安全性

YDFLP ファイバーレーザを操作する前に、このマニュアルを注意深くお読みください。これは、安全性、製品の操作、およびその他の必要な参照情報に関する基本情報を提供しています。安全性および性能を最大限に引き出すために、以下の安全性の通達に厳密に従ってください。

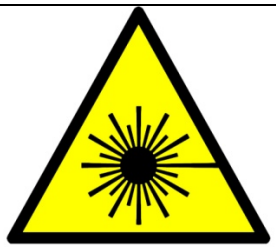
- +DC24V の電源が正しく接続されていることを確認して下さい。不適切な接続は、製品を破損させる可能性があります。

- JPT 社の許可なく、本製品のカバーを開けないでください。許可なく開けた場合は、安全性の問題の原因となったり、保証が無効になる場合があります。

- 製品の動作中は、いかなる場合も図-1に示すようなレーザゴーグルを着用してください。このレ ーザモジュールは、定格平均出力10W 以上、定格ピーク出力7kW 以上の目に見えないレーザ光を放射するクラス4レーザに該当します。直接または散乱したレーザ光が目に入ると、眼に永久的な損傷を引き起こしたり、人体の組織がやけどしたり、火災の原因になることがあります。

- 注意：0%の出力設定でも、平均パワーは依然として約90ミリワット出力されます。

表1　安全性ラベル

シンボル	内　容
	レーザ放射に関するレーザ警告ラベルは（出力ファイバーの近くに貼付）
	組み込み部品用ラベル（本製品の上部カバーに貼付）

Wavelength 1040-1200nm Pulsed Output: Max Pulse Energy <2.0mj Repetition Frequency 20-500kHZ Pulse duration >10ns Max Average Power <50W CW Output Power <50W IEC/EN 60825-1:2001	安全性情報（本製品の上部カバーに付属）
CAUTION-CLASS 4 INVISIBLE LASER RADIATION WHEN OPEN AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION	安全警告（出力ファイバアーイソレーター＆コリメーターに貼付）

図-1　レーザ安全ゴーグル

内　容

1. Product Tour

1.1 Product Description

The JPT YDFLP pulsed fiber laser adopts the MOPA (Master Oscillator Power Amplifier) configuration, in which a semiconductor laser diode serves as the master oscillator and the fiber amplifiers boost the output power. For this MOPA pulsed fiber laser, the pulse width and pulse repetition frequency are able to be adjusted independently. By changing the pulse width of the fiber laser, the peak power of this MOPA fiber laser can be maintained at the same level for different pulse repetition frequency. This feature makes the product an ideal laser source for various industrial applications.

The MOPA fiber lasers get pumps through fiber couplers, which embed them with higher slope efficiency compared to conventional solid state lasers. The fiber laser is more compact and easy to carry, because it only uses three cooling fans to effectively remove the heat generated inside the chamber. Besides, the all fiber based laser cavity enables higher beam quality of the laser output.

JPT's MOPA fiber laser adopts the standard DB25 interface, and it is power supplied with 24V/10A DC power supply, which makes it a good compatibility. A photograph of a typical JPT MOPA fiber laser is as shown in Figure 2.

Figure 2 JPT's MOPA Fiber Laser

1.2 Packaging List

Please refer to the packaging list in table 2.

Table 2 Packaging List of YDFLP

Item	Quantity	Comments
Fiber Laser	1	
24V Power Cable	1	
Measured Parameter List	1	
Configuration List	1	
Consideration List	1	
Configuration List	1	

1.3 Operation conditions and safety instructions

In order to maintain good performance and reliability of this product, please always operate the laser under normal conditions as below:

1) This fiber laser shall be operated with 24V/10A DC power supply; **wrong connection will lead the fiber laser can't work**

2) There should be 10-cm-wide air gaps in front and behind the fiber laser chamber, and the air flow direction should be the same with the fiber laser module and the rest of the whole system; **Short Ventilation distance and wrong air flow direction will lead the fiber laser can't work.**

3) The operating temperature should be 0~40℃; the fiber laser will alarm internal if the temperature above 40℃; It's a protection action in order to insure the long time operational reliability.

4) Please keep the laser module clean during the operation, especially for the fiber pigtail and output isolator; please remember cover up isolator exit during unworking time.

5) Power off the product before installing or uninstalling this fiber laser;

6) Never look at the fiber laser head, and **please wear laser goggle when operate this fiber laser;**

7) The YDFLP-X-LP (1/2)-X-X pulse width is fixed at 200ns. If you need other fixed pulse width, please contact us for customization;

1.4 YDFLP Product Series Naming Convention

Table 3 Naming Convention for Pulsed Fiber Laser

YDFLP-XX-XX-X-X

1 2 3 4 5

1. Product name
2. Average Output power
3. Product Series
4. Optical Fiber Types
5. Product Types

1. Product name.	YDFLP Ytterbium Doped Fiber Laser Pulse		
2. Average Output power (optional).	20W		
	30W		
	60W/70W/100W/120W/150W		
3. Product Series (optional).	Pulse width adjustable	M Series	M1+
			M6+
		LM1 Series	large pulse width
	Pulse width fixed	LP series	
4. Optical Fiber Types	S	Single mode	
	L	Low mode	
	H	High mode	
5. Customized	Without: Standard product;	R:Built-in red pilot laser	

Table 3 Naming Convention for Pulsed Fiber Laser

For example:

YDFLP- 20—M1+—S: Means this is a standard product of M1+ using single mode type of optical fiber with the nominal output power @ 20W.

YDFLP- 30—M1+—L—R: Means this is a customized product of M1+ using low mode type of optical fiber with the nominal output power @ 30W,Integrated red pilot laser.

1.5 Technical Specifications

Table 4 Specifications of the LP series pulsed fiber laser

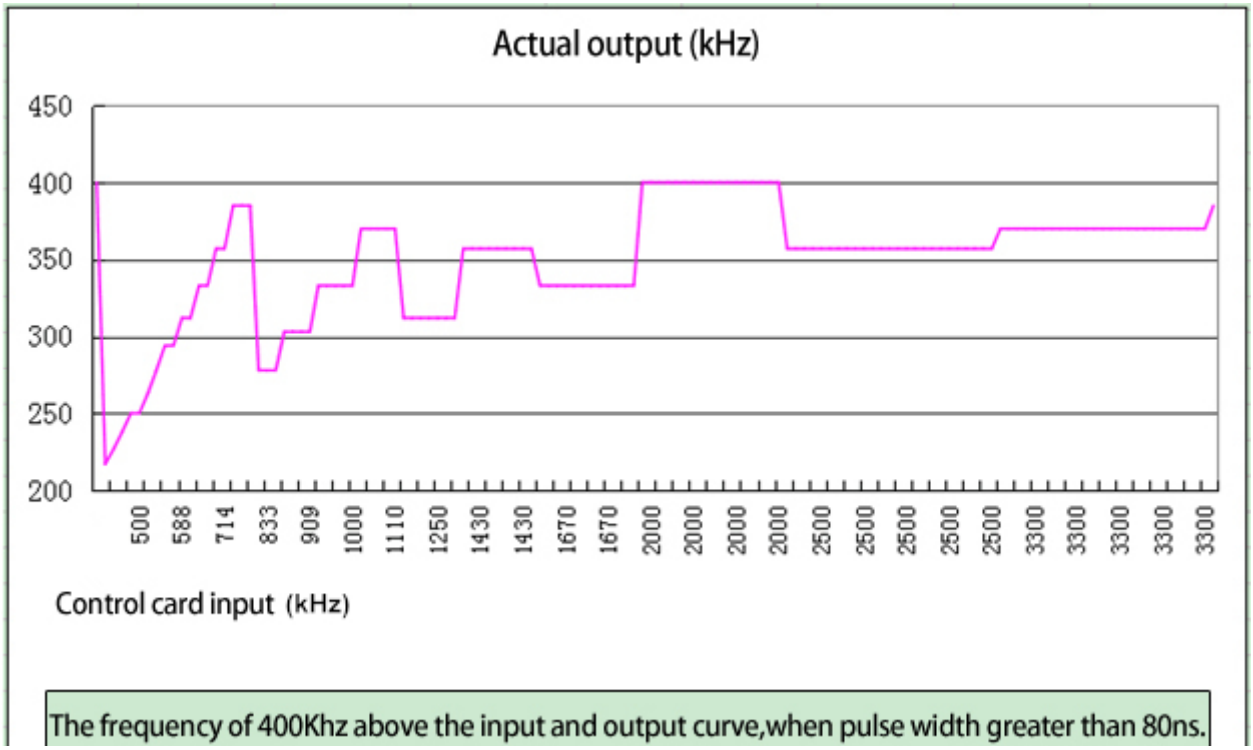
Laser Type	Unit	MOPA				
Power	W	30			20	60
M^2		<1.8		<1.3		<1.8
Laser Model		LP2-L1	LP1-L1	LP1-S	LP1-S	LP1-L1
Output Fiber Length	m	2				3
Average Power	W	>30			>20	>60
Pulse energy	mJ	1.0	1.2	0.66		1.2
Full Power Frequency Range	kHz	30-400	25-400	45-400	30-400	50-400
Adjustable Frequency Range	kHz	1-400				
Pulse Width Range	ns	200				
Output Power Stability		<5%				
Cooling Method		Air Cooling				
Supply voltage	V	24V				
Current demand	A	<10			<8	<15
Current Supply Consumption	A	>10			>8	>15
Power Consumption (20 °C) (W)	W	<150			<120	<350
Center Wavelength	nm	1064				
FWHM (nm) @3dB	nm	<15				
Polarization		Random				
Anti-Reflection Protection		Yes				
Output Beam Diameter (mm)	mm	6		7	7	6
Power Range	%	0-100				
Operation Temperature Range	℃	0-40				
Storage Temperature Range	℃	-10-60				
Dimensions	mm	315*220*99				315*275*99
Weight	KG	Net:8 Gross:9.75				Net:10 Gross:12

Table 5 Threshold Frequency（kHz）of LP series laser

Pulse width(ns)	YDFLP-30-LP-L1	YDFLP-30-LP2-L1	YDFLP-30-LP-S	YDFLP-20-LP-S	YDFLP-60-LP-L1
200	25khz	30khz	45Khz	30Khz	50Khz

The cut-off frequency is the minimum frequency that the laser can be operated with maximum peak power and average power. Please operate the fiber laser at frequency higher than the cut-off frequency.

For safety concern, when pulse width ⩾80ns , frequency ⩾400 kHz, input and output frequency is as shown in the figure below:



***Above the cut-off Frequency value is the fiber laser full power output range, oppositely, below the cut-off frequency value is the cut-off power output range. That means the fiber laser will reduce the output power to protect the machine when below the cut-off frequency value. Below is the charts that showed the change between frequency and output ：**

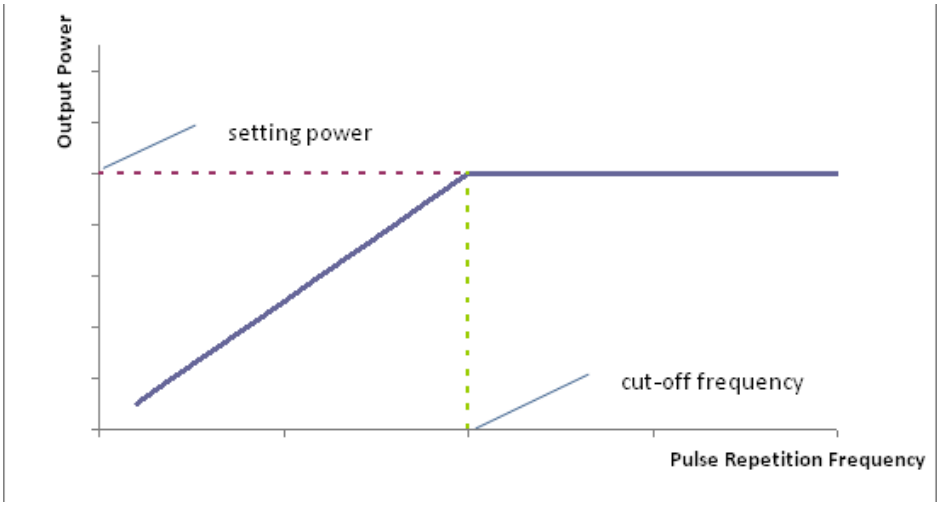


Figure 3 Cut-off Frequency & Output power relationship charts

*** Remarks:**

Threshold frequency = Cut-off frequency, of which the definition are the same.

2. Installation

2.1 Dimensions

1. Dimension of main body

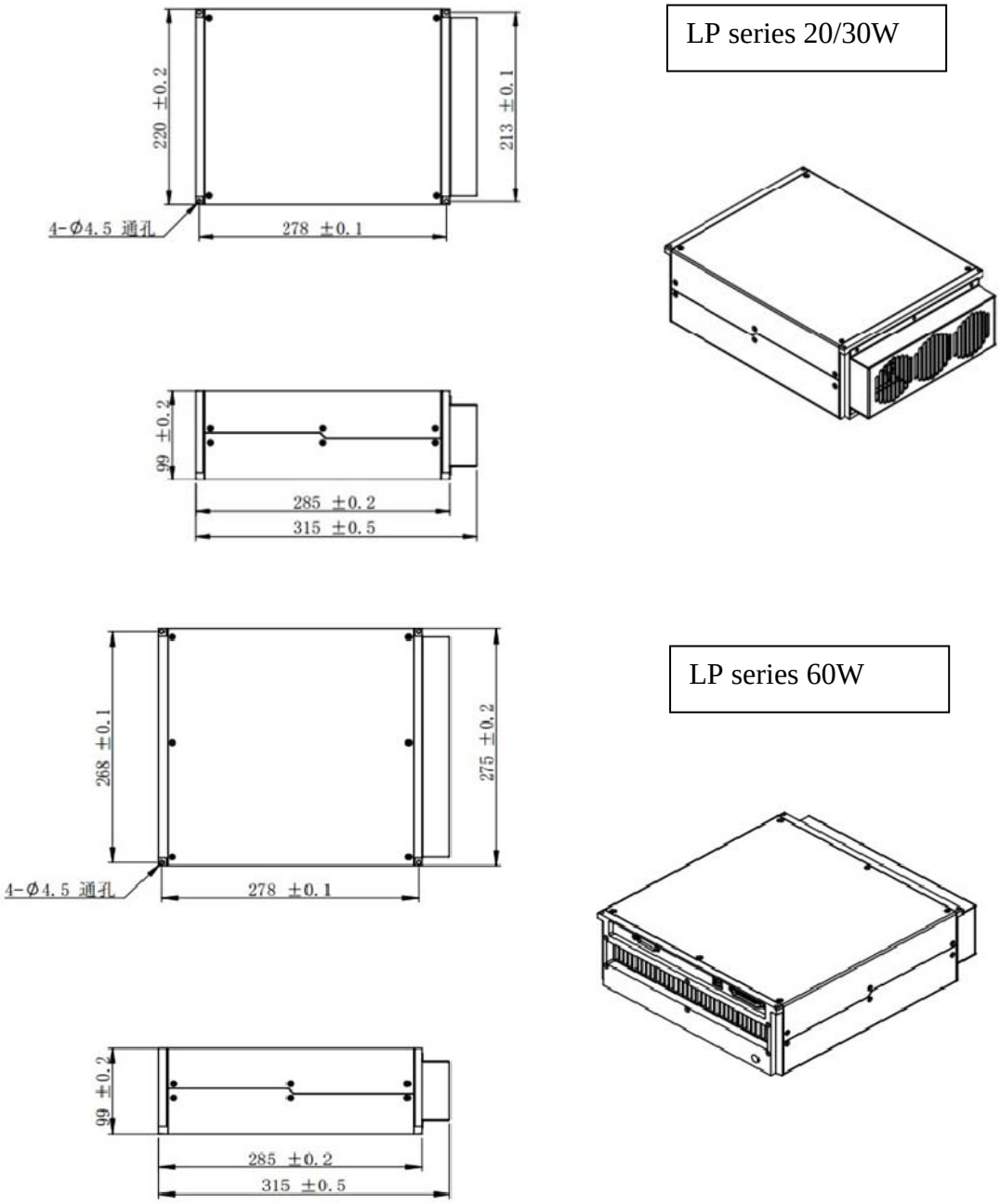
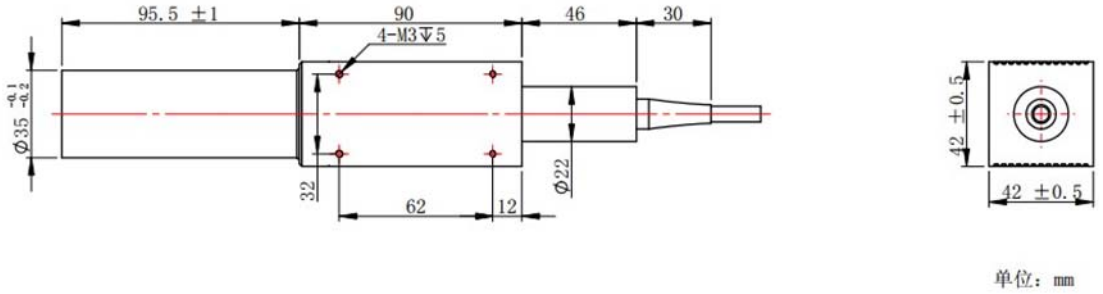
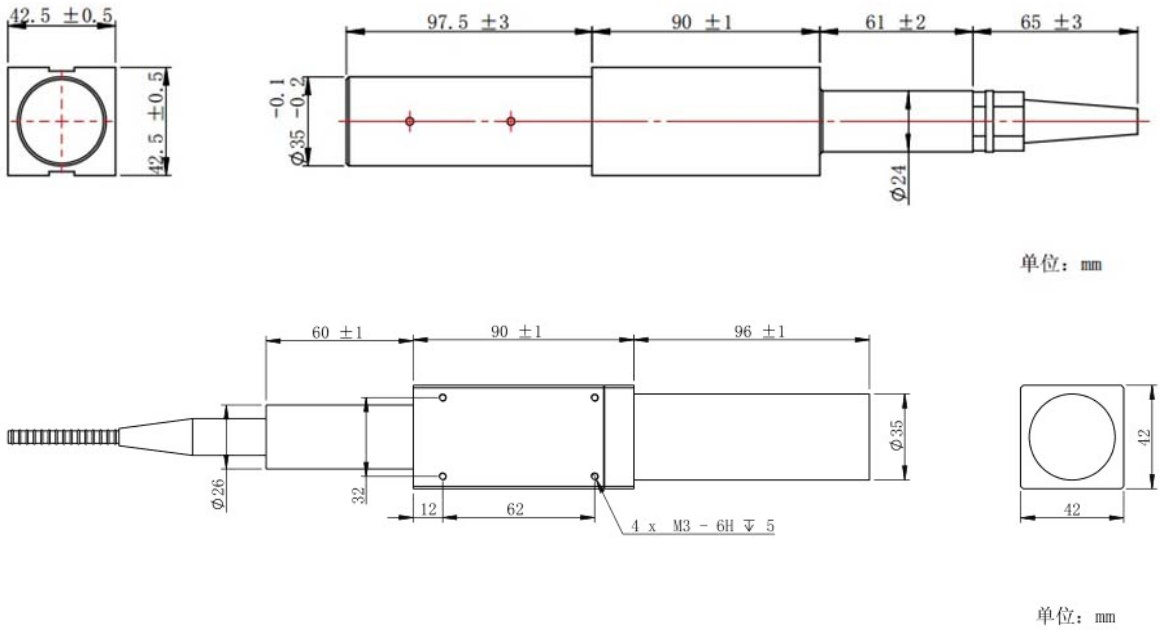


Figure 4 Mechanical Dimensions of the fiber laser module (Unit: mm)

2. Mechanical Dimensions of the output isolator



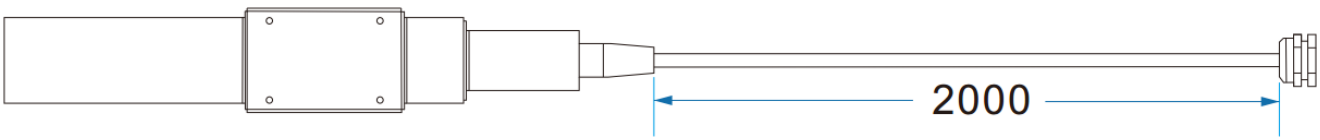
LP series 20/30W



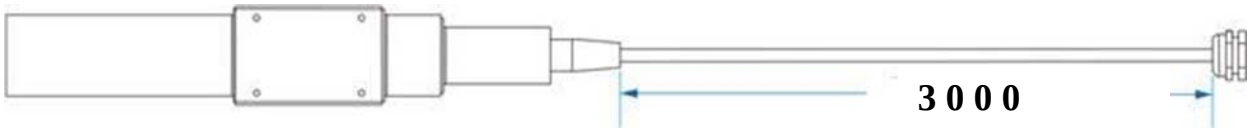
LP series 60W

Figure 5 Mechanical Dimensions of the output isolator (Unit: mm)

3. Mechanical Dimensions of the output fiber cable



LP series 20/30W



LP series 60W

Firgure 6 fiber cable length

2.2 Installation Procedures

1) Fix the laser module onto the mounting panel; make sure enough air gaps around the laser module for sufficient air flow.
2) Connect the power cables with the 24V DC power supply correctly according to the color code, i.e. Red: DC positive, Black: DC negative and Olivine: GND).

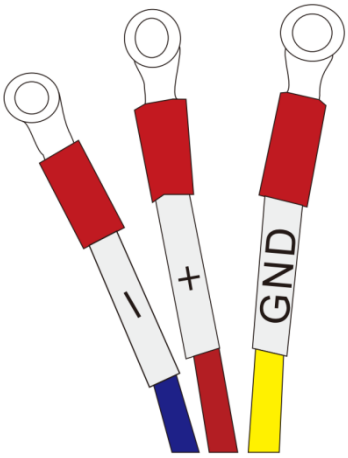


Figure 7 Color code of the power supply cable

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**.

3. Control and Monitoring Interfaces

3.1 Control Interface

DB25 behind the power module is the interface used to connect the control system (such as marking machines) to the laser system. Please make sure that the interface is connected firmly before the operation.

The PIN is defined as shown in Figure 7 and Table 6.

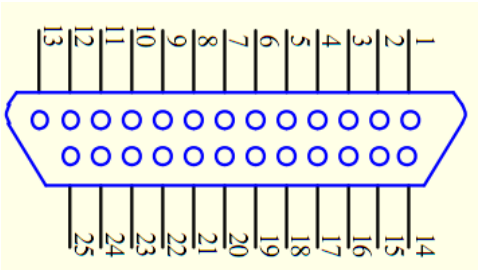


Figure 8 DB25 interface

Table 6 DB25 interface definition of LP1 pulsed fiber laser

DB25 PIN #	Description
1-8	IP0-IP7 Power Control
10-15	GND Description: PIN10-15 have connected inside fiber laser,only need to connect control card GND with another Pin
16 , 21	Warning signal Description: 16 low level, 21 high level: Normal 16 low level, 21 low level: temperature alarm
19	Laser starting signals (PA) shows that high level is just as open and low level is just as off. If PIN19 at the high level before add the 24VDC main power supply, the fiber laser can't recognize (PA) is on-state
20	Frequency Modulation (TTL)
22	A. Control the pulse width ENABLE B. High Level: Red Beam Turned On; Low Level: Red Beam Turned Off

18	MO signal for turn on/off high level is just as open and low level is just as off. The laser will shooting after turning on the laser for 1s together with the rising of MO
9,17,23,24,25	No need to connect

3.1.1 Interface Setting

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 7:

Table 7 Current setting of the MOPA fiber laser

	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 %

Below is the DB25 control timing diagram:

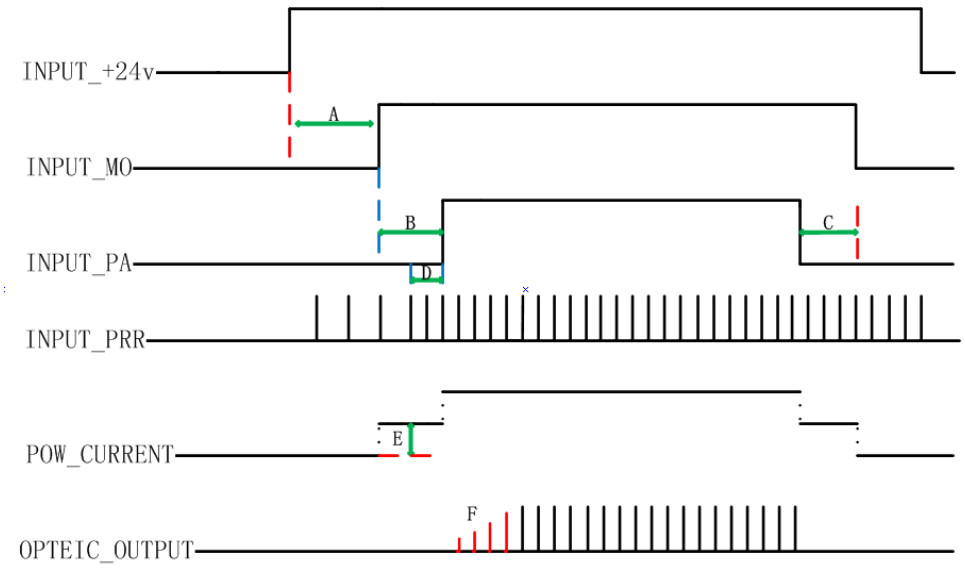


Figure 9 DB25 Controlling Time Series Diagram

- A System initialization time: The laser will shooting after turning on the laser for 12s together with the rising of MO
- B Pump charging time: Range (8ms-35ms), 8ms is recommended.
- C Range: 1ms-8ms, 4ms is recommended.
- D Frequency switching time: Range: 4-8ms, 8ms is recommended.
- E Class II SIMMER: This value is for controlling 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: This can be adjusted via GUI (the supporting software of the laser).

Remarks: After provide 24V voltage, you need to wait 12s to operate

① **Fiber laser control system self-locking:** If fiber laser received unusual testing signal (Such as: long time not connected to control card, high temperature, the PA frequency signal is lower than 1K when GUI selected the external frequency, the 24V power supply is too low) the fiber laser will stop to receive the instruction. Please again power supply the fiber laser if you need to recover the machine.

4. Operation Procedure

4.1 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.

4.2 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 **12s** 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.

4.3 Precautions during the laser operation

1）Wear laser safety goggle.

2）Please stop the laser processing before turning off the fiber laser.

Thank you for your support to JPT Electronics.