## 20GHz Compact USB Real-Time Spectrum Analyzer

## **SAE-200**

## **Product Brochure V1.1**

2023-10-18

- 9 kHz~20 GHz real-time spectrum analyzer
- Superheterodyne digital receiver architecture, 19 segments pre-selected filter
- 9 kHz~9 GHz typical image suppression>90 dB, typical IF rejection>90 dB
- 9 GHz~20 GHz typical image suppression>60 dB, typical IF rejection>90 dB
- 100 MHz analysis bandwidth with adjustable sampling rate, 1.2 THz/sec spectrum sweep speed
- FPGA based digital signal processing
- Core module supported, light as 195g, size 125×60×15mm, power consumption 10-14 W
- Highly compatible API interfaces and SAStudio4 GUI
- Compatible with ARM and x86 processors, Linux and Windows operating systems
- Operating temperatures range from 20 °C/- 40 °C to 65 °C (option)
- Built-in OCXO (option), temperature drift≤0.15 ppm





	l Specifications * (typ	ical value)				
Indicator test basis	Hardware Version: R3	API: 0.50.1 FPGA: 0.50.0	MCU: 0.50.2	SAS4: 1.50.40		
Frequency						
Frequency Range	9 kHz~20 GHz					
Initial Frequency Accuracy	<1 ppm, Supporting program manual correction					
Reference Clock	Internal or external, program-controlled switching Internal TCXO aging<1 ppm/year, temperature drift<1 ppm; Internal OCXO (option), temperature drift<0.15 ppm					
Spectrum Purity	1					
SSB Phase Noise		dBc/H	z			
Carrier Frequency	1 GHz	3 GHz	10 GHz	19.9 GHz		
1 kHz	-91.2	-90.0	-86.1	-80.6		
10 kHz	-99.7	-100.9	-92.5	-90.6		
100 kHz	-101.1	-104.2	-94.4	-96.2		
1 MHz	-121.6	-123.4	-112.1	-111.5		
10 MHz	-134.4	-134.2	-131.9	-129.2		
Docidual Decree	Frequency Range	R.L.=0 dBm	R.L.=-20 dBm	R.L.=-50 dBm		
Residual Response Spurious rejection off	9 kHz~1.0 GHz	< -90	< -100	< -120		
dBm	1.0 GHz~3.0 GHz	< -80	< -100	< -120		
RBW =1 kHz	3.0 GHz~9.0 GHz	< -90	< -100	< -120		
Positive Peak Detector	9.0 GHz~20 GHz	< -90	< -100	< -120		
mage Frequency	9 kHz~9 GHz	>90 dBc (spurious rejection	off), >90 dBc (spurious re	ejection on)		
Suppression	9 GHz~20 GHz	>60 dBc (spurious rejection		<u> </u>		
. rejection (N.L0 ub)	>90 dBc (spurious rejection	n on), >80 dBc (spurious rejec	tion off)			
IF rejection (R.L.=0 dB)  Local Oscillator Related Spurious  Input Related	<-65 dBc (Offset Center Fr	equency +/- (N/M)*125MHz,	N/M = 1,2,3,4,5)			
Local Oscillator Related Spurious	<-65 dBc (Offset Center Fr		N/M = 1,2,3,4,5)			
Local Oscillator Related Spurious Input Related Spurious Linearity	<-65 dBc (Offset Center Fro	equency +/- (N/M)*125MHz, on on), <-50 dBc (spurious rej	N/M = 1,2,3,4,5) ection off)			
Local Oscillator Related Spurious  nput Related Spurious  Linearity  IIP3 (dBm)	<-65 dBc (Offset Center Fro	equency +/- (N/M)*125MHz, on on), <-50 dBc (spurious rejo 3 GHz	N/M = 1,2,3,4,5) ection off)	19.9 GHz		
Local Oscillator Related Spurious  nput Related Spurious  Linearity  IIP3 (dBm)  R.L.= 20 dBm	<-65 dBc (Offset Center From the content of the con	equency +/- (N/M)*125MHz, on on), <-50 dBc (spurious reju 3 GHz 47.3	N/M = 1,2,3,4,5) ection off)  10 GHz 43.6	35.3		
Local Oscillator Related Spurious  nput Related Spurious  Linearity  IIP3 (dBm)  R.L.= 20 dBm  R.L.= 0 dBm	<-65 dBc (Offset Center From the content of the con	equency +/- (N/M)*125MHz, on on), <-50 dBc (spurious rejo 3 GHz 47.3 27.2	N/M = 1,2,3,4,5) ection off)  10 GHz 43.6 23.2	35.3 21.0		
Local Oscillator Related Spurious  nput Related Spurious  Linearity  IIP3 (dBm)  R.L.= 20 dBm  R.L.= 0 dBm  R.L.= -20 dBm	<-65 dBc (Offset Center From the content of the con	equency +/- (N/M)*125MHz, on on), <-50 dBc (spurious reju 3 GHz 47.3	N/M = 1,2,3,4,5) ection off)  10 GHz 43.6	35.3		
Local Oscillator Related Spurious  nput Related Spurious  Linearity  IIP3 (dBm)  R.L.= 20 dBm  R.L.= 0 dBm  R.L.= -20 dBm	<-65 dBc (Offset Center From the content of the con	equency +/- (N/M)*125MHz, on on), <-50 dBc (spurious rejonate) 3 GHz 47.3 27.2 7.5	N/M = 1,2,3,4,5) ection off)  10 GHz 43.6 23.2 -8.9	35.3 21.0 -3.0		
Local Oscillator Related Spurious Input Related Spurious Linearity IIP3 (dBm) R.L.= 20 dBm R.L.= 0 dBm R.L.= -20 dBm Signal Processing	<-65 dBc (Offset Center From the content of the con	equency +/- (N/M)*125MHz, on on), <-50 dBc (spurious rejo 3 GHz 47.3 27.2	N/M = 1,2,3,4,5) ection off)  10 GHz 43.6 23.2 -8.9	35.3 21.0 -3.0		
Local Oscillator Related Spurious Input Related Spurious Linearity IIP3 (dBm) R.L.= 20 dBm R.L.= 0 dBm	<-65 dBc (Offset Center From the content of the con	equency +/- (N/M)*125MHz, on on), <-50 dBc (spurious rejonate) 3 GHz 47.3 27.2 7.5	N/M = 1,2,3,4,5)  ection off)  10 GHz 43.6 23.2 -8.9  IF analog BW set as 2), De adjustable, 1 Hz step	35.3 21.0 -3.0 ecimate Factor:1		
Local Oscillator Related Spurious Input Related Spurious Linearity IIP3 (dBm) R.L.= 20 dBm R.L.= 0 dBm R.L.= -20 dBm Signal Processing Analysis Bandwidth	<-65 dBc (Offset Center From the content of the con	an on), <-50 dBc (spurious rejoins), <-50 dBc	N/M = 1,2,3,4,5)  ection off)  10 GHz 43.6 23.2 -8.9  IF analog BW set as 2), De adjustable, 1 Hz step	35.3 21.0 -3.0 ecimate Factor:1		
Local Oscillator Related Spurious Input Related Spurious Linearity IIP3 (dBm) R.L.= 20 dBm R.L.= 0 dBm R.L.= -20 dBm Signal Processing Analysis Bandwidth Q Data	<-65 dBc (Offset Center From Inc.)  -75 dBc (spurious rejection Inc.)  1 GHz 45.5 27.5 4.7  Maximum 100 MHz (IF and Inc.)  122.88 MSPS, supporting Inc.  Decimate factor: 1,2,4,8,10  The built-in memory deposition of the Inc.  Supports continuous and Inc.	an on), <-50 dBc (spurious rejoins), <-50 dBc	N/M = 1,2,3,4,5)  ection off)  10 GHz 43.6 23.2 -8.9  IF analog BW set as 2), De adjustable, 1 Hz step 048,4096 supported (FPG) en the data generation recommends and the data generation recommends.	35.3 21.0 -3.0 ecimate Factor:1		
Local Oscillator Related Spurious Input Related Spurious Linearity IIP3 (dBm) R.L.= 20 dBm R.L.= 0 dBm R.L.= -20 dBm Signal Processing Analysis Bandwidth Q Data Storage Depth External Trigger	<-65 dBc (Offset Center From Inc.)  -75 dBc (spurious rejection Inc.)  1 GHz 45.5 27.5 4.7  Maximum 100 MHz (IF and Inc.)  122.88 MSPS, supporting Inc.  Decimate factor: 1,2,4,8,10  The built-in memory deposition of the Inc.  Supports continuous and Inc.	an on), <-50 dBc (spurious rejoin on), <-50 dBc (spurious rejo	N/M = 1,2,3,4,5)  ection off)  10 GHz 43.6 23.2 -8.9  IF analog BW set as 2), De adjustable, 1 Hz step 048,4096 supported (FPG) en the data generation recommends and the data generation recommends.	35.3 21.0 -3.0 ecimate Factor:1		
Local Oscillator Related Spurious Input Related Spurious Linearity IIP3 (dBm) R.L.= 20 dBm R.L.= 0 dBm R.L.= -20 dBm Signal Processing Analysis Bandwidth Q Data Storage Depth External Trigger Response	<-65 dBc (Offset Center From Inc.)  1 GHz 45.5 27.5 4.7  Maximum 100 MHz (IF and Inc.) 122.88 MSPS, supporting 20 Decimate factor: 1,2,4,8,10 The built-in memory deposition of the store bandwidth, and the store inc.)	an on), <-50 dBc (spurious rejoin on), <-50 dBc (spurious rejo	N/M = 1,2,3,4,5)  ection off)  10 GHz 43.6 23.2 -8.9  IF analog BW set as 2), De adjustable, 1 Hz step 048,4096 supported (FPG) en the data generation recommends and the data generation recommends.	35.3 21.0 -3.0 ecimate Factor:1		
Local Oscillator Related Spurious Input Related Spurious Linearity IIP3 (dBm) R.L.= 20 dBm R.L.= 0 dBm R.L.= -20 dBm Signal Processing Analysis Bandwidth	<-65 dBc (Offset Center From Indicate Section 1) GHz 45.5 27.5 4.7 Maximum 100 MHz (IF and 122.88 MSPS, supporting 2) Decimate factor: 1,2,4,8,10. The built-in memory deposition of the bandwidth, and the store bandwidth, and the store Maximum response frequence.	an on), <-50 dBc (spurious rejoin on), <-50 dBc (spurious rejo	N/M = 1,2,3,4,5)  ection off)  10 GHz 43.6 23.2 -8.9  IF analog BW set as 2), De adjustable, 1 Hz step 048,4096 supported (FPG) en the data generation recommends and the data generation recommends.	35.3 21.0 -3.0 ecimate Factor:1		
Local Oscillator Related Spurious Input Related Spurious Linearity IIP3 (dBm) R.L.= 20 dBm R.L.= 0 dBm R.L.= -20 dBm Signal Processing Analysis Bandwidth Q Data Storage Depth External Trigger Response Analog IF Output Amplitude	<-65 dBc (Offset Center From Indicate Section 1) GHz 45.5 27.5 4.7 Maximum 100 MHz (IF and 122.88 MSPS, supporting 2) Decimate factor: 1,2,4,8,10. The built-in memory deposition of the bandwidth, and the store bandwidth, and the store Maximum response frequence.	an on), <-50 dBc (spurious rejoin on), <-50 dBc (spurious rejo	N/M = 1,2,3,4,5)  ection off)  10 GHz 43.6 23.2 -8.9  IF analog BW set as 2), De adjustable, 1 Hz step 148,4096 supported (FPG) en the data generation retained the hard disk capacity	35.3 21.0 -3.0 ccimate Factor:1 A)		
Local Oscillator Related Spurious Input Related Spurious Linearity IIP3 (dBm) R.L.= 20 dBm R.L.= 0 dBm R.L.= -20 dBm Signal Processing Analysis Bandwidth Q Data Storage Depth External Trigger Response Analog IF Output	<-65 dBc (Offset Center From Inc.)  1 GHz 45.5 27.5 4.7  Maximum 100 MHz (IF and Inc.) 122.88 MSPS, supporting Inc. Decimate factor: 1,2,4,8,10 The built-in memory deposition of the store bandwidth, and the store bandwidth, and the store Supporting 307.2 MHz +/-1	an on), <-50 dBc (spurious rejoin on), <-50 dBc (spurious rejo	N/M = 1,2,3,4,5)  ection off)  10 GHz 43.6 23.2 -8.9  IF analog BW set as 2), Decental distable, 1 Hz step (PPG)  en the data generation recent the hard disk capacity  eamplifier off (R.L. ≥ 0 dB)	35.3 21.0 -3.0 ccimate Factor:1 A)		
Local Oscillator Related Spurious Input Related Spurious Linearity IIP3 (dBm) R.L.= 20 dBm R.L.= 0 dBm R.L.= -20 dBm Signal Processing Analysis Bandwidth Q Data Storage Depth External Trigger Response Analog IF Output Amplitude Maximum safe input	<-65 dBc (Offset Center From Inc.) <-75 dBc (spurious rejection) 1 GHz 45.5 27.5 4.7 Maximum 100 MHz (IF and 122.88 MSPS, supporting 20 Decimate factor: 1,2,4,8,10 The built-in memory deposition) Supports continuous and bandwidth, and the store Maximum response frequency Supporting 307.2 MHz +/-1 23 dBm	an on), <-50 dBc (spurious rejoins on), <-50 dBc (spurious rej	N/M = 1,2,3,4,5)  ection off)  10 GHz 43.6 23.2 -8.9  IF analog BW set as 2), Decental distable, 1 Hz step (PPG)  en the data generation recent the hard disk capacity  eamplifier off (R.L. ≥ 0 dB)	35.3 21.0 -3.0 ccimate Factor:1 A)		

Amplitude Accuracy	±2.0 dB						
IF in-band spectrum ripple	±1.75 dB (40	1.75 dB (40 MHz analog IF bandwidth), ±2.0 dB (100 MHz analog IF bandwidth)					
Reference level (R.L.)	-50 dBm~23	dBm~23 dBm					
RF Preamplifiers	_	Converting bands (frequency ≥ 50MHz) are equipped with preamplifier that can be set as automatically turn on or forcibly turn off					
Displayed Average Noise Level (DANL) dBm/Hz	Frequency Range		R.L.=0 (IFGainGra		R.L.=-20dBm (IFGainGrade=2)	R.L.=-50 dBm (IFGainGrade = 3)	
	9 kHz		-123	.3	-141.2	-152.3	
	100 kHz~100 MHz		-135	.2	-152.2	-160.2	
RBW=10kHz RMS detector	100 MHz	100 MHz~3.0 GHz		.1	-147.2	-165.3	
detector	3.0 GHz^	9.0 GHz	-132	.2	-139.1	-157.1	
	9.0 GHz~	9.0 GHz~20.0 GHz		.1	-138.2	-159.5	
Standard Spectrum Ana	lysis						
Detector	Positive peak	, Negative pea	ak, Sampling, Av	erage, RMS, M	ax Power		
RBW	1 Hz~10 MHz	!					
VBW	1 Hz~10 MHz	~10 MHz					
Trace Function	Sample, Posi	ple, Positive Peak, Negative Peak, Local average, Maximum hold, Minimum hold, Average					
Data Chart	SAStudio4 s	AStudio4 software provides regular spectrum, waterfall chart, and historical trace					
Measurements	Phase noise IM3	Phase noise, Channel power, Occupied bandwidth, X dB bandwidth, Adjacent channel suppression, M3					
Sweep speed -	1.24 THz/s	FPGA			w, spurious rejection: B		
Standard Spectrum	520.0 GHz/s						
Analysis	132.0 GHz/s						
Detection Analysis/Zero		3 GHz/s   CPU   RBW=1 kHz, B-Nuttal window, spurious rejection: Bypass				pass	
Highest Time Resolution	8 ns						
Maximum Analysis Bandwidth	100 MHz						
Detector	Positive peak	ive peak, Negative peak, Sampling, Average, RMS, Max Power					
Real Time Spectrum An	· · · · · · · · · · · · · · · · · · ·	, -0	,  - 0,	0 - , - ,			
FFT Analysis	suppo There FFT re N is t	Variable point FFT engine implemented by FPGA. frame rate compression and trace detection are supported.  There is strictly no gap and overlap between FFT frames  FFT refresh rate=10 ^ 9 ns/(N * D * 8 ns); POI = 2*N*D*8ns  N is the number of FFT points (2048, 1024,512,256,128,64,32), and D is the decimate factor (1, 2, 4, 8)					
	,,	Typical Settings		FFT Re	efresh Rate	POI	
		N = 2048, D = 1		61,035 t	imes /second	32.768 us	
		N = 32, D = 1		3,906,250	times /second	0.512 us	
Real-time Analysis Bandwidth	100 N	100 MHz					
Window Function	B-Nut	B-Nuttall, FlatTop					
RBW	14.73 type	14.73 MHz-3.59 kHz (Flattop window); 7.81 MHz~1.90 kHz (B-Nuttall); 13 grades for each window type					
Amplitude Resolution	0.75	0.75 dB					
General							
Input And Output	Powe	Power Supply  Type-C (1), dedicated power supply port, please provide 5 V2 A peak power supply capacity Allowable voltage range: 4.75~5.25 V, ripple less than 200 mVpp					

	1			
	Data	Type-C (2), USB3.0 (USB2.0 Available but bandwidth limited)		
	RF input	2.92 mm (F), Input impedance 50 $\Omega$		
	External reference clock input	MMCX (F) (1), amplitude $\ge$ 1.5 Vpp, input impedance 330 Ω		
	External 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		
	External trigger output	Integrated in MUXIO, 3.3 V CMOS		
	Analog IF Output	MMCX (F) (2), maximum output power -25 dBm, output impedance 50 $\Omega$		
Power Consumption	Peak: 14 W, typical: 10 V	V~14 W, power port (5 V2 A Max), data port (5 V1 A Max)		
Operating Temperature	0~50 °C/0~70 °C (Standard temperature class)			
(ambient temperature /core	-20~65 °C/-20~85 °C (Extended Temperature Class Option) (plastic enclosure and fan not included)			
temperature)	-40~65 °C/-40~85 °C (Wide Temperature Class Option) (plastic enclosure and fan not included)			
Storage Temperature	-20~70 °C (Standard temperature class)			
(ambient temperature)	-40~85 °C (Extended temperature class and wide temperature options) (plastic enclosure and fan not included)			
Size (D * W * H) and weight	125 x60 x15 mm, 195 g (excluding protective shell and structural fittings, including joint length) 139 x69 x29 mm, 385 g (including protective shell and structural fittings, including joint length)			
Packaging and Accessories	Flash disk * 1, USB 3.0 cable * 2, Power adapter * 1			

<sup>\*</sup>The typical values of the indicators are applicable for the following conditions: (1) Start up and warm up for 10 minutes; (2) Ambient temperature 25 °C (core temperature 50 °C); (3) Spurious suppression off; (4) 100MHz analog IF and IFGainGrade=2; (5) The user shall provide the necessary heat dissipation conditions to ensure that the ambient temperature and the core temperature of the equipment are within the rated range at the same time.

Code Name	Option	Explanation
01	Built-in OCXO reference clock (hardware opt.)	Providing a reference clock with better stability than the standard configuration, with a temperature drift of<0.15 ppm, increasing the overall power consumption by 0.8 W.
10	IO extension board (accessory)	Converting the MUXIO interface into multiple MMCX and board to wire connector to facilitate the connection of trigger input, output, and other signals.
11	External GNSS (accessory)	Standard GNSS module connected to MUXIO.
12	External high precision GNSS (accessory)	High precision GNSS module connected to MUXIO.
13	External GNSS disciplined OCXO reference clock (accessory)	Providing GNSS disciplined reference clock and 1PPS, increasing the overall power consumption by 1.1W.
20	Extended temperature class (hardware opt.)	- 20~65 °C/- 20~85 °C(Extended temperature class opt.)
21	Wide temperature class (hardware opt.)	- 40~65 °C/- 40~85 °C(Wide temperature class opt.)

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**SAE-200 Product Brochure** 

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