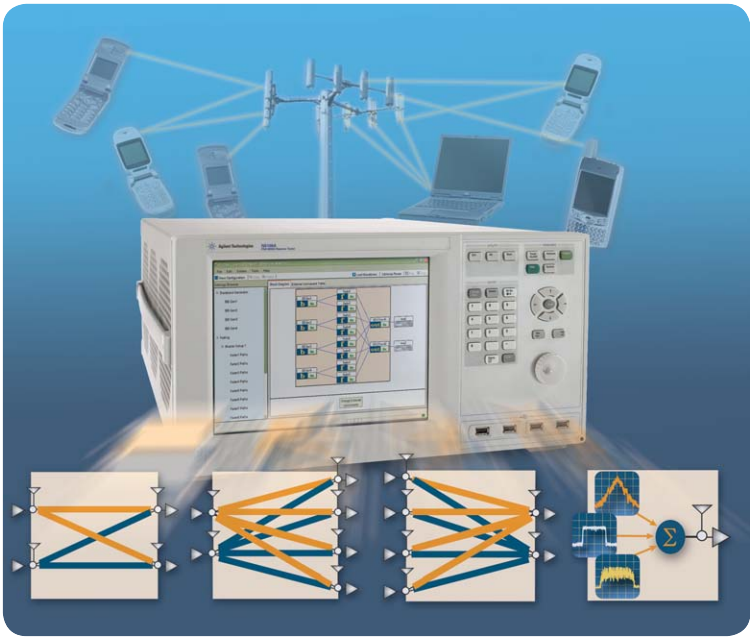
Agilent N5106A PXB MIMO Receiver Tester

Data Sheet



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Definitions

Specification (spec): Represents warranted performance. Because this instrument is primarily digital in nature, there are no analog performance specifications.

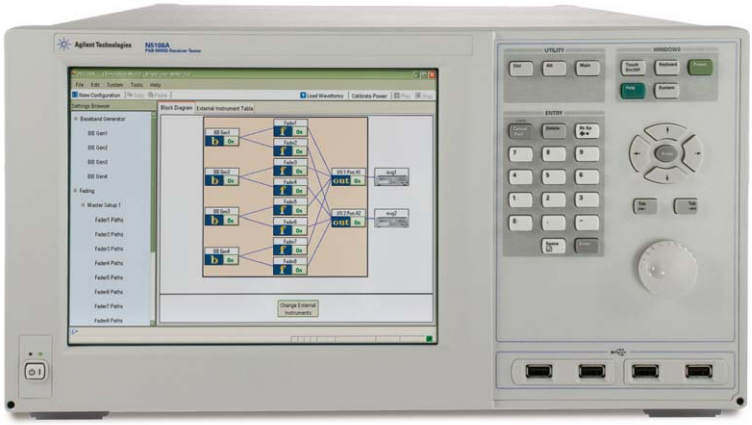
Typical (typ): Represents characteristic performance that is non-warranted. Describes performance that will be met by a minimum of 80% of all products.

Nominal (nom): Represents characteristic performance that is non-warranted. Represents the value of a parameter that is most likely to occur; the expected mean or average.

Measured (meas): Represents characteristic performance that is non-warranted. Represents the value of a parameter measured during the design phase.

Note: All graphs contain measured data from several units at room temperature (approximately 25 °C) unless otherwise noted.

General Characteristics



N5106A PXB MIMO receiver tester

Supported use cases and configurations

Use cases	Configurations
Baseband generation[1]	1, 2, 4 channels
Baseband generation and sum[1]	2, 4 channels
Baseband generation and fading[1]	1, 2 channels
Single-user MIMO[1]	2x2, 2x4, 4x2
Multi-user MIMO[1]	2x2
RF fading[1, 2]	1, 2 channels
MIMO RF fading[1, 2]	2x2

1. This use case supports RF output with vector MXG/ESG and digital I/Q output with N5102A.
2. This use case supports RF input with MXA.

Baseband Generator Characteristics (requires Option EFP)

Number of baseband generators Up to 4

Arbitrary waveform memory 512 Msa (2 GB) per baseband generator

Sample rate 1 kSa/sec - 150 MSa/sec[1]

Signal bandwidth

PXB output interface		Bandwidth
Analog I/Q outputs[2]		120 MHz[3]
Digital bus[4]	N5102A digital signal interface module	120 MHz
	N5182A MXG vector signal generators[5]	100 MHz
	E4438C ESG vector signal generators[6]	80 MHz

Resolution 14 bits[7]

Baseband frequency offset range –60 MHz to 60 MHz[8]

Compatible signal formats Signal Studio, E4438C, N5182A, Advanced Design System (ADS), SystemVue 2008, custom I/Q waveforms[9]

Numeric formats Two's complement, offset binary

Waveform length 256 samples to 512 Msa

Waveform loading speed[10] LAN to PXB hard drive: 250 MB/min (nom)
PXB hard drive to arbitrary waveform memory: 1 GB/min (nom)

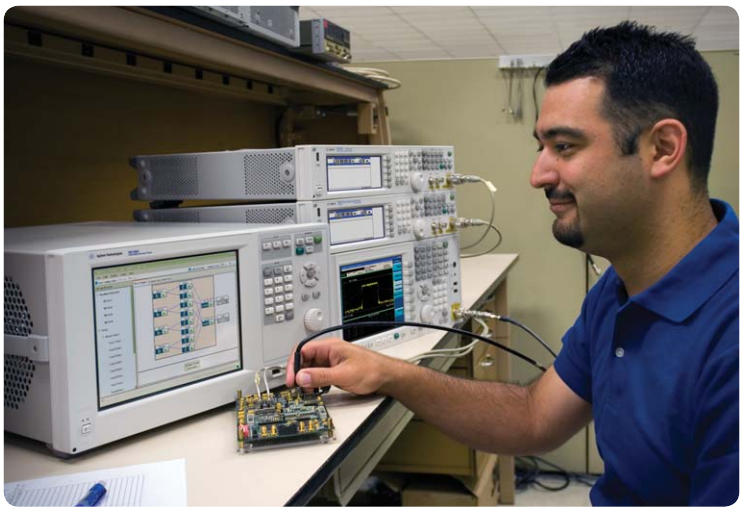
External eSATA hard drive to PXB arbitrary waveform memory: 4 GB/min (nom)

RMS values for power control Measured, previous RMS, user entered, waveform header RMS

When connected to the MXG/ESG via the digital bus, the PXB has negligible contribution to RF flatness, EVM, and ACP. See MXG/ESG data sheet for performance details.

1. Each baseband generator can individually set sample rate.
2. The PXB connected to the E4438C ESG via analog I/Q provides accurate power calibration at RF up to 120 MHz. RF power management when connected via the PXB's analog I/Q outputs to all other signal generators requires external power calibration.
3. 60 MHz I and 60 MHz Q.
4. When the PXB output is connected via digital bus to the MXG/ESG, bandwidth is limited by the vector signal generator.
5. Requires MXG firmware revision A.01.44 or later.
6. Requires ESG firmware revision C.05.23 or later. Contact division for demo firmware.
7. 16-bit I/Q waveforms created for the E4438C and N5182A are compatible with the PXB. For optimal performance, PXB waveforms should be created with 16-bit resolution. Refer to the online documentation for more information.
8. Baseband offset range is limited by output instrument when connected via digital bus.
9. Users load waveforms into the PXB baseband generator for playback. See online documentation for details on custom waveform format.
10. Performance varies depending on external PC and LAN connection.

Fader Characteristics (requires Option QFP)



Simulate real-world conditions to test MIMO receivers more quickly and validate design robustness earlier in the development cycle with the PXB.

Number of faders Up to 8

Fading bandwidth

Internal baseband generation and fading		Maximum bandwidth
Analog I/Q outputs[1]		120 MHz[2]
Digital bus[3]	N5102A digital signal interface module	120 MHz
	N5182A MXG vector signal generators[4]	100 MHz
	E4438C ESG vector signal generators[5]	80 MHz

External RF input for fading		Bandwidth
Digital bus[6]	N9020A vector signal analyzer[7]	25 MHz

Paths per fader

6 paths @ 120 MHz
12 paths @ 80 MHz
24 paths @ 40 MHz

Power accuracy

When connected to the MXG/ESG via the digital bus, the PXB has negligible contribution to power accuracy. This is in comparison to the signal generators set to the same conditions separately. See MXG/ESG data sheet for performance details.

1. The PXB connected to the E4438C ESG via analog I/Q provides accurate power calibration at RF up to 120 MHz. RF power management when connected via the PXB's analog I/Q outputs to all other signal generators requires external power calibration.
2. 60 MHz I and 60 MHz Q.
3. When the PXB output is connected via digital bus to the MXG/ESG, bandwidth is limited by the vector signal generator.
4. Requires MXG firmware revision A.01.44 or later.
5. Requires ESG firmware revision C.05.23 or later. Contact division for demo firmware.
6. When the PXB input is connected via digital bus to the MXA, fading bandwidth is limited by the vector signal analyzer.
7. Requires MXA firmware revision A.01.61 or later.

Fader Characteristics (requires Option QFP)

continued...

Predefined channel models	W-CDMA, HSDPA, HSUPA, COST 259, TD-SCDMA, cdma2000, cdmaOne, 1xEV-DO, GSM, EDGE, WLAN, TETRA, 802.16 OFDM, 802.16 OFDMA, LTE (includes high speed train)
Predefined MIMO channel models	LTE: 3GPP standard 36.101 Annex B (requires Option TFP) Mobile WiMAX™: MIMO channel model for MTG RCT (requires Option RFP)
Repetition interval	> 7 days
Random seed	89 bits
Fading types	Pure Doppler, Rayleigh, Rician, Suzuki, log normal
Spectral shape	Classical 3 dB, classical 6 dB, flat, rounded, Jakes classical, Jakes rounded
Rayleigh distribution Deviation from CDF, filtered noise	0.5 dB from –30 to + 10 dB of mean power level
Rician	
Power ratio (k) range	–84 dB to 84 dB
LOS AoA	0 to 360°
Path delay	0 to 2 ms
Resolution	0.1 ns
Accuracy	±(0.4 ns + 0.2% path delay) (meas)
Phase shift	0 to 360°
Resolution	0.01°
Path loss	0 to 84 dB
Resolution	0.01 dB
Accuracy	0.1 dB (meas)
Vehicle speed[1]	0 to 864 km/h @ 2 GHz
Resolution	0.01 km/h
Doppler frequency[1]	0 Hz to 1.6 kHz
Resolution	0.001 Hz
Accuracy	0.05% (meas)
Angle of arrival (AoA)	0 to 360°
Resolution	0.01°
Angle of departure (AoD)	0 to 360°
Resolution	0.01°

1. Doppler frequency of vehicle speed is coupled to the carrier frequency setting in the Fader Setup view.

Fader Characteristics (requires Option QFP)

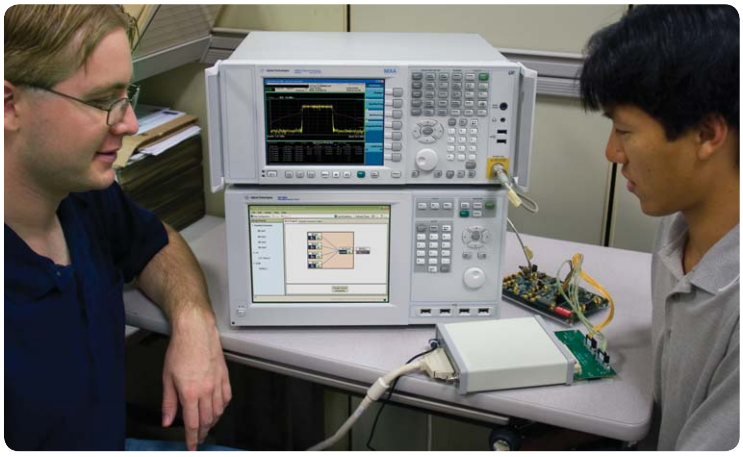
continued...

AoA Azimuth spread	0 to 360°
Resolution	0.01°
AoD Azimuth spread	0 to 360°
Resolution	0.01°
Log normal	
Standard deviation	0 to 12 dB
Decorrelation length	1 m to 1 km
MIMO correlation source	From wireless standard, from custom antenna setup, from custom correlation matrix
Custom correlation matrix	Channel to channel, path to path
Path configuration source	From wireless standard, custom
Antenna patterns	Omni-directional, three-sector, six-sector
Antenna spacing	–20 to 20 wavelengths in X and Y coordinates

Additive White Gaussian Noise (AWGN) Characteristics (requires Option JFP)

AWGN bandwidth	Up to 120 MHz
Carrier to noise (C/N) ratio	–30 dB to 30 dB
Resolution	0.1 dB
Accuracy	0.3 dB (meas)
Crest factor	12.88 dB
Units	SNR, Eb/No
Repetition interval	> 7 days

Digital Output Characteristics



Test baseband chipsets with the PXB and the N5102A digital signal interface module.

Logic types (requires N5102A)[1]	Single-ended: LVTTL, CMOS (1.5V, 1.8V, 2.5V, 3.3.V) Differential: LVDS
Number of digital output ports[2]	2 per I/O card, up to 8 total[3]
Resolution	14 bits
Baseband frequency offset	–60 MHz to 60 MHz[4]
I/Q skew	–2 ns to 2 ns
Resolution	1 ps
I/Q gain balance	–4 dB to 4 dB
Resolution	0.01 dB
Delay	0 to 500 ns
Resolution	1 ps
Quadrature skew	–30 to 30°
Resolution	0.01°
Compatible output devices to connect via digital bus	N5182A MXG E4438C ESG N5102A digital signal interface module

1. Logic types available when connected to N5102A digital signal interface module.
2. Each output port must be designated as analog or digital in the PXB user interface. The same port cannot be used for both simultaneously.
3. Current configurations only support up to 4 outputs.
4. Baseband offset range is limited by output instrument when connected via digital bus.

Analog Output Characteristics

Port type	Analog I/Q, single-ended and differential
Number of analog I/Q ports[1]	2 per I/O card, up to 8 total[2]
Level	2.0 Vpp; 50 Ω
Resolution	14 bits
Baseband frequency offset	–60 MHz to 60 MHz[3]
I/Q skew	–2 ns to 2 ns
Resolution	1 ps
I/Q gain balance	–4 dB to 4 dB
Resolution	0.01 dB
Delay	0 to 500 ns
Resolution	1 ps
Quadrature skew	–30 to 30°
Resolution	0.01°
Common I/Q offset	–2.5 V to 2.5 V
Resolution	10 mV
Differential I offset	–25 mV to 25 mV
Resolution	1 mV
Differential Q offset	–25 mV to 25 mV
Resolution	1 mV
I/Q peak level	0 V to 1 Vpk
Resolution	10 mV

1. Each output port must be designated as analog or digital in the PXB user interface. The same port cannot be used for both simultaneously.
2. Current configurations only support up to 4 outputs.
3. Baseband offset range is limited by output instrument when connected via digital bus.

Analog Output Characteristics

continued...

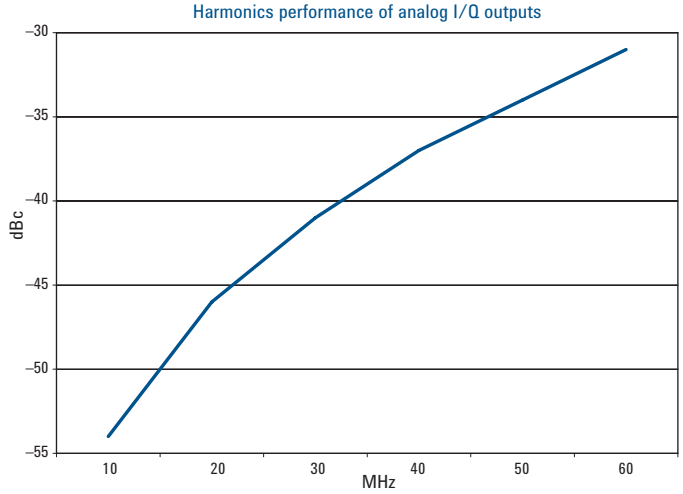
Maximum reverse power Max DC voltage 20 VDC (nom)
250 kHz to 500 MHz 1 W (nom)

Flatness[1] 1 dB (typ)

Spurious free dynamic range[1] < –76 dBc (typ)

Harmonics[1]

Harmonics performance of analog I/Q outputs

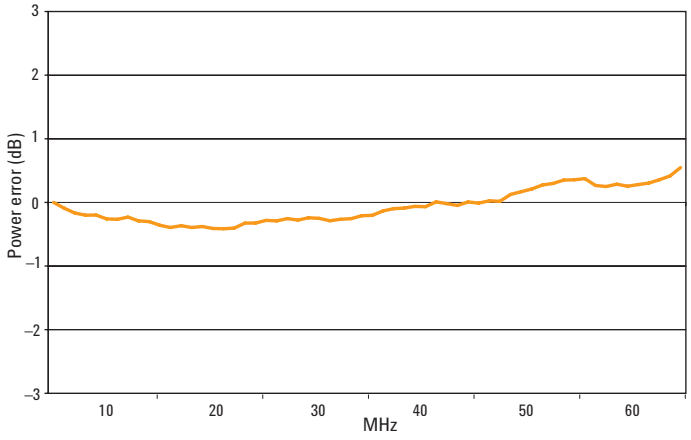


Phase noise[1] –147 dBc/Hz (typ)
10 MHz sinewave at 10 kHz offset

Noise floor[1] –152 dBc/Hz (typ)
10 MHz sinewave at 1.9 MHz offset

Flatness[1]

Analog I/Q output flatness vs. frequency (MHz)



1. These values apply at the PXB analog I/Q outputs only. When connected to the MXG/ESG via the digital bus, the PXB has negligible contribution. See MXG/ESG data sheet for performance data.

Frequency Reference Characteristics

Internal time base reference	OCXO, 10 MHz, stability ±0.01 ppm, from +20 to +30 °C Aging ±0.1 ppm/year for the first year Aging ±0.15 ppm/year for the first 2 years Operating temperature range is from 0-40 °C
External reference input	1 MHz – 100 MHz, –5 to + 10 dBm; 50 Ω
Reference output	10 MHz, 0.9 Vpp ±10%; 50 Ω

Clock, Trigger, and Marker Characteristics

Channel synchronization	< 21 ns
Trigger source	Software, hardware, bus (GPIB, LAN)
External trigger in	3.3 V CMOS (nom)
Trigger delay	0 to 1.5 us
Trigger jitter	5 ns
Trigger to analog I/Q out latency	250 ns (nom)
Trigger to RF latency	N5182A MXG: 600 ns (nom) E4438C ESG: 1.3 us (nom)
RF to RF latency[1]	N5182A MXG: < 55 us (nom) E4438C ESG: < 48 us (nom)
Marker outputs[2]	3 markers per I/O port 3.3V CMOS (nom)
Marker source	Separate marker file, markers embedded in waveform, dynamic marker generation
Marker delay	0 to 1,024 samples (settable in time)
Marker polarity	Positive, negative
Dynamic marker type	Periodic, range detect, zero detect

1. Latency is measured from the MXA's RF input to the signal generator's RF output.
2. Markers are labeled 1, 3, and 4. Marker 2 is reserved for internal use only.

General Chassis Characteristics

OS	Windows® XP Professional
Programming language	SCPI[1]
Connectivity	Gigabit LAN, IEEE 488 GPIB
Non-volatile storage	160 GB hard drive total 90 GB available for waveform and user data on D: partition (supplemented by external USB drives)
Available chassis slots	Up to 6 baseband cards (or 12 DSP blocks) and up to 4 I/O cards
Power requirements	100 to 120 VAC 50 to 60 Hz, or 200 to 240 VAC 50 to 60 Hz (automatically selected); < 875W typical, 1075W maximum
Operating temperature	10 to 40 °C
Acoustic noise	Idle: 57 dBA (nom) Normal: 60 dBA (nom) Worst case: 70 dBA (nom) Typical Agilent equipment: Normal = 54 dBA (nom)
Weight	Fully loaded: < 33 kg (72 lb)
Dimensions	222 mm H x 426 mm W x 584 mm D (8.75 in H x 16.8 in W x 23 in D)

PXB rear panel view.

1. Does not apply to Signal Studio programming control.

General Chassis Characteristics

continued...

System clock rear panel connectors

EXT I/O CLK IN	Reserved for future use
EXT SYNC	Reserved for future use
EXT TRIG IN	External trigger signal used to trigger the start of the FPGA process 3.3V CMOS [male SMB] Damage level: < 0 V and > 3.3 V
EXT REF IN	Input for an external frequency reference signal 1 MHz to 100 MHz, –5 to + 10 dBm; 50 Ω [male SMB] Lock range: ±5 ppm Damage level: < 0 V and > 3.3 V
10 MHz OUT	10 MHz reference output used to lock the frequency reference of other test equipment to the PXB 900 mVpp; 50 Ω [male SMB] Damage level: < 0 V and > 3.3 V
100 MHz SYS CLK OUT	100 MHz system clock output 2 Vpp; 50 Ω [male SMB] Damage level: < 0 V and > 3.3 V
I/O CLK OUT	Reserved for future use
MARKER OUT	Reserved for future use
AUX I/O	Reserved for future use

CPU host controller rear panel connectors

MONITOR	VGA connection of an external monitor
USB SLAVE (top)	Standard USB 2.0 ports, Type A connect to external peripherals such as a mouse, keyboard, printer, DVD drive, or hard drive
USB MASTER (top)	USB 2.0 port, Type B USB TMC (test and measurement class) connects to an external PC controller to control the PXB and for data transfers over a 480 Mbps link
LAN	Network interface used to control the PXB remotely

General Chassis Characteristics
continued...

CPU host controller rear panel connectors
continued...

GPIB	A General Purpose Interface Bus (IEEE 488 GPIB) connection that can be used for remote operation
INTERCONNECT 1 & 2	Reserved for future use
eSATA	This port provides access to external eSATA Hard Disk Drive (HDD) storage devices to increase system file storage capacity with higher transfer rates than the USB port
PCIe x4 FROM UPSTREAM	Reserved for future use
PCIe x4 TO DOWNSTREAM	Reserved for future use
USB (bottom)	Reserved for future use

I/O card(s) rear connectors

CLOCK IN	Reserved for future use
TRG IN	Reserved for future use
MKR OUT	Marker outputs for each I/O board channel numbered 1, 3 and 4 (marker 2 is reserved for internal use) 3.3 V CMOS [male SMB] Damage level: < 0 V and > 3.3 V
CLOCK OUT	Reserved for future use
DIGITAL BUS	Digital bus connectors enable operation with other test equipment such as the MXA signal analyzer, MXG signal generator, ESG signal generator, and digital signal interface module
I+, I–	Analog I/Q modulation from the internal baseband generator 2 Vpp; 50 Ω [male SMB] Damage level: < –15 V and > 15 V
Q+, Q–	Analog I/Q modulation from the internal baseband generator 2 Vpp; 50 Ω [male SMB] Damage level: < –15 V and > 15 V

Additional Resources

Literature

Agilent N5106A PXB MIMO Receiver Tester, Brochure, 5989-8970EN

Agilent N5106A PXB MIMO Receiver Tester, Configuration Guide, 5989-8972EN

Agilent N5106A PXB MIMO Receiver Tester, Photo Card, 5989-8969EN

MIMO Channel Modeling and Emulation Test Challenges, Application Note, 5989-8973EN

Ten Things You Should Know About MIMO SM (Spatial Multiplexing), Poster, 5989-9618EN

Agilent N5106A PXB MIMO Receiver Tester, Video Demonstration CD, 5989-8974EN

Agilent E4438C ESG Vector Signal Generator, Data Sheet, 5988-4039EN

Agilent E4428C and E4438C ESG Signal Generators, Configuration Guide, 5988-4085EN

Agilent E4438C ESG Vector Signal Generator, Brochure , 5988-3935EN

Agilent N5182A MXG and N5162A MXG ATE Vector Signal Generators, Data Sheet, 5989-5261EN

Agilent MXG Signal Generators, Configuration Guide, 5989-5485EN

Agilent MXG and MXG ATE RF Signal Generators, Brochure, 5989-5453EN

Agilent MXA Signal Analyzer N9020A, Data Sheet, 5989-4942EN

Agilent MXA Signal Analyzer N9020A, Configuration Guide, 5989-4943EN

Agilent MXA Signal Analyzer N9020A, Brochure, 5989-5047EN

Web

For more information or to view product literature online, please visit:

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www.agilent.com/find/PXBconfig

www.agilent.com/find/signalstudio

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