Signal Analysis Utilities in the SSA5000A Series Spectrum Analyzer

Application Guide

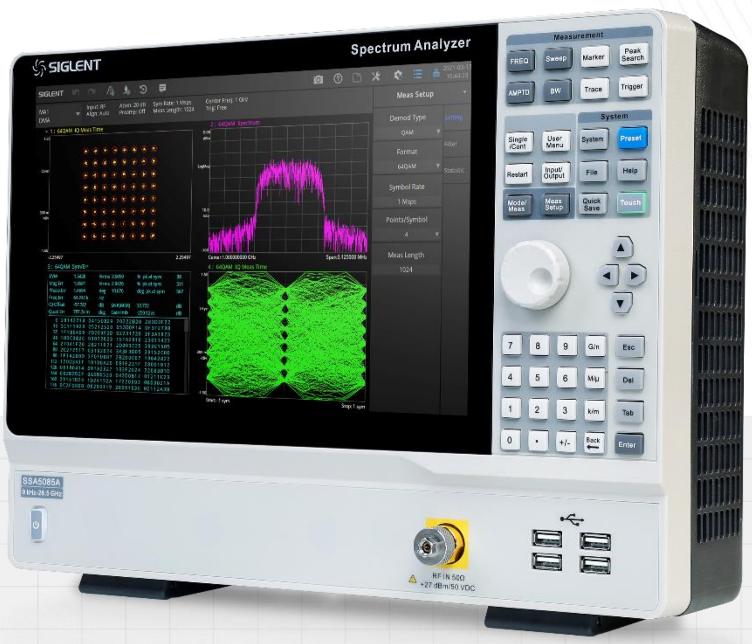

Table Of Contents

- SIGIQPro Bluetooth signal generation and SSA5000A Bluetooth analysis function
- SSA5000A noise figure measurement option
- SSA5000A phase noise analysis function
- SSA5000A pulse measurement option

Demonstration of the SIGIQPro Bluetooth signal generation and SSA5000A Bluetooth analysis function

1 Introduction

As a wireless communication technology, Bluetooth technology is widely used in various devices and application scenarios. The article aims at RF verification of Bluetooth transmitter. Through fast one-click RF measurement, SSA5000A spectrum analyzer is transformed into a standard-based Bluetooth RF transmission tester to help you design, evaluate and manufacture Bluetooth devices. The measurement application conforms to the standard of Bluetooth core specification, and can safely verify your Bluetooth design, covering Bluetooth BR, EDR and LE. The article will demonstrate how to use the Bluetooth analysis function of SSA5000A to carry out Bluetooth analysis and measurement quickly and effectively.

1.1 Bluetooth Analysis Function

Bluetooth SIG specifies the RF test items of Bluetooth® Classic and Bluetooth® Low Energy Bluetooth measurement specifications. Tables 2 and 3 list the corresponding test items supported by SSA5000A and suitable for transmitter testing. The SIGLENT Bluetooth measurement application refers to the following Bluetooth RF test specifications:

Table 1 Supported standard versions

Type	Bluetooth device
Standard version	Bluetooth radio frequency system specification 1.2/2.0/2.0+EDR/2.1/2.1+EDR revision 2.1.E.0 - basic rate - enhanced data rate Bluetooth Low Energy RF PHY test specification (LE RF-PHY.TS/4.0/4.2) Bluetooth RF PHY test specification (Bluetooth 5, 5.1 and 5.3)
Power	Class 1, class 2 and class 3
Frequency	Bluetooth basic rate and EDR system: 2.400 to 2.4835 GHz (f = 2402 +k MHz, k = 0, …, 78) Bluetooth low energy system: 2.400 to 2.4835 GHz (f = 2402 +kx2 MHz, k = 0, …, 39)

Table 2 Supported Classic test items

Transmitter test	TP/TRM/CA/BV-xx-C
Basic Rate (BR)	
Output power	01
Modulation characteristic	07
Initial carrier frequency tolerance	08
Carrier frequency drift	09
Enhanced Data Rate (EDR)	
EDR relative transmit power	10
EDR carrier frequency stability and modulation accuracy	11
EDR differential phase encoding	12

Table 3 Supported LE test items

Low Energy (LE)					
Transmitter test	LE 1M 1 Mb/s	LE 2M 2 Mb/s	LE 1M 1 Mb/s, SMI	LE 2M 2 Mb/s, SMI	Coded, S=8 1 Mb/s, SMI

Output power	01				
Modulation characteristics	05	10	09	11	13
Carrier frequency offset and drift	06	12			14

1.2 Configuration information

You need to install the appropriate firmware version and options on the required instruments.

Table 4 Configuration information

Type	Model	Configuration information
Signal Generation Software	SigIQPro	Optional: SigIQPro-BT
Vector Signal Generator	SSG5000X-V	Firmware: V2.1.2.4.1and above Optional: SigIQPro-BT
Arbitrary Waveform Generator	SDG7000A	Firmware: V1.1.1.32 and above Optional: SigIQPro-BT
Spectrum Analyzer	SSA5000A	Firmware: V1.1.2.2.0 and above Optional: SSA5000A-BT

1.3 Measurement Parameters

SSA5000A Bluetooth analysis provides one-button measurement.

Table 5 Measurement Parameters

Bluetooth Analysis	Basic Rate (BR)	Enhanced Data Rate (EDR)	Low Energy (LE)
Output power			
◆ Peak power	●		●
◆ Average power	●		●
Modulation characteristics			
◆ ΔF1 Avg/Max	●		●
◆ ΔF2 Avg/Max	●		●
◆ ΔF1/ΔF2 Ratio	●		●
Initial carrier frequency tolerance (ICFT)	●		
Frequency offset			●
Carrier frequency drift			
◆ Frequency drift	●		●
◆ Max drift rate	●		●
◆ Init freq drift			●
Relative transmit power			

◆ GFSK average power		●	
◆ DPSK average power		●	
◆ Rel average power		●	
Frequency stability and modulation accuracy			
◆ Freq offset w_i		●	
◆ Freq offset w_0		●	
◆ w_0+w_i		●	
◆ RMS DEVM		●	
◆ Peak DEVM		●	
Differential phase decoding			
◆ BER		●	
◆ Bit errors		●	
◆ 99% DEVM		●	
Guard Interval		●	

1.4 Connection Settings

Connect a PC with SigIQPro software to SSG5000X-V / SDG7000A through GPIB / LAN / USB. Complete the connection according to the setup instructions of SigIQPro, and then perform the following steps to interconnect SSG5000X-V / SDG7000A and SSA5000A:

1) Connect SSG5000X-V/ SDG7000A RF output port to SSA5000A RF input port.
2) It is suggested to connect the 10 MHz IN output of SSG5000X-V / SDG7000A to the Ext Refl port (back panel) of SSA5000A to improve the frequency accuracy.

Figure 1-1 Connection settings

1.5 Test Result

SSA5000A calculates the measurement results according to the Bluetooth® RF test specification, carries out Bluetooth BR/ EDR/LE one-button measurement and displays a single view with four traces. The one-button measurement function can conveniently and quickly complete the test purposes listed in Table 2 and 3 at one time, and provide an overview of multiple emission tests. Users can switch from the four-trace overview to a single power, modulation and spectrum measurement display to view the results in more detail. All signal parameters can be modified independently, such as RF channel, packet type, mode type, etc. SSA5000A is helpful for users to troubleshoot flexibly in the laboratory and optimize RF design easily and quickly.

Figure 1-2 Test result

Using the SSA5000A noise figure measurement option

1 Introduction

The article demonstrates how to use the noise figure analysis function of SIGLENT SSA5000A spectrum analyzer to make high quality noise figure measurements quickly and efficiently.

1.1 Noise Figure Fundamentals

1.1.1 Definition of Noise Figure

Noise is the interference generated inside components or systems, which leads to the deterioration of circuit performance; There are three main parameters for noise quantization: noise figure (NF), noise factor (F) and equivalent noise temperature (Te).

The noise factor (F) is defined as the ratio of the signal-to-noise power ratio at the input to the signal-to-noise power ratio at the output.

Noise Factor: $F = (Sin/Nin)/(Sout/Nout)$

Where Sin = input signal power; Sout = output signal power; Nin = input noise power; Nout = output noise power.

To express the noise factor in decibels (dB) is the noise figure (NF): NF (dB) = 10*log (F).

Most LNAs are described by noise figure, but Te is commonly used to characterize the noise of an LNA when the noise factor is less than 1 dB: Te = 290*(F-1). The equation expresses the relationship between noise figure and temperature: NF (dB) = 10*lg (1+ Te /290)

1.1.2 Noise Figure Measurement Method

There are two main methods to measure noise figure: Y factor method and cold source method. In this paper, we discuss the Y factor method.

The noise source is an essential equipment for the Y-factor method of measurement. The noise source is a noise generator that can generate two different noise powers. Usually, it needs a DC pulse power supply drive voltage. When the DC drive voltage is supplied, it is equivalent to the noise source being on, which is called hot state. At this time, a large noise power is output. When the power supply is turned off, it is equivalent to the noise source off, which is called cold state. At this time, the noise power at room temperature is output. For a given noise source, the value of ENR will change with frequency. According to the different internal attenuators, the nominal value of ENR of typical noise sources ranges from 6 dB to 15 dB. Using the noise source, two noise power measurement results can be obtained at the output port of the device under test. The ratio of these two measurement results (called Y factor) can be used to calculate the noise figure: NF=ENR-10lg(Y-1), and ENR is generally given by the specifications of the noise source.

Figure 1-1 NSD28

1.2 Amplifier Measurement

In this section, a low noise amplifier with a frequency range of DC-10 GHz is used as an example to demonstrate how to use the noise figure analysis function of SSA5000A to measure the noise figure quickly and effectively.

Table 1-1 DUT Specifications

Frequency Range	Gain	Noise Figure
DC-10 GHz	26 dB	6 dB

1.2.1 Calibration Step

In order to accurately measure the noise figure, before measuring the DUT, the measurement system must be calibrated to identify and correct the inherent noise figure of the system, and the measured instrument noise figure is removed from the total noise figure measurement value, so that only the noise figure and gain of the DUT are displayed.

Figure 1-2 Connection setting of noise figure measurement calibration

Operating procedure:

1. After 30 minutes of warm-up, click Spectrum Analyzer in the upper left corner to enter the window management page, and click **Noise Figure (NF)** > **Noise Figure** to add noise figure analysis window. At this time, the SSA5000A works in the noise figure measurement mode.
2. Connect the noise source: Connect the noise source and the spectrum analyzer according to the calibration settings in Figure 1-2. The analyzer controls the noise source through USB connection and directly connects the output of the noise source to the RF signal input end of the analyzer.
3. Setting amplitude: Select **AMPTD**. When entering the noise figure mode, the internal preamplifier will be turned on automatically, and the input attenuation value will be fixed at 0 in the automatic mode.
4. Setting frequency: Select **FREQ**, set the start frequency to 10 MHz, the stop frequency to 10 GHz and the number of scanning points to 11.
5. Setting ENR: Select **Meas Setup** > **ENR** > **Edit ENR** and fill it in the ENR table, which is a series of frequencies and ENR values corresponding to frequencies.
6. Save the ENR table: Select **Meas Setup** > **ENR** > **Save** and save the filled ENR value and display ENR to verify the data has been transmitted correctly.

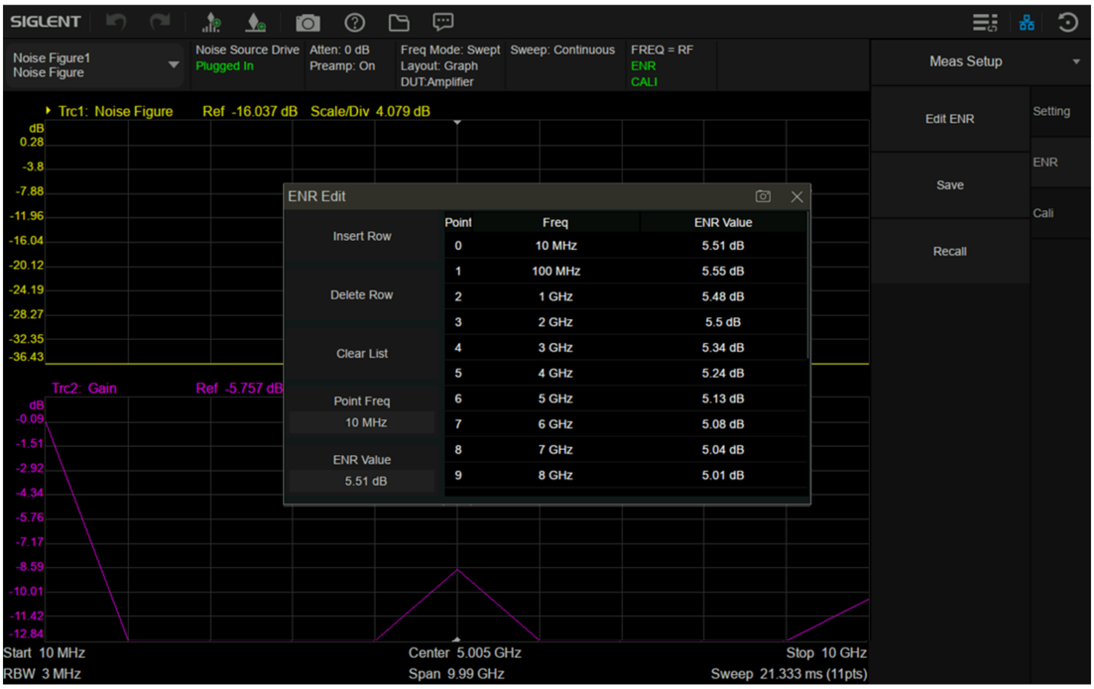

Figure 1-3 ENR table

7. Set average: Select **Meas Setup** > **Setting**, the average number of times is 10 and switch to on.
8. Perform calibration: Select **Meas Setup** > **Cail** > **Calibrate now** > **Enter**.

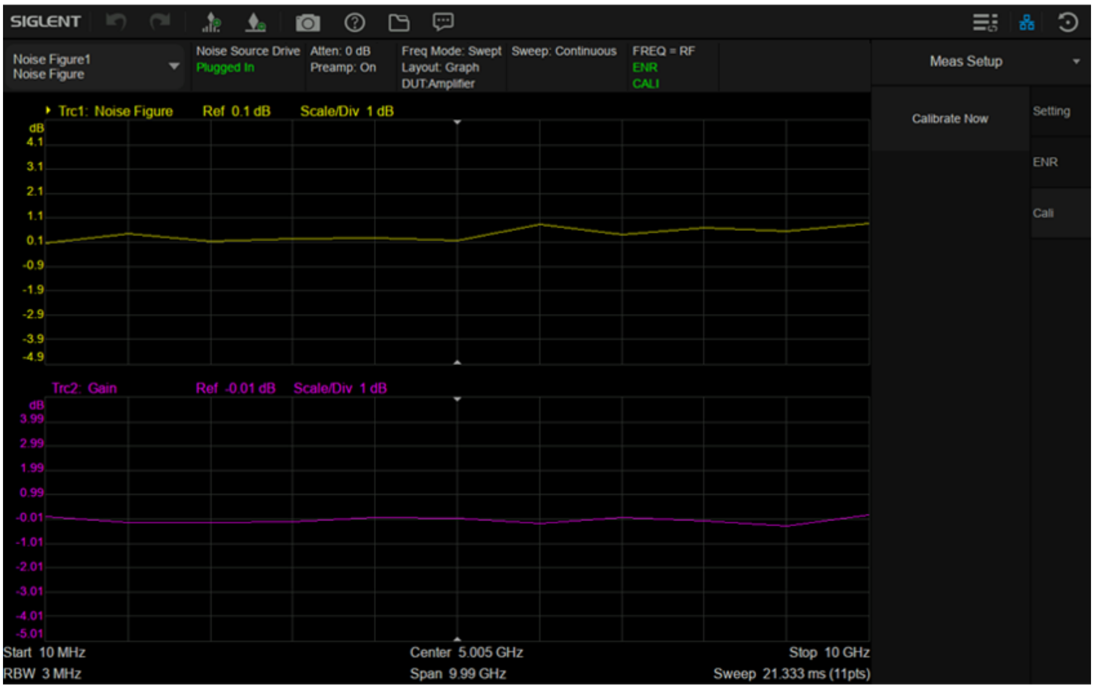

Figure 1-4 Noise figure measurement calibration

9. View the results in the table: Select **Trace** > **Format** > **Layout** > **Table**. When the calibration is completed and the device under test is not inserted, the gain and noise figure are close to 0 dB, which indicates that the analyzer has removed the noise components from the measurement system, and the results can be better viewed by using the table layout mode.

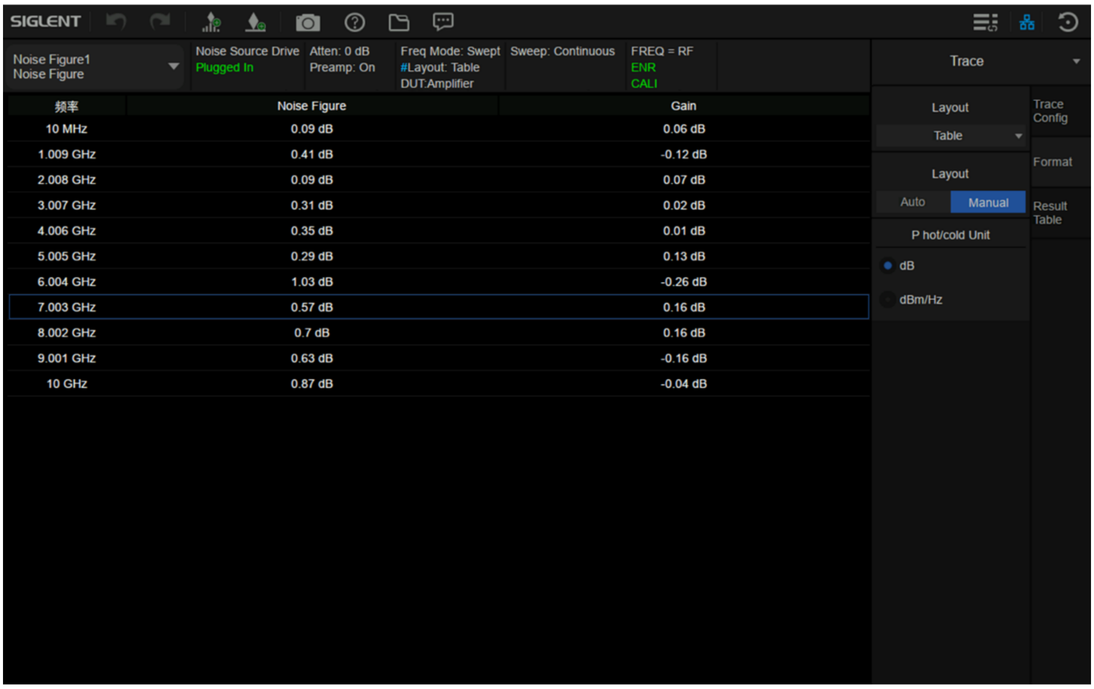

Figure 1-5 Noise figure measurement calibration

1.2.2 Measurement Step

After the calibration is completed, maintain the control of the analyzer on the noise source, connect the output of the noise source to the input of the DUT, and connect the output of the DUT to the RF signal input port of the analyzer.

Figure 1-6 Connection settings for noise figure measurement

After connecting the DUT and the noise source, the measurement results appear on the display screen of the analyzer. The results show that the noise figure of DUT is 6.12 dB and the gain is 26.69 dB. Therefore, the device under test meets the manufacturer's specifications in the target frequency range.

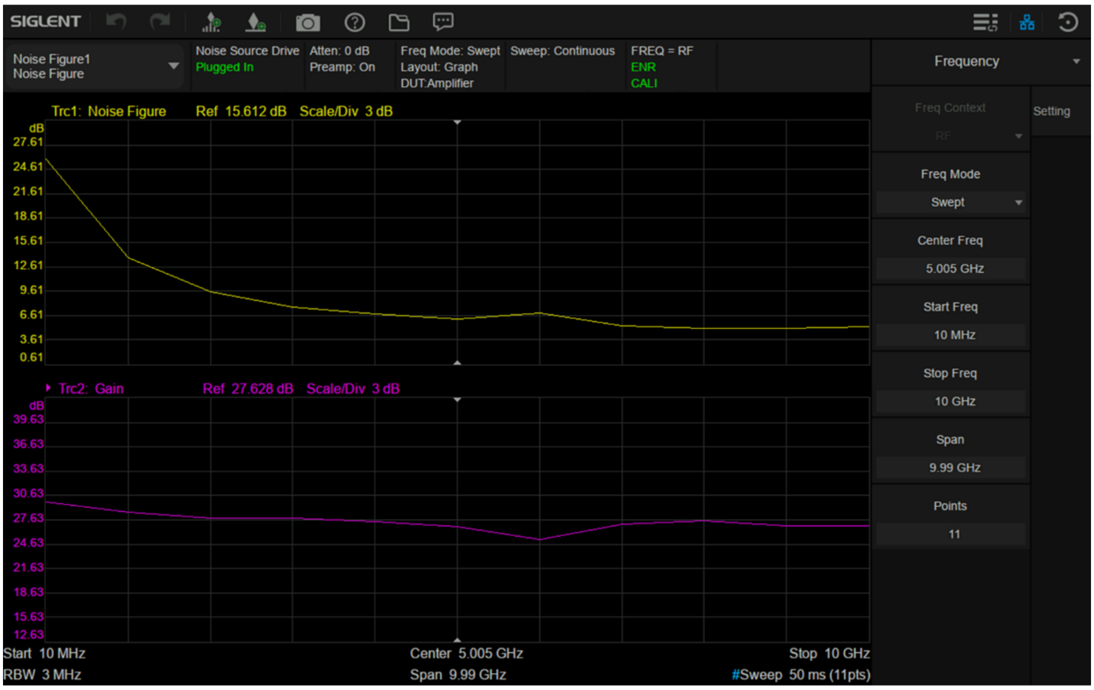

Figure 1-7 Noise figure measurement result

1.2.3 Gain Measurement Method

We use the gain method to make a simple check on the measurement results. The accuracy of this method is lower than that of the Y-factor method which needs to be calibrated by the noise source, and it is equivalent to the amplitude accuracy of the analyzer.

DANL reflects the minimum level that the analyzer can measure, and also reflects the level of internal noise of the analyzer. Connect a 50Ω matching load to the input of the analyzer or directly suspend the input interface, and the measured DANL is -161.92 dBm/Hz. Then, the output of the amplifier is connected to the input of the analyzer, and the input of the amplifier is connected to a 50Ω matching load or directly suspended. The noise power spectral density measured without power supply is -161.97 dBm/Hz, and the noise power spectral density measured with power supply is -142.05 dBm/Hz.

Operating procedure：

1. Select **FREQ**, set the center frequency to 5 GHz and the Span to 10 MHz.
2. Select **AMPTD**, set the attenuation to 0 dB, and turn on the preamp.
3. Select **BW** and set the resolution bandwidth to 3 MHz.
4. Select **Trace** and set the average trace type.
5. Select **Marker** > **Marker Function** and set the Noise Marker.

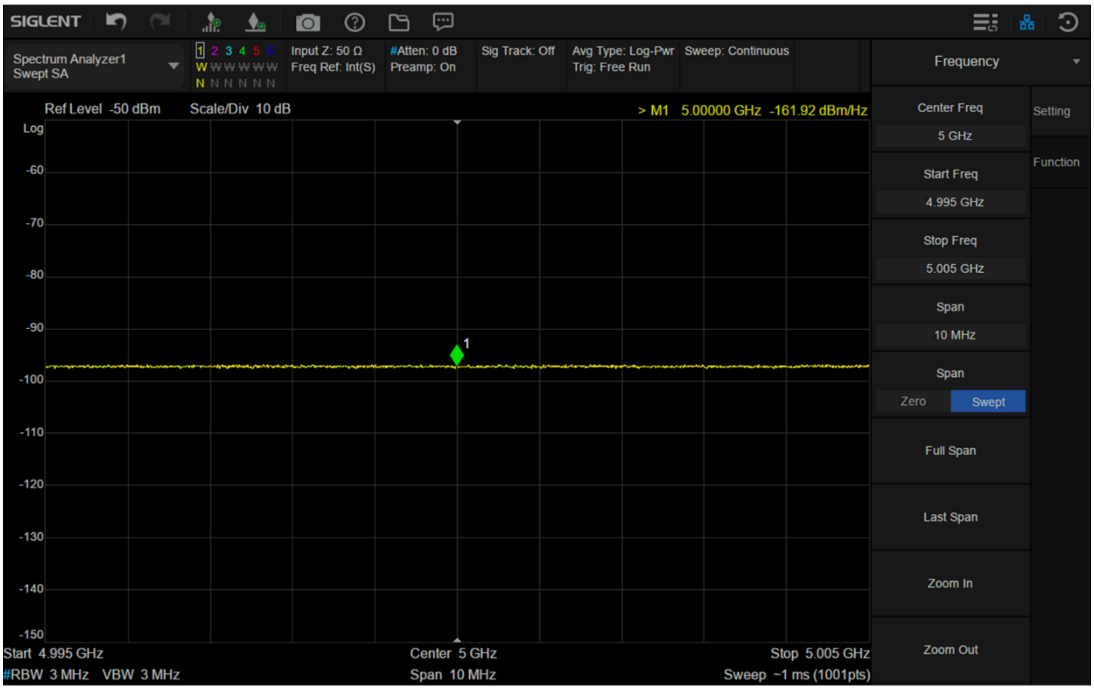

Figure 1-8 Noise power spectral density of analyzer

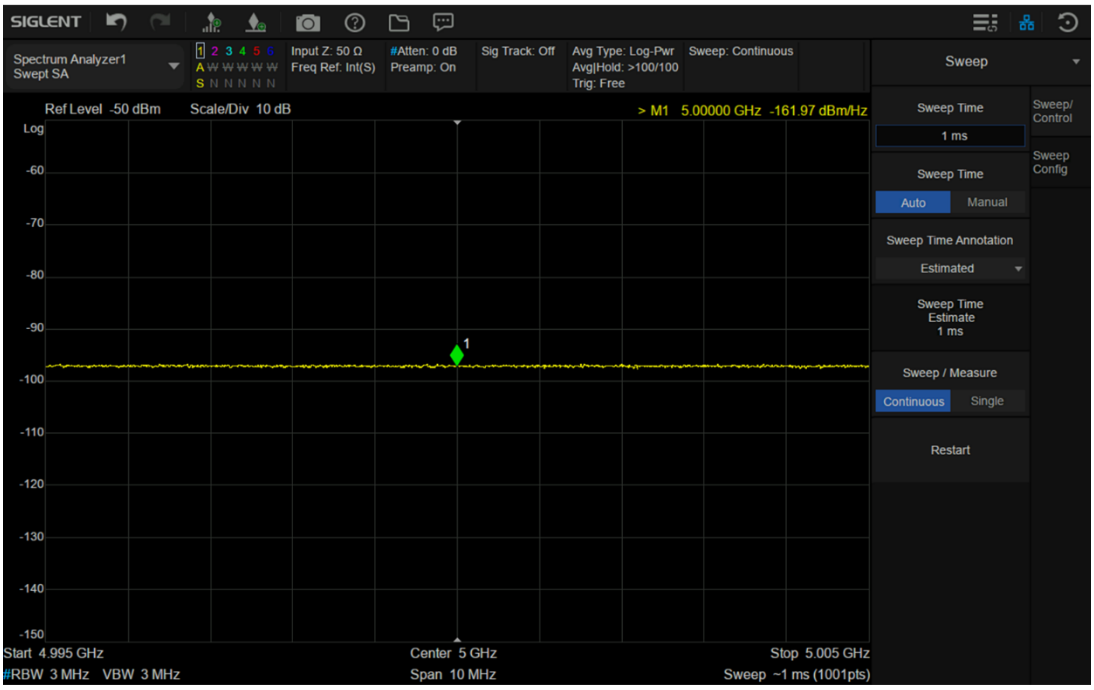

Figure 1-9 Noise power spectral density of unconnected power supply

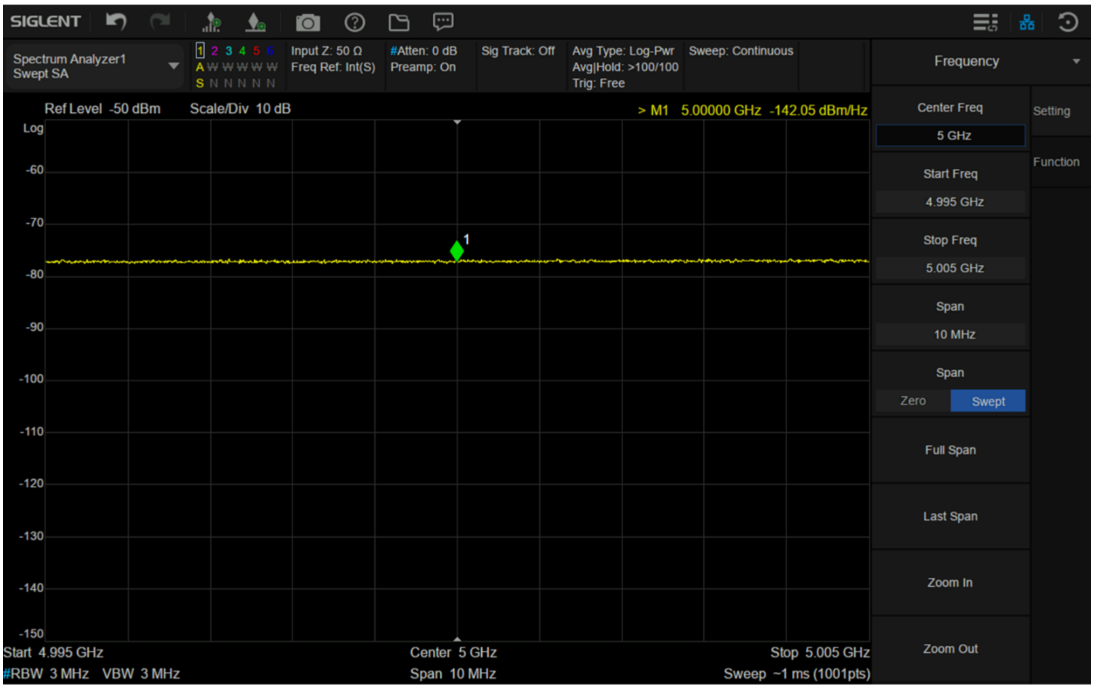

Figure 1-10 Noise power spectral density of connected to power supply

The logarithmic form of noise figure is:

$$\mathrm{NF(dB)} = 10\mathrm{lgF} = 10\mathrm{lg}\frac{\mathrm{P_{out}}}{\mathrm{GkT_0B}} = 10\mathrm{lgP_{out}} - 10\mathrm{lgG} - 10\mathrm{lgB} - 10\mathrm{lgkT_0}$$
$$= \mathrm{P_{out}(\,dBm/Hz)} + 174(\,\mathrm{dBm/Hz}) - \mathrm{Gain(dB)} = -142 + 174 - 26 = 6$$

Therefore, the gain measurement method needs to obtain the gain of the DUT and the noise power spectral density of its output when the physical temperature of the input terminal of the DUT is 290K. The thermal noise at room temperature is -174 dBm/Hz (the theoretical minimum value of DANL at room temperature), and the power spectral density can be measured by the analyzer. The biggest limitation of the measurement comes from the noise floor of the analyzer. Because the $\mathrm{P_{out}(\,dBm/Hz)}$ of a DUT with low gain and low noise figure is very small, which is often far less than the noise floor of analyzer, the gain measurement method is only suitable for a DUT with high gain and high noise figure.

Using the SSA5000A phase noise analysis function

1 Introduction

A stable frequency source is a common need for many electronic devices and most RF equipment. Phase noise can be used to characterize the short-term frequency stability of these frequency sources. In this document, we will briefly describe how to use the phase noise analysis function of Siglent SSA5000A Spectrum analyzers.

2 Typical Phase Noise Measurement Methods

Using the Spectrum analyzers' spectrum analysis mode is the most typical and the most direct and widely used method to measure phase noise,shown as Figure 2-1.First measure the carrier power (P_c) in dBm. Next use the delta marker mode to set the marker to a specific frequency offset from the carrier, i.e. a point in the phase noise sideband. Then we measure the noise power (P_n) in 1 Hz bandwidth at that offset. If setting the resolution bandwidth (RBW) of the spectrum analyzer to 1Hz for scanning, it will take too long. You can use the noise marker function to normalize the noise measured by the RBW filter to 1Hz bandwidth. The power of the noise will be reduced by NdB after normalization, for which N=10*log(RBW/Hz). In the most cases, measuring phase noise requires repeating the process at different offsets from the carrier.

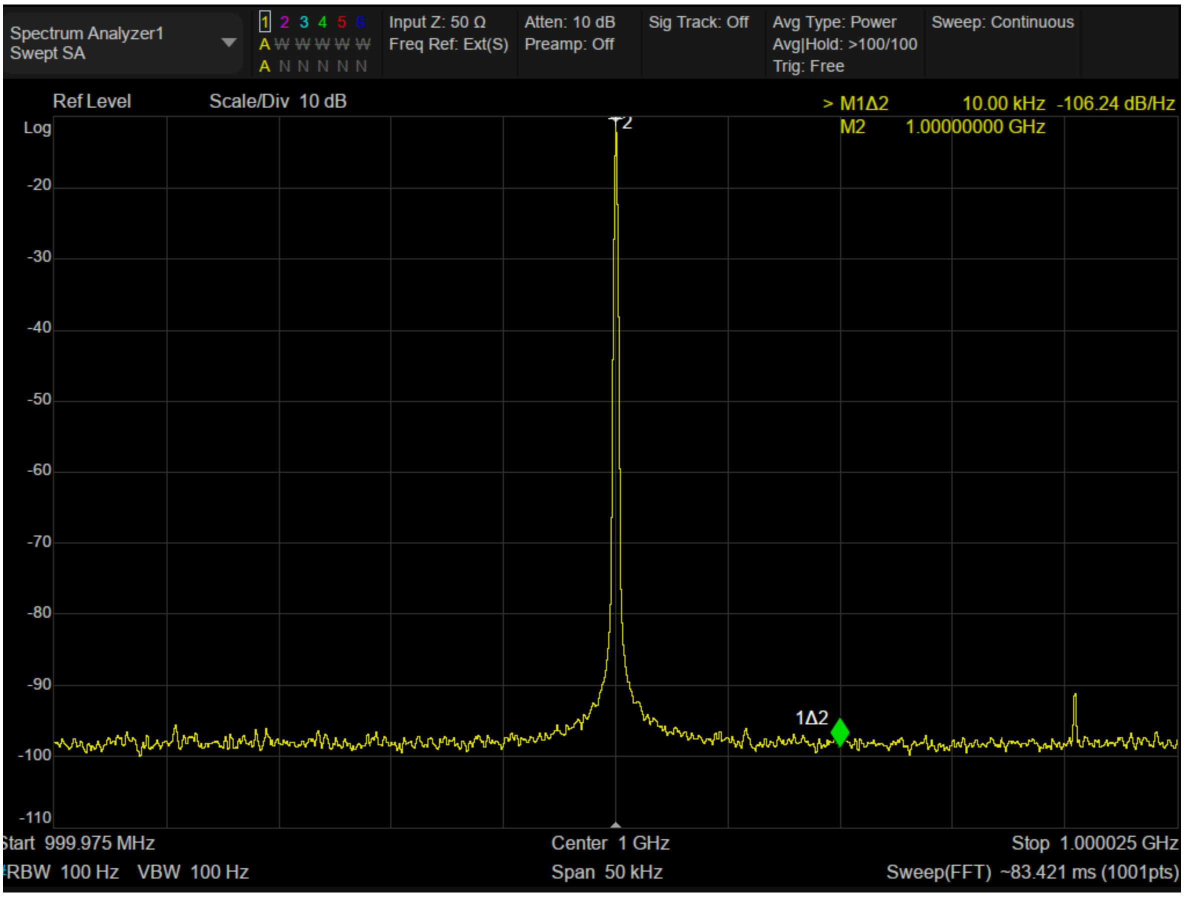

Figure 2-1 Typical Phase Noise Measurement Methods

3 Phase noise analysis function

In practical measurements, it is often too cumbersome to repeat the measurement using different frequency offsets after locating the carrier frequency. The SSA5000A offers an automated measurement method.

Click Spectrum Analyzer in the upper left corner after powering to enter the window management page. Click **Phase Noise** > **Log Plot** to add a window for phase noise analysis, and then the Spectrum analyzers will work in the phase noise measurement mode.

The working interface of phase noise analysis is similar to that of spectrum analysis, shown as follows:

① Mode/Measure： Indicate the current working mode and measurement function of the analyzer, and click to switch, such as spectrum analysis mode, real-time spectrum mode, etc.

② Instrument Configuration：Indicate the main working states of trace, interface, sweep, trigger, etc.

③ Measurement Result: Display the signal measurement results of the analyzer in various forms such as waveform, spectral line, cursor, table, statistics, and constellation diagram.

④ Sweep Parameter: Indicate and control the main sweep parameters, such as frequency, resolution, scanning time, etc.

⑤ Menu: Complete the parameter setting of the analyzer.

Figure 3-1 Operation interface of phase noise analysis function

3.1 Frequency Settings

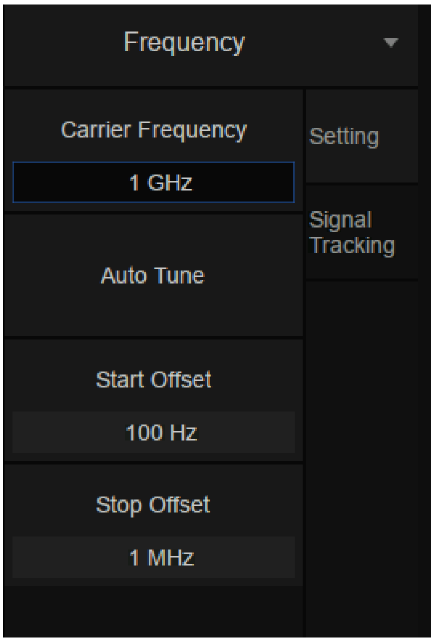

Figure 3-2Frequency Settings

Carrier Frequency: set the frequency of the carrier

Auto-tune: Spectrum analyzers will automatically locate and set the carrier frequency and set the offsets.

Start Offset: minimum offset from the carrier frequency

Stop offset: maximum offset from the carrier frequency

After completing the setup, the Spectrum analyzers will automate the measurement process and repeat the measurement within the defined frequency offset range.

3.2 Signal Tracking Setup

Span: Since the input source is not always stable, it will have a frequency deviation around, resulting in biased test results. This function tracks the frequency deviation within a specified range, to minimize the effects of frequency deviation.

3.3 Test results reference

The single-sideband phase noise measured within the specified frequency offset range is shown in Figure 3-3. In the figure, the offset range is 100 Hz to 1 MHz. The log scale is used for the horizontal axis because in this way it is possible to obtain both a wider frequency range and a finer resolution when close to the carrier——smaller offsets tend to reflect the quality of the signal better than phase noise at larger frequency offsets.

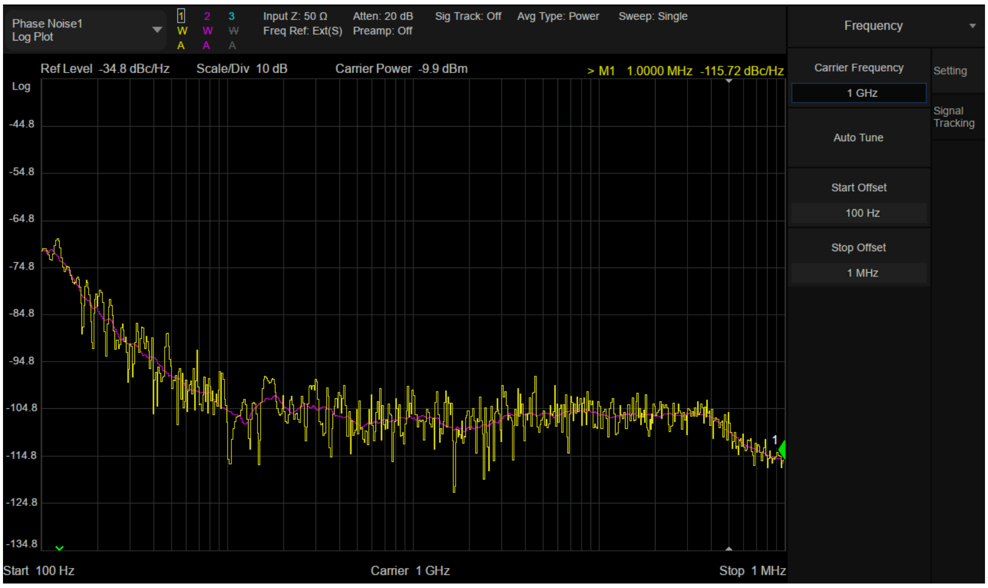

Figure 3-3 Test results

In the Figure 3-3, trace 1 is the original data and trace 2 is the smoothed single-sideband phase noise.

4 Advantages of SSA5000A phase noise function

4.1 Lower Displayed Average Noise Levels

When using the spectrum analyzer for phase noise measurements, the phase noise is calculated from the carrier power and the noise power at different offsets of the carrier. The noise power to be measured is generally small, and in order to keep the phase noise from being covered by the Spectrum analyzers' display average noise level（DANL）, the Spectrum analyzers' display average noise level is required to be very low. The SSA5000A's display average noise level is lower than -165dBm/Hz. Users can evaluate whether the input signal amplitude is appropriate and if the measurement is correct based on DANL and the phase noise of the Spectrum analyzers.

4.2 Smaller resolution bandwidth

The performance of Spectrum analyzers is highly demanded when measuring phase noise with very small offsets from the carrier. A very narrow resolution bandwidth is required to avoid measuring carrier power and noise power in an RBW filter. The SSA5000A has a minimum resolution bandwidth of 1 Hz, and the starting frequency offset in the phase noise measurement function also supports a 1 Hz setting.

4.3 Lower phase noise

The phase noise of the Spectrum analyzers can also have an effect on the test. Spectrum analyzers usually have multiple local oscillators (LOs). During testing, the spectrum analyzer's oscillators have their own phase noise, which will be added to the phase noise of the measured signal as it moves through different stages in the analyzer.

Therefore, when using a spectrum analyzer to measure phase noise, it is necessary to distinguish the phase noise in the original signal from the phase noise added by the instrument. The simplest way is to ensure that the spectrum analyzer's phase noise specifications are far superior to the device under test (DUT). Siglent's SSA5000A has a phase noise lower than -105 dBc/Hz@1GHz at 10kHz offset, which meets a considerable number of measurement requirements.

Using the SSA5000A pulse measurement option

1 Introduction

RF pulse signals are widely used in pules modulated radar, and testing of pulse signals is necessary for engineers working in related fields. In some critical areas such as aerospace national defense and radar EW applications, signal design and verification require integrated time domain/frequency domain/modulation test tools for pulse radar signal analysis. SIGLENT SSA5000A's Pulse function provides pulse analysis that can help engineers better analyze today's dynamic signal environment.

2 Characterization of Pulse Signals

Figure 2-1 shows the simplest way to generate RF pulse signals. The pulse modulator can be understood as a switch. The baseband pulse controls the on and off of the signal, thereby converting the input CW signal into a radio frequency pulse signal. This process can also be understood as the time domain multiplication of CW signal and baseband pulse signal.

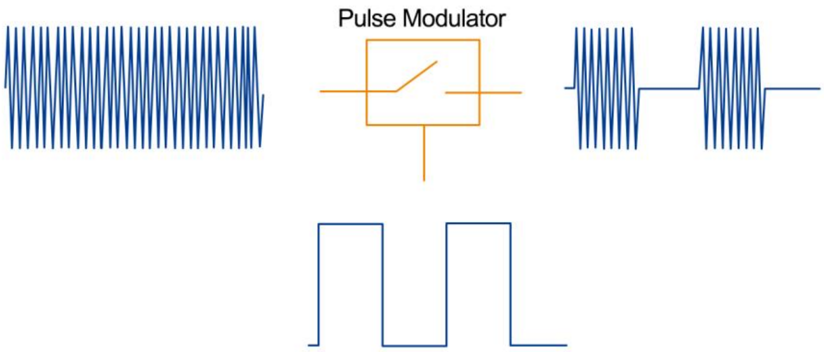

Figure 2-1pulse modulated signal

Multiplication of two signals in the time domain is equivalent to the convolution of their spectra. The spectrum of the CW signal is theoretically a single spectrum line. According to the spectrum of the baseband pulse signal, the spectrum of the radio frequency pulse signal can be obtained as shown in Figure 2-2.

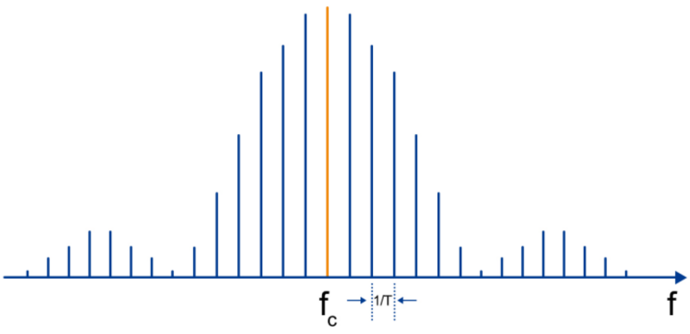

Figure 2-2 spectrum of radio frequency pulse signal

The pulse-modulated signal is a periodic signal, and its spectrum is a discrete spectrum. The amplitude of each spectral line changes according to the Sinc function. The spacing between neighboring spectral lines is the reciprocal of the baseband pulse period T. When actually testing with a spectrum analyzer, the envelope spectrum or line spectrum can be shown by setting different RBW. When the RBW is smaller than the spectral line spacing, a line spectrum is obtained; when the RBW is gradually increased, it is gradually shown as a pulse envelope spectrum.

In terms of the time domain, the greatest characteristic of the pulsed signal is the discontinuity in time domain. Burst characteristics in the time domain are a basic requirement for pulsed use in radar applications, and therefore the pulse signal parameters are also the main metrics for radar signal quality assessment. The time-domain discontinuity of pulsed signals also adds to the difficulties in power and spectral testing.

In this note we will discuss time and frequency domain testing of pulses.

3 Analysis pulses by using the Pulse Function of the SSA5000A

3.1 Configure the SSA5000A

As a universal instrument that can handle both spectral power and bandwidth analysis, the spectrum analyzer can be used for power testing while observing the spectrum if there are no especially demanding requirements for accuracy. The pulse function of the SSA5000A can be used to measure pulse width, amplitude and time parameters. In the pulse analysis function, the spectrum analyzer is in zero-span mode. At this time, the spectrum analyzer is equal to a peak power meter, which can be used to detect the envelope of the signal at a specific frequency point with a certain bandwidth and draw the time-dependent power curve. In this case the RBW of the spectrometer is equivalent to the bandwidth of this detector. The spectrometer in zero span mode will pin the local oscillator at the center frequency, so we need to set the center frequency correctly in the frequency settings when performing pulse analysis. Actually, if the center frequency is offset a little from the actual carrier frequency, you may also get an acceptable test result, that's because most of the power of the pulse signal can pass through the IF filter.

Figure 3-1 test result of pulse test

The test results are shown in Figure 3-1, where the horizontal axis of the spectrometer is time and the vertical axis is power. The analyzer will automatically recognize the rising and falling edges of the pulse signal and calculate the power and rise/fall time during pulse switch. For narrow pulses, you can increase the analyzer's RBW for more accurate measurements. In fact, the rise time measured by the analyzer generally can't be better than the optimal rise time of the spectrum analyzer. The rise time of the analyzer is determined by the following formula: Tr=0.66/max RBW. The maximum RBW of the SSA5000A is 10MHz, which means that the rise time of the pulse must be greater than 66ns otherwise the analyzer won't give a correct result. For the line spectrum test, the VBW setting does not have much effect on the test results of the spectrum, but for the pulse test, the VBW should not be smaller than the RBW, otherwise it will result in a lower peak power. The VBW filter filters the envelope of the signal passing through the IF filter. While in pulse test, where multiple spectral lines pass through the IF filter at the same time, the synthesized envelope has it own bandwidth, and if the bandwidth is greater than the VBW bandwidth, the test result will be decreased. Generally, when testing sinusoidal signals, the VBW:RBW is selected from 1 to 3, while testing pulse signals, the VBW:RBW is generally selected 10 to minimize the effect on signal amplitude.

For pulse signals with known period, you can select periodic trigger in Trigger and set the trigger Period and pulse period to be the same. Thus, you can get a stabilized triggered pulse signal.

3.2 Result analysis

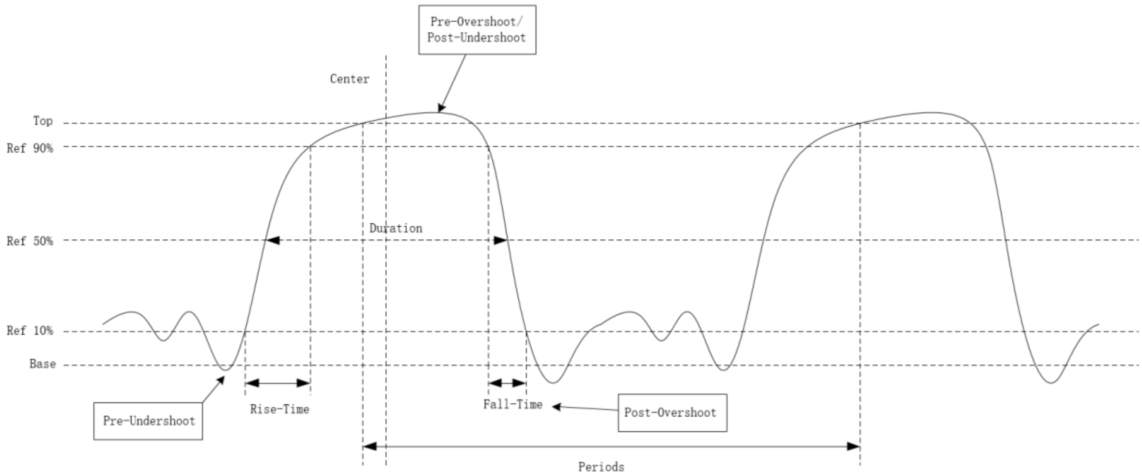

Figure 3-2 Pulse Signal Schematic

The schematic diagram of the pulse is shown in Figure 3-2, from which the individual results of the pulse measurement can be clearly seen. In the power measurements result Pospeak is the highest level on the trace and NegPeak is the lowest level on the current trace. The spectrum analyzer calculates Amptmid = (PosPeak - NegPeak) / 2 + NegPeak. When a trace continuously passes through the pulse low reference (RefLow, 10%), pulse continuous reference (RefDuration, 50%), pulse high reference (RefHigh, 90%) (referred to as the rising edge), or when it passes through these three reference amplitudes in the opposite direction (referred to as the falling edge), mark this trace as the edge of the pulse. For a complete measurement of the parameters of the pulse, at least 3 edges are required. In pulse characteristics the pulse duration is the time difference between a positive pulse (negative pulse) passing through the pulse duration reference (RefDuration, 50%) on the rising edge (falling edge) and a falling edge (rising edge) passing through the pulse duration reference (RefDuration, 50%).

Pulse Off Time = Pulse Period - Pulse Duration. The duty cycle and frequency of the pulse can be calculated from the period and pulse width.

In the conversion characteristics, the rise-time is the time spent between the first rising edge of the pulse crossing RefLow and crossing RefHigh, and the fall time is the time spent between the first falling edge of the pulse crossing ReHigh and crossing RefLow. And the analyzer will automatically calculate the Pre-Overshoot, Pre-Undershoot, Post-Undershoot and Post-Overshoot of the pulse in dB.

4 Analyze the Spectrum of a Pulse Signal Using SSA5000A

4.1 Measure the pulse spectrum using the swept SA

Measuring the pulse spectrum by sweeping Spectrum Analyzer is the classic way which is commonly used by engineers in the last decades. This method is suitable for observing stable pulse signals with known pulse width and period. However, due to the limitation of the sweeping speed of the swept frequency spectrum analyzer, the analyzer has limit to track and capture the transient signals, and cannot observe the shortcut pulse signals and broadband modulated pulse signals well. When observing the Linear Spectrum using a sweep, we need to set the RBW smaller. However, when the RBW is small, the speed of data acquisition is much faster than the speed of digital processing speed, so it has a long dead time, and if there are some short disturbances, it is likely that these signals will be missed. The SSA5000A automatically switches the scan mode to FFT at 10kHz RBW or lower. In this way the analyzer will stay longer each time it tunes to a certain frequency, and will also analyze all the energy within a frequency spectrum. In this sense, the FFT can be viewed as a parallel array of IF filters operating simultaneously, thus speeding up the sweep speed. Therefore, when analyzing the spectrum of a pulsed signal, the results obtained using an FFT scan mode will be more accurate. The test results are shown in Figure 4-1

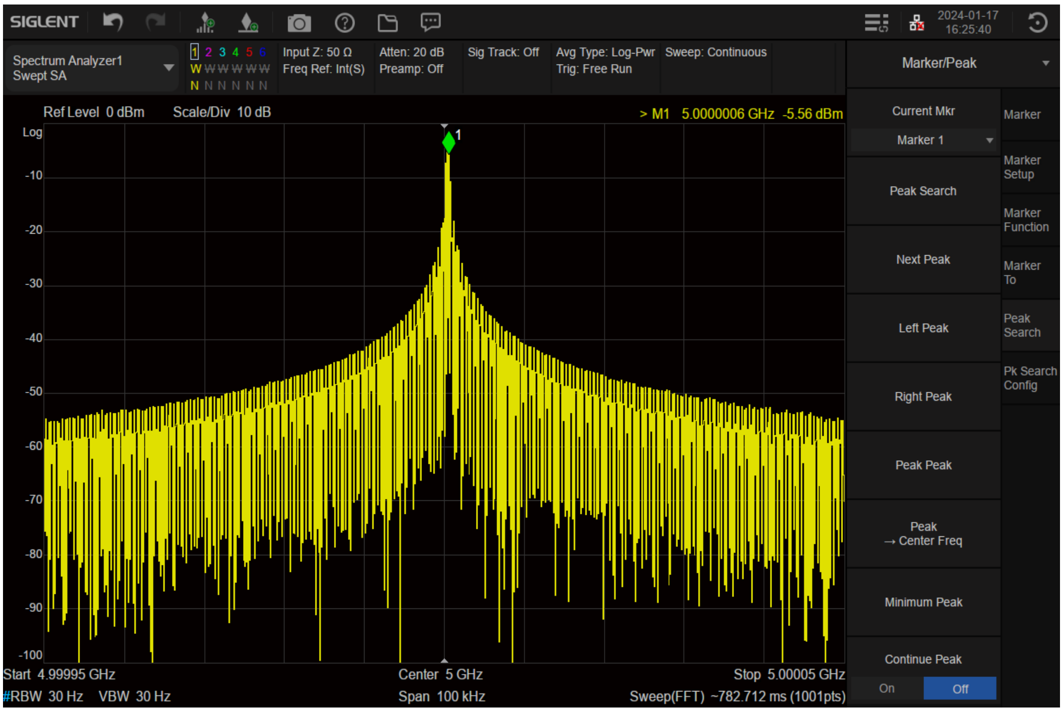

Figure 4-1 Spectrum of pulse modulation in SA mode

4.2 Measure the pulse spectrum using the RTSA

Unlike traditional swept spectrum analyzers, real-time spectrum analyzers do not perform oscillation scanning, but use a broadband ADC to sample signals within a certain bandwidth and perform spectrum calculations with the help of real-time FFT functions of FPGAs. This enables continuous spectrum generation of all ADC sample data without loss, so that no instant signal change is missed. Based on a large number of continuous FFT results, the real-time spectrometer can perform real-time frequency template triggering as well as three-dimensional displays in the time, frequency, and amplitude domains to accurately depict the signal change process. The biggest advantage of real-time spectrum analysis is the uninterrupted measurement of the spectrum and frequency-selective triggering. So, using these two advantages, RTSA is the most scientific tool for complex pulse analysis. The test result of spectrum and spectrogram in real-time spectrum mode are shown in Figure 4-2.

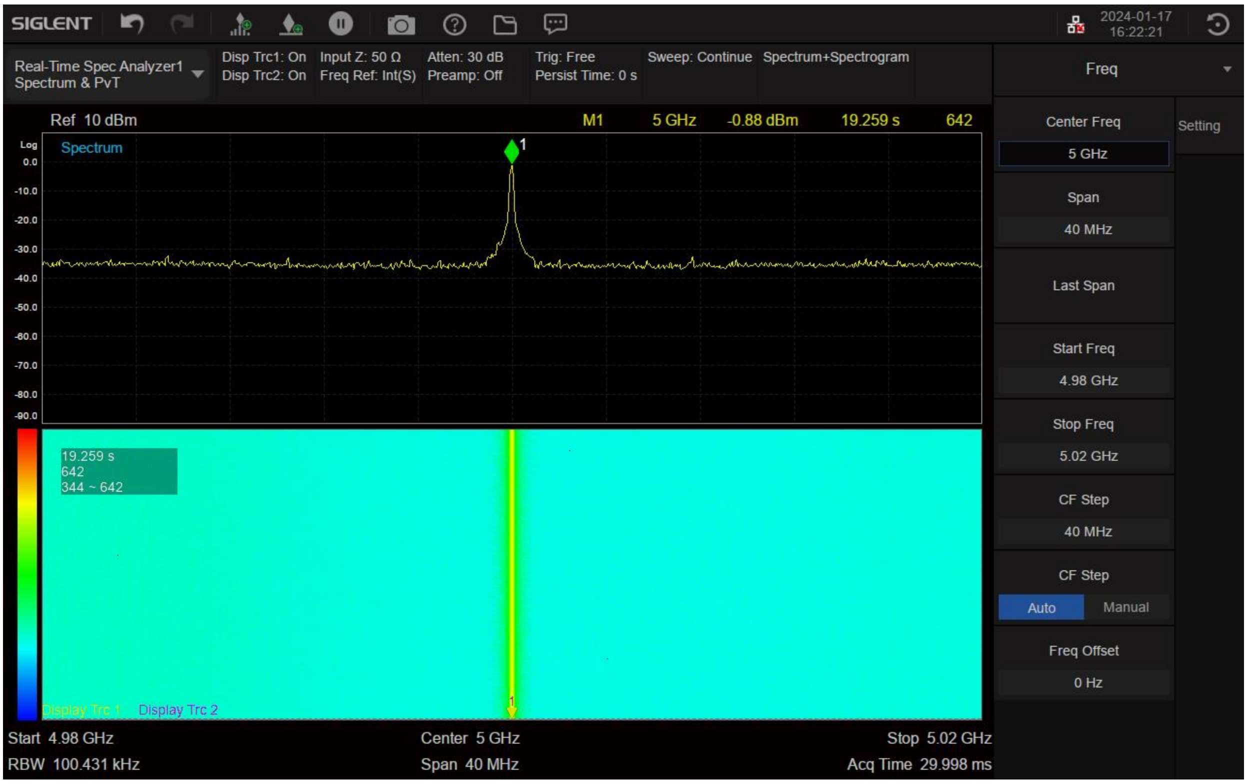

Figure 4-2 test result of spectrum and spectrogram

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About SIGLENT

SIGLENT is an international high-tech company, concentrating on R&D, sales, production and services of electronic test & measurement instruments.

SIGLENT first began developing digital oscilloscopes independently in 2002. After more than a decade of continuous development, SIGLENT has extended its product line to include digital oscilloscopes, isolated handheld oscilloscopes, function/arbitrary waveform generators, RF/MW signal generators, spectrum analyzers, vector network analyzers, digital multimeters, DC power supplies, electronic loads and other general purpose test instrumentation. Since its first oscilloscope was launched in 2005, SIGLENT has become the fastest growing manufacturer of digital oscilloscopes. We firmly believe that today SIGLENT is the best value in electronic test & measurement.

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