



USB
REAL-TIME SPECTRUM
ANALYZER

SAE SERIES
9.5/20 GHz

Key facts

Create your own RF system with limited budget

Frequency range: 9 kHz to 9.5/20 GHz

1 GHz DANL: -168 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

ARM and X86 processor are supported

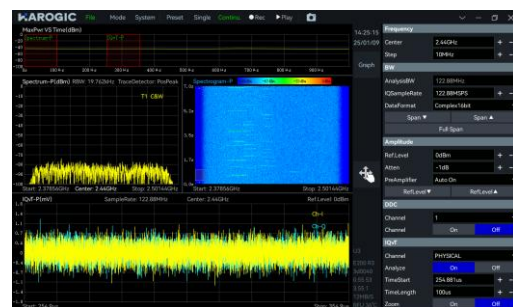
Linux and Windows operating systems are supported

Applications

Standard spectrum sweep



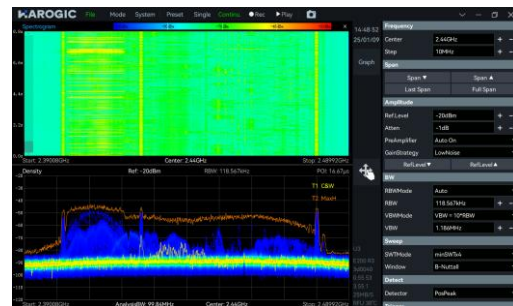
IQ streaming and analysis



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 (opt23)	disciplined OCXO	<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 (opt23)	disciplined OCXO	<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

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>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)

Carrier frequency	SAE-90		SAE-200	
	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	90 MHz-9.5/20 GHz and the preamplifier is off		
	10 dBm	9 kHz-90 MHz or preamplifier is on		
Max. DC voltage	±10 VDC			
Display range	DANL-23 dBm			
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			
RF preamplifiers	automatically turn on or forcibly turn off			
VSWR	<2.0:1			
90 MHz to Max.Freq.				
Display average noise level (DANL) (dBm/Hz)				
RBW=10 kHz				
Reference level	SAE-90		SAE-200	
	-20 dBm	-50 dBm	-20 dBm	-50 dBm

9 kHz	-136.8	-142.4	-141.2	-152.3
100 kHz - 90 MHz	-146.3	-150.9	-152.2	-160.2
90 MHz - 3.0 GHz	-145.7	-165.1	-147.2	-165.3
3.0 GHz - 9.5 GHz	-148.9	-157.4	-139.1	-157.1
9.5 GHz - 20 GHz	-	-	-138.2	-159.5

STANDARD SPECTRUM ANALYSIS

Detector	PosPeak, NegPeak, Sample, Average, RMS, MaxPower
RBW	0.1 Hz-10 MHz
VBW	0.1 Hz-10 MHz
Data chart	SASudio4 software provides spectrum, waterfall chart, and historical trace
Measurements	Channel power, OBW, X dB bandwidth, Adjacent channel power ratio, IM3

Sweep speed	SAE-90	SAE-200
RBW \geq 1 MHz FPGA spur reject = bypass	about 1.1 THz/s	about 1.1 THz/s
RBW = 250 kHz FPGA spur reject = standard	about 570 GHz/s	about 598 GHz/s
RBW = 30 kHz FPGA spur reject = bypass	about 150 GHz/s	about 153 GHz/s
RBW = 1 kHz CPU spur reject = bypass	about 4.8 GHz/s	about 4.7 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	125MSPS, decimate factor: 1,2,4,8,32,64,128,256,512,1024,2048,4096 supported (FPGA)
External trigger response	Maximum response frequency 500 times/sec

DETECTION ANALYSIS

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 = $10^9 \text{ ns} / (N * D * 8 \text{ ns})$; POI = $N * D * 8 \text{ ns}$ 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-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 supply	Type-C, dedicated power supply port. Acceptable voltage range: 4.75 to 5.25 V (ripple < 0.2 Vpp). Device will fetch up to 2 A current from this port
Data interface	Type-C, USB3.0 and USB2.0 (lower bandwidth) Device will fetch up to 1 A current from this port
RF input	2.92 mm (F), input impedance 50 Ω
Reference input	MMCX (F), amplitude $\geq 1.5 \text{ Vpp}$, input impedance is 330 Ω
Reference output	Integrated in MUXIO, 3.3 V CMOS, programmable on/off
External trigger input	Integrated in MUXIO, 3.3 V CMOS, input: high impedance
External 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 \pm 50 MHz

Power consumption	10-14 W	
Enclosure	Core with no enclosure and fan is provided	
Size (D * W * H) and weight	SAE-90	SAE-200
	130 x70 x30 mm and about 375 g	140 x65 x30 mm and about 400 g
GNSS synchronization	External GNSS (opt21)	+/- 100 ns
	External GNSS (opt22)	+/- 75 ns
	External GNSS (opt23)	+/- 50 ns
System requirements	Linux	aarch64, x64
	Windows	x64
Operating temperature	T0 class (std.)	0-50 °C/0-70 °C
(ambient/core)	T1 class (opt40)	-20-65 °C/-20-85 °C
	T2 class (opt41)	-40-85 °C (core)
Storage temperature	T0 class (std.)	-20-70 °C
(ambient)	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

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 modulation analysis	software
72	Pulse signal measurement	software

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