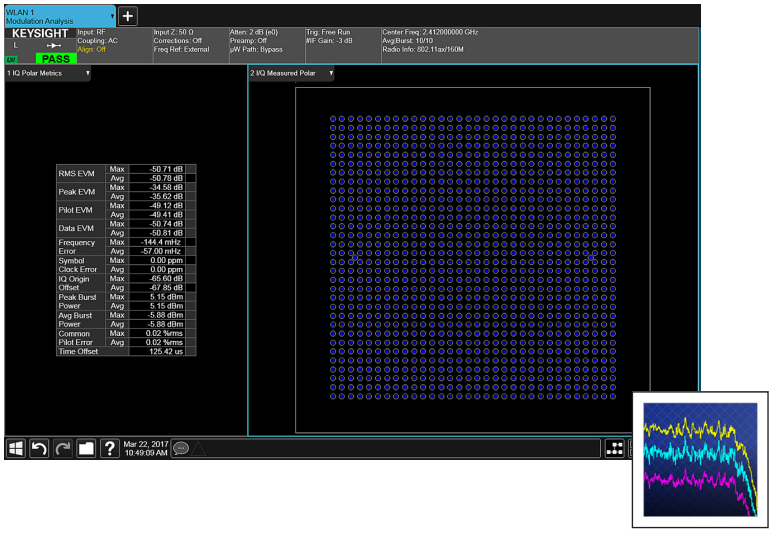
Keysight Technologies
WLAN 802.11a/b/g/j/p/n/ac/af/ah/ax X-Series Measurement Application N9077C

Technical Overview



- 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 1024QAM
- Perform one-button, standard-based measurements with pass/fail tests
- Multi-touch user interface and SCPI remote user interface
- Built-in, context-sensitive help
- Move application between X-Series signal analyzers with transportable-licensing

KEYSIGHT TECHNOLOGIES

Unlocking Measurement Insights

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.

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 and digital video applications, covering established standards and modulation types. Applications are supported across X-Series analyzers, with the only difference being the level of performance achieved by the hardware you select.

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

Top Features

By using the X-Series signal analyzers with the WLAN measurement application, you can perform WLAN transmitter measurements in the time, frequency, and modulation domains. IEEE 802.11a/b/g/j/p signals, 802.11ah 1/2/4/8/16 MHz signals, 802.11n 20 MHz and 40 MHz signals, 802.11af 6/7/8MHz, 802.11ac 20/40/80/160 MHz and 80+80 MHz, as well as 802.11ax 20/40/80/160 MHz and 80+80 MHz signals with all modulation formats, as shown in Table 6, can be measured automatically.

Numerical display

Numerical results summarize modulation accuracy. Parameters for WLAN signals are shown in figure 1.

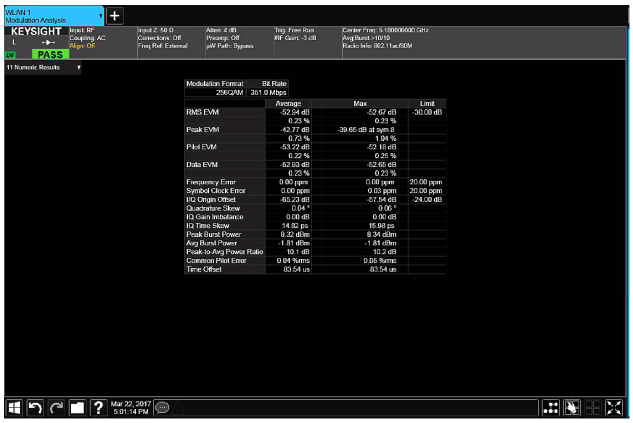


Figure 1.

OFDM EVM display

The OFDM EVM displays four traces with EVM vs. symbol, EVM vs. subcarrier, constellation, and measurement results, as shown in figure 2.

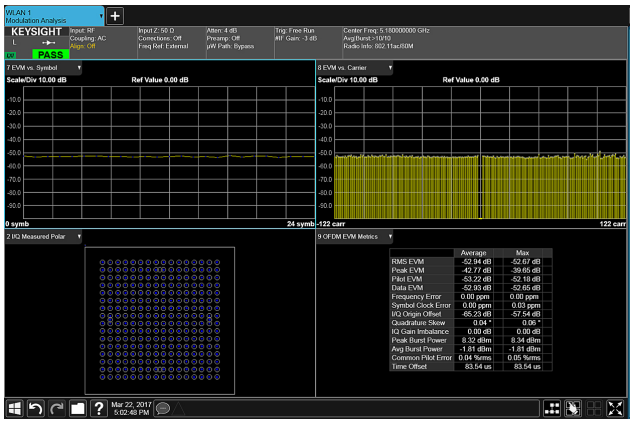


Figure 2.

Transmit spectrum mask display

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

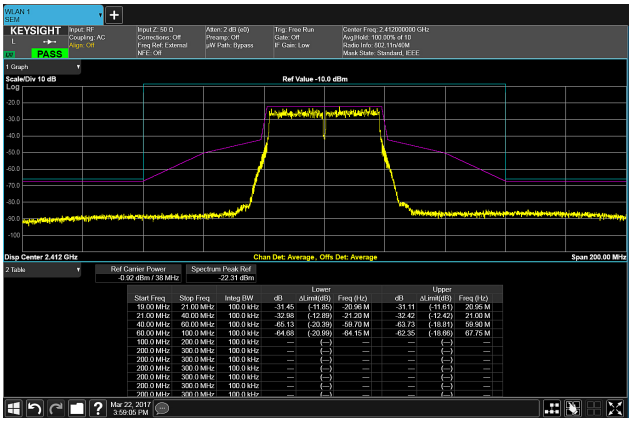


Figure 3.

Spectrum flatness display

Spectrum flatness of a 40 MHz IEEE 802.11n signal (Greenfield mode) is shown in figure 4.

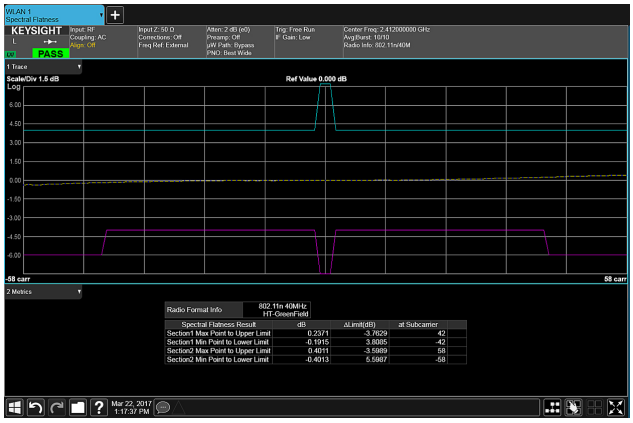


Figure 4.

Time-domain display

Figure 5 shows a time-domain view of an 802.11g burst.

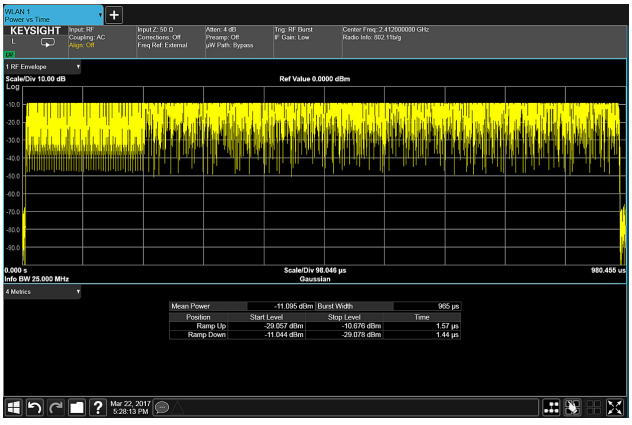


Figure 5.

Modulation analysis display

The modulation analysis of a 160 MHz 802.11ax signal with an MCS11 1023QAM signal.

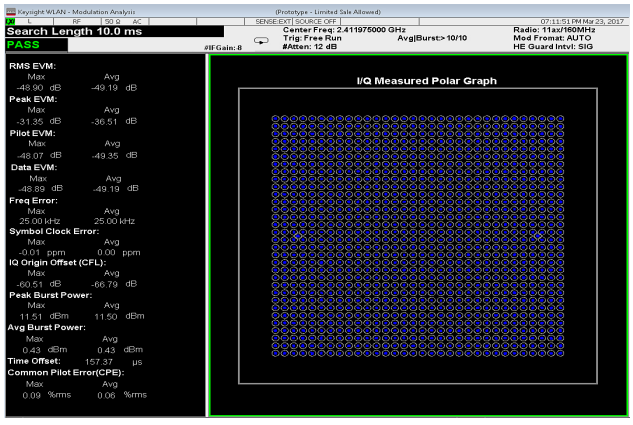


Figure 6.

Measurement Summary

Standard-based RF transmitter tests

Table 1. Required 802.11a/b/g WLAN transmitter measurements and the corresponding measurements in the N9077C and 89600 VSA software

IEEE 802.11a/j/p	IEEE 802.11b	IEEE 802.11g	Transmitter test	N/W9077A Option 2FP 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 [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 N9077C 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 N9077C and 89600 VSA software

IEEE 802.11n	Transmitter test	N9077C Option 1FP 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[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 802.11ac WLAN transmitter measurements and the corresponding measurements in N9077A and 89600 VSA software

IEEE 802.11ac (D7.0)	Transmitter test	N9077C Option 4FP WLAN measurement application	89601B Option BHJ 802.11ac and MIMO 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**	**N9077C Option 6FP 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**	**N9077C Option 7FP 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 N9077C 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 N9077C and 89600 VSA software

IEEE 802.11ax (D1.3)	Transmitter test	N9077C Option 8FP WLAN measurement application	89601B Option BHX 802.11ax 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 N9077C 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 N9077C 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+80M Hz)[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	•	•	•	•
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.

Key Specifications

This section contains specifications for the N/W9077A WLAN 802.11 measurement applications. 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 (≈2σ) 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 DSSS-CCK/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=0-11 802.11af 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:
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**

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=0-11 802.11ax 20[5]/40[6]/80[7]/160[8] MHz, 80+80 MHz[7], MCS=0-11 802.11af 6/7/8 MHz 802.11ah 1/2/4/8/16 MHz, MCS0-10				
Modulation formats	BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM				
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 Applicable [3]
EVM floor (5GHz band)	–47.0 dB (0.45%)	–47.0 dB (0.45%)	–47.0 dB (0.44%) [10]	Not 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)

Software Licensing and Configuration

Choose from two license types:

- Fixed, perpetual license:
  This allows you to run the application in the X-Series analyzer in which it is initially installed.
- Transportable, perpetual license:
  This allows you to run the application in the X-Series analyzer in which it is initially installed, plus it may be transferred from one X-Series analyzer to another.

You Can Upgrade!

Options can be added after your initial purchase.
All of our X-Series application options are license-key upgradeable.

The table below contains information on our fixed, perpetual licenses. For information on transportable licenses and other options, please visit the product web pages.

N9077C WLAN 802.11a/b/g/n/ac/af/ah/ax X-Series measurement application

Description	Model-Option	Additional Information
	UXA, PXA, MXA, EXA, CXA[1]	
802.11a/b/g/j/p/n	N9077C-1FP	
802.11ac	N9077C-4FP	Requires 1FP
802.11ah	N9077C-6FP	Requires firmware above version A.16.05
802.11af	N9077C-7FP	Requires firmware above version A.18.01
802.11ax	N9077C-8FP	Requires firmware above version A.19.05
802.11ax OFDMA	N9077C-MFP	Requires 8FP

1. The maximum analysis bandwidth for CXA is 25 MHz, which allows the CXA to support 802.11a/b/g/j/p and 802.11n 20 MHz measurements.

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:

- UXA N9040B
- PXA N9030B
- MXA N9020B
- EXA N9010B
- CXA N9000B

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

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

Product page:
www.keysight.com/find/N9077C

X-Series measurement applications:
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Published in USA, December 5, 2017
5992-2239EN
www.keysight.com