# 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*® 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*® 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[1]

### Output power

**Link conditions**

| | |
|---|---|
| Link mode | Test mode (loopback, Tx), normal mode (ACL, SCO) |
| Hopping[2] | On or off |
| Packet type[2] | DH1, DH3, DH5, HV3 |
| Payload[2] | PRBS9, BS00, BSFF, BSOF, BS55 |

**Measurement**

| | |
|---|---|
| Supported measurements | Average power, peak power |
| Number of measurement channels[3] | 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[3] | 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[2] | On or off |
| Packet type[2] | DH1, DH3, DH5, HV3 |
| Payload[2] | 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[3] | 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[4] | 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 ±((2.402 GHz x 10 Hz)/10 MHz) ± 100 Hz = ±2402 Hz ± 100 Hz = ±2502 Hz.*

## Initial carrier frequency tolerance

### Link conditions

| | |
|---|---|
| Link mode | Test mode (loopback, Tx), normal mode (ACL) |
| Hopping[1] | On or off |
| Packet type[1] | DH1, DH3, DH5, HV3 |
| Payload[1] | PRBS9, BSOO, BSFF, BSOF, BS55 |

### Measurement

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

## Carrier frequency drift

### Link conditions

| | |
|---|---|
| Link mode | Test mode (loopback, Tx), normal mode (ACL) |
| Hopping[1] | On or off |
| Packet type[1] | DH1, DH3, DH5, HV3 |
| Payload[1] | PRBS9, BSOO, 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[2] | 3 |
| RF input level range | +23 to –70 dBm |
| Measurement range | ±100 kHz |
| Measurement accuracy[3] | As frequency reference ±100 Hz |

## Sensitivity – single slot packets

### Link conditions

| | |
|---|---|
| Link mode | Test mode (loopback, Tx), normal mode (ACL) |
| Hopping[1] | On or off |
| Packet type[1] | DH1, DH3, DH5 |
| Payload[1] | PRBS9, BSOO, 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[2] | 3, hopping |
| Range | 0 to –90 dBm |
| Resolution | 0.1 dB |
| Accuracy[4, 5] | ±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 ±((2.402 GHz x 10 Hz)/10 MHz) ± 100 Hz = ±2402 Hz ± 100 Hz = ±2502 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, BSOO, 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[1] | 3, hopping |
| Range | 0 to −91 dBm |
| Resolution | 0.1 dB |
| Accuracy[2, 3] | ±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, BSOO, 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[1] | 3 |
| Range | 0 to −90 dBm |
| Resolution | 0.1 dB |
| Accuracy[2, 3] | ±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, BSOO, 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[1] | 3, hopping |
| Range | +23 to –70 dBm |
| Resolution | 0.01 dB |
| Accuracy[2] | ±0.5 dB |

### EDR modulation accuracy and carrier frequency stability

**Link conditions**

| | |
|---|---|
| Link mode | Test mode (loopback, Tx) |
| Hopping | On or off |
| Payload | PRBS9, BSOO, 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[1] | 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[3] | As frequency reference ±100 Hz |

## EDR differential phase encoding

**Link conditions**

| | |
|---|---|
| Link mode | Test mode (Tx) |
| Hopping | On or off |
| Payload | PRBS9, BSOO, 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[1] | 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, BSOO, 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[1] | 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 ±((2.402 GHz x 10 Hz)/10 MHz) ± 25 Hz = ±2402 Hz ± 25 Hz = ±2427 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 ±((2.402 GHz x 10 Hz)/10 MHz) ± 100 Hz = ±2402 Hz ± 100 Hz = ±2502 Hz.*

# *Bluetooth* EDR receiver tests

## EDR Rx sensitivity

### Link conditions

| | |
|---|---|
| Link mode | Test mode (loopback) |
| Payload | PRBS9, BSOO, 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[1] | 3, hopping |
| Range | 0 to −90 dBm |
| Resolution | 0.1 dB |
| Accuracy[2, 3] | ±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, BSOO, 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[1] | 3, hopping |
| Range | 0 to −90 dBm |
| Resolution | 0.1 dB |
| Accuracy[2, 3] | ±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, BSOO, 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[1] | 3, hopping |
| Range | 0 to −90 dBm |
| Resolution | 0.1 dB |
| Accuracy[2, 3] | ±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[1] | As frequency reference ±25 Hz |
| Offset range | *±300 kHz* |
| Offset accuracy | ±210 Hz, *±200 Hz typical* |

### Output power

| | |
|---|---|
| Range | 0 to –90 dBm |
| Resolution | 0.1 dB |
| Accuracy[2, 3] | ±0.6 dB, –35 to –90 dBm |
| | *±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[4] | ±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[2] (center frequency ±400 kHz) | As frequency reference ±100 Hz |

### Power measurement

| | |
|---|---|
| Range | +23 to –70 dBm |
| Damage level | +25 dBm |
| Resolution | 0.01 dB |
| Accuracy[5] | ±0.5 dB |
| Input VSWR | < 1.5:1 |

### Modulation

| | |
|---|---|
| Type | GFSK, DQPSK, D8PSK |
| Deviation range | ±400 kHz |
| Deviation resolution | 0.1 kHz |
| Modulation depth | As frequency reference ±100 Hz |
| DQPSK and D8PSK rms differential error vector magnitude (DEVM) accuracy[6] | *< 2% (nominal)* |
| 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 ±((2.402 GHz x 10 Hz)/10 MHz) ± 25 Hz = ±2402 Hz ± 25 Hz = ±2427 Hz.*

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.*

4. *Verified by interpolation to static frequency offset measurements.*

5. *Add 0.02 dB/°C from 30 to 55 °C and 0.025 dB/°C from 20 to 0 °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 ±((2.402 GHz x 10 Hz)/10 MHz) ± 100 Hz = ±2402 Hz ± 10 Hz = 2502 Hz.*

# N4010A Option 113 *Bluetooth* audio generation and analysis[1]

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).

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

## N4010A *Bluetooth* audio system performance and SINAD floor specification[2,3]

| | |
|---|---|
| Number of SCO channels supported | *1* |
| CODEC air interfaces supported | *CVSD, A-law, µ-law* |
| Frequency response | *+0.6 to −1.0 dB (320 to 3200 Hz[4, 5]) See Figure 1 for CVSD frequency response)* |
| Maximum input/output signal levels | *3.28 V pk-pk = 1.16 Vrms[5, 6] For CVSD, recommend level < 138 mVrm[6]* |
| Distortion/noise (THD+N) | *Better than −52 dB (A-law, µ-law) Better than −35 dB (CVSD[5, 6]) See Figure 2 for CVSD distortion characteristics* |
| Variation of gain (−55 to +3 dBm, 225 to 2040 Hz) | *< 0.5 dB[5, 6]* |
| Idle noise (200 Hz to 20 kHz) | *Better than −64 dBm* |
| SINAD floor for N4010A audio paths (at 1.125 kHz frequency and −15 dBmO level) | *> 29 dB* |
| Out of band performance (4 to 32 kHz) | *Better than −30 dB (A-law, µ-law) Better than −42 dB (CVSD)* |
| Input/output connectors | *BNC input, BNC output* |
| Input impedance | *150 kΩ* |
| Output impedance | *50 kΩ (AC coupled)* |
| Minimum output load | *0 Ω (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 of due to the slew-rate limitations set by Bluetooth's CVSD algorithm parameters.*

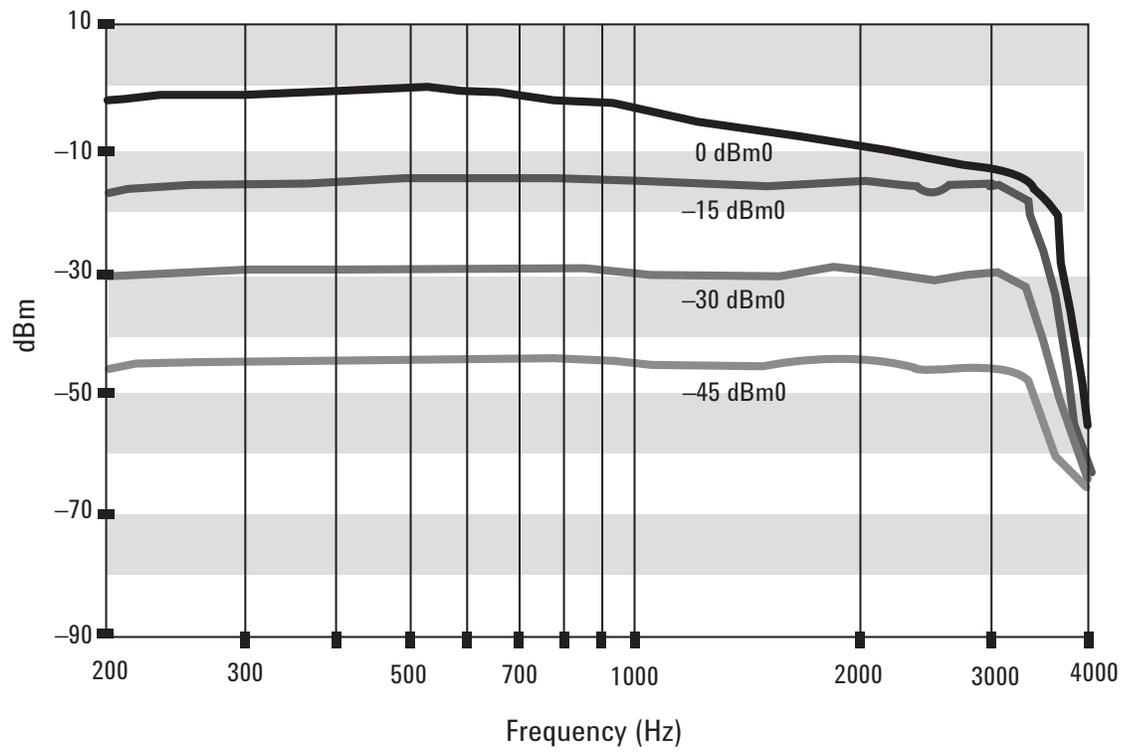6. *CVSD distortion (THD+N) at 1020 Hz and level −15 dBm0 is better than 4 percent.*
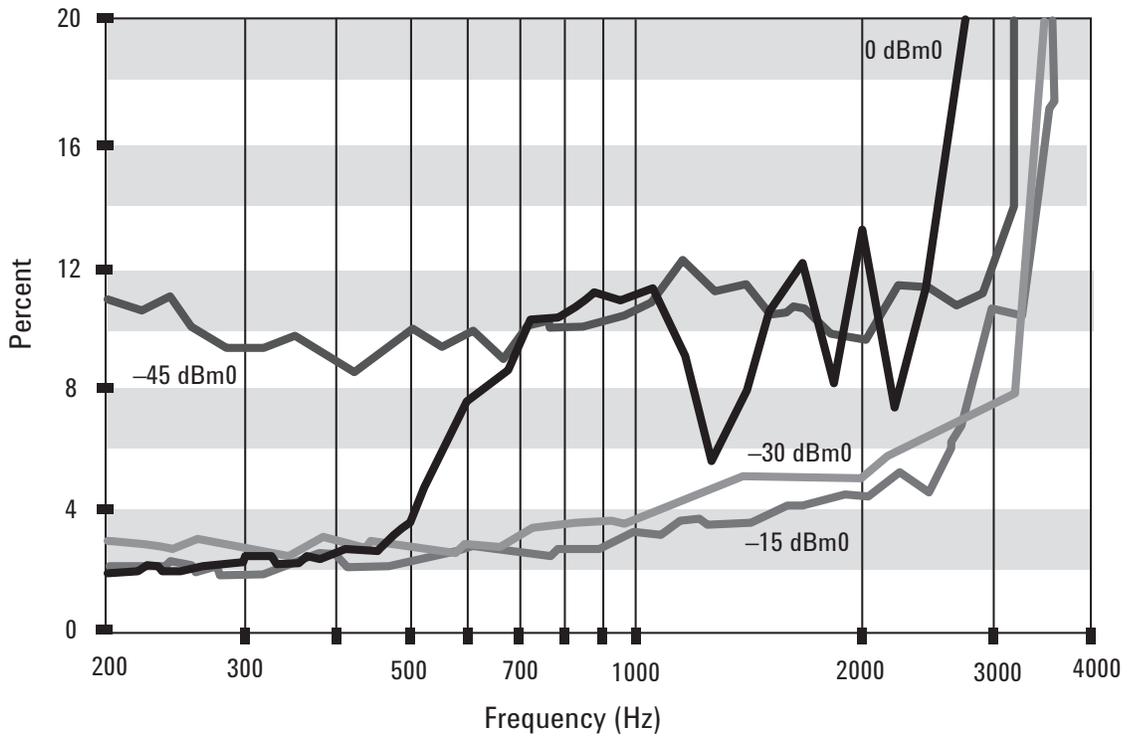
Figure 1. CVSD frequency response

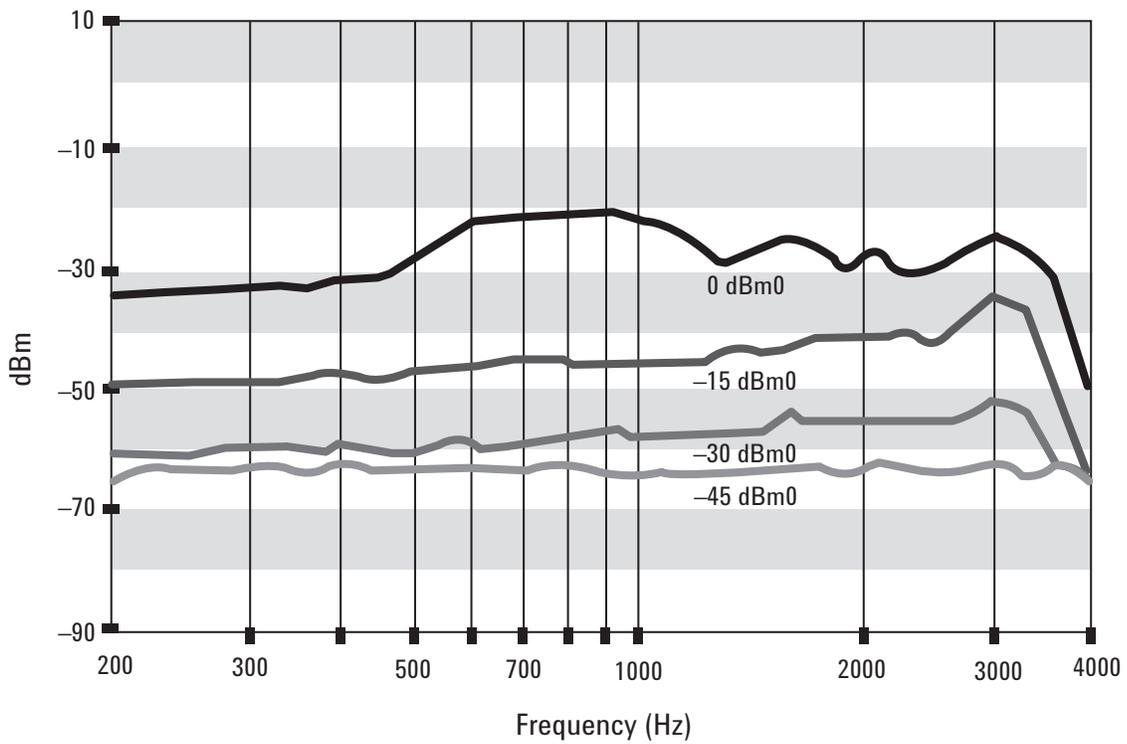*Figure 2a. CVSD distortion percentage characteristic*



*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 |
|---|---|---|
| **Auto-range** | Yes | Yes |
| **CW** | | |
| Average power | Yes | No |
| CW frequency offset | Yes | No |
| **Bursted OFDM** | | |
| 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 |
| **Fast OFDM demodulation measurement** | | |
| EVM | Yes | No |
| Frequency error | Yes | No |
| IQ offset | Yes | No |
| Gated power | Yes | No |
| **Gated spectrum** | Yes | No |
| **Bursted DSSS** | | |
| 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 |
| **Fast DSSS demodulation measurement** | | |
| EVM (peak) | Yes | No |
| EVM (RMS) | Yes | No |
| Frequency error | Yes | No |
| IQ offset | Yes | No |
| Gated power | Yes | No |
| **Gated spectrum** | 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[1] | As frequency reference ±25 Hz[2] |
| Output power range | 2.402 to 2.484 GHz: −10 to −95 dBm[1] |
| | 802.11b DSSS: |
| | *−8 dBm maximum (nominal)* |
| | 4.800 to 5.875 GHz: −15 to −95 dBm[1] |
| | 802.11a/g OFDM: |
| | *−13 dBm maximum (nominal)* |
| Absolute amplitude accuracy[1] | 2.402 to 2.484 GHz: |
| | ±0.9 dB[3] (−10 to −90 dBm) |
| | *±0.6 dB[4] (−10 to −90 dBm)* |
| | *±0.9 dB (> −90 to −95 dBm)* |
| | 4.800 to 5.875 GHz: |
| | ±0.9 dB[3] (−15 to −90 dBm) |
| | *±0.6 dB[4] (−15 to −90 dBm)* |
| | *±0.9 dB (> −90 to −95 dBm)* |
| Resolution | 0.1 dB |
| Output impedance | 50 Ω (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%[5] |
| | 802.11b: < 5%[5, 6] |
| | 802.11g: < 2%[5] |
| | 802.11n: < 2%[7] |

---

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 ±((2.402 GHz x 10 Hz)/10 MHz) ±25 Hz = ±2402 Hz ±25Hz = ±2427 Hz.*

3. *Add 0.013 dB/°C from 30 to 55 °C, add 0.02 dB/°C from 20 to 0 °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[1] | 2.381 to 2.519 GHz |
| | 4.800 to 5.875 GHz (Option 103 only) |
| Frequency resolution | 1 MHz |
| Frequency accuracy[2] | As frequency reference ±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[2] | ±0.5 dB[3] (2.381 to 2.519 GHz) |
| | *±0.3 dB[4] (+23 to −55 dBm)* |
| | *±0.35 dB[4] (< −55 dBm)* |
| | ±0.8 dB[3] (4.800 to 5.875 GHz) |
| | *±0.35 dB[4] (+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[5, 6] | *> 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[7] | *< −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 vector magnitude (EVM) | *802.11a: 5 GHz band; 54 Mbps 64QAM OFDM: < 2.25% (power range 0 to −20 dBm)* |
| | *802.11b: DSSS: < 3.0% (power range 0 to −30 dBm)* |
| | *802.11g: 2.4 GHz band; 54 Mbps 64QAM OFDM: < 1.25%[8] (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%[9](power range 0 to −10 dBm)* |
| | *802.11n: 54 Mbps 64QAM OFDM: < 3.0%[9](power range −10 to −20 dBm)* |
| | *Bluetooth EDR: < 2% (rms DEVM)* |

---

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/°C from 30 to 55 °C, add 0.025 dB/°C from 20 to 0 °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**

## N4010A general specifications

**Frequency reference**

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

**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 Ω |

**Rear panel**

| | |
|---|---|
| 10 MHz REF IN | BNC(f), 50 Ω |
| 10 MHz REF OUT | BNC(f), 50 Ω |
| 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 Ω |
| TRIG IN | BNC(f), 50 Ω; input has TTL compatible logic levels |
| TRIG OUT | BNC(f), 50 Ω; output has TTL compatible logic levels |
| 75 MHz IF output | SMA (f), 50 Ω |
| Event 1 | BNC(f), 50 Ω |
| Event 2 | BNC(f), 50 Ω |
| *Bluetooth* and WLAN triggers, data, and clock | 25-way D (f) |

## Size and weight

| **Dimensions** | **(H x W x D)** |
|---|---|
| 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[1] | 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 ≥ 99% and a confidence level (C) of 90%.

| | |
|---|---|
| Input match for DUT ports[1] | *< –15 dB* |
| Insertion loss (RF IN/OUT – DUT)[1, 2] | *< 12 dB (2.0 to 2.6 GHz)*<br>*< 14 dB (> 2.6 to 6.0 GHz)* |
| Insertion loss (REF – DUT)[1] | *< 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)[1] | *< –11.5 dB* |
| Input match for REF ports[1] (golden radio) | *< –12 dB* |
| Insertion loss (REF – RF IN/OUT)[1] | *< 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 |

## Size and weight

| | |
|---|---|
| Dimensions (H x W x D) | 88 mm x 107 mm x 353 mm |
| Weight | 1.9 kg (net)<br>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 | *Bluetooth* test |
| N4010A-107 | *Bluetooth* EDR link plus measurements |
| N4010A-113 | *Bluetooth* audio generation and analysis |
| N4010A-112 | *Bluetooth* 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[1] | Additional input/output connectivity (required with N4010A-102/103) |
| N4010A-AX4[1] | Rack flange kit |
| N4010A-191[1] | 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**
**www.agilent.com/find/n4011a**

For more information on the N4017A Graphical Measurement Application visit:

**www.agilent.com/find/n4017a**

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

**www.agilent.com/find/n4019c**

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

**www.agilent.com/find/bluetooth**
**www.agilent.com/find/wlan**
**www.agilent.com/find/zigbee**
**www.agilent.com/find/mimo**

---

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

**Agilent Email Updates**

**www.agilent.com/find/emailupdates**
Get the latest information on the products and applications you select.

**Agilent Channel Partners**

**www.agilent.com/find/channelpartners**
Get the best of both worlds: Agilent's measurement expertise and product breadth, combined with channel partner convenience.

Agilent
Advantage
Services

Agilent Advantage Services is committed to your success throughout your equipment's lifetime. We share measurement and service expertise to help you create the products that change our world. To keep you competitive, we continually invest in tools and processes that speed up calibration and repair, reduce your cost of ownership, and move us ahead of your development curve.

**www.agilent.com/find/advantageservices**

Agilent Electronic Measurement Group
KEMA Certified
**ISO 9001:2008**
Quality Management System

**www.agilent.com/quality**

For more information on Agilent Technologies' products, applications or services, please contact your local Agilent office. The complete list is available at:

**www.agilent.com/find/contactus**

**Americas**

| | |
|---|---|
| Canada | (877) 894 4414 |
| Brazil | (11) 4197 3500 |
| Mexico | 01800 5064 800 |
| United States | (800) 829 4444 |

**Asia Pacific**

| | |
|---|---|
| Australia | 1 800 629 485 |
| China | 800 810 0189 |
| Hong Kong | 800 938 693 |
| India | 1 800 112 929 |
| Japan | 0120 (421) 345 |
| Korea | 080 769 0800 |
| Malaysia | 1 800 888 848 |
| Singapore | 1 800 375 8100 |
| Taiwan | 0800 047 866 |
| Other AP Countries | (65) 375 8100 |

**Europe & Middle East**

| | |
|---|---|
| Belgium | 32 (0) 2 404 93 40 |
| Denmark | 45 70 13 15 15 |
| Finland | 358 (0) 10 855 2100 |
| France | 0825 010 700* |
| | *0.125 €/minute |
| Germany | 49 (0) 7031 464 6333 |
| Ireland | 1890 924 204 |
| Israel | 972-3-9288-504/544 |
| Italy | 39 02 92 60 8484 |
| Netherlands | 31 (0) 20 547 2111 |
| Spain | 34 (91) 631 3300 |
| Sweden | 0200-88 22 55 |
| United Kingdom | 44 (0) 118 9276201 |

*For other unlisted Countries:*
**www.agilent.com/find/contactus**
Revised: October 14, 2010

Product specifications and descriptions in this document subject to change without notice.

**Agilent Technologies**