# Keysight Technologies
# M9393A PXIe Performance Vector Signal Analyzer
## 9 kHz to 8.4, 14, 18 or 27 GHz

Data Sheet


KEYSIGHT TECHNOLOGIES

# Table of Contents

# 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 Keysight Technologies, Inc. is taking flexibility farther with the M9393A PXIe performance vector signal analyzer. The M9393A is the realization of our microwave 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 Keysight 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. 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 modular vector signal analyzer for frequencies from 9 kHz to 8.4, 14, 18 or 27 GHz. A typical PXI VSA configuration includes four individual PXI modules – M9300A frequency reference, M9308A synthesizer, M9365A downconverter and M9214A digitizer. For more information on product options and configurations, see the Configuration Guide, literature number 5991-4580EN.

# 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 Keysight M9300A frequency reference and Keysight 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. 2σ 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. Keysight 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 | 9 kHz to 8.4, 14, 18 or 27 GHz |
| Double conversion | 9 kHz to 3.6 GHz |
| Single high | 3.6 GHz to 8.4, 14, 18 or 27 GHz |
| Single low | 3.6 GHz to 8.4, 14, 18 or 27 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.
- 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

## Block diagram

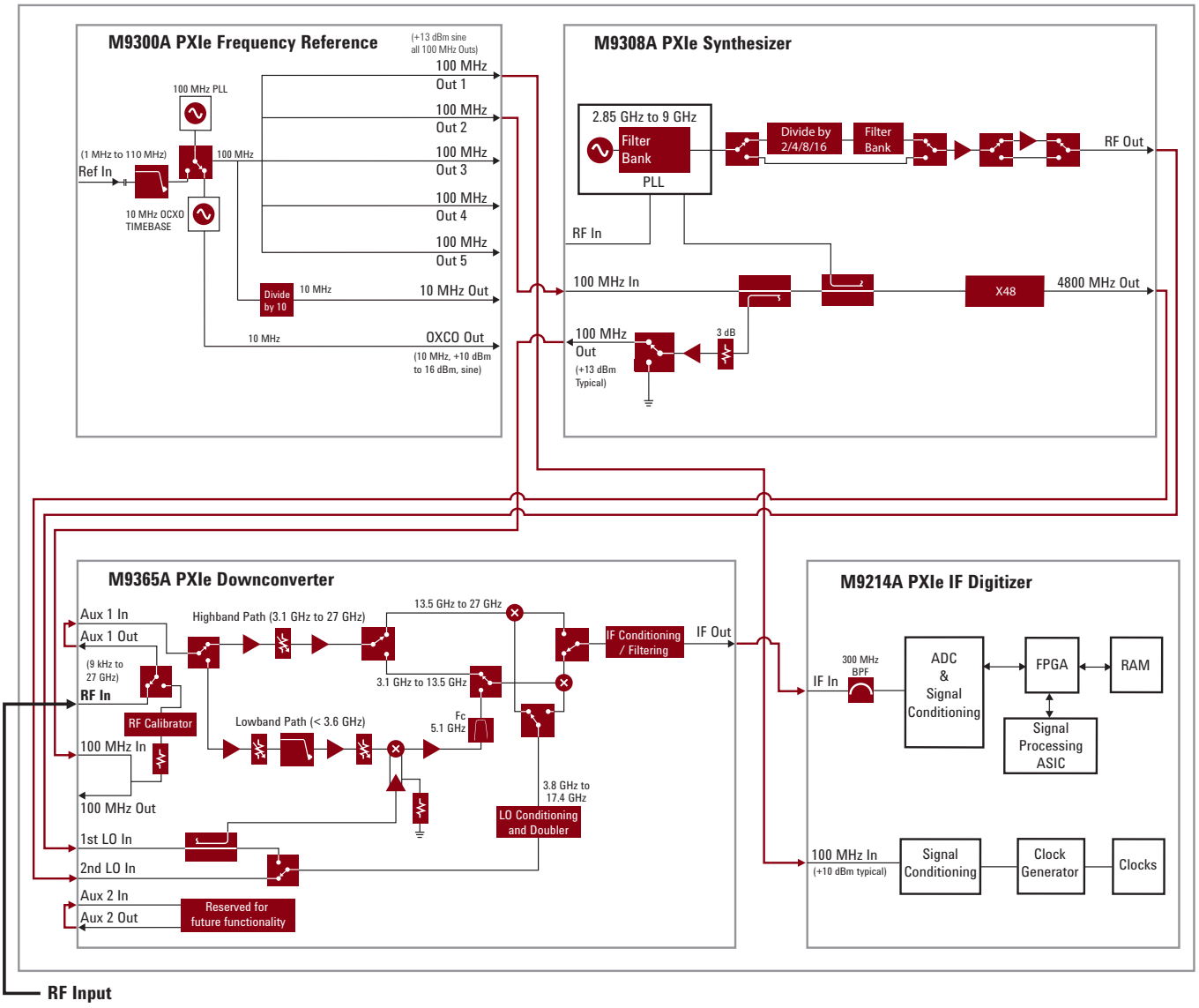



Figure 2. M9393A PXIe vector signal analyzer block diagram with four modules consisting of the M9308A synthesizer, M9365A downconverter, M9214A digitizer and the optional M9300A frequency reference.

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 configuration guide, literature number 5991-4580EN.

# Technical Specifications and Characteristics

## 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 | |
| **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 |

| **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.

# Technical Specifications and Characteristics

## Frequency (cont'd)

| **Frequency switching speed** [5, 6] | | | |
|---|---|---|---|
| **List mode switching speed** [7] | **Band** | **Standard, nominal** | **Option UNZ, nominal** |
| Baseband frequency offset change [9] | < 40 MHz | *5 ms* | *26 µs* |
| | ≥ 40 MHz to ≤ 100 MHz | | *12 µs* |
| | > 100 MHz to < 180 MHz | | *95 µs* |
| | ≥ 180 MHz | | *11 µs* |
| Arbitrary frequency change within: | 0: < 3.6 GHz | *5 ms* | *175 µs* |
| | 1: 3.6 to 8.4 GHz | | *135 µs* |
| | 2: 8.4 to 13.6 GHz | | *135 µs* |
| | 3: 13.6 to 17.1 GHz | | *155 µs* |
| | 4: 17.1 to 27 GHz | | *145 µs* |

| **Non-list mode switching speed** [8] | **Standard, nominal** | **Option UNZ, nominal** |
|---|---|---|
| Baseband frequency offset change [9] | *5 ms* | *250 µs* |
| Arbitrary frequency change | *5 ms* | *1 ms* |

| **Resolution bandwidth (RBW)** | | |
|---|---|---|
| Minimum RBW | 1 Hz | |
| **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<br>Stepped: 800 Hz to 27 GHz |
| Resolution | 2 Hz |

5. When used with the M9018A PXIe chassis (2-link configuration: 1 x 8 [factory default]) and M9037A PXIe embedded controller.
6. 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.
7. 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.
8. 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.
9. 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.

# Technical Specifications and Characteristics

## 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<br>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 | +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 | .01 dB |

| **Electronic attenuator** [10] | |
|---|---|
| Frequency range | 9 kHz to 27 GHz |
| Attenuation range | 0 to 42 dB |
| Step size | 0.25 dB |

**Absolute amplitude accuracy** [11]

| **Frequency** [12] | **Pre-amp OFF** [13] | | | **Pre-amp ON** [14] | | |
|---|---|---|---|---|---|---|
| | Specification | 95th percentile | Typical | Specification | 95th 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** [12] | **Pre-amp OFF, expected input level ≤ -5 dBm** [15] | | |
|---|---|---|---|
| | Specification | 95th 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* |

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

# Technical Specifications and Characteristics

## Amplitude (cont'd)

| **Amplitude repeatability and linearity** | | | | | | |
|---|---|---|---|---|---|---|
| | Pre-amp OFF, typical | | | Pre-amp ON, typical | | |
| Repeatability[16] | *±0.03 dB* | | | *±0.06 dB* | | |
| **Linearity [17]** | **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 [18, 19]** | **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 [18, 19]** | **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 [20]** | | | |
|---|---|---|---|
| | 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 [21]** | | | | | | |
|---|---|---|---|---|---|---|
| | **Pre-amp OFF [22]** | | | | **Pre-amp ON [23]** | |
| | ≤ –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* |

16. 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.
17. Input level 20 dB above the noise floor and ADC dither on, no change in hardware settings, below expected input level.
18. Deviation from the mean error of the entire bandwidth, all conversion types.
19. Expected input level = 0 dBm, Mixer level offset = 0.
20. Amplitude error relative to the reference IF bandwidth filter of 40 MHz. Preamplifier mode is set in the on or off position, not Auto.
21. Measured using an attenuator with VSWR performance equal to or better than the Keysight 8490D-020 coaxial attenuator. Peak to average = 0 dB.
22. Measurement referenced to Expected input level setting of –5 dBm
23. Measurement referenced to Expected input level setting of –3 dBm

# Technical Specifications and Characteristics

## Amplitude (cont'd)

| **Amplitude switching speed** [24] | | | |
|---|---|---|---|
| **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 [25] | *90 µs* | *180 µs* | *50 µs* |
| From higher to lower power [25] | *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** [26] | **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* |

24. When using M9018A PXIe chassis (2-link configuration: 1x8 [factory default]) and M9037A PXIe embedded controller. Amplitude settled to within 0.1 dB. Does not include data acquisition or processing time.
25. No pre-amplifier switching.
26. Gain is normalized to pre-amplifier OFF state.

# Technical Specifications and Characteristics

## Dynamic range

| **Displayed average noise level (DANL)** [27] | | | | | |
|---|---|---|---|---|---|
| | | **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 900 MHz | –147 dBm/Hz | –158 dBm/Hz | *–150 dBm/Hz* | *–161 dBm/Hz* |
| | 900 MHz to 2.6 GHz | –145 dBm/Hz | –156 dBm/Hz | *–148 dBm/Hz* | *–158 dBm/Hz* |
| | 2.6 to 3.6 GHz | –143 dBm/Hz | –154 dBm/Hz | *–146 dBm/Hz* | *–157 dBm/Hz* |
| | 3.6 to 7.4 GHz | –146 dBm/Hz | –157 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 21 GHz | –133 dBm/Hz | –144 dBm/Hz | *–136 dBm/Hz* | *–147 dBm/Hz* |
| | 21 to 22 GHz | –131 dBm/Hz | –142 dBm/Hz | *–135 dBm/Hz* | *–145 dBm/Hz* |
| | 22 to 26 GHz | –124 dBm/Hz | –134 dBm/Hz | *–128 dBm/Hz* | *–138 dBm/Hz* |
| | 26 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 | –147 dBm/Hz | *–142 dBm/Hz* | *–152 dBm/Hz* |
| | 51 to 2.8 GHz | –154 dBm/Hz | –165 dBm/Hz | *–158 dBm/Hz* | *–168 dBm/Hz* |
| | 2.8 to 3.6 GHz | –153 dBm/Hz | –164 dBm/Hz | *–157 dBm/Hz* | *–168 dBm/Hz* |
| | 3.6 to 9 GHz | –152 dBm/Hz | –163 dBm/Hz | *–156 dBm/Hz* | *–166 dBm/Hz* |
| | 9 to 16.2 GHz | –150 dBm/Hz | –160 dBm/Hz | *–154 dBm/Hz* | *–164 dBm/Hz* |
| | 16.2 to 21 GHz | –147 dBm/Hz | –157 dBm/Hz | *–152 dBm/Hz* | *–163 dBm/Hz* |
| | 21 to 23.9 GHz | –143 dBm/Hz | –153 dBm/Hz | *–149 dBm/Hz* | *–159 dBm/Hz* |
| | 23.9 to 25.9 GHz | –139 dBm/Hz | –150 dBm/Hz | *–145 dBm/Hz* | *–155 dBm/Hz* |
| | 25.9 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** [28] | | |
|---|---|---|
| **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* |

27. Expected input level = –60 dBm, Mixer level offset = 0 dBm, Noise Correction ON uses 100 averages, Conversion = auto, PeakToAverage = 0 dB.

28. 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

## Dynamic range (cont'd)

| Third order intermodulation distortion (TOI) | | | | |
|---|---|---|---|---|
| | **Frequency** | **Specification [31]** | **Typical** | **Nominal** |
| Pre-amp OFF [29] | 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 [30] | 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 [34]** | **Nominal** |
| Pre-amp OFF [32] | 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 [33] | 10 MHz to 1.5 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* |

29. 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 calsulate distortion in dBc.
30. 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 calsulate distortion in dBc.
31. 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.
32. Expected input level = 0 dBm . Signal level of 0 dBm used to calculate distortion in dBc.
33. Expected input level = –30 dBm . Signal level of -30 dBm used to calculate distortion in dBc.
34. 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

## Dynamic range (cont'd)

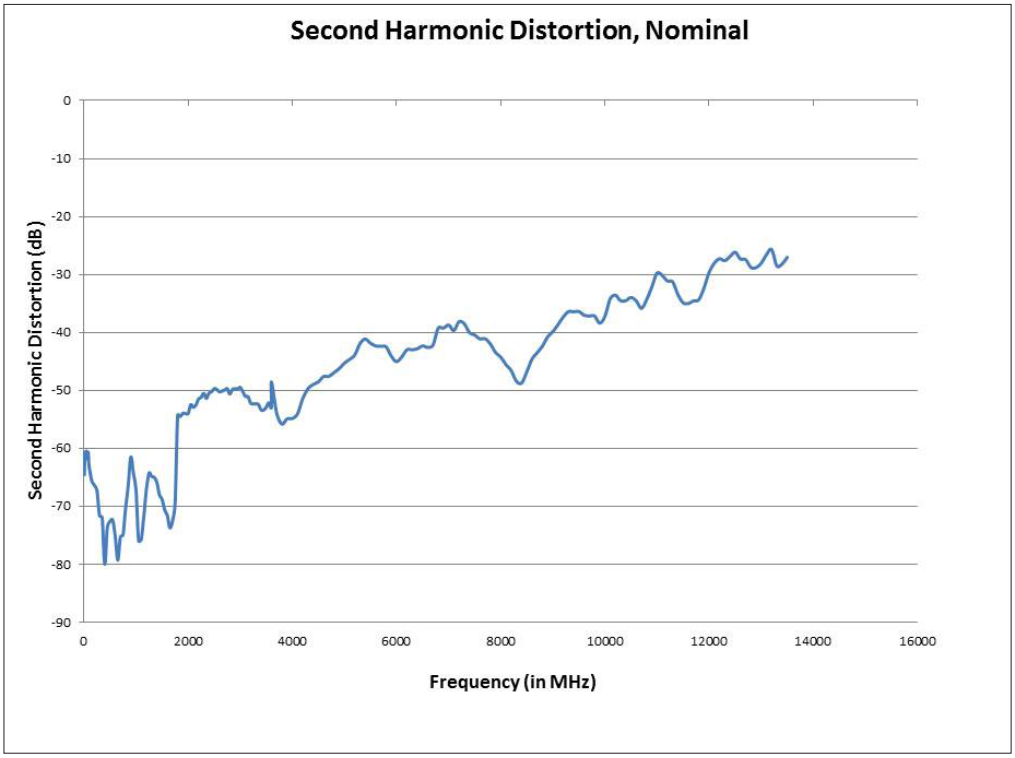



Figure 3. Nominal second harmonic distortion, expected input level = 0 dBm.

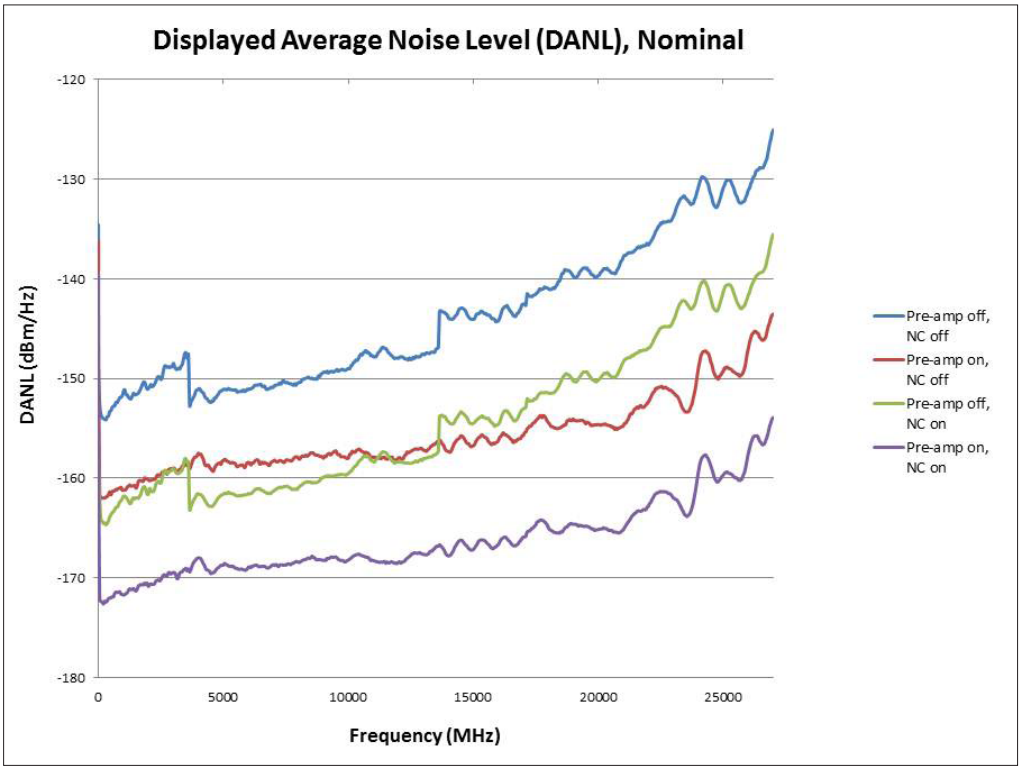



Figure 4. Nominal displayed average noise level. Expected input level = -60 dBm, Mixer level offset = 0 dBm, Noise correction (NC) ON uses 100 averages.

# Technical Specifications and Characteristics

## Dynamic range (cont'd)

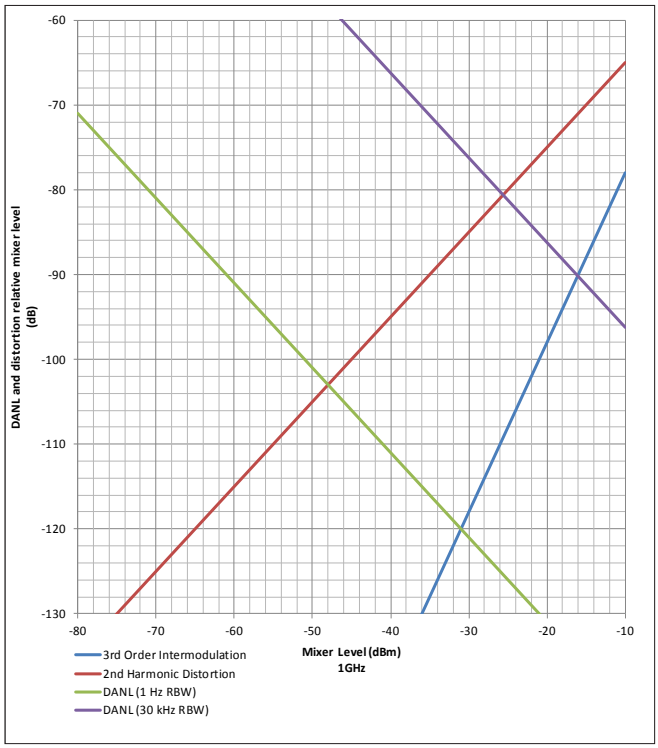



Figure 5. Dynamic range at 1 GHz.

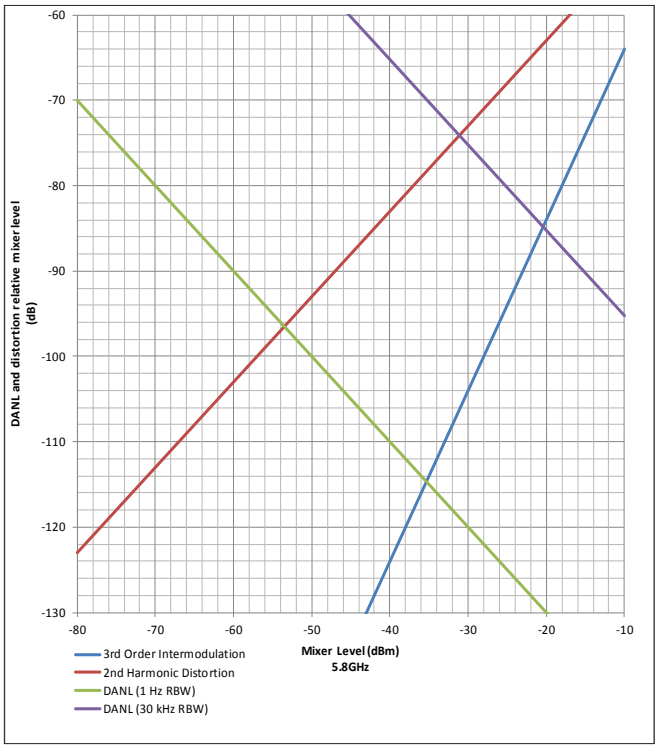



Figure 6. Dynamic range at 5.8 GHz.

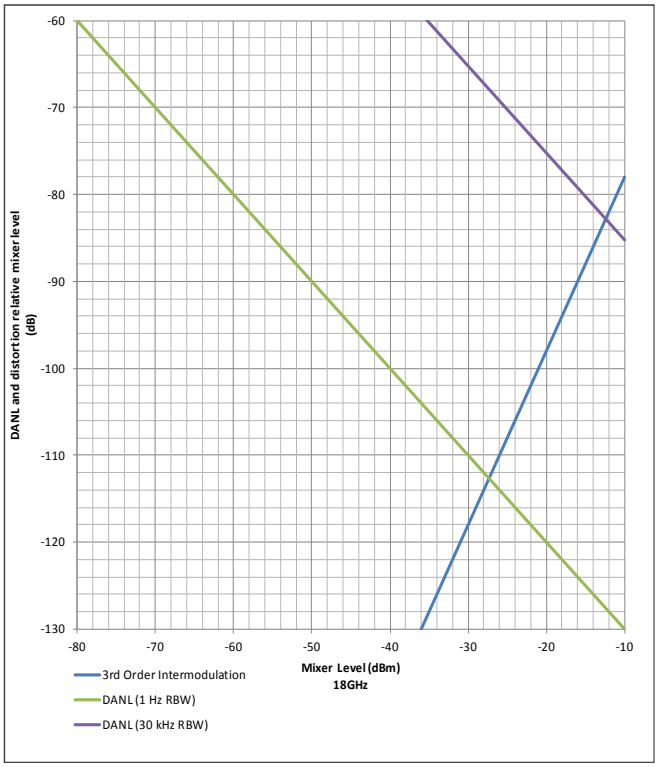



Figure 7. Dynamic range at 18 GHz.

# Technical Specifications and Characteristics

## Spectral purity

| Phase noise [35] | | | | |
|---|---|---|---|---|
| **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* |

35. 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

# Technical Specifications and Characteristics

## Spectral purity (cont'd)

| **Residuals, images & spurious responses [36]** | | | | |
|---|---|---|---|---|
| **Non-input related spurs [37]** | **Frequency** | **Specification** | **Typical** | **IF Dither On, Nominal** |
| IF bandwidth filter = 40 MHz | 0.1 to 150 MHz | –96 dBm | *–103 dBm* | *–113 dBm* |
| | 150 MHz to 1.6 GHz | –99 dBm | *–106 dBm* | *–113 dBm* |
| | 1.6 to 1.8 GHz | –97 dBm | *–104 dBm* | *–112 dBm* |
| | 1.8 to 2.5 GHz | –83 dBm | *–91 dBm* | *–110 dBm* |
| | 2.5 to 3.1 GHz | –97 dBm | *–104 dBm* | *–110 dBm* |
| | 3.1 to 3.6 GHz | –93 dBm | *–101 dBm* | *–109 dBm* |
| | 3.6 to 13 GHz | –95 dBm | *–102 dBm* | –– |
| IF bandwidth filter = 100/160 MHz | 0.1 to 550 MHz | –99 dBm | *–106 dBm* | *–115 dBm* |
| | 550 to 910 MHz | –66 dBm | *–74 dBm* | *–114 dBm* |
| | 910 MHz to 1.7 GHz | –93 dBm | *–102 dBm* | *–113 dBm* |
| | 1.7 to 2.5 GHz | –76 dBm | *–84 dBm* | *–110 dBm* |
| | 2.5 to 3.6 GHz | –81 dBm | *–89 dBm* | *–105 dBm* |
| | 3.6 to 13.6 GHz | –96 dBm | *–102 dBm* | *–111 dBm* |
| IF bandwidth filter = 40/100/160 MHz | > 13.6 GHz | *–100 dBm, nominal* | | |

| **LO related spurs [38]** | **Offset** | **IF Dither On, Nominal** | | **IF Dither On, Nominal** | | **IF Dither On, Nominal** | | **IF Dither On, Nominal** |
|---|---|---|---|---|---|---|---|---|
| | 200 Hz - 1 kHz | | 1 - 10 kHz | | 10 - 100 kHz | | 100 kHz - 10 MHz | |
| 100 kHz to 3.6 GHz | –67 dBc | *–83 dBc* | –66 dBc | *–83 dBc* | –67 dBc | *–79 dBc* | –65 dBc | *–74 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 [39] | < –50 dBc + 20log(N), nominal | | | | IF dither On, < -65 + 20log(N), nominal | | | |

| **First and higher order spurious responses [40]** | **Frequency** | **Specification** | **Nominal** | **IF Dither On, Nominal** |
|---|---|---|---|---|
| IF BW filter = 40 MHz | 100 kHz to 3.6 GHz | –63 dBc | *–74 dBc* | *–107 dBc* |
| | 3.6 to 8.4 GHz | –95 dBc | *–105 dBc* | *–111 dBc* |
| | 8.4 to 17 GHz | –101 dBc | *–108 dBc* | *–110 dBc* |
| | 17 to 27 GHz | –88 dBc | *–96 dBc* | *–97 dBc* |
| IF BW filter = 100/160 MHz | 100 kHz to 3.6 GHz | –63 dBc | *–78 dBc* | *–90 dBc* |
| | 3.6 to 8.4 GHz | –87 dBc | *–101 dBc* | *–111 dBc* |
| | 8.4 to 17 GHz | –90 dBc | *–105 dBc* | *–109 dBc* |
| | 17 to 27 GHz | –85 dBc | *–96 dBc* | *–97 dBc* |

36. IF dither only available in stepped spectrum mode in both driver and 89600 VSA software.
37. 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. For frequencies > 3.6 GHz specifications apply in stepped spectrum mode only with digital image rejection enabled.
38. Input level = – 10 dBm, Expected input level = 0 dBm, Mixer level offset = 0 dBm, Averages = 50.
39. N is the LO multiplication factor. See LO multiplier table for the N value versus frequency range.
40. Input level = 0 dBm, Expected input level = 0 dBm, Mixer level offset = 0 dBm, Noise correction ON, Averages = 10. For frequencies > 3.6 GHz specifications apply in stepped spectrum mode only with digital image rejection enabled.

# Technical Specifications and Characteristics

## Spectral purity (cont'd)

| **Residuals, images & spurious responses (cont'd)** | | | |
|---|---|---|---|
| **IF rejection, nominal [41]** | | | |
| 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 [42]** | | **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 [43]** | **Pre-amp OFF, nominal** | | **Pre-amp ON, nominal** |
| ≤ 100 MHz | *–69 dBm* | | *–82 dBm* |
| > 100 MHz | *–80 dBm* | | |

41. Suppression of signal at IF frequencies when turned at least 2x IF filter bandwidth away.

42. Expected input level = –10 dBm, Mixer level offset = 0 dB, Peak to average = 0 dB, $f_C$ = analyzer center frequency, $f_{IMAGE}$ = input frequency that is an image to analyzer center frequency, $f_{FINAL\ IF}$ = 240, 300, 326 MHz, $f_{FIRST\ IF}$ = 5040, 5100, 5126 MHz. Digital image rejection only available for frequencies > 3.6 GHz in stepped spectrum mode.

43. 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

## Time and 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) [44] | 512 MSample (2 GB) to ~ 1 GSample (3.999 GB) [44] |
| **Segments** | | |
| Minimum length | 32 bytes | |
| Maximum length | Full capture memory [45] | |
| **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 [46] | –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 [47]** | | |
| Channel-to-channel synchronization | ≤ ± *1.3 ns, nomial* | |
| Repeatability across instrument state changes | < *50 ps, nominal* | |

44. 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.

45. 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.

46. Negative trigger delay limited to capture size.

47. Configured with a Keysight M9018A PXIe chassis. Repeatability across power cycles, IVI sessions, and module slot changes.

# Technical Specifications and Characteristics

## Measurement speed

| **IQ data capture [48]** | **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 [49]** | | | |
|---|---|---|---|
| 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* |

48. 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]).

49. 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]).

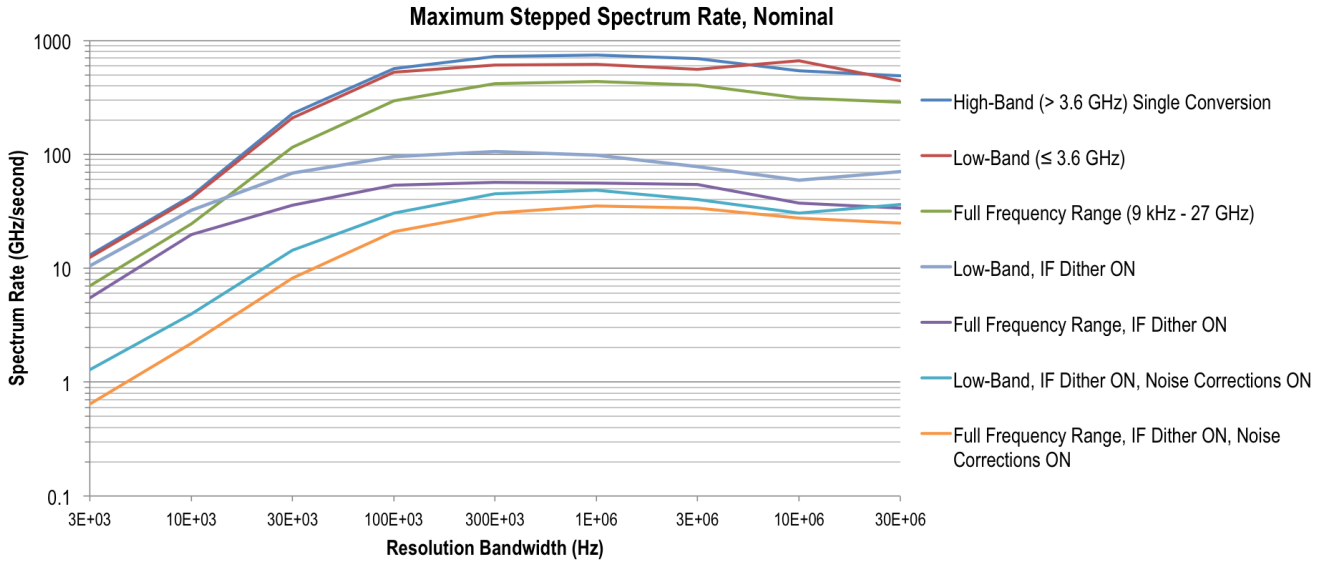



Figure 9. With 89600 VSA software Option SSA version 18.5 power spectrum measurement with M9037A PXIe embedded controller. M9214A IF digitizer in x8 slot and M9393A Option B16 (160 MHz bandwidth) and Option UNZ (fast switching).

# Technical Specifications and Characteristics

## Format specific measurement data

| **16QAM** [50] | | | |
|---|---|---|---|
| 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** [51] | | |
|---|---|---|
| | Parameters | Nominal |
| Pilot EVM | Fc = 0.9, 1.9 GHz | *0.37%* |

| **GSM** [51] | | |
|---|---|---|
| | Parameters | Nominal |
| Global phase error | Fc = 0.9, 1.8, 1.9 GHz | *0.18 °* |
| 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** [51] | | |
|---|---|---|
| | 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** [51] | | | |
|---|---|---|---|
| | Parameters | | Nominal |
| Residual EVM | Fc = 0.9, 1.8, 1.9, 2.0, 2.1 GHz | | *0.50%* |
| | | Noise corrections OFF | Noise corrections ON |
| 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* |

50. 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.

51. 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.

# Technical Specifications and Characteristics

## Format specific measurement data (cont'd)

| **802.11g** [52] | **Parameters** | **Nominal** |
|---|---|---|
| EVM | 2.4 GHz, 20 MHz BW | *–50.5 dB* |

| **802.11a** [52] | **Parameters** | **Nominal** |
|---|---|---|
| EVM | 5.8 GHz, 20 MHz BW | *–50 dB* |

| **802.11n** [52, 53] | **Parameters**<br>**64-QAM** | **Nominal**<br>**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** [52, 53] | **Parameters**<br>**256-QAM** | **Nominal**<br>**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** [52] | **Parameters** | |
|---|---|---|
| SEM | 2.4 GHz, 20 MHz BW | See figure 11 |
| | 5.5 GHz, 20 MHz BW | See figure 12 |

| **802.11e** [52] | **Parameters** | **Nominal** |
|---|---|---|
| OFDMA WiMAX™ EVM | Fc = 2.5, 3.5, & 5.8 GHz | *–48 dB* |

| **LTE FDD-single channel** [52] | | **Nominal** | | |
|---|---|---|---|---|
| **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** [52, 53] | **Carrier frequency** | **2-channel, nominal** | **4-channel, nominal** |
|---|---|---|---|
| 10 MHz BW EVM, R9 downlink, 64 QAM, open loop spacial multiplexing | 900 MHz | *-50.7 dB (0.29%)* | *-50.7 dB (0.29%)* |
| | 2 GHz | *-49.3 dB (0.34%)* | *-48.9 dB (0.36%)* |

| **LTE-TDD MIMO** [52, 53] | **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%)* |

52. 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.

53. Minimum M9393A instrument driver version 1.1 required for multi-channel/MIMO operation.

# Technical Specifications and Characteristics

## Format specific measurement (cont'd)

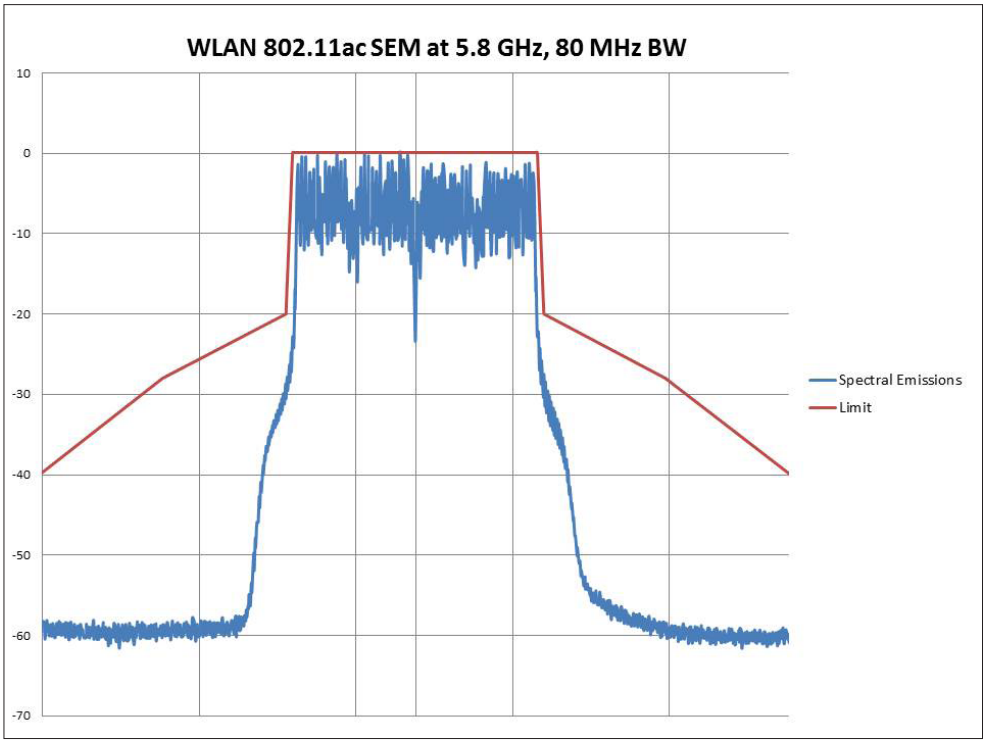



Figure 10. WLAN 802.11ac SEM at 5.8 GHz, 80 MHz bandwidth.

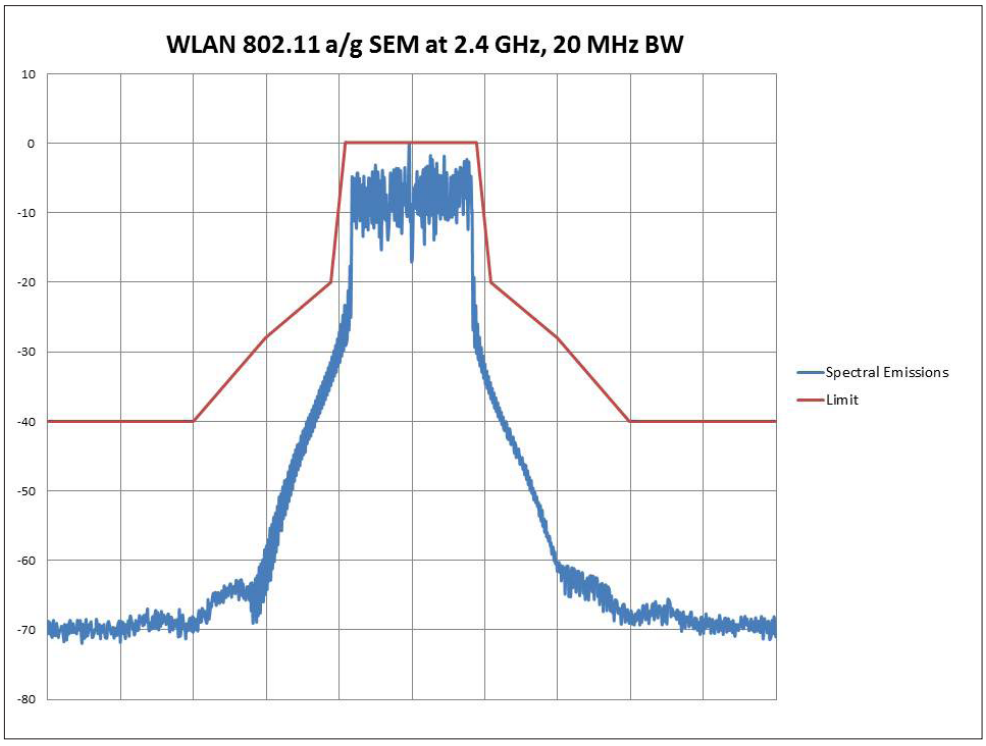



Figure 11. WLAN 802.11 a/g SEM at 2.4 GHz, 20 MHz bandwidth.

# Technical Specifications and Characteristics

## Format specific measurement (cont'd)

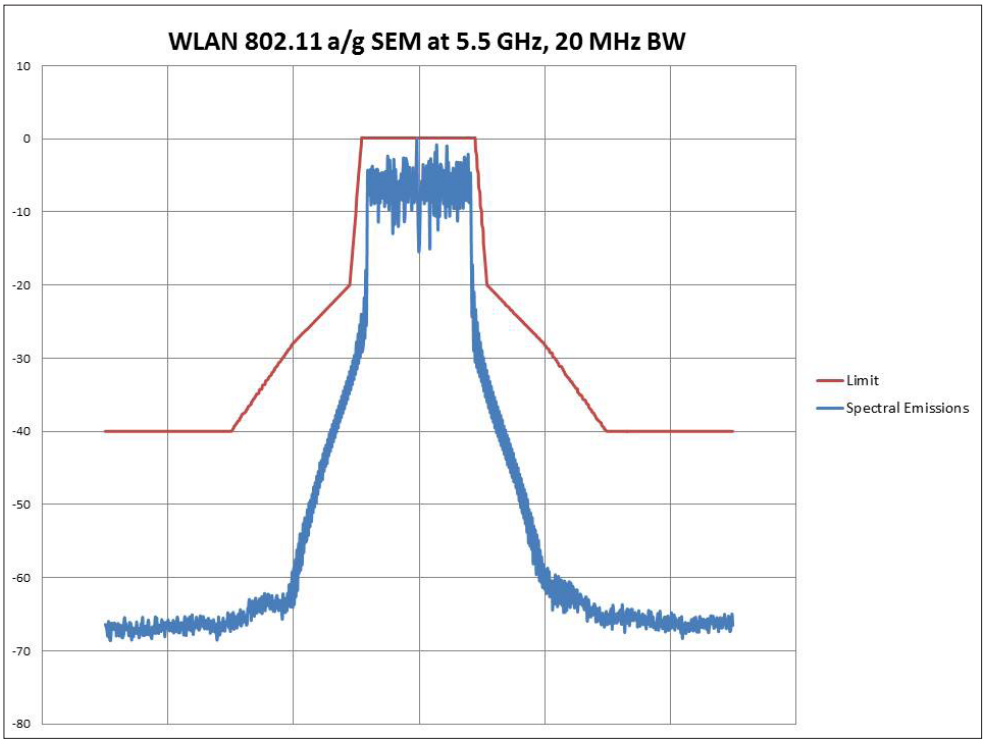



Figure 12. WLAN 802.11 a/g SEM at 5.5 GHz, 20 MHz bandwidth.

# Technical Specifications and Characteristics

| **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 [54] | | | Type tested at 95%, +40 °C (non-condensing) | |
| Shock/vibration [54] | Operating random vibration<br>Survival random vibration<br>Functional shock<br>Bench handling | | Type tested at 5 to 500 Hz, 0.21 g rms<br>Type tested at 5 to 500 Hz, 2.09 g rms<br>Type tested at half-sine, 30 g, 11 ms<br>Type tested per MIL-PRF-28800F | |
| Altitude | | | Up to 15,000 feet (4,572 meters) [55] | |
| Connectors | RF In | | APC 3.5 mm (f) | |
| EMC | | | Complies with European EMC Directive 2004/108/EC<br>– IEC/EN 61326-2-1<br>– CISPR Pub 11 Group 1, class A<br>– AS/NZS CISPR 11<br>– ICES/NMB-001<br>This ISM device complies with Canadian ICES-001.<br>Cet appareil ISM est conforme a la norme NMB-001 du Canada. | |
| Warm-up time | | | 30 minutes | |
| Size | M9300A<br>M9308A<br>M9365A<br>M9214A | | 1 PXIe slot<br>1 PXIe slot<br>2 PXIe slots<br>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<br>M9308A<br>M9365A<br>M9214A | | 0.55 kg (1.21 lbs)<br>0.59 kg (1.31 lbs)<br>1.05 kg (2.31 lbs)<br>0.36 kg (0.79 lbs) | |
| Power drawn from chassis | M9300A<br>M9308A<br>M9365A<br>M9214A | | ≤ 18 W<br>≤ 37 W<br>≤ 50 W<br>≤ 35 W | |

54. Samples of this product have been type tested in accordance with the Keysight 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.

55. At 15,000 feet, the maximum environmental temperature is de-rated to 52 °C.

# Technical Specifications and Characteristics

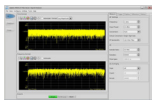
| **System requirements** | |
|---|---|
| Operating system [56] | Windows 7 (32 & 64 bit) |
| Processor speed | 1.5 GHz dual core (x86 or x64) minimum,<br>2.4 GHz recommended<br>No support for Itanium64 |
| Available memory | 4 GB minimum<br>8 GB recommended |
| Available disk space [57] | 1.5 GB available hard disk space includes:<br>1 GB for Microsoft .NET framework 4.0 [58]<br>100 MB for Keysight IO libraries suite |
| Video | Support for DirectX 9 graphics with 128 MB graphics recommended (SuperVGA supported) |
| Browser | Microsoft Internet Explorer 7.0 or greater |

56. Due to Microsoft end of support for Windows XP, M9393A is not supported on Windows XP. At the time of release 1.1 there were no known critical issues running on Windows XP, however if you encounter an issue unique to Windows XP, Keysight may not attempt to address the issue.

57. For a list of computers compatible with Keysight Technologies PXIe M9018A chassis, refer to *Tested Computer Technical Note* (literature no. 5990-7632EN).

58. .NET framework runtime components are installed by default with Windows 7. Therefore, you may not need this amount of available disk space.

# Software

| | | | |
|---|---|---|---|
| **Instrument connection software** | | | |
|  | Keysight IO library | The IO library suite offers a single entry point for connection to the most common instruments including AXIe, PXI, GPIB, USB, Ethernet/LAN, RS-232, and VXI test instruments from Keysight and other vendors. It automatically discovers interfaces, chassis, and instruments. The graphical user interface allows you to search for, verify, and update IVI instrument and soft front panel drivers for modular and traditional instruments. The IO suite safely installs in side-by-side mode with NI I/O software. | Free software download at www.keysight.com/find/iosuite |
| **Module setup and usage** | | | |
|  | Keysight soft front panel | The PXI module includes a soft front panel (SFP), a software-based graphical user interface (GUI) which enables the instrument's capabilities from your PC. | Included on CD-ROM shipped with module or online |
| **Module management** | | | |
| Keysight connection expert | | Connection expert is the graphical user interface included in the IO libraries suite that allows you to search for, verify and update IVI instrument and soft front panel drivers for modular and traditional instruments | Free software download at www.keysight.com/find/iosuite |
| **Programming** | | | |
| **Driver** | | **Development environments** | |
| IVI-COM<br>IVI-C<br>MATLAB | | Visual Studio (VB.NET, C#, C/C++), VEE, LabVIEW, LabWindows/CVI, MATLAB | Included on CD-ROM shipped with module. |
| **Programming assistance** | | | |
|  | Command expert | Assists in finding the right instrument commands and setting correct parameters. A simple interface includes documentation, examples, syntax checking, command execution, and debug tools to build sequences for integration in Excel, MATLAB, Visual Studio, VEE, and SystemVue. | Free software download at www.keysight.com/find/commandexpert |
| Programming examples | | Each module includes programming examples for Visual Studio.net, MATLAB, and Keysight VEE Pro. | Included on CD-ROM shipped with module. |
| **Signal analysis software** | | | |
|  | X-Series measurement applications for modular instruments | The X-Series measurement applications transform modular PXI VSAs into standards based RF transmitter testers. Provides conformance measurements for communications standards including : LTE, WLAN 802.11ac and others. | Licensed software. For more information, visit www.keysight.com/find/pxi-x-series_apps |
|  | 89600 VSA | 89600 VSA software sees through the complexity of emerging and existing industry standards, serving as your window into complex signal interactions. | Licensed software. For more information, visit www.keysight.com/find/vsa |
|  | SystemVue | SystemVue is a system-level EDA platform for designing communications and defense systems. Used with the M9393A, SystemVue enables you to create model-based design validation tests to ensure consistency from design to manufacturing. | Licensed software. For more information, visit www.keysight.com/find/systemvue |

# Setup and Calibration Services

| | | |
|---|---|---|
| **Assistance** | | |
| One day startup assistance | Gain access to a technical expert who will help you get started quickly with the M9393A PXI Performance VSA and its powerful software tools. The flexible instruction format is designed to get you to your first measurements and familiarize you with ways to adapt the equipment to a specific application. | Included in base configuration |
| **Calibration and traceability** | | |
| Factory calibration | The M9393A PXI Performance VSA ships factory calibrated with an ISO-9002, NIST-traceable calibration certificate. | Included in base configuration |
| Calibration cycle | A one year calibration cycle is recommended. | |
| Calibration sites | – At Keysight worldwide service xenters<br>– On-site by Keysight<br>– By self-maintainers | For more information visit www.keysight.com/find/infoline |
| N7800A calibration and adjustment software | The M9393A PXI Performance VSA is supported by Keysight's calibration and adjustment software. This is the same software used at Keysight service centers to automate calibration. The software offers compliance tests for ISO 17025:2005, ANSI/NCSL Z540.3-2006, and measurement uncertainty per ISO Guide to Expression of Measurement Uncertainty. | Licensed software.<br>For more information, visit www.keysight.com/find/calibrationsoftware |
| Keysight calibration status utility | The Keysight calibration status utility helps ensure your M9393A is calibrated by managing the calibration interval and providing messages regarding instrument and module calibration status. | Included in base configuration |

# Support and Warranty

| | | |
|---|---|---|
| **Warranty** | | |
| Global warranty | Keysight's warranty service provides standard coverage for the country where product is used.<br>– All parts and labor necessary to return to full specified performance<br>– Recalibration for products supplied originally with a calibration certificate<br>– Return shipment | Included |
| Standard | Return to Keysight warranty–3 years<br>15 days typical turnaround repair service | Included |
| R-51B-001-5Z | Return to Keysight warranty–5 years<br>15 days typical turnaround repair service | Optional |
| R-51B-001-3X<br>Express warranty<br>3 years | The express warranty upgrades the global warranty to provide, for 3 years, a 5 day typical turnaround repair service in the US, Japan, China and many EU countries. | Optional |
| R-51B-001-5X<br>Express warranty<br>5 years | The express warranty upgrades the global warranty to provide, for 5 years, a 5 day typical turnaround repair service in the US, Japan, China and many EU countries. | Optional |
| **Support** | | |
| Core exchange program | Keysight's replacement core exchange program allows fast and easy module repairs. A replacement core assembly is a fully functioning pre-calibrated module replacement that is updated with the defective module serial number, allowing the replacement module to retain the original serial number. | For qualified self-maintainers in US only |
| Self-test utility | A self-test utility runs a set of internal tests which verifies the health of the modules and reports their status. | Included in base configuration |

# Configuration and Ordering Information

## Ordering information

| Model | Description |
|---|---|
| M9393A | PXIe performance vector signal analyzer:<br>9 kHz to 8.4, 14, 18, or 27 GHz<br>Includes:<br>M9308A PXIe synthesizer<br>M9365A PXIe downconverter<br>M9214A PXIe IF digitizer<br>One day startup assistance<br>Module interconnect cables<br>Software, example programs and product information on CD<br>Return to Keysight warranty–3 Years |
| **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<br>Required for warranted specifications | PXIe frequency reference:<br>10 and 100 MHz<br>Adds M9300A PXIe frequency reference:<br>10 and 100 MHz (M9300A module can support multiple M9393A modular instruments) |

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

| Configurable options | |
|---|---|
| Frequency | |
| M9393A-F14 | 9 kHz to 14 GHz |
| M9393A-F18 | 9 kHz to 18 GHz |
| M9393A-F27 | 9 kHz to 27 GHz |
| Switching speed | |
| M9393A-UNZ | Fast tuning |
| 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 |

# 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 |
| Keysight IO libraries (version 16.3 or newer) | Includes: VISA libraries, Keysight Connection Expert, IO monitor |
| Keysight 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) | 89601B-200 Basic VSA software<br>89601B-300 Hardware connectivity<br>89601B-SSA Spectrum analysis<br>89601B-AYA digital demodulation<br>89601B-BHF Custom OFDM<br>89601B-B7T cdma2000®/1xEV-DO<br>89601B-B7U W-CDMA/HSPA+<br>89601B-B7R WLAN 802.11a/b/g/j/p<br>89601B-BHJ WLAN 802.11ac MIMO<br>89601B-B7X TD-SCDMA<br>89601B-BHD LTE FDD<br>89601B-BHG LTE FDD - Advanced<br>89601B-BHE LTE TDD<br>89601B-BHH LTE TDD - Advanced<br>89601B-B7W 1xEV-DO<br>89601B-B7R 3G bundle<br>89601B-BHC RFID<br>89601B-BHK Custom IQ |
| X-Series Measurement Applications for Modular Instruments transportable perpetual license. | M9063A Analog<br>M9064A VXA Vector Signal Analysis<br>M9071A GSM/EDGE/Evo<br>M9072A cdma2000/cdmaOne<br>M9073A W-CDMA/HSPA+<br>M9076A 1xEV-DO<br>M9077A WLAN 802.11a/b/g/n/ac<br>M9079A TD-SCDMA/HSDPA<br>M9080B LTE/LTE-A FDD<br>M9081A *Bluetooth*®<br>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** | |
|---|---|
| Keysight Advantage Services is committed to your success throughout your equipment's lifetime | |
| R-51B-001-5Z | Return to Keysight warranty - 5 years |
| R-51B-001-3X | Express warranty - 3 years |
| R-51B-001-5X | Express warranty - 5 years |
| N7800A | Calibration & adjustment software |

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