

Specifications Guide

Agilent Technologies E4406A VSA Series Spectrum Analyzer

This manual provides documentation for the following instrument:

E4406A (7 MHz to 4 GHz)



Agilent Technologies

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1 Transmitter Tester Specifications

All specifications apply over 0 °C to +55 °C, except when otherwise specified. The instrument will meet its specifications after 2 hours of storage at a constant temperature, within the operating temperature range, 1 hour after the instrument is turned on and within 24 hours after “Align All Now” has been run.

Frequency

| | Specifications | Supplemental Information |
|--|--------------------------------------|--------------------------|
| Frequency Range (RF Input) | 7 MHz to 314 MHz 329 MHz to 4 GHz | |
| Frequency Range (Baseband I and Q Inputs) | 0 Hz to 5 MHz | |

| | Specifications | Supplemental Information |
|---|----------------------------------|---|
| Frequency Spans (Baseband IQ Inputs) | 5 Hz to 5 MHz 10 Hz to 10 MHz | Baseband I or Q Inputs Composite I/Q |

| | Specifications | Supplemental Information |
|-------------------------------------|----------------|--------------------------|
| Frequency Setting Resolution | 1 Hz | |

| | Specifications | Supplemental Information |
|---|--|---|
| Frequency Reference | | |
| Accuracy | $\pm[(\text{time since last adjustment} \times \text{aging rate}) + \text{temperature stability} + \text{calibration accuracy}]^a$ | |
| Initial calibration accuracy | $\pm 5 \times 10^{-8}$ | |
| Stability | $\pm 2 \times 10^{-9}$ | |
| Aging rate | | |
| During any 24 hours, following 24-hour warmup | | $\pm 5 \times 10^{-10}$, (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) |
| Within 10 minutes after turn-on | | $\pm 1 \times 10^{-7}$ (relative to measurement after 1 hour) |
| Within 20 minutes after turn-on | | $\pm 1 \times 10^{-8}$ (relative to measurement after 1 hour) |
| Within 15 minutes at ambient temperature of +25 ±3 °C | | $\pm 5 \times 10^{-8}$, relative to the frequency at the previous turn-off time (powered for at least 72 hours prior to removing power for 24 hours) |

| | Specifications | | |
|---|-----------------|----------------------|---------------------|
| Stability | 7 to 678.59 MHz | 678.6 to 1678.59 MHz | 1678.60 to 4000 MHz |
| RMS residual FM 3.3 ms data acquisition time, 3 kHz pre-ADC bandwidth | ≤4.0 Hz | ≤8.0 Hz | ≤16.0 Hz |

a. Initial calibration accuracy depends on how accurately the frequency standard was adjusted to 10 MHz.

| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| Noise Sidebands (RF Input) ^{ab} | | |
| 673.6 MHz | | |
| Offset 100 Hz | ≤-85 dBc/Hz | |
| Offset 1 kHz | ≤-92 dBc/Hz | |
| Offset 10 kHz | ≤-102 dBc/Hz | |
| Offset 100 kHz | ≤-131 dBc/Hz | |
| Offset 600 kHz | ≤-138 dBc/Hz | |
| Offset 1.2 MHz | ≤-141 dBc/Hz | |
| Offset 6.0 MHz | ≤-145 dBc/Hz | |
| Offset 10.0 MHz | ≤-145 dBc/Hz | |
| 960 MHz | | |
| Offset 100 Hz | ≤-81 dBc/Hz | |
| Offset 1 kHz | ≤-87 dBc/Hz | |
| Offset 10 kHz | ≤-96 dBc/Hz | |
| Offset 100 kHz | ≤-125 dBc/Hz | |
| Offset 600 kHz | ≤-136 dBc/Hz | |
| Offset 1.2 MHz | ≤-140 dBc/Hz | |
| Offset 6.0 MHz | ≤-146 dBc/Hz | |
| Offset 10.0 MHz | ≤-146 dBc/Hz | |

-
- a. Noise sidebands and spurious responses may be affected by the quality of the external reference when an external reference is used.
 - b. Offsets <1 MHz measured with RF Input ≥ -2 dBm; Offsets ≥ 1 MHz measured with RF Input >+12 dBm.

| | Specifications | Supplemental Information |
|---|--------------------|------------------------------|
| 1990 MHz | | |
| Offset 100 Hz | ≤ -75 dBc/Hz | |
| Offset 1 kHz | ≤ -82 dBc/Hz | |
| Offset 10 kHz | ≤ -86 dBc/Hz | |
| Offset 100 kHz | ≤ -118 dBc/Hz | |
| Offset 600 kHz | ≤ -132 dBc/Hz | |
| Offset 1.2 MHz | ≤ -137 dBc/Hz | |
| Offset 6.0 MHz | ≤ -141 dBc/Hz | |
| Offset 10.0 MHz | ≤ -141 dBc/Hz | |
| Noise Sidebands^a (Baseband IQ Inputs) | | |
| 0 to 5 MHz | | |
| Offset 1 kHz | ≤ -120 dBc/Hz | |
| Offset 10 kHz | ≤ -133 dBc/Hz | |
| Offset 100 kHz | ≤ -134 dBc/Hz | |
| Offset 1.0 MHz | | ≤ -135 dBc/Hz (nominal) |
| Offset 5.0 MHz | | ≤ -135 dBc/Hz (nominal) |

a. No DC offset applied

| | Specifications | Supplemental Information |
|--|---|--------------------------|
| <p>Spurious Responses (RF Input)^a -10 dBm at input mixer, ^b Manual ADC range</p> <p>Input CW frequency from 700 MHz to < 793 MHz 3kHz ≤ offset ≤ 50 MHz</p> <p>Input CW frequency from 793 MHz to 1678.6 MHz 3kHz ≤ offset ≤ 150 MHz Except for 2 x input frequency - 964.2 MHz</p> <p>Input CW frequency from > 1678.6 MHz to < 2200 MHz 3kHz ≤ offset ≤ 150 MHz</p> <p>Input CW frequency from 2200 MHz to 3700 MHz 3kHz ≤ offset ≤ 1200 MHz Except for offsets of -160.7 MHz, -482.1 MHz, and -642.8 MHz</p> <p>Input CW frequency from > 3700 MHz to 4000 MHz 3kHz ≤ offset ≤ 150 MHz</p> <p>Spurious Responses^{cd} (Baseband IQ Inputs) Full Scale input level, +13 dBm range</p> | <p>≤-59 dBc</p> <p>≤-59 dBc</p> <p>≤-53 dBc</p> <p>≤-53 dBc</p> <p>≤-53 dBc</p> <p>≤-80 dBc</p> | |

-
- a. Noise sidebands and spurious responses may be affected by the quality of the external reference when an external reference is used.
 - b. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).
 - c. Noise sidebands and spurious responses may be affected by the quality of the external reference when an external reference is used.
 - d. No DC offset applied

| | Specifications | Supplemental Information |
|--|--|--------------------------|
| Residual Responses (RF Input) 50 Ω Input terminated, 0 dB input attenuation, +18 dB ADC gain 20 MHz to 2 GHz 2 GHz to 4 GHz Residual Responses^a (Baseband IQ Inputs) 50 Ω Input terminated 0 to 5 MHz | ≤ -85 dBm ≤ -80 dBm ≤ -90 dBm | |

| | Specifications | Supplemental Information |
|--|----------------------------|--------------------------|
| Spurious Sidebands^b (Baseband IQ Inputs) > 1 kHz Offset | ≤ -80 dBc | |

-
- a. No DC offset applied
 - b. No DC offset applied

Amplitude

| | Specifications | Supplemental Information |
|--------------------------------------|---|--------------------------|
| RF Input | | |
| Maximum measurement power | +30 dBm (1 W) | |
| Maximum safe dc voltage | ±26 Vdc | |
| Maximum safe input power | +35 dBm (3.16 W) | |
| Baseband IQ Inputs | | |
| Input Ranges 50 Ω Input Z | -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 Z | -18 to 0 dBV in four ranges of 6 dB steps: -18 dBV, -12 dBV, -6 dBV, 0 dBV | |
| Maximum safe input voltage | ±5 V (DC + AC) | |

| | Specifications | Supplemental Information |
|--|--|--------------------------|
| 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 | |

| | Specifications | Supplemental Information |
|---|----------------|---|
| 1st LO Emission from RF Input | | |
| $f_{\text{emission}} = \text{Center Freq.} \pm 321.4 \text{ MHz}$ | | $\leq (-23 \text{ dBm} - \text{Input Attenuation}),$ (nominal) |

| | Specifications | | Supplemental Information |
|--|-------------------------|------------------|--------------------------|
| Third-order Intermodulation Distortion (RF Input) | Distortion ^a | TOI ^b | TOI |
| Input power ≤ +27 dBm Pre-ADC Filter ON | | | |
| 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) |

-
- a. Computed from measured TOI, using the equation: Distortion (in dBc) = 2[mixer tone level (in dBm) – TOI]
 - b. TOI= third order intercept. The TOI is given by the mixer tone level (in dBm) minus (distortion/2) where distortion is the relative level of the distortion tones in dBc. The measurement is made with two -10 dBm tones at the input mixer.

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| Harmonic Distortion (Baseband IQ Inputs) For one CW input signal 0 to -10 dB below Range | ≤ -63 dBc | |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| 1 dB Gain Compression Pre-ADC Filter ON Total power at input mixer ^a | | |
| 1 tone | 0 dBm | |
| 2 tones, separation \geq 3 MHz | +2 dBm | +6 dBm, (typical) |
| 2 tones, separation \geq 40 MHz | +5 dBm | +10 dBm, (typical) |

a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| Absolute Power Measurement Accuracy (RF Input) Excluding mismatch errors Excluding FFT scalloping errors Frequency tuned to the input CW frequency 0 to 40 dB input attenuation (-2 dBm to -28 dBm) + attenuation, +18 °C to +30 °C 810 MHz to 960 MHz 1710 MHz to 2205 MHz 1428 MHz to 1503 MHz 10 dB input attenuation +8 dBm to -18 dBm 400 MHz to 2205 MHz +18 °C to +30 °C 20 dB input attenuation +18 dBm to -8 dBm 400 MHz to 2205 MHz +18 °C to +30 °C 0 to 20 dB input attenuation (-2 dBm to -28 dBm) + attenuation 7 MHz to 1000 MHz 1000 MHz to 2205 MHz 2205 MHz to 4000 MHz 21 to 30 dB input attenuation (-2 dBm to -28 dBm) + attenuation 7 MHz to 1000 MHz 1000 MHz to 2205 MHz 2205 MHz to 4000 MHz 31 to 40 dB input attenuation (-2 dBm to -28 dBm) + attenuation 7 MHz to 1000 MHz 1000 MHz to 2205 MHz 2205 MHz to 4000 MHz | ±0.60 dB | ±0.4 dB, (typical) |
| | ±0.60 dB | ±0.4 dB, (typical) |
| | ±0.60 dB | ±0.5 dB, (typical) |
| | ±0.75 dB | |
| | ±0.80 dB | |
| | ±1.0 dB | |
| | ±1.3 dB | |
| | ±1.8 dB | |
| | ±1.1 dB | |
| | ±1.5 dB | |
| | ±2.0 dB | |
| | ±1.1 dB | |
| | ±1.6 dB | |
| | ±2.6 dB | |

| | Specifications | Supplemental Information |
|---|-----------------------------------|--|
| Absolute Power Measurement Accuracy (Baseband IQ Inputs) Input Impedance = 50 Ω, all ranges Input Impedance = 600 Ω, all ranges 0 to 1 MHz 1 MHz to 5 MHz Input Impedance = 1 M Ω, all ranges Unbalanced Balanced 0 to 1 MHz 1 MHz to 5 MHz | ±0.6 dB ±0.6 dB ±2.0 dB | ±0.7 dB, (nominal) ±0.6 dB, (nominal) ±2.0 dB, (nominal) |

| | Specifications | Supplemental Information |
|---|----------------------------------|--|
| Amplitude Accuracy (–2dBm) Relative to –2 dBm at the Input Mixer ^a (RF Input) Power level at the mixer, no averaging –2 dBm to –78 dBm ^b –78 dBm to –88 dBm ^c –88 dBm to –98 dBm ^c Power level at the mixer, with 10 averages –78 dBm to –88 dBm ^c –88 dBm to –98 dBm ^c | ±0.25 dB ±0.70 dB ±1.20 dB | ADC range is set to AUTO. ±0.15 dB, (typical) ±0.40 dB, (typical) ±0.80 dB, (typical) ±0.25 dB, (nominal) ±0.35 dB, (nominal) |

-
- a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).
 - b. Uncertainty due to amplitude linearity. Does not include uncertainty due to noise.
 - c. Uncertainty due to amplitude linearity and noise (1 Hz resolution bandwidth)

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| Amplitude Accuracy (-12 dBm) Relative to -12 dBm at the Input Mixer ^a (RF Input) Power level at the mixer, no averaging -12 dBm to -62 dBm ^b | ±0.15 dB | ±0.10 dB, (typical) |

-
- a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).
 - b. Uncertainty due to amplitude linearity. Does not include uncertainty due to noise.

| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| Amplitude Linearity (Baseband IQ Inputs) | | |
| 0 to -35 dB below Range | ±0.17 dB | |
| -35 to -55 dB below Range | ±1.0 dB | |

| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| 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 | -111 dBm, (typical) |
| 20 MHz to 2000 MHz | -106 dBm | -111 dBm, (typical) |
| 2000 MHz to 2700 MHz | -103 dBm | -108 dBm, (typical) |
| 2700 MHz to 4000 MHz | -98 dBm | -104 dBm, (typical) |
| Displayed Average Noise Level^a (Baseband IQ Inputs) Input terminated in 50 Ω, 50 Ω input impedance, 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) |

| | Specifications | Supplemental Information |
|---------------------------------------|----------------------|---|
| DC Offset (Baseband IQ Inputs) | | |
| After Auto-Zero | < -40 dB below Range | -55 dB below Range, (typical) |
| Compensation for Customer DC Offset | ≤ ±2.0 V DC | Offset Accuracy ±2.0% of Range, (nominal) |

a. No DC offset applied

| | Specifications | Supplemental Information |
|---|--|--------------------------|
| Channel Match (Baseband IQ Inputs) Amplitude match 0 to 5.0 MHz Phase match 0 to 5.0 MHz | ± 0.25 dB ± 2.0 degrees | |

| | Specifications | Supplemental Information |
|--|----------------------------------|--------------------------|
| Crosstalk (Baseband IQ Inputs) Input Impedance = 50 Ω Input Impedance = 600 Ω | < -60 dB < -52 dB | |

| | Specifications | Supplemental Information |
|---|----------------------------------|--------------------------|
| Common Mode Rejection (Baseband IQ Inputs) 600 Ω Balanced Inputs 0 to 0.5 MHz > 0.5 MHz to 5.0 MHz | < -50 dB < -35 dB | |

Measurements

These specifications apply to the measurements available in the Basic or Service Modes.

| | Specifications | Supplemental Information |
|---|--|--|
| Spectrum Measurement | | |
| Range at RF Input Maximum: Minimum: | +30 dBm (1 W) Displayed Avg Noise Level | |
| Range at IQ Input Maximum (50 Ω Input): Maximum (600 Ω, 1 M Ω Input): Minimum: | +13 dBm (20 mW) 0 dBV Displayed Avg Noise Level | |
| Span Range (RF Input) | 10 Hz to 10 MHz | Maximum is 15 MHz in Service Mode 1, 1.5, 2, 3, 5, 7.5, 10 sequence or arbitrary user-definable |
| Span Range (Composite I/Q Input) | 10 Hz to 10 MHz | 1, 1.5, 2, 3, 5, 7.5, 10 sequence or arbitrary user-definable |
| Span Range (Baseband I or Q Only Inputs) | 10 Hz to 5 MHz | 1, 1.5, 2, 3, 5, 7.5, 10 sequence or arbitrary user-definable |
| Capture time | | 267 ns to 40 s 8 points to 65536 points Coupled to span and resolution bandwidth |
| Resolution BW ranges Overall (Manual): | 100 MHz to 3 MHz | 1, 1.5, 2, 3, 5, 7.5, 10 sequence or arbitrary user-definable |
| Pre-FFT filter Type: BW: | Gaussian, Flat 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 Avg number: Avg mode: Avg type: | 1 to 10,000 Exponential, Repeat Power Avg (RMS), Log-Power Avg (Video), Voltage Avg, Maximum, Minimum | |

| | Specifications | Supplemental Information |
|-------------------------------|--|---|
| Spectrum Measurement | | |
| Displays (RF Input) | Spectrum, Linear Spectrum, I/Q waveform, I/Q Polar, Spectrum & I/Q waveform, Adjacent Channel Power, Power Stat CCDF | Service Mode also has RF Envelope and Quad-View |
| Displays (Baseband IQ Inputs) | Spectrum, Linear Spectrum, I/Q waveform, I/Q Polar, Spectrum & I/Q waveform, Power Stat CCDF | |
| Y-axis display | | |
| Dynamic range: | 10 divisions × scale/div | |
| Log scale/div range: | 0.1 to 20 dB | |
| Log scale/div increment: | 0.01 dB | |
| Voltage scale/div range: | 1 nV to 20 V | |
| Controls: | Scale/Div, Ref Value, and Ref Position | Allows expanded views of portions of the trace data |
| Markers | Normal, Delta, Band power, Noise | |
| Measurement resolution | | |
| Displayed: | 0.01 dB | |
| Remote query: | 0.001 dB | |
| Trigger (RF Input) | | |
| Source: | Free Run (immediate), Video (IF envelope), RF Burst (wideband), External Front Input, External Rear Input, Frame Timer, Line | |
| Delay, Holdoff, & Auto: | | See Trigger Specifications. |
| Trigger (Baseband IQ Inputs) | | |
| Source: | Free Run (immediate), Video (IQ envelope), External Front Input, External Rear Input, Frame Timer, Line | |
| Delay, Holdoff, & Auto: | | See Trigger Specifications. |

| | Specifications | Supplemental Information |
|-------------------------------|---|--|
| Waveform Measurement | | |
| Range (RF Input) | | |
| Maximum: | +30 dBm (1 W) | |
| Minimum: | Displayed avg noise level | |
| Range (IQ Input) | | |
| Maximum (50 Ω Input): | +13 dBm (20 mW) | |
| Maximum (600 Ω, 1 M Ω Input): | 1 Volt | |
| Minimum: | Displayed Avg Noise Level | |
| Sweep time range | | |
| RBW ≤ 7.5 MHz: | 10 μs to 200 ms | Minimum with decimation = 1 Maximum with decimation = 4 |
| 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 k points, (nominal) |
| Resolution bandwidth | | 1, 1.5, 2, 3, 5, 7.5, 10 sequence or arbitrary user-definable |
| Gaussian filter: | 10 Hz to 8 MHz | |
| Flat filter: | 10 Hz to 10 MHz | |
| Averaging | | |
| Avg Number: | 1 to 10,000 | |
| Avg Mode: | Exponential, Repeat | |
| Avg Type: | Power Avg (RMS), Log- power Avg (Video), Maximum, Minimum | |
| Displays (RF Input) | Signal Envelope, I/Q waveform, I/Q Polar | |
| Displays (Baseband IQ Inputs) | Signal Envelope, Linear Envelope, I/Q waveform, I & Q waveform, I/Q Polar | |
| Y-axis display | | |
| Dynamic range: | 10 divisions x scale/div | |
| Log scale/div range: | 0.1 to 20 dB | |
| Log scale/div increment: | 0.01 dB | |
| Voltage scale/div range: | 1 nV to 20 V | |
| Controls: | Scale/Div, Ref Value, and Ref Position | Allows expanded views of portions of the trace data. |
| X-axis display | | |
| Range: | 10 divisions x scale/div | |
| Controls: | Scale/Div, Ref Value, and Ref Position | Allows expanded views of portions of the trace data. |
| Polar Display | | |
| Controls | | |
| Voltage scale/div range: | 1 nV to 20 V | |
| I and Q Origin | ±250 V | |

| | Specifications | Supplemental Information |
|--|--|-----------------------------|
| Waveform Measurement | | |
| Markers | Normal, Delta, Band Power | |
| Measurement resolution Displayed: Remote query: | 0.01 dB 0.001 dB | |
| Trigger (RF Input) Source: | Free Run (immediate), Video (IF envelope), RF Burst (wideband), External Front Input, External Rear Input, Frame Timer, Line | |
| Delay, Holdoff, & Auto: Trigger (Baseband IQ Inputs) Source: | Free Run (immediate), Video (IQ envelope), External Front Input, External Rear Input, Frame Timer, Line | See Trigger Specifications. |
| Delay, Holdoff, & Auto: | | See Trigger Specifications. |

| | Specifications | Supplemental Information |
|---------------------------------------|---------------------|--|
| Trigger (RF Input) | | |
| Trigger delay | | For Video, Ext Front, Ext Rear |
| Range: | -500 ms to +500 ms | |
| Repeatability: | ±33 ns | |
| Resolution: | 33 ns | |
| Trigger slope | Positive, Negative | |
| Trigger holdoff | | |
| Range: | 0 to 500 ms | |
| Resolution: | 1 µs | |
| Auto trigger | On, Off | |
| Time interval range: | | 0 to 1000 s, (nominal) Does an immediate trigger if no trigger occurs before the set time interval. |
| RF burst trigger | | Wideband IF for repetitive burst signals. |
| 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, (nominal) |
| Video (IF envelope) trigger | | |
| Range: | +50 dBm to -200 dBm | |

| | Specifications | Supplemental Information |
|--|--|---|
| Trigger (Baseband I/Q Inputs) Trigger delay Range: Repeatability: Resolution: Trigger slope Auto trigger Time interval range: Trigger holdoff Range: Resolution: IQ Envelope Trigger Range: | –500 ms to +500 ms ±33 ns 33 ns Positive, Negative On, Off 0 to 500 ms 1 μs +50 dBm to –200 dBm | For Video, RF Burst, Ext Front, Ext Rear 0 to 1000 s, (nominal) Does an immediate trigger if no trigger occurs before the set time interval. |

| | Specifications | Supplemental Information |
|----------------------------|----------------|--|
| Measurement Control | | Single, Continuous, Restart, Pause, Resume |

Options

| | |
|-------------|---|
| Option BAC: | cdmaOne Personality |
| Option BAE: | NADC, PDC Personalities |
| Option BAF: | W-CDMA Personality |
| Option BAH: | GSM Personality |
| Option B78: | cdma2000 Personality |
| Option B7C: | Baseband I/Q Inputs |
| Option 202: | EDGE (with GSM) Personality |
| Option 204: | 1xEV-DO Personality |
| Option 300: | Provides a 321.4 MHz IF rear-panel output |

General

| | Specifications | Supplemental Information |
|--------------------------|------------------|--------------------------|
| Temperature Range | | |
| Operating | 0 °C to +55 °C | |
| Non-operating | -40 °C to +71 °C | |

| | Specifications | Supplemental Information |
|----------------------------|----------------|--------------------------|
| Display^a | | |
| Resolution | 640 × 480 | |

| | Specifications | Supplemental Information |
|--------------------------|---|--------------------------|
| EMI Compatibility | Conducted and radiated emission is in compliance with CISPR Pub. 11/1990 Group 1 Class A. | |

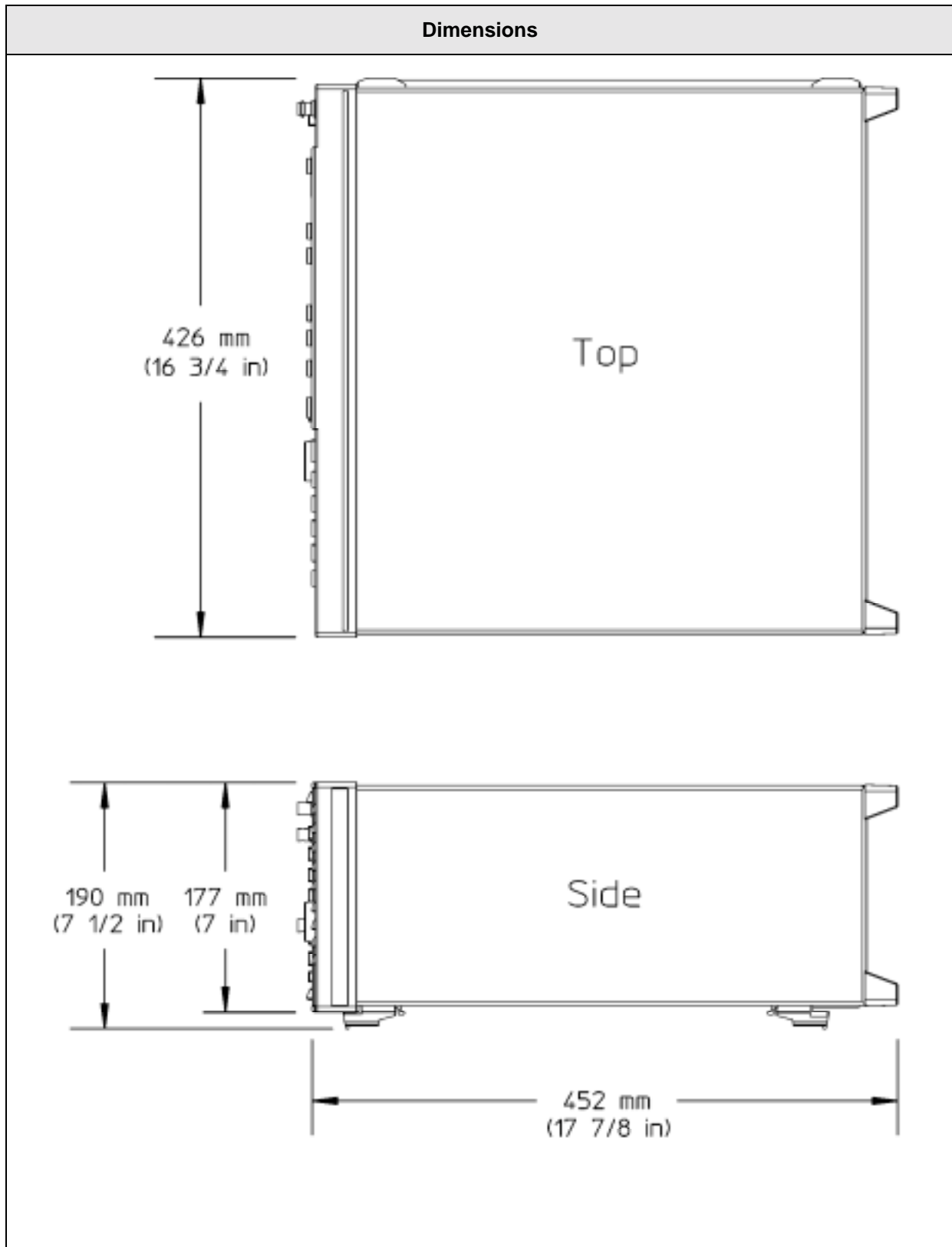
-
- a. The LCD display is manufactured using high precision technology. However, there may be up to five bright points (white, blue, red or green in color) that constantly appear on the LCD screen. These points are normal in the manufacturing process and do not affect the measurement integrity of the product in any way.

| | Specifications | Supplemental Information |
|--|----------------|---|
| Immunity Testing (RF Input) Radiated Immunity Electrostatic Discharge | | <p>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.</p> <p>In accordance with IEC 801-2/1991, an 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 may cause damage to the associated circuitry.</p> |

| | Specifications | Supplemental Information |
|---|----------------|--|
| Immunity Testing (Baseband I/Q Inputs) Radiated Immunity Electrostatic Discharge | | <p>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.</p> <p>In accordance with IEC 801-2/1991, an 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 may cause damage to the associated circuitry.</p> |

| | Specifications | Supplemental Information |
|--|---|--------------------------|
| Power Requirements Voltage, frequency Power consumption, ON Power consumption, Standby | 90 to 132 V rms, 47 to 440 Hz 195 to 250 V rms, 47 to 66 Hz <350 W <20 W | |

| | Specifications | Supplemental Information |
|--|----------------|--|
| Weight Net Standard E4406A E4406A Option B7C Shipping Standard E4406A E4406A Option B7C | | 19 kg (42 lb), (nominal) 20 kg (44 lb), (nominal) 39 kg (86 lb), (nominal) 40 kg (88 lb), (nominal) |



Front Panel

| | Specifications | Supplemental Information |
|---|---|---|
| RF INPUT Connector Impedance VSWR 20 MHz to 2205 MHz 2205 MHz to 4 GHz 50 MHz | Type N female $\leq 1.4 : 1$ $\leq 1.6 : 1$ $\leq 1.4 : 1$ | 50 Ω , nominal $\leq 1.24 : 1$, (typical) $\leq 1.4 : 1$, (typical) $\leq 1.08 : 1$, (typical) |
| Baseband I/Q INPUTS Connectors (4 each I, Q, I, Q) Balanced Input Impedance (4 connectors: I, Q, I, and Q) Unbalanced Input Impedance (2 connectors: I and Q) VSWR 50 Ω Impedance Only | BNC female $\leq 1.4 : 1$ | See Frequency and Amplitude sections for Baseband Input details 600 Ω , 1 M Ω , nominal (switchable) 50 Ω , 1 M Ω , nominal (switchable) $\leq 1.08 : 1$, (typical) |
| PROBE PWR Voltage/Current | | +15 Vdc $\pm 7\%$ at 150 mA max. -12.6 Vdc $\pm 10\%$ at 150 mA max. |
| EXT TRIGGER INPUT Connector Impedance Trigger level | BNC female | 10 k Ω , nominal -5 V to +5 V |
| Disk Device | | Accepts 10-cm (3 1/2-inch) 1.44 megabyte flexible disk (MS-DOS \neq format) |

Rear Panel

| | Specifications | Supplemental Information |
|------------------------------|----------------|--------------------------|
| 10 MHz OUT (SWITCHED) | | |
| Connector | BNC female | |
| Impedance | | 50 Ω, nominal |
| Output amplitude | | ≥ 0 dBm, (nominal) |

| | Specifications | Supplemental Information |
|---|----------------|--|
| EXT REF IN | | |
| Connector | BNC female | Note: Instrument noise sidebands and spurious responses may be affected by the quality of the external reference used. |
| Impedance | | 50 Ω, nominal |
| Input amplitude range | | -5 to +10 dBm, (nominal) |
| Maximum dc level | ±28 V dc | |
| Frequency | | 1 MHz to 30 MHz, selectable |
| Internal 10 MHz ^a error | | |
| When EXT REF IN is an integer multiple of 500 kHz or 1.25 MHz | | 0 Hz |
| When EXT REF IN is not an integer multiple of 500 kHz or 1.25 MHz | | ≤0.533 nHz (≤1 degree phase error in 60 days) |
| Frequency lock range | | ±5 x 10 ⁻⁶ of the specified external reference input frequency |

a. 100 MHz VCXO divided by 10.

| | Specifications | Supplemental Information |
|--|----------------|--|
| TRIGGER IN Connector Impedance Trigger level | BNC female | 10 k Ω , nominal -5 V to +5 V |
| TRIGGER 1 OUT Connector Impedance Level | BNC female | 50 Ω , nominal 0 V to +5 V (No load) |
| TRIGGER 2 OUT Connector Impedance Level | BNC female | 50 Ω , nominal 0 V to +5 V (No load) |

| | Specifications | Supplemental Information |
|---|----------------|--|
| 321.4 MHz OUT (Opt. 300) Connector Impedance Bandwidth Conversion Gain (Input Attenuator 0 dB) Tuned Frequency: 50 MHz 400 MHz 600 MHz 800 MHz 1000 MHz 2000 MHz 2500 MHz 3000 MHz 4000 MHz | BNC female | 50 Ω , nominal >300 MHz, (nominal) -3.5 dB, (nominal) -4.5 dB, (nominal) -5.0 dB, (nominal) -6.0 dB, (nominal) -5.5 dB, (nominal) -7.0 dB, (nominal) -7.5 dB, (nominal) -10.5 dB, (nominal) -13.0 dB, (nominal) |

| | Specifications | Supplemental Information |
|-----------------------|-----------------------------------|--|
| MONITOR Output | | |
| Connector | VGA compatible, 15-pin mini D-SUB | VGA (31.5 kHz horizontal, 60 Hz vertical sync rates, non-interlaced) |
| Format | | |
| Resolution | 640 x 480 | |

| | Specifications | Supplemental Information |
|---------------------------|------------------------|---|
| PARALLEL Interface | | Printer port only |
| Connector | 25-pin D-SUB | |
| SERIAL Interface | | RS 232 serial interface Feature not implemented |
| Connector | 9-pin D-SUB | |
| LAN-TP | | |
| Connector | RJ45 Ethertwist | |
| GP-IB Interface | | |
| Connector | IEEE-488 bus connector | SH1, AH1, T6, SR1, RL1, PP0, DC1, DT1, L4, C0 |
| GP-IB codes | | |
| SCSI Interface | | SCSI 2 (Slow narrow single-ended) Feature not implemented |
| Connector | Mini D50, female | |
| KYBD | | Feature not implemented for operation; used for service only |
| Connector | 6-pin mini-DIN | |



2 Regulatory Information



Safety Warnings and Cautions

WARNING **Warning denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.**

CAUTION Caution denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in damage to or destruction of the instrument. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met.



WARNING **This is a Safety Class 1 Product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protected earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.**

WARNING The power cord is connected to internal capacitors that may remain live for 5 seconds after disconnecting the plug from its power supply.

International Regulatory Information

CAUTION This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 1010 and 664 respectively.

NOTE This product has been designed and tested in accordance with IEC Publication 1010, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

| | |
|---|--|
|  | The CE mark is a registered trademark of the European Community. |
|  | The CSA mark is the Canadian Standards Association safety mark. |
| ISM 1-A | This is a symbol of an Industrial Scientific and Medical Group 1 Class A product (CISPR 11, Clause 4). |

Compliance with German Noise Requirements

This is to declare that this instrument is in conformance with the German Regulation on Noise Declaration for Machines (Laermangabe nach der Maschinenlaermrrerordnung - 3.GSGV Deutschland).

| Acoustic Noise Emission/Geraeuschemission | |
|--|--|
| LpA <70 dB Operator position Normal position per ISO 7779 | LpA <70 dB am Arbeitsplatz normaler Betrieb nach DIN 45635 t.19 |

Declaration of Conformity

| DECLARATION OF CONFORMITY | |
|--|--|
| According to ISO/IEC Guide 22 and CEN/CENELEC EN 45014 | |
| Manufacturer's Name: | Agilent Technologies, Inc. |
| Manufacturer's Address: | 1400 Fountaingrove Parkway Santa Rosa, CA 95403-1799 USA |
| Declares that the product | |
| Product Name: | VSA Series Transmitter Tester |
| Model Number: | E4406A |
| Product Options: | This declaration covers all options of the above product. |
| Conforms to the following product specifications: | |
| EMC: IEC 61326-1:1997+A1:1998 / EN 61326-1:1997+A1:1998 | |
| <u>Standard</u> | <u>Limit</u> |
| CISPR 11:1990 / EN 55011-1991 | Group 1, Class A |
| IEC 61000-4-2:1995+A1998 / EN 61000-4-2:1995 | 4 kV CD, 8 kV AD |
| IEC 61000-4-3:1995 / EN 61000-4-3:1995 | 3 V/m, 80 - 1000 MHz |
| IEC 61000-4-4:1995 / EN 61000-4-4:1995 | 0.5 kV sig., 1 kV power |
| IEC 61000-4-5:1995 / EN 61000-4-5:1996 | 0.5 kV L-L, 1 kV L-G |
| IEC 61000-4-6:1996 / EN 61000-4-6:1998 | 3 V, 0.15 - 80 MHz |
| IEC 61000-4-11:1994 / EN 61000-4-11:1998 | 1 cycle, 100% |
| Safety: IEC 61010-1:1990 + A1:1992 + A2:1995 / EN 61010-1:1993 +A2:1995 CAN/CSA-C22.2 No. 1010.1-92 | |
| Supplementary Information: The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carries the CE-marking accordingly. | |
|  | |
| Santa Rosa, CA, USA | 26 April 2000 |
| Greg Pfeiffer/Quality Engineering Manager | |
| For further information, please contact your local Agilent Technologies sales office, agent or distributor. | |

3 cdmaOne Specifications

This chapter contains specifications for the cdmaOne mode. All specifications apply over 0 °C to +55 °C, except when otherwise specified. The instrument will meet its specifications after 2 hours of storage at a constant temperature, within the operating temperature range, 1 hour after the instrument is turned on and within 24 hours after “Align All Now” has been run. The specifications for each measurement apply for the measurement’s factory default setup.

Measurements

Measurement specifications only apply over the cellular frequency bands supported by this option.

| Measurement | Specifications | Supplemental Information |
|---|----------------|---|
| Channel Power Measurement (1.23 MHz Integration BW) | | |
| Integration BW range 1 kHz to 10 MHz | | |
| Range at UUT^a | | |
| Base station maximum: | +47 dBm (50 W) | With ≥ 20 dB external attenuation |
| Mobile station maximum: | +40 dBm (10 W) | With ≥ 13 dB external attenuation |
| Minimum: | -70 dBm | With ≤ 10 dB external attenuation |
| Range at RF Input | | |
| Maximum: | +30 dBm (1 W) | |
| Minimum: | -80 dBm | |
| Absolute power accuracy for in-band signal (excluding mismatch error) | | |
| +30 dBm to -28 dBm at RF Input: | | |
| +18 °C to +30 °C: | ± 0.6 dB | ± 0.4 dB, (typical) |
| 0 °C to +55 °C: | ± 1.1 dB | ± 0.7 dB, (typical) |
| -28 dBm to -50 dBm at RF Input: | | |
| +18 °C to +30 °C: | ± 0.8 dB | ± 0.7 dB, (typical) |
| 0 °C to +55 °C: | ± 1.3 dB | ± 0.9 dB, (typical) |
| -50 dBm to -80 dBm at RF Input^b: | | |
| +18 °C to +30 °C: | ± 1.0 dB | ± 0.9 dB, (typical) |
| 0 °C to +55 °C: | ± 1.2 dB | |
| Relative power accuracy (same channel, different Tx power, input attenuator fixed)^b | | |
| Input level change 0 to -76 dB ^c : | ± 0.2 dB | ± 0.1 dB, (typical) |
| Resolution | | |
| Displayed: | 0.01 dB | |
| Remote query: | 0.001 dB | |
| Instrument repeatability (over 30 days with daily internal self-alignment) | | |
| | | ± 0.05 dB, (nominal) Measurement repeatability = instrument repeatability + signal repeatability |

a. UUT = Unit Under Test

b. Does not include uncertainty due to noise.

c. Minimum value is for RF Input ≥ -2 dBm and optimum input attenuation.

| Measurement | Specifications | Supplemental Information |
|--|--|---|
| Code Domain (Base Station) | | |
| Carrier power range at UUT ^a | | |
| Base station | +47 dBm to -10 dBm | With 20 dB external attenuation |
| Mobile station | +40 dBm to -17 dBm | With 13 dB external attenuation |
| Carrier power range at RF Input | +30 dBm to -30 dBm | |
| Measurement interval range | 0.25 ms to 30 ms | |
| Code domain power | | |
| Display dynamic range | 50 dB | |
| Accuracy (Walsh channel power within 20 dB of total power) | ±0.3 dB | Measurement interval ≥ 1.25 ms. |
| Resolution | 0.01 dB | |
| Other reported power parameters (dB referenced to total power) | Average active traffic Maximum inactive traffic Average inactive traffic Pilot, paging, sync channels | |
| Carrier frequency error measurement accuracy | ±10 Hz | Excludes frequency reference. Measurement interval ≥ 1.25 ms. |
| 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 | Measurement interval ≥ 1.25 ms. |
| Accuracy | ±10 ns | |
| Resolution | 0.1 ns | |
| Code domain phase | | (Pilot to code channel phase tolerance) |
| Range | ±200 mrad | Measurement interval ≥ 1.25 ms. |
| Accuracy | ±20 mrad | |
| Resolution | 0.1 mrad | |
| Displays | | Power graph & metrics Power graph & 4 markers Power, timing, & phase graphs |

a. UUT = Unit Under Test

| Measurement | Specifications | Supplemental Information |
|---|---|---|
| Modulation Accuracy | | |
| Carrier power range at UUT ^a | | |
| Base station | +47 dBm to -20 dBm | With 20 dB external attenuation |
| Mobile station | +40 dBm to -27 dBm | With 13 dB external attenuation |
| Carrier power range at RF Input: | +30 dBm to -40 dBm | |
| Measurement interval range | 0.25 ms to 30 ms | |
| Rho (waveform quality) | | |
| Range | 0.9 to 1.0 | Usable range 0.5 to 1.0 |
| Accuracy | ±0.005 | |
| Resolution | 0.0001 | |
| Frequency error | | |
| Input frequency error range | ±900 Hz | |
| Accuracy | ±10 Hz + (transmitter frequency × frequency reference accuracy) | Measurement interval ≥1.25 ms. |
| Resolution | 0.1 Hz | |
| Base station pilot time offset | | |
| Range | -13.33 ms to +13.33 ms | (From even second signal to start of PN sequence) |
| Accuracy | ±250 ns | |
| Resolution | 10 ns | |
| EVM | | |
| Floor | 2.5% | 1.8% (typical) |
| Accuracy | ±0.5% | |
| Resolution | 0.1% | |
| Carrier feedthrough | | |
| Floor | -55 dBc | |
| Accuracy | ±2.0 dB | |
| Resolution | 0.1 dB | |
| Magnitude error | | |
| Floor | 2.5% | |
| Accuracy | ±0.5% | |
| Resolution | ±0.01% | |
| Phase error | | |
| Accuracy | ±1.0 degrees | |
| Resolution | 0.1 degrees | |
| Displays | Metric summary Magnitude error graph Phase error graph EVM graph I/Q measured polar graph | |

a. UUT = Unit Under Test

| Measurement | Specifications | Supplemental Information |
|---|----------------|---|
| Adjacent Channel Power Ratio | | |
| Carrier power range at UUT ^a | +47 to 0 dBm | With 20 dB external attenuation |
| Carrier power range at RF Input | +30 to -20 dBm | |
| Dynamic range | | Referenced to average power of carrier in 1.23 MHz BW |
| Offset Freq. Integ. BW | | |
| 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 ^b | ±0.9 dB | |
| Resolution | 0.01 dB | |

| Measurement | Specifications | Supplemental Information |
|---|--------------------|--|
| Spur Close | | At Tx Max Power |
| Carrier power range at UUT ^c | | With 20 dB external attenuation With 13 dB external attenuation |
| Base station: | +47 dBm to +13 dBm | |
| Mobile station: | +40 dBm to +6 dBm | |
| Carrier power range at RF Input | +30 dBm to -30 dBm | |
| Minimum spurious emission power sensitivity at RF Input | -70 dBm | 30 kHz BW |
| Absolute accuracy for in-band signal (excluding mismatch error) | ±1.0 dB | |
| Relative accuracy ^d | ±1.0 dB | |
| Resolution | 0.01 dB | |

- a. UUT = Unit Under Test
b. Does not include uncertainty due to noise.
c. UUT = Unit Under Test
d. Does not include uncertainty due to noise.

| Measurement | Specifications | Supplemental Information |
|-----------------|--|--------------------------|
| Spectrum | See Spectrum Measurement on page 24. | |

| Measurement | Specifications | Supplemental Information |
|-------------------------------|--|--------------------------|
| Waveform (Time Domain) | See Waveform Measurement on page 26. | |

Frequency

| | Specifications | Supplemental Information |
|--------------------------------|--|--------------------------|
| In-Band Frequency Range | 824 to 849 MHz 869 to 894 MHz 1850 to 1910 MHz 1930 to 1990 MHz | IS-95 J-STD-008 |

General

| | Specifications | Supplemental Information |
|--|--|---|
| Trigger Trigger source Trigger delay, level, and slope Trigger delay Range: Repeatability: Resolution: External trigger inputs Level: Impedance: | -500 to +500 ms ±33 ns 33 ns | RF burst (wideband), Video (IF envelope), Ext Front, Ext Rear. Actual available choices dependent on measurement. Each trigger source has a separate set of these parameters. -5 V to +5 V, (nominal) 10 kΩ, nominal |

| | Specifications | Supplemental Information |
|---|----------------------------------|---|
| Demod Sync Even second input PN offset range | 0 to 511 x 64[chips] | Level and impedance same as Ext Trigger |

4 GSM/EDGE Specifications

This chapter contains specifications for the GSM/EDGE mode. All specifications apply over 0 °C to +55 °C, except when otherwise specified. The instrument will meet its specifications after 2 hours of storage at a constant temperature, within the operating temperature range, 1 hour after the instrument is turned on and within 24 hours after “Align All Now” has been run. The specifications for each measurement apply for the measurement’s factory default setup.

| Measurement | Specifications | Supplemental Information |
|--|--|---|
| EDGE Error Vector Magnitude (EVM) | | $3\pi/8$ 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 ^a | | 0 to 25% (nominal) |
| Floor (RMS) | 0.5% | 0.3% (typical) |
| Accuracy ^b (RMS) | ±0.5 % | Power range at RF input from +27 to -12 dBm |
| EVM range 1% to 11% | | |
| Frequency Error | ±1 Hz + (transmitter frequency × frequency reference accuracy) | |
| IQ Origin Offset Range ^a | -20 to -45 dBc | |

- a. The range specification applies when the Burst Sync is set to Training Sequence.
- b. The accuracy specification applies when the EVM to be measured is well above the measurement floor. When the EVM does not greatly exceed the floor, the errors due to the floor add to the accuracy errors. The errors due to the floor are noise-like and add incoherently with the UUT EVM. The errors depend on the EVM of the UUT and the floor as follows: $\text{floorerror} = \sqrt{\text{EVMUUT}^2 + \text{EVMsa}^2} - \text{EVMUUT}$, where EVMUUT is the EVM of the UUT in percent, and EVMsa is the EVM floor of the analyzer in percent. For example, if the EVM of the UUT is 3%, and the floor 0.5%, the error due to the floor is 0.04%. The total reading can be, at its maximum, EVMUUT + floorerror + accyerror, when the accyerror and floorerror are both at their maximums. The minimum reading that would be within the specifications would occur when the floor is near zero and the accuracy error is at its negative limit; in this case the reading could be as low as EVMUUT - accyerror.

| Measurement | Specifications | Supplemental Information |
|---|--|--|
| <p>Power vs. Time and EDGE Power vs. Time</p> <p>Minimum carrier power at RF Input for GSM and EDGE</p> <p>Absolute power accuracy for in-band signal (excluding mismatch error)^a</p> <p>18 to 30°C</p> <p>0 to 55°C</p> <p>Power ramp relative accuracy</p> <p>RF Input Range = Auto^b +6 dB to noise^{bc}</p> <p>Mixer Level ≤ -12 dBm^b +6 dB to noise^{bc}</p> <p>Measurement floor</p> <p>Time resolution</p> <p>Burst to mask uncertainty</p> | <p>-0.11 ± 0.60 dB</p> <p>-0.11 ± 0.90 dB</p> <p>±0.26 dB</p> <p>±0.26 dB</p> <p>200 ns</p> <p>±0.2 bit (approx ±0.7 μs)</p> | <p>GMSK modulation (GSM) 3π/8 shifted 8PSK modulation (EDGE)</p> <p>Measures mean transmitted RF carrier power during the useful part of the burst (GSM method) and the power vs. time ramping. 510 kHz RBW</p> <p>-30 dBm (nominal)</p> <p>-0.11 ± 0.40 dB (typical)</p> <p>Referenced to mean transmitted power</p> <p>-81 dBm + Input Attenuation (nominal)</p> |

- a. The power versus time measurement uses a resolution bandwidth of about 510 kHz. This is not wide enough to pass all the transmitter power unattenuated, leading the consistent error shown in addition to the uncertainty. A wider RBW would allow smaller errors in the carrier measurement, but would allow more noise to reduce the dynamic range of the low-level measurements. The measurement floor will change by $10 \times \log(\text{RBW}/510\text{kHz})$. The average amplitude error will be about $-0.11\text{dB} \times ((510\text{kHz}/\text{RBW})^2)$. Therefore, the consistent part of the amplitude error can be eliminated by using a wider RBW.
- b. Using auto setting of RF Input range optimizes the dynamic range of analysis, but the scale fidelity is poorer at the relatively high mixer levels chosen. Because of this, manually setting the input attenuator so that the mixer level (RF Input power minus Input Attenuation) is lower can improve the relative accuracy of power ramp measurements as shown.

- c. The relative error specification does not change as the levels approach the noise floor, except for the effect of the noise power itself. If the mixer level is not high enough to make the contribution of the measurement floor negligible, the noise of the analyzer will add power to the signal being measured, resulting in an error. That error is a function of the signal (carrier power) to noise (measurement floor) ratio (SN), in decibels.

The function is $\text{error} = 10 \times \log(1 + 10^{-(\text{SN}/10)})$. For example, if the mixer level is 26.4 dB above the measurement floor, the error due to adding the noise of the analyzer to the UUT is only 0.01 dB.

| Measurement | Specifications | Supplemental Information |
|----------------------------------|--|---|
| 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) | | |
| Phase error range 1° to 15° | ±0.5° | |
| Peak phase error | | |
| Accuracy | | |
| Phase error range 3° to 25° | ±2.0° | |
| Frequency error | | |
| Accuracy | ±5 Hz + (transmitter frequency × frequency reference accuracy) | |
| I/Q offset | | |
| Range | | -15 dBc to -50 dBc (nominal) |
| Burst sync time uncertainty | ±0.1 bit (approx ±0.4 μs) | |

| Measurement | Specifications | Supplemental Information |
|--|--------------------------|--|
| Output RF Spectrum and EDGE Output RF Spectrum | | GMSK modulation (GSM) 3 π /8 shifted 8PSK modulation (EDGE) |
| Minimum carrier power at RF Input | | -15 dBm (nominal) |
| ORFS Relative RF Power Uncertainty ^a | | |
| Due to modulation | | |
| Offsets \leq 1.2 MHz | ± 0.26 dB | |
| Offsets \geq 1.8 MHz | ± 0.36 dB | |
| Due to switching | | ± 0.27 dB (nominal) ^b |
| ORFS Absolute RF Power Accuracy | ± 0.60 dB | ± 0.40 dB (typical) |
| 18 to 30°C | | |
| Dynamic Range, Spectrum due to modulation ^c | | 5-pole sync-tuned filters ^d Methods: Direct Time ^e and FFT ^f |
| 18 to 30°C | | |
| <i>Offset Frequency</i> | GSM EDGE | |
| 100 kHz ^g | 67.7 dB | |
| 200 kHz ^g | 73.3 dB | |
| 250 kHz ^g | 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 ^h | 90.3 dB | 82.4 dB |
| 6.0 MHz ^h | 94.0 dB | 85.3 dB |
| Dynamic Range, Spectrum due to switching ^c | | 5-pole sync-tuned filters ⁱ |
| 18 to 30°C | | |
| <i>Offset Frequency</i> | | |
| 400 kHz ^g | 68.7 dB | 71.2 dB (95%) ^j |
| 600 kHz | 71.0 dB | 73.1 dB (95%) ^j |
| 1.2 MHz | 74.1 dB | 77.0 dB (95%) ^j |
| 1.8 MHz | 78.4 dB | 80.4 dB (95%) ^j |

- a. The uncertainty in the RF power ratio reported by ORFS has many components. This specification does not include the effects of added power in the measurements due to dynamic range limitations, but does include the following errors: detection linearity, RF and IF flatness, uncertainty in the bandwidth of the RBW filter, and compression due to high drive levels in the front end.
- b. ORFS due to switching has very small theoretical errors. But Agilent has been unable to verify this computed accuracy, therefore it is listed as nominal and is not warranted.
- c. Maximum dynamic range requires RF input power above -2 dBm for offsets of 1.2 MHz and below. For offsets of 1.8 MHz and above, the required RF input power for maximum dynamic range is $+6$ dBm for GSM signals and $+5$ dBm for EDGE signals
- d. ORFS standards call for the use of a 5-pole, sync-tuned filter; this and the following footnotes review the instrument's conformance to that standard. Offset frequencies can be measured by using either the FFT method or the direct time method. By default, the FFT method is used for offsets of 400 kHz and below, and the direct time method is used for offsets above 400 kHz. The FFT method is slower and has lower dynamic range than the direct time method.
- e. The FFT method uses an exact 5-pole sync-tuned RBW filter, implemented in software.
- f. The direct time method uses digital Gaussian RBW filters whose noise bandwidth (the measure of importance to "spectrum due to modulation") is within $\pm 0.5\%$ of the noise bandwidth of an ideal 5-pole sync-tuned filter. However, the Gaussian filters do not match the 5-pole standard behavior at offsets of 400 kHz and less, because they have *lower* leakage of the carrier into the filter. The lower leakage of the Gaussian filters provides a superior measurement because the leakage of the carrier masks the ORFS due to the UUT, so that less masking lets the test be more sensitive to variations in the UUT spectral splatter. But this superior measurement gives a result that does not conform with ORFS standards. Therefore, the default method for offsets of 400 kHz and below is the FFT method.
- g. The dynamic range for offsets at and below 400 kHz is not directly observable because the signal spectrum obscures the result. These dynamic range specifications are computed from phase noise observations.
- h. Offsets of 1.8 MHz and higher use 100 kHz analysis bandwidths.
- i. The impulse bandwidth (the measure of importance to "spectrum due to switching transients") of the filter used in the direct time method is 0.8% less than the impulse bandwidth of an ideal 5-pole sync-tuned filter, with a tolerance of $\pm 0.5\%$. Unlike the case with spectrum due to modulation, the shape of the filter response (Gaussian vs sync-tuned) does not affect the results due to carrier leakage, so the only parameter of the filter that matters to the results is the impulse bandwidth. There is a mean error of -0.07 dB due to the impulse bandwidth of the filter, which is compensated in the measurement of ORFS due to switching. By comparison, an analog RBW filter with a $\pm 10\%$ width tolerance would cause a maximum amplitude uncertainty of 0.9 dB.
- j. Dynamic ranges for ORFS due to switching marked as "95%" are derived from 95th percentile observations with 95% confidence during a pilot run whose size was statistically significant. A guardband is added to the results to account for measurement uncertainty in the measurement of the components of ORFS due to switching and environmental changes over the 18-30 °C temperature.

Frequency

| Description | GSM Specifications | EDGE Specifications | Supplemental Information |
|---|--------------------------------------|--------------------------------------|--------------------------|
| In-Band Frequency Ranges^a | | | |
| GSM 900, P-GSM | 890 to 915 MHz 935 to 960 MHz | 890 to 915 MHz 935 to 960 MHz | |
| GSM 900, E-GSM | 880 to 915 MHz 925 to 960 MHz | 880 to 915 MHz 925 to 960 MHz | |
| DCS1800 | 1710 to 1785 MHz 1805 to 1880 MHz | 1710 to 1785 MHz 1805 to 1880 MHz | |
| PCS1900 | 1850 to 1910 MHz 1930 to 1990 MHz | | |
| GSM850 | 824 to 849 MHz 869 to 894 MHz | | |

| Description | GSM Specifications | EDGE Specifications | Supplemental Information |
|---|--|---------------------|--------------------------|
| Alternative Frequency Ranges^b | | | |
| Down Band GSM | 400 to 500 MHz | 400 to 500 MHz | |
| GSM450 | 450.4 to 457.6 MHz 460.4 to 467.6 MHz | | |
| GSM480 | 478.8 to 486 MHz 488.8 to 496 MHz | | |
| GSM700 | 447.2 to 761.8 MHz | | |

- a. Frequency ranges over which all specifications apply.
- b. Frequency ranges with tuning plans but degraded specifications for absolute power accuracy. The degradation should be nominally ± 0.30 dB.

General

| Description | Specifications | Supplemental Information |
|---|--|--|
| Trigger Trigger source Trigger delay, level, and slope Trigger delay Range Repeatability Resolution External trigger inputs Level Impedance | -500 to +500 ms ±33 ns 33 ns | RF burst (wideband), Video (IF envelope), Ext Front, Ext Rear, Frame Timer. Actual available choices dependent on measurement. Each trigger source has a separate set of these parameters. 5V TTL (nominal) 10 kΩ (nominal) |
| Burst Sync Source Training sequence code Burst type | | Training sequence, RF amplitude, None. Actual available choices dependent on measurement. GSM defined 0 to 7 Auto (search) or Manual Normal (TCH & CCH) Sync (SCH) Access (RACH) |
| Range Control | | RF Input Autorange ^a Manually set Max Total Pwr Manually set Input Atten |

- a. Autorange is *not* continuous with each measurement acquisition; it will run only once immediately following a measurement restart, initiated either by pressing the **Restart** hardkey, or by sending the GPIB command `INIT:IMM`. This behavior was chosen to maintain best measurement speed, but it requires caution when input power levels change. If the input signal power changes, the analyzer will not readjust the input attenuators for optimal dynamic range unless a measurement restart is initiated. For example, if a sequence of power measurements is made, beginning with a maximum power level that is large enough to require non-zero input attenuation, it is advisable to do a measurement restart to automatically set a lower input attenuator value to maintain optimal dynamic range for approximately every 3 dB the input signal power level is reduced, or smaller, depending upon how precisely dynamic range needs to be optimized. Conversely, if the input signal power increases to a high enough level, input overloading will occur if the input attenuators are not readjusted by doing a measurement restart.

5 NADC Specifications

All specifications apply over 0 °C to +55 °C, except when otherwise specified. The instrument will meet its specifications after 2 hours of storage at a constant temperature, within the operating temperature range, 1 hour after the instrument is turned on and within 24 hours after “Align All Now” has been run. The specifications for each measurement apply for the measurement’s factory default setup.

Measurements

Measurement specifications only apply over the cellular frequency bands supported by this option.

| Measurement | Specifications | Supplemental Information |
|---|----------------|----------------------------|
| Adjacent Channel Power Ratio | | |
| Carrier Power Range at UUT ^a | +36 to -11 dBm | With 11 dB external atten. |
| Carrier Power Range at RF Input | +27 to -20 dBm | |
| Adjacent Channel Power Ratio Range: | | 0 to -35 dB, (nominal) |
| At 30 KHz offset | 0 to -65 dB | |
| At 60 KHz offset | 0 to -70 dB | |
| At 90 KHz offset | | |
| Accuracy | ±1.0 dB | |

| Measurement | Specifications | Supplemental Information |
|---|----------------|----------------------------|
| Error Vector Magnitude (EVM) | | |
| Carrier Power Range at UUT ^b | +36 to -11 dBm | With 11 dB external atten. |
| Carrier Power Range at RF Input | +27 to -20 dBm | |
| EVM | | ±0.5 %, (typical) |
| Range | 0 to 25 % | |
| Floor | 1.0 % | |
| Accuracy | ±0.6 % | Display resolution |
| Resolution | 0.01 % | |
| I/Q Origin offset | | Display resolution |
| Range | -10 to -50 dBc | |
| Resolution | 0.01 dB | |
| Carrier Frequency Error | | Display resolution |
| Frequency Resolution | 0.01 Hz | |

a. UUT = Unit Under Test

b. UUT = Unit Under Test

| Measurement | Specifications | Supplemental Information |
|-------------------------------|--|--------------------------|
| Spectrum | See Spectrum Measurement on page 24. | |
| Waveform (Time Domain) | See Waveform Measurement on page 26. | |

Frequency

| | Specifications | Supplemental Information |
|--------------------------------|-------------------------------------|--------------------------|
| In-Band Frequency Range | | |
| 800 MHz Band | 824 to 849 MHz 869 to 894 MHz | |
| PCS Band | 1850 to 1910 MHz 1930 to 1990MHz | |

General

| | Specifications | Supplemental Information |
|---------------------------------|-----------------|---|
| Trigger | | |
| Trigger source | | RF burst (wideband), Video (IF envelope), Ext Front, Ext Rear. Actual available choices dependent on measurement. |
| Trigger delay, level, and slope | | Each trigger source has a separate set of these parameters. |
| Trigger delay | | |
| Range | -500 to +500 ms | |
| Repeatability | ±33 ns | |
| Resolution | 33 ns | |
| External trigger inputs | | |
| Level | | -5 V to +5 V, (nominal) |
| Impedance | | 10 kΩ, nominal |

6 PDC Specifications

All specifications apply over 0 °C to +55 °C, except when otherwise specified. The instrument will meet its specifications after 2 hours of storage at a constant temperature, within the operating temperature range, 1 hour after the instrument is turned on and within 24 hours after “Align All Now” has been run. The specifications for each measurement apply for the measurement’s factory default setup.

Measurements

Measurement specifications only apply over the cellular frequency bands supported by this option.

| Measurement | Specifications | Supplemental Information |
|---|----------------|----------------------------|
| Adjacent Channel Power Ratio | | |
| Carrier Power Range at UUT ^a | +37 to -10 dBm | With 10 dB external atten. |
| Carrier Power Range at RF Input | +27 to -20 dBm | |
| Adjacent Channel Power Ratio Range | | |
| At 50 KHz offset | 0 to -55 dB | |
| At 100 KHz offset | 0 to -70 dB | |
| Accuracy | ±1.0 dB | |

| Measurement | Specifications | Supplemental Information |
|---|----------------|----------------------------|
| Error Vector Magnitude (EVM) | | |
| Carrier Power Range at UUT ^b | +37 to -10 dBm | With 10 dB external atten. |
| Carrier Power Range at RF Input | +27 to -20 dBm | |
| EVM | | |
| Range | 0 to 25 % | |
| Floor | 1.0 % | |
| Accuracy | ±0.6 % | ±0.5 %, typical |
| Resolution | 0.01 % | Display resolution |
| 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 |

a. UUT = Unit Under Test

b. UUT = Unit Under Test

| Measurement | Specifications | Supplemental Information |
|--|---|----------------------------|
| Occupied Bandwidth Carrier power range at UUT ^a Carrier power range at RF Input Frequency Resolution Accuracy | +37 to -10 dBm +27 to -20 dBm 0.1 kHz +400 Hz, -100 Hz | With 10 dB external atten. |

| Measurement | Specifications | Supplemental Information |
|-----------------|--|--------------------------|
| Spectrum | See Spectrum Measurement on page 24. | |

| Measurement | Specifications | Supplemental Information |
|-------------------------------|--|--------------------------|
| Waveform (Time Domain) | See Waveform Measurement on page 26. | |

a. UUT = Unit Under Test

Frequency

| | Specifications | Supplemental Information |
|--------------------------------|--------------------------------------|--------------------------|
| In-Band Frequency Range | | |
| 800MHz Band #1 | 810 to 828 MHz 940to 958 MHz | |
| 800MHz Band #2 | 870 to 885 MHz 925 to 940 MHz | |
| 800MHz Band #3 | 838 to 840 MHz 893 to 895 MHz | |
| 1500 MHz Band | 1477 to 1501 MHz 1429 to 1453 MHz | |

General

| | Specifications | Supplemental Information |
|---------------------------------|-----------------|--|
| Trigger | | |
| Trigger source | | RF burst (wideband), Video (IF envelope), Ext Front, Ext Rear, Frame Timer. Actual available choices dependent on measurement. |
| Trigger delay, level, and slope | | Each trigger source has a separate set of these parameters. |
| Trigger delay | | |
| Range | -500 to +500 ms | |
| Repeatability | ±33 ns | |
| Resolution | 33 ns | |
| External trigger inputs | | |
| Level | | -5 V to +5 V, (nominal) |
| Impedance | | 10 kΩ, nominal |

7 W-CDMA Specifications

All specifications apply over 0 °C to +55 °C, except when otherwise specified. The instrument will meet its specifications after 2 hours of storage at a constant temperature, within the operating temperature range, 1 hour after the instrument is turned on and within 24 hours after “Align All Now” has been run. The specifications for each measurement apply for the measurement’s factory default setup.

Conformance With 3GPP TS 25.141

Conformance With 3GPP TS 25.141 Base Station Requirements for a Manufacturing Environment

| Sub-clause | Name | 3GPP Required Test Instrument Tolerance (as of 2002-06) | Instrument Tolerance Interval ^{abc} | Supplemental Information |
|--|--|--|--|--|
| Conditions 25 to 35 °C ^d Derived tolerances ^e 95th percentile ^a 100 % limit tested ^b Calibration uncertainties included ^c | | | | |
| 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 ^f |
| 6.3.4 | Frequency Error | ±12 Hz (95 %) | ±10 Hz (100 %) | Freq Ref locked ^g |
| 6.4.2 | Power Control Steps^h 1 dB step 0.5 dB step Ten 1 dB steps Ten 0.5 dB steps | ±0.1 dB (95 %) ±0.1 dB (95 %) ±0.1 dB (95 %) ±0.1 dB (95 %) | ±0.03 dB (95 %) ±0.03 dB (95 %) ±0.03 dB (95 %) ±0.03 dB (95 %) | Test Model 2 Test Model 2 Test Model 2 Test Model 2 |
| 6.4.3 | Power Dynamic Range | ±1.1 dB (95 %) | ±0.50 dB (95 %) | |
| 6.4.4 | Total Power Dynamic Range^h | ±0.3 dB (95 %) | ±0.015 dB (95 %) | Ref -35 dBm at mixer ⁱ |
| 6.5.1 | Occupied Bandwidth | ±100 kHz (95 %) | ±38 kHz (95 %) | 10 averages ^j |
| 6.5.2.1 | Spectrum Emission Mask | ±1.5 dB (95 %) | ±0.59 dB (95 %) | Absolute peak ^k |
| 6.5.2.2 | ACLR 5 MHz offset 10 MHz offset | ±0.8 (95 %) ±0.8 (95 %) | ±0.34 dB (95 %) ±0.40 dB (95 %) | ±0.93dB (100 %) ±0.82dB (100 %) |
| 6.7.1 | EVM | ±2.5 % (95 %) | ±1.0 % (95 %) | Range 15 to 20 % ^l |
| 6.7.2 | Peak Code Domain Error | ±1.0 dB (95 %) | ±1.0 dB (nominal) | |

- a. Those tolerances marked as 95 % are derived from 95th percentile observations with 95 % confidence.
- b. Those tolerances marked as 100 % are derived from 100 % limit tested observations. Only the 100 % limit tested observations are covered by the product warranty.
- c. The computation of the instrument tolerance intervals shown includes the uncertainty of the tracing of calibration references to national standards. It is added, in a root-sum-square fashion, to the observed performance of the instrument.

- d. This table is intended for users in the manufacturing environment, and as such, the tolerance limits have been computed for temperatures of the ambient air near the analyzer of 25 to 35 °C.
- e. Most of the tolerance limits in this table are derived from measurements made of standard instrument specifications, rather than direct observations.
- f. Tolerance limits are computed for a CPICH code domain power of -10 dB relative to total signal power.
- g. The frequency references of the DUT and the test equipment must be locked together to meet this tolerance interval.
- h. These measurements are obtained by utilizing the code domain power function or general instrument capability. The tolerance limits given represent instrument capabilities.
- i. The tolerance interval is based on the largest signal power being -35 dBm at the mixer.
- j. The OBW measurement errors are dominated by the noise-like nature of the signal. The errors decline in proportion to the square root of the number of averages. The tolerance interval shown is for ten averages.
- k. The tolerance interval shown is for the peak absolute power of a CW-like spurious signal. The standards for SEM measurements are ambiguous as of this writing; the tolerance interval shown is based on Agilent's interpretation of the current standards and is subject to change.
- l. EVM tolerances apply with signals having EVMs within ± 2.5 % of the required 17.5 % EVM limit.

| Measurement | Specifications | Supplemental Information |
|---|---|--------------------------|
| Channel Power | | |
| Minimum power at RF Input | | -70 dBm (nominal) |
| Absolute power accuracy ^a 18 to 30°C | ±0.63 dB | ±0.41 dB (typical) |
| Measurement floor | | -73 dBm (nominal) |
| Channel Power (Baseband IQ Inputs) | | |
| Input Ranges | | |
| 50 Ω Input Z | -5 to +13 dBm in four ranges of 6 dB steps: -5 dBm , +1 dBm, +7 dBm , +13 dBm | |
| 600 Ω, 1 MΩ, Input Z | -18 to 0 dBV in four ranges of 6 dB steps: -18 dBV, -12 dBV, -6 dBV, 0 dBV | |
| Absolute power accuracy for in-band signal (excluding mismatch error) 18 °C to 30 °C | | |
| Input Impedance = 50 Ω, all ranges | ±0.6 dB | |
| Input Impedance = 600 Ω, all ranges | | |
| 0 to 1 MHz | ±0.6 dB | |
| 1 MHz to 5 MHz | ±2.0 dB | |
| Input Impedance = 1 MΩ, all ranges | | |
| Unbalanced | | ±0.7 dB (nominal) |
| Balanced | | |
| 0 to 1 MHz | | ±0.6 dB (nominal) |
| 1 MHz to 5 MHz | | ±2.0 dB (nominal) |

- a. Absolute power accuracy includes all error sources for in-band signals except mismatch errors and repeatability due to incomplete averaging. It applies when the mixer level is high enough that measurement floor contribution is negligible. If the mixer level is not high enough to make the contribution of the measurement floor negligible, the noise of the analyzer will add power to the signal being measured, resulting in an error. That error is a function of the signal (channel power) to noise (measurement floor) ratio, SN, in decibels. The function is $\text{error} = 10 \cdot \log(1 + 10^{-(SN/10)})$. For example, if the mixer level is 26.4 dB above the measurement floor, the error due to adding the analyzer's noise to the UUT is only 0.01 dB.

| Measurement | Specifications | Supplemental Information |
|--|----------------|---|
| Adjacent Channel Power Ratio (ACPR; ACLR)^a | | |
| Minimum power at RF Input | | -27 dBm (nominal) |
| ACPR Accuracy ^b | | |
| Radio | Offset Freq. | RRC weighted, 3.84 MHz noise bandwidth |
| MS (UE) | 5 MHz | At ACPR range of -30 to -36 dBc with optimum mixer level ^c |
| MS (UE) | 10 MHz | At ACPR range of -40 to -46 dBc with optimum mixer level ^d |
| BTS | 5 MHz | At ACPR range of -42 to -48 dBc with optimum mixer level ^e |
| BTS | 10 MHz | At ACPR range of -47 to -53 dBc with optimum mixer level ^d |
| BTS | 5 MHz | At -48 dBc non-coherent ACPR ^f |
| Dynamic Range | | RRC weighted, 3.84 MHz noise bandwidth |
| Offset Frequency | | |
| 5 MHz | | -68 dB (nominal) ^g |
| 10 MHz | | -72 dB (nominal) ^g |

- a. Most versions of adjacent channel power measurements use negative numbers, in units of dBc, to refer to the power in an adjacent channel relative to the power in a main channel, in accordance with ITU standards. The standards for W-CDMA analysis include ACLR, a positive number represented in dB units. In order to be consistent with other kinds of ACP measurements, this measurement and its specifications will use negative dBc results, and refer to them as ACPR, instead of positive dB results referred to as ACLR. The ACLR can be determined from the ACPR reported by merely reversing the sign.
- b. The accuracy of the Adjacent Channel Power Ratio will depend on the mixer drive level and whether the distortion products from the analyzer are coherent with those in the UUT. Except for the “noncoherent case” described in footnote f, the specifications apply even in the worst case condition of coherent analyzer and UUT distortion products. For ACPR levels other than those in this specifications table, the optimum mixer drive level for accuracy is approximately $-29 \text{ dBm} - (\text{ACPR}/3)$, where the ACPR is given in (negative) decibels.
- c. In order to meet this specified accuracy when measuring mobile station (MS) or user equipment (UE) within 3 dB of the required -33 dBc ACPR, the mixer level (ML) must be optimized for accuracy. This optimum mixer level is -15 dBm , so the input attenuation must be set as close as possible to the average input power $- (-15 \text{ dBm})$. For example, if the average input power is -6 dBm , set the attenuation to 9 dB. This specification applies for the normal 3.5 dB peak-to-average ratio of a single code. Note that, if the mixer level is set to optimize dynamic range instead of accuracy, accuracy errors are nominally doubled.
- d. ACPR accuracy at 10 MHz offset is warranted when the input attenuator is set to give an average mixer level of -7 dBm .
- e. To meet this specified accuracy, the mixer level must be optimized for accuracy when measuring node B of the Base Transmission Station (BTS) within 3 dB of the required -45 dBc ACPR. This optimum mixer level is -11 dBm , so the input attenuation must be set as close as possible to the average input power $- (-11 \text{ dBm})$. For example, if the average input power is -6 dBm , set the attenuation to 5 dB. This specification applies for

the normal 10 dB peak-to-average ratio (at 0.01 % probability) for Test Model 1. Note that, if the mixer level is set to optimize dynamic range instead of accuracy, accuracy errors are nominally doubled.

- f. Accuracy can be excellent even at low ACPR levels assuming that the user sets the mixer level to optimize the dynamic range, and assuming that the analyzer and UUT distortions are incoherent. When the errors from the UUT and the analyzer are incoherent, optimizing dynamic range is equivalent to minimizing the contribution of analyzer noise and distortion to accuracy, though the higher mixer level increases the display scale fidelity errors. This incoherent addition case is commonly used in the industry and can be useful for comparison of analysis equipment, but this incoherent addition model is often not justified.
- g. The optimum mixer drive level will be approximately -7 dBm.

| Measurement | Specifications | Supplemental Information |
|---|----------------|---|
| Multi-Carrier Power Minimum Carrier Power at RF Input ACPR Dynamic Range, two carriers 5 MHz offset 10 MHz offset ACPR Accuracy, two carriers 5 MHz offset, -48 dBc ACPR | | -15 dBm (nominal) RRC weighted, 3.84 MHz noise bandwidth -64 dB (nominal) -68 dB (nominal) ±0.70 dB (nominal) |

| Measurement | Specifications | Supplemental Information |
|---|--|----------------------------|
| Power Statistics CCDF | | |
| Minimum Power at RF Input | | -40 dBm, average (nominal) |
| Histogram Resolution | 0.01 dB ^a | |
| Power Statistics CCDF (Baseband IQ Inputs) | | |
| Input Ranges | | |
| 50 Ω Input Z | -5 to +13 dBm in four ranges of 6 dB steps: -5 dBm, +1 dBm, +7 dBm, +13 dBm | |
| Input Ranges | | |
| 600 Ω, 1 MΩ Input Z | -18 to 0 dBV in four ranges of 6 dB steps: -18 dBV, -12 dBV, -6 dBV, 0 dBV | |
| Absolute power accuracy for in-band signal (excluding mismatch error) 18 °C to 30 °C | | |
| Input Impedance = 50 Ω, all ranges | ±0.6 dB | |
| Input Impedance = 600 Ω, all ranges | | |
| 0 to 1 MHz | ±0.6 dB | |
| 1 MHz to 5 MHz | ±2.0 dB | |

- a. The Complementary Cumulative Distribution Function (CCDF) is a reformatting of a histogram of the power envelope. The width of the amplitude bins used by the histogram is the histogram resolution. The resolution of the CCDF will be the same as the width of those bins.

| Measurement | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| Intermodulation Minimum Carrier Power at RF Input Third-order Intercept | | -20 dBm (nominal) |

| Measurement | Specifications | Supplemental Information |
|--|----------------|---|
| Occupied Bandwidth Minimum carrier power at RF Input Frequency Resolution Frequency Accuracy | 100 Hz | -20 dBm (nominal) $\frac{1.4\%}{\sqrt{N_{\text{avg}}}}$ (nominal) ^a |

-
- a. The errors in Occupied Bandwidth measurement are due mostly to the noisiness of any measurement of a noise-like signal, such as the W-CDMA signal. The observed standard deviation of the OBW measurement is 60 kHz, so with 1000 averages, the standard deviation should be about 2 kHz, or 0.05 %. The frequency errors due to the FFT processing are computed to be 0.028 % with the RBW (30 kHz) used.

| Measurement | Specifications | Supplemental Information |
|--------------------------------------|----------------|--------------------------|
| Spectrum Emission Mask | | |
| Minimum power at RF Input | | -20 dBm (nominal) |
| Dynamic Range, relative ^a | | |
| 2.515 MHz offset ^b | -77.9 dB | -82.8 dB (typical) |
| 1980 MHz region ^c | -72.2 dB | -77.2 dB (typical) |
| Sensitivity, absolute ^d | | |
| 2.515 MHz offset ^e | -88.9 dBm | -93.9 dBm (typical) |
| 1980 MHz region ^f | -72.9 dBm | -77.9 dBm (typical) |
| Accuracy, relative | | |
| Display = Abs Peak Pwr ^g | ±0.60 dB | ±0.40 dB (typical) |
| Display = Rel Peak Pwr ^h | ±0.25 dB | |

- a. The dynamic range specification is the ratio of the channel power to the power in the offset and region specified. The dynamic range depends on the measurement settings, such as peak power or integrated power. This specification is derived from other analyzer performance limitations such as third-order intermodulation, DANL and phase noise. Dynamic range specifications are based on default measurement settings, with detector set to average, and depend on the mixer level. Mixer level is defined to be the input power minus the input attenuation.
- b. Default measurement settings include 30 kHz RBW. This dynamic range specification applies for the optimum mixer level, which is about -9dBm.
- c. Default measurement settings include 1200 kHz RBW. This dynamic range specification applies for a mixer level of 0dBm. Higher mixer levels can give up to 5 dB better dynamic range, but at the expense of compression in the input mixer, which reduces accuracy. The compression behavior of the input mixer is specified in the PSA Specifications Guide; the levels into the mixer are nominally 8 dB lower in this application when the center frequency is 2 GHz.
- d. The sensitivity is specified with 0 dB input attenuation. It represents the noise limitations of the analyzer. It is tested without an input signal.
- e. The sensitivity at this offset is specified in the default 30 kHz RBW.
- f. The sensitivity for this region is specified in the default 1200 kHz bandwidth.
- g. The absolute accuracy is a measure of the total power at the offsets. It applies for spectrum emission levels in the regions that are well above the dynamic range limitation.
- h. The relative accuracy is a measure of the ratio of the power at the offset to the main channel power. It applies for spectrum emission levels in the offsets that are well above the dynamic range limitation.

| Measurement | Specifications | Supplemental Information |
|------------------------------------|---|---|
| Code Domain | 25 to 35° C ^a 95 % ^b | Specifications apply to BTS and where the mixer level (RF input power minus attenuation) is between -20 and -10 dBm |
| Code domain power | | |
| Minimum power at RF input | | -70 dBm (nominal) ^{cd} |
| Relative accuracy ^e | | |
| Test signal | | |
| Test Model 2 | | |
| Code domain power range | | |
| 0 to -10 dBc | ±0.015 dB | |
| -10 to -30 dBc | ±0.06 dB | |
| -30 to -40 dBc | ±0.07 dB | |
| Test Model 1 with 32 DPCH | | |
| Code domain power range | | |
| 0 to -10 dBc | ±0.015 dB | |
| -10 to -30 dBc | ±0.08 dB | |
| -30 to -40 dBc | ±0.15 dB | |
| Symbol power vs. time ^f | | |
| Minimum power at RF Input | | -45 dBm (nominal) ^{cd} |
| Relative accuracy | | |
| Test signal | | |
| Test Model 1 with 32 DPCH signal | | |
| Code domain power range | | |
| 0 to -25 dBc | ±0.10 dB | |
| -25 to -40 dBc | ±0.50 dB | |
| Symbol error vector magnitude | | |
| Minimum power at RF Input | | -45 dBm (nominal) ^{cd} |
| Accuracy | | |
| Test signal | | |
| Test Model 1 with 32 DPCH signal | | |
| Code domain power range | | |
| 0 to -25 dBc | ±1.0 % | |

- a. This table is intended for users in the manufacturing environment, and as such, the tolerance limits have been computed for temperatures of the ambient air near the analyzer of 25 to 35 °C.
- b. All specifications given are derived from 95th percentile observations with 95 % confidence.
- c. Predefined test models under the Symbol Boundary menu are recommended for RF input power levels below -55 dBm. At low signal-to-noise ratios the auto channel ID algorithm may not correctly detect an active code channel as turned on. The predefined test model bypasses the auto channel ID algorithm.

- d. Nominal operating range. Accuracy specification applies when mixer level (RF input power minus attenuation) is between -20 and -10 dBm.
- e. A code channel power measurement made on a specific spreading code includes all power that projects onto that code. This power is primarily made up from the intended signal power that was spread using that code, but also includes that part of the SCH power (when present) that also projects onto the code being measured. The reason for this addition is that the SCH power is spread using a gold code, which is not orthogonal to the code being measured. The increase in decibels due to this SCH leakage effect is given by the following formula:

$$\text{SCH leakage effect} = 10 \log (10^{S/10}/(10F) + 10^{C/10}) - C$$

Where:

S = Relative SCH power in dB (during the first 10 % of each timeslot)

F = Spreading factor of the code channel being measured

C = Ideal relative code channel power in dB (excluding SCH energy)

For example, consider a composite signal comprising the SCH set to -10 dB during the first 10 % of each slot, and a DPCH at spreading factor 128 set to -28 dB. Performing a code channel power measurement on the DPCH will return a nominal code channel power measurement of -27.79 dB. The SCH leakage effect of 0.21 dB should not be considered as a measurement error but rather the expected consequence of the non-orthogonal SCH projecting energy onto the code used by the DPCH.

In order to calculate the ideal code channel power C from a code channel power measurement M that includes SCH energy, the following formula can be used:

$$C = 10 \log (10^{M/10} - 10^{S/10}/(10F))$$

Therefore a code channel power measurement M = -27.79 dB at spreading factor 128 of a signal including a relative SCH power of -10 dB indicates an ideal code channel power of -28 dB

- f. The SCH leakage effect due to its being spread by a gold code not orthogonal to the symbol power being measured will add additional power to the measured result during the portion of the slot where SCH power is present. When SCH power is present, the accuracy specification excludes the noise-like contribution of the SCH power.

| Description | Specifications | Supplemental Information |
|---------------------------|----------------|---|
| QPSK EVM | | |
| Minimum power at RF Input | | -20 dBm (nominal) |
| QPSK Downlink | | |
| EVM | | |
| Operating range | | 0 to 25 % (nominal) |
| Floor | | 1.5 % (nominal) |
| Accuracy ^a | | ±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 × frequency reference accuracy) |
| 12.2 k RMC Uplink | | |
| EVM | | |
| Operating range | | 0 to 20 % (nominal) |
| Floor | | 1.5 % (nominal) |
| Accuracy ^a | | ±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 × frequency reference accuracy) |

- a. The accuracy specification applies when the EVM to be measured is well above the measurement floor. When the EVM does not greatly exceed the floor, the errors due to the floor add to the accuracy errors. The errors due to the floor are noise-like and add incoherently with the UUT EVM. The errors depend on the EVM of the UUT and the floor as follows: $\text{error} = \sqrt{\text{EVMUUT}^2 + \text{EVMsa}^2} - \text{EVMUUT}$, where EVMUUT is the EVM of the UUT in percent, and EVMsa is the EVM floor of the analyzer in percent. For example, if the EVM of the UUT is 7 %, and the floor is 2.5 %, the error due to the floor is 0.43 %. The total error can cause a reading as high as $\text{EVMUUT} + \text{floorerror} + \text{accyerror}$, or as low as $\text{EVMUUT} - \text{accyerror}$, where floorerror is the result of the error computation due to the floor, and accyerror is the specified accuracy.

| Measurement | Specifications | Supplemental Information |
|---|----------------|--|
| <p>Power Control and Power vs. Time</p> <p>Absolute power measurement</p> <p>Accuracy</p> <p> 0 to -20 dBm</p> <p> -20 to -60 dBm</p> <p>Relative power measurement</p> <p>Accuracy</p> <p> Step range ±1.5 dB</p> <p> Step range ±3.0 dB</p> <p> Step range ±4.5 dB</p> <p> Step range ±26.0 dB</p> | | <p>Using 5 MHz resolution bandwidth</p> <p>±0.7 dB (nominal)</p> <p>±1.0 dB (nominal)</p> <p>±0.1 dB (nominal)</p> <p>±0.15 dB (nominal)</p> <p>±0.2 dB (nominal)</p> <p>±0.3 dB (nominal)</p> |

| Measurement | Specifications | Supplemental Information |
|---|--|---|
| <p>Modulation Accuracy (Composite EVM)</p> <p>Minimum power at RF input</p> <p>Composite EVM</p> <p>Test Model 4</p> <p>Range</p> <p>Floor</p> <p>Accuracy^b</p> <p>Test Model 1 with 32 DPCH</p> <p>Range</p> <p>Foor</p> <p>Accuracy</p> <p>Peak Code Domain Error Using Test Model 3 with 16 PCH signal, and a spreading code of 256.</p> <p>Accuracy</p> <p>I/Q orgin offset</p> <p>Range</p> <p>Frequency error Specified for CPICH power ≥ -15 dBc</p> <p>Range</p> <p>Accuracy</p> <p>Time Offset</p> <p>Frame offset accuracy</p> <p>Relative offset accuracy^c</p> | <p>0 % to 25 %</p> <p>1.5 %</p> <p>± 1.0 %</p> <p>0 % to 25 %</p> <p>1.5 %</p> <p>± 1.0 %</p> <p>± 1.0 dB (nominal)</p> <p>-10 to -50 dBc (nominal)</p> <p>± 500 Hz</p> <p>± 2 Hz + (transmitter frequency \times frequency reference accuracy)</p> <p>± 150 ns</p> <p>± 1.25 ns</p> | <p>Specifications apply to BTS and where the mixer level (RF input power minus attenuation) is between -20 and -10 dBm.</p> <p>-75 dBm (nominal)^a</p> |

- a. Predefined test models under the Symbol Boundary menu are recommended for RF input power levels below -55 dBm. At low signal-to-noise ratios the auto channel ID algorithm may not correctly detect an active code channel as turned on. The predefined test model bypasses the auto channel ID algorithm.
- b. The accuracy specification applies when the EVM to be measured is well above the measurement floor. When the EVM does not greatly exceed the floor, the errors due to the floor add to the accuracy errors. The errors due to the floor are noise-like and add incoherently with the UUT EVM. The errors depend on the EVM of the UUT and the floor as follows: $\text{error} = \sqrt{\text{EVMUUT}^2 + \text{EVMsa}^2} / \text{EVMUUT}$, where EVMUUT is the EVM of the UUT in percent, and EVMsa is the EVM floor of the analyzer in percent. For example, if the EVM of the UUT is 7 %, and the floor is 2.5 %, the error due to the floor is 0.43 %. The total error can cause a reading as high as $\text{EVMUUT} + \text{floorerror} + \text{accyerror}$, or as low as $\text{EVMUUT} - \text{accyerror}$, where floorerror is the result of the error computation due to the floor, and accyerror is the specified accuracy.
- c. The accuracy specification applies when the measured signal is the combination of CPICH (antenna-1) and CPICH (antenna-2), and where the power level of each CPICH is -3 dB relative to the total power of the combined signal. Further, the range of the measurement over which the accuracy specification applies is a maximum offset of ± 0.5 chips.

Frequency

| Measurement | Specifications | Supplemental Information |
|-------------------------|--------------------------------------|--------------------------|
| In-Band Frequency Range | 2110 to 2170 MHz 1920 to 1980 MHz | |

General

| Measurement | Specifications | Supplemental Information |
|--|--|--|
| Trigger Trigger sources Trigger delay, level, & slope Trigger delay Range Repeatability Resolution External trigger inputs Level Impedance | ± 33 ns 33 ns | RF burst (wideband), Video (IF envelope), Ext Front, Ext Rear. Actual choices are dependent on measurement. Each trigger source has separate set of these parameters. -100 to +500 ms -5 V to +5 V (nominal) 10 k Ω (nominal) |
| Range Control | | RF Input Autorange ^a Manually set Max Total Pwr Manually set Input Atten |

a. Autorange is *not* continuous with each measurement acquisition; it will run only once immediately following a measurement restart, initiated either by pressing the **Restart** hardkey, or by sending the GPIB command `INIT:IMM`. This behavior was chosen to maintain best measurement speed, but it requires caution when input power levels change. If the input signal power changes, the analyzer will not readjust the input attenuators for optimal dynamic range unless a measurement restart is initiated. For example, if a sequence of power measurements is made, beginning with a maximum power level that is large enough to require non-zero input attenuation, it is advisable to do a measurement restart to automatically set a lower input attenuator value to maintain optimal dynamic range for approximately every 3 dB the input signal power level is reduced, or smaller, depending upon how precisely dynamic range needs to be optimized. Conversely, if the input signal power increases to a high enough level, input overloading will occur if the input attenuators are not readjusted by doing a measurement restart.

8 cdma2000 Specifications

All specifications apply over 0 °C to +55 °C, excepting when otherwise specified. The instrument will meet its specifications after 2 hours of storage at a constant temperature, within the operating temperature range, 1 hour after the instrument is turned on and within 24 hours after “Align All Now” has been run. The specifications for each measurement apply for the measurement’s factory default setup.

Measurements

Measurement specifications only apply over the cellular frequency bands supported by this option.

| Measurement | Specifications | Supplemental Information |
|---|--|--|
| Channel Power (RF Input) Power range Absolute power accuracy for in-band signal (excluding mismatch error) 18 °C to 30 °C +30 to -28 dBm -28 to -50 dBm -50 to -80 dBm | +30 to -80 dBm ±0.6 dB ±0.8 dB ±1.0 dB | |
| Channel Power (Baseband IQ Inputs) Input Ranges 50 Ω Input Z Input Ranges 600 Ω, 1 M Ω Input Z Absolute power accuracy for in-band signal (excluding mismatch error) 18 °C to 30 °C Input Impedance = 50 Ω, all ranges Input Impedance = 600 Ω, all ranges 0 to 1 MHz 1 MHz to 5 MHz Input Impedance = 1 M Ω, all ranges Unbalanced Balanced 0 to 1 MHz 1 MHz to 5 MHz | -5 to +13 dBm in four ranges of 6 dB steps: -5 dBm, +1 dBm, +7 dBm, +13 dBm -18 to 0 dBV in four ranges of 6 dB steps: -18 dBV, -12 dBV, -6 dBV, 0 dBV ±0.6 dB ±0.6 dB ±2.0 dB | ±0.7 dB, (nominal) ±0.6 dB, (nominal) ±2.0 dB, (nominal) |

| Measurement | Specifications | Supplemental Information |
|-------------------------------------|----------------|--|
| Adjacent Channel Power Ratio | | |
| Power range at RF input | +30 to -20 dBm | Referenced to average power of carrier in 1.25 MHz BW. |
| Dynamic range | | |
| Offset Freq. Integ. BW | | |
| 750 kHz 30 kHz | -82 dBc | |
| 885 kHz 30 kHz | -82 dBc | |
| 1.98 MHz 30 kHz | -85 dBc | |
| Relative accuracy | ±0.9 dB | |

| Measurement | Specifications | Supplemental Information |
|---|---|---|
| <p>Power Statistics CCDF (RF Input)</p> <p>Range</p> <p>Maximum:</p> <p>Minimum:</p> <p>Power Statistics CCDF (Baseband IQ Inputs)</p> <p>Input Ranges</p> <p>50 Ω Input Z</p> <p>Input Ranges</p> <p>600 Ω, 1 M Ω Input Z</p> <p>Absolute power accuracy for in-band signal (excluding mismatch error)</p> <p>18 $^{\circ}$C to 30 $^{\circ}$C</p> <p>Input Impedance = 50 Ω, all ranges</p> <p>Input Impedance = 600 Ω, all ranges</p> <p>0 to 1 MHz</p> <p>1 MHz to 5 MHz</p> <p>Input Impedance = 1 M Ω, all ranges</p> <p>Unbalanced</p> <p>Balanced</p> <p>0 to 1 MHz</p> <p>1 MHz to 5 MHz</p> | <p>+30 dBm (average)</p> <p>+40 dBm (peak)</p> <p>-40 dBm (average)</p> <p>-5 to +13 dBm in four ranges of 6 dB steps: -5 dBm, +1 dBm, +7 dBm, +13 dBm</p> <p>-18 to 0 dBV in four ranges of 6 dB steps: -18 dBV, -12 dBV, -6 dBV, 0 dBV</p> <p>± 0.6 dB</p> <p>± 0.6 dB</p> <p>± 2.0 dB</p> | <p>± 0.7 dB, (nominal)</p> <p>± 0.6 dB, (nominal)</p> <p>± 2.0 dB, (nominal)</p> |

| Measurement | Specifications | Supplemental Information |
|---|--|--------------------------|
| Inter-Modulation Carrier Power range at RF Input Inter-modulation Power Range: Relative Accuracy: Resolution: | +30 to -20 dBm -20 to -65 dBc ±1.5 dB 0.01 dB | Display resolution |

| Measurement | Specifications | Supplemental Information |
|---|---|--------------------------|
| Occupied Bandwidth Carrier power range at RF Input Frequency Resolution Accuracy | +30 to -20 dBm 1 kHz ±3 kHz | |

| Measurement | Specifications | Supplemental Information |
|--|--|--|
| Spectrum Emission Mask Carrier Power range at RF Input Spectrum Emission Power Range: Relative Accuracy: Resolution: | +30 to -20 dBm ±1.0 dB 0.01 dB | ≤-136 dBc/Hz at 1 MHz offset, (nominal) Display resolution |

| Measurement | Specifications | Supplemental Information |
|---|---|--|
| Code Domain (RF Input) | | |
| Code domain power | | |
| Power range | Mixer level (RF input power minus attenuation) is between -20 and -10 dBm. | |
| Accuracy | | |
| Relative range | | |
| 0 to -10 dBc | ±0.015 dB | |
| -10 to -30 dBc | ±0.18 dB | |
| -30 to -40 dBc | ±0.51 dB | |
| Symbol power vs. time | | |
| Power range | +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 | | |
| Power range | +30 to -20 dBm | |
| Pilot time offset | | |
| Range | -13.33 ms to +13.33 ms | (From even second signal to start of PN sequence) |
| Accuracy | ±250 ns | |
| Resolution | 10 ns | |
| Code Domain (Baseband IQ Inputs) | | |
| Input Ranges | | |
| 50 Ω Input Z | -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 Z | -18 to 0 dBV in four ranges of 6 dB steps: -18 dBV, -12 dBV, -6 dBV, 0 dBV | |
| Absolute power accuracy for in-band signal (excluding mismatch error) | | |
| 18 °C to 30 °C | | |
| Input Impedance = 50Ω, all ranges | ±0.6 dB | |
| Input Impedance = 600Ω, all ranges | | |
| 0 to 1 MHz | ±0.6 dB | |
| 1 MHz to 5 MHz | ±2.0 dB | |
| Input Impedance = 1 M Ω, all ranges | | ±0.7 dB, (nominal) |
| Unbalanced | | |
| Balanced | | ±0.6 dB, (nominal) |
| 0 to 1 MHz | | ±2.0 dB, (nominal) |
| 1 MHz to 5 MHz | | |

| Measurement | Specifications | Supplemental Information |
|---|--|---|
| QPSK EVM (RF Input) | | |
| Power range | +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 × frequency reference accuracy) |
| QPSK EVM (Baseband IQ Inputs) | | |
| Input Ranges | | |
| 50 Ω Input Z | -5 to +13 dBm in four ranges of 6 dB steps: -5 dBm, +1 dBm, +7 dBm, +13 dBm | |
| 600 Ω, 1 M Ω Input Z | -18 to 0 dBV in four ranges of 6 dB steps: -18 dBV, -12 dBV, -6 dBV, 0 dBV | |
| Absolute power accuracy for in-band signal (excluding mismatch error) 18 °C to 30 °C | | |
| Input Impedance = 50 Ω, all ranges | ±0.6 dB | |
| Input Impedance = 600 Ω, all ranges | | |
| 0 to 1 MHz | ±0.6 dB | |
| 1 MHz to 5 MHz | ±2.0 dB | |
| Input Impedance = 1 M Ω, all ranges | | |
| Unbalanced | | ±0.7 dB, (nominal) |
| Balanced | | |
| 0 to 1 MHz | | ±0.6 dB, (nominal) |
| 1 MHz to 5 MHz | | ±2.0 dB, (nominal) |
| Voltage range at I or Q inputs | | |
| 50 Ω Input Z | -5 to +13 dBm in four ranges of 6 dB steps: -5 dBm, +1 dBm, +7 dBm, +13 dBm | |
| 600 Ω, 1 M Ω Input Z | -18 to 0 dBV in four ranges of 6 dB steps: -18 dBV, -12 dBV, -6 dBV, 0 dBV | |

| Measurement | Specifications | Supplemental Information |
|---|--|--------------------------|
| Modulation Accuracy (global EVM meas) (RF Input) | | |
| Carrier Power range | +30 to -50 dBm | |
| Global EVM | | |
| Range | 0 to 25% | |
| Floor | 2.0% or less for pilot only signal. 2.0% or less for pilot with 16 DPCH signal. | RC3 at 9600 bps |
| 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 (nominal) (transmitter frequency × frequency reference accuracy) | |
| Resolution | 0.01 Hz | Display resolution |
| Modulation Accuracy (global EVM meas) (Baseband IQ Inputs) | | |
| Input Ranges | | |
| 50 Ω Input Z | -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 Z | -18 to 0 dBV in four ranges of 6 dB steps: -18 dBV, -12 dBV, -6 dBV, 0 dBV | |
| Absolute power accuracy for in-band signal (excluding mismatch error) 18 °C to 30 °C | | |
| Input Impedance = 50 Ω, all ranges | ±0.6 dB | |
| Input Impedance = 600 Ω, all ranges | | |
| 0 to 1 MHz | ±0.6 dB | |
| 1 MHz to 5 MHz | ±2.0 dB | |
| Input Impedance = 1 M Ω, all ranges | | |
| Unbalanced | | ±0.7 dB, (nominal) |
| Balanced | | |
| 0 to 1 MHz | | ±0.6 dB, (nominal) |
| 1 MHz to 5 MHz | | ±2.0 dB, (nominal) |

| Measurement | Specifications | Supplemental Information |
|-----------------------------|--|--------------------------|
| Spectrum (Frequency Domain) | See Spectrum Measurement on page 24. | |

| Measurement | Specifications | Supplemental Information |
|------------------------|--|--------------------------|
| Waveform (Time Domain) | See Waveform Measurement on page 26. | |

Frequency

| | Specifications | Supplemental Information |
|---|--------------------------------------|--------------------------|
| In-Band Frequency Range | | |
| Band Class 0 (North American Cellular) | 869 to 894 MHz 824 to 849 MHz | |
| Band Class 1 (North American PCS) | 1930 to 1990 MHz 1850 to 1910 MHz | |
| Band Class 2 (TACS) | 917 to 960 MHz 872 to 915 MHz | |
| Band Class 3 (JTACS) | 832 to 870 MHz 887 to 925 MHz | |
| Band Class 4 (Korean PCS) | 1840 to 1870 MHz 1750 to 1780 MHz | |
| Band Class 6 (IMT-2000) | 2110 to 2170 MHz 1920 to 1980 MHz | |

General

| | Specifications | Supplemental Information |
|---------------------------------|-----------------|---|
| Trigger | | |
| Trigger source | | RF burst (wideband), Video (IF envelope), Ext Front, Ext Rear. Actual available choices are dependent on measurement. |
| Trigger delay, level, and slope | | Each trigger source has a separate set of these parameters. |
| Trigger delay | | |
| Range: | -100 to +500 ms | |
| Repeatability: | ±33 ns | |
| Resolution: | 33 ns | |
| External trigger inputs | | |
| Level: | | -5 V to +5 V, (nominal) |
| Impedance: | | 10 kΩ, nominal |

9 1xEV-DO Specifications

All specifications apply over 0 °C to +55 °C, excepting when otherwise specified. The instrument will meet its specifications after 2 hours of storage at a constant temperature, within the operating temperature range, 1 hour after the instrument is turned on and within 24 hours after “Align All Now” has been run. The specifications for each measurement apply for the measurement’s factory default setup.

Measurements

Measurement specifications only apply over the cellular frequency bands supported by this option.

| Measurement | Specifications | Supplemental Information |
|--|---|------------------------------------|
| Channel Power (1.23 MHz Integration Bandwidth) Carrier Power range at RF input Power accuracy, absolute ^a -28 to +30 dBm -50 to -28 dBm -80 to -50 dBm | -80 to +30 dBm ±0.6 dB ±0.8 dB ±1.0 dB | In-band signals for 18 °C to 30 °C |

| Measurement | Specifications | Supplemental Information |
|--|--|--------------------------|
| Power Statistics CCDF Carrier power range at RF input Maximum average Maximum peak Minimum average | +30 dBm +40 dBm -40 dBc | |
| Inter-Modulation Carrier power range at RF input Inter-modulation power range Accuracy, relative Resolution | -20 to +30 dBm -65 to -20 dBm ±1.5 dB 0.01 dB | display resolution |

a. Absolute power accuracy includes all error sources for in-band signals except mismatch errors.

| Measurement | Specifications | Supplemental Information |
|--|--------------------------------------|---|
| Occupied Bandwidth Carrier power range at RF input Frequency accuracy Frequency resolution | –20 to +30 dBm ±3 kHz 1 kHz | at 1 kHz resolution bandwidth |
| Spurious Emissions & ACP Carrier power range at RF input Spurious emissions power range Accuracy, relative Resolution | –20 to +30 dBm ±1.0 dB 0.01 dB | ≤–136 dBc/Hz at 1 MHz offset, (nominal) display resolution |

| Measurement | Specifications | Supplemental Information |
|--|---------------------------|--|
| Code Domain Code domain power range at RF input Accuracy ^a (for Pilot, MAC, QPSK Data, or 8PSK Data) | –50 to +30 dBm ±0.3 dB | within 20 dB spread channel power relative to total power |
| QPSK EVM Carrier power range at RF input: EVM Range Floor Accuracy I/Q origin offset range Frequency error Range Accuracy: | –20 to + 30 dBm | 0 to 25%, (nominal) 1.5%, (nominal) ±1.0%, (nominal) –50 to –10 dBc, (nominal) ±500 Hz, (nominal) ±10 Hz (nominal) + (transmitter frequency × frequency reference accuracy) |

a. Based on EI test for Modulation Accuracy (Rho) measurements in cdma2000 of which floor is ≤2.0%, with compensated deviations by firmware design.

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1xEV-DO Specifications

| Measurement | Specifications | Supplemental Information |
|--|--------------------|---|
| Modulation Accuracy (Composite Rho) | | |
| Carrier power range at RF input | -50 to +30 dBm | |
| EVM (Pilot, MAC, QPSK Data, 8PSK Data) | | |
| Range | 0 to 25% | |
| Floor | 2.5% | |
| Accuracy | ±1.0% | at the range of 5% to 25% |
| Rho (Pilot, MAC, QPSK Data, 8PSK Data) | | |
| Range | 0.9 to 1.0 | |
| Floor | 0.99938 | (0.99938 equals 2.5% EVM) |
| Accuracy | ±0.0010 ±0.0044 | at 0.99751 Rho (5% EVM) at 0.94118 Rho (25% EVM) |
| Frequency error (Pilot, MAC, QPSK Data, 8PSK Data) | | |
| Range | | ±400 Hz, (nominal) |
| Accuracy | | ±10 Hz (nominal) + (transmitter frequency × frequency reference accuracy) |
| Resolution | 0.01 Hz | display resolution |
| I/Q origin offset | | |
| Range | -10 to -50 dBc | |
| Resolution | 0.02 dB | display resolution |
| Power vs Time | | |
| Carrier Power range at RF input | | -80 to +30 dBm, (nominal) |
| Power accuracy, absolute ^a In-band signals 18 °C to 30 °C | | |
| -28 to +30 dBm | | ±0.6 dB, (nominal) |
| -50 to -28 dBm | | ±0.8 dB, (nominal) |
| -80 to -50 dBm | | ±1.0 dB, (nominal) |

a. Absolute power accuracy includes all error sources for in-band signals except mismatch errors.

| Measurement | Specifications | Supplemental Information |
|-----------------------------|--|--------------------------|
| Spectrum (Frequency Domain) | See Spectrum Measurement on page 24. | |

| Measurement | Specifications | Supplemental Information |
|------------------------|--|--------------------------|
| Waveform (Time Domain) | See Waveform Measurement on page 26. | |

Frequency

| Measurement | Specifications | Supplemental Information |
|---|------------------|--|
| In-Band Frequency Range^a (Access Network Only) | | |
| Band Class 0 | 869 to 894 MHz | North American and Korean Cellular bands |
| Band Class 1 | 1930 to 1990 MHz | North American PCS band |
| Band Class 2 | 917 to 960 MHz | TACS band |
| Band Class 3 | 832 to 869 MHz | JTACS band |
| Band Class 4 | 1840 to 1870 MHz | Korean PCS band |
| Band Class 6 | 2110 to 2170 MHz | IMT-2000 band |
| Band Class 8 | 1805 to 1880 MHz | 1800 MHz band |
| Band Class 9 | 925 to 960 MHz | 900 MHz band |

| Measurement | Specifications | Supplemental Information |
|--|--|--------------------------------------|
| Alternative Frequency Ranges^b (Access Network Only) | | |
| Band Class 5 | 421 to 430 MHz 460 to 470 MHz 489 to 494 MHz | NMT-450 bands |
| Band Class 7 | 746 to 764 MHz | North American 700 MHz Cellular band |

a. Frequency ranges over which all specifications apply.

b. Frequency ranges with tuning plans but degraded specifications for absolute power accuracy. The degradation should be nominally ± 0.30 dB.

General

| Measurement | Specifications | Supplemental Information |
|--|--|---|
| Trigger Trigger source Trigger delay, level, and slope Trigger delay Range: Repeatability: Resolution: External trigger inputs Level: Impedance: | -100 to +500 ms ±33 ns 33 ns | RF burst (wideband), Video (IF envelope), Ext Front, Ext Rear. Actual available choices are dependent on measurement. Each trigger source has a separate set of these parameters. -5 V to +5 V, (nominal) 10 kΩ, nominal |
| Range Control | | RF Input Autorange ^a Manually set Max Total Pwr Manually set Input Atten |

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- a. Autorange is *not* continuous with each measurement acquisition; it will run only once immediately following a measurement restart, initiated either by pressing the **Restart** hardkey, or by sending the GPIB command `INIT:IMM`. This behavior was chosen to maintain best measurement speed, but it requires caution when input power levels change.

If the input signal power changes, the analyzer will not readjust the input attenuators for optimal dynamic range unless a measurement restart is initiated. For example, if a sequence of power measurements is made, beginning with a maximum power level that is large enough to require non-zero input attenuation, it is advisable to do a measurement restart to automatically set a lower input attenuator value to maintain optimal dynamic range for approximately every 3 dB the input signal power level is reduced, or smaller, depending upon how precisely dynamic range needs to be optimized. Conversely, if the input signal power increases to a high enough level, input overloading will occur if the input attenuators are not readjusted by doing a measurement restart.