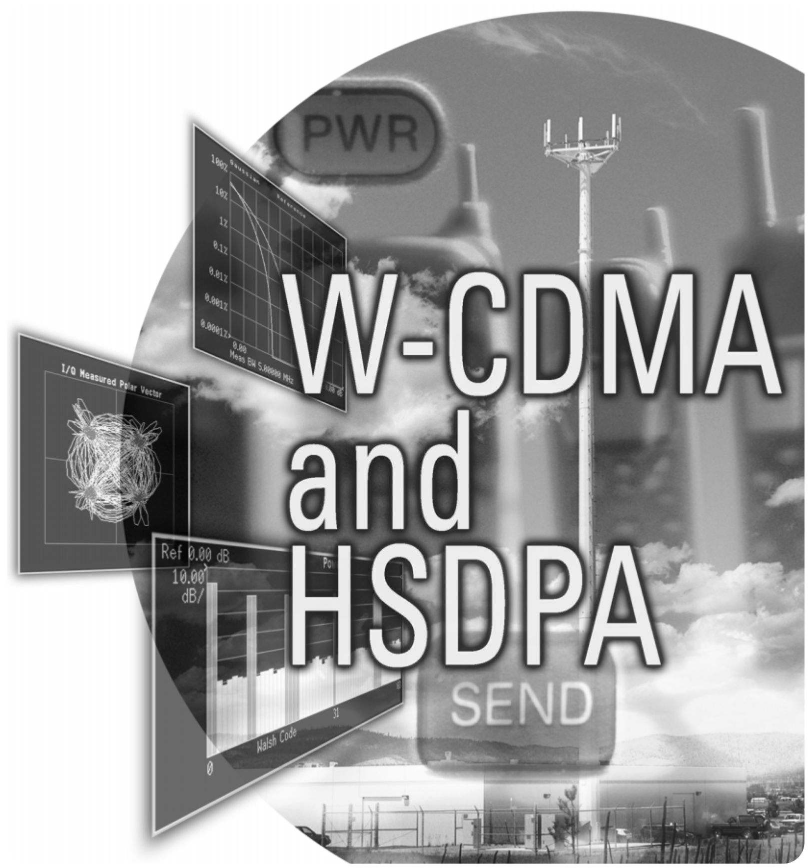
Agilent
89601A Vector Signal Analysis Software for W-CDMA and HSDPA Evaluation and Troubleshooting

Technical Overview with Self-Guided Demonstration

Measure, evaluate, and troubleshoot Wideband Code Domain Multiple Access (W-CDMA) and High Speed Downlink Packet Access (HSDPA) compatible signals with the 89601A Vector Signal Analysis (VSA) software and its 3G modulation analysis Option B7N.

This software works with a variety of measurement hardware including Agilent spectrum analyzers, Infiniium scopes, and the 89600 VXI systems.



Agilent Technologies

Robust Analysis Tools and Unusual Flexibility

The 89601A Vector Signal Analysis software is one of the most advanced signal analysis packages on the market today. It combines a robust set of analysis tools with unusual flexibility for applying and teaming these tools. Use this robustness and flexibility to

- test your signal to its standard
- troubleshoot problems when your signal fails to meet its standard

Use the 89601A software to

- analyze signals as wide as 6 GHz bandwidth (requires Infiniium scope)
- record signals and play them back to extend analysis capabilities
- demodulate standards-based signals ranging from NADC, to W-CDMA, to 802.11g WLAN
- demodulate signals based on less common or even proprietary standards
- troubleshoot digitally modulated signal problems, isolate symbol clock errors, identify filtering problems, and more
- use analog demodulation to
  - demodulate and analyze AM, FM, and PM modulated signals
  - analyze settling problems in oscillators and PLLs
  - locate unintentional modulation
- work in multiple domains and formats
- access a full set of markers to find peaks, measure frequency, phase, amplitude, offsets, simplify channel-power measurements, perform gated measurements, and more
- work with a wide selection of measurement hardware
  - high dynamic range VXI bundles
  - spectrum analyzers offering high dynamic range and up to 50 GHz frequency range
  - scopes with up to 6 GHz analysis bandwidth
- integrate analysis with the Agilent EEsof Advanced Design System (ADS)
  - analyze design simulations
  - analyze product/component performance
  - yield performance data for CAD substitution
  - produce data for further analysis/reporting

Excellent W-CDMA/HSDPA analysis tools

Option B7N adds W-CDMA and HSDPA demodulation capability to the 89601A VSA software.

These capabilities descramble, despread, and demodulate W-CDMA uplink and downlink signals. The analyzer automatically identifies all active channels regardless of the symbol rate or spread-code-length.

Signal analysis capabilities include composite code domain power, composite time, and channel specific analysis. Measurement results may be shown in several trace display formats as well as numeric error data formats. Flexible display scaling and marker functionality enhance these measurement capabilities.

The flexible software-based 89601A W-CDMA/HSDPA demodulator incorporates advanced technology that does not require coherent carrier signals or symbol-clock timing signals. It includes a built-in root raised-cosine filter, with user-definable alpha (defines roll-off factor for chip shaping.) Signal locking requires only the carrier frequency, chip rate, uplink/downlink direction, sync type (CPICH/SCH), and scramble code be input. The demodulator uses the measured signal, called I/Q Meas Time, to generate an ideal signal, called IQ Ref Time. The software uses these signals to provide comparison data, modulation quality data, results, and error summary data.

Measurement result data include: time and frequency domain trace data, code domain power data (composite or layer specific), code domain error data (composite or layer specific), channel data results, and overall error summary results.

If you have measurement hardware with two baseband channels, the 89601A VSA software provides IQ baseband measurement capability. You can also perform IQ baseband measurements on data from a file or the stream interface, i.e. ADS simulation.

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W-CDMA/HSDPA Modulation Analysis Features

These features are applicable to W-CDMA modulation analysis

- standard presets for
  - W-CDMA (3GPP) uplink (mobile station or user equipment)
  - W-CDMA (3GPP) downlink (mobile station)
- variable, user-definable chip rate (3.84 MHz standard preset)
- single layer and composite signal code-domain power (CDP) and code-domain error displays (the composite display shows all code layers simultaneously.) You can normalize code-domain power to display the CDP relative to the total signal power in the code domain
- composite and single channel time-domain displays such as constellation, trellis and eye diagrams, IQ magnitude/phase error, and error vector traces
- adjustable filter alpha (default 0.22)
- mirrored (flipped) frequency spectrums can be used to remove the effects of high-side mixing
- measurement offset and interval (similar to time gating) used to select specific data slots for analysis
- flexible active channel identification for CDP and composite results
- automatic identification of active code-channels, using auto or manually computed thresholds
- gated active channel identification to analyze signals with adaptive modulation coding (AMC)
- predefined 3GPP test models one through four
- averaging for pre-demodulated spectrum, code domain power, and code domain error trace data results

These additional W-CDMA features are applicable to HSDPA modulation

- automatic modulation scheme detection for HS-PDSCH channels using QPSK or 16QAM
- manual or automatic control of modulation scheme for despreading HS-PDSCH channels
- gated modulation detection to analyze signals with AMC
- predefined Test Model 5 options as defined in Section 6.1.1 of *3GPP TS.25.141 V5.7.0 (2003-06) Rel 5* technical specification

Demonstration Preparation

This demonstration uses the 89601A VSA software and a PC meeting the requirements shown in Tables 1a and b. No measurement hardware is required because the demonstration uses a pre-recorded signal recalled from a file.

PC requirement	Desktop	Laptop
CPU	180 MHz Pentium® or AMD-K6 (> 300 MHz recommended)	> 300 MHz Pentium or AMD-K6
Empty slots *(required only if using measurement hardware)*	1 PCI-bus slot (two recommended)	1 CardBus type II slot (two recommended)
RAM	192 MB (256 MB recommended)	192 MB (256 MB recommended)
Video RAM	4 MB (8 MB recommended)	4 MB (8 MB recommended)
Hard disk space	200 MB available	200 MB available
Operating system	Microsoft® Windows 2000® or XP Professional®	Microsoft Windows 2000 or XP Professional
Additional drive	CDROM or 3.5 inch floppy (if no network access available)	CDROM or 3.5 inch floppy (if no network access available)
Interface support *(required only if using measurement hardware)*	IEEE 1394-19951 (FireWire), LAN, or GPIB	IEEE 1394-19951 (FireWire), LAN, or GPIB

Table 1a. Demonstration PC and software requirements.

Software requirements	
Version	v5.20, or higher
Option	• –200: Basic vector signal analysis • –300: Hardware connectivity (required only if measurement hardware will be used) • –B7N: 3G modulation analysis

Table 1b. Demonstration PC and software requirements.

Setup Procedures

This procedure is intended to help users get started using the 89601A VSA software to evaluate W-CDMA/HSDPA signals. Detailed information and explanations of the signal and the operation of the software are available in the 89601A on-line **Help** located on the software's toolbar.

Recall the W-CDMA/HSDPA example signal

The 89601A VSA software includes a pre-recorded W-CDMA/HSDPA signal. Recall this recording as shown in Table 2.

The following pre-recorded W-CDMA signals are also provided in the default signal directory but are not used in this procedure

- 3GPPDown.sdf (W-CDMA downlink)
- 3GPPUp.sdf (W-CDMA uplink)

Setup the RF measurement parameters

Set the RF parameters, as shown in Table 3, to measure the pre-recorded W-CDMA/HSDPA signal.

Connecting the signal to the analyzer

No hardware is required to analyze the recorded signal used in this procedure.

The 89601A software can analyze RF and baseband (I/Q) signals. Refer to the 89601A on-line **Help** for information on HSDPA or W-CDMA hardware set-up. Refer to the *Ordering Information* at the end of this document for information on measurement hardware.

Center frequency

Center frequency does not need to be exact, only within ±500 Hz, because the VSA will make the final adjustments automatically.

For W-CDMA downlink with the SCH sync type, the center frequency may need to be within ±300 Hz of the carrier frequency.

Frequency span

When preparing to demodulate a signal, it is usually best to select a span that is slightly larger than the bandwidth of your signal. If you select a span that is too narrow, your measurement may have excessive errors or the software may lose carrier lock. Use a span set as follows

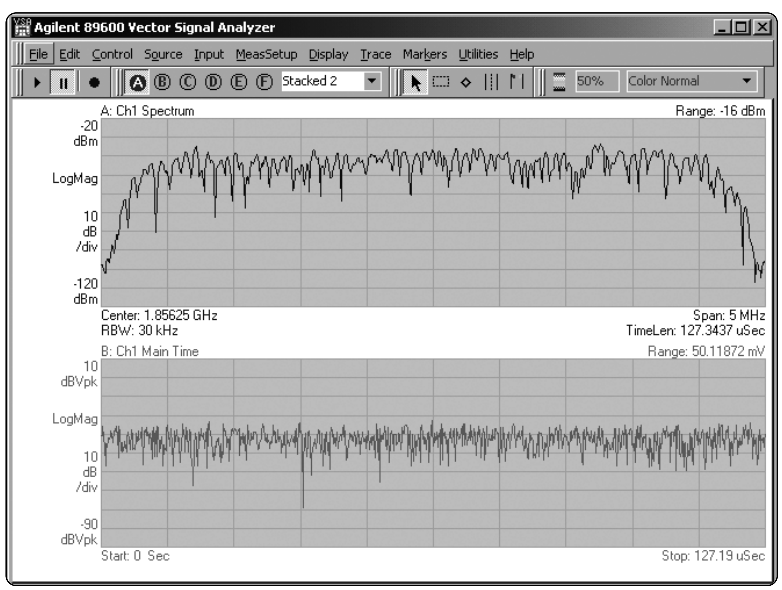
Frequency span ≥ chip rate x (1+filter alpha)

Instructions	Toolbar menus
Go to the default signal directory (c:\Program Files\Agilent\89600VSA\Help\Signals)	File > Recall > Recall Recording
Select the recording	3GPPTM5H8D30.sdf > Open
Start measurement	Click on "▶" *(toolbar, left side)*

Table 2. Signal recall instructions.

Instructions	Toolbar menus
Set center frequency and frequency span	MeasSetup > Frequency > Center *Enter: 1.85625 GHz* > Span *Enter: 5.0 MHz* > Close
Set input range	Input > Range > Range *Enter: –16 dBm* > Close
Auto scale trace A	Place cursor in trace A, right click the mouse > Y Auto Scale

Table 3. RF parameters setup.



For best results with W-CDMA/HSDPA signals, the frequency span should be set according to the following formula

Frequency span ≥ chip rate x 1.22

Input range

The input range must be set correctly to obtain accurate measurements. Input ranges that are too low overload the hardware front-end. Input ranges that are too high increase noise, which increases errors reported in error data results, such as error vector magnitude (EVM.) In general, set input range as low as possible without overload.

Setting the input range is not required on this prerecorded signal. The example sets the input range only to illustrate how to use the input range control.

Y Auto Scale

Clicking **Y Auto Scale** rescales and repositions the active trace to ensure that all points fall within the bounds of the trace display on the Y-axis. Unlike spectrum analyzers, the Y-axis scale is not tied directly to the input range. Changing the Y-axis scale does not change the input range attenuation of the measurement hardware.

Setup the demodulator

Select the W-CDMA/HSDPA demodulator as shown in Table 4.

You should always view the signal spectrum first to be sure that the signal is present, and that the center frequency, span, and input range are correct before selecting a demodulator.

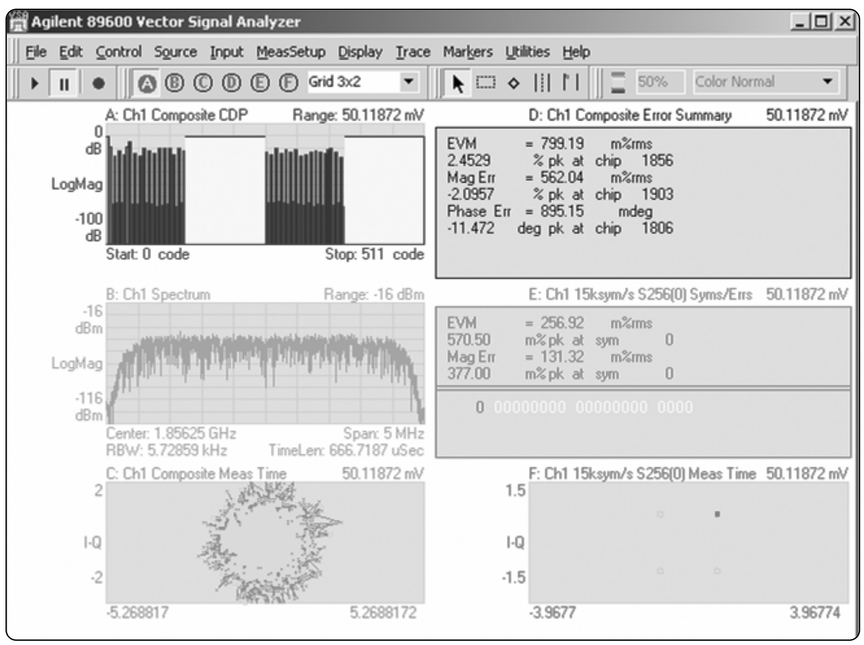
After selecting the demodulator, you need to set its parameters. The software will do this automatically if you select one of the available **Preset to Default** choices, or you can configure the demodulator manually using the **Demod Properties** menu.

By default, traces A, C, and D show displays of the composite signal. Trace B shows the signal's spectrum. Note that trace D shows the Composite Error Summary table. This table contains error information for your signal. Common error parameters, such as EVM and frequency error (Freq Err) provide quick indicators that show you the quality of your signal.

For details about 3GPP displays, see **About Trace Data** (W-CDMA) in the 89601A on-line **Help**.

Instructions	Toolbar menus
Select the demodulator	MeasSetup > Demodulator > 3G Cellular > W-CDMA(3GPP)/HSDPA
Preset demodulator parameters to Downlink and enable HSDPA analysis	MeasSetup > Demod Properties > Format *(tab)* > Preset to Default... > Downlink > Enable HSDPA analysis > Close
Add four traces to the display	Display > Layout > Grid 3x2
Start the measurement (the traces may take several seconds to fill/update)	Click on " ▶"

Table 4. Demodulation setup.



Composite Measurements

A composite measurement is a measurement made on all channels at once. These measurements include: composite code domain power (CDP), composite code domain error (CDE), as well as time domain measurements such as rho, EVM, EVM spectrum, and EVM time. These measurements are useful for evaluating the overall in-band performance of the W-CDMA/HSDPA signal.

Composite vector diagram and error summary table

The steps shown in Table 5 set up the composite constellation and Composite Error Summary table. *(These steps are provided for instruction purposes. The same information is already available in traces C and D of the previous step.)*

Trace A: Composite measurement time (constellation display)
This constellation is quite noisy but is characteristic of the composite W-CDMA/HSDPA signal. Seeing this shape provides an indication the demodulator is setup properly.

Trace B: Composite error summary
The composite error summary display shows you the following measurement results for the composite signal.

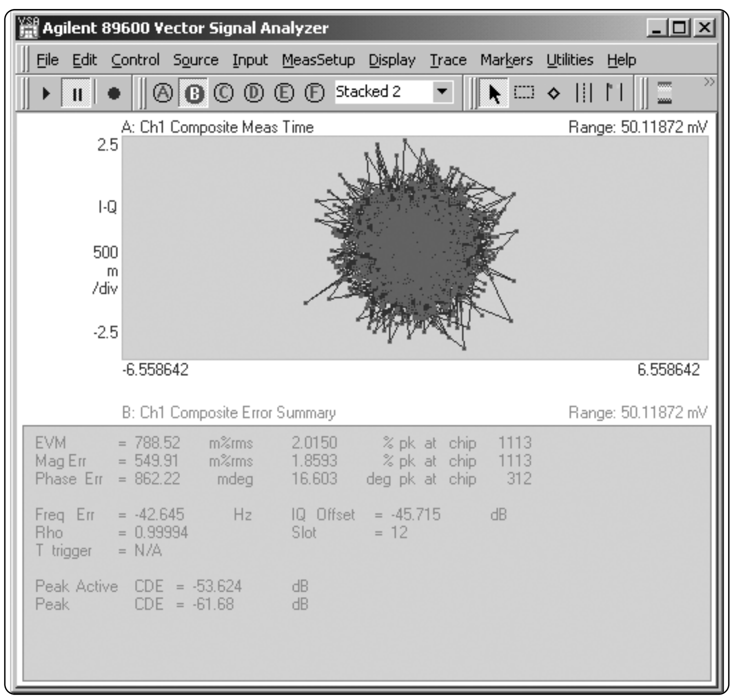
Composite EVM (EVM) is the error vector magnitude for the composite signal, including all spread code lengths and code channels. The table shows RMS percentage EVM, the peak (largest) percentage EVM, and the chip number with the peak percentage EVM. This parameter is computed at the chip rate.

Composite magnitude error (Mag Err) is the difference in amplitude between the I/Q measured signal and the I/Q reference signal for the composite signal.

The display shows these magnitude error values: the RMS percentage magnitude error, the peak percentage magnitude error, and the chip number with the peak percentage magnitude error.

Instructions	Toolbar menus
Set the display to a stack of two traces	Display > Layout > Stacked 2
Change trace A to show composite IQ time (vector diagram)	Double click on trace A's title *(upper left corner of trace)* > Channel 1[1] Comp > IQ Meas Time > OK
Auto-scale trace A	Right click on trace A > Y Auto Scale
Change trace B to show the composite error summary table	Double click on trace B's title *(upper left corner of trace)* > Channel1[1] Comp > Error Summary > OK

Table 5. Composite constellation and composite error summary setup.



1. *Channel 1* refers to the measurement channel not to any channel contained in the signal

Composite phase error (Phase Err) is the difference, in phase, between the I/Q reference signal and the I/Q measured signal for composite signal, including all spread code lengths and code channels.

The display shows these phase error values (in degrees): the RMS phase error, the peak phase error, and the chip number with the peak phase error.

Composite IQ offset, also called I/Q origin offset, indicates the magnitude of the carrier feed-through signal. When there is no carrier feed-through, IQ offset is zero (infinity dB). See *EVM time and EVM spectrum* in this section for a second measure of carrier leakage.

Composite frequency error (Freq Err) shows the composite signal carrier frequency error relative to the analyzer's center frequency. This parameter is displayed in Hertz and is the amount of frequency shift, from the analyzer's center frequency, that the analyzer must perform to achieve carrier lock.

Composite rho is the normalized correlation coefficient between the measured and ideal reference signals and is designated as the waveform quality factor. The maximum value of rho is 1.0, which means the measured signal and reference signal are identical.

Composite slot identifies the time slot used for the composite measurements. The composite slot ignores the measurement offset.

Composite T trigger shows the amount of time, in chips, from the trigger to the start of the frame. If you select a trigger that starts the measurement at the beginning of a PCG, the T trigger value is zero chips. The T trigger value is displayed only for triggered measurements.

Composite peak active CDE is the largest active code channel code domain error (in dB). This is the largest measured CDE of all *active* code channels in the composite signal.

Composite peak CDE is the largest measured code channel code domain error. This is the largest measured CDE for *all* code channels (active and inactive) in the base code layer (the code layer with the smallest symbol rate) in the composite *signal*.

If averaging is on, averaging is applied to most numeric error data in the error summary data with the following exceptions. The peak data values, such as peak EVM, peak magnitude, and peak phase error, are averaged only for the continuous peak hold averaging type.

Composite CDP and CDE

CDP and CDE measure the power and error of the signal by code channel. They provide more detail on signal behavior and modulation quality than the composite EVM or rho.

The steps shown in Table 6 take you through setting up these measurements.

Trace A: Composite CDP
The CDP trace shows the power in every channel in the composite signal. CDP is an analysis of the distribution of signal power across the set of code-channels, normalized to the total signal power. If the measurement interval (**MeasSetup > Demod Properties > Time**) is greater than one, all slots within the measurement interval are averaged together to produce the composite CDP results.

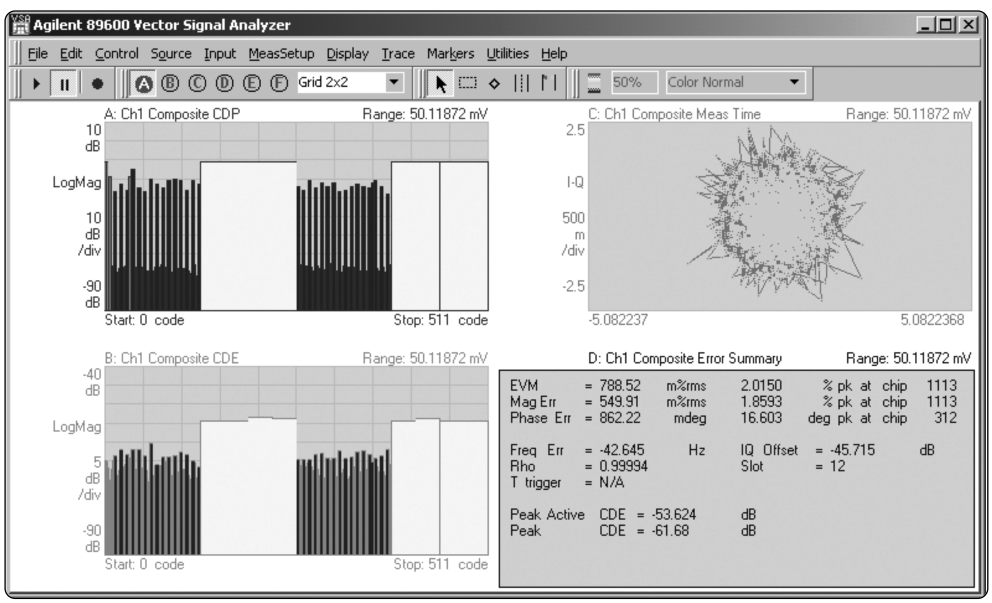
The trace assigns a unique color to each code layer and related active code-channels to make it easier to distinguish the active code-channels (Code-Channel) for a given code layer (Spread-Code-Length). Use the marker (see next step) to determine the color assigned to each code layer. In this example spread code length 256 is orange, spread code 128 is blue, and spread code 16 is yellow. These colors are user-definable (**Display > Appearance > Color** (tab).)

Trace B: Composite CDE
This trace shows the channel power error values for each active code channel for all code layers (Spread-Code-Lengths). It also shows the CDE value for each inactive code channel at the lowest code layer. The CDE of a particular code-channel is a measure of the error power in a code-channel relative to the total signal power. When IQ normalization is on, the CDE is expressed in dBc and is relative to the total power in the signal. When IQ normalization is off, the CDE is expressed in dBm.

CDE composite trace data results are computed only from the first measured slot.

Instructions	Toolbar menus
Add two more grids to the display so CDP and CDE can be shown	Display > Layout > Grid 2x2
Change trace A to show composite CDP	Double click on Trace A's title > Channel 1[1] CDP > CDP composite > OK
Auto-scale trace A	Right click on trace A > Y Auto Scale
Change trace B to show composite CDE	Double click on Trace B's title > Channel 1[1] CDP > CDE composite > OK
Auto-scale trace B	Right click on trace B > Y Auto Scale

Table 6. Setup of CDP and CDE.



1. *Channel 1* refers to the measurement channel not to any channel contained in the signal

Markers

The 89601A VSA software includes several markers and marker functions accessible from the **Markers** menu. Each trace has its own set of markers. You can quickly set marker locations, manually re-position them, locate peak values, and couple the markers between traces to show common values. Marker calculation features allow you to easily calculate band power, RMS band power, and channel-to-noise power.

Markers also help you understand the information presented in a trace. For W-CDMA/HSDPA modulation, the CDP and CDE displays assign a unique color to each code layer and related active code-channels to make it easier to distinguish the active code-channels for a given code layer (Spread-Code-Length). If you place the marker on each color, the marker readout at the bottom of the display will show the code layer and code channel for that color.

Trace A: Composite CDP, bit reverse code order, with markers
The bit-reversed generation of code channels displays related code channels adjacent to each other.

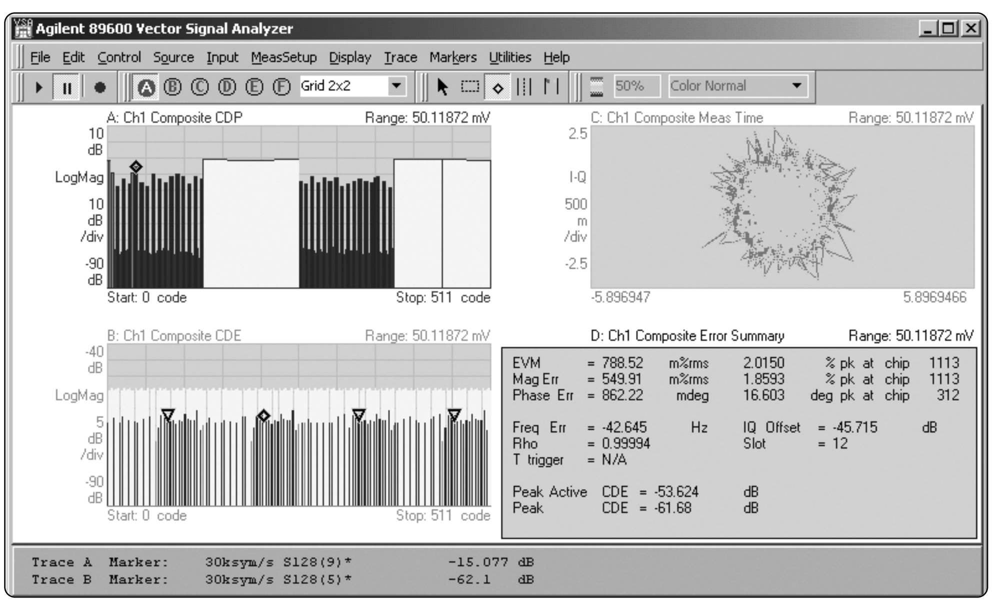
The marker is on a blue colored channel and shows the following values (bottom of screen):

Symbol rate	30 Ksym/s
Spread code length	128
Code number	9
Power level	–15.077 dB
Asterisk *	The asterisk indicates the marker is positioned on an active channel

Trace B: Composite CDE, Hadamard order
This trace shows the code channels in the Hadamard order. Note that the marker automatically points to all of the parts of the code channel as it is spread by the Hadamard ordering.

Instructions	Toolbar menus
Enable the trace A marker *(the marker may be moved by dragging it with the cursor)*	Click on trace A > Markers > Tool > Marker *OR* Right click on trace A > Show Marker
Enable the trace B marker	Right click on trace B > Show Marker
Change the code order in trace B to bit reverse	Click on trace B > Trace > Digital Demod > Code Order *(drop down menu)* > Hadamard > Close

Table 7. Marker setup.



EVM time and EVM spectrum

Two useful displays for evaluating the behavior of the composite signal are error vector time and error vector spectrum. The steps shown in Table 8 will take you through setting up these measurements.

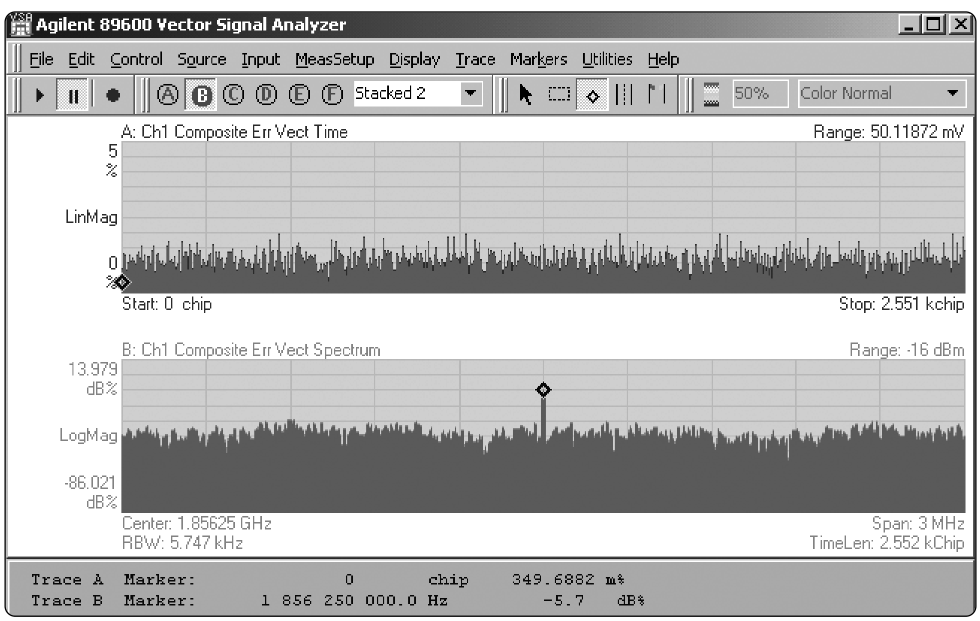
Trace A: EVM time
Error vector time shows the EVM behavior over time, where chips represent time. You can view EVM time data as EVM, error vector phase, the I component, or the Q component. This feature is used to find impulsive errors such as a transient overload event or a spiking clock circuit. It is also useful for finding low frequency errors caused by close-in phase noise. Trace A is typical of a signal without any of these problems. It is relatively flat and consistent across all 2.551 kchips of time.

Trace B: EVM spectrum
Error vector spectrum is the FFT of the EVM time trace and shows the frequency content of the EVM. Trace B shows a high error signal at 1.856 GHz (Trace B marker value at bottom of display.) This is the signal carrier frequency and represents carrier feed through. Carrier feed through is not the only signal the EVM spectrum trace will show. Any spurious signal will show up as a discrete peak in the composite error vector spectrum trace.

The analyzer's demodulator removes carrier-frequency error. Therefore, in the composite error vector spectrum display, you must add the carrier-frequency error to marker readouts to obtain exact frequency information. The carrier-frequency error (Freq Err) is shown in the Composite Error Summary table.

Instructions	Toolbar menus
Setup a display with only two vertically stacked traces	Display > Layout > Stacked 2
Set the top trace to display error vector time	Double click on the top trace's title > Channel 1 Comp > Error Vector Time
Set the bottom trace to display error vector spectrum	Double click on the bottom trace's title > Channel 1 Comp > Error Vector Spectrum
Enable a marker in the bottom trace	Click on the bottom trace > Markers > Tool > Marker *OR* Right click on the bottom trace > Show Marker
Put the marker on the peak near the center of the trace	Right click on the bottom trace > Peak
Start the measurement	Click on " ▶"

Table 8. EVM time and spectrum setup.



Channel Measurements

Measuring a single channel

The instructions in Table 9 show how to use markers and the **Copy Marker to Despread Chan** function to quickly view a single channel in your W-CDMA/HSDPA signal. You can also go directly to the desired channel by entering its parameters in the **Demod Properties** menu.

Copy Marker to Despread Chan sets the despread channel parameters including: spread code length, code channel, IQ branch. These parameter enable the following measurements: channel error vector, channel IQ measurement time, channel IQ reference time, channel mag error, channel phase error, and chan syms/errs trace data.

Trace A: Ch1 Composite CDE
See the previous section.

Trace B: Ch1 Chan Error Vector Time
This trace shows how the EVM changes with time (where symbols represent time) for a single code-channel within a specified code layer (Spread-Code-Length/Symbol Rate.)

The error vector time trace is made up of complex, time-domain data. Each point in the trace has two components: I and Q. To make sense of the data you must select an appropriate trace data format (**Trace > Format > Format:** drop-down list.)

Linear mag	Shows the EVM
Real (I)	Shows the I component of the error vector
Imag (Q)	Shows the Q component of the error vector
Wrap phase	Shows error vector phase

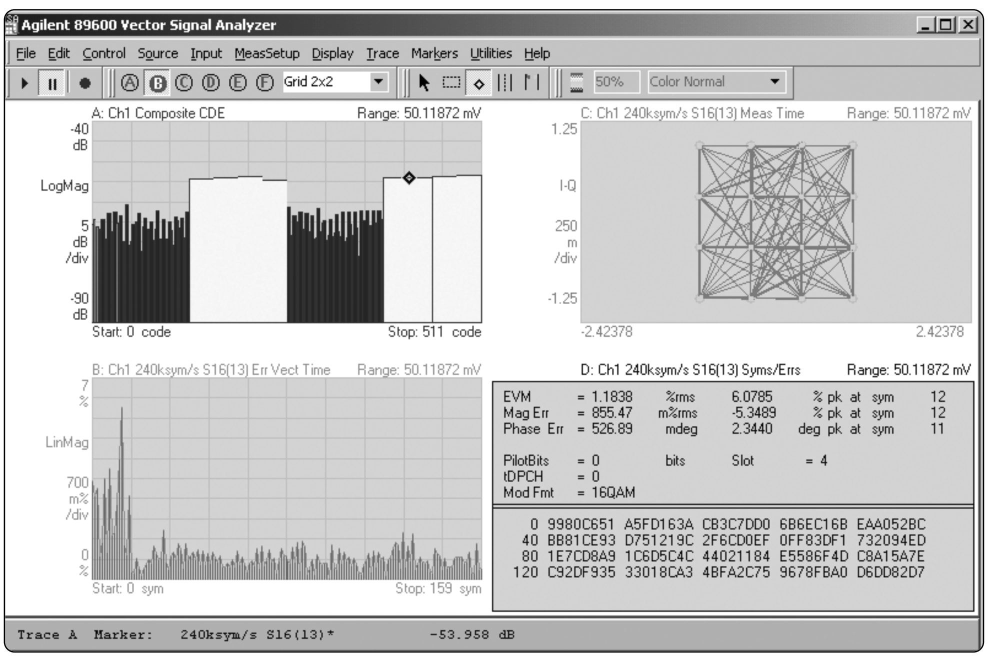
The ideal error vector time trace is low level and relatively flat. Notice the errors shown in trace B. These errors are caused by the Sync signal that comprises ten percent of each slot in a 3GPP downlink signal. Because the Sync signal is not orthogonal, it increases the EVM.

Instructions	Toolbar menus
Setup a 2x2 display grid	Display > Layout > Grid 2x2
Pause the measurement *(this speeds the set up by delaying display updates until all displays are changed)*	Click on || (left side of toolbar)
Set trace A to display Composite Code Domain Error	Double click on trace A's label > Channel 1 CDP > CDE composite > OK
Auto-scale trace A's vertical scale to get better resolution	Right click on trace A > Y Auto Scale
Enable the trace A marker	Right click on trace A > Show Marker
Send the marker to the channel with the highest CDE	Right click on trace A > Peak
Select the marked channel for more detailed analysis	Right click on trace A > Copy Marker to Despread Chan
Change Trace C to display the vector diagram for the selected channel	Double click trace C's title > Channel 1 Chan > IQ Meas Time > OK
Change Trace D to display the symbol table for the selected channel	Double click on trace D's title > Channel 1 Chan > Syms/Errs > OK
Change Trace B to display the Error Vector Time trace for the selected channel	Double click on trace B's title > Channel 1 Chan > Error Vector Time > OK
Start the measurement	Click on "▶"

Table 9. Instructions for viewing a single channel.

Trace C: Ch1 240 ksym/sec S16(13) measured time (vector constellation diagram)
The Channel IQ Meas trace is the demodulated time data, re-sampled at the chip times, for the specified code-channel and code layer (Spread-Code-Length). The data is corrected for IQ origin offset, burst amplitude droop compensation, filtering, and system gain normalization.

Trace D: Ch1 Syms/Errs
The symbol table in Trace D provides both error summary information and demodulated bits for the selected channel. For W-CDMA downlink signals, the symbol table also shows information about the demodulated channel, such as the number of pilot bits detected in the DPCH channel, the tDPCH timing value for the DPCH channel, and the first slot used in the measurement. For details about the symbol table, see on-line **Help "About the Channel Symbol Table (W-CDMA)."** For details about error information in the symbol table, see on-line **Help "About Channel Error Summary Data (W-CDMA)."**



Measuring code layer CDP and CDE

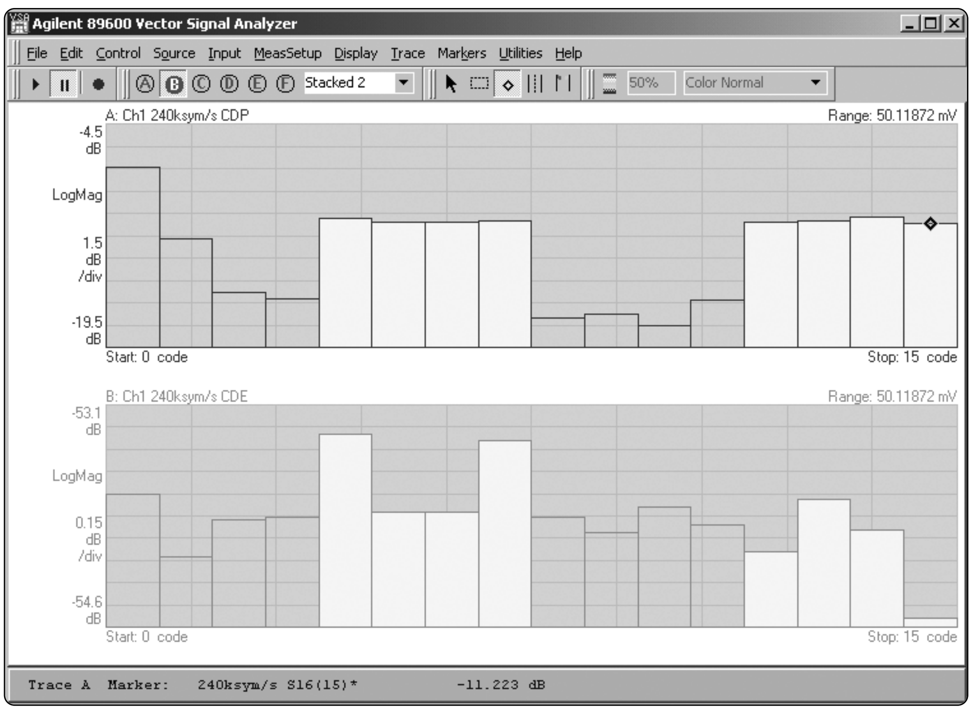
The instructions in Table 10 show how to measure code domain power and code domain error for a specific spread code length, or layer.

Trace A: Code domain power (Layer S16)
This trace shows the CDP trace data for all code-channels within the specified code layer (Spread-Code-Length.) If the measurement interval is greater than one, all slots within the measurement interval are averaged together to produce the CDP Layer results.

Trace B: Code domain error (Layer S16)
This trace shows the channel power error values for each code channel within the specified code layer (Spread-Code-Length.) The CDE of a particular code-channel is a measure of the error power in a code-channel relative to the total signal power. CDE layer trace data results are computed only from the first measured slot. This is different than CDP layer trace data results, which can include more than the first slot in the measurement results.

Instructions	Toolbar menus
Select trace A and setup a display with only two vertically stacked traces	Click on trace A Display > Layout > Stacked 2
Set the demodulator to measure the CDP for SF16	MeasSetup > Demod Properties > Channel/Layer *(tab)* > Spread code length > 16 (240 ksym/s) *(drop down menu)* > Close
Set trace A to display the CDP for the layer	Double click on trace A's label > Channel 1 CDP > CDP layer > OK
Auto scale trace A	Right click on trace A > Y Auto Scale
Set trace B to display the CDE for the layer	Double click on trace B's label > Channel 1 CDP > CDE layer > OK
Auto scale trace B	Right click on trace B > Y Auto Scale

Table 10. CDP and CDE measurement setup.



Test model

This selection provides a method to override the automatic active code channel detection algorithm with known 3GPP test models. It lets you specify a 3GPP test model to use as the basis for the reference signal in W-CDMA analysis. This bypasses the automatic active channel identification section of the W-CDMA analysis algorithm. Test model setting is useful if you are working with a known test model signal, or are trying to understand the problems of a signal intended to match a known 3GPP test model. Test model parameters only apply to the downlink signals.

The analyzer allows you select from the following list of predefined transmitter test model configurations (**MeasSetup > Demod Properties > Test Model**)

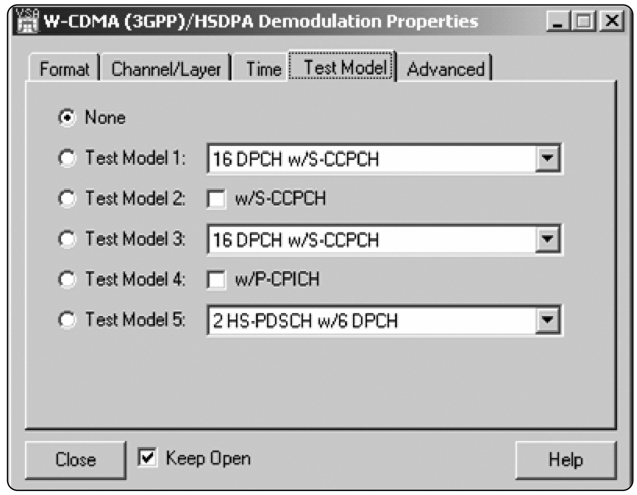
None (Default)
Does not use a test model for automatic active channel detection

Test Model 1
Allows further selections of Test Model 1 with 16, 32, or 64 DPCH channels, and to select a test model with or without S-CCPCH.

- *16 DPCH w/S-CCPCH* – Select this to set the active channel detection to the Test Model 1 with 16 DPCH channels and 1 S-CCPCH channel
- *32 DPCH w/S-CCPCH* – Select this to set the active channel detection to Test Model 1 with 32 DPCH channels and 1 S-CCPCH channel
- *64 DPCH w/S-CCPCH* – Select this to set the active channel detection to Test Model 1 with 64 DPCH channels and 1 S-CCPCH channel
- *16 DPCH* – Select this to set the active channel detection to the Test Model 1 with 16 DPCH channels and no S-CCPCH channel
- *32 DPCH* – Select this to set the active channel detection to Test Model 1 with 32 DPCH channels and no S-CCPCH channel
- *64 DPCH* – Select this to set the active channel detection to Test Model 1 with 64 DPCH channels and no S-CCPCH channel

Test Model 2
Allows further selections of Test Model 2, with or without S-CCPCH

- *Selected* – Set the active channel detection to Test Model 2 with S-CCPCH
- *Cleared* – Set the active channel detection to Test Model 2 and no S-CCPCH



Test Model 3
Allows further selections from Test Model 3 with 16 or 32 DPCH channels, and to select a test model with or without S-CCPCH.

- *16 DPCH w/S-CCPCH* – Select this to set the active channel detection to Test Model 3 with 16 DPCH channels and 1 S-CCPCH channel
- *32 DPCH w/S-CCPCH* – Select this to set the active channel detection to Test Model 3 with 32 DPCH channels and 1 S-CCPCH channel
- *16 DPCH* – Select this to set the active channel detection to Test Model 3 with 16 DPCH channels and no S-CCPCH channel
- *32 DPCH* – Select this to set the active channel detection to Test Model 3 with 32 DPCH channels and no S-CCPCH channel

Test Model 4
Allow further selections of Test Model 4, with or without P-CPICH.

- *Selected* – Set the active channel detection to Test Model 4 with P-CPICH channel
- *Cleared* – Set the active channel detection to Test Model 4 and no P-CPICH channel

Test Model 5[1]
Allow further selections of Test Model 5 with 2, 4, or 8 HS-PDSCH channels.

- *2 HS-PDSCH w/6 DPCH* – Select this to set the active channel detection to the Test Model 5 with 2 HS-PDSCH channels and 6 DPCH channels
- *4 HS-PDSCH w/14 DPCH* – Select this to set the active channel detection to the Test Model 5 with 4 HS-PDSCH channels and 14 DPCH channels
- *8 HS-PDSCH w/30 DPCH* – Select this to set the active channel detection to the Test Model 5 with 8 HS-PDSCH channels and 30 DPCH channels

1. Test Model 5 requires that **Enable HSPDA Analysis** be selected (**MeasSetup > Demod Properties > Format** (tab).)

Additional Measurements

Channel power

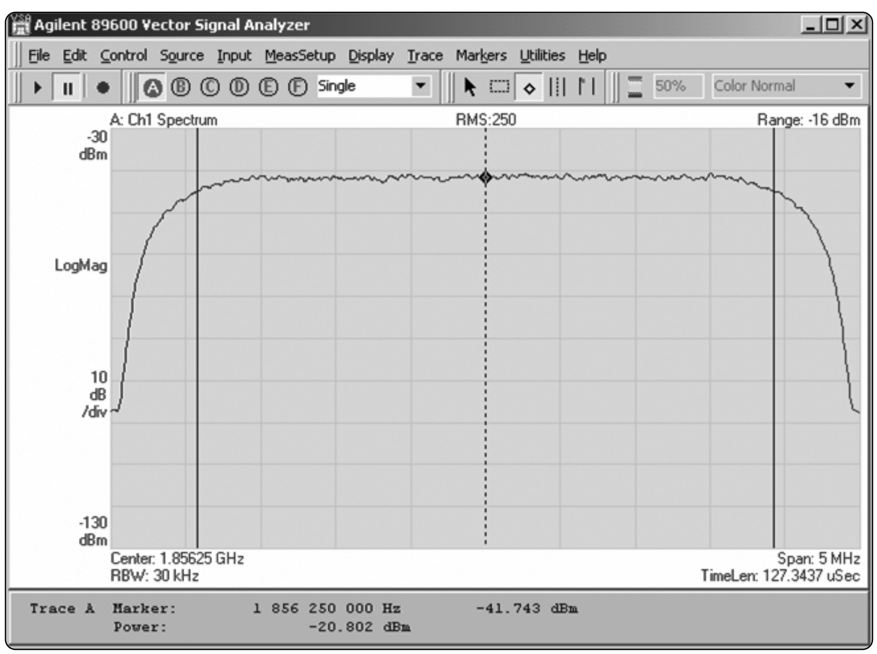
The 89601A VSA band power measurement determines the total power in a user-specified bandwidth. This is used to make standards-based channel power measurements by setting the bandwidth and center frequency of the band power marker to the values called out in the standard.

The following band power measurement parameters are user-controlled

- center frequency
- bandwidth
- number of averages (in **MeasSetup > Average** menu)
- power calculation
  band power (dB)
  RMS Sqrt power (Vrms)
  C/N – carrier to noise power (dB)
  C/N_o – carrier to noise density (dB/Hz)

Instructions	Toolbar menus
This measurement is made on the spectrum of the signal. Refer to *Setup the RF measurement parameters* section of *Setup Parameters.*	
Activate the band power marker in the spectrum trace	Right click the trace > Show Band Power
Set the center frequency and span for the measurement	Markers > Calculation > Center, Width *Center: 1.85625 GHz* *Width: 3.84 MHz*
Select the power calculation	Markers > Calculation > Calculate > Band Power
Optional: Activate a marker and put it at the center frequency (shows frequency and power at center of span)	Right click on trace > Show Marker Markers > Position > X Position *Enter: 1.85625 GHz*
Optional: Average the power measurements	Click on trace A > MeasSetup > Average > Average Type > RMS (Video) Exponential *(drop down menu)* > Count *Enter: 250* > Close

Table 11. Channel power setup.



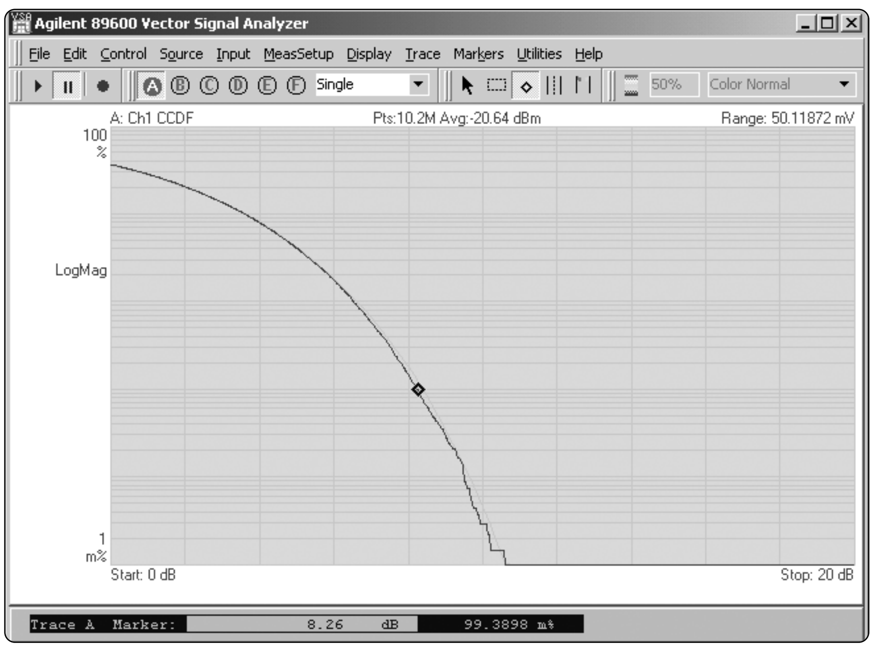
Power statistics (CCDF)

The complementary cumulative distribution function (CCDF) characterizes the power statistics of a signal by plotting the peak-to-average power ratio (PAR) versus probability of occurrence. This is a key measurement for power amplifiers designed for W-CDMA/HSDPA base stations as these devices must be capable of handling the PAR of the digitally modulated signals while maintaining good adjacent channel leakage performance.

In the example the average power of the signal is –20.64 dBm (top center of grid) and only 0.099 m% of all signal peaks measured were more than 8.26 dB above the signal's average power.

Instructions	Toolbar menus
This measurement is made on the time trace of the signal. Refer to *Setup the RF measurement parameters* section of *Setup Procedures*. The digital demodulators must be off for this measurement to work. (MeasSetup > Demodulator > Demod Off)	
Change the Main time trace to CCDF	Double click on the trace title (upper left corner of grid) > Channel 1 > CCDF
Start the measurement	Click on " ▶ "
Activate a marker on the CCDF trace	Right click on the trace > Show Marker
Find the PAR needed to assure the signal will be clipped < 0.1 percent of the time	Drag the marker along the CCDF plot until the marker readout at the bottom of the display shows < 100 m%
If the bottom of the CCDF graph is jagged (looks like stair steps) keep running the measurement. CCDF is a statistical measurement and gives best results with large sample sizes. The sample size is shown as "Pts" parameter at the top of the CCDF trace. The "Avg" parameter shows average measured signal power.	

Table 12. Power statistics setup.

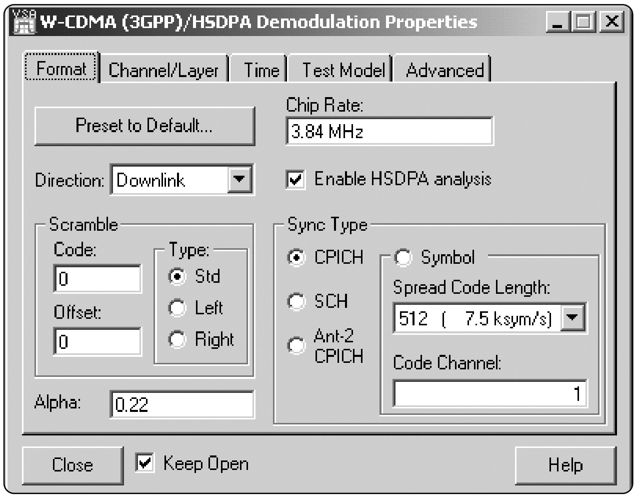


Key Menu Reference

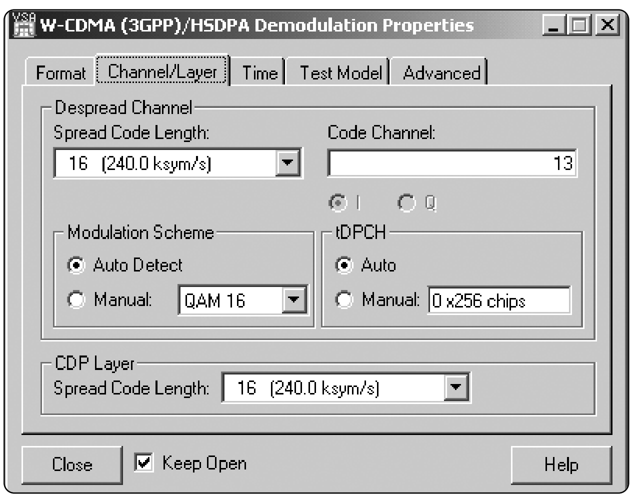
Demod properties menu

Access these menus via the toolbar by clicking **MeasSetup > Demod Properties** (the W-CDMA/HSDPA demodulator must be selected.) For more information on the functions controlled by the menu click the **Help** button in the lower right corner of the menu.

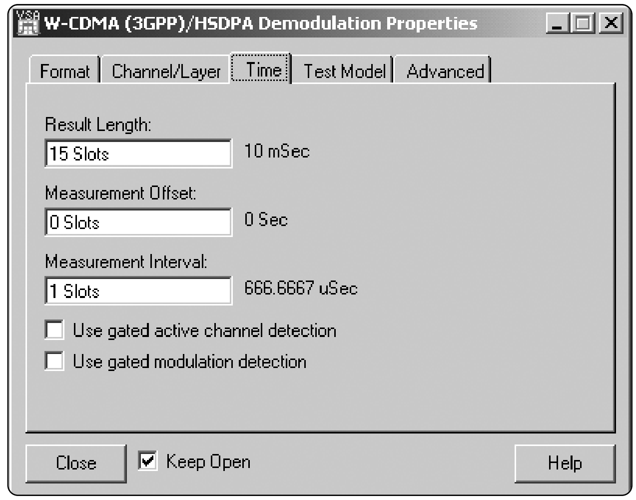
Demod Properties menu > **Format** tab



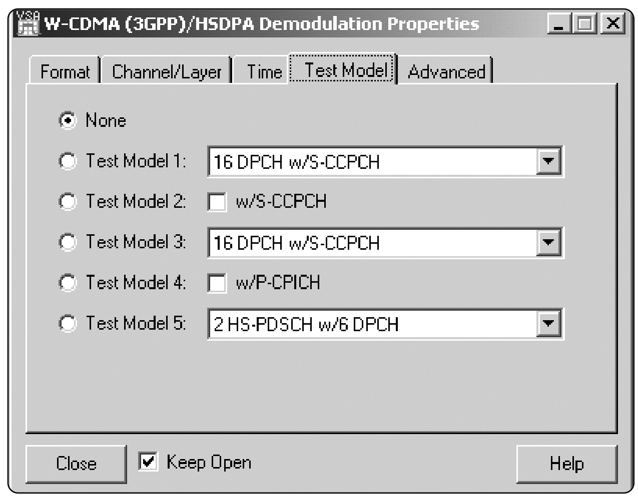
Demod Properties menu > **Channel/Layer** tab



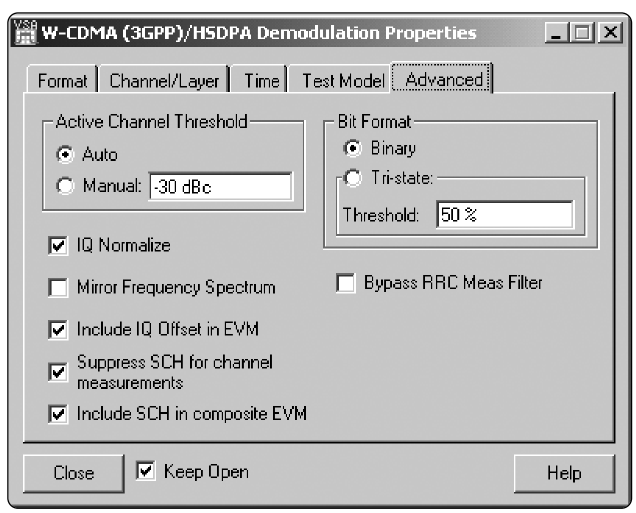
Demod Properties menu > **Time** tab



Demod Properties menu > **Test Model** tab

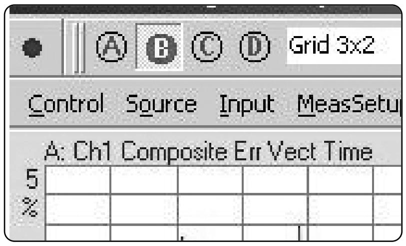


Demod Properties menu > **Advanced** tab



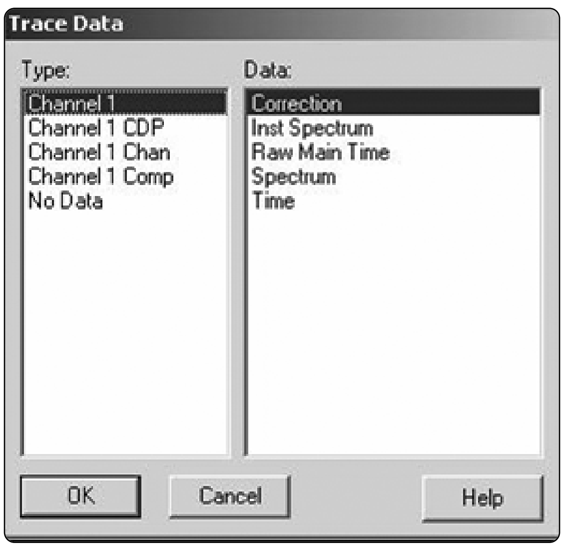
Trace data menus

Access this menu by clicking **Trace > Data > Ch1 Chan** in the toolbar or by double clicking on the trace title annotation at the upper left corner of the trace you wish to change.

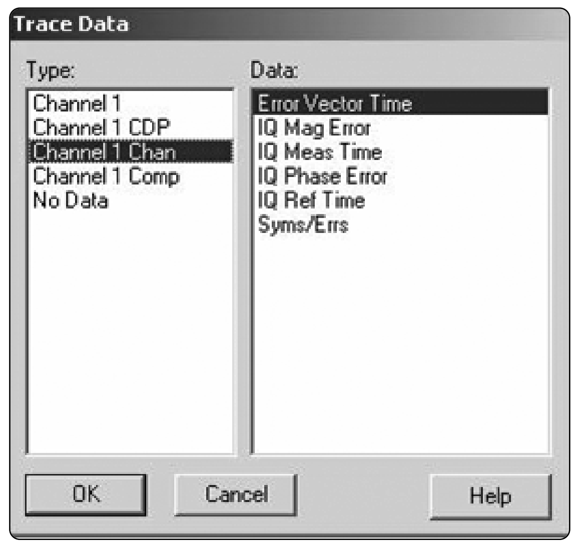


For more information on the functions controlled by the menu click the **Help** button in the lower right corner of the menu.

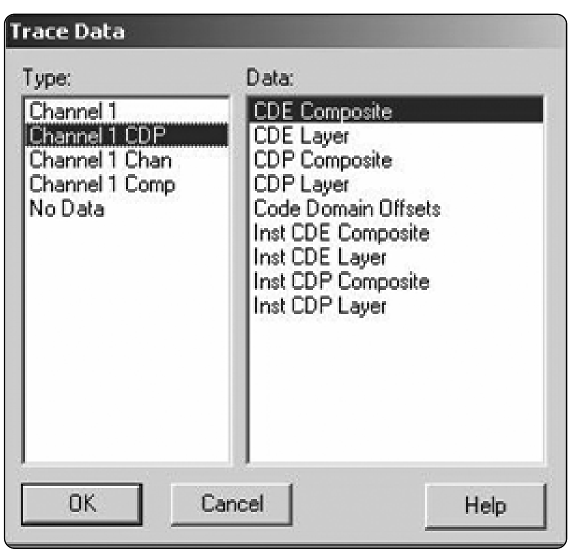
Trace data menu > **Type: Channel 1** > **Data** (display) menu selections



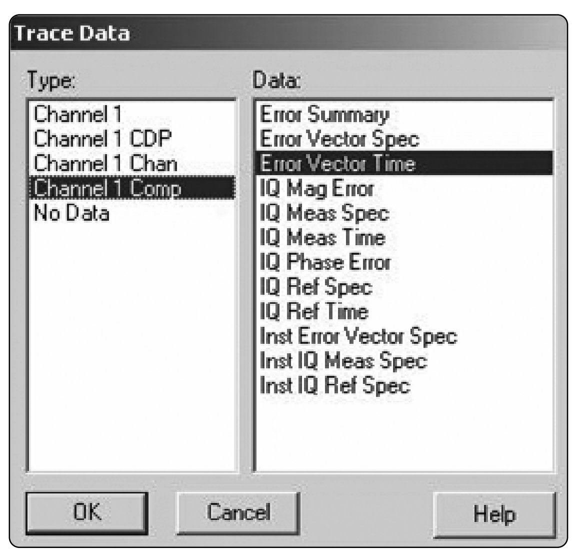
Trace data > **Type: Channel 1 Chan** > **Data** (display) menu selections



Trace data > **Type: Channel 1 CDP** > **Data** (display) menu selections



Trace data > **Type: Channel 1 Comp** > **Data** (display) menu selections



Ordering Information

The 89601A VSA software works with a variety of measurement hardware, and sourcing hardware, and other software.

In general, an external PC with LAN, FireWire, or GPIB interface is required to run the software and control the hardware.

Vector signal analysis software

89601A	VSA software, node locked license
89601AN	VSA software, floating license
Opt 200	Basic analysis software
Opt 300	Hardware connectivity
Opt AYA	Flexible vector modulation analysis
Opt B7N	3GPP modulation analysis
Opt B7R	WLAN modulation analysis
Opt 105	Advanced design system streaming interface

Measurement Hardware

Vector signal analyzer bundled systems[1]
(Two baseband channels and/or two RF channels available)

Models	Frequency range	Max. analysis bandwidth
89610S	DC to 40 MHz	40 MHz
89611S	52 to 88 MHz	36 MHz
89640S	DC to 2.7 GHz	36 MHz
89641S	DC to 6.0 GHz	36 MHz
89650A	3 Hz to 26.5 GHz	80 MHz

PSA Series spectrum analyzers

Models	Frequency range	Max. analysis bandwidth
E4440A	3 Hz to 26.5 GHz	8 MHz
E4443A	3 Hz to 6.7 GHz	8 MHz
E4445A	3 Hz to 13.2 GHz	8 MHz
E4446A	3 Hz to 44 GHz	8 MHz
E4448A	3 Hz to 50 GHz	8 MHz

ESA-E Series spectrum analyzers

Models	Frequency range	Max. analysis bandwidth
E4401B	9 kHz to 1.5 GHz	10 MHz
E4402B	9 kHz to 3.0 GHz	10 MHz
E4404B	9 kHz to 6.7 GHz	10 MHz
E4405B	9 kHz to 13.7 GHz	10 MHz
E4407B	9 kHz to 26.5 GHz	10 MHz

Infiniium oscilloscopes

Models	Frequency range	Max. analysis bandwidth
54830B/D	DC to 780 MHz	780 MHz
54831B/D	DC to 780 MHz	780 MHz
54832B/D	DC to 1.0 GHz	1 GHz
54853B[2]	DC to 2.5 GHz	2.5 GHz
54854B[2]	DC to 4.0 GHz	4 GHz
54855B[2]	DC to 6.0 GHz	6 GHz

Sources

ESG Series digital RF signal generators

E4431B	250 kHz to 2 GHz
E4432B	250 kHz to 3 GHz
E4433B	250 kHz to 4 GHz
E4434B	250 kHz to 1 GHz
E4435B	250 kHz to 2 GHz
E4436B	250 kHz to 3 GHz
E4437B	250 kHz to 4 GHz
E4438C	250 kHz to 1/2/3/4/6 GHz

PSG Series microwave signal generators

E8267	250 kHz to 20 GHz

Software

Advanced Design System (ADS) software
Advanced RF/µW design and simulation software.

1. 89601A/AN software included
2. Software can be run on Infiniium internal PC

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Printed in USA February 24, 2004
5989-0679EN

Agilent Technologies