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User's guide Ytterbium Pulsed Fiber Laser RFL-P20MB Ver.: 2.0

Ytterbium Pulsed Fiber Laser User's Guide

RFL-P20MB

Wuhan Raycus Fiber Laser Technologies Co., Ltd., 2018
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Safety Information

Please read this instruction carefully and familiarize yourself with the information we have provided before you use the product. In this brochure, important operation procedures, safety and other information are provided for you and all future users. In order to ensure operating safely and optimal performance of the product, please do according to following warnings, cautions and other information.

- Raycus pulsed fiber laser is classified as a high power Class IV laser device. Before supplying the power to the device, please make sure that the correct voltage of 24VDC power source is connected and the anode and cathode are right. Failure to connect power source correctly will cause damage to the device.
- The device emits invisible 1060~1085nm wavelength light with average power 20W. Do not expose your eyes or skin to the radiation of the laser.
- Do not take apart the device, because there are no replaceable accessories available for users to use. Any maintenance can only be proceeded in Raycus.
- Do not look into the light output end directly. Use appropriate laser safety eyewear when operating the device.

Safety labels and locations



Be careful
Avoid direct laser irradiation

The two labels above is located on the top of the cover of the device, representing laser radicalization.

Content

1. Description.....	1
1.1. Product description.....	1
1.2. Actual configuration list.....	1
1.3. Environmental requirements and cautions.....	1
1.4. Specifications.....	2
2. Mounting.....	3
2.1 Mounting dimensions.....	3
2.2 Method of installation.....	4
3. Control Interface.....	5
4. Operation Regulations.....	9
4.1 Pre-inspection.....	9
4.2 Operation procedures.....	9
4.3 Cautions.....	10
5. Instructions for warranty, return and maintenance.....	10
5.1 General warranty.....	10
5.2 Limitations of warranty.....	10
5.3 Service and repairs.....	11

1. Description

1.1. Product description

Raycus pulsed laser is an ideal high power laser source with high speed and high efficiency. It is specially designed for industrial laser making system and other applications.

Compared with traditional lasers, pulsed laser has some unique advantages in increasing the conversion efficiency of the pump light 10 times higher. Its low power consumption and automotive design make it appropriate for operating both in and outside the lab. Besides, it is exquisite and convenient for its independence in placement, free time in using and facility in connecting to equipment directly.

The device can emit 1060~1085nm wavelength pulsed light under the control of industrial laser's standard interface driven by 24VDC power source.

1.2. Actual configuration list

Table 1. Configuration list

Items	Quantity	Remark
Fiber Laser module	1	

1.3. Environmental requirements and cautions

Pulsed laser should be driven by 24VDC \pm 1V power source.

- 1) Caution: Make sure the corresponding wires of the device are properly grounded.
- 2) All the maintenance to the device should only be done by Raycus, because there is no replacement or accessory provided with the device. Please do not try to damage the labels or open the cover in order to prevent against electric shock, or the warranty will be invalid.
- 3) The output head of the product is connected with an optical cable. Please be careful handling the output head. Avoid dirt and any other contaminations. Please use the specialized lens paper when cleaning the lens. Please lid the laser with protective cover of the light isolator to be against dirt only when the laser is not installed in the device or not in working.
- 4) If the operating the device fails to follow this instruction, the protective function will be weakened. Therefore, it should be used under normal conditions.
- 5) Do not install the collimating device into the output head when the laser device is in working.

- 6) The device has three cooling fans at the rear panel to dissipate heat. In order to guarantee enough airflow to help giving heat off, there must be a space of at least 10 cm's width for airflow in front and rear side of the device. As the cooling fans are working at blow condition, if laser is mounted in a cabinet with fans, the direction should be same as laser's fans.
- 7) Do not look into the output head of the device directly. Please do wear appropriate laser safety eyewear during the time when operating the device.
- 8) Make sure the pulse repetition rate higher than 10 kHz.
- 9) For the longest time without pulse is only 100 us. If there is no pulse output, please stop marking at once, to avoid further damage of the device.
- 10) Power source sudden interruption will do great harm to the laser device. Please make sure the power supply works continuously.

1.4.Specifications

Table 2. 20MB pulsed fiber laser specifications

NO.	Characteristic	Min	Typ.	Max	Uni	Remark
1	Central Emission Wavelength	1060	1064	1085	nm	/
2	Polarization	Random				/
3	Nominal Average Output Power	20	21.5	23	W	/
4	Pulse Repetition Rate	10	500	1000	KHz	/
5	Single pulse energy	/	0.5@40kHz	/	mJ	/
6	Selectable pulse durations	2	/	350	ns	2-350ns are optional
7	Output Power Tunability	10	/	100	%	/
8	Long-term average power instability	<3% @24hrs			%	
9	Beam quality M²	/	1.3	/	/	M ²
10	Output beam diameter	6	7	8	mm	1/e ²
11	Guide Laser Power	Optional			/	
12	Output Fiber Cable Length	2	2	/	m	
13	Anti Strong Back Reflection	Yes			/	/

14	Supply voltage	23	24	25	VDC	/
15	Power Consumption	/	/	150	W	@25°C
16	Cooling	Forced Air Cooled				/
17	Operating Temperature	0	/	40	°C	/
18	Store Temperature	-10	/	70	°C	/
19	Humidity	30	/	85	%	/
20	Laser module dimensions	286×215×95			mm	W×D×H

2. Mounting

2.1 Mounting dimensions

1) Fiber Laser module dimensions (As shown in Fig. 1).

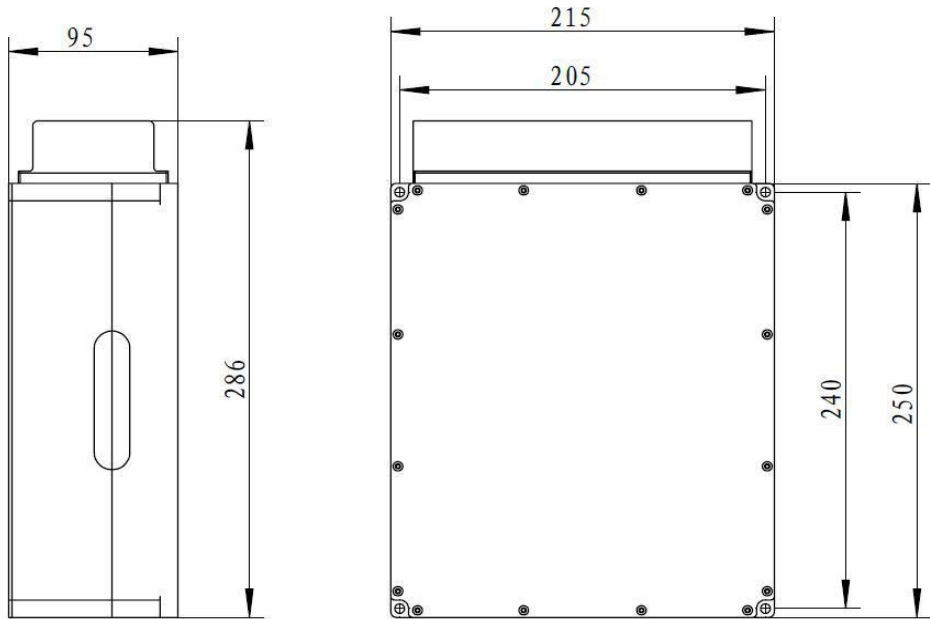


Figure 1. Dimension drawing of laser module (Unit: mm).

2) Isolated output isolator (As shown in Fig. 2).

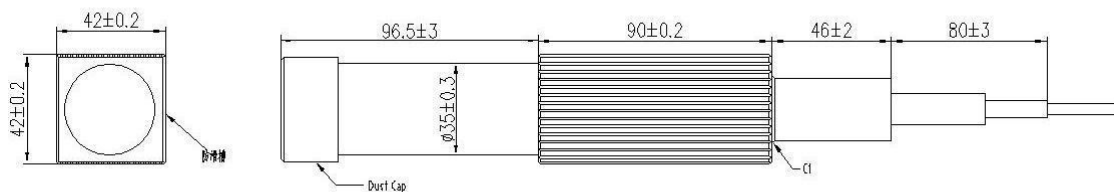


Figure 2. Dimension drawing of output isolator (Unit: mm).

2.2 Method of installation

- 1) Fix the module stable to the bracket and keep the laser in good ventilation.
- 2) Connect the power line to 24VDC power and ensure enough DC output power. Keep it clear to the polarity of the electric current: anode-brown; cathode-blue; PE-yellow and green. The definition figure is shown in Fig. 3.

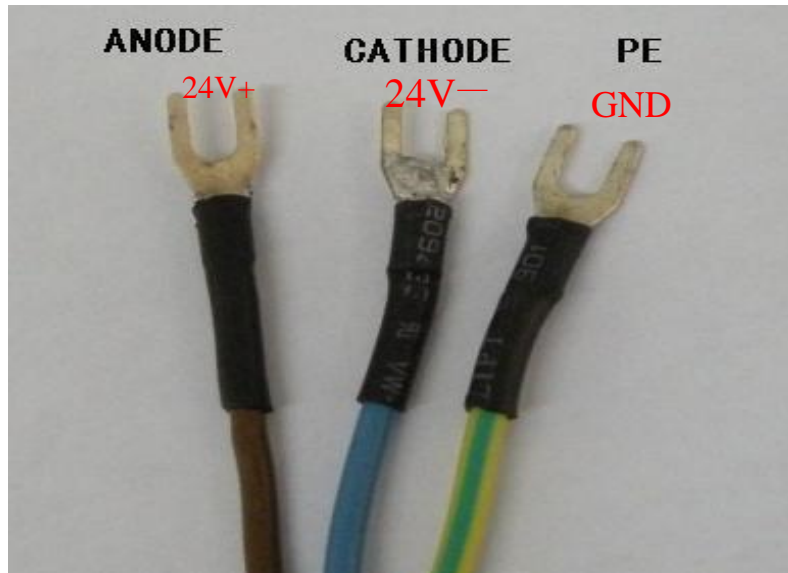


Figure 3. Definition of power line wires

- 3) Make sure that the interface of the external controller matches the laser and the control cable is well connected to the laser's interface. The recommended electrical connection is shown in Fig. 4.

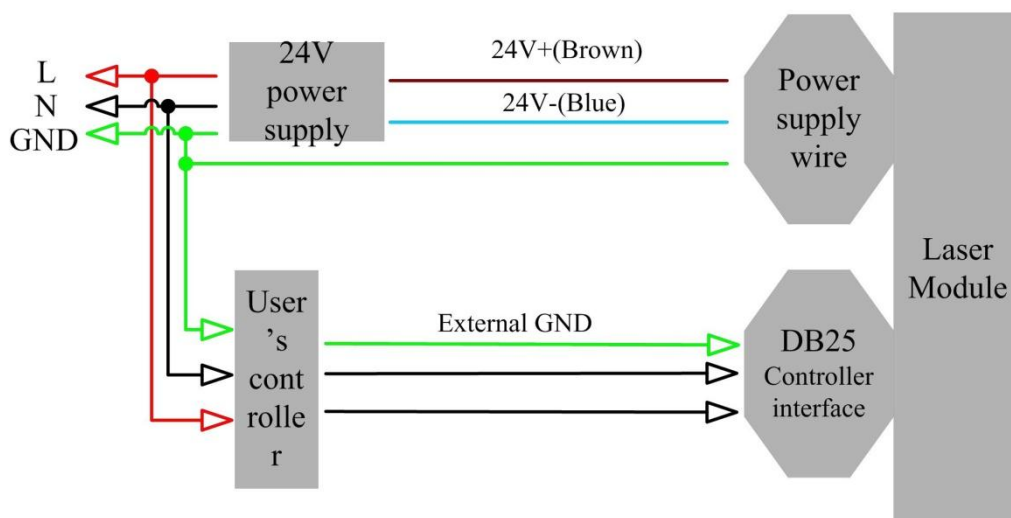


Figure 4. Schematic of recommended electrical connection

- 4) The bending radius of the delivery fiber should not exceed 15 cm.

3. Control Interface

There are DB9 and DB25 interfaces at the rear of the laser. The DB9 is a RS232 interface only used for debugging, no needs to connect. And DB25 is the joint interface connecting control system to the laser system, please make sure the connection is reliable before operation. Feet of the DB25 are defined as follows in Fig. 5.

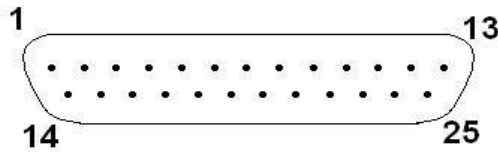


Figure 5. Connect port of controller

Table 3 Definition of connect ports of controller

PIN No.	Name	Description
1-8 (D0-D7)	Power Setting	8 bits parallel port, D0 is minimum bit and D7 is maximum bit; Range: 0-255 (hexadecimal: 0x00-0xFF); 0 is minimum power and 255 is maximum power.
10,14	Ground	Digital GND
11,12,16,21	Laser alarms status	see alarm codes in the table 5
17	VCC	+5VDC power supply input for independent operation of the guide laser and PCB
18	EE	Emission Enable (EE) signal. HIGH: Emission Enable LOW or disconnected: Emission Disable
19	EM	Emission Modulation (EM) input. HIGH (>3V): Emission ON LOW or disconnected (<1V): Emission OFF
20	Sync	Pulse Repetition Rate (Synchronization) input, square wave.
22	Guide Laser signal (pulse duration control enable signal)	Guide Laser (red diode) ON/OFF input. Definition of pulse duration control is shown in table 6.
9,13,15,23,24,25	Obligate PIN	Reserved

- 1) The pump current of diode laser and the laser output power are controlled by setting the value of PIN1-PIN8 (TTL level). PIN1-PIN8 can be set from 0~255, corresponding to the laser output power from 0~100% (the actual laser power may not be strictly linear with the setting value). The relationship between PIN value and output power is shown in Table 4:

Table 4 Definition of power control pins.

	Setting 1	Setting 2	Setting 3	Setting 4	Setting 5
PIN 1	0	0	0	0	1
PIN 2	0	0	0	0	1
PIN 3	0	0	0	0	1
PIN 4	0	0	0	0	1
PIN 5	0	0	0	1	1
PIN 6	0	0	1	1	1
PIN 7	0	1	1	1	1
PIN 8	1	1	1	1	1
Current	~50 %	~75 %	~87.5 %	~93.75 %	100%

- 2) PIN 10 and PIN 14 are all digital GND.
- 3) PIN 17 receives external 5V DC voltage to provide power supply for alarm signal.
- 4) PIN 18 is the start signal of the MO. PIN19 is the input for the optical output signal. The electrical level for both PIN18 and PIN19 are 5V. Before turning on PIN 19, MO signal must be switched ON, in other word, the signal of PIN 18 must be ahead of PIN 19 at least 5 ms, and otherwise the laser machine may be damaged.
- 5) PIN 20 provides control of the frequency. The frequency range should be 10 kHz~1000 kHz, depends on the varying power levels of different laser machines.

ATTENTION: The frequency signal must be ahead of the EM signal at least 5 ms, otherwise the laser machine may be damaged.

Below figure shows DB25 sequence diagram:

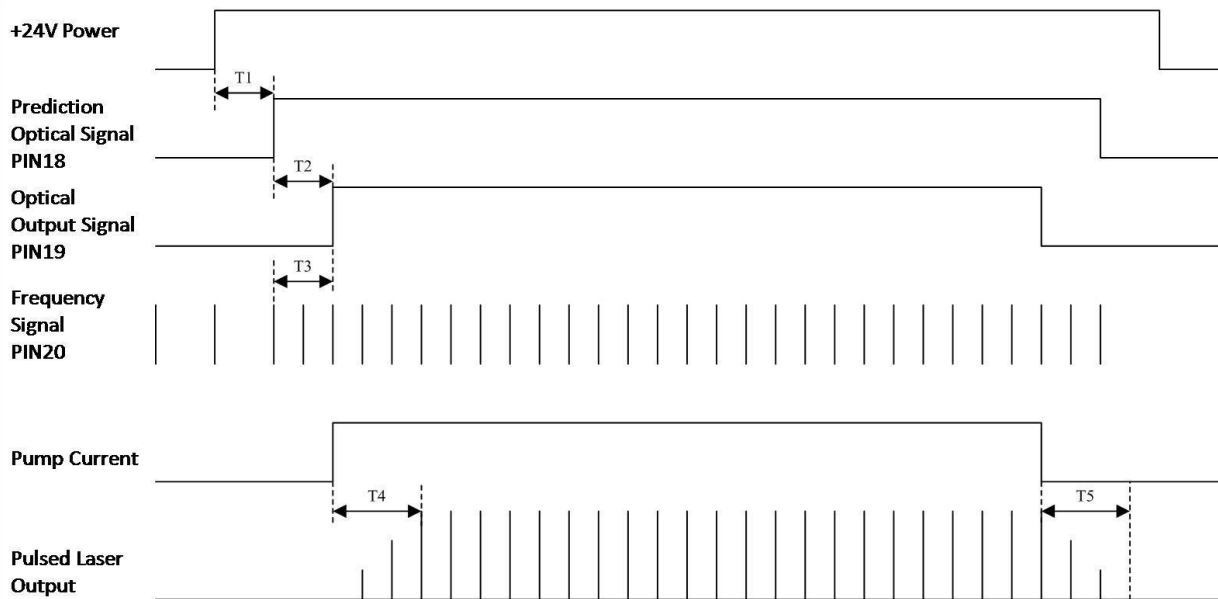


Figure 6 DB25 sequence diagram

T1: Represent the initialization time of the laser machine. The initialization time is less than 10s from power-on to perform initialization.

T2: Represent the pump recharge time, usually around 5ms.

T3: Represent the frequency switching time. Frequency needs to be adjusted before optical laser output, and the switching time should not less than 5ms.

T4: Represent the pulse build-up time. Usually the build-up time is less than 200 us from the pump current raising up to reach the 90% power of the optical pulse.

T5: Represent the pulse shut down time. Usually the shut down time is less than 100 us from the pump current decliner to drop to the 10% power of the optical pulse.

6) Definition of alarm signal

Table 5 Definition of warning signal

PIN12	PIN11	PIN16	PIN21	Alarm content
X	Low	Low	Low	Laser Temperature Warning ¹
X	Low	Low	High	Normal
X	High	Low	Low	Abnormal State ²
X	Low	High	High	Main Oscillator Error ³

PS 1: PIN 17 receives external DC voltage to provide power supply for alarm signal. Therefore, please make sure PIN17 is connected to the +5V power supply. The temperature warning will

remain if the power or DB25 port is not well connected.

PS 2: If the voltage or current states of the laser are abnormal, the alarm might present “POWER ERR” due to using different marking card (for example: Beijing JCZ Technology Co. marking card,).

PS 3: If the laser output system is abnormal, the alarm might present “SYSTEM ERR” due to using different marking card (for example: Beijing JCZ Technology Co. marking card,).

7) Introduction of laser pulse duration control

PIN2, 3, and 22 on DB25 port not only used for the foundation control of the laser machine, but also achieves the pulse duration control as the extender.

Table 6 Laser duration control signal

PIN	Name	Description
2	Serial input	The setting of the data bits synchronize with rising edge of the serial clock.
3	Serial clock	Serial clock , frequency range: 10kHz~1MHz.
22	Pulse duration control Enable	High: Enable, PIN2 and PIN3 control the pulse duration Low or disconnected: Disable

The principle of the laser duration control is described as follows:

a) Marking machine send the command to the laser machine by the PIN2 on the DB25 port, meanwhile send the clock signal to the PIN3. The comment is the binary form, and delivers the most significant bit as the priority.

b) The order structure from marking machine to the laser machine is: 0xA5+instruction code.

c) 0xA5 (A5h) is the comment byte to active the laser pulse duration control port. 0xA5 and the following data will be directly sent as the serial input form to the PIN2 on the DB25 port.

d) The input data length is 4 bytes: the first byte of instruction code should be 0x01 (01h) , the second byte and the third byte are the value of the binary coding of laser duration (for example: 200 is the decimal number of 0x00C8, represents the setting pulse duration is 200ns).

e) PIN22 is the Enable signal. The Enable should achieve high state at least 10us before PIN2 and PIN3 changing. The Enable should achieve low state at least 10us after PIN2 and PIN3 changing. Figure 7 shows the adjustment process of laser duration control.

f) PIN19 should decrease to low state before adjusting laser pulse duration.

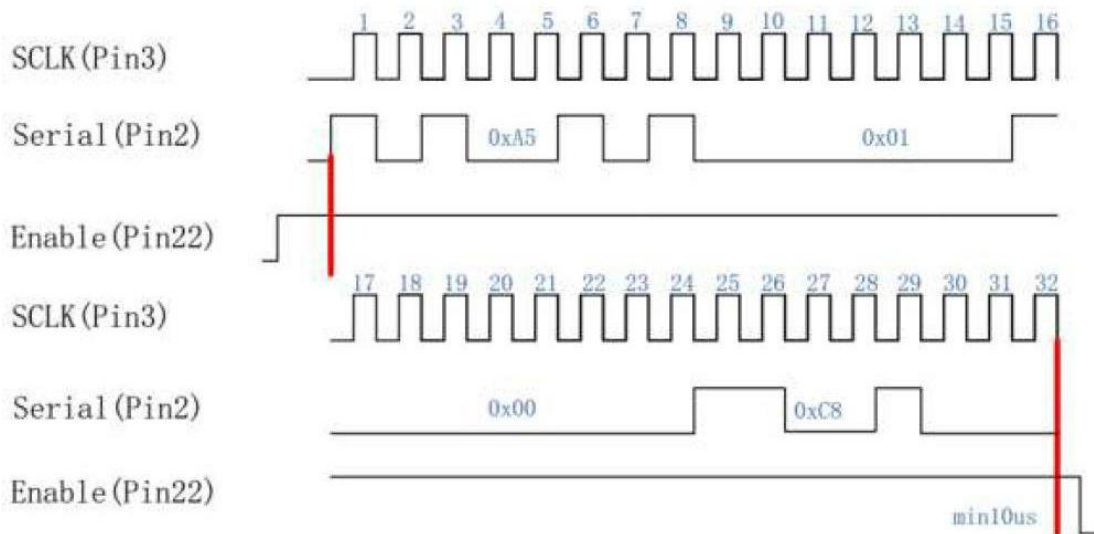


Figure 7 Schematic of laser pulse duration adjustment (200ns)

For example, if using Beijing JCZ Technology Co. marking card to adjust laser pulse duration, the setting processes are described as follows:

- a) Make sure the power supply, DB25 cable, control card and computer are correctly connected, and then turn on the 24V power supply.
- b) Open Ezcad2.7.6 (or other version), then click 'F3', the configuration parameter should show up, select 'Fiber' in category of the 'Laser Control' panel, follow that select 'IPG_YLPM', and then close this window.
- c) Pulse duration can be modified by the 'Duration' on the right side of the window. If the setting duration is smaller than the limiting minimum value, the duration of output laser will be 2ns (minimum). If the setting duration is larger than the limiting maximum value, the duration of output laser will be 200ns (maximum). If the setting duration within the range, the duration of output laser will tend to the smaller side.

4. Operation Regulations

4.1 Pre-inspection

- 1) Make sure the device appearance is in good condition and the output fiber is neither excessively bended nor broken.
- 2) Make sure signal line of laser and marking system are properly connected.

4.2 Operation procedures

1) Starting procedures

Please make sure the control system is on before you turn on the fiber laser. Only after at least 1 minute since the power turned on, the subsequent operations can be proceeded.

2) Frequency set introductions

The frequency setting range is from 10 kHz to 1000 kHz.

3) Laser marking checking

For the device initial testing, first turn the power down to zero without turning on the marking system after the device is successfully started. Then draw a quadrature, marking continuously while slowly increasing the power from 0% to 100% at the same time. Meanwhile, use a ceramic material to observe the laser and the laser should become stronger, otherwise shut down the device and check. If operating normally, the marking system can be used in common order afterwards.

4.3 Cautions

- 1) Marking frequency must be in the range of 10 kHz to 1000 kHz.
- 2) It should not modify the frequency while marking.
- 3) Stop marking first before shutting down the device, then turn the power down to zero and cut the power off.

5. Instructions for warranty, return and maintenance

5.1 General warranty

All products are warranted by Raycus against defects and problems in materials and workmanship during the warranty period according to the purchase order or specifications and we guarantee the product will accord with the specification under normal use.

Raycus has the right to choose to repair or replace any product that proves to be defective in materials and workmanship selectively during the warranty period. Only products with particular defects are under warranty. Raycus reserves the right to issue a credit note for any defective products produced in normal conditions.

5.2 Limitations of warranty

The warranty does not cover the maintenance or reimbursement of our product of which the problem results from tampering, disassembling, misuse, accident, modification, unsuitable physical or operating environment, improper maintenance, damages due to excessive use or not



following the instructions caused by those who are not from Raycus. Customer has the responsibility to understand and follow this instruction to use the device. Any damage caused by fault operating is not warranted. Accessories and fiber connectors are excluded in this warranty.

According to the warranty, client should write to us within 31 days since the defect is discovered. This warranty does not involve any other party, including specified buyer, end-user or customer and any parts, equipment or other products produced by other companies.

5.3 Service and repairs

Raycus is responsible for all the maintenance, for there is no accessory available inside for users to use. Please contact Raycus as soon as possible when problems under warranty about maintenance happen to the product. The product returned with permission should be placed in a suitable container. If any damage happens to the product, please notify the carrier in document immediately.

All the items about warranty and service above provided by Raycus are only for reference; formal contents about warranty and service are subject to the contract.

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