4024 Series

Spectrum Analyzer

Quick Start Guide

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Foreword

Thank you for choosing 4024 Spectrum Analyzer developed and produced by China Electronics Technology Instruments Co., Ltd.

We take customer demands as our own duty, 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.

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China Electronics Technology Instruments Co., Ltd.

Statement

The information contained in this User Manual is subject to change without prior notice. China Electronics Technology Instruments Co., Ltd. reserves the right of final interpretation for the content and terms used in this Manual.

Product Quality Assurance

The warranty period of the product is 18 months from the date of delivery. We shall repair or replace the damaged part as the case may be within warranty period. For this purpose, the user shall return the product to the manufacturer and prepay the mailing expense which shall be returned to the user by the manufacturer together with the product after maintenance.

Product Quality Certificate

The product meets the indicator requirements of the manual at the time of delivery. Calibration and measurement are completed by the measuring organization with qualifications specified by the state, and relevant data are provided for reference.

Quality/Environment Management

Research, development, manufacturing and testing of the product comply with the requirements of the quality and environmental management system. China Electronics Technology Instruments Co., Ltd. has passed the ISO 9001 and ISO 14001 certifications.

Precautions

Warning

“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 shall fully understand and meet all the conditions in the warning before proceeding to the next step.

Caution

“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 operations may result in damage to the instrument or loss of important data. You shall fully understand and meet all the conditions in the caution before proceeding to the next step.

Table of Contents

Chapter 1 Manual Guide

This Manual describes the structure and use of 4024 Spectrum Analyzer (hereinafter referred to as 4024 or Spectrum Analyzer) in an all-around and three- dimensional manner from aspects of instrument panel, power supply, start to use, typical applications and after-sales help. By reading this Manual, you will have an overall understanding of 4024 and quickly master the basic operations of this device in a systematic manner. For the convenience of operation, please carefully read the manual before operating the instrument, and properly operating it according to the guidance in the manual.

Chapters in the *Quick Use Guide of 4024 Spectrum Analyzer* are:

- **Preparation for use**

This chapter introduces preparations before use, start to use, panel introduction and battery replacement. By reading this chapter, you will gain the perceptual knowledge of 4024 as a whole and make preliminary preparations for correct and safe operation of this device.

- **Typical application**

This chapter explains basic measurement methods of 4024 and operating steps of basic measurement functions in details through test instances on how to distinguish closely spaced signals, how to improve frequency measurement accuracy and how to measure small signals. In addition, this chapter also briefly describes the skills used in tests. By reading this chapter, you can use 4024 to complete certain typical tests independently.

- **Help**

This chapter consists of after-sales repair and its procedures with the emphasis on problem solving, maintenance and repair of this device during use.

Chapter 2 Preparation for use

4024 Spectrum Analyzer series is characterized by wide operating frequency band, high performance index, fast sweeping, multiple test functions and easy operation. In terms of performance index, this series has good average noise level, phase noise, fast sweep speed and multiple measurement functions. Adopting the 8.4-inch integrated liquid crystal and capacitive touchscreen and portable structure with small volume and light weight, this series features flexible power supply and is particularly suitable for field use. This chapter emphatically introduces the test environment, power supply, structure and battery replacement of this device.

2.1 Pre-operation preparation

This section describes the precautions for the first use of 4024 Spectrum Analyzer for the first time. The safety of 4024 meets the requirements in GJB3947A-2009. Please carefully read the following safety precautions before use in order to avoid any damage to the device or unnecessary personal injury.

Warning

To prevent damage to the instrument and avoid electric shock, fire and personal injury:

- Do not open this device without authorization;
- Do not disassemble or modify any part which is not described in this manual. Any disassembly without authorization may result in reduction of electromagnetic shielding performance or damage to the parts inside the device, thus comprising product reliability. We shall not offer free repair service to any product which is disassembled without authorization even if the product is still within warranty period.

2.1.1 Environmental Requirements

In order to ensure the longer service life of 4024 and the effectiveness and accuracy of measurement, tests should be done under the following conditions.

1. Temperature range:

Storage temperature range: -40℃~+70℃

Operating temperature range: -10℃~+50℃

Operating temperature range of power supply by Li-ion battery：0℃～+45℃

Warning

As the battery storage temperature range is -20℃ to 60℃, the battery must not work continuously in a long time at high temperature, so as to avoid risks arising from high temperature. It is recommended to use the adapter to supply power.

2. Low pressure

Low air pressure (altitude): 0~4600m

2.1.2 Power supply requirements

Three power supply forms are supported by 4024:

1. AC power supply and power supply with adapter

The accompanying AC-DC adapter must be used for AC power supply. The input power supply of the adapter is 100~240V, 50/60Hz AC.

When transported and carried in a backpack, please do not connect the AC-DC adapter to the device to avoided overheating. The AC-DC adapter has a wide range of voltage input. When in use, please make sure the power supply voltage is within the scope specified in Table 2.1.

Table 2.1 Power supply requirements

Power supply parameter	Applicable range
Input voltage	100V~240VAC
Rated input currency	1.7A
Work frequency	50/60Hz
Output Voltage/Current	15.0V/4.0A

Caution

The working voltage and frequency ranges are subject to the parameters provided on the nameplate of the power adapter.

2. DC power supply

Voltage: 15V

Current: 3A (min.)

3. Power supply with built-in battery

4024 can be powered by rechargeable li-ion battery. The battery will discharge if it is not used for a long time. Therefore, the battery must be recharged before use. Please refer to Section 2.6 for details about battery use. Basic parameters of accompanying battery are as follows:

Nominal voltage: 10.8V

Nominal capacity: 7,800mAh

Caution	The rechargeable battery must not be exposed to fire or high-temperature environments (above 70℃), or placed in fresh water or salt water, or made wet. It must be kept away from children. The rechargeable battery is reusable and should be stored in proper container to avoid short circuit. Heavy metals such as nickel and chromium in the battery can pollute natural environment. Waste battery shall not be discarded but shall be put into a special battery recycle box.

2.1.3 Electrostatic protection (ESD)

Attention should be paid to electrostatic protection when using the device. If condition permits, the following electrostatic protection measures may be taken:

1. Before connecting the power cable to the device for test, make sure the central conductor of the power cable is grounded. This can be realized through the following steps: Connect a short-circuiter to one end of the cable to realize short circuit between the central conductor and outer conductor of the cable. When wearing a anti-static wrist band, hold on to the casing of the cable connector and connect the casing to the other end of the cable before removing the short-circuiter.

2. The operator should be grounded before cleaning or checking the test port of the device or connection. This can be realized by holding on to the metal casing of grounded device or the casing of test cable connector.

2.2 Description of start for use

Before powering 4024, please check the power supply equipment as per “Power supply requirements” in Section 2.1.2. Power-on test can only be carried out after confirmation.

Press the Power ON/OFF (【⏻】key) for about 3 seconds, a beep can be heard. Then, release the ON/OFF key and the device will enter host program after about 30 seconds. To ensure the stability of performance indexes of parts inside the device in order to achieve better test results, a 30-minute warming period is recommended before measurement.

2.3 Overview of front panel

This section describes the front panel of 4024 in details. Fig. 2.1 shows the front panel of 4024.

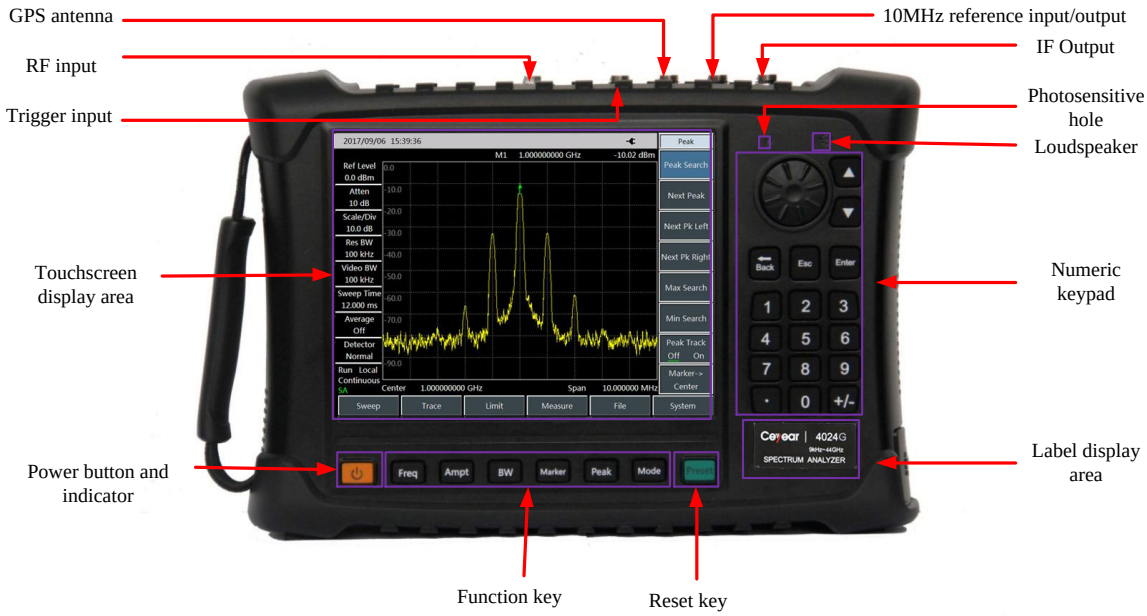

Fig. 2.1 Front panel of 4024 Spectrum Analyzer

2.3.1 Power key and indicator

Power key and the indicator are located at the lower left of the front panel. The power indicator is inside the yellow power key. The indicator for power off is yellow and that for power on is green. The correlation between color of the indicator and physical status of the device is shown in the table below.

Table 2.2 Description of indicator status

Instrument status	Indicator status	Physical status of the Spectrum Analyzer
Power off	Off	a) battery installed, power not connected. b) battery not installed, power not connected.
	Yellow normally on	a) battery not installed, power connected. b) battery installed and full, power connected.
	Yellow flickering	Battery installed but not full, power connected.
Power on Status	Green normally on	a) battery not installed, power connected. b) battery installed and full, power connected. c) battery installed, power not connected.
	Green flickering	Battery installed but not full, power connected.

2.3.2 Functional key zone

Commonly-used functional keys are described as follows:

- 【Freq】: Set the scope of frequency measured, frequency step, signal standard, etc.
- 【Ampt】: Set the amplitude of measurement results displayed, including display format, display scale and control of pre-amplifier.
- 【BW】: Set the resolution bandwidth, video bandwidth, detector type, average value and other measurement parameters.
- 【Marker】: Enable function menu related to the marker. When enabled, the marker can be operated by dragging, clicking or other touch modes.
- 【Peak】: Enable the peak search function.
- 【Mode】: Select the operating mode of the device, including spectrum analyzer, interference analyzer, AM-FM-PM analyzer, power meter, channel scanner and other modes.

2.3.3 Preset button

Preset or reboot the system to restore to default initial state. Preset can be realized by pressing and releasing this key.

2.3.4 Photosensitive hole

This hole can sense the intensity of external light for auto adjustment of liquid crystal brightness.

2.3.5 Numeric keypad

- Numeric keys: You can input corresponding value of the parameter selected with numerical keys at front panel and input the data after selecting corresponding unit at soft menu.
- 【•】: Input the decimal point for decimal value when entering a decimal value with a decimal point.
- 【+/-】: Positive/negative sign: before inputting a numerical value, you can use this key to input a positive or negative value.
- 【↑】 and 【↓】 You can use these keys to control the step up or down or to select current item.
- 【Cancel】: You can use this key to exit from any functional operation without changing current parameter. Cancel the active function, and exit the number operation and file dialog box.
- 【Backspace】 You can use this key to remove a character before the marker in the input area.
- 【Enter】: You can use this key to receive data in default unit in the input area.
- Knob: You can use this knob to move the marker and change the value of current parameter. This knob is generally used for fine tuning the parameter to the optimal value.

2.3.6 Loudspeaker

4024 is equipped with a loudspeaker. Please keep the loudspeaker hole clean to avoid compromising the sound effect.

2.3.7 Label display area

This area displays the model, frequency range, label and name of this 4024 Spectrum Analyzer.

2.4 Overview of operation interface

4024 adopts the design of 8.4-inch integrated liquid crystal and capacitive touchscreen. The operation interface is shown in Fig. 2.2.

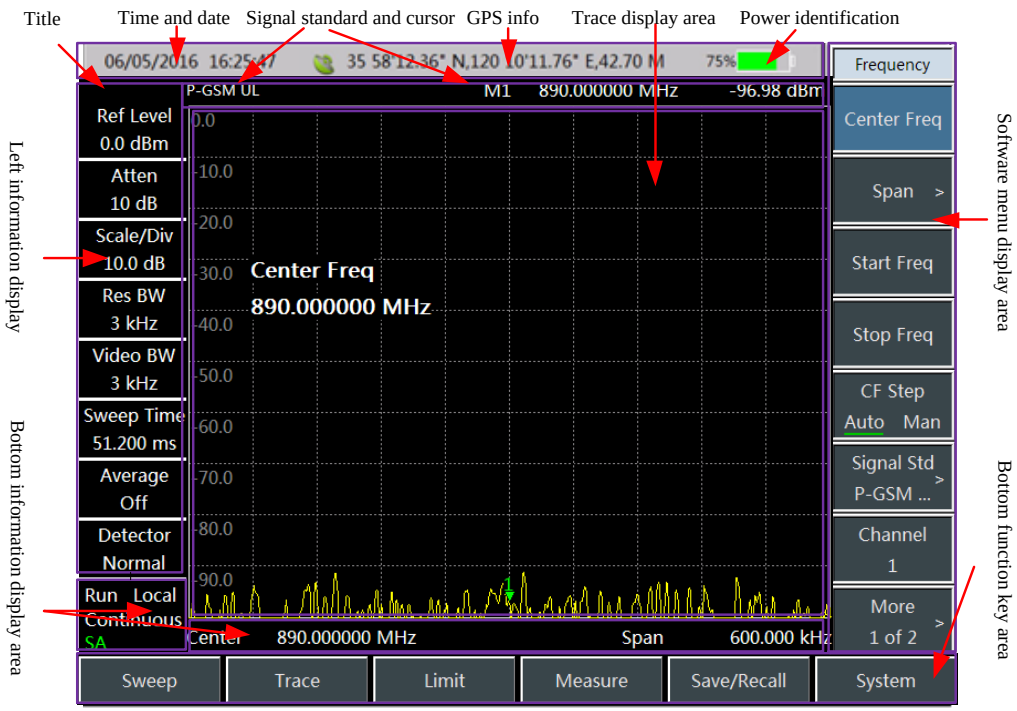

Fig. 2.2 Operation interface of 4024 Spectrum Analyzer

2.5 Overview of top panel

The top panel of 4024 is shown in Fig. 2.3 and it consists of a power interface, a digital interface and a test port.

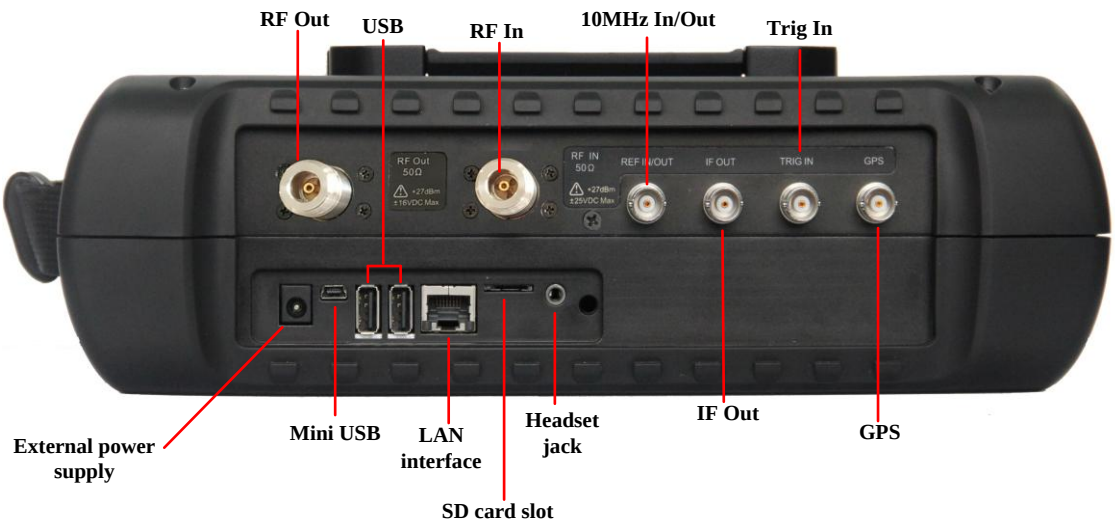

Fig. 2.3 Top panel of 4024 Spectrum Analyzer

2.5.1 Power interface

The power interface of the device is for powering the device through DC output of AC-DC adapter or through external DC power source. The conductor inside the external power interface is positive and the external conductor is grounded.

2.5.2 Test port

1. RF Input port: This port is for inputting tested signal. The test signal input port of 4024 is 50Ω. 4GHz, 6.5GHz, 9GHz, 20GHz and 26.5GHz models use N type female port and 32GHz and 44GHz models use 2.4mm male port.

2. RF Output port: This port is for signal output. 50Ω impedance, N-type female port, provided only when customers need the tracking generator option.

3. 10MHz Input / Output port: This port is for connecting 10MHz signal of other devices as the reference signal of the analyzer. It can also be used for outputting the internal 10MHz reference signal for other devices.

4. IF Output port: Under zero span, this port can be used for outputting the IF signals for other devices through software configuration.

5. Trigger input port: External trigger mode can be set for 4024. The scope of trigger source must be -5V~+5V when connecting the external trigger source to the trigger input port of the Spectrum Analyzer. Rising edge trigger or fall edge trigger can be set by the software.

6. GPS antenna port: This port can be used for connecting GPS antenna device for locating current position of the Spectrum Analyzer.

Warning

To better protect the Spectrum Analyzer, some identifiers are provided at the test port of the device. The user must pay attention to the content on these identifiers when using this device, in order to avoid any permanent damage to the device.

Please refer to Section 2.5.4 for detailed explanation of symbols in the figure.

2.5.3 Digital interfaces

1. Mini USB interface: This interface is used for connecting external PC which realizes program control or data transmission for 4024 through program control commands or function library.

Caution	Equipment drive should be installed for connecting the device to PC through USB interface for the first time.

2. USB A type interface: This interface is used for connecting USB peripheral equipment, such as USB storage device, USB power detector.

3. LAN (network) interface: This interface is a 10/100Mbps network interface through which a PC can be connected to the device through a network cable. PC can realize program control or data transmission for 4024 through program control commands or function library.

4. SD card slot: This Micro SD card slot can be used to extend the storage space of the device.

5. Headset jack: This is a standard headset jack for 3.5mm/3 line for audio output of FM/AM/SSB demodulation. When a headset is not connected to this jack, the audio output will be realized through the loudspeaker of the device. When a headset is connected to this jack, audio output will be automatically switched from the loudspeaker to the headset.

2.5.4 Device symbols

Device symbols indicated in the figure below indicate that the maximum power of RF IN and the maximum input DC level. When the device is in operation, the user is not allowed to connect signal exceeding this range to the port. Otherwise, the device may be destroyed!

2.6 Battery installation or replacement

4024 accompanies with a large-capacity rechargeable Li-ion battery with a battery life of 2.5 hours. For field test for long period, it is recommended to purchase a battery of same mode as a standby battery.

Caution	To guarantee the longer service life of the battery, the battery should be removed from battery holder during the transportation and long-time storage, and try not to make the battery power less than 5%, otherwise the battery may not be able to charge.

Installation or replacement of battery can be carried out by reference to Fig. 2.4 for battery installation or replacement of 4024.

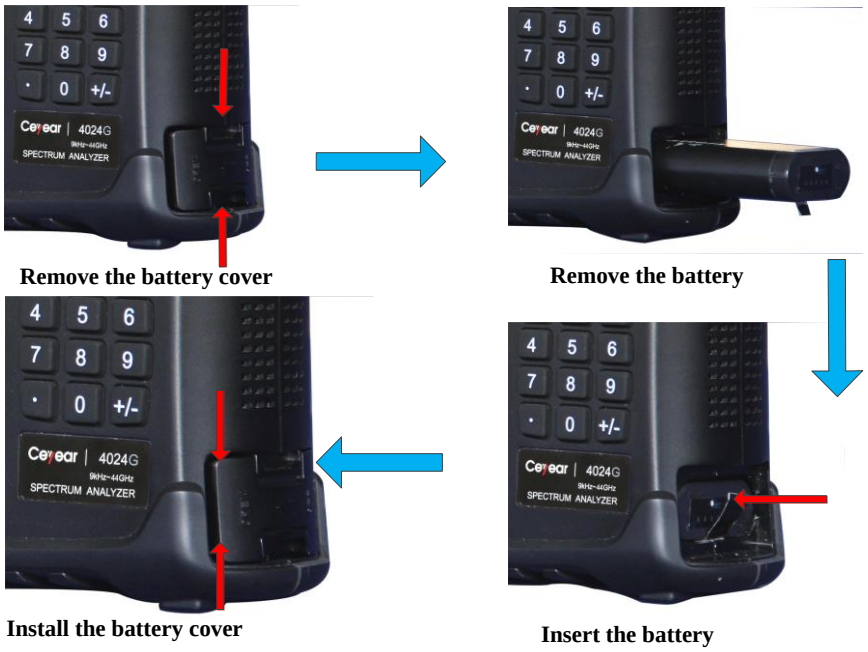

Fig. 2.4 Install or replace the battery

Chapter 3 Typical application

Several working modes are available in 4024, including spectrum analyzer, interference analyzer (option), AM-FM-PM analyzer (option), power meter (option) and channel scanner (option). Several intelligent measurement functions are provided for each working mode. This chapter mainly describes basic tests under spectrum analyzer mode. For detailed operation of each optional mode, please refer to the *User Manual of 4024 Spectrum Analyzer*.

Caution

In this Guide, keys on the front panel are shown in the form of 【XXX】, in which XXX is the name of the key. Bottom buttons on the touchscreen are shown in the form of [XXX], in which XXX is the name of the key; buttons on the right menu are shown in the form of [XXX], in which XXX is the name of menu.

3.1 Basic signal measurement

Basic measurements include marking the frequency and amplitude of signal by a marker on the screen of the Spectrum Analyzer. Input signals can be measured by following the steps below and current measurement results can be saved using the file menu:

a) Set center frequency

Set the frequency of external signal generator as 1GHz. Set the center frequency of the Spectrum Analyzer. Press 【Freq】, select [Center Freq] and set the center frequency as 1GHz. Or you can directly input [1] [GHz] using the keys in numerical keypad on the front panel. These numerical keys can be used for setting the exact value of current parameter. The value of center frequency can also be changed by the step key and knob, as shown in Fig. 3.1.

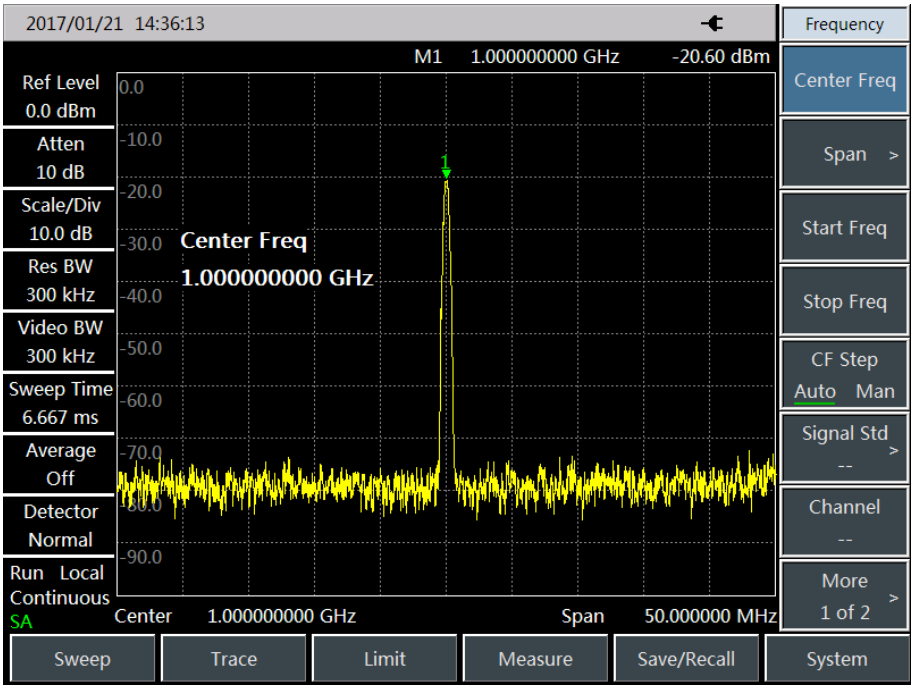

Fig. 3.1 Center frequency is 1GHz

b) Set span

Press 【Freq】 →[Span]. Please note if the span is shown in the active function area in order to confirm currently activated parameter. To reduce the span to, for example, 10MHz, you can input [1] [0] using the numerical keypad and select the unit as [MHz], or you can use 【↓】 key to reduce to this value by step (the numerical keys and step keys can be used for changing the value of current parameter). The result is shown in Fig. 3.2. Attention should be paid to check if the resolution bandwidth and the video bandwidth are adaptable to the span as they will be automatically adjusted to a proper value based on the given span value. The sweep time is also adaptable.

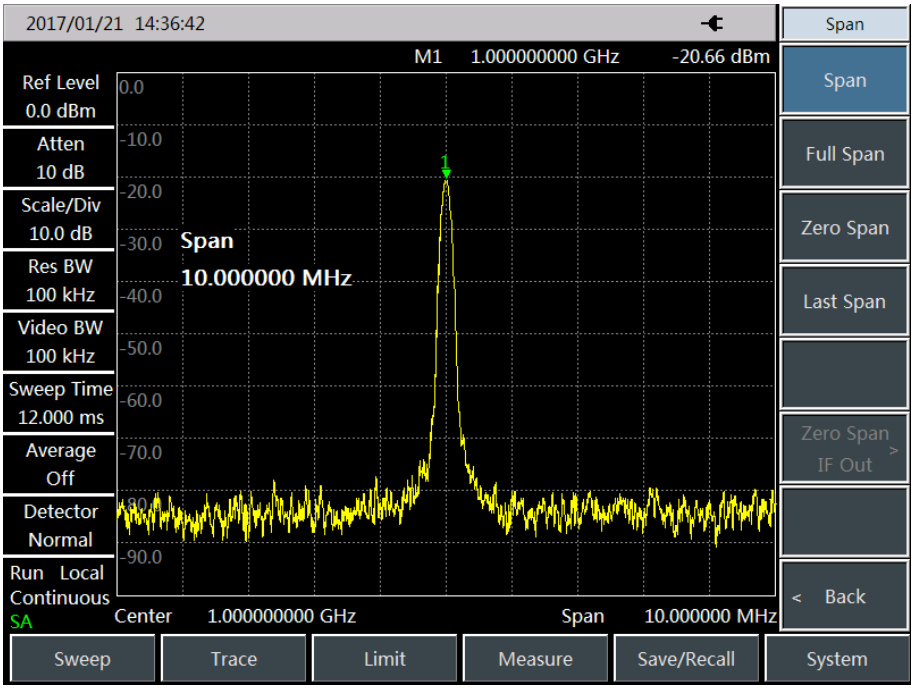

Fig. 3.2 The center frequency is 1GHz and the span is 10MHz

c) Set the sweep time

Press 【Sweep】 and select [Sweep Time Auto Man] soft key. This soft key can be used for setting the control mode of sweep time as auto control or manual control. The underlined item is currently activated option. For example, when “Auto” is underlined, the sweep time will be automatically adaptable to other relevant parameter settings.

d) Activate the marker

By pressing 【Marker】, common marker will be activated and displayed in the center of the horizontal coordinates (the frequency and amplitude will be read by the marker and shown in the active function area). The marker reads the frequency as 1GHz and amplitude as -20dBm, as shown in Fig. 3.3.

If the marker is not at the peak, you can press 【Peak】 key to enable the marker to automatically jump to the peak of the signal or use the knob on the front panel to manually position the marker on the maximum value of the signal.

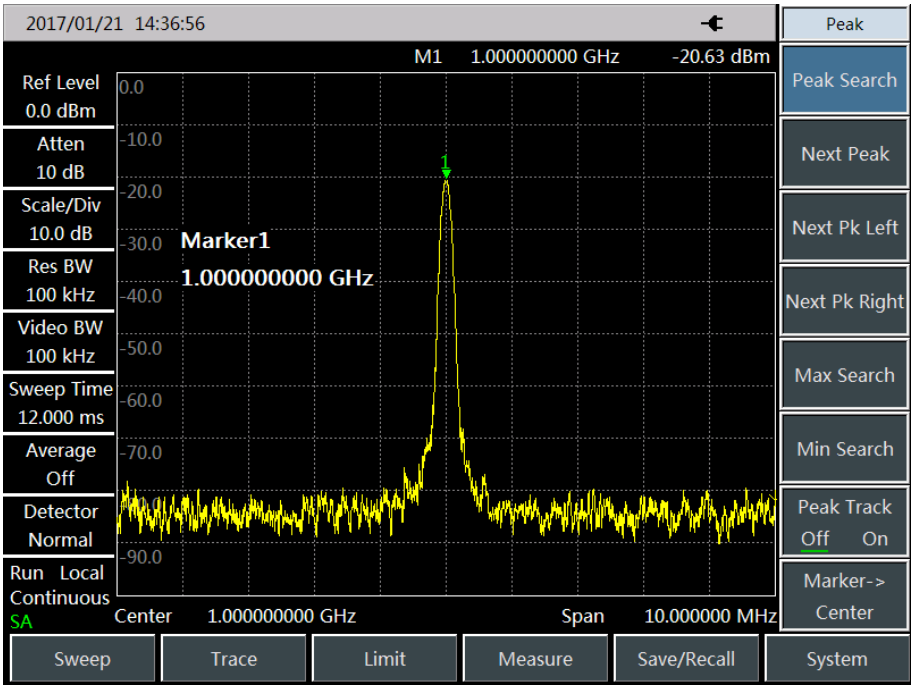

Fig. 3.3 Activate the marker

e) Adjust amplitude parameter

Generally, optimal amplitude measurement accuracy can be obtained by putting the signal peak at the reference level position, as shown in Fig. 3.4. Press 【Ampt】 →[Ref Level] to set the reference level as the amplitude of the marker.

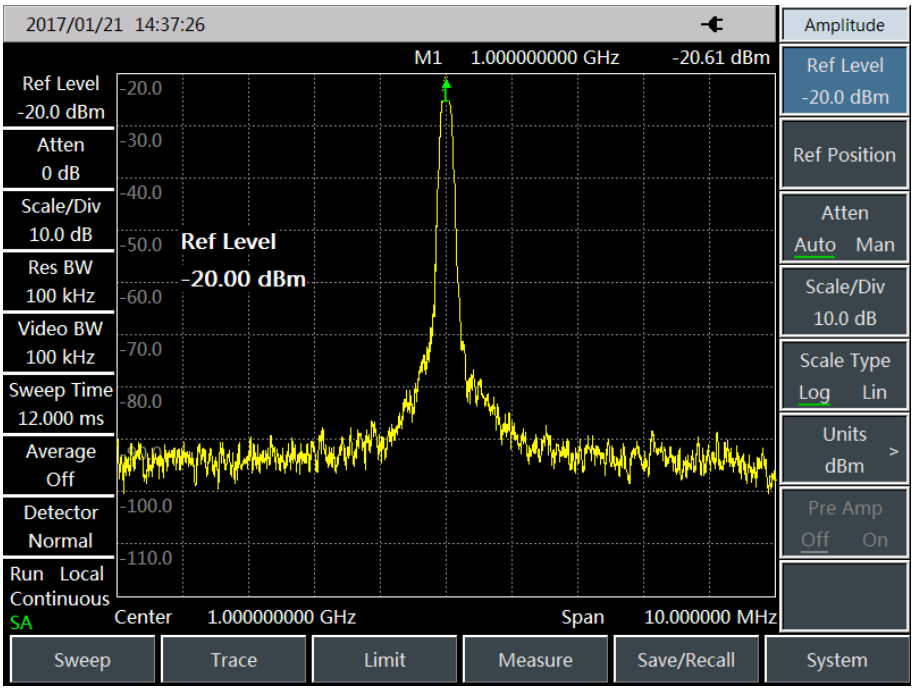

Fig. 3.4 -20dBm reference level

f) Save the test results

Press 【File】→[Save Data] (or select the save state or picture) and an interface shown in Fig. 3.5 will pop up. Input the name on the interface and then press [OK] to save.

Fig. 3.5 Save file

3.2 How to improve frequency measurement accuracy

This section will take the measurement of external 1GHz signal as an instance to describe how to use the marker count function to improve the frequency reading accuracy for measurement. The test steps are as follows:

a) Reset the Spectrum Analyzer

Press 【Preset】 key to re-start the Spectrum Analyzer.

b) Set center frequency

Set the frequency of external signal generator as 1GHz. Set the center frequency of the Spectrum Analyzer. Press 【Freq】, select [Center Freq] and set the center frequency as 1GHz. Or you can directly input [1] [GHz] using the keys in numerical keypad on the front panel. These numerical keys can be used for setting the exact value of current parameter. The value of center frequency can also be changed by the step key and knob.

c) Enable the marker count function

Press 【Maker】 to activate the marker. Press 【Maker】→[Count Mkr Off On] to enable the marker count function. Press 【Peak】 to position the marker on the signal frequency. Observe the reading of the marker and the resolution of frequency can reach 1Hz. As shown in Fig.3.6

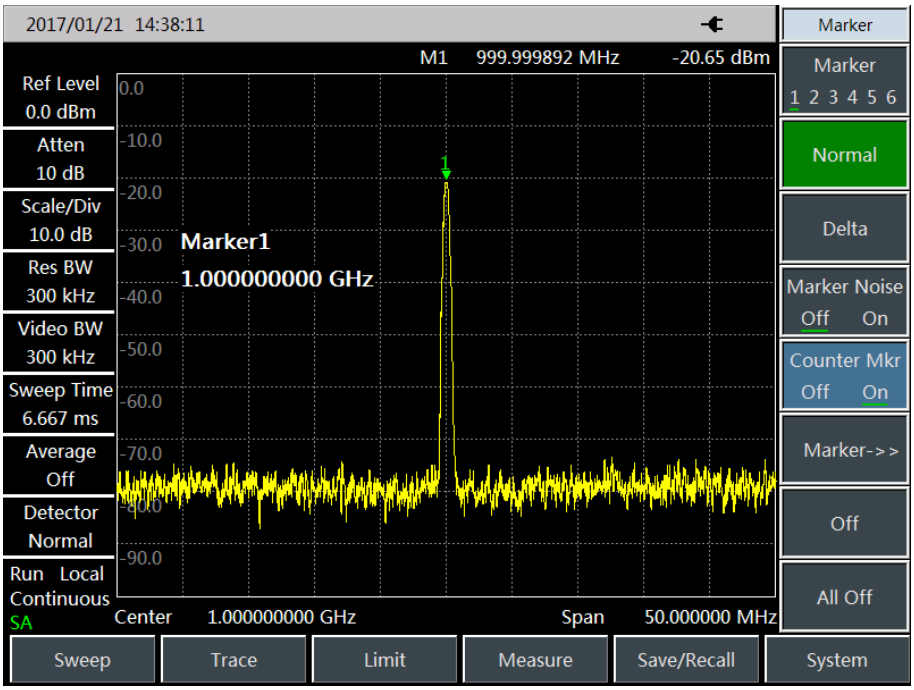

Fig. 3.6 Use marker function to improve frequency measurement accuracy

The marker count function can only measure continuous wave signal or discrete spectrum component with signal amplitude over -50 dBm and above the noise level of 30 dB.

d) Disable marker counter function

Press 【Marker】→ [Counter Mkr Off On] to disable the marker count function.

Caution	When executing frequency count function, if the sweep speed of the Spectrum Analyzer slows down, this is normal as the Spectrum Analyzer is taking some time for accurate positioning of signal and IF count in the background!

Caution	When executing frequency count function, to accurately measure the frequency, the tested signal generator should share the same time base with the Spectrum Analyzer!

3.3 How to measure small signals

The noise generated inside the Spectrum Analyzer determines the ability of the device to measure small signals. The following methods can be used to change the measurement setting, thus improving the measurement sensitivity of the Spectrum Analyzer.

3.3.1 Reduce RF attenuator decrement to measure small signals

The input attenuator affects the signal level of the input instrument. If the input signal is very close to the noise base, by reducing the decrement of the attenuator, the signal can be extracted from the noise.

Caution	The total power of all signals input in the device shall be ensured not to exceed +30dBm (1W)!

a) Reset the Spectrum Analyzer

Press 【Preset】 key to re-start the Spectrum Analyzer.

b) Set the center frequency, span and reference level

Set the frequency of external signal generator as 300MHz and amplitude as -80dBm and connect the RF output of the signal generator to the RF input of the Spectrum Analyzer. Set the center frequency of the Spectrum Analyzer. Press 【Freq】, select [Center Freq] and set the center frequency as 300MHz. Set [Span] and set the span as 5MHz. Press 【Ampt】, select [Ref Level] and set the reference level as -40dBm.

c) Move signal peak to center frequency (300MHz in this case)

Press 【Peak】, [Marker-> Center] to move signal peak to the center frequency.

d) Reduce bandwidth

Press 【BW】 and set the bandwidth as 1MHz. If necessary, repeat Step c) to ensure that the signal peak is the center frequency of the Spectrum Analyzer. Display as shown in Fig. 3.7

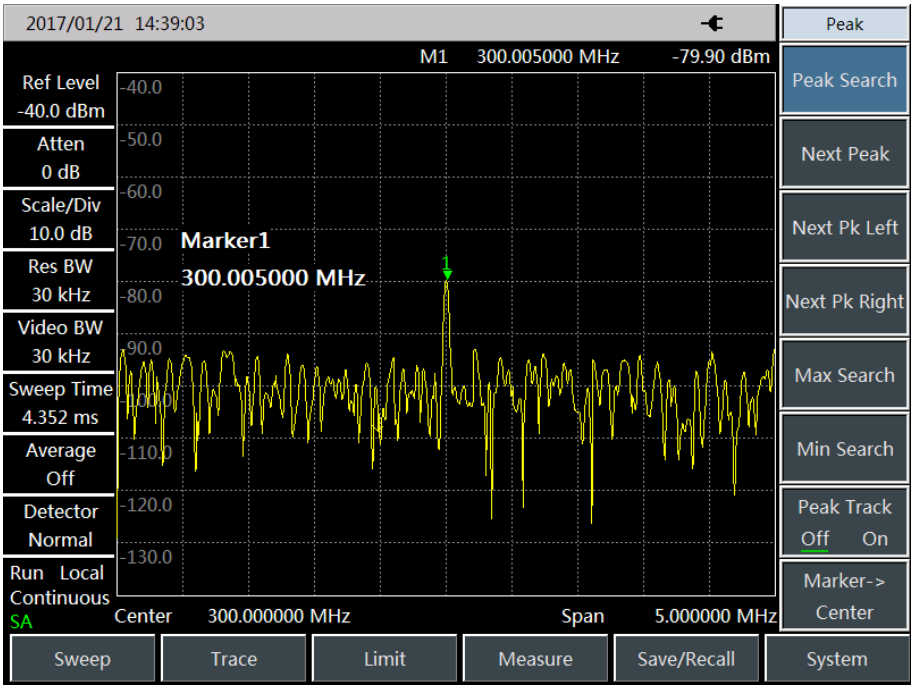

Fig.3.7 Small signal when pre-amplifier Off

e) Enable the pre-amplifier

On this basis, you can further enable the pre-amplifier by pressing 【Ampt】 →[Pre Amp Off On], as shown in Fig. 3.8.

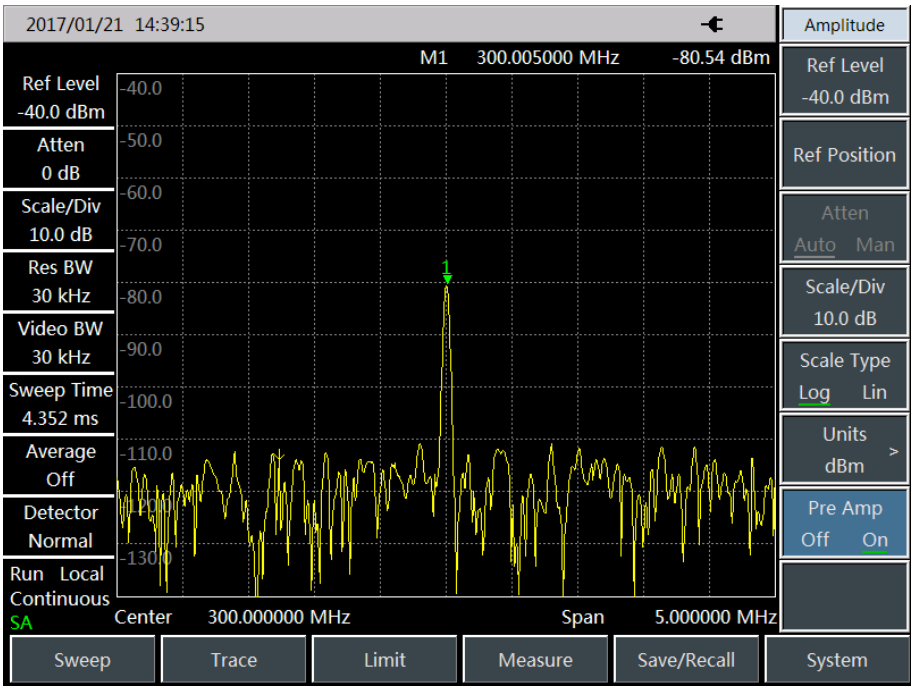

Fig. 3.8 Small signal when pre-amplifier On

Caution After finishing the test, please remember to increase the attenuation of the Spectrum Analyzer to protect the RF input port of the Spectrum Analyzer.

3.3.2 Reduce resolution bandwidth to measure small signals

The resolution bandwidth affects the internal noise base of the Spectrum Analyzer but will not affect the level of measured continuous wave signal. The relation between noise reduction and resolution bandwidth can be expressed with the following formula:

$$\Delta L = 10 \log \frac{BW_1}{BW_2}$$

Where: ΔL— is the noise amplitude change, unit: dB.

BW_1 and BW_2— are different resolution bandwidths, unit: Hz.

Therefore, when the frequency bandwidth is reduced by 10 times, the noise floor will be reduced by 10 dB.

a) Reset the Spectrum Analyzer

Press 【Preset】 key to re-start the Spectrum Analyzer.

b) Set the center frequency, span and reference level

Set the frequency of external signal generator as 300MHz and amplitude as -80dBm and connect the RF output of the signal generator to the RF input of the Spectrum Analyzer. Set the center frequency of the Spectrum Analyzer. Press 【Freq】, select [Center Freq] and set the center frequency as 300MHz. Set [Span] and set the span as 5MHz. Press 【Ampt】, select [Ref Level] and set the reference level as -40dBm.

c) Use the step key 【↓】 to reduce the resolution bandwidth

As shown in Fig.3.9, the noise floor reduces and therefore we can see the signal more clearly.

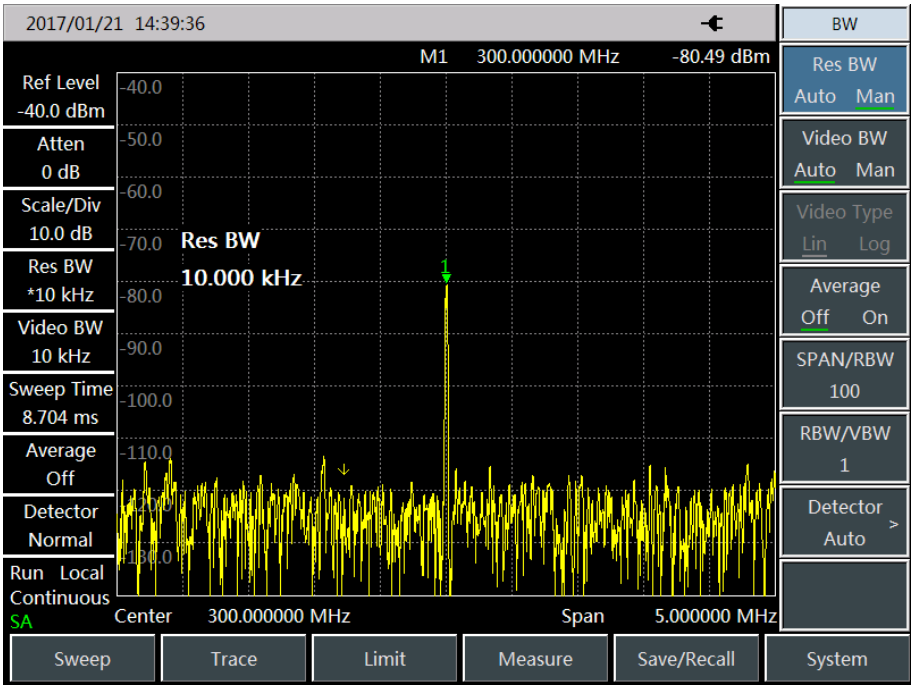

Fig. 3.9 Reduce resolution bandwidth to measure small signals

As the reduction of resolution bandwidth will increase the sweep time, in the 4024 Spectrum Analyzer, resolution bandwidth 1Hz~10MHz is realized by step 1-3-10. Proper resolution bandwidth should be selected to realize delicate compromise between sweep time and resolution bandwidth.

3.3.3 Measure small signals with average detector and increase in sweep time

When the noise base of the Spectrum Analyzer masks the small signal, the noise can be smoothed by using average detector or increasing sweep time, thus improving the signal visibility. Slower sweep speed can realize better average noise variance.

a) Reset the Spectrum Analyzer

Press 【Preset】 key to re-start the Spectrum Analyzer.

b) Set the center frequency, span and reference level

Set the frequency of external signal generator as 300MHz and amplitude as -80dBm and connect the RF output of the signal generator to the RF input of the Spectrum Analyzer. Set the center frequency of the Spectrum Analyzer. Press 【Freq】, select [Center Freq] and set the center frequency as 300MHz. Set [Span] and set the span as 5MHz. Press 【Ampt】, select [Ref Level] and set the reference level as -40dBm.

c) Select the detector mode of the Spectrum Analyzer as average detector

Press 【BW】, [Detector] and [Average] to select average detector mode. Now the information bar at the left of the screen will display “Detector *Average”, indicating the detector mode is manually set as average detector.

d) Increase the sweep time of Spectrum Analyzer

Press 【Sweep】, [Sweep Time Auto Man] and 【↑】 to increase the sweep time. By increasing the sweep time, there will be more time to average the data of each trail pixel dot.

3.3.4 Measure small signals with video average

In video average function, digital method is used to average the mean values of current trace point for sweeping and previous same trace position. Enable video average to set the number of video average. The video average gets different result from the average detector.

a) Reset the Spectrum Analyzer

Press 【Preset】 key to re-start the Spectrum Analyzer.

b) Set the center frequency, span and reference level

Set the frequency of external signal generator as 300MHz and amplitude as -80dBm and connect the RF output of the signal generator to the RF input of the Spectrum Analyzer. Set the center frequency of the Spectrum Analyzer. Press 【Freq】, select [Center Freq] and set the center frequency as 300MHz. Set [Span] and set the span as 5MHz. Press 【Ampt】, select [Ref Level] and set the reference level as -40dBm.

c) Enable the video average function

Press 【BW】 and [Average Off On]. With the averaging of track by the average program, the small signal will become clearer. The default number of average is 16.

d) Set the number of average as 25

Input number 25 by the numerical keypad on the front panel and press [ok], or 【Enter】 key on the soft menu, as shown in Fig. 3.10. The Remarks window at the left of the screen will display the number of average. Once the set number of average is reached, the Spectrum Analyzer will continue to perform average computation on this data basis. If you want to stop the measurement after the number of average is reached, you may use single sweep function. Press 【Sweep】 and [Sweep Cont Single]

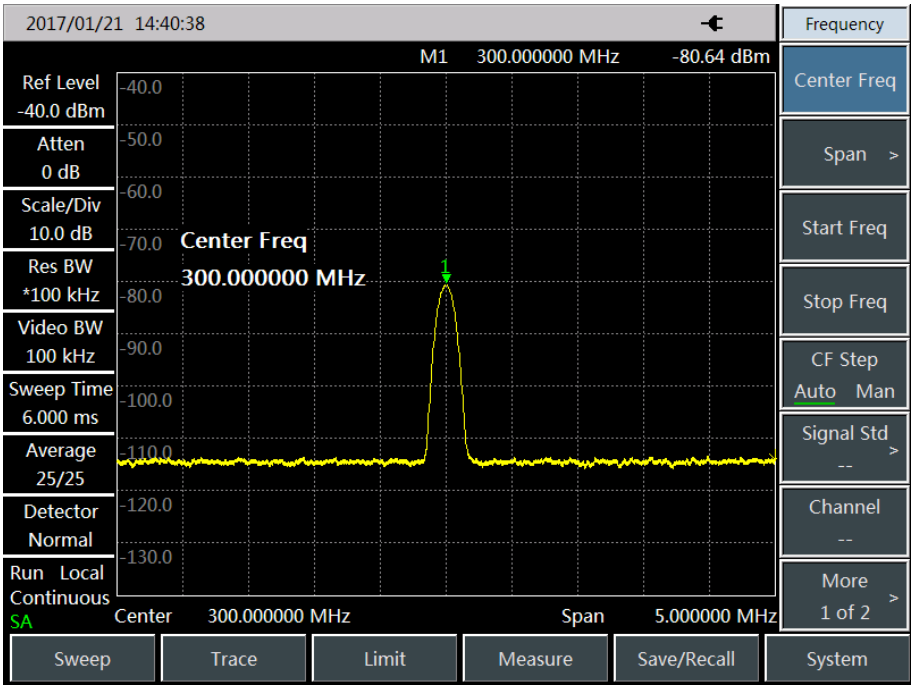

Fig. 3.10 Measure small signals with trace average

3.4 How to identify signal with closely spaced frequency

3.4.1 Resolution bandwidth description

Signal resolution is determined by the bandwidth of IF filter of the Spectrum Analyzer, i.e. the resolution bandwidth (RBW) When a signal passing through the IF filter, the Spectrum Analyzer uses the signal to sweep the band pass shape of the IF filter. When the Spectrum Analyzer receives two signals with the same amplitude and closely spaced frequency, the top of a band pass filter waveform swept by one signal will cover the other signal, and as a result, the two signals may look like one signal. If the two signals have different amplitudes but the frequency is still close, then the small signal may be covered up by the response of large signal.

3.4.2 Distinguish measurements of two signals with same amplitude

Generally, in order to distinguish two signals of same amplitude, the resolution bandwidth must be less than or equal to the frequency spacing of two signals. Taking distinguishing signals of same amplitude with a spacing of 100 kHz as an example, the user should select the resolution bandwidth of the Spectrum Analyzer as less than or equal to 100 kHz.

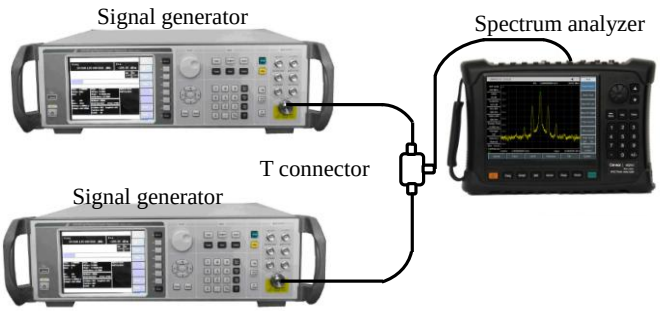

Fig. 3.11 Test instrument connection diagram of two input signals

a) Reset the Spectrum Analyzer

Press 【Preset】 key to re-start the Spectrum Analyzer.

b) Set signal generator

Use a T connector to connect the output of two signal generators to the RF input port of the Spectrum Analyzer, as shown in Fig. 3.11. Set the frequency of one signal generator as 300MHz and the other as 300.1MHz and set the output amplitude of two signal generators as -20dBm. Adjust the signal output amplitude of two signal generators and observe the signal displayed on the Spectrum Analyzer so that the amplitude of these two signals displayed on the Spectrum Analyzer is the same.

c) Set the center frequency, span and resolution bandwidth of the Spectrum Analyzer

Press 【Freq】, [Center Freq] to set the center frequency of the Spectrum Analyzer as 300MHz. Select [Span] to set the span as 2MHz. Press 【BW】, [RBW Auto Man] to set the resolution bandwidth as 300 kHz.

d) Observe the signal in the Spectrum Analyzer

On the display screen of the Spectrum Analyzer, only one signal peak can be seen and signals with close frequency spacing cannot be distinguished, as shown in Fig. 3.12.

e) Adjust resolution bandwidth

Press 【BW】, [RBW Auto Man] to adjust the resolution bandwidth as 100kHz so that the resolution bandwidth is less than or equal to the frequency spacing of two signals. It can be seen on the screen that the signal peak becomes flat, indicating there may be two signals.

f) Reduce video bandwidth

Press 【BW】, [VBW Auto Man] to adjust the video bandwidth as 10kHz. Two signals can be seen on the screen, as shown in Fig. 3.13. Use the knob or 【↓】 key on the front panel to continue to reduce the resolution bandwidth to show two signals more clearly.

For spectrum analyzer which the resolution bandwidth steps in the form of 1-3-10, to distinguish two signals with the frequency spacing of 200 kHz, the resolution bandwidth must be 100 kHz. As the primary filter on the spectrum analyzer is 300 kHz which is higher than the 200 kHz frequency spacing, the two signals cannot be distinguished.

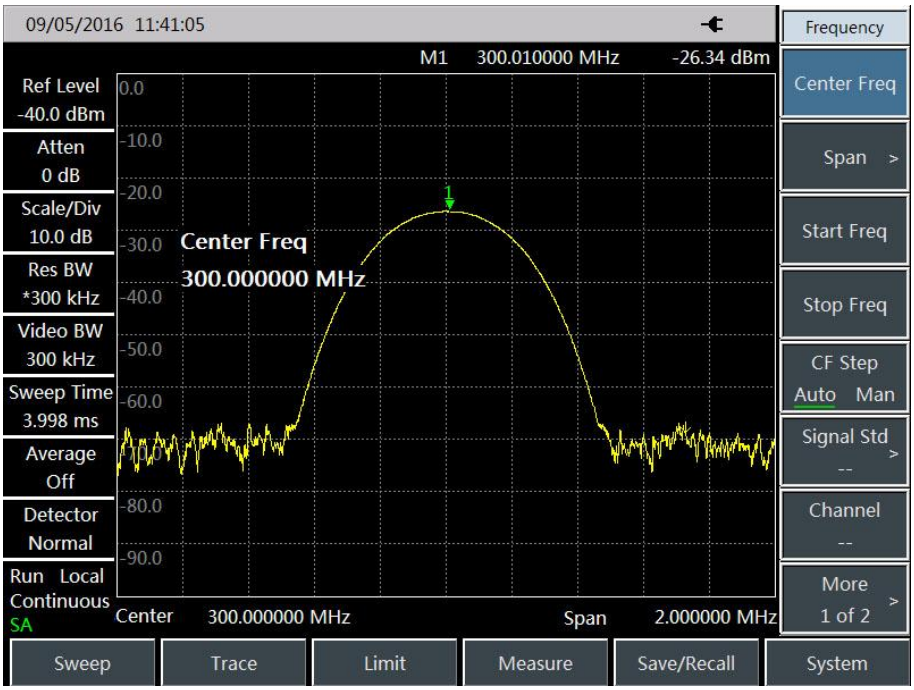

Fig. 3.12 Unable to distinguish two signals of same amplitude

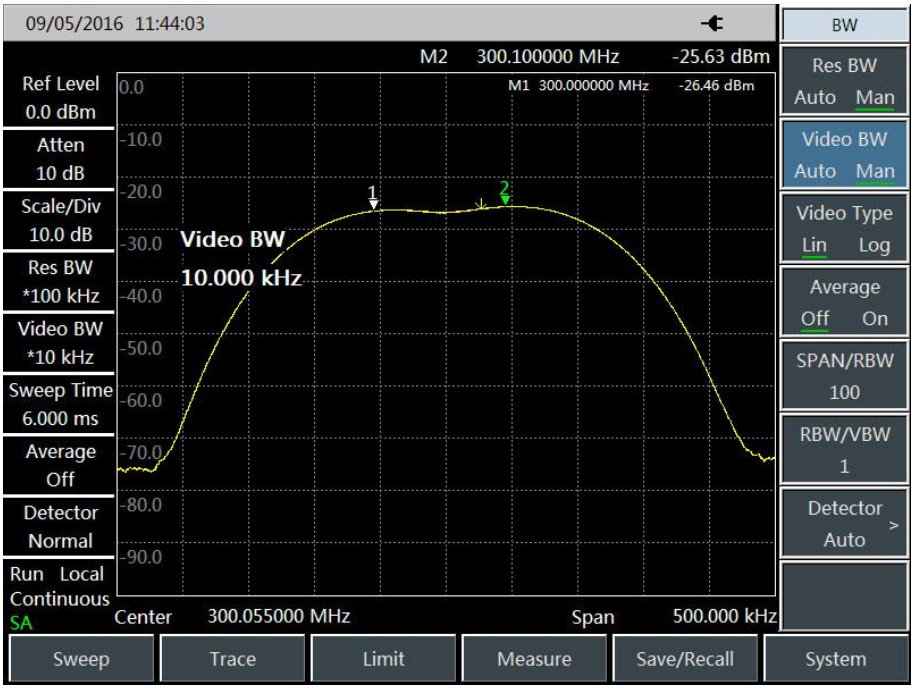

Fig. 3.13 Able to distinguish two signals of same amplitude

Chapter 4 Help

Generally, problems are caused by hardware, software or improper use. In case of any problem, check and save error information, analyze possible causes, and perform preliminary troubleshooting with reference to the method prescribed in “4.1 Fundamental inspection”. You can also contact our customer service center and provide the collected error information. We will assist you to solve the problem as soon as possible. Please refer to Section 4.2 for specific contact, or you can visit www.ceyear.com to inquire for the nearest technical support.

4.1 Basic inspections

You can inspect the 4024 as per the following instructions in the case of any failure in your device. Please contact us if the failure cannot be removed.

- ✧ If 4024 cannot be started when the Power key is pressed, check whether the power supply is normal, whether the adapter indicator is ON and whether the power supply battery is normal. If the above items are normal, the instrument failure may occur. In this case, contact us for repair.

- ✧ If you cannot enter the system or application after starting 4024, please press 【Preset】 key to restore the 4024 to a known state. If 4024 still cannot work properly, an instrument failure may occur. In this case, contact us for repair.

- ✧ Press 【System】-[More 1 of 2]-[System Info], and you can view details about self-inspection of relevant parts. If self-inspection fails, please press 【Preset】 key to restore the 4024 to a known state. If self-inspection still fails, an instrument failure may occur. In this case, contact us for repair.

- ✧ If there is something wrong with the response of 4024 touch screen, please press 【Preset】 key to restore the 4024 to a known state. If it still fails, an instrument failure may occur. In this case, contact us for repair.

- ✧ If the performance indicators of 4024 are abnormal, check whether the test tools and test environment conform to the requirements, whether the connector of the test port is damaged and whether the performance indicators of the calibration kit are normal. If the above items are normal, instrument failure may occur. In this case, contact us for repair.

- ✧ If 4024 fails to pass LAN communication, please first confirm the IP address setting of the

Spectrum Analyzer and check the yellow LED near the LAN interface at the back panel. If this indicator is off, check LAN cable and connection. If it still fails, an instrument failure may occur. In this case, contact us for repair.

4.2. Help information

4024 offers “Error Log” function. If a problem occurs, the instrument will automatically generate “Error Log” which will record abnormalities such as hardware, file loss and program control operation of the instrument. The log has three levels which are prompting, warning and error for assisting the analysis of instrument fault. The user can view the error log through 【System】 → [Page Down] → [Error Log].

Moreover, our customer service support center can offer help to users at any time. We have established sales points and offices all over China where we have appointed technical support personnel. Our technical support personnel can quickly arrive at the user site for technical communication, training, product maintenance and other services, providing all-around, convenient technical support and relevant services for you to use this instrument.

Tel: **+86-0532-86880796**

Website: **www.ceyear.com**

E-mail: **sales@ceyear.com**

Add.: **NO.98 Xiangjiang Rd., Qingdao City, China**

Zip code: **266555**

You can also visit www.ceyear.com where our QQ online customer service specialist will offer your online consultancy and help.

Our instruments have passed the inspection carried out by our quality and safety department and we offer an 18-month warranty period for our devices for long-term maintenance. For instrument within the warranty period, we offer maintenance service free of charge for any fault which is not resulted by manmade causes. For instrument which the warranty period expires, we will charge the service cost. Depending on specific fault, we will solve your problem through telephone or field maintenance.

Moreover, please contact us in time if there is anything wrong with the instrument. We will provide necessary help and return the device to the factory for maintenance if necessary. The user is not allowed to disassemble the instrument without authorization in order to avoid any damage to the internal circuit or component due to improper operation.

Warning	We shall not be held responsible for any damage to the instrument or personal injury caused by improper operation or rule-breaking operations!

4.3 Repair

You can contact us by telephone or fax if your 4024 has any problem. If it is confirmed that repair is required, please pack the instrument by the following steps:

1) Write a hard copy of file describing the failure phenomenon of this instrument and put it into the packing box with the Spectrum Analyzer.

2) Use the original packaging materials to pack the instrument properly to minimize damage.

3) Place pads properly in the four corners of the external packaging before the instrument is put into the external packaging;

4) 4) Seal the external packaging with adhesive tape and secure it with nylon tape;

5) Mark “Fragile! No touch! Handle with Care” on the packing case.

6) Ship this instrument as a precision instrument, and keep a copy of all the shipping documents.

Annex I: Technical index

Technical indexes of 4024 are subject to strict test when ex-factory. The user can test and verify the device based on the technical indexes in this manual. Main technical indexes of 4024 are shown in the table below.

Caution

4024 Spectrum Analyzer should be put under ambient temperature for 2 hours and warmed up for 30 minutes. The device will meet the performance indexes under given operating temperature scope. Supplementary features in the form of typical value are only for reference but not assessment.

Schedule 1 Technical index of 4024 Spectrum Analyzer

Inspection items	Indicator requirement	
Model	4024A/B/C/D/E/F/G	
Frequency range	4024A：9kHz~4GHz 4024C：9kHz~9GHz 4024E：9kHz~26.5GHz 4024G：9kHz~44GHz	4024B：9kHz~6.5GHz 4024D：9kHz~20GHz 4024F：9kHz~32GHz
Frequency readout accuracy	± (Frequency reading × frequency reference error + 2% × span + 10% × resolution bandwidth)	
Frequency reference	Frequency reference error: ± (Last calibration date × aging rate + temperature stability + calibration accuracy) Aging rate: $\pm 5\times 10^{-7}$/year Temperature stability: $\pm 1\times 10^{-7}$(-10℃ ~ 50℃, relative to 25±5℃) Initial calibration accuracy: $\pm 3\times 10^{-7}$ Note: The default time elapsed since the last calibration date is one year.	
Frequency span	Range: 100Hz～upper frequency limit of corresponding model or 0Hz Accuracy: ±2.0%	
Sweep time	Range: 10μs~600s (Zero Span) Accuracy: ±2.00% (Zero Span)	
Resolution Bandwidth	Range: 1Hz~10MHz (step by 1-3)	
Video Bandwidth	Range: 1Hz~10MHz (step by 1-3)	
Single-sideband phase noise (Carrier wave 1GHz, 20℃ ~30℃)	4024A/B/C： ≤-108dBc/Hz@10kHz Offset ≤-112dBc/Hz@100kHz Offset ≤-118dBc/Hz@1MHz Offset ≤-129dBc/Hz@10MHz Offset	4024D/E/F/G： ≤-102dBm/Hz@10kHz Offset ≤-106dBm/Hz@100kHz Offset ≤-111dBm/Hz@1MHz Offset ≤-123dBm/Hz@10MHz Offset
Display average noise level (50Ω load at the input end, 0dB input attenuation, average detector mode, logarithmic Video Type,	Preamp off: ≤-138dBm（10MHz~20GHz） ≤-127dBm（32GHz~40GHz） Preamp on: ≤-157dBm（10MHz~20GHz）	≤-135dBm（20GHz~32GHz） ≤-120dBm（40GHz~44GHz） ≤-154dBm（20GHz~32GHz）

RBW normalization to 1Hz, 20-30℃, tracking Generator off)	≤-148dBm（32GHz~40GHz） ≤-140dBm（40GHz~44GHz）	
Second harmonic distortion (attenuation: 0dB; input signal: -30dBm)	4024A/B/C： <-65dBc	4024D/E/F/G： <-60dBc
3-order intermodulation distortion (-15dBm double-tone signal, 100kHz spacing, 0dB attenuation, pre-amplifier off)	4024A/B/C： ≥+10dBm 50MHz~9GHz	4024D/E/F/G： ≥+7dBm 50MHz~4GHz ≥+6dBm 4GHz~13GHz ≥+6dBm 13GHz~44GHz
1dB gain compression (Double-tone test, 10MHz signal spacing)	4024A/B/C： ≥+2dBm 50MHz~9GHz	4024D/E/F/G： ≥-2dBm 50MHz~4GHz ≥-3dBm 4GHz~13GHz ≥-3dBm 13GHz~44GHz
Image response, multiple response and out-of-band response. (mixer level: -10dBm)	≤ -65dBc 10MHz~20GHz ≤ -60dBc 20GHz~44GHz	
Residual response (RF input match, 0dB attenuation, tracking Generator off)	4024A/B/C： (exceptional frequency: 3200MHz) Preamp on: ≤-95dBm (10MHz～9GHz) Preamp off: ≤-82dBm (10MHz～9GHz)	4024D/E/F/G： (exceptional frequency: 3200MHz) Preamp on: ≤-100dBm (10MHz～20GHz) ≤-95dBm (20GHz～44GHz) Preamp off: ≤-90dBm (10MHz～13GHz) ≤-85dBm (13GHz～20GHz) ≤-80dBm (20GHz～44GHz)
Scale fidelity	±1.00dB	
Input attenuator	4024A/B/C: Scope of attenuation 0dB~30dB, 5dB step Conversion uncertainty: ±1.20dB	4024D/E/F/G: Scope of attenuation 0dB~50dB, 10dB step Conversion uncertainty: ±1.20dB
Reference level	Range: logarithmic type: -120dBm~+30dBm 1dB step linear type: 22.36uV~7.07 V，0.1% step Conversion uncertainty: ±1.20dB (reference level 0dBm~-60dBm)	
Display scale	Logarithm scale 0.1~10dB per scale, 0.1dB step minimum (10-scale display) Linear scale: 10 scale display Scale unit: V, A, W, dBm, dBW, dBV, dBmV, dBuV, dBA, dBmA, dBuA	
Total level uncertainty (frequency range 10MHz~40GHz, input signal 0~-50dBm, all settings are auto couple, 20℃ ~30℃)	±1.80dB 10MHz～13GHz ±2.30dB 13GHz～40GHz	
Maximum safety input level	4024A/B/C: +27dBm, typical value (⩾ 10dB attenuation, pre-amplifier off)	4024D/E/F/G: +30dBm, typical value (⩾ 10dB attenuation, pre-amplifier off)

Tracking Generator (Option)	Frequency Range	4024A：100kHz~4GHz 4024B：100kHz~6.5GHz 4024C：100kHz~9GHz
	Amplitude Range	0dBm~-40dBm
	Minimum Amplitude Step	0.1dB
	Amplitude Accuracy	±2.50dB（Frequency Range 10MHz~9GHz, Amplitude Range 0dBm~-40dBm ,20℃~30℃）
	Sideband Noise	1GHz frequency point，0dBm output: ≤-90dBc/Hz@10kHz frequency offset ≤-95dBc/Hz@100kHz frequency offset ≤-110dBc/Hz@1MHz frequency offset

Annex II: List of accessories/options

Schedule 2 List of accessories/options of 4024 Spectrum Analyzer

Affiliation	Number of accessory/option	Accessory/option
Attachment	---	Power cable 1 piece
	---	Power adapter 1 piece
	---	Rechargeable Li-ion battery 1 piece
	---	USB interface cable 1 piece
	---	Quick Start Guide of 4024 Spectrum Analyzer 1 piece
	---	Certificate of Conformity 1 piece
Options	4024-001	English version options
	4024-002	User Manual Chinese Version
	4024-003	User Manual English Version
	4024-004	Programming Manual Chinese Version
	4024-005	Programming Manual English Version
	4024-006	Power adapter
	4024-007	Rechargeable Li-ion battery
	4024-008	Purple Cat5e network cable
	4024-009	MicroSD card
	4024-010	GPS antenna
	4024-011	USB Power Meter Function Options
	4024-012	87230 USB continuous wave power probe
	4024-013	87231 USB continuous wave power probe
	4024-014	87232 USB continuous wave power probe
	4024-015	87233 USB continuous wave power probe
	4024-016	Interference Analyzer Function Options
	4024-017	AM-FM-PM Analyzer Function Options
	4024-018	Channel Scanner Function Options
	4024-019	List Scanner Function Options
	4024-020	Zero Span IF Output

	4024-021	89101A Antenna
	4024-022	89101B Antenna
	4024-023	89101C Antenna
	4024-024	89101D Antenna
	4024-025	89401 Antenna Amplifier
	4024-026	89901 Antenna
	4024-027	89902 Antenna
	4024-028	Functional backpack
	4024-029	Shoulder pack for carrying
	4024-030	Safety instrument carrying case
	4024-031	89901 Antenna handle
	4024-032	89902 Antenna handle
	4024-033	Signal Analyzer
	4024-034	Field Strength Option
	4024-035	4GHz Tracking Generator
	4024-036	6.5GHz Tracking Generator
	4024-037	9GHz Tracking Generator