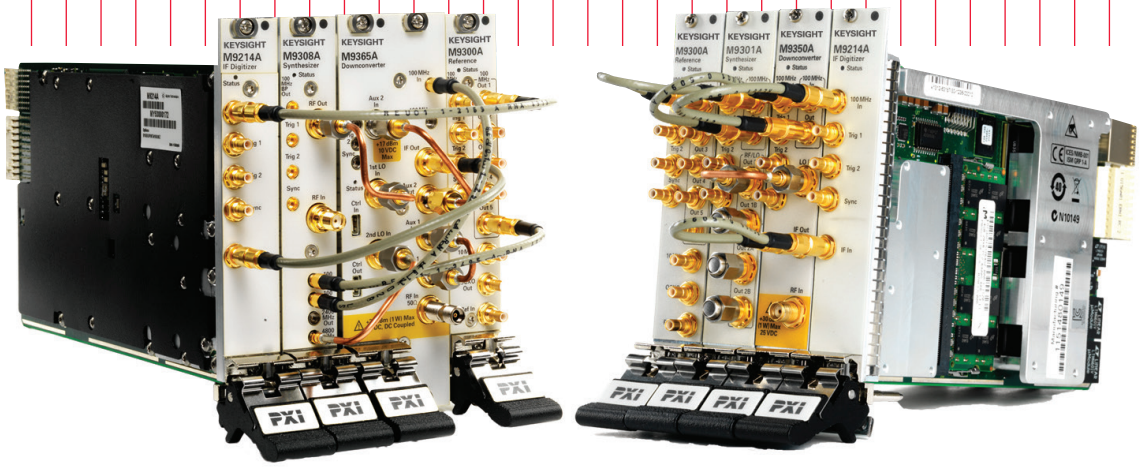
Keysight Technologies
M9073A W-CDMA/HSPA+
X-Series Measurement Application for PXI Vector Signal Analyzers

Technical Overview



KEYSIGHT TECHNOLOGIES

– Perform W-CDMA, HSPA, and HSPA+ downlink and uplink transmitter test per 3GPP standard

– Perform transmitter tests with pass/fail limit per 3GPP standard

– PC-based SCPI remote interface and manual user interface

– Leverage built-in, context-sensitive help with SCPI command reference

– Transportable license supports up to four PXI VSA channels in one mainframe

W-CDMA/HSPA+ X-Series Measurement Application for Modular Instruments

Expand the capabilities of your M9391A and M9393A PXIe vector signal analyzers (PXI VSAs) with the Keysight Technologies, Inc. library of measurement applications – the same applications used to increase the capability and functionality of its X-Series signal analyzers. Eleven of the most popular applications are now available for use with Keysight's new M9393A PXI Performance VSA and the M9391A PXI VSA. When you combine the raw hardware speeds of the PXI VSAs and the X-Series measurement applications for modular instruments, you can test more products in less time while ensuring measurement continuity from design to manufacturing.

The M9073A W-CDMA/HSPA+ X-Series measurement application for modular instruments transforms the PXI VSAs into 3GPP standard-based transmitter testers. The application provides fast, RF conformance measurements to help you speed up manufacturing of your W-CDMA/HSPA/HSPA+ base station and user equipment devices. The measurement application closely follows the 3GPP standard, allowing you to stay on the leading edge of your design and manufacturing challenges.

The W-CDMA/HSPA+ measurement application is one in a common library of several measurement applications in the Keysight X-Series, an evolutionary approach to signal analysis that spans instrumentation, measurements, and software. Proven algorithms, and a common user interface across the X-Series analyzers and modular PXI VSAs create a consistent measurement framework for signal analysis that ensures repeatable results and measurement integrity so you can leverage your test system software through all phases of product development. You can further extend your test assets by utilizing up to four PXI VSAs with one software license.

Keysight's X-Series applications for modular instruments include a unique "Resource Manager" that provides direct access to PXI VSA hardware drivers for the fastest power and spectrum-based measurements, while simul–taneously using the X-Series applications for fast modulation quality measurements and 89600 VSA for fast spectrum measurements.

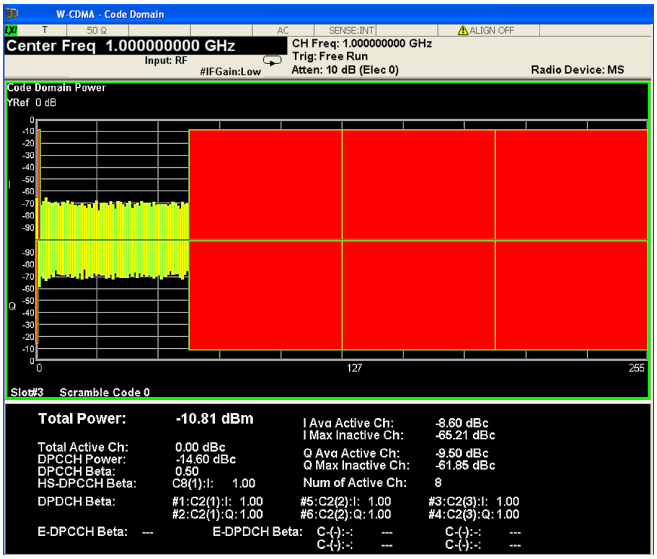


Figure 1. M9073A W-CDMA/HSPA+ X-Series measurement application for modular instruments.

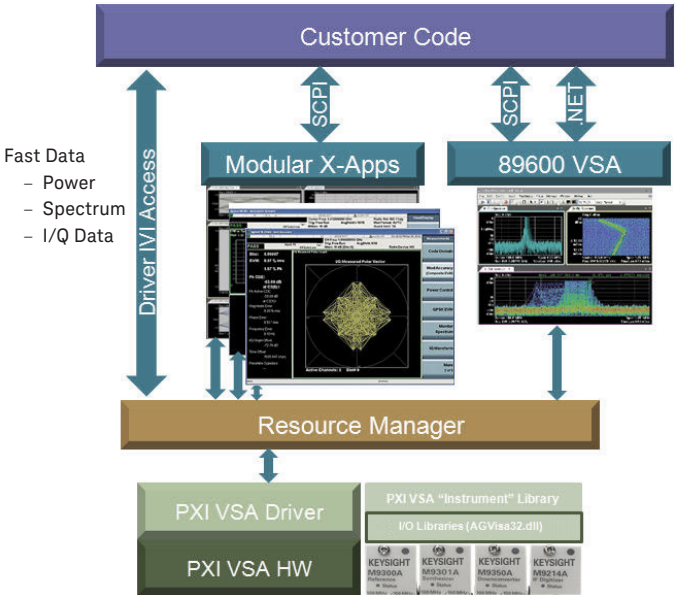


Figure 2. Resource manager included with all X-Series measurement applications for modular instruments.

W-CDMA/HSPA+ Technology Overview

Wideband code-division multiple-access (W-CDMA) is one of the main technologies for the implementation of third-generation (3G) cellular systems. Release 99 of the 3GPP specifications provided the evolutionary path for GSM, GPRS, and EDGE technologies, enabling more spectrally efficient and better performing voice and data services through the introduction of a 5 MHz W-CDMA carrier.

High speed downlink packet access (HSDPA), the first step in the evolution of WCDMA was introduced in Release 5 of the 3GPP standard. HSDPA enhances the WCDMA downlink packet-data performance and capabilities in terms of higher peak data rate, reduced latency, and increased capacity.

High-speed uplink packet access (HSUPA) also known as "enhanced uplink" was introduced in W-CDMA Release 6. It provides improvements in W-CDMA uplink capabilities and performance in terms of much higher data rates in the uplink, reduced latency, and improved system capacity and is therefore a companion technology to HSDPA. Together, HSDPA and HSUPA are commonly referred to as high-speed packet access (HSPA).

HSPA+, also known as "HSPA evolution," was introduced to W-CDMA in Release 7 with significant enhancements in Releases 8, 9 and 10 of the 3GPP standard. 3GPP Release 7 of the standard introduced new major HSPA+ features such as multiple input multiple output (MIMO) for downlink as well as higher order modulation; 64QAM in the downlink and 4PAM (16QAM) in the uplink. However, for downlink, it only allowed operation for either MIMO or the 64QAM. Release 8 of the standard allowed simultaneous operation of 64QAM and MIMO as well as defined dual carrier operation in the downlink (dual cell HSDPA). Release 9 of the standard defined dual carrier operation in the uplink (dual cell HSUPA), dual band HSDPA as well as combination of dual cell HSDPA and MIMO. Release 10 of the standard introduced four carrier HSDPA (quad-cell HSDPA).

Table 1. Key differences in W-CDMA, HSPA and HSPA+ standards.

	W-CDMA		HSPA		HSPA+	
	Downlink	**Uplink**	**HSDPA**	**HSUPA**	**HSPA+ downlink**	**HSPA+ uplink**
3GPP standard	Release 99	Release 99	Release-5	Release-6	Release 7 and beyond	Release 7 and beyond
Modulation	QPSK	BPSK	QPSK, 16QAM	BPSK	QPSK, 16QAM, 64QAM	BPSK, 4PAM (16QAM)
Carrier bandwidth	5 MHz	5 MHz	5 MHz	5 MHz	5 MHz, 10 MHz with dual-cell (Release 8), 20 MHz with four carrier HSDPA (Release 10)	5 MHz, 10 MHz with dual-cell (Release 9)
Data channel	Dedicated (voice/ packet)	Dedicated (voice/ packet)	Shared (packet)	Dedicated (packet)	Shared (packet)	Dedicated (packet)
Peak data rate	384 kbps	384 kbps	14.4 Mbps (16QAM)	5.7 Mbps	– 21.1 Mbps (64QAM) – 42.2 Mbps (64QAM and MIMO) – 84.4 Mbps (64QAM DC-HSDPA and MIMO) – 168.8 Mbps (64QAM QC-HSDPA and MIMO)	– 11.5 Mbps (16QAM) – 23 Mbps (DC-HSUPA)

RF Transmitter Tests

With modular PXI VSAs and the W-CDMA/HSPA+ measurement application you can perform RF transmitter measurements on base station and user equipment devices in time, frequency, and modulation domains. Measure basic W-CDMA signals as well as HSPA (HSDPA/HSUPA) and HSPA+ signals with all channel configurations.

For high-speed manufacturing, a single acquisition combined W-CDMA measurement is available where the speed is up to 20 times faster than traditional one-button measurements (for details refer to Ordering Information).

Standard-based RF transmitter tests

The RF transmitter test requirements for W-CDMA/HSPA/HSPA+ are defined in 3GPP TS 25.141 (BTS) and 3GPP TS34.121 (UE) of the 3GPP standard. Table 2 shows the 3GPP required BTS RF transmitter tests along with the corresponding measurements available in the X-Series and 89600 VSA W-CDMA applications. Table 4 shows similar information for UE transmitter tests.

Table 2. Required base station (BTS) RF transmitter measurements and the corresponding measurements in the M9073A and 89600 VSA.

3GPP TS25.141 subclause	Transmitter test	M9073A X-Series measurement application	89601B Option B7U
6.2.1	Base station maximum output power	Total power[1]	Total power[1]
6.2.2	CPICH power accuracy	CPICH power[1]	CPICH power[1]
6.3	Frequency error	Freq error[1]	Freq error[1]
6.4.1	Inner loop power control	Channel power[2]	IQ meas time[3]
6.4.2	Power control steps	Channel power[2]	IQ meas time[3]
6.4.3	Power control dynamic range	Channel power[2]	IQ meas time[3]
6.4.4	Total power dynamic range	Total power[1]	Total power[1]
6.4.5	IPDL time mask	Chip power vs. time[4]	Composite meas time[4]
6.5.1	Occupied bandwidth	Occupied BW	OBW[5]
6.5.2.1	Spectrum emission mask	Spectrum emission mask	Not available[6]
6.5.2.2	Adjacent channel leakage power ratio	ACP	ACP[5]
6.5.3	Spurious emissions	Spurious emissions	Not available[6]
6.6	Transmit intermodulation	ACP, SEM, spur emissions or spectrum analyzer mode	Not available[6]
6.7.1	Error vector magnitude	EVM[1]	EVM[1]
6.7.2	Peak code domain error	PkCDE[1]	PkCDE[1]
6.7.3	Time alignment error in Tx diversity and MMO transmission	Time offset[7] (under mod accuracy)	Time offset (under error summary or MIMO info trace). Note: 89601B-B7U supports 2x2 MIMO.[7]
6.7.4	Relative code domain error	64QAM RCDE (under mod accuracy)	RCDE for 64QAM (under composite error summary)

1. For M9073A application, these values are found in "Capture Time Summary" view under Mod Accuracy measurement. For 89601B-B7U, these values are found under "Composite Slot Summary" trace.
2. This "channel power" metric is reported under Symbol EVM error summary result under code domain power measurement quad view. "Symbol power" trace under code domain power quad view can also be used for this measurement however RMS slot power is not provided.
3. Measurement parameters must be set up manually. IQ Meas Time with LogMag (dB) format with band marker over each slot length can be used.
4. Measurement parameters must be set up manually. For M9073A application, "chip power vs. time" is one of the traces displayed in the "symbol power" display under code domain quad view. For 89601B-B7U, "composite Meas Time" trace with LogMag (dB) format provides chip power in dB (dBm value not available).
5. Measurement parameters must be set up manually. If 89601B Option B7U is used with a Keysight spectrum or signal analyzer, these measurements are available as part of the spectrum analyzer mode under power suite measurements.
6. If 89601B Option B7U is used with a Keysight spectrum or signal analyzer, these measurements are available as part of the spectrum analyzer mode under power suite measurements.
7. Both the M9073A and 89601B Option B7U can perform the time offset measurement for Tx diversity. In addition, the 89601B Option B7U supports 2x2 MIMO analysis using dual channel hardware such as dual-MXA, dual-EXA, N7109A multi-channel signal analyzer, or Keysight Oscilloscopes.

Measurement details

All of the RF transmitter measurements as defined by the 3GPP standard, as well as a wide range of additional measurements and analysis tools, are available with a press of a button (Table 3 and 5). These measurements are fully remote controllable via the IEC/IEEE bus or LAN, using SCPI commands.

Measurement details for base station transmitter test

Table 3. One-button measurements for base station provided by the M9073A measurement application.

Technology	W-CDMA	HSDPA	HSPA+
Modulation Accuracy			
Rho	●	●	●
RMS EVM	●	●	●
Peak EVM	●	●	●
Pk CDE	●	●	●
Pk active CDE	●	●	●
RMS mag error	●	●	●
RMS phase error	●	●	●
Freq error	●	●	●
I/Q origin offset	●	●	●
Time offset	●	●	●
CPICH power	●	●	●
Total power	●	●	●
64QAM RCDE			●
QPSK EVM	●	●	●
Code domain power	●	●	●
Time alignment error for Tx diversity, and MIMO	●	●	●
Channel power	●	●	●
ACP	●	●	●
Spectrum emission mask (SEM)	●	●	●
Spurious emissions	●	●	●
Occupied bandwidth	●	●	●
CCDF	●	●	●
Monitor spectrum	●	●	●
I/Q waveform	●	●	●

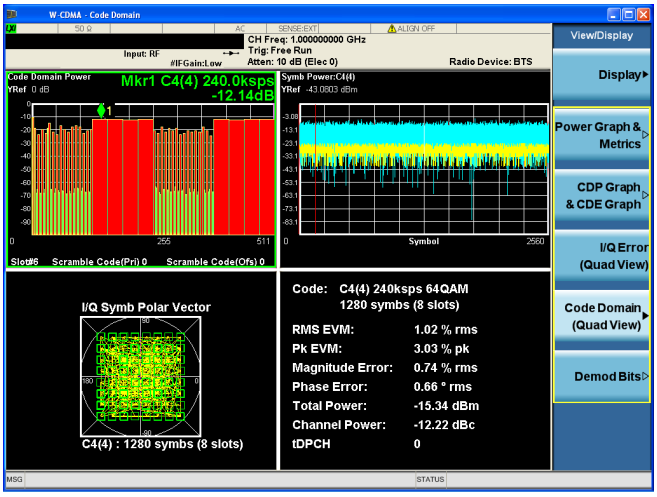


Figure 3. HSPA+ 64QAM code domain power quad view.

Figure 4. W-CDMA capture time summary trace showing error metrics for 15 consecutive slots.

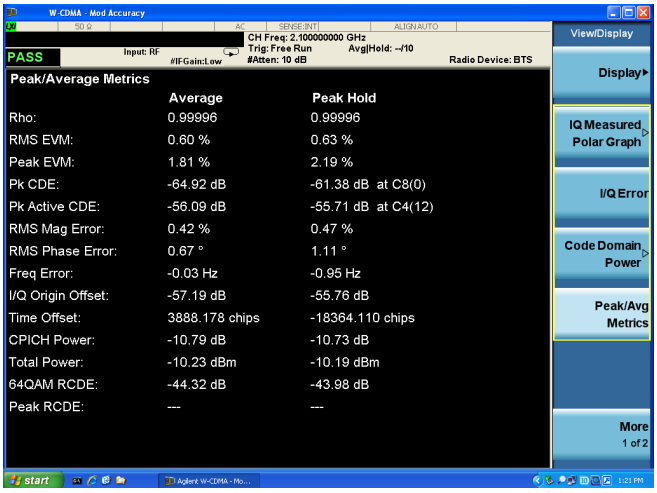


Figure 5. HSPA+ modulation analysis with 64QAM RCDE metrics.

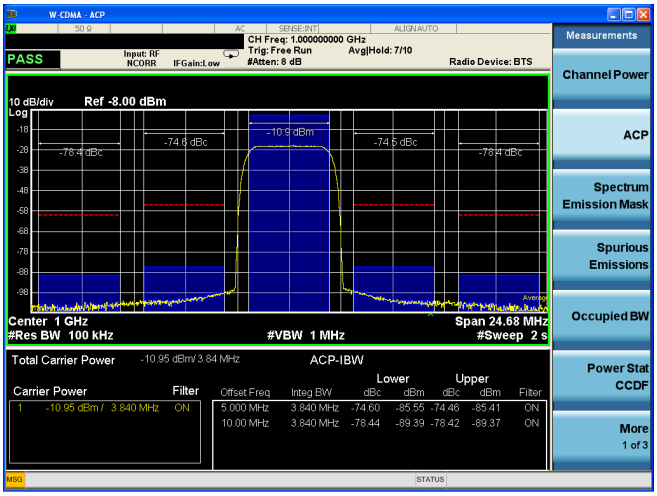


Figure 6. W-CDMA ACLR measurement.

Choosing between X-Series Measurement Applications and 89600 VSA Software

X-Series measurement applications provide format-specific, one-button measurements for X-Series analyzers and modular PXI VSAs. With fast measurement speed, SCPI programmability, pass/fail testing and simplicity of operation, these applications are ideally suited for design verification and manufacturing. The 89600 VSA is the industry-leading measurement software for evaluating and troubleshooting signals for R&D and design validation. Supporting numerous measurement platforms and multiple measurement channels, the 89600 VSA provides flexibility and sophisticated measurements tools essential to find and fix signal problems. Recent enhancements for the modular PXI VSA platforms (89601B-SSA) provide fast spectrum measurements with benchtop analyzer SCPI programming compatibility.

www.keysight.com/find/89600B

Table 4. Required user equipment (UE) RF transmitter measurements and the corresponding measurements in M9073A and 89600 VSA.

3GPP TS34.121 subclause	Transmitter test	M9073A X-Series measurement application	89601B Option B7U
5.2	Maximum output power	Total power[1]	Total power[1]
5.2A, 5.2AA	Maximum output power with HS-DPCCH	Total power[1]	Total power[1]
5.2B	Maximum output power with HS-DPCCH and E-DCH	Total power[1]	Total power[1]
5.2C	UE Relative code domain power accuracy	Not available[2]	Not available[2]
5.2D	UE Relative code domain power accuracy for HS-DPCCH and E-DCH	Not available[2]	Not available[2]
5.2E	UE Relative code domain power accuracy for HS-DPCCH and E-DCH with 16QAM	Not available[2]	Not available[2]
5.3	Frequency error	Freq error[1]	Freq error[1]
5.4.1	Open loop power control in the uplink	Power control (Meas type = PRACH power)	Not available
5.4.2	Inner loop power control in the uplink	Power control (Meas type = slot power)	IQ Meas Time[3]
5.4.3	Minimum output power	Channel power	Channel power using band power marker
5.4.4	Out-of-synchronization handling of output power	Manual configuration using symbol power vs. time or I/Q waveform (time domain) trace	Not available
5.5.1	Transmit off power	Power control (Meas type = slot power and I/Q waveform with RRC filtered)	Not available
5.5.2	Transmit on/off time mask	Power control (Meas type = PRACH power)	Manual configuration using "Time" trace with trigger and band power marker
5.6	Change of TFC	Power control (Meas type = slot power)	IQ meas time[3]
5.7	Power setting in uplink compressed mode	Power control (Meas type = slot power)	IQ meas time[3]
5.7A	HS-DPCCH power control	Power control (Meas type = slot phase) with meas interval = 0.5 slot	IQ meas time with "LogMag (dB)" with band marker over each half-slot length.
5.8	Occupied bandwidth	Occupied bandwidth	OBW[4]
5.9	Spectrum emission mask	Spectrum emission mask	Not available[5]
5.9A	Spectrum emission mask with HS-DPCCH	Spectrum emission mask	Not available[5]
5.9B	Spectrum emission mask with E-DCH	Spectrum emission mask	Not available[5]
5.10	Adjacent channel leakage power ratio	ACP	ACP[4]
5.10A	Adjacent channel leakage power ration with HS-DPCCH	ACP	ACP[4]
5.10B	Adjacent channel leakage power ratio with E-DCH	ACP	ACP[4]
5.11	Spurious emissions	Spurious emissions	Not available[5]
5.12	Transmit intermodulation	ACP	ACP[4]
5.13.1	Error vector magnitude	EVM[1]	EVM[1]

1. For M9073A application, these values are found in "Capture Time Summary" table under Mod Accuracy measurement. For 89601B-B7U, these values are found under "Composite Slot Summary" trace.
2. This measurement is not supported. One possible way is to make code domain power measurement and subtract the result from the expected code domain power value.
3. Measurement parameters must be set up manually. IQ Meas Time trace with LogMag(dB) format and band power marker over each slot length.
4. Measurement parameters must be set up manually. If 89601B Option B7U is used with a Keysight spectrum or signal analyzer, these measurements are available as part of the spectrum analyzer mode under PowerSuite measurements.
5. If 89601B Option B7U is used with a Keysight spectrum or signal analyzer, these measurements are available as part of the spectrum analyzer mode under power suite measurements.

Table 4. (continued)

3GPP TS34.121 Paragraph #	Transmitter test	M9073A X-Series measurement application	89601B Option B7U
5.13.1A	Error vector magnitude with HS-DPCCH	Power control (meas type = slot phase) with meas interval = 0.5 slot	EVM (over half-slot length)
5.13.1AA	Error vector magnitude and phase discontinuity with HS-DPCCH	Power control (meas type = slot phase) with meas interval = 0.5 slot	Not available
5.13.1AAA	EVM and IQ origin offset for HS-DPCCH and E-DCH with 16QAM	Mod accuracy	Error summary trace
5.13.2	Peak code domain error	PkCDE [1]	PkCDE [1]
5.13.2A	Relative code domain error with HS-DPCCH	RCDE in mod accuracy	RCDE in code domain offsets
5.13.2B	Relative code domain error with HS-DPCCH and E-DCH	RCDE in mod accuracy	RCDE in code domain offsets
5.13.2C	Relative code domain error with HS-DPCCH and E-DCH with 16QAM	RCDE in mod accuracy	RCDE in code domain offsets
5.13.3	UE phase discontinuity	Power control (meas type = slot phase)	Not available
5.13.4	PRACH preamble quality	QPSK EVM	QPSK EVM (using Option AYA)

1. For M9073A application, these values are found in "Capture Time Summary" table under Mod Accuracy measurement. For 89601B-B7U, these values are found under "Composite Slot Summary" trace.

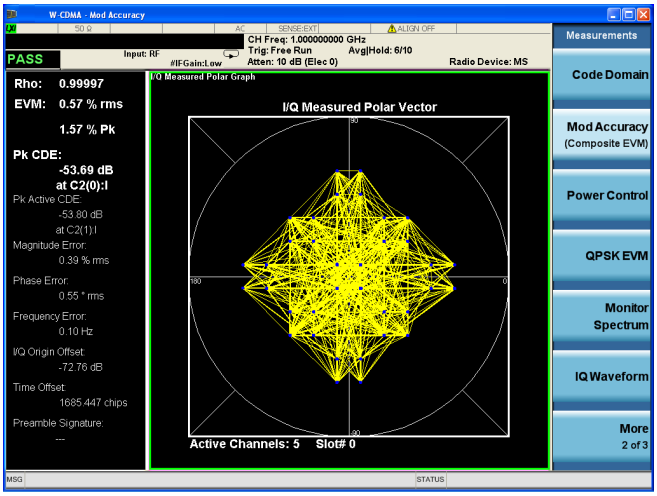


Figure 7. W-CDMA uplink EVM measurement.

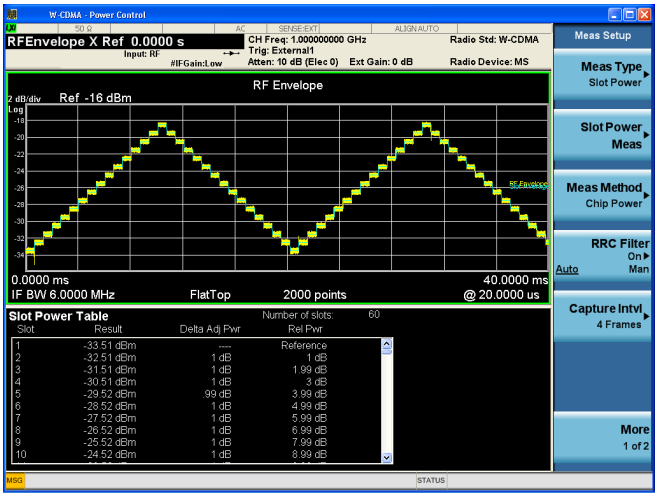


Figure 8. W-CDMA UL power control measurement.

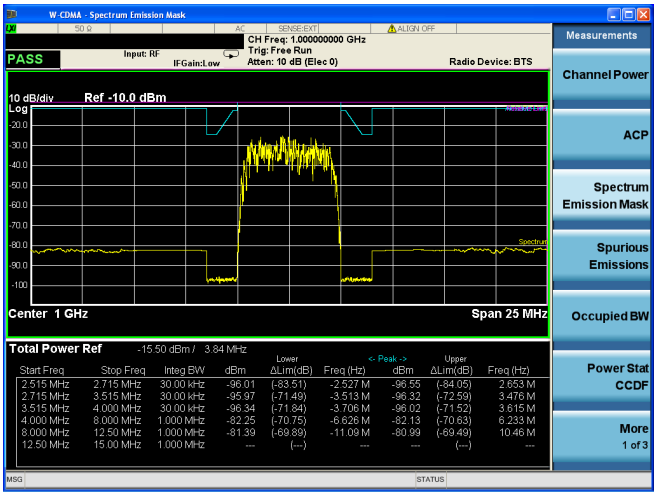


Figure 9. W-CDMA spectrum emissions mask measurement.

Figure 10. HSUPA capture time summary trace showing error metrics for 15 consecutive slots.

Measurement details for user equipment transmitter test

Table 5. One-button measurements for user equipment provided by the M9073A measurement application.

Technology	W-CDMA	HSUPA	HSPA+
Modulation accuracy			
Rho	●	●	●
RMS EVM	●	●	●
Peak EVM	●	●	●
Pk CDE	●	●	●
Pk active CDE	●	●	●
RMS mag error	●	●	●
RMS phase error	●	●	●
Freq error	●	●	●
I/Q origin offset	●	●	●
Time offset	●	●	●
Total power	●	●	●
Peak RCDE	●	●	●
QPSK EVM	●	●	●
Code domain power	●	●	●
Power control	●	●	●
PRACH power	●	●	●
Slot power	●	●	●
Slot phase	●	●	●
Channel power	●	●	●
ACP	●	●	●
Spectrum emission mask (SEM)	●	●	●
Spurious emissions	●	●	●
Occupied bandwidth	●	●	●
CCDF	●	●	●
Monitor spectrum	●	●	●
I/Q waveform	●	●	●

Key Specifications

Definitions

– Specifications describe the performance of parameters covered by the product warranty.

– 95th percentile values indicate the breadth of the population (≈2σ) of performance tolerances expected to be met in 95% of cases with a 95% confidence. These values are not covered by the product warranty.

– Typical values are designated with the abbreviation "typ." These are performance beyond specification that 80% of the units exhibit with a 95% confidence. These values are not covered by the product warranty.

– Nominal values are designated with the abbreviation "nom." These values indicate expected performance, or describe product performance that is useful in the application of the product, but is not covered by the product warranty.

Note: Data subject to change

Performance Specifications

Modulation Accuracy (composite EVM)	**Nominal**
WCDMA EVM (2.0 GHz)	*0.55%*
Adjacent Channel Power	
WCDMA (2.0 GHz), Adjacent Channel	*–70.5 dB*
WCDMA (2.0 GHz), Alternate Channel	*–71.7 dB*

For a more complete list of specifications, please refer to the M9391A datasheet at literature number 5991-2603EN.

Try before you buy!

Free 30-day trials of X-Series measurement applications provide unrestricted use of each application's features and functionality on your modular PXI VSA.

See www.keysight.com/find/M90XA for more information.

You can upgrade!

Options can be added after your initial purchase.

All of our X-Series applications options are license-key upgradeable.

Ordering Information

Software licensing and configuration

Transportable, perpetual license:
This allows you to run the application using an embedded PXI PC controller or external PC, plus it may be transferred from one controller or PC to another. One software license supports up to four modular PXI VSA channels in one PXI mainframe.

The table below contains information on our transportable perpetual licenses. For more information, please visit the product web pages.

M9073A W-CDMA/HSPA+ measurement application

Model-option	Description	Notes
M9073A-1TP	W-CDMA measurement application, transportable perpetual license	
M9073A-2TP	HSPA measurement application, transportable perpetual license	Requires 1TP
M9073A-3TP	HSPA+ measurement application, transportable perpetual license	Requires 1TP and 2TP
M9073A-XTP	Single acquisition combined W-CDMA measurement application, transportable perpetual license	Requires 1TP
M9071A-MEU	Minor enhancement update, transportable license	Provides latest updates to previous software versions

Single acquisition combined measurements

The M9073A-XTP single acquisition combined W-CDMA measurement application is for high-speed manufacturing of W-CDMA mobile phone transmitters, wireless components, such as power amplifiers, and low-cost pico/femtocell base stations. Used with the PXI VSAs it provides up to 20 times speed improvement compared to traditional one-button measurements for a combined W-CDMA ACP, modulation quality (Rho) and QPSK EVM. Note that the M9073A-XTP does not provide the N9073A-XTP's List Power Step measurement feature. Instead you can get better performance using the M9391A or M9393A PXI VSA hardware driver's List Power feature.

Hardware configuration

M9391A PXI VSA

Description	Model-Option	Additional information
M9391A-F03 or -F06	3 GHz or 6 GHz frequency range	One required
M9391A-B04 or -B10 or -B16	40 MHz, 100 MHz or 160 MHz analysis bandwidth	One required. B16 recommended for fast spectrum measurements with 89600 VSA software – option SSA.
M9391A-300	PXIe frequency reference	Recommended
M9391A-UNZ	Fast tuning	Recommended. Highly recommended for fastest spectrum measurements with 89600 VSA software – option SSA
M9391A-M01 or -M05 or -M10	Memory options (512MB, 2GB, or 4GB)	Recommend 1Gsa/4GB memory

Hardware configuration (continued)

M9393A PXI Performance VSA

Description	Model-Option	Additional information
M9393A-F08, -F14, -F18 or -F27	8 GHz, 14 GHz, 18 GHz or 27 GHz frequency range	One required
M9393A-B04 or -B10 or -B16	40 MHz, 100 MHz or 160 MHz analysis bandwidth	One required. B16 recommended for fast spectrum measurements with 89600 VSA software – option SSA.
M9393A-300	PXIe frequency reference	Recommended
M9393A-UNZ	Fast tuning	Recommended. Highly recommended for fastest spectrum measurements with 89600 VSA software – option SSA
M9393A-M01 or -M05 or -M10	Memory options (512MB, 2GB, or 4GB)	Recommend 1Gsa/4GB memory

Related Literature

N9073A & W9073A W-CDMA/HSPA/HSPA+ Self-Guided Demonstration, Literature Number 5990-5926EN

N9073A & W9073A W-CDMA/HSPA/HSPA+ Measurement Application, Measurement Guide, Part Number N9073-90017

Designing and Testing 3GPP W-CDMA Base Transceiver Stations (Including Femtocells), Application Note 1355, Literature Number 5980-1239E

Designing and Testing 3GPP W-CDMA User Equipment, Application Note 1356, Literature Number 5980-1238E

Concepts of High Speed Downlink Packet Access: Bringing Increased Throughput and Efficiency to W-CDMA, Application Note, Literature Number 5989-2365EN

User's and Programmer's Reference Guide is available in the library section of the N9073A and W9073A product pages.

M9391A PXIe Vector Signal Analyzer, Datasheet, literature number 5991-2603EN

M9391A & M9381A PXIe Vector Signal Analyzer & Generator, Configuration Guide, literature number 5991-0897EN

X-Series Measurement Applications for Modular Instruments, Brochure, literature number 5991-2604EN

Web

Product pages:
www.keysight.com/find/M9073A

X-Series measurement applications for modular instruments:
www.keysight.com/find/M90XA

M9391A PXIe vector signal analyzer:
www.keysight.com/find/M9391A

M9393A PXIe performance vector signal analyzer:
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X-Series signal analyzers:
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Application pages:
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