Technologies

M9391A PXIe Vector Signal Analyzer

1 MHz to 3 GHz or 6 GHz

Data Sheet

Overview

Be ready for tomorrow - today

RF requirements keep growing while timelines keep shrinking. To help ease the technical and business pressures, the right test solution provides continuity in measurements and longevity in capability. The Technologies, Inc. M9391A PXIe vector signal analyzer (PXI VSA) is the next logical step in RF signal analysis.

The M9391A PXI VSA, combined with the M9381A PXIe vector signal generator provides a complete solution for fast, high quality measurements optimized for RF manufacturing test environments.

To help you get proven results even faster, Keysight's PXI VSA can be used with X-Series measurement applications for modular instruments, 89600 VSA software and SystemVue. These software applications enable you to investigate, validate and test your RF communications designs.

From fully modular hardware to software leverage to worldwide support, the PXI VSA is the low-risk way to manage change and be ready for tomorrow—today.

Product description

The M9391A PXI VSA is a modular vector signal analyzer for frequencies from 1 MHz to 6 GHz and up to 160 MHz analysis bandwidth. The M9391A is comprised of four individual PXI modules - M9350A downconverter, M9214A digitizer, M9301A synthesizer and M9300A frequency reference. A single M9300A frequency reference can be shared between multiple instruments to minimize footprint.

The flexible, modular design of the M9391A enables you to efficiently scale to multi-channel signal analysis to test multiple-input, multiple-output (MIMO) devices. Capability can also be scaled with options for memory, frequency range and modulation bandwidth which can be easily upgraded in the field.

Applications

- Power amplifier and front-end-module design validation and manufacturing
- Radio transceiver design validation and production test
- MIMO and multi-channel device test

Reference solutions

Application specific reference solutions, a combination of recommended hardware, software, and measurement expertise, provide the essential components of a test system. The following reference solutions include the M9391A PXI VSA as a hardware component.

Figure 1. M9391A PXIe vector signal analyzer with four modules consisting of the M9214A digitizer, M9301A synthesizer, M9350A downconverter and M9300A frequency reference.

Technical Specifications and Characteristics

Definitions for specifications

Temperatures referred to in this document are defined as follows:

- Full temperature range = Individual module temperature of 25 to 75 °C, as reported by the module, and environment temperature of 0 to 55 °C.
- Controlled temperature range = Individual module temperature of 40 to 51 °C, as reported by the module, and environment temperature of 20 to 30 °C.

Specifications describe the warranted performance of calibrated instruments. Data represented in this document are specifications under the following conditions unless otherwise noted.

- Calibrated instruments have been stored for a minimum of 2 hours within the full temperature range
- 45 minute warm-up time
- Calibration cycle maintained
- When used with M9300A frequency reference and interconnect cables

Characteristics describe product performance that is useful in the application of the product, but that is not covered by the product warranty. Characteristics are often referred to as Typical or Nominal values and are italicized.

- *Typical* describes characteristic performance, which 80% of instruments will meet when operated within the controlled temperature range.
- *Nominal* describes representative performance that is useful in the application of the product when operated within the controlled temperature range.

Recommended best practices in use

- Use slot blockers and EMC filler panels in empty module slots to ensure proper operating temperatures. chassis and slot blockers optimize module temperature performance and reliability of test.
- Set chassis fan to high at environmental temperatures above 45 °C
- Maintain temperature stability for best multi-channel phase coherence
  - Set chassis fans to maximum
  - Maintain stable ambient temperature
  - Perform warm-up with session open and representative acquisition waveform running

Conversion type operating range

Conversion types	Frequency range
Auto	1 MHz to 3 or 6 GHz
Image protect	1 MHz to 3 or 6 GHz
Single high	400 MHz to 3 or 6 GHz
Single low	1.1 GHz to 3 or 6 GHz

Additional information

- Mixer level offset modifies the receiver gain prior to the first mixer of the receiver. A negative setting improves distortion (i.e., TOI) at the cost of noise performance (i.e., DANL). A positive setting improves noise performance at the cost of distortion.
- Performance described in this document applies for module temperature within ± 3 degrees of comprehensive alignment, unless otherwise noted.
- When used with a M9018A PXIe chassis, compre-hensive alignment requires chassis FPGA version 1.05 or greater.

- When configured for multi-channel, phase-coherent operation (shared synthesizer configuration), instrument level warranted specifications only apply to the M9391A which was previously calibrated with the M9301A synthesizer, showing a valid calibration indicator. For all other M9391A channels, specifications revert to typical performance. If using an external LO distribution unit, such as the V2802A LO distribution network, specifications for all M9391A channels revert to typical performance.
- All graphs contain measured data from one unit and is representative of product performance within the controlled temperature range unless otherwise noted.
- The specifications contained in this document are subject to change.

Technical Specifications and Characteristics

Block diagram

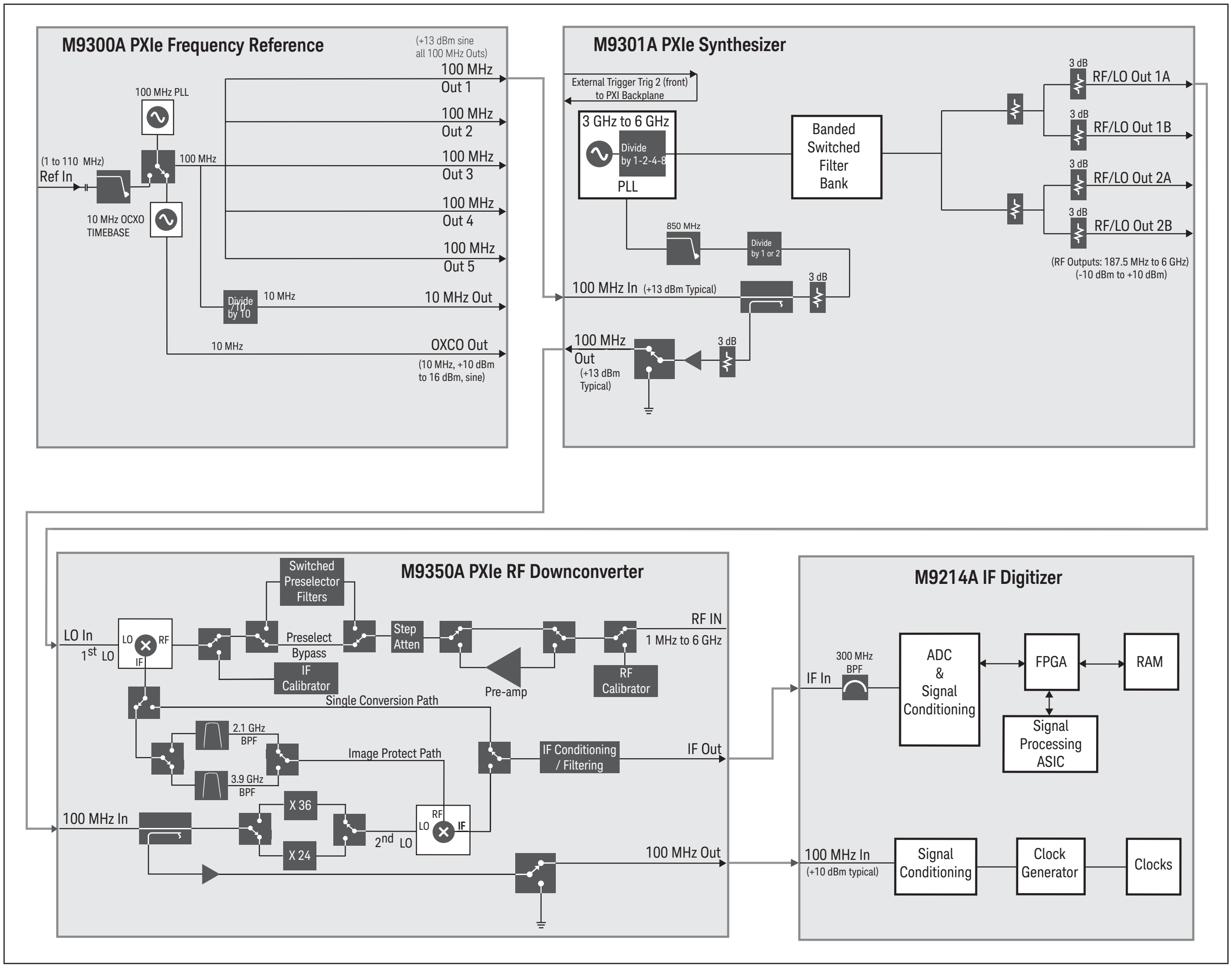


Figure 3. M9391A PXIe vector signal analyzer block diagram with four modules consisting of the M9301A synthesizer, M9350A downconverter, M9214A digitizer and optional M9300A frequency reference.

Technical Specifications and Characteristics

Frequency

Frequency range and resolution		
Option F03	1 MHz to 3 GHz	
Option F06	1 MHz to 6 GHz	
Tuning resolution	0.001 Hz	
IF frequency		**Nominal**
	15 MHz filter	326 MHz
	40 MHz filter	240 MHz
	160 MHz filter	300 MHz

Analysis bandwidth [1]		
Maximum bandwidth	Option B04	40 MHz
	Option B10	100 MHz
	Option B16	160 MHz

Frequency switching speed [2,3]

List mode switching speed [4]	**Sample rate**	**Acquisition bandwidth**	**Standard, nominal**	**Option UNZ, nominal**
Baseband frequency offset change [5]	≤ 100 MHz	≤ 80 MHz	*5 ms*	*27 µs*
	> 100 MHz to < 180 MHz	> 80 MHz to < 144 MHz	*5 ms*	*102 µs*
	≥ 180 MHz	≥ 144 MHz	*5 ms*	*15 µs*
Arbitrary frequency change			*5 ms*	*320 µs*
Non-list mode switching speed [6]			**Standard, nominal**	**Option UNZ, nominal**
Baseband frequency offset change [5]			*5 ms*	*310 µs*
Arbitrary frequency change			*5 ms*	*2.3 ms*

1. Instantaneous bandwidth (1 dB bandwidth) available around a center frequency over which the input signal can be digitized for further analysis or processing in the time, frequency or modulation domain.
2. When used with the M9018A PXIe chassis (2-link configuration: 1 x 8 [factory default]) and M9036A PXIe embedded controller.
3. Settled to within 1 kHz or 1 ppm, whichever is greater of final value. Does not include data acquisition or processing time. Amplitude settled to within 0.1 dB. Channel filter set to none. Applies for all conversion types.
4. Time from trigger input to frequency and amplitude settled. Minimum IQ sample rate ≥ 6 MHz. Minimum spectrum acquisition ≥ 4.8 MHz. Minimum power acquisition channel filter bandwidth ≥ 4.8 MHz. For lists with first point < 400 MHz or for frequency changes from > 400 MHz to < 400 MHz, add 40 ms.
5. Baseband offset can be adjusted ± from carrier frequency within limits determined by RF analysis bandwidth and IF filter bandwidth. Synthesizer frequency and amplitude are not changing. Baseband offset settled to within 1 kHz.
6. Mean time from IVI command to carrier frequency settled to within 1 kHz or 1 ppm, whichever is greater. Amplitude settled within 0.1 dB. Simultaneous carrier frequency and amplitude switching. For frequency changes from > 400 MHz to < 400 MHz, add 40 ms.

Technical Specifications and Characteristics

Frequency (continued)

Frequency reference (M9300A PXIe frequency reference module)		
Reference outputs		
100 MHz Out (Out 1 through Out 5)		
Amplitude	≥ 10 dBm	13 dBm, *typical*
Connectors	5 SMB snap-on	
Impedance	50 Ω, *nominal*	
10 MHz Out		
Amplitude	9.5 dBm, *nominal*	
Connectors	1 SMB snap-on	
Impedance	50 Ω, *nominal*	
OCXO Out		
Amplitude	11.5 dBm, nominal	
Connectors	1 SMB snap-on	
Impedance	50 Ω, nominal	
Frequency accuracy		
Same as accuracy of internal time base or external reference input		
Internal timebase		
Accuracy	± [(time since last adjustment x aging rate) ± temperature effects ± calibration accuracy]	
Frequency stability		
Aging rate		
Daily	*< ±0.5 ppb/day, after 72 hours of warm-up*	
Yearly	*< ±0.1 ppm/year, after 72 hours of warm-up*	
Total 10 years	*< ±0.6 ppm/10yrs, after 72 hours of warm-up*	
Achievable initial calibration accuracy (at time of shipment)	$\pm 5 \times 10^{-8}$	
Temperature effects		
20 to 30 °C	*< ±10 ppb*	
Full temperature range	*< ±50 ppb*	
Warm up		
5 minutes over +20 to +30 °C, with respect to 1 hour	< ±0.1 ppm	
15 minutes over +20 to +30 °C, with respect to 1 hour	< ±0.01 ppm	
External reference input		
Frequency	1 to 110 MHz, sine wave	
Lock range	±1 ppm, nominal	
Amplitude	0 to 10 dBm, nominal	
Connector	1 SMB snap-on	
Impedance	50 Ω, nominal	

Technical Specifications and Characteristics

Amplitude

Input level

Max safe average total power	+30 dBm (1 W)	
Max DC voltage	25 Vdc	
Max RF input (specified performance)	1 to 2 MHz	0 dBm
	2 to 4 MHz	+4 dBm
	4 to 100 MHz	+12 dBm
	100 MHz to 6 GHz	+30 dBm

Expected input level setting

Range	
Pre-amp ON	–170 to 0 dBm
Pre-amp OFF	–170 to +30 dBm
Pre-amp AUTO [7]	–170 to +30 dBm
Resolution	0.1 dB

Absolute amplitude accuracy & total absolute amplitude accuracy

		Full temperature range		Controlled temperature range		@ 46 °C module temp[10], typical
Conversion type	**Frequency**	**Total absolute amplitude accuracy [8]**	**Absolute amplitude accuracy [9]**	**Total absolute amplitude accuracy [8]**	**Absolute amplitude accuracy [9]**	**Total absolute amplitude accuracy [8]**
40 MHz IF filter		**Module temperature within ± 3 °C of alignment, pre-amp ON & OFF**				
Image protect	≤ 3 GHz	±1.78 dB	±1.72 dB	±1.27 dB	±1.21 dB	*±0.46 dB*
	> 3 GHz	±1.54 dB	±1.48 dB	±1.19 dB	±1.13 dB	*±0.46 dB*
Single	All	±1.47 dB	±1.41 dB	±1.22 dB	±1.17 dB	*±0.45 dB*
160 MHz IF filter		**Module temperature within ±3 °C of alignment, Pre-amp OFF[11]**				
Image protect	≤ 3 GHz	±1.46 dB	±1.34 dB	±0.96 dB	±0.85 dB	*±0.33 dB*
	> 3 GHz	±1.54 dB	±1.48 dB	±1.16 dB	±1.09 dB	*±0.45 dB*
Single	All	±1.18 dB	±1.08 dB	±0.94 dB	±0.86 dB	*±0.36 dB*
160 MHz IF filter		**Module temperature within ±3 °C of alignment, Pre-amp ON[12]**				
Image protect	≤ 3 GHz	±1.68 dB	±1.60 dB	±1.18 dB	±1.10 dB	*±0.39 dB*
	> 3 GHz	±1.55 dB	±1.49 dB	±1.21 dB	±1.15 dB	*±0.45 dB*
Single	≤ 3 GHz	±1.09 dB	±0.96 dB	±0.85 dB	±0.72 dB	*±0.29 dB*
	> 3 GHz	±1.36 dB	±1.28 dB	±1.04 dB	±0.96 dB	*±0.39 dB*

7. At expected input level ≤ –37 dBm, pre-amp is switched on.
8. Total absolute amplitude accuracy is the total of all amplitude measurement errors. This specification includes the sum of the following individual specifications: linearity, expected input level switching uncertainty, IF bandwidth filter switching uncertainty, absolute amplitude accuracy. The wide range of settings used (i.e., expected input level, etc.) are tested independently. The individual error contributions are calculated as follows: a 99.8 % proportion and 95% confidence are computed for each parameter on a statistically significant number of instruments. The root-sum-square (RSS) of these four independent Gaussian parameters is then taken. To that RSS value, two environmental effects and measurement uncertainty are added. One environmental effect is that of temperature (full and controlled temperature range, as defined above) and the other is the temperature variation of ±3 degrees around a field alignment. Applies over the following subset of settings and conditions: expected input level –50 dBm to +30 dBm; input signals within 60 dB below expected input level; 40 MHz and 160 MHz IF filters; input signal at center frequency over full frequency range.
9. The absolute amplitude accuracy is the amplitude measurement error when only changing frequency. The expected input level, conversion type and IF bandwidth settings remain the same and the error introduced by those parameters are not included. Pre-amp auto/OFF expected input level +10 dBm and –12 dBm. Pre-amp ON expected input level –30 dBm.
10. Typical specifications shown at M9350A downconverter reported module temperature of 46 °C and a corresponding environment temperature of 25 °C.
11. When using pre-amp auto mode, applies for signal level within expected input level >–37 dBm.
12. When using pre-amp auto mode, applies for signal level within expected input level ≤–37 dBm.

Technical Specifications and Characteristics

Amplitude (continued)

Amplitude repeatability and linearity

	Input signal relative to expected input level setting	Specification
Repeatability		*<0.05 dB, nominal*
Linearity [13]	>–35 dB	±0.12 dB *±0.03 dB, nominal*
	≤–35 dB	±0.21 dB *±0.04 dB, nominal*

IF flatness [14, 15]

Analysis bandwidth	IF filter	Nominal
40 MHz	40 MHz	*± 0.08 dB*
100 MHz	160 MHz	*± 0.09 dB*
160 MHz	160 MHz	*± 0.10 dB*

IF phase linearity [15]

Analysis bandwidth	Conversion type	Peak to peak, nominal
40 MHz	All	*1.0 º*
100 MHz	Single	*0.8 º*
	Image protect	*1.7 º*
160 MHz	Single	*1.4 º*
	Image protect	*1.8 º*

13. Input level 20 dB above the noise floor and dither on, no change in hardware settings, below expected input level.
14. Amplitude deviation from the mean error of the entire bandwidth, all conversion types.
15. Expected input level 0 dBm. Center frequency ≥ 250 MHz.

Technical Specifications and Characteristics

Amplitude (continued)

IF bandwidth filter switching uncertainty [16]	Specification	Typical	Nominal
	±0.4 dB	*±0.15 dB*	*±0.09 dB*

Expected input level switching uncertainty	Specification	Typical	Nominal
Pre-amp Auto/OFF			
Max input to +5 dBm	±0.45 dB	*±0.14 dB*	*±0.10 dB*
Crossing +5 dBm	±0.63 dB	*±0.24 dB*	*±0.17 dB*
Pre-amp OFF			
+5 to –50 dBm	±0.41 dB	*±0.16 dB*	*±0.11 dB*
Pre-amp ON			
+0 to –50 dBm	±0.64 dB	*±0.27 dB*	*±0.21 dB*
Pre-amp AUTO			
Crossing –37 dBm	±0.95 dB	*±0.19 dB*	*±0.12 dB*

Amplitude switching speed

Arbitrary amplitude change	Standard, nominal	Option UNZ, nominal
List mode switching speed [17]	*≤ 5 ms*	*≤ 136 µs*
Non-list mode switching speed [18]	*≤ 5 ms*	*≤ 1.5 ms*

Input voltage standing wave ratio (VSWR)	Nominal
< 10 MHz	*1.7:1*
10 MHz to 2.5 GHz	*1.4:1*
> 2.5 GHz	*1.7:1*

16. Amplitude error relative to the reference IF bandwidth filter of 40 MHz.
17. Settled to within 0.1 dB of final value. Does not include data acquisition or processing time.
When used with the M9018A PXIe chassis (2-link configuration: 1 x 8 [factory default]) and the M9036A PXIe embedded controller.
18. Mean time from IVI command to amplitude settled.

Technical Specifications and Characteristics

Dynamic range

Displayed average noise level (DANL) [19]

Conversion type	Frequency	Specification	Nominal
Pre–amp OFF			
Image protect	< 100 MHz		*–145 dBm/Hz*
	100 to < 700 MHz	–137 dBm/Hz	*–147 dBm/Hz*
	700 MHz to < 5.75 GHz	–140 dBm/Hz	*–148 dBm/Hz*
	5.75 to 6 GHz	–129 dBm/Hz	*–146 dBm/Hz*
Single	<1.2 GHz	–148 dBm/Hz	*–154 dBm/Hz*
	1.2 to 3.1 GHz	–143 dBm/Hz	*–152 dBm/Hz*
	> 3.1 to < 5.4 GHz	–138 dBm/Hz	*–149 dBm/Hz*
	5.4 to 6 GHz	–133 dBm/Hz	*–148 dBm/Hz*
Pre–amp ON			
Image protect	< 100 MHz		*–162 dBm/Hz*
	100 MHz to < 2.7 GHz	–156 dBm/Hz	*–161 dBm/Hz*
	2.7 to 4.4 GHz	–155 dBm/Hz	*–160 dBm/Hz*
	> 4.4 to < 5.6 GHz	–152 dBm/Hz	*–157 dBm/Hz*
	5.6 to 6 GHz	–141 dBm/Hz	*–154 dBm/Hz*
Single	<1.1 GHz	–157 dBm/Hz	*–161 dBm/Hz*
	1.1 to < 3.6 GHz	–154 dBm/Hz	*–158 dBm/Hz*
	3.6 to 5 GHz	–151 dBm/Hz	*–156 dBm/Hz*
	> 5 to 6 GHz	–146 dBm/Hz	*–153 dBm/Hz*

Third order intermodulation distortion (TOI) [20]		**TOI**[23]		**Distortion**[24]
Conversion type: auto	**Frequency**	**Specification**	**Typical**	**Specification**
Pre–amp OFF [21]	≤ 400 MHz	+15 dBm	+20.5 dBm	–52 dBc
	> 400 MHz to 3 GHz	+18 dBm	+23 dBm	–52 dBc
	> 3 GHz	+20 dBm	+23.5 dBm	–52 dBc
Pre–amp ON [22]	≤ 100 MHz	–9.9 dBm	–2.5 dBm	–56 dBc
	> 100 to 850 MHz	–7.9 dBm	+2 dBm	–58 dBc
	> 850 MHz to 2 GHz	–4.3 dBm	+5 dBm	–47 dBc
	> 2 to 3 GHz	–0.9 dBm	+7 dBm	–41 dBc
	> 3 to 6 GHz	+1 dBm	+5 dBm	–32 dBc

19. Expected input level of –50 dBm. Mixer level offset +10 dB.
20. Two tone, 100 kHz tone spacing.
21. Expected input level –5 dBm. Mixer level offset +10 dB.
22. Expected input level –25 dBm. Mixer level offset +15 dB.
23. TOI = third order intercept. The TOI is given by the input tone level (in dBm) minus (distortion/2) where distortion is the relative level of the distortion tones in dBc.
24. Expected input level -10 dBm with preamp off and -30 dBm with preamp on.

Technical Specifications and Characteristics

Dynamic range (continued)

Second harmonic distortion (SHI)

Conversion type: image protect	Frequency	SHI, nominal[26]	Distortion, nominal[27]
Pre-amp OFF [25]	≤ 1.35 GHz	*+35 dBm*	*– 45 dBc*
	> 1.35 GHz	*+95 dBm*	*–105 dBc*

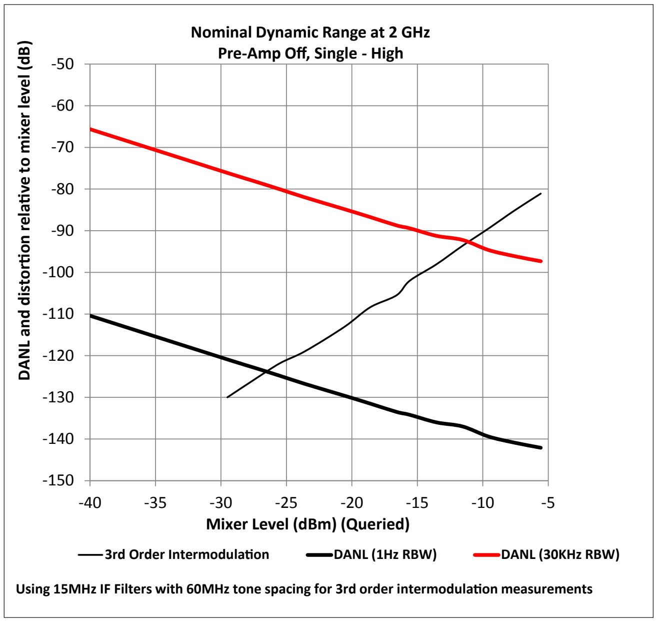


Figure 4. Dynamic range at 2 GHz, pre-amp OFF, single-high conversion type.

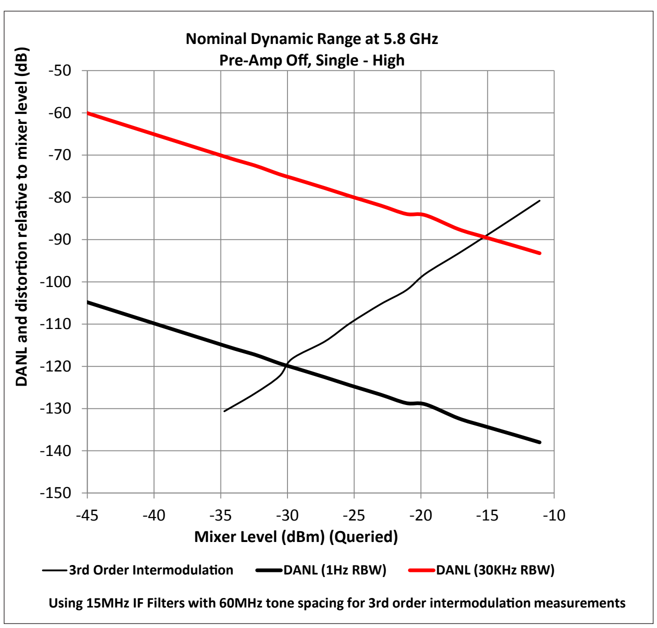


Figure 5. Dynamic range at 5.8 GHz, pre-amp OFF, single-high conversion type.

25. Expected input level -10 dBm. Mixer level offset +10 dB.
26. SHI = second harmonic intercept. The SHI is given by the input power in dBm minus the second harmonic distortion level relative to the input signal in dBc.
27. For 0 dBm input signal.

Technical Specifications and Characteristics

Dynamic range (continued)

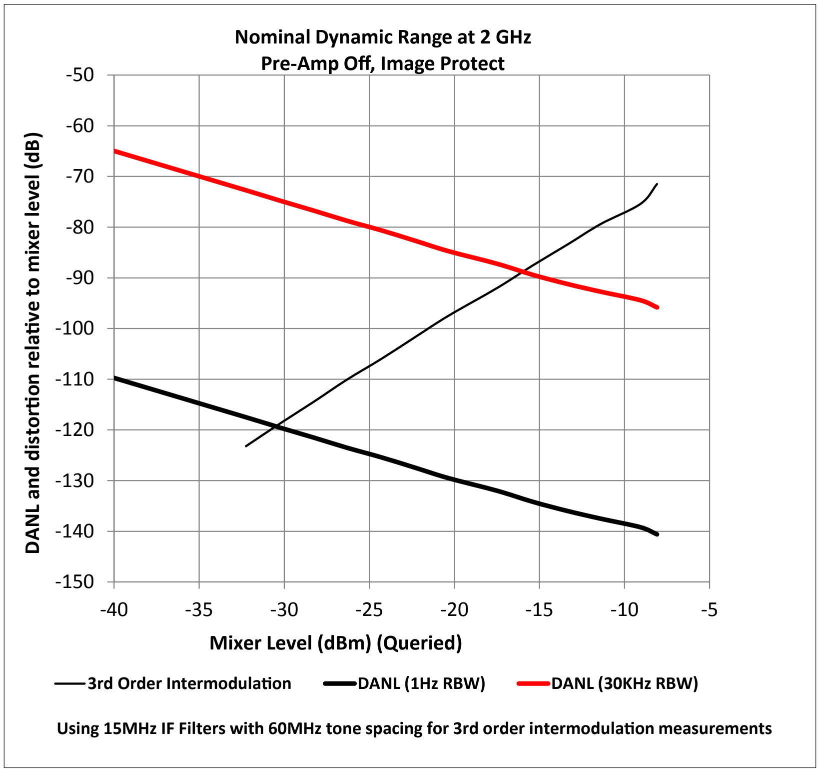


Figure 6. Dynamic range at 2 GHz, pre-amp OFF, image protect conversion type.

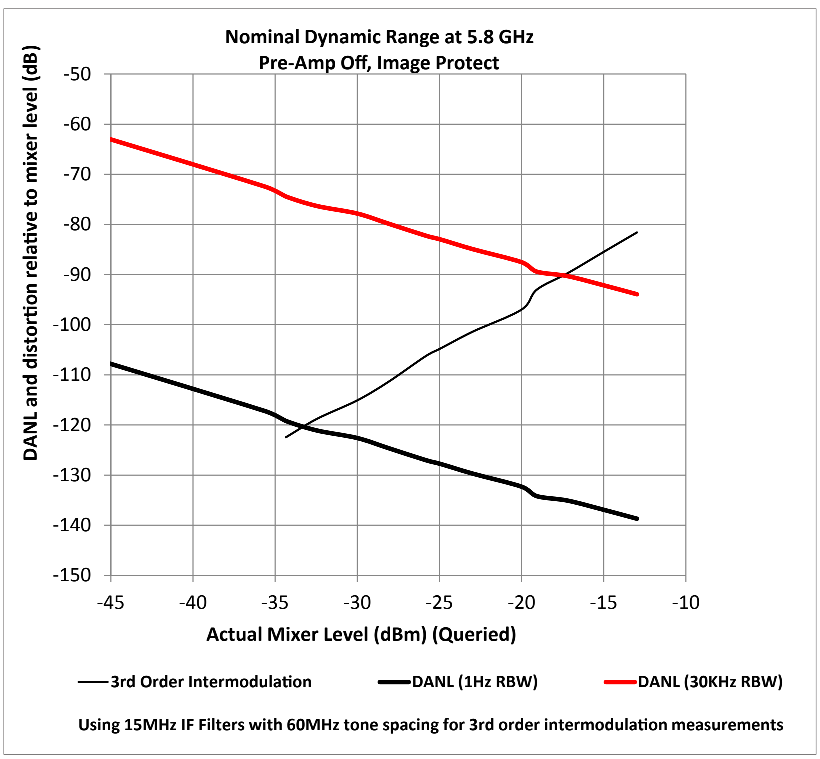


Figure 7. Dynamic range at 5.8 GHz, pre-amp OFF, image protect conversion type.

Technical Specifications and Characteristics

Spectral purity

Phase noise [28]

Conversion type	Center frequency	Offset	Nominal
Single low	1.1 GHz	10 kHz	*–120 dBc/Hz*
Single high	1 GHz	10 kHz	*–119 dBc/Hz*

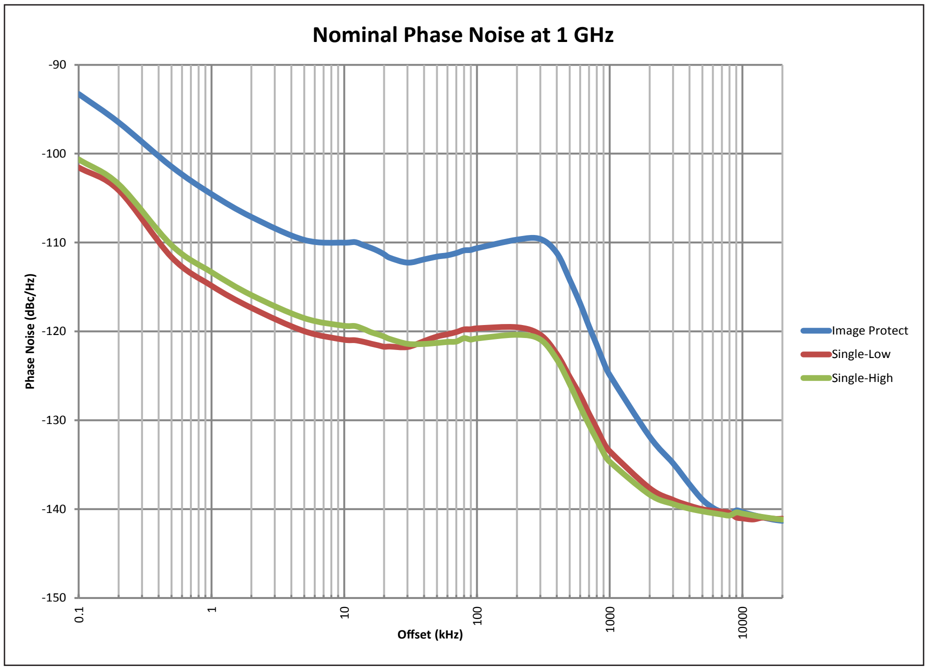


Figure 8. Phase noise at 1 GHz
(1.1 GHz for single-low conversion type).

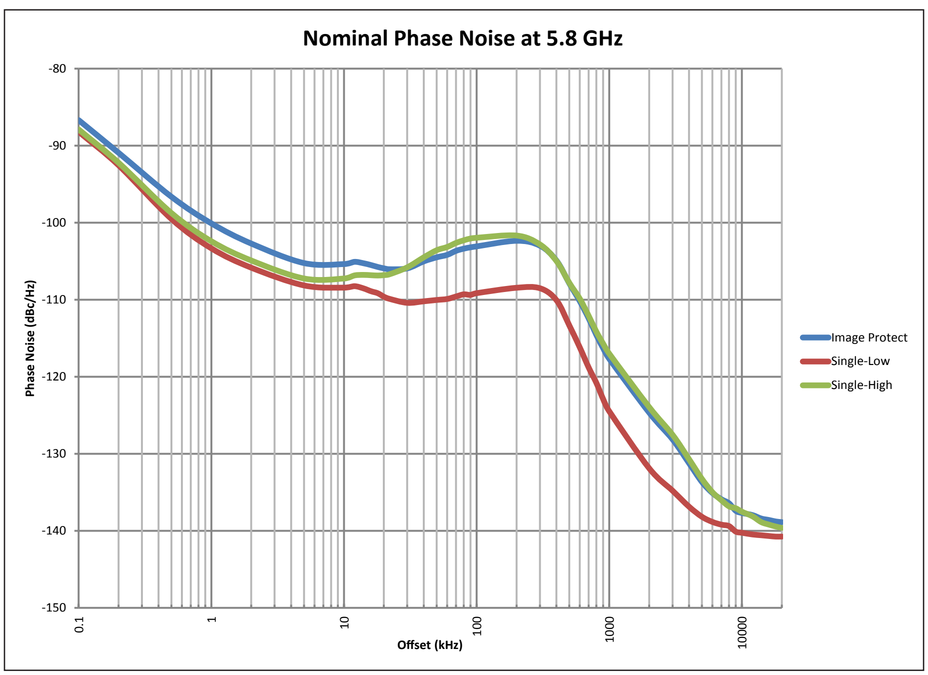


Figure 9. Phase noise at 5.8 GHz.

28. Mixer level offset +20 dB.

Technical Specifications and Characteristics

Spectral purity (continued)

Residuals, images & spurious responses

Non-input related spurs [29]	Conversion type	Frequency	Nominal
Expected input level			
Pre-amp ON			
≤ 0 dBm (measured at –50 dBm)	Single	All	< –120 dBm
	Image protect	All [30]	< –120 dBm
Pre-amp OFF			
< +5 dBm (measured at –50 dBm)	Single	≤ 3 GHz	< –120 dBm
		> 3 GHz	< –116 dBm
	Image protect	All [31]	< –105 dBm
≥ +5 dBm (measured at +6 dBm)	Single	All	< –98 dBm
	Image protect	All [32]	< –90 dBm
LO related spurs [33]	**Offsets from carrier**	**Frequency**	**Nominal**
	200 to 10 kHz	All	*– 82 dBc*
	10 kHz to 10 MHz	All	*– 55 dBc*
First order RF spurious responses [34]	**Offsets from carrier**	**Frequency**	**Nominal**
	≥ 10 MHz	≥ 200 MHz to 6 GHz	*–60 dBc*
Higher order RF spurious responses [34]	**Offsets from carrier**	**Frequency**	**Nominal**
	≥ 10 MHz	≥ 200 MHz to 6 GHz	*–60 dBc*
Image responses [35]	**Conversion type**	**Frequency**	**Nominal**
	Image protect	All	*< –68 dBc*
IF rejection [36]	**IF bandwidth filter**	**Frequency**	**Nominal**
	15 MHz	≤ 400 MHz	*< –57 dBc*
		> 400 MHz	*< –105 dBc*
	40 MHz	≤ 450 MHz	*< –57 dBc*
		> 450 MHz	*< –98 dBc*
	160 MHz	All	*< –85 dBc*
LO emission [37]	**Conversion type**	**Frequency**	**Nominal**
	Single	≤ 3 GHz	*–72 dBm*
		> 3 GHz	*–62 dBm*
	Image protect	All	*–88 dBm*

29. Mixer level offset at 10 dB, input terminated, with 50Ω load.
30. From 4.72 to 4.88 GHz, specification at <-108 dBm, nominal.
31. From 4.72 to 4.88 GHz, specification at <-96 dBm, nominal.
32. From 4.72 to 4.88 GHz, specification at <-80 dBm, nominal.
33. Expected input level 0 dBm. Mixer offset level -10 dB.
34. Conversion type: image protect, pre-amp OFF, expected input level -20 dBm and mixer level offset 0 dB.
35. Excitation frequency: [F=2*Final IF] MHz, expected input level -20 dBm, mixer level offset -30 dB.
36. Suppression of signal at IF frequencies when tuned at least 2 x IF BW away.
    All input paths, image protect, expected input level -30 dBm. Input signal at -30 dBm and mixer level offset 0 dB.
37. Expected input level -50 dBm. Mixer level offset +10 dB.

Technical Specifications and Characteristics

Data acquisition

Maximum capture memory	Non-list mode	List mode
Option M01	128 MSample (512 MB)	128 MSample (512 MB)
Option M05	512 MSample (2 GB)	512 MSample (2 GB)
Option M10	1 GSample (4 GB) [38]	512 MSample (2 GB) to ~ 1 GSample (3.999 GB) [39]
Segments		
Minimum length	1 sample [40]	
Maximum length	Full capture memory [38]	
Maximum sample rate		
Option B04 / 40 MHz	50 MS/s complex, 100 MS/s real	
Option B10 / 100 MHz	125 MS/s complex, 250 MS/s real	
Option B16 / 160 MHz	200 MS/s complex, 400 MS/s real	
List mode		
Maximum number of segments	3201	
Trigger sources	External, magnitude	
Trigger modes	Per acquisition, interval timer trigger	
Triggering		
Delay range [41]	–500 ms to +500 ms, *nominal*	
Delay resolution	1 sample, *nominal*	
External trigger signal frequency range	10 to 30 MHz for pulse	
External trigger signal level	TTL	
External trigger signal duty cycle range	20% to 80%	
External trigger signal waveform	Sine, pulse/square, ramp (symmetry 0% to 100%)	

Channel-to-channel synchronization [42]

	Timing	Phase
Skew	*≤400 ps, nominal*	–
Jitter [43]	*≤50 ps, nominal*	*≤0.3°, nominal*
Repeatability [44]	*≤80 ps, nominal*	*≤1.0°, nominal*
Adjustment resolution [45]	50 ps	0.05°
Drift over 12 hours	*20 ps, nominal*	*0.5°, nominal*

38. The default mode for allocation of capture memory is AgM9391MemoryModeNormal, where the digitizer's memory is shared by both the default single acquisition (capture ID = 0) and all the other acquisitions with non-zero capture IDs. In particular, the memory for the default single acquisition is allocated from the area unused by the list acquisitions. If the available memory is not sufficient for the single acquisition, the user must release memory allocated for the non-zero capture ID acquisitions manually, thus increasing free space. Total memory usage is limited according to the memory option. Note that the maximum size of acquisition is 2 GB in this mode. To perform the default single acquisition with memory size larger than 2 GB, AgM9391MemoryModeLargeAcquisition must be selected. The non-zero capture ID acquisitions cannot be per formed in this mode. All data acquired with AGM9391MemoryMode Normal will be invalidated.
39. The maximum size for a single list point capture is limited to 512 MSamples (2 GB). However, with option M10, total capture of up to 3.999 GB is available across all list mode captures.
40. 64-bit mode, 2 samples for 32-bit mode.
41. Negative trigger delay limited to capture size.
42. Multi-channel capability only supported with up to 8-channels when configured with a M9018A PXIe chassis with FPGA version 1.05 or greater. Characteristics measured at 400, 900, 2400, 5800 MHz and apply in Auto Conversion mode at frequencies ≥400 MHz with IF filter = 160 MHz. V2802A LO distribution network used for phase synchronization for more than 4 channels.
43. Jitter indicates measurement-to-measurement variation and applies over short time interval at room temperature without resetting or reinitializing a driver session.
44. Repeatability indicates stability of alignment between channels across power cycles and IVI sessions, with identical cabling and hardware settings (frequency, span, sample rate, etc.)
45. Channel time and phase offsets can be adjusted using OffsetDelay and OffsetPhase properties respectively.

Technical Specifications and Characteristics

Measurement speed[46]

IQ data capture [47]	Nominal	
Large block (50 MSamples)	*1.5 s*	Transferred in 100 kSa or 1 MSa blocks
Small block (100 captures, 100 ksamples each)	*292 ms*	Transferred in 10 kSa blocks
Adjust level, freq (10 ksamples)	*1.7 ms*	Transferred in 10 kSa blocks

Power measurements [48]

Channel power settings & filter bandwidth	Acquisition Time	Averages	Nominal
3.84 MHz	400 µs	None	*1.8 ms*
		10	*7.6 ms*
	100 µs	None	*1.3 ms*
		10	*4.1 ms*
	50 µs	None	*1.3 ms*
		10	*3.4 ms*
30 kHz	100 µs	None	*3.9 ms*
		10	*30.4 ms*

46. EVM, ACPR and servo loop test times for the RF power amplifier test, reference solution are included in the solution brochure 5991-4104EN.
47. Capture block, transfer to host memory, 160 MHz BW, excludes frequency transitions below 400 MHz, with M9037A embedded controller (2-link configuration: 1 x 8 [factory default]).
48. Transfer to host memory, 160 MHz IF bandwidth filter, excludes frequency transitions below 400 MHz, with M9037A embedded controller (2-link configuration: 1 x 8 [factory default]).

Noise Figure Measurement Application

Description	Specifications		Supplemental Information
Noise figure			Uncertainty calculator[49]
< 10 MHz			See footnote[50]
10 MHz to 6 GHz			Internal and external preamplification recommended[51]
	Noise source ENR	Measurement range	Instrument uncertainty[52]
	4 to 6.5 dB	0 to 20 dB	± 0.054 dB
	12 to 17 dB	0 to 30 dB	± 0.102 dB
	20 to 22 dB	0 to 35 dB	± 0.119 dB

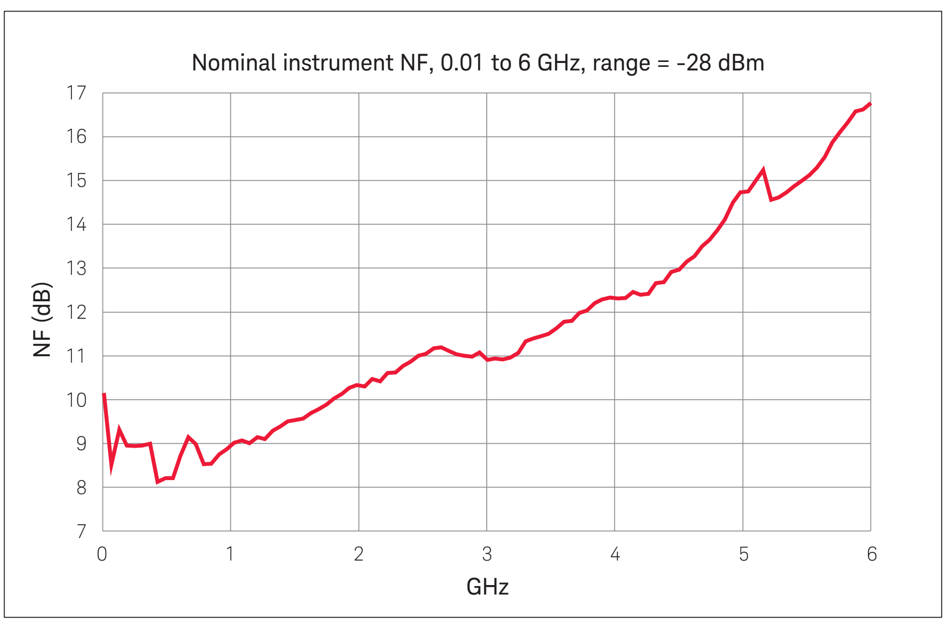
49. The figures given in the table are for the uncertainty added by the X-Series Signal Analyzer instrument only. To compute the total uncertainty for your noise figure measurement, you need to take into account other factors including: DUT NF, Gain and Match, Instrument NF, Gain Uncertainty and Match; Noise source ENR uncertainty and Match. The computations can be performed with the uncertainty calculator included with the Noise Figure Measurement Personality. Go to Mode Setup then select Uncertainty Calculator.
50. Uncertainty performance of the instrument is nominally the same in this frequency range as in the higher frequency range. However, performance is not warranted in this range. There is a paucity of available noise sources in this range, and the analyzer has poorer noise figure, leading to higher uncertainties as computed by the uncertainty calculator.
51. The NF uncertainty calculator can be used to compute the uncertainty. For most DUTs of normal gain, the uncertainty will be quite high without preamplification.
52. "Instrument Uncertainty" is defined for noise figure analysis as uncertainty due to relative amplitude uncertainties encountered in the analyzer when making the measurements required for a noise figure computation. The relative amplitude uncertainty depends on, but is not identical to, the relative display scale fidelity, also known as incremental log fidelity. The uncertainty of the analyzer is multiplied within the computation by an amount that depends on the Y factor to give the total uncertainty of the noise figure or gain measurement. See App Note 57-2, literature number 5952-3706E for details on the use of this specification. Jitter (amplitude variations) will also affect the accuracy of results. The standard deviation of the measured result decreases by a factor of the square root of the Resolution Bandwidth used and by the square root of the number of averages. This application uses the 4 MHz Resolution Bandwidth as default because this is the widest bandwidth with uncompromised accuracy.

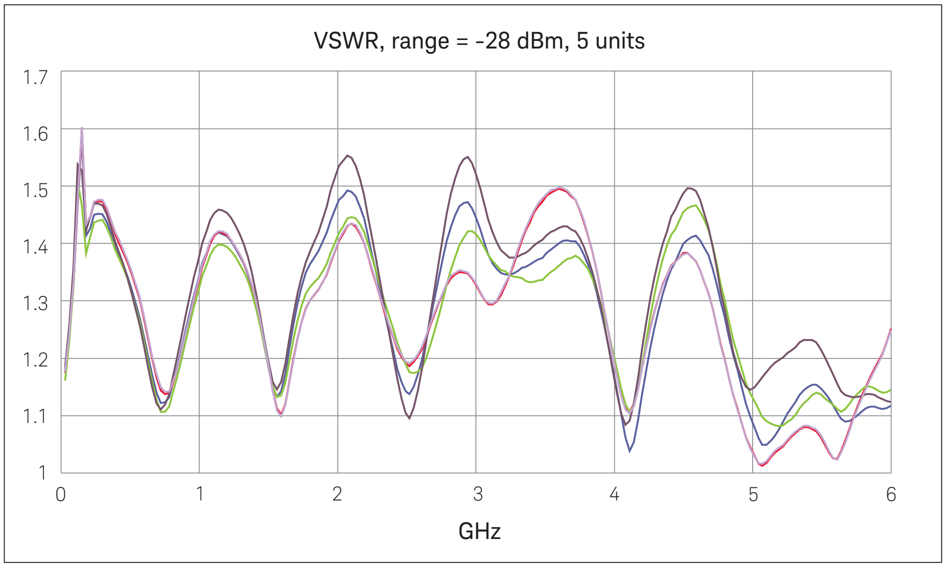
Description	Specifications	Supplemental Information
Gain		
Instrument uncertainty[53]		DUT gain range = -20 to +40 dB. See note[54]
< 10 MHz		
10 MHz to 6 GHz	± 0.21 dB	

53. "Instrument Uncertainty" is defined for gain measurements as uncertainty due to relative amplitude uncertainties encountered in the analyzer when making the measurements required for the gain computation. See App Note 57-2, literature number 5952-3706E for details on the use of this specification. Jitter (amplitude variations) will also affect the accuracy of results. The standard deviation of the measured result decreases by a factor of the square root of the Resolution Bandwidth used and by the square root of the number of averages. This application uses the 4 MHz Resolution Bandwidth as default since this is the widest bandwidth with uncompromised accuracy. Under difficult conditions (low Y factors), the instrument uncertainty for gain in high band can dominate the NF uncertainty as well as causing errors in the measurement of gain. These effects can be predicted with the uncertainty calculator.
54. Uncertainty performance of the instrument is nominally the same in this frequency range as in the higher frequency range. However, performance is not warranted in this range. There is a paucity of available noise sources in this range, and the analyzer has poorer noise figure, leading to higher uncertainties as computed by the uncertainty calculator.

Description	Specifications	Supplemental Information
Noise figure uncertainty calculator[55]		
Instrument noise figure uncertainty	See the noise figure table earlier in this chapter	
Instrument gain uncertainty	See the gain table earlier in this chapter	
Instrument noise figure		See graphs of "nominal instrument noise figure"; noise figure is DANL + 176.24 dB (nominal)[56]
Instrument input match		See graphs: nominal VSWR

55. The Noise Figure Uncertainty Calculator requires the parameters shown in order to calculate the total uncertainty of a Noise Figure measurement.
56. Nominally, the noise figure of the spectrum analyzer is given by NF = D – (K – L + N + B) where D is the DANL (displayed average noise level) specification, K is kTB (-173.98 dBm in a 1 Hz bandwidth at 290 K) L is 2.51 dB (the effect of log averaging used in DANL verifications) N is 0.24 dB (the ratio of the noise bandwidth of the RBW filter with which DANL is specified to an ideal noise bandwidth) B is ten times the base-10 logarithm of the RBW (in hertz) in which the DANL is specified. B is 0 dB for the 1 Hz RBW. The actual NF will vary from the nominal due to frequency response errors.





Format specific measurement data

GSM [57, 58]

	Parameters	Nominal
Global phase error	0.9, 1.8, 1.9, 2.0, 2.1, 2.2 GHz	*0.17 º*
ORFS dynamic range	200 kHz offset	*–36 dBc*
	250 kHz offset	*–41 dBc*
	400 kHz offset	*–69 dBc*
	600 kHz offset	*–73 dBc*
	800 kHz offset	*–77 dBc*
	1200 kHz offset	*–80 dBc*
	1800 kHz offset	*–78 dBc*

EDGE [57, 58]

	Parameters	Nominal
Residual EVM	0.9, 1.8, 1.9, 2.0, 2.1, 2.2 GHz	*0.23% rms*
ORFS dynamic range	200 kHz offset	*–37 dBc*
	250 kHz offset	*–42 dBc*
	400 kHz offset	*–69 dBc*
	600 kHz offset	*–73 dBc*
	800 kHz offset	*–77 dBc*
	1200 kHz offset	*–80 dBc*
	1800 kHz offset	*–77 dBc*

57. Synthesizer PLL mode set to PLL mode best wide offset.
58. Expected input level 0 dBm, input signal (total power) 0 dBm, mixer level offset +10 dB, conversion type: Auto, PeakToAverage set per signal peak to average.

Technical Specifications and Characteristics

Format specific measurement (continued)

W–CDMA [59, 60]	**Parameters**		**Typical**	**Nominal**
Residual EVM	2 GHz, 1 DPCH, 1 carrier			*0.5%*
ACLR dynamic range	2 GHz, 1 DPCH, 1 carrier (power mode)	Adjacent	*–68.1 dBc*	*–69.8 dBc*
		Alternate	*–70.7 dBc*	*–71.7 dBc*

802.11g [59, 60, 64]	**Parameters**	**Nominal**
EVM	2.4 GHz, 20 MHz BW	*–52.8 dB*

802.11a [59, 60, 64]	**Parameters**	**Nominal**
EVM	5.8 GHz, 20 MHz BW	*–48.1 dB*

802.11n [59, 60, 64]	**Parameters**			**Nominal**	
		1-channel	**2-channel** [62]	**3-channel** [62]	**4-channel** [62]
EVM	2.4 GHz, 40 MHz BW	*–52.0 dB*	*–51.6 dB*	*–50.6 dB*	*–50.9 dB*
	5.8 GHz, 40 MHz BW	*–48.6 dB*	*–46.6 dB*	*–45.3 dB*	*–46.0 dB*

802.11ac [59, 60]	**Parameters**			**Nominal**		
		1-channel	**2-channel** [62]	**3-channel** [62]	**4-channel** [62]	**8-channel** [62]
				Preamble only		
EVM [63]	5.8 GHz, 80 MHz BW	*–46.5 dB*	*–44.3 dB*	*–43.0 dB*	*–43.6 dB*	*-41.2 dB*
	5.8 GHz, 160 MHz BW	*–44.7 dB*	*–43.4 dB*	*–41.7 dB*	*–43.3 dB*	*-40.1 dB*
				Preamble, pilots & data		
EVM [63]	5.8 GHz, 80 MHz BW	*–49.4 dB*	*–48.6 dB*	*–47.3 dB*	*–46.4 dB*	*-42.3 dB*
	5.8 GHz, 160 MHz BW	*–47.5 dB*	*–47.5 dB*	*–44.7 dB*	*–45.1 dB*	*-40.1 dB*
SEM	5.8 GHz, 80 MHz BW	see Figure 10				

802.11a/g [62, 60]	**Parameters**	
SEM	2.4 GHz	see Figure 11
	5.5 GHz	see Figure 12

802.11e [62, 60, 65]	**Parameters**	
OFDMA WiMAX™ EVM	2.5, 3.5, & 5.8 GHz	*–48.3 dB, nominal*

59. Synthesizer PLL mode set to PLL mode best wide offset.
60. Expected input level 0 dBm, input signal (total power) 0 dBm, conversion type: Auto. PeakToAverage set per signal peak to average.
61. Synthesizer PLL mode set to PLL mode normal.
62. Multi-channel performance data applies when each channel is configured with its own independent synthesizer. Sharing a single synthesizer will degrade EVM performance approximately 1 dB.
63. Mixer level offset = +5 dB
64. Mixer level offset = +10 dB
65. Mixer level offset = +15 dB

Technical Specifications and Characteristics

Format specific measurement (continued)

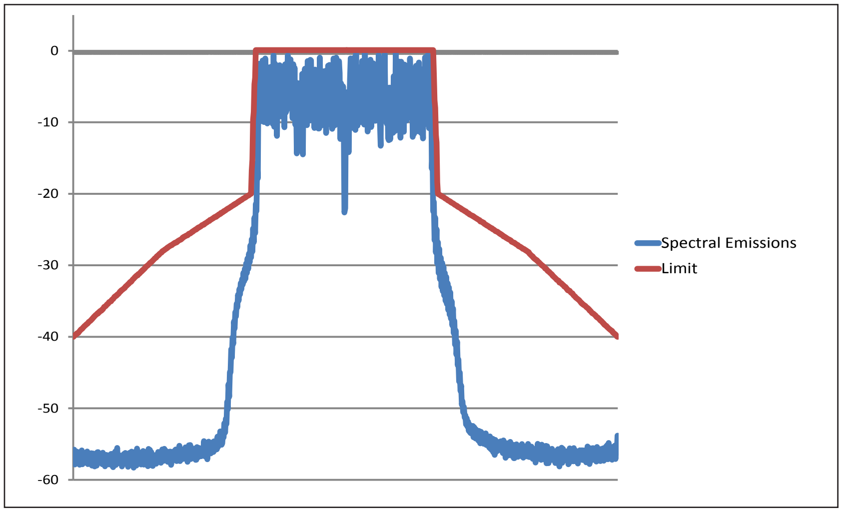


Figure 10. WLAN 802.11ac SEM
at 5.8 GHz, 80 MHz bandwidth.

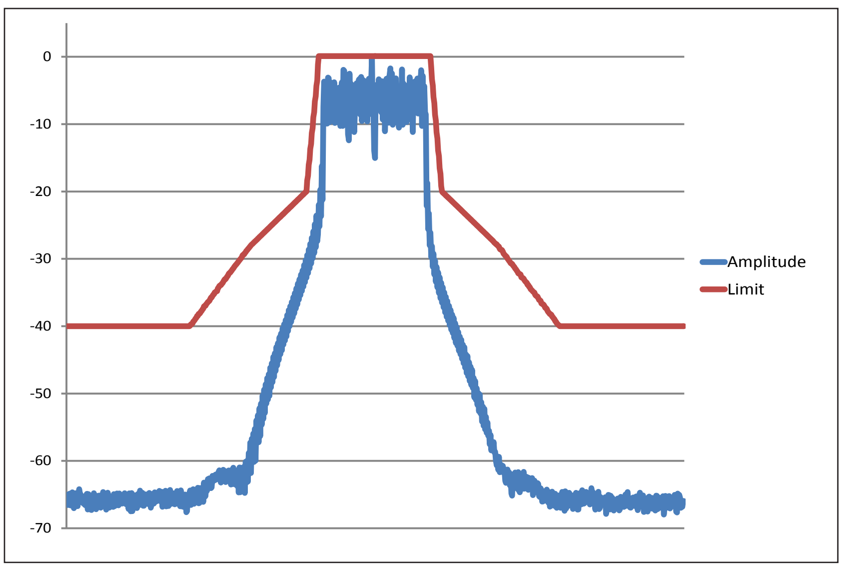


Figure 11. WLAN 802.11a/g SEM
at 2.4 GHz, 20 MHz bandwidth.

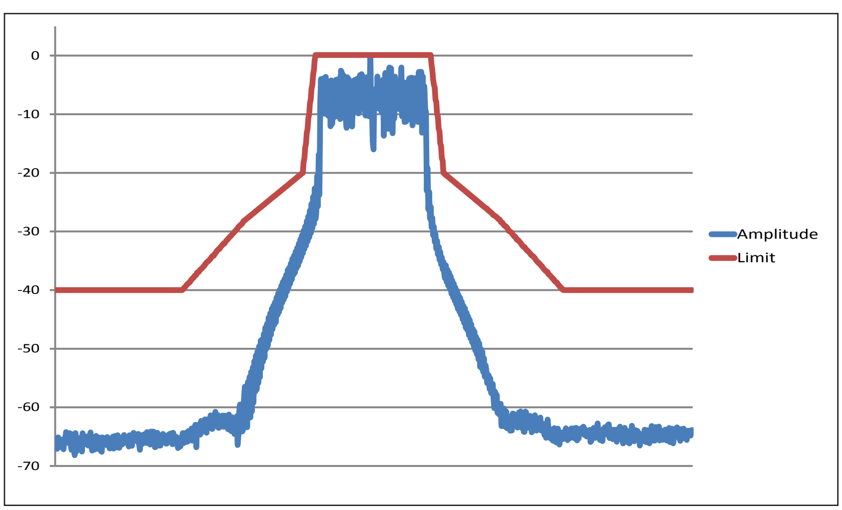


Figure 12. WLAN 802.11a/g SEM
at 5.5 GHz, 20 MHz bandwidth.

Technical Specifications and Characteristics

Format specific measurement (continued)

LTE FDD - single channel [66, 67]	Parameters		1-channel, nominal
10 MHz BW EVM, E–TM 3.1 [61, 62]	0.7, 0.9 GHz		*–52.2 dB (0.25%)*
	1.8, 1.9, 2.0, 2.1, 2.2 GHz		*–51.0 dB (0.28%)*
10 MHz BW ACLR, E–TM 1.1 [63]	0.7, 0.9, 1.8, 1.9, 2.0, 2.1, 2.2 GHz (power mode)	Adjacent	*–64.2 dBc*
		Alternate	*–65.5 dBc*

LTE FDD - MIMO [66, 67, 68]	Parameters	2-channel, nominal [72]	4-channel, nominal [72]	8-channel, nominal [73]
	0.9 GHz	*–49.8 dB (0.32%)*	*–50.1 dB (0.31%)*	*-52.6 dB (0.23%)*
	2.0 GHz	*–49.2 dB (0.35%)*	*–49.3 dB (0.34%)*	*-48.8 dB (0.36%)*

LTE TDD - MIMO [66, 67, 68]	Parameters	2-channel, nominal [72]	4-channel, nominal [72]	8-channel, nominal [73]
	0.9 GHz	*–50.7 dB (0.29%)*	*–50.3 dB (0.31%)*	*-56.3 dB (0.15%)*
	2.0 GHz	*–49.0 dB (0.36%)*	*–49.0 dB (0.36%)*	*-54.8 dB (0.18%)*

66. Expected input level 0 dBm, input signal (total power) 0 dBm, conversion type: Auto. PeakToAverage set per signal peak to average.
67. Synthesizer PLL mode set to PLL mode normal.
68. Multi-channel performance data applies when each channel is configured with its own independent synthesizer. Sharing a single synthesizer will degrade EVM performance approximately 1 dB.
69. PDCCH power boost = 1.065 dB
70. Mixer level offset = +10 dB
71. Mixer level offset = +15 dB
72. 10 MHz BW EVM, R9 downlink, 64 QAM, open loop spatial multiplexing
73. 10 MHz BW, DL, TM9 multi-layer, TM4 closed loop spatial multiplexing

Technical Specifications and Characteristics

Environmental and physical specifications

Temperature	Operating		Individual module temp 25 to 75 °C as reported by the module and environment temp of 0 to 55 °C	
	Non-operating (storage)		Environment temp of –40 to +70 °C	
Humidity [74]			Type tested at 95%, +40 °C (non-condensing)	
Shock/vibration [74]	Operating random vibration Survival random vibration Functional shock Bench handling		Type tested at 5 to 500 Hz, 0.21 g rms Type tested at 5 to 500 Hz, 2.09 g rms Type tested at half-sine, 30 g, 11 ms Type tested per MIL-PRF-28800F	
Altitude			Up to 15,000 feet (4,572 meters) [75]	
Connectors	RF In		SMA female	
EMC			Complies with European EMC Directive 2004/108/EC – IEC/EN 61326-2-1 – CISPR Pub 11 Group 1, class A – AS/NZS CISPR 11 – ICES/NMB-001 This ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB-001 du Canada.	
Warm-up time			45 minutes	
Size	M9300A M9301A M9350A M9214A		1 PXIe slot 1 PXIe slot 1 PXIe slot 1 PXIe slot	
Dimensions	Module	Length	Width	Height
	M9300A	210 mm	22 mm	130 mm
	M9301A	210 mm	22 mm	130 mm
	M9350A	210 mm	22 mm	130 mm
	M9214A	210 mm	22 mm	130 mm
Weight	M9300A M9301A M9350A M9214A		0.55 kg (1.21 lbs) 0.54 kg (1.19 lbs) 0.56 kg (1.23 lbs) 0.36 kg (0.79 lbs)	
Power drawn from chassis	M9300A M9301A M9350A M9214A		≤ 18 W ≤ 25 W ≤ 30 W ≤ 35 W	

74. Samples of this product have been type tested in accordance with the Environmental Test Manual and verified to be robust against the environmental stresses of storage, transportation and end-use--those stresses include but are not limited to temperature, humidity, shock, vibration, altitude and power-line conditions. Test methods are aligned with IEC 60068-2 and levels are similar to MIL-PRF-28800F Class 3.
75. At 15,000 feet, the maximum environmental temperature is de-rated to 52 °C.

Technical Specifications and Characteristics

System requirements

Topic	Windows 7 requirements
Operating systems	Windows 7 (32-bit and 64-bit)
Processor speed	1 GHz 32-bit (x86), 1 GHz 64-bit (x64) (no support for Itanium 64)
Available memory	4 GB minimum 8 GB or greater recommended
Available disk space [76]	1.5 GB available hard disk space, includes: 1 GB available for Microsoft .NET Framework 3.5 SP1 [77] 100 MB for IO Libraries Suite
Video	Support for DirectX 9 graphics with 128 MB graphics memory recommended (Super VGA graphics is supported)
Browser	Microsoft Internet Explorer 7 or greater
M9391A vector signal analyzer instrument drivers	
IO libraries	Version 16.3.17914 or greater

76. Because of the installation procedure, less disk space may be required for operation than is required for installation.
77. NET Framework Runtime Components are installed by default with Windows 7. Therefore, you may not need this amount of available disk space.

Configuration and Ordering Information

Software information

Supported operating systems	Microsoft Windows 7 (32/64-bit)
Standard compliant drivers	IVI-COM, IVI-C, LabVIEW, MATLAB
Supported application development environ-ments (ADE)	VisualStudio (VB.NET, C#, C/C++), VEE, LabVIEW, LabWindows/CVI, MATLAB
IO libraries (version 16.3 or newer)	Includes: VISA libraries, Connection Expert, IO monitor
Command Expert	Instrument control for SCPI or IVI-COM drivers
89600 VSA Software (version 17.21 or newer; Option SSA added in version 18.5)	89600B-200 Basic VSA software 89601B-300 Hardware connectivity 89601B-SSA Spectrum analysis 89601B-AYA GP analysis 89601B-B7T cdma2000®/1xEV-DO 89601B-B7U W-CDMA/HSPA+ 89601B-B7R WLAN 802.11a/b/g/j/p 89601B-B7X TD-SCDMA 89601B-BHD LTE FDD 89601B-BHG LTE FDD - Advanced 89601B-BHE LTE TDD 89601B-BHH LTE TDD - Advanced
X-Series Measurement Applications for Modular Instruments transportable perpetual license.	M9063A Analog demodulation M9064A Vector signal analysis M9071A GSM/EDGE/Evo M9072A cdma2000®/cdmaOne M9073A W-CDMA/HSPA+ M9076A 1xEV-DO M9077A WLAN 802.11a/b/g/n/ac M9079A TD-SCDMA/HSDPA M9080B LTE/LTE-A FDD M9081A *Bluetooth*® M9082B LTE/LTE-A TDD

Accessories

Model	Description
Y1212A	Slot blocker kit: 5 modules
Y1213A	PXI EMC filler panel kit: 5 slots
Y1299A	PXI solutions startup kits
Y1243A	Cable kit for M9301A LO distribution
M9021A	PCIe® cable interface
M9045B	PCIe express card adaptor for laptop connectivity
Y1200B	PCIe cable for laptop connectivity
M9048A	PCIe desktop adaptor for desktop connectivity
Y1202A	PCIe cable for desktop connectivity

Related products

Model	Description
M9381A	PXIe vector signal generator
M9380A	PXIe CW source
M9300A	PXIe frequency reference
M9018A	PXIe 18-slot chassis
M9037A	PXIe embedded controller

Advantage services: Calibration and warranty

Advantage Services is committed to your success throughout your equipment's lifetime

R-51B-001-5Z	Return to warranty - 5 years
R-51B-001-3X	Express warranty - 3 years
R-51B-001-5X	Express warranty - 5 years
N7800A	Calibration & adjustment software

Technologies M9393A PXIe Performance Vector Signal Analyzer

Data Sheet

KEYSIGHT
TECHNOLOGIES

Unlocking Measurement Insights

Overview

Acquire the performance edge in PXI

Whether your system supports a leading-edge design or a legacy platform, change is certain. Modular solutions are highly adaptable, and Technologies, Inc. is taking flexibility farther with the M9393A PXIe performance vector signal analyzer. The M9393A is the realization of our micro-wave measurement expertise in modular form. It integrates core signal-analysis capabilities with hardware speed and accuracy, enabling you to tailor your solution to fit specific needs – today and tomorrow. Deploy the M9393A and acquire the performance edge in PXI.

Validate the true performance of your device

The M9393A meets stringent system requirements with microwave performance previously unseen in modular. Quickly test to tighter tolerances with best-in-class switching speed and amplitude accuracy.

Get consistent, accurate results faster with optimized software elements

The M9393A leverages Keysight's trusted measurement science, providing proven, familiar software applications that minimize development time and reduce risk.

X-Series measurement applications: Verify signal compliance with standards-based measurements for LTE, WLAN and more, while simplifying software migration through deep programmatic compatibility with benchtop signal analyzers.

89600 VSA software: Characterize signals across the entire frequency range with new high-speed stepped spectrum capability along with existing software support for > 75 signal formats and multi-channel analysis.

Ensure success at microwave frequencies today and tomorrow

Easily adapt to changing test needs with license key upgradable options and hardware designed for extensibility. Rely on unmatched supportability based on Keysight's N7800A calibration and adjustment software for TME self-maintainers and Keysight's standard 3-year warranty.

Applications

- Aerospace and defense manufacturing and depot test
- Wireless device design validation and manufacturing

Figure 1. Standard M9393A PXIe performance vector signal analyzer with four modules consisting of M9300A frequency reference, M9308A synthesizer, M9365A downconverter and M9214A digitizer.

Product description

The M9393A PXI performance VSA is a vector signal analyzer with frequency coverage up to 50 GHz. The standard configuration provides frequency coverage from 9 kHz to 8.4, 14, 18 or 27 GHz and includes four individual PXI modules — M9214A digitizer, M9308A synthesizer, M9365A downconverter and M9300A frequency reference. The extended frequency configuration can be used to provide frequency coverage from 3.6 to 50 GHz with the recommended addition of the M9169E switchable attenuator module. For more information on product options and configurations, see the configuration guide, literature number **5991-4580EN**.

Reference solutions

Application specific reference solutions, a combination of recommended hardware, software, and measurement expertise, provide the essential components of a test system. The following reference solutions include the M9393A PXI VSA as a hardware component.

- RF PA/FEM characterization and test, Reference Solution for the industry's fastest envelope tracking test, rapid waveform download, tight synchronization, automated calibration and digital pre-distortion.
- LTE/LTE-A multi-channel test, Reference Solution for faster insight into carrier aggregation and spatial multiplexing designs.
- Satellite Signal Monitoring, Reference Solution for monitoring large blocks of spectrum and efficient validation of signal integrity.

Technical Specifications and Characteristics

Definitions for specifications

Temperatures referred to in this document are defined as follows:

- Full temperature range = Individual module temperature of 15 to 75 °C, as reported by the module, and environment temperature of 0 to 55 °C.
- Controlled temperature range = Individual module temperature of 36 to 50 °C, as reported by the module, and environment temperature of 20 to 30 °C.

Specifications describe the warranted performance of calibrated instruments. Data represented in this document are specifications under the following conditions unless otherwise noted.

- Calibrated instruments have been stored for a minimum of 2 hours within the full temperature range
- 30 minute warm-up time
- Calibration cycle maintained
- When used with M9300A frequency reference and interconnect cables

***Characteristics** describe product performance that is useful in the application of the product, but that is not covered by the product warranty. Characteristics are often referred to as Typical or Nominal values and are italicized.*

- **Typical** describes characteristic performance, which 80% of instruments will meet when operated within the controlled temperature range.
- **Nominal** describes representative performance that is useful in the application of the product when operated within the controlled temperature range.
- **95th percentile** values indicate the breadth of the population (approx. 2 σ of performance tolerances expected to be met in 95 percent of the cases with a 95 percent confidence, for any ambient temperature in the range of 20 to 30 °C. In addition to the statistical observations of a sample of instruments, these values include the effects of the uncertainties of external calibration references. These values are not warranted. These values are updated occasionally if a significant change in the statistically observed behavior of production instruments is observed.

Recommended best practices in use

- Use slot blockers and EMC filler panels in empty module slots to ensure proper operating temperatures. chassis and slot blockers optimize module temperature performance and reliability of test.
- Set chassis fan to high at environmental temperatures above 45 °C.

Conversion type operating range

Conversion types	Frequency range
Auto	All frequencies
Double conversion	9 kHz to 3.6 GHz
Single high	3.6 GHz to max frequency
Single low	3.6 GHz to max frequency

Additional information

- Mixer level offset modifies the receiver gain prior to the first mixer of the receiver. A negative setting improves distortion (i.e., TOI) at the cost of noise performance (i.e., DANL). A positive setting improves noise performance at the cost of distortion.
- The PeakToAverage property is used with expected RF Power property to optimize level settings in the Downconverter. Set this to the ratio, in dB, of the peak power to the average power. The Downconverter uses this value to optimize mixer level, IF gain, and ADC clip level.
- IF Level Offset (dB) provides additional adjustment of IF power level. Positive values reduce noise. Negative values reduce distortion.
- Digitizer Level Offset (dB) provides additional adjustment of Downconverter IF power to the digitizer. Positive values increase power to the digitizer. Negative values decrease power to the digitizer.
- All graphs contain measured data from one unit and are representative of product performance within the controlled temperature range unless otherwise noted.
- Default conditions apply, unless otherwise noted.
- The specifications contained in this document are subject to change.

Technical Specifications and Characteristics

Standard Configuration - Options F08, F14, F18, F27

Block diagram

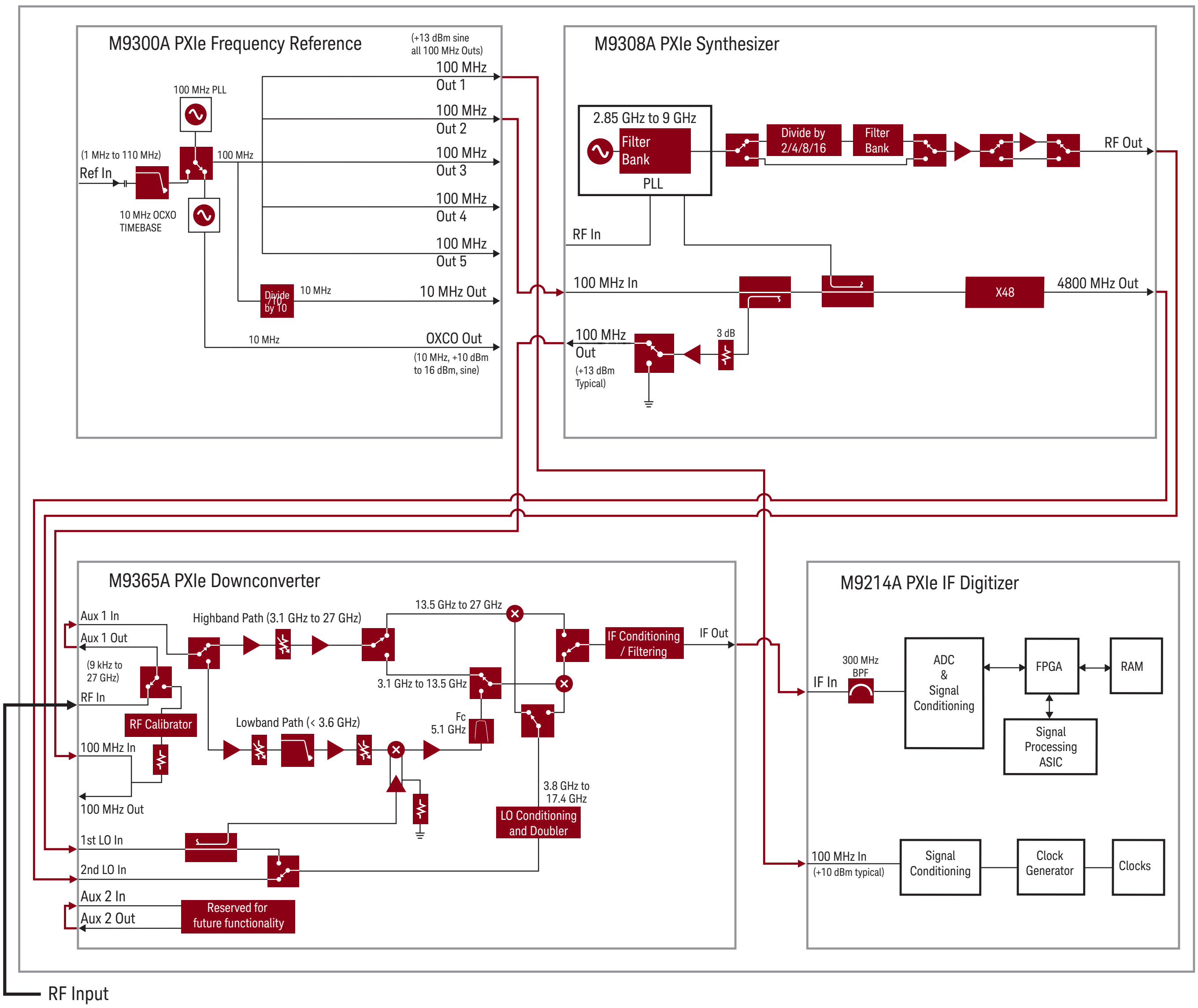


Figure 2. Standard M9393A PXIe vector signal analyzer (9 kHz to 27 GHz) block diagram with four modules consisting of the M9308A synthesizer, M9365A downconverter, M9214A digitizer and the optional M9300A frequency reference.

To maximize the M9300A's 100 MHz outputs, especially for multi-channel configurations, an SMB T-type adapter (not shown) can be used to split the signal between the M9214A 100 MHz In and the M9308A 100 MHz In. For more information, please refer to the M9393A startup guide, literature number M9393-90002.

Technical Specifications and Characteristics

Standard Configuration – Options F08, F14, F18, F27

Frequency

Frequency range and resolution			
Option F08	9 kHz to 8.4 GHz		
Option F14	9 kHz to 14 GHz		
Option F18	9 kHz to 18 GHz		
Option F27	9 kHz to 27 GHz		
Tuning resolution	0.01 Hz		
Analysis bandwidth [1]			
Maximum bandwidth	Option B04 (standard)	40 MHz	
	Option B10	100 MHz	
	Option B16	160 MHz	
	Option WB1 [5]	*1 GHz IF output, nominal*	
IF frequency [2]		**Final IF**	**First IF (< 3.6 GHz)**
	40 MHz IF path	240 MHz	5040 MHz
	100/160 MHz IF path	300 MHz	5100 MHz
	40 MHz alternate IF path [3]	326 MHz	5126 MHz
	Bypass path (Option WB1) [6]	Adjustable	--
Band	**Harmonic mixing mode**	**LO multiple (N)** [4]	**Frequency**
Band 0	1	1	9 kHz to 3.6 GHz
Band 1	1	1	3.6 to 8.4 GHz
Band 2	1	2	8.4 to 13.6 GHz
Band 3	2	2	13.6 to 17.1 GHz
Band 4	2	4	17.1 to 27 GHz

1. Instantaneous bandwidth (1 dB bandwidth) available around a center frequency over which the input signal can be digitized for further analysis or processing in the time, frequency or modulation domain.
2. Double conversion below 3.6 GHz, single conversion above 3.6 GHz.
3. Only used for some frequencies below 3.6 GHz for best performance as determined by the instrument software.
4. N is the LO multiplication factor.
5. Enables bypassing of IF filters to provide access to wideband IF output from downconverter for use with an external digitizer. Available > 3.6 GHz. Full 1 GHz not available at band crossings.
6. IF frequency can be tuned from 200 to 800 MHz with a default value of 500 MHz.

Standard Configuration – Options F08, F14, F18, F27

Frequency (cont'd)

Frequency switching speed [7, 8]			
List mode switching speed [9]	**Band**	**Standard, nominal**	**Option UNZ, nominal**
Baseband frequency offset change [11]	< 40 MHz ≥ 40 MHz to ≤ 100 MHz > 100 MHz to < 180 MHz ≥ 180 MHz	*5 ms*	*26 µs* *12 µs* *95 µs* *11 µs*
Arbitrary frequency change within:	0: < 3.6 GHz 1: 3.6 to 8.4 GHz 2: 8.4 to 13.6 GHz 3: 13.6 to 17.1 GHz 4: 17.1 to 27 GHz	*5 ms*	*175 µs* *135 µs* *135 µs* *155 µs* *145 µs*
Non-list mode switching speed [10]		**Standard, nominal**	**Option UNZ, nominal**
Baseband frequency offset change [11]		*5 ms*	*250 µs*
Arbitrary frequency change		*5 ms*	*1 ms*

Resolution bandwidth (RBW)		
Minimum RBW	1 Hz	
Maximum span:RBW ratio [12]	135 x 10^6	
Maximum RBW (ENBW)	**IF dither OFF**	**IF dither ON**
Flat top (160 MHz IF)	31.25 MHz	27.3 MHz
Flat top (40 MHz IF)	7.8 MHz	3.9 MHz
Gaussian top (160 MHz)	19.4 MHz	16.99 MHz
Gaussian top (40 MHz)	4.8 MHz	2.4 MHz

Video bandwidth (VBW)	
Range	1 Hz to maximum RBW and wide open to 50 MHz
Accuracy	VBW is implemented by averaging to achieve a similar variance reduction effect for the same VBW value.

Frequency span	
Range	Single FFT: 800 Hz to 160 MHz Stepped: 800 Hz to 27 GHz
Resolution	2 Hz

7. When used with the M9018A PXIe chassis (2-link configuration: 1 x 8 [factory default]) and M9037A PXIe embedded controller.
8. Settled to within 2 kHz or 1 ppm, whichever is greater of final value. Does not include data acquisition or processing time. Amplitude settled to within 0.1 dB. Channel filter set to none.
9. Time from trigger input to frequency and amplitude settled. Minimum IQ sample rate ≥ 6 MHz. Minimum spectrum acquisition ≥ 4.8 MHz. Minimum power acquisition channel filter bandwidth ≥ 4.8 MHz. For frequency changes crossing 3.6 GHz with option UNZ, switching time is 2 ms. For frequency changes crossing any other bands with option UNZ, switching time is < 300 µs.
10. Mean time from IVI command to carrier frequency settled to within 2 kHz or 1 ppm, whichever is greater. Amplitude settled within 0.1 dB. Simultaneous carrier frequency and amplitude switching. For frequency changes crossing 3.6 GHz with option UNZ, switching time is 2 ms.
11. Baseband offset can be adjusted ± from carrier frequency within limits determined by RF analysis bandwidth and IF filter bandwidth. Synthesizer frequency and amplitude are not changing. Baseband offset settled to within 2 kHz.
12. Indicates minimum RBW which can be set for a given measurement span in 64-bit, stepped spectrum acquisition mode.

Technical Specifications and Characteristics

Standard Configuration - Options F08, F14, F18, F27

Frequency (cont'd)

Frequency reference (M9300A PXIe frequency reference module)		
Reference outputs		
100 MHz Out (Out 1 through Out 5)		
Amplitude	≥ 10 dBm	*13 dBm, typical*
Connectors	5 SMB snap-on	
Impedance	*50 Ω, nominal*	
10 MHz Out		
Amplitude	*9.5 dBm, nominal*	
Connectors	1 SMB snap-on	
Impedance	*50 Ω, nominal*	
OCXO Out		
Amplitude	*11.5 dBm, nominal*	
Connectors	1 SMB snap-on	
Impedance	*50 Ω, nominal*	
Frequency accuracy		
Same as accuracy of internal time base or external reference input		
Internal timebase		
Accuracy	± [(time since last adjustment x aging rate) ± temperature effects ± calibration accuracy]	
Frequency stability		
Aging rate		
Daily	*< ± 0.5 ppb/day, after 72 hours of warm-up*	
Yearly	*< ± 0.1 ppm/year, after 72 hours of warm-up*	
Total 10 years	*< ± 0.6 ppm/10 years, after 72 hours of warm-up*	
Achievable initial calibration accuracy (at time of shipment)	± 5 x 10-8	
Temperature effects		
20 to 30 °C	*< ± 10 ppb*	
Full temperature range	*< ± 50 ppb*	
Warm up		
5 minutes over +20 to +30 °C, with respect to 1 hour	*< ± 0.1 ppm*	
15 minutes over +20 to +30 °C, with respect to 1 hour	*< ± 0.01 ppm*	
External reference input		
Frequency	1 to 110 MHz, sine wave	
Lock range	*± 1 ppm, nominal*	
Amplitude	*0 to 10 dBm, nominal*	
Connector	1 SMB snap-on	
Impedance	*50 Ω, nominal*	

Technical Specifications and Characteristics

Standard Configuration – Options F08, F14, F18, F27

Amplitude

Input level						
Max safe average total power	+35 dBm					
Max DC voltage	± 10 Vdc					
Max RF input (specified performance)	+30 dBm					
Expected input level setting	**Pre-amplifier OFF, peak to average 0 dB**					
Range	–170 to +30 dBm					
Resolution	0.01 dB					
Electronic attenuator [13]						
Frequency range	9 kHz to 27 GHz					
Attenuation range	0 to 42 dB					
Step size	0.25 dB					
Absolute amplitude accuracy [14]						
Frequency [15]	**Pre-amp OFF [16]**			**Pre-amp ON [17]**		
	Specification	95^{th} percentile	Typical	Specification	95^{th} percentile	Typical
100 kHz to 1 MHz	± 1.53 dB	*± 0.97 dB*	*± 0.71 dB*	± 1.76 dB	*± 1.01 dB*	*± 0.71 dB*
1 MHz to 20 MHz	± 1.23 dB	*± 0.7 dB*	*± 0.49 dB*	± 1.59 dB	*± 0.9 dB*	*± 0.61 dB*
20 MHz to 100 MHz	± 0.61 dB	*± 0.32 dB*	*± 0.17 dB*	± 0.71 dB	*± 0.41 dB*	*± 0.24 dB*
100 MHz to 3.6 GHz	± 0.54 dB	*± 0.25 dB*	*± 0.13 dB*	± 0.74 dB	*± 0.38 dB*	*± 0.26 dB*
3.6 GHz to 8 GHz	± 0.61 dB	*± 0.31 dB*	*± 0.16 dB*	± 0.85 dB	*± 0.4 dB*	*± 0.26 dB*
8 GHz to 14 GHz	± 0.71 dB	*± 0.36 dB*	*± 0.23 dB*	± 0.95 dB	*± 0.45 dB*	*± 0.32 dB*
14 GHz to 18 GHz	± 0.79 dB	*± 0.47 dB*	*± 0.35 dB*	± 1.03 dB	*± 0.59 dB*	*± 0.47 dB*
18 GHz to 26.5 GHz	± 1.43 dB	*± 0.55 dB*	*± 0.37 dB*	± 2.12 dB	*± 1.08 dB*	*± 0.92 dB*
26.5 GHz to 27 GHz	± 2.37 dB	*± 0.57 dB*	*± 0.4 dB*	± 2.65 dB	*± 0.66 dB*	*± 0.48 dB*
Frequency [15]	**Pre-amp OFF, expected input level ≤ -5 dBm [18]**					
	Specification	95^{th} percentile	Typical			
100 kHz to 1 MHz	± 1.21 dB	*± 0.74 dB*	*± 0.53 dB*			
1 MHz to 20 MHz	± 1.14 dB	*± 0.66 dB*	*± 0.46 dB*			
20 MHz to 100 MHz	± 0.69 dB	*± 0.36 dB*	*± 0.21 dB*			
100 MHz to 3.6 GHz	± 0.67 dB	*± 0.35 dB*	*± 0.23 dB*			

13. Electronic attenuator set by firmware based on expected input level, peak to average, and frequency settings.
14. Measured using an attenuator with VSWR performance equal to or better than the 8490D-020 coaxial attenuator. Applies after comprehensive alignment and module temperature within ± 3 °C.
15. Frequency is exclusive on the start frequency and inclusive on the stop frequency.
16. Expected input level set to 6 dBm below 3.6 GHz. Expected input level set to –5 dBm above 3.6 GHz. Peak to average 0 dBm.
17. Expected input level set to –3 dBm. Peak to average 0 dBm.
18. Expected input level set to –5 dBm. Peak to average 0 dBm.

Technical Specifications and Characteristics

Standard Configuration - Options F08, F14, F18, F27

Amplitude (cont'd)

Amplitude repeatability and linearity				
	Pre-amp OFF, typical		Pre-amp ON, typical	
Repeatability [19]	*± 0.03 dB*		*± 0.06 dB*	
Linearity [20]	**ADC dither high**		**ADC dither Low**	
Input signal relative to expected input level setting	Specification	Typical	Specification	Typical
> –35 dB	0.08 dB	*0.03 dB*	0.08 dB	*0.03 dB*
≤ –35 dB	0.1 dB	*0.04 dB*	0.21 dB	*0.1 dB*

IF flatness, typical [21, 22]	**Across any 20 MHz in 40 MHz path**	**Across any 20 MHz in 160 MHz path**	**40 MHz**	**100 MHz**	**160 MHz**
≤ 13.6 GHz	*± 0.08 dB*	*± 0.14 dB*	*± 0.16 dB*	*± 0.21 dB*	*± 0.34 dB*
> 13.6 GHz	*± 0.12 dB*	*± 0.14 dB*	*± 0.17 dB*	*± 0.31 dB*	*± 0.47 dB*

IF phase linearity, typical [21, 22]	**Across any 20 MHz in 40 MHz path**	**Across any 20 MHz in 160 MHz path**	**40 MHz**	**100 MHz**	**160 MHz**
≤ 13.6 GHz	*± 0.68 °*	*± 1.28 °*	*± 0.81 °*	*± 1.34 °*	*± 1.56 °*
> 13.6 GHz	*± 1.46 °*	*± 1.54 °*	*± 1.69 °*	*± 2.56 °*	*± 3.59 °*

IF bandwidth filter switching uncertainty [23]			
	Specification	Typical	Nominal
Preamp On	± 0.3 dB	*± 0.14 dB*	*± 0.1 dB*
Preamp Off	± 0.45 dB	*± 0.25 dB*	*± 0.2 dB*

Expected input level switching uncertainty [24]						
	Pre-amp OFF [25]				**Pre-amp ON [26]**	
	≤ –5 dBm		> –5 dBm		≤ –3 dBm	
	Specification	Typical	Specification	Typical	Specification	Typical
> 100 kHz to 1 MHz	± 0.14 dB	*± 0.03 dB*	± 1.53 dB	*± 0.6 dB*	± 0.48 dB	*± 0.18 dB*
> 1 to 20 MHz	± 0.18 dB	*± 0.04 dB*	± 1.56 dB	*± 0.64 dB*	± 0.48 dB	*± 0.18 dB*
> 20 to 100 MHz	± 0.15 dB	*± 0.04 dB*	± 0.56 dB	*± 0.24 dB*	± 0.39 dB	*± 0.15 dB*
> 100 MHz to 3.6 GHz	± 0.16 dB	*± 0.04 dB*	± 0.53 dB	*± 0.24 dB*	± 0.44 dB	*± 0.18 dB*
> 3.6 to 8 GHz	± 0.18 dB	*± 0.05 dB*	± 0.39 dB	*± 0.15 dB*	± 0.34 dB	*± 0.12 dB*
> 8 to 17 GHz	± 0.16 dB	*± 0.05 dB*	± 0.71 dB	*± 0.19 dB*	± 0.53 dB	*± 0.17 dB*
> 17 to 24 GHz	± 0.19 dB	*± 0.05 dB*	± 2.38 dB	*± 0.39 dB*	± 0.78 dB	*± 0.17 dB*
> 24 to 27 GHz	± 0.18 dB	*± 0.06 dB*	± 1.39 dB	*± 0.31 dB*	± 0.55 dB	*± 0.16 dB*

19. Input level –11 dBm, LO nulling run at ~1 GHz, 150 ms allowed for amplitude settling, measurement made at 1 kHz from center of IF.
20. Input level 20 dB above the noise floor and ADC dither on, no change in hardware settings, below expected input level.
21. Deviation from the mean error of the entire bandwidth, all conversion types.
22. Expected input level = 0 dBm, Mixer level offset = 0.
23. Amplitude error relative to the reference IF bandwidth filter of 40 MHz. Preamplifier mode is set in the on or off position, not Auto.
24. Measured using an attenuator with VSWR performance equal to or better than the 8490D-020 coaxial attenuator. Peak to average = 0 dB.
25. Measurement referenced to Expected input level setting of –5 dBm.
26. Measurement referenced to Expected input level setting of –3 dBm.

Standard Configuration – Options F08, F14, F18, F27

Amplitude (cont'd)

Amplitude switching speed [27]			
Option UNZ, nominal			
List mode switching speed	9 kHz to 3.6 GHz	3.6 to 6 GHz	6 to 27 GHz
From lower to higher power [28]	*90 µs*	*180 µs*	*50 µs*
From higher to lower power [28]	*90 µs*	*50 µs*	*50 µs*
Pre-amp OFF to pre-amp ON	*245 µs*	*190 µs*	*190 µs*
Pre-amp ON to pre-amp OFF	*160 µs*	*220 µs*	*90 µs*
Non-list mode switching speed	*1 ms*		
Standard, nominal	*5 ms*		

Input voltage standing wave ratio (VSWR)		
	Pre-amp OFF, nominal	**Pre-amp ON, nominal**
10 MHz to ≤ 50 MHz	*< 1.38 : 1*	*< 2.57 : 1*
> 50 MHz to ≤ 3 GHz	*< 1.21 : 1*	*< 1.9 : 1*
> 3 GHz to ≤ 3.6 GHz	*< 1.12 : 1*	*< 1.61 : 1*
> 3.6 GHz to ≤ 12 GHz	*< 1.49 : 1*	*< 1.4 : 1*
> 12 GHz to ≤ 20 GHz	*< 1.99 : 1*	*< 1.99 : 1*
> 20 GHz to ≤ 23 GHz	*< 1.36 : 1*	*< 1.36 : 1*
> 23 GHz to ≤ 27 GHz	*< 1.81 : 1*	*< 1.82 : 1*

Trace detectors	
With IVI driver	Normal
With 89600 VSA software	Normal, Max, Sample, Average, Min

Preamplifier	
Frequency range	
Option F08	9 kHz to 8.4 GHz
Option F14	9 kHz to 14 GHz
Option F18	9 kHz to 18 GHz
Option F27	9 kHz to 27 GHz
Gain [29]	**Typical**
< 3.6 GHz	*+15.5 dB*
3.6 to < 15 GHz	*+25.0 dB*
15 to < 25 GHz	*+22.0 dB*
25 to 27 GHz	*+19.0 dB*

27. When using M9018A PXIe chassis (2-link configuration: 1 x 8 [factory default]) and M9037A PXIe embedded controller. Amplitude settled to within 0.1 dB. Does not include data acquisition or processing time.
28. No pre-amplifier switching.
29. Gain is normalized to pre-amplifier OFF state.

Technical Specifications and Characteristics

Standard Configuration - Options F08, F14, F18, F27

Dynamic range

Displayed average noise level (DANL) [30]					
		Specification		**Typical**	
		Noise corrections OFF	Noise corrections ON	Noise corrections OFF	Noise corrections ON
Pre-amp OFF	9 to 300 kHz	–120 dBm/Hz	–125 dBm/Hz	*–129 dBm/Hz*	*–135 dBm/Hz*
	300 kHz to 51 MHz	–143 dBm/Hz	–147 dBm/Hz	*–147 dBm/Hz*	*–154 dBm/Hz*
	51 to 800 MHz	–147 dBm/Hz	–158 dBm/Hz	*–150 dBm/Hz*	*–161 dBm/Hz*
	800 MHz to 2.5 GHz	–145 dBm/Hz	–156 dBm/Hz	*–148 dBm/Hz*	*–158 dBm/Hz*
	2.5 to 3.6 GHz	–142 dBm/Hz	–153 dBm/Hz	*–146 dBm/Hz*	*–157 dBm/Hz*
	3.6 to 7.4 GHz	–146 dBm/Hz	–156 dBm/Hz	*–149 dBm/Hz*	*–160 dBm/Hz*
	7.4 to 10 GHz	–144 dBm/Hz	–155 dBm/Hz	*–148 dBm/Hz*	*–158 dBm/Hz*
	10 to 13.6 GHz	–142 dBm/Hz	–152 dBm/Hz	*–145 dBm/Hz*	*–156 dBm/Hz*
	13.6 to 17 GHz	–136 dBm/Hz	–147 dBm/Hz	*–141 dBm/Hz*	*–151 dBm/Hz*
	17 to 20.5 GHz	–133 dBm/Hz	–144 dBm/Hz	*–136 dBm/Hz*	*–147 dBm/Hz*
	20.5 to 22 GHz	–131 dBm/Hz	–142 dBm/Hz	*–135 dBm/Hz*	*–145 dBm/Hz*
	22 to 25.5 GHz	–123 dBm/Hz	–134 dBm/Hz	*–128 dBm/Hz*	*–138 dBm/Hz*
	25.5 to 27 GHz	–117 dBm/Hz	–127 dBm/Hz	*–122 dBm/Hz*	*–133 dBm/Hz*
Pre-amp ON	9 to 300 kHz	–120 dBm/Hz	–126 dBm/Hz	*–131 dBm/Hz*	*–134 dBm/Hz*
	300 kHz to 51 MHz	–135 dBm/Hz	–146 dBm/Hz	*–142 dBm/Hz*	*–152 dBm/Hz*
	51 to 2.3 GHz	–154 dBm/Hz	–165 dBm/Hz	*–158 dBm/Hz*	*–168 dBm/Hz*
	2.3 to 3.6 GHz	–153 dBm/Hz	–164 dBm/Hz	*–157 dBm/Hz*	*–168 dBm/Hz*
	3.6 to 9 GHz	–152 dBm/Hz	–162 dBm/Hz	*–156 dBm/Hz*	*–166 dBm/Hz*
	9 to 16.2 GHz	–149 dBm/Hz	–160 dBm/Hz	*–154 dBm/Hz*	*–164 dBm/Hz*
	16.2 to 20.5 GHz	–147 dBm/Hz	–157 dBm/Hz	*–152 dBm/Hz*	*–163 dBm/Hz*
	20.5 to 23.5 GHz	–143 dBm/Hz	–153 dBm/Hz	*–149 dBm/Hz*	*–159 dBm/Hz*
	23.5 to 25.6 GHz	–139 dBm/Hz	–150 dBm/Hz	*–145 dBm/Hz*	*–155 dBm/Hz*
	25.6 to 27 GHz	–136 dBm/Hz	–147 dBm/Hz	*–141 dBm/Hz*	*–152 dBm/Hz*

For nominal, see figure 4.

Gain compression (0.1 dB two-tone), nominal [31]		
Frequency	**Pre–amp OFF**	**Pre–amp ON**
< 3.6 GHz	*0 dBm*	*–15 dB*
3.6 to 5 GHz	*–5 dBm*	*–28 dB*
5 to 17 GHz	*–3 dBm*	*–27 dB*
17 to 27 GHz	*+1 dBm*	*–21 dB*

30. Expected input level = –60 dBm, Mixer level offset = 0 dBm, Noise Correction ON uses 100 averages, Conversion = auto, PeakToAverage = 0 dB.
31. Large signals can cause the analyzer to incorrectly measure on-screen signals because of two-tone gain compression. This specification tells how large an interfering signal must be in order to cause a 0.1 dB change in a low power signal. Tone spacing = 100 kHz, measuring a –30 dBm signal for the low power tone. Expected input level = 0 dBm, Mixer level offset = 0 dB.

Technical Specifications and Characteristics

Standard Configuration – Options F08, F14, F18, F27

Dynamic range (cont'd)

Third order intermodulation distortion (TOI)				
	Frequency	**Specification** [34]	**Typical**	**Nominal**
Pre-amp OFF [32]	10 to 600 MHz	+26 dBm / -52 dBc	*+29 dBm*	*+31 dBm*
	600 MHz to 3.6 GHz	+26 dBm / -52 dBc	*+31 dBm*	*+33.5 dBm*
	3.6 to 13.6 GHz	+26 dBm / -52 dBc	*+29 dBm*	*+30 dBm*
	13.6 to 16.5 GHz	+24 dBm / -48 dBc	*+28.5 dBm*	*+29.5 dBm*
	16.5 to 18 GHz	+21 dBm / -42 dBc	*+25 dBm*	*+28.5 dBm*
	18 to 27 GHz	+24 dBm / -48 dBc	*+29 dBm*	*+31 dBm*
Pre-amp ON [33]	10 to 600 MHz	+3 dBm / -56 dBc	*+8.5 dBm*	*+12.5 dBm*
	600 MHz to 3.6 GHz	+4 dBm / -58 dBc	*+10 dBm*	*+13 dBm*
	3.6 to 13.6 GHz	–1.5 dBm / -47 dBc	*+3.5 dBm*	*+4.5 dBm*
	13.6 to 16.5 GHz	–4.5 dBm / -41 dBc	*+2 dBm*	*+4 dBm*
	16.5 to 18 GHz	–9 dBm / -32 dBc	*–3 dBm*	*+1 dBm*
	18 to 24 GHz	–7 dBm / -36 dBc	*0 dBm*	*+3 dBm*
	24 to 27 GHz	–1 dBm / -48 dBc	*+5 dBm*	*+7.5 dBm*

Second harmonic distortion (SHI)			
	Frequency	**Typical** [37]	**Nominal**
Pre-amp OFF [35]	10 to 300 MHz	*+56 dBm / –56 dBc*	*+60 dBm*
	300 MHz to 1.8 GHz	*+60 dBm / –60 dBc*	*+62 dBm*
	1.8 to 5.2 GHz	*+41 dBm / –41 dBc*	*+44 dBm*
	5.2 to 10 GHz	*+32 dBm / –32 dBc*	*+36 dBm*
	10 to 13.5 GHz	*+21 dBm / –21 dBc*	*+25 dBm*
Pre-amp ON [36]	10 MHz to 1.8 GHz	*+33 dBm / –63 dBc*	*+35 dBm*
	1.8 to 4 GHz	*+16 dBm / –46 dBc*	*+22 dBm*
	4 to 10 GHz	*0 dBm / –30 dBc*	*+3 dBm*
	10 to 13.5 GHz	*–10 dBm / –20 dBc*	*–5 dBm*

32. Tone separation = 100 kHz, Expected input level = 3 dBm, Mixer offset level = 0 dB, PeakToAverage = 6 dB, Conversion type Auto. Signal level of 0 dBm used to calculate distortion in dBc.
33. Tone separation = 100 kHz, Expected input level = –22 dBm, Mixer offset level = 0 dB, PeakToAverage = 6 dB, Conversion type Auto. Signal level of –25 dBm used to calculate distortion in dBc.
34. TOI = third order intercept. The TOI is given by the input tone level (in dBm) minus (distortion/2) where distortion is the relative level of the distortion tones in dBc.
35. Expected input level = 0 dBm . Signal level of 0 dBm used to calculate distortion in dBc.
36. Expected input level = –30 dBm . Signal level of -30 dBm used to calculate distortion in dBc.
37. SHI = second harmonic intercept. The SHI is given by the input power in dBm minus the second harmonic distortion level relative to the input level in dBc.

Technical Specifications and Characteristics

Standard Configuration – Options F08, F14, F18, F27

Dynamic range (cont'd)

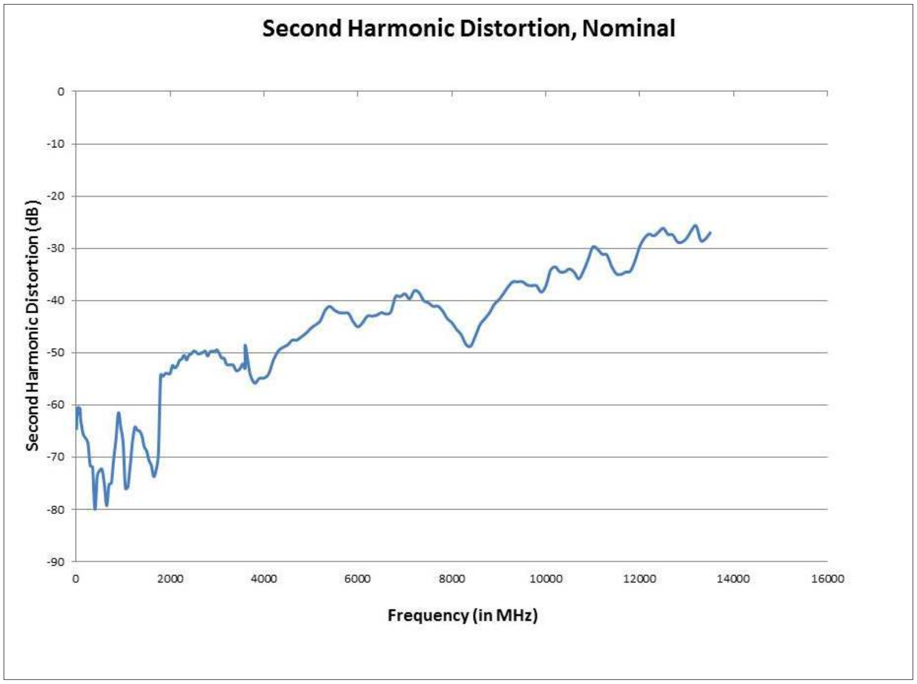


Figure 3. Nominal second harmonic distortion, expected input level = 0 dBm.

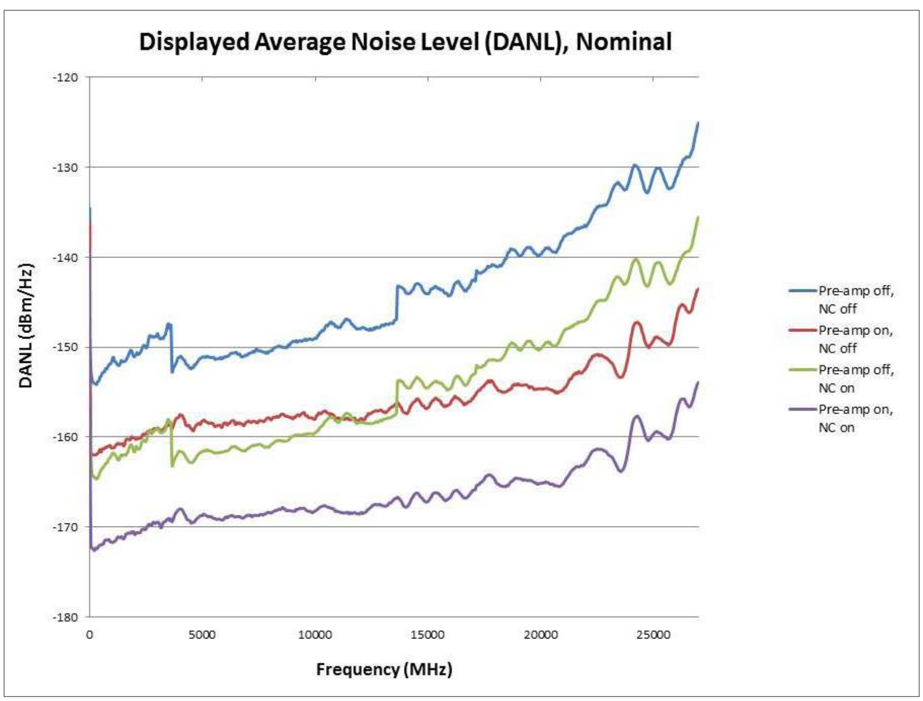


Figure 4. Nominal displayed average noise level. Expected input level = –60 dBm, Mixer level offset = 0 dBm, Noise correction (NC) ON uses 100 averages.

Technical Specifications and Characteristics

Standard Configuration – Options F08, F14, F18, F27

Dynamic range (cont'd)

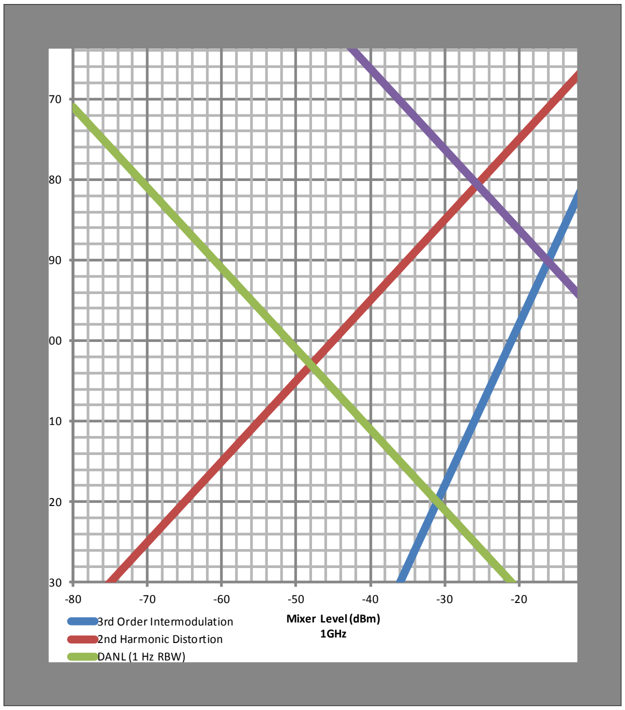


Figure 5. Dynamic range at 1 GHz.

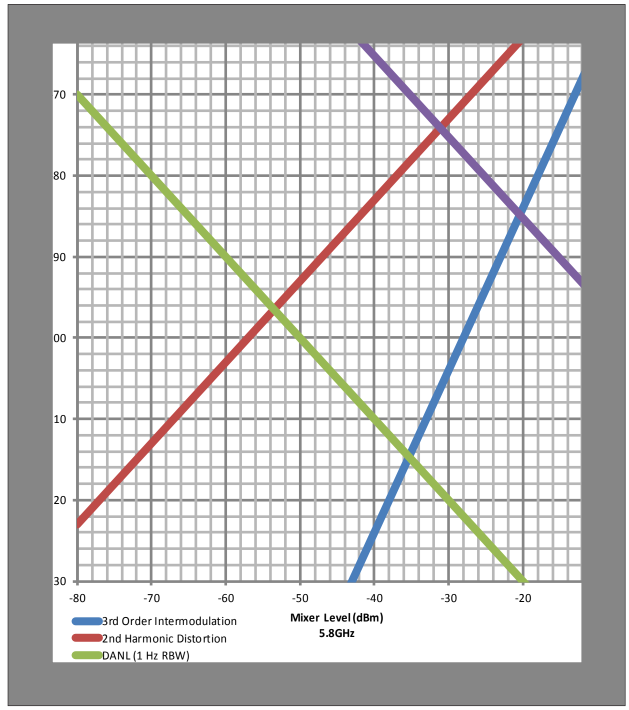


Figure 6. Dynamic range at 5.8 GHz.

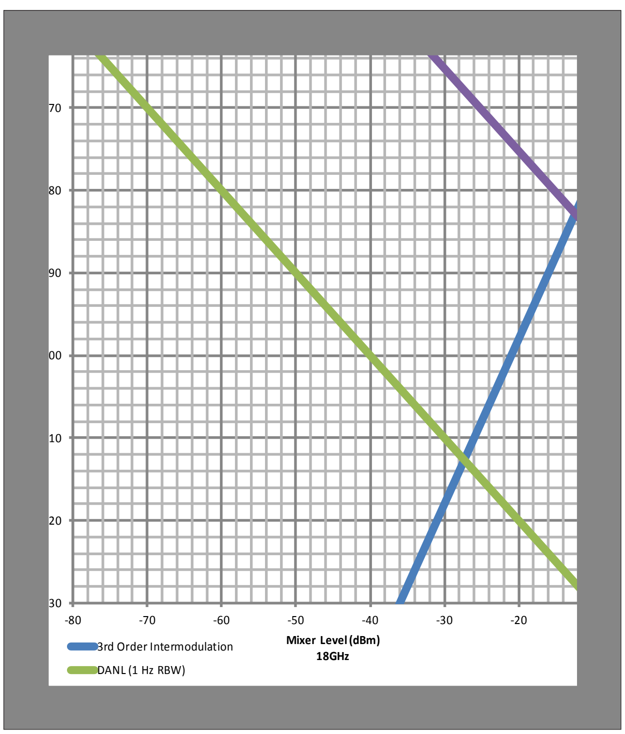


Figure 7. Dynamic range at 18 GHz.

Technical Specifications and Characteristics

Standard Configuration - Options F08, F14, F18, F27

Spectral purity

Phase noise [38]				
Center frequency	**Offset**	**Specification, noise corrections OFF**	**Typical, noise corrections OFF**	**Typical, noise corrections ON**
1 GHz	100 Hz		*–88 dBc/Hz*	
	1 kHz		*–105 dBc/Hz*	
	10 kHz	–107 dBc/Hz	*–110 dBc/Hz*	
	100 kHz		*–107 dBc/Hz*	
	300 kHz		*–118 dBc/Hz*	
	1 MHz	–131 dBc/Hz	*–134 dBc/Hz*	*–134 dBc/Hz*
	3 MHz		*–139 dBc/Hz*	*–141 dBc/Hz*
	10 MHz		*–141 dBc/Hz*	*–144 dBc/Hz*

38. Expected input level = 0 dBm, Mixer level offset = 0 dB, Pre-amp = OFF, Noise correction ON results use a counted average of 100, PeakToAverage = 5.

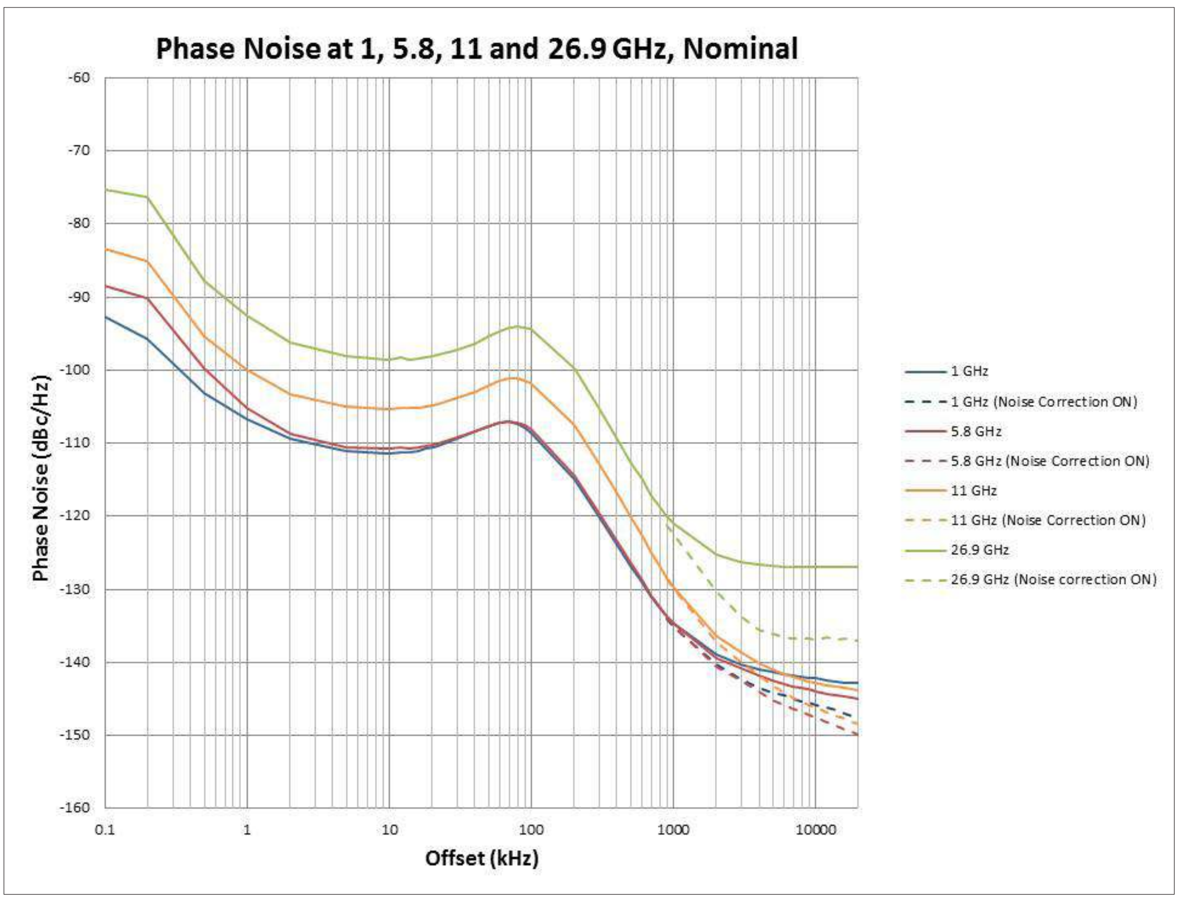


Figure 8. Nominal phase noise 1 to 26.9 GHz. Expected input level = 0 dBm, Mixer level offset = 0 dB, Pre-amp = OFF, Noise correction ON results use a counted average of 100, PeakToAverage = 5.

Standard Configuration – Options F08, F14, F18, F27

Spectral purity (cont'd)

Residuals, images & spurious responses									
Non-input related spurs [39, 40]									
< –100 dBm, nominal									
LO related spurs [41]	**Offset**	**Nominal**		**Nominal**		**Nominal**		**Nominal**	**Nominal**
	200 Hz - 1 kHz		1 - 10 kHz		10 - 100 kHz		100 kHz - 10 MHz		> 10 MHz
100 kHz to 3.6 GHz	–67 dBc	*–83 dBc*	–66 dBc	*–83 dBc*	–67 dBc	*–79 dBc*	–65 dBc	*–74 dBc*	*< –65 dBc*
3.6 to 8.4 GHz	–62 dBc	*–81 dBc*	–63 dBc	*–81 dBc*	–68 dBc	*–83 dBc*	–64 dBc	*–75 dBc*	
8.4 to 13.6 GHz	–57 dBc	*–76 dBc*	–59 dBc	*–78 dBc*	–64 dBc	*–78 dBc*	–63 dBc	*–72 dBc*	
13.6 to 17.1 GHz	–55 dBc	*–74 dBc*	–57 dBc	*–79 dBc*	–62 dBc	*–75 dBc*	–61 dBc	*–68 dBc*	
17.1 to 27 GHz	–52 dBc	*–70 dBc*	–52 dBc	*–74 dBc*	–58 dBc	*–71 dBc*	–48 dBc	*–64 dBc*	

Frac-N-Spur [42]	*< –50 dBc + 20log(N), nominal*	*IF dither On, < -65 + 20log(N), nominal*
First and higher order spurious responses [39, 43]		
	Below the noise floor by design	

IF rejection, nominal [44]			
Frequency	40 MHz IF path	40 MHz alternate IF path	100/160 MHz IF path
< 3.6 GHz			
Final IF	*–80 dBc*	*–85 dBc*	*–82 dBc*
First IF	*–64 dBc*	*–80 dBc*	*–71 dBc*
3.6 to 13.6 GHz	*–78 dBc*	*–83 dBc*	*–78 dBc*
13.6 to 20 GHz	*–70 dBc*	*–81 dBc*	*–70 dBc*
20 to 27 GHz	*–53 dBc*	*–80 dBc*	*–55 dBc*
Image responses [45]		**Specification**	**Typical**
≤ 3.6 GHz	$f_{IMAGE} = (f_C \pm 2 * f_{FINAL\ IF})$	–63 dBc	*–72 dBc*
	$f_{IMAGE} = (f_C \pm 2 * f_{FIRST\ IF})$	–77 dBc	*–85 dBc*
> 3.6 GHz (digital image rejection ON)	$f_{IMAGE} = (f_C \pm 2 * f_{FINAL\ IF})$	Images are nominally below the noise floor	
Line related spurious responses			
	–60 dBc, nominal		
Spurious free dynamic range (SFDR)			
	–72 dBc, nominal		
LO emission [46]	**Pre-amp OFF, nominal**		**Pre-amp ON, nominal**
≤ 100 MHz	*–69 dBm*		*–82 dBm*
> 100 MHz	*–80 dBm*		

39. Only applies in stepped spectrum mode with digital image rejection and IF dither enabled.
40. Expected input level: –50 dBm, mixer level offset: 0 dBm, pre-amp OFF, noise correction OFF. Enabling pre-amp and/or noise correction will yield a nominal 10 dB improvement. Known non-input related spur at 2.4 GHz nominally < –85 dBm.
41. Input level: –10 dBm, expected input level: 0 dBm, mixer level offset: 0 dBm, averages: 50.
42. N is the LO multiplication factor. See LO multiplier table for the N value versus frequency range.
43. Input level: 0 dBm, expected input level: 0 dBm, mixer level offset: 0 dBm, noise correction ON, averages: 10.
44. Suppression of signal at IF frequencies when turned at least 2x IF filter bandwidth away.
45. Expected input level = –10 dBm, Mixer level offset = 0 dB, Peak to average = 0 dB, fC = analyzer center frequency, fIMAGE = input frequency that is an image to analyzer center frequency, fFINAL IF = 240, 300, 326 MHz, fFIRST IF = 5040, 5100, 5126 MHz. Digital image rejection only available for frequencies > 3.6 GHz in stepped spectrum mode.
46. Expected input level = –50 dBm, RF attenuation = 0 dB. LO emissions refers to the LO power leaking out at the RF input port.

Technical Specifications and Characteristics

Standard Configuration – Options F08, F14, F18, F27

Time and acquisition

Maximum capture memory [47]	Memory size	Non-list mode acquisition limit	List mode acquisition limit
Option M01	512 MB	128 MSample	64 MSample
Option M05	2 GB	512 MSample	256 MSample
Option M10	4 GB	1 GSample	512 MSample [48]

Segments	
Minimum length	32 bytes
Maximum length	Full capture memory [49]
Maximum sample rate	**Specification**
Option B04 / 40 MHz	50 MS/s complex, 100 MS/s real
Option B10 / 100 MHz	125 MS/s complex, 250 MS/s real
Option B16 / 160 MHz	200 MS/s complex, 400 MS/s real
List mode	
Maximum number of segments	3201
Trigger sources	External, magnitude, wideband magnitude, wideband burst, software, immediate
Trigger modes	Per acquisition
Triggering	
Delay range [50]	–0.1 to +1 s
Delay resolution	1 sample
Delay accuracy	2 ns
Holdoff range	0 to 1 s
Holdoff resolution	10 ns
Acquisition minimum size	2 samples
Acquisition maximum size	1 GSamples
Timing [51]	
Channel-to-channel synchronization	*≤ ± 1 ns, nominal*
Repeatability across instrument state changes	*< 50 ps, nominal*

47. Sample count is based on 32-bit samples. For 64-bit samples, divide by 2.
48. The maximum size for a single list point capture is limited to 512 MSamples (2 GB). However, with option M10, total capture of up to 3.999 GB is available across all list mode captures.
49. The user can allocate memory for one or more acquisitions. Each acquisition takes up the memory that needs to be a power of 2. Minimum is 32 bytes.
50 Negative trigger delay limited to capture size.
51. Configured with a M9018A PXIe chassis for up to 4 channels. Repeatability across power cycles, IVI sessions, and module slot changes. Chassis FPGA version 1.05 or greater required.

Technical Specifications and Characteristics

Standard Configuration – Options F08, F14, F18, F27

Measurement speed

IQ data capture [52]	**Nominal**		
Large block (50 MSamples)	*1.2 s*	Transferred in 10 kSa blocks	
Small block (100 captures, 100 ksamples each)	*252 ms*	Transferred in 10 kSa blocks	
Adjust level, freq (10 ksamples)	*1.6 ms*	Transferred in 10 kSa blocks	
Power measurements [53]			
Channel power settings & filter bandwidth	Acquisition Time	Averages	Nominal
3.84 MHz	400 µs	None	*1.7 ms*
		10	*8.6 ms*
	100 µs	None	*1.2 ms*
		10	*3.8 ms*
	50 µs	None	*1.1 ms*
		10	*3.3 ms*
30 kHz	100 µs	None	*3.9 ms*
		10	*30.7 ms*

52. Capture block, transfer to host memory, 160 MHz BW, excludes frequency band transitions, with M9037A PXIe embedded controller and M9018A PXIe chassis (2-link configuration: 1 x 8 [factory default]).
53. Transfer to host memory, 160 MHz IF bandwidth filter, excludes frequency band transitions, with M9037A PXIe embedded controller and M9018A PXIe chassis (2-link configuration: 1 x 8 [factory default]).

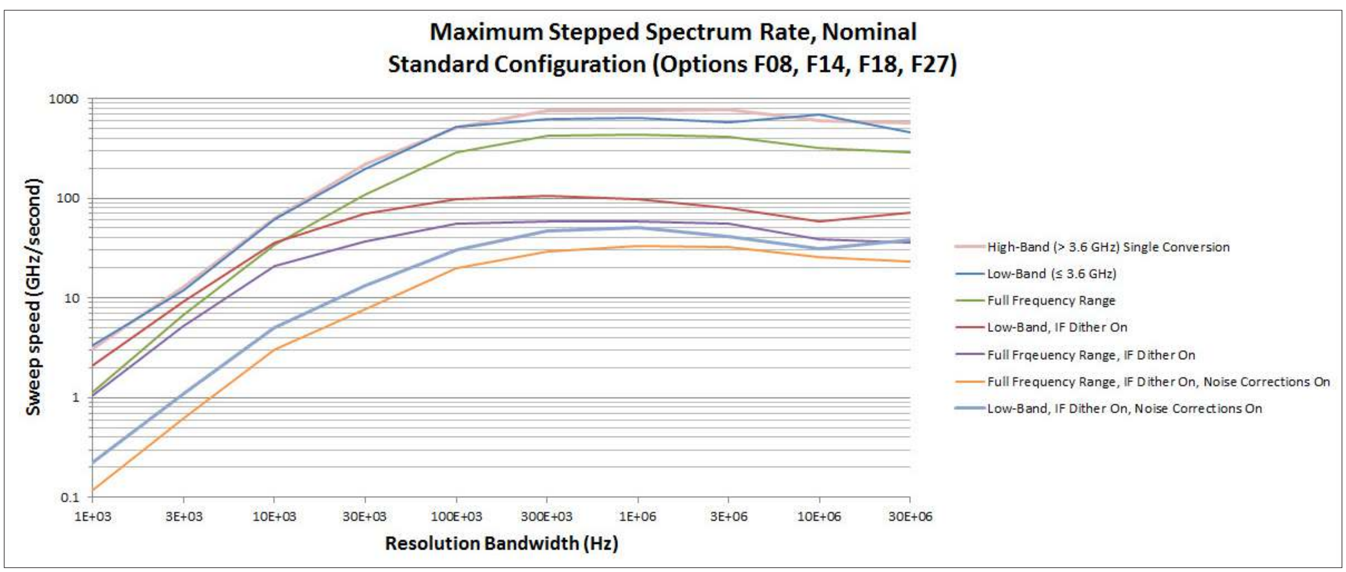


Figure 9. With 89600 VSA software Option SSA version 18.5 power spectrum measurement with M9037A PXIe embedded controller. M9214A IF digitizer in x8 slot and M9393A Option B16 (160 MHz bandwidth) and Option UNZ (fast switching).

Noise Figure Measurement Application

Description	Specifications		Supplemental Information
Noise figure			Uncertainty calculator[54]
< 10 MHz			See footnote[55]
10 MHz to 3.6 GHz			Internal and External preamplification recommended[56]
	Noise source ENR	Measurement range	Instrument Uncertainty[57]
	4 to 6.5 dB	0 to 20 dB	± 0.02 dB
	12 to 17 dB	0 to 30 dB	± 0.025 dB
	20 to 22 dB	0 to 35 dB	± 0.03 dB

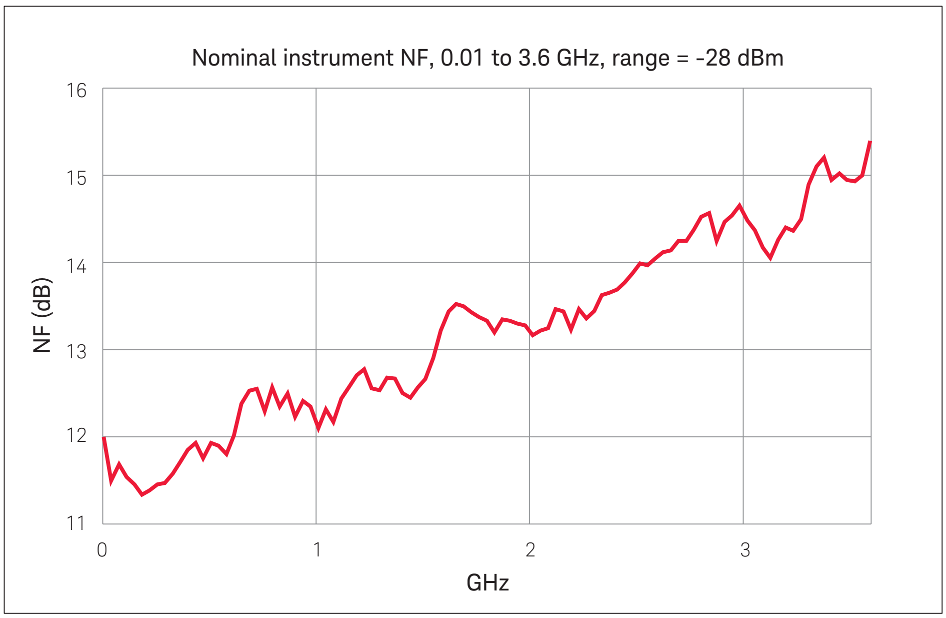
54. The figures given in the table are for the uncertainty added by the X-Series Signal Analyzer instrument only. To compute the total uncertainty for your noise figure measurement, you need to take into account other factors including: DUT NF, Gain and Match, Instrument NF, Gain Uncertainty and Match; Noise source ENR uncertainty and Match. The computations can be performed with the uncertainty calculator included with the Noise Figure Measurement Personality. Go to Mode Setup then select Uncertainty Calculator.
55. Uncertainty performance of the instrument is nominally the same in this frequency range as in the higher frequency range. However, performance is not warranted in this range. There is a paucity of available noise sources in this range, and the analyzer has poorer noise figure, leading to higher uncertainties as computed by the uncertainty calculator.
56. The NF uncertainty calculator can be used to compute the uncertainty. For most DUTs of normal gain, the uncertainty will be quite high without preamplification.
57. "Instrument Uncertainty" is defined for noise figure analysis as uncertainty due to relative amplitude uncertainties encountered in the analyzer when making the measurements required for a noise figure computation. The relative amplitude uncertainty depends on, but is not identical to, the relative display scale fidelity, also known as incremental log fidelity. The uncertainty of the analyzer is multiplied within the computation by an amount that depends on the Y factor to give the total uncertainty of the noise figure or gain measurement. See App Note 57-2, literature number 5952-3706E for details on the use of this specification. Jitter (amplitude variations) will also affect the accuracy of results. The standard deviation of the measured result decreases by a factor of the square root of the Resolution Bandwidth used and by the square root of the number of averages. This application uses the 4 MHz Resolution Bandwidth as default because this is the widest bandwidth with uncompromised accuracy.

Description	Specifications	Supplemental Information
Gain		
Instrument uncertainty[58]		DUT gain range = –20 to +40 dB. See note[59]
< 10 MHz		
10 MHz to 3.6 GHz	± 0.10 dB	

58. "Instrument Uncertainty" is defined for gain measurements as uncertainty due to relative amplitude uncertainties encountered in the analyzer when making the measurements required for the gain computation. See App Note 57-2, literature number 5952-3706E for details on the use of this specification. Jitter (amplitude variations) will also affect the accuracy of results. The standard deviation of the measured result decreases by a factor of the square root of the Resolution Bandwidth used and by the square root of the number of averages. This application uses the 4 MHz Resolution Bandwidth as default since this is the widest bandwidth with uncompromised accuracy. Under difficult conditions (low Y factors), the instrument uncertainty for gain in high band can dominate the NF uncertainty as well as causing errors in the measurement of gain. These effects can be predicted with the uncertainty calculator.
59. Uncertainty performance of the instrument is nominally the same in this frequency range as in the higher frequency range. However, performance is not warranted in this range. There is a paucity of available noise sources in this range, and the analyzer has poorer noise figure, leading to higher uncertainties as computed by the uncertainty calculator.

Description	Specifications	Supplemental Information
Noise figure uncertainty calculator[60]		
Instrument noise figure uncertainty	See the noise figure table earlier in this chapter	
Instrument gain uncertainty	See the gain table earlier in this chapter	
Instrument noise figure		See graphs of "nominal instrument noise figure"; noise figure is DANL + 176.24 dB (nominal)[61]
Instrument input match		See graphs: nominal VSWR

60. The Noise Figure Uncertainty Calculator requires the parameters shown in order to calculate the total uncertainty of a Noise Figure measurement.
61. Nominally, the noise figure of the spectrum analyzer is given by NF = D – (K – L + N + B) where D is the DANL (displayed average noise level) specification, K is kTB (-173.98 dBm in a 1 Hz bandwidth at 290 K) L is 2.51 dB (the effect of log averaging used in DANL verifications) N is 0.24 dB (the ratio of the noise bandwidth of the RBW filter with which DANL is specified to an ideal noise bandwidth) B is ten times the base-10 logarithm of the RBW (in hertz) in which the DANL is specified. B is 0 dB for the 1 Hz RBW. The actual NF will vary from the nominal due to frequency response errors.



Technical Specifications and Characteristics

Standard Configuration – Options F08, F14, F18, F27

Format specific measurement data

16QAM [62]			
EVM	Fc	Unequalized, nominal	Equalized, nominal
RRC Alpha = 0.2, 50 MSymbols/s	1.8 GHz	*0.39%*	*0.21%*
	5.95 GHz	*0.41%*	*0.20%*
RRC Alpha = 0.35, 50 MSymbols/s	5.95 GHz	*0.39%*	*0.19%*

CDMA2000 [63]		
	Parameters	Nominal
Pilot EVM	Fc = 0.9, 1.9 GHz	*0.37%*

GSM [63]		
	Parameters	Nominal
Global phase error	Fc = 0.9, 1.8, 1.9 GHz	*0.18 º*
ORFS dynamic range (noise corrections OFF)	200 kHz offset	*–36 dBc*
	250 kHz offset	*–41.5 dBc*
	400 kHz offset	*–68 dBc*
	600 kHz offset	*–75 dBc*
	800 kHz offset	*–77.5 dBc*
	1200 kHz offset	*–81.5 dBc*
	1800 kHz offset	*–79.5 dBc*

EDGE [63]		
	Parameters	Nominal
Residual EVM	Fc = 0.9, 1.8, 1.9, 2.0, 2.1, 2.2 GHz	*0.25%*
ORFS dynamic range (noise corrections OFF)	200 kHz offset	*–36.5 dBc*
	250 kHz offset	*–42 dBc*
	400 kHz offset	*–67 dBc*
	600 kHz offset	*–73.5 dBc*
	800 kHz offset	*–76.5 dBc*
	1200 kHz offset	*–81 dBc*
	1800 kHz offset	*–78.5 dBc*

W-CDMA [63]			
	Parameters		Nominal
Residual EVM	Fc = 0.9, 1.8, 1.9, 2.0, 2.1 GHz		*0.50%*
		Noise corrections OFF, nominal	Noise corrections ON, nominal
ACLR dynamic range (channel bandwidth = 5 MHz, Fc = 2 GHz)	Adjacent	*–73 dB*	*–75 dB*
	Alternate	*–75 dB*	*–79 dB*
W-CDMA channel power accuracy			*± 0.5 dB*

62. Input signal (total power) 0 dBm, range set to just above overload, conversion mode: Auto, Mixer level offset and IF level offset optimized for EVM performance.
63. Expected input level 0 dBm, input signal (total power) 0 dBm, Mixer level offset 0 dB, conversion mode: Auto, PeakToAverage set per signal peak to average.

Standard Configuration - Options F08, F14, F18, F27

Format specific measurement data (cont'd)

802.11g [64]	**Parameters**	**Nominal 1-channel**
EVM	2.4 GHz, 20 MHz BW	*–50.5 dB*

802.11a [64]	**Parameters**	**Nominal 1-channel**
EVM	5.8 GHz, 20 MHz BW	*–50 dB*

802.11n [64, 65]	**Parameters 64-QAM**	**Nominal 1-channel**	**2-channel**	**3-channel**	**4-channel**
Preamble only					
EVM	2.4 GHz, 40 MHz BW		*–48.4 dB*	*–47 dB*	*–47.9 dB*
	5.8 GHz, 40 MHz BW	*–50.5 dB*	*–49.1 dB*	*–48 dB*	*–48.7 dB*
Preamble, pilots, and data					
EVM	2.4 GHz, 40 MHz BW		*–51.4 dB*	*–50.7 dB*	*–50.4 dB*
	5.8 GHz, 40 MHz BW		*–52.2 dB*	*–51.8 dB*	*–51.2 dB*

802.11ac [64, 65]	**Parameters 256-QAM**	**Nominal 1-channel**	**2-channel**	**3-channel**	**4-channel**
Preamble only					
EVM	5.8 GHz, 80 MHz BW	*–48.5 dB*	*–46.9 dB*	*–45.5 dB*	*–46.4 dB*
	5.8 GHz, 160 MHz BW	*–46 dB*	*–45.7 dB*	*–44.3 dB*	*–45.4 dB*
Preamble, pilots, and data					
EVM	5.8 GHz, 80 MHz BW	*–51.5 dB*	*–50.9 dB*	*–49.8 dB*	*–48.7 dB*
	5.8 GHz, 160 MHz BW	*–49.5 dB*	*–49.4 dB*	*–46.9 dB*	*–47.1 dB*
SEM	5.8 GHz, 80 MHz BW	See Figure 10			

802.11a/g [64]	**Parameters**	
SEM	2.4 GHz, 20 MHz BW	See Figure 11
	5.5 GHz, 20 MHz BW	See Figure 12

802.16e [64]	**Parameters**	**Nominal 1-channel**
OFDMA WiMAX™ EVM	Fc = 2.5, 3.5, & 5.8 GHz	*–48 dB*

64. Expected input level 0 dBm, input signal (total power) 0 dBm, Mixer level offset 0 dB, conversion mode: Auto, PeakToAverage set per signal peak to average, demod symbol time adjustment –3.125%.
65. Minimum M9393A instrument driver version 1.1 required for multi-channel/MIMO operation.

Standard Configuration - Options F08, F14, F18, F27

Format specific measurement (cont'd)

LTE FDD-single channel [66]		Nominal 1-channel		
E–TM 3.1		**5 MHz**	**10 MHz**	**20 MHz**
EVM	Fc < 3.6 GHz	*–47.5 dB*	*–48.5 dB*	*–48 dB*
	Fc ≥ 3.6 GHz	*–49 dB*	*–51.5 dB*	*–50.5 dB*
	Channel BW = 5 MHz, Fc = 2 GHz	**Noise corrections OFF**	**Noise corrections ON**	
ACLR	Adjacent	*–68.5 dB*	*–71 dB*	
	Alternate	*–71 dB*	*–77.5 dB*	

LTE-FDD MIMO [66, 67]	Carrier frequency	2-channel, nominal	4-channel, nominal
10 MHz BW EVM, R9 downlink, 64 QAM, open loop spacial multiplexing	900 MHz 2 GHz	*–50.7 dB (0.29%)* *–49.3 dB (0.34%)*	*–50.7 dB (0.29%)* *–48.9 dB (0.36%)*

LTE-TDD MIMO [66, 67]	Carrier frequency	2-channel, nominal	4-channel, nominal
10 MHz BW EVM, R9 downlink, 64 QAM, open loop spacial multiplexing	900 MHz	*–49.4 dB (0.34%)*	*–49.4 dB (0.29%)*
	2 GHz	*–47.9 dB (0.4%)*	*–47.8 dB (0.41%)*

66. Expected input level 0 dBm, input signal (total power) 0 dBm, Mixer level offset 0 dB, conversion mode: Auto, PeakToAverage set per signal peak to average, demod symbol time adjustment –3.125%.
67. Minimum M9393A instrument driver version 1.1 required for multi-channel/MIMO operation.

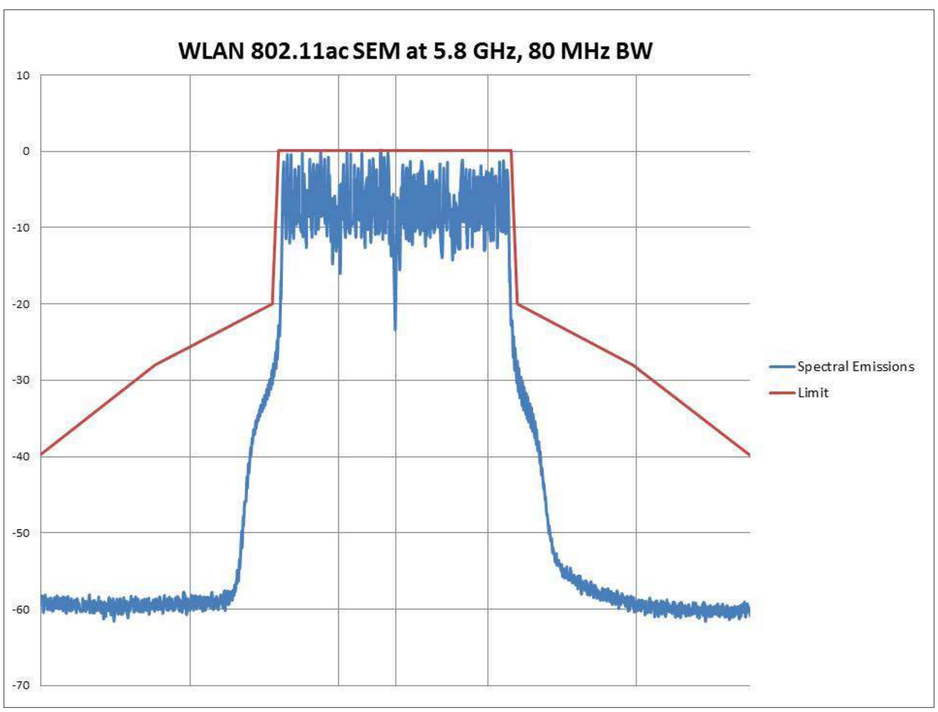


Figure 10. WLAN 802.11ac SEM at 5.8 GHz, 80 MHz bandwidth.

Standard Configuration - Options F08, F14, F18, F27

Format specific measurement (cont'd)

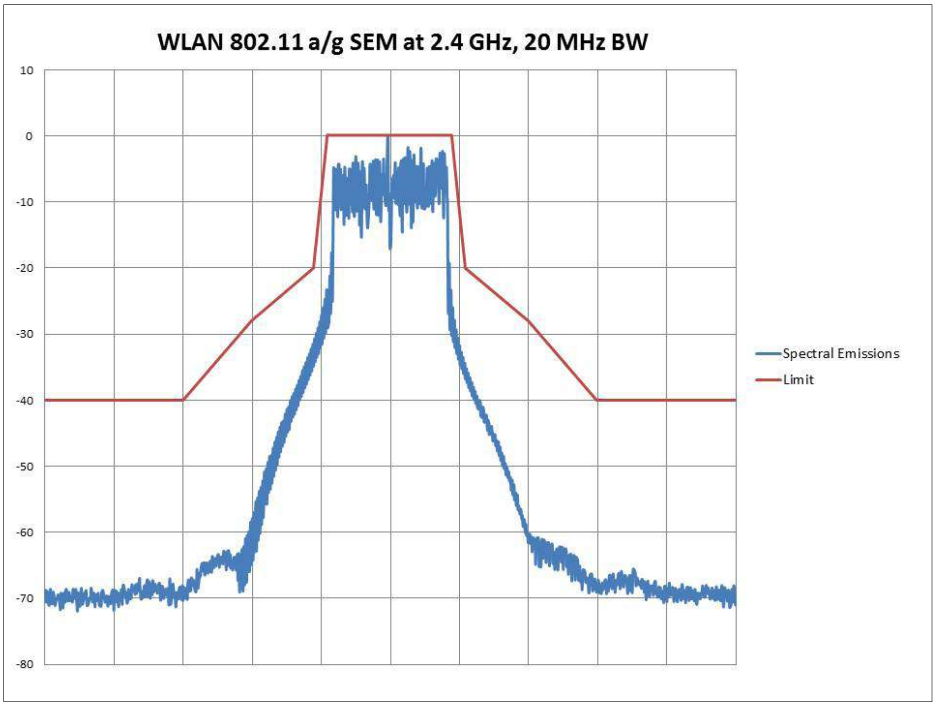


Figure 11. WLAN 802.11 a/g SEM at 2.4 GHz, 20 MHz bandwidth.

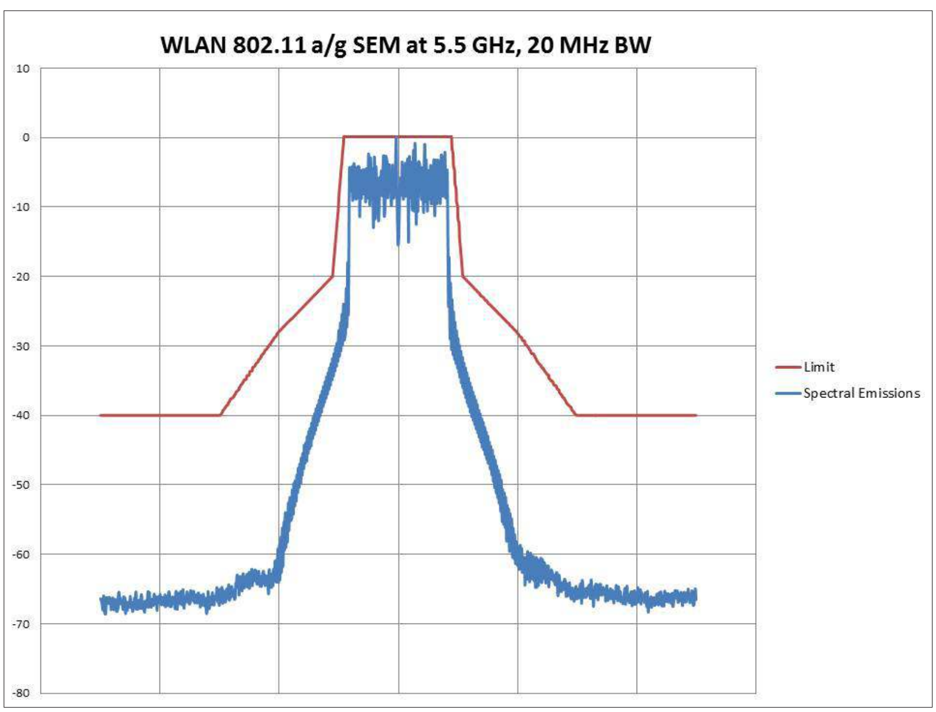


Figure 12. WLAN 802.11 a/g SEM at 5.5 GHz, 20 MHz bandwidth.

Technical Specifications and Characteristics

Extended Frequency Configuration – Option FRX

Block diagram

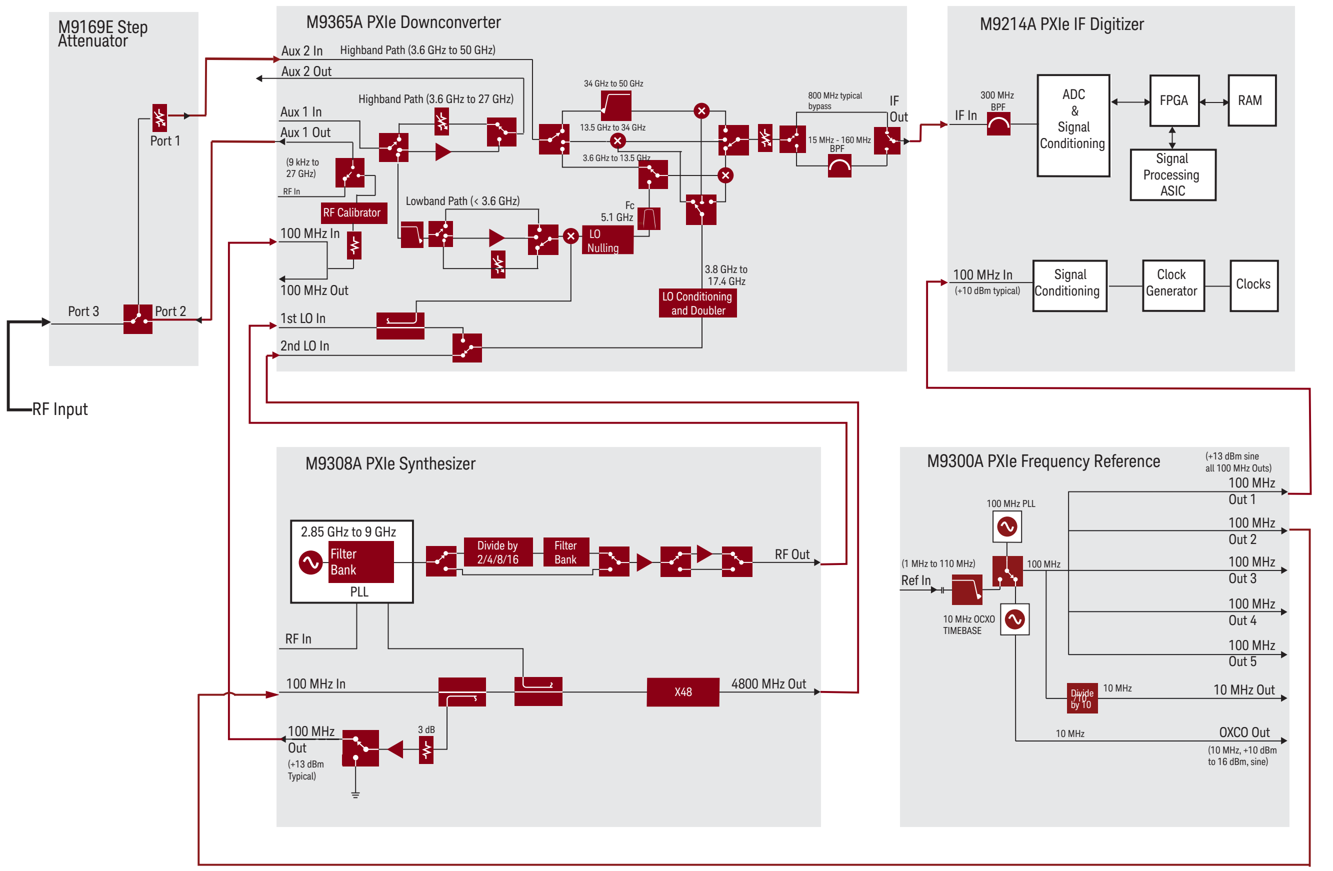


Figure 13. Extended frequency M9393A PXIe vector signal analyzer (3.6 to 50 GHz) block diagram with five modules consisting of the M9308A synthesizer, M9365A downconverter, M9214A digitizer and the optional M9300A frequency reference and M9169E switch input programmable step attenuator.

Technical Specifications and Characteristics

Extended Frequency Configuration - Option FRX

Frequency

Frequency range and resolution			
Option FRX	3.6 to 50 GHz		
Tuning resolution	Same as standard configuration		
Analysis bandwidth	Same as standard configuration		
IF frequency	Same as standard configuration		
Band	**Harmonic mixing mode**	**LO multiple (N)**	**Frequency**
Band 1	1	1	3.6 to 8.4 GHz
Band 2	1	2	8.4 to 13.6 GHz
Band 3	2	2	13.6 to 17.1 GHz
Band 4	2	4	17.1 to 27 GHz
Band 5	2	4	27 to 34 GHz
Band 6	4	8	34 to 50 GHz
Frequency switching speed [68]			
List mode switching speed	**Band**	**Standard, nominal**	**Option UNZ, nominal**
Baseband frequency offset change	Same as standard configuration		
Arbitrary frequency change within:	Bands 1 - 4	Same as standard configuration	
	Band 5	*5 ms*	*< 200 µs*
	Band 6	*5 ms*	*< 200 µs*
Non-list mode switching speed	Same as standard configuration		
Resolution bandwidth (RBW)			
Minimum RBW	Same as standard configuration		
Maximum span:RBW ratio	Same as standard configuration		
Maximum RBW			
3.6 to 31.8 GHz	Same as standard configuration		
> 31.8 GHz	10 MHz		
Video bandwidth (VBW)	Same as standard configuration		
Frequency span			
Range	Single FFT: Same as standard configuration Stepped: 800 Hz to 46.4 GHz		
Resolution	Same as standard configuration		
Frequency reference	Same as standard configuration		

68. Frequency changes may result in attenuator state changes when operating with M9169E module. Frequency switching speed does not include attenuator switching time.

Extended Frequency Configuration – Option FRX

Amplitude

Input level	Without M9169E		With M9169E	
Max safe average total power	+ 17 dBm		Refer to the M9169E data sheet	
Max DC voltage	± 10 Vdc			
Max RF input (recommended)	– 14 dBm			
Expected input level setting	**Without M9169E**		**With M9169E**	
Range	– 170 to – 14 dBm		– 170 to + 30 dBm	
Resolution	Same as standard configuration			
Attenuator	Not available for this configuration		Mechanical attenuator available with M9169E. Refer to M9169E data sheet	
Absolute amplitude accuracy, nominal [69]	**Without M9169E [70]**		**With M9169E [71]**	
3.6 to 15 GHz	*± 0.15 dB*		*± 0.20 dB*	
> 15 to 30 GHz	*± 0.39 dB*		*± 0.38 dB*	
> 30 to 50 GHz	*± 1.58 dB*		*± 0.83 dB*	
IF flatness, nominal [72]	**Without M9169E [73]**		**With M9169E**	
Frequency	**3.6 to 18 GHz**	**> 18 to 50 GHz**	**3.6 to 18 GHz**	**> 18 to 50 GHz**
Across any 20 MHz in 40 MHz path	*± 0.08 dB*	*± 0.18 dB*	*± 0.1 dB*	*± 0.21 dB*
Across any 20 MHz in 160 MHz path	*± 0.1 dB*	*± 0.26 dB*	*± 0.12 dB*	*± 0.31 dB*
40 MHz	*± 0.12 dB*	*± 0.29 dB*	*± 0.25 dB*	*± 0.36 dB*
100 MHz	*± 0.15 dB*	*± 0.46 dB*	*± 0.33 dB*	*± 0.76 dB*
160 MHz	*± 0.23 dB*	*± 0.77 dB*	*± 0.43 dB*	*± 1.05 dB*
IF phase linearity, nominal [72]	**Without M9169E [73]**		**With M9169E**	
Frequency	**3.6 to 17 GHz**	**> 17 to 50 GHz**	**3.6 to 17 GHz**	**> 17 to 50 GHz**
Across any 20 MHz in 40 MHz path	*± 1.57 °*	*± 2.13 °*	*± 1.8 °*	*± 2.17 °*
Across any 20 MHz in 160 MHz path	*± 1.43 °*	*± 2.51 °*	*± 1.39 °*	*± 2.35 °*
40 MHz	*± 1.58 °*	*± 2.3 °*	*± 1.8 °*	*± 2.62 °*
100 MHz	*± 1.88 °*	*± 3.64 °*	*± 2.38 °*	*± 4.06 °*
160 MHz	*± 2.89 °*	*± 3.8 °*	*± 2.57 °*	*± 4.06 °*
IF bandwidth filter switching uncertainty	Same as standard configuration with pre-amp off			
Expected input level switching uncertainty, nominal [69, 70]			**With M9169E**	
3.6 to 30 GHz			*± 0.15 dB*	
> 30 to 50 GHz			*± 0.3 dB*	

69. Measured using an attenuator with VSWR performance equal to or better than the 8490D-020 coaxial attenuator. Peak to average = 0 dB. Applies after comprehensive alignment. Frequency is exclusive on the start frequency and inclusive on the stop frequency.
70. Referenced to expected input level setting of –14 dBm for configuration without M9169E.
71. Referenced to expected input level setting of –5 dBm for configuration with M9169E.
72. Applies after comprehensive alignment. Deviation from the mean error of the entire bandwidth. Expected input level = 0 dBm, Mixer level offset = 0. Applies for bandwidths where (center frequency ± bandwidth/2) does not exceed the frequency range.
73. Measured using an attenuator with VSWR performance equal to or better than the 8490D-020 coaxial attenuator.

Technical Specifications and Characteristics

Extended Frequency Configuration - Option FRX

Amplitude (cont'd)

	Without M9169E	With M9169E
Amplitude switching speed	—	Refer to M9169E data sheet
Trace detectors	Same as standard configuration	
Preamplifier	Not available for this configuration	

Dynamic range

Displayed average noise level (DANL), nominal [66]	**Without M9169E**	**With M9169E**
3.6 to 13.6 GHz	*–161 dBm/Hz*	*–158 dBm/Hz*
> 13.6 to 34 GHz	*–158 dBm/Hz*	*–153 dBm/Hz*
> 34 to 45 GHz	*–156 dBm/Hz*	*–151 dBm/Hz*
> 45 to 50 GHz	*–153 dBm/Hz*	*–147 dBm/Hz*

Third order intermodulation distortion (TOI), nominal [67]	**Without M9169E**	**With M9169E**
3.6 to 13.6 GHz	*9.5 dBm / -53 dBc*	*11 dBm / -56 dBc*
> 13.6 to 34 GHz	*5.5 dBm / -45 dBc*	*8.5 dBm / -51 dBc*
> 34 to 50 GHz	*–2 dBm / -30 dBc*	*2.5 dBm / –39 dBc*

Second harmonic distortion (SHI), nominal	**Without M9169E**	**With M9169E**
3.6 to 13.6 GHz	*33 dBm / –33 dBc*	Add loss from M9169E data sheet
13.6 to 34 GHz	*25.5 dBm / –25.5 dBc*	
34 to 50 GHz	*18 dBm / –18 dBc*	

74. Mixer level offset = 0, Conversion = auto, PeakToAverage = 0. Expected input level = -60 dBm
75. Tone separation = 100 kHz, Expected input level = -14 dBm, Mixer offset level = 0 dB, PeakToAverage = 6 dB, Conversion type Auto. Signal level of -17 dBm used to calculate distortion in dBc. TOI = third order intercept. The TOI is given by the input tone level (in dBm) minus (distortion/2) where distortion is the relative level of the distortion tones in dBc.

Technical Specifications and Characteristics

Extended Frequency Configuration – Option FRX

Spectral purity

Phase noise

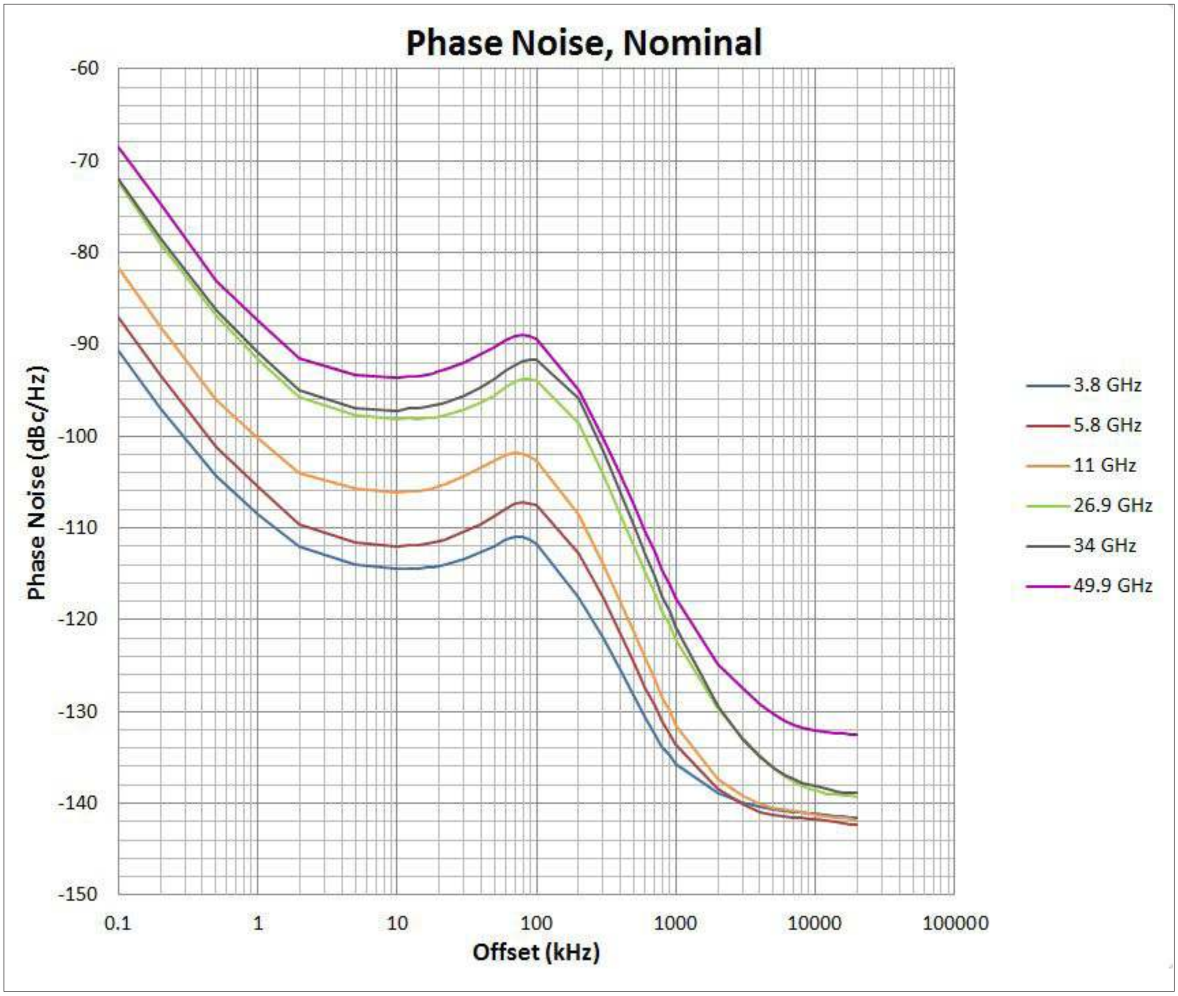


Figure 14. Nominal phase noise 1 to 49.9 GHz. Expected input level = -14 dBm, Mixer level offset = 0 dB, PeakToAverage = 5.

Spurious free dynamic range (SFDR)	Same as standard configuration

Technical Specifications and Characteristics

Extended Frequency Configuration – Option FRX

Time and acquisition

Maximum capture memory	Same as standard configuration
Segments	Same as standard configuration
Maximum sample rate	Same as standard configuration
List mode	Same as standard configuration
Triggering	Same as standard configuration
Timing [76]	
Channel-to-channel synchronization	< ± *1 ns, nominal*
Repeatability across instrument state changes	< ± *50 ps, nominal*

Measurement speed

IQ data capture	Same as standard configuration
Power measurements	Same as standard configuration

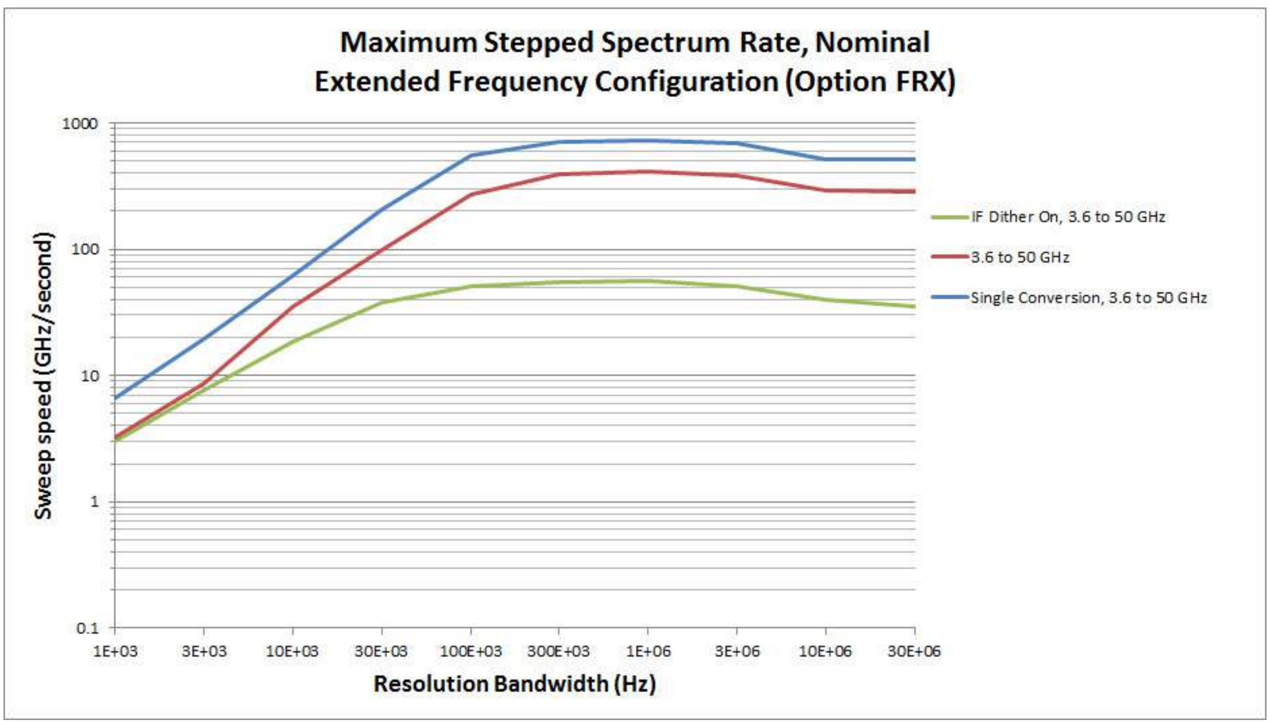


Figure 15. FRX spectrum frequency plot

76. Configured with a M9018A PXIe chassis. Repeatability across power cycles and IVI sessions. Applies to 2 channels in configura-tions both with and without M9169E with chassis FPGA version 1.05 or greater required
77. Input signal (total power) 0 dBm, range set to just above overload, conversion mode: Auto, Mixer level offset and IF level offset optimized for EVM performance..

Technical Specifications and Characteristics

Extended Frequency Configuration – Option FRX

16 QAM [78] EVM		Without M9169E		With M9169E	
	Fc	Unequalized. nominal	Equalized, nominal	Unequalized. nominal	Equalized, nominal
RRC Alpha = 0.2, 50 MSymbols/s	5.95 GHz	0.43%	0.22%	0.49%	0.22%
RRC Alpha = 0.35, 50 MSymbols/s	5.95 GHz	0.37%	0.21%	0.43%	0.20%
RRC Alpha = 0.2, 62.5 MSymbols/s	5.95 GHz	0.57%	0.22%	0.69%	0.22%
RRC Alpha = 0.35, 62.5 MSymbols/s	5.95 GHz	0.54%	0.21%	0.60%	0.20%
	15 GHz	-	-	0.47%	0.37%
	24 GHz	-	-	1.54%	0.99%
	31 GHz	-	-	1.32%	0.55%
	40 GHz	-	-	1.21%	0.77%
RRC Alpha = 0.35, 104.167 MSymbols/s	15 GHz	-	-	0.50%	0.40%
	24 GHz	-	-	1.87%	1.21%
	31 GHz	-	-	1.76%	0.55%
	40 GHz	-	-	1.32%	0.77%

78. Input signal (total power) 0 dBm, range set to just above overload, conversion mode: Auto, Mixer level offset and IF level offset optimized for EVM performance.

Environmental and Physical Specifications

Temperature	Operating		Individual module temp 15 to 75 °C as reported by the module and environment temp of 0 to 55 °C	
	Non-operating (storage)		Environment temp of –40 to +70 °C	
Humidity [79]			Type tested at 95%, +40 °C (non-condensing)	
Shock/vibration [79]	Operating random vibration Survival random vibration Functional shock Bench handling		Type tested at 5 to 500 Hz, 0.21 g rms Type tested at 5 to 500 Hz, 2.09 g rms Type tested at half-sine, 30 g, 11 ms Type tested per MIL-PRF-28800F	
Altitude			Up to 15,000 feet (4,572 meters) [80]	
Connectors	RF In		APC 3.5 mm (f)	
	Aux 2 In		2.4 mm (f)	
EMC			Complies with European EMC Directive 2004/108/EC – IEC/EN 61326-2-1 – CISPR Pub 11 Group 1, class A – AS/NZS CISPR 11 – ICES/NMB-001 This ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB-001 du Canada.	
Warm-up time			30 minutes	
Size	M9300A M9308A M9365A M9214A		1 PXIe slot 1 PXIe slot 2 PXIe slots 1 PXIe slot	
Dimensions	Module	Length	Width	Height
	M9300A	210 mm	22 mm	130 mm
	M9308A	210 mm	22 mm	130 mm
	M9365A	210 mm	44 mm	130 mm
	M9214A	210 mm	22 mm	130 mm
Weight	M9300A M9308A M9365A M9214A		0.55 kg (1.21 lbs) 0.59 kg (1.31 lbs) 1.05 kg (2.31 lbs) 0.36 kg (0.79 lbs)	
Power drawn from chassis	M9300A M9308A M9365A M9214A		≤ 18 W ≤ 37 W ≤ 50 W ≤ 35 W	

79. Samples of this product have been type tested in accordance with the Environmental Test Manual and verified to be robust against the environmental stresses of storage, transportation and end-use – those stresses include but are not limited to temperature, humidity, shock, vibration, altitude and power-line conditions. Test methods are aligned with IEC 60068-2 and levels are similar to MIL-PRF-28800F Class 3.
80. At 15,000 feet, the maximum environmental temperature is de-rated to 52 °C.

Configuration and Ordering Information

Ordering information

Model	Description
M9393A	PXIe performance vector signal analyzer: 9 kHz to 8.4, 14, 18, or 27 GHz Includes: M9308A PXIe synthesizer M9365A PXIe downconverter M9214A PXIe IF digitizer One day startup assistance Module interconnect cables Software, example programs and product information on CD (optional) Return to warranty – 3 years
Standard base configuration	
M9393A-F08	Frequency range: 9 kHz to 8.4 GHz
M9393A-B04	Analysis bandwidth, 40 MHz
M9393A-M01	Memory, 128 MSa
M9393A-300 Required for warranted specifications	Adds M9300A PXIe frequency reference: 10 and 100 MHz (M9300A module can support multiple M9393A modular instruments)

Configurable options

For a complete list of the M9393A PXI Performance VSA product options, please consult the M9393A configuration guide, literature number **5991-4580EN**.

Frequency		
M9393A-F14	9 kHz to 14 GHz	
M9393A-F18	9 kHz to 18 GHz	
M9393A-F27	9 kHz to 27 GHz	
M9393A-FRX	3.6 to 50 GHz	Requires Option F27
Additional capability		
M9393A-UNZ	Fast tuning	
M9393A-WB1	Wideband IF output	
Analysis bandwidth		
M9393A-B10	100 MHz	
M9393A-B16	160 MHz	
Memory		
M9393A-M05	512 MSa	
M9393A-M10	1024 MSa	
Pre-amplifier		
M9393A-P08	8.4 GHz preamplifier	
M9393A-P14	14 GHz preamplifier	
M9393A-P18	18 GHz preamplifier	
M9393A-P27	27 GHz preamplifier	
Other		
M9393A-UK6	Commercial calibration certificate with test data for M9393A (M9308A, M9365A, M9214A)	
M9300A-UK6	Commercial calibration certificate with test data for M9300A (module only)	
Related products in recommended configuration		
M9037A	PXIe embedded controller	
M9018A	18-slot PXIe chassis	
M9169E	Programmable step attenuator recommended for Option FRX	
M9203A	PXIe wideband IF digitizer for Option WB1	

Configuration and Ordering Information

Software information

Supported operating systems	Microsoft Windows 7 (32/64-bit)
Standard compliant drivers	IVI-COM, IVI-C, MATLAB
Supported application development environments (ADE)	VisualStudio (VB.NET, C#, C/C++), VEE, LabVIEW, LabWindows/CVI, MATLAB
IO libraries (version 16.3 or newer)	Includes: VISA libraries, Connection Expert, IO monitor
Command Expert	Instrument control for SCPI or IVI-COM drivers
89600 VSA Software (recommended minimum version 20)	89601B-200 89600 VSA software, basic and hardware connectivity 89601B-SSA Spectrum analysis 89601B-AYA Digital demodulation 89601B-BHF Custom OFDM 89601B-B7T cdma2000®/1xEV-DO 89601B-B7U W-CDMA/HSPA+ 89601B-B7R WLAN 802.11a/b/g/j/p 89601B-BHJ WLAN 802.11ac MIMO 89601B-B7X TD-SCDMA 89601B-BHD LTE FDD 89601B-BHG LTE FDD - Advanced 89601B-BHE LTE TDD 89601B-BHH LTE TDD - Advanced 89601B-B7W 1xEV-DO 89601B-B7R 3G bundle 89601B-BHC RFID 89601B-BHK Custom IQ 89601B-BHL Channel quality 89601B-BHM DOCSIS 3.1 89601B-BHP FMCW radar 89601B-BHQ Pulse
X-Series Measurement Applications for Modular Instruments transportable perpetual license (only available for M9393A standard configuration)	M9063A Analog M9064A VXA Vector Signal Analysis M9068A Phase noise M9071A GSM/EDGE/Evo M9072A cdma2000/cdmaOne M9073A W-CDMA/HSPA+ M9076A 1xEV-DO M9077A WLAN 802.11a/b/g/n/ac M9079A TD-SCDMA/HSDPA M9080B LTE/LTE-A FDD M9081A *Bluetooth*® M9082B LTE/LTE-A TDD

Accessories

Model	Description
Y1212A	Slot blocker kit: 5 modules
Y1213A	PXI EMC filler panel kit: 5 slots
Y1214A	Air inlet kit: M9018A 18-slot chassis
Y1215A	Rack mount kit: M9018A 18-slot chassis

Related products

Model	Description
M9381A	PXIe vector signal generator
M9380A	PXIe CW source
M9300A	PXIe frequency reference
M9021A	PCIe® cable interface
M9045B	PCIe express card adaptor for laptop connectivity
Y1200B	PCIe cable for laptop connectivity
M9048A	PCIe desktop adaptor for desktop connectivity
Y1202A	PCIe cable for desktop connectivity

Advantage services: Calibration and warranty	
Advantage Services is committed to your success throughout your equipment's lifetime	
R-51B-001-5Z	Return to warranty – 5 years
R-51B-001-3X	Express warranty – 3 years
R-51B-001-5X	Express warranty – 5 years
N7800A	Calibration & adjustment software