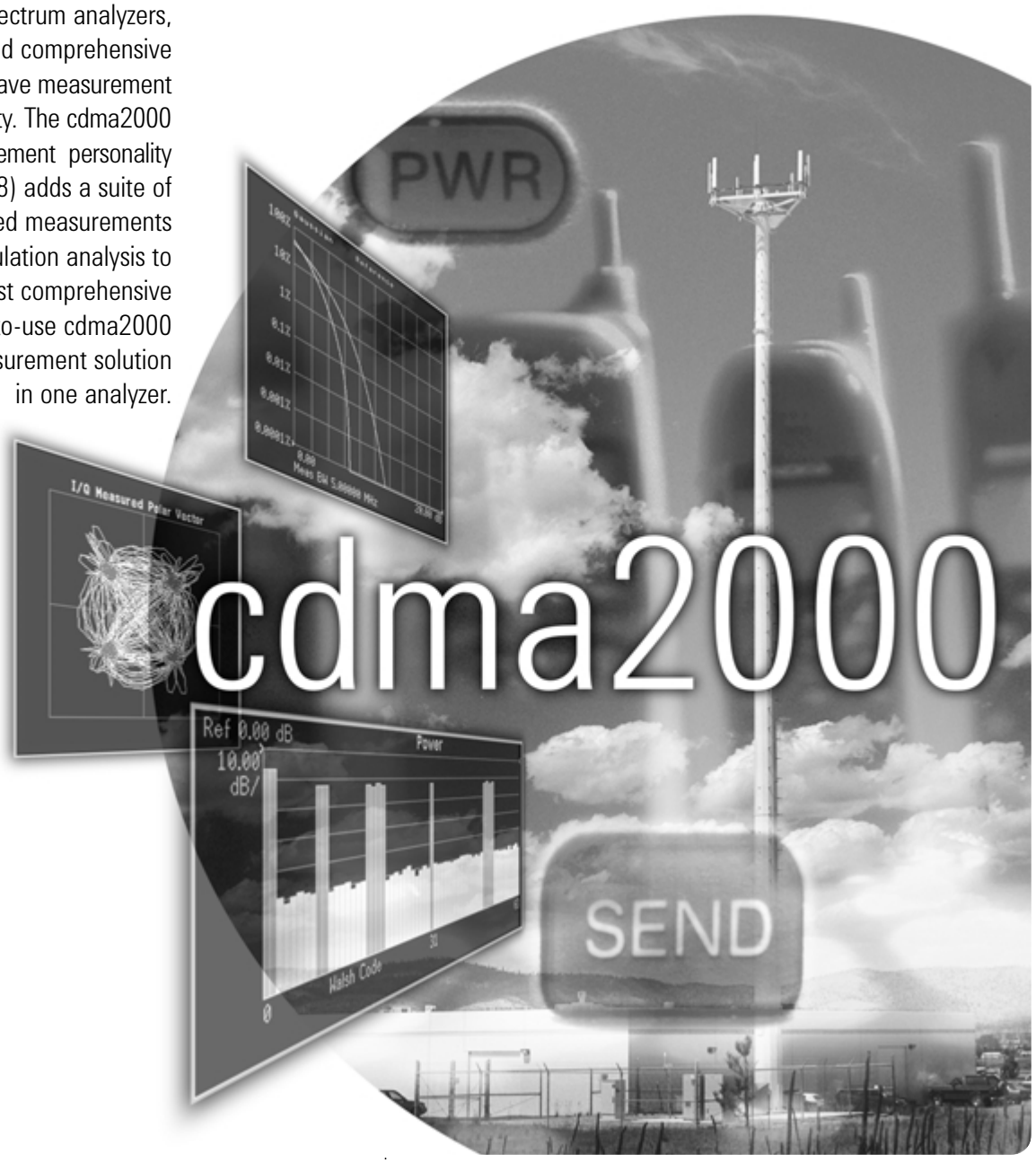
Agilent
PSA Series Spectrum Analyzers
cdma2000 Measurement Personality

Product Overview

The PSA series, Agilent Technologies' highest performing spectrum analyzers, offer advanced and comprehensive RF and microwave measurement capability. The cdma2000 measurement personality (Option B78) adds a suite of standard-based measurements with digital modulation analysis to provide the most comprehensive and easy-to-use cdma2000 measurement solution in one analyzer.



Agilent Technologies

Make the transition to third-generation (3G) wireless technology faster and easier

Migrating from cdmaOne to cdma2000 will introduce new challenges in design and test of base stations and mobile transmitters. Be at ease in this transition with a comprehensive, one analyzer solution from Agilent.

- 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 PSA series of high-performance spectrum analyzers provides exceptional levels of speed, accuracy, flexibility, and dynamic range. It also offers the most complete and easy-to-use, one-button RF power measurements with format-based setups for popular communications standards. Add the optional cdma2000 measurement personality for standards-based advanced power and digital demodulation measurements.

- sophisticated spectrum and modulation analysis
- examine multiple layers of a signal with comprehensive analysis from channel power to demodulated I/Q bits
- in-channel and out-of-channel measurements
- easy to use customizable limits and intuitive displays with pass/fail indicators and color graphics
- measurements derived from Agilent's E4406A vector signal analylzer (VSA) cdma2000 measurement personality incorporating three iterations of customer feedback

cdma2000 measurements

The cdma2000 personality provides key transmitter measurements for analyzing systems based on the 3GPP2 TSGC standards (March 2001). Measurements may be performed on the forward and reverse link signals.

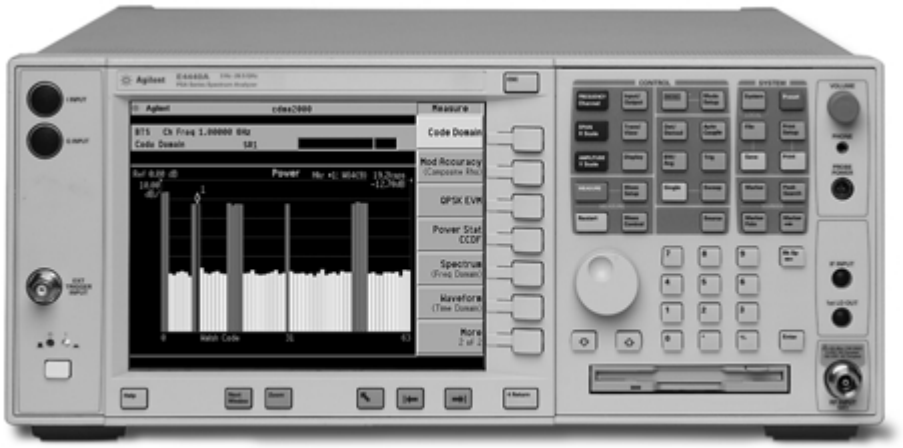
Channel power

ACPR

Occupied bandwidth

Spectrum emission mask

Code domain analysis



Modulation accuracy

QPSK EVM

Power statistics (CCDF)

Intermodulation distortion

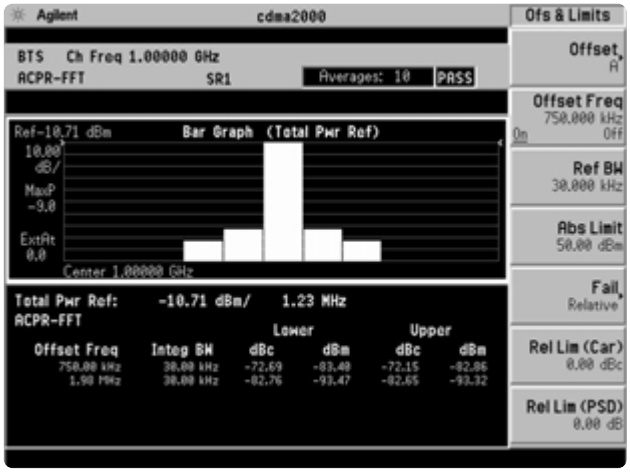
Spectrum and waveform

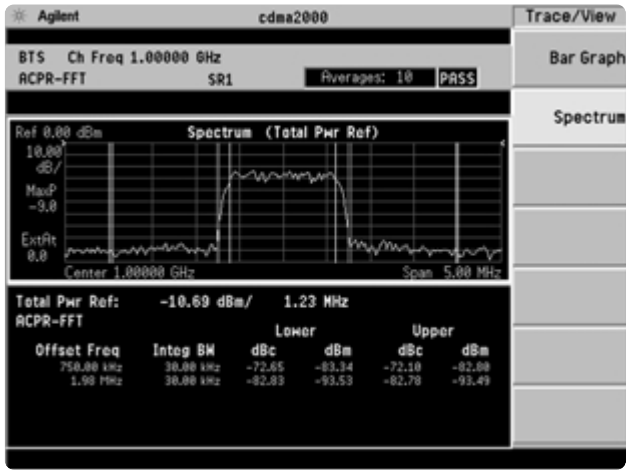
Channel power

The channel power measurement determines the total rms power in a user-specified bandwidth. The power spectral density (PSD) is also displayed in dBm/Hz.

Control the following channel power measurement parameters:

- integration bandwidth (defaults to 1.23 MHz)
- channel power span (defaults to 2 MHz)
- number of trace averages (defaults to 20)
- data points displayed (64 to 65536, defaults to 512)

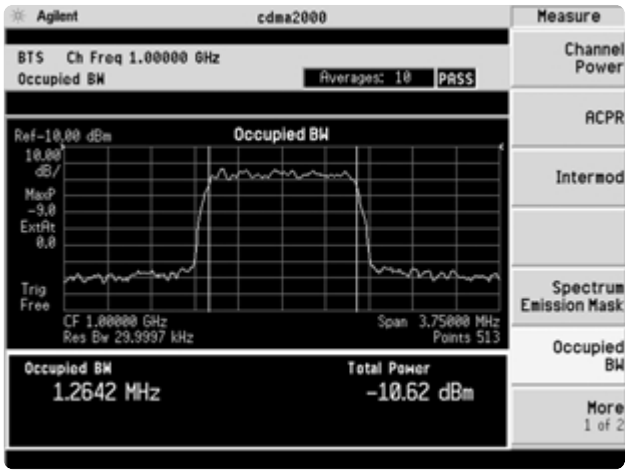




Adjacent channel power ratio (ACPR)

To maintain a quality call by avoiding channel interference, it is important to measure and reduce any adjacent channel leakage power transmitted from a base station. Reducing transmitter channel leakage allows for more channels to be transmitted simultaneously, which, in turn, increases base station efficiency. The characteristics of adjacent channel leakage power are mainly determined by the transmitter design. The adjacent channel power ratio is a measure of the power in adjacent channels relative to the transmitted power.

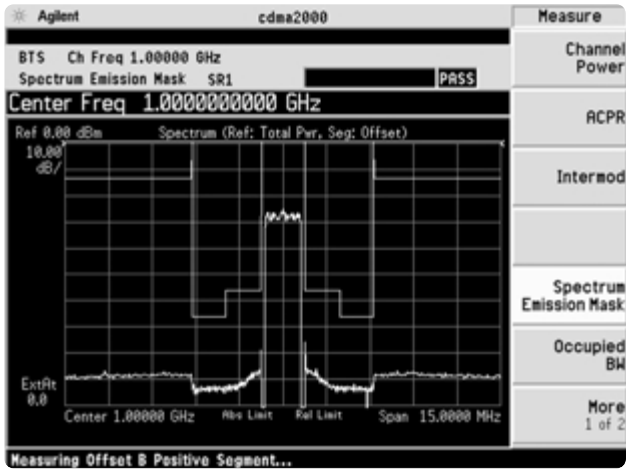
- adjust integration bandwidth (defaults to 1.23 MHz)
- evaluate up to five adjacent channel pairs
- choose adjacent channel offset frequency, reference bandwidth, and limit values
- adjust and display both absolute and relative limits
- troubleshoot with a FFT-based sweep
  - customizable resolution bandwidth and detector settings
  - variable sweep acquisition time for better repeatability
- measure the total power in dBm or the PSD in dBm/Hz
- view bar graph or spectrum



Occupied bandwidth

The standards recommended by the 3GPP2 for cdma2000 have occupied bandwidth (OBW) requirements for some of the band classes. Effectively, OBW determines the frequency bandwidth that contains 99 percent of the total radiated power.

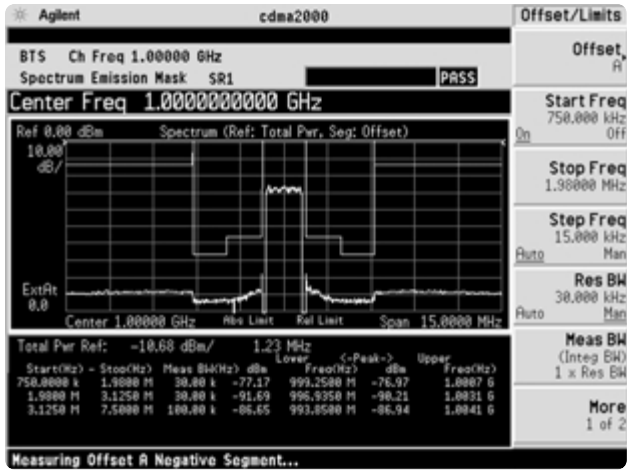
- specify the resolution bandwidth (defaults to 30 kHz) and the span (defaults to 3.75 MHz)
- customize a simple PASS/FAIL limit test (defaults to 1.48 MHz)
- specify number of averages (defaults to 10)

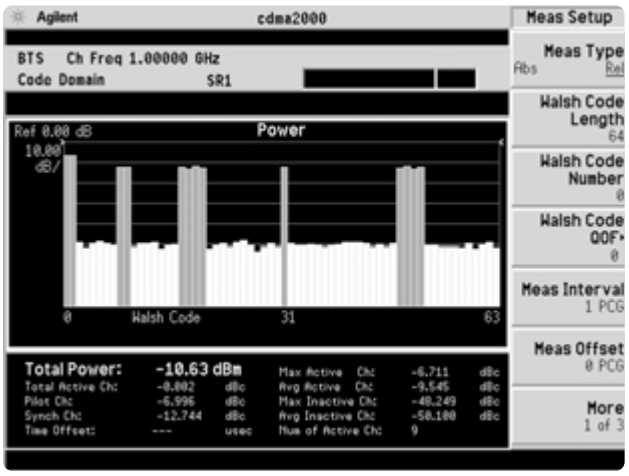


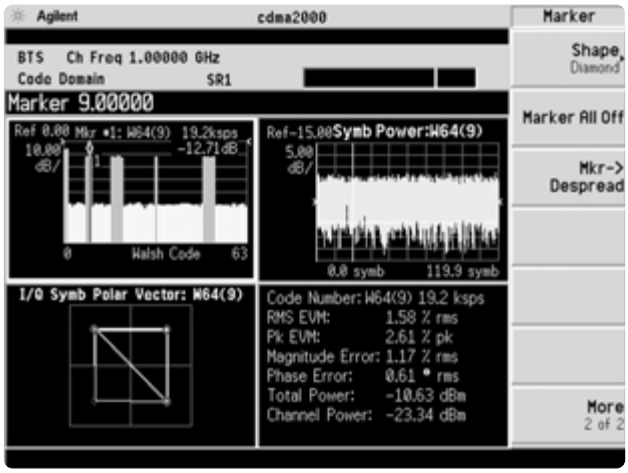
Spectrum emission mask

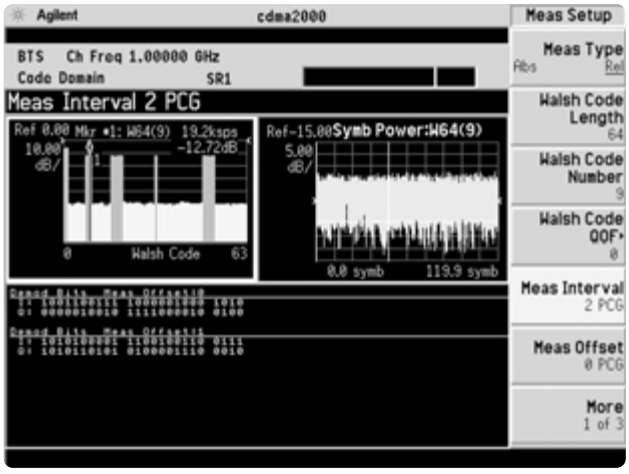
The performance standards recommended by the 3GPP2 for cdma2000 have specific limits for transmitted spurious emissions. This measurement has different limits for different frequency offsets measured in different resolution bandwidths. Completing this measurement with a traditional spectrum analyzer can be tedious and time consuming. The PSA makes this measurement with one button press.

- view table and spectrum formats
- measure the total power in dBm or the PSD in dBm/Hz
- select the average or peak detector (defaults to average)
- adjust measurement interval (defaults to 1 ms)
- choose offset frequency, reference bandwidth, and limit values
- optimize speed and accuracy with variable measurement bandwidth
- customize reference channel span, step frequency, and resolution bandwidth





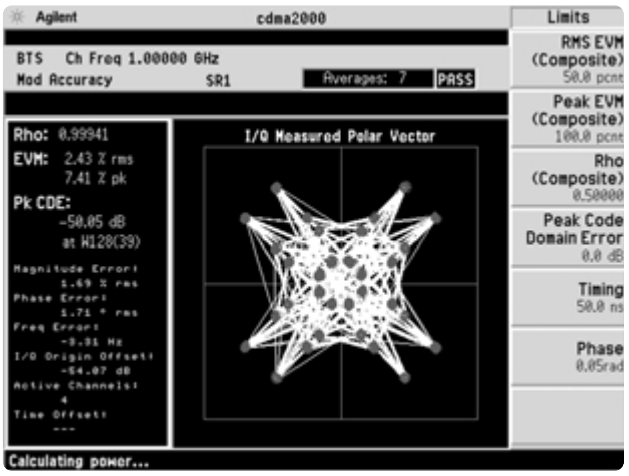


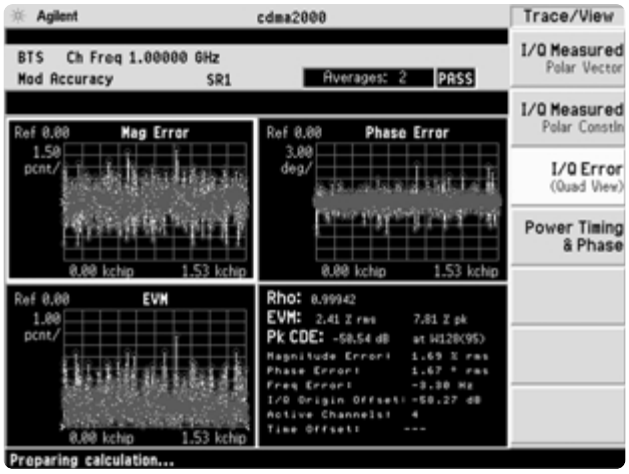


Code domain analysis

The code domain analysis measurement provides a variety of different data display options. 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 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.

- specify Hadamard or bit-reverse code order demodulation algorithms
- use the active channel identification feature or manually set the code channel power threshold level
- customize capture interval (1 to 32 power control groups [PCG])
- move the analysis window by varying the measurement interval and offset
- select PN (pseudonoise sequence) offset
- measure quasi-orthogonal functions
- take advantage of multiple result views:
  - code power and symbol rates bar graph and table
  - I/Q symbol magnitude and phase errors and EVM plots
  - symbol power plot
  - I and Q bits
- measure low–level signals more easily with optional preamplifier (Option 105)

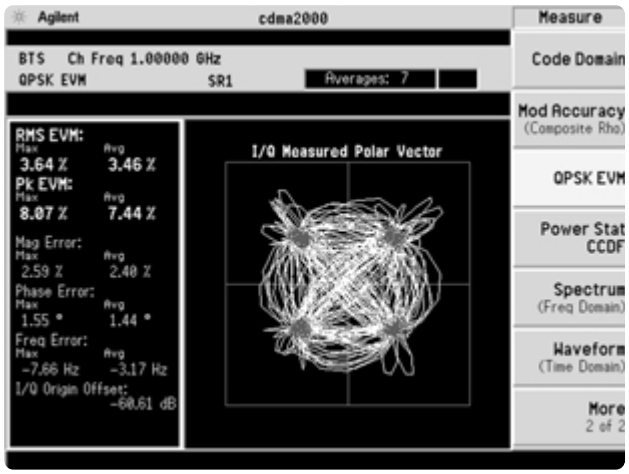




Modulation accuracy (composite rho)

An important measure of modulation accuracy for cdma2000 signals is rho. Rho is the ratio of the correlated power to the total power. It allows you to verify the overall modulation accuracy for a transmitter, regardless of the channel configuration, as long as a pilot channel is present.

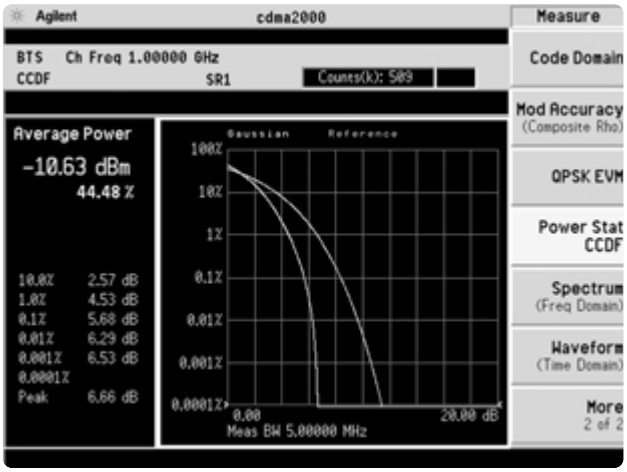
- measure EVM, rho, and peak code domain error (CDE)
- customize limits for rms EVM, peak EVM, rho, peak CDE, timing error, and phase error
- specify chip and PN offsets
- view I/Q polar constellation and magnitude error, phase error, and EVM plots
- read power, timing, phase and EVM data for each active channel
- choose to include or exclude the I/Q origin offset in the EVM calculation
- Use the optional preamplifier to measure low–level signals



QPSK EVM

The QPSK EVM measurement is used to get some indication of the modulation quality at the chip level for a single-channel signal. It can detect baseband filtering, modulation, and RF impairments, but does not detect spreading or scrambling errors.

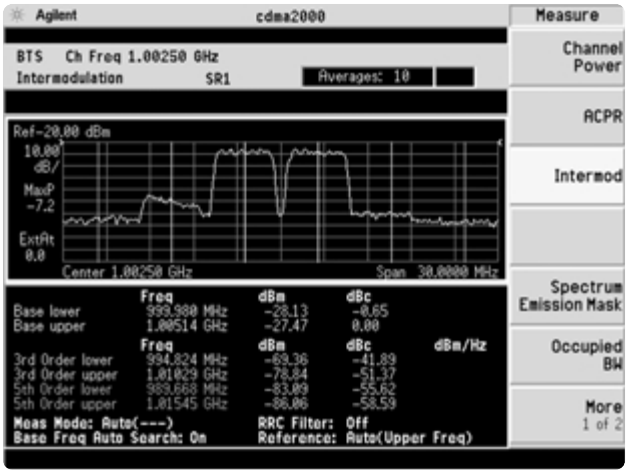
- determine rms and peak EVM (maximum and average)
- view I/Q polar vector diagram or magnitude error, phase error, and EVM plots
- specify measurement interval (128 to 1536, defaults to 256 chips)



Power statistics (CCDF)

The complementary cumulative distribution function (CCDF) is a plot of peak-to-average power ratio versus probability. It is often used to show compression and expansion of a signal by non-linear operation of amplifiers.

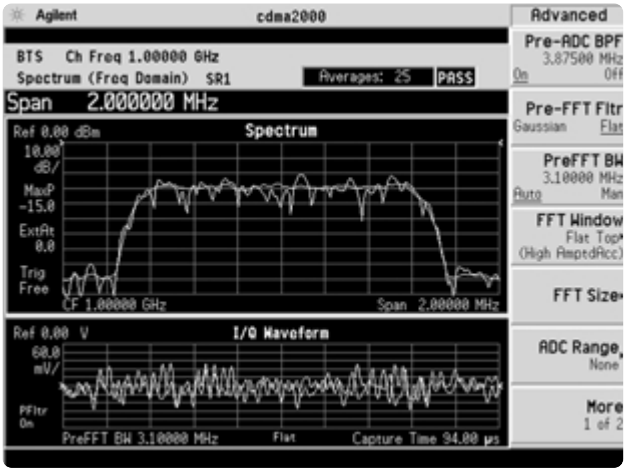
- customize measurement band width (defaults to 5 MHz)
- specify measurement interval
- set a reference trace or compare to Gaussian noise trace
- take advantage of the 0.1 dB histogram resolution



Intermodulation distortion

The harmonic distortion of a system is an indication of the linearity of its components. This measurement quantifies the third and fifth harmonic distortion components of two continuous wave (CW) signals or of a cdma2000 modulated signal and a CW signal.

- select number of averages (defaults to 10)
- measure two-tone or transmitted intermodulation (IM) distortion
- choose to specify base frequency or have it automatically detected
- apply RRC filtering if desired



Spectrum and waveform

View the frequency spectrum, I/Q waveform, or RF envelope (time domain) of a cdma2000 signal.

- take advantage of advanced FFT windowing and filtering options
- control the ADC range

Key specifications[1]

	E4443A/E4445A/E4440A	E4446A/E4448A
Frequency range	3 Hz to 6.7/13.2/26.5 GHz	3 Hz to 44/50 GHz
Speed		
Sweep time, span ≥ 10 Hz	1 ms to 2000 s	1 ms to 2000 s
Sweep time span = 0 Hz	1 µs to 6000 s	1 µs to 6000 s
Local measurement update rate	≥ 50 measurements/sec	≥ 50 measurements/sec
Remote measurement update rate	≥ 22 measurements/sec	≥ 22 measurements/sec
Resolution		
Resolution bandwidth range, swept and FFT	1 Hz to 3 MHz (10% steps), 4, 5, 8 MHz	1 Hz to 3 MHz (10% steps), 4, 5, 8 MHz
Variable sweep (trace) point range	101 to 8192	101 to 8192
Phase noise at 1 GHz		
10 kHz offset	–114 dBc/Hz –117 dBc/Hz (typical)	–114 dBc/Hz –117 dBc/Hz (typical)
1 MHz offset	–144 dBc/Hz –148 dBc/Hz (nominal)	–144 dBc/Hz –148 dBc/Hz (nominal)
10 MHz offset	–151 dBc/Hz –157 dBc/Hz (nominal)	–151 dBc/Hz –157 dBc/Hz (nominal)
Residual FM	< (1 Hz x N2) p-p in 1 s	< (1 Hz x N2) p-p in 1 s
Dynamic range		
Displayed average noise level (DANL)		
10 MHz to 3 GHz	–152 dBm	–151 dBm
3 GHz to 20 GHz	–146 dBm	–144 dBm
20 GHz to 26.5 GHz	–143 dBm	–140 dBm
26.5 GHz to 44 GHz	N.A.	–131 dBm
44 GHz to 50 GHz	N.A.	–126 dBm
Preamplifier (DANL) - 10 MHz to 3 GHz	–166 dBm	–164 dBm
1 dB gain compression		
200 MHz to 3 GHz	+3 dBm (+7 dBm nominal)	+3 dBm (+7 dBm nominal)
Input attenuator range	0 to 70 dB in 2 dB steps	0 to 70 dB in 2 dB steps
TOI - 1.7 GHz to 3.0 GHz	+17 dBm (+19 dBm typical)	+18 dBm (+21 dBm typical)
SHI - 400 MHz to 1.25 GHz	+52 dBm	+51 dBm
ACPR, W-CDMA (5 MHz offset)		
Dynamic range	–74.5 dB (typical)	–74.5 dB (typical)
Dynamic range w/noise correction	–81 dB (typical)	–81 dB (typical)
Accuracy		
Absolute amplitude accuracy	±(0.24 dB + frequency response) ±(0.06 dB + frequency response), (typical)	±(0.24 dB + frequency response) ±(0.06 dB + frequency response), (typical)
95% confidence, 3 Hz to 3 GHz	±0.24 dB	±0.24 dB
Frequency response, 3 Hz to 3 GHz	±0.38 dB (±0.10 dB typical)	±0.38 dB (±0.10 dB typical)
Frequency accuracy at 1 GHz and a stable temperature	±100 Hz	±100 Hz
Span accuracy	$\pm 0.2\% + \frac{\text{span}}{\text{sweep points} - 1}$	$\pm 0.2\% + \frac{\text{span}}{\text{sweep points} - 1}$
W-CDMA ACPR accuracy (5 MHz offset)		
Mobile station	±0.12 dB	±0.12 dB
Base station	±0.22 dB	±0.22 dB
Warranty	3 years (standard)	3 years (standard)

1. See PSA series spectrum analyzers data sheet for more specification details (literature number 5980-1284E).
2. N is harmonic mixing mode.

cdma2000 measurement personality (10 MHz to 3 GHz)

The following specifications are nominal for models E4446A and E4448A.

Channel power

Minimum power at RF input	–74 dBm (nominal)
Absolute power accuracy:	
Attenuation > 2 dB	±0.67 dB (±0.18 dB typical)
Attenuation ≤ 2 dB	±0.76 dB (±0.24 dB typical)
Relative power accuracy:	
Mixer level -52 to -12 dB	±0.08 dB (±0.03 dB typical)

ACPR

Minimum power at RF input	–38 dBm (nominal)
Dynamic range (reference to average power of carrier in 1.25 MHz bandwidth)	
Offset frequency / integrated bandwidth	
750 kHz / 30 kHz	–84.9 dBc
885 kHz / 30 kHz	–85.2 dBc
1256.25 kHz / 12.5 kHz	–89.6 dBc
1980 kHz / 30 kHz	–86.8 dBc
2750 kHz / 1000 kHz	–71.7 dBc
ACPR relative accuracy	±0.09 dB

CCDF

Minimum carrier power at RF input	–30 dBm (nominal)
Histogram resolution	0.01 dB

Intermodulation distortion

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

Occupied bandwidth

Minimum carrier power at RF input	-40 dBm
Frequency accuracy	≥ 0.3% (nominal)

Spectrum emission mask

Minimum carrier power at RF input	–20 dBm
Dynamic range, relative:	
750 kHz offset (30 kHz RBW)	–84.7 dB (-86.4 dB typical)
1980 MHz region (1200 kHz RBW)	–80.7 dB (-83.0 dB typical)
Sensitivity, absolute:	
750 kHz offset (30 kHz RBW)	–97.9 dBm (-99.9 dBm typical)
1980 MHz region (1200 kHz RBW)	–81.9 dBm (-83.9 dBm typical)
Accuracy, relative:	
750 kHz offset	0.14 dB
1980 MHz region	0.56 dB

Code domain

Code domain power:	
Minimum power at RF input	–60 dBm (nominal)
Relative accuracy	±0.15 dB
Symbol power versus time:	
Minimum power at RF input	–40 dBm (nominal)
Accuracy	±0.1 dB

QPSK EVM

Minimum power at RF input	–20 dBm (nominal)
EVM accuracy	±1.0% (nominal)
Frequency error accuracy	±10 Hz (nominal) + (transmitter frequency x frequency reference error)

Modulation accuracy (composite EVM)

Minimum carrier power at RF input	–60 dBm (nominal)
Accuracy	
Global EVM	±0.75%
Rho	±0.0015
Frequency error	±10 Hz + (transmitter frequency x frequency reference error)

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-202	GSM w/ EDGE measurement personality
E444xA-B78	cdma2000 measurement personality
E444xA-204	1xEV-DO measurement personality
E444xA-BAC	cdmaOne measurement personality
E444xA-BAE	NADC, PCD measurement personality

Phase noise measurement

E444xA-226	Phase noise measurement personality

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

Code compatibility

E444xA-266	HP 8566B/8568B code compatibility measurement personality

Accessories

E444xA-1CM	Rack mount kit
E444xA-1CN	Front handle kit
E444xA-1CP	Rack mount with handles
E444xA-1CR	Rack slide kit
E444xA-045	Millimeter wave accessory kit

Documentation

E444xA-0B1	Extra manual set including CD ROM

Calibration documentation

E444xA-UK6	Commercial calibration certificate with test data

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[1]

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
E444xA-OBW	Service manual and calibration software

1.Options not available in all countries.

Product literature

PSA Series - The Next Generation, brochure,
literature number 5980-1283E

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

Phase Noise Measurement Personality, product overview,
literature number 5988-3698EN

W-CDMA Measurement Personality, product overview,
literature number 5988-2388EN

GSM with EDGE Measurement Personality, product overview,
literature number 5988-2389EN

cdma2000 Measurement Personality, product overview,
literature number 5988-3694EN

1xEV-DO Measurement Personality, product overview,
literature number 5988-4828EN

cdmaOne Measurement Personality, product overview,
literature number 5988-3695EN

NADC/PDC Measurement Personality, product overview,
literature number 5988-3697EN

PSA Series Spectrum Analyzers, Option H70, 70 MHz IF Output, product overview,
literature number 5988-5261EN

Self-Guided Demonstration for Spectrum Analysis, product note,
literature number 5988-0735EN

Self-Guided Demonstration for Phase Noise Measurements, product note,
literature number 5988-3704EN

Self-Guided Demonstration for W-CDMA Measurements, product note,
literature number 5988-3699EN

Self-Guided Demonstration for GSM and EDGE Measurements, product note,
literature number 5988-3700EN

Self-Guided Demonstration for cdma2000 Measurements, product note,
literature number 5988-3701EN

Self-Guided Demonstration for 1xEV-DO Measurements, product note,
literature number 988–6208EN

Self-Guided Demonstration for cdmaOne Measurements, product note,
literature number 5988-3702EN

Self-Guided Demonstration for NADC and PDC Measurements, product note,
literature number 5988-3703EN

PSA Series Demonstration CD, literature number 5988-2390EN

Optimizing Dynamic Range for Distortion Measurements, product note,
literature number 5980-3079EN

PSA Series Amplitude Accuracy, product note,
literature number 5980-3080EN

PSA Series Swept and FFT Analysis, product note,
literature number 5980-3081EN

PSA Series Measurement Innovations and Benefits, product note,
literature number 5980-3082EN

PSA Series Spectrum Analyzer Performance Guide Using 89601A Vector Signal Analysis Software, product note,
literature number 5988-5015EN

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

8 Hints for Millimeter Wave Spectrum Measurements, application note,
literature number 5988–5680EN

PSA Series Spectrum Analyzer Performance Guide Using 89601A Vector Signal Analysis Software, product note,
literature number 5988-5015EN

89600 series + PSA, 802.11A and HiperLAN2 ODFM Measurements, product note,
literature number 5988-4094EN

N4256A Amplifier Distortion Test Set, product overview,
literature number 5988-2925EN

BenchLink Web Remote Control Softeware, product overview,
literature number 5988-2610EN

HP 8566B/68B Programming Code Compatibility for PSA and ESA-E Series Spectrum Analyzers, product overview,
literature number 5988-5808EN

IntuiLink Software, Data Sheet,
Literature Number 5980-3115EN

Agilent Technologies Wireless/GSM Solutions, application note,
literature number 5968-2320E

Measuring EDGE Signals - New and Modified Techniques and Measurement Requirements, application note, literature number 5980-2508EN

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

8 Hints for Better Millimeter Wave Spectrum Measurements, application note, literature number 5988–5680EN

Designing and Testing cdma2000 Base Stations, application note, literature number 5980–1303E

Designing and Testing cdma2000 Mobile Stations, application note, literature number 5980–1237E

HPSK Spreading for 3G, application note, literature number 5968–8438E

For more information on the PSA series, please visit:

www.agilent.com/find/psa

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Our Promise

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Your Advantage

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Printed in USA, June 4, 2002
5988-3694EN

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