

S-Series

SVA Vector Signal Analyzer Modulation Analysis Options

AEROFLEX
A passion for performance.



The SVA modulation analysis options support the following:

- GSM/EDGE
- UMTS/HSUPA
- LTE (FDD)
- LTE (TDD)
- CDMA2000, 1xRTT and EV-DO Rev O, A, B
- TD-SCDMA
- WLAN
- Bluetooth® (+ EDR)

The SVA modulation analysis options complement the capabilities of the SGD digital signal generator creating a high performance integrated laboratory or factory test solution.

Included as standard are spectrum analyzer and generic demodulation giving general purpose spectrum or time domain analysis for RF component testing or alignment of radio communications transceivers.

Optional modulation analysis suites 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 these capabilities provide power, spectrum and modulation analysis with results displayed in two user configurable windows. A variety of trace displays are provided as appropriate to the communication standard each permitting close examination signal parameters and performance. When used synchronously with the SGD, stimulus and response component measurements or complete transceiver characterization can be accomplished with ease.

Digitizer Mode

The digitizer mode is a general purpose interface to control the SVA's 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.

The digitizer 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 narrow spans of a single spectrum in detail.

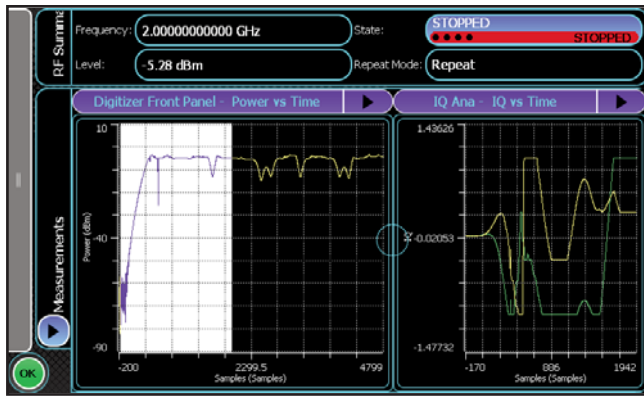


Figure 1. Using drag and drop to analyze a GSM burst

Spectrum Analyzer Mode

The spectrum analyzer mode enables spectrum and time domain measurements to be performed within on acquired I & Q data from the SVA.

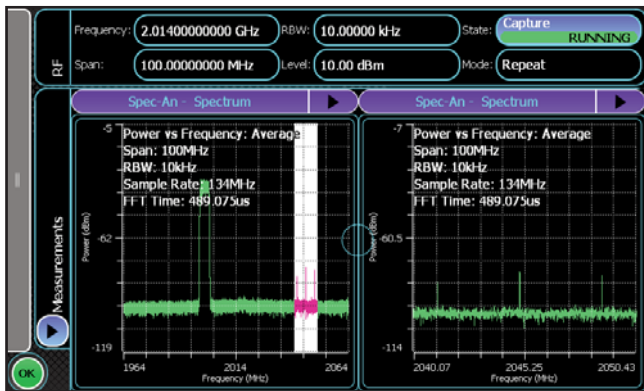


Figure 2. Spectrum Analyzer screenshot of UMTS with spurious signals

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 Suites

Each optional measurement suite 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, GSM/EDGE/EGPRS Transmitter(Tx) Test cases as defined in sections 13.1-4, 13.6-13.9, 13.16.1-3, 13.17.1, 3, 4 and Receiver (Rx) Test cases as defined in 14.2.1, 14.16.1, 14.18.1 of ETSI TS 51.010 are supported.

- TX average power and single/multi slot burst power profile
- GSM phase error (peak and RMS)
- 8PSK EVM, origin offset suppression
- 8PSK 95th percentile EVM
- Frequency error
- Output radio frequency spectrum
- Receiver GSM BER, EDGE, BLER measurement
- Fast Sequence Tuning (FST)

The GSM/EDGE measurement suite supports analysis of GSM/HSCSD/GPRS/EGPRS/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/BLER (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.

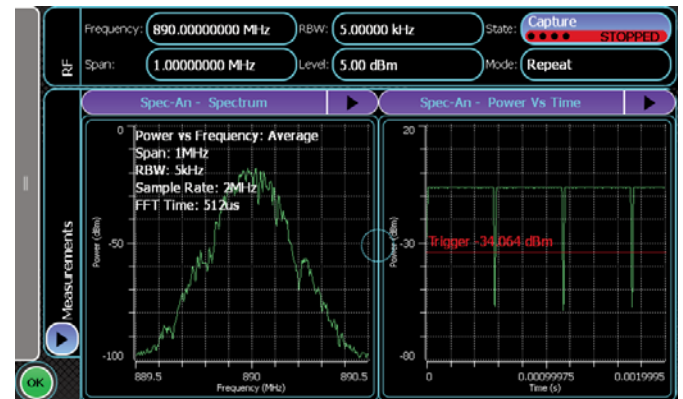


Figure 3. GSM/EDGE screenshot

This option 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. Measurements can be made for single or multiple contiguous active-slot frames.

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
- Inner Loop Power Control (ILPC)
- Receive sensitivity (BER) using loopback
- Fast Sequence Tuning (FST)

The UMTS measurement suite enables the measurement of all major 3GPP W-CDMA UE transceiver parameters including RF power, ILPC (inner loop power control) 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.

This option 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.

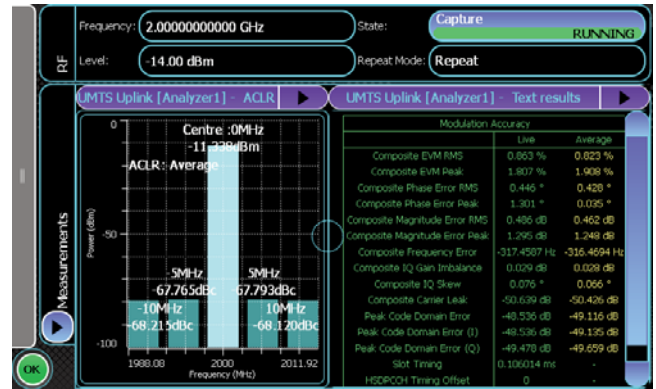


Figure 4. UMTS typical screenshot

LTE FDD and LTE TDD

The LTE TDD and FDD measurement suites provide a library of measurement functions designed to characterize LTE TDD and FDD signals respectively in accordance with the requirements of ETSI TS 36.521-1.(3GPP release 8.4.0).

- Power
- Transmit signal quality:
 - Frequency error
 - Error Vector Magnitude (EVM)
 - IQ skew/Gain Imbalance
 - Symbol clock error
 - IQ-component (carrier leak)
 - In-band emissions for non allocated RB
 - Spectrum flatness
- Output RF spectrum emissions:
 - Occupied bandwidth
 - Spectrum Emission Mask
 - Adjacent Channel Leakage power Ratio
- CCDF
- Fast Sequence Tuning (FST)

LTE FDD and LTE TDD are available as separate SVA options. In each case LTE analysis is supported for uplink (SC-FDMA) transmissions for all bandwidths, 1.4 MHz, to 20 MHz and modulation types QPSK, QAM16 and QAM64. In addition to numerical measurement results, the measurement suite provides trace displays for spectrum emission mask, CCDF, constellation plots, EVM vs. Carrier and EVM vs. Symbol.

EVM analysis for uplink PUSCH, PUCCH and SRS is supported. A user defined window position can be selected when performing EVM measurements. This helps to track down problems associated with baseband timing and windowing. The capability to perform signal measurements in the presence of discontinuous transmissions (DTX) is also supported.

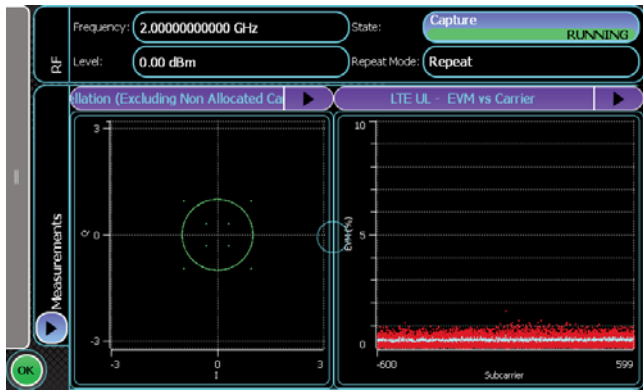


Figure 5. LTE FDD typical screenshot

CDMA2000 AND 1xEVDO MEASUREMENT SUITE

A complete suite of measurement functions to analyze cdma2000, 1xRTT, 1xEV-DO Rev 0, A and B signal characteristics in accordance with the requirements of 3GPP2 C.S0033-B version 1 and C.S0024-B version 2.0 for reverse link transmissions.

- cdma2000 RC1 to 4 reverse link analysis
- 1xEV-DO rev A and rev B (No Feedback Multiplexing mode) reverse link analysis
- Channel power
- Total power
- ACPR
- Phase Error and Magnitude Error
- Spurious emissions (spectral emission mask)
- Composite modulation accuracy (RHO and EVM)
- QPSK origin offset
- Code domain powers and PCDE
- Frequency error
- CCDF
- Fast Sequence Tuning (FST)
- Carrier Leak (Carrier Feed through)

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

TD-SCDMA MEASUREMENT SUITE

A complete suite of measurement functions to characterize TD-SCDMA signals in accordance with the requirements of 3GPP TS 34.122.

- Power results
 - Total average power plus midamble / data power
- Spectrum analysis:
 - Occupied bandwidth
 - Spectrum mask
 - Adjacent Channel Leakage power Ratio
- Modulation accuracy:
 - Composite constellation
 - Data and midamble modulation accuracy
 - RHO
 - EVM
 - IQ skew, Gain imbalance
 - IQ offset
 - Magnitude error
 - Phase error
 - Frequency error
 - Detected mid shifts (midamble only)
 - Timing error
 - Peak code domain error
 - Peak active code domain error
 - Detected code channel results
- CCDF
- Fast Sequence Tuning (FST)

The TD-SCDMA measurement suite provides analysis capabilities for all major 3GPP TD-SCDMA mobile transmitter RF parameters such as power, spectrum, and modulation accuracy.

This option provides trace displays for code domain power and code domain error as well as constellation diagrams and spectrum masks.

WLAN MEASUREMENT SUITE

A comprehensive suite of measurement tools enabling the analysis of all WLAN OFDM, DSSS and DSSS-OFDM RF signal characteristics in accordance with the requirements of IEEE 802.11a,b PMD 1999, IEEE 802.11g PMD 2003 and IEEE 802.11n /D7.0.

- 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

signal characteristics of Bluetooth® and Bluetooth® EDR transceivers such as burst power, PSK modulation accuracy, initial and maximum frequency error and origin offset and Receive sensitivity (BER).

- 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
- Receive Sensitivity (BER) using loopback

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.

Receiver sensitivity (BER) test for signals adhering to Test Suite Structure (TSS) and Test Purposes (TP) System Specification 1.2/2.0/2.0 + EDR/2.1/2.1 + EDR can be performed either in single ended or loopback mode. In loopback mode the device is configured to re-transmit received packets and the measurement suite performs the measurement and displays the result. In this case receiver and transmitter measurements can be performed concurrently.

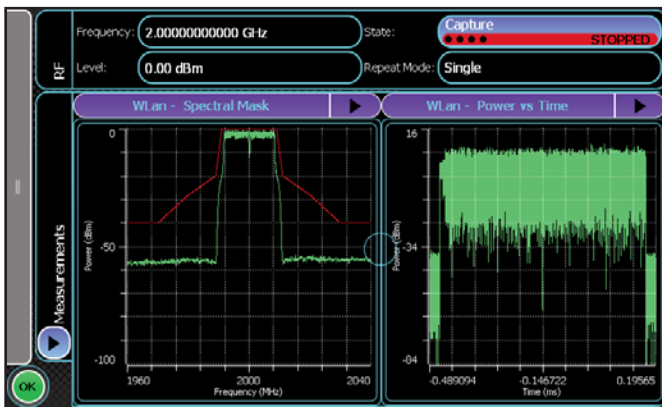


Figure 6. WLAN typical screenshot

Data rates and corresponding modulation and encoding formats up to 450 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 option easy to operate and integrate within a test application.

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

For 802.11n testing, modulation and coding schemes (MCS) 0 through 23 and 32 through 52 are supported which correspond to a maximum of three spatial streams.

BLUETOOTH® (+EDR) MEASUREMENT SUITE

A suite of measurement functions to characterize Bluetooth® and Bluetooth® EDR radio transceivers 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

SPECIFICATIONS

SPECTRUM ANALYZER

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 (Search length)

Up to 333 seconds (sample rate dependent)

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 descending power

Average Power

The RMS average power over the selected search length

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

Spectrum trace, Occupied bandwidth, Adjacent channel power, Power versus time trace, Frequency versus time trace, Phase versus time.

Measurement Results

Adjacent Channel Power

Occupied Bandwidth

Average Power

Peak Values

GSM/EDGE (OPTION 152)

All specifications are defined in any GSM band between 400 MHz and 2000 MHz. GSM/EDGE BER/BLER measurements additionally require an SGD digital RF signal generator

CONFIGURATION

The following table provides a summary of the relationship between system and band, power control level, absolute radio frequency channel number (ARFCN) and uplink frequency ranges.

System Type	Power Control Level (PCL)	ARFCN	Uplink Frequency (MHz)
GSM400	0-31	259-293 306-340	450.6-457.4
GSM700	0-31	438-511	747.2-761.8
GSM850	0-31	128-251	824.2-848.8
GSM900	0-31	0-124 975-1023	890.0-914.8 880.2-889.8
DCS1800	0-31	512-885	1710.2-1784.8
PCS1900*	0-15 30-31	512-810	1850.2-1909.8

*Note: for the PCS1900 band the PCL range 16-29 is reserved.

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 (LVDS, TTL)

Synchronisation (Auto Burst Detection)

Burst Detection threshold (dB)

Search length (ms)

Burst Timing Latency Compensation

0 to ± 78.125 symbols

BER/BLER Loopback (requires 302x²)

GSM (Mode A/B)

Number of Speech Frames: 1 to 250

GSM (Mode C)

Number of Burst Frames: 1 to 1000

GPRS

Number of Radio Blocks: 1 to 100,000

EDGE

Number of Radio Blocks: 1 to 100,000

Downlink Signal Mode

GSM, GPRS, EDGE

EDGE Modulation and Coding Scheme

MCS1 to 9

GPRS Coding Scheme

CS1 to 4

Measurement Display Types

Spectrum (RBW 10 kHz, 30 kHz, 100 kHz)

Captured power versus time

Power Profile (complete, useful, rising, falling, guard)

Phase error versus time

EVM versus time

ORFS Relative/Absolute (Spectrum due to Modulation)

ORFS Relative/Absolute (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)

GSM / EDGE POWER PROFILE

Measurement can be performed for upto 7 contiguous active slots, of same modulation type.

Complete Frame

Power versus time traces

Rising/falling edge

Complete

Measurement Results

Complete Profile (Pass/Fail)

Rising/Falling part (Pass/Fail)

Complete Profile Fail time (in symbols)

Rising/Falling Fail time (in US)

Burst (each active slot)

Power versus time traces

Useful part

Guard

Measurement Results

Useful Part/Guard (Pass/Fail)

Useful Part/Guard Fail time (in symbols)

Useful Part/Guard Fail level (in dB)

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

Dynamic Range

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

Accuracy (rising falling edges)

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

Time accuracy <0.5 μ s

Accuracy (useful part)

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

Time accuracy <0.25 symbol

Accuracy (Guard)

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

Time Accuracy <0.25 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

Traces

Peak phase error versus time

Accuracy

Typically $\pm 0.5^\circ$ rms phase error $\pm 1.0^\circ$ 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

EVM % (rms and peak), phase error degrees (rms and peak), 95th percentile EVM %, origin offset suppression, and droop

Accuracy

$\pm 0.4\%$ RMS $\pm 1\%$ 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 can be performed for single or multiple active slots.

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

Frequency Error Range

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 and 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	
	1 GHz	2 GHz	1 GHz	2 GHz
Carrier Frequency	dBc	dBc	dBc	dBc
Frequency Offset				
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	
	1 GHz	2 GHz	1 GHz	2 GHz
Carrier Frequency	dBc	dBc	dBc	dBc
Frequency Offset				
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⁾

BLER

Measurement Results

Block Error Rate (%)

Number of Radio Blocks Tested

Number of Radio Blocks in Error

Number of Active Slots Analyzed per frame

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) For EDGE or GPRS BLER, the loopback mode is not selectable

UMTS UL (OPTION 152)

All specifications are defined in all WCDMA 3GPP FDD bands.

CONTROL PARAMETERS

Scrambling Code

0 to 10000

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 DISCONTINUITY

Phase difference between measured slot and the preceding 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, 3, 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

$< \pm 0.05 \text{ dB}/10 \text{ dB}^{(1)}$

FREQUENCY STABILITY

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

Frequency Error Range

$\pm 7 \text{ kHz}$ ($\pm 3 \text{ kHz}$ for HSPA)

Frequency Error Accuracy

$< \pm(10 \text{ Hz} + (\text{Freq Standard Error} \times \text{Transmitter Freq}))$

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 Peak/rms

In %

Residual Error

$< \pm 1\%$

Composite Modulation Results

Magnitude Error Peak/rms

In %

Frequency Error

In Hz

Phase Error Peak/rms

In degrees

IQ Gain Imbalance

In dB

IQ Skew

In degrees

Carrier Leak

In dB

Slot Timing

In ms

HS-DPCCH Timing Offset

PEAK CODE DOMAIN ERROR

Code domain errors are computed over user specified spreading factor. The peak code domain errors are defined as the maximum values for the computed code domain errors. The measurements interval is 1 slot (2560 chips).

CDE Spreading Factor

2,4,8,16,32,64,128,256

Trace

Power(dBc) versus code for I and Q channels

Results

Peak code domain error for I and Q channels (in dB)

CCDF

Complimentary cumulative distribution function

Trace

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

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

Branch: I/Q

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

ILPC (Inner Loop Power Control)

The purpose of the measurement is to ensure that the User Equipment being tested is able to respond accurately to Power Control Commands given by the Radio Base Station.

SETUP

Test Segment

ABC (Power Control Algorithm 2, 1 dB step size)

EF (Power Control Algorithm 1, 1 dB step size)

GH (Power Control Algorithm 1, 2 dB step size)

Initial Power Tolerance

1 to 10 dB

Measurement Results

ILPC Absolute Power Vs. Slot Table

Slot No

Slot Power (dBm)

Step (Pass/Fail)

Ten Step (Pass/Fail)

ILPC Relative Power Vs. Slot Table

Slot No

Step Power (dB)

Step (Pass/Fail)

Ten Step Power (dB)

Ten Step (Pass/Fail)

ILPC Overall

Result (Pass/Fail)

Fail Reason

ILPC Power

Max Power (dBm)

Min Power (dBm)

Traces

ILPC Relative Power vs. Slot

ILPC Absolute Power vs. Slot

ILPC Relative Power vs. Slot (10 steps).

BER

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

LTE FDD AND TDD (OPTIONS 107 AND 108)

All specifications are defined in all LTE 3GPP FDD and TDD bands. The LTE FDD and LTE TDD are available as separate measurement suites.

CONFIGURATION

Nominal Bandwidth

1.4, 3, 5, 10, 15, 20 MHz

Subframes (link direction)

Uplink

BURST SET UP

Burst Type

Uplink PUSCH: Normal data

MEASUREMENT SET-UP

Cell ID

0 to 503

Cyclic Prefix Type

Normal or Extended

EVM Window Position

Low, Middle or High

Analysis Mode

Random slot or Specific slot

Number of Slots to Analyze

Dependent on measurement interval

Spectrum Analysis Mode⁽²⁾

Measure All IQ Data, Measure Analyzed Slots

Signal Composition⁽²⁾

Uplink and Downlink, Uplink

Uplink Cyclic Prefix Type⁽²⁾

Normal or Extended

Downlink Cyclic Prefix Type⁽²⁾

Normal or Extended

Uplink-Downlink Configuration⁽²⁾

1 to 6 (as defined in table 4.2-2 of 3GPP TS36.211 v8.6.0 (2009-03))

Special Subframe Configuration (2)

1 to 8 (as defined in table 4.2-1 of 3GPP TS36.211 v8.6.0 (2009-03))

Synchronization Slot (for specific slot analysis only)

0 to 19

Half Subcarrier Shift

On/Off

DTX Present⁽³⁾

On/Off

PILOT TRACKING

Phase Tracking

On/Off

Amplitude Tracking

On/Off

Symbol Time Tracking

On/Off

PUSCH SETUP

PUSCH Present

On/Off

DMRS Dss

0 to 29

n⁽²⁾DMRS

0,2,3,4,6,8,9,10

PUCCH SETUP

PUCCH Present

On/Off

Delta Shift Dss

1 to 3

Cyclic Shift

0 to 7

Resource Index 2

0 to 1175

Number of Reserved Resource Blocks

1 to 503

SRS SETUP

SRS Present

On/Off

Cyclic Shift

0 to 7

Transmission Combination

0 to 1

Slot Configuration

RB Auto Detect

On/off

Channel Type

OFF, PUSCH, PUCCH

Number of RBs

1 to max number of RBs for selected Bandwidth

RB Offset

0 to max-1

Modulation Type

QPSK, 16QAM, 64QAM

n⁽²⁾DMRS

0,2,3,4,6,8,9,10

POWER

Indication

dBm

Trace

Captured power vs. time

Power vs slot

Power vs resource block

FREQUENCY ERROR

Modulated carrier frequency error over one sub-frame excluding the guard period (Cyclic prefix).

Indication

Hz

Accuracy

As per reference frequency

EVM

The difference between the reference waveform and the measured waveform corrected by the sample timing offset and RF frequency offset with origin offset removed.

Indication

%/dB

Exclude Exclusion Period

On/Off

Traces

EVM (rms) vs. sub-carrier

EVM (rms) vs. symbol

EVM (rms) for non allocated RB

Constellation (with/without non allocated carriers)

Measurement Results

EVM (rms)

EVM PUCCH (rms)

EVM PUSCH (rms)

EVM DMRS (rms)

EVM SRS (rms)

EVM Non Allocated Carriers

Indication

%

Accuracy

<-40 dB residual EVM

IQ COMPONENT

IQ Origin Offset (in dB)

IQ gain imbalance (in dB)

IQ skew (in degrees)

Symbol Clock Error

Indication

ppm

SPECTRUM FLATNESS

Mask Type

Normal conditions

Extreme conditions

User defined

Indication

For each slot analyzed:-

Mask Pass/Fail

Mask Upper Pass/Fail

Mask Lower Pass/Fail

Traces

dBr values for each sub-carrier

SYMBOL / CHIP CLOCK TOLERANCE

Indication

ppm

Accuracy

As per reference frequency

OBW

Occupied bandwidth is defined as the bandwidth containing 99% of the total integrated mean power of the transmitted spectrum on the assigned channel.

Indication

Hz

SPECTRAL EMISSION 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

General, NS_03, NS_04, or NS_06

Measurement BW

As determined by Mask Type selected

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

ACLR

Number Channels

1 to 5

Indication

Reference channel power dBm

1st upper and lower adjacent channel power dBc

2nd upper and lower adjacent channel power dBc

Notes

(1) Available in LTE FDD only

(2) Available in LTE TDD only

CDMA2000R 1XRTT AND 1xEV-DO REV 0, A AND B (OPTION 102)

All specifications are defined when operating in cdmaOne, cdma2000 and 1xEVDO band classes BC0 to BC15.

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

Subtype Configuration (1xEV-DO only)

Subtype 0, 1, 2 and 3

POWER MEASUREMENT

Channel Power

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

Average Power

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

Burst Power

For burst 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

The power to the power measured at frequency offsets relative to the reference channel power.

(Not supported for 1xEV-DO Subtype 3).

Offsets

4 fixed or 4 user defined

Fixed Offsets

± 885 kHz, ± 1980 kHz

User Offsets

Up to ± 4 MHz

Dynamic Range

-82 dBc (for 303x input levels > -10 dBm)

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.

Adjacent Carriers (1xEV-DO Subtype 3 only), Two carriers maximum frequency separation (1xEV-DO Subtype 3 only)

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 composite RHO, EVM as per 3GPP2 C.50011_A or 3GPP2 C.S0033-A.

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 μ s (cdma200 RC1/2), 3.2 ms (cdma200 RC3/4), 1xEV-DO or user defined).

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

In dB

Carrier Leak (Carrier Feed Through)

In dB

Time Error

In μ s

EVM

Composite EVM Range

0 to 20% RMS

0 to 40% Peak

Residual Error

Typically 1%

Magnitude Error Peak/rms ⁽²⁾

In dB

Phase Error Peak/rms ⁽²⁾

In degrees

ORIGIN OFFSET

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 SVA tuned frequency.

Frequency Error Range

RC1-2: ± 5 kHz

RC3-4: ± 2 kHz

1xEV-DO: ± 2 kHz

QPSK: ± 10 kHz

Frequency Error Accuracy

Typically $\pm(10 \text{ Hz} + (\text{Freq standard error} \times \text{transmitter freq}))$

CODE DOMAIN POWER (RC3/RC4, 1XEVD0)

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⁾ Excluding the effects of noise

⁽²⁾ CDMA2000 only

TD-SCDMA (OPTION 109)

All specifications are defined when operating in TD-SCDMA band classes 0-12.

CONTROL PARAMETERS

Auto-detect Basic Midamble Code

Auto-detect Channel Configuration

Sync Mode

Pilot or Midamble

Channel Threshold and Slot Threshold

Auto or Manual (dB)

Slots to Analyze

TS0 to TS6, DwPTS (TS7) and UpPTS (TS8)

System Code Configuration

Sync downlink code

Sync uplink code

Scramble code

Basic Midamble code

Any code

Code Channel Configuration

Channel Status

Channel Code

Channel Spreading Factor

Channel Modulation Type

Slot Timing Reference

DwPTS or UpPTS

Slot Frequency Reference

Pilot or Midamble

POWER MEASUREMENT

Total Power

Sum of the midamble and data average power for the analyzed period of time.

Average Power

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

Midamble Power

Average power (dBm) in the midamble for the analyzed timeslot.

Data Power

Average power in the data segments pre and post midamble for the analyzed time slot.

Data Power (data segments outside midamble in dBm)

Left Data Power (before midamble in dBm)

Right Data Power (post midamble in dBm)

Traces

Captured Power (dBm) vs Time (s) Trace

ADJACENT CHANNEL LEAKAGE POWER RATIO MEASUREMENT

The power measured at frequency offsets relative to the reference channel power.

Offsets

4 fixed or 4 user defined

Fixed Offsets

± 1.6 MHz, ± 3.2 MHz

User Offsets

Up to ± 10 MHz

Dynamic Range

-82 dBc (for 303x input levels > -10 dBm)

Indication

Ref Channel Power in dBm (1.6 MHz channel bandwidth)

Offset power in dBc (30 kHz RBW)

Traces

Adjacent Channel Leakage power Ratio (dBm) vs frequency (Hz) Trace

Accuracy

Typically 0.05 dB/10 dB⁽¹⁾

SPECTRAL EMISSION MASK

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

Indication

Pass/fail

Frequency + dBm mask value with closest proximity to mask

Traces

Spectral trace + mask trace

Accuracy

Typically 0.05 dB/10 dB⁽¹⁾

OCCUPIED BANDWIDTH

Bandwidth containing 99% of the total power.

Indication

Hz

TRANSMIT MODULATION

Modulation Accuracy

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

Modulation Accuracy measurements for Data and Midamble are available.

Trace

Composite constellation trace

Detected Channel Threshold (Data only)

dB

Detected Basic Midamble Code

0-127

Detected Scramble Code

0-127

DwPTS Phase Coding

In degrees

Timing Error

In milli-chips (mChips)

Rho

0.9 to 1

EVM RMS AND PEAK

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

±5 kHz

Frequency Error Accuracy

Typically $\pm(10 \text{ Hz} + (\text{Freq standard error} \times \text{transmitter freq}))$

Magnitude Error Peak/RMS

In %

Phase Error Peak/RMS

In degrees

ORIGIN OFFSET (CARRIER LEAK)

Range

0 to 20%

Residual Error

Typically 1%

IQ Gain Imbalance

In dB

IQ Skew

In degrees

CODE DOMAIN POWER (Data only)

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

Trace

Power (dBm) versus code channel

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 (dB)

Peak Active Code Domain Error (dB)

Trace

Code domain error (dB) versus code channel

MIDAMBLE MID SHIFTS MEASUREMENTS

Midamble Number of Mid Shifts

Midamble Mid Shifts

CCDF

Complimentary cumulative distribution function.

Trace

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

⁽¹⁾ Excluding the effects of noise

WLAN (OPTION 103)

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

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. For 802.11n HT signals this also includes MCS index.

Analysis Mode

802.11a/b/g, 802.11n HT(high throughput), 802.11n non-HT

Channel Bandwidth (802.11n only)

20 MHz/40 MHz

Channel Offset (802.11n only)

None, Upper, Lower

Number of Spatial Streams (Nss)*

1, 2 or 3 (MCS 0 to 23 and 32 to 52)

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 its 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

Bandwidth containing 99% of total of the transmitted PPDU spectrum

Indication

Hz

Accuracy

Typically <100 kHz

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

802.11n

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 (FOR DSSS SIGNALS)

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 and Alternate Channel Bandwidth

±11 MHz, ±22 MHz

Indication

1st lower dBc

2nd lower dBc

1st upper dBc

2nd upper dBc

Measurement Range

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

Traces

Constellation display

Trace of EVM values versus sub carrier or symbol number

System Type, Modulation Type, Data Rate, Number of PSDU bits/symbols HT format (Greenfield or Mixed), 802.11N –HT mode only

Accuracy

Typically <40 dB residual EVM

IQ Gain Imbalance

In dB

IQ Skew

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 (FOR NON-DSSS SIGNALS)

Indication

Pass/Fail

Upper Pass/Fail

Lower Pass/Fail

Trace display of dBr versus sub carrier and mask

HT CROSS POWER

Support for up to two spatial streams

Indication

dBm

CCDF

Complimentary cumulative distribution function.

Trace

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

* Support for Nss = 2 or higher requires the presence of an Aeroflex 3061 RF combiner

** For all enabled antennas

BLUETOOTH® & BLUETOOTH® EDR (OPTION 106)

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), 2-EV3, 2-EV5

Payload Length

Up to 1021 bytes

Payload Bit Pattern

10101010, 11110000, PN9

Synchronisation (Demodulation)

RF burst and PO

EDR Blocks (x 50 symbols)

1 to 99999

Path Loss

In dB

BLUETOOTH® MEASUREMENTS

Output Power

Average power across a burst (dBm)

Peak power within a burst (dBm)

Accuracy

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: Δf_{avg} (Hz), Δf_{max} (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 μ s)

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 (dBm)

b) PSK payload Avg power (dBm)

c) relative power (dB) 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

Adjacent channel powers dBm / dBc in $\pm N$ 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

BER

Measurement Results

Number of bits analyzed

Block error rate (%)

Number of error bits

Number of packets analyzed

Number of invalid packets

Packet error rate (%)

Number of error packets

Number of missing packets

Number of CRC error packets

Setup

Number of bits to analyze: 1 to 2,000,000

ORDERING

SVA is supplied as standard with RF Digitizer, Signal Spectrum Analyzer, and Generic Demod.

Optional measurement suites may be purchased with the SVA at time of order or purchased as an upgrade to the SVA.

GSM/EDGE, UMTS Uplink

When purchased with a SVA, order as: SVA option 152

When purchased as an upgrade, then order as: RTROPT152/SVA

CDMA2000 and 1xEVDO Rev A/B

When purchased with SVA, order as: SVA option 102

When purchased as an upgrade, then order as: RTROPT102/SVA

WLAN

When purchased with SVA, order as: SVA option 103

When purchased as an upgrade, then order as: RTROPT103/SVA

Bluetooth*

When purchased with a SVA, order as: SVA option 106

When purchased as an upgrade, then order as: RTROPT106/SVA

LTE (FDD)

When purchased with a SVA, order as: SVA option 107

When purchased as an upgrade, then order as: RTROPT107/SVA

LTE (TDD)

When purchased with a SVA, order as: SVA option 108

When purchased as an upgrade, then order as: RTROPT108/SVA

TD-SCDMA

When purchased with a SVA, order as: SVA option 109

When purchased as an upgrade, then order as: RTROPT109/SVA

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