

Test Equipment Solutions Datasheet

Test Equipment Solutions Ltd specialise in the second user sale, rental and distribution of quality test & measurement (T&M) equipment. We stock all major equipment types such as spectrum analyzers, signal generators, oscilloscopes, power meters, logic analysers etc from all the major suppliers such as Agilent, Tektronix, Anritsu and Rohde & Schwarz.

We are focused at the professional end of the marketplace, primarily working with customers for whom high performance, quality and service are key, whilst realising the cost savings that second user equipment offers. As such, we fully test & refurbish equipment in our in-house, traceable Lab. Items are supplied with manuals, accessories and typically a full no-quibble 2 year warranty. Our staff have extensive backgrounds in T&M, totalling over 150 years of combined experience, which enables us to deliver industry-leading service and support. We endeavour to be customer focused in every way right down to the detail, such as offering free delivery on sales, covering the cost of warranty returns BOTH ways (plus supplying a loan unit, if available) and supplying a free business tool with every order.

As well as the headline benefit of cost saving, second user offers shorter lead times, higher reliability and multivendor solutions. Rental, of course, is ideal for shorter term needs and offers fast delivery, flexibility, try-before-you-buy, zero capital expenditure, lower risk and off balance sheet accounting. Both second user and rental improve the key business measure of Return On Capital Employed.

We are based near Heathrow Airport in the UK from where we supply test equipment worldwide. Our facility incorporates Sales, Support, Admin, Logistics and our own in-house Lab.

All products supplied by Test Equipment Solutions include:

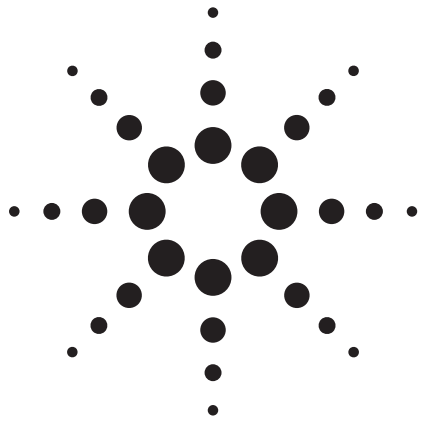
- No-quibble parts & labour warranty (we provide transport for UK mainland addresses).
- Free loan equipment during warranty repair, if available.
- Full electrical, mechanical and safety refurbishment in our in-house Lab.
- Certificate of Conformance (calibration available on request).
- Manuals and accessories required for normal operation.
- Free insured delivery to your UK mainland address (sales).
- Support from our team of seasoned Test & Measurement engineers.
- ISO9001 quality assurance.

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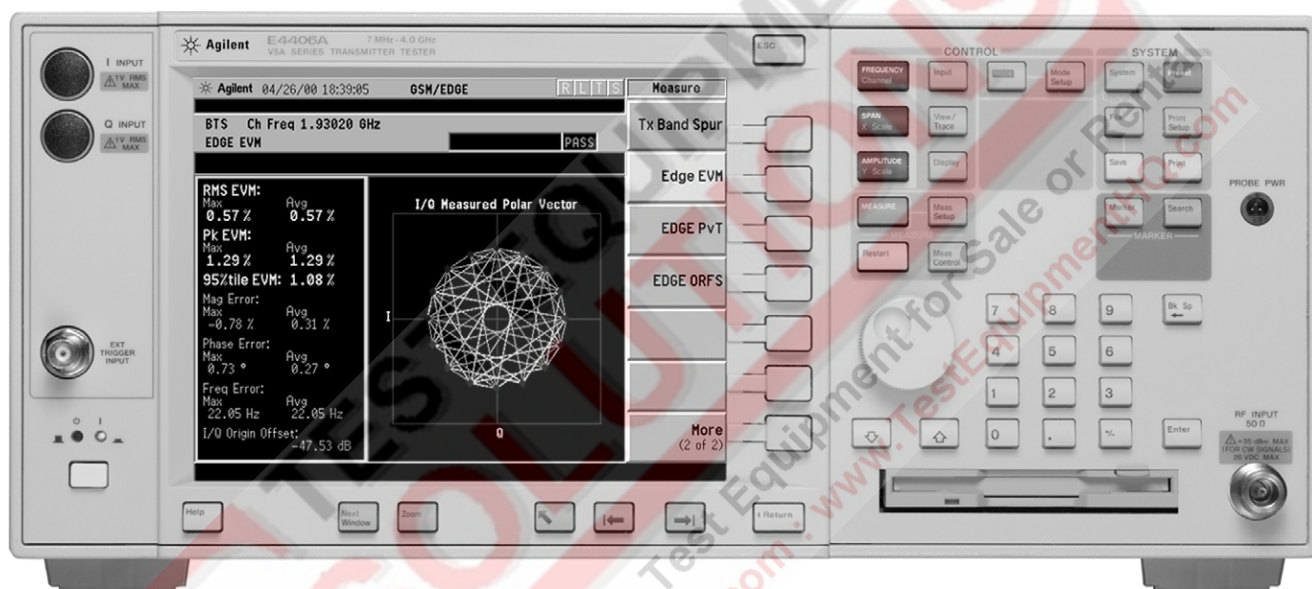
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Agilent E4406A Vector Signal Analyzer

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 7 MHz to 314 MHz and 329 MHz to 4 GHz

Baseband IQ inputs 0 Hz to 5 MHz

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

Frequency setting resolution 1 Hz

Frequency reference

Accuracy $\pm[(\text{time since last adjustment aging} + \text{rate}) + \text{temperature stability} + \text{calibration accuracy}]$

Initial calibration accuracy $\pm 5 \cdot 10^{-8}$

Settability $\pm 2 \cdot 10^{-9}$

Aging rate during any 24 hrs $\pm 5 \cdot 10^{-10}$, typically following 24-hour warm-up

Per year temperature stability $\pm 1 \cdot 10^{-7}$, typically $\pm 5 \cdot 10^{-8}$ 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

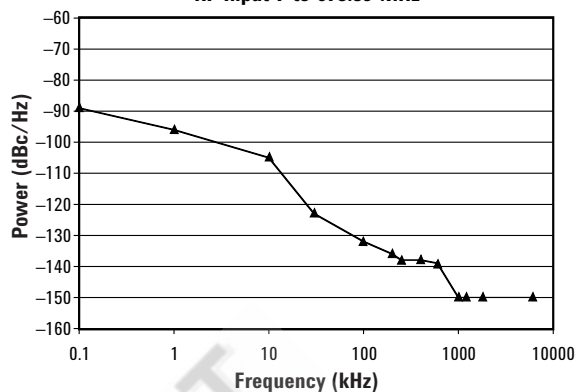
2 GHz to 4 GHz -80 dBm

Baseband IQ inputs

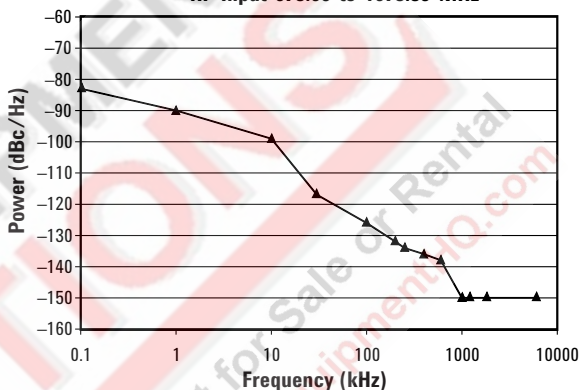
50 Ω input terminated

0 to 5 MHz ≤ -90 dB

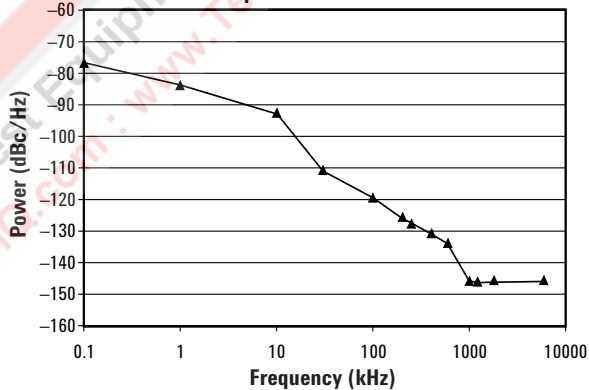
RF Input 7 to 678.59 MHz



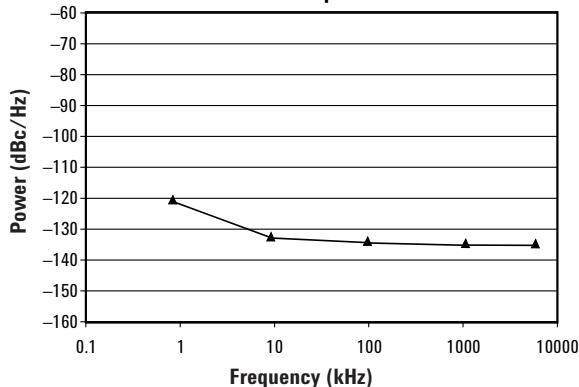
RF Input 678.60 to 1678.59 MHz



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	–5 to +13 dBm in four ranges of 6 dB steps: –5 dBm, +1 dBm, +7 dBm, +13 dBm
50 Ω input impedance	
Input ranges	–18 to 0 dBV in four ranges of 6 dB steps: –18 dBV, –12 dBV, –6 dBV, 0 dBV
600 Ω, 1 M Ω input impedance	
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	≤ –60 dBc
–6 to –10 dBm below range	

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	+8 dBm to –18 dBm, +18°C to +30°C
10 dB input attenuation	
400 MHz to 2205 MHz	±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

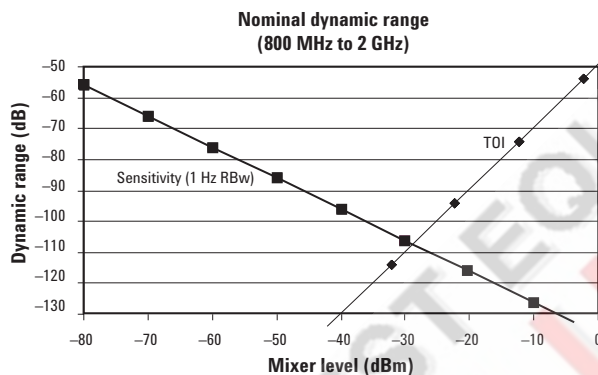
Input terminated in 50 Ω , 0 dB attenuation, 1 kHz RBW, 10 kHz span, +24 dB ADC gain

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 $\leq \pm 2.0$ Vdc
DC offset

Channel match

Baseband IQ inputs

Amplitude match ± 0.25 dB
0 to 5.0 MHz

Phase match ± 2.0 degrees
0 to 5.0 MHz

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 μ s to 200 ms
RBW 1 MHz 10 μ s to 400 ms
RBW 100 kHz 10 μ s to 2 s
RBW 10 kHz 10 μ s 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 overall 100 MHz to 3 MHz
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 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 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

Accuracy	+30 to –50 dBm ±0.3 dB (characteristic, with 15 slot measurement interval and spread channel power within –40 dB of total power – averaged over a slot)
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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
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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
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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), 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 ratio of the power spectral density. Simulated spectrum analyzer mode is for those who are accustomed to spectrum analyzers.

Power range at +30 to –20 dBm
RF input

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 $\pm 1.0\%$ (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 3p/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 3p/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 UUT¹

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)
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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
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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
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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
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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 $\pm$ selected resolution bandwidth and 321.4 MHz $\pm$ 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
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Balanced input impedance (4 connectors: I, Q, $\bar{I}$, and $\bar{Q}$)	600 Ω , 1 M Ω , nominally (switchable)
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Unbalanced input impedance (2 connectors: I and Q)	50 Ω , 1 M Ω , nominally (switchable)
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VSWR	1.4:1, 1.08:1, typically
50 Ω impedance only	

Probe pwr

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

EXT TRIGGER INPUT

Connector	BNC female
Impedance	> 10 k Ω , 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	$\pm 5 \cdot 10^{-6}$ 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 k Ω , nominally
Trigger level	–5 V to +5 V

TRIGGER 1 OUT and TRIGGER 2 OUT

Connector	BNC female
Impedance	> 10 k Ω , 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

GPIO 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

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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:

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Canada:

(tel) 1 877 894 4414

(fax) (905) 282 6495

China:

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