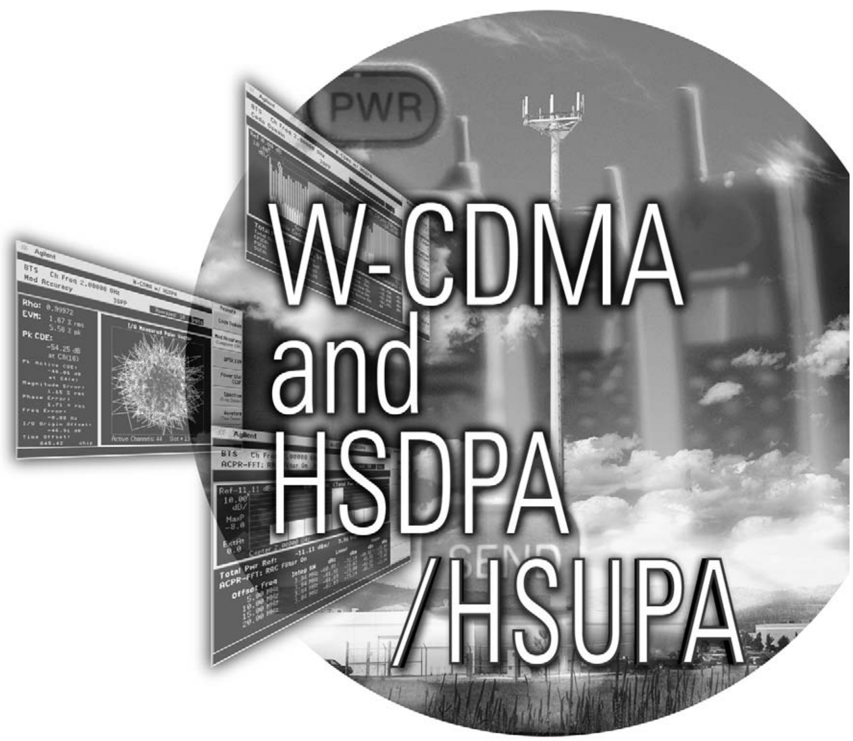
Agilent
PSA Series Spectrum Analyzers W-CDMA and HSDPA/HSUPA Measurement Personalities

Technical Overview with Self-Guided Demonstration Options BAF and 210



The PSA Series, Agilent Technologies' highest performing spectrum analyzers offers comprehensive RF measurement and modulation analysis capabilities.

The W-CDMA and HSDPA/HSUPA 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/HSUPA 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 HSDPA/HSUPA (High Speed Downlink Packet Access/High Speed Uplink Packet Access) 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.
- Track the latest 3GPP standard with firmware updates.

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/HSUPA (Option 210) measurement 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 though 6. To enable modulation analysis of HSDPA and HSUPA signals like downlink HS-PDSCH in 16QAM and 64QAM and uplink E-DPDCH with spreading factor 2 defined in 3GPP Release 5 and 6, the HSDPA/HSUPA measurement personality (Option 210) is needed.

This technical overview includes:

- Measurement details
- Demonstrations
- PSA Series key specifications for W-CDMA and HSDPA/HSUPA 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 PSA Series and the N5182A MXG vector signal generator. Keystrokes surrounded by [ ] indicate hard keys located on the front panel, while key names surrounded by { } indicate soft keys located on the right edge of the display.

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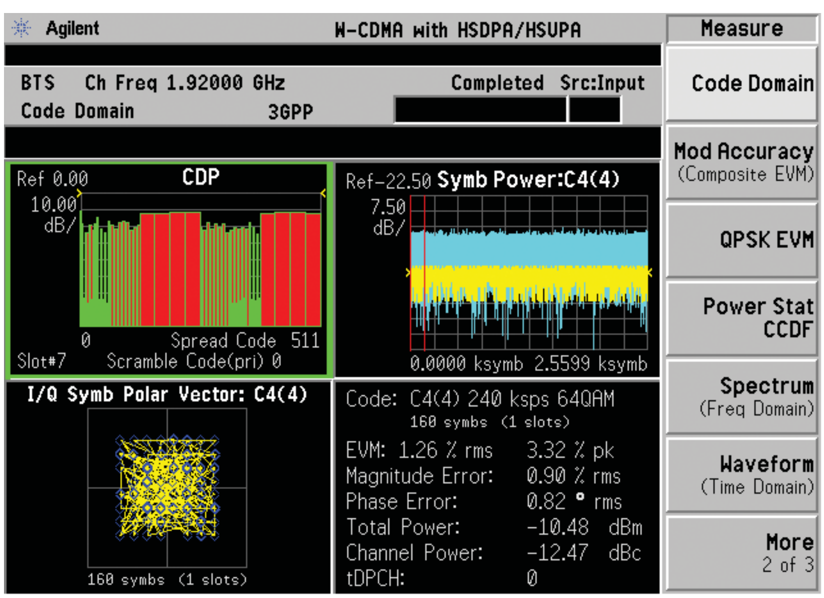

Code domain analysis for a W-CDMA with HSDPA PSA Series spectrum analyzer with Options BAF and 210

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Power statistics (CCDF) page 16

Available measurements

W-CDMA measurement personality (Option BAF)

- Channel power
- Adjacent channel power ratio (ACPR/ACLR)
- Intermodulation
- Multi-carrier power
- Spectrum emission mask
- Occupied bandwidth
- Code domain analysis
- Modulation accuracy (composite EVM)
- QPSK EVM
- Power statistics (CCDF)
- Power control (slot power, PRACH power, and slot phase for UE phase discontinuity)
- Power vs time

HSDPA/HSUPA Option 210 adds the following capabilities to BAF

- Code domain analysis
- Pre-defined test model 5 and 6
- HS-PDSCH 64QAM/16QAM/QPSK auto-detection
- Demodulated bits in binary/ hexadecimal format
- Adaptive modulation and coding (AMC) support
- Correct power beta calculation based on DPCH/E-DPCH configuration defined in 3GPP TS25.213
- E-RGCH/E-AGCH/E-HICH analysis in downlink
- E-DPCCH and E-DPDCH in SF 2 demodulation
- Modulation accuracy
- HSDPA and HSUPA signals for EVM and DL Relative CDE

Demonstration preparation

The following options are required for the ESG and the PSA Series in order to perform this demonstration. Please update the firmware to the latest version, available at: **www.agilent.com/find/psa**

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).

Product type	Model number	Required options
ESG vector signal generator	E4438C	503, 504, or 506 – frequency range up to at least 3 GHz 601 or 602 – baseband generator 400 – 3GPP W-CDMA-FDD 418 – HSDPA over W-CDMA (not required in this self-guided demo)
Signal Studio software	N7600B	3GPP W-CDMA (not required in this self-guided demo)
PSA Series spectrum analyzer	E4440A/E4443A/ E4445A/ E4446A/ E4447A/E4448A (firmware revision A.11.04 or later)	B7J – Digital demodulation hardware BAF – W-CDMA measurement personality 210 – HSDPA/HSUPA measurement personality

Instructions	Keystrokes
On the ESG:	
Set the carrier frequency to 1.92 GHz.	[Preset] [Frequency] [1.92] {GHz}
Set amplitude to –20 dBm.	[Amplitude] [–20] {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.

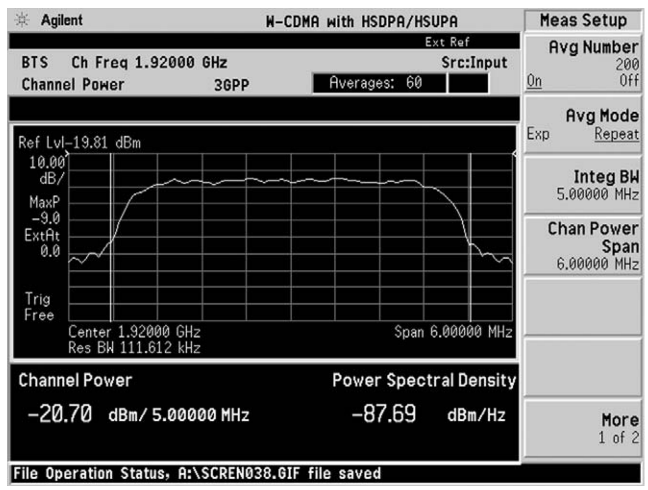
Control the following channel power measurement parameters:

- 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.	[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 1.92 GHz.	[Preset] [Frequency] [1.92] {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 (Figure 1).	[MEASURE] {Channel Power}

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.	[Meas Setup] {Ofs & Limits} {Rel Lim (Car)} [–90] {dBc}
Notice as the green PASS indicator in the upper right corner changes to a red FAIL when the signal does not meet limit requirements.	
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]

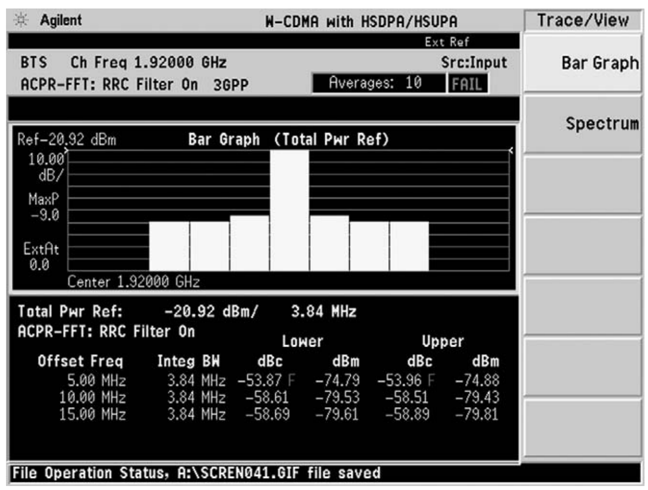


Figure 2.
Multi-offset ACPR

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 (excerpt from the 3GPP TS25.104 v6.17.0 (2008-3). PSA has test limits defined in TS 25.141 v6.19.0 (2008-03) by default. 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}

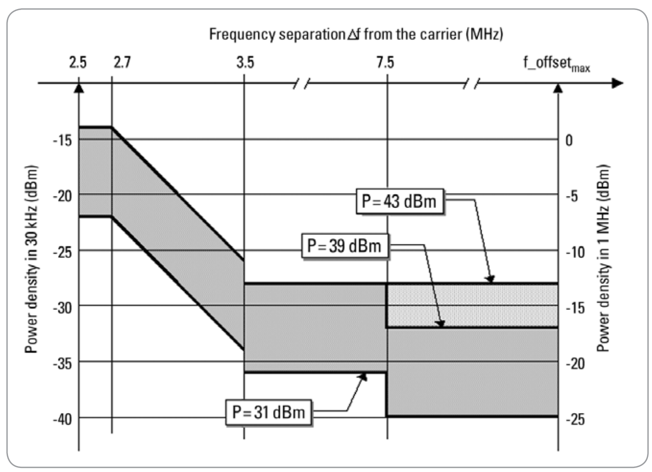


Figure 3. W-CDMA specification for spectrum emission mask (from TS25.104 v6.17.0 (2008-03))

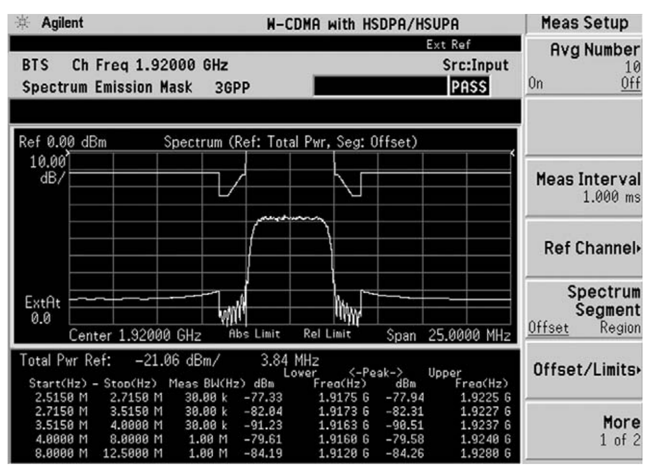


Figure 4. Spectrum emission mask

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}

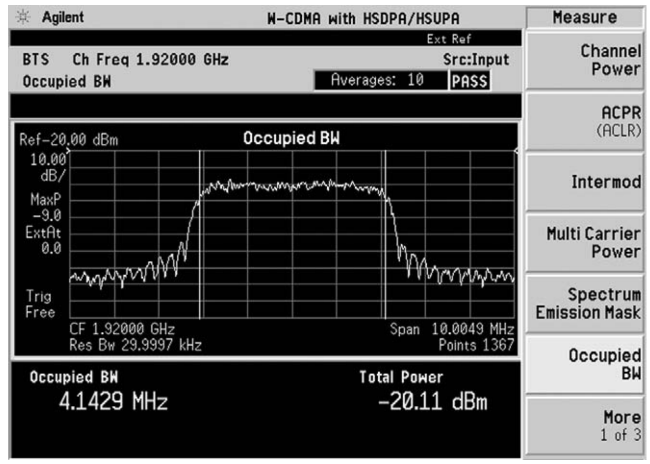


Figure 5. Occupied bandwidth

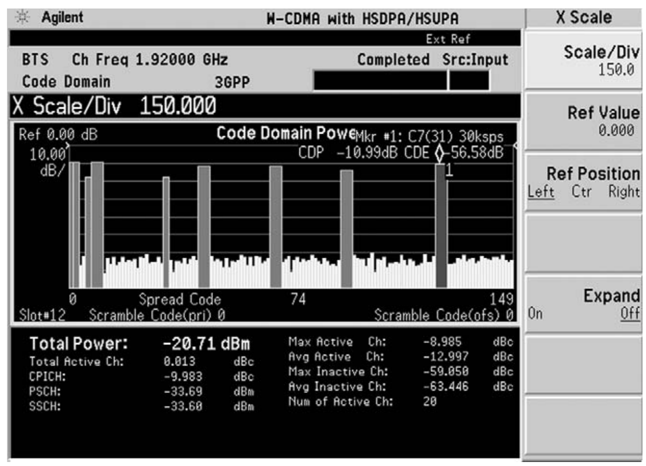
Code domain analysis

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, antenna-2 CPICH in STTD, SCH antenna-1 or 2 in TSTD 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, CDP and CDE graphs, 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 8 or 16 frames with capture interval.
- Add advanced symbol analysis for compressed mode, burst/DTX and closed loop diversity support.
- Share the captured data with modulation accuracy for in-depth analysis and troubleshooting.

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



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

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 demodulated. W-CDMA combats this by replacing the lost bits with Xs so the operator can see which bits are lost.

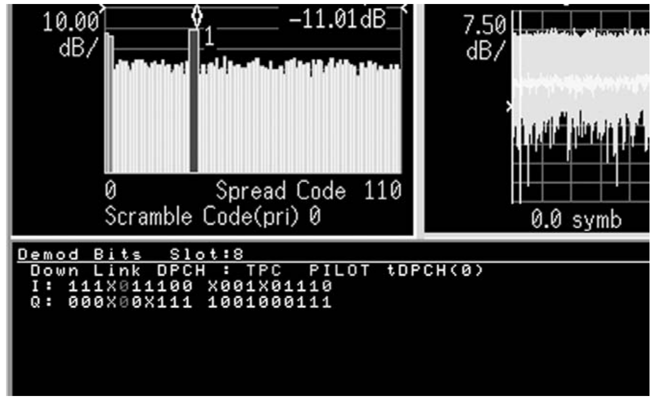
Select DTX/Burst Detect ON under {Symbol Analysis} key under [Meas Setup]. This helps to detect any DTX or burst power off period in code channel during the capture interval. Figure 7 is an example of how X's are shown in demodulated bits. Figure 8 also shows PICH power off period by X's in demodulated 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.

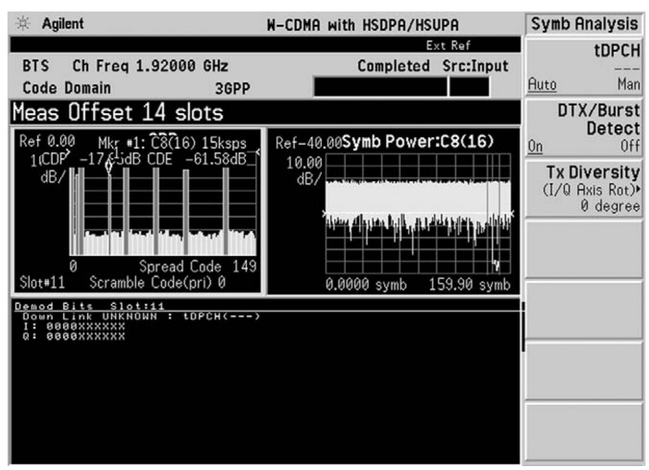
This exercise examines the characteristics of the marked code channel.

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.	[Meas Setup] {Meas offset}, rotate KNOB, [↑] or [↓]
Change bit format from binary (0,1) to tri-state (0,1,X) to make burst off period more visible (Figure 8).	[Meas Setup] {More} {Symbol Analysis} {DTX/Burst Detect On/Off}

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 PSA:	
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/HSDPA code channel.

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}
Change from active channel ID to measure test model 5 with 8 HS-PDSCH.	[Meas Setup] {More} {Symbol Boundary} {Pre-Defined Test Models} {Test Model 5 w/8 HSDPSCH}
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 that channel. (Figure 9)	[Marker] [140] [Enter]

Now examine the HSDPA signal capture options.

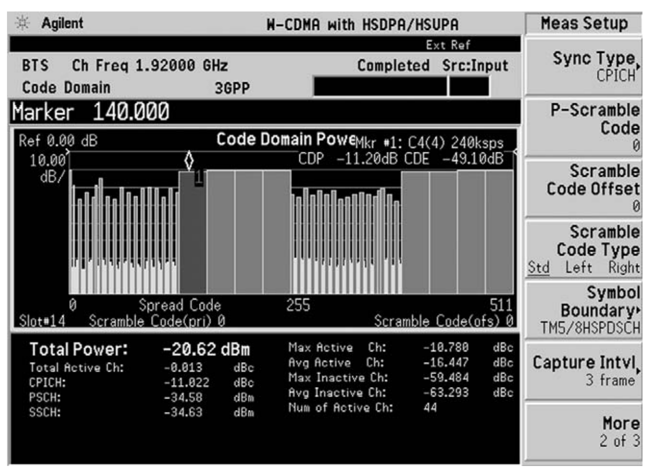


Figure 9. Setting the capture interval

More powerful analysis for HSPA downlink is available.

- Pre-defined test model 5 and 6 for fast measurement
- Auto-detection of modulation scheme as QPSK, 16QAM or 64QAM
- 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:	
Switch the view to observe the selected HS-PDSCH. (Marker at 140).	[Trace/View] {Code Domain (Quad view)}
Despread the marked code channel (Figure 10). The 16 QAM modulated channel can be seen in symbol polar vector.	[Marker] {More} {Mkr → Despread}
Change the view for demodulated bits, move selected window to the bottom, and switch format from binary to hexadecimal (Figure 11).	[Trace/View] {Demod Bits} [Next Window] [Display] {Demod Bit Format Bin/Hex}

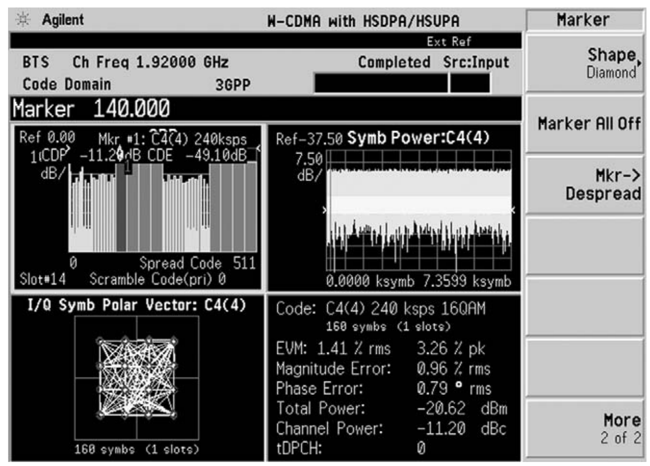


Figure 10. Code domain quad view

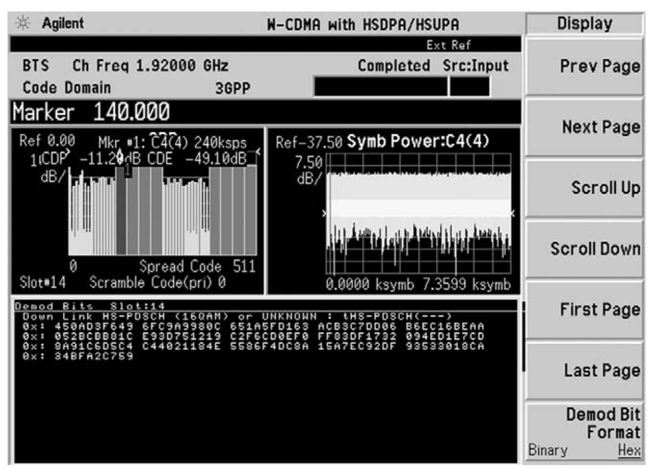


Figure 11. Demodulated bits in hexadecimal

HSUPA in 3GPP release 6

These are sample screen shots with HSUPA signals created by Agilent ESG E4438C with N7600B Signal Studio software. It contains DPCCH, E-DPCCH and 4 E-DPDCH at 1.92 GHz with -20 dBm.

For details, please visit **http://www.agilent.com/find/signalgenerator/.**

HSUPA measurement capabilities are newly added over Option 210 on PSA firmware revision 9 or later. If Option BAF (W-CDMA) and 210 (HSDPA) are already installed to your PSA, please upgrade the firmware to the latest revision to obtain the HSUPA analysis features in Code Domain and Modulation Accuracy.

For the firmware updates, please visit **http://www.agilent.com/find/psa_firmware/**.

Following features are available for HSUPA with Option 210.

- Auto-detection of E-DPDCH in spreading factor 2
- E-DPCCH power beta based on 3GPP standard configuration
- Adaptive modulation support
- Relative code domain error result

High Speed Uplink Packet Access (HSUPA) is a new technology over W-CDMA and HSDPA defined 3GPP release 6 to improve the uplink data rate. It is also described as E-DCH (Enhanced Dedicated Channel) in 3GPP standards. Theoretically it may improve the uplink data rate to 5.76 Mbps with new physical channels of E-DPCCH (E-DCH Dedicated Physical Control Channel) and E-DPDCH. (E-DCH Dedicated Physical Data Channel). In downlink, there are three new physical channels for HSUPA as E-AGCH (E-DCH Absolute Grant Channel), E-RGCH (E-DCH Relative Grant Channel), and E-HICH (E-DCH HARQ Indicator Channel).

Theoretical Bit Rate

Effective coding rate	**Number of data channels / spreading factor (SF)**			
	1 @ SF4	2 @ SF4	2 @ SF2	2 @ SF4 2 @ SF2
1/2	480 kbps	960 kbps	1920 kbps	2880 kbps
3/4	720 kbps	1440 kbps	2880 kbps	4320 kbps
4/4	950 kbps	1920 kbps	3840 kbps	5760 kbps

Figure 12. HSUPA uplink code domain analysis

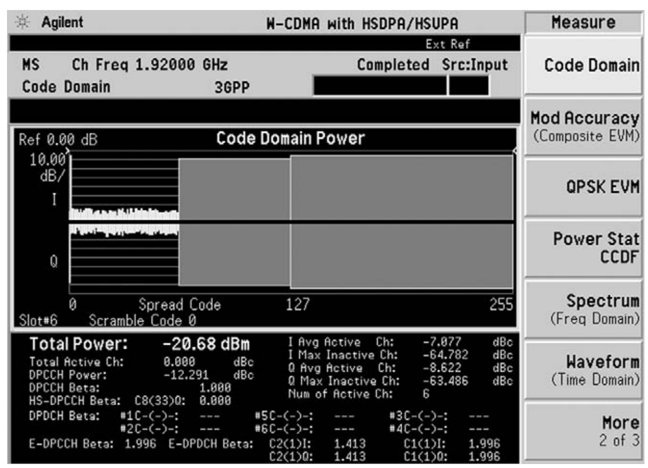
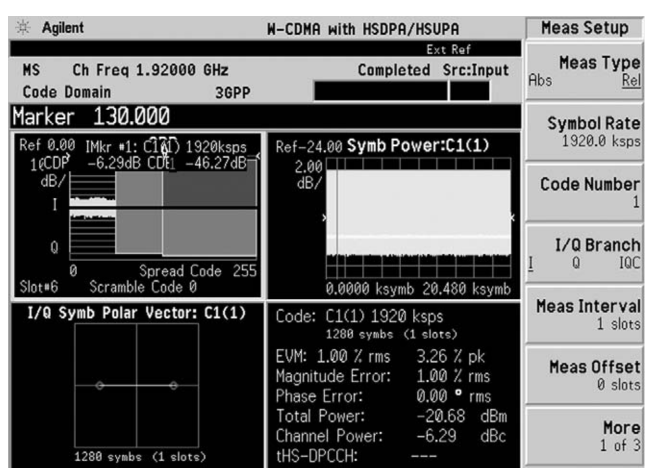


Figure 13. Symbol analysis of E-DPDCH in spreading factor 2 (1920 ksps)



Modulation accuracy (composite EVM)

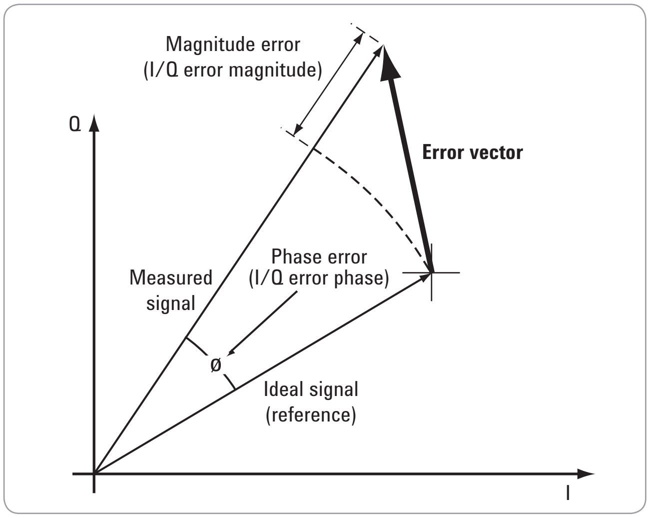
An effective way to quantify modulation accuracy is to compare the signal being measured to an ideal signal. Figure 12 defines the error vector, a measure of the amplitude and phase differences between the ideal modulated signal and the actual modulated signal.

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 14.
Error plots of EVM, magnitude error, and phase error over 15 slots



Key features in modulation accuracy:

- Report EVM, peak code domain error, relative code domain error, phase, magnitude and frequency errors
- Extend capture interval up to 15 slots for 3GPP release 6 support
- Add capture summary table and Avg/Peak view for easier result analysis
- Test model compliance from 1 to 6
- 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 in STTD, SCH antenna-1 or 2 in TSTD 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
- View the captured signal in I/Q polar graph, I/Q error, code domain power, Peak/Avg metrics, and slot CDE/EVM
- Share the captured data with code domain for in-depth analysis

When Option 210 HSDPA/HSUPA is installed, the same measurement features are applicable on HSDPA and HSUPA configured signals for both downlink and uplink.

This exercise explores the different ways in which the modulation accuracy measurement can be used for HSDPA downlink signals.

Instructions	Keystrokes
On the PSA:	
Activate modulation accuracy measurement (Figure 15). Observe the I/Q measured polar vector display on the right and the quantitative data provided on the left.	[MEASURE] {More} {Mod Accuracy} [Meas Control] {Measure Single}
View magnitude and phase error and EVM plots. (Figure 16).	[Trace/View] {I/Q Error}

Figure 15. Modulation accuracy of HSDPA signal

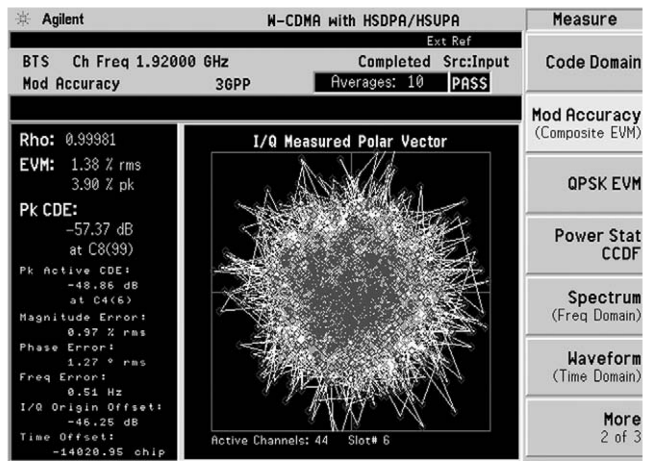
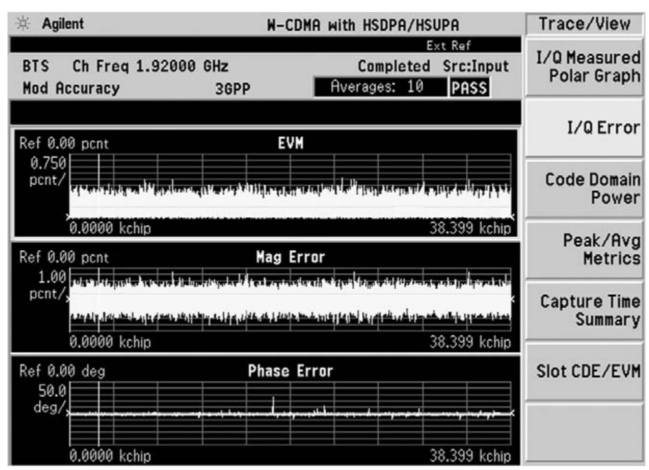


Figure 16. Error plots of magnitude error,phase error, and EVM over 15 slots



Instructions	Keystrokes
On the PSA:	
View code domain power to check the channel power and CDE. You can look through the list by expanding the view with the Zoom key (Figure 17).	[Trace/View] {Code Domain Power} [Next Window] [Zoom] [Display] {Next Page} or {Scroll Down}
View the Peak/Avg metrics to monitor the worst value over the averaging period.	[Trace/View] {Peak/Avg Metrics}
View the result summary table over the captured 15 slots. You can find the average over the captured period on the bottom and worse results over 15 slots can be seen in yellow.	[Trace/View] {Capture Time Summary}
View the EVM, peak CDE and frequency error in the slot based trace (Figure 18).	[Trace/View] {Slot CDE/EVM}

Figure 17.
Code domain power list in modulation accuracy

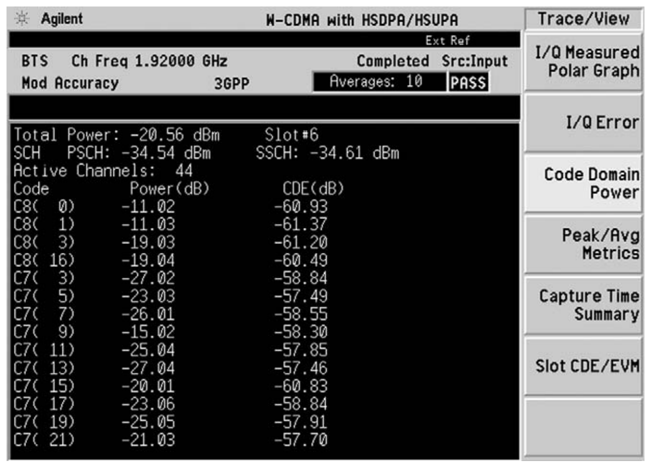
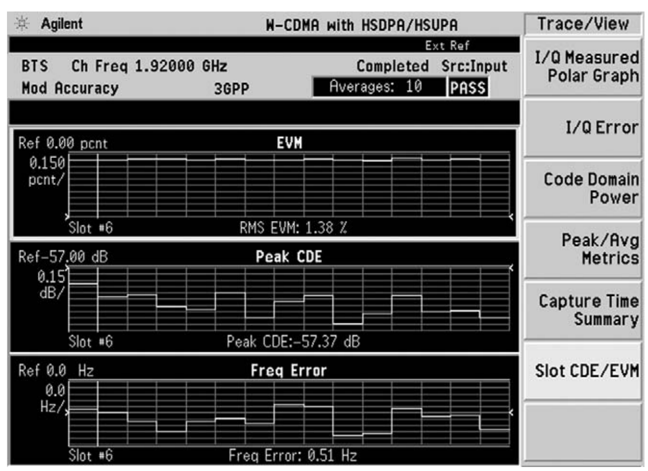


Figure 18.
Slot-based trace for EVM, peak CDE and frequency error



Power statistics (CCDF)

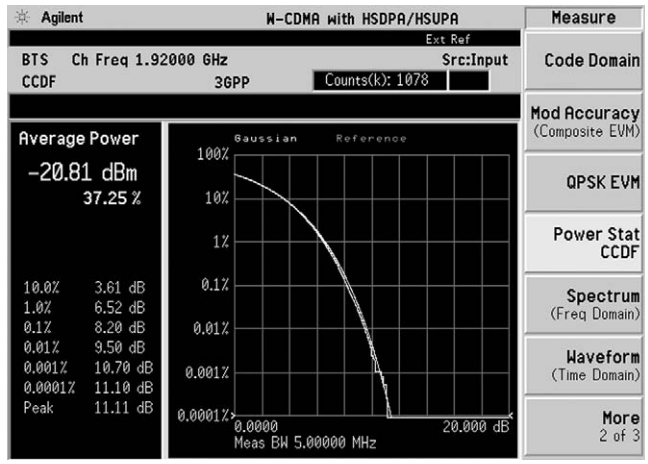
The complementary cumulative distribution function (CCDF) is a plot of peak-to-average power ratio (PAR) versus probability and fully characterizes the power statistics of a signal. It is a key tool for power amplifier design for W-CDMA base stations, which is particularly challenging because the amplifier must be capable of handling the high PAR which 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 19). The yellow line is the input signal. The blue reference line is the CCDF of Gaussian noise.	[MEASURE] {More} {Power Stat CCDF}

Figure 19. CCDF



PSA Series Key Specifications [1]

W-CDMA and HSDPA/HSUPA 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	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)

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

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

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

PSA Series Key Specifications, continued

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)

PSA Series 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
E4447A	3 Hz to 42.98 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, 7 or 8)

Example options	E4440A-B7J, E4448A-1DS

Warranty & service

Standard warranty is one year.

R-51B-001-3C	1-year return-to-Agilent warranty extended to 3 years

Calibration [1]

Recommended calibration cycle is two years

R-50C-011-3	Inclusive calibration plan, 3 year coverage
R-50C-013-3	Inclusive calibration plan and cal data, 3 year coverage
E444xA-0BW	Service manual
E444xA-UK6	Commercial calibration certificate with test data
E444xA-A6J	Factory ANSI Z540 standard-compliant calibration
E444xA-1A7	Factory ISO 17025 standard-compliant calibration
R-52A	Calibration software and licensing (ordered with PSA)
N7810A	PSA Series calibration application software (stand-alone order)

1. Options not available in all countries

Measurement personalities

E444xA-226	Phase noise	
E444xA-219	Noise figure	Requires Option 1DS or 110 to meet specifications
E444xA-241	Flexible digital modulation analysis	
E444xA-BAF	W-CDMA	Requires B7J
E444xA-210	HSDPA/HSUPA (for W-CDMA)	Requires B7J and BAF
E444xA-202	GSM w/ EDGE	Requires B7J
E444xA-B78	cdma2000	Requires B7J
E444xA-214	1xEV-DV	Requires B7J and B78
E444xA-204	1xEV-DO	Requires B7J
E444xA-BAC	cdmaOne	Requires B7J
E444xA-BAE	NADC, PCD	Requires B7J
E444xA-217	WLAN	Requires 122 or 140
E444xA-211	TD-SCDMA power measurement	
E444xA-212	TD-SCDMA modulation	Requires B75
E444xA-213	HSPA for TD-SCDMA	Requires Option B75 and 212
E444xA-215	External source control	
E444xA-266	Programming code compatibility suite	
E444xA-233	Built-in measuring receiver personality	
E444xA-23A	AM/FM/PM triggering	Requires Option 233
E444xA-23B	CCITT filter	Requires Option 233
E444xA-239	N9039A RF preselector control	

PSA Series Ordering Information (continued)

Hardware

E444xA-1DS	RF internal preamplifier (100 kHz to 3 GHz)	Excludes 110
E444xA-110	RF/μW internal preamplifier (10 MHz to upper frequency limit of the PSA)	Excludes 1DS
E444xA-B7J	Digital demodulation hardware	
E444xA-122	80 MHz bandwidth digitizer	E4440A/43A/45A/46A/48A, excludes 140, 107, H70
E444xA-140	40 MHz bandwidth digitizer	E4440A/43A/45A/46A/48A, excludes 122, 107, H70
E444xA-123	Switchable MW preselector bypass	Excludes AYZ (For E4446A/48A, Option HY3 allows coexistance of 123 and AYZ)
E444xA-124	Y-axis video output	
E444xA-AYZ	External mixing	E4440A/47A/46A/48A only, excludes 123 (For E4446A/48A, Option HY3 allows coexistance of 123 and AYZ)
E444xA-107	Audio input 100 kΩ	Requires 233 to operate; excludes 122, 140
E444xA-111	USB device side I/O interface	Shipped standard since September 2007
E444xA-115	512 MB user memory	Shipped standard in all PSA instruments with serial number prefix ≥ MY4615 unless 117 license is activated
E444xA-117	Secure memory erase	Excludes 115
E4440A-BAB	Replaces type-N input connector with APC 3.5 connector	
E444xA-H70	70 MHz IF output	Excludes 122, 140. Not available for E4447A
E444xA-HYX	21.4 MHz IF output	Available for all PSA models
E444xA-HY3	Switched LO for Options AYZ and 123	For E4446A/48A only

PC software

E444xA-230	BenchLink Web Remote Control Software	
E444xA-235	Wide BW digitizer external calibration wizard	Requires 122 or 140 E4443A/45A/40A/46A/48A

Accessories

E444xA-1CM	Rack mount kit
E444xA-1CN	Front handle kit
E444xA-1CP	Rack mount with handles
E444xA-1CR	Rack slide kit
E444xA-015	6 GHz return loss measurement accessory kit
E444xA-045	Millimeter wave accessory kit
E444xA-0B1	Extra manual set including CD ROM

Related Literature

Publication title	Publication type	Publication number
PSA in general		
Selecting the Right Signal Analyzer for Your Needs	Selection Guide	5968-3413E
PSA Series	Brochure	5980-1283E
PSA Series	Data Sheet	5980-1284E
PSA Series	Configuration Guide	5989-2773EN
Self-Guided Demonstration for Spectrum Analysis	Product Note	5988-0735EN
Wide bandwidth and vector signal analysis		
40/80 MHz Bandwidth Digitizer	Technical Overview	5989-1115EN
Using Extended Calibration Software for Wide Bandwidth Measurements, PSA Option 122 & 89600 VSA	Application Note 1443	5988-7814EN
PSA Series Spectrum Analyzer Performance Guide Using 89601A Vector Signal Analysis Software	Product Note	5988-5015EN
89650S Wideband VSA System with High Performance Spectrum Analysis	Technical Overview	5989-0871EN
Measurement personalities and applications		
Phase Noise Measurement Personality	Technical Overview	5988-3698EN
Noise Figure Measurement Personality	Technical Overview	5988-7884EN
External Source Measurement Personality	Technical Overview	5989-2240EN
Flexible Digital Modulation Analysis Measurement Personality	Technical Overview	5989-1119EN
W-CDMA and HSDPA/HSUPA Measurement Personalities	Technical Overview	5988-2388EN
GSM with EDGE Measurement Personality	Technical Overview	5988-2389EN
cdma2000® and 1xEV-DV Measurement Personalities	Technical Overview	5988-3694EN
1xEV-DO Measurement Personality	Technical Overview	5988-4828EN
cdmaOne Measurement Personality	Technical Overview	5988-3695EN
WLAN Measurement Personality	Technical Overview	5989-2781EN
NADC/PDC Measurement Personality	Technical Overview	5988-3697EN
TD-SCDMA Measurement Personality	Technical Overview	5989-0056EN
Built-in Measuring Receiver Personality/Agilent N5531S Measuring Receiver	Technical Overview	5989-4795EN
BenchLink Web Remote Control Software	Product Overview	5988-2610EN
IntuiLink Software	Data Sheet	5980-3115EN
Programming Code Compatibility Suite	Technical Overview	5989-1111EN
EMI Measurement Receiver	Technical Overview	5989-6807EN
Hardware options		
PSA Series Spectrum Analyzers Video Output (Option 124)	Technical Overview	5989-1118EN
PSA Series Spectrum Analyzers, Option H70,70 MHz IF Output	Product Overview	5988-5261EN
Spectrum analyzer fundamentals		
Optimizing Dynamic Range for Distortion Measurements	Product Note	5980-3079EN
PSA Series Amplitude Accuracy	Product Note	5980-3080EN
PSA Series Swept and FFT Analysis	Product Note	5980-3081EN
PSA Series Measurement Innovations and Benefits	Product Note	5980-3082EN
Spectrum Analysis Basics	Application Note 150	5952-0292
Vector Signal Analysis Basics	Application Note 150-15	5989-1121EN
8 Hints for Millimeter Wave Spectrum Measurements	Application Note	5988-5680EN
Spectrum Analyzer Measurements to 325 GHz with the Use of External Mixers	Application Note 1453	5988-9414EN
Making Precompliance EMI Measurements	Application Note 150-10	5989-1550EN

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