SA Series

PRODUCT DATASHEET

USB REAL-TIME SPECTRUM ANALYZER

SAE SERIES
9.5/20 GHz

V1.4 25/08/08

HAROGIC

SAE SERIES OVERVIEW

Key facts

Frequency range: 9 kHz - 9.5/20 GHz

1 GHz DANL: -166 dBm/Hz

1 GHz phase noise: -100 dBc/Hz@10 kHz

Analysis bandwidth: up to 100 MHz

USB3.0/2.0 type C interface

Highly compatible API interface

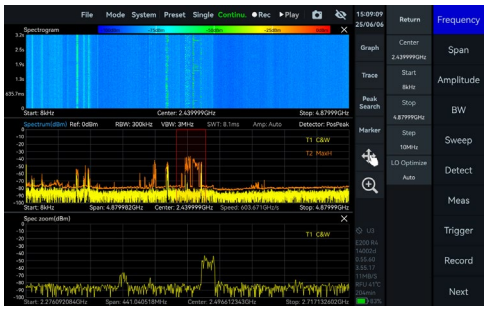
Windows 11/10/8/7 (x86, x64) are supported

Debian 12/11/10 (x64, AArch64) are supported

Ubuntu 24.04/22.04/20.04/18.04 (x64, AArch64) are supported

Applications

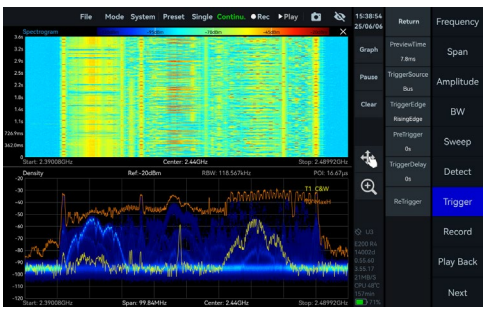
Standard spectrum sweep



IQ streaming and analysis

Power vs time analysis

Real-time analysis



Specifications*

FREQUENCY

Frequency range	**SAE-90**	**SAE-200**
	9 kHz - 9.5 GHz	9 kHz - 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
	Ext. GNSS disciplined OCXO (opt23)	<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
	Ext. GNSS disciplined OCXO (opt23)	<1 ppm/year, <0.05 ppm

SPECTRUM PURITY

SSB phase noise (dBc/Hz)

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

Image rejection	**SAE-90**	**SAE-200**
9 kHz - 3 GHz	> 90 dBc (typ.)	> 90 dBc (typ.)

3 GHz - 9.5 GHz	> 90 dBc(typ.) for spur reject = enhanced; > 60 dBc (typ.) for spur reject = bypass	> 90 dBc (typ.)
9.5 GHz - 20 GHz	-	> 90 dBc(typ.) for spur reject = enhanced; > 60 dBc (typ.) for spur reject = bypass

IF rejection	> 90 dBc (typ.) for spur reject = enhanced; > 80 dBc (typ.) for spur reject = bypass
Local oscillator related spurious	<-65 dBc Center frequency ± (N/M)*100 MHz, N, M = 1, 2, 3, 4, 5…

IIP3 / IIP2 (dBm)

	SAE-90		**SAE-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 - 9.5/20 GHz and the preamplifier is off
	10 dBm	9 kHz - 50 MHz or preamplifier is on
Max. DC voltage		±10 VDC
Display range		DANL-23 dBm (typ.)
Amplitude accuracy	9 kHz - 9.5 GHz	±2.0 dB
	9.5 GHz - 20 GHz	±3.0 dB
IF in-band flatness		±2.0 dB
Reference level (R.L.)		-50 dBm - 23 dBm (typ.)
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		**SAE-200**	
Reference level	-20 dBm	-50 dBm	-20 dBm	-50 dBm

9 kHz - 1 MHz	-143.0	-152.4	-143.6	-152.6
1 MHz - 90 MHz	-152.0	-159.2	-151.8	-160.0
90 MHz - 3.0 GHz	-146.0	-167.5	-149.7	-166.3
3.0 GHz - 9.5 GHz	-153.6	-167.0	-151.4	-157.5
9.5 GHz - 20 GHz	-	-	-156.1	-160.6

STANDARD SPECTRUM ANALYSIS

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

Sweep speed	**SAE-90**	**SAE-200**
RBW ≥ 1 MHz FPGA **Spur reject = bypass**	about 1.0 THz/s	about 1.0 THz/s
RBW = 250 kHz FPGA **Spur reject = standard**	about 561.7 GHz/s	about 566.4 GHz/s
RBW = 50 kHz FPGA **Spur reject = bypass**	about 209.8 GHz/s	about 214.6 GHz/s
RBW = 1 kHz CPU **Spur reject = bypass**	about 4.2 GHz/s	about 4.0 GHz/s

IQ RECORDING

Burst recording bandwidth	Maximum: 100 MHz The built-in memory depth is 128 Mbytes
Continuous recording bandwidth	Maximum: 50 MHz limited by the bandwidth of USB interface and hard disk. The storage depth is limited by the hard disk capacity
IQ sample rate	Maximum: 125 MSPS decimate factor: 1, 2, 4, 8, 32, 64, 128, 256, 512, 1024, 2048, 4096
External trigger response	Maximum response frequency 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/s	16.384 us
N = 32, D = 1	3,906,250 times/s	0.256 us

Max. analysis bandwidth	100 MHz
Window function	B-Nuttall, Flat-top, LowSideLobe
RBW	14.73 MHz - 3.59 kHz (Flat-top) 7.81 MHz - 1.90 kHz (B-Nuttall) 13 grades for each window type
Amplitude resolution	0.75 dB

GENERAL

Input and output

Power	Type-C, power supply dedicated port, please provide 5V2A peak power supply capacity Allowable voltage range 4.75 - 5.25 V, ripple less than 200mVp
Data	Type-C, USB 3.0 (USB 2.0 available but bandwidth limited) Device will fetch up to 1 A current from this port
RF input	2.92 mm (F), input impedance 50 Ω
External reference clock input	MMCX (F), amplitude ≥ 1.5 Vpp, input impedance is 330 Ω
Reference clock output	Integrated in MUXIO, 3.3 V CMOS, programmable on/off
External trigger input	Integrated in MUXIO, 3.3 V CMOS, input: high impedance
Trigger output	Integrated in MUXIO, 3.3 V CMOS

Analog IF output	MMCX (F), maximum output power - 25 dBm, output impedance 50 Ω Supporting, 307.2 MHz ± 50 MHz	
Power consumption	10 - 14 W	
Size (D * W * H) and weight	**SAE-90**	**SAE-200**
	131 * 70 * 30 mm and about 383 g	139 * 68 * 31 mm and about 408 g
GNSS synchronization	External GNSS (opt21)	±100 ns
	External GNSS (opt22)	±75 ns
	External GNSS (opt23)	±50 ns
System requirements	Windows 11/10/8/7	x86, x64
	Debian 12/11/10	x64, AArch64
	Ubuntu 24.04/22.04/20.04/18.04	x64, AArch64
Operating temperature (ambient/core)	T0 class (std.)	0 - 50 °C/0 - 70 °C
	T1 class (opt40)	-20 - 65 °C/-20 - 85 °C
	T2 class (opt41)	-40 - 85 °C (core)
Storage temperature (ambient)	T0 class (std.)	-20 – 70 °C
	T1 class (opt40)	-40 - 85 °C
	T2 class (opt41)	-40 – 85 °C (core)
Packaging and accessories	Flash disk * 1, USB 3.0 cable * 2, Power adapter * 1	

*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) Stand spectrum analysis mode-spurious rejection enhance 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

Code		
01	Built-in OCXO reference clock	built-in hardware
20	MUXIO IO board	accessory
21	External GNSS	accessory
22	External high precision GNSS	accessory
23	External GNSS disciplined OCXO reference clock	accessory
34	External omnidirectional antenna, 400-8000MHz, Gain<2dBi	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