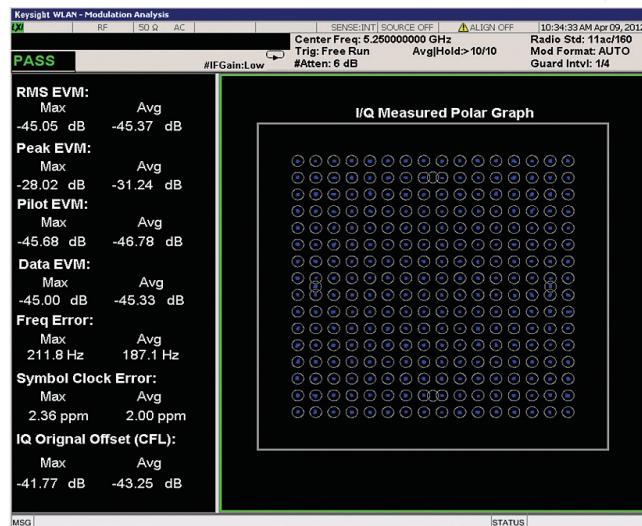


# WLAN 802.11a/b/g/j/p/n/ac/af/ah/ax X-Series Measurement App, Traditional UI

WLAN 802.11a/b/g/j/p/n/af/ah: N9077EMOD

WLAN 802.11ac/ax: N9077EM1D

- Perform WLAN spectrum and modulation measurements based on IEEE 802.11a/b/g/j/p/n/ac/af/ah
- 802.11ac/ax 20/40/80/160 MHz and 80+80 MHz, modulation format support up to 1024QAM
- Perform one-button, standard-based measurements with pass/fail tests
- Hardkey/softkey manual 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



# 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  $\mu$ s 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).

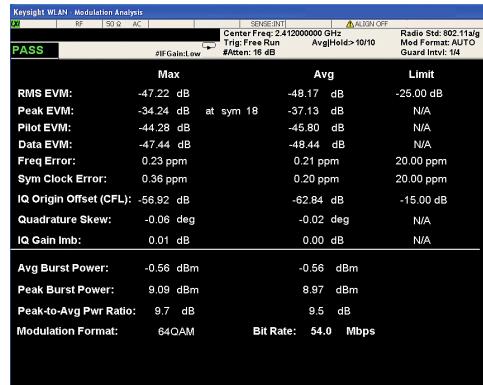


# Top Features

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.

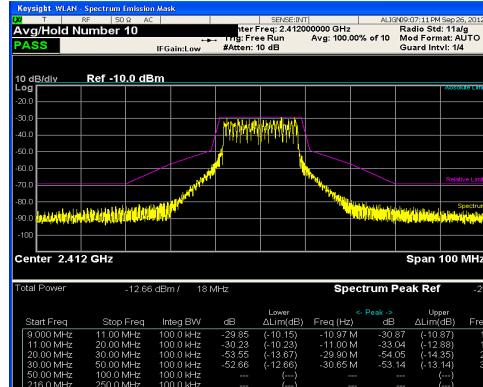
## Numerical display

Numerical results summarize modulation accuracy. Parameters for WLAN signals.



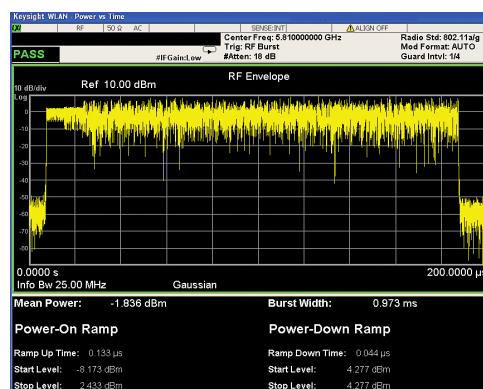
## Transmit spectrum mask display

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



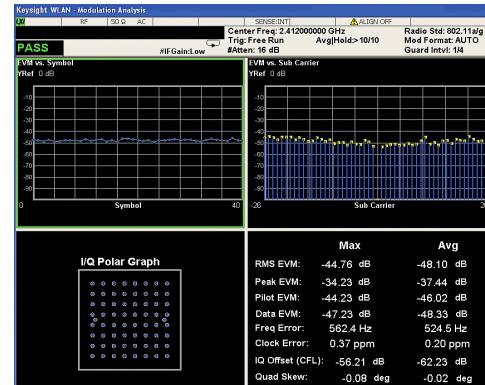
## Time-domain display

Time-domain view of an 802.11a burst.



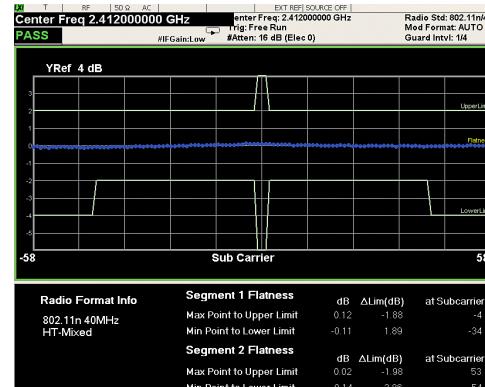
## OFDM EVM display

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



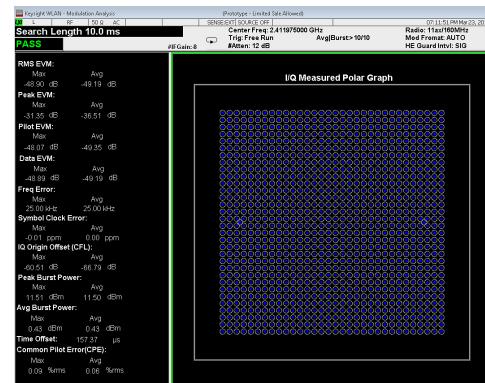
## Spectrum flatness display

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



## 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 N9077EMOD and 89600 VSA software

IEEE 802.11a/j/p	IEEE 802.11b	IEEE 802.11g	Transmitter test	N9077EMOD WLAN measurement application	89601B Option B7R WLAN 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 <sup>1</sup>
18.3.9.4	17.4.6.9	18.3.9.4	Transmission spurious	Spurious emission	Not available <sup>1</sup>
18.3.9.5	17.4.7.5	18.3.9.5 19.4.8.3	Center frequency tolerance	Frequency error <sup>2</sup>	Frequency error <sup>2</sup>
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 <sup>2</sup>	Symbol clock error <sup>2</sup>
18.3.9.7.1	18.3.9.7.1 17.4.7.7 17.4.7.8	Center frequency leakage Power on/down ramp RF carrier suppression	IQ origin offset <sup>2</sup> Power vs time Carrier suppression <sup>2</sup>	IQ offset <sup>2</sup> Not available Not available	OFDM equalized channel frequency resp. EVM (rms) Modulation analysis
18.3.9.7.3	18.3.9.7.3	Spectral flatness	Spectral flatness		
18.3.9.7.4	18.3.9.7.4	Constellation error (EVM rms)	RMS EVM		
18.3.9.8	17.4.7.9	18.3.9.8	Modulation accuracy test <sup>3</sup>	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 N9077EMOD 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 N9077EMOD and 89600 VSA software

IEEE 802.11n	Transmitter test	N9077EMOD WLAN measurement application	89601B Option B7Z 802.11n MIMO 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 <sup>1</sup>	Frequency error <sup>1</sup>
20.3.20.6	Symbol clock frequency tolerance	Symbol (chip) clock error <sup>1</sup>	Symbol clock error <sup>1</sup>
20.3.20.7.2	Center frequency leakage	IQ origin offset <sup>1</sup>	IQ offset <sup>1</sup>
20.3.20.7.3	Constellation error (EVM rms)	RMS EVM	EVM (rms)
20.3.20.7.4	Modulation accuracy test <sup>2</sup>	Modulation analysis	Modulation analysis

Table 3. Required WLAN 802.11ac/ah/af transmitter measurements and the corresponding measurements available in N9077EMOD/EM1E and 89600 VSA software.

<b>IEEE 802.11ac Transmitter test (D7.0)</b>		<b>N9077EM1D WLAN measurement application</b>	<b>89601B Option BHJ 802.11ac and MIMO modulation analysis</b>
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 <sup>1</sup>	Frequency error <sup>1</sup>
22.3.18.3	Symbol clock frequency tolerance	Symbol (chip) clock error <sup>1</sup>	Symbol clock error <sup>1</sup>
22.3.18.4.2	Transmit center frequency leakage	IQ origin offset <sup>1</sup>	IQ offset <sup>1</sup>
22.3.18.4.3	Transmit constellation error (EVM rms)	RMS EVM	EVM (rms)
22.3.18.4.2	Modulation accuracy test <sup>2</sup>	Modulation analysis	Modulation analysis
<b>IEEE 802.11ah Transmitter test (D3.0)</b>		<b>N9077EMOD WLAN measurement application</b>	
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 <sup>1</sup>	
24.3.16.4	Symbol clock frequency tolerance	Symbol clock error <sup>1</sup>	
24.3.16.4.2	Transmit center frequency leakage	IQ origin offset <sup>1</sup>	
24.3.16.4.3	Transmit constellation error (EVM rms)	RMS EVM	
24.3.16.4.4	Modulation accuracy test <sup>2</sup>	Modulation analysis	
<b>IEEE 802.11af Transmitter test (2013)</b>		<b>N9077EMOD WLAN measurement application</b>	
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 N9077EMOD 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 N9077EM1D and 89600 VSA software

<b>IEEE 802.11ax Transmitter test (D3.2)</b>		<b>N9077EM1D WLAN measurement application</b>	<b>89601B Option BHX 802.11ax modulation analysis</b>
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 <sup>1</sup>	Frequency error <sup>1</sup>
26.3.14.3	Symbol clock frequency tolerance	Symbol (chip) clock error <sup>1</sup>	Symbol clock error <sup>1</sup>
26.3.14.4.2	Transmit center frequency leakage	IQ origin offset <sup>1</sup>	IQ offset <sup>1</sup>
26.3.14.4.3	Transmit constellation error (EVM rms)	RMS EVM	EVM (rms)
26.3.14.4	Modulation accuracy test <sup>2</sup>	Modulation analysis	Modulation analysis

1. For the N9077EMOD 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 N9077EMOD 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+80 MHz) <sup>1</sup> , 802.11ah (1/2/4/8/16 MHz), 802.11af (6/7/8 MHz)	IEEE 802.11ax (20/40/80/160, 80+80 MHz) <sup>1</sup>
Modulation analysis				
RMS EVM	• <sup>2</sup>	•	•	•
Peak EVM	•	•	•	•
Pilot EVM		•	•	•
Data EVM		•	•	•
1K chips EVM	•			
RMS magnitude error	•			
Peak magnitude error	•			
RMS phase error	•			
Peak phase error	•			
Frequency 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			•	•
OFDM burst & sig info			•	
User info			•	•
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 (N9077EMOD and N9077EM1D). 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 ( $\approx 2\sigma$ ) 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

Device type	
	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
Standard version	802.11ac 20/40/80/160 MHz, 80+80 MHz, MCS=0-11 802.11af 6/7/8 MHz 802.11ah 1/2/4/8/16MHz, MCS0-10
	802.11ax 20/40/80/160 MHz, 80+80 MHz, MCS=0-11
Modulation formats	BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM

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

#### Benchtop

PXA: [www.keysight.com/find/pxa\\_specifications](http://www.keysight.com/find/pxa_specifications)

MXA: [www.keysight.com/find/mxa\\_specifications](http://www.keysight.com/find/mxa_specifications)

EXA: [www.keysight.com/find/exa\\_specifications](http://www.keysight.com/find/exa_specifications)

CXA: [www.keysight.com/find/cxa\\_specifications](http://www.keysight.com/find/cxa_specifications)

#### PXIe:

VSA up to 6 GHz: [www.keysight.com/find/m9391a](http://www.keysight.com/find/m9391a)

VSA up to 50 GHz: [www.keysight.com/find/m9393a](http://www.keysight.com/find/m9393a)

VXT: [www.keysight.com/find/m9421a](http://www.keysight.com/find/m9421a)

## Key Specifications

Description	PXA (N9030A)	MXA (N9020A)	EXA (N9010A)	CXA (N9000A)
Supported standards	802.11a, 802.11g ERP-OFDM, 802.11g DSSS-OFDM, 802.11b/g DSSS/CCK/PBCC, 802.11j, 802.11p, 802.11a turbo mode	802.11n (20 MHz <sup>4</sup> , 40 MHz <sup>5</sup> ) HT Mixed, HT Greenfield, Non-HT		
	802.11ac 20 <sup>5</sup> /40 <sup>6</sup> /80 <sup>7</sup> /160 <sup>8</sup> MHz, 80+80 MHz <sup>7</sup> , MCS=0-11	802.11af 6/7/8 MHz		
	802.11ah 1/2/4/8/16MHz, MCS=0-10	802.11ax 20 <sup>5</sup> /40 <sup>6</sup> /80 <sup>7</sup> /160 <sup>8</sup> MHz, 80+80 MHz <sup>7</sup> , MCS=0-11		
Modulation formats	BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM			
<b>Modulation accuracy (nominal)</b>				
Center frequency in 2.4 GHz band <sup>1</sup>				
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%) <sup>8</sup>	-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%) <sup>8</sup>	-46 dB (0.47%)	Not Applicable <sup>3</sup>
Center frequency in 5.0 GHz band <sup>2</sup>				
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%) <sup>7</sup>	-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%) <sup>8</sup>	-45 dB (0.53%)	Not Applicable <sup>3</sup>
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%) <sup>8</sup>	Not Applicable <sup>3</sup>	Not Applicable <sup>3</sup>
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%) <sup>8</sup>	Not Applicable <sup>3</sup>	Not Applicable <sup>3</sup>
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				
<b>Center frequency in Sub GHz band</b>				
EVM floor <sup>10</sup>	-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 <sup>9</sup>			

- 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)
- 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)
- The CXA with Option B25 can only support the bandwidth of 25 MHz. EXA with Option B40 can only support 40 MHz bandwidth.
- Requires N90x0A-B25 25 MHz analysis bandwidth option or higher
- Requires N90x0A-B40 40 MHz analysis bandwidth option or higher
- Requires N90x0A-B85 85 MHz analysis bandwidth option or higher
- Requires N90x0A-B1X 160 MHz analysis bandwidth option
- EVM specification for MXA is for instruments with serial number prefix ≥ MY/SG/US5233 (those instruments ship standard with N9020A-EP2 as the identifier). Refer to the WLAN chapter of the MXA specification guide for specification on the other MXA: [www.keysight.com/find/mxa\\_specifications](http://www.keysight.com/find/mxa_specifications). For MXA, phase noise optimization is set to fast tuning.
- tfa = transmitter frequency × frequency reference accuracy
- For this specification, MXA Serial Number should be later than MY/SG/US5233. EXA serial number should be above MY/SG/US5340.

## Key Specifications (continued)

Modulation accuracy (nominal)				
Center frequency in 2.4 GHz band <sup>1</sup>				
802.11b/g (DSSS/CCK/PBCC); Reference filter: Gaussian; RF input level = -10 dBm, Attenuation = 10 dB				
Center frequency in 2.4 GHz band <sup>1</sup>				
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 <sup>2</sup>	—	—	—
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)	-51.7 dB (0.26%)	-50.3 dB (0.31%) <sup>3</sup>	—	—
EVM floor (5 GHz band)	-50.5 dB (0.30%)	-50.3 dB (0.31%) <sup>3</sup>	—	—
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)	-47.5 dB (0.42%)	-47.3 dB (0.43%) <sup>3</sup>	—	—
EVM floor (5 GHz band)	-47.0 dB (0.45%)	-47.0 dB (0.43%) <sup>3</sup>	—	—

1. 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)

2. tfa = transmitter frequency × frequency reference accuracy

3. For this specification, MXA Serial Number should be later than MY/SG/US5233. EXA serial number should be above MY/SG/US5340.

## Key Specifications (continued)

Description	PXA (N9030A)	MXA (N9020A)	EXA (N9010A)	CXA (N9000A)
<b>Channel power</b>				
Minimum power at RF input	-50 dBm (nominal)			
<b>Center frequency in 2.4 GHz band</b>				
<b>802.11b/g (DSSS/CCK/PBCC); Integration bandwidth = 22 MHz</b>				
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)
<b>802.11a/g/j/p (OFDM), 802.11g (DSSS-OFDM), 802.11n (20 MHz), 802.11ac (20 MHz); Integration bandwidth = 20 MHz</b>				
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)
<b>802.11n (40 MHz), Integration bandwidth= 40 MHz</b>				
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)
<b>Center frequency in 5.0 GHz band</b>				
<b>802.11a/g/j/p (OFDM), 802.11n (20 MHz), 802.11ac (20 MHz); Integration bandwidth= 20 MHz</b>				
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)
<b>802.11n (40 MHz), 802.11ac (40 MHz); Integration bandwidth = 40 MHz</b>				
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)
<b>802.11ac (80 MHz); Integration bandwidth = 80 MHz</b>				
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)
<b>802.11ac (160 MHz); Integration bandwidth = 160 MHz</b>				
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)
<b>802.11ax (80 MHz); Integration bandwidth = 80 MHz</b>				
Measurement floor	-72.7 dBm (typical)	-70.1 dBm (typical)	–	–
<b>802.11ax (160 MHz); Integration bandwidth = 160 MHz</b>				
Measurement floor	-67.7 dBm (typical)	-67.7 dBm (typical)	–	–
<b>802.11ah (1 MHz); Integration bandwidth = 1 MHz</b>				
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
<b>Power versus Time (nominal)</b>				
<b>802.11b/g (DSSS/CCK/PBCC)</b>				
<b>Center frequency in 2.4 GHz band</b>				
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
<b>Spectrum emission mask</b>				
<b>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</b>				
<b>Center frequency in 2.4 GHz band</b>				
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)
<b>802.11a/g (OFDM), 802.11n (20 MHz), 802.11ac (20 MHz); Integration bandwidth = 18 MHz, RBW = 100.0 kHz, 11.0 MHz offset</b>				
<b>Center frequency in 5.0 GHz band</b>				
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 (N9030A)	MXA (N9020A)	EXA (N9010A)	CXA (N9000A)
<b>802.11n (40 MHz), 802.11ac (40 MHz) @ 5 GHz only; Integration bandwidth = 38 MHz, RBW = 100.0 kHz, 21.0 MHz offset</b>				
<b>Center frequency in 2.4 GHz band</b>				
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)
<b>Center frequency in 5.0 GHz band</b>				
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)
<b>802.11b/g (DSSS/CCK/PBCC); Integration bandwidth = 22 MHz, RBW = 100.0 kHz, 11.0 MHz offset</b>				
<b>Center frequency in 2.4 GHz band</b>				
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)
<b>802.11ac (80 MHz); Integration bandwidth = 78 MHz, RBW = 100.0 kHz, 41.0 MHz offset</b>				
<b>Center frequency in 5.0 GHz band</b>				
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)
<b>802.11ac (160 MHz); Integration bandwidth = 158 MHz, RBW = 100.0 kHz, 81.0 MHz offset</b>				
<b>Center frequency in 5.0 GHz band</b>				
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)
<b>802.11ax (80 MHz); Integration bandwidth = 79 MHz, RBW = 100.0 kHz, 40.5 MHz offset</b>				
<b>Center frequency in 2.4 GHz band</b>				
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)	—	—
<b>Center frequency in 5.0 GHz band</b>				
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)	—	—
<b>802.11ax (160 MHz); Integration bandwidth = 159 MHz, RBW = 100.0 kHz, 80.5 MHz offset</b>				
<b>Center frequency in 2.4 GHz band</b>				
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)	—	—
<b>Center frequency in 5.0 GHz band</b>				
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)	—	—
<b>802.11ah (1 MHz); Integration bandwidth=0.9 MHz, RBW=10.0 kHz, 0.6MHz offset</b>				
<b>Center frequency in Sub GHz band</b>				
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

WLAN 802.11a/b/g/j/p/n/af/ah measurement app (N9077EM0D)  
WLAN 802.11ac/ax measurement app (N9077EM1D)

Software License Type	Software License	Support Subscription
Node-locked perpetual	R-Y5C-001-A	R-Y6C-001-Z <sup>2</sup>
Node-locked time-based	R-Y4C-001-Z <sup>1</sup>	Included
Transportable perpetual	R-Y5C-004-D	R-Y6C-004-Z <sup>2</sup>
Transportable time-based	R-Y4C-004-Z <sup>1</sup>	Included
Floating perpetual	R-Y5C-002-B	R-Y6C-002-Z <sup>2</sup>
Floating time-based	R-Y4C-002-Z <sup>1</sup>	Included
USB portable perpetual	R-Y5C-005-E	R-Y6C-005-Z <sup>2</sup>
USB portable time-based	R-Y4C-005-Z <sup>1</sup>	Included

### One month software support subscription extensions <sup>3</sup>

Model	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
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

- 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.
- 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.
- Support subscription for all perpetual licenses can be extended with monthly extensions.

### You Can Upgrade!

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



### 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](http://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](http://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](http://www.keysight.com/find/X-Series_apps_model)

## Hardware Configuration

For optimizing the WLAN measurement application, Keysight recommends a minimum level of instrument hardware functionality at each instrument performance point. Supported instruments include:

### Benchtop:

- PXA N9030A
- MXA N9020A

- EXA N9010A
- CXA N9000A

### PXIe:

- VSA (6 GHz) M9391A
- VSA (50 GHz) M9393A
- VXT M9420/21A

## N90x0A X-Series signal analyzer

Capability	Instrument Option	Benefit
Analysis bandwidth	25 MHz minimum (B25 or wider)	<b>Required:</b> Analysis bandwidth depends on the WLAN format. 40/85/160 MHz analysis bandwidth options can be chosen depending on the specified signal analyzer model.
Precision frequency reference	-PFR	<b>Recommended:</b> For enhanced frequency accuracy and repeatability for lower measurement uncertainty
Electronic attenuator	-EA3	<b>Recommended:</b> 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	<b>Recommended:</b> For maximizing the measurement sensitivity
Fine resolution step attenuator	-FSA	<b>Recommended:</b> Useful for maximizing useable dynamic range to see signals
Analog baseband I/Q inputs	-BBA on PXA and MXA only	<b>Optional:</b> To extend measurements at baseband if required by device under test

## M9391/93A PXIe VSA vector signal analyzer

Description	Model-Option	Additional information
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 B16	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

## M9420/21A PXIe VXT vector transceiver

Description	Model-Option	Additional information
Frequency range 3.8 or 6 GHz	M9420A/M9421A-504, or 506	One required
Analysis bandwidth 40, 80 or 160 MHz	M9420A/M9421A-B40/B80/B1X	One required
Memory 256 or 512 MSa	M9420A/M9421A-M02/M05	One required
Half duplex port	M9420A/M9421A-HDX	Optional
High output power	M9420A/M9421A-1EA	Optional
True MIMO measurement	M9420A/M9421A-MMO	Optional
Multi-tester synchronization for MIMO	M9420A/M9421A-MTS	Optional (requires option MMO)

## 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, traditional UI product webpage  
[www.keysight.com/find/N9077D](http://www.keysight.com/find/N9077D)

WLAN 802.11ac/ax X-Series measurement app, traditional UI product webpage  
[www.keysight.com/find/N9077EM1D](http://www.keysight.com/find/N9077EM1D)

X-Series measurement applications:  
[www.keysight.com/find/X-Series\\_Apps](http://www.keysight.com/find/X-Series_Apps)

X-Series signal analyzers:  
[www.keysight.com/find/X-Series](http://www.keysight.com/find/X-Series)

Application pages:  
[www.keysight.com/find/WLAN](http://www.keysight.com/find/WLAN)

Internet of Things pages:  
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