EDFA-R

Erbium Doped Fiber Amplifier with Redundant Power Supplies

Product User Manual

Offices

Australia, Melbourne	Tel: +61-3-8561-1400
China, Beijing	Tel: +86-10-5791-0655
Americas	Tel: +1-888-339-8805
EMEA, Netherlands	Tel: +31-36-536-8011

Email: support@pbnglobal.com

Website: www.pbnglobal.com

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Product User Manual

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Prepared by	Pacific Broadband Networks
Prepared for	Product Users

Table of Contents

Safety Precautions

Please read the manual first before installing and using this product. The manufacturer is not responsible for any equipment damage, personal injury, or property damage caused from improper operation.

	**The laser output is a high-power invisible laser. The laser radiation can seriously damage your eyes or skin.**
	**Avoid vibration and collision. The device contains precision optical components that can be damaged.**
	**Please handle carefully and ensure the device is properly grounded. The device is sensitive to static electricity**
	**Special notice for the optical fiber interface:** **1. The optical fiber interface must be clean.** **2. When setting up the device insert the output fiber first. Then insert the input fiber. When removing optical cables, remove the input first and then the output cable.**
	**Do not open the device. If there are any issues contact a PBN representative immediately.**

1. The description of the High Power EDFA-R

1.1 Overview

The EDFA-R occupies 1RU or 2RU in a 19" sub-rack. The key components of the product are high reliability multimode PUMP laser. A unique Automatic Power Control (APC) and Automatic Temperature Control (ATC) circuit ensures table and reliable output power. The unique optical circuit design ensures the excellent optical performance.

The optical circuit is designed specifically for CATV systems. It features a low noise profile to ensure an excellent CNR for analog systems sensitive to noise. The device also has a high level of spectral flatness across the entire C-band to ensure better CSO. The design includes dual hot-swappable redundant power supplies to reduce the MTBF.

The EDFA-R has an intelligent temperature control system that can reduce power consumption by up to 30%. When the case temperature is over 45 degrees Celsius, a fan will start and continue to operate until the temperature is under 40 degrees Celsius. The technology ensures the thermal stability of the system and increase the fan’s lifespan.

It has an intelligent network management system. The device can be controlled through the Ethernet interface, the RS-485 interface, and RS-232 interface. In addition, it can be controlled through SNMP MIB to integrate it with a variety of network management systems.

1.2 Features:

- Low noise profile: Typically less than 4.5 dB (0 dBm input)
- Extremely low CSO distortion: <-70 dBc
- Dual power supplies supporting 220V Mixed interpolation with 48V
- High stability and reliability: MTBF 100000 hours
- Multiple management interfaces: Ethernet, RS-485, and RS-232
- Supports Telnet and standard SNMP Network management
- High precision AGC/ APC circuit: Precision is ± 0.05 dB
- Intelligent Temperature Control System: Power consumption reduced by up to 30% compared to similar products
- 1RU or 2RU in a 19” sub-rack
- Bellcore GR-1312-CORE compatible

1.3 Models and Options

Model Code:

EDFA-R-[U-V]-[W]-[X]-[Y]-[Z]

Erbium Doped Fiber Amplifier (Optical Amplifier) with Redundant Power Supplies

EDFA-R-I-[U-V]-[W]-[X]-[Y]-[Z]

Erbium Doped Fiber Amplifier (Optical Amplifier) with Redundant Power Supplies and Input Power Threshold range of -10~10 dBm

Options:

U-V Number of Output Ports and Output Power

1RU Height

1-13 1 * 13 dBm (13 dBm/per port, 1 port. total 20 mw, 13 dBm), 1RU

… …

1-24 1 * 24 dBm (24 dBm/per port, 1 port. total 250 mw, 24 dBm), 1RU

2-13 2 * 13 dBm (13 dBm/per port, 2 ports. total 40 mw, 16 dBm), 1RU.

… …

2-21 2 * 21 dBm (21 dBm/per port, 2 ports. total 250 mw, 24 dBm), 1RU.

4-13 4 * 13 dBm (13 dBm/per port, 4 ports. total 80 mw, 19 dBm), 1RU

… …

4-18 4 * 18 dBm (18 dBm/per port, 4 ports. total 250 mw, 24 dBm), 1RU.

4-22 4 * 22 dBm (22 dBm/per port, 4 ports. total 634 mw, 28 dBm), 1RU.

5-16 5 * 16 dBm (16 dBm/per port, 5 ports. total 200 mw, 23 dBm), 1RU.

6-16 6 * 16 dBm (16 dBm/per port, 6 ports. total 240 mw, 24 dBm), 1RU.

2RU Height[1]

8-15 8 * 15 dBm (15 dBm/per port, 8 ports. total 256 mw, 24 dBm), 2RU.

8-16 8 * 16 dBm (16 dBm/per port, 8 ports. total 320 mw, 25 dBm), 2RU.

8-22 8 * 22 dBm (22 dBm/per port, 8 ports. total 1268 mw, 31 dBm), 2RU.

10-22 10 * 22 dBm (22 dBm/per port, 10 ports. total 1585 mw, 32 dBm), 2RU.

12-16 12 * 16 dBm (16 dBm/per port, 12 ports. total 480 mw, 27 dBm), 2RU.

16-16 16 * 16 dBm (16 dBm/per port, 16 ports. total 640 mw, 28 dBm), 2RU.

16-17 16 * 17 dBm (17 dBm/per port, 16 ports. total 802 mw, 29 dBm), 2RU.

16-20 16 * 20 dBm (20 dBm/per port, 16 ports. total 1585 mw, 32 dBm), 2RU.

20-20 20 * 20 dBm (20 dBm/per port, 20 ports. total 2000 mw, 33 dBm), 2RU.

24-8 24 * 8 dBm (8 dBm/per port, 24 ports. total 151 mw, 22 dBm), 2RU.

[1] The 2RU device is used for the types with more than 6 output ports.

24-16 24 * 16 dBm (16 dBm/per port, 24 ports. total 960 mw, 30 dBm), 2RU.

24-18 24 * 18 dBm (18 dBm/per port, 24 ports. total 1585 mw, 32 dBm), 2RU.

32-17 32 * 17 dBm (17 dBm/per port, 32 ports. total 1585 mw, 32 dBm), 2RU.

W Optical Connector

S SC/APC optical connector

E E2000/APC optical connector

F FC/APC fit optical connector

L LC/APC optical connector

X Network Management

0 None

1 SNMP

Y Power Supply Options

AC = 90~265 Vac, 50~ 60 Hz; DC = 36~72 Vdc

1A Single mains power supply 220Vac

2A Dual mains power supplies 220Vac

1D Single mains power supply -48 Vdc

2D Dual mains power supplies -48 Vdc

AD With two mains power supplies of 220Vac and -48 Vdc

Z Power Cable

EU Power Cable for Europe (not for use in UK)

CN Power Cable for China

CH Power Cable for Switzerland

US Power Cable for USA

UK Power Cable for UK

AU Power Cable for Australia

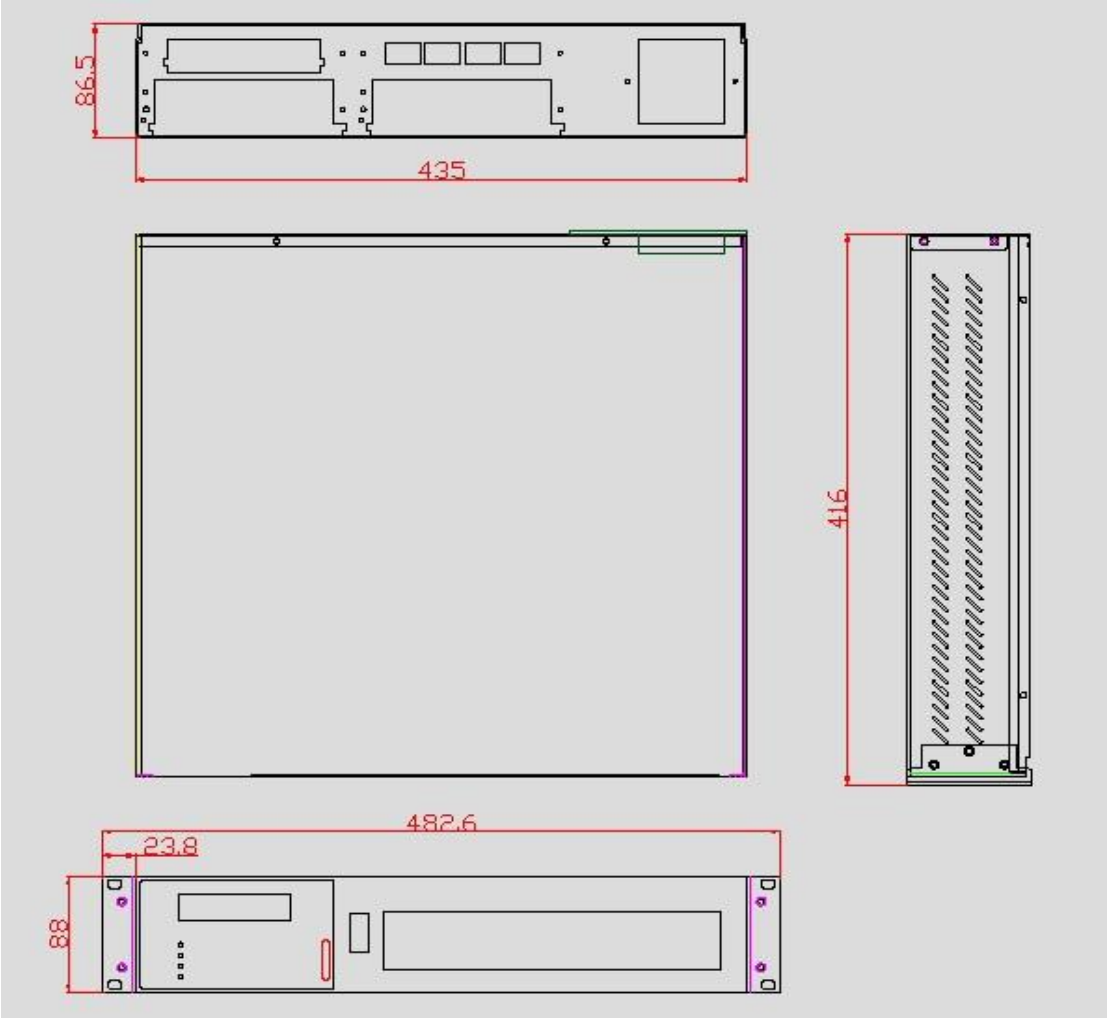
Accessories

Power Supply

EDFA-RPSAC Mains power supply 220 Vac (AC = 90~265 Vac, 50~60 Hz)

EDFA-RPSDC Mains power supply -48 Vdc (DC = 36~72 Vdc)

1.4 Mechanical Figures

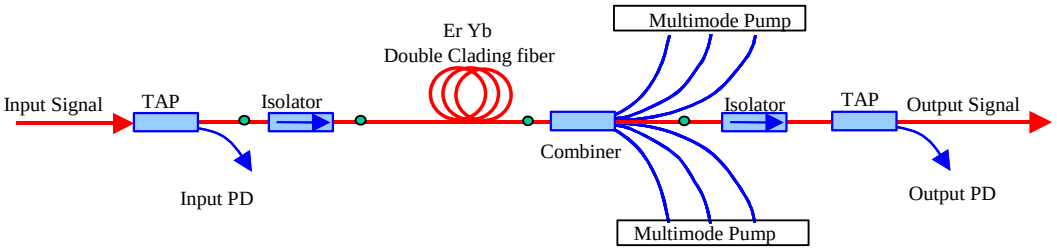


Case Size: 483 × 380 × 44 mm (MAX)

Net weight: 6.1 kg

2. Operating principle

2.1 The architecture of the equipment



Amplifier Unit

3. Specifications

3.1 Parameters

Optical Performance

Parameters	Symbol	Min	Typ	Max	Unit
Optical wavelength	λc	1530	1550	1565	nm
Saturated output power[1]	Posat	13	------	32	dBm
Input power[2]	Pi	-3	------	+10	dBm
Gain	G	------	20	------	dB
Noise Level[3]	NF	------	4.5	------	dB
Output Power Stability	ΔPo	------	±0.05	±0.1	dB
Input Isolation	ISOi	30	-------	-------	dB
Output Isolation	ISOo	30	-------	-------	dB
Input pump leakage	PLi	-------	-------	-35	dBm
Output pump leakage	PLo	-------	-------	-45	dBm
Return Loss	RL	-------	-------	-45	dB
Polarization Dependent Gain	PDG	-------	------	0.3	dB
PMD	PMD	-------	-------	0.5	ps
Optical connector	SC/APC, E2000/APC, FC/APC, LC/APC				

Electrical Performance

Parameters	Symbol	Min	Typ	Max	Unit
Power Supply[4]	Vps	85/170	220	132/264	VAC
Power Consumption[5]	P	------	------	18	W

General

Parameters	Symbol	Min	Typ	Max	Unit
Operation Temperature	Tw	-5	------	60	℃
Storage Temperature	Ts	-40	------	80	℃
Humidity (no condensation)	Pi	10	------	90	%
Dimensions (H x W x D)	44 x 483 x 220 mm				
Weight	6.0 kg				

[1] Customer Optional.

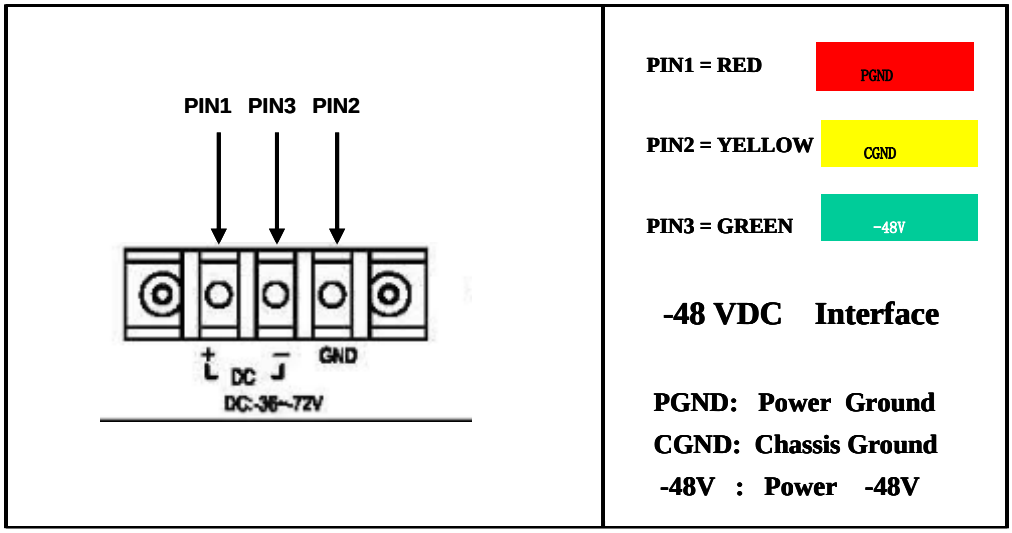
[2] Standard input power range, only for EDFA-R-[U-V]-[W]-[X]-[Y]-[Z].

[3] Test at 0 dBm input power.

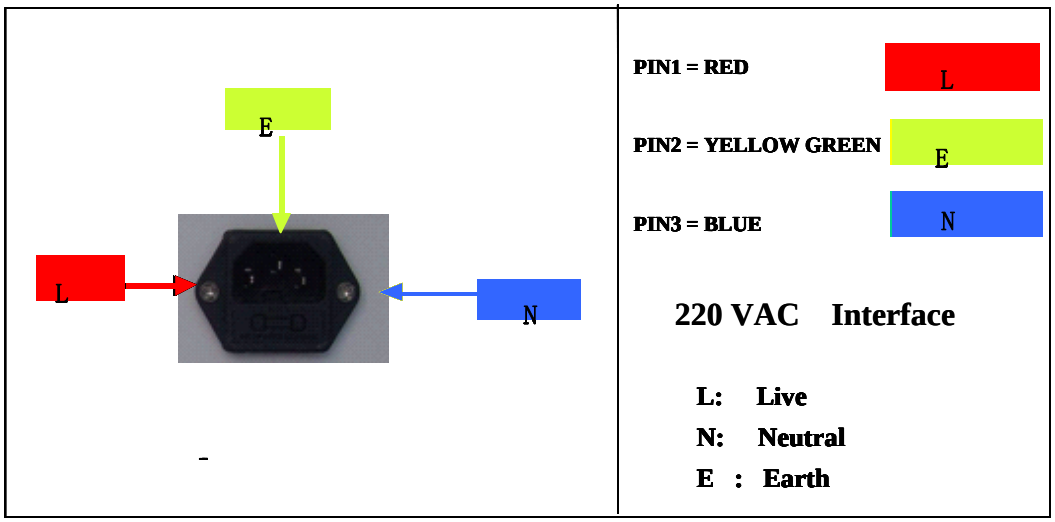
[4] 220 Vac, -48 Vdc and 220 Vac / -48 Vdc are optional.

[5] The actual power consumption is relative to output power and operation environment temperature.

-48 VDC Interface Definition:



220VAC Interface Definition:



3.2 Management interface hardware feature

3.2.1 RS232 interface

- General features

  Interface type: DB-9 (female)

  Baud rate: 9600 bit/s

  Data Bit: 8

  Parity: Off

  Stop bit: 1

Data flow control: Off

- RS232 Interface specification

  RS232 Interface rule for example Table 3.1

Table 3.1 RS232 Interface Feature

Transmission Line	PIN2 (RXD) PIN3 (TXD) PIN5 (GND)
RXD, TXD Logic1 (MARK) Voltage Amplitude	-3~15 V
RXD, TXD Logic0 (SPACE) Voltage Amplitude	3~15 V
The Max. Transmission Distance	15 m
Driver Load Capacitance	<2500 pf

- RS232 interface specification

  RS232 interface is fully compliant with standard RS232 interface specifications to ensure distortion is less than 4%.

3.2.2 RJ45 Ethernet interface hardware feature

- RJ45 Ethernet interface specifications

Table 3.2 RJ45 Ethernet interface specifications

Interface type	RJ45
Speed rate	10 Mbit/s

3.3 SNMP AGENT network management system

The SNMPv1 and SNMPv2 are supported by the firmware. It can be accessed by the standard SNMP network management tools.

Through network management software, detailed parameters can be viewed including performance parameters, power information, device temperatures, and history record.

3.3.1 Standard Compliant

1. Compliant with SNMP version 1.
2. Compliant with SNMP version 2.

3.3.2 Main features

1. Fault monitoring: notifications when there is an error or abnormality in the network.
2. Configuration management: configuration parameters can be set through the configuration

interface

3. Performance management: the device can automatically collect statistical data for the to assess system performance

3.3.3 MIB File

Standard MIB tree (Figure: 3-1).

Please PBN's technical support for the full list of MIB parameters.

3.4 RS 232 monitoring and terminal management (with RS232 communications)

The equipment can be accessed from a PC by a female to female DB-9 connection and the communication distance must not exceed 12 m.

3.4.1 Hardware condition

Item	Parameter	Quantity
RS232 cross line	DB-9(female)	1
PC	serial port software, with DB-9 male COM port, Windows system	1
Amplifier	2U Amplifier、with serial port communication	1

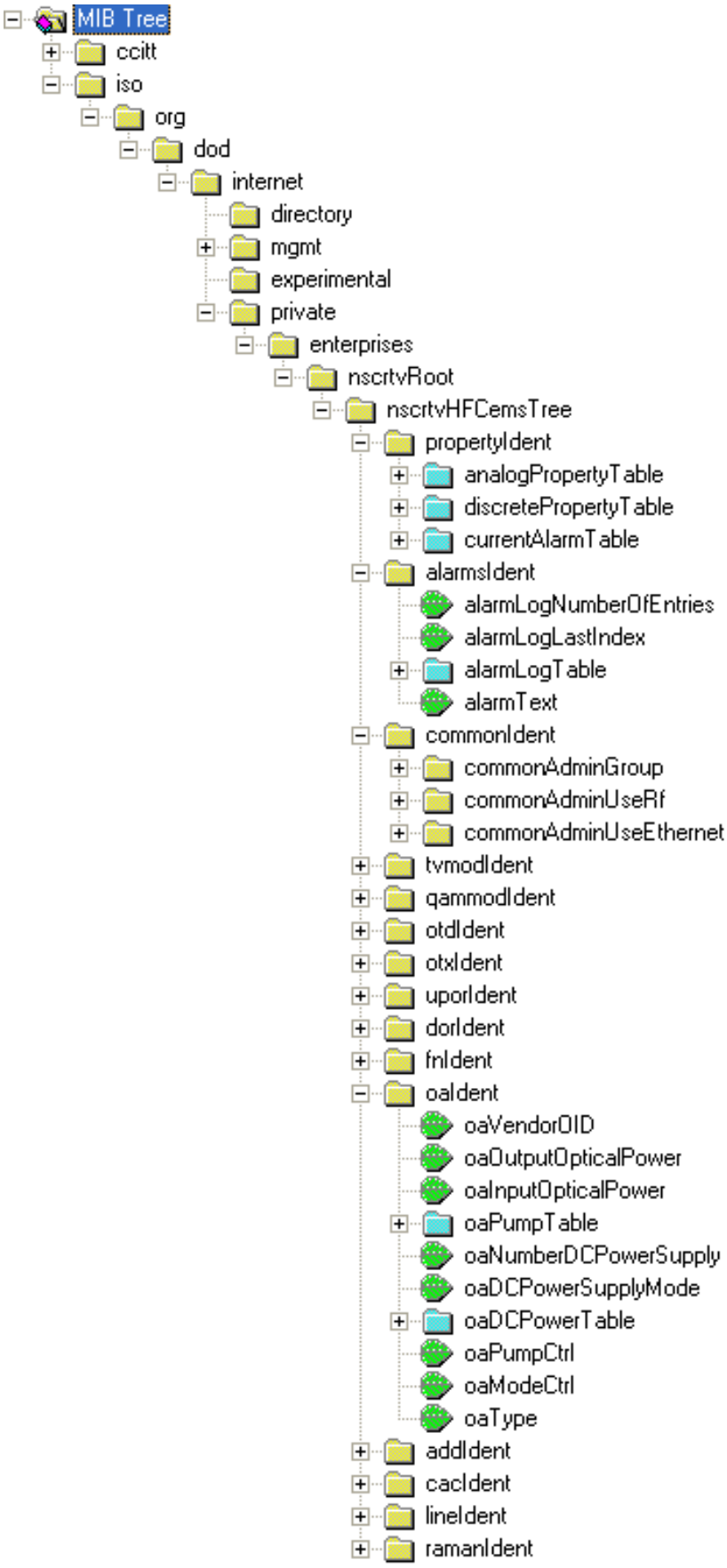


Figure 3-1 standard MIB tree

DB-9 cross line connectivity

DB-9 female 1	DB-9 female 2	connectivity
PIN2	PIN3	interconnected
PIN3	PIN2	interconnected
PIN5	PIN5	interconnected
PIN1, PIN4, PIN6 PIN7, PIN8, PIN9	PIN1, PIN4, PIN6 PIN7, PIN8, PIN9	Interconnected or disconnect

Crosses line connectivity figure：

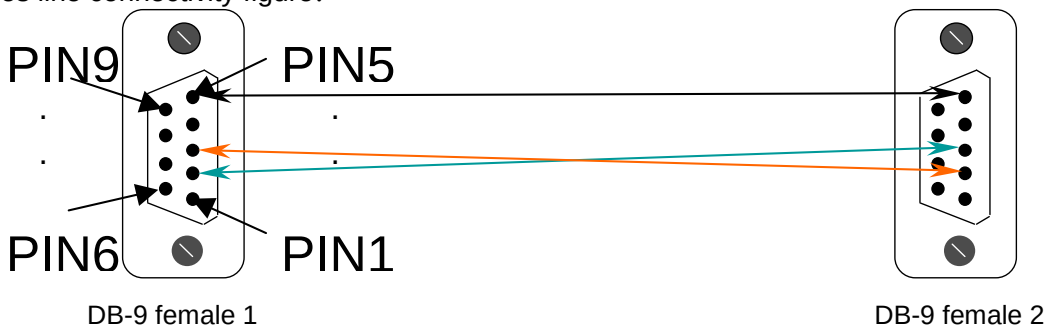
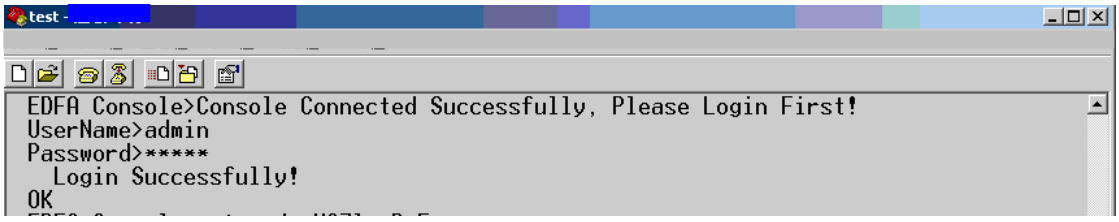


Figure 3-2 DB-9 cross connection layout

3.4.2 Terminal management

Connect the equipment and PC by a serial cable and power on the equipment, and then start the terminal software according to the parameters of the selected serial port (9600 bps, 8 bit data, 1 bit stop, parity and flow control off).

Once a terminal connection is successfully established, please input the user name “**admin**” and the password “**12345**”.



After successfully logging in, type “**?**” or “**help**”, then press the [**Enter**] key to retrieve a list of supported commands.

Serial port console commands

Command	Syntax	Command Explanation	Additional information
exit	N/A	exit serial console mode	This command exits serial

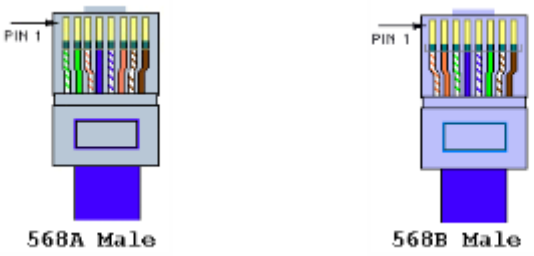
			console mode. The [**Enter**] key must be pressed 3 times before another entering command.
enter	N/A	In application mode, pressing [**Enter**] key 3 times to use console mode	
Admin	N/A	The username is ADMIN when logging in.	The unit only supports one user account
password	N/A	When the terminal displays a "*****", the user is bring prompted for a password	The default admin password is "**12345**"
logout	N/A	Logs the current user out	
help	N/A	Displays the help interface	
?	N/A	Displays the help interface	
ver	N/A	Displays the equipment version	
set	Ip [IP Address]	Used to set an IP address	
show	N/A	Displays the equipment configuration information	
set	logo xxxxxx	Set a string of text to act as a logo	The content of logo text must be less than 20 characters and quotation marks must be used

3.5 TELNET management and SNMP network management

3.5.1 Hardware Requirements

Item	Parameter	Quantity
Network line	Crossover cable, straight-through cable	1
PC	Network management software and a telnet client should be installed.	1
Amplifier	2U Amplifier, with Ethernet port	1
Network	LAN, Internet	1

The corresponding Figure 3-3 of network cable:



568A Male：

Orange and white——1，Orange——2，Green and white——3，Blue——4，

Blue and white——5，Green——6，Brown and white——7，Brown——8；

568B Male：

Green and white——1，Green——2，Orange and white——3，Blue——4，

Blue and white——5，Orange——6，Brown and white——7，Brown——8；

Cross lines：

Two heads the center line of a different order, namely: one for the T568A, one for the T568B;

Direct line:

Two heads the center line of the same order, such as the two are T568B stander;

Figure 3-3 Network line connection figure

3.5.2 Network Configuration

The steps for directly connecting the equipment with a PC：

1. Set the IP address through the front panel
2. Connect the RJ-45 port to a PC Ethernet port using a crossover Ethernet cable

The steps for connecting equipment with a PC through a network：

1. Set the IP address by front panel
2. Connect the RJ-45 port on equipment to a switch, router, or hub that also connects to a PC

The steps for connecting equipment with PC through network：

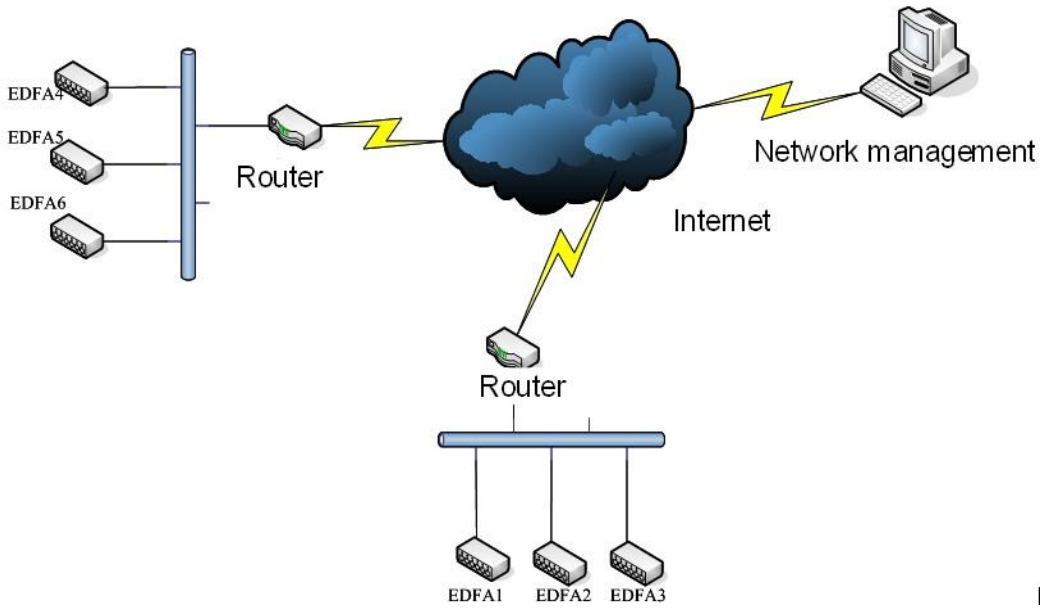
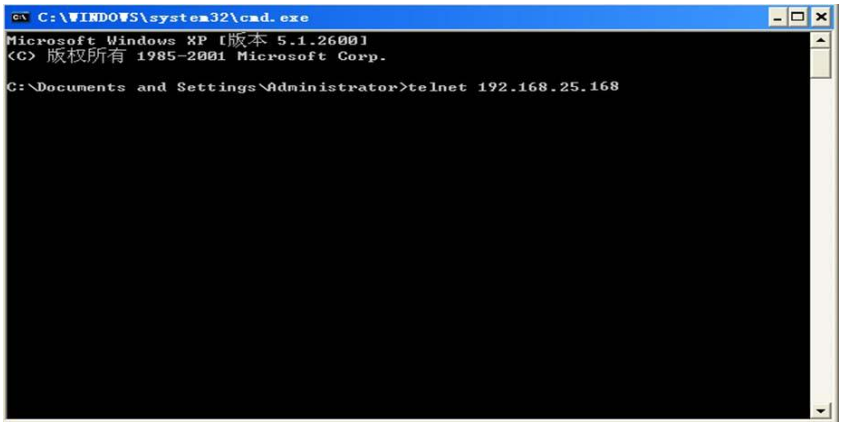


Figure 3-4 Network connect

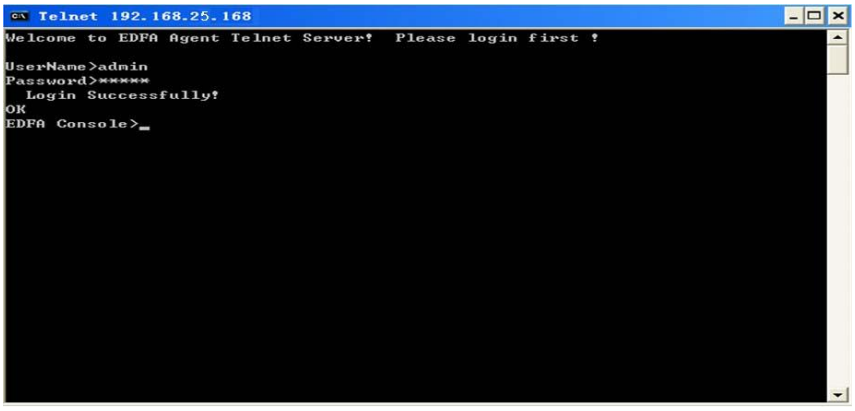
3.5.3 TELNET operation

1. The EDFA-R supports TELNET management.

   To access the EDFA-R's TELNET server from Windows, open a DOS command prompt and type "**telnet 192.168.25.168**". Press the [**Enter**] key and the computer should connect with the equipment. In this example, "**192.168.25.168**" is the IP address of the equipment.



2. After successfully connecting, the user name and password is required.



Compared with traditional TELNET clients, the command prompt TELNET client that comes with Microsoft Windows has some minor differences：

- The “**quit**” command is used to exit a session
- Only one telnet window session is allowed to the equipment at the same time.
- The TELNET session will disconnect automatically if it is idle for 5 minutes. The “**telnet [IP Address]**” command should be used to reconnect to the equipment.
- After successful connecting, the user can exit the TELNET session. The “[**Control**]+[**X**], [**Control**]+[**D**], and the [**Control**]+[**C**]” hotkeys are supported.
- If the TELNET window closes abnormally (such as a computer crash, close the command window directly by clicking “X” in the top right of the window to close it. Reconnecting to the equipment immediately will fail. You must wait 5 minutes for the previous session to timeout.

If the EDFA-R restarts abnormally, but the TELNET command line window was not closed, you must force close the window and wait for 5 minutes to reconnect.

3.6 Laser safety

This product belongs has a category 3B laser. The output power is between 1 mW ~ 200 mW. Direct laser exposure will damage human skin and eyes.

Figure 3-5 Laser alarm and description mark

3.6.1 Laser safety precautions

The optical fiber adapter and optical jumper have a safety cover. **DO NOT** remove the cover before the equipment is connected to prevent any direct laser exposure. The cover should be removed and the adapter connected to the equipment before it is powered on.

3.7 Packaging, transport and storage

3.7.1 Package Manafest

The product package includes the performance test data, equipment specifications, power cable, and the amplifier. Plastic film is used to cover and protect the package when it is transported and stored.

3.7.2 Transportation

1. When transporting the product, it is recommended to cover the equipment packages with canvas to prevent damage from moisture or condensation.
2. Stack the products in manner that prevents them from moving during shipment.
3. It is recommended to not ship the equipment with flammable, explosive, or corrosive products.
4. Place equipment must be carefully handled. Never turn the equipment upside-down.

3.7.3 Storage

1. When storing the equipment, place it in its original packaging.
2. The environment should be kept clean and dry. The temperature should be between -20 degrees Celsius ~ +70 degrees Celsius. The humidity should be kept between 10%~90%.
3. The package should be placed on a rack more than 30 cm from the ground and more than 40 cm away from walls.

4. Equipment operation

4.1 Panel keys

Definition	key	Description
▲	Scroll up	This key is used to change the menu or move the selector on the panel up.
▼	Scroll down	This key is used to change the menu or move the selector on the panel down.
▶	Scroll right	This key is used to change the menu or move the selector on the panel right.
◀	Scroll left	This key is used to change the menu or move the selector on the panel left.
OK	Enter	This key is used to select menu entries, enter into submenus, and confirm the changes.
ESC	Esc	This key is used to exit the current menu or to exit the a submenu

4.2 Panel LEDs description

Definition	Description
◎ Power 1	Power 1 indicated the status of Power Module 1. Red and yellow colors indicate a problem. A green color indicates a normal state.
◎ Power 2	Power 2 indicated the status of Power Module 2. Red and yellow colors indicate a problem. A green color indicates a normal state.
◎ Alarm	General warning indicator. This LED Is used to indicate non-optical problems with the EDFA-R unit. Red and yellow colors indicate a problem. A green color indicates a normal state.
◎ Signal	Optical activity indicator. Red and yellow colors indicate a problem with either input or output optical signals. A green color indicates a normal state.

Notice:

When the equipment is experiencing problems, the indicator LEDs will be yellow or red. The red LED indicates a critical warning. The warning should be addressed by an operator immediately resolve the issue. The yellow led indicates a minor alert and the equipment may still be functioning. The alert should be addressed by the operator so the problem does not escalate.

4.3 Status display menu and instruction

Check the voltage and confirmed unit is properly grounded. The dual power supply is -48VDC , a

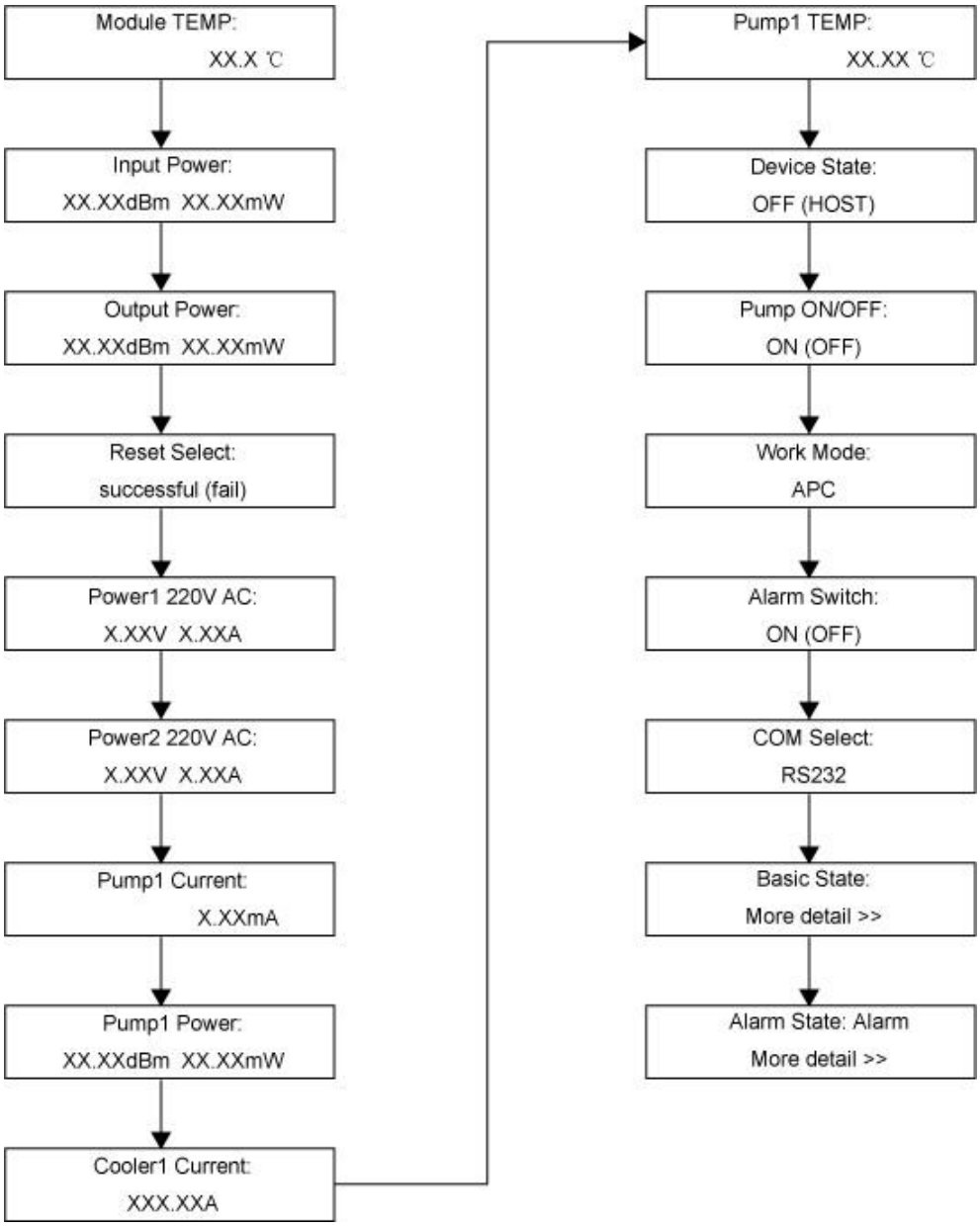
mix of -48VDC and 220VAC, or dual 220VAC.

The EDFA-R will be in stable state 30 minutes after powering the unit on.

After powering the device, the screen shows the company and model information. After 3 seconds, the device parameter menu will be showed.

4.3.1 EDFA-R's Front Display Main Menu

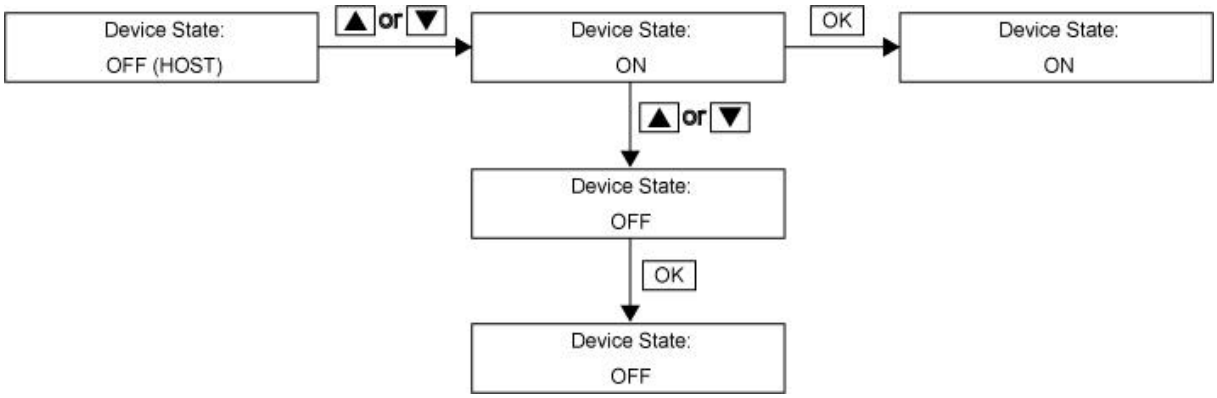
The display menu will change when the ▼ key is pressed.



Notice:

If there is one pump laser, the menu will display the pump state information, if two pump lasers exist, all pump information will be displayed.

4.3.2 Device State Setting

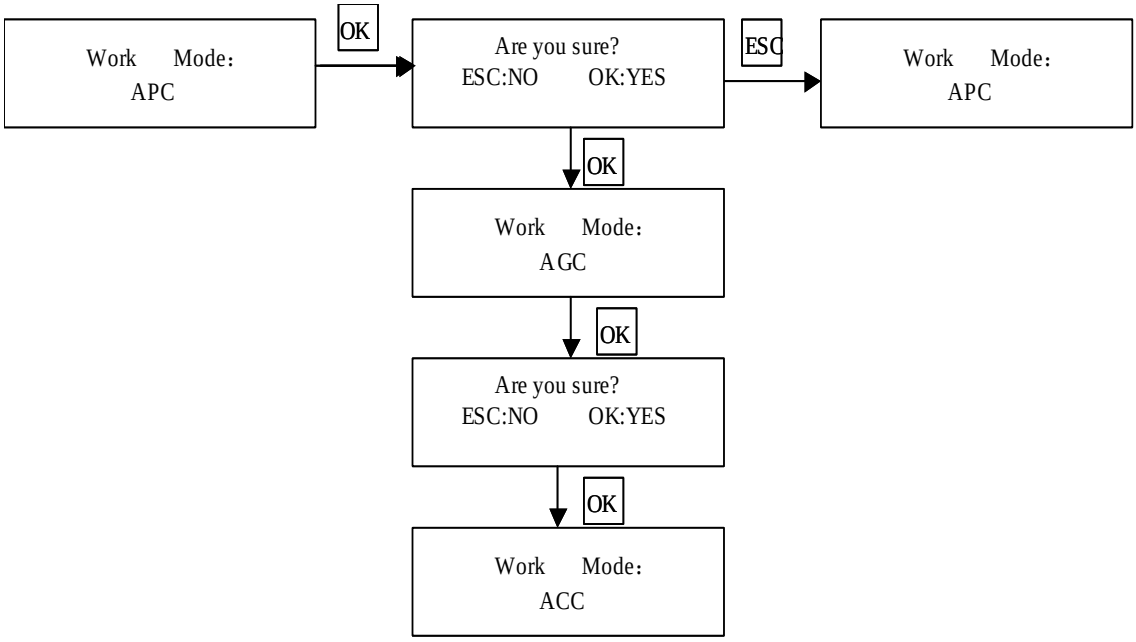


"Device State" setting is to open or close the function of redundancy. The default setting of "Device State" is OFF.

Notice:

Make sure the device state is **"OFF"** if the EDFA-R amplifier doesn't work at redundancy mode (In redundancy mode, 2 EDFA-R amplifiers are linked with cables). **Otherwise, the EDFA-R amplifier will fail to restart the pump when it is repowered or reset**.

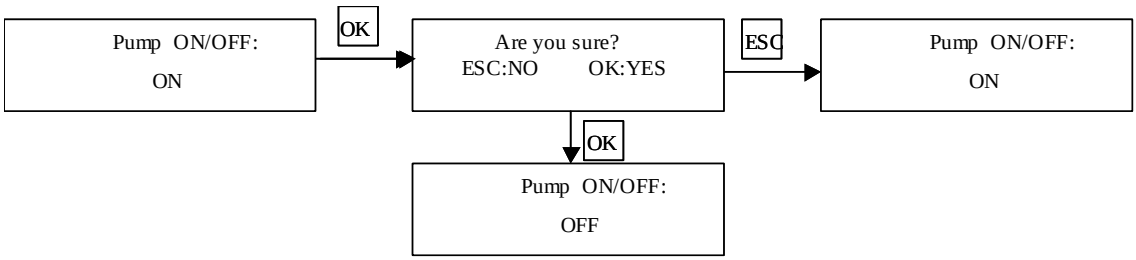
4.3.3 Modify the working mode of the equipment



Notice: The equipment is already calibrated. There are no calibration settings for the optical output in different work modes. The output power may be incorrect when if the work mode is changed. Consult a PBN representative before making changes to the work mode.

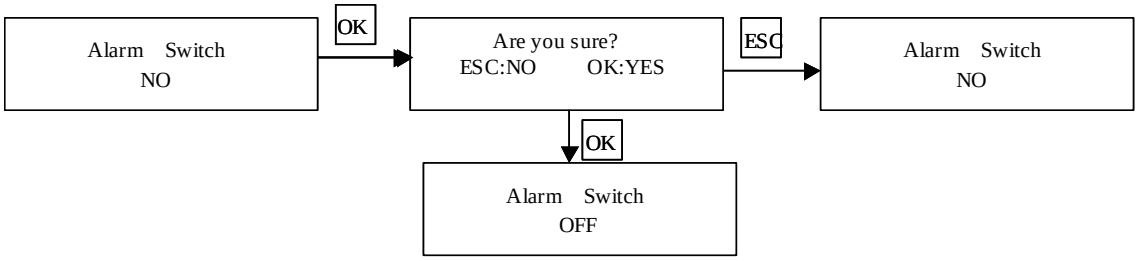
Notice: **DO NOT** change the work mode without checking with a PBN representative.

4.3.4 Change the Pump Laser State



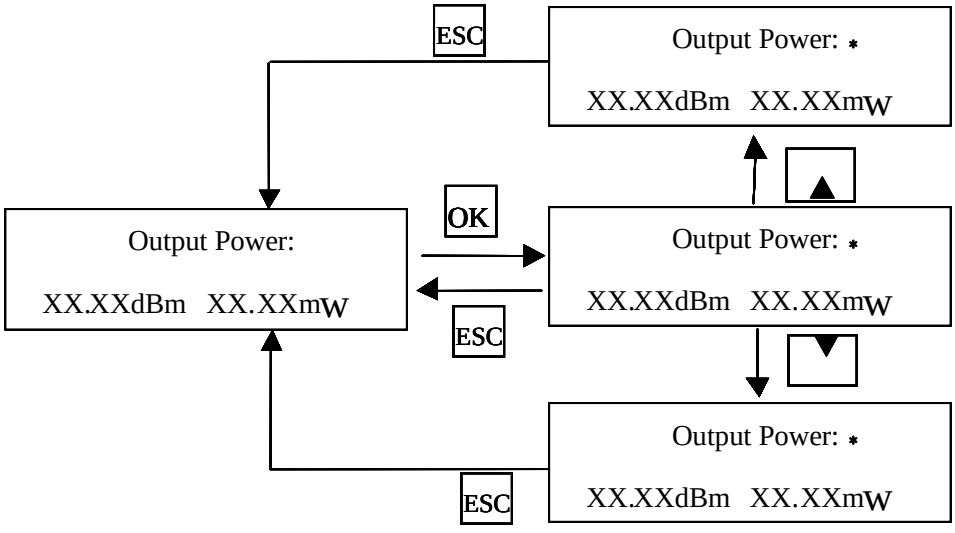
Notice: The equipment may not function correctly if pump laser state is changed.

4.3.5 Modify the equipment alarm status

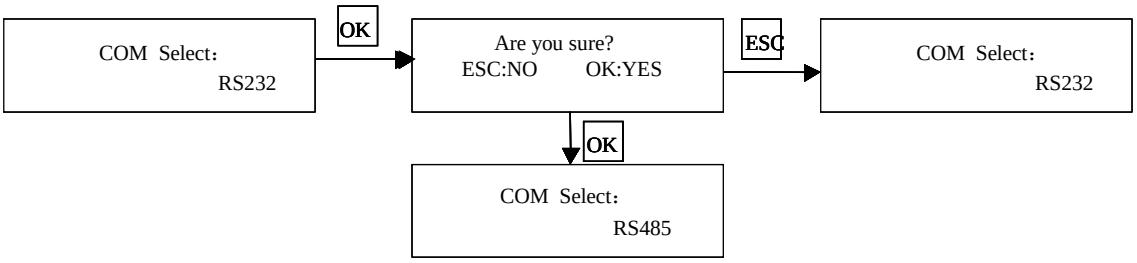


An alarm will not indicate any problems if it is disabled.

4.3.6 Change the output power

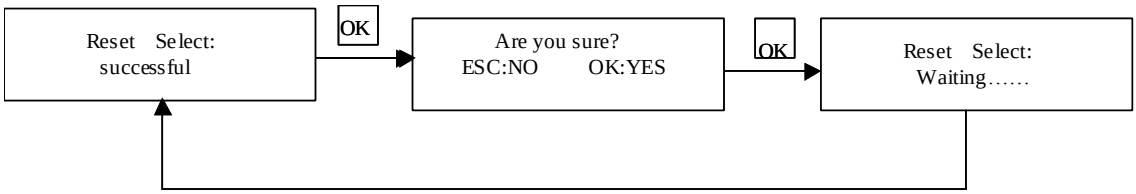


4.3.7 Select the COM port



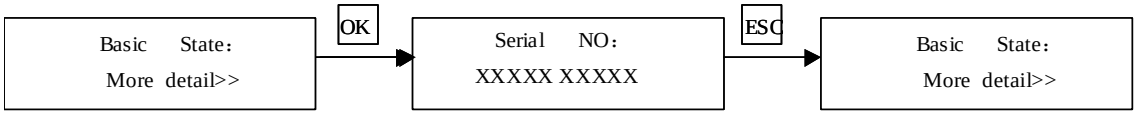
Changes the serial port's communication port.

4.3.8 Resetting the device

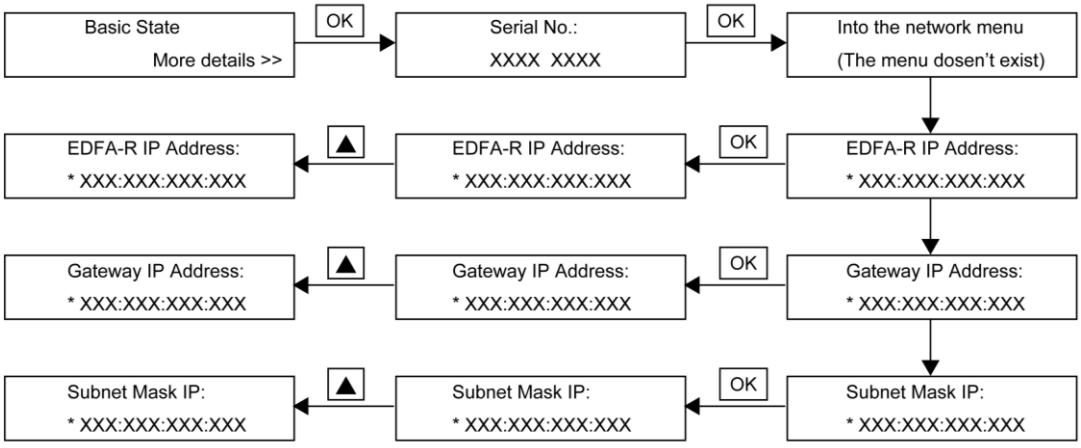


When the network control card is swapped or changed, the device will need to be reset. It is recommended to restore the default settings when changing the network control card.

4.3.9 View the device's serial number



4.3.10 Network Parameter Configuration Operation



Modify IP address

Select the EDFA-R IP Address menu, then press the "**OK**" key. The next menu appears and there will be flashing cursor which can use the up or down across to select a number 0 through 9. The left and right navigation keys are used to move cursor to the correct position to modify network configuration under the customer requirements.

Notice: Set and confirm the IP address, the subnet mask, and the default gateway address. Consult your network administrator for more information.

4.3.11 LCD display translation table

Display item	Translation		Display item	Translation
Serial No	the serial number of the equipment		Pump 1 TEMP MAX	the maximum temperature of the pump 1 alarm threshold
EDFA-R Model	equipment model information		Pump 1 TEMP M in	the minimum temperature of the pump 1 alarm threshold
Voltage	Operating voltage		Time of Day	Equipment working time
Working Temp	Operating temperature		+5V Power	Voltage of the equipment
EDFA-R MAC Address	MAC address		Module TEMP	Module temperature
EDFA-R IP Address	IP address		In Power	input power
Gateway IP Address	IP Gateway address		Out Power	output power
Subnet Mask IP	The subnet mask		Pump 1 TEMP	Pump 1 temperature
EDFA-R PORT Number	Reserved for factory		Pump 1 Current	Pump 1 current
Module TEMP MAX	the maximum equipment temperature alarm threshold		Pump 1 Power	Pump 1 power
Module TEMP Min	the minimum equipment temperature alarm threshold		Cooler 1 Current	Pump 1 cooling current
Pump Laser Threshold	Threshold to shutdown the pump		Reset Select	Reset key

In Power MAX	The maximum input power alarm threshold		Power 1 220VAC	the supplied voltage of from power supply 1
In Power Min	The minimum input power alarm threshold		Power 2 220VAC	the supplied voltage of from power supply 1
Out Power MAX	the maximum output power alarm threshold		Pump ON / OFF	Pump ON / OFF
Out Power Min	the minimum output power alarm threshold		Work Mode	working mode
Pump 1 Current Max	the maximum current of pump 1's alarm threshold		Alarm Switch	Alarm Enable Switch
Pump 1 Current Min	the minimum current of pump 1's alarm threshold		Com Select	Serial Mode
Pump 1 Power Max	the maximum power of pump 1's alarm threshold		Basic State	Basic information item
Pump 1 Power Min	the minimum power of pump 1's alarm threshold		Fan speed monitor	

4.4 The definition of the alarm threshold

When the alarm values are beyond or below the threshold set, the corresponding alarms will be indicated. Corresponding LEDs are change according to the type of the alarm. In addition, network management software can also show alarms.

There are four level alarms: Hi-Hi, Hi, Lo, and Lo-Lo.

Alarm Level	Description	LED indicator
Hi-Hi Threshold	When an alarm variable is higher than the threshold, a Hi-Hi alarm is used to indicate the unit is not functioning correctly.	The alarm LED will flash red
Hi Threshold	When an alarm variable is higher than the threshold, a Hi alarm is used to indicate the unit is not functioning correctly.	The alarm LED will flash yellow
Normal	When the value of a physical variables is between the Hi and Lo thresholds, the device is functioning	The green LED will flash

	normally.	
Lo Threshold	When an alarm variable is higher than the threshold, a Lo alarm is used to indicate the unit is not functioning correctly.	The alarm LED will flash yellow
Lo-Lo Threshold	When an alarm variable is higher than the threshold, a Lo-Lo alarm is used to indicate the unit is not functioning correctly.	The alarm LED will flash red
Hysteresis Value	When the equipment has an alarm, if the alarm variables revert to the normal operating range, the alarm will not turn off immediately unless the value is lower than the difference of the threshold and the hysteresis value. For example the normal temperature scope is -5 to 70 degress Celsius, the Hi-Hi threshold is 70 and the hysteresis value is 1. If the temperature of the equipment is up to 75 degrees Celsius, then the Hi-Hi temperature alarm indicates the temperature has exceeded the Hi-Hi threshold of 70 degrees Celsius.	

The following table shows the various parameter ranges of the device. The parameters may vary depending on the application of the device. The specific values for the device can be viewed from the associated network management software and the following parameter values are only for reference.

Description		Hi-Hi Threshold	Hi Threshold	Lo-Threshold	Lo-Lo Threshold	Hysteresis Value
input power(unit：dBm)	X~Y(X,Y is the input power range)	Y+2	Y+1	X-1	X-2	0.1
output power(unit：dBm)	X~Y(X,Y is output power range)	Y+2	Y+1	X-1	X-2	0.1
Single supply	voltage(V)	6	5.5	4.5	4	0.1
dual supply	Voltage 1(V)	6	5.5	4.5	4	0.1

	Voltage 2(V)	6	5.5	4.5	4	0.1
	Current 1(A)	7	5	-1	-2	0.1
	Current 1(A)	7	5	-1	-2	0.1
Equipment temperature (degrees Celsius)		80	75	-5	-10	0.1
pump temperature (unit degrees Celsius)		35	30	20	15	0.1
cooling current (unit mA)		3000	2500	-2500	-3000	0.1
pump working current (unit：mA)		1500	1400	10	5	0.1

5. Product Warranty

Pacific Broadband Networks guarantees its equipment is free of manufacturing for a period of one year from the date of shipment, provided it is installed and operated in accordance with factory recommendations.

The liability of Pacific Broadband Networks under this warranty is solely limited to repairing; replacing or issuing credit provided that:

1. The warranty registration has been completed and received by Pacific Broadband Networks.
2. Pacific Broadband Networks' helpdesk is promptly notified in writing or by telephone that a failure or defect has occurred.
3. A return authorization number is obtained from Pacific Broadband Networks' helpdesk and clearly marked on the outside of the shipping container and all documents.
4. Customer is responsible for all shipping and handling charges. C.O.D. and freight collect will not be accepted without prior approval from Pacific Broadband Networks' helpdesk.
5. The equipment (in PBN's sole discretion) has not been abused, misused or operated under conditions outside manufacturer's specifications.

The warranty does not cover the following:

1. Products purchased from someone other than an authorized Pacific Broadband Networks dealer.
2. Damage caused by accident, negligence, misuse, abuse, improper operation or failure to operate the equipment within the manufacturer's specifications.
3. Damage caused by fluctuation in electrical current, lightning, power surges, etc.
4. Damage resulting from overhaul, repair, or an attempted repair caused by someone other than Pacific Broadband Networks' qualified service personnel.
5. Any product, in which the serial number has been defaced, modified or removed.
6. Any product that has been opened or modified without prior written permission from PBN.
7. Replacement of parts necessitated by normal wear and tear.
8. Any consequential or implied damages.
9. Pacific Broadband Networks will not be liable for DFB Laser failure after 90 days from receipt of item. Any claim for DFB Lasers will be presented to the laser vendor for replacement. Pacific Broadband Networks will make every effort to replace faulty lasers although ultimate judgment is at the laser vendor's discretion. Pacific Broadband Networks will provide all labor costs associated with the replacement of the laser within the one-year warranty period.

Offices

Australia, Melbourne	Tel: +61-3-8561-1400
China, Beijing	Tel: +86-10-5791-0655
Americas, Florida	Tel: +1-888-339-8805
EMEA, Netherlands	Tel: +31-36-536-8011

Email: support@pbnglobal.com

Website: www.pbnglobal.com