Agilent
89601A Vector Signal Analysis Software for WiMAX – Option B7S

Technical Overview

First WiMAX Signal Analysis Tool

Market Leading WiMAX Signal Analysis

Agilent is the industry leader in baseband, RF, and modulation quality measurements for IEEE-802.16-2004 (WiMAX) signals. Whether your measurements are on baseband, IF or RF signals, or even simulated signals from ADS design simulations, the 89601A VSA software with Option B7S has the tools you need to troubleshoot your WiMAX designs today.

Figure 1. Familiar and new tools combine to provide invaluable troubleshooting information. Here the 6 displays simultaneously show (l to r) I-Q constellation, time, CCDF, spectrum, modulation error summary, and error vector vs. time.
Comprehensive Coverage

Analyzing OFDM signals requires developers like you to think in the time and frequency domains simultaneously. You need OFDM-specific signal analysis tools to help you manipulate and break down the signal in order to effectively troubleshoot the situation. The 89601A WiMAX vector signal analysis software helps you do this quickly and efficiently.

First, the new 89601A-B7S beta software provides comprehensive coverage of the IEEE-802.16-2004 standard:
- All 802.16-2004 modulation formats, including BPSK, QPSK, 16QAM, 64QAM
- TDD, FDD, and H-FDD
- Uplink and downlink
- Bursted and continuous*
- All frame lengths, guard intervals, and sampling factors
- Demodulation down to the raw bit level

Second, the software allows you to set up and adjust the demodulator for the best analysis of your signal:
- Automatically detect the signal modulation type on sub-carriers. You can also manually override the auto-detect feature for specific troubleshooting needs.
- Manually adjust the nominal signal bandwidth, guard interval, and sampling factor (Fs/BW ratio). Standard guard interval and sampling factors are provided.
- Adjust carrier pilot tracking to track amplitude, phase, or timing and identify errors that automatic pilot tracking can hide. These errors can cause you to inadvertently lower design margins.
- **Verify your signal setup using the burst information provided — a text table conveniently shows burst power, modulation format, burst symbol length, and EVM.**

*Features in italics not yet implemented in beta release.

Figure 2. Setting up the 802.16 demodulator is as easy as presetting to the Standard, or as sophisticated as manually entering the guard interval, Fs/BW ratio, and more.
The software also provides a wide range of error analysis measurements and displays.

These include traditional spectrum analysis measurements such as:
- Band power
- Carrier-to-noise
- Peak-to-average power (CCDF)
- Amplitude
- Group delay

**OFDM and WiMAX Specific Measurements**

New measurements specifically for OFDM and more specifically for WiMAX signals include:
- Relative constellation error (RCE) in % or dB
- RCE vs. symbol number
- RCE vs. subcarrier number
- Equalizer frequency and *impulse response* *
- Error vector spectrum/time, including RMS error vector
- Quadrature skew, gain imbalance, I-Q offset
- Frequency error
- Symbol clock error
- Common Pilot Error (CPE)

![Figure 3. The modulation error analysis screen provides a wealth of information. Note that the RCE is provided in dB and %. The lower half of the display provides demodulated (encoded) bits. The pilot tones are shown in lighter colors. The error summary table also includes RCE for the pilot tones alone.](image-url)

*Features in italics not yet implemented in beta release.*
In addition, these tools let you analyze your signal selectively by time or frequency for troubleshooting and uncovering problems that you’ve never been able to see before.

For instance:

- With demodulation off, use time gating markers to analyze the desired portions of the time trace or spectrum of the signal, e.g., the short training signal, signal estimation sequences, signal symbol, etc. You can apply many other measurements to the time gated area. This is especially useful when making measurements like peak to average power, when you may want to measure only the data portion of the burst, since including the timing and estimation sequences can bias the value lower.
- Focus your modulation analysis to a subset of the symbols, i.e., time-selective analysis.
- Focus your modulation analysis on just a single carrier, i.e., frequency-selective analysis. By viewing the constellation for just one carrier, you can determine if an interferer is internally generated or coming from outside the system.

![802.16 OFDM Demodulation Properties](image)

Figure 4. Control the portion of the burst that the analyzer demodulates using the time tab.
Figure 5. Advanced demodulation setup lets you select a single subcarrier, pilots only, or all subcarriers, adjust the symbol timing, and more.

All standard 89601A VSA software measurements are available to you, including time capture with playback and overlap processing, sophisticated measurement displays with an easy-to-use Windows® user interface, and 2000+ equivalent pages of help text. See the 89600 brochure and data sheet for more information.

This software is available only via the 89600 WiMAX beta software program at this time. Contact your local Agilent sales representative for terms and requirements. Purchase of final software required for continued use of features.
General Specifications

OFDM modulation analysis (software only, typical specifications)
Please note, italicized items are not implemented in the beta version.

Signal acquisition
Supported standards IEEE 802.16-2004;
Supported modes Uplink and downlink; continuous and burst; TDD, FDD, H-FDD
Modulation formats BPSK, QPSK, 16QAM, 64QAM (auto detect, manual input)
(during beta only: or read from FCH symbol at start of downlink subframe)

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
Subcarrier selection Selectable all; or one of subcarrier # -100 to +100 (0 not allowed); or pilot subcarriers 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 subcarrier 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 subcarrier; frequency response shown dependent on
equalizer training value selected
Equalizer impulse response Result length = 4 x FFT length
Error vector spectrum One point per subcarrier per analyzed OFDM symbol time
Error vector time One point per subcarrier per analyzed OFDM symbol time;
all modulation formats shown
IQ measured data One point per subcarrier per analyzed OFDM symbol time;
all modulation formats shown
IQ reference data One point per subcarrier 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 subcarrier
RMS averaged error vector time One point per OFDM symbol analyzed
Symbols/error Error summary with raw OFDM detected symbols
Tx2 Eq Chan Freq Resp If space-time coded (STC) preamble detected, equalizer channel
frequency response for the second transmit antenna
Tx2 Eq Imp Resp If STC preamble detected, equalizer impulse response for the second
transmit antenna

*Features in italics not yet implemented in beta release.
General Specifications, Continued

### Additional trace results

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

### Error information/results

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPE RMS</td>
<td>RMS level of (CPE-1), where CPE is the complex correction value detected during pilot tracking</td>
</tr>
<tr>
<td>RCE RMS</td>
<td>RMS level of the relative constellation error vector, % or dB</td>
</tr>
<tr>
<td>RCE peak</td>
<td>Peak level of the relative constellation error vector, % or dB</td>
</tr>
<tr>
<td>RCE peak symbol</td>
<td>OFDM symbol number where RCE peak was detected</td>
</tr>
<tr>
<td>Frequency error</td>
<td>Averaged measured carrier frequency minus analyzer center frequency</td>
</tr>
<tr>
<td>IQ gain imbalance</td>
<td>Ratio of I (in-phase) to Q (quadrature phase), dB</td>
</tr>
<tr>
<td>IQ offset</td>
<td>Carrier leakage measured during channel estimation sequence portion of preamble, dB</td>
</tr>
<tr>
<td>IQ quadrature error</td>
<td>Quadrature skew, degrees</td>
</tr>
<tr>
<td>Pilot EVM</td>
<td>RMS EVM level for pilot subcarriers, averaged over all analyzed OFDM symbols</td>
</tr>
<tr>
<td>Preamble type</td>
<td>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</td>
</tr>
<tr>
<td>Symbol clock error</td>
<td>Timing error, ppm</td>
</tr>
<tr>
<td>Sync correlation</td>
<td>Correlation coefficient between measured and ideal preamble</td>
</tr>
</tbody>
</table>

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Printed in USA, August 26, 2004
5989-1607EN