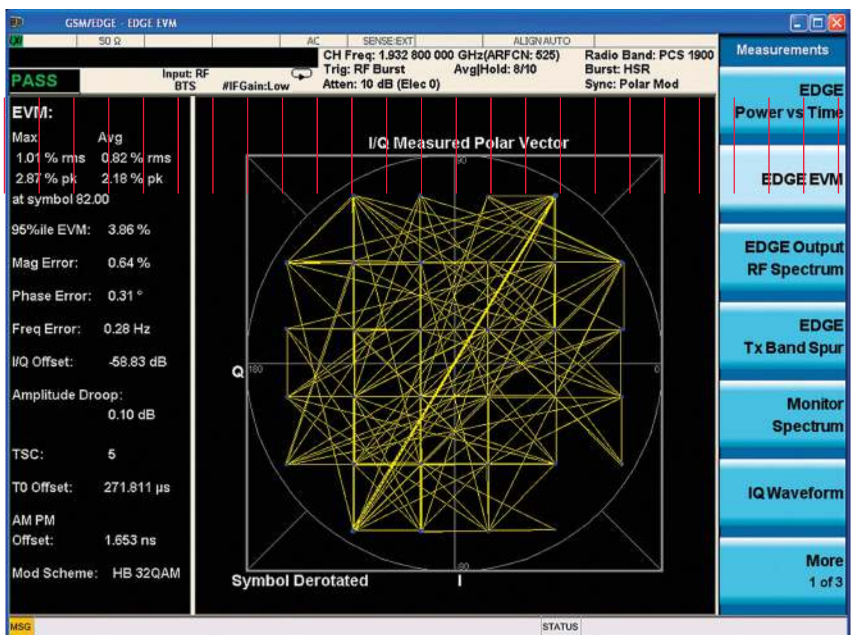
Keysight Technologies

N9071A GSM/EDGE/EDGE Evolution
W9071A GSM/EDGE

X-Series Measurement Application

Demo Guide



KEYSIGHT
TECHNOLOGIES

Introduction

The GSM/EDGE/EDGE Evolution measurement application transforms the X-Series signal analyzers into GSM/EDGE/EDGE Evolution transmitter testers by adding fast one-button measurements and modulation analysis capabilities to help you design, evaluate and manufacture your GSM/EDGE devices.

Demonstration Preparation

Minimum equipment configuration requirements

All demonstrations utilize an X-Series signal analyzer with the GSM/EDGE measurement application and an MXG vector signal generator with GSM/EDGE Signal Studio software.

Note:
To measure GSM/EDGE/EDGE Evolution signals at analog baseband I/Q, connect them to the single-ended or differential I/Q inputs of the MXA signal analyzer with Option BBA. By switching input from RF to I/Q, you can make the same measurements available in the GSM/EDGE and EDGE Evolution measurement application (N9071A-2FP/3FP).

Connect the hardware as follows:

1. Using a 50 Ω RF cable, connect the **RF Output 50 Ω** port on the MXG to the **RF INPUT 50 Ω** port on the X-Series signal analyzer as shown in Figure 1.
2. Using a second 50 Ω RF cable, connect the **10 MHz OUT** on the X-Series signal analyzer to the **REF IN** on the MXG signal generator.
3. Using a third 50 Ω RF cable, connect the **EVENT 1 OUT** from the MXG to the **Trigger 1 IN** of the X-Series signal analyzer.

Instruments	Model number	Required options
MXG vector	N5182A	503 or 506 – frequency range at 3 GHz or 6 GHz 651, 652 or 654 – internal
Signal Studio software	N7602B	EFP – Basic GSM/EDGE FFP – Basic EGPRS2 (EDGE Evolution) 1FP, 2FP or 3FP – connect to signal generator
X-Series signal analyzer	N9030A PXA N9020A MXA N9010A EXA N9000A CXA	503, 508 (507 for EXA and CXA), 513, or 526 – frequency range up to 26.5 GHz (up to 7.5 GHz for CXA) EA3 – Electric attenuator, 3.6 GHz (recommended) P03 – Preampifier (recommended for measuring low level signal) N9020A-BBA - Analog baseband IQ inputs on MXA (required for analog baseband analysis)
X-Series GSM/EDGE/EDGE Evolution measurement application	N9071A W9071A (2FP only)	2FP – GSM/EDGE measurement application 3FP – EDGE Evolution measurement application XFP – GSM/EDGE single acquisition combined measurement application for MXA and EXA
Controller PC for Signal Studio		Install N7602B to generate and download the signal waveform into the MXG via GPIB or LAN (TCP/IP). Please refer the online documentation for installa-tion and setup.

Helpful tip:

Update your instrument firmware and software to the latest versions, available in the following Technical Support, Drivers & Software sections of:

www.keysight.com/find/mxg
www.keysight.com/find/signalstudio
www.keysight.com/find/X-Series

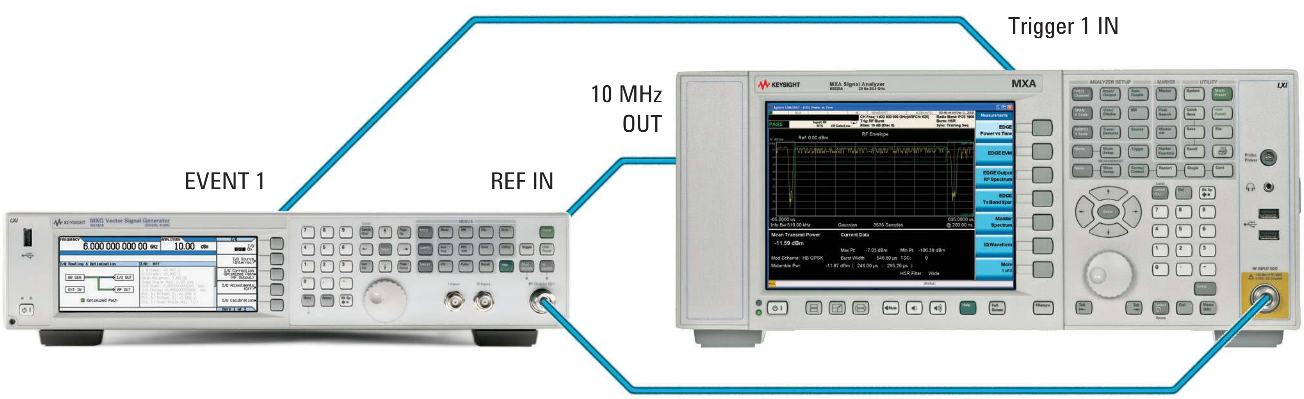


Figure 1. Connecting the X-Series and MXG

Demonstration Setup

Switch to the GSM/ EDGE measurement application

Since EDGE is spectrum and time-slot compatible with GSM, most of the same transmitter measurements are required—some differ only in terms of specified limits. Whenever a measurement is specific to either standard, it will be prefixed by the appropriate name.

Keystrokes surrounded by [ ] indicate hard keys, while key names surrounded by { } indicate soft keys located on the right edge of the display.

Set up a GSM signal for analysisx

Instructions	Software operations
On the Signal Studio software:	
Start the Signal Studio software	Start > All Programs > Keysight Signal Studio > GSM EDGE
Configure the MXG as a hardware connected via GPIB or LAN (TCP/IP)	Follow the Signal Studio instructions to connect to the MXG N5182A.
Set the basic parameters of the signal for PCS1900 radio band at center frequency 1.9328 GHz; this is absolute RF channel number (ARFCN) 525; amplitude –10 dBm and RF Output turned ON	In the tree view, select **Waveform Setup** Set Frequency band to PCS1900 Set ARFCN to 525. In the tree view, select **Signal Generator** Amplitude = –10 dBm, RF Output = On
Select the predefined GSM waveform under waveform setup; default is "GSM All Timeslots Normal"; change this configuration to "GSM 1 Timeslot, 1 Carrier"	Click **Carrier 1** under **Waveform Setup** Click  to open a window with a list of predefined carrier configurations. Select **GSM 1 Timeslot, 1 Carrier** and click **OK**
Download the signal to the MXG	Press the Generate and Download button on the top tool bar. If you encounter any errors, please refer to the online help in the Signal Studio software.

Instructions for the X-Series signal analyzer	Keystrokes
Switch to the GSM/EDGE measurement application	[Preset] [Mode] {GSM/EDGE}[1]
Set the band to GSM PCS band; the default device setting is the BTS	[Mode Setup] {Radio} {Band} {PCS 1900} Note: Various different bands are supported!
Verify the BTS type is Normal	[Mode Setup] {Radio} {BTS Type} {Normal} Note: Various different BTS types are supported!
Set center frequency to absolute RF channel number (ARFCN) 525 (1.9328 GHZ) Note: user can either enter center frequency or ARFCN	[Freq] {ARFCN} [525] {Enter}
Turn on time gating for GSM burst signal analysis	[Sweep/Control] {Gate} {Gate On}

1. *Mode key label will be {GSM/EDGE/EDGE Evo} if N9071A-3FP license is installed for EDGE Evolution.*

You should see a spectrum of the GSM signal as shown in Figure 2. If you do not, make sure that you have downloaded the Signal Studio waveform to the MXG and that the MXG's RF is turned ON [RF on/off].

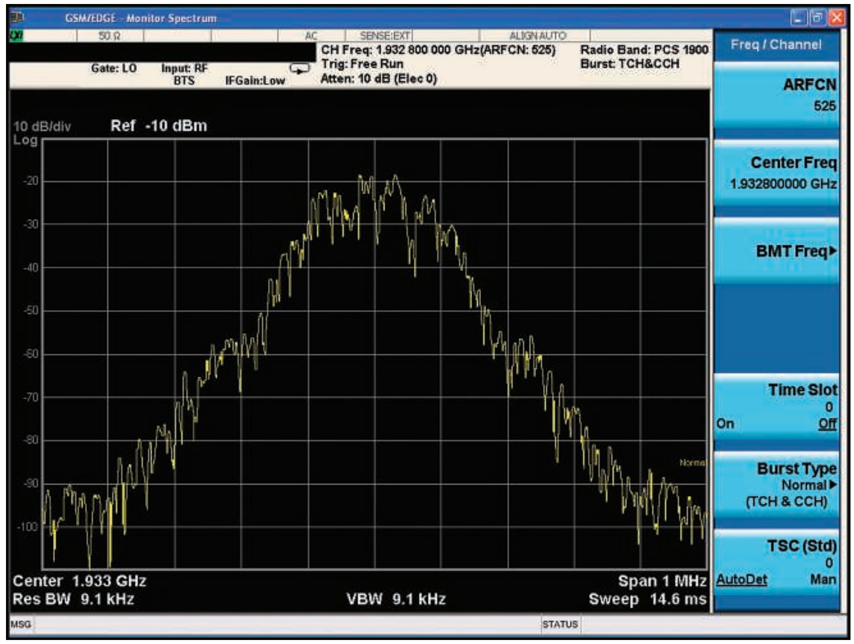


Figure 2. GSM spectrum

Helpful tip:

Do not forget the [Help] key. Whether you would like to learn about a particular measurement, or would like to know the SCPI command for it, press the [Help] button and the measurement key you would like to know more about. Turn off help by pressing [Cancel(Esc)], which is located above the [7] key.

Demonstrations

Demonstration 1.

Power versus time

The GSM/EDGE measurement application offers one-button power versus time measurements and gives you a pass/fail result based on the GSM/EDGE standard.

You can control the following power vs. time measurement parameters:

– Power control level (PCL): PvT mask shape is determined from the PCL value

– Burst synchronization: allows you to choose to synchronize to the training sequence, the RF amplitude of the burst, or “none”. When “none” is selected, the burst synchronization is solely determined by trigger signal and user-defined trigger delay.

– Measurement time: default to 1 slot; selectable up to 8 slots for multi-slot analysis

– Burst search threshold

– Average mode and type

The measurement has flexible view capabilities with a:

– ”Rise and Fall” view which allows you to analyze the performance of the burst modulator

– “On Burst” which allows you to focus on the modulated part of the burst to identify errors like amplitude droop due to amplifier thermal effects and modulation problems

These views can be zoomed for an even closer analysis.

Try zoom (display expansion) in the control window keys if you want to see the detail of rising or falling edge as shown in Figure 5 on the next page.

Instructions for the X-Series signal analyzer	Keystrokes
Measure power versus time mask (Figure 3)	[Meas] {GMSK power vs. time}
View the max, min and average trace to make sure all three traces are within the PvT mask	[Meas Setup] {Avg Hold Num 10 On/Off} [Trace/Detector] {Max Hold Trace On/Off} {Min Hold Trace On/Off}
Change the scale/div to view the minimum trace (Figure 4)	[AMPTD] {Scale/Div} [15] {dB}
View the rising and falling edge of the burst (Figure 5)	[View/Display] {Rise & Fall}
Turn on time gating for GSM burst signal analysis	[Sweep/Control] {Gate} {Gate On} Use the windows control hard keys  located next to the On/Off hard key to select the rising or falling edge of the burst and zoom on it.

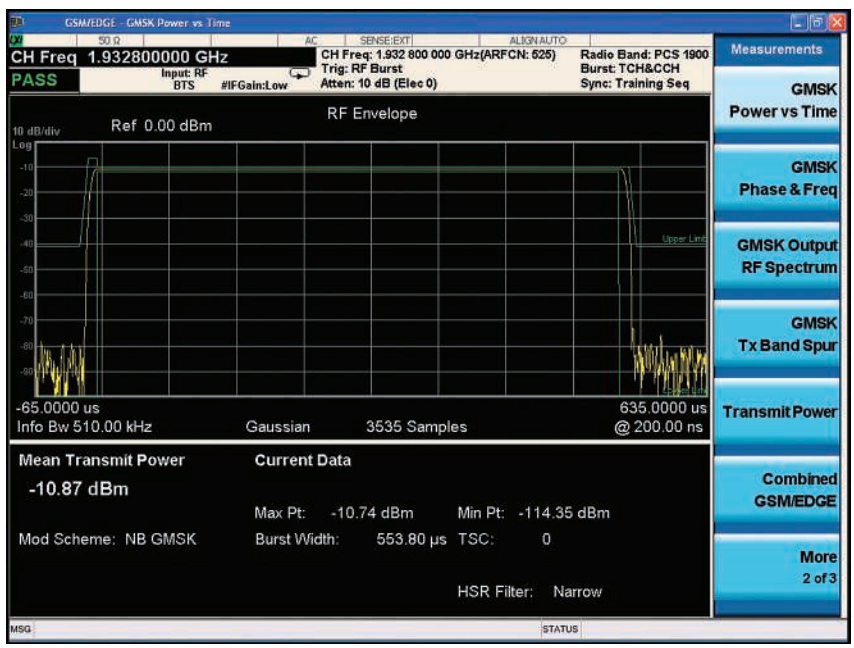


Figure 3. GMSK power versus time mask measurement with pass/fail functionality

Reference power type can be selected from following selections under [Meas Setup] {More} {Advanced} key;

– Useful part (default): reference power is calculated with long term averaging by useful part of burst defined in 3GPP (refer TS45.002 and TS45.004 subclause 4)

– Midamble (training sequence): measurement speed can be faster, but it may not be accurate when higher order modulation used for EDGE Evolution

– Estimated carrier power (ECP): this is designed to estimate long term average power with much fewer averaging. For more details, refer to the following article at (**http://www.commsdesign.com/show-Article.jhtml?articleID=18902745**).

If you want to change the power reference level in absolute value, try to access [Meas Setup] {More} {Advanced} {Ref Power} to manually set the power level.

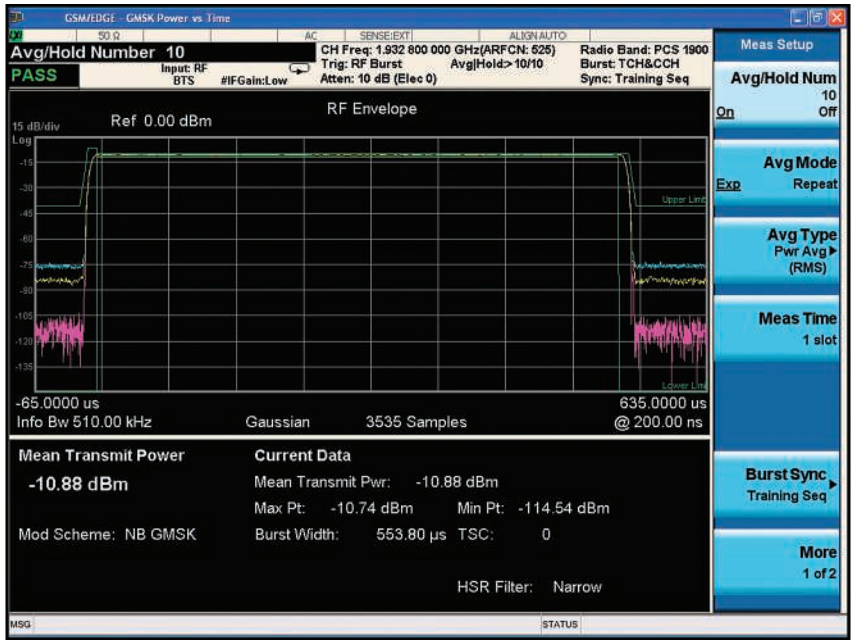


Figure 4. GMSK power versus time, mask measurement with max (blue), min (pink) and average (yellow) traces

Figure 5. Rising and falling edge view in GSM power versus time measurement

Demonstration 2.

Multi-slot power vs. time

EDGE multi-slot power vs. time

Conventional GSM mobiles use a single time-slot on the uplink and downlink. With the advent of GPRS and EDGE, multiple users are allowed to transmit on multiple time-slots at varying power levels. These time-slots need not be contiguous. Consequently, it has become necessary to be able to perform flexible multi-slot power vs. time measurement to analyze a whole frame.

Now change the signal from GSM to EDGE Evolution higher symbol rate (HSR) burst.

Instructions for the MXG signal studio	Software operations
Generate an EDGE signal with 8 active timeslots	Click **Carrier 1** under **Waveform Setup** Click [icon] to open a window with a list of predefined carrier configurations. Select **HSR QPSK/16QAM/32QAM Mixed All Timeslots, 1 Carrier** and click **OK**
Download the signal to the MXG	Press the **Generate and Download** on top tool bar

Instructions for the X-Series signal analyzer	Keystrokes
Make an EDGE power vs. time measurement	[Meas] {EDGE power vs. time}
Configure the target signal of EDGE Evolution HSR burst	[Mode Setup] {Demod} {Burst Type Higher Symbol Rate}
Select modulation scheme auto detection	{Mod Scheme} {HSR – HB 16QAM Auto Det/Man}
Change the HSR pulse shaping filter	{HSR Pulse Shaping Filter Narrow/Wide}
Go back to normal burst view (Figure 6)	[View/Diplay] {Burst}
Expand measurement timeslots from 1 to 8	[Meas Setup] {More 1 of 2} {Meas Time} [8] {Enter}
Switch display to view multi-slot (Figure 7)	[View/Display] {Multi-Slot}

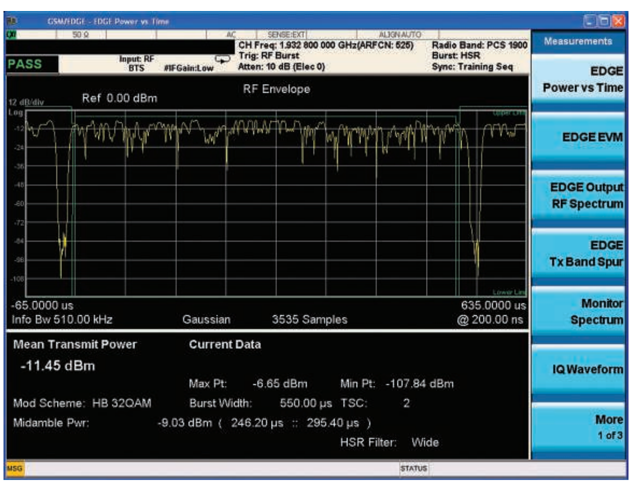


Figure 6. EDGE power vs. time measurement with automatically detected modulation scheme report

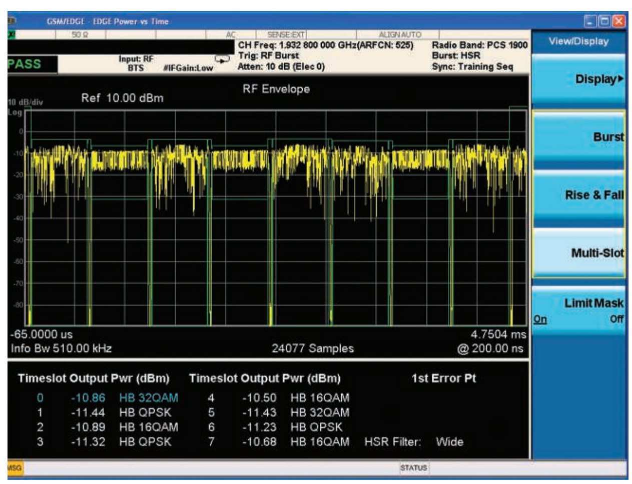


Figure 7. Multi-slot power vs. time on mixed modulation types of EDGE Evolution HSR burst

Demonstration 3.

Modulation quality: EDGE EVM

Modulation quality

The modulation quality measurement is significantly different between GSM and EDGE signal formats. This is due to different modulation schemes used between these two formats. GSM uses a GMSK modulation scheme, which is a constant amplitude scheme that transmits information in differential phase shifts. Therefore, phase and frequency accuracy are critical to the system's performance. EDGE, on the other hand, uses 3π/8 rotated 8PSK modulation scheme. EDGE Evolution has additional modulation formats such as 3pi/4 rotated QPSK, pi/4 rotated 16QAM and -pi/4 rotated 32QAM. These are non-constant amplitude modulation schemes, therefore the transmitter's phase, frequency and amplitude accuracy are critical to the system's performance. The modulation quality metric used for EDGE is Error Vector Magnitude (EVM).

EDGE EVM

The GSM/EDGE measurement application allows measurements of EDGE EVM and all related metrics. This measurement provides an I/Q constellation diagram, error vector magnitude (EVM) in RMS and peak, as well as magnitude error versus time, phase error versus time, and EVM versus time in a quad-view display. These additional views are invaluable in design, allowing one to view modulation quality while troubleshooting a design and isolate sources of impairments.

Instructions for the X-Series signal analyzer	Keystrokes
Make an EDGE EVM measurement	[Meas] {EDGE EVM} [Meas Setup} {Avg Hold Num 10 On/Off}
Measure the AM to PM timing offset. Note; The signal configured for this demo is not using polar modulation, however this step is done to demonstrate the unique capability of the GSM/EDGE measurement application for users who are using polar modulation (mostly this is for power amplifier measurement) (Figure 8).	[Meas Setup] {Burst Sync} {Polar Modulation}

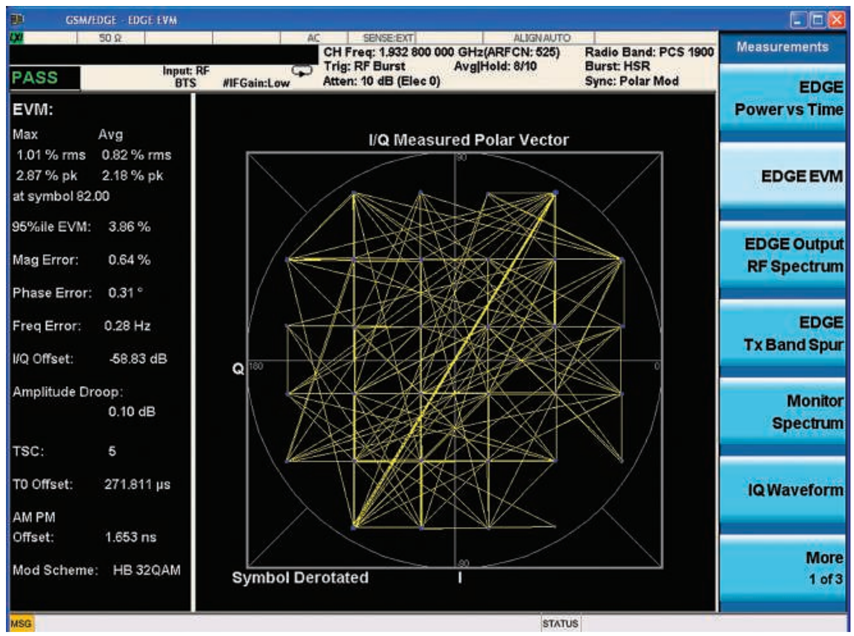


Figure 8. Polar vector display in EDGE EVM measurement with symbol de-rotated by default. A "real" EDGE signal has considerable inter-symbol interference (ISI), however, Keysight's proprietary ISI compensation algorithm provides both a clear constellation diagram and accurate EVM metrics. Also note, the AM to PM time offset result is displayed.

You can control the following EVM measurement parameters:

– Burst synchronization: This allows you to choose to synchronize to the training sequence, to the RF amplitude of the burst, to "none," or to the polar modulation sync.[2]
– When "none" is selected, the burst synchronization is solely determined by trigger signal and user defined trigger delay.
– Average mode
– Test limit setting: This setting allows for a user-editable pass/fail limit
– Carrier bandpass filter: This filter allows you to make EVM measurements in the presence of other carriers
– Droop compensation: This setting allows you to correct amplitude variations across a burst.
– Burst search threshold: This setting allows you to define a threshold where a valid burst is identified, after the data has been acquired.

Easily identify sources of impairments with the quad view display. When integrating a communications system, many signals (digital, baseband, IF, and RF) are present. The close proximity of the components is an invitation to cross-talk and can lead to unwanted signals in the signal output. The interfering signal is usually too small to be seen in the frequency domain. However, the EVM displays are capable of easily highlighting the presence of such interference. The interfering signal causes the amplitude or phase of the transmitted signal to be different each time the signal passes through the same state. PM interference causes a variation of the phase around the ideal symbol reference point.

Instructions for the MXG front panel	Keystrokes
Set the MXG to local mode from its current remote mode	[Cancel (Esc)] this puts the MXG in local mode
Go to the frequency and phase modulation menu on the front panel and toggle to the phase modulation menu	Press [FM/ϕM] {FM/ϕM} The ϕM term should be highlighted
Set the frequency of the internally-generated phase modulating signal to 5 kHz. **And** Set the phase modulation deviation to approximately 3 degrees	{ϕM Rate} [5] {kHz} {ϕM Dev} [2] {deg}
Turn on the phase modulation	Press {ϕM Off On}

Instructions for the X-Series signal analyzer	Keystrokes
Make an EDGE EVM measurement	[Meas] {EDGE EVM}
Change to the I/Q error quad view display (Figure 9)	[View/Display] {I/Q Error}
Change to the data bits display to look at the demod bits (Figure 10)	[View/Display] {Data Bits}

2. *The EDGE EVM measurement supports AM to PM timing offset measurements for power amplifiers that use polar modulation. Since polar modulation power amplifiers have two paths (AM and PM path), there are several measurement challenges that are hard to address by conventional methods. The EDGE EVM measurement makes this easy by calculating the timing offset of the amplitude modulation path to the phase modulation path and returns the AM to PM time offset metric. The user can also choose to compensate the measured AM-PM timing offset for EVM calculations. Verifying the time offset and calibrating (compensating for) it is important for polar modulated power amplifier design and manufacturing.*

The measurement passes, but a poor modulation quality could mean that engineers have to put up with lower data rates that have more redundancy in terms of error correction. A poor EVM due to poor magnitude accuracy would have pointed to problems in the amplifier, perhaps due to compression.

Figure 9. The quad view display in the EVM measurement shows that there is a regular phase modulating interfering signal that is degrading the EVM

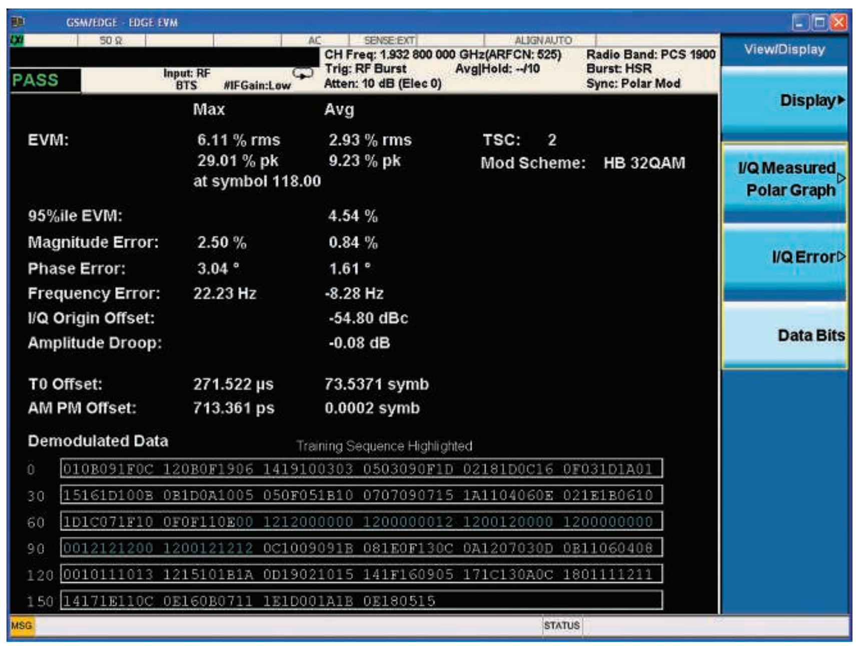


Figure 10. Notice that the TS (training sequence or midamble) is highlighted. The only portion of the timeslot that is not demodulated is the guard field. The data is only demodulated to the symbol level, thus for any of the payload data that is channel encoded, it will not be decoded to bit level.

Demonstration 4.

Modulation quality: GMSK phase and frequency error

GMSK phase and frequency error

Phase and frequency error is the equivalent modulation accuracy measurement for GSM systems. Like EVM, this metric can reveal a lot about a transmitter's performance. The GMSK modulation scheme used in GSM is more robust than the 3pi/8 rotated 8PSK used in EDGE. Regardless, a poor phase error metric means a likely reduction in the ability of a receiver to correctly demodulate a signal. With degrading modulation quality, the range at which a cell phone can operate reduces. A poor frequency error could mean that a receiver will not be able to synchronously demodulate a signal or the transmitter could interfere with other users.

The GSM/EDGE application provides a one-button phase and frequency error test, with a constellation display and phase error vs. time plot for further analysis.

Switch back to a GSM signal

Instructions for the MXG front panel	Keystrokes
Turn off the phase modulation that was turned on for the previous demo	[FM/ϕM] Press {ϕM Off On} Make sure Off is highlighted

Instructions for the MXG signal studio	Software operations
Generate a GSM signal with one timeslot turned on	Click **Carrier 1** under **Waveform Setup** Click  to open a window with a list of predefined carrier configurations. Select **GSM 1 Timeslot**, **1 Carrier** and click **OK**
Download the signal to the Keysight MXG	Press **Generate and Download** on the top tool bar

Instructions for the MXG X-Series signal analyzer	Keystrokes
Make a GMSK phase & frequency error measurement (Figure 11)	[Meas] {GMSK Phase & Freq}
If you have multiple timeslots ON, two vertical white bars will be displayed in the RF envelope plot of the lower left part of the display to indicate which timeslot is being measured.	
View the polar vector diagram (Figure 12)	[View/Display] {I/Q Measured Polar Graph}
View the demodulated data bits (Figure 13)	[View/Display] {Data Bits}

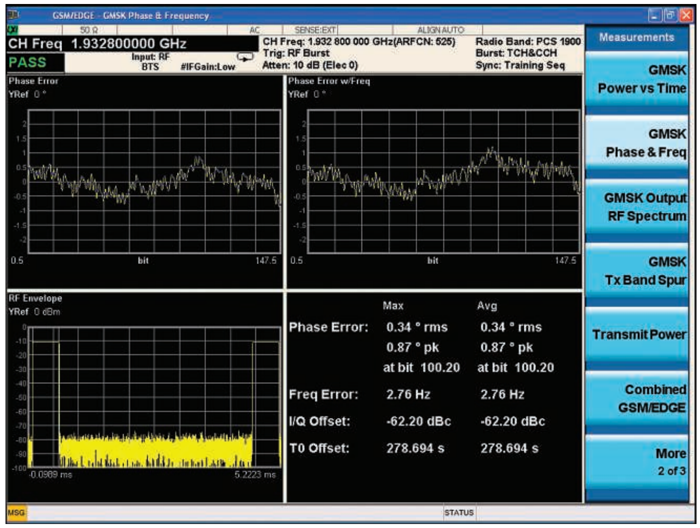


Figure 11. Quad view display showing phase error vs. time and phase with frequency error vs. time plots as well as RF envelope and result metrics. If you have multiple timeslots ON, two vertical white bars will be displayed in the RF Envelope plot of the lower left part of the display to indicate which timeslot is being measured.

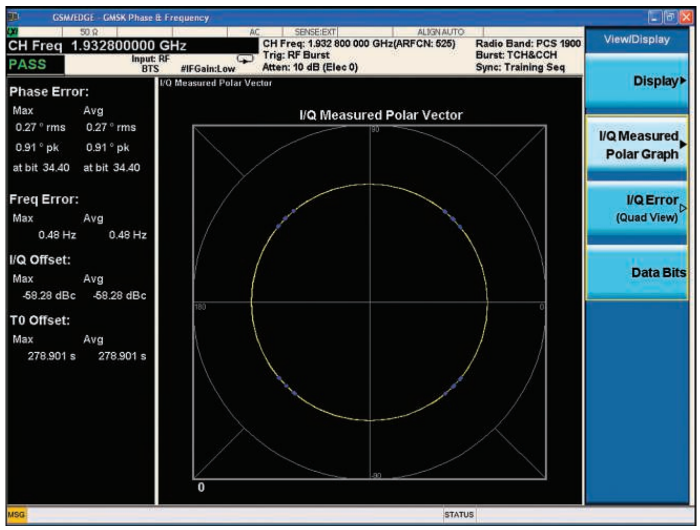


Figure 12. Polar vector display of phase and frequency error with the N9071A measurement application

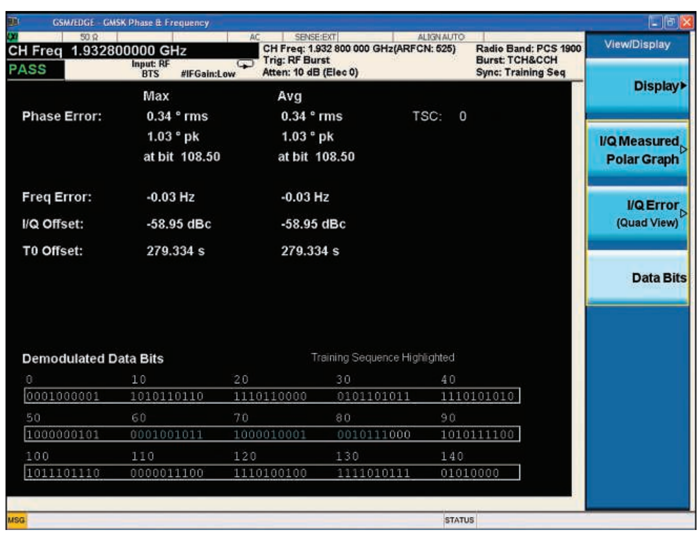


Figure 13. I and Q demodulated bits. Notice that the TS (training sequence or midamble) is highlighted. The only portion of the timeslot that is not demodulated is the guard field. The data is only demodulated to the symbol level, thus for any of the payload data that is channel encoded, it will not be decoded to bit level.

Demonstration 5.

Output RF spectrum

GMSK and EDGE output RF spectrum (ORFS)

The ORFS measurement is the GSM/EDGE version of the adjacent channel power (ACP) measurement. It is a measure of energy spilled from the transmitter into adjacent channels, caused by two elements:

1. modulation and wideband noise and
2. switching transients.

Spectrum due to modulation and wideband noise

The modulation process in a transmitter causes the CW carrier to spread spectrally. The spectrum due to modulation and wideband noise measurement is used to ensure that the modulation process does not cause excessive spectral spread. If it did, other users who are operating on different frequencies would experience interference. This measurement also checks for wideband noise from the transmitter, which will cause interference to other users. The specification requires the entire transmit band to be tested.

Spectrum due to switching

During the power vs. time measurement, a burst that ramps up too fast will be evident. However, there will be no violation of a mask. The test that will quantitatively indicate the existence of a problem is the spectrum due to switching on the ORFS measurement.

The GSM/EDGE measurement application divides the ORFS measurement into four one-button measurement types:

1. ORFS due to modulation and wideband noise
2. ORFS due to switching transients
3. ORFS due to modulation and switching
4. Full frame modulation (Fast)

Instructions for the X-Series signal analyzer	Keystrokes
Select the GMSK ORFS measurement	[Meas] {GMSK Output RF Spectrum}
Measure ORFS due to modulation and switching	[Meas Setup] {Meas Type} {Mod & Switch}
Change the multi-offset frequency list to standard so it measures ORFS to wider offset (Figure 14)	[Meas Setup] {Multi-Offset Freq List} {Standard}
Change the measurement to single offset and examine the ORFS at a 250 kHz offset from carrier (Figure 15)	[Meas Setup] {Meas Method} {Single Offset (Examine)}
Change measurement type to modulation or switching to view swept mode	[Meas Setup] {Meas Type} {Modulation} [Meas Setup] {Meas Method} {Swept}

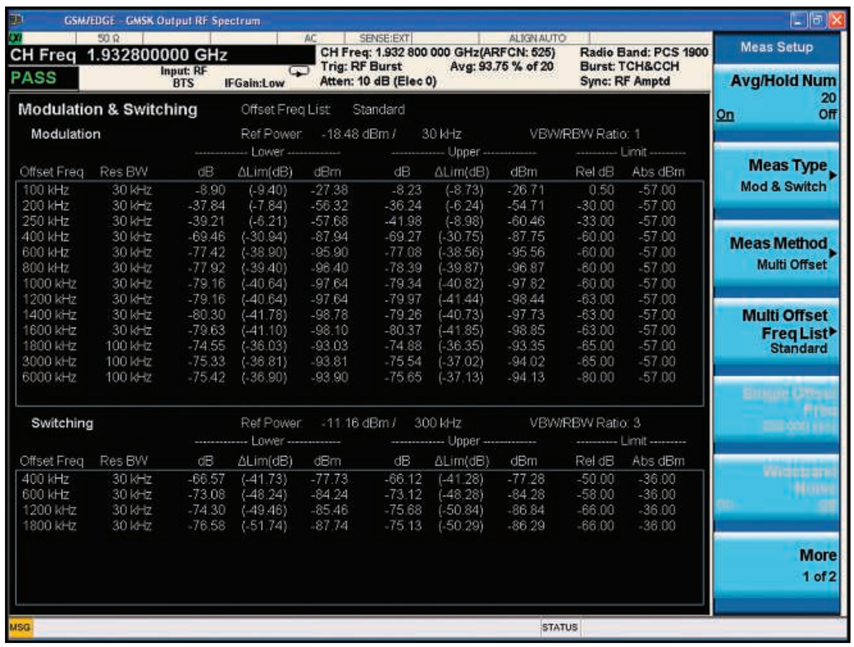


Figure 14. ORFS measurement due to modulation and switching in multi-offset mode; pass/fail indicator to signify compliance with the GSM specification

There are three measurement methods for measuring ORFS on the GSM/EDGE measurement application:

1. Multi-offset method which measures multiple offsets as defined by the standard
2 Single offset method which can be regarded as an examine mode, where the power of the modulated signal at a single offset from the carrier frequency is calculated
3. Swept method where the measurement is made in the frequency domain and the analyzer sweeps the range as opposed to stepping through the defined frequency offsets. This is a great feature to represent the spectrum due to modulation in a spectrum trace with a mask.

You can control the following ORFS measurement parameters:

– Averaging
– Multi-offset freq list: allows you to set short, standard, or customized offset frequency lists
– Fast average: improves measurement speed by almost 2 times for modulation measurement when measurement method is set to single offset or multi offset
– Fast peak detection: improves measurement speed by almost three times by using peak detection mode; only valid for switching measurement
– Mod avg type: allows you to set log power averaging or power (RMS) averaging
– RBWs for the carrier as well as the various offsets

Note:
Remember to choose the appropriate measurement type from Modulation, Switching or Mod & Switch for speed tuning. Mod & Switch combined measurement speed is slower than others because of more complicated calculations in the background.

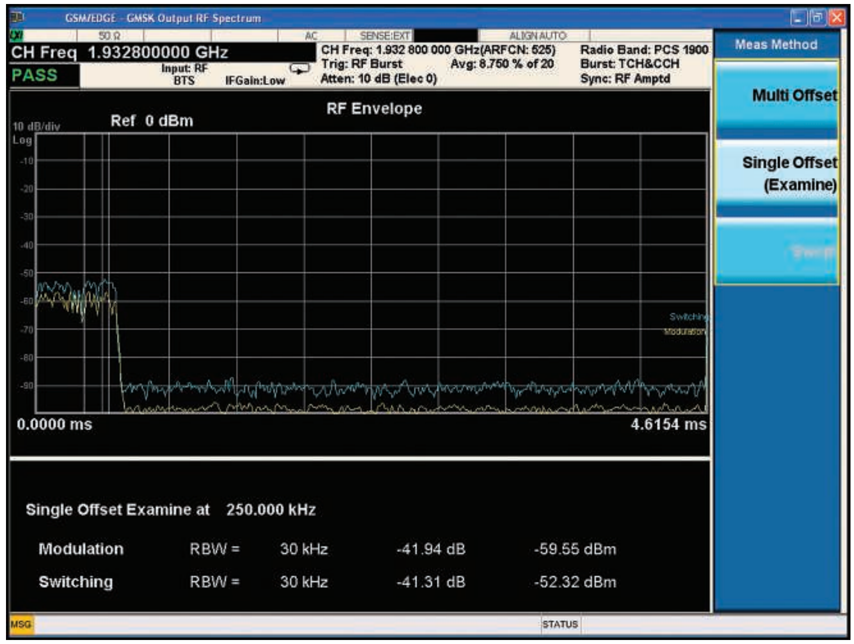


Figure 15. ORFS measurement due to modulation in single offset or examine mode on the measurement application plus pass/fail indicator to signify compliance with the GSM specification

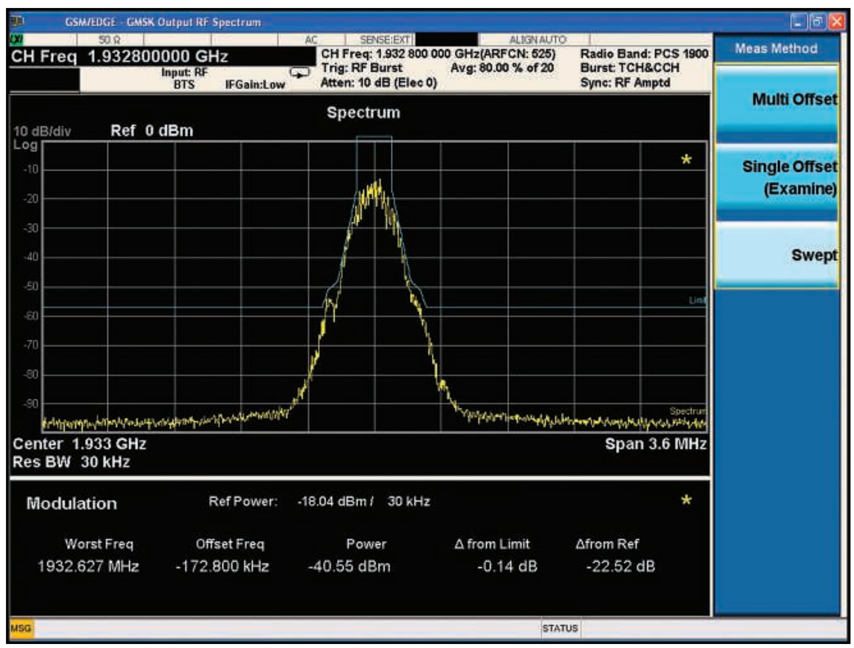


Figure 16. ORFS measurement due to modulation in swept mode on the measurement application plus pass/fail indicator to signify compliance with the GSM specification

Demonstration 6.

Transmit band spur

GMSK transmitter band spurious

Tx band spurious is a measurement that identifies undesirable energy in the wrong parts of the Tx band. This measurement reveals little more than the ORFS measurement. However, it is a swept measurement with no time gating.

Instructions for the MXG front panel	Keystrokes
Set the MXG to local mode from its current remote mode	[Cancel (Esc)] this puts the MXG in local mode
Change frequency to 1.9302 GHz; this is ARFCN 512	[FREQ] [1.9302] {GHz}
Increase the GSM signal amplitude	[AMPTD] [15] {dBm}

Instructions for the X-Series signal analyzer	Keystrokes
Change frequency to 1.9302 GHz; this is ARFCN 512	[FREQ] {ARFCN} [512] {Enter}
Change frequency channel to Bottom	[FREQ] {BMT Freq} {Bottom}
Measure transmitter band Spurious with a marker (Figure 17)	[Meas] {GMSK Tx Band Spur} [Marker]
Change measurement type to Examine	[Meas Setup] {Meas Type Examine/Full}
Select display to show the Highest Segment	[View/Display] {Highest Segment}

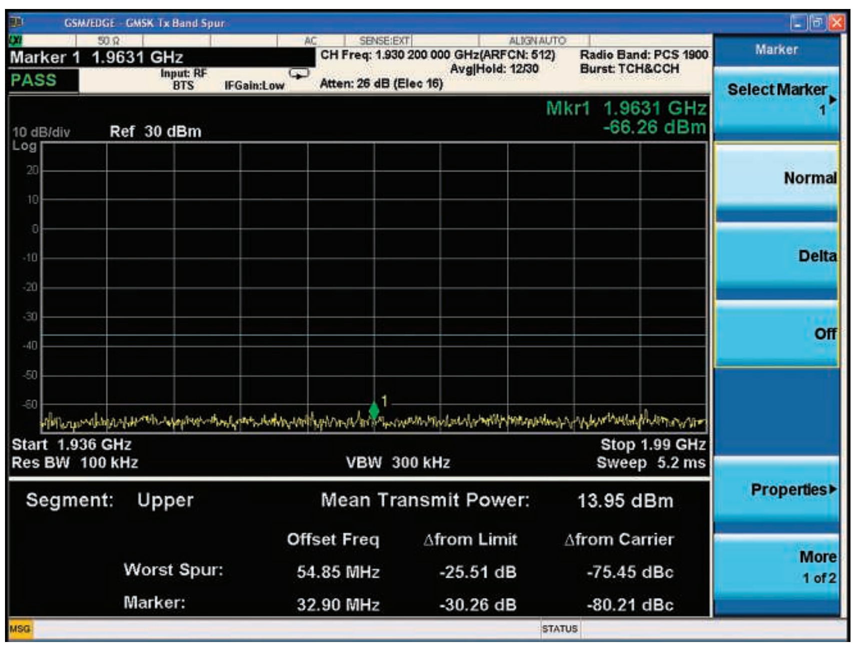


Figure 17. GMSK Tx band spurious

Transmit power

Carrier power is the measure of in-channel power for GSM/EDGE systems. Mobiles and base stations must transmit enough power with sufficient modulation accuracy to maintain a call of acceptable quality without the power leaking into other frequency channels or timeslots. GSM systems use dynamic power control to ensure that each link is maintained with minimum power consumption. This gives two fundamental benefits: overall system interference is kept to a minimum and, in the case of mobile stations, battery life is maximized.

Instructions for the X-Series signal analyzer	Keystrokes
Measure Transmit Power	[Meas] {Transmit Power}
Move the threshold level to –40 dB. Notice the horizontal, white level bar move down (Figure 18)	[Meas Setup] {Threshold Lvl Rel} [–40] {dB}

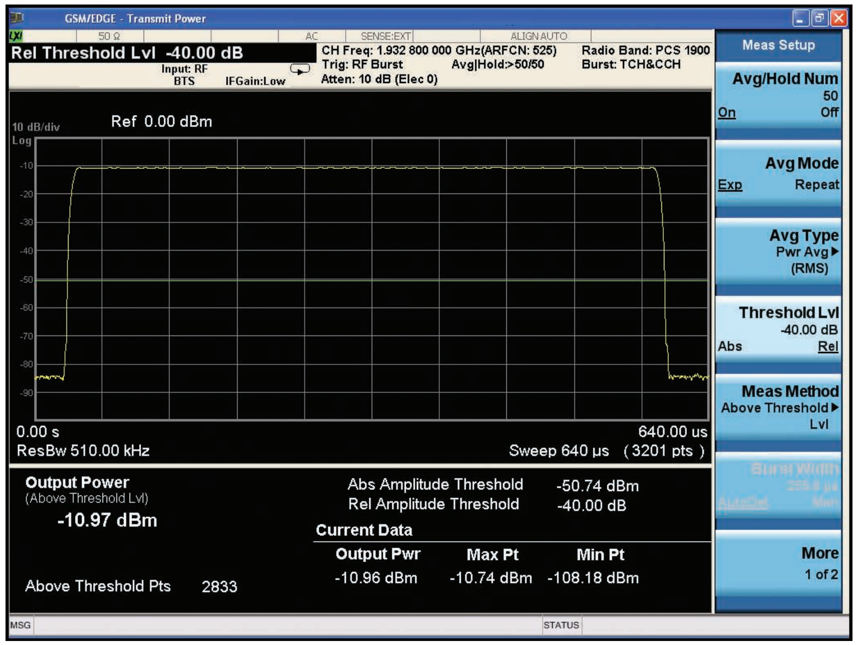


Figure 18. GSM transmit power

Single Acquisition Combined GSM/EDGE Measurement Application

Introduction

The increasing complexity of today's mobile devices, driven by the need for multiple-frequency/band coverage, multiple support (2G/3G and emerging communication technologies), and applications (phone, multimedia and PDA)—combined with increasing pressure to lower expenses and speed production, are driving manufacturers to look for ways to reduce test times and test costs. By using general-purpose RF test equipment without any call-processing for production testing, it is possible to apply new measurement techniques to drastically reduce the test time and save money.

The Keysight N9071A-XFP single acquisition combined GSM/EDGE measurement application is a new breakthrough high-speed manufacturing test solution available for the first time as an option on Keysight's highest speed, general-purpose X-Series signal analyzers (MXA/EXA). When testing GSM/EDGE mobile phone transmitters,
wireless components (such as power amplifiers), as well as and low-cost pico/femto cell base stations, the N9071A-XFP measurement application allows manufacturers to make measurements up to 20 times faster than traditional one-button measurements. The N9071A-XFP measurement application is designed for time-critical tests on the production line, and the high dynamic range of the Keysight X-Series signal analyzers ensures that the measurements remain as accurate as possible.

Helpful tip:

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.

In order to perform the single acquisition combined measurements, the N9071A-XFP measurement application option requires the N9071A-2FP GSM/EDGE measurement application option to be installed.

Features and benefits

– SCPI[3]-based measurement application allows production familiar remote programming commands for ease of test software development

– Test speeds up to 20 times fasterthan traditional one-button approaches

– Flexible selections of predefined parameters allow easy and customizable set-up of the measurements to suit various production test requirements

– Tabular user interface showing the measurement list, parameter list and result metrics keeps the display simpler and easier to understand rather than only showing a list of SCPI commands

– Additional views for Power vs. Time (PvT), marker measures, and RF envelope provide troubleshooting tools

Available measurements

– List power step measurement

– Phase and frequency error (PFER) for GMSK modulation

– EDGE EVM (EEVM) for 8PSK

– Power versus time (PvT)

– Output RF spectrum (ORFS)

– Marker measurements

– Harmonics

3. *SCPI is the abbreviation for Standard Commands for Programmable Instruments.*

Measurement overview

Single acquisition combined measurements are performed using the following sequence for production tests:

Step 1: List power step measurement for power level calibration[4]

Step 2: Transmitter performance verification with combined GSM/EDGE measurements

Step 1: List power step measurement for rapid power calibration ("Fast Device Tune")

The list power step measurement allows fast frequency versus power calibration for RF transmitters. This offers an alternative approach to the use of a power meter based test to determine the calibration matrix for a transmitter, and this approach eliminates the need for active signaling during the test. The user can specify a range of frequency and power levels, and the instrument will make all of these measurements sequentially on receipt of the trigger to begin the test.

As more manufacturers move to non-signaling mode measurements on the production line, the N9071A-XFP measurement application option's list power step measurement provides a new approach for performing "Fast Device Tune" (FDT) measurement using a general-purpose signal analyzer.

Figure 19 shows an example signal which has six amplitude steps in a frame. The first frame is on 1 GHz, the second on 2 GHz. The timing between the two frames is 1 millisecond. Figure 20 shows the results view for the example. The same result metrics can also be listed in a tabular format when "result metrics" is selected (refer to Figure 21).

Fast measurement settling time:

The Keysight X-Series signal analyzers have an extremely short local oscillator (LO) settling time of less than 500 microseconds. Coupled with a fast LO re-tune speed, the analyzers are capable of rapid frequency stepping for full transmitter power calibration in fractions of a second.

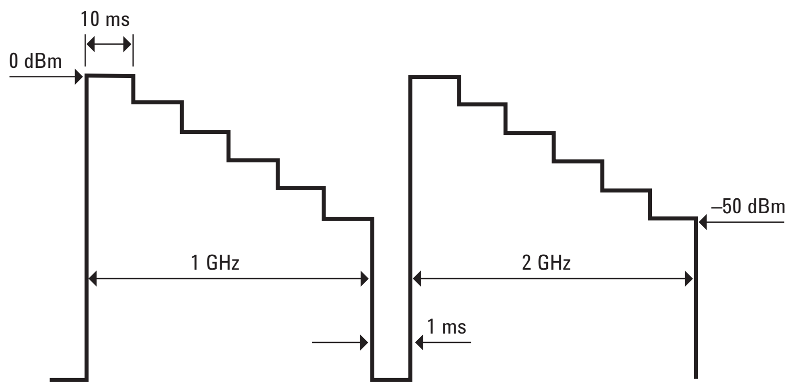


Figure 19. List power step measurement provides another approach for signal calibration

Figure 20. Example of result trace view

4. *This requires mobile phone support to output at a series of frequencies and levels.*

Step 2: Transmitter performance verification with combined GSM/EDGE measurements

The N9071A-XFP combined measurement application option can make any combination of PFER, EEVM, ORFS and Power vs. Time (PvT) measurements after the individual measurement item is enabled using the associated remote SCPI command. The data capture will be done once. The acquired data is a sequence of captures and all of the results will be calculated after the capture is completed. The zero-span measurements will be executed if either Marker or Harmonics measurement is selected. If there is more than one frequency to be measured, the user can specify multiple frequencies in a capture list using SCPI commands, along with an allowable time period for the "Single Capture Interval" at each frequency in the sequence.

The combined GSM/EDGE measurement consists of two types of acquisitions, I/Q data acquisition and zero span data acquisition. The supported measurement items are shown in Table 2.

The marker functions are identical to those in the general-purpose spectrum measurement application. For example, the 12 Normal, Delta, Noise, Band power and band density markers are all supported. The harmonics measurement executes multiple zero span acquisitions according to how many harmonics are specified in the frequency list.

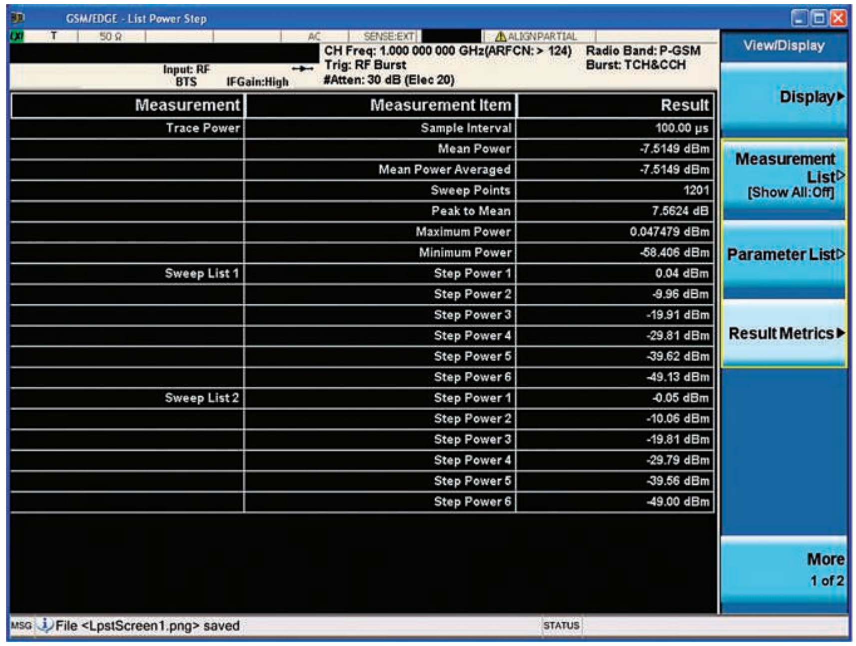


Figure 21. Same results listed in tabular format in result metrics view

Table 2. Description of the two types of acquisitions used in a combined GSM/EDGE measurement application

Acquisition types	Support measurements	Associated enable/disable SCPI commands
I/Q data acquisition	Phase and Frequency Error (PFER) for GSM or GMSK[5] EDGE EVM (EEVM) for 3π/8 8PSK modulation[5] Output RF Spectrum (ORFS) GMSK and EDGE Power versus Time (PvT).	Demod Enable [:SENSe]:CGSM:DEMod[:ENABle] ON|OFF ORFS Enable [:SENSe]:CGSM:ORFS[:ENABle] ON|OFF PVT Enable [:SENSe]:CGSM:PVT[:ENABle] ON|OFF
Zero span data acquisition	Marker measurement Harmonics measurement	Marker Enable [:SENSe]:CGSM:ZSPan[:ENABle] ON|OFF Harmonics Enable [:SENSe]:CGSM:HARMonics[:ENABle] ON|OFF

5. *The PFER and EVM are exclusive at a same frequency.*

Combined GSM/EDGE Application Measurements

1. Acceleration of test speed without required measurement switching and using fewer acquisitions

Compared with traditional one-button measurements which limit the "speed" of tests due to measurement switching time (such as from PFER to ORFS), the combined GSM/EDGE measurement application uses SCPI-based programming to configure the X-Series signal analyzer to conduct the specified measurements ahead of time, without measurement switching, and with fewer acquisitions that normally would require processing of the data after each capture is completed.

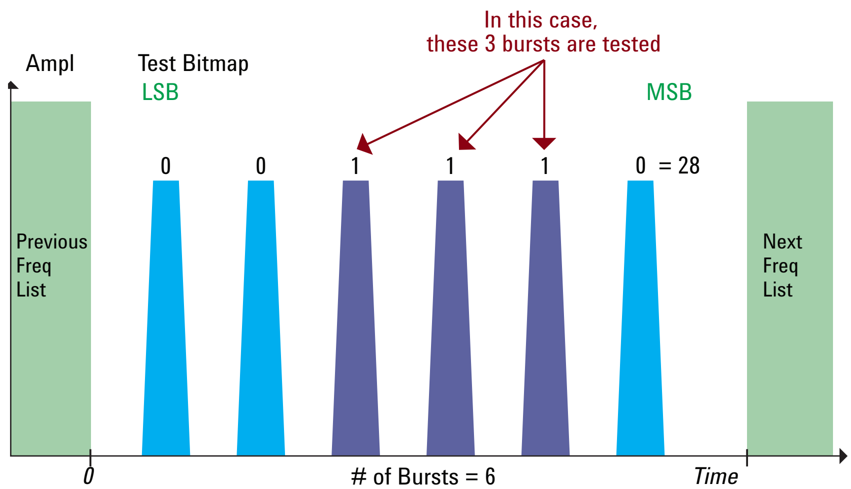


Figure 22. The "Test Bitmap" specifies which bursts are to be tested

2. Greater flexibility of measurement setup using the "Test Bitmap" concept

The N9071A-XFP measurement application option provides high flexibility for the set-up of combined measurement parameters. Figure 22 shows an example of a 6-burst GSM signal at one frequency. The "Test Bitmap" specifies which bursts are to be tested. Set the bit to 1 to test the burst. Set the bit to 0 to ignore the burst. For modulation analysis performed on the 4th and 5th bursts, set the test bitmap value to the decimal integer value of the binary number. In Figure 22, the binary number is 001110, so the integer is 28. The test bitmap has a 16-bit field (0 to 65535 in decimal) allowing up to 16 bursts to be tested. The SCPI command example is:

```
[:SENSe]:CGSM:DEMod:TEST 28
[:SENSe]:CGSM:DEMod:TEST?
```

Each measurement can have its test bitmap set independently.

3. Simplified user interface for reduced processing overhead allows for highest speed

The user interface of the N9071A-XFP measurement application option is designed for production users.

Figure 23 shows a “measurement list” view which provides the current status of all enabled measurements and result items. The measurement list can be customized according to specific production test requirements. Disabled measurements are grayed out.

Figure 24 shows a “parameter list” view that lists all names, remote SCPI commands, and parameter values of the measurement commands. The value can be verified or modified by using the menu and front panel keys or by using a mouse and keyboard, which is more convenient than accessing to the SCPI programming interface for minor changes.

Figure 25 shows a tabular "result metrics" view that contains information in the same order as the remote SCPI command measurement results by index (n = 1).

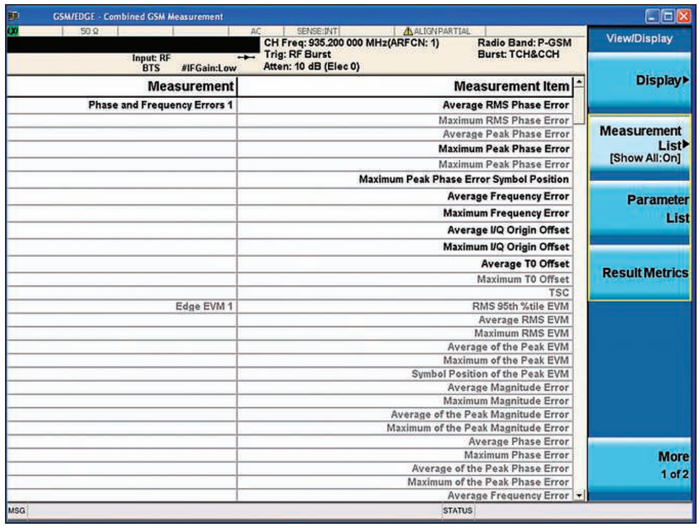


Figure 23. Measurement list view

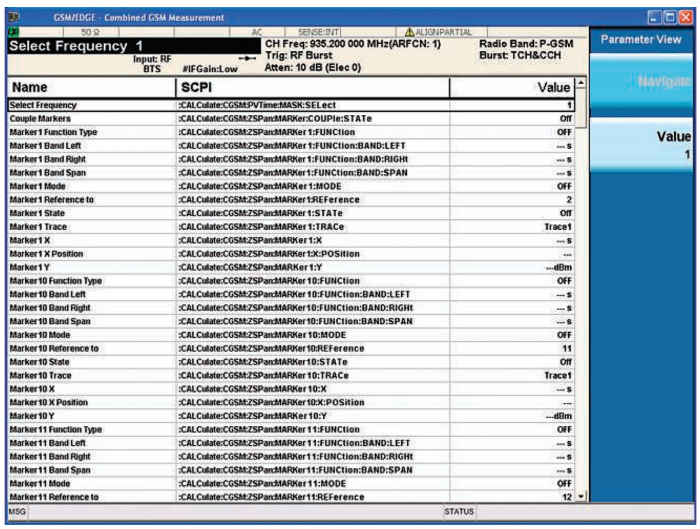


Figure 24. Parameter list view

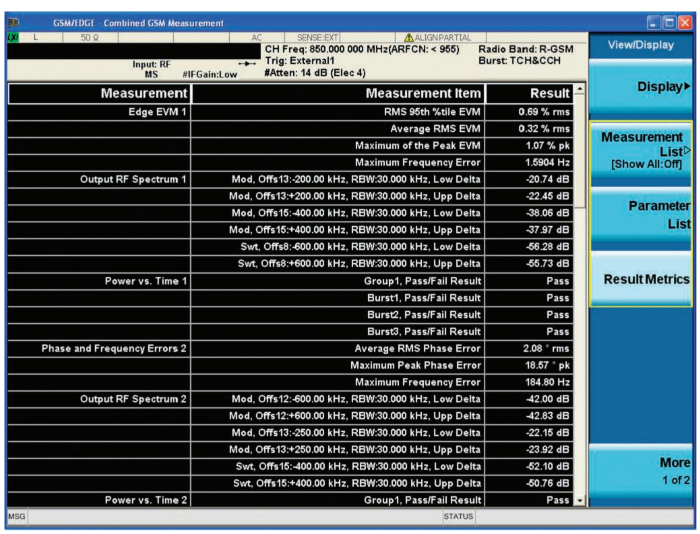


Figure 25. Results metrics view

4. Comprehensive user interface for troubleshooting

For troubleshooting or diagnostic purposes, the N9071A-XFP measurement application option provides a graphical user interface with display of measurement traces.

Figure 26 is a view of the time-domain magnitude plot with a PvT mask of the selected burst for the selected frequency. The burst and frequency are specified by 'Burst Index' and 'Frequency Index' SCPI commands respectively.

Figure 27 shows a trace of a GSM signal in zero span, and the marker is turned on when the "Marker Meas." is selected.

Figure 28 shows a view of a RF envelope. In this view, the instrument can acquire a trace for demodulation in addition to ORFS and PvT measurements.

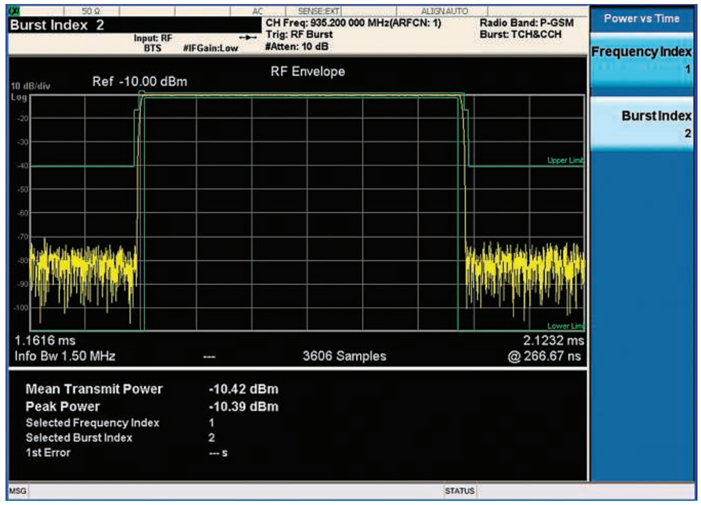


Figure 26. Power vs. time

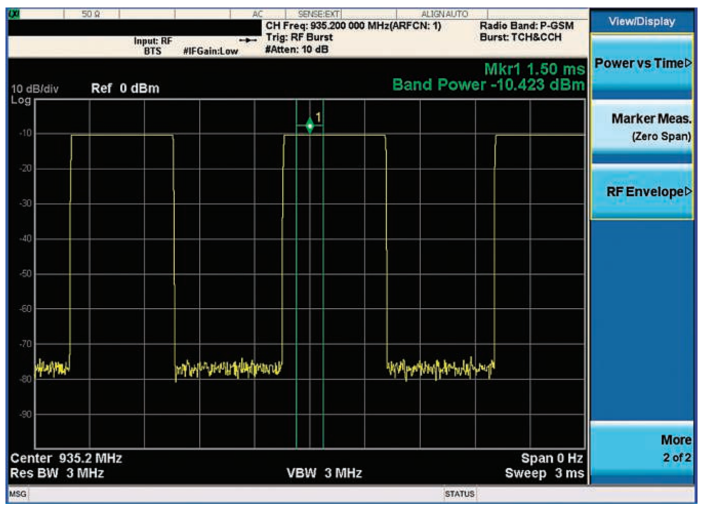


Figure 27. Marker measurement view

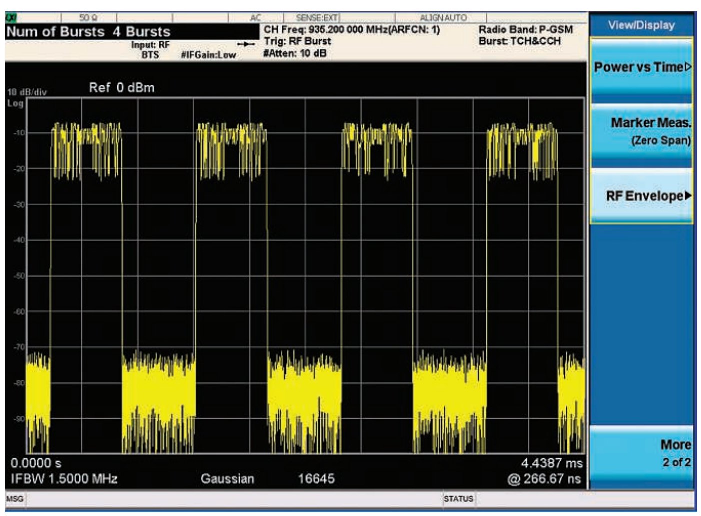


Figure 28. RF envelope view

Web Resources

Product pages:
www.keysight.com/find/N9071A and
www.keysight.com/find/W9071A

X-Series signal analyzers:
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