

## TO1310-TO1550

# Series Internal Modulation Optical Transmitter Instructions(V 1.3)



---

## Foreword

This manual is applicable to the TO1310 series internal modulation laser transmitter. It mainly describes the performance characteristics, technical parameters, installation and debugging, and common fault handling methods of the product. In order to ensure the smooth installation and correct operation of the equipment, please be sure to read this manual carefully before installing or commissioning the equipment. Perform the installation and commissioning in strict accordance with the operating procedures specified in the manual to avoid unnecessary damage to the equipment or injury to the operator's body; if in doubt, please contact the company in time.

### Special Note :

- This equipment is a professional and precise equipment. The installation and commissioning must be performed by professional and technical personnel. Read this manual carefully before operation to avoid damage to the equipment due to misoperation, or to cause accidental injury to the operator.
- When the optical transmitter is working, there will be an invisible laser beam in the optical signal output adapter on the rear panel. The optical signal output port should be prevented from aligning with the human body, and the optical output port should not be directly viewed with the naked eye. Human's eyes may be caused permanent damage!!!
- Any operation on the output jumper should be done with the pump laser switched off. Do not insert or pull the output port, or the jumper and output power will be influenced.
- When installing the fiber optic connector, the force should be appropriate, otherwise it may cause the ceramic tube in the adapter to crack. Once the ceramic tube is fragmented, the output optical power will be greatly reduced, and the optical fiber connector will rotate slightly, and the output optical power will change significantly.
- Before the equipment is powered on, it should be confirmed that the grounding terminals of the chassis and the power socket have been reliably grounded (the grounding resistance should be  $< 4\Omega$ ) to prevent the static electricity from damaging the laser device and prevent the chassis from being electrified and causing damage to the human body.
- In order to ensure long-term stable operation of the equipment, users are advised to configure dedicated AC power supply for the equipment in areas where the grid voltage is unstable or where the voltage waveform is poor. Conditional users can also configure uninterruptible power supply (UPS) systems. In areas where the ambient temperature changes too much or the room environment is poor (the ideal operating ambient temperature of the equipment is  $25^{\circ}\text{C}$ ), it is recommended that the user configure a dedicated air conditioning system for the equipment to improve the working environment of the equipment.

## Contents

1. Application .....	1
2. Performance characteristics .....	1
3. Block diagram.....	4
4. Technical Parameters.....	2
5. Model Description .....	2
6. External function description.....	6
6.1 Front panel .....	6
6.2 Rear panel .....	3
7. Menu system.....	4
7.1 Menu Button Description .....	4
7.2 Menu Display Description .....	4
<b>8. Network management connection and data serial port connection .....</b>	<b>9</b>
8.1 Network Management Steps.....	9
8.2 MicroUSB2.0 Interface Connection Procedure .....	11
9. Installation and commissioning .....	13
9.1 open box to check .....	13
9.2 Check accessories .....	13
9.3 installation steps.....	13
10. After-sales service .....	15
11. Optical fiber movable connector cleaning and maintenance method .....	15
12. Disclaimer.....	16

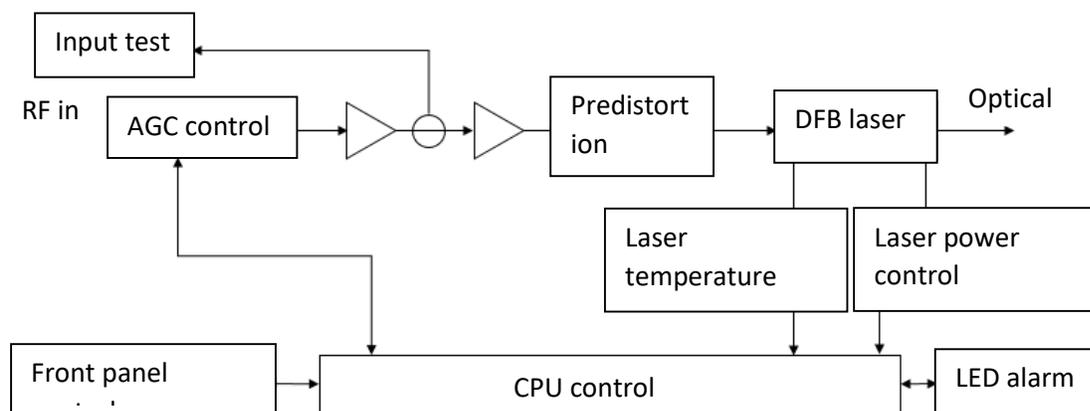
## 1. Application

- 1310nm/1550nm optical fiber transmission network;
- Build CATV secondary network signal transmission;
- Cooperate with multi-port high-power optical amplifier to build the fiber-to-the-home (FTTH) network.

## 2. The performance characteristics

- International famous brands high-performance DFB lasers are adopted, narrow spectral lines, good linearity, and high output power.
- The drive circuit adopts advanced multi-frequency RF predistortion technology and RF power automatic processing technology, which can automatically optimize the drive level so that the C/CTB, C/CSO, and C/N indicators are always at optimal values.
- 32-bit ARM processor can efficiently coordinate the working status of each module and accurately monitor and control each operating parameter.
- Laser temperature stabilization circuit (ATC) and optical power output stabilization circuit (APC) ensure optimal laser performance.
- 47-862MHz (1000Mhz can be customized) operating bandwidth.
- Reserved dual module structure, can increase the function of light emitting, EDFA, light collection, RF switch and other functional modules, can achieve a multi-purpose machine;
- Modular structure, easy to extend the function of the equipment and maintenance;
- Standard network management interface, in line with SNMP network management protocol;
- The dual power supply is hot backup, snap-type fixed, one-touch pull. Easy to operate, firmly fixed. Voltage 220V & 110V & 48V optional.

## 3. Block diagram

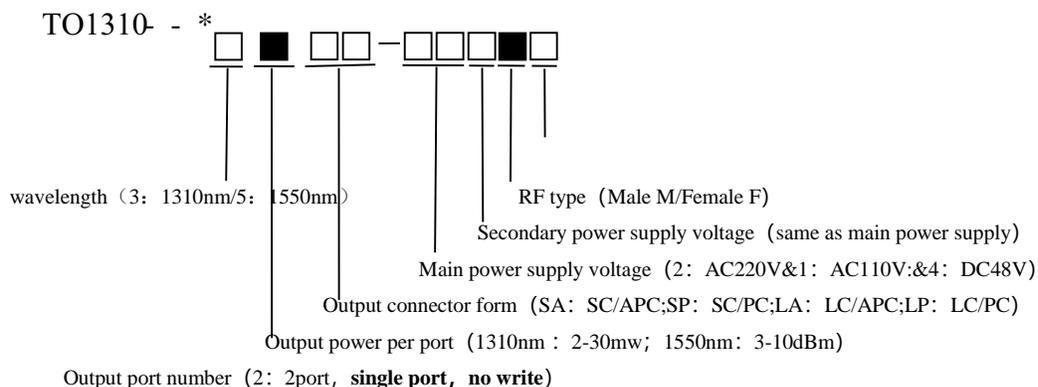


#### 4. Technical Parameters

Test items		Performance parameters	
		TO1310	TO1550
Optical characteristics parameters	Output optical power	2~30mW	3~10dBm
	Wavelength	1310nm±20	1550nm±15
	Laser type	LD//DFB Laser	
	Optical modulation	Direct optical intensity modulation	
	Optical connector form	FC/APC&SC/APC (can be customized)	
RF characteristics parameters	Frequency Range	47~860MHz (can be customized 1000MHz)	
	RF input level	75~90dBuV (Recommended best value 80dBuV)	
	In-band flatness	±1dB	
	AGC accuracy	0.5dB	
	MGC adjustment range	0~15dB	
	RF input impedance	75Ω	
	Input reflection loss	≥16	
	C/CTB	≥65	
	C/CSO	≥60	
	Carrier to noise ratio(C/N)	≥51	
Normal characteristics parameters	Supply voltage	AC220V(160V ~ 265V) /AC110V (90 ~130V) /DC48V (38 - 58V)	
	Total power consumption	< 12W	
	Work temperature	-5°C~+45°C	
	Relative humidity	95% max, no condensation	
	Storage temperature	-30°C~+70°C	
	Product net size	357(W)*482(L)*44(H)	
	Single product packaging size	595(W)*490(L)*120(H)	
	FCL package size (2 sets)	595(W)*490(L)*230(H)	
	Product Weight	3kgs(single power supply)	
	Single product packaging net weight	4kgs (single power supply)	
	Gross weight of whole package (2 sets)	9kgs	

## 5. Model Description

TO1310- Number of ports \* Power per port - Output connector type + Mains supply voltage + Auxiliary supply voltage + Output connector form - With wave division + wave tap type (**Note: When black box is not available for order, no write**)



Example: TO1310-5-2\*5-SA21M

**Explanation: This equipment is 1U light emitting equipment, wavelength 1550nm, 2 output, each output 5dBm, output connector SC / APC, the main power supply 220V, sub power supply 110V, RF type is Male**

## 6. External function description

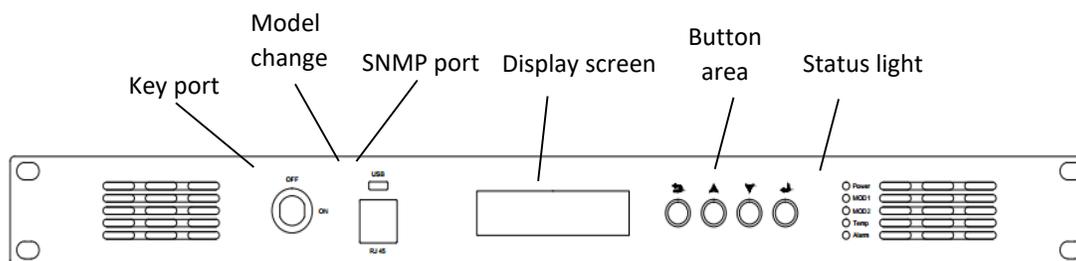


Figure 6.1 Front Panel

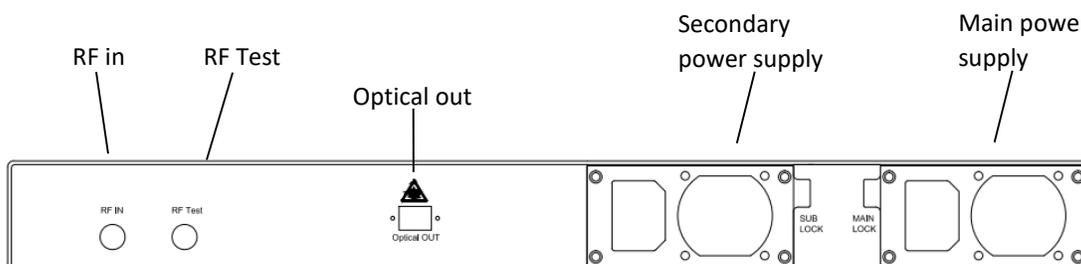


Figure 6.2 Rear Panel

## 6.1 Front panel function description, as shown in Table 6.1:

Project	Function description	
key	Pump the laser switch and turn the laser on when the key is turned ON. When turned OFF, the laser power is cut off.	
Model modify	MicroUSB2.0 interface, can be directly connected to the computer through the data line for serial communication.	
SNMP port	RJ45 network management interface	
Display window	Display function menus, parameter values, and other information	
Button		return key
		Page up / parameters +
		Page Down/Parameters -
		OK button
Indicator	Power	Power indicator, green light indicates power is on
	MOD1	Module 1 Online Indicator Lights up in normal status (module communication is lost, MOD1 turns red)
	MOD2	Module 2 online indicator This lamp is off
	Temp	System temperature status indicator (Green indicates 35°C or less, Orange indicates 35 to 50°C, Red indicates 50°C or more)
	Alarm	Module working status indicator (red light when the module works abnormally)

**Note: The internal CPU system of this machine can automatically monitor the working status of the equipment and deal with various problems arising from the equipment. When an alarm occurs, it indicates that the machine has a serious failure. Record the alarm parameter value as far as possible, and immediately contact the company.**

## 6.2 Rear panel function description, as shown in the following table

Project	Function description
RF in	RF IN RF input interface
RF test	FR Test RF Monitor
Optical power output	Optical OUT optical power output port. Make sure to confirm the fiber connector before connecting. Remember to use a dust cap to cover this connector when it is not connected to protect the internal fiber connector end face. It is also forbidden to inject laser light into the user's eyes to prevent accidental injury.
SUB power supply	SUB Power supply interface and power switch
main power	MAIN Power main power interface and power switch

## 7. Menu system

### 7.1 Menu Button Description

The menus are operated through the following four navigation keys on the chassis panel:

↶: Return to previous menu

▲: Turn up / parameter +

▼: Turn down / parameter -

↵: enter

### 7.2 Menu Display Description

#### 7.2.1 The standby interface is displayed as shown in Figure 7.2.1:

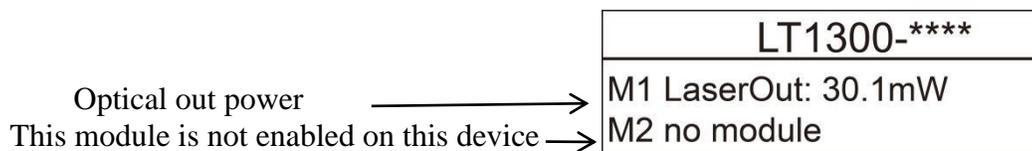


Figure 7.2.1

#### 7.2.2 MOD1 Parameter Display Items

The content of Module\_1 State (device parameter monitoring sub-menu) is the display of various operating parameters of the optical transmitter module.

In Figure 7.2.1 interface, press ▼ key to enter the first main menu. "\*1.Module\_1 State", this menu monitors the operating status of MOD1 key parameters in real time. As shown in Figure 7.2.2, the interface displays:

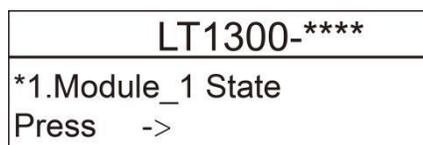


Figure 7.2.2

In the Figure 7.2.2 interface, press the ↵ key to enter the sub-menu and display the 1-1, 1-2 two-parameter status, as shown in Figure 7.2.3:

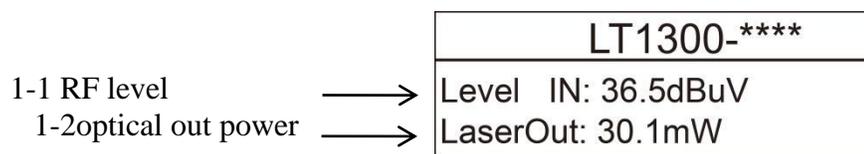


Figure 7.2.3

In the interface of Figure 7.2.3, press the ▼ key to display the status of 1-3, 1-4 parameters, as shown in Figure

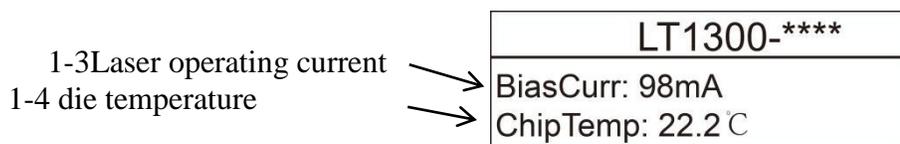


Figure 7.2.4

In the Figure 6.2.4 interface, press the ▼ key to display the 1-5, 1-6 parameter status, as shown in Figure 7.2.5:

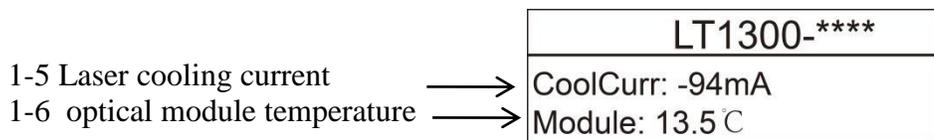


Figure 7.2.5

At this point, the MOD1 parameter display item is displayed. Press the ⏪ key in Figure 7.2.5 and the device will return to the interface of 7.2.1. That is "\*1.Module\_1 State", interface.

### 7.2.3 MOD2 parameter display item

7.2.1, press ▼ key to enter the second main menu "\*2.Module\_2 State" interface, as shown in Figure 7.2.6: This device MOD2 is a reserved module, press ↵ key, the screen displays "no module" Function parameter display.



Figure 7.2.6

### 7.2.4 MOD1 key parameter setting items

Under the 7.2.6 interface, press the ▼ key to enter the third main menu. "\*3.Module\_1 Set", users of this menu can set some key parameters of MOD1 according to actual network usage. As shown in Figure 7.2.7, the interface displays:



Figure 7.2.7

In Figure 7.2.7, press the ↵ key to enter the sub-menu and display the status of the 3-1,3-2 parameters, as shown in Figure 7.2.8:

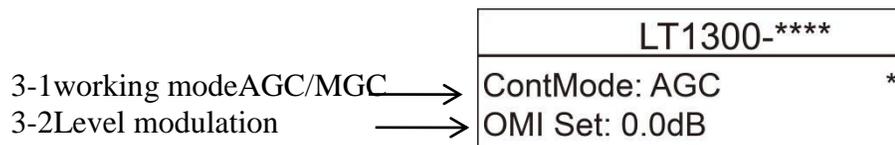


Figure 7.2.8

(1) Working mode setting: In this interface, the "\*" on the far right side is on the same level as 3-1, which means that 3-1 enters the pre-set state. At this time, press the ↵ key to underline the current working mode. As shown in Figure 7.2.9:

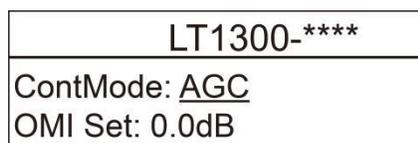


Figure 7.2.9

At this time, use the "▼" two buttons to reset the working mode (AGC/MGC). After setting, press the ↵ key to save the settings. As shown in Figure 7.2.10, the working mode of the device enters the set state.

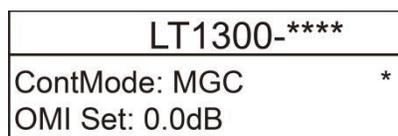


Figure 7.2.10

(2) Modulation level setting: In the Figure 7.2.10 interface, press the ▼ key, the "\*" number will follow down, and the menu 3-2 on the same level as the "\*" will enter the pre-set state. As shown in Figure 7.2.11: At this time, press the ↵ key, the underline appears under the current value, in this interface with the "▼", set the modulation level value, increase or decrease the step is 0.5dB, adjustment range (75 ~100)dB. Press the ↵ key after the device is finished to save the settings. The device enters the set state immediately.

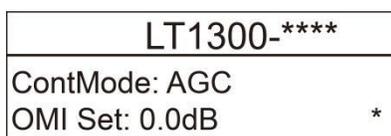


Figure 7.2.11

(3) Set the output power value and RF level attenuation (attenuation range 0~26.5dB). In the 7.2.11 interface, press the ▼ key, the "\*" will follow down, the display interface as shown in Figure 7.2.12, according to 7.2.4 (2) of the operation steps, can be set to 3-3,3-4 set. Among them, 3-3 step 0.1mW, 3-4 step 0.5dB.

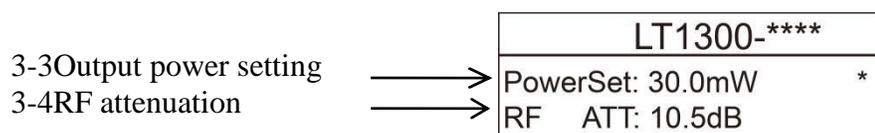


Figure 7.2.12

### 7.2.5 MOD2 parameter setting items

Under page 6.2.8, press ▼ key to enter the fourth main menu “4.Module\_2 Set” interface. This device MOD2 is a reserved module and can be set without parameters. As shown in Figure 7.2.13:

LT1300-****
*4.Module_2 Set
Press ->

Figure 7.2.13

### 7.2.6 Network parameter setting items

7.2.13 page, press ▼ key to enter the fifth item of the main menu "Network Set" interface, as shown in Figure 7.2.14: In this interface, press the key to enter the network management parameter view and modify page, as shown in Figure 7.2.15 Show, 5-1 and 5-2 menus.

LT1300-****
*5.Notwork Set
Press ->

Figure 7.2.14

LT1300-****
5-1 IPAddress viewing and modification → IP: 192.168.0.160 *
5-2Mask view and modify → Mask: 255.255.255.0

Figure 7.2.15

(1) IP address modification: In the figure 7.2.15 display, the “\*” and 5-1 are on the same horizontal line. Press the key at this time and the underline will appear under the first group of data, as shown in Figure 7.2.16. The user can modify the first set of data by step 1 according to the actual needs in conjunction with "▼". After modify press ↵ key, press the ▼ key to transfer to the second group of data, according to the first group of data modification methods, the entire IP address can be modified. Press the ↵ key after the modification is completed, and the reset data will be saved automatically. (factory default IP: 192.168.0.160)

LT1300-****
IP: <u>192.168.0.160</u>
Mask: 255.255.255.0

Figure 7.2.16

(2) Mask, gateway modification: Press the ▼ key. When the “\*” level on the right indicates the relevant menu, refer to 7.2.6 (1) setting method, and other parameters can be set. (factory default gateway 255.255.255.0; default subnet mask: 192.168.0.1)

LT1300-****
5-3Gateway → GW: 192.168.0.1 *

Figure 7.2.17

### 7.2.7 System status display

In Figure 7.2.14, press the ▼ key to enter the "\*6.System State" interface of the sixth main menu, as shown in Figure 7.2.18.

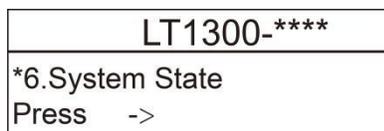


Figure 7.2.18

At this time, press the ↵ key to display the 6-1, 6-2 two parameters, as shown in Figure 7.2.19, continue to press the ▼ key to display 6-3, 6-4 The item parameters are shown in Figure 7.2.20. At this point, 6 menu items are displayed. Press ↵ key to return to Figure 7.2.18 display interface.

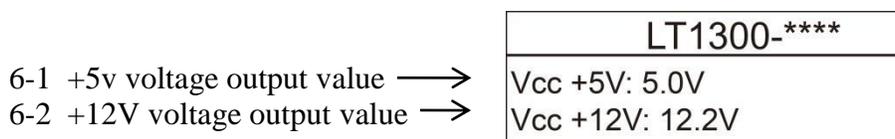


Figure 7.2.19

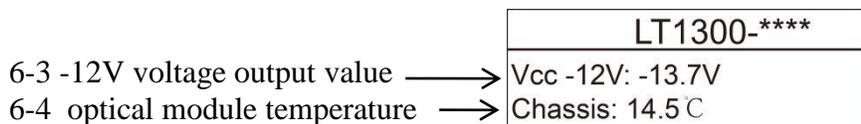


Figure 7.2.20

### 6.2.8 System information display

In the interface shown in Figure 7.2.18, press the ▼ key to enter the "\*7.System info" interface of the seventh main menu, as shown in Figure 7.2.21:

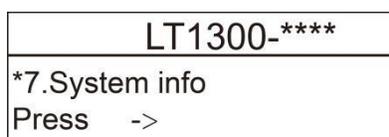


Figure 7.2.21

At this time, press the ↵ key to display the 7-1, 7-2 two parameters, as shown in Figure 7.2.22, press the ▼ key to display 7-3 "Module 1 two parameters are shown in Figure 7.2.23. Continue to press the ▼ key to display the 7-4 "Module 2" parameter as shown in Figure 7.2.24.

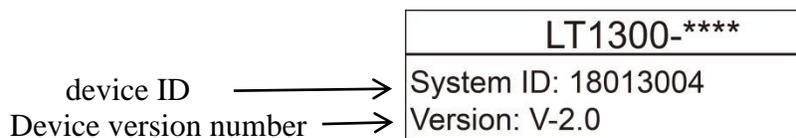


Figure 7.2.22

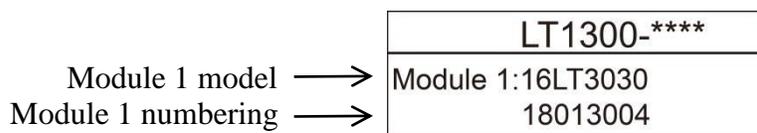


Figure 7.2.23

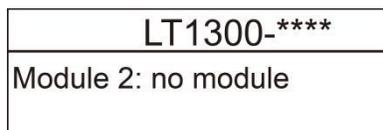


Figure 7.2.24 (Module 2 has no module, so this display shows no module)

At this point, 7 menu items are displayed. Press twice  to return to Figure 7.2.1 Standby Display Interface

## 8. Network management connection and data serial port connection

### 8.1 Network Management Steps

**based on the premise that the device has been powered on)**

(1) Use a network cable to connect the device's network management interface to the computer.

(2) Change the IP address on the computer to the address segment corresponding to the local IP address, but it cannot be duplicated with the local IP address (The factory default IP address is 192.168.5.233 and the setting address is 192.168.5.\*\*\*. \*\*\*<255 but ≠233). The PC's subnet mask and gateway are the same as this one.

The steps for this step are as follows:

①From the computer "Network and Sharing Center" right click on the "Local Connection" right click Enter the Figure 8.1.1 display interface.

访问类型: Internet  
连接:  本地连接

Figure 8.1.1

② After left-clicking, select the option shown in Figure 8.1.2 on the popup screen.

③ Left-click on the pop-up window shown in Figure 8.1.3. Select “Properties” on the interface and left-click. The dialog box shown in Figure 8.1.4 will pop up. Fill in the contents according to the figure.

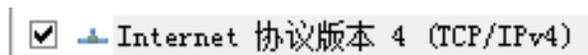


Figure 8.1.3

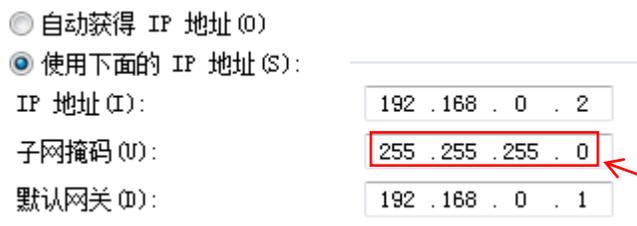


Figure 8.1.2

**Note: In the figure above, the value is <255 but 160**

Figure 8.1.4

(3) Click the OK button after the setting is complete. At this time, the network management port will be steady green and the orange light will flash.

(4) Double-click the web page login icon, as shown in Figure 8.1.5, enter the local IP address “192.168.1.160” in the web address input box as shown in Figure 8.1.6



Figure 8.1.5



Figure 8.1.6





Figure 8.2.1

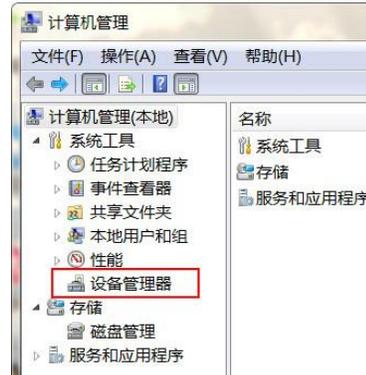


Figure 8.2.2

5. Click "Device Manager" on the 8.2.2 diagram and the 8.2.3 picture will pop up. Click the triangle on the left of the red rectangle icon to bring up the image in Figure 8.2.4. The new "COM1" is a USB interface.

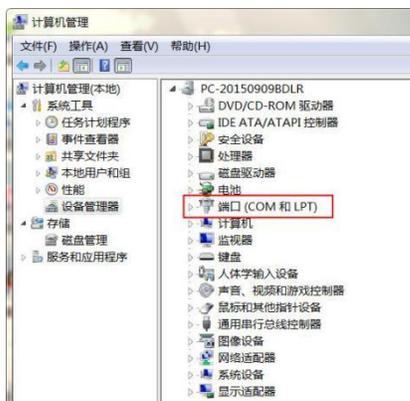


Figure 8.2.3



Figure 8.2.4

6. find the "front panel display settings tool" icon, as shown in Figure 8.2.5, double-click to enter the debug interface, as shown in Figure 8.2.6, left click and pop up Figure 8.2.7 dialog box, modify the completed Rear:



Figure 8.2.5



figure 8.2.6

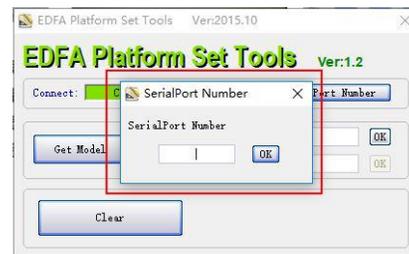


figure 8.2.7

7. modify the port: According to Figure 8.2.4 shows the port number, modify the port number in the red rectangle in Figure 8.2.7 interface, click "OK" button, the port number setting is over.
8. Change the device model display: Click the "Get display information" button, the current device display model will be displayed in the right "model" corresponding dialog box. As shown in Figure 8.2.9 and 8.2.10.

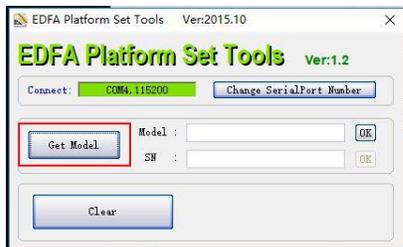


Figure 8.2.9

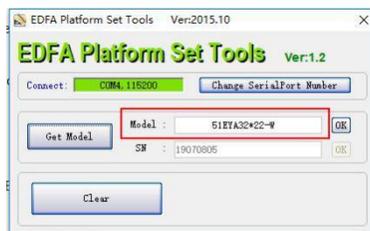


Figure 8.2.10

9. with the computer keyboard, modify the device model, after the change is complete, click the "OK" button, the device model has been modified.

## 9. Installation and debugging

### 9.1 Unpacking

1. Before the equipment is unpacked, please confirm that the outer packing is intact; if you find that the outer packing is damaged or has water marks, contact your local dealer or carrier immediately.
2. After unpacking, please check the equipment and accessories in the inventory box according to the packing list. If you have any problems, please contact your local dealer immediately or call our company directly.
3. After unpacking, if you think the equipment is damaged, please don't power on it to avoid more serious damage to the equipment, or cause accidental injury to the operator; please contact your local dealer or call our company immediately.

### 9.2 Check accessories

accessories	Quantity
AC power cable	1
manual	1
System lock key	1

### 9.3 The normal installation instructions for this machine

- ① Insert the equipment into the slot of a standard cabinet and secure the optical transmitter to the cabinet with two fastening screws. Make sure that the rear seat section of the unit, especially the rear section, has sufficient ventilation and cooling space.
- ② Check that the power outlet to be used and its grounding are reliable. Improper grounding may damage the equipment.
- ③ Verify that the laser switch of the external dimming transmitter is set to the "OFF" position.
- ④ Use a spectrum analyzer to verify the RF signal amplitude to ensure that the input RF signal input level is within the (80±3) dBuV range. If the level is appropriate, connect the RF signal cable to the RF input port.

⑤ Insert the optical power meter or the externally connected fiber connector into the fiber adapter.

Note: The laser may cause eye damage. Please confirm before performing this action that the power of the rear panel has been turned off.

⑥ Connect the rear panel AC power cable and plug it into the socket to set the working status of the device. If the “Power, RF, Temp” indicator on the front panel is green and the “Laser” indicator is red (the system operation is unstable for a short time after power on, the laser needs to be turned on for a while, and the laser switch in front of us is set to “OFF”. Position), the display shows "WT1500\*\*\*\*". Turn the laser switch to the “ON” position and turn on the laser switch. The “Laser” indicator turns green and the optical transmitter is working properly.

⑦ Test output optical power. When undetectable, check the optical power meter to detect whether the mirror is clean, check the jumper is new, check the jumper and flange match (when the test jumper and flange do not match, do not tighten the jumper, Look at the optical power meter and loosely lock it.) Turn off the power and check if the ceramic core in the flange on the machine breaks.

## Precautions! ! !

Clean the end face of the optical fiber: Use a clean cloth (about 3 × 3cm), half wet with anhydrous alcohol, gently wipe the end face of the optical fiber. Then, on the other side of the unsweetened lint-free cloth, gently wipe the end face of the fiber, and then quickly shake the end face of the fiber, and after drying, insert it into the fiber outlet. Do not use any compressed gas to directly hit the end face of the optical fiber, otherwise it may scratch the optical fiber end face due to dust particles, resulting in permanent scratches. When cleaning, please pay special attention to never look directly at the fiber connector, so as not to hurt the eyes!

### 9.4 Disassembly instructions

To remove the machine, follow these steps:

- ① Turn the laser switch lock to the "OFF" position and unplug the power cord.
- ② Disconnect the RF input, optical output connector, and wear a dust shield on the fiber adapter.
- ③ Loosen the screws securing the chassis on the cabinet and remove the screws.
- ④ Then hold the sides of the chassis with both hands and keep the horizontal direction to pull the entire unit out of the cabinet.

**note:** Do not apply stress points to other parts such as fiber optic connectors. (All assembly work should be done by qualified operators) 9.4 Operational Precautions

- Try to avoid colliding with the optical transmitters installed in the cabinet, especially the optical fibers connected to them.
- Try to avoid bending, twisting, twitching, and squeezing the fiber.
- Correctly use the fiber guide slot to discharge the fiber in the fiber guide slot.
- Electrostatic energy causes permanent damage to the laser. Before use, be sure to connect the optical transmitter to the true ground (ground resistance  $\leq 4\Omega$ ) and minimize any possible static factors during operation.
- Do not wipe fiber connectors with your hands or other inappropriate items.
- Avoid frequent startup and shutdown during use to ensure the life of the laser.
- Since the life of the laser is directly related to the temperature, the temperature in the equipment room should be suitable to ensure a good heat dissipation environment.

- After the power is turned on, the light output port on the rear panel of the light transmitter is facing forward to prevent permanent damage to the eyes. When the 16LT1300\*\*\*\* series optical transmitter operates, it emits a high-power laser beam. Even when the unit is turned off, the fiber introduced from an external light source emits a laser beam. Although the laser beam is invisible to the human eye, it can damage the human body and, in particular, cause permanent damage to the eyes. Therefore, avoid observing and touching the end face of the optical fiber whenever and wherever. When cleaning the end face, make sure that the light source is turned off.

**Remember! !! Connect the optical transmitter output optical connector, and then turn on the power. Before plugging and inserting the fiber head, it is necessary to turn off the laser power first (the switch lock is turned off).**

## 10. After-sales service

1. This equipment is guaranteed for one year. We will only be responsible for the maintenance of equipment failure caused by user's misoperation or due to irresistible natural factors.

Collect the appropriate material cost fee.

2. In the event of equipment failure, immediately contact your local distributor or call our technical support hotline.

3. The on-site maintenance of the faulty equipment must be performed by professional and technical personnel to avoid causing more serious damage to the equipment.

**pay attention:** For the equipment that has been dismantled and repaired by the user, our company will not provide free warranty and will charge reasonable maintenance costs and material costs.

## 11. Optical fiber movable connector cleaning and maintenance method

**In many cases, we will misjudge the optical power drop at the output port as an optical device's failure. Actually, the optical fiber connector may be contaminated by dust or dirt. Only proper cleaning and maintenance of the optical fiber connector can be performed to keep troubleshooting. Here's how to clean and maintain the fiber optic connector.**

1. Turn off the device and carefully remove the fiber optic connector from the adapter.

2. Carefully clean the optical connector with a good texture mirror paper or medical degreasing alcohol cotton; when the specific operation is cleaned, the end face of the joint is oriented obliquely downward, and the amount of alcohol in the alcohol cotton should not be too large, but the moist but non-alcoholic dripping good.

3. After the cleaning is completed, wait 1 to 2 minutes for the alcohol on the surface of the movable connector to dry. (You can avoid blowing the fiber connector by mouth by gently shaking the connector to speed up alcohol evaporation!)

4. When the cleaned fiber optic connector is connected back to the adapter, care should be taken to avoid cracking the ceramic tube in the adapter.

5. After the optical fiber connector is cleaned, the output optical power is not normal. At this time, the adapter should be removed and the opposite side of this connector in the machine should be turned to clean it. If the cleaning is completed, the optical power is still low. It is possible that the inside of the adapter has been contaminated and the adapter should be cleaned. (Note: Be careful when removing the adapter to avoid damaging the internal fiber.)

The adapter can be cleaned with special compressed air or a sliver of degreasing alcohol. When cleaning with compressed air, align the adapter's ceramic tube with the nozzle of the compressed air tank and blow the compressed air into the ceramic tube for cleaning. When cleaning with the degreasing alcohol tampon, carefully insert the alcohol sliver into the ceramic tube for cleaning. Note that the direction of penetration of the alcohol sliver should always be the same, otherwise it may not be able to reach the desired cleaning effect.

## **12. Disclaimer**

The company reserves the right to change the products described herein at any time without notice. The company does not assume any responsibility or obligation arising from the use of the products described herein, unless the company expressly agrees in writing. The use and purchase of this product do not transfer any of the company's patents, copyrights, trademark rights or any intellectual property rights. The use of the product in the manner described herein does not infringe any third-party patent and this article does not state or warrant.