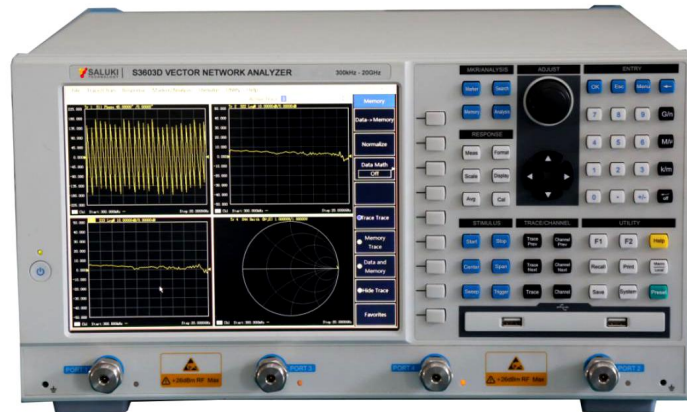




# S3603D Vector Network Analyzer

## User Manual



Saluki Technology Inc.

**The manual applies to the vector network analyzers of the following models:**

- S3603D vector network analyzer (300kHz - 20GHz).

**Options of the S3603D vector network analyzer in addition to standard accessories:**

Part No.	Name	Description
S3603D-12	20403 Electronic calibration kit	10MHz - 26.5GHz, 3.5mm (female to male), 2 port
S3603D-13	20405 Electronic calibration kit	10MHz - 20GHz, 3.5mm (female), 4 port
S3603D-19	Cabinet	Easy to build system
S3603D-30	3.5mm calibration kit	DC - 26.5GHz
S3603D-31	3.5NMD/3.5mm-KJ testing cable	\
S3603D-32	3.5NMD/3.5mm-KK testing cable	\
S3603D-33	3.5mm testing cable	GORE-FB0HA0HB025.0
S3603D-34	3.5mm testing cable	GORE-FB0HA0HC025.0
S3603D-35	2-port option	\
S3603D-37	4-port option	\
S3603D-38	Aluminum carrying case	\

## Preface

Thanks for choosing S3603D vector network analyzer produced by Saluki Technology Inc. Please read this user manual carefully for your convenience.

We devote ourselves to meeting your demands, providing you high-quality measuring instrument and the best after-sales service. We persist with “superior quality and considerate service”, and are committed to offering satisfactory products and service for our clients.

## Manual No.

S3603D-03-01

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Saluki Technology

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"Warning" indicates danger. It reminds the user to pay attention to a certain operation process, operation method or similar situations. Noncompliance with the rules or improper operation may result in personal injuries. You must fully understand the warning and all the conditions in it shall be met before the next step



"Attention" indicates important prompts and no danger. It reminds the user to pay attention to a certain operation process, operation method or similar situations. Noncompliance with the rules or improper operation may result in damage to the instrument or loss of important data. You must fully understand the caution and all the conditions in it shall be met before the next step.

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## 1. Brief Introduction

S3603D is a powerful and efficient Vector Network Analyzer widely used in industries like wireless communications, cable TV, automotive electronics etc. S3603D is capable to do an accurate measurement to filters, amplifiers, antenna, cable etc. S3603D has a LCD screen and a friendly GUI. It also supports various interfaces such as USB, LAN, GPIB and VGA to build a measurement system.

S3603D Vector Network Analyzer has powerful functions such as time domain and frequency domain, and provide multiple display in formats such as logarithm magnitude, linear magnitude, standing-wave ratio (SWR), phase, group delay, Smith circle diagram Smith chart and polar coordinates as well as multiple calibrations including the calibration of response, single port, response isolation and enhanced response, the calibration of full double ports and the electric calibration.

### Key Features

- 64 independent Measure channels
- 32 display windows, max. 8 traces are displayed in each.
- Time domain analysis
- Interfaces such as LAN, USB, GP-IB and VGA
- Multiple display formats such as magnitude, phase, group delay, Smith chart, polar coordinates and standing-wave ratios
- Windows XP/ 7 Operation System
- 10.4 true-color and high-resolution LCD providing simultaneous display in multiple windows and channels

## 2. Safety Instruction

### **Please read safety instruction carefully and Strictly follow !**

We will spare no efforts to ensure that production process comply with latest safety standards so as to safeguard the safety of our users. The design and tests of our products and accessory equipment comply with relevant safety standards. We have established quality assurance system so that we can better supervise product quality and ensure that all products accord with standards in the system. To maintain the sound state of equipment and ensure safe operation, please comply with the following instruction. Contact us if you have any questions.

It is also your responsibility to use this product in correct manner. Suitable for industrial, laboratory and field uses, this equipment, however, must be used in correct manner so as to prevent personal injuries and property damages. For problems caused by misuses, liabilities rest on users. By proper use, it means that users should use this product according to prescriptions in the product document and in the required conditions. As sufficient expertise is required, only professional technicians and people that have been strictly trained and have mastered necessary skills are qualified to use this product. Please keep safety manual and product document in a proper manner, and deliver them to the end user. To forestall personal injuries and property loss, please abide by these safety instructions. Prior to using this product, please read carefully and comply with these instructions accordingly.

### 2. 1. Device safety

- a) Use designated packing container in shipping and avoid falling or violent collisions in moving, which may cause damages to the device.
- b) Use AC-DC adapter shipped with the device to supply power to the product. Using other power adapters may cause damages to internal hardware.
- c) Use 220V three-wire regulated voltage AC power supply to prevent high-power spike pulse interference from damaging internal hardware.
- d) Ensure that power supply is well connected to the ground to prevent damages to the device caused by poor connection or false connection.
- e) Take such anti-static measures as wearing anti-static wrist strap when operating this device so as to prevent static from damaging the device.
- f) Injection of DC signal into input end is prohibited. Signal power needs to be lower than 0.5W. If not, damage to the device may occur.
- g) If device uses external or internal batteries, replace these batteries with the same or equivalent type of batteries. When using other types of batteries, blast may occur.
- h) Both insertions of objects into the gap of the device housing and dumping of liquids over device housing or into device are prohibited, which may cause short circuit, electric shock, fire or personal injuries.
- i) Notches or gaps in the device, designed to help internal ventilation and whereby prevent overheating, must not be covered. The device must not be put on couch, wrapped with carpet, or placed in airtight housing unless ventilation is good.
- j) This device must not be placed on radiator, dish heater and other heating devices. Ambient temperature must not surpass the maximal temperature prescribed in this manual.
- k) Attention: Once this device is on fire, it may release toxic gases or liquids.

### 2. 2. Precautions on personal safety.

- a) When moving the device, use proper tools and move the device softly so as to avoid personal injuries caused by the falling of

the device.

- b) Device should be properly grounded so as to prevent personal injuries caused by poor or false grounding
- c) When cleaning the device, please unplug the device to avoid electric shock. Use dry or moist soft cloth to clean the device. Do not clean the internal of the device.
- d) Before using this device, personnel need to be trained. When using the device, concentration is required. Operation by unqualified people may cause personal injuries and property losses.
- e) Use of this device when power line is broken is prohibited. Regular check on power line is necessary. Proper measures should be taken to keep power line in good state and prevent stumble and electric shock.
- f) Field use of the device when there is lightning is prohibited, which may cause personal injuries and property loss.

### 3. Overview

This chapter will help the user get to know S3603D quickly. This chapter includes introductions of:

- Front Panel
- Rear Panel
- Interface
- Screen Area
- Trace, Window and Channel

#### Prompt

In this guide, the physical keys on the front panel are indicted as [XXX]and XXX is the name of the keys. The menus and keys on the screen (software UI) are displayed as [XXX] and XXX is the names of menus and keys.

#### 3. 1. Front Panel

The front panel of S3603D vector network analyzer is shown in the following figure, including a number of key functional zones, display zones, USB interfaces and Measure ports. The section will describe the function and performance index of each part in details.

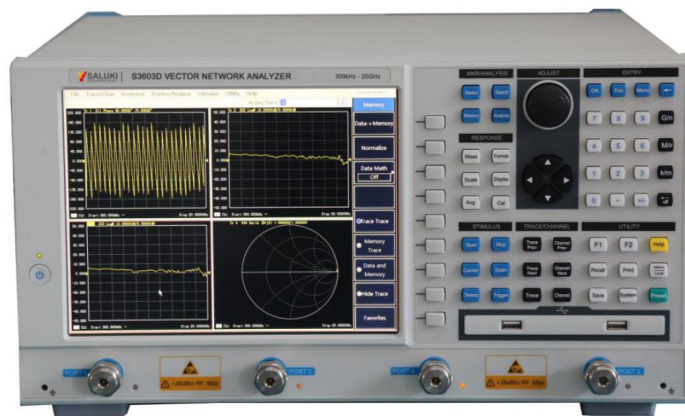


Fig.3-1 Front Panel of the Analyzer

##### 3. 1. 1. Adjust Block

It covers the navigation keys and Adjust knobs.



Fig.3-2 Adjust Keys

### Adjust Knobs

Turn the knob to adjust the setting value in the currently Stimulus input box.

[◀] and [▶]

- Move the option menu towards left or right in operation interface of vector network procedure.
- Switch stimulated options dialog box of operation interface of vector network procedure.
- When operation interface of vector network procedure is not in action or shutdown, and any user operation interface other than vector network procedure or the user interface of Help in vector network is entered, it is operatable by moving mouse arrow towards both left and right. (Default position of mouse arrow is bottom right corner of the screen)

[▲] and [▼]

- Move choice menu items in the menu upwards and downwards.
- It plays the following roles in dialog box:
  - ◆ Change numeral value.
  - ◆ Select items in dropdown list.
  - ◆ Select the desired option in a group of option buttons.
- When operation interface of vector network procedure is not in action or shutdown, and any user operation interface other than vector network procedure or the user interface of Help in vector network is entered, it is operatable by moving mouse arrow towards both left and right. (Default position of mouse arrow is bottom right corner of the screen)

[Click]

It has the same function with mouse click.

### 3. 1. 2. Utility Zone

For operation of instrument system.



Fig.3-3 Utility Keys

#### **[Save]**

It's used for saving instrument status, calibration data or Measure data in specified files.

#### **[System]**

It's used for some system-related configuration and selection of software language, etc.

#### **[Preset]**

It's used to reset Analyzer to default (predefined) status.

#### **[Recall]**

It's used for invoking files containing Analyzer status, calibration data and Measure data.

#### **[Print]**

It's used to start printing function, select print settings and printer for printing.

#### **[Micro/Local]**

- When Analyzer is in external control state, press this key to make the Analyzer re-respond to the buttons on front panel.
- When Analyzer is in normal working state, press this key to access a set of user-defined macros associated with executable files.

Analyzer can name and store 10 macros at most.

#### **[F 1]**

It is used to record shortcut keys in operating a certain Measure (the record can be effective only by operating with front-panel keys).

#### **[F 2]**

It is used to record shortcut keys in operating a certain Measure (the record can be effective only by operating with front-panel keys).

#### **[Help]**

It is used to open the user manual of the analyzer (a built-in file).

### **3. 1. 3. Response Zone**

It's used for various operation of Measure data Trace.





Fig.3-4 Response Keys

**[Meas]**

It is used to select the type of S parameter to be measured and the type of any specific-value or non-specific value power Measure.

**[Format]**

It is used to select the format in which the Measure data are displayed on the analyzer.

**[Scale]**

It is used to set the scale at which the Measure trace is displayed on the analyzer.

**[Display]**

It is used to create a new window, select or Stimulus the current window, or make display settings.

**[Avg]**

With the key [Avg], the noise can be reduced by use of the Measure averaging function. The analyzer reduces the effect of random noise on the Measure result by executing complex exponential average of a number of sweeps for designated times when the average factor is designated.

**[Cal]**

The Measure calibration can be started to make operations such as power calibration.

### 3. 1. 4. Trace/Chan Zone

Managing Trace and Channel on display of Analyzer.



**Fig. 3-5 Trace/Channel Keys****[Trace Prev]**

It is used to Stimulus previous trace curve.

**[Channel Prev]**

It is used to Stimulus previous channel curve.

**[Trace Next]**

It is used to Stimulus the next trace curve.

**[Channel Next]**

It is used to Stimulus the next channel curve.

**[Trace]**

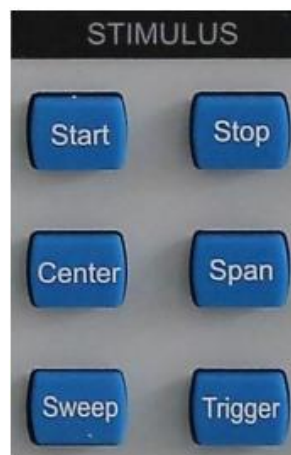
The corresponding trace soft-key menu will be displayed. Press the corresponding soft-keys to make creation, deletion or selection of the Stimulus traces.

**[Channel]**

Display the corresponding channel soft-key menu and make channel management with corresponding soft-keys.

### 3. 1. 5. Stimulate Zone

Determining the range, sweep type or trigger mode of the measured data.

**Fig. 3-6 Stimulus Keys****[Start]**

It is used to set the range of starting frequency value and the frequency offset.

**[Stop]**

It is used to set the stop frequency value.

**[Center]**

It is used to set the center frequency value.

**[Span]**

It is used to set the frequency range.

**[Sweep]**

It is used to select the manner of signal source sweep and relevant properties.

**[Trigger]**

It is used to set how to start an initialized sweep Measure.

**3. 1. 6. Mkr/Analysis Zone**

Controlling all aspects of data analysis, including marker and mathematical calculation.



Fig. 3-7 Marker/Analysis Keys

**[Marker]**

It is used to Stimulus the marker and set the stimulus value of the marker. The marker can provide digital reading of the Measure result. The analyzer can support at most 9 markers and the reference marker R.

**[Search]**

It provides the marker search function. Press this key to Stimulus a marker if there are no markers displayed.

**[Memory]**

It is used to set the mathematical operation and saving of Measure data by the analyzer.

**[Analysis]**

It includes the functions such as limit test, trace statistic, conversion of gates, windows and time domains.

**3. 1. 7. Entry Zone**

These keys are used to enter Measure settings.



Fig. 3-8 Entry Keys

### [OK]

It is used to confirm the setting and entry value in the dialog box and close the dialog box. It is equivalent to the “OK” button in the dialog box.

### [Esc]

It is used to ignore the setting and entry in the dialog box and close the dialog box. It is equivalent to the “cancel” button in the dialog box.

### [Menu]

Press the key [Menu] to browse the menu with the navigation key. Press this key and then press the utility key on the front panel to quickly open the dialog box for utility setting. For example, press the key [Menu] and then press the key [Search] to open the dialog box for search setting.

### [←]

The marker will backspace to delete the previous entry by pressing this key, after the value is entered.

### Numeric Key

The numbers 0 – 9 are included. It is used to enter the value in Measure setting and complete entry by pressing the corresponding unit key.

### Unit Key

It is used to end the value entry and allocate a unit to the entry value. The corresponding units to keys are as below:

- [G/n] G/n (109/10-9)
- [M/μ] M/μ (106/10-6)
- [k/m] k/m (103/10-3)
- [↵/En off] Basic unit: dB, dBm, degree, second, Hz or dB/GHz. It can be also used to enter the value without a unit. It has the function equivalent to Enter key.

### Prompt

After entering the value, you need to press the unit key to finish the setting. When entering the value without units, press [↵/En off] to finish the entry. When using the external connected keypad, press the character key correspondent to the unit to finish the setting.

- [.]

It is used to enter the decimal point when entering a decimal value.

- [+/-]

Before inputting a value, press this key to Stimulus entry of a positive or negative value.

### 3. 1. 8. Soft-keys

They work with the keys in other utility areas on the front panel and can easily carry out all instrument operations without a mouse.

- An additional key can be used as a user key.
- Soft key menu associated with a key can be called up by pressing this key on front panel.



Fig. 3-9 Soft-keys

### 3. 1. 9. USB Interface

USB interface can be used to connect keyboard, mouse or other USB devices, a total of 2 USB interfaces meeting USB2.0 specifications are provided on front panel, the interface jack is A-type configuration (embedded 4 contacts: contact 1 on the left); each interface has the following features:

- Contact 1:  $V_{cc}$ : 4.75V - 5.25V, maximum output current: 500mA.
- Contact 2: data -.
- Contact 3: data +.
- Contact 4: ground.



Fig. 3-10 USB Interfaces

### 3. 1. 10. Display Screen

Screen display of Analyzer is shown in the following figure.

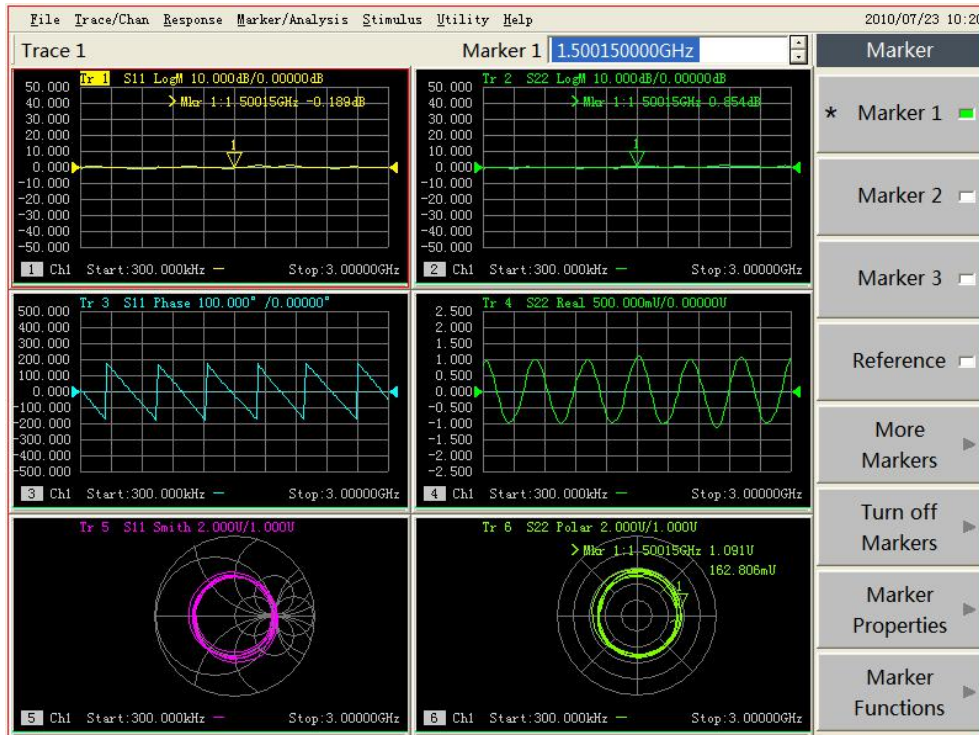


Fig. 3-11 Display Screen of the Analyzer

TFT LCD is adopted for the display screen of Analyzer, with technical specifications as follows:

- TFT, 10.4 inches, LCD
- Resolution: 800×600.
- Vertical refresh rate: 60.31Hz.
- Horizontal refresh rate: 37.88 kHz.
- Brightness: >350NIT.

### 3. 1. 11. [On/Standby]Key and Indicator Light

[On/Standby]switch the analyzer between On and Standbys condition.

- For the On condition, the indicator light is green.
- For the Standbys condition, the indicator light is orange.
- When the analyzer is On, press [On/Standby], the analyzer will quit the application program, switch off the power and enter Standbys condition automatically.
- When the analyzer is Standby, press [On/Standby], the analyzer will automatically run
- Windows XP Operation System and load the Measure application program of the analyzer.
- The key [On/Standby] is only a standby switch that is not connected directly to the external power supply and can not cut off connection of the analyzer with the external power supply. The external power supply to the analyzer can be disconnected with the power switch on the rear panel. Removing the power cord can completely cut off connection of the analyzer with the external power supply.



Fig. 3-12 [On/Standby]Key and Indicator Light

### 3. 1. 12. Measure Ports



Fig. 3-13 Measure Ports of the Analyzer

The 3603D analyzer includes two 3.5mm male interfaces for measurement. The switching can be made between the RF source and receiver to measure the DUT in two directions. The yellow lamp is used to indicate the current source output port.

- The input damage level: RF power: +26dBm, DC voltage:  $\pm 30V$ .

#### **Warning**

The damage level limit of the analyzer is +26dBm RF power or  $\pm 30V$  DC voltage. The input exceeding the above range may burn the instrument.

## 3. 2. Rear Panel Tour

The rear panel of Analyzer is shown as the following figure:



Fig. 3-14 Analyzer Rear Panel

### 3. 2. 1. 10MHz Reference Connector



**Fig. 3-15 10MHz Reference Connector**

- 10MHz reference input connector

10MHz reference input BNC female connector is used for input of external reference signals. If a 10 MHz external reference signal is detected at this port, it will be used as the instrument frequency references instead of the internal frequency reference. The requirements of the analyzer to the 10MHz input reference signals are as follows:

- Input frequency: 10MHz±10ppm.
- Input level: -15dBm to +20dBm.
- Input impedance: 200Ω.

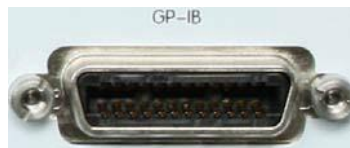
- 10MHz reference output connector

10 MHz reference output BNC female connector provides reference signals with the following properties:

- Output frequency: 10MHz ±10ppm.
- Signal type: sine wave.
- Output level: 10dBm±4dB.
- Output impedance: 50Ω.

### 3. 2. 2. GP-IB Connector

GP-IB connector is a 24-pin D female connector for sending and receiving GP-IB/SCPI command, complying with IEEE-488 standard.

**Fig. 3-16 GP-IB Connector**

### 3. 2. 3. VGA Output Connector

This is a 15-pin D female connector connecting VGA display with the corresponding resolution externally, therefore, we can use internal and external displays to observe Measure at the same time, and wherein, the default resolution of external monitor is 800×600, which is the same as the resolution of LCD screen of Analyzer.

**Fig. 3-17 VGA Output Connector**

In the Windows table, click the right button of the mouse and with the right click menu, the multi-monitor mode can be configured.



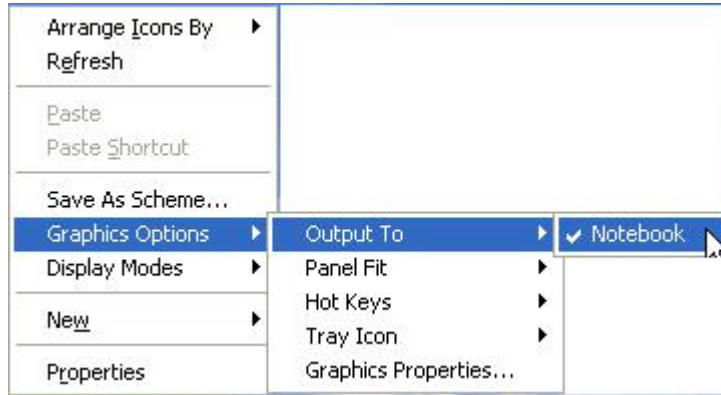


Fig. 3-18 Configuration of Multi-Display Mode

- When **[Monitor]** is checked, only the external VGA monitor can be used to observe the display and there is no display on the internal LCD.
- When **[Computer]** is checked, only the internal LCD can be used to observe the display and there is no display on the external VGA.
- When **[Monitor+Computer]** is checked, the external VGA monitor and the internal LCD can be used at the same time.

### 3. 2. 4. LAN Connector

This is a 10/100 BaseT Ethernet connector with standard 8-pin structure, which can automatically select one from the two data rates.



Fig. 3-19 LAN Connector

### 3. 2. 5. USB Connector

The plughole of the connector is Type A configuration (embedding 4 contacts: Contact 1 is on the left), providing two interfaces complying with USB 2.0 specification, and the property of every interface is as below:

- Contact 1: Vcc, 4.75V - 5.25V, 500mA (maximum output current).
- Contact 2: Data-.
- Contact 3: Data+.
- Contact 4: Ground.

This connector can connect USB mouse, keyboard and other USB interface devices.



Fig. 3-20 USB Connector

### 3. 2. 6. External Trigger Input Connector

The Trig In port is used for external trigger signal input..



Fig. 3-21 External Trigger Input Connector

### 3. 2. 7. External Trigger Output Connector

After the system is all set, the vector network can output trigger signals.



Fig. 3-22 External Trigger Output Connector

### 3. 2. 8. Power Socket and Power Switch



Fig. 3-23 Power Socket and Power Switch

#### 3. 2. 8. 1. Power socket

The power socket is used to connect power cords and the three-core power cord with ground wire (provided along with instrument) is recommended.

#### 3. 2. 8. 2. Power switch

During the normal working process of Analyzer, the power switch shall be kept in "ON" position, and please do not turn off the instrument by the power switch or unplug the power cord, which may cause faults on software or hardware of Analyzer.

## 3. 3. Display Screen / User Interface

The Analyzer interface refers to the method of setting and operating Analyzer by users, including front panel interface and mouse-driven user interface:

### 3. 3. 1. Front Panel Interface







Users can use front panel key to set and operate Analyzer by 2 ways.

- Using soft-key toolbar

This method can make a setting of Analyzer quickly in 4 steps:

- a) Press the corresponding utility keys of the front panel to Stimulus the soft-key toolbar of the item.
  - b) Observe the function options of active project toolbar.
  - c) Select required function based on the corresponding soft-key.
  - d) Enter values (if necessary).
- Use a Drop-down List

This method can use all functions of Analyzer, but the operation is relatively complicated and trivial, and the specific steps are as below:

- a) Press [Menu] key to switch to the Menu/Dialog mode.
- b) Press the [  [  keys and [  [  ] keys to browse the menu; press down the knob key to make a selection.
- c) Browse and set the dialog box through the [  ]、 [  ] key (if the dialog box is open).
- d) Entry values (if necessary).
- e) Press the [OK] in the ENTRY area to close the dialog box (if the dialog box is opened).

### 3. 3. 2. Mouse Interface

The following operations can be done by using mouse:

- a) Click on the menu bar to display the drop-down list.
- b) Click the existing item soft-key toolbar to select the function.
- c) Click the **Measure** toolbar to add Measure tracks.
- d) Click the **Control** toolbar to control the sweep.
- e) Click the **Incentives** toolbar to set the Sweep excitation.
- f) Click the **Marker** toolbar to set the marker.
- g) Right click on the screen to display the right click menu.

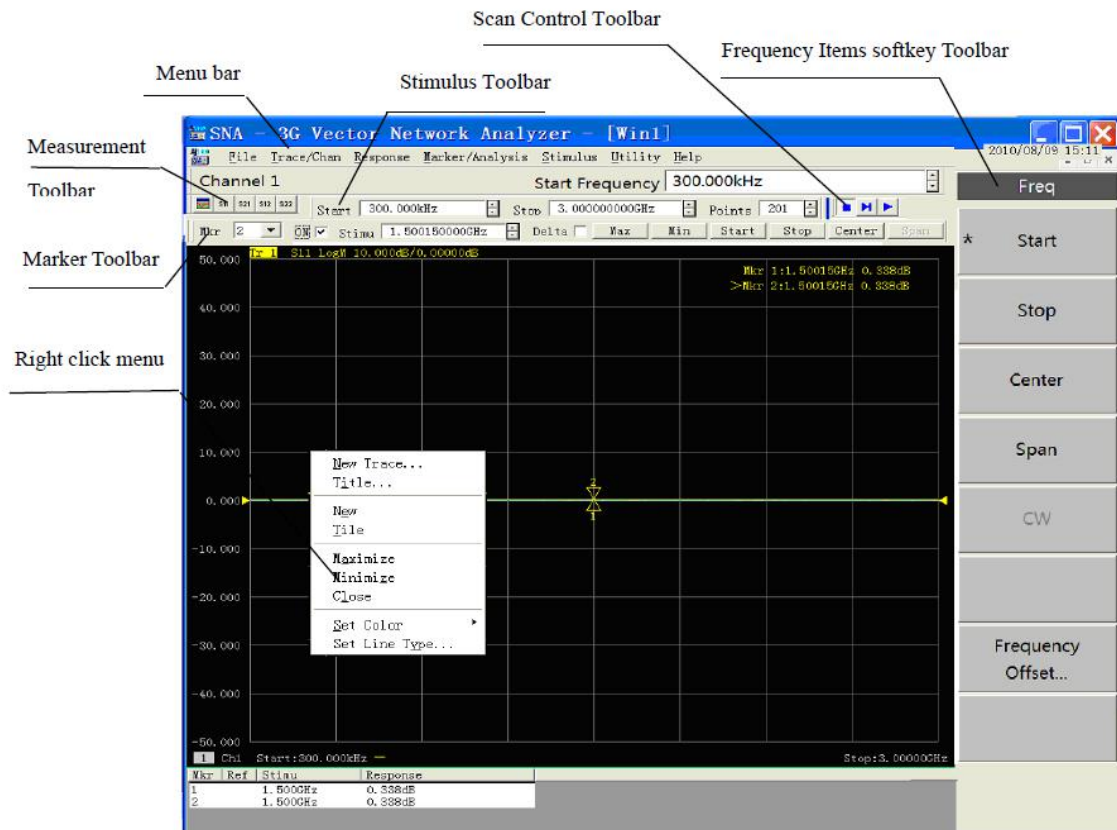


Fig. 3-24 Analyzer User Interface

### 3. 4. Traces, Channels and Windows

#### 3. 4. 1. Traces

Trace is a series of measured data points and its setting will influence arithmetical operation and display of measured data, and only when Trace is in the Stimulus state, it can change its setting. Single click the corresponding Trace state button to activate the Trace, and the detailed setting method is shown in “Changing Stimulus State of Trace” Part of “Selecting Measure Parameter” in Section 2 of Chapter V, and the setting for Trace includes:

- Parameters
- Format
- Scale
- Calibration ON / OFF
- Trace Math
- Marker
- Electrical Delay
- Phase Bias
- Smoothing
- Time Domain Transformation

#### 3. 4. 2. Channels

Channels contain traces. The analyzer supports up to 64 independent channels. Channel settings determine how the trace data is

measured. All traces that are assigned to a channel share the same channel settings. A channel must be selected (active) to modify its settings. When the traces in a channel are active, the channel is also active. The following are channel settings:

- Frequency span
- Power
- Calibration data
- IF bandwidth
- Number of Points
- Sweep Setup
- Average
- Trigger (some settings)

### 3. 4. 3. Window

Window is used to observe Measure traces. The analyzer supports up to 32 windows, with each window displaying up to eight traces. Window and channel are completely independent. Through the **[Response]** menu, window display can be set.

- Creating a new window
  - By mouse or touch screen

Click **[Response]** and in the drop-down list, click **[Display]**; select **[New Window]** in the **[Windows]**, and the analyzer will create a window, which is defaults for no traces.

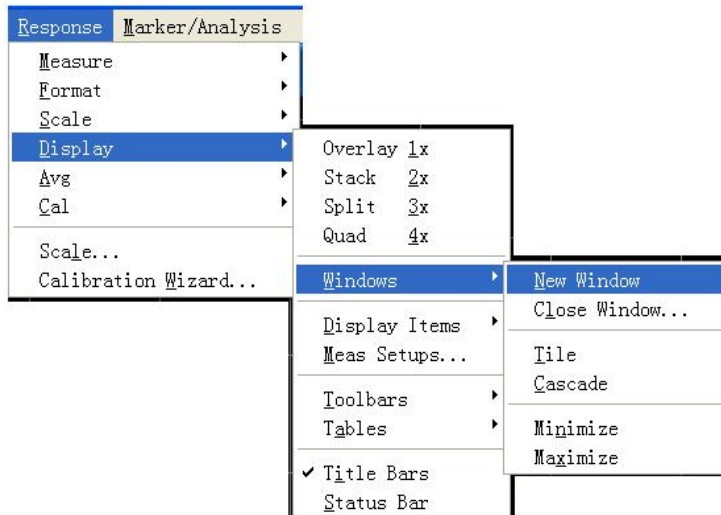


Fig. 3-25 Creating a New Window

- By front panel keys
  - a) Press **[Display]** key in the **RESPONSE** area.
  - b) In the soft-key menu displayed on the right screen, press **[Windows]** corresponding soft-key to display the lower soft-key menu.
  - c) Press **[New Window]** corresponding soft-key, and the analyzer will create a new window, which are defaults for no traces.
- Viewing a Window with the Full Screen View

When there are too many windows on the screen, the windows will be too small and the traces will not be clear; then the full screen

can be used to display a particular window for better viewing of the traces.

- By mouse or touch screen

When you operate with the mouse, there are 3 following ways:

- 1) When the title bar is open, click the **[Max]** button on the bar.
  - 2) When the title bar is closed, click the window you want to view with the full screen so that the corresponding window is set as the current active window, click **[Response]**, in the Response menu, click **[Display]**, and in the lower menu, select **[Max]** in the **[Windows]**.
  - 3) Point the mouse to the window you want to view with the full screen and press the right button of the mouse. Click **[Max]** in the right button menu.
- By front panel keys
    - 1) Press the **[Display]** key in the RESPONSE menu. Press **[Windows]** corresponding soft key on the right side of the screen to display the lower menu; press [More] corresponding soft-key.
    - 2) Press **[Select Window]** corresponding soft-key, select the window to be Stimulus in the dialog box of Active Window by [ $\Delta$ ], [ $\nabla$ ] keys and press **[Max]** corresponding soft-key.

## 4. Measurement Setting

This chapter will introduce how to make the measurement settings. Normally, following setting operations should be done during a test. This chapter will introduce these operations in sequence.

- Resetting Analyzer
- Selecting Measure parameter
- Setting frequency range
- Setting signal power level
- Sweep Setup
- Selecting triggering mode
- Setting data format and scale
- Observing multi-Trace and enabling multichannel
- Setting Analyzer display
- Configure 4-port Measure

### 4. 1. Resetting Analyzer

#### 4. 1. 1. Reset state

When [**Preset**] key is pressed, the Analyzer will be returned to a default state which is known as reset state, and the reset state for S3603DVector Network Analyzer is set as follows:

- **Measure parameter:** S11
- **Frequency setting:**
  - Start frequency: 300kHz
  - Stop frequency: 20GHz
  - CW Time: 2GHz
- **Power setting:**
  - Measuring port power: 0dBm
  - Coupled port power: on
  - Attenuation: automatic attenuation
  - Attenuation value : 0dB
- **Sweep setup:**
  - Sweep type: linear frequency
  - Sweep time: automatic
  - Sweep spot number: 201
- **Segment sweep setup:**
  - Number of started segment: 1
  - Start frequency: 300kHz

- Stop frequency: 20GHz
- Points: 21
- Power: 0dBm
- IFBW: 30kHz
- **Trigger setting:**
  - Trigger source: internal
  - Trigger mode: continuous
- **Display format:**
  - Format: log-magnitude
  - When different formats are chosen, the corresponding setting in detail is as follows:
    - Avg factor: 1
    - Smoothing: off
    - Smoothing factor: 2.49% of value range
    - Electrical delay: 0s
    - Velocity factor: 1
    - Phase offset: 0o
    - Display Trace: data Trace
- **Calibration setting:**
  - Correction: off
  - Insertion: on
  - Calibration type: none
  - impedance: 50Ω.
  - Port extension: off
  - Port extension value: 0s
- **Marker setting:**
  - Original frequency: 10.0001GHz
  - Reference marker R: off
  - Discrete marker: off
  - Format: Trace format
  - Type: standard
  - Marker search type: minimum
  - Search domain: full span
  - Marker table: blank
  - Marker coupling: off
  - Displaying all Trace markers: on



- **Limit test setting:**
  - Limit test: off
  - Limit line display: off
  - Failure sound warning: off
- **Limit table setting:**
  - Type: OFF
  - Start activation: 300kHz
  - Stop activation: 20GHz
  - Start response: -100dB
  - Stop response: 100dB
- **Time domain transformation setting:**
  - Time domain transformation: off
  - Transformation mode: band-pass
  - Transformation start: -10ns
  - Transformation stop: 10ns
  - Gaesarian window  $\beta$  factor: 6.0
  - Time domain gate: off
  - Gate start: -10ns
  - Gate stop: 10ns
  - Gate shape: standard
  - Gate type: band-pass
- **Global display setting:**
  - Status bar of Trace: on
  - Frequency/activation: on
  - Marker reading: on
  - Toolbar displayed: current input
  - Status bar: off

#### 4. 1. 2. User reset state

The Analyzer can be reset to a known default state or a state defined by user. Under the default condition, the Analyzer is reset to the default state defined before leaving factory and it can be reset to the state specified by user via setting.

##### 4. 1. 2. 1. Setting user reset state

- 1) By mouse or touch screen
- 2) Single click **[Utility]** and then single click **[Define User State..]** in the system menu to display the dialog box of defining user reset state.
- 3) Single click **[save current state as user state]** button, the Analyzer will save the current instrument setting as user reset

state.

- 4) If you want to use the existing state, single click **[load exist file as user reset state]** button, select state file from the opened dialog box to enable it, and the selected file is used as state file for user reset by Analyzer.
- 5) Click **[Enable user reset state]** to mark check box.
- 6) Single click **[OK]** button to close the dialog box.

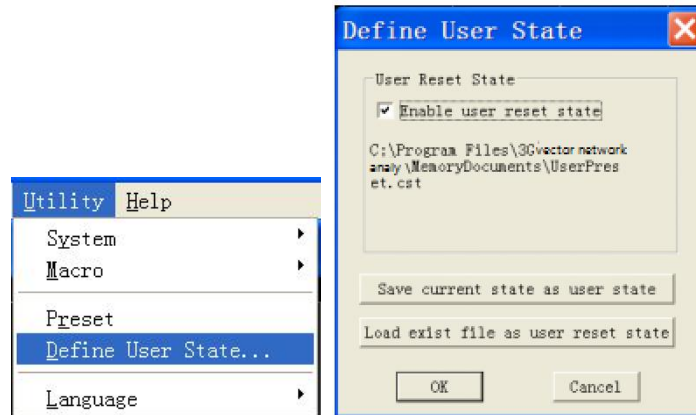


Fig.4-1 Define User Reset State

- By front panel keys

- 1) Press **[Menu]** key in ENTRY area.
- 2) Press **[ ]**, **[ ]** key in ADJUST area to switch to the **[Define User State]** menu item under the system menu and press **[Click]** key in Adjust area to display the dialog box of Define User Reset State.
- 3) If you want to make the current setting of Analyzer at user reset state, press **[ ]**, **[ ]** to switch to **[Save Current State as User Preset]** button and then press **[Click]**.
- 4) If you want to use the existing state, press **[ ]**, **[ ]** to switch to **[Load Existed File as User reset State]** button and then press **[Click]**, and select state file from the opened dialog box to enable it and the selected file is used as state file for reset.
- 5) Press **[ ]**, **[ ]** in ADJUST area to switch to **[Enable User Reset State]** and press **[Click]** to mark check box.
- 6) Press **[OK]** in ENTRY area to close dialog box.

### 4. 1. 3. Reset Analyzer

- By mouse or touch screen

Single click **[Utility]**, and then single click **[Preset]** in the Utility menu.

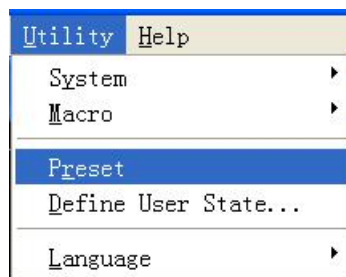


Fig. 4-2 Resetting Analyzer

- By front panel keys

Press **[Preset]** in UTILITY area.

## 4. 2. Selecting Measure Parameter

We can set the Analyzer to use the following parameters to measure electrical properties of a device:

- S parameter (fixed ratio)
- Arbitrary ratio (Measure of user-defined ratio)
- Measure of non-ratio power (absolute power Measure)

### 4. 2. 1. S parameter

S parameter (scattering parameter) is used to describe how a device changes input signals, which can depict reflection and transmission properties of DUT. S parameter uses the numeric arrangement pattern specified to indicate the ratio relation of two complex vectors including amplitude and phase information.

$$S_{\text{output input}}$$

Output refers to the output port number of response signals of DUT and input averages the input port number of activation signals of DUT. The Analyzer includes two Measure ports, which can measure S parameter of a device with one or two ports. We can set the signal output port measured by S parameter, and when the activation signals are output from Port 1 of Analyzer, we call it that the Analyzer is under positive-going Measure, and when the activation signals are output from Port 2, it is believed that the Analyzer is experiencing reverse Measure, and the Analyzer can switch over direction of Measure automatically based on selected Measure parameters, therefore, all of 4 S parameters for a two-port device can be measured through one connection.

S parameter is complex linear value, of which the Measure accuracy depends on index of calibration kit and adopted Measure and connection technology and is also related with the matching conditions of non-activation port, and its unfavorable load matching will make  $a_2$  during positive-going Measure and  $a_1$  during reversing Measure unequal to zero, which disobeys the definition of S parameter and introduces Measure errors. Full dual-port calibration can modify source and load matching errors to improve accuracy of Measure.

#### 4. 2. 1. 1. Creating new S parameter Measure Trace

- By mouse or touch screen
  - 1) Single click **[Trace]**, single click **[New Trace...]** in **[New Trace]** menu, and display the dialog box of New Create Trace.
  - 2) Select new S parameter Measure Trace to be created in the dialog box.
  - 3) Single click **[OK]** button to close the dialog box after the setting is completed.

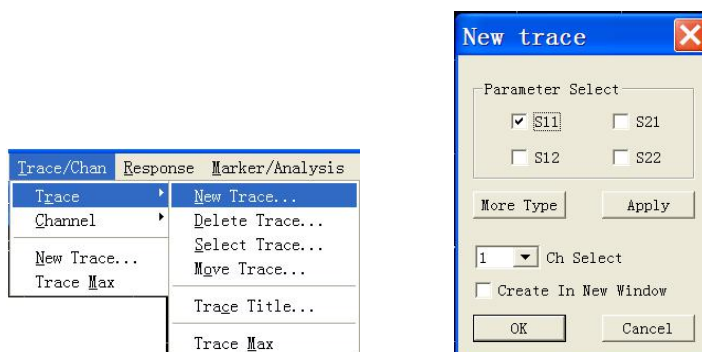


Fig. 4-3 Create New S Parameter Trace

- By front panel keys
  - 1) Press **[Trace]** key in TRACE/CHAN area.
  - 2) Press the corresponding soft-key of **[New S-Param]** to create new Traces.

#### 4. 2. 1. 2. Creating new Trace dialog box

- Parameter select zone

It is used to select new S parameter Measure Trace to be created.

- **[More Type]**

Opening the dialog box to create new arbitrary ratio or non-ratio power Measure Traces.

- **[Ch Select]**

It is used for selecting the channel for a new Trace.

- **[Create in New Window]**

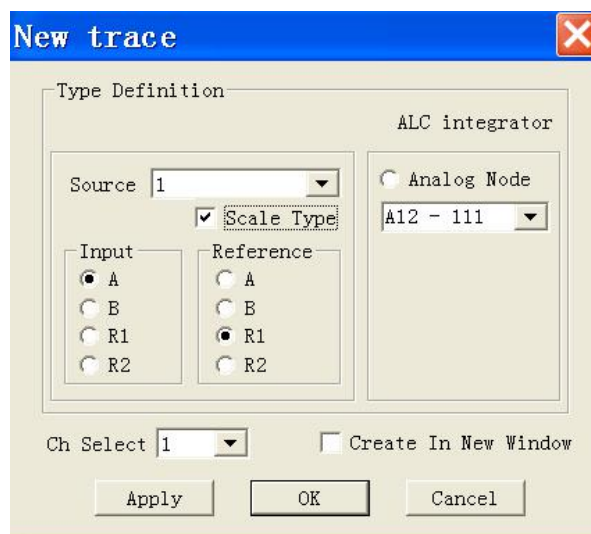
A Trace is created in a new window when it is checked and is generated in the current window at the elimination.

#### 4. 2. 2. Arbitrary ratio Measure

The arbitrary ratio Measure allows to select input signals and reference signals for ratio Measure from receivers (A, B, R1 and R2).

##### 4. 2. 2. 1. Creating new arbitrary ratio Measure Trace

- By mouse or touch screen
  - 1) Single click **[Trace/Chan]**, single click **[New Trace...]** in **[Trace]** menu, and display the dialog box of Create New Trace.
  - 2) Single click **[More Type]** button in the dialog box to display the dialog box of New Trace.
  - 3) Select the output port of Analyzer source signals from **[Source]** box.
  - 4) Click **[Scale Type]** to mark check box.
  - 5) Select input receiver for ratio Measure from Input zone.
  - 6) Select reference receiver for ratio Measure from Reference zone.
  - 7) Single click **[OK]** button to close the dialog box.



**Fig. 4-4 Creating New Arbitrary Ratio Measure Trace**

- By front panel keys
  - 1) Press **[Trace]** in TRACE/CHAN area and press the soft-key corresponding to **[New Trace...]** in soft-key menu displayed on the right of screen to show New Trace dialog box.
  - 2) Press **[□]**、**[□]** in ADJUST area to switch to **[More Type]** button and press **[Click]** to display New Trace dialog box.
  - 3) Press **[□]**、**[□]** in ADJUST area to switch to **[Source]** box and press **[△]** and **[▽]** or rotate knob to select source output port of Analyzer.
  - 4) Press **[□]**、**[□]** in ADJUST area to switch to **[Scale Type]** and press **[Click]** to mark check box.
  - 5) Press **[□]**、**[□]** in ADJUST area to switch to Input zone and press **[△]** and **[▽]** or rotate knob to select input receiver of ratio Measure.
  - 6) Press **[□]**、**[□]** in ADJUST area to switch to Reference zone and press **[△]** and **[▽]** or rotate knob to select reference receiver of ratio Measure.
  - 7) Press **[OK]** in ENTRY area to close dialog box.

### 4. 2. 3. Non-ratio power Measure

The non-ratio power Measure parameter can measure the absolute power entering receivers (i.e. A, B, R1 and R2), but Measures of phase and group delay and any other Measures enabling average functions cannot be performed.

#### 4. 2. 3. 1. Creating new non-ratio power Measure Trace

- By mouse or touch screen
  - 1) Single click **[Trace/Chan]**, single click **[New Trace...]** in **[Trace]** menu, and display the dialog box of Create New Trace.
  - 2) Single click **[More Type]** button to display the dialog box of New Trace.
  - 3) Select the source output port of Analyzer from **[Source]** box.
  - 4) Click **[Scale Type]** to eliminate check box (if marked).
  - 5) Select Measure receiver of signals from Input zone.
  - 6) Single click **[OK]** button to close the dialog box after the setting is completed.
- By front panel keys
  - 1) Press **[Trace]** in TRACE/CHAN area and press the soft-key corresponding to **[New Trace...]** in the corresponding soft-key menu to show New Trace dialog box.
  - 2) Press **[□]**、**[□]** in ADJUST area to switch to **[More Type]** button and press **[Click]** to display New Trace dialog box.
  - 3) Press **[□]**、**[□]** in ADJUST area to switch to **[Source]** box and press **[△]** and **[▽]** or rotate knob to select source output port of Analyzer.
  - 4) Press **[□]**、**[□]** in ADJUST area to switch to **[Scale Type]** and press **[Click]** to eliminate check box (if marked).
  - 5) Press **[□]**、**[□]** in ADJUST area to switch to Input zone and press **[△]** and **[▽]** or rotate knob to select Measure receiver of signals.
  - 6) Press **[OK]** in ENTRY area to close dialog box.

#### 4. 2. 3. 2. Creating new Trace dialog box (arbitrary ratio and non-ratio power Measure)

- **[Source]**

Select output port of Analyzer source signals.

- [Scale Type]

Create new arbitrary ratio Measure Trace when it is checked a new non-ratio power Measure Trace during elimination.

- [Input]

Select input receiver for measuring response signals of DUT.

- [Reference]

Select reference receiver for performing ratio Measure.

- [Ch Select]

It is used for selecting the channel for a new Trace.

- [Create in New Window]

A Trace is created in a new window when it is checked and another one is created in current window during elimination.

#### 4. 2. 4. Changing Measure Type of Trace

For Analyzer, if some Trace needs to be set and modified, the Trace must be changed to the current Active Trace, and then can be modified.

##### 4. 2. 4. 1. Changing Stimulus state of Trace

- By mouse or touch screen

Single click Trace Status Bar on the upper part of window and the corresponding Trace becomes the current Active Trace.



Fig. 4-5 Changing Stimulus State of Trace

- By front panel keys

Press [Trace Prev] or [Trace Next] in TRACE/CHAN area. Or, the following operation methods can be employed:

- Press [Trace] in TRACE/CHAN area and press the soft-key corresponding to [Select Trace] in the corresponding soft-key menu to show Current Trace dialog box.
- Press [Δ] and [↓] in ADJUST area or rotate knob to select the Trace requiring to be Stimulus in Current Trace dialog box.

##### 4. 2. 4. 2. Setting S parameter Measure type of current Active Trace

- By mouse or touch screen

- 1) Single click [Response] and point to [Measure] in Response menu to display submenu of Measure.
- 2) Single click S parameter Measure type to be selected from the submenu.

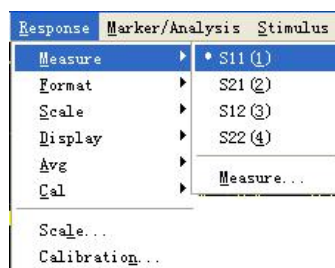


Fig. 4-6 Setting S Parameter Measure Type of Current Active Trace

- By front panel keys

- 1) Press **[Meas]** in RESPONSE area.
- 2) Press the corresponding soft-key to select S-parameter Measure type on existing soft-key menu.

#### 4. 2. 4. 3. Changing current Active Trace to be arbitrary ratio type

- By mouse or touch screen
  - 1) Single click **[Response]** and point to **[Measure]** in Response menu to display submenu of Measure.
  - 2) Single click menu item of **[Measure...]** in submenu to display Measure dialog box.
  - 3) Single click **[More Type]** button to display Measure dialog box.
  - 4) Select the source output port of Analyzer from **[Source]** box.
  - 5) Click **[Scale Type]** to mark check box.
  - 6) Select input receiver for ratio Measure from Input zone.
  - 7) Select reference receiver for ratio Measure from Reference zone.
  - 8) Single click **[OK]** button to close the dialog box after the setting is completed.

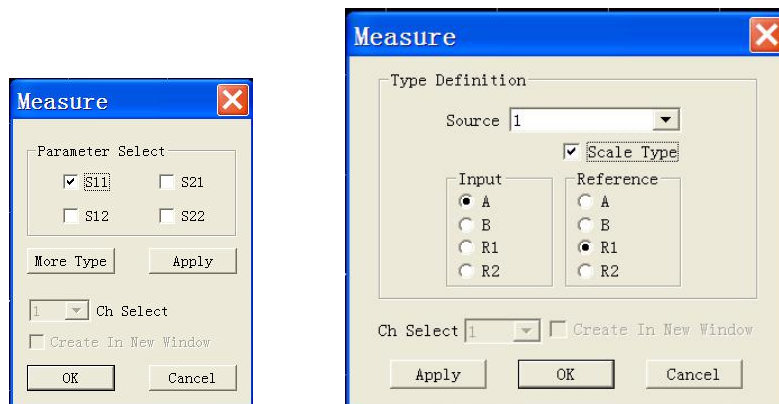


Fig. 4-7 Changing Current Active Trace to be Arbitrary Ratio Type

- By front panel keys
  - 1) Press **[Meas]** in RESPONSE area and single click the soft-key corresponding to **[Measure...]** to display Measure dialog box.
  - 2) Press **[□]**、**[□]** in ADJUST area to switch to **[More Type]** button and press **[Click]** to display Next-level Measure dialog box.
  - 3) Press **[□]**、**[□]** in ADJUST area to switch to **[Source]** box and press **[△]** and **[▽]** or rotate knob to select source output port of Analyzer.
  - 4) Press **[□]**、**[□]** in ADJUST area to switch to **[Scale Type]** and press **[Click]** to mark check box.
  - 5) Press **[□]**、**[□]** in ADJUST area to switch to Input zone and press **[△]** and **[▽]** or rotate knob to select input receiver of ratio Measure.
  - 6) Press **[□]**、**[□]** in ADJUST area to switch to Reference zone and press **[△]** and **[▽]** or rotate knob to select reference receiver of ratio Measure.
  - 7) Press **[OK]** in ENTRY area to close dialog box.

#### 4. 2. 4. 4. Changing current Active Trace to be non-ratio power Measure type

- By mouse or touch screen

- 1) Single click [**Response**] and point to [Measure] in Response menu to display submenu of Measure.
  - 2) Single click [**Measure...**] in submenu to display Measure dialog box.
  - 3) Single click [**More Type**] to display Measure dialog box.
  - 4) Select the source output port of Analyzer from [Source] box.
  - 5) Click [**Scale Type**] to eliminate check box (if marked).
  - 6) Select Measure receiver from Input zone.
  - 7) Single click [**OK**] to close the dialog box after the setting is completed.
- By front panel keys
- 1) Press [**Meas**] in RESPONSE area and single click the soft-key corresponding to [Measure...] to display Measure dialog box.
  - 2) Press [□]、 [□] in ADJUST area to switch to [**More Type**] button and press [**Click**] to display Next-level Measure dialog box.
  - 3) Press [□]、 [□] in ADJUST area to switch to [Source] box and press [△] and [▽] or rotate knob to select source output port of Analyzer.
  - 4) Press [□]、 [□] in ADJUST area to switch to [**Scale Type**] and press [**Click**] to eliminate check box (if marked).
  - 5) Press [□ ]、 [□ ] in ADJUST area to switch to Input zone and press [△ ] and [▽ ] or rotate knob to select Measure receiver.
  - 6) Press [**OK**] in ENTRY area to close dialog box after the setting is completed.



### 4. 3. Setting Frequency Range

The frequency range refers to the frequency span of device Measure and the frequency resolution of S3603D vector Network Analyzer is 1Hz. The whole frequency range includes several wave bands, and when frequency Sweep passes through switching points of these wave bands or sweeps the highest frequency of setting for retracing Sweep, the power input to DUT will be adjusted to minimum to prevent oversized peak power from burning up DUT. If the frequency range of Sweep only consists of one wave band, the power will be kept unchanged at retracing Sweep. The frequency range of every wave band of Analyzer is shown as follows:

Table 4-2 Wave Band Division of S3603D

Wave Band	S3603D Frequency Range
B0	300kHz - 10MHz
B1	10MHz - 20000MHz

#### 4. 3. 1. Setting Frequency Range

There are two methods of setting frequency range:

- Designating start frequency and stop frequency
- Designating center frequency and frequency span

##### 4. 3. 1. 1. Setting start frequency and stop frequency

- By mouse or touch screen
  - 1) Single click **[Stimulus]**, point to **[Freq]** in Stimulus menu, and single click menu item of **[Start/Stop...]** to display Frequency Start/ Stop dialog box.
  - 2) Single click **[Start]** and input start frequency value.
  - 3) Single click **[Stop]** and input stop frequency value.
  - 4) Single click **[OK]** to close the dialog box after the setting is completed.

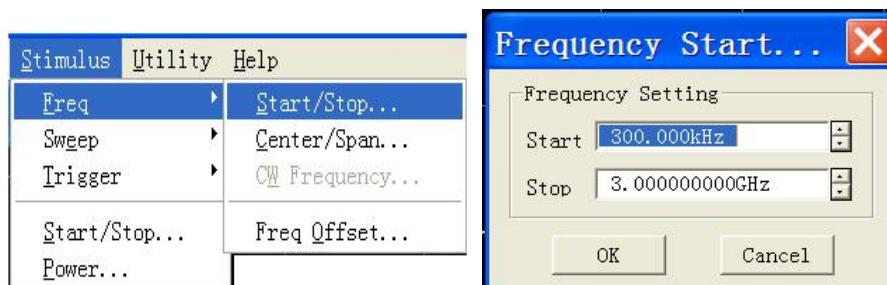


Fig. 4-8 Designating Start Frequency and Stop Frequency

- By front panel keys
  - 1) Press **[Start]** key in STIMULUS area to set start frequency value in existing input bar.
  - 2) Press **[Stop]** key in STIMULUS area to set stop frequency value in existing input bar.

##### 4. 3. 1. 2. Setting the center frequency and frequency span

- By mouse or touch screen
  - 1) Single click **[Stimulus]**, point to **[Freq]** in Stimulus menu, and single click menu item of **[Center/Span...]** to display Frequency Center/Span dialog box.

- 2) Single click **[Center]** and input center frequency value.
- 3) Single click **[Span]** and input frequency span value.
- 4) Single click **[OK]** to close the dialog box after the setting is completed.

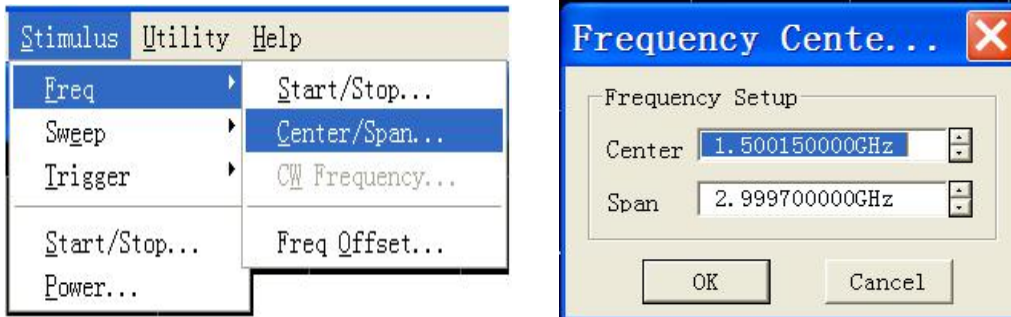


Fig. 4-9 Designating Center Frequency and Frequency Span

- By front panel keys
  - 1) Press **[Center]** in STIMULUS area to set center frequency value in existing input bar.
  - 2) Press **[Span]** in STIMULUS area to set frequency span value in existing input bar.

#### 4. 4. Setting Signal Power Level

Power level refers to the power level for Analyzer measuring port output source signals and the technical index for power level of output signals at port of S3603D Vector Network Analyzer is as below:

Table 4-3 Source Signal Power Level Index

Frequency	Source Power Range (dBm)	Resolution (dB)
S3603D (300kHz - 20GHz)	-25 to +10	0.01

##### 4. 4. 1. Setting Power Level

###### 4. 4. 1. 1. By mouse or touch screen

- 1) Single click **[Stimulus]** and single click **[Power...]** in Stimulus menu to show Power dialog box.
- 2) Single click **[Port Power Level]** and input power level from Port 1. The port power is coupled under default condition, so the power level of Port 2 is also set.
- 3) If the power level for every port shall be set independently, eliminate **[Port Power Coupled]** check box, select setting port in **[Port]**, and set power level in **[Port Power]**.
- 4) Single click **[OK]** to close the dialog box.

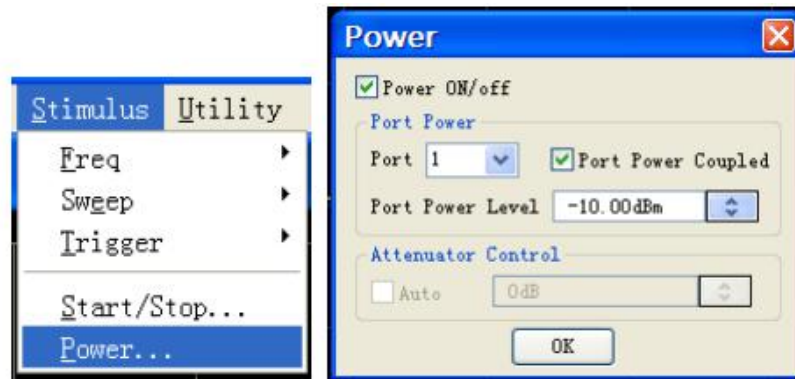


Fig. 4-10 Setting Power Level

#### 4. 4. 1. 2. By front panel keys

- 1) Press **[Sweep]** in STIMULUS area and press the soft-key corresponding to **[Power]** on existing soft-key menu.
- 2) Input power level in Power Level dialog box.

#### 4. 4. 1. 3. Power dialog box

- **[Power ON/off]**

During marking, power can be output normally from port and the output power from port turned off during elimination.

- Selecting port zone

- **[Port]**

Select the port for setting power level.

- **[Port Power Coupled]**

By default, Mark [Coupled Port Power] check box and the power level settings for 2 ports of Analyzer are identical. When [Coupled Port Power] check box is eliminated, the Analyzer allows to set power level for every port respectively.

### **Warning**

If the input power at Measure port of Analyzer is too large, it may burn the receiver of Analyzer and the maximum input radio-frequency power level at Measure port of Analyzer is: +26dBm

- **[Port Power Level]**

It is used to set power level of port.

- Attenuator control zone

- **[Auto] and [Attenuation control]**

When [Auto] check box is marked, the Analyzer can be set as any power level within the allowable power range and [Attenuation Setting] is forbidden, and the Analyzer can select automatically attenuator setting so as to utilize optimum power range.

#### 4. 4. 2. Turning Port Power Off

- By mouse or touch screen

- 1) Single click **[Stimulus]** and single click **[Power...]** in Stimulus menu to show Power dialog box.
- 2) Eliminate **[Power ON/off]** check box.

- 3) Single click **[OK]** to close the dialog box.
- By front panel keys
    - 1) Press **[Sweep]** in STIMULUS area and press the soft-key corresponding to **[Power]** on existing soft-key menu.
    - 2) Press the corresponding soft-key in **[Power ON | off]** menu on the corresponding soft-key menu.

## 4. 5. Sweep Setup

Sweep refers to the measuring process of continuous data points with stimulus values in specified sequence.

### 4. 5. 1. Sweep type

The Analyzer supports five types of sweep as follows:

- Linear frequency

This is the default sweep type for Analyzer. The frequency intervals between two neighbor measuring points are equal.

- Logarithmic frequency

Under the setting of logarithmic frequency, source frequency increases in logarithmic step size and frequency ratios between two neighboring measuring points are the same.

- Power sweep

Power sweep is adopted for power-sensitive parameters, such as gain compression or AGC (automatic gain control) slope. Power sweep is conducted in CW Time. The maximum available sweep range is 25dB and the default power sweep range is -15dBm to +10dBm. During sweep, the power is swept with scattered step value from start value to end value and the step size is decided by Sweep spot number and power range.

- CW Time

For this sweep type, Analyzer is set to single sweep frequency. The measuring data is sampled continuously and precisely in time interval decided by Sweep time and measuring points, showing the change of measuring data over time.

- Segment sweep

This sweep type is made up with several segments, each of which can be defined with independent power level, IF bandwidth and Sweep time. When calibrations are completed for all segments, Measures can be conducted for one or more segments. The segments are defined in the sequence of frequency increase and the frequency range cannot overlap. The attenuator setting for power level of all segments must be the same so as to prevent the attenuator from being damaged by frequent switching of attenuator. When the attenuator setting for current defined segment is different from that for defined segment, Analyzer will automatically change the power level and attenuator setting of defined segment.

### 4. 5. 2. Setting of Sweep Type

#### 4. 5. 2. 1. Setting of sweep type - linear frequency

- By mouse or touch screen
  - 1) Click **[Stimulus]**, then click **[Sweep Type...]** in menu **[Sweep]** to show Sweep Type dialog box.
  - 2) Click **[Linear Frequency]** option button in Sweep Type.
  - 3) Set start frequency, stop frequency and Sweep spot number in Sweep Feature.
  - 4) Click **[OK]** to close the dialog box.

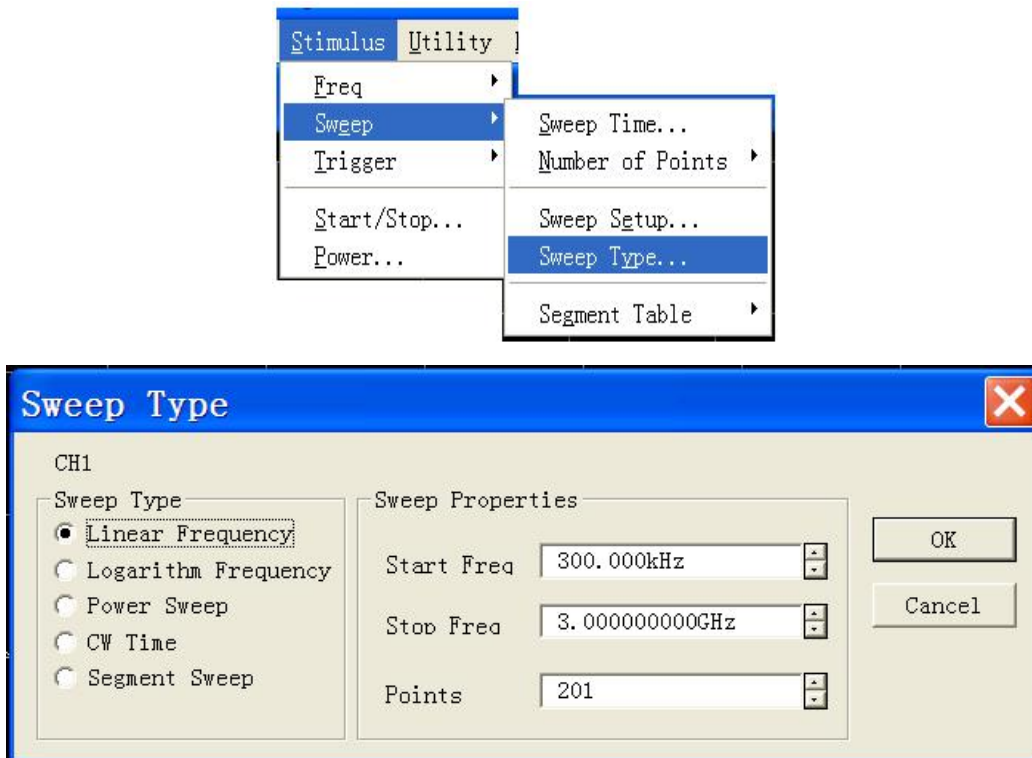
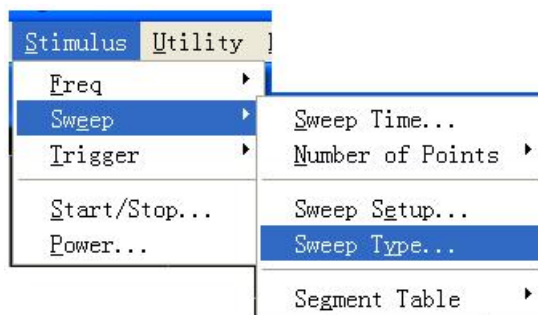


Fig.4-11 Setting of Sweep Type - Linear Frequency

- By front panel keys
  - 1) Press **[Sweep]** in STIMULUS area and press the soft-key in soft-key menu corresponding to **[Sweep Type]**.
  - 2) Press the soft-key corresponding to **[Linear Frequency]** to select the sweep type.
  - 3) Press **[Start]** in STIMULUS area and enter start frequency in Start Frequency box; press **[Stop]** in STIMULUS area and enter stop frequency in Stop Frequency box.
  - 4) Press **[Sweep Setup]** in STIMULUS area, press the soft-key corresponding to **[Number of Points]** and enter Sweep spot number in Number of Points box.

#### 4. 5. 2. 2. Setting of sweep type - logarithm frequency

- By mouse or touch screen
  - 1) Click **[Stimulus]**, then click **[Sweep Type...]** from menu **[Sweep]** to show Sweep Type dialog box.
  - 2) Click **[Logarithm Frequency]** option button from Sweep Type.
  - 3) Set start frequency, stop frequency and Sweep spot number in Sweep Feature.
  - 4) Click **[OK]** to close the dialog box.



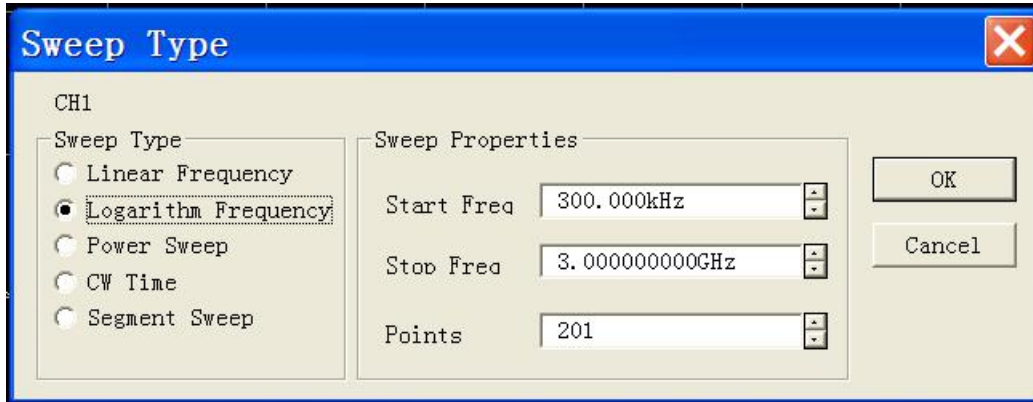
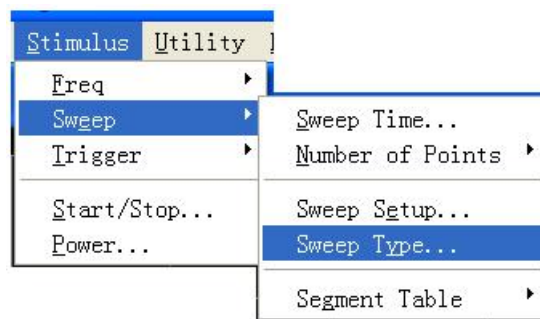


Fig. 4-12 Setting of Sweep Type - Logarithmic Frequency

- By front panel keys
  - 1) Press **[Sweep]** key in STIMULUS area and press the soft-key in soft-key menu corresponding to **[Sweep Type]**.
  - 2) Press the soft-key corresponding to **[Logarithm Frequency]** to select the sweep type.
  - 3) Press **[Start]** in STIMULUS area and enter start frequency in start frequency box; press **[Stop]** in Stimulus area and enter stop frequency in stop frequency box.
  - 4) Press **[Sweep]** in STIMULUS area, press the soft-key corresponding to **[Number of Points]** and enter Sweep spot number in Number of Points box.

#### 4. 5. 2. 3. Setting of power sweep type

- By mouse or touch screen
  - 1) Click **[Stimulus]**, then click **[Sweep Type...]** from menu **[Sweep]** to show dialog box Sweep Type.
  - 2) Click **[Power Sweep]** option button from Sweep Type.
  - 3) Set start power, stop power and center frequency in Sweep Feature.
  - 4) Click **[OK]** to close the dialog box.



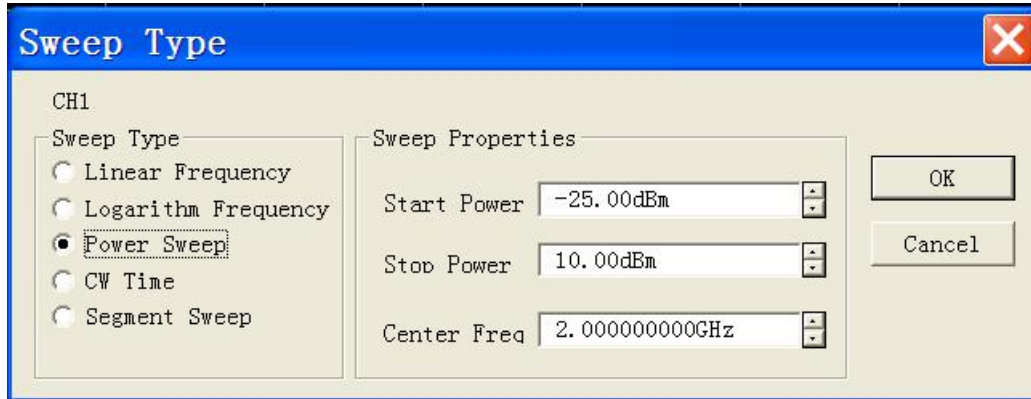
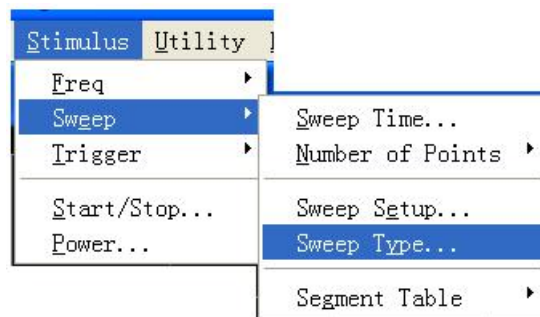


Fig. 4-13 Setting of Power Sweep Type

- By front panel keys
  - 1) Press **[Sweep]** in STIMULUS area and press the soft-key on soft-key menu corresponding to **[Sweep Type]**.
  - 2) Press the soft-key corresponding to **[Power Sweep]** to select the sweep type.
  - 3) Press **[Start]** in STIMULUS area to show corresponding soft-key menu. Press soft-key corresponding to **[CW Frequency]** and enter center frequency value in CW Frequency box.
  - 4) Press **[Sweep]** in STIMULUS area, press in soft-key menu the soft-key corresponding to **[Power]**; press in submenu the soft-key corresponding to **[Start Power]** and input start power in Start Power box; press the soft-key corresponding to **[Stop Power]** and enter stop power in Stop Power box.

#### 4. 5. 2. 4. Setting of CW Time sweep type

- By mouse or touch screen
  - 1) Click **[Stimulus]**, then click **[Sweep Type...]** from menu Sweep to show Sweep Type dialog box.
  - 2) Click **[CW Time]** option button from Sweep Type.
  - 3) Set center frequency, Sweep time and Sweep spot number in Sweep Feature.
  - 4) Click **[OK]** to close the dialog box.



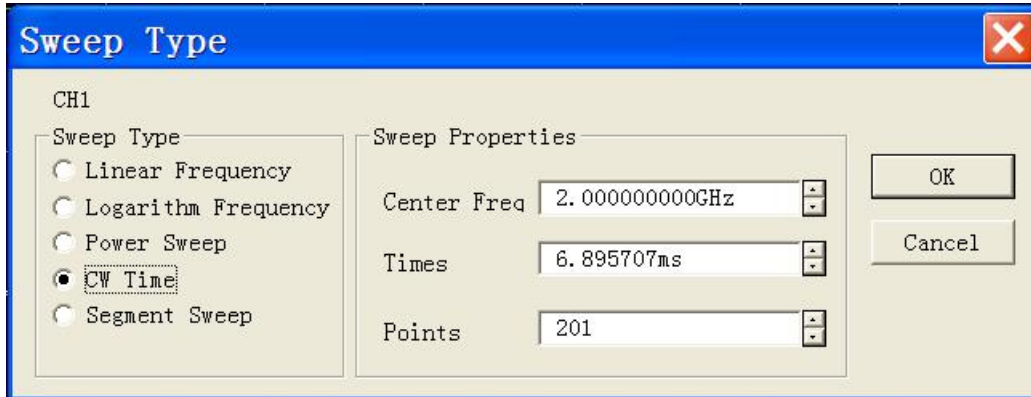


Fig.4-14 Setting of CW Time Sweep Type

- By front panel keys
  - 1) Press **[Sweep]** in STIMULUS area and press the soft-key in soft-key menu corresponding to **[Sweep Type]**.
  - 2) Press the soft-key corresponding to **[CW Time]** to select the sweep type.
  - 3) Press **[Start]** in STIMULUS area to show corresponding soft-key menu. Press soft-key corresponding to **[CW Time]** and enter center frequency value in CW Frequency.
  - 4) Press **[Sweep Setup]** in STIMULUS area, press the soft-key corresponding to **[Sweep Time]** and enter Sweep time in Sweep Time box; press the soft-key corresponding to **[Number of Points]** and enter Sweep spot number in Number of Points.

#### 4. 5. 2. 5. Setup of segment sweep type

- By mouse or touch screen
  - 1) Click **[Stimulus]**, then click **[Sweep Type...]** from menu [Sweep] to show the dialog box of Sweep Type.
  - 2) Click **[Segment Sweep]** option button from Sweep Type.
  - 3) Click **[OK]** to close the dialog box.

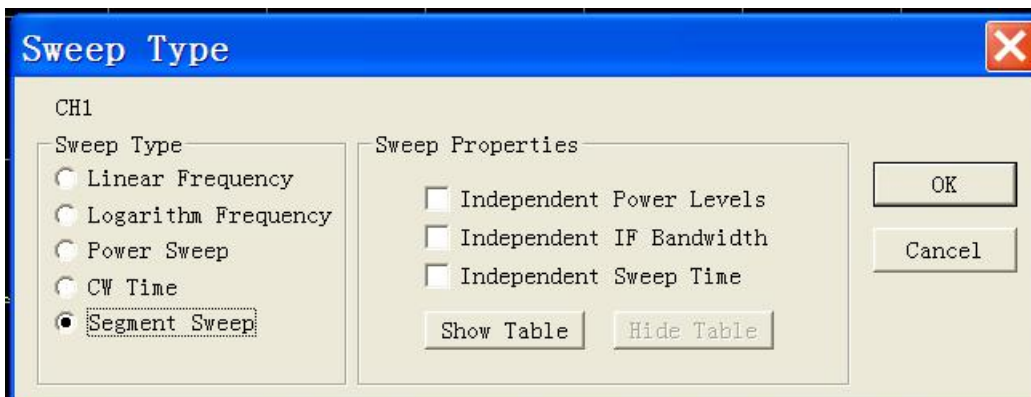
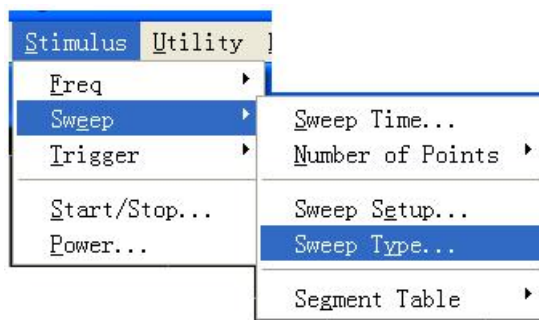




Fig.4-15 Setup of Segment Sweep Type

- Options in Sweep Feature zone
  - ◆ **[Independent Power Level]** check box: when selected, independent power level can be set for each segment which must be of the same attenuator setting.
  - ◆ **[Independent IF Bandwidth]** check box: when selected, independent IF bandwidth can be set for each segment.
  - ◆ **[Independent Sweep Time]** check box: when selected, independent Sweep time can be set for each segment.
  - ◆ **[Show Table]** button: click the button to show segment table, then create and edit the segment table.
  - ◆ **[Hide Table]** button: click to hide segment sweep list.

- By front panel keys

- 1) Press **[Sweep]** in STIMULUS area and press the soft-key in soft-key menu corresponding to **[Sweep Type]**.
- 2) Press the soft-key corresponding to **[Segment Sweep]** to select the sweep type.
- 3) Press the soft-key corresponding to **[Segment Table on | OFF]** to show segment table for edit.

#### 4. 5. 2. 6. Insertion and deletion of segment

The segment table can be edited only when it's in display status.

- By mouse or touch screen

- 1) Click **[Stimulus]**, point to **[Segment Table]** in Sweep submenu to show the submenu of segment table.
- 2) Select **[Show Table]** in Segment Table submenu.
- 3) Click **[Insert Segment]** in Segment Table submenu to insert a new segment before the selected segment.
- 4) Click **[Delete Segment]** in Segment Table submenu to delete all selected segments. Click **[Delete All Segment]** to delete all segments.

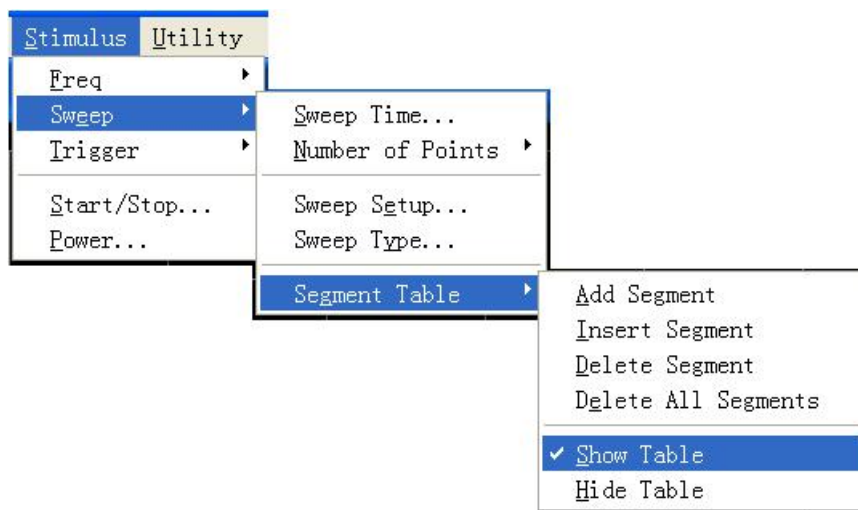


Fig. 4-16 Insertion and Deletion of Segment

- By front panel keys

- 1) Press **[Sweep]** in STIMULUS area to show corresponding soft-key menu.
- 2) Press the soft-key corresponding to **[Segment Table]** menu and press the soft-key corresponding to **[Segment Table on | OFF]** to show segment table.
- 3) Press the soft-key corresponding to **[Insert Segment]** menu to insert a new segment before the selected segment.

- 4) Press the soft-key corresponding to **[Delete Segment]** menu to delete all selected segments.

When the last segment of the segment table is ON, Analyzer will add automatically one segment in OFF; when the last segment of the segment table is in Stimulus status, several segments can be added quickly by continuously pressing [↓] in ADJUST area or turning the knob.

#### 4. 5. 2. 7. Edit segment table

- By mouse or touch screen
  - 1) Double click **[State]** for segment, select ON or OFF to open or close segment.
  - 2) Double click **[Start]** for segment and enter start frequency of the segment.
  - 3) Double click **[Stop]** for segment and enter stop frequency of the segment.
  - 4) Double click **[Points]** for segment and enter Sweep spot number of the segment.
  - 5) Double click **[PWR]** for segment and enter power level of the segment (when Independent Power Level option is enabled).
  - 6) Double click **[IFBW]** for segment and enter IF bandwidth (when Independent IF Bandwidth option is enabled).
  - 7) Double click **[Time]** for segment and set Sweep time (when Independent Sweep Time option is enabled).
- By front panel keys
  - 1) Press [△], [▽] in ADJUST area or turn the knob to select the segment to be edited.
  - 2) Press [□]、[□] in ADJUST area to **[Status]**, press [←/off] in ENTRY area to enable submenu, press [△], [▽] or turn the knob to select ON and press [←/off] to select enabled segment. When OFF is selected, the segment will be closed.
  - 3) Press [□]、[□] to **[Start]**, press [←/off] in Stimulus Input box, then enter start frequency.
  - 4) Press [□]、[□] in **[Stop]**, press [←/off] in Stimulus Input box, then enter stop frequency.
  - 5) Press [□]、[□] in **[Points]**, press [←/off] in Stimulus Input box, then enter Sweep spot number.
  - 6) Press [□]、[□] in **[PWR]**, press [←/off] in Stimulus Input box, and then enter power level (when Independent Power Level option is enabled).
  - 7) Press [□]、[□] in **[IFBW]**, press [←/off] in Stimulus Input box, then enter IF bandwidth (when Independent IF Bandwidth option is enabled).
  - 8) Press [□]、[□] in **[Time]**, press [←/off] in Stimulus Input box, then enter Sweep time (when Independent Sweep Time option is enabled).

#### 4. 5. 3. Sweep Time

When Measure settings are completed, Analyzer will adopt the fastest Sweep time as possible, but more Sweep time may be added to meet specific Measure needs. The maximum settable Sweep time is 86400 seconds. If Sweep time is set to be 0 second, Analyzer will select automatically the fastest Sweep time. When Sweep time is more than or equal to 300 milliseconds, Analyzer will display a Sweep indicator to indicate a point-to-point Measure Sweep. Sweep indicator is an upward small arrow, pointing to the point on the Trace which just finished Measure.

##### 4. 5. 3. 1. Setting of Sweep time

- By mouse or touch screen
  - 1) Click **[Stimulus]**, then click **[Sweep Time...]** in menu Sweep to show Sweep Time dialog box.
  - 2) Enter Sweep time in **[Sweep Time]** box.

- 3) Click **[OK]** to close the dialog box.

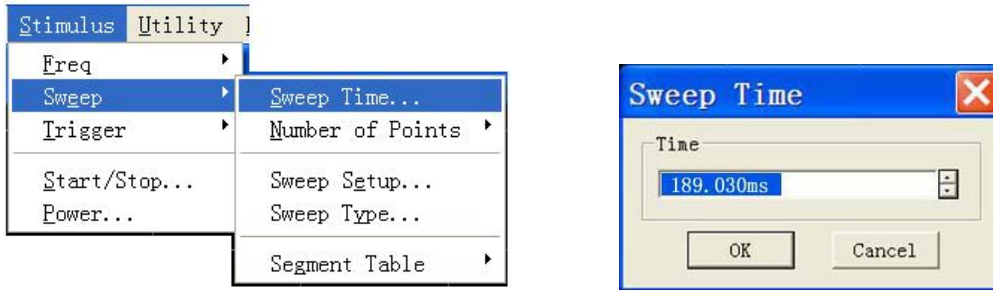


Fig. 4-17 Setting of Sweep Time

- By front panel keys
  - 1) Press **[Sweep]** in STIMULUS area.
  - 2) Press the soft-key corresponding to **[Sweep Time]** and enter Sweep time in Sweep time box.

#### 4. 5. 3. 2. Sweep Setup

- By mouse or touch screen
  - 1) Click **[Stimulus]**, then click **[Sweep Setup...]** in menu Sweep to show Sweep Setup dialog box.
  - 2) Click **[Channel]** to select setting channel.
  - 3) If the default Step Sweep mode is adopted, click **[Dwell Time]** and set the dwell time of each measuring point; if analog sweep mode takes priority, clear **[Step Sweep]**.
  - 4) If Alternate Sweep mode is to be selected, select **[Alternate Sweep]**.
  - 5) If external fixed amplitude is needed, select **[External ALC]**.
  - 6) After setting, click **[OK]** to close the dialog box.

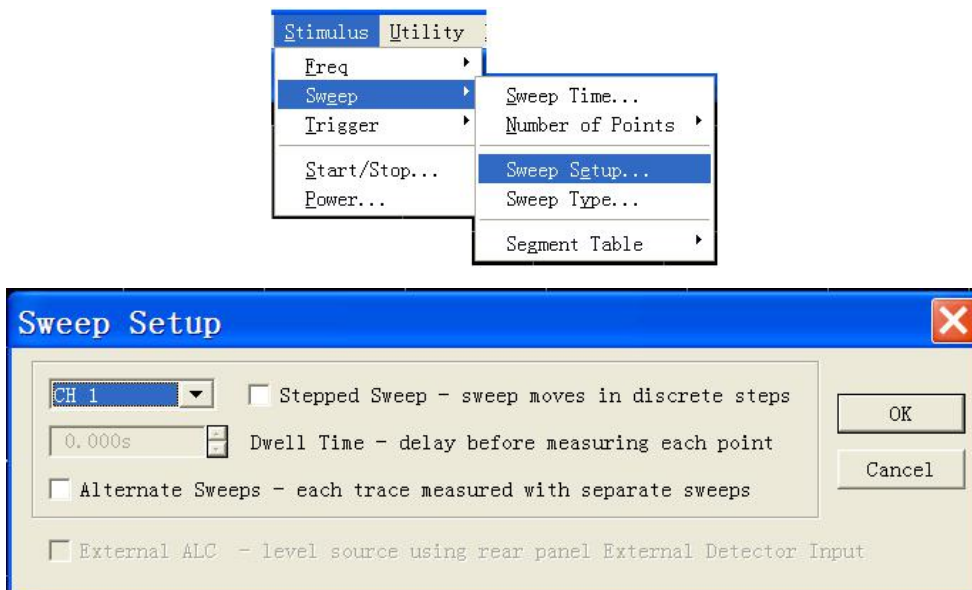


Fig. 4-18 Sweep Setup

- By front panel keys
  - 1) Press **[Sweep]** key in STIMULUS area to show corresponding soft-key menu. Press the soft-key corresponding to **[Sweep Setup...]** to show Sweep Setup dialog box.

- 2) Press [□]、[□] in ADJUST area to **[Channel]**. Press [△]、[▽] in ADJUST area or turn the knob to select channel setting.
- 3) If the default Step Sweep mode is adopted, press [□]、[□] in **[Dwell Time]** to set dwell time of each measuring point.
- 4) If Alternate Sweep mode is to be selected, press [□]、[□] in **[Alternate Sweep]**, and press **[Click]** to select the check box.
- 5) If external fixed amplitude is needed, press [□]、[□] in **[External ALC]**, and press **[Click]** to select the check box.
- 6) After setting, press **[OK]** in ENTRY area to close the dialog box.

#### 4. 5. 3. 3. Sweep Setup dialog box

- **[Channel]** box:

Select the channel adaptable to Sweep Setup.

- **[Step Sweep]** check box

When Step Sweep mode is selected, the source will be tuned to a frequency measuring point, waiting for measuring of this frequency point after a specified dwell time, and then it will be tuned to the next frequency point. This working mode is slower than Analog Sweep mode, but can conduct precise Measure for devices with long electrical delay. When this check box is cleared, Analyzer may operate either in Analog Sweep mode or Step Sweep mode, which depends on the setting of Sweep time and IF bandwidth but preferentially selects Analog Sweep mode based on Measure settings.

- **[Dwell Time]** input box

It will appoint the dwell time of Analyzer at each point before Measure data is obtained, which is suitable for Step Sweep working mode only.

### 4. 6. Selecting Triggering Mode

Trigger signal is the signal controlling the Analyzer for Sweep Measure. Trigger settings determines the Sweep mode of Analyzer and when the sweep stops and returns to hold mode. The Analyzer is quite flexible in trigger function settings.

#### 4. 6. 1. Simple Trigger Settings

Simple trigger settings can set the trigger mode for the current Stimulus channel only.

- By mouse or touch screen

- 1) Click **[Stimulus]** and point to **[Trigger]** in Stimulus menu to show the submenu of Trigger.
- 2) Select the trigger mode needed in the submenu.

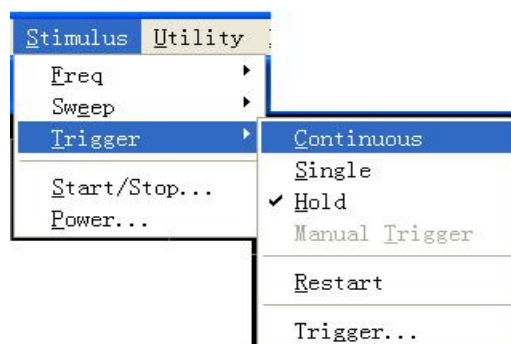


Fig. 4-19 Simple Trigger Mode

- By front panel keys

- 1) Press **[Trigger]** in STIMULUS area to show corresponding soft-key menu.
- 2) Press the corresponding soft-key to select the trigger mode needed.

### 4. 6. 2. Detailed Trigger Settings

#### 4. 6. 2. 1. By mouse or touch screen

- 1) Click **[Stimulus]**, point to Trigger in Stimulus menu and click **[Trigger...]** in the submenu of Trigger to show Trigger dialog box.
- 2) Complete trigger settings in the dialog box.
- 3) After setting, click **[OK]** to close the dialog box.

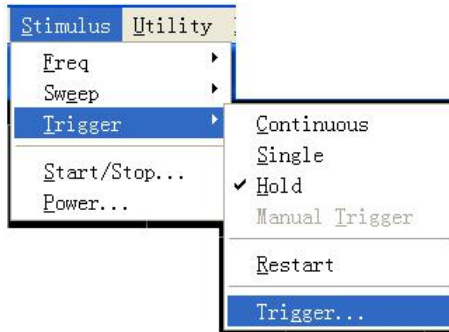


Fig. 4-20 Submenu of Trigger

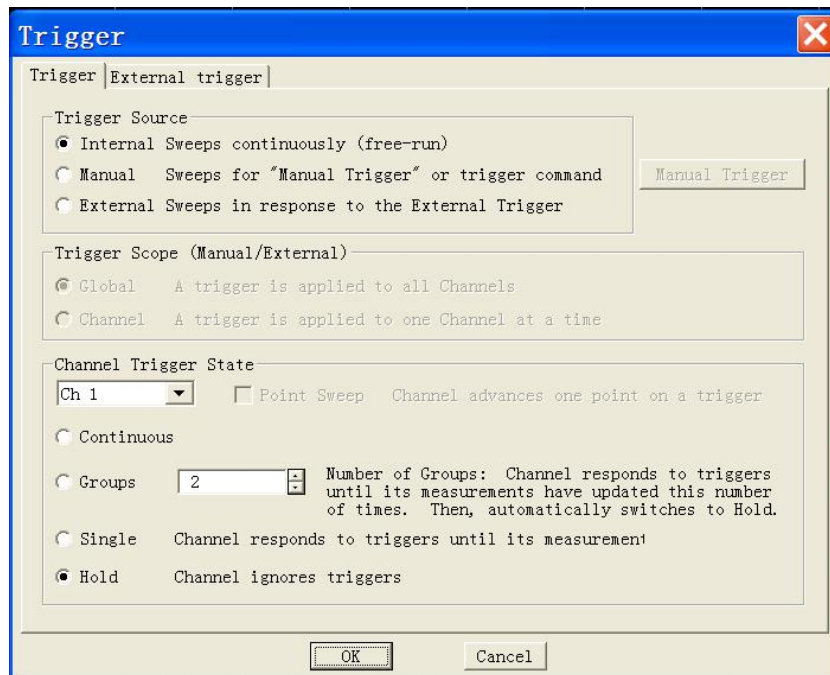


Fig. 4-21 Trigger Dialog Box

#### 4. 6. 2. 2. By front panel keys

- 1) Press **[Trigger]** Key in STIMULUS area to show corresponding soft-key menu.
- 2) Press the soft-key corresponding to **[Trigger...]** to show Trigger dialog box.
- 3) Complete trigger settings in the dialog box.

- 4) After setting, press **[OK]** key in ENTRY area to close the dialog box.

#### 4. 6. 2. 3. Trigger dialog box

##### ● Trigger Source

Trigger source settings determine where the trigger signal is from. Effective trigger signal will yield only when the Analyzer is not Sweep. The Analyzer may select 3 types of trigger source: internal, manual and external. Once the trigger source is set, the Analyzer will apply this trigger source to all channels.

- [Internal] (default)
  - ◆ The Analyzer will automatically control the generation of trigger signal.
  - ◆ The Analyzer will generate a trigger signal immediately after a Measure.
- [Manual]
  - ◆ Manual trigger signal may be created by the following averages:
  - ◆ Click [Manual Trigger] in Trigger dialog box.
  - ◆ Press the Trigger key in front panel and press the corresponding soft-key to [Manual Trigger] in soft-key toolbar.
  - ◆ Call program control command.
- [External]
  - ◆ Trigger signal is input from external trigger input connector on the rear panel.
  - ◆ The signal is TTL level.
  - ◆ Level trigger, active level (high active or low active) is set via External Trigger dialog box.
  - ◆ Pulse width shall be at least 1us but not longer than Sweep time (several triggers may be aroused when pulse width is longer than Sweep time).

##### ● Trigger Scope zone

Trigger range settings determine what Measure channels of Analyzer will receive trigger signal. There are two settings for trigger range: **All** and **Channel**:

- [All]

This is the default setting for Analyzer. All the other channels will receive trigger signal except for the channel in **Hold** mode.

- [Channel]

Only the next channel not in **Hold** mode will receive trigger signal. When Measure is completed for the current channel, Analyzer will select automatically the next channel to receive trigger signal. All the other channels will be selected in order except for the channel in **Hold** mode. This setting has no evident influence on Measure unless **Trigger Source** is set to be manual status. When **Channel** setting is selected, **spot sweep** function will be available.

##### ● Channel Trigger State zone

Trigger settings determine how many trigger signals will be received by one channel. There are four channel trigger status:

- [Continuous]

The channel will receive unlimited trigger signals and continue to sweep.

- [Group]

The channel will receive the trigger signal with the number specified in [Group] input box to conduct Sweep for specified times and

then enter into Hold mode.

- [Single]

The channel will receive one trigger signal to conduct one Sweep, and then enter into Hold mode.

- [Hold]

The channel will not receive trigger signal and stop Sweep.

- [Channel Selection]

Select the channel adaptable to trigger settings.

- [Spot Sweep]

This trigger mode can be selected only when trigger source is manual or external and trigger range is channel. Under spot sweep mode, when the channel receives trigger signal, the next data point in the Sweep will be measured. The channel will receive trigger signal until all Measures in the channel are complete, and then it will trigger the next channel not in Hold mode.

#### 4. 6. 2. 4. External trigger dialog box

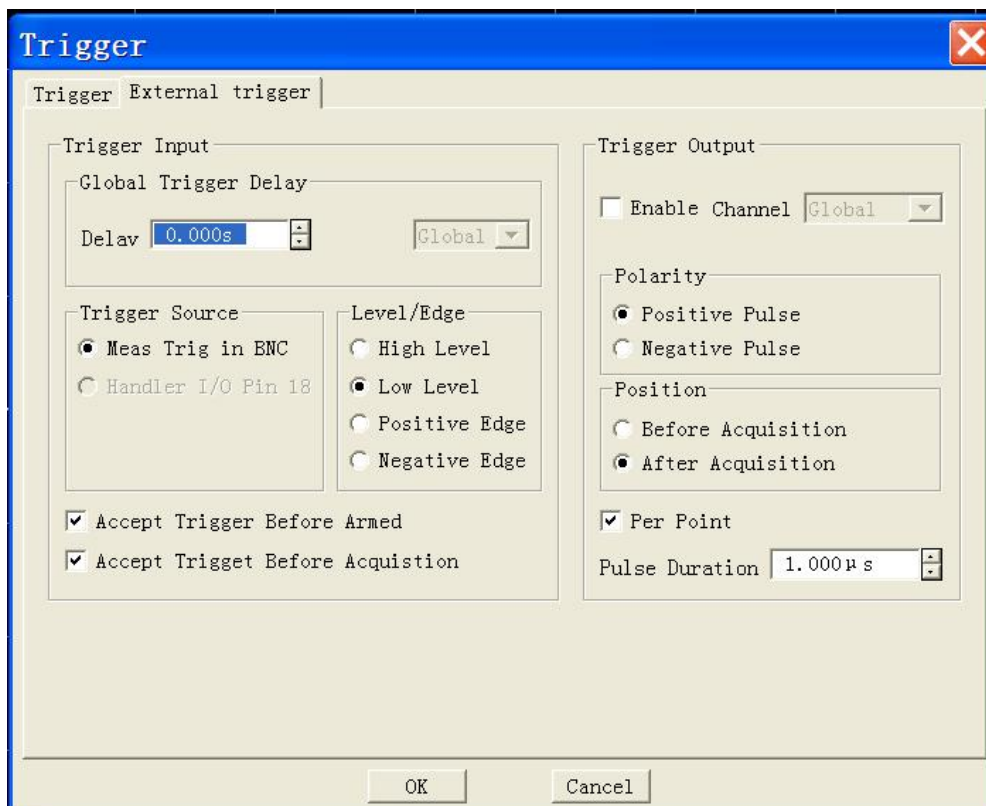


Fig. 4-22 External Trigger Dialog Box

- **Trigger input zone**

- Global trigger delay zone

When external trigger signals are received, the Analyzer will start Sweep after the delay time as set in Time Delay dialog box.

- Trigger source zone

It can be set that through which rear panel connector the Analyzer will receive trigger signals.

- Level/edge zone

- ◆ High level

When the Analyzer is ready for triggering, it will trigger at the high level of the selected TTL input signal.

- ◆ Low level

When the Analyzer is ready for triggering, it will trigger at the low level of the selected TTL input signal.

- ◆ Positive edge

When the Analyzer is ready for triggering, it will trigger at the next rising edge of the received signal.

- ◆ Negative edge

When the Analyzer is ready for triggering, it will trigger at the next falling edge of the received signal.

- **Trigger output zone**

- Enable channel

When selected, it may trigger output.

- Polarity zone

Set the polarity of trigger output.

- Position zone

Set where the trigger output may occur and the width of trigger pulse.

## 4. 7. Selecting Data Format and Scale

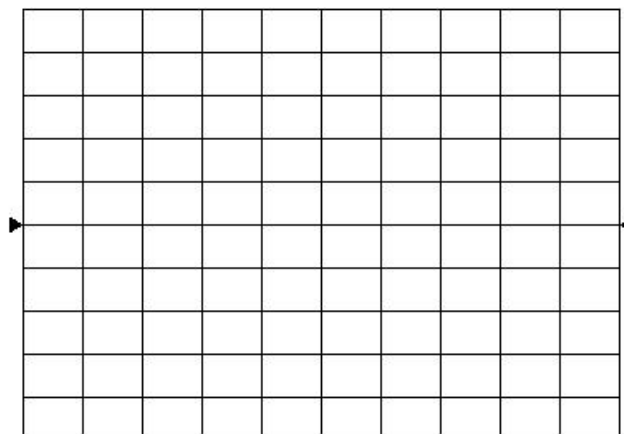
Data format refers to the way the Analyzer graphically displays Measure data. The data format most suitable for understanding the property of measured piece shall be selected during the Measure. This section introduces 9 data formats and how to set the scale so as to better display measuring information.

### 4. 7. 1. Data Format

#### 4. 7. 1. 1. Rectilinear coordinate format

7 among the 9 data formats display measuring data information in rectilinear coordinate, which is also called Descartes format, X/Y format or linear grid format. This is most suitable for displaying frequency response information of the measured piece. Rectilinear coordinate will display the following information:

- By default, X axis displays stimulus value in linear scale (frequency, power or time).
- Y axis displays the corresponding response value at different stimulus values.





**Fig. 4-23 Rectilinear Coordinate Format**

The 7 data formats displayed in rectilinear coordinate are:

- Log-magnitude format
  - Display magnitude information (without phase information).
  - Y axis unit: the unit is dB when ratio is measured and it is dBm when non-ratio power is measured.
  - Suitable typical Measure: return loss, insertion loss and gain.
- Phase format
  - Display phase information (without magnitude information).
  - Y axis unit: phase (degree).
  - Suitable typical Measure: linear phase deviation.
- Group delay format
  - Display the transfer time of signal passing through the measured piece.
  - Y axis unit: time (second).
  - Suitable typical Measure: group delay.
- Linear magnitude format
  - Only positive value will be displayed.
  - Y axis: no unit (U) when ratio is measured and the unit is watt (W) when non-ratio power is measured.
  - Suitable typical Measure: reflectance and transfer factor (magnitude value), time domain transformation.
- SWR format
  - It display reflection Measure data through the formula:  $(1+p)/(1-p)$ , in which  $p$  is the reflectance.
  - It is effective only reflection Measure is conducted.
  - Y axis: no unit.
  - Suitable typical Measure: standing wave ratio format.
- Real format
  - Display the real part of measuring complex data.
  - Similar with linear magnitude format, but may display positive and negative value.
  - Y axis: no unit.
  - Suitable typical Measure: time domain Measure, auxiliary input voltage signal Measure for maintenance purpose.
- Imaginary format
  - Display the imaginary part of measuring complex data only.
  - Y axis: no unit.
  - Suitable typical Measure: impedance Measure when matching network is designed.

#### 4. 7. 1. 2. Polar coordinate format

Polar coordinate format includes magnitude and phase information, and the vector value is read by the following averages:

- The magnitude for any point is determined by the displacement from this point to the center point (or zero point). By default, the magnitude is in linear scale and the outer circle is set to be at the ratio 1.
- The phase value of any point is determined by its included angle to X axis.
- As there is no frequency information, frequency information is read through marker. By default, the marker format is real/imaginary part. The other formats may be selected through the Marker dialog box in Marker menu.

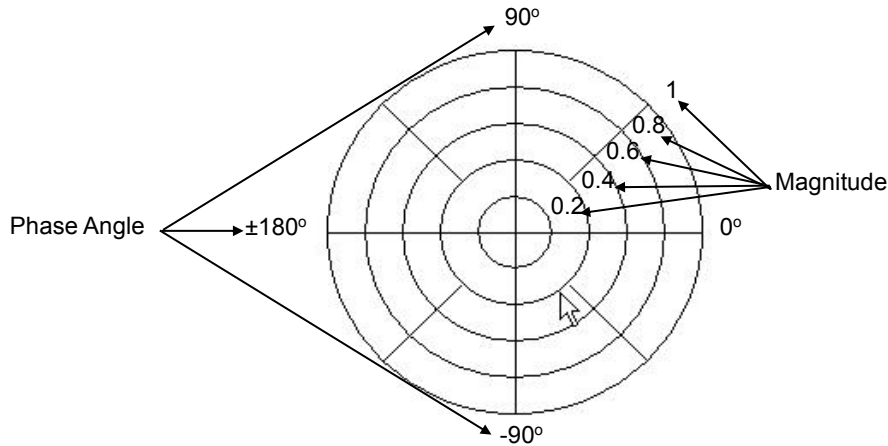


Fig. 4-24 Polar Coordinate Format

### 4. 7. 1. 3. Smith Chart format

Smith Chart is a tool for mapping the reflection Measure data of the measured piece to impedance. Each point on the chart represents one complex impedance made up of real resistance (R) and virtual reactance ( $\pm jX$ ). The resistance value, reactance value and reactance equivalent capacitance or inductance of the measured piece may be read through the marker.

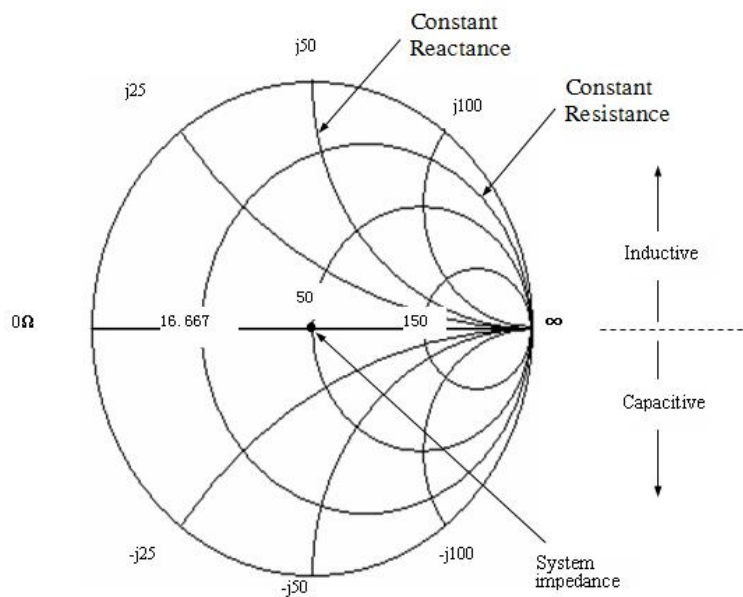


Fig. 4-25 Smith Chart Format

- The central horizontal axis of Smith Chart represents pure resistance, and the center point of horizontal axis represents system impedance; the far left resistance is zero which represents short circuit; the far right resistance of horizontal axis is infinite which represents enabled circuit.

- On the chart, the points on the circle intersecting with horizontal axis have the same resistance value.
- On the chart, the points on the circle (or arc) tangent with horizontal axis have the same resistance value.
- On the chart, the reactance of the upper part is positive, therefore it's inductive zone; the reactance of the lower part is negative, therefore it's capacitive zone.

#### 4. 7. 2. Setting of Data Format

- By mouse or touch screen
  - 1) Click **[Response]** and point to **[Format]** in Response menu to show the submenu of Format.
  - 2) Select the format needed in the submenu.

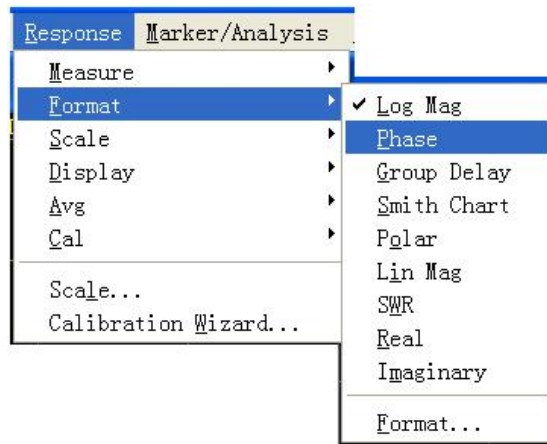


Fig. 4-26 Data Format Settings

- By front panel keys
  - 1) Press **[Format]** key in RESPONSE area to show corresponding soft-key toolbar.
  - 2) Press the corresponding soft-key to select the format needed.

#### 4. 7. 3. Scale

Scale is used to set the scale of the vertical part of grid shown. In Polar coordinate format or Smith Chart format, it is used to set the full scale of the outer circle. The scale and format settings determine the display mode of measuring data on the screen. In Logarithmic format, the scale setting range is: 0.001dB/grid - 500dB/grid.

##### 4. 7. 3. 1. By mouse or touch screen

- 1) Click **[Response]**, point to **[Scale]** in Response menu to show submenu. Click **[Scale...]** to show Scale dialog box.
- 2) Click the corresponding input zone or button to set suitable scale, reference position and reference value.
- 3) After setting, click **[OK]** button to close the dialog box.

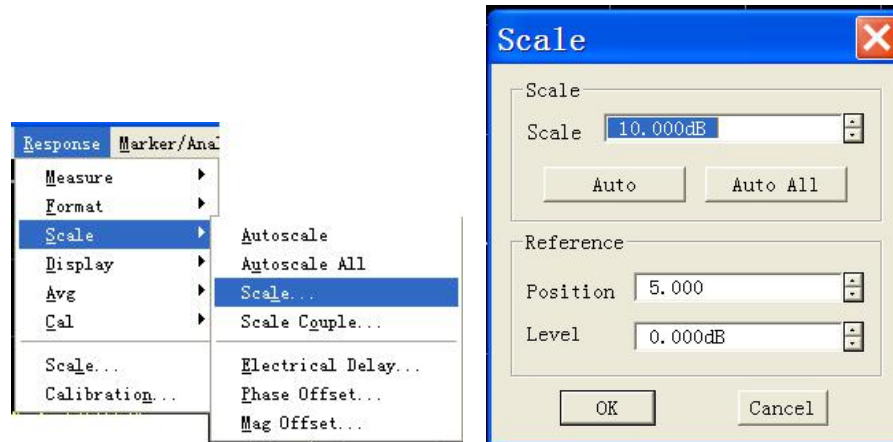


Fig. 4-27 Scale Settings

#### 4. 7. 3. 2. By front panel keys

- 1) Press **[Scale]** in RESPONSE area to show corresponding soft-key toolbar.
- 2) Press the soft-key corresponding to **[Autoscale]** and Analyzer will set automatically suitable scale and reference level.
- 3) Press the soft-key corresponding to **[Scale]** and set suitable scale in Scale Per division.
- 4) Press the soft-key corresponding to **[Reference Level]** and set reference level in Reference Level.
- 5) Press the soft-key corresponding to **[Reference Position]** and set suitable reference position in Reference Position.

#### 4. 7. 3. 3. Scale settings dialog box

- Scale zone

- **[Scale]**

Set the scale.

- **[Auto Scale]**

Click **[Auto Scale]** button, the Analyzer will select automatically vertical scale to better show the Active Trace in the vertical grid of the screen. The stimulus value is not influenced, but the scale and reference value will be changed.

- ◆ The Analyzer will select suitable scaleality factor to show the data in 80% zone of the screen.
- ◆ If the reference position is at the center of the screen, the reference value will select the center value of the Trace on the screen.

- **[Auto All]**

Click **[All Auto Scale]** button, the Analyzer will set suitable scale for all Traces in the window to better show them in the vertical grid of the window.

- Reference setting zone

- **[Position]**

Reference position refers to the position of the reference line in rectangular chart. In the chart, the position of the line at the bottom is 0, the position of the line at the top is 10 and the default value at reference position is 5.

- **[Level]**

Reference value refers to the value of reference line in rectangular coordinates format and the value of outer circle in polar coordinate and Smith Chart format. Its setting range in log-magnitude format is -500dB to +500dB.

## 4. 8. Observing Multi-Trace and Enabling Multichannel

### 4. 8. 1. Measure Settings for Pre-Configuration

The pre-configuration of Analyzer provides a most convenient way to conduct Measure for multi-Trace, multichannel and multi-window. The Analyzer provides for four Measure settings for pre-configuration, each of which, when selected, shall close the current Trace and window and create new Trace and window. The arrangement for the window of the four pre-configurations is as follows:

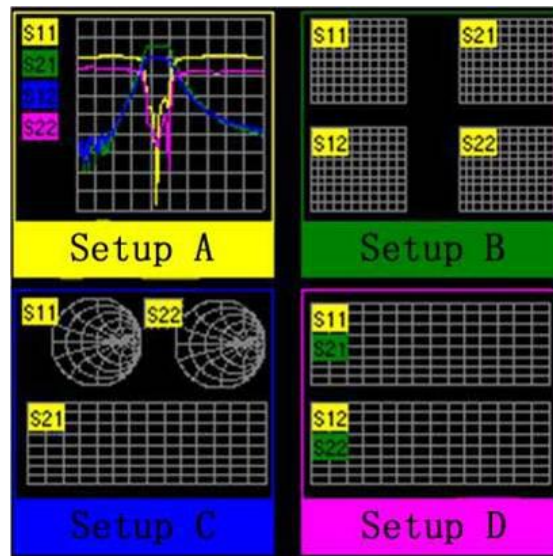


Fig. 4-28 Arrangement for Pre-Configuration Window

- Setup A

Setting A will create four Traces in window 1: S11, S21, S12 and S22, log-magnitude format and channel 1 setting.

- Setup B

Setting B will create four Traces in four windows, log-magnitude format, and channel 1 setting. S11 displays in window 1, S21 displays in window 2, S12 displays in window 3 and S22 displays in window 4.

- Setup C

Setting C will create three Traces in three windows and channel 1 setting. S11, Smith Chart format displays in window 1; S22, Smith Chart format displays in window 2; and S21, log-magnitude format displays in window 3.

- Setup D

Setting D will create four Traces in two windows, two channel settings and log-magnitude format. S11 and S21 display in window 1, channel 1 setting; S12 and S22 display in window 2, channel 2 setting.

#### 4. 8. 1. 1. Pre-Configuration Measure Settings

- By mouse or touch screen

- 1) Click [**Response**], point to [**Display**] in Response menu and select [**Meas Setups**] in the submenu.
- 2) Select the pre-configuration Measure needed in the pop-up dialog box.

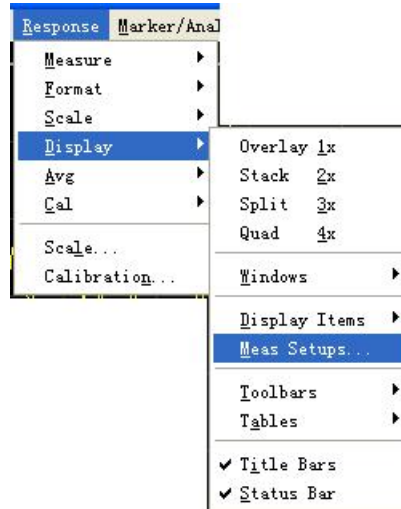


Fig. 4-29 Pre-Configuration Meas Setups

- By front panel keys
  - 1) Press **[Display]** key in RESPONSE area to show corresponding soft-key toolbar.
  - 2) Press **[Meas Setups...]** and press the corresponding soft-key to select pre-configuration Measure.

#### 4. 8. 2. Window Arrangement

The Analyzer provides several methods to adjust window display:

- Move the window and adjust the window of the Analyzer with mouse.
- Arrange the window of the Analyzer with **[Tile]**, **[Cascade]**, **[Minimize]** and **[Maximize]** menu item.
- Click **[Display]** in Response menu and select four window arrangements.
- Adjust or hide the display of Analyzer window by use of **[Minimize]**, **[Maximize/Restore Down]** and **[Close]**.
- Press **[Display]** on Response keypad on front panel to show corresponding soft-key toolbar. Press corresponding soft-key to **[Window]**, select the window to be Stimulus, and press the soft-key corresponding to **[More...]** to set window display.

The **[Display]** menu item in Response menu of Analyzer provides four window arrangements, which can allocate the existing Traces to different windows according to certain arithmetic. The said window arrangement modes include:

- Overlay 1x

For this type of arrangement, all Traces overlaying by each other can be displayed in one window.

- Stack 2x

For this type of arrangement, all Traces can be displayed in two windows which are vertically stacked.

- Split 3x

For this type of arrangement, all Traces can be displayed in three windows, two of which are at the top and one at the bottom.

- Quad 4x

For this type of arrangement, all Traces can be displayed in four windows, each of which takes up 1/4 of the screen.

##### 4. 8. 2. 1. Window arrangement settings

- By mouse or touch screen
  - 1) Click **[Response]** and point to **[Display]** in Response menu to show the submenu.

- 2) Select the arrangement mode of window in the submenu shown.

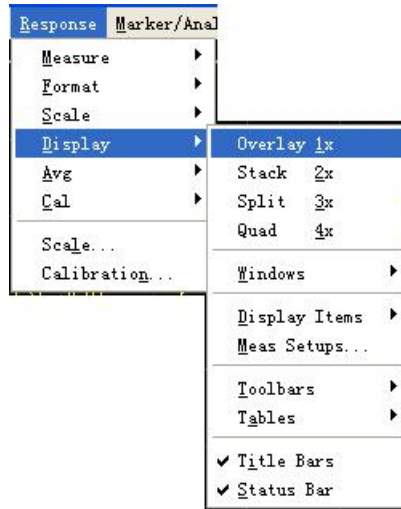


Fig. 4-30 Window Arrangement Settings

- By front panel keys
  - 1) Press [Display] in RESPONSE area to show soft-key toolbar.
  - 2) Press the corresponding soft-key to select the window arrangement mode needed.

### 4. 8. 3. Moving Traces

The Analyzer supports the dragging of mouse to move Traces in Measure window. If the Measure channel for moving Traces is not included in the purpose window, the purpose window will create corresponding channel after Trace movement. The setting method is as follows:

- If there are several Traces in the window, click the up-down arrow button at the Trace status bar for roll display until the Trace status button required shows in the Trace status bar.
- Activate the Trace status button corresponding to the moving Trace with mouse. Press the left key of mouse and hold on.
- Drag the mouse until the mouse pointer turns to motion indicator “”, pull the mouse pointer to Trace status bar of the purpose window, release the left key and the Trace moving is over.

## 4. 9. Setting Analyzer Display

We can define OSD (on screen display) by means of Display menu in Response menu of the Analyzer. Optional screen display elements contain the status bar, tool bar, form, Measure setting, Trace status, title bar, etc., and they are quite useful for observation, setup and Measure modification.

### 4. 9. 1. Status Bar



When the status bar is enabled, it is displayed at the bottom of screen, and displayed contents are as follows:

- Current Stimulus channel
- Measure parameters of current Active Trace
- Display the arithmetical operation carried out by Active Trace when the Trace math function is enabled
- Error modification condition of Stimulus channel
- Average factors of current Stimulus channel and times of average operation carried out are displayed, when average function is

enabled.

- Smoothing spots are displayed when smoothing function is enabled.
- TRANSFORM:ON is displayed when time domain transformation function is enabled.
- GATE:ON is displayed when gate function is enabled.
- GP-IB condition: LOCAL or REMOTE
- Clock reference signal condition: INT or EXT

#### 4. 9. 1. 1. Triggering of status bar display

- By mouse or touch screen

Click **[Response]** once, point at **[Display]** on dropdown menu to get the submenu, click and tick **[Status bar]** to enable status bar display, and remove the tick to close status bar display.

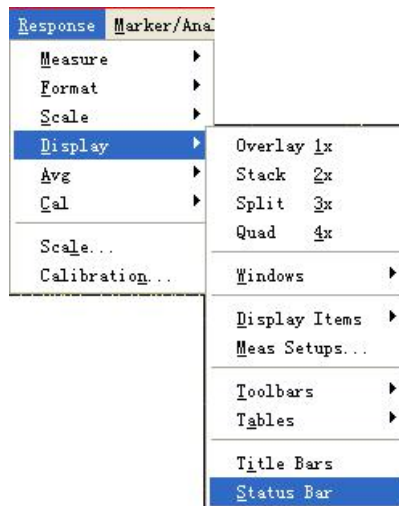


Figure 4-31 Triggering of Status Bar Display

- By front panel keys
  - 1) Press **[Display]** in RESPONSE area, the corresponding soft-key tool bar turns up, and press soft-key corresponding to **[More]**.
  - 2) Press soft-key corresponding to **[Status bar on/OFF]** in the displayed soft-key tool bar to enable the status bar display.

#### 4. 9. 2. Tool Bar

The Analyzer can simultaneously display 6 different tool bars at most, and it is quite easy to set up Measure by the tool bar.

- Active input tool bar



The active input tool bar is displayed at the top of screen and under the menu bar; press different Utility keys on the front panel, different active input tool bars will be displayed, and it is feasible to input corresponding numerical value if names of tool bars correspond to names of keys.

- Marker tool bar



The marker tool bar is used to set up and modify marker, as well as change Analyzer setup. By the marker tool bar, it is feasible to

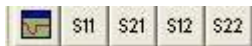




set up:

- Current Stimulus marker
- stimulus value of Stimulus marker
- $\Delta$  marker, carry out maximum/minimum value search, and set up start/stop and center/span stimulus value of the Analyzer according to the marker position.

When the marker tool bar is enabled, if you want to change the position of Stimulus marker by the knob on the front panel, firstly click [Stimulus] frame in the marker tool bar, and then turn the knob to change the marker position, referring to Section 1 “Marker” in Chapter VIII for detailed information about marker.

- Measure tool bar



The Measure tool bar is used to create required S parameter Trace in the current Stimulus window or new window, create S parameter Trace in the current Stimulus window when the leftmost button in the Measure tool bar is uplifted () , and create S parameter Trace in the new window when the button is pressed down () .

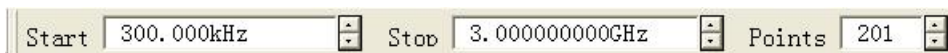
- Sweep control tool bar



Buttons on the sweep control tool bar respectively set up the trigger way of the Stimulus channel to be:

- Hold mode
- Single Sweep, and then enter into Hold mode
- Continuous Sweep

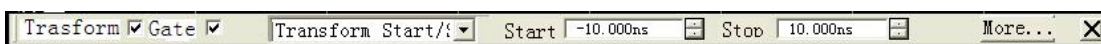
- Stimulus toolbar



The Stimulus toolbar is used to observe and set up sweep activation, and it is able to set up:

- Start stimulus value
- Stop stimulus value
- Sweep spot number

- Time domain toolbar



The following settings can be carried out by using the time domain toolbar:

- Enable or stop the time domain transformation and the time gate functions.
- Change settings of start/stop or center/span of the time domain transformation and the time gate time.
- Click [More...] button to open the Time Domain Transformation dialog box.
- Click [X] button to close the time domain toolbar.

- Close all menus

Click [All OFF] menu, and all toolbars can be closed once.

### 4. 9. 2. 1. Triggering of toolbars display

- By mouse or touch screen
  - 1) Click **[Response]**, point at **[Display]** on the Response menu, and point at **[Toolbars]** on the display submenu.
  - 2) Click the tool bar to be set up in Toolbars submenu, enable toolbar display when checking, and close toolbar display when removing the tick.

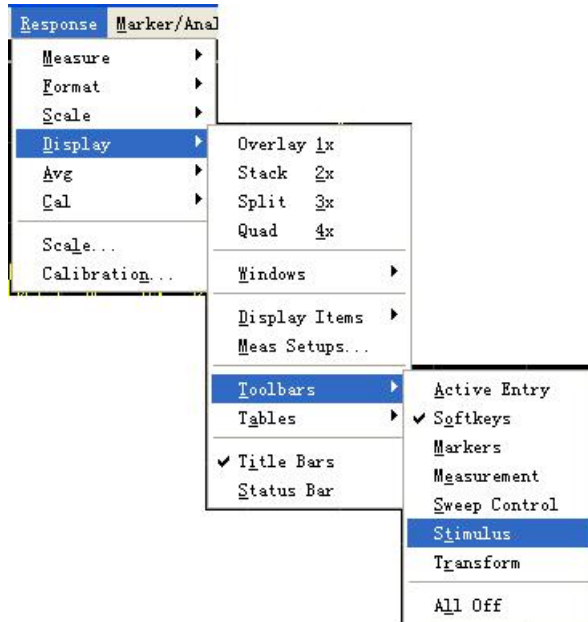


Figure 4-32 Triggering of Toolbars Display

- By front panel keys
  - 1) Press **[Display]** in RESPONSE area to display the corresponding soft-key tool bar, and press soft-key corresponding to **[More]**.
  - 2) Press the soft-key corresponding to **[Toolbars]** to display the Toolbars submenu.
  - 3) Press the wanted toolbar soft-key, enable the toolbar display when it is “On”, and close toolbar display when it is “Off”.

### 4. 9. 3. Tables

The Analyzer can display the marker table, limit table and segment table, and it can observe and modify their settings (can not edit the marker table).

- The table is displayed under the corresponding window.
- Every window can display only one table every time.

#### 4. 9. 3. 1. Marker table

Mkr	Ref	Stimu	Response
1		0.00000s(0...	0.030dB
2		10.000ns(2...	-61.874dB
3		0.00000s(0...	0.030dB
R		0.00000s(0...	0.030dB

Figure 4-33 Marker Table

The marker table is used to display settings of marker, and these settings contain:

- Marker number

- Reference marker (used for the relative Measure)
- stimulus value of marker
- Response valve at the place of marker

#### 4. 9. 3. 2. Limit table

	Type	Begin Stimulus	End Stimulus	Begin Response	End Response	Limit Type
1	MAX	100.000kHz	100.000kHz	-100.000dB	-100.000dB	SLOP
2	MIN	100.000kHz	3.000GHz	-100.000dB	-100.000dB	FLAT
3	OFF	100.000kHz	3.000GHz	-100.000dB	100.000dB	SLOP

Figure 4-34 Limit Table

The limit table is used to display and modify the limit test settings, and these settings contain:

- Type of limit test (MAX, MIN or OFF)
- Start and stop stimulus values of the limit line segment
- Start and stop response values of the limit line segment
- Display type of the limit line segment (SLOT, FLAT or POINT)

#### 4. 9. 3. 3. Segment table

	State	Start	Stop	Points
1	ON	300.000kHz	3.000GHz	21
2	ON	3.000GHz	3.000GHz	21
3	OFF	3.000GHz	3.000GHz	21

Figure 4-35 Segment Table

The segment table is used to set up and modify the segment Sweep, and these settings contain:

- Segment condition (ON/OFF)
- Start and stop stimulus values of the segment
- Sweep spot number of the segment
- Power level (each segment can be set up individually)
- Intermediate-frequency bandwidth (each segment can be set up individually)
- Sweep time (each segment can be set up individually)

#### 4. 9. 3. 4. Triggering of table display

- By mouse or touch screen
  - 1) Click **[Response]**, point at **[Display]** on the Response menu, and point at **[Tables]** on the display submenu.
  - 2) Click the table to set up in the Tables submenu, enable the table display when checking, and close table display when removing the tick.

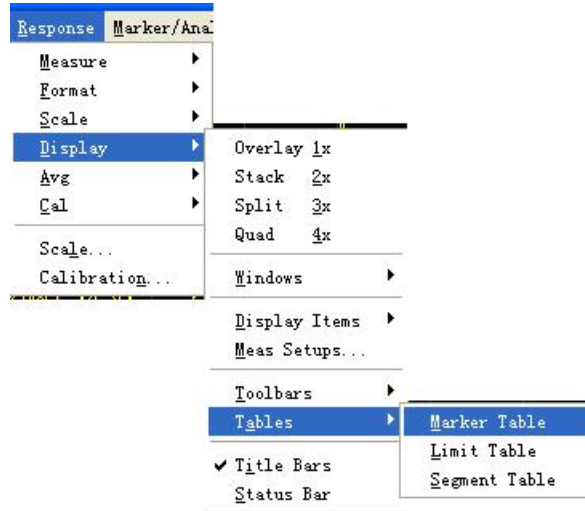


Figure 4-36 Triggering of Tables Display

- By front panel keys
  - 1) Press **[Display]** in RESPONSE area to display the corresponding soft-key tool bar, and press soft-key corresponding to **[More]**.
  - 2) Press the soft-key corresponding to **[Tables]** to display Tables submenu.
  - 3) Press the corresponding soft-key to select the table to be enabled.

#### 4. 9. 4. Measure Display

We can display and hide 6 kinds of Measure information to set up and observe Measure, and the information contains:

- Trace status bar
- Frequency/Activation
- Marker reading
- One marker for each Trace
- Big marker
- Limit test result
- Limit line
- Title

##### 4. 9. 4. 1. Trace status bar

The Trace status bar is displayed above each window on the screen, and displayed contents are as follows:



- Measure parameter and format
- Scale
- Reference value

Clicking the Trace status bar can make the corresponding Trace change to the current Active Trace so as to set up the Trace. Click the right mouse button when the marker is on the Trace status, use right key menu to delete the Trace or set up the scale, color and line type of the Trace.

#### 1) Frequency/stimulus value



The frequency/activation information is displayed under each window on the screen, this display can be hidden for the purpose of keeping secret. The information it displays is as follows:

- Channel No.
- Start stimulus value
- Stop stimulus value

#### 4. 9. 4. 2. Marker reading



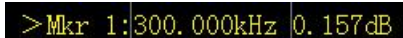
The marker reading information is displayed at the top right corner of each window on the screen, and it displays information as follows:

- Marker No.
- stimulus value of marker
- Response value of marker selection format

#### 4. 9. 4. 3. One marker for each Trace

When checking this item, only 1 marker can be enabled on each Trace.

#### 4. 9. 4. 4. Big marker



When checking this item, the typeface of marker reading becomes bigger.

#### 4. 9. 4. 5. Limit test result

The limit test result (PASS or FAIL) is displayed at the lower right corner of each window.

#### 4. 9. 4. 6. Limit line

The limit line targets at Active Trace display in the designated window, and its position depends on following settings;

- Limit table
- Format
- Scale
- Reference level

#### 4. 9. 4. 7. Title

Each window can have a title, the title can be created by the Title Input dialog box below, and it is displayed at the upper right corner of the window. If you want to remove the title, delete it in [Input] of the dialog box and click [OK] to close the dialog box.

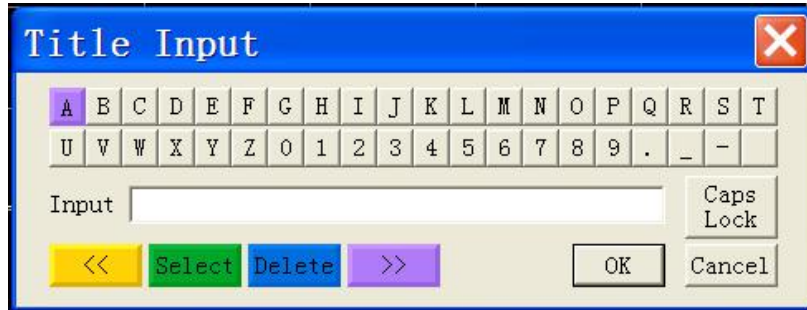


Figure 4-37 Title Input Dialog Box

Refer to the part of “Triggering Measure display” in the section for the method of displaying the Title Input dialog box.

#### 4. 9. 4. 8. Triggering of Measure display

- By mouse or touch screen
  - 1) Click [**Response**], point at [**Display**] on the dropdown menu, and point at [**Display Items**] on the display submenu.
  - 2) Click the Measure display item to be displayed or hidden on the Display Items submenu, show the Measure display item when checking, and hide the Measure display item when removing the tick.

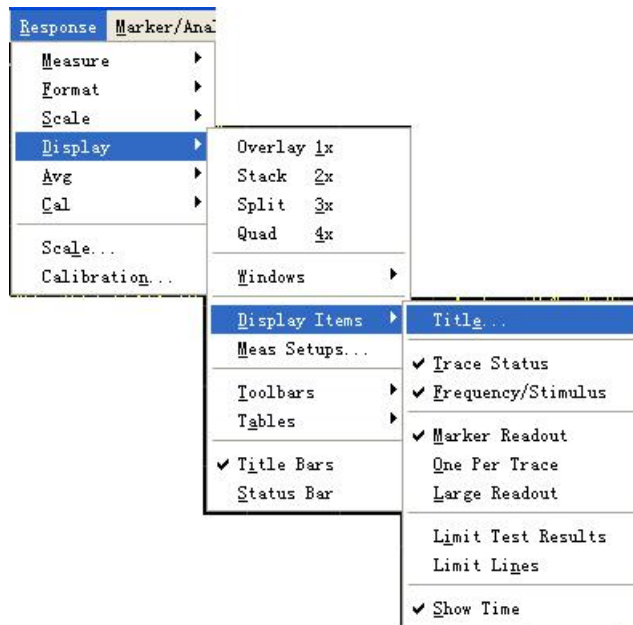


Figure 4-38 Triggering of Measure Display

- By front panel keys
  - 1) Press [**Display**] key in RESPONSE area, and press the soft-key corresponding to [**Display Items**] on the soft-key menu.
  - 2) Press the soft-key corresponding to [**Marker Display**] on the soft-key menu. The three items of [**Mkr Readout ON |off**], [**One per Trace on|OFF**] and [**Larde Readout on|OFF**] will turn up, press the corresponding soft-key to select the desired Measure display.
  - 3) Press [Analysis] in the MKR/ANALYSIS area, the soft-key menu turns up, press the soft-key corresponding to [**Limits**], the [**Limit Test on|OFF**] and [**Limit Line on|OFF**] turn up, and press the corresponding soft-key to select the desired Measure display.

#### 4. 9. 5. Triggering of Data Trace and Memory Trace Display

##### 4. 9. 5. 1. By mouse or touch screen

Click **[Marker/Analysis]**, point at **[Memory]** on the submenu, and click **[Data Trace]** or **[Memory Trace]** on the **Save** menu.  
 Display the corresponding Trace when checking, and hide the corresponding Trace when removing the tick.

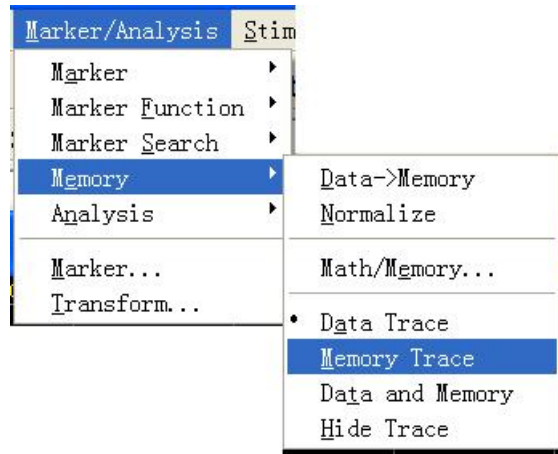


Figure 4-39 Triggering of Data Trace and Memory Trace Display

If you want to observe the saved Trace, you must save the Trace into memory firstly, and then you can carry out arithmetical operation, including plus, minus, multiply and divide on the data Trace and saved Trace. .

#### 4. 9. 5. 2. By front panel keys

Press **[Memory]** in the MKR/ANALYSIS area to display the corresponding soft-key menu, it is feasible to display corresponding Trace when pressing and checking the soft-key corresponding to **[Data Trace]** or **[Memory Trace]**, hide the corresponding Trace when removing the tick.

#### 4. 9. 6. Title Bar

The title bar contains the main Measure applications title bar and window title bar, and it displays window titles and window control buttons. Hiding the title bar is able to hide all title bars on the screen, so that there is a bigger screen to display the Measure result.



#### 4. 9. 6. 1. Triggering of title bar display

- By mouse or touch screen

Click **[Response]**, and click **[Display]** on the submenu, then click **[Title Bars]** on the Display submenu. Display the title bar when checking, and hide the title bar when removing the tick.



Figure 4-40 Triggering of Title Bars Display

- By front panel keys
  - 1) Press **[Display]** in RESPONSE area, the corresponding soft-key tool bar turns up; Press **soft-key** corresponding to **[More]**, and the submenu turns up.
  - 2) Press the soft-key corresponding to **[Title Bar on[OFF]]**, display the title bar when it is “ON”, and hide the title bar when it is “OFF”.

#### 4. 9. 7. User Configuration Display

##### 4. 9. 7. 1. By mouse or touch screen

- Single click **[UTILITY]**, single click **[ConFig]** on the [System] menu, and single click **[User Config...]** on the appearing submenus to display the User Configure dialog box.

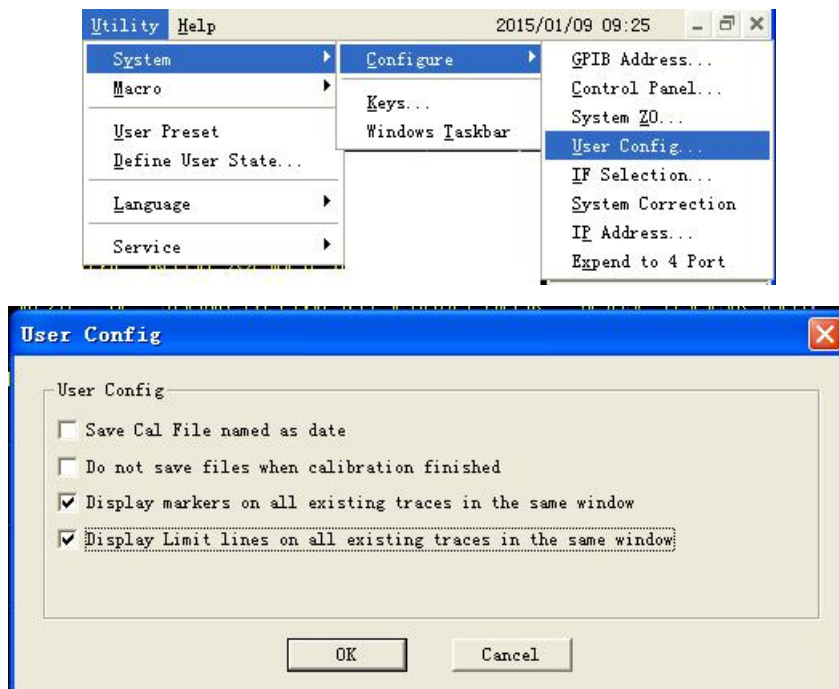


Figure 4-41 User Configuration Dialog Box

- Tick the option “Display markers on all exiting trace in the same window” and the option “Display Limit lines on all existing traces in the same window”.



## 5. Calibration

### 5. 1. Selecting Calibration Type

S3603D Vector Network Analyzer supports 7 calibration types. The detailed information on each calibration type is as follows:

#### 5. 1. 1. Open Response

- Calibration precision: low to medium.
- Measure parameters: S11 and S22.
- The required calibration standard: open-circuit device.
- The corrected system errors:
  - Reflection Tracing
- Measure application:
  - Reflection Measure on any port.

#### 5. 1. 2. Short Response

- Calibration precision: low to medium.
- Measure parameters: S11 and S22.
- The required calibration standard: short-circuit device.
- The corrected system errors:
  - Reflection Tracing
- Measure application:
  - Reflection Measure on any port.

#### 5. 1. 3. Through Response

- Calibration precision: medium.
- Measure parameters: S12 and S21.
- The required calibration standard: through standard.
- The corrected system errors:
  - Transmission Tracing
- Measure application:
  - Transmission Measure in any direction.

#### 5. 1. 4. Through Response and Isolation

- Calibration precision: medium.
- Measure parameters: S12 and S21.
- The required calibration standards: through standard, two loads (each port needs one load).
- The corrected system errors:
  - Transmission Tracing

- Crosstalk
- Measure application:
  - Transmission Measure in any direction.
  - Measure requiring isolation calibration to improve system dynamic range.

### Prompt

If each port can not connect one load at the same time, isolation calibration can not be conducted.

#### 5. 1. 5. Enhanced Response Calibration

- Calibration precision: medium to high.
- Measure parameters: S12 and S21 or S22 and S12.
- The required calibration standards: through standard, open-circuit device, short-circuit device and load.
- The corrected system errors:
  - Directivity
  - Source matching
  - Reflection Tracing
  - Transmission Tracing
- Measure application:
  - Transmission Measure in any direction.
  - Reflection Measure on any port.

#### 5. 1. 6. 1- Port (Reflection)

- Calibration precision: high.
- Measure parameters: S11 and S22.
- The required calibration standards: open-circuit device, short-circuit device and load.
- The corrected system errors:
  - Directivity
  - Source matching
  - Reflection Tracing
- Measure application:
  - Reflection Measure on any port.

#### 5. 1. 7. Quick SOLT

- Calibration precision: medium.
- Measure parameters: all.
- The required calibration standards: open-circuit device, short-circuit device, load and through standard.
- The corrected system errors:
  - Directivity

- Source matching
- Reflection Tracing
- Crosstalk
- Transmission Tracing
- Load matching
- Measure application:
  - Measure of all S parameters.

#### 5. 1. 8. Full Dual-port SOLT

- Calibration precision: high.
- Measure parameters: all.
- The required calibration standards: open-circuit device, short-circuit device, load and through standard.
- The corrected system errors:
  - Directivity
  - Source matching
  - Reflection Tracing
  - Crosstalk
  - Transmission Tracing
  - Load matching
- Measure application:
  - Measure of all S parameters.
  - Measure requiring 12 errors correction to improve the Measure precision.

#### 5. 1. 9. Full Dual-port TRL

- Calibration precision: very high.
- Measure parameters: all.
- The required calibration standards: through standard, reflection standard, and transmission standard.
- The corrected system errors:
  - Directivity
  - Source matching
  - Reflection Tracing
  - Crosstalk
  - Transmission Tracing
  - Load matching
- Measure application:
  - Measure of all S parameters.

- Measure requiring 12 errors correction to improve the Measure precision.
- Measure requiring the maximum calibration precision.

## 5. 2. Calibration Setup

Calibration can be set up and conducted by using the **Calibration** menu of th Analyzer.

### 5. 2. 1. Starting Calibration

- By mouse or touch screen
  - 1) Click [**Response**], and click [**Calibration Wizard...**] on the [**Cal**] submenu, to display the Calibration dialog box.

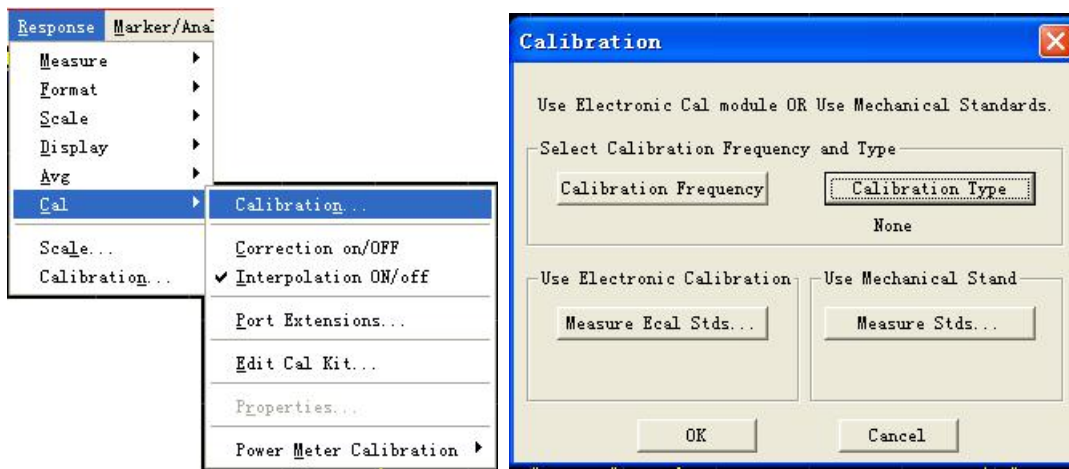


Figure 5-1 Starting Calibration Wizard

- 2) If it is required to set the frequency range of calibration, click [**Calibration Frequency**] button in Calibration dialog box, to display the **Frequency Start/Stop** dialog box. Click [**OK**] to close **Frequency Start/Stop** dialog box after completing frequency setting.

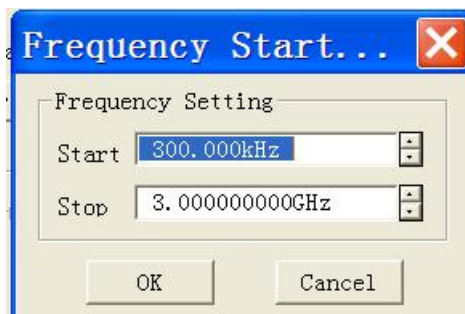


Figure 5-2 Setting Calibration Frequency

- 3) Click [**Calibration Type**] in Calibration dialog box, to display the **Calibration Type** dialog box, and Click [**OK**] to close **Calibration Type** dialog box after completing calibration type selection.
  - ◆ The selectable calibration type is relevant to the Measure parameters of the current Stimulus channel. For instance, when Measure parameter is S11, **Through Response** as well as **Through Response and Isolation Calibration** can not be selected.
  - ◆ When conducting full dual-port calibration, if isolation calibration is not required, tick the [**Omit Isolation (2-Port Types)**] check box.

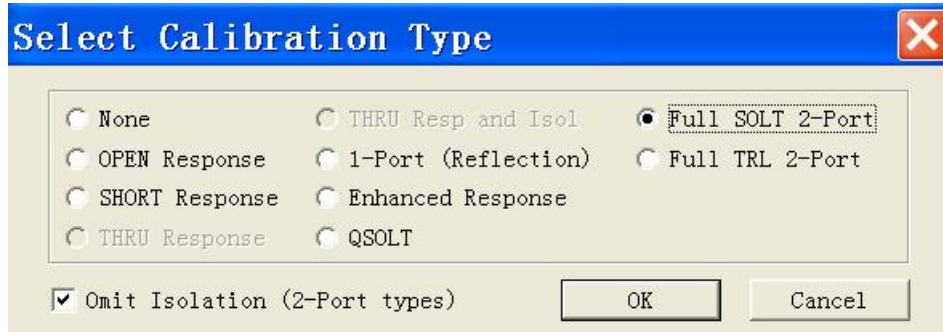


Figure 5-3 Selecting Calibration Type

- 4) Click **[Measure Stds]** in the **Calibration** dialog box, to display the **Measure Mechanical Standard** dialog box.

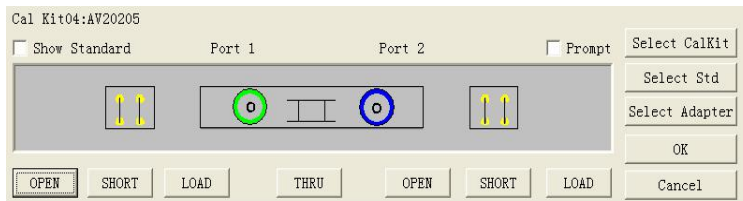


Figure 5-4 Measure of Mechanical Standard Dialog Box

- 5) If the used calibration kit is different from the default calibration kit of Analyzer, click **[Select CalKit]** in the **Measure Mechanical Standard** dialog box, to display the **Select Calibration Kit** dialog box and select the used calibration kit in the box. Click **[OK]** to close the **Select Calibration Kit** dialog box.

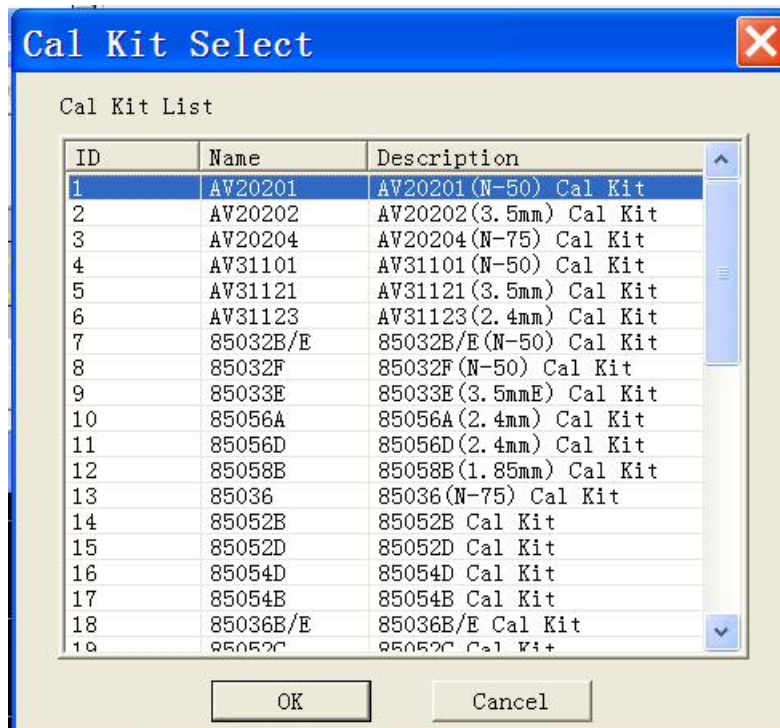


Figure 5-5 Selecting Calibration Kit

- 6) If it is required to set calibration standard, click **[Select Std]** in the **Measure Mechanical Standard**, to display the **Type Information** dialog box, and click **[OK]** to close the **Type Information** after completing setting.

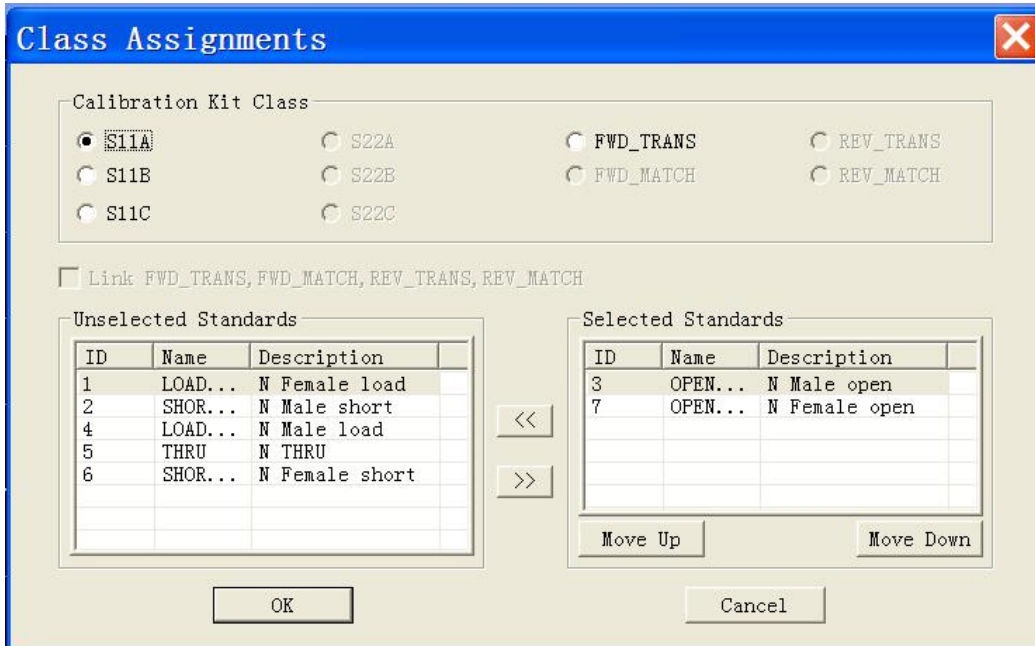


Figure 5-6 Type Information Dialog Box

- 7) Connect calibration standard on the port, and tick the **[Show Standard]** dialog box in the top left corner of **Measure Mechanical Standard** dialog box. When the button corresponding to the calibration standard to be measured (such as **[OPEN]**) is clicked, the **Multiple Standards** dialog box will be displayed. If the average function should be used to reduce noise effects during Measure of calibration standard, click to tick the **[Average]** check box, and set suitable average factors.

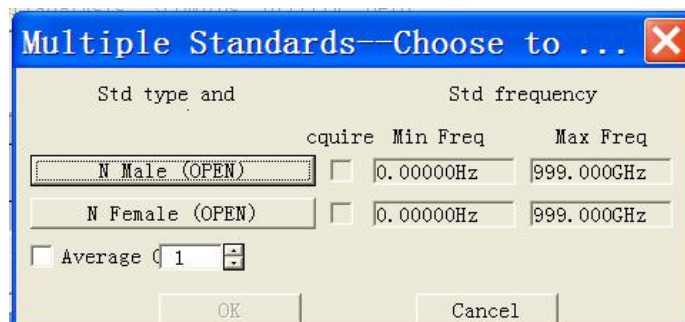


Figure 5-7 Multiple Standards Dialog Box

- 8) If the **[Prompt]** dialog box in the top right corner of Measure Mechanical Standard dialog box is ticked, when the button corresponding to the calibration standard, e.g. **[N Male (OPEN)]**, is clicked in the Multiple Standards dialog box, the Prompt for Connect Cal standard dialog box will be displayed. Click **[OK]** button to start Measure after confirming the connected calibration standard is correct, and the Analyzer automatically ticks the corresponding **[Acquire]** check box in the Multiple Standards dialog box after Measure is completed. Click **[OK]** button to close the Multi-calibration Kit Measure dialog box after completing all the required calibration standard Measures. Button of the calibration standard whose Measure is completed in the Measure Mechanical Standard dialog box turns into green.

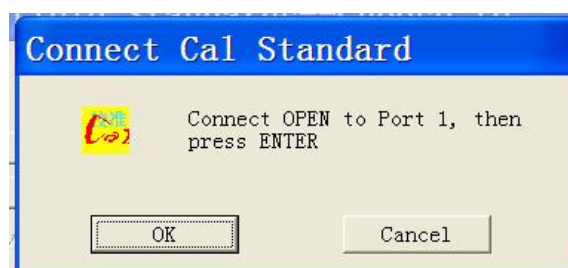


Figure 5-8 Connect Calibration Standard Dialog Box

- 9) Repeat steps g) through h), to complete all the calibration standard Measures. Click **[OK]** to close the **Measure Mechanical Standard** dialog box, to complete calibration.
- By front panel keys
    - 1) Press **[Cal]** in RESPONSE area, press the soft-key corresponding to **[Cal Kit]** to display the sub soft-key menu, and press the soft-key corresponding to the required calibration kit model to select calibration kit.
    - 2) Press the soft-key corresponding to **[Mechanical Calibration]**, and select calibration type in the displayed sub soft-key menu.
    - 3) Conduct a calibration Measure by taking Thru Response calibration Measure for example. Press the soft-key corresponding to **[Response]**, and press the soft-key corresponding to **[Thru Response]** in the sub soft-key menu. Press the soft-key corresponding to **[FWD THRU]**. After this menu item turns into **[FWD THRU]**, a calibration Measure is completed by pressing **[DONE Response]**.
    - 4) Repeat steps b) through c), to complete the required calibration standard Measures.

### 5. 2. 2. Calibration User Configuration

Calibration User Configuration includes two settings, Save Cal File named as date and Do not save files when calibration finished.

#### 5. 2. 2. 1. Mouse or touch screen procedure

- 1) Single click **[UTILITY]**, click **[Configure]** in the **[System]** menu, and click **[User Config]** in the submenu to display the **User Config** dialog box.

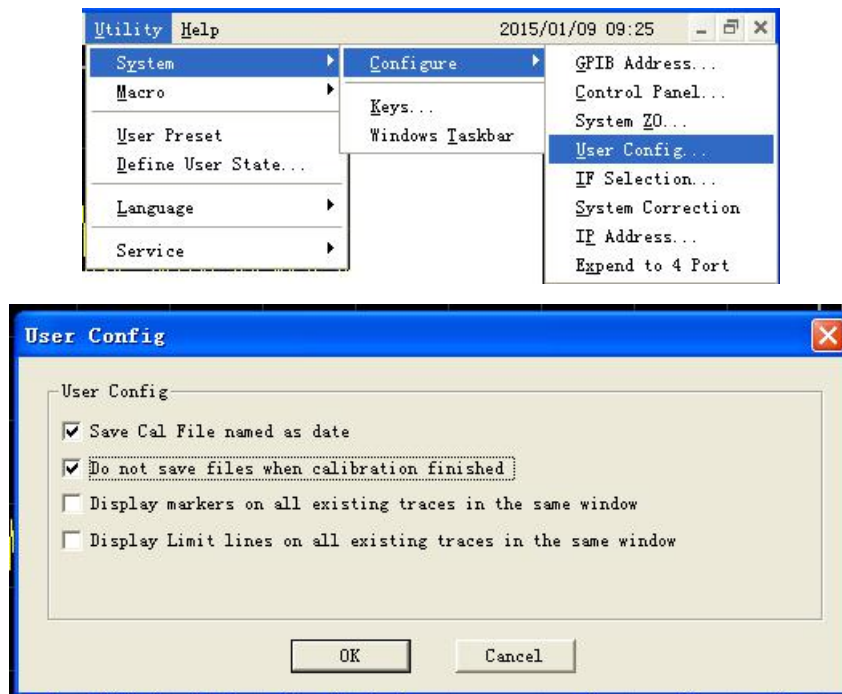


Figure 5-9 User Config dialog box

- 2) Tick **Save Cal File named as date** in the dialog box.
- 3) Tick **Do not save files when calibration finished** in the dialog box.

### 5. 3. High-precision Measure Calibration

Calibration precision depends on the selected calibration type, calibration kit quality and calibration process. This section mainly

discusses how to conduct high-precision calibration.

### 5. 3. 1. Measure Reference Plane

In most Measures, the measured piece is not directly connected to the port of Analyzer, but it is more likely to be connected by a test fixture or cable. If the maximum Measure precision is needed, calibration must be conducted on the connection surface of the measured piece, which is called Measure reference plane. If calibration is conducted on the Measure reference plane, errors related to Measure assembly (such as cable, test fixture, adapter between Analyzer port and reference plane) are removed through calibrating the measured piece.

### 5. 3. 2. Effects of Using Incorrect Calibration Kit

In normal conditions, calibration standard in calibration kit and the connector of the measured piece are of the same type. But in some cases, there may not be calibration kit of the same type as the connector of the measured piece. If the port of the measured piece is 3.5mm, connector type for Analyzer and calibration kit is N type. If N type calibration kit is used for calibration and adapter of N/3.5mm is connected for Measure, because the adapter is not included in calibration process, significant Measure error will be caused. If the used calibration kit is different from the calibration kit specified in calibration process, calibration precision will also be reduced, the extent of which depends on the difference between the specified calibration kit and the calibration kit actually used.

### 5. 3. 3. Precision of Interpolation Measure

When the status settings of Analyzer in Measure is different from the calibration status, Analyzer can automatically interpolate calibration data, then unpredictable Measure precision will be caused, which may reduce significantly, or may be not affected. Measure error must be determined according to the actual situation. When the increased phase shift of two measuring points exceeds 180°, because Analyzer can not interpolate the correct phase data, Measure precision will reduce significantly.

### 5. 3. 4. Effects of Power Level

In order to obtain a higher error correction precision, do not modify power level after calibration. However, when modifying power level under the same attenuator settings as in calibration, Measure precision of S parameters reduces a little. If attenuator settings are modified, error correction precision will reduce further.

### 5. 3. 5. System Impedance

- By mouse or touch screen
  - a) Click **[Utility]**, point to **[ConFig.]** on **System** menu, and click **[System Z0...]** on ConFig. submenu, to display the System Zo dialog box.
  - b) Set system Z0 value in **[Z0]**.
  - c) Click **[OK]** button to close the dialog box.

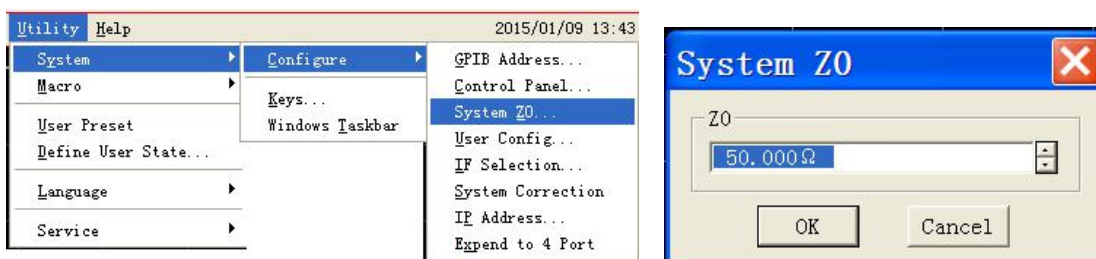


Fig. 5-10 Setting System Impedance

- By front panel keys
  - a) Press **[System]** key in UTILITY area, press the soft-key corresponding to **[ConFig.]** menu, and press the soft-key



corresponding to **[System Z0]** on the displayed submenu, to display the System Z0 dialog box.

- b) Set system Z0 in the input box of **[System Z0]**.

### 5. 3. 6. Port Extension

Additional phase shift will be introduced by connecting additional cable, adapter or fixture after calibration, leading to change of Measure reference plane, and then the port extension function can be used to compensate additional phase shift. Port extension is the simplest way to compensate the additional phase shift between calibration plane and Measure plane, but it does not compensate loss and mismatching of the path between calibration plane and Measure plane, therefore, loss and mismatching shall be reduced as much as possible, to obtain the maximum Measure precision.

### 5. 3. 7. Conducting Isolation Calibration Correctly

Crosstalk error between ports is corrected in the calibration process of full dual-port calibration. Isolation calibration is required only when high-insertion loss Measure, e.g. isolation Measure of filter with external inhibition and switch, is required. When crosstalk signal is very close to the noise background of Analyzer, isolation calibration will introduce noise in error model, so in order to improve calibration precision:

- Conduct isolation calibration only when necessary.
- Use narrow intermediate-frequency bandwidth.
- Use Sweep Average to reduce noise.

During isolation calibration Measure, load is required to be connected to the Measure port of Analyzer. In order to obtain the maximum calibration precision, it is better to connect loads to both Measure ports for isolation calibration Measure. In case of only one load, a well-matching device can be connected to the non-Measure port.

### 5. 3. 8. Calibration of Non-insertable Device

Measure ports can be connected together directly after insertable DUT are removed from Measure ports, as shown in the following Figure.:

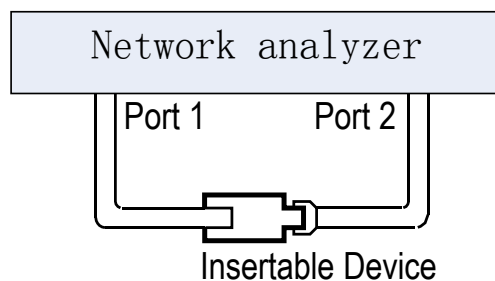


Fig. 5-11 Measure Connection of Insertable Device

When calibrating the insertable device, Measure ports are directly connected together on Measure reference plane, which is called zero-length through, namely, the through piece is with zero length, no delay and loss. Calibration kit is not provided with through standard piece, and Measure ports can not be directly connected together on Measure reference plane when calibrating non-insertable device, as shown in the following Figure., so calibration of non-insertable device can not be conducted directly.

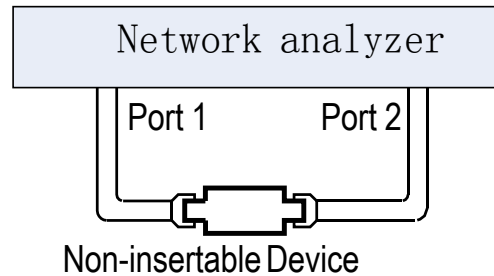


Fig. 5-12 Measure Connection of Non-insertable Device

When calibrating non-insertable device, if an adapter is used during calibration process for through connection and such adapter is not included in subsequent Measure, Measure precision will be reduced. Calibration methods of non-insertable device include:

(1) Calibration method of through adapter with unknown properties

It is the simplest calibration method with the poorest precision. Adapter is directly used for through calibration Measure during calibration process. Due to unknown loss and delay properties of the adapter, its effects can not be removed in Measure. This method will deteriorate transmission Tracing error, and can not correct load matching error effectively.

(2) Method of defining through adapter

Method of defining through adapter is to specify the loss and delay of through standard piece in the definition file of calibration kit for Analyzer, to remove effects of through adapter during calibration process, and to correct transmission Tracing error of Analyzer. But because the effects of reflection of adapter itself are not considered, load matching error can not be completely corrected.

Adapter manufacturer generally provides loss and delay data of the adapter, if not, it can be measured directly. Because the through adapter used is also a non-insertable device itself, correct calibration method must be adopted. Equivalent adapters exchanging method and adapter removing method to be discussed below can be used for calibration. Calibration process for method of defining through adapter is as follows:

- (a) Use equivalent adapters exchanging method or adapter removing method for calibration.
- (b) Measure loss and delay of through adapter.
- (c) Modify the definition of through standard in the definition file of calibration kit.
- (d) Use the through adapter for full dual-port calibration.

(3) Equivalent adapters exchanging method

This calibration method works very well for Measures of non-insertable devices with identical connector type (e.g. the DUT with ports of SMA and female). Use two adapters with precise matching of impedances, insertion loss and electrical delay in calibration, one for through calibration during full dual-port calibration process, the other for reflection calibration and Measure of the measured piece. Calibration kit manufacturers provide such adapters. Type of the adapter used in calibration is related to the specific connector type for Measure port and the measured piece. Calibration process of an equivalent adapters exchanging method is as follows:

- (a) Select Full Dual-port SOLT calibration in Calibration Guide.
- (b) Connect Adapter A between Port 1 and Port 2, for through calibration Measure.



Fig. 5-13 Calibration Connection 1 for Equivalent Adapters Exchanging Method

(c) Remove Adapter A, and connect Adapter B to the correct port (Port 1 in this example). Connect open-circuit device, short-circuit device and load to Adapter B and Port 2 respectively for reflection calibration of full dual-port SOLT calibration.



Fig. 5-14 Calibration Connection 2 for Equivalent Adapters Exchanging Method

(d) Keep Adapter B connected to Port 1, for Measure of the measured piece.



Fig. 5-15 Measure Connection for Equivalent Adapters Exchanging Method

Calibration error of equivalent adapters exchanging method results from property matching error and connection error between adapters.

#### (4) Adapter removing calibration

Adapter removing calibration offers the most precise calibration method for Measure of non-insertable devices, which requires connecting the adapter to Port 1 and Port 2 of Analyzer respectively for two full dual-port calibrations. Then adapter properties can be determined, thus removing effects of adapter completely.

Conducting adapter removing calibration requires a through adapter with the same connector type as the measured piece as well as calibration kit corresponding to the connector type of the measured price.

## 5. 4. Measure Error

Learning the measure errors sources and error correction methods is helpful for improving the precision of Measure, because there is still uncertainty however carefully the Measure is done. Three kinds of errors may occur when the Network Analyzer is used to carry out Measure:

### 5. 4. 1. Drift Error

- Drift error occurs due to the performance alteration of the Analyzer or test system after the calibration.
- Major reasons of drift error are the expansion and contraction of cable interconnected inside the Analyzer and the property alteration of the receiver. Drift error can be eliminated by re-calibration.
- Measure environment determines how long the accurate calibration will be kept; stable environmental temperature can minimize the drift error.

### 5. 4. 2. Random Error

Through random errors are unpredictable and can not be eliminated by calibration, their impact on the Measure results can be decreased by some methods. Random errors can be divided into three types:

#### (1) Random noise error of Analyzer

Electric disturbances of internal components of Analyzer may contribute to random noise, mainly including:

- Low level noise caused by broadband background noise.
- High level noise or data Trace vibration, mainly caused by the background noise inside the Analyzer and LO source phase

noise.

Random noise error can be decreased by following methods:

- Increase source power input to the measured piece.
- Decrease intermediate-frequency bandwidth.
- Use Sweep average.

#### (2) Repeatability error of switch

For the Analyzer, RF mechanical switch is adopted to change over the settings of the source attenuator. When the switch is actuated, some times, the closing of contact differs from the closing state last time, and that will affect the Measure accuracy terribly if it happens. Thus during the high-precision Measure, changing the settings of attenuator should be avoided so as to decrease the repeatability error of switch.

#### (3) Repeatability error of connector

Every time the connector is connected, its status is different, which leads to repeatability error. Abrasion of connector will change its electrical performance. Correct connection and maintenance method of the connector can be used to decrease the repeatability error.

### 5. 4. 3. System Error

System error is caused by undesirable properties of Analyzer hardware, which is repeatable (thus it is predictable), assuming it does not change with time. System errors can be eliminated by calibration and eliminated during the Measure through mathematical calculation.

However, they can not be eliminated thoroughly and some residual errors are always left due to the limitation of calibration. Residual system errors after the calibration are mainly from:

- Undesirable calibration standards.
- Measure connection.
- Interconnection cable.
- Instrument itself.

For reflection Measure, related residual errors are:

- Effective directivity.
- Valid source matching.
- Valid reflection tracing.

Additionally, for transmission Measure, following residual errors will be added as:

- Crosstalk.

- Valid load matching.
- Valid transmission tracing.

#### (1) Directivity errors

Analyzer makes reflection Measure through directional coupler or bridge. At the coupling end of ideal coupler, only reflection signals are output to the receiver for Measure, and actually, a few of incident signals will leak to the coupling port via the primary route of coupler and directional errors may occur in the Measure. Analyzer determines and decreases directional errors through following methods:

- a) In calibration, connect the load to the metering port and believe that the load port will not reflect back.
- b) Output signals of coupling port are rightly the directional error signals leaked out.
- c) Subtract directional error signals during the Measure.

#### (2) Crosstalk error

Ideally, only transmission signals passing through the measured piece get to the receiver, and actually, a few signals will get to the receiver via other routes of the Analyzer which are called crosstalk signals.

The Analyzer determines and decreases crosstalk errors by following methods:

- a) Connect load at port 1 and port 2 in calibration.
- b) Signals received in Measure receiver are the crosstalk signals leaking out of the Analyzer.
- c) Eliminate the crosstalk errors through error correction during the Measure.

#### (3) Source matching error

In reflection measure, on the ideal conditions, the measure receiver receives all signals reflected from the DUT, but actually, a part of signals reflected back from the DUT are reflected back to the DUT by the measuring port. Receiver can not measure said signals so that source matching errors will occur.

The Analyzer determines and decreases source matching errors by following methods:

- a) In calibration, connect the short-circuit device to the measuring port, use the Analyzer to measure reflected signals coming from the short-circuit device and store the measured values in the Analyzer.
- b) Connect the open-circuit device to the port, use the Analyzer to measure the reflected signals coming from the open-circuit device and store the measured values in the Analyzer.
- c) Use the Analyzer to compare the measured values with the given values of open-circuit device and short-circuit device so as to determine the source matching errors.
- d) Eliminate the source matching errors through error correction during the Measure.

#### (4) Load matching error

In ideal transmission measure, measure the transmission signals via the DUT that the receiver receives, and actually, partial signals are reflected by the measuring port and can not be measured, thus load matching errors may occur. The Analyzer determines and decreases load matching errors by following methods:

- a) Connect port 1 with port 2 together to carry out zero-length through.
- b) When the source is at port 1, Measure signals of receiver A include reflected signals of port 2, and when the source is at port 2, Measure signals of receiver B include reflected signals of port 1, thus load matching errors can be determined.

c) Eliminate the load matching errors through error correction during the Measure.

#### (5) Reflection tracing error

Reflection measure is done by comparing signals of receivers A and R1 or signals of receivers B and R2, which is also called ratio Measure. For ideal reflection Measure, frequency responses of receivers A and R1 or receivers B and R2 are identical, but actually, that is impossible, thus reflection Tracing errors may occur. Reflection Tracing errors are vectors and errors resulting from various test deviations, and their magnitudes and phases will vary with the frequency. Sources of those deviations include:

- Signal separation devices.
- Test cable and adapter.
- Difference between reference and Measure signal routes.

The Analyzer determines and decreases reflection Tracing errors by following methods:

- a) In calibration, connect the short-circuit device to the measuring port, use the Analyzer to measure reflection signals coming from the short-circuit device and store the measured values in the Analyzer.
- b) Connect the open-circuit device to the port, use the Analyzer to measure the reflected signals coming from the open-circuit device and store the measured values in the Analyzer.
- c) Use the Analyzer to compare the measured values with the given values of open-circuit device and short-circuit device so as to determine the reflection matching errors.
- d) Eliminate the reflection matching errors through error correction during the Measure.

#### (6) Transmission tracing error

Transmission measure is done by comparing signals of receivers A and R2 or signals of receivers B and R1, which is also called ratio Measure. For ideal transmission Measure, frequency responses of receivers A and R2 or receiver B and R1 are identical absolutely. But actually, that is impossible, and then transmission Tracing errors may occur. Transmission Tracing errors are vectors and errors resulting from various test deviations, and their magnitudes and phases will vary along with the frequency. Sources of those deviations include:

- Signal separation devices.
- Test cable and adapter.
- Difference between reference and Measure signal routes.

The Analyzer determines and decreases transmission Tracing errors by following methods:

- a) Connect port 1 with port 2 together to carry out zero-length through.
- b) Measure signals of receivers A and R2 or signals of receivers B and R1.
- c) Determine the transmission Tracing errors by comparing the signals in both receivers.
- d) Eliminate the transmission Tracing errors through error correction during the Measure.

## 5. 5. Modifying the Definition of Calibration Kit

The analyzer can be used to change the definition of calibration of calibration kit or create calibration kit defined by customers themselves.

### 5. 5. 1. Definition of calibration kit

Each calibration standard (represented by standard ID) in calibration kit are specified physical device with accurate definition. There are 4 basic types of calibration standards totally: open-circuit device, short-circuit device, load and through piece/adapter/transmission line. Each standard has their own special model structure in which numerical and physical characteristics of the standards are described. It is permitted to use other calibration standards besides calibration kit only if the properties of standards are defined in advance.

### 5. 5. 2. Changing and creating calibration kit

For most measure applications, default calibration kit model is enough to carry out accurate calibration, but sometimes, it may be required to modify calibration kit definition document or create user-defined calibration kit, for example, in several Measure applications below, it is required to create user-defined calibration kit or modify the definition of calibration kit:

- Connector type is not in conformity to the definition of calibration kit model.
- Use standards different from the calibration kit definition, e.g., use three different offset short-circuit devices to replace open-circuit device, short-circuit device and load to implement single-port (reflection) calibration.
- Improve the precision of predefined calibration kit model. The calibration will be more accurate when the model can describe the actual properties of standards better, e.g., Change the impedance value of the load into actual value  $50.1 \Omega$  instead of  $50 \Omega$  in the definition.
- Modify the definition of through piece to implement non-insertable device calibration.
- Implement TRL calibration.

When the user-defined calibration kit is created by an user, the connector type must be defined first, such as APC7, 3.5mm, Type-N( $50 \Omega$ ), in addition, it is best that each calibration kit is limited with only one connector type though each calibration kit is permitted to be defined with more than one connector type. It is required to make definitions respectively if connectors are divided into female connector and male connector.

#### 5.5.2.1 Modification of calibration kit definition

- a) Click **[Response]**, click **[Edit Cal Kit...]** on the **[Cal]** menu, display **Edit Cal Kit** dialog box.
- b) Click the calibration to be modified in the dialog box, click **[Edit Kit]** button, display **Edit Kit** dialog box.
- c) Select the calibration standard to be modified in Standard box in Edit Calibration Kit dialog box, click **[Edit...]**, display related dialog box and modify the calibration standards.
- d) After the completion of modification, respectively click **[OK]** button to close all dialog boxes.

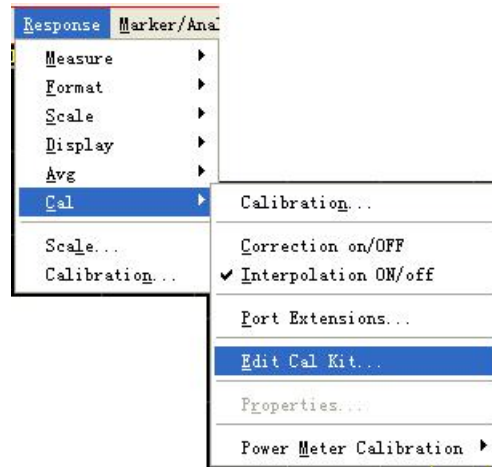


Fig.5-16 Modification of calibration kit definition

### 5.5.2.2 Creation of user-defined calibration kit

- a) Click **[Response]**, click **[Edit Cal Kit...]** on **[Cal]** menu, display Edit Calibration Kit dialog box.
- b) Click **[Insert New ...]** button, then Edit Calibration Kit dialog box displays, make following settings in Calibration Kit Identification zone of the dialog box:
  - Input user-defined ID No. of calibration box in **[Kit Number]**.
  - Input user-defined name of calibration kit in **[Kit Name]**.
  - Input characteristic description of calibration kit in **[Kit Description]**.
- c) Click **[Add]** button at Connector zone, then Add Connector dialog box displays, make following settings:
  - Select connector type at **Gender** zone: **[Male]**, **[Female]** or **[No Gender]**.
  - Input connector name in **[Connector Family]** box at **Identification** zone.
  - Input property description of connector in **[Description]** box at **Identification** zone.
  - Set minimum and maximum working frequencies of the connector at **Frequency Range** zone.
  - Input characteristic impedance value in **[Z0]** at Impedance zone, e.g., 50Ω.
  - Select medium type of the connector in **Media**: **COAX** or **WAVE**.
  - Click **[OK]** button to close the dialog box after correct check and input, and it is forbidden to edit the connector property any more.
- d) Repeat step c) to complete the addition of all connectors.
- e) Click **[Add...]** button at **Standard** zone in **Edit Kit** dialog box, display **Add Standard** dialog box displays, select the standard to be added from **[OPEN]**, **[SHORT]**, **[LOAD]**, **[THRU]**, **[ADAPTER]** or **[LINE]**, click **[OK]** button to close Add Standards dialog box, at the same time display the edition dialog box of the selected standard(s).
- f) Complete defining the standards in the edition dialog box of Standard (Such As Open); for band-pass calibration standards, their frequency scope may be different from the working frequency scope of the connector. Set minimum and maximum frequencies based on the actual properties of calibration standards, then click **[OK]** button to close the dialog box after the completion of setting.
- g) Repeat step e)~f) to complete defining all standards of user-defined calibration kits.



h) Click **[Class Assignments]** and select standard type in **Edit Kit** dialog box, then click **[Edit]** button, display **Class Assignments** dialog box, and click **[OK]** button to close **Class Assignments** dialog box after completing classifying calibration standards.

i) Click **[OK]** button to close **Edit Kit** dialog box.

### 5.5.2.3 Modification of calibration kit dialog box

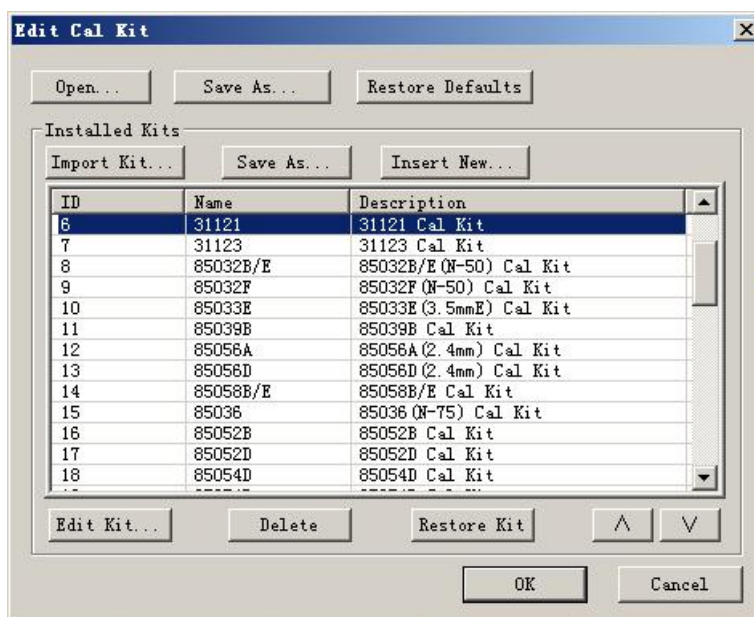


Fig.5-17 Modification of calibration kit dialog box

#### **[Open]**

Open calibration kit listfile and pack definitions of all calibration kits listed in the file into the Analyzer.

#### **[Save As]**

Save definitions of all calibration kits which are in current Analyzer into calibration kit list file.

#### **[Restore Defaults]**

Re-install all calibration kits that the Analyzer supports.

#### **Installed Kits zone**

##### a) **[Import Kit...]**

Call Open dialog box and import calibration kit definition files saved on the hardware or other drivers.

##### b) **[Save As]**

Open Save As dialog box and save the definition of selecting calibration kits.

##### c) **[Insert New...]**

Open Edit Calibration Kit dialog box and create a new calibration kit definition.

##### d) **[Edit Kit...]**

Display Edit Calibration Kit dialog box and modify the selected calibration kit definitions.

##### e) **[Delete]**

Delete the selected calibration kit definitions.

##### f) **[Restore Kit]**

Recover the modification of selected calibration kits and return to default state.

g) [^], [v]

Click [^], [v] buttons to select calibration kits.

### 5.5.2.4 Edit kit dialog box

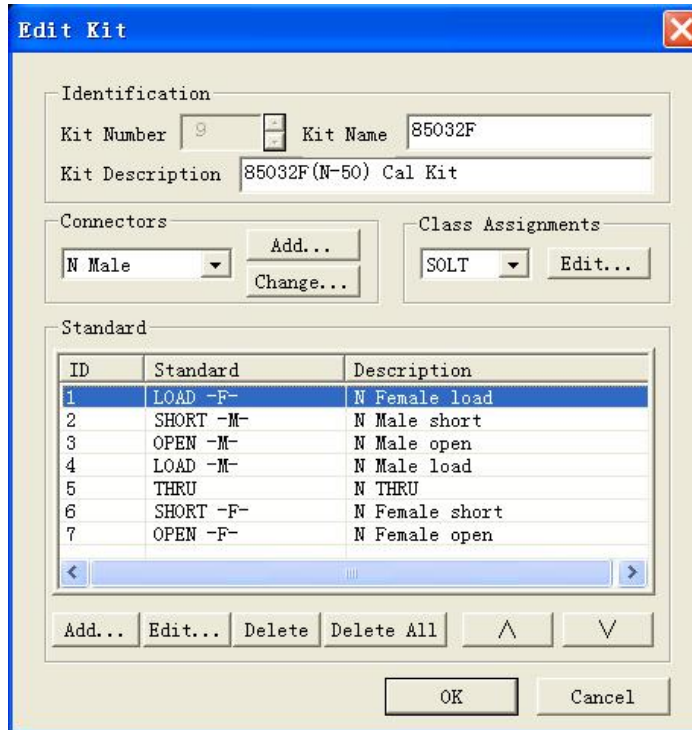


Fig.5-18 Edit kit dialog box

#### Identification zone

a) [Kit Number]

Display ID No. of calibration kits.

b) [Kit Name]

Display or edit names of calibration kits.

c) [Kit Description]

Display or edit property description of calibration kits.

#### Connectors zone

a) [Connector]

Click to select connector type.

b) [Add]

Click [Add] button to display Add Connectors dialog box and add new connector types of calibration kits.

c) [Change]

Click and display Modify Connector Name dialog box as below and modify names of connectors.

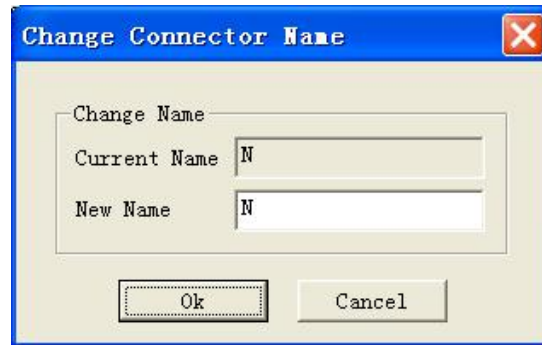


Fig.5-19 Change connector name dialog box

### Class Assignments zone

#### a) [Class]

Select calibration methods and classify the calibration standards. Selectable calibration methods include: SOLT and TRL.

#### b) [Edit]

Click Edit Type button to display Type Information dialog box and classify calibration standards.

### Standards zone

#### a) [Calibration Standard]

Display ID, names and descriptions of all calibration standards in edited calibration kits, to select calibration standards.

#### b) [Add]

Click and display Add Standards dialog box and select new calibration standards to be added.

#### c) [Edit]

Click [Edit] button to display edit dialog box of selected calibration standards, and modify the definitions of calibration standards.

#### d) [Delete]

Click and delete definitions of selected calibration standards.

#### e) [Delete All]

Click to delete definitions of all calibration standards in calibration kits.

#### f) [^], [V]

Aim to select calibration standards.

### 5.5.2.5 Add connector dialog box

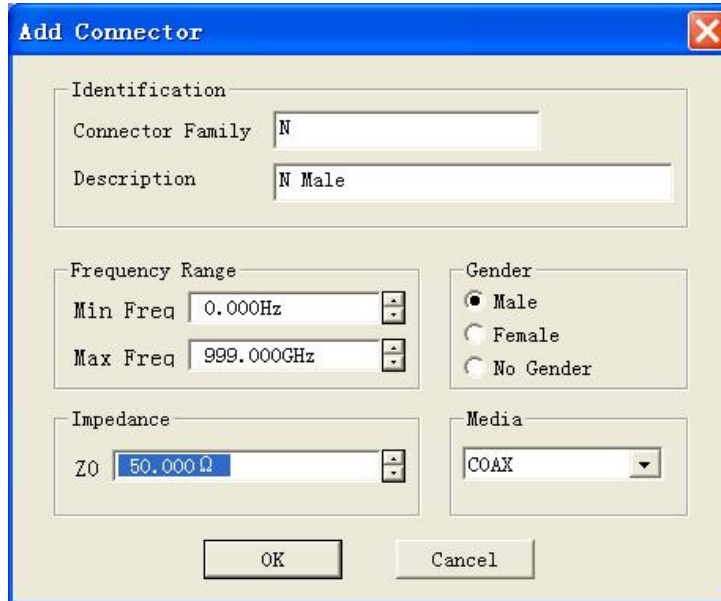


Fig.5-20 Add connector dialog box

**Identification zone**

a) **[Connector Family]**

Define names of calibration kits connectors.

b) **[Description]**

Define property description of calibration kits connectors.

**Frequency Range zone**

a) **[Min Freq]**

Defines minimum frequency at which the connector of calibration standard is allowed to be used.

b) **[Max Freq]**

Defines maximum frequency at which the connector of calibration standard is allowed to be used.

**Gender zone**

Select the polarities of connectors from **[Male]**, **[Female]** or **[No Gender]**.

**Impedance zone**

**[Z0]**

Define the characteristic impedance of the connector.

**Media zone**

**[Media]**

Select the medium defining calibration standards: coaxial or waveguide.

**5.5.2.6 Dialog box of class assignments**

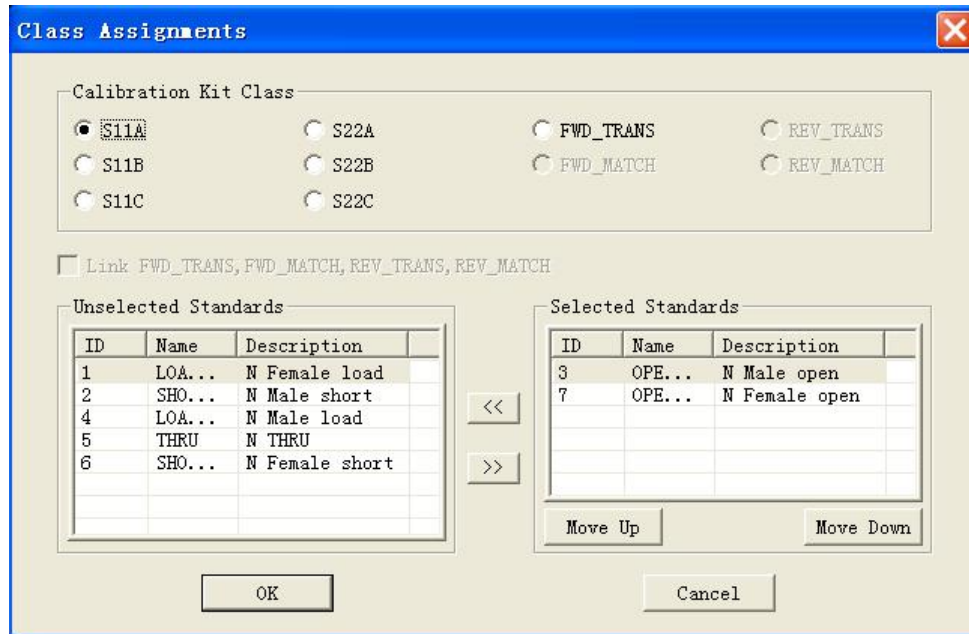


Fig.5-21 Dialog box of class assignments

### Calibration Kit Class Area

Select the type of calibration kit to be edited or observed.

[>>], [<<]

Use [>>] and [<<] buttons to add or delete calibration standards included in the selected calibration kit type, select calibration standards in Unselected Standards box, click [>>] button to add the selected standards into Selected Standards box; select calibration standards in Selected Standards box, click [<<] button to delete calibration standards in calibration kit type.

### [Selected Standards]

Display the calibration standards included in current calibration kit type.

### [Move Up] and [Move Down]

Use [Move Up] and [Move Down] buttons to adjust the display order of calibration standards in Selected Standards box; in the course of calibration, all calibration standards in Selected Standards box will appear in Multiple Calibration Kits Measure box, and it is required to select related calibration standards based on the positive and negative polarities of measuring ports and the frequency scope of the Measure.

Select calibration standards in Selected Standards box, click [Move Up] or [Move Down] button to change the display order of calibration standards, which is quite helpful in following two Measure applications:

- It is required for one calibration kit type to use several calibration standards to cover the whole frequency scope, and the display order of standards in Selected Standards box is consistent with that of calibration standards in Multiple Calibration Kits Measure dialog box, thus it is best to arrange calibration standards based on the working frequency scope.
- While using male and female calibration kits to make calibration, it is possible to determine the display order of calibration standards as per the port configuration of DUT, e.g., port 1 of measured piece is male, port 2 is female, arrange the male standard pieces at row 1 while distributing standards of type S11, and arrange the female standard pieces at row 1 while distributing standards of type S22, for making selection in calibration.

### [Unselected Standards]

Display the standards not included in current calibration kit type.

### 5.5.2.7 Dialog box of modify TRL calibration class assignments

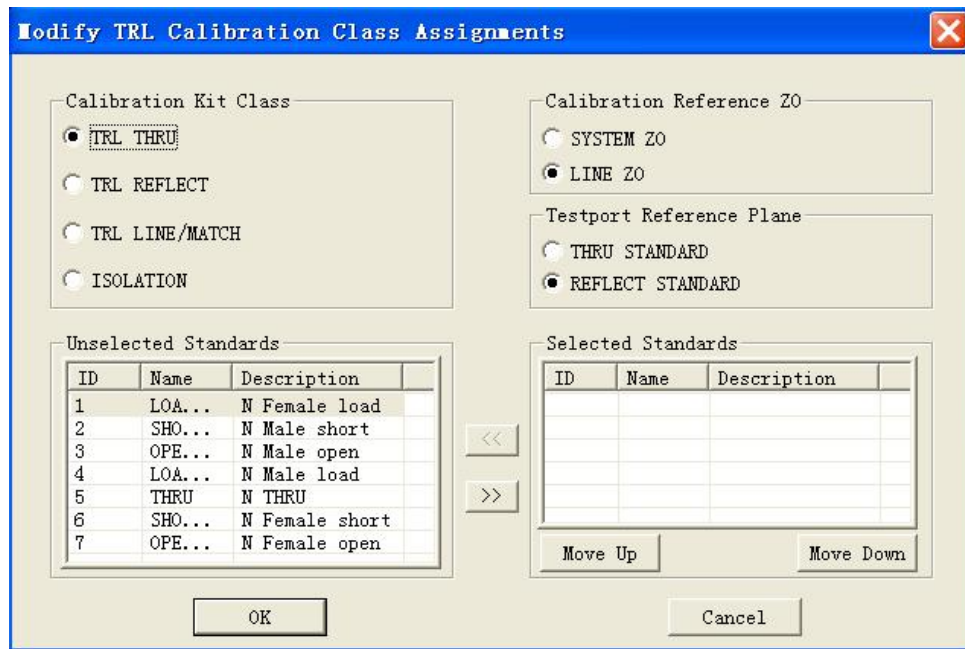


Fig.5-22 Dialog box of modify TRL calibration class assignments

#### Calibration Reference Z0 zone

##### a) [System Z0]

Regard the system impedance as reference impedance, and select this option button when the impedance of measuring port differs from that of transmission line.

##### b) [Line Z0]

Regard the impedance of transmission line as reference impedance or the center of Smith Chart, and summarize all reflections from the transmission line as directional errors.

#### Test Port Reference Plane zone

##### a) [THRU STANDARD]

Use the definition of through standard to built Measure reference plane, and select this option button when the length of through standard is 0.

##### b) [REFLECT STANDARD]

Use the definition of reflection standard to build Measure reference plane, and select this option button when the through standard is not very proper and the delay of reflection standard is defined accurately.

### 5.5.2.8 Open dialog box

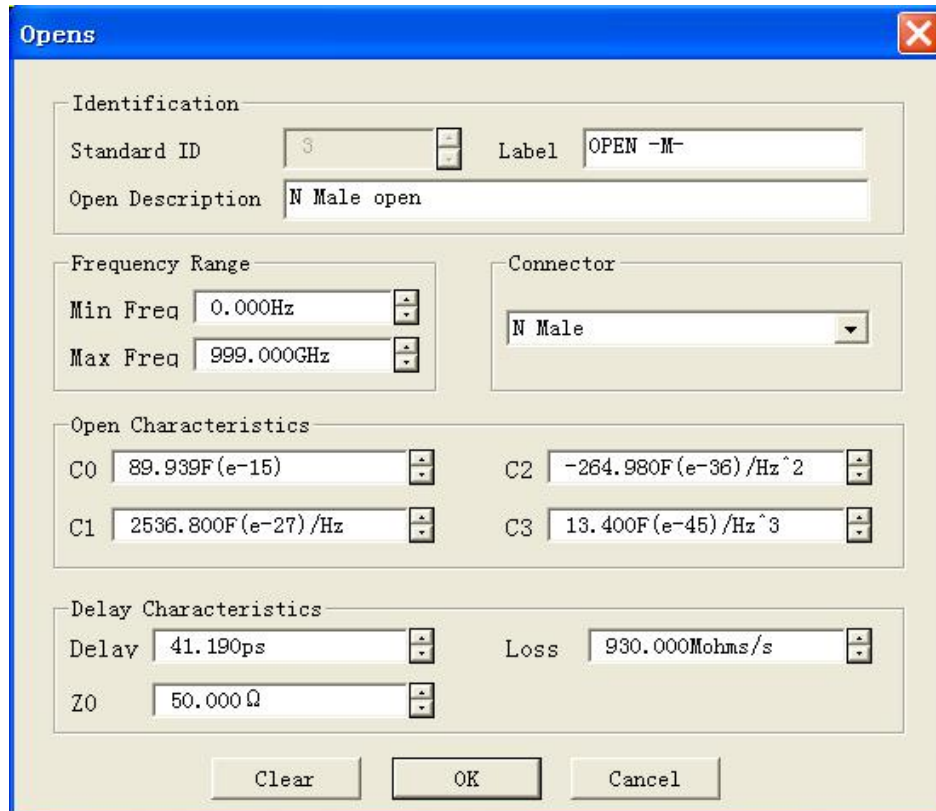


Fig.5-23 Opens box

**Identification zone**

a) **[Standard ID]**

Used to display and edit ID No. of calibration standards.

b) **[Label]**

Used to display or edit names of standards.

c) **[Open Description]**

Used to display or edit characteristic description of standards.

**Frequency Range zone**

a) **[Min Freq]**

Define the minimum frequency at which the open-circuit device can operate in calibration.

b) **[Max Freq]**

Define the maximum frequency at which the open-circuit device can operate in calibration.

**Connector zone**

**[Connector]**

Select the type of open-circuit device connector.

**Open Characteristics zone**

Define the magnitude of open-circuit device fringe capacitance through **[C0]**, **[C1]**, **[C2]** or **[C3]** box.

**Delay Characteristics zone**

a) **[Delay]**

Define one-way transmission time from calibration plane to calibration standard.

b) [Loss]

Define the energy loss of calibration standard due to skin effect. The unit is Gohm/S and the frequency is 1GHz. In loss calculation, respectively measure the insertion loss and delay of calibration standards at 1GHz, and use following formula to calculate:

$$Loss\left(\frac{\Omega}{S}\right) = \frac{Insertion\ loss\ (dB) \times IMPEDANCE\ (\Omega)}{4.3429\ (dB) \times DELAY\ (S)}$$

b) [Z0]

Define the impedance of standard.

5.5.2.9 Shorts dialog box

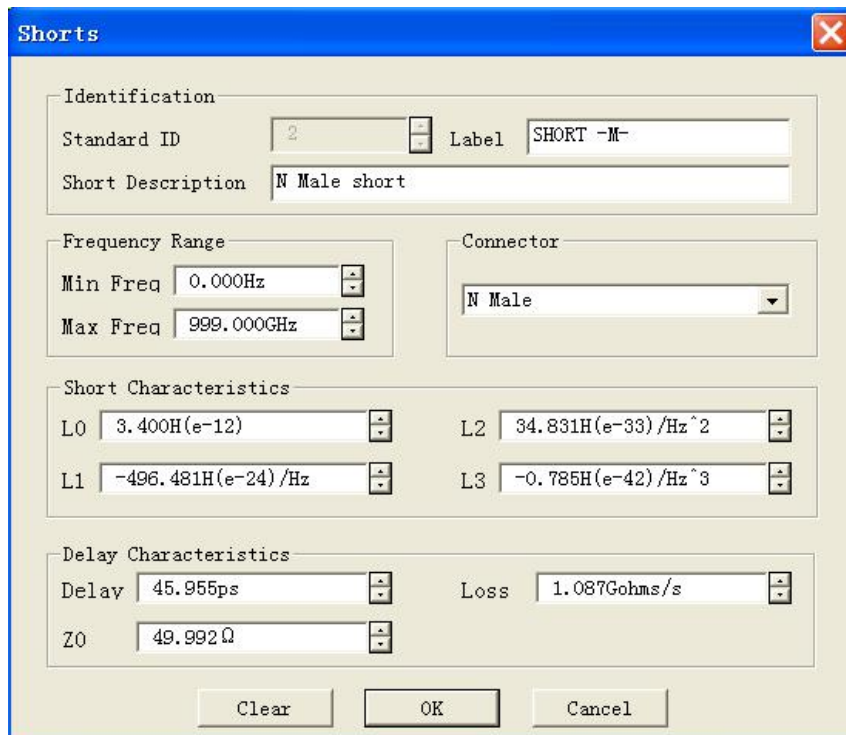


Fig.5-24 Shorts dialog box

**Short Characteristics zone**

Define the magnitude of short-circuit device residual inductance through [L0], [L1], [L2] and [L3] box.

5.5.2.10 Loads dialog box



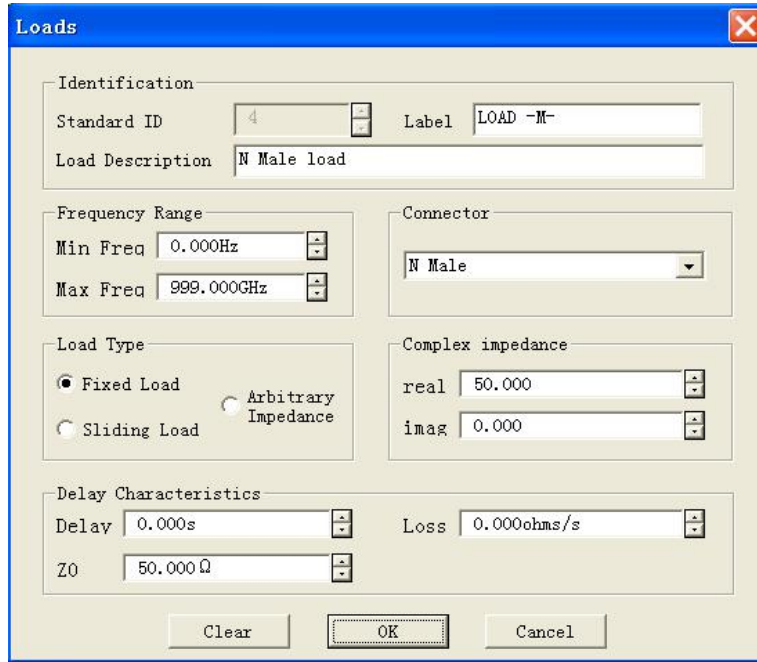


Fig.5-25 Loads dialog box

### Load Type zone

#### a) [Fixed Load]

Designate the load type as blocked load by selecting it.

#### b) [Sliding Load]

Designate the load type as slip load by selecting it.

#### c) [Arbitrary Impedance]

Designate the load with impedance value different system impedance Z<sub>0</sub> by selecting it. And the setting of Complex Impedance zone is valid only when the [Special Impedance] is selected.

### Complex Impedance zone

#### a) [Real]

Define the resistance of complex impedance.

#### b) [Imag]

Define the reactance of complex impedance.

## 5. 6. Calibration Standards

This section mainly describes basic principles of calibration kits and some terms in calibration kit definition files.

### 5. 6. 1. Calibration kit

Calibration kit is composed of a set of physical devices named calibration standards. The response information of each standard magnitude and phase changing along with the frequency is accurately known or predictable. To enable the Analyzer to use the definitions of these calibration standards, the response value of each standard must be defined by mathematical methods, and all standards must be organized into calibration types which correspond with the error modification models used by the Analyzer.

### 5. 6. 2. Calibration standards

Calibration standards provide the basic reference when the Analyzer carrying out error modification Measure. The Electrical delay, impedance and loss of each standard has been accurately defined, and the Analyzer saves these definitions and calculates all error items in the error models through those definitions. The Analyzer in calibration measures the responses of these calibration standards and calculate them to obtain error items by comparing the measured values with the given values of standards. While measuring the DUT, get rid of the impact of those error items on the Measure results through the mathematics theory named as error modification.

### 5. 6. 3. Types of calibration standards

Calibration standards are divided into 4 types which correspond with different standard definition structures or forms. These 4 calibration standard types are shown as follows:

Calibration standards	Terminal impedance
Open-circuit device	$\infty\Omega$
Short-circuit device	$0\Omega$
Load	System impedance
Through/air line/adapter	No terminal impedance

### 5. 6. 4. Definitions of calibration standards

Definitions of calibration standards describe electrical properties of standards and frequency scopes in which they can be used, including:

a) Minimum Frequency

Designate minimum frequency that standards can be used in calibration.

b) Maximum Frequency

Designate maximum frequency that standards can be used in calibration.

c) Impedance

Designate the characteristic impedance of standards, neither characteristic impedance of system nor terminal impedance of standards.

d) Delay

Define the transmission delay of the transmission line between calibration standards and actual calibration plane.

e) Type

Designate types of calibration standards: open-circuit device, short-circuit device, load or through/transmission line/adapter.

f) Loss

Designate the energy loss due to skin effect. The loss unit is Gohm/S, and the related frequency is 1GHz. In loss calculation, respectively measure the loss and delay of calibration standards at 1GHz, and use following formula to calculate:

$$Loss\left(\frac{\Omega}{S}\right) = \frac{Insertionloss(dB) \times IMPEDANCE(\Omega)}{4.3429(dB) \times DELAY(S)}$$

g) Open-circuit device fringe capacitance model

At high-frequency segment, due to the impact of fringe capacitance, the open-circuit device has few ideal reflection properties and its phase shift will change along with frequencies. Those impacts can not be eliminated. But the model of open-circuit device

defines fringe capacitance, and said capacitance model is a cubic polynomial with the frequency as the function; coefficients of polynomial are determined by actual properties of open-circuit device. The equation of fringe capacitance model is:

$$C=(C_0)+(C_1 \times F)+(C_2 \times F^2)+(C_3 \times F^3) \text{ (F represents measuring frequency)}$$

h) Short-circuit device residual inductance model

At high-frequency segment, due to the impact of fringe capacitance, the short-circuit device has few ideal reflection properties and its phase shift will change along with frequencies. Those impacts can not be eliminated. But short-circuit device model defines residual inductance, and said inductance model is a cubic polynomial with the frequency as the function; coefficients of polynomial is determined by actual properties of short-circuit device. The equation of residual inductance model is:

$$C=(L_0)+(C_1 \times F)+(C_2 \times F^2)+(C_3 \times F^3) \text{ (F represents measuring frequency)}$$

### 5. 6. 5. Classification of calibration standards

When the definition of calibration standards is completed, it must be distributed to a calibration type. One calibration type is composed of one group of standards which is organized on the basis of the error modification model of the Analyzer. The number of calibration types is equivalent to the number of error items to be modified in error model, e.g., response calibration requires one calibration type only; each port calibration requires three calibration types; one full dual-port SOLT standard in neglectation of isolation requires ten calibration types. Each calibration type may include one calibration only or several standards.

#### (1) S11A, S11B, S11C (S22A, S22B, S22C)

S11A, S11B and S11C standard types are used for reflection calibration of port 1, while S22A, S22B and S22C are used for the reflection calibration of port 2. Besides, they are used for full dual-port calibration and used to determine directional, source matching and reflection Tracing errors. Standards distributed in S11A, S22A are open-circuit devices, standards distributed in S11B, S22B are short-circuit devices, standards distributed in S11C, S22C are load.

#### (2) TRANS and MATCH (FWD and REV)

The four types are applicable for implementing full dual-port SOLT standards: standards of TRANS type are used to determine transmission Tracing errors and standards of MATCH type are used to determine the load matching errors. Typical standards included in the four types are through pieces or delay lines.

#### (3) ISOLATION

Standards of ISOLATION type are adapted for implementing SOLT calibration and TRL calibration, to determine the forward and backward crosstalk error in error modification model. The distributed calibration standards are loads.

#### (4) TRL through

Standards of TRL through type are applicable for implementing full dual-port TRL calibration. This type includes a through standard or a short transmission line. If through piece of non-zero length is included, corresponding calibrations are called LRL calibration and LRM calibration.

#### (5) TRL reflection

Standards of TRL reflection type are applicable for implementing full dual-port TRL calibration. This type is supposed to include a high-reflection coefficient standard, and is open-circuit device or short-circuit device usually. In calibration, it is not required to know the given actual magnitude value of standard reflection coefficient, but the phase angle must be determined. In the process of TRL calibration, both ports should use identical reflection standards.

#### (6) TRL transmission line/matching

Standards of TRL transmission line/matching type are used to implement full-dual port TRL standards, and it is supposed to include a transmission line standard or a load standard or both. If transmission line standard is used, it must have its phase shift different from through standard by  $20^\circ - 160^\circ$ , thus available frequency scope can be limited as 8:1, e.g., 2 - 18GHz. A wider frequency scope can be covered with several transmission lines of different lengths and usually a load is used to cover the lower end of the frequency, because the transmission line is too long to be used in this frequency scope. When using a load, the corresponding calibration types are TRM or LRM.

## 5. 7. TRL Calibration

TRL (Thru-Reflect-Line) calibration includes a series of calibration technologies, such as TRM(Thru-Reflect-Match). TRL calibration determines 12 error coefficients by measuring two transmission standards and a reflection standard, while conventional SOLT calibration determines the 12 error coefficients by measuring a transmission standard (T) and three reflection standards (SOL).

### 5. 7. 1. Why making TRL calibration?

TRL calibration is quite accurate and is more accurate than SOLT calibration in some situations, but calibration kits available for TRL are few. If high Measure precision is demanded and there is no calibration kit of the same type with measured piece connector, e.g., use fixture to make Measure or use probes to measure on the wafer, it is often required to make TRL calibration. Then it is necessary to build and define calibration kits which are the same with the measured piece medium, and it is easier to develop 3 TRL standards than develop 4 SOLT standards. TRL standard has an disadvantage that it is required to use several transmission line standards while make wideband calibration, e.g., the frequency range of 2GHz - 26GHz requires two transmission line standards, and the transmission line standard is quite long in low frequency range.

### 5. 7. 2. TRL calibration standard

Three standards are required in TRL calibration kit: through standard, reflection standard and transmission line standard.

#### (1) Through standard

Through standard can be zero length or non-zero length. The standard of zero length is more accurate because of no loss and characteristic impedance. Electrical delay of through standard must differ from the transmission line standard. It can be used to build the Measure reference plane in calibration if its phase and electrical length are defined accurately.

#### (2) Reflection standard

Reflection standard can be any physical device with high reflection coefficient. Properties connected to the reflection standards of two measuring ports must be identical absolutely. In calibration, regardless of the magnitude reflected by standard piece, the phase must be given and the electrical length must be within  $1/4$  wavelength. It can be used to build Measure reference plane if the magnitude and phase of reflection standard is defined accurately.

#### (3) Transmission line standard

Transmission line standard is used to develop Measure reference impedance after the calibration. TRL standard is inadequate in following aspects due to the limitations of transmission line standard:

- Transmission line standard must have the same impedance with through standard.
- Electrical length of transmission line standard can not be identical with that of through standard.

- Transmission line standard must have appropriate electrical length in the whole frequency scope. At each frequency point, the phase difference between transmission line standard and through standard must be more than  $20^\circ$  and less than  $160^\circ$ , thus the frequency scope that actual single transmission line can cover is 8:1. To cover wider frequency range, several transmission line standards are required.

- Transmission line standard is quite long at low frequency range. The optimized length of transmission line standard is  $1/4$  wavelength of frequency-span geometric average frequency (square root of start frequency  $\times$  stop frequency).

#### **(4) Matching standard**

Matching standard can be used to replace the transmission line when the required length or lost transmission line can not be produced.

- Matching standard is low reflection terminal connected to the port.
- While calculating the error coefficients of TRL calibration, take the matching standard as high-loss transmission line of indefinite length.
- Impedance of matching standard becomes reference impedance for measurement.

## 6. Data Analysis

This chapter intends to describe how to read Measure result and calculate and Analysis the result, including following contents:

- Marker
- Trace math and statistics
- Limit test
- Bandwidth test
- Bandwidth searching
- Ripple test
- Fixture Simulator
- Parameter Transformation

### 6. 1. Marker

Marker can be used to read measured data, search measured values of specified types and change the settings of Analyzer. Each Trace can use 9 normal markers and 1 reference marker.

#### 6. 1. 1. 1. Create a marker

By mouse or touch screen -marker toolbar

- 1) Click **[Response]**, point to **[Toolbars]** on **[Display]** menu, click and check **[Markers]** on Toolbar submenu, then the Analyzer displays Marker toolbar.
- 2) Select the marker to be enabled in **[Mkr]** box of the toolbar.
- 3) Click and check **[ON]** check box.
- 4) Set stimulus values of the marker in **[Stimu]** box.

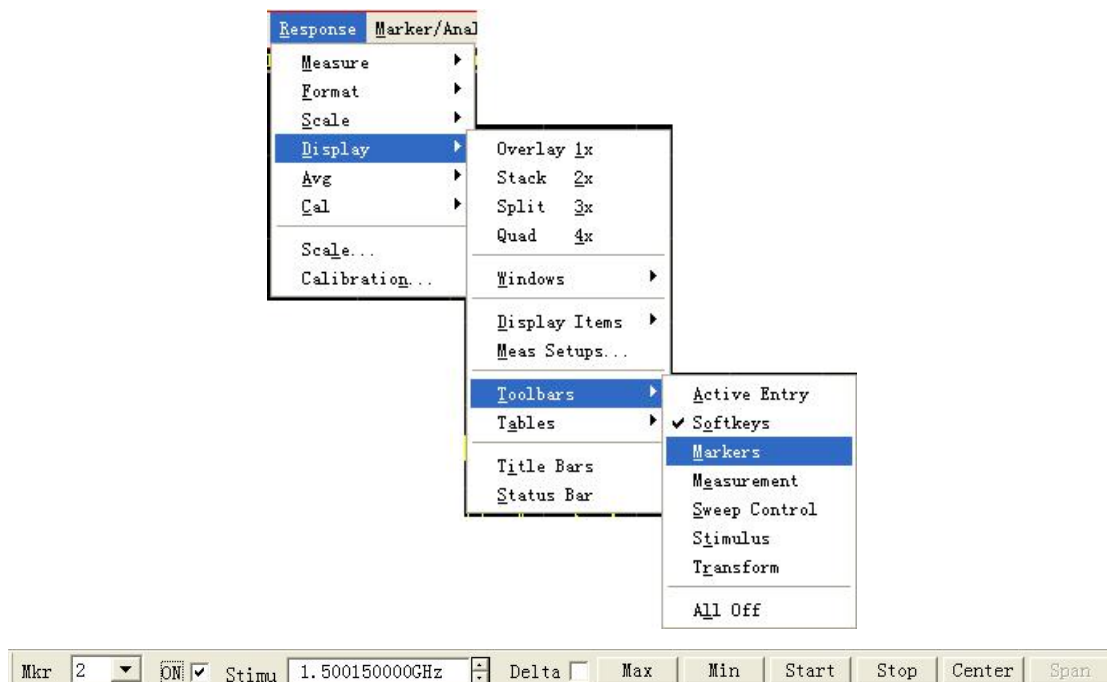


Fig. 6-1 Using Marker Toolbar to Create the Marker

### 6. 1. 1. 2. By mouse or touch screen - marker dialog box

- 1) Click **[Marker/Analysis]**, click **[Marker...]** on **[Marker]** menu, display Marker dialog box.
- 2) Select the marker to be enabled in **[Marker]** box.
- 3) Click and check **[on]** check box.
- 4) Set stimulus values of the marker in **[Stimulate]** box.
- 5) Click **[OK]** to close the dialog box.

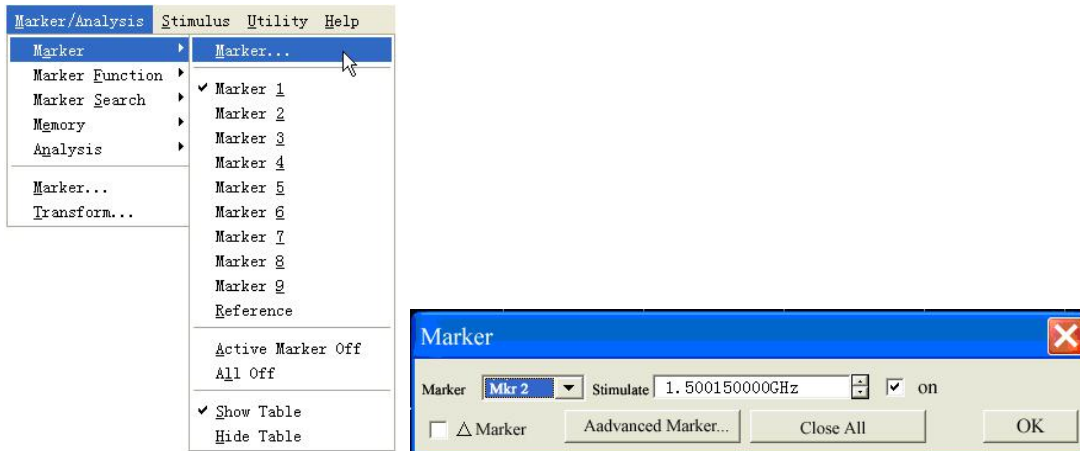


Fig 6-2 Using Marker Dialog Box to Create the Marker

### 6. 1. 1. 3. By mouse or touch screen -marker menu

- 1) Click **[Marker/Analysis]**, point to **[Marker]** on Marker/Analysis menu, display Marker submenu.
- 2) Click and select the marker to be enabled on submenu.

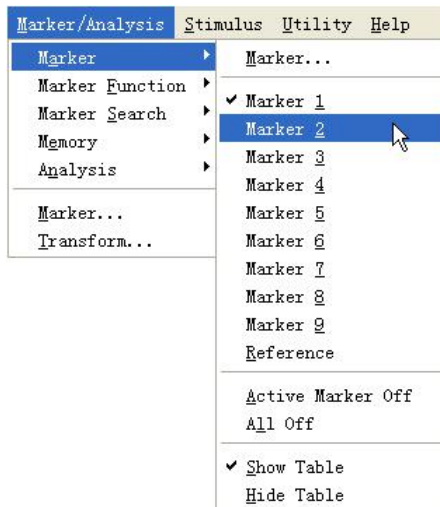


Fig 6-3 Using Marker Menu to Create Marker

### 6. 1. 1. 4. By front panel keys

- 1) Press **[Marker]** at MKR/ANALYSIS area, display the marker to be enabled in appropriate soft-key menu toolbar.
- 2) Press the soft-key corresponding to the marker to be enabled to enable the marker.
- 3) Set marker stimulus values in **Marker** box of the toolbar.

### 6. 1. 1. 5. Marker dialog box

- **[Marker]**

Used to select the marker to be defined.

- **[Stimulate]**

Set and select the stimulus values of marker axle X.

- **[on]**

Check it to enable the marker in [Marker], clear and close the marker in [Marker].

- **[△ Marker]**

When checking it, the Analyzer displays the relative values between selected marker and marker R. If marker R is not enabled, it will be enabled automatically.

- **[Advanced Marker]**

Click it and display [Marker Advanced Options] dialog box.

- **[Close All]**

Click it and close all enabled marker.

### 6. 1. 2. Moving the marker

- 1) Select the marker to be moved by one of the methods mentioned above to make it be the current Stimulus marker.
- 2) Use appropriate methods to move the marker

a. Click **[Stimu]** in Marker toolbar, and move the marker by following methods:

- ◆ Directly input marker stimulus values.
- ◆ Revolve the knob to move the marker.
- ◆ Click UpDown on **[Stimu]** to move the marker.
- ◆ Press [ △ ] or [ ▽ ] in ADJUST area to move the marker.

b. Click **[Stimulate]** box in Marker dialog box, and move the marker by following methods:

- ◆ Directly input marker stimulus values.
- ◆ Revolve the knob to move the marker.
- ◆ Click UpDown on **[Stimulate]** box to move the marker.
- ◆ Press [ △ ] or [ ▽ ] in ADJUST area to move the marker.

c. Move the marker by following methods in the Marker box of **Marker** corresponding to the soft-key toolbar.

- ◆ Directly input stimulus values.
- ◆ Revolve the knob to move the marker.
- ◆ Click UpDown on Marker box to move the marker.
- ◆ Press [ △ ] or [ ▽ ] in ADJUST area to move the marker.

For above described methods of moving the marker, the marker can only be moved after it is activated. Besides, S3603D Vector Network Analyzer supports moving the marker by dragging the mouse directly, and the method is:

Point the mouse to indicator “▽” (active marker) or “△” (inactive marker) of the marker to be moved, press left mouse button, then after the mouse pointer becomes horizontal Adjust indicator “↔”, drag the mouse to the position where the marker is required to be



moved, release the left mouse button and complete moving the marker.

### 6. 1. 3. Marker Search

Marker search function can be used to search special measured value. Without matching measured data, marker will retain unchanged in the current position.

#### 6. 1. 3. 1. By mouse or touch screen

- 1) Click **[Marker/Analysis]**, click **[Marker Search...]** on **[Marker Search]** menu, and then Marker Search dialog box will be displayed.
- 2) Select the marker used for searching measured value in the **[Marker]**.
- 3) Set up search type and search domain in the dialog box, and click **[Execute]** to search measured value.
- 4) Click **[OK]** to close the dialog box.

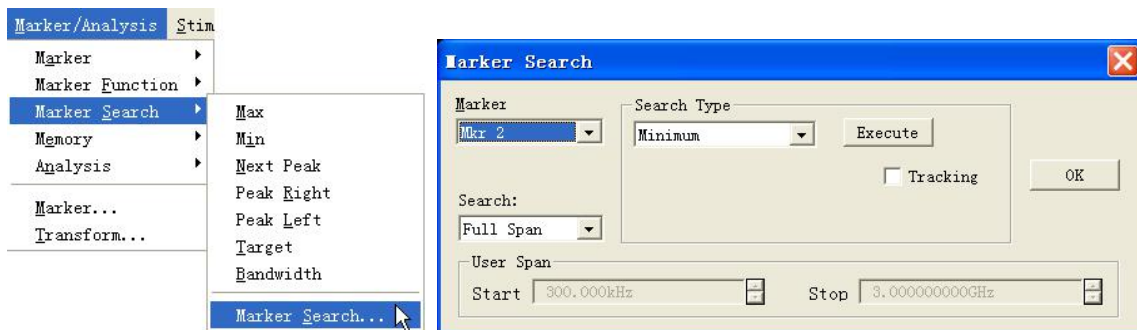


Figure 6-4 Marker Search

#### 6. 1. 3. 2. By front panel keys

- 1) Press **[Search]** in MKR/ANALYSIS area.
- 2) Press corresponding soft-key to select search function in soft-key search toolbar.

#### 6. 1. 3. 3. Marker Search dialog box

- **[Marker]**

Select the marker which makes search definition and implements search function.

- **[Search]**

It is used to define the search scope of marker; the default search scope is full bandwidth, and in addition, it supports 9 users' settings. When selecting the search scope of user settings, definition must be made for user settings in the scope of user domain. The search scopes of user settings can be mutually overlapped, and different markers can use the same search domain; the following figure shows a set of search scopes of user settings.

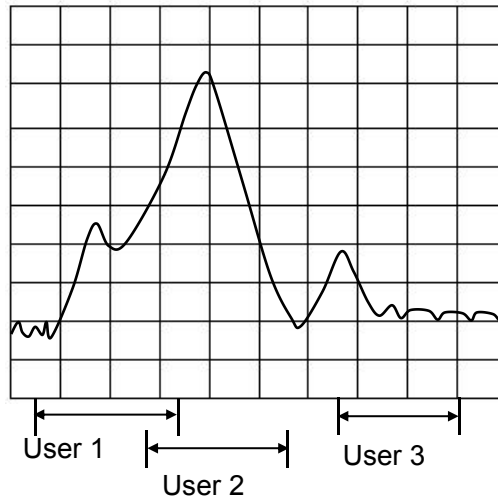


Figure 6-5 Search Scope of User Settings

- **User Span**

Define search scope of user settings through [Start] and [Stop] box.

- **Search Type Zone**

- a) **[Type]**

It is used to select search type of marker; the Analyzer supports the following 7 search types.

- Minimum value: to search the minimum measured data point.
- Maximum value: to search the maximum measured data point.
- Right peak value: to search the next effective peak value at the right side of marker.
- Left peak value: to search the next effective peak value at the left side of marker.
- Next peak value: to search the next peak value lower than current marker amplitude value.

When searching peak value, definition of peak must be made at first. Definition of peak is made through **[threshold]** and **[shift]** boxes. **[Threshold]** defines the minimum peak point. The peak point of effective peak must be above threshold, and valleys at both sides can be lower than threshold. **[Bias]** defines the minimum vertical distance between peak point and valley point, the vertical distance between the peak value of effective peak and valleys at both sides must be larger than offset value. The default threshold value is -100dB, and offset value is 3dB. Definition and settings of peak value for Analyzer are as below:

<b>Threshold:</b>	-50dB
<b>Bias:</b>	10dB
<b>Scale:</b>	10dB/grid

In the following figure, A is an effective peak, threshold and offset of which satisfy requirements; B is not an effective peak, without satisfactory offset; C is also not an effective peak, without satisfactory threshold.

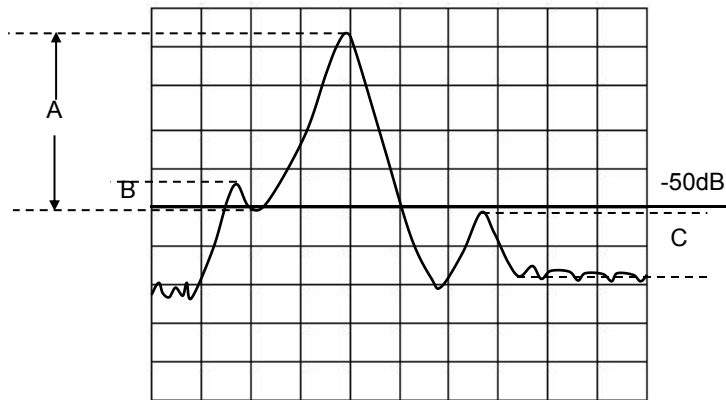


Figure 6-6 Definition of Peak

➤ Target: input the target value to be searched in the **[Logarithm Value]**, and click **[Execute]** value. When marker moves to the first target value at the right side of current marker position, continuously click **[Execute]** to make marker move to the next target value at the right side until to the highest end of stimulus value, and then return to the lowest end of stimulus value to search target value.

◆ When selecting **[Discrete Marker]** in the **[Marker Advanced Options]**, if a data point is respectively at both sides of interpolative target value, marker will move to the discrete data point most close to the target value.

◆ When clearing **[Discrete Marker]** in the **[Marker Advanced Options]**, marker will move to the interpolative data point equal to target value.

➤ Left target: only searching the target value at the left side of current marker.

➤ Right target: only searching the target value at the right side of current marker.

➤ Bandwidth: when selecting bandwidth search function, set up level which drops from peak value at both sides in **[level]** (defaulted as -3dB), click **[Execute]** to make bandwidth Measure at this level. Use marker 1-4 during Measure, marker 1 searches the maximum peak value, marker 2 searches the point at the left side of peak value dropping to the specified level, marker 3 searches the point at the right side of peak value dropping to the specified level, and marker 4 searches the center point of bandwidth, and the following data will be shown after the completion of Measure:

**Marker1:** X-axis value and Y-axis values of peak point.

**Bandwidth:** X-axis D-value of marker 2 and 3.

**Center:** X-axis center value between marker 2 and 3.

**Q-value:** Ratio of center frequency to bandwidth.

**Loss:** Y-axis value of marker 4, this is the loss value of filter center.

#### b) **[Execute]**

Click **[Execute]** button to carry out marker search with specified type once.

#### c) **[Tracking]**

When selecting **[Tracing]** check box, Analyzer shall implement search function after the completion of Sweep each time according to the current search type and settings of search domain, thus it can be ensured that marker is at the expected position after Sweep every time. If marker Tracing function is on, the stimulus value of search marker can be manually set up.

### 6. 1. 4. Marker Function

Status settings of Analyzer can be changed by Stimulus marker position, such as initial frequency and stop frequency.

#### 6. 1. 4. 1. Set up Measure by marker function

### By mouse or touch screen -marker function dialog box

- 1) Click **[Marker/Analysis]**, and click **[Marker Function...]** on the **[Marker Function]** menu to display Marker Function dialog box.
- 2) Select the required Analyzer function settings in the dialog box.
- 3) Click **[OK]** to close the dialog box after setting is complete.



Figure 6-7 Measure by Use of Marker Function Dialog box Settings

### By mouse or touch screen -marker toolbar

- 1) Click **[Response]**, point to **[Toolbar]** of the **[Display]** submenu, click and select **[Marker]** on the Toolbar submenu to display Marker toolbar.
- 2) Select the required Analyzer function settings in the Marker toolbar.

### By front panel keys

- 1) Press **[Marker]** in MKR/ANALYSIS area.
- 2) Press corresponding soft-key of **[Marker Functions]**, and press corresponding soft-key to select Analyzer setting functions in the arisen marker function soft-key toolbar.

### Marker function dialog box

- **[Marker->Start]**

When clicking, start value of Sweep Setup is equal to the value for Stimulus marker.

- **[Marker->Stop]**

When clicking, stop value of Sweep Setup is equal to the value for Stimulus marker.

- **[Marker->Center]**

When clicking, center value of Sweep Setup is equal to the value for Stimulus marker.

- **[Marker->Ref Level]**

When clicking, reference value settings are equal to response values for Stimulus marker.

- **[Marker->Delay]**

When clicking **[Marker->Delay]** button, Analyzer will use phase slope to adjust Electrical delay of receiving path, thus the phase locus near the Stimulus marker can be flattened. This function can be used to make electrical length and phase offset Measure, and it is only applicable for ratio Measure.

- **[Marker->Span]**

When clicking it, span value of Sweep Setup is equal to activation D-value between Stimulus marker and marker R ( $\Delta$  marker value), and this button is only valid when marker is Stimulus and  $\Delta$  marker function is on.

### 6. 1. 5. Advanced Marker Option Setting

### 6. 1. 5. 1. By mouse or touch screen

- 1) Click **[Marker/Analysis]**, and click **[Marker ...]** on the **[Marker]** menu to display Marker dialog box.
- 2) Click **[Advanced Marker...]** button to display Advanced Marker dialog box.
- 3) Set up marker in the dialog box.
- 4) Click **[OK]** to close the dialog box.

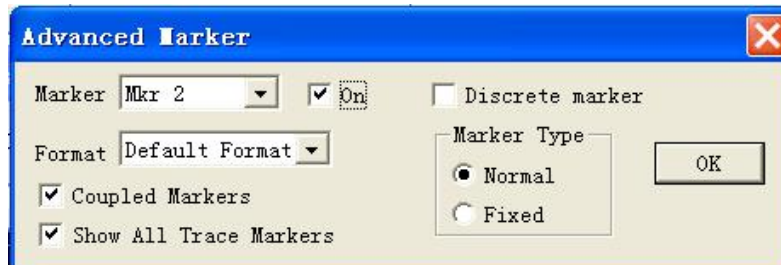


Figure 6-8 Marker Advanced Options Dialog box

### 6. 1. 5. 2. By front panel keys

- 1) Press **[Marker]** in MKR/ANALYSIS area, and press corresponding soft-key of **[Marker Properties]** on the arisen soft-key menu.
- 2) Press corresponding soft-key of **[Advanced Marker]** to display Advanced Marker dialog box.
- 3) Set up marker in the dialog box.
- 4) Press **[OK]** in the input keypad to close the dialog box after settings are completed.

### 6. 1. 5. 3. Advanced Marker dialog box

- **[Marker]**

Select the marker to be set up.

- **[On]**

When it is selected, marker in **[Marker]** box will be displayed on screen, and corresponding marker display will be close if it is cleared.

- **[Discrete Marker]**

When it is selected, marker only displays data at actual measuring point, and it also displays interpolative data point between measuring points when it is cleared.

- **[Format]**

Select the format of marker to display measured data, the format of marker data can be different from that of screen Trace data, but they are same under the default condition.

- **[Coupled Marker]**

When selecting and enabling marker coupling function, markers with the same number on different Traces and corresponding markers on Active Traces have the same stimulus value settings. Change of Stimulus settings of Stimulus marker can also change Stimulus settings of markers with the same number on other Traces at the same time. If domains of X-axis are identical (for instance, the same as frequency domain or time domain), all markers of channels, Traces and windows are coupled, and the markers on Traces different from Active Traces X-axis will not be coupled. When clearing the check box, only settings for Stimulus marker can be changed.

- **[Show All Trace Markers]**

When selecting it, markers of all Traces will be displayed, and when clearing it, only markers of Active Traces will be displayed.

- Marker type
  - [Normal]

Standard marker has fixed X-axis position, Y-axis position will change with amplitude of Trace data, and marker can be shifted left and right on X-axis by changing stimulus value of marker.

- [Fixed]

According to the position on Traces when it is set up as Fixed type marker, the marker will constantly keep fixed X-axis and Y-axis coordinates unchanged; it will not fluctuate with change of Trace data amplitude. Its position on X-axis can be shifted by changing its stimulus value, but coordinate on Y-axis can remain unchanged. This type of marker is mainly used to observe change of Trace marker, for example, the fixed type marker can be used to compare variance of insertion loss before and after tuning wave-filter.

### 6. 1. 6. Marker Table

Marker Table can be enabled to display all marker data of Active Traces, and marker data will be displayed in specified format of each marker.

#### 6. 1. 6. 1. Settings of show table

##### By mouse or touch screen -marker menu

- 1) Click **[Marker/Analysis]**, point to **[Marker]** in Marker/Analysis menu.
- 2) Select **[Show Table]** in submenu to enable Show table.
- 3) Select **[Hide Table]** in submenu to close Show table.

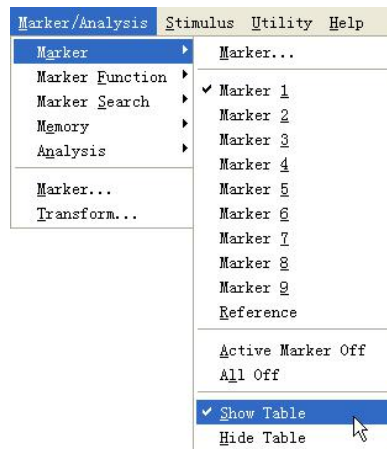


Figure 6-9 Settings of Show table via Marker Menu

##### By mouse or touch screen -view menu

- 1) Click **[Response]**, point to **[Table]** in [Display] menu.
- 2) Select **[Marker Table]** in submenu of Table to enable Marker Table display.
- 3) Click clear and select **[Marker Table]** in submenu of Table to close Marker Table display.

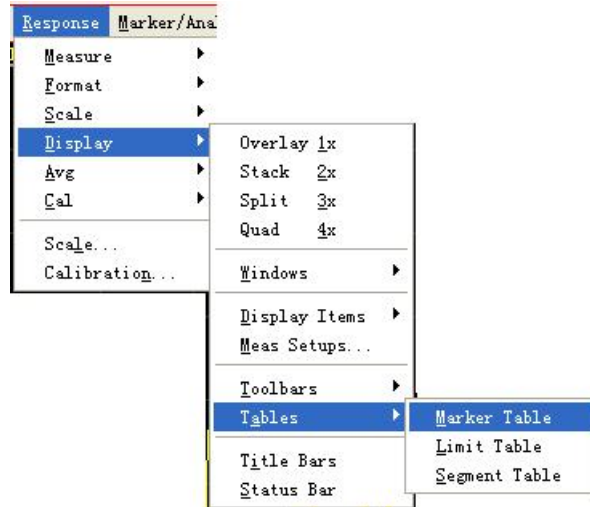


Figure 6-10 Settings of Marker Table Display by View Menu

### By front panel keys

- 1) Press **[Display]** in RESPONSE area, and press **[More]** corresponding soft-key on arisen soft-key menu.
- 2) Press corresponding soft-key of **[Tables]**, press corresponding soft-key of **[Marker Table]** in arisen soft-key menu to select and enable Marker Table display.
- 3) Press corresponding soft-key of **[Hide Table]** to select and close Marker Table display.

## 6. 2. Trace Math and Statistics

Analyzer can carry out 4 types of mathematical operation to current Active Trace and storage Trace; in addition, it also provides 3 kinds of Trace statistical functions.

### 6. 2. 1. Trace Math

Before Execution of any type of Trace math, a Trace must be saved in memory, and Trace math is vector operation made on complex data before formatted display.

#### 6. 2. 1. 1. Settings of Trace math

##### By mouse or touch screen

- 1) Click **[Marker/Analysis]**, and click **[Math/Memory]** on **[Memory]** menu to display Math/Memory dialog box.
- 2) Set up math and display of Trace in the dialog box.
- 3) Click **[OK]** button to close the dialog box.

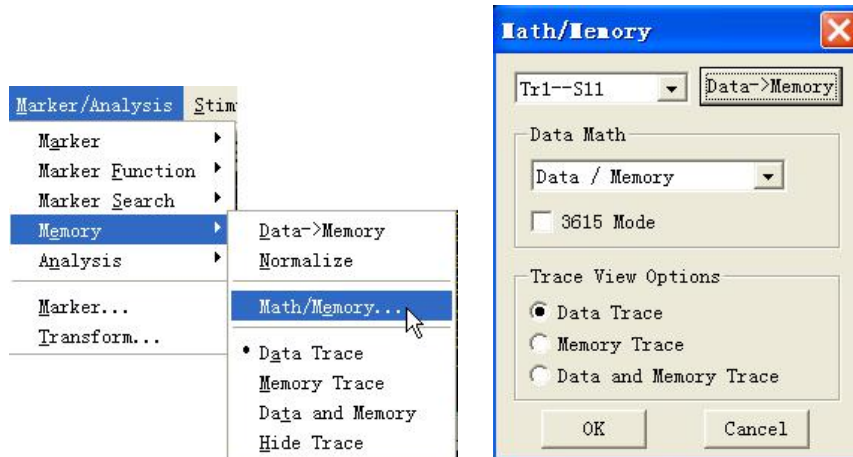


Figure 6-11 Settings of Trace Math

### By front panel keys

- 1) Press **[Memory]** key in MKR/ANALYSIS area.
- 2) Press corresponding soft-key of **[Data->Memory]** to save current measured Trace data in memory.
- 3) Press corresponding soft-key of **[Data Math Off]** to display various mathematical operation and set up computation of Trace according to corresponding soft-key.
- 4) Press corresponding soft-key of **[Data Trace]** to display measured data.
- 5) Press corresponding soft-key of **[Memory Trace]** to only display measured data.
- 6) Press corresponding soft-key of **[Data and Memory]** to display measured data and stored data at the same time.

### Computation/ Storage dialog box

- **[Data->Memory]**

When clicking it, current measured data will be saved in memory.

- **[Data Math]**

It is used to select Trace math type, and the Analyzer supports the following Trace math:

- **Data**: it will not make any type of mathematical operation.
- **Data + Memory**: it will implement addition computation for measured data and stored data.
- **Data – Memory**: it implements subtraction operation for measured data and stored data, and this function can be used for simple error correction; firstly save vector error data in memory, and then subtract error data from measured data of the part.
- **Data \* Memory**: it will implement multiplication operation for measured data and stored data.
- **Data / Memory**: it implements division operation for measured data and stored data, and this function is mainly used to make ratio Measure, such as gain and attenuation Measure.

### Trace View Option Zone

- **[Data Trace]**

When it is selected, data after Trace math will be only displayed.

- **[Memory Trace]**

When it is selected, stored Trace data will be only displayed.



- [Data and Memory Trace]

When selecting it, data Trace and storage Trace after Trace math will be displayed at the same time.

### 6. 2. 2. Trace Statistics

The Analyzer provides statistics functions for average, standard deviation and peak-to-peak value Traces, which can be used to calculate full Stimulus bandwidth or statistical value within user definition scope. Each channel supports full bandwidth and statistical ranges of 9 user settings, these ranges are identical to search domain of user settings in marker search, they use the same memory address, therefore, they share the same Stimulus settings. If search domain of channel user settings is defined through marker search function, the same range settings can be called by selecting corresponding user settings in Trace statistics.

Trace statistical function can easily measure peak-peak value of pass-band ripple wave without searching maximum value and minimum value. Statistic of Trace is calculated according to data display format:

- Rectangular Coordinates Format: statistic is calculated according to displayed scalar data.
- Polar Coordinates and Smith Chart Format: statistic is calculated according to display value of data in log-magnitude format.

#### 6. 2. 2. 1. Settings of Trace statistics

##### By mouse or touch screen

- 1) Click **[Marker/Analysis]**, and click **[Trace Statistics...]** on the **[Analysis]** menu to display Trace Statistics dialog box.
- 2) Click **[Statistics]** and select check box to enable Trace statistical function.
- 3) Click **[User Range]** box to select setting of Trace statistical range.
- 4) If select user settings range, click **[Start]** and **[Stop]** in definition zone of user domain, and input definition of user settings range.
- 5) Click **[OK]** to close the dialog box after settings are completed.

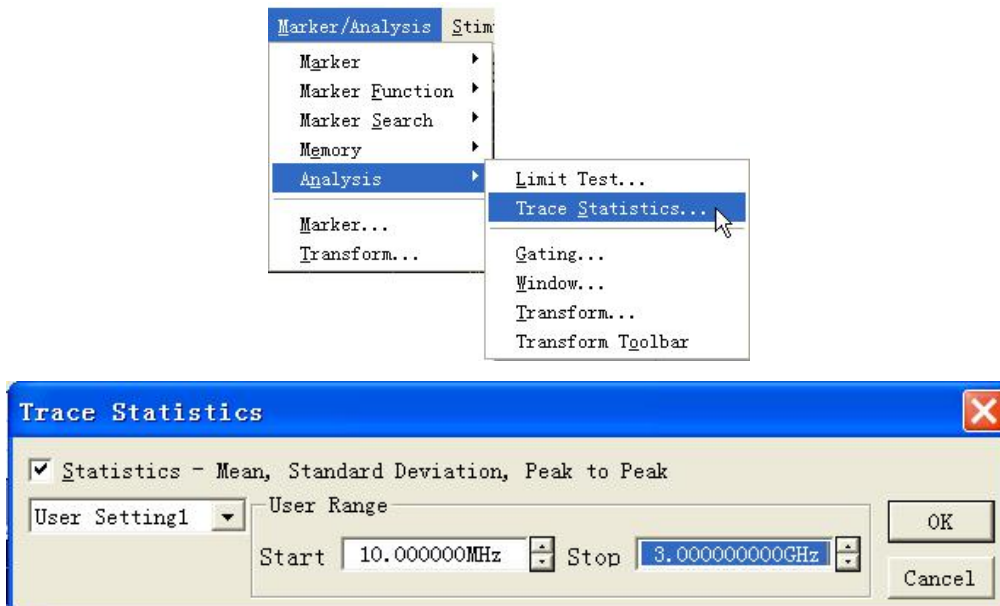


Figure 6-12 Settings of Trace Statistics

##### By front panel keys

- 1) Press **[Analysis]** in MKR/ANALYSIS area, and press corresponding soft-key of **[Statistics]** on arisen soft-key menu.
- 2) Press corresponding soft-key of **[Trace Statistics...]** to display Trace Statistics dialog box.

- 3) Press [  ], [  ] in ADJUST area to shift to **[Statistics-Mean, Standard Deviation, Peak to Peak]** check box, press the knob key and select check box to enable Trace statistical function.
- 4) Press [  ], [  ] to shift to **[User Setting]** box, press [  ] and [  ] in ADJUST area or rotate knob to select settings of Trace statistical range. If select user settings range, click [  ], [  ] to shift to **[Start]** and **[Stop]** in definition scope of user domain so as to input definition of user settings range.
- 5) Press **[OK]** in the input keypad to close the dialog box after settings are completed.

### Trace statistical dialog box

- [Statistics-Mean, Standard Deviation, Peak to Peak]

When it is selected, Trace statistical function will be on, and when it is cleared, Trace statistical function will be off.

- [User Setting]

It is used to select range settings of Trace statistics, and full bandwidth or 9 user-defined settings can be selected.

- Definition Zone of User Range

- [Start]

It is used to define starting value of user settings range.

- [Stop]

It is used to define ending value of user settings range.

## 6. 3. Limit Test

Limit test function can compare measured data with defined constraint (limit), and the user-defined limit will be displayed on screen in the form of limit line. There are the following advantages for using limit line.

- It provides the debugging personnel with an intuitive indication.
- It provides index properties of a device meeting required standard.
- It provides intuitive comparison between measured data of device and index requirements.

Limit test function can compare measured data with defined limits, and provide PASS and FAIL information; each Trace can support more than 100 separate limit line sections to make precise definition for limit.

### 6. 3. 1. Creating and Editing Limit Line

Analyzer can create limit lines for all measured Traces; a limit line is composed of multiple separate limit line sections, each line section is determined by 4 coordinates: start and stop stimulus values of X-axis and starting and ending response values of Y-axis, and limit line is created and edited by using limit table.

#### 6. 3. 1. 1. By mouse or touch screen

- 1) Click **[Marker/Analysis]**, and click **[Limit Test ...]** in the **[Analysis]** menu to display Limit Test dialog box.
- 2) Click **[Show Table]** in the dialog box to turn on limit table display.
- 3) Click **[OK]** to close the dialog box.
- 4) Click **[Type]** box of limit table, and select limit test type in drop-down box.
- 5) Double-click **[Begin Stimulus]** to set up start stimulus value.
- 6) Double-click **[End Stimulus]** to set up stop stimulus value.

- 7) Double-click [**Begin Response**] to set up initial response value.
- 8) Double-click [**End Response**] to set up stop response value.
- 9) Click [**Limit Type**] of limit table, and select limit line display type in drop-down box.
- 10) After opening limit line section of last row, Analyzer will automatically add a row under limit table, repeat steps 4)-8) to complete edition and addition of all limit sections.

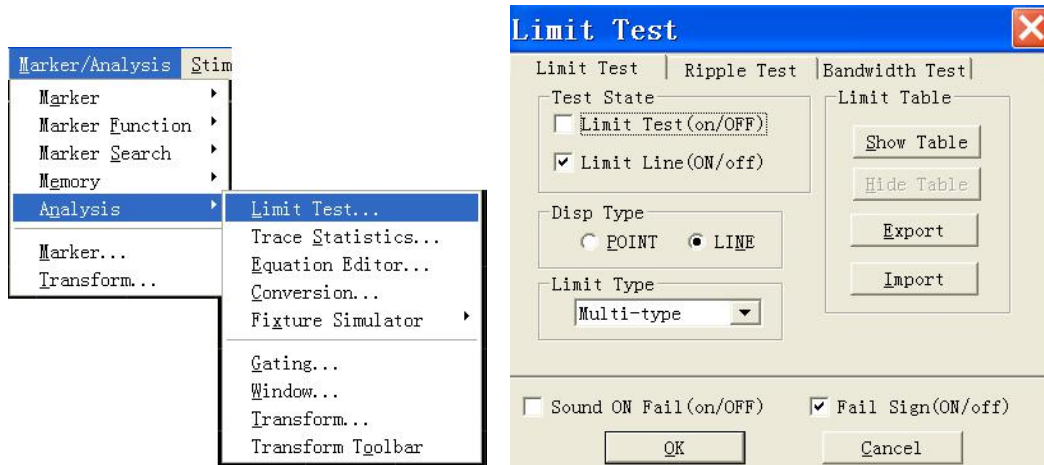


Figure 6-13 Display Limit Table

### 6. 3. 1. 2. By front panel keys

- 1) Press [**Analysis**] in MKR/ANALYSIS area, press corresponding soft-key of [**Limits**] in arisen soft-key menu, press corresponding soft-key of [**Edit Limit Table**], and press corresponding soft-key of [**Limit Table on/Off**] to turn on Limit Table Display.
- 2) Press [□],[□] in ADJUST area to shift to [**Type**] of limit table, press the knob button in ADJUST area to open Type drop-down box, rotate knob or press [△] and [▽] in ADJUST area to select limit test type and press the knob button for confirmation of choice.
- 3) Press [□],[□] to shift to [**Begin Stimulus**], and press the knob button to Stimulus start activation input box, and set up start stimulus value.
- 4) Press [□],[□] to shift to [**End Stimulus**] box, and press the knob button to Stimulus stop activation input box, and set up start stimulus value.
- 5) Press [□],[□] to shift to [**Begin Response**] box, and press the knob button to Stimulus start response input box, and set up start response value.
- 6) Press [□],[□] to shift to [**End Response**] box, and press the knob button to Stimulus stop response input box, and set up stop response value.
- 7) Press [□],[□] to shift to [**Limit Type**] box of limit table, and press the knob button to open the drop-down box of limit type, rotate the knob or press the [△], [▽] in ADJUST area to select the limit line display type, and press the knob button to confirm the selection.
- 8) After opening limit line sections of last row, Analyzer will automatically add a row under limit table, different row can be selected to edit by pressing [△] and [▽]. When active region is at the last row, a row will automatically add under limit table when pressing [▽].
- 9) Repeat Steps 2)-8) to complete addition and edition of all limit line sections.

### 6. 3. 1. 3. Limit Table

	Type	Begin Stimulus	End Stimulus	Begin Response	End Response	Limit Type
1	MAX	100.000kHz	100.000kHz	-100.000dB	100.000dB	SLOP
2	MIN	100.000kHz	3.000GHz	-100.000dB	-100.000dB	FLAT
3	OFF	100.000kHz	3.000GHz	-100.000dB	100.000dB	SLOP

Figure 6-14 Limit Table

- **Type**

- Setting limit test types in type box:
- MAX: When Trace is above limit line section, limit test fails.
- MIN: When Trace is below limit line section, limit test fails.
- OFF: Stop the limit section test

- **Begin Stimulus Box and End Stimulus**

They are used to set up begin and end stimulus values of limit line section (X-axis start and stop coordinates of limit line section).

- **Begin Response Box and End Response**

They are used to set up begin and end response values of limit line section (Y-axis start and stop coordinates of limit line section).

- **Limit Type**

Setting the limit line display types:

- · SLOP:display declined limit line
- · FLAT:display horizontal limit line
- · POINT:display punctual limit line

### 6. 3. 2. Setting Limit Test

After limit line is created, the limit line of some Trace can be chosen to display or hide. When the limit line is hidden, corresponding limit test is still effective. For limit test which can not be made for stored Traces, it can be chosen to send out alarming and display FAIL information to instruct limit test. When enabling limit test function, failed part of traces for limit test will be displayed as red, and passed parts of traces will remain unchanged. You can change the color of FAIL information through the color setup item in the right key menu of the mouse.

#### 6. 3. 2. 1. By mouse or touch screen

- 1) Click **[Marker/Analysis]**, and click **[Limit Test ...]** on **[Analysis]** menu to display Limit Test dialog box.
- 2) Set up limit test in the dialog box.
- 3) Click **[OK]** button to close the dialog box.

#### 6. 3. 2. 2. By front panel keys

- 1) Press **[Analysis]** in MKR/ANALYSIS area, and press corresponding soft-key of **[Limit]** in arisen soft-key menu.
- 2) Press corresponding soft-key of **[Limit Test on/OFF]** to trigger enable and close of limit test function.
- 3) Press corresponding soft-key of **[Limit Line on/OFF]** to trigger display of limit line.
- 4) Press corresponding soft-key of **[Sound on Fail on/OFF]** to enable failure sound prompt.
- 5) Press corresponding soft-key of **[Fail Sign on/OFF]** to trigger display of FAIL Mark of limit test.
- 6) Press corresponding soft-key of **[Edit Limit Table]**, and press corresponding soft-key of **[Limit Table on/OFF]** on

the sub-menu to trigger display of limit table.

Limit test is only made at actual Sweep measured point, when Sweep points are less, performance index of measured piece may not meet requirements, but it still can pass limit test, therefore during actual Measure, adequate canning points must be used to make limit test.

### 6. 3. 2. 3. Limit Test dialog box

- [Limit Test(ON/off)]

When it is selected, limit test function of Active Trace will be enabled, when it is cleared, limit test function of Active Trace will be closed.

- [Limit Line(ON/off)]

When it is selected, limit line of Active Trace will be displayed on screen, when it is cleared, display of limit line of Active Trace will be closed, but it will not affect limit test function.

- [Sound on Fail]

When it is selected, if Trace data point test is failed, buzzer will send out warning tone.

- [FAIL Mark(ON/off)]

When it is selected, if Trace data point test is failed, the mark of fail will be displayed on the screen.

- [Dot]

Use symbol "v" (Measure type as MAX) and "^"(Measure type as MIN)to indicate corresponding discrete limit value of measured data point during selecting.

- [Line]

Use line to connect all discrete limit set point during selecting.

- [Show Table]

When it is clicked, limit table will be showed for edition, and when the limit table is enabled, the button will change into forbidden status.

- [Hide Table]

When it is clicked, limit table display will be closed, and if it is closed, the button will change into forbidden status.

- [Export Table]

When it is clicked, storage dialog box will turn up, you can select storage route and store the file with \*.csv format.

- [Import Table]

When it is clicked, storage dialog box will turn up, select the storage route of the file to be opened and you can open file with \*.csv format.

- [Limit Test Type]

Single-click the drop-down box, you can select limit test type. There are totally four types: Multi-type limit line、 Declined limit line、 Punctual limit line and Horizontal limit line.

## 6. 4. Bandwidth Test

Bandwidth test function is mainly applied to test the bandwidth of band-pass filter.

Bandwidth test can find out signal peak value in the pass band and locate two points on specified amplitude on the two sides of the

pass band. The amplitude is lower than the signal peak value and can be adjusted through setting N dB point (default value is 3 dB). The frequency range between the two points is the bandwidth of the filter under test.

Bandwidth test can set the minimum bandwidth and maximum bandwidth that the users allow before testing and the tested bandwidth will compare automatically with the two values. If the result is not satisfactory, the users will see the fail information on the screen or hear the sound hint, which are convenient for the the users to see if the characteristics of the device under test can meet the requirement.

### 6. 4. 1. Open and set bandwidth test

The bandwidth threshold(N dB point)、 maximum bandwidth and minimum bandwidth must be set before making bandwidth test and multiple traces can be set.

#### 6. 4. 1. 1. By mouse or touch screen

- 1) Click **[Marker/Analysis]**, and click **[Limit Test...]** on **[Analysis]** menu to display Limit Test.
- 2) Click **[Bandwidth Test]** button in the dialog box to display bandwidth test dialog box.

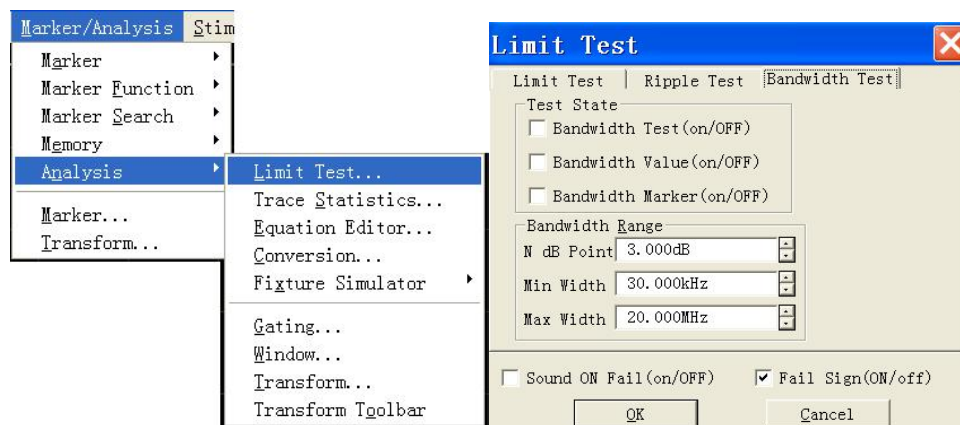


Figure 6-15 Bandwidth Test Dialog Box

- 3) Click **[Bandwidth Test(on/OFF)]** in the check box to enable the bandwidth test.
- 4) Click **[Bandwidth Value(on/OFF)]** check box to display the tested bandwidth on the screen.
- 5) Click **[Bandwidth Marker (on/OFF)]** check box to display the bandwidth locating mark on the screen.
- 6) Click **[N dB Point]** to set the threshold of bandwidth.
- 7) Click **[MIN width]** to set Minimum bandwidth.
- 8) Click **[MAX width]** to set Maximum bandwidth.
- 9) Click **[Sound On Fail(on/OFF)]** to make sound alarm when the bandwidth test fails.
- 10) Click **[Fail Sign(on/OFF)]** to display FAIL when bandwidth test fails.
- 11) Click **[OK]** to finish the setup of bandwidth test.

#### 6. 4. 1. 2. By front panel keys

- 1) Press **[Analysis]** in MKR/ANALYSIS area, and press corresponding soft-key of **[Bandwidth Test]** in the soft-key menu that turns up.
- 2) Press corresponding soft-key of **[BW Test on|OFF ]** to enable bandwidth test.
- 3) Press corresponding soft-key of **[BW Display on|OFF]** to enable bandwidth display function.
- 4) Press corresponding soft-key of **[BW Marker on|OFF]** to enable bandwidth locating marker.

- 5) Press corresponding soft-key of **[Fail Sign on|OFF]** to enable the display of fail mark of bandwidth test.
- 6) Press corresponding soft-key of **[N dB Points]**, and set bandwidth threshold in the input box.
- 7) Press corresponding soft-key of **[Min BW]** and set minimum bandwidth in the input box.
- 8) Press corresponding soft-key of **[Max BW]** and set maximum bandwidth in the input box.

#### 6. 4. 2. Display bandwidth test result

The result of bandwidth test is displayed on the upper left side of the trace, if the test is passed, the word "PASS" will turn up on the screen. The red T shaped bandwidth mark distribute on the two sides of bandwidth.

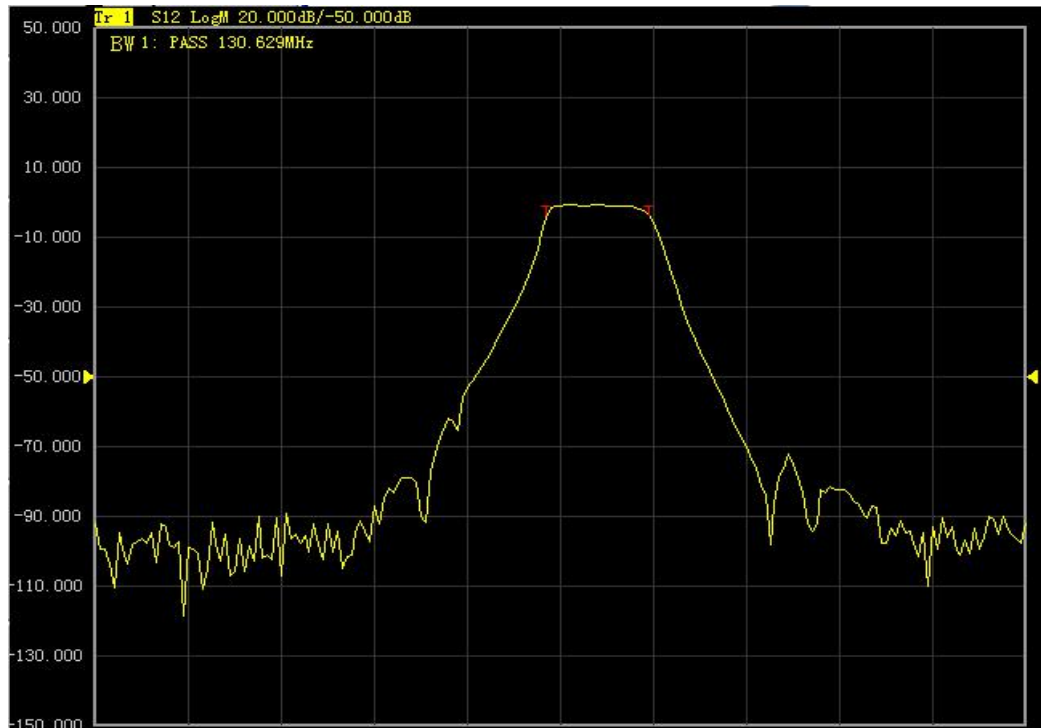


Figure6-16 Bandwidth Test Result Display

#### 6. 4. 3. Close bandwidth test

##### 6. 4. 3. 1. By mouse or touch screen

- 1) Click **[Marker/Analysis]** and click **[Limit Test...]** on the menu of **[Analysis]** to display limit test dialog box.
- 2) Click **[Bandwidth Test]** in the dialog box to display the bandwidth test dialog box.
- 3) Click **[Bandwidth Test(on/OFF)]** to close bandwidth test.
- 4) Click **[Bandwidth Value(on/OFF)]** to close the display of bandwidth test.
- 5) Click **[Bandwidth Marker (on/OFF)]** to close the display of bandwidth locating marker.
- 6) Click **[OK]** to close bandwidth test.

##### 6. 4. 3. 2. By front panel keys

- 1) Press **[Analysis]** in MKR/ANALYSIS area and press corresponding soft-key of **[Bandwidth Test]** in the soft-key menu that turns up.
- 2) Press corresponding soft-key of **[BW Test ON|off]** to close bandwidth test function.
- 3) Press corresponding soft-key of **[BW Display ON|off]** to close the display of bandwidth .

- 4) Press corresponding soft-key of **[BW Marker ON|off]** to close the locating marker of bandwidth.
- 5) Press corresponding soft-key of **[Fail Sign ON|off]** to close the display of fail mark of bandwidth test.

## 6. 5. Bandwidth Searching

Bandwidth searching is a function to confirm trace bandwidth, center frequency, cut-off point, Q value and insertion loss through searching signal peak value in the band.

Bandwidth searching function menu has newly increased the filter test function, which is used for the automatic test of filter. The tested parameters of filter is automatically displayed on the screen, this function simplifies the setup of filter test process and improves the test speed of filter.

### 6. 5. 1. Open and close bandwidth searching

Bandwidth searching can only be set through soft-key menu.

- 1) Press **[Search]** in MKR/ANALYSIS area, press corresponding soft-key of **[Bandwidth]** on the soft-key menu that turns up.
- 2) Press corresponding soft-key of **[Bandwidth]** to enable bandwidth searching function.
- 3) Press corresponding soft-key of **[Bandwidth Level]** and set bandwidth level in the input box which can change the bandwidth cut-off frequency.
- 4) Press corresponding soft-key of **[Tracking on|OFF]** to enable search and track function.
- 5) Press corresponding soft-key of **[Bandwidth Off]** to close bandwidth searching function.

### 6. 5. 2. Display bandwidth searching result

The six parameters of bandwidth will be displayed on the upper right of the trace.

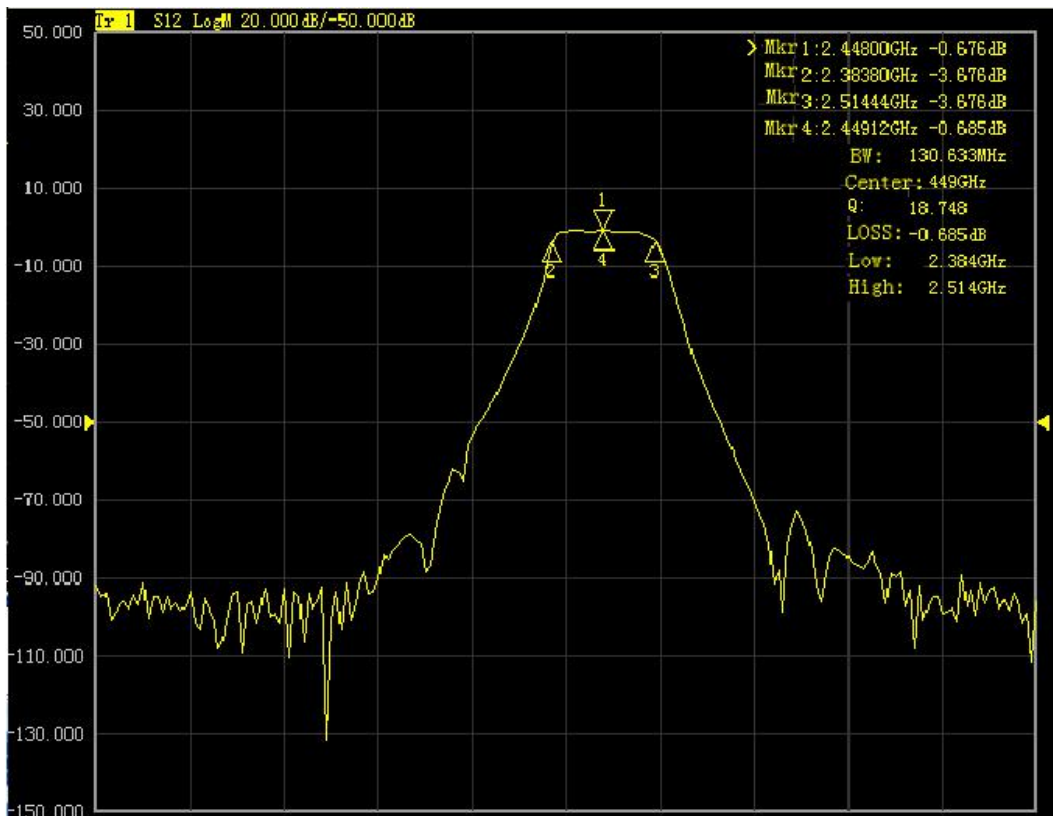


Figure 6-17 Bandwidth Searching



### 6. 5. 2. 1. Parameter definition

- BW

Frequency difference between right and left cut-off frequency point.

- Center

The middle frequency between right and left cut-off frequency point.

- Q

The value of dividing bandwidth with central frequency.

- LOSS

The tested value of bandwidth central frequency point.

- Low

The lower frequency of the two points which are lower than the signal peak value on specific bandwidth level.

- High

The higher frequency of the two points which are lower than the signal peak value on specific bandwidth level .

### 6. 5. 3. Filter test

The analyzer is installed with a shortcut function for the test of filter. All the tested parameters will be displayed on the screen and it is very convenient for users to see the test results. The filter test function decreases the manual setup during the test process and improves the test speed greatly.

#### 6. 5. 3. 1. Open and close filter test

The filter test function can only be set through soft-key menu.

- 1) Press [**Search**] in MKR/ANALYSIS area, and press corresponding soft-key of [**Bandwidth**] on the soft-key menu that turns up.
- 2) Press corresponding soft-key of [**Tracking on|OFF**] to enable track function.
- 3) Press corresponding soft-key of [**Filter Test**] and press corresponding soft-key of [**Filter Test on|OFF**] to enable filter test function.
- 4) Press corresponding soft-key of [**BW1 Level**] and set the level value of bandwidth1 in the input box.
- 5) Press corresponding soft-key of [**BW2 on|OFF**] to enable bandwidth2 function.
- 6) Press corresponding soft-key of [**BW2 Level**] and set the level value of bandwidth2 in the input box.
- 7) Press corresponding soft-key of [**Freq Offset**] and set the value of frequency difference percentage in the input box.
- 8) Press corresponding soft-key of [**Filter Test ON|off**] to close filter test function.

#### 6. 5. 3. 2. Display bandwidth searching result

The eight parameters of filter test will be displayed on the upper left side of the trace. Enabling the **filter test** , the bandwidth searching function will be activated automatically and the six parameters of bandwidth test will be displayed on the upper right side of the trace.

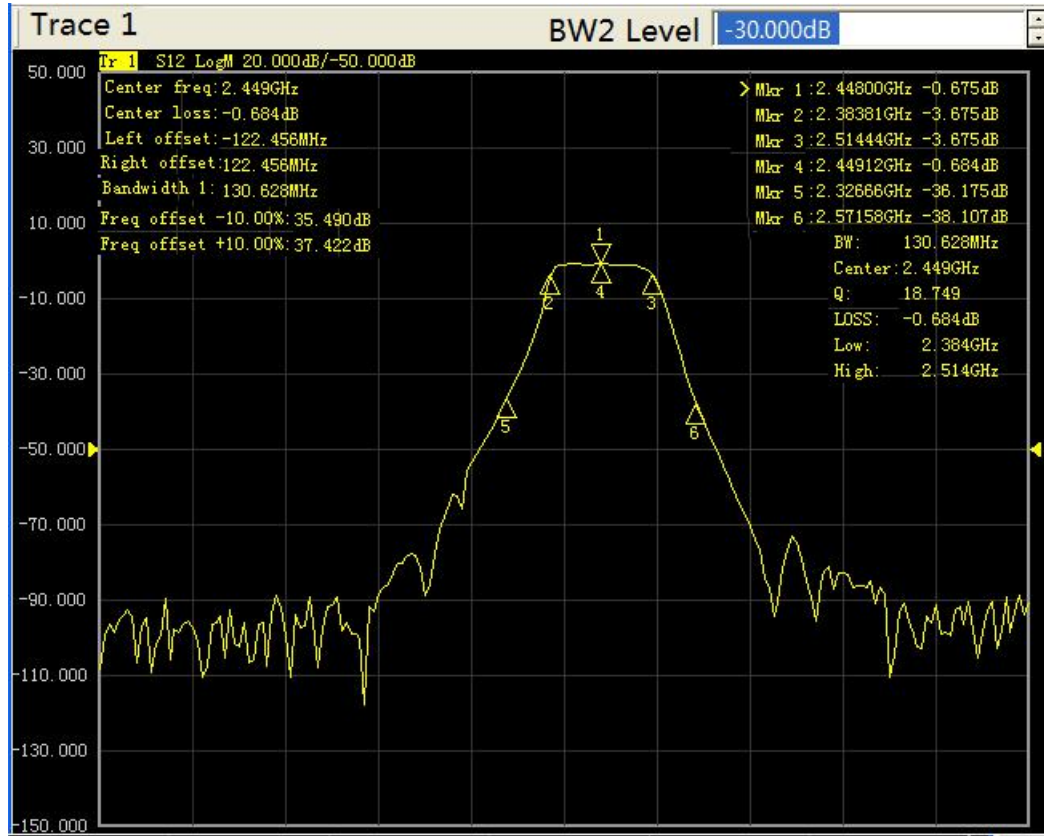


Figure 6-18 Filter Test

## 6. 6. Ripple Test

Ripple test can assess the test results through setting up fluctuation limit. It compares the test data with the defined fluctuation limit, provides PASS and FAIL information and the test result will be displayed directly on the screen. Each trace supports 12 separated limit segments at best. Each limit segment can be set with start stimulus, stop stimulus and maximum fluctuation value. The stimulus setup of different segments can overlap.

### 6. 6. 1. Create and edit ripple limit line

It can make multiple ripple limit test at one time and you only need to set the ripple limit after activating the trace.

#### 6. 6. 1. 1. By mouse or touch screen

- 1) Click **[Marker/Analysis]** and click **[Limit Test...]** of the **[Analysis]** to display limit test dialog box.
- 2) Click **[Ripple Test]** in the dialog box to display the ripple test box.

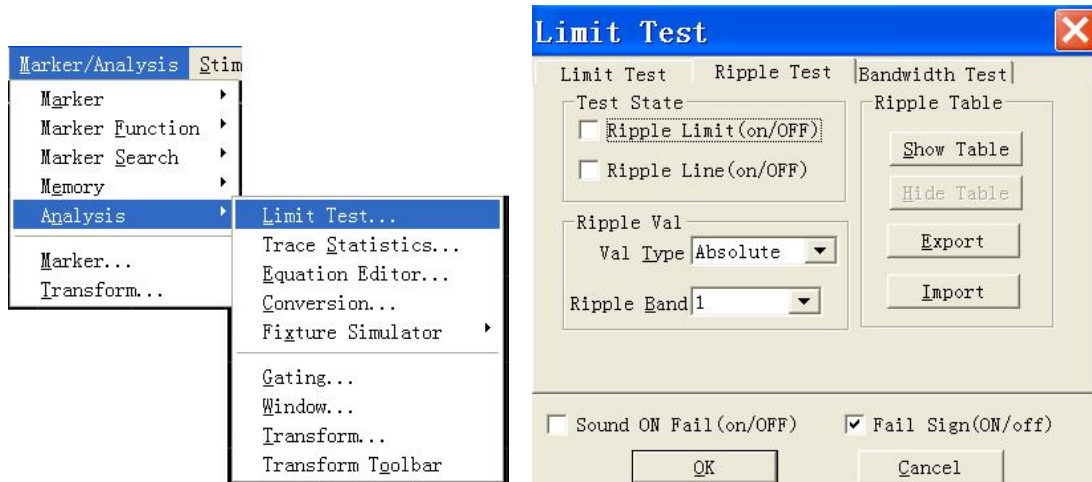


Figure 6-19 Display Ripple Test Box

- 3) Click **[Show Table]** in the dialog box to enable ripple limit table.
- 4) Click **[Type]** box in the ripple limit table, and select “ON” to activate the table.
- 5) Double click **[Begin Stimulus]** to set the initial stimulus value.
- 6) Double click **[End Stimulus]** to set the stop stimulus value.
- 7) Double click **[MAX Ripple]** to set maximum fluctuation value.
- 8) The analyzer will add a new row to the limit table after opening the last row.
- 9) Repeat step 4)-7) to complete the editing and adding of all limit segments.

### 6. 6. 1. 2. By front panel keys

- 1) Press **[Analysis]** in MKR/ANALYSIS area, press corresponding soft-key of **[Ripple Test]** on the soft-key menu that turns up, press **[Edit Ripple Limit]** and press **[Ripple Table on/OFF]** on the sub-menu to open the ripple limit table.
- 2) Press **[□],[□]** in ADJUST area to **[Type]** box of ripple limit table, press the knob key in ADJUST area to open type drop-down box, rotate the knob or **[△], [▽]** in ADJUST area to select, and press the knob key to confirm the selection.
- 3) Press **[□],[□]** to **[Begin Stimulus]** box, press the knob key to enable the start stimulus input box to set the initial stimulus value.
- 4) Press **[□],[□]** to **[End Stimulus]** box, press the knob key to enable the stop stimulus input box to set the stop stimulus value.
- 5) Press **[□],[□]** to **[MAX Ripple]** box, press the knob key to enable maximum fluctuation input box to set maximum fluctuation value.
- 6) The analyzer will add a new row to the limit table after opening the last row. Press **[△], [▽]** to select different rows of the limit table to edit, when the active area is in the last row, press **[▽]** to add a new row to the limit table.
- 7) Repeat step 2)-4) to complete the adding and editing of all the limit segments.

### 6. 6. 1. 3. Ripple limit table

	Type	Begin Stimulus	End Stimulus	Max Ripple
1	ON	100.000kHz	2.000GHz	5.000dB
2	ON	2.000GHz	3.000GHz	10.000dB
3	OFF	100.000kHz	3.000GHz	100.000dB

Figure 6-20 Ripple Limit Table

- Type

The type box is used to set the type of limit test:

- ON:to activate the limit segment test.
- OFF:to close the limit segment test.

- Begin stimulus and End stimulus

To set the start stimulus value and stop stimulus value of ripple limit line segment.

- Max Ripple

To set the maximum fluctuation value the limit line can display in the ripple segment test.

## 6. 6. 2. Set ripple test

After the creation of ripple limit line, you can choose to display or hide the ripple limit line of any trace. When the limit line is hidden, the corresponding ripple test is still effective. You can choose to send out alarm sound and display FAIL mark to indicate the test. When the ripple test function is enabled, the default color of the failed trace is set to red and you can change the color through the color setup of the right key menu of the mouse and the color of the passed part of the limit test remains unchanged.

### 6. 6. 2. 1. By mouse or touch screen

- 1) Click **[Marker/Analysis]**,click **[Limit Test...]** in the **[Analysis]** menu to display the limit test box.
- 2) Set the limit test in the dialog box.

### 6. 6. 2. 2. Click [OK] to close the box.By front panel keys

- 1) Press **[Analysis]** in MKR/ANALYSIS area and press corresponding soft-key of **[Ripple Test]** on the soft-key menu that turns up.
- 2) Press corresponding soft-key of **[Ripple Test on|OFF]** to trigger the opening and closing of limit test function.
- 3) Press corresponding soft-key of **[Ripple Show on|OFF]** to display the ripple limit line.
- 4) Press corresponding soft-key of **[Fail Sign on|OFF]** to enable the FAIL mark display of the limit test.
- 5) Press corresponding soft-key of **[Edit Ripple Limit]** and press corresponding soft-key of **[Ripple Table on|OFF]** in the sub-menu that turns up to enable the display of limit table.

The ripple test is only made at actual sweeping test points. When there is a few sweeping points, the performance of the device under test may not meet the requirement but it can also pass the ripple test. So, in the actual test, you must use enough sweeping points.

### 6. 6. 2. 3. Ripple test dialog box

- Ripple Limit (on/OFF)

To enable the ripple test function if checked, to disable the ripple test function if unchecked.

- Ripple Line (on/OFF)

To display the fluctuation line of the activated trace if checked, to close the display if unchecked,but it does not influence the ripple test function.

- Sound ON Fail (on/OFF)

If checked, the buzzer will send out alarm sound when the data point test on the trace fails.

- Fail Sign (on/OFF)

If checked, the FAIL mark will be displayed on the screen when the data point test on the trace fails.

- Show Table

Click it to display and edit the ripple limit table. It will be shifted to disabled state after the table is opened.

- Hide Table

Click it to close the display of ripple limit table. It will be shifted to disabled state after the table is closed.

- Export

Click it, storage dialog box will appear. Users could select storage route and save the file with \*.csv format.

- Import

Click it, storage dialog box will appear. Select the storage route of the file to be opened. It can open the file of \*.csv format.

- Val Type

Click the drop-down box to select the ripple value type: none、absolute、margin. The default setup of the analyzer is absolute value.

- Ripple Band

Click the drop-down box to select the number of fluctuation limit segments to be opened and it can open 12 segments at best.

### 6. 6. 3. Display ripple test result

If the result of ripple test passes, the word “PASS” will appear on the upper left side of the screen, otherwise, the word “ FAIL” will appear on the screen. If multiple trace tests are made at the same time, the word “ PASS” or “ FAIL” for each trace will appear respectively at the same time. The stimulus ranges of different ripple limit segments can overlap with different fluctuation limits.

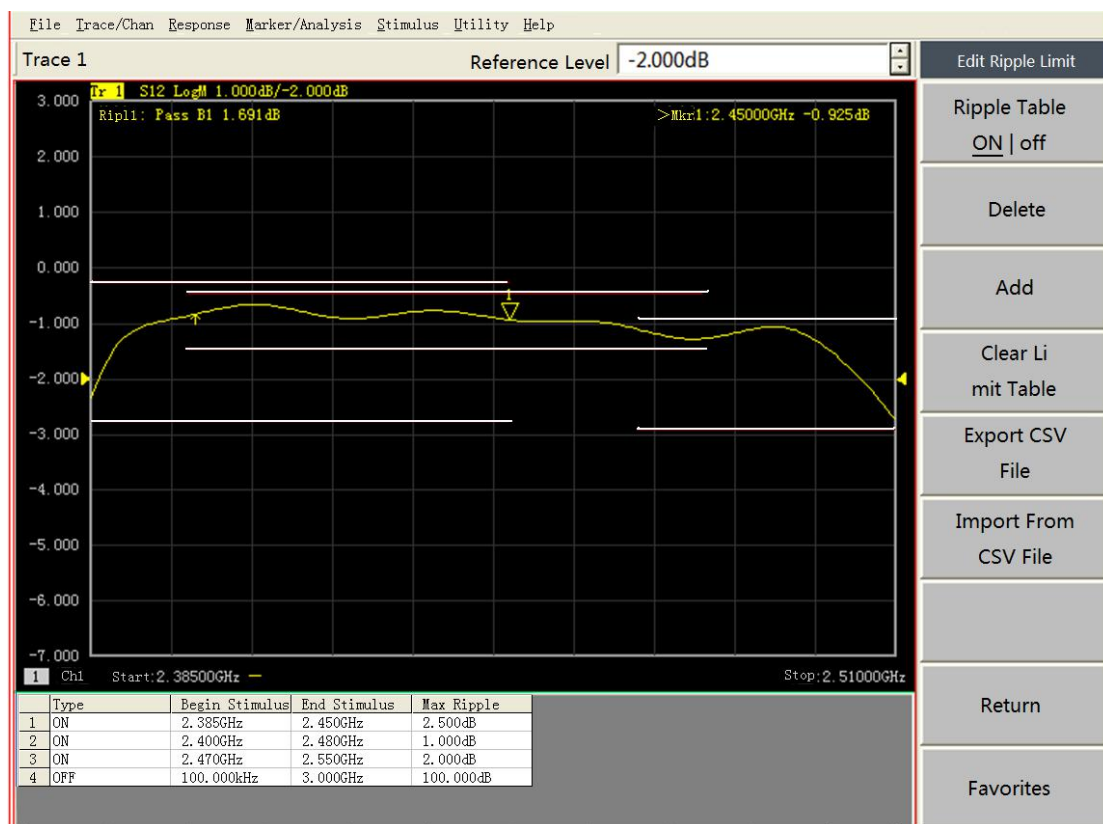


Figure 6-21 Ripple Test Result

## 6. 7. Fixture Simulator

Fixture simulator could simulate various test conditions which are based on the test results during the manufacturing. It will make quick and real-time simulation on the corresponding test result.

### 6. 7. 1. Reference impedance conversion of port

To converse the test result under 50Ω port impedance to the test results under any port reference impedance.

#### 6. 7. 1. 1. By mouse or touch screen

- 1) Click **[Marker/Analysis]** menu,click **[Fixture Simulator]** on the menu of **[Analysis]** and click **[Fixture Simulator on/OFF]** on the sub-menu to open fixture simulator function.
- 2) Click **[Marker/Analysis]** menu, click **[Fixture Simulator]** on the menu of **[Analysis]** and click **[Z Conversion]** on the sub-menu to open impedance conversion dialog box.
- 3) Click **[On/Off (Z)]** to enable impedance conversion function.
- 4) Enter corresponding values in the editing box of the real part and imaginary part of the port1 and port2.
- 5) Click **[OK]** to open the dialog box and save the input;click **[Cancel]** to close the dialog box and cancel the saving of the input.

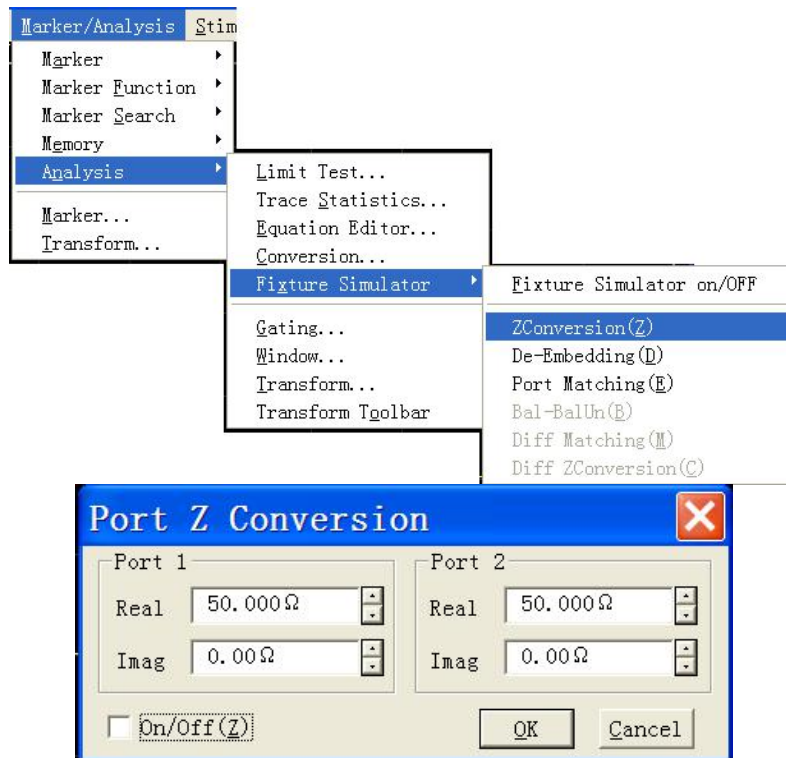


Figure 6-22 Impedance Conversion Dialog Box

#### 6. 7. 1. 2. By front panel keys

- 1) Press **[Analysis]** in MKR/ANALYSIS area, and press corresponding soft-key of **[Fixture Simu...]** in the soft-key menu that turns up.
- 2) Press corresponding soft-key of **[Fixture Simu... on/OFF]** to trigger the opening and closing of fixture simulator function.
- 3) Press corresponding soft-key of **[Port ZConver...]** and press corresponding soft-key of **[Z Conversion on/OFF]** on the sub-menu to enable the impedance conversion function.

- 4) Press corresponding soft-key of **[Port1 Z0 Real]**, **[Port1 Z0 Imag]**, **[Port2 Z0 Real]**, **[Port2 Z0 Imag]** , and enter corresponding value in the input box that turns up.

### 6. 7. 2. Network De-embedding

Network De-embedding function can eliminate any network characteristics defined by Touchstone data file(.snp) between test plane and DUT plane to extend corresponding calibration plane.

#### 6. 7. 2. 1. By mouse or touch screen

- 1) Click **[Marker/Analysis]** menu, click **[Fixture Simulator]** in the menu of **[Analysis]**, and click **[Fixture Simulator on/OFF]** on the sub-menu to enable the fixture simulator function.
- 2) Click **[Marker/Analysis]** menu, click **[Fixture Simulator]** in the menu of **[Analysis]**, and click **[De-embedding]** in the sub-menu that turns up to open the fixture de-embedding dialog box.
- 3) Click **[ON/OFF]** in the dialog box to enable the fixture de-embedding function.
- 4) Click corresponding soft-key of **[Enable1]**, **[Enable2]** button of port1 and port2 to activate the de-embedding function of corresponding port.

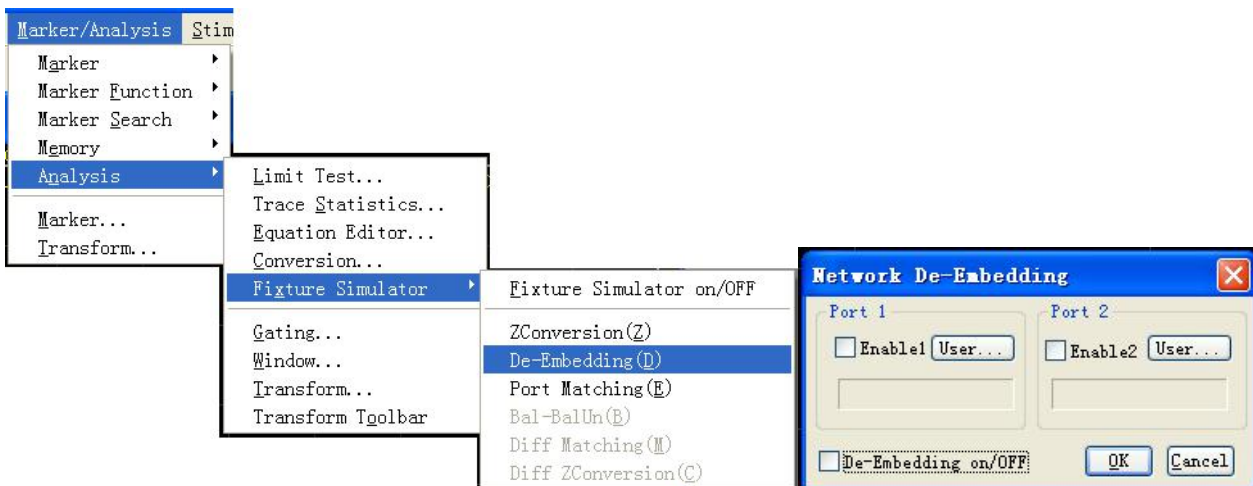


Figure 6-23 Display Fixture De-embedding Dialog Box

- 5) Click **[Import File]** of corresponding port, select the S2P file to be used in the dialog box that turns up and the file name will be displayed in the box at the lower part.
- 6) Click **[OK]** to close the dialog box, and save the input;click **[Cancel]** to close the dialog box,and cancel the saving of the input.

#### 6. 7. 2. 2. By front panel keys

- 1) Press **[Analysis]** in MKR/ANALYSIS area, and press corresponding soft-key of **[Fixture Simu...]** in the soft-key menu that turns up.
- 2) Press corresponding soft-key of **[Fixture Simu... on/OFF]** to open and close the fixture simulator function.
- 3) Press corresponding soft-key of **[De-Embedding]** and press corresponding soft-key of **[De-Embedding on/OFF]** in the sub-menu of soft-key that turns up to enable the network de-embedding function.
- 4) Press the soft-key of **[Select Port 1|2]**, to shift to corresponding port.
- 5) Press the soft-key of **[Select Type User|None]**, to shift to corresponding type;User corresponds to the enabling of corresponding port; None corresponds to the disabling of the corresponding port.
- 6) Press the soft-key of **[User File...]** select the S2P file to be used in the dialog box that turns up and the file name will

be displayed under the soft-key.

### 6. 7. 3. Matching circuit embedding

It can add virtual matching circuit for every test port to simulate the whole test characteristics.

#### 6. 7. 3. 1. By mouse or touch screen

- 1) Click **[Marker/Analysis]** menu, click **[Fixture Simulator]** in the menu of **[Analysis]** and click **[Fixture Simulator on/OFF]** in the sub-menu to enable the fixture simulator function.
- 2) Click **[Marker/Analysis]** menu, click **[Fixture Simulator]** in the menu of **[Analysis]**, and click **[Port Matching]** in the sub-menu that turns up to open the matching circuit embedding dialog box.
- 3) Click **[On/Off]** in the dialog box to enable the matching circuit embedding function.

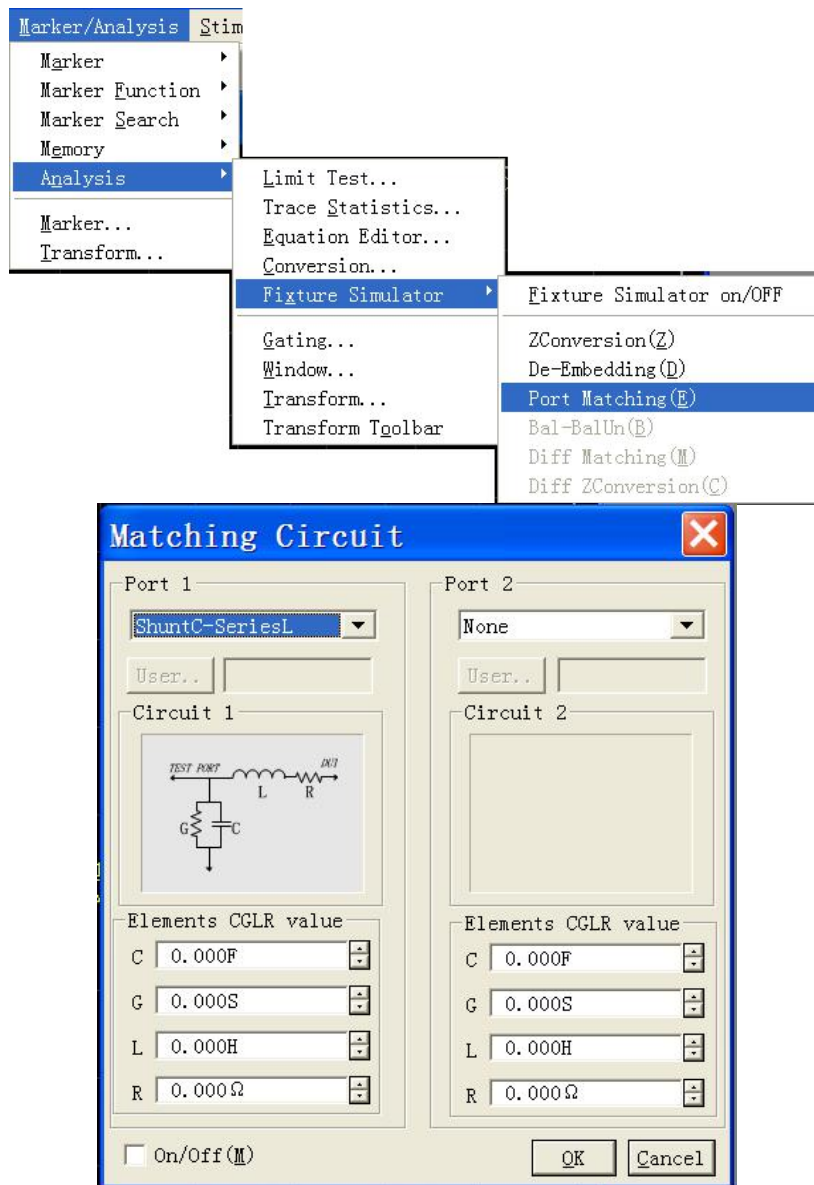


Figure 6-24 Display Matching Circuit Embedding Dialog Box

Choose proper circuit type in the drop-down box corresponding to port1 and port2, the circuit type will be displayed at the lower part. Enter the value of capacitance, conductance, inductance and resistance in corresponding editing box; when the circuit type is USER, the **[Self Define]** will be in enabled state, click **[Self Define]**, select the S2P file to be used in the dialog box that turns up and the file name will be displayed in the box aside.



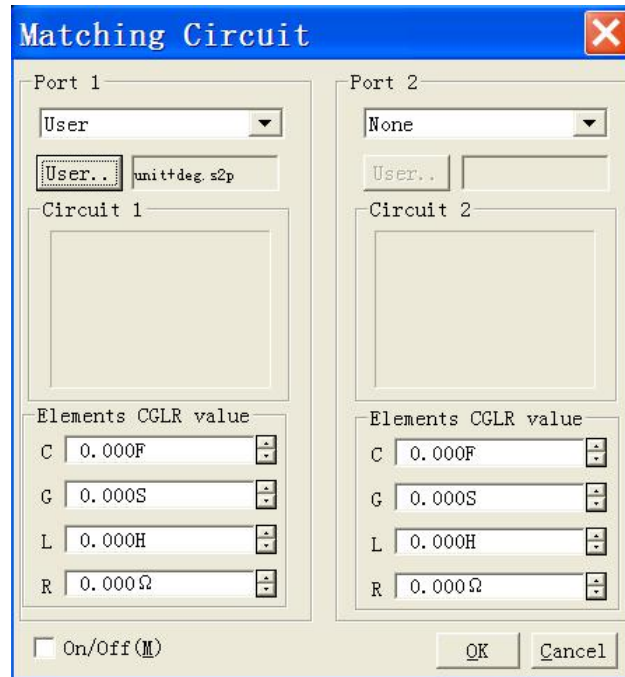


Figure 6-25 Self Define Matching Circuit Embedding Dialog Box

### 6. 7. 3. 2. By front panel keys

- 1) Press **[Analysis]** in MKR/ANALYSIS area, and press corresponding soft-key of **[Fixture Simu...]** in the soft-key menu that turns up.
- 2) Press corresponding soft-key of **[Fixture Simu... on[OFF]** to trigger the opening and closing of fixture simulator function.
- 3) Press corresponding soft-key of **[Port Matching]** and press corresponding soft-key of **[Port Matching on[OFF]** in the sub-menu that turns up to enable the matching circuit embedding function.
- 4) Press corresponding soft-key of **[Select Port 1|2]** to shift to corresponding port.
- 5) Press corresponding soft-key of **[Select Circuit]**, choose proper circuit type on the sub-menu that turns up. When the circuit type is "User", you can choose the S2P file to be used in the dialog box that turns up and press corresponding soft-key of **[Back]**.
- 6) Press corresponding soft-key of **[C(F)], [G(S)], [L(H)], [R(Ω)]**, and enter the value in corresponding editing box.

## 6. 8. Parameter Transformation

Parameter transformation function can transform the test result of S parameter into other parameters in real time.

### 6. 8. 1. Parameter transformation

#### 6. 8. 1. 1. By mouse or touch screen

- 1) Click **[Marker/Analysis]** menu, and click **[Conversion]** on the menu of **[Analysis]** to open the dialog box of parameter transformation.
- 2) Click the **[Enable]** check box in the dialog box to enable the parameter transform function.
- 3) Click the parameter transformation type box in the dialog box and select the parameter type to be transformed on the drop-down menu.

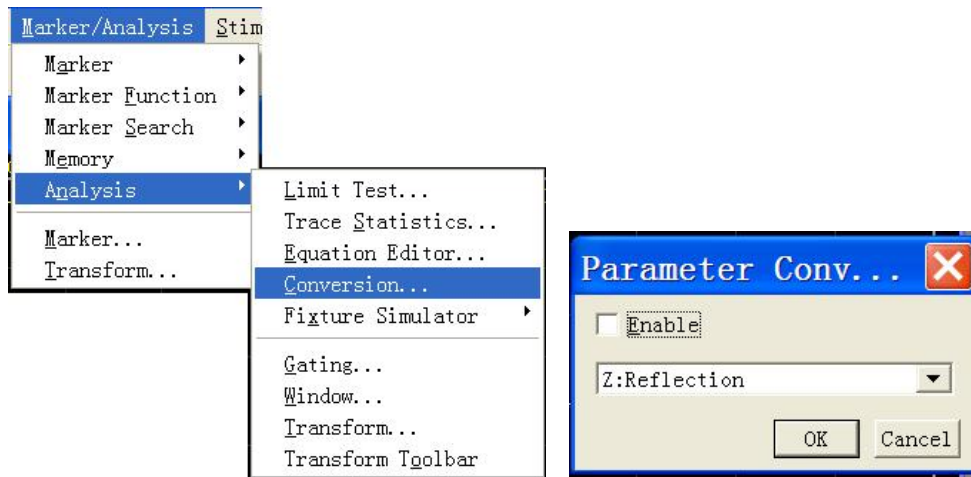


Figure 6-26 Parameter Transformation Dialog Box

#### 6. 8. 1. 2. By front panel keys

- 1) Press **[Analysis]** in MKR/ANALYSIS area and press **[Conversion]** in the soft-key menu that turns up.
- 2) Press **[Conversion on|OFF]** to trigger the opening and closing of parameter transformation function.
- 3) Press **[Function]**, and select corresponding transformation type in the sub-menu of soft-key that turns up.

### 6. 8. 2. Function type of parameter transformation

Parameter transformation function is used to transform the test result of S parameter (S<sub>xy</sub>) into the following parameters:

**Impedance (Z<sub>r</sub>) and admittance (Y<sub>r</sub>) in reflection test**

$$Z_r = Z_{0X} \times \frac{1+S_{xy}}{1-S_{xy}}, \quad Y_r = \frac{1}{Z_r}$$

**Impedance(Z<sub>t</sub>)and admittance(Y<sub>t</sub>) in transmission test**

$$Z_t = \frac{2 \times \sqrt{Z_{0X} \times Z_{0Y}}}{S_{xy}} - (Z_{0X} + Z_{0Y}), \quad Y_t = \frac{1}{Z_t}$$

**Impedance(Z<sub>ts</sub>)and admittance (Y<sub>ts</sub>) in the parallel transmission**

$$Z_{ts} = \frac{S_{xy}}{2 \times \sqrt{\frac{1}{Z_{0X}} \times \frac{1}{Z_{0Y}} - \left( \frac{1}{Z_{0X}} + \frac{1}{Z_{0Y}} \right) \times S_{xy}}}, \quad Y_{ts} = \frac{1}{Z_{ts}}$$

Inverse:

$$1/S_{xy}$$

Adjoint:

It means to conjugate on complex  $S_{xy}$ , in which,  $Z_{0X}$  and  $Z_{0Y}$  represent the characteristic

Impedance of port X and port Y respectively.

When the impedance conversion function in the fixture simulator is enabled, the characteristic impedance of corresponding port is the set value in the impedance conversion. Otherwise, use the system impedance  $Z_0$  (default value is 50Ω).

## 6. 9. Setting Time Domain Transformation Measure (Optional)

### 6. 9. 1. By mouse or touch screen

- 1) Click [**Marker/Analysis**], click [**Transform...**] on submenu to display Time Domain Transform dialog box.
- 2) Click to select [**Transform**] check box and Stimulus time domain transformation function.
- 3) Click [**Start**], [**Stop**] or [**Center**], [**Span**] box to set time domain Measure range.
- 4) Select transformation mode in Transformation Mode zone: [**Low Pass Impulse**], [**Low Pass Step**] or [**Band Pass**].

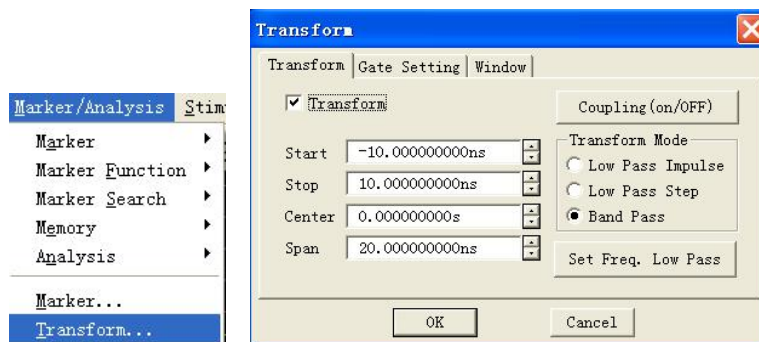


Fig.6-27 Setting Time Domain Transformation Measure

- 5) Set Window function: click [**Window**] Selection Button in Time Domain Transform dialog box and set window filter with three methods below:
  - ◆ Drag sliding box with mouse till pulse width or sidelobe level meets the requirement.
  - ◆ Click [**Gaesarian Window β Para**] to adjust setting of value β, till pulse width or sidelobe level meets the requirement.
  - ◆ Click [**Pulse Span**] to set response pulse width directly.

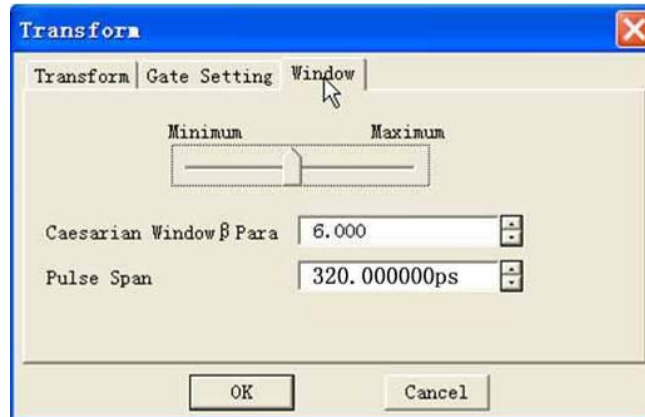


Fig.6-27 Time Domain Transformation Measure—Setting Window

- 6) Set filtering function of time domain gate: click **[Gate Setting]** option button in Time Domain Transform dialog box and click to select **[Gating]** check box to enable filtering function of time domain gate.
  - ◆ Click **[Start]**, **[Stop]** or **[Center]**, **[Span]** box to set gate border.
  - ◆ Select gate type in **[Gate Type]** box: band pass, band stop.
  - ◆ Select gate form in **[Gate Shape]**: minimum, normal, wide, maximum.

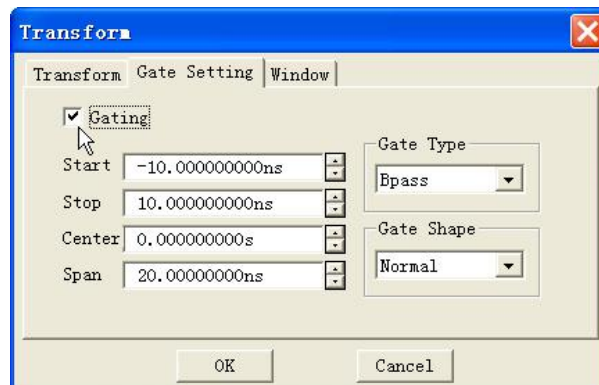


Fig.6-28 Time Domain Transformation Measure—Gate Setting

- 7) If it is necessary to observe frequency domain response of the measured piece when the gate function is still effective, click **[Transform]** option button in Time Domain Transform dialog box and click to clear **[Transform]** check box.
- 8) Click **[OK]** to close Time Domain Transform dialog box after setting.

### 6. 9. 2. By front panel keys—Time Domain Transform Dialog Box

- 1) Press **[Analysis]** in MKR/ANALYSIS area, press soft-key corresponding to **[Transform]**, relative soft-key menu appears, press corresponding soft-key of **[Transform ...]** to display Time Domain Transform dialog box.
- 2) Press **[ ]**, **[ ]** in ADJUST area to switch to **[Transform]** check box, press the knob button to select check box to Stimulus time domain transformation function.
- 3) Press **[ ]**, **[ ]** to switch to Transformation Mode zone, Press **[ Δ ]**, **[ ∇ ]** in ADJUST area or rotate knob to select **[Low Pass Impulse]**, **[Low Pass Step]** or **[Band Pass]** mode.
- 4) Press **[ ]**, **[ ]** to switch to **[Start]**, **[Stop]** or **[Center]**, **[Span]** box to set time domain Measure range.
- 5) Set window function: press **[ ]**, **[ ]** to switch to **[Transform]** option button, press **[ Δ ]**, **[ ∇ ]** or rotate knob to switch to **[Window]** option button and then set window filter in three methods below:
  - ◆ Press **[ ]**, **[ ]** to switch to sliding block box, press **[ Δ ]**, **[ ∇ ]** or rotate knob till pulse width or sidelobe level meets

- the requirement.
- ◆ Press [□],[□] to switch to [**Gaesarian Window  $\beta$  Para**] to adjust setting of value  $\beta$ , till pulse width or sidelobe level meets the requirement.
  - ◆ Press [□],[□] to switch to [**Pulse Span**] to set response pulse width directly.
- 6) Set filtering function of time domain gate: press [□],[□] to switch to [**Window**] option button, press [△], [▽] or rotate knob to switch to [**Gate Setting**] option button, press [□],[□] to switch to [**Gating**] check to, press the knob button to select the check box and Stimulus filtering function of time domain gate, then set the function of time domain gate.
- ◆ Press [□],[□] to switch to [**Start**], [**Stop**] or [**Center**], [**Span**] to set gate border.
  - ◆ Press [□],[□] to switch to [**Gate Type**] box, press [△], [▽] or rotate knob to select gate type: band pass, band stop.
  - ◆ Press [□],[□] to switch to [**Gate Shape**] box, press [△], [▽] or rotate knob to select gate form: minimum, standard, wide, maximum.
- 7) If it is necessary to observe frequency domain response of the measured piece when the gate function is still effective, press [□],[□] to switch to [**Gate Setting**] option button, press [△], [▽] or rotate knob to switch to [**Transform**] option button, press [□],[□] to switch to [**Transform**], press the knob button to clear the check box and close time domain transformation function.
- 8) Press [**OK**] in Input keypad to close Time Domain Transform dialog box after setting

## 7. Data Output

The chapter introduces how to save and call back status settings and Measure results of the Analyzer, and it also introduces methods for printing out Measure results with a printer, including:

- Saving and calling back files
- Printing Measure display

### 7. 1. Saving and Calling back Files

Analyzer supports saving and call-back of files in multiple formats.

#### 7. 1. 1. Saving File

##### 7. 1. 1. 1. By mouse or touch screen

Click **[File]**, click **[Save]** or **[Save As...]** in file menu.

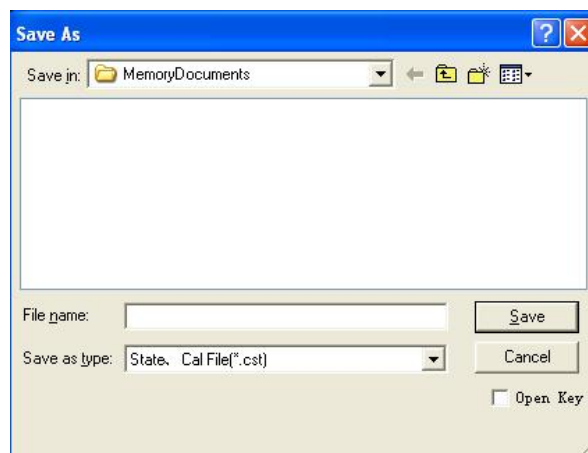
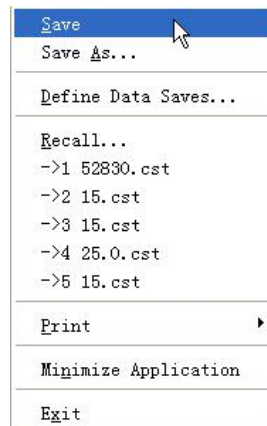


Figure 7-1 Saving File

- When clicking **[Save]**, Analyzer will save instrument status and calibration data in default file of a specified directory, and if default file already exists, Analyzer will display a dialog box for confirming whether it is covered.
- When click **[Save As...]**, Analyzer will open [Save As] dialog box for file save settings.

##### 7. 1. 1. 2. By front panel keys

- 1) Press **[Save]** in UTILITYT area.
- 2) Press corresponding soft-key of **[Save default.cst]** to save instrument status and calibration data in default file

(default.cst) of Analyzer, if default file already exists, a dialog box is displayed to ask if user would cover it.

- 3) Press corresponding soft-key of **[Save As]** to display Save As dialog box, and save file according to user setup.

### 7. 1. 1. 3. Save As dialog box

- [Save In:]

It is used to display and set up file storage path.

- [File List]

It is used to display folder under current path and save all type matching files; if click a file among them, file name of save data can be setup, and if double-click folder, the current path can be modified.

- [File Name]

It is used to set up saved file name, display input file name or clicked file name in [Listed File] box.

- [Save as Type]

It is used to select file save type, and the Analyzer supports the following file types:

- cst file: to save Analyzer status and calibration data.
- sta file: only to save Analyzer status data.
- cal file: only to save calibration data of Analyzer.
- dat file: If user selects to save dat type file, when clicking [Save] button, Analyzer will open Data Save Setting dialog box, it will save Trace data as per user requirements.
- s1p and s2p files: If user selects to save s1p or s2p type files, when clicking [Save] button, Analyzer will open Designated Data Storage Format dialog box, and it will save Trace data as per user requirements.
- prn file: only to save current Stimulus Trace data.
- bmp file: to save screen display information of Analyzer in BMP format.
- jpg file: to save screen display information of Analyzer in jpeg format.

### 7. 1. 2. Calling back file

It can save Analyzer status and calibration data, if necessary it will be called-back in the future. Analyzer supports the following 3 types of files for call-back.

- sta file: status data of Analyzer is saved in sta files, including settings, Trace data, limit line and marker of Analyzer.
- cal file: calibration data is only saved in cal file, excluding status data of Analyzer. Correction precision of calibration data is relevant to status setting of Analyzer; therefore, in order to obtain the highest Measure precision, it shall be ensured that status settings of Analyzer during cal file call-back consistent with that during calibration, otherwise calibration precision can not be guaranteed.
- cst file: cst file saves all Measure status and calibration data of Analyzer, therefore calling cst file can save test time and improve Measure accuracy.

#### 7. 1. 2. 1. By mouse or touch screen

- 1) Click **[File]**, and click **[Recall]** on file menu to display Open dialog box.
- 2) Select call-back file type in **[Files of Type]** box.
- 3) Set up directory of call-back file through **[Look in:]** box and the following **[File name]** box.

- 4) Use the following methods to load call-back file.
- 5) Double-click call-back file in **[File name]**.
- 6) Click call-back file in **[File name]**, and click **[Open]** button.
- 7) Input called-back file name in **[File name]** box, and click **[Open]** button.

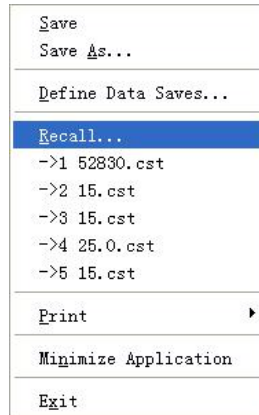


Figure 7-2 Call-Back File

### 7. 1. 2. 2. By front panel keys

- 1) Press **[Recall]** in function keypad.
- 2) Press corresponding soft-key to load corresponding call-back file in a default directory.
- 3) If there is no required call-back file in call-back soft-key toolbar, press corresponding soft-key of **[Recall...]** to open dialog box, and select call-back file or change path and call files in other directories.

### 7. 1. 3. Data File

Data files save Measure results in ASCII format, these files can be edited by using text editing software and spreadsheet software, but can not be called back by Analyzer itself. Analyzer can save three types data files.

#### 7. 1. 3. 1. dat file

Dat file is used to save Measure data of the Stimulus Trace or all Traces, data is saved in formatting or unformatted form, and data save mode is defined by Data Save Setting dialog box.

#### Saving dat file

- By mouse or touch screen
  - 1) Click **[File]**, and click **[Save As...]** on File menu to display Save As dialog box.



- 2) Set up the saved file type as Data File (\*.dat) in **[Save as Type]** box.
  - 3) Set up file save directory via **[Save In:]** box and **[File List]** box.
  - 4) Set up the saved file name in **[File Name]**.
  - 5) Click **[Save]** to display Data Save Setting dialog box
  - 6) Set up content and format of saved file in the dialog box, click **[Formatted]** or **[Unformatted]** to save data file, and then close the dialog box.
- By front panel keys
    - 1) Press **[Save]** in function keypad.
    - 2) Press corresponding soft-key of **[Save As]** to display **[Save As]** dialog box.
    - 3) Press **[□],[□]** in regulating keypad to shift to **[Save as Type]**, press **[△]** and **[▽]** in regulating keypad or rotate knob to select save file type as data file (\*.dat), and press **[←/off]** key of Enter keypad to complete selection.
    - 4) Set up file save directory via **[Save In:]** and **[File List]** box.
    - 5) Press **[□],[□]** to shift to **[File Name]**, and set up the saved file name.
    - 6) Press **[OK]** key in Enter keypad to display Data Save Setting dialogue.
    - 7) Set up content and format of saved file in the dialog box, click **[□],[□]** to shift to **[Formatted]** or **[Unformatted]**, press **[OK]** key to save data and close dialog box.
  - Data Save Setting dialog box

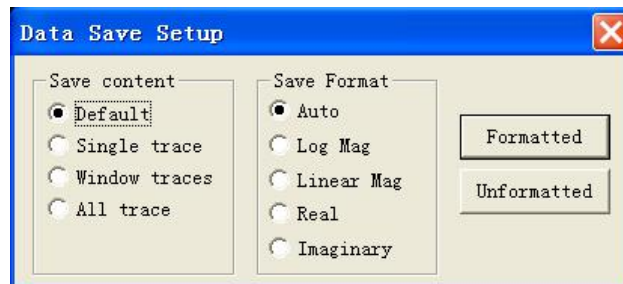


Figure 7-3 Data Save Setting Dialog box

➤ Save content zone

Save content zone will define which Trace data is saved in file.

◆ [Default]

To save Stimulus Trace data of all windows.

◆ [Single Trace]

To save current Stimulus Trace data.

◆ [Window Traces]

To save all Trace data in current Stimulus window.

◆ [All Trace]

To save all Trace data

➤ Save format zone

◆ [Auto]

Save data according to actual display format of Trace

- ◆ [Log Mag]

Save Trace data according to logarithm amplitude format.

- ◆ [Linear Mag]

Save Trace data according to linear amplitude format.

- ◆ [Real]

Save Trace data according to real part format.

- ◆ [Imaginary]

Save Trace data according to imaginary part format.

- ◆ [Formatted]

Save Trace data as per the format setting in Save Format Zone.

- ◆ [Unformatted]

Save Trace data according to real or imaginary part format.

### 7. 1. 3. 2. snp (s1p and s2p) files

Files in snp format can be called by computer assistance engineering (CAE) software (such as ADS of Agilent company), it is a data output file, but can not be called by Analyzer itself. s1p file saves property of single port device, only including one S parameter (S11/S22), and s2p file saves properties of f double port device, including four S parameters. If full double-port correction is enabled, Analyzer will save all four S parameters in s2p file. If full double-port correction is closed, Analyzer will save as much as possible Measure data in s2p file. For instance, if full double-port correction is closed, current Stimulus Trace is S11, and S21Measure still exists in channel, Measure results of S11 and S21 will be saved in s2p file, because there is no effective Measure data of S11 and S21, corresponding data in s2p file is 0.

#### Saving snp file

- By mouse or touch screen
  - 1) Click **[File]**, and click **[Save As...]** on File menu to display Save As dialog box.
  - 2) Set up the saved file type as Data File (\*.dat) in [Save as Type] box.
  - 3) Set up file save directory via **[Save In:]** and **[File Name]** box.
  - 4) Set up file name in **[File Name]** box.
  - 5) Click **[Save]** to complete data storage.
- By front panel keys
  - 1) Press **[Save]** in UTILITY area.
  - 2) Press corresponding soft-key of **[Save As]** to display **[Save As]** dialog box.
  - 3) Press **[□], [□]** in ADJUST area to shift to **[Save as Type]** box, press **[△]** and **[▽]** in ADJUST area or rotate knob to select save file type as data file (\*.s1p) or (\*.s2p), and press **[←/off]** in ENTRY area to complete selection.
  - 4) Set up file save directory via **[Save In:]** and **[File List]** box.
  - 5) Press **[□], [□]** to shift to **[File Name]** box, and set up file name.
  - 6) Press **[←/off]** in ENTRY area to display Data Save Setting dialog box.

- 7) Press [□],[□] to shift to format selection zone, press [△] and [▽] or rotate knob to select data save format.
- 8) Press [←/off] to close dialog box, and complete data save at the same time.

### 7. 1. 3. 3. prn file

prn file save measured data of Stimulus Trace in the form of row and column, and each row corresponds to a measuring point: the first column corresponds to measured activation value, the second column corresponds to measured response value. Columns are separated by comma (,), and format is as following:

S11	Log Mag
LIN_SWEEP(Hz),	LOG_FORMAT(dB)
3.000000e+005,	-9.232986e+000
7.502250e+008,	-3.219671e-001
1.500150e+009,	-6.892332e+000
2.250075e+009,	-1.146303e+000
3.000000e+009,	-1.245240e+001

### Saving prn file

- By mouse or touch screen
  - 1) Click **[File]**, and click **[Save As...]** on File menu to display Save As dialog box.
  - 2) Set up file storage type as List File (\*.prn) in **[Save as Type]** box.
  - 3) Set up file save directory via **[Save In:]** box and **[File List]** box.
  - 4) Set up file name in **[File Name]** box.
  - 5) Click **[Save]** button to save file and close the dialog box.
- By front panel keys
  - 1) Press **[Save]** in UTILITY area.
  - 2) Press corresponding soft-key of **[Save As]** to display [Save As] dialog box.
  - 3) Press [□],[□] in ADJUST area to shift to **[Save as Type]** box, press [△] and [▽] in ADJUST area or rotate knob to select save file type as list file (\*.prn).
  - 4) Set up file save directory via **[Save In:]** and **[File List]** box.
  - 5) Press [□],[□] to shift to **[File Name]** box, and set up file name.
  - 6) Press [←] in ENTRY area to save file and close the dialog box.

## 7. 2. Printing Measure Display

Analyzer can output or print Measure display content to a specified file via printer. Printer can be local or network printer, types including parallel port, serial port or USB interface printers. Measure print can be realized once addition of printer to Windows XP operation system is completed.

### 7. 2. 1. Setting Print Content

Analyzer supports setting print content and printout mode, and methods are as following:

### 7. 2. 1. 1. By mouse or touch screen

- 1) Click **[File]**, and click **[Page Setup...]** on **[Print]** menu to display Page Settings dialog box.
- 2) Set up printed content in the dialog box.
- 3) Click **[OK]** to close the dialog box.

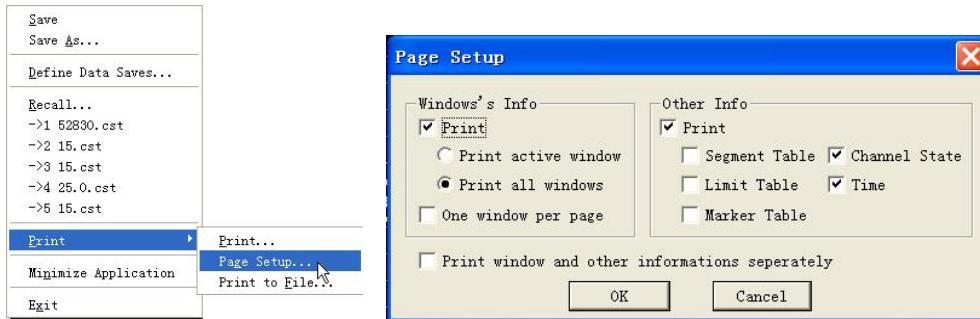


Figure 7-4 Print Content Setting

### 7. 2. 1. 2. Dialog box of print Page Setup

- Window's Info zone

- [Print]

If it is selected, window Trace information will be printed, and if not, window Trace information will not be printed. The following options can be effective only when the check box is selected.

- [Print Active Window]

If selecting it, only the content of current Stimulus window is printed.

- [Print All Windows]

If selecting it, content information of all windows will be printed.

- [One Window per Page]

If it is selected, one window is only printed per page; if it is cleared, all windows content will be continuously printed without forced page break.

- Other Info zone

- [Print]

When it is selected, other settings and status information will be printed, and the following options are effective; when it is cleared, and the information will not be printed.

- [Segment Table]

When it is selected, segment table will be printed.

- [Limit Table]

When it is selected, limit table will be printed.

- [Marker Table]

When it is selected, marker table will be printed.

- [Channel State]

When it is selected, channel settings status information will be printed.

➤ [Time]

When it is selected, current time information will be printed.

● [Print Window and Other Information Separately]

When it is selected, window information and other setup information will be printed on separate pages, and when it is cleared, and the information will be printed on the same page.

### 7. 2. 2. Printing Measure Display

After addition of printer to Windows XP operation system of Analyzer is completed and print content is set up in Measure application program, the required Measure information can be output via the printer.

#### 7. 2. 2. 1. By mouse or touch screen

- 1) Click [File], and click [Print...] in [Print] menu to display Print Setup dialog box.
- 2) Click [OK] to begin print after print setup is completed in dialog box.

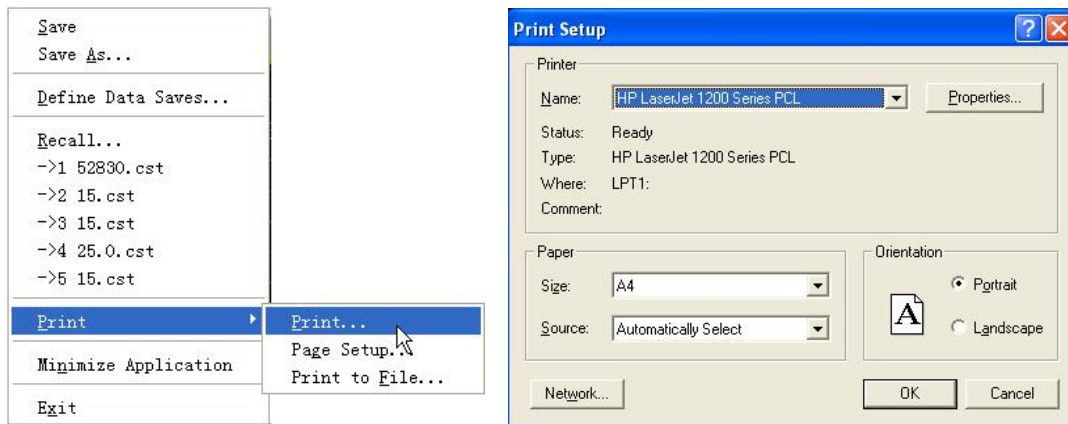


Figure 7-5 Print Measure Information

#### 7. 2. 2. 2. By front panel keys

- 1) Press [Print] in UTILITY area, and press corresponding soft-key of [Print...] to display Print Setup dialog box.
- 2) Press [↵] in ENTRY area to begin print after settings are completed.

### 7. 2. 3. Printing to File

Analyzer supports outputting the printed content to bmp file. If multi-page print is required, multiple bmp files will be automatically established. Each file corresponds to one page, and other files are identified in the form of "file name (number).bmp", such as amp.bmp, amp(1).bmp and amp(2).bmp.

#### 7. 2. 3. 1. By mouse or touch screen

- 1) Click [File], and click [Print to File...] on [Print] menu to display Save As dialog box.
- 2) Set up file storage directory and file name in the dialog box.
- 3) Click [Save] to save file.

#### 7. 2. 3. 2. By front panel keys

- 1) Press [Print] in UTILITY area, and press corresponding soft-key of [Print to File...] to display Save As dialog box.
- 2) Set up file save directory and file name in the dialog box.

3) Press [↵] in ENTRY area to save file.

## 8. Time Domain Measure

This chapter describes the basic principle for time domain Measure performed by Analyzer, how to set up the instrument to improve accuracy of time domain Measure and how to analyze result of time domain Measure, including contents below:

- Principle for time domain Measure
- Resolution and range of time domain Measure
- Window filtering
- Time domain gate filtering
- Time domain Measure data
- Band pass and low pass time domain modes
- Setting time domain transformation Measure

### 8.1. Principle for Time Domain Measure

In general Measures, the Analyzer displays the response of measured piece which varies with frequency, and this is called frequency domain Measure. When performing time domain Measure, the Analyzer obtains time domain data through inverse Fourier Transform of frequency domain, the Measure results are indicated by taking time as X axis, the response values appear at the time of separation and characteristics or fault points of the measured piece can be Analysisd. Figure below is the reflection Measure result of frequency domain and time domain of the same cable which has two bends, both bending points resulting in transmission line mismatch or impedance change.

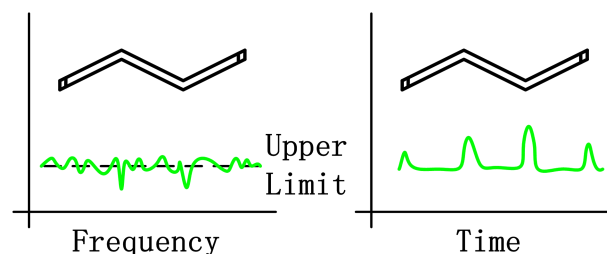


Fig. 8-1 Frequency Domain and Time Domain Measures

- Frequency domain response of S11 measured at input port indicates the combined reflection response caused by interaction of mismatched cable waves; however, definite physical location of the cable mismatch is hard to be determined.
- Time domain response indicates location and size of each mismatch and we can see from the response that apparent mismatch occurs at the second bend of the cable.
- In time domain, the Analyzer can filter undesired responses by using gate function and then converts time domain data back to frequency domain data. This function can be used to measure response of specific signal in network and filter effects of external instruments such as connector or adapter.

Time domain Measure function of the Analyzer simulates conventional time domain reflectometer (TDR). An impulse or step-function signal is transmitted to the measured piece from time domain reflectometer, then observe energy of the reflected signal and impedance change of the measured piece can be determined by analyzing amplitude, duration and waveform of the reflected signal. When performing time domain Measure, Network Analyzer doesn't generate incident impulse or step-function signal actually, but performs Sweep Measure and then calculates time domain information from frequency domain Measure result through Fourier Algorithm.

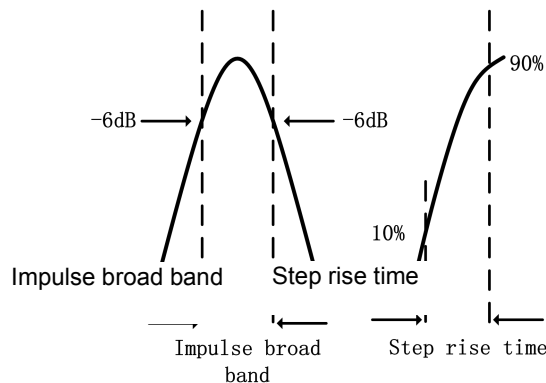
Generally, Vector Network Analyzer performs time domain transformation Measure through ration Measure.  $S_{11}$  reflection Measure does not only indicate size of the reflected signal received by receiver A or B simply, but also indicates the Measure result of the ratio between Measure receiver and reference receiver. In addition,  $S_{11}$  ratio Measure can eliminate system errors by calibration, which is very important to time domain Measure, since Measure reference plane is set through calibration and the calibrating point becomes zero point of time axis X, all time and distance data take this point as a reference point, and both time and amplitude data are very accurate through calibration.

## 8. 2. Resolution and Range of Time Domain Measure

This section discusses how to observe all effective time domain data of the measured piece and how to set up the instrument to obtain highest resolution and maximum Measure range.

### 8. 2. 1. Response Resolution

Time domain response resolution of the Analyzer refer to the capability of Analyzer to distinguish two adjacent responses. For response of identical amplitudes, it equals to the pulse width of impulse response defined by 50% (6dB) amplitude point, or the rise time of step response defined by 10% - 90% amplitude point, shown as figure below:

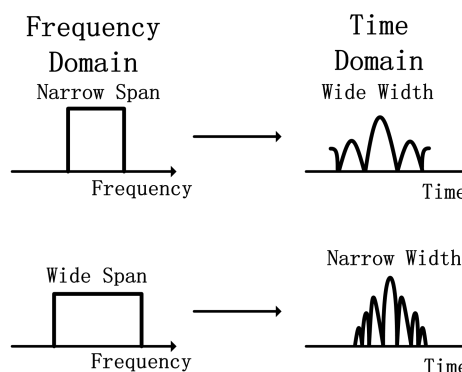


**Fig. 8-2 Time Domain Response Resolution**

Time domain response resolution is affected by factors below:

#### a) Frequency span

Figure below indicates the effect of frequency span toward response resolution:



**Figure 8-3 Effect of Frequency Span toward Response Resolution**

- Time domain Measure response under narrow frequency span is indicated as that impulse response pulses which shall be independent from each other are overlapped.
- When performing time domain Measure under broad frequency span, the Analyzer can distinguish different response pulses



well.

- Frequency span and pulse width are in inverse ratio. The broader the frequency span is, the narrower the impulse response pulse is; The shorter the step response rise time is, the higher the response Measure resolution is.

#### b) Window width (parameter $\beta$ )

Response resolution is also the function of time domain transformation window width. The smaller the  $\beta$  is, the narrower the impulse response pulse is, and the shorter the step response rise time is, the higher the response Measure resolution is.

Selection of window width depends on response of the measured piece. If the response is signal with equal electrical level, minimum window shall be applied to improve Measure resolution, and if not, maximum window shall be implemented to improve dynamic range of Measure; see Section 3 "Window Filtering" in this chapter for detailed information about window setting.

When setting time domain Measure, in Time Domain Transform dialog box, the Analyzer will calculate width of response pulse automatically according to current setting.

#### c) Time domain transformation mode

In low-pass and band-pass transformation modes, resolutions of Measure responses are different. For the same frequency span and Sweep spot number, low-pass mode has higher resolution and pulse width can reduce by half compared with band-pass mode; figure below provides the resolution comparison in two modes.

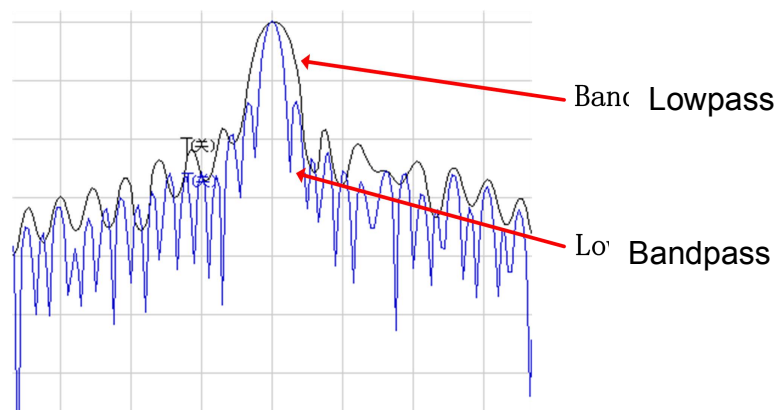


Fig. 8-4 Effect of Transformation Modes on Resolution

See Section 8.6 "Band Pass and Low Pass Time Domain Modes" in this chapter for detailed information about time domain transformation mode.

#### Techniques to optimize response resolution

- In most conditions, the highest time resolution is obtained by selecting maximum frequency span; however, frequency setting must meet operating frequency requirements of the DUT.
- Resolution is affected by frequency span, window width and time domain mode, so optimal setting must be performed according to response of the DUT.

### 8. 2. 2. Display Resolution

Display resolution of time domain refers to the capability to locate a signal response accurately in term of time. Good display resolution can improve peak point of response and location accuracy of zero point and display resolution is affected by time span and Sweep spot number:

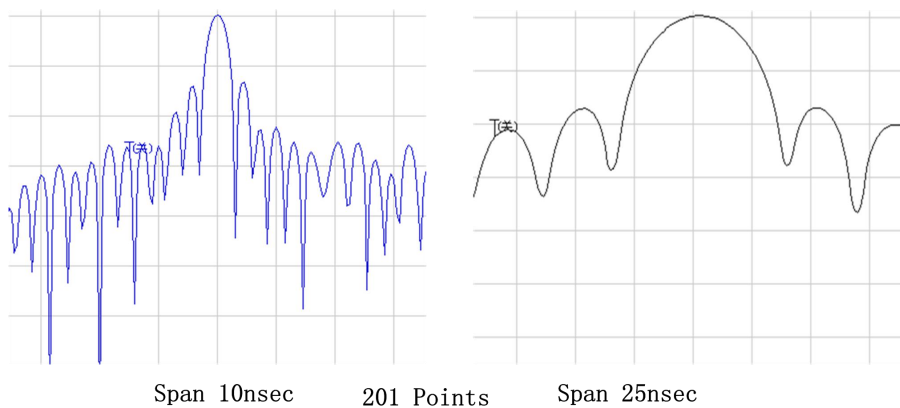
$$Display\ resolution = \frac{timespan}{scanningspotnumber - 1}$$

Display resolution can be improved with two methods below:

- Reduce time span.
- Increase Sweep spot number.

Figure below provides the Measure result of the same measured piece in different time spans with 201 Sweep spot number.

- Resolution of 50 psec can be obtained within time span of 10nsec.
- Resolution of 12.5 psec can be obtained within time span of 2.5nsec.



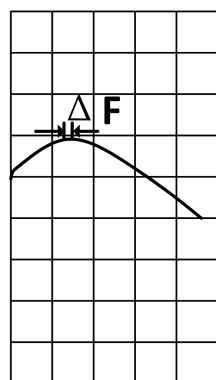
**Fig.8-5 Display Resolution**

### 8. 2. 3. Measure Range

In time domain Measure, Measure range can be defined as the maximum time span set and no repeated response will occur within this time span when performing Measure.

Measure range has an inverse relationship with response resolution; one increase, the other will be reduced.

Time domain waveform is the periodic signal repeating with time, thus repeated response will occur. Repeated response (false response) is not true response of the measured piece and it only appears at specific time interval (1/frequency interval of Sweep spots), hence Measure range is determined by frequency interval  $\Delta F$  of Sweep spots:



$$\Delta F = \frac{\text{Frequency Span}}{\# \text{ of Points} - 1}$$

For Example:

Frequency Span=1GHz

# of Points=201

$\Delta F=5\text{MHz}$

**Fig.8-6 Frequency Interval Definition of Sweep Spots**

When performing time domain Measure, maximum terminal time that can be set is:  $1/\Delta F$ , Measure range is in direct scale to Sweep

spot number - 1 and in inverse scale to frequency span, to increase Measure range, setting of two items below can be modified:

- Increase Sweep spot number.
- Reduce frequency span.

Measure range in meter can be obtained by multiplying vacuum light velocity with Measure, in order to calculate physical length of actual Measure range, relative speed rate of transmission medium shall be multiplied also and relative speed rate of some medium are below:

- Vpolythene = 0.66
- Vpolytef = 0.70

$$\text{Physical length of actual Measure range} = \frac{V_{\text{medium}}}{\Delta F} \times 3 \times 10^8 \text{ m/s}$$

### 8. 3. Window Filtering

Due to effect of sidelobe and pulse width, time domain transformation is limited in term of resolution. Window filtering function can be used to mitigate the effect when performing Measure. Window function provided by the Analyzer in time domain can distinguish various responses effectively and it can change width of response pulse, rise time of step response and sidelobe level.

#### 8. 3. 1. Advantages of Window Filtering

In frequency domain Measure, sudden change exists at initial and terminal frequencies, which will result in overshoot and ringing in step response of time domain. Using window filtering function can reduce effect caused by sudden change in frequency domain; besides, Analyzer also has following deficiencies when performing time domain Measure:

- Pulse width of impulse response or rise time of step response: this is caused by limitation property of the system itself, limiting the capability of Analyzer to distinguish two adjacent response signals. Pulse width is in inverse scale to frequency span measured, and to reduce pulse width, frequency span shall be increased.
- Impulse response sidelobe: this is caused by sudden change at terminal frequency. Sidelobe of adjacent high electrical level response will cover low level response signal, which limits dynamic range of time domain Measure, however, using window filtering can inhibit sidelobe, as shown in the figure below:

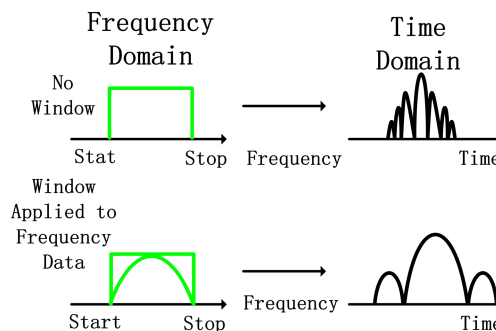
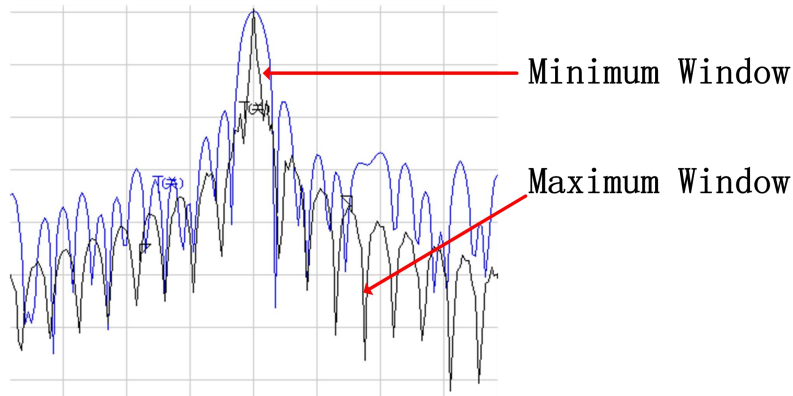


Fig.8-7 Inhibiting Sidelobe by Use of Window Wave Filter

- Using narrow window can reduce width of impulse response pulse and improve response resolution to distinguish two adjacent responses in a better way.
- Using broad window can reduce sidelobe level of impulse response and improve dynamic range to measure low level response in a better way.

Effects when using window wave filter is shown below:



**Fig.8-8 Effect of Window toward Response Signal**

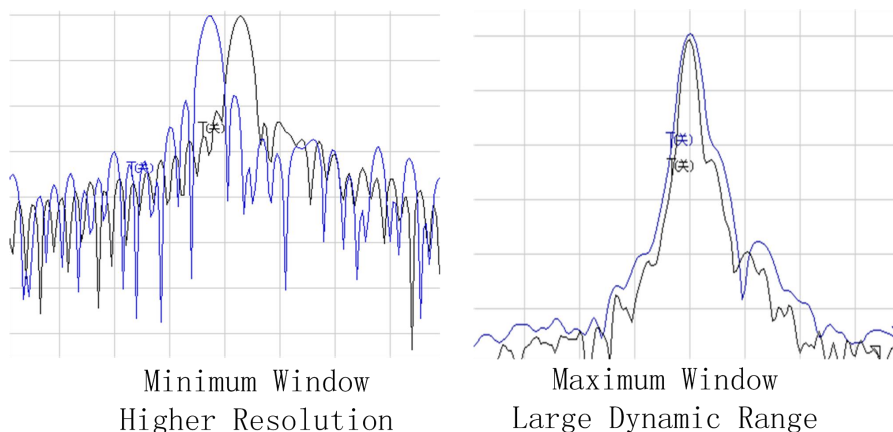
The Analyzer performs window filtering to frequency domain Measure data and has following effects on time domain Measure of the measured piece:

- In impulse transformation mode, it affects pulse width and sidelobe level, changing resolution and dynamic range of Measure.
- In low-pass step transformation mode, it can mitigate overshoot and ringing.

### 8. 3. 2. Setting Window Value Correctly

When performing time domain Measure, proper window value must be selected according to response type of the measured piece:

- Response of the measured piece with identical amplitude: small window is selected to obtain narrow pulse width to improve resolution of time domain Measure.
- Response of the measured piece with different amplitudes: large window is selected to obtain low sidelobe level to improve dynamic range of time domain Measure.



**Fig.8-9 Correct Window Setting**

## 8. 4. Time Domain Gate Filtering

Use of time domain gate function can select or filter a specific response in time domain, while the Analyzer can transform the processed time domain data to frequency domain again for observation. That is to say, after time domain filtering is performed to time domain data, function of time domain transformation can be turned off, and then frequency domain response of the measured piece can be observed in the condition that function of time domain is effective. For example, during transmission Measure, eliminate effect of multi-pass transmission by use of time domain gate, or observe a single time domain response signal at a time and then Analysis the effect of each single response toward Measure result in frequency domain.

### 8. 4. 1. How to Use Gate Function

In actual Measure, Measure steps with time domain gate function are as follows:

- a) **Measure the measured piece in frequency domain.**
- b) **witch on time domain transformation function and the Analyzer will calculate time domain response of the measured piece.**
- c) **Select gate type:**
  - Band-pass: set the gate at the center requiring response reservation, switch on gate function and response outside the gate is removed from the displayed Measure through mathematical manipulation.
  - Band-stop: set the gate at the center from which the response is to be eliminated, switch on gate function and response inside the gate is removed from the displayed Measure through mathematical manipulation.
- d) **Turn off time domain transformation function, observe frequency domain response of the measured piece and see the effect of specific response toward Measure result.**

Figure below illustrates the Measure application of a band-pass time domain gate:

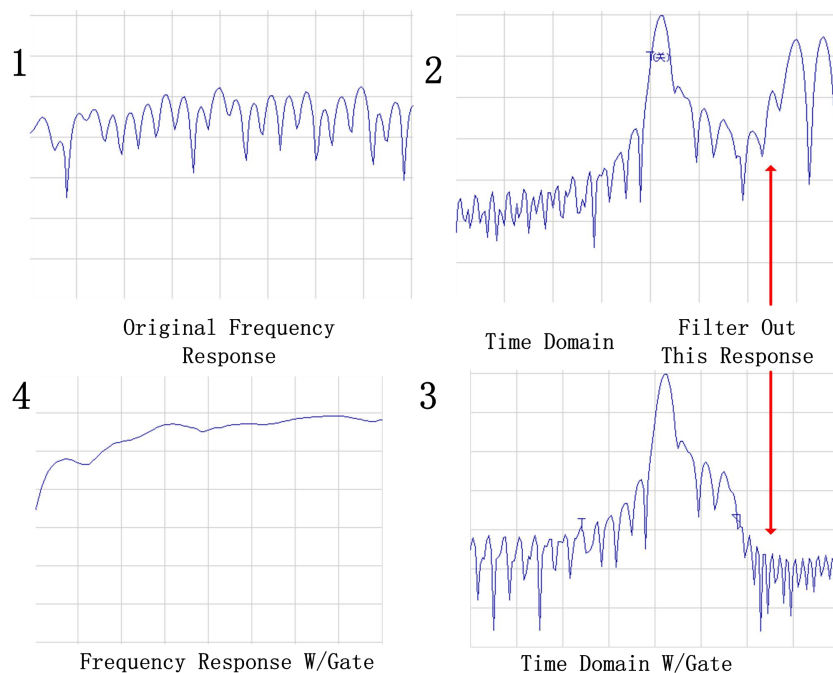


Fig.8-10 Observing Effect of Single Response toward Measure Result by Use of Time Domain Gate

### 8. 4. 2. Gate Settings

Border and function of the gate can be set and defined as below:

- Start and stop: to define -6dB cut-off time of the gate.
- Center: to define center time of the gate.
- Span: it equals to terminal time minus start time.
- Gate Type:
  - **Band-pass:** to filter response outside the gate.
  - **Band-stop:** to filter response inside the gate.

### 8. 4. 3. Gate Form

Similar to window wave filter, the gate also has corresponding wave filter form and Measure can be optimized by selecting reasonable wave filter form:

- **Minimum gate:** the wave filter has highest sidelobe level, with sharpest edge falling and maximum band-pass ripples.
- **Maximum gate:** the wave filter has lowest sidelobe level, with slowest edge falling and minimum pass band ripples.

#### 8. 4. 3. 1. Passband ripples of the gate

The gate is a pass band (or band-stop) wave filter on time domain and each form of wave filter has different filter property. Figure below indicates band-pass ripples of four filters in different forms and the scale in the figure is 0.5dB/grid. It can be seen from the figure that the minimum gate has the largest band-pass ripples.

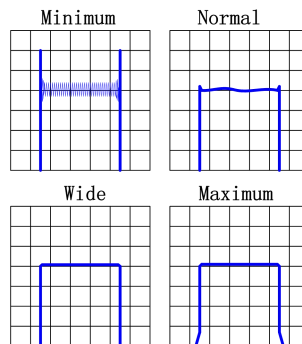


Fig.8-11 Band-Pass Ripples of Different Gate Wave Filters

#### 8. 4. 3. 2. Sidelobe level of the gate

Four wave filters of different forms have different sidelobe levels, in actual Measure, there must be a balance between lower sidelobe level and faster cut-off ratio.

- The minimum gate is with highest sidelobe level and fastest cut-off speed, which is very applicable to filtering undesired interference near the response.
- The maximum gate is with lowest sidelobe level, slowest cut-off speed, widest gate band-pass and maximum attenuation outside the gate band.

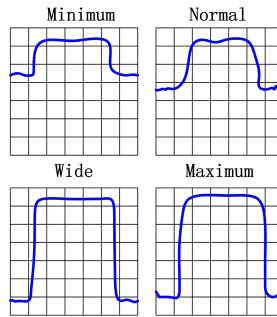


Fig.8-12 Sidelobe Level of Different Gates

### 8. 4. 3. 3. Property index of the gate

Different forms of gate have different properties and the properties are defined by index below:

- Pass band ripples and sidelobe level: to describe the gate form.
- Cut-off time: it is the time between end time of the gate (at -6dB of the filter edge) and the first sidelobe peak point.
- Minimum gate span: it equals to end time minus start time and it is twice of the cut-off time.

Table 8-1 Property Index of Different Gates

Gate Form	Pass Band Ripple	Sidelobe Level	Cut-off Time	Min. Gate Span
Min.	±0.10dB	-48dB	1.4/frequency span	2.8/frequency span
Standard	±0.01dB	-68 dB	2.8/frequency span	5.6/frequency span
Width	±0.01dB	-57 dB	4.4/frequency span	8.8/frequency span
Max.	±0.01dB	-70 dB	12.7/frequency span	25.4/frequency span

Each form of gate has a recommended minimum gate span to operate correctly, which is determined by limited cut-off ratio of the gate. If the gate span set is smaller than this minimum value, the Analyzer will produce effects below:

- The gate form is distorted, without pass band.
- Indication of start and end time is incorrect.
- Sidelobe level would be increased.

## 8. 5. Time Domain Measure Data

This section will provide examples of various Measure types to facilitate understanding of time domain response of the measured piece.

### 8. 5. 1. Screening

Screening will affect the response observed during time domain Measure; therefore, when explaining time domain Measure data, what is screening and its effect toward Measure result must be known clearly.

Screening occurs when discontinuous points or loss nearest to reference plane affects response of each discontinuous point.

Energy reflected or absorbed by the first discontinuous point won't approach the subsequent discontinuous points.

Response of each subsequent discontinuous point is smaller than that without screening.

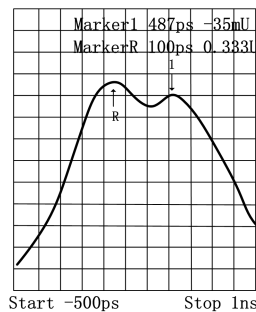
#### 8. 5. 1. 1. Screening caused by energy reflection

With serious mismatch, screening by energy reflection happens, examples below illustrate such phenomenon:

- When a section of 50Ω transmission line is connected with a section of 25Ω air line and connected with another 50Ω

transmission line, reflection coefficient of both discontinuous points is 0.333.

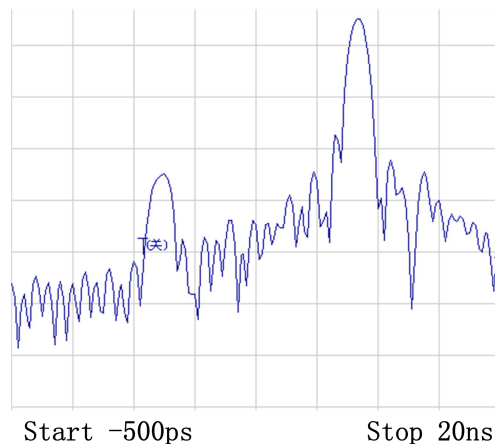
- During time domain Measure, if reflection coefficient of the first discontinuous point is about 0.333, this is the right case.
- Response value of the second discontinuous point is not 0.333 and it can be found from  $\Delta$  marker that there is an amplitude of 35mU between two responses, this is because that energy reflection caused by the first mismatch makes the incident pulse amplitude of the second response smaller than unit value 1U.



**Fig.8-13 Effect of Screening Caused by Energy Reflection toward Measure**

### 8. 5. 1. 2. Screening caused by energy absorption

Screening caused by energy absorption happens when measuring loss circuit. In Measure below, an open-circuit device is terminated to a cable and the Measure result displays the screening caused by energy absorption.



**Fig.8-14 Effect of Screening Caused by Energy Absorption toward Measure Result**

- Marker 1 displays that return loss of open-circuit device is -2.5dB (observed in the format of logarithm amplitude).
- Actual return loss of open-circuit device shall be 0dB.
- Value of Marker 1 represents the sum of forward and backward pass losses.

### 8. 5. 2. Reflection Measure in Band Pass Mode

Horizontal axis data:

- It represents the time used when pulse is transmitted from measuring port and transferred to discontinuous point and then gets back to measuring port.

Vertical axis data:

- With format of logarithm amplitude, it represents return loss (dB).
- With format of linear amplitude, it represents reflection coefficient.



An example of reflection Measure in band pass mode is provided below:

- There is a pulse at 0 point on time axis, which represents the first discontinuous point (connector) met from the measuring port output.
- The subsequent pulse represents the second discontinuous point (connector) met by impulse signal.

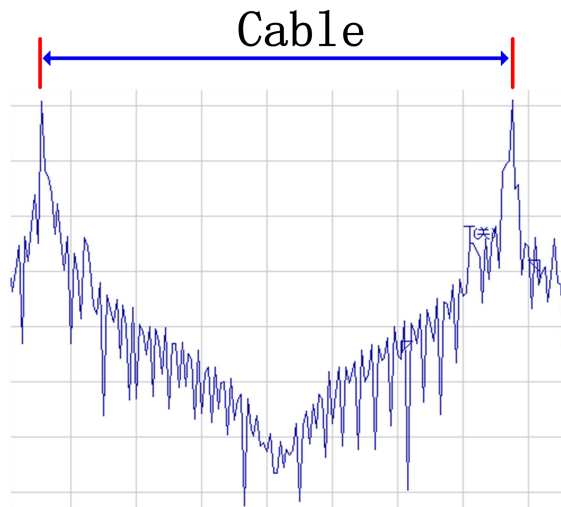


Fig.8-15 Reflection Measure in Band Pass Mode

### 8. 5. 3. Transmission Measure in Band Pass Mode

Horizontal axis data:

- It represents transmission delay when passing the measured piece.

Vertical axis data:

- In the format of logarithm amplitude, it represents transmission loss or transmission gain.
- In the format of linear amplitude, it represents transmission coefficient.

An example of surface filter (SAW) transmission Measure in band pass mode is provided below:

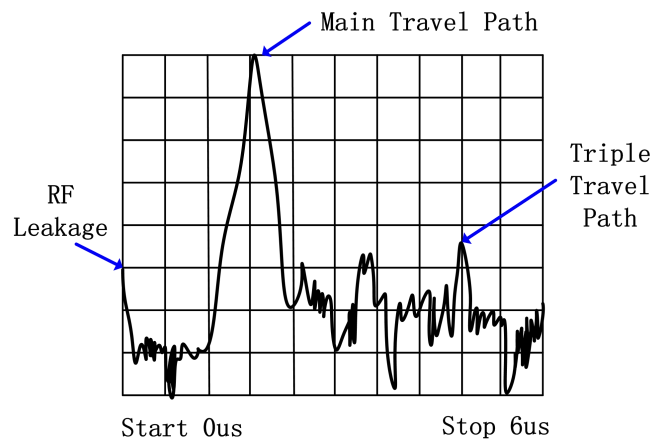


Fig.8-16 Transmission Measure in Band Pass Mode

- Three transmissions in surface acoustic wave (SAW) filter can be found from Measure results: the signal is reflected back to input port by output port and then reflected back to output port again.
  - Pulse closest to 0 time point represents transmission time of the shortest path between input and output of the measured piece; however, it is neither the maximum pulse definitely nor representing the expected transferring path.

- Each subsequent pulse represents other potential paths which are longer than the shortest path.

In order to observe main path response of surface filter (SAW), other responses can be filtered by gate function to observe frequency response of the main path only.

### 8.5.4. Fault Location by the Use of Low Pass Mode

The measured piece response of time domain reflectometer (TDR) can be simulated by the use of real part format and such response includes definite discontinuous type of information which is very useful. Figure below provides the low pass response in the format of known discontinuous real part, and each discontinuous circuit has corresponding time domain  $S_{11}$  response waveform. Measure can be performed by the use of low pass step or low pass impulse mode; however, it is easier to distinguish discontinuous types by the use of low pass step mode, which is similar to Measure with conventional time domain reflectometer (TDR).

IMPEDANCE	STEP RESPONSE	IMPULSE RESPONSE
OPEN	Unity Reflection	Unity Reflection
SHORT	Unity Reflection=180	Unity Reflection=180
RESISTOR $R > Z_0$		
RESISTOR $R < Z_0$		
INDUCTOR		
CAPACITOR		

Fig.8-17 Low Pass Time Domain Response Waveform of Discontinuous Circuit

### 8.5.5. Reflection Measure in Low Pass Mode

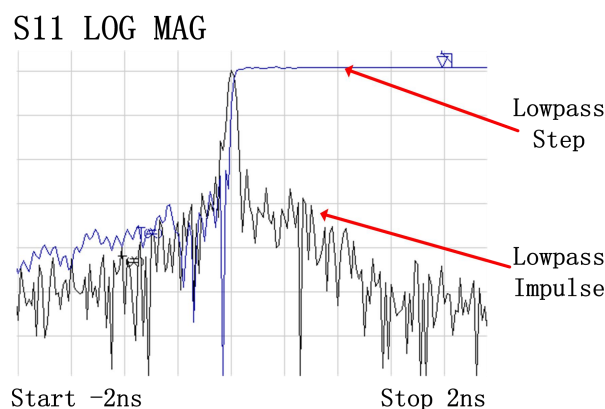
Horizontal axis data:

- It represents the time used when pulse is transmitted from measuring port and transferred to discontinuous point and then gets back to measuring port.

Vertical axis data:

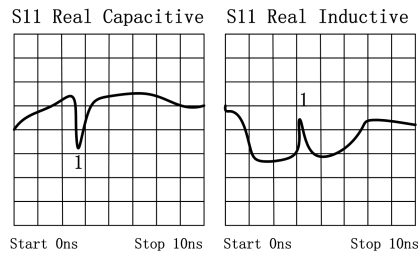
- In real part format, it represents reflection coefficient ( $\rho$ ).

Example below is the Measure result of the same reflection by the use of both low pass impulse and low pass step modes:



Fi.8-18 Reflection Measure in Low Pass Mode

Example below provides Measure results of two different cables in real part format and low pass response includes physical location and impedance type information of the discontinuous points.



**Fig.8-19 Low Pass Step Measure Results of Different Cables**

- **The left Measure:** response of the bending cable with capacitive discontinuous points.
- **The right Measure:** response of the wearing cable with inductive discontinuous points.

### 8. 5. 6. Transmission Measure in Low Pass Mode

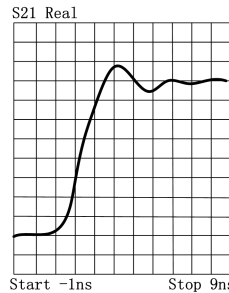
Horizontal axis data:

- Average transmission time during which the signal passes the measured piece in a frequency range.
- Average Electrical delay of the measured piece.

Vertical axis data:

- In logarithm amplitude format, it represents transmission loss and gain (limited to impulse mode only).

An example of low pass step response of amplifier is provided below:



**Fig.8-20 Low Pass Step Measure Results of Amplifier**

- Average group delay within Measure frequency range is the differential value between step and amplifier response.
- Step rise time is directly related to highest frequency of frequency domain sweep, the higher the frequency, the shorter the rise time is.
- Ringing of amplifier response indicates that it is underdamped design.

## 8. 6. Band Pass and Low Pass Time Domain Modes

When setting time domain Measure, transformation mode must be selected first and this section will make comparison between band pass and low pass Measure modes.

### 8. 6. 1. Modes Comparison

#### 8. 6. 1. 1. Band pass mode

- Easiest use.
- Very applicable to Measure of band pass instruments not working to direct current.

- It is allowable to set start and stop frequency randomly.
- It measures impulse response only since there is no DC item in transformation data.
- It can perform reflection and transmission Measure.
- It can be used for fault location.

#### 8. 6. 1. 2. Low pass mode

- Very useful to measure low pass instruments that can work to direct current.
- It simulates conventional time domain reflectometer (TDR).
- Measure frequency points are related to DC item harmonic wave and DC item is obtained through point extrapolation at frequency domain start.
- Since transformation data includes DC item, it can be used for impulse and step response Measure.
- It can locate fault and distinguish impedance types (capacity, induction) indicated by discontinuous points.
- It can perform reflection and transmission Measure.
- For the same frequency span, it has higher response resolution compared with band pass mode.

#### 8. 6. 2. Mode Selection

- If the measured piece operates at band pass, band stop or high pass state, select band pass mode.
- If low end operating frequency of the measured piece can be up to direct current, i.e. frequency response falls rapidly at low end, select low pass mode also.

#### 8. 6. 3. Frequency Span and Number of Points

##### 8. 6. 3. 1. Band pass mode

- Any start and stop frequency can be selected within operating frequency range of the Analyzer.
- The Analyzer utilizes all Measure data within start and stop frequency range.
- It provides impulse response only.

##### 8. 6. 3. 2. Low pass mode

- It is required to obtain direct current item through several measuring point extrapolation starting from a frequency domain.
- Data points with equifrequent interval are required.
- All Measure frequency points of the Analyzer are related to start frequency harmonic wave.
- Stop frequency=start frequency x Sweep spot number, it has certain limitation for each Sweep spot number N and selection of start and stop frequency.

#### 8. 6. 4. Impulse Response and Step Response

The Analyzer can display impulse response and step response of the measured piece, just like using impulse or step signal to stimulate measured piece.

- **Impulse activation:** it is a voltage waveform, of which the amplitude value changes to 1 from 0 and then changes back to 0 again, and pulse width depends on frequency span for frequency domain Measure.
- **Step activation:** it is a voltage waveform, of which the amplitude value changes to 1 from 0 and step rise time depends on the highest frequency for frequency domain Measure.

- According to transformation mode selected, the Analyzer calculates low pass impulse, low pass step or band pass impulse response by the use of frequency domain data.

### 8. 6. 5. Useful Data Format

#### 8. 6. 5. 1. Useful data format in band pass mode

- Linear amplitude format
  - For reflection Measure, this format represents the average amplitude of reflection coefficient ( $\rho$ ) within the whole Measure frequency range.
  - For transmission Measure, this format represents the average transmission coefficient ( $\tau$ ) of the transmission path within the whole Measure frequency range.
  - This format is very useful to observe the response with similar amplitudes.
- Log-magnitude format
  - For reflection Measure, this format represents return loss (dB) and the display value represents average return loss of discontinuous points within the whole Measure frequency range.
  - For transmission Measure, this format represents transmission loss or gain (dB) and the display value represents average loss or gain of the transmission path within the whole Measure frequency range.
  - This format is very useful to observe the response of dynamic range.
- Standing wave ratio
  - For reflection Measure, this format represents the average value of standing wave ratio of the discontinuous points within the whole Measure frequency range.

#### 8. 6. 5. 2. Useful data format in band pass mode

- Real part

This format utilizes real part unit to represent response of the measured piece.

### 8. 7. Setting Time Domain Transformation Measure (Optional)

#### 8. 7. 1. 1. By mouse or touch screen

- a) Click **[Marker/Analysis]**, click **[Transform...]** in submenu to display Time Domain Transform dialog box.
- b) Click to select **[Transform]** check box and Stimulus time domain transformation function.
- c) Click **[Start]**, **[Stop]** or **[Center]**, **[Span]** box to set time domain Measure range.
- d) Select transformation mode in Transformation Mode zone: **[Low Pass Impulse]**, **[Low Pass Step]** or **[Band Pass]**.

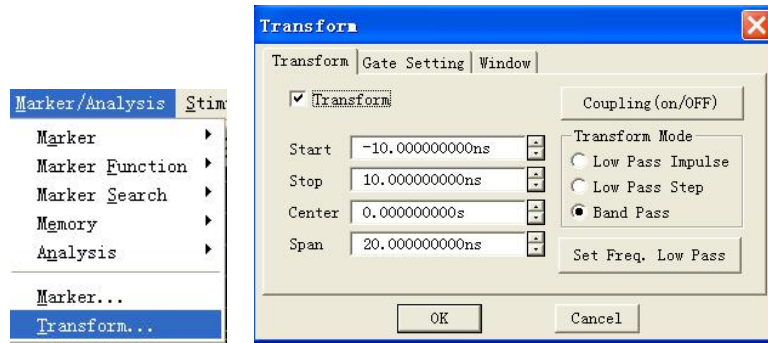


Fig.8-21 Setting Time Domain Transformation Measure

- e) Set Window function: click **[Window]** Selection Button in Time Domain Transform dialog box and set window filter with three methods below:
- Drag sliding box with mouse till pulse width or sidelobe level meets the requirement.
  - Click **[Caesarian Window  $\beta$  Para]** to adjust setting of value  $\beta$ , till pulse width or sidelobe level meets the requirement.
  - Click **[Pulse Span]** to set response pulse width directly.

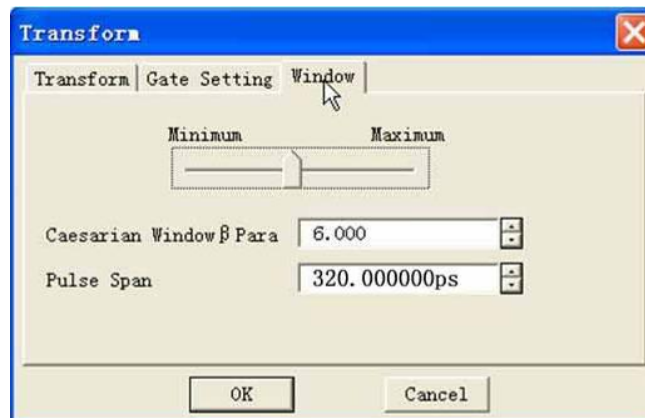


Fig.8-22 Time Domain Transformation Measure—Setting Window

- f) Set filtering function of time domain gate: click **[Gate Setting]** option button in Time Domain Transform dialog box and click to select **[Gating]** check box to enable filtering function of time domain gate.
- Click **[Start]**, **[Stop]** or **[Center]**, **[Span]** box to set gate border.
  - Select gate type in **[Gate Type]** box: band pass, band stop.
  - Select gate form in **[Gate Shape]**: minimum, normal, wide, maximum.

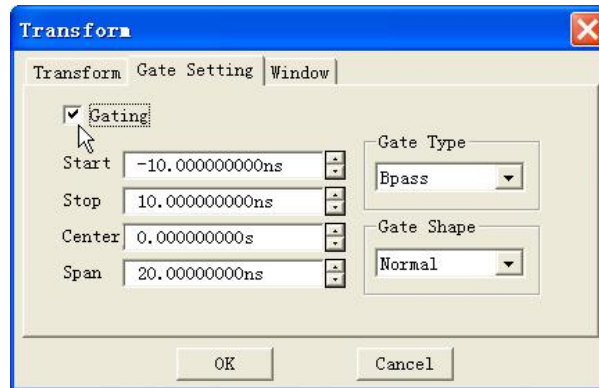


Fig.8-23 Time Domain Transformation Measure—Gate Setting

- g) If it is necessary to observe frequency domain response of the measured piece when the gate function is still effective, click **[Transform]** option button in Time Domain Transform dialog box and click to clear **[Transform]** check box.
- h) Click **[OK]** to close Time Domain Transform dialog box after setting.

#### Techniques for time domain transformation setting

When closing Time Domain Transform dialog box while starting time domain transformation and time domain gate, drag the mouse to change border settings of time domain gate: indicate start and stop of the gate with symbol “ $\nearrow$ ” and “ $\searrow$ ”, point start or stop symbol of the gate with the mouse, press left key of the mouse, when mouse pointer become horizontal indication “ $\leftrightarrow$ ”, drag mouse to move border indicating symbol of the gate to location required and release left key to finish the setting of gate start or stop.

After setting of time domain Measure are finished through Time Domain Transform dialog box, close Time Domain Transform dialog box, enable Time Domain toolbar to adjust settings for time domain Measure, and in this way, effect of setting change toward Measure can be observed clearly. See “Trigger Toolbar Display” in Section 9 “Setting Analyzer Display” in Chapter V for setting method of Time Domain toolbar.

#### 8. 7. 2. By front panel keys—Time Domain Transform Dialog Box

- a) Press **[Analysis]** in MKR/ANALYSIS area, press soft-key corresponding to **[Transform]**, relative soft-key menu appears, press corresponding soft-key of **[Transform ...]** to display Time Domain Transform dialog box.
- b) Press **[□],[□]** in ADJUST area to switch to **[Transform]** check box, press the knob key to select check box to Stimulus time domain transformation function.
- c) Press **[□],[□]** to switch to Transformation Mode zone, Press **[△],[▽]** in ADJUST area or rotate knob to select **[Low Pass Impulse]**, **[Low Pass Step]** or **[Band Pass]** mode.
- d) Press **[□],[□]** to switch to **[Start]**, **[Stop]** or **[Center]**, **[Span]** box to set time domain Measure range.
- e) Set window function: press **[□],[□]** to switch to **[Transform]** option button, press **[△],[▽]** or rotate knob to switch to **[Window]** option button and then set window filter in three methods below:
  - Press **[□],[□]** to switch to sliding block box, press **[△],[▽]** or rotate knob till pulse width or sidelobe level meets the requirement.
  - Press **[□],[□]** to switch to **[Gaesarian Window  $\beta$  Para]** to adjust setting of value  $\beta$ , till pulse width or sidelobe level meets the requirement.
  - Press **[□],[□]** to switch to **[Pulse Span]** to set response pulse width directly.
- f) Set filtering function of time domain gate: press **[□],[□]** to switch to **[Window]** option button, press **[△],[▽]** or rotate knob to switch to **[Gate Setting]** option button, press **[□],[□]** to switch to **[Gating]** check to, press the knob key to select the check box and Stimulus filtering function of time domain gate, then set the function of time domain gate.

- Press [,] to switch to [Start], [**Stop**] or [**Center**], [**Span**] to set gate border.
  - Press [,] to switch to [**Gate Type**] box, press [ $\Delta$  ], [ $\nabla$  ] or rotate knob to select gate type: band pass, band stop.
  - Press [,] to switch to [**Gate Shape**] box, press [ $\Delta$  ], [ $\nabla$  ] or rotate knob to select gate form: minimum, standard, wide, maximum.
- g) If it is necessary to observe frequency domain response of the measured piece when the gate function is still effective, press [,] to switch to [**Gate Setting**] option button, press [ $\Delta$  ], [ $\nabla$  ] or rotate knob to switch to [**Transform**] option button, press [,] to switch to [**Transform**], press the knob key to clear the check box and close time domain transformation function.
- h) Press [**OK**] in Input keypad to close Time Domain Transform dialog box after setting.

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