

# PXI Modules

## GSM/EDGE Measurement Suite

**AEROFLEX**  
A passion for performance.



A complete suite of measurement functions to analyze GSM and EDGE mobile transceiver RF performance in conjunction with Aeroflex 3000 Series PXI RF modules.

- TX average power and burst power profile
- GMSK phase error (peak and RMS)
- 8PSK EVM, origin offset suppression
- 95th Percentile EVM
- Frequency error
- Output radio frequency spectrum
- Reference sensitivity (BER, BER II, RBER II & FER)
- Use with 3030 & 3020 series PXI RF Modular Instruments

### Introduction

The GSM/EDGE measurement suite is a collection of software tools designed for use with Aeroflex 3000 series RF modular instruments to perform high speed RF measurements of mobile devices components and sub assemblies during R&D design verification test system engineering, manufacturing test and quality control.

The measurement suite is comprised of three elements:

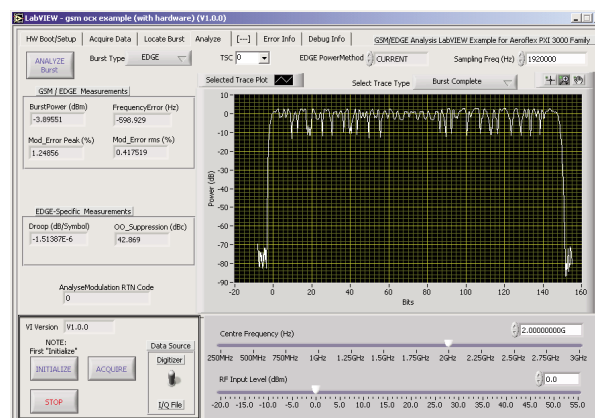
Two analysis libraries (C/C++ .dll and associated .net assemblies) of specialized functions that together characterize the Tx and Rx RF performance of GSM/EDGE transceivers in accordance with 3GPP 51-101-1 V5.2.1 sections 12.17.1 to 4 for Tx and 13.14.2 for Rx. Transmitter measurements include parameters associated with power modulation and spectrum and Rx measurements include receiver sensitivity (BER, class II RBER and FER) using loopback methods as defined in ETSI ETS 100 293 (GSM 01.14). These libraries require separately acquired I and Q samples as provided from a 3030 series RF Digitizer. Rx sensitivity measurements additionally require a 3020 series RF Signal Generator.

A simple to use high level measurement library, (.dll) providing a programming interface for use in a wide range of application development environments (ADE), such as National Instruments LabView™ and LabWindows™ CVI and Microsoft Visual Studio™ and Visual Basic™ for high speed automated test applications. This library combines optimised RF Digitizer and RF Signal Generator control together with GSM/EDGE analysis libraries above.

A virtual instrument (VI) graphical user interface plug-in for use with Aeroflex's PXI-Studio application software to provide a manual user interface for use during R&D and programme development.

### Highlights

The GSM/EDGE measurement suite provides analysis of all major GSM/EDGE signal characteristics including average RF power, burst profile, modulation quality (either as phase error or error vector magnitude), frequency error and spectrum due to modulation and switching, Rx receiver reference sensitivity (BER, class II RBER and FER). EDGE signals can be further characterized in terms of Origin Offset Suppression and 95th Percentile EVM.



GSM/EDGE Measurement Suite examples

### Measurement Speed

Typical measurement times are shown below for measurements of a GSM/EDGE mobile operated in TCH mode.

Measurement times are based on asynchronous data capture of either 1 or 10 TDMA frames using an embedded 2.2 GHz P4 CPU.

Mode	Measurement	Measurement time (ms)	
		1 burst	10 bursts
GSM	Tx Power Power profile Frequency Error Phase Error (peak/rms)	7.6	55.6
	ORFS	10.3	85
	All parameters	10.3	85
EDGE	Tx Power Power profile EFVM, carrier leak & frequency error	9.6	76.3
	ORFS	9.8	100.5
	All parameters	11.6	100.5

#### Typical GSM/EDGE transmitter measurement times

A specific fast power measurement method is also provided that can perform fast burst power analysis independently from demodulation. In this mobile Tx power calibration can be accelerated.

### Bit Error Rate (BER)

Making fast measurement of GSM receiver BER is possible with the inclusion of a 3020 Digital Signal Generator with an appropriate BER test waveform (supplied). BER measurement requires the use of non-signalling test modes within the mobile receiver. BER can be measured using GSM test loops A, B or C. Additionally, FER can be measured for test loop B. Using test loop A or B, the BER measurement can be performed for a user defined number of speech frames (20 ms) each containing 78 class II un-encoded data bits. Using test loop C, (burst by burst), a faster measurement is performed using all 114 data bits with a user defined number of TDMA bursts.

Marker events within the test waveform can be used to perform synchronous data capture in the 3030 series RF Digitizer. This not only simplifies the test set-up but also reduces the amount of data that must be acquired and therefore minimizes measurement time still further.

Using test loop C, BER can be measured in 0.4 s for 72 frames (8,200 bits). This time includes signal acquisition and measurement processing based on using a 1.86 GHz Intel™ Core2Duo processor.

Note: -The downlink signal waveforms supplied are compatible for use with any Aeroflex 3020 series module irrespective of option status.

## SPECIFICATION

All specifications are defined for the GSM/EDGE measurement .dll API / PXI Studio GSM/EDGE plug-in in conjunction with a 3030 series PXI RF digitizer operating in any GSM band between 400 MHz and 2000 MHz. GSM BER and Tx Burst Timing Error measurements additionally require a 3020 series PXI digital RF signal generator. The 3030 and 3020 modules are required to be populated on a common PXI trigger bus segment.

### CONFIGURATION SETTINGS

#### Frequency

Frequency can be entered as an absolute value in Hz or as a channel number 0 to 1023, where channel number corresponds to the ARFCN for the System Band selected

#### System Band

GSM400, GSM700, GSM850, GSM900, DCS1800, PCS1900.

#### RF Level Mode

Manual or Power Control Level (PCL) 0 to 31 as defined by the System Band in use

#### Burst Type

Normal, Access or Auto

#### Training Sequence

0 to 7 or Auto

#### Timeslot number

1 to 8

#### Path loss

External path losses on Downlink and Uplink in dB

## GSM/EDGE SPECTRUM

### Frequency Span

From 0.5 MHz to 10 MHz, resolution 1 Hz

### Resolution Bandwidth

10 kHz, 30 kHz or 300 kHz

## I&Q POWER VS. TIME

Power versus time of captured I & Q data

### Capture time range

0 to 1000 ms

## GSM/EDGE AVERAGE POWER

The transmitter output power is the average value of the power over the time that the useful information bits of one burst are transmitted. Power can be measured either together with or without modulation analysis results. When measured alone (Fast Burst Power) results are processed more quickly. Accuracy is specified with PXI Studio RF Level Attenuation Mode set to Auto.

### Indication

#### Average power across the timeslot in dBm measurement range

S/N >25 dB in GSM channel

#### EDGE power methods

Current, long term average or estimate

#### Accuracy (refer also to 3030 series specification)

RF Level Attenuation Mode set to Auto, S/N >40 dB in the temperature range 23°C ±5°C

### 3030A/3035

All GSM bands  $< \pm 0.5$  dB, typically  $\pm 0.3$  dB

### 3030C/3035C

GSM 400 band  $< \pm 1.0$  dB typically  $\pm 0.5$  dB

All other GSM bands  $< \pm 0.7$  dB typically  $\pm 0.3$  dB

## GSM / EDGE POWER PROFILE

Power versus time mask for the complete burst, rising edge, falling or useful part only.

### Indication

Global pass/fail indication with respect to power mask

Separate pass/fail indication for rising, falling and useful part

The level (dB relative to mask) and time position of the worse case failing point or nearest point in proximity to the mask is displayed for the entire burst and each of the rising, falling and useful parts.

Power versus time/symbol and mask traces for complete burst, useful part, rising part and falling part (mask trace is defined by selected GSM band and PCL level)

### Dynamic Range

RF Attenuation mode set to Auto and for input levels  $> 0$  dBm

### Accuracy (power ramp up/down)

Level:  $\pm 0.1$  dB/10 dB<sup>(1)</sup> (relative to peak power)

Time:  $< 0.5$   $\mu$ s

<sup>(1)</sup> Excludes the effects of noise.

### Accuracy (useful part)

Level:  $\pm 0.02$  dB (relative to peak power)

Time accuracy  $< \pm 0.1$  symbol

## BURST TIMING ERROR

The relative timing error between the downlink signal out of 302x and the uplink response input to 303x

### Indication

Symbols

Value requires correction to eliminate propagation delays within the test system

## GMSK MODULATION

### Phase Error Range

0 to  $10^\circ$  RMS

0 to  $40^\circ$  peak

### Indication

RMS + Peak phase error in degrees

Trace display of phase error versus symbol number

### Accuracy

$< \pm 0.5^\circ$  rms

$< \pm 1.0^\circ$  peak

## 8PSK MODULATION

The minimum RMS magnitude of the error vector is calculated for a single slot.

### EVM Range

0 to 20% EVM rms

0 to 40% EVM peak

### Indication

RMS + Peak EVM in %.

Trace display of EVM versus symbol number

### Accuracy

$< \pm 0.4\%$  rms

$< \pm 1\%$  peak

### Offset Origin Suppression Range

$> 20$  dB to 60 dB (floor)

### Offset Origin Suppression Accuracy

$< \pm 0.5$  dB at 33 dB

### Droop (amplitude)

Slope of power variation across useful part of the burst

### Indication

$\pm$  dB/symbol

## FREQUENCY ERROR

Measurements are performed for a single slot.

The frequency error measured is the difference between the 303x RF input signal and the nominal 303x tuned frequency.

### Frequency Error Range

Typically  $\pm 10$  kHz GMSK,  $\pm 6$  kHz 8 PSK

### Frequency Error Accuracy

$< \pm (5 \text{ Hz} + (\text{Tx freq} \times \text{freq standard error}))$

## ORFS (OUTPUT RADIO FREQUENCY SPECTRUM)

### SPECTRUM DUE TO MODULATION

This measurement determines the time gated average power at up to 20 specified frequency offsets.

### Burst Type

Normal

### Range offset

$\pm 10$  MHz

### Measurement Range (typical)

Carrier Frequency	GMSK		8PSK	
	$\leq 1$ GHz	$\leq 2$ GHz	$\leq 1$ GHz	$\leq 2$ GHz
Frequency Offset	dBc	dBc	dBc	dBc
100 kHz	-76	-70	-73	-67
200 kHz	-81	-75	-78	-72
250 kHz	-82	-76	-79	-73
400 kHz	-83	-77	-80	-74
1.8 MHz	-84	-79	-81	-76
6 MHz	-85	-79	-82	-76

## Accuracy

Typically  $\pm 0.05$  dB/10 dB

Excludes the effects of noise

## SPECTRUM DUE TO SWITCHING

This measurement determines the peak power at selected frequency offsets.

### Burst Type

Normal

### Range offset

$\pm 10$  MHz

### Measurement Range (typical)

Carrier Frequency	GMSK		8PSK	
	$\leq 1$ GHz	$\leq 2$ GHz	$\leq 1$ GHz	$\leq 2$ GHz
Frequency Offset	dBc	dBc	dBc	dBc
400 kHz	-73	-67	-70	-64
1.8 MHz	-74	-69	-71	-66

## Accuracy

Typically  $\pm 0.05$  dB/10 dB

Excludes the effects of noise

## BER, BER II, RBER II, FER

### Loopback Modes

Speech loopback (loop A, B)

Burst loopback (loop C)

### Number of Frames

Speech Frames (loop A, B)

78 class II data bits in each speech frame

Burst by burst (loop C)

114 class II data bits in each TDMA burst

### TCH Timeslot

0 or 5

## Measurement Results

Number of bits examined

Number of error bits found

Bit Error Rate (%)

Number of frames examined\*

Number of error frames found\*

\* loop B only

## ORDERING

This application is designed for use in conjunction with the 3030 PXI RF Digitizer.

It may be either purchased with the 3030 at time of order or purchased as an upgrade to the 3030.

When purchased with the 3030, order as: 3030 option 100

When purchased as an upgrade, then order as: RTROPT100/3030

### CHINA Beijing

Tel: [+86] (10) 6539 1166  
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