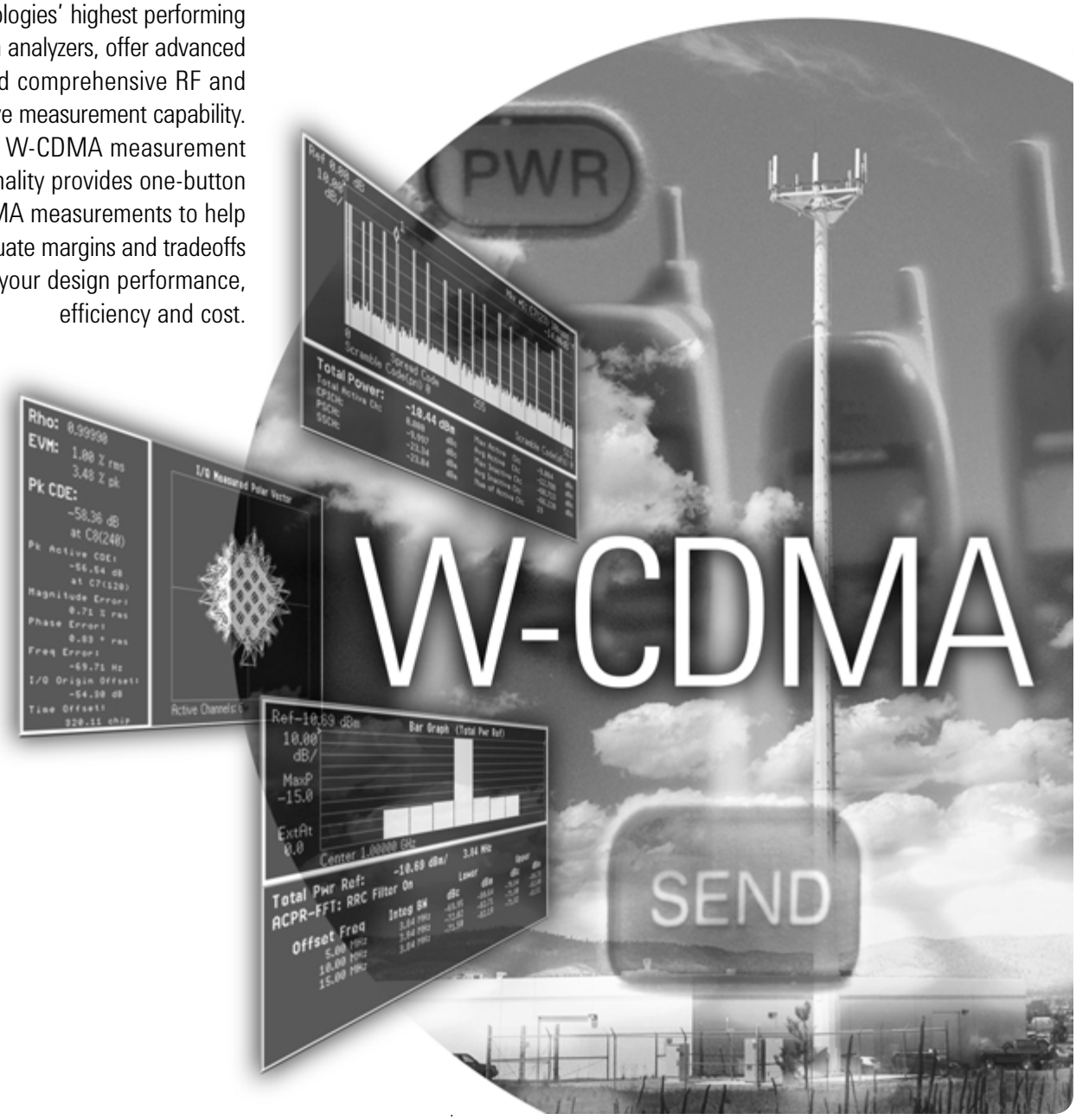
Agilent
PSA Series Spectrum Analyzers
W-CDMA Measurement Personality

Product Overview

The PSA series, Agilent Technologies' highest performing spectrum analyzers, offer advanced and comprehensive RF and microwave measurement capability. The W-CDMA measurement personality provides one-button W-CDMA measurements to help you evaluate margins and tradeoffs in your design performance, efficiency and cost.



Agilent Technologies

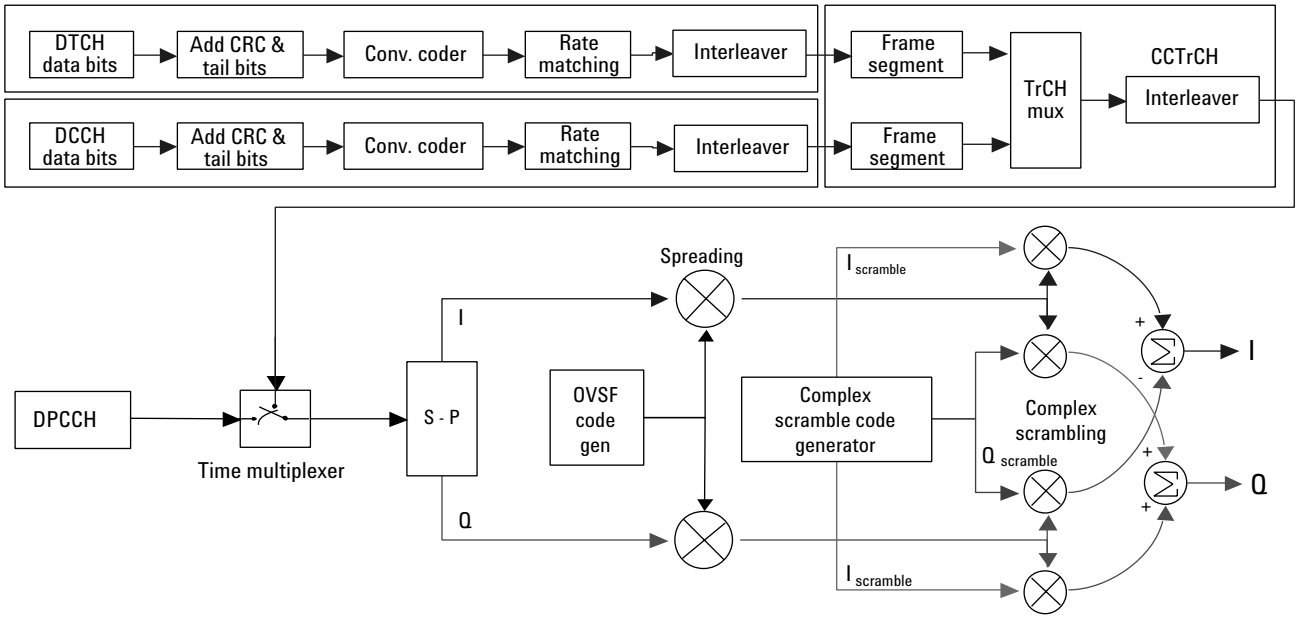
Use the PSA W-CDMA personality to evaluate your designs quickly and thoroughly for fast development completion.

The PSA series of high-performance spectrum analyzers provides unprecedented 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. As a developer and manufacturer of W-CDMA base stations, you are under pressure to get your designs to market and revenue as soon as possible. The Agilent PSA series provides modern, high-performance signal analysis. Combine performance with W-CDMA one button measurement capability to evaluate the RF and digital performance of your base transceiver station (BTS). For more in-depth analysis use the measurement setup of the W-CDMA personality to gain flexibility in adjusting measurement parameters.

Perform the following conformance tests with the W-CDMA measurement personality

- BTS maximum power (channel power)
- CPICH power accuracy (code domain power)
- frequency stability (composite EVM)
- power control steps (symbol power versus time)
- power control dynamic range (symbol power versus time)
- total power dynamic range (channel power)
- occupied bandwidth (OBW)
- spectrum emissions mask
- ACLR (ACPR)
- modulation accuracy (composite EVM)
- transmitter inter-modulation

With the W-CDMA measurement personality you can perform the conformance tests listed above. The titles listed in the parenthesis are the captions on the measurement keys.



W-CDMA Measurements

With the W–CDMA measurement personality (Option BAF) you can make the following measurements in compliance with version 2001–12 of the 3GPP standards.

Channel power

ACPR (ACLR)

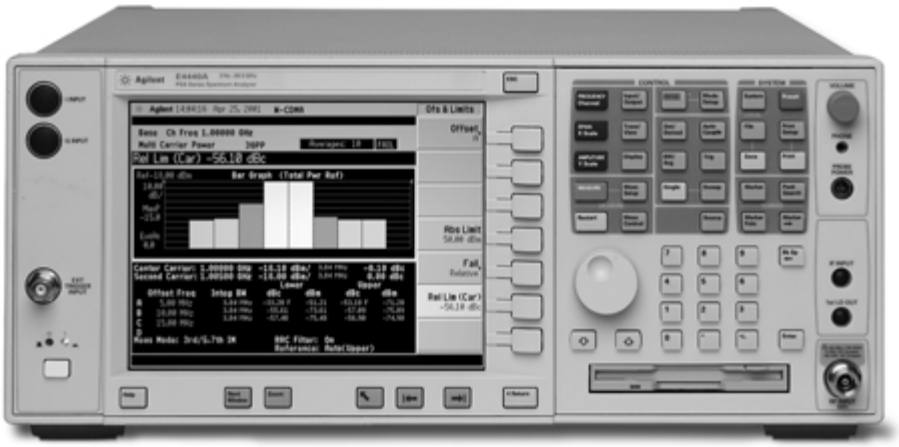
Multi-carrier power

Intermodulation

Spectrum mask

OBW

Code domain



Modulation accuracy

QPSK EVM

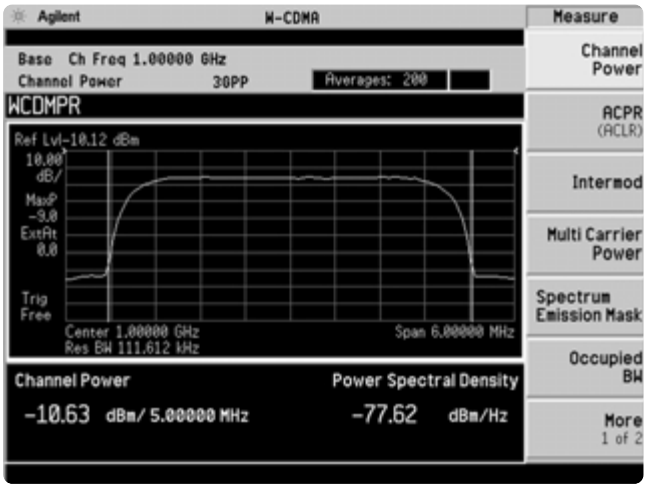
Composite EVM

CCDF

Spectrum

Time domain

Use fast one-button measurements or change measurement parameters for in-depth analysis of your design. For many of the measurements above, you can choose a view to gain the greatest insight into the analysis



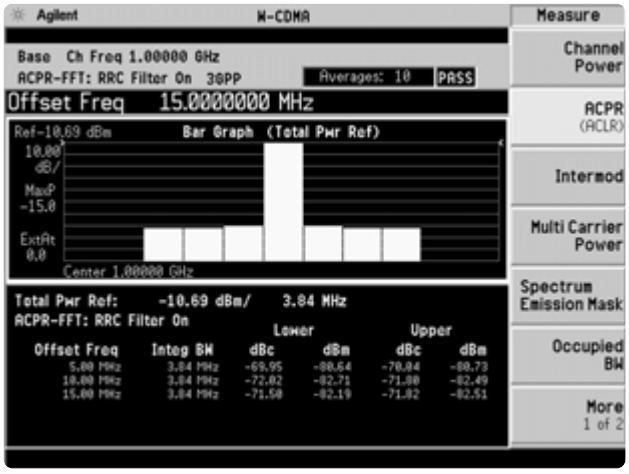
Channel power

Channel power

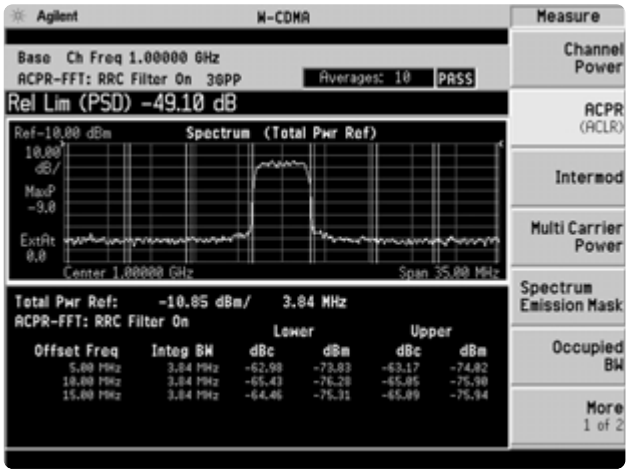
Channel power measures the total RMS power in a user-specified bandwidth. The following specifications apply for the default bandwidth of 5 MHz for the 3GPP standard and the power spectral density (PSD) in dBm/Hz.

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 (default to free run)



ACPR bar graph

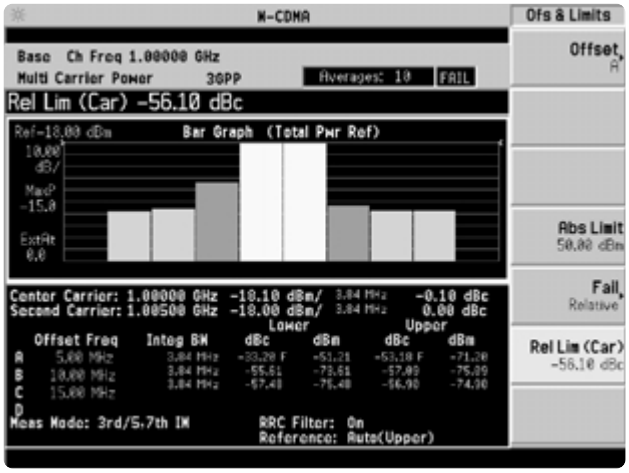


ACPR spectrum

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 adjacent channel power ratio, designated by the 3GPP standard, as the adjacent channel leakage power ratio (ACLR), is a measure of the power in adjacent channels relative to the transmitted power. The adjacent channel leakage power ratio measures up to five pairs of offset channels and relates them to the carrier power. The standard requires that the power of both the transmitted and adjacent channels be measured through a root-raised cosine filter (RRC) with a roll-off factor of 0.22. There are three ACPR modes of operation, which include FFT mode, swept mode and fast mode. The fast mode of obtaining ACPR measurements updates at 61 ms per measurement, but is limited to four offsets with bar graph, RRC filter and 5 MHz offset frequency only.

- obtain ACPR measurements with three modes – FFT, swept, and fast
- adjust integration bandwidth
- select up to five channel offsets
- chose 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 filters alpha value

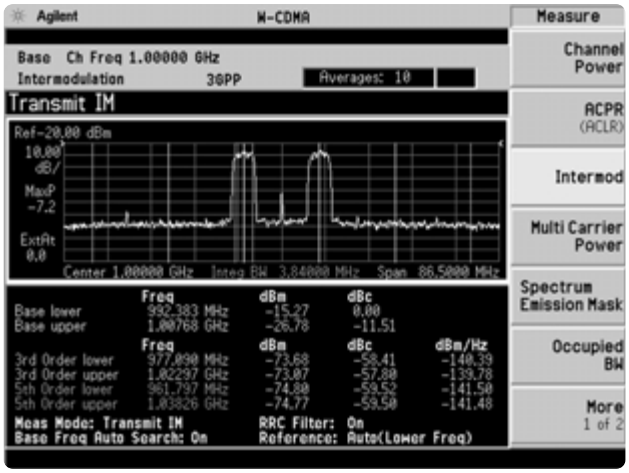


Multi-carrier power

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

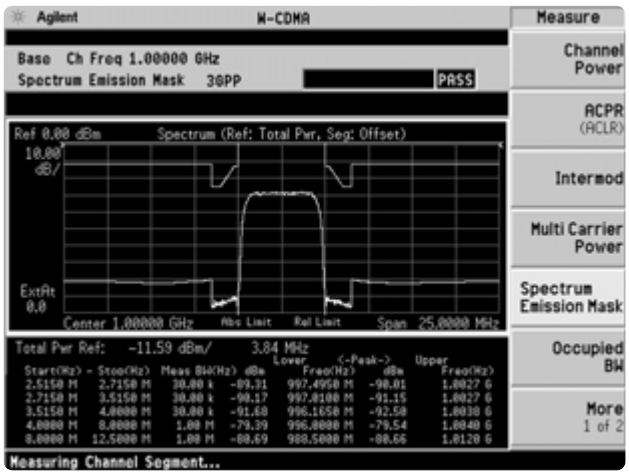


IM distortion

Intermodulation distortion

This measurement determines the third and fifth order inter-modulation distortion. Measurements are made using two single tones or a single tone and a W-CDMA signal.

- select measurement mode, two tone or transmitter IM
- select RRC filter on/off and choose the alpha value

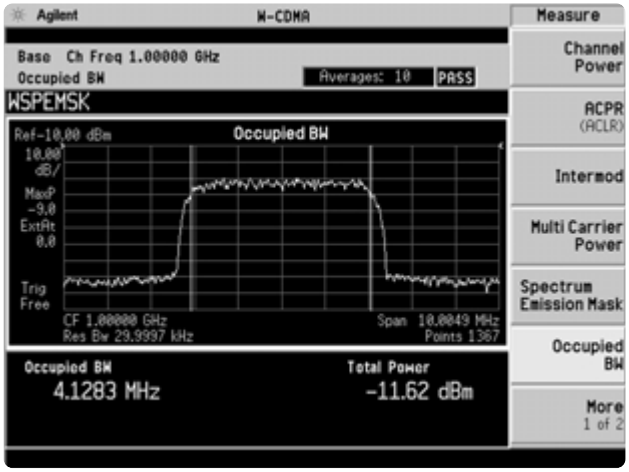


Spectral emissions mask

Spectrum emission mask

This measurement determines the in-channel power and out-of-channel spurious emissions to provide useful figures of merit for spectral regrowth emissions. The spectrum emission mask measurement required by 3GPP encompasses different power limits and different measurement bandwidths (resolution bandwidths) at various frequency offsets.

- now supports the new 3GPP standard for 50 kHz RBW measurements
- select up to five segments, with individual RBWs, segments, and limits.
- choose the alpha value of the filter

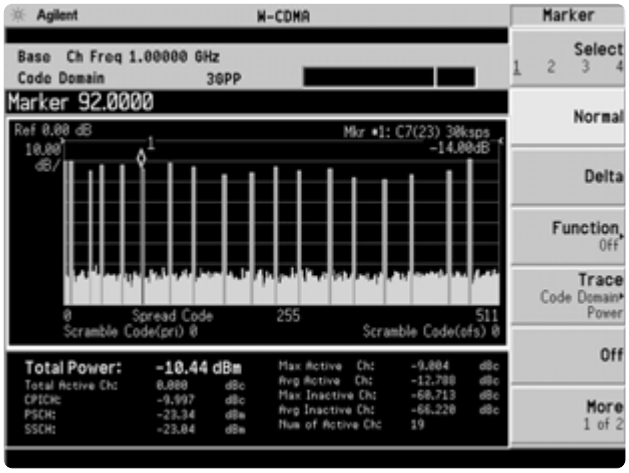


Occupied bandwidth display

Occupied bandwidth

The OBW measurement finds the frequency bandwidth corresponding to 99 percent of the total transmitted power.

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



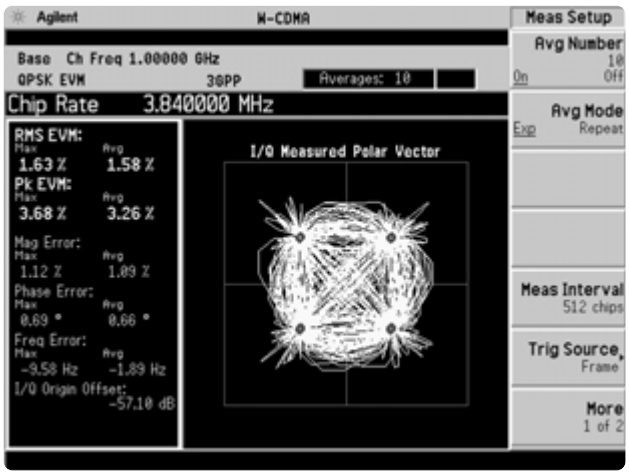
Code domain power

Code domain

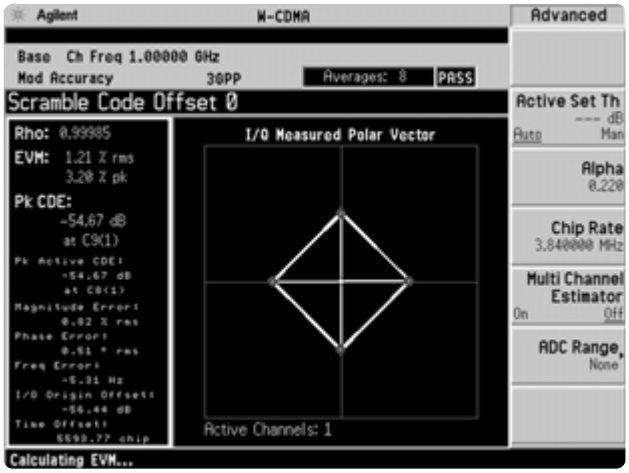
The code domain measurement provides a great deal of information about in channel characteristics of W-CDMA signals. Use code domain power measurements to gain information about active channels and their individual power. Code domain power analysis measures the distribution of signal power across the set of code channels, with both absolute and relative code channel power displayed. This measurement helps to verify that each code channel is operating at its proper level and to identify problems throughout the transmitter design from the coding to the RF section. System imperfections, such as amplifier non-linearity, will present itself as an undesired distribution of power in the code domain. Additionally, the PSA will despread any single code channel to provide magnitude and phase error and EVM data, symbol power versus time and symbol polar vector plots, and despread I and Q bits.

- choose any code channel for in depth analysis.
- measure peak EVM, RMS, EVM, phase and magnitude error, total power and channel power
- select code domain (quad view) to display symbol power, symbol polar vector and channel power graphic
- data can be re-demodulated 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 the sync type CPICH or SCH
  - use the symbol-based synchronization and select the code channel and symbol rate to synchronize to if the signal does not contain CPICH or synchronization channel (SCH)
- set scramble code settings available for number, offset, type (std, left or right)
- select pre-defined test models for fast analysis
- view power graph and metrics, I/Q error, code domain quad view, or demod bits
- select the type and source of the trigger, i.e. free run, video, burst, external or frame
- speedup analysis by shortening the default length of two frames to one frame or even one slot
- achieve deeper analysis using four frames or eight frames
- view low–level signals more easi–ly with optional preamplifier (Option 1DS)



Error vector magnitude



Modulation accuracy (RHO)

I/Q of 6 active channels

QPSK EVM

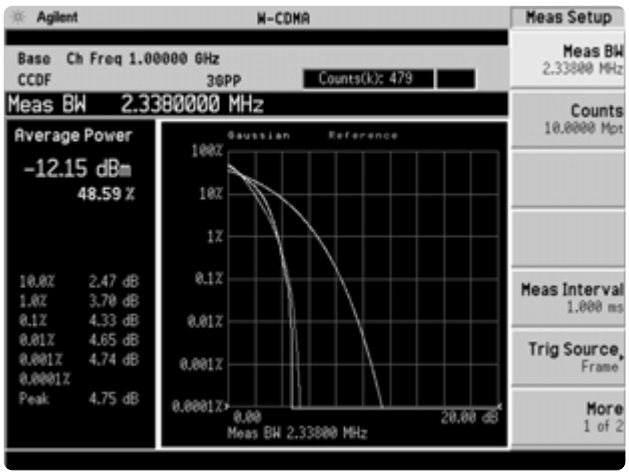
This measurement measures the modulation quality of QPSK modulated signals. The measurement provides an I/Q constellation diagram, error vector magnitude (EVM) in RMS and peak as well as magnitude error versus chip, phase error versus chip, and EVM versus chip.

- measurement interval is adjustable from 128 to 512 chips
- trigger sources are free run, video, burst, frame or external
- adjust alpha from 0.01 to 0.50
- chip rate adjustable
- rotate QPSK display by 45 degrees

Composite EVM (modulation accuracy)

Measure the performance of a W-CDMA transmitter's modulation circuitry. Also measure for a pilot channel along with other channel structures, i.e. multiple traffic channels.

- multi-sync options: CHICH, SCH, symbol based
- primary scramble code: 0 to 511
- scramble code offset: 0 to 15
- scramble code type: std, left, right
- test models: compliant test models 1, 2 and 3
- interpolate between states and rotate the constellation by +45 degrees
- measure EVM, Rho, peak CDE, phase, magnitude and frequency error, I/Q origin offset and active channels view magnitude error, phase error and EVM versus chip
- choose to include the SCH in the composite EVM
- use the multi-channel estimator to align the individual code channels to the pilot channel to improve phase error
- include or exclude the I/Q offset in EVM calculation (the current standard includes the I/Q offset)
- use the optional preamplifier to measure low–level signals

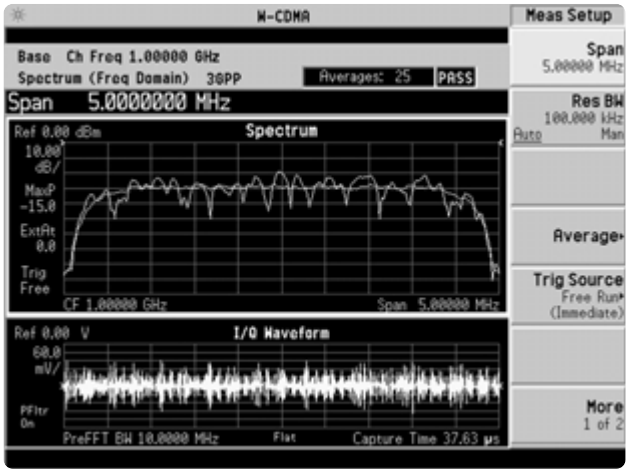


Complementary-cumulative distribution function (CCDF)

CCDF

The complementary cumulative distribution function provides how much time the waveform spends at or above a given power level. The percentage of time the signal spends at or above the level defines the probability for that particular power level.

- 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

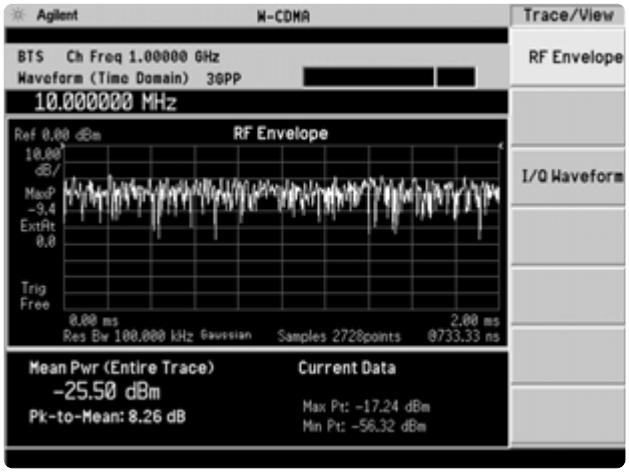


W-CDMA spectrum and I/Q waveform

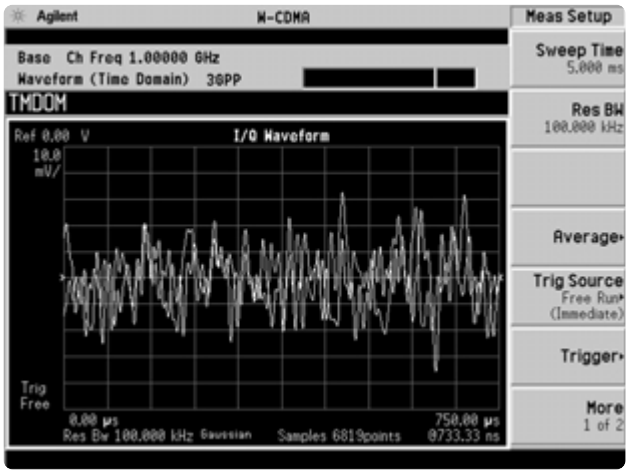
Spectrum

View the frequency spectrum of a W-CDMA signal along with the I/Q waveform over time.

- change the span range up to 10MHz
- select the resolution bandwidth
- choose from three types of averaging: RMS, video and voltage
- view the minimum and maximum value of the spectrum



RF envelope in time domain



IQ display

Time domain

Display the analog signal in amplitude versus time. Adjust the scale and time span for a closer look at the signal.

- select analog-to-digital converter (ADC) range, auto or manual (0 to 18 dB) and get full access to the capability of the new 14-bit ADC with a new bypass mode
- choose from three average types: RMS, video and voltage
- adjust the sweep time and resolution bandwidth
- select resolution bandwidth filter type: Gaussian or flat
- choose trigger types: free run, video, RF burst, frame or line
- view the I/Q waveform or RF envelop
- transfer I/Q waveform data across GPIB or LAN with 10 MHz bandwidth

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.

W-CDMA measurement personality

The following specifications are nominal for models E4446A and E4448A.

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 2001-12)	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%)	0.0325 dB (100%)
	0.5 dB step	0.1 dB (95%)	0.0325 dB (100%)
	Ten 1 dB steps	0.1 dB (95%)	0.0325 dB (100%)
	Ten 0.5 dB steps	0.1 dB (95%)	0.0325 dB (100%)
6.4.3	Power dynamic range	0.2 dB (95%)	0.075 dB (100%)
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 (typical)
- 10 MHz offset –82 dB (typical)

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)

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)

Power statistics CCDF

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

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

Occupied bandwidth

Minimum power at RF input	–40 dBm (nominal)
Frequency accuracy	0.2% (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	
2.515 MHz offset	0.14 dB
1980 MHz region	0.56 dB

Code domain

Code domain power	
Minimum power at RF input	–75 dBm (nominal)
Relative power accuracy (test model 2)	
CDP between 0 and –10 dBc	±0.0325 dB
CDP between –10 and –30 dBc	±0.075 dB
CDP between –30 and –40 dBc	±0.15 dB
Relative power accuracy (test model 3 w/32 DPCH)	
CDP between 0 and –10 dBc	±0.04 dB
CDP between –10 and –30 dBc	±0.075 dB
CDP between –30 and –40 dBc	±0.2 dB

QPSK EVM

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

Modulation accuracy (composite EVM)

Minimum power at RF input	–75 dBm
Composite EVM (test model 2)	
Accuracy	±1.0%
Frequency error accuracy	±10 Hz + (transmitter frequency x frequency reference accuracy)
Peak code domain error accuracy	±1.0% (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-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

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