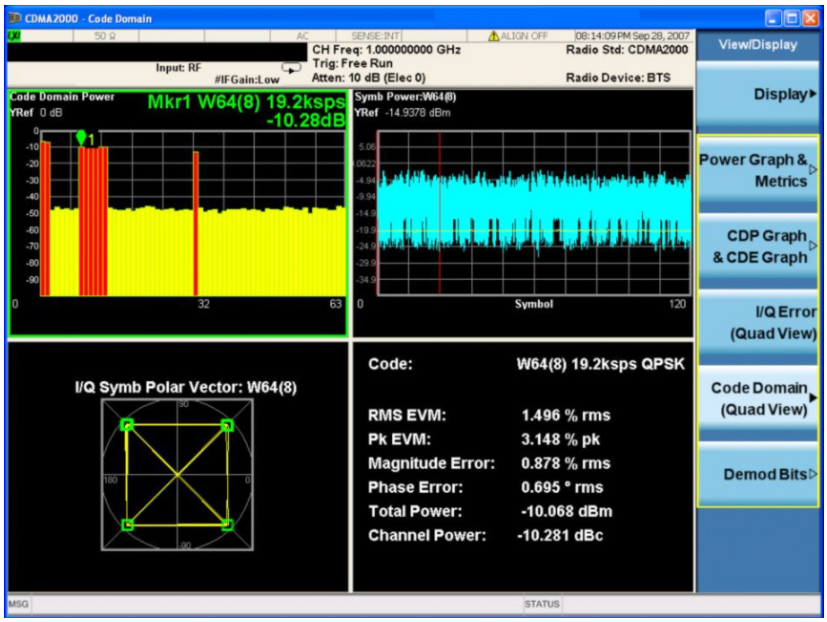
Keysight cdma2000®
X-Series Measurement App, Traditional UI
N9072EM0D

Technical Overview



- Perform IS-95 or cdmaOne and cdma2000® forward link and reverse link RF transmitter measurements per 3GPP2 specifications
- Perform one-button tests with pass/fail limit per 3GPP2 standard
- Use hardkey/softkey manual user interface or SCPI remote user interface
- Use hardkey/softkey manual user interface or SCPI remote user interface
- Leverage built-in context sensitive help
- Flexible licensing provides the option of using perpetual or time based licenses with one or multiple signal analyzers

KEYSIGHT TECHNOLOGIES

cdma2000 Measurement Application

The cdma2000 measurement application transforms the X-Series signal analyzers into CDMA standard-based transmitter testers. The application provides fast one-button RF conformance measurements to help you design, evaluate, and manufacture your IS-95 or cdmaOne and cdma2000 devices.

X-Series measurement applications can help you:

- Gain more insight into device performance with intuitive display and graphs for your application. Select from our library of over 25 different measurement applications.
- Ensure that your design meets the latest standard. Updates are made to the X-Series measurement applications as standards evolve.
- Apply the same measurement science across multiple hardware platforms for consistent measurement results over your design cycle from R&D to production.
- Choose the license structure that meets your business needs. We provide a range of license types (node-locked, transportable, floating or USB portable) and license terms (perpetual or time-based).

cdma2000 Technology Overview

cdma2000 is one of the wireless transmission format technologies that meets the IMT-2000 requirements for a Third Generation (3G) global wireless communications system. It uses direct sequence modulation with digital codes to spread its spectrum. cdma2000, also known as IMT–CDMA Multi-Carrier or 1xRTT (Single-Carrier Radio Transmission Technology), is derived from IS-95. The IS-95A revision was first published in May 1993 as a solution for voice communication. The IS-95B revision standard can support a data rate of up to 115 kbps by bundling up to eight channels. The IS-95A and IS-95B are combined into the cdmaOne family.

cdma2000 1x (IS-2000) incorporates a number of improvements that result in roughly twice the spectral efficiency of IS-95. It supports circuit-switched voice communications as well as a packet data rate up to 307 kbps in a single 1.25 MHz channel for low-speed mobility, and up to 2 Mbps for fixed installations.

Key differences of IS-95 or cdmaOne and cdma2000 are summarized in Table 1.

Table 1. Differences in 1x EV-DO Rel. 0, Rev. A and Rev. B standards

	IS-95/cdmaOne		cdma2000	
	Forward link	**Reverse link**	**Forward link**	**Reverse link**
Modulation	BPSK	BPSK	QPSK	HPSK
Chip rate	1.2288 Mcps	1.2288 Mcps	1.2288 Mcps (SR1) 3.6864 Mcps (SR3)	1.2288 Mcps (SR1) 3.6864 Mcps (SR3)
Data rate	1.2 kbps 2.4 kbps 4.8 kbps 9.6 kbps	1.8 kbps 3.6 kbps 7.2 kbps 14.4 kbps	– RC1: 9.6, 4.8, 2.4, and 1.2 kbps – RC2: 14.4, 7.2, 3.6 and 1.8 kbps – RC3 is based on 9,600 bps and goes up to 153,600 bps – RC4 is based on 9,600 bps and goes up to 307,200 bps Note: RC = Radio Configuration. RC1 to 5 are for SR1 RC6 to 9 are defined for SR3 but not list in this table	– RC1 is based on 9,600 bps traffic – RC2 is based on 14,400 bps traffic – RC3 is based on 9,600 bps and goes up to 307,200 bps – RC4 is based on 14,400 bps and goes up to 230,400 bps Note: RC1 to 4 are for SR1 RC5 to 6 are defined for SR3 but not list in this table
Pilot channel	Yes	No	Yes	Yes

cdma2000 Transmitter Tests

With the X-Series signal analyzers and the cdma2000 measurement application, you can perform RF transmitter measurements on base station and user equipment devices in time, frequency and modulation domains. Measure basic IS-95 or cdmaOne signals as well as cdma2000 signals with all radio configurations in SR1.

Standard-based RF transmitter tests

The latest RF transmitter test requirements for cdma2000 are defined in 3GPP2 C.S0010-D(BTS) and 3GPP2 C.S0011-C (MS) of the 3GPP2 standard. Table 2 shows the 3GPP2 required BTS RF transmitter tests along with the corresponding measurements available in the X-Series and 89600 VSA software cdma2000 applications.

Table 2. Required base station (BTS) RF transmitter measurements and the corresponding measurements in N9072EM0D and 89600 VSA software

3GPP2 C.S0010 Paragraph #	Transmitter test	N9072EM0D cdma2000 X-Series measurement application	89601B-B7N 3G modulation analysis (includes cdma2000, W-CDMA, 1x-EVDO and TD-SCDMA)
4.1.2	Frequency tolerance	Frequency error[1]	Freq error[1]
4.2.1.1	Pilot time tolerance	Time offset[1]	T trigger[1]
4.2.1.2	Pilot channel to code channel time tolerance	Timing[2]	Timing[2]
4.2.1.3	Pilot channel to code channel phase tolerance	Phase[2]	Phase[2]
4.2.2	Waveform quality	EVM/Rho[1]	EVM/Rho[1]
4.3.1	Total power	Total power[3]	Can be performed using band power marker
4.3.2	Pilot power	Pilot Ch[3]	CDP composite
4.3.3	Code domain power	Code domain power[4]	Power[2]
4.3.4	Femto cell transmission authorization	Channel power	Can be performed using band power marker
4.4.1	Conducted spurious emissions	ACP and spectrum emission mask	ACP can be performed using marker function; SEM is not available
4.4.2	Radiated spurious emissions	Spurious emissions	Not available[5]
4.4.3	Inter-base station transmitter intermodulation	Channel power, ACP, SEM, spur emissions or spectrum analyzer mode	Not available[5]
4.4.4	Occupied bandwidth	Occupied BW	Can be performed using marker function

1. For N9072EM0D application, these values are found in “IQ Measured Polar Graph” view under Mod Accuracy (Composite Rho) measurement. For 89601B-B7N, these values are found under “Composite Error Summary” trace.
2. For N9072EM0D application, these values are found in “Power Timing & Phase” view under Mod Accuracy (Composite Rho) measurement. For 89601B-B7N, these values are found under “Code Domain Offsets” trace.
3. For N9072EM0D application, these values are found in “Power Graph & Metrics” view under Code Domain measurement. For 89601B-B7N, these values are found under “Composite Slot Summary” trace.
4. For N9072EM0D application, these values are found in “Code Domain (Quad View)” view under Code Domain measurement. For 89601B-B7N, these values are found under “Composite Slot Summary” trace.
5. If 89601B-B7N is used with a Keysight spectrum or signal analyzer, these measurements are available as part of the spectrum analyzer mode under PowerSuite measurements.

Measurement details

All of the RF transmitter measurements as defined by the 3GPP2 standard, as well as a wide range of additional measurements and analysis tools, are available with a press of a button (Table 3). These measurements are fully-remote controllable via the IEC/IEEE bus, GPIB or LAN, using SCPI commands.

Analog baseband measurements are available on the PXA or MXA signal analyzer with BBIQ hardware. Supported baseband measurements include all of the modulation quality pus I/Q waveform measurements.

Table 3. List of one-button measurements provided by N9072EM0D measurement application

Technology	**IS-95/cdmaOne**		**cdma2000**	
X-Series signal analyzer	**PXA, MXA, EXA, PXIe VXT, PXIe VSA**	**CXA**	**PXA, MXA, EXA, PXIe VXT, PXIe VSA**	**CXA**
Channel power	●	●	●	●
ACP	●	●	●	●
Spectrum emission mask	●	●	●	●
Spurious emissions	●	●	●	●
Occupied bandwidth	●	●	●	●
Code domain	●	●	●	●
Modulation Accuracy				
Rho	●	●	●	●
EVM	●	●	●	●
Peak CDE	●	●	●	●
Magnitude Error	●	●	●	●
Phase Error	●	●	●	●
Frequency Error	●	●	●	●
I/Q Origin Offset	●	●	●	●
Active Channels	●	●	●	●
Pilot Offset	●	●	●	●
Power Stat CCDF	●	●	●	●
QPSK EVM	●	●	●	●
Monitor spectrum	●	●	●	●
I/Q waveform	●	●	●	●

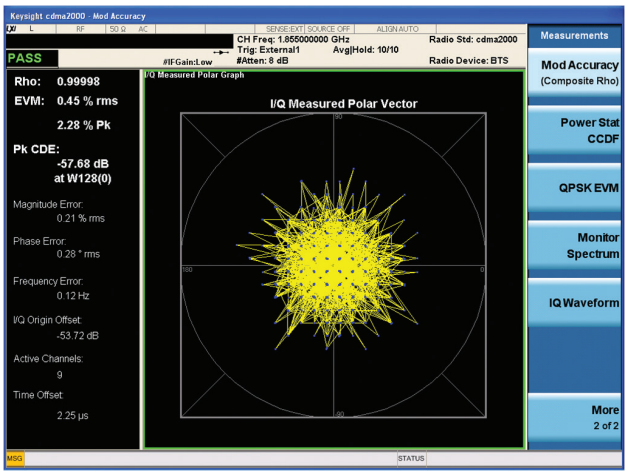


Figure 1. Modulation accuracy with cdma2000 forward 9 channels signal

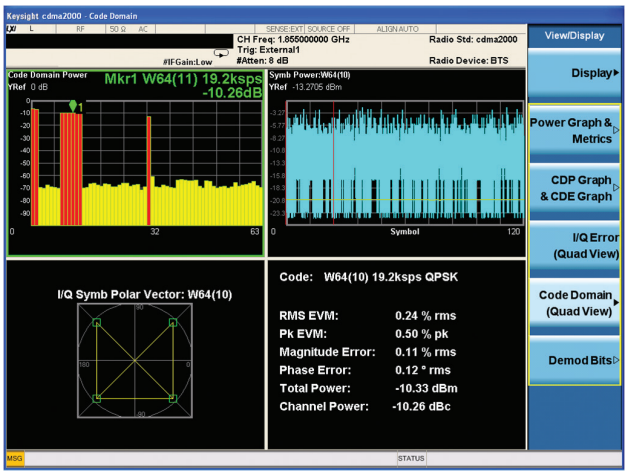


Figure 2. Code Domain Power quad view

Figure 3. Power, Timing, Phase and CDE by each Walsh code

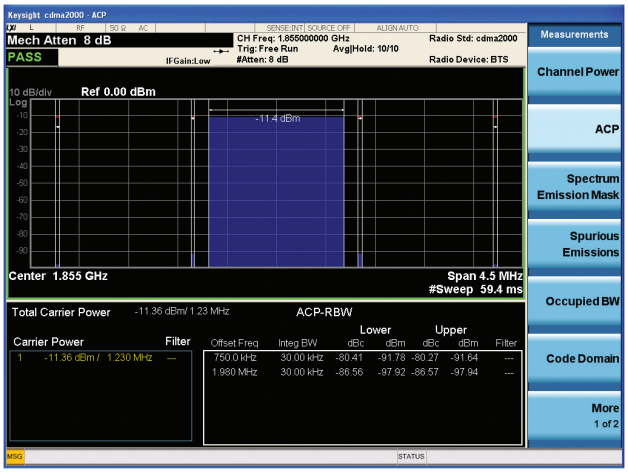


Figure 4. cdma2000 ACP measurement

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.
- PXA specifications apply to analyzers with frequency options of 526 and lower. For analyzers with higher frequency options, specifications are not warranted but performance will nominally be close to that shown in this section.

Note: Data subject to change

Supported devices and radio bands

Device type	BTS, MS
Standard version	Mobile station: 3GPP2 C.S0011-C Base station: 3GPP2 C.S0010-D

Performance Specifications

Description	PXA	MXA	EXA	CXA
Channel power				
Minimum power at RF input	–50 dBm (nom)			
Absolute power accuracy	± 0.61 dB ± 0.19 dB (95th percentile)	± 0.82 dB ± 0.23 dB (95th percentile)	± 0.94 dB ± 0.27 dB (95th percentile)	± 1.33 dB ± 0.61 dB (95th percentile)
Measurement floor	–90.8 dBm (nom)	–88.8 dBm (nom)	–84.0 dBm (nom)	–83.8 dBm (nom)
Adjacent channel power				
Minimum power at RF input	–36 dBm (nom)			
Dynamic range (reference to average power of carrier in 1.23 MHz bandwidth)				
Offset frequency/integrated bandwidth				
750 kHz/30 kHz	–85.9 dBc –89.5 dBc (typ)	–78.6 dBc –85.1 dBc (typ)	–73.6 dBc –81.0 dBc (typ)	–67.4 dBc –72.7 dBc (typ)
1980 kHz/30 kHz	–87.6 dBc –90.6 dBc (typ)	–83.1 dBc –87.9 dBc (typ)	–78.3 dBc –83.9 dBc (typ)	–75.6 dBc –79.6 dBc (typ)
ACPR relative accuracy				
Offsets < 750 kHz	± 0.04 dB	± 0.09 dB	± 0.09 dB	± 0.09 dB
Offsets > 1.98 MHz	± 0.04 dB	± 0.10 dB	± 0.10 dB	± 0.10 dB
Spectrum emission mask				
Dynamic range (relative)				
750 kHz (30 kHz RBW)	85.9 dBc 89.5 dBc (typ)	78.6 dBc 85.1 dBc (typ)	73.6 dBc 81.0 dBc (typ)	67.4 dBc 72.7 dBc (typ)
Sensitivity, absolute				
750 kHz (30 kHz RBW)	–103.7 dBc –106.7 dBc (typ)	–99.7 dBc –104.7 dBc (typ)	–94.7 dBc –100.7 dBc (typ)	–93.7 dBc –99.7 dBc (typ)
Accuracy, relative				
750 kHz (30 kHz RBW)	± 0.04 dB	± 0.09 dB	± 0.09 dB	± 0.09 dB
Spurious emission				
Dynamic range, relative (RBW=1 MHz)	88.8 dB 92.1 dB (typ)	81.3 dB 82.8 dB (typ)	76.9 dB 77.4 dB (typ)	71.7 dB 76.6 dB (typ)
Sensitivity, absolute (RBW=1 MHz)	–88.5 dBm –91.5 dBm (typ)	–84.5 dBm –89.5 dBm (typ)	–82.5 dBm –86.5 dBm (typ)	–78.4 dBm –84.4 dBm (typ)
Accuracy (attenuation = 10 dB)				
20 Hz to 3.6 GHz (100 kHz to 3.0 GHz for CXA)	± 0.19 dB (95th percentile)	± 0.29 dB (95th percentile)	± 0.38 dB (95th percentile)	± 0.81 dB (95th percentile)
3.5 GHz to 8.4 GHz (3.0 GHz to 7.5 GHz for CXA)	± 1.08 dB (95th percentile)	± 1.17 dB (95th percentile)	± 1.22 dB (95th percentile)	± 1.80 dB (95th percentile)
8.3 GHz to 13.6 GHz	± 1.48 dB (95th percentile)	± 1.54 dB (95th percentile)	± 1.59 dB (95th percentile)	NA
Occupied bandwidth				
Minimum power at RF input	–30 dBm (nom)			
Frequency accuracy	± 2 kHz (nom) (RBW = 30 kHz, Number of points = 1001, Span = 2 MHz)			

Performance Specifications (continued)

Description	PXA	MXA	EXA	CXA
Code domain (–25 dBm ≤ ML ≤ –15 dBm, 20 to 30 °C)				
Code domain power				
Relative accuracy				
Code domain power range				
0 to –10 dBc			± 0.015 dB	
–10 to –30 dBc			± 0.06 dB	
–30 to –40 dBc			± 0.07 dB	
Symbol power vs. time				
Relative accuracy				
Code domain power range				
0 to –10 dBc			± 0.015 dB	
–10 to –30 dBc			± 0.06 dB	
–30 to –40 dBc			± 0.07 dB	
Symbol error vector magnitude				
Accuracy				
0 to –25 dBc			± 1.0% (nom)	
Modulation accuracy (Composite EVM) (–25 dBm ≤ ML ≤ –15 dBm, 20 to 30 °C)				
Accuracy				
Composite EVM (for 12.5% < EVM < 22.5%)	± 0.5%	± 0.5%	± 0.5%	± 0.5%
Composite Rho (at Rho 0.99751 (EVM 5%))	± 0.0010	± 0.0010	± 0.0010	± 0.0010
Pilot time offset	± 300 ns	±300 ns	± 300 ns	± 300 ns
Code domain timing	± 1.25 ns	± 1.25 ns	± 1.25 ns	± 1.25 ns
Code domain phase	± 10 mrad	± 10 mrad	± 10 mrad	± 10 mrad
Peak code domain error	± 1.0 dB (nom)	± 1.0 dB (nom)	± 1.0 dB (nom)	± 1.0 dB (nom)
Frequency error	± 10 Hz + tfa	± 10 Hz + tfa	± 10 Hz + tfa	± 10 Hz + tfa
Power statistics CCDF				
Histogram resolution			0.01 dB	
QPSK EVM (–25 dBm ≤ ML ≤ –15 dBm, 20 to 30 °C)				
EVM range	0 to 25%	0 to 25%	0 to 25%	0 to 25%
EVM accuracy	± 1.0%	± 1.0%	± 1.0%	± 1.0%
Frequency error accuracy	± 5 Hz + tfa	± 5 Hz + tfa	± 5 Hz + tfa	± 5 Hz + tfa

For a complete list of specifications refer to the appropriate specifications guide.

Benchtop:
PXA: **www.keysight.com/find/pxa_specifications**
MXA: **www.keysight.com/find/mxa_specifications**
EXA: **www.keysight.com/find/exa_specifications**
CXA: **www.keysight.com/find/cxa_specifications**

PXIe:
VSA up to 6 GHz: **www.keysight.com/find/m9391a**
VSA up to 50GHz: **www.keysight.com/find/m9393a**
VXT: **www.keysight.com/find/m9421a**

Ordering Information

Flexible licensing and configuration

- **Perpetual:** License can be used in perpetuity.
- **Time-based:** License is time limited to a defined period, such as 12-months.
- **Node-locked:** Allows you to use the license on one specified instrument/computer.
- **Transportable:** Allows you to use the license on one instrument/computer at a time. This license may be transferred to another instrument/computer using Keysight's online tool.
- **Floating:** Allows you to access the license on networked instruments/computers from a server, one at a time. For concurrent access, multiple licenses may be purchased.
- **USB portable:** Allows you to move the license from one instrument/computer to another by end-user only with certified USB dongle, purchased separately.
- **Software support subscription:** Allows the license holder access to Keysight technical support and all software upgrades

You Can Upgrade!

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

UP GRADE

cdma2000 measurement application (N9072EM0D)

Model	Software License Type	Support Contract	Support Subscription (12-month) [2]
N9072EM0D-1FP	Node-locked perpetual	R-Y5C-001-A[2]	R-Y6C-001-L[2]
N9072EM0D-1FL	Node-locked 12-month	R-Y4C-001-L[1]	Included
N9072EM0D-1TP	Transportable perpetual	R-Y5C-004-D[2]	R-Y6C-004-L[2]
N9072EM0D-1TL	Transportable 12-month	R-Y4C-004-L[1]	Included
N9072EM0D-1NP	Floating perpetual	R-Y5C-002-B[2]	R-Y6C-002-L[2]
N9072EM0D-1NL	Floating 12-month	R-Y4C-002-L[1]	Included
N9072EM0D-1UP	USB portable perpetual	R-Y5C-005-E[2]	R-Y6C-005-L[2]
N9072EM0D-1UL	USB portable 12-month	R-Y4C-005-L[1]	Included

One month software support subscription extensions [3]

Model	Description
R-Y6C-501[3]	1-month of software support subscription for node-locked license
R-Y6C-502[3]	1-month of software support subscription for floating license
R-Y6C-504[3]	1-month of software support subscription for transportable license
R-Y6C-505[3]	1-month of software support subscription for USB portable license

1. All time-based X-Series measurement application licenses includes a 12-month support contract which also includes the 12-month software support subscription as same duration.
2. Support contract must bundle software support subscription for all perpetual licenses in the first year. All software upgrades and Keysight support are provided for software licenses with valid support subscription.
3. After the first year, software support subscription may be extended with annual or monthly software support subscription extensions for perpetual licenses.

Try Before You Buy!

Evaluate a full-featured version of our X-Series measurement application with our ***FREE*** trial. Redeem one 30-day trial license of each measurement application online at: www.keysight.com/find/X-Series_apps_trial

Hardware Configurations

To learn more about compatible platforms and required configurations, please visit: www.keysight.com/find/X-Series_apps_platform

Software Models & Options

To learn more about X-Series measurement application licensing, model numbers and options, please visit: www.keysight.com/find/X-Series_apps_model

Hardware Configuration

For optimizing the LTE and LTE-Advanced FDD/TDD measurement application, Keysight recommends a minimum level of instrument hardware functionality at each instrument performance point. Supported instruments include:

Benchtop:
- PXA N9030A
- MXA N9020A
- EXA N9010A
- CXA N9000A

PXIe:
- VSA (6 GHz) M9391A
- VSA (50 GHz) M9393A
- VXT M9420/21A

N90x0A X-Series signal analyzer

Capability	Instrument Option	Benefit
Analysis bandwidth	10 or 25 MHz as default or higher	**Required**: Wider analysis bandwidth options such as 25/40/85/160 MHz can be selected depending on the specified signal analyzer model
Precision frequency reference	-PFR	**Recommended**: For enhanced frequency accuracy and repeatability for lower measurement uncertainty
Electronic attenuator	-EA3	**Recommended**: Fast and reliable attenuation changes ideal for manufacturing without the wear associated with mechanical attenuators up to 3.6 GHz in 1 dB steps
Pre-amplifier	3.6 GHz (-P03) or higher	**Recommended**: For maximizing the measurement sensitivity
Fine resolution step attenuator	-FSA	**Recommended**: Useful for maximizing useable dynamic range to see signals
Analog baseband I/Q inputs	-BBA on PXA and MXA only	**Optional**: To extend measurements at baseband if required by device under test

M9391/93A PXIe VSA vector signal analyzer

Description	Model-Option	Additional information
Frequency range 3 or 6 GHz	M9391A-F03, or F06	One required for M9391A
Frequency range 8.4, 14, 18, or 27 GHz Frequency extension to 43.5 or 50 GHz	M9393A-F08, F14, F18, or F27 M9393A-FRZ or FRX	One required for M9393A Optional (requires M9393A-F27)
Analysis bandwidth 40, 100 or 160 MHz	M9391A/M9393A-B04, B10 or B16	One required
Memory 128, 512 or 1024 MSa	M9391A/M9393A-M01, M05 or M10	One required
Frequency reference 10 MHz and 100 MHz	M9391A/M9393A-300	One required

M9420/21A PXIe VXT vector transceiver

Description	Model-Option	Additional information
Frequency range 3.8 or 6 GHz	M9420A/M9421A-504, or 506	One required
Analysis bandwidth 40, 80 or 160 MHz	M9420A/M9421A-B40/B80/B1X	One required
Memory 256 or 512 MSa	M9420A/M9421A-M02/M05	One required
Half duplex port	M9420A/M9421A-HDX	Optional
High output power	M9420A/M9421A-1EA	Optional

Related Literature

Description	Publication number
N9072A & W9072A Self-Guided Demonstration	5990-8011EN
Understanding CDMA Measurements for Base Stations and Their Components, Application Note 1311	5968-0953E
Testing and Troubleshooting Digital RF Communications Transmitter Designs, Application Note 1313	5968-3578E
User's and Programmer's Reference Guide is available in the library section of the N9083A and W9083A product pages.	

Web

Product page:
www.keysight.com/find/N9072D

X-Series measurement applications:
www.keysight.com/find/X-Series_Apps

X-Series signal analyzers:
www.keysight.com/find/X-Series

PXIe VXT vector transceiver:
www.keysight.com/find/VXT

PXIe VSA vector signal analyzer:
www.keysight.com/find/M9391A
www.keysight.com/find/M9393A

Application pages:
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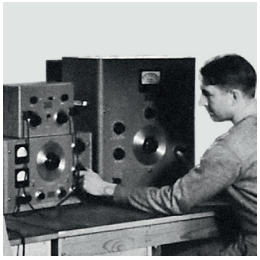

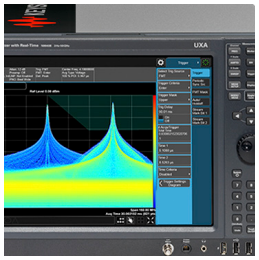

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www.keysight.com/find/X-Series_apps
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