PX Series NX Series SA Series

SASTUDIO4
USER GUIDE

SA/NX/PX Series User Guide

Real-time Spectrum Analyzer up to 40 GHz

HAROGIC

V1.1 2025/09/01

Content

1. Version Management

Updated Description Sheet

Version Number	Content	Time
V1.0	Initial version	2025-8-8
V1.1	1. Added a section on switching the X-axis scale 2. Added a section on peak tracking 3. Added a function for automatic parameter adjustment in left/right peak searching	2025-8-25

2. Preface

The software supports three display modes:

- **SA/NX Series instruments**: Single-column workstation mode (default), dual-column workstation mode, and tablet mode
- **PX Series instruments**: Tablet mode

This document uses the tablet mode in the software as an example to describe the interface layout, operating modes, and operation methods of the spectrum analysis software. Although the supported display modes vary among different instruments, the operation logic is consistent across all modes. The corresponding interface diagrams are shown below.

Figure 1 Tablet mode interface display

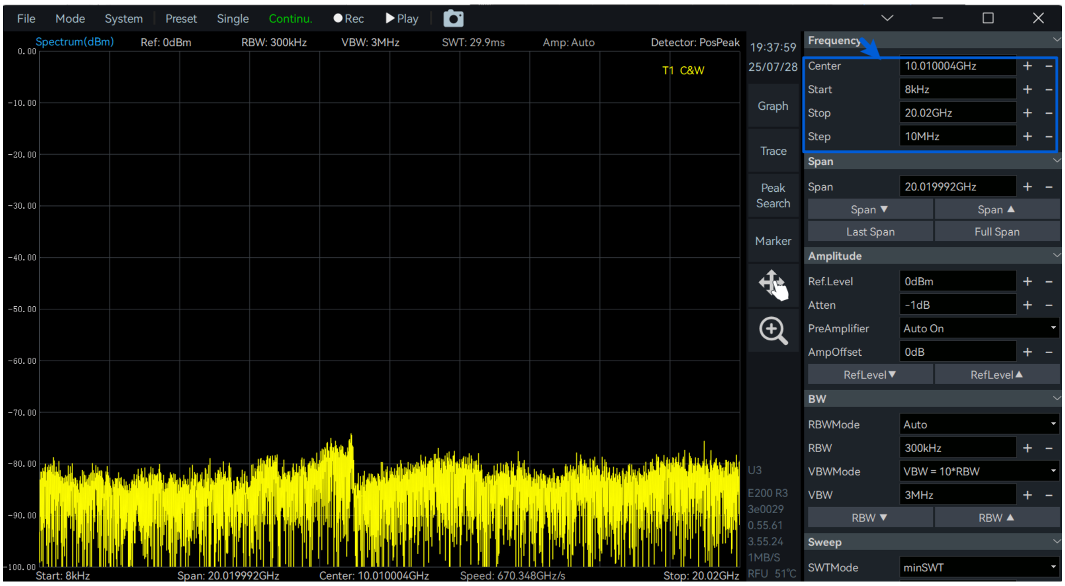

Figure 2 Tablet mode interface display

3. Preparation

3.1 Software Compatibility

The spectrum analysis software is compatible with the full range of SA, NX, and PX instruments running firmware version 55.

3.2 Operating Environment Requirements

For the SA/NX series, which are kernel-based instruments, the spectrum analysis software must be installed on a host computer. The recommended operating environment for the host computer is shown in the table below: Only the basic recommended configurations are listed in the table. For systems below the recommended specifications, please refer to the actual test results.

Table 1 System Operating Environment Requirements

Operating System	Windows 11/10/8/7, requires VS2019 C++ redistributables Ubuntu 22.04/20.04/18.04, Debian 12/11/10, Raspberry Pi OS 64-bit
Architecture	Windows: x64, AArch64 (only on NX devices) Linux: x64, AArch64
Processor	Windows: Intel i3 or above; AArch64 tested only on Snapdragon 8CX Gen2 Linux: Tested on Raspberry Pi 4B, RK3399, RK3588, etc.
Memory	4 GB or above
Storage	For IQ signal recording, the continuous write speed of the storage system must exceed 400 MBytes/s
Data Interface	USB 2.0 or USB 3.0 (USB 3.0 recommended) The bandwidth and duration of IQ signal recording are limited by the data interface bandwidth
Display Resolution	Not less than 1280 * 800 pixels
Other	Certain antivirus software may cause the system to malfunction

3.3 Default Software Storage Paths

For PX series instruments, the software is installed by default in the userdata directory on the desktop. For SA/NX series instruments, the software is installed in a user-defined directory:

- data folder: Recording files, Configuration files, and Spectrogram CSV data files
- images folder: Chart images
- reports folder: CSV files containing chart data and the corresponding configuration files

Except for quick record/playback files and quick screenshots, all other recording files or images can be stored in a user-defined path (PX series instruments require an external storage device, while SA/NX series instruments can define the storage path directly).

3.4 Software Acquisition

Please refer to the Software Update section for instructions on obtaining and installing the latest version of the software.

Note: By default, Windows x64, Linux x86_64 and Linux aarch64 versions of the software are provided. If a Windows x86 version is required, please contact official technical support for assistance.

4. Working Modes Overview

Software offers working modes, including Standard Spectrum Analysis (SWP), IQ Streaming (IQS), Power Detection Analysis (DET), Real-time Spectrum Analysis (RTA), Phase Noise Measure and Basic Digital Demodulation. The measurement functions available in each working mode will be explained in the following sections.

4.1 Standard Spectrum Analysis

In the standard spectrum analysis mode, the instrument performs frequency hopping according to the configuration to achieve frequency scanning. This mode is suitable for applications focused on frequency trace measurement and analysis. The measurement and analysis functions provided in the standard spectrum analysis mode include:

- Spectrum panoramic sweep
- Local spectrum zoom display
- Spectrogram
- Spectrum record and playback
- SEM
- Signal tracking
- IM3
- Channel Power
- OBW
- ACPR
- Amplitude correction
- Peak table

4.2 IQ Streaming

In the IQ streaming mode, the instrument acquires time-domain data within the analysis bandwidth according to the specified trigger signal and returns it to the user. This mode is suitable for applications such as time-domain signal recording and basic demodulation analysis. The functions provided in the IQ streaming mode include:

- IQ time domain waveform
- Spectrogram
- Power-time waveform
- Multi-channel DDC
- Pulse signal detection (option)
- Spectrum analysis
- AM/FM demodulation
- Audio analysis
- IQ data recording and playback

4.3 Power Detection Mode

In the detector analysis mode, the instrument performs continuous detection analysis on the time-domain signal within the analysis bandwidth. This mode is suitable for observing the relationship between time and power within a certain bandwidth, such as pulse parameter measurements. The functions provided in the detector analysis mode include:

- Power-Time waveform and zoom
- Pulse signal detection (option)
- DET data recording and playback

4.4 Real-Time Spectrum Analysis Mode

In the real-time spectrum analysis mode, the instrument performs real-time spectrum analysis on the time-domain signal within the analysis bandwidth and returns the spectrum results to the user. This mode is suitable for applications that focus on instantaneous and transient signals, such as interference troubleshooting and the identification of characteristic signals in complex electromagnetic environments. The functions provided in the real-time spectrum analysis mode include:

- Real-time spectrum probability density graph and spectrogram
- Real-time spectrum data recording and playback

4.5 Harmonic Analysis Mode

In the harmonic analysis mode, the instrument performs harmonic analysis on the signal based on its fundamental frequency and displays the frequency, amplitude, and the relative difference from the fundamental for each harmonic. This mode is suitable for analyzing harmonic distortion in signals and helps identify and evaluate their nonlinear characteristics. The functions provided in the harmonic analysis mode include:

- Harmonic spectrum diagram
- Harmonic measurement table

4.6 Phase Noise Measurement Mode

In the phase noise measurement mode, the instrument uses automated measurement techniques to provide high-precision phase noise plots and detailed data tables, enabling users to thoroughly analyze the phase stability of a signal and the noise density at different frequency offsets. The functions provided in the phase noise measurement mode include:

- SSB phase noise plot
- Phase noise measure table

4.7 Digital Demodulation Mode (Option)

In the digital demodulation mode, the instrument supports demodulation of various modulated signals and evaluates their modulation quality from multiple perspectives. This function is suitable for a wide range of applications, particularly for in-depth analysis and quality assessment of known modulated signals. The functions provided in the digital demodulation mode include:

- Constellation and eye diagram
- Bit table and demodulation
- Modulated signal spectrum analysis
- ASK/FSK/PSK/QAM demodulation

4.8 Application Software UI Layout

The application software UI consists of the following sections:

- Menu
- Graph Set Area
- Graph Display Area
- Main Setting Area
- Instrument State
- Parameter Quick Set

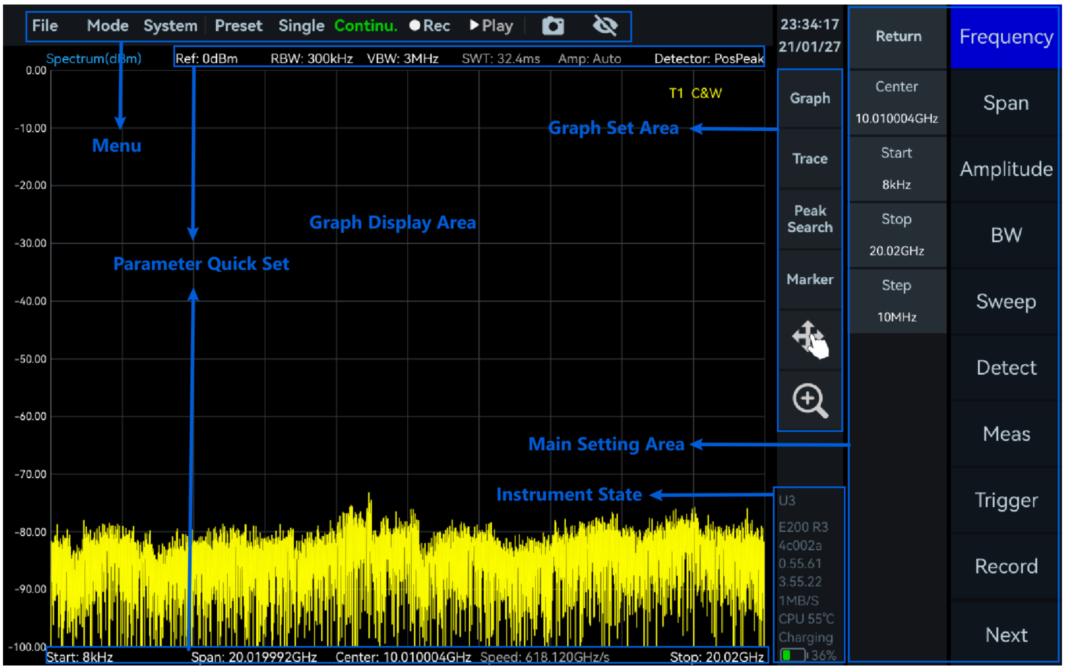

Figure 3 Software Interface Layout

4.8.1 Menu

- Save and load configuration
- Working Mode Switch
- Single or Continuous Preview
- Quick screenshot
- Fan Control (SA/NX only)
- Set startup state
- Measurement Mode Selection
- Record and playback
- GNSS, Instrument Information View
- Display Mode Switch (SA/NX only)

4.8.2 Graph Set Area

- Graph Settings
- Marking Settings
- Trace Settings
- Display Measurement Results

4.8.3 Main Settings Area

- Measurement and analysis settings
- Data record and playback
- Trigger settings
- System settings

4.8.4 Instrument State

- Instrument Model
- Current instrument temperature
- GNSS antenna connection status
- Instrument battery status (PX only)
- Software version
- Bus data throughput
- Last Six Digits of Instrument UID

5. Common Operation

5.1 Save and Recall Instrument Configuration

1. Save the current configuration

(1) Click "File" -> "Save Configuration" in the menu bar;

(2) In the "Save Configuration File" pop-up window, set the save path and file name, click "Confirm" to save the configuration file.

2. Open pre-stored configurations

(1) Click "File" -> "Open Configuration" in the menu bar;

(2) Select the configuration file in the "Please select a file" pop-up window, click "Confirm" to open the pre-stored configuration.

5.2 Save the Pictures

1. Click "File" -> "Save Picture" on the menu bar;
2. In the "Save Picture" pop-up window, set the path to save the picture and the picture name, and click "Confirm" to save the screenshot.
3. Users can also take screenshots by clicking the shortcut button " " in the menu bar, the pictures are saved in the "/images" folder by default, and the storage path cannot be changed.

5.3 Deleting files and images

For PX series instruments, drag the images from the *images* folder in the software directory to the "Trash Can", then click "Yes" in the Confirm pop-up window to delete the screenshots.

(The deletion method for record files and configuration files is the same as for screenshots.).

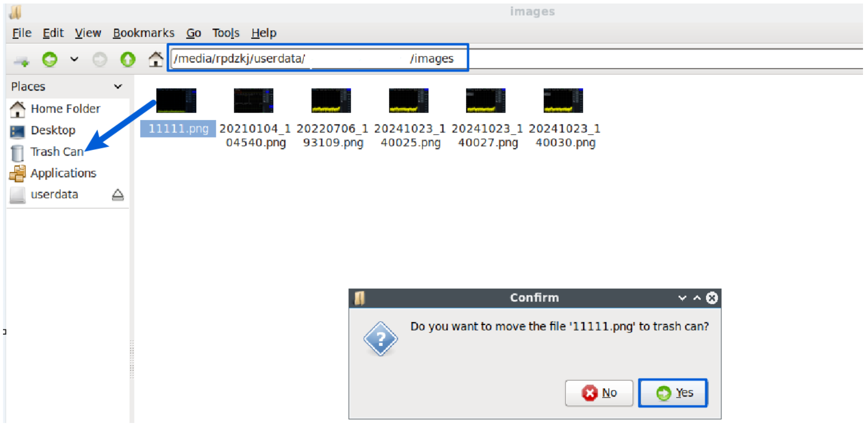

Figure 4 PX Series Instruments Delete Picture

5.4 Setting the Startup State

The instrument supports user-defined startup states, the relevant startup state description is detailed in Table 2.

Table 2 Upper computer software startup status

No.	Startup State	
1	**Default**	Uses the instrument's factory default configuration
2	**User Preset**	Loads a user-saved configuration file as the initial startup configuration.
3	**Last Used**	Restores the parameter settings from the last session before exiting the software.

If you want to set the startup state, follow these steps.

1. Click "File" -> "Startup Status" in the menu bar;
2. "Default" and "Last" can be ticked directly, the software will take this option as the initial state when it starts next time;
3. Select "User Preset", select the user's pre-saved configuration file in the "Please select a file" pop-up window that appears, and the software will open with the specified configuration at the next startup.

5.5 Switching operating modes

Click "Mode" in the menu bar to switch between standard spectrum analysis, IQ flow, detector analysis, real-time spectrum analysis, phase noise measurement, harmonic analysis and digital demodulation.

5.6 Professional and concise settings

You can switch between "Simple Settings" and "Professional Settings" by clicking "System" -> "Settings Mode" in the menu bar. You can switch between "Simple Settings" and "Professional Settings". Compared with the Simple Mode, the Professional Mode provides more abundant parameter options in the main setup area, so users can flexibly choose the appropriate setup mode according to their actual needs.

5.7 Theme Settings

Click "System" -> "Themes" in the menu bar to switch between "Dark" and "Bright" themes. Switch between "Dark" and "Bright".

5.8 Parameter Settings

Click "System" -> "Parameter Settings" in the menu bar, and you can set the following functions in the pop-up setting window:

Table 3 Parameter Setting Parameter Description

Parameter	Description
Vibration Feedback (PX only)	When enabled, the instrument provides haptic feedback via vibration during touchscreen operations.
Screen Lock	When enabled, a lock icon "" appears on the right side of the screen. Tap the icon "" to lock the screen and prevent accidental operations, tap again to unlock.
Numeric Detection	When enabled, reduces the refresh rate of certain displayed parameters (including marker) to aid observation and recording.
Idle Brightness Reduction (PX only)	When enabled, the instrument automatically lowers screen brightness if there is no operation for one minute.
Brightness (PX only)	Adjusts the screen brightness for PX series instruments.
Volume (PX only)	Adjusts the volume for PX series instruments.
Data/Time (PX only)	When GNSS is not locked, the user can manually set the PX series system time. Once GNSS is locked, system time can be synced once using Auto UTC Time or continuously synced using Sync UTC Time.

5.9 GNSS use

This section details how to obtain real-time positioning data using either the inbuilt or external GNSS module. Among them, the inbuilt module is provided with the instrument and the external module is selected by the user. It also describes how to use the 1PPS trigger and 10MHz reference clock of the inbuilt GNSS module.

Table 4 Description of GNSS parameters

No.	Parameter	Description
1	**GPS Type**	Select internal or external GNSS module.
2	**Baud Rate**	Serial port baud rate for the external GNSS module. Required only when using an external GNSS module.

3	**Format**	Provides two formats: Local Time and UTC Time.
4	**Antenna**	Select Internal Antenna or External Antenna (Currently only external antenna is supported). Required only when using the internal GNSS module.
5	**SatNum**	Number of satellites currently positioned.
6	**SNR(Max)**	Maximum signal-to-noise ratio of positioned satellites.
7	**SNR(Min)**	Minimum signal-to-noise ratio of positioned satellites.
8	**SNR(Avg)**	Average signal-to-noise ratio of positioned satellites.

5.9.1 Using Internal GNSS module

1. Click "System" -> "GNSS Info", and set "GPS Type" to "Internal GPS" and "Antenna" to "External" in the GNSS Info box;
2. Wait 1 - 3 minutes for the GNSS to lock, you can judge whether the GNSS is locked or not according to the GNSS lock logo in the status bar information, after locking the GNSS lock logo is green, if it is grey, then it is not locked. see table 4 for the explanation of the parameters in the GNSS information pop-up window.

Figure 5 Locked GNSS external antenna

5.9.2 1PPS Trigger Using Internal GNSS Module

Only IQS mode, DET mode and RTA mode can use 1PPS trigger of GNSS module. This section will take IQS mode as an example and explain in detail how to configure the 1PPS trigger function of the GNSS module.

1. Refer to the section on Using Internal GNSS module to ensure that the GNSS is locked;
2. Click "Mode" -> "IQStreaming" to switch to IQS mode;
3. Click "Next" -> "Trigger" in the main setup area, and set "TriggerSource" to "GNSS1PPS" in the "Trigger" submenu to use the GNSS module 1PPS trigger.

Figure 6 Triggered using GNSS 1 PPS

5.9.3 10 MHz Reference Clock Using Internal GNSS Module

Note: only high quality GNSS modules.

1. Please refer to the section on Using Internal GNSS module to ensure that GNSS is locked;
2. Set "DOCXO" to "LockMode" in the GNSS Info box, wait for 5-10 minutes, if "DOCXO Locked" appears in the GNSS Info box, OCXO is locked successfully;
3. Set "RefCLKSource" to "Internal_Premium" and "RefCLKFreq" to "10MHz" under the System submenu in the main setup area. At this time, the reference clock source is OCXO.

Figure 7 10MHz reference clock using high quality GNSS modules

5.9.4 Using External GNSS module

1. Connect the external GNSS module to the PC USB port of the PX series or SA/NX series instrument using a USB-to-serial cable;
2. In the software, click "System" -> "GNSS Info";
3. In the popup window, set "GPS Type" to "External GPS";

4. Click the "Refresh" button in the "COM Device" column and select the newly recognized "ttyUSBX" or "COMX" device;
5. Set the "Baud Rate" to the actual output of the GNSS module (e.g. "9600") and click the "Connect" button below;
6. The instrument will parse and display the received GNSS positioning information, see Table 4 for an explanation of the parameters in the GNSS information pop-up window.

Figure 8 Connecting an external GNSS module

5.10 Viewing Instrument Information

Click "System" -> "About" in the menu bar, the UID number and firmware version of the current instrument will be displayed in the pop-up window.

5.11 Preset

Click the "Preset" button in the menu bar to restore the current software configuration to the default initial state of the instrument.

5.12 Single or Continuous Preview

Single preview: click "Single", Continuous preview: click "Continu.".

5.13 Quick Record and Playback

- **Record**: Click "Rec" to start recording data, and click "Stop" to stop recording.
- **Playback**: Click "Play" in the menu bar to play back the last recorded data, and click "Pause" to pause the playback. Click the "Continu." button in the menu bar to resume normal data acquisition and display.

5.14 Hide Panel

Click the hide icon "" in the menu bar to hide the main settings menu and expand the display area. This function is only available in Tablet Mode.

5.15 Offset

The display offset of the trace can be adjusted in any of the following ways:

1. Click "Graph" -> "Offset" in the chart setting area, and enter the offset value in the offset setting interface, where a positive value indicates that the trace is offset downward and a negative value indicates that the trace is offset upward.

2. Click on the "" icon in the chart setting area, enable the manual adjustment function, when enabled, you can hold down the trace and slide up and down to quickly adjust its display position.

5.16 Switch X-axis scale

Click the chart display area "Graph" -> "XScale" to display the X-axis of the spectrum either in "Lin" or "Log" mode.

5.17 Display Line

Click "Graph" -> "Line" to enable a configurable visual reference line. Set the "LinePos" value to adjust its position on the y-axis.

5.18 Setting Chart Units

Click "Graph" -> "Units" to set the display units of the graph, including dBm, dBmV, dBmA, W, V, A, dBuV, dBuA and dBpW.

5.19 Spectrogram

Only the Standard Spectrum, IQStreaming and Real-time Spectrum modes support the spectrogram function, and the description of each control in the spectrogram setting interface is shown in the following table:

Table 5 Description of Spectrogram Controls

Graph Setting Area	
Scan Depth	The time length cached on the y-axis of the spectrogram Cache limit: 8000 lines of pixels
Time Density	The refresh rate of the spectrogram When set to 100, scrolls 100 lines of pixels per second
Color	Sets the color gradient for the spectrogram

1. Click "Graph" -> "Spectrogram" to create a spectrogram corresponding to the spectrum;
2. Click the Spectrogram, switch to the corresponding chart setting area of the spectrogram, and then click "Graph" to enter the spectrogram setting interface;
3. "Export Image" can export the current spectrogram in PNG format to the "/images" folder, "DataExport" can export the current cached data not exceeding the scan depth to the "/data" folder in CSV format, and the exported data is sorted in reverse chronological order.

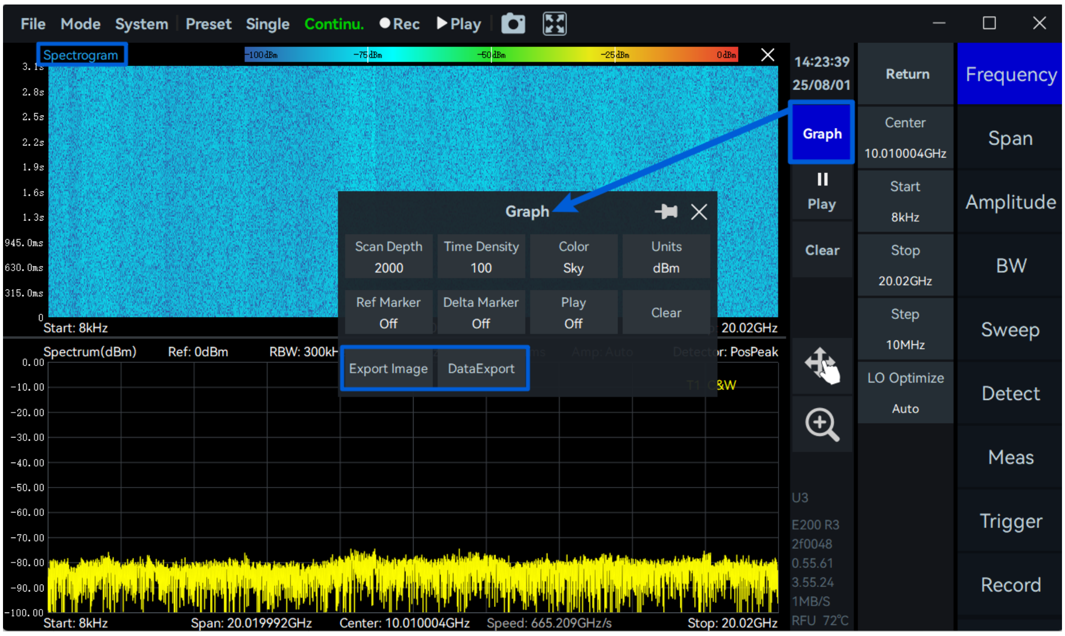

Figure 9 Enable Spectrogram

5.20 Export Data

The PNG image or CSV data of the current chart can be exported in any of the following ways: Export as follows:

1. Click "Graph" -> "DataExport" in the setting area of the chart where the data is to be exported;
2. Click the right mouse button in the chart display area, open the shortcut menu, select "DataExport".

- The "Image" option allows you to export the current chart as a PNG image file, which is saved to the "/images" folder by default;
- "Data" can export chart data to CSV file, default save to "/reports" folder.

5.21 Record and Playback

Please refer to table 6 for key parameters in record and playback function.

Table 6 Record and playback parameter description

Record	
RecordMode	Fixed Duration: Allows presetting the number of recording points and file size (must not exceed file storage limit) Manual Mode: Requires manual control over the number of recording points(Note: In manual mode, the software will automatically stop recording when the size of the recording file exceeds the single file size limit)
RecordTime	Set the recording duration, only effective when the record mode is "Fixed"
FileSizeLimit	The storage size limit for a single recording file
Diskcapacity	the remaining and total disk capacity
Play Back	
Last frame	Rewind by one frame
Next frame	Fast forward by one frame.
Back	Rewind by multiple frames.
Forward	Fast forward by multiple frames.

1. Data recording

(1) Click "Record"-> "RecordMode" in the main setting area and select the desired record mode;

(2) Click "REC File Path" to set the storage location of the log files, the default path is "/data" folder, users can also customize the storage path;

(3) In "Fixed" mode, click "Record" to automatically record data of a preset size. In "Manual" mode, you can manually control the recording duration by clicking "Record" and "Stop". Automatically stops recording when the file size exceeds the file size limit.

2. Data playback

(1) Click "Play Back" -> "Open File" in the main setting area, and select the record file to be played back in the pop-up window.

(2) Click "Playback" to start playback, click "Pause" to stop playback, click "Stop" to exit the playback interface to resume data acquisition, and enable Turn on "Auto Loop" to loop back the record file.

5.22 Graph Zoom Function

Zoom function can be used to view the details of the local area in the spectrum graph or time domain graph, the instrument provides two kinds of zoom mode: Zoom function and magnifying glass function, the user can choose according to the needs of flexibility.

1. Zoom Function

(1) Spectrum Zoom (Only in SWP mode)

1) Click "Graph" and open "Zoom" in the pop-up submenu;

2) Click to select "Spec zoom", click "Graph", set the frequency range to be zoomed in the pop-up submenu, or directly drag the zoom box and its edges in the spectrum graph to adjust the position and zoom area.

Figure 10 Spectrum amplification in SWP mode

(2) Time Domain Zoom (Only in IQvT, PvT, and DET Modes)

1) IQvT and PvT

In IQS mode, click "IQvT" or "PvT" in the main setting area, select the corresponding channel, open "Analyze" and "Zoom". Open "Analyze" and "Zoom", adjust the zoom area by holding down the zoom area and sliding the zoom frame, or holding down the zoom border and dragging it left and right.

2) DET mode

a) Click on "Graph" and open "Zoom" in the pop-up submenu;

b) Slide the zoom frame by holding down the zoom area, drag the zoom border left and right, select the zoom graph "PvT Zoom", and click "Graph" to set the "TimeCenter" and "TimeRange". You can adjust the zoom area.

2. Magnifying Glass Function

(1) Click on the magnifying glass button "" to frame the area of interest;

(2) A thumbnail view will be displayed in the upper right corner of the main interface, showing the complete trace and the position of the zoomed-in area in the global picture;

(3) You can quickly switch the position of the zoomed-in area by dragging the red box in the thumbnail, or you can re-select a new area to zoom in;

(4) Click the Zoom button again to exit the zoomed-in view and restore the original trace display.

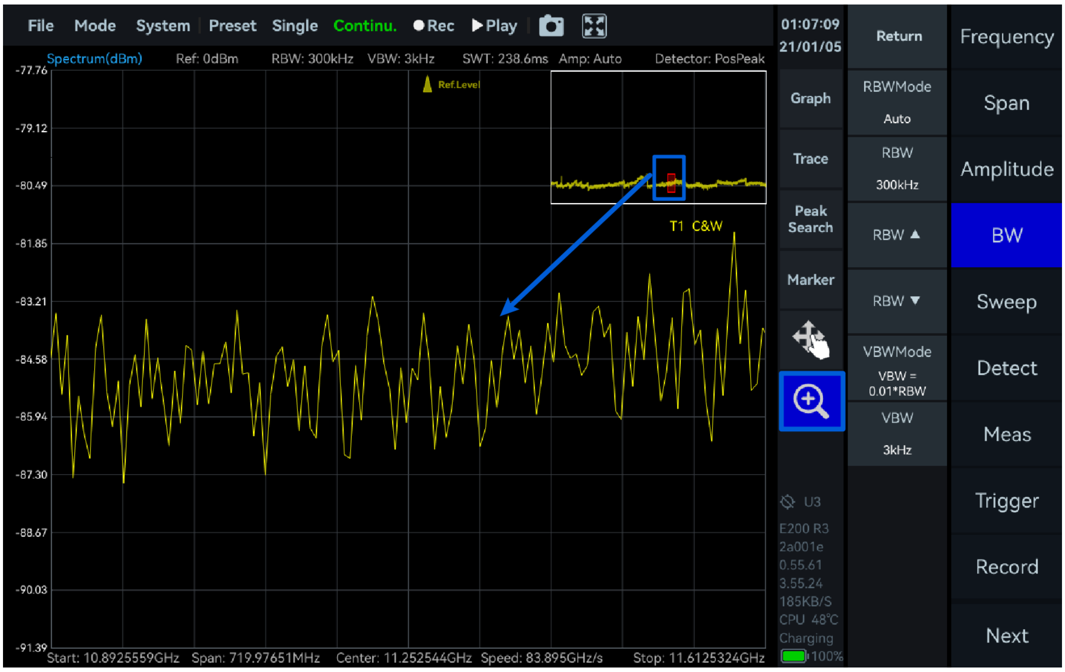

Figure 11 Magnifying Glass Zoom in SWP Working Mode

5.23 Trace settings

Click on "Trace" in the chart settings area and see the following table for a description of the parameters in the additional menu:

Table 7 Trace Control Parameter Description

Trace	
Enabled	On: Turn on the traces of the corresponding labels, the upper limit is 4.
Type	ClearWrite, MaxHold, MinHold and Average
Avg	Setting the average number of times the average type of trace is averaged
StateReset	Clears the current trace data and restarts the display according to the set trace type.
Edit Lable	Modify trace name for user to edit and manage multiple traces.
Max/Avg/C&W	Simultaneously enable three traces for MaxHold, Average and ClearWrite
Max/Avg/Min	Simultaneously enable three traces for MaxHold, Average and MinHold
Reset	Resets the trace display method, clears all current trace data, and reverts to the default clear write type

5.24 Maker Function

5.24.1 Create Markers

1. Create a Marker

Double-click on the chart display area, or click on "PeakSearch" in the chart settings area to quickly bring up the reference marker.

2. Create multiple Markers

Click the "Marker" submenu in the Chart Settings area, select the marker you want to create, and then click "Enable" to enable the selected marker.

5.24.2 Create Marker Pairs

Marker pairs can be created in any of the following ways (reference marker and difference marker as a group, current limit 5 groups):

1. In the "Marker" sub-menu, select the marker pairs you want to create (e.g., "M1R" and "M1D") and click on "Enable";
2. Right-click on the chart display area to open the shortcut menu and select "Create marker pair";
3. Click "Graph" -> "Marker Pair" in the Graph Settings area to quickly enable a pair of reference marker and difference marker, and click continuously to enable multiple pairs of markers.

5.24.3 Close Markers

1. Close individual Marker

In the "Marker" sub-menu, select the marker you want to disable and click "Enable" to disable the selected marker.

2. Close all Markers

All currently enabled markers can be cleared in one of the following ways.

(1) Click "Graph" in the Chart Settings area and select "Clear All" in the pop-up window;

(2) Click the right mouse button in the chart display area, open the shortcut menu, select "Clear all markers".

5.24.4 Change Markers Frequency

1. Manual entry of frequency values

Click "Marker" sub-menu, select the enabled marker (e.g. M1R, M2R), click the "Freq:" area on the top of the pop-up window, and set the marker frequency value.

2. Drag the marker or click to jump

(1) Drag the marker: press and hold the marker and drag it to the desired position and then release it;

(2) Click to jump: after selecting the marker and double clicking the target frequency point, the marker will automatically jump to the position.

5.24.5 Marker switching traces

Marker switching traces can be achieved in any of the following ways:

1. Click "Marker" in the chart device area, select the target trace (e.g. switch from T1 to T2), the marker will automatically jump from T1 to the corresponding frequency position of T2;

2. Click the right mouse button in the chart display area, open the shortcut menu, select "Marker Switching Trace", you can switch the target trace associated with the current marker.

5.24.6 Marker Peak Search

1. Local peak search

Double-click on the chart near a local peak, or select the marker and click "Marker" -> "Local Peak".

2. Global peak search

Click on "Peak Search" in the Chart Settings area to enable global peak search.

3. Left and right peak search

(1) Enable Auto Parameter Setting

After enabling the cursor, click "Marker" -> "Left Peak" / "Right Peak" in the chart setting area. By default, "AutoParam" is enabled, and the software will calculate appropriate peak thresholds and peak offsets based on the noise floor and signal distribution of the current trace, so as to accurately identify valid local peaks.

(2) Set Custom Peak Threshold and Peak Offset

After the marker is enabled, click "Marker" -> "Advanced" in the chart setting area, set the "Threshold" and "Excursion" for left and right peak searching. After that, click "Left Peak" or "Right Peak", when a qualified signal is detected, the marker will automatically locate to the signal position.

- Excursion: the minimum amplitude difference (dB) between the peak and the troughs on either side, used to determine if the peak is sufficiently prominent.

5.24.7 Delta Marker

The difference marker is to be used in conjunction with the reference marker to indicate the difference in frequency, time and magnitude from the reference marker.

Figure 12 Enable Delta Marker

5.24.8 Noise Density

After creating the marker, turn on "NoiseDensity" in the "Marker" section of the chart settings area to convert the original power values to power density per Hz.

5.24.9 Marker to Center

The Marker to Centre function aligns the frequency of the current reference marker to the center of the chart, which can be achieved in any of the following ways:

1. After moving the reference marker to the target frequency point, click "Marker" -> "to Center" in the chart setting area;
2. After moving the reference marker to the target frequency point, click the right mouse button on the chart display area, open the shortcut menu and select "Marker to center".

5.24.10 Marker Switch to Mode

The Marker to Mode function quickly switches to other operating modes and sets the frequency at which the current reference marker is located as the center frequency of the new mode. This function can be realized in any of the following ways:

1. After moving the reference marker to the target frequency point, click "Marker" -> "Switch to" in the chart

setting area, and select the target mode;

2. After moving the reference marker to the target frequency point, click the right mouse button in the chart display area, open the shortcut menu, select "Marker to Mode", and select the target mode.

5.24.11 Frequency tracking

Frequency tracking supported in standard spectrum analysis mode only.

1. Click "Marker" in the chart setting area, in the pop-up submenu, click "More", and then click "Advanced". Set the "Threshold" and "Shake Range" for the tracking signal (when the peak frequency jitters within this range, the frequency value will not be frequently aligned to the center position);

Figure 13 Set the Peak Threshold and Shake Range

2. Click "Signal Track", the reference marker will search for peaks within the span at this time, and align the peak signal to the center frequency, when the frequency of the target signal drifts, the spectrometer will automatically adjust its own center frequency, so that the signal is always located in the center of the chart display area, which is convenient for the user to observe and analyze.

Figure 14 Frequency Tracking

Note: In general, this function only moves the frequency position and does not change the span. However, it is difficult to continue tracking signals with particularly large drift beyond the current span; for signals at the edge of the instrument's scanning range, because of frequency limitations, the span will be further reduced.

5.24.12 Peak table

Peak meter function supported in spectrum analysis mode only:

1. Click "Marker" in the chart settings area. In the pop-up submenu, click "More," then "Advanced." Set the threshold for the Peak Table. For detailed setup instructions, see the Frequency Tracking section;
2. Click "Peak Table." The instrument will automatically detect and mark peak points that exceed the threshold within the current sweep span (up to 10 peaks). These peaks are listed in the Peak Table below the display area, showing the frequency and power of each peak in descending order of signal power, allowing users to quickly identify the main signals in the spectrum.

Figure 15 Peak Table

5.24.13 Peak tracking

Click "Marker" -> "Peak Tracking" in the chart setting area. After enabling, the cursor will automatically locate and continuously track the maximum peak within the current sweep span. When the signal amplitude or frequency changes, the cursor position will update in real time, allowing the user to continuously observe variations in signal amplitude.

Note: The peak tracking function is only effective within the currently set sweep span. If the signal goes beyond this range, tracking will no longer continue.

5.25 Quick Parameter Setting

5.25.1 Parameter setting

Quick parameter setting currently supports: Reference Level, RBW, VBW, Detector, Start frequency, Stop frequency, Span, Center frequency and other commonly used parameters for spectrum analysis.

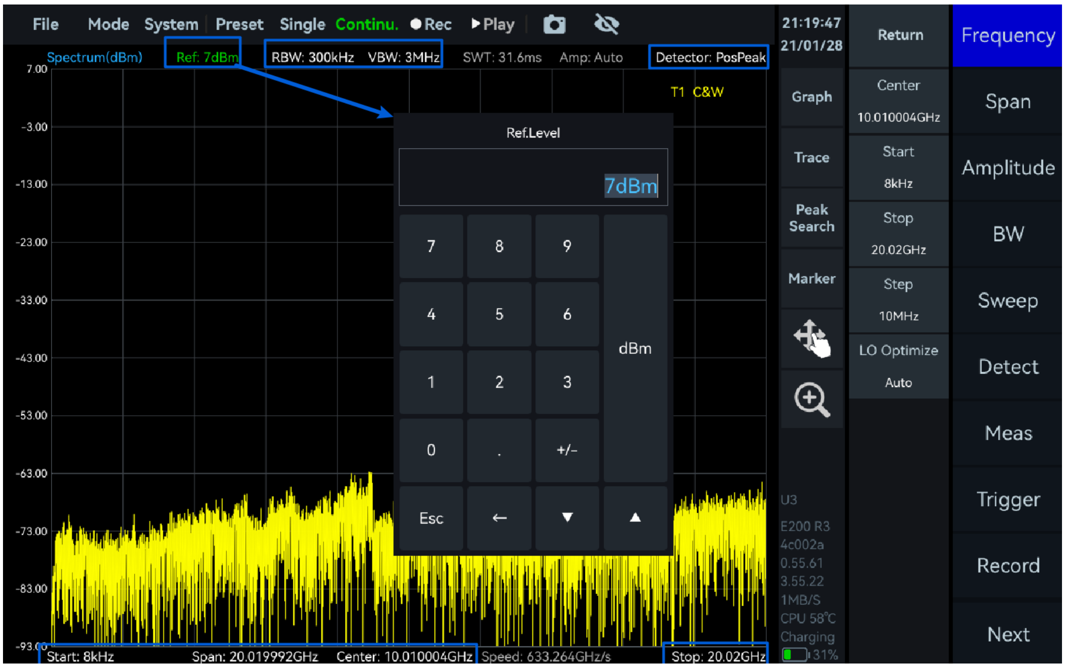

Figure 16 Setting Quick Parameters

5.25.2 Parameter display

In addition to the quick parameterization, this area also supports the display of some of the key parameters during the measurement:

- SWT: Scan time for a single trace in the current configuration
- Amp: Preamplifier enabled status
- Spurious Suppression Label: Displays the spurious suppression mode in the current configuration (Note: Supported when GUI version is 3.55.26 and above)
  - "S" Indicates Standard Spurious Rejection
  - "E" Indicates Enhanced Spurious Suppression
  - Blank Indicates spurious suppression is not enabled
- Speed: the width of the spectrum swept per unit time in the current configuration (Hz/s)

5.26 Modifying the IQSampleRate

In IQ streaming mode, click "BW" in the main setup area and modify the value of "IQSampleRate" in the submenu to modify the sampling rate of the instrument.

5.27 Amplitude Correction

To ensure the accuracy and repeatability of spectrum measurements, the instrument provides an amplitude correction function, which supports the user to compensate by manually inputting external gain/loss and importing the frequency response correction table. Currently, the amplitude correction function is only supported in spectrum analysis mode.

5.27.1 Correction Rules

- Between the start frequency and the first compensation point in the current span, compensation is performed according to the offset value of the first frequency point;
- Between multiple compensation points, compensation is performed by linear interpolation based on the frequency data in the correction table;
- Between the last compensation point and the termination frequency, according to the offset value of the

last frequency point.

5.27.2 Amplitude Correction Example

Take the 1 GHz-3 GHz band to compensate for -20 dB, the 3 GHz - 5 GHz band to perform -20 dB - 10 dB interpolation compensation, and the 5 GHz - 7 GHz band to compensate for 10 dB as an example, the operation steps are as follows:

1. Click "Frequency" and set "Start Frequency" to "1 GHz" and "Stop Frequency" to "7 GHz";
2. Click "System" -> "Amplitude Correction" in the menu bar;
3. Enable the amplitude correction function in the pop-up window, and then click "Add" to add one frequency correction item at a time;
4. Set Frequency 1 to "3 GHz" and Offset 1 to "-20 dB", click "Add" again and set Frequency 2 to "5 GHz" and Offset 2 to "10 dB";
5. Click "Apply" in the bottom right corner of the pop-up window to apply the amplitude correction function;

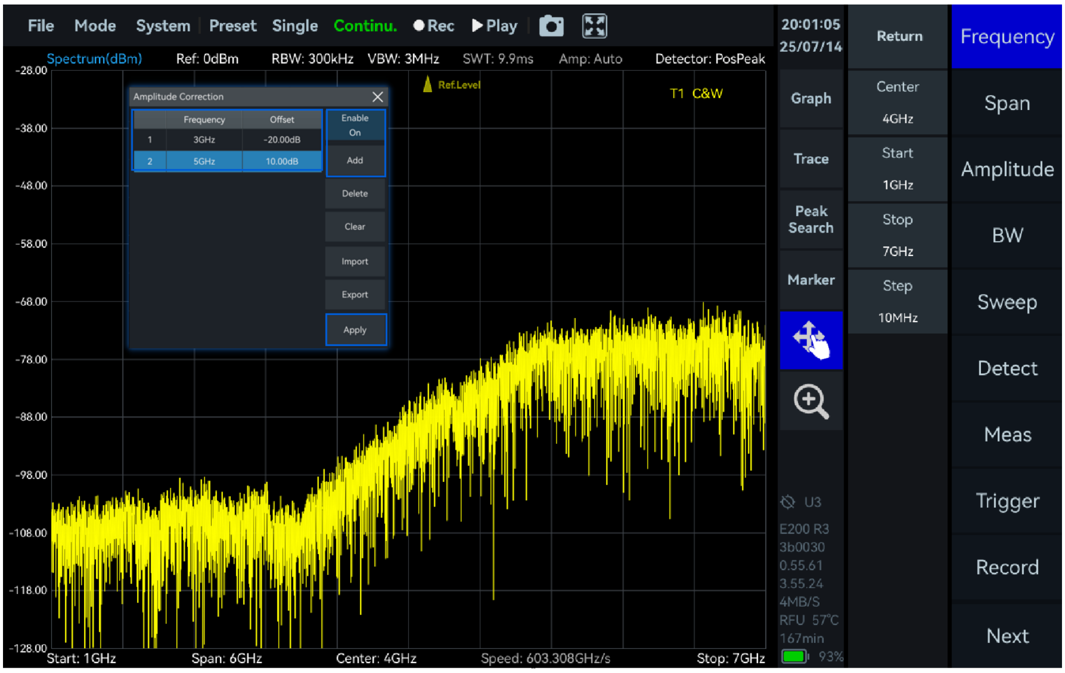

Figure 17 Amplitude correction application

6. Users can export the current correction configuration to an Excel table file via "Export" in the pop-up window, and the default export is to the "/data" folder;
7. The user can also customize the amplitude correction table according to the format of the exported configuration and import it using the "Import" button.

5.28 Display modes (only in SA/NX series)

The upper computer software of SA/NX supports three display modes: workstation single-column (default), workstation dual-column, and flat-panel mode; PX series instruments only support flat-panel mode. Users can choose the appropriate display mode according to their own needs.

Table 8 Display Mode Lookup Table

Display Mode	Description
Workstation One Col	Single-column parameter display, providing more spectrum display space for focused spectrum observation.
Workstation Two Col	Two-column parameter display, allowing more convenient parameter settings and simultaneous viewing/comparison of multiple parameters.

Tablet	Suitable for tablets and other mobile devices, featuring a clean interface and easy touch operation.

5.29 Fan Control (only in SA series)

SA series instruments support users to set the instrument fan status, click "System" -> "Fan Control" in the menu bar to set the fan status, see the following table for status details. (Note: Turning off the fan for a long period of time may cause the device to overheat, thus affecting the performance and service life, so please use the function of turning off the fan forcibly with caution).

Table 9 Fan Status Lookup Table

Fan Control	Descriptions
On	Switch on the fan.
Off	Switch off the fan.
Auto	Default mode. The fan is intelligently controlled, and automatically turns on when the device temperature reaches 50 °C, and automatically turns off when it drops to 40 °C. (SAE/SAN-400 series instruments have the fan on by default, not programmable)

6. Using of the SWP mode

This section highlights some of the important parameters and test methods of the standard spectrum analysis model.

6.1 Introduction to the General Parameters of the SWP Mode

The important parameters of the SWP mode are described in Table 10.

Table 10 Description of SWP Mode Parameters

Frequency	
LO Optimize	Auto: default low spurious mode; Speed: high sweep speed mode; Spur: low spurious mode; PhaseNoise: low phase noise.
Amplitude	
PreAmplifier	Set the operation of the preamplifier: Auto On: The preamp turns on automatically when the reference level is below approximately -30 dBm. Forced Off: The preamp remains off regardless of the reference level.
GainStrategy	LowNoise: Focuses on low noise while keeping the noise floor flat. HighLinearity: Focuses on high linearity while keeping the noise floor flat.
IFGainGrade	0 – X steps, 3 dB gain difference per step Increasing IF Gain Step: Reduces RF gain, raises noise floor, improves linearity, and reduces spurs. Decreasing IF Gain Step: Increases RF gain, lowers noise floor, reduces linearity, and increases spurs.
Atten	0 – 33 dB (maximum varies across frequency bands), step size 1 dB Atten = -1 dB (default): No attenuation. Atten ≥ 0 dB: Attenuation is enabled; the reference level = attenuation value – 10 dB.
Sweep	
SWTMode	min SWT: minimum sweep time; min SWTx2: approximately 2 times of min SWT; min SWTx4: approximately 4 times of min SWT; min SWTx10: approximately 10 times of min SWT; min SWTx20: approximately 20 times of min SWT; min SWTx50: approximately 50 times of min SWT; min SWTxN: approximately N times of min SWT, N = SweepTimeMultiple; Manual: approximately equal to the target SweepTime.
PointsStrategy	SweepSpeed: priority is given to the fastest sweep speed; PointsAccuracy: priority is given to ensuring that the number of trace points is close to the target.
SpurRejection	Bypass, Standard and Enhanced.
FFTExecution	Auto: automatically selects the CPU or FPGA for FFT calculation based on the settings (using CPU for RBW below 30 kHz and FPGA for RBW above 30 kHz), CPU preferred, FPGA preferred, CPU Low Occ, CPU Mid Occ, CPU High Occ, FPGA only.
Window	FlatTop Window: higher amplitude accuracy. B-Nuttal Window: greater frequency selectivity.

	LowSideLobe Window: higher accuracy in measuring low-frequency signals.
System	
RefCLKSource	When using an external reference clock source, set the reference clock frequency to 10MHz.

6.2 Channel Power

As an example, a BPSK signal with a carrier frequency of 1 GHz, a power of -20 dBm and a symbol rate of 1 MHz is tested.

6.2.1 Parameters description

Only some of the important parameters are described here: the important parameters in the channel power measurement section are shown in Table 11.

Table 11 Description of Channel Power Measurement Parameters

Channel Power	
Meas BW	The bandwidth of the channel to be measured; channel power is the integrated power within this bandwidth.
SpanPower	The measurement bandwidth to the current span and calculates the channel power within this range.

6.2.2 Procedure

1. Set "Center" to 1 GHz and "Ref.Level" to 0 dBm, click "Meas" menu and select "ChannelPower" in the submenu;
2. The software will automatically configure the default parameters, and the test results are shown below. The upper left corner of the measurement box shows the channel power value. In the lower "ChannelPower" column, you can also view the Meas BW, ChannelPower and Power Density values;
3. You can adjust the channel center frequency (press and hold the measurement area and slide to select), measurement bandwidth (press and hold the measurement border and drag left and right or adjust the Meas BW setting), and also modify the parameters such as "Center", "Span", "Ref.Level" and "RBW" in the main setting area to suit different signals.

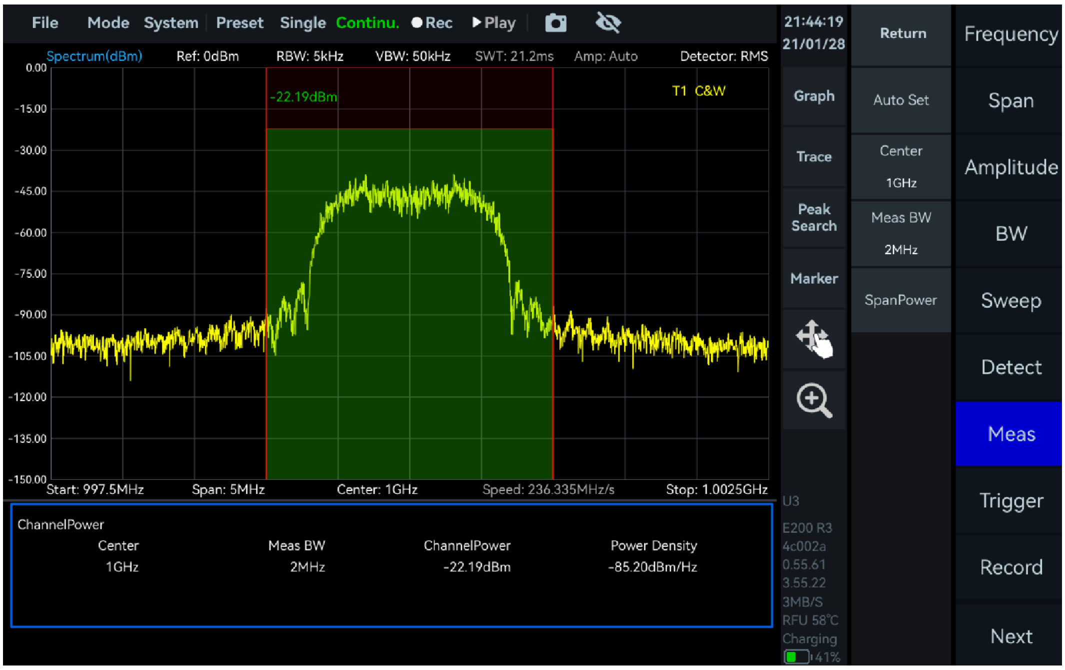

Figure 18 Measurement of ChannelPower

6.3 Occupied Bandwidth

As an example, a BPSK signal with a carrier frequency of 1 GHz, a power of -20 dBm and a symbol rate of 1 MHz is tested.

6.3.1 Parameters description

Only some of the important parameters are described here: some of the important parameters of the occupied bandwidth measurement are shown in Table 12.

Table 12 Description of OBW Parameters

OBW	
Method	XdB, Percentage
XdB/%	Set specific XdB values/percentages

6.3.2 Procedure

1. Set "Center " to 1 GHz and "Ref.Level" to 0 dBm, click "Meas" menu and select "OBW" in the submenu;
2. Click on "BW" and set "RBW" to 50 kHz;
3. The software will automatically configure the measurement parameters, and the measurement results are shown in the figure. You can see the occupied bandwidth value in the lower "OBW" column;
4. You can also modify the parameters such as "Center ", "Span", "Ref.Level" and "RBW", etc. in the main setup area to suit the measurement of different signals.

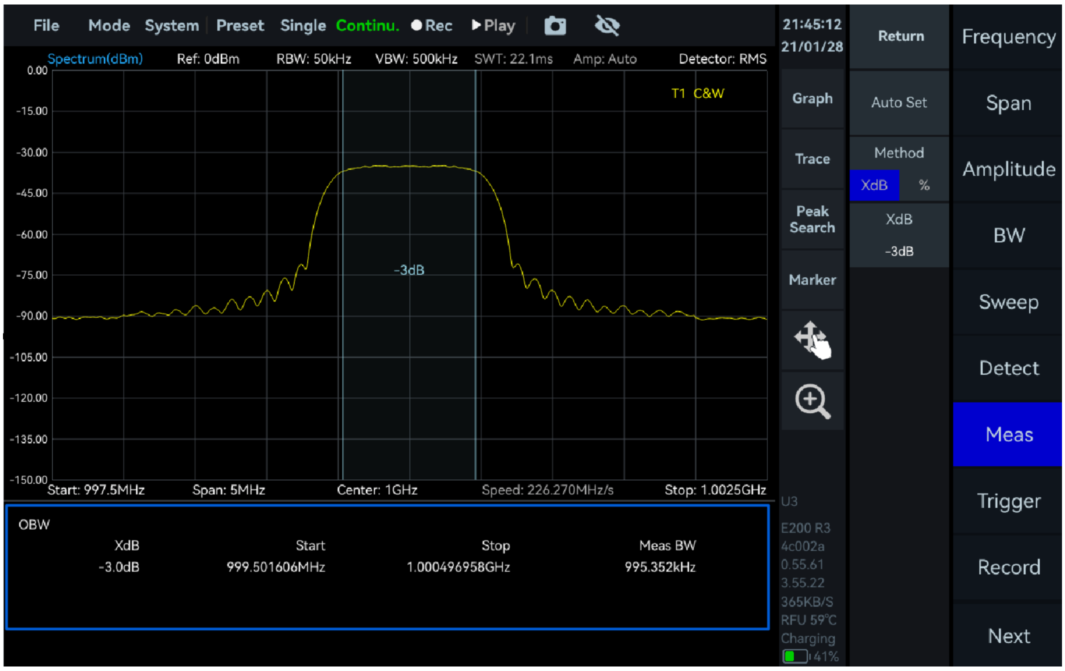

Figure 19 Measurement of OBW

6.4 Adjacent Channel Power Ratio (ACPR)

As an example, a BPSK signal with a carrier frequency of 1 GHz, a power of -20 dBm and a symbol rate of 1 MHz is tested.

6.4.1 Parameters description

Only some of the important parameters are described here: some of the important parameters of the adjacent channel power ratio measurement are shown in Table 13

Table 13 Description of ACPR Measurement Parameters

ACPR	
Space	Setting the frequency interval between the main channel and the adjacent channel.
Count	Set the number of adjacent pairs, upper limit 2 pairs.

6.4.2 Procedure

1. Set "Center" to 1 GHz and "Ref.Level" to 0 dBm, click "Meas" menu and select "ACPR" in the submenu;
2. The software will automatically configure the default parameters and the test results are shown below. The top green channel bandwidth is the power value of each channel. You can also check the Adj Center, Adj Power and Adj Ratio in the "ACPR" column at the bottom;
3. You can set the center frequency of the main channel, the bandwidth of each channel, the adjacent channel spacing and the number of adjacent channel pairs, and you can also modify the parameters such as "Center", "Span", "Ref.Level" and "RBW", etc. in the main setting area to suit the measurement of different signals.

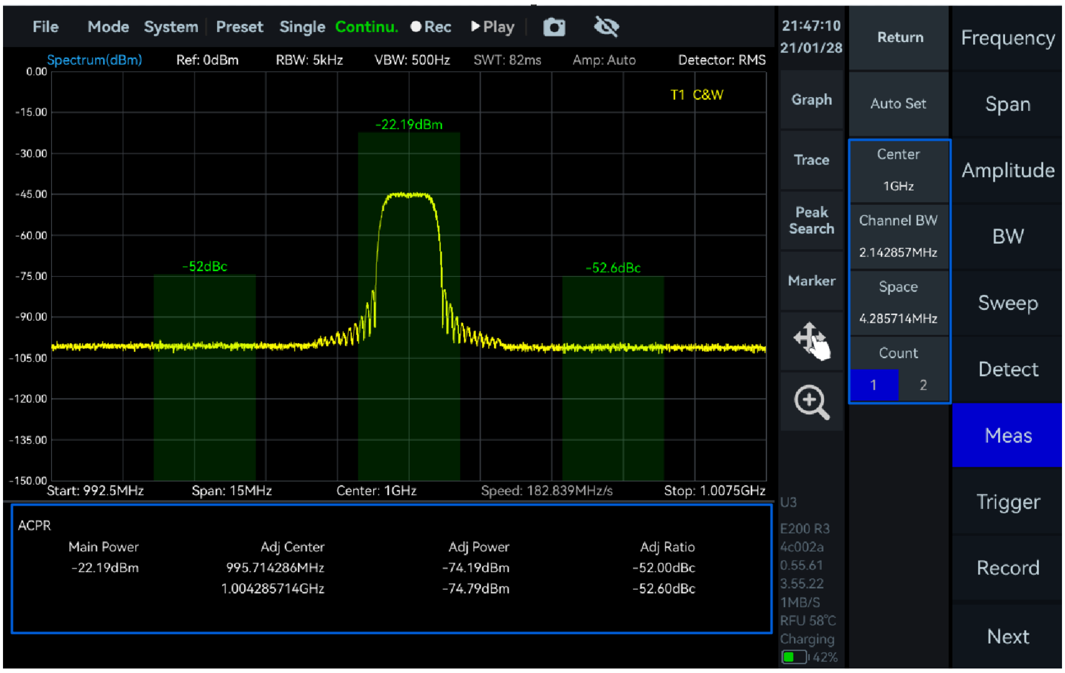

Figure 20 Measurement of ACPR

6.5 IP3/IM3

Example of testing IP3/IM3 at the 1 GHz frequency point.

6.5.1 Parameters description

Only some of the important parameters are described here: Some of the important parameters for IP3/IM3 measurements are shown in Table 14.

Table 14 Description of IP3/IM3 Measurement Parameters

IP3/IM3	
LowTone Frequency/Power	Frequency/Power of the input low-frequency signal.
HighTone Frequency/Power	Frequency/Power of the input high-frequency signal.
LowIM3P Frequency/Power	Frequency/Power of the intermodulation-generated low-side signal.
HighIM3P Frequency/Power	Frequency/Power of the intermodulation-generated high-side signal.
TonePowerDiff	High and low frequency power difference of the input signal.

6.5.2 Procedure

1. Combine the signals with a center frequency of 999 MHz and an amplitude of 0 dBm and a center frequency of 1.001 GHz and an amplitude of 0 dBm into a single signal by means of two signal sources and combiners, and input them into the instrument;
2. Set the "Center" of the instrument to 1 GHz and the "Ref.Level" to 0 dBm, click the "Meas" menu and select "IM3" in the submenu;
3. Adjust the signal power so that the third-order intermodulation interference signal appears approximately 6 dB below the reference level in the spectrum;
4. The software will automatically configure the default parameters and the test results are shown below. The IP3 test results can be viewed in the "IM3" column below.

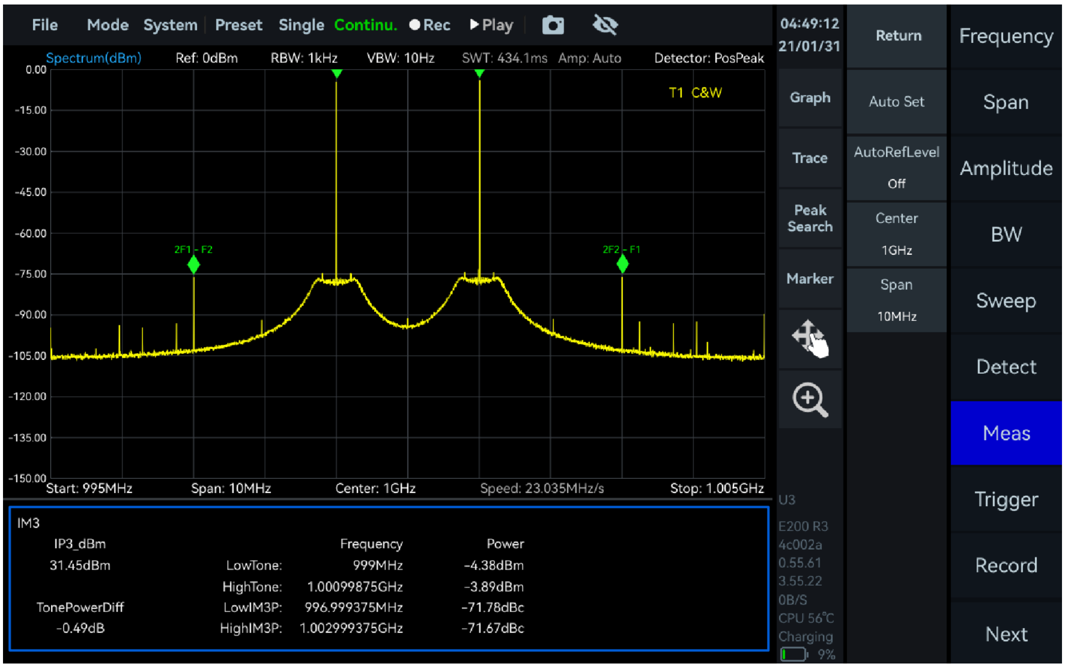

Figure 21 Measurement of IP3/IM3

6.6 SEM

The Spectrum Emission Template (SEM) is a measurement function used to assess whether a wireless signal has excessive emissions or spurious signals outside the operating frequency band.

As an example, an IEEE 802.11ac signal with a frequency of 1 GHz and a power of -20 dBm is evaluated for compliance with the standard.

6.6.1 Parameters description

Only some of the important parameters are described here: some of the important parameters for SEM measurements are shown in Table 15.

Table 15 Description of SEM Measurement Parameters

SEM		
Auto Set	Linkage with peak reference type, automatically using the signal peak as the current relative reference when enabled.	
Ref Set Type	Manual: When enabled, user-defined relative reference level. Peak: When enabled, the peak of the current signal is used as the relative reference level.	
Manual Ref	Sets the relative reference level value. This function only works when "Manual" is selected as the reference type The set manual reference value will be used as the reference for calculating the start/stop threshold in the offset table.	
Offset Table	**StarFreq/StopFreq**	Set the upper offset band to indicate the offset distance relative to the center frequency. The system automatically generates upper and lower offset bands symmetrical to the center frequency, and up to 16 offset bands can be configured.
	LimitStart/LimitStop	Setting the power limit of the signal in the corresponding upper and lower offset bands
	Mode	Absolute: Measurement in absolute amplitude, based on the actual power value, independent of the reference value. Relative: Measurement relative to a set "Manual" value, based on the reference value to calculate the power limit in the offset band.

	Priority	Required: must meet the requirements of the template, if not, it will be regarded as a failure. Suggested: recommended to meet the requirements of the template, if not, then prompt a warning.
	Save Table	Save the current measurement template Default path: "/data".
	Load Table	Load user pre-stored measurement templates
	Load Preset	Select the appropriate template from the predefined templates provided with the device Template type: 802.11a/g, 802.11b, 802.11n (20MHz, 40MHz), 802.11ac (20MHz, 40MHz, 80MHz, 160MHz) AM NRSC, FM FCC 73.317, FM NRSC Hybrid, AM NRSC 5K Hybrid, AM NRSC 8K Hybrid, Bluetooth
Export Result	Export the measurement table below the trace as a table Default path: "/reports".	

6.6.2 Procedure

1、 Set the "Center" to 1 GHz and the "Ref.Level" to -20 dBm;

2、 Click "Meas" and select "SEM" in the additional menu;

3、 Click "Offset Table", select the "Load Preset" button in the pop-up window, and select the "802.11ac (20MHz)" template in the template list;

4、 Click "BW", adjust "RBW" to "5 kHz" and "VBW Mode" to "VBW = 0.01 RBW";

5、 Click "Sweep", set "SWTMode" in the additional menu to "minSWT×20", and set "Detector" to "Average";

6、 The measurement results are shown in the figure below, the spectrum map will show whether this spectrum meets the requirements of the template, and the maximum margin on each offset band is shown in the table below the measurement results.

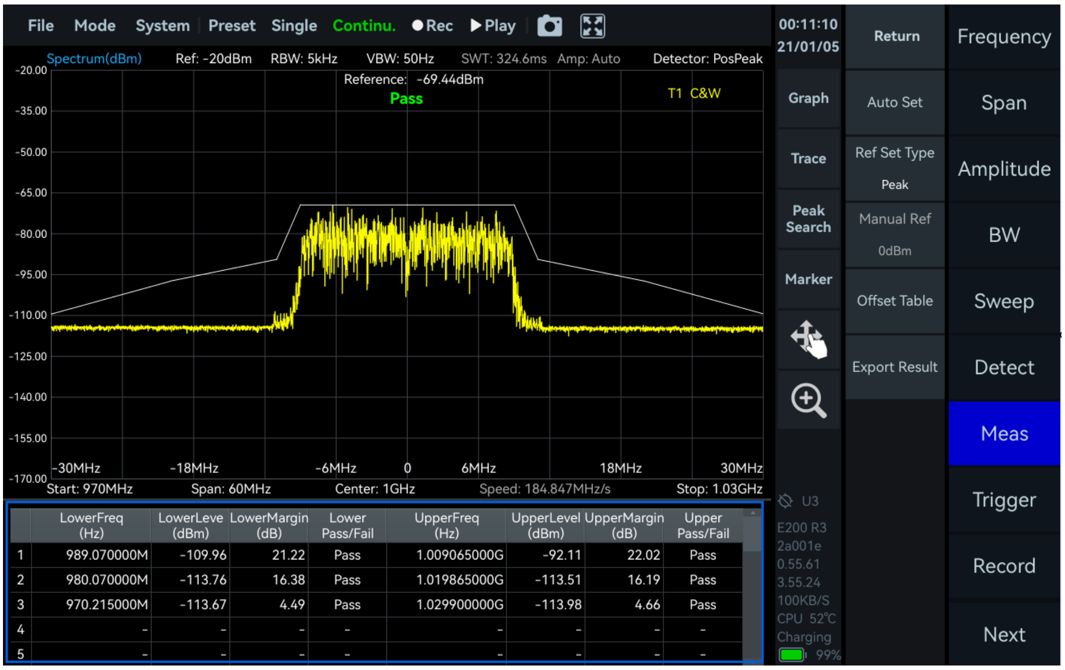

Figure 22 Measurement of SEM

7. Using of the IQS mode

This chapter describes in detail some of the important parameters of the IQ streaming mode, and focuses on describing how to carry out further analyses of the time-domain IQ data acquired by the system, such as spectral analysis, time-domain analysis, power-time analysis, digital down-conversion, demodulation, etc.

7.1 Introduction to the General Parameters of The IQS mode

Table 16 Description of IQS Mode Parameters

Frequency	
LO Optimize	Please refer to the parameter with the same name in the Introduction to the General Parameters of SWP Mode.
BW	
IQSampleRate	ADC sampling rate, 110 MSPS - 130 MSPS can be set.
AnalysisBw	Display the equivalent sampling rate after extraction: Span * 0.8.
DataFormat	8-bit: Lower precision. When there is no signal, many zeros are likely to be captured. Supports continuous streaming with decimation factor of 2 or higher. 16-bit: Default configuration. Supports continuous streaming with decimation factor of 4 or higher. 32-bit: Higher precision. Supports continuous streaming with decimation factor of 8 or higher.
Amplitude	
PreAmplifier **GainStrategy** **IFGainGrade** **Atten**	Please refer to the parameter with the same name in the Introduction to the General Parameters of SWP Mode.
Record	
RecordMode **RecordTime** **FileSizeLimit** **Diskcapacotu**	Please refer to the parameter with the same name in the Record and Playback.
Playback	
Last frame **Next frame** **Back** **Forward**	Please refer to the parameter with the same name in the Record and Playback.

7.2 IQS Working Mode Overview

The initial interface of the IQ Stream Mode consists of a Max Power vs. Time thumbnail, a spectrum plot, and a time-domain plot. Click "Next" in the main settings area, then click "Trigger." In the submenu, modify the "Preview Time" parameter to adjust the preview time range of the IQ stream in the Max Power vs. Time thumbnail.

The display ranges of the spectrum plot and the IQ time-domain plot are determined by the red selection boxes, "Spectrum-P" and "IQvT-P," in the Max Power vs. Time thumbnail. By adjusting the position and range of these selection boxes, you can observe IQ time-domain signals from different time segments, or perform spectrum analysis on IQ time-domain signals captured over different time periods.

7.3 Spectrum Analysis

7.3.1 Parameters description

Only some of the important parameters are described here: the important parameters in the spectrum analysis section are shown in Table 17.

Table 17 Description of Spectrum Analysis Parameters

Spectrum analysis	
Window	Please refer to the parameter with the same name in the Introduction to the General Parameters of SWP Mode.
Intercept	Spectrum interception: e.g. Intercept = 0.8, displays 80% of the FFT spectrum analysis results in order to intercept the transition band spectral components

7.3.2 Procedure

1. Click "FFT" in the main settings area and enable "Analyze." Drag the red selection box "Spectrum-P" in the Max Power vs. Time thumbnail, or adjust the values of "TimeStart" and "TimeLength" to perform spectrum analysis on IQ signals collected over different time segments. Adjust the values of "Center" in the "Frequency" submenu and "Span" in the "BW" submenu to change the center frequency and analysis bandwidth of the spectrum;
2. Use "FFTsize" to set the number of points for spectrum analysis, "Window" to select different window functions, "TraceDetector" to set different trace detectors, and "Intercept" to crop the displayed spectrum. When Intercept = 0.8, the transition band can be cropped.

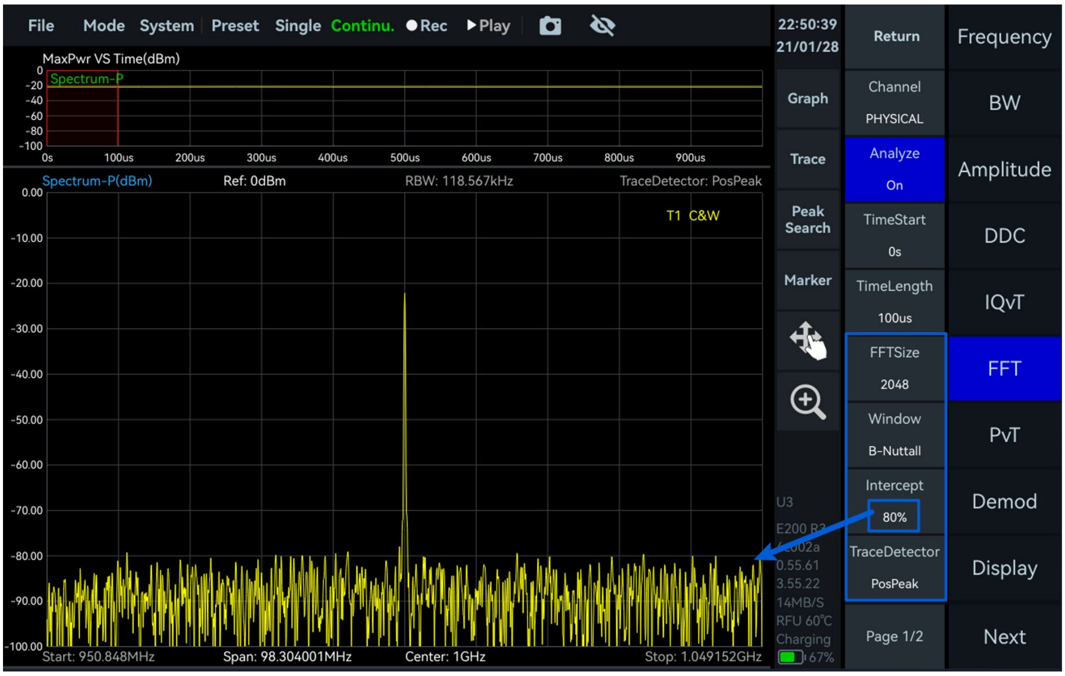

Figure 23 Spectrum analysis of IQ data

7.4 IQvT

7.4.1 Procedure

Click "IQvT" in the main settings area and enable "Analyze." Drag the red selection box "IQvT-P" in the Max Power vs. Time thumbnail, or adjust the values of "TimeStart" and "TimeLength." Then click "Auto Range" under "Graph" to perform time-domain analysis on IQ signals from different time segments.

Figure 24 IQ Time-Domain Plot and Zoom

7.5 PvT

7.5.1 Procedure

Click "PvT" in the main settings area and enable "Analyze." Drag the red selection box "PvT-P" in the Max Power vs. Time thumbnail, or adjust the values of "TimeStart" and "TimeLength" to perform power-vs.-time analysis on IQ signals from different time segments.

Figure 25 IQ Power-Time Plot and Zoom

7.6 AM Demodulation

As an example, demodulate an AM signal with a carrier frequency of 1 GHz, a power of -20 dBm, a modulation rate of 3 kHz and a modulation depth of 70%.

7.6.1 Parameters description

Only some of the important parameters are described here: the important parameters of the AM demodulation section are shown in Table 18

Table 18 Description of AM Demodulation Parameters

AudioFilter	
n	Number of Filter Taps: The larger the number of taps, the steeper the filter's transition band and the smaller the passband ripple.
fc	Cutoff Frequency: 0<Fc<0.50. For example, if set to 0.25, a low-pass filter is applied to half of the bandwidth.
as	Stopband Attenuation: The higher the stopband attenuation, the stronger the suppression in the stopband. Attenuation is specified in dB.
mu	Fractional Sample Offset: It is recommended to use the default value.

7.6.2 Procedure

1. Set "Center" to 1.0001 GHz. Adjust the range of "IQvT-P" in the Max Power vs. Time thumbnail. Select the IQ time-domain plot, click "Graph," and choose "Auto Range" in the Graph submenu;
2. Click "Demod" in the main settings area and set "Type" in the submenu to "AM". Select the AM demodulated time-domain plot, then click "Auto Range" under the Graph control;
3. Click "BW" in the main settings area and increase "Span" in the submenu to adjust the analysis bandwidth. In this example, set the analysis bandwidth to 12.288 MHz.

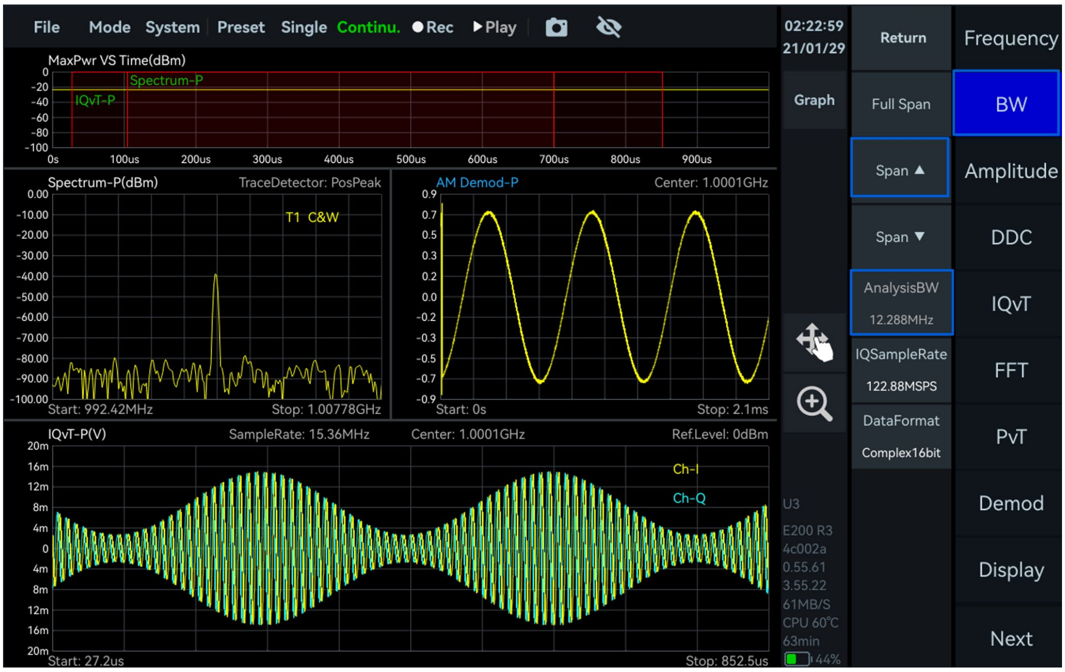

Figure 26 AM Demodulation

7.6.3 Audio analysis

Can be used to test the demodulation sensitivity of an instrument.

1. Refer to AM demodulation chapter Demodulation of AM signals;
2. Click "Demod" in the main settings area, open "AudioAnalysis" in the submenu, and enable audio analysis. Check whether the audio analysis frequency matches the modulation rate. You can also measure the signal's SINAD and Total Harmonic Distortion.

Figure 27 Audio analysis of AM demodulation

7.7 FM Demodulation

As an example, demodulate an FM signal with a carrier frequency of 1 GHz, a power of -20 dBm, a modulation frequency of 5 kHz and a frequency offset of 75 kHz.

7.7.1 Parameters description

Please refer to the AM demodulation parameter description chapter. When listening to FM broadcast signals, the FM demodulated signals can be low-pass filtered to reduce some of the high-frequency noise and make the listening sound purer.

7.7.2 Procedure

1. Set "Center" to 1 GHz. Adjust the range of "IQvT-P" in the Max Power vs. Time thumbnail. Select the IQ time-domain plot, click "Graph," and choose "Auto Range" in the Graph submenu;
2. Click "Demod" in the main settings area and set "Type" in the submenu to "FM". Select the FM demodulated time-domain plot, then click "Auto Range" under the Graph control;
3. Click "BW" in the main settings area and increase "Span" in the submenu to adjust the analysis bandwidth. In this example, set the analysis bandwidth to 6.144 MHz.

Figure 28 FM Demodulation

7.7.3 Audio analysis

After demodulating the FM signal, please refer to the Audio analysis section for audio analysis of the demodulated signal.

7.8 DDC Digital Down Conversion

Perform digital down conversion and resampling on the IQ data stream to generate sub-IQ streams for further spectrum analysis. The following example demonstrates DDC on a single-tone signal at 1 GHz with a power of -20 dBm.

7.8.1 Parameters description

Only some of the important parameters are described here: some of the important parameters of the DDC digital down conversion are shown in Table 19.

Table 19 Description of DDC Digital Down Conversion Parameters

State	
OffsetFreq	Frequency shift of complex mixing, for >0, the spectrum is shifted to the right; for <0, the spectrum is shifted to the left.
Decimate	Setting the DDC extraction multiplier, i.e., the resampling rate.

7.8.2 Procedure

1. Set "Center" to 1 GHz and "Ref. Level" to 0 dBm. Adjust the range of "IQvT-P" in the Max Power vs. Time thumbnail. Select the IQ time-domain plot, click "Graph," and choose "Auto Range" in the Graph submenu;
2. Click "DDC" in the main settings area. In the additional submenu, click "State On" to enable Channel 1. Set DDC1 channel parameters as follows: "Center" = 1.003 GHz, "OffsetFreq" = -3 MHz, "Step" = 1 MHz, and "Decimate" = 3;
3. Click "FFT" in the main settings area. In the additional submenu, select "DDC1" and enable "Analyze." Drag the red selection box "Spectrum-D1" in the Max Power vs. Time thumbnail, or adjust "TimeStart" and

"TimeLength" to perform spectrum analysis on the IQ substream generated by DDC over different time segments;

4. Click "IQvT" in the main settings area. In the additional submenu, select "DDC1" and enable "Analyze." Drag the red selection box "IQvT-D1" in the Max Power vs. Time thumbnail, or adjust "TimeStart" and "TimeLength" to perform spectrum analysis on the IQ substream generated by DDC over different time segments;

Figure 29 View the time-domain diagram of the IQ subflow under DDC

5. In the main settings area, click "PvT", select "DDC1", and enable "Analyze." Then drag the red "PvT-D1" box in the Max Power vs. Time thumbnail, or adjust "TimeStart" and "TimeLength" to analyze the IQ substream from DDC over different time segments.

Figure 30 View the power-time graph of the IQ subflow under DDC

8. Using of the DET Mode

This chapter describes in detail some of the parameters of the detector analysis mode and the measurement of pulse signals in this mode.

8.1 Introduction to the General Parameters of DET Mode

Only some of the important parameters are described here: some of the important parameters of the detector analysis mode are shown in Table 20.

Table 20 Description of DET Mode Parameters

Frequency	
LO Optimize	Please refer to the parameter with the same name in the Introduction to the General Parameters of SWP Mode.
Amplitude	
PreAmplifier **GainStrategy** **IFGainGrade** **Atten**	Please refer to the parameter with the same name in the Introduction to the General Parameters of SWP Mode.

8.2 Pulse Signal Measurement

For example, a pulse modulated signal with a carrier frequency of 1 GHz, a power of -10 dBm, a pulse period of 80 us and a pulse width of 40 us is tested.

8.2.1 Procedure

1. Set "Center" to 1 GHz. Click "Single" in the menu bar to enable single-shot preview mode;
2. Click "Graph" in the chart settings area, then click "Zoom" to enable zoom. Adjust the zoom region by dragging the selected area or by dragging the edges of the zoom box left or right;
3. Select the zoomed plot, click "Graph" in the chart settings area, and choose "Marker Pair" to create two pairs of cursors. Move M1R to the rising edge of a pulse, M1D to the falling edge of the same pulse, M2R to the rising edge of the pulse, and M2D to the rising edge of the next pulse. At this point, the values displayed for M1D and M2D in the upper-left corner of the zoomed plot correspond to the pulse width and pulse period, respectively. The duty cycle can be calculated using the following formula:

$$\mathrm{DutyCycle} = \frac{\mathrm{PulseWidth(M1D)}}{\mathrm{PulsePeriod(M2D)}}$$

Figure 31 Pulse Signal Period and Width Measurement

8.3 Pulse Signal Detection (Option 72)

If you purchase the Pulse Detection Option at a later date, please refer to the Pulse Detection Option section to apply for a license in order to use the function properly.

8.3.1 Parameters description

Only some of the important parameters are described here: The important parameters of the pulse signal detection section are shown in Table 21.

Table 21 Description of Pulse Signal Detection Parameters

Pulse Det	
Threshold	Pulse detection threshold, greater than the threshold value of the pulse signal will be determined as a valid pulse.
Pulse Count	Upper limit of pulse signal detection at current preview time.

8.3.2 Procedure

An example is the detection of a pulsed signal at 1 GHz, -20 dBm, with a pulse width of 40 us and a pulse period of 80 us.

1. Set "Center" to 1 GHz and "Ref. Level" to 0 dBm;
2. Click "BW" in the main settings area and adjust the "BW" value in the additional menu to set different analysis bandwidths. In this example, set "AnalysisBW" to 61.44 MHz;
3. Click "Trigger" in the main settings area and set "PreviewTime" to 500 µs;
4. Click "Pulse Det" in the main settings area to enable pulse detection. Drag the "Trigger.Level" in the power vs. time plot to set the pulse detection threshold, and adjust "Pulse Count" to set the maximum number of pulses detected within the current preview time;
5. Click "Single" in the menu bar. The pulse detection results under the current configuration are shown in the figure below. From the figure, you can obtain parameters for each detected pulse signal, including Top Level (dBm), Base Level (dBm), Rise Time, Rise Edge, Fall Time, Fall Edge, Width, PRI, and Duty Cycle. Additionally, statistical parameters of the detected pulses are available, such as Max, Min, and Mean PRI and PW, as well

as PRI deviation (%) and PW deviation (%).

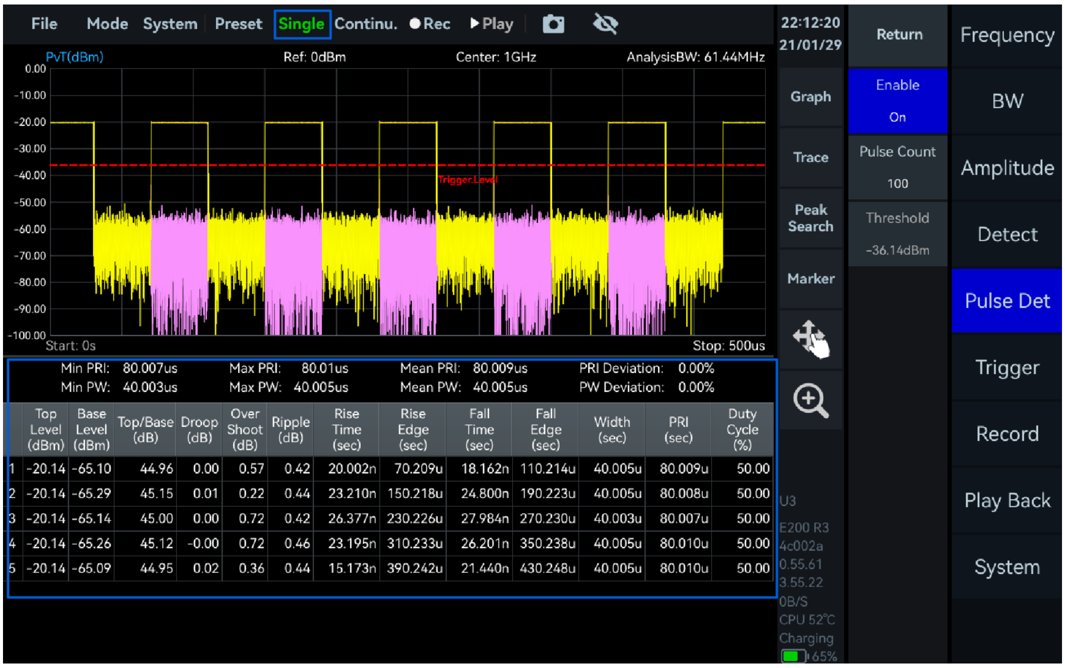

Figure 32 Result of Pulse Detection

9. Using of the RTA mode

This chapter provides a detailed introduction to certain parameters of the real-time spectrum analysis mode, the disabling of the probability density plot, and the measurement of Wi-Fi signals in this mode.

9.1 Introduction to the General Parameters of RTA Mode

Only some of the important parameters are described here: some of the important parameters of the real-time spectrum analysis mode are shown in Table 22.

Table 22 Description of RTA Mode Parameters

Frequency	
LO Optimize	Please refer to the parameter with the same name in the Introduction to the General Parameters of SWP Mode.
Amplitude	
PreAmplifier	Please refer to the parameter with the same name in the Introduction to the General Parameters of SWP Mode.
GainStrategy	
IFGainGrade	
Atten	
Sweep	
SWTMode	Please refer to the parameter with the same name in the Introduction to the General Parameters of SWP Mode.
Window	

9.2 Probability Density Plot

9.2.1 Parameters description

Graph	
BitMap	On: Enable probability density plot display Off: Disable probability density plot display
Color	Sky, Sea(Default), Jet, Cold, Hot, and Gray
Afterglow	Increase: Extend the persistence of signal traces, suitable for capturing burst signals. Decrease: Speed up the refresh rate, suitable for tracking continuous signals.

9.2.2 Close Probability Density Plot

Click "Graph" in the chart settings area, and in the pop-up window disable "BitMap" to turn off the probability density plot.

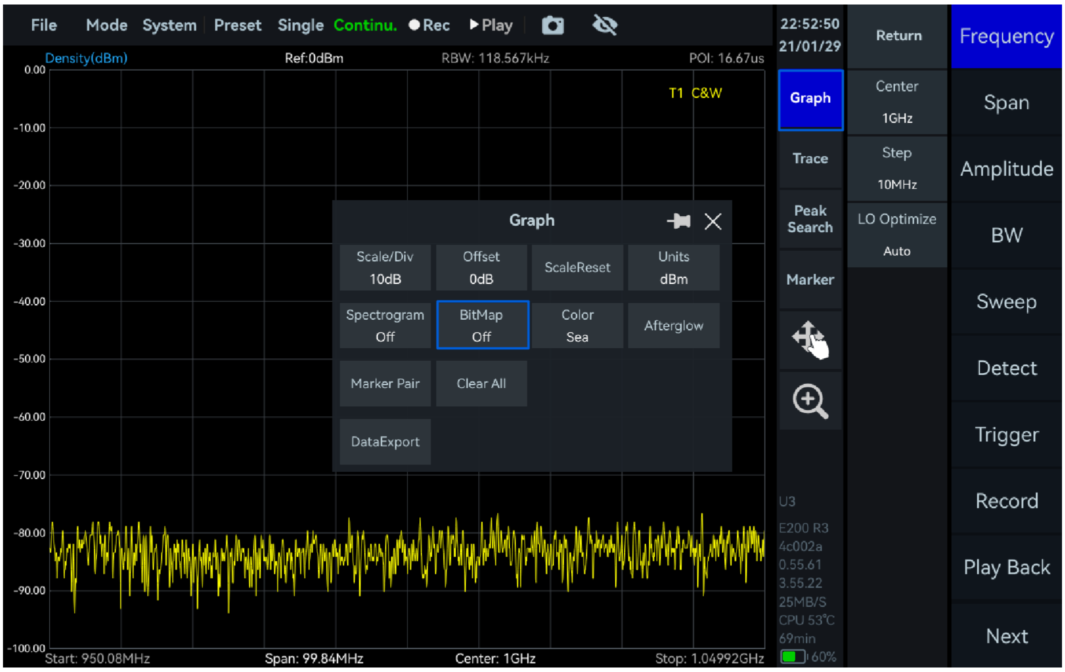

Figure 33 Close Probability Density Plot

9.3 WIFI Signal Measurement

1. Connect the antenna to the RF input port "RFIN";
2. Set the "Center" frequency to 2.44 GHz, and increase the "Afterglow" value under the "Graph" submenu in the chart settings area to more clearly observe the Wi-Fi signal.

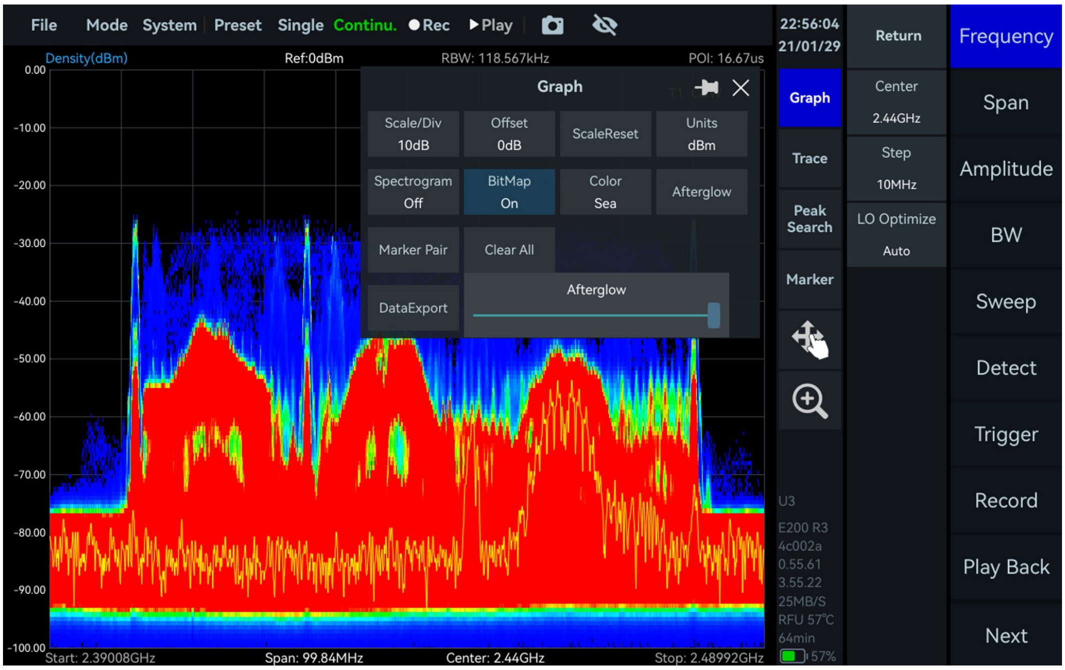

Figure 34 Probability Density Plot of WIFI Signal

10. Digital Demodulation (Option 71)

If you purchase the Pulse Detection option at a later date, please refer to the Digital Demodulation option section to apply for a license and a demodulation library in order to use the function properly.

10.1 Parameters description

Only some of the important parameters are described here: some of the important parameters are shown in Table 23.

Table 23 Description of Digital Demodulation Parameters

Digital Demod	
SymbolRate	The number of symbols per second transmitted by the signal, which should be filled in according to the symbol rate of the modulated signal to ensure correct demodulation at the receiving end
ModType	2ASK, 2FSK, 4FSK, GMSK, BPSK, QPSK, 8PSK, 16QAM, 64QAM, 128QAM, 256QAM
FilterAlpha	The roll-off rate of the filter used to limit the signal bandwidth in the transition band needs to be consistent with the roll-off coefficient at the transmitter to ensure efficient processing and correct demodulation of the signal by the demodulator

10.2 Introduction to Functions

The initial interface of the digital demodulation mode consists of the modulated signal spectrum, the demodulated constellation diagram, the eye diagram, and demodulation parameters. It enables in-depth analysis of the modulation quality, provides multiple error metrics, and effectively evaluates the integrity and reliability of the signal during transmission.

10.3 Procedure

As an example, demodulation of a 64QAM signal at 1 GHz, -20 dBm, SymbolRate 100 kHz, FilterAlpha 0.35.

1. Click "Mode" -> "Digital Demod";
2. Set the "Center" to 1 GHz and the "Ref.Level" to 0 dBm;
3. Click "Demod" in the main settings area. In the additional menu, set "ModType" to QAM64, "SymbolRate" to 1 MSPS, and "FilterType" to 0.35. Then click "Single" in the menu bar. The demodulation results under the current configuration are shown in the figure below:

- Constellation Diagram: The constellation points are clear and tightly clustered. The theoretical and actual demodulated points nearly coincide, indicating high modulation quality and good overall performance of the communication system.
- Eye Diagram: The diagram is clear with a wide opening, indicating minimal inter-symbol interference and that the receiver can reliably distinguish symbols.
- Summary: Error Vector Magnitude (EVM), amplitude error, phase error, frequency error, Signal-to-Noise Ratio (SNR/MER), and part of the decoded bit sequence can also be obtained.

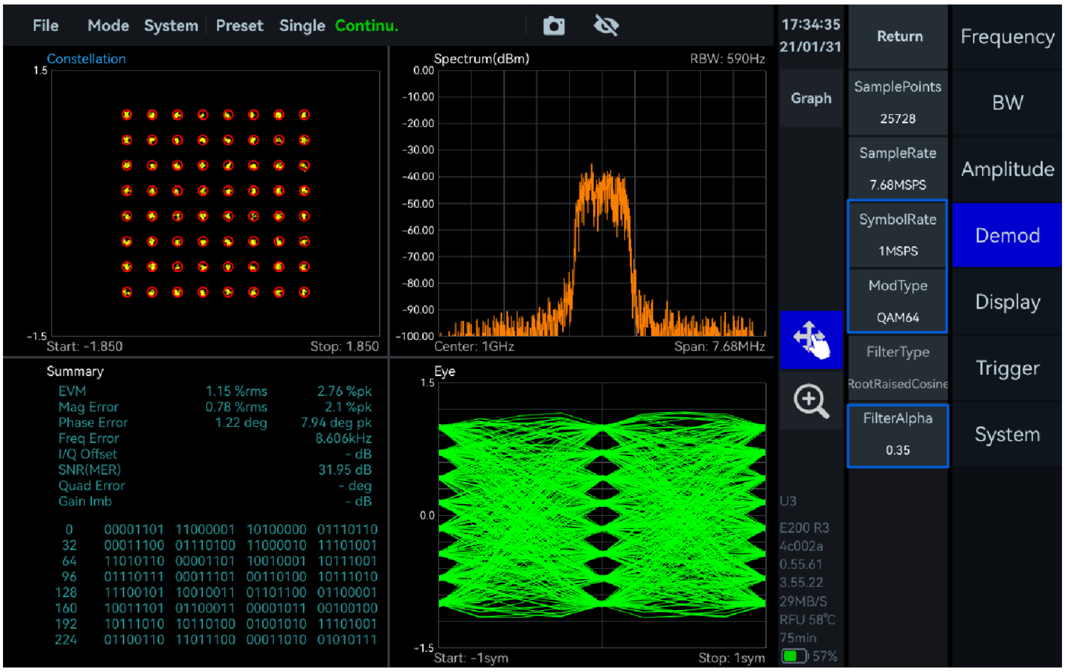

Figure 35 64QAM Demodulation

11. Harmonic Analysis Mode

11.1 Version Requirements

1. Refer to the Current Instrument Information section to view the soft and firmware version;
2. Ensure the version meets the following requirements:

- GUI Version: 4.3.55.24 or above
- API Version: 0.55.0 or above
- FPGA Version: 0.55.0 or above
- MCU Version: 0.55.0 or above

3. If the GUI version does not meet the above requirements, please refer to the section on Software Update to obtain the appropriate version of the host computer software.

11.2 Enable Harmonic Analysis Function

After updating the software and firmware to the required version, restart the host software, and click "Mode" -> "Harmonics" in the menu bar to use the harmonic analysis function normally.

11.3 Parameters description

Only some of the important parameters are described here: the important parameters of the harmonic analysis section are shown in Table 24.

Table 24 Description of Harmonic Analysis Parameters

Frequency	
Center	The center frequency of the fundamental signal.
Span	
Span	The measurement bandwidth for each harmonic. Range: 10 Hz – 100 MHz.
Amplitude	
Offset	Adjust the position of the spectrum plot along the amplitude axis.
Meas	
Harm Count	Set the number of harmonics to measure and plot, up to 10.
Meas Type	Peak: Measure the peak power of the fundamental and each harmonic. ChannelPower: Measure the channel power of the fundamental and harmonics within their respective sweep bandwidths.
Trace Type	ClearWrite: Update the spectrum plot in real time, suitable for observing instantaneous signal changes. MaxHold: Hold the peak value of the displayed signal, suitable for capturing instantaneous peaks.
PK Tracking	On: Enable peak tracking of the fundamental signal, aligning its peak to the center frequency.
THD	Used to evaluate the distortion level of the signal.

11.4 Procedure

An example is the measurement of the third harmonic of a 1 GHz, -20 dBm signal.

1. Click "Frequency" in the main settings area and set "Center" to 1 GHz;
2. Click "Amplitude" and set "Ref. Level" to –10 dBm;
3. Click "Meas", set "Harm Count" to 3, and enable "PK Tracking". Keep other parameters at their default values;
4. Click "Span" and set the "Span" to 10 MHz;
5. Click "BW" and adjust "RBW" and "VBW" values to stabilize the trace. In this example, set RBW to 1 kHz and VBW to 100 Hz;
6. The test results are shown in the figure below. The THD is displayed in the top-right corner of the spectrum plot. In the harmonic measurement table below, the frequencies, amplitudes, and differences from the fundamental of the second and third harmonics are listed.

Figure 36 Measurement of Third Harmonic

12. Phase Noise Measurement Mode

12.1 Version Requirements

1. Refer to the Current Instrument Information section to view the soft and firmware version;
2. Ensure the version meets the following requirements:
- GUI Version: 4.3.55.12 or above
- API Version: 0.55.58 or above
- FPGA Version: 0.55.17 or above
- MCU Version: 0.55.49 or above
3. If the soft and firmware version does not meet the above requirements, please refer to the section on Software Update and Firmware Update to update.

12.2 Enable Phase Noise Measurement Function

After updating the software and firmware to the required version, restart the host software, and click "Mode" -> "Phase Noise" in the menu bar to use the phase noise measurement function normally.

12.3 Parameters description

Only some of the important parameters are described here: The important parameters for the phase noise measurement are shown in Table 25.

Table 25 Description of Phase Noise Measurement Parameters

Frequency	
Center	Set the center frequency of the fundamental.
Start Offset	Set the frequency offset start point: Range: 1 Hz – 9 MHz.
Stop Offset	Set the frequency offset stop point: Range: 10 Hz – 10 MHz.
Threshold	Set the threshold above which carriers will be identified.
Meas	
RBW/Offset	RBW Radio**:** (RBW of each frequency segment or start frequency of each frequency segment), range: 0.01 – 0.3.
Detect	Frame Detection Rate: The default configuration is recommended. If the test signal exhibits significant low-frequency jitter near the carrier, increase the frame detection rate in the near region to obtain more stable measurement results.
Trace	
Average	Set the number of averaging times for the trace.
Smooth	On: Enable trace smoothing. Off: Disable trace smoothing.
Window Length	Set the window length of the smoothing algorithm, range: 0 – 10%.

12.4 Procedure

12.4.1 Phase Noise Measurement with Known Carrier Information

As an example, the phase noise of a 1 GHz, 0 dBm signal is measured over an offset range of 100 Hz to 10 MHz.

1. Click "Frequency" in the main settings area. In the additional menu, set "Center" to 1 GHz, "Start Offset" to 100 Hz, and "Stop Offset" to 10 MHz. It is recommended to keep the other parameters at their default settings;
2. If the test signal exhibits strong jitter near the carrier, click "Meas" in the main settings area. Then, in the additional menu, select "Detect". In the pop-up window, appropriately increase the frame detection rate for the corresponding frequency band to obtain more convergent measurement results;

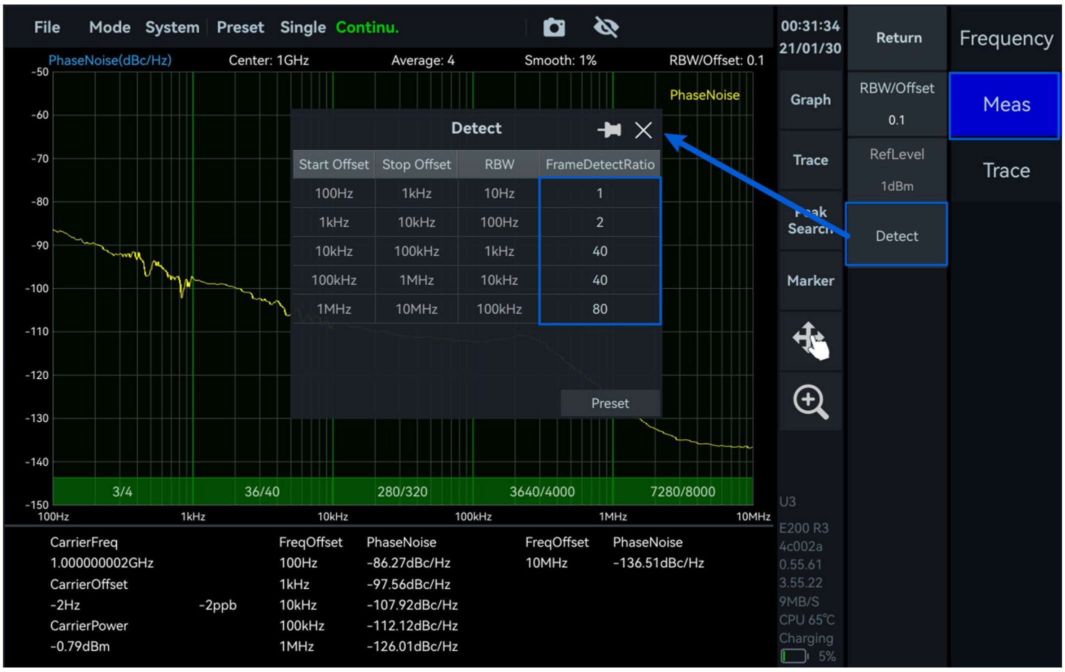

Figure 37 Pulse Signal Detection Settings

3. If significant spurious components appear in the single-sideband phase noise spectrum, click "Trace" in the main settings area. Then, in the additional menu, select "Window Length" and gradually increase its parameter value to reduce the impact of spurious signals on the measurement results;
4. The instrument will automatically perform phase noise measurements within the specified frequency offset range. The measurement results are shown below. In the phase noise measurement table at the bottom of the interface, information about the carrier as well as the phase noise values (in dBc/Hz) at characteristic offset points can be obtained.

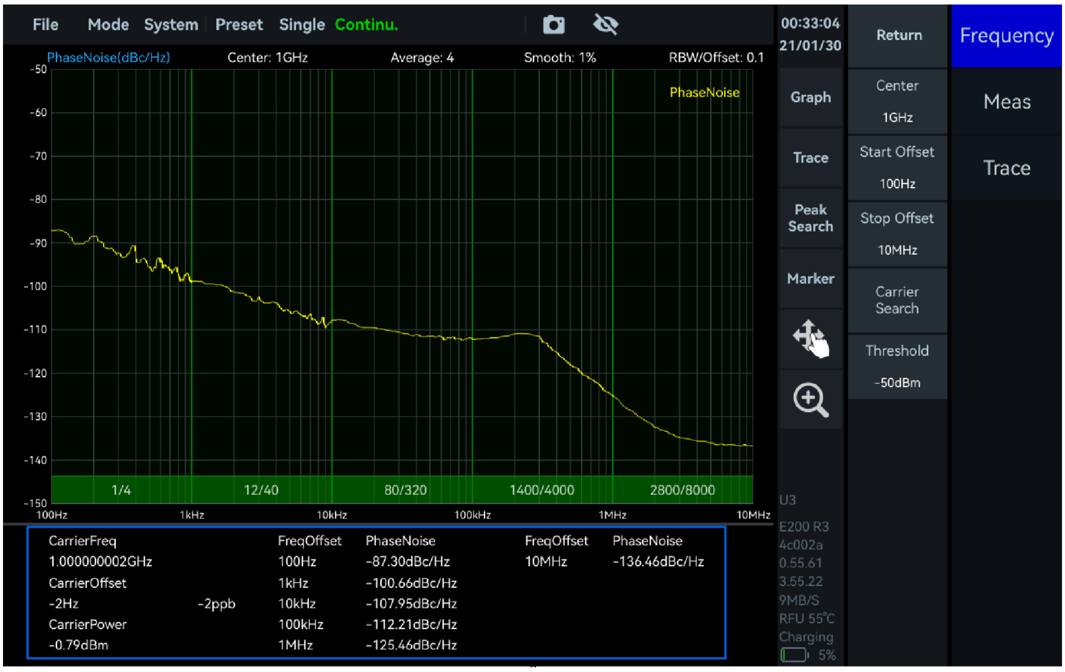

Figure 38 Result of Phase Noise Measurement

12.4.2 Phase Noise Measurement with Unknown Carrier Information

When the signal carrier parameters are unknown, it is recommended to follow the procedure below for phase noise measurement

1. Click "Carrier". The instrument will automatically perform a full-band scan to search for and locate peak signals that exceed the carrier threshold, which will be used as the test carrier;
2. After locating the carrier signal, refer to the Phase Noise Measurement with Known Carrier Information to set the start and stop frequency offsets, and perform the phase noise measurement.

14. ASG Function (Option 02)

ASG is an analogue signal source option function that can output monotone signals, frequency sweep signals and power sweep signals. Instruments that support the ASG option are shown in Table 26.

Table 26 Support ASG Option Instrument List

Product Series	Models
SA	SAM-80, SAM-60, SAN-60 and SAN-45
NX	NXM-80, NXM-60, NXN-60 and NXN-45

14.1 Introduction to the General Parameters of the ASG

Table 27 Description of ASG Mode Parameters

RF	On: Enables the signal source output Off: Disables the signal source output
Center	Set the frequency for single-tone and power sweep signals
Level	Set power for single-tone and frequency sweep signals
FreqSweep	
Start	Set the start frequency of the frequency sweep signal
Stop	Set the stop frequency of the frequency sweep signal
Step	Set the frequency step of the frequency sweep signal
PowerSweep	
Start	Set the start power of the power sweep signal
Stop	Set the stop power of the power sweep signal
Step	Set the power step of the power sweep signal
DwellTime	Set the dwell time for sweep signals, effective in "PowerSweep" and "FrequencySweep" modes
Trig-InSource	The trigger input source for the signal generator: Free Run, External Trigger, Bus Trigger
Trig-InMode	The trigger input mode: No Action, Single-Point Trigger (triggers a single frequency or power configuration), Single Sweep Trigger (triggers one sweep cycle), Continuous Sweep Trigger (triggers continuous operation)
Trig-OutMode	The trigger output mode: No Output, Output Trigger per Configuration, Single Sweep Output Trigger
Mute(APP Exit)	Continue outputting the signal after exiting the software Yes: Stops output after exit No: Continues output after exit

14.2 Instructions for Using the ASG Function

The signal is output through the instrument's RFOUT port, which can either provide an input signal to other devices or be connected via cable to the instrument's own RF input port. The following example demonstrates a self-transmit-and-receive setup.

14.2.1 Output a Single-Tone Signal

1. Click "AUXS" -> "RF On" in the main settings area to enable the signal source option;
2. In the "AUXS" submenu, set "Center" to 1 GHz and "Level" to –20 dBm to output a single-tone signal at 1

GHz with a power level of –20 dBm.

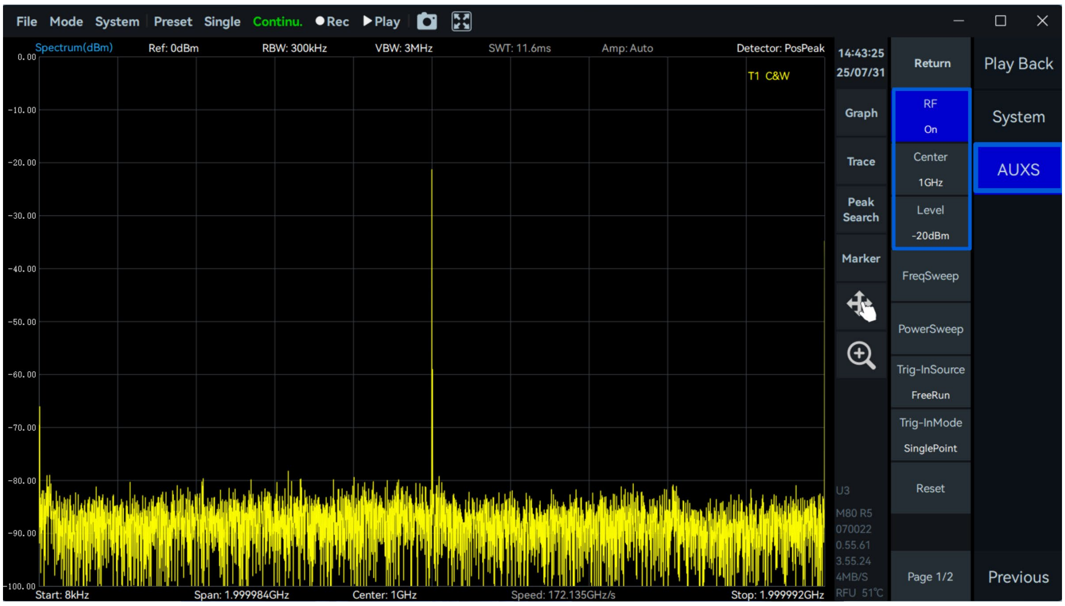

Figure 39 ASG Single-Tone Signal Output

14.2.2 Output a Frequency Sweep Signal

1. Refer to Step 1 in the Output a Single-Tone Signal section to enable the signal source function;
2. Enable the "FreqSweep" mode. In the sweep signal parameter settings area, set "Start" to 2.8 GHz, "Stop" to 3.4 GHz, "Step" to 40 MHz, "Level" to -20 dBm, and "Dwell Time" to 8 ms;
3. The ASG outputs a frequency sweep signal with a start frequency of 2.8 GHz, a stop frequency of 3.4 GHz, a frequency step of 40 MHz, a dwell time of 8 ms, and an amplitude of -20 dBm.

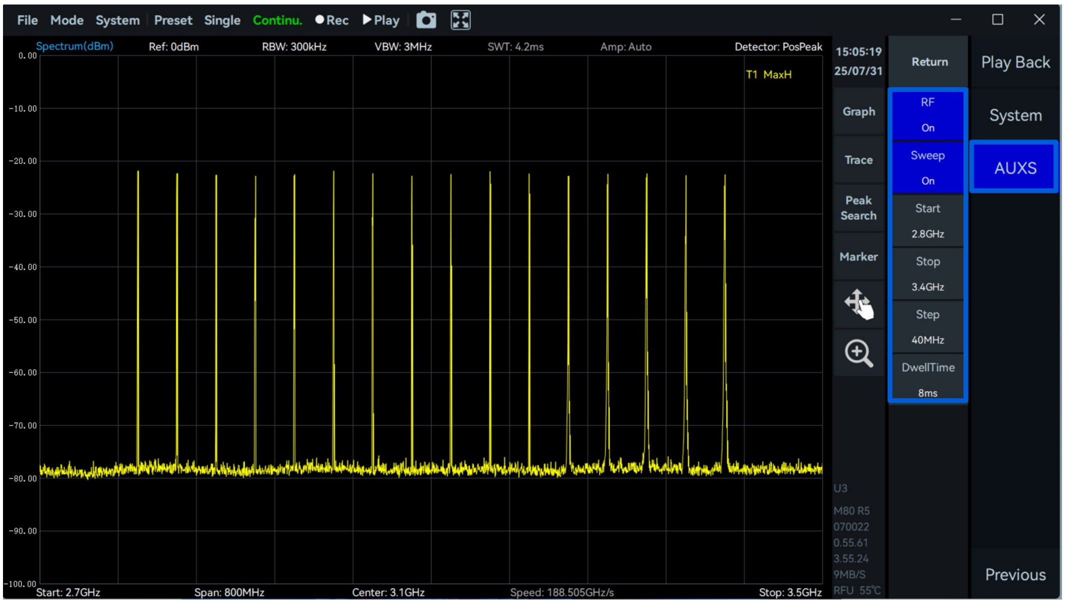

Figure 40 ASG Frequency Sweep Signal Output

14.2.3 Output a Power Sweep Sigal

1. Refer to Step 1 in the Output a Single-Tone Signal section to enable the signal source function;
2. Enable the "PowerSweep" mode. In the power sweep signal parameter settings area, set "Center" to 1 GHz, "Start" to -40 dBm, "Stop" to -10 dBm, "Step" to 1 dB, and "Dwell Time" to 100 ms;
3. The ASG outputs a power sweep signal with a frequency of 1 GHz, a start power of –40 dBm, a stop power

of –10 dBm, a power step of 1 dB, and a dwell time of 100 ms.

15. Additional Functions

This chapter briefly describes the IF outputs of the instrument, as well as the trigger function, the input of an external reference clock, and the remote control of the device.

15.1 Description of Trigger Functions

15.1.1 SWP Frequency Sweep Mode

Trigger

TriggerSource	FreeRun, ExtPerHop, Ext. PerSweep, Ext.PerProfile
TriggerEdge	RisingEdge, FallingEdge, DoubleEdge
TriggerOut	None. PerHop: outputs a trigger for each completed frame of analysis. PerSweep: outputs a trigger for each trace scan completed. PerProfile: outputs a trigger for each switching configuration.
PulsePolarity	Positive, Negative

15.1.2 Fixed Frequency Point Mode for IQS, DET and RTA

Trigger

TriggerSource	External, Bus, Level, Timer, DevSyncByExt, DevSyncBy1PPS, GNSS1PPS
TriggerEdge	RisingEdge, FallingEdge, DoubleEdge
TriggerDelay	Set the time to delay acquisition after triggering
PreTrigger	Set the time to collect in advance before triggering
ReTrigger	The instrument responds multiple times after capturing a trigger

ReTrigger-On

Count	After a single trigger response, additional responses may be required.
Period	The time interval between multiple responses to a single trigger corresponds to the trigger period under the timer trigger mode.

TriggerSource-Level

Level	Set the level trigger threshold. A signal exceeding the threshold indicates that the trigger condition is met.
SafeTime	Set the debounce safety time for the level trigger.

TriggerSource-Timer

Period	Trigger period under the timer trigger mode
Sync	Not synchronized with the external trigger Synchronized with the external trigger's rising edge Synchronized with the external trigger's falling edge Single-shot synchronization with the external trigger's rising edge Single-shot synchronization with the external trigger's falling edge

	Synchronization with the GNSS-1PPS rising edge Synchronization with the GNSS-1PPS falling edge Single-shot synchronization with the GNSS-1PPS rising edge Single-shot synchronization with the GNSS-1PPS falling edge

15.2 IF Output Application Guide

The frequency of the analogue IF output signal is between 307.2 MHz ± 50 MHz. The center frequency of the analogue IF output of each instrument can be viewed in the IF calibration file in the "/bin/CalFile" folder in the software installation directory.

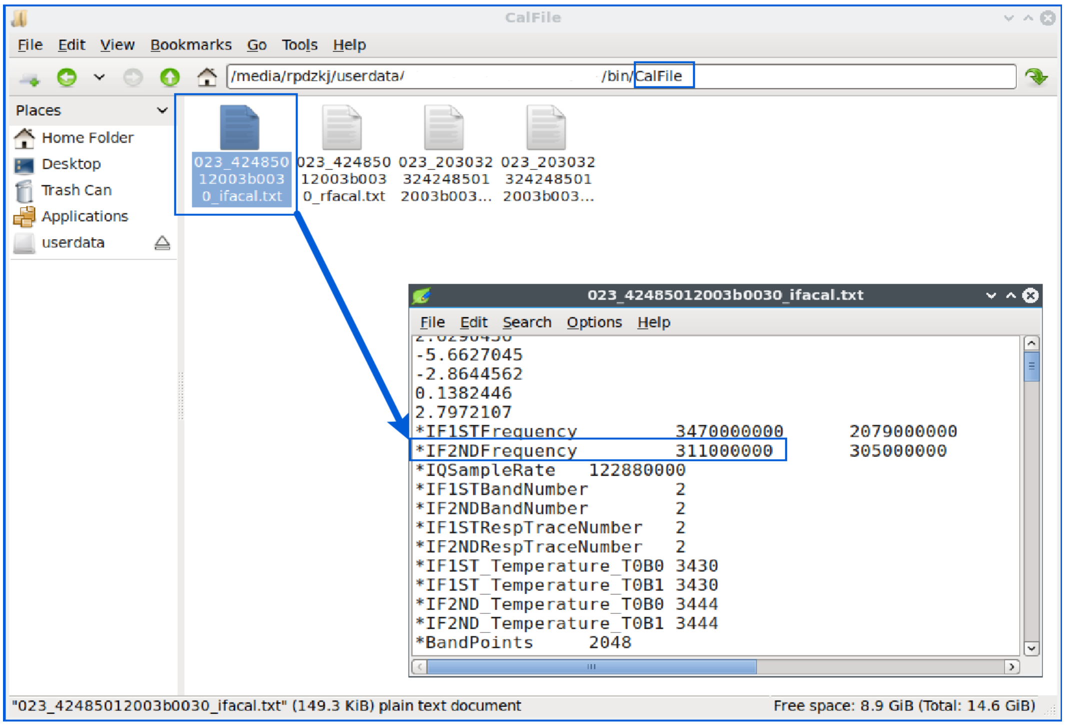

Figure 41 Check the IF Output Center Frequency on PX Series Instruments

15.3 External Reference Clock Input

1. Refer to the interface description in the *Spectrum Analyzer Product Manual* to input the external reference clock;
2. In the main settings area, click "Next" -> "System", set the reference clock frequency "RefCLKFreq" to 10 MHz, and select "External" as the reference clock source "RefCLKSource". If the reference clock source displays "External", the switch is successful. If it reverts to "Internal" and an error message pops up, the switch has failed. In this case, click "Preset" to switch back to the internal clock.

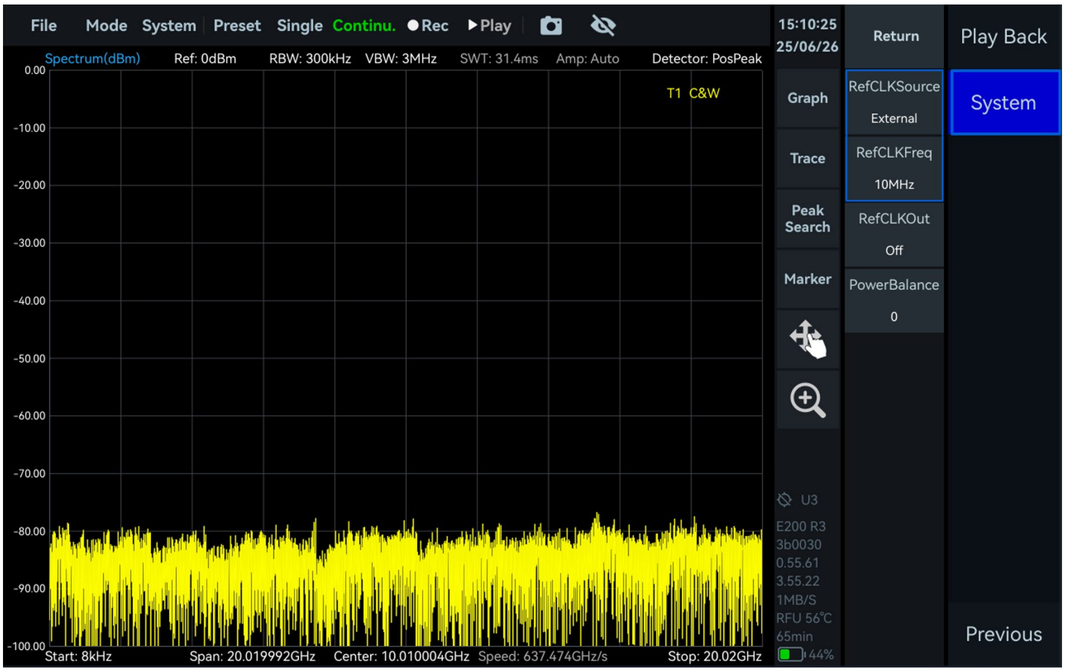

Figure 42 Use an external 10 MHz reference clock

16. Application for Options

16.1 Pulse Detection Option

16.1.1 Application for License

1. Refer to the Current Instrument Information section to view the soft and firmware version;
2. Ensure the version meets the following requirements:

- GUI Version: 4.3.55.6 or above
- API Version: 0.55.55 or above
- FPGA Version: 0.55.15 or above
- MCU Version: 0.55.32 or above

3. If the soft and firmware version does not meet the above requirements, please refer to the section on Software Update and Firmware Update to update.
4. Click "System" -> "About", take a screenshot of the entire software interface, and send it to the official technical support team to apply for the corresponding device license.

16.1.2 License Placement

1. Place the Pulse detection license for SA/NX Series instruments

1) Copy the obtained Pulse Detection license to the "/bin/CalFile" folder of the software;
2) Restart the software. In the menu bar, click "Mode" -> "Power Detection", then enable "Pulse Det" in the main settings area to use the pulse signal detection function.

2. Place the Pulse detection license for PX Series instruments

1) Click "File" -> "Exit" to close the software interface;
2) Extract and copy the "PX_Demod" file to a USB flash drive. Insert the drive into the instrument's USB port, and when the "Removable medium is inserted" dialog box appears, click "OK";
3) Drag and drop the "PX_Demod" folder from the USB drive to the desktop;
4) Open the "PX_Demod" folder and click "Tools" to launch the terminal. Enter *sudo sh install.sh* and press Enter. When prompted, enter the password *rpdzkj* and press Enter again. If the terminal displays "The option has been successfully installed", the installation has been completed successfully;

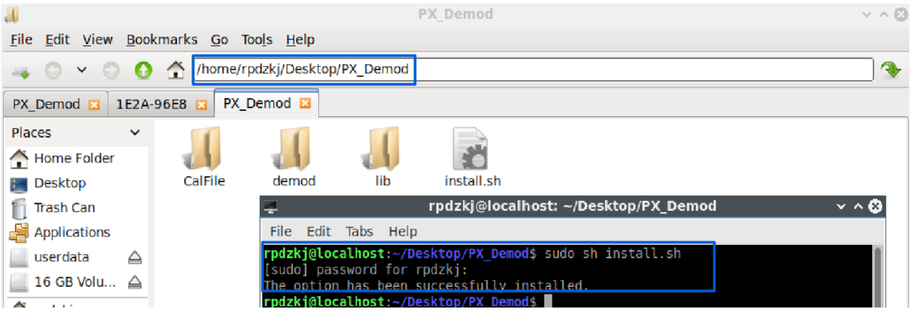

Figure 43 Install the Pulse Detection Option License

5) Close the popup window and restart the software. In the menu bar, click "Mode" -> "Pulse Detection", then enable "Pulse Det" in the main settings area to use the pulse signal detection function.

16.2 Digital Demodulation Option

16.2.1 Application for License and Digital Demodulation Library

Refer to the license application for Pulse Signal Detection to apply for the corresponding license and digital demodulation library.

16.2.2 License and Digital Demodulation Library Placement

1. Place the Digital demodulation license and Library for SA/NX Series instruments

1) Copy the "DigitalSigDemod.dll" demodulation library file into the "/bin" folder under the software directory;
2) Copy the digital demodulation license into the "/bin/CalFile" folder under the software directory;
3) Restart the software. In the menu bar, click "Mode" -> "Digital Demod" to enable and use the digital demodulation function.

2. Place the Digital demodulation license and Library for PX Series instruments

1) Refer to the Place the Pulse detection license for PX Series Instruments section, and use the command *sudo sh install.sh* to install the corresponding license and demodulation library with one click;
2) Close the popup window and start the software. In the menu bar, click "Mode" -> "Digital Demod" to use the digital demodulation function.

16.2.3 ASG Option

For later purchases of the ASG option, the device must be returned for an upgrade.

17. Software Update

This chapter describes how to update the software version of PX Series instruments using a .deb package, as well as how to obtain the latest version of the PC software for SA/NX Series instruments.

17.1 Software Acquisition

Visit the official website at https://www.harogic.com/support/download-center/ and download the latest software version.

17.2 Software Update for SA/NX Series Instruments

17.2.1 Software Update under Windows

1. Copy the SA/NX Series software package downloaded from the official website to the desktop or another directory on the computer, and extract it;
2. Copy the contents of the "/bin/CalFile" folder from the original software to the same directory in the new version of the software;
3. For SA Series instruments, skip this step. For NX Series instruments, open the "/bin/Setting.ini" file and change "Interface=USB" to "Interface=ETH";
4. Double-click the executable file in the "/bin" directory to launch the software.

17.2.2 Software Update under Linux

1. Copy the software package downloaded from the official website to the Linux system and extract it;
2. Navigate to the extracted folder, execute *sudo sh install.sh* in the terminal to run the installation script, and enter the password as prompted to complete the installation;
3. After the installation is complete, enter *sh app.sh* in the terminal to launch the software.

17.3 Software Update for PX Series Instruments

1. Extract the PX Series software installation package downloaded from the official website and copy it to a USB flash drive;
2. Power on the instrument normally, then click "File" -> "Exit" in the menu bar to close the PC software;
3. Use a USB or Type-C hub, connect the USB flash drive containing the .deb installation package, along with the mouse and keyboard, to the instrument;
4. Copy the .deb installation package from the USB flash drive to the system desktop;
5. Click "Tools", and then click "Open Current Folder in Terminal" to open the terminal;

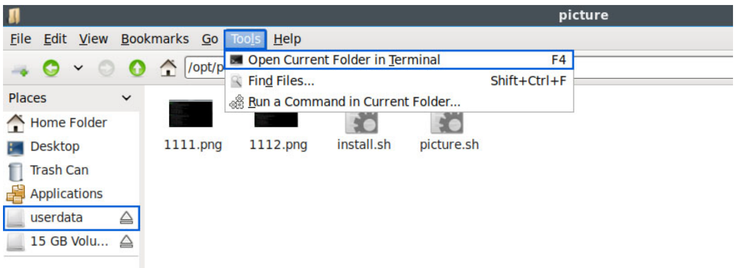

Figure 44 Open the terminal

6. Enter *cd ~/Desktop/* to navigate to the desktop;
7. Enter *sudo dpkg -i EN_PXConfig_3.55.22.23.deb* (Note: when entering the command, replace *EN_PXConfig_3.55.22.23.deb* with the actual version of the .deb package you are using) to install the .deb package, and press Enter to confirm. Then, when prompted, enter the password *rpdzkj*, press Enter again,

and wait for the installation to complete;

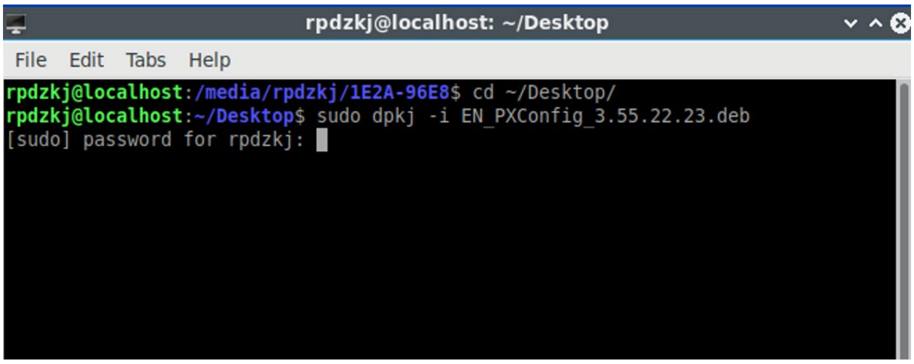

Figure 45 Software Update for PC

8. Wait until the installation package has finished running. The device will automatically restart and enter the interface of the new version of the PC software, indicating that the software installation has been completed;
9. Click "System" in the menu bar, select "About" from the drop-down menu, and check in the popup window whether the GUI and API have been updated to the latest version.

18. Firmware Update

This chapter describes how to update the MCU, FPGA, and GNSS firmware versions of SA and PX Series instruments using the updater program.

18.1 Firmware Acquisition

Visit the official website at https://www.harogic.com/support/download-center/ and download the latest version of "Firmware Updater".

18.2 Firmware Update for SA/NX Series Instruments

1. Extract and open the "Updater_0_55_61_V11" folder (please use the actual downloaded version);
2. Before updating, carefully read the "README.txt" file in the folder to confirm the update requirements. If the instrument does not meet the update prerequisites, contact official technical support for assistance;
3. If the current instrument meets the update requirements, properly connect the instrument and double-click "Updater_Win07-16-25.exe" (please use the actual downloaded version) to perform the firmware update;
4. The program will display the current firmware version of the device and the firmware version in the update package. After verifying that the information is correct, press Enter to start the upgrade;
5. During the update process, please wait patiently according to the progress bar until the update is complete, and then press Enter as prompted to finish the update;
6. After closing the updater program, launch the software and click "System" -> "About" to check whether the MCU and FPGA of the instrument have been updated.

18.3 Firmware Update for PX Series Instruments

1. Refer to Steps 1 – 2 of the Firmware Update for SA/NX Series Instruments to check whether the current instrument meets the update requirements. If it does not, please contact official technical support for the update;
2. Connect a driver-free hub with an Ethernet port to the instrument's USB port, and use a network cable to connect the hub to the PC's Ethernet port;
3. Click "File" -> "Exit" in the menu bar to close the PC software;
4. On the PC, open the Ethernet configuration interface. In the IP settings section, click "Edit", select "Manual", enable the IPv4 option, and configure the IP address and subnet mask (the PC IP and the instrument IP must be on the same subnet). For example, set the PC IP address to 192.168.1.2 and the subnet mask to 255.255.255.0;
5. Open the CMD window and enter *ping 192.168.1.100*. If the ping is successful, the network connection has been established;
6. Refer to Steps 3 – 6 of the Firmware Update for SA/NX Series Instruments to update the firmware.