40 GHz Compact USB Real-Time Spectrum Analyzer

SAN-400 M2

Product Brochure V0.3

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- 9 kHz~40 GHz real-time spectrum analyzer
- Superheterodyne digital receiver architecture, 11 segments pre-selected filter
- 100 MHz analysis bandwidth, 500 GHz/sec spectrum sweep speed
- FPGA based digital signal processing
- 1/10/40 GHz DANL = -161/-158/-147 dBm/Hz
- 1/10/40 GHz phase noise = -107/-100 /-85dBc/Hz@10 kHz
- Core module supported, weight 185 g, size: 125×60×17 m.
- Highly compatible API interfaces and SAStudio4 GUI
- Compatible with ARM and x86 processors, Linux and Windows operating systems
- Built-in OCXO (option)
- Operating temperatures range from - 20 °C/- 40 °C to 65 °C (opt.)
- USB3.0/2.0 Type-C interface supported

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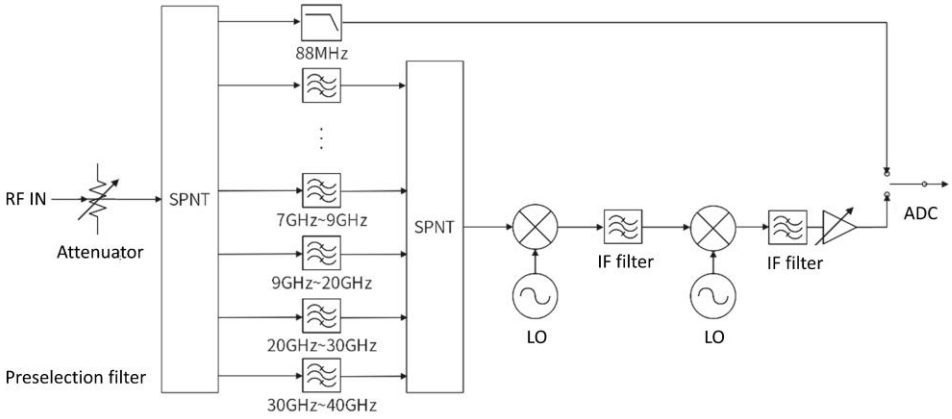
Technical Characteristics

The SAN-400 M2 uses a direct sampling channel at 88 MHz and below, and a superheterodyne mixing channel at 88 MHz to 40 GHz. Within 7.8 GHz, enough preselected filter is distributed. Above 7.8 GHz, the number of preselected filters is limited and can only provide partial anti-jamming capability with very limited image suppression. SAN-400 M2 provides additional image suppression by turning on the spurious suppression algorithm in standard spectrum sweep mode (not valid in other analysis modes). The image suppression and intermediate frequency suppression of each frequency band are given below.



SAN-400 RF section simplified block diagram

Frequency range	Spurious rejection on		Spurious rejection off	
	image suppression	IF suppression	image suppression	IF suppression
90MHz~3.35GHz	≥90dBc	≥90dBc	≥90dBc	≥90dBc
3.35GHz~4.35GHz	≥90dBc	≥90dBc	≥83dBc	≥90dBc
4.35GHz~5.35GHz	≥90dBc	≥90dBc	≥79dBc	≥90dBc
5.35GHz~6.6GHz	≥90dBc	≥90dBc	≥81dBc	≥90dBc
6.6GHz~7.55GHz	≥90dBc	≥90dBc	≥84dBc	≥90dBc
7.55GHz~8.2GHz	≥90dBc	≥90dBc	≥90dBc	≥90dBc
8.2GHz~12GHz	≥90dBc	≥90dBc	≥25dBc	≥68dBc
12GHz~18GHz	≥90dBc	≥90dBc	≥15dBc	≥76dBc
18GHz~21.75GHz	≥90dBc	≥90dBc	≥21dBc	≥76dBc
21.75GHz~25GHz	≥90dBc	≥90dBc	No suppression or suppression of only a few components	≥90dBc
25GHz~29.95GHz	≥90dBc	≥90dBc		≥90dBc
29.95GHz~33GHz	≥90dBc	≥90dBc		≥90dBc
33GHz~35GHz	≥68dBc	≥90dBc		≥90dBc
35GHz~40GHz	≥58dBc	≥90dBc		≥90dBc

*Reference Level = 0 dBm

SAN-400 M2 Technical Specifications * (typical value)

Indicator test basis **Hardware Version: R2V2** **API: 0.55.30** **FPGA: 0.55.8** **MCU: 0.55.30** **SAS4: 1.54.42**

Frequency					
Frequency Range	9 kHz~40 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					
SSB Phase Noise	dBc/Hz				
Carrier Frequency	1 GHz	3 GHz	10 GHz	20 GHz	40 GHz
1 kHz	-99.0	-96.1	-91.4	-85.6	-78.4
10 kHz	-107.5	-105.0	-99.5	-94.6	-85.7
100 kHz	-107.7	-105.6	-99.6	-94.9	-85.1
1 MHz	-122.7	-122.2	-115.7	-111.4	-100.8
10MHz	-132.1	-131.3	-130.5	-126.6	-122.8
Residual Response Spurious rejection off dBm RBW =1 kHz Positive Peak Detector	Frequency Range	R.L.=0 dBm		R.L.=-20 dBm	
		Spurious rejection off	Spurious rejection on	Spurious rejection off	Spurious rejection on
	9 kHz~10 GHz	-72	-72	-93	-93
	10 GHz~20 GHz	-91	-94	-109	-113
	20 GHz~30 GHz	-85	-90	-104	-107
	30 GHz~40 GHz	-89	-92	-107	-110
Image Frequency Suppression (Spurious rejection on)	90MHz~33GHz > 90 dBc; 33GHz~40GHz, > 58dBc; refer to technical characteristics for details				
IF rejection (Spurious rejection off)	> 90 dBc; excluding 0.35 GHz~21.75 GHz, > 68 dBc				
IF rejection (Spurious rejection on)	> 90 dBc				
Local Oscillator Related Spurious	<-65 dBc (Offset Center Frequency +/- (N/M)*125 MHz, N,M = 1,2,3,4,5…)				
Input Related Spurious (Spurious rejection on)	<-60 dBc; refer to technical characteristics for details				
Signal Processing					
Analysis Bandwidth	Maximum 100 MHz				
IQ Data	122.88 MSPS, 1 Hz step 1,2,4,8,16,32,64,128,256,512,1024,2048,4096 supported.				
Storage Depth	The built-in memory depth is 128 Mbytes				
	Supports continuous and uninterrupted storage when the data generation rate is less than the bus bandwidth, and the storage depth is only limited by the hard disk capacity				
External Trigger Response	Maximum response frequency 500 times/sec				
Analog IF Output	Supporting 307.2 MHz +/-50 MHz				
Amplitude					
Maximum safe input power (CW)	23 dBm	88 MHz~40 GHz pre-amplifier off			
	10 dBm	100 kHz~88 MHz or pre-amplifier on			
Maximum DC Voltage	+/-12 VDC				
Display Range	DANL~23 dBm				

Amplitude Accuracy	+/- 2.0 dB (9 kHz~9 GHz)； +/- 3.0 dB (> 9 GHz)			
IF in-band spectrum ripple	+/- 1.75 dB (Analog IF bandwidth 40 MHz); +/- 2.0 dB (Analog IF bandwidth 100 MHz)			
Reference level (R.L.)	-50 dBm~23 dBm			
RF Preamplifiers	No pre-amplifier as standard			
Display Average Noise Level (DANL) dBm/Hz RBW=10 kHz RMS detector	Frequency Range	R.L.= 0 dBm	R.L.=-20 dBm	R.L.=-50 dBm
	9 kHz	-121	-134	-145
	100 kHz~88 MHz	-132	-151	-157
	1GHz	-136	-155	-161
	88 MHz~9 GHz	-132	-148	-148
	9 GHz~19 GHz	-130	-151	-158
	19 GHz~30 GHz	-127	-145	-149
	30 GHz~40 GHz	-128	-146	-147
Standard Spectrum Analysis				
Detector	Positive peak, Negative peak, Sampling, Average, RMS, Max Power			
RBW	0.1 Hz~10 MHz			
VBW	0.1 Hz~10 MHz			
Trace Function	Sample, Positive Peak, Negative Peak, Local average, Maximum hold, Minimum hold, Average			
Data Chart	SAStudio4 software provides regular spectrum, waterfall chart, and historical trace			
Measurements	Phase noise, Channel power, Occupied bandwidth, X dB bandwidth, Adjacent channel suppression, IM3			
Sweep speed - Standard Spectrum Analysis	490 GHz/s	FPGA	RBW≥1 MHz, B-Nuttal window, spurious rejection: Standard	
	500 GHz/s	FPGA	RBW = 250 kHz, B-Nuttal window, spurious rejection: Standard	
	65 GHz/s	FPGA	RBW=30 kHz, B-Nuttal window, spurious rejection: Standard	
	2.4 GHz/s	CPU	RBW=1 kHz, B-Nuttal window, spurious rejection: Standard	
Detection Analysis/Zero Span				
Highest Time Resolution	8 ns			
Maximum Analysis Bandwidth	100 MHz			
Detector	Positive peak, Negative peak, Sampling, Average, RMS, Max Power			
Real Time Spectrum Analysis				
FFT Analysis	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 Refresh Rate	POI	
	N = 2048， D = 1	61,035 times /second	16.384 us	
	N = 32， D = 1	3,906,250 times /second	0.256 us	
Real-time Analysis Bandwidth	100 MHz			
Window Function	B-Nuttall, FlatTop			
RBW	14.73MHz-3.59kHz (Flattop window);7.81MHz~1.90kHz (B-Nuttall); 13 grades for each window type			
Amplitude Resolution	0.75dB			
General				

Input and Output	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
	Data	Type-C (2), USB3.0 (USB2.0 Available but bandwidth limited)
	RF input	2.92 mm (F), Input impedance 50 Ω
	External reference clock input	MMCX (F) (1), amplitude ≥ 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 Ω
Weight and Size	Size: 125x60x17 mm, Weight:185 g (core modular)	
Power Consumption	Peak: 14 W, typical: 10 W~14 W	
Operating Temperature (ambient temperature /core temperature)	0~50 ºC/0~70 ºC (Standard temperature class)	
	-20~65 ºC/-20~85 ºC (Extended Temperature Class Option) (plastic enclosure and fan not included)	
	-40~65 ºC/-40~85 ºC (Wide Temperature Class Option) (plastic enclosure and fan not included)	
Storage Temperature (ambient temperature)	-20~70 ºC (Standard temperature class)	
	-40~85 ºC (Extended temperature class and wide temperature options) (plastic enclosure and fan not included)	
Size (D * W * H) and weight	125 x60 x17 mm, 185 g (excluding protective shell and structural fittings, including joint length); 139 x69 x29 mm, 390 g (including protective shell and structural fittings, including joint length)	
Packaging and Accessories	Flash disk *1， USB 3.0 cable * 2， Power adapter * 1	

*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 ℃ (core temperature 50 ℃); (3) Spurious suppression off; (4) 100MHz analog IF and IFGainGrade=4;(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)	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	MUXIO IO extended 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)	- 20~65 ℃/- 20~85 ℃(Extended temperature class opt.)
21	Wide temperature class (hardware)	- 40~65 ℃/- 40~85 ℃(Wide temperature class opt.)