PXI Studio

Application software for advanced RF digital communications test

Vector Signal Generator and Vector Signal Analyzer /Spectrum Analyzer application software with options for wireless data and cellular standards:

- GSM/EDGE
- UMTS/HSUPA
- CDMA2000 and 1xEV-DO Rev A
- WiMAX
- WLAN
- Bluetooth (+ EDR)

Ideal for R&D and test system engineering applications using Aeroflex 3000 Series PXI modular RF instruments.

INTRODUCTION

PXI Studio is a Windows™ software application for use with the Aeroflex 3000 Series. This highly flexible application allows you to simultaneously generate and characterize complex modulated RF signals. Measurement tools enable difficult problems to be tracked down quickly and help simplify design proving or test system development.

PXI Studio installed in a PC and connected with your PXI hardware modules forms a tightly coupled high performance laboratory test instrument.

PXI Studio presents a single integrated graphical user interface to control multiple configurations of Aeroflex PXI 3000 Series modules. As standard it provides Signal Generator and/or RF Digitizer control with general purpose spectrum or time domain analysis for RF component testing or alignment of radio communications transceivers.

Optional measurement plug-ins extend measurement support to cater for a wide variety of communication standards within the same application framework making the test solution extremely versatile. In each case the plug-in extends the capabilities to provide power, spectrum and modulation analysis with results displayed in user configurable tiles. A variety of trace displays are provided as appropriate to the communication standard each permitting close examination of underlying problems beyond the scope of traditional measurement instruments. When used synchronously with complex signal generation, stimulus and response component measurements or complete transceiver characterization can be accomplished with ease.

All measurement processing is performed within the host PC. Performance is therefore directly enhanced as PC processing power improves and thereby prolongs the productive life of the system.

PXI Studio plug-ins each have an associated remote programming interface (.dll with .net assemblies) for use in a wide variety of application development environments such as National Instruments LabView/LabWindows CVI/Test Stand, Microsoft Visual Studio and Visual Basic. In addition, each measurement suite provides hardware independent low-level function libraries enabling more experienced programmers the option to maximize test system flexibility by coding PXI hardware control and measurement functions independently.

STANDARD PXI STUDIO PLUG-INS

PXI Studio automatically determines how many and what type of logical instruments can be formed from the PXI hardware resources connected. Any number of logical instruments may be formed and controlled simultaneously from the same application making PXI Studio adaptable to whatever 3000 Series PXI modules are in use. Three basic logical instrument types are defined RF Digitizer, Signal Generator and RF Combiner. The performance and operating range of each is determined by which module variant is used.

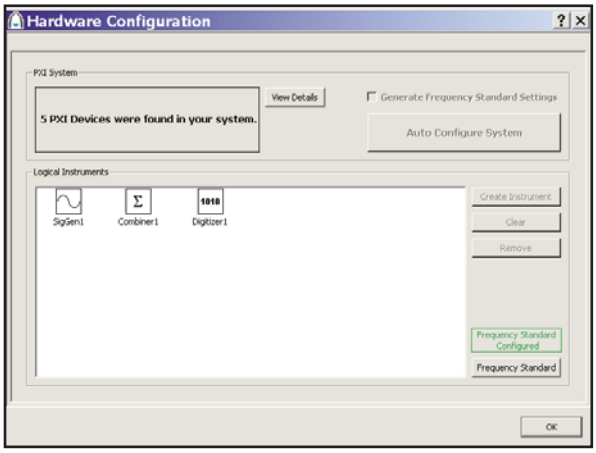

Figure 1. PXI Studio hardware configuration

Digitizer Plug-in

The digitizer plug-in is a general purpose interface to control any 3030 Series digitizer and output or plot the acquired signal in a variety of ways. A zoom feature allows you to examine the signal viewed in fine detail without acquiring new data.

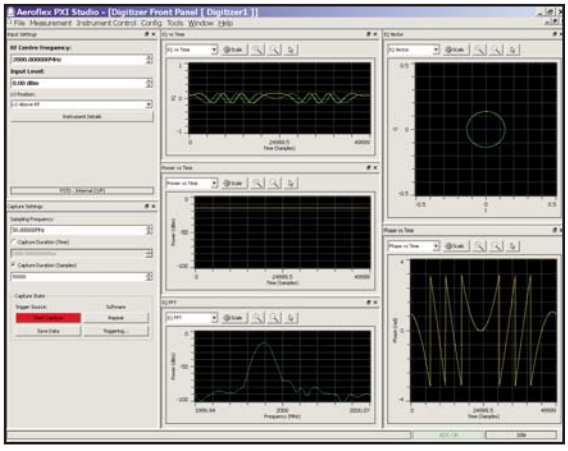

Figure 2. RF Digitizer screenshot

The digitizer plug-in provides a drag and drop facility to view the spectrum in one tile for a user defined time window from another tile as shown in Figure 3 or to simultaneously view multiple narrows spans of a single spectrum in detail.

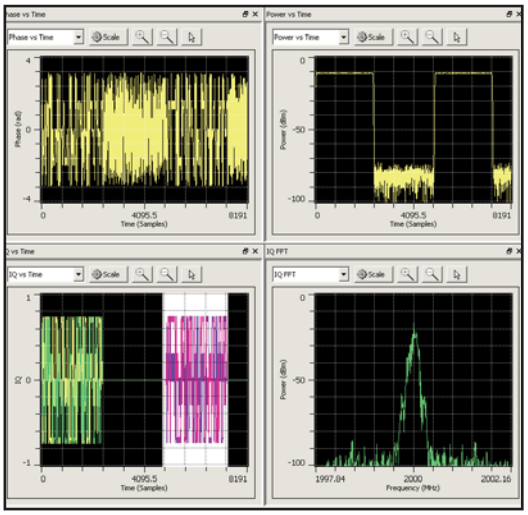

Figure 3. Using drag and drop to see time gated spectra

Signal Generator Plug-in

The signal generator plug-in is a general purpose interface to control any 3020 Series digital signal generator. RF output and modulation settings, triggering and list mode operation are just a few of the primary controls provided to the user.

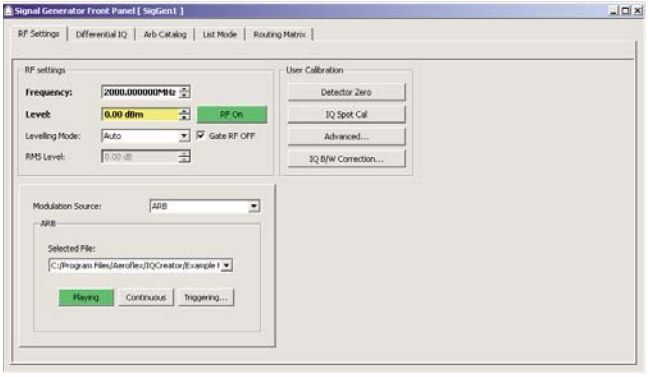

Figure 4: Signal Generator plug-in main screen

Combiner Plug-in

The combiner plug-in is used to couple up to 3 instruments together at a single calibrated reference port. For example to provide connection to a full duplex transceiver, to test amplifier intermodulation products or it can be used simply as a switch to share PXI resources.

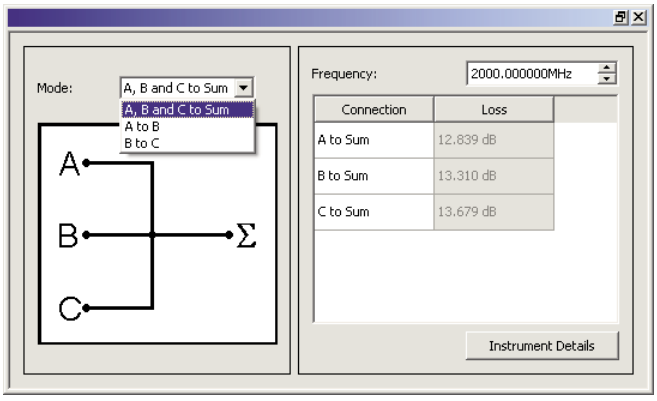

Figure 5: RF Combiner plug-in

Spectrum Analyzer Plug-in

The spectrum analyzer plug-in enables spectrum and time domain measurements to be performed within PXI Studio on acquired I & Q data from 3030 Series RF digitizers.

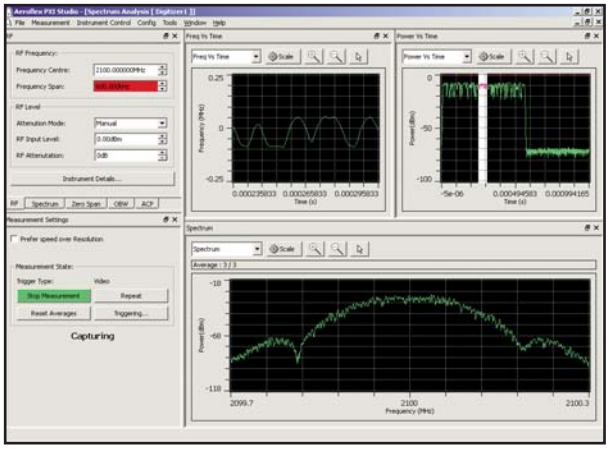

Figure 6: Spectrum Analyzer plugin screenshot

Spectrum measurements can be made over a maximum span width of 200 MHz with continuously variable resolution bandwidths from 1 Hz to 10 MHz (limited by span).

The spectrum analyzer supports measurement of occupied bandwidth and adjacent channel power where up to 99 channels can be specified each with arbitrary channel spacing and channel bandwidth.

The spectrum analyzer provides display traces of power, frequency and phase versus time as well as power spectrum.

Optional system specific measurement plug-ins

Each optional measurement plug-in provides a complete set of measurement functions to characterize the RF parametric performance of components and devices in accordance with the requirements of the relevant communications standard.

GSM/EDGE MEASUREMENT SUITE

A complete suite of measurement functions to characterize GSM and EDGE mobile transceiver RF performance using procedures as defined in 3GPP 51-010-1 V5.2.1 sections 13.17.1-4 and 13.14.2

- 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
- Receiver BER measurement

The GSM/EDGE measurement suite supports analysis of all major GSM/EDGE Tx and Rx characteristics including average RF power, burst profile, modulation quality (either as phase error or error vector magnitude), frequency error, spectrum due to modulation and switching and Rx BER (using loopback methods as defined in ETSI TS 100 293-GSM 04.14). EDGE signals can be further characterized in terms of Origin Offset Suppression and 95th Percentile EVM.

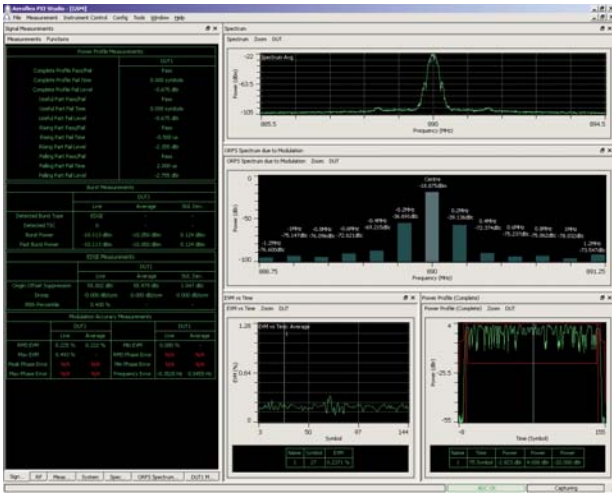

Figure 7: GSM/EDGE plug-in screenshot

The PXI Studio plug-in enables analysis of either Normal or Access burst types with automatic detection of modulation type and training sequence (TSC). Results are provided as both numerical tabular or graphical trace displays.

UMTS MEASUREMENT SUITE

A complete suite of measurement functions to characterize UMTS mobile transceiver performance in accordance with ETSI TS 34.121 (3GPP release 6).

- Maximum output power
- Frequency stability
- ACLR
- Spectrum emission mask
- Phase discontinuity
- CCDF
- Occupied bandwidth
- EVM (Peak and RMS)
- Phase and amplitude errors *
- IQ skew and gain imbalance *
- Carrier leak
- Origin offset
- Tx slot timing error
- Code domain power
- Peak code domain error
- Demodulated symbol data for active channels
- Enhanced physical channels and HS-DPCCH
- Receive sensitivity (BER) using loopback *

The UMTS measurement suite enables the measurement of all major 3GPP W-CDMA UE transceiver parameters including RF power, ACLR (adjacent channel leakage ratio), occupied bandwidth, spectrum emission mask, modulation accuracy, frequency stability, code domain power and peak code domain error and receiver sensitivity.

The PXI Studio plug-in provides a variety of trace displays including constellation diagram, code domain power and spectral mask.

Set up for UMTS uplink measurement requires only user entry of DPCCH slot format 3 and scrambling code. Active channel detection can be set automatically or defined by the user. Measurements can then be made for any user specified or a random timeslot 0 to 14.

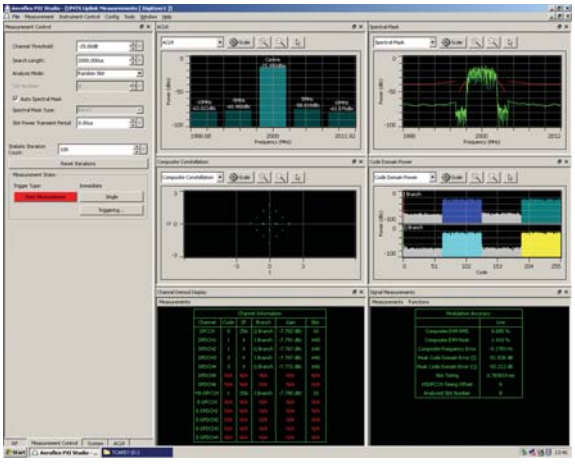

Figure 8. UMTS plug-in typical screenshot

* From version 3.2.0 onwards

CDMA2000 AND 1XEVDO REV A MEASUREMENT SUITE

A complete suite of measurement functions to analyze cdma2000 and 1xEVDO Rev A signal characteristics in accordance with the requirements of 3GPP2 C.S0011-A release C and C.S0024-A version 2.0 for reverse link transmissions.

- cdma2000 RC1 to 4 and 1xEV-DO rev A reverse link analysis
- Channel power
- Total power
- ACPR
- Phase Error and Amplitude Error*
- Spurious emissions (spectral emission mask)
- Composite modulation accuracy (RHO and EVM)
- QPSK EVM (cdma2k RC3 and RC4, 1xEVDO)
- QPSK origin offset
- Code domain powers and PCDE
- Frequency error

The cdma2000 and 1xEV-DO reverse link measurement suite enables precision characterization of power, modulation and spectral parameters for both cdma2000 rev C and 1xEV-DO rev A reverse link transmissions.

Trace displays are provided for de-scrambled code domain powers for both cdma2000 RC3/4 and 1xEV-DO channels and constellation diagrams.

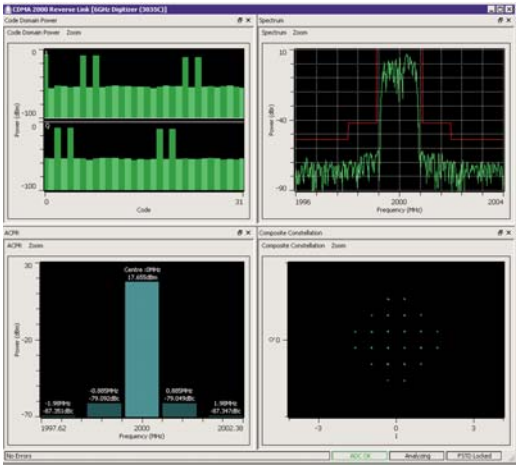

Figure 10. CDMA 2000 plug-in typical screenshot

* From version 2.4.0 onwards

WIMAX MEASUREMENT SUITE

A complete suite of measurement functions to characterize WIMAX signals in accordance with the requirements of IEEE 802.16e (2005) and the WiMAX Forum.

- Transmit power
- Spectral mask
- Occupied bandwidth
- EVM (all, data only, pilots only)
- Frequency error
- Gain imbalance, Skew*
- CCDF*
- Symbol/chip clock frequency error
- Carrier leakage*
- Spectral flatness

The WiMAX measurement suite enables measurement of all major signal characteristics of WiMAX CPE devices including power, modulation accuracy and spectral parameters.

Configuration for each zone and burst within the sub-frame is made easily configurable using point and click/drag and drop. Color is used to differentiate between modulation types.

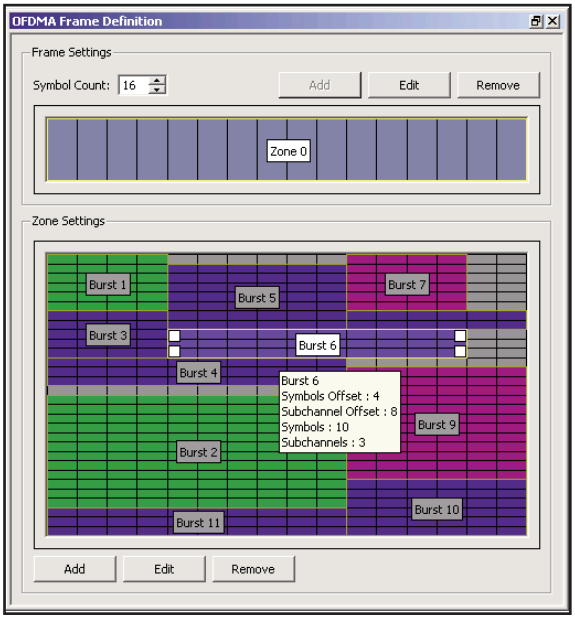

Figure 11. Zone Definition

Complex EVM results can be viewed as a function of sub-carrier or symbol for each burst in a multi-burst frame. Markers can be used to link between EVM vs sub-carrier and sub-carrier EVM vs symbol views.

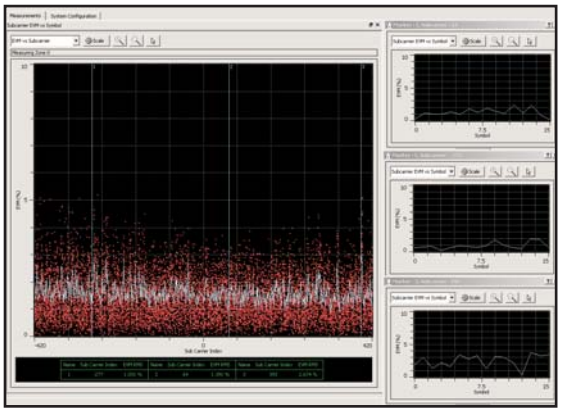

Figure 12. EVM Vs Subcarrier with marker inspection

Spectral measurements are displayed and checked against standard compliant or user defined spectral mask.

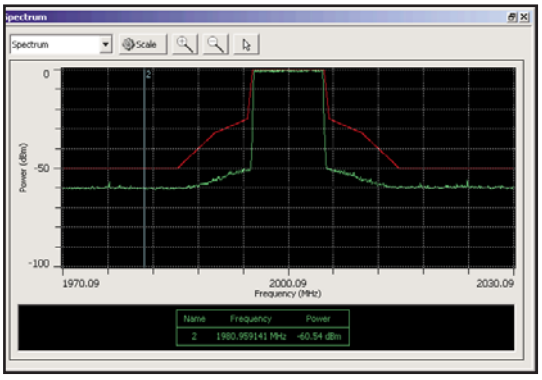

Figure 13. Spectral mask

Spectral flatness results provide a pass/fail indication independently for each portion of the mask and check the relative level between successive sub-carriers as well as providing trace data with markers.

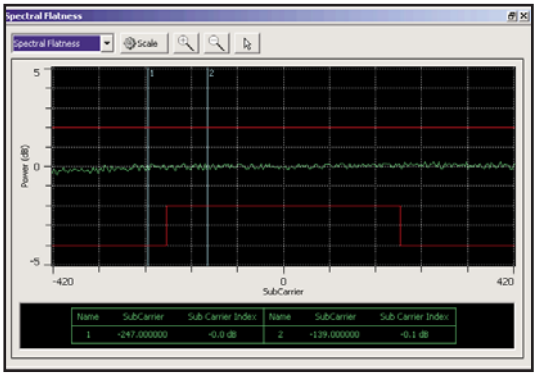

Figure 14. Spectral flatness

* From version 2.2.0 onwards

WLAN MESUREMENT SUITE

A comprehensive suite of measurement tools enabling the analysis of all WLAN OFDM and DSSS RF signal characteristics in accordance with the requirements of IEEE 802.11a,b PMD 1999 and IEEE 802.11g PMD 2003.

- Transmit power
- Transmit burst length
- Transmit power on, off timing
- Spectral mask
- Occupied bandwidth
- Frequency tolerance
- Symbol / chip clock frequency tolerance
- Carrier suppression/leakage*
- Skew* / Gain imbalance*
- Modulation accuracy (EVM)
- Spectral flatness

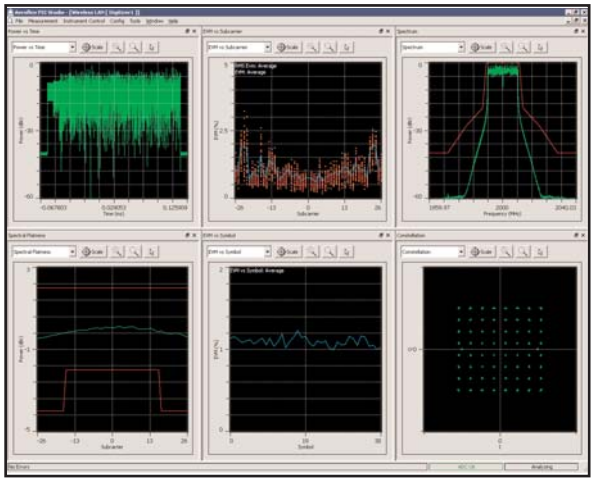

Figure 15. WLAN plug-in typical screenshot

Data rates and corresponding modulation and encoding formats up to 54 Mb/s are supported. Modulation format, data rate and modulation type are all determined automatically from preamble and header decoding thus requiring no user set-up making using the measurement library easy to operate and integrate within a test application.

Measurements may be performed with/without compensation for pilot time, amplitude and phase tracking enabled.

* From version 1.0.0 onwards

BLUETOOTH (+EDR) MEASUREMENT SUITE

A suite of measurement functions to characterize Bluetooth and Bluetooth EDR radio signals in accordance with the requirements of Bluetooth Specification 1.2 / 2.0 / 2.0+EDR / 2.1 / 2.1+EDR revision 2.1E1(2008).

The Bluetooth measurement suite enables fast measurement of key signal characteristics of Bluetooth and Bluetooth EDR signals such as burst power, PSK modulation accuracy, initial and maximum frequency error and origin offset.

- Burst position and power
    - EDR relative Tx power
- Spectrum
    - -20 dB bandwidth
    - Power density
    - Occupied bandwidth
    - Adjacent channel power
    - EDR spurious emissions
- Modulation characteristics
- Initial carrier frequency tolerance
- Carrier frequency drift and drift Rate
- Burst profile
- Modulation accuracy
- CW measurements

The Bluetooth measurement suite is suitable for characterizing devices operated in test mode. Measurement results for burst length, position, rise and fall times and power are provided for the entire packet as well as the individual GFSK and PSK modulated elements within the packet. For PSK modulation, the DEVM is reported together with max frequency error and origin offset. Time domain trace displays are provided for burst power, GFSK frequency deviation and DEVM. Additionally PSK modulation can be viewed as a constellation diagram.

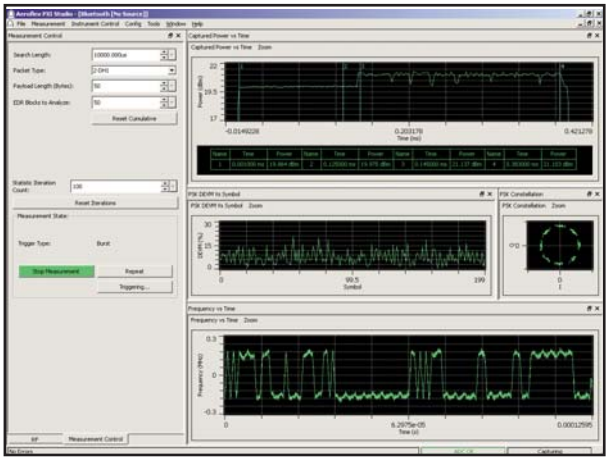

Figure 16. Bluetooth plug-in screenshot

SPECIFICATIONS

GENERAL

Operating System

PXI Studio is designed for operation under Windows® 2000 (service pack 4)/Windows® XP (service pack 2) and 32-bit Vista.

Required Memory

512 Mbytes minimum, 1024 Mbytes recommended

Minimum graphical display resolution

Minimum 1024 x 768

Other

Aeroflex 3000 Series modules require NI VISA version 3.1 or later (NI Visa 4.2 or later under Windows® Vista).

Aeroflex 3000 Series module drivers version 5.4.0 or later

Power Level Accuracy

See 3030 Series data sheet

SPECTRUM ANALYZER PLUG-IN

All specifications are defined when used in conjunction with the 3030 Series PXI RF digitizer.

Frequency Span

Variable between 2 kHz to 200 MHz and zero span

Resolution 1 Hz

Resolution Bandwidth

Variable between 1 Hz to 10 MHz (depending on span)

Resolution 1 Hz

Window Type

NEBW: Gaussian 3 dB: Gaussian fixed: Blackman Harris 5 term

Zero Span Time

Up to 333 seconds

Resolution 4 ns

MEASUREMENTS

Channel Power and Adjacent Channel Power

Adjacent channels: 2 upper and 2 lower or user defined up to 99

Channel filter alpha: 0.0 to 1.0

Channel spacing: up to 15 MHz

Channel width: up to 25 MHz

Occupied Bandwidth (OBW)

Percentage range: 1% to 99.99%

N Peaks

Frequency and power output for up to 10 signal peaks sorted in order of decending power

Average Power

The RMS average power for all IQ samples

Markers

4 markers plus delta marker

Marker Functions

Marker power and frequency with peak search, next peak, peak track

Power and time

Frequency and time

Traces

Live, avg, max. hold

Spectrum trace, power versus time trace, frequency versus time trace, phase versus time trace[1]

Text results summary

GSM/EDGE

All specifications are defined when used in conjunction with the 3030 Series PXI RF digitizer operating in any GSM band between 400 MHz and 2000 MHz. GSM BER measurements additionally require a 3020 Series PXI digital RF signal generator

CONFIGURATION

System Type

GSM400 GSM700, GSM850, GSM900, DCS1800, PCS1900

Frequency

ARFCN 0 to 1023 (valid range dependent on system type selected) or Hz

Level (DUT Output)

PCL (power control level) 0 to 31 or Manual dBm*

**valid range and corresponding dBm value is system type dependent*

Burst Type

GMSK: Auto or Manual (Normal / Access)

8PSK: Normal

TSC

Uplink: Auto or Manual (0 to 7)

Path Loss Correction

Tx and Rx (dB)

Acquisition Trigger Source

Immediate (free run), Burst (video), Ext (PXI trigger bus, local bus, star trigger, LVDS, TTL)

Synchronisation (Auto Burst Detection)

Burst Detection threshold (dB)

Search length (ms)

Burst Timing Latency Compensation

0 to ±78.125 symbols

BER Loopback (requires 302x)

Mode A/B or C

Number of frames 1 to 1000

Measurement Display types

Captured power versus time

Burst power versus time with/without masks

Burst spectrum (RBW 10 kHz, 30 kHz, 100 kHz)

Phase error versus time

EVM versus time

ORFS (Spectrum due to Modulation)

ORFS (Spectrum due to Switching)

MEASUREMENTS:

GSM / EDGE AVERAGE BURST 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

Fast Burst Power is measured without midamble synchronization.

Indication

GMSK Average burst power in dBm

EDGE, Current Avg power, long term average power or estimated long term average power dBm

Detected burst type and TSC

Burst Timing Error (symbols)

[1] *From version 1.6.0 onwards*

GSM / EDGE POWER PROFILE

Indication

Pass/fail indication with respect to a single burst power template for mobile station (MS)

Values with closest proximity to mask or worst case failure for the complete, rising edge, falling edge and useful parts of the burst

Power versus time traces

Rising/falling edge

Useful part

Complete burst

Dynamic Range

Typically -80 dBc (for input levels > 0dBm)

Accuracy (rising falling edges)

Level: Typically ±0.1 dB/10 dB[1] (relative to peak power)

Time accuracy <0.5 µs

Accuracy (useful part)

Level: Typically ±0.02 dB (relative to peak power)

Time accuracy <0.1 symbol

GMSK MODULATION

GMSK phase error measurements performed for a single slot

Phase Error Range

0 to 10° RMS

0 to 40° peak

Indication

Results are expressed as numerical values for RMS + Peak phase error

Peak phase error versus time

Accuracy

Typically ±0.5° rms phase error ±1.0° peak phase error

8PSK MODULATION

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

Burst Type

Normal only

EVM Range

0 to 20% EVM RMS

0 to 40% EVM peak

Indication

rms EVM %, peak EVM %, 95th percentile EVM %, origin offset suppression, and droop

Accuracy

±0.4% RMS ±1% peak

Offset Origin Suppression Range

>20 dB to 60 dB (floor)

Offset Origin Suppression Accuracy

Typically ±0.5 dB at 33 dB

FREQUENCY ERROR

Measurements are performed for a single slot.

The frequency error measured is the difference between the input signal and the nominal 3030 tuned frequency.

Frequency Error Range [2]

Typically ±300 kHz GMSK (GSM)

Typically ±100 kHz 8PSK (EDGE)

Frequency Error Accuracy

±5 Hz + (Tx freq x freq standard error)

SPECTRUM DUE TO MODULATION & SWITCHING

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

Burst Type

Normal

Range offset

Up to ±10 MHz

Measurement Range (typical)

Spectrum due to modulation

	GMSK		8PSK	
Carrier Frequency	1 GHz	2 GHz	1 GHz	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

Spectrum due to switching

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

Indication

Table of values;

Reference power (dBm), frequency offset (Hz) and level (dBc) relative to reference power

Accuracy

Typically ±0.05 dB/10 dB[1]

BER, BER II, RBER II, FER

Measurement Results

Mode C burst loopback

Number of bits examined

Number of error bits found

Bit Error Rate (%)

Mode A/B Speech loopback

Number of frames examined

Erased Speech Frames

Speech Frame Erasure Rate (%)

Notes

[1] Excluding the effects of noise

[2] From version 2.4.0 onwards

UMTS UL

All specifications are defined when used in conjunction with the 3030 series PXI RF digitizer operating in all WCDMA 3GPP FDD bands.

CONTROL PARAMETERS

Scrambling Code

0 to 16777215

Power Control Mode

Disable/Drive to level

Analysis Mode

Random or specific slot

Specific Slot Number: 0 to 14

DPCCH slot format

0 to 3

SLOT POWER

Measurement Range

Up to +30 dBm at digitizer input

Indication

Average Power in dBm

Slot Power in dBm (random or specific)

OCCUPIED BANDWIDTH

Measurement of the bandwidth containing 99% of the total power of the transmitted spectrum

Indication

Hz

Accuracy

<100 kHz

SPECTRUM EMISSION MASK

The spectral density of the transmitted signal should lie within the relevant spectral mask for each WCDMA 3GPP FDD band or a user defined mask.

Measurement BW

30 kHz and 1 MHz depending on frequency offset

Measurement Range

±12.5 MHz

Indication

Global Pass / Fail

The worst case dBc level value and its corresponding frequency relative to the mask

Traces

FFT power spectrum and selected mask values

PHASE DISCOINTINUITY

Phase difference between measured slot and the preceeding slot

Indication

Degrees, slot number

ADJACENT CHANNEL LEAKAGE RATIO

ACLR due to modulation is the ratio of the channel power to the power measured in the upper and lower adjacent and alternate channel.

Number channels

Time domain: 1 to 5

Frequency domain: 1 to 5

Dynamic Range

Residual noise in 3.84 MHz BW: typically better than -68 dB

Indication

Reference channel power dBm

1st upper and lower adjacent channel power dBc

2nd upper and lower adjacent channel power dBc

Accuracy

<± 0.05 dB/10 dB[1]

FREQUENCY STABILITY

The frequency error measured is the difference between the input signal and the nominal 3030 tuned frequency

Frequency Error Range

±7 kHz (± 3 kHz for HSPA)

Frequency Error Accuracy

<±(10 Hz + (Freq Standard Error x Transmitter Freq))

TRANSMIT MODULATION

Modulation Accuracy

Modulation accuracy results are provided for either composite modulation or for QPSK modulation. Composite EVM results are provided for either a specific or random slot number.

Composite EVM range

0 to 20% RMS

0 to 40% Peak

Residual Error

<± 1%

Composite Modulation Results

Magnitude error peak/rms [2]

in dB

Phase error peak/rms [2]

in degrees

IQ gain imbalance [2]

in dB

IQ skew [2]

in degrees

Carrier leak

in dB

HS-DPCCH Timing Offset

QPSK EVM range

0 to 10% RMS

0 to 20% Peak

Residual Error

Typically <± 1%

QPSK Origin offset (carrier leak)

range

0 to 20%

Residual Error

Typically <± 1%

QPSK Modulation Results

Magnitude and Phase Error

QPSK magnitude and phase component errors are available both with and without origin offset removed.

Range

Magnitude: 0 to 15 %

Phase: 0 to 10 degrees

Residual Error

Magnitude: < 1% typically

Phase: <5 degrees typically

IQ gain imbalance

in dB

IQ Skew

in degrees

Frequency Error

in Hz

DEMODULATED SYMBOLS

Symbol data is available for each active channel

Channel Types

DPCCH
DPDCH1 to 6
HS-DPCCH
E-DPCCH
E-DPDCH1 to 4

CHANNEL DETECTION RESULTS

Spreading Factor

Code number

Gain factor

Number of bits

TX SLOT TIMING ERROR

Measured relative to an external trigger input with a result expressed in samples

CODE DOMAIN POWER

Code domain power is computed providing dBc readings for 256 orthogonal channels.

Indication

Code domain power versus code number

PEAK CODE DOMAIN ERROR

Code domain errors are computed providing dBc reading for 4 orthogonal channels. The peak code domain errors are defined as the maximum values for the 4 code domain errors. The measurements interval is 1 slot (2560 chips).

Indication

Peak code domain error for I and Q channels

CCDF

Complimentary cumulative distribution function

Trace

Peak to average power (dB) versus probability (%)

BER [2]

Measurement Results

Bit error rate (%)
Number of bits examined
Number of bits in error
Number of blocks examined
Number of blocks in error
Block error rate (%)

Setup

Number of DTCH blocks: Up to 100

Number of bits to compare: Up to 24,400

Reference data pattern type: all ones, all zeros, PRBS PN9 or PN15

Notes

[1] Excluding the effects of noise

[2] From version 3.2.0 onwards

CDMA2000 AND 1XEVDO REV A

All specifications are defined when used in conjunction with the 3030 series PXI RF digitizer operating in cdmaOne, cdma2000 and 1xEVDO band classes BC0 to BC12.

CONTROL PARAMETERS

Long Code Mask

Long code mask range: 0 to 4,398,046,511,103

Radio Configuration Mode (cdma2000 only)

RC1/RC2 or RC3/RC4

Slot number (1xEVDO only)

0 to 15

POWER MEASUREMENT

Channel Power

The channel power is the power measured in the 1.23 MHz bandwidth. Channel power is measured concurrent with ACPR measurement

Average Power

The broadband average power is measured for a user defined segment.

Bursted Power

For bursted signals, the peak power is measured together with burst duration, burst position, power on and power off times.

Indication

Channel power, average power, burst power in dBm

Burst duration and burst position in samples

Power on time and power off time in seconds

ADJACENT CHANNEL POWER RATIO MEASUREMENT

ACPR is the ratio of the channel power to the power measured at frequency offsets outside the assigned cdma channel. Reference channel measured in 1.23 MHz, offset measured in 30 kHz.

Offsets

4 fixed or 4 user defined

Fixed offsets

±885 kHz, ±1980 kHz

User offsets

Up to ±4 MHz

Dynamic Range

-82 dBc

Indication

Ref Channel Power in dBm (1.23 MHz channel bandwidth)

Offset power in dBc (30 kHz RBW)

Accuracy

Typically 0.05 dB/10 dB[1]

SPECTRAL EMISSION MASK

The power spectrum of the transmitted signal is compared to a mask.

Mask Type

Cellular, PCS, user defined

Indication

Pass/fail

Frequency + dBr mask value with closest proximity to mask

Spectral trace + mask trace

Number of failed points

Accuracy

Typically 0.05 dB/10 dB[1]

TRANSMIT MODULATION

Modulation Accuracy

The modulation accuracy can be measured for either composite RHO, EVM as per 3GPP2 C.50011_A or 3GPP2 C.S0033-A or QPSK EVM (RC3 & 4, 1xEV-DO only).

1xEV-DO composite RHO is computed for default or user channel settings. When set to user channel settings, RHO is measured only on the selected channel subset.

The modulation accuracy is a measure of the difference between the measured waveform and the theoretical modulated waveform (the error vector).

The minimum measurement interval for composite rho / EVM is 500 µs (cdma200 RC1/2), 3.2 ms (cdma200 RC3/4), 1xEV-DO or user defined.

For QPSK EVM the measured interval can be user defined in chips from 256.

COMPOSITE RHO

Mode(1xEVDO only)

Random / Specific slot 0 to 15

rho Range

0.9 to 1

Indication

32 bit floating point

Accuracy

Better than ±0.003 for rho values between 0.9 and 1.0

Amplitude Error [1]

in dB

EVM & QPSK EVM

Composite EVM range

0 to 20% RMS

0 to 40% Peak

QPSK EVM range

0 to 10% RMS

0 to 20% Peak

Residual Error

Typically 1%

Magnitude error peak/rms [2]

in dB

Phase error peak/rms [2]

in degrees

QPSK ORIGIN OFFSET (CARRIER LEAK)

Range

0 to 20%

Residual Error

Typically 1%

FREQUENCY ERROR

The frequency error is derived from modulation quality measurement and is the frequency relative to the 3030 tuned frequency.

Frequency Error Range

RC1-2: ±5 kHz

RC3-4: ±2 kHz

1xEV-DO: ±2 kHz

QPSK: ±10 kHz

Frequency Error Accuracy

Typically ±(10 Hz + (Freq standard error x transmitter freq))

CODE DOMAIN POWER (RC3/RC4, 1XEVDO)

Code domain power is a measure of the power in each code channel of a CDMA channel. Code domain power gives the distribution of signal energy among the code channels, normalized by the total signal energy.

Indication

Pilot channel power (dB)

Data channel power (dB)

Ack channel power (dB), (1xEVDO only)

DRC channel power (dB), (1xEVDO only)

Trace

Power dBm versus code channel (dB)

Peak Code Domain Error

Code domain error is a measure of the code domain distribution of error power, provided by a code domain power measurement of the error signal. Peak code domain error is the largest power in the error.

Indication

Peak Code Domain Error I (dB)

Peak Code Domain Error Q (dB)

[1] From version 2.4.0 onwards

[2] CDMA2000 only

WIMAX

All specifications for accuracy and range relate to performance when used in conjunction with a 3030 Series PXI RF digitizer.

CONFIGURATION

Standards supported

IEEE 802.16e (2005) OFDMA

FRAME SETUP

Frame Length

2.5, 4.0, 5.0, 8.0, 10.0, 12.5, 20 ms

Nominal Bandwidth

1.25, 3.5, 4.375, 5, 7, 8.75, 10, 14, 15, 17.5, 20, 28[1] MHz

[1] Supported in 3030A, 3030C, 3035, 3035C

FFT size

128, 512, 1024, 2048

Guard Period

¼, 1/8 , 1/16, 1/32

Subframes (link direction)

Uplink, Downlink

Downlink preamble Index

0 to 113

Uplink cell ID

0 to 31

ZONE SETUP

Type

PUSC

Number of Zones

Downlink: 8

Uplink: 3

Length

1 to max. symbol count set by frame length and guard period

Offset

0 to max. symbol count - 1 set by frame length and guard period

Permutation Base

Downlink: 0 to 31

Uplink: 0 to 69

BURST SET UP

Burst type

Downlink, Uplink

Uplink PUSC: Normal data

Downlink PUSC: Normal data

Burst edit operations

Add, delete

Burst definition

Single/multiple

Modulation: QPSK, 16QAM, 64QAM

Burst Type: Normal data

Modulation[1]

BPSK (pilots), QPSK, 16QAM, 64QAM

Number of symbols[1]

1 to n where n is the number of symbols in the zone

Number of sub-channels[1]

1 to n where n is the number of subchannels in the zone set by the zone type and FFT size

Symbol offset[1,2]

0 to n - 1 where n is the number of symbols in the zone

Sub-channel offset[1,2]

0 to n - 1 where n is the number of subchannels in the zone set by the zone type and FFT size

[1] For each burst in a multi-burst zone

[2] non overlapping

MEASUREMENT SET-UP

Channel Equalisation Methods:

Channel estimation sequence only; channel estimation sequence and pilots

Channel Estimation Sequence Only

Downlink - using preamble

Uplink - no equalization

Channel Estimation Sequence and Pilots

Downlink - using preamble and pilot sub-carriers of the data symbols in the sub-frame

Uplink - Pilot sub-carriers of the data symbols of the sub-frame.

PILOT TRACKING

Phase Tracking

On/Off

Amplitude Tracking

On/Off

Symbol Time Tracking

On/Off

BURST POWER MEASUREMENTS

TRANSMIT POWER

The Peak and RMS power is measured for a single UL or DL subframe.

Indication

dBm

Power vs time trace

OBW

Bandwidth containing 99% of total of the transmitted power

Indication

Hz

Accuracy

Typically <100 kHz

SPECTRAL MASK

The spectral density of the transmitted signal should lie within the spectral mask.

The mask is frequency aligned to the maximum spectrum density.

Mask Type

IEEE802.16e (2005) 10 MHz, 20 MHz,

WiMAX Forum 5 MHz, 10 MHz masks,

User defined

Measurement BW

User defined or as determined by mask type selected

Measurement Range

80 MHz

Indication

Global Pass/Fail

The worst case dBc level value and its corresponding frequency relative to the mask are reported

Traces

FFT power spectrum and mask values

MODULATION ACCURACY

The error vector magnitude (EVM) is the magnitude of the IQ vector at the decision point measured relative to the ideal constellation point.

RCE (residual constellation error) / EVM (error vector mangnitude)

Composite RCE / EVM (rms), (all sub-carriers and symbols within a zone)

EVM (rms) for a single burst within a zone

EVM (rms) for a single sub-carrier

EVM (rms) all data sub-carriers (within a burst or zone)

EVM (rms) for a specific symbol on a specific sub-carrier within a burst

EVM (rms) all pilot sub-carriers (CPE-common pilot error)

EVM (rms) for unmodulated subcarriers

Indication

%/dB

IQ gain imbalance [1]

in dB

IQ skew [1]

in degrees

Traces

EVM (rms) vs. sub-carrier for a specific burst or for all symbols

EVM (rms) vs. symbol for a specific burst or for all sub-carriers

Constellation for a specific burst or for all sub-carriers

Accuracy

Typically <-40 dB residual EVM

FREQUENCY TOLERANCE

Lock Range (% of sub carrier spacing)

±20%

Indication

Hz

Accuracy

As per reference frequency

TX CENTRE FREQUENCY LEAKAGE / RF CARRIER SUPPRESSION

Indication

dB

SYMBOL / CHIP CLOCK TOLERANCE

Range

±50 ppm

Indication

ppm

clock error vs time

Accuracy

As per reference frequency

SPECTRAL FLATNESS

Mask Type

WiMAX Standard

802.16 2005

User defined

Indication

Mask Pass/Fail

Mask Upper Pass/Fail

Mask Lower Pass/Fail

Adjacent sub-carrier Pass/Fail

Trace

dBr values for each sub-carrier

WLAN

All specifications for accuracy and range relate to performance when used in conjunction with a 3030 series PXI RF digitizer operating in any ISM band up to 6 GHz. The following are preliminary specifications for WLAN.

CONFIGURATION

The WLAN measurement suite assumes the measured signal includes a correctly formatted PSDU containing valid header information in order to perform demodulation.

Automatic setting of System Type (OFDM/DSSS/DSSS-OFDM), Data Rate, Modulation Type is decoded from header information.

Compensation

Pilot time tracking, on/off

Pilot amplitude tracking, on/off

Pilot phase tracking, on/off

Burst Profile type

Average power or peak power

Measurement results

Live, average, min hold, max hold, std dev

BURST POWER MEASUREMENTS

TRANSMIT POWER

The Peak and RMS power is measured for a single PPDU.

Indication

dBm

BURST LENGTH

The burst length is the time between the rising and falling edge of a single PPDU burst.

Indication

µs

Rising / Falling Edge Time (802.11b and g)

Measures the time taken for the burst power of a single PPDU to change between 10% and 90% of it's value (peak or rms).

Indication

Global Pass/Fail

Ramp up Pass/Fail

Ramp up time in µs (10% to 90% points)

Ramp down Pass/Fail

Ramp down time in µs (90% to 10% points)

Burst position µs relative to trigger point

POWER VERSUS TIME TRACE OBW (802.11A AND G ONLY)

Bandwidth containing 99% of total of the transmitted PPDU spectrum in 34 MHz

Indication

Hz

Accuracy

Typically <100 kHz

[1] *From version 2.2.0 onwards*

SPECTRAL MASK

The spectral density of the transmitted PPDU signal should lie within the spectral mask:

The mask is frequency aligned to the maximum spectrum density.

Mask types *802.11a*

802.11b/g

User defined

Measurement BW

100 kHz

Measurement Range

80 MHz

Indication

Global Pass / Fail

The worst case dBc level value and its corresponding frequency relative to the mask

Spectral trace display with mask

Accuracy

Typically ±0.05 dB/10 dB

Assumes common 3030 Series attenuator settings for reference and offset measurements

ADJACENT CHANNEL POWER

The power measured in the upper and lower adjacent and alternate channels relative to the power in the reference channel

Reference Channel bandwidth

22 MHz

Adjacent & Alternate Channel bandwidth

±11 MHz, ±22 MHz

Indication

1st lower dBc

2nd lower dBc

1st upper dBc

2nd upper dBc

Measurement Range

Typically 62 dB for IEEE802.11a/g 54 Mbps QAM

Typically 65 dB for IEEE802.11b 11 Mbps CCK

Accuracy

Typically ±0.05 dB/10 dB

Assumes common 3030 Series attenuator settings for reference and offset measurements

MODULATION ACCURACY

The error vector magnitude (EVM) is the magnitude of the IQ vector at the decision point measured relative to the ideal constellation point.

EVM

Composite EVM (% rms) and RCE (rms dB)

EVM (% rms) and RCE (rms dB) all data carriers

EVM (% rms) and RCE (rms dB) all pilot carriers

EVM (Peak) - 802.11b/g only

Indication

Constellation display

Trace of EVM values versus sub carrier or symbol number

System Type, Modulation Type, Data Rate, Number of PSDU bits/symbols

Accuracy

Typically <40 dB residual EVM

IQ gain imbalance [1]

in dB

IQ skew [1]

in degrees

Carrier leak

in dB

FREQUENCY TOLERANCE

Lock Range

±50 ppm

Indication

Hz

Accuracy

As per reference frequency

TX CENTRE FREQUENCY LEAKAGE / RF CARRIER SUPPRESSION

Indication

dB

SYMBOL / CHIP CLOCK TOLERANCE

Range

±50 ppm

Indication

ppm

Accuracy

As per reference frequency

SPECTRAL FLATNESS (802.11 A AND G ONLY)

Indication

Pass/Fail

Upper Pass/Fail

Lower Pass/Fail

Trace display of dBr versus sub carrier and mask

[1] *From version 1.0.0 onwards*

BLUETOOTH & BLUETOOTH EDR

Performance is specified over the frequency range 2400 MHz to 2483.5 MHz when used in conjunction with any 3030 Series RF digitizer and where applicable any 3020 series RF signal generator.

Measurements are performed in accordance with the requirements of Bluetooth Specification 1.2/2.0/2.0+EDR/2.1/2.1+EDR.

CONFIGURATION

Channel Number/Frequency

0 to 78 or Hz

Packet Types

DHx, 2-DHx, 2-EVx, 3-DHx (where x = 1,3, or 5)

Payload Length

Up to 1021 bytes

Synchronisation (Demodulation)

RF burst and P0

EDR blocks (x 50 symbols)

1 to 99999

Tx Loss

In dB

Triggering

See digitizer plug-in

BLUETOOTH MEASUREMENTS

Output Power

Measurements: Average power across a burst and Peak power within a burst (dBm)

3030A/3035:

<±0.5 dB, typically ±0.3 dB

3030C/3035C:

<±0.7 dB, typically ±0.3 dB

Power Density

Measurements: Peak power density (dBm) per 100 kHz

TX Output Spectrum –20 dB Bandwidth

Measurements: -20 dB bandwidth (kHz)

TX Output Spectrum Adjacent Channel Power

Measurements: Adjacent channel power(s) in ±N channels

Modulation Characteristics

Measurements: Δfavg (Hz), Δfmax (Hz)

Packet type: longest supported (DH1, DH3, DH5)

Initial Carrier Frequency Tolerance

Measurements: ICFT, carrier behaviour at burst turn on

Carrier Frequency Drift

Measurements: carrier drift (per packet), drift rate in payload (per 50 µs)

Packet Type: DH1, DH3, DH5

Payload: 10101010

BLUETOOTH EDR MEASUREMENTS

Packet Types

2-DHx, 2-EVx, 3-DHx

EDR Relative Transmit Power

Measurements:

a) GFSK (header) Avg power

b) PSK payload Avg power

c) relative power between a) and b)

EDR Carrier Frequency Stability and Modulation Accuracy

Measurements: (taken per packet and EDR Blocks)

Worst case carrier frequency error (ω_o) for all packets (Carrier frequency stability)

Worst case carrier frequency error (ω_i) for all blocks

($\omega_o+\omega_i$) for all blocks

DEVM (rms & peak)

99% DEVM

Measurement uncertainties:

Frequency error, typically 2 Hz excluding frequency reference error

EDR In-band Spurious Emissions

Measurements: Adjacent channel powers dBm / dBc in ±N channel (Max N =5)

GENERAL BURST ANALYSIS

Measurement results

Burst position (leading P_{av} –3 dB point relative to start of burst) µs

Burst length (between P_{av} -3 dB points) µs

Burst power (P_{av} and P_{Pk}) dBm

Rise time (10% P_{av} to 90% P_{av}) µs

Fall time (90% P_{av} to 10% P_{av}) µs

Measurement Uncertainty

Burst length, Rise time, fall time <2 samples

Burst power. As per specified 303x level accuracy

OCCUPIED BANDWIDTH

Bandwidth containing 99% of total transmitted burst power

Indication

in Hz

Measurement Range

1 MHz

TRACES

Captured I&Q power (dBm) versus time

Burst power (dBm) versus time

GFSK frequency offset versus time

DPSK DEVM (%) versus symbol

DPSK measured and ideal constellation diagrams

Burst spectrum

ORDERING

PXI Studio is supplied as standard with plug-ins for RF Digitizer, Signal Generator, RF Combiner and Spectrum Analyzer.

Optional measurement plug-ins may be purchased with the 303x at time of order or purchased as an upgrade to the 303x.

GSM/EDGE

When purchased with a 303x, order as:	*3030 option 100*
When purchased as an upgrade, then order as:	*RTROPT100/3030*

UMTS uplink

When purchased with a 303x, order as:	*3030 option 101*
When purchased as an upgrade, then order as:	*RTROPT101/3030*

CDMA2000 and 1xEVDO Rev A

When purchased with a 303x, order as:	*3030 option 102*
When purchased as an upgrade, then order as:	*RTROPT102/3030*

WLAN

When purchased with a 303x, order as:	*3030 option 103*
When purchased as an upgrade, then order as:	*RTROPT103/3030*

WiMAX

When purchased with a 303x, order as:	*3030 option 104*
When purchased as an upgrade, then order as:	*RTROPT104/3030*

Bluetooth

When purchased with a 303x order as:	*3030 option 106*
When purchased as an upgrade, then order as:	*RTROPT106/3030*

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AEROFLEX
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Our passion for performance is defined by three attributes represented by these three icons: solution-minded, performance-driven and customer-focused.

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