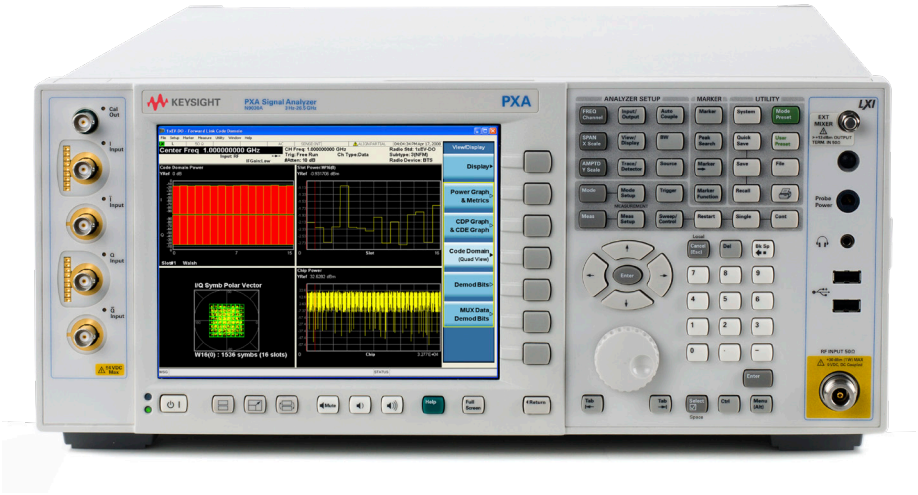
Keysight Technologies
1xEV-DO
X-Series Measurement App, Traditional UI
N9076EM0D

Technical Overview



- Perform 1xEV-DO forward and reverse link transmitter tests per 3GPP2 standards
- Support 1xEV-DO Rel. 0, Rev. A and Rev. B for single and multi carriers
- Full power and spectrum suite measurements with Pass/Fail indicator
- Use hardkey/softkey manual user interface and 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

1xEV-DO Measurement Application

The 1xEV-DO measurement application transforms the X-Series signal analyzers into 3GPP2 standard-based transmitter testers. The application provides fast one-button RF conformance measurements to help you design, evaluate, and manufacture your cdma2000® 1xEV-DO base station (Access Network) and mobile station (Access Terminal) devices. The measurement application is fully standard compliant to the 3GPP2 (Rel. 0, Rev. A and Rev. B) helping you to check your 1xEV-DO design with confidence and support manufacturing with a single application covering 1xEV-DO technologies for production.

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).

1xEV-DO Overview

1xEV-DO is standardized by 3rd Generation Partnership Project 2 (3GPP2) as an evolution of cdma2000 technologies that would support high data rates. The 1xEV-DO name means 1x Evolution-Data Optimized or 1x Evolution-Data Only. It uses multiplexing techniques, including code division multiple access (CDMA) as well as time division multiple access (TDMA), to maximize both individual users throughput and the overall system throughput. 1xEV-DO is spectrally compatible with cdma2000, thus the same amplifier, combiners, and antennas can be used on both 1xEV-DO and cdma2000 systems to reduce the installation cost of 1xEV-DO.

There have been several revisions of the 1xEV-DO standard, starting with Release 0 (Rel. 0), which provides air interface data rates of up to 2.4 Mbps on forward links and 153.2 kbps on reverse links. 1xEV-DO Rev. A is a successor to 1xEV-DO Rev. 0. It offers improved peak data rates on both the forward and reverse links. On forward links, peak data rates increase to 3.072 Mbps, while reverse link peak data rates have increased to 1.8 Mbps. Rev. A also offers higher sector capacity within the same 1.25 MHz channel, allowing operators to support more users and richer applications.

1xEV-DO Rev. B is a multi-carrier evolution of the Rev. A. It delivers dramatically improved data rates by aggregation of multiple carriers and high order modulation (64QAM). Typical deployments are expected to include three carriers for a peak rate of 14.7 Mbps on forward links and 5.4 Mbps on reverse links, making it possible to enable new services such as high-definition video streaming. 1xEV-DO Rev. B has backward compatibility with both 1xEV-DO Rel. 0 and Rev. A, allowing Rev. B carriers to continue to support older Rel. 0 and Rev. A devices.

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

	1xEV-DO Rel. 0		**1xEV-DO Rev. A**		**1xEV-DO Rev. B**	
	Forward link	**Reverse link**	**Forward link**	**Reverse link**	**Forward link**	**Reverse link**
Modulation	QPSK, 8-PSK, 16QAM	BPSK	QPSK, 8-PSK, 16QAM	BPSK, QPSK, 8-PSK	QPSK, 8-PSK, 16QAM, 64QAM	BPSK, QPSK, 8-PSK
Carrier bandwidth	1.25 MHz	1.25 MHz	1.25 MHz	1.25 MHz	20 MHz (15 carriers)[1]	20 MHz (15 carriers)[1]
Peak data rate	2.5 Mbps	153.6 kbps	3.1 Mbps	1.8 Mbps	14.7 Mbps[2]	5.4 Mpbs[2]

1. Rev. B standard supports up to 15 aggregated Rev. A carriers technically.
2. This peak rate for three EV-DO carriers with 64QAM on forward links.

RF Transmitter Tests

With the X-Series signal analyzers and the 1xEV-DO measurement application, you can perform RF transmitter measurements on base stations and mobile stations in time, frequency, code and modulation domains. The measurement application is fully-standard compliant to the 3GPP2 (Rel. 0, Rev. A and Rev. B), helping you to check your 1xEV-DO design with confidence and support manufacturing with a single application covering 1xEV-DO technologies from product development to production.

Standard-based RF transmitter tests

The RF transmitter test requirements for 1xEV-DO are defined in 3GPP2 C.S0032 (base station) and 3GPP2 C.S0033 (mobile station) standards. Table 2 shows the required base station RF transmitter tests along with the corresponding measurements. According to the standard recommendation that is required to use the test equipment with signaling supportable for the mobile devices tests, please refer to the Keysight E1966A for more details.

Table 2. Required base station RF transmitter measurements and the corresponding measurements in N9076EM0D and 89600 VSA software

3GPP2 C.S0032 Paragraph #	Transmitter test	X-Series N9076EM0D 1xEV-DO measurement application	89601B-B7N 3G modulation analysis (includes cdma2000, W-CDMA, 1x-EVDO and TD-SCDMA)[1]
4.1.2	Frequency tolerance	Freq error[2]	Freq error[2]
4.2.1	Synchronization and timing	Pilot Offset[3]	Composite error summary (meas chan=Pilot)[3]
4.2.2	Waveform quality	Forward link mod accuracy (waveform quality)	Composite error summary (meas chan=Pilot, MAC or data)
4.3.1	Total power	Power vs. Time	Not available
4.3.2	Pilot/MAC channel power	Power vs. Time	Not available
4.3.3	Code domain power	Forward link code domain	CDP composite
4.4.1	Conducted spurious emissions	ACP and spectrum emission mask	ACP can be performed using marker function; SEM is not available[4]
4.4.2	Radiated spurious emission	Spurious emission	Not available[4]
4.4.3	Inter-sector transmitter intermodulation	Channel power, ACP, SEM, spur emissions or spectrum analyzer mode	Not available[4]
4.4.4	Occupied bandwidth	Occupied BW	Can be performed using marker function[5]

1. 89601B-B7N only supports 1xEV-DO demodulation analysis for Rel. 0.
2. For the N9076EM0D application, these values are found in “IQ Measured Polar Graph” view under Forward Link Mod Accuracy (Waveform Quality) measurement. For 89601B-B7N, these values are found under “Composite Error Summary” trace.
3. For the N9076EM0D application, these values are found in “Result Metrics” view under Forward Link Mod Accuracy (Waveform Quality) measurement. For 89601B-B7N, these values are found under “Composite Error Summary” trace.
4. 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.
5. Measurement parameters must be set up manually. 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. These measurements are fully-remote controllable via the IEC/IEEE bus or LAN, using SCPI commands. A detailed list of supported measurements is shown in Table 3.

Table 3. One-button measurements for base station provided by the N9076EM0D measurement application

	1xEV-DO Rel. 0	**1xEV-DO Rev. A**	**1xEV-DO Rev. B**
X-Series signal analyzer	**PXA, MXA, EXA, CXA, PXIe VXT, PXIe VSA**	**PXA, MXA, EXA, CXA, PXIe VXT, PXIe VSA**	**PXA, MXA, EXA, CXA, PXIe VXT, PXIe VSA**
Modulation Accuracy			
Rho	■	■	■
EVM	■	■	■
Peak CDE	■	■	■
Magnitude Error	■	■	■
Phase Error	■	■	■
Frequency Error	■	■	■
I/Q Origin Offset	■	■	■
Active Channels	■	■	■
Pilot Offset	■	■	■
QPSK EVM	■	■	■
Forward Link Code Domain	■	■	■
Channel power	■	■	■
ACP	■	■	■
Power vs Time	■	■	■
Spectrum emission mask	■	■	■
Spurious emissions	■	■	■
Occupied bandwidth	■	■	■
Power Stat CCDF	■	■	■
Monitor spectrum	■	■	■
I/Q waveform	■	■	■

Table 4. One-button measurements for mobile station provided by the N9076EM0D measurement application

X-Series signal analyzer	1xEV-DO Rel. 0 PXA, MXA, EXA, CXA, PXIe VXT, PXIe VSA	1xEV-DO Rev. A PXA, MXA, EXA, CXA, PXIe VXT, PXIe VSA	1xEV-DO Rev. B PXA, MXA, EXA, CXA, PXIe VXT, PXIe VSA
Modulation accuracy			
Rho	■	■	■
EVM	■	■	■
Peak CDE	■	■	■
Magnitude error	■	■	■
Phase error	■	■	■
Frequency error	■	■	■
I/Q origin offset	■	■	■
Active channels	■	■	■
Pilot offset	■	■	■
QPSK EVM	■	■	■
Reverse link code domain	■	■	■
Channel power	■	■	■
ACP	■	■	■
Spectrum emission mask	■	■	■
Spurious emissions	■	■	■
Occupied bandwidth	■	■	■
Power stat CCDF	■	■	■
Monitor spectrum	■	■	■
I/Q waveform	■	■	■

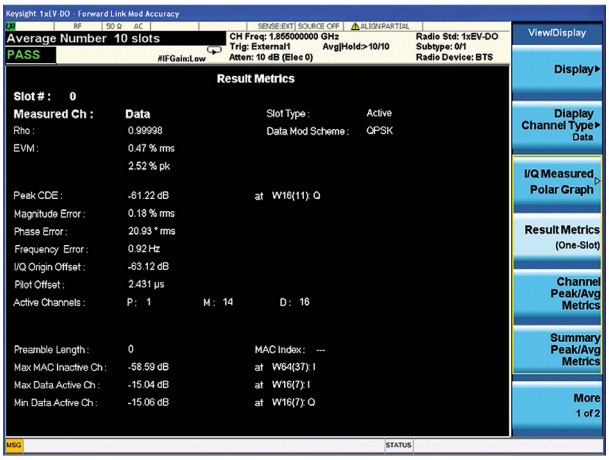


Figure 1. Forward Link Mod Accuracy (waveform quality) with Result Metrics view

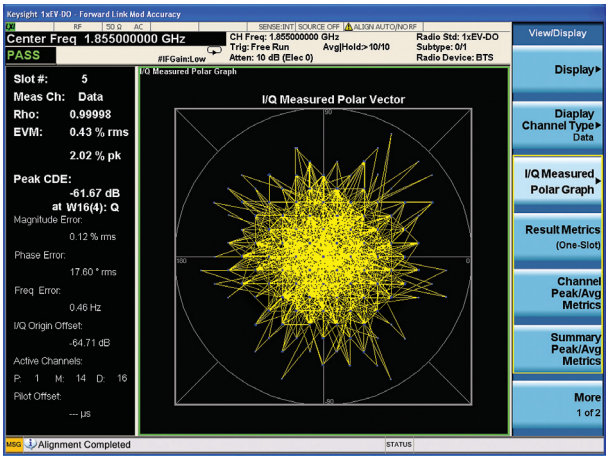


Figure 2. Forward Link Mod Accuracy (waveform quality) with I/Q measured Polar Graph

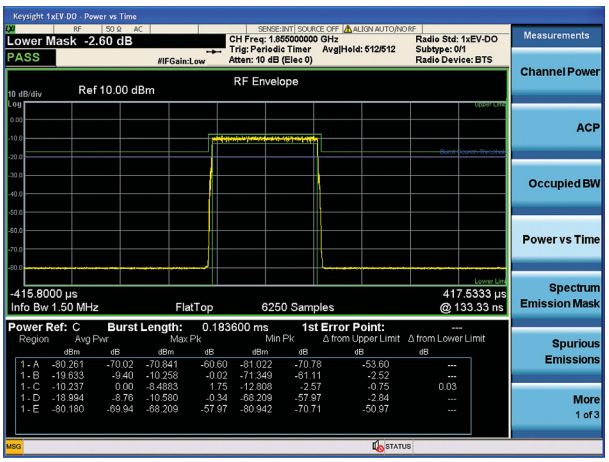


Figure 3. Power vs. Time

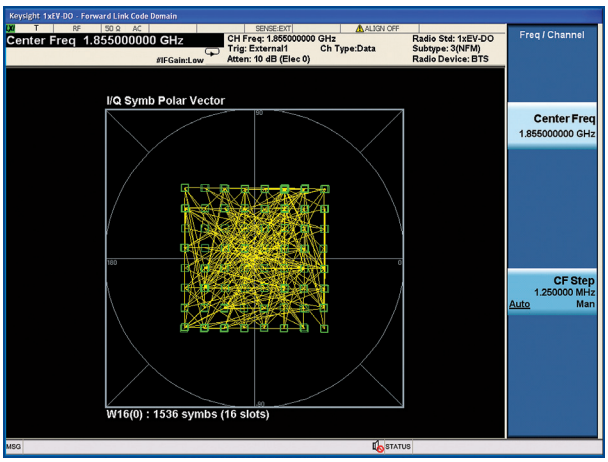


Figure 4. Forward Link Code Domain quad view for Rev. B signal with 64QAM

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

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)
Power vs. time				
Minimum power at RF input	–50 dBm (nom)			
Absolute power accuracy (20 to 30 °C)	± 0.19 dB (nom)	± 0.23 dB (nom)	± 0.3 dB (nom)	± 0.6 dB (nom)
Measurement floor	–90.8 dBm (nom)	–88.8 dBm (nom)	–84.8 dBm (nom)	–83.8 dBm (nom)
Relative power accuracy	± 0.11 dB (nom)	± 0.11 dB (nom)	± 0.16 dB (nom)	± 0.31 dB (nom)
Spectrum emission mask and adjacent channel power				
Minimum power at RF input		–20 dBm (nom)		
Dynamic range (relative)				
Offset frequency/integrated bandwidth				
750 kHz/30 kHz	–89.6 dBc (typ)	–85.1 dBc (typ)	–81.0 dBc (typ)	–73.1 dBc (typ)
1980 kHz/30 kHz	–90.6 dBc (typ)	–87.9 dBc (typ)	–83.9 dBc (typ)	–79.7 dBc (typ)
Sensitivity, absolute				
750 kHz/30 kHz	–106.7 dBm (typ)	–104.7 dBm (typ)	–100.7 dBm (typ)	–99.7 dBm (typ)
1980 kHz/30 kHz	–106.7 dBm (typ)	–104.7 dBm (typ)	–104.7 dBm (typ)	–99.7 dBm (typ)
Accuracy, relative				
750 kHz/30 kHz	± 0.04 dB	± 0.09 dB	± 0.09 dB	± 0.09 dB
1980 kHz/30 kHz	± 0.04 dB	± 0.10 dB	± 0.10 dB	± 0.10 dB
Occupied bandwidth				
Minimum power at RF input		–40 dBm (nom)		
Frequency accuracy		± 2 kHz (nom) (RBW = 30 kHz, Number of points = 1001, Span = 2 MHz)		
Power statistics CCDF				
Minimum power at RF input		–40 dBm (nom)		
Histogram resolution		0.01 dB		
Spurious emission				
Dynamic range, relative	107.4 dB (typ)	100.3 dB (typ)	97.1 dB (typ)	86.8 dB (typ)
Sensitivity, absolute	–91.4 dBm (typ)	–89.4 dBm (typ)	–85.4 dBm (typ)	–84.4 dBm (typ)
Accuracy, absolute				
20 Hz to 3.6 GHz (100 kHz to 3.0 GHz for CXA)	± 0.19 dB (95th percentile)	± 0.29 dB (95th percentile)	± 0.41 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

Description	PXA	MXA	EXA	CXA
Code domain (BTS measurements)				
Code domain power				
For pilot, 2MAC channels and 16 channels of QPSK data				
Absolute power accuracy			± 0.15 dB	
Modulation accuracy (composite rho)				
Composite EVM				
Range			0 to 25% (nom)	
Floor	1.5% (nom)	1.5%	1.5%	1.5% (nom)
Accuracy			1.0%	
Composite Rho				
Range			0.94118 to 1.0 (nom)	
Floor	0.99978 (nom)	0.99978	0.99978	0.99978 (nom)
Accuracy			± 0.0010 dB (at Rho 0.99751, EVM 5%) ± 0.0045 dB (at Rho 0.94118, EVM 25%)	
Frequency error				
Range			± 400 Hz (nom) (pilot, MAC, QPSK Data, 8PSK Data)	
Accuracy			± 10 Hz + tfa	
I/Q origin offset				
DUT maximum offset			–10 dBc (nom)	
Analyzer noise floor			–50 dBc (nom)	
QPSK EVM				
EVM				
Range			0 to 25% (nom)	
Floor	1.5% (nom)	1.5%	1.5%	1.6% (nom)
Accuracy			1%	
I/Q origin offset				
DUT maximum offset			–10 dBc (nom)	
Analyzer noise floor			–50 dBc (nom)	
Frequency error				
Range			± 30 kHz (nom)	
Accuracy			± 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

1xEV-DO measurement application (N9076EM0D)

Model	Software License Type	Support Contract	Support Subscription (12-month) [2]
N9076EM0D-1FP	Node-locked perpetual	R-Y5C-001-A[2]	R-Y6C-001-L[2]
N9076EM0D-1FL	Node-locked 12-month	R-Y4C-001-L[1]	Included
N9076EM0D-1TP	Transportable perpetual	R-Y5C-004-D[2]	R-Y6C-004-L[2]
N9076EM0D-1TL	Transportable 12-month	R-Y4C-004-L[1]	Included
N9076EM0D-1NP	Floating perpetual	R-Y5C-002-B[2]	R-Y6C-002-L[2]
N9076EM0D-1NL	Floating 12-month	R-Y4C-002-L[1]	Included
N9076EM0D-1UP	USB portable perpetual	R-Y5C-005-E[2]	R-Y6C-005-L[2]
N9076EM0D-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

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

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.

Hardware Configuration

For optimizing the 1xEV-DO measurement application, Keysight recommends a minimum level of instrument hardware functionality at each instrument performance point. Supported instruments include:

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

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

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
Keysight Forward Link Measurements for 1xEV-DO Access Networks	5988-6125EN
PSA Spectrum Analyzer 1xEV-DO Measurement Personality, Technical Overview	5988-4828EN
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/N9076D

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:
www.keysight.com/find/cellular

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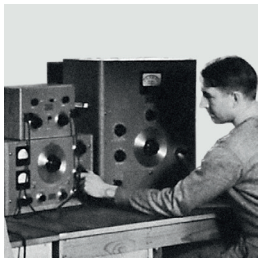

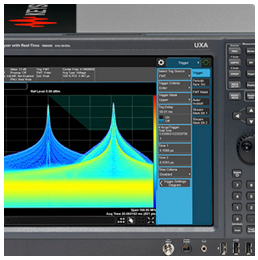

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www.keysight.com/find/X-Series_apps
www.keysight.com/find/N9076D

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