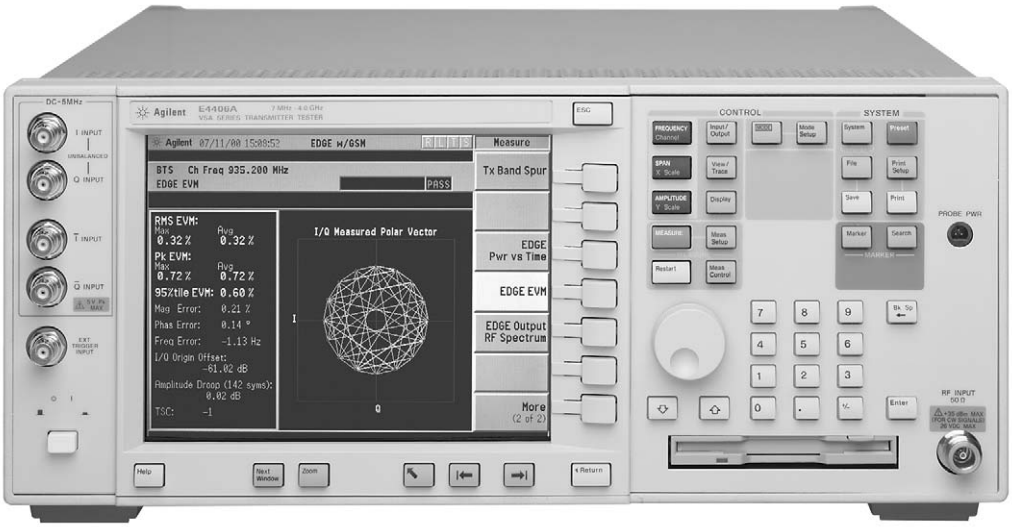
Agilent E4406A
Vector Signal Analyzer

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, 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, HSDPA/HSUPA, cdma2000, 1xEV-DV, 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 series of digital RF signal generators, the E4406A VSA provides a powerful, transmit-receive test solution for wireless-equipment manufacturers.

Agilent Technologies

Frequency

Frequency range

RF input	7 to 314 MHz and 329 MHz to 4 GHz
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 x aging rate) + temperature stability + calibration accuracy]
Initial calibration accuracy	$\pm 5 \times 10^{-8}$
Settability	$\pm 2 \times 10^{-9}$
Aging rate	
During any 24 hrs following 24-hr warm-up	$\pm 5 \times 10^{-10}$ (nominal)
Per year	$\pm 1 \times 10^{-7}$ (nominal)
Temperature stability	$\pm 5 \times 10^{-8}$ variation from frequency at +25 °C over the temperature range of 0 to +55 °C
Warm-up time	1 hour (nominal)

Residual responses

RF input

50 Ω input terminated, 0 dB input attenuation, +18 dB ADC gain

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

Baseband IQ inputs

50 Ω input terminated

0 to 5 MHz	≤ –90 dBm (typical)[2]

Noise Sidebands (RF Input)

673.6 MHz

Offset	Specifications	Supplemental
100 Hz	≤ –85 dBc/Hz	
1 kHz	≤ –92 dBc/Hz	
10 kHz	≤ –102 dBc/Hz	
100 kHz	≤ –131 dBc/Hz	
600 kHz	≤ –138 dBc/Hz	
1.2 MHz	≤ –141 dBc/Hz	
6.0 MHz	≤ –145 dBc/Hz	
10.0 MHz	≤ –145 dBc/Hz	

960 MHz

Offset	Specifications	Supplemental
100 Hz	≤ –81 dBc/Hz	
1 kHz	≤ –87 dBc/Hz	
10 kHz	≤ –96 dBc/Hz	
100 kHz	≤ –125 dBc/Hz	
600 kHz	≤ –136 dBc/Hz	
1.2 MHz	≤ –140 dBc/Hz	
6.0 MHz	≤ –146 dBc/Hz	
10.0 MHz	≤ –146 dBc/Hz	

1990 MHz

Offset	Specifications	Supplemental
100 Hz	≤ –75 dBc/Hz	
1 kHz	≤ –82 dBc/Hz	
10 kHz	≤ –86 dBc/Hz	
100 kHz	≤ –118 dBc/Hz	
600 kHz	≤ –132 dBc/Hz	
1.2 MHz	≤ –137 dBc/Hz	
6.0 MHz	≤ –141 dBc/Hz	
10.0 MHz	≤ –141 dBc/Hz	

Noise Sidebands[1] (Baseband IQ Inputs)

0 to 5 MHz

Offset	Specifications	Supplemental
1 kHz		≤ –120 dBc/Hz (typical)[2]
10 kHz		≤ –133 dBc/Hz (typical)[2]
100 kHz		≤ –134 dBc/Hz (typical)[2]
1.0 MHz		≤ –135 dBc/Hz (nominal)
5.0 MHz		≤ –135 dBc/Hz (nominal)

1. No DC offset applied
2. 100 percent of Option B7C baseband IQ assemblies are measured in the factory. More than 80 percent of these instruments exceed this typical specification.

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

$f_{emission}$ = center frequency ±321.4 MHz	≤ (–23 dBm – input attenuation) (nominal)

Third-order intermodulation distortion (RF input)

Input power ≤ +27 dBm, Pre-ADC Filter ON

	Distortion	TOI
Tone separation ≥ 5 MHz, 50 MHz to 4 GHz	< –56 dBc	+18 dBm (+23 dBm, typical)
Tone separation ≥ 50 kHz, 30 MHz to 4 GHz	< –54 dBc	+17 dBm (+21 dBm, typical)

Absolute power measurement accuracy

RF input

+18 to +30 °C

0 to 40 dB input attenuation
(–2 to –28 dBm) + attenuation

810 to 960 MHz	±0.60 dB (±0.4 dB, typical)
1710 to 2205 MHz	±0.60 dB (±0.4 dB, typical)
1428 to 1503 MHz	±0.60 dB (±0.5 dB, typical)

10 dB input attenuation
+8 to –18 dBm

400 to 2205 MHz	±0.75 dB

0 to 20 dB input attenuation
(–2 to –28 dBm) + attenuation

7 to 1000 MHz	±1.0 dB
1000 to 2205 MHz	±1.3 dB
2205 to 4000 MHz	±1.8 dB

Baseband IQ inputs

Input impedance = 50 Ω, all ranges	±0.6 dB (typical)[3]

Input impedance = 600 Ω, all ranges

0 Hz to 1 MHz	±0.6 dB (typical)[3]
1 to 5 MHz	±2.0 dB (typical)[3]

Input impedance = 1 MΩ, all ranges

Unbalanced	±0.7 dB (nominal)
Balanced	
0 to 1 MHz	±0.6 dB (nominal)
1 to 5 MHz	±2.0 dB (nominal)

Amplitude accuracy

RF input

(Relative to –2 dBm at the input mixer)

No averaging

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

With 10 averages

–78 to –88 dBm	±0.25 dB (nominal)
–88 to –98 dBm	±0.35 dB (nominal)

(Relative to –12 dBm at the input mixer)

–12 to –62 dBm	±0.15 dB (±0.10 dB, typical)

3. 100 percent of Option B7C baseband IQ assemblies are measured in the factory. More than 80 percent of these instruments exceed this typical specification.

Amplitude linearity

Baseband IQ inputs

0 to –35 dB below range	±0.17 dB (typical)[4]
–35 to –55 dB below range	±1.0 dB (typical)[4]

Displayed average noise level

RF input

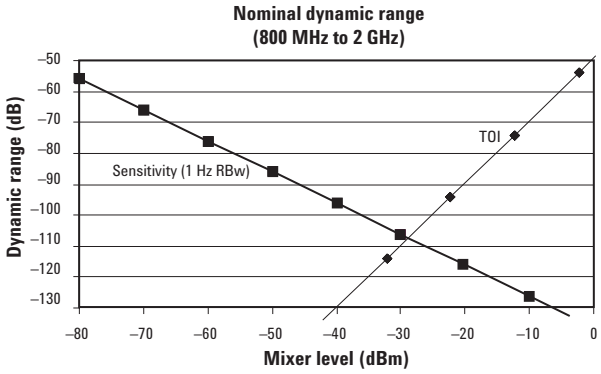
Input terminated in 50 Ω, 0 dB attenuation, 1 kHz RBW, 10 kHz span, +18 dB ADC gain

7 to 20 MHz	–103 dBm (–111 dBm, typical)
20 to 2000 MHz	–106 dBm (–111 dBm, typical)
2000 to 2700 MHz	–103 dBm (–108 dBm, typical)
2700 to 4000 MHz	–98 dBm (–104 dBm, typical)

Baseband IQ inputs

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

+13 dBm range	–100 dBm, (typical)
+7 dBm range	–105 dBm, (typical)
+1 dBm range	–108 dBm, (typical)
–5 dBm range	–110 dBm, (typical)



DC offset

Baseband IQ inputs

After auto-zero	–55 dB below range, (typical)[4]
Compensation for customer DC offset	≤ ±2.0 Vdc (typical)[4]
Offset accuracy	±2.0% of range (nominal)

Channel match

Baseband IQ inputs

Amplitude match 0 to 5.0 MHz	±0.25 dB (typical)[4]
Phase match 0 to 5.0 MHz	±2.0 degrees (typical)[4]

Crosstalk

Baseband IQ inputs

Input impedance = 50 Ω	< –60 dB (typical)[4]
Input impedance = 600 Ω	< –52 dB (typical)[4]

Common mode rejection

Baseband IQ inputs

600 Ω balanced inputs

0 to 0.5 MHz	< –50 dB (typical)[4]
> 0.5 to 5.0 MHz	< –35 dB (typical)[4]

Measurements

Waveform measurement

Range at RF input	
Maximum	+30 dBm (1 W)
Minimum	Displayed average noise level
Range at IQ input	
Maximum (50 Ω input)	+13 dBm (20 mW)
Maximum (600 Ω, 1 MΩ input)	1 V
Minimum	Displayed average noise level
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 (nominal)
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
Markers	Normal, delta, band power

4. 100 percent of Option B7C baseband IQ assemblies are measured in the factory. More than 80 percent of these instruments exceed this typical specification.

Spectrum measurement

Range at RF input	
Maximum	+30 dBm (1 W)
Minimum	Displayed average noise level
Range at IQ input	
Maximum (50 Ω input)	+13 dBm (20 mW)
Maximum (600 Ω, 1 MΩ input)	0 dBV
Minimum	Displayed average noise level
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
Resolution BW range overall	100 mHz to 3 MHz 1, 1.5, 2, 3, 5, 7.5, 10 sequence or arbitrary bandwidth user-definable
Pre-FFT filter	
Type	Gaussian, flat
BW	Auto, manual 1 Hz to 10 MHz
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
Measurement resolution	
Displayed	0.01 dB
Remote query	0.001 dB

Trigger

Trigger sources	
RF input	Free run (immediate), video (IF envelope), RF burst (wideband), frame timer, external front, external rear, line
Baseband IQ inputs	Free run (immediate), video (IQ envelope), external front input, external rear input, frame timer, line
Delay range	–500 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 to –40 dBm
Trigger level range	0 to –25 dB (relative to signal peak)
Bandwidth	> 15 MHz (nominal)

Video (IF envelope)

Trigger range	+50 to –200 dBm

W-CDMA (Option E4406A-BAF) HSDPA/HSUPA (Option E4406A-210)

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.

Minimum power at RF input	–70 dBm (nominal)
Absolute power accuracy, 18 to 30 °C	±0.63 dB (±0.41 dB, typical)
Measurement floor	-73 dBm (nominal)

ACPR measurement (ACLR)

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.

Minimum power at RF input		–27 dBm (nominal)
ACPR accuracy		RRC weighted, 3.84 MHz noise bandwidth
Radio	**Offset frequency**	**Specification**
MS (UE)	5 MHz	±0.20 dB, at ACPR range of –30 to –36 dBc with optimum mixer level
MS (UE)	10 MHz	±0.30 dB, at ACPR range of –40 to –46 dBc with optimum mixer level
BTS	5 MHz	±0.93 dB, at ACPR range of –42 to –48 dBc with optimum mixer level
BTS	10 MHz	±0.82 dB, at ACPR range of –47 to –53 dBc with optimum mixer level
BTS	5 MHz	±0.39 dB, at –48 dBc non-coherent ACPR
Dynamic range		RRC weighted, 3.84 MHz noise bandwidth
Offset frequency		
5 MHz		–68 dB (nominal)
10 MHz		–72 dB (nominal)

For more detail, please refer to the E4406A specifications that can be found 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.

Minimum power at RF input	–40 dBm, average (nominal)
Histogram resolution	0.01 dB

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.

Code domain power 25 to 35°C 95% confidence	
Minimum power at RF input	–70 dBm (nominal)
Relative code domain accuracy	Using Test Model 1 with 32 DPCH signal
±0.015 dB[5]	Code domain power between 0 and –10 dBc
±0.08 dB[5]	Code domain power between –10 and –30dBc
±0.15 dB[5]	Code domain power between –30 to–40dBc
Symbol power vs. time	
Minimum power at RF input	–45 dBm (nominal)
Accuracy	Using Test Model 1 with 32 DPCH signal
±0.10 dB[5]	Code domain power between 0 and –25 dBc
±0.50 dB[5]	Code domain power between –25 to –40dBc
Symbol error vector magnitude	
Minimum power at RF input	–45 dBm (nominal)
Accuracy	Using Test Model 1 with 32 DPCH signal
± 1.0%	Code domain power between 0 and –25 dBc

5. Nominals in using test model 5 with 8 HS-PDSCH.

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.

QPSK EVM	QPSK selected
Minimum power at RF input	–20 dBm (nominal)
EVM	
Operating range	0 to 25% (nominal)
Floor	1.5% (nominal)
Accuracy	±1.0% (nominal) at EVM of 10%
I/Q origin offset	
Range	–10 to –50 dBc (nominal)
Frequency error	
Range	±300 kHz (nominal)
Accuracy	±10 Hz (nominal) + (transmitter frequency x frequency reference accuracy)

QPSK EVM	12.2k RMC selected
Minimum power at RF input	–20 dBm (nominal)
EVM	
Operating range	0 to 20% (nominal)
Floor	1.5% (nominal)
Accuracy	±1.0% (nominal) at EVM of 10%
I/Q origin offset	
Range	–10 to –50 dBc (nominal)
Frequency error	
Range	±20 kHz (nominal)
Accuracy	±10 Hz (nominal) + (transmitter frequency x frequency reference accuracy)

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.

Minimum power at RF input	–70 dBm (nominal)
Composite EVM	Using Test Model 4
Range	0 to 25%[6]
Floor	1.5%[6]
Accuracy	±1.0%[6]
Peak code domain error	Using Test Model 3 with 16 DPCH w/spreading code of 256
Accuracy	±1.0 dB (nominal)
I/Q origin offset	
Range	–10 to –50 dBc (nominal)
Frequency error	Specified for CPICH power ≥ –15 dBc
Range	±500 Hz
Accuracy	±2 Hz + (transmitter frequency x frequency reference accuracy)
Time offset	
Absolute frame offset accuracy	±150 nsec
Relative frame offset accuracy	±5.0 ns (nominal)
Relative offset accuracy (for STTD diff mode)	±1.25 nsec

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.

Minimum carrier power at RF input	–20 dBm (nominal)

6. Nominals in using test model 5 with 8 HS-PDSCH.

Power vs. time and power control measurement

Absolute power measurement

Using 5 MHz resolution bandwidth

Accuracy

0 to –20 dBm	±0.7 dB (nominal)
–20 to –60 dBm	±1.0 dB (nominal)

Relative power measurement

Accuracy

Step range ± 1.5 dB	±0.1 dB (nominal)
Step range ± 3.0 dB	±0.15 dB (nominal)
Step range ± 4.5 dB	±0.2 dB (nominal)
Step range ± 26.0 dB	±0.3 dB (nominal)

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.

Minimum carrier power at RF input	–15 dBm (nominal)
ACPR dynamic range, two carriers	RRC weighted, 3.84 MHz noise bandwidth
5 MHz offset	–64 dB (nominal)
10 MHz offset	–68 dB (nominal)
ACPR accuracy, two carriers	
5 MHz offset, –48 dBc ACPR	±0.70 dB (nominal)

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.

Minimum power at RF input	–20 dBm (nominal)
Dynamic range, relative	
2.515 MHz offset	–77.9 dB (–82.8 dB, typical)
1980 MHz region	–72.2 dB (–77.2 dB, typical)
Sensitivity, absolute	
2.515 MHz offset	–88.9 dBm (–93.9 dBm, typical)
1980 MHz region	–72.9 dBm (–77.9 dBm, typical)
Accuracy	
Display = Abs Peak Pwr	±0.60 dB (±0.40 dB, typical)
Display = Rel Peak Pwg	±0.25 dB

Occupied bandwidth measurement

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

Minimum carrier power at RF input	–20 dBm (nominal)
Frequency resolution	100 Hz
Frequency accuracy	$\frac{1.4\%}{\sqrt{N_{avg}}}$ (nominal)

Conformance with 3GPP TS 25.141 base station requirements for a manufacturing environment

Sub-clause	Name	3GPP required test instrument tolerance	Instrument tolerance interval	Supplemental information
6.2.1	**Maximum output power**	±0.7 dB (95%)	±0.29 dB (95%)	±0.63 dB (100%)
6.2.2	**CPICH power accuracy**	±0.8 dB (95%)	±0.30 dB (95%)	–10 dB CDP
6.3.4	**Frequency error**	±12 Hz (95%)	±10 Hz (100%)	Freq ref locked
6.4.2	**Power control steps**			
	1-dB step	±0.1 dB (95%)	±0.03 dB (95%)	Test Model 2
	0.5-dB step	±0.1 dB (95%)	±0.03 dB (95%)	Test Model 2
	Ten 1-dB steps	±0.1 dB (95%)	±0.03 dB (95%)	Test Model 2
	Ten 0.5-dB steps	±0.1 dB (95%)	±0.03 dB (95%)	Test Model 2
6.4.3	**Power dynamic range**	±1.1 dB (95%)	±0.50 dB (95%)	
6.4.4	**Total power dynamic range**	±0.3 dB (95%)	±0.015 dB (95%)	Ref –35 dBm at mixer
6.5.1	**Occupied bandwidth**	±100 kHz (95%)	±38 kHz (95%)	10 averages
6.5.2.1	**Spectrum emission mask**	±1.5 dB (95%)	±0.59 dB (95%)	Absolute peak
6.5.2.2	**ACLR**			
	5 MHz offset	±0.8 dB (95%)	±0.34 dB (95%)	±0.93 dB (100%)
	10 MHz offset	±0.8 dB (95%)	±0.40 dB (95%)	±0.82dB (100%)
6.7.1	**EVM**	±2.5% (95%)	±1.0% (95%)	Range 15 to 20%
6.7.2	**Peak code domain error**	±1.0 dB (95%)	±1.0 dB (nominal)	

Conditions

25 to 35 °C

Derived tolerances

- 95th percentile
- 100% limit tested

Calibration uncertainties included

cdma2000 (Option E4406A-B78) 1xEV-DV (Option E4406A-214)

Channel power measurement

Range at RF input	+30 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

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

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

QPSK EVM measurement

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

Code domain measurement

Code domain power	
Power range	Mixer level (RF input power minus attenuation) is between –15 and –5 dBm
Accuracy	QPSK modulated code signal
Relative range	
0 to –10 dBc	±0.015 dB[7]
–10 to –30 dBc	±0.18 dB[7]
–30 to –40 dBc	±0.51 dB[7]
Symbol power vs. time	QPSK modulated code signal
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)[3]
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 to +13.33 ms
Accuracy	±250 ns
Resolution	10 ns

Intermodulation distortion

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

Spectrum emission mask measurement

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

Occupied bandwidth measurement

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

7. Nominals for 8PSK/16QAM modulated code signal.

Modulation accuracy measurement (composite rho)

Range at RF input	+30 to –50 dBm
EVM	
Range	0 to 25%
Floor	2.0% or less[8]
Resolution	0.01% display resolution
I/Q origin offset	
Range	–10 to –50 dBc
Resolution	0.02 dB display resolution
Frequency error	
Range	±900 Hz
Accuracy	±10 Hz + transmitter accuracy (nominal)
Resolution	±0.01 Hz display resolution
Pilot time offset	
Range	–13.33 to +13.33 ms
Accuracy	±250 ns
Resolution	10 ns
Code domain timing	
Range	±200 ns
Accuracy	±1.25 ns
Resolution	0.1 ns
Code domain phase	
Range	±200 mrad
Accuracy	±10 mrad
Resolution	0.1 mrad

1xEV-DO (Option E4406A-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 (nominal)
Accuracy (Pilot, MAC, Data QPSK/Data 8PSK)	±0.3 dB (nominal, spread channel power is within 20 dB of total power)

8. Nominal for 1xEV-DV signal.

QPSK EVM measurement

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

Modulation accuracy measurement (waveform quality)

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

Range at RF input	+30 to –50 dBm (nominal)
EVM	
Range	0 to 25% (nominal)
Floor	2.5% or less (nominal)
Accuracy	±1.0% at the range of 5% to 25%
Rho	
Range	0.9 to 1.0
Floor	> 0.99938 (0.99938 equals 2.5%EVM)
Accuracy	±0.0010 at 0.99751 Rho (5% EVM)
	±0.0044 at 0.94118 Rho (25% EVM)
Frequency error	
Range	±400 Hz (nominal)
Accuracy	±10 Hz (nominal) + (transmitter frequency x frequency reference accuracy)
Resolution	0.01 Hz display resolution
I/Q origin offset	
Range	–10 to –50 dBc (nominal)
Resolution	0.02 dB display resolution

Power vs. time

Range at RF input	+30 to –80 dBm (nominal)
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 (nominal)
–28 to –50 dBm at RF input	±0.8 dB (nominal)
–50 to –80 dBm at RF input	±1.0 dB (nominal)

Intermodulation distortion

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

Spurious emissions & ACP

Range at RF input	+30 to –20 dBm
Spectrum emission	
Power range	–136 dBc/Hz at 1 MHz offset (nominal)
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 (Option E4406A-BAC)

Channel power measurement

Range at RF input	+30 to –80 dBm
Integration 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

RF input

+30 to –28 dBm	±0.6 dB (±0.4 dB, typical)
–28 to –50 dBm	±0.8 dB (±0.7 dB, typical)
–50 to –80 dBm	±1.0 dB (±0.9 dB, typical)

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

0 to –76 dB	±0.2 dB (±0.1 dB, typical)

Code domain measurement (base station)

Range at RF input	+30 to –30 dBm
Measurement interval range	0.25 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 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

Modulation accuracy (rho) measurement

Power range at RF input	+30 to –40 dBm
Measurement interval range	0.25 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 + (transmitter frequency x frequency reference accuracy)
Resolution	0.1 Hz
Pilot time offset (from even second signal to start of PN sequence)	
Range	–13.33 to +13.33 ms
Accuracy	±250 ns
Resolution	10 ns
EVM	
Floor	2.5% (1.8%, typical)
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

Adjacent channel power ratio measurement

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	12.5 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)

Carrier power range at RF input	+30 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/GSM (Option E4406A-202)
3π/8 8PSK Modulation
GSM (Option E4406A-BAH)
GSMK Modulation

Power versus time measurement

Power versus time measures the average power during the "useful part" of the EDGE or GSM burst and verifies that the power ramp is within the EDGE or GSM mask. The specified EDGE or 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).

Power vs. time and EDGE power vs. time

GMSK modulation (GSM)
3π/8 shifted 8PSK modulation (EDGE)

Measures mean transmitted RF carrier power during the useful part of the burst (GSM method) and the power vs. time ramping. 510 kHz RBW

Minimum carrier power at RF input for GSM and EDGE	–30 dBm (nominal)
Absolute power accuracy for in-band signal (excluding mismatch error)	
18 to 30 °C;	–0.11 ± 0.60 dB (–0.11 ± 0.40 dB, typical)
0 to 55 °C;	–0.11 ± 0.90 dB
Power ramp relative accuracy	Referenced to mean transmitted power
RF input range = Auto +6 dB to noise	±0.26 dB
Mixer level ≤ -12 dBm +6 dB to noise	±0.26 dB
Measurement floor	–81 dBm + input attenuation (nominal)
Time resolution	200 ns
Burst to mask uncertainty	±0.2 bit (approx ±0.7 µs)

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.

EDGE EVM (Error Vector Magnitude)	3π/8 shifted 8PSK modulation Specifications based on 3GPP essential conformance requirements, and are based on 200 bursts
Carrier power range at RF input	–45 dBm (nominal)
EVM	
Range	0 to 25% (nominal)
Floor (RMS)	0.5%, (0.3%, typical)
Accuracy (RMS)	±0.5% (Power range at RF input from +27 to –12 dBm, EVM range 1% to 11%)
Frequency error	±1 Hz + (transmitter frequency x frequency reference accuracy)
I/Q origin offset range	–20 to –45 dBc
Trigger to T0 time offset	
Relative offset accuracy	±5.0 ns (nominal)

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 or 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.

Minimum carrier power at RF input	-15 dBm (nominal)
ORFS relative RF power uncertainty	
Due to modulation	
Offsets ≤ 1.2 MHz	±0.26 dB
Offsets ≥ 1.8 MHz	±0.36 dB
Due to switching	±0.27 dB (nominal)
ORFS absolute RF power accuracy 20 to 30 °C	±0.60 dB (±0.40 dB, typical)
Dynamic range	5-pole sync-tuned filters
Spectrum due to modulation	Methods: direct time and FFT

Offset frequency	**GSM**	**EDGE**
100 kHz	67.7 dB	67.7 dB
200 kHz	73.3 dB	73.3 dB
250 kHz	76.3 dB	76.3 dB
400 kHz	78.4 dB	77.9 dB
600 kHz	81.1 dB	80.2 dB
1.2 MHz	85.0 dB	83.3 dB
1.8 MHz	90.3 dB	82.4 dB
6.0 MHz	94.0 dB	85.3 dB

Spectrum due to switching

Offset frequency		
400 kHz	68.7 dB (100%)	71.2 dB (95%)
600 kHz	71.0 dB (100%)	73.1 dB (95%)
1.2 MHz	74.1 dB (100%)	77.0 dB (95%)
1.8 MHz	78.4 dB (100%)	80.4 dB (95%)

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.

Transmit power	GMSK modulation (GSM)
Carrier power range at	+30dBm(1W) to –60 dBm
Absolute power accuracy for in-band signal (excluding mismatch error)	+30 to –40dBm at RF input
+18 to 30 °C	±0.6 dB (±0.4 dB, typical)
0 to +55 °C	±0.9 dB
Relative power accuracy (same channel, different transmit power, input attenuator fixed), input level change 0 to –76 dB	±0.25dB (±0.1dB, typical)
Resolution	
Displayed	0.01dB
Remote query	0.001dB
Instrument repeatability	±0.05 dB (nominal)

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.

Phase and Frequency Error	GMSK modulation (GSM) Specifications based on 3GPP essential conformance requirements, and are based on 200 bursts.
Carrier power range at RF Input	+27 to –45 dBm (nominal)
Phase error	
Floor (RMS)	<0.5°
Accuracy (RMS)	±0.5° (phase error range 1° to 15°)
Peak phase error	
Floor	<1.5°
Accuracy	±2.0° (phase error range 3° to 25°)
Frequency error	
Accuracy	±5 Hz + (transmitter frequency x frequency reference accuracy)
I/Q offset	
Range	–15 to –50 dBc (nominal)
Burst sync time uncertainty	±0.1 bit (approx. ±0.4 µs)
Trigger to T0 time offset	
Relative offset accuracy	±5.0 ns (nominal)

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/PDC (Option E4406A-BAE)

ACPR measurement

Carrier power range at RF input	+27 to –20 dBm
Dynamic range	
NADC mode	
Offset frequency (Integ BW)	
30 kHz (32.8 kHz)	–35 dB (nominal)
60 kHz (32.8 kHz)	–65 dB
90 kHz (32.8 kHz)	–70 dB
PDC mode	
Offset frequency (Integ BW)	
50 kHz (21.0 kHz)	–55 dB
100 kHz (21.0 kHz)	–70 dB
Relative accuracy	
Resolution	±1.0 dB
Display resolution	0.01 dB

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 (Common in NADC and PDC)	+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 (PDC only)

Range at RF input	+27 to –20 dBm
Frequency	
Resolution	0.1 kHz
Accuracy	+400 Hz, –100 Hz

In-band frequency range (NADC)

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

In-band frequency range (PDC)

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

EMI compatibility

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

Radiated immunity (RF input)

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) (nominal) 20 kg (44 lb) with baseband IQ inputs
Shipping	39 kg (86 lb) (nominal)

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 (nominal)
VSWR	
20 to 2205 MHz	≤ 1.4:1 (≤ 1.24:1, typical)
2205 MHz to 4 GHz	≤ 1.6:1 (≤ 1.4:1, typical)
50 MHz	≤ 1.4:1 (≤ 1.08:1, typical)
Baseband I/Q inputs	Supports: Basic, W-CDMA/HSDPA, cdma2000/1xEV-DV, and EDGE/GSM modes
Connectors	(4 each I, Q, $\overline{I}$, $\overline{Q}$) BNC female
Balanced input impedance (4 connectors: I, Q, $\overline{I}$, and $\overline{Q}$)	600 Ω, 1 MΩ (nominal) (switchable)
Unbalanced input impedance (2 connectors: I and Q)	50 Ω, 1 MΩ (nominal) (switchable)
VSWR 50 Ω impedance only	≤ 1.4:1 (≤ 1.08:1, typical)

Probe pwr

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

Rear panel

10 MHz OUT	
Connector	BNC female
Impedance	50 Ω (nominal)
Output amplitude	≥ 0 dBm (nominal)

EXT REF IN

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

TRIGGER IN

Connector	BNC female
Impedance	–10 kΩ (nominal)
Trigger level	–5 to +5 V

TRIGGER 1 OUT and TRIGGER 2 OUT

Connector	BNC female
Impedance	50 kΩ (nominal)
Trigger level	0 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

LAN interface

Allows communication with 10baseT LAN

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

Agilent E4406A vector signal analyzer product and application information

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

PSA Series Spectrum Analyzers E4406A Vector Signal Analyzer Technical Overviews
- *W-CDMA and HSDPA/HSUPA Measurement Personality*
  Literature number 5988-2388EN
- *cdma2000 and 1xEV-DV Measurement Personality* Literature number 5988-3694EN
- *1xEV-DO Measurement Personality*
  Literature number 5988-4828EN
- *GSM with EDGE Measurement Personality*
  Literature number 5988-2389EN

Select the Right Agilent Signal Analyzer for Your Needs, Selection Guide
Literature number 5968-3413E

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/EDGE Transmitter and Receiver Measurements for Base Transceiver Stations and their Components
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 5968-5537E

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

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