



Pulsed Fiber Laser

YDFLP-100-M8-M-R

USER MANUAL

Version 1.0



JPT

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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 100 W and peak power over 7 kW. 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 2W.

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)

Additional Description This product is intended as a component for incorporation into a laser product, and as such requires additional features for laser safety and to comply with 21 CFR1040.10	Compliance Label (Attached on the cover plate)
$P_o \leq 200W$ $P_p \leq 100KW$ $F: 1-4000KHz$ $t: 1-500ns$ $\lambda: 1040-1200nm$	Product Rating Information (Attached on the cover plate)



Figure 1 Laser Safety Goggle

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1. Product Introduction

1.1 Product Description

JPT pulsed fiber lasers adopt the MOPA (Master Oscillator Power Amplifier) structure. The main oscillation uses a semiconductor laser as the seed source. Amplification is realized by traveling wave fiber amplifier. This MOPA fiber laser has the characteristics of independently adjustable pulse width and frequency, and can still maintain a high and stable peak power output under the condition of changing the pulse width and frequency, which is the best option for industrial laser marking and other applications.

This kind of fiber laser adopts the mode of fiber coupled output semiconductor laser to pump, which has high energy conversion efficiency. And the laser adopts the water cooling system, the heat dissipation structure is more compact, the volume is smaller, the portability is more convenient. And integrated full optical design, so that the system without maintenance, convenient for customers to use.

JPT pulsed fiber laser control with standard DB25 interface and use 48V/10A DC power supply. It has good compatibility. Compared with similar products, JPT pulsed fiber laser can adjust pulse frequency within a certain range and maintain a stable peak power output, which is particularly advantageous in high-speed marking applications.

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
Test Report	1
48V Power Cable	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.

- Make sure that the 48V/10A DC power supply is connected in the correct way. Wrong connection or input voltage might damage the product.
- The required running ambient temperature range is 0~40℃, and the temperature range of the chiller is the optimal water temperature $\pm 3^{\circ}\text{C}$. Exceeding the operating temperature range may lead to internal alarm of the laser source, which is a protective behavior, so as to effectively protect the long-term reliability of the laser.
- The laser has a high requirement for environmental cleanliness. When using or moving the laser, please handle the collimating output isolator carefully to prevent dust or other pollution. Use protection cover to cover the output window when it is not working. Dust on the window will cause heat and damage the lens, which results in output power decrease even laser damage.
- Please make sure that the power is off before installing and uninstalling.
- Please **do not** look at the output window anytime when power on, and wear laser safety goggle when operating the fiber laser!

YDFLP-100-M8-M-R contains 10 wave-forms: 6ns, 8ns, 12ns, 20ns, 30ns, 40ns, 50ns, 60ns, 80ns, 100ns. Other pulse width is available for customization request.

1.4 Cooling System

1.4.1 Cooling System Introduction

Optical fiber laser system uses water cooling, which has strict requirements for cooling water circulation system. The laser can not be normal used caused by improper water cooling system, it

causes damage if it is serious.

Chiller is a kind of water cooling equipment, which is capable of providing constant temperature, current and pressure. The chiller works by injecting a certain amount of water into the internal tank of the machine, and the water is cooled by refrigeration system of the chiller. Then the low temperature with frozen water is injected into the equipment that needs to be cooled by the pump inside of the machine. The chilled water takes the heat away from the inside of the machine and returns the hot water to the tank again for cooling.

Chiller selection:

1. According to the configuration of the laser specification to choose the corresponding cooling capacity of the water cooler.
2. Choose the high precision of temperature control, better is somewhere between $\pm 0.5^{\circ}\text{C}$ and $\pm 1.0^{\circ}\text{C}$.

◆ The nominal refrigerating capacity and flow rate of the water cooler are as follows:

Series	Nominal refrigerating capacity
100 W	500 W

◆ As JPT pulsed fiber laser using water as cooling medium, so the operating temperature of the laser needs to be in the optimal operating water temperature.

1. Recommended setting of water temperature:

See label on machine for optimum operating temperature

Working temperature range of laser: the optimal water temperature $\pm 3^{\circ}\text{C}$

2. Anti-freezing measures:

- 1) Do not turn off the chiller at night when there will never be a power failure.
- 2) Draining the cooling liquid in the laser, laser output head and water cooler after the daily use.
- 3) Add a certain proportion mixture of antifreeze and purified water as coolant.

1.4.2 Precautions for Water Cooling System

- ◆ Using deionized water or purified water as cooling water, distilled water is also available to use.
- ◆ To prevent the growth of bacteria caused damage to waterways, it is recommended to add a certain proportion of anhydrous ethanol solution when filling pure water.
- ◆ Need to change water of chiller regularly, and the normal cycle is half a month to a month. Use deionized purified water or purified water.
- ◆ Add antifreeze (Recommended brand: CLARIANT) mixed proportionally (antifreeze : water) when the temperature is too low. Pipeline must be cleaned with purified water after winter and using deionized water or purified water as coolant in case of the corrosion of waterway.
- ◆ This may cause irreparable damage to the laser if the inlet and outlet are connected reversely .
- ◆ Be sure to drain the cooling water inside of the cooling system and laser system when in an extended outage, otherwise may cause irreparable damage to the laser.

1.5 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:

M 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-200-M7-H-R: Customized M7, using high mode type of optical fiber with the nominal output power 200W, built-in red pilot laser.

1.6 Technical Specifications

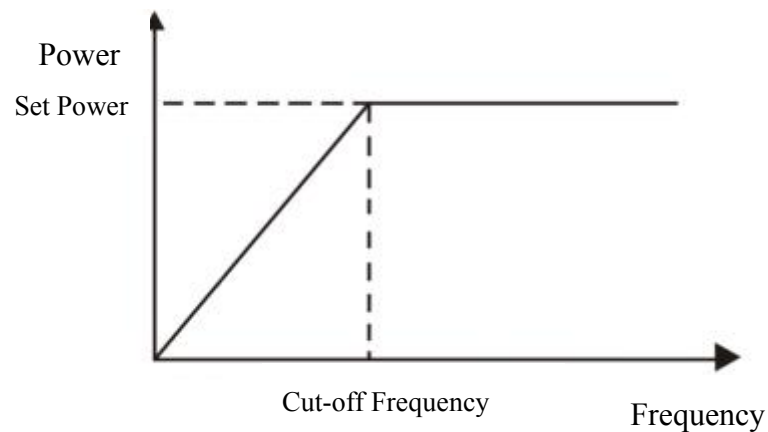
Table 3 Specifications of the M8 Series Pulsed Fiber Laser

Characteristic\ Laser Type		YDFLP-100-M8-M-R
M ²		1.4
Average Output Power	W	>100
Maximum Pulse Energy	mJ	0.58mJ@12ns
Full Power Pulse Repetition Rate Range	kHz	85-4000
Pulse Repetition Rate Range	kHz	1-4000
Pulse Width	ns	6-100
Output Power Instability	%	<5
Cooling Method		Water-cooled
Power Supply Voltage (DC)	V	48
Power supply current requirement	A	> 10
Central Wavelength	nm	1064
Power Consumption	W	< 480
Emission Bandwidth@3dB	nm	<30
Polarization		Random
Anti-Reflection Protection		Yes
Built-in Red Beam		Yes
Output Beam Diameter	mm	3.0±0.5
Output Power Tuning Range	%	0~100
Ambient Temperature Range	°C	0~40
Chiller Temperature Range	°C	optimal water temperature ±3
Storage Temperature Range	°C	-10~60
Dimensions	mm	450*235*70
Package Size	mm	660*380*145
Weight	Kg	Net: 10.2 Gross: 12.5

Table4 M8 Series Fiber Laser Cut-off Frequency Value (kHz)

Pulse Width (ns)	100-M8-M-R	Max pulse frequency
6	280	4 MHz
8	220	
12	170	3 MHz
20	130	
30	110	
40	105	2 MHz
50	100	
60	95	
80	90	
100	85	1 MHz

* 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 2 Cut-off Frequency & Output Power Relationship Charts**

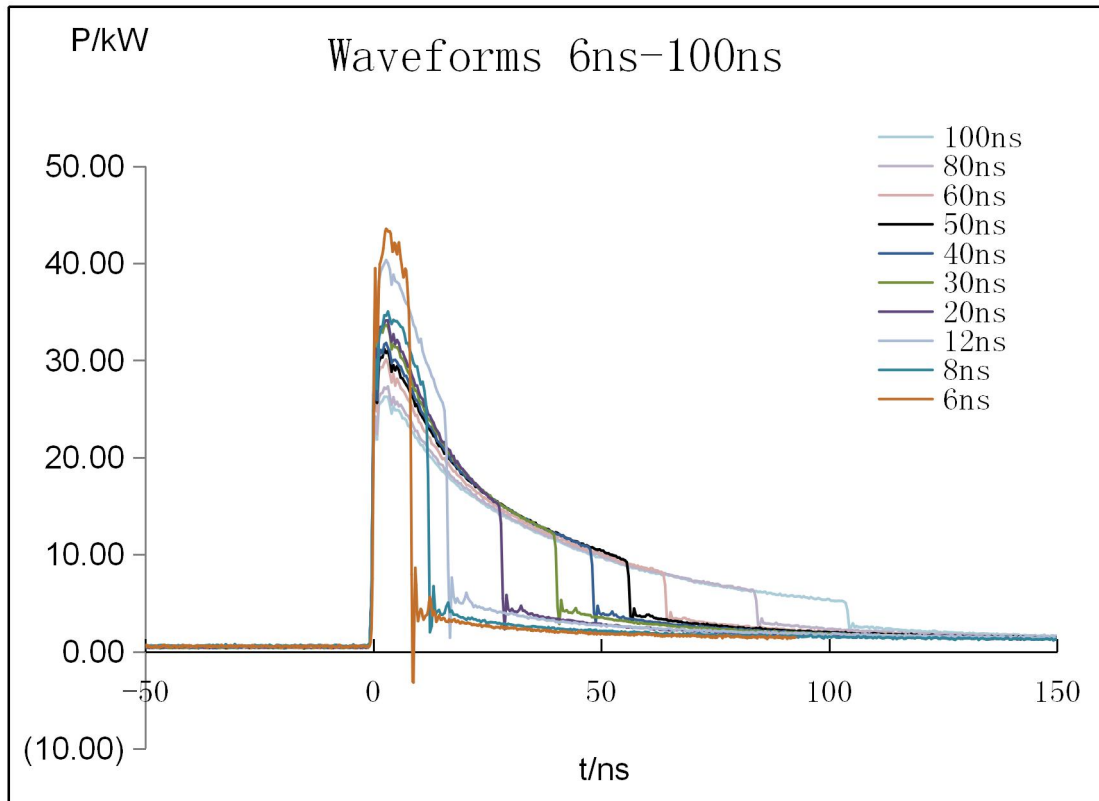


Figure 3 YDFLP-100-M8-M-R Output Waveform Graph

2. Installation

2.1 YDFLP-100-M8-M-R Laser Dimensions

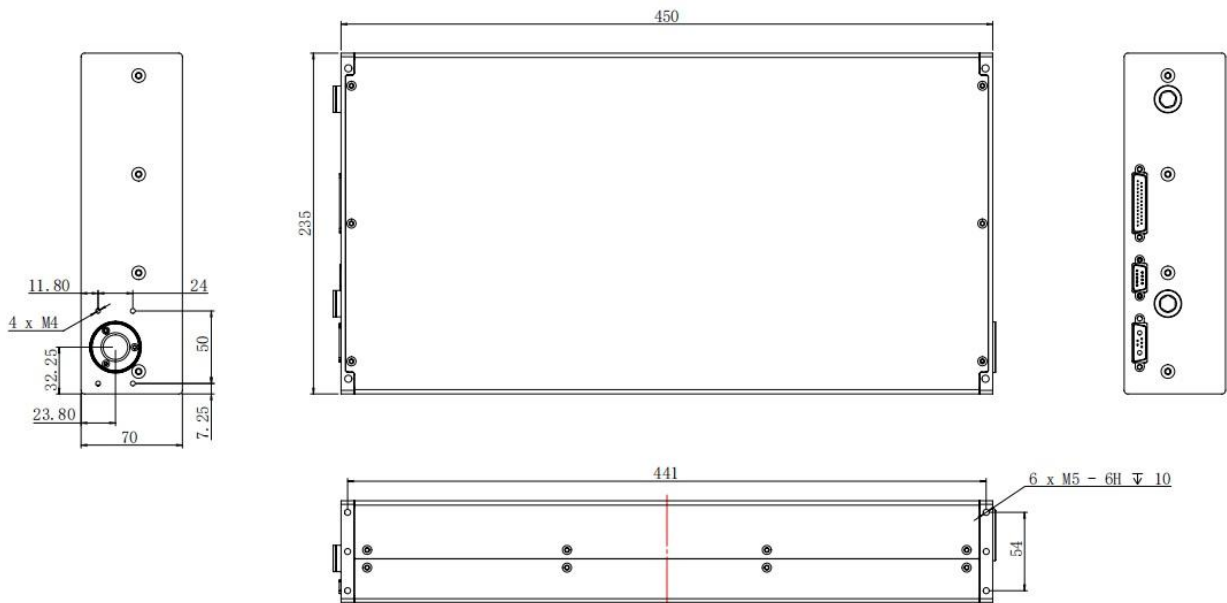


Figure 4 YDFLP-100-M8-M-R Laser Module Dimensions (Unit: mm)

2.2 Installation Methods

- 1) Fix the laser module on the support and keep the laser well ventilated.
- 2) Connect the laser to the 48V DC power supply, and make sure that the DC power supply can provide sufficient output power. Please connect and lock the connector in the way shown in Figure 5. The black power cable "48V +" is 48V DC positive, "48V-" is 48V DC negative. The yellow cable "PE" is the ground wire.

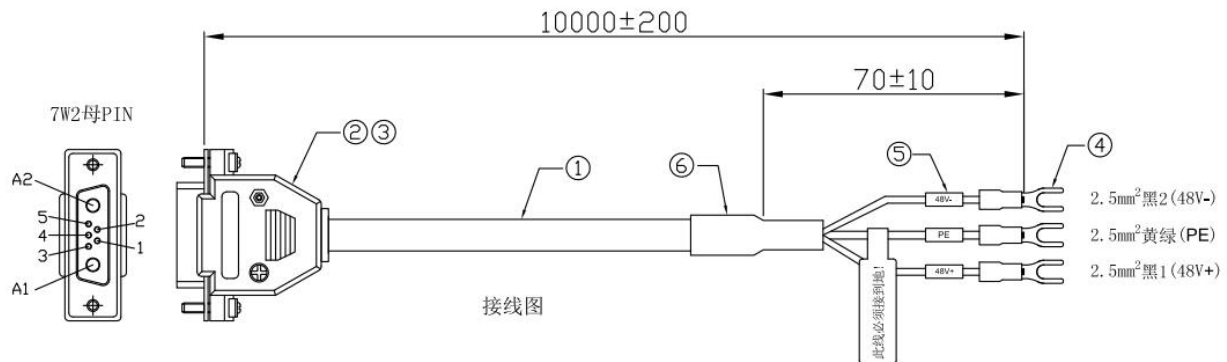


Figure 5 Diagram of the Power Supply Cable

- 3) After verifying that the control interface of the external controller matches the laser, connect the control cable to the laser control interface and **lock it securely.**

3. Laser Interface

3.1 Power Interface

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

Table 5 Definition of Power Interface

PIN#	Description
A1	+48V DC, laser pump power supply
A2	-48V DC
1, 3, 4	No need to connect
2	+48V DC, control circuit power supply, Maximum current 0.2A
5	Ground wire

In Table 6, PIN_A1 and PIN_2 pins are connected to Figure 8 "+", PIN_A2 is connected to "-", and PIN_5 is connected to "GND". If independent power supply is required, please separate PIN_A1 and PIN_2 for power supply.

3.2 RS-232 Control Connector Interface

Pins definition of RS-232 connector is shown in below Figure6 & Table 6:

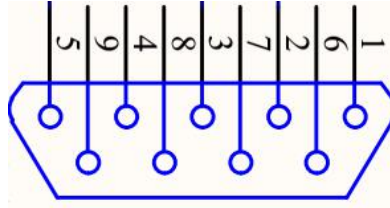


Figure 6 RS232 Connector DB9

Table 6 RS-232 Interface Definition

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

3.3 DB25 Control Connector Interface

DB25 behind the power module is the interface to connect the marking control system (e.g. marking machine) and the laser source system. Be sure to connect reliably before work. The Pins are defined as shown in Figure 7 and Table 7.

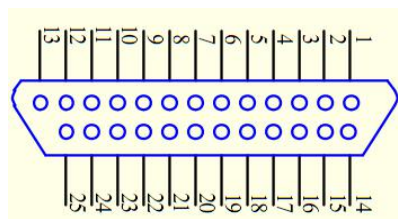


Figure 7 DB25 Connector

Table 7 DB25 Interface Definition

DB25 PIN#	Definition
1-8	IP0-IP7 Power Control
9	Latches power setting of the laser (effective during rising edge)
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 The system can receive PA status only when MO is set to H and the system is powered on after 12 seconds.
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 and pulse width adjustment ENABLE (Please refer to the following pulse width control section for specific control mode).
18	MO signal for turn on/off HIGH: ON LOW: OFF Only after 12S and MO high level can the laser be emitted.
17, 24, 25	No need to connect

Note: The high voltage range of DB25 control connect is required between 4.6V and 5.4V; Low voltage range is between 0V and 0.5V.

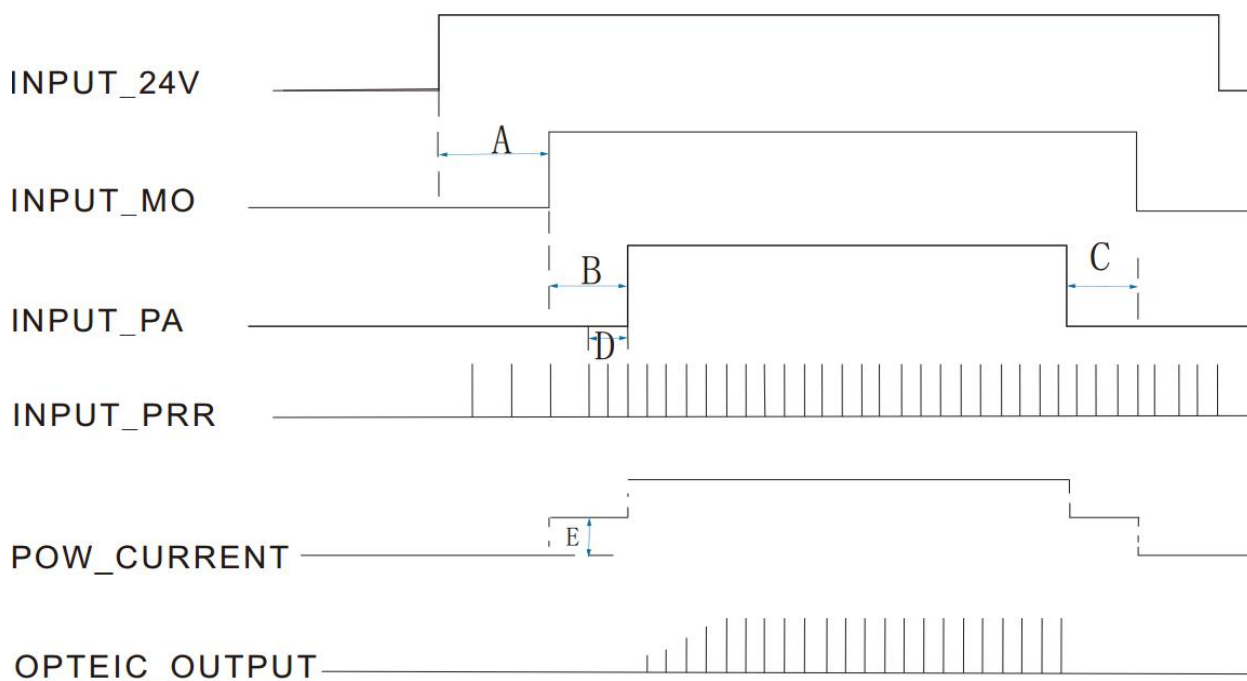
3.3.1 Interface Setting

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 in table 8 current setting:

Table 8 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%

DB25 Sequence:

**Figure 8 Diagram of DB25 Control Time Sequence**

- A: System initialization time: can be received input signal after 12 seconds of power supply.
- B: Pump charging time: range(8ms-35ms), recommend 8ms.
- C: Range under internal frequency mode 0ms-8ms, recommend 4ms.
- D: Frequency switching duration: 0ms-8ms, recommend 8ms.
- E: CLASS II SIMMER: The height of the first pulse which can be adjusted via GUI (the supporting software of the laser).
- F: The height of the first pulse: It can be adjusted via GUI (the supporting software of the laser).

Note: After 48V voltage is supplied to the laser, subsequent operations can be carried out after 12 seconds.

Fiber laser control system self-locking: If fiber laser is on abnormal status (high temperature, low 24V power supply etc.), it will stop working to protect the whole system. Please restart the fiber laser. Error messages are recorded in GUI.

Pulse Width Control Pins:

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 M8 laser.

Table 9 Pulse Width Control Pin and Signal Description of M8 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, $8\text{kHz} \leq \text{Clock Frequency} \leq 10\text{kHz}$, 10KHZ is recommended.
22	Enable	Pulse width control function: High: Enable, Pin2 and Pin3 to control the pulse width Low or Not connection: Disable

3.3.2 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:



➤ 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 fiber laser will be at high level status at least 10us in advance before changing Enable. At any connector, and will be at low level status at least 10us after all change finished.
- All instruction design starts with byte 0xA5.
- Set Pin19 low before using pulse width control function.

3.3.3 Pulse Width Control Code

Table 10 Pulse Width Control Instruction Code

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

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

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

3.3.4 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.

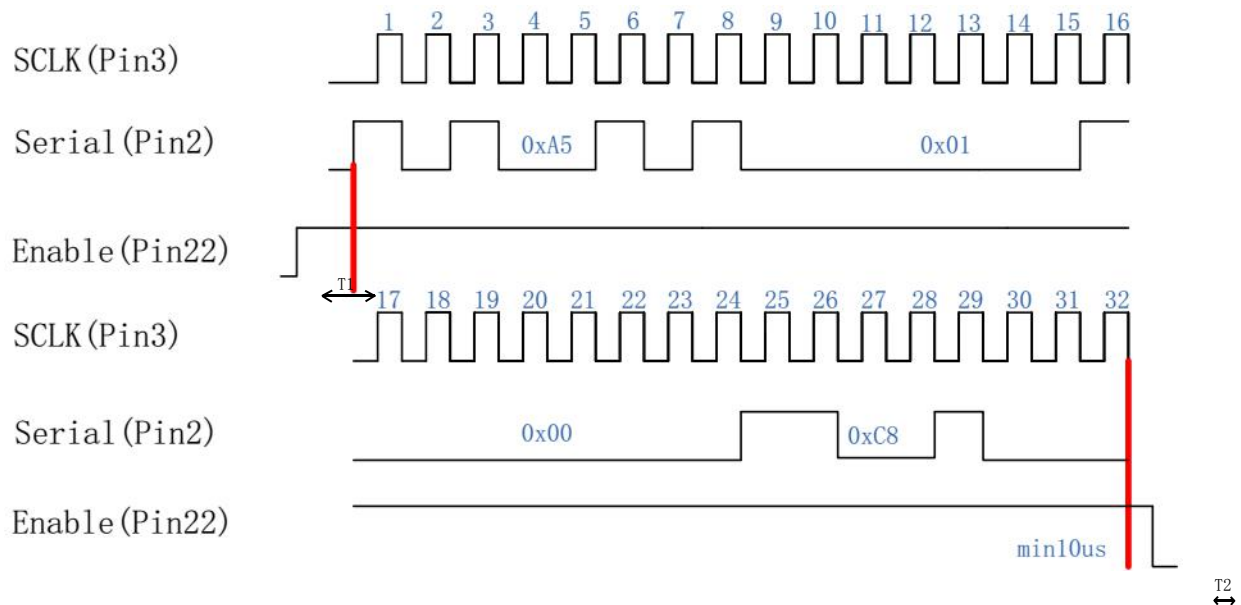


Figure 9 Diagram of 200ns Pulse Width Control Sequence

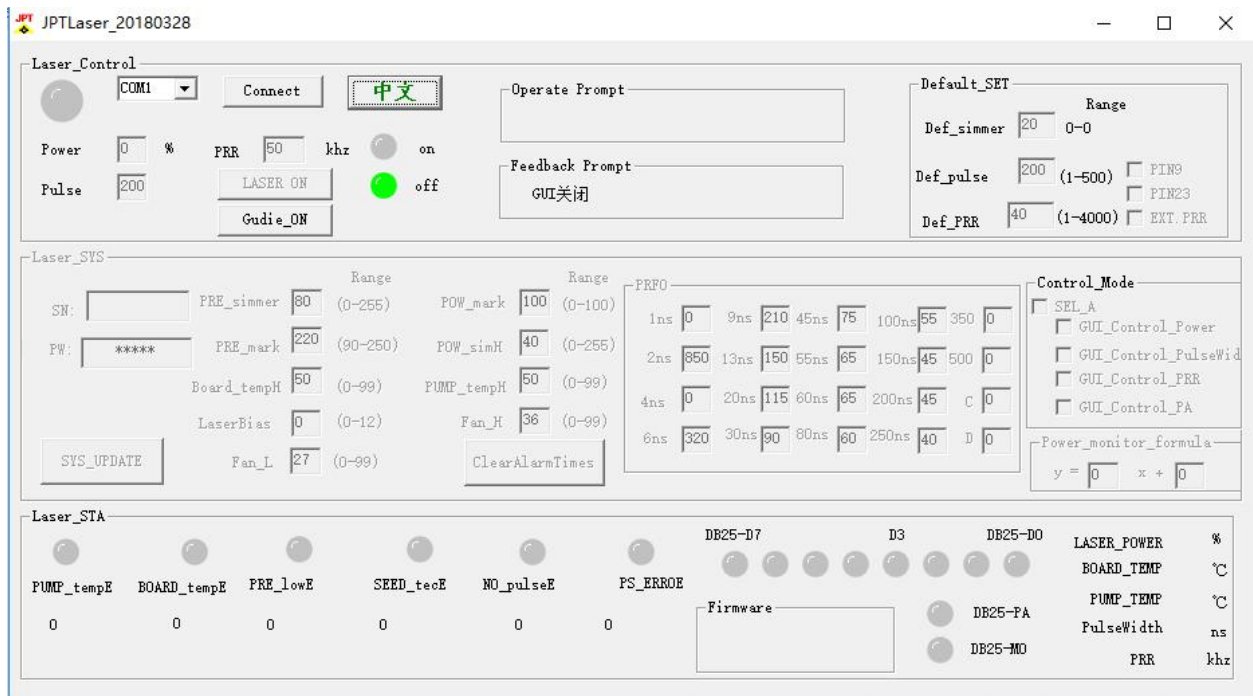
- The parameter of this instruction is the binary value of pulse width.
- The user can compile any pulse width, but the laser only accepts the specified pulse width (refer to the specifications of various versions for specific pulse width). If the given pulse width is out of the range, the laser will default to the pulse width value set last time.

4. JPT GUI Laser Testing Software

4.1 Software Installation

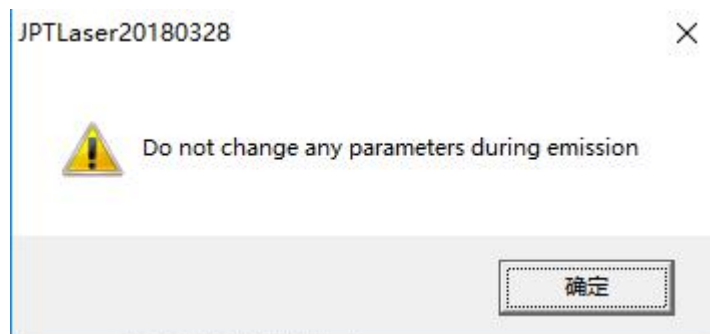


Installation steps: decompress installation package → install driver → install software library → open GUI software



4.2 Software Introduction

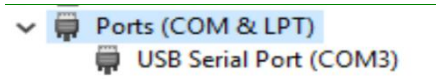
1. JPTlaser GUI has multiple functions including laser control, setting the default parameters, operation instruction, feedback instruction, setting the control mode, alarm monitoring, DB25 interface monitoring, internal parameters monitoring etc.
2. The parameter setting on GUI is effective immediately, no need to restart laser.
3. The parameters setting of "default setting" and "control mode" has the power-off saving function.
4. Except the "power" setting parameter of the laser control bar can be changed during emission (including DB25 emission and GUI emission), other setting parameters are not allowed to be set during emission. If there is a setting during emission, the alarm [Figure 17] will be prompted.



4.3 Software Use

4.3.1 Open the Serial COM Port

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



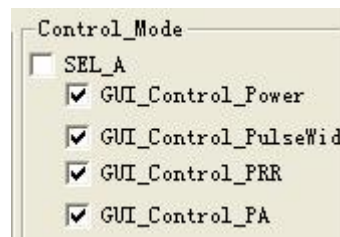
If the Serial Port Number is bigger than 4, revise the COM number to ≤ 4 .

Click and open the Serial Com Number as follow:

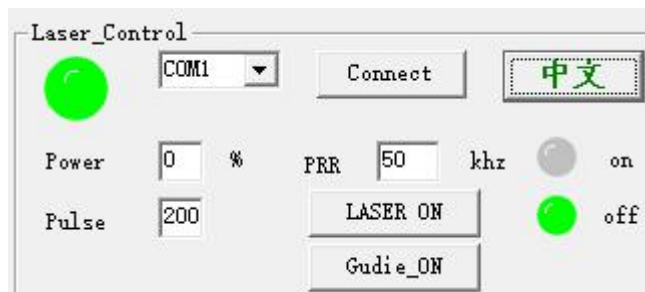


4.3.2 GUI Control the Emission

(1) Choose the GUI control Mode



Set all parameters with GUI control. The settings will be saved by laser even when the power is off. Therefore, you need to cancel the GUI control mode every time you do not use the GUI to control laser.



The laser can be controlled by GUI software to emit laser with the power & frequency & pulse width you set.

ON: Set the corresponding marking parameters, and then click "LASER ON". "ON" indicator is

green when emission and "OFF" indicator is green when laser off.

Language: Click "中文" in English interface to switch to English, click "English" in Chinese interface to switch to Chinese.

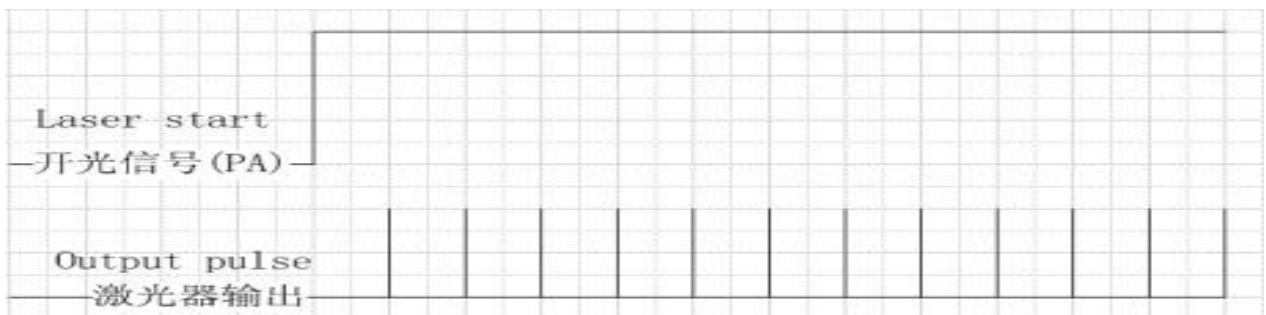
(2) Default Parameter Setting

The laser can modify the laser's default parameter setting(e.g.default SIMMER, default pulse width, default PRR and so on.)in the "default setting" option. The parameter setting is effective immediately, and it has the power-off saving function.

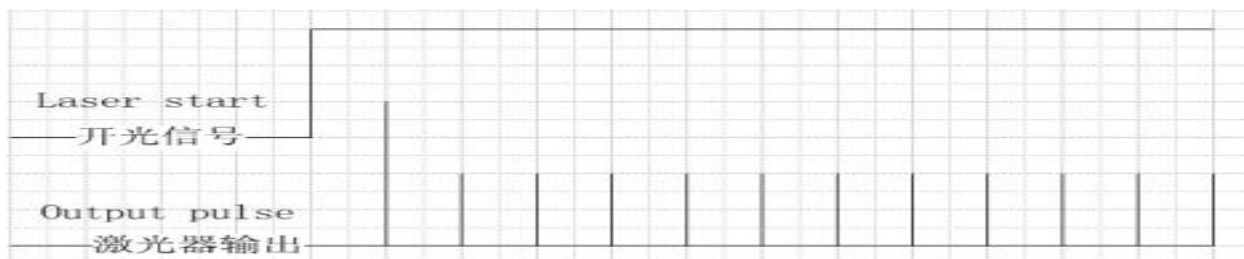
Default_SET		Range	
Def_simmer	10	0-100	
Def_pulse	200	(1-500)	☐ PIN9
			☐ PIN23
Def_PRR	50	(1-4000)	☒ EXT. PRR

Default Simmer: Can be used for controlling the height of first pulse. The higher the value, the larger the first pulse.

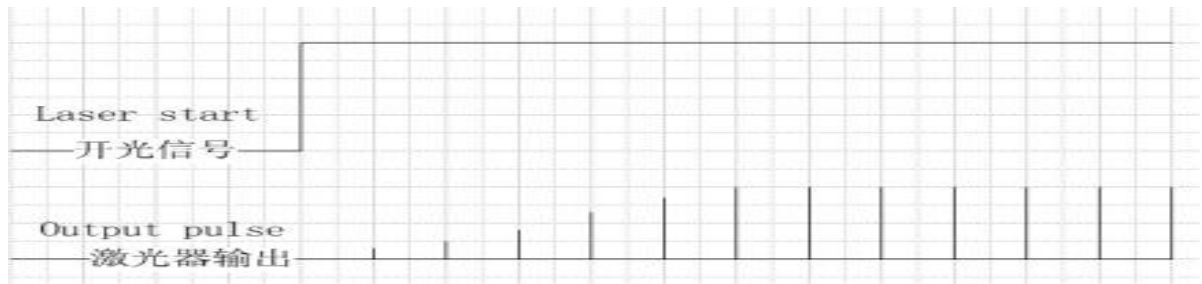
Simmer setting examples:



[Appropriate Simmer]



[High Simmer]



[Low Simmer]

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

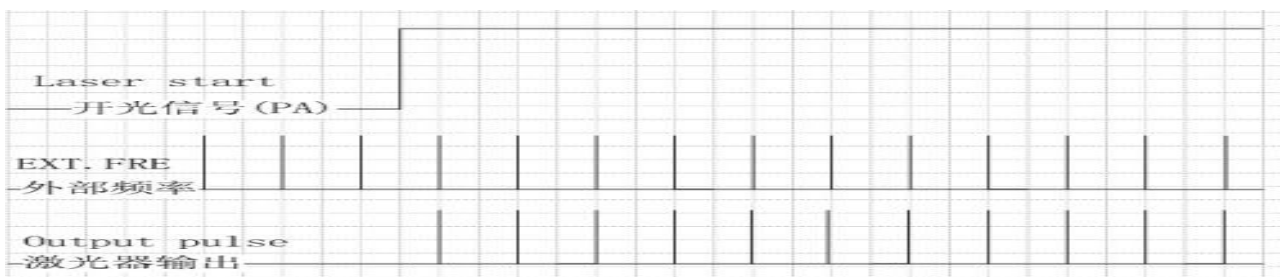
Default frequency: If the external control fails to provide frequency signal, the laser will output according to the default frequency setting value.

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.

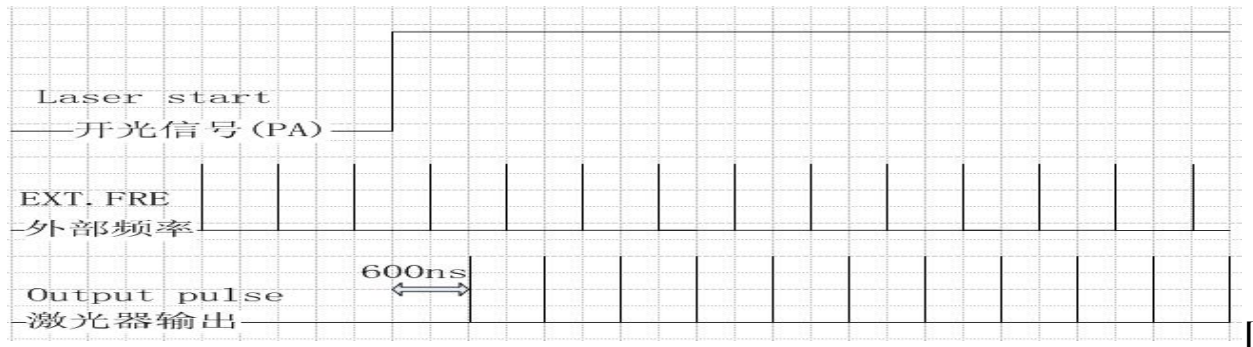
When this option is not selected, the laser will use with internal frequency mode. And the laser will calculate external frequency signal and then its own pulse parameter signal. If the control card has no external frequency signal given to laser, you can use this mode to define the laser default frequency.

External frequency mode is used by default.

External frequency and internal frequency setting examples:



[External Frequency]



Internal Frequency]

(3) The Fan Speed Control

When the temperature is and higher than Fan_L, the fan starts to work. And the temperature is up to Fan_H, the fan works at maximum speed.

1. The fan works at maximum speed for 5s after the power on, then steps into the stage of speed control.
2. If the sensor temperature below Fan_L, the fan does not work. (At the beginning, sensor temperature is higher than Fan_L, then lower than this value, the fan works at fixed speed.)
3. The Fan works at speed control when the sensor temperature between between Fan_L and Fan_H, the closer the sensor temperature gets to the Fan_H, the closer the fans run at maximum speed.
4. The fans work at maximum speed when the temperature is higher than Fan_H.

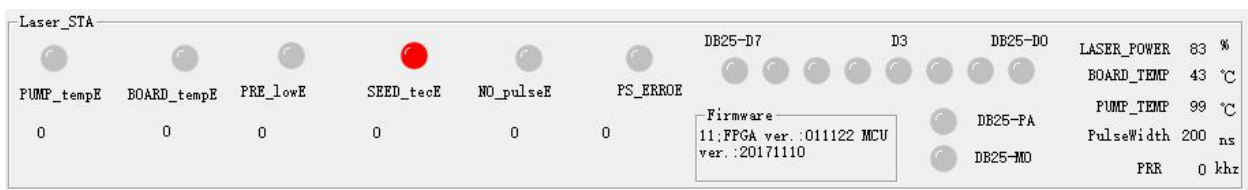
(4) Power Latch and Emergency Stop Control

Default_SET			
		Range	
Def_simmer	10	0-100	
Def_pulse	200	(1-500)	☒ PIN9
			☒ PIN23
Def_PRR	50	(1-4000)	☒ EXT. PRR

Pin9Lock: Power latch function is enabled if selected, rising edge is effective. Default setting is not selected.

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

4.4 Laser Monitoring Function



The monitoring function of JPT GUI 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.

DB25-D0,D3,DB25-D7,DB25-PA,DB25-MO are the states when the laser receives DB25 power, PA and MO signal. The green light is on when high level and off when low level.

"Pulse width"and "Frequency"are the working pulse width and frequency value of the current laser.

"Laser power" is the percentage of the current converted from the laser pump source.

5. Operation Procedure

5.1 Preparatory examination of the product

- 1) Check the laser casing and the fiber cable for any unexpected conditions;
- 2) Check the connection between laser system and the fiber laser module, and tighten the connection cable.

5.2 Operation Procedure

- 1) Power on the system

Turn on the fiber laser at the same time or after turning on the marking machine. Wait for about

1 minute before move on to the next step. Please take note that the fiber laser will be locked automatically if the laser control card has not been power on within 5s after turning on the laser.

If so, please restart the fiber laser in order to function normally.

2) Procedures for laser marking

To test the fiber laser, firstly please set the power to 0% and draw a simple figure using the laser marking software, drive the marking and observe the laser output using the frequency doubling piece of pottery and porcelain. Then gradually increase the laser power and change the settings for the marking process. Under normal circumstances, the laser output observed using the frequency doubling piece of pottery and porcelain should be stronger and stronger, or else, turn down the machine and check it.

5.3 Precautions during the laser operation

- 1) Wear laser safety goggle;
- 2) Please stop the laser processing before turning off the fiber laser.

Product warranty and service terms above are for users' reference only. Official service and warranty scope will be specified in the contract.

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