SER Series EMI Receiver

User Manual

SER300/SER2000/SER3600

Saluki Technology Inc.

Security requirements

General Safety Summary

Know the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid possible dangers, please use this product in accordance with the regulations.

Use the correct power cord

Only use the power cord approved for this product in your country.

Ground the product

This product is grounded through the protective earth of the power cable. To avoid electric shock, before connecting any input or output terminals of this product, please ensure that the grounding terminal of the power cable of this product is reliably connected to the ground terminal of the protective connection.

Properly connect the probe

Proper use of the probe, the ground wire of the probe is the same as the ground, do not connect the ground wire to high voltage.

View All Terminal Ratings

In order to avoid fire and the impact of excessive current, please check all the ratings and marking instructions on the product. Please refer to the product manual for the detailed information of the rating when connecting the product.

Use suitable overvoltage protection

Make sure that no overvoltage, such as that caused by lightning, reaches the product. Otherwise, the operator may suffer from electric shock again.

Do not open the cover to operate

Do not operate this product with the instrument case open.

Do not insert foreign objects into the exhaust vent of the fan

Do not insert foreign objects into the air outlet of the fan to avoid damage to the instrument.

Use the proper fuse

Only use fuses with specifications specified for this product.

Avoid circuit exposure

Do not touch exposed connections and components when power is on.

Maintain proper ventilation

Poor ventilation can cause the temperature of the instrument to rise, which can cause damage to the instrument. Keep well ventilated when in use, and check the vents and fans regularly.

Do not operate in wet environment

To avoid the risk of short circuit or electric shock inside the instrument, do not operate the instrument in wet environment.

Please keep the product surface clean and dry

To avoid dust and moisture in the air from affecting the performance of the instrument, please keep the surface of the product clean and dry.

Anti-static protection

Static electricity will cause damage to the instrument, and the test may be performed in an anti-static area. Before connecting a cable to an instrument, briefly ground its inner and outer conductors to discharge static electricity.

Pay attention to handling safety

In order to prevent the instrument from slipping during transportation and causing damage to the buttons, knobs or interfaces on the panel of the instrument, please pay attention to the safety of transportation.

General inspection

Check shipping packaging

If the shipping packaging is damaged, keep the damaged packaging and shockproof material until the shipment has been fully inspected.

If the instrument is damaged due to transportation, the sender and the carrier will contact each other for compensation. Saluki does not provide free repair and replacement.

Check the whole machine

If there is mechanical damage or missing, or the instrument fails the electrical performance test. Please contact Saluki Technology Inc. or your distributor.

Check the accessories

Please check the accompanying accessories according to the packing list. If there is any loss or missing, please contact Saluki Technology Inc.

Power connection

Please use the power cord provided in the accessories to connect the spectrum analyzer to the AC power supply.

This instrument supports 100V-24V, 45-440Hz AC power supply. When the spectrum analyzer is connected to the AC power supply through the power cord, the instrument automatically adjusts to the correct voltage range, no need to manually select the voltage range.

⚠ **Notice:**
To avoid electric shock, make sure the instrument is properly grounded.

Maintenance and Cleaning

Maintainance

Do not place the instrument in a place exposed to sunlight and humidity for a long time.

Cleaning

Please clean the instrument frequently according to usage conditions.

Methods as below:

1. Disconnect the power
2.Wipe the exterior of the instrument with a soft cloth soaked in mild detergent or water. Be careful not to scratch the LCD display.

⚠ **Notice:**
Do not let any corrosive liquid get on the instrument, so as not to damage the instrument.

Overview

SER series is a small size, light weight, highly integrated portable EMI receiver. It has an easy-to-operate keyboard layout, a high-definition color LCD display, and rich remote communication interfaces, and can be widely used in many fields such as education science, enterprise research and development, and industrial production.

Key features:

The frequency range is 1kHz—300MHz/2GHz/3.6GHz

There are multiple detection functions

There are various EMI measurement standards

Best Sensitivity-145dBm

8.4-inch bright TFT LCD display

Universal USB, LAN for easy control

Weight less than 6.5kg

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1. Receiver Introduction

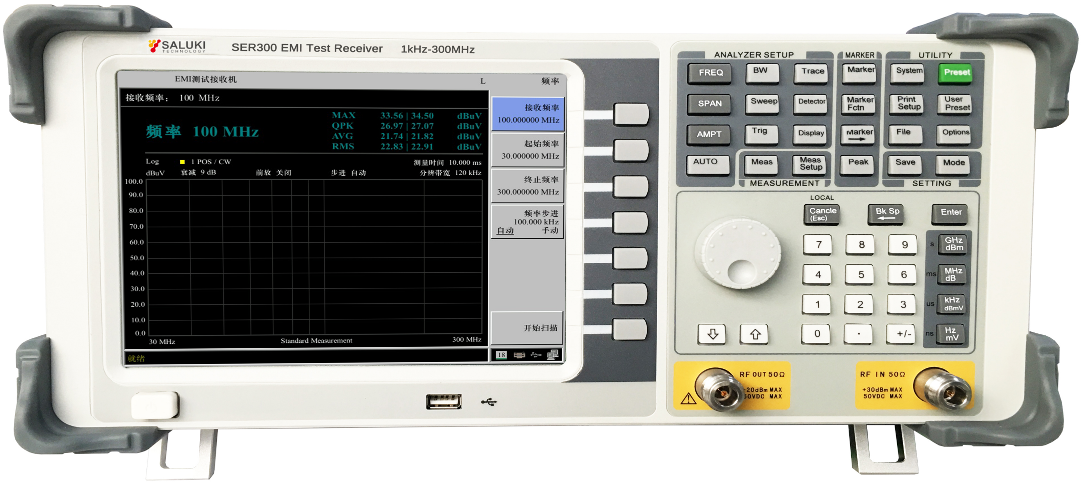


Figure 1.1 EMI Receiver

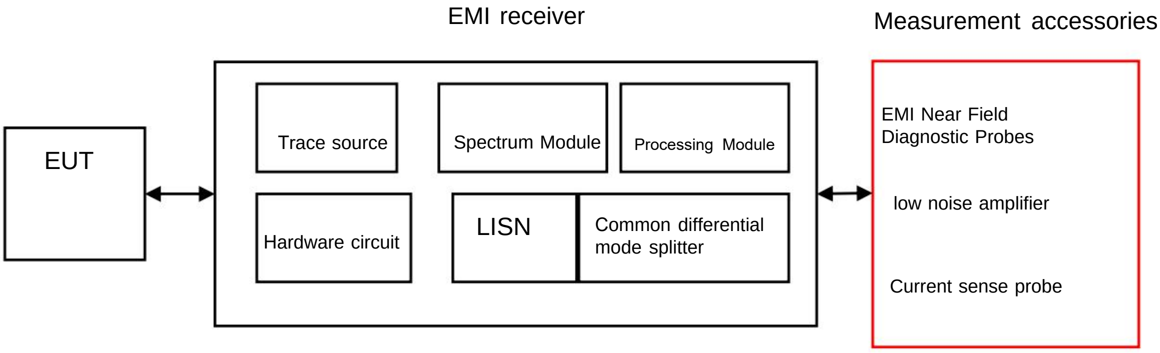


Figure 1.2 EMI receiver measurement block diagram

1.1 Front panel

The EMI receiver provides the user with a simple and well-defined front panel for basic operation. panel It includes a knob and function keys, and the function of the knob is similar to that of other instruments. There are 7 function soft keys on the right side of the display, keys, through which different options of the current menu can be set. Other keys are function keys, through them, it is possible to enter different function menus or directly obtain specific function applications.

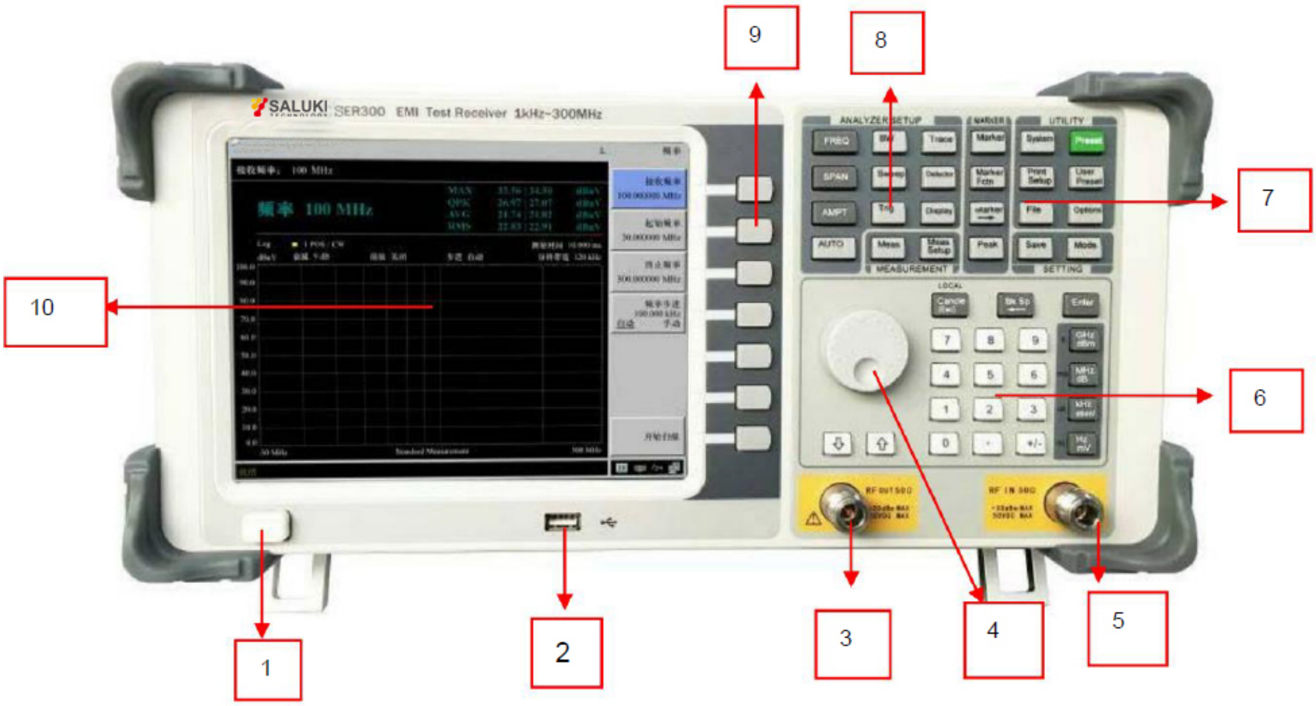


Figure 1.3 Front panel of ER series EMI receiver

1. Power switch
2. USB interface
3. Tracking source output terminal
4. Knob
5. RF input terminal
6. parameter input area
7. Cursor keypad
8. System function area
9. soft menu setting area
10. display screen

1.2 Rear panel

Figure 1.4 ER series EMI receiver rear panel

1.RS232 interface

2.LAN interface

3.10MHz reference signal input/output connector

4.VGA interface

5.USB interface

6.headphone jack, audio output

7.EMI receiver power input socket

1.3 Button control area

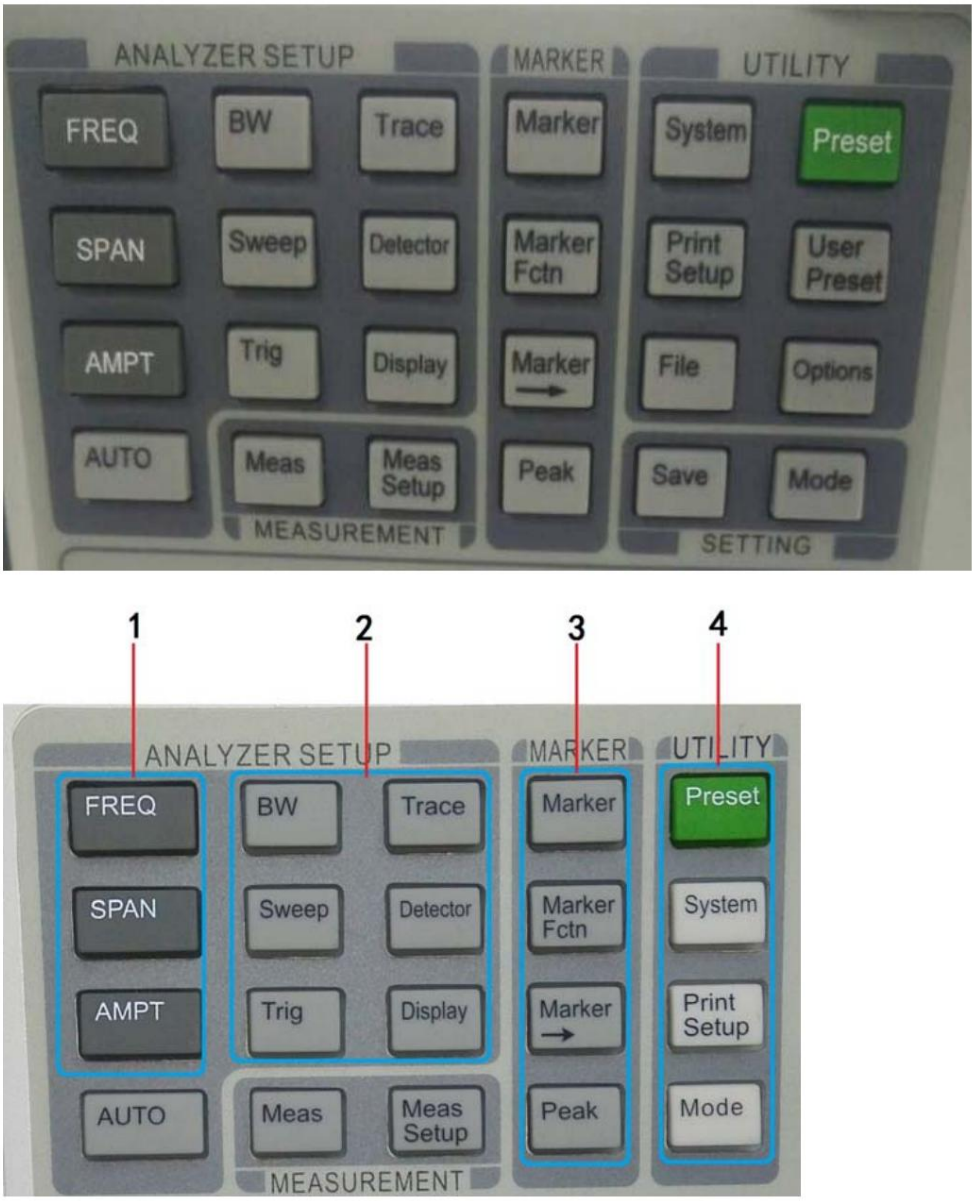


Figure 1.5 Explanation diagram of button and knob control area

1.Common function key area

2.Parameter setting keypad

3.Cursor measurement function key area

4.System function key area

1.4 Detailed Description of Function Keys

Function key detailed table

function key	Functional positioning	Function details

Analyzer Setup Keypad		
【FREQ】	Frequency parameter setting	center frequency, start frequency, stop frequency, frequency step (from manual/manual), frequency offset (default 0Hz), frequency reference (internal internal/external), LF channel (on/off)
【SPAN】	Span setting	Span (automatic/manual), full span, zero span, previous span
【AMPT】	Amplitude setting	Reference level, attenuator, scale/div (default 10dB), scale Type (Linear/Logarithmic), Reference Bias (0dB), Reference units (dBm, dBuV, dBpW, dBmW, dBmV, W, V), pre-amplification (automatic/manual)
【AUTO】	Auto Search	Automatically test RF IN 50ÿ input RF signal
【BW】	Resolution Bandwidth Set	resolution bandwidth (auto/manual), resolution step (default/continuous continued), video bandwidth (on/off)
【Sweep】	Scanning Time Set	the scanning time (automatic/manual), single scanning, continuous scanning, Scan point settings
【Trig】	Trigger mode setting	automatic, video (-20.00dB), external (rising edge/falling edge)
【Trace】	Trace settings	Trace (1, 2, 3), Refresh, Max Hold, Min Hold, Blanking, viewing, trace calculation
【Detector】	Detection mode	setting automatic, normal, positive peak, negative peak, sampling
【Display】	Display settings	Full screen display, window scaling (on/off), display lines -25dBm (on/off), grid (on/off), amplitude Ruler (on/off), label (on/off)

Measurement function keypad		
【Meas】	Measurement function settings	time spectrum (on/off), adjacent channel power (on/off), Channel power (on/off), occupied bandwidth (on/off)
【Meas Setup】	Measuring settings	Default state, cannot be replaced
Frequency standard function key area		
【Marker】	Frequency marker indication setting	key frequency marker (1, 2, 3, 4, 5), trace (1, 2, 3), normal, Difference, Off, All Off, Marker List (On/Off)
【Marker Fctn】	Frequency marker function key	Function off, NdB3.00 (on/off), frequency standard noise (on on, off), frequency counting (on/off)
【Marker → 】	Frequency marker indication change key	Frequency marker center frequency, frequency marker frequency step, frequency marker start Frequency, Frequency StandardÿStop Frequency, Frequency StandardÿReference Level
【Peak】	Peak measurement key	Maximum search, next peak, left peak, right peak, minimum Value search, peak search (on/off)
System Function Keypad		
【Preset】	System reset	
【System】	system setting key	System information, configuration I/O, power on/reset, date/time, Backlight adjustment, user calibration, system service, screen refresh (on on/off), 75ÿ impedance compensation 0.00dB (on/off) storage (screenshots, trace data, user status)
【Print Setep】	Print setup	paper size, printing language, printing type (black and white/color), Orientation (Landscape/Portrait)

【Mode】	mode selection key	EMI receivers, spectrum analyzers, network measurements, filter simulations real

1.5 Parameter input interface

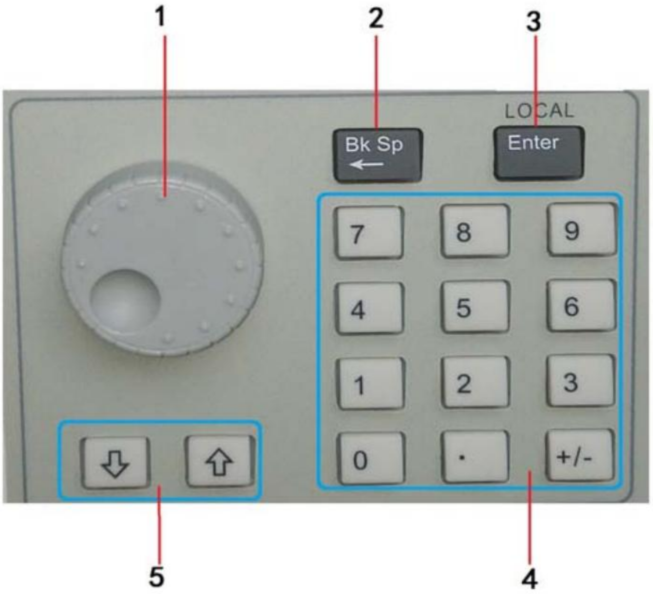


Figure 1.6 Explanation diagram of parameter input interface

1.Knob	2.Backspace key
3.Confirm key	4.Number keypad
5.Arrow keys	

The 3 modes **of the user interface** are as follows:

1) Spectrum analyzer user interface

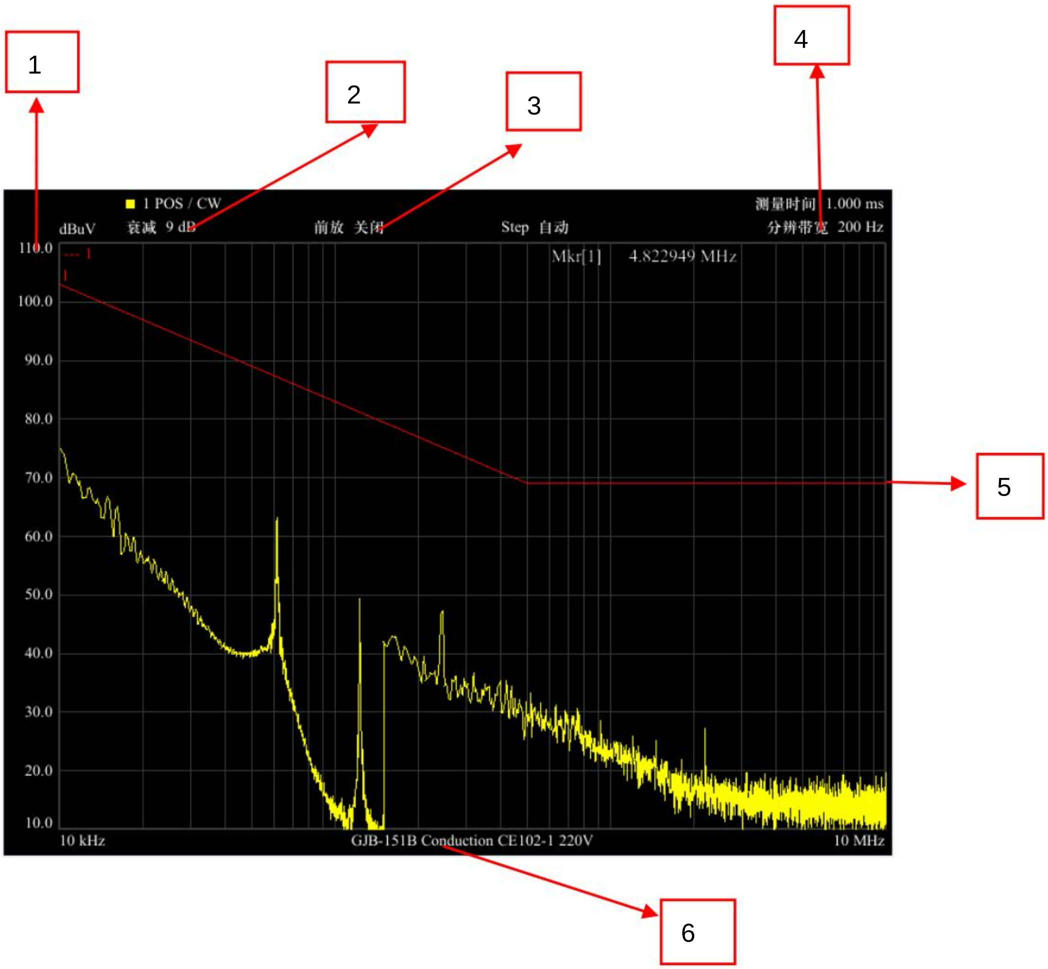
2) EMI receiver user interface

3) Network measurement interface

2. Introduction to EMI Receiver

2.1 EMI Receiver

2.1.1 EMI receiver instrument interface



1 POS / CW

衰减 9 dB

前放 关闭

Step 自动

测量时间 1.000 ms

分辨带宽 200 Hz

Mkr[1] 4.822949 MHz

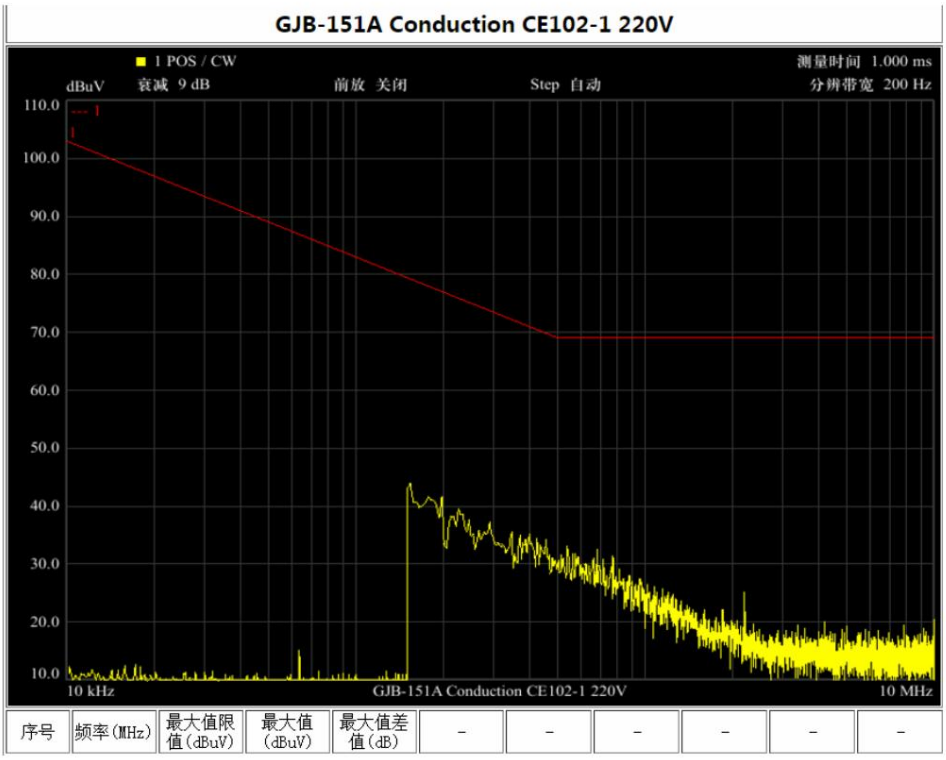
GJB-151B Conduction CE102-1 220V

Figure 2.2 EMI receiver user interface

NO.	Name	Description	NO.	Name	Description

1	Amplitude sitting mark	Display amplitude value range	4	resolution band Width	Display current BW value
2	Amplitude sheet bit	Single display of the current amplitude value bit	5	Standard baseline	Show standard limit curves
3	Attenuation value	Displays the value of the attenuator	6	Measurement Item	Displays the current measurement item

Test report style:



序号	频率(MHz)	最大值限值(dBuV)	最大值(dBuV)	最大值差值(dB)	-	-	-	-	-	-

Figure 2.3 EMI receiver CE102 operation interface

2.1.2 EMI Receiver Test Standards

SN.	Standard	Remark
1	GJB151A	CE102 (28V, 115V, 220V) RE102 (RE102-1, RE102-2, RE102-3)
2	GJB151B	CE102 (28V, 115V, 220V) RE102 (ships, submarines, air, ground)
3	GB17743	GB17743 conduction, GB17743 radiation
4	GB9254	Conduction: GB9254A, GB9254B Radiation: GB9254A, GB9254B
5	EN55014	Conduction: power terminal, below 700W, 700W-1000W, above 1000W Harassment: power terminal, below 700W, 700W-1000W, above 1000W
6	EN55015	Conduction: power terminal, below 700W, 700W-1000W, above 1000W Harassment: power terminal, below 700W, 700W-1000W, above 1000W
7	FCC Part 15B	FCC conduction
8	JAPAN lamps	Conduit, Harassment
9	JAPAN home appliance	conduction: power terminal, below 700W, 700W-1000W, above 1000W Harassment: power terminal, below 700W, 700W-1000W, above 1000W
10	GB4824	Conduction: ≤20kVA, >20kVA;
11	EN55011	Conduction

2.1.3 Common EMI Receiver Operations

2.2.3.1 Common parameter settings

Common parameters of the receiver include: start frequency, stop frequency, attenuation, preamplification, dynamic range, bandwidth,

Measurement time, scan mode, etc.

【Start Frequency】

Operation steps: [FREQ]→[Start Frequency], the default is 30MHz, after adjustment, the frequency spectrum displays the area frequency

rate range auto-adjust

【Stop frequency】

Operation steps: [FREQ]→[Stop Frequency], the default is 1GHz, after adjustment, the spectrum displays the regional frequency

auto range adjustment

【attenuation】

Operation steps: [AMPT] → [Attenuation], the default is 9dB, the range of change is 0~39dB, 3dB step

【Pre-amplification】

Operation steps: [AMPT] → [Pre-amplification], the default is off, and the gain can be increased by 20dB after opening

【Dynamic Range】

The spectrum display area displays the range, which can display 100dB dynamic range by default, and the minimum level is 0dBuV.

Operation steps: [AMPT] → [level range], the default is 100dB, and the adjustable range is 10dB~200dB

[AMPT] → [Minimum level], default 0dBuV , Adjustable range

-93dBuv~297dBuV

After the setting is completed, the dynamic range of the spectrum display area is automatically updated.

【bandwidth】

Operation steps: [BW] → [Resolution Bandwidth] Receiver mode provides

10Hz/100Hz/200Hz/1kHz/9kHz/10kHz/100kHz/120kHz/1MHz total 9 file resolution

Bandwidth, you can cycle through the up and down arrow keys, and the menu area displays commonly used

200Hz/9kHz/120kHz/1MHz four-speed resolution bandwidth

【measure time】

Receiver measurement time range: 100us~100s

Operation steps: 【Meas】→【Measuring time】, the default is 10ms

【Scan mode】

Operation steps: [Sweep] → [List Sweep] / [Current Settings]

[List Scan] mode provides 10 independent measurement intervals, and each interval can be set for different measurements

Parameters, executed in interval order during measurement

【Current setting】Quick measurement, equivalent to an interval measurement

2.2.3.2 Fixed frequency measurement

Fixed frequency measurements are automatically activated when not scanning, and automatically hide after starting a scan or measurement

接收频率： 100 MHz

频率 100 MHz

MAX 47.56 | 48.46 dBuV
QPK -82.19 | -78.67 dBuV
AVG 34.08 | 34.10 dBuV
RMS 35.17 | 35.18 dBuV

The fixed frequency is determined by the receiving frequency, and the maximum value (MAX), quasi-peak value (QPK),

Average value (AVG), effective value (RMS) four kinds of detection results display, each detection value has a maximum hold

Hold function in dBuV. As shown in the figure above, the maximum value (MAX) detection, the current real-time value is 47.56dBuV,

The historical maximum is 48.46dBuV. After the receiving frequency is modified, the maximum hold value is automatically reset.

2.2.3.3 Fast scan/measurement

EMI receiver quick measurement is divided into single-segment measurement and multi-segment measurement.

Single-segment measurement: scan with the parameters currently set by the receiver. The scanning step is automatic according to the IF bandwidth

The start and end frequency can be set by [FREQ] menu; the resolution bandwidth can be set by [BW]

Certainly.

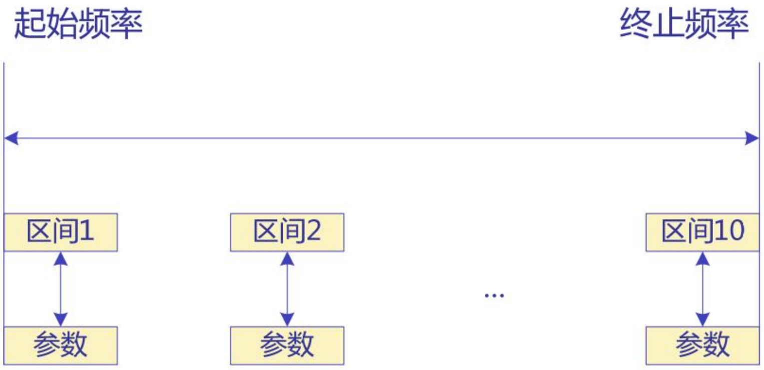
Operation steps, first [Sweep] → [Current Settings] → [Start Scanning], and then set other

Related parameters, such as frequency [FREQ], amplitude [AMPT], bandwidth [BW], measurement time [Meas],

Trace [Trace], detector [Detector].

ÿ Multi-segment measurement: The receiver mode has built-in 10 interval measurements with adjustable steps, and each interval can be carried out

Measurement of different parameters



Interval parameters can be set independently, up to 10 intervals can be set, after the setting is completed, click 【Sweep】→【Column】

Table scan] → [Start scan] to complete multi-segment scan.

Default interval 1 parameter

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Scan start	1KHz				
Scan termination	300MHz				

step	40kHz				
Resolution bandwidth	120kHz				
Measurement time	100us				
Attenuation	9dB				
Preamp	off				

Description of parameters in the above figure: start frequency 1kHz, stop frequency 300MHz, minimum level 0dBuV, level

Display range 100dB, continuous scanning. Specific parameter input is mainly by means of up and down direction keys and pulse rotation

button to switch and input. in,

Scan start: set the scan frequency at the start of the interval, and modify it by inputting the number keys

Scanning termination: set interval termination scanning frequency, number key input modification

Stepping: currently in automatic mode, without modification, it will be automatically assigned by the system

Resolution bandwidth: 6dB resolution bandwidth selection, switch by [Enter]

Measuring time: scanning time of stepping frequency, number key input modification

Attenuation: 0~39dB input range, 3dB step, can be modified by numeric key input, or by [Enter]

to switch

Pre-amp: Built-in 20dB amplifier switch, open when measuring small signals

2.1.3.4 Standard measurements

(1) EMI receiver system entry steps

Take the GJB151B CE102 test as an example:

[Mode]→[EMI]→[Meas]→[Standard]→[CE102]→[220V]

NOTE: Follow these steps for other standard inputs.

(2) Standard curve marking and viewing:

[Stop scanning]→[FREQ][Receive frequency change (check mark)][Start scanning]

(3) Limit line editing: You can edit the measurement standard limit line by yourself

[Meas Setup][New/Edit]Name]Value[Add/Insert]Save

(4) Compensation setting: You can input antenna coefficient, near-field probe calibration coefficient, LISN insertion loss, etc.

[Mode]→[EMI]→[Meas]→[Compensation]

2.2 Network measurement

introduce:

Network measurement is a port measurement, using the signal source and receiving source inside the instrument to complete the port connection test,

Specifically, it can directly test the filter, the insertion loss value of the cable, the magnification of the amplifier, etc.

Enter the operation interface:

[Mode]→[Network Measurement]→[FREQ]→[Output Power]→[Scan Points]

Use the output terminal RF OUT 50[input and RF OUT 50] terminals to make a test. See 3.3 for detailed operation

section introduction.

3. EMI Receiver Measurements

3.1 Measurement items under EMI state

3.1.1 Main functions

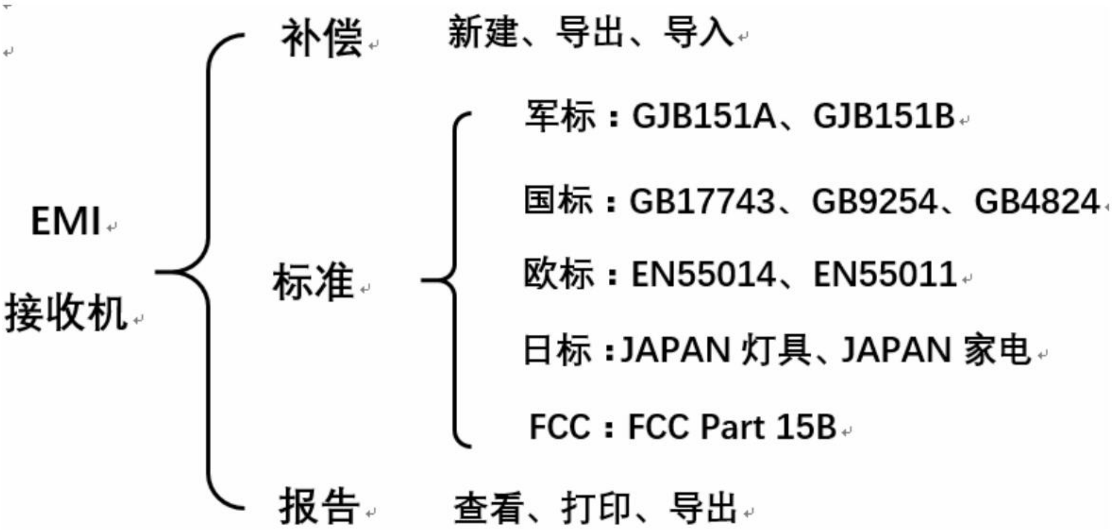
1. Able to use the instrument to check military standards (GJB151A, GJB151B), national standards (GB17743, GB9254, GB4824),

European standard (EN55014, EN55011), FCC (FCC Part 15B), Japanese standard (JAPAN lamps, JAPAN home

Electricity) and other standards for testing.

2. Ability to self-edit measurement standard limits

3.1.2 EMI receiver menu structure



3.1.3 Standard tests under EMI receiver

3.2.3.1 GJB151A conducted emission test

In this test example, the GJB151A CE102 220V test is used as an example. After setting up the experimental platform, directly

For the conduction data test of EUT, the CE102 conduction emission test platform is shown in the figure below:

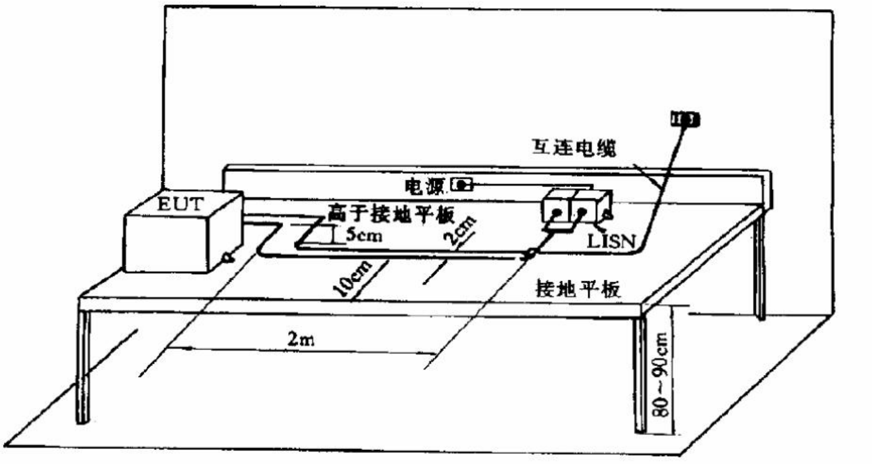


Figure 3.20 CE102 test block diagram and specifications

Figure 3.11 Build CE102 test platform

Figure 3.12 Specific Field Test Connection Diagram

Line Impedance Stabilization Network (LISN) Instructions for Use WARNING

1. When using the power supply impedance to stabilize the network, the ground terminal on the rear panel of the instrument must be connected to the reference ground.

   Reliable connection.

2. **Only when the equipment under test (EUT) works normally, the monitoring of the power supply impedance stabilization network**

   Connect the terminal to the input terminal of the spectrum analyzer. In order to protect the safety of the test equipment, avoid the signal too

   If it is too strong and burns out the receiver, a 20dB attenuator should be added to the receiver input.

3. When the monitoring terminal of the source impedance stabilization network (LISN) is connected to the receiver, do not

   Power off the device under test! Because when the current is cut off suddenly, the 50μH inductance in LISN

   may cause overvoltage spikes and damage the receiver.

4. When the monitoring end of the power supply impedance stabilization network is not connected to the receiver, it should be connected to a monitoring end

   50Ω load.

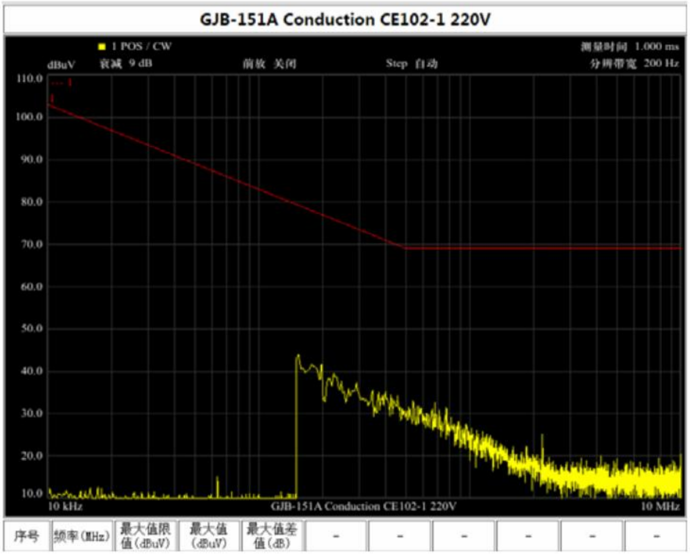
5. After each measurement, first unplug the connecting cable between the monitoring terminal of LISN and the spectrum analyzer, Then turn off the power of the spectrum analyzer, and finally turn off the power of the device under test.

6. Because there is a relatively large filter capacitor in the power supply impedance stabilization network, it cannot be used in leaky on the electrical protection grid. If it is used in a general laboratory, it must be transformed by power isolation The transformer feeds the mains impedance stabilization network.

After setting up the experimental test platform, follow the steps below to test:

1: After booting and warming up for 25 minutes, the system will automatically enter the EMI receiver system interface;

2: Test standard selection. PressÿMeasÿto select the EMC test standard, and use the softkeys on the interface to directly select Select [Standard], select [GJB151A] in the standard list, select [CE102] in the national military standard list, according to The DUT is required to select the [220V] reference line, and the test interface under this standard is as follows:



GJB-151A Conduction CE102-1 220V

1 POS / CW

衰减 9 dB

前放 关闭

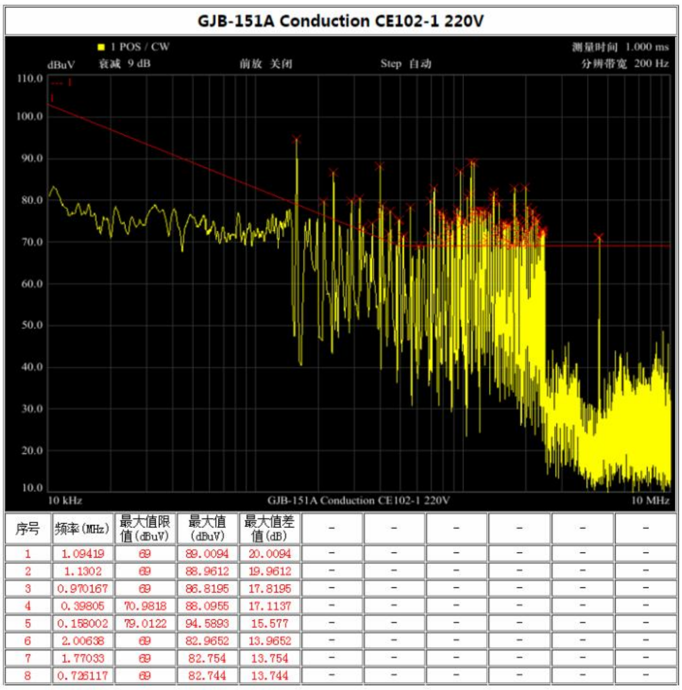
Step 自动

测量时间 1.000 ms

分辨带宽 200 Hz

序号	频率(MHz)	最大值限值(dBuV)	最大值(dBuV)	最大值差值(dB)	-	-	-	-	-	-

Figure 3.13 CE102 interface



序号	频率(MHz)	最大值限值(dBuV)	最大值(dBuV)	最大值差值(dB)	-	-	-	-	-	-
1	1.09419	69	89.0094	20.0094	-	-	-	-	-	-
2	1.1302	69	88.9612	19.9612	-	-	-	-	-	-
3	0.970167	69	86.8195	17.8195	-	-	-	-	-	-
4	0.39805	70.9818	88.0955	17.1137	-	-	-	-	-	-
5	0.158002	79.0122	94.5893	15.577	-	-	-	-	-	-
6	2.00638	69	82.9652	13.9652	-	-	-	-	-	-
7	1.77033	69	82.754	13.754	-	-	-	-	-	-
8	0.726117	69	82.744	13.744	-	-	-	-	-	-

Figure 3.14 Test report and list of out-of-standard points

3.1.3.1 GJB151B radiated emission test

In this test example, the GJB151B RE102 test is used as an example. After setting up the experimental platform, directly test the

The EUT data test, RE102 launch test platform is shown in the figure below:

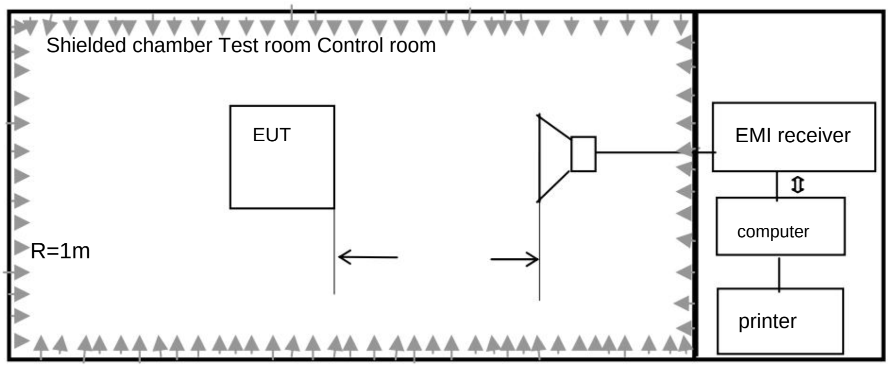


Figure 3.15 Schematic diagram of RE102 measurement

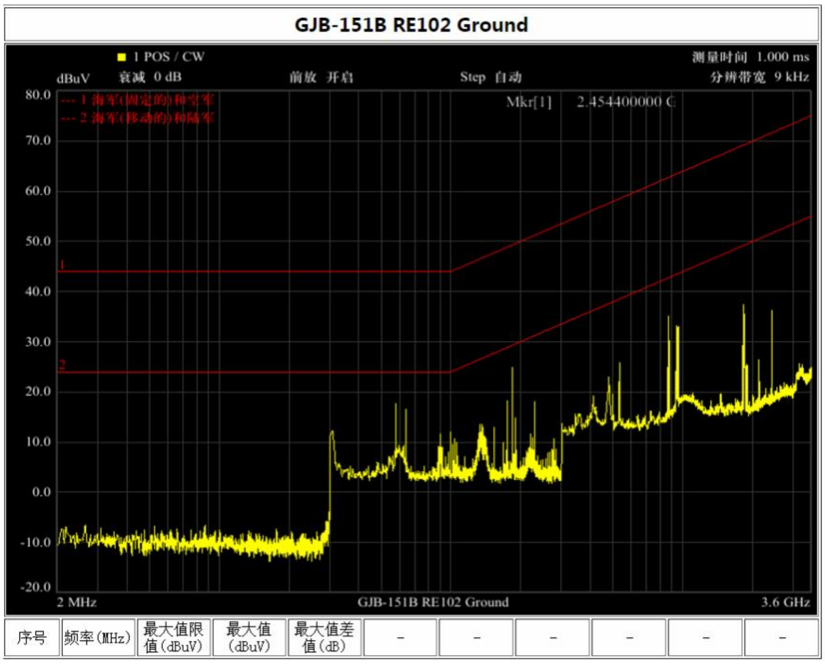
The specific test steps under this standard are as follows:

1: After booting and warming up for 25 minutes, the system will automatically enter the EMI receiver system interface;

2: Test standard selection. PressÿMeasÿto select the EMC test standard, and use the softkeys on the interface to directly select

Select [Standard], select [GJB151B] in the standard list, select [RE102] in the national military standard list, according to

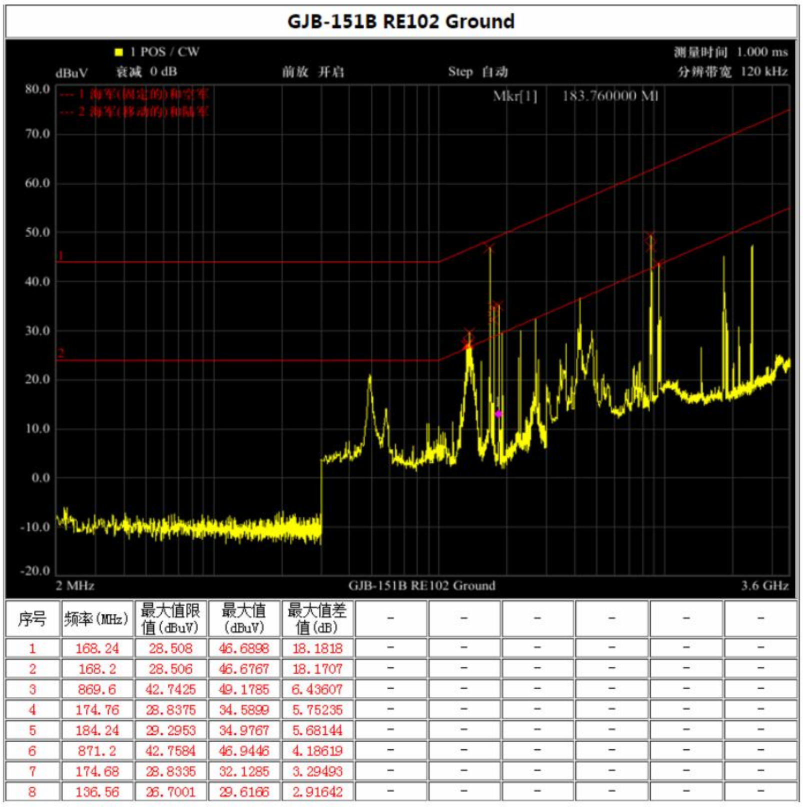
The DUT requires to select the limit value, for example, select [Ground] limit value, the standard test interface is as follows:



序号	频率(MHz)	最大值限值(dBuV)	最大值(dBuV)	最大值差值(dB)	-	-	-	-	-	-

Figure 3.16 GJB151B RE102 test interface

After starting the test, the test curve is shown in the figure below:



序号	频率(MHz)	最大值限值(dBuV)	最大值(dBuV)	最大值差值(dB)	-	-	-	-	-	-
1	168.24	28.508	46.6898	18.1818	-	-	-	-	-	-
2	168.2	28.506	46.6767	18.1707	-	-	-	-	-	-
3	869.6	42.7425	49.1785	6.43607	-	-	-	-	-	-
4	174.76	28.8375	34.5899	5.75235	-	-	-	-	-	-
5	184.24	29.2953	34.9767	5.68144	-	-	-	-	-	-
6	871.2	42.7584	46.9446	4.18619	-	-	-	-	-	-
7	174.68	28.8335	32.1285	3.29493	-	-	-	-	-	-
8	136.56	26.7001	29.6166	2.91642	-	-	-	-	-	-

Figure 3.17 GJB151B RE102 test report

3.2 Operation of network measurement

ER series EMI receivers have network measurement function and are mainly used for amplitude-frequency characteristic measurement. can be measured

Insertion loss, isolation, and amplifier gain for passive networks such as filters, attenuators, and cabling

wait. For example, to measure the performance of the filter: connect the output of the signal tracking source to the input of the filter, and then connect the filter

Connect the output terminal of the oscilloscope to the input terminal of the spectrum analyzer to measure the filtering characteristics of the filter.

Measurement methods:

Setting parameters

—Press [Mode]key to select [Network Measurement]

—Press[SPAN]key to adjust the span to the required width (eg. 200MHz)

1. Use an adapter (short connector) to connect the tracking generator output cable to the spectrum input cable,

Open the network measurement function, press the arrow keys【⬆】【⬇】or number keys to change the output power, reference level, Scan time and scan points.

—Press the [Normalization] key, and the display will display a straight line in the center of the screen, as shown in Figure 3,28.

Figure 3.28 Normalized measurement

If you want to expand the vertical display range, you can adjust the reference level soft key to adjust the normalized line to the top of the display part, as shown in Figure 3,29.

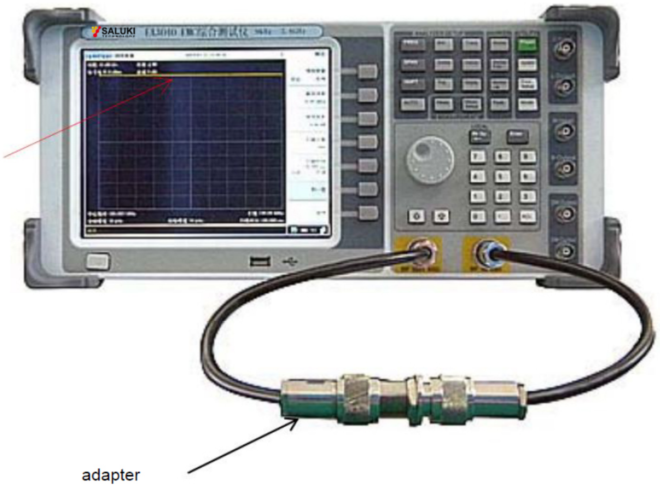


Figure 3.29 Normalized measurement

2. Remove the adapter and replace the adapter with a filter to display the filter characteristics, as shown in Figure 3.30 shown.

Figure 3.30 Filter measurement

If necessary, adjust the [SPAN] key, and then you can see the complete filtering characteristics of the filter on the display.

—Press 【Marker】key to move the cursor to -3dB, then you can measure the 3dB bandwidth of the filter.

If you want to take a closer look at the filter characteristics, you can choose the ordinate scale of 1dB/grid.

4 Accessory Test Operation Guide

4.1 Near-field probes

Using a near-field probe with a receiver can directly measure the frequency and amplitude of the interference signal, which is very effective in finding electric and magnetic field interference. Compared with similar probes, the Baluelec near-field probe has high gain and small volume, and can perform quantitative measurements.

Electric field probe TEPEST-E Magnetic field probe TEPEST-H

4.1.1 Use a near-field probe to find electromagnetic leakage in the chassis gap

Any shielded case has gaps, various windows and input/output lines, and electromagnetic waves are likely to come from

These places leak out. The solution is: all the gaps must be blocked with conductive voltage strips, and the window

Different light-transmitting shielding materials should be used for the mouth. All input/output lines must pass through filters and shielded enclosures

external circuit connections. If the selection or installation of conductive voltage strips and filters is not suitable, or the light-transmitting screen of the window

If the performance of the shielding material is not good, there will be electromagnetic leakage, and the near-field diagnostic probe can be used to check the leakage location and leakage.

the size of.

Measurement methods

1. Device connection

Connect the near-field probe to the spectrum input of the spectrum analyzer.

2. Parameter setting

1) Reset the instrument

—Press [Preset]

2) Setting parameters

—Press [FREQ]key to adjust the center frequency to the estimated detection frequency

—Press[SPAN]key to set the sweep width to the widest first, so that the display will be a panoramic spectrum.

Move the probe (as shown in the figure) at the place where the EUT needs to be inspected (such as gaps, ventilation windows, etc.).

Adjust the center frequency to a relatively large spectral line, and use the frequency marker to observe the frequency and amplitude of the spectral line.

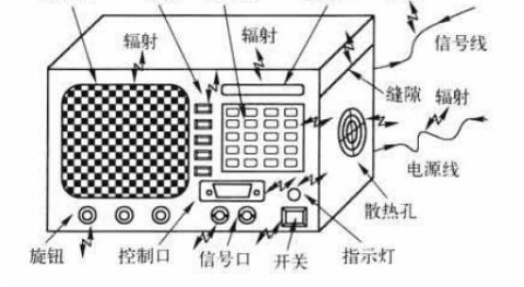


Figure 4.1 Measuring Electromagnetic Emissions from Equipment with Near Field Probes

After seeing a relatively large interference signal, reduce the sweep width and IF bandwidth to observe the details of the spectral line part. If the measured signal is too small, then

—Press the [BW] key to reduce the IF bandwidth, and press the [Attenuator] key to reduce the attenuation

You can also turn on the internal preamplifier, or use an external low noise amplifier to amplify the measured signal.

—Press[AMPT]key to adjust [reference level], and adjust the amplitude of the signal under test to a position convenient for observation.

Observe while moving the probe. Find the relatively large radiation frequency and amplitude. It is also possible to use the maximum hold Function record signal line

—Press [Trace]key to select [Maximum Hold] function

—Press[Marker]key to move the cursor to the spectral line to be measured

4.1.2 Use a near-field probe to find the source of electromagnetic interference on the PCB

Electronic circuits are composed of many components (resistors, capacitors, inductors, transistors, integrated circuits, semiconductors Switching devices and high-frequency clock processor chips, etc.) are connected by wires, cables and connectors. each element Devices have their inherent characteristics, and some components can generate strong electromagnetic radiation.

Some cables are often bundled together, which creates a potential hazard for near-field coupling or crosstalk. wire It can be equivalent to a dipole antenna and can act as a radiation antenna, thus becoming a part of the electromagnetic interference radiation source It can also function as a receiving antenna and becomes an important part of the system that is sensitive to radiated emissions. use near field The diagnostic probe can find out the components with large electric field radiation and the magnitude of the electromagnetic field radiation.

The measurement method is the same as 4.1.1.

Figure 4.2 Measuring electromagnetic radiation of PCB board with near-field probe

The above are all relative measurements, and relative measurements can only qualitatively analyze the magnitude of the measured signal.

For example, the radiated emission (RE102) measurement of a certain military equipment exceeds the standard, and at 100MHz, the limit value is exceeded

10dB, in order to meet the requirements of the military standard, this product must be reinforced and improved.

The correct way to strengthen is to measure with a diagnostic probe first, and the signal exceeds the standard at 100MHz.

The magnitude value of the number, measure after reinforcement measures, compare the data of the two measurements, if the second measurement data

The value reduced by less than 10dB compared with the first measurement data indicates that the reinforcement measures are not enough. If the reduced value

If it is greater than 10dB, it may pass the military standard limit requirement. Because the change of the electromagnetic field strength in the near field and the change of the far field

The rules are basically the same.

4.1.3 Quantitative testing (absolute value measurement) is possible with near-field probes

All TEMPEST electromagnetic field probes have been calibrated by nationally certified measurement units, and the corresponding

Probe calibration coefficient AF, with which the field strength quantitative test can be carried out, and the absolute

For the field strength value, such as the electrical field near the transmitter, substation, radio room, computer room, cabinet and inside the case, etc.

Places with strong magnetic radiation.

The calculation formula of electromagnetic field theory is as follows:

Electric field strength E(dBBμv/m)=V(dBBμv)+AF(dB/m)

Magnetic field strength H(dBBμA/m)= V(dBBμv)+AF(dBs/m)

Magnetic induction (magnetic flux density) B(dBpT) = H(dBÿA/m)+2dB= V(dBBμv)+AF(dBs/m) +2dB

In the formula: V(dBBμv) —— measured value of spectrum analyzer

AF(dB/m)——electric field probe correction factor

AF(dBs/m)——Correction coefficient of magnetic field probe

Measuring with a diagnostic probe is different from the method of measuring according to the military standard. The diagnostic measurement is a near-field measurement, and the near-field measurement is a With a probe, the probe is in close proximity to the radiation source. The measurement according to the electromagnetic compatibility standard basically belongs to the far-field measurement, and the far-field measurement The amount is with an antenna. The military standard requires that the distance between the antenna and the device under test is 1m. In order to eliminate the environmental electromagnetic interference, the radiation emission Radiation measurements must be carried out in a shielded dark room.

Probe Measurement Error Analysis: There are many factors affecting near-field measurement

(1) The magnetic component of the signal is coupled to the probe through magnetic induction, while the electrical component is coupled through capacitive onto the probe. Since the distributed capacitance is not fixed, the induced electric component also changes, so each measurement The repeatability is poor. (2) Influence of the probe: when the probe is placed near the radiation source, due to the presence of the probe, the The capacitance of the source is increased, thereby changing the distribution of the current at the interaction point, thus changing the flux density of the source Spend. This can also lead to measurement errors. (3) The wave impedance in the near field changes and is particularly sensitive to the position of the probe.

(4) The influence of the human body: when a person holds the probe, the electrical signal component can pass through the separation between the human body and the probe. The distributed capacitance is coupled to the probe, and the position of the person or the method of holding the probe is different, the distributed capacitance is also different. same.

During diagnostic measurement, keep the human body as far away from the probe and measurement cable as possible to eliminate the influence of the human body. Due to electromagnetic waves There is a problem with the direction of polarization, so the direction of the probe should be rotated during the measurement in order to measure the largest signal. For phase For measurement, the conditions before and after the measurement should be as similar as possible. As long as you pay attention to the measurement method, you can reduce the measurement error.

Due to the many measurement errors caused by near-field measurement, how to equate the near-field measurement data to the far-field There is no ready-made theoretical calculation formula. Because the size of the shielded darkroom is different, the electromagnetic wave reflection is different, The test distance is different, so it is difficult to derive a theoretical calculation formula for the equivalent far and near field. However, there are conditions Some units can conduct actual measurements according to the specific conditions of their own laboratories to find out a rule. In general, near The electromagnetic field strength measured in the far field is much stronger than that measured in the far field, and it increases with frequency The difference also decreases linearly. In this way, it can be pre-estimated whether the device under test can pass the military standard requirements.

4.2 Current Sense Probes and Current Injection Probes

Most of the interference signals are related to the presence of interference currents in wires and cables, which can wait for The effect is a loop antenna and a dipole antenna, which can both transmit and receive signals. In EMC measurements, Measuring the performance of the transmitted signal on the cable of the equipment is called conducted emission measurement; applying a certain intensity to the cable of the equipment To assess the anti-interference ability of the equipment with a high-degree signal is called conduction sensitivity measurement. Whether measuring interference on the cable Whether to inject disturbances into the cable, a coupling device is required, which is usually called a current probe (or called a current caliper). Current probes can be classified into current sense probes and current injection probes. Current sense probe Used to measure conducted emissions, to measure interference on conductors and cables; current injection probes are used to measure conducted susceptibility Quantity, that is, the technology of injecting strong interference signals into the cable, referred to as BCI (Buik Current Injection). When using a current probe, the probe does not touch the wire, and generally does not change the normal state of the circuit under test. State of working or normal arrangement.

4.2.1. Measuring interference on power and signal lines with a current detection probe

Connect the current detection probe to the input terminal of the spectrum analyzer, and snap the current detection probe to the power line under test, In this way, the electromagnetic interference on the power line can be measured, and it can also be stuck on the signal line to measure the interference on the signal line.

As shown below.

Figure 4.3 TEMPEST detection probe

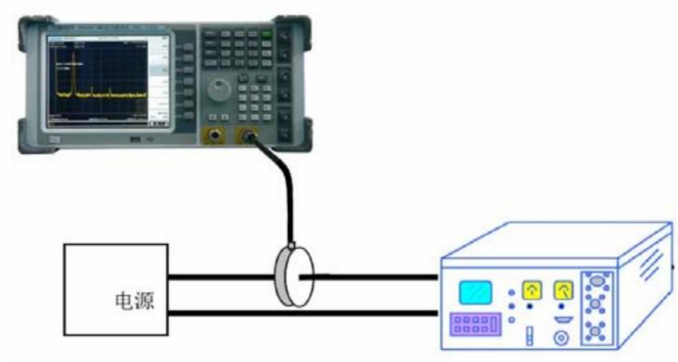


Figure 4.4 Current detection probe measures interference on power and signal lines

4.2.2 Measuring the Conducted Sensitivity of the DUT with a Current Injection Probe

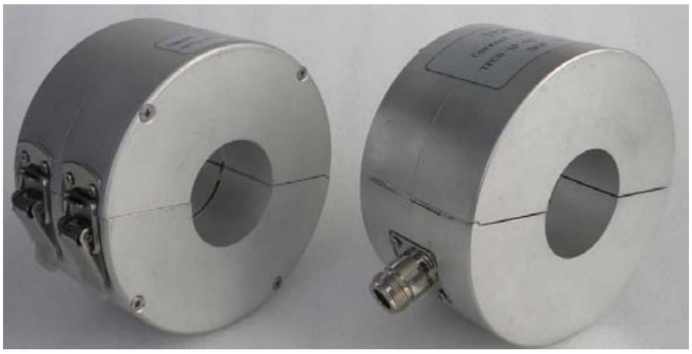


Figure 4.5 TEMPEST injection probe

Measurement methods:

Clamp the current injection probe to the signal cable or power line under test, and pass the output signal of the signal source through the

The power amplifier is amplified and added to the current injection probe, and the current detection probe is used to monitor the injection into the wire

Signal current size. In this way, the purpose of sensitivity measurement can be achieved. As shown in Figure 4.6.

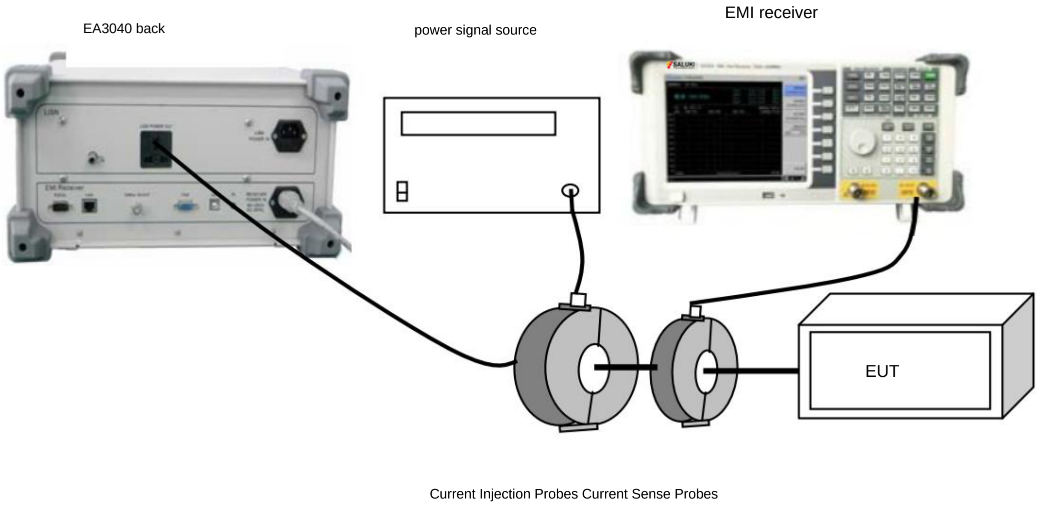


Figure 4.6 Sensitivity measurement by current injection method

4.3. Measuring common-mode and differential-mode signals with a common-differential mode separator

The traditional conduction measurement can only measure the total amount of conduction interference of the device under test from the L/N detection terminal of the LISN.

The total amount of interference includes common-mode components and differential-mode components. I don't know how much each of the common-differential mode components is. This gives EMI

It is difficult for design and modification engineers to choose which filter to use.

With the common and differential mode separation function in the EA3040B integrated analyzer, the common mode can be separated from the total interference

Component and differential mode component, which is convenient for designers and rectification personnel to carry out interference analysis and directional processing.

The specific operation of the common-differential mode separation function is explained below with specific examples.

1) Device connection

Connect the equipment according to the GJB151A/152A conducted emission measurement in section 6.3. After the actual connection as shown in the figure

21.

Figure 4.7 Connection Diagram of CE102 Conduction Test Example

2) Parameter setting

—PressÿModeÿkey

—Press [EMI **Receiver]**

— by [Standard]

- Press [Conduct]

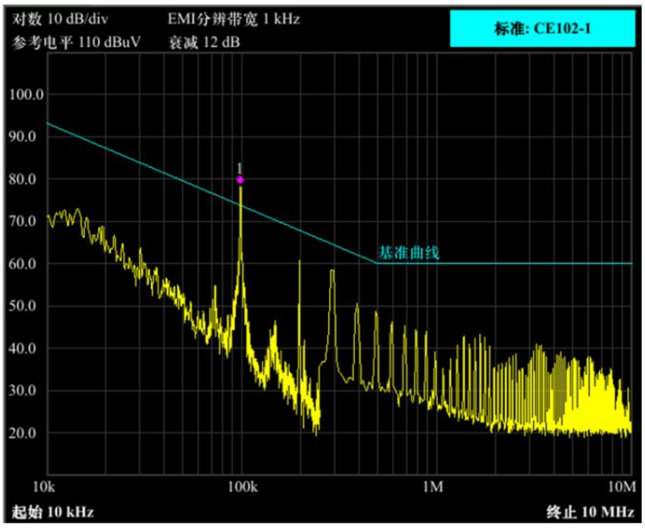
—Press [CE102-1]

3) Total interference measurement

After the parameters are set, connect the detection terminal "L Output/N Output" of the front panel LISN to the frequency spectrum

After the scan is stable, observe whether the curve exceeds the standard limit, and adjust the frequency to exceed the standard limit.

On the target spectral line, at this time, the total amount of interference exceeds the standard by 22dB at 131kHz. As shown in Figure 4.8.



To use the new simulation software to test

volume chart

Figure 4.8 The total amount of conducted test interference

5 Editing and saving of instruments

5.1 Limit line editing of the instrument

5.1.1 Limit lines of the instrument

The measurement limit lines of built-in standards cannot be edited, and the measurement of custom standards needs to define limit lines. limit line knitting

After the editing is completed, it can be saved to the device, and it can be browsed, edited and deleted when it is started next time.

The picture below is a blank page

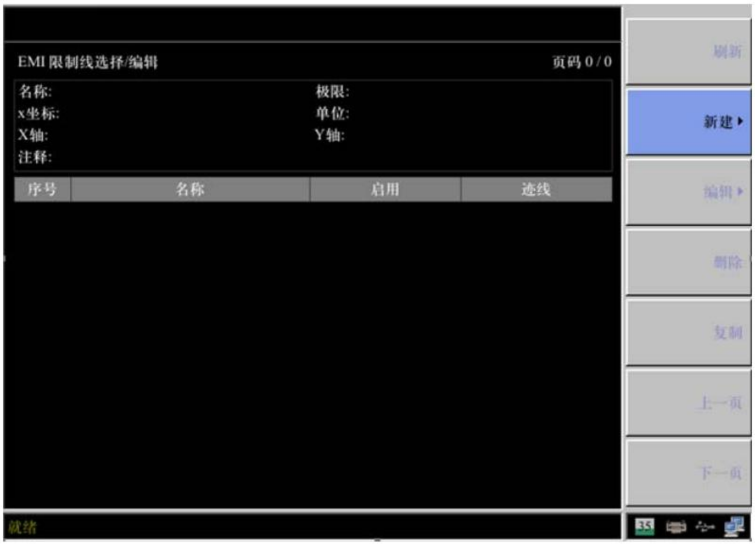


Figure 5.1 Limit line edit blank page

5.1.2 Limit line parameters and operation steps

[Page number] The limit line list displays 12 items per page, and will be displayed in pages after more than 12 items

[Name] The name of the limit line, input from the software disk, after the cursor switches to the name parameter, click on the front panel

[Enter] key can activate/deactivate the software disk

ÿLimitÿ Limit line type definition, upper limit/lower limit

[X coordinate] Linear/logarithmic, currently only supports X coordinate logarithmic unit only supports dBuV unit

[Note] Custom description, the input method is the same as the name

edit line operation

After the instrument is turned on and the system enters the EMI receiver, click [Meas Setup] to enter the limit line editing page,

Specifically: [Meas Setup] → [New], start creating limit lines

The left side is the limit line parameter editing part, and the right side is the shortcut switch and function menu

[Name] Quickly locate the cursor to the name parameter column

[Value] Quickly position the cursor to the first frequency

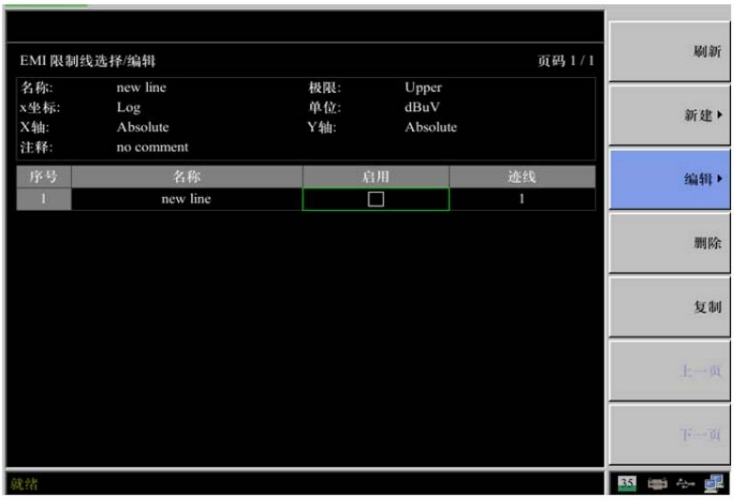
[Add]Create a new frequency, amplitude line and position

[Insert]When the cursor is in the frequency/amplitude row, perform an insertion before it, and if it is not there, perform an add operation

[Delete] Delete frequency/amplitude line

[Give up]Cancel creation/editing and return to limit line list page

[Save] Save the creation/editing and return to the limit line list page



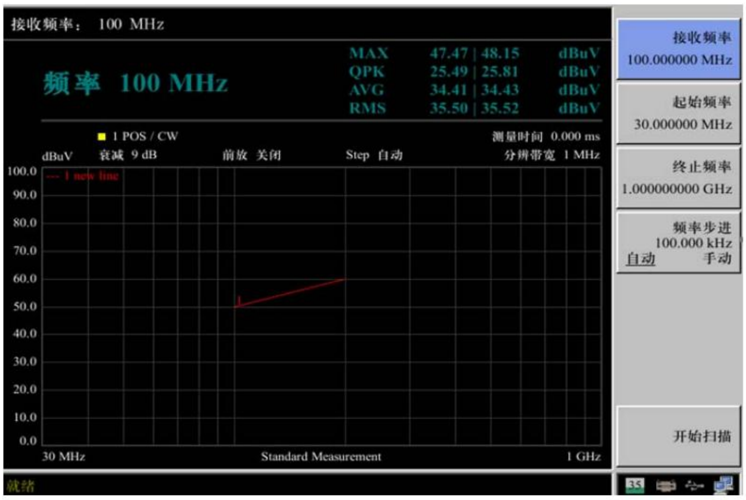
EMI 限制线选择/编辑　页码 1 / 1

名称: new line　极限: Upper
x坐标: Log　单位: dBuV
X轴: Absolute　Y轴: Absolute
注释: no comment

序号	名称	启用	迹线
1	new line	□	1

就绪

Figure 5.2 Limit line edit page



接收频率： 100 MHz

频率 100 MHz

MAX	47.47 | 48.15	dBuV
QPK	25.49 | 25.81	dBuV
AVG	34.41 | 34.43	dBuV
RMS	35.50 | 35.52	dBuV

1 POS / CW　测量时间 0.000 ms
衰减 9 dB　前放 关闭　Step 自动　分辨带宽 1 MHz

接收频率 100.000000 MHz
起始频率 30.000000 MHz
终止频率 1.000000000 GHz
频率步进 100.000 kHz 自动 手动

就绪

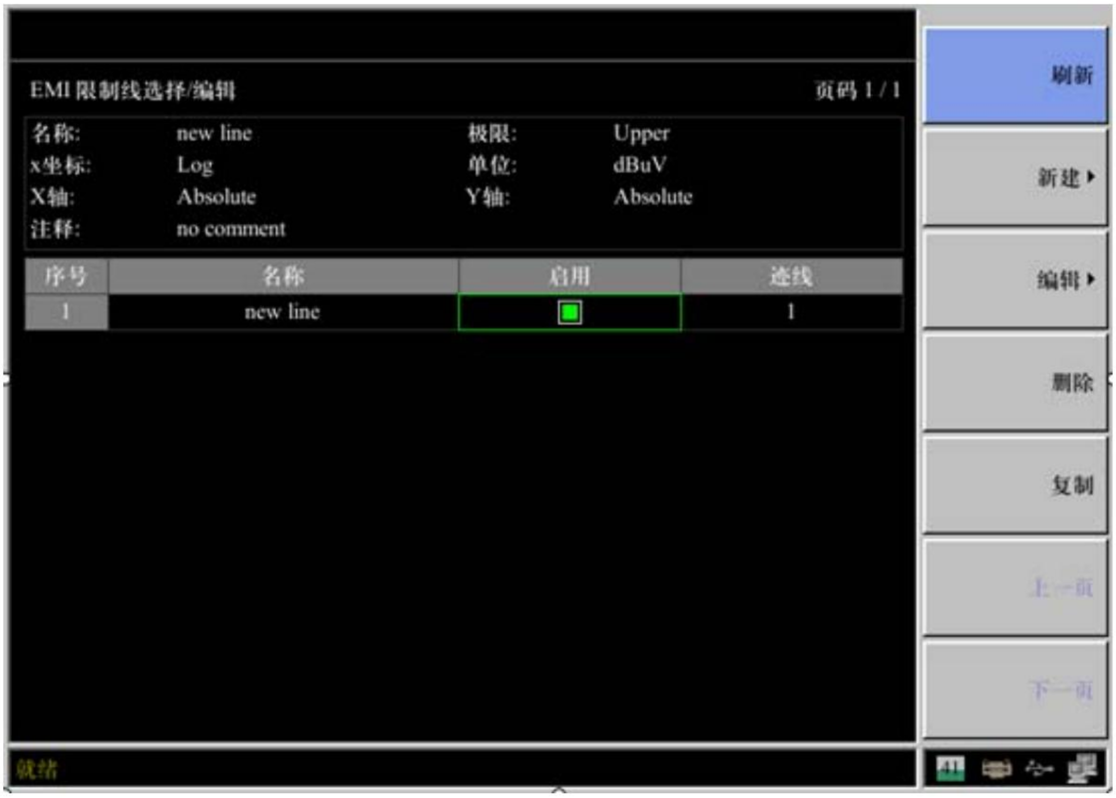
Figure 5.3 Limit line after editing

The operation of editing a page is exactly the same as that of creating a page. After editing, click [Save] to return to the list page.

5.1.3 Creation and use of limit lines

You can edit and use limit lines yourself for quick measurements, also for list sweeps.

[Meas Setup] menu contains all the operations of the limit line, the menu functions are as follows



EMI 限制线选择/编辑 页码 1 / 1

名称: new line
极限: Upper
x坐标: Log
单位: dBuV
X轴: Absolute
Y轴: Absolute
注释: no comment

序号	名称	启用	迹线
1	new line	☑	1

就绪

The left part is the limit line list that has been created, and the parameters included in the limit line list are

[Name]Limit line name

[Limit] Limit line type, including Upper (upper limit line) and Lower (lower limit line), upper limit line table

Indicates that when the detection result exceeds the limit line, it is qualitatively exceeded, and the lower limit line is just the opposite, lower than the lower limit line

out of bounds

[X coordinate] Horizontal axis display mode, Log means logarithmic display, Line means linear display

[Unit]dBuV

[X axis]Display the absolute frequency value

[Y axis]display relative frequency value

[Note] Remarks

Limit line operations mainly include: browse/refresh, create, edit, delete and copy operations.

5.1.3.1 Create limit lines

[Meas Setup]j→[New], enter the interface for creating limit lines

创建限制线

名称	new line
极限	Upper
x坐标	Log
单位	dBuV
X轴	Absolute
Y轴	Absolute
注释	no comment

频率	限值(dBuV)
100 MHz	50.0

Set limit line name

Input the limit line name through the soft keyboard, click [Name] to pop up the soft keyboard

The soft keyboard contains English letters and common symbols, which can be moved by the pulse knob and the up and down keys, [Enter] to confirm

When inputting numbers, it can also be input through the number keys on the panel, and the [Cancel] and [OK] keys close the soft key.

keyboard.

Add extreme frequency points: Click [Add]/[Insert], the limit line frequency point list will automatically add a line, pulse

The knob moves to the frequency or limit table that needs to be modified, input and modify through the number keys on the panel.

After editing, click [Save], and the system will automatically return to the limit line list interface.

5.1.3.2 Enabling limit lines

[Meas Setup]Enter the limit line list home page

序号	名称	启用	迹线
1	new line	□	1

Use the pulse knob to switch between enable and trace form, enable or cancel by [Enter] key, trace selection

The selection range is from 1 to 3, and the corresponding trace is selected according to the actual set parameters. After reset, the system automatically cancels all

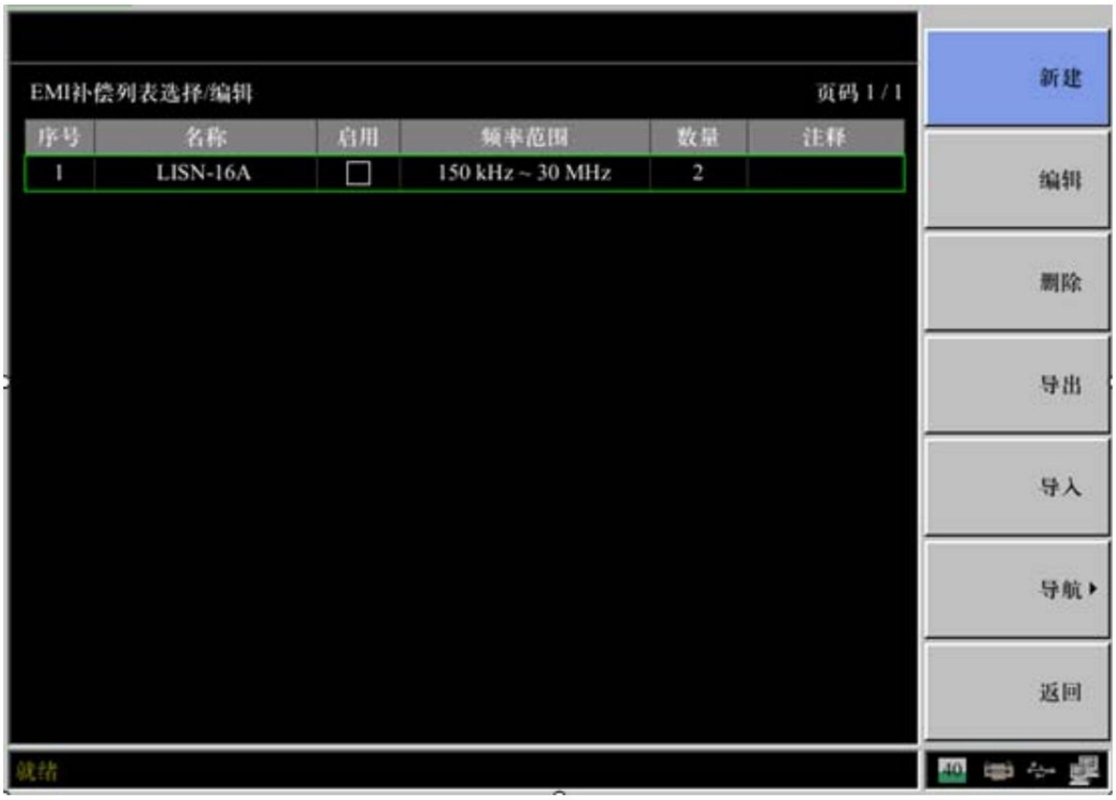
There are limit lines.

5.2 Instrument Compensation Factor Editing

Compensation factors can be edited for testing accessories such as LISN, probe, antenna, limiter, attenuator, amplifier, etc.

Corresponding compensation is made for the insertion loss and frequency response to ensure accurate and reliable test results.

Operation steps: [Meas]→[Compensation], enter the compensation factor interface



EMI补偿列表选择/编辑 页码 1 / 1

序号	名称	启用	频率范围	数量	注释
1	LISN-16A	□	150 kHz ~ 30 MHz	2	

就绪

5.2.1 Creating Compensation Factors

Operation steps: [Meas]→[Compensation]→[New], after entering the page, you can set the compensation name, add Frequency list, set frequency and amplitude


幅度： −0.60 dB

创建补偿表 - unDefine　页码 1 / 1

序号	频率	幅度(dBu)
1	150 kHz	-0.60
2	1 MHz	0.90
3	5 MHz	0.59
4	10 MHz	1.60
5	15 MHz	2.10
6	20 MHz	6.50
7	25 MHz	-1.80
8	28 MHz	-0.80
9	29 MHz	-3.10
10	30 MHz	1.20

就绪

After the creation is complete, click [Save]

5.2.2 Load compensation factor

[Meas]→[Compensation], enter the compensation list interface, use the up and down keys to select the compensation name, press [Enter] key to enable compensation


EMI补偿列表选择/编辑　页码 1 / 1

序号	名称	启用	频率范围	数量	注释
1	LISN-16A	□	150 kHz ~ 30 MHz	2	
2	unDefine	□	150 kHz ~ 30 MHz	10	

Note: Only one of them can be selected in the compensation list at a time.

5.3 Save operation

The interface saving of the instrument is divided into two types: report export under the EMI receiver system and interface saving under other methods.

live.

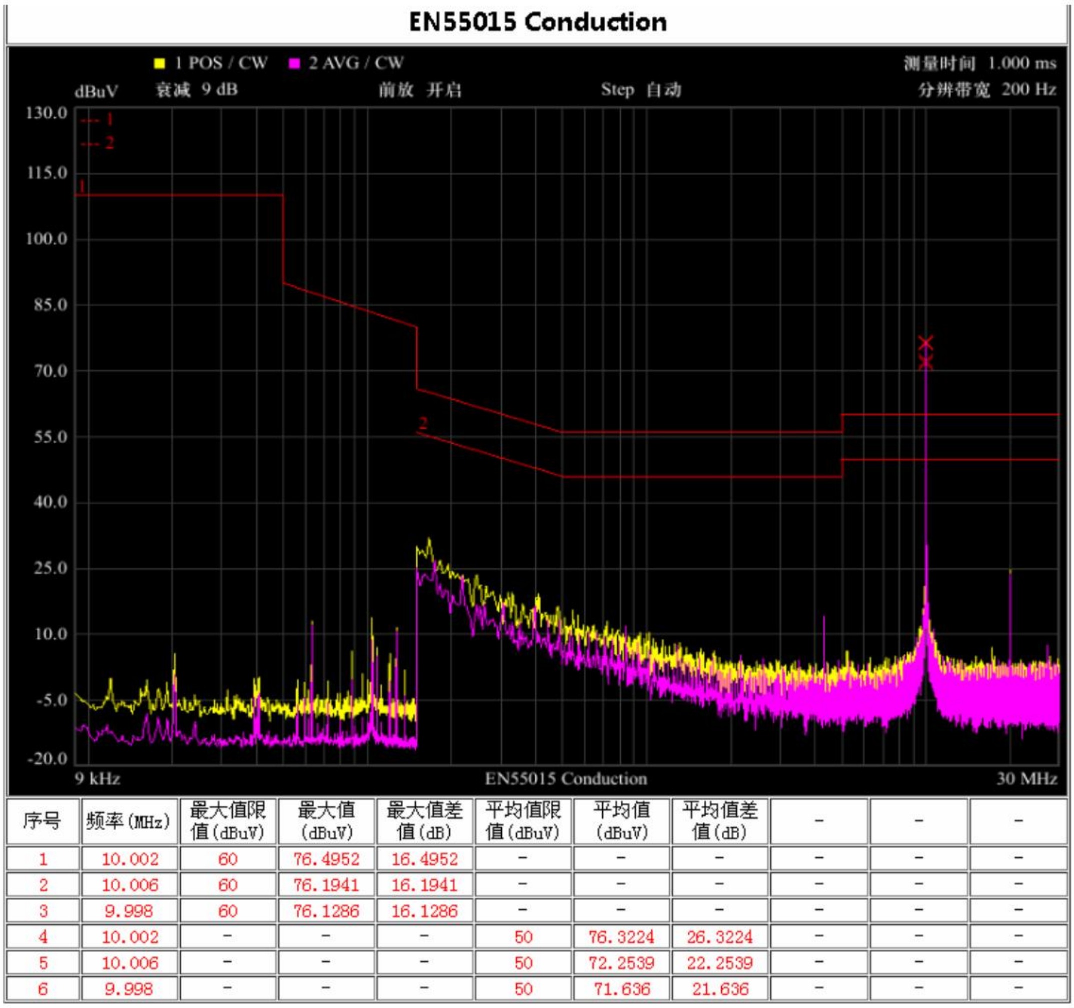
Report export:

Under the EMI receiver system, stop scanning, click [Meas], click [Report], and select [Export]

After that, the report can be saved to flash memory. There are two saving formats, .png and .html. When viewing the two

Put the files in the same path, just open the file with the suffix html.

The test report style is as follows



EN55015 Conduction

序号	频率(MHz)	最大值限值(dBuV)	最大值(dBuV)	最大值差值(dB)	平均值限值(dBuV)	平均值(dBuV)	平均值差值(dB)	-	-	-
1	10.002	60	76.4952	16.4952	-	-	-	-	-	-
2	10.006	60	76.1941	16.1941	-	-	-	-	-	-
3	9.998	60	76.1286	16.1286	-	-	-	-	-	-
4	10.002	-	-	-	50	76.3224	26.3224	-	-	-
5	10.006	-	-	-	50	72.2539	22.2539	-	-	-
6	9.998	-	-	-	50	71.636	21.636	-	-	-

The test report includes measurement spectrum and outlier data information. The exceeding standard point data gives the current exceeding standard frequency point limit

value, the measured value and the difference between the measured value and the limit value.

Interface save:

In the spectrum analyzer mode, the interface is saved in the form of screenshots, after [System], click [Save]

[Storage], click [Screenshot], and click [Save to Flash]. The save format is only .png.

6. Precautions for using the instrument

When using the instrument, pay attention to electricity safety.

After the instrument is turned on, it needs to warm up for 25 minutes. After the system is stable, start measuring.

When the instrument is conducting a conduction test, when using it with an external LISN, pay attention to the order of the test steps, note

Pay attention to electricity safety.

When using the instrument, pay attention to the issue of safety grounding, which requires good grounding.

Do not place the instrument in a place exposed to sunlight for a long time after use.

When the instrument is not in use, please disconnect the power supply.