N/E9083EM0E Multi-Standard Radio (MSR) X-Series Measurement App, Multi-Touch UI

Multi-Standard Radio (MSR) Measurement Application

The MSR measurement application transforms the X-Series signal analyzers into standard-based MSR base station transmitter testers by adding fast one-button RF conformance measurements to help you evaluate and manufacture your MSR base station and base station components.

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).

Key features

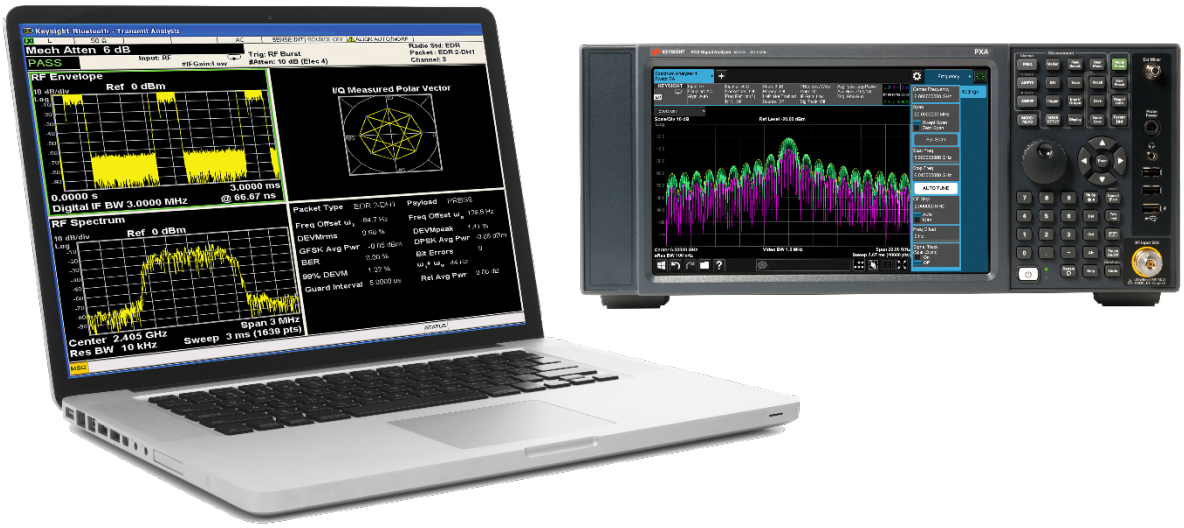
- Perform MSR base station transmitter tests on any combination of LTE FDD, W-CDMA/HSPA/HSPA+ and GSM/EDGE/Evo Evolution signals (license required for each measurement application)
- Perform one-button tests per the 3GPP Release 10 standard
- (TR/TS 37 series)
- Use hardkey/softkey manual user interface or SCPI remote user interface
- Extend test assets with transportable licenses between X-series signal analyzers with multi-touch UI

KEYSIGHT

Real-time spectrum analysis for MSR

Adding real-time spectrum analysis to a UXA, PXA or MXA signal analyzer addresses the measurement challenges associated with dynamic RF signals, such as bursted transmissions of GSM or LTE-TDD in an MSR signal configuration, and enables identification of interference caused by multiple signals of different radio access technologies transmitted in the same base station RF bandwidth.

- Accurately observe power changes for an MSR signal within the real-time bandwidth
- Capture random interfering signals with durations as short as 3.57 µs
- Perform fast, wideband measurements without compromising performance



Multi-Standard Radio (MSR) Technology Overview

The rapid evolution of mobile broadband and the need to deploy next generation cellular technologies alongside legacy deployment has lead to development of multi-standard radio (MSR) base stations. 3GPP defines an MSR base station by the ability of its receiver and transmitter to process two or more carriers in common, active RF components simultaneously in a declared RF bandwidth, where at least one carrier is of a different radio access technology (RAT) than the other carrier(s).

The key drivers behind MSR are coexistence of different technologies in a single network, spectrum “refarming,” and cost reduction. MSR allows operators to put spectrum space to a new use, resulting in seamless network migration from the currently deployed 2/3G radio formats to 4G. In terms of cost reduction, using the same base station hardware for multiple technologies reduces the number of sites, site rental costs, and the amount of on-site equipment required.

Traditionally the RF specifications for base station transmitters and receivers have been developed separately for the different RATs. However, in an MSR base station, the base station transmitter and receiver is capable of simultaneously processing multiple carriers of different RATs using common RF hardware, requiring a new set of RF specifications. As such, 3GPP developed a dedicated RF specification for MSR-capable base stations in the 3GPP Release 9 and 10 (TR/TS 37 series).

The operating bands for which MSR base stations are defined are divided into three different band categories (BCs): BC1 for LTE-FDD and W-CDMA operation; BC2 for LTE-FDD, W-CDMA and GSM/EDGE operation; and BC3 for LTE-TDD operation. MSR conformance tests are required when carriers of multiple RATs are being activated. This is done through a set of multi-RAT test configurations (TCs) of contiguous and non-contiguous frequency allocations.

Required transmitter measurements in a multi-RAT configuration include channel power, modulation quality (EVM), frequency error, spurious emissions, and operating band unwanted emissions (SEM). Alternatively, ACLR occupied BW and time alignment between transmitter branches are performed in single-RAT configurations, as defined in the TS37.141 conformance requirements.

RF Transmitter Tests

An X-Series signal analyzer, along with the MSR measurement application, can perform RF transmitter measurements on MSR base stations and base station components in time, frequency, and modulation domain. BC1 and BC2, along with the different transmitter test configurations, are supported. For BC1, the MSR measurement application analyzes any combination of W-CDMA/HSPA/ HSPA+ and LTE-FDD signals, and, for BC2, it analyzes any combination of GSM/EDGE/EDGE Evolution, W-CDMA/HSPA/HSPA+, and LTE-FDD signals.

For the demodulation measurements, such as EVM and frequency error, the measurement application uses an automatic sequencing function, instead of a single wideband capture of the multi-carrier, multi-RAT signal, eliminating the need for the wide analysis bandwidth option on the X-Series signal analyzer and thereby reducing the overall test equipment cost.

Standard-based RF transmitter tests

The RF transmitter test requirements for MSR base stations are defined in the TS 37 series of the 3GPP standard. Table 1 shows the required base station RF transmitter tests, along with the corresponding measurement applications.

Table 1. Required BTS RF transmitter measurements and the corresponding measurements in N9083EM0E and 89600 VSA software.

3GPP TS 37.141 paragraph #	Transmitter test	X-Series N9083EM0E multi-standard radio (MSR) measurement application (supports BC1 & BC2)	89600 VSA multi-measurement capability [1]
6.2.1	Base station maximum output power	Channel power	Channel power using band power marker
6.2.2	E-UTRA DL RS power	Conformance EVM	Error summary [2]
6.2.3	UTRA FDD primary CPICH power	Conformance EVM	Code domain power [2]
6.2.4	UTRA TDD primary CCPCH power	Not available (only applied for BC3 BTS)	Code domain power [2]
6.3	Output power dynamics	Conformance EVM	Error summary [2]
6.4	Transmit ON/OFF power	Not available (only applied for BC3 BTS)	Not available
6.5.1	Modulation quality	Conformance EVM	Error summary [2]
6.5.2	Frequency error	Conformance EVM	Error summary [2]
6.5.3	Time alignment error	Conformance EVM	MIMO info table [2]
6.6.1	Transmitter spurious emissions	Spurious emissions	89600 based solutions offer modulation quality measurements. For 1-button, non-demodulation, measurements such as ACLR and spectrum emission mask, the embedded application should be used.
6.6.2	Operation band unwanted emissions	Spectrum emission mask	
6.6.3	Occupied bandwidth	Occupied BW	
6.6.4	Adjacent channel leakage power ratio (ACLR)	ACP Cumulative ACLR (CACLR) for non-contiguous allocation	
6.7	Transmitter intermodulation	ACP	

1. The 89600 VSA multi-measurement capability is a standard feature with 89600 VSA software version 15 or higher. Unlike the N/W9083A, it does not provide presets for MSR as defined by 3GPP Release 9, so the user must manually configure the software for the signal under test. Also, it is not limited to the radio access technologies defined in the 3GPP standard. It can be configured to simultaneously analyze waveforms with any combination of the over 75 standards and modulation types supported by the VSA software.
2. These traces exist within each format. For example, for W-CDMA modulation quality, the user must enable W-CDMA demodulation first, then view EVM metrics under the error summary trace. Similar steps apply for GSM/EDGE and LTE.

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. 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 2.

Table 2. List of one-button measurements provided by the N9083EM0E measurement application.

GSM/EDGE/EDGE Evolution (N/E9071EM0E)	W-CDMA/HSPA/HSPA+ (N/E9073EM0E)	LTE-FDD (N/E9080EM0E)
Conformance EVM results		
RMS 95th %ile EVM	RMS EVM	EVM
Average RMS EVM	Peak EVM	EVM peak
Maximum RMS EVM	Rho	Data EVM
Average peak EVM	Magnitude error	3GPP-defined QPSK EVM
Maximum peak EVM	Phase error	3GPP-defined 16QAM EVM
Symbol position of the peak EVM	Frequency error	3GPP-defined 64QAM EVM
Average RMS magnitude error	Peak code domain error	3GPP-defined 1024QAM
Maximum RMS magnitude error	I/Q origin offset	RS EVM
Average RMS phase error	Time offset	Frequency error
Maximum RMS phase error	CPICH power over a slot	IQ offset
Average frequency error	Total power over a slot	IQ gain imbalance
Maximum frequency error	Channel number	IQ quad error
Average absolute peak phase error	Number of active channels	IQ timing skew
	First slot number	Common tracking error
Maximum absolute peak phase error	DPCCH slot format	Symbol clock error
	PRACH preamble signature	Time offset
Average I/Q origin offset		Channel power
Amplitude droop error		RS Tx power
Maximum I/Q origin offset		OFDM symbol Tx power
Trigger to TO		Reference signal Rx power
Timing offset of AM/PM path		Reference signal Rx quality
Detected TSC		Received signal strength indicator
Detected mod scheme		Sync correlation
		Sync type
		CP length mode
		Cell ID
		Cell ID group/sector
		RS-OS/PRS
Channel power		
Occupied BW [1]		
ACP		
Spectrum emission mask		
Spurious emissions		
Monitor spectrum [2]		
Power stat CCDF [2]		
IQ waveform2		

1. Occupied BW is not provided for each carrier separately. It is a composite value for all carriers within the measurement span.
2. These are general purpose measurements for quick examination of a signal under test.

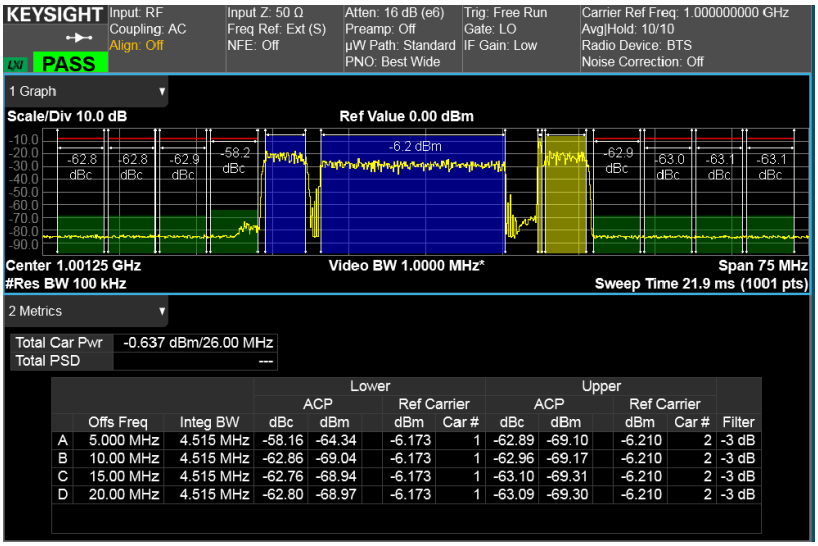


Figure 1. Cumulative adjacent channel leakage power ratio (CACLR) measurement on a non-contiguously allocated GSM/EDGE + W-CDMA/HSPA + LTE-FDD MSR signal.

Figure 2. MSR error summary trace showing EVM and frequency error, plus additional error metrics.

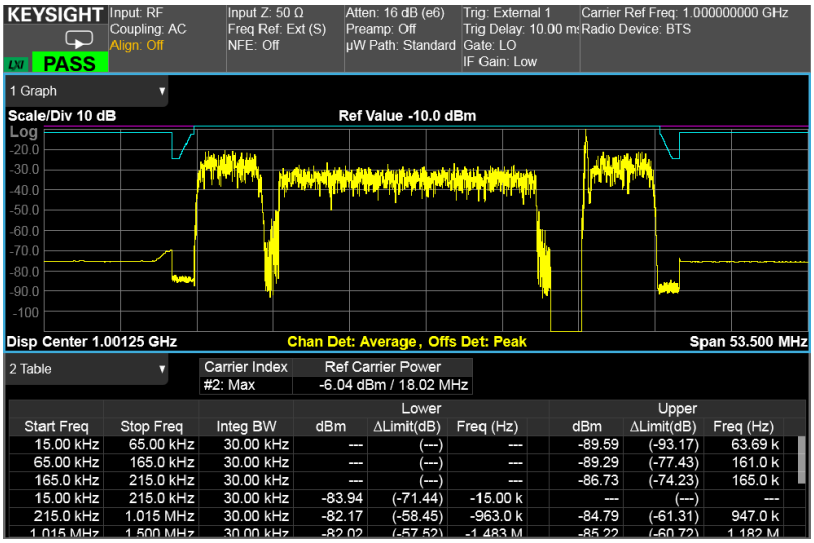


Figure 3. MSR spectrum emissions mask (SEM) measurement: GSM/EDGE + W-CDMA/HSPA + LTE-FDD with full limit mask according to 3GPP TS 37.141.

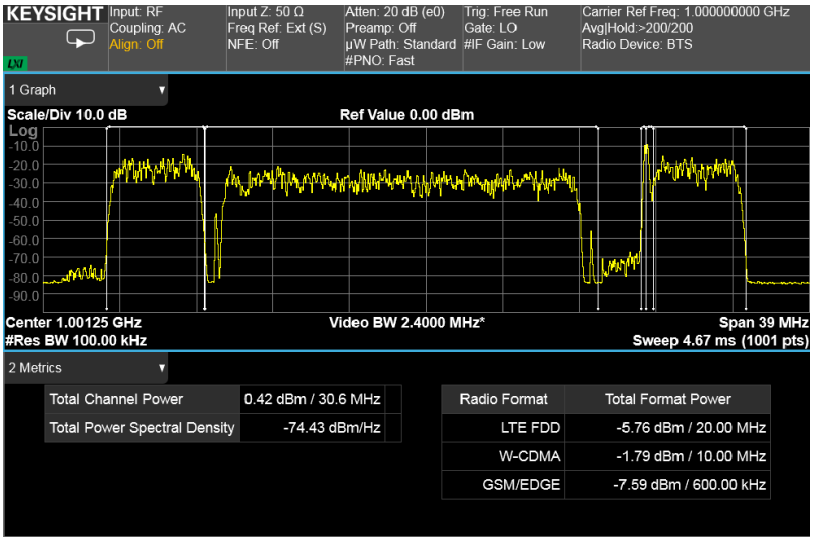


Figure 4. MSR channel power measurement showing the measured power of each carrier.

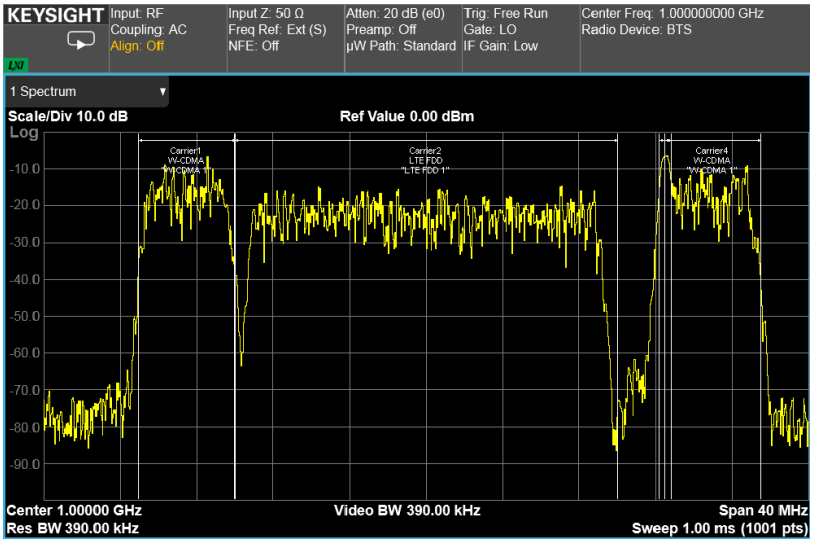


Figure 5. MSR monitor spectrum trace showing general information about each carrier.

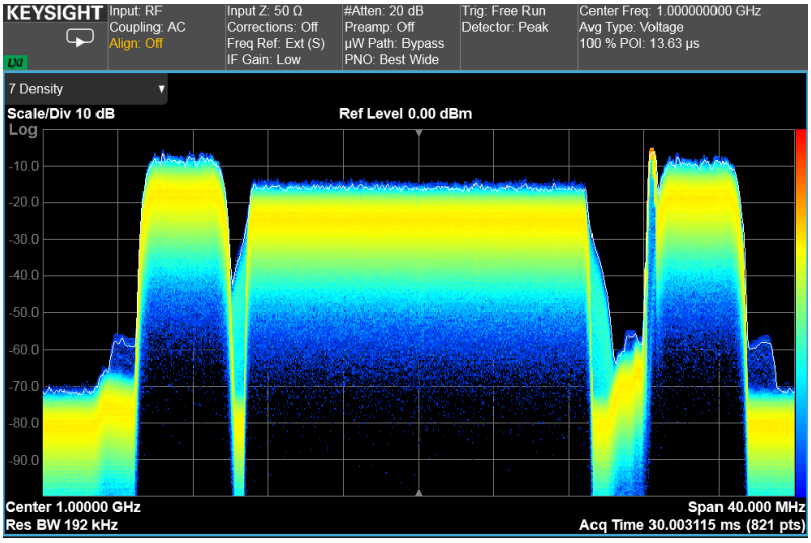


Figure 6. Real-time view of MSR signal using the RTSA option on the UXA, PXA or MXA signal analyzers.

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 and EXA 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.

Description	PXA	MXA	EXA	CXA
Channel power				
Minimum power at RF input	-50 dBm (nom)			
Power accuracy (95% confidence)	± 0.19 dB	± 0.23 dB	± 0.27 dB	± 0.61 dB
Occupied bandwidth				
Minimum power at RF input	-30 dBm (nom)			
Frequency accuracy	± (Span/1000) (nom)			
Power statistics CCDF				
Histogram resolution	0.01 dB			
Spurious emissions				
Accuracy (Attenuation = 10 dB) Frequency range	± 0.19 dB (95%) 20 Hz to 3.6 GHz	± 0.29 dB (95%) 20 Hz to 3.6 GHz	± 0.38 dB (95%) 20 Hz to 3.6 GHz	± 0.81 dB (95%) 100 Hz to 3 GHz
Frequency range	±1.08 dB (95%) 3.5 GHz to 8.4 GHz	± 1.17 dB (95%) 3.5 GHz to 8.4 GHz	± 1.22 dB (95%) 3.5 GHz to 7.0 GHz	± 1.80 dB (95%) 3.0 GHz to 7.5 GHz
Frequency range	± 1.48 dB (95%) 8.3 GHz to 13.6 GHz	± 1.54 dB (95%) 8.3 GHz to 13.6 GHz	± 1.59 dB (95%) 6.9 GHz to 13.6 GHz	N/A
Conformance EVM [1]				
GSM/EDGE [2] EVM, rms - floor (EDGE)	0.6%	0.6%	0.7%	0.7%
Phase error, rms - floor (GSM)	0.5°	0.5 °	0.6°	0.6°
W-CDMA [2] Phase error, rms - floor (GSM)	1.5%	1.5%	1.5%	1.5%
LTE-FDD [2] EVM floor for downlink (OFDMA) [3] Signal bandwidth				
5 MHz	0.44% (-47.1 db)	0.49% (-46.1 db)	0.66% (-43.6 db)	0.72% (-42.8 db)
10 MHz	0.36% (-48.8 db)	0.41% (-47.7 db)	0.66% (-43.6 db)	0.67% (-43.4 db)
20 MHz	0.38% (-48.4 db)	0.43% (-47.3 db)	0.65% (-43.7 db)	0.72% (-42.8 db)

1. Signal level is within one range step of overload. The specifications for floor do not include signal-to-noise impact which may decrease by increasing number of carriers. The noise floor can be estimated by DANL + 2.51 + 10 x log10(MeasBW), where DANL is the displayed average noise level specification in dBm and MeasBW is measurement bandwidth at receiver in Hz.
2. Applies when carrier spacing is 600 kHz for GSM/EDGE, 5 MHz for W-CDMA, and equal to the signal bandwidth for LTE-FDD, and each carrier power of adjacent channels is ≤ the carrier power of the tested channel for EVM.
3. EVM numbers for MXA is for instruments with serial number prefix ≥ MY/SG/US5233 (those instruments ship standard with N9020A-EP2 as the identifier). Refer to the LTE chapter of the MXA specification guide for specification on other MXAs: www.keysight.com/find/mxa_specifications.

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

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.

Multi-Standard Radio (MSR) measurement application (N/E9083EM0E)

LTE/LTE-Advanced measurement application (N/E9080EM0E)

GSM/EDGE/Evo measurement application (N/E9071EM0E)

W-CDMA/HSPA+ measurement application (N/E9073EM0E)

Software license type	Software license	Support subscription
Node-locked perpetual Node-locked time-based	R-Y5C-001-A R-Y4C-001-z [1]	R-Y6C-001-z [2] Included
Transportable perpetual Transportable time-based	R-Y5C-004-D R-Y4C-004-z [1]	R-Y6C-004-z [2] Included
Floating perpetual Floating time-based	R-Y5C-002-B R-Y4C-002-z [1]	R-Y6C-002-z [2] Included
USB portable perpetual USB portable time-based	R-Y5C-005-E R-Y4C-005-z [1]	R-Y6C-005-z [2] Included

One month software support subscription extensions [3]

Support contract	Description
R-Y6C-501	1-month of support subscription for node-locked perpetual license
R-Y6C-502	1-month of support subscription for floating perpetual license
R-Y6C-504	1-month of support subscription for transportable perpetual license
R-Y6C-505	1-month of support subscription for USB portable perpetual license

1. z means different time-based license duration. F for six months, L for 12 months, X for 24 months, and Y for 36 months. All time-based licenses have included the support subscription same as the time-base duration.
2. z means different support subscription duration. L for 12 months (as default), X for 24 months, Y for 36 months, and Z for 60-months. Support subscription must be purchased for all perpetual licenses with 12-months as the default. All software upgrades and KeysightCare support are provided for software licenses with valid support subscription.
3. Support subscription for all perpetual licenses can be extended with monthly extensions.

You Can Upgrade!

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

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 Multi-Standard Radio (MSR) measurement application, Keysight recommends a minimum level of instrument hardware functionality at each instrument performance point. Supported instruments include:

Benchtop:

- UXA N9041B/N9040B
- PXA N9030B
- MXA N9020B
- EXA N9010B
- CXA N9010B

N90x0B 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 40/85/160/255/510 MHz or 1 GHz 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

Related Literature

Description	Publication number
N9083A & W9083A Multi-Standard Radio (MSR) Measurement Application Measurement Guide	N9083-90002
3GPP Long Term Evolution: System Overview, Product Development, and Test Challenges, Application Note	5989-8139EN
Designing and Testing 3GPP W-CDMA Base Transceiver Stations (Including Femtocells), Application Note 1355	5980-1239E
Concepts of High Speed Downlink Packet Access: Bringing Increased Throughput and Efficiency to W-CDMA, Application Note	5989-2365EN
Understanding GSM/EDGE Transmitter and Receiver Measurements for Base Transceiver Stations and their Components, Application Note	5968-2320E
Measuring EDGE Signals – New and Modified Techniques and Measurement Requirements, Application Note 1361	5980-2508EN

Web

Product page:
www.keysight.com/find/N9083E

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