SA Series

PRODUCT DATASHEET

USB REAL-TIME SPECTRUM ANALYZER

SAM SERIES
6.3/8.5 GHz

V1.1 24/10/28

HAROGIC

SAM SERIES OVERVIEW

Key facts

Create your own RF system with limited budget

Frequency range: 9 kHz to 6.3/8.5 GHz

1 GHz DANL: -166 dBm/Hz

1 GHz phase noise: -110 dBc/Hz@10 kHz

Analysis bandwidth: up to 100 MHz

USB3.0/2.0 type C interface

Highly compatible API interface

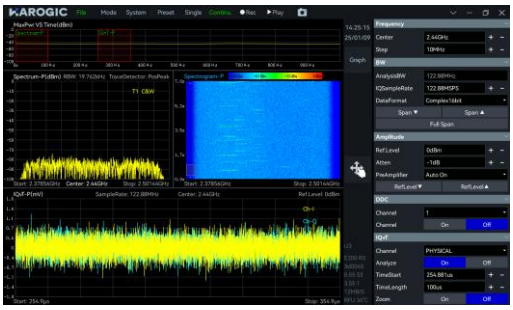
ARM and X86 processor are supported

Linux and Windows operating systems are supported

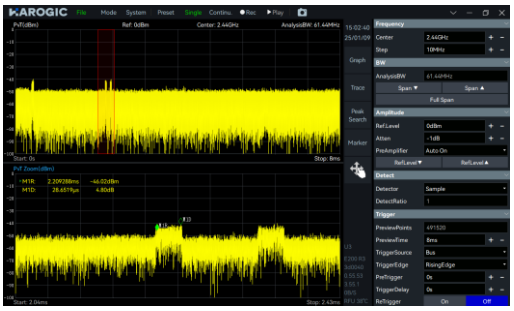
Applications

Standard spectrum sweep

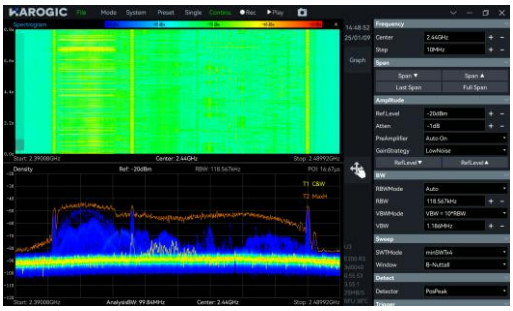
IQ streaming and analysis



Power vs time analysis



Real-time analysis



Specifications*

FREQUENCY

Frequency range		**SAM-60 M3**	**SAM-80**
		9 kHz-6.3 GHz	9 kHz-8.5 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)

	SAM-60 M3		SAM-80	
Carrier frequency	1 GHz	6.3 GHz	1 GHz	8.5 GHz
1 kHz	-107.5	-92.7	-110.3	-93.5
10 kHz	-114.2	-99.7	-120.0	-100.5
100 kHz	-112.5	-98.6	-120.1	-100.8
1 MHz	-132.8	-120.1	-131.4	-116.9

Residual response (dBm)
spur reject = enhanced
RBW =1 kHz
PosPeak detector

	SAM-60 M3		SAM-80	
Reference level (R.L.)	0 dBm	-50 dBm	0 dBm	-50 dBm
100 kHz-100 MHz	-101	-123	-99	-122
100 MHz-6.3 GHz	-87	-116	-88	-119
6.3 GHz-8.5 GHz	-	-	-84	-113

Image rejection	>90 dBc (typ.) for spur reject = enhanced >35 dBc (typ.) for spur reject = bypass
IF rejection	Low IF architecture

Local oscillator related spurious	<-65 dBc Center frequency ± (N/M)*125 MHz, N,M = 1,2,3,4,5…

IIP3 / IIP2 (dBm)

	SAM-60 M3		SAM-80	
Carrier frequency	1 GHz	6.3 GHz	1 GHz	8.5 GHz
R.L. = 20 dBm	51.0 / 84.9	43.4 / 65.9	49.6 / 87.5	41.0 / 57.4
R.L. = 0 dBm	40.1 / 85.1	25.3 / 94.6	35.6 / 84.3	25.5 / 44.8
R.L. = -20 dBm	10.0 / 66.4	4.7 / 17.7	11.5 / 67.4	2.4 / 34.2

AMPLITUDE

Max. input power (CW)	23 dBm	30 MHz-6.3/8.5 GHz and the preamplifier is off
	10 dBm	9 kHz-30 MHz or preamplifier is on
Max. DC voltage		±10 VDC
Display range		DANL- 23 dBm
Amplitude accuracy		±2.0 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	R.L. = 10 dBm	<1.7:1
30 MHz to Max.Freq.	R.L. = 0 dBm	<2.0:1
	R.L. = -40 dBm	<2.5:1

Display average noise level (DANL) (dBm/Hz)
RBW=10 kHz

	SAM-60 M3		SAM-80	
Reference level	-20 dBm	-50 dBm	-20 dBm	-50 dBm
9 kHz	-134.6	-149.3	-133.3	-151.2
100 kHz - 30 MHz	-138.6	-161.2	-139.1	-161.1
30 MHz - 3.0 GHz	-145.0	-161.0	-150.4	-166.4
3.0 GHz – 6.3 GHz	-141.0	-158.0	-145.6	-164.4
6.3 GHz – 8.5 GHz	-	-	-134.3	-154.9

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, waterfall chart, and historical trace
Measurements	Channel power, OBW, X dB bandwidth, Adjacent channel power ratio, IM3

Sweep speed	**SAM-60 M3**	**SAM-80**
RBW = 250kHz FPGA spur reject = standard	about 379 GHz/s	about 339 GHz/s
RBW = 250 kHz FPGA spur reject = enhanced	about 179 GHz/s	about 170 GHz/s
RBW = 30 kHz FPGA spur reject = enhanced	about 9 GHz/s	about 8 GHz/s
RBW = 1 kHz CPU spur reject = enhanced	about 1.3 GHz/s	about 1.2 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: 1,2,4,8,16,32,64,128,256,512,1024,2048,4096 supported (FPGA)
External trigger response	Maximum response frequency 500 times/sec

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-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	SMA (F), Input impedance 50 Ω
RF output	SMA (F), Input impedance 50 Ω
Reference input	MCX (F), amplitude ≥ 1.5 Vpp, input impedance is 330 Ω
Reference output	Unavailable
External trigger input	Type-C, 3.3 V CMOS, input: high impedance
External trigger output	Type-C (3), 3.3 V CMOS
Analog IF output	Unavailable

	SAM-60 M3	SAM-80
Power consumption	7-10 W	9-12 W
Enclosure	Core with no enclosure and fan is provided	

Size (D * W * H) and weight	156x62x22 mm and about 278 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 (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

OPTIONS

Code		
01	Built-in OCXO reference clock	built-in hardware
02	Built-in signal generator	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

BUILT-IN SIGNAL GENERATOR (opt02)

Frequency range	100 kHz-6.3 GHz, step 10 Hz	
Power range	-50 dBm-0 dBm, 0.25 dB for each step	
VSWR	<2.0:1	30 MHz-6.3 GHz
Non-harmonic spurs	<-50 dBc	

Harmonics

Frequency range	Second harmonic	Third harmonic and above
100 kHz-30 MHz	<-10 dBc	<-10 dBc
30 MHz-1.6 GHz	<-10 dBc	<-10 dBc
1.6 GHz-3 GHz	<-20 dBc	<-20 dBc
3 GHz-3.2 GHz	<-20 dBc	<-20 dBc
3.2 GHz-6.3 GHz	<-20 dBc	<-20 dBc

Leakage to receiver

100 kHz-30 MHz	>90 dBc
30 MHz-3 GHz	>80 dBc
3 GHz-6.3 GHz	>70 dBc

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