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Keysight Technologies
N7109A Multi-Channel Signal-Analyzer

Data Sheet



KEYSIGHT TECHNOLOGIES

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Introduction

Adapt as MIMO Testing Evolves

Overview

In the development of next-generation wireless technologies, MIMO measurements are becoming an essential part of every R&D engineer's toolkit. From 802.11n to LTE-Advanced and beyond, the Keysight Technologies, Inc. N7109A multi-channel signal analyzer provides excellent MIMO RF performance at attractive price points for two-, four- and eight-channel systems.

Product Description

The N7109A combines scalable measurement hardware with the MIMO and multi-channel measurement capabilities of the industry-leading Keysight 89600 VSA software. This combination enables fast, informative measurements on devices ranging from 2x2 to 4x4 to 8x8, including LTE beamforming and a variety of cross-channel characterization measurements.

Applications

- Wireless communications
- Wideband signal analysis

Features

- Frequency range per channel: 20 MHz to 6 GHz
- 40 MHz bandwidth per channel (preselected and independently tunable).
- Up to 8 phase synchronous measurement channels for LTE antenna beamforming, 8x8 MIMO, and a variety of cross-channel measurements—frequency response, cross correlation, coherence, etc.
- Independently tunable measurement channels for LTE-A Carrier Aggregation (both in-band and multiband), simultaneous uplink/down link measurements, and more.
- Correction Wizard provides superb amplitude and phase accuracy at the device-under-test.
- Fully integrates with 89600 VSA software for fastest measurement results.

Customer values

- Provides early insight into multi-channel/MIMO wireless device designs to stay one step ahead of rapidly evolving standards.
- Fastest multi-channel/MIMO measurements minimizes test time and speeds your time-to-results.
- Modular platform is expandable as measurement

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Adapt as MIMO Testing Evolves

Make multi-channel and MIMO measurements from 2x2 to 4x4 to 8x8

The basic measurement configuration is shown in the diagram below. Up to eight vector signal generators provide inputs to the MIMO device-under-test (DUT) and an N7109A with two, four or eight channels measures the outputs. The 89600 VSA software runs on the host PC, providing simultaneous signal acquisition and analysis.

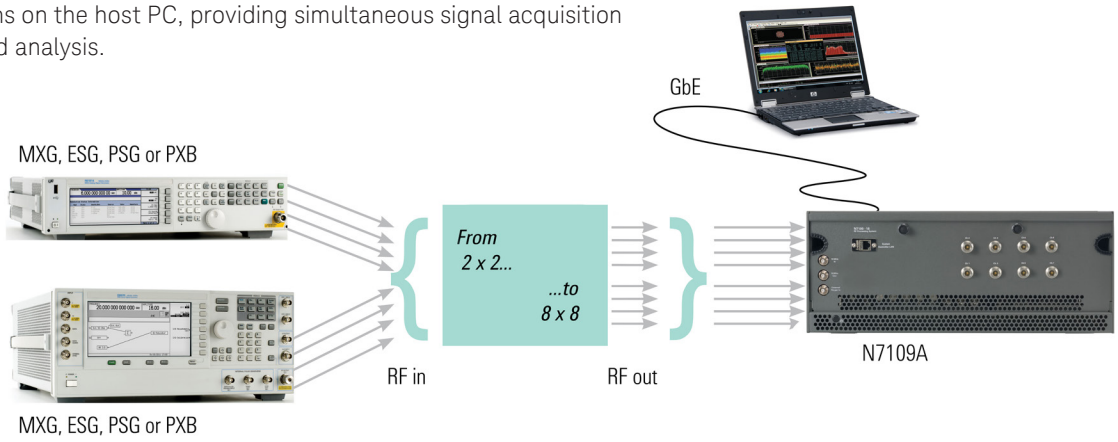


Figure 1. Typical MIMO test setup

Apply advanced signal generation

Our range of vector signal generators provides outstanding signal quality at baseband, RF and microwave frequencies, plus arbitrary waveform playback and sophisticated real-time signal generation. Examples include the N5182B MXG, E4438C ESG and E8267D PSG vector signal generators as well as the N5106A PXB baseband generator and channel emulator. Keysight's Signal Studio and SystemVue applications are useful additions for the creation of Keysight-validated and performance-optimized reference signals. These PC-based software applications enable generation of numerous application-specific test signals at baseband, RF and microwave frequencies. Flexible and easy to use, they cut the time you'll spend on signal simulation.

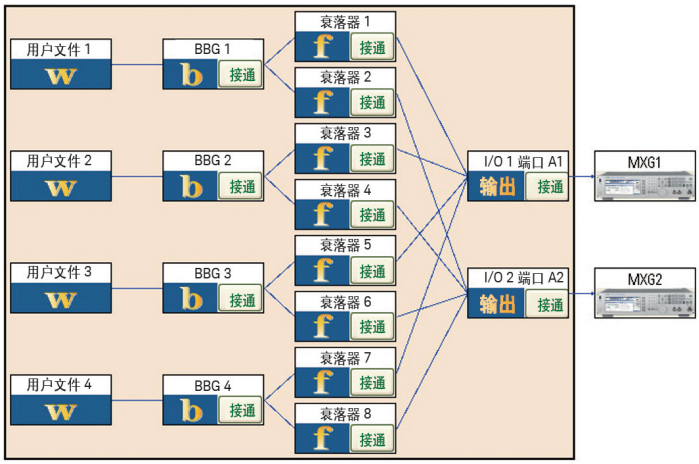


Figure 2. SystemVue signal generation project

Get fast, lexible measurements

The N7109A is a modular, compact measurement platform. You can configure a system with one, two or four N7130A two-channel receiver modules that provide 40 MHz analysis bandwidth from 20 MHz to 6 GHz. Each channel can be independently tuned and includes a built-in preamp and multiple fixed pre-selectors, to optimize off-the-air measurements.

Processing power comes from integrated CPU and FPGA modules. These combine to deliver onboard data reduction, fast measurements and, with the Gigabit Ethernet PC link, rapid data transfers. Even a fully loaded eight channel configuration fits into a 19-inch mainframe that's rack mountable and just 4U high. We also include a front cover that simplifies signal connections, provides additional RF shielding, and ensures proper measurement calibration.

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See Through the Complexity



The 89600 VSA software is a window into what is happening inside complex wireless devices. It is equipped to measure more than 70 signal standards and modulation types, including LTE (FDD/TDD), W-CDMA HSPA+, GSM/ EDGE Evolution, 802.16 OFDMA and ultra-wideband (UWB) MB-OFDM.

The 89600's 20:20 trace/marker capability lets you open new windows into what's happening. Pinpoint problems with arbitrary arrangement and flexible sizing of up to 20 measurement traces at once. Isolate the sources of unexpected signal interactions with up to 20 markers per trace, and activate trace-to-trace coupling of markers. To help you capture and analyze random or transient events, the 89600 also provides multi-domain digital-persistence and cumulative-history displays.

The 89600 VSA software version 16 and later enables multiple independent measurements to be performed simultaneously on each N7109A measurement channel. Since each channel can be independently tuned to different frequencies, you can save test time and cost by using one N7109A to perform a variety of measurements simultaneously.

Keep up with rapidly evolving standards

The N7109A combined with the latest 89600 VSA software releases helps you keep pace with rapidly evolving measurements standards, such as LTE-Advanced. New measurement capabilities included in the 89600 VSA software version 16 and later include:

- Phase synchronous measurements now up to 8-channels for LTE beamforming, 8x8 MIMO, and a variety of crosschannel measurements (frequency response, cross correlation, coherence, etc).
- Independent center frequency tuning for LTE-A Carrier Aggregation (both in-band and multi-band), simultaneous uplink/downlink measurements, and more.
- Correction Wizard to provide superb amplitude and phase accuracy at the device under test.

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Typical Performance Characteristics (20°-30°)

Frequency		
Frequency coverage	20 MHz to 6 GHz	
Center frequency tuning range	40 MHz to 6 GHz	
Vector signal analyzer	1 Hz to 40 MHz (1-8 channels)	
Center frequency resolution	10 mHz	
Frequency accuracy		
Initial accuracy	± 0.04 ppm (typical)	
Initial accuracy	± 0.15 ppm (guaranteed)	
Aging	+ 0.35 ppm after 2 years[1]	
Phase noise		
	3.5GHz	> 3.5GHz
> 10 kHz offset	-97 dBc/Hz	-93 dBc/Hz
> 100 kHz offset	-96 dBc/Hz	-92 dBc/Hz
> 1 MHz offset	-112 dBc/Hz	-112 dBc/Hz
Third-order intercept (TOI, in band)	+6 dBm (-20 dBm range, pre-amp on); +28 dBm (+5 dBm range)	
Amplitude		
Full scale accuracy	± 1.5 dB	
Flatness, VSA mode		
Over full IF	±1.5 dB	
Dynamic range		
Residual responses:	< -90 dBm or -70 dBfs, whichever is larger (except -75 dBm or -25 dBfs on -50 dBm range)	
Sidebands (1 kHz to 1.5 MHz)	< -67 dBc	
Sidebands (1.5 MHz to 20 MHz)	< -58 dBc	
Input-related spurious responses	< -40 dBc	
Cross channel isolation	-70 dB	
Input sensitivity		
Ranges		
≥ -40 dBm	-149 dBm/Hz (5.7 GHz), -147 dBm/Hz (> 5.7 GHz)	
-50 dBm range	-152 dBm/Hz (5.7 GHz), -151 dBm/Hz (> 5.7 GHz)	
Phase Group delay linearity	± 6 ns typical, single-channel variation (half peak-to-peak), CF ± 19 MHz	

1. 15-min stabilization required when switching VSA software between External and Internal Reference.

RF Input	
Input channels	Two, four, or eight (phase coherent and independently tunable)
Full scale range	+10 dBm to -50 dBm in 1-dB attenuator steps
Maximum safe input level	+20 dBm, 50 Vdc
Nominal impedance	50 Ω
Connector	Type-N on front panel cover.
Input coupling	AC
VSWR (0.02 - 6.0 GHz, -20 dBm range)	
20 MHz – 1 GHz	2:1
>1 GHz	3:1
External Reference & Trigger	
External frequency reference input	
Input frequency	10 MHz
Lock range	±50 ppm
Capture range	±10 ppm
Impedance	50 Ω
Connector types	BNC (front)
External frequency reference output	
Output frequency	10 MHz
Output amplitude	6 dBm
Impedance	50 Ω
Connector types	BNC (front)
External trigger input	
Impedance	3 kΩ
Connector types	BNC (front)

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Typical Performance Characteristics (20°-30°)

Cross-Channel Tracking	
Within same 2-ch tuner, or adjacent tuners, with tuners locked together referenced to channel 1.	
Amplitude match	±1.0 dB typical
Group delay match	± 7 nsec typical
	± 14 nsec guaranteed

Time Capture Memory

Time capture memory and record length

132 MSa (64 MSa in 1- or 2-ch mode, 32 MSa in 4- or 8-ch mode)

Recording length

Span/bandwidth	1- or 2-ch mode	4- or 8-ch mode
40 MHz	1.3 s	0.65 s
20 MHz	2.6 s	1.3 s
10 MHz	5.2 s	2.6 s

MIMO

Typical EVM and measurement update speed performance

Using Keysight 89600B VSA software, HP EliteBook 8540p PC w/2.67 GHz i7 CPU, 8 GB RAM, Windows7, 1 Gb LAN.

802.11n 64QAM, 2x2, 20MHz BW @ 2.412 GHz	< -45 dB (0.5%), 0.1 seconds/update
802.16e WiMAX, 2x2, 10 MHz BW @ 2 GHz	< -42 dB (0.8%), 0.2 seconds/update
TD-LTE, 2x2, 5 MHz BW @ 1 GHz	< -44 dB (0.6%), 0.4 seconds/update
TD-LTE, 2x2, 5 MHz BW @ 2 GHz	< -44 dB (0.6%), 0.4 seconds/update
TD-LTE, 2x2, 20 MHz BW @ 1 GHz	< -45 dB (0.5%), 1.8 seconds/update
TD-LTE, 2x2, 20 MHz BW @ 2 GHz	< -44 dB (0.5%), 1.8 seconds/update
TD-LTE, 2x2, 20 MHz BW @ 5.8 GHz	< -42 dB (0.8%), 1.8 seconds/update
LTE, 4x4, 5 MHz BW @ 1 GHz	< -43 dB (0.7%), 1.5 seconds/update
LTE, 4x4, 5 MHz BW @ 2 GHz	< -43 dB (0.7%), 1.5 seconds/update
LTE, 4x4, 20 MHz BW @ 1 GHz	< -42 dB (0.8%), 1.5 seconds/update
LTE, 4x4, 20 MHz BW @ 2 GHz	< -41 dB (0.8%), 1.5 seconds/update

System Environmental Characteristics	
Operating temperature range	+15° C to +45° C
Storage temperature range	-40° C to +70° C
Humidity	Maximum 95% at +40° C, non-condensing
Maximum altitude	3000 meters.
Line input power requirements	100 VAC to 240 VAC nominal (±10%) < 400 W typical (800 W maximum). 50/60/400 Hz nominal (47 Hz to 440 Hz)
Warm-up time	30 minutes
Safety standards	IEC 61010-1:2001 / EN 61010-1:2001 Canada: CAN/CSA-C22.2 No. 61010-1-04 USA: ANSI/UL 61010-1:2004
EMC standards	Tested for Compliance with European EMC Directive 2004/108/EC. IEC 61326-1:2005 / EN 61326-1:2006 CISPR 11, Group 1, Class A ICES/NMB-001 This ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme à la norme NMB-001 du Canada.
Mechanical	
Operating vibration	5 – 500 Hz, 0.21 gRMS random, 0.5 g (0 to peak) swept sine
Non-operating vibration	5 – 500 Hz, 2.10 gRMS random
Transportation shock	30 g, 6.8 m/s, trapezoidal pulse 7.6 in. x 19 in. x 20 in.
Overall dimensions H x W x D (with bottom feet & front panel cover)	19.3 cm x 48.26 cm x 50.8 cm
Weight	Up to 20.7 kg depending on configuration
Chassis Cooling	< 30°C 26 liters/sec (55 CFM) > 30°C up to 60 liters/sec (127 CFM)
Airflow is front to rear, except for rear right-side power supply inlet. Blocking front side inlets limits maximum temperature to 40°C.	

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Definitions for Specifications

Specifications describe the warranted performance of calibrated instruments that have been stored for a minimum of 2 hours within the operating temperature range of +15 °C to +45 °C, unless otherwise stated, and after a 45 minute warm-up period. Data represented in this document are specifications unless otherwise noted.

Characteristics describe product performance that is useful in the application of the product. Characteristics are often referred to as Typical or Nominal values.

- Typical describes characteristic performance, which 80% of instruments will meet when operated over a 20 °C to 30 °C temperature range. Typical performance is not warranted.
- Nominal describes representative performance that is useful in the application of the product when operated over a 20 °C to 30 °C temperature range. Nominal performance is not warranted.

Note: All graphs contain measured data from several units at room temperature unless otherwise noted.

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Ordering and Configuration

Hardware

Model	Description
N7109A	Multi-Channel Signal Analysis System
N7109A-C02	Two-channel system (includes one each)
N7125A	Mainframe
N7130A	6 GHz tuner module
N7140A	CPU module
N7145A	FPGA module
N7109A-C04	Four-channel system (includes one each)
N7125A	Mainframe
N7130A	6 GHz tuner modules (includes 2)
N7140A	CPU module
N7145A	FPGA modules
N7109A-C08	Eight-channel system (includes one each)
N7125A	Mainframe
N7130A	6 GHz tuner modules (includes 4)
N7140A	CPU module
N7145A	FPGA modules (includes 2)
N7109AF-4CH	Factory upgrade from 2-channels to 4-channels (requires system return to Everett, WA)
N7109AF-8CH	Factory upgrade from 4-channels to 8-channels (requires system return to Everett, WA)

Accessories

Software, example programs, and product information on CD (included)	
Y1161A	Rack mount kit (optional ordered separately)

Related Products

Model	Description
N5182A	MXG RF Vector Signal Generator
E4438C	ESG Vector Signal Generator
E8267D	PSG Vector Signal Generator
N5106A	PXB Baseband Generator and Channel Emulator
SystemVue	Keysight SystemVue Software
VSA Software	Keysight 89600 Vector Signal Analysis Software

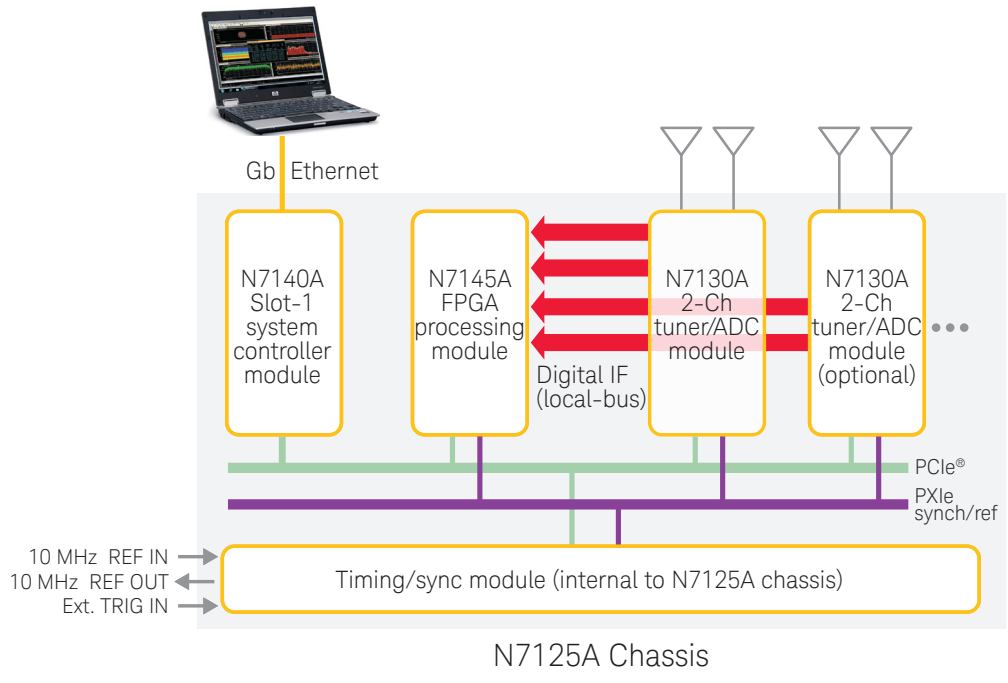


Figure 3. N7109A system architecture.

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PC Requirements

A Windows-based system host PC (required) is not included with the N7109A. Your PC must include the following:

- A Gigabit Ethernet LAN interface for connection to the N7125A mainframe.
- Sufficient processing power, memory, and disc space for the 89600 VSA software. Please refer to the product configuration guide for detailed requirements.

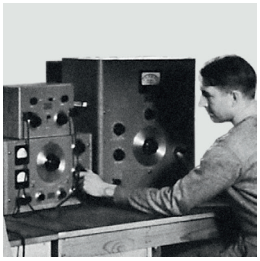


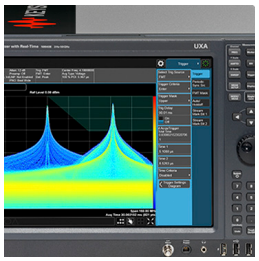
Figure 4. N7109A with PC showing 89600 VSA LTE beam forming measurement.

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