

# Keysight Technologies

## M9071A GSM/EDGE/EVO

X-Series Measurement Application for PXI Vector Signal Analyzers

### Technical Overview



- Measure GSM, EDGE, and EDGE Evolution RF transmitter performance, including multi-carrier base transceiver stations (MC-BTS)
- Test voice services over adaptive multi-user channels on one slot (VAMOS) enabled transmitters
- 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

## GSM/EDGE/EVO 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 X-Series 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 VSA 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 M9071A GSM/EDGE/EVO X-Series measurement application for modular instruments transforms the PXI VSAs into standards-based GSM, EDGE, and EDGE-Evolution transmitter testers by adding fast RF conformance measurements to help you speed up manufacturing of your GSM/EDGE devices. The measurement application is further enhanced to support multicarrier (MC) BTS and voice services over adaptive multi-user channels on one slot (VAMOS)—allowing you to stay on the leading edge of your design and manufacturing challenges.

The GSM/EDGE/EVO measurement application is just 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 also include a unique "Resource Manager" that provides direct access to PXI VSA hardware drivers for the fastest power and spectrum-based measurements, while simultaneously using the X-Series applications for fast modulation quality measurements and 89600 VSA for fast spectrum measurements.

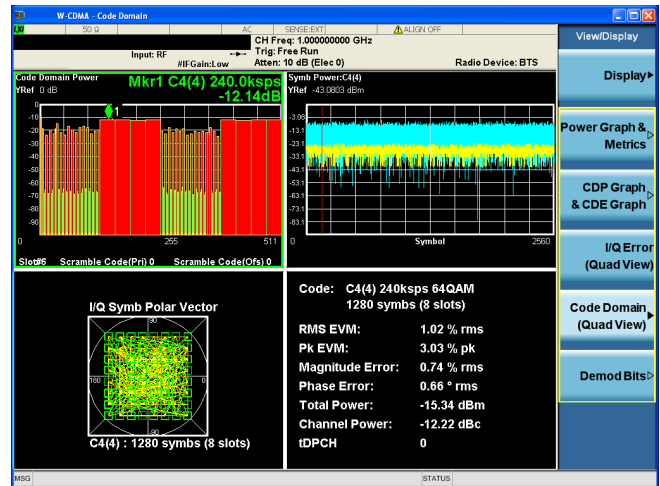


Figure 1. Multi-slot power vs. time on mixed modulation types of GSM and EDGE burst.

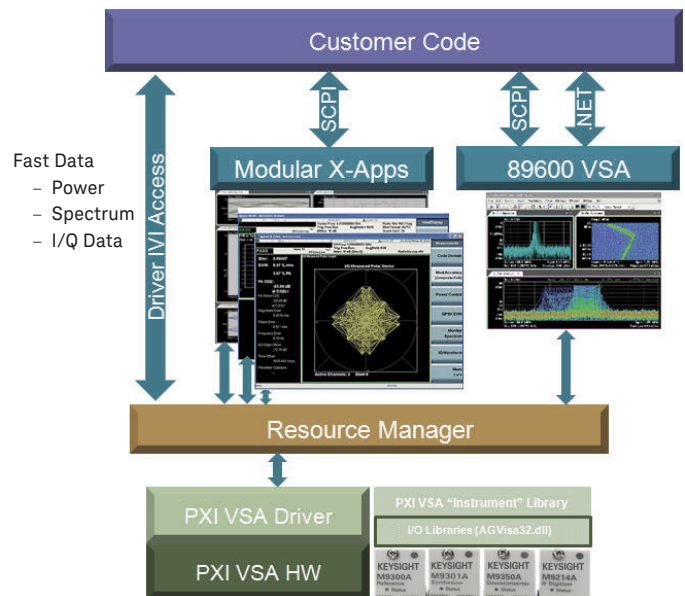


Figure 2. Resource manager included with all X-Series measurement applications for modular instruments.

## GSM/EDGE Technology Overview

The global system for mobile communications (GSM) digital cellular standard is a time division multiple access (TDMA) channel access scheme that uses Gaussian minimum shift keying (GMSK) modulation. It uses 200 kHz RF channels, time division multiplexed, to enable up to eight users to access each carrier.

Enhanced data rates for GSM evolution (EDGE) technology is an upgrade to the GSM standard, providing higher data rates in the same frequency spectrum by using higher density modulation,  $3\pi/8$  rotating 8PSK modulation. The rotation prevents symbol transitions through the origin, reducing the peak-to-average power, thereby minimizing spectral re-growth and improving power efficiency. The  $3\pi/8$  rotating 8PSK is not a constant amplitude modulation; hence a standard Gaussian filter (non-linear) will distort the signal. Therefore, EDGE uses a special "linearized" version of the Gaussian filter from GSM resulting in a spectrum that is very similar to that of GSM, while minimizing non-linear distortion in the baseband signal.

EDGE Evolution or EGPRS2 is a technology to offer near-UMTS (universal mobile telecommunications system) level data throughput with more than double the spectrum efficiency. For a higher data rate, the EDGE Evolution signal configuration has normal burst (NB) and higher symbol rate (HSR) burst including new modulation formats such as QPSK, 16QAM, and 32QAM. New pulse shaping filters are defined as narrow and wide filters for HSR. This is necessary to adjust the HSR spectrum with normal EDGE mask tests because GSM, EDGE, and EDGE Evolution will coexist in commercial services.

Now included in 3GPP Release 9 is voice services over adaptive multi-user channels on one slot (VAMOS). VAMOS can double the channel number assignment capacity of existing GSM networks by sending two sub channels on one slot. It utilizes adaptive QPSK (AQPSK), which is PSK with four state points whose positions are adjustable via a parameter Alpha.

Table 1. Key differences in GSM, EDGE, and EDGE Evolution standards

	GSM	EDGE	EDGE Evolution (EGPRS2)	
			Level A (EGPRS2-A)	Level B (EGPRS2-B)
Modulation	GMSK	$3\pi/8$ shift 8PSK	GMSK $3\pi/8$ shift 8PSK, $+\pi/4$ shift 16QAM, $-\pi/4$ shift 32QAM	$3\pi/8$ shift QPSK, $+\pi/4$ shift 16QAM, $-\pi/4$ shift 32QAM
Bits per symbol	1	3	1, 3, 4, 5	2, 4, 5
Payload per timeslot	114 bits (57+57)	348 bits (174+174)	114 bits (57+57) 348 bits (174+174) 464 bits (232+232) 580 bits (290+290)	276 bits (138+138) 552 bits (276+276) 690 bits (345+345)
Symbol rate	270.833 ksps	270.833 ksps	270.833 ksps	325 ksps
Amplitude modulation	No	Yes	Yes	Yes
Filter	Gaussian	Linearized Gaussian (EDGE)	Linearized Gaussian (EDGE)	Narrow or wide pulse shaping filter
BT	0.3	0.3	0.3	–

# RF Transmitter Tests

With the modular PXI VSAs, and the GSM/EDGE/EVO measurement application, you can perform RF transmitter measurements on BTS and mobile devices in time, frequency, and modulation domains. Measure basic GSM and EDGE signals as well as EDGE Evolution signals with Level A (normal burst) and Level B (high symbol rate) with all modulation formats and transmit filters. In addition, MC-BTS and VAMOS

transmitter measurements according to Release 9 of the 3GPP standard is supported.

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

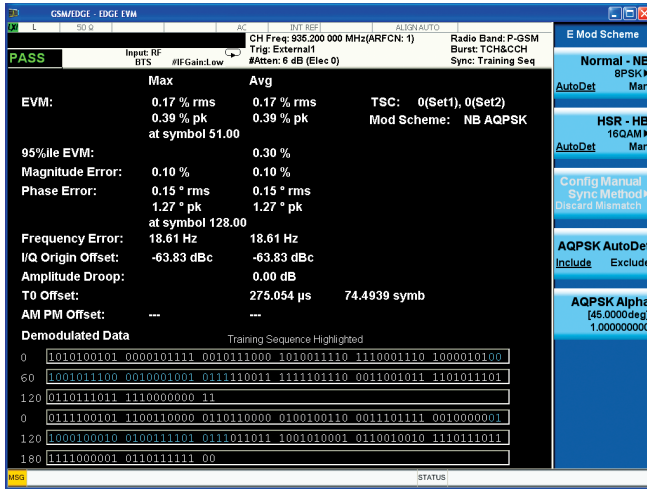


Figure 3. EVM and demodulated bits for VAMOS (AQPSK modulation) signals. Training sequences for both VAMOS sub channels are highlighted.

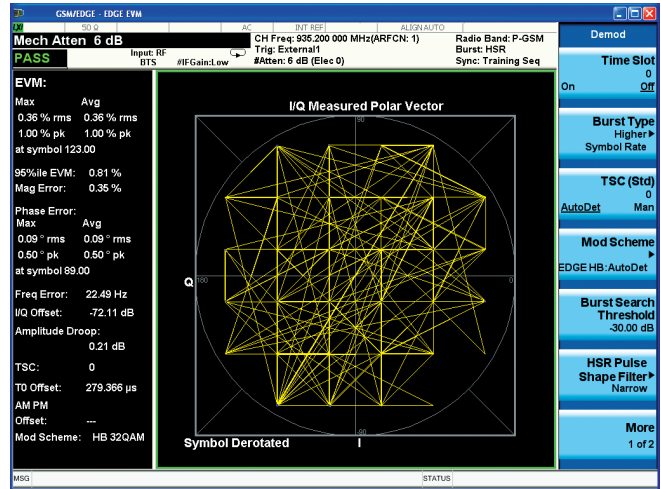


Figure 4. Constellation diagram and error summary of an HSR 32QAM EDGE Evolution signal.

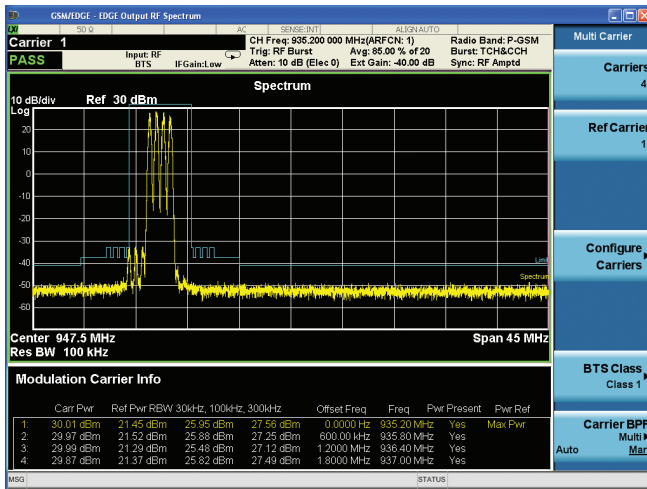


Figure 5. Multi-carrier BTS (MC-BTS) ORFS with limit mask for ORFS and up to 5th order intermodulation products. MC-BTS ORFS can also be configured for non-contiguous frequency allocation.

## Standards-based RF transmitter test

The RF transmitter test requirements for GSM/EDGE/EDGE Evolution are defined in TS 45 and 51 series of the 3GPP standard. Table 2 shows the required base station RF transmitter tests along with the corresponding measurement applications.

Table 2. Required BTS RF transmitter measurements and the corresponding measurements in M9071A and 89600 VSA software

3GPP TS.51.021 subclause	Transmitter test	M9071A X-Series measurement application	89600 VSA software Option AYA
6.2	Modulation accuracy	EVM	EVM
6.3	Mean transmitted RF carrier power	Transmit power	Can be performed using band power marker
6.4	Transmitted RF carrier power versus time	Power vs. time	
6.5.1	Spectrum due to modulation and wideband noise	Output RF spectrum (ORFS) due to modulation and wideband noise	
6.5.2	Switching transients spectrum	Output RF spectrum (ORFS) due to switching	
6.6	Spurious emissions from the transmitter antenna connector	Inband Tx spur	
6.7	Intermodulation attenuation	Spectrum analyzer mode - Spurious emissions	
6.8	Intra base station system intermodulation attenuation	Spectrum analyzer mode - Spurious emissions	89600 VSA offers modulation quality measurements. For one button, non-demodulation, measurements such as ORFS and PvT, use the M9071A.
6.9	Intra base station system intermodulation attenuation, MXM 850 and MXM 1900	Spectrum analyzer mode - Spurious emissions	
6.10	Intra base station system intermodulation attenuation, PCS 1900, GSM 850, GSM 700	Spectrum analyzer mode - Spurious emissions	
6.11	Intermodulation attenuation (GSM 700, GSM 850, MXM 850, PCS 1900, and MXM 1900)	Spectrum analyzer mode - Spurious emissions	
6.12	Wideband noise and intra-BSS intermodulation attenuation in multicarrier operation	MCBTS ORFS due to modulation and wideband noise. Available for both contiguous and non-contiguous frequency allocation.	

### 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](http://www.keysight.com/find/89600B)

## 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). These measurements are fully remote controllable via the IEC/IEEE bus or LAN, using SCPI commands.

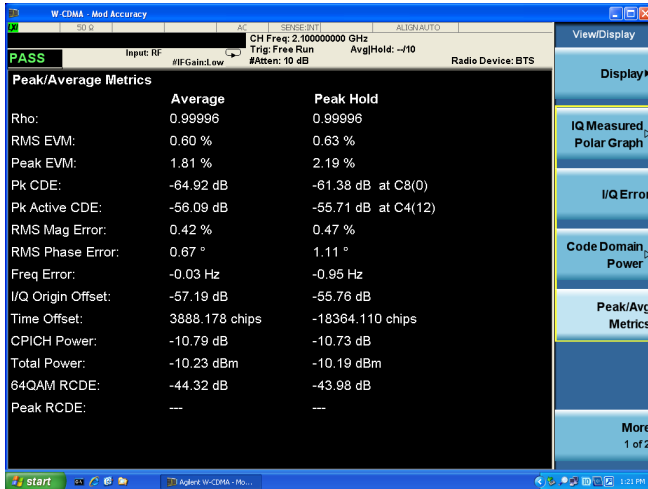


Figure 6. Combined view of ORFS due to modulation and switching transients.

Table 3. Measurements provided by the M9071A measurement application

Technology	GSM/EDGE	EDGE Evolution Level A (EGPRS2-A) Level B (EGPRS2-B)	MC BTS For contiguous and non-contiguous frequency allocation	VAMOS
<b>Measurements</b>				
EVM	●	●	●	●
RMS EVM	●	●	●	●
Peak EVM	●	●	●	●
95% EVM	●	●	●	●
Frequency error	●	●	●	●
Phase error	●	●	●	●
Magnitude error	●	●	●	●
I/Q origin offset	●	●	●	●
TO offset	●	●	●	●
AM PM offset	●	●	●	●
Transmit power	●	●	●	●
Power vs. time	●	●	●	●
<b>ORFS</b>				
Due to modulation and wideband noise	●	●	●	●
Due to switching transients	●	●	●	●
Unwanted emissions			●	
In-band Tx spur	●	●		

# Key Specifications

## Definitions

- Specifications describe the performance of parameters covered by the product warranty.
- 95th percentile values indicate the breadth of the population ( $\approx 2\sigma$ ) 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

## Supported devices and standards

Device type	BTS, MS
Standard version	Mobile station: 3GPP TS 51.010-1 v.10.0.0 (2012-03) Base Station: 3GPP TS 51.021 v.10.4.0 (2012-03)
BTS type	Normal, Micro1, Micro2, Micro3, Pico
Radio band	P-GSM 900, E-GSM 900, R-GSM 900, DCS1800, PCS1900, GSM 850, T-GSM 810, GSM 700, GSM 480, GSM 450

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

## Performance specifications (nominal)

Description	M9391A	
<b>Demodulation</b>		
GSM Global Phase Error	0.12°	
GSM EDGE Residual EVM	0.2%	
<b>ORFS</b>	<b>GSM</b>	<b>EDGE</b>
<b>Signal offset</b>		
200 kHz	-36.5 dB	-38.6 dB
250 kHz	-40.8 dB	-42.6 dB
400 kHz	-68.6 dB	-69.6 dB
600 kHz	-72.4 dB	-72.5 dB
800 kHz	-76.5 dB	-76.5 dB
1200 kHz	-80.6 dB	-80.7 dB
1800 kHz	-77.9 dB	-77.9 dB

## 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.

### 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](http://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.



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

### M9071A GSM/EDGE/EVO measurement application

Model-option	Description	Notes
M9071A-2TP	GSM/EDGE measurement application, transportable perpetual license	
M9071A-3TP	EDGE Evolution measurement application, transportable perpetual license	Requires 2TP
M9071A-XTP	Single acquisition combined GSM/EDGE measurement application, transportable perpetual license	Requires 2TP
M9071A-MEU	Minor enhancement update, transportable license	Provides latest updates to previous software versions



## Single acquisition combined measurements

The M9071A-XTP single acquisition combined GSM/EDGE measurement application is for high-speed manufacturing of GSM/EDGE 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 phase and frequency error (PFR), EDGE EVM, PVT, ORFS, marker measurements, and harmonics. Note that the M9071A-XTP does not provide the N9071A-XTP's List Power Step measurement feature. Instead you can get better performance using the M9391A and M9393A PXI VSA hardware driver's List Power feature.

## Single acquisition

Contains one continuous block of captured data collected using predefined capture settings. The capture period can be defined by test engineers to suit the requirements for specific device tests, for example, the number of GSM bursts required to provide the engineer with enough data to ensure a good measurement on the DUT.

## Combined measurements

Implies that the measurement sequence performed by the analyzer can accommodate any mix of transmitter power measurements and modulation quality measurements performed on the data collected within the capture period.

## 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

### 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

*N9071A & W9071A GSM/EDGE/EDGE Evolution, Self-Guided Demonstration*, literature number 5990-5927EN

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*N9080A & W9080A LTE Measurement Application, Measurement Guide, Part Number N9080-90006*

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*N9071A & W9071A GSM/EDGE/EDGE Evolution, Measurement Guide, part number N9071-90016*

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*Understanding GSM/EDGE Transmitter and Receiver Measurements for Base Transceiver Stations and Their Components, Application Note*, literature number 5968-2320E

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*Measuring EDGE Signals – New and Modified Techniques and Measurement Requirements, Application Note 1361*, literature number 5980-2508EN

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*User's and Programmer's Reference Guide* is available in the library section of the N9071A and W9071A product pages.

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

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

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

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## Web

Product page: [www.keysight.com/find/M9071A](http://www.keysight.com/find/M9071A)

X-Series measurement applications: [www.keysight.com/find/M90XA](http://www.keysight.com/find/M90XA)

M9391A PXIe Vector Signal Analyzer: [www.keysight.com/find/M9391A](http://www.keysight.com/find/M9391A)

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