

USER MANUAL

Extend RF Boundaries.

HANDHELD REAL-TIME SPECTRUM ANALYZER UP TO 40 GHz

0.99912 %ms 2.460 % 0.1403 %ms 0.05725 deg % 0 deg 0.05725 deg % 30.8686 d

1 0111111 011011 1101 1 0111111 010010 11010101 11 1010111 1010010 0000001 11 0111001 1111100 01010011 10 0010100 0000000 0101000 10 0000000 0111000 00101001 111 0010000 1000011 0010011 111 0010011 1010011 1011011 111 0010010 10010011 001001

HAROGIC

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1. Version Management

-	-	
Version Number	Content	Time
V1.0	Add digital demodulation and pulse option measurement description	2025-3-27
V1.1	 Add phase noise test function description Pulse signal detection version description Modify trigger function introduction (based on the latest SAS4) 	2025-4-3
V1.2	1. Add pulse signal test in DET mode 2. Modify some details in the document	2025-4-8
V1.3	 Add requirements for operating environment and probability density chart section Remove SWP mode pulse detection and digital demodulation hardware dongle instructions 	2025-4-30

Version Update Description Table

2. Quick Start Guide

This chapter covers Quick Start Guide for PX series handheld spectrum analyzer, with key topics including safety instructions, instrument power on/off, SAStudio4 software operation and external interface descriptions.

2.1 Safety Instruction

2.1.1 Safety rules

1. Please check the following items before running the instrument:

- The appearance of instrument is intact;
- The power cable and adapter are not damaged;
- The fan's air vent is unobstructed;
- The instrument is dry, without moisture or condensation;
- The ambient temperature meets specifications in product datasheet;
- If any damage is found before first operation, please contact HAROGIC official after-sales service.

2. During operation, please follow these guidelines:

- The fans work properly and the operating temperature meets the requirements from the product datasheet;
- Please connect the external port properly and ensure that input signal level is
- within maximum input power;
- Battery is suggested to be above 5%;
- It is prohibited to open the instrument's casing to avoid the risk of electric shock;
- In case of any error, please contact HAROGIC official after-sales service.

3. After completing the use of the instrument, please follow the guidelines below:

• After the instrument is properly shut down, ensure that the storage temperature

and humidity meet the range specified in the product datasheet.

2.1.2 Replacing the power adapter

If you are unable to use the original power adapter for certain situations, please select an appropriate power adapter according to the corresponding product datasheet.

2.1.3 Replacing the battery

The service for PX series battery replacement is officially offered. If you need to replace the battery, please contact official after-sales service for assistance.

2.2 External Interface Description

All external interfaces are integrated on the top panel of PX series instrument. Please refer to Table 1 for detailed information of each interface.



Table 1 Detailed information of external interface

No	Interface	Description
1	Power	On/Off instrument
2	Charging	Instrument charging port, USB PD 20V 3.25A. Please connect the power supply according to the datasheet
3	Micro HDMI	For extended display
4 5 6	USB3 USB2 USB1	USB interface: USB3 is USB 3.0 interface, USB1 and USB2 are USB 2.0 interface. This interface connects to external storage devices, USB keyboards, or mice. It can also be used to connect a driver-free Hub with an Ethernet port, allowing the instrument to be remotely controlled by a PC via network cable
7	Audio Output	3.5mm headphone jack. Volume can be adjusted via the menu: "System" \rightarrow "Device" \rightarrow "Volume."
8	MUXIO	Please refer to Table 2 for more details
9	Charging Indicator Light	Green flash indicates charging, and green solid light indicates a full charge
10	Analog IF Output	MMCX(F), maximum output power -25 dBm, output impedance 50 $\boldsymbol{\Omega}$
11	Trigger Output	3.3V CMOS
12	Trigger Input	3.3V CMOS, high impedance input
13	Reference Clock Input	MMCX (F), amplitude 1.5Vpp, input impedance 330 Ω . Sine wave, square wave, and clipped sine wave are supported
14	GNSS Antenna	MMCX (F), amplitude 1.5Vpp, input impedance 330 Ω
15	RF Input	N (F) or 2.4 mm (M), input impedance 50 Ω

Pin	Name	Direction	Voltage Standard	Description
1	GPIO0	/	/	Reserved
2	TRG IO2	/	/	Reserved
3	GPIO1	/	/	Reserved
4	GND	/	/	Ground
5	GPIO2	/	/	Reserved
6	3V3/5VIN	0	/	Power output, 5V output for PXN-400 and PXE series
7	GPIO3	/	/	Reserved
8	GND	/	/	Ground
9	USART_TX_FP	/	/	Reserved
10	SYNC_RXRFLO	I	3.3V	RF LO synchronization
11	SYNC_ADCCLK	I	3.3V	ADC clock synchronization
12	SYNC_RXIFLO	I	3.3V	IF LO synchronization
13	GND	/	/	Ground
14	REFCLK_OUT_FP	0	/	Reference clock output outputs a standard clock signal of 10 MHz

Table 2 Pin description for MUXIO interface 8 (from left to right)

2.3 First Use of the Instrument

The battery level may be below 5% after long-distance transportation. It is recommended to connect the power adapter before powering on the instrument for the first time.

2.3.1 Power on/off the Instrument

Turn on/off the instrument using the power button (Interface 1) on the top of the instrument. After powering on, the blue power indicator will light up. After powering off, the power indicator light will go out.

2.3.2 Charging indicator

When the instrument is connected to the power adapter, the charging status light (Interface 9) will flash green. Once fully charged, the charging status light will always stay on green.

2.3.3 SAStudio4 operation

Press the power button to turn on the instrument. After booting up, the instrument will enter the desktop and automatically launch the SAStudio4 software. The standard operating UI is shown in the following picture:



3. SAStudio4 Operation Overview

This chapter mainly explains the UI layout, working modes, and common features of SAStudio4 software.

3.1 Working Modes Overview

PX series handheld spectrum analyzers offer 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.

3.1.1 Standard spectrum analysis (SWP)

In SWP mode, the instrument performs frequency hopping to realize frequency sweep. This mode is suitable for frequency trace-based measurement and analysis applications. The measurement and analysis functions provided in SWP mode include:

- Spectrum panoramic sweep
- Local spectrum zoom display
- Waterfall graph
- Spectrum record and playback
- Signal tracking

- IP3/IM3
- **Channel Power**
- OBW
- ACPR
- Peak table

3.1.2 IQ streaming (IQS)

In IQS analysis mode, the instrument keeps the LO configuration unchanged to obtain IQ time domain data. IQS mode is suitable for time-domain signal recording, basic demodulation analysis, and other applications. The functions provided in IQS mode include:

- IQ time domain waveform
- Waterfall graph
- Power-time waveform
- Multi-channel DDC
- 3.1.3 Power detection mode (DET)

In DET analysis mode, the instrument keeps the LO configuration unchanged to obtain IQ time domain data. DET mode is suitable for observing the relationship between time and power within a certain bandwidth. The functions provided in DET mode include:

Power-time waveform Record and playback

3.1.4 Real time analysis mode (RTA)

In RTA analysis mode, the instrument keeps the LO configuration unchanged to obtain IQ time domain data. RTA mode is suitable for applications that focus on transient and burst signals. The functions provided in RTA mode include:

- Real-time spectrum probability density graph and waterfall graph
- Record and playback

- Spectrum analysis of IQ data
 - AM/FM demodulation
- Audio analysis
- IQ record and playback

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3.1.5 Phase Noise Measurement Mode (PNM)

In phase noise measurement mode, the instrument provides high-precision phase noise spectra and detailed data tables through automated measurement technology. These measurement results help users to deeply analyze the phase stability, noise distribution, and noise density at different frequency offsets of the signal. The functions provided by the phase noise measurement mode include:

- Single-sideband phase noise spectrum
- Phase noise measure table

3.1.6 Digital demodulation mode (Option71)

In digital demodulation mode, the instrument demodulates the modulated signal and analyzes the modulation quality from various perspectives. The demodulation functionality is suitable for multiple applications, especially in environments where known modulated signals need to be analyzed, quality-assessed, and data extracted. The functions provided in digital demodulation mode include:

- Constellation and eye diagram
- Modulated signal spectrum analysis

3.2 SAStudio4 UI Layout

The SAStudio4 UI consists of the following sections:

- Menu
- Graph Display Area
- Instrument State

- Bit table and demodulation
- ASK/FSK/PSK/MSK/QAM
- Main Setting Area

Parameter Quick Set

HAROGIC File Mode System Preset Single Continu. ●Rec ▶Play Ó 5 11:02:19 Frequency Return 24/11/08 ectrum(dBm) Ref: 0dBm VBW: 3MHz SWT: 30.243ms Amp: Auto RBW: 300kHz Detector: PosPeak Center T1 C&W Graph Span 10.0100045GHz Graph Set Area ◀ Start Trace Amplitude 9kHz Peak Stop BW Search Parameter Quick Set 20.02GHz Step Marker Sweep -40 10MHz +je Detect Meas Trigger Instrument State Record Next

Figure 1 SAStudio4 UI layout

3.2.1 Menu

- Save and load configuration
- Set startup state

Graph Set Area



- Working mode switch
- Single/Continue preview
- Quick screenshot

3.2.2 Graph set area

- Graph settings
- Marker settings

3.2.3 Main settings area

- Measurement and analysis settings
- Data record and playback

3.2.4 Instrument state

- Instrument model
- Current instrument temperature
- GNSS antenna connection status

3.3 SAStudio4 Common Operation Overview

3.3.1 Store or load configuration

- 1. Store measurement configuration
- 1) Meau-File-Save State;

2) In the Save Configuration File dialog, set the save path and file name, then click Confirm to save the configuration file.

File Spectrum(dBm) Ref: 0dBm	Mode Sy RBW: 300	vstem Preset DkHz VBW: 3MH	Single C	<mark>ontinu.</mark> 30.155ms	• Rec •	Play De	tector: P	XX PosPeak	11:16:15 24/11/08	Return
0	Save Configu	ration File					10.087		Circuit ()	Center
-10	Second Contract Contr	Dir: Local\			Name				€ Back	Start
-30		 20241108_110 20241108_111 20241108_111 	0911.xml 1041.xml							9kHz Stop
-40										20.02GHz Step
-50										10MHz
-60										
-70										
-80	File Name:	20241108_11160	19						Confirm	
	File Type:	xml							Cancel	

2. Load configuration

- 1) Menu-File-Recall state;
- 2) In the "Please Select file" dialog, choose the configuration file and click "Confirm" to open

- System setting
- Record and playback
- GNSS, Instrument Information View
- Trace settings
- Display Measurement Results
- Trigger settings
- System settings
- Software and firmware versions
- Bus data throughput
- Instrument battery status

Frequency

Span

Amplitude

BW

Sweep

Detect

Meas

Trigger

Record

Next

the previously saved configuration.

Spectrum(dBm) Ref: 0dBmRBW	System Preset Singl	le Continu. ●Rec ►	Play 🗖 🗞	11:18:22 24/11/08	Return	Frequency
Please se	ect file	Allp. Auto			Center .0100045GHz	Span
-20	Dir: Local	Size	Date Modified	TBack	Start 9kHz	Amplitude
-30	20241108_11041.xm	il 12.31 KiB	2024/11/8 11:15		Stop 20.02GHz	BW
-40					Step 10MHz	Sweep
-50						Detect
-60						Meas
-70						Trigger
			Cancel	Confirm		Record
-100 Start: 9kHz Span: 20.01999	IGHz Center: 10.0100045G	Hz Speed: 663.750GHz/s	Stop: 20.02GHz	1MB/S CPU 56°C Charging		Next

3.3.2 Startup state settings

PX series spectrum analyzers allow users to configure the instrument's startup state. The supported startup states are listed in Table 3.

Table 3 SAStudi	o4 software	startup state
-----------------	-------------	---------------

No	Startup state	Description
1	Default	Default configuration
2	User Preset	Use a user-saved configuration file as the startup state configuration
3	Last State	Use the parameter configuration when last software exit as the startup state configuration

To configure the startup state, follow these steps:

1. Click "File" in menu bar, and select "Power On State" to set the software startup state;

2. For "Default" and "Last State", simply click the corresponding option. The software will use the state as the initial startup state when it is launched for the next time.

3. To select "User Preset," click on the "Please Select File" dialog that appears, choose the user-saved configuration file, and then click "Confirm." The software will start with the user-specified configuration next time.



3.3.3 Working modes switch

Click on "Mode" to switch working mode to SWP, IQS, DET, RTA, or Digital Demodulation.



3.3.4 Save a screenshot

1. Click "File" in the menu bar, and select "Save Image";

2. In the "Save Image" dialog, set the image save path and file name, then click "Confirm" to save the screenshot (when no external storage is connected, the image will be saved locally by default; when external is connected, you can choose to save directly to external disk). Alternatively, you can use the shortcut key in the menu bar "

Spectrum(dBm) Ref: 0dBm	Mode System Preset Single Continu.	PRec ►Play 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	18:57:23 22/07/06	Return	Frequency
-10	Save Image		> Rock	Center	Span
-20	Local Di. Local	Name	_ Dack	Start 9kHz	Amplitude
-30				Stop 9.52GHz	BW
-40				Step 10MHz	Sweep
-50					Detect
-60					Meas
-70 -80 marilalit (). all all all all all all all all all al	File Name: 20220706_185638		Confirm		Trigger
-90	File Type: png		Cancel		Record
-100 Start: 9kHz Spa	n: 9.519991GHz Center; 4.7600045GHz Speed: 1.148	THz/s Stop: 9.52GHz	RFU 48°C Charging		Next

3.3.5 GNSS information

Click "System" in the menu bar, and select "GNSS Info". After selection, a "GNSS Info" pop-up window will appear. See Table 4 for key parameter descriptions in the pop-up window.

File Mode System	Preset Sir	ngle Continu. ●Rec ▶Play	Ľ	Ø	14:52:38	Return	Frequency
Spectrum(dBm) Ref: 0dBm RBW: 300kHz V	/BW: 3MHz	SWT: 30.157ms Amp: Auto	Detec	tor: PosPeak	24/11/08		
-10	GNSS Info Format	Local Time	× т1	C&W	Graph	Center 10.0100045GHz	Span
-20	Antenna Date	GNSS_AntennaExternal			Trace	Start 9kHz	Amplitude
-30	Time	14:52:42			Peak Search	Stop 20.02GHz	BW
-40	Latitude	32° 02′ 30.75″			Marker	Step 10MHz	Sweep
-50	SatNum	16/24			₩.	LO Optimize Auto	Detect
-60	SNR(Min)	31dB / 18dB					Meas
-70	Locked	370872308		ي مارا م			Trigger
							Record
-100 Start: 9kHz Span: 20.019991GHz Cer	ter: 10.010005	GHz Speed: 663.869GHz/s	Sto	p: 20.02GHz	1MB/S RFU 46°C 122min		Next

Table 4 GNSS parameters description

No	Parameter	Description
1	Format	"Local Time" and "UTC Time"
2	Antenna	Select "Internal Antenna" or "External Antenna" (currently only external antenna is supported)

3	SatNum	Number of locked satellites/Number of visible satellites
4	SNR(Max)	Maximum signal-to-noise ratio (SNR) of the locked satellites/Maximum SNR of the unlocked satellites
5	SNR(Min)	Minimum SNR of the locked satellites/Minimum SNR of the unlocked satellites
6	SNR(Avg)	Average SNR of the locked satellites/ Average SNR of the unlocked satellites

3.3.6 Preset

Click on "Preset" to restore the software configuration to the instrument's default state.



3.3.7 Single or Continuous preview

Single Preview: Click "Single", Continuous Preview: Click "Continue".



3.3.8 Quick Record and Playback

Quick Record: Click "Rec" to start recording data, and click "stop" to stop recording. Playback: Click "Play" to play back the most recent recorded data, and click "Pause" to pause playback.

Click the "Continue" button to resume normal data acquisition and display.



3.3.9 Professional or Basic settings

Click "System" in the menu bar, then select "Setting Mode" to choose either "Basic" or "Professional" mode. Compared to the basic settings, the professional settings provide more parameters in the main settings area. Users can choose the appropriate setting mode based on application.

Spectrum(dBm) Ref: 0dBm RBW	System Preset Single Continu. ●Rec ▶Play 🔯 🗞	11:35:58 24/11/08	Return	Frequency
-10	Language Professional T1 C&W	Graph	Center 10.0100045GHz	Span
-20	Device	Trace	Start 9kHz	Amplitude
-30		Peak Search	Stop 20.02GHz	BW
-40		Marker	Step 10MHz	Sweep
-50		÷.		Detect
-60				Meas
-70	New July			Trigger
		3d0040 0.55.51 2.55.29		Record
-100 Start: 9kHz Span: 20.01999	IGHz Center: 10.0100045GHz Speed: 663.237GHz/s Stop: 20.02GHz	CPU 56°C Charging		Next

3.3.10 Hide panel

Click the hide icon " in the menu bar to hide the main settings menu and expand the display area.



3.3.11 Current instrument information

System-About, the current instrument information will be displayed in the "About" popup window.

Spectrum(dBm) Ref: 0dBm RBW:	System Preset	Single Continu	I. ●Rec	► Play	Detector	کې PosPeak	11:38:20 24/11/08	Return	Frequency
-10	Language	,			T1 C	&W	Graph	Center 10.0100045GHz	Span
-20	Device About	•					Trace	Start 9kHz	Amplitude
-30		About		×			Peak Search	Stop 20.02GHz	BW
-40		Device E20 UID 424 HCD 1	0 R3 3500a003d0	040			Marker	Step 10MHz	Sweep
-50		GUI 4.2.3 API 0.55 FPGA 0.55	.51 .15				÷.		Detect
-60		MCU 0.55 Revision c7al	.38)4444a						Meas
-70		1.1.1.1				ي م الل			Trigger
				Notice Line					Record
-100 Start: 9kHz Span: 20.01999	1GHz Center: 10.01	100045GHz Speed: 6	63.480GHz/	s	Stop: 2	20.02GHz	RFU 38°C Charging		Next

3.3.12 Marker function

The marker function is configured in the "Marker" submenu under the Graph Settings area. SAStudio4 also provides some quick operations to use markers. This section will explain in detail how to use markers in SAStudio4.

- 1. Create Markers
- 1) Create a Marker

Double-click in the Graph Display area or click the "Peak Search" button in the Graph Settings area to quickly create a marker.

2) Create multiple Markers

Click the "Marker" submenu in the Graph Settings area, select the marker you want to create, and then click "Enabled" to activate the marker.

•	AROGIC File	Mode System	Preset VBW: 3MHz	Single SWT	Continu.	• Rec •	Play 🕻	tor: PosPeak	12:57:43 24/11/08	Return	Frequency
-10	M1R: 8.7711GHz	-76.86dBm					T	C&W	Graph	Center 10.0100045GHz	Span
-20									Trace	Start 9kHz	Amplitude
-30						Freq:	8.7711GHz	×	Peak Search	Stop 20.02GHz	BW
-40						M1F		r1 -	Marker	Step 10MHz	Sweep
-50						M1R M1D M2R		Enabled Local Peak	₩.		Detect
-60						M2D M3R		to Center			Meas
-70			(III)			M3D	١	loiseDensity			Triggor
-80	uluk kitan	L. Linet Hill	a harth	والسري ل	ulilitin a c.b.t	M4R		Switch To			mggei
-00					in the definition	M5R		More			Record
-90						M5D		Right Peak ►			
-100	tart: 9kHz Span	: 20.019991GHz C	enter: 10.010	0045GHz	Speed: 664	137GHz/s	Sto	p: 20.02GHz	Charging		Next

2. Create Marker pair

Click "Graph" in the Graph Settings area, then select "Marker Pair" in the popup window to quickly create a pair of reference markers and delta markers. Click repeatedly to enable multiple pairs of markers(currently up to 5 groups).



3. Close Markers

1) Close a single Marker

Click the "Marker" submenu in the Graph Settings area, select the marker you want to close, and then click "Enabled" to disable the selected marker.

Spectrum(dBm) Ref: 0dBm	Mode System Preset RBW: 300kHz VBW: 3MH	Single Continu.	● Rec ▶ Play Amp: Auto De	tector: PosPeak	11:54:44 24/11/08	Return	Frequency
M1R: 1.820008182GHz M1D: 1.819999182GHz -10 M2R: 5.460006545GHz	-83.94dBm -0.17dB -97.57dBm			T1 C&W	Graph	Center 10.0100045GHz	Span
M2D: 1.819999182GHz M3R: 9.100004909GHz ⁻²⁰ M3D: -9.027104909GHz	16.97dB -85.79dBm 3.91dB				Trace	Start 9kHz	Amplitude
-30			Freq: 1.820008	3182GHz X	Peak Search	Stop 20.02GHz	BW
-40			M1R -	т1 -	Marker	Step 10MHz	Sweep
-50			±	Enabled Local Peak	4		Detect
-60			SlidePanel	to Center			Meas
-70		e i De r	≣	NoiseDensity Switch To	U3 E200 R3		Trigger
-90 KSP AND				More	3d0040 0.55.51 2.55.29		Record
-100 Start: 9kHzSpan: 2	0.019991GHz Center: 10.010	00045GHz Speed: 664.3	✓ Left Peak 294GHz/s	Right Peak ►	RFU 38°C Charging		Next

2) Close All Markers

Click "Graph" in the Graph Settings area, then select "Clear All" in the popup window to close all markers.

File Spectrum(dBm) Ref: 0dBm	Mode System	Preset Single	Continu. /T: 30.184ms	● Rec ▶ P Amp: Auto	Play Detector	Ri PosPeak	11:55:51 24/11/08	Return	Frequency
0 M1R: 1.820008182GHz M1D: 1.819999182GHz -10 M2R: 5.460006545GHz	-86.22dBm 2.31dB -82.47dBm				т1 с	&W	Graph	Center 10.0100045GHz	Span
M2D: 1.819999182GHz M3R: 9.100004909GHz ⁻²⁰ M3D: -9.027104909GHz	1.48dB -83.93dBm 2.39dB						Trace	Start 9kHz	Amplitude
-30		Scale/Div	Gra p Offset	bh	→ ×		Peak Search	Stop 20.02GHz	BW
-40		10dB Spectrogram	0dB Zoom	ScaleRes	set		Marker	Step 10MHz	Sweep
-50		Off Marker Pair	Off Clear All				4		Detect
-60		DataExport							Meas
-70	t aliphu	M							Trigger
-80 (^{MSD}) -80 (^{MSD}) -80 (^{MSD}) -80 (^{MSD}) -80 (^{MSD})		ANSR 1941 (H. Dud							Record
-100 Start: 9kHz Span	20.019991GHz Cer	nter: 10.0100045GH	z Speed: 663	267GHz/s	Stop:	20.026Hz	1MB/S RFU 37°C Charging		Next

- 4. Marker peak search
- 1) Local peak search

Double-click near the local peak in the graph, or select a marker and click "Marker" \rightarrow "Local Peak" to enable local peak search.

Spectrum(dBm) Ref: 0dBm RBW: 300kHz VBW: 3MHz	ngle Continu. ●Rec ▶Play SWT: 30.163ms Amp: Auto D	Detector: PosPeak	15:06:14 24/11/08	Return	Frequency
U M1R: 8.64GHz -75.35dBm M2R: 5.460006545GHz -84.57dBm -10		T1 C&W	Graph	Center 10.0100045GHz	Span
-20			Trace	Start 9kHz	Amplitude
-30	Freq: 8.64GH	lz X	Peak Search	Stop 20.02GHz	BW
-40	M1R	• T1 •	Marker	Step 10MHz	Sweep
-50		Enabled Local Peak	Ť.		Detect
-60	SlidePanel	to Center			Meas
		NoiseDensity Switch To			Trigger
-90 -90		More			Record
-100 Start: 9kHz Span: 20.019991GHz Center: 10.01000	45GHz Speed: 663.718GHz/s	Right Peak ►	CPU 56°C Charging		Next

2) Global peak search

Click "Peak Search" to enable global peak search.

J		C Fi	le Moo	de Syster BW: 300kHz	n Preset	Single Hz SW	Continu. T: 30.151ms	• Rec	▶ Play	tector:	N PosPeak	11:59:50 24/11/08	Return	Frequency
-11	M1R:	8.77110	iHz -77.	32dBm						т1 С	&W	Graph	Center 10.0100045GHz	Span
-2(0											Trace	Start 9kHz	Amplitude
-31	0											Peak Search	Stop 20.02GHz	BW
-41	0											Marker	Step 10MHz	Sweep
-51	0											₩.		Detect
-61	0													Meas
-70			Ť.	. Jahu	N1R	J . 146								Trigger
-91									lahulati (M			3d0040 0.55.51 2.55.29 1MB/S		Record
-10	Start: 9kHz		Span: 20.01	9991GHz	Cepter: 10.0	100045GHz	Speed: 663	994GH7/s		Stop: 2	20.02GHz	RFU 37°C Charging		Next

5. Delta Marker

The delta marker is typically applied alongside the reference marker to indicate the frequency, time and amplitude difference between the reference marker and the delta marker.

KAROGIC File Mode System Preset Single Continu. ●Rec ▶Play MaxPwr VS Time(dBm)	13:35:08 24/11/08	Return	Frequency
-0 Spectrum-P IQvT-P	Graph	Full Span	BW
⁻¹⁰⁰ 0s 100 μs 200 μs 300 μs 400 μs 500 μs 600 μs 700 μs 800 μs 900 μs Spectrum-P(dBm) Ref: 0dBm RBW: 19.762kHz TraceDetector: PosPeak	– Trace	Span 🔺	Amplitude
-10 M1R: 948.863636MHz -94.00dBm T1 C&W -20 M1D: 11.363636MHz 4.83dB -40	Peak Search	Span ▼	DDC
-50 -70 -80 -80	Marker	AnalysisBW 125MHz	IQvT
-100	4	IQSampleRate 125MSPS	FFT
1 M1R: 229.83µs 110.5µν Ch-I 0.8 Ch-Q Ch-Q		DataFormat Complex16bit	PvT
			Demod
-o-s -o-s -o-s			Display
-1 -1.3 Start: 207.9us Stop: 770.6us	RFU 38°C Charging		Next

6. Noise density

After creating a marker, open "NoiseDensity" in the "Marker" submenu under the Graph Settings area to convert the original power value into power density per Hertz.



7. Marker to Center

After moving the reference marker to the target frequency, click "to Center" in the "Marker" submenu under the Graph Settings area to align the marker's frequency to the center position.

•		C File Ref: 0dBn	n Ri	d e Syster BW: 300kHz	n Preset VBW: 3MH:	Single z SW	Continu. I: 30.167ms	• Rec	► Play	Detec	tor: Posl	R Peak	13:39:25 24/11/08	Return	Frequency
-10	• M1R:	8.8794GH	lz -77.	14dBm						T1	C&W		Graph	Center 10.0100045GHz	Span
-20													Trace	Start 9kHz	Amplitude
-30								Fr	eq: 8.8794	GHz		×	Peak Search	Stop 20.02GHz	BW
-40									M1R	- 1			Marker	Step 10MHz	Sweep
-50									₫		Enable Local Pe	ed eak	÷.		Detect
-60									– SlidePanel		to Cent	er			Meas
-70					Mir	العراق ال	lu I		₽		loiseDer Switch	nsity To			Trigger
-90											More		3d0040 0.55.51 2.55.29		Record
-100	Start: 9kHz	Sp	pan: 20.01	9991GHz	Center: 10.010	00045GHz	Speed: 663	.650GHz	✓ Left Peak I I I I I I I I I I I I I I I I I I I	F Sto	Right Pe	ak ► IIII GHz	CPU 56°C Charging		Next

8. Marker Switch To Mode

After moving the reference marker to the target frequency, click the "Switch To" button in the "Marker" under the Graph Settings area to quickly switch to another working mode and set the frequency value of the current marker position as the center frequency of the new mode.



3.3.13 Waterfall graph

Waterfall plot functionality is supported only in SWP, IQS, and RTA modes. Click on the waterfall graph in the Graph Settings area to access the waterfall graph settings. The controls for the waterfall plot are introduced in the table 5:

Table 5 Waterfall Graph Controls

Graph Settings Area

Scan Depth	the time length cached on the y-axis of the waterfall graph
Time Density	the refresh rate of the waterfall graph
ColorGradation	Sets the color gradient for the waterfall graph

Click "Graph" to open "Spectrogram" and create a corresponding spectrum waterfall graph.



3.3.14 Local zoom

- 1. Spectrum Zoom (Only in SWP Mode)
- 1) Click "Graph" and open "Zoom" in the pop-up submenu.

2) Click to select the spectrum zoom graph, then click "Graph" and set the frequency range to zoom in on in the pop-up submenu.

Spectrum(dBm) Ref: 0dBm RBW: 300kHz	Preset Sir	gle Continu. SWT: 30.247ms	● Rec ▶ F	Play D etector: Pe	& osPeak	13:46:17 24/11/08	Return	Frequency
-10 -20				T1 C&V	V	Graph	Center 10.0100045GHz	Span
-30		Gra	oh	-₩ ×		Trace	Start 9kHz	Amplitude
-50 -60 -70	Scale/Div 10dB	Offset 0dB	ScaleReset			Peak Search	Stop 20.02GHz	BW
	Start 1GHz	Stop 5GHz	Center 3GHz	FreqRange 4GHz		Marker	Step 10MHz	Sweep
Span: 20.019991GHz Ce Spec zoom(dBm)	Spectrogram Off				12GHz ×	÷.		Detect
-10	Marker Pair	Clear All						Meas
-30 -40 -50	DataExport							Trigger
-60 -70 -80								Record
-90 -90 Start: 1GHz Span: 4GHz	Cente	r: 3GHz		Stop	: 5GHz	RFU 39°C Charging		Next

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 settings area, select the corresponding channel, then open "Analyze" and "Zoom". Adjust the zoom area by holding and sliding the zoom box or dragging the zoom edges left or right.



2) DET mode

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

(2) Adjust the zoom area by holding and sliding the zoom box, dragging the zoom edges left or right, or selecting "PvT Zoom." Then click "Graph" to set "TimeCenter" and "TimeRange" to adjust the zoom area.

PvT(dBm) Ref: 0dBm	eset Single _{Ce}	Continu.	Rec ▶Pla	y ta	&	13:59:02 24/11/08	Return	Frequency
-10 -20						Graph	Center 1GHz	BW
-30						Trace	Step 10MHz	Amplitude
-50 -60 -70	Scale/Div	Graph Offset	olla lind di la	-⊨ ×	undialitic da tra	Peak Search		Detect
	10dB TimeCenter	0dB TimeRange			W phy	Marker		Trigger
Start: 0s PVT Zoom(dBm)	327.119us Marker Pair	215.234us Clear All			Stop: 1ms	4		Record
-10 -20 -30	DataExport							Play Back
-40 -50	nt far kark te st	و بر ایران ا	a bralan a	a s an I	latore o			System
-00 Monte Scholard Control of Con				Stop	434.74us	360040 0.55.51 2.55.29 5MB/S CPU 56°C Charging		

3.3.15 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
RecordTime	Set the recording duration, only effective when the record mode is "Fixed."
FileSizeLimit	The storage size limit for a single recording file.
Disk	the remaining and total disk capacity
Playback	
Last frame	Rewind by one frame
Next frame	Fast forward by one frame.
Next frame Back	Fast forward by one frame. Rewind by multiple frames.
Next frame Back Forward	Fast forward by one frame.Rewind by multiple frames.Fast forward by multiple frames.

1. Data recording

Click "Record" in the main settings area, then click the "RecordMode" submenu to select the recording mode.

Click "REC File Path" to set the storage path for the recording file. The default storage path is '.../userdata/SAStudio4/data'.

Spectrum(dBm) Ref: (File Mode	System	Preset	Single Continu.	• Rec	▶ Play	Detecto	or: PosPeak	17:17:16 24/11/09	Return	Frequency
-10							T1	C&W	Graph	Record Off	Span
-20	Please selec	t folder				D.			Trace X	RecordMode Manual	Amplitude
-30	Local	Dir: Loca	ν.		Name			1	Back	RecordTime 5s	BW
-40										FileSizeLimit 4GB	Sweep
-50										REC File Path Local	Detect
-60										Diskcapacity 12GB / 14GB	Meas
-80 - 11	u du										Trigger
-90											Record
-100 Start: 9kHz	s)	Can	icel (Confirm		Next

In Fixed Duration Mode, click "Record on" to automatically record the preset amount of data. In Manual Mode, click "Record on" and "Record off" to manually control the recording duration. The recording will automatically stop when the file size exceeds the available disk capacity. 2. Data playback

Click the "Open File" button under "Play Back" in the main settings area, select the recording file to be played back in the pop-up window, and click "Confirm."

Click "Play Back" to start playback, "Pause" to stop, and "Stop" to exit playback and resume data acquisition. Set the "PlaybackRate" value to adjust the playback speed. Enabling "Auto Loop" will loop the playback of the selected file.



3.3.16 Export data

1. Click "Graph" in the corresponding graph settings area, then select "DataExport" from the pop-up submenu. The "image" option allows you to export the chart data as an image, while the "Data" option exports the chart data as a CSV file.

CAROGIC File Mode System Preset	Single Continu. ●Rec ▶Play in the sector: PosPeak	10:33:17 24/11/11	Return	Frequency
	Graph + X Scale/Div Offset	Graph	Center 10.0100045GHz	Span
-20	10dB 0dB ^{ScaleReset} Spectrogram Zoom	Trace	Start 9kHz	Amplitude
-30	Off Off Marker Pair Clear All	Peak Search	Stop 20.02GHz	BW
-40	DataExport	Marker	Step 10MHz	Sweep
-50	Image	÷.		Detect
-60				Meas
-70				Trigger
				Record
-100 Start: 9kHz Span: 20.019991GHz Center: 10.0	0005GHz Speed: 636.145GHz/s Stop: 20.02GHz	1MB/S RFU 40°C Charging		Next

2. In the "Save" pop-up window, set the data save path and file name, then click "Confirm" to save the image/CSV file. If no external storage is connected, the file will be saved locally; if external storage is connected, you can choose to save directly to the storage device.



3. The PX series instruments by default store data in the "images" (for chart images), "data" (for recorded files and configuration files), and "reports" (for chart data CSV files and corresponding configuration files) folders under the "userdata" - "SAStudio4_x.xx.xx" directory on the Desktop.

1	reports	× • 😵
Eile Edit View Bo	okmarks <u>G</u> o Tools <u>H</u> elp	
	/media/rpdzkj/userdata/SAStudio4_aarch64_10_16_11_12/reports	*
Places Home Folder Desktop Tash Can Applications Userdat 15 GB Volu	20241030_1 20241030_1 data1.csv data1_Profile .bt	
4 items		Free space: 12.5 GiB (Total: 14.6 GiB)

3.3.17 Delete files and images

1. Click "File" \rightarrow "Exit" to exit the SAStudio4 interface;

2. Navigate to "userdata" - "SAStudio4_x.xx.xx" - "images," drag the image to the "Trash Can," and click "Yes" in the Confirm pop-up window to delete the screenshot (the method for deleting recorded files and configuration files is the same as for deleting screenshots).



3.3.18 Modify sampling rate

In IQS mode, click "BW" in the main settings area, and modify the value of "IQSampleRate" in the submenu to change the instrument's sampling rate.

	le Mode System	Preset Single	Continu. • F	Rec ▶Pla	iy 🗖	Ø	15:24:19 24/11/08	Return	Frequency
0 20 20 20 50 50 50 50 50 50 50 50 50 50 50 50 50							Graph	Full Span	BW
-100 0s 100 Hs 200 Spectrum-P(dBm)	0 ⊭s 300 ⊭s 400 ⊮ Ref:0dBm	s 500 µs 60 RBW: 19.7	00 µs 700 µs 62kHz	800 µ s Tra	4 ₉₀₀ aceDetecto	s or: PosPeak	Trace	Span 🔺	Amplitude
-10 -20 -30				IQSam	T1 pleRate	C&W	Peak Search	Span ▼	DDC
-40				125	MSPS	CSDS	Marker	AnalysisBW 125MHz	IQvT
-70 -80 -90 -100	www.www.www.	hindunation	///// 4	5	6	MSPS	÷.	IQSampleRate 125MSPS	FFT
Start: 937.5MHz IQvT-P(mV)	AnalysisBW: 125MH SampleRate: 125MH	Iz Center: 1G Hz Center: 1G	Hz Hz 1			kSPS		DataFormat Complex16bit	PvT
135 90 45					+/-	SPS	U3 E200 R3		Demod
0 -45 -90			Esc	Back			3d0040 0.55.51 2.55.29 11MB/S		Display
-135 -180 -225 Start: 0s					s	top: 100us	CPU 56°C Charging		Next

3.3.19 Quick parameter settings

The quick parameter settings currently support fast configuration of commonly used spectrum analysis parameters, including reference level, RBW (Resolution Bandwidth), VBW (Video Bandwidth), detector, start frequency, stop frequency, sweep span, center frequency, and more.



4. SWP Working Mode

This chapter will provide you with important parameters and measurement methods for SWP mode.

4.1 SWP Working Mode Parameters Overview

Important parameters for the SWP mode are listed in Table 7.

Table 7 Parameters description in SWP working mode

Frequency	
LO optimization	Auto: default low spurious mode; Speed: high sweep speed mode; Spur: low spurious mode; Phase noise: low phase noise.
Amplitude	
Pre-Amplifier	Preamplifier setting: Auto: automatically enables the preamplifier; When the reference level is below -30 dBm, the preamplifier is manually on or off; Forced off: always off.
Gain Strategy	Low Noise: minimizing noise while maintaining a flat noise floor. High Linearity: achieving high linearity while maintaining the noise floor flat.
IF Gain Grade	Gain grade 0-X: each grade for 3dB gain; Increase IF Gain Setting: RF gain decreases, noise floor increases, linearity improves, spurious signals decrease Decrease IF Gain Setting: RF gain increases, noise floor decreases, linearity degrades, spurious signals increase
Attenuation	0-33 dB (upper limit is different for different frequency bands), 1 dB step; Atten = -1dB (default): attenuation is off. Atten ≥ 0dB: attenuation is enabled, and the reference level is calculated as Reference Level = Attenuation Value - 10.
Sweep	
Sweep Time Mode	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 50 times of min SWT; Manual: approximately equal to the target sweep time.
Trace Points Strategy	Sweep Speed: priority is given to the fastest sweep speed; Points Accuracy: priority is given to ensuring that the number of trace points is close to the target.
Spurious rejection	Bypass, standard and enhanced.

FFT execution	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.

4.2 Channel Power

A BPSK signal with a carrier frequency of 1 GHz, power of -20 dBm and symbol rate of 1 MHz is as input to spectrum analyzer.

4.2.1 Parameter description

This section provides an explanation of some important parameters in channel power measurement mode, as listed in Table 8.

Table 8 parameters for channel power measurement

Channel Power

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

4.2.2 Instruction steps

1. Set the center frequency as 1 GHz and reference level as 0 dBm. Click the "Meas" menu and select "ChannelPower" from the dropdown menu;

2. Parameters are automatically configured to default parameters. The results are shown in the figure below. The top left corner of the measurement box displays the channel power value. The "Channel Power" section below also shows the measurement bandwidth, channel power, and power spectral density values;



3. You can also manually adjust the channel center frequency (drag to select the measurement area) and the measurement bandwidth (drag the measurement border left or right or adjust the Meas BW settings).

4.3 Occupied Bandwidth

A BPSK signal with a carrier frequency of 1 GHz, power of -20 dBm and symbol rate of 1 MHz is as input to spectrum analyzer.

4.3.1 Parameter description

This section provides an explanation of some important parameters: Important parameters for occupied bandwidth measurement are listed in Table 9.

Table 9 Occupied bandwidth measurement parameter description

Parameters	
Method	XdB、Percentage
XdB/Percent	the specific XdB value or percentage

4.3.2 Instruction step

1. Set the center frequency as 1 GHz and the reference level as 0 dBm. Click the "Meas" menu and select "OBW" from the dropdown menu;

2. Parameters are automatically configured to default parameters. The results are shown in the figure below. The occupied bandwidth value can be viewed in the "OBW" section below.

	OGIC File	Mode	System	Preset	Single Iz SV	Continu. VT: 20.97ms	• Rec	▶ Play	Detec	tor: RMS	15:35:09 24/11/08	Return	Frequency
-15									т1 са	šW	Graph	Auto Set	Span
-30											Trace	Method XdB %	Amplitude
-60											Peak Search	XdB -3dB	BW
-75		~~~		-3dI							Marker		Sweep
-105											÷.		Detect
-135													Meas
-150 Start: 997	.5MHz Sp	an: 5MHz	Ce	nter: 1GHz		Speed: 238	3.432MHz/	's Si	:op: 1.(0025GHz			Trigger
- obw	dBc -3.0dB	999.505	Start 054MHz		1.0004939	Stop 222GHz		Meas 988.868	BW ‹Hz				Record
											CPU 56°C Charging		Next

4.4 Adjacent Channel Power Ratio (ACPR)

A BPSK signal with a carrier frequency of 1 GHz, power of -20 dBm and symbol rate of 1 MHz is as input to spectrum analyzer.

4.4.1 Parameter description

This section provides an explanation of some important parameters: Important parameters for adjacent channel power ratio (ACPR) measurement are listed in Table 10.

Table 10 ACPR measurement parameter description

Parameters

Space	the frequency interval between the main channel and adjacent channels						
Count	the number of adjacent channel pairs						
Main Power	The power of the main channel						
Adj Center	Center frequency of the adjacent channel						
Adj Power	Measured power of the adjacent channel						
Adj Ratio	Measured adjacent channel power ratio						

4.4.2 Instruction step

1. Set the center frequency as 1 GHz and the reference level as 0 dBm. Click the "Meas" menu and select "ACPR" from the dropdown menu.

2. Parameters are automatically configured to default parameters. The results are shown in the figure below. The power values of each channel are displayed at the top of the green channel bandwidth. The "ACPR" section below also shows the adjacent channel center frequency, adjacent channel power, and adjacent channel power ratio.
3. You can also manually set the center frequency of the main channel, the bandwidth of each channel, the spacing of adjacent channels, and the number of adjacent channel pairs.

Spectrum(dBm) R	File Mode	System Preset /: 5kHz VBW: 500	Single Continu. Hz SWT: 65.559ms	●Rec ▶Play	Detect	or: RMS	15:53:01 24/11/08	Return	Frequency
-15		-21.88	3dBm		T1 C&	w	Graph	Auto Set	Span
-30		ماندا بيني					Trace	Center 1GHz	Amplitude
-60							Peak Search	Channel BW 2.142857MHz	BW
-75	-54.16dBc	M	MAAL	-55.48dBc			Marker	Space 4.285714MHz	Sweep
-105	ray an in the property of the second s	MANNA WWW	MWW	ngantaspartenninkan karingan tanigramitet	ibelikai maji yangi n	H ^{angle} iyemri	÷.	Count	Detect
-135									Meas
ACPR	Span: 15MHz	Center: 1GHz	Speed: 228	.802MHz/s	Stop: 1.0	075GHz			Trigger
Main Power -21.88dBm	م 995.71 1. <u>00428</u>	dj Center 4286MHz 85714GHz	Adj Power -76.04dBm -77.36dBm	Ad -54. -55.	lj Ratio .16dBc .48dBc				Record
							CPU 56°C Charging		Next

4.5 IP3/IM3

Center frequency point of 1 GHz is utilized for IP3/IM3 measurement.

4.5.1 Parameter description

This section provides an explanation of some important parameters: Important parameters for IP3/IM3 measurement are listed in Table 11.

Table 11 IP3/IM3 measurement parameter description

LowToneFreq	Frequency of the input low-frequency signal
LowTonePower	Power of the input low-frequency signal
HighToneFreq	Frequency of the input high-frequency signal
HighTonePower	Power of the input high-frequency signal
LowIM3PFreq	Low-side intermodulation frequency
LowIM3P	Low-side intermodulation power
HighIM3PFreq	High-side intermodulation frequency
HighIM3P	High-side intermodulation power
TonePowerDiff	Power difference between the high and low frequency signals

4.5.2 Instruction step

1. Two signals with one signal having a center frequency of 999 MHz and amplitude of 0 dBm, and the other having a center frequency of 1.001 GHz and amplitude of 0 dBm is combined using a combiner. Then it is as the input signal to the spectrum analyzer;

2. Set the spectrum analyzer's center frequency as 1 GHz and the reference level as 0 dBm. Click the "Meas" menu and select "IM3" from the dropdown menu;

3. Adjust the signal power so that the signal power displayed in the spectrum graph is approximately 6 dB below the reference level;

4. Parameters are automatically configured to default parameters. The results are shown in the figure below. The "IM3" section at the bottom displays the IP3 test results.



4.6 Frequency Tracking

1. Click the "Marker" in the chart settings area. In the pop-up submenu, click "More", then click "Advanced". Set the peak threshold and jitter range for the tracking signal (When the signal being tracked jitters within the specified range, the position of the center frequency will not change due to the signal jitter).



2. Click "Signal Track". The reference marker will search for peaks within the current sweep span and align the peak signal to the center frequency position. When the target signal frequency drifts, the spectrum analyzer will automatically adjust its center frequency so that the signal always remains in the center of the display area, facilitating user observation and analysis.



Note: Generally, this function only moves the frequency position and does not change the span. However, for signals with a particularly large drift that exceed the current span, tracking becomes difficult. For signals at the edge of the instrument's sweep range, the span will be further reduced due to frequency limitations.

4.7 Peak Table

1. Click the "Marker" in the graph settings area. In the pop-up submenu, click "More", then click "Advanced". Set the threshold value for the peak table. For detailed settings, refer to the section <u>Frequency tracking</u>.

2. Click "Peak Table". The spectrum analyzer will automatically detect and mark the peak points exceeding the threshold within the current sweep span (up to 10 peaks) and display frequency and power information of each peak in descending order of peak signal power in the peak table at the bottom of the display area, enabling users to quickly view the main signals in the spectrum.



5. IQS Working Mode

This chapter provides a detailed introduction for important parameters of the IQS mode, including time-domain IQ data and spectrum analysis, power vs. time analysis, digital down-conversion, demodulation, etc.

5.1 IQS Parameters Overview

Table 12 IQS parameters overview

Frequency		
LO optimize	Please refer to <u>SWP working mode</u> for reference	
BW		
Sample rate	ADC sample rate: 110MSa/s ~ 130MSa/s	
Analysis bandwidth	Equivalent sampling rate after decimation: ADC sampling rate / decimation factor	
Data format	 8-bit: low precision, there may be many zeros in the absence of a signal, supporting streaming acquisition with decimate factor higher than 2. 16-bit: default configuration, supporting streaming acquisition with decimate factor higher than 4. 32-bit: high precision, supporting continuous streaming acquisition with decimate factor higher than 8. 	
Amplitude		
Preamplifier		
Gain strategy		
IF gain grade	Please refer to <u>SWP working mode</u> for reference	
Attenuation		
Record		
RecordMode		
RecordTime	Please refer to Record and Playback in SWP working mode for	
FileSizeLimit	reference	
Disk		
Playback		
Last frame		
Next frame	Please refer to Record and Playback in SWP working mode for	
Back	reference	
Forward		

5.2 IQS Working Mode Overview

The UI of the IQS mode is shown in the figure below, consisting of a maximum power vs time thumbnail, spectrum graph, and time-domain graph. Click "Next" in the main settings area, then click "Trigger". Modify the "PreviewTime" value in the submenu to change the preview time of the IQ stream in the maximum power vs time thumbnail.

The spectrum graph and IQ time-domain graph are determined by the red selected boxes "Spectrum-P" and "IQvT-P" in the maximum power vs time thumbnail, respectively. By changing the selection range, you can observe the IQ time-domain signals at different time intervals, and you can also perform spectrum analysis on the IQ time-domain signals at different times.



5.3 Spectrum Analysis

5.3.1 Parameter description

This section provides an explanation of some important parameters for spectrum analysis listed in table 13.

Table 13 Parameter description for spectrum analysis

Spectrum analysis	_
Window	Please refer to <u>SWP working mode</u> for reference
Spectrum Intercept	Spectrum interception: If Intercept = 0.8, 80% of the FFT spectrum analysis results are displayed in order to intercept the transition band spectrum components.

5.3.2 Operation instructions

1. Click "FFT" in the main settings area to enable "Analyze", Drag the red box "Spectrum-P" in the maximum power vs time thumbnail, or adjust the values of "TimeStart" and "TimeLength" to perform spectrum analysis at different time intervals. Adjust the values in the "Center" submenu of "Frequency" and the "Span" submenu of "BW" to change the center frequency and analysis

bandwidth;

2. Use "FFTsize" to set the number of points for spectrum analysis, "Window" to set different window functions, "TraceDetector" to set different trace detectors, and "Intercept" to intercept and display the spectrum. When Intercept = 0.8, it can intercept the transition band.



5.4 IQvT

5.4.1 Operation instructions

Click "IQvT" in the main settings area to enable "Analyze", drag the red selection box "IQvT-P" in the maximum power vs time thumbnail, or adjust the values of "TimeStart" and "TimeLength". This allows you to perform time-domain analysis at different time intervals.



5.5 PvT

5.5.1 Operation instructions

Click "PvT" in the main settings area to enable "Analyze". Drag the red selected box "PvT-P" in the maximum power vs time thumbnail, or adjust the values of "TimeStart" and "TimeLength". This allows you to perform power versus time analysis on IQ signals at different time intervals;



5.6 AM Demodulation

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

5.6.1 Parameter description

This section provides an explanation of some important parameters for AM demodulation, listed in table 14.

Table 14 AM demodulation parameter description

Filter submenu

n	Number of filter taps. The larger the number taps, the steeper the transition band of the filter and the smaller the passband ripple
Fc	Cutoff frequency, 0 < Fc < 0.5. For example, if Fc is 0.25, then low-pass filtering is performed on half of the bandwidth.
As	Stopband attenuation. The larger the stopband attenuation, the stronger the suppression effect on the stopband in dB.
mu	Fractional sample offset, recommended to use the default value.

5.6.2 Operation instruction

1. Set the "Center Frequency" as 1.0001 GHz, adjust the range of the "IQvT-P" in the maximum power vs time thumbnail, select the IQ time domain graph, click "Graph", and choose "Auto

Range" in the Graph submenu.

2. Click "Demod" in the main settings area, set "Type" to AM in the submenu, select the AM demodulated time-domain graph, and click "Auto Range" under the "Graph" control.

3. Click "BW" in the main settings area, increase the "Span" in the submenu to adjust the analysis bandwidth. In this example, set the analysis bandwidth to 15.36 MHz.



5.6.3 Audio analysis

This function is used to test the demodulation sensitivity of the instrument.

1. Refer to the AM demodulation section to demodulate the AM signal.

2. Click "Demod" in the main settings area, open "AudioAnalysis" in the submenu, enable audio analysis, and check if the frequency of the audio analysis matches the modulation rate. You can also test the signal-to-noise ratio and total harmonic distortion.



5.7 FM Demodulation

The FM signal with a carrier frequency of 1 GHz, power of -20 dBm, modulation frequency of 5 kHz, and frequency deviation of 75 kHz is employed as an example.

5.7.1Parameter description

Please refer to <u>AM demodulation</u> for reference. When listening to FM broadcasting, low-pass filtering can be applied to the demodulated FM signal to reduce some high-frequency noise, making the voice cleaner.

5.7.2 Operation instruction

1. Set the "Center Frequency" as 1 GHz, adjust the range of the "IQvT-P" in the maximum power vs time thumbnail, select the IQ time domain graph, click "Graph", and choose "Auto Range" in the Graph submenu.

2. Click "Demod" in the main settings area, set "Type" to FM in the submenu, select the FM demodulated time-domain graph, and click "Auto Range" under the "Graph" control.

3. Click "BW" in the main settings area, increase the "Span" in the submenu to adjust the analysis bandwidth. In this example, set the analysis bandwidth to 7.68 MHz.



5.7.3 Audio analysis

After demodulating the FM signal, please refer to <u>audio analysis</u> section to analyze the demodulated signal. The analysis results are shown below:



5.8 DDC-Digital Down Conversion

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

5.8.1 Parameter description

This section provides an explanation of some important parameters for digital down-conversion (DDC), listed in Table 15.

Table 15 DDC parameter description

Sampling submenu

OffsetFreq	Frequency offset of complex mixing >0: Spectrum shifts to the right <0: Spectrum shifts to the left
Decimate	decimation factor for the DDC, i.e., the resampling rate

5.8.2 Operation instruction

1. Set "Center" as 1 GHz and "Ref.Level" to 0 dBm. Adjust the range of "IQvT-P" in the maximum power time thumbnail, select the IQ time-domain graph, click "Graph", and choose "Auto Range" from the Graph submenu.

2. Click "DDC" in the main settings area, enable "Channel1", and set the "Center" of the DDC1 channel to 1.003 GHz, "OffsetFreq" to -3 MHz, "Step" to 1 MHz, and "Decimate" to 3.



3. Click "FFT" in the main settings area, select "DDC1 Channel" from the dropdown menu, enable "Analyze", drag the red selection box "Spectrum-D1" in the maximum power time thumbnail, or adjust the "TimeStart" and "TimeLength" values to perform spectrum analysis on the sub-IQ streams generated by the DDC at different time intervals.



4. Click "IQvT" in the main settings area, select "DDC1 Channel" from the dropdown menu, enable "Analyze", drag the red selection box "IQvT-D1" in the maximum power time thumbnail, or adjust the "TimeStart" and "TimeLength" values to perform time-domain analysis on the sub-IQ streams generated by the DDC at different time intervals.



5. Click "PvT" in the main settings area, select "DDC1 Channel" from the dropdown menu, enable "Analyze", drag the red selection box "PvT-D1" in the maximum power time thumbnail, or adjust the "TimeStart" and "TimeLength" values to perform power vs. time analysis on the sub-IQ streams generated by the DDC at different time intervals.



6. DET Working Mode

This chapter provides a detailed introduction to some parameters of the DET mode and the measurement of pulse signals in this mode.

6.1 DET Parameter Description

This section provides an explanation of some important parameters for the DET mode, listed in Table 16.

Table 16 DET working mode description

Frequency	
LO optimize	Please refer to <u>SWP working mode</u> for reference
Amplitude	
Preamplifier	
Gain strategy	Please refer to <u>SWP working mode</u> for reference
IF gain grade	
Attenuation	

6.2 Pulse Signal Measurement

A pulse modulation signal with a carrier frequency as 1 GHz, power of -10 dBm, pulse period of 80 μ s, and pulse width of 40 μ s as an example.

6.2.1 Operation instruction

1. Set the "Center" as 1 GHz and click the "Single" in the menu bar to enable the single preview mode;

2. Click "Graph" in the chart settings area, then click "Zoom" to enable zooming. Adjust the zoom area by dragging the selected zoom area or dragging the zoom border left or right.

3. Select the zoomed-in graph, click "Graph" in the chart settings area, and choose "Marker Pair" to create two pairs of markers. Move the M1R marker to the pulse rising edge, M1D marker to the same pulse falling edge, M2R marker to the pulse rising edge, and M2D marker to the next pulse rising edge. The results displayed by the M1D and M2D markers in the top left corner of the zoomed-in graph will be the pulse width and pulse period of the pulse signal, respectively. The duty radio can be calculated using the following formula.

 $Duty radio = \frac{Pulse width}{Pulse period}$



6.3 Pulse Signal Detection (Option72)

This chapter introduces the basic operation methods for pulse signal detection and how customers who purchase the pulse detection option later can obtain and place the license.

6.3.1 Apply for License

If the pulse detection option was included when you purchased the device, you can ignore the content of this section. If you purchase the pulse detection option later, please follow the steps below to obtain and place the pulse detection license to use this feature properly.

1. Click on "System" in the menu bar, select "About" from the dropdown menu, and check the version information in the popup window;



- 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 software and firmware versions do not meet the above requirements, please refer to the <u>Software and Firmware Update</u> section to update them to the required versions;

4. After updating the software and firmware to the required versions, send a screenshot of the entire interface to the official technical support of HAROGIC Technology to apply for the pulse detection license for the respective device. The required interface schematic is as follows:



5. Click "File" \rightarrow "Exit" to exit the SAStudio4 running interface;

6. Copy the license obtained from technical support to a USB drive, then connect the USB drive to the USB port on the instrument's front panel, and click "OK" in the pop-up window "Removable medium is inserted";

7. Copy the pulse detection license from the USB drive to the desktop by dragging and dropping;

1495-62C0
File Edit View Bookmarks Go Tools Help
→ → → → → → → → → → → → → → → → → → →
userdata
SAStudio4
userdata
023_203032 32424850
"023_2030323242485012003b0030_pulsedet.lic" Free space: 10.4 GiB (Total: 14.3 GiB)

8. Navigate to "userdata" \rightarrow "SAStudio4_x.xx.xx" \rightarrow "bin" \rightarrow "CalFile", and drag and drop the

pulse detection license file into the "CalFile" folder;

1495-62C0	
	J CalFile V ^ 🛇
	<u>F</u> ile <u>E</u> dit <u>V</u> iew <u>B</u> ookmarks <u>G</u> o Too <u>l</u> s <u>H</u> elp
	🚙 🤤 🖌 🔿 🐧 🏠 //media/rpdzkj/userdata/SAStudio4_3.55.6/bin/CalFile
useruata	Places V
	Thome Folder
l k	Besktop 023_424850 023_424850 023_424850 023_203032 0L0752_am
SAStudio4	Trash Can 0_config.txt 0_ifacal.txt 0_rfacal.txt 2003b003
	Applications
	📃 userdata 🛛 🛆
• • • • • • • • • • • • • • • • • • •	📃 15 GB Volu 🛆
023_203032	
32424850	
	5 items Free space: 13.4 GiB (Total: 14.6 GiB)

9. Close the pop-up window and launch the SAStudio4 software, click "Mode" in the menu bar, select "Power Detection" to enter the detection analysis mode, enable "Pulse Det" in the main settings area, and the pulse signal detection function can be used normally;



6.3.2 Parameter Description

Only some important parameters are explained here: Important parameters for pulse signal detection are shown in Table 17. Error! Reference source not found.

Table 17 Pulse Signal Detection Parameter Description1

Pulse Det	
-----------	--

Threshold	Pulse detection threshold, only pulse signals greater than this threshold value will be considered valid pulses.
Maximum Number	Upper limit of pulse signal detection at current preview time

6.3.3 Operating Steps

Taking the detection of a pulse signal with 1 GHz, -20 dBm, pulse width of 40 us, and pulse period of 80 us as an example.

1. Set "Center" to 1 GHz and "Ref.Level" to 0 dBm;

2. Click "BW" in the main settings area and adjust the value of "BW" in the additional menu to set different analysis bandwidths. In this example, set "AnalysisBW" to 62.5 MHz;



3. Click "Trigger" in the main settings area and set "PreviewTime" to 500 us;



4. Click "Pulse Det" in the main settings area to enable the pulse detection function. Drag the value of "Trigger.Level" in the power time graph to set the pulse detection threshold, and adjust the value of "MaxPulseCount" to set the upper limit of pulse signal detection under the current preview time;



5. Click "Single" in the menu bar, and the pulse detection results under the current configuration are shown in the figure below. From the figure, you can obtain parameters such as the peak level (dBm), reference level (dBm), rise time, leading edge, fall time, trailing edge, pulse width, period, and duty cycle of each detected pulse signal. Also, the statistical parameters of the detected pulse signals, such as the maximum, minimum, average pulse period and width, period deviation percentage, and pulse width deviation percentage.



6. If the user encounters a measurement freeze/stop state during pulse detection, this can be avoided by reducing the analysis bandwidth or increasing the pulse period.

7. RTA Working Mode

This chapter provides a detailed introduction to some parameters of the RTA mode and the measurement of WIFI signals in this mode.

7.1 RTA Parameter Description

This section provides an explanation of some important parameters: Important parameters for RTA mode are listed in Table 18.

Table 18 RTA mode parameter description

Frequency	
LO optimize	Please refer to <u>SWP working mode</u> for reference
Amplitude	
Preamplifier	
Gain strategy	Please refer to SWP working mode for reference
IF gain settings	Flease refer to <u>SWF Working mode</u> for reference
Attenuation	
Sweep	
Sweep Time Mode	Places refer to SWP working mode for reference
Window	Flease refer to <u>SWF working mode</u> for reference
7.2 Probability Density G	raph
7.2.1Parameter Descriptio	n
Graph	
Probability Graph On:	Enable probability density graph display

Probability Graph	On: Enable probability density graph display Off: Disable probability density graph display
Color Scale	Sky color, Deep sea color (default), Jet color, Cool color, Hot color, Grayscale
Afterglow	Increase: Extend the signal afterglow display time, suitable for capturing burst signals Reduce: Speed up refresh rate, suitable for tracking continuous signals

7.2.2 Close probability density graph

Click "Graph" in the chart settings area, and in the pop-up window, close "BitMap" to close the probability density graph.

	le Mode Systen	Preset	Single Continu.	●Rec	▶Play	Ċ	Ø				- 🗆 X
Density 0		Ref:0dBm		RBW: 1	18.567kHz			POI: 16.67μs T1 C&W	14:49:58 25/04/11	Return	Frequency
-10									Graph	Center 1GHz	Span
-20									Trace	Step 10MHz	Amplitude
-30			Scale/Div 10dB	Offset 0dB	Graph ScaleR	eset	- - ×		Peak Search	LO Optimize Auto	BW
-40			Spectrogram Off	BitMap Off	Colo		Afterglow		Marker		Sweep
-50			Marker Pair	Clear All) 🛃		Detect
-60			DataExport						Ð		Trigger
-80					ta.						Record
-90	when when he have	nh MANN	(MANANA ANA	hum	n Miller	WW	Myaha M	AMAR AM			Play Back
-100	IL I. M. LINK	"									Next

7.3 WIFI Signal Measurement

1. Connect the antenna to the RF input port "RFIN";

2. Set the "Center" as 2.44 GHz. Increase the "Afterglow" value in the "Graph" submenu of the chart settings area to observe the WIFI signal more clearly.



8. Digital demodulation (option)

This chapter introduces the basic operation methods of digital demodulation and how customers can enable the digital demodulation function through a license.

8.1 Apply for License

If your device purchase includes the digital demodulation option, you can ignore the content of this chapter. If you purchase the digital demodulation option later, please follow the steps below to obtain and place the digital demodulation license for normal use of this function. 1. Refer to <u>the pulse signal detection license application</u> chapter to apply for the corresponding device digital demodulation license and place it in the "CalFile" folder;

2. Close the pop-up window and launch SAStudio4 software, click on the "Mode" menu, select "Digital Demod", and you can use the digital demodulation function normally.



8.2 Parameter Description

Here, only some important parameters are explained: Some important parameters are shown in Table 19.**Error! Reference source not found.**

Table 19 Parameter description for digital demodulation

Digital Demod

SymbolRate	The number of symbols transmitted per second by the signal needs to be filled in according to the symbol rate of the modulated signal to ensure that the receiving end can demodulate correctly
Demod type	AM、FM、PM、CW、LSB、USB、2ASK、2FSK、4FSK、BPSK、 QPSK、16QAM、64QAM
FilterAlpha	The roll-off rate of the filter used to limit the signal bandwidth in the transition band must be consistent with the roll-off coefficient at the transmitter to ensure that the demodulator can effectively process and demodulate the signal correctly.

8.3 Function Overview

The initial UI of the digital demodulation mode is shown in the figure below, consisting of the modulation signal spectrum, demodulated constellation diagram, eye diagram, and demodulation parameters. It allows for an in-depth analysis of the modulation quality of the signal and provides various error metrics to effectively evaluate the integrity and reliability of the signal during transmission.



8.4 Operating Steps

Take the demodulation of a 1 GHz, -20 dBm, symbol rate 100 kHz, filter roll-off factor 0.35, 64QAM signal as an example.

1. Set "Center" to 1 GHz, "RefLevel" to 0 dBm;

2. Click "Demod" in the main settings area, set "ModType" in the additional menu to QAM64, "SymbolRate" to 100 KSPS, "FilterType" to 0.35, and click "Single" in the menu bar. The demodulation result under the current configuration is shown in the figure below. The constellation points in the constellation diagram are clear and closely distributed, with the theoretical and actual demodulation point positions almost coinciding, indicating high modulation quality of the signal and good overall performance of the communication system. The eye diagram is clear with a large opening, indicating minimal inter-symbol interference, allowing the receiver to reliably distinguish symbols. Meanwhile, it also provides error vector magnitude (EVM), amplitude error, phase error, frequency error, signal-to-noise ratio (SNR/MER), and part of the decoded bit sequence.

HAROGIC	File	Mode	System	m Prese	et Single Conti	nu. 🛛 🗖 🗞			$-\Box$
Constellation						Spectrum(dBm) RBW	58Hz 17:50:20 25/01/1	5 Return	Frequenc
		• •					Graph	SamplePoints 16384	BW
	•••		00	• •		-40		SampleRate 480kSPS	Amplitud
						-60		SymbolRate 100kSPS	Demod
-1.5							ulle	ModType QAM64	Display
Start: -2.258					Stop: 2.258	Center: 1GHz AnalysisBW: 4	80kHz	FilterType	Trigger
EVM			1.03 %		2.39 %pk	1.5		RootRaisedCosin	
Mag Error Phase Error Freq Error I/Q Offset			0.69 %r 1.08 c	leg	2.1 %pk -7.98 deg pk -134Hz - dB		2	FilterAlpha 0.35	System
SNR(MER) Quad Error Gain Imb					25.35 dB - deg - dB				
0 1111001 32 1000001 64 0010010	10 011000 11 101011 00 111101	11 0100 01 0000 00 1000	0000 110 1111 101 0001 010	01101 00110 111010			U3		
96 0000010 128 0110001 160 1010011	01 110111 11 100010 10 111100	10 0001 01 1100 11 1000	0100 010 1111 001 1111 010	10000 00111 00100			E200 R3 3f0010 0.55.55		
192 0011010 224 1100011	01 100100 11 111100	10 1101 10 0011	1101 010 0010 111	01010 01110		-1.5	mod2 0B/S		
						Start: -1s/m Stor	I I I I I I I I I I I I I I I I I I I		

9. Phase Noise Measurement Mode

9.1 Version Requirements

1. Click "System" in the menu bar, select "About" in the drop-down menu, and view the version information in the pop-up window.



- 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 software/firmware version does not meet the above requirements, please refer to the software/firmware update section to update the software/firmware to the required version. <u>Soft Firmware Update</u>

9.2 Enable Phase Noise Measurement Function

After updating the software/firmware to the required version, restart the SAStudio4 software, click "Mode" in the menu bar, and select "Phase Noise" to use the phase noise measurement function normally.



9.3 Parameter Description

Here, only some important parameters are explained: Some important parameters of phase noise measurement are shown in Table 20.

Table 20 Phase Noise Measurement Mode Parameter Description2

Frequency	
Start Frequency Offset	Set the starting point of the frequency offset, range: 1~10 MHz
Stop Frequency Offset	Sets the end point for the frequency offset, range: 10~10 MHz
Carrier Identification Threshold	Set the carrier identification threshold; only carriers above this threshold will be identified.
Search Carrier	Search the entire frequency band to locate signals above the carrier identification threshold.
Meas	
RBW/Offset	RBW ratio (RBW of each frequency segment / starting frequency of each frequency segment), range: 0.01~0.3
Detection Settings	Frame Detection Rate: Recommended to use the default configuration. If there is obvious low-frequency jitter near the signal under test, the frame detection rate near the end can be increased to obtain more stable measurement results.
Trace	
Average	Sets the number of trace averages
Smooth	On: Enables trace smoothing function Off: Disables trace smoothing function
Window Length	Sets the window length of the smoothing algorithm, range: $0{\sim}10\%$

9.4 Operation Steps

9.4.1 Phase Noise Measurement with Known Carrier Information

Taking the measurement of phase noise of a 1 GHz, 0 dBm signal in the 100 Hz to 10 MHz offset range as an example.

1. Click 'Frequency' in the main settings area, and in the additional menu, set 'Center Frequency' to 1 GHz, "Start Frequency Offset" to 100 Hz, and "Stop Frequency Offset" to 10 MHz. It is recommended to use the default configuration for the remaining parameters;



2. If there is strong jitter at the near end of the signal under test, click "Meas" in the main settings area, then select "Detection Settings" in the additional menu. In the pop-up window, appropriately increase the frame detection rate of the corresponding frequency band to obtain more convergent measurement results;



3. If there are obvious spurs in the single sideband phase noise spectrum, you can click "Trace"



in the main settings area, then select "Window Length" in the additional menu, and gradually increase its parameter value to reduce the interference of spurs on the measurement results;

4. The instrument will automatically complete the phase noise measurement within the set frequency offset range, and the measurement results are shown below. In the phase noise measurement table at the bottom of the interface, you can obtain the carrier information and the phase noise values of each characteristic frequency offset point (unit: dBc/Hz).



9.4.2 Phase Noise Measurement of Unknown Carrier Information

When the signal carrier parameters are unknown, it is recommended to perform phase noise measurement according to the following process. (Assuming that the unknown carrier signal is 2 GHz, -10 dBm at this time)

1. Click "Carrier Search", the instrument will automatically perform a full-band scan, search for and locate the peak signal exceeding the carrier threshold as the carrier under test;



2. After locating the carrier signal, refer to the <u>Phase Noise Measurement of Known Carrier</u> <u>Information</u> section to set the start frequency offset and end frequency offset for phase noise measurement.



10. Additional Functions

In this chapter, you can find detailed information for how to operate GNSS, trigger and remote control etc.

10.1 GNSS Operation Guide

10.1.1 Connect GNSS antenna

Connect GNSS antenna and MMCX-SMA convertor and then use the MMCX side to connect with GA port (port 14), shown in the below figure (When using external GNSS antenna, please make the receiving side of antenna towards sky without obstructions).



10.1.2 GNSS information check

1. Open SAStudio4 and click System in the menu to choose GNSS Info. In the dialog box, choose antenna as "GNSS_AntennaExternal";

2. Wait for 1-3 minutes for the GNSS to lock. You can determine whether the GNSS is locked based on the GNSS lock icon in the status bar. The GNSS lock icon is green when locked, otherwise gray.

Spectrum(dBm) Ref: 0dBm RBW: 300kHz	Preset Sin	gle Continu. ●Rec ▶Play	Detec	1 🔌	14:52:38 24/11/08	Return	Frequency
	GNSS Info	Local Time	× T1	C&W	Graph	Center 10.0100045GHz	Span
-20	Antenna Date	GNSS_AntennaExternal			Trace	Start 9kHz	Amplitude
-30	Time	14:52:42 118° 38' 36.49″			Peak Search	Stop 20.02GHz	BW
-40	Latitude	32° 02′ 30.75″			Marker	Step 10MHz	Sweep
-50	SatNum	16 / 24 47dB / 37dB			4	LO Optimize Auto	Detect
-60	SNR(Min)	31dB / 18dB					Meas
-70	Locked	399B / 258B		a li			Trigger
	la a de la dela. No						Record
-100 Start: 9kHz Span: 20.019991GHz Cc	enter: 10.010005(GHz Speed: 663.869GHz/s	Sto	p: 20.02GHz	1MB/S RFU 46°C 122min		Next

10.1.3 1PPS trigger in GNSS module

The 1PPS trigger of the external GNSS module can be used only in IQS, DET, and RTA mode.

- 1. Please refer to Connect GNSS antenna section for connecting antenna with instrument;
- 2. Please refer to GNSS Information Check section for ensuring GNSS is locked;
- 3. Click "Mode" to choose "IQStreaming" to enter into IQS mode;

4. Main setting area-Tigger, set trigger source as "GNSS-1PPS" to enable 1PPS trigger in the GNSS module.



10.1.4 GNSS application note

When the GNSS module is not locked, it is not recommended to use the GNSS 1PPS and 10MHz clock signal outputs.

10.2 Trigger Features Overview

10.2.1 SWP working mode

Trigger In

Trigger Source	FreeRun, External PerHop, External PerSweep, External PerProfile
Trigger Edge	RisingEdge, FallingEdge, Double Edge
Trigger Out	
Trigger Out	Null; PerHop: Output a trigger after each frame analysis is completed PerSweep: Each time a trace scan is completed, a trigger is output PerProfile
Trigger Out Pulse Polarity	Positive、Negative
10.2.2 IQS、DET、RTA Trigger In	working mode
Trigger Source	External, Bus, Level, Timer, DevSyncByExt, DevSyncBy1PPS, GNSS1PPS
Trigger Mode	Fixed, Adaptive
Trigger Edge	RisingEdge, FallingEdge, DoubleEdge
Trigger Delay	Set the delay time after triggering
PreTrigger	Set the acquisition time before triggering
ReTrigger	At FixedPoints mode, the instrument responds multiple times after capturing a trigger
Count	After a single trigger response, several additional responses are required
Period	The time interval between multiple responses of a single-trigger instrument is same as trigger period in the timer trigger mode
Period (RTA)	The actual sampling time of the instrument after triggering
Trigger In- Level	
Trigger Level	Set the level trigger threshold value. If the value is higher than the threshold value, it means the trigger condition is met.
Debounce SafeTime	Set the level-triggered debounce safety time
TriggerIn-Timer	
Period	Trigger period in timer trigger mode
Sync	Not synchronized with the external trigger
	Synchronized with the external trigger's rising edge
	eynemenzea with the external trigger a family eage

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

10.3 IF Output

The frequency of the analog IF output signal is between 307.2MHz±50MHz. The center frequency of the analog IF output of each instrument can be viewed in the IF calibration file of the instrument.



10.4 External Reference Clock Input

The waveform of the reference clock input can be selected as sine wave, square wave or clipped sine wave. The frequency must be set to 10 MHz and the amplitude must be 3.3V CMOS level.

Below is the GPSDO as the 10 MHz reference clock input:

1. Connect the GPSDO "10 MHz" port to the instrument's "RI" port via a BNC to MMCX cable. The connection is shown below:



2. Click "Next"-"System" in the main setting area, set the reference clock frequency "RefCLKFreq" to 10 MHz, and select "External" for the reference clock source "RefCLKSource". If the reference clock source displays "External", it means the switch is successful. If the reference clock source rebounds to "Internal" and an error pop-up window appears, it means the switch failed. At this time, you can click "Preset" to switch back to the internal clock.

KAROGIC	File Mode Syster	m Preset Single C	Continu. •Rec	▶ Play 📔 🚺	& 16:33:12 24/11/09	Return	Trigger
MaxPwr VS Time(dBm ⁰ Spectrum-P -40 -60	n) IQvT-P				Graph	RefCLKSource External	Record
-80 -100 0s 100µs Spectrum-P(dBm)	200μs 300μs 40 Ref: 0dBm	0µs 500µs 600 RBW: 19.76k	µs 700µs Hz	800µs 900µs TraceDetector: F	rosPeak	RefCLKFreq 10MHz	Play Back
-10 -20 -30				T1 C&	W Peak Search	RefCLKOut Off	System
-40 -50 -60					Marker	RxPort External	
-70 -80 -90 -100 Start: 938.56MHz	AnalysisBW: 122.8	8MHz Center: 1GHz	white the transmitter of the test of test of the test of test	Stop: 1.06	L.		
IQvT-P(mV)	SampleRate: 122.8	38MHz Center: 1GHz		Ref.Leve	l: 0dBm		
180 135 90 45 0 -45 -90 -90				Ch-I Ch-Q			
-135 -180 -225 Start: 213.6µs				Stop: 3	CPU 48°C 37min 313.6µs		Previous

10.5 Remote Control

10.5.1 Using LAN port

1. Connect the driver-free expansion dock with network port to the USB port on the upper panel of the instrument (USB3 is USB3.0 port, USB1 and USB2 are USB2.0 ports);


2. Connect the expansion dock to the network port of the computer or embedded instrument via a network cable;



3. Click "File" - "Exit" in the menu bar to exit SAStudio4;

4. After successfully connecting according to the above steps, open "Settings", select "Network & Internet", and click "Properties";

5. Enter Ethernet, find the IP section and click "Edit";

← Settings	-		×
•	Network & internet > Ethernet		
Find a setting	Q Not connected	^	
A Home	Authentication settings Edit		
SystemBluetooth & devices	Metered connection Some apps might work differently to reduce data usage when you're connected to this Off Intervention of the other of the other othe		
🔷 Network & internet	Set a data limit to help control data usage on this network		
🥖 Personalization	IP assignment: Automatic (DHCP) Edit		
Apps	DNS server assignment: Automatic (DHCP) Edit		

6. Select "Manual" to set IP, turn on the IPv4 option, and set the IP address and subnet mask (the computer IP and the instrument IP must be in the same network segment). For example, set the computer IP address to 192.168.1.2 and the subnet mask to 255.255.255.0;

	Edit IP settings			
•	Manual	~		
Find a setting	IPv4			^
A Home	IP address		Edit	
System	192.168.1.2		connected to this Off 🦲	\supset
8 Bluetooth & devices	Subnet mask			
Network & internet	255.255.255.0	×		
Personalization	Gateway		Edit	

7. Open the cmd window and enter "ping 192.168.1.100". If it can be pinged, the network connection is successful;

C:\WINDOWS\system32\cmd. × + v	-	×
Microsoft Windows [Version 10.0.22631.4037] (c) Microsoft Corporation. All rights reserved.		
C:\Users\10418>ping 192.168.1.100		
Pinging 192.168.1.100 with 32 bytes of data: Reply from 192.168.1.100: bytes=32 time<1ms TTL=64 Reply from 192.168.1.100: bytes=32 time<1ms TTL=64 Reply from 192.168.1.100: bytes=32 time<1ms TTL=64 Reply from 192.168.1.100: bytes=32 time<1ms TTL=64		
Ping statistics for 192.168.1.100: Packets: Sent = 4, Received = 4, Lost = 0 (0% loss), Approximate round trip times in milli-seconds: Minimum = 0ms, Maximum = 0ms, Average = 0ms		

8. Go to the \SAStudio4\configuration\ folder on the PC, double-click to open the Settings.ini file, and set Interface to ETH;

	> SAStudio4 > configuration	n Sear
lô	▲ ▲ ▲ Sort	~ 🗏 View ~ …
ſ	Name Profile.xml	Settings.ini
	restartProfile.xml	File Edit View
	rt_spectrum_default_label.xml	[General]
	rt_spectrum_default_trace.xml	Interface=ETH
E.	saMeasureProfile.xml	DeviceNum=0
	Settings.ini	Port=5000
	Settings.xml	Debug=0

9. Click "Userdata" \rightarrow "SAStudio4_X.XX.XX" \rightarrow "bin" \rightarrow "CalFile" on the instrument desktop, and save the calibration file to the external storage device by dragging and dropping.

👖 reports	×
<u>File Edit View Bookmarks Go Tools Help</u>	
Imedia/rpdzkj/userdata/SAStudio4_aarch64_10_16_11_12/reports	•
Places Home Folder Desktop Tash Can Applications Userdata 15 GB Volu.	
4 items	Free space: 12.5 GiB (Total: 14.6 GiB)

10. Copy the instrument calibration to "..\SAStudio4\bin\CalFile" on the PC, double-click SAStudio4.exe under "SAStudio4\bin" on the PC to open the SAStudio4 interface to achieve remote control of the PX series instruments.



Note: The SAStudio4 on the PC and instrument cannot be opened at the same time.

10.5.2 Using local area network

1. Connect the driver-free expansion dock with network port to the USB port on the upper panel of the spectrum analyzer (USB3 is USB3.0 port, USB1 and USB2 are USB2.0 ports);

2. Connect the Hub to the router's network port via an Ethernet cable;



- 3. Click "File" \rightarrow "Exit" in the menu bar to exit SAStudio4;
- 4. Click "userdata" \rightarrow "Tools" \rightarrow "Open Current Folder in Terminal";



5. Enter "ifconfig" in the terminal to query the IP address assigned to the instrument by the current router. In this example, the IP address is "192.168.31.55";



6. Connect the PC to the same router via WIFI, and be in the same LAN as the spectrum analyzer. Enter the "\SAStudio4\configuration\" folder, double-click to open the "Settings.ini" file, set the Interface to ETH, and set the Address to "192.168.31.55"

Q	> SAStudio4(1) > configuration	n Search configuration
6	④ 论 ① 1 Sort ~	≣ View ∨ ····
	Name restartProfile.xml rt_spectrum_default_label.xml	Settings.ini + File Edit View
2	rt_spectrum_default_trace.xml saMeasureProfile.xml	[General] Interface=ETH
*	Settings.ini	Address=192.168.31.55 Port=5000
e	shortcut_det.xml shortcut_iqs.xml	Debug=0 panelwidth=Narrow

7. Click "Userdata" \rightarrow "SAStudio4_X.XX.XX" \rightarrow "bin" \rightarrow "CalFile" on the desktop, and save the calibration file to the external storage device by dragging and dropping;

1	reports 🗸 🗸 😵
Eile Edit View Bookmarks Go Tools Help	
🚙 🧿 🖌 🔘 🐧 [/media/rpdzkj/userdata/SAStudio4_aarch64_10_16_11_1	2/reports
Places Home Folder Desktop Trash Can Applications Userdata 15 GB Volu	
4 items	Free space: 12.5 GiB (Total: 14.6 GiB)

8. Copy the instrument calibration to "..\SAStudio4\bin\CalFile" on the PC, double-click "SAStudio4.exe" under "SAStudio4\bin" on the PC to open the SAStudio4 UI to achieve remote control of the PX series instruments.



11. Software and Firmware Update

This chapter describes how to use the updater to update the MCU firmware, FPGA firmware, GNSS firmware, and SAStudio4 software of the PX series instrument

11.1 Version Requirements

The instrument firmware update must meet the following version requirements: The firmware version must be 0.54.0 or higher. If the GNSS module is updated, the MCU firmware version must be 0.55.32 or higher. The version can be viewed as follows: Click "System"-"About" in the menu bar to view the current instrument version information.



After firmware updates, you need to ensure that the instrument's MCU firmware, FPGA firmware, and SAStudio4 software (API) are in the same major version. Different major versions are incompatible with each other. For example, they must be 0.55.x to work properly.

11.2 Update Package Download

Visit the HAROGIC official website(<u>https://www.harogic.com/support/download-center/</u>) to download and unzip the firmware update package to the desktop.

	About Us Latert News Product Cooperation Support Contact Us	Q 🕂 🛤
DATASHEET	Firmware for HAROGIC SA/NX Series Spectrum Analyzer 2024-10-09	
MANUAL 4	Firmware for HAROGIC PX Series Spectrum Analyzer	
APIs 1		
software		
FIRMWARE		21 7 1

11.3 Firmware Update Using Updater

Note: If an error occurs in the update process, please refer to Error Check section.

1. Please refer to <u>Remote Control</u> section, connect the instrument with PC and ensure they are in the same network segment.

2. Open Updater 0.55 M39F15 file and double click to run Updater_Win.exe.

ジーローン Updater 0.55 M32F10 >			Search Updater 0.55 M32F10	Q
(1) (A) (A) (A) (A) (A) (A) (A) (A) (A) (A				📑 Details
Name	Date modified	Туре	Size	
data	1/6/2025 8:21 PM	File folder		
libgcc_s_dw2-1.dll	6/8/2024 12:00 AM	Application extension	123 KB	
🖻 libliquid.dll	6/8/2024 12:00 AM	Application extension	1,743 KB	
libwinpthread-1.dll	6/8/2024 12:00 AM	Application extension	67 KB	
README.txt	6/8/2024 12:00 AM	Text Document	1 KB	
Updater_Win.exe	8/8/2024 9:04 AM	Application	967 KB	

3. When the instrument is under update, SAStudio4 software will be updated first. As shown in the figure, wait for about 2 minutes to complete the update. During this period, if the instrument displays -1 or other errors, do not process them, just wait for the update to complete.

E C:\Users\60536\Desktop\Upd × + ∨	
NXServer need to update. Step2: it will take about 60 seconds Reconnecting device, please wait about 60s: 59	
Updating SAStudio4, please wait a minute: 37 SAStudio4 update complete	
Current MCU firmware version: 0.55.32 Current FPGA firmware version: 0.55.10	
New MCU firmware version: 0.55.39 New FPGA firmware version: 0.55.15	
Press Enter to update MCU or FPGA or GNSS	

4. After the SAStudio4 software is updated, the program will display the current instrument firmware version and the new firmware version in the update program. After confirming that they are correct, press Enter to start the update. (In the following, Updater 0.55 M39F15 is used as an example. M39 is MCU 0.55.39, and F15 is FPGA 0.55.15).



5. The terminal will display the update progress during the update. The MCU update time is about 4 minutes, and the FPGA update time is about 15 minutes.



6. The GNSS firmware will be automatically updated while the program is running.



7. After the update is completed, press Enter to end the update or simply click the cross in the

upper right corner to close the program.

⊡ C:\Users\60536\Desktop\Upd × + ∨
Current MCU firmware version: 0.55.32 Current FPGA firmware version: 0.55.10
New MCU firmware version: 0.55.39 New FPGA firmware version: 0.55.15
Press Enter to update MCU or FPGA or GNSS Ready to update GNSS firmware, please wait for about 5 seconds Updating GNSS Firmware100.00% GNSS firmware update completed Ready to update MCU firmware, please wait for about 3 minutes Updating100.00% MCU firmware update completed Ready to update FPGA, please wait and do not close the program Application 1 Hardware upgrade in progress
Erase Flash, please wait Erase completed! Data packet number is 19961 Downloading 99.99% FPGA firmware update completed! Press Enter to end

8. Restart the instrument to check the current version.



11.4 Software Update Using .deb Package

If you only want to update SAStudio4 without updating the firmware or cannot use the network port to remotely control the instrument, you can directly use the .deb installation package to update. The process is as follows:

1. download the PX series software installation package(<u>https://www.harogic.com/support/download-center/</u>) and copy it to a USB flash drive.

AROGIC About Us Latest Ne	ews Product	Cooperation	Support Contact Us		Q 🖁 🛤
DATASHEET Software Models: SAN NXN-400 11 2024-10-11	for HAROGIC \$	SA/NX Seri , SAE-90, SAE-2	es Spectrum Analyze 00 and SAN-400, NXN-45/60	97 , NXM-60/60, NXE-90, NXE-20	10 and
4 Software Software Models: PXE 2024-09-01	for HAROGIC -90, PXE-200 and PX	PX Series H (N-400	andheld Spectrum A	nalyzer	
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Name	Date modifie	d	Туре	Size	
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📜 Linux	1/9/2025 11:	39 AM	File folder		
📒 Windows	1/9/2025 11;	40 AM	File folder		-spine
Overview for Documents in Flash Disk pdf	7/27/2023 12	2:00 AM	Microsoft Edge P	257 KB	
EN_PXConfig_2.55.29.11.deb	1/9/2025 4:1	9 PM	DEB File	268,737 KB	- and and

2. Open the instrument normally, click "File" \rightarrow "Exit" in the menu bar to exit SAStudio4.

3. Use a hub with a USB or Type-C interface to connect the USB flash drive carrying the .deb installation package and the mouse and keyboard to the instrument.



- 4. Copy the .deb installation package in the USB flash drive to the instrument.
- 5. Click Tools, then click Open Current Folder in Terminal to open the terminal.

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<u>File Edit View Boo</u>	okmarks <u>G</u> o To	oo <u>i</u> s <u>H</u> elp			
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	deb	Documents 2	022-07-2		
0 items			F	12.6 610 (7	
8 items			Free space:	13.6 GIB (TO	tai: 14.3 GIB)

6. Enter cd ~/Desktop/ to enter the desktop.

7. Type sudo dpkg -i EN_PXConfig_2.55.29.11.deb to Install the .deb installation package and enter the password rpdzkj as prompted.

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Places ∨ ↑ Home Folder Desktop Trash Can Applications userdata △	File Linux System Volume Information	EN PXConfi g_2.55.29
15 GB Volu Windows EN_PXC	(Confi	calhost: ~/Desktop
7 items	rpdzkj@kocalhost:/media/rpdzkj0A7C-B rpdzkj@kocalhost:/Desktop5 sudo dpkg [sudo] password for rpdzkj: ■	2265 cd -/Desktop/ ∙i EN_PXConfig_2.55.29.11.deb

8. Then wait for the installation package to complete.



9. After the software is updated, check the SAStudio4 software GUI and API to confirm whether they have been updated to the latest version.



11.5 Error Check

11.5.1 Firmware update error

If during the firmware update process, the Updater program displays an error message indicating that it cannot detect the firmware as shown in the figure, no action is required and just continue to wait until the program detects the firmware.



11.5.2 Firmware corruption error

If the instrument fails to update the firmware due to unexpected circumstances such as network disconnection or power outage during the process of updating the MCU, FPGA, or GNSS, please restart the Updater program and wait for SAStudio4 to update. After that, the situation shown in the figure will appear. Follow the prompts to enter the instrument model into the terminal and press Enter to re-update (here we take the PXE-200 R3 instrument as an example).



Wait for the update to complete and then close the program.



11.5.3 SAStudio4 accidental deletion

If you accidentally delete SAStudio4 during normal use of the instrument and the instrument becomes unusable, you can repair SAStudio4 according to the .deb update SAStudio4 process.

11.5.4 SAStudio4 update failed

If SAStudio4 update is interrupted by unexpected events such as network disconnection or power outage during the SAStudio4 update process, shown in the figure. At this time, you must first repair SAStudio4 according to <u>.deb package update</u> SAStudio4, and then you can update the firmware normally according to <u>Firmware Update</u>.





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