

# E6680A Wireless Test Set

Verify Wi-Fi 6E and 802.11be designs

## Look to the Future with a Solution for IEEE 802.11 Testing

Signal bandwidths up to 320 MHz – twice the bandwidth of 802.11ax signals – and 4096 Quadrature Amplitude Modulation (QAM) are two of the biggest changes introduced within the Physical Layer (PHY) of the Institute of Electrical and Electronic Engineers' (IEEE) newest technology, 802.11be.

The E6680A is ready. Verifying Wi-Fi 6E and 802.11be devices is quick and easy with bandwidth to 800 MHz and frequency to 7.3 GHz. Generating and analyzing 1024QAM and 4096QAM signals uses application software based on Keysight's familiar PathWave Signal Generation and X-Series Applications.

### Optimize throughput without sacrificing flexibility

More bands and more antennas would seem to add test time and reduce throughput. The 32 ports of the E6680A flexibly test multiple bands, multiple antennas, and multiple devices supporting many use cases.



# Performance Characteristics

## Definitions

### Specifications

Specifications are warranted for a calibrated instrument that has been stored for a minimum of two hours within the operating temperature range. A 45-minute warm-up period is required. Specifications are valid from 20 to 35 °C when an alignment has been performed at the current operating temperature.

### Typical (typ)

The characteristic performance, that 95 percent of the units exhibit with a 95 percent confidence level. This data, shown in italics, is not warranted, does not include measurement uncertainty, and is only valid at room temperature, about 23 °C.

### Nominal (nom)

The mean or average characteristic performance, or the value of an attribute determined by design. This data is not warranted and measured at room temperature, about 23 °C.

## Conditions

The specifications in this document apply to each port of a transceiver in the E6680A wireless test set. Ports are configured as Half Duplex (HD) – transmit or receive, or Full Duplex (FD) - transmit and receive.

# Vector signal analyzer performance characteristics

Measured at the eight RF ports of each transceiver in the E6680A.

Frequency	Performance	Conditions
Frequency range	380 to 7535 MHz	
Frequency reference	Refer to reference performance	
CW measurement frequency accuracy	<i>(Transmitter frequency x frequency reference accuracy) ± 50 Hz, typical</i>	
CW measurement frequency resolution	<i>1 Hz, typical</i>	
IF bandwidth, maximum	100 MHz	430 to < 550 MHz
	200 MHz	550 to < 1310 MHz
		1310 to < 1900 MHz
	200 MHz	With option E6680A-B2X
	400 MHz	With option E6680A-B4X
	600 MHz	With option E6680A-B8X
		1900 to 7135 MHz
	200 MHz 400 MHz 800 MHz <sup>1</sup>	With option E6680A-B2X With option E6680A-B4X With option E6680A-B8X

Amplitude	Performance	Conditions
CW input level range	-70 to 30 dBm	
CW input power accuracy, ports configured as HD	< ±0.50 dB	> -35 to 30 dBm input
	< ±0.30 dB, <i>typical</i>	380 to 2500 MHz
	< ±0.55 dB	-70 to -35 dBm input
	< ±0.33 dB, <i>typical</i>	380 to 2500 MHz
CW input power accuracy, ports configured as FD	< ±0.75 dB	-70 to 30 dBm input
	< ±0.50 dB, <i>typical</i>	2500 to 7535 MHz <sup>2</sup>
	< ±0.50 dB	> -35 to 30 dBm input
	< ±0.30 dB, <i>typical</i>	380 to 2570 MHz
VSWR	< ±0.55 dB	-70 to -35 dBm input
	< ±0.33 dB, <i>typical</i>	380 to 2570 MHz
	< 1.7:1, nominal	380 to 2500 MHz
Port-to-port isolation, VSG to VSA	< 2.0:1, nominal	2500 to 7535 MHz
	> 110 dB, nominal	380 to 2500 MHz
	> 80 dB, nominal	2500 to 7535 MHz

<sup>1</sup> Maximum bandwidth is limited to 320 MHz for 6.40 to 6.44 GHz and to 400 MHz for 6.33 to 6.40 GHz.  
<sup>2</sup> Performance degrades at 4800 MHz.

Spectral	Performance	Conditions
Image responses	< -58 dBc, nominal	200 MHz bandwidth
Residual responses	< -81 dBm, nominal	0 dBm input 380 to 4600 MHz 5000 to 7535 MHz
	< -74 dBm, nominal	0 dBm input > 4600 to < 5000 MHz
Spectral flatness	< ±1.0 dB, nominal	200 and 400 MHz bandwidths
Phase noise	< -110 dBc/Hz, nominal	1 kHz offset at 1 GHz

## Vector signal generation performance characteristics

Measured from the eight RF ports of each transceiver in the E6680A.

Frequency	Performance	Conditions
Frequency range	380 to 7135 MHz	
Frequency reference	Refer to reference performance	
IF bandwidth, maximum	100 MHz	430 to < 550 MHz
	200 MHz	550 to < 1310 MHz
	200 MHz	1310 to < 1900 MHz
	400 MHz	With option E6680A-B2X
	600 MHz	With option E6680A-B4X
		With option E6680A-B8X
	200 MHz	1900 to 7135 MHz
	400 MHz	With option E6680A-B2X
	800 MHz	With option E6680A-B4X
		With option E6680A-B8X
CW output level range	-120 to 5 dBm	
CW output power accuracy, 1 port active, ports configured as HD	< ±0.50 dB	> -60 to 5 dBm output 380 to < 3000 MHz
	< ±0.40 dB, typical	
	< ±0.60 dB	> -75 to -60 dBm output 380 to < 3000 MHz
	< ±0.40 dB, typical	
	< ±0.75 dB	-100 to -75 dBm output 380 to < 3000 MHz
	< ±0.65 dB, typical	
	< ±1.0 dB	> -75 to 5 dBm output 3000 to 7135 MHz <sup>3</sup>
	< ±0.50 dB, typical	
	< ±1.0 dB	-100 to -75 dBm output 3000 to 7135 MHz <sup>3</sup>
	< ±0.85 dB, typical	
CW output power accuracy, 1 port active, ports configured as FD	< ±0.50 dB	> -60 to -5 dBm output 380 to 2690 MHz
	< ±0.40 dB, typical	
	< ±0.60 dB	> -5 to 5 dBm output
	< ±0.40 dB, typical	> -75 to -60 dBm output 380 to 2690 MHz
	< ±0.75 dB	-100 to -75 dBm output
	< ±0.65 dB, typical	380 to 2690 MHz

<sup>3</sup> Performance degrades at 4800 MHz.

Frequency	Performance	Conditions
CW output power accuracy, 4 ports active (broadcast mode), ports configured as HD	< ±0.65 dB, typical	> -75 to 5 dBm output 380 to < 3000 MHz
	< ±0.90 dB, typical	-100 to -75 dBm output 380 to < 3000 MHz
	< ±0.75 dB, typical	> -60 to -15 dBm output 3000 to 7135 MHz <sup>4</sup>
	< ±0.90 dB, typical	> -75 to -60 dBm output 3000 to 7135 MHz <sup>4</sup>
	< ±1.60 dB, typical	-100 to -75 dBm output 3000 to 7135 MHz <sup>4</sup>

Spectral	Performance	Conditions
CW in-channel spurious	< -60 dBc, nominal	0 dBm output 200 MHz bandwidth 380 to 7135 MHz <sup>5</sup>
Spectral flatness	< ±1.0 dB, nominal	200 and 400 MHz bandwidths
Phase noise	< -110 dBc/Hz, nominal	1 kHz offset at 1 GHz
Carrier leakage	< -50 dBc, nominal	> -30 dBm output

## WLAN performance characteristics

Measured with one of the WLAN software applications installed on the E6680A.

Measurement	Characteristic	Conditions
Power accuracy relative to CW	< ±0.30 dB, nominal	0 dBm input 2400 to 2484 MHz
	< ±0.60 dB, nominal	0 dBm input 5150 to 7135 MHz
802.11a/n EVM	< -50 dB, nominal	-20 dBm input 20 and 40 MHz bandwidths 5800 MHz
802.11b/g EVM	< -50 dB, nominal	-20 dBm input 20 MHz bandwidth 2400 MHz
802.11ac EVM (256QAM)	< -50 dB, nominal	-10 dBm input 80 MHz bandwidth 5800 and 7000 MHz
802.11ax EVM (1024QAM)	< -48 dB, nominal	-10 dBm input 160 MHz bandwidth 5800 MHz
	< -49 dB, nominal	-10 dBm input 160 MHz bandwidth 7000 MHz

<sup>4</sup> Performance degrades at 4800 MHz.

<sup>5</sup> Performance is < -45 dBc, nominal, at 6400 MHz.

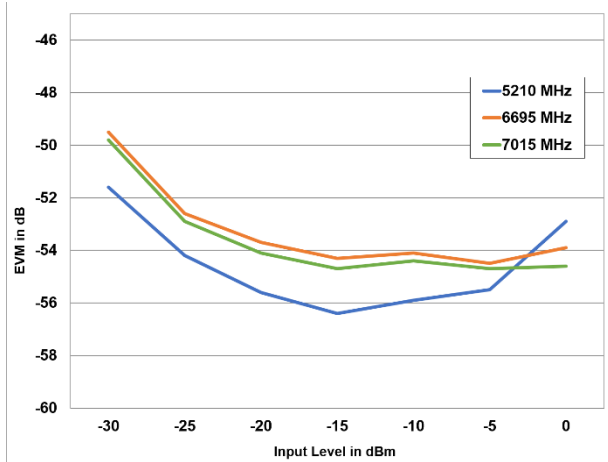


Figure 1. 802.11ax VSA EVM, 80 MHz, 1024QAM

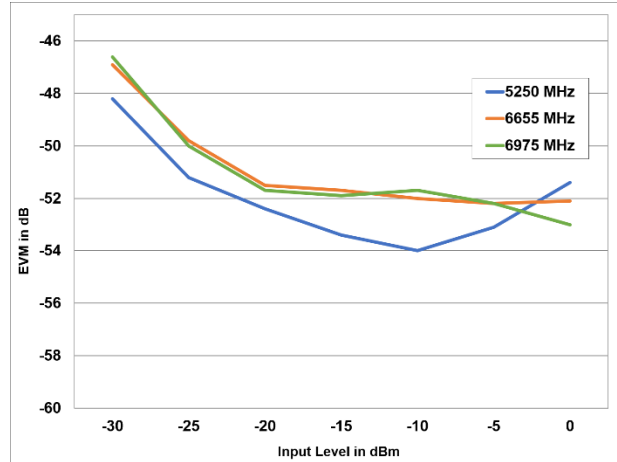


Figure 2. 802.11ax VSA EVM, 160 MHz, 1024QAM

Measurement	Characteristic	Conditions
802.11ax EVM (4096QAM, requires Y/V90EMQAMA license)	< -54 dB, nominal	-10 dBm input 80 MHz bandwidth 7015 MHz
	< -52 dB, nominal	-10 dBm input 160 MHz bandwidth 6975 MHz

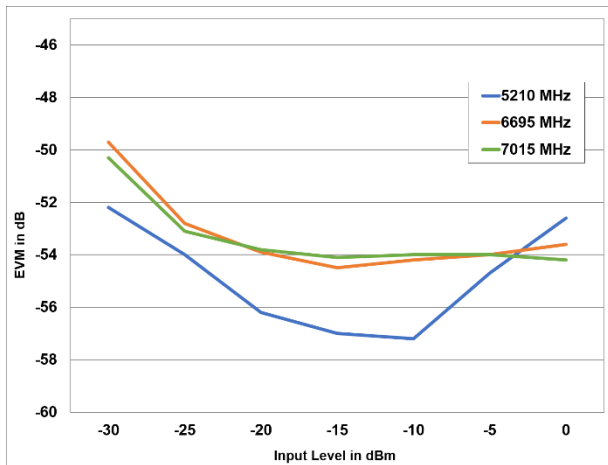


Figure 3. 802.11ax VSA EVM, 80 MHz, 4096QAM

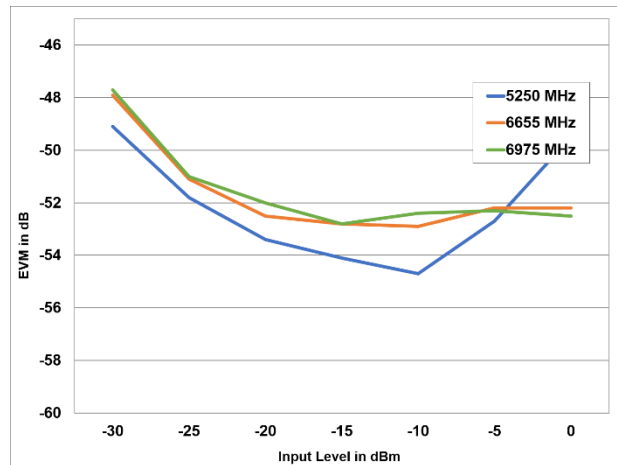


Figure 4. 802.11ax VSA EVM, 160 MHz, 4096QAM

Measurement	Characteristic	Conditions
802.11be loopback EVM (4096QAM, requires Y/V90EMQAMA license)	< -50 dB, nominal	-10 dBm input 320 MHz bandwidth 6985 MHz

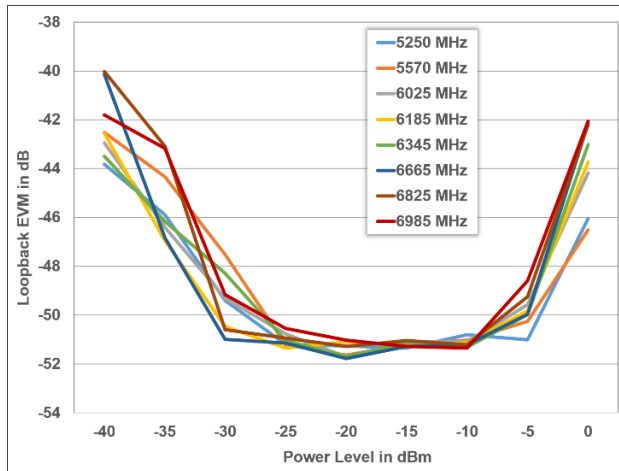


Figure 5. 802.11be loopback EVM, 320 MHz, 4096QAM

Source	Characteristic	Conditions
802.11a/n EVM	< -48 dB, nominal	-20 dBm output 20 and 40 MHz bandwidths 5800 MHz
802.11b/g EVM	< -50 dB, nominal	-20 dBm output 20 MHz bandwidth 2400 MHz
802.11ac EVM (256QAM)	< -50 dB, nominal	-10 dBm output 80 MHz bandwidth 5800 MHz
802.11ax EVM (1024QAM)	< -48 dB, nominal	-10 dBm output 160 MHz bandwidth 5800 MHz
	< -48 dB, nominal	-10 dBm output 80 MHz bandwidth 7000 MHz
	< -47 dB, nominal	-10 dBm output 160 MHz bandwidth 7000 MHz

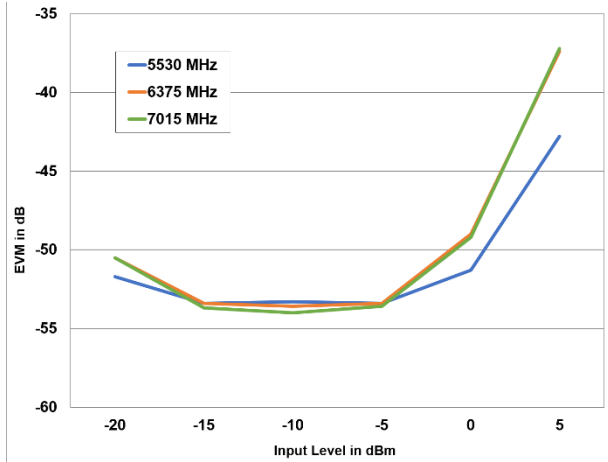


Figure 6. 802.11ax VSG EVM, 80 MHz, 1024QAM

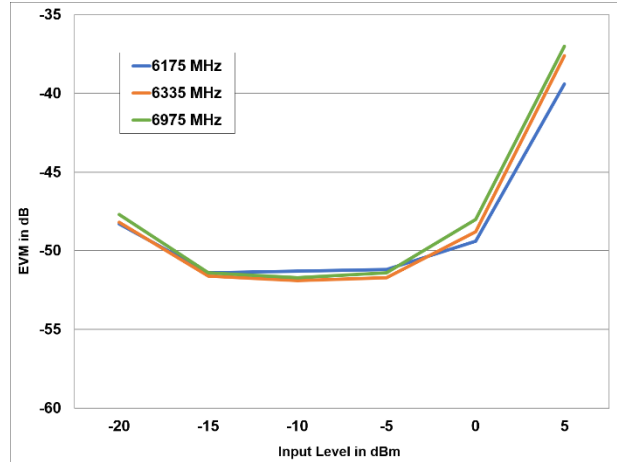


Figure 7. 802.11ax VSG EVM, 160 MHz, 1024QAM

Source	Characteristic	Conditions
802.11ax EVM (4096QAM, requires Y/V90EMQAMA license)	< -54 dB, nominal	-10 dBm output 160 MHz bandwidth 6975 MHz

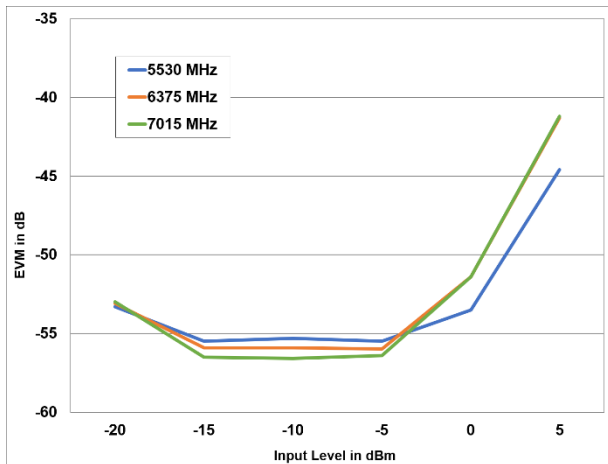


Figure 8. 802.11ax VSA EVM, 80 MHz, 4096QAM

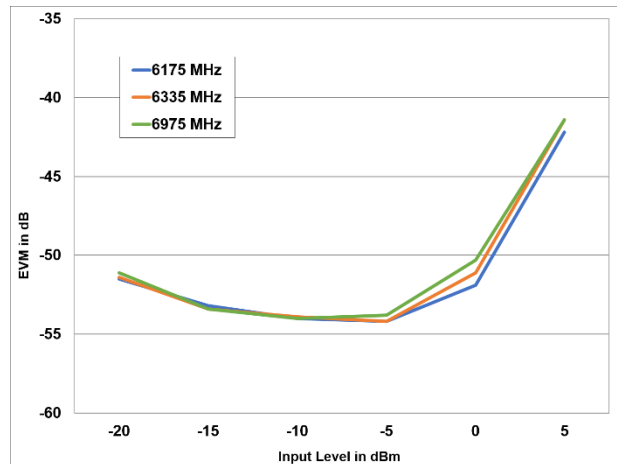


Figure 9. 802.11ax VSA EVM, 160 MHz, 4096QAM

## 5G NR performance characteristics

Measured with one of the 5G NR software applications installed on the E6680A.

Measurement	Characteristic	Conditions
Power accuracy relative to CW	< $\pm 0.25$ dB, nominal	0 dBm input
Residual EVM, 64/256QAM	< 0.35 %, nominal	-10 dBm input 100 MHz bandwidth $\leq 5000$ MHz
	< 0.5 %, nominal	-10 dBm input 100 MHz bandwidth > 5000 MHz

Source	Characteristic	Conditions
Composite EVM, 64/256QAM	< 0.4 %, nominal	-10 dBm output 100 MHz bandwidth 4000 MHz
	< 0.6 %, nominal	-10 dBm output 100 MHz bandwidth 5000 and 7000 MHz

## LTE/LTE-Advanced FDD and TDD performance characteristics

Measured with one of the LTE/LTE-Advanced software applications installed on the E6680A.

Measurement	Characteristic	Conditions
Power accuracy relative to CW	< $\pm 0.25$ dB, nominal	0 dBm input 695 to 3800 MHz
Residual EVM	< 0.4 %, nominal	0 dBm input 20 MHz bandwidth 695 to 3800 MHz

Source	Characteristic	Conditions
Composite EVM, 64QAM	< 0.4 % rms, nominal	-5 dBm output 20 MHz bandwidth 695 to 3800 MHz

## Bluetooth® performance characteristics

Measured with one of the *Bluetooth* software applications installed on the E6680A.

Measurement	Characteristic	Conditions
Power accuracy relative to CW	< ±0.26 dB, nominal	0 dBm input 2400 to 2486 MHz
EDR modulation floor	< 0.6 %, nominal	-20 dBm input 2400 to 2486 MHz

Source	Characteristic	Conditions
EDR DEVM error	< 0.6 % rms, nominal	-10 dBm output 1620 to 2700 MHz

## W-CDMA/HSPA+ performance characteristics

Measured with one of the W-CDMA/HSPA+ software applications installed on the E6680A.

Measurement	Characteristic	Conditions
Power accuracy relative to CW	< ±0.48 dB, nominal	0 dBm input 695 to 920 MHz 1425 to 2700 MHz
Residual EVM, QPSK	< 0.9 %, nominal	0 dBm input 695 to 920 MHz 1425 to 2700 MHz

Source	Characteristic	Conditions
Composite EVM	< 1.0 % rms, nominal	0 dBm output 695 to 920 MHz 1425 to 2700 MHz

## GSM/EDGE/Evo performance characteristics

Measured with one of the GSM/EDGE/Evo software applications installed on the E6680A.

Measurement	Characteristic	Conditions
Power accuracy relative to CW	< ±0.26 dB, nominal	0 dBm input 450 to 490 MHz 820 to 920 MHz 1710 to 1910 MHz
Phase error, GMSK	< 0.3 ° average, nominal < 0.85 ° peak, nominal	0 dBm input 450 to 490 MHz 820 to 920 MHz 1710 to 1910 MHz
EDGE EVM	< 0.65 % rms, nominal < 2.0 % peak, nominal	0 dBm input 450 to 490 MHz 820 to 920 MHz 1710 to 1910 MHz

Source	Characteristic	Conditions
Phase error, GMSK	< 0.3 °rms, nominal < 2.0 °peak, nominal	0 dBm output 380 to 490 MHz 695 to 960 MHz 1425 to 2180 MHz
EDGE EVM	< 1.0 % rms, nominal	0 dBm output 380 to 490 MHz 695 to 960 MHz 1425 to 2180 MHz

## Reference performance characteristics

Internal timebase	Performance	Conditions
Accuracy	± [(time since last adjustment x aging rate) + temperature stability + calibration accuracy]	
Achievable initial calibration accuracy	±5 x 10 <sup>-8</sup>	
Frequency stability – aging rate	< ±0.5 ppb/day, nominal	Daily, after 72-hour warmup
	< ±0.10 ppm/year, nominal	Annually
	< ±0.6 ppm/10 years, nominal	Over 10 years
Frequency stability – temperature effects	< ±10 ppb, nominal	20 to 30 °C
	< ±50 ppb, nominal	Full temperature range
Frequency stability - warmup	< ±0.1 ppm, nominal	Over 5 minutes, 20 to 30 °C, after one-hour warmup
	< ±0.01 ppm, nominal	Over 15 minutes, 20 to 30 °C, after one-hour warmup

Measured at the Ref In port of the E6680A.

External reference input	Characteristic	Conditions
Frequency	10 MHz	Sine wave
Lock range	±1 ppm, nominal	
Amplitude	0 to 10 dBm, nominal	
Impedance	50 ohms, nominal	

Measured from the 10 MHz Out port of the E6680A.

External reference input	Characteristic	Conditions
Frequency	10 MHz	
Amplitude	9.5 dBm, nominal	
Impedance	50 ohms, nominal	

## Trigger performance characteristics

Measured at the two Trig 1/2 ports of each transceiver in the E6680A.

Trigger input	Performance	Conditions
Amplitude	-3.5 to 3.5 V, nominal	
Impedance	> 10 kohms, nominal	

Trigger output	Performance	Conditions
Amplitude	-3.3 V LVTTTL, nominal	
Impedance	> 10 kohms, nominal	

## Instrument Characteristics

General attribute	Characteristic
Power consumption	720 W, fully loaded with four transceivers
Dimensions (W x H x D)	450 x 190 x 581 mm
Weight	29.4 kg, fully loaded with four transceivers
Operating temperature	5 to 45 °C
Storage temperature	-40 to 65 °C
Maximum relative humidity, non-condensing	95% up to 40 °C, decreasing linearly to 73%RH at 45°C <sup>1</sup>
Power requirements	100–120 V, 50/60 Hz, 1200 W maximum 200–240 V, 50/60 Hz, 1300 W maximum
Calibration period	12 months

1. From 40 to 45°C, the maximum% relative humidity follows the line of constant dew point

## Regulatory information

## Performance

### EMC

Complies with the essential requirements of the European EMC Directive as well as current editions of the following standards (dates and editions are cited in the Declaration of Conformity):

- IEC/EN 61326-1
- CISPR 11, Group 1, class A

**Caution:** This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

- AS/NZS CISPR 11
- ICES/NMB-001

This ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB-001 du Canada.

South Korean Class A EMC declaration:

This equipment has been conformity assessed for use in business environments. In a residential environment this equipment may cause radio interference.

### 사용자안내문

이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.

### Safety

Complies with the essential requirements of the European Low Voltage Directive as well as current editions of the following standards (dates and editions are cited in the Declaration of Conformity):

- IEC/EN 61010-1
- Canada: CSA C22.2 No. 61010-1
- USA: UL std no. 61010-1

### Acoustic statement

(European Machinery Directive)

Acoustic noise emission

LpA <70 dB

Operator position

Normal operation mode per ISO 7779

To find a current Declaration of Conformity for a specific Keysight product, visit:  
[www.keysight.com/go/conformity](http://www.keysight.com/go/conformity).

# Instrument Inputs and Outputs

Front panel	Label	Description	Type
Monitor port		Connection to external monitor	Mini DisplayPort
LAN ports	LAN1/2	TCP/IP interface to LAN using DHCP	RJ45
USB ports	USB 3.0 (SS)	Two USB 3.0 ports	Type A
	USB 2.0	Four USB 2.0 ports	Type A
RF ports	RFIO1 to RFIO8	Eight RF in/out ports on each transceiver for connection to devices under test	Type N
Trigger ports	Trig1/2	Two trigger ports on each transceiver	BNC
Reference ports	10MHz Out	Timebase reference output	BNC
	Ref In	Timebase reference input	BNC

Rear panel	Label	Description	Type
Fan speed	FAN	Fan speed control	Toggle switch

# The E6680A Is the Solution to Verify WLAN Designs

Speed test development, design verification, and manufacturing test with just the right capability and flexibility.

- Be ready for the future with bandwidth to 800 MHz and frequency to 7.3 GHz.
- Get the flexibility needed to optimize test cases with up to 32 ports.
- Simplify test system configuration with internal switching between ports.
- Analyze performance using industry-proven application software.

## Keysight's E6680A Wireless Test Set Is Easy to Use, Flexible, and Future-Proof

A solution for the lab, bench, and production line, the E6680A is ready to test WLAN designs. Right out of the box, its familiar application software is licensed to desired specifications. Software-only upgrades and three bandwidth options deliver just what is needed today and tomorrow.

Visit [www.keysight.com/find/e6680a](http://www.keysight.com/find/e6680a), or contact a Keysight sales representative for details.

Keysight's E6680E Wireless Test Set uses the same software and firmware with fewer RF ports providing an alternative solution for situations where 8 ports are not necessary to verify a design. Learn more at [www.keysight.com/find/e6680e](http://www.keysight.com/find/e6680e).

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