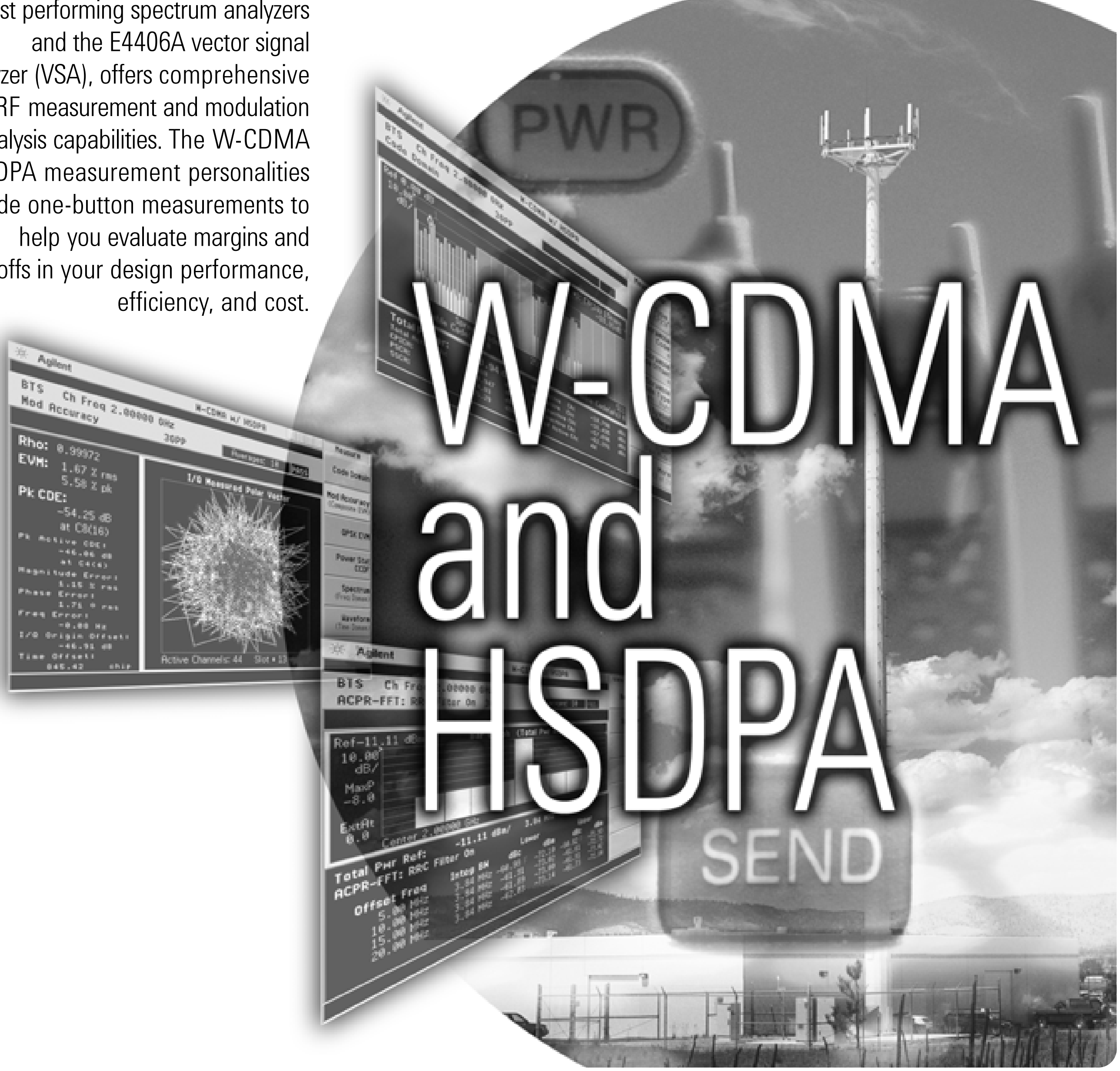
Agilent
PSA Series Spectrum Analyzers
E4406A Vector Signal Analyzer
W-CDMA and HSDPA
Measurement Personalities

Technical Overview with Self-Guided Demonstration
Options BAF and 210

The PSA Series, Agilent Technologies' highest performing spectrum analyzers and the E4406A vector signal analyzer (VSA), offers comprehensive RF measurement and modulation analysis capabilities. The W-CDMA and HSDPA measurement personalities provide one-button measurements to help you evaluate margins and tradeoffs in your design performance, efficiency, and cost.



Agilent Technologies

Use the W-CDMA and HSDPA Personalities to Evaluate Your Designs Quickly and Thoroughly for Fast Development Completion.

The complexity of 3GPP demands the flexibility and depth of demodulation capability provided by W-CDMA and high speed downlink packet access (HSDPA) measurement personalities.

- Expand design possibilities with powerful measurement capability and flexibility.
- Expedite troubleshooting and design verification with numerous features and an intuitive user interface.
- Streamline manufacturing with speed, reliability, and ease of use.
- Improve yields with highly accurate measurements and operator-independent results.
- Simplify test systems with digital demodulation, RF power measurements, spur searches, and general high-performance spectrum analysis in one analyzer.

The Agilent PSA Series offers high-performance spectrum analysis up to 50 GHz with powerful one-button measurements, a feature set, and a leading-edge combination of flexibility, speed, accuracy, and dynamic range. Expand the PSA to include W-CDMA vector signal analysis capability with the W-CDMA (Option BAF) and HSDPA (Option 210) measurement personalities.

For many manufacturing needs, the E4406A VSA – strictly a vector signal analyzer – is an affordable platform that also offers the W-CDMA and HSDPA personalities.

The W-CDMA measurement personality provides key transmitter measurements for analyzing systems based on Technical Specifications Group TS25.141 and TS34.121 in 3GPP Release 99. To enable modulation analysis of HSDPA signals defined in 3GPP Release 5, the HSDPA measurement personality is needed. Measurements may be performed on HPSK uplink or downlink QPSK and 16QAM signals.

This technical overview includes

- measurement details
- demonstrations
- PSA Series key specifications for W-CDMA and HSDPA measurements
- ordering information
- related literature

All demonstrations utilize the PSA Series and the E4438C ESG vector signal generator; however, they can also be performed with the E4406 VSA. Keystrokes surrounded by [ ] indicated hard keys located on the front panel, while key names surrounded by { } indicated soft keys located on the right edge of the display.

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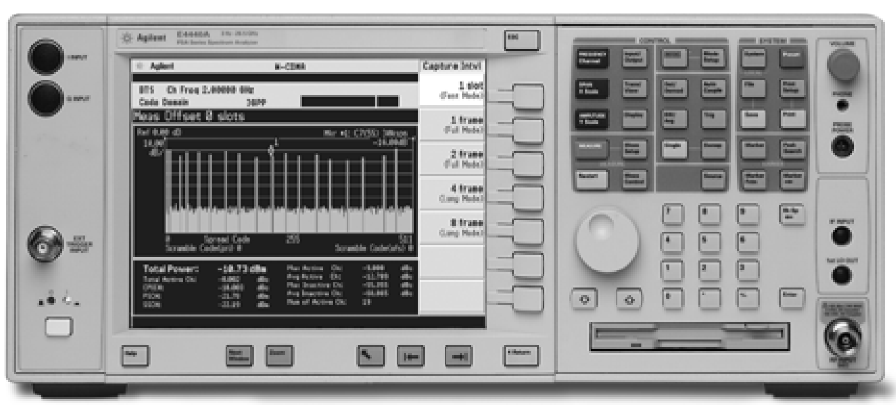


PSA Series spectrum analyzer

E4406A vector signal analyzer

Available measurements

W-CDMA measurement personality (Option BAF)

- Channel power
- Adjacent channel power ratio (ACPR)
- Intermodulation
- Multi-carrier power
- Spectrum emission mask
- Occupied bandwidth
- Code domain analysis
- Modulation accuracy (composite EVM)
- QPSK EVM
- Power statistics (CCDF)
- Power control
- Power vs time

HSDPA Option 210 adds the following capabilities to BAF

- Code domain analysis
  - Pre-defined test model 5
  - 16 QAM/QPSK detection
  - Demodulated bits in binary/hexadecimal format
  - Adaptive modulation support
  - HS-DPCCH power β
- Modulation accuracy
  - HSDPA signal support

Demonstration preparation

The following options are required for the ESG and the PSA Series in order to perform this demonstration.

Product type	Model number	Required options
ESG vector signal generator	E4438C	503, 504, or 506 – frequency range up to at least 3 GHz 001 or 002 – baseband generator 400 – 3GPP W-CDMA-FDD personalities
PSA Series spectrum analyzer	E4440A/E4443A/E4445A/ E4446A/E4448A	B7J – Digital demodulation hardware BAF – W-CDMA measurement personality 210 – HSDPA measurement personality

To configure these instruments, connect the ESG's 50 Ω RF output to the PSA's 50 Ω RF input with a 50 Ω RF cable. Turn on the power in both instruments.

Now set up the ESG to provide a W-CDMA signal (test model 1).

Instructions	Keystrokes
On the ESG:	
Set the carrier frequency to 2 GHz.	[Preset] [Frequency] [2] {GHz}
Set amplitude to –10 dBm.	[Amplitude] [–10] {dBm}
Select W-CDMA mode.	[Mode] {W-CDMA} {Arb W-CDMA}
Choose W-CDMA test model 1.	{W-CDMA Select} {Test Models} {Test Model 1 w/16 DPCH}
Turn on W-CDMA modulation.	{W-CDMA On}
Turn on RF output.	[RF On]

Channel power

The channel power measurement identifies the channel power within a specified bandwidth (default of 5 MHz, as per the Third-Generation Partnership Project (3GPP) W-CDMA technical specifications) and the power spectral density (PSD) in dBm/Hz.

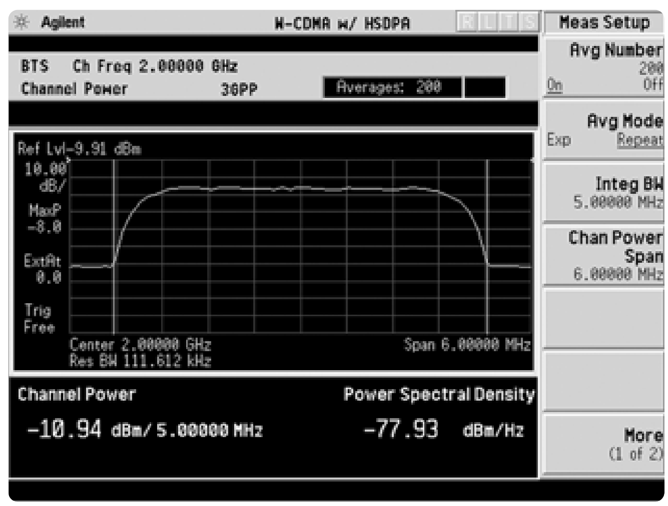
Control the following channel power measurement parameters:

- integration bandwidth (defaults to 5 MHz)
- channel power span (defaults to 6 MHz)
- number of trace averages (defaults to 200)
- data points displays, 64 to 65536 (defaults to 512)
- trigger source: free run, external front panel, external rear panel (defaults to free run)

This exercise demonstrates the one-button channel power measurement on the PSA.

Instructions	Keystrokes
On the PSA:	
Perform factory preset. (Skip this step for E4406A VSA.)	[System] {Power On/Preset} {Preset Type} {Factory}
Enter the W-CDMA mode in the analyzer. If {W-CDMA} does not appear in the Mode menu, try {More}.	[Preset] [Mode] {W-CDMA}
Set center frequency to 2 GHz.	[FREQUENCY] [2] {GHz}
Choose transmitter device.	[Mode Setup] {Radio} {Device BTS}
Activate channel power measurement. Observe the white bars indicating the spectrum channel width and the quantitative values given beneath.	[MEASURE] {Channel Power}
Examine settings (Figure 1). Use this step to make setup changes in any measurement.	[Meas Setup]

Figure 1.
Channel power



Adjacent channel power ratio (ACPR)

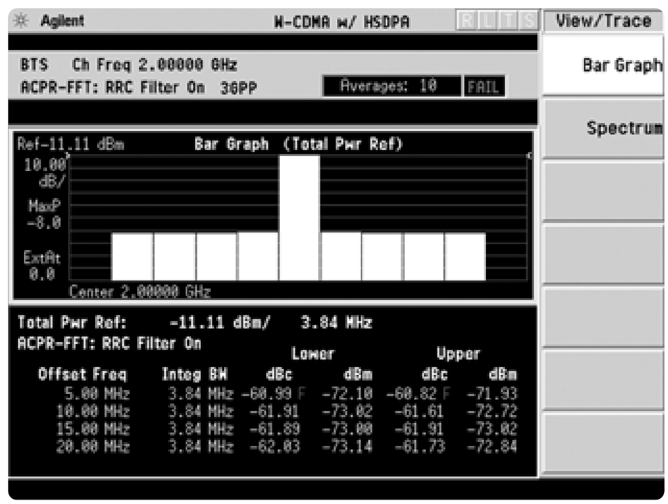
Reducing transmitter channel leakage allows for more channels to be transmitted simultaneously, which, in turn, increases base station efficiency. The ACPR, designated by the 3GPP W-CDMA specifications as the adjacent channel leakage power ratio (ACLR), is a measure of the power in adjacent channels relative to the transmitted power. The standard requires the power of both the transmitted and adjacent channels be measured through a root raised cosine (RRC) filter with a roll-off factor of 0.22.

- obtain ACPR measurements with three modes – FFT, swept and fast
- adjust integration bandwidth
- select up to five channel offsets
- choose channel offset frequency
- adjust and display both absolute and relative limits
- view bars or spectrum
- switch in a root-raised cosine filter and change the filter's alpha value

In this exercise, the ACPR measurement will be made and the customizable offsets and limits explored.

Instructions	Keystrokes
On the PSA:	
Activate ACPR measurement.	[MEASURE] {ACPR}
Enable spectrum view.	[Trace/View] {Spectrum}
Expand spectrum display. Use this to expand any window in any measurement.	[Next Window] until spectrum display is highlighted in green, [Zoom]
Adjust the limit for one offset pair. Notice as the green PASS indicator in the upper right corner changes to a red FAIL when the signal does not meet limit requirements.	[Meas Setup] {Ofs & Limits} {Rel Lim (Car)} [–90] {dBc}
Add two more offsets.	{Offset} {C} {Offset Freq On} {Offset} {D} {Offset Freq On}
Return to bar graph view with table (Figure 2). Observe the fail indicators in the table.	[Trace/View] {Bar Graph} [Zoom]

Figure 2.
Multi-offset ACPR



Spectrum emission mask

The spectrum emission mask measurement required by 3GPP specifications encompasses different power limits and different measurement bandwidths (resolution bandwidths) at various frequency offsets. Figure 3 is a diagram of the specification requirements for power density versus frequency offset from carrier (excerpted from the 3GPP W-CDMA specifications document TS 25.104 v3.12.0). Completing the many measurements required to comply with this standard is made quick and easy with the PSA.

This exercise illustrates the spectrum emission mask measurement and explores some of the customizable features. Notice in the PSA measurement that the mask limit is represented by a green trace on the screen.

Instructions	Keystrokes
On the PSA:	
Activate the spectrum emission mask measurement. Observe the mask and trace in the upper window and the table of measured values in the lower window.	[MEASURE] {Spectrum Emission Mask}
Choose the type of values to display. Observe the measurement values change in the lower window to reflect the selected value type.	[Display], choose {Abs Peak Pwr & Freq}, {Rel Peak Pwr & Freq} or {Integrated Power}
View customizable offsets and limits. Measurement parameters as well as limit values may be customized for any of the five offset pairs or for any individual offset.	[Meas Setup] {Offset/Limits} {More} {Limits}
Specify measurement interval (up to 10 ms) and select detector type (average or peak) (Figure 4).	[Meas Setup] {Meas Interval}, rotate KNOB, [⇑] or [⇓], {More}, toggle {Detector}

Figure 3. 3GPP W-CDMA specification for spectrum emission mask (from TS 25.104 v3.12.0 (2003-03))

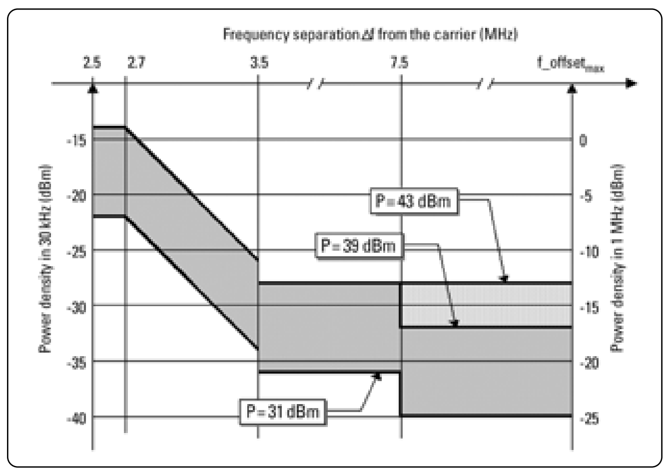
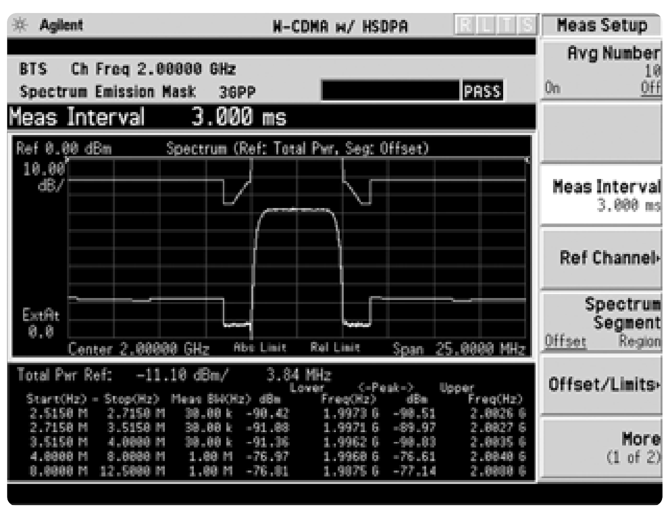


Figure 4. Spectrum emission mask



Occupied bandwidth

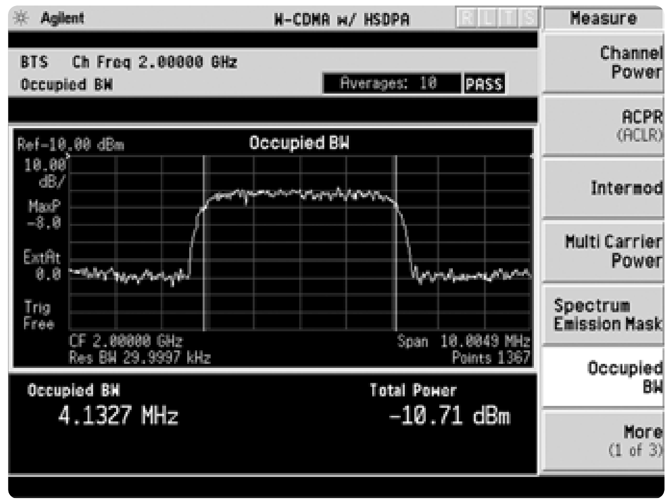
The 3GPP specifications require the occupied bandwidth (OBW) of a transmitted W-CDMA signal to be less than 5 MHz, where occupied bandwidth is defined as the bandwidth containing 99 percent of the total channel power.

- choose from a wide selection of FFT windows (flat top, uniform, Hanning, Hamming, Gausssian, Blackman)
- set occupied bandwidth alarms
- select the span and RBW

In this measurement, the total power of the displayed span is measured. Then the power is measured inward from the right and left extremes until 0.5 percent of the power is accounted for in each of the upper and lower part of the span. The calculated difference is the occupied bandwidth. In accordance with the 3GPP specification, the PSA defaults to a 5-MHz PASS/FAIL limit value.

Instructions	Keystrokes
On the PSA:	
Measure the occupied bandwidth (Figure 5).	[MEASURE] {Occupied BW}

Figure 5.
Occupied bandwidth



Code domain analysis

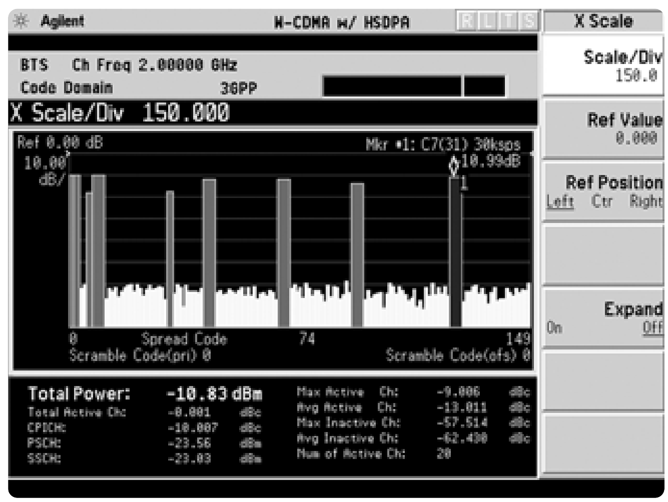
The code domain analysis measurement provides a variety of different results. First, code domain power analysis measures the distribution of signal power across the set of code channels, normalized to the total signal power. This measurement helps to verify that each code channel is operating at its proper level and helps to identify problems throughout the transmitter design from coding to the RF section. System imperfections, such as amplifier non-linearity, will present themselves as an undesired distribution of power in the code domain.

- measure peak EVM, RMS EVM, phase and magnitude error, total power and channel power
- re-demodulate data using manually adjustable parameters: select a code channel from 0 to 511 and set the symbol rate for 7.5 ks/s to 960 ks/s
- select from multiple synchronization options, set sync type CPICH, SCH, symbol based or antenna-2 CPICH in STTD for downlink
- PRACH message synchronization with preamble signature detection and DPCCH sync for uplink
- select pre-defined test models for fast analysis
- view power graph and metrics, I/Q error, code domain quad view, or demod bits
- get fast analysis by shortening the default length to one frame or even one slot
- increase analysis depth using four or eight frames

Now analyze the W-CDMA signal using code domain analysis.

Instructions	Keystrokes
On the PSA:	
Activate the code domain measurement. This measurement takes a few seconds while the PSA identifies the active channels.	[MEASURE] {More} {Code Domain}
Look at the power and rate of a specific channel. Notice that active channels are red and the width of a code channel is proportionate to the data rate of that channel.	[Marker] [125] [Enter]
Zoom (Figure 6). This function allows close-up views of channel widths. Leave on widest span for the next step.	[Span], rotate KNOB

Figure 6.
Code domain power



Discontinuous transmission

Code channel amplitude can fluctuate during transmission. This is called DTX or discontinuous transmission. As a result, some bits are lost or not easily demodulate. W-CDMA combats this by replacing the lost bits with Xs so the operator can see which bits are lost.

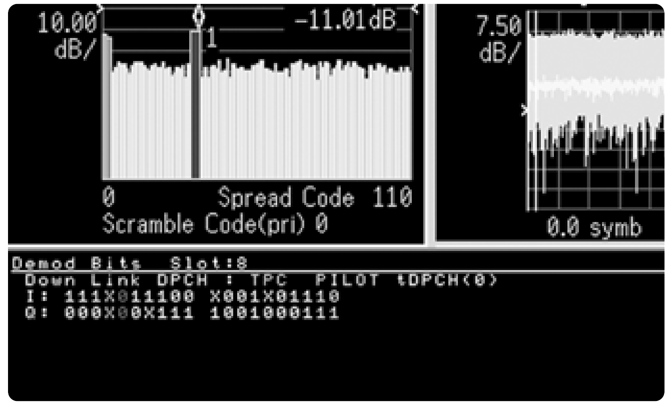
Select *Tri* under the *Bit Format* key to represent the lost bits by an X. Choose the percent of the signal. For example, if 50 percent is chosen and a bit drops off to half of the signal, an X will replace the demodulated bit. Figure 7 is an example of how Xs are added in place of demodulated bits.

In the 3GPP standard, compressed mode signals have several power-off slots during the transmission. This power-off period prevents active channel identification in code domain. Without identification as active channels, tDPCH (timing offset of DPCH from CPICH) cannot be detected. This means that the slot boundary for a code channel is not correctly identified, which in turn means the demodulation bits and code channel power are affected. Setting tDPCH manually helps to examine the signal in compressed mode correctly because of adjusted slot boundary.

Additionally, detailed information about any single code channel can be viewed in code domain. You can switch the view for magnitude error, phase error, and EVM in I/Q error view, symbol power vs time trace, symbol polar vector plots in code domain (quad view), and demodulated (but not decoded) I/Q data bits in demod bits.

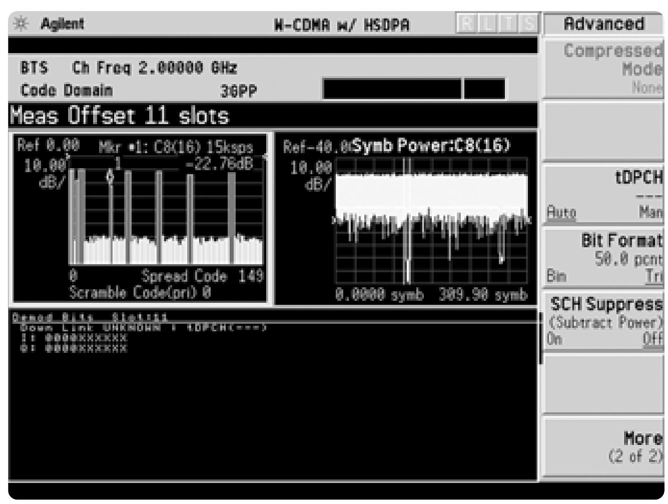
This exercise examines the characteristics of the marked code channel.

Figure 7.
X's used to replace demodulated bits.



Instructions	Keystrokes
Set the market to PICH.	[Marker] [32] [Enter]
Examine characteristics of the code channel with the active marker (32).	[Marker] {More} {Mkr → Despread}
Show I and Q symbol bits.	[Trace/View] {Demod Bits}
Shift the selected slot to the power off gap. Notice the indicated measurement interval change	[Meas Setup] {Meas offset}, rotate KNOB, [⇑] or [⇓]
Change bit format from binary to tri-state (0,1,X) (Figure 8).	[Meas Setup] {More} {Advanced} {Bit format Bin/Tri}

Figure 8.
Symbol power and demodulated I/Q bits



HSDPA in 3GPP release 5

Now set up the ESG to provide an HSDPA signal (test model 5)

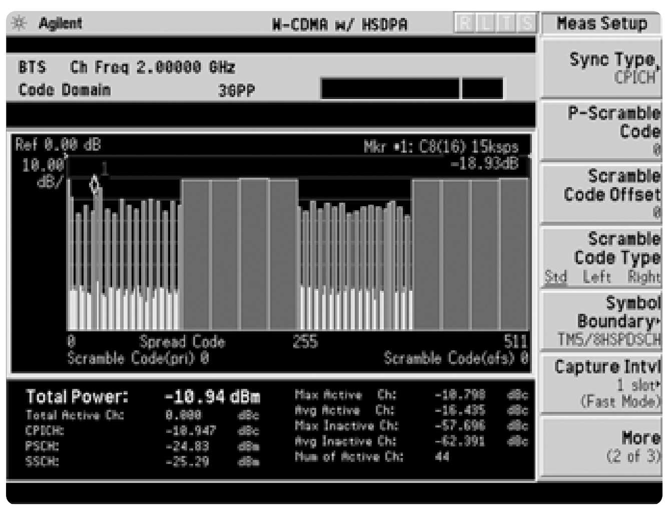
Instructions	Keystrokes
On the ESG:	
Select W-CDMA mode.	[Mode] {W-CDMA} {Arb W-CDMA}
Choose W-CDMA test model 5.	{W-CDMA Select} {Test Models} {Test Model 5 w/8 HSPDSCH}
Turn on W-CDMA modulation.	{W-CDMA On},
Turn on RF output.	[RF On]

The PSA also offers flexibility features that enable you to customize measurements for your particular needs. Setting the capture interval determines the measurement time – short for fast measurements or long for in-depth analysis. Test models are pre-programmed into the PSA that allow you to disable the active channel identification functionality for fast mode capture intervals. Lastly, the analyzer may be programmed to synchronize from any W-CDMA code channel.

Now examine the HSDPA signal capture options.

Instructions	Keystrokes
On the PSA:	
Return to the power graph.	[Trace/View] {Power Graph & Metrics}
Change the X scale of the screen.	[Span] {Scale/Div} [512] {Enter}
Set measure type to continuous. The default capture interval is for somewhat in-depth analysis. Observe the time it takes to make a measurement.	[Meas Control] {Measure Cont}
Change from active channel ID to measure test model 1 with 8 HS-PDSCH.	[Meas Setup] {More} {Symbol Boundary} {Pre-Defined Test Model}{Test Model 5} {Test Model 5 w/8 HSPDSCH}
Set capture interval to fast mode (Figure 9). Again observe the time to make a measurement; it has increased significantly.	[Meas Setup] {Capture Intvl} {1 slot}

Figure 9. Setting the capture interval



More powerful analysis for HSDPA is available.

- pre-defined test model 5 for fast measurement
- auto-detection of modulation scheme as QPSK or 16 QAM
- adaptive modulation support
- HS-DPCCH power β for uplink
- demodulation bits in binary and hexadecimal format

Now examine the HSDPA signal using advanced functions for code domain analysis.

Instructions	Keystrokes
On the PSA:	
Set capture interval to full mode, 3 frames	[Meas Setup] {Capture Intvl} {3 frame}
Change measure type to single.	[Meas Control] {Measure Single}
Look at the power and rate of a specific channel. Notice that active channels are red and the width of a code channel is proportionate to the data rate of the channel.	[Marker] [140] [Enter]
Switch the view to observe the selected HS-PDSCH.	[Trace/View] {Code Domain (Quad view)}
Despread the marked code channel (Figure 10). The 16QAM modulated channel can be seen in symbol polar vector.	[Marker] {More} {Mkr –> Despread}
16QAM modulated channel may have more influence of SCH than QPSK channel. Eliminate the influence by using SCH suppression. (Figure 11).	[Meas Setup] {More} {Advanced} {SCH Suppress On}

Figure 10. Code domain quad view with SCH influence

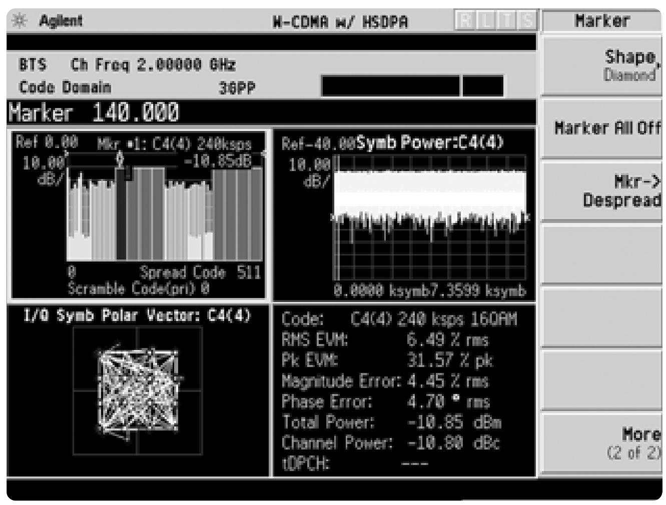
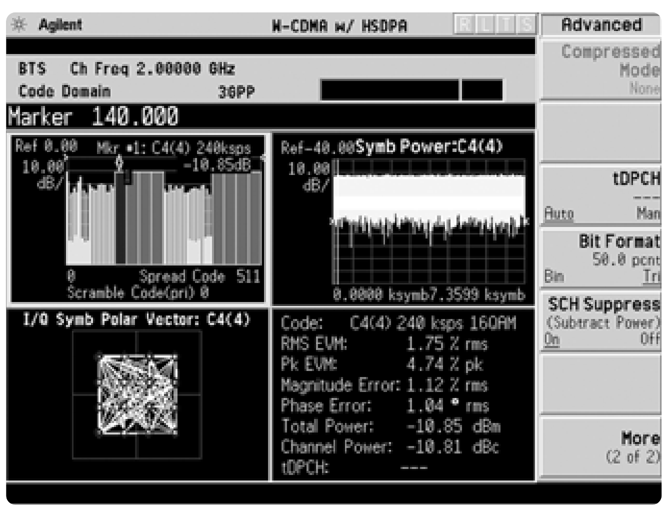


Figure 11. Code domain quad view with SCH suppression



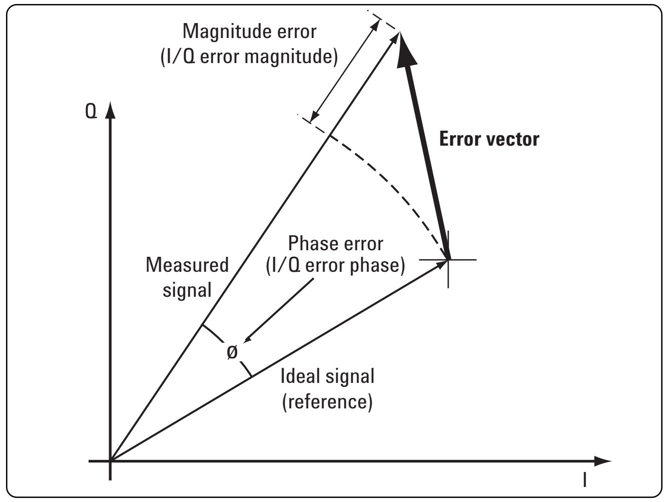
Modulation accuracy (composite EVM)

An effective way to quantify modulation accuracy is to compare the signal being measured to an ideal signal. Figure 12 defines the error vector, a measure of the amplitude and phase differences between the ideal modulated signal and the actual modulated signal. The root mean square (rms) of the error vector is computed and expressed as a percentage of the square root of the mean power of the ideal signal. This is the error vector magnitude (EVM). EVM is a common modulation quality metric widely used in digital communications.

Composite EVM measures the EVM of the multi-code channel signal. It is valuable for evaluating the quality of the transmitter for a multi-channel signal, detecting spreading or scrambling errors, identifying certain problems between baseband and RF sections, and analyzing errors that cause high interference in the signal.

CDMA-based formats, which rely on correlation as part of their operation, use another parameter called rho (ρ). Rho is a measure of the correlated power to the total power. The correlated power is computed by removing frequency, phase, and time offsets and performing a cross correlation between the corrected measured signal and the ideal reference. Rho is important because uncorrelated power appears as interference to a receiver.

Figure 12.
The error vector



In addition to measuring EVM and rho, this measurement personality also features:

- peak CDE, phase, magnitude and frequency error measurements.
- test model compliance
- multi-channel estimator to align individual code channels to the pilot channel and improve phase error
- select from multiple synchronization options, set sync type CPICH, SCH, symbol based, antenna-2 CPICH or STTD differential for downlink
- space time transmit diversity (STTD) measurements for dual antenna measurements
- PRACH message synchronization with preamble signature detection and DPCCH synch for uplink.
- optional preamplifier to measure low-level signals

This exercise explores the different ways in which the modulation accuracy measurement can be used.

Instructions	Keystrokes
On the PSA:	
Activate modulation accuracy measurement (Figure 13). Observe the I/Q measured polar vector display on the right and the quantitative data provided on the left.	[MEASURE] {More} {Mod Accuracy}
View magnitude and phase error and EVM plots. (Figure 14).	[Trace/View] {I/Q Error}

Figure 13.
Modulation accuracy of HSDPA signal

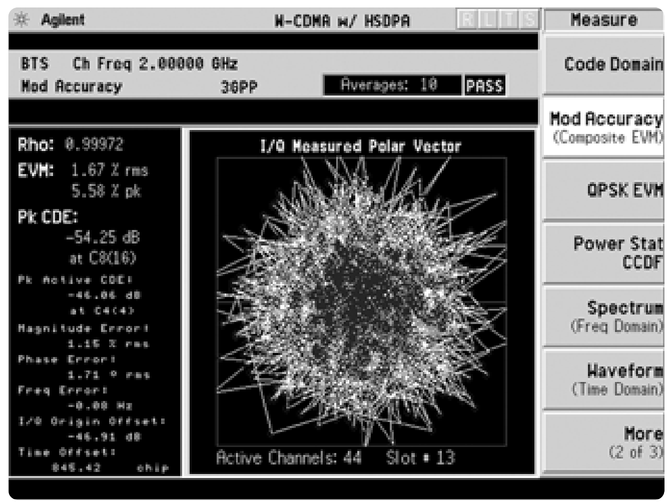
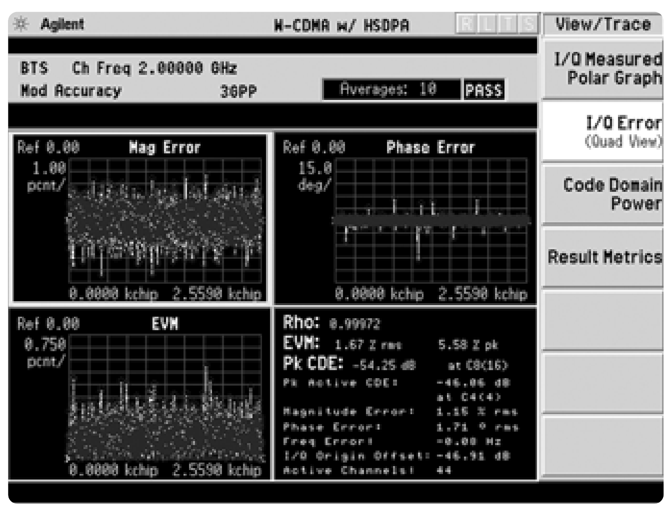


Figure 14.
Error plots



QPSK EVM

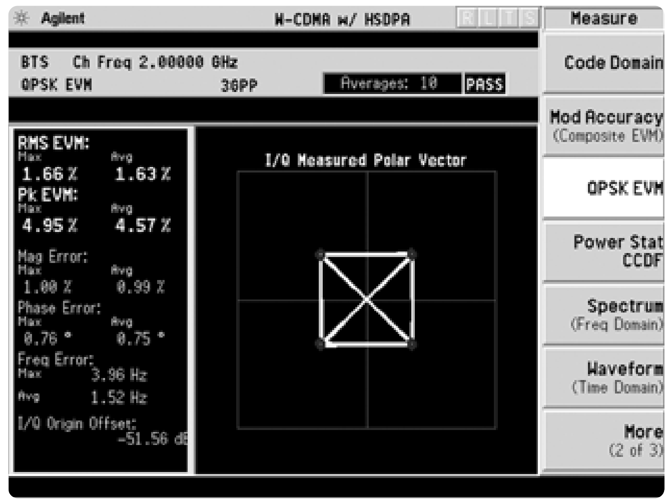
This measurement measures the modulation quality of QPSK modulated signals. The measurement provides an I/Q constellation diagram, error vector magnitude (EVM) in RMS and peak as well as magnitude error versus chip, phase error versus chip, and EVM versus chip.

- measurement interval adjustable from 128 to 5120 chips
- pre-defined constellations of QPSK and 12.2 k RMC for uplink
- EVM with 4096 chips for PRACH preamble
- trigger sources free run, video, burst, frame or external
- adjust alpha from 0.01 to 0.50
- chip rate adjustable
- rotate QPSK display by 45 degrees

This exercise involves changing the W-CDMA signal to a single-channel signal and measuring the error characteristics.

Instructions	Keystrokes
On the ESG:	
Change the W-CDMA signal to 1 DPCH.	{W-CDMA Select} {1 DPCH}
On the PSA:	
Switch on the QPSK EVM measurement (Figure 15).	[MEASURE] {More} {QPSK EVM}
View magnitude and phase error and EVM plots.	[Trace/View] {I/Q Error}

Figure 15.
QPSK EVM



Power statistics (CCDF)

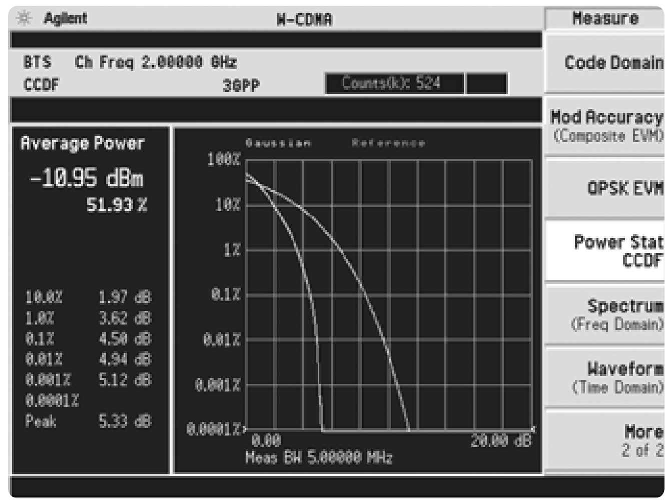
The complementary cumulative distribution function (CCDF) is a plot of peak-to-average power ratio (PAR) versus probability and fully characterizes the power statistics of a signal. It is a key tool for power amplifier design for W-CDMA base stations, which is particularly challenging because the amplifier must be capable of handling the high PAR the signal exhibits while maintaining good adjacent channel leakage performance. Designing multi-carrier power amplifiers pushes complexity yet another step further.

- set a reference trace, compare to Gaussian noise trace
- select measurement bandwidth and measurement interval
- choose trigger source: frame, burst, external, free run, or video

> This exercise illustrates the simplicity of measuring CCDF for W-CDMA.

Instructions	Keystrokes
On the PSA:	
Measure the CCDF (Figure 16). The yellow line is the input signal. The blue reference line is the CCDF of Gaussian noise.	[MEASURE] {More} {Power Stat CCDF}

Figure 16.
CCDF



Multi-carrier power

This measurement is used for adjusting two-carrier power amplifiers to transmit well balanced multiple carriers. This is a combination of ACPR and inter-modulation distortion. The 3GPP standard has strict requirements for multi-carrier intermodulation distortion at ±5 MHz, ±10 MHz and ±15 MHz offsets. The PSA series makes this measurement quickly and easily and provides results in an easy-to-read tabular format. Choose the offset of the second carrier and the measurement will automatically configure the offset channel configuration based on which intermodulation harmonics are selected.

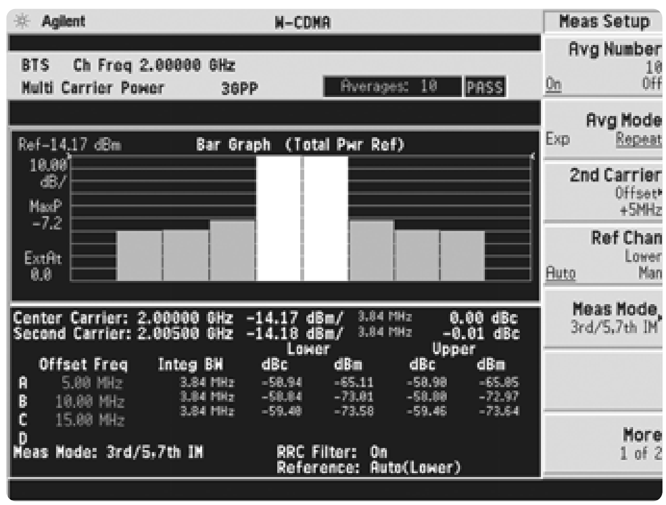
- choose the measurement mode, third IM only, third, fifth and seventh IM or all channels
- select the reference channel or use the auto function to select the reference channel automatically
- adjust the second carrier offset from +15 MHz to –15MHz
- set the limits in either absolute or relative units for each offset A through D
- select a RRC filter and the alpha value

This section requires setting up the ESG to transmit a two-carrier signal to be measured with the PSA.

This exercise examines the offset level in a multi-channel signal.

Instructions	Keystrokes
On the ESG:	
Turn off W-CDMA modulation.	{W-CDMA Off}
Turn on the multi-carrier function.	{Multicarrier On}
Change Freq Offset for rows 1 and 2 to –2.5 MHz and 2.5 MHz, respectively. This sets the carrier frequency separation to 5 MHz.	{Multicarrier Define}, use arrows to highlight desired item, {Edit Item}, key in desired value, {MHz}, repeat, {Apply Multicarrier}
Change the center frequency to 2.0025 GHz (this puts one carrier at 2 GHz and one at 2.005 GHz) and re-activate W-CDMA modulation.	[Return] {W-CDMA On} [Frequency] [2.0025] {GHz}
On the PSA:	
Enable the multi-carrier power measurement.	[MEASURE] {Multi Carrier Power}
Measure three offsets (Figure 17).	{Meas Setup} {Meas Mode} {3rd/5, 7th IM}

Figure 17.
Multi-carrier power



PSA Series Key Specifications[1]

W-CDMA and HSDPA measurement personalities

The following specifications apply only to models E4443A/45A/40A only. Models E4446A and E4448A have similar, but not warranted performance.

Conformance with 3GPP TS 25.141 base station requirements for a manufacturing environment

Note: Those tolerances marked as 95% are derived from 95th percentile observations with 95% confidence. Those tolerances marked as 100% are derived from 100% limit tested observations. Only the 100% limit tested observations are covered by the product warranty.

Sub-clause	Name	3GPP required test instrument tolerance (as of 2002-06)	Instrument tolerance intervals
6.2.1	Maximum output power	0.7 dB (95%)	0.28 dB (95%) (0.71 dB, 100%)
6.2.2	CPICH power accuracy	0.8 dB (95%)	0.29 dB (95%)
6.3.4	Frequency error	12 Hz (95%)	10 Hz (100%)
6.4.2	Power control steps (test model 2)		
	1 dB step	0.1 dB (95%)	0.03 dB (95%)
	0.5 dB step	0.1 dB (95%)	0.03 dB (95%)
	Ten 1 dB steps	0.1 dB (95%)	0.03 dB (95%)
	Ten 0.5 dB steps	0.1 dB (95%)	0.03 dB (95%)
6.4.3	Power dynamic range	1.1 dB (95%)	0.50 dB (95%)
6.4.4	Total power dynamic range	0.3 dB (95%)	0.015 dB (95%)
6.5.1	Occupied bandwidth	100 kHz (95%)	38 kHz (95%)
6.5.2.1	Spectrum emission mask	1.5 dB (95%)	0.59 dB (95%)
6.5.2.2	ACLR		
	5 MHz offset	0.8 (95%)	0.22 dB (100%)
	10 MHz offset	0.8 (95%)	0.22 dB (100%)
6.5.3	Spurious emissions		
	f < 3 GHz	1.5 to 2.0 dB (95%)	0.65 dB (100%)
	3 GHz < f < 4 GHz	2.0 dB (95%)	1.77 dB (100%)
	4 GHz < f < 12.6 GHz	4.0 dB (95%)	2.27 dB (100%)
6.7.1	EVM	2.5% (95%)	1.0% (95%)
6.7.2	Peak code domain error	1.0 dB (95%)	1.0 dB (nominal)

Channel power

Minimum power at RF input	–70 dBm (nominal)
Absolute power accuracy	
Manually set mixer level	±0.71 dB (±0.19 dB typical)
Auto attenuation	±0.80 dB (±0.25 dB typical)

Adjacent channel power ratio (ACPR, ACLR)

Minimum power at the RF input	–27 dBm (nominal)	
Dynamic range (3.84 MHz integration BW)		
5 MHz offset	–74.5 dB (nominal)	
10 MHz offset	–82 dB (nominal)	
ACPR accuracy		
Radio	Offset frequency	
MS (UE)	5 MHz	±0.12 dB (ACPR –30 to –36 dBc)
MS (UE)	10 MHz	±0.17 dB (ACPR –40 to –46 dBc)
BTS	5 MHz	±0.22 dB (ACPR –42 to –48 dBc)
BTS	10 MHz	±0.22 dB (ACPR –47 to –53 dBc)
BTS	5 MHz	±0.17 dB (–48 dBc non-coherent ACPR)

Intermodulation

Minimum carrier power at RF input	–30 dBm (nominal)
Third-order intercept	
CF = 1 GHz	+7.2 dB
CF = 2 GHz	+7.5 dB

1. See PSA series spectrum analyzers data sheet for more specification details (literature number 5980-1284E).

PSA Series Key Specifications – continued

Multi-carrier power

Minimum carrier power at input	–12 dBm (nominal)
ACLR dynamic range, two carriers	
5 MHz offset	–70 dB (nominal)
10 MHz offset	–75 dB (nominal)
ACLR accuracy, two carriers	±0.38 dB (nominal)

Spectrum emission mask

Minimum power at RF input	–20 dBm (nominal)
Dynamic range, relative	
2.515 MHz offset	–86.7 dB (–88.9 dB typical)
1980 MHz region	–80.7 dB (–83.0 dB typical)
Sensitivity, absolute	
2.515 MHz offset	–97.9 dBm (–99.9 dBm typical)
1980 MHz region	–81.9 dBm (–83.9 dBm typical)
Accuracy, relative	
Display = Abs Peak Pwr	±0.14 dB
Display = Rel Peak Pwr	±0.56 dB

Occupied bandwidth

Minimum power at RF input	–40 dBm (nominal)
Frequency accuracy	0.2% (nominal)

Code domain

Code domain power	
Minimum power at RF input	
Preamp off	–75 dBm (nominal)
Preamp on	–102 dBm (nominal)
Relative power accuracy (test model 2)	
CDP between 0 and –10 dBc	±0.015 dB
CDP between –10 and –30 dBc	±0.06 dB
CDP between –30 and –40 dBc	±0.07 dB
Relative power accuracy (test model 5 with 8 HS-PDSCH)	
CDP between 0 and –10 dBc	±0.015 dB (nominal)
CDP between –10 and –30 dBc	±0.08 dB (nominal)
CDP between –30 and –40 dBc	±0.15 dB (nominal)

Modulation accuracy (composite EVM)

Minimum power at RF input	–75 dBm (preamp off, nominal)
Composite EVM accuracy (test model 4)	±1.0%
(test model 5 with 8 HS-PDSCH)	±1.0% (nominal)
Frequency error accuracy	±10 Hz + (transmitter frequency x frequency reference accuracy)
Peak code domain error accuracy	±1.0% (nominal)

QPSK EVM

Minimum power at RF input	–20 dBm (nominal)
EVM accuracy	±1.0% (at EVM of 10%, nominal)

Power statistics CCDF

Minimum carrier power at input	–40 dBm (nominal)
Histogram resolution	0.01 dB

Power control/power vs. time

Absolute power measurement	
Accuracy 0 and –20 dBm	±0.7 dB (nominal)
Accuracy –20 to –60 dBm	±1.0 dB (nominal)
Relative power measurement accuracy	
Step range ±1.5 dB	±0.1 dB (nominal)
Step range ±3.0 dB	±0.15 dB (nominal)
Step range ±4.5 dB	±0.2 dB (nominal)
Step range ±26.0 dB	±0.3 dB (nominal)

Ordering Information

PSA Series spectrum analyzer

E4443A	3 Hz to 6.7 GHz
E4445A	3 Hz to 13.2 GHz
E4440A	3 Hz to 26.5 GHz
E4446A	3 Hz to 44 GHz
E4448A	3 Hz to 50 GHz

Options

To add options to a product, use the following ordering scheme:

Model	E444xA (x = 0, 3, 5, 6 or 8)
Example options	E4440A-B7J E4448A-1DS

Digital demodulation hardware

E444xA-B7J	Digital demodulation hardware (required for digital demodulation measurement personalities)

Digital demodulation measurements

E444xA-BAF	W-CDMA measurement personality
E444xA-210	HSDPA measurement personality[1]
E444xA-202	GSM w/ EDGE measurement personality
E444xA-B78	cdma2000 measurement personality
E444xA-214	1xEV-DV measurement personality[2]
E444xA-204	1xEV-DO measurement personality
E444xA-BAC	cdmaOne measurement personality
E444xA-BAE	NADC, PCD measurement personality

General purpose measurements

E444xA-226	Phase noise measurement personality
E444xA-219	Noise figure measurement personality
E444xA-211	TD-SCDMA measurement personality
E4440A-AYZ	External mixing
E4446A-AYZ	External mixing
E4448A-AYZ	External mixing

Amplifiers

E444xA-1DS	100 kHz to 3 GHz built-in preamplifier

Inputs and outputs

E4440A-BAB	Replaces type-N input connector with APC 3.5 connector

Connectivity software

E444xA-230	BenchLink Web Remote Control Software

Warranty and service

For warranty and service of 5 years, please order 60 months of R-51B (quantity = 60). Standard warranty is 36 months.

R-51B	Return-to-Agilent warranty and service plan

Calibration[3]

For 3 years, order 36 months of the appropriate calibration plan shown below. For 5 years, specify 60 months.

R-50C-001	Standard calibration
R-50C-002	Standards compliant calibration

E4406A vector signal analyzer

E4406A 7 MHz to 4 GHz

Options

To add options to a product, use the following ordering scheme:

Model	E4406A
Example options	E4406A-BAH

Digital demodulation measurements

E4406A-BAF	W-CDMA measurement personality
E4406A-210	HSDPA measurement personality[1]
E4406A-B78	cdma2000 measurement personality
E4406A-214	1xEV-DV measurement personality[2]
E4406A-202	EDGE with GSM measurement personality
E4406A-204	1xEV-DO measurement personality
E4406A-BAH	GSM measurement personality
E4406A-BAC	cdmaOne measurement personality
E4406A-BAE	NADC, PDC measurement personality
E4406A-HN1	IDEN measurement personality

Inputs and outputs

E4406A-B7C	I/Q inputs

Connectivity software

E444xA-230	BenchLink Web Remote Control Software

Warranty and service

For warranty and service of 5 years, please order 60 months of R-51B (quantity = 60). Standard warranty is 36 months.

R-51B	Return-to-Agilent warranty and service plan

Calibration[3]

For 3 years, order 36 months of the appropriate calibration plan shown below. For 5 years, specify 60 months.

R-50C-001	Standard calibration
R-50C-002	Standards compliant calibration

1. Requires Option BAF.
2. Requires Option B78.
3. Options not available in all countries.

Product Literature

Selecting the Right Signal Analyzer for Your Needs, selection guide, literature number 5968-3413E

PSA Series literature

PSA Series, brochure, literature number 5980-1283E

PSA Series, data sheet, literature number 5980-1284E

E4406A VSA literature

E4406A VSA, brochure, literature number 5968–7618E

E4406A VSA, data sheet, literature number 5968–3030E

Application literature

Designing and Testing 3GPP W-CDMA User Equipment, application note, literature number 5980–1238E

Designing and Testing 3GPP W-CDMA Base Stations, application note, literature number 5980–1239E

For more information on the E4406A VSA or the PSA Series, please visit:

www.agilent.com/find/vsa
www.agilent.com/find/psa

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