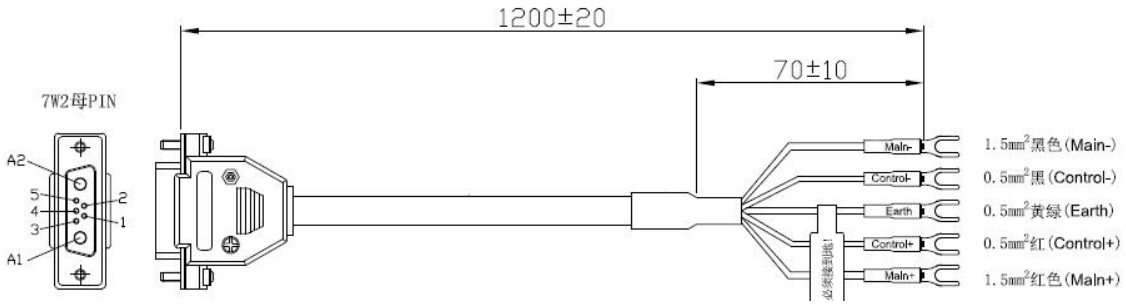


Figure 7　Diagram of the power supply cable

"Main +" and "Main -" are power supply pins of laser pump, "Control +" and "Control -" are power supply pins of control circuit. If independent power supply function is not required, main and control power cable can be used in parallel.

The power interface of the laser is DB-7W2 plug (male), and the pin distribution is as follows:

Table 6　Definition of power supply cable

PIN#	Description
A1	+48VDC，laser pump power supply
A2	-48VDC
1，3，4	No need to connect
2	+48VDC，control circuit power supply
5	Ground wire

Note: Housekeeping (main and control power supply independent) function can be customized.

2.2 RS-232 Control 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:

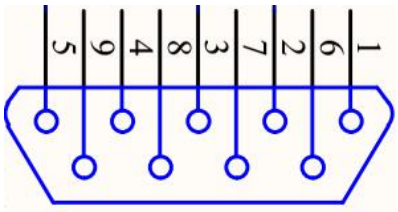


Figure 8 RS232 Connector DB9

Table 7 RS-232 Interface Definition

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

2.3 DB25 Control Connector

DB25 is the interface usually used to connect the marking control system. The Pins are defined as shown in Figure9 and Table 8.

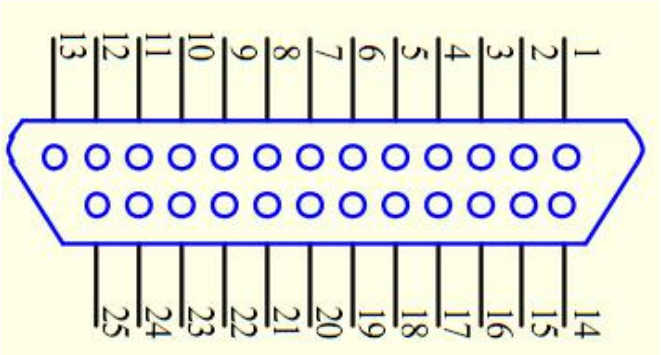


Figure 9 DB25 Connector

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(This feature can be enabled in the GUI)
10-15	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.
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: The default setting is red beam preferred. 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 up in GUI (please refer to Chapter 3.1.2).

PIN 1~8 Output Power Control

PIN1~8 controls the output laser power by TTL signal. The encoding can be set within the range of 0~255, which is corresponding to the 0~100% output power. The actual output laser power may not be a linear relationship with these settings. And the actual output power also related to the frequency. Please refer to the example of current setting 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%

PIN 18-20 DB25 Sequence

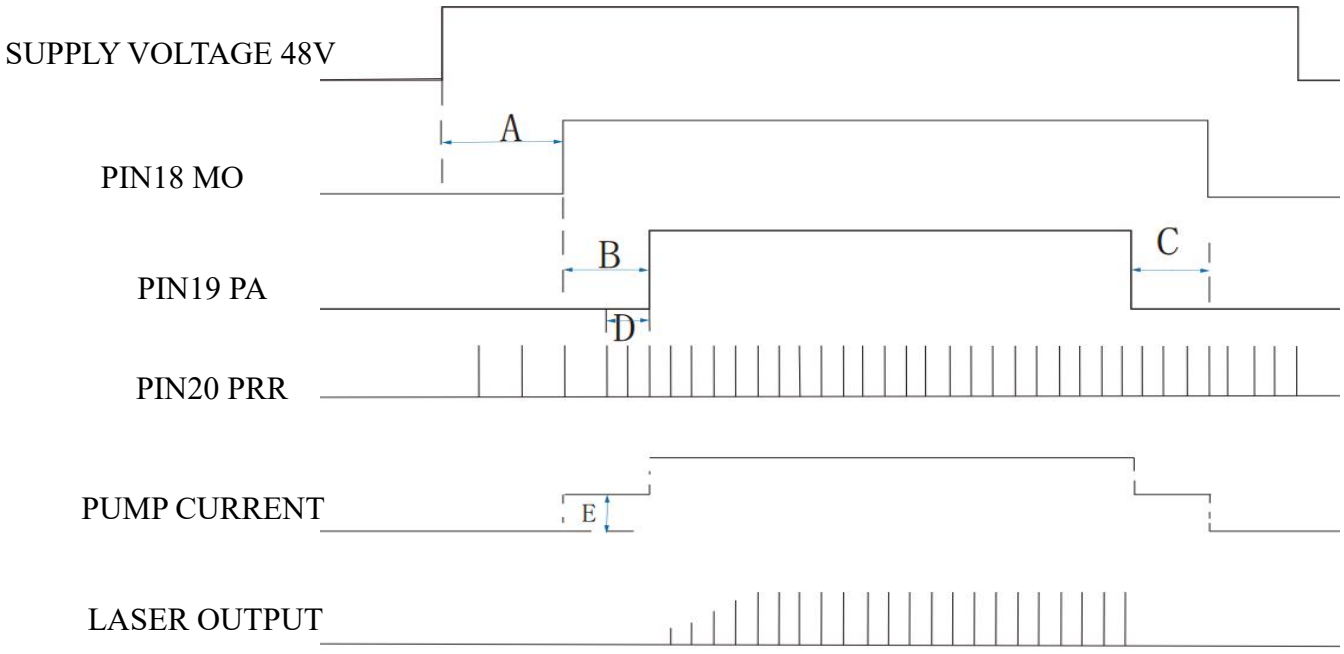


Figure 10 Diagram of DB25 Control Time Sequence

- A: 12 seconds System initialization time.
- B: ⩾4ms MO and PA signal delay time.
- 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 (eg.frequency signal<1khz, high temperature, low power supply etc.), it will stop working to protect the whole system. Please restart the fiber laser and power on.

PIN2, 3, 22 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 M7 laser.

Table 10 Pulse Width Control Pin and Signal Description of E-M7 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

- **Pulse width control instruction**

  - 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 Table 11).
- All instruction design starts with byte 0xA5.
- Set Pin19 low before using pulse width control function.

- **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.

- 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 @200ns.

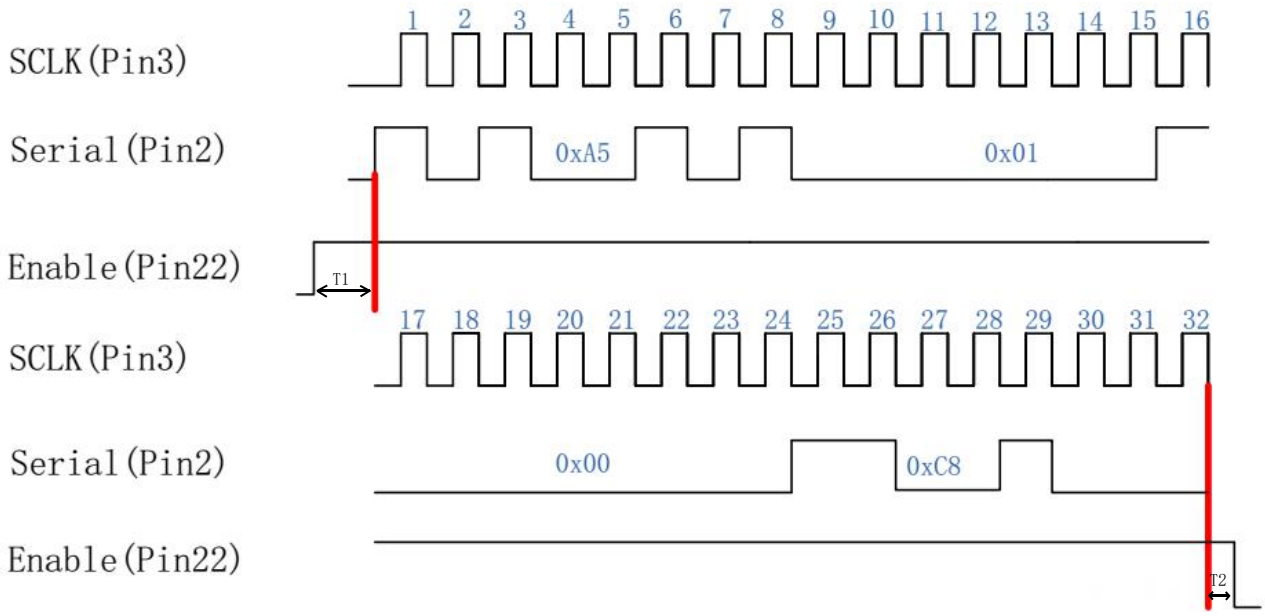


Figure 11 Diagram of 200ns Pulse Width Control Sequence

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 Laser Testing Software-TypeE

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. Using the matched GUI software for JPT laser is recommended. The GUI software, in addition to set the parameters, also can be used for signal monitoring and troubleshooting etc.

3.1 GUI Operation

Software Installation

Figure 12 Installation Package and Driver

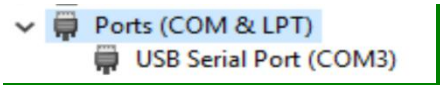
Installation steps: decompress installation package → install driver → install software library → open TypeE-GUI software

3.1.1 Serial COM Port

1) Connecting method

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

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



If the Serial Port Number is bigger than 4, revise the COM number to <4

Click and open the Serial COM Number as follow:

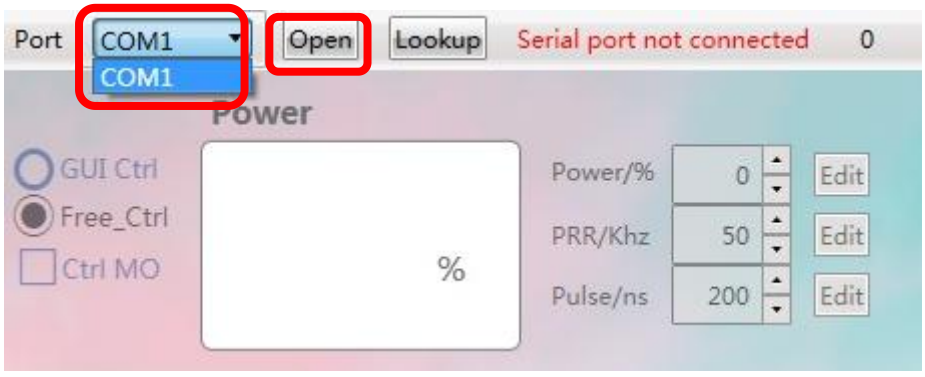


Figure 13 The Selection of GUI Serial Port Connection

2). Connecting State

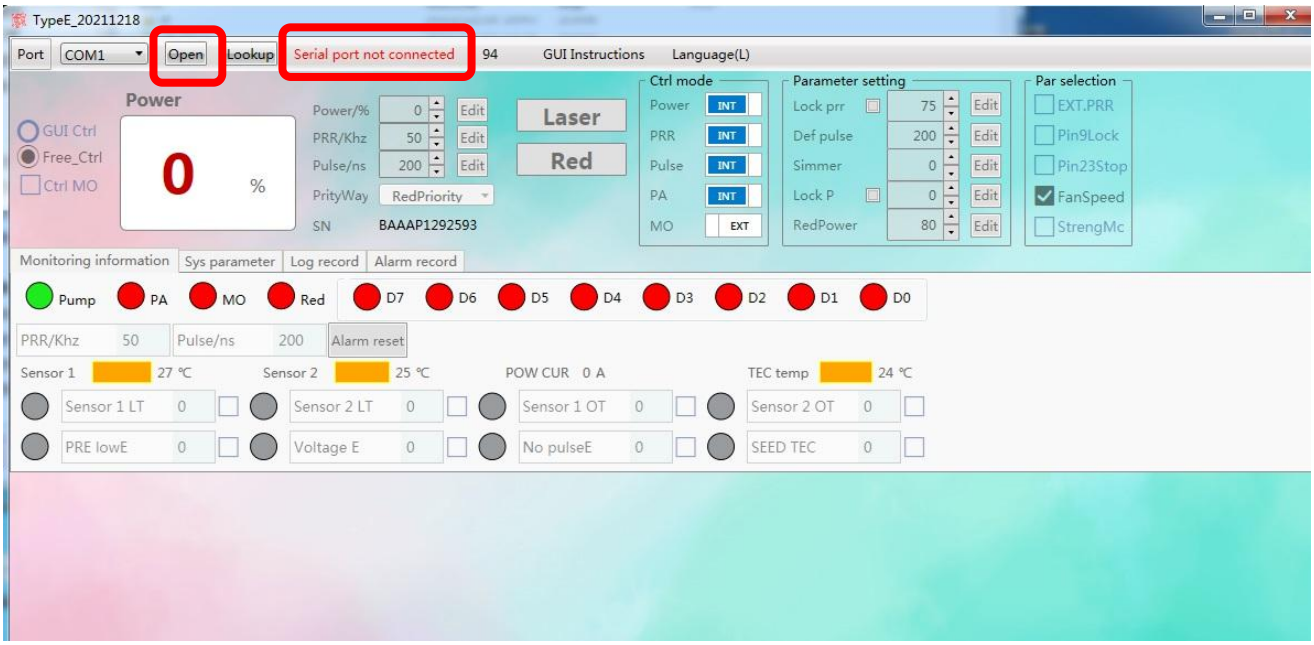


Figure 14 GUI Disconnected State

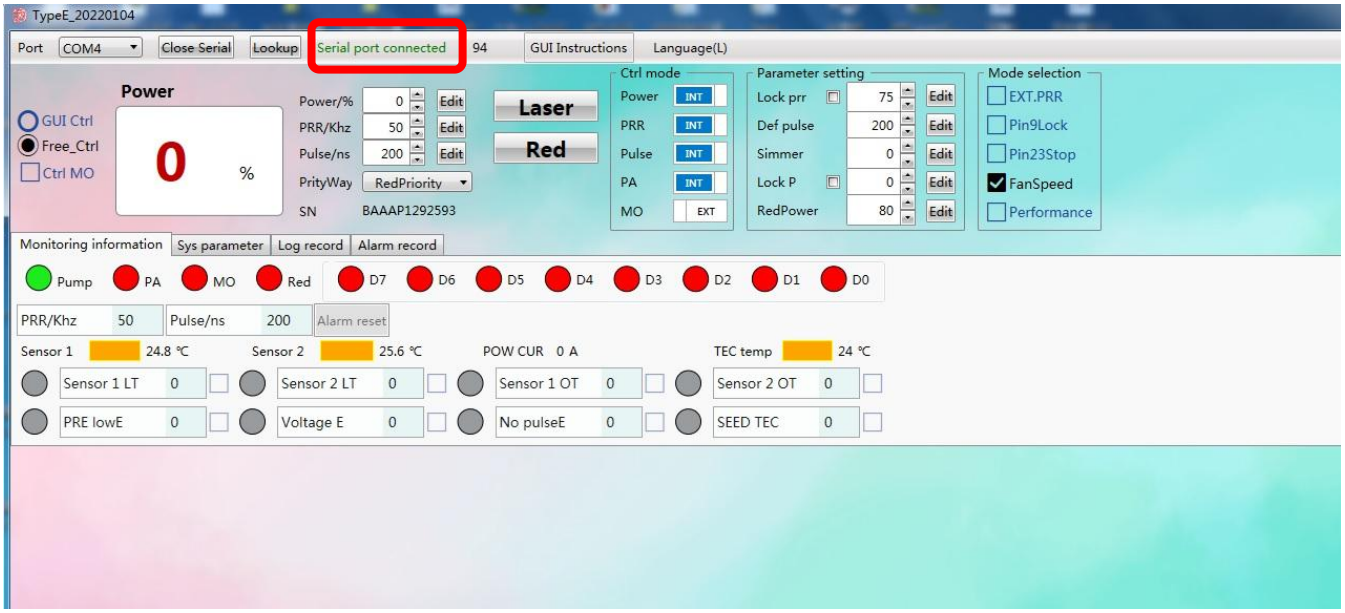


Figure 15 GUI Connected State

3.1.2 Laser Monitoring Function

1) GUI Control the Emission

① Choose the GUI control Mode

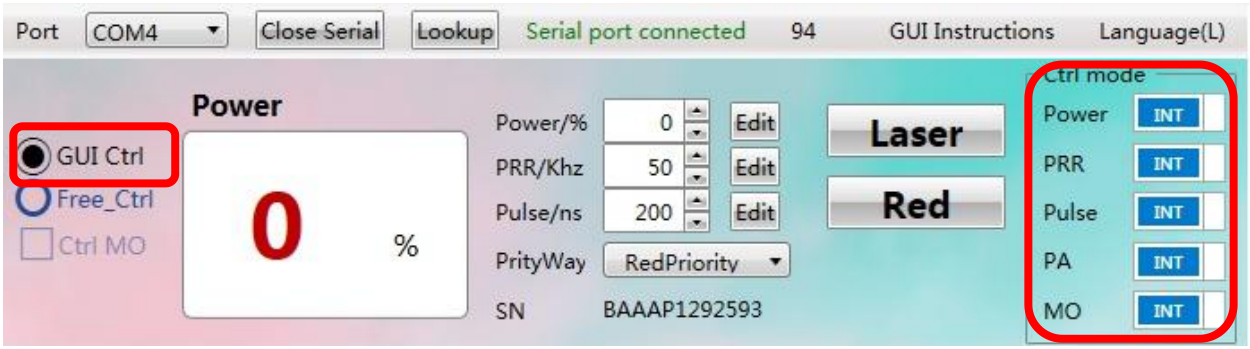


Figure 16 GUI Full Ctrl mode

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 external control mode setting. User can select this mode to temporarily test the emission of laser.

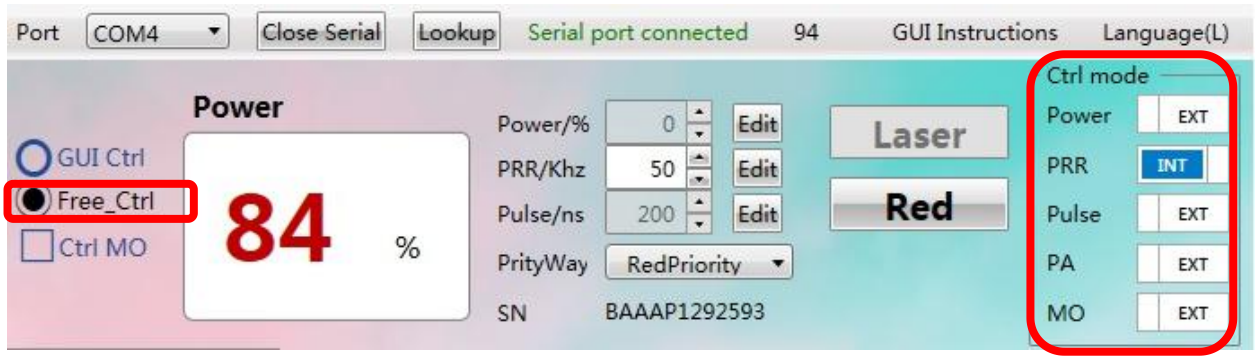


Figure 17 Free Ctrl mode

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

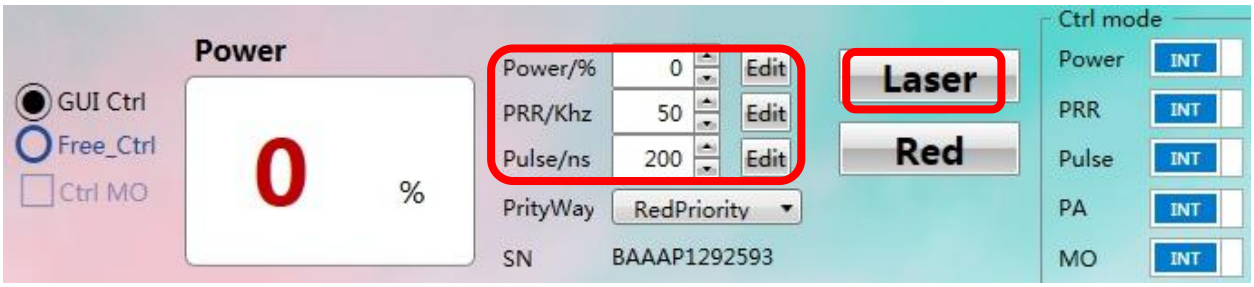


Figure 18 Setting parameters and emitting

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

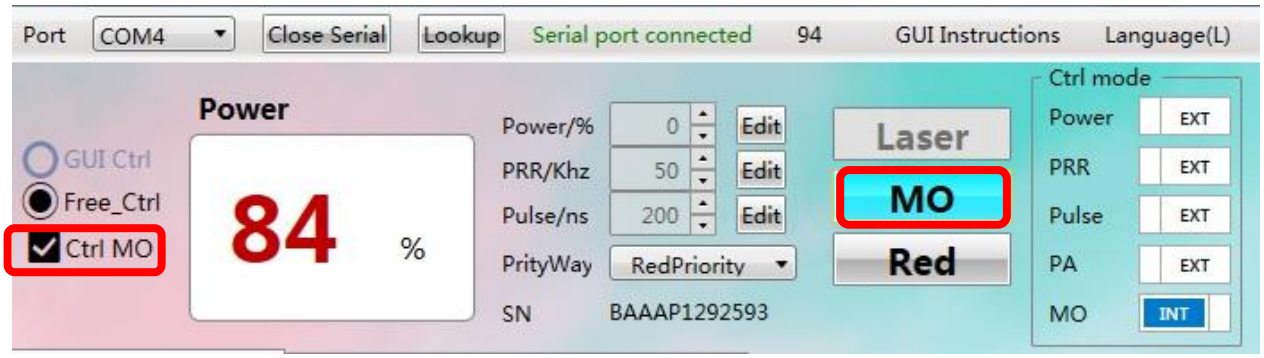


Figure 19 GUI control MO state

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.

2)Default parameter setting and selection

① Selecting red beam/laser priority mode

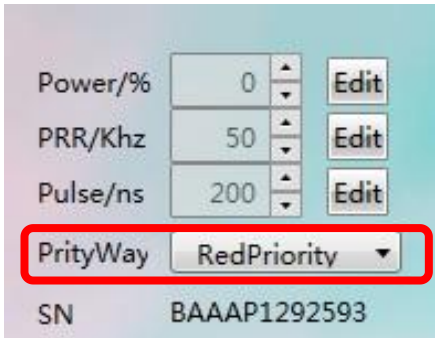


Figure 20 Selection Red Beam/ Laser Priority Mode

Laser priority: Laser is prior when laser and red beam are mutually exclusive.

Red priority: Red beam is prior when laser and red beam are mutually exclusive.

Laser priority and red beam switching on: Laser and red beam are mutually exclusive. Red beam is enabled by default setting when there is no laser emission(*password is required for this setting).

② Default parameter setting and mode selection

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

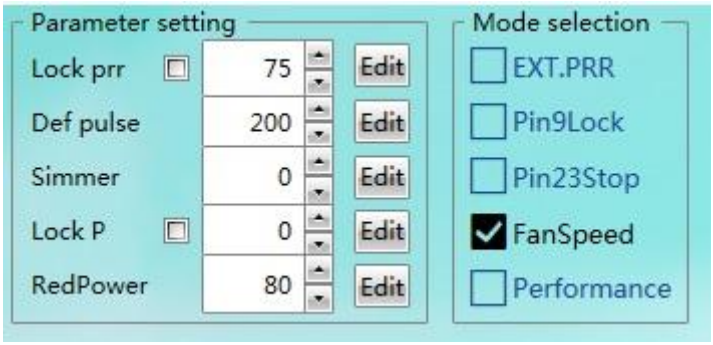


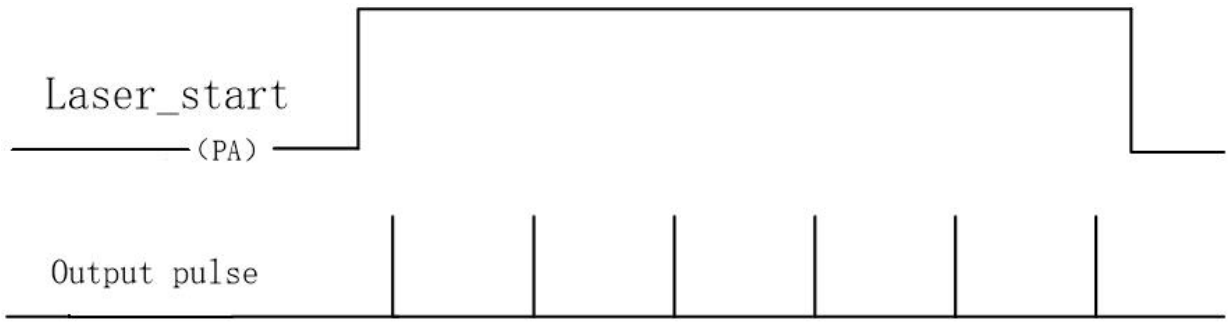
Figure 21 Default parameter settings and mode selection

Lock PRR: Laser will lock to GUI setting frequency.

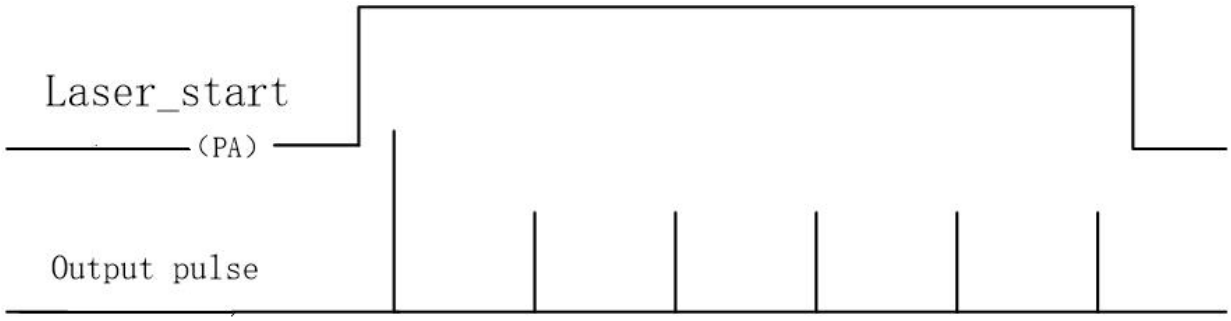
Default pulse: The laser will use GUI default pulse when no pulse width control command received.

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

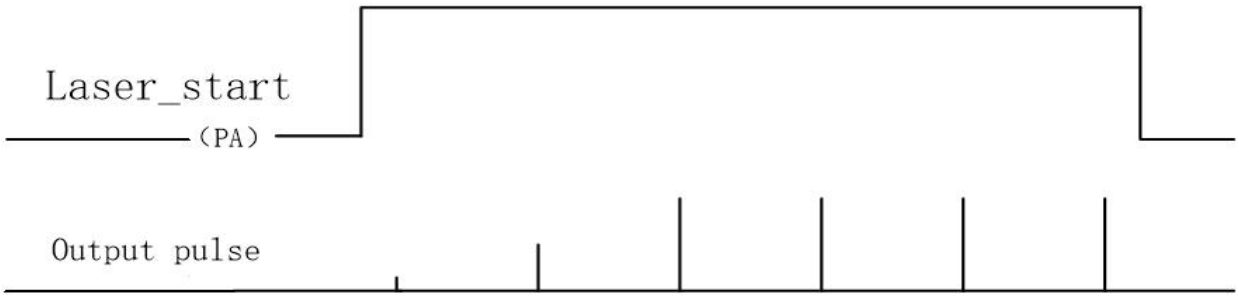
Simmer setting examples:



[Appropriate Simmer]



[High Simmer]



[Low Simmer]

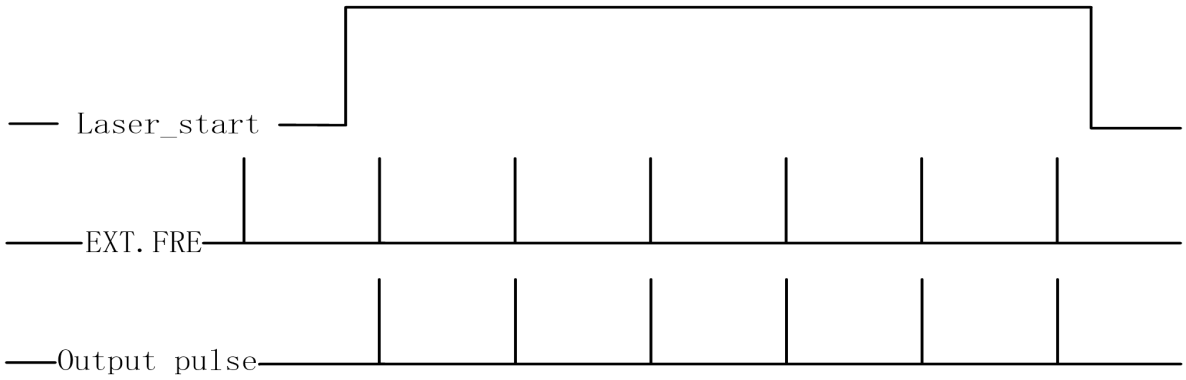
Lock power: Laser will lock to GUI setting power.

Red Power: Brightness of built-in red pilot(optional) can be adjusted, value range is 0-100.

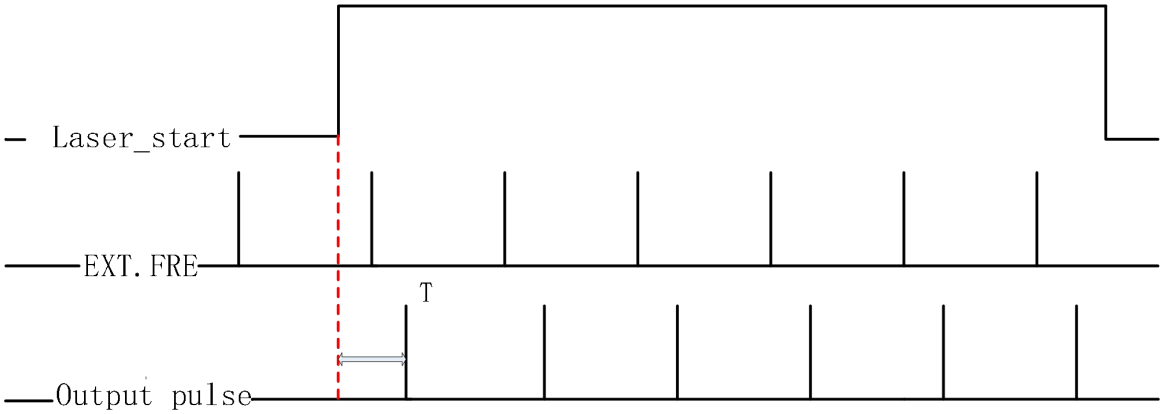
External frequency: When selecting external frequency mode, the laser output pulse will be synchronized with external frequency signal. If the control card has optimized the external frequency signal, this mode can be used.

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

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.

Fan Speed Control: The laser fan speed will be control according to the value of the built in temperature sensor. If not selected, the fans will run at full speed. Default setting is selected.

Performance Mode:

Figure 22 Optional function of performance mode

Selecting “Performance mode” in GUI, the average output power of the laser can be increased by 20% under the same cut-off frequency. The operational environmental temperature range 5~35℃ is recommended at this point.The sensor might be alarm if temperature beyond 5-35℃ and continuous emitting the laser under the high energy. (Please refer to Monitoring function and Alarm Description in Chapter 3.2.) This mode is not selected for default setting.

The recommended operation temperature range refers to below Table 12.

Table 12 Recommended Operating Temperature Range

Operational Mode	Recommended Operating Temperature Range
Normal Mode	0~40℃
Performance Mode	5~35℃

Note：The parameter setting of TypeE software takes effect immediately, no need to restart laser.

3.2 Monitoring Function and Alarm Description

Some operation parameters and alarm conditions can be read by TypeE software. The laser will send the number of saved alarms in the system to the GUI software each time when it is turned on.

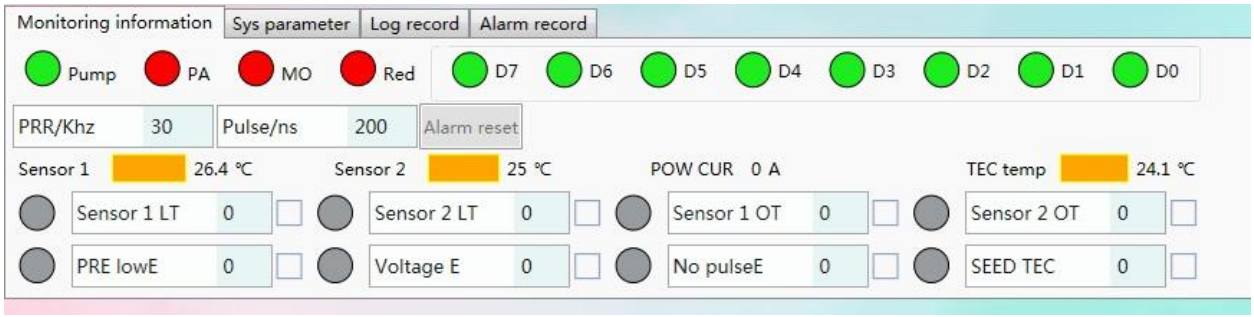


Figure 23 Laser Running Status Monitoring

1) Status Monitoring

Pump indicator light: Monitor whether the pump of the laser is currently in normal working state, which is green under normal conditions, and red light if abnormal alarm occurs.

PA、 MO、 Red indicator light: Monitor the control signal. Green light means signal is effective(high level), and red light means signal is not effective(low level).

D0-D7 indicator light： Monitor the current power signal of the laser, corresponding the 8-bit binary mode, D0 is the lowest and D7 is the highest. Green light means this pin signal is effective(high level), and red light means this pin signal is not effective(low level).

PRR/kHz and PULSE/ns : Monitor the actual laser working frequency and pulse width.

Pump temperature: Monitor the temperature of optical module.

Power current: Monitor the secondary drive current value of the laser.

TEC temperature: Monitor the current seed source temperature.

System parameter: Internal system parameter setting interface.(For JPT internal use only)

Log record： To record the laser setting and alarm.

Alarm record： To record the sequence of the latest 10 laser alarms.

2)Alarm description

Board tempLT: The board temperature is lower than the set temperature.

Board tempOT: The board temperature is higher than the set temperature.

Pump tempLT: The pump temperature is lower than the set temperature.

Pump tempOT: The pump temperature is higher than the set temperature.

PRE lowE: the pre amplifier low current alarm.

Voltage error: Supplying voltage is too low or too high.

No pulseE: No seed source backlight signal detected or the seed source backlight signal less than 1kHz.

Seed TEC: Seed source temperature is abnormal.

3)Alarm description of flashing Red indicator light

Alarm of the laser under the abnormal condition, not only can be viewed in GUI monitoring status, but also can be directly reflected by the irregular flashing indicator light. (refer to below Table 13)

Table 13 Alarm Description of Red indicator light

Status of flashing Red Light	Alarm descriptions
Short flashing	Sensor1 alarm
Long flashing	Sensor2 alarm
Long-Short-Short	No pulseE alarm
Short-Long-Short	PRE lowE alarm
Short-Long-Long	Seed TEC alarm
Long-Short-Long	Low voltage alarm

The temperature alarm for sensor1 and sensor2 can be recovered automatically, which means the laser will be released the alarm state after the alarm temperature restores to the normal temperature range, but the laser can emit is required to receive the emission signal again. Except the alarm for sensor1 and sensor2, all other alarms are required to restart the laser before the alarm state can be released.

Warranty and service terms in User's Manual are for reference only. Official service and warranty are subject to official contract.