SA Series NX Series

SA/NX
PRODUCT MANUAL

USB/NETWORKED REAL-TIME SPECTRUM ANALYZER

SAE/NXE Series

9.5/20 GHz

V1.7
2025/11/05

AROGIC

SAE/NXE Series Overview

WELL-BALANCED PERFORMANCE AND SIZE: SAE and NXE series are high-performance spectrum analyzers that deliver outstanding RF performance while maintaining a compact form factor. They can be easily integrated into various automated test systems, ensuring RF performance such as spectrum purity while significantly reducing deployment and operational costs, making them particularly suitable for space- and cost-constrained applications.

USB AND ETHERNET PORTS: The SAE series features USB connectivity supporting USB 3.0 and 2.0 interfaces, while the NXE series offers Ethernet connectivity compatible with 1000M/100M networks.

UNIFIED API: All series and models employ a consistent API interface, enabling seamless hardware migration without code modifications. Support is provided for development environments including C/C++, C#, Python, MATLAB, QT, and LabVIEW, compatible with both Windows and Linux operating systems.

RICH MEASUREMENT FUNCTIONS: A rich set of advanced measurement capabilities comes standard, including channel power, occupied bandwidth, X dB, harmonic measurement, SEM, AM/FM demodulation, and automatic phase noise analysis.

Key Features

- Frequency: 9 kHz to 9.5/20 GHz
- 1 GHz DANL: -166 dBm/Hz
- 1 GHz phase noise: < -100 dBc/Hz@10 kHz
- Analysis bandwidth: 100 MHz
- SAE series support USB3.0/2.0 type C interfaces
- NXE series support 1000M/100M ethernet interfaces
- Provides a highly compatible API interface
- Support Windows 11/10/8/7 (x86, x64, AArch64)

  Note: AArch64 only available for NX series
- Support Debian 12/11/10 (x64, AArch64)
- Support Ubuntu 24.04/22.04/20.04/18.04 (x64, AArch64)
- Support standard SCPI protocol

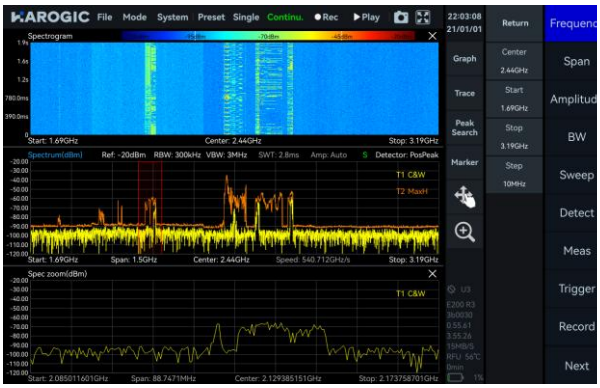
Main Operating Modes Overview

Offers seven main operating modes including: Standard Spectrum Analysis mode, IQ Streaming mode, Power Detection Analysis mode, Real-time Spectrum Analysis mode, Phase Noise Measurement mode, Digital Demodulation mode (option), and Harmonics Analysis mode.

SAStudio4 Main Operating Modes Description

■ Standard Spectrum Analysis Mode

This mode provides a wide range of measurement functions, including full-span spectrum sweep, channel power, OBW, ACPR, IM3 and SEM. It also supports spectrum recording and playback. Combined with auxiliary tools such as signal tracking, peak table, and amplitude correction, it delivers a one-stop platform for comprehensive spectrum check.



■ IQ Streaming Mode

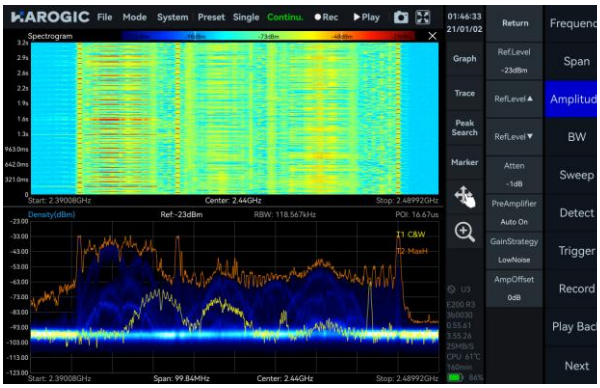
This mode supports up to 100 MHz analysis bandwidth and allows IQ data acquisition through multiple trigger methods. It provides IQ time-domain waveform display, spectrum and spectrogram views, AM/FM demodulation, and digital down conversion (DDC).

■ Power Detection Analysis Mode

This mode enables detection and analysis of time-domain signals within the analysis bandwidth, making it suitable for applications focused on in-band power-versus-time relationships, such as pulse signal measurements.

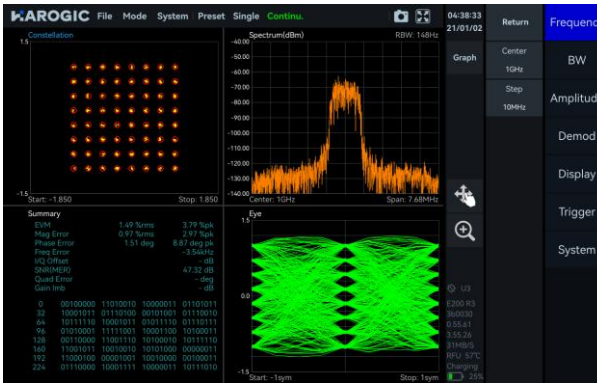
Real-time Spectrum Analysis Mode

This mode is powered by a high-speed FPGA-based FFT engine, featuring with strictly gapless and overlap-free FFT, achieving true real-time monitoring across the full bandwidth.



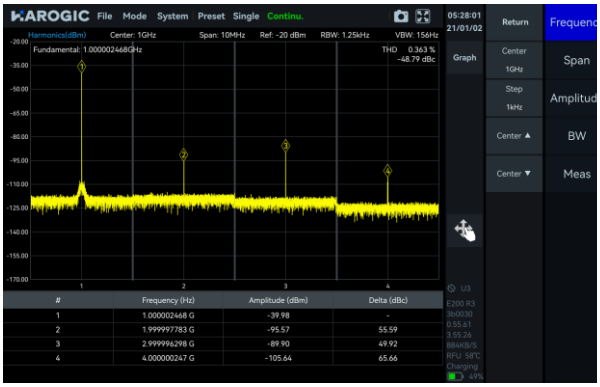
Digital Demodulation Mode (option)

This mode supports 2ASK, 2FSK, 4FSK, GMSK, BPSK, QPSK, 8PSK, 16QAM, 64QAM, 128QAM, and 256QAM signals.



Harmonics Analysis Mode

This mode supports detection and measurement of up to 10 harmonic components, including harmonic peaks, harmonic channel power, and total harmonic distortion.



Phase Noise Measurement Mode

This mode supports offset ranges from 1 Hz to 10 MHz for evaluating carrier phase stability. With the built-in automatic carrier search function, the software can quickly locate the target carrier without manual adjustment.

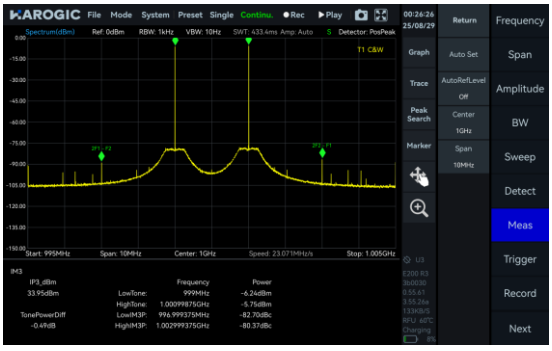
Main Functions Overview

Channel Power

OBW

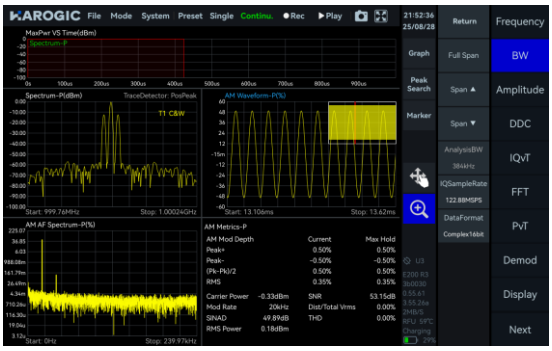
ACPR

IM3

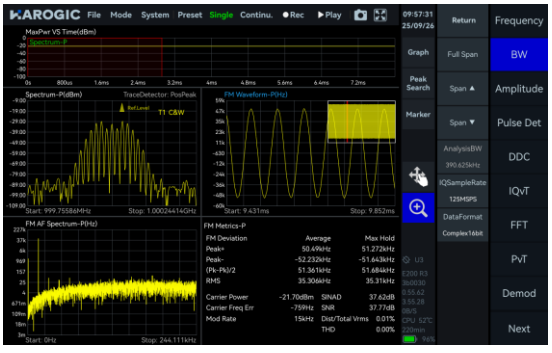


SEM

AM Demodulation



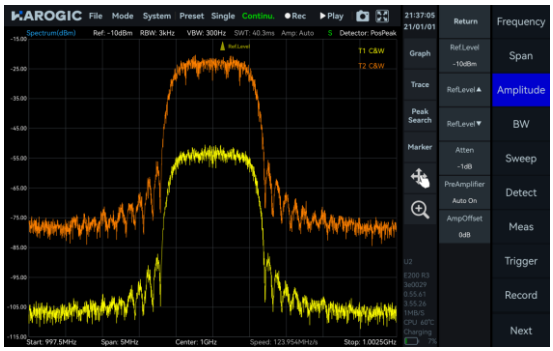
FM Demodulation



Pulse Detection (option)

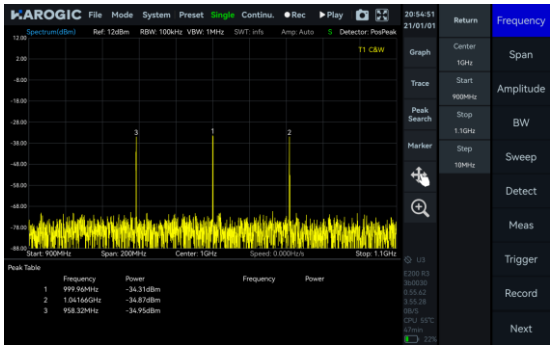
Antenna Factor

Amplitude Offset



Signal Track

Peak Table



Data Record and Playback

Multiple Unit Display

Specifications*

FREQUENCY

	SAE-90 / NXE-90	SAE-200 / NXE-200
Frequency range	9 kHz to 9.5 GHz	9 kHz to 20 GHz
Reference clock	Internal or external	
Frequency accuracy	TCXO (std.)	<1 ppm, manual correction is available
	OCXO (opt01)	<1 ppm, manual correction is available
	GNSS disciplined OCXO (opt 23/06)	<0.05 ppm, when locked to GNSS
Aging and temperature stability	TCXO (std.)	<1 ppm/year, <1 ppm
	OCXO (opt01)	<1 ppm/year, <0.15 ppm
	GNSS disciplined OCXO (opt 23/06)	<1 ppm/year, <0.05 ppm

SPECTRUM PURITY

SSB phase noise (dBc/Hz)

	SAE-90 / NXE-90		SAE-200 / NXE-200	
Carrier frequency	1 GHz	9.5 GHz	1 GHz	20 GHz
1 kHz	-95.2	-91.5	-91.2	-80.6
10 kHz	-101.6	-98.5	-99.7	-90.6
100 kHz	-100.6	-99.7	-101.1	-96.2
1 MHz	-120.9	-116.2	-121.6	-111.5

Residual response (dBm)
Spur reject = bypass
RBW = 1 kHz
PosPeak detector

	SAE-90 / NXE-90		SAE-200 / NXE-200	
Reference level (R.L.)	0 dBm	-50 dBm	0 dBm	-50 dBm
9 kHz to 1 GHz	-83	-120	-90	-120
1 GHz to 3 GHz	-83	-120	-80	-120
3 GHz to 9.5 GHz	-90	-130	-90	-120
9.5 GHz to 20 GHz	-	-	-90	-120

Image rejection (dBc)	Typical			
	SAE-90 / NXE-90		SAE-200 / NXE-200	
Spur reject function	standard	bypass	standard	bypass
90 MHz to 3 GHz	>90	>76	>90	>79
3 GHz to 9.5 GHz	>90	>60	>90	>68
9.5 GHz to 20 GHz	-	-	>90	>60

IF rejection (dBc)	Typical	
Spur reject function	enhanced	bypass
	>90	>80
Local oscillator related spurious	<-65 dBc Center frequency ± (N/M) × 125 MHz, N, M = 1, 2, 3, 4, 5...	

IIP3/IIP2（dBm）

	SAE-90 / NXE-90		SAE-200 / NXE-200	
Carrier frequency	1 GHz	9.5 GHz	1 GHz	20 GHz
R.L. = 20 dBm	46.1 / 83.2	40.5 / 92.8	45.5 / 82.6	35.3 / 93.6
R.L. = 0 dBm	26.7 / 85.0	19.2 / 90.3	25.5 / 81.1	21.0 / 89.0
R.L. = -20 dBm	10.5 / 82.2	2.0 / 49.3	7.9 / 81.5	-4.5 / 55.3

AMPLITUDE

Max. input power (CW)	23 dBm	50 MHz to 9.5/20 GHz and the preamplifier is off
	10 dBm	9 kHz to 50 MHz or preamplifier is on
Max. DC voltage	±10 VDC	
Display range	DANL to 23 dBm	
Amplitude accuracy	9 kHz to 9.5 GHz	±2.0 dB
	9.5 GHz to 20 GHz	±3.0 dB
IF in-band flatness	±2.0 dB	
Reference level (R.L.)	-50 dBm to +23 dBm	
RF preamplifiers	Automatically turn on or forcibly turn off	
VSWR 90 MHz to Max. Freq.	<2.0:1	

Display average noise level (DANL)
dBm/Hz
RBW=1 kHz

	SAE-90 / NXE-90		SAE-200 / NXE-200	
Reference level (R.L.)	-20 dBm	-50 dBm	-20 dBm	-50 dBm
9 kHz to 1 MHz	-143.0	-152.4	-143.6	-152.6
1 MHz to 90 MHz	-152.0	-159.2	-151.8	-160.0
90 MHz to 3.0 GHz	-146.0	-167.5	-149.7	-166.3
3.0 GHz to 9.5 GHz	-153.6	-167.0	-151.4	-157.5
9.5 GHz to 20 GHz	-	-	-156.1	-160.6

STANDARD SPECTRUM ANALYSIS

Detector	PosPeak, NegPeak, Sample, Average, RMS, MaxPower
RBW	0.1 Hz to 10 MHz
VBW	0.1 Hz to 10 MHz
Data chart	SAStudio4 software provides spectrum, spectrogram, and historical trace
Measurements	Channel power, OBW, X dB bandwidth, Adjacent channel power ratio, IM3

Sweep Speed	SAE-90 SAE-200	NXE-90 NXE-200
RBW = 250 kHz FPGA spur reject = bypass	1.1 THz/s	665.6 GHz/s
RBW = 250 kHz FPGA spur reject = standard	561.7 GHz/s	324.6 GHz/s
RBW = 50 kHz FPGA spur reject = bypass	209.8 GHz/s	161.6 GHz/s
RBW = 1 kHz CPU spur reject = bypass	4.0GHz/s	3.3 GHz/s

IQ RECORDING

	SAE-90 SAE-200	NXE-90 NXE-200
Continuous recording bandwidth	Maximum: 50 MHz	Maximum: 6.25 MHz
Burst recording bandwidth	Maximum: 100 MHz The built-in memory depth is 128 Mbytes	
IQ sample rate	Maximum: 125 MSPS decimate factor: 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096	
External trigger response	Maximum frequency response: 500 times/s	

DETECTION ANAYLSYS

Lowest time resolution	8 ns
Max. analysis bandwidth	100 MHz
Detector	PosPeak, NegPeak, Sample, Average, RMS, MaxPower

REAL TIME SPECTRUM ANALYSIS

FFT analysis	FFT engine is implemented in FPGA. Frame compression and trace detection are supported. No missing samples between FFT frames FFT frame update rate=10 ^ 9 ns/(N × D × 8 ns); POI = N × D × 8 ns N for FFT points (2048, 1024, 512, 256, 128, 64, 32) D for decimate factor (1, 2, 4, 8...)		
	Typical settings	FFT refresh rate	POI
	N = 2048, D = 1	61,035 times/sec	16.384 us
	N = 32, D = 1	3,906,250 times/sec	0.256 us
Max. analysis bandwidth	100 MHz		
Window function	B-Nuttall, Flat-top, LowSideLobe		
RBW	14.73 MHz to 3.59 kHz (Flat-top) 7.81 MHz to 1.90 kHz (B-Nuttall) 13 grades for each window type		
Amplitude resolution	0.75 dB		

GENERAL

Input and output

	SAE-90	SAE-200	NXE-90	NXE-200
RF input	SMA(F)	2.92mm(F)	SMA(F)	2.92mm(F)
	Impedance 50 Ω			
Power	Type-C, 5V 2A supply capacity voltage range 4.75 to 5.25 V ripple less than 200 mVpp		Type-C, 12V 2A supply capacity voltage range 9 to 12 V ripple less than 200 mVpp	
USB port	Type-C, USB3.0 (USB2.0 bandwidth limited) Requires 5V 0.9A power supply		RJ45 1000 Mbps * 1, 100 Mbps * 1	
External trigger input	Integrated in AUXIO, 3.3 V CMOS high impedance		MMCX(F), 3.3V CMOS high impedance	
Trigger output	Integrated in AUXIO, 3.3 V CMOS		MMCX(F), 3.3V CMOS	

Analog IF output	MMCX (F), maximum output power -25 dBm impedance 50 Ω, 307.2 MHz ± 50 MHz			
External reference clock input	MMCX (F), amplitude ≥ 1.5 Vpp, impedance 330 Ω			
Reference clock output	Integrated in AUXIO, 3.3 V CMOS, programmable on/off			
	SAE-90	**SAE-200**	**NXE-90**	**NXE-200**
Weight	383 g	408 g	680 g	658 g
Size (D × W × H)	131 x 70 x 30 mm	139 x 68 x 31 mm	167 x 117 x 30 mm	
Power consumption	10 to 14 W		13 to 16 W	
GNSS type	External		Internal	
GNSS 1PPS Synchronization Accuracy	Opt21, ±100 ns Opt22, ±75 ns opt23, ±50 ns		Std, ±100 ns Opt05, ±75 ns Opt06, ±50 ns	
Packaging and accessories	Flash disk * 1, USB 3.0 cable * 2, Power adapter * 1		Flash disk * 1, USB 2.0 cable * 1, Power adapter * 1	
System requirements	Windows 11/10/8/7 (x86,x64,AArch64), only NX series support AArch64 Debian 12/11/10 (x64,AArch64) Ubuntu 24.04/22.04/20.04/18.04 (x64,AArch64)			
Operating/Storage temperature (Ambient)	T0 class (std.) T1 class (opt40) T2 class (opt41)		0 to 50 °C / -20 to +70 °C -20 to +65 °C / -40 to +85 °C -40 to +65 °C / -40 to +85 °C	
Operating Relative Humidity	Ambient Temp.: 0 to 40 °C Ambient Temp.: > 40 °C		5 to 75% 5 to 45%	

*Specification applies under the following conditions:
(1) Start up and warm up for 10 minutes
(2) Ambient temperature 25 °C (core temperature 50 °C)
(3) Standard spectrum analysis mode-spurious rejection standard on.
(4) Necessary heat dissipation is provided to ensure the ambient and core temperature within the rated range at the same time
(5) Sweep speed and display average noise level test conditions: MCU:0.55.57, FPGA:0.55.22, API:0.55.61

OPTIONS

Code		
01	Built-in OCXO reference clock	built-in hardware
05	Internal high precision GNSS	built-in hardware
06	Build-in GNSS disciplined reference clock	built-in hardware
20	AUXIO IO Expansion board	accessory
21	External GNSS	accessory
22	External high precision GNSS	accessory
23	External GNSS disciplined OCXO reference clock	accessory
34	External omnidirectional antenna, 400MHz to 8000MHz, Gain<2dBi	accessory
35	External active directional antenna, frequency range: 0.5 to 10 GHz Gain: < 5 dBi (amp off); < 25 dBi(amp on)	accessory
40	T1 temperature class	built-in hardware
41	T2 temperature class, only available for core	built-in hardware
71	Basic digital demodulation	software
72	Pulse detection	software

www.harogic.com
info@harogic.com
+65-8299 8857