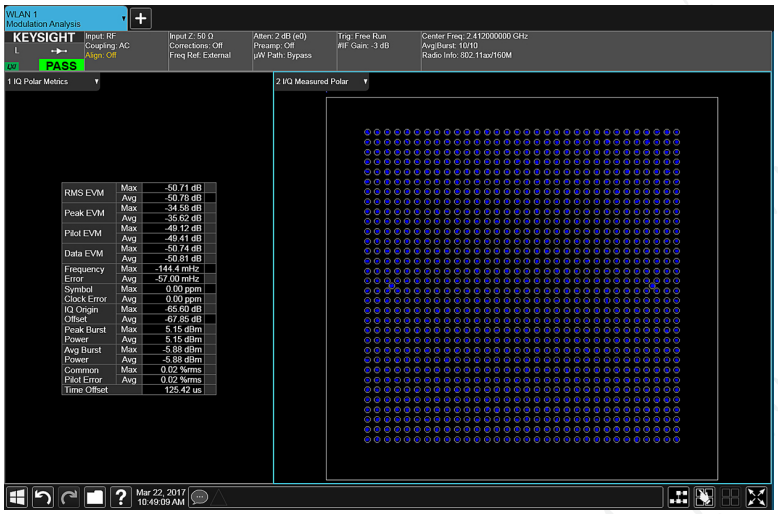
TECHNICAL OVERVIEW

WLAN 802.11a/b/g/j/p/n/ac/af/ah/ax X-Series Measurement App, Multi-Touch UI

WLAN 802.11a/b/g/j/p/n/af/ah: N9077EM0E
WLAN 802.11ac/ax: N9077EM1E

- Perform WLAN spectrum and modulation measurements based on IEEE 802.11a/b/g/j/p/n/ac/af/ah/ax
- 802.11ac/ax 20/40/80/160 MHz and 80+80 MHz, modulation format support up to 4096QAM
- Perform one-button, standard-based measurements with pass/fail tests
- Multi-touch user interface and SCPI remote user interface
- Built-in, context-sensitive help
- Flexible licensing provides the option of using perpetual or time based licenses with one or multiple signal analyzers



KEYSIGHT TECHNOLOGIES

WLAN 802.11a/b/g/j/p/n/ac/af/ah/ax Measurement Application

The WLAN measurement application transforms the X-Series signal analyzers into IEEE 802.11 standard-based WLAN transmitter testers by adding fast, one-button RF conformance measurements that will help you design, evaluate, and manufacture your WLAN transmitter. The software's capabilities are further enhanced because it is closely aligned with the IEEE standards– including 802.11a/b/g/j/p/n/ac/af/ah/ax–allowing you to stay on the leading edge of design and manufacturing challenges.

Real-time spectrum analysis for WLAN 802.11

Adding real-time spectrum analysis to a PXA or MXA signal analyzer addresses the measurement challenges associated with dynamic RF signals such as bursted packet transmissions of WLAN, and to identify interference caused by various signals in the ISM (2.4 or 5 GHz) bands.

- Accurately observe power changes for an 802.11 signal within a 160-MHz real-time bandwidth
- Capture random interfering signals with durations as short as 3.57 µs in ISM bands for WLAN signals
- Perform fast, wideband measurements without compromising EVM, ACPR and other RF measurements
- Enhance dynamic range with 1-dB variable attenuation (< 3.6 GHz) and fine-adjustable resolution bandwidths

X-Series measurement applications

X-Series measurement applications increase the capability and functionality of Keysight Technologies, Inc. signal analyzers to speed time to insight. They provide essential measurements for specific tasks in general-purpose, cellular communications, wireless connectivity applications, covering established standards or modulation types. Applications are supported on both benchtop and modular, with the only difference being the level of performance achieved by the hardware you select.

X-Series measurement applications can help you:

- Gain more insight into device performance with intuitive display and graphs for your application. Select from our library of over 25 different measurement applications.
- Ensure that your design meets the latest standard. Updates are made to the X-Series measurement applications as standards evolve.
- Apply the same measurement science across multiple hardware platforms for consistent measurement results over your design cycle from R&D to production.
- Choose the license structure that meets your business needs. We provide a range of license types (node-locked, transportable, floating or USB portable) and license terms (perpetual or time-based).

Top Features

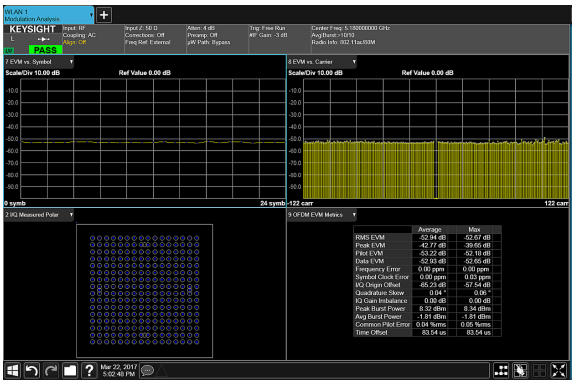
Perform WLAN transmitter measurements in the time, frequency, and modulation domains. The X-Series measurement application covers WLAN specifications from IEEE 802.11a to 802.11ax 20/40/80/160 MHz and 80+80 MHz signals with all modulation formats. Here are a few examples.

Numerical display

Numerical results summarize modulation accuracy. Parameters for WLAN signals.

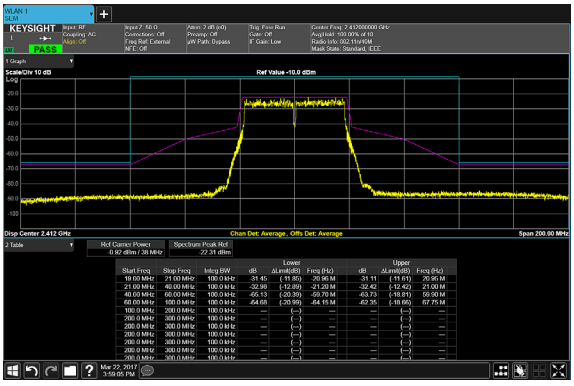
OFDM EVM display

The OFDM EVM displays four traces with EVM vs. symbol, EVM vs. subcarrier, constellation, and measurement results.



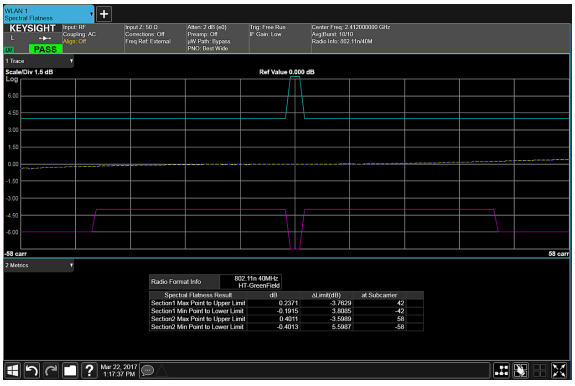
Transmit spectrum mask display

Figure 3 shows a transmitter spectrum mask measurement with IEEE defined limits.



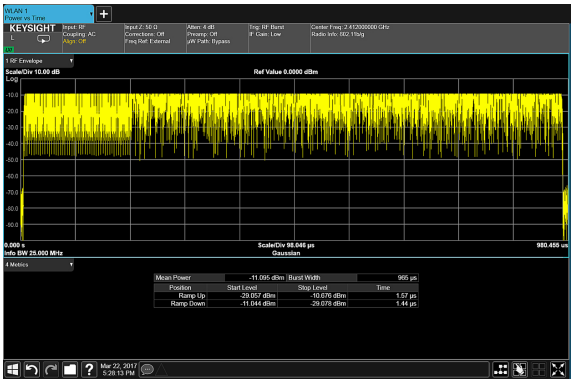
Spectrum flatness display

Spectrum flatness of a 40 MHz IEEE 802.11n signal (Greenfield mode).



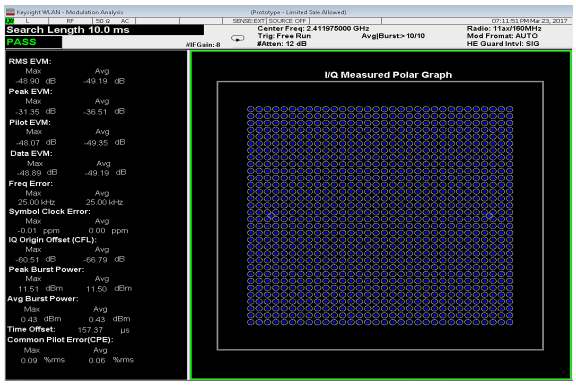
Time-domain display

Time-domain view of an 802.11g burst.



Modulation analysis display

The modulation analysis of a 160 MHz 802.11ax signal with an MCS11 1024QAM signal.



Measurement Summary

Standard-based RF transmitter tests

Table 1. Required 802.11a/b/g WLAN transmitter measurements and the corresponding measurements in the N9077EM0E and 89600 VSA software

IEEE 802.11a/j/p	IEEE 802.11b	IEEE 802.11g	Transmitter test	N9077EM0E WLAN measurement application	89601B7RC Wireless Connectivity modulation analysis
18.3.9.2	17.4.7.2	18.3.9.2 19.4.8.2	Transmit power	Channel power	Can be performed using band power marker
18.3.9.3	17.4.7.4	18.3.9.3 19.5.5	Spectrum mask	Spectrum emission mask	Not available [1]
18.3.9.4	17.4.6.9	18.3.9.4	Transmission spurious	Spurious emission	Not available[1]
18.3.9.5	17.4.7.5	18.3.9.5 19.4.8.3	Center frequency tolerance	Frequency error [2]	Frequency error [2]
18.3.9.6	17.4.7.6	18.3.9.6 19.4.8.4	Symbol (chip) clock frequency tolerance	Symbol (chip) clock error[2]	Symbol clock error [2]
18.3.9.7.1		18.3.9.7.1	Center frequency leakage	IQ origin offset [2]	IQ offset [2]
	17.4.7.7		Power on/down ramp	Power vs time	Not available
	17.4.7.8		RF carrier suppression	Carrier suppression [2]	Not available
18.3.9.7.3		18.3.9.7.3	Spectral flatness	Spectral flatness	OFDM equalized channel frequency resp.
18.3.9.7.4		18.3.9.7.4	Constellation error (EVM rms)	RMS EVM	EVM (rms)
18.3.9.8	17.4.7.9	18.3.9.8	Modulation accuracy test [3]	Modulation analysis	Modulation analysis

1. If 89601B with Option B7R is used with a Keysight spectrum or signal analyzer, these measurements are available as part of the spectrum analyzer mode under the power suite measurements.
2. For the N9077EM0E application, these values are found in the “numeric results” trace under the modulation analysis view. For 89601B with Option B7R, these values are found under the “Syms/Errs” trace.
3. The standard describes the procedure for making this measurement, but doesn’t specify test limits.

Table 2. Required 802.11n WLAN transmitter measurements and the corresponding measurements in N9077EM0E and 89600 VSA software

IEEE 802.11n	Transmitter test	N9077EM0E WLAN measurement application	89601BHXC High Throughput WLAN modulation analysis
20.3.20.1	Transmit spectrum mask	Spectrum emission mask	Not available
20.3.20.2	Spectral flatness	Spectral flatness	OFDM equalized channel frequency resp.
20.3.20.3	Transmit power	Channel power	Can be performed using band power marker
20.3.20.4	Transmit center frequency tolerance	Frequency error[1]	Frequency error [1]
20.3.20.6	Symbol clock frequency tolerance	Symbol (chip) clock error [1]	Symbol clock error [1]
20.3.20.7.2	Center frequency leakage	IQ origin offset[1]	IQ offset[1]
20.3.20.7.3	Constellation error (EVM rms)	RMS EVM	EVM (rms)
20.3.20.7.4	Modulation accuracy test[2]	Modulation analysis	Modulation analysis

Table 3. Required WLAN 802.11ac/ah/af transmitter measurements and the corresponding measurements available in N9077EM0E/EM1E and 89600 VSA software.

IEEE 802.11ac (D7.0)	Transmitter test	N9077EM1E WLAN measurement application	89601BHXC High Throughput WLAN modulation analysis
22.3.18.1	Transmit spectrum mask	Spectrum emission mask	Not available
22.3.18.2	Spectral flatness	Spectral flatness	Channel freq resp.
22.3.18.3	Transmit center frequency tolerance	Frequency error [1]	Frequency error [1]
22.3.18.3	Symbol clock frequency tolerance	Symbol (chip) clock error [1]	Symbol clock error [1]
22.3.18.4.2	Transmit center frequency leakage	IQ origin offset [1]	IQ offset[1]
22.3.18.4.3	Transmit constellation error (EVM rms)	RMS EVM	EVM (rms)
22.3.18.4.2	Modulation accuracy test [2]	Modulation analysis	Modulation analysis
IEEE 802.11ah (D3.0)	**Transmitter test**	**N9077EM0E WLAN measurement application**	
24.3.16.1	Transmit spectrum mask	Spectrum emission mask	
24.3.16.2	Spectral flatness	Spectral flatness	
24.3.16.3	Transmit center frequency tolerance	Frequency error [1]	
24.3.16.4	Symbol clock frequency tolerance	Symbol clock error [1]	
24.3.16.4.2	Transmit center frequency leakage	IQ origin offset [1]	
24.3.16.4.3	Transmit constellation error (EVM rms)	RMS EVM	
24.3.16.4.4	Modulation accuracy test [2]	Modulation analysis	
IEEE 802.11af (2013)	**Transmitter test**	**N9077EM0E WLAN measurement application**	
23.3.18.1	Transmit spectrum mask	Spectrum emission mask	
23.3.18.2	Spectral flatness	Spectral flatness	
23.3.18.3	Transmit center frequency tolerance	Frequency error	
23.3.18.3	Transmit symbol clock tolerance	Symbol clock error	
23.3.18.4.2	Transmit center frequency leakage	I/Q origin offset	
23.3.18.4.3	Transmit constellation error (EVM rms)	RMS EVM	
23.3.18.4.4	Modulation accuracy test	Modulation analysis	

1. For the N9077EM0E application, these values are found in the "numeric results" trace under the modulation analysis view. For 89601B with Option B7R and Option BHJ, these values are found under the "Syms/Errs" trace.
2. The standard describes the procedure for making this measurement, but doesn't specify test limits.

Table 4. Required 802.11ax WLAN transmitter measurements and the corresponding measurements in N9077EM1E and 89600 VSA software

IEEE 802.11ax (D5.0)	Transmitter test	N9077EM1E WLAN measurement application	89601BHXC High throughput WLAN modulation analysis
26.3.14.1	Transmit spectrum mask	Spectrum emission mask	Not available
26.3.14.2	Spectral flatness	Spectral flatness	Channel freq resp.
26.3.14.3	Transmit center frequency tolerance	Frequency error[1]	Frequency error[1]
26.3.14.3	Symbol clock frequency tolerance	Symbol (chip) clock error[1]	Symbol clock error[1]
26.3.14.4.2	Transmit center frequency leakage	IQ origin offset[1]	IQ offset[1]
26.3.14.4.3	Transmit constellation error (EVM rms)	RMS EVM	EVM (rms)
26.3.14.4	Modulation accuracy test[2]	Modulation analysis	Modulation analysis

1. For the N9077EM0E application, these values are found in the "numeric results" trace under the modulation analysis view. For 89601B with Option BHX, these values are found under the "Syms/Errs" trace.
2. The standard describes the procedure for making this measurement, but doesn't specify test limits.

Measurement Details

All of the RF transmitter measurements as defined in the IEEE standard, as well as a wide range of additional measurements and analysis tools, are available with the press of a button. These measurements are fully remote controllable via the IEC/IEEE bus or LAN, using SCPI commands. A detailed list of supported measurements is shown in Table 5.

Table 5. List of one-button measurements provided by the N9077EM0E measurement application

Technology	IEEE 802.11b/g (DSSS/CCK/PBCC)	IEEE 802.11a/g (ERP-OFDM, DSSS-OFDM), 802.11j, 802.11p	IEEE 802.11n (20 MHz, 40 MHz), 802.11ac(20/40/80/160,80+80MHz)[1], 802.11ah (1/2/4/8/16 MHz), 802.11af (6/7/8 MHz)	IEEE 802.11ax (20/40/80/160, 80+80 MHz)[1]
Modulation analysis				
RMS EVM	•[2]	•	•	•
Peak EVM		•	•	•
Pilot EVM		•	•	•
Data EVM		•	•	•
1K chips EVM	•			
RMS magnitude error	•			
Peak magnitude error	•			
RMS phase error	•			
Peak phase error	•			
Frequency error	•	•	•	•
Common pilot error			•	
Chip clock error	•			
Symbol clock error				
I/Q origin offset (CFL)	•	•	•	•
Quadrature skew	•	•	•	•
I/Q gain imbalance	•	•	•	•
Carrier suppression	•	•	•	•
Average burst power	•	•	•	•
Peak burst power	•	•	•	•
Pk-to-avg power ratio	•	•	•	•
Modulation format	•	•	•	•
Bit rate	•	•	•	•
Preamble frequency error			•	•
Burst & Sig Info			•	•
User info				•
HE-SIG-B (common & user field)				•
Unused Tone Error & Metrics				•
Channel power	•	•	•	•
Occupied bandwidth	•	•	•	•
CCDF	•	•	•	•
Spectrum emission mask (SEM)	•	•	•	•
Spurious emissions	•	•	•	•
Power vs. time	•	•	•	•
Spectral flatness	•	•	•	•
Monitor spectrum	•	•	•	•
I/Q waveform	•	•	•	•

1. 802.11ac/ax is not supported on the CXA.
2. You can choose the 802.11b EVM result by standard 1997, 2007 or 2016.

Key Specifications

This section contains specifications for the WLAN 802.11 measurement applications (N9077EM0E and N9077EM1E). The specifications below are limited to modulation accuracy, channel power, power versus time, and spectrum emission mask measurements.

Definitions

- Specifications describe the performance of parameters covered by the product warranty.
- 95th percentile values indicate the breadth of the population (≈2**σ**) of performance tolerances expected to be met in 95% of cases with a 95% confidence. These values are not covered by the product warranty.
- Typical values are designated with the abbreviation “typ.” These are performance beyond specification that 80% of the units exhibit with a 95% confidence. These values are not covered by the product warranty.
- Nominal values are designated with the abbreviation “nom.”
- These values indicate expected performance, or describe product performance that is useful in the application of the product, but is not covered by the product warranty.

Note: Data subject to change

Supported devices and standards

Table 6. Supported standards and modulation formats

Device type	
Standard version	802.11a, 802.11g ERP-OFDM, 802.11g DSSS-OFDM, 802.11b/g DSSSCCK/PBCC, 802.11j, 802.11p, 802.11a turbo mode
	802.11n (20MHz,40MHz) HTMixed, HTGreenfield, Non-HT
	802.11ac 20/40/80/160 MHz, 80+80 MHz, MCS=0-13 802.11af 6/7/8 MHz 802.11ah 1/2/4/8/16MHz, MCS0-10
	802.11ax 20/40/80/160 MHz, 80+80 MHz, MCS=0-13
Modulation formats	BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM, 4096QAM

For a complete list of specifications refer to the appropriate specifications guide.

UXA: **www.keysight.com/find/uxa_specifications**
PXA: **www.keysight.com/find/pxa_specifications**
MXA: **www.keysight.com/find/mxa_specifications**
EXA: **www.keysight.com/find/exa_specifications**
CXA: **www.keysight.com/find/cxa_specifications**
PXIe: VSA up to 6 GHz: **www.keysight.com/find/m9391a**
VSA up to 50 GHz: **www.keysight.com/find/m9393a**
CXA: **www.keysight.com/find/m9421a**
www.keysight.com/find/m9410a
www.keysight.com/find/m9411a

Key Specifications

Description	UXA (N9040B)	PXA (N9030B)	MXA (N9020B)	EXA (N9010B)	CXA (N9000B)
Supported standards	802.11a, 802.11g ERP-OFDM, 802.11g DSSS-OFDM, 802.11b/g DSSS/CCK/PBCC, 802.11j, 802.11p, 802.11-a turbe mode				
	802.11n (20 MHz[5], 40 MHz[6]) HT Mixed, HT Greenfield, Non-HT 802.11ac 20[5]/40[6]/80[7]/160[8] MHz, 80+80 MHz[7], MCS=0-13 802.11ax 20[5]/40[6]/80[7]/160[8] MHz, 80+80 MHz[7], MCS=0-13 802.11af 6/7/8 MHz 802.11ah 1/2/4/8/16 MHz, MCS0-10				
Modulation formats	BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM, 4096QAM				
Modulation accuracy (nominal) **Center frequency in 2.4 GHz band [1]**					
802.11a/g/j/p (OFDM), 802.11g (DSSS-OFDM), 802.11n (20 MHz); Code rate: 3/4; **Equalizer training = channel est. seq. only, Track phase: On; RF input level = –10 dBm, Attenuation = 10 dB**					
EVM floor		–53 dB (0.23%)	–52 dB (0.25%)9	–49 dB (0.36%)	–44 dB (0.63%)
802.11n (40 MHz); Code rate: 3/4; Equalizer training = channel est. seq. only, **Track phase: On; RF input level = –10 dBm, Attenuation = 10 dB**					
EVM floor		–50 dB (0.32%)	–50 dB (0.32%)9	–46 dB (0.47%)	Not Applicable [3]
Center frequency in 5.0 GHz band [2]					
802.11a/g/j/p (OFDM), 802.11n (20 MHz), 802.11ac (20 MHz); Code rate: 3/4; **Equalizer training = channel est. seq. only, Track phase: On; RF input level = –10 dBm, Attenuation = 10 dB**					
EVM floor		–50 dB (0.29%)	–49 dB (0.34%) [8]	–47 dB (0.45%)	–40 dB (0.95%)
802.11n (40 MHz), 802.11ac (40 MHz); Code rate: 3 4; **Equalizer training = channel est. seq. only, Track phase: On; RF input level = –10 dBm, Attenuation = 10 dB**					
EVM floor		–48 dB (0.40%)	–47 dB (0.42%)8	–45 dB (0.53%)	Not Applicable [3]
802.11ac (80 MHz); Code rate: 3/4; Equalizer training = channel est. seq. only, **Track phase: On; RF input level = –10 dBm, Attenuation = 6 dB**					
EVM floor		–47 dB (-0.45%)	–46 dB (0.50%) [9]	Not Applicable [3]	Not Applicable [3]
802.11ax (80 MHz); MCS 11, Equalizer training = channel est.seq.only, Frequency sync = Preamble, pilot & data **Track phase: On; Track amp: Off; Track timing: On; RF input level= -10 dBm, Attenuation = 6 dB**					
EVM floor (2.4 GHz band)		–52.0 dB (0.25%)	–51.7 dB (0.30%)	–50.3 dB (0.31%) [10]	Not Applicable [3]
EVM floor (5GHz band)		–50.5 dB (0.30%)	–47.5 dB (0.30%)	–50.3 dB (0.31%) [10]	Not Applicable [3]
802.11ax (160 MHz); MCS 11, Equalizer training = channel est.seq.only, Frequency sync = Preamble, pilot & data **Track phase: On; Track amp: Off; Track Timing: On; RF input level= -10 dBm, Attenuation = 6 dB**					
EVM floor (2.4 GHz band)	–47.8 dB (0.41%)	–47.5 dB (0.42%)	–47.3 dB (0.43%) [10]	Not Applicable [3] Not	Not Applicable [3]
EVM floor (5GHz band)	–47.0 dB (0.45%)	–47.0 dB (0.45%)	–47.0 dB (0.44%) [10]	Applicable [3]	Not Applicable [3]
802.11ac (160 MHz); Code rate: 3/4; Equalizer training = channel est. seq. only, **Track phase: On; RF input level = –10 dBm, Attenuation = 8 dB**					
EVM floor		–46 dB (0.50%)	–45 dB (0.56%) [9]	Not Applicable [3]	Not Applicable [3]
802.11ah (1 MHz); Code Rate: 3/4; Equalizer training = channel est. seq only, Track phase:ON; RF input level = -10 dBm, Atten=10 dB **Center frequency in Sub GHz band**					
EVM floor [11]		–58 dB (0.13%)	–54 dB (0.19%)	–53 dB (0.22%)	–46 dB (0.46%)
Accuracy (EVM range: 0 to 8%)		± 0.30%			
Frequency error accuracy		± 10 Hz+tfa[9]			
802.11b/g (DSSS/CCK/PBCC); Reference filter: Gaussian; RF input level = –10 dBm, Attenuation = 10 dB **Center frequency in 2.4 GHz band [4]**					
EVM floor (Equalizer off)		–41 dB (0.80%)	–40 dB (1.00%)	–39 dB (1.03%)	–36 dB (1.49%)
EVM floor (Equalizer on)		–54 dB (0.20%)	–46 dB (0.50%)	–46 dB (0.50%)	–44 dB (0.60%)
Accuracy (EVM range: 0 to 2%)		± 0.90%			
Accuracy (EVM range: 2 to 20%)		± 0.40%			
Frequency error accuracy		± 10 Hz+tfa[9]			

1. 2.4 GHz band for radio standard 802.11a/g (OFDM), 802.11 (DSSS-OFDM), 802.11n (20 MHz or 40 MHz) is applied channel center frequency = 2407 MHz + 5xk MHz (k = 1,...,13)
2. 5.0 GHz band for radio standard 802.11a/g (OFDM), 802.11g (DSSS-OFDM), 802.11n (20 MHz or 40 MHz), 802.11ac (20 MHz, 40 MHz, 80 MHz, 160 MHz, 80 + 80 MHz) is applied channel center frequency = 5000 MHz + 5xk MHz (k = 0,1,2,...200)
3. The CXA with Option B25 can only support the bandwidth of 25 MHz. EXA with Option B40 can only support 40 MHz bandwidth.
4. 2.4 GHz band for radio standard 802.11b/g (DSS/CCK/PBCC) is applied channel center frequency = 2407 MHz + 5xk MHz (k = 1,...,13)
5. Requires N90x0B-B25 25 MHz analysis bandwidth option or higher
6. Requires N90x0B-B40 40 MHz analysis bandwidth option or higher
7. Requires N90x0B-B85 85 MHz analysis bandwidth option or higher
8. Requires N90x0B-B1X 160 MHz analysis bandwidth option
9. tfa = transmitter frequency × frequency reference accuracy
10. MXA with -EP2 option (S/N prefix≥MY/SG/US5233, ship standard with N9020B-EP2)

Key Specifications (continued)

Description	PXA (N9030B)	MXA (N9020B)	EXA (N9010B)	CXA (N9000B)
Channel power				
Minimum power at RF input	–50 dBm (nominal)			
Center frequency in 2.4 GHz band				
802.11b/g (DSSS/CCK/PBCC); Integration bandwidth = 22 MHz				
Absolute power accuracy	± 0.19 dB (95th percentile)	± 0.23 dB (95th percentile)	± 0.27 dB (95th percentile)	± 0.61 dB (95th percentile)
Measurement floor	–78.3 dBm (typical)	–76.3 dBm (typical)	–72.3 dBm (typical)	–71.3 dBm (typical)
802.11a/g/j/p (OFDM), 802.11g (DSSS-OFDM), 802.11n (20 MHz), 802.11ac (20 MHz); Integration bandwidth = 20 MHz				
Absolute power accuracy	± 0.19 dB (95th percentile)	± 0.23 dB (95th percentile)	± 0.27 dB (95th percentile)	± 0.61 dB (95th percentile)
Measurement floor	–78.7 dBm (typical)	–76.7 dBm (typical)	–72.7 dBm (typical)	–71.7 dBm (typical)
802.11n (40 MHz), Integration bandwidth= 40 MHz				
Absolute power accuracy	± 0.19 dB (95th percentile)	± 0.23 dB (95th percentile)	± 0.27 dB (95th percentile)	± 0.61 dB (95th percentile)
Measurement floor	–75.7 dBm (typical)	–73.7 dBm (typical)	–69.7 dBm (typical)	–68.7 dBm (typical)
Center frequency in 5.0 GHz band				
802.11a/g/j/p (OFDM), 802.11n (20 MHz), 802.11ac (20 MHz); Integration bandwidth= 20 MHz				
Absolute power accuracy	± 0.41 dB (95th percentile)	± 0.50 dB (95th percentile)	± 0.50 dB (95th percentile)	± 1.24 dB (95th percentile)
Measurement floor	–76.7 dBm (typical)	–76.7 dBm (typical)	–72.7 dBm (typical)	–64.7 dBm (typical)
802.11n (40 MHz), 802.11ac (40 MHz); Integration bandwidth = 40 MHz				
Absolute power accuracy	± 0.41 dB (95th percentile)	± 0.50 dB (95th percentile)	± 0.50 dB (95th percentile)	± 1.24 dB (95th percentile)
Measurement floor	–73.7 dBm (typical)	–73.7 dBm (typical)	–69.7 dBm (typical)	–61.7 dBm (typical)
802.11ac (80 MHz); Integration bandwidth = 80 MHz				
Absolute power accuracy	± 0.41 dB (95th percentile)	± 0.50 dB (95th percentile)	± 0.50 dB (95th percentile)	± 1.24 dB (95th percentile)
Measurement floor	–70.7 dBm (typical)	–70.7 dBm (typical)	–66.7 dBm (typical)	–58.7 dBm (typical)
802.11ac (160 MHz); Integration bandwidth = 160 MHz				
Absolute power accuracy	± 0.41 dB (95th percentile)	± 0.50 dB (95th percentile)	± 0.50 dB (95th percentile)	± 1.24 dB (95th percentile)
Measurement floor	–67.7 dBm (typical)	–67.7 dBm (typical)	–63.7 dBm (typical)	–55.7 dBm (typical)
802.11ax (80 MHz); Integration bandwidth = 80 MHz				
Measurement floor	–72.7 dBm (typical)	–70.1 dBm (typical)		
802.11ax (160 MHz); Integration bandwidth = 160 MHz				
Measurement floor	–67.7 dBm (typical)	– 67.7 dBm (typical)		
802.11ah (1MHz); Integration bandwidth = 1 MHz				
Absolute power accuracy	± 0.19 (95th percentile)	± 0.23 (95th percentile)	± 0.27 (95th percentile)	± 0.61 (95th percentile)
Measurement floor	–91.7 dBm (typical)	–89.7 dBm	–86.7 dBm	–84.7 dBm
Power versus Time (nominal)				
802.11b/g (DSSS/CCK/PBCC)				
Center frequency in 2.4 GHz band				
Measurement results type		Min, Max, Mean		
Measurement time		Up to 88 ms		
Dynamic range	64.0 dB	62.0 dB	58.0 dB	57.0 dB
Spectrum emission mask				
802.11a/g/j/p (OFDM), 802.11g (DSSS-OFDM), 802.11n (20 MHz); Integration bandwidth = 18 MHz, RBW = 100.0 kHz, 11.0 MHz offset				
Center frequency in 2.4 GHz band				
Dynamic range, relative	87.3 dB (typical)	84.3 dB (typical)	79.9 dB (typical)	79.8 dB (typical)
Sensitivity, absolute	–101.5 dBm (typical)	–99.5 dBm (typical)	–95.5 dBm (typical)	–94.5 dBm (typical)
Accuracy, relative	± 0.05 dB	± 0.12 dB	± 0.12 dB	± 0.12 dB
Accuracy, absolute	± 0.20 dB (95th percentile)	± 0.27 dB (95th percentile)	± 0.31 dB (95th percentile)	± 0.64 dB (95th percentile)
802.11a/g (OFDM), 802.11n (20 MHz), 802.11ac (20 MHz); Integration bandwidth = 18 MHz, RBW = 100.0 kHz, 11.0 MHz offset				
Center frequency in 5.0 GHz band				
Dynamic range, relative	85.3 dB (typical)	84.3 dB (typical)	79.9 dB (typical)	73.2 dB (typical)
Sensitivity, absolute	–99.5 dBm (typical)	–99.5 dBm (typical)	–95.5 dBm (typical)	–87.5 dBm (typical)
Accuracy, relative	±0.05 dB	±0.12 dB	±0.12 dB	±0.11 dB
Accuracy, absolute	±0.41 dB (95th percentile)	±0.54 dB (95th percentile)	±0.54 dB (95th percentile)	±1.28 dB (95th percentile)

Key Specifications (continued)

Description	PXA (N9030B)	MXA (N9020B)	EXA (N9010B)	CXA (N9000B)
802.11n (40 MHz), 802.11ac (40 MHz) @ 5 GHz only; Integration bandwidth = 38 MHz, RBW = 100.0 kHz, 21.0 MHz offset				
Center frequency in 2.4 GHz band				
Dynamic range, relative	87.3 dB (typical)	84.5 dB (typical)	80.2 dB (typical)	80.0 dB (typical)
Sensitivity, absolute	–101.5 dBm (typical)	–99.5 dBm (typical)	–95.5 dBm (typical)	–94.5 dBm (typical)
Accuracy, relative	± 0.05 dB	± 0.12 dB	± 0.12 dB	± 0.12 dB
Accuracy, absolute	± 0.20 dB (95th percentile)	± 0.27 dB (95th percentile)	± 0.31 dB (95th percentile)	± 0.64 dB (95th percentile)
Center frequency in 5.0 GHz band				
Dynamic range, relative	85.4 dB (typical)	84.5 dB (typical)	80.2 dB (typical)	73.3. dB (typical)
Sensitivity, absolute	–99.5 dBm (typical)	–99.5 dBm (typical)	–95.5 dBm (typical)	–87.5 dBm (typical)
Accuracy, relative	± 0.05 dB	± 0.12 dB	± 0.12 dB	± 0.11 dB
Accuracy, absolute	± 0.41 dB (95th percentile)	± 0.54 dB (95th percentile)	± 0.54 dB (95th percentile)	± 1.28 dB (95th percentile)
802.11b/g (DSSS/CCK/PBCC); Integration bandwidth = 22 MHz, RBW = 100.0 kHz, 11.0 MHz offset				
Center frequency in 2.4 GHz band				
Dynamic range, relative	87.3 dB (typical)	84.3 dB (typical)	80.0 dB (typical)	79.9 dB (typical)
Sensitivity, absolute	–101.5 dBm (typical)	–99.5 dBm (typical)	–95.5 dBm (typical)	–94.5 dBm (typical)
Accuracy, relative	± 0.05 dB	± 0.12 dB	± 0.12 dB	± 0.12 dB
Accuracy, absolute	± 0.20 dB (95th percentile)	± 0.27 dB (95th percentile)	± 0.31 dB (95th percentile)	± 0.64 dB (95th percentile)
802.11ac (80 MHz); Integration bandwidth = 78 MHz, RBW = 100.0 kHz, 41.0 MHz offset				
Center frequency in 5.0 GHz band				
Dynamic range, relative	85.4 dB (typical)	84.6 dB (typical)	80.4 dB (typical)	73.4 dB (typical)
Sensitivity, absolute	–99.5 dBm (typical)	–99.5 dBm (typical)	–95.5 dBm (typical)	–87.5 dBm (typical)
Accuracy, relative	± 0.05 dB	± 0.12 dB	± 0.12 dB	± 0.11 dB
Accuracy, absolute	± 0.41 dB (95th percentile)	± 0.54 dB (95th percentile)	± 0.54 dB (95th percentile)	± 1.28 dB (95th percentile)
802.11ac (160 MHz); Integration bandwidth = 158 MHz, RBW = 100.0 kHz, 81.0 MHz offset				
Center frequency in 5.0 GHz band				
Dynamic range, relative	85.4 dB (typical)	84.7 dB (typical)	80.4 dB (typical)	73.4 dB (typical)
Sensitivity, absolute	–99.5 dBm (typical)	–99.5 dBm (typical)	–95.5 dBm (typical)	–87.5 dBm (typical)
Accuracy, relative	± 0.05 dB	± 0.12 dB	± 0.12 dB	± 0.11 dB
Accuracy, absolute	± 0.41 dB (95th percentile)	± 0.54 dB (95th percentile)	± 0.54 dB (95th percentile)	± 1.28 dB (95th percentile)
802.11ax (80 MHz); Integration bandwidth = 79 MHz, RBW = 100.0 kHz, 40.5 MHz offset				
Center frequency in 2.4 GHz band				
Dynamic range, relative	87.4 dB (typical)	85.1 dB (typical)		
Sensitivity, absolute	–101.5 dBm (typical)	–99.5 dBm (typical)		
Accuracy, relative	± 0.15 dB	± 0.26 dB		
Accuracy, absolute	± 0.22 dB (95th percentile)	± 0.28 dB (95th percentile)		
Center frequency in 5.0 GHz band				
Dynamic range, relative	85.4 dB (typical)	85.1 dB (typical)		
Sensitivity, absolute	–99.5 dBm (typical)	–99.5 dBm (typical)		
Accuracy, relative	± 0.60 dB	± 0.67 dB		
Accuracy, absolute	± 0.42 dB (95th percentile)	± 0.54 dB (95th percentile)		
802.11ax (160 MHz); Integration bandwidth = 159 MHz, RBW = 100.0 kHz, 80.5 MHz offset				
Center frequency in 2.4 GHz band				
Dynamic range, relative	87.4 dB (typical)	85.2 dB (typical)		
Sensitivity, absolute	–101.5 dBm (typical)	–99.5 dBm (typical)		
Accuracy, relative	± 0.18 dB	± 0.23 dB		
Accuracy, absolute	± 0.22 dB (95th percentile)	± 0.28 dB (95th percentile)		
Center frequency in 5.0 GHz band				
Dynamic range, relative	85.4 dB (typical)	85.2 dB (typical)		
Sensitivity, absolute	–99.5 dBm (typical)	–99.5 dBm (typical)		
Accuracy, relative	± 0.75 dB	± 0.82 dB		
Accuracy, absolute	± 0.42 dB (95th percentile)	± 0.54 dB (95th percentile)		
802.11ah (1MHz); Integration bandwidth=0.9MHz,RBW=10.0 kHz,0.6MHz offset				
Center frequency in Sub GHz band				
Dynamic range, relative	90.1 dB (typical)	89.9 dB (typical)	87.9 dB (typical)	78.7 dB (typical)
Sensitivity, absolute	–111.5 dBm (typical)	–109.5 dBm (typical)	–106.5 dBm (typical)	–104.5 dBm (typical)
Accuracy, relative	± 0.06 dB	± 0.13 dB	± 0.13 dB	± 0.14 dB
Accuracy, absolute	± 0.21 dB (95th percentile)	± 0.27 dB (95th percentile)	± 0.31 dB (95th percentile)	± 0.65 dB (95th percentile)

Ordering Information

Flexible licensing and configuration

- **Perpetual:** License can be used in perpetuity.
- **Time-based:** License is time limited to a defined period, such as 12-months.
- **Node-locked:** Allows you to use the license on one specified instrument/computer.
- **Transportable:** Allows you to use the license on one instrument/computer at a time. This license may be transferred to another instrument/computer using Keysight's online tool.
- **Floating:** Allows you to access the license on networked instruments/computers from a server, one at a time. For concurrent access, multiple licenses may be purchased.
- **USB portable:** Allows you to move the license from one instrument/computer to another by end-user only with certified USB dongle, purchased separately.
- **Software support subscription:** Allows the license holder access to Keysight technical support and all software upgrades

You Can Upgrade!

All of our X-Series application options are license-key upgradeable.

WLAN 802.11a/b/g/j/p/n/af/ah measurement app (N9077EM0E)
WLAN 802.11ac/ax measurement app (N9077EM1E)

Software License Type	Software License	Support Subscription (12-month) [2]
Node-locked perpetual	R-Y5C-001-A	R-Y6C-001- Z[2]
Node-locked time-based	R-Y4C-001-Z[1]	Included
Transportable perpetual	R-Y5C-004-D	R-Y6C-004- Z[2]
Transportable time-based	R-Y4C-004- Z[1]	Included
Floating perpetual (single site)	R-Y5C-002-B	R-Y6C-002- Z[2]
Floating time-based (single site)	R-Y4C-002- Z[1]	Included
USB portable perpetual	R-Y5C-005-E	R-Y6C-005- Z[2]
USB portable time-based	R-Y4C-005- Z[1]	Included

One month software support subscription extensions [3]

Support Subscription	Description
R-Y6C-501	1-month of support subscription for node-locked perpetual license
R-Y6C-502	1-month of support subscription for floating perpetual license (single site)
R-Y6C-504	1-month of support subscription for transportable perpetual license
R-Y6C-505	1-month of support subscription for USB portable perpetual license

1. z means different time-based license duration. F for six months, L for 12 months, X for 24 months, and Y for 36 months. All time-based licenses have included the support subscription same as the time-base duration.
2. z means different support subscription duration. L for 12 months (as default), X for 24 months, Y for 36 months, and Z for 60-months. Support subscription must be purchased for all perpetual licenses with 12-months as the default. All software upgrades and KeysightCare support are provided for software licenses with valid support subscription.
3. Support subscription for all perpetual licenses can be extended with monthly extensions.

Try Before You Buy!

Evaluate a full-featured version of our X-Series measurement application with our ***FREE*** trial. Redeem one 30-day trial license of each measurement application online at: www.keysight.com/find/X-Series_apps_trial

Hardware Configurations

To learn more about compatible platforms and required configurations, please visit: www.keysight.com/find/X-Series_apps_platform

Software Models & Options

To learn more about X-Series measurement application licensing, model numbers and options, please visit: www.keysight.com/find/X-Series_apps_model

Hardware Configuration

For optimizing WLAN measurement applications, Keysight recommends a minimum level of X-Series multi-touch instrument hardware functionality at each instrument performance point. Supported instruments include:

Benchtop:
- UXA N9041B[1]
- UXA N9040B
- PXA N9030B
- MXA N9020B
- EXA N9010B
- CXA N9000B

PXIe:
- VSA up to 6 GHz M9391A
- VSA up to 50 GHz M9393A
- VXT M9421A
- VXT M9410A/M9411A

N90x0B X-Series signal analyzer

Capability	Instrument Option	Benefit
Analysis bandwidth	25 MHz minimum (-B25) or wider.	Required: based on bandwidth of WLAN signal under test
Electronic attenuator	-EA3	Recommended: fast and reliable attenuation changes ideal for manufacturing without the wear associated with mechanical attenuators up to 3.6 GHz in 1 dB steps
Pre-amplifier	3.6 GHz (-P03) or higher up to instrument maximum RF frequency as available	Recommended: for maximizing the measurement sensitivity
Microwave preselector bypass option	-MPB	Required: for measurements > 3.6 GHz
Real-time spectrum analysis	-RT1 or -RT2	Required: for real-time spectrum analysis; maximum bandwidth varies by instrument

Note 1: Currently pulse analysis measurement application has only been qualified for UXA N9041B Input 1 Port.

M9421A/M9410A/M9411A PXIe VXT vector transceiver

Capability	Instrument Option	Benefit
Frequency range 3.8 or 6 GHz	M9421A-504/506	One required
Analysis bandwidth 40, 80 or 160 MHz	M9421A-B1X	One required
Memory 256 or 512 MSa	M9421A-M02/M05	One required
Half duplex port	M9421A-HDX	Optional
High output power	M9421A-1EA	Optional

M9410A/M9411A PXIe VXT vector transceiver

Capability	Instrument Option	Benefit
Frequency range 6 GHz	M9410A/M9411A-001	One required
Analysis bandwidth 300, 600 or 1200 MHz	M9410A/M9411A-B3X/B6X/B12	One required
Memory 256 or 512 MSa	M9410A/M9411A-M02/M05	One required
Half duplex port	M9410A/M9411A-HDX	Optional
High output power	M9410A/M9411A-1EA	Optional

M9391A/M9393A PXIe VSA vector signal analyzer

Capability	Instrument Option	Benefit
Frequency range 3 or 6 GHz	M9391A-F03, or F06	One required for M9391A
Frequency range 8.4, 14, 18, or 27 GHz	M9393A-F08, F14, F18, or F27	One required for M9393A
Frequency extension to 43.5 or 50 GHz	M9393A-FRZ or FRX	Optional (requires M9393A-F27)
Analysis bandwidth 40, 100 or 160 MHz	M9391A/M9393A-B04, B10 or B1	One required
Memory 128, 512 or 1024 MSa	M9391A/M9393A-M01, M05 or M10	One required
Frequency reference 10 MHz and 100 MHz	M9391A/M9393A-300	One required

Related Literature

RF Testing of Wireless Products, Application Note 1380-1,
literature number 5988-5411EN

IEEE 802.11 Wireless LAN PHY Layer (RF) Operation and Measurement, Application note 1380-2, literature number 5988-3762EN

Testing New-generation Wireless LAN, Application note,
literature number 5990-8856EN

Keysight MIMO Wireless LAN PHY Layer [RF] Operation & Measurement, Application note 1509, literature number 5989-3443EN

Web

WLAN 802.11a/b/g/j/p/n/af/ah X-Series measurement app, multi-touch UI product webpage
www.keysight.com/find/N9077E

WLAN 802.11ac/ax X-Series measurement app, multi-touch UI product webpage
www.keysight.com/find/N9077EM1E

X-Series measurement applications:
www.keysight.com/find/X-Series_Apps

X-Series signal analyzers:
www.keysight.com/find/X-Series

Application pages:
www.keysight.com/find/WLAN

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