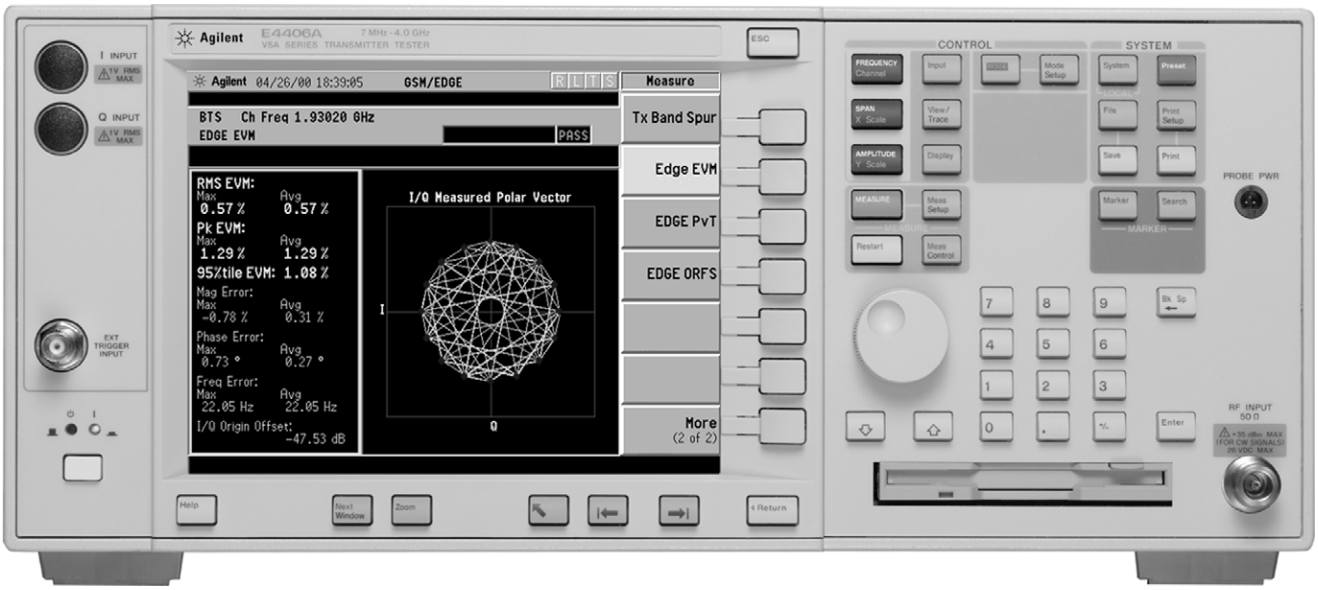
Agilent E4406A
Vector Signal Analyzer

Data Sheet



The Agilent Technologies E4406A vector signal analyzer (VSA) is a full-featured transmitter tester designed to meet the test needs of wireless equipment developers and manufacturers. For wireless base station and mobile transmitters and their components, the easy-to-use E4406A provides the best combination of speed and accuracy for a wide range of digital modulation analysis capability. And, with multiformat capability (W-CDMA, cdma2000, 1xEV-DO, cdmaOne, EDGE, GSM, NADC, and PDC) the E4406A is the ideal, flexible choice for your production line.

Easily configure one-button measurements with the simple, straight-forward menu structure and view them on the large, high-resolution color display. With built-in, standards-compliant tests and state-of-the-art digital IF technology, engineers can be confident that test results are accurate. And, when combined with the Agilent ESG-D series of RF digital signal generators, the E4406A VSA provides a powerful, transmit-receive test solution for wireless-equipment manufacturers.

Agilent Technologies

Frequency

Frequency range
RF input 7 MHz to 314 MHz and 329 MHz to 4 GHz

Frequency range
Baseband IQ inputs 0 Hz to 5 MHz

Frequency spans
Baseband IQ inputs 5 Hz to 5 MHz (Baseband I or Q inputs)
10 Hz to 10 MHz (Composite I/Q)

Frequency setting resolution 1 Hz

Frequency reference

Accuracy	±[(time since last adjustment aging + rate) + temperature stability + calibration accuracy]
Initial calibration accuracy	±5 10^{-8}
Settability	±2 10^{-9}
Aging rate during any 24 hrs	±5 10^{-10}, typically following 24-hour warm-up
Per year temperature stability	±1 10^{-7}, typically ±5 10^{-8} variation from frequency at +25°C over the temperature range of 0 to +55°C
Warm-up time	1 hour, typically

Residual responses

RF input

50 Ω input terminated, 0 dB input attenuation, +24 dB ADC gain

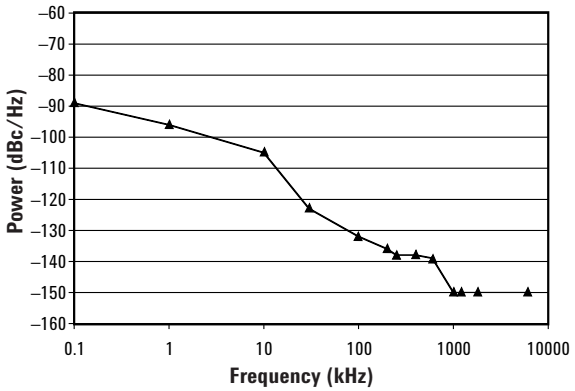
20 MHz to 2 GHz	–85 dBm
2 GHz to 4 GHz	–80 dBm

Baseband IQ inputs

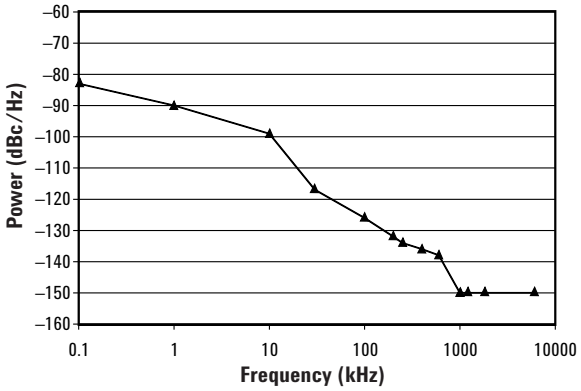
50 Ω input terminated

0 to 5 MHz	≤ –90 dB

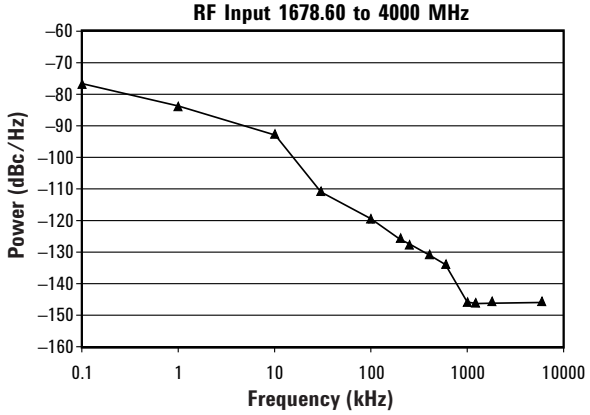
RF Input 7 to 678.59 MHz



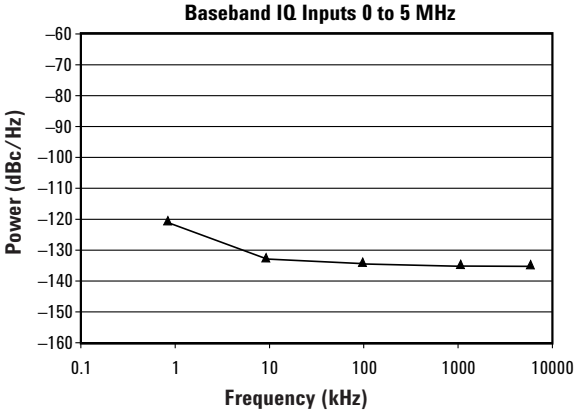
RF Input 678.60 to 1678.59 MHz



RF Input 1678.60 to 4000 MHz



Baseband IQ Inputs 0 to 5 MHz



Noise sidebands (typically)

Amplitude

The following amplitude specifications apply for all measurements unless otherwise noted within the measurement specification.

RF input

Maximum measurement power	+30 dBm (1W)
Maximum safe DC voltage	±26 Vdc
Maximum safe input power	+35 dBm (3.16W)

Baseband IQ inputs

Input ranges 50 Ω input impedance	–5 to +13 dBm in four ranges of 6 dB steps: –5 dBm, +1 dBm, +7 dBm, +13 dBm
Input ranges 600 Ω, 1 M Ω input impedance	–18 to 0 dBV in four ranges of 6 dB steps: –18 dBV, –12 dBV, –6 dBV, 0 dBV
Maximum safe voltage	±5 V (DC + AC)

Input attenuator

RF input

Range	0 to +40 dB
Step size	1 dB steps
Accuracy at 50 MHz	±0.3 dB relative to 10 dB attenuation

First LO emission from RF input

≤ (–23 dBm – input attenuation) typically

$f_{emission}$ = center frequency ±321.4 MHz

Third-order intermodulation distortion

RF input with pre-filter

For separation ≥ 5 MHz, Freq ≥ 800 MHz	+24 dBm third order intercept, characteristic

Baseband IQ inputs

For two CW input signals –6 to –10 dBm below range	≤ –60 dBc

External loss correction

–50 to 100 dB

Absolute power measurement accuracy

RF input

Input power	(–2 dBm to –28 dBm) + attenuation, +18°C to +30°C
810 to 960 MHz	±0.6 dB
1710 to 2205 MHz	±0.6 dB
1428 to 1503 MHz	±0.6 dB
Input power 10 dB input attenuation 400 MHz to 2205 MHz	+8 dBm to –18 dBm, +18°C to +30°C ±0.75 dB
Input power	(–2 dBm to –28 dBm) + attenuation
0 to 20 dB input attenuation	
7 MHz to 1000 MHz	±1.0 dB
1000 MHz to 2205 MHz	±1.3 dB
2205 MHz to 4000 MHz	±1.8 dB

Baseband IQ inputs

Input impedance = 50 Ω, all ranges	±0.6 dB
Input impedance = 600 Ω, all ranges	
0 Hz to 1 MHz	±0.6 dB
1 MHz to 5 MHz	±2.0 dB
Input impedance = 1 MΩ all ranges	
Unbalanced	±0.7 dB characteristically
Balanced	
0 to 1 MHz	±0.6 dB characteristically
1 MHz to 5 MHz	±2.0 dB characteristically

Amplitude accuracy

RF input

(Relative to –2 dBm at the input mixer)

–2 dBm to –78 dBm	±0.25 dB	±0.15 dB, typically
–78 dBm to –88 dBm	±0.70 dB	±0.40 dB, typically
–88 dBm to –98 dBm	±1.20 dB	±0.80 dB, typically

(Relative to –12 dBm at the input mixer)

–12 dBm to –62 dBm	±0.15 dB	±0.10 dB, typically

Amplitude Linearity

Baseband IQ inputs

0 to –35 dB below range	±0.17 dB
–35 to –55 dB below range	±1.0 dB

Displayed average noise level

RF input

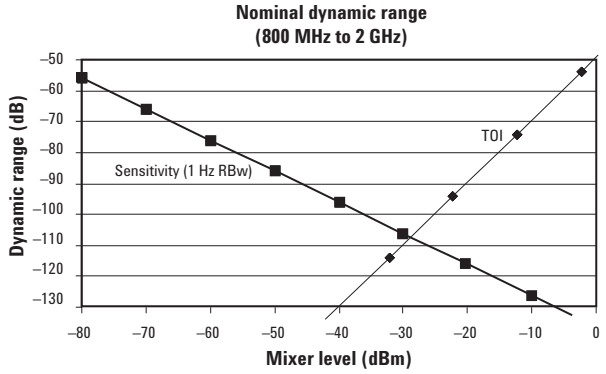
Input terminated in 50 Ω, 0 dB attenuation, 1 kHz RBW, 10 kHz span, +24 dB ADC gain

7 MHz to 20 MHz	–103 dBm
20 MHz to 2000 MHz	–106 dBm
2000 MHz to 2700 MHz	–103 dBm
2700 MHz to 4000 MHz	–98 dBm

Baseband IQ inputs

Input terminated in 50 Ω, 1 kHz RBW, 1 kHz to 5 MHz

+13 dBm Range	–95 dBm	(–100 dBm, typical)
+7 dBm Range	–	(–105 dBm, typical)
+1 dBm Range	–	(–108 dBm, typical)
–5 dBm Range	–106 dBm	(–110 dBm, typical)



DC offset

Baseband IQ inputs

After auto-zero	< –40 dB below range
Compensation for customer DC offset	≤ ±2.0 Vdc

Channel match

Baseband IQ inputs

Amplitude match 0 to 5.0 MHz	±0.25 dB
Phase match 0 to 5.0 MHz	±2.0 degrees

Crosstalk

Baseband IQ inputs

Input impedance = 50 Ω	< –60 dB
Input impedance = 600 Ω	< –52 dB

Common mode rejection

Baseband IQ inputs

0 to 0.5 MHz	< –50 dB
> 0.5 MHz to 5.0 MHz	< –35 dB

Measurements

Waveform measurement

Sweep time range

RBW 7.5 MHz	10 µs to 200 ms
RBW 1 MHz	10 µs to 400 ms
RBW 100 kHz	10 µs to 2 s
RBW 10 kHz	10 µs to 20 s

Time record length	2 to > 900,000 points, typically

Resolution bandwidth

1, 1.5, 2, 3, 5, 7.5, 10 sequence, or arbitrary bandwidth (user-definable)

Gaussian filter	10 Hz to 8 MHz
Flat filter	10 Hz to 10 MHz

Averaging

Average number	1 to 10,000
Average mode	Exponential, repeat
Average type	Power average (RMS), log-power average (video), maximum, minimum

Displays

RF input	Signal envelope, I/Q waveform, I/Q polar
Baseband IQ input	Signal envelope, linear envelope, I/Q waveform, I and Q waveform, I/Q polar, phase

Markers	Normal, delta, band power

Spectrum measurement

Span range	
RF input	10 Hz to 10 MHz
Composite I/Q input	10 Hz to 10 MHz
Baseband I or Q only inputs	10 Hz to 5 MHz
Capture time	66 ns to 40 s, typically
Resolution BW range	100 MHz to 3 MHz
overall	1, 1.5, 2, 3, 5, 7.5, 10 sequence or arbitrary user-definable actual range depends on span
FFT window	Flat top; (high amplitude accuracy); Uniform; Hanning; Hamming; Gaussian; Blackman; Blackman-Harris; Kaiser-Bessel 70, 90, 110
Averaging	
Average number	1 to 10,000
Average mode	Exponential, repeat
Average type	Power average (RMS), log-power average (video), maximum, minimum, voltage average
Displays	
RF input	Spectrum, linear spectrum, I/Q waveform, spectrum and I/Q waveform, I/Q polar, adjacent channel power, power stat CCDF
Baseband IQ inputs	Spectrum, linear spectrum, I/Q waveform, spectrum and I/Q waveform, I/Q polar, power stat CCDF
Markers	Normal, delta, band power, noise

Trigger

Trigger sources	Free run (immediate), video (IF envelope), RF burst (wideband), frame timer, external front, external rear, line
Delay range	–500 ms to +500 ms
Delay accuracy	±33 ns
Delay resolution	33 ns
Trigger slope	Positive, negative
Holdoff range	0 to 500 ms
Holdoff resolution	1 µs

RF burst trigger

Peak carrier power range at RF input	+30 dBm to –40 dBm
Trigger level range	0 to –25 dB relative to signal peak
Bandwidth	> 15 MHz, typically

Video (IF envelope)

Trigger range	+30 dBm to noise floor

W-CDMA (Option BAF)

Channel power measurement

The channel power measurement measures the total RMS power in a user-specified bandwidth. The following specifications apply for the default bandwidth of 3.84 MHz for the 3GPP standard.

Range at RF input +30 dBm to –70 dBm

Absolute power accuracy for in-band signal (excluding mismatch error), 18°C to 30°C

+30 to –28 dBm at RF input	±0.6 dB
–28 to –50 dBm at RF input	±0.8 dB
–50 to –80 dBm at RF input	±1.0 dB

ACPR measurement

The adjacent channel power ratio (ACPR) measurement measures up to five pairs of offset channels and relates them to the carrier power. The measurement result is a ratio of the channel power to the power in each offset. The results can be displayed as a ratio to the total power in each bandwidth, or as a ration of the power spectral density. Simulated spectrum analyzer mode is for those who are accustomed to spectrum analyzers.

Power range at RF input +30 to –20 dBm

Dynamic range (referenced to average power of carrier in 3.84 MHz BW)

Offset frequency	Integ BW	Dynamic range
5 MHz	3.84 MHz	–68 dBc (characteristic)
10 MHz	3.84 MHz	–72 dBc (characteristic)

ACPR accuracy

Radio	Offset frequency	Specifications
MS(UE)	5 MHz	±0.31 dB at ACPR range of –30 to –36 dBc with the optimum mixer level
MS(UE)	10 MHz	±0.27 dB at ACPR range of –40 to –46 dBc with the optimum mixer level
BTS	5 MHz	±0.59 dB at ACPR range of –42 to –48 dBc with the optimum mixer level
BTS	10 MHz	±0.28 dB at ACPR range of –47 to –53 dBc with the optimum mixer level
BTS	5 MHz	±0.33 dB at –48 dBc non-coherent ACPR

For more detail, please refer E4406A specifications at www.agilent.com/find/vsa

Power statistics CCDF measurement

The complementary-cumulative distribution function (CCDF) traces provide you with how much time the waveform spends at or above a given power level. The percent of time the signal spends at or above the level defines the probability for that particular power level.

Range at RF input

Maximum	+30 dBm (average)
	+40 dBm (peak)
Minimum	–40 dBm (average)

Code domain measurement

The code domain measurement provides a tremendous amount of information about the in-channel characteristics of the W-CDMA signal. Code domain power (CDP) view directly informs the user of the active channels with their individual channel powers. The CDP view also leads you to symbol rate analysis such as symbol rate EVM and symbol power versus time.

Range at RF input	+30 to –50 dBm
Accuracy	±0.3 dB (characteristic, with 15 slot measurement interval and spread channel power within –40 dB of total power – averaged over a slot)
Symbol power vs. time	
Range at RF input	+30 to –40 dBm
Accuracy	±0.3 dB (spread channel power is within 20 dB of total power)

Symbol error vector magnitude

Range at RF input	+30 to –20 dBm

QPSK EVM measurement

The QPSK EVM measurement measures the modulation quality of QPSK modulated signal. This measurement provides an IQ 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.

Range at RF input +30 to –20 dBm

EVM

Range	0 to 25%
Floor	3.0%
Accuracy	±1.0%

I/Q origin offset

Range	–10 to –50 dBc

Frequency error

Range	±500 Hz
Accuracy	±(10 Hz + reference oscillator accuracy)

Note: All baseband IQ input specifications are preliminary.

Modulation accuracy measurement (composite EVM)

Composite EVM is a measure of the performance of a W-CDMA transmitter's modulation circuitry. Composite EVM can be measured for a pilot channel along with other channel structures, i.e. multiple traffic channels.

Range at RF input	+30 to –50 dBm
EVM	
Range	0 to 25%
Accuracy	±1.0% (for test model 3, characteristics within the range of 2.0 to 25.0%)
Floor	2.0% or less for test model 3
Resolution	0.01% display resolution
I/Q origin offset	
Range	–10 to –50 dBc
Resolution	0.02 dB display resolution
Frequency error	
Range	±500 Hz
Accuracy	±(10 Hz + reference oscillator accuracy)
Resolution	±0.01 Hz display resolution
Peak code domain error	
Accuracy	±1.0% (for test model 3, characteristics within the range of 28 to 38 dB from total power)
Resolution	±0.01 dB

Intermodulation distortion measurement

The intermodulation distortion measurement determines the third order and fifth order intermodulation products caused by nonlinear devices in the transmitter. This measurement is made with two single tones or a single tone and a modulated W-CDMA signal. The results are displayed in relative power to the carrier in dBc or in absolute power in dBm.

Range at RF input	+30 to –20 dBm
Input intermodulation power range	–20 dBc to –65 dBc
Relative accuracy	±1.5 dB
Resolution	0.01 dB display resolution

Multicarrier power measurement

This measurement is used for adjusting multicarrier power amplifiers to transmit well balanced multiple carriers. The measurement is similar to a combination of those for ACPR and intermodulation distortion product measurements giving in-channel and out-of-channel performance results. The results are displayed for the different frequency offsets either in relative power to the carrier in dBc or in absolute power in dBm.

Range at RF input	+30 to –20 dBm
Adjacent channel power ratio range	
At 5 MHz offset	–65 dBc (characteristic)
At 10 MHz offset	–69 dBc (characteristic)
Relative accuracy	±1.0 dB (at 0 dB to minimum measurement range +10 dB)
Resolution	0.01 dB display resolution

Spectrum emission mask measurement

The spectrum emission mask measurement measures the in-channel and out-of-channel spurious emissions to provide useful figures of merit for spectral regrowth and emissions produced by components and circuit blocks. Up to five pairs of offsets/regions can be defined in which the user can specify the start and stop frequencies, resolution bandwidth, and the start and stop amplitudes of the mask.

Range at RF input	+30 dBm to –20 dBm
Frequency range	329 MHz to 3.678 GHz
Spectrum emission power range	–136 dBc/Hz at 1 MHz offset (characteristic)
Relative accuracy	±1.0 dB
Resolution	0.01 dB display resolution

Occupied bandwidth measurement

Occupied bandwidth (OBW) measurement measures the frequency bandwidth corresponding to 99 percent of the total transmitted power.

Range at RF input	+30 dBm to –20 dBm
Frequency	
Resolution	1 kHz
Accuracy	±3 kHz at 1 kHz resolution bandwidth
In-band frequency range	2110 to 2170 MHz 1920 to 1980 MHz

Note: All baseband I/Q input specifications are preliminary.

cdma2000 (Option B78)

Channel power measurement

The channel power measurement measures the total RMS power in a user-specified bandwidth. The following specifications apply for the default bandwidth of 1.23 MHz.

Range at RF input	+30 dBm to –80 dBm

Absolute power accuracy for in-band signal (excluding mismatch error), 18ºC to 30ºC

+30 to –28 dBm at RF input	±0.6 dB
–28 to –50 dBm at RF input	±0.8 dB
–50 to –80 dBm at RF input	±1.0 dB

ACPR measurement

The adjacent channel power ratio (ACPR) measurement measures up to five pairs of offset channels and relates them to the carrier power. The measurement result is a ratio of the channel power to the power in each offset. The results can be displayed as a ratio to the total power in each bandwidth, or as a ratio of the power spectral density. Simulated spectrum analyzer mode is for those who are accustomed to spectrum analyzers.

Power range at RF input	+30 to –20 dBm

Dynamic range (referenced to average power of carrier in 1.25 MHz BW)

Offset frequency	Integ BW	Dynamic range
750 kHz (BTS)	30 kHz	–82 dBc
885 kHz (MS)	30 kHz	–82 dBc
1.98 MHz	30 kHz	–85 dBc

Relative accuracy	±0.9 dB

Power statistics CCDF measurement

The complementary-cumulative distribution function (CCDF) traces provide you with how much time the waveform spends at or above a given power level. The percent of time the signal spends at or above the level defines the probability for that particular power level.

Range at RF input	
Maximum	+30 dBm (average)
	+40 dBm (peak)
Minimum	–40 dBm (average)

Code domain measurement

The code domain measurement provides a tremendous amount of information about the in-channel characteristics of the cdma2000 signal. Code domain power (CDP) view directly informs the user of the active channels with their individual channel powers. The CDP view also leads you to symbol rate analysis such as symbol rate EVM and symbol power versus time.

Code domain power	
Range at RF input	+30 to –50 dBm
Accuracy	±0.3 dB (spread channel power is within 20 dB of total power)
Symbol power vs. time	
Range at RF input	+30 to –40 dBm
Accuracy	±0.3 dB (spread channel power is within 20 dB of total power; averaged power over a slot)
Symbol error vector magnitude	
Range at RF input	+30 to –20 dBm
Pilot time offset (from even second signal to start PN sequence)	
Range	–13.33 ms to +13.33 ms
Accuracy	±250 ns
Resolution	10 ns

QPSK EVM measurement

The QPSK EVM measurement measures the modulation quality of a QPSK modulated signal. This 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.

Range at RF input	+30 to –20 dBm
EVM	
Range	0 to 25%
Floor	1.5%
Accuracy	±1.0%
I/Q origin offset	
Range	–10 to –50 dBc
Frequency error	
Range	±500 Hz
Accuracy	±10 Hz

Modulation accuracy measurement (composite rho)

Composite rho is measure of the performance of a cdma2000 transmitter's modulation circuitry. Composite rho can be measured for multichannel structure, i.e. a pilot channel with multiple traffic channels.

Range at RF input	+30 to –50 dBm
EVM	
Range	0 to 25%
Floor	2.0% or less for pilot only signal
Resolution	0.01% display resolution
I/Q origin offset	
Range	–10 to –50 dBc
Resolution	0.02 dB display resolution
Frequency error	
Range	±500 Hz
Accuracy	±(10 Hz + reference oscillator accuracy)
Resolution	±0.01 Hz display resolution

Intermodulation distortion

The intermodulation distortion measurement determines the third order and fifth order intermodulation products caused by nonlinear devices in the transmitter. This measurement is made with two single tones or a single tone and a modulated cdma2000 signal. The results are displayed in relative power to the carrier in dBc or in absolute power in dBm.

Range at RF input	+30 to –20 dBm
Input intermodulation power range	–20 dBc to –65 dBc
Relative accuracy	±1.5 dB
Resolution	0.01 dB display resolution

Spectrum emission mask measurement

The spectrum emission mask measurement measures the in-channel and out-of-channel spurious emissions to provide useful figures of merit for spectral regrowth and emissions produced by components and circuit blocks. Up to five pairs of offsets/regions can be defined in which the user can specify the start and stop frequencies, resolution bandwidth, and the start and stop amplitudes of the mask.

Range at RF input	+30 dBm to –20 dBm
Spectrum emission power range	–136 dBc/Hz at 1 MHz offset (characteristic)
Relative accuracy	±1.0 dB
Resolution	0.01 dB display resolution

Occupied bandwidth measurement

Occupied bandwidth (OBW) measurement measures the frequency bandwidth corresponding to 99 percent of the total transmitted power.

Range at RF input	+30 dBm to –20 dBm
Frequency	
Resolution	1 kHz
Accuracy	±3 kHz

1xEV-DO (Option 204)

Channel power measurement

1.23 MHz integration BW
Range at RF input +30 dBm to –80 dBm
Absolute power accuracy for in-band signal
(excluding mismatch error), 18°C to 30°C
+30 to –28 dBm at RF input ±0.6 dB
–28 to –50 dBm at RF input ±0.8 dB
–50 to –80 dBm at RF input ±1.0 dB

Power statistics CCDF measurement

Range at RF input	
Maximum	+30 dBm (average)
	+40 dBm (peak)
Minimum	–40 dBm (average)

Code domain measurement

For Pilot, 2 MAC channels, 16 channels of QPSK data

Code domain power	
Range at RF input	+30 to –50 dBm (characteristic)
Accuracy	±0.3 dB (characteristic, spread
(Pilot, MAC, Data	channel power is within 20 dB
QPSK Data 8PSK)	of total power)

QPSK EVM measurement

Range at RF input	+30 to –20 dBm (characteristic)
EVM	
Range	0 to 25% (characteristic)
Floor	1.5% (characteristic)
Accuracy	±1.0% (characteristic)
I/Q origin offset	
Range	–10 to –50 dBc (characteristic)
Frequency error	
Range	±500 Hz (characteristic)
Accuracy	±10 Hz (nominal) + (transmitter frequency x frequency reference accuracy)

Modulation accuracy measurement (composite rho)

For Pilot, 2 MAC channels, 16 channels of QPSK data

Range at RF input	+30 to –45 dBm (characteristic)
EVM	
Range	0 to 25% (characteristic)
Floor	2.5% or less (characteristic)
Rho range 0.94 to 1.0	
Floor	0.99938 or more
	(0.99938 = EVM 2.5%, characteristic)
Accuracy	±0.0010 at rho is 0.99751
	(= EVM 25%, characteristic)
Frequency error	
Range	±400 Hz (characteristic)
Accuracy	±1 Hz + (transmitter frequency x frequency reference accuracy)
Resolution	0.01 Hz display resolution
I/Q origin offset	
Range	–10 to –50 dBc (characteristic)
Resolution	0.02 dB display resolution

Power vs. Time

Range at RF input +30 dBm to –80 dBm (characteristic)
Absolute power accuracy for in-band signal
(excluding mismatch error), 18°C to 30°C
+30 to –28 dBm at RF input ±0.6 dB (characteristic)
–28 to –50 dBm at RF input ±0.8 dB (characteristic)
–50 to –80 dBm at RF input ±1.0 dB (characteristic)

Intermodulation distortion	
Input signal must not be bursted	
Range at RF input	+30 to –20 dBm
Input intermodulation	
Power range	–20 dBc to –65 dBc
Relative accuracy	±1.5 dB
Resolution	0.01 dB display resolution

Spurious emissions & ACP

Range at RF input	+30 dBm to –20 dBm
Spectrum emission	
Power range	–136 dBc/Hz at 1 MHz offset
	(characteristic)
Relative accuracy	±1.0 dB
Resolution	0.01 dB display resolution

Occupied bandwidth measurement

Range at RF input	+30 dBm to –20 dBm
Frequency	
Resolution	1 kHz
Accuracy	±3 kHz at 1 kHz resolution bandwidth

cdmaOne specifications (Option BAC)

Channel power measurement

The channel power measurement measures the total RMS power in a user-specified bandwidth. The following specifications apply for the default bandwidth of 1.23 MHz.

Range at RF input	+30 dBm to –80 dBm
Channel bandwidth range	1 kHz to 10 MHz (default is 1.23 MHz)

Absolute power accuracy for in-band signal (excluding mismatch error), 18°C to 30°C

+30 to –28 dBm at RF input	±0.6 dB	±0.4 dB, typically
–28 to –50 dBm at RF input	±0.8 dB	±0.7 dB, typically
–50 to –80 dBm at RF input	±1.0 dB	±0.9 dB, typically

Relative power accuracy (same channel, different transmit power, input attenuator fixed) input level change

0 to –76 dB	±0.2 dB	±0.1 dB, typically

Code domain measurement (base station)

Code domain measures the power, timing, and phase, of each of the 64 Walsh channels in an cdmaOne base-station transmitter. Code-domain power is measured for each Walsh channel relative to the total power inside the 1.23 MHz channel. Code-domain phase is the measured phase error for each Walsh channel relative to the pilot channel. Code-domain timing is the measured timing error for each Walsh channel relative to the pilot channel. Time offset, frequency error, and carrier feedthrough are also measured.

Range at RF input	+30 dBm to –30 dBm
Measurement interval range	0.25 ms to 30 ms
Code domain power (measurement interval 1.25 ms)	
Display dynamic range	50 dB
Accuracy	±0.3 dB (Walsh channel power within 20 dB of total power)
Resolution	0.01 dB
Other reported power parameters	Average active traffic, maximum inactive traffic, average inactive traffic, pilot, paging, sync channels
Frequency error accuracy	±10 Hz (excludes frequency reference)
Pilot time offset (from even second signal to start of PN sequence)	
Range	–13.33 ms to +13.33 ms
Accuracy	±250 ns
Resolution	10 ns
Code domain timing (pilot to code-channel time tolerance)	
Range	±200 ns
Accuracy	±10 ns
Resolution	0.1 ns
Code domain phase (pilot to code-channel phase tolerance)	
Range	±200 mrad
Accuracy	±20 mrad
Resolution	0.1 mrad
Displays	Power graph and metrics power graph and four markers power, timing, and phase graphs

Modulation accuracy (rho) measurement

Rho is a measure of the performance of a cdmaOne transmitter's modulation circuitry. Rho can be measured for a base station only when a pilot is the only active channel. Rho can be measured for a reverse channel offset-QPSK signal when the data is all zeros going into the short code spreading. Error vector magnitude, time offset, frequency error, and carrier feedthrough are also measured and reported.

Power range at RF input +30 dBm to –40 dBm
Measurement interval range 0.25 ms to 30 ms

Rho (waveform quality) (usable range 0.5 to 1.0)
- Range 0.9 to 1.0
- Accuracy ±0.005
- Resolution 0.0001

Frequency error (frequency error excludes instrument time base error)
- Input frequency error range ±900 Hz
- Accuracy ±10 Hz
- Resolution 0.1 Hz

Pilot time offset (from even second signal to start of PN sequence)
- Range –13.33 ms to +13.33 ms
- Accuracy ±250 ns
- Resolution 10 ns

EVM
- Floor 2.5% 1.8%, typically
- Accuracy ±0.5%
- Resolution 0.1%

Carrier feedthrough
- Accuracy ±2.0 dB
- Resolution 0.1 dB

Magnitude error
- Accuracy ±0.5%
- Resolution ±0.01%

Phase error
- Accuracy ±1.0 degrees
- Resolution 0.1 degrees

Displays Metric summary, magnitude error versus chips, phase error versus chips, EVM versus chips, I/Q measured polar graph

Adjacent channel power ratio measurement

The adjacent channel power ratio (ACPR) measurement measures up to five pairs of offset channels and relates them to the carrier power. The measurement result is a ratio of the channel power to the power in each offset. The results can be displayed as a ratio to the total power in each bandwidth, or as a ratio of the power spectral density.

Power range at RF input +30 to –20 dBm

Dynamic range (referenced to average power of carrier in 1.23 MHz BW)

Offset frequency	Integ BW	Dynamic range
750 kHz	30 kHz	–82 dBc
885 kHz	30 kHz	–82 dBc
1.25625 MHz	2.5 kHz	–86 dBc
1.98 MHz	30 kHz	–85 dBc
2.75 MHz	1 MHz	–56 dBc

Relative accuracy ±0.9 dB
Resolution 0.01 dB

Spurious close measurement (at transmitter maximum power)

Spurious close measures the spurious emissions in the transmit band relative to the channel power in the selected channel. The unit under test is typically set for the maximum output power.

Carrier power range at RF input +30 dBm to –30 dBm

Minimum spurious emission power sensitivity at RF input –70 dBm (30 kHz RBW)

Absolute accuracy for in-band signal ±1.0 dB

Relative accuracy ±1.0 dB

Resolution 0.01 dB

Demod sync

Even second input Level and impedance same as external trigger
PN offset range 0 to 511 x 64 (chips)

In-band frequency range
- IS-95 824 to 849 MHz, 869 to 894 MHz
- J-STD-008 1850 to 1910 MHz, 1930 to 1990 MHz

EDGE specifications (Option 202)
3p/8 8PSK modulation

Power versus time measurement

Power versus time measures the average power during the "useful part" of the EDGE burst and verifies that the power ramp is within the EDGE mask. The specified EDGE masks for both base transceiver stations and mobile stations are provided. Power versus time also lets you view the rise, fall, and "useful part" of the burst. The timings are referenced to the transmitter from bit 13 to 14 of the training sequence (midamble).

Range at RF input	+30 dBm (1W) to –31 dBm
Power ramp relative accuracy (referenced to mean RF transmitted carrier power)	
0 to +6 dB	±0.25 dB
0 to 70 dB	±0.20 dB
Resolution	
Displayed	0.01 dB
Remote query	0.001 dB
Instrument repeatability	±0.05 dB, characteristic

EDGE EVM measurement

The EDGE EVM measurement measures the modulation quality of the 3π/8 8PSK modulated signal providing you with IQ constellation diagram, error vector magnitude (EVM) in RMS and peak, 95 percentile, and I/Q origin offset.

Carrier power range at RF input	+27 to –31 dBm	
EVM		
Range	0 to 25%	
Floor	0.6%	
Accuracy		
EVM range 1% to 10%	±1.0%	±0.55%, typically
EVM range 10% to 20%	±1.75%	±1.4%, typically
Resolution	0.01% display resolution	
Time resolution	≤ 0.2 µs	

Output RF spectrum measurement

The output RF spectrum measurements determine the spectral energy emitted into the adjacent channels. The measurements are divided into two types: spectrum due to 3π/8 8PSK modulation and noise, and spectrum due to switching transients (burst ramping). A single offset can be examined with a corresponding trace, or up to 15 offsets can be measured with a tabular data display.

Carrier power range at UUT[1]		
Offsets ≤ 1800 kHz, 30 kHz RBW		
BTS	+50 dBm to +15 dBm	
MS	+40 dBm to +5 dBm	
Relative accuracy		
0 to –76 dB	±0.25 dB	±0.1 dB, typically
–76 to –86 dB	±0.70 dB	±0.4 dB, typically

Spectrum due to modulation displayed dynamic range	
100 kHz offset	30 dB, characteristic
200 kHz offset	60 dB, characteristic
250 kHz offset	60 dB, characteristic
400 kHz offset	70 dB, characteristic
600 kHz offset	80 dB, characteristic
1200 kHz offset	80 dB, characteristic
1.8 to 6.0 MHz offset	82 dB, characteristic, (100 kHz RBW)

Spectrum due to switching transients displayed dynamic range	
400 kHz offset	62 dB, characteristic
600 kHz offset	80 dB, characteristic
1200 kHz offset	85 dB, characteristic
1800 kHz offset	85 dB, characteristic

Burst sync

Source	Training sequence, RF amplitude, external rear, none. Actual available choices dependent on measurement.
Training sequence code	EDGE defined 0 to 7 auto (search) or manual
Burst type	Normal (TCH and CCH), Sync (SCH), Access (RACH)

In-band frequency range

Down band GSM	400 to 500 MHz
GSM 900, P-GSM	890 to 915 MHz 935 to 960 MHz
GSM 900, E-GSM	880 to 915 MHz 925 to 960 MHz
DCS1800	1710 to 1785 MHz 1805 to 1880 MHz
PCS1900	1850 to 1910 MHz 1930 to 1990 MHz

1. UUT - Unit under test

GSM specifications (Option BAH)
GSMK modulation

Transmit power measurement

The transmit power measurement determines the average power for an RF signal burst at or above a user specified threshold value. The threshold value may be absolute, or relative to the peak value of the signal.

Range at RF input	+30 dBm (1W) to –60 dBm

Absolute power accuracy for in-band signal (excluding mismatch error) 10 dB or 20 dB attenuator, +18°C to +30°C, +30 to –40 dBm at RF input

	±0.6 dB
	±0.4 dB, typically

Relative power accuracy (same channel, different transmit power, input attenuator fixed), input level change 0 to –76 dB

	±0.25 dB
	±0.1 dB, typically
Resolution	
Displayed	0.01 dB
Remote query	0.001 dB
Instrument repeatability	±0.05 dB, characteristic

Power versus time measurement

Power versus time measures the average power during the "useful part" of the GSM burst and verifies that the power ramp is within the GSM mask. The specified GSM masks for both base transceiver stations and mobile stations are provided. Power versus time also lets you view the rise, fall, and "useful part" of the burst. The timings are referenced to the transmitter from bit 13 to 14 of the training sequence (midamble).

Range at RF input	+30 dBm (1 W) to –50 dBm

Power ramp relative accuracy (referenced to mean RF transmitted carrier power.)

0 to +6 dB	±0.25 dB
0 to 70 dB	±0.20 dB

Resolution	
Displayed	0.01 dB
Remote query	0.001 dB
Instrument repeatability	±0.05 dB, characteristic
Time resolution	≤ 0.2 µs
Maximum record length	50 slots (29 ms),145 k points, characteristic with default pre-trigger
Burst to mask uncertainty	±0.2 bit (approx. ±0.7 µs)

Phase and frequency error measurement

Phase and frequency error measures the modulation quality of a GSM transmitter. Phase and frequency error can be displayed both numerically and or graphically. A binary representation of the demodulated data bits is also available.

Range at RF input	+30 dBm to –40 dBm

Phase error (phase trajectory)	
Range	–180° to +180°
Resolution	±0.01°
Peak measurement accuracy	±2°
RMS measurement accuracy	±1.0°
	±0.5°, typically
Frequency error	
Initial frequency error range	±200 kHz
Accuracy	±5 Hz
I/Q offset	
Range	80 dBc to –10 dBc
Accuracy	±0.5 dB
Burst sync time uncertainty	±0.1 bit (approximately ±0.4 µs)
Displays	I/Q error quad view, phase error versus bit phase error with frequency versus bit, RF envelope versus bit numeric summary, I/Q measured polar vector, and data bits

Output RF spectrum measurement

The output RF spectrum measurements determine the spectral energy emitted into the adjacent channels. The measurements are divided into two types: spectrum due to 0.3 GMSK modulation and noise, and spectrum due to switching transients (burst ramping). A single offset can be examined with a corresponding trace or up to 15 offsets can be measured with a tabular data display.

Range at RF input	
Offsets 1800 kHz, 30 kHz RBW	+30 dBm to –5 dBm
Offsets > 1800 kHz, 100 kHz RBW	+30 dBm to +10 dBm

Relative accuracy		
0 to –76 dB	±0.25 dB	±0.1 dB, typically
–76 to –86 dB	±0.70 dB	±0.4 dB, typically

Spectrum due to modulation displayed dynamic range		
100 kHz offset	30 dB	35 dB, typically
200 kHz offset	60 dB	65 dB, typically
250 kHz offset	60 dB	65 dB, typically
400 kHz offset	70 dB	75 dB, typically
600 kHz offset	80 dB	85 dB, typically
1200 kHz offset	80 dB	85 dB, typically
1.8 to 6 MHz offset	82 dB	87 dB, typically (100 kHz RBW)

Spectrum due to switching transient displayed dynamic range		
400 kHz offset	62 dB	65 dB, typically
600 kHz offset	80 dB	85 dB, typically
1200 kHz offset	85 dB	90 dB, typically
1800 kHz offset	85 dB	90 dB, typically

Burst sync

Source	Training sequence, RF amplitude, external rear, none. Actual available choices dependent on measurement.
Training sequence code	GSM defined 0 to 7 auto (search) or manual
Burst type	Normal (TCH and CCH), Sync (SCH), Access (RACH)

In-band frequency range

Down band GSM	400 to 500 MHz
GSM 900, P-GSM	890 to 915 MHz 935 to 960 MHz
GSM 900, E-GSM	880 to 915 MHz 925 to 960 MHz
DCS 1800	1710 to 1785 MHz 1805 to 1880 MHz
PCS1900	1850 to 1910 MHz 1930 to 1990 MHz
GSM 450	450.4 to 457.6 MHz 460.4 to 467.6 MHz
GSM480	478.8 to 486 MHz 488.8 to 496 MHz
GSM850	824 to 849 MHz 869 to 894 MHz

NADC (Option BAE)

ACPR measurement

The adjacent channel power ratio (ACPR) measurement measures up to five pairs of offset channels and relates them to the carrier power. The measurement result is a ratio of the channel power to the power in each offset. The results can be displayed as a ratio to the total power in each bandwidth, or as a ratio of the power spectral density.

Power range at RF input +27 to –20 dBm

Dynamic range

Offset frequency	Integ BW	Dynamic range
30 kHz	32.8 kHz	–35 dBc, typically
60 kHz	32.8 kHz	–65 dBc
90 kHz	32.8 kHz	–70 dBc

Relative accuracy ±1.0 dB
Resolution 0.01 dB display resolution

EVM measurement

EVM measurement measures the modulation quality of pi/4QPSK modulated signal providing you with IQ constellation diagram, error vector magnitude (EVM) in RMS and peak as well as each chip of magnitude error, phase error and EVM.

Range at RF input +27 to –20 dBm

EVM
Range 0 to 25%
Floor 1.0%
Accuracy ±0.6%

I/Q origin offset
Range –10 to –50 dBc
Resolution 0.01 dB display resolution
Carrier frequency error
Frequency resolution 0.01 Hz display resolution

NADC in-band is defined as the following frequency ranges:

800 MHz band
Mobile transmit 824 to 849 MHz
Base station transmit 869 to 894 MHz
PCS band
Mobile transmit 1850 to 1910 MHz
Base station transmit 1930 to 1990 MHz

PDC (Option BAE)

ACPR measurement

The adjacent channel power ratio (ACPR) measurement measures up to five pairs of offset channels and relates them to the carrier power. The measurement result is a ratio of the channel power to the power in each offset. The results can be displayed as a ratio to the total power in each bandwidth, or as a ratio of the power spectral density.

Power range at RF input +27 to –20 dBm

Dynamic range

Offset frequency	Integ BW	Dynamic range
50 kHz	21.0 kHz	–55 dBc
100 kHz	21.0 kHz	–70 dBc

Relative accuracy ±1.0 dB

Resolution 0.01 dB display resolution

EVM measurement

EVM measurement measures the modulation quality of pi/4QPSK modulated signal providing you with IQ constellation diagram, error vector magnitude (EVM) in RMS and peak as well as each chip of magnitude error, phase error and EVM.

Range at RF input +27 to –20 dBm

EVM

Range 0 to 25%

Floor 1.0%

Accuracy ±0.6%

I/Q origin offset

Range –10 to –50 dBc

Resolution 0.01 dB display resolution

Carrier frequency error

Frequency resolution 0.01 Hz display resolution

OBW measurement

Occupied bandwidth (OBW) measurement measures the frequency bandwidth corresponding to 99% of the total transmitted power.

Range at RF input +27 to –20 dBm

Frequency

Resolution 0.1 kHz

Accuracy +400 Hz, –100 Hz

In-band frequency range

800 MHz band #1	810 to 828 MHz 940 to 958 MHz
800 MHz band #2	870 to 885 MHz 925 to 940 MHz
800 MHz band #3	838 to 840 MHz 893 to 895 MHz
1500 MHz band	1477 to 1501 MHz 1429 to 1453 MHz

General characteristics

Temperature range

Operating	0°C to +55°C
Non-operating	–40°C to +71°C

EMI compatibility

Conducted and radiated emission is in compliance with CISPR Pub. 11/1990 Group 1 Class A.

Radiated immunity

When tested at 3 V/m according to IEC 801-3/1984, the displayed average noise level will be within specifications over the full immunity test frequency range of 27 to 500 MHz, except that at immunity test frequencies of 278.6 MHz ± selected resolution bandwidth and 321.4 MHz ± selected resolution bandwidth, the displayed average noise level may be up to –90 dBm. When the analyzer tuned frequency is identical to the immunity test signal frequency there may be signals of up to ±90 dBm displayed on the screen.

Electrostatic

In accordance with IEC 801-2/1991, an discharge air discharge of up to 8 kV, or a contact discharge of up to 4 kV, will not cause any change of instrument state or measurement data. However, discharges to center pins of front or rear panel connectors might cause damage to the associated circuitry.

Power requirements

Voltage, frequency	90 to 132 V rms, 47 to 440 Hz 195 to 250 V rms, 47 to 66 Hz
Power consumption, ON	< 350 W
Power consumption, standby	< 20 W

Weight

Net	19 kg (42 lb), typically
Shipping	40 kg (88 lb), typically

Dimensions

177 mm H x 426 mm W x 432 mm D
(7.0 in H x 16.8 in W x 17 in D)

Front panel

RF INPUT

Connector	Type N female
Impedance	50 Ω, nominally
VSWR, 20 MHz to 2 GHz	1.4 :1 1.2 : 1, typically
VSWR, 2 GHz to 4 GHz	1.9 :1 1.4 : 1, typically

Baseband I/Q inputs

Connectors	(4 each I, Q, $\bar{I}$, $\bar{Q}$) BNC female
Balanced input impedance (4 connectors: I, Q, $\bar{I}$, and $\bar{Q}$)	600 Ω, 1 MΩ, nominally (switchable)
Unbalanced input impedance (2 connectors: I and Q)	50 Ω, 1 MΩ, nominally (switchable)
VSWR 50 Ω impedance only	1.4:1, 1.08:1, typically

Probe pwr

Voltage/current	+15 Vdc, ±7% at 150 mA maximum –12.6 Vdc, ±10% at 150 mA maximum

EXT TRIGGER INPUT

Connector	BNC female
Impedance	> 10 kΩ, nominally
Trigger level	–5 V to +5 V

Rear panel

10 MHz OUT

Connector	BNC female
Impedance	50 Ω, nominally
Output amplitude	0 dBm, typically

EXT REF IN

Connector	BNC female
Impedance	50 Ω, nominal
Input amplitude range	–5 to +10 dBm, typically
Maximum DC level	±28 Vdc
Frequency	1 MHz to 30 MHz, selectable
Frequency lock range	±5 10^{-6} of the specified external reference input frequency

Note: Instrument noise sidebands and spurious responses might be affected by the quality of the external reference used.

General characteristics, continued

TRIGGER IN

Connector	BNC female
Impedance	> 10 kΩ, nominally
Trigger level	–5 V to +5 V

TRIGGER 1 OUT and TRIGGER 2 OUT

Connector	BNC female
Impedance	> 10 kΩ, nominally
Trigger level	0 V to +5 V (no load)

MONITOR output

Connector	VGA compatible, 15-pin mini D-SUB
Format	VGA (31.5 kHz horizontal, 60 Hz vertical sync rates, noninterlaced)
Resolution	640 x 480

PARALLEL interface

Allows printing to compatible printers

GPIB interface

Allows communication with compatible devices

Agilent E4406A vector signal analyzer product and application information

General information

Agilent E4406A Vector Signal Analyzer, brochure
Literature number 5968-7618E

Self-Guided Demo for the E4406A Vector Signal Analyzer
Literature number 5968-7617E

Wireless Communications Products
Literature number 5968-6174E

Solutions brochures

CDMA Solutions from Agilent Technologies
Literature number 5966-3058E

GSM Solutions from Agilent Technologies
Literature number 5966-1550E

Wireless 3G Solutions
Literature number 5968-5860E

Solutions for Wireless Communication Manufacturers
Literature number 5966-4809E

Application notes

AN 1298 Digital Modulation in Communications Systems–An Introduction
Literature number 5965-7160E

AN 1311 Understanding CDMA Measurements for Base Stations and Their Components
Literature number 5968-0953E

AN 1312 Understanding GSM Transmitter Measurements for Base Transceiver Stations and Mobile Stations
Literature number 5968-2320E

AN 1313 Testing and Troubleshooting Digital RF Communications Transmitter Designs
Literature number 5968-3578E

AN 1314 Testing and Troubleshooting Digital RF Communications Receiver Designs
Literature number 5968-3579E

AN 1324 Understanding PDC and NADC Transmitter Measurements for Base Transceiver Stations and Mobile Stations
Literature number 5968-5537

AN 1335 HPSK Spreading for 3G
Literature number 5968-8438E

AN 1355 Designing and Testing 3GPP W-CDMA Base Stations
Literature number 5980-1239E

AN 1356 Designing and Testing 3GPP W-CDMA User Equipment
Literature number 5980-1238E

AN 1357 Designing and Testing cdma2000 Base Stations
Literature number 5980-1303E

AN 1358 Designing and Testing cdma2000 Mobile Stations
Literature number 5980-1237E

See Agilent's VSA internet page for the latest VSA news, product and support information, application literature, firmware upgrades, and more at:

www.agilent.com/find/vsa

Agilent Technologies
Test and Measurement Support, Services, and Assistance Agilent Technologies aims to maximize the value you receive, while minimizing your risk and problems. We strive to ensure that you get the test and measurement capabilities you paid for and obtain the support you need. Our extensive support resources and services can help you choose the right Agilent products for your applications and apply them successfully. Every instrument and system we sell has a global warranty. Support is available for at least five years beyond the production life of the product. Two concepts underlay Agilent's overall support policy: "Our Promise" and "Your Advantage."

Our promise
Our Promise means your Agilent test and measurement equipment will meet its advertised performance and functionality. When you are choosing new equipment, we will help you with product information, including realistic performance specifications and practical recommendations from experienced test engineers. When you use Agilent equipment, we can verify that it works properly, help with product operation, and provide basic measurement assistance for the use of specified capabilities, at no extra cost upon request. Many self-help tools are available.

Your advantage
Your Advantage means that Agilent offers a wide range of additional expert test and measurement services, which you can purchase according to your unique technical and business needs. Solve problems efficiently and gain a competitive edge by contracting with us for calibration, extra-cost upgrades, out-of-warranty repairs, and on-site education and training, as well as design, system integration, project management, and other professional services. Experienced Agilent engineers and technicians worldwide can help you maximize your productivity, optimize the return on investment of your Agilent instruments and systems, and obtain dependable measurement accuracy for the life of those products.

By internet, phone, or fax, get assistance with all your test and measurement needs

Online assistance:

www.agilent.com/find/assist

Phone or Fax
United States:
(tel) 1 800 452 4844

Canada:
(tel) 1 877 894 4414
(fax) (905) 282 6495

China:
(tel) 800 810 0189
(fax) 1 0800 650 0121

Europe:
(tel) (31 20) 547 2323
(fax) (31 20) 547 2390

Japan:
(tel) (81) 426 56 7832
(fax) (81) 426 56 7840

Korea:
(tel) (82 2) 2004 5004
(fax) (82 2) 2004 5115

Latin America:
(tel) (305) 269 7500
(fax) (305) 269 7599

Taiwan:
(tel) 080 004 7866
(fax) (886 2) 2545 6723

Other Asia Pacific Countries:
(tel) (65) 375 8100
(fax) (65) 836 0252
Email: tm_asia@agilent.com

Product specifications and descriptions in this document subject to change without notice.

Printed in USA, January 11, 2002
5968-3030E

Agilent Technologies