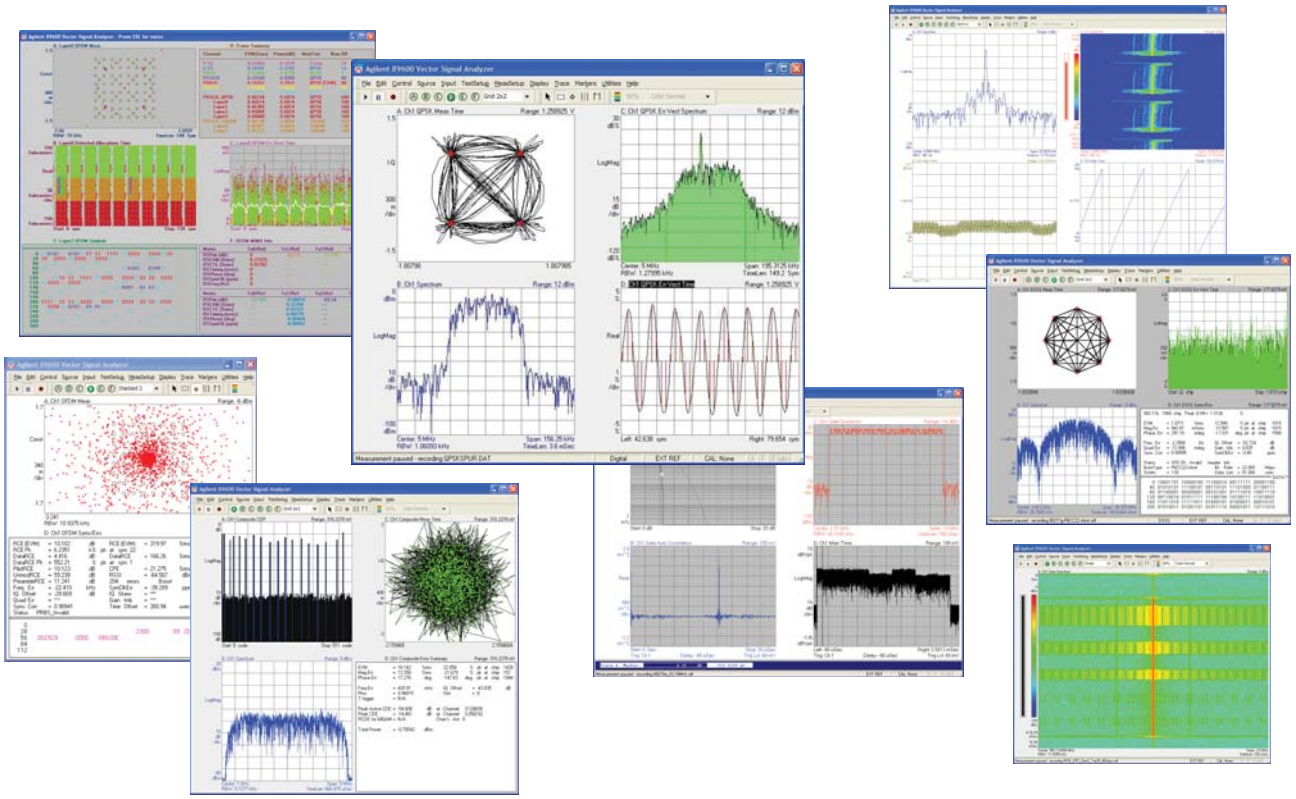
Agilent 89600 Vector Signal Analysis Software

Data Sheet

- Reach deeper into signals
- Gather more data on signal problems
- Gain greater insight



Agilent Technologies

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Introduction

The 89600 vector signal analysis (VSA) software is designed to help baseband and RF design engineers measure, evaluate and troubleshoot complex (I/Q) modulated signals.

This software runs on a PC and works with a variety of hardware measurement platforms. These platforms include the 89600S VXI based vector signal analysis systems, the 89650S wide-band vector signal analysis system with high performance spectrum analysis, the PSA high per-formance spectrum analyzers, the ESA general-purpose spectrum analyzers, the X-Series signal analyzers, Infiniium and InfiniiVision 6000 and 7000 Series oscilloscopes, many Agilent Acqiris digitizer modules, several Agilent logic analyzers, and more. For a complete list, see the Option 300 Hardware Connectivity information. These platforms down convert and digitize the signal, provide signal capture capability, and move the data to the PC in a sequential stream of data blocks. The 89600 software processes the data in the time, frequency and modulation domains.

Two-channel analysis is available with the 89600S VXI systems, Agilent Acqiris digitizers, Agilent Infiniium and InfiniiVision oscilloscopes. Two MXA, EXA, or PSA signal analyzers can be slaved together to perform 2-channel analysis for some applications. Up to 4-channel analysis is pos-sible with the supported oscilloscope families.

The following tables describe the capabilities of the 89600 vector signal analysis software and its options on these platforms, with the EEsof Advance Design System or SystemVue RF and microwave design and simulation software, and with The MathWorks Simulink Simulation and Model-Based Designs. Refer to the Hardware Measurement Platforms for the 89600 Series Vector Signal Analysis Software, Data Sheet, literature number 5989-1753EN, for performance specifications.

Basic Vector Signal Analysis (Option 200)

Time and waveform

The 89600 VSA software has two signal processing modes: base band and zoom. These two processing modes affect the appearance and the duration of input waveforms displayed by the 89600. Most 89600 measurements are made with a non-zero start frequency, called the Zoom mode. In these cases, the time domain display shows a complex envelope representa tion of the input signal – that is, the magnitude and phase of the signal relative to the analyzer's center frequency. This provides a powerful capability to examine the base band components of a signal without the need to first demodulate it.

Base band mode refers to the special case where the measurement begins at 0 Hz. Here, the input signal is directly digitized and the waveform display shows the entire signal (carrier plus modulation), very much as an oscilloscope would.

Time record characteristics

In the 89600 VSA application, measurements are based on time records. A time record is a block of samples of the signal waveform from which time, frequency, and modulation domain data is derived. Time records have these characteristics:

Time record length (main time)

$$\frac{\text{(Number of frequency points} - 1)}{\text{Span with RBW mode set to arbitrary, auto-coupled}}$$

Time sample resolution

1/(k x span)
Where:

k	=	2.56 for time data mode set to base band
k	=	1.28 for all other modes (default) including zoom
Span	=	Currently selected frequency span

Time recording characteristics

In recording (time capture) mode the 89600 VSA application captures the incoming waveform gap-free into high-speed time capture memory. This data may then be replayed through the analyzer at full or reduced speed, saved to mass storage, or transferred to another software application.

When time analyzing the captured waveform, users may adjust measurement span and center frequency in order to zoom in on a signal, as long as the new measurement span lies entirely within the originally captured span.

Time recording memory size

Memory size is dependent on the hardware used. See hardware specifications for more information.

Measurement display and control

Input	Hardware dependent
Channels:	1, 2, 3, or 4
Format:	Individual or I+jQ (ch1 + jch2); dual I+jQ (ch1 + jch2, ch3 + jch4)
Triggering	
Trigger types	
Spectrum application	(VXI hardware only) Free run, channel, external (separate trigger per frequency segment)
Vector signal analysis application	Free run, channel, IF magnitude, external
Pre-trigger delay resolution	Same as time capture sample resolution
Pre-trigger delay range	Hardware dependent.
Post-trigger delay resolution	Same as time capture sample resolution
Post-trigger delay range	Hardware dependent.
IF trigger	Used to trigger on in-band energy, where the trigger bandwidth is determined by the measurement span (rounded to the next higher cardinal span). *Specifications are dependent on the hardware used. See hardware specifications for more information.*

Measurement display and control—*continued*

Trigger hold-off	Used to improve trigger repeatability on TDMA and other bursted signals. Once armed, trigger hold-off prevents re-triggering of the analyzer until a full hold-off period has elapsed. Magnitude trigger hold-off for IF or playback signals allows you to set below or above-level trigger hold-off. This allows hold-off to be armed by a low-to-high power transition when the trigger signal is above (or below) the trigger threshold for the hold-off duration, which is especially useful for RFID analysis.
Hold-off resolution	Same as time capture sample resolution
Hold-off range	Hardware dependent.
External trigger	*External trigger is dependent on the hardware used. See hardware specifications for more information.*
Trace data	For 1, 2, 3, or 4 channels, displayed in an individual trace
Autocorrelation	Autocorrelation for the selected input channel, used to determine if the signal repeats within itself, as in multipath
CCDF	Complementary cumulative distribution function
CDF	Cumulative distribution function
Correction	Shows the correction data derived by the VSA from calibration data
Instantaneous main time	Unaveraged time data
PDF	Probability density function
PSD	Power spectral data
Raw main time	Raw time series data
Spectrum	Frequency spectrum computed from time trace data
Marker	Displays ACPR or OBW tabular data
Math	Displays computed data in math register
Channel N x 1 cross channel data	Cross channel data referenced to channel 1 for channels 2-4; for dual I+jQ , channel 2 referenced to channel 1
Coherence	Indicates similarity between two signals
Cross correlation	Determines time delays of a common signal between two different paths
Cross spectrum	Cross power spectrum of ch N vs ch1
Frequency response	Frequency response of ch N vs ch 1
Impulse response	Inverse of frequency response for ch N vs ch 1
Averaging	
Types	
Spectrum application (VXI hardware only)	RMS (video), RMS (video) exponential, peak hold
Vector signal analysis application	RMS (video), RMS (video) exponential, peak hold, time, time exponential
Number of averages, maximum	$> 10^8$
Overlap processing	0 to 99.99%
Analog demodulation	
AM demodulation	
Demodulator bandwidth	Same as selected measurement span
PM demodulation	
Carrier locking	Automatic
Demodulator bandwidth	Same as selected measurement span
FM demodulation	
Carrier locking	Automatic
Demodulator bandwidth	Same as selected measurement span
Time gating	*Provides time-selective frequency domain analysis on any input or analog demodulated time-domain data. When gating is enabled, markers appear on the time data; gate position and length can be set directly. Independent gate delays can be set for each input channel. See "Time and waveform" specification for main time length and time resolution details.*

Measurement display and control—*continued*

Gate length, maximum	Main time length
Gate length, minimum	Window shape/(0.3 x frequency span) where window shape is: • Flat-top window 3.8 • Gaussian window 2.2 • Hanning window 1.5 • Uniform window 1.0

Markers

Types	Marker, offset, spectrogram, gate time
Search	Peak, next peak left, next peak right, peak lower, peak higher, minimum
Copy marker to	Start freq, stop freq, center freq, ref level, despread chan, offset to span, counter to center frequency
Marker functions	Peak signal track, frequency counter, band power, couple, zero offset, show offset and delta
Band power	Can be placed on any time, frequency, or demodulated trace for direct computation of band power, rms square root (of power), C/N, or C/No, computed within the selected portion of the data.
Occupied bandwidth (OBW)	Placed on spectrum traces only to dynamically compute the bandwidth required to provide x% of power in the band. User selectable from 0 to 100%
OBW results	Total power in span Power in OBW Power ratio (OBW/Span) OBW lower frequency OBW higher frequency OBW Centroid frequency Offset frequency (measurement center freq – centroid freq)
Adjacent channel power	*Placed on spectrum traces only*
User-settable parameters	Center frequency and bandwidth of the carrier channel Offset frequency and bandwidth of each offset channel Reference offset allows offset channel to be centered anywhere on screen Hardware mixer level control (PSA, E4406, 89650S, 89600S options 040 and 041, only)
ACPR results	Pass/fail limits for each offset (applied to both lower and upper result) Carrier band power Power in both lower and upper offset bands for each frequency offset Power in both lower and upper offset bands for each frequency offset, relative to the carrier power (ACPR) Worst case (of the upper and lower offsets) ACPR for each frequency offset Pass/fail condition relative to user supplied thresholds

Limit lines

Compatibility	VSA application only
Limit tests	*Collection of limit lines applied to trace data*
Test edit features	Create, modify, delete, save, export, recall, import, copy
Test edit parameters	Unique name; limit line; collection of limit lines;
Type	User-defined, or saved trace
Display appearance	User-specified color for limit, fail limit, margin, fail margin
Number	One per each of six simultaneous trace displays
Marker results	Pass/fail status for limit and margin; worst-case failed point, or smallest-margin point if no failure; limit test status for all traces; limit line table with tabular results
Limit line editing	*Define, enter and edit a list of limit points*
Identification	User specified name

Measurement display and control—*continued*

Settable line parameters	Upper, lower limit; limit margin
Line draw	One line, connected points; linear or log interpolation on x- and y-axis
Line display	Limit, margin, limit and margin
Trace failure display	In trace color, or user-settable fail color
Limit data X-domain	Frequency or time, only
Limit data Y-format	Linear, log
Limit data Y-unit	Auto, Peak, RMS, Power, mRMS
X-reference	Absolute, or relative (to center frequency or starting time)
Y-reference	Absolute, or relative to reference level
Limit point editing	Sorted in ascending x-axis order
Limit point attributes	X-axis, y-axis, connection flag
Number allowed	> 32,000 points
Programming	*All features controllable via COM API*
Limit test failure	Generates measurement status event
Other	Worst-case y axis and corresponding x-value available for each limit line
Trace math	*Trace math can be used to manipulate data on each measurement. Applications include user-defined measurement units, data correction, and normalization.*
Operands	Measurement data, data register, constants, jω
Operations	+, -, x, /, conjugate, magnitude, phase, real, imaginary, square, square root, FFT, inverse FFT, windowing, logarithm, exponential, peak value, reciprocal, phase unwrap, zero
Trace formats	Log mag (dB or linear), linear mag, real (I), real (Q), wrap phase, unwrap phase, I-Q, constellation, I-eye, Q-eye, trellis-eye, group delay
Trace layouts	1 to 6 traces on one, two, three, four, or six grids
Number of colors	User-definable color palette
Spectrogram display	
Adjustable parameters	
Height	Height of viewable portion of spectrogram; in number of scan or secs
Fixed height	Yes/no; sets maximum height of spectrogram based on height setting (vs. size of window)
Top trace	Time or scan value for the first (top) trace in the viewable portion of the spectrogram
Trace offset	Yes/no; when selected, the top trace of the spectrogram display will be the value shown in the Top Trace text box
Buffer depth	Specifies the maximum number of individual traces that will be stored and/or displayed
Color count	Specifies the number of colors used for spectrogram display; max 64
Enhance	Determines how colors are distributed in the color bar for spectrogram displays; default 50% (even distribution of colors in the color bar)
Map color scheme	Color normal, color reverse, grey normal, grey reverse, user-defined
Show spectrogram	Yes/no; enables spectrogram display for the active trace
Threshold	Sets threshold for the currently selected spectrogram display; useful for removing noise-floor clutter
Trace select	When a measurement is paused any trace in the trace buffer can be selected by trace number. The marker values and marker functions apply to selected trace.
Marker	Display of frequency, amplitude, and time since trigger for any point on selected trace. Offset marker shows the absolute value of second marker in time, frequency and amplitude. Delta shows the difference between the main marker and the offset marker in a status line.

Measurement display and control—*continued*

Z-axis value	The z-axis value is the time the trace data was acquired relative to the start of the measurement. The z-axis value of the selected trace is displayed as the start of the marker readout.
Memory (characteristic) traces).	Displays occupy PC memory at a rate of 128 traces/MB (401 frequency point

Software interface

The 89600 VSA appears to other Windows® software as an ActiveX object. Implemented according to the industry-standard Component Object Model (COM), the software exposes a rich object model of properties, events, and methods, as described in the 89600 documentation.

Because all 89600 functionality is implemented within its software, direct programmatic access to the measurement front-end hardware is never necessary and is not supported. Software development environments that are capable of interacting with COM objects include Agilent VEE, Microsoft® Visual Basic, Microsoft Visual C++, C#, MATLAB®, National Instruments LabVIEW, and others.

In addition, many end-user applications are able to interact directly with COM objects, using built-in macro languages such as Visual Basic for Applications (VBA). For example, in Microsoft Excel a VBA macro could be used to set up the instrument, collect the measurement data, and automatically graph the results.

Macro language

The analyzer's built-in Visual Basic script interpreter enables easy automation of many types of measurement and analysis tasks. Scripts may be developed using any text editor, or may be recorded automatically from a sequence of menu selections. Completed scripts may be named and integrated onto the analyzer's toolbar, allowing them to be launched with a single button press.

Remote displays

To operate the 89600 VSA or view its display from a remote location, the use of commercially available remote PC software such as Microsoft NetMeeting or Symantec pcAnywhere is recommended.

Remote programming

Beginning with Microsoft Windows NT 4.0, COM objects on one PC are accessible from software running on another PC. This capability, known as Distributed COM (DCOM), makes the 89600 object model fully programmable from any other PC having network connectivity to the analyzer's host PC.

File formats

For storage and recall of measured or captured waveforms, spectra and other measurement results.

ASCII	Tab delimited (.txt), comma delimited (.csv)
Binary	Agilent standard data format (.sdf, .cap, .dat), Agilent E3238 search system time snapshot (.cap), time recording (.cap) files under 2 GB in size. Agilent N5110 signal generator files (.bin) under 2 GB in size.
MATLAB® 4 and later	MAT-file (.mat)
MATLAB 2006 and later	MAT-file (.mat) and HDF5 file format (.hdf, .h5)

Hardware Connectivity (Option 300)

Signal acquisition hardware and software

The 89600 software can analyze data from several types of signal acquisition hardware. Full VSA functionality is provided within the signal acquisition capabilities of the hardware with which it is working. Table 1 provides information on the models supported. See hardware specifications for more information, literature number 5989-1753EN.

Table 1. Supported acquisition hardware and software for 89600 VSA software[1]

Description	Models Supported	VSA Input Channels Supported	BBIQ (ch 1 + jch2)	MIMO
89600S VXI-based VSA	89610, 89611, 89640, 89641	1 or 2, baseband and/or RF	Yes, optional; all models	2x2
X-Series signal analyzers	N9000A, N9010A, N9020A, N9030A	1	Yes, optional (N9020A only)	2x2 (2 units slaved, N9010/20 only)
PSA spectrum analyzer	E4440A, E4443A, E4445A, E4446A, E4447A, E4448A	1	No	No
ESA spectrum analyzer	ESA-E Series	1	No	No
Infiniium oscilloscopes	8064, 8104, 9064, 9104, 9254, 9404, 80204, 80304, 80404,80604, 80804, 81004, 81204, 813404,90254, 90404, 90604, 90804, 91204,91304	1, 2, 3, 4	Yes, including dual I+jQ	4x4
InfiniiVision oscilloscopes	601x, 603x, 703x, 605x, 705x, 610x, 710x, 6014, 6054, 6104	1, 2, 3, 4 depending on model and options	Yes, for all scopes; dual I+jQ with 4-channel models	2x2
Logic analyzer	1680/1690; 16800/ 16900; RDX	2	No	2x2
Agilent Acqiris digitizers	U1066A (DC440, DC438) or U1065A (DC282, DC252, DC222)	1 or 2 depending on model	Yes, for 2 channel models	No
Wireless connectivity test set	N4010	1 or 2	No	2x2 WLAN-HT
Baseband Studio application	N5110 with N5101 or N5102	1	No	No
Baseband Studio for CPRI RE test application	N5120 with N5101 or N5103	1	No	No
LXI spectrum analyzer [2]	N8201 with N8221	1	No	No
Agilent EEsof simulation software	Various ADS, SystemVue models	2	Yes	Yes
The Mathworks Simulink Simulation and Model-based Design	Various	2	Yes	No

Sources

The 89600 VSA can control Agilent signal generators via GPIB, LAN or USB. Table 2 provides information on the models supported. Frequency and level control of CW signals is provided via the VSA GUI. Arbitrary signals may be downloaded from the VSA time capture memory to the signal generator for replay. The same time record may be played over and over contiguously. A window function can be applied to smooth the start-up and finish of replay.

Signal types: CW (single frequency sine wave), arbitrary

Frequency range: Same as the signal generator used

Level range: –136 dBm to 20 dBm, 0.02 dBm steps

Table 2. Supported sources

Description	Model	Required Options
ESG signal source	E4438C	001, 002, 601 or 602
MXG signal source	N5182A	651, 652, or 654
PSG signal source	E8267C or E8267D	002, 601 or 602

1. *Not all revisions support all hardware. For more information, please go to the Upgrade Options section of this document.*
2. *For 89600 software revisions less than 8.xx. For the most current list of supported hardware, go to www.agilent.com/find/89600.*

Vector Modulation Analysis (Option AYA)

Signal acquisition

Number of input channels supported	2, plus dual ch1 + jch2
Data block length	10 to 4,096 symbols, user adjustable
Samples per symbol	1 to 20, user adjustable
Symbol clock	Internally generated
Carrier lock	Internally generated
Triggering	Single/continuous, external, pulse search (searches data block for beginning of TDMA burst and performs analysis over selected burst length)
Data synchronization	User-selected synchronization words

Supported data formats

EDGE Evolution analysis and pre-set available as separate mode

Carrier types	Continuous, pulsed (burst, such as TDMA)
Modulation formats	FSK: 2, 4, 8, 16 level (including GFSK) MSK (including GMSK) Type 1, Type 2 CPM BPSK, QPSK, OQPSK, DQPSK, D8PSK, π/4DQPSK, 8PSK, 3π/8 8PSK (EDGE); π/8 D8PSK; QAM (absolute encoding): 16, 32, 64, 128, 256, 512, 1024 QAM (differential encoding per DVB standard): 16, 32, 64, 128, 256 Star QAM: 16, 32 APSK: 16, 16 w/DVB, 32, 32 w/DVB VSB: 8, 16

Single button pre-sets

EDGE Evolution analysis and pre-set available as separate mode

Cellular	CDMA (base), CDMA (mobile), CDPD, EDGE, GSM, NADC, PDC, PHP (PHS), W-CDMA
Wireless networking	*Bluetooth*™, HiperLAN1 (HBR), HiperLAN1 (LBR), IEEE 802.11b, ZigBee 868 MHz, ZigBee 915 MHz, ZigBee 2450 MHz
Digital video	DTV8, DTV16, DVB16, DVB32, DVB64, DVB128, DVB256, DVB 16APSK, DVB 32APSK
Other	APCO 25, APCO-25 P2 (HCPM); APCO-25 P2 (HDQPSK), DECT, TETRA, VDL mode 3 MIL-STD 188-181C:CPM (Option 21)

Filtering

Filter types	Raised cosine, square-root raised cosine, IS-95 compatible, Gaussian, EDGE, low pass, rectangular, half-sine (reference filter only, for use with ZigBee), none
Filter length	40 symbols: VSB, QAM, and DVB-QAM for $\alpha < 0.2$ 20 symbols: all others
User-selectable alpha/BT	Continuously adjustable from 0.05 to 10
User-defined filters	User-defined impulse response, fixed 20 points/symbol Maximum 20 symbols in length or 401 points

Vector Modulation Analysis (Option AYA)—*continued*

Maximum symbol rate

Frequency span/(1 + α) (maximum symbol rate doubled for VSB modulation format). Symbol rate is limited only by the measurement span; that is, the entire signal must fit within the analyzer's currently selected frequency span.

Measurement results (formats other than FSK)

I-Q measured	Time, spectrum (filtered, carrier locked, symbol locked)
I-Q reference	Time spectrum (ideal, computed from detected symbols)
I-Q error versus time	Magnitude, phase (I-Q measured versus reference)
Error vector	Time, spectrum (vector difference between measured and reference)
Symbol table and error summary	Error vector magnitude is computed at symbol times only
Instantaneous	Time, spectrum, search time
Offset EVM	OQPSK only

Measurement results (FSK)

FSK measurement	Time, spectrum
FSK reference	Time, spectrum
Carrier error	Magnitude
FSK error	Time, spectrum

GSM/EDGE/EDGE Evolution

Provided as part of Option AYA

Standard supported

- 3GPP TS 45.912 V8.0.0 (2008-12)
- 3GPP TS 45.001 V8.0.0 (2008-12)
- 3GPP TS 45.002 V8.0.0 (2008-12)
- 3GPP TS 45.003 V8.0.0 (2008-12)
- 3GPP TS 45.004 V8.0.0 (2008-12)
- 3GPP TS 45.005 V8.3.0 (2008-11)
- 3GPP TS 51.021 V8.1.0 (2008-11)

Format

Preset to standard	Sets default format parameters; manual setting available
Burst type	Sync (SCH); Normal (TCH & CCH); HSR (TCH &CCH); Mixed (NB/HB); Access (RACH)
Burst sync mode	Training Seq (TSC); RF Amp; Polar Mod; None
TSC Index	Auto select or Manual, 0-7
Modulation scheme	Auto select or Manual: GMSK, 8PSK (EDGE), 16QAM, 32QAM, HSR QPSK, HSR 16QAM, HSR 32QAM
Discard non-matching slots	Yes, no
HSR pulse shape filter	Narrow, wide; only for HSR, Access bursts

Time

Search length	Length of time acquired by the analyzer over which pulse search is performed; sec or slots
Time slot	Auto select or manual, 0-7

Advanced

Normal symbol rate	Specifies the symbol rate for normal (not HSR) signals
High symbol rate	Specifies the symbol rate for HSR signals
Burst search threshold	Specifies the relative threshold from the peak power level, which is used to determine the burst rising and falling edges
IQ constellation type	Determines constellation displayed: meas filtered only; meas and complementary filtered; derotated meas and complementary filtered

Vector Modulation Analysis (Option AYA)—*continued*

Advanced—continued

IQ normalize	Enables normalization of demodulation results to nominal value
Mirror frequency spectrum	Yes, no; Causes software to perform a frequency inversion before attempting to synchronize to and demodulate the signal
Wide frequency lock range	Increases frequency error tolerance when selected
Multi-carrier filter	Enables or disables a multi-carrier filter, which allows EVM measurements in the presence of signals in an adjacent channel
Compensate droop	Enables or disables droop compensation, which corrects amplitude variations across a burst
Align polar modulation	Enables or disables polar modulation for polar modulation burst sync mode

Results

Pre-demodulation

Correction	Displays frequency domain correction applied to raw measured time data
Instantaneous spectrum	Frequency spectrum of time trace; always un-averaged
Raw main time	Block of time data acquired by the hardware, including additional time samples for filter settling, with no time-domain corrections or re-sampling
Spectrum	Frequency spectrum of the time trace, including any averaging selected
Time	Time data for the time slot chosen for analysis
Search time	Acquired time data used to search for analysis timeslot

Demod trace results

CDF	Cumulative density function of the measurement data used for demodulation
CCDF	Complementary cumulative density function of the measurement data used for demodulation
PDF	Probability density function of the measurement data use for demodulation
Error vector time	Difference between the IQ measured vector time and the IQ reference vector time
IQ mag error	Error between the magnitude of the measured IQ measured signal and the magnitude of the reference signal
IQ meas time	IQ data results for the measured input signal
IQ phase error	Error between the phase of the measured IQ measured signal and the phase of the reference signal
IQ ref time	IQ data results that would have been derived for the ideal input signal
Symbols	Demodulated symbol bits
Summary table	Includes the following information:
Mod scheme	Modulation scheme of the analyzed timeslot
TSC	Training sequence value (0-7) of analyzed timeslot
Slot index	Detected slot index
EVM	Root Mean Square (RMS) of the error vectors computed and expressed as a percentage of the magnitude of the peak symbol point in the ideal signal
Mag err	Difference in amplitude between the I/Q measured signal and the I/Q reference signal
Phase err	Phase difference between the I/Q reference signal and the I/Q measured signal measured at the symbol time
Pk EVM	Pk EVM equals the mean (average) of the peak EVMs—one per measurement
95% EVM	Error-vector-magnitude (EVM) below which 95% of the individual symbol EVMs occur
Freq err	Average frequency offset of the entire analyzed timeslot
IQ offset	Ratio between power at the center frequency and overall signal power
Quad err	Angle error between I and Q
Time offset	Time interval between the measurement trigger and T0
Amp droop	Average amplitude droop, in dB/symbol
Gain imbalance	Amplitude ratio between I and Q, in dB
AM/PM skew	Time interval between the AM and PM parts of the signal
Sub channel A symbols	Value of symbols in sub channel A (AQPSK only)
Sub channel B symbols	Value of symbols in sub channel B (AQPSK only)

Vector Modulation Analysis (Option AYA)—*continued*

Display formats

The following trace formats are available for measured data and computed ideal reference data, with complete marker and scaling capabilities and automatic grid line adjustment to ideal symbol and constellation states.

Polar diagrams	
Constellation	Samples displayed only at symbol times
Vector	Display of trajectory between symbol times with 1 to 20 points/symbol
I-Q versus time	
I or Q only	Continuous versus time
Eye diagram	Adjustable from 0.1 to 40 symbols
Trellis diagram	Adjustable from 0.1 to 40 symbols
Error vector magnitude	Continuous versus time
Errors table	Measurements of modulation quality made automatically and displayed by the symbol/error trace type. RMS and peak values.
Formats other than FSK	Error vector magnitude, magnitude error, phase error, frequency error (carrier offset frequency), I-Q/origin offset, amplitude droop (PSK and MSK formats), SNR (8/16 VSB and QAM formats), quadrature error, gain imbalance *For VSB formats:* VSB pilot level is shown in dB relative to nominal. SNR is calculated from the real part of the error vector only. *For DVB formats:* EVM is calculated without removing IQ offset
FSK format	FSK error, magnitude error, carrier offset frequency, deviation
Symbols table (detected bits)	Bits are displayed in binary and grouped by symbol. Multiple pages can be scrolled for viewing large data blocks. The symbol marker (current symbol shown in inverse video) is coupled to measurement trace displays to identify states with corre sponding bits. For modulation formats other than DVBQAM and MSK, bits are user-definable for absolute or differential symbol states.[1]

Adaptive equalizer

Removes the effects of linear distortion (i.e. non-flat frequency response, multipath, etc.) from modulation quality measurements. Equalizer performance is a function of the setup parameters (equalization filter length, convergence, taps/symbol) and the quality of the signal being equalized.

Type	Decision directed, LMS, feed-forward, equalization with adjustable convergence rate
Filter length	3 to 99 symbols, adjustable
Filter taps	1, 2, 4, 5, 10, or 20 taps/symbol
Measurement results provided	Equalizer impulse response, channel frequency response
Supported modulation formats	All supported modulation formats, except FSK and GSM/EDGE/EDGE Evolution

1. *Synchronization words are required to resolve carrier phase ambiguity in non-differential modulation formats.*

3G Modulation Analysis Bundle (Option B7N)

Option B7N is an ordering convenience equivalent to options B7T, B7U, B7W, and B7X. It provides all the functionality listed below for those options.

W-CDMA/HSPA+ Modulation Analysis (Option B7U)

Signal acquisition	Description		Version	Date
Standards supported	TS 25.211	Release 8 Physical channels and mapping of transport channels onto physical channels (FDD)	8.4.0	2009-03
	TS 25.212	Release 8 Multiplexing and channel coding (FDD)	8.5.0	2009-03
	TS 25.213	Release 8 Spreading and modulation (FDD)	8.4.0	2009-03
	TS 25.214	Release 8 Physical layer procedures (FDD)	8.5.0	2009-03
	TS 25.141	Release 8 BS conformance testing (FDD)	8.6.0	2009-03
	TS 34.121-1	Release 8 UE conformance specification, Radio transmission and reception, Conformance specification (FDD)	8.4.0	2009-03
	TS 25.214	Release 8 MIMO operation of HS-DSCH	8.5.0	2009-03

Modulation formats supported	E-HSPA: (64QAM downlink and 4PAM I or Q), 4PAM-IQ uplink; W-CDMA (3GPP)
Result length	Adjustable from 1 to 64 slots maximum. Actual value hardware dependent.
Settable in slots, frames, seconds	
Samples per symbol	1
Triggering	Single/continuous, external
Measurement region	Length and offset adjustable within result length; for HSPA analysis, also adjust
sub measurement offset and interval	

Signal playback

Result length	Adjustable from 1 to 64 slots maximum. Actual value hardware dependent.
Capture length (gap-free analysis at 0 % overlap and 5 MHz span)	*Capture length is hardware dependent. See hardware specifications for more information, literature number 5989-1753EN.*

Measurement format setup

Direction	Uplink, downlink
Enable HSPA analysis	On/off
Chip rate	Continuously adjustable
Sync start slot	Auto, or user-selected slot 0-14
Filter alpha	Adjustable from 0.05 to 1
Uplink setup	
Sync type	DPCCH (slot format 0-5, auto), or PRACH message
(auto preamble signature, or manual setting)	
Scramble code	0-16777215
Downlink setup	
Sync type	CPICH, SCH, Ant-2 CPICH, or symbol, with variable spread code length
and code channel selection	
Pilot-aided timing estimation	on, off
Scramble code	0-511
Scramble code offset	0-15
Scramble code type	Standard, left, right
Number of Tx antennas	1,2

W-CDMA/HSPA+ Modulation Analysis (Option B7U)—*continued*

Channel/Layer setup	
De-spread channel	Selectable code channel
Uplink	
Spread code length	2- 256 (1.92 Msym/s to 15 ksym/s)
Decode channel	Select 1-255 and I,Q, or IQ branch data to display
CDP layer	Select spread code length: 2-256 (1.92 Msym/s to 15 ksym/s)
Modulation scheme	Auto-detect, or manual selection of BPSK or 4-PAM; HSPA with spread code length of 2 only
tHS-DPCCH	*HSPA uplink only*
Value	N x 256 chips; adjustable when analyzing HS-DPCCH channel
Code location	S256(1):I; S256(32):Q; S256(33):Q; S256(64:Q)
Downlink	
Spread code length	4-512 (960 ksym/s to 7.5 ksym/s)
Decode channel	Select 1-255 and I,Q, or IQ branch data to display
tDPCH	Auto, or manually set n x 256 chips value
CDP layer	Select spread code length: 4-512 (960 ksym/s to 7.5 ksym/s)
Test Model	*Downlink only*
None	Auto active-channel detection
Test Model 1	16 DPCH, 32 DPCH, 64 DPCH (with or without S-CCPCH)
Test Model 2	With or without S-CCPCH
Test Model 3	16 DPCH, 32 DPCH (with or without S-CCCH)
Test Model 4	With or without P-CPICH
Test Model 5	2 HS-PDSCH with 6 DPCH, 4 HS-PDSCH with 14 DPCH, 8 HS-PDSSCH with 30 DPCH (only when HSPA selected)
Test Model 6	2 HS-PDSCH with 6 DPCH, 4 HS-PDSCH with 14 DPCH, 8-64QAM HS-PDSSCH with 30 DPCH (HSPA analysis only)
Advanced measurement setup	
Active channel threshold	Auto, manual (0 dBc to -120 dBc)
Frequency error tolerant range	Configures the frequency tolerance range for synchronization with DPCCH; normal, wide *(uplink only)*
IQ normalize	On/off; determines whether to normalize IQ meas, IQ ref, error vector time, and error vector spectrum displays
Mirror frequency spectrum	On/off; determines whether to do a frequency inversion before synchronizing and demodulating signal
Include IQ offset in EVM	Controls whether the composite IQ Offset is included in the composite EVM data result
Bypass RRC measurement filter	Disables internal root-raised-cosine (RRC) measurement filter to measure W-CDMA signals with externally-applied RRC measurement filtering
Suppress SCH	Specifies whether the non-orthogonal SCH and the resulting leakage power is removed from channel analysis measurements; downlink only
DTX/Burst detection	On/off *(HSDPA only)*
Use multichannel estimator	Determines whether timing and phase errors will be the same for each channel; on/off *(downlink only)*
MIMO Setup	
Compensate channel	Yes/no
PCI	Specifies pre-coding matrix; 0, 1, 2, 3
Freq offset model	Selects impairment model; Tx or Rx

W-CDMA/HSPA+ Modulation Analysis (Option B7U)—*continued*

Measurement results

Channel data	*Time and frequency trace data results derived from pre-demodulated data*
Correction	Shows the correction data derived by the analyzer from calibration data
Instantaneous spectrum	Non-averaged frequency spectrum of the pre-demodulated time trace data
Raw main time	Raw data read from the input hardware or playback file
Spectrum	Frequency spectrum of the pre-demodulated time trace data
Time	Time data record before demodulation or averaging
CDF	Cumulative distribution function
CCDF	Complementary cumulative distribution function
PDF	Probability density function
Antenna code domain power (CDP) measurement results	*CDP and code domain error (CDE) trace data results for either the composite signal or for a specified code layer for each available antenna input*
CDE composite	Channel power error values for each active code channel for all code layers (spread code lengths)
CDE layer	Channel power error values for each code channel within the specified code layer (spread code lengths)
CDP layer	CDP trace data for all code channels within the specified code layer (spread code length)
Code domain offsets	Table summarizing active code channel power, CDE, RCDE in dB
Inst CDE composite	Shows the instantaneous (non-averaged) code channel power error data for the composite signal
Inst CDE layer	Shows the instantaneous (non-averaged) code channel power error values for all active code channels (Walsh code number) within the specified code layer (spread code length)
Inst CDP composite	Shows the instantaneous (non-averaged) measured code channel power for the composite signal
Inst CDP layer	Non-averaged CDP layer trace
Slot summary	Table summarizing EVM; Pk CDE and location; frequency error; CPICH *(downlink only)*; total power by slot number

W-CDMA/HSPA+ Modulation Analysis (Option B7U)—*continued*

Antenna composite results	*Time and frequency domain trace data results for designated Antenna N for the composite signal derived from data for the total signal*
Error summary	Table showing, for the composite signal, average and peak values and location for EVM, magnitude error, phase error; frequency error, IQ offsest, Rho, slot number, T trigger; average and channel location for peak active CDE, peak CDE; RCDE for 64QAM, channels active (number of 64QAM channels used when calculating RCDE); total power
Error vector spectrum	Error vector for composite signal across frequency
Error vector time	Error vector for composite signal over time (chip)
IQ mag error	Composite magnitude error over time
IQ measured spectrum	Spectrum of demodulated time data results for the composite signal
IQ measured time	Time data results of demodulation of composite signal
IQ phase error	Phase error between the I/Q measured and the I/Q reference signals for the composite signal
IQ reference spectrum	Spectrum of the IQ reference time for the composite signal
IQ reference time	Ideal signal generated from the measured signals demodulated bits
Inst error vector spectrum	Instantaneous error vector for composite signal with no averaging
Inst IQ measured spectrum	Instantaneous spectrum of demodulated time data results for the composite signal with no averaging
Inst IQ reference spectrum	Instantaneous reference spectrum of demodulated time data results for the composite signal with no averaging
Antenna despread code data (MIMO)	*Time domain trace data results from HS Transport Block for designated Antenna N for a single code channel within a specified code layer (spread code length/symbol rate)*
Error vector time	Shows the time domain error vector trace data results for the specified code channel and code layer (spread code length)
IQ magnitude error	Shows the magnitude error between the I/Q measured and the I/Q reference trace data at the sampled chip times for the specified code channel and code layer (spread code length)
IQ meas time	Demodulated time data results for the measured input signal, sampled at the chip times, for the specified code channel and code layer (spread code length)
IQ phase error	Phase error between the I/Q measured and the I/Q reference trace data at the sampled chip times for the specified code channel and code layer (spread code length)
IQ reference time	Demodulated time data results that would be derived from an ideal input signal (reference), sampled at the chip times, for the specified code channel and code layer (spread code length)
Symbols/error table	Average and peak value/location for EVM, magnitude error, phase error; RCDE, slot number, modulation format; demodulated bits; pilot bits and tDPCH *(downlink only)*
Cross channel data (2x1)	Available for MIMO 2x2 measurements
Coherence	Indicates measure of power in the output signal caused by input
Cross correlation	Determines time delays of a common signal between two different paths
Cross spectrum	Cross power spectrum of ch 2 vs. ch 1
MIMO Info[1]	Tabular data for MIMO measurements[1]
Condition number	Single value indicating the correlation of the MIMO channel, assuming static fading
Metrics	Color-coded data available for each Tx/Rx pair
CPICH Timing Offset	Detected timing offset of the CPICH channel for each path
CPICH Freq Offset	Detected frequency offset of the CPICH channel for each path
CPICH Phase Offset	Computed phase offset of the CPICH channel for each path based on H value
CPICH Mag Offset	Computed m offset of the CPICH channel for each path based on H value
H. (I+jQ)	Estimated MIMO channel matrix

cdma2000®/1xEV-DV Modulation Analysis (Option B7T)

Signal acquisition

Result length	1 to 64 PCGs forward link; 1 and 48 PCGs reverse link maximum. Value hardware-dependent.
Samples per symbol	1
Triggering	Single/continuous, external
Measurement region	Length and offset adjustable within result length

Signal playback

Result length	Adjustable from 1 to 64 PCGs, forward link; 1 to 4 PCGs, reverse link maximum. Value hardware-dependent.
Capture length (gap-free analysis at 0% overlap; 2.6 MHz span)	*Capture length is dependent on hardware. See hardware specifications for more information.*

Adjustable parameters

Format	Forward, reverse
Single button presets	Forward, reverse
Chip rate	Continuously adjustable
Long code mask (reverse)	0
Base code length	64, 128
Channel modulation scheme (forward)	Auto, QPSK, 8PSK, 16QAM
Active channel threshold	Auto, manual (0 dBc to –120 dBc)
Enable 1xEV-DV analysis	Off, On
Gated active channel detection	Off, On
Multi-carrier filter	Off, On
PN offset	0 x 64 to 511 x 64 chips
Wash code QOF	0,1,2,3
Defined active channels[1]	Off, On
Walsh code column index[1]	0,1,2,3
Walsh mask[1]	0 to 1111111111111 (binary)
F-PDCH0/1 number of codes[1]	F-PDCH0 + F-PDCH1 ≤ 28
F-PDCH0/1 modulation scheme[1]	QPSK, 8PSK, 16QAM
Gated modulation detection[1]	Off, On
Modulation scheme[1]	Auto, QPSK, 8PSK, 16QAM

1. *Value subject to Force Code Group Setting.*

cdma2000/1xEV-DV Modulation Analysis (Option B7T)—*continued*

Measurement results

Composite	*All code channels at once or all symbol rates taken together.*
Code domain power	Composite (all symbol rates together) Individual symbol rates (9.6, 19.2, 38.4, 76.8, 153.6, 307.2 ksps)
Code domain error	Composite (all symbol rates together) Individual symbol rates (9.6, 19.2, 38.4, 76.8, 153.6, 307.2 ksps)
I-Q measured	Time, spectrum
I-Q reference	Time, spectrum (reference computed from detected symbols)
I-Q error versus time	Magnitude and phase (IQ measured versus reference)
Error vector	Time, spectrum (vector difference between measured and reference symbol point)
Symbol table and error summary	EVM, magnitude error, phase error, rho, peak active CDE, peak CDE, trigger, frequency error, IQ (origin) offset, PCG number
Code domain offset table	Timing and phase offset for each active code
Channel	*Individual code channels*
I-Q measured	Time
I-Q reference	Time (reference computed from detected symbols)
I-Q error versus time	Magnitude and phase (IQ measured versus reference symbol)
Error vector	Time (vector difference between measured and reference symbol)
Symbol table and error summary	EVM, magnitude error, phase error, PCG number, modulation format
Other measurement results	
Pre-demodulation	Time, spectrum, PDF, CDF, CCDF, correction, raw main time, instantaneous spectrum

Display formats

CDP measurements results	I and Q shown separately on same trace
Channel measurement results	I and Q shown separately
Code order	Hadamard, bit reverse

1xEV-DO Modulation Analysis (Option B7W)

Signal acquisition

Result length	
Forward link	1 to 64 slots maximum. Value hardware dependent.
Reverse link	1 to 64 slots maximum. Value hardware dependent.
Samples per symbol	1
Triggering	Single/continuous, external
Measurement region (applies to CDP results)	Interval and offset adjustable within result length

Signal playback

Result length	
Forward link	1 to 64 slots maximum. Value hardware dependent.
Reverse link	1 to 64 slots maximum. Value hardware dependent.
Capture length (gap-free analysis at 0% overlap at 1.5 MHz span)	*Capture length is hardware dependent. See hardware specifications for more information.*

1xEV-DO Modulation Analysis (Option B7W)—*continued*

Supported formats

Formats	Forward (BTS), reverse (AT)
Single-button presets	Forward, reverse

Other adjustable parameters

Chip rate	Continuously adjustable
Analysis channel (forward)	Preamble, pilot, MAC, data
PN offset (forward)	Continuously adjustable from 0x64 to 511x64 chips
Preamble length (forward)	Adjustable from 0 to 1,024 chips or auto detection
Data modulation type (forward)	QPSK, 8PSK, 16QAM
Long code masks (reverse)	Continuously adjustable from 0x0000000000 to 0x3FFFFFFFFF

Measurement results

Overall	
Error summary (forward)	Overall 1 and overall 2 results for: rho, EVM, magnitude error, phase error, frequency error, slot number, and IQ offset

Composite	*All code channels at once or all symbol rates taken together.*
Code domain power	All symbols taken together Individual symbol rates (9.6, 19.2, 38.4, 76.8, 153.6, 307.2 ksps)
Code domain error (reverse)	All symbols taken together Individual symbol rates (9.6, 19.2, 38.4, 76.8, 153.6, 307.2 ksps)
IQ measured	Time, spectrum
IQ reference	Time, spectrum
IQ error versus time	Magnitude and phase (IQ measured versus reference)
Error vector	Time, spectrum (vector difference between measured and reference)
Error summary (forward)	EVM, magnitude error, phase error, rho, frequency error, IQ offset, slot number, preamble length
Error summary (reverse)	EVM, magnitude error, phase error, rho, frequency error, IQ offset, slot number, peak CDE, pilot, RRI, ACK, DRC, data power

Channel	*Individual code channel, reverse only.*
IQ measured	Time
IQ reference	Time
IQ error versus time	Magnitude and phase (IQ measured versus reference)
Error vector	Time (vector difference between measured and reference)
Symbol table and error summary	EVM, magnitude error, phase error, slot number

Other

Pre-demodulation	Time, spectrum, PDF, CDF, CCDF, correction, raw main time, instantaneous spectrum

Display formats (characteristic)

CDP measurement results	I and Q shown separately on same trace
Channel measurement results (reverse)	I and Q shown separately
Code order	Hadamard, bit reverse

TD-SCDMA Modulation Analysis (Option B7X)

Signal acquisition	
Result length	1 to 8 subframes maximum. Value hardware dependent.
Start boundary	Sub-frame, 2 frames
Time reference	Trigger point, downlink pilot, uplink pilot
Samples per symbol (code channel results)	1
Samples per chip (composite results)	1
Triggering	Single/continuous, external
Measurement region	Analysis timeslot selectable within first sub-frame
Signal playback	
Result length	1 to 8 subframes maximum. Value hardware dependent.
Capture length (gap-free analysis at 0% overlap at 1.6 MHz span)	*Capture length is hardware dependent. See hardware specifications for more information.*
Supported formats	
Standards supported	3GPP TDD 1.28 Mc/s option, Release 5.0.0, December 2003
Formats	Downlink, uplink
Single-button presets	3GPP N-TDD 1.28 Mcps
Modulation formats	QPSK, 16QAM, HSDPA/8PSK/64QAM
Other adjustable parameters	
Chip rate	Continuously adjustable
Filter alpha	Continuously adjustable between 0.05 and 1.0
Downlink pilot sequence	0 to 31[1]
Uplink pilot sequence	0 to 255[1]
Scramble sequence	0 to 127[1]
Basic midamble sequence	0 to 127[1]
Midamble autodetect	Detects midamble code ID and sets Basic Midamble and Scrambling Code IDs (when in Midamble subframe synchronization mode)
Max users (selectable for each timeslot)	2, 4, 6, 8, 10, 12, 14, 16
Slot frequency reference	Pilot, midamble
Subframe synchronization	Pilot, midamble
Force code group settings	
Downlink pilot	Downlink pilot code ID acts as master to determine the Code Group states. Non-standard code ID sequence allocations also allowed via Code Group check boxes.
Any code	User-selected Code ID (downlink pilot, uplink pilot, scramble or basic midamble) determines master for Code Group states.
Measurement results	
Composite	*All code channels at once or all symbol rates taken together.*
Code domain power	All symbol rates and code channels taken together; individual symbol rates (80, 160, 320, 640, 1280 ksps)
Code domain error	All symbol rates and code channels taken together; individual symbol rates (80, 160, 320, 640, 1280 ksps)
IQ measured	Time, spectrum
IQ reference	Time, spectrum
IQ error versus time	Magnitude and phase (IQ measured versus reference)
Error vector	Time, spectrum (vector difference between measured and reference)
Error summary	EVM, magnitude error, phase error, rho, peak active CDE, peak CDE, frequency error, IQ offset, IQ skew, slot amplitude droop

TD-SCDMA Modulation Analysis (Option B7X)—*continued*

Channel	*Individual code channel*
IQ measured	Time
IQ reference	Time
IQ error versus time	Magnitude and phase (IQ measured versus reference)
Error vector	Time (vector difference between measured and reference)
Symbol table and error summary	EVM, magnitude error, phase error, code phase (degs), detected modulation, data bits
Layer	*All code channels at once*
Code domain power	All symbol rates taken together; individual symbol rates (80, 160, 320, 640, 1280 ksps)
Code domain error	All symbol rates taken together; individual symbol rates (80, 160, 320, 640, 1280 ksps)
Overall	
Time	Aligned analysis region; active timeslots highlighted
Filtered time	IQ time, RRC filtered, resampled to 4x chip rate
Gate time	Gated IQ time
Gate spectrum	Averaged and instantaneous
Gate PDF, CDF	PDF, CDF of gate time magnitude
Error summary	Timing error, total power, midamble power, data power for each timeslot, data power left (before preamble), and data power right (after preamble)
Other	
Analysis timeslot	Analyze single timeslot for time, spectrum, PDF, CDF, CCDF
Pre-demodulation	Time, spectrum, correction, raw main time, instantaneous spectrum
Display formats	
Overall time measurement results	Active timeslots highlighted with background color
CDP and CDE measurement results	Active code channels highlighted by CDP layer color
Composite	
Trace data available	Error vector spectrum, error vector time, IQ magnitude error, IQ measured spectrum, IQ measured time, IQ phase error, IQ reference spectrum, IQ reference time, instantaneous IQ measured spectrum, instantaneous error vector spectrum, instantaneous reference spectrum
Error summary	Rho, EVM, magnitude error, phase error, frequency error, IQ offset, quadrature error, gain imbalance, peak active CDE, peak CDE, midamble rho, midamble EVM, midamble magnitude error, midamble phase error, midamble IQ offset, midamble quadrature error, midamble gain imbalance, number of multiple midamble shifts detected, list of shift values
Symbols	Table of symbol numbers and value

LTE FDD Modulation Analysis (Option BHD)
LTE TDD Modulation Analysis (Option BHE)

Both options include all of the following except as noted

Format

Including preset to standard

Standards supported	Description	Version	Date
	36.201 (Phy General description)	8.3.0	2009-03
	36.211 (Phy General description)	8.6.0	2009-03
	36.212 (MUX and channel coding)	8.6.0	2009-03
	36.213 (Phy layer procedures)	8.6.0	2009-03
	36.214 (Phy Measurements)	8.6.0	2009-03
	36.101 (UE Radio Tx/Rx)	8.5.0	2009-03
	36.104 (BS Radio Tx/Rx)	8.5.0	2009-03
	36.141 (BS conformance)	8.2.0	2009-03
	36.521-1 (UE conformance)	8.1.0	2009-03

Direction	Downlink, uplink
Preset to Standard	1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz
Downlink parameters	*Available when direction = downlink*
Sync type	P-SS, or RS
Cell ID	Auto-detected, or manually set
RS-PRS	3GPP or custom
Number of Tx antennas	1, 2, or 4
Number of Rx channels	1, 2, or 4
Ref Tx antenna	Port 0, 1, 2, or 3
Ref Input Channel	Rx0, Rx1, Rx2, Rx3
P-SS/S-SS antenna port	Port 0, 1, 2, 3, or all
Antenna detection threshold	Sets the threshold for Tx antenna port signal detection
Include inactive antenna paths	Yes, no
MIMO decoding	3GPP MIMO decoding, joint equalizer decoding, no decoding
PDSCH cell specific ratio	p_B/p_A=1; P_B=0; P_B=1; P_B=2; P_B=3
Uplink parameters	Available when direction = uplink
Sync type	PUSCH DM-RS; PUCCH DM-RS; S-RS; PRACH
Half-subcarrier shift	Yes, no
PUSCH DFT swap	Yes, no
UL/DL configuration	TDD only: Specifies the uplink-downlink configuration of a TDD frame; 0-6
Dw/GP/Up Len	TDD only: Specifies which special subframe configuration is being used in the TDD signal; 0-8

Profile

Allows specification of user channel allocations as well as specifying which channels are displayed and used in EVM, power calculations

RB auto-detect	Yes, no
Composite display	Selects which of the following groups of channels is to be used in the analysis: non-allocated channels, include all channels, exclude all channel. For downlink: QPSK, 16QAM, 64QAM (by layer); P-SS; S-SS; PBCH; PCFICH; PHICH; PDCCH; RS. For uplink: user blocks.
Edit user mapping	Open LTE allocation editor where user allocations are setup
Edit control parameters	Launches downlink control channel properties dialog which allow you to set control channel power boost, PDCCH allocations, PHICH allocations, and other parameters

LTE FDD Modulation Analysis (Option BHD)—*continued*
LTE TDD Modulation Analysis (Option BHE)—*continued*

Time

Sets time data parameters used for demodulation. Graphical timing diagram provided for ease in visualization.

Result length	Determines how many slots will be available for demodulation
Measurement offset	Specifies offset from the start of the result length to the beginning of measurement interval (the data sent to the demodulator); in slots + symbol-times
Measurement interval	Determines how much data after the measurement offset is sent to the demodulator; in slots+ symbol times
Analysis start boundary	Specifies the alignment boundary of the result length time data; frame, half-frame, sub-frame, slot

Advanced

Advanced configuration parameters, which modify the default standard-compliant analysis algorithm, useful for troubleshooting, especially in early design stages

CP length	Auto, normal, extended
Extend frequency lock range	Increases demodulator lock range when selected
Mirror frequency spectrum	Entire frequency spectrum flipped around the carrier frequency when selected
Time scale factor	Sets the value by which to scale the bandwidth and time lengths of the signal; used to compensate for mis-tuned crystals or allow demodulation of signals at lower rates, during early design development
Multi-carrier filter	Additional filtering to reject adjacent LTE channels
Equalizer training	Off, RS, RS+data, RS with moving avg filter
EVM minimization	Used to select reference signal corrections: 3GPP or tracking; tracking corrections include amplitude, frequency/phase, timing, IQ offset (uplink, 3GPP only)
Symbol timing adjustment	Determines where the FFT used for EVM and demodulation results is located within the symbol + cyclic prefix time data; select from max of EVM window start/end; min of EVM window start/end; EVM window start; EVM window end; EVM window center; % of FFT size
EVM window length	Specifies the length of the window used for the EVM calculations; 3GPP, custom
Results format	Allows selection of data presented in results table: report EVM in dB; report relative power levels; power boost normalize

Decode

Uplink parameters	*Available when direction = uplink*
Decoded symbol table results	PUSCH bits select none or descrambled
Downlink parameters	*Available when direction = downlink*
Decoded Symbol table results	
PBCH bits	None, descrambled, deratematched, decoded
PCFICH bits	None, descrambled, decoded
PDCCH bits	None, demapped, deinterleaved, descrambled, deratematched, decoded
PDSCH bits	None, descrambled, deratematched, decoded CB, decoded TB
DCI format detection	Include: formats 1 and 1b, formats 1 and 1d, format 1 only, format 1b only, format 1d only
RNTI Ranges	User defined
RA-RNTI range	Min value: 0-60, max value: 0-60
TPC-RNTI range	Min value: 0-60, max value: 0-60

Trace data	*Available measurement displays*
Channel data	Pre-demodulation information about each of the input channels
CCDF	Displays the complementary cumulative distribution function of the data in the measurement interval for the selected channel
CDF	Displays the cumulative distribution function of the data in the measurement interval for the selected channel
Correction	Shows the correction data derived by the analyzer from the calibration data and applied to the acquired data's spectrum
Instantaneous spectrum	Non-averaged frequency spectrum of the pre-demodulated Time trace data for the current measurement
PDF	Displays Probability Density Function, a normalized histogram of the Time data
Raw main time	Shows the raw data read from the input hardware or playback file for the selected channel
Search time	Displays the time record data after resampling and time adjustment
Spectrum	Displays the frequency spectrum of the pre-demodulated Time trace data
Time	Shows the time data that is to be demodulated (the data in the measurement interval) for the selected channel
Demodulation data	Uplink and Downlink
Common tracking error	Shows the corrections calculated by EVM minimization
Eq chan frequency response diff	Shows the channel response's rate of change with respect to frequency
Eq chan freq resp	Displays the equalization frequency response of the currently selected Ref Input Channel
Eq impulse response	Shows the channel equalization impulse response of the currently selected Ref Input Channel

LTE FDD Modulation Analysis (Option BHD)—*continued*
LTE TDD Modulation Analysis (Option BHE)—*continued*

Error summary	*Contains information about the quality of the signal being analyzed (in the Measurement Interval)*
Cell ID	Physical-layer Cell ID of the signal
Cell ID group/sector	Signal's Cell ID group and Cell ID sector, determined by physical-layer Cell ID
Common tracking error	RMS average of the correction applied to each symbol by EVM Minimization
CP length mode	Current CP Length: normal or extended (useful when CP length is set to Auto in demod properties)
Data EVM	RMS Error Vector Magnitude of the user channels
EVM	Overall RMS Error Vector Magnitude for all selected channels in Composite Include setup parameter
EVM pk	Peak EVM value and coordinates
Freq err	Average error in carrier frequency calculated for the data in the measurement interval
IQ gain imbalance	I vs Q amplifier gain imbalance (ratio of I-gain to Q-gain)
IQ offset	Magnitude of carrier feed-through
IQ quadrature error	Amount of angle skew between I and Q
IQ timing skew	Time difference between the I and Q parts of the signal
OFDM symbol Tx power	Average power (dBm) for OFDM data subcarriers
RS EVM	RMS Error Vector Magnitude of the reference signal
RS-PRS	Current setting of the RS-PRS measurement parameter
RS Tx pwr (avg)	Average (dBm) reference signal power
Sync corr	Correlation between the measured P-SS signal and the reference P-SS signal
Symbol clock err	Frequency error of the measured signal's symbol clock
Time offset	The distance from the start of the Search Time trace to the beginning of the measurement interval
Frame summary	Table showing EVM, power, modulation format, and number of RBs for channels present in a frame, color-coded by channel
Downlink channels included	Non-Alloc ; P-SS; PBCH; PCFICH ; PDCCH; PDSCH; PHICH; RS; S-SS
Uplink channels included	Non-Alloc ; PRACH; PUCCH; PUCCH DMRS; PUSCH; PUSCH DMRS; SRS
Freq err per slot	Average frequency error for each slot
Inst eq chan freq resp diff	Displays the channel frequency response derivative for the current measurement
Inst eq chan freq resp	Displays the channel frequency response of the current measurement
Demodulation data	*Uplink only*
Detected allocations time	Color-coded display showing a two dimensional grid where each point on the grid represents a single resource element
Error vector spectrum	Difference between the measured values and the reference values for each resource element
Error vector time	Difference between the measured symbols and the reference symbols for each symbol in the measurement interval
IQ frequency meas	IQ data taken after the OFDM symbol FFT has been performed on the measured data
IQ frequency reference	Displays the reference (demodulated) IQ values of the subcarriers for each OFDM symbol point at the output of the FFT
IQ measured time	Displays the same information as IQ Meas when the data is displayed in the Const or I-Q trace format
IQ measured	Displays a composite trace of the measured IQ values for PUSCH after despreading (IFFT), overlaid on the measured IQ values of the other physical channels and signals' subcarriers from the output of the FFT
IQ offset per slot	Displays the average IQ offset for each slot in the measurement interval
IQ ref time	Displays the same information as IQ Ref when the data is displayed in the Const or I-Q trace format
IQ ref	Displays a composite trace of the reference IQ values for PUSCH after despreading (IFFT), overlaid with the reference IQ values of the subcarriers from the output of the FFT for other channels and signals
RB error magnitude time	Displays the EVM of each resource block (RB)

LTE FDD Modulation Analysis (Option BHD)—*continued*
LTE TDD Modulation Analysis (Option BHE)—*continued*

Demodulation data—***continued***

RB power spectrum	Shows the resource block power spectrum for the demodulated data specified by measurement interval and measurement offset
RB power time	Shows the resource block power for each slot in the time interval specified by Measurement Interval and Measurement Offset
RMS error vector spectrum	Root Mean Square (RMS) average EVM for each subcarrier
RMS error vector time	Root Mean Square (RMS) average EVM for each symbol
Symbol table	Demodulated bits, color-coded by channel/signal type
Layer data	*Downlink only*
Detected allocations time	Color-coded display showing a two dimensional grid where each point on the grid represents a single resource element of the selected layer
Error vector spectrum	Difference between the measured values and the reference values for each resource element in a layer
Error vector time	Difference between the measured symbols and the reference symbols for each symbol in the measurement interval
IQ measured time	Displays the same information as IQ meas when the data is displayed in the Const or I-Q trace format
IQ meas	Displays the measured IQ values of the subcarriers from the output of the FFT (frequency domain) for the selected layer
IQ ref time	Displays the same information as IQ Ref when the data is displayed in the Const or I-Q trace format
RB error mag spectrum	Displays the EVM of each resource block (RB) in the selected layer
RB error mag time	Displays the EVM of each resource block (RB) in the selected layer
RB power spectrum	Shows the resource block power spectrum for the demodulated data specified by measurement interval and measurement off for the selected layer
RB power time	Shows the resource block power for each slot in the time interval specified by measurement interval and measurement offset in the selected layer
RMS error vector spectrum	Root Mean Square (RMS) average EVM for each subcarrier
RMS error vector time	Root Mean Square (RMS) average EVM for each symbol
Symbol table	Demodulated bits, color-coded by channel/signal type
MIMO data	*Downlink only*
Common tracking error	Shows the common tracking error data for all Rx/Tx antenna paths
Eq chan freq resp difference	Displays the slope of the channel frequency response for all four antenna ports
Eq chan freq resp	Displays the channel frequency response for all four antenna ports
Eq cond number	Displays the MIMO condition number for each subcarrier
Eq impulse response	Displays the equalizer impulse response for all four antenna ports
Info table	Provides the following metrics for each Tx/Rx pair, color coded by path
RS power	Average (RMS) RS signal power
RS EVM	Average (RMS) RS EVM
RS CTE	Average (RMS) RS Common Tracking Error
RS timing	RS timing error
RS symbol clock	Average RS symbol clock error
RS frequency	RS frequency shift error

WLAN Modulation Analysis (Option B7R)

OFDM modulation analysis[1]

Signal acquisition

Supported standards	IEEE 802.11a, HiperLAN2, and IEEE 802.11g (OFDM)
Modulation format	BPSK, QPSK, 16QAM, 64QAM (auto detect or manual override)
Search length	*Maximum values. Actual value hardware dependent*
Minimum	Result length + 6 symbol times (24 µs)
Maximum	6,800 symbol times
Result length	Auto detect or adjustable from 1 to 1367 symbol times maximum; actual value hardware dependent
Triggering	Single/continuous, free-run/channel/external
Measurement region	Length and offset adjustable within result length

Signal playback

Result length	Auto detect or adjustable from 1 to 1,367 symbol times maximum; actual value hardware dependent
Capture length (gap-free analysis at 0% overlap; at 31.25 MHz span)	*Capture length is hardware dependent. See hardware specifications for more information.*

Adjustable parameters

Data format	IEEE 802.11a, HiperLAN2
Single button presets	IEEE 802.11a/g/OFDM, HiperLAN2, IEEE 802.11g DSSS-OFDM, IEEE 802.11a/g turbo mode, IEEE 802.11p DSRC, IEEE 802.11j 10 MHz
I-Q normalize	On/Off
Sub-carrier spacing	Continuously adjustable
Symbol timing adjust	Adjustable between 0 and guard interval
Guard interval	1/4, 1/8 (HiperLAN2 only), adjustable between 0 and 1 in 1/64 increments
Pilot tracking	Phase, amplitude, timing
Carriers to analyze	All, single, or pilots

Demodulation measurement results

I-Q measured	All carriers over all symbol times
I-Q reference	All carriers over all symbol times (reference computed from detected symbols)
Error vector	Time, spectrum (for each carrier and symbol in the frame)
RMS error vector	Time, spectrum
Common pilot error	Phase, magnitude
Symbol table and error summary	EVM, pilot EVM, CPE (common pilot error), IQ (origin) offset, frequency error, symbol clock error, sync correlation, number of symbols, modulation format, code rate, bit rate, IQ gain imbalance, IQ quadrature skew

Equalizer measurement results

Equalizer impulse response	Computed from preamble
Channel frequency response	Computed from preamble

Pre-demodulation measurement results

Time	Instantaneous
Spectrum	Instantaneous, average
Search time	Instantaneous

Display formats

Error vector spectrum	Error values for each symbol time plotted for each carrier
Error vector time	Error values for each carrier plotted for each symbol time

1. Not compatible with all supported hardware.

WLAN Modulation Analysis (Option B7R)—*continued*

DSSS modulation analysis

Signal acquisition

Modulation format	Auto detect or manual override: Barker1, Barker2, CCK5.5, CCK11, PBCC5.5, PBCC11, PBCC22, PBCC33
Preamble	Auto detect (short, long)
Pulse search length dependent	Adjustable between result length and 25 ms maximum; actual value hardware
Result length	Auto detect or adjust between 1 and 275,000 chips (25 ms) maximum; actual value hardware dependent
Triggering	Single/continuous, free-run, channel, external
Measurement region	Interval and offset adjustable within result length

Signal playback

Result length	Auto detect or adjustable between 1 and 275,000 chips (25 ms) maximum; actual value hardware dependent
Capture length (gap free analysis at 0% overlap; 34.375 MHz span)	*Capture length is dependent on hardware. See hardware specifications for more information.*

Supported formats

Formats	IEEE 802.11b including optional short preamble and optional PBCC modes; IEEE 802.11g including PBCC22 and PBCC33 modes
Single-button presets	DSSS/CCK/PBCC

Adjustable parameters

IQ normalize	On/off
Mirror frequency spectrum	On/off
Chip rate	Continuously adjustable
Clock adjust	Continuously adjustable between ±0.5 chips
Equalizer	On/Off
Equalizer filter length	3 to 99 chips
Descrambler mode	On/off, preamble only, preamble, header only
Reference filter	Rectangular, Gaussian, root raised cosine
Filter BT	.05 to 100

Demodulation measurement results

IQ measured	IQ measured time, IQ measured spectrum, instantaneous IQ measured spectrum
IQ reference	IQ reference time, IQ reference spectrum, instantaneous IQ reference spectrum
Other IQ error traces	IQ magnitude error, IQ phase error
Error vector	Error vector time, error vector spectrum, instantaneous error vector spectrum
Despread symbols	Preamble, header, data
Symbol and error table summary	IEEE 802.11b 1,000-chip peak EVM, EVM, magnitude error, phase error, IQ offset, frequency error, sync correlation, burst type, bit rate, number of data octets, data length

Equalizer measurement results	*Equalizer impulse response, channel frequency response*
Equalizer impulse response	Computed from preamble
Channel frequency response	Computed from preamble

Pre-demodulation measurement results

Time	Main raw, search
Spectrum	Instantaneous
Other	CCDF, CDF, PDF

Display formats

Error vector spectrum	Error values for each symbol time plotted for each carrier
Error vector time	Error values for each carrier plotted for each symbol time

IEEE 802.11n MIMO Modulation Analysis (Option B7Z)

Signal acquisition	*Note that not all supported hardware is compatible with all bandwidths and channel configurations. See Table 1.*
Standards supported	IEEE P802.11n HT (20 MHz, 40 MHz)
Operating modes supported	HT-greenfield, HT-mixed, Non-HT duplicate, HT duplicate
Data sub-carrier modulation formats	BPSK, QPSK, 16QAM, 64QAM, 256QAM
Data sub-carrier modulation detect	Auto-detect, manual override, or read from HT-SIG
Spatial streams supported	1-4, equivalent to the number of channels being analyzed
Spatial streams detect	Auto-detect, manual override, or read from HT-SIG
Guard interval	1/8; 1/4; or user-settable
Guard interval detect	Auto-detect, manual override, or read from HT-SIG
Channel usage	Channel 1 through 4 individually; 2x2; 3x3; 4x4 MIMO
Adjustable parameters	
Time parameters	
Search length	Adjustable; default 1 ms; minimum must be longer than maximum result length
Result length	Number of OFDM data symbols after the preamble to analyze. May be auto-detected, manually specified, or read from the HT-SIG. Max is 20,000 symbols
Measurement interval	Adjustable; must be less than or equal to the maximum result length
Measurement offset	Adjustable; specifies the portion of the result length to analyze and display
Advanced parameters	
Compensate IQ mismatch	Allows removal of IQ mismatch from EVM calculation so as to better understand EVM performance for systems where the IQ mismatch may be removed later
IQ normalize	On/off; determines whether to normalize IQ meas, IQ ref, error vector time, and error vector spectrum displays
Mirror frequency spectrum	On/off; determines whether to do a frequency inversion before synchronizing and demodulating signal
Remove equalizer phase ramp	Allows visibility of the phase profile of other channels and data streams that may be masked by the cyclic delay that is normally applied to the other data streams
Subcarrier spacing	Specifies spacing between OFDM subcarriers, in Hz
Symbol time adjust	Allows user-adjust of the symbol timing used when demodulating
Subcarrier select	Specifies which OFDM carriers are analyzed; user can select all, pilots only, or choose a single subcarrier
Pilot tracking	Phase, amplitude, timing
Tracking type	Pre-equalizer, post-equalizer
Equalizer training	Train on channel estimation sequence, or channel estimation sequence plus data
FFT length	64 or 128
Measurement results	*The following results are available for each input channel*
CCDF	Complementary cumulative distribution function of the time trace
CDF	Cumulative distribution function of the time trace
Correction	Shows frequency domain correction applied to the raw measured time data to ensure that the input hardware has a flat frequency response
Instantaneous spectrum	Frequency spectrum of the current time trace, with no averaging
PDF	Probability density function of the time trace
Preamble frequency error	Frequency error versus time, during the the preamble (initial 16 µs of burst)
Raw main time	Block data acquired by the hardware, before any software time-domain corrections or any software re-zooming or re-sampling
Search time	Shows block of data that was acquired and searched through for an RF burst
Spectrum	Frequency spectrum of the time trace, including averaging, if any
Time	Block of data detected by pulse search; serves as input to demodulation analysis

1. *Not all supported hardware is compatible with all bandwidths.*

IEEE 802.11n MIMO Modulation Analysis (Option B7Z)—*continued*

These results are available for each spatial stream

Common pilot error	Shows the common pilot error (phase and magnitude), with one point per OFDM symbol
Error vector spectrum	Shows the error vector by subcarrier for every OFDM symbol time analyzed
Error vector time	Shows the error vector by OFDM symbol time for every subcarrier
IQ measured	IQ measured data, with one point per subcarrier per analyzed OFDM symbol time; includes multiple modulation formats if present
IQ reference	IQ reference data, with one point per subcarrier per analyzed OFDM symbol time; includes multiple modulation formats if present
RMS error vector spectrum	Instantaneous RMS averaged error vector, shown with one point per subcarrier, calculated for current scan only
RMS error vector time	RMS averaged error vector, shown with one point per OFDM symbol analyzed
Symbols/Errs Table	Shows raw OFDM detected symbols plus error measurements
Stream EVM	dB, or %rms
Stream EVM Pk	dB, or %rms
Stream Pilot EVM	dB
CPE	%rms
Stream Data EVM	dB

For each stream, the following traces are available for each channel

Equalizer channel frequency response	Reciprocal of the equalizer frequency response; one point per subcarrier
Equalizer impulse response	Result length = 4 x FFT length
Instantaneous equalizer channel frequency response	Non-averaged version of the equalizer channel frequency response trace

The following cross-channel measurements are available

OFDM Error Summary Table	*Each input channel (1-4) has a column containing the following measurement results, plus an additional column with averaged data.*
Frequency error	Average, Hz*
Symbol clock error	Average, ppm*
CPE	Average, % rms*
EVM	RMS level of the error vector, averaged overall subcarriers and all analyzed OFDM symbols; in dB
EVM peak	Peak EVM, averaged over all subcarriers and all analyzed OFDM symbols; in dB
Pilot EVM	RMS level of the error vector computed just at the pilot subcarriers, averaged over all OFDM symbols; in dB
Data EVM	RMS EVM of just the data subcarriers, averaged overall OFDM symbols; in dB
IQ offset	Carrier leakage, as measured during the HT-LTF portion of the preamble; in unitless power ratio
IQ quadrature error	Quadrature skew, in degrees
IQ gain imbalance	Ratio of the gain of the in-phase portion of the signal to the gain of the quadrature phase portion of the signal; in dB
IQ time skew	Time difference between the I and Q branches of the signal
Cross power	dB
Sync correlation	Correlation coefficient between the measured preamble and ideal preamble; computed on the initial HT-GF-STF part of the preamble

1. *Not all supported hardware is compatible with all bandwidths.*

IEEE 802.11n MIMO Modulation Analysis (Option B7Z)—*continued*

OFDM Data Burst Info	Listing of data burst type and fields found in the L-SIG and HT-SIG symbols
Symbols detected	L-LTF, HT-GF-STF, L-SIG, HT-SIG, HT-STF, HT-LTF, HT-Data, HT-SIG CRC pass/fail
Data provided	Modulation format, length (in symbols), power (dBm), EVM (dB); total information for length, power, and EVM
OFDM HT-SIG information	Decoded bits for HT-SIG and L-SIG, if present
Modulation & coding scheme	
CBW	20 MHz or 40 MHz
Length	Number of bytes in frame
Reserved ones	Verify all values = 1
Aggregation	Yes if PPDU in data portion of packet contains an A-MPDU; No, otherwise
STBC	Indicates the difference between the number of transmit chains used and the number of spatial stream indicated by the MCS
FEC coding	Yes = FEC coding; No = BCC
Short GI	Indicates that the short GI is used after the HT training
Number of extension spatial streams	0 to 3
CRC	CRC of bits 0 to 23 in HT-SIG1 and bits 0 to 9 in HT-SIG2
Tail bits	Verify 0 value (used to terminate the trellis of the convolutional coder)
Smooth	Indicates whether channel estimate smoothing is allowed; yes/no
NotSnd	Indicates if the packet is not a sounding packet; yes/no
OFDM Eq MIMO condition number	Ratio of equalizer channel response matrix max singular value to min singular value
OFDM MIMO channel matrix	Complex value matrix of channel vs stream showing linear average over all subcarriers of the equalizer channel frequency response for the corresponding input channel and data stream
OFDM MIMO channel frequency response	Overlaid traces of equalizer channel frequency response traces
Preamble frequency error	The difference between the measured center frequency of the transmitted signal and the 89600 VSA center frequency

IEEE 802.16-2004 OFDM Modulation Analysis (Option B7S)

General specifications[1]

Signal acquisition

Supported standards	IEEE 802.16-2004
Supported modes	Uplink and downlink; continuous and burst; TDD, FDD, H-FDD
Modulation formats	BPSK (pilots only), QPSK, 16QAM, 64QAM (auto detect, manual input)

OFDM parameters

Bandwidth	Settable, nominal per standard
Fs/BW ratio	Settable to 8/7, 57/50, 86/75, 144/125, 316/275, or arbitrary between 0.5 and 2.0
Equalizer training	Via channel estimation sequence in preamble; or estimation sequence plus data
Sub carrier selection	Selectable all; or one of sub carrier # -100 to +100 (0 not allowed); or pilot sub carriers only
Subchannel index	1 to 31 (for uplink signal analysis)

Measurement parameters

Result length	Auto-detected, or manually adjustable
Search length	Adjustable, limits may depend on input hardware
Pilot sub carrier tracking	Amplitude, phase, timing
Symbol timing	Adjustable from –(guard interval)/100 to 0
Averaging	RMS, RMS exponential
Span	Constrained to within approximately 10x signal bandwidth

OFDM trace results

Burst info	Text table containing information on burst power, modulation format, EVM, and length in symbols
Common pilot error	One point analyzed per OFDM symbol
Equalizer channel frequency response	One point per sub carrier; frequency response shown dependent on equalizer training value selected; also differential and instantaneous differential traces available
Equalizer impulse response	Result length = 4 x FFT length
Error vector spectrum	One point per sub carrier per analyzed OFDM symbol time
Error vector time	One point per sub carrier per analyzed OFDM symbol time
IQ measured data	One point per sub carrier per analyzed OFDM symbol time; all modulation formats shown
IQ reference data	One point per sub carrier per analyzed OFDM symbol time; all modulation formats shown
Preamble frequency error	Frequency error vs. time, during the preamble (including during all the long preamble)
RMS averaged error vector spectrum	One point per sub carrier
RMS averaged error vector time	One point per OFDM symbol analyzed
Symbols/error	Error summary with raw OFDM detected symbols

IEEE 802.16-2004 OFDM Modulation Analysis (Option B7S) General specifications1 *—continued*

Additional trace results

CCDF	Complementary cumulative distribution function of time trace; extra time data before start and after end of burst not included
CDF	Cumulative distribution function of time trace; extra time data before start and after end of burst not included
Correction	Frequency domain correction applied to raw measured time data
Instantaneous spectrum	Frequency spectrum of the time trace
PDF	Probability density function of time trace
Raw main time	Block data acquired by hardware, including extra data for filter settling
Search time	Block data acquired and searched for an RF burst
Spectrum	Frequency spectrum of time trace, or averaged time if averaging on
Time	Block data detected by pulse search

Error information/results

CPE RMS	RMS level of (CPE-1), where CPE is the complex correction value detected during pilot tracking
RCE (Residential Constellation Error) RMS	RMS level of the relative constellation error vector, % or dB
RCE peak	Peak level of the relative constellation error vector, % or dB
RCE peak symbol	OFDM symbol number where RCE peak was detected
Frequency error	Averaged measured carrier frequency minus analyzer center frequency
IQ gain imbalance	Ratio of I (in-phase) to Q (quadrature phase), dB
IQ offset	Carrier leakage measured during channel estimation sequence portion of preamble, dB
IQ quadrature error	Quadrature skew, degrees
Pilot EVM	RMS EVM level for pilot sub carriers, averaged over all analyzed OFDM symbols
Preamble type	Detected preamble: short, long, STC, AAS; also will display non-standard preamble consisting of optional P4x64 sequence followed by one of the P_{even}, P_{odd}, P_{aas}, or P_{all} sequences
Symbol clock error	Timing error, ppm
Sync correlation	Correlation coefficient between measured and ideal preamble

IEEE 802.16 OFDMA Modulation Analysis (Option B7Y)[1]

Signal acquisition setup

Standards supported	IEEE Std 802.16-2009 (Mobile WiMAX™)
Maximum demod span	Max Span = BW * BWRatio * 4 /1.28
Auto-configuration	DLMAP-driven for downlink measurements; automatic DIUC0 detection; uplink subframe statistically evaluated to determine permutation base and burst geometry for most mobile WiMAX default profiles; auto-configuration information from decoded MAPs may be copied to user MAPFile

Format Setup

Standard	Drop down menu for Standard selection; P802.16 OFDMA (Cor1/D2), IEEE 802.16e OFDMA
Single-button presets to Standard	802.16e:10 MHz; 802.16e:5 MHz; WiBRO
Frame definition	
Nominal BW Standards	1.25, 3.5, 4.375, 5, 7, 8.75, 10, 14, 15, 17.5, 20, 28 MHz, or user settable under Manual selection. Note: *Standard* selection locks BW ratio, and FFT size to nominal BW; can be overridden for troubleshooting by selecting *Manual*
FFT size	128, 512, 1024, 2048
BW ratio	8/7, 28/25 or user-settable for troubleshooting
Guard interval	1/8 default, user settable from 0 to 1.0
Frame length	User settable
Downlink ratio	0-100%; defines start of uplink subframe
Subframe analysis	Uplink (mobile transmitter), downlink (basestation)
Supported modes	Zone OFDM analysis without subchannelization; Data burst analysis with predefined data bursts for UL and DL
Downlink definition	
Preamble index	0 to 113
Manual	Yes/no. If yes, then IDCell and segment data entered are used for analysis. If no, then the preamble index is used exclusively
IDCell	Starting IDCell value for the frame, usually derived from preamble; 0 to 31
Segment	0, 1, or 2; only one segment may be analyzed at a time; usually derived from preamble
Subchannel group bitmask	User selectable on/off values to represent 6-bit bitmask specifying which subchannel groups can be used to define DL-PUSC data bursts
STC/MIMO analysis setup	
Use Matrix Decoder	No, or choose Matrix analysis stream 1 or 2
Input Channel select	Data from channel 1 or 2 (2-channel hardware systems only)
Use TX antenna	Select from antenna 0,1, 2, or 3
Include inactive antenna paths	Yes/no

Zone Definition Setup

Define zone	Auto-detected or via map file, recalled setup file, import of N7615A Signal Studio OFDMA setup file, or GUI; edit downlink or uplink zones; auto-configure from decoded DLMAP and ULMAP management messages in analyzed signal
Edit map file operations	New, edit, delete, export, import, from setup
Data burst analysis	Yes/no; Allows for using defined boosting levels

1. Not all supported hardware is compatible with all bandwidths.

IEEE 802.16 OFDMA Modulation Analysis (Option B7Y)—*continued*

Zone Definition Setup—***continued***

Use defined boosting levels	Yes/no; Specifies whether reference power level for data burst analysis is derived from the boosting levels in the data burst definitions, or from the measured power of the data bursts; downlink only
Use all subchannels	Yes/no
Downlink zone edit	Define uniform zone or zone with data burst analysis
Name	User-input
Type	PUSC, FUSC, OFUSC, AMC
AMC parameters	Available to both UL and DL zone definitions
Type	2:3; 1:6; 4:2
Wrap	Symbol, subchannel
PermBase	0 to 31; or override PermBase with IDCell Value
Couple	Yes/no. Specifies how the DL_PermBase value is determined for downlink subframe analysis
Offset	1 to (maximum symbol time permitted by frame length and downlink ratio minus 1); parameter coupled to Length
Length	1 to (maximum symbol time permitted by frame length and downlink ratio), constrained by symbol Offset
PrbsID	0, 1, or 2
Use all subchannels	Yes/no; Determines how the subchannels are allocated for the DL-PUSC zone analysis (Downlink zone only)
Dedicated pilots	On/off; Associates only pilots located within allocated data bursts as being active.
Active	Yes/no
Locked	Yes/no; only applies to editing map files
STC	Analysis for DL-PUSC. Single channel Matrix A analysis, or analysis for 2-Antenna Matrix A and 2-Antenna Matrix B signals supported (2 channel analysis hardware required)
Type	None, 2, 3, 4 antenna
Matrix	A,B,C; read from DLMAP, or present in zone definition provided by the customer
Uplink zone edit	Define uniform zone or zone with data burst analysis
Name	User-input
Type	PUSC, OPUSC, AMC
AMC parameters	
Type	2:3, 1:6, 4:2
Wrap	Subchan, Symbol
Permbase	0 to 69
Offset	0 to (maximum symbol time permitted by frame length and downlink ratio minus 1)
Length	1 to (maximum symbol time permitted by frame length and downlink ratio), constrained by Offset
Subchannel rotation	Yes/no; enables measurements of zones with the UL-PUSC subchannel rotation scheme disabled
Active	Yes/no
Locked	Yes/no; only applies to editing map files
Zone definition grid	GUI display of symbol index vs. subchannel for each data burst; display dependent on multiple zone parameters. All defined bursts within a zone shown. Automatic accommodation of Normal, FCH and DLMAP burst definitions in DL-PUSC zones, and Normal, CDMA, PAPR, and FFB regions in UL-PUSC zones; burst definition via mouse or fill-in form
Data burst analysis	Downlink, uplink
Data tone modulation format	QPSK, 16QAM, 64QAM
Boosting level	–12 dB to 9 dB, in 3 dB steps; downlink only
Active	Yes/no

IEEE 802.16 OFDMA Modulation Analysis (Option B7Y)—*continued*

Zone Definition Setup—*continued*	
Burst shape	Rectangular, wrapped; visual display on data burst definition grid
Burst type	Downlink, uplink
All Uplink	Normal, CDMA, PAPR, or FFB allocation definitions
Downlink PUSC	Normal, FCH, or DL-MAP allocation definitions
All other downlink	Normal
STC mode	None/SM (Collaborative Spatial Multiplexing--uplink PUSC only)
Pilot pattern	A/B (uplink PUSC only)
Burst offset and interval	Defined in symbols or subchannels
Burst edit operations	New, delete, rename
Time Properties Setup	
Result length	Determines how many frames are included in the acquisition, 1 to 64; maximum value hardware dependent
Frame offset	Specifies which frame within the result length will be used for analysis
Timing diagram	Visualization aid showing result length, frame offset, frame length, zone offset, zone length
Define manual measurement region	
Measurement offset	Units of symbol-times; limited by zone or data burst definition
Measurement interval	Units of symbol-times; limited by zone or data burst definition
Pre-demod waveform	Determines what time record information to include in time domain displays and calculations. User selectable from frame, zone, measurement, or preamble region
Include extra time in pre-demod traces	On/off; Specifies whether an extra 10% of time domain data is present before and after the pre-demod region in the time trace. Useful for observing transitions before and after an analysis region which may be affecting results
Pulse search	On/off
Include zone offset	On/off
Manual sync search	On/off
Sync search offset	Symbols
Advanced Properties Setup	
IQ normalize	On/off
Mirror frequency spectrum	On/off
Symbol timing adjust	%
CDD	On/off
Subcarrier select	All, subset; only applies for uniform zone (data burst analysis off)
Subset offset	Specifies starting subcarrier number; value dependent on analysis zone type and FFT size
Subset interval	Specifies the number of adjacent subcarriers to analyze starting with the value listed in subcarrier offset
Derotate modulation PRBS	On/off
Use cor1/D2 DL-PUSC cluster renumbering	On/off
Use multi-channel filter	On/off
Decode DLMAP	On/off
Decode ULMAP	On/off
Burst power is per-subcarrier	On/off
Compensate I/Q mismatch	On/off
Use default settings	Automatically switches between uplink and downlink default parameters
Include inactive subchannels in EVM	On/off; only applicable to data burst analysis
Pilot tracking	Select any or all: amplitude, phase, timing; available even if PRBS mismatch
Equalizer training	Using data and pilots, or on pilots only, or no equalization; selectable equalizer smoothing function
Data tone modulation	Manual (from burst definition), or auto-detect
Formats supported	BPSK (pilots only), QPSK, 16QAM, 64QAM

IEEE 802.16 OFDMA Modulation Analysis (Option B7Y)—*continued*

Burst Profiles Properties	Provides user-defined interpretation of DIUC (Downlink) and UIUC (Uplink) values in decoded DLMAP and ULMAP into modulation type. Automatic DIUC0 detection. This may be used for auto-configured measurements in Downlink, and is used to convert the decoded DLMAP and ULMAP into a MapFile.
OFDMA trace results	*IEEE 802.16 OFDMA traces are similar to other OFDM traces, but with distinct differences which will cause the traces to look different. One difference is that pilot tones shift from symbol-time to symbol-time. So, when analyzing a single subcarrier, some tones may be pilot tones, while others may be data tones. The difference is annotated using data point coloring. Further, in data burst analysis mode, subchannelization is distributed across subcarriers and OFDM symbols, so the trace results below may be sparse, with blanked points at OFDM symbol/subcarrier locations which are not in the defined analysis region. OFDMA trace results available also depend on whether 1 or 2-channel STC/MIMO measurements are being made. Some results are available for Channel 1 MIMO only, while others are available for Channel 1 and/or Channel 2. Cross channel results are also available for 2 channel MIMO measurements.*
Channel 1 results	*OFDMA results available for Channel 1 only*
Chan freq resp adj diff	Adjacent subcarrier power difference in dB
Chan freq resp	Measured equalizer frequency response; dependent on subframe type and equalizer training mode
Common pilot error (CPE)	Common pilot error trace vs. symbol: RMS magnitude value or phase error value
Detected allocations	A 2-dimensionsal graph of symbols vs. subcarriers showing detected allocations color-coded by user
DL-MAP info summary	Decoded FCH and DLMAP messages of the Downlink subframe
FCH type	Normal or FFT128
Used subchannels	Bitmap of used subchannels; 0-63
DLMAP type	Normal or compressed
Length	Length of DLMAP in slots
Coding type	Coding used by the DLMAP, CC, CTC
Status	CRC check for valid DLMAP and DLMAP parsing
Frame length	Frame length of DLMAP; seconds
DL subframe	Length of downlink subframe including preamble, in symbols
Frame	Frame counter value
DCD count	DCD counter index to apply when using this DLMAP
BSID	Unique 12-hex characters value to denote the transmitting basestation
NumIEs	Total number of IEs counted in the decoded DLMAP
Decoded DLMAP IEs	List of each encountered IE, for normal burst, STC_Zone_Switch, and CID_Switch IE
Data burst info	For each data burst analyzed, and only when data burst analysis is active: burst name, modulation format, size, power, RCE, data RCE. For uplink, this also provides the number of detected active CDMA codes, and lists the active CDMA codes, symbol location, subchannel location, length (in symbols), and power level (in dBm). The active CDMA codes are computed by analyzing any defined (for manual zone definition mode) or auto-detected (for auto zone definition mode) CDMA regions in a UL-PUSC zone; for UL-PUSC signals Normal, CSM-A or CSM-B to indicate if collaborative spatial multiplexing is used.
Equalizer impulse response	Impulse response of the equalization filter
Error vector spectrum	Signal RCE (EVM) vs. carrier, shown for all symbols
Error vector time	Signal RCE (EVM) vs. symbol, shown for all carriers

IEEE 802.16 OFDMA Modulation Analysis (Option B7Y)—*continued*

Channel 1 results—***continued***

Frame Summary	Provides the mean, peak, and standard deviation values for the following:
RMSEVM	RMS levels of the error vector magnitude; dB and % rms
Data RCE (EVM)	RCE measurement excluding pilot carriers; dB and % rms
Pilot RCE (EVM)	RCE measurement of pilot carriers only; dB and % rms
Unmod RCE (EVM)	Quantifies noise in the unallocated subcarriers; dB and % rms
Frequency error	Carrier frequency error; Hz
Symbol clock error	Difference between ideal and actual symbol clock frequency; ppm
Preamble power (RSSI)	dBm
Preamble RCE (EVM)	RCE of preamble only; dB and % rms
Preamble PCINR R1	CINR reuse 1 value; dB
Preamble PCINR R3	CINR reuse 3 value; dB
IQ measured	Measured IQ symbol values of the subcarriers. There is one complex value for each subcarrier for each symbol-time in the burst
IQ reference	Reference IQ symbol values of the subcarriers. There is one complex value for each subcarrier for each symbol-time in the burst
Inst ch freq resp adj diff	Instantaneous channel frequency response adjacent difference; the unaveraged Ch Freq Resp Adj Difference
Inst chan freq resp	Equalizer channel frequency response with no averaging
Preamble frequency error	Total frequency error during the preamble; for downlink analysis only
RMS error vector spectrum	RMS average of signal RCE (EVM) vs. carrier, shown for all symbols
RMS error vector time	RMS average of signal RCE (EVM) vs. symbol, shown for all carriers
Symbol/errors table	Error summary table with raw OFDM detected symbols, color-coded by data burst index
EVM	RMS level of the error vector magnitude, averaged over all active subcarriers and all detected OFDM symbols in the analysis region; dB or %rms
EVM peak	Peak level of the error vector magnitude, over all subcarriers and all detected OFDM symbols in the analysis region; %
Data RCE	RCE (Relative Constellation Error) measurement excluding pilot carriers; dB or %rms
Data RCE peak	Peak level of RCE measurement excluding pilot carriers; %
Pilot RCE	RMS value of the error vector magnitudes (in dB) of the pilot subcarriers for all symbols over the entire burst
Common pilot error (CPE)	RMS level of the common pilot error trace data minus 1 expressed as a percentage of an ideal signal; % rms
Unmodulated RCE	Quantifies the amount of noise present in the unallocated subcarriers (data burst analysis only); dB
RSSI	Received signal strength indicator based on preamble power for active segment; for downlink signal only; dBm
Preamble RCE	Compares received preamble subcarriers to ideal preamble subcarriers; dB
Boost	Indicates the boosting level of preamble subcarriers relative to the average data subcarrier level; dB
Frequency error	Carrier frequency error relative to the analyzer's center frequency; Hz
Symbol clock error	Difference between the ideal and actual symbol clock frequency in ppm

IEEE 802.16 OFDMA Modulation Analysis (Option B7Y)—*continued*

Channel 1 results—***continued***

IQ offset	Carrier leakage; dB
IQ skew	Deviation in path length between I and Q branches (sec)
Quadrature error	Orthogonal error between the I and Q signals
Gain imbalance	Compares the gain of the I signal with the gain of the Q signal
Sync correlation	Correlation coefficient between the measured preamble and an ideal preamble (downlink); normalized CP auto-correlation (uplink)
Time offset	Provides the time (in sec) between the trigger location and the start of the analysis frame
Status	Analyzer automatically detects the PRBS seed value and provides information on PRBS match to register definition per standard and setup parameters
ULMAP info summary	Decode values in the ULMAP message if such a message is decoded in the Downlink subframe
ULMAPType	Normal or FFT128
Status	Decoded status; *** (N/A), DLMAP_FAIL, PARSE_FAIL, CRC_FAIL, or DECODED
UL subframe	Length of uplink subframe; symbols
ULStart	Uplink subframe start time relative to frame start, indicated in seconds and PS units
UCD count	UCD counter index to apply when using this ULMAP
NumIEs	Total number of IEs counted in the decoded UL MAP
Decoded ULMAP IEs	List of each encountered IE for normal burst, STC_Zone_Switch, CDMA BW request/ranging; PAPR reduction/Safety/Sounding, CDMA Allocation, FAST-FEEDBACK Allocation, UL Zone, UL Allocation Start

OFDMA trace results for Channel 1

MIMO

Channel frequency response adjacent difference	Provides overlaid adjacent subcarrier power difference traces in dB for each antenna with respect to itself and the other antenna(s)
Channel frequency response	Provides overlaid channel frequency response traces for each antenna with respect to itself and the other antenna(s)
Common pilot error (CPE)	Provides overlaid CPE traces for each antenna
Equalizer condition number	Ratio of the max/min singular values of the subcarrier matrices
Equalizer impulse response	Provides overlaid equalizer impulse response for each antenna

IEEE 802.16 OFDMA Modulation Analysis (Option B7Y)—*continued*

OFDMA trace results for Channel 1 MIMO—***continued***

Info	MIMO Info table summary
Type	STC mode used by analyzed zone; none, 2-, 3-, or 4-antenna
Matrix	A,B,C
Antenna	Indicates which antenna was used for RCE analysis. Determined by user in Zone Definition, or auto-detected
Data subcarrier power	RMS per-subcarrier power level as computed over all active subcarriers in the measured zone (dB relative to reference subcarrier power)
Reference subcarrier power	Per subcarrier power level used as "unboosted" 0 dB reference (dBm). In MIMO analysis this is derived from preamble only. In SISO analysis this depends on the chosen EQ training mode
Pilot Power	Indicates the total power present in the pilot pattern defined for each transmitter/receiver pair; dBm
Pilot subcarrier power	RMS per-subcarrier power level as computed over all active pilots in the measured zone (dB relative to reference subcarrier power). Provided per available Tx/Rx path
Pilot RCE	Indicates the residual constellation error observed on the unique pilot pattern for each Tx/Rx antenna pair; dB
CPE	Common pilot error for each Tx/Rx pair; in % rms
Timing	Timing relationship between different Tx/Rx paths
Phase	Phase relationship between different Tx/Rx paths
Symbol Clock	Detected symbol clock error for each Tx/Rx pair; in ppm
Frequency	Detected frequency error for each Tx/Rx pair; in Hz
Instantaneous channel frequency response adjacent difference	Provides overlaid adjacent subcarrier power difference traces in dB for each antenna with respect to itself and the other antenna(s)
Instantaneous channel frequency response	Provides instantaneous channel frequency response traces for each antenna with respect to itself and the other antenna(s)

OFDMA trace results for Channel 2	*All OFDMA Results seen in Channel 2 can also be seen in Channel 1*
CCDF	Complementary cumulative distribution function of time trace
CDF	Cumulative distribution function of time trace
Correction	Shows the correction curve used to correct for the frequency response of the input hardware and input digital filtering
Instantaneous spectrum	Instantaneous (pre-demodulated) spectrum of the input signal
PDF	Probability density function of the time trace
Raw main time	Time data before any software time-domain corrections, and before any software re-zooming or re-sampling
Search time	Acquired time data used to search for the RF envelope pulse
Spectrum	Spectrum of the input signal, derived from pre-demodulated time data
Time	Time record before digital demodulation and after pulse search, as defined by measurement region parameters

OFDMA traces for cross-channel measurements	*Available only with 2 input channel hardware*
Coherence	Indicates the similarity between the two signals present on Channel 1 and Channel 2
Cross correlation	Determines time delays of a common signal between Channel 1 and Channel 2
Cross spectrum	Cross power spectrum of Channel 1 and Channel 2

TEDS (TETRA Enhanced Data Services) Modulation Analysis and Test (Option BHA)

Modulation parameters–all slot formats

RF sub-carriers	Number of carriers	Channel bandwidth	Analysis sub-carriers (descriptors)
	8	25 kHz	–4, –3, –2, –1, +1, +2, +3, +4
	16	50 kHz	–8, –7, –6, –5, –4, –3, –2, –1, +1, +2, +3, +4, +5, +6, +7, +8
	32	100 kHz	–16, –15, ...–3, –2, –1, +1, +2, +3, ...+15, +16
	48	150 kHz	–24, –23, ...–3, –2, –1, +1, +2, +3, ...+23, +24
Sub-carrier spacing	2.7 kHz		
Sub-carrier symbol rate	2400 sym/s		
Symbol filter	Root Raised Cosine (RRC) with alpha = 0.2		
Demodulation	Coherent (pilot symbol assisted)		
Frame rate	32 slots/frame		
Slot interleave	Variable		

Bits per symbol	4QAM	16QAM	64QAM
	2	4	6

Slot format-specific parameters

	Normal downlink	Normal uplink	Random access uplink	Control uplink
Channel bandwidth	25 kHz, 50 kHz, 100 kHz, 150 kHz	25 kHz, 50 kHz, 100 kHz, 150 kHz	25 kHz only	25 kHz, 50 kHz, 100 kHz, 150 kHz
Modulation type	M-4 QAM M-16 QAM M-64 QAM	M-4 QAM M-16 QAM M-64 QAM	M-4 QAM	M-4 QAM M-16 QAM M-64 QAM
Minimum search length	14.167 msec (85/6 ms)	14.167 msec (85/6 ms)	7.083 msec (85/12 ms)	7.083 msec (85/12 ms)
Number of symbols (per sub-carrier)	34	31	14	14

Demodulation setup parameters

Format

Preset to standard	Normal uplink, normal downlink, random access uplink, control uplink
Channel bandwidth	25 kHz, 50 kHz, 100 kHz, 150 kHz
Slot format	Normal uplink, normal downlink, random access uplink, control uplink
Mirror frequency spectrum	Allows correct demodulation of frequency spectrums that are mirrored (flipped) about the center frequency

Analysis

Analysis sub-carrier	–24 to +24, dependent on channel bandwidth
Modulation type	M-4 QAM, M-16 QAM, M-64 QAM, dependent on slot format
Search length	Time length used for searching for particular signal characteristics

TEDS (TETRA Enhanced Data Services) Modulation Analysis and Test (Option BHA) *—continued*

Advanced

Extend frequency lock range	Increases frequency lock range for analysis by an additional ±20kHz
Filter alpha	Root raised cosine (Nyquist) filter alpha used to process the output of the corresponding sub-carrier symbol generator
Include droop	On/off; include droop correction
Include header symbols	On/off; includes header symbols in EVM calculations
Include sync/pilot symbols	On/off; includes synchronization and pilot symbols in EVM calculations
IQ normalize	On/off; includes IQ normalize corrections into measurements and analysis;
Pilot tracking	On/off; includes pilot tracking in EVM calculations
PvT off analysis time	Length (in time) of a signal viewed before (pre) and after (post) the burst
Time scale factor	0.001 to 1000; scales the timebase of signal

ACP PvT adjustments

ACP alpha	Alpha for ACP filter in ACP PvT measurement
ACP bandwidth	Bandwidth for ACP PvT filter
ACP offset	Frequency offset from the carrier center frequency for ACP PvT filter

Trace data

Channel trace data	Time and frequency trace data from pre-demodulated time record data
ACP PvT Summary	Summary of the adjacent channel powers over time for both the upper and lower channels
ACP upper and lower PvT Time	Time display of the upper or the lower adjacent channels
Correction	Values that are applied to the acquired data to compensate for phase and magnitude anomalies detected during calibration
Instantaneous spectrum	Most recent spectrum measurement, before averaging
Main time	Time record samples from which time, frequency, and modulation domain data is derived
PvT summary	Summary of the composite signal power levels; includes reference power, overall slot power, burst power, and power-off levels
PvT time	Non-complex time display with time=0 aligned to the first symbol of the burst
Raw main time	Raw data from the input hardware or recorded signal
Search time	Time-data acquired and searched through for pulse
Spectrum	Frequency spectrum of time data, averaged if averaging on
Composite trace data	Combined data from all TEDS sub-carriers
Error summary	Error summary for the composite TEDS signal
Syms	Summary of all the symbols for the selected slot format

TEDS (TETRA Enhanced Data Services) Modulation Analysis and Test (Option BHA) *—continued*

Sub-carrier trace data	*Single TEDS sub-carrier selected for analysis*
Error summary	Error summary for a selected analysis sub-carrier
Error vector time	Error vector time for a specified analysis sub-carrier on a symbol-by-symbol basis
IQ mag error	IQ magnitude time error for a selected analysis sub-carrier on a symbol-by-symbol basis
IQ meas time	All symbols for a selected analysis sub-carrier
IQ phase error	IQ phase error for a selected analysis sub-carrier on a symbol-by-symbol basis
IQ ref time	Sequence of ideal I and Q states for a specific analysis sub-carrier
Overlaid trace data	*Trace data for all TEDS sub-carriers (not individual sub-carriers)*
Error vector spectrum	Error vector spectrum of analysis sub-carriers (in green), overlaid with an average trace (in white)
Error vector time	Error vector time of analysis sub-carriers (in green), overlaid with an average trace (in white)
IQ mag error	IQ magnitude error for every sub-carrier symbol on a symbol-by-symbol basis, overlaid with an average trace (in white)
IQ meas time	All sub-carrier symbols
IQ phase error	IQ phase error for every sub-carrier symbol on a symbol-by-symbol basis, overlaid with an average trace (in white)
IQ ref time	Sequence of ideal I and Q states as a composite of all sub-carriers
TEDS tests	*Configures 89600 VSA software to make standards-based measurements; preset test definitions; customizable*
Occupied bandwidth test	Shows bandwidth in which a defined percentage of the total transmitter power is contained. Summary data provided
Adjacent channel power test	Calculates a ratio between power in a reference band and one or more adjacent bands. User control for up to 3 adjacent channel bands available
Modulation quality overview	Shows summary of the composite EVM in %rms; displayed as overlaid measurement time with composite error summary
Power versus time test	Shows slot power at specific time intervals during the slot burst
Adjacent channel power versus time test	Shows ratio between power in a reference band and one or more adjacent bands at specific time intervals during the slot burst

MB-OFDM Ultra-wideband Modulation Analysis (Option BHB)

Signal acquisition	
Standards supported	Release 1.2 (February, 2007) "MultiBand OFDM Physical Layer Specification", published by the WiMedia Alliance, plus selected version 1.2 enhancements (February 22, 2007)
Presets	Selected TFC in selected band group
Band groups supported	1-6
Channels supported	9-15; 17-23; 25-31; 33-39; 45-46; 49-52; 72-74; 80-82; 88-90; 96-98; 112-113; 150
Data rate (Mb/s)	*Choose from menu or auto-detect*
PSDU (data)	53.3, 80, 106.7, 160, 200, 320, 400, 480
Modulation format	
Data rates ≤ 200 Mb/s	QPSK
Data rates > 200 Mb/s	Dual carrier modulation
Header	QPSK
Preamble	Select type: auto detect; Standard–30 symbols; Burst–18 symbols; includes 6 symbol channel estimation sequence
Time Frequency Code (TFC)	1-4 (TFI–hopping); 5-7 (FFI–non-hopping); 8-10 (TFI2); or select auto-detect
Time parameters	
Search length	Time length used when searching for packet
Result length	Number of symbol times after the preamble which are to be available for EVM analysis, defining the packet length. This may be auto-selected by the software, or read from the header. Alternatively, you may manually override and enter a value for the result length in symbol times or octets
Payload octets	Same as result length minus the header, but in octets
Measurement offset	Number of symbol times from the start of the PLCP Header at which to begin EVM analysis
Measurement interval	The number of symbol times to include in analysis after the measurement offset
Packet parameters	*Apply to analysis provided in the Composite/low/Mid/High Packet time displays and corresponding spectrum traces*
Packet average RBW	RBW of Hanning window used in overlap-window-FFT-RMS processing; defaults to 5 MHz, as called out by standard for Spectral Mask and ACPR tests
Pre-symbol time	Defines beginning of time gate for each symbol in a given band; applies to low/mid/high packet time and spectrum displays; default 0 symbol-times per standard for Spectral Mask and ACPR tests
Post symbol time	Defines the end of time gate for each symbol in a given band; applies to low/mid/high packet time and spectrum displays; default 0.194 per standard
Pre-packet time	Additional time shown before first symbol of packet; applies to all packet displays; default 0 symbol-times per standard for Spectral Mask and ACPR tests
Post-packet time	Additional time shown after last symbol of packet; applies to all packet displays; default 0 symbol-times per standard for Spectral Mask and ACPR tests
Symbol gate length	Alternative to post-symbol time entry; samples, symbol-times, or seconds

MB-OFDM Ultra-wideband Modulation Analysis (Option BHB)—*continued*

Advanced parameters

IQ normalize	On/off; enables IQ normalize function, which sets the outermost state of the ideal constellation diagram to magnitude of one
Mirror frequency spectrum	On/off; specifies whether to do frequency inversion before attempting to demodulate the signal; allows demodulation of frequency spectrums that are mirrored (flipped) about the center frequency
Pulse search	On/off; tells demodulator to search for amplitude rise at beginning of packet, ignoring "off times" between symbols
Phase track average length	1-1000 symbol-times; sets the length of the average used in tracking phase changes during demodulation
Frequency hopping analysis	On/off; default on; when off, synchronization pattern of selected TFC is used, but signal is assumed to occupy only one band
Show filtered CPE	Display output of CPE filter instead of raw CPE values; default off
Subcarrier select	Determines which subcarriers are selected for symbol-domain or subcarrier-domain analysis; all, single carrier, pilots only
Symbol timing adjust	Fine positioning of the demodulation FFT
Time Scale Factor	Scales all modulation time/frequency parameters; use for designs with scaled-down speeds or bandwidths
Scale Hop Freq Offset	On/off; default off; scales the hopping frequency offset with the Time Scale Factor entry
Decode PSDU	Turns on decoding of PSDU bits, FSU on/off; default is off
Decoder level	Controls complexity of decoding algorithm; default 0, range 0-5
Enable tone nulling	Determines if null tones will be ignored in EVM algorithm; on/off
Threshold	Value below which a tone will be labeled as null; dB
Band centered FFI analysis	On/off; selects whether the FFI analysis is centered on the active band or the center of the Band Group, making the center frequency the same for all TFCs in a Band Group
Auto CPE Filter Length	On/off; dynamically select CPE filter length, depending on TFC

Trace data

Composite	*Includes results from all bands*
Band error summary	
Band	Band ID reference: low, medium, high
EVM	Error Vector Magnitude; % rms, dB
EVM pk	Error Vector magnitude Peak, plus symbol location for peak; %
CPE	Common Pilot Error; % rms
Freq Err	Error between carrier frequency, relative to analyzer's center frequency; Hz
IQ Offset	Magnitude of carrier feedthrough signal, as measured during channel estimation sequence portion of preamble; dB
Band packet error summary	Table provides summary information for all bands, individually and simultaneously. For all bands, low, mid, high, the following information is available:
Channel estimation power	Value of power in the channel estimation sequence; dBm
Header EVM	Error vector magnitude in Header section of current packet averaged over each band individually; %rms and dB
Header power	Value of power in header; dBm
Overall EVM	Error vector magnitude averaged over each band individually; %rms and dB
Packet power	Value of power in the packet; used for testing the Tx Power Control (TPC) attenuator settings; dBm
Payload EVM	Error vector magnitude averaged over each band individually; %rms and dB
Payload power	Power in payload; dBm
Relative channel estimation (CE) power	Power of channel estimation relative to sync power; dB
Relative header power	Power of header relative to sync power, dB
Relative payload power	Power of payload relative to sync power; dB
Sync power	Value of power in the sync correlation portion of the signal; dBm
Channel frequency response	Channel frequency response of the equalizer, combined for all bands
Common pilot error	Difference between the measured and ideal pilot subcarrier symbols

MB-OFDM Ultra-wideband Modulation Analysis (Option BHB)—*continued*

Composite–continued	*Includes results from all bands*
Eq impulse response	Impulse response of equalization filter
Error summary table	Composite results
EVM	EVM averaged over all subcarriers and all detected OFDM symbols, computed as a percentage (%rms) and dB
EVM peak at symbol	Peak EVM level over all subcarriers and all detected OFDM symbols, in percentage RCE (%) along with number of symbol where EVM Pk occurred
Frequency error	Error between carrier frequency, relative to analyzer's center frequency
Symbol clock error	Difference between ideal and actual symbol clock frequency, (ppm)
I/Q offset	Magnitude of carrier feedthrough signal, as measured during channel estimation sequence portion of preamble
Quadrature error	Orthogonal error between I and Q
Gain imbalance	Difference in gain between I and Q paths
Common pilot error (RMS)	RMS level of common pilot error trace data, expressed as percentage of ideal signal
Sync correlation	Correlation coefficient between measured preamble and ideal preamble
Sync correlation (minimum)	Per the standard, the minimum sync correlation value across all of the PS/FS symbols; symbol location of minimum value given as well
Preamble correlation	Symbol by symbol correlation of the PS/FS (sync) and CE (channel estimation) portions; %
Channel estimation correlation	Correlation of channel estimation sequence; %
Channel estimation correlation (minimum)	Minimum CE correlation and symbol location at which it occurred
Inter-packet spacing	Gap between the last symbol of the current packet and the first symbol of the next, in symbol times; includes a range of values detected if averaging is turned on
Detected Time Frequency Code	TFC detected using automatic TFC detection algorithm
Detected preamble type	Preamble type detected: standard, burst
Error vector spectrum	Error vector spectrum of the combined Low, Mid, High Bands
Error vector time	EVM value for all carriers in all bands, across symbols
Header Info/Data	Values extracted and decoded from the PLCP Header. Decoded header bits are presented as well
Band Group LSB	1/0
Burst Mode	Burst type for the following packet; 1, if next packet is part of a burst; 0, if is not
HCS	Status results from HS check
PLCP Data Rate	MB/s
Preamble Type	Preamble type used for the current packet; standard/burst
PSDU Length	Octets
R-S parity	Reed-Solomon parity check
Scrambler Initialization	Seed value used for the data scrambler; 1/0
TFC	Transmitter time frequency code for the current packet

MB-OFDM Ultra-wideband Modulation Analysis (Option BHB)—*continued*

Composite–continued	*Includes results from all bands*
IQ measurement	Subcarrier-domain trace that shows the measured IQ symbol values of the subcarriers across the selected symbol-times (bursts) for all low, mid, and high bands combined
IQ measurement time	Symbol-domain trace that shows IQ constellation diagram for the combined high, low, and mid band_IDs
IQ reference spectrum	Subcarrier-domain trace that shows ideal IQ symbol values of subcarriers across the selected symbol-times (bursts) for all low, mid, and high bands combined
Instantaneous channel frequency response	Non-averaged channel frequency response
Packet spectrum	Shows combined packet spectrum across full frequency span
Packet summary table	Table provides summary information for all bands, averaged collectively
Channel estimation power	Absolute value of the power in the channel estimation sequences; dB
Channel estimation relative power	Channel estimation power relative to the sync power; dB
Header EVM	EVM of header only; %rms & dB
Header relative power	Header power relative to the sync power; dB
Overall EVM	EVM of the headers + payloads; %rms and dB
Packet power	Absolute value of average power in the packets; dBm
Payload EVM	EVM of payload (PSDU) portions only; %rms & dB
Payload power	Absolute value of the power in the payloads; dBm
Payload relative power	Payload power relative to the sync power; dB
Sync power	Absolute value of average power in the syncs; dBm
Packet time	Shows packet waveform across full frequency span
Preamble correlation	Symbol by symbol correlation of the entire preamble, including the sync and channel estimation portions
Preamble phase err	Phase error in the preamble, in degrees
RMS error vector spectrum	RMS average EVM across each subcarrier for *all* symbols within the measurement interval
RMS error vector time	RMS average EVM at each symbol
Symbols	Detected symbols; includes DCM symbols
Tone nulling status	Values are 1, if sub-carrier is used; 0, if nulled, as determined by whether the power is above or below the tone nulling threshold set

MB-OFDM Ultra-wideband Modulation Analysis (Option BHB)—*continued*

Band-specific demodulation traces	*Available for high, mid, and low bands, displayable simultaneously*
Channel frequency response	Equalizer channel frequency response
Common pilot error	Difference between the measured and ideal pilot subcarrier symbols
Equalizer impulse response	Impulse response of the equalization filter
Error vector spectrum	Error vector spectrum of the high band, low band, or mid band, separately
Error vector time	For a given band, shows a series of vertical lines where each line represents a band burst of 122 sub-carriers organized by magnitude of the error vector time
Instantaneous channel frequency response	Non-averaged channel frequency response
IQ meas	Subcarrier-domain trace showing measured IQ values of subcarriers across the selected symbol-times (bursts) for the selected band
Packet time	Shows packet waveform for selected band for hopping sequence determined by time-frequency code
Packet spectrum	Shows just the selected band's spectrum portion of the composite spectrum for analysis
Non-demodulation traces	
Raw main time	Time data that was acquired by the hardware, including any extra acquisition to allow for filter settling
Search time	Shows time-data before pulse search and demodulation; is the acquired time data used to search for the burst
Time	Shows the time record used for EVM analysis
Spectrum	Shows averaged frequency spectrum of Time trace used for EVM analysis
Instantaneous spectrum	Shows frequency spectrum of the Time trace used for EVM analysis
CDF	Displays the Cumulative Distribution Function for the selected input channel
CCDF	Displays the Complementary Cumulative Distribution Function for the selected input channel
PDF	Shows the Probability Density Function
Correction	Shows the correction curve used to correct for frequency response of input hardware and digital filtering

ACPR measurements

A new reference offset used with the existing standard Adjacent Channel Power marker capabilities allows the markers to be centered anywhere on the screen. This allows ACPR measurements per the WiMedia test specifications to be made on low and high hopped bands

Spectral mask measurements

The limit test functionality has been enhanced to allow its Y Reference to track the output of a measurement, allowing MB-OFDM Spectral Mask measurements to be made with the top of the mask always positioned at the highest point in the carrier band, in compliance with the WiMedia test specifications

RFID Modulation Analysis (Option BHC)

Signal acquisition

Standards supported (with presets)	EPCglobal Class-1 Generation-2 (ISO 18000-6 Type C); ISO 18000-4 Mode-1[1]; ISO 18000-6 Type-A[1]; ISO 18000-6 Type-B[1]; ISO 18092 (106, 212, and 424 kbps, for passive and active targets); ISO 14443 Type A (106, 212, 424, 848 kbps); ISO 14443 Type B (106, 212, 424, 848 kbps); ISO 15693 (Low/High Rate)
Auto-direction	Automatically determine link direction; on/off
Direction	For both the forward link (interrogator -> tag) and return link (tag->interrogator), independently set:
Modulation format	
Forward direction	DSB-ASK, SSB-ASK, PR-ASK, FSK-2, OOK
Return direction	DSB-ASK, FSK-2, OOK
Line coding	
Forward direction	None (NRZ), Manchester, FM0, PIE (ISO 18000-6 Type-A), PIE (EPC C1Gen2), Modified Miller, ISO 15693 1-out-of-4; ISO 15693 1-out-of-256
Return direction	None (NRZ), Manchester, FM0, Miller, Miller-2, Miller-4, Miller-8, Modified Miller, Subcarrier Manchester, Subcarrier BPSK1, Subcarrier BPSK2, Subcarrier BPSK4, Subcarrier BPSK8; for ISO 15693: Single Subcarrier LR, Single Subcarrier HR, Dual Subcarrier LR, Dual Subcarrier HR
Invert	On/off; inverts the raw demod bits going into the line decoding
Bit rate	Manually set, or auto-detected; bps
Tari	Manually set, or auto-detected; used only for PIE line coding; forward direction only
Symbol rate	Rate (frequency) at which symbols occur; symbols/sec
ASK Auto Bit Rate/Tari	Adjusts the expected bit rate by analyzing input data; on/off
Points/symbol	Number of points to be used for MeasTime and RefTime traces; 10, 20
Measurement modes	Modulation analysis (burst), CW analysis, or both
Measurement filters	None, root raised cosine
Reference filters	None, raised cosine, Gaussian
Alpha/BT	Alpha of root raised cosine, or raised cosine filter; or BT of Gaussian filter

Adjustable parameters

Acquisition length	Length over which demodulation will occur; secs
Burst search	On/off
Burst index	Specifies which burst is selected for demodulation when burst search on
Result length	Measurement interval; secs
Sync search length	Specifies the length of time over which to search for the sync pattern
Sync search offset	Specifies where to start the search for the sync pattern
Sync offset	Used to determine the start of the demodulated data, as an offset from the location of the sync pattern; only used when Sync search is on, and burst search is off
Result offset	Offset for measurement start point, secs
Synch search	Used to measure a signal that has a certain symbol pattern; on/off
Type	Per standard preamble and/or delimiter values; or user-defined bit pattern encoded per specified line coding

Advanced parameters

IQ normalize	Valid only for non-ASK formats; on/off
Mirror frequency spectrum	Determines whether to do a frequency inversion before synchronizing and demodulating a signal
Clock adjust	Allows user-adjustment of symbol timing used when demodulating; symbols
Thresholds	Used for setting levels used when calculating CW or ASK errors; CW lower/upper/settling; ASK lower/upper, if applicable

1. Beta implementation only.

RFID Modulation Analysis (Option BHC)—*continued*

Channel 1 trace results	
Raw main time	Time data acquired by the hardware, including any extra acquisition to allow for filter settling
Acquisition time	Block of data acquired and searched for bursts
Spectrum	Averaged frequency spectrum of time trace
Instantaneous spectrum	Frequency spectrum of time trace
Time	Time record block of data
Correction	Frequency domain correction applied to raw measured time data
Raw demod bits	Raw demod bit stream obtained
Burst summary table	Table of values for all detected bursts in the acquisition time, including burst index, offset length, link direction, off interval
CW summary table power-down	Summary of time-domain characteristics of the interrogator CW power-up and
CW rise time	Time for the CW to transition between CW lower and upper threshold values during power up; secs
CW overshoot	Overshoot of CW signal during power-up; % of steady-state CW level
CW undershoot	Undershoot of CW signal during power-up; % of steady-state CW level
CW settling time	Time from the end of the CW rise time until the CW has settled to within the CW settling threshold of the steady state CW level; secs
CW fall time	Time it takes the CW to transition between the CW upper threshold and the CW lower threshold during power-down; secs
CW start to burst	Time between the end of the CW burst and the start of the next CW burst
End to next CW	Time between the start of CW and the start of the first burst

Channel 1 demod trace results	***Trace results available for ASK, OOK, FSK; dependent on burst selected for analysis***
Demod bits	Decoded raw demod bit stream using selected line-coding method
Hex bits	Hexadecimal display of demodulated bits; follows Symbol Table Bit Order for MSB- or LSB-first
Meas time with CW	Signal trace that is filtered, resampled, and frequency-, phase-compensated
Meas time	Same as Meas Time with interrogator CW power removed
Magnitude error	Amplitude difference between the I/Q reference signal and the I/Q measured signal measured at the symbol times
Ref time	Reference of signal which is shaped using the reference filter
Error time	Error trace calculated as [Meas Time] – [Ref Time]

RFID Modulation Analysis (Option BHC)—*continued*

Channel 1 demod trace results—*continued*

Summary table	*For non-FSK formats*
Modulation depth	Calculated from Meas time with CW
Modulation index	Calculated from Meas time with CW
On amplitude	Calculated from Meas time with CW; average, max, min calculated for a single scan
Off amplitude	Calculated from Meas time with CW; average, max, min calculated for a single scan
On ripple overshoot	Calculated from Meas time; avg, max calculated for a single scan
On ripple undershoot	Calculated from Meas time; avg, max calculated for a single scan
Off ripple overshoot	Calculated from Meas time; avg, max calculated for a single scan
Off ripple undershoot	Calculated from Meas time; avg, max calculated for a single scan
ASK error	Calculated from Error time; rms avg, max calculated for a single scan
Duty cycle	Calculated from Meas time; avg, max, min calculated for a single scan
On width	Calculated from Meas time; avg, max, min calculated for a single scan
Off width	Calculated from Meas time; avg, max, min calculated for a single scan
D0 time	Calculated from Meas time when PIE encoding selected
D1 time	Calculated from Meas time when PIE encoding selected
Rise time	Calculated from Meas time; avg, max calculated for a single scan
Fall time	Calculated from Meas time; avg, max calculated for a single scan
Frequency error	Avg frequency offset between the center of the signal and the center frequency of the front end instrument
Bit rate	Calculated from Meas time, when auto bit rate enabled or PIE line coding selected
Tag phase	Phase of tag relative to CW; avg, max, min values
Tag amplitude	Amplitude of tag relative to CW; avg, max, min values
FSK summary table	*For FSK formats only*
FSK error	Calculated from FSK error time; rms avg, max calculated for a single scan
Magnitude error	Carrier magnitude drift from a constant reference line; rms avg, max
Deviation	Frequency deviation of the FSK signal
Frequency error	Average carrier offset of FSK signal
NFC summary	*Summary table specific to NFC formats*
t1 Fall Time + Off Time	Avg, max, min values
t2 Off Time	Avg, max, min values
t3 Rise Time	5 to 90% rise time; avg, max, min values
t4 60% Rise Time	5 to 60% rise time; avg, max, min values
t1 Old	Avg, max, min fall off time using a previous definition
t5 Off Time	Avg, max, min values for t5 (ISO 14443 Type A standard)
t6 Rise Time	Avg, max, min values for t6 (ISO 14443 Type A standard)
14443B EGT	Extra guard time separation between transmitted characters (ISO 14443 Type B standard); etu
14443B SOF On Width	Length of the logic "1" start of frame field (ISO 14443 Type B standard)
14443B SOF Off Width	Length of logic "0" part of start of frame field (ISO 14443 Type B standard)
14443B EOF Off Width	Length of logic "0" part of the end of frame field (ISO 14443 Type standard)
14443 Local Max	Avg, max, min values of the local peaks during the Local Maximum search period (ISO 14443 signals using ASK only)
14443B TR0	Time between PCD end of EOF and PICC start of subcarrier (ISO 14443B signals only)
14443B TR1	Time between PICC start of subcarrier and start of SOF (ISO 14443B signals only)
14443B TR2	Time between PICC start of EOF and PCD start of SOF (ISO 14443B signals only)
14443B FsToOff	Time between PICC end of EOF and end of subcarrier (ISO 14443B signals only)
Frame structure table	*EPC Class 1 Gen 2 signals only. Additional table entries may also be present depending on frame type.*
Link	Defines the direction of the burst: forward or reverse
Standard	Displays the standard being used for the measurement
Off interval	Interval between bursts preceding the numbered burst
Frame type	Type of frame. Additional information specific to the frame type is also displayed
Preamble type	Shows the preamble type: Preamble or FrameSync
Command	Multi-bit command code corresponding to frame type

Dynamic Link to EEsof ADS/SystemVue (Option 105)

Source component

This option links the 89600 VSA with design simulations running on the Agilent EEsof Advanced Design System or SystemVue ESL providing real-time, interactive analysis of results. It adds vector signal analyzer sink and source components to the Agilent Ptolemy simulation environment. When a simulation is run, the 89600 software is automatically launched.

The VSA sink component analyzes waveform data from a simulation. Its user interface and measurement functions are the same in this mode as for hardware-based measurements. The VSA source component outputs measurement data to a simulation. Its input data can be from a recording or hardware. Front-end hardware need not be present when using either component unless live measurements are to be sourced into a simulation.

ADS version required	ADS 2001 or later
SystemVue version required	SystemVue 2008 or later
Output data types supported	
Data	Timed Frequency Demod errors Complex scalar Float scalar Integer scalar
Control	Data gap indicator
VSA input modes	Hardware, recording
VSA analysis range	Dependent on input mode and hardware installed
VSA component parameters (user settable)	VSATitle ControlSimulation OutputType Pause VSATrace Tstep SetUpFile RecordingFile SetUpUse AutoCapture DefaultHardware AllPoints
VSA component parameters (passed to ADS, timed output only)	Carrier frequency Tstep

Dynamic Link to EEsof ADS (Option 105)—*continued*

Sink component

ADS version required	ADS 1.5 or later
SystemVue version required	SystemVue 2008 or later
Input data types supported	Float Complex Timed – base band Timed – ComplexEnv
VSA input modes	Single channel, dual channel, I + jQ
VSA analysis range	
Carrier frequency	DC to > 1 THz
Tstep (sample time)	$< 10^{-12}$ to > 10^{3} seconds
VSA component parameters (user settable)	VSATitle Tstep SamplesPerSymbol RestoreHW SetupFile Start Stop TclTkMode RecordMode SetFreqProp
VSA component parameters (passed from ADS/SystemVue)	Carrier frequency Tstep Data type
Number of VSAs that can run concurrently	
ADS version 1.5 and later	20
ADS version 1.3	1

Dynamic Link to The MathWorks Simulink Simulation and Model-Based Design (Option 106)

When Option 106 of the 89600 VSA software is enabled, the Agilent 89600 VSA Blockset is installed in the "toolbox" sub-directory of the MATLAB's installation directory (MATLABROOT). The blockset is the means of communication between The MathWorks' Simulink software and Agilent's 89600 VSA software.

The 89600 VSA software can be used to analyze and display Simulink signals using the "VSA Sink Block," and can also act as a signal source in Simulink using the "VSA Source Block." The VSA Source block allows you to take measurements with real hardware, and input the data into a Simulink simulation

VSA Blockset	Multiple VSA source and sink blocks, and their associated 89600 VSA analyzers, can be configured independently and included in the same Simulink model
VSA Sink Agilent's 89600 VSA software	A Simulink block that routes data from The MathWorks' Simulink software to
VSA Source	A Simulink block that routes data from Agilent's 89600 VSA software to The MathWorks' Simulink software

Software requirements	
Simulink	Simulink version 6.4 or higher
MATLAB	MATLAB version R2006A or higher installed
Blocksets	Optional, but recommended; may be required for some demos Communications blockset Communications toolbox Data acquisition toolbox Instrument control toolbox RF blockset RF toolbox Signal processing blockset Signal processing toolbox

Dimensionalities and signal types	Valid dimensionalities and signal types of signals that can be connected to the VSA block's port
Double [N x 1]	1-Dimensional array of real values; VSA data comes in on Channel 1, Zoom = false
Double (c) [N x 1]	1-Dimensional array of complex values; VSA data comes in on Channel 1, Zoom = true
Double [N x 2]	2-Dimensional array of real values; VSA data comes in on Channel 1 and Channel 2, Zoom = false; VSA can interpret data as I + jQ
Double (c) [N x 2] Channel 2, Zoom = true	2-Dimensional array of complex values; VSA data comes in on Channel 1 and

Dynamic Link to The MathWorks Simulink Simulation and Model-Based Design (Option 106)—*continued*

VSA source and sink setup

Get VSA settings	Automatically saves the current VSA analyzer measurement configuration settings in the model
Set VSA settings	Automatically sets the current VSA analyzer measurement configurations from data saved in the model
Export/Import VSA settings	Saves/recalls all necessary information, including configuration settings of any associated VSA Analyzer application
Export/Import files types	State and setup files are saved as a ZIP file with vsaconfig extension. When exploded, the following files are available: vsaMeasurement.set: configuration setup file for the 89600 VSA vsaDisplay.dap: display appearance setup file for the 89600 VSA vsaHardwareState.mat: hardware state setup file for the 89600 VSA vsaDialogParams.mat: VSA blockset parameters
VSA properties	Copies the properties of the VSA analyzer application to the source block in a Simulink window during import operation; yes/no
Show VSA analyzer	Restores the associated VSA application window, or launches it if previously closed

VSA sink

VSA details	Reported for information only
Block size	Denotes the number of samples that the VSA analyzer application needs to acquire a measurement
Points to next measurements	The number of remaining samples that the VSA analyzer application needs from Simulink design simulation to acquire a measurement
Center frequency	Center frequency of simulated data

VSA source

VSA source file properties	
Playback file	Specifies that the signal being generated from the VSA source block is the same pre-recorded signal being played back in the associated VSA Analyzer application; yes/no
Time step	Instructs the VSA Analyzer application to resample the pre-recorded signal with a different sampling time; in seconds, or –1 to inherit from VSA
Points in frame	Allows the user to set the frame size, which is the number of samples to be output from the Source block in one frame time, to be processed by other blocks in the Simulink model, or –1 to inherit from VSA

Ordering Information

89601A	Vector signal analysis software, including 1-year of software update subscription service
Options	*Option 200 required at initial order. One year of update service (or optionally 2 years) included when Option 200 ordered by automatically adding Option 012 (or choosing Option 024) along with Option D12 discount.*
89601A-200	Basic vector signal analysis software
89601A-300	Hardware connectivity
89601A-D12	Discount on first 12 months of bundled software update subscription service
89601A-012	12 month software update service (qualifies for 12 month discount)
89601A-024	24 month software update service (qualifies for 12 month discount)
89601A-AYA	Flexible modulation analysis
89601A-B7N	3G modulation analysis bundle (includes B7T, B7U, B7W, B7X)
89601A-B7T	cdma2000/1xEV-DV modulation analysis
89601A-B7U	W-CDMA/HSPA modulation analysis
89601A-B7W	1xEV-DO modulation analysis
89601A-B7X	TD-SCDMA modulation analysis
89601A-B7R	WLAN modulation analysis
89601A-B7S	IEEE 802.16-2004 OFDM modulation analysis
89601A-B7Y	IEEE 802.16 OFDMA modulation analysis
89601A-B7Z	IEEE 802.11n MIMO modulation analysis
89601A-BHA	TEDS modulation and test
89601A-BHB	MB-OFDM ultra-wideband modulation analysis
89601A-BHC	RFID modulation analysis
89601A-BHD	LTE FDD modulation analysis
89601A-BHE	LTE TDD modulation analysis
89601A-105	Dynamic link to EEsof ADS/SystemVue
89601A-106	Dynamic link to The MathWorks Simulink Simulation and Model-Based Design software
89601AN	Vector signal analysis software (floating license for 1 server)
Options	*Note: multiple quantities of one option may be ordered per each server. Option 200 required at initial order. One year of update service (or optionally 2 years) included when Option 200 ordered by automatically adding Option 012 (or choosing Option 024) along with Option D12 discount. Every user must have Option 200, so the maximum quantity of any option may not exceed the quantity of Option 200. For multiple servers, order additional 89601AN.*
89601AN-200	Basic vector signal analysis software
89601AN-300	Hardware connectivity
89601AN-D12	Discount on first 12 months of bundled software update subscription service
89601AN-012	12 month software update service for Option 200 & associated options (qualifies for 12 month discount)
89601AN-024	24 month software update service for Option 200 & associated options (qualifies for 12 month discount)
89601AN-AYA	Flexible modulation analysis
89601AN-B7N	3G modulation analysis bundle (includes B7T, B7U, B7W, B7X)
89601AN-B7T	cdma2000/1xEV-DV modulation analysis
89601AN-B7U	W-CDMA/HSPA modulation analysis
89601AN-B7W	1xEV-DO modulation analysis
89601AN-B7X	TD-SCDMA modulation analysis
89601AN-B7R	WLAN modulation analysis
89601AN-B7S	IEEE 802.16-2004 OFDM modulation analysis
89601AN-B7Y	IEEE 802.16 OFDMA modulation analysis
89601AN-B7Z	IEEE 802.11n MIMO modulation analysis
89601AN-BHA	TEDS modulation and test
89601AN-BHB	MB-OFDM ultra-wideband modulation analysis
89601AN-BHC	RFID modulation analysis
89601AN-BHD	LTE FDD modulation analysis
89601AN-BHE	LTE TDD modulation analysis
89601AN-105	Dynamic link to EEsof ADS/SystemVue
89601AN-106	Dynamic link to The MathWorks Simulink Simulation and Model-Based Design software

Ordering Information—*continued*

89601N12	Vector signal analysis software, 12-month limited-term package floating license for 1 server; includes 1-year software update subscription.
Options	*Required. Multiple 801 options may be ordered per server. For multiple servers, order additional 89601N12*
89601N12-801	Twelve-month floating license software package including VSA software options -200, -300, -105, -106, -AYA, -B7N, -B7R, -B7S, -B7Y, -B7Z, -BHA, -BHB, -BHC, -BHD, -BHE
Software update subscription service	Software update subscription service keeps your VSA software up to date with the latest features, and ability to add new options. *Note: Bundled with each 89601A or 89601AN order of Option 200 are 12 months of update service and a discount option to offset the 12 months. You may also order a total of 24 months and still have the 12 month discount apply.*
89601AS	Additional software update subscription service *Renewal orders only. Twelve-month minimum. Twenty-four month maximum coverage, total. Order 89601AS with Option 89601AS-0xx (xx = number of months coverage, max 24) See* ***www.agilent.com/find/vsaupdate*** *for descriptions of actual product and option structure.*
89601ASN	Software update subscription service for 1 server (floating license) *Renewal orders only. Order 89601ASN, with Option 89601ASN-0xx , quantity yy (xx = number of months coverage, max 24; yy=number of Option 200 licenses on one server to cover). For additional servers, order additional 89601ASN.* *See* ***www.agilent.com/find/vsaupdate*** *for descriptions of actual product and option structure.*

Product Upgrades

You may order any of the options after purchase. Depending on your software revision, purchase of 1-year 89601AS/ASN software update subscription service may be required. Because of this, when purchasing an upgrade, please indicate to your sales representative that you are doing so.

When you purchase an option as an upgrade, you will receive an option license for the current software revision that you own. For that reason, not all revisions of software support all options. The upgrade options table provides a list of the options and the minimum software revision levels required.

89601A customers must purchase one year of the 89601AS software update subscription service to upgrade to the most current version of software if they do not meet the minimum software version.

To upgrade to the current revision of software, 89601AN customers must purchase at least one year of 89601ASN update service to support each new upgrade option desired.

Upgrade options

Upgrade option desired	Minimum 89600 software revision level required for upgrade	Comments
-105 ADS/SystemVue connectivity	1.0	v11.0 or greater required for use with SystemVue
-106 Link to The MathWorks Simulink Simulation and Model-Based Design	7.0	
-200 basic VSA	1.0	Since Option 200 is required for all new orders, it cannot be purchased as an upgrade option Note 1
-300 hardware connectivity	5.0	Note 1
-AYA flexible modulation analysis	1.0	Note 1
-B7N 3G modulation analysis	2.0	Significant product enhancements occurred at revision 5.2; customers are urged to purchase update sub scription service
-B7R WLAN modulation analysis	3.0	Note 1
-B7S IEEE 802.16-2004 modulation analysis	5.3	
-B7T cdma2000/1xEV-DV modulation analysis	6.1	
-B7U WCDMA/HSPA modulation analysis	6.1	Revision 8.0 required for full HSPA analysis; v11.0 required for HSPA+ MIMO
-B7W 1xEV-DO modulation analysis	6.1	
-B7X TD-SCDMA modulation analysis	6.1	
-B7Y IEEE 802.16 OFDMA modulation analysis	6.1	Note 1
-B7Z IEEE 802.11n MIMO modulation analysis	6.2	Rev 10.0 required for 4x4 MIMO
-BHA TEDS modulation analysis and test	6.3	
-BHB MB-OFDM ultra-wideband modulation analysis	6.3	
-BHC RFID modulation analysis	7.0	
-BHD LTE FDD modulation analysis	8.0	Major changes at Rev 9.0 and beyond; puchase update service to obtain
-BHE LTE TDD modulation analysis	11.0	

Notes:
1. Significant product enhancements have occurred since the initial release. Customers more than 1 revision level below the current revision are encouraged to purchase an update subscription service.

For additional information on product upgrades, go to **www.agilent.com/find/saupgrades** and look for *"How do I upgrade my 89600 Vector Signal Analyzer?"* Complete information on software upgrades and revision history are available there.

Product Support and Training

Agilent provides both product-specific and application training, as well as specialized consulting services. Of particular interest are the following:

PS-S20-01	One day of start-up assistance **(recommended)**
PS-S10	Phone assistance **(Six hours recommended)**
PS-T10-896xx	89600 users' course
PS-T11-896xx	Digital radio troubleshooting
PS-T12-896xx	Wireless LAN technology fundamentals
R1362A-250	VSA wireless LAN measurements

The 89600 users' course and W-LAN technology fundamentals are classes available on-site at your location. The VSA wireless LAN measurements and productivity assistance products are consulting services tailored to your needs.

User-Supplied PC Requirements

The 89600 VSA requires a PC to control the hardware and display results on the PC in a PC-based instrument. The following are the minimum requirements for a user-supplied PC. For best immunity to electrostatic discharge (ESD), use a desktop PC.

Characteristic	**Microsoft® Windows XP Professional, Service Pack 2**	**Microsoft Windows Vista Business, Enterprise, or Ultimate**	**Microsoft Windows Windows 7 Business, Enterprise, or Ultimate**
CPU	600 MHz Pentium® or AMD-K6 > 600 MHz (> 2 GHz recommended)	1 GHz 32-bit (x86) (> 2 GHz recommended)	1 GHz 32-bit (x86) (> 2 GHz recommended)
RAM	512 MB (1 GB recommended)	1 GB (2 GB recommended)	1 GB (2 GB recommended)
Video RAM	4 MB (16 MB recommended)	128 MB (512 MB recommended)	128 MB (512 MB recommended)
Hard disk	1 GB available	1 GB available	1 GB available
Additional drives	CD-ROM to load the software; license transfer requires network access or a USB memory stick	CD-ROM to load the software; license transfer requires network access or a USB memory stick	DVD to load the software; license transfer requires network access or a USB memory stick
Interface support	LAN, GPIB, USB, or FireWire[1] interface (VXI HW only)	LAN, GPIB, USB, or FireWire[1] interface (VXI HW only)	LAN, GPIB, USB, or FireWire[1] interface (VXI HW only)

1. *For a list of supported IEEE-1394 (FireWire) interfaces, visit www.agilent.com/find/89600 and search the FAQ's for information on "What type of IEEE-1394 interface can I use in my computer to connect to the 89600S VXI hardware?".*

Related Literature

89600 Vector Signal Analysis Software
Technical Overview, literature number 5989-1679EN

Hardware Measurement Platforms for the Agilent 89600 Vector Signal Analysis Software,
Data Sheet, literature number 5989-1753EN

89600S VXI-Based Vector Signal Analyzers,
Configuration Guide, literature number 5968-9350E

89600 Series VSA Software for MB-OFDM Ultra-Wideband,
Technical Overview and Self-Guided Demonstration, literature number 5989-5452EN

Infiniium Oscilloscopes Performance Guide Using 89600 VSA Software,
Application Note, literature number 5988-4096EN

InfiniiVision Series Oscilloscopes Performance Guide Using 89600 VSA Software,
Application Note, literature number 5989-4523EN

89607A WLAN Test Suite Software,
Technical Overview, literature number 5988-9574EN

89604A Distortion Suite Software,
Technical Overview, literature number 5988-7812EN

How to measure Digital Baseband and IF Signals Using Agilent Logic Analyzers,
Application Note, literature number 5989-2384EN

Agilent Logic Analyzers and 89601A Vector Signal Analysis Software,
Technical Overview, literature number 5989-3359EN

Agilent Acqiris Broadband High-Speed Digitizers Using 89601A Vector Signal Analyzer Software,
Application Note, literature number 5989-7672EN

Related Web Resources

For more information, visit: **www.agilent.com/find/89600**

Agilent Email Updates

www.agilent.com/find/emailupdates
Get the latest information on the products and applications you select.

LXI

www.lxistandard.org
LXI is the LAN-based successor to GPIB, providing faster, more efficient connectivity. Agilent is a founding member of the LXI consortium.

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Taiwan	0800 047 866
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Netherlands	31 (0) 20 547 2111
Spain	34 (91) 631 3300
Sweden	0200-88 22 55
Switzerland	0800 80 53 53
United Kingdom	44 (0) 118 9276201

Other European Countries:
www.agilent.com/find/contactus

Revised: October 1, 2009

Product specifications and descriptions in this document subject to change without notice.

Printed in USA, April 9, 2010
5989-1786EN

Agilent Technologies