

# Agilent N4010A Wireless Connectivity Test Set and N4011A MIMO/Multi-port Adapter

## Data Sheet



## N4010A Introduction

The Agilent N4010A wireless connectivity test set is a measurement solution that enables efficient and lower cost test for products and components that incorporate *Bluetooth*<sup>®</sup> wireless technology, Wireless LAN (WLAN), and other emerging wireless connectivity technologies.

The *Bluetooth* (N4010A Option 101) feature set provides the ability to connect to *Bluetooth* version 1.1 and 1.2 devices in either test mode or normal mode, and make measurements in accordance with the *Bluetooth* RF test specification. *Bluetooth* EDR link plus measurements (Option 107) add BTv2.0+EDR support and enhanced data rate (EDR) measurement capabilities.

*Bluetooth* audio generation and analysis (Option 113), simplifies *Bluetooth* audio test configurations and provides cost-effective functional test of *Bluetooth* audio devices by performing a basic set of audio measurements. Headset profile (Option 112) enables testing of *Bluetooth* voice channels, audio gateway, and headset products.

The N4017A *Bluetooth*<sup>®</sup> graphical measurement application, a PC-based software product, works in a complementary manner with the N4010A test set and provides the ability to fully configure the test set and display both numerical and graphical results.

The Wireless LAN feature set (N4010A Option 102/102) combines a fully-calibrated vector signal generator and wide bandwidth signal analyzer into a single test set, which enables efficient and repeatable WLAN module test from R&D through to production. N4010A Option 108 provides the software license for the 802.11n MIMO modulation analysis measurements within the test set.

The N4010A test set also works with the Agilent 89601A and 89607A vector signal analyzer software. This software provides the flexibility to make a broad range of measurements for evaluating wireless formats in the 2.4 GHz or 5 GHz band, including ZigBee/IEEE 802.15.4.

The test set will meet its warranted performance after one hour within the stated environmental operating range plus 40 minutes after turn on. Unless otherwise stated, all specifications are valid over the temperature range 20 to 30 °C. Supplemental characteristics are intended to provide additional information, useful in applying the instrument by giving typical (expected), but not warranted, performance parameters. These characteristics are shown in italics or labeled as nominal.



**Agilent Technologies**

# Bluetooth Specifications

## N4010A Option 101 Bluetooth

- Provides ability to act as a *Bluetooth* master, perform inquiry, and establish a connection in test mode or normal mode
- Makes measurements in accordance with *Bluetooth* RF Test Specification 1.2
- Integral sequencer allows test plans to be created and edited easily
- All tests default to SIG standard settings – user may change settings to match particular test requirements

## Bluetooth tests<sup>1</sup>

### Output power

#### Link conditions

Link mode	Test mode (loopback, Tx), normal mode (ACL, SCO)
Hopping <sup>2</sup>	On or off
Packet type <sup>2</sup>	DH1, DH3, DH5, HV3
Payload <sup>2</sup>	PRBS9, BS00, BSFF, BSOF, BS55

#### Measurement

Supported measurements	Average power, peak power
Number of measurement channels <sup>3</sup>	3
Range	+23 to –70 dBm
Measurement resolution	0.01 dB
Measurement accuracy	±0.5 dB

### Power control

#### Link conditions

Link mode	Test mode (loopback, Tx)
Hopping	On or off
Packet type	DH1, DH3, DH5, HV3
Payload	PRBS9, BS00, BSFF, BSOF, BS55

#### Measurement

Supported measurements	Average power, min/max step size
Number of measurement channels <sup>3</sup>	3
Range	+23 to –70 dBm
Measurement resolution	0.01 dB
Measurement accuracy	±0.5 dB

### Modulation characteristics

#### Link conditions

Link mode	Test mode (loopback, Tx), normal mode (ACL, SCO)
Hopping <sup>2</sup>	On or off
Packet type <sup>2</sup>	DH1, DH3, DH5, HV3
Payload <sup>2</sup>	BS55, BSOF

#### Measurement

Supported measurements	Min/max $\Delta f1_{avg}$ , min $\Delta f2_{max}$ (kHz), total $\Delta f2_{max} > \Delta f2_{max}$ lower limit (%) min of min $\Delta f2_{avg}$ / max $\Delta f1_{avg}$ , pseudo frequency deviation ( $\Delta f1$ and $\Delta f2$ ) in normal mode
Number of measurement channels <sup>3</sup>	3
RF input level range	+23 to –70 dBm
Deviation range	–400 to +400 kHz
Deviation resolution	100 Hz
Ratio resolution	0.1%
Measurement accuracy <sup>4</sup>	As frequency reference ±100 Hz

1. Performance of the N4010A signal source or signal analyzer over wider temperature (specified later in this document) applies to all Bluetooth tests listed.
2. Normal mode measurements made with hopping on, NULL packet, and no payload.
3. Internal sequencer enables three measurement channels to be measured consecutively. Measurements on all 79 Bluetooth channels are supported.
4. Example, using the 10 MHz reference with accuracy of 10 Hz (1 ppm), at frequency of 2.402 GHz, frequency accuracy would be in the range of  $\pm((2.402 \text{ GHz} \times 10 \text{ Hz})/10 \text{ MHz}) \pm 100 \text{ Hz} = \pm 2402 \text{ Hz} \pm 100 \text{ Hz} = \pm 2502 \text{ Hz}$ .

## Initial carrier frequency tolerance

### Link conditions

Link mode	Test mode (loopback, Tx), normal mode (ACL)
Hopping <sup>1</sup>	On or off
Packet type <sup>1</sup>	DH1, DH3, DH5, HV3
Payload <sup>1</sup>	PRBS9, BS00, BSFF, BSOF, BS55

### Measurement

Supported measurements	Maximum and minimum error/channel
Number of measurement channels <sup>2</sup>	3
RF input level range	+23 to -70 dBm
Frequency	Nominal channel freq ±150 kHz
Measurement accuracy <sup>3</sup>	As frequency reference ±100 Hz

## Carrier frequency drift

### Link conditions

Link mode	Test mode (loopback, Tx), normal mode (ACL)
Hopping <sup>1</sup>	On or off
Packet type <sup>1</sup>	DH1, DH3, DH5, HV3
Payload <sup>1</sup>	PRBS9, BS00, BSFF, BSOF, BS55

### Measurement

Supported measurements	Maximum and minimum measurements drift at each frequency during the test, pseudo frequency drift in normal mode
Number of measurement channels <sup>2</sup>	3
RF input level range	+23 to -70 dBm
Measurement range	±100 kHz
Measurement accuracy <sup>3</sup>	As frequency reference ±100 Hz

## Sensitivity – single slot packets

### Link conditions

Link mode	Test mode (loopback, Tx), normal mode (ACL)
Hopping <sup>1</sup>	On or off
Packet type <sup>1</sup>	DH1, DH3, DH5
Payload <sup>1</sup>	PRBS9, BS00, BSFF, BSOF, BS55
Number of bits	1 to 200,000,000

### Impairments – default to table

Frequency offset	±75 kHz
Modulation index	0.28 to 0.35
Modulation index resolution	0.01
Symbol timing	-20 ppm, 0, +20 ppm
Symbol timing resolution	1 ppm

### Measurement

Supported measurements	BER, number of bit errors, number of Rx bits, PER, number of NACK packets, number of errored packets, number of Tx packets, PER only in normal mode
Number of measurement channels <sup>2</sup>	3, hopping
Range	0 to -90 dBm
Resolution	0.1 dB
Accuracy <sup>4,5</sup>	±0.6 dB, -35 to -90 dBm, ±1 dB, > -35 dBm

### Sine impairments (applicable for single slot packets, multi-slot packets, and maximum input level)

Modulation frequency range	300 Hz to 1.6 kHz
Resolution	100 Hz
Maximum deviation range	0 Hz to 40 kHz
Resolution	1 kHz

### 'Dirty transmitter' impairments table for Rx sensitivity tests (applicable for single slot packets, multi-slot packets, and maximum input level)

Set of parameters	Carrier frequency offset (kHz)	Modulation index	Symbol timing error (ppm)
1	75	0.28	-20
2	14	0.30	-20
3	-2	0.29	+20
4	1	0.32	+20
5	39	0.33	+20
6	0	0.34	-20
7	-42	0.29	-20
8	74	0.31	-20
9	-19	0.28	-20
10	-75	0.35	+20

1. Normal mode measurements made with hopping on, NULL packet, and no payload.
2. Internal sequencer enables three measurement channels to be measured consecutively. Measurements on all 70 Bluetooth channels are supported.
3. Example, using the 10 MHz reference with accuracy of 10 Hz (1 ppm), at frequency of 2.402 GHz, frequency accuracy would be in the range  $\pm((2.402 \text{ GHz} \times 10 \text{ Hz})/10 \text{ MHz}) \pm 100 \text{ Hz} = \pm 2402 \text{ Hz} \pm 100 \text{ Hz} = \pm 2502 \text{ Hz}$ .
4. Verified using CW measurements.
5. Add 0.01 dB/°C from 30 to 55 °C, add 0.07 dB/°C from 20 to 0 °C.

## Sensitivity – multi-slot packets

### Link conditions

Link mode	Test mode (loopback)
Hopping	On or off
Packet type	DH1, DH3, DH5
Payload	PRBS9, BS00, BSFF, BSOF, BS55
Number of bits	1 to 200,000,000

### Impairments – default to table

Frequency offset	±75 kHz
Modulation index	0.28 to 0.35
Modulation index resolution	0.01
Symbol timing	-20 ppm, 0, +20 ppm
Symbol timing resolution	1 ppm

### Measurement

Supported measurements	BER, number of bit errors, number of Rx bits, PER, number of NACK packets, number of errored packets, number of Tx packets
Number of measurement channels <sup>1</sup>	3, hopping
Range	0 to -91 dBm
Resolution	0.1 dB
Accuracy <sup>2,3</sup>	±0.6 dB, -35 to -90 dBm, ±1 dB, > -35 dBm

## Maximum input level

### Link conditions

Link mode	Test mode (loopback)
Hopping	On or off
Packet type	DH1, DH3, DH5
Payload	PRBS9, BS00, BSFF, BSOF, BS55
Number of bits	1 to 200,000,000

### Measurement

Supported measurements	BER, number of bit errors, number of Rx bits, PER, number of NACK packets, number of errored packets, number of Tx packets
Number of measurement channels <sup>1</sup>	3
Range	0 to -90 dBm
Resolution	0.1 dB
Accuracy <sup>2,3</sup>	±0.6 dB, -35 to -90 dBm, ±1 dB, > -35 dBm

1. Internal sequencer enables three measurements channels to be measured consecutively. Measurements on all 79 Bluetooth channels are supported.

2. Verified using CW measurements.

3. Add 0.01 dB/°C from 30 to 55 °C, add 0.07 dB/°C from 20 to 0 °C.

# N4010A Option 107 Bluetooth EDR link plus measurements

## Bluetooth EDR transmitter tests EDR relative transmit power

### Link conditions

Link mode	Test mode (loopback, Tx)
Hopping	On or off
Payload	PRBS9, BS00, BSFF, BS55
Packet type	2-DH1, 2-DH3, 2-DH5, 3-DH1, 3-DH3, 3-DH5

### Measurement

Supported measurements	Power in GFSK header, power in PSK payload, relative power between GFSK header to PSK payload
Number of measurement channels <sup>1</sup>	3, hopping
Range	+23 to -70 dBm
Resolution	0.01 dB
Accuracy <sup>2</sup>	±0.5 dB

## EDR modulation accuracy and carrier frequency stability

### Link conditions

Link mode	Test mode (loopback, Tx)
Hopping	On or off
Payload	PRBS9, BS00, BSFF, BS55
Packet type	2-DH1, 2-DH3, 2-DH5, 3-DH1, 3-DH3, 3-DH5

### Measurement

Supported measurements	Worst case initial frequency error ( $\omega_i$ ) for all packets (carrier frequency stability), worst case frequency error for all blocks ( $\omega_0$ ), ( $\omega_0 + \omega_i$ ) for all blocks, rms DEVM, peak DEVM, 99% DEVM
Number of measurement channels <sup>1</sup>	3, hopping
Range	+23 to -70 dBm
Resolution	±100 Hz carrier frequency stability and frequency error

### Accuracy

Modulation accuracy	
N4010A receiver rms DEVM	< 2% (nominal)
N4010A source rms DEVM	< 5% (nominal)

Carrier frequency stability and frequency error <sup>3</sup>	As frequency reference ±100 Hz
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## EDR differential phase encoding

### Link conditions

Link mode	Test mode (Tx)
Hopping	On or off
Payload	PRBS9, BS00, BSFF, BS55
Packet type	2-DH1, 2-DH3, 2-DH5, 3-DH1, 3-DH3, 3-DH5

### Measurement

Supported measurements	BER, number of bit errors, number of Rx bits, PER, number of NACK packets, number of errored packets, number of Tx packets, number of HEC, CRC, and NACK error
Number of measurement channels <sup>1</sup>	3, hopping
RF input level range	+23 to -70 dBm

## Guard interval measurement

### Link conditions

Link mode	Test mode (loopback, Tx)
Hopping	On or off
Payload	PRBS9, BS00, BSFF, BS55
Packet type	2-DH1, 2-DH3, 2-DH5, 3-DH1, 3-DH3, 3-DH5

### Measurement

Supported measurements	Average, maximum, and minimum guard time
Number of measurement channels <sup>1</sup>	3, hopping
RF input level range	+23 to -70 dBm
Resolution	0.1 μs

1. Internal sequencer enables three measurement channels to be measured consecutively. Measurements on all 79 Bluetooth channels are supported.

2. Example, using the 10 MHz reference with accuracy of 10 Hz (1 ppm), at frequency of 2.402 GHz, frequency accuracy would be in the range  $\pm((2.402 \text{ GHz} \times 10 \text{ Hz})/10 \text{ MHz}) \pm 25 \text{ Hz} = \pm 2402 \text{ Hz} \pm 25 \text{ Hz} = \pm 2427 \text{ Hz}$ .

3. Example, using the 10 MHz reference with accuracy of 10 Hz (1 ppm), at frequency of 2.402 GHz, frequency accuracy would be in the range  $\pm((2.402 \text{ GHz} \times 10 \text{ Hz})/10 \text{ MHz}) \pm 100 \text{ Hz} = \pm 2402 \text{ Hz} \pm 100 \text{ Hz} = \pm 2502 \text{ Hz}$ .

## Bluetooth EDR receiver tests

### EDR Rx sensitivity

#### Link conditions

Link mode	Test mode (loopback)
Payload	PRBS9, BS00, BSFF, BS55
Packet type	2-DH1, 2-DH3, 2-DH5, 3-DH1, 3-DH3, 3-DH5
Number of bits	1 to 200,000,000

#### Impairments

Frequency offset	±100 kHz
Frequency offset resolution	1 kHz
Symbol timing	–30 to +30 ppm
Symbol timing resolution	1 ppm

#### “Dirty transmitter” impairments for EDR Rx sensitivity measurements

Set of parameters	Carrier offset frequency (kHz)	Symbol timing offset (ppm)
1	0	0
2	+65	+20
3	–65	–20

#### Sine impairments for EDR Rx sensitivity measurements

Modulation frequency range	300 Hz to 10 kHz
Resolution	100 Hz
Maximum deviation range	0 Hz to 40 kHz
Resolution	1 kHz

#### Measurement

Supported measurements	BER, number of bit errors, number of Rx bits, PER, number of NACK packets, number of errored packets, number of Tx packets, number of HEC, CRC, and NACK error
Number of measurement channels <sup>1</sup>	3, hopping
Range	0 to –90 dBm
Resolution	0.1 dB
Accuracy <sup>2,3</sup>	±0.6 dB, –35 to –90 dBm ±1 dB, > –35 dBm

### EDR Rx BER floor sensitivity

#### Link conditions

Link mode	Test mode (loopback)
Hopping	On or off
Payload	PRBS9, BS00, BSFF, BS55
Packet type	2-DH1, 2-DH3, 2-DH5, 3-DH1, 3-DH3, 3-DH5
Number of bits	1 to 200,000,000

#### Measurement

Supported measurements	BER, number of bit errors, number of Rx bits, PER, number of NACK packets, number of errored packets, number of Tx packets, number of HEC, CRC, and NACK error
Number of measurement channels <sup>1</sup>	3, hopping
Range	0 to –90 dBm
Resolution	0.1 dB
Accuracy <sup>2,3</sup>	±0.6 dB, –35 to –90 dBm ±1 dB, > –35 dBm

### EDR Rx maximum input level

#### Link conditions

Link mode	Test mode (loopback)
Hopping	On or off
Payload	PRBS9, BS00, BSFF, BS55
Packet type	2-DH1, 2-DH3, 2-DH5, 3-DH1, 3-DH3, 3-DH5
Number of bits	1 to 200,000,000

#### Measurement

Supported measurements	BER, number of bit errors, number of Rx bits, PER, number of NACK packets, number of errored packets, number of Tx packets, number of HEC, CRC, and NACK error
Number of measurement channels <sup>1</sup>	3, hopping
Range	0 to –90 dBm
Resolution	0.1 dB
Accuracy <sup>2,3</sup>	±0.6 dB, –35 to –90 dBm ±1 dB, > –35 dBm

1. Internal sequencer enables three measurement channels to be measured consecutively. Measurements on all 79 Bluetooth channels are supported.

2. Verified using CW measurements.

3. Add 0.01 dB/°C from 30 to 55 °C, add 0.07 dB/°C from 20 to 0 °C.

## N4010A Option 101 and Option 107 signal source

The N4010A signal source is used in *Bluetooth* test cases described earlier in this document.

### Frequency

Range 2.402 to 2.480 GHz; 79 channels at 1 MHz spacing

Accuracy<sup>1</sup> As frequency reference  $\pm 25$  Hz

Offset range  $\pm 300$  kHz

Offset accuracy  $\pm 210$  Hz,  $\pm 200$  Hz typical

### Output power

Range 0 to  $-90$  dBm

Resolution 0.1 dB

Accuracy<sup>2,3</sup>  $\pm 0.6$  dB,  $-35$  to  $-90$  dBm  
 $\pm 1$  dB,  $> -35$  dBm

Output VSWR 1.5:1

### Modulation

In accordance with *Bluetooth* Radio specification version 2.0+EDR

Type GFSK, DQPSK, D8PSK

Modulation index range 0.28 to 0.35

Modulation index resolution 0.01

GFSK depth accuracy<sup>4</sup>  $\pm 0.5$  kHz

DQPSK and D8PSK rms

differential error vector magnitude (DEVm)  $< 5\%$  (nominal)

Baseband filter To *Bluetooth* specification

Symbol timing  $-20$  to  $+20$  ppm

Symbol timing resolution 1 ppm

## N4010A Option 101 and Option 107 signal analyzer

The N4010A signal analyzer is used in *Bluetooth* test cases described earlier in this document.

### Frequency

Range 2.402 to 2.480 GHz ; 79 channels at 1 MHz spacing

Accuracy<sup>2</sup> (center frequency  $\pm 400$  kHz) As frequency reference  $\pm 100$  Hz

### Power measurement

Range  $+23$  to  $-70$  dBm

Damage level  $+25$  dBm

Resolution 0.01 dB

Accuracy<sup>5</sup>  $\pm 0.5$  dB

Input VSWR  $< 1.5:1$

### Modulation

Type GFSK, DQPSK, D8PSK

Deviation range  $\pm 400$  kHz

Deviation resolution 0.1 kHz

Modulation depth As frequency reference  $\pm 100$  Hz

DQPSK and D8PSK rms  $< 2\%$  (nominal)

differential error vector magnitude (DEVm) accuracy<sup>6</sup>

Baseband filter bandwidth 1.3 MHz (compliant to *Bluetooth* specification), 3 or 5 MHz

1. Example, using the 10 MHz reference with accuracy of 10 Hz (1 ppm), at frequency of 2.402 GHz, frequency accuracy would be in the range  $\pm((2.402 \text{ GHz} \times 10 \text{ Hz})/10 \text{ MHz}) \pm 25 \text{ Hz} = \pm 2402 \text{ Hz} \pm 25 \text{ Hz} = \pm 2427 \text{ Hz}$ .

2. Verified using CW measurements.

3. Add 0.01 dB/ $^{\circ}$ C from 30 to 55  $^{\circ}$ C, add 0.07 dB/ $^{\circ}$ C from 20 to 0  $^{\circ}$ C.

4. Verified by interpolation to static frequency offset measurements.

5. Add 0.02 dB/ $^{\circ}$ C from 30 to 55  $^{\circ}$ C and 0.025 dB/ $^{\circ}$ C from 20 to 0  $^{\circ}$ C.

6. Example, using the 10 MHz reference with accuracy of 10 Hz (1 ppm), at frequency of 2.402 GHz, frequency accuracy would be in the range  $\pm((2.402 \text{ GHz} \times 10 \text{ Hz})/10 \text{ MHz}) \pm 100 \text{ Hz} = \pm 2402 \text{ Hz} \pm 10 \text{ Hz} = 2502 \text{ Hz}$ .

# N4010A Option 113 *Bluetooth* audio generation and analysis<sup>1</sup>

N4010A Option 113 simplifies *Bluetooth* audio test configurations and provides cost-effective functional test of *Bluetooth* audio devices by performing a basic set of audio measurements (level, SINAD, and THD+N).

<b>Audio routing settings</b>	Loopback, audio input/output, audio generator/analyzer
<b>Audio generator</b>	
Frequency	125 Hz to 3.875 kHz, default of 1.0 kHz
Frequency resolution	125 Hz
Level	-75 to +3 dBm0, default -15 dBm0
Level resolution	1 dBm0
<b>Audio analyzer</b>	
Range	125 Hz to 3.875 kHz in 125 Hz steps
Measurements	SINAD (dB), total harmonic distortion + noise (%) frequency (Hz), level (dBm0)
Frequency accuracy	Accuracy as frequency reference, resolution 7.8125 Hz
Measurement variation (at frequency 1.125 kHz, level -15 dBm0 and EUT in SCO loopback) <sup>2,3</sup>	
Level	< ±0.2%
Distortion + noise	< ±1%
SINAD	< ±1 dB
Number of averages	1 to 100

## N4010A *Bluetooth* audio system performance and SINAD floor specification<sup>2,3</sup>

Number of SCO channels supported	1
CODEC air interfaces supported	CVSD, A-law, $\mu$ -law
Frequency response	+0.6 to -1.0 dB (320 to 3200 Hz <sup>4,5</sup> ) See Figure 1 for CVSD frequency response)
Maximum input/output signal levels	3.28 V pk-pk = 1.16 Vrms <sup>5,6</sup> For CVSD, recommend level < 138 mVrms <sup>6</sup>
Distortion/noise (THD+N)	Better than -52 dB (A-law, $\mu$ -law) Better than -35 dB (CVSD <sup>5,6</sup> ) See Figure 2 for CVSD distortion characteristics
Variation of gain (-55 to +3 dBm, 225 to 2040 Hz)	< 0.5 dB <sup>5,6</sup>
Idle noise (200 Hz to 20 kHz)	Better than -64 dBm
SINAD floor for N4010A audio paths (at 1.125 kHz frequency and -15 dBm0 level)	> 29 dB
Out of band performance (4 to 32 kHz)	Better than -30 dB (A-law, $\mu$ -law) Better than -42 dB (CVSD)
Input/output connectors	BNC input, BNC output
Input impedance	150 k $\Omega$
Output impedance	50 k $\Omega$ (AC coupled)
Minimum output load	0 $\Omega$ (AC coupled, no damage caused by short)

1. Qualified in accordance to ITU specification G.711 [8], where 775 mVrms (0 dBm) analog sine wave input voltage is translated to 0 dBm0 digital CVSD transmit signal and 0 dBm0 sine wave CVSD receive signal is output as 775 mVrms (0 dBm) analog voltage. All audio characteristics are nominal.
2. When using N4010A audio frequencies which are multiples of 1 kHz, harmonic distortion components may cause variations in SINAD measurements. Frequency setting of 1.125 kHz is recommended for optimum internal audio/generator measurements.
3. N4010A *Bluetooth* audio system performance (frequency response, distortion/noise, etc) will also contribute to the overall measurement performance of Option 113 audio analyzer. This also applies to the use of external audio analyzers/generators with the N4010A.
4. For CVSD this performance only applies within the CVSD linear range.
5. CVSD linear range is defined as signals of 320 to 3200 Hz and level < -15 dBm0 (138 mVrms analogue). Outside the CVSD linear range (e.g. signals of frequencies above 600 Hz with levels > -15 dBm0) the response rolls off due to the slew-rate limitations set by *Bluetooth*'s CVSD algorithm parameters.
6. CVSD distortion (THD+N) at 1020 Hz and level -15 dBm0 is better than 4 percent.

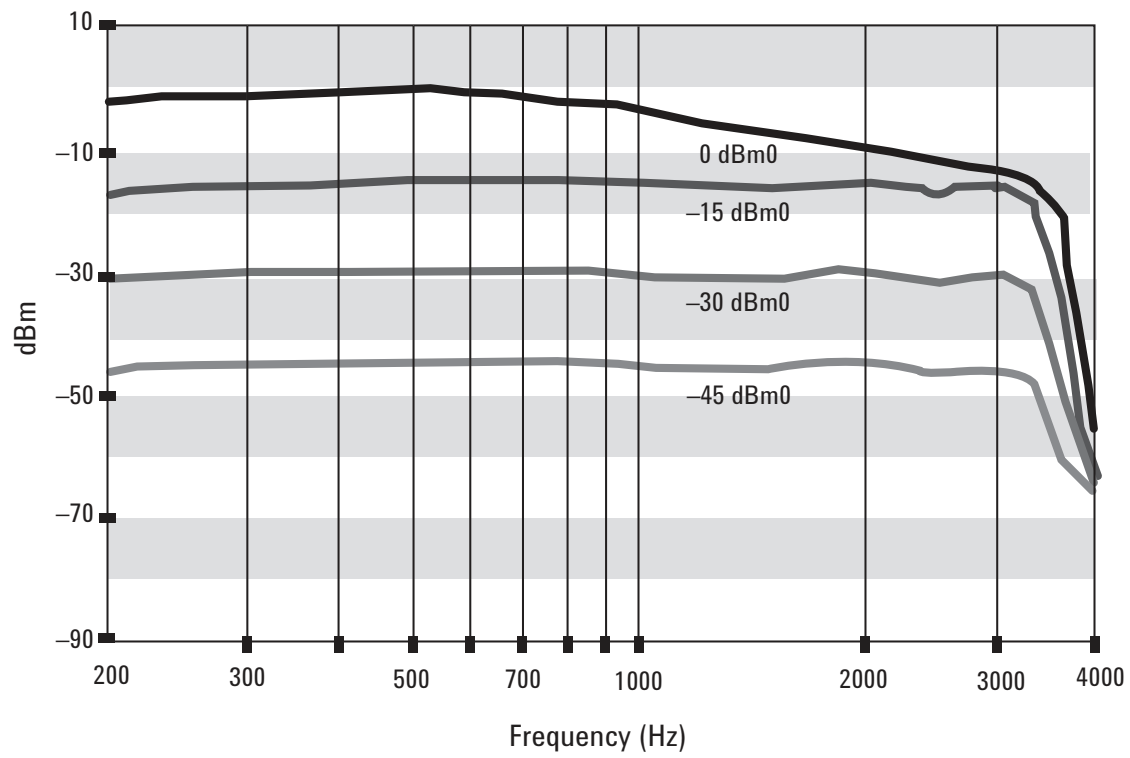


Figure 1. CVSD frequency response

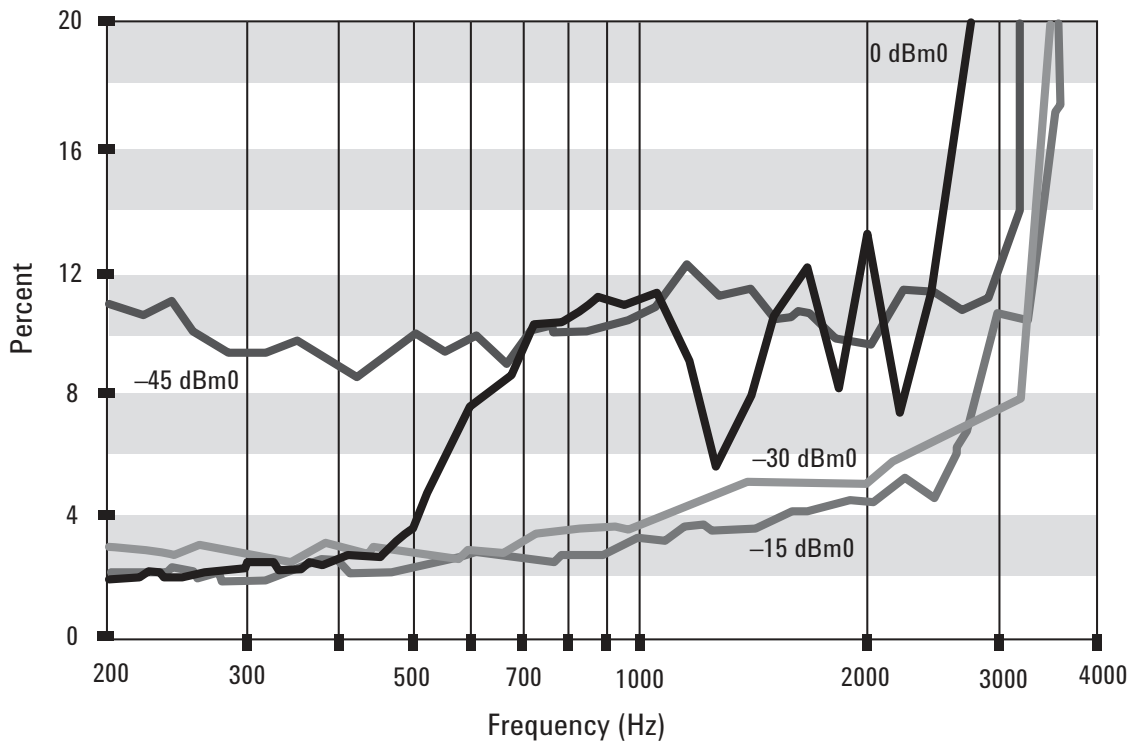


Figure 2a. CVSD distortion percentage characteristic

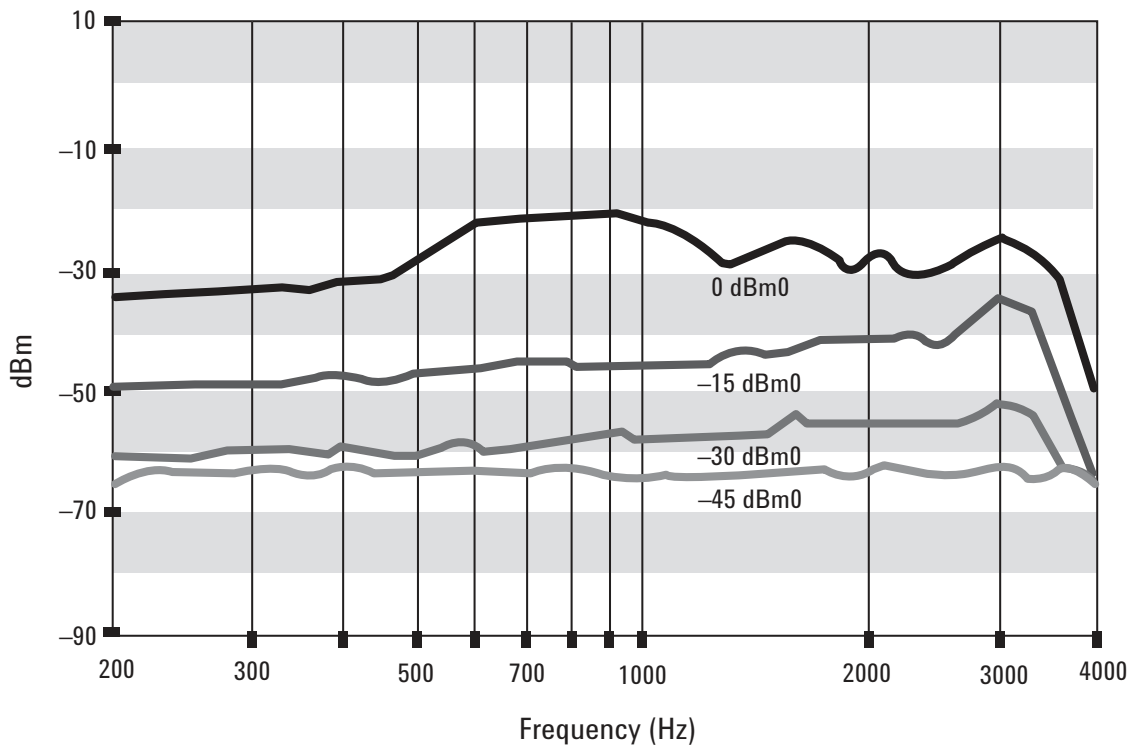


Figure 2b. CVSD distortion dBm characteristic

# Wireless LAN specifications

## N4010A Options 102/103 WLAN Tx/Rx analysis

### Measurements

The table below shows the key measurements covered by the N4010A Options 102/103 and the 89607A WLAN test suite software. For further N4010A/89607A data, refer to the application note *Agilent N4010A Wireless Connectivity Test Set Performance Guide Using the 89601 Vector Signal Analysis Software and the 89607A WLAN Test Suite Software*, literature number 5989-0637EN.

Transmitter functionality	N4010A	
	Options 102/103	89607A
<b>Auto-range CW</b>	Yes	Yes
Average power	Yes	No
CW frequency offset	Yes	No
<b>Bursted OFDM</b>		
Average power	Yes	Yes
Peak power	No	Yes
Center frequency tolerance	Yes	Yes
	(Frequency error)	
Clock frequency tolerance	Yes	Yes
Constellation error (EVM)	Yes	Yes
Center frequency leakage	Yes	Yes
Spectral flatness	Yes	Yes
Spectral mask	Yes	Yes
<b>Fast OFDM demodulation measurement</b>		
EVM	Yes	No
Frequency error	Yes	No
IQ offset	Yes	No
Gated power	Yes	No
<b>Gated spectrum</b>	Yes	No
<b>Bursted DSSS</b>		
Average power	Yes	Yes
Peak power	No	Yes
Center frequency tolerance	Yes	Yes
	(Frequency error)	
Chip clock frequency tolerance	Yes	Yes
Center frequency leakage	Yes	Yes
	(Carrier suppression)	
Predicted suppression	Yes	Yes
EVM (RMS)	Yes	Yes
EVM (peak)	Yes	Yes
Power up ramp	Yes	Yes
Power down ramp	Yes	Yes
Spectral mask	Yes	Yes
<b>Fast DSSS demodulation measurement</b>		
EVM (peak)	Yes	No
EVM (RMS)	Yes	No
Frequency error	Yes	No
IQ offset	Yes	No
Gated power	Yes	No
<b>Gated spectrum</b>	Yes	No

Receiver functionality	N4010A	
	Options 102/103	89607A
Standard DSSS waveform file	Yes	No
Standard DSSS sequence file	Yes	No
Standard OFDM waveform file	Yes	No
Standard OFDM sequence file	Yes	No
Blanking marker files	Yes	No
High power mode	Yes	No
CW tone	Yes	No
Sampling rate	Yes	No

### N4010A vector signal generator specifications

The specifications apply to the N4010A with Options 102 or 103 installed. The vector signal generator is used in WLAN receiver tests described earlier in this document. N4010A-101 and 107 *Bluetooth* signal source specifications are different and are given in the *Bluetooth* section in this document.

Frequency range	2.402 to 2.484 GHz; 4.800 to 5.875 GHz (Option 103 only)
Frequency accuracy <sup>1</sup>	As frequency reference $\pm 25$ Hz <sup>2</sup>
Output power range	2.402 to 2.484 GHz: $-10$ to $-95$ dBm <sup>1</sup> 802.11b DSSS: $-8$ dBm maximum (nominal) 4.800 to 5.875 GHz: $-15$ to $-95$ dBm <sup>1</sup> 802.11a/g OFDM: $-13$ dBm maximum (nominal)
Absolute amplitude accuracy <sup>1</sup>	2.402 to 2.484 GHz: $\pm 0.9$ dB <sup>3</sup> ( $-10$ to $-90$ dBm) $\pm 0.6$ dB <sup>4</sup> ( $-10$ to $-90$ dBm) $\pm 0.9$ dB ( $> -90$ to $-95$ dBm) 4.800 to 5.875 GHz: $\pm 0.9$ dB <sup>3</sup> ( $-15$ to $-90$ dBm) $\pm 0.6$ dB <sup>4</sup> ( $-15$ to $-90$ dBm) $\pm 0.9$ dB ( $> -90$ to $-95$ dBm)
Resolution	0.1 dB
Output impedance	50 $\Omega$ (nominal)
Modulation type	Arbitrary based on downloaded file
Arbitrary waveform memory	64 MSa (256 MB RAM; 1 sample = 4 bytes)
Error vector magnitude	802.11a: $< 2\%$ <sup>5</sup> 802.11b: $< 5\%$ <sup>5,6</sup> 802.11g: $< 2\%$ <sup>5</sup> 802.11n: $< 2\%$ <sup>7</sup>

1. Verified using CW measurements.
2. Example, using the 10 MHz reference with accuracy of 10 Hz (1 ppm), at frequency of 2.402 GHz, frequency accuracy would be in the range  $\pm((2.402 \text{ GHz} \times 10 \text{ Hz})/10 \text{ MHz}) \pm 25 \text{ Hz} = \pm 2402 \text{ Hz} \pm 25 \text{ Hz} = \pm 2427 \text{ Hz}$ .
3. Add 0.013 dB/ $^{\circ}\text{C}$  from 30 to 55  $^{\circ}\text{C}$ , add 0.02 dB/ $^{\circ}\text{C}$  from 20 to 0  $^{\circ}\text{C}$ .
4. Typical specification applies to instruments serial number GB4617 or greater, or instruments with the serial number starting MY.
5. Up to 40 MHz bandwidth.
6. Specification applies to instruments serial number GB4617 or greater, or instruments with the serial number starting MY; otherwise this specification is  $< 10\%$ .
7. Specification applies to instruments with Option 108.

## N4010A vector signal analyzer specifications

When used with 89601A/89607A (requires Option 110 and at least one of Option 101, 102, or 103). For the full N4010A/89601A performance guide refer to application note *Agilent N4010A Wireless Connectivity Test Set Performance Guide Using the 89601A Vector Signal Analysis Software and the 89607A WLAN Test Suite Software*, literature number 5989-0637EN.

### Performance

Sampling frequency	100 MHz digital down-conversion
Quantization	14 bits
Sampling resolution	10 ns
Acquisition buffer	5 ms

### Frequency specifications

Frequency range <sup>1</sup>	2.381 to 2.519 GHz 4.800 to 5.875 GHz (Option 103 only)
Frequency resolution	1 MHz
Frequency accuracy <sup>2</sup>	As frequency reference $\pm 100$ Hz
IF bandwidth	Switchable between 22 and 40 MHz
Stability (noise sidebands) offset	10 kHz: $< -75$ dBc/Hz (nominal) 100 kHz: $< -95$ dBc/Hz (nominal)

### Amplitude specifications

Power measurement range	+23 to $-70$ dBm (2.381 to 2.519 GHz) +23 to $-50$ dBm (4.800 to 5.875 GHz)
Maximum safe input level	+25 dBm
Absolute power measurement accuracy <sup>2</sup>	$\pm 0.5$ dB <sup>3</sup> (2.381 to 2.519 GHz) $\pm 0.3$ dB <sup>4</sup> (+23 to $-55$ dBm) $\pm 0.35$ dB <sup>4</sup> ( $< -55$ dBm) $\pm 0.8$ dB <sup>3</sup> (4.800 to 5.875 GHz) $\pm 0.35$ dB <sup>4</sup> (+23 to $-55$ dBm)
RF input VSWR	$< 1.5:1$ (return loss: $> 14$ dB) (2.381 to 2.519 GHz) $< 1.8:1$ (return loss: $> 10$ dB) (4.800 to 5.875 GHz)
Signal-to-noise ratio <sup>5, 6</sup>	$> 52$ dB for 22 MHz bandwidth (2.381 to 2.519 GHz) $> 45$ dB for 22 MHz bandwidth (4.800 to 5.875 GHz)
Spurious responses	$< -90$ dBm (2.381 to 2.519 GHz)
In-band spurious <sup>7</sup>	$< -60$ dBm (4.800 to 5.875 GHz)
Trigger ranges	
Internal trigger power	$-60$ to +23 dBm for 22 MHz bandwidth; $-65$ to +23 dBm for 5 MHz bandwidth (2.381 to 2.519 GHz) $-65$ to 0 dBm for 22 MHz bandwidth (4.800 to 5.875 GHz)
External trigger voltage	3.3 V (TTL)
Trigger delay range	$-4.5$ to 5.2 ms, or time capture length, whichever is shorter (see performance guide 5989-0637EN)
Trigger hold-off range	20 ns to 0.65 ms

### Modulation specifications

Residual error	802.11a: 5 GHz band; 54 Mbps 64QAM OFDM: $< 2.25\%$ (power range 0 to $-20$ dBm)
vector magnitude (EVM)	802.11b: DSSS: $< 3.0\%$ (power range 0 to $-30$ dBm) 802.11g: 2.4 GHz band; 54 Mbps 64QAM OFDM: $< 1.25\%$ <sup>8</sup> (power range 0 to $-30$ dBm) 802.11g: 2.4 GHz band; 54 Mbps 64QAM OFDM: $< 2.5\%$ (power range +5 to 0 dBm) 802.11n: 54 Mbps 64QAM OFDM: $< 1.75\%$ <sup>9</sup> (power range 0 to $-10$ dBm) 802.11n: 54 Mbps 64QAM OFDM: $< 3.0\%$ <sup>9</sup> (power range $-10$ to $-20$ dBm) Bluetooth EDR: $< 2\%$ (rms DEVIM)

1. This is the center frequency tuning range for a 22 MHz span. With a 40 MHz span, the frequency ranges are 2.39 to 2.51 GHz and 4.809 to 5.866 GHz.
2. Verified using CW measurements.
3. Add 0.02 dB/ $^{\circ}$ C from 30 to 55  $^{\circ}$ C, add 0.025 dB/ $^{\circ}$ C from 20 to 0  $^{\circ}$ C.
4. Typical specification applies to instruments serial number GB4617 or greater, or instruments with the serial number starting MY.
5. 0 dBm input.
6. Specification applies to instruments serial number GB45460101 or greater, otherwise this specification for the 2.4 GHz band is  $> 46$  dB (22 MHz bandwidth).
7.  $> 50$  dB (5 MHz bandwidth).
8. Specification applies to instruments serial number GB45460101 or greater, otherwise this specification is  $< -70$  dBm (2.381 to 2.519 GHz).
9. Typical specification applies to instruments serial number GB4617 or greater, or instruments with the serial number starting MY; otherwise the specification is  $< 2.0\%$ .
10. Specification applies to instruments with Option 108.

## PC Hardware specifications

- Microsoft® Windows® 2000 and XP® only
- 2.4 GHz Pentium® or equivalent minimum, 2.8 GHz recommended
- 200 MH available on hard drive
- 256 MB RAM minimum, 500 MB RAM recommended
- USB 2.0, TCP-IP LAN, or GPIB connection to test set
- Agilent I/O Libraries Suite 14.1 or greater. For information on Agilent I/O Libraries Suite features and installation requirements, please go to:  
[www.agilent.com/find/iosuite/datasheet](http://www.agilent.com/find/iosuite/datasheet)

## N4010A general specifications

### Frequency reference

Frequency	10 MHz
Accuracy	
20 to 30 °C	$\pm 1 \times 10^{-6}$ ( $\pm 1$ ppm)
0 to 55 °C	$\pm 1.5 \times 10^{-6}$ ( $\pm 1.5$ ppm)
Aging (first year)	$\pm 1 \times 10^{-6}$ /year
10 MHz input	BNC(f), 50 $\Omega$
10 MHz output	BNC(f), 50 $\Omega$

### Power requirements

Voltage	100 to 240 VAC, 47 to 63 Hz
Power	150 VA maximum

### Environmental

Operating temperature	0 to 55 °C
Storage temperature	-40 to +70 °C
Operating humidity	15 to 95% relative humidity (non-condensing)
EMI compatibility	Radiated emission is in compliance with CISPR Pub 11/1990 Group 1 Class A

## Inputs/outputs

### Front panel

RF input/output	Type-N (f), 50 $\Omega$
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### Rear panel

10 MHz REF IN	BNC(f), 50 $\Omega$
10 MHz REF OUT	BNC(f), 50 $\Omega$
GPIB	IEEE-488
LAN	RJ-45, 10/100-T
USB	USB 1.0/2.0

Additional rear panel connectivity with N4010A input/output connectivity Option 110

AUX RF input/output	Type-N (f), 50 $\Omega$
TRIG IN	BNC(f), 50 $\Omega$ ; input has TTL compatible logic levels
TRIG OUT	BNC(f), 50 $\Omega$ ; output has TTL compatible logic levels
75 MHz IF output	SMA (f), 50 $\Omega$
Event 1	BNC(f), 50 $\Omega$
Event 2	BNC(f), 50 $\Omega$
<i>Bluetooth</i> and WLAN triggers, data, and clock	25-way D (f)

## Size and weight

### Dimensions

With handle and bumpers	105 mm x 370 mm x 390 mm
Without handles and bumpers	105 mm x 330 mm x 375 mm

### Weight

	5.9 kg (12.98 lbs) for N4010A-101
	7.2 kg (15.84 lbs) for N4010A-102, 103

## Regulatory information

### Product safety

Conforms to the following product specifications:  
IEC61010-1:2001/  
EN61010-1:2001  
CAN/CSA-C22.2 No 1010.1-92  
Low voltage directive 72/23/EEC

### General conditions

The conformity assessment requirements have been met using the technical construction file route for compliance with the requirements of the EMC Directive 89/336/EEC

## N4011A Introduction

The N4011A MIMO/Multi-port Adapter is a ¼ rack-width unit, used in conjunction with a N4010A test set to provide additional features to support production testing of multi-port MIMO-capable devices and modules. It provides a switch matrix to connect the multi-ports of the device-under-test (DUT) to the single RF In/Out port of the N4010A. In addition, the N4011A provides interfaces to allow the DUT to be connected to a reference (golden) radio.



The N4011A will operate functionally at power-up, within the stated environmental operating range, and perform to specification after power-on assuming the unit is in the temperature range 20 to 30 °C.

**Note:** The power cable from the N4010A test set must be connected to the N4011A adapter with the power off.

Unless otherwise stated all specifications are valid over the temperature range 20 to 30 °C. Supplemental characteristics are intended to provide additional information, useful in applying the adapter by giving typical (expected), but not warranted, performance parameters. These characteristics are shown in italics or labeled as nominal.

### General RF performance

Frequency range <sup>1</sup>	As N4010A-103
Maximum specified input power	+23 dBm, CW (applies to all ports)
Damage level (maximum safe input level)	+25 dBm, CW (applies to all ports)

### RF input and output specifications

The following characteristics are calculated using a proportion (P) of  $\geq 99\%$  and a confidence level (C) of 90%.

Input match for DUT ports <sup>1</sup>	< -15 dB
Insertion loss (RF IN/OUT – DUT) <sup>1,2</sup>	< 12 dB (2.0 to 2.6 GHz) < 14 dB (> 2.6 to 6.0 GHz)
Insertion loss (REF – DUT) <sup>1</sup>	< 25 dB
Isolation (DUT – DUT)	> 50 dB
Channel flatness (RF IN/OUT – DUT) (pk-pk ripple across any 40 MHz 802.11n channel span)	< 0.2 dB
Channel matching (difference between gain of individual N4011A DUT channels)	< 1.0 dB
Input match (RF IN/OUT Port) <sup>1</sup>	< -11.5 dB
Input match for REF ports <sup>1</sup> (golden radio)	< -12 dB
Insertion loss (REF – RF IN/OUT) <sup>1</sup>	< 36 dB
Isolation (REF – RF IN/OUT)	> 60 dB

### Power

Power consumption	160 mA at +5 V; 160 mA at +12 V; 20 mA at -12 V
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### Size and weight

Dimensions (H x W x D)	88 mm x 107 mm x 353 mm
Weight	1.9 kg (net) 2.5 kg (shipping)

### Environmental characteristics

Operating temperature	0 to 55 °C
Storage temperature	-40 to 70 °C
Operating humidity	15 to 95% relative humidity (non-condensing)
General conditions	The conformity assessment requirements have been met using the technical construction file route for compliance with the requirements of the EMC Directive 89/336/EEC

1. Actual S-parameter data, over the frequency range 2 to 6 GHz, is stored within the N4011A.

2. Automatic path loss compensation performed by the N4010A is applied between RF IN/OUT and DUT ports.

## Ordering Information

Model number	Description
N4010A	Wireless Connectivity Test Set
N4010A-101	<i>Bluetooth</i> test
N4010A-107	<i>Bluetooth</i> EDR link plus measurements
N4010A-113	<i>Bluetooth</i> audio generation and analysis
N4010A-112	<i>Bluetooth</i> headset profile
N4010A-102	2.4 GHz wireless LAN Tx/Rx analysis
N4010A-103	2.4 GHz/5 GHz wireless LAN Tx/Rx analysis
N4010A-104	Fully-flexible arbitrary waveform generation
N4010A-108	802.11n MIMO modulation analysis
N4010A-204	N4010A Signal Studio license
N4010A-110 <sup>1</sup>	Additional input/output connectivity (required with N4010A-102/103)
N4010A-AX4 <sup>1</sup>	Rack flange kit
N4010A-191 <sup>1</sup>	Carry handle kit

### Related hardware products

N4011A MIMO-Multiport Adapter

### Related software products

N4017A *Bluetooth* Graphical Measurement Application

N4017A-205 *Bluetooth* EDR

N4019C *Bluetooth* and WLAN Wireless Test Manager, development license and software

89601A Vector signal analysis software (version 5.20 or greater required)

89601A-200 Basic vector signal analysis software

89601A-300 Hardware connectivity

89601A-AYA Vector modulation analysis

89601A-B7R WLAN modulation analysis (OFDM and DSSS/CCK/PBCC)

or

89607A-100 Basic WLAN test suite (with hardware connectivity)

## Related Literature

*Agilent N4010A Wireless Connectivity Test Set Configuration Guide*, literature number 5989-3486EN

*Test Multiple Wireless Connectivity Technologies with One Test Platform*, brochure, literature number 5989-4150EN

*Agilent N4017A Bluetooth Graphical Measurement Application*, product overview, literature number 5989-2771EN

*Agilent N4018C and N4019C, Bluetooth® and WLAN Wireless Test Manager*, brochure, literature number 5989-5809EN

*Agilent N4010A Wireless Connectivity Test Set Performance Guide Using the 89601A Vector Signal Analysis Software and the 89607A WLAN Test Suite Software*, literature number 5989-0637EN

*89600 Series Wide-Bandwidth Vector Signal Analyzer*, brochure, literature number 5980-0723E

*Agilent 89600 Series Vector Signal Analysis Software 89601A/89601N12*, data sheet, literature number 5989-1786EN

*89607A WLAN Test Suite Software*, technical overview, literature number 5988-9547EN

*Agilent – Next Generation of WLAN Manufacturing Test Solutions*, brochure, literature number 5989-1194EN

*Test ZigBee™ modules and appliances – today!*, product overview, literature number 5989-3980EN

## For More Information

For more information on the N4010A and N4011A visit:

[www.agilent.com/find/n4010a](http://www.agilent.com/find/n4010a)  
[www.agilent.com/find/n4011a](http://www.agilent.com/find/n4011a)

For more information on the N4017A Graphical Measurement Application visit:

[www.agilent.com/find/n4017a](http://www.agilent.com/find/n4017a)

For more information on the *Bluetooth* and WLAN Wireless Test Manager visit:

[www.agilent.com/find/n4019c](http://www.agilent.com/find/n4019c)

For more information on Agilent Technologies' *Bluetooth*, WLAN, ZigBee, and MIMO solutions visit:

[www.agilent.com/find/bluetooth](http://www.agilent.com/find/bluetooth)  
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[www.agilent.com/find/zigbee](http://www.agilent.com/find/zigbee)  
[www.agilent.com/find/mimo](http://www.agilent.com/find/mimo)

1. Options 110, AX4, and 191 are supplied as standard with N4010A products ordered after March 2006.



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