Ceyear

6433 Series

Lightwave Component

Analyzer

User Manual

Ceyear Technology Co., Ltd.

This manual applies to the following models of lightwave component analyzer:

- 6433D Lightwave Component Analyzer (10MHz–20GHz)

- 6433F Lightwave Component Analyzer (10MHz~43.5GHz)

- 6433H Lightwave Component Analyzer (10MHz~50GHz)

- 6433L Lightwave Component Analyzer (10MHz~67GHz)

Foreword

Thank you very much for choosing and using the 6433 series lightwave component analyzer produced by Ceyear Technologies Co.,Ltd. Please read this manual carefully for your convenience.

We will meet your requirements to the maximum, provide you with high quality measuring instruments, and bring you first-class after-sales service. Our consistent tenet is "good quality, good service", to provide satisfactory products and services is our commitment to customers.

Manual Authorization

The contents of this manual are subject to change without notice. The contents of this manual and the terms used in the final interpretation rights belong to Ceyear Technologies Co.,Ltd.

This copyright manual belongs to Ceyear Technologies Co.,Ltd, and no unit or individual shall modify or alter the contents of this manual, nor shall they reproduce or disseminate this manual for profit purposes unless authorized by this document. Ceyear Technologies Co.,Ltd reserves the right to pursue legal liability against the infringer.

Product warranty

This product is warranted for 18 months from the date of delivery. During the warranty period, the instrument manufacturer will repair or replace the damaged parts according to the actual conditions. Therefore, the user needs to return the product to the manufacturer and pay the mailing fee. The manufacturer will return the cost to the user together with the product after maintaining the product.

Product quality certification

This product is guaranteed to meet the specifications in the manual from the date of delivery. The calibration survey shall be completed by the measurement unit with national qualification, and relevant materials shall be provided for the user's reference.

Quality/Environment Management

This product complies with quality and environmental management systems throughout the development, manufacturing and testing process.Ceyear Technologies Co.,Ltd has qualified and passed ISO 9001 and ISO 14001 management systems.

Safety matters

⚠ **Warning** signs indicate a danger. It prompts the user to pay attention to an operation procedure, method of operation, or the like. Failure to comply with the rules or operate correctly may result in personal injury. Do not proceed to the next step until the indicated warning conditions are fully understood and satisfied.

Note Note signs represent important informational cues, but do not cause danger. It prompts the user to notice a procedure, method of operation, or the like. Failure to comply with the rules or operate correctly may result in damage to the instrument or loss of important data. Do not proceed to the next step until the noted conditions are fully understood and satisfied.

Table of Contents

1 Manual Navigation

This chapter introduces the functions, chapter composition and main contents of the user manual of the 6433 series lightwave component analyzer, and also introduces the related documents of the instrument provided for the user.

1.1 About the Manual

This manual introduces the purpose, performance index, basic working principle, usage method and precautions of the 6433 series lightwave component analyzer produced by Ceyear Technologies Co.,Ltd, so as to help you get familiar with the operation method and the key points of using the instrument. Please read this manual carefully and follow the instructions in the manual.

Due to the tight time and limited author's level, errors and omissions in this manual are inevitable. Please comment and correct! We apologize for the inconvenience caused by our mistake.

The user manual contains the following sections:

- **Overview**

  The characteristics and precautions of the 6433 series lightwave component analyzer are described, including product overview and safe use guide.

- **Getting Started**

  This chapter describes the preparations before using the 6433 series lightwave component analyzer, routine maintenance of the system and instrument, overview of the front panel, overview of the rear panel, and operation interface.

- **Operation Guide**

  In this chapter, various Settings of 6433 series optical component analyzer are introduced in detail, including: instrument switch, microwave parameter setting, electro-electric calibration, optical wave parameter setting, typical optical device S parameter test,etc.

- **Optimized measurement**

  This chapter describes how to optimize the measurement accuracy through reasonable setting adjustments.

- **Fault diagnosis and repair**

Including the operation principle of the whole machine, fault diagnosis and solution, and repair method.

- **Functions and technical specifications**

This chapter introduces the main technical indexes of 6433 series light wave component analyzer and the instructions of test method recommended for users.

1.2 Associated Documents

6433 series product documentation includes:

- 6433 Series Lightwave Component Analyzer Programming Manual
- 3674 Series Vector Network Analyzer User Manual
- 3674 Series Vector Network Analyzer Program Control Manual

2 Overview

This chapter introduces the main performance characteristics and application scope of the 6433 series lightwave component analyzer. At the same time, it explains how to operate the instrument correctly and the precautions for electric safety.

2.1 Product Overview

The 6433 series lightwave component analyzer provides electric-optical (E/O) modulation, optical-electric (O/E) modulation, optical-optical (O/O) modulation characteristics test functions in one of the high-performance lightwave component test instrument. It is mainly used for the core electric-optical components in modern high-speed optical transmission systems. (Electrical-Optical Modulator, Direct Modulation Laser, Light Emitter Assembly) Photoelectric devices (PIN Photodetector, APD Photodetector, Light Receiving Assembly) . Test the modulation bandwidth characteristic of optical-optical components (optical fiber and filter) and the transmission characteristic, reflection characteristic, and frequency response characteristic. The main test parameters include modulation bandwidth, impedance, transmission coefficient, reflection coefficient, etc. It can be called "vector network analyzer" in the field of optoelectronic devices. In terms of large test types, this product not only has the S parameter test function of photoelectric, electro-optic and opto-optic components, but also inherits the "electro-electric" network test function of vector network analyzer. The 6433 series lightwave component analyzer consists of two modules: the upper part of microwave module is 3674 series vector network analyzer developed by our company, and the lower part of optical wave module completes the electro-optic modulation and photoelectric signal conversion.

Product Features:

- 12.1 inch high resolution touchscreen display;
- Windows operating system, Chinese menu and English menu options;
- It has multiple calibration methods such as frequency response, single port, response isolation, full dual port, TRL, electrical calibration, etc.
- Up to 16 display windows, each window displays up to 8 tracks simultaneously, and 64 independent measurement channels to quickly execute complex test schemes.
- It has logarithmic amplitude, linear amplitude, standing wave, phase, group time delay, Smith circle graph, polar coordinate and so on.

➢ It can test the modulation bandwidth characteristics of electro-optical devices, opto-optical devices and opto-optical devices.

Hint

1. The microwave module on the upper part of the 6433 series lightwave component analyzer is 3674 series vector network analyzer developed by our company.
2. For the operation of vector network analyzer, please refer to 3674 Series Vector Network Analyzer User Manual.

2.2 Safe Use Guide

Please carefully read and strictly observe the following precautions!

We will spare no effort to ensure that all production links comply with the latest safety standards to provide the highest security for users. Our products and auxiliary equipment are designed and tested to meet relevant safety standards, and a quality assurance system is in place to monitor the quality of our products to ensure that they are consistently met. To keep the equipment in good condition and ensure safe operation, please observe the precautions given in this manual. If you have any questions, please feel free to contact us.

It is also your responsibility to use this product correctly. Read and observe the safety instructions carefully before beginning to use this instrument. This product is suitable for use in industrial and laboratory environments or on-site measurement. Be sure to use it correctly according to the product restrictions to avoid personal injury or property damage. If the product is improperly used or not used as required, you will be responsible for any problems and we will not be liable. Therefore, to prevent personal injury or property damage caused by hazardous situations, be sure to follow the safe use instructions. Keep the basic safety instructions and product documentation safe and deliver them to the end user.

2.2.1 Safety Signs

2.2.1.1 Product-related

The following table lists the safety warning signs on the product.

Table 2.1 Product Safety Label

symbol	significance	symbol	significance
	Note that the information specifically alerts the user to the information. Operation information or instructions to remind users of.	| ○	Power On/Off
	Attention, handling heavy equipment.		Standby indication
	Danger! Watch out for shock.	---	Direct Current (DC)
	Warning! Watch out for surface heat.	~	Alternating current (AC)
	Protective conductive end	≈	DC/AC (DC/AC)
	ground	▢	Instrument Reinforcement Insulation Protection
	Grounding terminal		EU ID of the battery and battery. For details, refer to item 1 in section 2.2.8 Waste Disposal/Environmental Protection.
	Be careful with classic sensitive devices.		Collect EU logos for electronic components separately. For details, refer to item 2 in
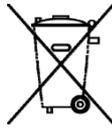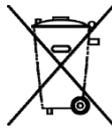
		▬	section 2.2.8 Waste Disposal/Environmental Protection.
⚠	Warning! radiation. For details, see item 7 in section 2.2.4 "Operation Precautions".		

2.2.1.2 Manual-Related

To remind users of safe operation of instruments and related information, the following safety warning signs are used in the product manual, which are described as follows:

⚠Danger	Dangerous signs, if not avoided, may cause personal and equipment injury.
⚠Warning	Warning signs, if not avoided, may cause personal and equipment injury.
⚠Caution	Be careful to mark, which, if not avoided, may result in mild or moderate injury to persons and equipment.
Note	Note signs that represent important information but do not cause danger.
Hint	Information about the instrument and operating instrument.

2.2.2 Operating status and position

Note before operating the instrument:

1) The operating environment of the 6433 series lightwave component analyzer shall meet the following requirements: stable placement of the instrument and indoor operation. The maximum altitude for operating instruments shall not exceed 2000 m, and the maximum altitude for transporting instruments shall not exceed 4500 m. The actual power supply voltage is allowed to vary within ±10% of the marked voltage, and the power supply frequency is allowed to vary within ±5% of the marked frequency. The overpressure level is 2 and the pollution intensity is 2.

2) Do not place the instrument on watery surfaces, vehicles, cabinets, and tables that are not fixed and do not meet the load conditions. Place the instrument securely and secure it on a solid surface (e.g., an antistatic workbench).

3) Do not place the instrument on the surface of objects (e.g., heat sink). The operating environment temperature should not exceed the specifications of the product. Overheating of the product may lead to electric shock and fire.

2.2.3 Electricity Safety

Precautions for power consumption of the instrument:

1) Before powering up the instrument, ensure that the actual power supply voltage matches the power supply voltage marked on the instrument. If the power supply voltage changes, replace the fuse model of the instrument.

2) According to the power supply requirements of the back panel of the instrument, use the three-core power cable. Ensure that the power supply grounding cable is reliably grounded. The floating ground or poor grounding may cause damage to the instrument and even damage to the operator.

3) Do not damage the power cable. Otherwise, electricity leakage may result in damage to the instrument and even injury to the operator. If external power cables or wiring boards are used, check before use to ensure power safety.

4) If the power supply socket does not provide the power on/off switch, if the instrument needs to be powered off, the power plug can be directly pulled out, so that the power plug can be easily plugged out.

5) Do not use damaged power cables. Before connecting power cables, check the integrity and safety of the power cables. Place the power cables properly to avoid human factors, for example, tripping of the power cables.

6) TN/TT power supply network shall be used for the instrument, and the maximum rated current of the fuse shall be 16A. (If fuses with higher rated current are used, discuss with the manufacturer.)

7) Keep the socket neat and clean, and the plug and socket should be in good contact and inserted firmly.

8) Sockets and power cords should not be overloaded, otherwise fire or electric shock may occur.

9) If tested in circuits with voltage Vrms > 30 V, take appropriate protection measures to avoid instrument damage (e.g., using suitable test instruments, installing fuses, limiting current values, electrical isolation and insulation, etc.).

10) The instrument must comply with IEC60950-1/EN60950-1 or IEC61010-1/EN 61010-1 to meet the requirements of connecting PC or industrial computer.

11) Unless otherwise permitted, do not open the instrument case at will. This may expose internal circuits and components and cause unnecessary damage.

12) If the instrument needs to be fixed at the test location, a qualified electrician should first install the protective grounding cable between the test location and the instrument.

13) Appropriate overload protection shall be taken to prevent damage to the instrument by overload voltage (e.g., caused by lightning) or personal injury.

14) Do not place objects that are not inside the instrument when the instrument case is opened. Otherwise, short circuits may be caused, the instrument may be damaged, and personnel may be injured.

15) Unless otherwise specified, the instrument has not been waterproofed. Therefore, the instrument should not be exposed to liquid to prevent damage to the instrument or even personal injury.

16) Do not move the instrument in an environment where fog is easy to form. For example, move the instrument in an environment where cold and hot alternates. Water drops formed on the instrument may cause electric shock.

2.2.4 Operation Precautions

1) Instrument operators need to have certain professional technical knowledge, good psychological quality, and have certain emergency response capability.

2) Refer to the instructions in section 2.2.7 Shipping before moving or transporting the instrument.

3) Substances (e.g. nickel) that may cause allergic reactions are unavoidable during the manufacture of the instrument, if the operator of the instrument has allergic symptoms during the operation (e.g., rash, frequent sneezing, red eyes, or difficulty breathing, etc.), please seek medical attention in time to find out the cause and resolve the symptoms.

4) Before disassembling the instrument for scrapping, please refer to 2.2.8 Discarding/Environmental Protection instructions in this section.

5) Radio frequency instruments will produce high electromagnetic radiation. In this case, pregnant women and operators with cardiac pacemakers need special protection. If the radiation level is high, corresponding measures can be taken to remove the radiation source to prevent personal injury.

6) In the event of fire, damaged instruments will release toxic substances, and the operator should have appropriate protective equipment (e.g. protective masks and protective clothing) in order to prevent the occurrence.

7) Laser products need to be marked with warning signs according to the laser category, because the radiation characteristics of lasers and such devices have high electromagnetic power characteristics, will cause harm to human

body. If the product integrates other laser products (such as CD/DVD drive), the product does not provide other functions except the settings and functions described in the product manual to prevent the laser beam from harming human body.

8) Electromagnetic compatibility level (compliant with EN 55011/CISPR 11, EN 55022/CISPR 22 and EN 55032/CISPR 32)

– Class A equipment:

This device can be used in all areas except residential areas and low voltage supply environments.

Note: Class A equipment is applicable to industrial operation environment, and it will cause wireless communication disturbance to residential areas. Therefore, the operator shall take relevant measures to reduce the disturbance impact.

– Class B equipment:

Suitable for residential and low voltage power supply environment equipment.

2.2.5 Maintenance

1) Only authorized and technically trained operators may open the instrument case. Before performing such operations, disconnect the power cable to prevent damage to the instrument or even personnel.

2) The repair, replacement and maintenance of the instrument shall be completed by the electronic engineer of the manufacturer, and the replacement and maintenance part shall be subjected to safety test to ensure the subsequent safe use of the product.

2.2.6 Battery and Power Module

Before using the battery and power module, read the related information carefully to avoid explosion, fire, or personal injury. In some cases, discarded alkaline batteries (e.g. lithium batteries) are disposed of according to EN 62133. The precautions for using batteries are as follows:

1) Do not expose batteries and power modules to heat sources such as open flame. Keep it clean and dry when storing. Clean the connection ports of the battery or power module using a clean, dry soft cotton cloth.

2) Do not short the battery or power module. Do not store multiple batteries or power modules in paper boxes or drawers because they are in contact with

each other or with other conductors. Do not remove the original packaging of the battery and power module before use.

3) Do not suffer mechanical impact on batteries and power modules.

4) If the battery leaks liquid, do not touch skin or eyes. If contact occurs, rinse with plenty of water and seek medical attention.

5) Use the battery and power module that are supplied by the manufacturer. Any incorrect replacement and charging of alkaline batteries (e.g. lithium batteries) may cause explosion.

6) Wasted batteries and power modules need to be recycled and disposed of separately from other waste items. Discard or recycle the toxic substances in the battery according to local regulations.

2.2.7 Transportation

1) If the instrument is heavy, please move it carefully. If necessary, use tools to move the instrument so as not to damage your body.

2) Instrument handles are applicable to personal handling of instruments, but cannot be used to secure instruments to transport equipment. In order to prevent property and personal injury, please operate according to the safety regulations of the manufacturer for transportation instruments.

3) Do not use the instrument during transportation, and take reinforcement measures to ensure the safety of the product transportation.

2.2.8 Waste Disposal/Environmental Protection

1) Do not dispose of the equipment marked with batteries or batteries together with unclassed waste. Collect the equipment separately and dispose of it at a suitable collection location or through the customer service center of the manufacturer.

2) Do not dispose of discarded electronic equipment with unclassed waste. Collect them separately. The manufacturer has the right and responsibility to help end users dispose of the discarded products. If necessary, please contact the customer service center of the manufacturer to handle the products to avoid damaging the environment.

3) Toxic substances (heavy metal dust such as lead, beryllium, nickel, etc.) may be released during mechanical or thermal reprocessing of the product or its internal components. For this purpose, specially trained and experienced technicians are required to disassemble to avoid personal injury.

4) For toxic substances or fuels released during reprocessing, please refer to the safety operation rules recommended by the manufacturer and adopt specific methods to avoid personal injury.

3 Getting Started

This chapter introduces the precautions, front and rear panels, and software interface of the 6433 series lightwave component analyzer. This will help users to understand the instrument.

3.1 Preparation for use

3.1.1 Preparations

This chapter describes the precautions before initial installation and use of the 6433 series lightwave component analyzer.

⚠Warning

Prevent damage to instrument

To avoid electric shock, fire and personal injury:

➢ Do not open the chassis without permission.

➢ Do not attempt to disassemble or modify any part not described in this manual. Disassembly by yourself may result in deterioration of electromagnetic shielding efficiency, damage to internal parts, and affect product reliability. If the product is under warranty, we will not provide free repair.

➢ Carefully read the relevant contents in section 2.2 "Safety Use Guide" of this manual and the following operation safety precautions, and pay attention to the specific operation environment requirements in the data pages.

Note

ESD protection

Take ESD preventive measures in the workplace to avoid equipment damage. For details, refer to section 2.2 "Safe Use Guide" in the manual.

Note

Note when operating the instrument:

Inappropriate operating position or measurement setting may damage the instrument or the instrument connected to it. Please note that:

➢ The fan blades are not obstructed, the heat dissipation holes are smooth, and the instrument is at least 10cm away from the wall.

➢ Keep the instrument dry;

➢ Place the instruments in a horizontal and reasonable position.

➢ The ambient temperature meets the requirements marked on the data sheet.

➢ The input signal power of the port is within the marked range.

➢ Signal output port properly connected, do not overload.

Hint

Effects of electromagnetic interference (EMI):

➢ Electromagnetic interference can affect the measurement results, for which:

➢ Select the appropriate shielded cable. For example, double shielded RF/network connection cables are used;

➢ Close the cable connection port that is opened and not used temporarily or connect the matched load to the connection port.

➢ Refer to the Electromagnetic Compatibility (EMC) level annotation in the Note data page.

3.1.1.1 Opening the Box

1) Appearance check

Step 1. Check whether the outer packing box and the anti-shock package of the instrument are damaged. If they are damaged, store the outer packing for backup and follow the instructions in Proceed with the following steps.

Step 2. Open the box, and check whether the main unit and the items attached to the box are damaged.

Step 3. Check whether the above items are correct according to Table 3.1.

Step 4. If the outer package is damaged, the instrument or the articles attached to the box are damaged or incorrect, do not power on the machine. Please refer

to the the service consultation hotline shall contact the service consultation center of our Institute, and we will repair or replace it as soon as possible.

Note

Moving: As the instrument and packing box are heavy, two persons should work together to move and place the instrument and packing box gently.

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2)   Model Confirmation

Table 3.1 List of items included with the box

Name	Amount	Function
Host:		
✧ 6433 Series Lightwave Component Analyzer	1	-
Standard:		
✧ FC/APC–FC/APC fiber jumper	1	-
✧ USB cable	1	-
✧ Power cord	2	-
✧ User Manual	1	-
✧ Certificate of conformity	1	-

3.1.1.2 Environmental Requirements

The operating place of the 6433 series lightwave component analyzer shall meet the following environmental requirements:

1)   Operating Environment

The operating environment must meet the following requirements:

Table 3.2 6433 Operating environment requirements

Temperature	0℃ ~ 40℃
Temperature range during error adjustment	23℃ ±5℃ (allowable temperature deviation < 1℃ during error adjustment)
Humidity	Hygrometer measurement range: 20% – 80% (uncondensing) at <+29℃
Altitude	0 to 2,000 m (0 to 6,561 ft)
vibrations	0.21 G max., 5 Hz – 500 Hz

> ### Note
>
> The above environmental requirements are only for the operating environment of the instrument, not for technical specifications.

2) Heat Dissipation Requirements

To ensure that the operating temperature of the instrument is within the temperature range required by the operating environment, the following requirements for the heat dissipation space of the instrument shall be met:

Table 3.3 6433 Heat Dissipation Requirements

Instrument position	heat dissipation distance
posterior side	≥180 mm
Left and right sides	≥60 mm

3) ESD protection

Static electricity is extremely destructive to electronic components and equipment, and we usually use two kinds of anti-static measures: conductive table pad and wrist combination; The conductive floor mat is combined with the ankle. When both are used together, good antistatic protection is provided. If used alone, only the former can provide protection. To ensure user safety, an ESD component must be equipped with an isolation resistance of at least 1MΩ to the ground.

Apply the following ESD measures to reduce electrostatic damage:

➢ Ensure that all instruments are properly grounded to prevent electrostatic generation.

➢ Before connecting the coaxial cable to the instrument, briefly contact the inner and outer conductors of the cable with the ground.

➢ Before touching the connectors, core wires or performing any assembly operations, the workers must wear antistatic wrists or take other antistatic measures.

3.1.1.3 Power On/Off

1) Precautions before power-on

Before powering up the instrument, pay attention to the following items:

a) Confirm the power supply parameters.

The 6433 series lightwave component analyzer adopts three-core power cable interface, which is in line with international safety standards. Before powering up the analyzer, ensure that the protection grounding wire of the power

supply socket is reliably grounded, and then insert the power cable into the standard three-core socket. Floating ground or poor grounding may damage the instrument or even cause personal injury. Do not use power cables without ground protection. Table 3.4 lists the requirements for external power supply when the lightwave component analyzer works normally.

Table 3.4 Parameter requirements for the 6433 power supply

Power supply parameters	Adaptation range
Voltage and frequency	220V±10%, 50Hz ~ 60Hz
Rated output current	>3A
Power consumption	>600W

b) Confirming and Connecting Power Cables

The 6433 series lightwave component analyzer adopts three-core power cable interface, which accords with national safety standard. Before powering up the lightwave component analyzer, ensure that the protective ground wire in the power cable of the lightwave component analyzer is reliably grounded. The floating ground or poor grounding may cause damage to the instrument or even harm the operator. Do not use power cables without protection grounding. When connected to a suitable power socket, the power cord ground the instrument housing. The rated voltage of the power cable should be greater than or equal to 250 V and the rated current should be greater than or equal to 6 A.

When the instrument is connected to the power cable:

Step 1. Ensure that the working power cable is not damaged.

Step 2. Use the power cord to connect the power supply plug on the rear panel of the instrument to a well-grounded three-core power socket.

⚠**Warning**

grounding

Poor grounding or incorrect grounding may cause damage to the instrument or even personal injury. Before powering on the lightwave component analyzer, ensure that the ground wire is in good contact with the ground wire of the power supply.

Please use a protected socket. Do not replace the ground protection wire with external cables, power cables and autotransformers without ground protection. If an

autotransformer must be used, connect the common terminal to the protection ground of the power connector.

2)   Initial power-on

The power-on/off method and precautions of the instrument are as follows:

a)   Connecting to the power supply

Before powering on for the first time, confirm the power supply parameters and power cables. For details, see section 3.1.1.3 "Precautions Before Powering On" in the user manual.

Step 1 Power cable connection: Connect one end of the power cable or three-core power cable matching the lightwave component analyzer in the packing box to the power socket on the rear panel of the lightwave component analyzer, as shown in Figure 3.1. Mark the voltage parameters required by the lightwave component analyzer next to the power socket to remind the user that the voltage used should meet the requirements. The other end of the power cable is connected to the AC power supply that meets the requirements.

Step 2 Turn on the power switch on the rear panel, as shown in Figure 3.2. Observe that the standby indicator above the power switch on the front panel turns yellow.

Step 3 Turn on the power switch of the front panel, as shown in Figure 3.3. Before powering on, do not connect any equipment to the lightwave component analyzer. If everything is normal, power on. After powering on, the indicator above the power switch of the front panel will turn green.

b)   Power On/Off

i.   Power on

Step 1. Turn on the rear panel power switch ("|").

Step 2. Turn on the power switch at the lower left corner of the front panel, and then turn on the power switch.⊐ The power indicator changes from yellow to green.

Step 3. The Lightwave Component Analyzer will take approximately 1 minute to power up the system and perform a series of self-tests and After adjusting the program, start running the main measurement program.

ii.   Shutdown

Step 1. Turn off the power switch at the lower left corner of the front panel. The instrument enters the process of shutting down (the power can be turned off only after the software and hardware are processed). After

ten seconds, the instrument is powered off, and the color of the power indicator above the power switch changes from green to yellow.

Step 2. Turn off the rear panel power switch ("O") or disconnect the instrument power.

Note

The instrument is powered off.

When the instrument is in normal working state, you can only shut down the instrument by operating the power switch on the front panel. Do not directly operate the power switch on the rear panel or disconnect the power from the instrument. Otherwise, the instrument will not enter the normal shutdown state, damage the instrument, or lose the current instrument status/measurement data. Please shut down the instrument properly. If you cannot normally power off the analyzer due to an operating system or application exception, hold down the power/standby key at least 4 seconds to turn off the analyzer.

---

c) Cut off the power

Under abnormal circumstances, to avoid personal injury, the optical component analyzer needs to be powered off for emergency. In this case, it is only necessary to unplug the power cable (from the AC power socket or from the power socket of the rear panel of the instrument). Therefore, sufficient operation space should be reserved when operating the instrument to meet the requirement of cutting off the power supply directly if necessary.

3.1.2 Routine Maintenance

This section describes the routine maintenance methods of the 6433 Series Lightwave Component Analyzer.

3.1.2.1 Instrument Surface Cleaning

To clean the surface of the instrument, follow the steps below:

Step 1. Shut down and disconnect the power cable connected to the instrument.

Step 2. Gently wipe the surface with a dry or slightly moist soft cloth. Do not wipe the inside of the instrument.

Step 3. Do not use chemical detergents such as alcohol, acetone, or dilutable detergents.

3.1.2.2 Monitor Cleaning

To clean the monitor, follow the steps below:

Step 1.   Shut down and disconnect the power cable connected to the instrument;

Step 2.   Dip clean soft cotton cloth with detergent and gently wipe the display panel;

Step 3.   Dry the display with a clean soft cotton cloth;

Step 4.   Connect the power cable after the cleaning agent is dry.

3.1.2.3 Test Port Maintenance

The front panel of the 6433 has optical output and optical input ports. If the ports are damaged or dust may affect the test result, maintain the ports by performing the following operations:

- ➢   Port should be away from dust, keep clean;
- ➢   To prevent electrostatic leakage (ESD), do not directly touch the surface of the connector.
- ➢   Do not use damaged connectors;
- ➢   After the optical input port is tested, cover the dustproof cap in time.

3.1.2.4 Cleaning of fiber jumpers

When using the instrument, ensure that the type of the optical fiber interface matches the type of the input interface of the instrument, and ensure that the end surface of the tested optical fiber is clean. If the end surface of the optical fiber becomes dirty, use the fiber cleaning pen or the absorbent cotton ball dipped in proper amount of absolute ethanol to clean the end surface of the optical fiber.

3.1.2.5 Storage

When storing the instrument, cover the input and output ports of the optical fiber with dust-proof caps to prevent the interface of the optical fiber from entering dust.

3.2 Front and Rear Panel Description

This section describes the composition and functions of the front and rear panels of the 6433 series lightwave component analyzer.

3.2.1 Front Panel Description

This section describes the composition and functions of the front panel of the 6433 series optical lightwave component analyzer. The front panel is shown in Fig. 3.1.
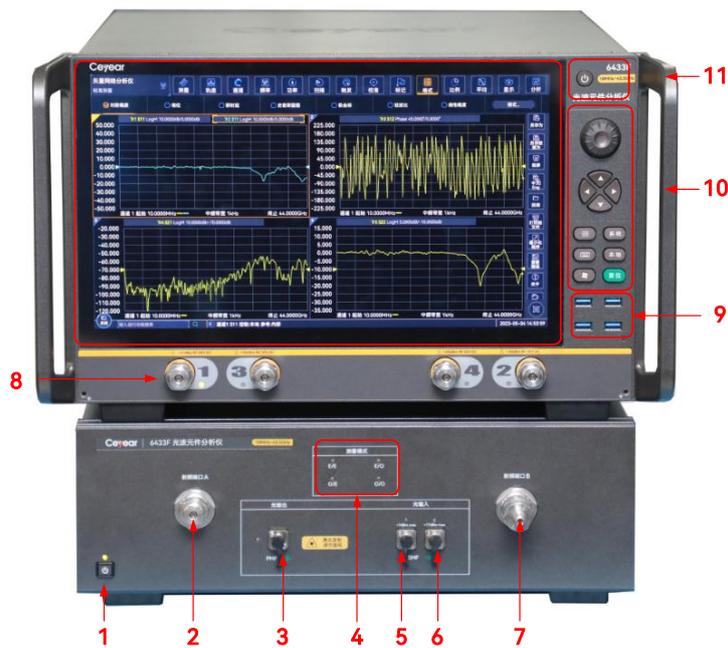
Fig. 3.1 Schematic diagram of front panel of 6433

Table 3.5 Functions of the front panel of the 6433

No.	Name	Description	Remarks
1	Power switch and indicator of the optical module	Optical module switch and power indicator.	
2	RF port A	Connects to RF modules.	
3	Optical output port	Output optical signals.	
4	Measurement mode indicator	Displays the current measurement mode.	
5	Optical input port 1	Optical signal receiving port 1.	
6	Optical input port 2	Optical signal receiving port 2.	
7	RF port B	Connects to RF modules.	
8	Vector network RF port	Vector network RF port	
9	USB interface	USB interface area	
10	Button area	Commonly used panel buttons for instruments.	
11	Power button	Vector network power button.	

3.2.2 Rear Panel Description

This section describes the composition and functions of the rear panel of the 6433 series lightwave component analyzer. The rear panel is shown in Figure 3.2.

3.2 Front and Rear Panel Description
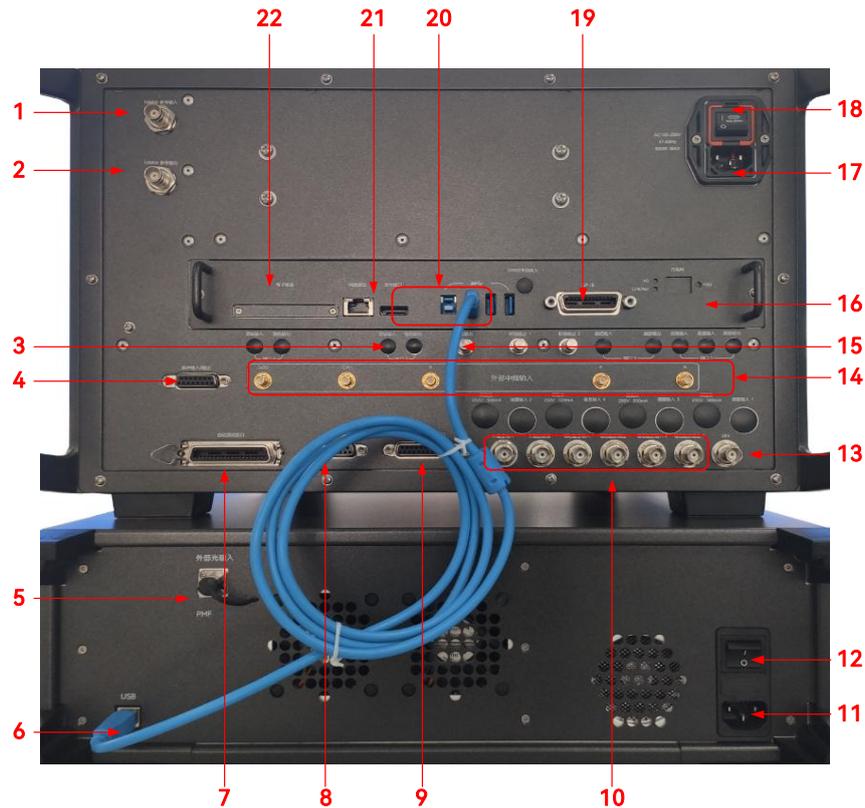
Fig. 3.2 6433 Rear Panel

Table 3.6 6433 Rear Panel Function Description

No.	Name	Description	Remarks
1	10 MHz reference input	Used with external reference signals.	
2	10 MHz reference output	It is used to provide reference signals.	
3	Local oscillator output connector	For fault detection and millimeter wave spread.	
4	Pulse Input/Output	Synchronous monitoring of the working status of the internal pulse generator.	
5	External optical input	Input of external optical signals.	
6	USB port	Used for VNA connection.	
7	Automatic test interface	Used for signaling interaction and provides an automatic test environment.	
8	Extended Interface	The connector is a 9-pin D female connector.	

9	External Test Device Interface	Control of the external test device.	
10	Trigger input/output connector	External and auxiliary trigger input and output interfaces.	
11	Power connector of the optical module	Power connector of the optical module.	
12	Power switch of the optical module	Power switch of the optical module.	
13	28V (BNC) connector	Used to drive a noise source.	
14	External IF input connector	The SMA interface is used as the external IF input of the VNA.	
15	RF output connector	Synchronize the operation status of the internal pulse generator.	
16	GPIB interface	GPIB interface.	
17	RF module power connector	Power connector.	
18	RF module power switch	Power switch.	
19	monitor	Used for external monitor.	
20	USB port	External keyboard, mouse and other devices.	
21	LAN interface	Connect to the network.	
22	Disk compartment	Hard disk port.	

3.3 Software Interface of Lightwave Component Analyzer

The software interface of the lightwave component analyzer includes the main software interface and the Lightwave test interface.

3.3.1 Software Main Interface

The main interface is shown in Fig. 3.3.

## 3.3 Software Interface of Lightwave Component Analyzer
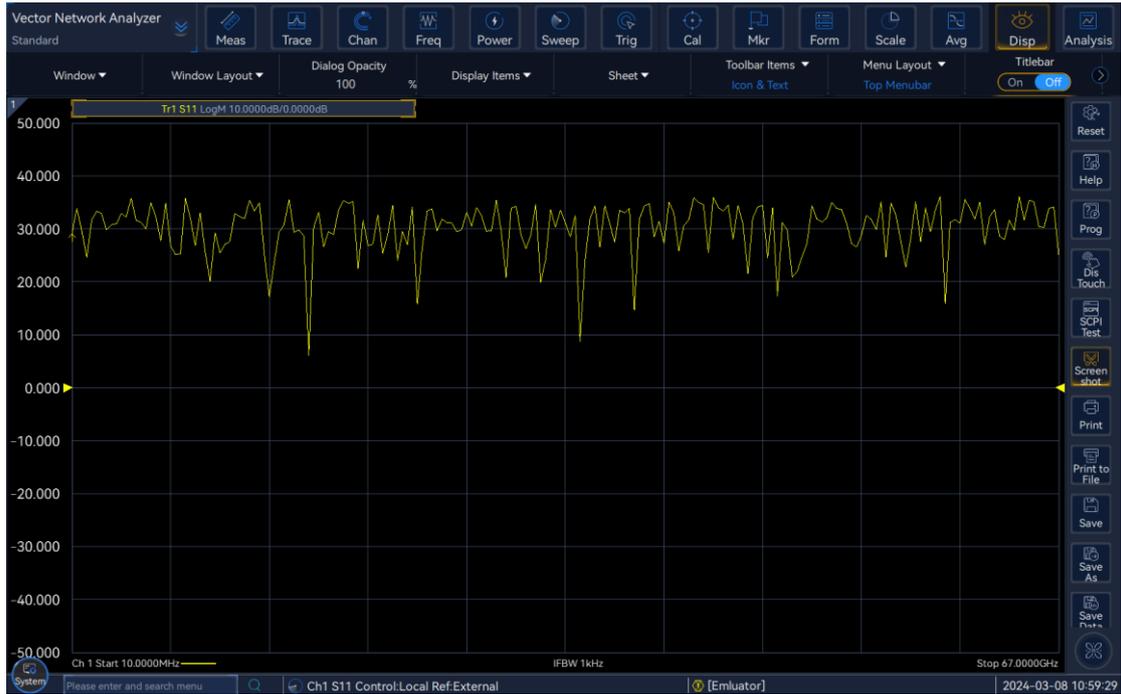
Figure 3.3 Main interface of the lightwave component analyzer software

3.3.2 Lightwave Test Interface

The Lightwave test interface is shown in Fig. 3.4.
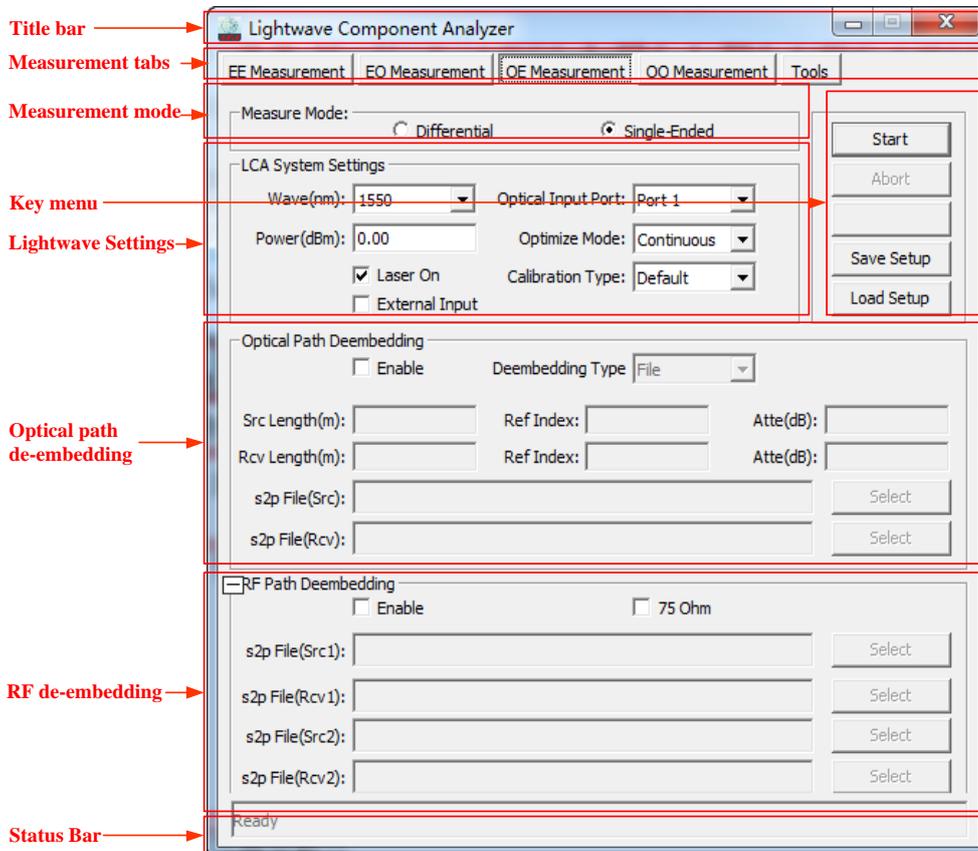
Fig. 3.4 Lightwave Test Interface of Lightwave Component Analyzer

> ## Hint
>
> ### Software interface
>
> The lightwave component analyzer program comprises a main program and a lightwave test program, and its interface comprises a main interface and a lightwave test interface.
>
> The main interface is vector network analyzer interface, which is called VNA interface or SNA(Super Network Analyzer) interface, etc.
>
> The lightwave(also called optical wave or light wave) test interface is the optical module control and analysis interface (LCA interface for short).
>
> ### Instrument Startup
>
> Start the instrument and enter the main program.Clicking the [LCA] button on the software shortcut menu to start the light wave test program.
>
> ### Startup Precautions
>
> Due to the main program preemption mechanism of the instrument, do not perform other operations within 15 seconds after the instrument enters the system, including but not limited to exiting the main program, opening the optical wave test program, and other operations on the interface of the industrial computer system of the instrument.

4 Operation Guide

This chapter mainly introduces the operation methods in the measurement process of the 6433 series lightwave component analyzer, including starting the lightwave component analyzer, electrical and electrical calibration, optical wave parameter setting, optical path calibration, and S parameter test of typical optical components.

4.1 Start-up of lightwave component analyzer

The lightwave component analyzer consists of two parts, and the upper and lower parts are supplied with independent power. Therefore, the startup steps are as follows:

1. Connect the power supply of the upper and lower parts respectively.

2. Connect the vector network analyzer and the optical module through a USB cable as shown in Figure 4.1.

3. Press the power button to power on the device.

4. After entering the main interface, wait for 20 seconds, and then.Clicking the [LCA] button on the software shortcut menu to start the optical wave test interface of the lightwave component analyzer.

4.1 Start-up of lightwave component analyzer

Figure 4.1 USB cable connection diagram of lightwave component analyzer

---

Hint

Cold start preheating of instrument

During cold start-up of 6433 series lightwave component analyzer, in order to achieve the specified performance index, the lightwave component analyzer shall be preheated for at least 60 minutes before measurement.


Hint

On/off

Short press the vector network analyzer to start and shut down. Press and hold for 3 seconds to power on and off the optical module.

When the power supply is connected, the light of the vector network analyzer and optical module is yellow. After the power supply is started, the colors all turn green.

Hint

Method of entering light wave test program

1、 The [LCA] button on the software shortcut menu;
2、 [System]->[Macro]->[LCA] in the bottom leftcorner of the screen。

> **Hint**
>
> The application automatically runs upon startup. If you exit the application, you can run the application again by using the following methods:
>
> Method 1: Click Start in the task bar at the lower left corner of the screen, point to Program in the start menu, and then click Program in the program submenu.Point to [SNA] in the middle, click [SNA] in the pop-up submenu to start the measurement application, or double-click the shortcut on the desktop to run the application.
>
> Method 2: Press the [Reset] button in the function key area to start running the 6433 series lightwave component analyzer application program.

4.2 Microwave Parameter Settings

4.2.1 Selecting Measurement Parameters

The 6433 Series Lightwave Component Analyzer can set measurement parameters to measure the characteristics of an optical component.

4.2.1.1 S-parameters

1) S-Parameter Overview

The S parameter (scattering parameter) is used to describe how a device changes the input signal. It describes the reflection and transmission characteristics of the tested device. The S-parameter is expressed in a conventional digital arrangement form to represent the ratio of two complex vectors containing amplitude and phase information.

The S parameter is a complex linear value, and its measurement accuracy depends on the index of the calibrator and the measurement connection technology adopted, and also on the termination of the non-measurement port (the port not excited).

2) Application of S-parameter

The following parameters can be measured with the S parameter:

a) Reflectometry: SXX (X=1, 2, 3, 4)

(1) Return loss standing wave ratio (SWR), (2) reflection coefficient, (3) impedance, (4) S11, S22, S33, S44

  b)   Transmission measurement: SXY(X=1, 2, 3, 4;Y=1, 2, 3, 4;X≠Y)

  (1) Insertion loss, (2) Transmission coefficient, (3) Gain, (4) Group delay, (5) SXY

3)   Create S-parameter measurement track

  Path: [Trace] -> [New Trace…], and click S-Parameter in the dialog box.

Figure 4.2 Creating an S-parameter track

4)   New Track dialog box

  a)   [S-Parameter]button

  Used to select the S parameter measurement track to be created.

  b)   [Receiver] button

  Opens the dialog box for creating a new arbitrary ratio or non-arbitrary

power measurement track.

    c)   Balance Parameter button

    Opens the dialog box for creating a new balance parameter measurement

track.

4.2.2 Setting the Frequency Range

There are two ways to set the frequency range:

    a)   Specify the start frequency and end frequency.

    b)   Specify the center frequency and frequency span.

    1)   Set the start frequency and end frequency.

    Path: [Freq].

    2)   Set the center frequency and frequency span.

    Path: [Freq].

Figure 4.3 Setting the Start and End Frequency
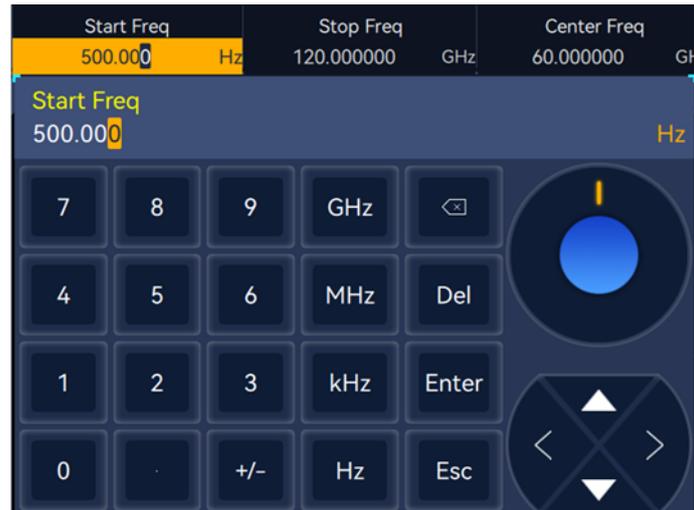
Figure 4.4 Setting Center Frequency and Frequency Span

4.2.3 Setting the Signal Power Level

The power level refers to the power level of the output signal of the analyzer test port source.

1) Set Power Level

Menu path: [Power]

Figure 4.5 Setting the Power Level

2) Shutdown Port Power

Menu path: [Power] > [Power Status On/Off], or change the power switch through the Power ON/off check box in the Power Setting dialog box.

3) Manually set attenuation

Menu path: [Power] > [Power and Attenuation]. The Power and Attenuation dialog box is displayed. Click the Clear Auto Decay Area check box. Click the attenuation input box and enter the attenuation value.

4) Set Power Ramp

Menu path: [Power] -> [Power…] to display the power dialog box; Click the [Ramp] check box. Click the Ramp input box and enter the power ramp value.

5) Power dialog box

    a)   Power ON/Off check box

When this option is selected, the output power of the port is normal. When this option is cleared, the output power of the port is disabled.

    b)   [Power – Port 1]

Select to set the power level of port 1.

    c)   Power Ramp check box

Select the [Power Ramp] check box and enter the ramp value in the [Ramp] input box to enable the power ramp function. The power ramp is used to compensate for the increased power loss of the cables and test fixtures as the frequency increases.

➢   When the power ramp function is enabled, the output power of the test port increases (or decreases) as the scan frequency increases.

➢   The unit of power ramp is dB/GHz.

➢   The power ramp can be set from –2 to +2.

6)   Power and Attenuation Dialog Box

    a)   [Power ON/Off] check box

When this option is selected, the output power of the port is normal. When this option is cleared, the output power of the port is disabled.

    b)   Coupling Port Power check box

By default, the Coupling Port Power check box is selected, and the power level settings of the two ports of the analyzer are the same. However, some measurement applications require different power levels for each port. For example, to measure the gain and reverse isolation of a high gain amplifier, the power of each port must be set separately because the input port of the amplifier requires much lower power than the output port. When the Coupling Port Power check box is cleared, the analyzer allows you to set the power level for each port separately.

    c)   [Status]

The default value is [Auto]. In this case, the port power switch status needs to be switched according to the measurement. [ON]indicates that the port power is always on, and [Off] indicates that the port power is always off.

    d)   [Port Power]

This command is used to set the power level of a port.

    e)   [Auto Attenuation]

When the check box is checked, you can set any power level within the instrument's allowable range. When the check box is cleared, you can

manually set the source power and attenuation values to make certain measurements, such as reflector amplifier (oscillator or some state unstable amplifiers) measurements, where, Very good source impedance matching (e.g., better than 20 dB return loss) is required over a wide frequency range.

f) [Attenuation] column

Sets the attenuation value.

g) [Stable Amplitude Mode] column

Used to set amplitude stabilization mode. There are three amplitude stabilization modes, namely [internal amplitude], [receiver] and [open loop]. [open loop] is not steady amplitude.

h) Power Ramp check box

Check the Ramp check box and enter the Ramp value in the Ramp input box to enable the power ramp function. The power ramp is used to compensate for the increased power loss of the cable and test fixture as the frequency increases.

➢ When the power ramp function is enabled, the output power of the test port increases (or decreases) as the scanning frequency increases.

➢ The power ramp is expressed in dB/GHz.

4.2.4 Set Scan

Scanning is the process of measuring continuous data points in a given order of excitation values.

4.2.4.1 Overview of Scan Types

The Network Analyzer supports the following three scan types:

1) Linear frequency

This is the default scan type for the instrument, with a linear and continuous frequency covering the entire frequency range.

2) Logarithmic frequency

Under the logarithmic frequency setting, the source frequency increases in logarithmic step, and the frequency ratios of two adjacent frequency points are the same.

3) S5egment scan

The segment sweep setting initiates a scan of multiple segments, each with an independently defined power level, IF bandwidth, and scan time. Once the

calibration is completed on all segments, calibrated measurements can be made on one or more segments.

Hint

Scan Type:

The lightwave component analyzer supports only linear frequency and logarithmic frequency, but does not support other scanning modes mentioned in the vector network analyzer.

4.2.4.2 Sweep Type Settings

Menu path: [Sweep] -> [Sweep Type].

Select the appropriate sweep type in the auxiliary menu bar or select the sweep type in the sweep type setup dialog box.

Figure 4.6 Setting the Linear Frequency Sweep Type

4.2.5 Setting Data Format and Proportion

The data format is the graphical display of the measured data by the analyzer. When measuring, select the data format that is most suitable for understanding the characteristic information of the tested part. This section describes nine different data formats and how to set the scale to better display measurement information.

4.2.5.1 Data Format

1) Rectangular coordinate format

Seven of the 9 data formats display the measured data in the rectangular coordinate format. This format is also called Cartesian format, X/Y format or straight line format. This format is very suitable for displaying the frequency response information of the tested device.

- ➢ By default, the X-axis displays the incentive values (frequency, power, or time) in a linear scale.
- ➢ The Y axis shows the corresponding response values for different excitation values.

a) logarithmic amplitude format
- ➢ Display amplitude information (no phase information)
- ➢ Y axis Unit: dB
- ➢ Typical Measurements: return loss, insertion loss, and gain

b) phase format
- ➢ Display phase information (no amplitude information)
- ➢ Y-axis unit: phase (degrees)
- ➢ Typical measurements: Linear phase deviation

c) group delay format
- ➢ Display the transmission time of the signal through the tested part.
- ➢ Y axis Unit: time (seconds)
- ➢ Typical Measurements: Group Delay

d) linear amplitude format
- ➢ Show positive values only
- ➢ Y axis: no unit (U) for ratio measurement, and milliwatts (mW) for non-ratio measurement
- ➢ Typical measurements: reflection and transmission coefficients (amplitude values), time domain transformation

e) standing wave ratio format
- ➢ Displays the reflection measurement data calculated using the formula $(1+\rho)/(1-\rho)$, where ρ is the reflection coefficient.

> ➢ Valid only for reflection measurement
>
> ➢ Y axis: no unit
>
> ➢ Typical measurements: standing wave ratio

f) real number format

> ➢ Displaying the real part of the measurement complex data
>
> ➢ Similar to linear amplitude format, but can display positive and negative values
>
> ➢ Y axis: no unit
>
> ➢ Typical measurements for use: time domain, auxiliary input voltage measurements for maintenance purposes

g) imaginary number format

> ➢ Show only imaginary parts of measurement data
>
> ➢ Y axis: no unit
>
> ➢ Typical Measurements: Impedance Measurements for Designing Matching Networks

2) polar coordinate format

a) The amplitude value of any point is determined by the displacement from the point to the central point (or zero). By default, the amplitude is linear scale, and the outer circle is set to a ratio of 1.

b) The phase value of any point is determined by the angle to the X axis.

c) Since there is no frequency information, the frequency information is read through the cursor, the default cursor formats are real and imaginary, or you can open the cursor dialog box through the Cursor/Analyze menu and select another format in Advanced Cursor.

3) Smith circle chart format

a) The central horizontal axis of Smith circle represents pure resistance, and the central point of horizontal axis represents system impedance. The leftmost resistance of the horizontal axis is zero, indicating a short circuit. The rightmost resistance of the horizontal axis is infinite, indicating an open circuit.

b) The points on the Smith circle chart and the horizontal axis intersect the circle have equal resistance values.

c) The points on Smith's circle graph and the tangent arc of horizontal axis have the same reactance value.

d) The reactance of the upper half of Smith's circle is positive, so it is an inductive region.

e) The reactance of the lower half of Smith's circle is negative, so it is a capacitive

region.

4.2.5.2 Setting Data Format

Menu path:[Format] , pop up [Format] submenu.
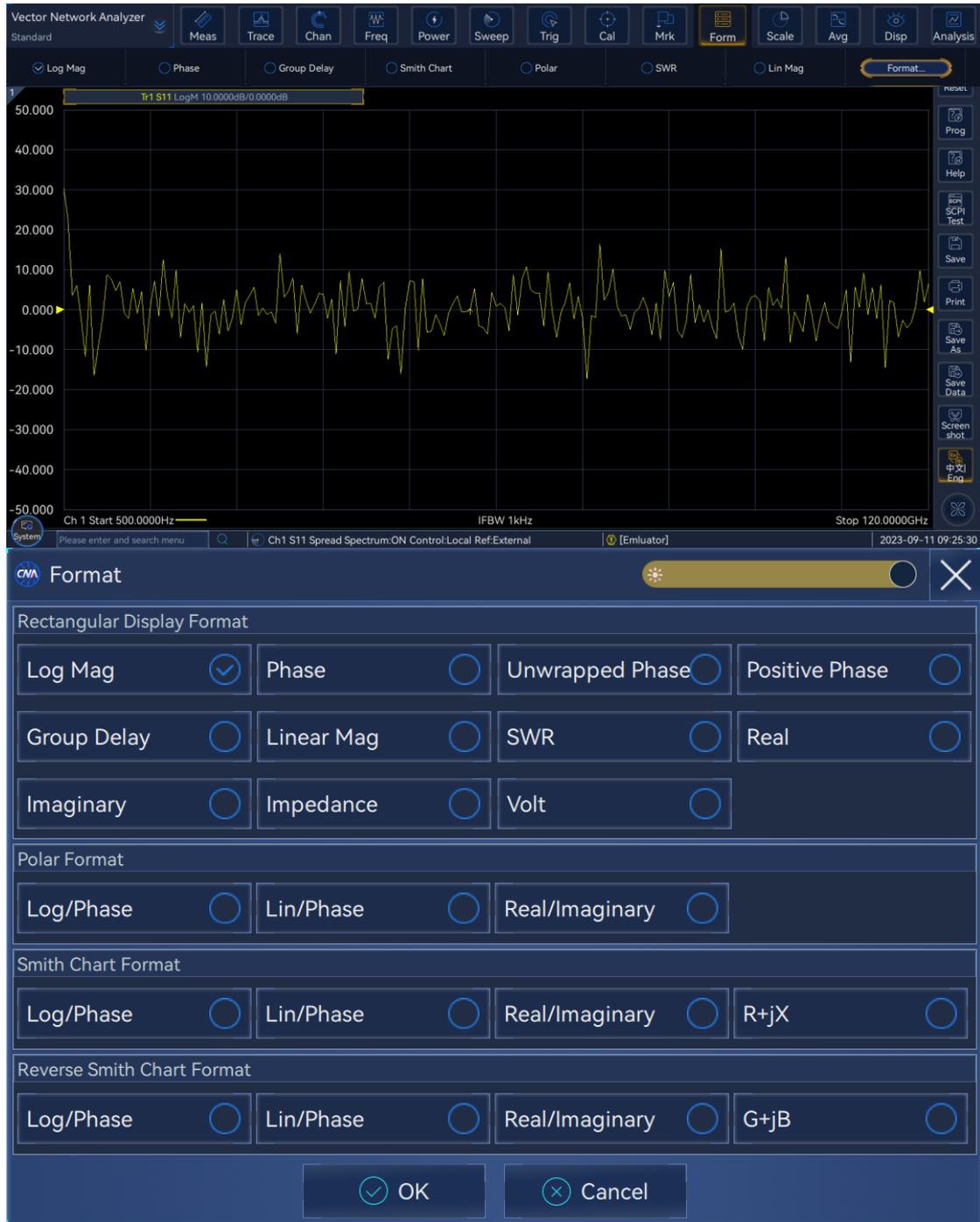
Figure 4.7 Setting the Data Format

4.2.5.3 Scale

Scale is used to set the proportion of the vertical part of the display grid. In polar

coordinate and Smith circle chart format, it is used to set the full proportion of the outer circle. The setting of scale and format determines the display mode of the measurement data on the screen. In logarithmic format, the setting range of scale is: 0.001dB/ grid ~ 500dB/ grid.

1) Set Scale

Menu path: [Scale] , pop up [Scale] submenu.

Click the appropriate input area or button to set the appropriate scale, reference position and reference level.

Figure 4.8 Setting the Scale

2) Scale Settings dialog box

 a) Scale zone

  ➤ [Scale] box

   Enter the scale setting value.

  ➤ [Auto Scale] button

   Click [Auto Scale], and the analyzer automatically selects the vertical scale so that the active track can be displayed in the vertical grid on the screen. The excitation value is not affected, but only the scale value and reference value are changed.

   i. The analyzer selects an appropriate scale factor so that the data is displayed in 80% of the screen.

   ii. Reference Value Selects the center value of the track on the screen.

  ➤ [Auto Scale All] button

   Click [Auto Scale All], and the analyzer sets appropriate scales for all

tracks in the window so that they can be better displayed in the vertical grid of the window.

b) Reference Setting Area

➢ [Reference Position] button

The reference position refers to the position of the reference line in the rectangular coordinate diagram. The position of the bottommost line in the diagram is 0, the position of the topmost line is 10, and the default value of the reference position is 5.

➢ [Reference Value] button

The reference value refers to the value of the reference line in the rectangular coordinate format, the value of the outer circle in the polar coordinate and Smith circle chart format, and the setting range in the logarithmic amplitude format is −500dB ~ +500dB.

4.3 Electro-Electric Calibration

4.3.1 Calibration Overview

Measurement calibration is a process in which the system errors are determined by the known standard of measurement characteristics, and then the influence of these system errors is removed during the measurement of the tested parts. The measurement errors can be reduced and the measurement precision of the analyzer can be improved by calibration.

4.3.1.1 Definition of Calibration

Calibration is the use of an error model to eliminate one or more systematic errors, and the analyzer measures high-quality calibration standards. (e.g., open, short,load, and through) To solve the error term in the error model, please refer to 3674 Series Vector Network Analyzer User Manual for detailed information on systematic errors.

Hint

Calibration and network measurement:

For details, see 3674 Series Vector Network Analyzer User Manual.

4.3.1.2 Significance of calibration

It is not possible to produce an ideal lightwave component analyzer without any error correction, in hardware circuits, and even if these hardware circuits are particularly well done, the need for error correction can be ignored, and the cost is extremely expensive. In addition, the measurement accuracy of the analyzer is largely

influenced by the external accessories of the analyzer. The changes in amplitude and phase of the components of the test, such as the connecting cables and adapters, may obscure the true response of the tested component. Therefore, the best method is to balance the performance and cost of hardware, to make the hardware as good as possible, and to improve the measurement accuracy through calibration.

4.3.1.3 Application situations of calibration

➢   It is desirable to obtain the highest possible measurement accuracy.

➢   Use different types of connectors or impedances.

➢   A cable is connected between the device under test and the analyzer test port.

➢   To measure the component under test over a wide frequency range or to measure long time delay devices.

➢   An attenuator or other similar device is connected to the input or output port of the tested component.

4.3.2 Select Calibration Type

6 calibration types commonly used by the 6433 series lightwave component analyzers, and details of each calibration type are as follows:

1)   open circuit response

   a)   Calibration accuracy: low to medium

   b)   Measurement parameters: S11, S22, S33 and S44

   c)   Required calibration standard: open circuit device

   d)   Corrected Systematic Errors: Reflection Tracking

   e)   Measurement application: reflection measurement at any port

2)   Short circuit response

   a)   Calibration accuracy: low to medium

   b)   Measurement parameters: S11, S22, S33 and S44

   c)   Required calibration standard: short circuit device

   d)   Corrected Systematic Errors: Reflection Tracking

   e)   Measurement application: reflection measurement at any port

3)   Through response

   a)   Calibration accuracy: Medium

   b)   Measurement parameter: transmission measurement S parameter

   c)   Required calibration standard: straight-through device

   d)   Corrected Systematic Errors: Transmission Tracking

   e)   Measurement applications: Transfer measurement in any direction

4) Through and Isolation

   a) Calibration accuracy: medium

   b) Measurement parameter: transmission measurement S parameter

   c) Required calibration standard: Pass-through, two loads (one load per port)

   d) Corrected systematic error:

     ➤ Transmission Tracking

     ➤ crosstalk

   e) Measurement application:

     ➤ Transfer measurement in any direction

     ➤ Need to increase the dynamic range of the system through isolation calibration

5) Single port (reflection)

   a) Calibration accuracy: high

   b) Measurement parameters: S11, S22, S33 and S44

   c) Required calibration standards: Opener, Shorter and Loader

   d) Corrected systematic error:

     ➤ directivity

     ➤ Source Matching

     ➤ reflex tracking

   e) Measurement application: reflection measurement of any single port

6) Full dual port SOLT

   a) Calibration accuracy: high

   b) Measurement parameters: all

   c) Required calibration standards: open circuit device, short circuit device, loader, pass-through device

   d) Corrected systematic error:

     ➤ directivity

     ➤ Source Matching

     ➤ reflex tracking

     ➤ crosstalk

     ➤ Transmission Tracking

   e) Measurement application:

     ➤ Measurement of all S parameters

     ➤ 12 error corrections are required to improve the accuracy of the measurement.

4.3.3 Calibration Wizard

The calibration wizard of the analyzer allows you to select the calibration type and perform the calibration. The following uses SOLT calibration as an example to describe the calibration process.

1) Start the calibration wizard for calibration. The menu path is [Cal] –> [Cal...] to display the calibration wizard dialog box.

Figure 4.9 Starting calibration

2) Set up information such as the number of calibration ports,type of tested component connectors and calibrator, and click [Next].

Figure 4.10 Seting Calibration

3) According to the prompt information, click button to per form calibration.

Figure 4.11 SOLT Calibration

4) Click [Finish] to complete the entirely calibration.

Figure 4.12 Calibration Completed

> **Note**

Correct selection of calibration standards for maximum calibration accuracy

In the Multi-Standard Measurement dialog box, the connector type displayed is the connector type of the calibration standard.

4.4 Lightwave Parameter Setting

4.4.1 Test Labels

The test labels of the lightwave component analyzer are divided into five labels: electro-electrical test, electro-optical test, photoelectric test, optical-optical test and tool. The first four labels are used for test, and the fifth label (tool label) is used for instrument control.

Electrical and electrical test: The electrical and electrical test function is the same as that of vector network analyzer.

Electro-optical test: Tests the S parameters of electro-optical components.

Optical-electrical test: Tests the S parameters of optical–electrical components.

Optical-optical test: Tests the S parameters of optical–optical components.

Tool: controls the optical output module and optical input module, facilitates debugging and instrument function verification.

The vector network analyzer can be used to test the electrical and electrical tests.
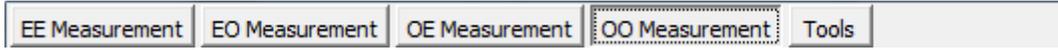
Figure 4.15 Test label and tool label on the LCA test interface

(1) Test label

The test labels of the lightwave component analyzer are classified into four types: electro-electrical test, electro-optical test, photoelectric test, and optical-optical test. In the four test modes, the enabling status of buttons and controls is as follows:
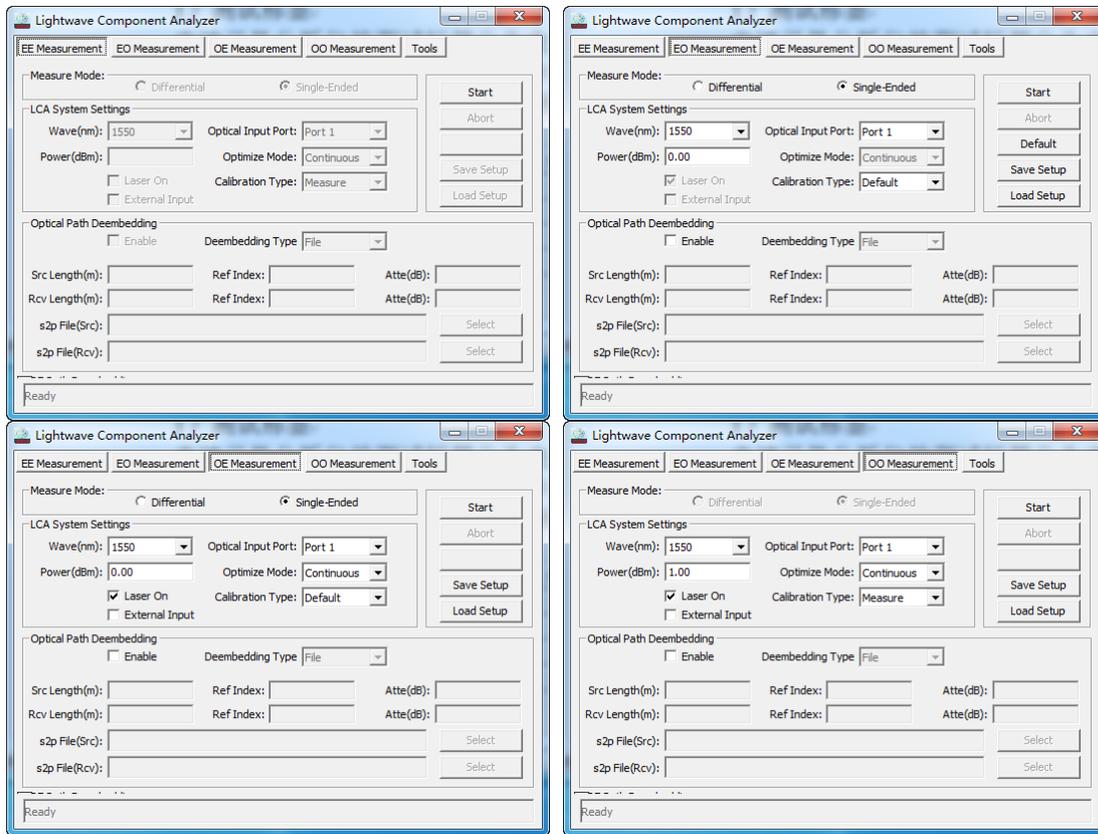
Figure 4.16 Control enabling status in four test modes

(2) Tool label

The following figure shows the tool label for the lightwave component analyzer.
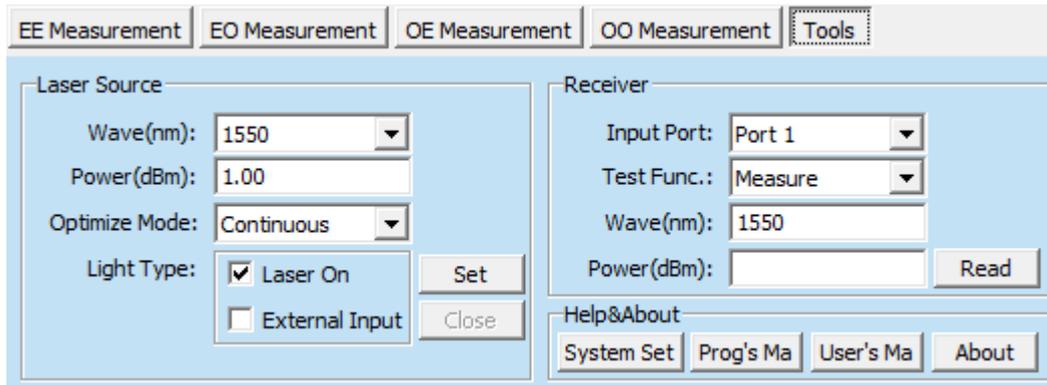
Figure 4.17 Tool label

The tool labels are divided into optical output modules and optical output modules. The optical output module can provide modulated light with a wavelength of 1310 nm and 1550 nm and a power of –2 to +4 dBm. The optical output module can measure the optical power.

4.4.2 Measurement Mode

The measurement modes of the lightwave component analyzer include differential mode and single-ended mode.

Single-ended mode: applicable to the test of dual-port optical components.

Differential mode: It is applicable to the test of balanced optical components such as three-port and four-port. It needs to be used with the four-port vector network analyzer.
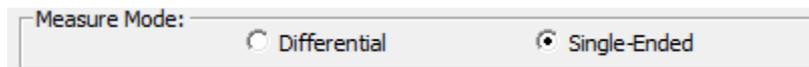
Figure 4.17 Measurement Mode

Hint

Measurement

Lightwave component analyzer supports single-ended test in Optical-Optical measurement only.

4.4.3 LCA System Settings

The LCA System Settings allows you to set parameters of the optical module, such as wavelength, power, input port, optimization mode, and calibration type.

Figure 4.18 LCA System Settings

1. Wavelength

   Wavelength characterization has two meanings.

   1. Wavelength of light output by the optical output module;

   2. Optical input Wavelength of the optical input module.

   The internal light source of the optical output module supports two wavelengths: 1310 nm and 1550 nm.

2. Power

   Power refers to the output optical power set by the optical output module.

3. Input port

   Input port refers to the port number connected to the optical input module. The maximum power of port 1 is 7 dBm and that of port 2 is 17 dBm.

4. Optimization Mode

   Optimization mode refers to the method used by the electro-optic modulator of the optical output module to track the dynamic working point. It can be divided into single mode and continuous mode.

5. Calibration Type

   Calibration Type refers to the method used for optical path calibration. There are four modes: Default,Measure, Load, and User.

   ➢ Default

      Perform optical path calibration using factory data.

   ➢ Measure

      Calibrate the optical path using the "Measure" method. This method has the highest accuracy.

   ➢ Load

      Use the file loaded by the user to calibrate the optical path.

   ➢ User

      Reuse last calibration data. This mode is the fastest and the accuracy depends on the last calibration mode used. When using this mode, make sure that the test conditions, test links, etc., are not changed except for the device under test.

> **Hint**
>
> **Light source type:**
>
> The light source types of the lightwave component analyzer include internal and external light sources. The standard version supports internal light sources, while the external light sources are optional and can be customized.
>
> The wavelengths of the internal light sources are 1310 nm and 1550 nm.

4.4.4 Optical Path De-embedding

During the test, some optical components need to be tested with additional optical fixtures. To ensure the accuracy of the test result, the impact of optical fixtures needs to be deducted. The deduction process is optical path de-embedding.

The types of optical path de-embedding are divided into file de-embedding and parameter de-embedding.

1. file

    The S parameters of the optical fixture are given in the form of *.s2p files. The impact of the optical fixture on the test can be directly deducted by calling this file.

2. Parameters:

    Parameter de-embedding means that the S parameter of the optical fixture is unknown, and the S parameter of the optical fixture needs to be solved by calculating the length, refractive index, attenuation and other parameters, and then the parameter is deducted.

Figure 4.19 Optical path de-embedding

> **Hint**
>
> **Deembedding type:**
>
> There are two types of optical path embedding in optical wave analyzer: file and parameter.
>
> Currently, the instrument supports only file de-embedding.

4.4.5 RF De-embedding

During the test, the RF end (electrical end) of some optical components needs to be tested with additional electrical fixtures. To ensure the accuracy of the test result, the impact of the electrical fixture needs to be deducted. The deduction process is RF de-embedding.
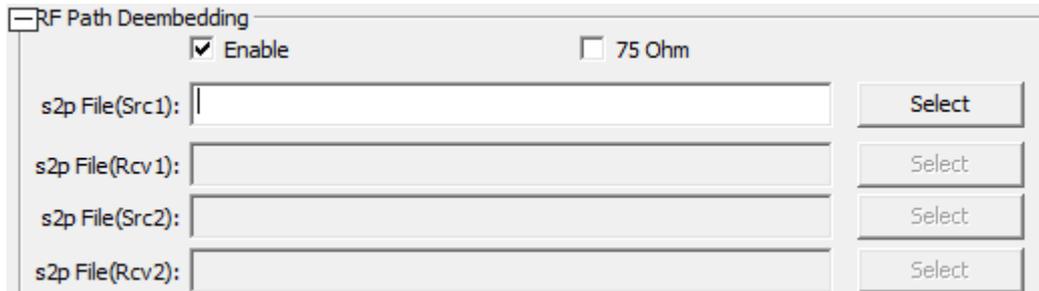
Figure 4.20 RF Deembedding

Hint

Optical path de-embedding and RF de-embedding:

In the electrical and electrical measurement mode, the optical path and RF path cannot be de-embedded.

In electro-optical measurement mode, you can use the optical path at the receive end to de-embed and the RF path at the source end to de-embed.

In photoelectric measurement mode, the optical path at the source end can be de-embedded and the RF module at the receive end can be de-embedded.

In optical-optical measurement mode, the optical path at the source end and the receive end can be used for de-embedding. RF de-embedding cannot be used.

Hint

Take photoelectric measurement as an example to illustrate the steps of de-embedding:

1. Select the Enabled check box for Optical Path De-embedding or the Enabled check box for RF De-embedding as required.

2. Click the Select button of the optical path to embed file (source end) or click the Select button of the RF path to embed file (receive 1).

3. Load and deembed files (in S2P format).

4. Click the Start button. During the measurement, the software will automatically de-embed.

4.4.6 System Reset

If the system crashes or freezes due to improper operation, you can press the [Reset] button in the function key area of the lightwave component analyzer to reset the system.

4.4.7 Optical Input Power Measurement

The 6433 series lightwave component analyzer has a calibrated optical power meter module for users to use. The detailed operations are as follows:

1. Click [LCA] -> [Tools] in the shortcut software area.
2. Set the optical input port to port 1 on the optical input module. The test function is optical test. Select the receive wavelength according to the wavelength to be measured. Click [Read] to view the optical power of the wavelength to be measured.
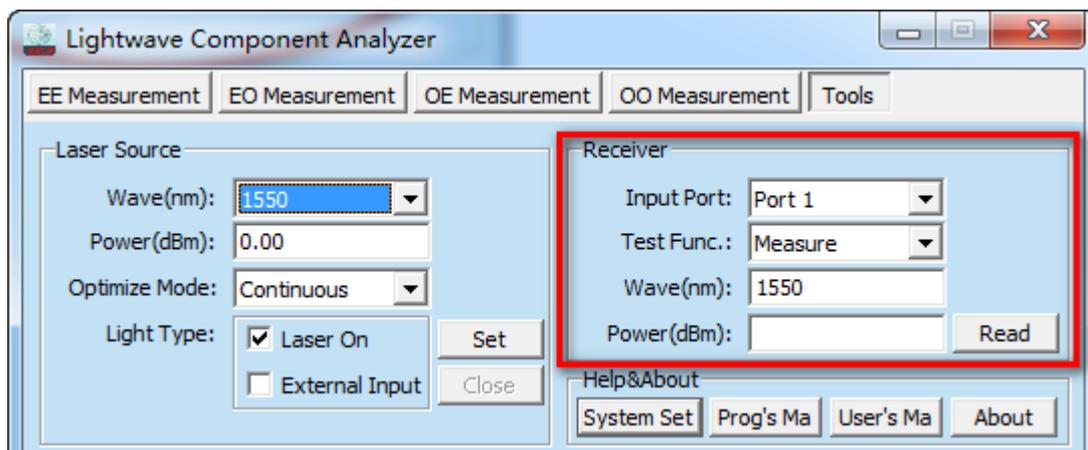
Figure 4.21 Optical input power measurement interface

4.4.8 On/Off of Light Output

The 6433 Series Lightwave Component Analyzer has 1310nm and 1550nm dual-wavelength light sources for users. The user can turn on or off the light source as described below.

1. Click [LCA] -> [Tools] in the shortcut software area.
2. Select the wavelength (1310 nm or 1550 nm) and power (-2 dBm to +4 dBm) in the light source module, set Optimization Mode to Continuous, and select Internal Light.
3. Wait until the indicator of the optical output port of the optical module is steady on. If the indicator is steady on, the optical source is output stably.
4. Click the Close button to turn off the light source.

4.4 Lightwave Parameter Setting
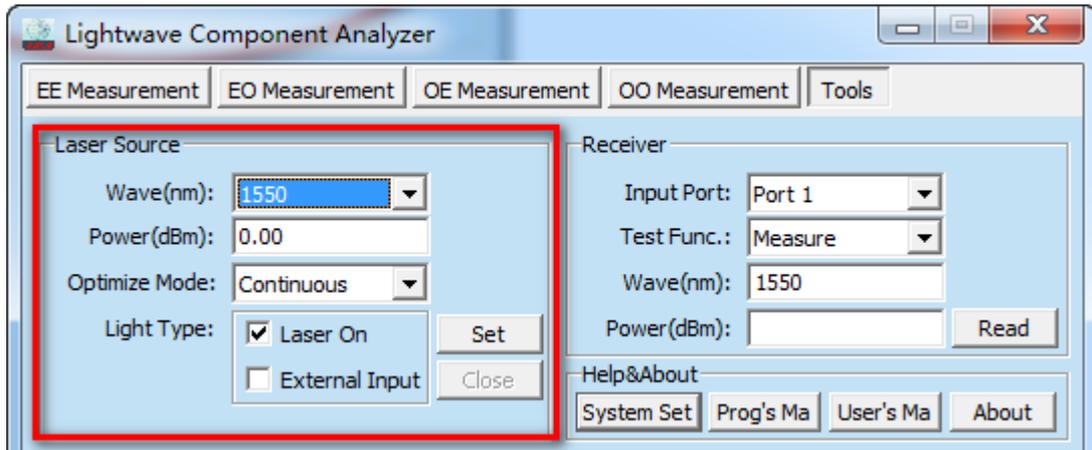
Fig. 4.22 Optical Output Setting Interface

⚠**Warning**

The light source output of the lightwave component analyzer is laser output. Do not look directly with your eyes after opening it. Close it and cover the dustproof cap after using it.

4.4.9 System Minimization and Exit Procedure

The software of the 6433 Series Lightwave Component Analyzer does not have a button for maximizing or closing peripherals. Users can click File in the menu bar and select Exit or Minimizing from the drop-down menu.
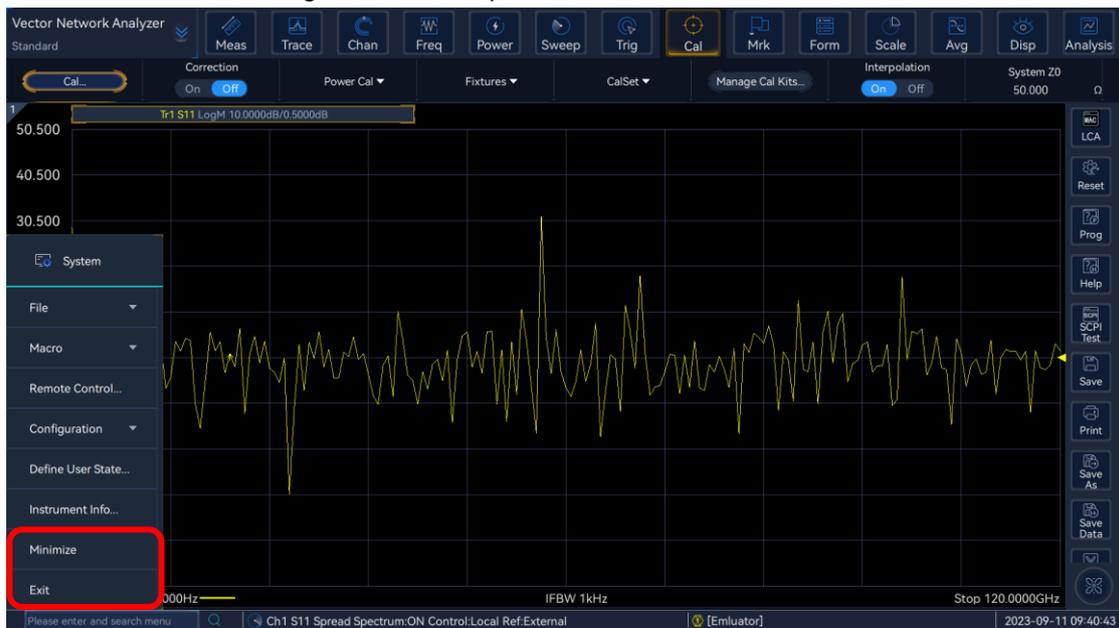
Fig. 4.23 Minimize and exit the system interface

4.5 Optical Path Calibration

When using the lightwave component analyzer to test the optical components, additional photoelectric/electrical-optical conversion module is needed to realize the complete test.

1. Electro-optical measurement

In electro-optical measurement, a photoelectric conversion module needs to be added at the output end of the electro-optical testing component to convert the output signal from the optical wave domain to the microwave domain.

2. photoelectric measurement

During the photoelectric measurement, an electrical-optical conversion module needs to be added at the input end of the photoelectric device to convert the input signal from microwave domain to optical wavelength domain.

3. Optical-optical measurement

During the optical-optical test, the photoelectric conversion module and the electro-optical conversion module need to be added at both ends of the tested component to form a microwave signal-optical wave signal-microwave signal test link.
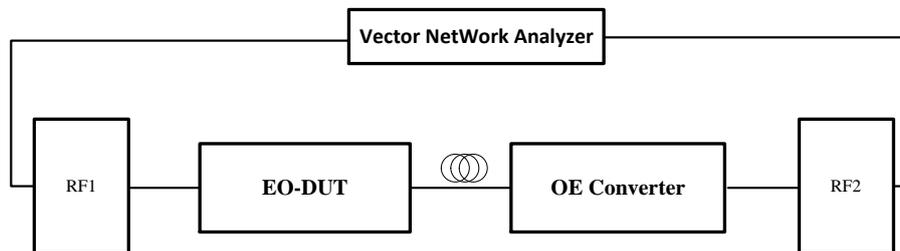
Figure 4.24 Electrical-optical test block diagram
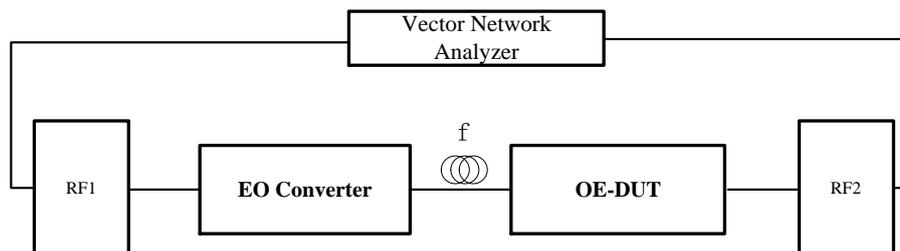
Figure 4.25 Photoelectric test block diagram

```
                    ┌─────────────────────┐
                    │   Vector Network    │
                    │     Analyzer        │
          ┌─────────┴─────────────────────┴─────────┐
          │                                         │
     ┌────┴───┐  ┌─────────┐      ┌────────┐      ┌─────────┐  ┌────────┐
     │        │  │   EO    │ ((   │        │  ))  │   OE    │  │        │
     │  RF1   │  │Converter│      │ OO-DUT │      │Converter│  │  RF2   │
     │        │  │         │      │        │      │         │  │        │
     └────────┘  └─────────┘      └────────┘      └─────────┘  └────────┘
```
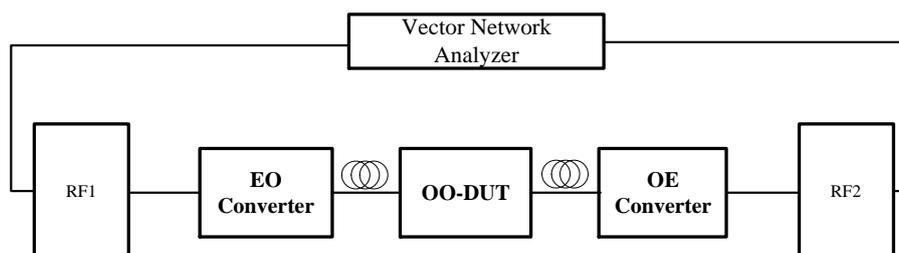
Figure 4.26 Optical-optical test block diagram

The optical path calibration is to deduct the influence of the electro-optical conversion module or photoelectric conversion module introduced during the test process, so as to achieve accurate measurement of the measured component.

Hint

Optical path calibration

For the electro-optical measurement, you need to calibrate the optical path of the photoelectric conversion module.

For the photoelectric measurement, you need to calibrate the optical path of the electrical-optical conversion module.

In the optical-to-optical test, the optical path of the O/E conversion module and the E/O conversion module need to be calibrated.

Hint

1. Optical path calibration classification

Optical path calibration includes optical-to-electrical conversion module calibration and electrical-to-optical conversion module calibration.

Calibration of photoelectric conversion module

This type of calibration is required for electro-optical and optical measurements.

Electro-optical conversion module calibration

This type of calibration is required for photoelectric and optical measurements.

2. Optical path calibration mode

Because of its robustness, photoelectric conversion module is not susceptible to external influences, its calibration adopts the form of "program self-calibration" without user operation.

The electro-optical conversion module is easily influenced by the outside world, and its calibration is divided into three types: Default, Load and Measure.

> ➢ Default
>
> Perform optical path calibration using factory data.
>
> ➢ Load
>
> Use the file loaded by the user to calibrate the optical path.
>
> ➢ Measure
>
> Calibrate the optical path using the test method. This method has the highest accuracy.

3. Calibration time of the E/O conversion module:

> To ensure the measurement accuracy, the optical path calibration of the E/O conversion module is performed with the test, that is , optical path calibration is performed for each test.

4.6 Typical Optical Component S Parameter Test

Before testing the S parameters of optical components, perform electrical and electrical calibration. The typical electrical and electrical calibration process is as follows:

1. Preheat the instrument for 60 minutes. Reset the instrument.

2. Set frequency and power.

3 Select measurement and create a new track.

4. Set the IF bandwidth (not mandatory).

5 Calibration.

After the electrical and electrical calibration is complete, you can test the optical components.

Hint

Electrical calibration must be performed before testing optical devices.

4.6.1 Optical–Optical Component Test
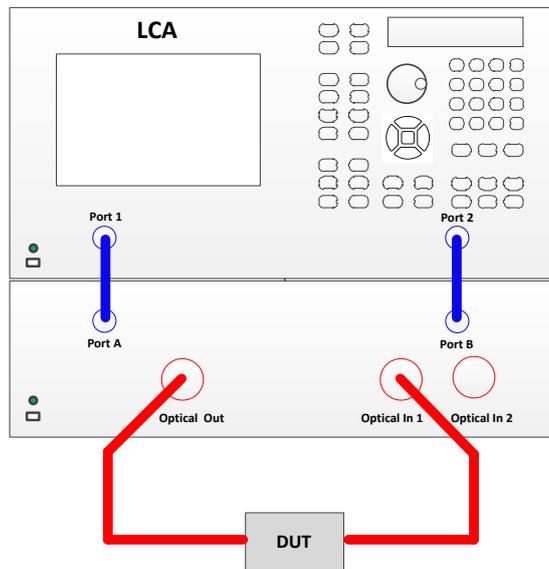
Figure 4.27 Optical–optical test block diagram

1) Connect the input signal line to the output signal line according to the requirements.

2) Reset instrument

3) Press [Reset] to set the initial status of the product.

4) Microwave Parameter Settings

5) Press [Power] -> Set Output Port Power. Press [Frequency]-> [Start Frequency] -> Set Start Frequency. Press [Frequency] -> [End Frequency] -> Set End Frequency. Press [Average] -> [IF Bandwidth] -> Set IF Bandwidth. Press [Sweep] -> [Sweep Points] -> Set Sweep Points. Press [Measure] ->[S21].

6) electro-electric calibration

7) Conduct electro-electric calibration, usually using SOLT calibration;

8) Optical Wave Parameter Setting

9) Click [LCA]. On the LCA tab page, select [OO Measurement]. Set Optical Wavelength, Optical Power, and Optical Input to Port 1. [Modulation Optimization] is set to Continuous and [Calibration Type] is set to [Measure].

10) Click [Start]

11) Click [Start] to start the hardware parameter setting, optical path calibration, and optical component test.

12) optical path calibration

13) After the optical source is stable (the optical module hardware parameters are set waiting), a dialog box is displayed, as shown in Figure 4.29. Use a standard fiber jumper to connect the optical output port and optical input port 1 as prompted. Click OK to calibrate the optical path. The Save EO Module Data dialog box is displayed (Figure 4.30), which enables you to save or cancel the saving of the calibration data of the EO conversion module. After the saving is complete, the dialog box shown in Figure 4.31 is displayed, indicating that the optical path calibration is complete.

14) Measure the measured light device

15) Connect the tested parts as shown in Figure 4.27.

16) Click single/continuous in the pop-up dialog shown in Figure 4.32 to begin measurement.
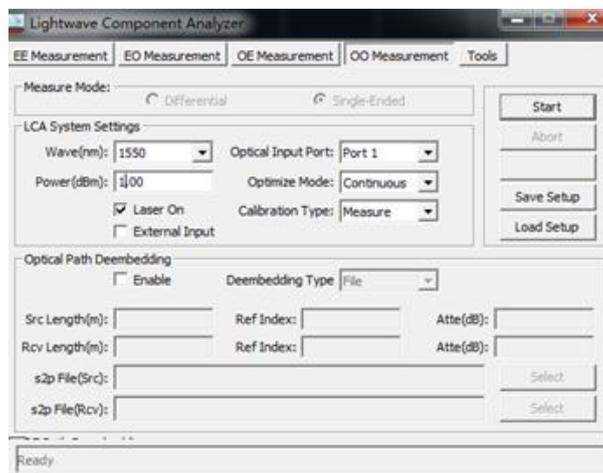
Figure 4.28 Optical/optical test–start test interface
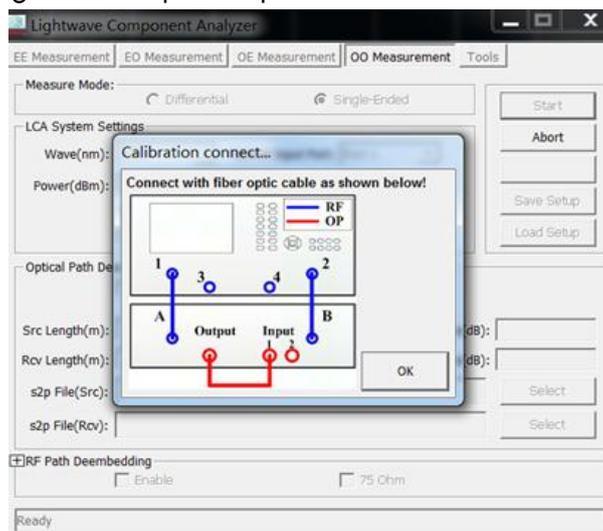
Figure 4.29 Optical test – optical path calibration

4.6 Typical Optical Component S Parameter Test
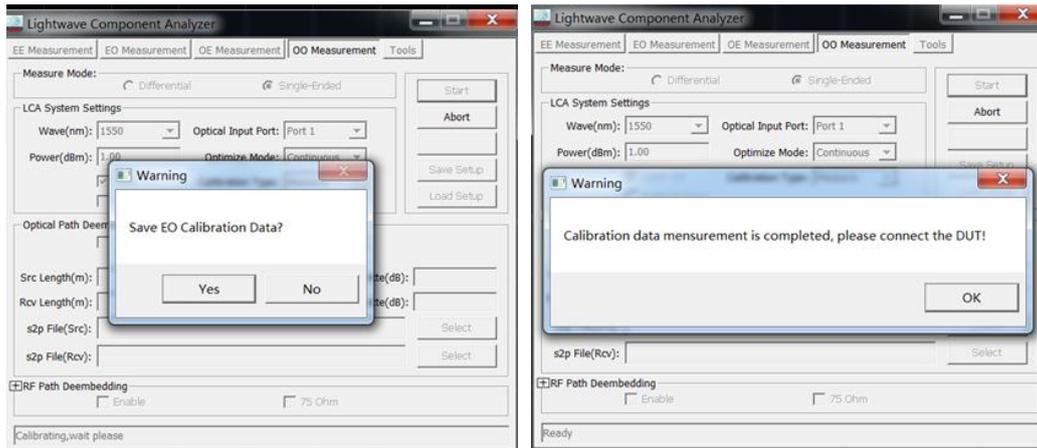
Figure 4.31 Optical Calibration completion   Figure 4.30 Optical saving calibration data
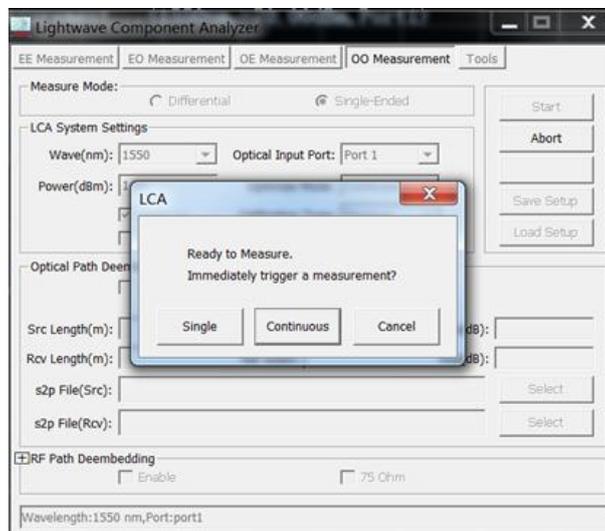
Figure 4.32 Optical/optical test-optical component test interface

Hint

Bevelled jumpers should be used during testing; If the light source is used, it should be tested after the stable output of the light source, otherwise the use effect will be affected.

4.6.2 Optoelectronic component testing
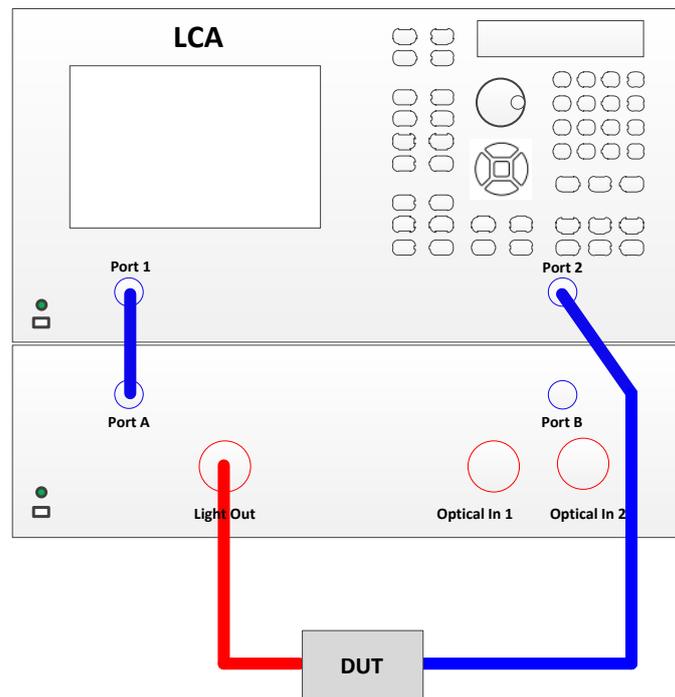
Figure 4.33 Block diagram of photoelectric measurement device

1) Connect the input signal line and the output signal line according to the requirements.

2) Press [Reset] to set the initial status of the product.

3) Press [Power] -> Set Output Port Power. Press [Frequency] -> [Start Frequency] -> Set Start Frequency. Press [Frequency] -> [End Frequency] -> Set End Frequency. Press [Average] -> [IF Bandwidth] -> Set IF Bandwidth. Press [Sweep] -> [Sweep Points] -> Set Sweep Points. Press [Measure] -> [S21].

4) Perform electro-electric calibration;

5) Connect the optical transmit port and optical receive port 1 using a standard fiber jumper. Click [LCA]. Open the [LCA] tab. Select the Optical-Electrical Measurement tab. Set User Calibration to [Measure]. Click [Start] to perform photoelectric calibration.

6) After calibration, connect the tested parts as shown in the figure, and finally start the test.

4.6.3 Electrical-Optical Component Test
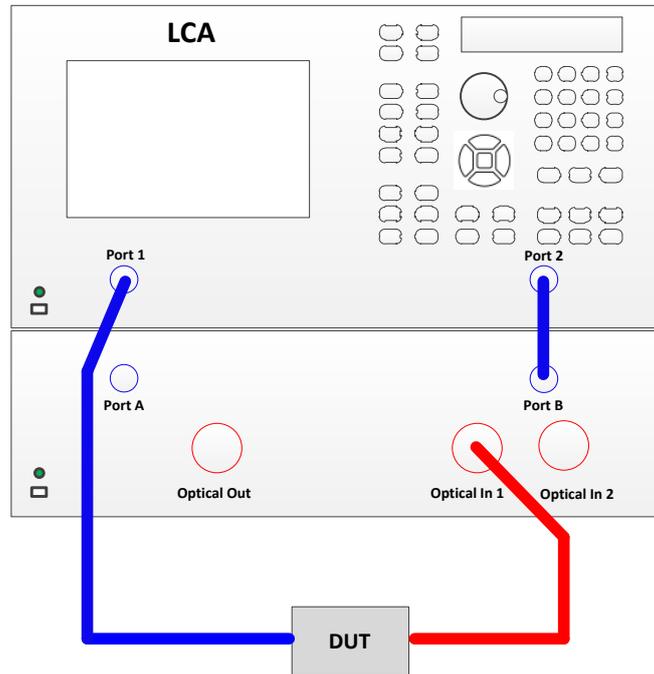
Figure 4.34 Block diagram of electro-optical measurement device

1) Connect the input signal line and the output signal line according to the requirements.

2) Press [Reset] to set the initial status of the product.

3) Press [Power] -> Set Output Port Power. Press [Frequency] -> [Start Frequency] -> Set Start Frequency. Press [Frequency] -> [End Frequency] -> Set End Frequency. Press [Average] > [IF Bandwidth] > Set IF Bandwidth. Press [Sweep] > [Sweep Points] > Set Sweep Points. Press [Measure] -> [S21].

4) Perform electro-electric calibration according to sub-section 5.3;

5) Click [LCA], select the [EO Measurement] tab, select the optical input interface, and click "Start", connect the measured part as shown in the figure, start measuring finally.

4.7 Differential Test

Traditional optical devices are single-end, that is, single-input and single-output, and the signals on the input and output interfaces have a common ground plane. However, with the emergence of advanced MMIC integrated circuits, more and more circuits are designed using differential balance. The differentially balanced clock rate of the backplane in computers and servers has reached hundreds of Gbps. If the clock rate is so high, the RF and microwave components must be considered.

The input or output of the balanced device is both ported. A signal transmitted by a balancing component is a difference or average value of the level between two ports, and the input ports or the output ports are used as reference for each other instead of ground.

Ideally, when a differential mode signal with equal amplitude and 180 degrees phase difference is added to the input end of the differential balancing device, the output end also obtains a differential mode signal. This working mode is called "differential mode/differential mode" mode. The ideal differential transmission line does not transmit signals with the same amplitude and phase, i.e. common mode signals, which can suppress common mode interference well. In fact, both the input and output signals of differential transmission lines are not ideal, and both the input and output signals have common mode signals with ground reference. The working mode in which the common mode signal is excited by the differential mode signal is referred to as the "differential mode/co-mode" mode. If the input signal contains a common-mode signal, differential-mode signals and common-mode signals are also obtained by excitation, and corresponding working modes are "co-mode/differential mode" and "co-mode/co-mode" modes respectively. The common mode/differential mode mode will introduce noise into the output differential mode signal, so the ability of differential transmission line to suppress differential mode signal generated by the common mode signal is an important index to judge the performance of the device. The traditional S-parameter cannot distinguish between the differential mode signal and the common mode signal, and can not reflect the transmission characteristics of different modes and the conversion characteristics of different modes of the differential transmission line. Therefore, the performance of a differential balancing device cannot be accurately measured. In order to fully characterize the characteristics of a differentially balanced device, it is necessary to know its response under differential mode and common mode excitations and the information of mode transition under these two excitations. Taking the four-port equilibrium parameters as an example, the mixed-mode S parameter matrix can fully characterize its characteristics.

4.7 Differential Test

S_{XYMN}	Stimulus			
X: Response Mode Y: Stimulus Mode M: Response Port N: Stimulus Port	Differential Mode		Common Mode	
	Port 1	Port 2	Port 1	Port 2
Response — Differential Mode — Port 1	S_{dd11}	S_{dd12}	S_{dc11}	S_{dc12}
Port 2	S_{dd21}	S_{dd22}	S_{dc21}	S_{dc22}
Common Mode — Port 1	S_{cd11}	S_{cd12}	S_{cc11}	S_{cc12}
Port 2	S_{cd21}	S_{cd22}	S_{cc21}	S_{cc22}

The mixed mode S parameter is represented in the form of S_{abxy}, the first two subscripts represent modes of the response and excitation signals respectively, d represents the differential mode signal, c represents the common mode signal, and the last two digital subscripts represent ports of the response and excitation respectively. The upper left quadrant of the matrix represents the differential mode response of transmission lines under differential mode excitation, and the lower right quadrant represents the common mode response of transmission lines under common mode excitation. The lower left quadrant of the matrix represents the common mode response of the transmission line under differential mode excitation, and the upper right quadrant represents the differential mode response of the transmission line under common mode excitation. The two quadrants describe the mode transition information of the differential transmission line.

Hint

For the measurement of differential devices, the LCA adopts fixed port configuration. Physical ports 1 or 4 on the vector network analyzer are connected to the optical module, and physical ports 2 and 3 on the vector network are connected to the corresponding electrical ports of the DUT.

Electro-optical measurement: Connect the input end of the electro-optical component to physical ports 2 and 3. Connect the OE conversion module of the optical module to physical port 4.

Optical/electrical measurement: Connect the output terminals of the photoelectric component to physical ports 2 and 3, and connect the EO conversion module of the optical module to physical port 1.

4.7.1 Electro-optical Component Differential Test

The balanced electro-optical device is differential electrical input and single-ended optical output. The component form is shown in Fig. 4.35.
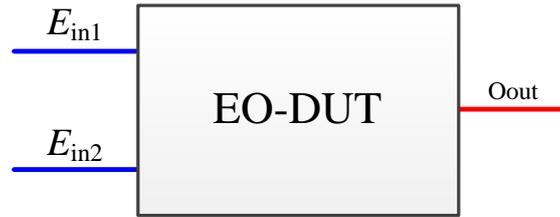
Figure 4.35 Balanced Electro-optical Devices

As shown in the figure above, the topology of the balanced electro-optical device is balanced-single end. The following figure shows the topology of the electro-optical test.
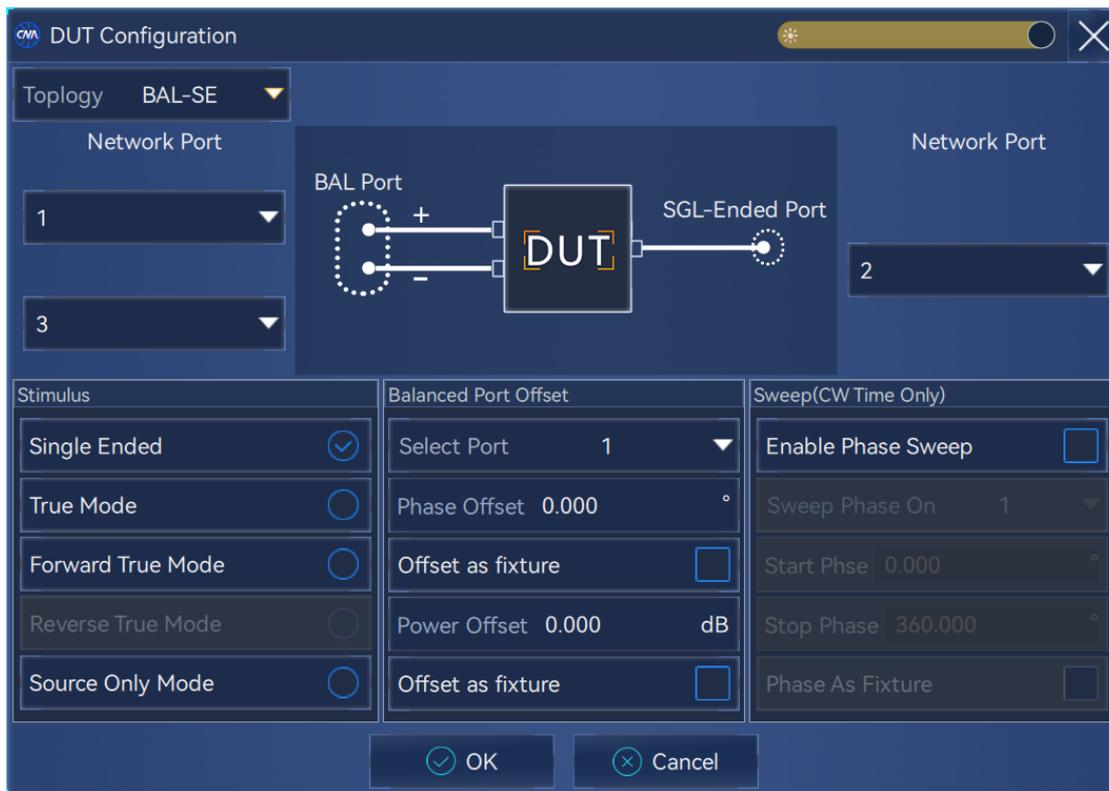

Figure 4.36 Topology and port mapping of balanced electro-optical components

During the electrical-optical test, logical port 1 is physical port 2 and 3, and logical port 2 is physical port 4.

The traditional S parameter concerned by electro-optical test is S_{42}, S_{43}, S_{22}, S_{33}, and the balanced S parameter is S_{sd21}, S_{sc21}

4.7 Differential Test

Stimulus		
Differential Mode	Common Mode	Single End
Port 1	Port 1	Port 2

$$
\begin{array}{c|ccc}
 & & & \\
\text{Response} \begin{array}{c} \text{Differential Mode Port 1} \\ \text{Common Mode Port 1} \\ \text{Single End Port 2} \end{array} & \begin{bmatrix} S_{dd11} & S_{dc11} & S_{ds12} \\ S_{cd11} & S_{cc11} & S_{cs12} \\ S_{sd21} & S_{sc21} & S_{ss22} \end{bmatrix}
\end{array}
$$
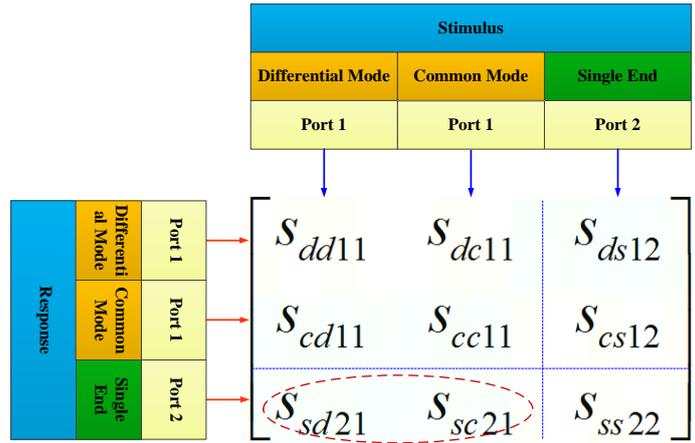
Figure 4.37-1 Schematic diagram of S parameters of balanced electro-optical components

The following figure shows the link connections during the test.
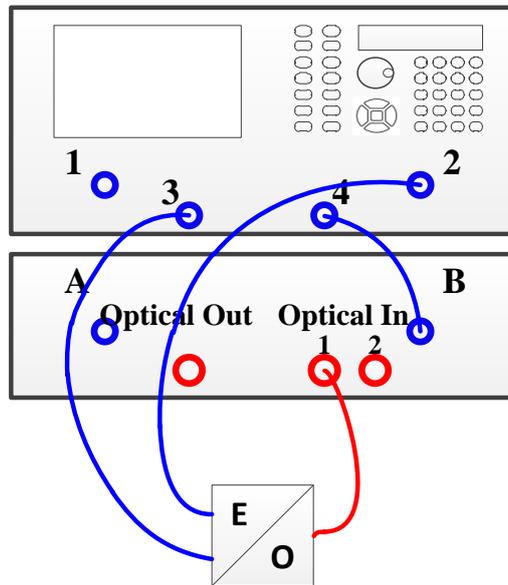
Figure 4.37-2 Link connection diagram of balanced electro-optical components

4.7.2 Optoelectronic Component Differential Test

The photoelectric device is single-ended optical input and differential electrical output. The component form is shown in Fig. 4.38.

Figure 4.38 Balanced Optoelectronic Devices

As shown in the figure above, the topology of the balanced optoelectronic device

is single ended-balanced. The following figure shows the topology of the optical/electrical test.
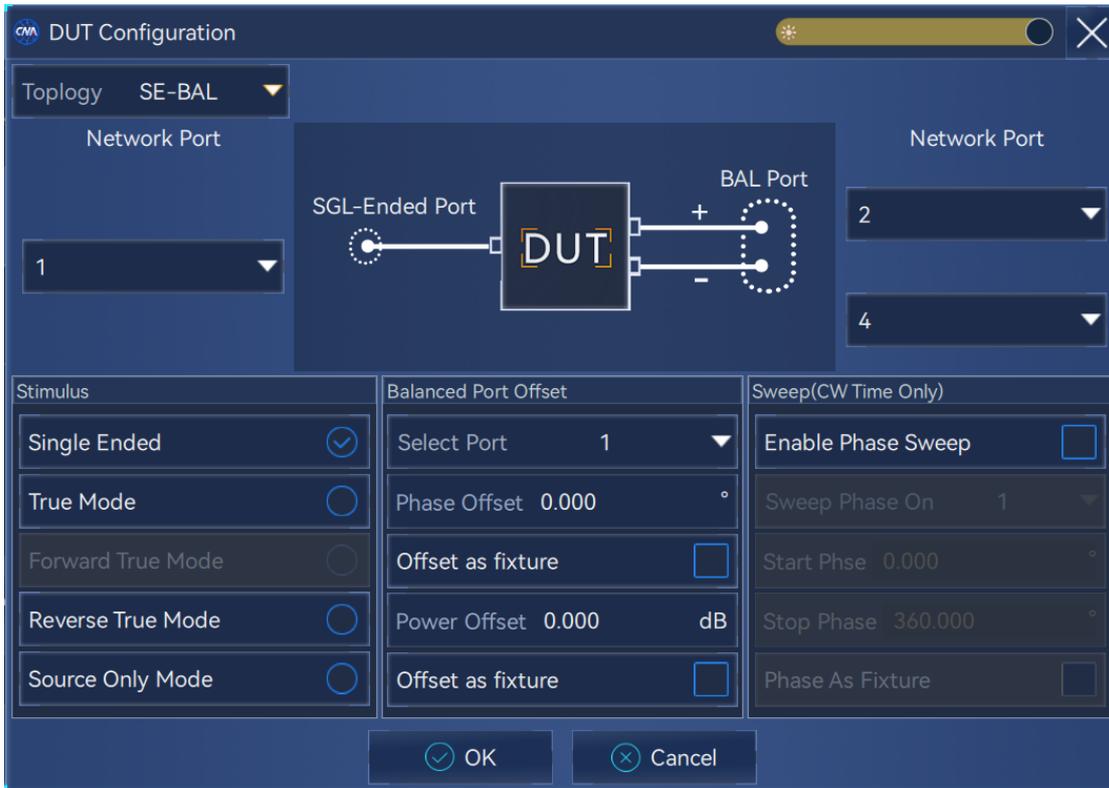
Figure 4.39 Topology and port mapping of balanced electro-optical components

In the optical/electrical test, single-ended logical port 1 is physical port 1, and balanced logical port 2 is physical ports 2 and 3.

The traditional S parameter concerned by photoelectric test is S_{21}, S_{31}, S_{22}, S_{33}, and the equilibrium S parameter is S_{ds21}, S_{cs21}
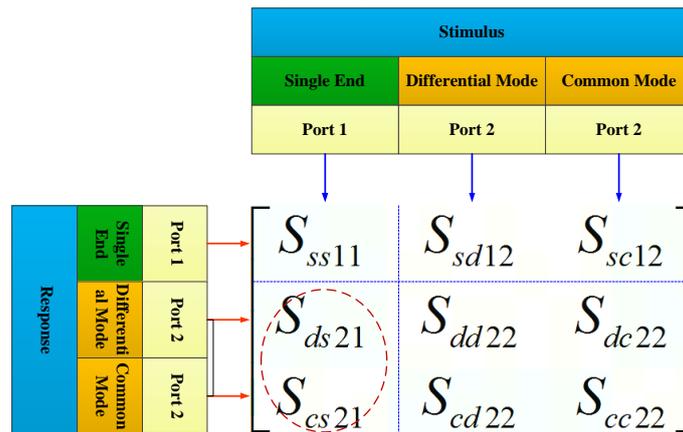
Figure 4.40 Schematic diagram of S parameters of balanced photoelectric device

The following figure shows the link connections during the test.

4.7 Differential Test
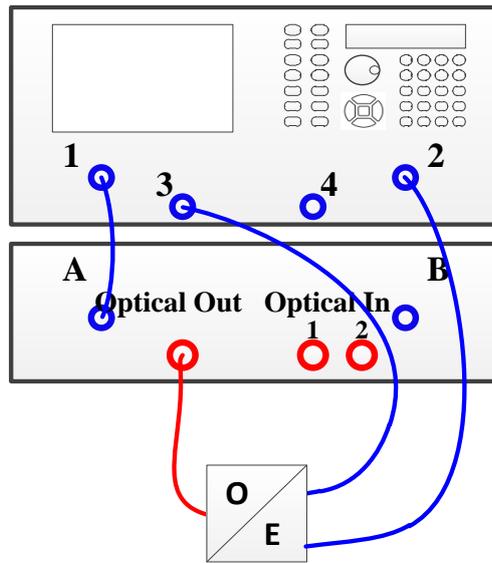
Figure 4.41 Link Connection of Balanced Optoelectronic Devices

5 Optimized measurement

Use the following method to adjust the settings to optimize the measurement accuracy:

5.1 Reduce trace noise

The Lightwave Component Analyzer function can be applied to reduce the noise on the measurement trajectory. Using the features below the analyzer helps to reduce the effect of trace noise.

5.1.1 Sweep Average

1) Sweep average
   a) Swept averaging is a feature that reduces the impact of random noise on measurements.
   b) The analyzer calculates each data point on the basis of averaging the same data point over several consecutive sweeps. The number of consecutive sweeps is determined by setting the average factor.
   c) The track average is added to all measurements in a channel, displaying its average count for each channel.
   d) The more the average number, the more noise reduction and the greater the dynamic range.
   e) The noise reduction effect of applying sweep average is the same as that of reducing the IF bandwidth.
2) Sweep Average Setting
   Menu path: [Response] -> [Average] -> [Average…].
   Select [Averaging on/OFF] to turn on the averaging function.
   In the average factor box, enter the value directly or press the arrow button to increase or decrease the number of   the analyzer averages times.

5.1.2 Smooth Track

The smoothing function can reduce the peak-to-peak noise of the wideband measurement data. The analyzer averages the data on a part of the display track, and then averages the number of adjacent data points together, also called smoothing aperture. The aperture can be specified as the number of data points or the percentage of the X-axis span.

> ## Hint
> **Smooth Use**
> - ➢ Show with enough dots to avoid misleading results.
> - ➢ Do not use smoothing for highly resonant devices or devices with wide trajectory variations, which may cause measurement errors.
> - ➢ You can set the smoothing function for each track independently.

1) Track Smoothing Settings

    Menu path: [Response] –> [Average] –> [Smooth…].

    Click [Smooth] to open the smoothing function.

    Select a method for which you want to specify the value for smoothing apertures:

    a) In the Smooth Percent box, enter a percentage value for smoothing. (Max 25%)

    b) In the Number of Smooth Points box, enter the number of smooth points. (maximum is 25% of total points of test sweep setup)

5.1.3 IF Bandwidth

Reducing the IF bandwidth can reduce the impact of random noise in measurement. The noise base can be reduced by 10 dB every time the IF bandwidth is reduced by 10 times. However, a narrow IF bandwidth can make the sweep time longer. The analyzer converts the received signal from the RF/microwave band to the lower IF of 7.606MHz. The bandwidth of the IF bandpass filter or IF can be tuned from 5MHz down to a minimum of 1Hz.

The IF bandwidth of each channel or segmented sweep can be set independently.

1) Setting IF Bandwidth

    Menu path: [Average] –> [IF Bandwidth…].

    In the IF Bandwidth dialog box, enter a value directly or press the arrow button to select a value.

5.2 Improving Measurement Stability

There are several conditions that can cause measurement instability. To ensure that you make repeated measurements, you can apply several methods to create a stable measurement environment. What follows will adversely affect your measurement accuracy.

1) frequency drift

    The frequency accuracy of the analyzer depends on the accuracy of the internal 10

MHz frequency oscillator. If your measurement application requires higher frequency accuracy and stability, you can provide a highly stable external frequency source via the 10 MHz reference input connector on the rear panel, regardless of the internal frequency standard.

2) Temperature drift

a) Thermal expansion and contraction may alter the electrical characteristics of the underlying components.

- Analyzer internal unit
- Standard for calibrators
- Test device
- Cable
- adapter

b) Ways to reduce the impact of temperature drift in your measurements:

- Apply a temperature controlled environment.
- Ensure the temperature stability of the calibrator.
- Avoid unnecessary operations on the calibrator during calibration.
- Ensure that the deviation between the ambient temperature and the measured calibration temperature is ±1℃

3) Incorrect measurement calibration

If the measurement calibration is incorrect, the correct response of the tested part cannot be measured. To ensure that your calibration is correct, you should consider the following:

a) Measure and calibrate the connection where you connect the tested part, that is, the reference surface.

b) If you insert any additional accessories (cables, adapters, attenuators) into the test piece after a measurement calibration, you can use the port extension function to compensate for the additional electrical length and delay.

c) Apply calibration standards consistent with the definitions in the calibration process.

See the exact measurement calibration section for more details.

4) Device Connector

A good connector is a must for repeatable measurements. For good connection, the method is as follows:

a) Inspect and clean the connectors of all components in the test device.

b) Use the correct connection method.

c) Avoid moving cables during measurements.

5) Use an external frequency reference

Input the external frequency reference signal to the rear panel connector.

a) Input frequency: 10 MHz±10 ppm

b) Input level: −15 dBm ~ +20 dBm

c) Input impedance: 200 ohms

6) Control room temperature

a) Run the analyzer for more than 30 minutes before performing a measurement calibration or a device measurement.

b) Perform device measurements in a temperature-controlled environment. All descriptions and features are applied within a range of 23℃±3℃(unless otherwise specified).

c) Ensure that the deviation between the ambient temperature and the measured calibration temperature is ±1℃。

7) Stable calibration standard temperature

a) One hour before measuring calibration, open the calibrator box and take out the standard piece from the protective foam.

b) Avoid unnecessary operations on the calibrator when performing a measurement calibration.

8) Get a good connector

a) Check all connectors with a magnifying glass. Look for signs of damage: wear, bend, breakage, deep scratches, dents, rounded shoulders, dirt, or metal chipping.

b) Clean all connectors with an isopropyl alcohol and cotton swab.
   ➢ let alcohol evaporate
   ➢ Air-drying connectors gradually with compressed air

c) Connect devices correctly
   ➢ Use an anti-static pad and wrist strap to attach yourself and all components to the ground.
   ➢ Arrange the connectors and line them up.
   ➢ Turn only the connecting nut.
   ➢ Use a torque wrench for final connection.

6 Fault diagnosis and repair

This chapter will tell you how to find problems and receive after-sales service. It will also explain the error information of the lightwave component analyzer.

If you have some problems in the operation of the 6433 series lightwave component analyzer, or you need to purchase the components or accessories of the lightwave component analyzer, the Institute will provide a complete after-sale service.

Generally, the reason for the problem is the improper use of hardware, software or user. If the problem occurs, please contact us immediately. If the lightwave component analyzer you purchased is under warranty, we will repair your instrument free of charge according to the warranty promise in the warranty form. If the warranty period is exceeded, we will only charge the cost.

6.1 Troubleshooting

Hint

Troubleshooting and Guidance

This section describes how to make a simple judgment and handling when the 6433 series lightwave component analyzer is faulty. If necessary, please feed back the problem to the manufacturer as accurately as possible so that we can solve it for you as soon as possible.

6.1.1 System Problems

6.1.1.1 The standby light doesn't work

Check whether the 220V AC input of the lightwave component analyzer is normal. The maximum allowable deviation is 220V±10%. If the input is too high or too low, the instrument may not work normally. If not, check the external circuit to find out the fault. After the fault is eliminated, power on and start the instrument again. If the 220V AC input is normal, check whether the power switch of the rear panel of the instrument is turned on. In normal state, the power switch of the rear panel should be in the " | ". If the fault is caused by the power supply of the instrument, take it back to the manufacturer for repair.

6.1.1.2 Failure to Access the System After Powering On

If the system cannot be accessed after the system is powered on, check whether the hard disk on the rear panel is loose. If the hard disk is loose, tighten the screws or remove the hard disk and insert it again. If the hard disk is not loose, try to recover the

system.

6.1.1.3 Network Analyzer Software Cannot Be Started Automatically After Startup

If the network analyzer software cannot be automatically started after the system is started, try to manually double-click the lightwave component analyzer icon on the desktop or press the Reset button on the front panel or choose Windows [Start Menu] ->[Programs]->[Network Analyzer] to start the network analyzer program. If the network analyzer program can be started successfully, Install antivirus software to check the virus and restart the system. If it does not start automatically, please uninstall the program and double-click the installation program in the root directory of the D drive or E drive.

6.1.2 The curve display is abnormal.

There are many reasons for abnormal curve display. First, check whether the user reset status is saved. Click [System] -> [Define User Reset Status] in the menu bar to open the Define User Status window. Clear the check boxes before Save Last State as User Reset State and Enable User Reset State, and click [OK] to close the Define User State window. Press the [Reset] button on the front panel, and the displayed S11 curve should be around 0 when the port is not connected to any load.

If the curve is still abnormal after trying the above methods, please contact our technical support staff to solve it.

6.1.3 Sweep Issues

6.1.3.1 Scan seems to stop

In the reset state of the system, the open-circuit curve of the port may give a false impression that the sweeping is not being performed, which is due to the high stability and fast sweeping speed of the lightwave component analyzer. Press [Stimulus] -> [Sweep] > Sweep Time, enter 20 and press Enter to see the sweep cursor.

6.1.3.2 Sweep Stop

Check whether the triggering status of the instrument is Hold. If yes, modify the triggering mode by pressing [Stimulus] -> [Trigger] -> [Continuous], or open the triggering dialog box to change the triggering mode to Auto Trigger.

6.1.3.3 White Sweep Cursor Below Screen

After the full dual-port calibration is completed, the two ports need to be scanned each time for dual-port correction. When the track is displayed only for the excitation source at port 1, the white cursor appears to scan at the bottom of the screen when

scanning port 2. This is a normal instrument scanning state and does not need to change the settings.

6.1.4 Display Issues

When the task bar blocks the display window, right-click the task bar, click Properties, select [Auto Hide Task Bar], and click [OK] to close the dialog box. At this time, the task bar will automatically hide and will not block the lightwave component analyzer test window.

6.1.5 Front Panel Buttons Do Not Respond

If the front panel button does not respond, it is caused by the damage of the instrument driver. In this case, you need to uninstall and reinstall the lightwave component analyzer program.

6.1.6 Menu Operation Failure

If the menu cannot be operated, first check whether the status of [Control] in the status bar at the bottom of the window is [LOCAL]. If the program has entered the program control state, press the [Local] key on the front panel or press the [ESC] key on the access keyboard to return to the local status.

6.1.7 Inaccurate Optical Power Measurement

If the optical power measurement is inaccurate, check and rectify the fault using the following methods:

1. Check whether the test wavelength and optical power unit are set correctly.
2. Check whether the operating environment of the instrument meets the requirements, such as the ambient temperature, ambient humidity, and heat dissipation status of the instrument.
3. Check whether the fiber flange is loose and tightened. Ensure that the fiber end face and optical input interface are free of contamination.
4. Check whether the insertion loss of fiber jumpers meets the requirements. Use single-mode and multi-mode fiber jumpers that meet the requirements.
5. Ensure that the optical power measurement port does not have laser input during power-on.

When weak optical power measurement is required or the measurement accuracy is high, it is recommended that the optical power measurement be performed indoors or in the shaded environment. Preheating the instrument before the test can improve the measurement accuracy.

6.1.8 Large deviation from previous use

If there is a large deviation between the test data and the previous test result, check whether the jumper or fiber end face is contaminated with dirt or dust. In this case, use lens paper or absorbent cotton dipped in proper amount of absolute ethanol to wipe the end face, and then perform the test again.

6.2 Return to the factory for repair

6.2.1 Contact Us

If the 6433 series lightwave component analyzer is faulty, first observe the error information and save the error information, analyze the possible causes, and then check and solve the problem in advance. If the problem persists, please contact our service consultation center according to the following contact information and provide the collected error information. We will assist you in solving the problem as quickly as possible.

Contact information:

Service Advisory: 0532 – 86889847   400 –1684191

Technical support: 0532 – 86880796

Quality supervision: 0532 – 86886614

Fax: 0532 – 86889056

Website: www.ceyear.com

Email: techbb@ceyear.com

Address: No.98 Xiangjiang Road, Huangdao District, Qingdao, Shandong Province

Zip code: 266555

6.2.2 Packing and Mailing

If you have a problem with your lightwave component analyzer, you can contact us by telephone or fax. If the lightwave component analyzer needs to be repaired, please pack the lightwave component analyzer with the original packaging material and packing box, and then pack it as follows:

1) Write a detailed description of the fault phenomena of the lightwave component analyzer and put it in the package with the lightwave component analyzer.

2) Pack the lightwave component analyzer in the original packaging material to reduce possible damage.

3) Place padding at the four corners of the outer packing carton, and place the instrument into the outer packing carton.

4) Seal the opening of the packing box with adhesive tape and reinforce the packing box with nylon tape.

5) Mark the box with "Bragile! Don't touch! "Handle with care!".

6) Please check it as per precision instrument.

7) Keep copies of all transport documents.

Note

Note for packaging lightwave component analyzer

Packaging lightwave component analyzers with other materials may damage the instrument. Do not use polystyrene pellets as packaging materials. On the one hand, they cannot fully protect the instrument; on the other hand, static electricity will be sucked into the instrument fan, causing damage to the instrument.

In addition, the lightwave component analyzer is heavy, so to avoid damage during transportation, please preferentially use the original packaging materials and double-layer packaging! If you do need to pack your own, ensure that the instrument is not damaged during shipping.

7 Principle, Functions and Technical Index

This chapter lists the working principle, main functions, performance indexes and technical parameters of the 6433 series lightwave component analyzer. By reading this chapter, you can have a better understanding of the main performance indexes of the product.

7.1 Working Principle

The principle of the 6433 series lightwave component analyzer is shown in the figure. The whole machine is mainly composed of main control module, power supply module, polarization-mainserving light source driver module, electro-optic modulation module, power tuning module, high-speed light receiving module, light power detection module, LED indicator module, vector network analysis module and so on.

The optical wave tuning analysis module is mainly composed of polarization-mainserving light source driving module, electro-optic modulation module, power tuning module, high-speed optical receiving module, optical power detection module and vector network analysis module. The stable polarization-preserving light generated by the drive module of polarization-preserving light source is modulated by the electro-optic modulation module and tuned by the power tuning module, and the stable and power adjustable high-speed modulation light is output;The photometric signal to be measured is converted into microwave signal by a high-speed optical receiving module and transmitted to a vector network analysis module for analysis. The vector network analysis module can generate and analyze microwave electrical signals. In this way, the measurement of optical-optical, optical-electrical, electrical-optical and electrical to electrical signals can be realized.

The main control module receives instruction information from the USB communication interface by the CPU control module, controls the optical power of the polarization-preserving light source driving module according to the instruction information, adjusts the working point of the electro-optic modulator according to the optical power before and after the electro-optic modulation module, The microwave signal of the electro-optical modulation module is added to the output optical signal, so that the optical power control and modulation of the optical signal are realized. The main control module controls the high-speed optical receiving module according to the instruction information, and converts the optical signal to the microwave signal.
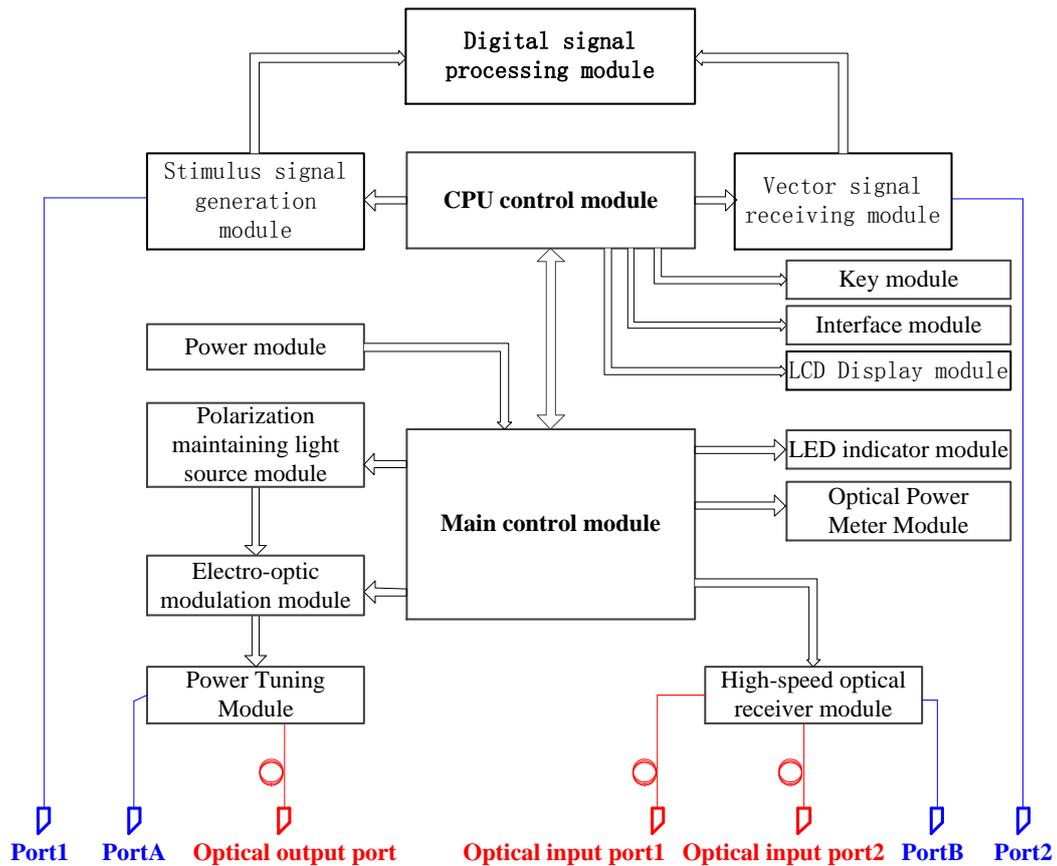
Figure 7.1 Schematic diagram of the lightwave component analyzer

7.2 Main Functions

The functions of the 6433 Series Lightwave Component Analyzer are as follows:

1. 3 dB bandwidth test;

2) Gain test function;

3) Loss test function;

4) Transmission coefficient test;

5) Reflectivity test function;

6) Input impedance test;

7) Group delay test;

8) Electrical–S network parameter test function;

9) Data storage and output.

Appendix 1 LCA Program Installation

1.1 LCA Program Installation

The LCA software runs in the vector network analyzer. The installation procedure is as follows:

1. Install the 3674 series vector network analyzer software. For details, refer to the user manual.

2. Copy the installation folder (folder name: 6433) to the root directory of drive C.

3. Open the vector network software, and click [Macro]–>[Macro Setup], pop up the dialog box as shown in the figure.
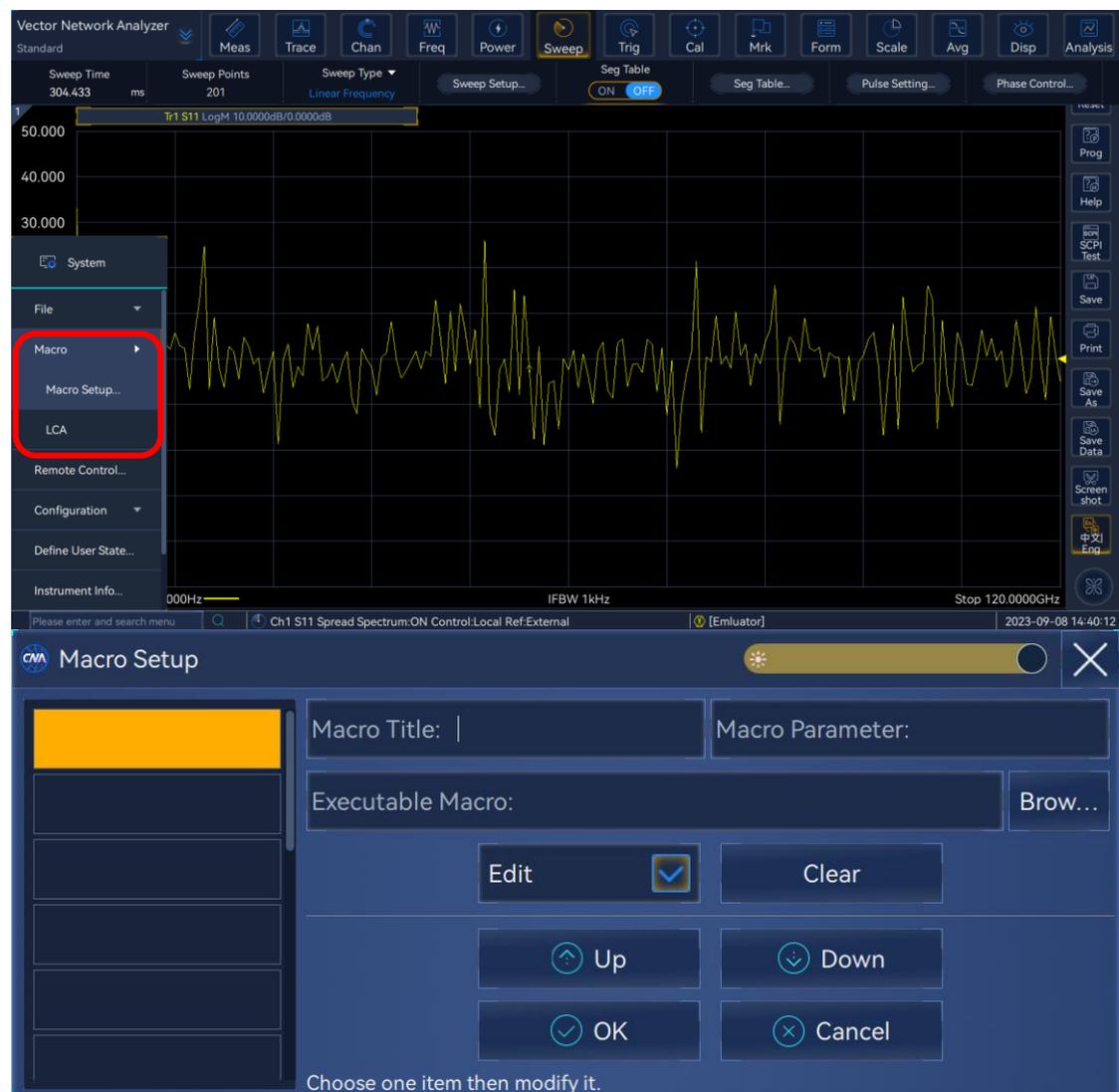
4. Click [Edit], enter the macro name LCA (recommended name), click [Browse], select the executable program in step 2, such as C:\6433\LCA.exe, and click [OK].

1.1 LCA Program Installation
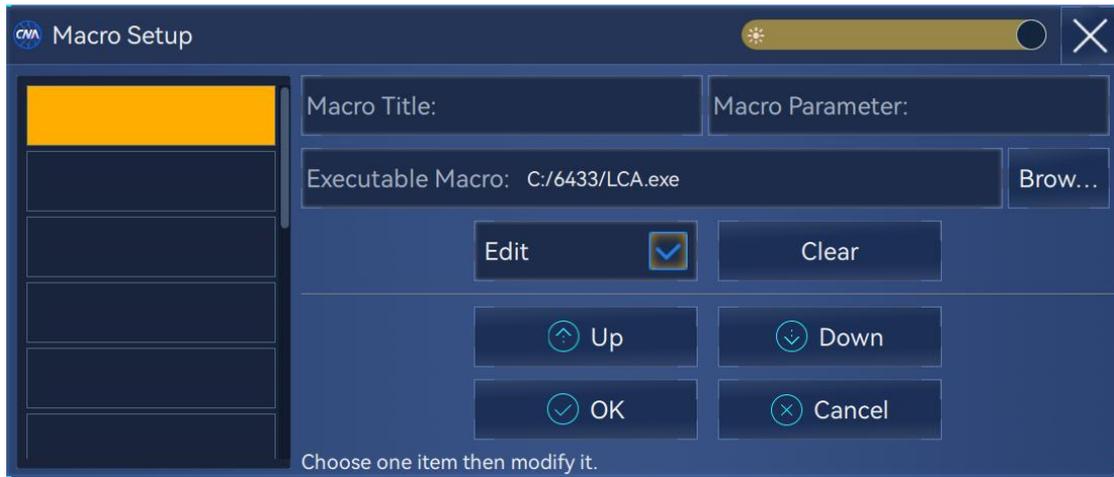
5. The LCA software has been installed.

Appendix 2 Driver Installation

2.1 Driver Installation

When using the LCA light base, you need to install the driver in the vector network analyzer. To install the driver, perform the following steps:

1. Connect the optical base to the vector network analyzer through a USB cable. See Figure 4.1 for connection mode.

2. Right-click the [Computer] in the industrial computer and select [Manage] in the pop-up menu, as shown in the following figure;
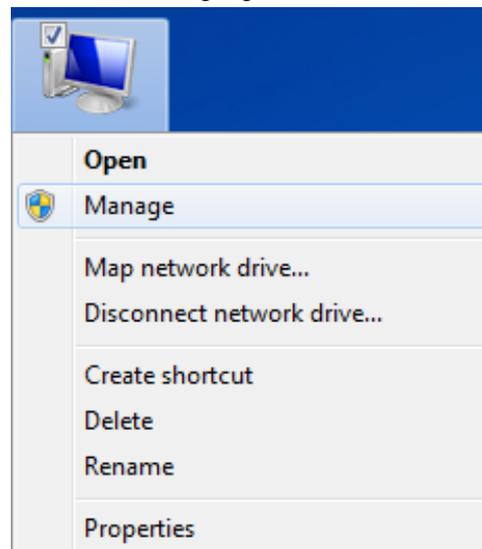
3. Choose [Device Manager] -> [Other Devices]. The EI41-USB-V1.0 device is displayed in the device list. The device is marked with a yellow exclamation mark, as shown in the following figure.
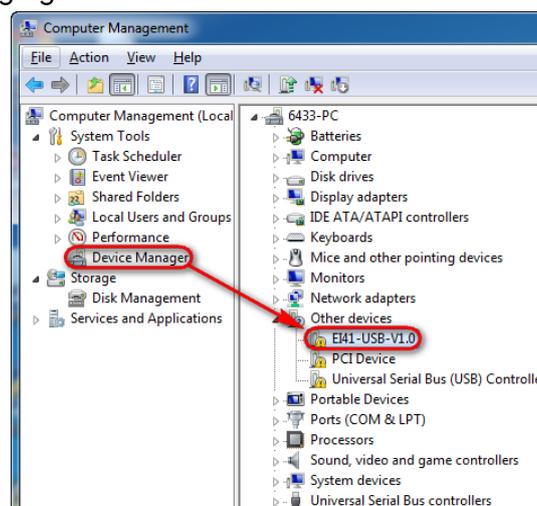
4. Right-click the [device] and select "Update Driver Software..." in the pop-up menu, as shown in the following figure:

2.1 Driver Installation
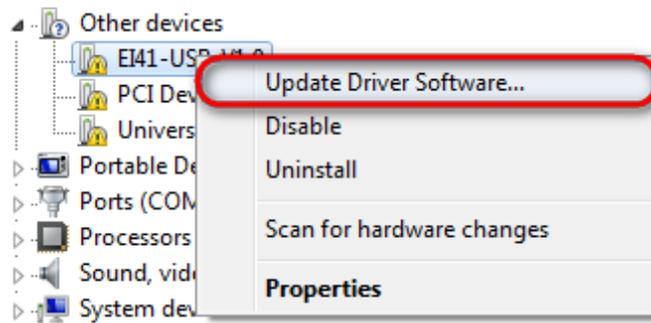
5. In the dialog box that appears, click the second item: Browse computer to find the driver software, as shown in the following figure.
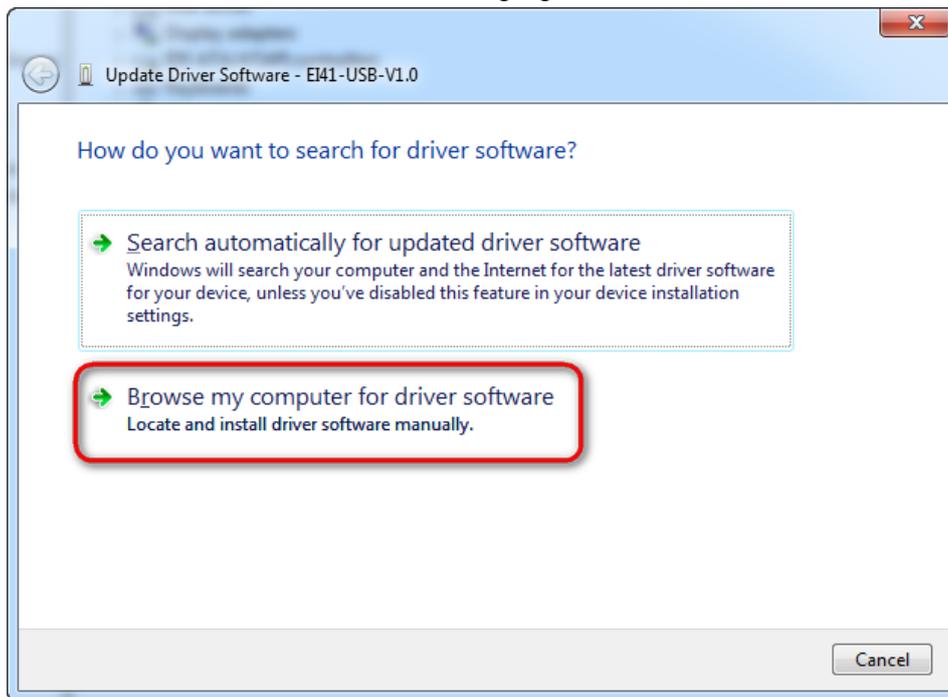
6. In the displayed dialog box, click [Browse], select the (6433_Cyusb Driver/wlh–win7/x64) folder where the driver resides, and click [OK], as shown in the following figure.
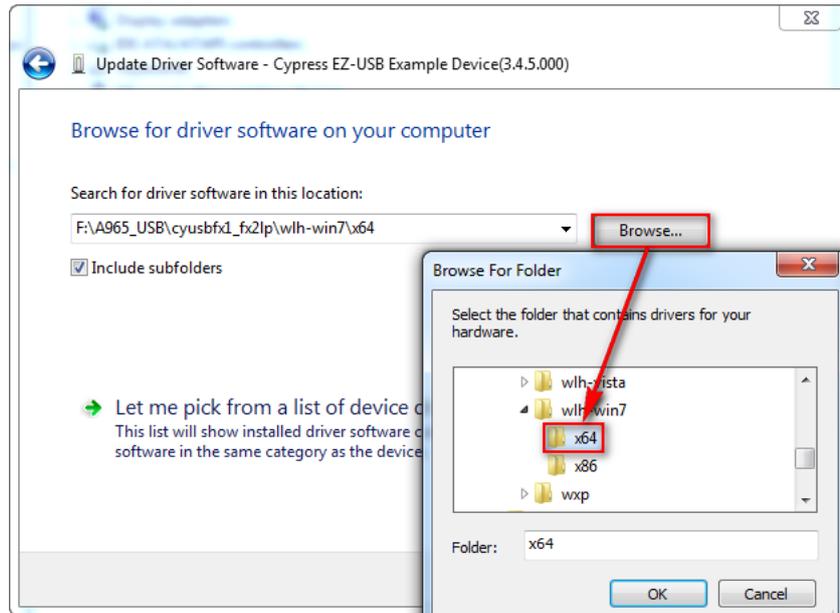
7. Click [Next] to complete the installation, as shown in the following figure.
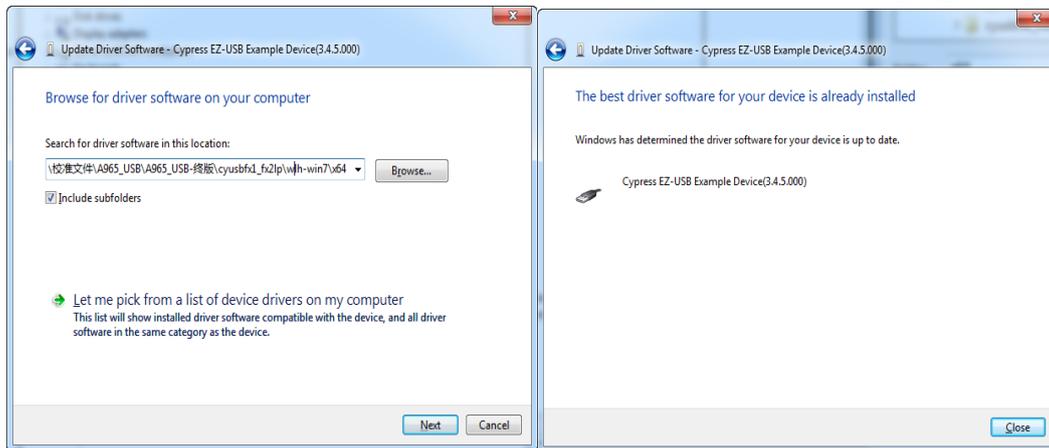
8. After the installation is complete, the device name is Cypress EZ–USB Example Device(3.4.5.000) in the Universal Serial Bus controller list, as shown in the following figure.

2.1 Driver Installation

- ▲ 🔓 Other devices
  - 🔓 PCI Device
  - 🔓 Universal Serial Bus (USB) Controller
- ▷ 📷 Portable Devices
- ▷ 📟 Ports (COM & LPT)
- ▷ 🖥 Processors
- ▷ 🎚 Sound, video and game controllers
- ▷ 💻 System devices
- ▲ 🔌 Universal Serial Bus controllers
  - 🔌 **Cypress EZ-USB Example Device(3.4.5.000)**
  - 🔌 Generic USB Hub
  - 🔌 Generic USB Hub
  - 🔌 Generic USB Hub
  - 🔌 Generic USB Hub
  - 🔌 Intel(R) 7 Series/C216 Chipset Family USB Enhanced Host Controller - 1E26
  - 🔌 Intel(R) 7 Series/C216 Chipset Family USB Enhanced Host Controller - 1E2D
  - 🔌 USB Root Hub
  - 🔌 USB Root Hub

Appendix 3 Boot and Startup Software

3.1 Power-on and start-up of the instrument

The lightwave component analyzer consists of two parts. The upper and lower parts are supplied with independent power. The startup steps are as follows:

1. Connect the power supply of the VNA and the optical module respectively.

2. Connect the vector network analyzer to the optical module using a USB cable as shown in the following figure (left).

3. Press the key to power on as shown in the following figure (right). Note: press the key for short to power on the VNA, and press the Optical module for three seconds to power on the module.

4. Power on and start the instrument.

USB cable connection and startup diagram of lightwave component analyzer

3.2 Method of entering the optical wave test program interface

Method of entering the light wave testing program:

1、 [LCA] in the software shortcut menu.

2、 [System]->[Macro]->[LCA] in the bottom right corner of the software.

3.2 Method of entering the optical wave test program interface

<div style="background:green">

Hint

</div>

Cold start preheating of instrument

For optimum performance of the instrument, preheat the lightwave component analyzer for at least 60 minutes before measurement.

On/off machine

Short press the vector network analyzer to start and shut down. Press and hold for 3 seconds to power on and off the optical module.

When the power is turned on but not started, the light color of the vector network analyzer and the optical module is yellow, and the color will change to green after startup.

Startup Precautions

Due to the main program preemption mechanism of the instrument, do not perform other operations within 15 seconds after the instrument enters the system, including but not limited to exiting the main program, opening the lightwave test program, and other operations on the interface of the industrial computer system of the instrument.

Appendix 4 SnP File Format and Data Storage

4.1 SnP File Format and Data Storage

The SnP file format saved by the lightwave component analyzer is as follows. Any SnP file can obtain its instrument information, calibration status and type, sweep type, S parameter type, date and time, measurement information and data information through the file header.

The following figure shows an S2P file. The file information is as follows:

The first point to be highlighted:

The nine columns in the red dashed box are as follows:

First column: frequency information;

Columns 2 and 3: S11 parameters;

Columns 4 and 5: S21 parameters;

Columns 6 and 7: S12 parameters;

Columns 8 and 9: S22 parameters.

Columns 2 to 9 indicate the S parameter type corresponding to the S parameter type in the fourth row of the file header.

The second point that needs to be highlighted:

The parameters in line 6 of the file header are as follows:

Hz: Hertz;

S: frequency domain;

dB: logarithmic phase;

R: system impedance;

50: The system impedance is 50 ohms.

If the third parameter is dB, it indicates that the form of the S parameter is logarithmic amplitude phase. If it is RI, it indicates that the form of S parameter is real part and imaginary part; If MA, the S parameter is in the form of linear amplitude

4.1 SnP File Format and Data Storage

phase.
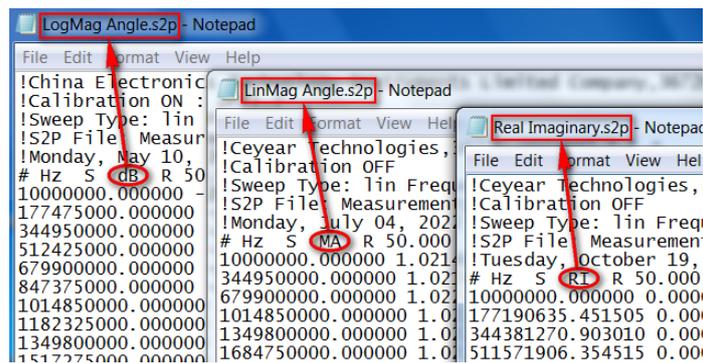
When saving files, you can select different save types in either of the following ways:

Method 1:

Click [File] -> [Save as]->[setting] to open the Define Storage Data dialog box, where you can set the data type of the file to be saved.

Method 2:

Click on [File] -> [Save as]->[setting] to open the define data storage dialog box,where you can set the data type of the file to be saved.

Appendix 5 Conversion Relationship

5.1 Electro-Optical Devices

Transmission coefficient: $T = S_{21}$

Reflection coefficient: $\Gamma = S_{11}$

Gain (dB): $G = 20Log\left|S_{21}\right|$

Loss (dB): $L = -20Log\left|S_{21}\right|$

Input Impedance: $Z_L = Z_0 \dfrac{1+\Gamma}{1-\Gamma}$

5.2 Optoelectronic Devices

Transmission coefficient: $T = S_{21}$

Reflection coefficient: $\Gamma = S_{22}$

Gain (dB): $G = 20Log\left|S_{21}\right|$

Loss (dB): $L = -20Log\left|S_{21}\right|$

Output Impedance: $Z_L = Z_0 \dfrac{1+\Gamma}{1-\Gamma}$

5.3 Photo-Optical Devices

Transmission coefficient: $T = S_{21}$

Gain (dB): $G = 20Log\left|S_{21}\right|$

Loss (dB): $L = -20Log\left|S_{21}\right|$

Appendix 6 Procedure for Creating and Importing a Calibration File

6.1 Importing Calibration Files

Step 1: Select [Cal] in the menu, as shown in Figure 1(a). Click [Edit Cal Kit…] to open the dialog box as shown in Figure 1(b).
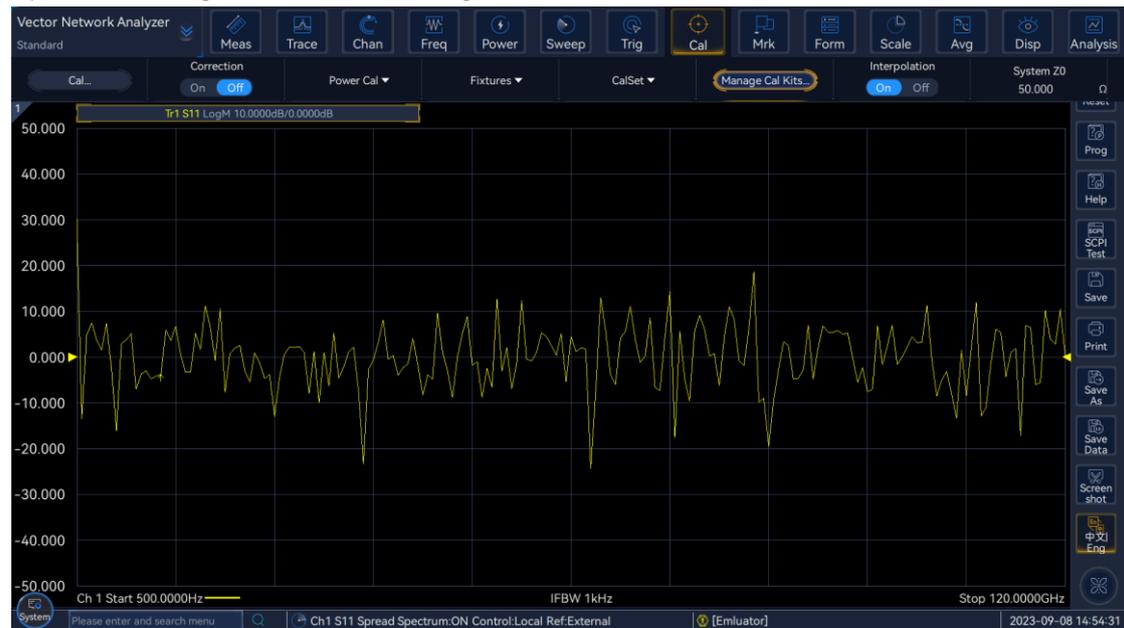
Figure 1(a)

6.1 Importing Calibration Files
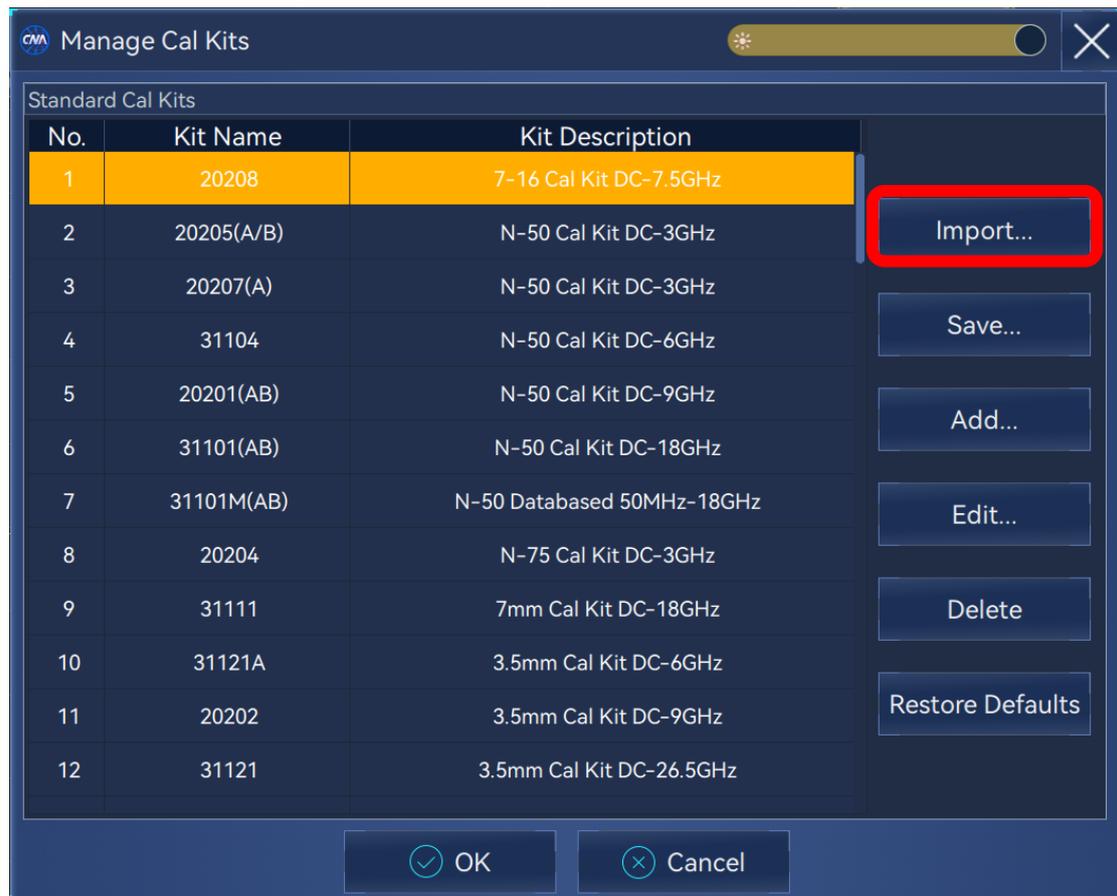
Figure 1(b)

Step 2: Click [Import kit…]in Figure 1(b) to pop up the Open dialog box as shown in Figure 2. Select a calibration file and click Open to import the calibration file. After the import is successful, the loaded calibration file will appear in the Edit Calibrator dialog box, as shown in Figure 3. Click OK to finish importing the calibration file.

Figure 2 Opening
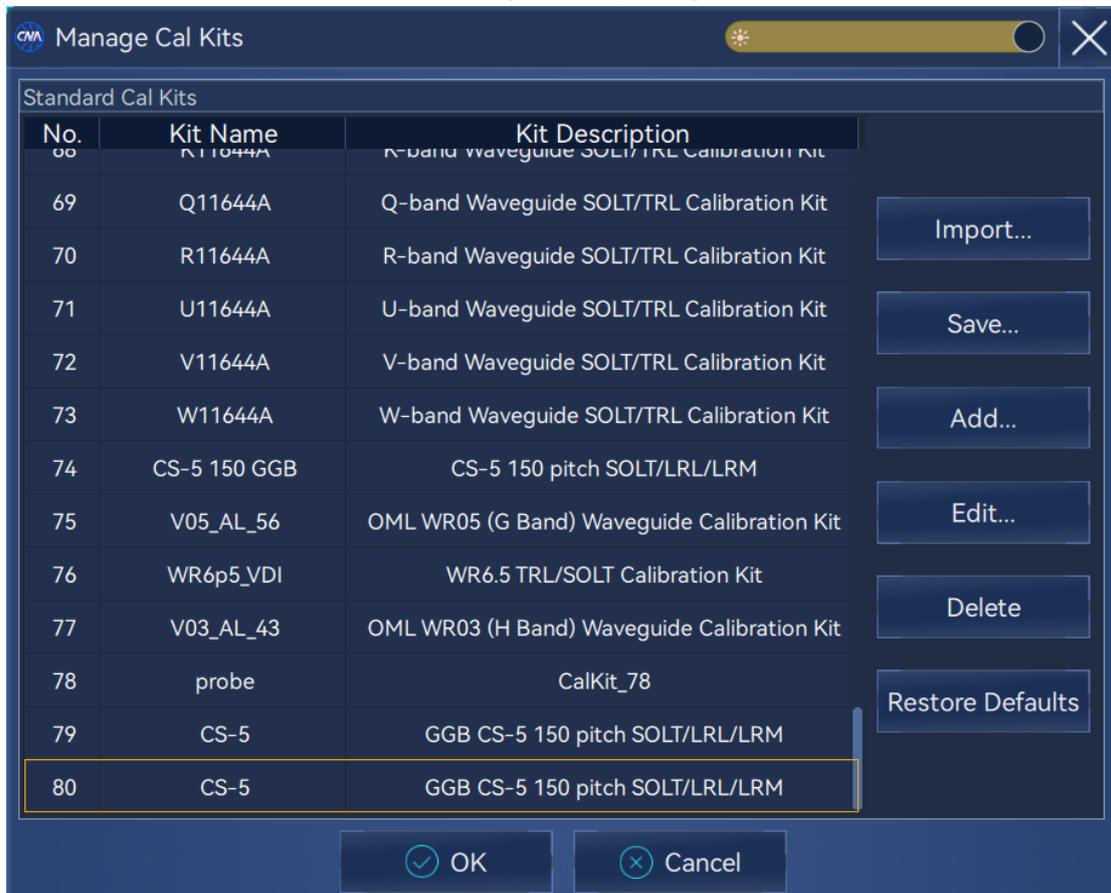
Figure 3 Successful import

6.2 New Calibration Standard

Step 1: Click "Cal…"->"Manage Cal Kits…", insequence,and a dialog box as shown in Figure1will pop up.
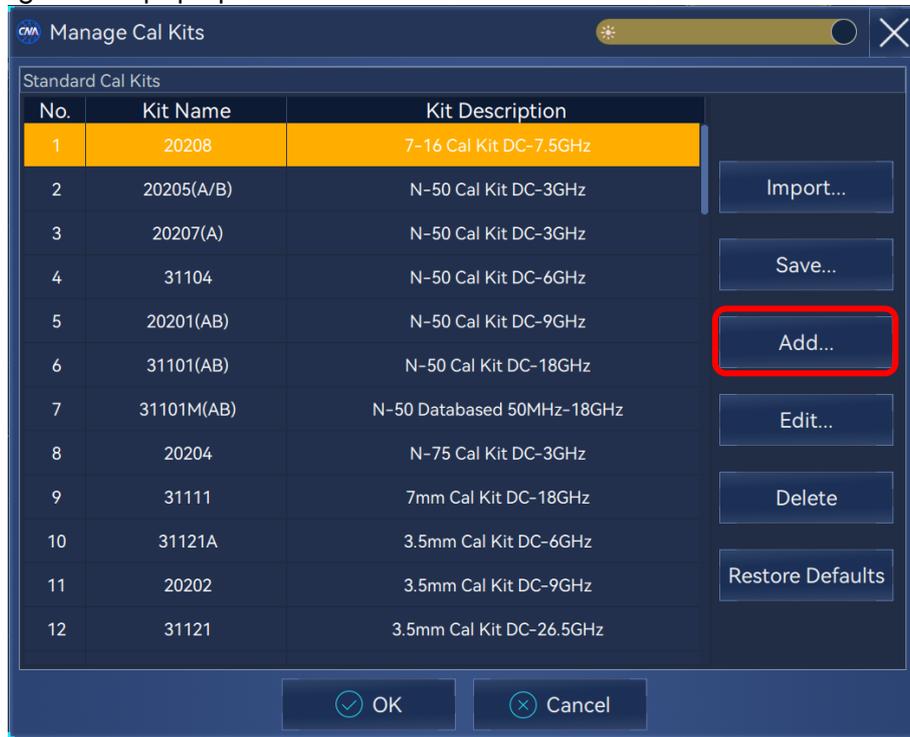
Figure 1

Step 2: Click on "Add…"in Figure 1 to pop up a dialog box as shown in Figure 2.
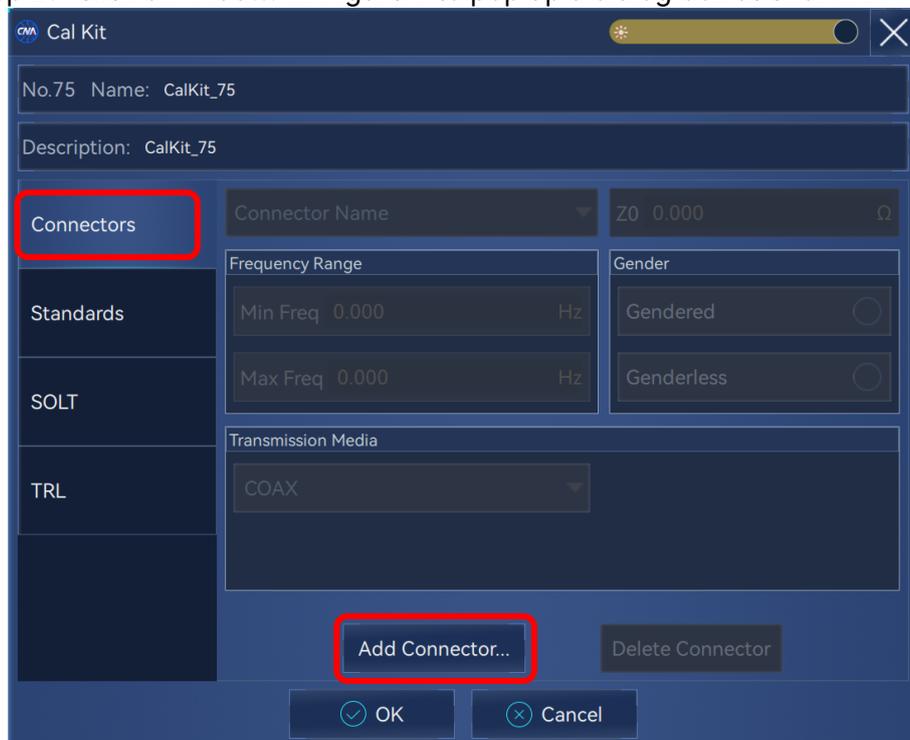
Figure 2 Edit Calibration dialog box

Step 3: Click on "Add Connector…"in Figure 1 to pop up a dialog box as shown in Figure 3.
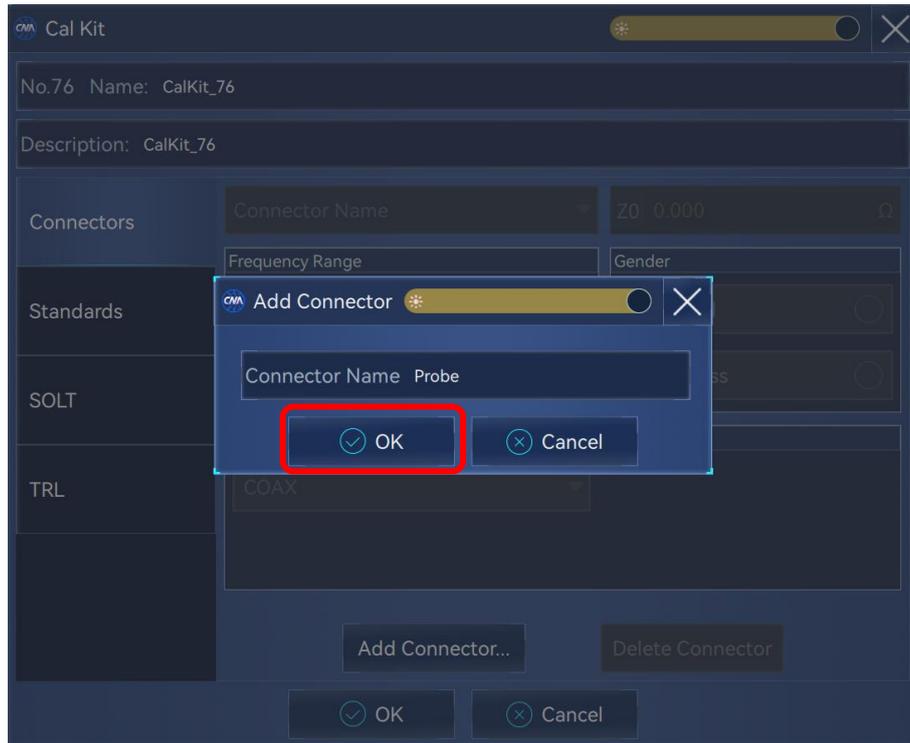
Figure 3 Add Connector dialog box

Step 4: Edit the connector name in the pop-up dialog box in Figure 3 and confirm.
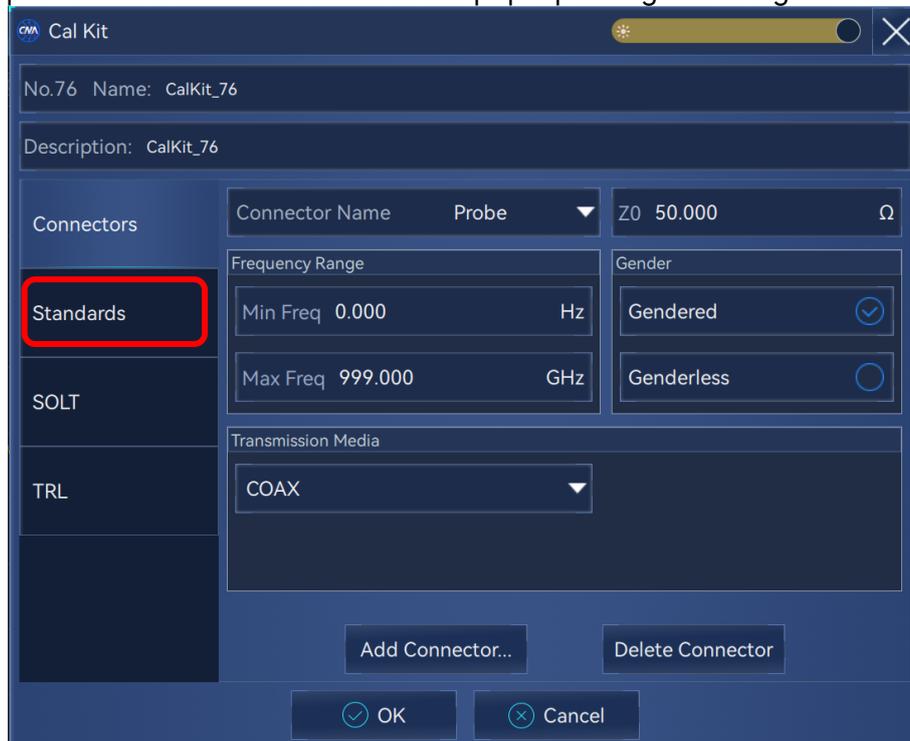
Figure 4 Edit Connector dialog box

Step 5: In the pop-up dialog box in Figure 4,set the polarity of the connector to:Gendered;The joint medium is COAX;Set the minimum frequency,maximum

6.2 New Calibration Standard

frequency,and impedance of 50Ω.

Step 6: Select the "Standards" button in the pop-up dialog box in Figure 4,and the dialog box shown in Figure 5 will pop up.
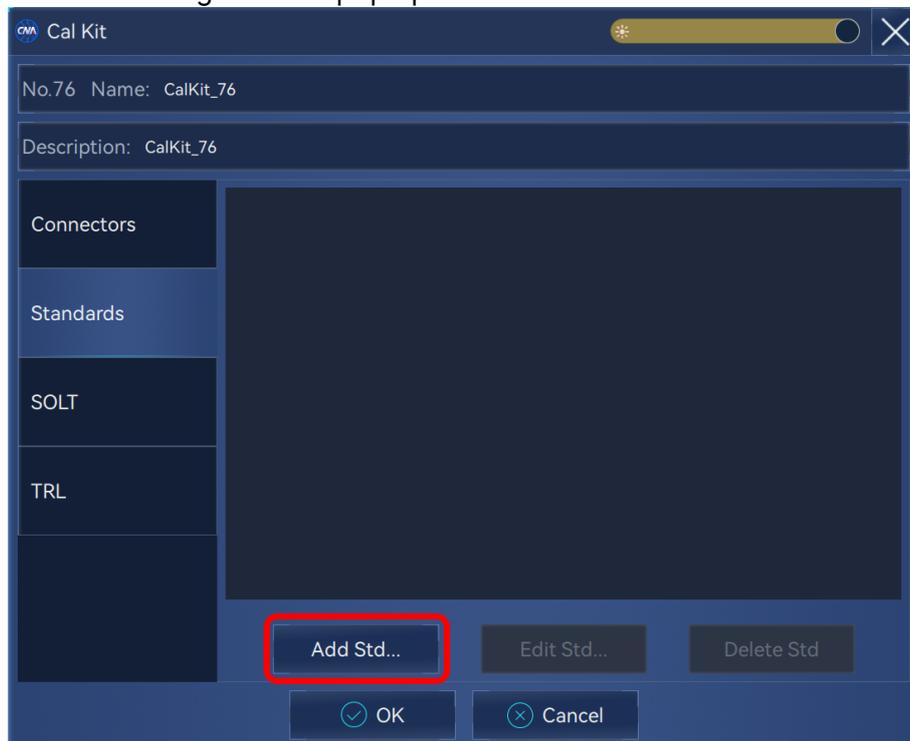
Figure 5 "Standards" dialog box

Step 7: Click the "Add Std…" button in the dialog box shown in Figure 4,and the dialog box shown in Figure 6 will pop up.
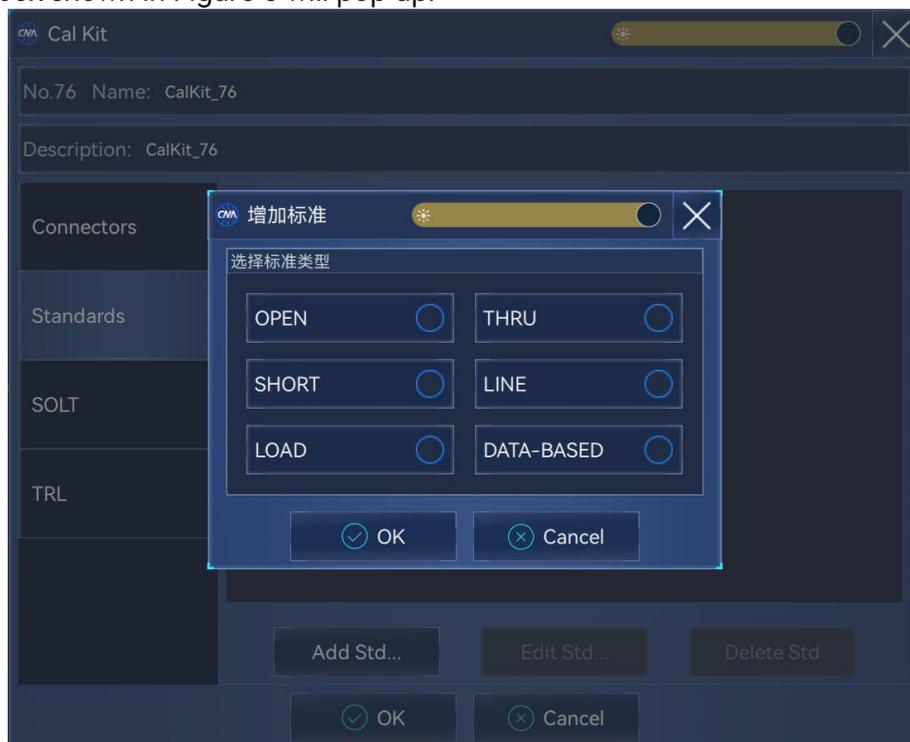

Figure 6 "Add Std…"dialog box

Step 8: According to the requerements, select "OPEN" "SHORT" "LOAD"and "THRU"in sequence.

The following is "OPEN": C0 is the C Open parameter in the factory data,while others are the default.
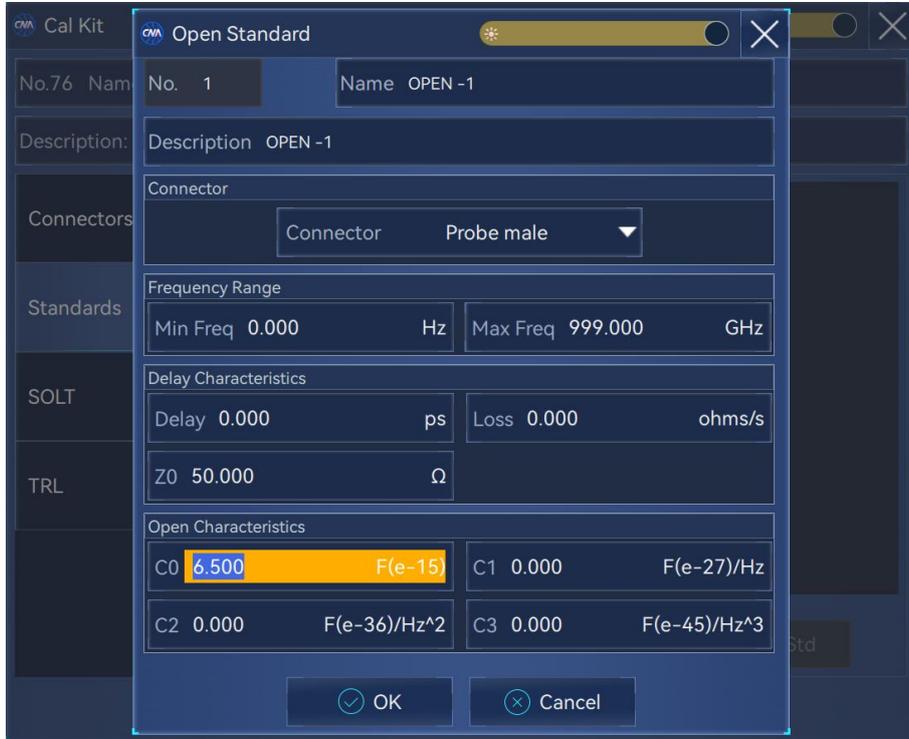
The following is "SHORT": L0 is the L Short parameter in the factory data,while others are the default.
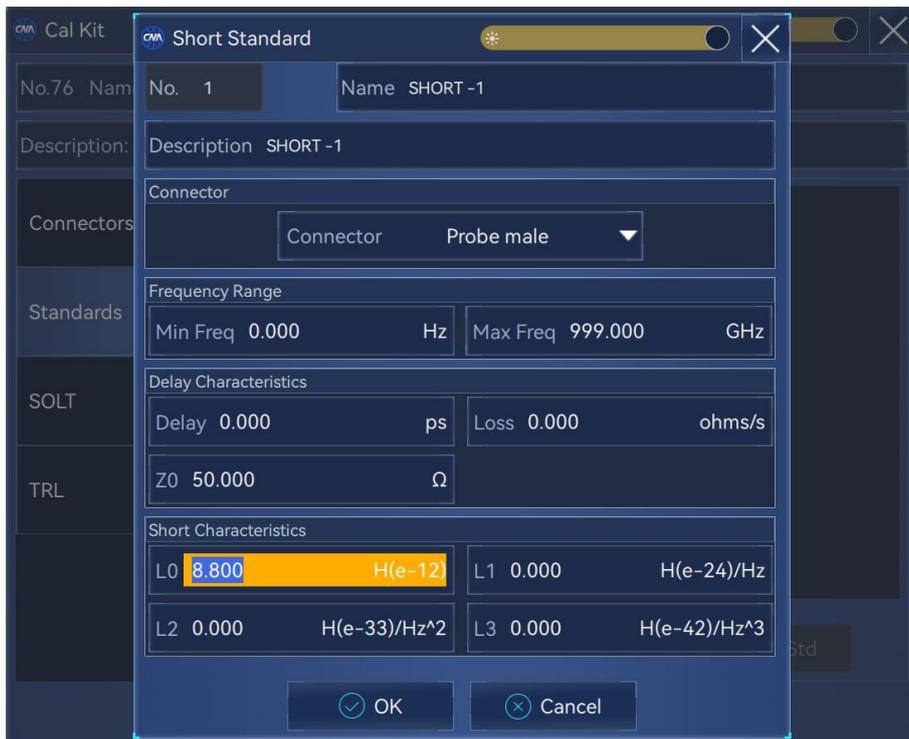
The following is "THUR": the delay is usually the length of the straight line of the calibration piece, while others are the default.
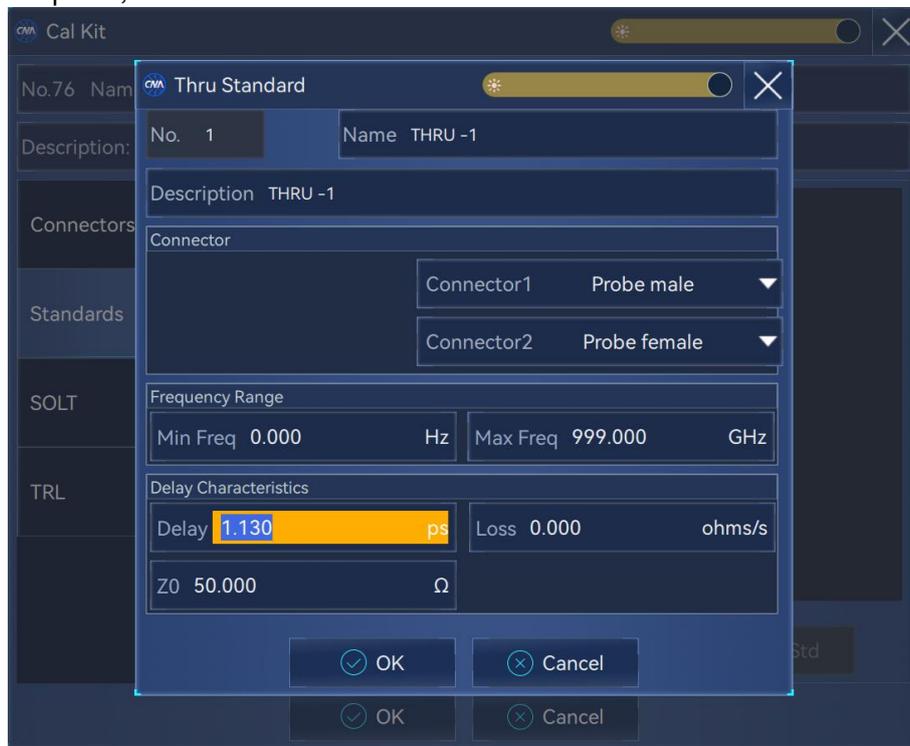

The following is "LOAD": the delay is L Term/500 in the factory file, and the impedance is 500Ω,or provide corresponding delay and impedance values based on the probe's file.
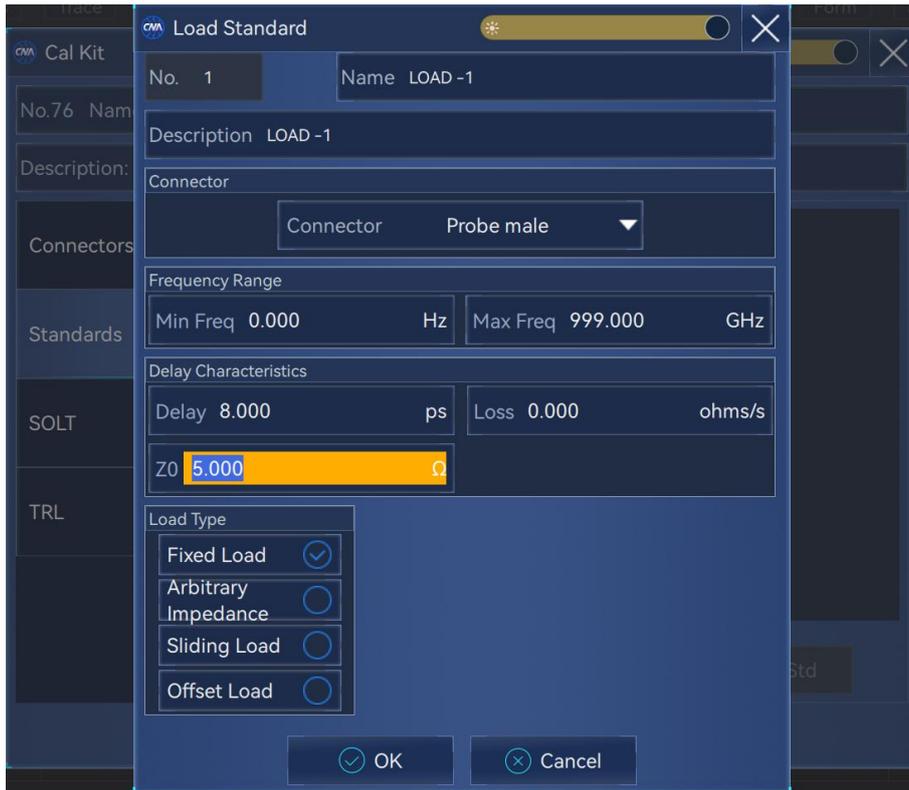
Step 9: After all parameters are successfully set, the inserted calibration parts will appear in the list.Click OK to complete the import of the calibration parts.
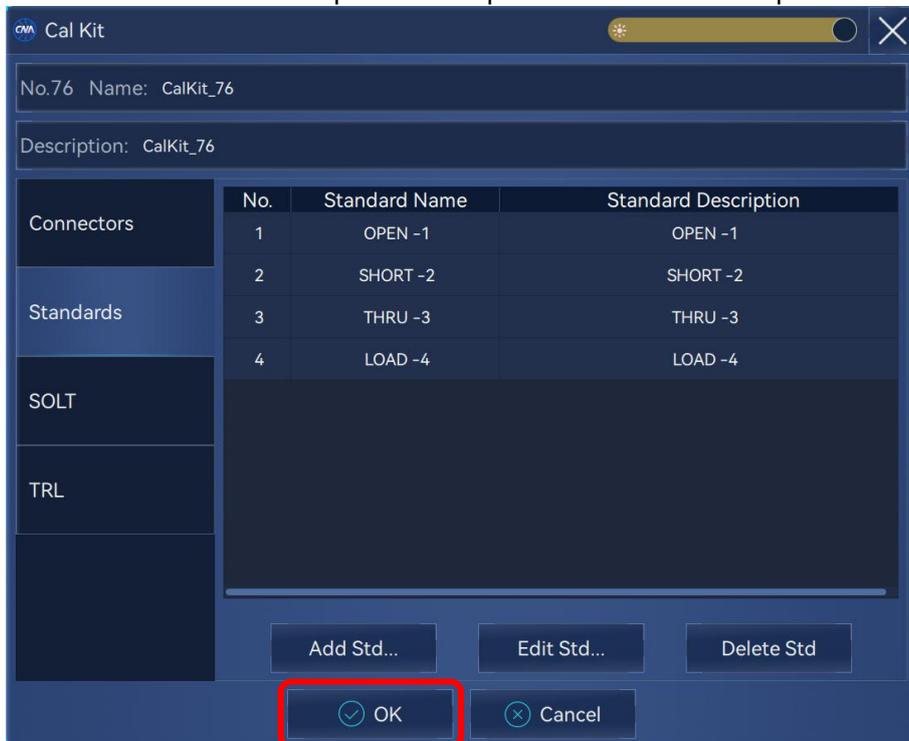
6.3 Using Calibration Standard

Wizard Calibration:

Select the type of calibration joint that has been set as the test component type, select the calibration component inserted in the preceding step, and then perform calibration.

Appendix 7 Quickly Performing EO/OE/OO Tests

7.1 Execute Measurement Quickly
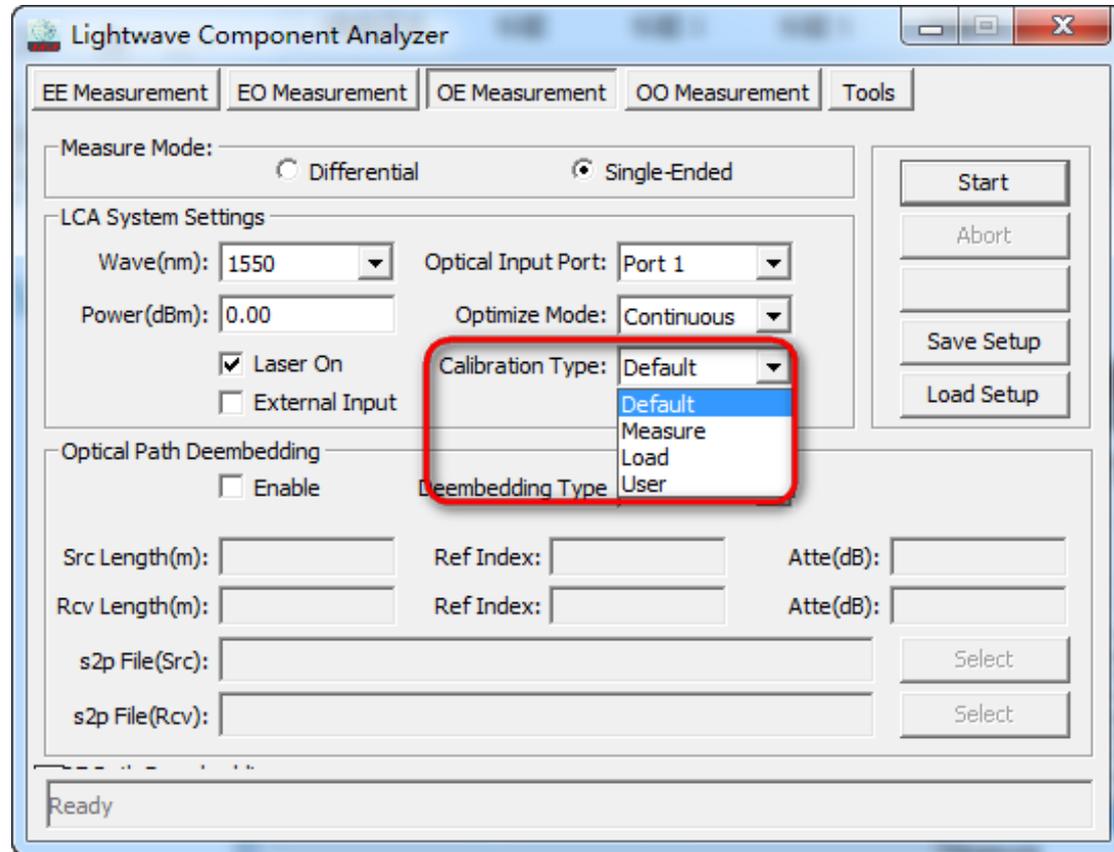
In the LCA parameter control interface,

There are two calibration types for the electro-optical measurement: Default and User.

There are four calibration types for photoelectric measurement: Default, Measure, Load, and User.

There are four calibration types for optical/optical measurement: Default, Measure, Load, and User.

Several calibration types are described as follows:

Default: The instrument is calibrated by calling the factory data of the electro-optical conversion module. The calibration precision is average and the calibration time is short.

Load: The user manually loads the data of the electro-optical conversion module (in .s2p format) for calibration. The calibration precision is affected by the loading file, and the calibration time is short.

Measure: The user performs a measurement to obtain the data of the

electro-optical conversion module in real time for calibration. The calibration precision is the highest, and the calibration takes a long time.

User: The instrument reuses the last calibration state; the calibration accuracy is the same as the last time, and the calibration takes zero time. The premise of using this mode is that other calibrations have been performed at least once, and no other changes have occurred except for the DUT (including but not limited to measurement parameters, connection links, etc.) during this measurement.

Usually on the first measurement, the user selects the "Measure" mode to obtain the most accurate calibration status. The second time and thereafter the user selects the "User" mode for the fastest measurement speed.

The specific steps are as follows:

Take the photoelectric measurement as an example:

1. Set parameters such as wavelength, power, input port, and optimize mode, and select the "Measure" calibration type. (Select "Measure" to ensure the highest test accuracy, or select Default or Load). Click [Start]. In the Start measurement dialog box, select [Single] to perform a complete photoelectric measurement.

2. For the second and subsequent measurements change the calibration type to "User" and click [Start] to perform a quick measurement.

Appendix 8 Connection diagram of the tested component

8.1 Connection diagram of the single ended optical device

Device type	Connection diagram	instruction
Electro-Optical device		/
Optical-Electro device		/
Optical-Optical device		/

8.2 Connection diagram of the balanced optical device

Device type	Connection diagram	instruction
Balanced Electro-Optical device		Balanced logical port 1 is physical port 2and 3 Single ended port 2 is physical port 4 Traditional S Parameters S_{42}、S_{43}、S_{22}、S_{33} balanced S Parameters S_{sd21}、S_{sc21}
Balanced Optical-Electro device		Single ended port 1 is physical port 1 Balanced logical port 2 is physical port 2and 3 Traditional S Parameters S_{21}、S_{31}、S_{22}、S_{33} balanced S Parameters S_{ds21}、S_{cs21}