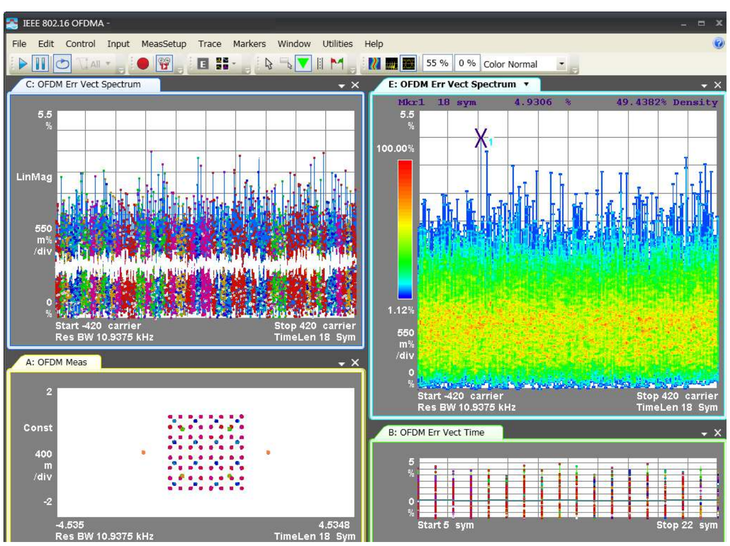
Keysight Technologies
89601B/BN-B7Y 802.16e Mobile and 802.16 OFDM Fixed WiMAX™ Modulation Analysis 89600B VSA Software

Technical Overview



Key Features

- Analyze a wide variety of WiMAX™ formats
- Easily configure the 89600B, with complete control over measurement setup parameters
- Gather info on PHY layer performance and errors
- Choose where to focus analysis
- Analyze 2x2 matrix A or B STC/MIMO systems (Mobile WiMAX™ only)
- Gain 20:20 insight into your signal using 20 traces, sized the way you want, each with 20 markers

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WiMAX Modulation Analysis

This high performance 89600B vector signal analysis (VSA) software provides RF and baseband engineers the industry's most comprehensive OFDMA and OFDM PHY layer analysis tools for the IEEE-802.16 standard. Perform time-selective, frequency-selective, or modulation measurements simultaneously to decompose a signal and uncover anomalies you have never been able to see before.

Option B7Y offers an advanced and comprehensive toolset for evaluating and troubleshooting the IEEE 802.16e-2005 OFDMA PHY layer signaling format. Perform analysis of uplink and downlink signals, with all zone types, all bandwidths, and all FFT lengths. Analyze DL-PUSC signals using 2-antenna matrix A or B transmission schemes for STC/MIMO.

The same option (B7Y) also supports advanced modulation analysis of IEEE 802.16-2004 OFDM signals and provides key insights into those signals. This toolset is capable of analyzing all modulation types: BPSK, QPSK, 16QAM, 64QAM, all frame formats, TDD, FDD, and H-FDD, both uplink and downlink signals, burst and continuous, plus all frame lengths, guard intervals, and sampling factors. With B7Y, you can demodulate your signal down to the raw bit level.

IEEE 802.16d and 802.16e are 2 of over 70 signal standards and modulation types for which the 89600B vector signal analysis software creates a window into what's happening inside your complex wireless devices. The 89600B tools provide views of virtually every facet of a problem, helping you see the "why?" behind signal problems. Whether you're working with emerging or established standards, Keysight's industry-leading 89600B VSA software helps you see through the complexity.

Technology overview

The IEEE 802.16-2004 and 802.16a-2003 standards, often referred to as Fixed WiMAX, define the physical layer (PHY) and medium access control (MAC) protocol that define products that extend broadband wireless access (BWA) from the local area network to the metropolitan area network. These standards contain specifications for licensed and unlicensed BWA networks operating between 2 and 11 GHz. In order to address the international wireless market and regional spectrum regulations, the WiMAX standard includes varying channel bandwidths, between 1.25 to 20 MHz. The 802.16-2004 standard, sometimes referred to as 802.16d, includes minor improvements over the earlier 802.16a-2003 standard. The 802.16-2004 standard also provides system profiles that can be used for product compliance testing.

Mobile WiMAX is based on 802.16-2004 and 802.16e-2005, now combined into a single document. The updated standard combines fixed and mobile services into network architecture similar to a cellular system where a single base station can support fixed, portable, and mobile terminals. Unlike existing cellular systems, Mobile WiMAX uses an all internet protocol backbone. The standard includes an OFDMA PHY layer with sub-channelization that allows the time and frequency resources to be dynamically allocated among multiple users across the downlink and uplink sub-frames.

Adding user mobility features to the conventional orthogonal frequency division multiplexing (OFDM) signal used for Fixed WiMAX introduced substantially more flexibility in the way that the radio signals are constructed. Mobility features give the network operator the freedom to adapt the operation of the base station (BS) to specific requirements of the physical location. It also introduces many variables that need to be understood and tested at several levels- from basic parametric tests, to end-to-end performance evaluation.

Try before you buy!

Download the 89600B software and use it free for 14 days to make measurements with your analysis hardware, or use our recorded demo signals by selecting

File > Recall > Recall Demo > WiMax OFDMA (or WiMax Fixed) > on the software toolbar.

Request your free trial license today: (www.keysight.com/find/89600B_trial)

Option B7S was discontinued on July 1, 2011 and replaced with Option B7Y, which provides both Mobile and Fixed WiMAX analysis.

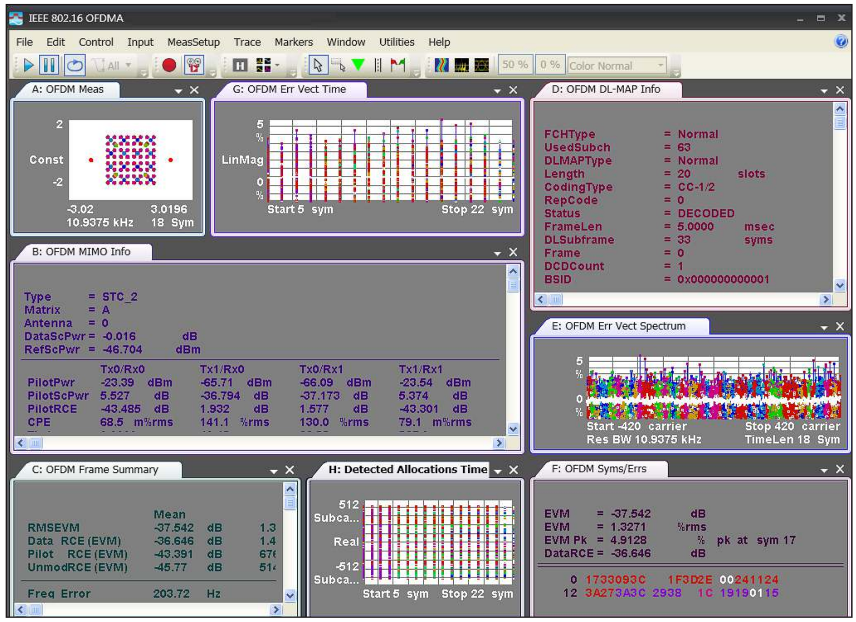
Analysis and Troubleshooting

Thoroughly analyze signals

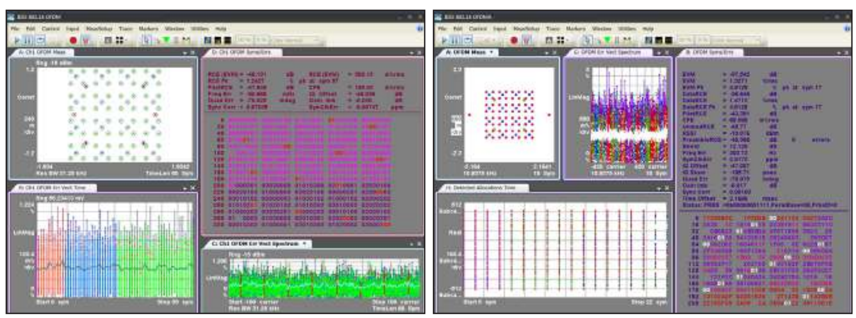
Troubleshoot using a full suite of time, frequency, and modulation domain analysis tools that let you demodulate and characterize errors down to the bit level. Focus on a sub-set of the symbols for time-selective analysis, or on a single carrier for frequency-selective analysis. Error traces provide detailed information on pilot errors, and signal RCE versus time and frequency. Evaluate results using a wide selection of measurement tools, including compound constellations and detected allocations (Mobile WiMAX), with all measurements color-coded for easy at-a-glance visualization. Option B7Y summary tables provide RCE/EVM and power metrics for data burst, frame, and overall signal.

Analyze a wide range of WiMAX formats

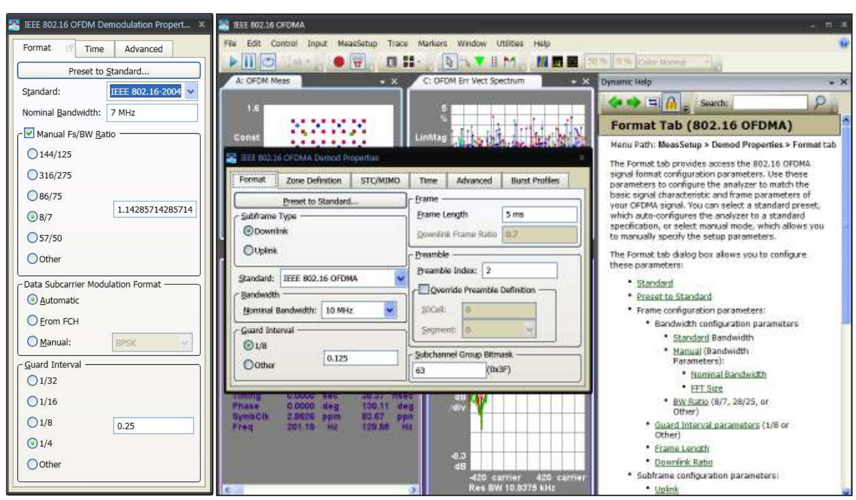
Option B7Y helps you measure Mobile WiMAX signals from the frame down to the bit level, and perform multi-burst or selective burst analysis–even MIMO. Use Option B7Y to completely characterize the Fixed WiMAX DL/UL PHY layer, including FDD, H-FDD, and TDD modes using all modulation formats, analysis bandwidths, frame lengths, guard intervals, and sampling factors.



WiMAX analysis offers important data burst, frame, and overall signal performance metrics in tabular or trace formats. Gain 20:20 clarity into your signal's performance using 20 screens, each with up to 20 markers each.



Appropriate use of color highlights the salient features for each format. In Fixed WiMAX, color represents the various modulation formats as each user transmit sequentially. In Mobile WiMAX color represents different user bursts.



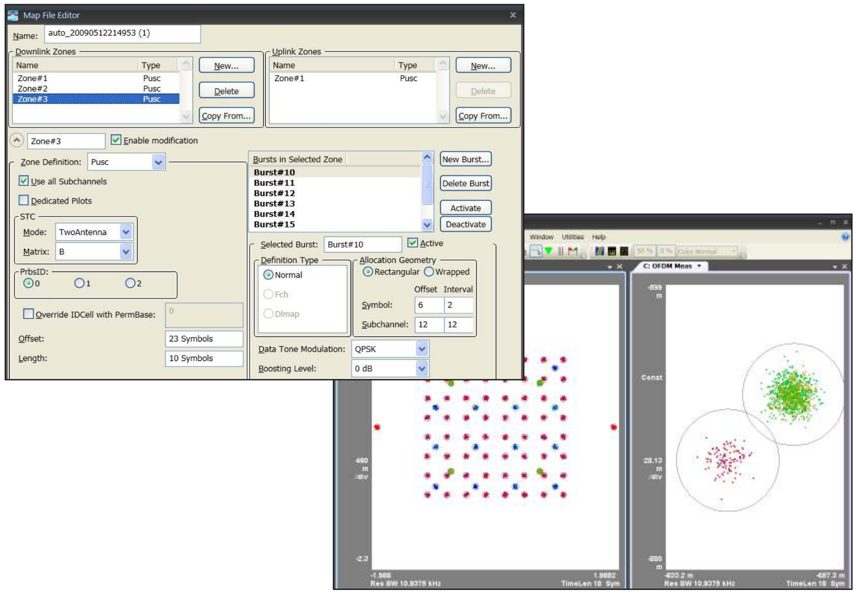
Compare the Format tabs for Fixed and Mobile WiMAX. Dynamic Help text provides information on either format, as well as many other important analysis features.

Easily set up measurements or use advanced setup controls

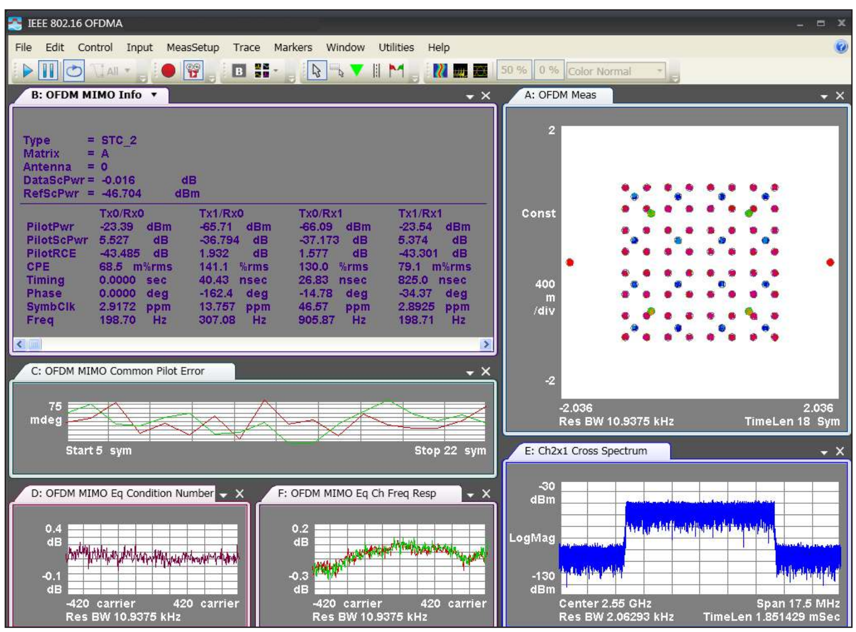
For fast setup, use the preset to standard feature, or manually adjust parameters. Identify hidden errors that lower design margins by setting carrier pilot tracking to track amplitude, or phase, or timing. Mobile WiMAX also features auto configuration and decoding, including auto zone detection and setup, plus DL/UL-MAP auto-configuration. Both options let you manually control a wide range of parameters.

Perform MIMO analysis (Mobile WiMAX only)

Using supported multi-channel hardware, analyze DL-PUSC signals using 2-antenna matrix A or B transmission schemes for STC/MIMO. It also handles other Wave 2 WiMAX signals, such as UL-PUSC signals containing data bursts with collaborative spatial multiplexing enabled, DL-PUSC and AMC zones with dedicated pilots, and UL subchannel derotation for beam-forming applications.



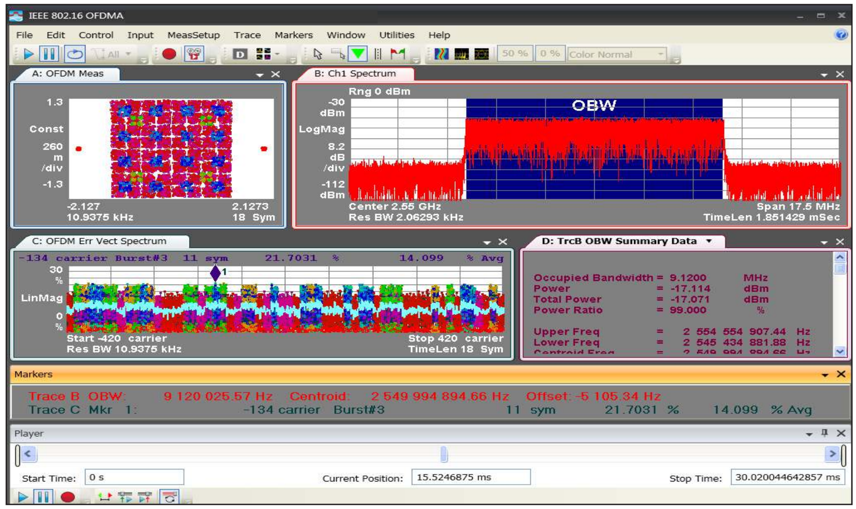
Use the Map File Editor to define Mobile WiMAX zones and bursts. Next to it is the resultant IQ constellation. To show greater detail, use the expand tool in the VSA toolbar to highlight a smaller area of interest.



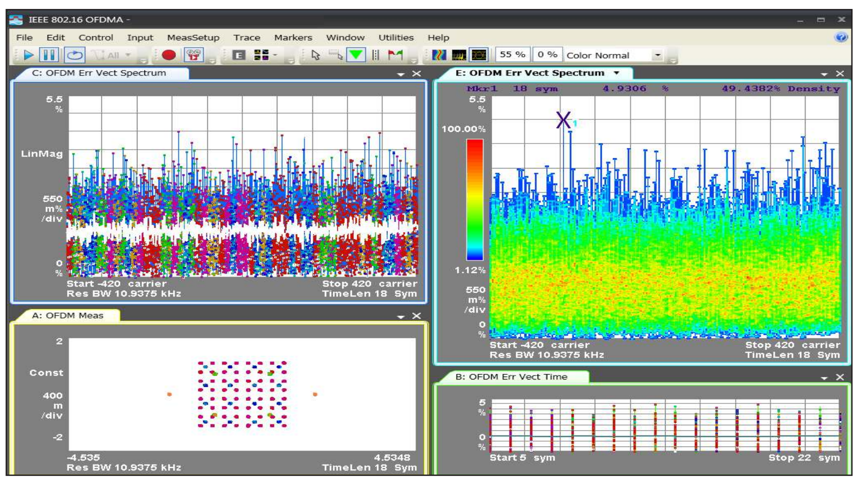
Gain key insight into multi-antenna STC/MIMO signals using a wide range of error traces available for stream, channel, and cross-channel. Note the many transmission metrics in the information table.

Helpful tools

The 89600B VSA includes signal capture and playback capabilities. Use it to capture burst and transient signals for analysis. Take advantage of tools like overlap processing for detailed "slow motion" analysis and the spectrogram and cumulative history traces for evaluating the dynamic frequency and amplitude behavior of your signal over time. Get a complete view of complex signals like WiMAX by using the 89600B's 20:20 capability: display 20 measurement windows, each with up to 20 markers each.



Take advantage of the 89600B's rich set of time-domain capabilities, including triggering, time gating, and powerful markers to analyze WiMAX signals.



Use the innovative cumulative history on error traces to gain important insight. Traces C and E are both showing EVM spectrum data. The marker in Trace D is on an apparent outlying point, but it has a 49% density, meaning that the signal landed on or transited through this point 49% of the time. This is an important insight when evaluating design margins.

Choosing between 89600B VSA software and X-Series measurement applications

89600B VSA is the industry-leading measurement software for evaluating and troubleshooting wireless signals in R&D. PC-based, supporting numerous measurement platforms, the 89600B provides the flexibility and sophisticated measurement tools essential to finding and fixing signal problems .

X-Series measurement applications provide embedded format-specific, one-button measurements for X-Series analyzers. With fast measurement speed, pass/fail testing and simplicity of operation, these applications are ideally suited for design verification and manufacturing. For more information, visit www.keysight.com/find/X-Series_Apps.

Software Features

Mobile WiMAX

Measurement conditions	
Signal acquisition	
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

Adjustable setup parameters	
Formats setup	
Preset to standard selections	TTA-Phase 2 (Wibro), IEEE 802.16 OFDMA (5MHz), IEEE 802.16 OFDMA (10 MHz)
Subframe type	Downlink, Uplink
Standard	IEEE 802.16 OFDMA, P802.16 OFDMA (Cor1/D2)
Nominal bandwidth	1.25, 3.5, 4.375, 5, 7, 8.75, 10, 14, 15, 17.5, 20, 28 MHz
Guard interval	1/8 default, user settable from 0 to 1.0
Frame length	User settable
Downlink frame ratio	0-1.00; defines start of uplink subframe
Preamble Index	User settable
Override preamble definition	Check box which allows manual setting of IDCell and Segment values
Subchannel group bitmask	Specifies which subchannel groups can be used to define DL-PUSC data bursts

Zone definition	
Enable bust analysis	Yes, no
Enable defined burst boosting levels	Yes/no; allows for using defined boosting level
Definition Source	Selects source defining map file used for decoding signal
Auto-detect (from decoded DLMAP)	Auto-configures the downlink subframe and uplink subframe zone definitions for the current downlink measurement based on the decoded FCH, DL-MAP, and UL-MAP messages of the downlink subframe
Zone index	Selects which zone described in the DLMAP will be analyzed
Save map file	Saves the auto-decoded map file to disk; downlink only
Map file	
Name	Select map file to use for decoding signal
Active zone	Select which zone to activate and display
Edit map file	Brings up map file editor which allows import, export of map file, or the ability to define downlink/ uplink zones, and bursts
Manual zone definition	Brings up detailed zone and burst editor to manually define map for signal decoding
Zone name	Enter zone name
Type	PUSC, FUSC, AMC, OFUSC
Use all subchannels	Checkbox to determines how the subchannels are allocated for the DL-PUSC zone analysis (DL only)
Dedicated pilots	Specifies whether the pilots are associated with each data burst, or whether common pilots are used by all data bursts (Downlink zone only)
STC setup	Determine STC parameters
Mode	None, two antenna, three antenna, four antenna
Matrix	A, B, C

Zone definition continued	
PrbsID	0, 1, 2 (downlink only)
Override IDCell with PermBase	Specifies that Permbase is to be used for IDCell value
Offset	Specifies the symbol offset within the measurement frame the data analysis region begins relative to the start of the subframe
Length	Defines maximum data analysis region for the measurement zone specified in symbols
Burst definition	
Bursts in selected zone	Names of bursts in zone, along with ability to create new burst, delete existing burst, and activate/deactivate existing burst
New burst definition	
Selected Burst	Name of selected burst, and active yes/no
Definition type	Normal, FCH, DLMap
Allocation geometry	Shape of selected burst: rectangular, wrapped
Symbol	Size/location of burst in symbols, listing # of symbols offset, and interval length
Subchannel	Size/location of burst in subchannels, listing # of subchannels offset, and interval length
Data tone modulation	QPSK, 16 QAM, 64 QAM
Boosting level	Ratio of the RMS/subcarrier power level of the active preamble subcarriers compared to the RMS/subcarrier power level of the active data subcarriers in the analysis zone; 9 to -12 dB in 3 dB steps
STC/MIMO setup	
Measure input channel	Select channel 1, 2
Matrix decoder	Enable, select matrix stream to measure: stream 1/2
Transmit antenna pilot pattern override	Enables override to sync to transmit antenna 0/1/2/3
Cyclic delay diversity (CDD)	Applies "Cyclic-Delay Diversity" (CDD) measurement analysis
Include inactive antenna paths on MIMO traces	Yes, no; includes inactive antenna paths into the STC/MIMO OFDMA analysis
Normalize each MIMO path in frequency response	Yes, no; selects normalized or non-normalized MIMO channel frequency response trace data
Time Setup	
Acquisition length	Signal capture length in terms of contiguous OFDMA frames; used by the analyzer for demodulation and signal analysis
Analysis offset	Number of frames that are offset from the start of the data acquisition
Pulse search	Allows the analyzer to demodulate 802.16 OFDMA signals that do not exhibit RF Burst characteristics
Override measurement region (demodulation)	Allows manual specification of "zoomed" measurement analysis region, and also allows change or addition of additional time domain data to the Time trace and computed trace results; set offset, interval
Measurement region (non-demod)	Allows selection of pre-defined region of the time record to include in the Time trace and therefore also defines what Time domain data is used to compute the Spectrum and CCDF/PDF/CDF traces; demodulation, frame, zone, preamble
Include transition regions	Yes, no; adds additional time domain data before and after the pre-demod data region in the Time trace
Advanced setup	
Enable additional demodulator settings	Yes, no; enables/disable most advanced demodulator settings
Restrict bandwidth to standard values	Yes, no
Data tone modulation	Enable/disable data tone modulation autodetect (use burst definitions)
Pilot tracking	Select from any/all of 3 channel estimation and error correction modes; Track Amplitude, Track Phase, and Track Timing

Advanced setup continued	
Compensation	
Compensate IQ mismatch	Allows removal of IQ impairments
Mirror frequency spectrum	Allows correct demodulation of frequency spectrums that are mirrored (flipped) about the center frequency
Enable multicarrier filter	Specifies whether to apply a filter to received signal to filter out adjacent carriers
Symbol time adjustment	Allows adjustment of the “useful symbol time period” (TFFT) within the “OFDMA extended symbol time period” (TS)
Display options	
Burst power is per-subcarrier	Selected, data burst power results computed as per-subcarrier power metric; cleared, data burst power results computed as total power over measurement interval
Compensate modulation PRBS (de-rotate)	Allows removal of the the modulation PRBS from the OFDM IQ traces
Normalize IQ traces	If selected, IQ trace data results (including IQ Meas, IQ Ref, Error Vector Time and Error Vector Spectrum) are normalized
Decoding	
DL-MAP decoding	Decodes DL-MAP messages of the downlink subframe and reports the interpreted results
UL-MAP decoding	Decodes UL-MAP messages of the downlink subframe when a UL-MAP exists and reports the interpreted results
Decode to map	Provides option to not replace the analyzer measurement state, which is saved to the setup file with current measurement auto-decoded Map File; downlink only
Equalizer training	
Preamble only	Equalizer trained using the channel estimation sequence in the preamble of the OFDMA burst; down-link only
Preamble, pilots, and data	Equalizer trained by analyzing entire OFDMA burst, including the channel estimation sequence (contained in the preamble), the data symbols, and pilot symbol; downlink only
Preamble and pilots	Equalizer trained by analyzing entire OFDMA burst, including the channel estimation sequence (contained in the preamble) and pilot symbols; downlink only
Enable equalizer smoothing filter	Applies filter to channel estimation frequency response
Burst profiles	
Downlink burst profiles	Provides a set of values for DIUC Index = 0 thru 12 , specifying a value for the burst profile used (modulation type, coding type and coding rate)
Uplink burst profiles	Provides a set of values for UIUC Index = 1 thru 10, specifying a value for the burst profile used (modulation type, coding type and coding rate)

Fixed WiMAX

Measurement conditions	
Signal acquisition	**Not all supported hardware is compatible with all bandwidths.**
Supported standards	IEEE 802.16-2004 (Fixed WiMAX)
Supported modes	Uplink and downlink; continuous and burst; TDD, FDD, H-FDD
Modulation formats	BPSK (pilots only), QPSK, 16QAM, 64QAM (auto detect, manual input)
Span	Constrained to within approximately 10x signal bandwidth
Adjustable setup parameters	
Format parameters	
Preset to standard	1.25 MHz, 1.5 MHz, 1.75 MHz, 2.5 MHz, 3 MHz, 3.5 MHz, 5 MHz, 5.5 MHz, 6 MHz, 7 MHz, 10 MHz, 11 MHz, 12 MHz, 14 MHz, 15 MHz, 20 MHz, 24 MHz, 28 MHz
Bandwidth	Settable, nominal per standard
Manual Fs/BW ratio	Settable to 8/7, 57/50, 86/75, 144/1 25, 316/275, or arbitrary between 0.5 and 2.0
Data subcarrier modulation format	Automatic, from FCH, or Manual: BPSK, QPSK, 16 QAM, 64 QAM
Guard Interval	Settable, 1/32, 1/16, 1/8, 1/4, or other value between 0 and 1
Time parameters	
Search length	Adjustable, limits may depend on input hardware
Result length	Auto-detected, from FCH, or manually adjustable
Measurement offset	Settable between 0 and (result length - measurement interval)
Measurement interval	Settable between 0 and result length
Advanced setup parameters	
Normalize IQ traces	Turns normalization on or off; on means each subcarrier is normalized so that the RMS level of the ideal constellation is one
Mirror frequency spectrum	Specifies whether to do frequency inversion before attempting to synchronize to and demodulate the signal
Subchannel index	1 to 31 (for uplink signal analysis)
Symbol timing	Adjustable from –(guard interval)/100 to 0
Sub carrier selection	Selectable all; or single sub carrier # –100 to +100 (0 not allowed); or pilot sub carriers only
Pilot sub carrier tracking	Amplitude, phase, timing
Equalizer training	Via channel estimation sequence in preamble; or estimation sequence plus data
OFDM 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
Equalizer channel frequency response	One point per sub carrier; frequency response shown dependent on equalizer training value selected; also instantaneous trace available
Equalizer channel frequency response differential	Shows the adjacent subcarrier power difference in dB
Common pilot error	Shows the difference between the measured and ideal pilot subcarrier symbols; one point analyzed per OFDM symbol
Correction	Frequency domain correction applied to raw measured time data
Equalizer impulse response	Impulse response of the equalization filter; impulse response result length = 4 x FFT length
Error vector spectrum	EVM at one point per sub carrier per analyzed OFDM symbol time

OFDM trace results continued	
Error vector time	EVM at one point per sub carrier per analyzed OFDM symbol time
Instantaneous spectrum	Frequency spectrum of the time trace, without averaging
IQ measured data	IQ data; one point per sub carrier per analyzed OFDM symbol time; all modulation formats shown
IQ reference data	IQ data used as ideal; one point per sub carrier per analyzed OFDM symbol time; all modulation formats shown
Marker data	Detailed OBW or ACP tables
PDF	Probability density function of time trace
Preamble frequency error	Frequency error vs. time, during the preamble (including during all the long preamble)
Raw main time	Block data acquired by hardware, including extra data for filter settling
RMS averaged error vector spectrum	RMS averaged EVM; one point per sub carrier
RMS averaged error vector time	EVM time; one point per OFDM symbol analyzed
Search time	Block data acquired and searched for an RF burst
Spectrum	Frequency spectrum of time trace, or averaged time if averaging on
Subframe information	Summarizes entire subframe data and power characteristics, including: modulation types used, their relative power, number of symbols and RCE for each one, preamble type, header checksum validation, frame number, and configuration change bit value
Symbols/error	Error summary with raw OFDM detected symbols
CPE RMS	RMS level of (CPE-1), where CPE is the complex correction value detected during pilot tracking
RCE (Relative Constellation Error) (EVM)	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 RCE	RMS EVM level for pilot sub carriers, averaged over all analyzed OFDM symbols
Symbol clock error	Timing error, ppm
Sync correlation	Correlation coefficient between measured and ideal preamble
Time	Block data detected by pulse search

Key Specifications[1]

This technical overview provides nominal performance specifications for the software when making measurements with the specified platform. Nominal values indicate expected performance, or describe product performance that is useful in the application of the product, but is not covered by the product warranty. For a complete list of specifications refer to the measurement platform literature.

Mobile WiMAX

X-Series signal analyzers

		PXA	MXA Includes Option BBA as noted	EXA Includes Option B25 as noted
Measurement conditions				
Range		Input range within one input attenuator step (2 dB) of total signal power	Input range ≥ –30 dBm, within 2 dB of full scale	Input range ≥ –30 dBm, within 2 dB of full scale
FFT size		128, 512, 1024, 2048	128, 512, 1024, 2048	128, 512, 1024, 2048
Bandwidth		1.25 MHz, 3.5 MHz, 4.375 MHz, 5 MHz, 7 MHz, 8.75 MHz, 10 MHz, 14 MHz[2], 15 MHz[2], 17.5 MHz[2], 20 MHz[2], 28 MHz[3]	1.25 MHz, 3.5 MHz, 4.375 MHz, 5 MHz, 7 MHz, 8.75 MHz, 10 MHz, 15 MHz[2], 17.5 MHz[2], 20 MHz[2]	1.25 MHz, 3.5 MHz, 4.375 MHz, 5 MHz, 7 MHz, 8.75 MHz, 10 MHz, 15 MHz[2], 17.5 MHz[2], 20 MHz[2]
Signal playback				
Result Length		15 frames, 5 msec frame length and span = 10 MHz		
Capture Length (Gap-free analysis)		21.4 s (10 MHz span)	80 msec (17.5 MHz span)[2]	80 msec (17.5 MHz span)[2]
		11.9s (17.5 MHz span) with Opt. B25	260 msec (10 MHz span) with Opt. BBA (BBIQ only): 11.8 sec (17.5 MHz span) 5 sec (80 MHz span-requires Opt. S40, BBA)	260 msec (10 MHz span)
Accuracy[2, 3, 4, 5]				
Center frequency		2.7 GHz, 3.5 GHz	2.7 GHz, 3.5 GHz	2.7 GHz, 3.5 GHz
Residual EVM		20 averages; RCE and Data RCE; Range = –10 dBm	20 averages; RCE and Data RCE	20 averages; RCE and Data RCE;
Downlink				
Signal BW	Zone			
5 MHz	PUSC, FUSC	–51 dB	≤ –46 dB (≤ 50 dB)[6]	≤ –44 dB
10 MHz	PUSC, FUSC	–50 dB	≤ –45 dB (≤ 48 dB)[6]	≤ –43 dB
20 MHz	PUSC, FUSC	–49 dB	≤ –44 dB (≤ 45 dB)[6]	≤ –42 dB
Uplink		With equalizer = chan est seq and pilots or equalizer = chan est seq and data. Span = BW. Uniform analysis or burst analysis with > 25 % subchannels occupied.		
Signal BW	Zone			
5 MHz	PUSC	–51 dB	≤ –45 dB (≤ –50 dB)[6]	≤ –42 dB (–40 db for freq > 3.0 GHz)
	OPUSC	–50 dB	≤ –44 dB (≤ –50 dB)[6]	≤ –42 dB (–40 db for freq > 3.0 GHz)
10 MHz	PUSC	–50 dB	≤ –44 dB (≤ –48 dB)[6]	≤ –42 dB (–40 db for freq > 3.0 GHz)
	OPUSC	–49 dB	≤ –43 dB (≤ –48 dB)[6]	≤ –42 dB (–40 db for freq > 3.0 GHz)
20 MHz	PUSC	–49 dB	≤ –43 dB (≤ –45 dB)[6]	≤ –42 dB (–40 db for freq > 3.0 GHz)
	OPUSC	–48 dB	≤ –42 dB (≤ –45 dB)[6]	≤ –42 dB (–40 db for freq > 3.0 GHz)

1. Data subject to change.
2. Option B25 required for spans > 10 MHz and < 25 MHz.
3. Option B40 required for spans > 25 MHz.
4. Using < 20 kHz phase optimization mode.
5. RCE/Data RCE/Unmodulated RCE computer per IEEE 802.16e 8.4.12.3.1 (for DL), IEEE 802.16e 8.4.12.3.2 (for UL).
6. Results apply to MXA with Option BBA.

Frequency error (relative to frequency standard)			
Lock range	Lock range depends on zone type, BW, BW Ratio, and FFT Size		
UL-PUSC, UL-OPUSC	± 1.45 x Subcarrier spacing[1,2] = ± 16 kHz, BW = 10 MHz		
DL-PUSC, DL-FUSC, DL/UL AMC	± 4.35 x Subcarrier spacing[1] = ± 48 kHz, BW = 10 MHz		
Accuracy			
Uniform analysis or burst analysis with > 25% subchannels occupied	± 0.5 ppm (relative to signal bandwidth)	± 0.5 ppm (relative to signal bandwidth)	± 0.5 ppm (relative to signal bandwidth)

1. Subcarrier spacing = (BW * BW Ratio)/FFT Size.
2. Reduced to ± 0.5 x subcarrier spacing if any data bursts use Collaborative Spatial Multiplexing.

2-Channel MIMO

	MXA[1]	EXA[1]
Accuracy measurement conditions		
Center frequency	2.5 GHz, –10 dBm range	
Residual EVM conditions	Data RCE, 10 symbol DL-PUSC zone with 2-antenna STC/MIMO; Span = BW = 10 MHz; Default parameters; Matrix decoder enabled or disabled; 100% subchannels occupied with 64 QAM data; Single Matrix A or Matrix B burst; 10 averages	
Configuration	Dual slaved	

Measurements performed on zone #2 and zone #3. Zone #1 and the preamble were transmitted by Antenna 0, while zone #2 and zone #3 were transmitted by both Antenna 0 and Antenna 1

Preamble	FCH DL-MAP/UL-MAP	DL-MAP/UL-MAP (continued)	DL-MAP/UL-MAP (continued)	Burst #1 (Matrix A)	Burst #2 (Matrix B)
Zone #1 (6 symbols)				Zone #2 (10 symbols)	Zone #3 (10 symbols)

	MXA[1]	EXA[1]
Accuracy		
Residual data RCE	< –45 dB	< –42 dB
Ant-1 time offset deviation[2,3]	± < 15 ns	± < 15 ns
Ant-1 phase offset deviation[2,3]	N/A	N/A
Ant-1 freq offset deviation[2]	± < 1 Hz	± < 1 Hz
Pilot subcarrier power deviation[2]	± < 0.1 dB	± < 0.1 dB
Data subcarrier power deviation[2]	± < 0.05 dB	± < 0.05 dB
Frequency error (relative to frequency standard)		
Lock range	± 4.35 x subcarrier spacing = ± 48 kHz @ BW = 10 MHz	
Accuracy	± 0.5 ppm (relative to signal BW)	

1. MXA and EXA are in dual slaved configuration.
2. Deviation metrics are nominal variation observed for above configuration with 10 acquisitions per averaged measurement.
3. MXA and EXA 2-channel RF configuration has channel 2 to channel 1 delay jitter of ± < 60 ns on acquisition-by-acquisition basis.

2-Channel MIMO

	90000 Series Infiniium oscilloscopes[1]
Accuracy measurement conditions	
Center frequency	2.5 GHz, –10 dBm range
Residual EVM conditions	Data RCE, 10 symbol DL-PUSC zone with 2-antenna STC/MIMO; Span = BW = 10 MHz; Default parameters; Matrix decoder enabled or disabled; 100 % subchannels occupied with 64 QAM data; Single Matrix A or Matrix B burst; 10 averages
Configuration	2 channel
Measurements performed on zone #2 and zone #3. Zone #1 and the preamble were transmitted by Antenna 0, while zone #2 and zone #3 were transmitted by both Antenna 0 and Antenna 1	

Pre-amble	FCH DL-MAP/ UL-MAP	DL-MAP/ UL-MAP (continued)	DL-MAP/ UL-MAP (continued)	Burst #1 (Matrix A)	Burst #2 (Matrix B)
Zone #1 (6 symbols)				Zone #2 (10 symbols)	Zone #3 (10 symbols)

Accuracy	
Residual data RCE	< –37 dB
Ant-1 time offset deviation[2]	± < 50 ps
Ant-1 phase offset deviation[2]	N/A
Ant-1 freq offset deviation[2]	± < 2 Hz
Pilot subcarrier power deviation[2]	± < 0.05 dB
Data subcarrier power deviation[2]	± < 0.05 dB
Frequency error (relative to frequency standard)	
Lock range	± 4.35 x subcarrier spacing = ± 48 kHz @ BW = 10 MHz
Accuracy	± 0.5 ppm (relative to signal BW)

1. For a list of supported scopes, see Infiniium Oscilloscopes with 89600B VSA, Literature part number 5990-6819EN.
2. Deviation metrics are nominal variation observed for above configuration with 10 acquisitions per averaged measurement.

Keep your 89600B VSA up-to-date

With rapidly evolving standards and continuous advancements in signal analysis, the 89601BU/BNU software update and subscription service offers you the advantage of immediate access to the latest features and enhancements available for the 89600B VSA software. www.keysight.com/find/89600B

Mobile WiMAX

X-Series signal analyzers

	PXA		MXA Includes Option BBA, B25 as noted		EXA Includes Option B25 as noted	
Center frequency	2.7 GHz, 3.5 GHz, 5.8 GHz		2.7 GHz, 3.5 GHz, 5.8 GHz		2.7 GHz, 3.5 GHz, 5.8 GHz	
Signal playback						
Result Length	15 frames, 5 msec frame length and span = 10 MHz		BW = span 7 MHz 10 MHz 20 MHz[2]	Result length 1105 symbol times 1594 symbol times 1745 symbol times	BW = span 7 MHz 10 MHz 20 MHz[2]	Result length 1105 symbol times 1594 symbol times 1745 symbol times
Capture length (Gap free analysis at 0 % overlap)	Span 12.5 MHz 18 MHz 36 MHz	Max length 16.7 s 11.6 s 5.8 s	Span 7 MHz, 10 MHz > 20 MHz[2] 50 MHz[3]	Max length 266 msec 88 msec 8.2 sec	Span 7 MHz, 10 MHz 20 MHz[2]	Max length 266 msec 88 msec
Accuracy						
Residual EVM	20 averages; input range within 2 dB of full scale. Range ≥ –20 dBm.		20 averages; input range within 2 dB of full scale; using > 30 kHz phase noise optimization mode			
Equalizer training = chan est. seq. and data	Signal band-width 20 MHz 7 MHz	EVM ≤ –48 dB ≤ –49 dB	Signal band-width 20 MHz[2] 7 MHz	EVM ≤ –45 dB[4] ≤ –48 dB[4, 5]	Signal band-width 20 MHz[2] 7 MHz	EVM ≤ –45 dB ≤ –48 dB
Equalizer training = chan est. seq. and data	Signal band-width	EVM	Signal band-width	EVM	Signal band-width	EVM
	20 MHz 7 MHz	≤ –46 dB ≤ –47 dB	20 MHz[2] 7 MHz	≤ –45 dB (≤ –42 dB)[4] ≤ –47 dB[6] (≤ –45 dB)[4]	20 MHz[2] 7 MHz	≤ –45 dB ≤ –47 dB
Frequency error						
Lock range	Signal band-width	EVM	Signal band-width	EVM	Signal band-width	EVM
	20 MHz 7 MHz	± 135 kHz ± 47.25 kHz	20 MHz[2] 7 MHz	± 135 kHz ± 47.25 kHz	10 MHz 7 MHz	± 67.5 kHz ± 47.25 kHz
Frequency accuracy	± 10 Hz		± 10 Hz		± 10 Hz	

1. Data subject to change
2. Span > 10 MHz requires Option B25.
3. With Opt. BBA and Opt. B25 or S40 (BBIQ only)
4. Results apply to MXA with Option BBA.
5. Degraded by up to 3 dB for 3.0 GHz < frequency < 3.6 GHz.
6. Degraded by up to 4 dB for 3.0 GHz < frequency < 3.6 GHz.

Additional Resources

Literature

89600B Vector Signal Analysis Software, Brochure, literature number 5990-6553EN

89600B Vector Signal Analysis Software, Configuration Guide, literature number 5990-6386EN

89600B Opt 200 Basic VSA and Opt 300 Hardware Connectivity, Technical Overview, literature number 5990-6405EN

Keysight 89600A and 89600B Vector Signal Analysis Software for Wave 2 Mobile WiMAX™ Measurements, Demonstration Guide, literature number 5989-7484EN

Mobile WiMAX™ PHY Layer (RF) Operation and Measurement, Application Note, literature number 5989-8309EN

Keysight WiMAX ™Signal Analysis, Part 3: Troubleshooting Symbols and Improving Demodulation, Application Note, literature number 5989-3039EN

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