Keysight Technologies

# M9381A PXIe Vector Signal Generator

## 1 MHz to 3 GHz or 6 GHz

Data Sheet


KEYSIGHT TECHNOLOGIES

# Overview

## Challenge the boundaries of test Keysight Modular Products 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 Keysight Technologies, Inc. M9381A PXIe Vector Signal Generator is the next logical step in RF signal generation.

The M9381A PXI VSG, combined with the M9391A PXIe Vector Signal Analyzer - the PXI VSA/G - 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/G can be used with its Signal Studio and Waveform Creator software as well as the 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/G is the low-risk way to manage change and be ready for tomorrow—today.

# Overview (continued)

## Product description

The M9381A PXIe vector signal generator (PXI VSG) is a compact modular solution that provides frequency coverage from 1 MHz to 3 or 6 GHz. A typical M9381A configuration includes four individual PXIe modules—M9311A digital vector modulator, M9310A source output, M9301A synthesizer, and the M9300A frequency reference—designed for fast data interfaces and high-speed automated test systems. Instrument control is provided through a soft front panel and programmatic interfaces tuned to your application development environment of choice.

The M9381A PXI VSG is MIMO ready, enabling design validation engineers to ensure that their WLAN and LTE designs perform well under a variety of conditions. MIMO receiver testing is supported by Keysight's multi-format Signal Studio software, with full support for 802.11ac and LTE standards based generation.

For more information on product configurations, see the M9381A & M9391A configuration guide, literature number 5991-0897EN. For more information on the M9391A PXI VSA, see the M9391A data sheet, literature number 5991-2603EN.

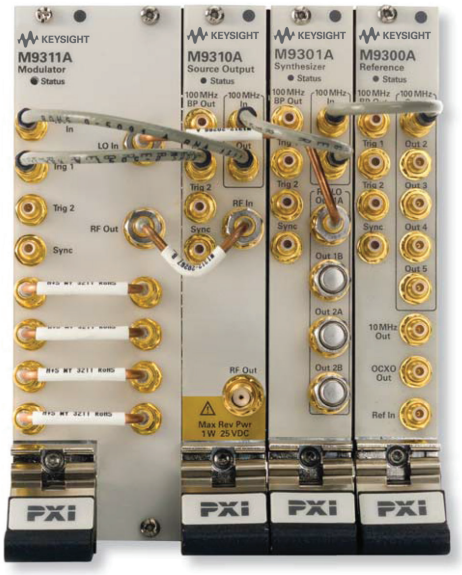



*Figure 1. M9381A PXIe vector signal generator with four modules consisting of the M9311A digital vector modulator, M9310A source output, M9301A synthesizer, and the M9300A frequency reference.*

## Applications

- Cellular picocell and femtocell test
- Handset component test
- Military component test
- Public safety and homeland security radio test
- Wireless device test
- Wireless transceiver design validation
- WLAN and LTE MIMO R&D, design validation and production test

fastune
Technology Innovation

Keysight ***fastune*** is an electrical power and radio frequency (RF) switching functionality that uses digital baseband power level changes and frequency offsets, while maintaining amplitude and phase calibrated accuracy, in order to provide the speed and accuracy needed to reduce the cost of test in modern communication manufacturing.

BEST IN TEST
2013 FINALIST

# Overview (continued)

## Product features

- Frequency coverage from 1 MHz to 3 GHz or 6 GHz.
- 10 µs switching speed with *fast***tune**.
  - Set the RF frequency to the center of the band being tested and then program the baseband frequency offset to any value within the modulation bandwidth (e.g., ± 80 MHz with 160 MHz bandwidth).
  - Set the RF power level to the maximum required for all tests and then set baseband power offset from 0 to 20 dB below RF level.
- Fast RF switching speed:
  - 240 µs for frequency and amplitude changes.
  - 105 µs for amplitude-only changes.
- Output power of +18 dBm across the frequency range.
- Better than ±0.4 dB absolute amplitude accuracy.
- RF modulation bandwidth up to 160 MHz, with < ±0.3 dB RF I/Q channel flatness.
- AM, FM, phase, pulse, and multitone modulation.
- Arbitrary waveform memory up to 1024 MSa.
- Supported Signal Studio software: W-CDMA/HSPA+, cdma2000®/1xEV-DO, GSM/EDGE/Evo, LTE/LTE-Advanced FDD, LTE/LTE-Advanced TDD, TD-SCDMA/HSDPA, WLAN 802.11a/b/g/n/ac, *Bluetooth*®, Broadcast radio, Digital video, Mobile WiMax™, and GNSS.
- License key upgrades for all performance options: frequency range, output power, fast switching, generation bandwidth, and memory.
- Chassis slot compatibility: PXIe slot.

## Uncompromising values

- Accelerates test throughput with the industry's fastest RF frequency and amplitude switching speeds and 3201 list mode points.
- Reduces test time with *fast***tune** that allows you to switch amplitude and frequency in < 10 µs.
- Ready to test wideband components with optional 160 MHz RF bandwidth.
- Keeps costs manageable—purchase what you need today and easily upgrade later using license-key upgrades without returning your modules to Keysight.
- Reduces development time and simplifies integration into existing test environments with multiple drivers and programmatic interfaces.
- Reduces startup time with Keysight IO libraries for easy configuration, one-step software install, and integrated instrument level VSG soft front panel.
- Fast repair turnaround time with calibrated core exchange.

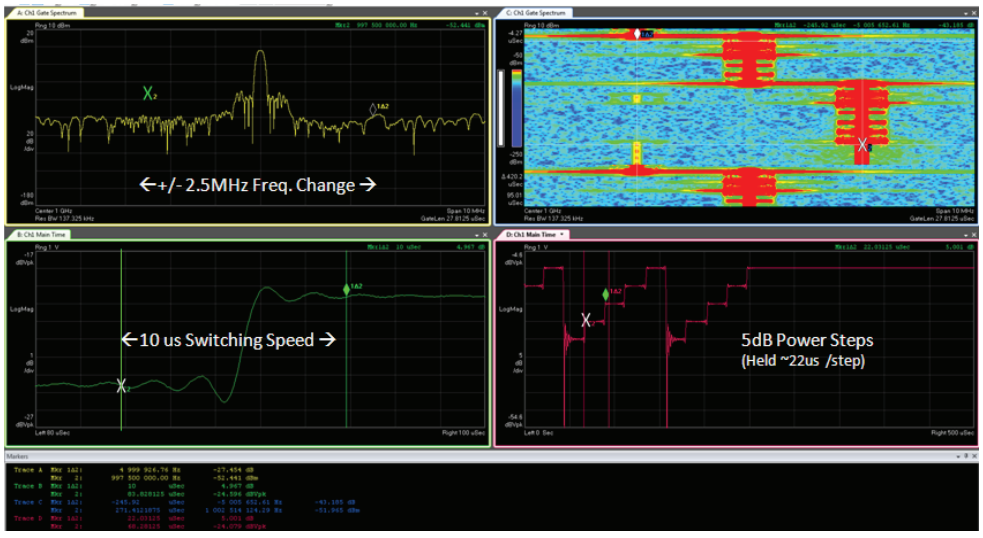



*Figure 2. M9381A baseband power and frequency offset tuning in < 10 µs as shown by the 89600 VSA software.*

# Technical Specifications and Characteristics

## Block diagram

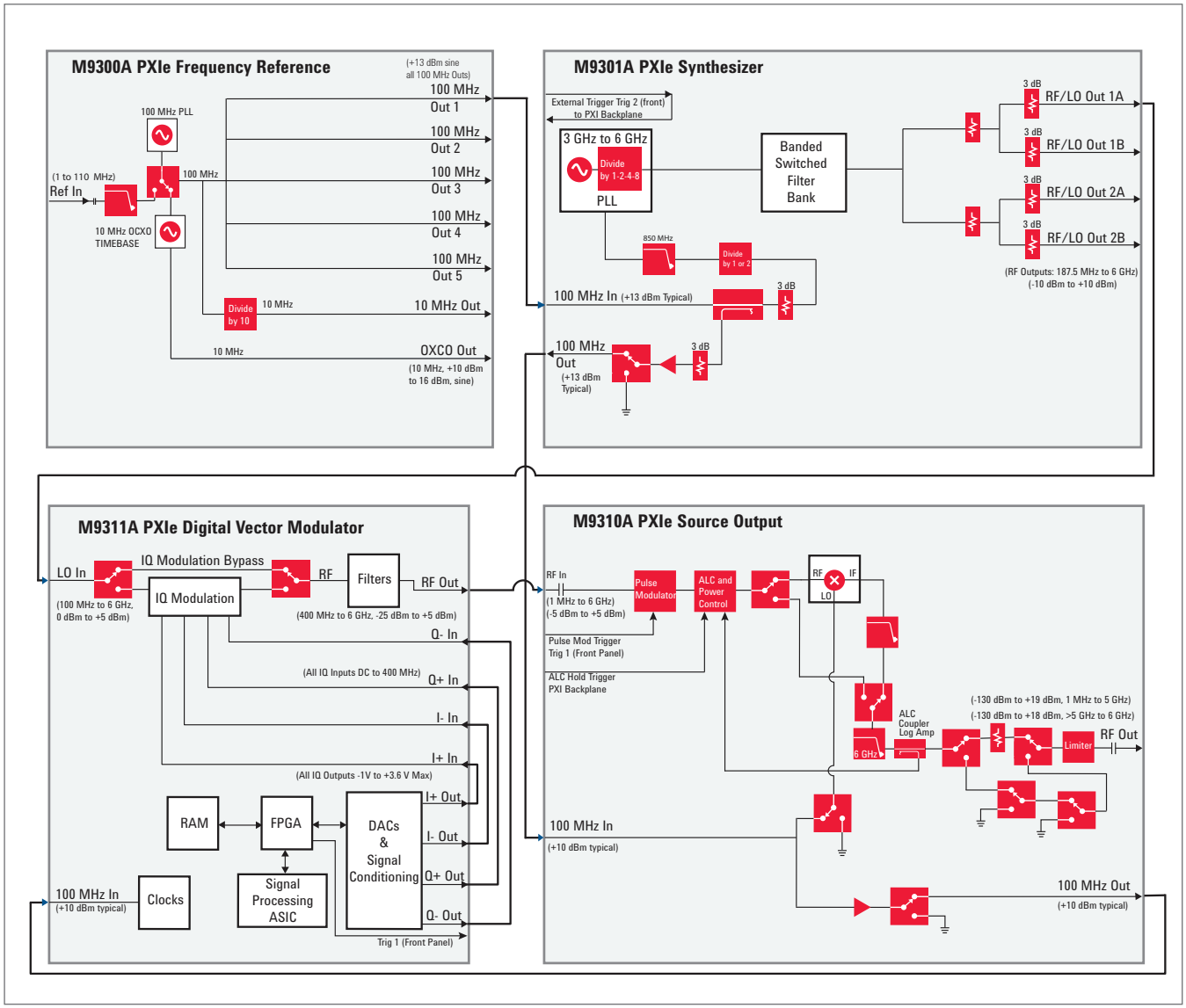



*Figure 5. M9381A PXIe vector signal generator block diagram with four modules consisting of the M9301A synthesizer, M9310A source output, M9311A digital vector modulator, and the optional M9300A frequency reference.*

# Technical Specifications and Characteristics (continued)

## Definitions for specifications

**Temperatures referred to in this document are defined as follows:**

- Full temperature range = Individual module temperature of ≤ 75 °C as reported by the module, and environment temperature of 0 to 55 °C.
- Controlled temperature range = Individual module temperature of ≤ 55 °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 unless otherwise noted under the following conditions.

- 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 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.*

## 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.
- At environment temperatures above 45 °C, chassis fan should be set to high.

## Additional information

- 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.
- Specifications use the normal PLL mode setting, unless otherwise stated. Narrow loop bandwidth refers to specifications using the best wide offset PLL mode setting AGM938X_VAL_SYNTHESIZER_PLL_MODE_BEST_WIDE_OFFSET, available in the M938x Vector Signal Generator/CW Source Instrument Drivers versions 1.2.300 and later.

# Technical Specifications and Characteristics (continued)

## Frequency

| Frequency range | |
|---|---|
| Option F03 | 1 MHz to 3 GHz |
| Option F06 | 1 MHz to 6 GHz |
| Resolution | 0.01 Hz |

| Frequency switching speed | Standard, nominal | Option UNZ, nominal | |
|---|---|---|---|
| List mode switching speed [1] | | Normal loop bandwidth | Narrow loop bandwidth |
| Baseband frequency offset change [2] | *≤ 5 ms* | *≤ 10 µs* | *≤ 10 µs* |
| **ALC off [3]** | | | |
| Arbitrary frequency change | *≤ 5 ms* | *≤ 185 µs* | *≤ 240 µs* |
| Frequency change < 100 MHz within a band [4] | *≤ 5 ms* | *≤ 115 µs* | *≤ 120 µs* |
| **ALC on [3]** | | | |
| Arbitrary frequency change | *≤ 5 ms* | *≤ 365 µs* | *≤ 365 µs* |
| Frequency change < 100 MHz within a band [4] | *≤ 5 ms* | *≤ 265 µs* | *≤ 265 µs* |
| Non-list mode switching speed [5] | | | |
| Baseband frequency offset change [2] | *≤ 5 ms* | *≤ 250 µs* | *≤ 250 µs* |
| Arbitrary frequency change | *≤ 5 ms* | *≤ 2 ms* | *≤ 2.1 ms* |

| List mode | |
|---|---|
| List mode channel parameters | 80 parameters including RF frequency, power, modulation arb and baseband, ALC, power search, triggers |
| Dwell time | 0 to 429 seconds |
| Number of points | 1 to 3201 |
| Triggering | Immediate, external, software, timer |

| 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* | |

1. *Time from trigger input to frequency and amplitude settled within limits given below with digital modulation on and channel corrections enabled. Specifications are for amplitudes lower than +17 dBm and using an M9036A embedded controller in an M9018A chassis.*
2. *Baseband offset frequency settled within 100 Hz. Baseband offset can be adjusted ± from carrier frequency within limits determined by RF modulation bandwidth. Synthesizer frequency and amplitude are not changing and ALC off.*
3. *Carrier frequency settled within 1 ppm or 1 kHz, whichever is greater, and amplitude settled within 0.2 dB (within the controlled temperature range) or within 0.5 dB (at the full temperature range). For frequency changes ≥ 1.6 GHz at carriers ≥ 3.2 GHz nominal frequency settling time within ±.05% of final frequency is 125 µs. Simultaneous carrier frequency and amplitude switching.*
4. *Frequency bands: One (1 to 400 MHz); Two (> 400 to < 750 MHz); Three (≥ 750 to < 1500 MHz); Four (≥ 1500 to < 3000 MHz); Five (≥ 3000 to 6000 MHz).*
5. *Mean time from IVI command to carrier frequency settled within 1 ppm or 1 kHz whichever is greater and amplitude settled within 0.2 dB. Simultaneous carrier frequency and amplitude switching.*

# Technical Specifications and Characteristics (continued)

## Frequency (continued)

| Frequency reference (continued) | |
|---|---|
| Reference outputs (continued) | |
| **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 hour warm-up* |
| Yearly | < *±0.1 ppm/year, after 72 hours warm-up* |
| Total 10 years | < *±0.6 ppm/10yrs, after 72 hours 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 (continued)

## Amplitude

| Output parameters | | |
|---|---|---|
| Settable range | Standard | Option 1EA |
| | +10.7 to –130 dBm | +20 to –130 dBm |
| **Resolution** | | |
| ALC on [6] | *0.02 dB, nominal* | |
| I/Q mode, ALC off [7] | *0.02 dB, nominal* | |
| I/Q mode, ALC off, baseband offset change | *0.001 dB, nominal* | |
| CW mode, ALC off | *0.3 dB, nominal* | |

| Maximum output power | | |
|---|---|---|
| Frequency | Standard | Option 1EA |
| 1 MHz to 5 GHz | +10 dBm | +19 dBm |
| > 5 to 6 GHz | +10 dBm | +18 dBm |

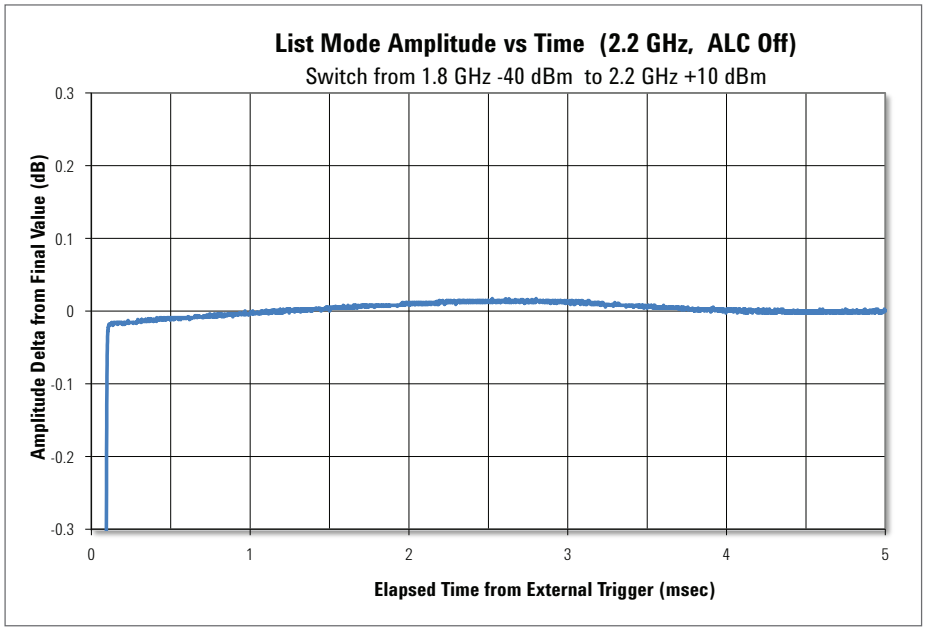



*Figure 6. List mode amplitude vs time showing fast settling time to specified level accuracy.*

6. *Settable to 0.01 dB.*
7. *After a power search.*

# Technical Specifications and Characteristics (continued)

## Amplitude (continued)

| Amplitude switching speed | Standard, nominal | Option UNZ, nominal |
|---|---|---|
| List mode switching speed [8] | | |
| Baseband power level change [9] | *≤ 5 ms* | *≤ 10 µs* |
| ALC off | *≤ 5 ms* | *≤ 105 µs* |
| ALC on | *≤ 5 ms* | *≤ 105 µs* |
| Non-list mode switching speed [10] | | |
| Baseband power level change [9] | *≤ 5 ms* | *≤ 250 µs* |
| Arbitrary power level change | *≤ 5 ms* | *≤ 1.5 ms* |

| List mode |
|---|
| See frequency specification section for more detail |

| Absolute level accuracy in CW mode [ALC on] [11] | | | | |
|---|---|---|---|---|
| Frequency | < Max power to –20 dBm | < –20 to –110 dBm | < –110 to –120 dBm | <–120 to –130 dBm |
| 1 MHz to 3 GHz | ±0.4 dB<br>*±0.15 dB, typical* | ±0.5 dB<br>*±0.15 dB, typical* | ±0.7 dB<br>*±0.25 dB, typical* | *±0.8 dB, nominal* |
| > 3 to 6 GHz | ±0.5 dB<br>*±0.15 dB, typical* | ±0.6 dB<br>*±0.25 dB, typical* | ±1.0 dB<br>*±0.5 dB, typical* | *±0.8 dB, nominal* |

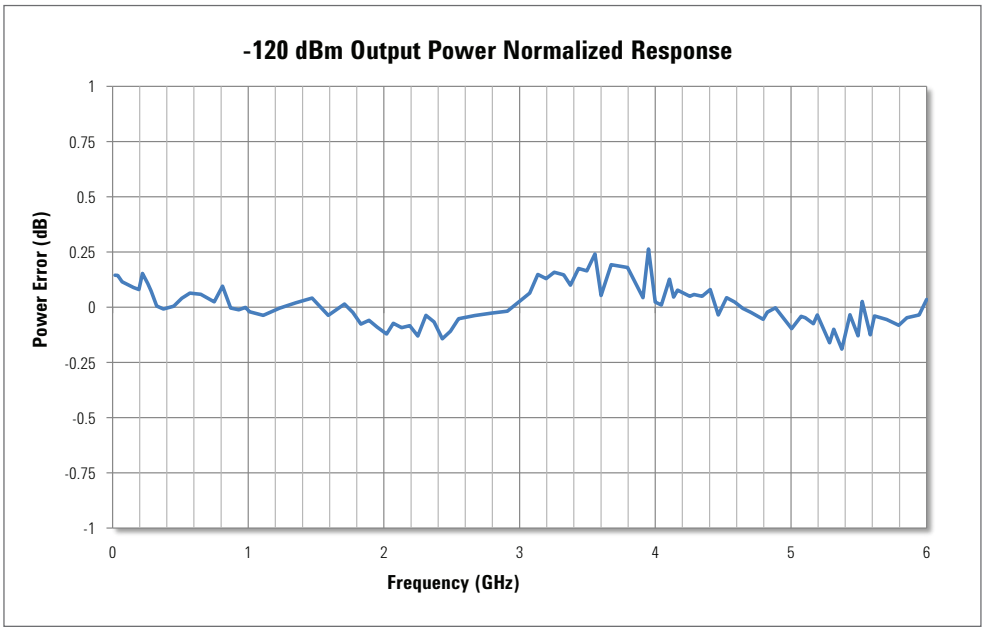



*Figure 7. Output power normalized response at –120 dBm.*

8. *Time from trigger input to amplitude settled within 0.2 dB (within the controlled temperature range) or within 0.5 dB (at the full temperature range). Carrier frequency is not changing. Measurements made with the M9036A embedded controller in an M9018A chassis.*
9. *Baseband offset amplitude settled within 0.2 dB. Baseband offset can be adjusted from 0 to –20 dB.*
10. *Mean time from IVI command to amplitude settled within 0.2 dB. Carrier frequency is not changing.*
11. *Specifications apply within the controlled temperature range. For temperatures outside this range, absolute level accuracy degrades by ±0.02 dB/°C.*

# Technical Specifications and Characteristics (continued)

## Amplitude (continued)

| Absolute level accuracy (ALC off, relative to ALC on) [12] | |
|---|---|
| Frequency | |
| 1 MHz to 5 GHz | *±0.25 dB, typical* |
| > 5 to 6 GHz | *±0.62 dB, typical* |
| Power search [13] | |
| Time | *< 20 ms, nominal* |
| Absolute level accuracy in digital I/Q mode (ALC on, relative to CW) [14] | |
| ≤ 15 dBm | ±0.7 dB *(±0.25 dB, nominal)* |
| ≤ 10 dBm | ±0.2 dB |
| ≤ 0 dBm | ±0.1 dB |

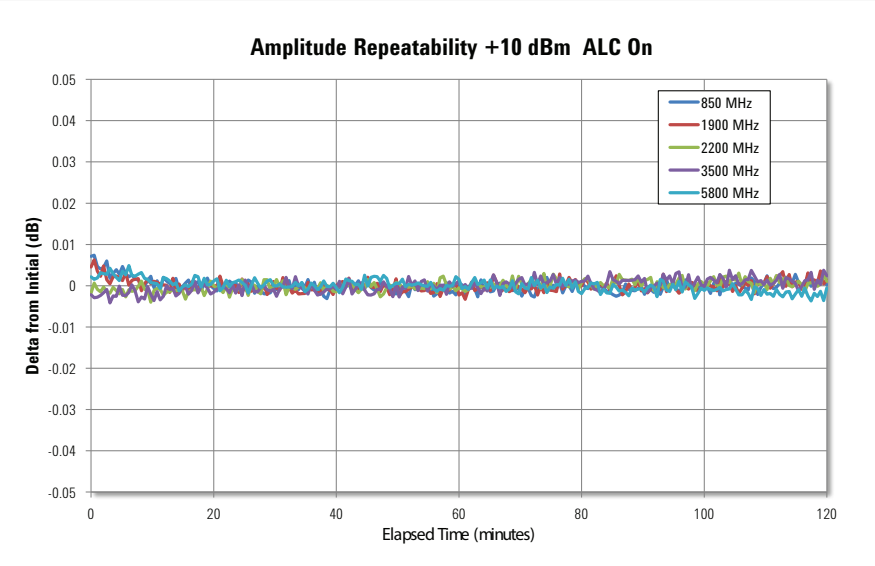



*Figure 8. Amplitude repeatability at various carrier frequencies. Repeatability measures the ability of the instrument to return to a given power setting after a random excursion to any other frequency and power setting. It should not be confused with absolute level accuracy.*

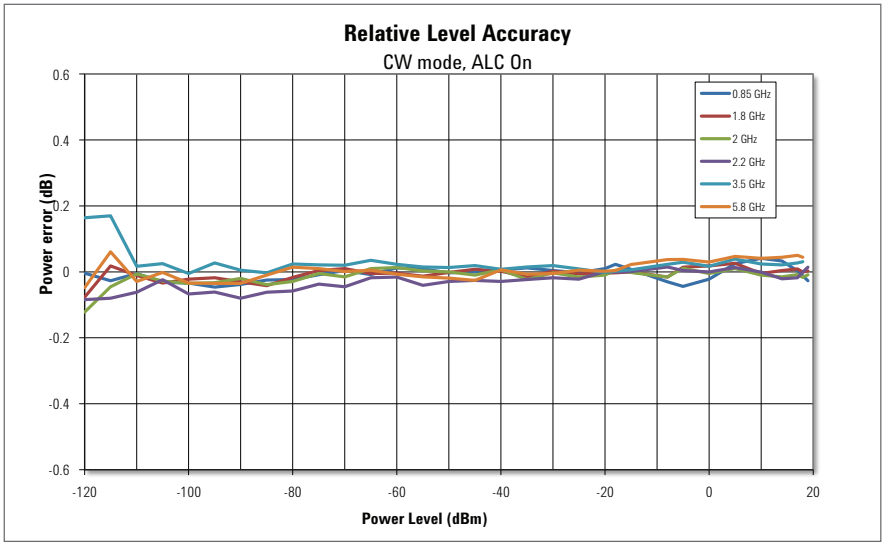



*Figure 9. Relative level accuracy at various carrier frequencies.*

*12. After a power search, with a single side-band signal and with power search blanking on.*

*13. Power search is an internal alignment routine that improves level accuracy with ALC off.*

*14. QPSK waveform 4 MSa/s symbol rate. Specifications apply within the controlled temperature range.*

# Technical Specifications and Characteristics (continued)

## Amplitude (continued)

| | |
|---|---|
| VSWR | |
| 1 MHz to 6 GHz | *< 1.5:1, nominal* |
| Maximum reverse power | |
| 1 MHz to 6 GHz | *1 W, nominal* |
| Max DC voltage | *25 VDC, nominal* |

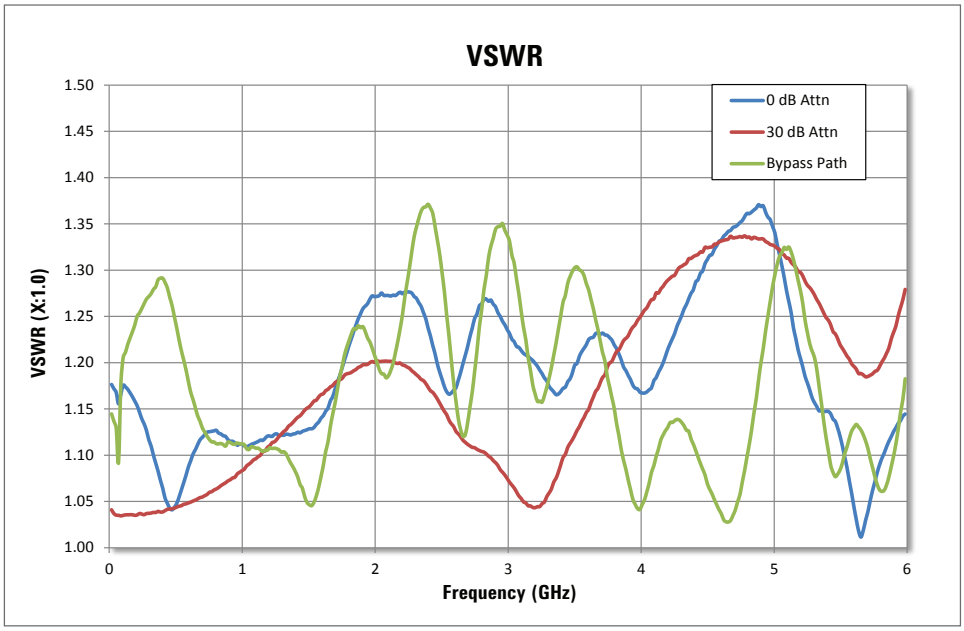



*Figure 10. Measured VSWR from 1 MHz to 6 GHz.*

# Technical Specifications and Characteristics (continued)

## Spectral Purity

| Phase noise at 20 kHz offset | Normal loop bandwidth |
|---|---|
| 1 GHz | *–122 dBc/Hz, typical* |
| 2 GHz | *–117 dBc/Hz, typical* |
| 3 GHz | *–112 dBc/Hz, typical* |
| 6 GHz | *–108 dBc/Hz, typical* |

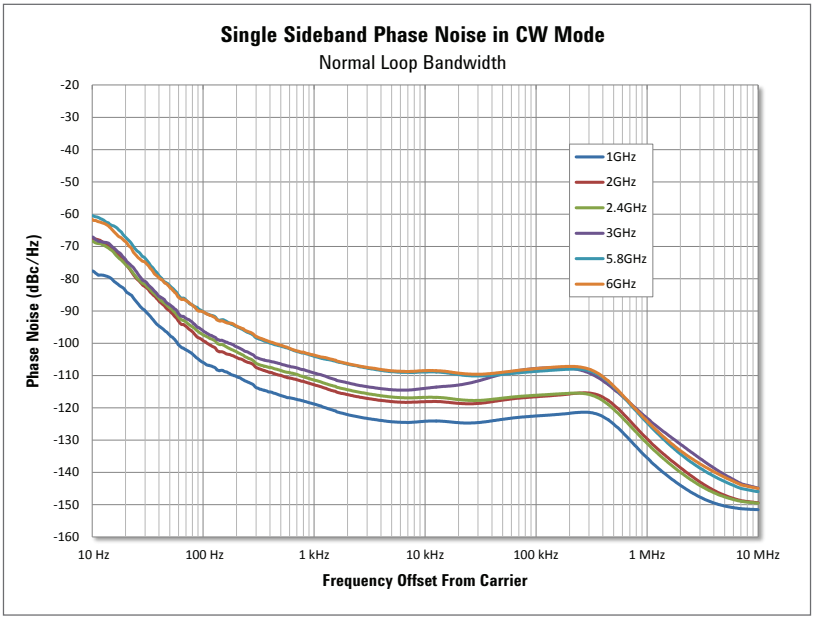



*Figure 11. Single sideband phase noise in normal loop bandwidth, CW mode from 10 Hz to 10 MHz, offset at 1, 2, 2.4, 3, 5.8, and 6 GHz.*

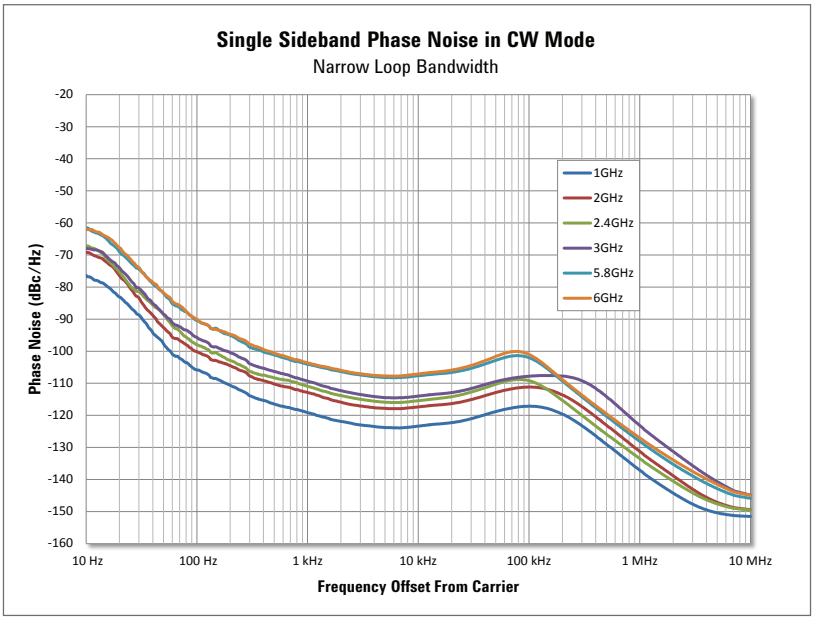



*Figure 12. Single sideband phase noise in narrow loop bandwidth, CW mode from 10 Hz to 10 MHz, offset at 1, 2, 2.4, 3, 5.8, and 6 GHz.*

# Technical Specifications and Characteristics (continued)

## Spectral Purity (continued)

| **Broadband noise floor** | | | | |
|---|---|---|---|---|
| Range | | | | |
| 1 MHz to 6 GHz | *< –140 dBc/Hz, nominal, at +10 dBm output power level* | | | |
| **Harmonics** | | | | |
| Range | ≤ 0 dBm | ≤ 0 dBm | ≤ +10 dBm | ≤ +10 dBm |
| 1 MHz to < 1 GHz | < –39 dBc | *–43 dBc, typical* | < –35 dBc | *–37 dBc, typical* |
| 1 to 2.5 GHz | < –34 dBc | *–38 dBc, typical* | < –32 dBc | *–34 dBc, typical* |
| > 2.5 GHz | < –35 dBc | *–38 dBc, typical* | < –30 dBc | *–32 dBc, typical* |
| Nonharmonics [15] | | | | |
| Nonharmonic miscellaneous spurious [16] | *< –70 dBc, nominal* | | | |
| Nonharmonic HET band mixing spurs (0 dBm) | *< –67 dBc, nominal* | | | |
| Nonharmonic Frac–N | *< –66 dBc, nominal* | | | |
| Subharmonics | | | | |
| 1 MHz to 6 GHz | none | | | |

*15. Non–harmonics include mixing spurs for frequencies below 400 MHz, synthesizer spurs, and other miscellaneous chassis and power supply products, for offsets > 10 kHz.*

*16. With Keysight M9036A embedded controller.*

# Technical Specifications and Characteristics (continued)

## Analog Modulation

| | |
|---|---|
| **Pulse parameters** | |
| Pulse on/off ratio 1 to 400 MHz | *> 85 dB, typical* |
| Pulse on/off ratio > 400 MHz to 6 GHz | *> 95 dB, typical* |
| Pulse on/off ratio with I/Q modulation | *> 140 dB, nominal* |
| Pulse rise/fall time | *< 10 ns, nominal* |
| **Frequency modulation (Option UNT) [17]** | |
| Maximum deviation | 1.25 MHz |
| Resolution of deviation | 0.1 Hz |
| Maximum rate | 5 MHz |
| **Phase modulation (Option UNT) [17]** | |
| Maximum deviation | 10 radians |
| Resolution of deviation | 0.001 radians |
| Maximum rate | 5 MHz |
| **Amplitude modulation (Option UNT) [17]** | |
| Maximum depth | 100% |
| Resolution of depth | 0.001% |
| Maximum rate | 6.25 MHz |
| **Pulse (Option UNT) [17]** | |
| Rate | 1 Hz to 1 MHz |
| Pulse on time | 200 ns to 2 ms |
| **Multitone (Option UNT) [17]** | |
| Rate (tone separation) | 100 Hz to 1 MHz |
| Number of tones | 2 to 16 |

*17. With arbitrary waveforms. Sine, dual–sine, triangle, ramp, and square waveforms supported.*

# Technical Specifications and Characteristics (continued)

## Vector Modulation

| Residual carrier leakage [18] | | |
|---|---|---|
| Frequency | Specifications | Typical |
| 1 MHz to 5 GHz | < –55 dBc | *< –62 dBc* |
| > 5 to 6 GHz | < –51 dBc | *< –58 dBc* |

| I/Q image suppression [18] | | |
|---|---|---|
| Frequency | Specifications | Typical |
| 1 to 850 MHz | < –43 dBc | *< –54 dBc* |
| > 850 MHz to 5 GHz | < –52 dBc | *< –61 dBc* |
| > 5 to 6 GHz | < –45 dBc | *< –54 dBc* |

| I/Q baseband feed-through [18] | |
|---|---|
| Frequency | Specifications |
| 1 to 400 MHz | *< –65 dBc, typical* |
| > 400 MHz to 3 GHz | *< –80 dBc, typical* |
| > 3 GHz | *< –90 dBc, typical* |

| RF modulation bandwidth with internal ARB | |
|---|---|
| Option B04 (standard) | 40 MHz |
| Option B10 | 100 MHz |
| Option B16 | 160 MHz |

| RF I/Q channel flatness | | |
|---|---|---|
| Bandwidth | 1 MHz to 5.5 GHz | > 5.5 to 6 GHz |
| 40 MHz BW (Option B04 standard) | *< ±0.1 dB, typical* | *< ±0.2 dB, typical* |
| 100 MHz BW (Option B10) | *< ±0.2 dB, typical* | *< ±0.3 dB, typical* |
| 160 MHz BW (Option B16) | *< ±0.3 dB, typical* | *< ±0.5 dB, typical* |

| Multi-channel [19] | |
|---|---|
| Maximum channel-to-channel deviation | *20 ns, nominal* |

*18. Measured with an SSB waveform with an I/Q scale factor of 0.25 for offsets ≤ 50 MHz, after executing IQ alignment. Specifications apply at 625 kHz and 50 MHz offsets.*

*19. MIMO capability only supported when configured with a Keysight M9018A PXIe chassis.*

# Technical Specifications and Characteristics (continued)

| Corrected phase error | | |
|---|---|---|
| Bandwidth | 1 GHz | 3 GHz |
| 40 MHz BW (Option B04 standard) | *± 0.25 °, nominal* | *± 1.25 °, nominal* |
| 100 MHz BW (Option B10) | *± 0.65 °, nominal* | *± 2.5 °, nominal* |
| 160 MHz BW (Option B16) | *± 0.9 °, nominal* | *± 3.0 °, nominal* |
| **Arbitrary waveform memory maximum playback capacity** | | |
| Option M01 (standard) | 32 MSa | |
| Option M05 | 512 MSa | |
| Option M10 | 1024 MSa | |

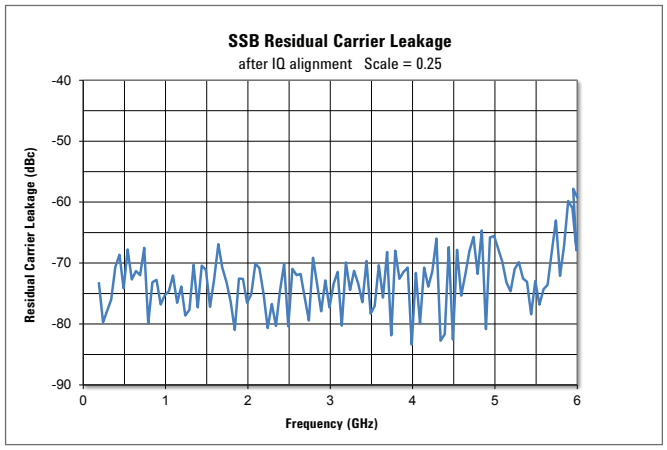



*Figure 13. SSB residual carrier leakage.*

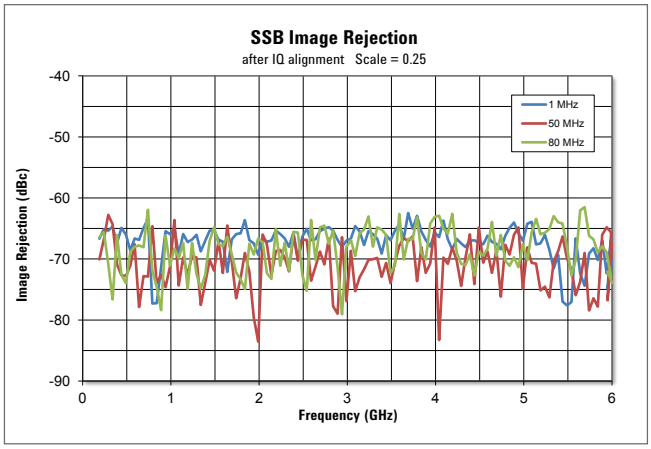



*Figure 14. SSB image rejection at 1, 50, and 80 MHz offsets.*

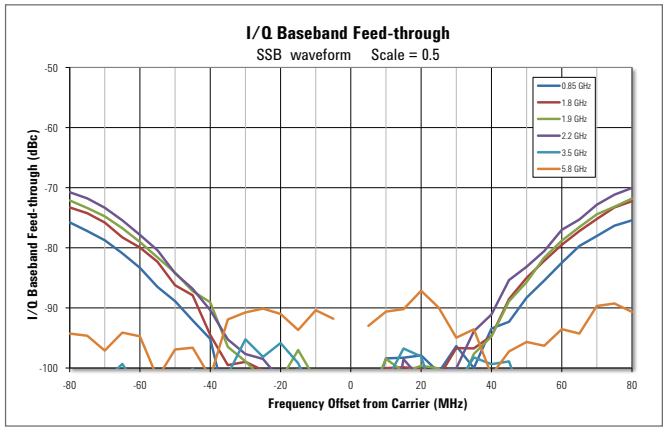



*Figure 15. I/Q baseband feed-through at various carrier frequencies.*

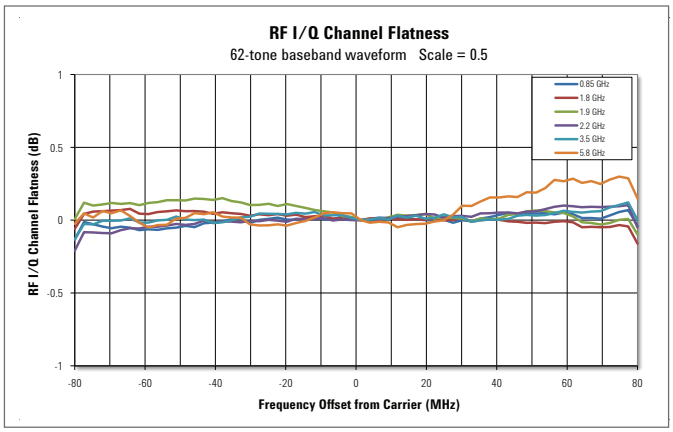



*Figure 16. RF I/Q channel flatness at various carrier frequencies.*

# Technical Specifications and Characteristics (continued)

| 3GPP W-CDMA performance data [20] | | | | | | |
|---|---|---|---|---|---|---|
| Modulation type | QPSK | | | | | |
| EVM (2 GHz, 1 DPCH, ≤ 5 dBm) | *0.57% rms, typical* | | | | | |
| **Channel distortion [21]** | | | **ACLR** | | | |
| | Power level | | 0 dBm | | 5 dBm | |
| Offset | Configuration | Frequency | Spec (dBc) | ***Typical (dBc)*** | **Spec (dBc)** | ***Typical (dBc)*** |
| Adjacent 5 MHz | 1 DPCH 1 carrier | 900 MHz | –70 | *–72* | –71 | *–72* |
| Alternate 10 MHz | | | –71 | *–73* | –72 | *–74* |
| Adjacent 5 MHz | | 1800 to 2200 MHz | –70 | *–72* | –70 | *–71* |
| Alternate 10 MHz | | | –71 | *–73* | –72 | *–73* |
| Adjacent 5 MHz | 64 DPCH 1 carrier | 900 MHz | –69 | *–71* | –69 | *–72* |
| Alternate 10 MHz | | | –71 | *–72* | –71 | *–73* |
| Adjacent 5 MHz | | 1800 to 2200 MHz | –68 | *–70* | –68 | *–70* |
| Alternate 10 MHz | | | –70 | *–72* | –71 | *–73* |

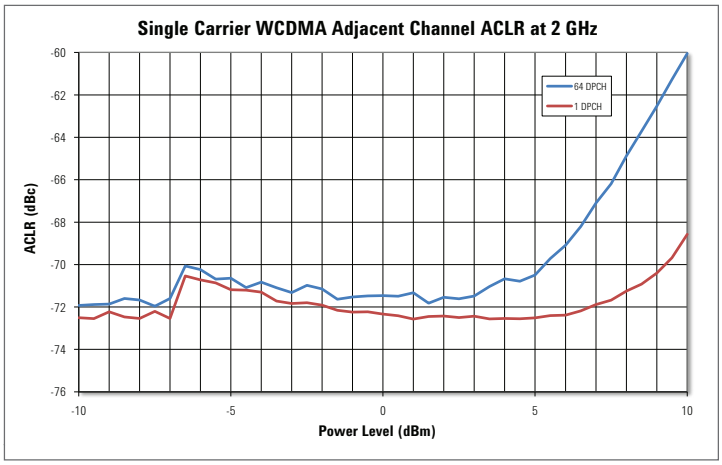



*Figure 17. Single carrier W-CDMA adjacent channel ACLR versus power level at 2 GHz.*

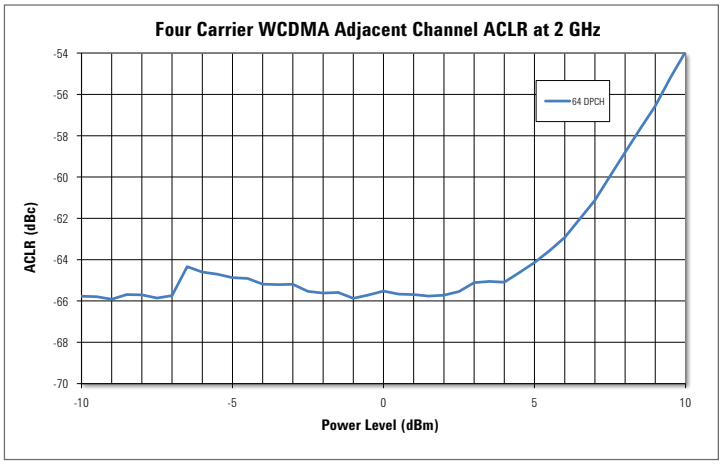



*Figure 18. Four carrier W-CDMA adjacent channel ACLR versus power level at 2 GHz.*

*20. W-CDMA characteristics apply at 900 MHz and between 1.8 to 2.2 GHz, 3.84 Mcps rate, within 5 °C of IQ alignment.*

*21. Specifications apply within the controlled temperature range.*

# Technical Specifications and Characteristics (continued)

| GSM/EDGE performance data [22] | | |
|---|---|---|
| | GSM | EDGE |
| Modulation type | GMSK bursted | 3pi/8-8PSK bursted |
| Modulation rate | 270.833 ksps | 70.833 ksps |
| EVM [ALC off] | *±0.15 ° rms global phase error, typical* | *0.3%, typical* |
| EVM [ALC on] | *±0.15 ° rms, global phase error, typical* | *0.6%, typical* |
| **Output RF spectrum (ORFS)** | **Narrow loop bandwidth** | **Narrow loop bandwidth** |
| Offset | GSM, *typical* | EDGE, *typical* |
| 200 kHz | *–37 dBc* | *–39 dBc* |
| 400 kHz | *–66 dBc* | *–66 dBc* |
| 600 kHz | *–71 dBc* | *–71 dBc* |
| 800 kHz | *–76 dBc* | *–76 dBc* |
| 1200 kHz | *–81 dBc* | *–81 dBc* |
| 1800 kHz | *–80 dBc* | *–79 dBc* |

| WLAN 802.11 performance data | EVM | | | | | |
|---|---|---|---|---|---|---|
| | **Preamble only - narrow loop bandwidth** | | | | | |
| Power level | –7 dBm | | 0 dBm | | +5 dBm | |
| | *Typical* | *Nominal* | *Typical* | *Nominal* | *Typical* | *Nominal* |
| 802.11n, 20 MHz, 64 QAM | | | | | | |
| 2.4 GHz | *–52.5 dB* | *–53.2 dB* | *–52.7 dB* | *–53.4 dB* | *–51.3 dB* | *–52.1 dB* |
| 5.8 GHz | *–44.6 dB* | *–45.8 dB* | *–45.2 dB* | *–45.8 dB* | *–41.3 dB* | *–42.8 dB* |
| 802.11n, 40 MHz, 64 QAM | | | | | | |
| 2.4 GHz | *–48.5 dB* | *–49.5 dB* | *–48.6 dB* | *–49.7 dB* | *–47.8 dB* | *–49.2 dB* |
| 5.8 GHz | *–44.1 dB* | *–44.5 dB* | *–44.1 dB* | *–44.7 dB* | *–40.1 dB* | *–41.7 dB* |
| 802.11ac, 80 MHz, 256 QAM | | | | | | |
| 5.8 GHz | *–42.2 dB* | *–45.6 dB* | *–42.8 dB* | *–46.1 dB* | *–40.6 dB* | *–42.8 dB* |
| 802.11ac, 160 MHz, 256 QAM | | | | | | |
| 5.8 GHz | *–42.5 dB* | *–43.7 dB* | *–42.7 dB* | *–44.1 dB* | *–39.8 dB* | *–40.6 dB* |

| | **Preamble, pilots & data - narrow loop bandwidth** | | |
|---|---|---|---|
| Power level | –7 dBm | 0 dBm | +5 dBm |
| | *Nominal* | *Nominal* | *Nominal* |
| 802.11n, 20 MHz, 64 QAM | | | |
| 2.4 GHz | *–54.4 dB* | *–54.7 dB* | *–54.5 dB* |
| 5.8 GHz | *–46.5 dB* | *–46.9 dB* | *–43.7 dB* |
| 802.11n, 40 MHz, 64 QAM | | | |
| 2.4 GHz | *–52.8 dB* | *–53.3 dB* | *–52.9 dB* |
| 5.8 GHz | *–47.2 dB* | *–47.6 dB* | *–44.0 dB* |
| 802.11ac, 80 MHz, 256 QAM | | | |
| 5.8 GHz | *–48.7 dB* | *–48.9 dB* | *–45.2 dB* |
| 802.11ac, 160 MHz, 256 QAM | | | |
| 5.8 GHz | *–47.2 dB* | *–47.8 dB* | *–43.9 dB* |

*22. GSM/EDGE characteristics apply 800 to 900 MHz, and 1800 to 1900 MHz, with 1 timeslot channel configuration, within ±5 °C of IQ alignment.*

# Technical Specifications and Characteristics (continued)

| WLAN 802.11 performance data | EVM, nominal | | |
|---|---|---|---|
| | **Preamble only - narrow loop bandwidth** | | |
| **Power level** | **0 dBm** | | |
| | *2-channel, nominal* | *3-channel, nominal* | *4-channel, nominal* |
| 802.11n, 20 MHz, 64 QAM | | | |
| 2.4 GHz | *–52.4 dB* | *–50.8 dB* | *–50.9 dB* |
| 5.8 GHz | *–45.6 dB* | *–44.3 dB* | *–45.1 dB* |
| 802.11n, 40 MHz, 64 QAM | | | |
| 2.4 GHz | *–49.2 dB* | *–48.3 dB* | *–48.8 dB* |
| 5.8 GHz | *–44.2 dB* | *–42.7 dB* | *–43.3 dB* |
| 802.11ac, 80 MHz, 256 QAM | | | |
| 5.8 GHz | *–43.3 dB* | *–42.0 dB* | *–42.9 dB* |
| 802.11ac, 160 MHz, 256 QAM | | | |
| 5.8 GHz | *–42.1 dB* | *–40.3 dB* | *–41.7 dB* |
| | **Preamble, pilots & data - narrow loop bandwidth** | | |
| **Power level** | **0 dBm** | | |
| | *2-channel, nominal* | *3-channel, nominal* | *4-channel, nominal* |
| 802.11n, 20 MHz, 64 QAM | | | |
| 2.4 GHz | *–54.2 dB* | *–54.2 dB* | *–52.9 dB* |
| 5.8 GHz | *–46.4 dB* | *–45.6 dB* | *–45.7 dB* |
| 802.11n, 40 MHz, 64 QAM | | | |
| 2.4 GHz | *–52.8 dB* | *–52.7 dB* | *–51.7 dB* |
| 5.8 GHz | *–47.1 dB* | *–46.1 dB* | *–45.3 dB* |
| 802.11ac, 80 MHz, 256 QAM | | | |
| 5.8 GHz | *–46.8 dB* | *–45.4 dB* | *–44.7 dB* |
| 802.11ac, 160 MHz, 256 QAM | | | |
| 5.8 GHz | *–45.4 dB* | *–43.0 dB* | *–43.3 dB* |

# Technical Specifications and Characteristics (continued)

| LTE FDD performance data - single channel | | |
|---|---|---|
| Modulation type | 64 QAM | |
| EVM | 1-channel [23] | |
| 900 MHz | *–52.0 dB (0.25%), nominal* | |
| 2 GHz | *–50.0 dB (0.32%), nominal* | |
| ACPR [23] | Adjacent (< 5 dBm) | Alternate (< 5 dBm) |
| 900 MHz | *–68 dBc, nominal* | *–70 dBc, nominal* |
| 2 GHz | *–67 dBc, nominal* | *–70 dBc, nominal* |
| **LTE FDD & LTE TDD performance data - multi-channel** | | |
| Modulation type | 64 QAM | |
| **LTE FDD - EVM** | **2-channel - MIMO [24]** | **4-channel - MIMO [24]** |
| 900 MHz | *–50.5 dB (0.30%), nominal* | *–51.5 dB (0.27%), nominal* |
| 2 GHz | *–50.0 dB (0.32%), nominal* | *–50.5 dB (0.30%), nominal* |
| **LTE TDD - EVM** | **2-channel - MIMO [24]** | **4-channel - MIMO [24]** |
| 900 MHz | *–51.0 dB (0.28%), nominal* | *–50.7 dB (0.29%), nominal* |
| 2 GHz | *–49.8 dB (0.32%), nominal* | *–49.7 dB (0.33%), nominal* |

| System requirements | | |
|---|---|---|
| Topic | Windows 7 and Vista requirements | Windows XP requirements |
| Operating systems | Windows 7 (32-bit and 64-bit)<br>Windows Vista, SP1 and SP2 (32-bit and 64-bit) | Windows XP, Service Pack 3 |
| Processor speed | 1 GHz 32-bit (x86), 1 GHz 64-bit (x64)<br>(no support for Itanium 64) | 600 MHz or higher required<br>800 MHz recommended |
| Available memory | 4 GB minimum<br>8 GB or greater recommended | 3 GB minimum |
| Available disk space [25] | 1.5 GB available hard disk space, includes:<br>– 1 GB available for Microsoft .NET framework 3.5 SP1 [26]<br>– 100 MB for Keysight IO libraries suite | |
| Video | Support for DirectX 9 graphics with 128 MB graphics memory recommended (Super VGA graphics is supported) | Super VGA (800 x 600) 256 colors or more |
| Browser | Microsoft Internet Explorer 7 or greater | Microsoft Internet Explorer 6 or greater |
| M938x vector signal generator/CW source instrument drivers | | |
| Keysight IO libraries | Version 16.3.16603.3 or later | |
| Narrow loop bandwidth | Narrow loop bandwidth using the best wide offset PLL mode setting AGM938X_VAL_SYNTHESIZER_PLL_MODE_BEST_WIDE_OFFSET requires instrument drivers version 1.2.300.0 or later | |

*23. LTE FDD E-TM 1.1 and E-TM 3.1, 10 MHz, 64 QAM PDSCH, full resource block, ≤+6 dBm. Characteristics apply with ±5 °C of IQ alignment.*

*24. LTE FDD/TDD MIMO R9 downlink, full filled 64 QAM 10 MHz (50 RB), at 0 dBm, open-loop spatial multiplexing transmission mode.*

*25. Because of the installation procedure, less disk space may be required for operation than is required for installation.*

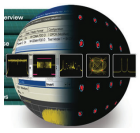
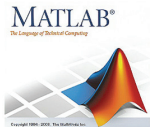
*26. NET framework runtime components are installed by default with Windows Vista and Windows 7. Therefore, you may not need this amount of available disk space.*

# Technical Specifications and Characteristics (continued)

| Environmental and physical specifications | | | | |
|---|---|---|---|---|
| Temperature | Operating<br>Non-operating (storage) | | 0 to 55 °C<br>–40 to +70 °C | |
| Humidity [27] | | | Type tested at 95%, +40 °C (non-condensing) | |
| Shock/vibration [27] | 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) | |
| Connectors | RF OUT | | SMA female | |
| 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 | | | 45 minutes | |
| Size | M9300A<br>M9301A<br>M9310A<br>M9311A | | 1 PXIe slot<br>1 PXIe slot<br>1 PXIe slot<br>2 PXIe slots | |
| Dimensions | **Module** | **Length** | **Width** | **Height** |
| | M9300A | 210 mm | 22 mm | 130 mm |
| | M9301A | 210 mm | 22 mm | 130 mm |
| | M9310A | 210 mm | 22 mm | 130 mm |
| | M9311A | 210 mm | 42 mm | 130 mm |
| Weight | M9300A<br>M9301A<br>M9310A<br>M9311A | | 0.551 kg (1.215 lbs)<br>0.535 kg (1.179 lbs)<br>0.551 kg (1.215 lbs)<br>0.901 kg (1.986 lbs) | |
| Power drawn from chassis | M9300A<br>M9301A<br>M9310A<br>M9311A | | ≤ 18 W<br>≤ 25 W<br>≤ 28 W<br>≤ 45 W | |

*27. 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.*

# 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 |
| **Programming** | | | |
| Driver | | Development environments | |
| IVI-COM<br>IVI-C<br>LabVIEW<br>MATLAB | | Visual Studio<br>(VB.NET, C#, C/C++)<br>VEE<br>LabVIEW, LabWindows/CVI, MATLAB | Included on CD-ROM shipped with module or online |
| **Programming assitance** | | | |
|  | 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, LabVIEW, VEE, and SystemVue. | Free software download at www.keysight.com/find/commandexpert |
| Programming examples | | Each module includes programming examples for Visual Studio.net, LabVIEW, MATLAB, LabWindows, and Keysight VEE Pro. | Included on CD-ROM shipped with module or online at www.keysight.com/find/m9381a |
| **Signal generation software** | | | |
|  | Signal Studio | Suite of flexible, easy-to-use, signal creation tools that provides validated and performance optimized reference signals for commonly used communications standards. It configures signals in an easy-to-use, application specific graphical interface and enables you to scale the capability and performance to meet your specific test needs. | Licensed software. For more information, visit www.keysight.com/find/signalstudio |
|  | Waveform Creator | Built around a drag-and-drop graphical user interface, Waveform Creator enables quick development of multi-format, multi-track custom waveforms to be used in the validation and test of digital communications products | Licensed software. For more information, visit www.keysight.com/find/m9099 |
|  | SystemVue | System–level EDA software platform for designing communications and defense systems. Used with the M9381A, SystemVue bridges the gap between simulation and prototyping to reduce design iterations and accelerate deployment of emerging wireless technologies. | Licensed software. For more information, visit www.keysight.com/find/systemvue |
|  | MATLAB | Interactive tools and command-line functions for instrument control and data analysis tasks such as signal processing, signal modulation, and digital filtering. | Licensed software. For more information, visit www.keysight.com/find/matlab |

# Setup and calibration services

| | | |
|---|---|---|
| **Assistance** | | |
| One day startup assistance | Gain access to a technical expert who will help you get started quickly with the M9381A VSG 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 M9381A VSG 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 Centers<br>– On-site by Keysight<br>– By self-maintainers | For more information visit www.keysight.com/find/infoline |
| N7800A calibration and adjustment software | The M9381A VSG 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. For more information, visit www.keysight.com/find/calibrationsoftware |
| Keysight calibration status utility | The Keysight calibration status utility helps ensure your M9381A 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 | |
| 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 |
|---|---|
| M9381A | PXIe vector signal generator:<br>1 MHz to 3 or 6 GHz<br>Includes:<br>M9301A PXIe synthesizer<br>M9310A PXIe source output<br>M9311A PXIe digital vector modulator<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** | |
| M9381A-F03 | Frequency range: 1 MHz to 3 GHz |
| M9381A-B04 | RF modulation bandwidth, 40 MHz |
| M9381A-M01 | Memory, 32 MSa |
| M9381A-300<br>Required for warranted specifications | PXIe frequency reference:<br>10 and 100 MHz<br>Adds M9300A PXIe frequency Reference: 10 and 100 MHz (M9300A module can support multiple M9381A modular instruments) |

| Configurable options | | |
|---|---|---|
| Frequency | | |
| | M9381A-F03 | 1 MHz to 3 GHz |
| ✓ | M9381A-F06 | 1 MHz to 6 GHz |
| Power | | |
| ✓ | M9381A-1EA | High output power |
| Switching Speed | | |
| ✓ | M9381A-UNZ | Fast switching |
| RF modulation bandwidth | | |
| | M9381A-B04 | 40 MHz |
| | M9381A-B10 | 100 MHz |
| ✓ | M9381A-B16 | 160 MHz |
| Memory | | |
| | M9381A-M01 | 32 MSa |
| | M9381A-M05 | 512 MSa |
| ✓ | M9381A-M10 | 1024 MSa |
| Other | | |
| ✓ | M9381A-UNT | Analog modulation |
| | M9381A-UK6 | Commercial calibration certificate with test data for M9381A (M9301A, M9310A, M9311A) |
| | M9300A-UK6 | Commercial calibration certificate with test data for M9300A (module only) |
| Related products in recommended configuration | | |
| ✓ | M9036A | PXIe embedded controller |
| ✓ | M9018A | 18-Slot PXIe chassis |

✓ *Recommended configuration*

# Configuration and Ordering Information (continued)

## Software information

| | |
|---|---|
| Supported operating systems | Microsoft Windows XP (32-bit)<br>Microsoft Windows 7 (32/64-bit)<br>Windows Vista, SP1 and SP2 (32-bit and 64-bit) |
| Standard compliant drivers | IVI-COM, IVI-C, LabVIEW, 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 |
| Signal Studio software:<br>▪ N76xxB-9TP, transportable perpetual license.<br>▪ N76xxB-9FP, fixed perpetual license.<br>▪ N7650B-2xx provides 5/50 waveform pack licenses. | N7600B W-CDMA/HSPA+<br>N7601B cdma2000®/1xEV-DO<br>N7602B GSM/EDGE/Evo<br>N7606B *Bluetooth*®<br>N7609B Global navigation satellite system<br>N7611B Broadcast radio<br>N7612B TD-SCDMA/HSDPA<br>N7615B Mobile WiMAX™<br>N7617B WLAN 802.11a/b/g/n/ac<br>N7623B Digital video<br>N7624B LTE/LTE-Advanced FDD<br>N7625B LTE/LTE-Advanced TDD |
| (Playback on up to four channels per license) | |
| Waveform Creator: | |
| M9099T | Waveform Creator |
| M9099T-LIC | Core w/utility & multi-tone plug-ins (required) |
| M9099T-AYA | Digital modulation plug-in |
| M9099T-SVM | SystemVue plug-in (requires System Vue v2013.08 or later) |
| M9099T-DFW | File based write unencrypted waveform license |
| M9099T-XXX-12M | Adds premium support for 1 yr |
| SystemVue software: | |
| W1461 | SystemVue architect |
| W1918 | LTE-Advanced |
| W1910 | LTE |
| W1916 | 3G (GSM/EDGE/CDMA/ cdma2000®/W-CDMA/HSPA+) |
| W1911 | WiMAX 802.16e |
| W1917 | WLAN 802.11a/b/g/n/ac |
| W1915 | mmWave WPN 802.15.3c/802.11ad |
| W1919 | Global navigation satellite system DVB-x2 |
| W1914 | Radar |
| W1905 | Digital predistortion builder |
| W1716 | |

## 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 |
| Y1299-001 | PXI solutions startup kit - MIMO solution |

## Related products

| Model | Description |
|---|---|
| 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 |
| M9380A | PXIe CW source |
| M9300A | PXIe frequency reference |

**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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