

Specifications Guide

Agilent Technologies ESA Spectrum Analyzers

This manual provides documentation for the following instruments:

Agilent ESA-E Series

E4401B (9 kHz - 1.5 GHz)

E4402B (9 kHz - 3.0 GHz)

E4404B (9 kHz - 6.7 GHz)

E4405B (9 kHz - 13.2 GHz)

E4407B (9 kHz - 26.5 GHz)

and

Agilent ESA-L Series

E4411B (9 kHz - 1.5 GHz)

E4403B (9 kHz - 6.7 GHz)

E4408B (9 kHz - 26.5 GHz)



Agilent Technologies

Manufacturing Part Number: E4401-90178

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The following safety symbols are used throughout this manual. Familiarize yourself with the symbols and their meaning before operating this instrument.

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.**

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

If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in a normal condition (in which all means for protection are intact) only.

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 protective 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 **If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in a normal condition (in which all means for protection are intact) only.**

CAUTION Always use the three-prong ac power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord may cause product damage.

CAUTION This instrument has autoranging line voltage input, be sure the supply voltage is within the specified range.

Warranty

This Agilent Technologies instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Agilent Technologies Company will, at its option, either repair or replace products which prove to be defective.

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Where to Find the Latest Information

Documentation is updated periodically. For the latest information about Agilent Spectrum Analyzers, including firmware upgrades and application information, please visit the following Internet URL:
<http://www.agilent.com/go/esa>.

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About This Chapter

This chapter contains specifications and characteristics for the E4401B spectrum analyzer. The distinction between specifications and characteristics is described as follows.

- Specifications describe the performance of parameters covered by the product warranty. (The temperature range is 0 °C to 55 °C, unless otherwise noted.)
- Characteristics describe product performance that is useful in the application of the product, but is not covered by the product warranty.
- Typical performance describes additional product performance information that is not covered by the product warranty. It is performance beyond an indicated specification, that most units will exhibit.
- Nominal values indicate the expected, but not warranted, value of a parameter.

The following conditions must be met for the analyzer to meet its specifications.

- The analyzer is within the one year calibration cycle.
- If **Auto Align All** is selected:
 - After 2 hours of storage within the operating temperature range.
 - 5 minutes after the analyzer is turned on with sweep times less than 4 seconds.
- If **Auto Align Off** is selected:
 - When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.
 - After the analyzer is turned on for a minimum of 90 minutes, and **Align Now All** has been run.
 - When **Align Now All** is run:
 - Every hour
 - If the ambient temperature changes more than 3 °C
 - If the 10 MHz reference changes

- If **Auto Align All but RF** is selected:
 - When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.
 - After the analyzer is turned on for a minimum of 90 minutes, and **Align Now RF** has been run.
 - When **Align Now RF** is run:
 - Every hour
 - If the ambient temperature changes more than 3 °C

Frequency

| | Specifications | Supplemental Information |
|--|--------------------|--------------------------|
| Frequency Range | | |
| 50 Ω | 9 kHz to 1.5 GHz | |
| 50 Ω , Preamp On (<i>Option 1DS</i>) | 100 kHz to 1.5 GHz | |
| 75 Ω (<i>Option 1DP</i>) | 1 MHz to 1.5 GHz | |
| 75 Ω , Preamp On (<i>Option 1DS, 1DP</i>) | 1 MHz to 1.5 GHz | |

| | Specifications | Supplemental Information |
|----------------------------|------------------------------|---|
| Frequency Reference | | |
| Aging Rate | $\pm 2 \times 10^{-6}$ /year | $\pm 1.0 \times 10^{-7}$ /day, characteristic |
| Settability | $\pm 5 \times 10^{-7}$ | |
| Temperature Stability | $\pm 5 \times 10^{-6}$ | |

| | Specifications | Supplemental Information |
|---|------------------------------|---|
| High Stability Frequency Reference (<i>Option 1D5</i>) | | |
| Aging Rate | $\pm 1 \times 10^{-7}$ /year | $\pm 5 \times 10^{-10}$ /day, 7-day average after being powered on for 7 days, characteristic |
| Settability | $\pm 1 \times 10^{-8}$ | |
| Temperature Stability | | |
| 20 to 30 $^{\circ}\text{C}$ | $\pm 1 \times 10^{-8}$ | |
| 0 to 55 $^{\circ}\text{C}$ | $\pm 5 \times 10^{-8}$ | |
| Warm-Up (Internal frequency reference selected) | | |
| After 5 minutes | | $< \pm 1 \times 10^{-7}$ of final frequency, ^a characteristic |
| After 15 minutes | | $< \pm 1 \times 10^{-8}$ of final frequency, ^a characteristic |

a. Final frequency is defined as frequency 60 minutes after power-on with analyzer set to internal frequency reference.

| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| Frequency Readout Accuracy (Start, Stop, Center, Marker) | $\pm((\text{frequency indication} \times \text{frequency reference error}^a) + 0.5\% \text{ of span} + \frac{\text{span}}{\text{sweep points} - 1} + 15\% \text{ of RBW} + 10 \text{ Hz})$ | |

a. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).

| | Specifications | Supplemental Information |
|--|---|---------------------------------|
| Marker Frequency Counter Resolution Accuracy ^a | Selectable from 1 Hz to 100 kHz $\pm(\text{marker frequency} \times \text{frequency reference error}^b + \text{counter resolution})$ | For RBW ≥ 1 kHz |

a. Marker level to displayed noise level > 25 dB, RBW/ Span ≥ 0.002, frequency offset = 0 Hz.
 b. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).

| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| Frequency Span Range Resolution Accuracy | 0 Hz (zero span), 100 Hz to 1.5 GHz 2 Hz $\pm(0.5\% \text{ of span} + 2 \times \frac{\text{span}}{\text{sweep points} - 1})$ | |

| | Specifications | Supplemental Information |
|--|-----------------------------|--|
| Sweep Time Range Tracking Generator On (Option 1DN or 1DQ) | 1 ms to 4000 s ^a | $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ to 4000 s 50 ms is the minimum sweep time |

Agilent E4401B Specifications and Characteristics
Frequency

| | Specifications | Supplemental Information |
|---|--|--|
| Fast Time-domain Sweep <i>(Option AXX)</i> (For Span = 0 Hz, RBW ≥ 1 kHz) | 5 μs to 4000 s ^b | $\frac{\text{sweep points} - 1}{20 \text{ MHz}}$ to 4000 s |
| Accuracy (Span = 0 Hz) | | |
| 1 ms to 4000 s ^a | ±1% | |
| <i>(Option AXX)</i> | ±1% | |
| 5 μs to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ | | |
| Sweep Trigger^{cd} | Free Run, Single, Line, Video, External, Delayed, Offset ^e | |
| <i>(Option 1D6)</i> | Add Gate | |
| <i>(Option B7B)</i> | Add TV | |
| Delayed Trigger^{cf} | | |
| Range | 1 μs to 400 s | |
| Resolution | $\frac{\text{delay in seconds}}{65000}$ rounded up to nearest μs | |
| Accuracy | ±(500 ns +(0.01% of delay)) | |
| Offset Trigger^e | | |
| Resolution | $\frac{\text{sweep time}}{\text{sweep points} - 1}$ | |
| Range | ±320 ms to ±323 ks | Where ST = sweep time and SP = sweep points $\frac{-32766 \times \text{ST}}{\text{SP} - 1}$ to $\frac{(32766 - \text{SP}) \times \text{ST}}{\text{SP} - 1}$ |
| Fast Time-domain sweep <i>(Option AXX)</i> (For sweep times 5.0 μs to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$) | ±1.64 ms to ±249 ms | $\frac{-32766 \times \text{ST}}{\text{SP} - 1}$ to $\frac{(32766 - \text{SP}) \times \text{ST}}{\text{SP} - 1}$ |

- a. For firmware revisions prior to A.04.00, 5 ms to 2000 s.
- b. For firmware revisions prior to A.04.00, 20 μs to 2000 s.
- c. Gate cannot be used simultaneously with delayed or TV trigger.
- d. Auto align is suspended in video, external, gate, and delayed trigger modes while waiting for a trigger event to occur.
- e. For firmware revision A.04.00 or later.
- f. Delayed trigger is available with line, external trigger, and TV trigger *(Option B7B)*.

| | Specifications | Supplemental Information |
|-----------------------------|-----------------------|---------------------------------|
| Sweep (trace) Points | | |
| Range | 101 to 8192 | |

| | Specifications | Supplemental Information |
|--|---|--|
| Resolution Bandwidth (RBW) | | |
| Range | | |
| -3 dB bandwidth | 1 kHz to 3 MHz, in 1-3-10 sequence, 5 MHz | |
| -6 dB bandwidth (EMI) | 9 kHz and 120 kHz | |
| <i>(Option 1DR)</i> | | |
| -3 dB bandwidth | Adds 10, 30, 100, 300 Hz | |
| -6 dB bandwidth (EMI) | Add 200 Hz | |
| Accuracy | | |
| 1 kHz to 3 MHz RBW | ±15% | |
| 5 MHz RBW | ±30% | |
| 10 Hz to 300 Hz RBW | ±10% | |
| <i>(Option 1DR)</i> | | |
| Shape | | |
| 1 kHz to 5 MHz RBW | | Synchronously tuned four poles, approximately Gaussian shape |
| 10 Hz to 300 Hz RBW | | Digital, approximately Gaussian shape |
| <i>(Option 1DR)</i> | | |
| Selectivity (60 dB/3 dB bandwidth ratio) | | |
| 1 kHz to 5 MHz RBW | | <15:1, characteristic |
| 10 Hz to 300 Hz RBW | | <5:1, characteristic |
| <i>(Option 1DR)</i> | | |

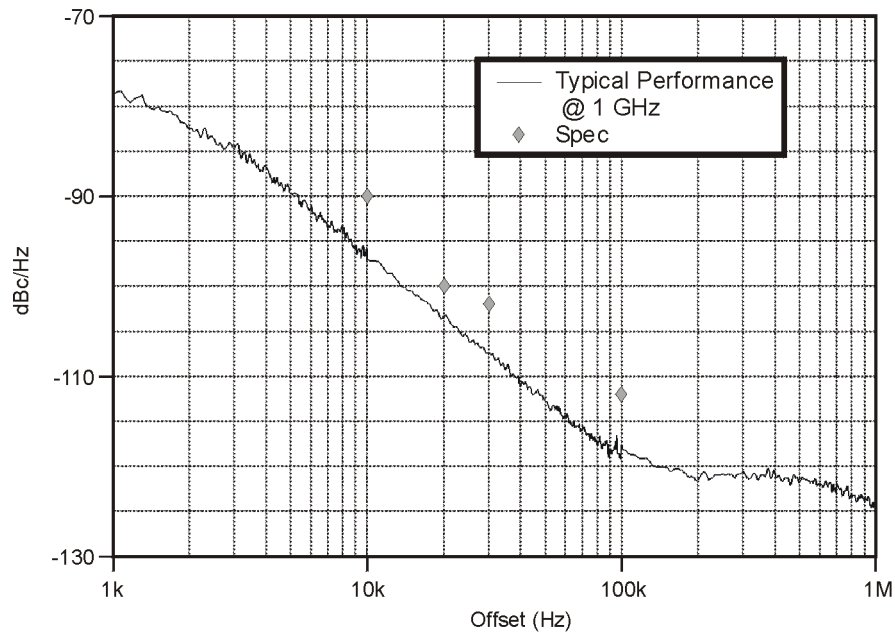
Agilent E4401B Specifications and Characteristics
Frequency

| | Specifications | Supplemental Information |
|--|--|--|
| <p>Video Bandwidth (VBW) (-3 dB)</p> <p>Range</p> <p><i>(Option 1DR)</i></p> <p>Accuracy</p> <p>Shape</p> | <p>30 Hz to 1 MHz in 1-3-10 sequence</p> <p>Adds 1, 3, 10 Hz for RBW's <1 kHz</p> | <p>3 MHz, characteristic</p> <p>±30%, characteristic</p> <p>Post detection, single pole low-pass filter used to average displayed noise</p> <p>Video bandwidths below 30 Hz are digital bandwidths with anti-aliasing filtering.</p> |

| | Specifications | Supplemental Information |
|---|---|--|
| <p>Stability</p> <p>Noise Sidebands (Offset from CW signal with 1 kHz RBW, 30 Hz VBW and sample detector)</p> <p>≥10 kHz</p> <p>≥20 kHz</p> <p>≥30 kHz</p> <p>≥100 kHz</p> <p>Residual FM</p> <p>1 kHz RBW, 1 kHz VBW <i>(Option 1D5)</i></p> <p>10 Hz RBW, 10 Hz VBW <i>(Option 1DR and 1D5)</i></p> <p>10 Hz RBW, 10 Hz VBW <i>(Option 1DR)</i></p> <p>System-Related Sidebands, offset from CW signal</p> <p>≥30 kHz</p> <p>Line-Related Sidebands, offset from CW signal <i>(Option 1DR)</i></p> | <p>≤ -90 dBc/Hz</p> <p>≤ -100 dBc/Hz</p> <p>≤ -102 dBc/Hz</p> <p>≤ -112 dBc/Hz</p> <p>≤150 Hz p-p in 100 ms</p> <p>≤100 Hz p-p in 100 ms</p> <p>≤2 Hz p-p in 20 ms</p> <p>≤ -65 dBc</p> | <p>≤10 Hz p-p in 20 ms, characteristic</p> |

| | Specifications | Supplemental Information |
|-------------------|----------------|--------------------------------|
| <300 Hz | | ≤ -50 dBc, characteristic |
| >300 Hz to 30 kHz | | ≤ -55 dBc, characteristic |

Noise Sidebands Normalized to 1 Hz Versus Offset From Carrier



wl73b

Amplitude

Amplitude specifications do not apply for the negative peak detector mode.

| | Specifications | Supplemental Information |
|--------------------------|---|--------------------------|
| Measurement Range | Displayed Average Noise Level to Maximum Safe Input Level | |
| Input Attenuator Range | 0 to 60 dB, in 5 dB steps | |

| | Specifications | Supplemental Information |
|--|------------------|--|
| Maximum Safe Input Level | | |
| Input attenuator setting ≥ 15 dB | | Signals $> +33$ dBm (2 W) nominal may trigger input protection, which disconnects the input path. (75 Ω : signals $> +79$ dBmV (1 W)) |
| Average Continuous Power or Peak Pulse Power | | |
| 50 Ω | +30 dBm (1 W) | |
| 75 Ω (Option 1DP) | +75 dBmV (0.4 W) | |
| dc | 100 Vdc | dc transients may momentarily trigger input protection |
| Input attenuator setting < 15 dB | | Signals $> +6$ dBm (4 mW) nominal may trigger input protection, which automatically increases input attenuation to 15 dB. (75 Ω : signals $> +61$ dBmV (15 mW)) |
| Average Continuous Power or Peak Pulse Power | | |
| 50 Ω | +3 dBm (2 mW) | |
| 75 Ω (Option 1DP) | +59 dBmV (10 mW) | |
| dc | 100 Vdc | dc transients may trigger input protection |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| 1 dB Gain Compression | | |
| Total power at input mixer ^{ab} | | |
| 50 MHz to 1.5 GHz | | |
| 50 Ω | 0 dBm | |

| | Specifications | Supplemental Information |
|--|----------------|---|
| 75 Ω (Option 1DP) Preamp On (Option 1DS) Total power at the preamp ^c 50 Ω 75 Ω | +46.75 dBmV | -20 dBm, characteristic 26.75 dBmV, characteristic |

- a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).
- b. For resolution bandwidths 1 kHz to 30 kHz, the maximum input signal amplitude must be \leq reference level +10 dB. (Option 1DP: For resolution bandwidths 1 kHz to 30 kHz, the maximum input signal amplitude must be \leq reference level +5 dB).
- c. Total power at the preamp = total power at the input (dBm).

| | Specifications | | Supplemental Information |
|---|------------------------|---------------------------------------|--------------------------|
| Displayed Average Noise Level (Input terminated, 0 dB attenuation, sample detector, Reference Level = -70 dBm) (75 Ω : Reference Level = -21.24 dBmV) | | | |
| 50 Ω | 1 kHz RBW 30 Hz VBW | 10 Hz RBW 1 Hz VBW (Option 1DR) | |
| 400 kHz to 10 MHz | ≤ -115 dBm | ≤ -134 dBm | |
| 10 MHz to 500 MHz | ≤ -119 dBm | ≤ -138 dBm | |
| 500 MHz to 1.0 GHz | ≤ -117 dBm | ≤ -136 dBm | |
| 1.0 GHz to 1.5 GHz | ≤ -113 dBm | ≤ -132 dBm | |
| 50 Ω , Preamp On (Option 1DS) | 1 kHz RBW 30 Hz VBW | 10 Hz RBW 1 Hz VBW (Option 1DR) | |
| 400 kHz to 10 MHz | ≤ -131 dBm | ≤ -149 dBm | |
| 10 MHz to 500 MHz | ≤ -135 dBm | ≤ -153 dBm | |
| 500 MHz to 1.0 GHz | ≤ -133 dBm | ≤ -151 dBm | |
| 1.0 GHz to 1.5 GHz | ≤ -129 dBm | ≤ -147 dBm | |
| 75 Ω , (Option 1DP) | 1 kHz RBW 30 Hz VBW | 10 Hz RBW 1 Hz VBW (Option 1DR) | |
| 1 MHz to 10 MHz | ≤ -63 dBmV | ≤ -82 dBmV | |

Agilent E4401B Specifications and Characteristics
Amplitude

| | Specifications | | Supplemental Information |
|---|------------------------|---------------------------------------|---------------------------------|
| 10 MHz to 500 MHz | ≤ -65 dBmV | ≤ -84 dBmV | |
| 500 MHz to 1.0 GHz | ≤ -60 dBmV | ≤ -79 dBmV | |
| 1.0 GHz to 1.5 GHz | ≤ -53 dBmV | ≤ -72 dBmV | |
| 75 Ω Preamp On (Option 1DP and 1DS) | 1 kHz RBW 30 Hz VBW | 10 Hz RBW 1 Hz VBW (Option 1DR) | |
| 1 MHz to 10 MHz | ≤ -80 dBmV | ≤ -98 dBmV | |
| 10 MHz to 500 MHz | ≤ -81 dBmV | ≤ -99 dBmV | |
| 500 MHz to 1.0 GHz | ≤ -76 dBmV | ≤ -94 dBmV | |
| 1.0 GHz to 1.5 GHz | ≤ -69 dBmV | ≤ -87 dBmV | |

| | Specifications | | Supplemental Information |
|--------------------------------|---|--|---------------------------------|
| Display Range | | | |
| Log Scale | Ten divisions displayed; 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps | | |
| RBW \geq 1 kHz | Calibrated 0 to -85 dB from Reference Level | | |
| RBW \leq 300 Hz (Option 1DR) | Calibrated 0 to -120 dB ^a from Reference Level | | |
| Linear Scale | Ten divisions | | |
| Scale Units (Option BAA) | dBm, dBmV, dB μ V, V, and W Add Hz | | |

a. 0 to -70 dB range when span = 0 Hz, or when auto ranging is off:
(:DISPlay:WINDow:TRACe:Y[:SCALe]:LOG:RANGe:AUTO OFF).

| | Specifications | | Supplemental Information |
|--|-----------------------|--|---------------------------------|
| Marker Readout Resolution | | | |
| Log scale | | | |
| RBW \geq 1 kHz 0 to -85 dB from ref level | 0.04 dB | | |
| RBW \leq 300 Hz | | | |

| | Specifications | Supplemental Information |
|--|---|--------------------------|
| 0 to -120 dB from ref level Linear scale Fast Sweep Times for Zero Span <i>(Option AYY)^a</i> 5 μs to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ Log 0 to -85 dB from ref level Linear | 0.04 dB 0.01% of Reference Level 0.3 dB 0.3% of Reference Level for linear scale | |

a. For firmware revisions prior to A.04.00, 20 μs to <5 ms.

| | Specifications | Supplemental Information |
|--|--|--|
| Frequency Response 50 Ω, Absolute ^a /Relative 9 kHz to 1.5 GHz 10 dB attenuation 20 to 30 °C 0 to 55 °C 0 dB, 5 dB, 15 to 60 dB attenuation 50 Ω, Absolute ^a /Relative Preamp On (<i>Option 1DS</i>) 100 kHz to 1.5 GHz 0 dB attenuation 20 to 30 °C 0 to 55 °C 5 dB to 20 dB attenuation 75 Ω, Absolute ^a /Relative (<i>Option 1DP</i>) 1 MHz to 1.5 GHz 10 dB attenuation | ±0.5 dB ±1.0 dB ±1.0 dB ±1.0 dB ±1.5 dB ±1.5 dB | ±1.0 dB, characteristic ±1.5 dB, characteristic |

Agilent E4401B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| 20 to 30 °C | ±0.5 dB | |
| 0 to 55 °C | ±1.0 dB | |
| 0, 5, 15 to 50 dB attenuation | | ±1.0 dB, characteristic |
| 55 to 60 dB attenuation | | |
| 1 MHz to 1 GHz | | ±1.0 dB, characteristic |
| 1 GHz to 1.5 GHz | | ±1.25 dB, characteristic |
| 75 Ω Absolute ^a /Relative Preamp On (<i>Option 1DS</i> and <i>1DP</i>) | | |
| 1 MHz to 1.5 GHz | | |
| 0 dB attenuation | | |
| 20 to 30 °C | ±1.5 dB | |
| 0 to 55 °C | ±2.0 dB | |
| 5 dB to 20 dB attenuation | | ±2.0 dB, characteristic |

a. Absolute flatness values are referenced to the amplitude at 50 MHz.

| | Specifications | Supplemental Information |
|--|--|--------------------------|
| Input Attenuation Switching Uncertainty at 50 MHz | | |
| Attenuator Setting | | |
| 0 dB to 5 dB | ±0.3 dB | |
| 10 dB | Reference | |
| 15 dB | ±0.3 dB | |
| 20 to 60 dB attenuation | ±(0.1 dB + 0.01 × Attenuator Setting) | |

| | Specifications | Supplemental Information |
|-----------------------------------|----------------|---|
| Preamp (<i>Option 1DS</i>) | | Refer also to Displayed Average Noise Level specification |
| Gain | | +20 dB, nominal ^a |
| Noise figure | | 4 dB, characteristic |

a. Amplifier is before the input attenuator.

| | Specifications | Supplemental Information |
|--|---|---------------------------------|
| Absolute Amplitude Accuracy | | |
| At reference settings ^a | ±0.34 dB | |
| Preamp On ^b (<i>Option 1DS</i>) | ±0.5 dB | |
| Overall Amplitude Accuracy ^c | | |
| 20 to 30 °C | ± (0.54 dB + Absolute Frequency Response) | |

- a. Settings are: reference level -25 dBm; (75 Ω reference level +28.75 dBmV); input attenuation 10 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, sample detector; signal at reference level.
- b. Settings are: reference level -30 dBm; (75 Ω reference level +18.75 dBmV); input attenuation 0 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, signal at reference level.
- c. For reference level 0 to -50 dBm; input attenuation 10 dB; RBW 1 kHz; VBW 1 kHz; scale log, log range 0 to -50 dB from reference level; sweep time coupled; signal input 0 to -50 dBm; span ≤20 kHz.

| | Specifications | Supplemental Information |
|---|-----------------------|---|
| RF Input VSWR (at tuned frequency) | | |
| Attenuator setting | | |
| 50 Ω | | |
| 0 to 5 dB attenuation | | ≤1.55:1, characteristic |
| 10 to 60 dB attenuation | | ≤1.35:1, characteristic |
| 75 Ω | | |
| 1 MHz to 1.1 GHz | | |
| 0 to 5 dB attenuation | | ≤1.55:1, characteristic |
| 10 to 60 dB attenuation | | ≤1.35:1, characteristic |
| 1.1 GHz to 1.5 GHz | | |
| 0 to 60 dB attenuation | | ≤2.0:1, characteristic |
| Input protection is tripped | | Open input, characteristic |
| Amptd Ref is On | | Open input, characteristic |
| Auto Align All is selected | | Open input momentarily during retrace, characteristic |

Agilent E4401B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| Auto Alignment^a Sweep-to-sweep variation | | ±0.1 dB, characteristic |

a. Set Auto Align to Off and use Align Now, All to eliminate this variation.

| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| Resolution Bandwidth Switching Uncertainty (at Reference Level) | | |
| 1 kHz RBW | Reference | |
| 3 kHz to 3 MHz RBW | ±0.3 dB | |
| 5 MHz RBW | ±0.6 dB | |
| 10 Hz to 300 Hz RBW (Option 1DR) | ±0.3 dB | |

| | Specifications | Supplemental Information |
|---|--|--------------------------|
| Reference Level | | |
| Range | -149.9 dBm to maximum mixer level + attenuator setting | |
| Resolution | | |
| Log Scale | ±0.1 dB | |
| Linear Scale | ±0.12% of Reference Level | |
| 50 Ω Accuracy (at a fixed frequency, a fixed attenuator, and referenced to -35 dBm (-10 dBm, Preamp On (Option 1DS)) | | |
| Reference Level (dBm) – input attenuator setting (dB) + preamp gain (dB) | | |
| -10 dBm to > -60 dBm | ±0.3 dB | |
| -60 dBm to > -85 dBm | ±0.5 dB | |
| -85 dBm to -90 dBm | ±0.7 dB | |

| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| <p>75 Ω (<i>Option 1DP</i>), Accuracy (at a fixed frequency, a fixed attenuator, and referenced to 18.75 dBmV (38.75 dBmV, Preamp On (<i>Option 1DS</i>)))</p> <p>Reference Level (dBmV) – input attenuator setting (dB) + preamp gain (dB)</p> <p>38.75 dBmV to > -11.25 dBmV</p> <p>-11.25 dBmV to > -26.25 dBmV</p> <p>-26.25 dBmV to -41.25 dBmV</p> | <p>± 0.3 dB</p> <p>± 0.5 dB</p> <p>± 0.7 dB</p> | |

| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| <p>Display Scale Switching Uncertainty</p> <p>Switching between Linear and Log</p> <p>Log Scale Switching</p> | <p>± 0.15 dB at Reference Level</p> <p>No error</p> | |

| | Specifications | Supplemental Information |
|---|---|--|
| <p>Display Scale Fidelity</p> <p>Log Maximum Cumulative</p> <p>0 to -85 dB from Reference Level</p> <p>RBW \leq 300 Hz (<i>Option 1DR</i>)</p> <p>Span > 0 Hz</p> <p>0 to -98 dB from Reference Level</p> <p>-98 to -120 dB from Reference Level</p> | <p>$\pm(0.3 \text{ dB} + 0.01 \times \text{dB from Reference Level})$</p> <p>$\pm(0.3 \text{ dB} + 0.01 \times \text{dB from Reference Level})$</p> | <p>$\pm 2.0$ dB, characteristic</p> |

Agilent E4401B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|---|---|--------------------------|
| Span = 0 Hz ^a | | |
| 0 to -60 dB from Reference Level | $\pm(0.3 \text{ dB} + 0.015 \times \text{dB from Reference Level})$ | |
| -60 to -70 dB from Reference Level | $\pm 1.5 \text{ dB}$ | |
| Log Incremental Accuracy | | |
| 0 to -80 dB ^b from reference level | $\pm 0.4 \text{ dB}/4 \text{ dB}$ | |
| Linear Accuracy | $\pm 2\%$ of Reference Level | |

a. or when auto ranging is off: (:DISPlay:WINDow:TRACe:Y[:SCALe]:LOG:RANGe:AUTO OFF)

b. 0 to -50 dB for RBWs \leq 300 Hz and span = 0 Hz, or when auto ranging is off.

| | Specifications | Supplemental Information |
|---|--|---|
| Spurious Responses | | |
| 50 Ω | | |
| Second Harmonic Distortion | | |
| Input Signal | | |
| 2 MHz to 750 MHz | $< -75 \text{ dBc}$ for -40 dBm signal at input mixer. ^a | +35 dBm SHI (second harmonic intercept) |
| Preamp On (<i>Option 1DS</i>) 2 MHz to 750 MHz | | 0 dBm SHI, characteristic |
| Third Order Intermodulation Distortion | | |
| 2 MHz to 10 MHz | | +5 dBm TOI (third order intercept), characteristic |
| 10 MHz to 1.5 GHz | $< -80 \text{ dBc}$ for two -30 dBm signals at input mixer ^a and $> 50 \text{ kHz}$ separation. | +10 dBm TOI +15 dBm TOI, typical, 20 to 30 °C |
| Preamp On (<i>Option 1DS</i>), 10 MHz to 1.5 GHz | | -16 dBm TOI, characteristic |
| Other Input Related Spurious | | |
| 30 kHz \leq offset \leq 1200 MHz | $< -65 \text{ dBc}$ for -20 dBm signals at input mixer ^a $\leq 1.5 \text{ GHz}$. | |

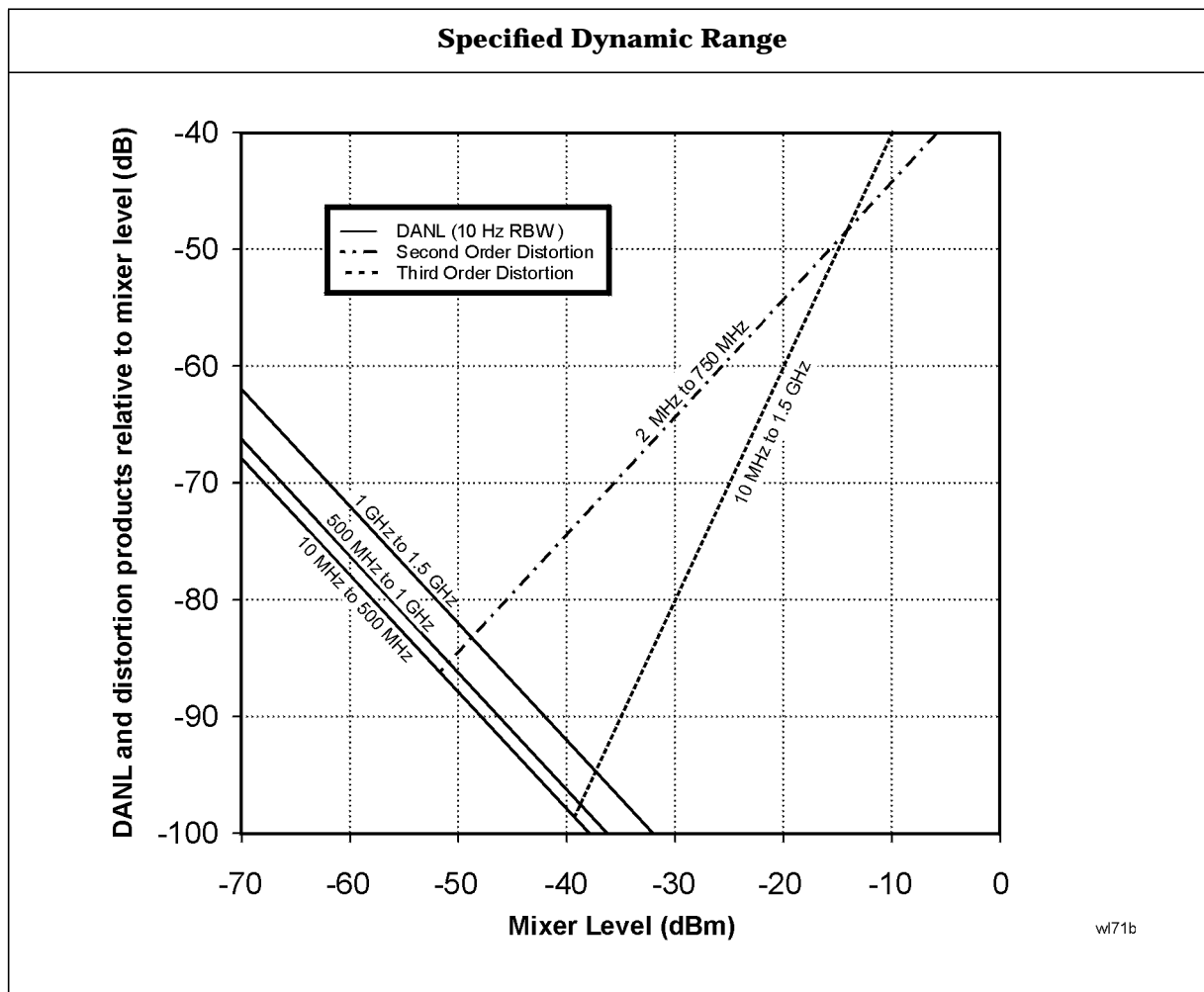
| | Specifications | Supplemental Information |
|--|--|--|
| Offset >1200 MHz Noise Floor Degradation Input frequency = 1210.7 MHz ± RBW | < -45 dBc for -20 dBm signal at input mixer ^a ≤1.5 GHz. | < -62 dBc for -45 dBm signal at input mixer ^a |

a. Mixer Power Level (dBm) = Input Power (dBm) – Input Attenuation (dB).

| | Specifications | Supplemental Information |
|--|--|---|
| Spurious Responses 75 Ω, (Option 1DP) Second Harmonic Distortion Input signal 2 MHz to 750 MHz Preamp On (Option 1DS), 2 MHz to 750 MHz Third Order Intermodulation Distortion 10 MHz to 1.5 GHz Preamp On (Option 1DS), 10 MHz to 1.5 GHz Other Input Related Spurious 30 kHz ≤ offset ≤1200 MHz Offset >1200 MHz Noise Floor Degradation | < -75 dBc for +8.75 dBmV signal at input mixer. ^a < -80 dBc for two +18.75 dBmV signals at input mixer ^a and >50 kHz separation. < -65 dBc for +28.75 dBmV signal at input mixer ^a ≤1.5 GHz. < -45 dBc, for +28.75 dBmV signal at input mixer ^a ≤1.5 GHz. | < -40 dBc for with 0 dB input attenuation, characteristic < -28 dBc for two +18.75 dBmV signals at the Input with 0 dB input attenuation and > 50 kHz separation, characteristic |

| | Specifications | Supplemental Information |
|---------------------------------------|----------------|---|
| Input frequency = 1210.7 MHz ± RBW | | < -62 dBc, for +3.75 dBmV signal at input mixer ^a |

a. Mixer Power Level (dBm) = Input Power (dBm) – Input Attenuation (dB)



| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| Residual Responses (Input terminated and 0 dB attenuation) | | |
| 50 Ω | | |
| 150 kHz to 1.5 GHz | < -90 dBm | |
| 75 Ω, (Option 1DP) | | |
| 1 MHz to 1.5 GHz | < -36 dBmV | |

Options

Time Gated Spectrum Analysis (Option 1D6)

| | Specifications | Supplemental Information |
|---|---|---|
| Gate Delay | | |
| Range | 1 μ s to 400 s | |
| Accuracy | $\pm(500 \text{ ns} + (0.01\% \times (\text{maximum of gate delay or length})))$ | From gate trigger input to positive edge of gate output |
| Gate Length | | |
| Range | 1 μ s to 400 s | |
| Accuracy | $\pm(500 \text{ ns} + (0.01\% \times (\text{maximum of gate delay or length})))$ | From positive edge to negative edge of gate output |
| Resolution | $((\text{maximum of gate delay or length in seconds})/65000)$ rounded up to nearest μ s | Dependent on the greater of gate delay or gate length |
| Additional Amplitude Error^a | | |
| Log Scale | $\pm 0.2 \text{ dB}$ | |
| Linear Scale | $\pm 0.1\%$ of reference level | |

a. While in gate mode.

Tracking Generator (Option 1DN or 1DQ)

| | Specifications | Supplemental Information |
|----------------|----------------|--------------------------|
| Warm-Up | 5 minutes | |

| | Specifications | Supplemental Information |
|-------------------------------|------------------|--------------------------|
| Output Frequency Range | | |
| 50 Ω (Option 1DN) | 9 kHz to 1.5 GHz | |
| 75 Ω (Option 1DQ) | 1 MHz to 1.5 GHz | |

| | Specifications | Supplemental Information |
|------------------------------|----------------|--|
| Minimum Resolution BW | 1 kHz | Not usable with resolution bandwidths ≤ 300 Hz (Option 1DR) |

| | Specifications | Supplemental Information |
|---|-----------------------|--------------------------|
| Output Power Level | | |
| Range | | |
| 50 Ω (Option 1DN) | | |
| 0 to 55 $^{\circ}\text{C}$ | 0 to -70 dBm | |
| 20 to 30 $^{\circ}\text{C}$ | 2 to -70 dBm | |
| 75 Ω (Option 1DQ) | +42.75 to -27.25 dBmV | |
| Resolution | 0.1 dB | |
| Absolute Accuracy (at 50 MHz with coupled source attenuator) | | |
| 50 Ω (Option 1DN) referenced to 0 dBm | ± 0.5 dB | |
| 75 Ω (Option 1DQ) referenced to +42.75 dBmV | ± 1.5 dB | |
| Vernier | | |
| Range | 10 dB | |
| Accuracy (with coupled source attenuator) | | |

| | Specifications | Supplemental Information |
|--|---------------------------------------|---------------------------------|
| 50 Ω (<i>Option 1DN</i>) referenced to 0 dBm | ±0.75 dB, for 0 to –10 dBm | |
| 75 Ω (<i>Option 1DQ</i>) referenced to 42.75 dBmV | ±0.9 dB, for +42.75 to +32.75 dBmV | |
| Output Attenuator Range | 0 to 60 dB in 10 dB steps | |

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| Maximum Safe Reverse Level | | |
| 50 Ω (<i>Option 1DN</i>) ^a | | +20 dBm (0.1 W), 100 Vdc, characteristic |
| 75 Ω (<i>Option 1DQ</i>) ^a | | +69 dBmV (0.1 W), 100 Vdc, characteristic |

a. dc transients may trigger reverse power protection.

| | Specifications | Supplemental Information |
|-----------------------------|--|---------------------------------|
| Output Power Sweep | | |
| Range | | |
| 50 Ω (<i>Option 1DN</i>) | (–15 to 0 dBm) – (Source Attenuator Setting) | |
| 75 Ω (<i>Option 1DQ</i>) | (27.75 to 42.75 dBmV) – (Source Attenuator Setting) | |
| Resolution | 0.1 dB | |
| Accuracy (zero span) | | |
| 50 Ω (<i>Option 1DN</i>) | <1.5 dB peak-to-peak | |
| 75 Ω (<i>Option 1DQ</i>) | <1.8 dB peak-to-peak | |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| Output Flatness | | |
| Referenced to 50 MHz, 0 dB attenuator | | |
| 50 Ω (<i>Option 1DN</i>) | | |
| 9 kHz to 10 MHz | ±2 dB | |
| 10 MHz to 1.5 GHz | ±1.5 dB | |

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Options

| | Specifications | Supplemental Information |
|---|--------------------------------|---------------------------------|
| 75 Ω (<i>Option 1DQ</i>) 1 MHz to 10 MHz 10 MHz to 1.5 GHz | ± 2.5 dB ± 2 dB | |

| | Specifications | Supplemental Information |
|--|---|---------------------------------|
| Spurious Outputs 50 Ω (<i>Option 1DN</i>) (0 dBm output), 75 Ω (<i>Option 1DQ</i>) (+42.75 dBmV output) Harmonic Spurs 9 kHz to 20 MHz 20 MHz to 1.5 GHz Non-harmonic Spurs | < -20 dBc < -25 dBc < -35 dBc | |

| | Specifications | Supplemental Information |
|----------------------|--|---------------------------------|
| Dynamic Range | Maximum Output Power Level – Displayed Average Noise Level | |

| | Specifications | Supplemental Information |
|---|-----------------------|---|
| Output Tracking Drift Swept Tracking Error | | No error No error for coupled sweep times |

| | Specifications | Supplemental Information |
|---|-----------------------|---|
| RF Power-Off Residuals 50 Ω (<i>Option 1DN</i>) 100 kHz to 1.5 GHz 75 Ω (<i>Option 1DQ</i>) 1 MHz to 1.5 GHz | | < -120 dBm, characteristic < 65 dBmV, characteristic |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| Output Attenuator Repeatability | | ±0.2 dB, characteristic |

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| Output VSWR 50 Ω (<i>Option 1DN</i>) 75 Ω (<i>Option 1DQ</i>) | | <2.5:1, characteristic <2.0:1, characteristic |

| | Specifications | Supplemental Information |
|-----------------------------------|-----------------------|---------------------------------|
| Output Attenuator Accuracy | | |
| 0 dB | Reference | |
| 10 dB | | ±0.6 dB, characteristic |
| 20 dB | | ±0.9 dB, characteristic |
| 30 dB | | ±1.2 dB, characteristic |
| 40 dB | | ±1.5 dB, characteristic |
| 50 dB | | ±1.8 dB, characteristic |
| 60 dB | | ±2.1 dB, characteristic |

| Tracking Generator Output Accuracy 50 Ω (Option 1DN) |
|--|
| Relative Accuracy (Referred to 0 dBm) = Output Attenuator Accuracy + Vernier Accuracy + Output Flatness |
| Absolute Accuracy = Relative Accuracy (Referred to 0 dBm) + Absolute Accuracy at 50 MHz |

| Tracking Generator Output Accuracy 75 Ω (Option 1DQ) |
|--|
| Relative Accuracy (Referred to +42.75 dBmV) = Output Attenuator Accuracy + Vernier Accuracy + Output Flatness |
| Absolute Accuracy = Relative Accuracy (Referred to +42.75 dBmV) + Absolute Accuracy at 50 MHz |

FM Demodulation (Option BAA)

The FM demodulation characteristics will be met after an **Align Now**, **FM Demod** has been run.

| | Specifications | Supplemental Information |
|---|----------------|--|
| Input Level | | $\geq (-60 \text{ dBm} + \text{attenuator setting} - \text{preamp gain})$, characteristic |
| Signal Level | | 0 to -30 dB below reference level, characteristic |
| FM Deviation | | |
| Range | | 10 kHz to 1 MHz |
| Resolution | | Provides 1 Hz display annotation resolution |
| FM Deviation Range | | |
| 10 kHz to 40 kHz | | 12 Hz, characteristic |
| $>40 \text{ kHz}$ to 200 kHz | | 60 Hz, characteristic |
| $>200 \text{ kHz}$ to 1 MHz | | 300 Hz, characteristic |
| Accuracy ^a | | |
| FM Rate $< \text{FM BW}/100$, | | $< (2\% \text{ of FM deviation range} + 2 \times \text{Resolution})$, characteristic |
| VBW $\geq (30 \times \text{FM Rate})$, | | |
| RBW $>$ the maximum of | | |
| $(30 \times \text{FM deviation})$ or | | |
| $(30 \times \text{FM Rate})$ | | |
| Offset Error ^a | | 5% of FM Deviation Range + 300 Hz, characteristic |
| FM Bandwidth (-3 dB) | | |
| FM Deviation Range | | |
| 10 kHz to 40 kHz | | $7.5 \times \text{FM deviation range}$, characteristic |
| $>40 \text{ kHz}$ to 200 kHz | | $1.3 \times \text{FM deviation range}$, characteristic |
| $>200 \text{ kHz}$ to 1 MHz | | $0.3 \times \text{FM deviation range}$, characteristic |

a. In time domain sweeps (span = 0 Hz).

TV Trigger and Picture On Screen (Option B7B)

Option BAA is required.

| | Specifications | Supplemental Information |
|---|---|--|
| TV Trigger and Picture On Screen | | TV Trigger initiates a sweep of the analyzer after the sync pulse of a selected line of a TV video field. Picture On Screen displays the TV picture on the analyzer display. |
| Amplitude Requirements TV Source: SA | | Top 50% of linear display, characteristic |
| TV Source: EXT VIDEO IN | | 500 mVp-p to 2 Vp-p, characteristic |
| Compatible Standards | NTSC-M, NTSC-Japan, PAL-M, PAL-B,D,G,H,I, PAL-N, PAL-N Combination, SECAM-L | |
| Field Selection | Entire frame, even, odd | |
| Sync Polarity | Positive or negative | |
| TV Trigger | | |
| Line Selection | 1 to 525, or 1 to 625, standard dependent | |

General

| | Specifications | Supplemental Information |
|--------------------------|----------------|--------------------------|
| Temperature Range | | |
| Operating | 0 to 55 °C | Floppy disk 10 to 40 °C |
| Storage | -40 to 75 °C | |

| | Specifications | Supplemental Information |
|---------------------------------|----------------|----------------------------|
| Audible Noise (ISO 7779) | | |
| Sound Pressure at 25 °C | | <40 dBa, (<4.6 Bels power) |

| | Specifications | Supplemental Information |
|-------------------------------|---|--------------------------|
| Military Specification | Has been type tested to the environmental specifications of MIL-PRF-28800F class 3. | |

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

| | Specifications | Supplemental Information |
|-------------------------|----------------|--|
| Immunity Testing | | |
| Radiated Immunity | | Testing was done at 3 V/m according to IEC 801-3/1984. When the analyzer tuned frequency is identical to the immunity test signal frequency there may be signals of up to -60 dBm displayed on the screen. |
| Electrostatic Discharge | | Air discharges of up to 8 kV were applied according to IEC 801-2/1991. Discharges to center pins of any of the connectors may cause damage to the associated circuitry. |

| | Specifications | Supplemental Information |
|----------------------------|--|---|
| Power Requirements | | Uses CUKonverter® topology in the power supply. |
| ac Operation | | |
| Voltage, frequency | 90 to 132 V rms, 47 to 440 Hz 195 to 250 V rms, 47 to 66 Hz | |
| Power Consumption, On | <300 W | |
| Power Consumption, Standby | <5 W | |
| dc Operation | | |
| Voltage | 12 to 20 Vdc | |
| Power Consumption | <200 W | |

| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| Measurement Speed | | |
| Local Measurement and Display Update rate ^{ab} | | |
| Sweep points = 101 | | ≥ 50/s, characteristic |
| Sweep points = 401 | | ≥ 35/s, characteristic |
| Remote Measurement and GPIB Transfer Rate ^{bcd} (Option A4H) | | |
| Sweep points = 101 | | ≥ 45/s, characteristic |
| Sweep points = 401 | | ≥ 30/s, characteristic |
| RF Center Frequency Tune, Measure, and GPIB Transfer Time ^{bce} (Option A4H) | | |
| Sweep points = 101 | | ≤ 75 ms, characteristic |
| Sweep points = 401 | | ≤ 90 ms, characteristic |

- a. Factory preset, auto align Off, fixed center frequency, RBW = 1 MHz, and span ≤400 MHz.
- b. Sweeping through 425.6 MHz or 914.6 MHz will cause measurement speed to degrade
- c. Display Off (:DISPlay:ENABle OFF), and 32-bit integer data format (:FORMat:DATA INT,32), if Option A YX or A $4J$ is installed, disable sweep ramp, (:SYStem:PORTs:IFVSweep:ENABle OFF), markers off, single sweep, measured with IBM compatible PC with 550 MHz Pentium® III running Windows® NT 4.0, one meter GPIB cable, National Instruments PCI-GPIB card and NI-48.2 DLL.
- d. Factory preset, auto align Off, RBW = 1 MHz, span= 20 MHz, fixed center frequency, average of 100 measurements.
- e. Factory preset, auto align Off, RBW = 1 MHz, span= 20 MHz, and center frequency tune step size = 50 MHz.

Agilent E4401B Specifications and Characteristics
General

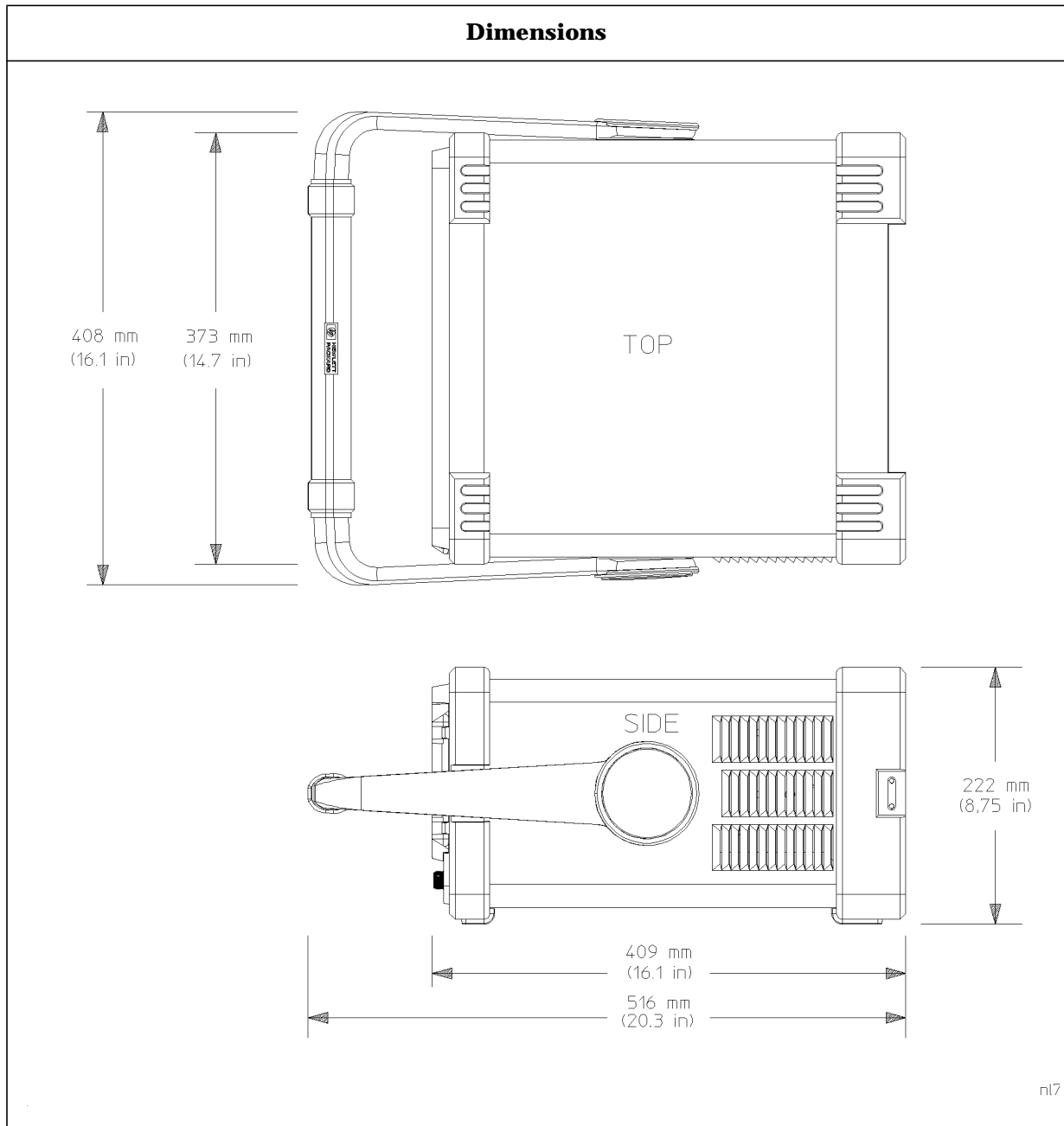
| | Specifications | Supplemental Information |
|--|-----------------------|--|
| Data Storage Internal External (10 to 40 °C) 3.5" 1.44 MB, MS-DOS® compatible floppy disk | | 200 Traces or States ^a 200 Traces or States ^a |

a. When storing traces set to 401 points.

| | Specifications | Supplemental Information |
|---|-----------------------|---|
| Downloadable Program Memory <i>(Option B72)</i> | | 2 MB available memory 10 MB available memory |

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| Demod Tune and Listen Demod <i>(Option BAA)</i> <i>(Option A4J, AYX, or BAA)</i> | AM Add FM | Internal speaker, front-panel earphone jack and front-panel volume control. An uncalibrated demodulated signal is available on the AUX VIDEO OUT or EXT VIDEO OUT connectors at the rear panel. |

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| Weight (without options) Net Shipping | | 13.2 kg (29.1 lb), characteristic 25.1 kg (55.4 lb), characteristic |



Inputs and Outputs

Internal

| | Specifications | Supplemental Information |
|---|----------------|--|
| Amptd Ref^a | | Amplitude reference |
| Frequency | | 50 MHz |
| Frequency Accuracy | | Frequency reference error ^b |
| 50 Ω Amplitude | | -25 dBm ^c , nominal |
| 75 Ω Amplitude (<i>Option 1DP</i>) | | +28.75 dBmV ^c , nominal |

- a. Turn the amplitude reference signal on/off by pressing the keys: **Input/Output**, **Amptd Ref**.
- b. Frequency reference error = (aging rate \times period of time since adjustment + settability + temperature stability).
- c. The internal amplitude reference actual power is stored internally.

Front Panel

| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| INPUT 50 Ω | | |
| Connector | Type-N female | |
| Impedance | | 50 Ω , nominal |
| INPUT 75 Ω (<i>Option 1DP</i>) | | |
| Connector | BNC female | |
| Impedance | | 75 Ω , nominal |

| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| RF OUT 50 Ω, (<i>Option 1DN</i>) | | |
| Connector | Type-N female | |
| Impedance | | 50 Ω , nominal |
| RF OUT 75 Ω, (<i>Option 1DQ</i>) | | |
| Connector | BNC female | |
| Impedance | | 75 Ω , nominal |

| | Specifications | Supplemental Information |
|---------------------------------------|----------------|--|
| PROBE POWER Voltage/Current | | +15 Vdc, $\pm 7\%$ at 150 mA max., characteristic -12.6 Vdc $\pm 10\%$ at 150 mA max., characteristic |

| | Specifications | Supplemental Information |
|--|------------------------|---|
| EXT KEYBOARD^a Connector | 6-pin mini-DIN | Used for entering screen titles and filenames only. Interface compatible with most IBM-compatible PC keyboards. |

a. The feature is not implemented in firmware revisions prior to A.04.00.

| | Specifications | Supplemental Information |
|----------------|----------------|----------------------------------|
| Speaker | | Front panel knob controls volume |

| | Specifications | Supplemental Information |
|---|--|--|
| Headphone Connector Power Output | 3.5 mm (1/8 inch) miniature audio jack | Front panel knob controls volume 0.2 W into 4 Ω , characteristic |

Rear Panel

| | Specifications | Supplemental Information |
|---|----------------|---|
| 10 MHz REF OUT Connector Impedance Output Amplitude | BNC female | 50 Ω , nominal >0 dBm, characteristic |

Agilent E4401B Specifications and Characteristics
Inputs and Outputs

| | Specifications | Supplemental Information |
|-----------------------|-----------------------|---|
| 10 MHz REF IN | | |
| Connector | BNC female | Note: Analyzer noise sidebands and spurious response performance may be affected by the quality of the external reference used. |
| Impedance | | 50 Ω , nominal |
| Input Amplitude Range | | -15 to +10 dBm, characteristic |
| Frequency | | 10 MHz, nominal |

| | Specifications | Supplemental Information |
|---|-----------------------|---|
| GATE TRIG/EXT TRIG IN | | |
| Connector | BNC female | |
| External Trigger Input | | |
| Trigger Level | | Selectable positive or negative edge initiates sweep in EXT TRIG mode (5 V TTL) |
| Gate Trigger Input (<i>Option 1D6</i>) | | |
| Minimum Pulse Width | | >30 ns (5 V TTL) |

| | Specifications | Supplemental Information |
|-----------------------------------|-----------------------|--|
| GATE/HI SWP OUT | | |
| Connector | BNC female | |
| High Sweep Output | | |
| Level | | High = sweep; Low = retrace (5 V TTL) |
| Gate Output (<i>Option 1D6</i>) | | |
| Level | | High = gate on; Low = gate off (5 V TTL) |

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

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------------|
| AUX IF OUT <i>(Option A4J or AXX)</i> | | |
| Connector | BNC female | RBW ≥ 1 kHz |
| Frequency | | 21.4 MHz, nominal |
| Amplitude Range (for signal at reference level and for reference levels – input attenuation + preamp gain of –10 to –70 dBm) | | –10 dBm (uncorrected), characteristic |
| Impedance | | 50 Ω, nominal |

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| AUX VIDEO OUT <i>(Option A4J or AXX)</i> | | |
| Connector | BNC female | RBW ≥ 1 kHz |
| Amplitude Range (into >10 kΩ) | | 0 to 1 V (uncorrected), characteristic |

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| HI SWP IN <i>(Option A4J or AXX)</i> | | |
| Connector | BNC female | |
| Input | | Open collector, low resets and holds the sweep (5 V TTL) |

Agilent E4401B Specifications and Characteristics
Inputs and Outputs

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| HI SWP OUT <i>(Option A4J or AYX)</i> Connector Output | BNC female | High = sweep, Low = retrace (5 V TTL) |

| | Specifications | Supplemental Information |
|--|-----------------------|------------------------------------|
| SWP OUT <i>(Option A4J or AYX)</i> Connector Amplitude | BNC female | 0 to +10 V ramp, characteristic |

| | Specifications | Supplemental Information |
|---|------------------------|---|
| GPIB Interface <i>(Option A4H)</i> Connector GPIB Codes | IEEE-488 bus connector | SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3 and C28 |

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| Serial Interface <i>(Option 1AX)</i> Connector | 9-pin D-SUB male | RS-232 |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| Parallel Interface <i>(Option A4H or 1AX)</i> Connector | 25-pin D-SUB female | Printer port only |

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| EXT VIDEO IN/TV TRIG OUT^a <i>(Option B7B or BAA)</i> | | EXT VIDEO IN is the Baseband composite video input for TV trigger and picture on screen. TV TRIG OUT is the TV trigger output. |

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| Connector Impedance <i>(Option BAA without Option B7B)</i> <i>(Option BAA with Option B7B)</i> External Video Input Video Amplitude TV Trigger Output Amplitude | BNC Female (75 Ω) | 75 Ω, nominal Feature not implemented 1 V _{p-p} , nominal, characteristic Positive edge indicates start of selected TV line after sync. pulse TTL (0 V and 3.4 V with 75 Ω series resistance), characteristic |

- a. This connector is labelled EXT VIDEO IN on older spectrum analyzers and EXT VIDEO IN/TV TRIG OUT on newer spectrum analyzers.

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| EXT VIDEO OUT <i>(Option B7B or BAA)</i> Connector Impedance <i>(Option BAA without Option B7B)</i> Amplitude <i>(Option BAA with Option B7B)</i> Amplitude TV Source: SA TV Source and EXT VIDEO IN | BNC female (75 Ω) | Baseband video output RBW ≥ 1 kHz 75 Ω, nominal 0 to 1 V (uncorrected), characteristic 0 to 1 V (uncorrected), characteristic Same as level at EXT VIDEO IN/TV TRIG OUT, characteristic |

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 (if accompanied by a year, it is the year when the design was proven).



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)

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 products

Product Name: Spectrum Analyzer

Model Number: HP E4401B, HP E4402B, HP E4403B,
HP E4404B, HP E4405B, HP E4407B,
HP E4408B, HP E4411B

Product Options: This declaration covers all options of the above products.

Conform 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 products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.



Santa Rosa, CA, USA 4 Feb. 2000

Greg Pfeiffer/Quality Engineering Manager

For further information, please contact your local Agilent Technologies sales office, agent or distributor.

Agilent E4401B Specifications and Characteristics
Regulatory Information

About This Chapter

This chapter contains specifications and characteristics for the E4402B spectrum analyzer. The distinction between specifications and characteristics is described as follows.

- Specifications describe the performance of parameters covered by the product warranty. (The temperature range is 0 °C to 55 °C, unless otherwise noted.)
- Characteristics describe product performance that is useful in the application of the product, but is not covered by the product warranty.
- Typical performance describes additional product performance information that is not covered by the product warranty. It is performance beyond an indicated specification, that most units will exhibit.
- Nominal values indicate the expected, but not warranted, value of a parameter.

The following conditions must be met for the analyzer to meet its specifications.

- The analyzer is within the one year calibration cycle.
- If **Auto Align All** is selected:
 - After 2 hours of storage within the operating temperature range.
 - 5 minutes after the analyzer is turned on with sweep times less than 4 seconds.
 - After the front-panel amplitude reference is connected to the INPUT, and **Align Now RF** has been run, after the analyzer is turned on. And, once every 24 hours, or if ambient temperature changes more than 30 °C¹.
- If **Auto Align Off** is selected:
 - When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.
 - After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now All** has been run.

1. 10 °C if Option 1DS is active.

- When **Align Now All** is run:
 - Every hour
 - If the ambient temperature changes more than 3 °C
 - If the 10 MHz reference changes
- When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):
 - Every 24 hours
 - If the ambient temperature changes more than 30 °C¹
- ☐ If **Auto Align All but RF** is selected:
 - When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.
 - After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now RF** has been run.
 - When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):
 - Every hour
 - If the ambient temperature changes more than 3 °C

1. 10 °C if Option 1DS is active.

Frequency

| | Specifications | Supplemental Information |
|---------------------------------|----------------|--------------------------|
| Frequency Range | 9 kHz to 3 GHz | |
| Preamp On (<i>Option 1DS</i>) | 1 MHz to 3 GHz | |

| | Specifications | Supplemental Information |
|----------------------------|------------------------------|---|
| Frequency Reference | | |
| Aging Rate | $\pm 2 \times 10^{-6}$ /year | $\pm 1.0 \times 10^{-7}$ /day, characteristic |
| Settability | $\pm 5 \times 10^{-7}$ | |
| Temperature Stability | $\pm 5 \times 10^{-6}$ | |

| | Specifications | Supplemental Information |
|---|------------------------------|---|
| High Stability Frequency Reference (<i>Option 1D5</i>) | | |
| Aging Rate | $\pm 1 \times 10^{-7}$ /year | $\pm 5 \times 10^{-10}$ /day, 7-day average after being powered on for 7 days, characteristic |
| Settability | $\pm 1 \times 10^{-8}$ | |
| Temperature Stability | | |
| 20 to 30 °C | $\pm 1 \times 10^{-8}$ | |
| 0 to 55 °C | $\pm 5 \times 10^{-8}$ | |
| Warm-Up (Internal frequency reference selected) | | |
| After 5 minutes | | $< \pm 1 \times 10^{-7}$ of final frequency, ^a characteristic |
| After 15 minutes | | $< \pm 1 \times 10^{-8}$ of final frequency, ^a characteristic |

a. Final frequency is defined as frequency 60 minutes after power-on with analyzer set to internal frequency reference.

| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| Frequency Readout Accuracy (Start, Stop, Center, Marker) | $\pm((\text{frequency indication} \times \text{frequency reference error}^a) + 0.5\% \text{ of span} + \frac{\text{span}}{\text{sweep points} - 1} + 15\% \text{ of RBW} + 10 \text{ Hz})$ | |

a. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).

| | Specifications | Supplemental Information |
|--|---|---------------------------------|
| Marker Frequency Counter Resolution Accuracy ^a | Selectable from 1 Hz to 100 kHz $\pm(\text{marker frequency} \times \text{frequency reference error}^b + \text{counter resolution})$ | For RBW ≥ 1 kHz |

a. Marker level to displayed noise level > 25 dB, RBW/ Span ≥ 0.002, frequency offset = 0 Hz.
 b. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).

| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| Frequency Span Range Resolution Accuracy | 0 Hz (zero span), 100 Hz to 3 GHz 2 Hz $\pm(0.5\% \text{ of span} + 2 \times \frac{\text{span}}{\text{sweep points} - 1})$ | |

| | Specifications | Supplemental Information |
|---|-----------------------------|--|
| Sweep Time Range Tracking Generator On (Option 1DN) | 1 ms to 4000 s ^a | $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ to 4000 s 50 ms is the minimum sweep time |

Agilent E4402B Specifications and Characteristics
Frequency

| | Specifications | Supplemental Information |
|---|--|--|
| Fast Time-domain Sweep (Option AYX) (For Span = 0 Hz, RBW ≥ 1 kHz) | 5 μs to 4000 s ^b | $\frac{\text{sweep points} - 1}{20 \text{ MHz}}$ to 4000 s |
| DSP and fast ADC (Option B7D) (For Span = 0 Hz, RBW ≥ 1 kHz) | 2.5 μs to 4000 s | $\frac{\text{sweep points} - 1}{40 \text{ MHz}}$ to 4000 s |
| Accuracy (Span = 0 Hz) | | |
| 1 ms to 4000 s ^a | ±1% | |
| (Option AYX) | ±1% | |
| 5 μs to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ | | |
| (Option B7D) | ±1% | |
| 2.5 μs to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ | | |
| Sweep Trigger ^{cd} | Free Run, Single, Line, Video, External, Delayed, Offset ^e | |
| (Option 1D6) | Add Gate | |
| (Option B7B) | Add TV | |
| Delayed Trigger ^{cf} | | |
| Range | 1 μs to 400 s | |
| Resolution | $\frac{\text{delay in seconds}}{65000}$ rounded up to nearest μs | |
| Accuracy | ±(500 ns +(0.01% of delay)) | |
| Offset Trigger ^e | | |
| Resolution | $\frac{\text{sweep time}}{\text{sweep points} - 1}$ | |
| Range | ±320 ms to ±323 ks | Where ST = sweep time and SP = sweep points $\frac{-32766 \times ST}{SP - 1}$ to $\frac{(32766 - SP) \times ST}{SP - 1}$ |

| | Specifications | Supplemental Information |
|--|---|--|
| Fast Time-domain sweep <i>(Option AYX)</i> (For sweep times 5.0 μ s to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$) | $\pm 1.64 \text{ ms}$ to $\pm 249 \text{ ms}$ | $\frac{-32766 \times ST}{SP - 1}$ to $\frac{(32766 - SP) \times ST}{SP - 1}$ |
| DSP and fast ADC <i>(Option B7D)</i> (For sweep times 2.5 μ s to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$) | $\pm 3 \text{ ms}$ to $\pm 5.15 \text{ s}$ | $\frac{-524031 \times ST}{SP - 1}$ to $\frac{(524031 - SP) \times ST}{SP - 1}$ |

- a. For firmware revisions prior to A.04.00, 5 ms to 2000 s.
- b. For firmware revisions prior to A.04.00, 20 μ s to 2000 s.
- c. Gate cannot be used simultaneously with delayed or TV trigger.
- d. Auto align is suspended in video, external, gate, and delayed trigger modes while waiting for a trigger event to occur.
- e. For firmware revision A.04.00 or later.
- f. Delayed trigger is available with line, external trigger, and TV trigger *(Option B7B)*.

| | Specifications | Supplemental Information |
|--------------------------------------|-----------------------|---------------------------------|
| Sweep (trace) Points Range | 101 to 8192 | |

| | Specifications | Supplemental Information |
|--|---|--|
| Resolution Bandwidth (RBW) Range | | |
| -3 dB bandwidth | 1 kHz to 3 MHz, in 1-3-10 sequence, 5 MHz | |
| -6 dB bandwidth (EMI) | 9 kHz and 120 kHz | |
| <i>(Option 1DR)</i> | | |
| -3 dB bandwidth | Adds 10, 30, 100, 300 Hz | |
| -6 dB bandwidth (EMI) | Add 200 Hz | |
| | | Only available in spans $\leq 5 \text{ MHz}$, sweep times $\geq \frac{\text{sweep points} - 1}{100 \text{ kHz}}$, and not usable with tracking generator on. <i>(Option 1DN)</i> |

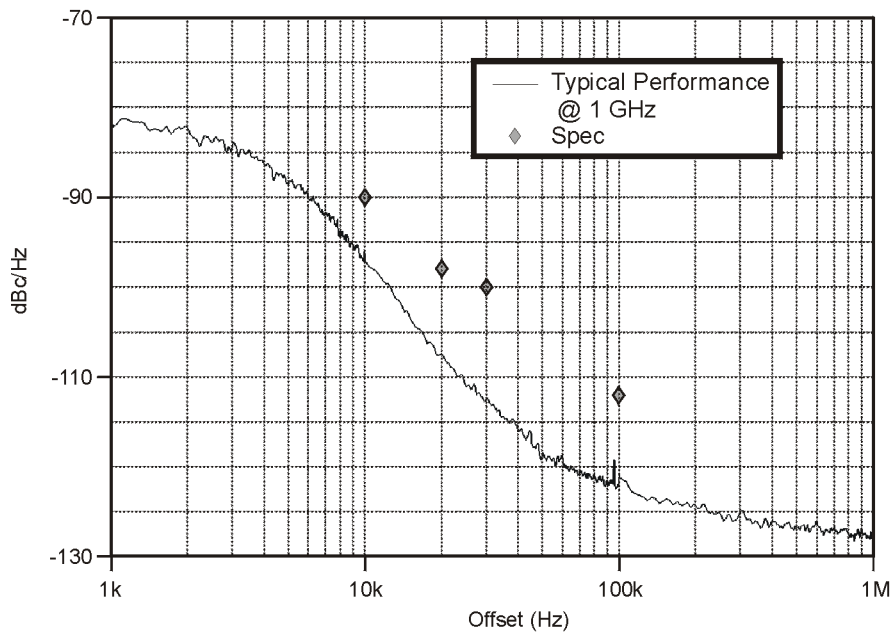
Agilent E4402B Specifications and Characteristics
Frequency

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| Accuracy 1 kHz to 3 MHz RBW 5 MHz RBW 10 Hz to 300 Hz RBW <i>(Option 1DR)</i> Shape 1 kHz to 5 MHz RBW 10 Hz to 300 Hz RBW <i>(Option 1DR)</i> Selectivity (60 dB/3 dB bandwidth ratio) 1 kHz to 5 MHz RBW 10 Hz to 300 Hz RBW <i>(Option 1DR)</i> | ±15% ±30% ±10% | Synchronously tuned four poles, approximately Gaussian shape Digital, approximately Gaussian shape <15:1, characteristic <5:1, characteristic |

| | Specifications | Supplemental Information |
|--|--|---|
| Video Bandwidth (VBW) (-3 dB) Range <i>(Option 1DR)</i> Accuracy Shape | 30 Hz to 1 MHz in 1-3-10 sequence Adds 1, 3, 10 Hz for RBW's <1 kHz | 3 MHz, characteristic ±30%, characteristic Post detection, single pole low-pass filter used to average displayed noise Video bandwidths below 30 Hz are digital bandwidths with anti-aliasing filtering. |

| | Specifications | Supplemental Information |
|--|--|--|
| Stability | | |
| Noise Sidebands (Offset from CW signal with 1 kHz RBW, 30 Hz VBW and sample detector) | | |
| ≥10 kHz | ≤ -90 dBc/Hz | |
| ≥20 kHz | ≤ -98 dBc/Hz | |
| ≥30 kHz | ≤ -100 dBc/Hz | |
| ≥100 kHz | ≤ -112 dBc/Hz | |
| Residual FM | | |
| 1 kHz RBW, 1 kHz VBW <i>(Option 1D5)</i> | ≤150 Hz p-p in 100 ms ≤100 Hz p-p in 100 ms | |
| 10 Hz RBW, 10 Hz VBW <i>(Option 1DR and 1D5)</i> | ≤2 Hz p-p in 20 ms | |
| 10 Hz RBW, 10 Hz VBW <i>(Option 1DR)</i> | | ≤10 Hz p-p in 20 ms, characteristic |
| System-Related Sidebands, offset from CW signal | | |
| ≥30 kHz | ≤ -65 dBc | |
| Line-Related Sidebands, offset from CW signal <i>(Option 1DR)</i> | | |
| <300 Hz | | ≤ -50 dBc, characteristic |
| >300 Hz to 30 kHz | | ≤ -55 dBc, characteristic |

Noise Sidebands Normalized to 1 Hz Versus Offset From Carrier



w174b

Amplitude

Amplitude specifications do not apply for the negative peak detector mode.

| | Specifications | Supplemental Information |
|--------------------------|---|---|
| Measurement Range | Displayed Average Noise Level to Maximum Safe Input Level | |
| Input Attenuator Range | 0 to 65 dB, in 5 dB steps | 0 to 75 dB, in 5 dB steps, characteristic |

| | Specifications | Supplemental Information |
|--|-----------------|--------------------------|
| Maximum Safe Input Level | | |
| Average Continuous Power (Input attenuator setting ≥ 5 dB) | +30 dBm (1 W) | |
| Peak Pulse Power (for <10 μ sec pulse width, $<1\%$ duty cycle, and input attenuation ≥ 30 dB) | +50 dBm (100 W) | |
| dc | 100 Vdc | |

| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| 1 dB Gain Compression | | |
| Total power at input mixer ^{ab} 50 MHz to 3.0 GHz | 0 dBm | |
| Preamp On (<i>Option 1DS</i>) Total power at the preamp ^c | | -20 dBm, characteristic |

- Mixer power level (dBm) = input power (dBm) – input attenuation (dB).
- For resolution bandwidths 1 kHz to 30 kHz, the maximum input signal amplitude must be \leq reference level +10 dB.
- Total power at the preamp (dBm) = total power at the input (dBm) – input attenuation (dB).

Agilent E4402B Specifications and Characteristics
Amplitude

| | Specifications | | Supplemental Information | | |
|---|------------------------|------------------------|---------------------------------------|-------------------------------|---------------------------------------|
| <p>Displayed Average Noise Level</p> <p>(Input terminated, 0 dB attenuation, sample detector, Reference Level = -70 dBm)</p> | | | | | |
| | 1 MHz to 10 MHz | 1 kHz RBW 30 Hz VBW | 10 Hz RBW 1 Hz VBW (Option 1DR) | 1 kHz RBW 30 Hz VBW | 10 Hz RBW 1 Hz VBW (Option 1DR) |
| | | | | ≤ -117 dBm, characteristic | ≤ -136 dBm, characteristic |
| | 10 MHz to 1.0 GHz | ≤ -117 dBm | ≤ -136 dBm | | |
| | 1.0 GHz to 2.0 GHz | ≤ -116 dBm | ≤ -135 dBm | | |
| | 2.0 GHz to 3.0 GHz | ≤ -114 dBm | ≤ -133 dBm | | |
| | Preamp On (Option 1DS) | 1 kHz RBW 30 Hz VBW | 10 Hz RBW 1 Hz VBW (Option 1DR) | 1 kHz RBW 30 Hz VBW | 10 Hz RBW 1 Hz VBW (Option 1DR) |
| | 0 to 55 °C | | | | |
| | 1 MHz to 10 MHz | | | ≤ -132 dBm, characteristic | ≤ -150 dBm, characteristic |
| | 10 MHz to 1.0 GHz | ≤ -132 dBm | ≤ -150 dBm | | |
| | 1.0 GHz to 2.0 GHz | ≤ -131 dBm | ≤ -149 dBm | | |
| | 2.0 GHz to 3.0 GHz | ≤ -129 dBm | ≤ -147 dBm | | |
| | 20 to 30 °C | | | | |
| | 10 MHz to 1.0 GHz | ≤ -133 dBm | ≤ -151 dBm | | |
| 1.0 GHz to 2.0 GHz | ≤ -133 dBm | ≤ -151 dBm | | | |
| 2.0 GHz to 3.0 GHz | ≤ -132 dBm | ≤ -150 dBm | | | |

| | Specifications | Supplemental Information |
|---|---|---------------------------------|
| <p>Display Range</p> <p>Log Scale</p> <p style="padding-left: 20px;">RBW \geq 1 kHz</p> <p style="padding-left: 20px;">RBW \leq 300 Hz (<i>Option 1DR</i>)</p> <p>Linear Scale</p> <p>Scale Units</p> <p style="padding-left: 20px;">(<i>Option BAA</i>)</p> | <p>Ten divisions displayed; 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps</p> <p>Calibrated 0 to -85 dB from Reference Level</p> <p>Calibrated 0 to -120 dB^a from Reference Level</p> <p>Ten divisions</p> <p>dBm, dBmV, dBμV, V, and W</p> <p>Add Hz</p> | |

a. 0 to -70 dB range when span = 0 Hz, or when auto ranging is off:
(:DISPlay:WINDow:TRACe:Y[:SCALe]:LOG:RANGe:AUTO OFF).

| | Specifications | Supplemental Information |
|---|---|---------------------------------|
| <p>Marker Readout Resolution</p> <p>Log scale</p> <p style="padding-left: 20px;">RBW \geq 1 kHz</p> <p style="padding-left: 40px;">0 to -85 dB from ref level</p> <p style="padding-left: 20px;">RBW \leq 300 Hz</p> <p style="padding-left: 40px;">0 to -120 dB from ref level</p> <p>Linear scale</p> <p>Fast Sweep Times for Zero Span</p> <p style="padding-left: 20px;">(<i>Option AYY</i>)^a</p> <p style="padding-left: 20px;">5 μs to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$</p> <p style="padding-left: 20px;">Log</p> <p style="padding-left: 40px;">0 to -85 dB from ref level</p> <p style="padding-left: 20px;">Linear</p> | <p>0.04 dB</p> <p>0.04 dB</p> <p>0.01% of Reference Level</p> <p>0.3 dB</p> <p>0.3% of Reference Level for linear scale</p> | |

Agilent E4402B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| <i>(Option B7D)</i> 2.5 μ s to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ Log 0 to -85 dB from ref level Linear | 0.2 dB 0.2% of Reference Level for linear scale | |

a. For firmware revisions prior to A.04.00, 20 μ s to <5 ms.

| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| Frequency Response 50 Ω Absolute ^a /Relative 9 kHz to 3.0 GHz 10 dB attenuation 20 to 30 °C 0 to 55 °C 50 Ω Absolute ^a /Relative Preamp On (<i>Option 1DS</i>) 1 MHz to 3.0 GHz 0 dB attenuation | ± 0.5 dB ± 1.0 dB ± 2.0 dB | |

a. Absolute flatness values are referenced to the amplitude at 50 MHz.

| | Specifications | Supplemental Information |
|---|---|---------------------------------|
| Input Attenuation Switching Uncertainty at 50 MHz Attenuator Setting 0 dB to 5 dB 10 dB 15 dB 20 to 65 dB attenuation | ± 0.3 dB Reference ± 0.3 dB $\pm (0.1 \text{ dB} + 0.01 \times \text{Attenuator Setting})$ | |

| Attenuation Accuracy Relative to the 10 dB Attenuator Setting, Characteristic | | |
|--|------------------------|--|
| | Frequency Range | |
| Attenuation | 9 kHz–3.0 GHz | |
| 0 dB | ±0.3 dB | |
| 5 dB | ±0.3 dB | |
| 10 dB | Reference | |
| 15 dB | ±0.4 dB | |
| 20 dB | ±0.4 dB | |
| 25 dB | ±0.5 dB | |
| 30 dB | ±0.5 dB | |
| 35 dB | ±0.6 dB | |
| 40 dB | ±0.6 dB | |
| 45 dB | ±0.7 dB | |
| 50 dB | ±0.7 dB | |
| 55 dB | ±0.9 dB | |
| 60 dB | ±0.9 dB | |
| 65 dB | ±1.0 dB | |

| | Specifications | Supplemental Information |
|-------------------------------------|-----------------------|---|
| Preamp (<i>Option 1DS</i>) | | Refer also to Displayed Average Noise Level specification |
| Gain | | +20 dB, nominal ^a |
| Noise figure | | 5 dB, characteristic |

a. Amplifier is between the input attenuator and the input mixer.

Agilent E4402B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|---|---|---------------------------------|
| Absolute Amplitude Accuracy | | |
| At reference settings ^a | ±0.34 dB | |
| Preamp On ^b (<i>Option 1DS</i>) | ±0.5 dB | |
| Overall Amplitude Accuracy^c | | |
| 20 to 30 °C | ± (0.54 dB + Absolute Frequency Response) | |

- a. Settings are: reference level -20 dBm; input attenuation 10 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, sample detector, signal at reference level.
- b. Settings are: reference level -30 dBm; input attenuation 0 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, signal at reference level.
- c. For reference level 0 to -50 dBm; input attenuation 10 dB; RBW 1 kHz; VBW 1 kHz; scale log, log range 0 to -50 dB from reference level; sweep time coupled; signal input 0 to -50 dBm; span ≤20 kHz.

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| RF Input VSWR (at tuned frequency) | | |
| Attenuator setting 0 dB | | |
| 100 kHz to 3 GHz | | ≤3.0:1, characteristic |
| Attenuator setting 5 dB | | |
| 100 kHz to 3 GHz | | ≤1.6:1, characteristic |
| Attenuator setting 10 to 65 dB | | |
| 9 kHz to 100 kHz | | ≤2.0:1, characteristic |
| 100 kHz to 3 GHz | | ≤1.4:1, characteristic |

| | Specifications | Supplemental Information |
|-----------------------------------|-----------------------|---------------------------------|
| Auto Alignment^a | | |
| Sweep-to-sweep variation | | ±0.1 dB, characteristic |

- a. Set Auto Align to Off and use Align Now, All to eliminate this variation.

| | Specifications | Supplemental Information |
|--|---|---------------------------------|
| <p>Resolution Bandwidth Switching Uncertainty (at Reference Level)</p> <p>1 kHz RBW</p> <p>3 kHz to 3 MHz RBW</p> <p>5 MHz RBW</p> <p>10 Hz to 300 Hz RBW (<i>Option 1DR</i>)</p> | <p>Reference</p> <p>±0.3 dB</p> <p>±0.6 dB</p> <p>±0.3 dB</p> | |

| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| <p>Reference Level</p> <p>Range</p> <p>Resolution</p> <p style="padding-left: 20px;">Log Scale</p> <p style="padding-left: 20px;">Linear Scale</p> <p>Accuracy (at a fixed frequency, a fixed attenuator, and referenced to -30 dBm (-10 dBm, Preamp On (<i>Option 1DS</i>)))</p> <p>Reference Level (dBm) – input attenuator setting (dB) + preamp gain (dB)</p> <p style="padding-left: 20px;">-10 dBm to > -60 dBm</p> <p style="padding-left: 20px;">-60 dBm to > -85 dBm</p> <p style="padding-left: 20px;">-85 dBm to -90 dBm</p> | <p>-149.9 dBm to maximum mixer level + attenuator setting</p> <p>±0.1 dB</p> <p>±0.12% of Reference Level</p> <p>±0.3 dB</p> <p>±0.5 dB</p> <p>±0.7 dB</p> | |

| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| <p>Display Scale Switching Uncertainty</p> <p>Switching between Linear and Log</p> <p>Log Scale Switching</p> | <p>±0.15 dB at Reference Level</p> <p>No error</p> | |

Agilent E4402B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|---|---|---------------------------------------|
| Display Scale Fidelity | | |
| Log Maximum Cumulative | | |
| 0 to -85 dB from Reference Level | $\pm(0.3 \text{ dB} + 0.01 \times \text{dB from Reference Level})$ | |
| RBW \leq 300 Hz (<i>Option 1DR</i>) | | |
| Span > 0 Hz | | |
| 0 to -98 dB from Reference Level | $\pm(0.3 \text{ dB} + 0.01 \times \text{dB from Reference Level})$ | |
| -98 to -120 dB from Reference Level | | $\pm 2.0 \text{ dB}$, characteristic |
| Span = 0 Hz ^a | | |
| 0 to -60 dB from Reference Level | $\pm(0.3 \text{ dB} + 0.015 \times \text{dB from Reference Level})$ | |
| -60 to -70 dB from Reference Level | $\pm 1.5 \text{ dB}$ | |
| Log Incremental Accuracy | | |
| 0 to -80 dB ^b from reference level | $\pm 0.4 \text{ dB}/4 \text{ dB}$ | |
| Linear Accuracy | $\pm 2\%$ of Reference Level | |

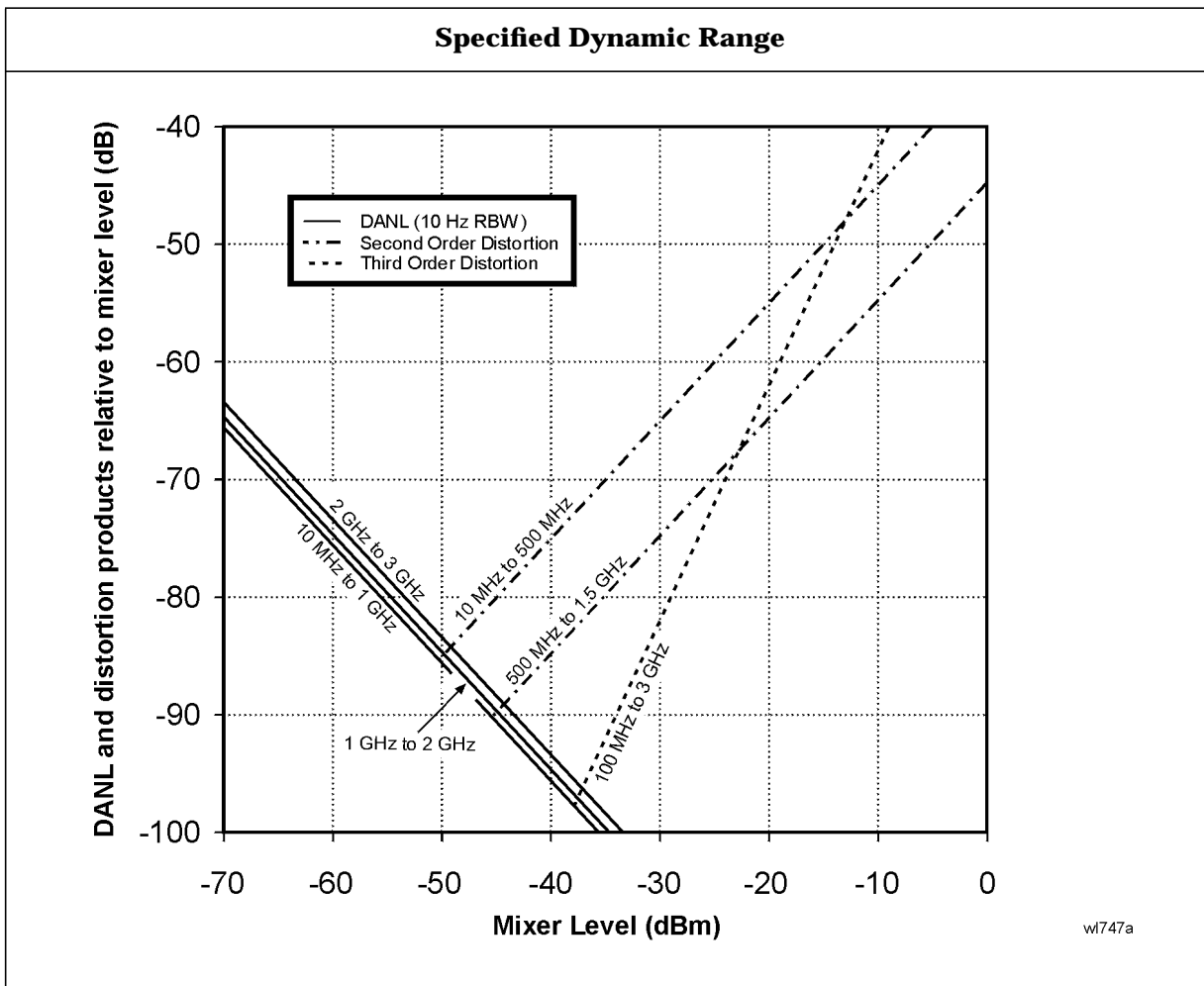
a. or when auto ranging is off: (:DISPlay:WINDow:TRACe:Y[:SCALE]:LOG:RANGe:AUTO OFF)

b. 0 to -50 dB for RBWs \leq 300 Hz and span = 0 Hz, or when auto ranging is off.

| | Specifications | Supplemental Information |
|--|--|---|
| Spurious Responses | | |
| Second Harmonic Distortion | | |
| Input Signal | | |
| 10 MHz to 500 MHz | $< -65 \text{ dBc}$ for -30 dBm signal at input mixer ^a | +35 dBm SHI (second harmonic intercept) |
| 500 MHz to 1.5 GHz | $< -75 \text{ dBc}$ for -30 dBm signal at input mixer ^a | +45 dBm SHI |
| Preamp On (<i>Option 1DS</i>) 10 MHz to 1.5 GHz | | -5 dBm SHI, characteristic |

| | Specifications | Supplemental Information |
|---|--|--|
| Third Order Intermodulation Distortion | | |
| 10 MHz to 100 MHz | | +7 dBm TOI (third order intercept), characteristic |
| 100 MHz to 3 GHz | < -82 dBc for two -30 dBm signals at input mixer ^a and >50 kHz separation | +11 dBm TOI +16 dBm TOI, typical, 20 to 30 °C |
| Preamp On (<i>Option 1DS</i>) 10 MHz to 3 GHz, | | -16 dBm TOI, characteristic |
| Other Input Related Spurious | | |
| >30 kHz offset | < -65 dBc for -20 dBm signal at input mixer ^a | |

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



Agilent E4402B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| Residual Responses (Input terminated and 0 dB attenuation) 150 kHz to 3 GHz | < -90 dBm | |

Options

Time Gated Spectrum Analysis (Option 1D6)

| | Specifications | Supplemental Information |
|---|---|---|
| Gate Delay | | |
| Range | 1 μ s to 400 s | |
| Accuracy | $\pm(500 \text{ ns} + (0.01\% \times (\text{maximum of gate delay or length})))$ | From gate trigger input to positive edge of gate output |
| Gate Length | | |
| Range | 1 μ s to 400 s | |
| Accuracy | $\pm(500 \text{ ns} + (0.01\% \times (\text{maximum of gate delay or length})))$ | From positive edge to negative edge of gate output |
| Resolution | $((\text{maximum of gate delay or length in seconds})/65000)$ rounded up to nearest μ s | Dependent on the greater of gate delay or gate length |
| Additional Amplitude Error^a | | |
| Log Scale | $\pm 0.2 \text{ dB}$ | |
| Linear Scale | $\pm 0.1\%$ of reference level | |

a. While in gate mode.

Tracking Generator (Option 1DN)

The spectrum analyzer tracking generator combination will meet its specification after a cable (8120-5148) and adapter are connected between RF OUT and INPUT and **Align Now**, TG has been run.

| | Specifications | Supplemental Information |
|----------------|----------------|--------------------------|
| Warm-Up | 5 minutes | |

| | Specifications | Supplemental Information |
|-------------------------------|------------------|--------------------------|
| Output Frequency Range | 9 kHz to 3.0 GHz | |

| | Specifications | Supplemental Information |
|------------------------------|----------------|--|
| Minimum Resolution BW | 1 kHz | Not usable with resolution bandwidths ≤ 300 Hz (<i>Option 1DR</i>) |

| | Specifications | Supplemental Information |
|--|--------------------------|--------------------------|
| Output Power Level | | |
| Range | -2 to -66 dBm | |
| Resolution | 0.1 dB | |
| Absolute Accuracy (at 50 MHz with coupled source attenuator, referenced to -20 dBm) | ± 0.75 dB | |
| Vernier | | |
| Range | 8 dB | |
| Accuracy (with coupled source attenuator, 50 MHz, -20 dBm) | | |
| Incremental | ± 0.2 dB/dB | |
| Cumulative | ± 0.5 dB, total | |
| Output Attenuator Range | 0 to 56 dB in 8 dB steps | |

| | Specifications | Supplemental Information |
|-----------------------------------|----------------|--|
| Maximum Safe Reverse Level | | +30 dBm (1 W), 50 Vdc, characteristic |

| | Specifications | Supplemental Information |
|---------------------------|---|---------------------------------|
| Output Power Sweep | | |
| Range | (-10 to -2 dBm) – (Source Attenuator Setting) | |
| Resolution | 0.1 dB | |
| Accuracy (zero span) | <1 dB peak-to-peak | |

| | Specifications | Supplemental Information |
|----------------------------------|-----------------------|---------------------------------|
| Output Flatness | | |
| Referenced to 50 MHz, -20 dBm | | |
| 9 kHz to 10 MHz | ±3 dB | |
| 10 MHz to 3 GHz | ±2 dB | |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| Spurious Outputs | | |
| (-2 dBm output) | | |
| Harmonic Spurs | | |
| TG Output 9 kHz to 20 kHz | ≤ -15 dBc | |
| TG Output 20 kHz to 3 GHz | ≤ -25 dBc | |
| Non-harmonic Spurs | | |
| TG Output 9 kHz to 2 GHz | ≤ -27 dBc | |
| TG Output 2 GHz to 3 GHz | ≤ -23 dBc | |
| LO Feedthrough | | |
| LO Frequency 3.921409 to 6.9214 GHz | ≤ -16 dBm | |

| | Specifications | Supplemental Information |
|----------------------|--|---------------------------------|
| Dynamic Range | Maximum Output Power Level – Displayed Average Noise Level | |

Agilent E4402B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|---|----------------|--|
| Output Tracking Drift Swept Tracking Error | | 1.5 kHz/5 minute, characteristic Usable in 1 kHz RBW after 5 minutes of warm-up |

| | Specifications | Supplemental Information |
|---|----------------|----------------------------|
| RF Power-Off Residuals 9 kHz to 3 GHz | | < -120 dBm, characteristic |

| | Specifications | Supplemental Information |
|--|----------------|---|
| Output Attenuator Repeatability 9 kHz to 300 MHz 300 MHz to 2.0 GHz 2.0 GHz to 3 GHz | | ±0.1 dB, characteristic ±0.2 dB, characteristic ±0.3 dB, characteristic |

| | Specifications | Supplemental Information |
|--|----------------|--|
| Output VSWR 0 dB attenuation ≥ 8 dB attenuation | | <2.0:1, characteristic <1.5:1, characteristic |

| | Specifications | Supplemental Information |
|---|----------------|---|
| Output Attenuator Accuracy 0 dB 8 dB 16 dB 24 dB 32 dB 40 dB 48 dB 56 dB | Reference | ±0.5 dB, characteristic ±0.5 dB, characteristic ±0.5 dB, characteristic ±0.6 dB, characteristic ±0.8 dB, characteristic ±1.0 dB, characteristic ±1.1 dB, characteristic |

| |
|--|
| Tracking Generator Output Accuracy |
| Relative Accuracy (Referred to -20 dBm) = Output Attenuator Accuracy + Vernier Accuracy + Output Flatness |
| Absolute Accuracy = Relative Accuracy (Referred to -20 dBm) + Absolute Accuracy at 50 MHz |

FM Demodulation (Option BAA)

The FM demodulation characteristics will be met after an **Align Now**,
FM Demod has been run.

| | Specifications | Supplemental Information |
|--|----------------|--|
| Input Level | | $\geq (-60 \text{ dBm} + \text{attenuator setting} - \text{preamp gain})$, characteristic |
| Signal Level | | 0 to -30 dB below reference level, characteristic |
| FM Deviation | | |
| Range | | 10 kHz to 1 MHz |
| Resolution | | Provides 1 Hz display annotation resolution |
| FM Deviation Range | | |
| 10 kHz to 40 kHz | | 12 Hz, characteristic |
| $>40 \text{ kHz}$ to 200 kHz | | 60 Hz, characteristic |
| $>200 \text{ kHz}$ to 1 MHz | | 300 Hz, characteristic |
| Accuracy ^a | | |
| FM Rate $< \text{FM BW}/100$, | | $< (2\% \text{ of FM deviation range} + 2 \times \text{Resolution})$, characteristic |
| VBW $\geq (30 \times \text{FM Rate})$, | | |
| RBW $>$ the maximum of (30 \times FM deviation) or (30 \times FM Rate) | | |
| Offset Error ^a | | 5% of FM Deviation Range + 300 Hz, characteristic |
| FM Bandwidth (-3 dB) | | |
| FM Deviation Range | | |
| 10 kHz to 40 kHz | | $7.5 \times \text{FM deviation range}$, characteristic |
| $>40 \text{ kHz}$ to 200 kHz | | $1.3 \times \text{FM deviation range}$, characteristic |
| $>200 \text{ kHz}$ to 1 MHz | | $0.3 \times \text{FM deviation range}$, characteristic |

a. In time domain sweeps (span = 0 Hz).

TV Trigger and Picture On Screen (Option B7B)

Option BAA is required.

| | Specifications | Supplemental Information |
|---|---|--|
| TV Trigger and Picture On Screen | | TV Trigger initiates a sweep of the analyzer after the sync pulse of a selected line of a TV video field. Picture On Screen displays the TV picture on the analyzer display. |
| Amplitude Requirements TV Source: SA | | Top 50% of linear display, characteristic |
| TV Source: EXT VIDEO IN | | 500 mVp-p to 2 Vp-p, characteristic |
| Compatible Standards | NTSC-M, NTSC-Japan, PAL-M, PAL-B,D,G,H,I, PAL-N, PAL-N Combination, SECAM-L | |
| Field Selection | Entire frame, even, odd | |
| Sync Polarity | Positive or negative | |
| TV Trigger | | |
| Line Selection | 1 to 525, or 1 to 625, standard dependent | |

cdmaOne Measurement Personality (Option BAC)

Unless otherwise noted, all specifications are with RF input range auto, default cdmaOne measurement settings, and in the in-band frequency range. *Option B72* is required.

| | Specifications | Supplemental Information |
|--------------------------------|--|--------------------------|
| In-Band Frequency Range | | |
| Cellular bands | 824 to 870 MHz 869 to 925 MHz | |
| PCS bands | 1715 to 1780 MHz 1805 to 1870 MHz 1850 to 1910 MHz 1930 to 1990 MHz | |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------------------|
| Channel Power (1.23 MHz Integration BW) | | Integration BW range 1 kHz to 10 MHz |
| Range at RF Input | 30 to -70 dBm | |
| Absolute power accuracy for in-band signal (Mean channel power at RF Input, plus any external attenuation, excluding mismatch error) | | |
| Cellular Bands | | |
| 30 to -5 dBm 20 to 30 °C | ±0.78 dB | ±0.33 dB, typical |
| 0 to 55 °C | ±1.21 dB | |
| -5 to -25 dBm 20 to 30 °C | ±0.72 dB | ±0.28 dB, typical |
| 0 to 55 °C | ±1.05 dB | |
| -25 to -45 dBm 20 to 30 °C | ±0.63 dB | ±0.22 dB, typical |
| 0 to 55 °C | ±0.91 dB | |
| -45 to -55 dBm 20 to 30 °C | ±0.70 dB | ±0.29 dB, typical |
| 0 to 55 °C | ±0.92 dB | |

| | Specifications | Supplemental Information |
|-------------------------------|----------------|--------------------------|
| -55 to -70 dBm 20 to 30 °C | ±0.82 dB | ±0.39 dB, typical |
| 0 to 55 °C | ±1.17 dB | |
| PCS Bands | | |
| 30 to -5 dBm 20 to 30 °C | ±0.67 dB | ±0.23 dB, typical |
| 0 to 55 °C | ±1.00 dB | |
| -5 to -25 dBm 20 to 30 °C | ±0.63 dB | ±0.21 dB, typical |
| 0 to 55 °C | ±0.94 dB | |
| -25 to -45 dBm 20 to 30 °C | ±0.63 dB | ±0.21 dB, typical |
| 0 to 55 °C | ±0.88 dB | |
| -45 to -55 dBm 20 to 30 °C | ±0.70 dB | ±0.28 dB, typical |
| 0 to 55 °C | ±0.89 dB | |
| -55 to -70 dBm 20 to 30 °C | ±0.82 dB | ±0.38 dB, typical |
| 0 to 55 °C | ±1.14 dB | |

| | Specifications | Supplemental Information |
|---|----------------------------|--------------------------|
| Channel power relative power accuracy (same channel, different Tx power, input attenuator fixed, RF input range manual). | See Display Scale Fidelity | |

| | Specifications | Supplemental Information |
|------------------------------|----------------|--------------------------|
| Receive Channel Power | | |
| Absolute Power Accuracy | | |
| Cellular bands | | |
| 30 to 0 dBm | ±1.07 dB | ±0.62 dB, typical |
| 0 to -85 dBm | ±1.64 dB | ±0.89 dB, typical |
| PCS bands | | |
| 30 to 0 dB | ±0.86 dB | ±0.42 dB, typical |
| 0 to -85 dBm | ±1.76 dB | ±0.94 dB, typical |

Agilent E4402B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|------------------------------|----------------|--------------------------|
| Preamp (<i>Option 1DS</i>) | | |
| Cellular bands | | |
| 30 to -80 dBm | ±2.96 dB | ±2.40 dB, typical |
| -80 to -100 dBm | ±4.07 dB | ±3.23 dB, typical |
| PCS bands | | |
| 30 to -80 dB | ±2.14 dB | ±1.45 dB, typical |
| -80 to -100 dBm | ±3.37 dB | ±2.40 dB, typical |

| | Specifications | Supplemental Information |
|---|----------------|---|
| Occupied Bandwidth | | |
| Carrier power range | 30 to -70 dBm | |
| Frequency resolution of occupied BW | 1.88 kHz | |
| Frequency accuracy of occupied BW (1.23 MHz channel BW) | | ±15 kHz, characteristic |
| Frequency resolution of delta frequency | 3.75 kHz | |
| Frequency accuracy of delta frequency | | ±(35 kHz + frequency reference error × carrier frequency), characteristic |

| | Specifications | Supplemental Information |
|---|--------------------|---|
| Code Domain (Requires <i>Options 1D5, B7D, and B7E</i> . Measurement interval ≥1.25 ms unless otherwise noted.) | | |
| Carrier power range at RF Input (Pilot channel power > -11 dBc) | 30 to -13 dBm | 30 to -65 dBm ^a , characteristic |
| Preamp (<i>Option 1DS</i>) | 30 to -30 dBm | 30 to -82 dBm ^a , characteristic |
| Measurement interval range | 0.5 ms to 26.67 ms | |
| Code domain power | | |
| Display dynamic range | 50 dB | |

| | Specifications | Supplemental Information |
|---|------------------------|---|
| Accuracy (Walsh channel power within 20 dB of total power) | ± 0.2 dB | |
| Displayed 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 interval ≥ 2.5 ms) | | Excludes frequency reference error. |
| Input frequency error range | ± 100 kHz | ± 200 kHz, typical |
| Accuracy | ± 10 Hz | ± 7 Hz, typical |
| Displayed resolution | Four digits | |
| Estimated Rho | | |
| Range | 0.9 to 1.0 | 0.5 to 1.0 ^b |
| Accuracy (With 9 channels active over the specified range) ^c | | ± 0.02 , characteristic |
| Displayed resolution | 0.0001 | |
| Pilot time offset | | From even second signal to start of PN sequence |
| Range | -13.33 ms to +13.33 ms | |
| Accuracy | ± 150 ns | |
| Displayed resolution | Four digits | |
| Code domain timing | | Pilot to code channel time tolerance |
| Range | ± 200 ns | |
| Accuracy (IS-97A nominal power levels) ^d | ± 15 ns | ± 7 ns, typical |
| Code domain phase | | Pilot to code channel phase tolerance |
| Range | ± 200 mrad | |
| Accuracy (IS-97A nominal power levels) ^d | ± 15 mrad | ± 10 mrad, typical |

Agilent E4402B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|----------|-----------------------|---|
| Displays | | Power Graph and Metrics, or Power, Timing, and Phase Graphs |

- a. Performance may degrade outside of the specified carrier power range at RF input listed in the specifications column.
- b. Performance may degrade outside of the estimated rho range listed in the specifications column.
- c. The Active Set Threshold is less than all active channels, but greater than -20 dBc.
- d. IS-97A nominal base station test model levels (fraction of carrier power); Pilot: 0.20 (-7.0 dBc), Sync: 0.0471 (-13.3 dBc), Paging: 0.1882 (-7.3 dBc), 6 Traffic channels: 0.09412 (-10.3 dBc)

| | Specifications | Supplemental Information |
|---|------------------------|---|
| Modulation Accuracy (Rho) (Requires <i>Options 1D5, B7D, and B7E</i> . Measurement interval ≥ 1.25 ms unless otherwise noted.) | | |
| Carrier power range at RF Input | 30 to -28 dBm | 30 to -70 dBm ^a , characteristic |
| Preamp (<i>Option 1DS</i>) | 30 to -45 dBm | 30 to -87 dBm ^a , characteristic |
| Measurement interval range | 0.5 ms to 26.67 ms | |
| Rho (waveform quality) | | |
| Range | 0.9 to 1.0 | 0.5 to 1.0 ^b , characteristic |
| Accuracy | ± 0.0015 | ± 0.0007 , typical |
| Displayed resolution | 0.0001 | |
| Carrier frequency error (Measurement interval ≥ 2.5 ms) | | Excludes frequency reference error |
| Input frequency error range | ± 100 kHz | ± 200 kHz, typical |
| Accuracy | ± 10 Hz | ± 7 Hz, typical |
| Displayed resolution | Four digits | |
| Pilot time offset | | From even second signal to start of PN sequence |
| Range | -13.33 ms to +13.33 ms | |
| Accuracy | ± 150 ns | |
| Displayed resolution | Four digits | |
| EVM | | |
| Floor | 3.0% | 2.6%, typical |

Agilent E4402B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|---|----------------|--|
| Out-of-Band Spurious^a | | Refer to the Amplitude specifications section in this guide. |

- a. The out-of-band measurement is made with the user-defined tables with 20 frequency ranges each (up to the top 10 spurs per range, 100 spurs maximum). Table parameters include frequency range, RBW, video BW, detector type, and amplitude test limits.

| | Specifications | Supplemental Information |
|---|-----------------|--------------------------|
| Receiver Spurious Emissions | | |
| Spurious emission power range | -20 to -83 dBm | |
| Preamp On (<i>Option 1DS</i>) | -40 to -101 dBm | |
| Absolute spurious emission power accuracy | | |
| -20 to -60 dBm | ±2.6 dB | ±1.7 dB, typical |
| -60 to -83 dBm | ±4.3 dB | ±3.4 dB, typical |
| Preamp On (<i>Option 1DS</i>) | | |
| -40 to -70 dBm | ±3.6 dB | ±2.6 dB, typical |
| -70 to -101 dBm | ±5.0 dB | ±3.9 dB, typical |

| | Specifications | Supplemental Information |
|-------------------------------------|----------------|--------------------------|
| External Correction | | |
| External attenuation, external gain | | |
| Range | -90 to 90 dB | |
| Resolution | 0.01 dB | |

| | Specifications | Supplemental Information |
|---|---------------------|--------------------------|
| Trigger | | |
| Trigger source (Actual available choices dependent on measurement) | Free run, external | |
| (<i>Option B7D and B7E</i>) | Add RF Burst, frame | |
| Delay trigger | | |
| Range | 0 to 500 ms | |
| Resolution | 300 ns | |

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| RF burst trigger level <i>(Option B7E)</i> | 0 to -25 dBc | Rear panel connector labelled EXT FRAME SYNC <i>(Option B7D)</i> |
| Trigger slope (External and RF burst) | Positive/Negative | |
| Frame timing period | 50 ns to 13.6533 s | |
| Frame synchronizing source | External frame sync | |
| Frame synchronizing slope | Positive/Negative | |

| | Specifications | Supplemental Information |
|--|-----------------------|---|
| Demod Trigger Source | | Rear panel connector labelled EXT FRAME SYNC |
| Even second input (Frame trigger only, <i>Option B7D and B7E</i>) | | |
| PN offset range | 0 to 511 x 64 [chips] | |

GSM Measurement Personality (Option BAH)

Unless otherwise noted, all specifications are with RF input range auto, default GSM measurement settings, and in the in-band frequency range. *Option 1D6* and *Option B72* are required.

| | Specifications | Supplemental Information |
|--------------------------------|--------------------------------------|--------------------------|
| In-Band Frequency Range | | |
| GSM 900, P-GSM bands | 890 to 915 MHz 935 to 960 MHz | |
| GSM 900, E-GSM bands | 880 to 915 MHz 925 to 960 MHz | |
| GSM 900, R-GSM bands | 876 to 915 MHz 921 to 960 MHz | |
| DCS 1800 bands | 1710 to 1785 MHz 1805 to 1880 MHz | |
| PCS 1900 bands | 1850 to 1910 MHz 1930 to 1990 MHz | |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| Transmitter Power (Requires <i>Option B7D</i> or <i>AYX</i>) | | |
| Range at RF Input | 30 to -60 dBm | |
| Absolute power accuracy for in-band signal (Mean channel power at RF Input, plus any external attenuation, excluding mismatch error) | | |
| P-GSM, E-GSM, and R-GSM Bands | | |
| 30 to -20 dBm 20 to 30 °C | ±0.89 dB | ±0.39 dB, typical |
| 0 to 55 °C | ±1.65 dB | |
| -20 to -30 dBm 20 to 30 °C | ±0.82 dB | ±0.38 dB, typical |
| 0 to 55 °C | ±1.48 dB | |

| | Specifications | Supplemental Information |
|------------------------------------|-----------------------|---------------------------------|
| -30 to -40 dBm 20 to 30 °C | ±0.87 dB | ±0.39 dB, typical |
| 0 to 55 °C | ±1.47 dB | |
| -40 to -50 dBm 20 to 30 °C | ±1.06 dB | ±0.57 dB, typical |
| 0 to 55 °C | ±1.60 dB | |
| -50 to -60 dBm 20 to 30 °C | ±1.19 dB | ±0.70 dB, typical |
| 0 to 55 °C | ±1.71 dB | |
| DCS 1800 and PCS 1900 Bands | | |
| 30 to -20 dBm 20 to 30 °C | ±0.76 dB | ±0.28 dB, typical |
| 0 to 55 °C | ±1.26 dB | |
| -20 to -30 dBm 20 to 30 °C | ±0.66 dB | ±0.27 dB, typical |
| 0 to 55 °C | ±1.06 dB | |
| -30 to -40 dBm 20 to 30 °C | ±0.71 dB | ±0.26 dB, typical |
| 0 to 55 °C | ±1.00 dB | |
| -40 to -50 dBm 20 to 30 °C | ±0.90 dB | ±0.44 dB, typical |
| 0 to 55 °C | ±1.13 dB | |
| -50 to -60 dBm 20 to 30 °C | ±1.03 dB | ±0.57 dB, typical |
| 0 to 55 °C | ±1.24 dB | |

| | Specifications | Supplemental Information |
|--|----------------------------|---------------------------------|
| Transmitter Power Relative Power Accuracy (same channel, different Tx power, input attenuator fixed, RF input range manual). | See Display Scale Fidelity | |

Agilent E4402B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|---|----------------|---|
| Power versus Time (Requires <i>Option B7D</i> or <i>AYX</i>) | | |
| Carrier power range at RF Input | 30 to -23 dBm | 30 to -55 dBm ^a , characteristic |
| Preamp On (<i>Option 1DS</i>) | 30 to -40 dBm | 30 to -72 dBm ^a , characteristic |
| Time resolution accuracy | | ±1% of sweep time, characteristic |
| Maximum record length | 8 time slots | |
| Burst to mask uncertainty (Requires <i>Option B7D</i> and <i>B7E</i>) | ±1.0 bit | |

a. Performance may degrade outside of the specified carrier power range at RF input listed in the specifications column.

| | Specifications | Supplemental Information |
|--|---------------------------------------|------------------------------|
| Output RF Spectrum | | |
| Carrier power range at RF Input | | |
| Offsets ≤1800 kHz, 30 kHz RBW | | 30 to -5 dBm, characteristic |
| Offsets >1800 kHz, 100 kHz RBW | | 30 to -4 dBm, characteristic |
| Reference power accuracy | Same as Transmitter Power measurement | |
| Relative accuracy ^a | See Display Scale Fidelity | |
| Spectrum due to modulation displayed dynamic range ^{bc} | | |
| 100 kHz offset | | 30 dB, characteristic |
| 200 kHz offset | | 60 dB, characteristic |
| 250 kHz offset | | 60 dB, characteristic |
| 400 kHz offset | | 70 dB, characteristic |
| 600 kHz to 1.8 MHz offset | | 79 dB, characteristic |
| 1.8 to 6.0 MHz offset | | 75 dB, characteristic |
| >6 MHz offset | | 76 dB, characteristic |
| Swept Mode Dynamic Range | | 70 dB, characteristic |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| Spectrum due to switching transients displayed dynamic range ^{bc} | | |
| 400 kHz offset | | 62 dB, characteristic |
| 600 kHz offset | | 79 dB, characteristic |
| 1200 kHz offset | | 79 dB, characteristic |
| 1800 kHz offset | | 80 dB, characteristic |
| Swept Mode Dynamic Range | | 70 dB, characteristic |

- a. Does not include uncertainty due to noise.
- b. Displayed dynamic range for specific frequency offsets - applies to CW signal at the specified offset. Dynamic range with a GSM signal may differ.
- c. Using default settings, the RBW filter has a corrected noise BW and impulse BW equivalent to five-pole synchronously tuned filter.

| | Specifications | Supplemental Information |
|--|----------------|---|
| Phase and Frequency Error (Requires <i>Option 1D5</i> , <i>B7D</i> , and <i>B7E</i>) | | |
| Carrier power range at RF Input | 30 to -23 dBm | 30 to -55 dBm ^a , characteristic |
| Preamp On (<i>Option 1DS</i>) | 30 to -40 dBm | 30 to -72 dBm ^a , characteristic |
| Phase error | | |
| Range | 0 to 180° | |
| Displayed resolution | 0.01° | |
| Accuracy (Averages ≥10) | | |
| Peak | ±2.1° | ±1.5°, typical |
| RMS | ±1.1° | ±0.6°, typical |
| Frequency error | | Excludes frequency reference error |
| Initial frequency error range | ±100 kHz | |
| Accuracy (Averages ≥10) | ±10 Hz | ±5 Hz, typical |
| I/Q offset range | -10 to -46 dBc | |
| Burst sync time uncertainty | ±1.0 bit | |
| Displays | | Numeric summary |

- a. Performance may degrade outside of the specified carrier power range at RF input listed in the specifications column.

Agilent E4402B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|-----------------------------------|-----------------------|---|
| Transmit Band Spurious | | |
| Carrier power range at RF Input | | 30 to -12 dBm, typical |
| Dynamic range | | |
| Upper and lower adjacent segments | | 55 dB, characteristic |
| Upper and lower segments | | 44 dB, characteristic |
| Relative accuracy | | $\pm(0.3 \text{ dB} + 0.01 \times (\text{dB from reference level}))$, characteristic |
| Displayed resolution | 0.01 dB | |

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| Out-of-Band Spurious^a | | |
| Absolute Spurious Power Accuracy | | Refer to the Amplitude specifications section in this guide. |
| Sensitivity ^b | | |
| RBW | | |
| 1 kHz | | -95 dBm, characteristic |
| 3 kHz | | -90 dBm, characteristic |
| 10 kHz | | -85 dBm, characteristic |
| 30 kHz | | -78 dBm, characteristic |
| 100 kHz | | -71 dBm, characteristic |
| 300 kHz | | -64 dBm, characteristic |
| 1 MHz | | -57 dBm, characteristic |
| 3 MHz | | -50 dBm, characteristic |

- a. The out-of-band spurious measurement is made in accordance with the tables defined in the appropriate GSM specification document. The measurement is made over several frequency ranges (up to 10 spurs per range, 100 spurs maximum).
- b. With input attenuation of 5 dB. For all other attenuation settings, add (input attenuation - 5) dB.

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| Receive Band Spurious Spurious emission power range ^a Preamp On (<i>Option 1DS</i>) Absolute spurious emission power accuracy –20 to –60 dBm –60 to –73 dBm Preamp on (<i>Option 1DS</i>) –40 to –70 dBm –70 to –91 dBm | | –20 to –73 dBm, characteristic –40 to –91 dBm, characteristic ±1.9 dB, characteristic ±2.5 dB, characteristic ±2.8 dB, characteristic ±4.1 dB, characteristic |

a. Requires bandpass filter centered on receive band, peak detector mode, 0 dB attenuation, 100 kHz RBW. Does not include insertion loss of bandpass filter.

| | Specifications | Supplemental Information |
|--------------------------------|-----------------------|---|
| Amplitude Range Control | | RF Input Autorange, Manually set Max Total Pwr Manually set Input Atten |

| | Specifications | Supplemental Information |
|--|---------------------------------|---------------------------------|
| External Gain/Attenuation Correction Base gain, base attenuation, mobile gain, mobile attenuation Range Resolution | 0 to 81.9 dB 0.01 dB | |

| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| Trigger Trigger source (Actual available choices dependent on measurement) (<i>Option B7D and B7E</i>) | Free run, external Add RF Burst and frame | |

Agilent E4402B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|---|-------------------------------------|---------------------------------|
| RF burst trigger <i>(Option B7E)</i> | | |
| Peak carrier power range ^a | 30 to -25 dBm | 30 to -30 dBm, typical |
| Preamp On <i>(Option 1DS)</i> | 30 to -45 dBm | 30 to -50 dBm, typical |
| Trigger level range | 0 to -25 dB relative to signal peak | |

a. With trigger level set to -6 dB.

| | Specifications | Supplemental Information |
|--|-----------------------|---|
| Burst Sync <i>(Requires Option AYZ or B7D)</i> | | |
| Source <i>(Actual available choices dependent on measurement)</i> | RF amplitude, none | |
| <i>(Option B7D and B7E)</i> | Add training sequence | |
| Training sequence code | | GSM defined 0 to 7 Auto (search) or Manual |
| Burst type | | Normal (TCH and CCH) Sync (SCH) Access (RACH) |

General

| | Specifications | Supplemental Information |
|--------------------------|----------------|--------------------------|
| Temperature Range | | |
| Operating | 0 to 55 °C | Floppy disk 10 to 40 °C |
| Storage | -40 to 75 °C | |

| | Specifications | Supplemental Information |
|---------------------------------|----------------|----------------------------|
| Audible Noise (ISO 7779) | | |
| Sound Pressure at 25 °C | | <40 dBa, (<4.6 Bels power) |

| | Specifications | Supplemental Information |
|-------------------------------|---|--------------------------|
| Military Specification | Has been type tested to the environmental specifications of MIL-PRF-28800F class 3. | |

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

| | Specifications | Supplemental Information |
|-------------------------|----------------|--|
| Immunity Testing | | |
| Radiated Immunity | | Testing was done at 3 V/m according to IEC 801-3/1984. When the analyzer tuned frequency is identical to the immunity test signal frequency there may be signals of up to -60 dBm displayed on the screen. |
| Electrostatic Discharge | | Air discharges of up to 8 kV were applied according to IEC 801-2/1991. Discharges to center pins of any of the connectors may cause damage to the associated circuitry. |

Agilent E4402B Specifications and Characteristics
General

| | Specifications | Supplemental Information |
|----------------------------|--|---|
| Power Requirements | | Uses CUKonverter® topology in the power supply. |
| ac Operation | | |
| Voltage, frequency | 90 to 132 V rms, 47 to 440 Hz 195 to 250 V rms, 47 to 66 Hz | |
| Power Consumption, On | <300 W | |
| Power Consumption, Standby | <5 W | |
| dc Operation | | |
| Voltage | 12 to 20 Vdc | |
| Power Consumption | <200 W | |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| Measurement Speed | | |
| Local Measurement and Display Update rate ^a | | |
| Sweep points = 101 | | ≥ 45/s, characteristic |
| Sweep points = 401 | | ≥ 30/s, characteristic |
| Remote Measurement and GPIB Transfer Rate ^{bc} (Option A4H) | | |
| Sweep points = 101 | | ≥ 45/s, characteristic |
| Sweep points = 401 | | ≥ 30/s, characteristic |
| RF Center Frequency Tune, Measure, and GPIB Transfer Time ^{bd} (Option A4H) | | |
| Sweep points = 101 | | ≤ 75 ms, characteristic |
| Sweep points = 401 | | ≤ 90 ms, characteristic |

- a. Factory preset, auto align Off, fixed center frequency, RBW = 1 MHz, and span >10 MHz and ≤600 MHz.
- b. Display Off (:DISPlay:ENABle OFF), and 32-bit integer data format (:FORMat:DATA INT,32), if Option AYX or A4J is installed, disable sweep ramp, (:SYStem:PORTs:IFVSweep:ENABle OFF), markers Off, single sweep, measured with IBM compatible PC with 550 MHz Pentium® III running Windows® NT 4.0, one meter GPIB cable, National Instruments PCI-GPIB card and NI-48.2 DLL.
- c. Factory preset, auto align Off, RBW = 1 MHz, span= 20 MHz, fixed center frequency, average of 100 measurements.

- d. Factory preset, auto align Off, RBW = 1 MHz, span= 20 MHz, and center frequency tune step size = 50 MHz.

| | Specifications | Supplemental Information |
|---|-----------------------|-----------------------------------|
| Data Storage | | |
| Internal | | 200 Traces or States ^a |
| External (10 to 40 °C) 3.5" 1.44 MB, MS-DOS [®] compatible floppy disk | | 200 Traces or States ^a |

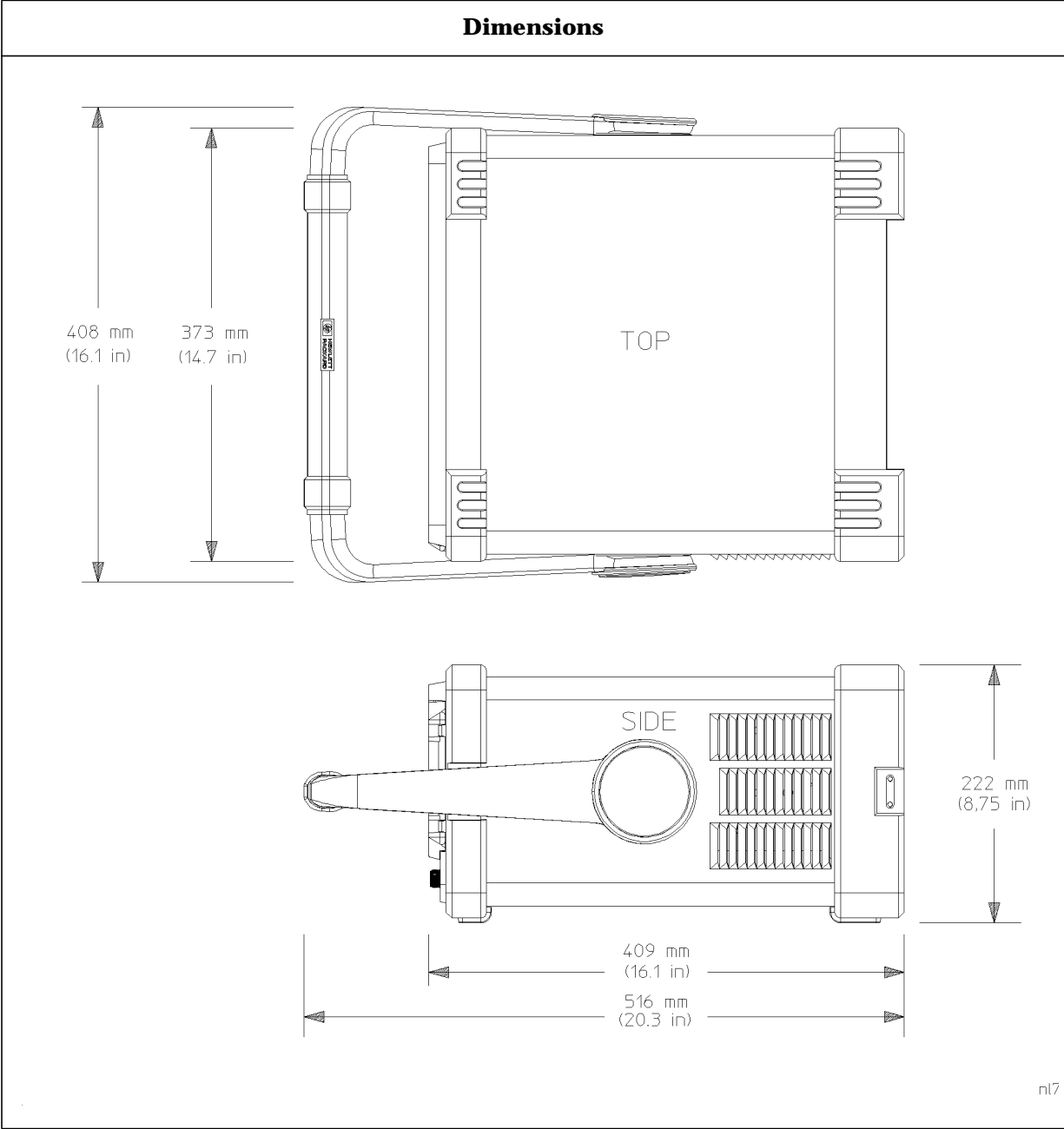
- a. When storing traces set to 401 points.

| | Specifications | Supplemental Information |
|------------------------------------|-----------------------|---------------------------------|
| Downloadable Program Memory | | 2 MB available memory |
| <i>(Option B72)</i> | | 10 MB available memory |

| | Specifications | Supplemental Information |
|-----------------------------------|-----------------------|---|
| Demod Tune and Listen | | |
| Demod | AM | Internal speaker, front-panel earphone jack and front-panel volume control. |
| <i>(Option BAA)</i> | Add FM | |
| <i>(Option A4J, AYX, or BAA)</i> | | An uncalibrated demodulated signal is available on the AUX VIDEO OUT or EXT VIDEO OUT connectors at the rear panel. |

| | Specifications | Supplemental Information |
|---------------------------------|-----------------------|-----------------------------------|
| Weight (without options) | | |
| Net | | 15.5 kg (34.2 lb), characteristic |
| Shipping | | 27.4 kg (60.4 lb), characteristic |

Agilent E4402B Specifications and Characteristics
General



Inputs and Outputs

Front Panel

| | Specifications | Supplemental Information |
|-------------------------------------|----------------|--------------------------|
| INPUT 50 Ω | | |
| Connector | Type-N female | |
| Impedance | | 50 Ω , nominal |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| RF OUT 50 Ω, (Option 1DN) | | |
| Connector | Type-N female | |
| Impedance | | 50 Ω , nominal |

| | Specifications | Supplemental Information |
|------------------------------------|----------------|--|
| AMPTD REF OUT^a | | Amplitude Reference |
| Connector | BNC female | |
| Impedance | | 50 Ω , nominal |
| Frequency | | 50 MHz |
| Frequency Accuracy | | Frequency reference error ^b |
| 50 Ω Amplitude ^c | | -20 dBm, nominal |

- Turn the amplitude reference on/off by pressing the keys: **Input/Output**, **Amptd Ref Out**.
- Frequency reference error = (aging rate \times period of time since adjustment + settability + temperature stability).
- The internal amplitude reference actual power is stored internally.

| | Specifications | Supplemental Information |
|--------------------|----------------|--|
| PROBE POWER | | |
| Voltage/Current | | +15 Vdc, $\pm 7\%$ at 150 mA max., characteristic -12.6 Vdc $\pm 10\%$ at 150 mA max., characteristic |

Agilent E4402B Specifications and Characteristics
Inputs and Outputs

| | Specifications | Supplemental Information |
|---------------------------------|-----------------------|---|
| EXT KEYBOARD^a | | Used for entering screen titles and filenames only. Interface compatible with most IBM-compatible PC keyboards. |
| Connector | 6-pin mini-DIN | |

a. The feature is not implemented in firmware revisions prior to A.04.00.

| | Specifications | Supplemental Information |
|----------------|-----------------------|----------------------------------|
| Speaker | | Front panel knob controls volume |

| | Specifications | Supplemental Information |
|------------------|--|--|
| Headphone | | Front panel knob controls volume |
| Connector | 3.5 mm (1/8 inch) miniature audio jack | |
| Power Output | | 0.2 W into 4 Ω , characteristic |

Rear Panel

| | Specifications | Supplemental Information |
|-----------------------|-----------------------|---------------------------------|
| 10 MHz REF OUT | | |
| Connector | BNC female | |
| Impedance | | 50 Ω , nominal |
| Output Amplitude | | >0 dBm, characteristic |

| | Specifications | Supplemental Information |
|-----------------------|-----------------------|---|
| 10 MHz REF IN | | |
| Connector | BNC female | Note: Analyzer noise sidebands and spurious response performance may be affected by the quality of the external reference used. |
| Impedance | | |
| Input Amplitude Range | | |
| Frequency | | |
| | | 50 Ω, nominal |
| | | -15 to +10 dBm, characteristic |
| | | 10 MHz, nominal |

| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| EXT REF IN <i>(Option B7E)</i> | | |
| Connector | BNC, female | 50 Ω, nominal |
| Impedance | | |
| Input amplitude range | -5 to 10 dBm | |
| Frequency | 1 to 30 MHz, selectable | |
| Frequency lock range | $\pm 5 \times 10^{-6}$ of specified external reference input frequency | |
| | | |

| | Specifications | Supplemental Information |
|--|-----------------------|------------------------------------|
| 10 MHz OUT <i>(Option B7E)</i> | | |
| Connector | BNC, female | 50 Ω, nominal |
| Impedance | | |
| Frequency | | |
| Level | | |
| | | 10 MHz, nominal |
| | | 0 dBm when Option 10 MHz Out is On |

Agilent E4402B Specifications and Characteristics
Inputs and Outputs

| | Specifications | Supplemental Information |
|--|-----------------------|---|
| GATE TRIG/EXT TRIG IN Connector External Trigger Input Trigger Level Gate Trigger Input <i>(Option 1D6)</i> Minimum Pulse Width | BNC female | Selectable positive or negative edge initiates sweep in EXT TRIG mode (5 V TTL) >30 ns (5 V TTL) |

| | Specifications | Supplemental Information |
|---|-----------------------|---|
| GATE/HI SWP OUT Connector High Sweep Output Level Gate Output <i>(Option 1D6)</i> Level | BNC female | High = sweep; Low = retrace (5 V TTL) High = gate on; Low = gate off (5 V TTL) |

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

| | Specifications | Supplemental Information |
|--|-----------------------|---|
| AUX IF OUT <i>(Option A4J or AXX)</i> Connector Frequency Amplitude Range (for signal at reference level and for reference levels – input attenuation + preamp gain of –10 to –70 dBm) Impedance | BNC female | RBW \geq 1 kHz 21.4 MHz, nominal –10 dBm (uncorrected), characteristic 50 Ω , nominal |

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| AUX VIDEO OUT <i>(Option A4J or AXX)</i> Connector Amplitude Range (into >10 k Ω) | BNC female | RBW \geq 1 kHz 0 to 1 V (uncorrected), characteristic |

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| HI SWP IN <i>(Option A4J or AXX)</i> Connector Input | BNC female | Open collector, low resets and holds the sweep (5 V TTL) |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------------|
| HI SWP OUT <i>(Option A4J or AXX)</i> Connector Output | BNC female | High = sweep, Low = retrace (5 V TTL) |

Agilent E4402B Specifications and Characteristics
Inputs and Outputs

| | Specifications | Supplemental Information |
|--|-----------------------|------------------------------------|
| SWP OUT <i>(Option A4J or AYX)</i> Connector Amplitude | BNC female | 0 to +10 V ramp, characteristic |

| | Specifications | Supplemental Information |
|--|------------------------|---|
| GPIB Interface <i>(Option A4H)</i> Connector GPIB Codes | IEEE-488 bus connector | SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3 and C28 |

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| Serial Interface <i>(Option 1AX)</i> Connector | 9-pin D-SUB male | RS-232 |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| Parallel Interface <i>(Option A4H or 1AX)</i> Connector | 25-pin D-SUB female | Printer port only |

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| EXT VIDEO IN/TV TRIG OUT^a <i>(Option B7B or BAA)</i> Connector Impedance <i>(Option BAA without Option B7B)</i> <i>(Option BAA with Option B7B)</i> External Video Input Video Amplitude | BNC Female (75 Ω) | EXT VIDEO IN is the Baseband composite video input for TV trigger and picture on screen. TV TRIG OUT is the TV trigger output. 75 Ω nominal Feature not implemented 1 V _{p-p} , nominal, characteristic |

| | Specifications | Supplemental Information |
|------------------------------------|-----------------------|---|
| TV Trigger Output Amplitude | | Positive edge indicates start of selected TV line after sync. pulse TTL (0 V and 3.4 V with 75 Ω series resistance), characteristic |

- a. This connector is labelled EXT VIDEO IN on older spectrum analyzers and EXT VIDEO IN/TV TRIG OUT on newer spectrum analyzers.

| | Specifications | Supplemental Information |
|--|---------------------------|---|
| EXT VIDEO OUT <i>(Option B7B or BAA)</i> Connector Impedance <i>(Option BAA without Option B7B)</i> Amplitude <i>(Option BAA with Option B7B)</i> Amplitude TV Source: SA TV Source and EXT VIDEO IN | BNC female (75 Ω) | Baseband video output RBW \geq 1 kHz 75 Ω , nominal 0 to 1 V (uncorrected), characteristic 0 to 1 V (uncorrected), characteristic Same as level at EXT VIDEO IN/TV TRIG OUT, characteristic |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| EXT FRAME SYNC <i>(Option B7D)</i> Connector Level | BNC, female | 5 V TTL |

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 (if accompanied by a year, it is the year when the design was proven).



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)

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 products

Product Name: Spectrum Analyzer

Model Number: HP E4401B, HP E4402B, HP E4403B,
HP E4404B, HP E4405B, HP E4407B,
HP E4408B, HP E4411B

Product Options: This declaration covers all options of the above products.

Conform 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 products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.



Santa Rosa, CA, USA 4 Feb. 2000

Greg Pfeiffer/Quality Engineering Manager

For further information, please contact your local Agilent Technologies sales office, agent or distributor.

3 Agilent E4403B Specifications and Characteristics

About This Chapter

This chapter contains specifications and characteristics for the E4403B spectrum analyzer. The distinction between specifications and characteristics is described as follows.

- Specifications describe the performance of parameters covered by the product warranty. (The temperature range is 0 °C to 55 °C, unless otherwise noted.)
- Characteristics describe product performance that is useful in the application of the product, but is not covered by the product warranty.
- Typical performance describes additional product performance information that is not covered by the product warranty. It is performance beyond an indicated specification, that most units will exhibit.
- Nominal values indicate the expected, but not warranted, value of a parameter.

The following conditions must be met for the analyzer to meet its specifications.

- The analyzer is within the one year calibration cycle.
- If **Auto Align All** is selected:
 - After 2 hours of storage within the operating temperature range.
 - 5 minutes after the analyzer is turned on with sweep times less than 4 seconds.
 - After the front-panel amplitude reference is connected to the INPUT, and **Align Now RF** has been run, after the analyzer is turned on. And, once every 24 hours, or if ambient temperature changes more than 30 °C.
- If **Auto Align Off** is selected:
 - When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.
 - After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now All** has been run.
 - When **Align Now All** is run:
 - Every hour
 - If the ambient temperature changes more than 3 °C
 - If the 10 MHz reference changes

- When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):
 - Every 24 hours
 - If the ambient temperature changes more than 30 °C
- ☐ If **Auto Align All but RF** is selected:
 - When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.
 - After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now RF** has been run.
 - When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):
 - Every hour
 - If the ambient temperature changes more than 3 °C

Frequency

| | Specifications | Supplemental Information |
|------------------------|----------------|--------------------------|
| Frequency Range | 9 kHz to 3 GHz | |

| | Specifications | Supplemental Information |
|----------------------------|------------------------------|---|
| Frequency Reference | | |
| Aging Rate | $\pm 2 \times 10^{-6}$ /year | $\pm 1.0 \times 10^{-7}$ /day, characteristic |
| Settability | $\pm 5 \times 10^{-7}$ | |
| Temperature Stability | $\pm 5 \times 10^{-6}$ | |

| | Specifications | Supplemental Information |
|--|---|--------------------------|
| Frequency Readout Accuracy (Start, Stop, Center, Marker) | $\pm((\text{frequency indication} \times \text{frequency reference error}^a) + 0.75\% \text{ of span} + 15\% \text{ of RBW} + 10 \text{ Hz})$ | |

a. Frequency reference error = (aging rate \times period of time since adjustment + settability + temperature stability).

| | Specifications | Supplemental Information |
|---------------------------------|--|--------------------------|
| Marker Frequency Counter | | |
| Resolution | Selectable from 1 Hz to 100 kHz | |
| Accuracy ^a | $\pm(\text{marker frequency} \times \text{frequency reference error}^b + \text{counter resolution})$ | |

a. Marker level to displayed noise level > 25 dB, RBW/ Span \geq 0.002, frequency offset = 0 Hz.

b. Frequency reference error = (aging rate \times period of time since adjustment + settability + temperature stability).

| | Specifications | Supplemental Information |
|-----------------------|-----------------------------------|---------------------------------|
| Frequency Span | | |
| Range | 0 Hz (zero span), 100 Hz to 3 GHz | |
| Resolution | 2 Hz | |
| Accuracy | ±1.0% of span | |

| | Specifications | Supplemental Information |
|---------------------------------------|---|--|
| Sweep Time | | |
| Range | 4 ms to 4000 s ^a | |
| Tracking Generator On (Option 1DN) | | 50 ms is the minimum sweep time |
| 4 ms to 4000 s ^a | ±1% | |
| Sweep Trigger ^b | Free Run, Single, Line, Video, External, Delayed, Offset ^c | |
| Delayed Trigger ^d | | |
| Range | 1 μs to 400 s | |
| Resolution | $\frac{\text{delay in seconds}}{65000}$ rounded up to nearest μs | |
| Accuracy | ±(500 ns +(0.01% of delay)) | |
| Offset Trigger ^c | | |
| Resolution | $\frac{\text{sweep time}}{400}$ | |
| Range | ±320 ms to ±323 ks | Where ST = sweep time $\frac{-32766 \times ST}{400}$ to $\frac{32365 \times ST}{400}$ |

- a. For firmware revisions prior to A.04.00, 5 ms to 2000 s.
- b. Auto align is suspended in video, external, gate, and delayed trigger modes while waiting for a trigger event to occur.
- c. For firmware revision A.04.00 or later.
- d. Delayed trigger is available with line and external trigger.

Agilent E4403B Specifications and Characteristics
Frequency

| | Specifications | Supplemental Information |
|-----------------------------|-----------------------|---------------------------------|
| Sweep (trace) Points | 401 | |

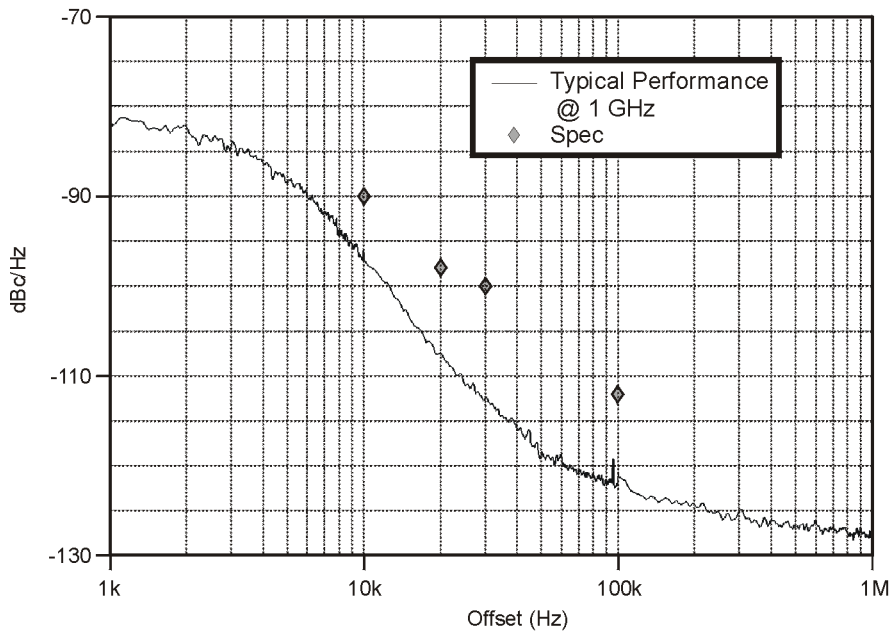
| | Specifications | Supplemental Information |
|--|---|--|
| Resolution Bandwidth (RBW) | | |
| Range | | |
| –3 dB bandwidth | 1 kHz to 3 MHz, in 1-3-10 sequence, 5 MHz | |
| –6 dB bandwidth (EMI) | 9 kHz and 120 kHz | |
| Accuracy | | |
| 1 kHz to 3 MHz RBW | ±15% | |
| 5 MHz RBW | ±30% | |
| Shape | | |
| 1 kHz to 5 MHz RBW | | Synchronously tuned four poles, approximately Gaussian shape |
| Selectivity (60 dB/3 dB bandwidth ratio) | | |
| 1 kHz to 5 MHz RBW | | <15:1, characteristic |

| | Specifications | Supplemental Information |
|--------------------------------------|-----------------------------------|---|
| Video Bandwidth (VBW) (–3 dB) | | |
| Range | 30 Hz to 1 MHz in 1-3-10 sequence | 3 MHz, characteristic |
| Accuracy | | ±30%, characteristic |
| Shape | | Post detection, single pole low-pass filter used to average displayed noise |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| Stability | | |
| Noise Sidebands (Offset from CW signal with 1 kHz RBW, 30 Hz VBW and sample detector) | | |

| | Specifications | Supplemental Information |
|--|-----------------------|--------------------------|
| ≥10 kHz | ≤ -90 dBc/Hz | |
| ≥20 kHz | ≤ -98 dBc/Hz | |
| ≥30 kHz | ≤ -100 dBc/Hz | |
| ≥100 kHz | ≤ -112 dBc/Hz | |
| Residual FM | | |
| 1 kHz RBW, 1 kHz VBW | ≤150 Hz p-p in 100 ms | |
| System-Related Sidebands, offset from CW signal | | |
| ≥30 kHz | ≤ -65 dBc | |

Noise Sidebands Normalized to 1 Hz Versus Offset From Carrier



w174b

Amplitude

Amplitude specifications do not apply for the negative peak detector mode.

| | Specifications | Supplemental Information |
|--------------------------|---|---|
| Measurement Range | Displayed Average Noise Level to Maximum Safe Input Level | |
| Input Attenuator Range | 0 to 65 dB, in 5 dB steps | 0 to 75 dB, in 5 dB steps, characteristic |

| | Specifications | Supplemental Information |
|--|-----------------|--------------------------|
| Maximum Safe Input Level | | |
| Average Continuous Power (Input attenuator setting ≥ 5 dB) | +30 dBm (1 W) | |
| Peak Pulse Power (for <10 μ sec pulse width, $<1\%$ duty cycle, and input attenuation ≥ 30 dB) | +50 dBm (100 W) | |
| dc | 100 Vdc | |

| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| 1 dB Gain Compression | | |
| Total power at input mixer ^{ab} 50 MHz to 3.0 GHz | 0 dBm | |

- a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).
- b. For resolution bandwidths 1 kHz to 30 kHz, the maximum input signal amplitude must be \leq reference level +10 dB.

| | Specifications | Supplemental Information |
|---|--|--|
| <p>Displayed Average Noise Level</p> <p>(Input terminated, 0 dB attenuation, sample detector, Reference Level = -70 dBm)</p> <p>1 MHz to 10 MHz</p> <p>10 MHz to 1.0 GHz</p> <p>1.0 GHz to 2.0 GHz</p> <p>2.0 GHz to 3.0 GHz</p> | <p>1 kHz RBW 30 Hz VBW</p> <p>≤ -117 dBm</p> <p>≤ -116 dBm</p> <p>≤ -114 dBm</p> | <p>1 kHz RBW 30 Hz VBW</p> <p>≤ -117 dBm, characteristic</p> |

| | Specifications | Supplemental Information |
|---|--|---------------------------------|
| <p>Display Range</p> <p>Log Scale</p> <p>Linear Scale</p> <p>Scale Units</p> | <p>Ten divisions displayed; 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps</p> <p>Calibrated 0 to -85 dB from Reference Level</p> <p>Ten divisions</p> <p>dBm, dBmV, dBμV, V, and W</p> | |

| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| <p>Marker Readout Resolution</p> <p>Log scale</p> <p>0 to -85 dB from ref level</p> <p>Linear scale</p> | <p>0.04 dB</p> <p>0.01% of Reference Level</p> | |

Agilent E4403B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|--|--|--------------------------|
| Frequency Response 50 Ω, Absolute ^a /Relative 9 kHz to 3.0 GHz 10 dB attenuation 20 to 30 °C 0 to 55 °C | ± 0.5 dB ± 1.0 dB | |

a. Absolute flatness values are referenced to the amplitude at 50 MHz.

| | Specifications | Supplemental Information |
|---|---|--------------------------|
| Input Attenuation Switching Uncertainty at 50 MHz Attenuator Setting 0 dB to 5 dB 10 dB 15 dB 20 to 65 dB attenuation | ± 0.3 dB Reference ± 0.3 dB $\pm (0.1 \text{ dB} + 0.01 \times \text{Attenuator Setting})$ | |

| Attenuation Accuracy Relative to the 10 dB Attenuator Setting, Characteristic | | |
|--|----------------------|--|
| | Frequency Range | |
| Attenuation | 9 kHz–3.0 GHz | |
| 0 dB | ± 0.3 dB | |
| 5 dB | ± 0.3 dB | |
| 10 dB | Reference | |
| 15 dB | ± 0.4 dB | |
| 20 dB | ± 0.4 dB | |
| 25 dB | ± 0.5 dB | |
| 30 dB | ± 0.5 dB | |
| 35 dB | ± 0.6 dB | |
| 40 dB | ± 0.6 dB | |
| 45 dB | ± 0.7 dB | |

| Attenuation Accuracy Relative to the 10 dB Attenuator Setting, Characteristic | | |
|--|------------------------|--|
| | Frequency Range | |
| Attenuation | 9 kHz–3.0 GHz | |
| 50 dB | ±0.7 dB | |
| 55 dB | ±0.9 dB | |
| 60 dB | ±0.9 dB | |
| 65 dB | ±1.0 dB | |

| | Specifications | Supplemental Information |
|---|--|---------------------------------|
| Absolute Amplitude Accuracy | | |
| At reference settings ^a | ±0.4 dB | |
| Overall Amplitude Accuracy ^b | | |
| 20 to 30 °C | ± (0.6 dB + Absolute Frequency Response) | |

- a. Settings are: reference level –20 dBm; input attenuation 10 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, signal at reference level.
- b. For reference level 0 to –50 dBm; input attenuation 10 dB; RBW 1 kHz; VBW 1 kHz; scale log, log range 0 to –50 dB from reference level; sweep time coupled; signal input 0 to –50 dBm; span ≤20 kHz.

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| RF Input VSWR (at tuned frequency) | | |
| Attenuator setting 0 dB | | |
| 100 kHz to 3 GHz | | ≤3.0:1, characteristic |
| Attenuator setting 5 dB | | |
| 100 kHz to 3 GHz | | ≤1.6:1, characteristic |
| Attenuator setting 10 to 65 dB | | |
| 9 kHz to 100 kHz | | ≤2.0:1, characteristic |
| 100 kHz to 3 GHz | | ≤1.4:1, characteristic |

Agilent E4403B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| Auto Alignment^a Sweep-to-sweep variation | | ±0.1 dB, characteristic |

a. Set Auto Align to Off and use Align Now, All to eliminate this variation.

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| Resolution Bandwidth Switching Uncertainty (at Reference Level) | | |
| 1 kHz RBW | Reference | |
| 3 kHz to 3 MHz RBW | ±0.3 dB | |
| 5 MHz RBW | ±0.6 dB | |

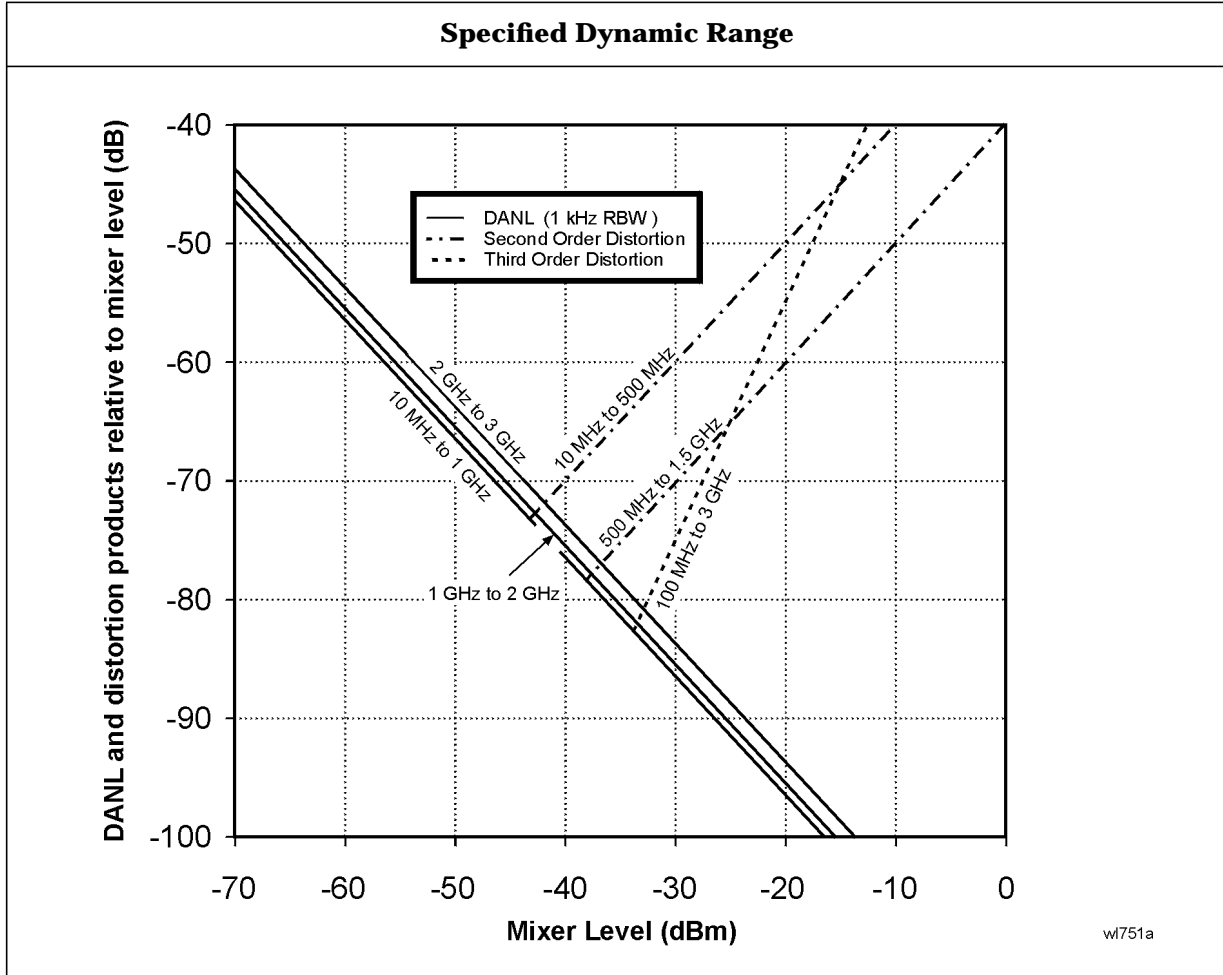
| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| Reference Level | | |
| Range | -149.9 dBm to maximum mixer level + attenuator setting | |
| Resolution | | |
| Log Scale | ±0.1 dB | |
| Linear Scale | ±0.12% of Reference Level | |
| Accuracy (at a fixed frequency, a fixed attenuator, and referenced to -30 dBm) | | |
| Reference Level (dBm) – input attenuator setting (dB) | | |
| -10 dBm to > -60 dBm | ±0.3 dB | |
| -60 dBm to > -85 dBm | ±0.5 dB | |
| -85 dBm to -90 dBm | ±0.7 dB | |

| | Specifications | Supplemental Information |
|--|-----------------------------|---------------------------------|
| Display Scale Switching Uncertainty | | |
| Switching between Linear and Log | ±0.15 dB at Reference Level | |
| Log Scale Switching | No error | |

| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| Display Scale Fidelity | | |
| Log Maximum Cumulative 0 to -85 dB from Reference Level | $\pm(0.3 \text{ dB} + 0.01 \times \text{dB from Reference Level})$ | |
| Log Incremental Accuracy 0 to -80 dB from reference level | $\pm 0.4 \text{ dB}/4 \text{ dB}$ | |
| Linear Accuracy | $\pm 2\%$ of Reference Level | |

| | Specifications | Supplemental Information |
|--|--|--|
| Spurious Responses | | |
| Second Harmonic Distortion | | |
| Input Signal | | |
| 10 MHz to 500 MHz | $< -60 \text{ dBc}$ for -30 dBm signal at input mixer ^a | +30 dBm SHI (second harmonic intercept) |
| 500 MHz to 1.5 GHz | $< -70 \text{ dBc}$ for -30 dBm signal at input mixer ^a | +40 dBm SHI |
| Third Order Intermodulation Distortion | | |
| 10 MHz to 100 MHz | | +5 dBm TOI (third order intercept), characteristic |
| 100 MHz to 3 GHz | $< -75 \text{ dBc}$ for two -30 dBm signals at input mixer ^a and >50 kHz separation | +7.5 dBm TOI |
| Other Input Related Spurious | | |
| >30 kHz offset | $< -65 \text{ dBc}$ for -20 dBm signal at input mixer ^a | |

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



| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| Residual Responses (Input terminated and 0 dB attenuation) 150 kHz to 3 GHz | < -90 dBm | |

Options

Tracking Generator (Option 1DN)

The spectrum analyzer tracking generator combination will meet its specification after a cable (8120-5148) and adapter are connected between RF OUT and INPUT and **Align Now, TG** has been run.

| | Specifications | Supplemental Information |
|----------------|----------------|--------------------------|
| Warm-Up | 5 minutes | |

| | Specifications | Supplemental Information |
|-------------------------------|------------------|--------------------------|
| Output Frequency Range | 9 kHz to 3.0 GHz | |

| | Specifications | Supplemental Information |
|---|--------------------------|--------------------------|
| Output Power Level | | |
| Range | -2 to -66 dBm | |
| Resolution | 0.1 dB | |
| Absolute Accuracy (at 50 MHz with coupled source attenuator, referenced to -20 dBm) | ± 0.75 dB | |
| Vernier | | |
| Range | 8 dB | |
| Accuracy (with coupled source attenuator, 50 MHz, -20 dBm) | | |
| Incremental | ± 0.2 dB/dB | |
| Cumulative | ± 0.5 dB, total | |
| Output Attenuator Range | 0 to 56 dB in 8 dB steps | |

| | Specifications | Supplemental Information |
|-----------------------------------|----------------|---------------------------------------|
| Maximum Safe Reverse Level | | +30 dBm (1 W), 50 Vdc, characteristic |

Agilent E4403B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|---------------------------|---|---------------------------------|
| Output Power Sweep | | |
| Range | (-10 to -2 dBm) – (Source Attenuator Setting) | |
| Resolution | 0.1 dB | |
| Accuracy (zero span) | <1 dB peak-to-peak | |

| | Specifications | Supplemental Information |
|-------------------------------|-----------------------|---------------------------------|
| Output Flatness | | |
| Referenced to 50 MHz, -20 dBm | | |
| 9 kHz to 10 MHz | ±3 dB | |
| 10 MHz to 3 GHz | ±2 dB | |

| | Specifications | Supplemental Information |
|-------------------------------------|-----------------------|---------------------------------|
| Spurious Outputs | | |
| (-2 dBm output) | | |
| Harmonic Spurs | | |
| TG Output 9 kHz to 20 kHz | ≤ -15 dBc | |
| TG Output 20 kHz to 3 GHz | ≤ -25 dBc | |
| Non-harmonic Spurs | | |
| TG Output 9 kHz to 2 GHz | ≤ -27 dBc | |
| TG Output 2 GHz to 3 GHz | ≤ -23 dBc | |
| LO Feedthrough | | |
| LO Frequency 3.921409 to 6.9214 GHz | ≤ -16 dBm | |

| | Specifications | Supplemental Information |
|----------------------|--|---------------------------------|
| Dynamic Range | Maximum Output Power Level – Displayed Average Noise Level | |

| | Specifications | Supplemental Information |
|------------------------|----------------|--|
| Output Tracking | | |
| Drift | | 1.5 kHz/5 minute, characteristic |
| Swept Tracking Error | | Usable in 1 kHz RBW after 5 minutes of warm-up |

| | Specifications | Supplemental Information |
|-------------------------------|----------------|----------------------------|
| RF Power-Off Residuals | | |
| 9 kHz to 3 GHz | | < -120 dBm, characteristic |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| Output Attenuator Repeatability | | |
| 9 kHz to 300 MHz | | ±0.1 dB, characteristic |
| 300 MHz to 2.0 GHz | | ±0.2 dB, characteristic |
| 2.0 GHz to 3 GHz | | ±0.3 dB, characteristic |

| | Specifications | Supplemental Information |
|--------------------|----------------|--------------------------|
| Output VSWR | | |
| 0 dB attenuation | | <2.0:1, characteristic |
| ≥ 8 dB attenuation | | <1.5:1, characteristic |

| | Specifications | Supplemental Information |
|-----------------------------------|----------------|--------------------------|
| Output Attenuator Accuracy | | |
| 0 dB | Reference | ±0.5 dB, characteristic |
| 8 dB | | ±0.5 dB, characteristic |
| 16 dB | | |
| 24 dB | | ±0.5 dB, characteristic |
| 32 dB | | ±0.6 dB, characteristic |
| 40 dB | | ±0.8 dB, characteristic |
| 48 dB | | ±1.0 dB, characteristic |
| 56 dB | | ±1.1 dB, characteristic |

| |
|--|
| Tracking Generator Output Accuracy |
| Relative Accuracy (Referred to -20 dBm) = Output Attenuator Accuracy + Vernier Accuracy + Output Flatness |
| Absolute Accuracy = Relative Accuracy (Referred to -20 dBm) + Absolute Accuracy at 50 MHz |

General

| | Specifications | Supplemental Information |
|--------------------------|----------------|--------------------------|
| Temperature Range | | |
| Operating | 0 to 55 °C | Floppy disk 10 to 40 °C |
| Storage | -40 to 75 °C | |

| | Specifications | Supplemental Information |
|---------------------------------|----------------|----------------------------|
| Audible Noise (ISO 7779) | | |
| Sound Pressure at 25 °C | | <40 dBa, (<4.6 Bels power) |

| | Specifications | Supplemental Information |
|-------------------------------|---|--------------------------|
| Military Specification | Has been type tested to the environmental specifications of MIL-PRF-28800F class 3. | |

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

| | Specifications | Supplemental Information |
|-------------------------|----------------|--|
| Immunity Testing | | |
| Radiated Immunity | | Testing was done at 3 V/m according to IEC 801-3/1984. When the analyzer tuned frequency is identical to the immunity test signal frequency there may be signals of up to -60 dBm displayed on the screen. |
| Electrostatic Discharge | | Air discharges of up to 8 kV were applied according to IEC 801-2/1991. Discharges to center pins of any of the connectors may cause damage to the associated circuitry. |

Agilent E4403B Specifications and Characteristics
General

| | Specifications | Supplemental Information |
|----------------------------|--|---|
| Power Requirements | | Uses CUKonverter® topology in the power supply. |
| ac Operation | | |
| Voltage, frequency | 90 to 132 V rms, 47 to 440 Hz 195 to 250 V rms, 47 to 66 Hz | |
| Power Consumption, On | <300 W | |
| Power Consumption, Standby | <5 W | |
| dc Operation | | |
| Voltage | 12 to 20 Vdc | |
| Power Consumption | <200 W | |

| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| Measurement Speed | | |
| Local Measurement and Display Update rate ^a | | ≥ 30/s, characteristic |
| Remote Measurement and GPIB Transfer Rate ^{bc} (<i>Option A4H</i>) | | ≥ 30/s, characteristic |
| RF Center Frequency Tune, Measure, and GPIB Transfer Time ^{bd} (<i>Option A4H</i>) | | ≤ 90 ms, characteristic |

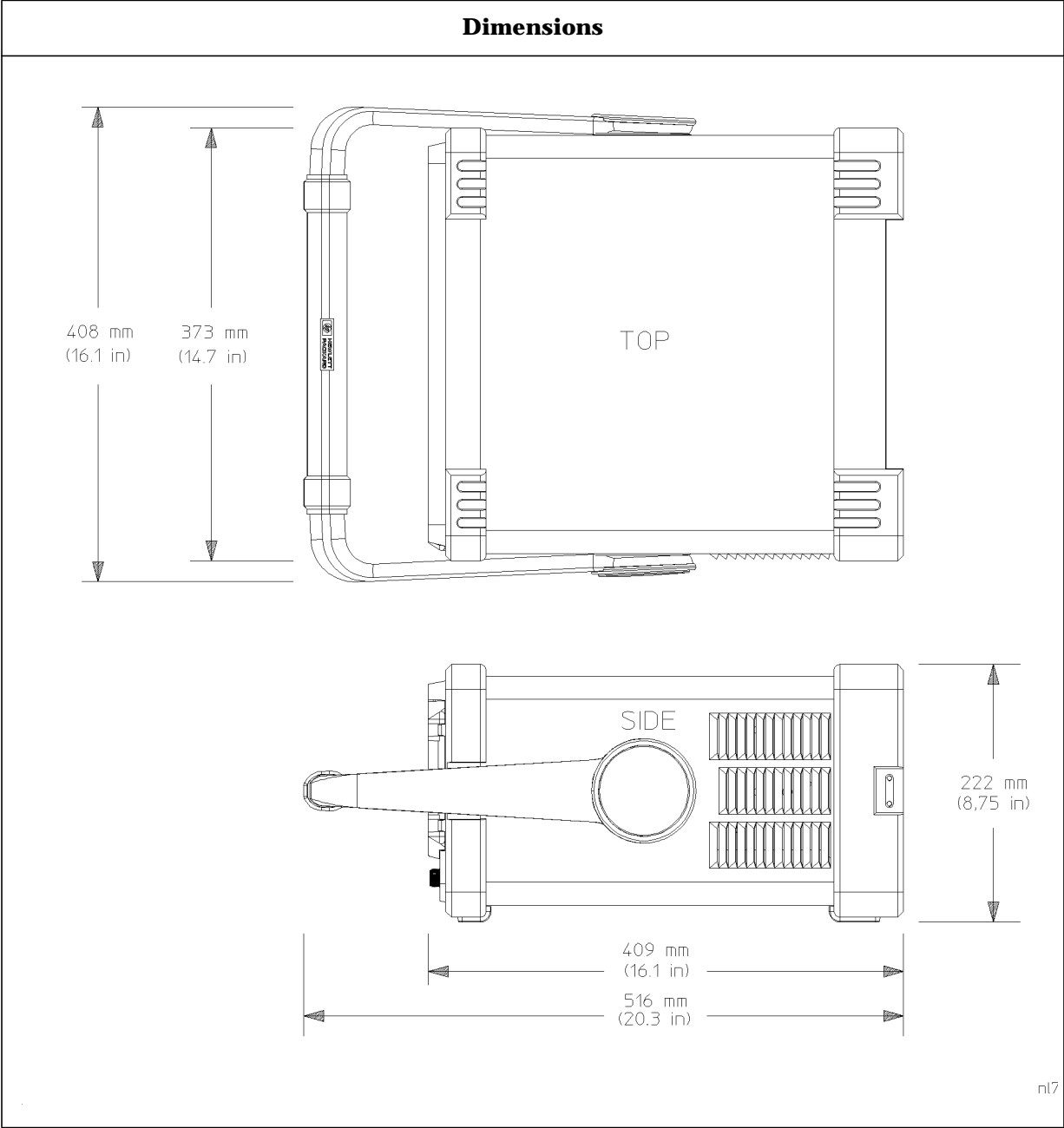
- a. Factory preset, auto align Off, fixed center frequency, RBW = 1 MHz, and span >10 MHz and ≤600 MHz.
- b. Display Off (:DISPlay:ENABle OFF), and 32-bit integer data format (:FORMat:DATA INT,32), if *Option A4J* is installed, disable sweep ramp, (:SYSTem:PORTs:IFVSweep:ENABle OFF), markers Off, single sweep, measured with IBM compatible PC with 550 MHz Pentium® III running Windows® NT 4.0, one meter GPIB cable, National Instruments PCI-GPIB card and NI-48.2 DLL.
- c. Factory preset, auto align Off, RBW = 1 MHz, span= 20 MHz, fixed center frequency, average of 100 measurements.
- d. Factory preset, auto align Off, RBW = 1 MHz, span= 20 MHz, and center frequency tune step size = 50 MHz.

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| Data Storage | | |
| Internal | | 200 Traces or States |
| External (10 to 40 °C) 3.5" 1.44 MB, MS-DOS® compatible floppy disk | | 200 Traces or States |

| | Specifications | Supplemental Information |
|----------------------------------|-----------------------|--|
| Demod Tune and Listen | | |
| Demod <i>(Option A4J)</i> | AM | Internal speaker, front-panel earphone jack and front-panel volume control. An uncalibrated demodulated signal is available on the AUX VIDEO OUT connector at the rear panel. |

| | Specifications | Supplemental Information |
|---------------------------------|-----------------------|-----------------------------------|
| Weight (without options) | | |
| Net | | 15.5 kg (34.2 lb), characteristic |
| Shipping | | 27.4 kg (60.4 lb), characteristic |

Agilent E4403B Specifications and Characteristics
General



Inputs and Outputs

Front Panel

| | Specifications | Supplemental Information |
|-------------------|----------------|--------------------------|
| INPUT 50 Ω | | |
| Connector | Type-N female | |
| Impedance | | 50 Ω, nominal |

| | Specifications | Supplemental Information |
|----------------------------------|----------------|--------------------------|
| RF OUT 50 Ω, (Option 1DN) | | |
| Connector | Type-N female | |
| Impedance | | 50 Ω, nominal |

| | Specifications | Supplemental Information |
|----------------------------------|----------------|--|
| AMPTD REF OUT^a | | Amplitude Reference |
| Connector | BNC female | |
| Impedance | | 50 Ω, nominal |
| Frequency | | 50 MHz |
| Frequency Accuracy | | Frequency reference error ^b |
| 50 Ω Amplitude ^c | | -20 dBm, nominal |

- a. Turn the amplitude reference on/off by pressing the keys: **Input/Output, Amptd Ref Out**.
- b. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).
- c. The internal amplitude reference actual power is stored internally.

| | Specifications | Supplemental Information |
|--------------------|----------------|--|
| PROBE POWER | | |
| Voltage/Current | | +15 Vdc, ±7% at 150 mA max., characteristic -12.6 Vdc ±10% at 150 mA max., characteristic |

Agilent E4403B Specifications and Characteristics
Inputs and Outputs

| | Specifications | Supplemental Information |
|---------------------------------|----------------|---|
| EXT KEYBOARD^a | | Used for entering screen titles and filenames only. Interface compatible with most IBM-compatible PC keyboards. |
| Connector | 6-pin mini-DIN | |

a. The feature is not implemented in firmware revisions prior to A.04.00.

| | Specifications | Supplemental Information |
|----------------|----------------|----------------------------------|
| Speaker | | Front panel knob controls volume |

| | Specifications | Supplemental Information |
|------------------|--|--|
| Headphone | | Front panel knob controls volume |
| Connector | 3.5 mm (1/8 inch) miniature audio jack | |
| Power Output | | 0.2 W into 4 Ω , characteristic |

Rear Panel

| | Specifications | Supplemental Information |
|-----------------------|----------------|--------------------------|
| 10 MHz REF OUT | | |
| Connector | BNC female | |
| Impedance | | 50 Ω , nominal |
| Output Amplitude | | >0 dBm, characteristic |

| | Specifications | Supplemental Information |
|-----------------------|-----------------------|---|
| 10 MHz REF IN | | |
| Connector | BNC female | Note: Analyzer noise sidebands and spurious response performance may be affected by the quality of the external reference used. |
| Impedance | | 50 Ω , nominal |
| Input Amplitude Range | | -15 to +10 dBm, characteristic |
| Frequency | | 10 MHz, nominal |

| | Specifications | Supplemental Information |
|------------------------------|-----------------------|---|
| GATE TRIG/EXT TRIG IN | | |
| Connector | BNC female | |
| External Trigger Input | | |
| Trigger Level | | Selectable positive or negative edge initiates sweep in EXT TRIG mode (5 V TTL) |

| | Specifications | Supplemental Information |
|------------------------|-----------------------|---------------------------------------|
| GATE/HI SWP OUT | | |
| Connector | BNC female | |
| High Sweep Output | | |
| Level | | High = sweep; Low = retrace (5 V TTL) |

| | Specifications | Supplemental Information |
|-------------------|-----------------------------------|---|
| VGA OUTPUT | | |
| Connector | VGA compatible, 15-pin mini D-SUB | |
| Format | | VGA (31.5 kHz horizontal, 60 Hz vertical sync rates, non-interlaced) Analog RGB |
| Resolution | 640 \times 480 | |

Agilent E4403B Specifications and Characteristics
Inputs and Outputs

| | Specifications | Supplemental Information |
|---|-----------------------|---|
| AUX IF OUT <i>(Option A4J)</i> Connector Frequency Amplitude Range (for signal at reference level and for reference levels – input attenuation of –10 to –70 dBm) Impedance | BNC female | 21.4 MHz, nominal –10 dBm (uncorrected), characteristic 50 Ω nominal |

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| AUX VIDEO OUT <i>(Option A4J)</i> Connector Amplitude Range (into >10 k Ω) | BNC female | 0 to 1 V (uncorrected), characteristic |

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| HI SWP IN <i>(Option A4J)</i> Connector Input | BNC female | Open collector, low resets and holds the sweep (5 V TTL) |

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------------|
| HI SWP OUT <i>(Option A4J)</i> Connector Output | BNC female | High = sweep, Low = retrace (5 V TTL) |

| | Specifications | Supplemental Information |
|---------------------------------------|-----------------------|------------------------------------|
| SWP OUT <i>(Option A4J)</i> | | |
| Connector | BNC female | |
| Amplitude | | 0 to +10 V ramp, characteristic |

| | Specifications | Supplemental Information |
|---|------------------------|---|
| GPIB Interface <i>(Option A4H)</i> | | |
| Connector | IEEE-488 bus connector | |
| GPIB Codes | | SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3 and C28 |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| Serial Interface <i>(Option 1AX)</i> | | |
| Connector | 9-pin D-SUB male | RS-232 |

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| Parallel Interface <i>(Option A4H or 1AX)</i> | | Printer port only |
| Connector | 25-pin D-SUB female | |

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 (if accompanied by a year, it is the year when the design was proven).



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)

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 products

Product Name: Spectrum Analyzer

Model Number: HP E4401B, HP E4402B, HP E4403B,
HP E4404B, HP E4405B, HP E4407B,
HP E4408B, HP E4411B

Product Options: This declaration covers all options of the above products.

Conform 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 products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.



Santa Rosa, CA, USA 4 Feb. 2000

Greg Pfeiffer/Quality Engineering Manager

For further information, please contact your local Agilent Technologies sales office, agent or distributor.

Agilent E4403B Specifications and Characteristics
Regulatory Information

About This Chapter

This chapter contains specifications and characteristics for the E4404B spectrum analyzer. The distinction between specifications and characteristics is described as follows.

- Specifications describe the performance of parameters covered by the product warranty. (The temperature range is 0 °C to 55 °C, unless otherwise noted.)
- Characteristics describe product performance that is useful in the application of the product, but is not covered by the product warranty.
- Typical performance describes additional product performance information that is not covered by the product warranty. It is performance beyond an indicated specification, that most units will exhibit.
- Nominal values indicate the expected, but not warranted, value of a parameter.

The following conditions must be met for the analyzer to meet its specifications.

- The analyzer is within the one year calibration cycle.
- If **Auto Align All** is selected:
 - After 2 hours of storage within the operating temperature range.
 - 5 minutes after the analyzer is turned on with sweep times less than 4 seconds.
 - After the front-panel amplitude reference is connected to the INPUT, and **Align Now RF** has been run, after the analyzer is turned on. And, once every 24 hours, or if ambient temperature changes more than 30 °C¹.
- If **Auto Align Off** is selected:
 - When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.
 - After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now All** has been run.
 - When **Align Now All** is run:

1. 10 °C if Option 1DS is active.

- Every hour
- If the ambient temperature changes more than 3 °C
- If the 10 MHz reference changes
- When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):
 - Every 24 hours
 - If the ambient temperature changes more than 30 °C¹
- If **Auto Align All but RF** is selected:
 - When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.
 - After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now RF** has been run.
 - When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):
 - Every hour
 - If the ambient temperature changes more than 3 °C

1. 10 °C if Option 1DS is active.

Frequency

| | Specifications | Supplemental Information |
|---------------------------------|---------------------|--------------------------|
| Frequency Range | | |
| dc Coupled | 9 kHz to 6.7 GHz | |
| ac Coupled | 100 kHz to 6.7 GHz | |
| Band | | |
| 0 | 9 kHz to 3.0 GHz | |
| 1 | 2.85 GHz to 6.7 GHz | |
| Preamp On (<i>Option 1D5</i>) | 1 MHz to 3 GHz | |

| | Specifications | Supplemental Information |
|----------------------------|------------------------------|---|
| Frequency Reference | | |
| Aging Rate | $\pm 2 \times 10^{-6}$ /year | $\pm 1.0 \times 10^{-7}$ /day, characteristic |
| Settability | $\pm 5 \times 10^{-7}$ | |
| Temperature Stability | $\pm 5 \times 10^{-6}$ | |

| | Specifications | Supplemental Information |
|---|------------------------------|---|
| High Stability Frequency Reference (<i>Option 1D5</i>) | | |
| Aging Rate | $\pm 1 \times 10^{-7}$ /year | $\pm 5 \times 10^{-10}$ /day, 7-day average after being powered on for 7 days, characteristic |
| Settability | $\pm 1 \times 10^{-8}$ | |
| Temperature Stability | | |
| 20 to 30 °C | $\pm 1 \times 10^{-8}$ | |
| 0 to 55 °C | $\pm 5 \times 10^{-8}$ | |
| Warm-Up (Internal frequency reference selected) | | |
| After 5 minutes | | $< \pm 1 \times 10^{-7}$ of final frequency, ^a characteristic |
| After 15 minutes | | $< \pm 1 \times 10^{-8}$ of final frequency, ^a characteristic |

- a. Final frequency is defined as frequency 60 minutes after power-on with analyzer set to internal frequency reference.

| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| Frequency Readout Accuracy (Start, Stop, Center, Marker) | $\pm((\text{frequency indication} \times \text{frequency reference error}^a) + 0.5\% \text{ of span} + \frac{\text{span}}{\text{sweep points} - 1} + 15\% \text{ of RBW} + 10 \text{ Hz})$ | |

- a. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).

| | Specifications | Supplemental Information |
|--|---|---------------------------------|
| Marker Frequency Counter Resolution Accuracy ^a | Selectable from 1 Hz to 100 kHz $\pm(\text{marker frequency} \times \text{frequency reference error}^b + \text{counter resolution})$ | For RBW ≥ 1 kHz |

- a. Marker level to displayed noise level > 25 dB, RBW/ Span ≥ 0.002, frequency offset = 0 Hz.
 b. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).

| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| Frequency Span Range Resolution Accuracy | 0 Hz (zero span), 100 Hz to 6.7 GHz 2 Hz $\pm(0.5\% \text{ of span} + 2 \times \frac{\text{span}}{\text{sweep points} - 1})$ | |

Agilent E4404B Specifications and Characteristics
Frequency

| | Specifications | Supplemental Information |
|---|--|---|
| Sweep Time | | |
| Range | 1 ms to 4000 s ^a | $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ to 4000 s |
| Tracking Generator On (Option 1DN) | | 50 ms is the minimum sweep time |
| Fast Time-domain Sweep (Option AYX) (For Span = 0 Hz, RBW ≥ 1 kHz) | 5 μs to 4000 s ^b | $\frac{\text{sweep points} - 1}{20 \text{ MHz}}$ to 4000 s |
| DSP and fast ADC (Option B7D) (For Span = 0 Hz, RBW ≥ 1 kHz) | 2.5 μs to 4000 s | $\frac{\text{sweep points} - 1}{40 \text{ MHz}}$ to 4000 s |
| Accuracy (Span = 0 Hz) | | |
| 1 ms to 4000 s ^a | ±1% | |
| (Option AYX) | ±1% | |
| 5 μs to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ | | |
| (Option B7D) | ±1% | |
| 2.5 μs to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ | | |
| Sweep Trigger ^{cd} | Free Run, Single, Line, Video, External, Delayed, Offset ^e | |
| (Option 1D6) | Add Gate | |
| (Option B7B) | Add TV | |
| Delayed Trigger ^{cf} | | |
| Range | 1 μs to 400 s | |
| Resolution | $\frac{\text{delay in seconds}}{65000}$ rounded up to nearest μs | |
| Accuracy | ±(500 ns +(0.01% of delay)) | |
| Offset Trigger ^e | | |
| Resolution | $\frac{\text{sweep time}}{\text{sweep points} - 1}$ | |

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| Range | ±320 ms to ±323 ks | Where ST = sweep time and SP = sweep points $\frac{-32766 \times ST}{SP - 1}$ to $\frac{(32766 - SP) \times ST}{SP - 1}$ |
| Fast Time-domain sweep (Option AYX) (For sweep times 5.0 μs to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$) | ±1.64 ms to ±249 ms | $\frac{-32766 \times ST}{SP - 1}$ to $\frac{(32766 - SP) \times ST}{SP - 1}$ |
| DSP and fast ADC (Option B7D) (For sweep times 2.5 μs to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$) | ±13 ms to ±5.15 s | $\frac{-524031 \times ST}{SP - 1}$ to $\frac{(524031 - SP) \times ST}{SP - 1}$ |

- a. For firmware revisions prior to A.04.00, 5 ms to 2000 s.
- b. For firmware revisions prior to A.04.00, 20 μs to 2000 s.
- c. Gate cannot be used simultaneously with delayed or TV trigger.
- d. Auto align is suspended in video, external, gate, and delayed trigger modes while waiting for a trigger event to occur.
- e. For firmware revision A.04.00 or later.
- f. Delayed trigger is available with line, external trigger, and TV trigger (Option B7B).

| | Specifications | Supplemental Information |
|-----------------------------|-----------------------|---------------------------------|
| Sweep (trace) Points | | |
| Range | 101 to 8192 | |

| | Specifications | Supplemental Information |
|-----------------------------------|---|--|
| Resolution Bandwidth (RBW) | | |
| Range | | |
| -3 dB bandwidth | 1 kHz to 3 MHz, in 1-3-10 sequence, 5 MHz | |
| -6 dB bandwidth (EMI) | 9 kHz and 120 kHz | |
| (Option 1DR) | | |
| -3 dB bandwidth | Adds 10, 30, 100, 300 Hz | |
| -6 dB bandwidth (EMI) | Add 200 Hz | |
| | | Only available in spans ≤ 5 MHz, sweep times ≥ $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$, and not usable with tracking generator on. (Option 1DN) |

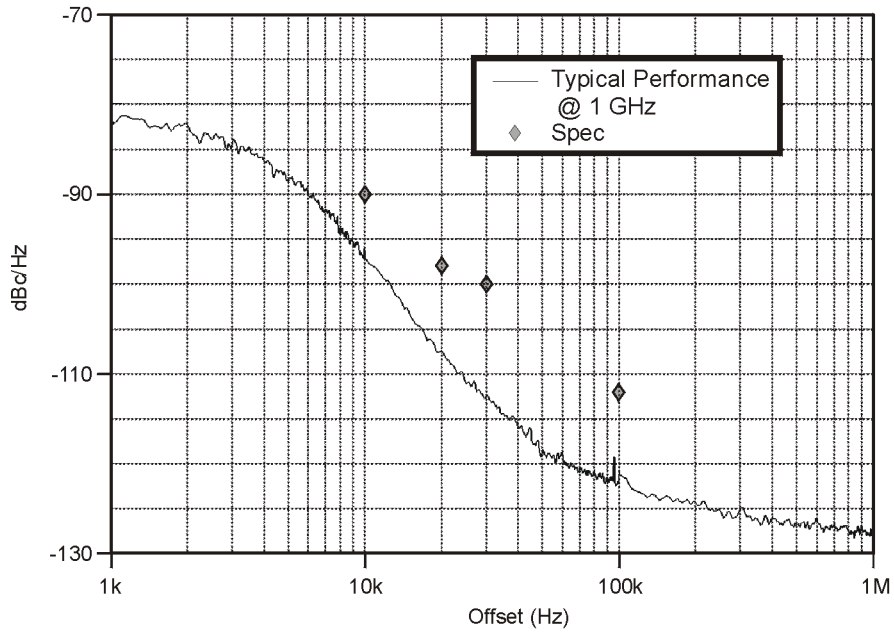
Agilent E4404B Specifications and Characteristics
Frequency

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| Accuracy 1 kHz to 3 MHz RBW 5 MHz RBW 10 Hz to 300 Hz RBW <i>(Option 1DR)</i> Shape 1 kHz to 5 MHz RBW 10 Hz to 300 Hz RBW <i>(Option 1DR)</i> Selectivity (60 dB/3 dB bandwidth ratio) 1 kHz to 5 MHz RBW 10 Hz to 300 Hz RBW <i>(Option 1DR)</i> | ±15% ±30% ±10% | Synchronously tuned four poles, approximately Gaussian shape Digital, approximately Gaussian shape <15:1, characteristic <5:1, characteristic |

| | Specifications | Supplemental Information |
|--|--|---|
| Video Bandwidth (VBW) (-3 dB) Range <i>(Option 1DR)</i> Accuracy Shape | 30 Hz to 1 MHz in 1-3-10 sequence Adds 1, 3, 10 Hz for RBW's <1 kHz | 3 MHz, characteristic ±30%, characteristic Post detection, single pole low-pass filter used to average displayed noise Video bandwidths below 30 Hz are digital bandwidths with anti-aliasing filtering. |

| | Specifications | Supplemental Information |
|--|--|--|
| Stability | | |
| Noise Sidebands (Offset from CW signal with 1 kHz RBW, 30 Hz VBW and sample detector) | | |
| ≥10 kHz | ≤ -90 dBc/Hz | |
| ≥20 kHz | ≤ -98 dBc/Hz | |
| ≥30 kHz | ≤ -100 dBc/Hz | |
| ≥100 kHz | ≤ -112 dBc/Hz | |
| Residual FM | | |
| 1 kHz RBW, 1 kHz VBW <i>(Option 1D5)</i> | ≤150 Hz p-p in 100 ms ≤100 Hz p-p in 100 ms | |
| 10 Hz RBW, 10 Hz VBW <i>(Option 1DR and 1D5)</i> | ≤2 Hz p-p in 20 ms | |
| 10 Hz RBW, 10 Hz VBW <i>(Option 1DR)</i> | | ≤10 Hz p-p in 20 ms, characteristic |
| System-Related Sidebands, offset from CW signal | | |
| ≥30 kHz | ≤ -65 dBc | |
| Line-Related Sidebands, offset from CW signal <i>(Option 1DR)</i> | | |
| <300 Hz | | ≤ -50 dBc, characteristic |
| >300 Hz to 30 kHz | | ≤ -55 dBc, characteristic |

Noise Sidebands Normalized to 1 Hz Versus Offset From Carrier



w174b

Amplitude

Amplitude specifications do not apply for the negative peak detector mode.

| | Specifications | Supplemental Information |
|--------------------------|---|---|
| Measurement Range | Displayed Average Noise Level to Maximum Safe Input Level | |
| Input Attenuator Range | 0 to 65 dB, in 5 dB steps | 0 to 75 dB, in 5 dB steps, characteristic |

| | Specifications | Supplemental Information |
|--|-----------------|--------------------------|
| Maximum Safe Input Level | | |
| Average Continuous Power (Input attenuator setting ≥ 5 dB) | +30 dBm (1 W) | |
| Peak Pulse Power (for <10 μ sec pulse width, $<1\%$ duty cycle, and input attenuation ≥ 30 dB) | +50 dBm (100 W) | |
| dc | | |
| dc Coupled | 0 Vdc | |
| ac Coupled | 50 Vdc | |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| 1 dB Gain Compression | | |
| Total power at input mixer ^{ab} | | |
| 50 MHz to 3.0 GHz | 0 dBm | |
| 3.0 GHz to 6.7 GHz | 0 dBm | |
| Preamp On (<i>Option 1DS</i>) | | |
| Total power at the preamp ^c | | -20 dBm, characteristic |

- Mixer power level (dBm) = input power (dBm) – input attenuation (dB).
- For resolution bandwidths 1 kHz to 30 kHz, the maximum input signal amplitude must be \leq reference level +10 dB.
- Total power at the preamp (dBm) = total power at the input (dBm) – input attenuation (dB).

Agilent E4404B Specifications and Characteristics
Amplitude

| | Specifications | | Supplemental Information | | |
|--|-------------------------------|------------------------|--|-------------------------------|---|
| Displayed Average Noise Level (Input terminated, 0 dB attenuation, sample detector, Reference Level = -70 dBm) | | | | | |
| | | 1 kHz RBW 30 Hz VBW | 10 Hz RBW 1 Hz VBW <i>(Option 1DR)</i> | 1 kHz RBW 30 Hz VBW | 10 Hz RBW 1 Hz VBW <i>(Option 1DR)</i> |
| | 1 MHz to 10 MHz | | | ≤ -116 dBm, characteristic | ≤ -134 dBm, characteristic |
| | 10 MHz to 1.0 GHz | ≤ -116 dBm | ≤ -135 dBm | | |
| | 1.0 GHz to 2.0 GHz | ≤ -115 dBm | ≤ -134 dBm | | |
| | 2.0 GHz to 3.0 GHz | ≤ -112 dBm | ≤ -131 dBm | | |
| | 3.0 GHz to 6.0 GHz | ≤ -112 dBm | ≤ -131 dBm | | |
| | 6.0 GHz to 6.7 GHz | ≤ -110 dBm | ≤ -129 dBm | | |
| | Preamp On <i>(Option 1DS)</i> | 1 kHz RBW 30 Hz VBW | 10 Hz RBW 1 Hz VBW <i>(Option 1DR)</i> | 1 kHz RBW 30 Hz VBW | 10 kHz RBW 1 Hz VBW <i>(Option 1DR)</i> |
| | 0 to 55 °C | | | | |
| | 1 MHz to 10 MHz | | | ≤ -131 dBm, characteristic | ≤ -149 dBm, characteristic |
| | 10 MHz to 1.0 GHz | ≤ -131 dBm | ≤ -149 dBm | | |
| | 1.0 GHz to 2.0 GHz | ≤ -129 dBm | ≤ -147 dBm | | |
| 2.0 GHz to 3.0 GHz | ≤ -127 dBm | ≤ -145 dBm | | | |
| 20 to 30 °C | | | | | |
| 10 MHz to 1.0 GHz | ≤ -132 dBm | ≤ -150 dBm | | | |
| 1.0 GHz to 2.0 GHz | ≤ -131 dBm | ≤ -149 dBm | | | |
| 2.0 GHz to 3.0 GHz | ≤ -130 dBm | ≤ -148 dBm | | | |

| | Specifications | Supplemental Information |
|---|---|---------------------------------|
| <p>Display Range</p> <p>Log Scale</p> <p style="padding-left: 20px;">RBW \geq 1 kHz</p> <p style="padding-left: 20px;">RBW \leq 300 Hz (<i>Option 1DR</i>)</p> <p>Linear Scale</p> <p>Scale Units</p> <p style="padding-left: 20px;">(<i>Option BAA</i>)</p> | <p>Ten divisions displayed; 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps</p> <p>Calibrated 0 to -85 dB from Reference Level</p> <p>Calibrated 0 to -120 dB^a from Reference Level</p> <p>Ten divisions</p> <p>dBm, dBmV, dBμV, V, and W</p> <p>Add Hz</p> | |

a. 0 to -70 dB range when span = 0 Hz, or when auto ranging is off:
(:DISPlay:WINDow:TRACe:Y[:SCALe]:LOG:RANGe:AUTO OFF).

| | Specifications | Supplemental Information |
|---|---|---------------------------------|
| <p>Marker Readout Resolution</p> <p>Log scale</p> <p style="padding-left: 20px;">RBW \geq 1 kHz</p> <p style="padding-left: 40px;">0 to -85 dB from ref level</p> <p style="padding-left: 20px;">RBW \leq 300 Hz</p> <p style="padding-left: 40px;">0 to -120 dB from ref level</p> <p>Linear scale</p> <p>Fast Sweep Times for Zero Span</p> <p style="padding-left: 20px;">(<i>Option AYY</i>)^a</p> <p style="padding-left: 20px;">5 μs to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$</p> <p style="padding-left: 20px;">Log</p> <p style="padding-left: 40px;">0 to -85 dB from ref level</p> <p style="padding-left: 20px;">Linear</p> | <p>0.04 dB</p> <p>0.04 dB</p> <p>0.01% of Reference Level</p> <p>0.3 dB</p> <p>0.3% of Reference Level for linear scale</p> | |

Agilent E4404B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|--|--|--------------------------|
| <i>(Option B7D)</i> 2.5 μ s to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ Log 0 to -85 dB from ref level Linear | 0.2 dB 0.2% of Reference Level for linear scale | |

a. For firmware revisions prior to A.04.00, 20 μ s to <5 ms.

| | Specifications | Supplemental Information |
|--|--|--|
| Frequency Response 50 Ω Absolute ^a /Relative 10 dB attenuation 20 to 30 °C 0 to 55 °C 50 Ω Absolute ^a /Relative Preamp On (<i>Option 1DS</i>) 1 MHz to 3.0 GHz 0 dB attenuation Preselector centered for frequency >3.0 GHz 3.0 GHz to 6.7 GHz 10 dB attenuation Absolute ^a 20 to 30 °C 0 to 55 °C Relative 20 to 30 °C 0 to 55 °C | 9 kHz to 3.0 GHz (dc coupled) \pm 0.5 dB \pm 1.0 dB (dc coupled) \pm 2.0 dB (dc coupled) \pm 1.5 dB \pm 2.5 dB \pm 1.3 dB \pm 1.5 dB | 100 kHz to 3.0 GHz (ac coupled) \pm 0.5 dB, characteristic \pm 1.0 dB, characteristic (ac coupled) \pm 2.0 dB (ac coupled) \pm 1.5 dB, characteristic \pm 2.5 dB, characteristic \pm 1.3 dB, characteristic \pm 1.5 dB, characteristic |

a. Absolute flatness values are referenced to the amplitude at 50 MHz.

| | Specifications | Supplemental Information |
|---|--|---------------------------------|
| Input Attenuation Switching Uncertainty at 50 MHz Attenuator Setting 0 dB to 5 dB 10 dB 15 dB 20 to 65 dB attenuation | ±0.3 dB Reference ±0.3 dB ±(0.1 dB + 0.01 × Attenuator Setting) | |

| Attenuation Accuracy Relative to the 10 dB Attenuator Setting, Characteristic | | |
|--|------------------------|--------------------|
| | Frequency Range | |
| Attenuation | 9 kHz–3.0 GHz | 3.0–6.7 GHz |
| 0 dB | ±0.3 dB | ±0.5 dB |
| 5 dB | ±0.3 dB | ±0.5 |
| 10 dB | Reference | Reference |
| 15 dB | ±0.4 dB | ±0.5 dB |
| 20 dB | ±0.4 dB | ±0.5 dB |
| 25 dB | ±0.5 dB | ±0.6 dB |
| 30 dB | ±0.5 dB | ±0.6 dB |
| 35 dB | ±0.6 dB | ±0.7 dB |
| 40 dB | ±0.6 dB | ±0.7 dB |
| 45 dB | ±0.7 dB | ±1.0 dB |
| 50 dB | ±0.7 dB | ±1.0 dB |
| 55 dB | ±0.9 dB | ±1.1 dB |
| 60 dB | ±0.9 dB | ±1.1 dB |
| 65 dB | ±1.0 dB | ±1.6 dB |

Agilent E4404B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|-------------------------------------|----------------|---|
| Preamp (<i>Option 1DS</i>) | | Refer also to Displayed Average Noise Level specification |
| Gain | | +20 dB, nominal ^a |
| Noise figure | | 5 dB, characteristic |

a. Amplifier is between the input attenuator and the input mixer.

| | Specifications | Supplemental Information |
|--|---|--------------------------|
| Absolute Amplitude Accuracy | | |
| At reference settings ^a | ±0.34 dB | |
| Preamp On ^b (<i>Option 1DS</i>) | ±0.5 dB | |
| Overall Amplitude Accuracy ^c | | |
| 20 to 30 °C | ± (0.54 dB + Absolute Frequency Response) | |

- a. Settings are: reference level -20 dBm; input attenuation 10 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, sample detector; signal at reference level.
- b. Settings are: reference level -30 dBm; input attenuation 0 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, signal at reference level.
- c. For reference level 0 to -50 dBm; input attenuation 10 dB; RBW 1 kHz; VBW 1 kHz; scale log, log range 0 to -50 dB from reference level; sweep time coupled; signal input 0 to -50 dBm; span ≤20 kHz.

| | Specifications | Supplemental Information | |
|---|----------------|--------------------------|----------------|
| RF Input VSWR (at tuned frequency) | | characteristic | characteristic |
| Attenuator setting 0 dB | | (dc coupled) | (ac coupled) |
| 9 kHz to 100 kHz | | ≤3.0:1 | |
| 100 kHz to 6.7 GHz | | ≤3.0:1 | ≤3.0:1 |
| Attenuator setting 5 dB | | (dc coupled) | (ac coupled) |
| 9 kHz to 100 kHz | | ≤2.0:1 | |
| 100 kHz to 300 kHz | | ≤1.4:1 | ≤2.3:1 |
| 300 kHz to 1.0 MHz | | ≤1.4:1 | ≤1.6:1 |
| 1.0 MHz to 3.0 GHz | | ≤1.4:1 | ≤1.4:1 |

| | Specifications | Supplemental Information | |
|--------------------------------|-----------------------|---------------------------------|--------------|
| 3.0 GHz to 6.7 GHz | | ≤1.4:1 | ≤1.7:1 |
| Attenuator setting 10 to 65 dB | | (dc coupled) | (ac coupled) |
| 9 kHz to 100 kHz | | ≤2.0:1 | |
| 100 kHz to 300 kHz | | ≤1.3:1 | ≤2.1:1 |
| 300 kHz to 1.0 MHz | | ≤1.3:1 | ≤1.5:1 |
| 1.0 MHz to 3.0 GHz | | ≤1.3:1 | ≤1.3:1 |
| 3.0 GHz to 6.7 GHz | | ≤1.3:1 | ≤1.5:1 |

| | Specifications | Supplemental Information |
|-----------------------------------|-----------------------|---------------------------------|
| Auto Alignment^a | | |
| Sweep-to-sweep variation | | ±0.1 dB, characteristic |

a. Set Auto Align to Off and use Align Now, All to eliminate this variation.

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| Resolution Bandwidth Switching Uncertainty (at Reference Level) | | |
| 1 kHz RBW | Reference | |
| 3 kHz to 3 MHz RBW | ±0.3 dB | |
| 5 MHz RBW | ±0.6 dB | |
| 10 Hz to 300 Hz RBW (Option 1DR) | ±0.3 dB | |

| | Specifications | Supplemental Information |
|------------------------|--|---------------------------------|
| Reference Level | | |
| Range | -149.9 dBm to maximum mixer level + attenuator setting | |
| Resolution | | |
| Log Scale | ±0.1 dB | |
| Linear Scale | ±0.12% of Reference Level | |

Agilent E4404B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| <p>Accuracy (at a fixed frequency, a fixed attenuator, and referenced to -30 dBm (-10 dBm, Preamp On (<i>Option 1DS</i>)))</p> <p>Reference Level (dBm) – input attenuator setting (dB) + preamp gain (dB)</p> <p>-10 dBm to > -60 dBm ± 0.3 dB</p> <p>-60 dBm to > -85 dBm ± 0.5 dB</p> <p>-85 dBm to -90 dBm ± 0.7 dB</p> | | |

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| <p>Display Scale Switching Uncertainty</p> <p>Switching between Linear and Log ± 0.15 dB at Reference Level</p> <p>Log Scale Switching No error</p> | | |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| <p>Display Scale Fidelity</p> <p>Log Maximum Cumulative</p> <p>0 to -85 dB from Reference Level $\pm(0.3 \text{ dB} + 0.01 \times \text{dB from Reference Level})$</p> <p>RBW \leq 300 Hz (<i>Option 1DR</i>)</p> <p>Span > 0 Hz</p> <p>0 to -98 dB from Reference Level $\pm(0.3 \text{ dB} + 0.01 \times \text{dB from Reference Level})$</p> <p>-98 to -120 dB from Reference Level ± 2.0 dB, characteristic</p> | | |

| | Specifications | Supplemental Information |
|------------------------------------|---|---------------------------------|
| Span = 0 Hz ^a | | |
| 0 to -60 dB from Reference Level | $\pm(0.3 \text{ dB} + 0.015 \times \text{dB from Reference Level})$ | |
| -60 to -70 dB from Reference Level | $\pm 1.5 \text{ dB}$ | |

Agilent E4404B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|---|------------------------|--------------------------|
| Log Incremental Accuracy 0 to -80 dB ^b from reference level | ±0.4 dB/4 dB | |
| Linear Accuracy | ±2% of Reference Level | |

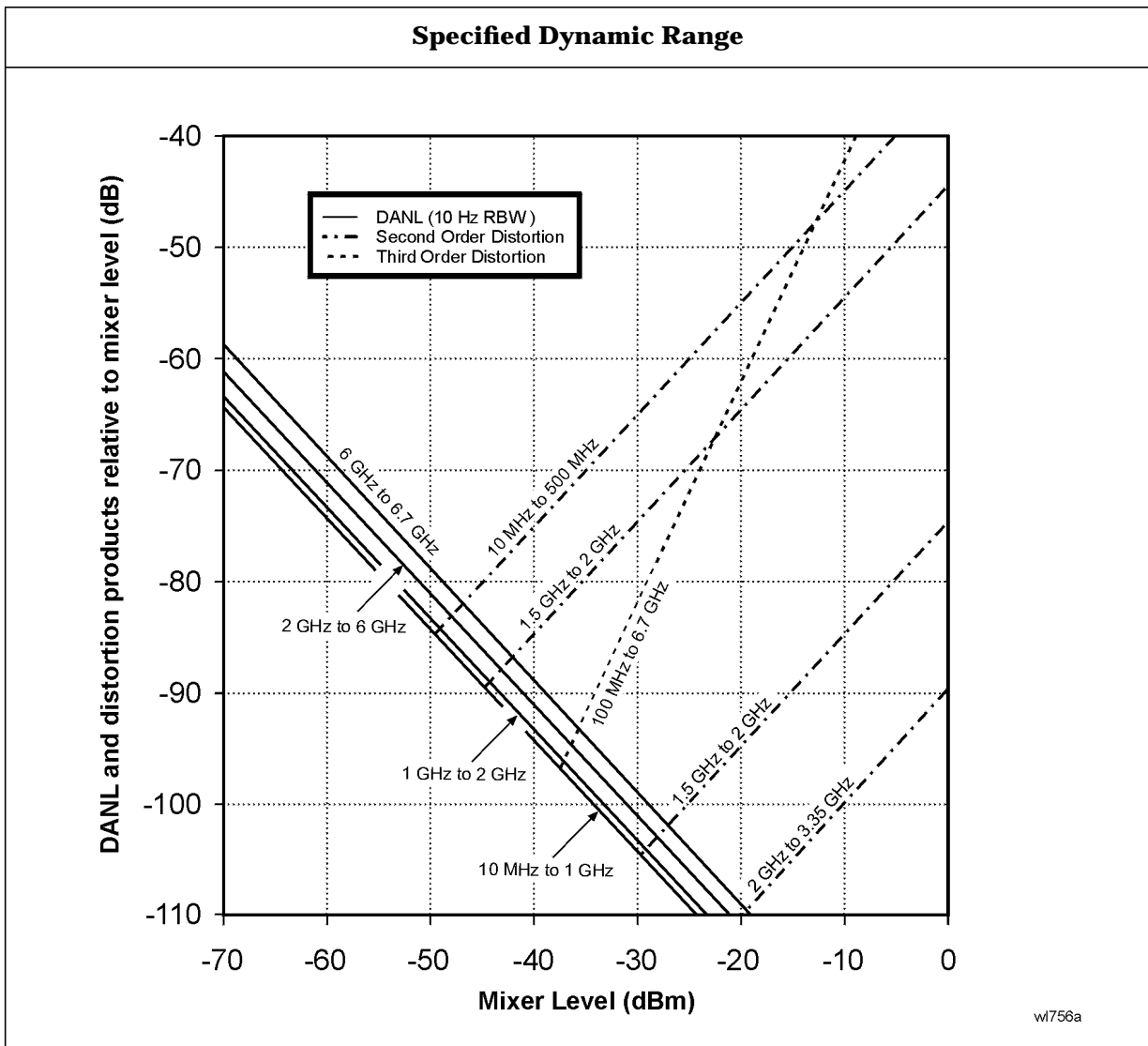
a. or when auto ranging is off: (:DISPlay:WINDow:TRACe:Y[:SCALE]:LOG:RANGe:AUTO OFF)

b. 0 to -50 dB for RBWs ≤ 300 Hz and span = 0 Hz, or when auto ranging is off.

| | Specifications | Supplemental Information |
|--|--|---|
| Spurious Responses | | |
| Second Harmonic Distortion | | |
| Input Signal | | |
| 10 MHz to 500 MHz | < -65 dBc for -30 dBm signal at input mixer ^a | +35 dBm SHI (second harmonic intercept) |
| 500 MHz to 1.5 GHz | < -75 dBc for -30 dBm signal at input mixer ^a | +45 dBm SHI |
| 1.5 GHz to 2.0 GHz | < -85 dBc for -10 dBm signal at input mixer ^a | +75 dBm SHI |
| 2.0 GHz to 3.35 GHz | < -100 dBc ^b for -10 dBm signal at input mixer ^a | +90 dBm SHI |
| Preamp On (<i>Option 1DS</i>) 10 MHz to 1.5 GHz | | -5 dBm SHI, characteristic |
| Third Order Intermodulation Distortion | | |
| 10 MHz to 100 MHz | | +7 dBm TOI (third order intercept), characteristic |
| 100 MHz to 3 GHz | < -82 dBc for two -30 dBm signals at input mixer ^a and >50 kHz separation | +11 dBm TOI +16 dBm TOI, typical, 20 to 30 °C |
| 3.0 GHz to 6.7 GHz | < -82 dBc for two -30 dBm signals at input mixer ^a and >50 kHz separation | +11 dBm TOI +18 dBm TOI, typical, 20 to 30 °C |
| Preamp On (<i>Option 1DS</i>) 10 MHz to 3 GHz, | | -16 dBm TOI, characteristic |

| | Specifications | Supplemental Information |
|---|--|--------------------------|
| Other Input Related Spurious Inband Responses >30 kHz offset Out-of-band Responses | < -65 dBc for -20 dBm signal at input mixer ^a < -80 dBc for -10 dBm signal at input mixer ^a | |

- a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).
b. or signal below displayed average noise level.



Agilent E4404B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| Residual Responses (Input terminated and 0 dB attenuation) 150 kHz to 6.7 GHz | < -90 dBm | |

Options

Time Gated Spectrum Analysis (Option 1D6)

| | Specifications | Supplemental Information |
|---|---|---|
| Gate Delay | | |
| Range | 1 μ s to 400 s | |
| Accuracy | $\pm(500 \text{ ns} + (0.01\% \times (\text{maximum of gate delay or length})))$ | From gate trigger input to positive edge of gate output |
| Gate Length | | |
| Range | 1 μ s to 400 s | |
| Accuracy | $\pm(500 \text{ ns} + (0.01\% \times (\text{maximum of gate delay or length})))$ | From positive edge to negative edge of gate output |
| Resolution | $((\text{maximum of gate delay or length in seconds})/65000)$ rounded up to nearest μ s | Dependent on the greater of gate delay or gate length |
| Additional Amplitude Error^a | | |
| Log Scale | $\pm 0.2 \text{ dB}$ | |
| Linear Scale | $\pm 0.1\%$ of reference level | |

a. While in gate mode.

Tracking Generator (Option 1DN)

The spectrum analyzer tracking generator combination will meet its specification after a cable (8120-5148) and adapter are connected between RF OUT and INPUT and **Align Now**, TG has been run.

| | Specifications | Supplemental Information |
|----------------|----------------|--------------------------|
| Warm-Up | 5 minutes | |

| | Specifications | Supplemental Information |
|-------------------------------|------------------|--------------------------|
| Output Frequency Range | 9 kHz to 3.0 GHz | |

| | Specifications | Supplemental Information |
|------------------------------|----------------|--|
| Minimum Resolution BW | 1 kHz | Not usable with resolution bandwidths ≤ 300 Hz (<i>Option 1DR</i>) |

| | Specifications | Supplemental Information |
|---|--------------------------|--------------------------|
| Output Power Level | | |
| Range | -2 to -66 dBm | |
| Resolution | 0.1 dB | |
| Absolute Accuracy (at 50 MHz with coupled source attenuator, referenced to -20 dBm) | ± 0.75 dB | |
| Vernier | | |
| Range | 8 dB | |
| Accuracy (with coupled source attenuator, 50 MHz, -20 dBm) | | |
| Incremental | ± 0.2 dB/dB | |
| Cumulative | ± 0.5 dB, total | |
| Output Attenuator Range | 0 to 56 dB in 8 dB steps | |

| | Specifications | Supplemental Information |
|-----------------------------------|----------------|---------------------------------------|
| Maximum Safe Reverse Level | | +30 dBm (1 W), 50 Vdc, characteristic |

| | Specifications | Supplemental Information |
|---------------------------|---|---------------------------------|
| Output Power Sweep | | |
| Range | (-10 to -2 dBm) – (Source Attenuator Setting) | |
| Resolution | 0.1 dB | |
| Accuracy (zero span) | <1 dB peak-to-peak | |

| | Specifications | Supplemental Information |
|----------------------------------|-----------------------|---------------------------------|
| Output Flatness | | |
| Referenced to 50 MHz, -20 dBm | | |
| 9 kHz to 10 MHz | ±3 dB | |
| 10 MHz to 3 GHz | ±2 dB | |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| Spurious Outputs | | |
| (-2 dBm output) | | |
| Harmonic Spurs | | |
| TG Output 9 kHz to 20 kHz | ≤ -15 dBc | |
| TG Output 20 kHz to 3 GHz | ≤ -25 dBc | |
| Non-harmonic Spurs | | |
| TG Output 9 kHz to 2 GHz | ≤ -27 dBc | |
| TG Output 2 GHz to 3 GHz | ≤ -23 dBc | |
| LO Feedthrough | | |
| LO Frequency 3.921409 to 6.9214 GHz | ≤ -16 dBm | |

| | Specifications | Supplemental Information |
|----------------------|--|---------------------------------|
| Dynamic Range | Maximum Output Power Level – Displayed Average Noise Level | |

Agilent E4404B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|------------------------|-----------------------|--|
| Output Tracking | | |
| Drift | | 1.5 kHz/5 minute, characteristic |
| Swept Tracking Error | | Usable in 1 kHz RBW after 5 minutes of warm-up |

| | Specifications | Supplemental Information |
|-------------------------------|-----------------------|---------------------------------|
| RF Power-Off Residuals | | |
| 9 kHz to 3 GHz | | < -120 dBm, characteristic |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| Output Attenuator Repeatability | | |
| 9 kHz to 300 MHz | | ±0.1 dB, characteristic |
| 300 MHz to 2.0 GHz | | ±0.2 dB, characteristic |
| 2.0 GHz to 3 GHz | | ±0.3 dB, characteristic |

| | Specifications | Supplemental Information |
|--------------------|-----------------------|---------------------------------|
| Output VSWR | | |
| 0 dB attenuation | | <2.0:1, characteristic |
| ≥ 8 dB attenuation | | <1.5:1, characteristic |

| | Specifications | Supplemental Information |
|-----------------------------------|-----------------------|---------------------------------|
| Output Attenuator Accuracy | | |
| 0 dB | Reference | ±0.5 dB, characteristic |
| 8 dB | | ±0.5 dB, characteristic |
| 16 dB | | |
| 24 dB | | ±0.5 dB, characteristic |
| 32 dB | | ±0.6 dB, characteristic |
| 40 dB | | ±0.8 dB, characteristic |
| 48 dB | | ±1.0 dB, characteristic |
| 56 dB | | ±1.1 dB, characteristic |

| |
|--|
| Tracking Generator Output Accuracy |
| Relative Accuracy (Referred to -20 dBm) = Output Attenuator Accuracy + Vernier Accuracy + Output Flatness |
| Absolute Accuracy = Relative Accuracy (Referred to -20 dBm) + Absolute Accuracy at 50 MHz |

FM Demodulation (Option BAA)

The FM demodulation characteristics will be met after an **Align Now**, **FM Demod** has been run.

| | Specifications | Supplemental Information |
|---|----------------|--|
| Input Level | | $\geq (-60 \text{ dBm} + \text{attenuator setting} - \text{preamp gain})$, characteristic |
| Signal Level | | 0 to -30 dB below reference level, characteristic |
| FM Deviation | | |
| Range | | 10 kHz to 1 MHz |
| Resolution | | Provides 1 Hz display annotation resolution |
| FM Deviation Range | | |
| 10 kHz to 40 kHz | | 12 Hz, characteristic |
| $>40 \text{ kHz}$ to 200 kHz | | 60 Hz, characteristic |
| $>200 \text{ kHz}$ to 1 MHz | | 300 Hz, characteristic |
| Accuracy ^a | | |
| FM Rate $< \text{FM BW}/100$, | | $< (2\% \text{ of FM deviation range} + 2 \times \text{Resolution})$, characteristic |
| VBW $\geq (30 \times \text{FM Rate})$, | | |
| RBW $>$ the maximum of | | |
| $(30 \times \text{FM deviation})$ or | | |
| $(30 \times \text{FM Rate})$ | | |
| Offset Error ^a | | 5% of FM Deviation Range + 300 Hz, characteristic |
| FM Bandwidth (-3 dB) | | |
| FM Deviation Range | | |
| 10 kHz to 40 kHz | | $7.5 \times \text{FM deviation range}$, characteristic |
| $>40 \text{ kHz}$ to 200 kHz | | $1.3 \times \text{FM deviation range}$, characteristic |
| $>200 \text{ kHz}$ to 1 MHz | | $0.3 \times \text{FM deviation range}$, characteristic |

a. In time domain sweeps (span = 0 Hz).

TV Trigger and Picture On Screen (Option B7B)

Option BAA is required.

| | Specifications | Supplemental Information |
|---|---|--|
| TV Trigger and Picture On Screen | | TV Trigger initiates a sweep of the analyzer after the sync pulse of a selected line of a TV video field. Picture On Screen displays the TV picture on the analyzer display. |
| Amplitude Requirements TV Source: SA | | Top 50% of linear display, characteristic |
| TV Source: EXT VIDEO IN | | 500 mVp-p to 2 Vp-p, characteristic |
| Compatible Standards | NTSC-M, NTSC-Japan, PAL-M, PAL-B,D,G,H,I, PAL-N, PAL-N Combination, SECAM-L | |
| Field Selection | Entire frame, even, odd | |
| Sync Polarity | Positive or negative | |
| TV Trigger | | |
| Line Selection | 1 to 525, or 1 to 625, standard dependent | |

cdmaOne Measurement Personality (Option BAC)

Unless otherwise noted, all specifications are with RF input range auto, default cdmaOne measurement settings, and in the in-band frequency range. *Option B72* is required.

| | Specifications | Supplemental Information |
|--------------------------------|--|--------------------------|
| In-Band Frequency Range | | |
| Cellular bands | 824 to 870 MHz 869 to 925 MHz | |
| PCS bands | 1715 to 1780 MHz 1805 to 1870 MHz 1850 to 1910 MHz 1930 to 1990 MHz | |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------------------|
| Channel Power (1.23 MHz Integration BW) | | Integration BW range 1 kHz to 10 MHz |
| Range at RF Input | 30 to -70 dBm | |
| Absolute power accuracy for in-band signal (Mean channel power at RF Input, plus any external attenuation, excluding mismatch error) | | |
| Cellular Bands | | |
| 30 to -5 dBm 20 to 30 °C | ±0.80 dB | ±0.36 dB, typical |
| 0 to 55 °C | ±1.13 dB | |
| -5 to -25 dBm 20 to 30 °C | ±0.77 dB | ±0.33 dB, typical |
| 0 to 55 °C | ±1.10 dB | |
| -25 to -45 dBm 20 to 30 °C | ±0.65 dB | ±0.29 dB, typical |
| 0 to 55 °C | ±1.00 dB | |
| -45 to -55 dBm 20 to 30 °C | ±0.72 dB | ±0.36 dB, typical |
| 0 to 55 °C | ±1.01 dB | |

| | Specifications | Supplemental Information |
|-------------------------------|----------------|--------------------------|
| -55 to -70 dBm 20 to 30 °C | ±0.86 dB | ±0.47 dB, typical |
| 0 to 55 °C | ±1.28 dB | |
| PCS Bands | | |
| 30 to -5 dBm 20 to 30 °C | ±0.70 dB | ±0.29 dB, typical |
| 0 to 55 °C | ±1.15 dB | |
| -5 to -25 dBm 20 to 30 °C | ±0.67 dB | ±0.26 dB, typical |
| 0 to 55 °C | ±1.11 dB | |
| -25 to -45 dBm 20 to 30 °C | ±0.66 dB | ±0.27 dB, typical |
| 0 to 55 °C | ±0.97 dB | |
| -45 to -55 dBm 20 to 30 °C | ±0.73 dB | ±0.34 dB, typical |
| 0 to 55 °C | ±0.98 dB | |
| -55 to -70 dBm 20 to 30 °C | ±0.87 dB | ±0.45 dB, typical |
| 0 to 55 °C | ±1.25 dB | |

| | Specifications | Supplemental Information |
|---|----------------------------|--------------------------|
| Channel power relative power accuracy (same channel, different Tx power, input attenuator fixed, RF input range manual). | See Display Scale Fidelity | |

| | Specifications | Supplemental Information |
|--------------------------------|----------------|--------------------------|
| Receive Channel Power | | |
| Absolute Power Accuracy | | |
| Cellular bands | | |
| 30 to 0 dBm | ±0.98 dB | ±0.55 dB, typical |
| 0 to -85 dBm | ±2.02 dB | ±1.33 dB, typical |
| PCS bands | | |
| 30 to 0 dB | ±1.00 dB | ±0.60 dB, typical |
| 0 to -85 dBm | ±1.52 dB | ±0.84 dB, typical |

Agilent E4404B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| Preamp (<i>Option 1DS</i>) Cellular and PCS bands 30 to -80 dBm | ±2.45 dB | ±1.70 dB, typical |
| -80 to -100 dBm | ±3.20 dB | ±2.30 dB, typical |

| | Specifications | Supplemental Information |
|--|-----------------------|---|
| Occupied Bandwidth | | |
| Carrier power range | 30 to -70 dBm | |
| Frequency resolution of occupied BW | 1.88 kHz | |
| Frequency accuracy of occupied BW (1.23 MHz channel BW) | | ±15 kHz, characteristic |
| Frequency resolution of delta frequency | 3.75 kHz | |
| Frequency accuracy of delta frequency | | ±(35 kHz + frequency reference error × carrier frequency), characteristic |

| | Specifications | Supplemental Information |
|---|-----------------------|---|
| Code Domain (Requires <i>Options 1D5, B7D, and B7E</i> . Measurement interval ≥1.25 ms unless otherwise noted.) | | |
| Carrier power range at RF Input (Pilot channel power > -11 dBc) | 30 to -13 dBm | 30 to -65 dBm ^a , characteristic |
| Preamp (<i>Option 1DS</i>) | 30 to -30 dBm | 30 to -82 dBm ^a , characteristic |
| Measurement interval range | 0.5 ms to 26.67 ms | |
| Code domain power | | |
| Display dynamic range | 50 dB | |
| Accuracy (Walsh channel power within 20 dB of total power) | ±0.2 dB | |
| Displayed resolution | 0.01 dB | |

| | Specifications | Supplemental Information |
|---|------------------------|--|
| 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 interval ≥ 2.5 ms) | | Excludes frequency reference error. |
| Input frequency error range | ± 100 kHz | ± 200 kHz, typical |
| Accuracy | ± 10 Hz | ± 7 Hz, typical |
| Displayed resolution | Four digits | |
| Estimated Rho | | |
| Range | 0.9 to 1.0 | 0.5 to 1.0 ^b |
| Accuracy (With 9 channels active over the specified range) ^c | | ± 0.02 , characteristic |
| Displayed resolution | 0.0001 | |
| Pilot time offset | | From even second signal to start of PN sequence |
| Range | -13.33 ms to +13.33 ms | |
| Accuracy | ± 150 ns | |
| Displayed resolution | Four digits | |
| Code domain timing | | Pilot to code channel time tolerance |
| Range | ± 200 ns | |
| Accuracy (IS-97A nominal power levels) ^d | ± 15 ns | ± 7 ns, typical |
| Code domain phase | | Pilot to code channel phase tolerance |
| Range | ± 200 mrad | |
| Accuracy (IS-97A nominal power levels) ^d | ± 15 mrad | ± 10 mrad, typical |
| Displays | | Power Graph and Metrics, or Power, Timing, and Phase Graphs |

- a. Performance may degrade outside of the specified carrier power range at RF input listed in the specifications column.
- b. Performance may degrade outside of the estimated rho range listed in the specifications column.

Agilent E4404B Specifications and Characteristics
Options

- c. The Active Set Threshold is less than all active channels, but greater than -20 dBc.
d. IS-97A nominal base station test model levels (fraction of carrier power); Pilot: 0.20 (-7.0 dBc), Sync: 0.0471 (-13.3 dBc), Paging: 0.1882 (-7.3 dBc), 6 Traffic channels: 0.09412 (-10.3 dBc)

| | Specifications | Supplemental Information |
|---|----------------------------|---|
| Modulation Accuracy (Rho) (Requires <i>Options 1D5, B7D, and B7E</i> . Measurement interval ≥ 1.25 ms unless otherwise noted.) | | |
| Carrier power range at RF Input | 30 to -28 dBm | 30 to -70 dBm ^a , characteristic |
| Preamp (<i>Option 1DS</i>) | 30 to -45 dBm | 30 to -87 dBm ^a , characteristic |
| Measurement interval range | 0.5 ms to 26.67 ms | |
| Rho (waveform quality) | | |
| Range | 0.9 to 1.0 | 0.5 to 1.0 ^b , characteristic |
| Accuracy | ± 0.0015 | ± 0.0007 , typical |
| Displayed resolution | 0.0001 | |
| Carrier frequency error (Measurement interval ≥ 2.5 ms) | | Excludes frequency reference error |
| Input frequency error range | ± 100 kHz | ± 200 kHz, typical |
| Accuracy | ± 10 Hz | ± 7 Hz, typical |
| Displayed resolution | Four digits | |
| Pilot time offset | | From even second signal to start of PN sequence |
| Range | -13.33 ms to $+13.33$ ms | |
| Accuracy | ± 150 ns | |
| Displayed resolution | Four digits | |
| EVM | | |
| Floor | 3.0% | 2.6%, typical |
| Accuracy ^c | $\pm 0.65\%$ | $\pm 0.46\%$, typical |
| Displayed Resolution | 0.01% | |
| Carrier feedthrough | | |
| Floor | -51 dBc | |

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| Accuracy (Carrier feedthrough ≥ -43 dBc) | ± 2.3 dB | Numeric results or Numeric results and IQ graph |
| Displayed resolution | 0.01 dB | |
| Magnitude error | | |
| Floor | 3.0% | |
| Accuracy ^c | $\pm 0.65\%$ | |
| Displayed resolution | 0.01% | |
| Phase error | | |
| Accuracy ^c | ± 0.4 degrees | |
| Displayed resolution | 0.01 degrees | |
| Displays | | |

- a. Performance may degrade outside of the specified carrier power range at RF input listed in the specifications column.
- b. Performance may degrade outside of the rho range listed in the specifications column.
- c. Accuracy does not include the effects of the EVM floor. The measurement variance increases as the result approaches the EVM floor.

| | Specifications | Supplemental Information |
|------------------------------------|--|---|
| Spur Close (In Band) | | |
| Carrier power range at RF Input | 30 to -12 dBm | $\pm(0.3$ dB + $0.01 \times$ (dB from reference level)), typical |
| Dynamic range | | |
| Input power | | |
| 30 to 25 dBm | 55 dB | |
| 25 to 20 dBm | 50 dB | |
| 20 to -12 dBm | 46 dB | |
| Relative accuracy | $\pm(2.7$ dB + $0.01 \times$ (dB from reference level)) | |
| Displayed resolution | 0.01 dB | |

Agilent E4404B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|---|----------------|--|
| Out-of-Band Spurious^a | | Refer to the Amplitude specifications section in this guide. |

- a. The out-of-band measurement is made with the user-defined tables with 20 frequency ranges each (up to the top 10 spurs per range, 100 spurs maximum). Table parameters include frequency range, RBW, video BW, detector type, and amplitude test limits.

| | Specifications | Supplemental Information |
|---|-----------------|--------------------------|
| Receiver Spurious Emissions | | |
| Spurious emission power range | -20 to -83 dBm | |
| Preamp On (<i>Option 1DS</i>) | -40 to -101 dBm | |
| Absolute spurious emission power accuracy | | |
| -20 to -60 dBm | ±2.6 dB | ±1.7 dB, typical |
| -60 to -83 dBm | ±4.3 dB | ±3.4 dB, typical |
| Preamp On (<i>Option 1DS</i>) | | |
| -40 to -70 dBm | ±3.6 dB | ±2.6 dB, typical |
| -70 to -101 dBm | ±5.0 dB | ±3.9 dB, typical |

| | Specifications | Supplemental Information |
|-------------------------------------|----------------|--------------------------|
| External Correction | | |
| External attenuation, external gain | | |
| Range | -90 to 90 dB | |
| Resolution | 0.01 dB | |

| | Specifications | Supplemental Information |
|---|---------------------|--------------------------|
| Trigger | | |
| Trigger source (Actual available choices dependent on measurement) | Free run, external | |
| (<i>Option B7D and B7E</i>) | Add RF Burst, frame | |
| Delay trigger | | |
| Range | 0 to 500 ms | |
| Resolution | 300 ns | |

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| RF burst trigger level <i>(Option B7E)</i> | 0 to -25 dBc | Rear panel connector labelled EXT FRAME SYNC <i>(Option B7D)</i> |
| Trigger slope (External and RF burst) | Positive/Negative | |
| Frame timing period | 50 ns to 13.6533 s | |
| Frame synchronizing source | External frame sync | |
| Frame synchronizing slope | Positive/Negative | |

| | Specifications | Supplemental Information |
|--|-----------------------|---|
| Demod Trigger Source | | Rear panel connector labelled EXT FRAME SYNC |
| Even second input (Frame trigger only, <i>Option B7D and B7E</i>) | | |
| PN offset range | 0 to 511 x 64 [chips] | |

GSM Measurement Personality (Option BAH)

Unless otherwise noted, all specifications are with RF input range auto, default GSM measurement settings, and in the in-band frequency range. *Option 1D6* and *Option B72* are required.

| | Specifications | Supplemental Information |
|--------------------------------|--------------------------------------|--------------------------|
| In-Band Frequency Range | | |
| GSM 900, P-GSM bands | 890 to 915 MHz 935 to 960 MHz | |
| GSM 900, E-GSM bands | 880 to 915 MHz 925 to 960 MHz | |
| GSM 900, R-GSM bands | 876 to 915 MHz 921 to 960 MHz | |
| DCS 1800 bands | 1710 to 1785 MHz 1805 to 1880 MHz | |
| PCS 1900 bands | 1850 to 1910 MHz 1930 to 1990 MHz | |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| Transmitter Power (Requires <i>Option B7D</i> or <i>AYX</i>) | | |
| Range at RF Input | 30 to -60 dBm | |
| Absolute power accuracy for in-band signal (Mean channel power at RF Input, plus any external attenuation, excluding mismatch error) | | |
| P-GSM, E-GSM, and R-GSM Bands | | |
| 30 to -20 dBm 20 to 30 °C | ±0.81 dB | ±0.38 dB, typical |
| 0 to 55 °C | ±1.31 dB | |
| -20 to -30 dBm 20 to 30 °C | ±0.74 dB | ±0.37 dB, typical |
| 0 to 55 °C | ±1.14 dB | |

| | Specifications | Supplemental Information |
|-------------------------------|----------------|--------------------------|
| -30 to -40 dBm 20 to 30 °C | ±0.79 dB | ±0.37 dB, typical |
| 0 to 55 °C | ±1.11 dB | |
| -40 to -50 dBm 20 to 30 °C | ±0.95 dB | ±0.53 dB, typical |
| 0 to 55 °C | ±1.21 dB | |
| -50 to -60 dBm 20 to 30 °C | ±1.09 dB | ±0.66 dB, typical |
| 0 to 55 °C | ±1.33 dB | |
| DCS 1800 and PCS 1900 Bands | | |
| 30 to -20 dBm 20 to 30 °C | ±0.68 dB | ±0.28 dB, typical |
| 0 to 55 °C | ±1.30 dB | |
| -20 to -30 dBm 20 to 30 °C | ±0.61 dB | ±0.27 dB, typical |
| 0 to 55 °C | ±1.12 dB | |
| -30 to -40 dBm 20 to 30 °C | ±0.66 dB | ±0.27 dB, typical |
| 0 to 55 °C | ±0.99 dB | |
| -40 to -50 dBm 20 to 30 °C | ±0.82 dB | ±0.43 dB, typical |
| 0 to 55 °C | ±1.09 dB | |
| -50 to -60 dBm 20 to 30 °C | ±0.96 dB | ±0.56 dB, typical |
| 0 to 55 °C | ±1.21 dB | |

| | Specifications | Supplemental Information |
|--|----------------------------|--------------------------|
| Transmitter Power Relative Power Accuracy (same channel, different Tx power, input attenuator fixed, RF input range manual). | See Display Scale Fidelity | |

Agilent E4404B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|---|-----------------------|---|
| Power versus Time (Requires <i>Option B7D</i> or <i>AYX</i>) | | |
| Carrier power range at RF Input | 30 to -23 dBm | 30 to -55 dBm ^a , characteristic |
| Preamp On (<i>Option 1DS</i>) | 30 to -40 dBm | 30 to -72 dBm ^a , characteristic |
| Time resolution accuracy | | ±1% of sweep time, characteristic |
| Maximum record length | 8 time slots | |
| Burst to mask uncertainty (Requires <i>Option B7D</i> and <i>B7E</i>) | ±1.0 bit | |

a. Performance may degrade outside of the specified carrier power range at RF input listed in the specifications column.

| | Specifications | Supplemental Information |
|--|---------------------------------------|---------------------------------|
| Output RF Spectrum | | |
| Carrier power range at RF Input | | |
| Offsets ≤1800 kHz, 30 kHz RBW | | 30 to -5 dBm, characteristic |
| Offsets >1800 kHz, 100 kHz RBW | | 30 to -4 dBm, characteristic |
| Reference power accuracy | Same as Transmitter Power measurement | |
| Relative accuracy ^a | See Display Scale Fidelity | |
| Spectrum due to modulation displayed dynamic range ^{bc} | | |
| 100 kHz offset | | 30 dB, characteristic |
| 200 kHz offset | | 60 dB, characteristic |
| 250 kHz offset | | 60 dB, characteristic |
| 400 kHz offset | | 70 dB, characteristic |
| 600 kHz to 1.8 MHz offset | | 79 dB, characteristic |
| 1.8 to 6.0 MHz offset | | 75 dB, characteristic |
| >6 MHz offset | | 76 dB, characteristic |
| Swept Mode Dynamic Range | | 70 dB, characteristic |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| Spectrum due to switching transients displayed dynamic range ^{bc} | | |
| 400 kHz offset | | 62 dB, characteristic |
| 600 kHz offset | | 79 dB, characteristic |
| 1200 kHz offset | | 79 dB, characteristic |
| 1800 kHz offset | | 80 dB, characteristic |
| Swept Mode Dynamic Range | | 70 dB, characteristic |

- a. Does not include uncertainty due to noise.
- b. Displayed dynamic range for specific frequency offsets - applies to CW signal at the specified offset. Dynamic range with a GSM signal may differ.
- c. Using default settings, the RBW filter has a corrected noise BW and impulse BW equivalent to five-pole synchronously tuned filter.

| | Specifications | Supplemental Information |
|--|-----------------------|---|
| Phase and Frequency Error (Requires <i>Option 1D5</i> , <i>B7D</i> , and <i>B7E</i>) | | |
| Carrier power range at RF Input | 30 to -23 dBm | 30 to -55 dBm ^a , characteristic |
| Preamp On (<i>Option 1DS</i>) | 30 to -40 dBm | 30 to -72 dBm ^a , characteristic |
| Phase error | | |
| Range | 0 to 180° | |
| Displayed resolution | 0.01° | |
| Accuracy (Averages ≥10) | | |
| Peak | ±2.1° | ±1.5°, typical |
| RMS | ±1.1° | ±0.6°, typical |
| Frequency error | | Excludes frequency reference error |
| Initial frequency error range | ±100 kHz | |
| Accuracy (Averages ≥10) | ±10 Hz | ±5 Hz, typical |
| I/Q offset range | -10 to -46 dBc | |
| Burst sync time uncertainty | ±1.0 bit | |
| Displays | | Numeric summary |

- a. Performance may degrade outside of the specified carrier power range at RF input listed in the specifications column.

Agilent E4404B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|-----------------------------------|----------------|---|
| Transmit Band Spurious | | |
| Carrier power range at RF Input | | 30 to -12 dBm, typical |
| Dynamic range | | |
| Upper and lower adjacent segments | | 55 dB, characteristic |
| Upper and lower segments | | 44 dB, characteristic |
| Relative accuracy | | $\pm(0.3 \text{ dB} + 0.01 \times (\text{dB from reference level}))$, characteristic |
| Displayed resolution | 0.01 dB | |

| | Specifications | Supplemental Information |
|---|----------------|--|
| Out-of-Band Spurious^a | | |
| Absolute Spurious Power Accuracy | | Refer to the Amplitude specifications section in this guide. |
| Sensitivity ^b | | |
| RBW | | |
| 1 kHz | | -95 dBm, characteristic |
| 3 kHz | | -90 dBm, characteristic |
| 10 kHz | | -85 dBm, characteristic |
| 30 kHz | | -78 dBm, characteristic |
| 100 kHz | | -71 dBm, characteristic |
| 300 kHz | | -64 dBm, characteristic |
| 1 MHz | | -57 dBm, characteristic |
| 3 MHz | | -50 dBm, characteristic |

a. The out-of-band spurious measurement is made in accordance with the tables defined in the appropriate GSM specification document. The measurement is made over several frequency ranges (up to 10 spurs per range, 100 spurs maximum).

b. With input attenuation of 5 dB. For all other attenuation settings, add (input attenuation - 5) dB.

| | Specifications | Supplemental Information |
|--|----------------|--------------------------------|
| Receive Band Spurious | | |
| Spurious emission power range ^a | | -20 to -73 dBm, characteristic |

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| Preamp On (<i>Option 1DS</i>) | | -40 to -91 dBm, characteristic |
| Absolute spurious emission power accuracy | | ±1.9 dB, characteristic |
| -20 to -60 dBm | | ±2.5 dB, characteristic |
| -60 to -73 dBm | | |
| Preamp on (<i>Option 1DS</i>) | | ±2.8 dB, characteristic |
| -40 to -70 dBm | | ±4.1 dB, characteristic |
| -70 to -91 dBm | | |

- a. Requires bandpass filter centered on receive band, peak detector mode, 0 dB attenuation, 100 kHz RBW. Does not include insertion loss of bandpass filter.

| | Specifications | Supplemental Information |
|--------------------------------|-----------------------|---|
| Amplitude Range Control | | RF Input Autorange, Manually set Max Total Pwr Manually set Input Atten |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| External Gain/Attenuation Correction | | |
| Base gain, base attenuation, mobile gain, mobile attenuation | | |
| Range | 0 to 81.9 dB | |
| Resolution | 0.01 dB | |

Agilent E4404B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|---|--|--|
| Trigger Trigger source (Actual available choices dependent on measurement) <i>(Option B7D and B7E)</i> RF burst trigger <i>(Option B7E)</i> Peak carrier power range ^a Preamp On <i>(Option 1DS)</i> Trigger level range | Free run, external Add RF Burst and frame 30 to -25 dBm 30 to -45 dBm 0 to -25 dB relative to signal peak | 30 to -30 dBm, typical 30 to -50 dBm, typical |

a. With trigger level set to -6 dB.

| | Specifications | Supplemental Information |
|---|---|--|
| Burst Sync (Requires <i>Option AYX</i> or <i>B7D</i>) Source (Actual available choices dependent on measurement) <i>(Option B7D and B7E)</i> Training sequence code Burst type | RF amplitude, none Add training sequence | GSM defined 0 to 7 Auto (search) or Manual Normal (TCH and CCH) Sync (SCH) Access (RACH) |

General

| | Specifications | Supplemental Information |
|--------------------------|----------------|--------------------------|
| Temperature Range | | |
| Operating | 0 to 55 °C | Floppy disk 10 to 40 °C |
| Storage | -40 to 75 °C | |

| | Specifications | Supplemental Information |
|---------------------------------|----------------|----------------------------|
| Audible Noise (ISO 7779) | | |
| Sound Pressure at 25 °C | | <40 dBa, (<4.6 Bels power) |

| | Specifications | Supplemental Information |
|-------------------------------|---|--------------------------|
| Military Specification | Has been type tested to the environmental specifications of MIL-PRF-28800F class 3. | |

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

| | Specifications | Supplemental Information |
|-------------------------|----------------|--|
| Immunity Testing | | |
| Radiated Immunity | | Testing was done at 3 V/m according to IEC 801-3/1984. When the analyzer tuned frequency is identical to the immunity test signal frequency there may be signals of up to -60 dBm displayed on the screen. |
| Electrostatic Discharge | | Air discharges of up to 8 kV were applied according to IEC 801-2/1991. Discharges to center pins of any of the connectors may cause damage to the associated circuitry. |

Agilent E4404B Specifications and Characteristics
General

| | Specifications | Supplemental Information |
|----------------------------|--|---|
| Power Requirements | | Uses CUKonverter® topology in the power supply. |
| ac Operation | | |
| Voltage, frequency | 90 to 132 V rms, 47 to 440 Hz 195 to 250 V rms, 47 to 66 Hz | |
| Power Consumption, On | <300 W | |
| Power Consumption, Standby | <5 W | |
| dc Operation | | |
| Voltage | 12 to 20 Vdc | |
| Power Consumption | <200 W | |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| Measurement Speed | | |
| Local Measurement and Display Update rate ^a | | |
| Sweep points = 101 | | ≥ 40/s, characteristic |
| Sweep points = 401 | | ≥ 28/s, characteristic |
| Remote Measurement and GPIB Transfer Rate ^{bc} (Option A4H) | | |
| Sweep points = 101 | | ≥ 40/s, characteristic |
| Sweep points = 401 | | ≥ 28/s, characteristic |
| RF Center Frequency Tune, Measure, and GPIB Transfer Time ^{bd} (Option A4H) | | |
| Sweep points = 101 | | ≤ 75 ms, characteristic |
| Sweep points = 401 | | ≤ 90 ms, characteristic |

- a. Factory preset, auto align Off, fixed center frequency, RBW = 1 MHz, span >10 MHz and ≤600 MHz, and stop frequency ≤3 GHz.
- b. Display Off (:DISPlay:ENABle OFF), and 32-bit integer data format (:FORMat:DATA INT,32), if Option AYX or A4J is installed, disable sweep ramp, (:SYStem:PORTs:IFVSweep:ENABle OFF), markers Off, single sweep, measured with IBM compatible PC with 550 MHz Pentium® III running Windows® NT 4.0, one meter GPIB cable, National Instruments PCI-GPIB card and NI-48.2 DLL.
- c. Factory preset, auto align Off, fixed center frequency, RBW = 1 MHz, and span = 20 MHz, fixed center frequency, stop frequency ≤3 GHz, average of 100 measurements.
- d. Factory preset, auto align Off, RBW = 1 MHz, span= 20 MHz, stop frequency ≤3 GHz, center frequency tune step size = 50 MHz.

| | Specifications | Supplemental Information |
|---|----------------|-----------------------------------|
| Data Storage | | |
| Internal | | 200 Traces or States ^a |
| External (10 to 40 °C) 3.5" 1.44 MB, MS-DOS [®] compatible floppy disk | | 200 Traces or States ^a |

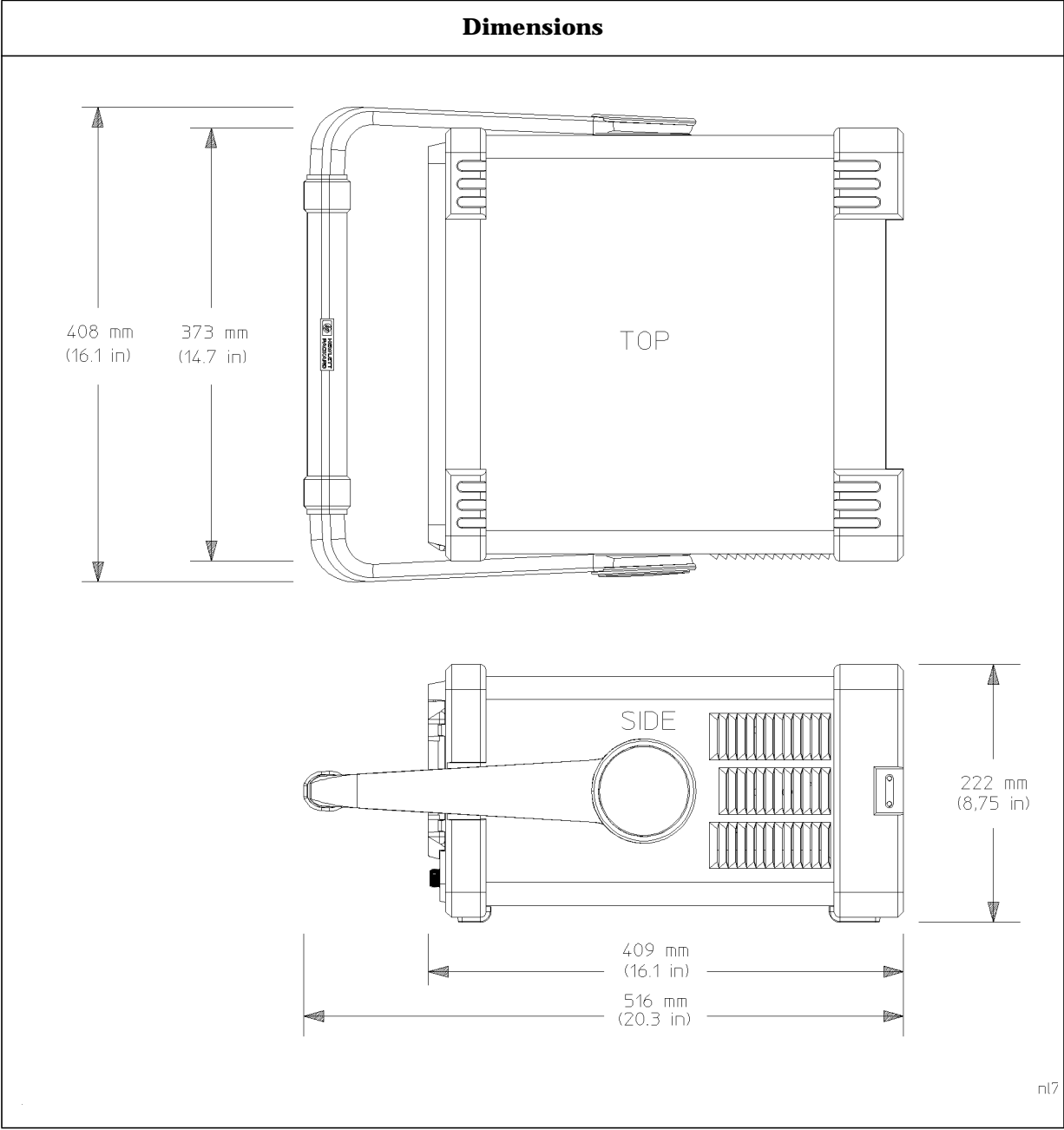
a. When storing traces set to 401 points.

| | Specifications | Supplemental Information |
|------------------------------------|----------------|--------------------------|
| Downloadable Program Memory | | 2 MB available memory |
| <i>(Option B72)</i> | | 10 MB available memory |

| | Specifications | Supplemental Information |
|-----------------------------------|----------------|---|
| Demod Tune and Listen | | |
| Demod | AM | Internal speaker, front-panel earphone jack and front-panel volume control. |
| <i>(Option BAA)</i> | Add FM | |
| <i>(Option A4J, AYX, or BAA)</i> | | An uncalibrated demodulated signal is available on the AUX VIDEO OUT or EXT VIDEO OUT connectors at the rear panel. |

| | Specifications | Supplemental Information |
|---------------------------------|----------------|-----------------------------------|
| Weight (without options) | | |
| Net | | 17.1 kg (37.7 lb), characteristic |
| Shipping | | 29.0 kg (64 lb), characteristic |

Agilent E4404B Specifications and Characteristics
General



Inputs and Outputs

Front Panel

| | Specifications | Supplemental Information |
|-------------------------------------|----------------|--------------------------|
| INPUT 50 Ω | | |
| Connector | Type-N female | |
| Impedance | | 50 Ω , nominal |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| RF OUT 50 Ω, (Option 1DN) | | |
| Connector | Type-N female | |
| Impedance | | 50 Ω , nominal |

| | Specifications | Supplemental Information |
|------------------------------------|----------------|--|
| AMPTD REF OUT^a | | Amplitude Reference |
| Connector | BNC female | |
| Impedance | | 50 Ω , nominal |
| Frequency | | 50 MHz |
| Frequency Accuracy | | Frequency reference error ^b |
| 50 Ω Amplitude ^c | | -20 dBm, nominal |

- Turn the amplitude reference on/off by pressing the keys: **Input/Output**, **Amptd Ref Out**.
- Frequency reference error = (aging rate \times period of time since adjustment + settability + temperature stability).
- The internal amplitude reference actual power is stored internally.

| | Specifications | Supplemental Information |
|--------------------|----------------|--|
| PROBE POWER | | |
| Voltage/Current | | +15 Vdc, $\pm 7\%$ at 150 mA max., characteristic -12.6 Vdc $\pm 10\%$ at 150 mA max., characteristic |

Agilent E4404B Specifications and Characteristics
Inputs and Outputs

| | Specifications | Supplemental Information |
|---------------------------------|----------------|---|
| EXT KEYBOARD^a | | Used for entering screen titles and filenames only. Interface compatible with most IBM-compatible PC keyboards. |
| Connector | 6-pin mini-DIN | |

a. The feature is not implemented in firmware revisions prior to A.04.00.

| | Specifications | Supplemental Information |
|----------------|----------------|----------------------------------|
| Speaker | | Front panel knob controls volume |

| | Specifications | Supplemental Information |
|------------------|--|--|
| Headphone | | Front panel knob controls volume |
| Connector | 3.5 mm (1/8 inch) miniature audio jack | |
| Power Output | | 0.2 W into 4 Ω , characteristic |

Rear Panel

| | Specifications | Supplemental Information |
|-----------------------|----------------|--------------------------|
| 10 MHz REF OUT | | |
| Connector | BNC female | |
| Impedance | | 50 Ω , nominal |
| Output Amplitude | | >0 dBm, characteristic |

| | Specifications | Supplemental Information |
|-----------------------|----------------|---|
| 10 MHz REF IN | | |
| Connector | BNC female | Note: Analyzer noise sidebands and spurious response performance may be affected by the quality of the external reference used. |
| Impedance | | 50 Ω , nominal |
| Input Amplitude Range | | -15 to +10 dBm, characteristic |

| | Specifications | Supplemental Information |
|-----------|-----------------------|---------------------------------|
| Frequency | | 10 MHz, nominal |

| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| EXT REF IN <i>(Option B7E)</i> | | |
| Connector | BNC, female | 50 Ω, nominal |
| Impedance | | |
| Input amplitude range | -5 to 10 dBm | |
| Frequency | 1 to 30 MHz, selectable | |
| Frequency lock range | $\pm 5 \times 10^{-6}$ of specified external reference input frequency | |

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| 10 MHz OUT <i>(Option B7E)</i> | | |
| Connector | BNC, female | 50 Ω, nominal 10 MHz, nominal 0 dBm when Option 10 MHz Out is On |
| Impedance | | |
| Frequency | | |
| Level | | |

| | Specifications | Supplemental Information |
|---|-----------------------|---|
| GATE TRIG/EXT TRIG IN | | |
| Connector | BNC female | Selectable positive or negative edge initiates sweep in EXT TRIG mode (5 V TTL) |
| External Trigger Input | | |
| Trigger Level | | |
| Gate Trigger Input <i>(Option 1D6)</i> | | |
| Minimum Pulse Width | | >30 ns (5 V TTL) |

Agilent E4404B Specifications and Characteristics
Inputs and Outputs

| | Specifications | Supplemental Information |
|---|----------------|--|
| GATE/HI SWP OUT | | |
| Connector | BNC female | |
| High Sweep Output Level | | High = sweep; Low = retrace (5 V TTL) |
| Gate Output (<i>Option 1D6</i>) Level | | High = gate on; Low = gate off (5 V TTL) |

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

| | Specifications | Supplemental Information |
|--|----------------|---------------------------------------|
| AUX IF OUT (<i>Option A4J or AYX</i>) | | RBW ≥ 1 kHz |
| Connector | BNC female | |
| Frequency | | 21.4 MHz, nominal |
| Amplitude Range (for signal at reference level and for reference levels – input attenuation + preamp gain of –10 to –70 dBm) | | –10 dBm (uncorrected), characteristic |
| Impedance | | 50 Ω, nominal |

| | Specifications | Supplemental Information |
|--|----------------|--|
| AUX VIDEO OUT (<i>Option A4J or AYX</i>) | | RBW ≥ 1 kHz |
| Connector | BNC female | |
| Amplitude Range (into >10 kΩ) | | 0 to 1 V (uncorrected), characteristic |

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| HI SWP IN <i>(Option A4J or AXX)</i> Connector Input | BNC female | Open collector, low resets and holds the sweep (5 V TTL) |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------------|
| HI SWP OUT <i>(Option A4J or AXX)</i> Connector Output | BNC female | High = sweep, Low = retrace (5 V TTL) |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| SWP OUT <i>(Option A4J or AXX)</i> Connector Amplitude | BNC female | 0 to +10 V ramp, characteristic |

| | Specifications | Supplemental Information |
|---|-----------------------|---|
| PRESEL TUNE OUTPUT Connector Load Impedance (dc coupled) Range Sensitivity | BNC female | > 10 k Ω , nominal 0 to +10 V, characteristic 0.33 V/GHz of tuned frequency > 3 GHz, characteristic |

Agilent E4404B Specifications and Characteristics
Inputs and Outputs

| | Specifications | Supplemental Information |
|---|------------------------|---|
| GPIB Interface <i>(Option A4H)</i> Connector GPIB Codes | IEEE-488 bus connector | SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3 and C28 |

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| Serial Interface <i>(Option 1AX)</i> Connector | 9-pin D-SUB male | RS-232 |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| Parallel Interface <i>(Option A4H or 1AX)</i> Connector | 25-pin D-SUB female | Printer port only |

| | Specifications | Supplemental Information |
|--|---------------------------|--|
| EXT VIDEO IN/TV TRIG OUT^a <i>(Option B7B or BAA)</i> Connector Impedance <i>(Option BAA without Option B7B)</i> <i>(Option BAA with Option B7B)</i> External Video Input Video Amplitude TV Trigger Output Amplitude | BNC Female (75 Ω) | EXT VIDEO IN is the Baseband composite video input for TV trigger and picture on screen. TV TRIG OUT is the TV trigger output. 75 Ω nominal Feature not implemented 1 V _{p-p} , nominal, characteristic Positive edge indicates start of selected TV line after sync. pulse TTL (0 V and 3.4 V with 75 Ω series resistance), characteristic |

a. This connector is labelled EXT VIDEO IN on older spectrum analyzers and EXT VIDEO IN/TV TRIG OUT on newer spectrum analyzers.

| | Specifications | Supplemental Information |
|---|--|--|
| <p>EXT VIDEO OUT <i>(Option B7B or BAA)</i></p> <p>Connector</p> <p>Impedance</p> <p><i>Option BAA without Option B7B</i> Amplitude</p> <p><i>Option BAA with Option B7B</i> Amplitude TV Source: SA</p> <p>TV Source and EXT VIDEO IN</p> | <p>BNC female (75 Ω)</p> | <p>Baseband video output RBW \geq 1 kHz</p> <p>75 Ω, nominal</p> <p>0 to 1 V (uncorrected), characteristic</p> <p>0 to 1 V (uncorrected), characteristic</p> <p>Same as level at EXT VIDEO IN/TV TRIG OUT, characteristic</p> |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| <p>EXT FRAME SYNC <i>(Option B7D)</i></p> <p>Connector</p> <p>Level</p> | <p>BNC, female</p> | <p>5 V TTL</p> |

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 (if accompanied by a year, it is the year when the design was proven).



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)

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 products

Product Name: Spectrum Analyzer

Model Number: HP E4401B, HP E4402B, HP E4403B,
HP E4404B, HP E4405B, HP E4407B,
HP E4408B, HP E4411B

Product Options: This declaration covers all options of the above products.

Conform 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 products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.



Santa Rosa, CA, USA 4 Feb. 2000

Greg Pfeiffer/Quality Engineering Manager

For further information, please contact your local Agilent Technologies sales office, agent or distributor.

Agilent E4404B Specifications and Characteristics
Regulatory Information

About This Chapter

This chapter contains specifications and characteristics for the E4405B spectrum analyzer. The distinction between specifications and characteristics is described as follows.

- Specifications describe the performance of parameters covered by the product warranty. (The temperature range is 0 °C to 55 °C, unless otherwise noted.)
- Characteristics describe product performance that is useful in the application of the product, but is not covered by the product warranty.
- Typical performance describes additional product performance information that is not covered by the product warranty. It is performance beyond an indicated specification, that most units will exhibit.
- Nominal values indicate the expected, but not warranted, value of a parameter.

The following conditions must be met for the analyzer to meet its specifications.

- The analyzer is within the one year calibration cycle.
- If **Auto Align All** is selected:
 - After 2 hours of storage within the operating temperature range.
 - 5 minutes after the analyzer is turned on with sweep times less than 4 seconds.
 - After the front-panel amplitude reference is connected to the INPUT, and **Align Now RF** has been run, after the analyzer is turned on. And, once every 24 hours, or if ambient temperature changes more than 30 °C¹.
- If **Auto Align Off** is selected:
 - When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.
 - After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now All** has been run.
 - When **Align Now All** is run:

1. 10 °C if Option 1DS is active.

- Every hour
- If the ambient temperature changes more than 3 °C
- If the 10 MHz reference changes
- When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):
 - Every 24 hours
 - If the ambient temperature changes more than 30 °C¹
- If **Auto Align All but RF** is selected:
 - When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.
 - After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now RF** has been run.
 - When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):
 - Every hour
 - If the ambient temperature changes more than 3 °C

1. 10 °C if Option 1DS is active.

Frequency

| | Specifications | Supplemental Information |
|---------------------------------|---------------------|--|
| Frequency Range | | |
| dc Coupled | 9 kHz to 13.2 GHz | |
| ac Coupled | 100 kHz to 13.2 GHz | |
| Band | | Harmonic Mixing Mode (N ^a) |
| 0 | 9 kHz to 3.0 GHz | 1– |
| 1 | 2.85 GHz to 6.7 GHz | 1– |
| 2 | 6.2 GHz to 13.2 GHz | 2– |
| Preamp On (<i>Option 1DS</i>) | 1 MHz to 3 GHz | |

- a. N is the harmonic mixing mode. For negative mixing modes (as indicated by the “–”), the desired 1st LO harmonic is higher than the tuned frequency by the 1st IF (3.9214 for the 9 kHz to 3 GHz band, 321.4 MHz for all other bands). For positive mixing modes, the desired 1st LO harmonic is lower than the tuned frequency by 321.4 MHz.

| | Specifications | Supplemental Information |
|----------------------------|------------------------------|---|
| Frequency Reference | | |
| Aging Rate | $\pm 2 \times 10^{-6}$ /year | $\pm 1.0 \times 10^{-7}$ /day, characteristic |
| Settability | $\pm 5 \times 10^{-7}$ | |
| Temperature Stability | $\pm 5 \times 10^{-6}$ | |

| | Specifications | Supplemental Information |
|---|------------------------------|---|
| High Stability Frequency Reference (<i>Option 1D5</i>) | | |
| Aging Rate | $\pm 1 \times 10^{-7}$ /year | $\pm 5 \times 10^{-10}$ /day, 7-day average after being powered on for 7 days, characteristic |
| Settability | $\pm 1 \times 10^{-8}$ | |
| Temperature Stability | | |
| 20 to 30 °C | $\pm 1 \times 10^{-8}$ | |
| 0 to 55 °C | $\pm 5 \times 10^{-8}$ | |

| | Specifications | Supplemental Information |
|---|----------------|--|
| Warm-Up (Internal frequency reference selected) | | |
| After 5 minutes | | $< \pm 1 \times 10^{-7}$ of final frequency, ^a characteristic |
| After 15 minutes | | $< \pm 1 \times 10^{-8}$ of final frequency, ^a characteristic |

- a. Final frequency is defined as frequency 60 minutes after power-on with analyzer set to internal frequency reference.

| | Specifications | Supplemental Information |
|--|---|--------------------------|
| Frequency Readout Accuracy (Start, Stop, Center, Marker) | $\pm((\text{frequency indication} \times \text{frequency reference error}^{\text{a}}) + 0.5\% \text{ of span} + \frac{\text{span}}{\text{sweep points} - 1} + 15\% \text{ of RBW} + 10 \text{ Hz} + 1 \text{ Hz} \times \text{N}^{\text{b}})$ | |

- a. Frequency reference error = (aging rate \times period of time since adjustment + settability + temperature stability).
b. N is the harmonic mixing mode.

| | Specifications | Supplemental Information |
|---------------------------------|--|--------------------------|
| Marker Frequency Counter | | |
| Resolution | Selectable from 1 Hz to 100 kHz | |
| Accuracy ^a | $\pm(\text{marker frequency} \times \text{frequency reference error}^{\text{b}} + \text{counter resolution})^{\text{c}}$ | For RBW \geq 1 kHz |

- a. Marker level to displayed noise level $>$ 25 dB, RBW/ Span \geq 0.002, frequency offset = 0 Hz.
b. Frequency reference error = (aging rate \times period of time since adjustment + settability + temperature stability).
c. For firmware revisions prior to A.03.00, add 1 Hz \times N, where N is the harmonic mixing mode.

Agilent E4405B Specifications and Characteristics
Frequency

| | Specifications | Supplemental Information |
|-----------------------|---|--------------------------|
| Frequency Span | | |
| Range | 0 Hz (zero span), 100 Hz to 13.2 GHz | |
| Resolution | 2 Hz x N ^a | |
| Accuracy | ±(0.5% of span + 2 × $\frac{\text{span}}{\text{sweep points} - 1}$) | |

a. N is the harmonic mixing mode.

| | Specifications | Supplemental Information |
|---|--|---|
| Sweep Time | | |
| Range | 1 ms to 4000 s ^a | $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ to 4000 s |
| Tracking Generator On (Option 1DN) | | 50 ms is the minimum sweep time |
| Fast Time-domain Sweep (Option AYX) (For Span = 0 Hz, RBW ≥ 1 kHz) | 5 μs to 4000 s ^b | $\frac{\text{sweep points} - 1}{20 \text{ MHz}}$ to 4000 s |
| DSP and fast ADC (Option B7D) (For Span = 0 Hz, RBW ≥ 1 kHz) | 2.5 μs to 4000 s | $\frac{\text{sweep points} - 1}{40 \text{ MHz}}$ to 4000 s |
| Accuracy (Span = 0 Hz) | | |
| 1 ms to 4000 s ^a | ±1% | |
| (Option AYX) | ±1% | |
| 5 μs to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ | | |
| (Option B7D) | ±1% | |
| 2.5 μs to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ | | |
| Sweep Trigger ^{cd} | Free Run, Single, Line, Video, External, Delayed, Offset ^e | |
| (Option 1D6) | Add Gate | |
| (Option B7B) | Add TV | |
| Delayed Trigger ^{cf} | | |

| | Specifications | Supplemental Information |
|--|--|---|
| Range | 1 μ s to 400 s | |
| Resolution | $\frac{\text{delay in seconds}}{65000}$ rounded up to nearest μ s | |
| Accuracy | $\pm(500 \text{ ns} + (0.01\% \text{ of delay}))$ | |
| Offset Trigger ^e | | |
| Resolution | $\frac{\text{sweep time}}{\text{sweep points} - 1}$ | |
| Range | $\pm 320 \text{ ms}$ to $\pm 323 \text{ ks}$ | Where ST = sweep time and SP = sweep points $\frac{-32766 \times \text{ST}}{\text{SP} - 1}$ to $\frac{(32766 - \text{SP}) \times \text{ST}}{\text{SP} - 1}$ |
| Fast Time-domain sweep (Option AYX) (For sweep times 5.0 μ s to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$) | $\pm 1.64 \text{ ms}$ to $\pm 249 \text{ ms}$ | $\frac{-32766 \times \text{ST}}{\text{SP} - 1}$ to $\frac{(32766 - \text{SP}) \times \text{ST}}{\text{SP} - 1}$ |
| DSP and fast ADC (Option B7D) (For sweep times 2.5 μ s to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$) | $\pm 13 \text{ ms}$ to $\pm 5.15 \text{ s}$ | $\frac{-524031 \times \text{ST}}{\text{SP} - 1}$ to $\frac{(524031 - \text{SP}) \times \text{ST}}{\text{SP} - 1}$ |

- a. For firmware revisions prior to A.04.00, 5 ms to 2000 s.
- b. For firmware revisions prior to A.04.00, 20 μ s to 2000 s.
- c. Gate cannot be used simultaneously with delayed or TV trigger.
- d. Auto align is suspended in video, external, gate, and delayed trigger modes while waiting for a trigger event to occur.
- e. For firmware revision A.04.00 or later.
- f. Delayed trigger is available with line, external trigger, and TV trigger (Option B7B).

| | Specifications | Supplemental Information |
|-----------------------------|-----------------------|---------------------------------|
| Sweep (trace) Points | | |
| Range | 101 to 8192 | |

Agilent E4405B Specifications and Characteristics
Frequency

| | Specifications | Supplemental Information |
|---|---|---|
| <p>Resolution Bandwidth (RBW)</p> <p>Range</p> <p>–3 dB bandwidth</p> <p>–6 dB bandwidth (EMI)</p> <p><i>(Option 1DR)</i></p> <p>–3 dB bandwidth</p> <p>–6 dB bandwidth (EMI)</p> <p>Accuracy</p> <p>1 kHz to 3 MHz RBW</p> <p>5 MHz RBW</p> <p>10 Hz to 300 Hz RBW <i>(Option 1DR)</i></p> <p>Shape</p> <p>1 kHz to 5 MHz RBW</p> <p>10 Hz to 300 Hz RBW <i>(Option 1DR)</i></p> <p>Selectivity (60 dB/3 dB bandwidth ratio)</p> <p>1 kHz to 5 MHz RBW</p> <p>10 Hz to 300 Hz RBW <i>(Option 1DR)</i></p> | <p>1 kHz to 3 MHz, in 1-3-10 sequence, 5 MHz</p> <p>9 kHz and 120 kHz</p> <p>Adds 10, 30, 100, 300 Hz</p> <p>Add 200 Hz</p> <p>±15%</p> <p>±30%</p> <p>±10%</p> | <p>Only available in spans ≤ 5 MHz, sweep times $\geq \frac{\text{sweep points} - 1}{100 \text{ kHz}}$, and not usable with tracking generator on. <i>(Option 1DN)</i></p> <p>Synchronously tuned four poles, approximately Gaussian shape</p> <p>Digital, approximately Gaussian shape</p> <p><15:1, characteristic</p> <p><5:1, characteristic</p> |

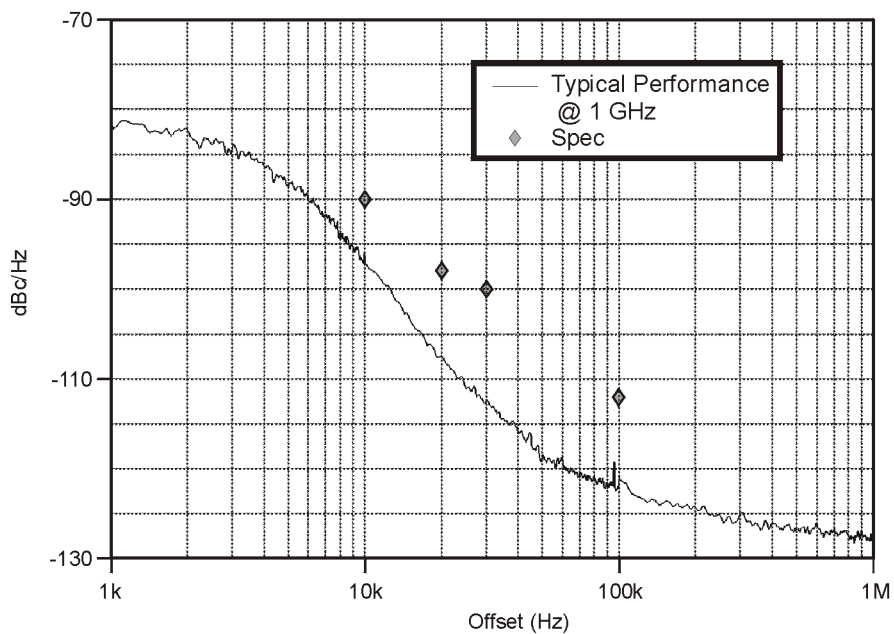
| | Specifications | Supplemental Information |
|---|--|--|
| <p>Video Bandwidth (VBW) (-3 dB)</p> <p>Range</p> <p><i>(Option 1DR)</i></p> <p>Accuracy</p> | <p>30 Hz to 1 MHz in 1-3-10 sequence</p> <p>Adds 1, 3, 10 Hz for RBW's <1 kHz</p> | <p>3 MHz, characteristic</p> <p>±30%, characteristic</p> |

| | Specifications | Supplemental Information |
|-------|-----------------------|---|
| Shape | | <p>Post detection, single pole low-pass filter used to average displayed noise</p> <p>Video bandwidths below 30 Hz are digital bandwidths with anti-aliasing filtering.</p> |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| <p>Stability</p> <p>Noise Sidebands (Offset from CW signal with 1 kHz RBW, 30 Hz VBW and sample detector)</p> <p> ≥ 10 kHz ≤ -90 dBc/Hz^a</p> <p> ≥ 20 kHz ≤ -98 dBc/Hz^a</p> <p> ≥ 30 kHz ≤ -100 dBc/Hz^a</p> <p> ≥ 100 kHz ≤ -112 dBc/Hz^a</p> <p>Residual FM</p> <p> 1 kHz RBW, 1 kHz VBW ≤ 150 Hz \times N p-p in 100 ms (<i>Option 1D5</i>) ≤ 100 Hz \times N p-p in 100 ms</p> <p> 10 Hz RBW, 10 Hz VBW ≤ 2 Hz \times N p-p in 20 ms (<i>Option 1DR and 1D5</i>)</p> <p> 10 Hz RBW, 10 Hz VBW ≤ 10 Hz \times N p-p in 20 ms, characteristic (<i>Option 1DR</i>)</p> <p>System-Related Sidebands, offset from CW signal</p> <p> ≥ 30 kHz ≤ -65 dBc^a</p> <p>Line-Related Sidebands, offset from CW signal (<i>Option 1DR</i>)</p> <p> <300 Hz ≤ -50 dBc^a, characteristic</p> <p> >300 Hz to 30 kHz ≤ -55 dBc^a, characteristic</p> | | |

a. Add 20 Log(N) for frequencies > 6.7 GHz

Noise Sidebands Normalized to 1 Hz Versus Offset From Carrier



w174b

Amplitude

Amplitude specifications do not apply for the negative peak detector mode.

| | Specifications | Supplemental Information |
|--------------------------|---|---|
| Measurement Range | Displayed Average Noise Level to Maximum Safe Input Level | |
| Input Attenuator Range | 0 to 65 dB, in 5 dB steps | 0 to 75 dB, in 5 dB steps, characteristic |

| | Specifications | Supplemental Information |
|--|-----------------|--------------------------|
| Maximum Safe Input Level | | |
| Average Continuous Power (Input attenuator setting ≥ 5 dB) | +30 dBm (1 W) | |
| Peak Pulse Power (for <10 μ sec pulse width, $<1\%$ duty cycle, and input attenuation ≥ 30 dB) | +50 dBm (100 W) | |
| dc | | |
| dc Coupled | 0 Vdc | |
| ac Coupled | 50 Vdc | |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| 1 dB Gain Compression | | |
| Total power at input mixer ^{ab} | | |
| 50 MHz to 3.0 GHz | 0 dBm | |
| 3.0 GHz to 6.7 GHz | 0 dBm | |
| 6.7 GHz to 13.2 GHz | -3 dBm | |
| Preamp On (<i>Option 1DS</i>) | | |
| Total power at the preamp ^c | | -20 dBm, characteristic |

- a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).
- b. For resolution bandwidths 1 kHz to 30 kHz, the maximum input signal amplitude must be \leq reference level +10 dB.
- c. Total power at the preamp (dBm) = total power at the input (dBm) – input attenuation (dB).

Agilent E4405B Specifications and Characteristics
Amplitude

| | Specifications | | Supplemental Information | | |
|--|-------------------------------|------------------------|--|-------------------------------|---|
| Displayed Average Noise Level (Input terminated, 0 dB attenuation, sample detector, Reference Level = -70 dBm) | | | | | |
| | | 1 kHz RBW 30 Hz VBW | 10 Hz RBW 1 Hz VBW <i>(Option 1DR)</i> | 1 kHz RBW 30 Hz VBW | 10 Hz RBW 1 Hz VBW <i>(Option 1DR)</i> |
| | 1 MHz to 10 MHz | | | ≤ -116 dBm, characteristic | ≤ -134 dBm, characteristic |
| | 10 MHz to 1.0 GHz | ≤ -116 dBm | ≤ -135 dBm | | |
| | 1.0 GHz to 2.0 GHz | ≤ -115 dBm | ≤ -134 dBm | | |
| | 2.0 GHz to 3.0 GHz | ≤ -112 dBm | ≤ -131 dBm | | |
| | 3.0 GHz to 6.0 GHz | ≤ -112 dBm | ≤ -131 dBm | | |
| | 6.0 GHz to 12 GHz | ≤ -110 dBm | ≤ -129 dBm | | |
| | 12 GHz to 13.2 GHz | ≤ -107 dBm | ≤ -126 dBm | | |
| | Preamp On <i>(Option 1DS)</i> | 1 kHz RBW 30 Hz VBW | 10 Hz RBW 1 Hz VBW <i>(Option 1DR)</i> | 1 kHz RBW 30 Hz VBW | 10 kHz RBW 1 Hz VBW <i>(Option 1DR)</i> |
| | 0 to 55 °C | | | | |
| | 1 MHz to 10 MHz | | | ≤ -131 dBm, characteristic | ≤ -149 dBm, characteristic |
| | 10 MHz to 1.0 GHz | ≤ -131 dBm | ≤ -149 dBm | | |
| | 1.0 GHz to 2.0 GHz | ≤ -129 dBm | ≤ -147 dBm | | |
| 2.0 GHz to 3.0 GHz | ≤ -127 dBm | ≤ -145 dBm | | | |
| 20 to 30 °C | | | | | |
| 10 MHz to 1.0 GHz | ≤ -132 dBm | ≤ -150 dBm | | | |
| 1.0 GHz to 2.0 GHz | ≤ -131 dBm | ≤ -149 dBm | | | |
| 2.0 GHz to 3.0 GHz | ≤ -130 dBm | ≤ -148 dBm | | | |

| | Specifications | Supplemental Information |
|---|---|---------------------------------|
| <p>Display Range</p> <p>Log Scale</p> <p style="padding-left: 20px;">RBW \geq 1 kHz</p> <p style="padding-left: 20px;">RBW \leq 300 Hz (<i>Option 1DR</i>)</p> <p>Linear Scale</p> <p>Scale Units</p> <p style="padding-left: 20px;">(<i>Option BAA</i>)</p> | <p>Ten divisions displayed; 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps</p> <p>Calibrated 0 to -85 dB from Reference Level</p> <p>Calibrated 0 to -120 dB^a from Reference Level</p> <p>Ten divisions</p> <p>dBm, dBmV, dBμV, V, and W</p> <p>Add Hz</p> | |

a. 0 to -70 dB range when span = 0 Hz, or when auto ranging is off:
(:DISPlay:WINDow:TRACe:Y[:SCALe]:LOG:RANGe:AUTO OFF).

| | Specifications | Supplemental Information |
|---|---|---------------------------------|
| <p>Marker Readout Resolution</p> <p>Log scale</p> <p style="padding-left: 20px;">RBW \geq 1 kHz</p> <p style="padding-left: 40px;">0 to -85 dB from ref level</p> <p style="padding-left: 20px;">RBW \leq 300 Hz</p> <p style="padding-left: 40px;">0 to -120 dB from ref level</p> <p>Linear scale</p> <p>Fast Sweep Times for Zero Span</p> <p style="padding-left: 20px;">(<i>Option AYY</i>)^a</p> <p style="padding-left: 20px;">5 μs to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$</p> <p style="padding-left: 20px;">Log</p> <p style="padding-left: 40px;">0 to -85 dB from ref level</p> <p style="padding-left: 20px;">Linear</p> | <p>0.04 dB</p> <p>0.04 dB</p> <p>0.01% of Reference Level</p> <p>0.3 dB</p> <p>0.3% of Reference Level for linear scale</p> | |

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| | Specifications | Supplemental Information |
|--|--|--------------------------|
| <i>(Option B7D)</i> 2.5 μ s to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ Log 0 to -85 dB from ref level Linear | 0.2 dB 0.2% of Reference Level for linear scale | |

a. For firmware revisions prior to A.04.00, 20 μ s to <5 ms.

| | Specifications | Supplemental Information |
|--|--|--|
| Frequency Response 50 Ω Absolute ^a /Relative 10 dB attenuation 20 to 30 °C 0 to 55 °C 50 Ω Absolute ^a /Relative Preamp On (<i>Option 1DS</i>) 1 MHz to 3.0 GHz 0 dB attenuation Preselector centered for frequency >3.0 GHz 3.0 GHz to 6.7 GHz 10 dB attenuation Absolute ^a 20 to 30 °C 0 to 55 °C Relative 20 to 30 °C 0 to 55 °C | 9 kHz to 3.0 GHz (dc coupled) \pm 0.5 dB \pm 1.0 dB (dc coupled) \pm 2.0 dB (dc coupled) \pm 1.5 dB \pm 2.5 dB \pm 1.3 dB \pm 1.5 dB | 100 kHz to 3.0 GHz (ac coupled) \pm 0.5 dB, characteristic \pm 1.0 dB, characteristic (ac coupled) \pm 2.0 dB (ac coupled) \pm 1.5 dB, characteristic \pm 2.5 dB, characteristic \pm 1.3 dB, characteristic \pm 1.5 dB, characteristic |

| | Specifications | Supplemental Information |
|-----------------------|-----------------------|---------------------------------|
| 6.7 GHz to 13.2 GHz | (dc coupled) | (ac coupled) |
| 10 dB attenuation | | |
| Absolute ^a | | |
| 20 to 30 °C | ±2.0 dB | ±2.0 dB, characteristic |
| 0 to 55 °C | ±3.0 dB | ±3.0 dB, characteristic |
| Relative | | |
| 20 to 30 °C | ±1.8 dB | ±1.8 dB, characteristic |
| 0 to 55 °C | ±2.0 dB | ±2.0 dB, characteristic |

a. Absolute flatness values are referenced to the amplitude at 50 MHz.

| | Specifications | Supplemental Information |
|--|---------------------------------------|---------------------------------|
| Input Attenuation Switching Uncertainty at 50 MHz | | |
| Attenuator Setting | | |
| 0 dB to 5 dB | ±0.3 dB | |
| 10 dB | Reference | |
| 15 dB | ±0.3 dB | |
| 20 to 65 dB attenuation | ±(0.1 dB + 0.01 × Attenuator Setting) | |

| Attenuation Accuracy Relative to the 10 dB Attenuator Setting, Characteristic | | |
|--|------------------------|---------------------|
| | Frequency Range | |
| Attenuation | 9 kHz–3.0 GHz | 3.0–13.2 GHz |
| 0 dB | ±0.3 dB | ±0.5 dB |
| 5 dB | ±0.3 dB | ±0.5 |
| 10 dB | Reference | Reference |
| 15 dB | ±0.4 dB | ±0.5 dB |
| 20 dB | ±0.4 dB | ±0.5 dB |
| 25 dB | ±0.5 dB | ±0.6 dB |
| 30 dB | ±0.5 dB | ±0.6 dB |
| 35 dB | ±0.6 dB | ±0.7 dB |

| Attenuation Accuracy Relative to the 10 dB Attenuator Setting, Characteristic | | |
|--|------------------------|---------------------|
| | Frequency Range | |
| Attenuation | 9 kHz–3.0 GHz | 3.0–13.2 GHz |
| 40 dB | ±0.6 dB | ±0.7 dB |
| 45 dB | ±0.7 dB | ±1.0 dB |
| 50 dB | ±0.7 dB | ±1.0 dB |
| 55 dB | ±0.9 dB | ±1.1 dB |
| 60 dB | ±0.9 dB | ±1.1 dB |
| 65 dB | ±1.0 dB | ±1.6 dB |

| | Specifications | Supplemental Information |
|-------------------------------------|-----------------------|---|
| Preamp (<i>Option 1DS</i>) | | Refer also to Displayed Average Noise Level specification |
| Gain | | +20 dB, nominal ^a |
| Noise figure | | 5 dB, characteristic |

a. Amplifier is between the input attenuator and the input mixer.

| | Specifications | Supplemental Information |
|--|---|---------------------------------|
| Absolute Amplitude Accuracy | | |
| At reference settings ^a | ±0.34 dB | |
| Preamp On ^b (<i>Option 1DS</i>) | ±0.5 dB | |
| Overall Amplitude Accuracy ^c | | |
| 20 to 30 °C | ± (0.54 dB + Absolute Frequency Response) | |

- a. Settings are: reference level –20 dBm; input attenuation 10 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, sample detector; signal at reference level.
- b. Settings are: reference level –30 dBm; input attenuation 0 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, signal at reference level.
- c. For reference level 0 to –50 dBm; input attenuation 10 dB; RBW 1 kHz; VBW 1 kHz; scale log, log range 0 to –50 dB from reference level; sweep time coupled; signal input 0 to –50 dBm; span ≤20 kHz.

| | Specifications | Supplemental Information | |
|---|-----------------------|---------------------------------|----------------|
| RF Input VSWR (at tuned frequency) | | characteristic | characteristic |
| Attenuator setting 0 dB | | (dc coupled) | (ac coupled) |
| 9 kHz to 100 kHz | | $\leq 3.0:1$ | |
| 100 kHz to 13.2 GHz | | $\leq 3.0:1$ | $\leq 3.0:1$ |
| Attenuator setting 5 dB | | (dc coupled) | (ac coupled) |
| 9 kHz to 100 kHz | | $\leq 2.0:1$ | |
| 100 kHz to 300 kHz | | $\leq 1.4:1$ | $\leq 2.3:1$ |
| 300 kHz to 1.0 MHz | | $\leq 1.4:1$ | $\leq 1.6:1$ |
| 1.0 MHz to 3.0 GHz | | $\leq 1.4:1$ | $\leq 1.4:1$ |
| 3.0 GHz to 6.7 GHz | | $\leq 1.4:1$ | $\leq 1.7:1$ |
| 6.7 GHz to 13.2 GHz | | $\leq 1.7:1$ | $\leq 1.9:1$ |
| Attenuator setting 10 to 65 dB | | (dc coupled) | (ac coupled) |
| 9 kHz to 100 kHz | | $\leq 2.0:1$ | |
| 100 kHz to 300 kHz | | $\leq 1.3:1$ | $\leq 2.1:1$ |
| 300 kHz to 1.0 MHz | | $\leq 1.3:1$ | $\leq 1.5:1$ |
| 1.0 MHz to 3.0 GHz | | $\leq 1.3:1$ | $\leq 1.3:1$ |
| 3.0 GHz to 6.7 GHz | | $\leq 1.3:1$ | $\leq 1.5:1$ |
| 6.7 GHz to 13.2 GHz | | $\leq 1.5:1$ | $\leq 1.7:1$ |

| | Specifications | Supplemental Information |
|-----------------------------------|-----------------------|---------------------------------|
| Auto Alignment^a | | |
| Sweep-to-sweep variation | | ± 0.1 dB, characteristic |

a. Set Auto Align to Off and use Align Now, All to eliminate this variation.

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Amplitude

| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| Resolution Bandwidth Switching Uncertainty (at Reference Level) | | |
| 1 kHz RBW | Reference | |
| 3 kHz to 3 MHz RBW | ±0.3 dB | |
| 5 MHz RBW | ±0.6 dB | |
| 10 Hz to 300 Hz RBW (<i>Option 1DR</i>) | ±0.3 dB | |

| | Specifications | Supplemental Information |
|---|--|--------------------------|
| Reference Level | | |
| Range | –149.9 dBm to maximum mixer level + attenuator setting | |
| Resolution | | |
| Log Scale | ±0.1 dB | |
| Linear Scale | ±0.12% of Reference Level | |
| Accuracy (at a fixed frequency, a fixed attenuator, and referenced to –30 dBm (–10 dBm, Preamp On (<i>Option 1DS</i>))) | | |
| Reference Level (dBm) – input attenuator setting (dB) + preamp gain (dB) | | |
| –10 dBm to > –60 dBm | ±0.3 dB | |
| –60 dBm to > –85 dBm | ±0.5 dB | |
| –85 dBm to –90 dBm | ±0.7 dB | |

| | Specifications | Supplemental Information |
|--|-----------------------------|--------------------------|
| Display Scale Switching Uncertainty | | |
| Switching between Linear and Log | ±0.15 dB at Reference Level | |
| Log Scale Switching | No error | |

| | Specifications | Supplemental Information |
|---|---|--------------------------------------|
| Display Scale Fidelity | | |
| Log Maximum Cumulative | | |
| 0 to -85 dB from Reference Level | $\pm(0.3 \text{ dB} + 0.01 \times \text{dB from Reference Level})$ | |
| RBW \leq 300 Hz (<i>Option 1DR</i>) | | |
| Span > 0 Hz | | |
| 0 to -98 dB from Reference Level | $\pm(0.3 \text{ dB} + 0.01 \times \text{dB from Reference Level})$ | |
| -98 to -120 dB from Reference Level | | $\pm 2.0 \text{ dB, characteristic}$ |
| Span = 0 Hz ^a | | |
| 0 to -60 dB from Reference Level | $\pm(0.3 \text{ dB} + 0.015 \times \text{dB from Reference Level})$ | |
| -60 to -70 dB from Reference Level | $\pm 1.5 \text{ dB}$ | |
| Log Incremental Accuracy | | |
| 0 to -80 dB ^b from reference level | $\pm 0.4 \text{ dB}/4 \text{ dB}$ | |
| Linear Accuracy | $\pm 2\%$ of Reference Level | |

a. or when auto ranging is off: (:DISPlay:WINDow:TRACe:Y[:SCALE]:LOG:RANGe:AUTO OFF)

b. 0 to -50 dB for RBWs \leq 300 Hz and span = 0 Hz, or when auto ranging is off.

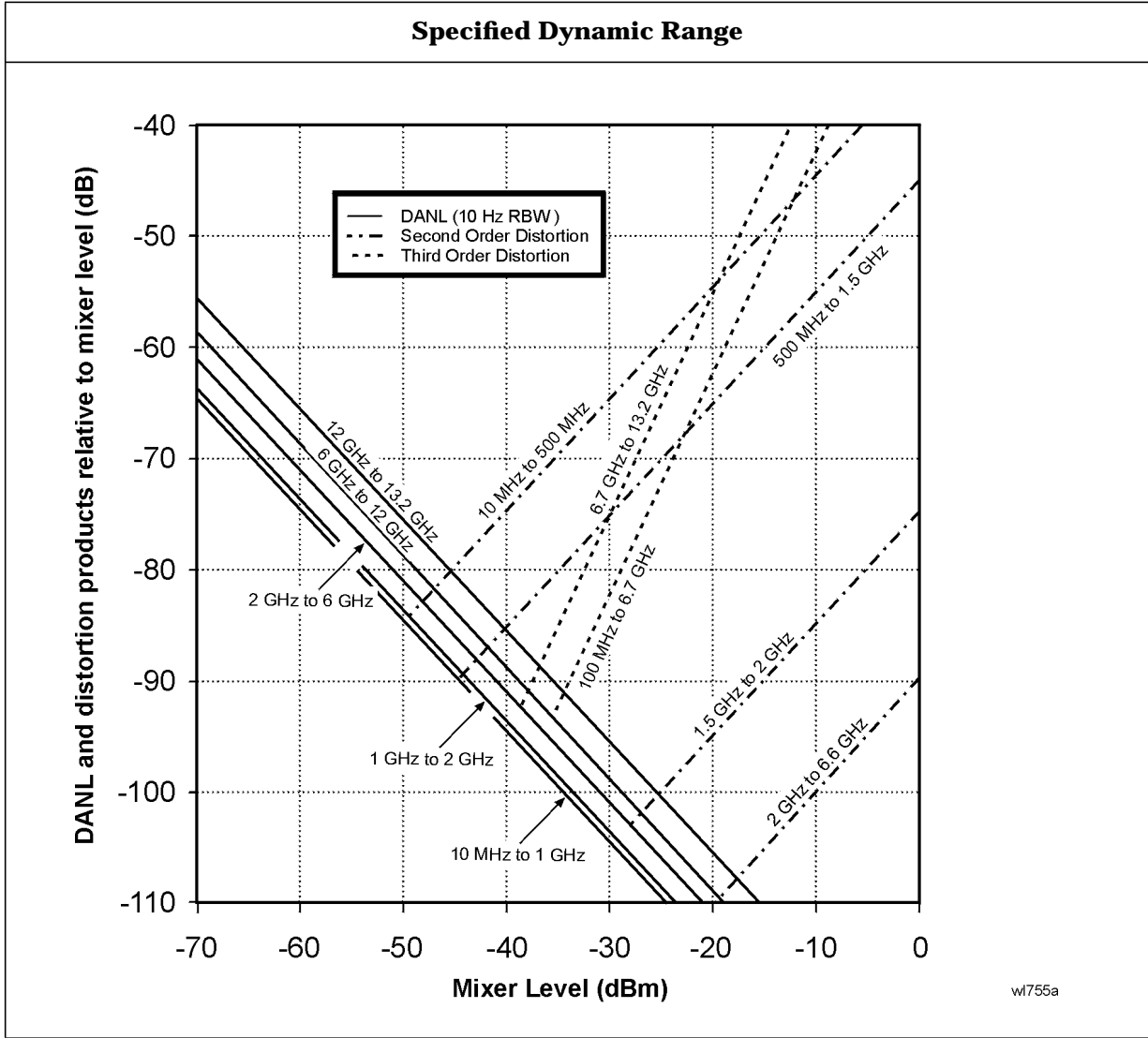
| | Specifications | Supplemental Information |
|----------------------------|--|---|
| Spurious Responses | | |
| Second Harmonic Distortion | | |
| Input Signal | | |
| 10 MHz to 500 MHz | $< -65 \text{ dBc}$ for -30 dBm signal at input mixer ^a | +35 dBm SHI (second harmonic intercept) |
| 500 MHz to 1.5 GHz | $< -75 \text{ dBc}$ for -30 dBm signal at input mixer ^a | +45 dBm SHI |
| 1.5 GHz to 2.0 GHz | $< -85 \text{ dBc}$ for -10 dBm signal at input mixer ^a | +75 dBm SHI |

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| | Specifications | Supplemental Information |
|--|--|--|
| 2.0 GHz to 3.35 GHz | < -100 dBc ^b for -10 dBm signal at input mixer ^a | +90 dBm SHI |
| 3.35 GHz to 6.6 GHz | < -100 dBc ^b for -10 dBm signal at input mixer ^a | +90 dBm SHI |
| Preamp On (<i>Option 1DS</i>) 10 MHz to 1.5 GHz | | -5 dBm SHI, characteristic |
| Third Order Intermodulation Distortion | | |
| 10 MHz to 100 MHz | | +7 dBm TOI (third order intercept), characteristic |
| 100 MHz to 3 GHz | < -82 dBc for two -30 dBm signals at input mixer ^a and >50 kHz separation | +11 dBm TOI +16 dBm TOI, typical, 20 to 30 °C |
| 3.0 GHz to 6.7 GHz | < -82 dBc for two -30 dBm signals at input mixer ^a and >50 kHz separation | +11 dBm TOI +18 dBm TOI, typical, 20 to 30 °C |
| 6.7 GHz to 13.2 GHz | < -75 dBc for two -30 dBm signals at input mixer ^a and >50 kHz separation | +7.5 dBm TOI +12 dBm TOI, typical, 20 to 30 °C |
| Preamp On (<i>Option 1DS</i>) 10 MHz to 3 GHz, | | -16 dBm TOI, characteristic |
| Other Input Related Spurious | | |
| Inband Responses | | |
| >30 kHz offset | < -65 dBc for -20 dBm signal at input mixer ^a | |
| Out-of-band Responses | < -80 dBc for -10 dBm signal at input mixer ^a | |

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

b. or signal below displayed average noise level.



| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| <p>Residual Responses (Input terminated and 0 dB attenuation)</p> <p>150 kHz to 6.7 GHz</p> | <p>< -90 dBm</p> | |

Options

Time Gated Spectrum Analysis (Option 1D6)

| | Specifications | Supplemental Information |
|---|---|---|
| Gate Delay | | |
| Range | 1 μ s to 400 s | |
| Accuracy | $\pm(500 \text{ ns} + (0.01\% \times (\text{maximum of gate delay or length})))$ | From gate trigger input to positive edge of gate output |
| Gate Length | | |
| Range | 1 μ s to 400 s | |
| Accuracy | $\pm(500 \text{ ns} + (0.01\% \times (\text{maximum of gate delay or length})))$ | From positive edge to negative edge of gate output |
| Resolution | $((\text{maximum of gate delay or length in seconds})/65000)$ rounded up to nearest μ s | Dependent on the greater of gate delay or gate length |
| Additional Amplitude Error^a | | |
| Log Scale | $\pm 0.2 \text{ dB}$ | |
| Linear Scale | $\pm 0.1\%$ of reference level | |

a. While in gate mode.

Tracking Generator (Option 1DN)

The spectrum analyzer tracking generator combination will meet its specification after a cable (8120-5148) and adapter are connected between RF OUT and INPUT and **Align Now**, TG has been run.

| | Specifications | Supplemental Information |
|----------------|----------------|--------------------------|
| Warm-Up | 5 minutes | |

| | Specifications | Supplemental Information |
|-------------------------------|------------------|--------------------------|
| Output Frequency Range | 9 kHz to 3.0 GHz | |

| | Specifications | Supplemental Information |
|------------------------------|----------------|--|
| Minimum Resolution BW | 1 kHz | Not usable with resolution bandwidths ≤ 300 Hz (<i>Option 1DR</i>) |

| | Specifications | Supplemental Information |
|---|--------------------------|--------------------------|
| Output Power Level | | |
| Range | -2 to -66 dBm | |
| Resolution | 0.1 dB | |
| Absolute Accuracy (at 50 MHz with coupled source attenuator, referenced to -20 dBm) | ± 0.75 dB | |
| Vernier | | |
| Range | 8 dB | |
| Accuracy (with coupled source attenuator, 50 MHz, -20 dBm) | | |
| Incremental | ± 0.2 dB/dB | |
| Cumulative | ± 0.5 dB, total | |
| Output Attenuator Range | 0 to 56 dB in 8 dB steps | |

| | Specifications | Supplemental Information |
|-----------------------------------|----------------|---------------------------------------|
| Maximum Safe Reverse Level | | +30 dBm (1 W), 50 Vdc, characteristic |

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| | Specifications | Supplemental Information |
|---------------------------|---|---------------------------------|
| Output Power Sweep | | |
| Range | (-10 to -2 dBm) – (Source Attenuator Setting) | |
| Resolution | 0.1 dB | |
| Accuracy (zero span) | <1 dB peak-to-peak | |

| | Specifications | Supplemental Information |
|----------------------------------|-----------------------|---------------------------------|
| Output Flatness | | |
| Referenced to 50 MHz, -20 dBm | | |
| 9 kHz to 10 MHz | ±3 dB | |
| 10 MHz to 3 GHz | ±2 dB | |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| Spurious Outputs | | |
| (-2 dBm output) | | |
| Harmonic Spurs | | |
| TG Output 9 kHz to 20 kHz | ≤ -15 dBc | |
| TG Output 20 kHz to 3 GHz | ≤ -25 dBc | |
| Non-harmonic Spurs | | |
| TG Output 9 kHz to 2 GHz | ≤ -27 dBc | |
| TG Output 2 GHz to 3 GHz | ≤ -23 dBc | |
| LO Feedthrough | | |
| LO Frequency 3.921409 to 6.9214 GHz | ≤ -16 dBm | |

| | Specifications | Supplemental Information |
|----------------------|--|---------------------------------|
| Dynamic Range | Maximum Output Power Level – Displayed Average Noise Level | |

| | Specifications | Supplemental Information |
|------------------------|----------------|--|
| Output Tracking | | |
| Drift | | 1.5 kHz/5 minute, characteristic |
| Swept Tracking Error | | Usable in 1 kHz RBW after 5 minutes of warm-up |

| | Specifications | Supplemental Information |
|-------------------------------|----------------|----------------------------|
| RF Power-Off Residuals | | |
| 9 kHz to 3 GHz | | < -120 dBm, characteristic |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| Output Attenuator Repeatability | | |
| 9 kHz to 300 MHz | | ±0.1 dB, characteristic |
| 300 MHz to 2.0 GHz | | ±0.2 dB, characteristic |
| 2.0 GHz to 3 GHz | | ±0.3 dB, characteristic |

| | Specifications | Supplemental Information |
|--------------------|----------------|--------------------------|
| Output VSWR | | |
| 0 dB attenuation | | <2.0:1, characteristic |
| ≥ 8 dB attenuation | | <1.5:1, characteristic |

| | Specifications | Supplemental Information |
|-----------------------------------|----------------|--------------------------|
| Output Attenuator Accuracy | | |
| 0 dB | Reference | ±0.5 dB, characteristic |
| 8 dB | | ±0.5 dB, characteristic |
| 16 dB | | |
| 24 dB | | ±0.5 dB, characteristic |
| 32 dB | | ±0.6 dB, characteristic |
| 40 dB | | ±0.8 dB, characteristic |
| 48 dB | | ±1.0 dB, characteristic |
| 56 dB | | ±1.1 dB, characteristic |

| |
|--|
| Tracking Generator Output Accuracy |
| Relative Accuracy (Referred to -20 dBm) = Output Attenuator Accuracy + Vernier Accuracy + Output Flatness |
| Absolute Accuracy = Relative Accuracy (Referred to -20 dBm) + Absolute Accuracy at 50 MHz |

FM Demodulation (Option BAA)

The FM demodulation characteristics will be met after an **Align Now**, **FM Demod** has been run.

| | Specifications | Supplemental Information |
|---|----------------|--|
| Input Level | | $\geq (-60 \text{ dBm} + \text{attenuator setting} - \text{preamp gain})$, characteristic |
| Signal Level | | 0 to -30 dB below reference level, characteristic |
| FM Deviation | | |
| Range | | 10 kHz to 1 MHz |
| Resolution | | Provides 1 Hz display annotation resolution |
| FM Deviation Range | | |
| 10 kHz to 40 kHz | | 12 Hz, characteristic |
| >40 kHz to 200 kHz | | 60 Hz, characteristic |
| >200 kHz to 1 MHz | | 300 Hz, characteristic |
| Accuracy ^a | | |
| FM Rate < FM BW/100, VBW $\geq (30 \times \text{FM Rate})$, RBW > the maximum of (30 \times FM deviation) or (30 \times FM Rate) | | $< (2\% \text{ of FM deviation range} + 2 \times \text{Resolution})$, characteristic |
| Offset Error ^a | | 5% of FM Deviation Range + 300 Hz, characteristic |
| FM Bandwidth (-3 dB) | | |
| FM Deviation Range | | |
| 10 kHz to 40 kHz | | 7.5 \times FM deviation range, characteristic |
| >40 kHz to 200 kHz | | 1.3 \times FM deviation range, characteristic |
| >200 kHz to 1 MHz | | 0.3 \times FM deviation range, characteristic |

a. In time domain sweeps (span = 0 Hz).

TV Trigger and Picture On Screen (Option B7B)

Option BAA is required.

| | Specifications | Supplemental Information |
|---|---|--|
| TV Trigger and Picture On Screen | | TV Trigger initiates a sweep of the analyzer after the sync pulse of a selected line of a TV video field. Picture On Screen displays the TV picture on the analyzer display. |
| Amplitude Requirements TV Source: SA | | Top 50% of linear display, characteristic |
| TV Source: EXT VIDEO IN | | 500 mVp-p to 2 Vp-p, characteristic |
| Compatible Standards | NTSC-M, NTSC-Japan, PAL-M, PAL-B,D,G,H,I, PAL-N, PAL-N Combination, SECAM-L | |
| Field Selection | Entire frame, even, odd | |
| Sync Polarity | Positive or negative | |
| TV Trigger | | |
| Line Selection | 1 to 525, or 1 to 625, standard dependent | |

cdmaOne Measurement Personality (Option BAC)

Unless otherwise noted, all specifications are with RF input range auto, default cdmaOne measurement settings, and in the in-band frequency range. *Option B72* is required.

| | Specifications | Supplemental Information |
|--------------------------------|--|--------------------------|
| In-Band Frequency Range | | |
| Cellular bands | 824 to 870 MHz 869 to 925 MHz | |
| PCS bands | 1715 to 1780 MHz 1805 to 1870 MHz 1850 to 1910 MHz 1930 to 1990 MHz | |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------------------|
| Channel Power (1.23 MHz Integration BW) | | Integration BW range 1 kHz to 10 MHz |
| Range at RF Input | 30 to -70 dBm | |
| Absolute power accuracy for in-band signal (Mean channel power at RF Input, plus any external attenuation, excluding mismatch error) | | |
| Cellular Bands | | |
| 30 to -5 dBm 20 to 30 °C | ±0.80 dB | ±0.36 dB, typical |
| 0 to 55 °C | ±1.13 dB | |
| -5 to -25 dBm 20 to 30 °C | ±0.77 dB | ±0.33 dB, typical |
| 0 to 55 °C | ±1.10 dB | |
| -25 to -45 dBm 20 to 30 °C | ±0.65 dB | ±0.29 dB, typical |
| 0 to 55 °C | ±1.00 dB | |
| -45 to -55 dBm 20 to 30 °C | ±0.72 dB | ±0.36 dB, typical |
| 0 to 55 °C | ±1.01 dB | |

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| | Specifications | Supplemental Information |
|-------------------------------|----------------|--------------------------|
| -55 to -70 dBm 20 to 30 °C | ±0.86 dB | ±0.47 dB, typical |
| 0 to 55 °C | ±1.28 dB | |
| PCS Bands | | |
| 30 to -5 dBm 20 to 30 °C | ±0.70 dB | ±0.29 dB, typical |
| 0 to 55 °C | ±1.15 dB | |
| -5 to -25 dBm 20 to 30 °C | ±0.67 dB | ±0.26 dB, typical |
| 0 to 55 °C | ±1.11 dB | |
| -25 to -45 dBm 20 to 30 °C | ±0.66 dB | ±0.27 dB, typical |
| 0 to 55 °C | ±0.97 dB | |
| -45 to -55 dBm 20 to 30 °C | ±0.73 dB | ±0.34 dB, typical |
| 0 to 55 °C | ±0.98 dB | |
| -55 to -70 dBm 20 to 30 °C | ±0.87 dB | ±0.45 dB, typical |
| 0 to 55 °C | ±1.25 dB | |

| | Specifications | Supplemental Information |
|---|----------------------------|--------------------------|
| Channel power relative power accuracy (same channel, different Tx power, input attenuator fixed, RF input range manual). | See Display Scale Fidelity | |

| | Specifications | Supplemental Information |
|--------------------------------|----------------|--------------------------|
| Receive Channel Power | | |
| Absolute Power Accuracy | | |
| Cellular bands | | |
| 30 to 0 dBm | ±0.98 dB | ±0.55 dB, typical |
| 0 to -85 dBm | ±2.02 dB | ±1.33 dB, typical |
| PCS bands | | |
| 30 to 0 dB | ±1.00 dB | ±0.60 dB, typical |
| 0 to -85 dBm | ±1.52 dB | ±0.84 dB, typical |

| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| Preamp (<i>Option 1DS</i>) Cellular and PCS bands 30 to -80 dBm | ±2.45 dB | ±1.70 dB, typical |
| -80 to -100 dBm | ±3.20 dB | ±2.30 dB, typical |

| | Specifications | Supplemental Information |
|--|----------------|---|
| Occupied Bandwidth | | |
| Carrier power range | 30 to -70 dBm | |
| Frequency resolution of occupied BW | 1.88 kHz | |
| Frequency accuracy of occupied BW (1.23 MHz channel BW) | | ±15 kHz, characteristic |
| Frequency resolution of delta frequency | 3.75 kHz | |
| Frequency accuracy of delta frequency | | ±(35 kHz + frequency reference error × carrier frequency), characteristic |

| | Specifications | Supplemental Information |
|---|--------------------|---|
| Code Domain (Requires <i>Options 1D5, B7D,</i> and <i>B7E</i> . Measurement interval ≥1.25 ms unless otherwise noted.) | | |
| Carrier power range at RF Input (Pilot channel power > -11 dBc) | 30 to -13 dBm | 30 to -65 dBm ^a , characteristic |
| Preamp (<i>Option 1DS</i>) | 30 to -30 dBm | 30 to -82 dBm ^a , characteristic |
| Measurement interval range | 0.5 ms to 26.67 ms | |
| Code domain power | | |
| Display dynamic range | 50 dB | |
| Accuracy (Walsh channel power within 20 dB of total power) | ±0.2 dB | |
| Displayed resolution | 0.01 dB | |

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| | Specifications | Supplemental Information |
|---|------------------------|--|
| 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 interval ≥ 2.5 ms) | | Excludes frequency reference error. |
| Input frequency error range | ± 100 kHz | ± 200 kHz, typical |
| Accuracy | ± 10 Hz | ± 7 Hz, typical |
| Displayed resolution | Four digits | |
| Estimated Rho | | |
| Range | 0.9 to 1.0 | 0.5 to 1.0 ^b |
| Accuracy (With 9 channels active over the specified range) ^c | | ± 0.02 , characteristic |
| Displayed resolution | 0.0001 | |
| Pilot time offset | | From even second signal to start of PN sequence |
| Range | -13.33 ms to +13.33 ms | |
| Accuracy | ± 150 ns | |
| Displayed resolution | Four digits | |
| Code domain timing | | Pilot to code channel time tolerance |
| Range | ± 200 ns | |
| Accuracy (IS-97A nominal power levels) ^d | ± 15 ns | ± 7 ns, typical |
| Code domain phase | | Pilot to code channel phase tolerance |
| Range | ± 200 mrad | |
| Accuracy (IS-97A nominal power levels) ^d | ± 15 mrad | ± 10 mrad, typical |
| Displays | | Power Graph and Metrics, or Power, Timing, and Phase Graphs |

a. Performance may degrade outside of the specified carrier power range at RF input listed in the specifications column.

b. Performance may degrade outside of the estimated rho range listed in the specifications column.

- c. The Active Set Threshold is less than all active channels, but greater than -20 dBc.
- d. IS-97A nominal base station test model levels (fraction of carrier power); Pilot: 0.20 (-7.0 dBc), Sync: 0.0471 (-13.3 dBc), Paging: 0.1882 (-7.3 dBc), 6 Traffic channels: 0.09412 (-10.3 dBc)

| | Specifications | Supplemental Information |
|---|------------------------|---|
| Modulation Accuracy (Rho) (Requires <i>Options 1D5, B7D, and B7E</i> . Measurement interval ≥ 1.25 ms unless otherwise noted.) | | |
| Carrier power range at RF Input | 30 to -28 dBm | 30 to -70 dBm ^a , characteristic |
| Preamp (<i>Option 1DS</i>) | 30 to -45 dBm | 30 to -87 dBm ^a , characteristic |
| Measurement interval range | 0.5 ms to 26.67 ms | |
| Rho (waveform quality) | | |
| Range | 0.9 to 1.0 | 0.5 to 1.0 ^b , characteristic |
| Accuracy | ± 0.0015 | ± 0.0007 , typical |
| Displayed resolution | 0.0001 | |
| Carrier frequency error (Measurement interval ≥ 2.5 ms) | | |
| Input frequency error range | ± 100 kHz | ± 200 kHz, typical |
| Accuracy | ± 10 Hz | ± 7 Hz, typical |
| Displayed resolution | Four digits | |
| Pilot time offset | | |
| Range | -13.33 ms to +13.33 ms | From even second signal to start of PN sequence |
| Accuracy | ± 150 ns | |
| Displayed resolution | Four digits | |
| EVM | | |
| Floor | 3.0% | 2.6%, typical |
| Accuracy ^c | $\pm 0.65\%$ | $\pm 0.46\%$, typical |
| Displayed Resolution | 0.01% | |
| Carrier feedthrough | | |
| Floor | -51 dBc | |

Agilent E4405B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| Accuracy (Carrier feedthrough ≥ -43 dBc) | ± 2.3 dB | Numeric results or Numeric results and IQ graph |
| Displayed resolution | 0.01 dB | |
| Magnitude error | | |
| Floor | 3.0% | |
| Accuracy ^c | $\pm 0.65\%$ | |
| Displayed resolution | 0.01% | |
| Phase error | | |
| Accuracy ^c | ± 0.4 degrees | |
| Displayed resolution | 0.01 degrees | |
| Displays | | |

- a. Performance may degrade outside of the specified carrier power range at RF input listed in the specifications column.
- b. Performance may degrade outside of the rho range listed in the specifications column.
- c. Accuracy does not include the effects of the EVM floor. The measurement variance increases as the result approaches the EVM floor.

| | Specifications | Supplemental Information |
|------------------------------------|--|--|
| Spur Close (In Band) | | |
| Carrier power range at RF Input | 30 to -12 dBm | |
| Dynamic range | | |
| Input power | | |
| 30 to 25 dBm | 55 dB | |
| 25 to 20 dBm | 50 dB | |
| 20 to -12 dBm | 46 dB | |
| Relative accuracy | $\pm(2.7 \text{ dB} + 0.01 \times (\text{dB from reference level}))$ | $\pm(0.3 \text{ dB} + 0.01 \times (\text{dB from reference level}))$, typical |
| Displayed resolution | 0.01 dB | |

| | Specifications | Supplemental Information |
|---|----------------|--|
| Out-of-Band Spurious^a | | Refer to the Amplitude specifications section in this guide. |

- a. The out-of-band measurement is made with the user-defined tables with 20 frequency ranges each (up to the top 10 spurs per range, 100 spurs maximum). Table parameters include frequency range, RBW, video BW, detector type, and amplitude test limits.

| | Specifications | Supplemental Information |
|---|-----------------|--------------------------|
| Receiver Spurious Emissions | | |
| Spurious emission power range | -20 to -83 dBm | |
| Preamp On (<i>Option 1DS</i>) | -40 to -101 dBm | |
| Absolute spurious emission power accuracy | | |
| -20 to -60 dBm | ±2.6 dB | ±1.7 dB, typical |
| -60 to -83 dBm | ±4.3 dB | ±3.4 dB, typical |
| Preamp On (<i>Option 1DS</i>) | | |
| -40 to -70 dBm | ±3.6 dB | ±2.6 dB, typical |
| -70 to -101 dBm | ±5.0 dB | ±3.9 dB, typical |

| | Specifications | Supplemental Information |
|-------------------------------------|----------------|--------------------------|
| External Correction | | |
| External attenuation, external gain | | |
| Range | -90 to 90 dB | |
| Resolution | 0.01 dB | |

| | Specifications | Supplemental Information |
|---|---------------------|--------------------------|
| Trigger | | |
| Trigger source (Actual available choices dependent on measurement) | Free run, external | |
| (<i>Option B7D and B7E</i>) | Add RF Burst, frame | |
| Delay trigger | | |
| Range | 0 to 500 ms | |
| Resolution | 300 ns | |

Agilent E4405B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| RF burst trigger level <i>(Option B7E)</i> | 0 to -25 dBc | Rear panel connector labelled EXT FRAME SYNC <i>(Option B7D)</i> |
| Trigger slope (External and RF burst) | Positive/Negative | |
| Frame timing period | 50 ns to 13.6533 s | |
| Frame synchronizing source | External frame sync | |
| Frame synchronizing slope | Positive/Negative | |

| | Specifications | Supplemental Information |
|--|-----------------------|---|
| Demod Trigger Source | | Rear panel connector labelled EXT FRAME SYNC |
| Even second input (Frame trigger only, <i>Option B7D and B7E</i>) | | |
| PN offset range | 0 to 511 x 64 [chips] | |

GSM Measurement Personality (Option BAH)

Unless otherwise noted, all specifications are with RF input range auto, default GSM measurement settings, and in the in-band frequency range. *Option 1D6* and *Option B72* are required.

| | Specifications | Supplemental Information |
|--------------------------------|--------------------------------------|--------------------------|
| In-Band Frequency Range | | |
| GSM 900, P-GSM bands | 890 to 915 MHz 935 to 960 MHz | |
| GSM 900, E-GSM bands | 880 to 915 MHz 925 to 960 MHz | |
| GSM 900, R-GSM bands | 876 to 915 MHz 921 to 960 MHz | |
| DCS 1800 bands | 1710 to 1785 MHz 1805 to 1880 MHz | |
| PCS 1900 bands | 1850 to 1910 MHz 1930 to 1990 MHz | |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| Transmitter Power (Requires <i>Option B7D</i> or <i>AYX</i>) | | |
| Range at RF Input | 30 to -60 dBm | |
| Absolute power accuracy for in-band signal (Mean channel power at RF Input, plus any external attenuation, excluding mismatch error) | | |
| P-GSM, E-GSM, and R-GSM Bands | | |
| 30 to -20 dBm 20 to 30 °C | ±0.81 dB | ±0.38 dB, typical |
| 0 to 55 °C | ±1.31 dB | |
| -20 to -30 dBm 20 to 30 °C | ±0.74 dB | ±0.37 dB, typical |
| 0 to 55 °C | ±1.14 dB | |

Agilent E4405B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|------------------------------------|-----------------------|---------------------------------|
| -30 to -40 dBm 20 to 30 °C | ±0.79 dB | ±0.37 dB, typical |
| 0 to 55 °C | ±1.11 dB | |
| -40 to -50 dBm 20 to 30 °C | ±0.95 dB | ±0.53 dB, typical |
| 0 to 55 °C | ±1.21 dB | |
| -50 to -60 dBm 20 to 30 °C | ±1.09 dB | ±0.66 dB, typical |
| 0 to 55 °C | ±1.33 dB | |
| DCS 1800 and PCS 1900 Bands | | |
| 30 to -20 dBm 20 to 30 °C | ±0.68 dB | ±0.28 dB, typical |
| 0 to 55 °C | ±1.30 dB | |
| -20 to -30 dBm 20 to 30 °C | ±0.61 dB | ±0.27 dB, typical |
| 0 to 55 °C | ±1.12 dB | |
| -30 to -40 dBm 20 to 30 °C | ±0.66 dB | ±0.27 dB, typical |
| 0 to 55 °C | ±0.99 dB | |
| -40 to -50 dBm 20 to 30 °C | ±0.82 dB | ±0.43 dB, typical |
| 0 to 55 °C | ±1.09 dB | |
| -50 to -60 dBm 20 to 30 °C | ±0.96 dB | ±0.56 dB, typical |
| 0 to 55 °C | ±1.21 dB | |

| | Specifications | Supplemental Information |
|--|----------------------------|---------------------------------|
| Transmitter Power Relative Power Accuracy (same channel, different Tx power, input attenuator fixed, RF input range manual). | See Display Scale Fidelity | |

| | Specifications | Supplemental Information |
|---|-----------------------|---|
| Power versus Time (Requires <i>Option B7D</i> or <i>AYX</i>) | | |
| Carrier power range at RF Input | 30 to -23 dBm | 30 to -55 dBm ^a , characteristic |
| Preamp On (<i>Option 1DS</i>) | 30 to -40 dBm | 30 to -72 dBm ^a , characteristic |
| Time resolution accuracy | | ±1% of sweep time, characteristic |
| Maximum record length | 8 time slots | |
| Burst to mask uncertainty (Requires <i>Option B7D</i> and <i>B7E</i>) | ±1.0 bit | |

a. Performance may degrade outside of the specified carrier power range at RF input listed in the specifications column.

| | Specifications | Supplemental Information |
|---|---------------------------------------|---------------------------------|
| Output RF Spectrum | | |
| Carrier power range at RF Input | | |
| Offsets ≤1800 kHz, 30 kHz RBW | | 30 to -5 dBm, characteristic |
| Offsets >1800 kHz, 100 kHz RBW | | 30 to -4 dBm, characteristic |
| Reference power accuracy | Same as Transmitter Power measurement | |
| Relative accuracy ^a | See Display Scale Fidelity | |
| Spectrum due to modulation displayed dynamic range ^{bc} | | |
| 100 kHz offset | | 30 dB, characteristic |
| 200 kHz offset | | 60 dB, characteristic |
| 250 kHz offset | | 60 dB, characteristic |
| 400 kHz offset | | 70 dB, characteristic |
| 600 kHz to 1.8 MHz offset | | 79 dB, characteristic |
| 1.8 to 6.0 MHz offset | | 75 dB, characteristic |
| >6 MHz offset | | 76 dB, characteristic |
| Swept Mode Dynamic Range | | 70 dB, characteristic |

Agilent E4405B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| Spectrum due to switching transients displayed dynamic range ^{bc} | | |
| 400 kHz offset | | 62 dB, characteristic |
| 600 kHz offset | | 79 dB, characteristic |
| 1200 kHz offset | | 79 dB, characteristic |
| 1800 kHz offset | | 80 dB, characteristic |
| Swept Mode Dynamic Range | | 70 dB, characteristic |

- a. Does not include uncertainty due to noise.
- b. Displayed dynamic range for specific frequency offsets - applies to CW signal at the specified offset. Dynamic range with a GSM signal may differ.
- c. Using default settings, the RBW filter has a corrected noise BW and impulse BW equivalent to five-pole synchronously tuned filter.

| | Specifications | Supplemental Information |
|--|-----------------------|---|
| Phase and Frequency Error (Requires <i>Option 1D5, B7D, and B7E</i>) | | |
| Carrier power range at RF Input | 30 to -23 dBm | 30 to -55 dBm ^a , characteristic |
| Preamplifier On (<i>Option 1DS</i>) | 30 to -40 dBm | 30 to -72 dBm ^a , characteristic |
| Phase error Range | 0 to 180° | |
| Displayed resolution | 0.01° | |
| Accuracy (Averages ≥10) | | |
| Peak | ±2.1° | ±1.5°, typical |
| RMS | ±1.1° | ±0.6°, typical |
| Frequency error | | Excludes frequency reference error |
| Initial frequency error range | ±100 kHz | |
| Accuracy (Averages ≥10) | ±10 Hz | ±5 Hz, typical |
| I/Q offset range | -10 to -46 dBc | |
| Burst sync time uncertainty | ±1.0 bit | |
| Displays | | Numeric summary |

- a. Performance may degrade outside of the specified carrier power range at RF input listed in the specifications column.

| | Specifications | Supplemental Information |
|-----------------------------------|-----------------------|---|
| Transmit Band Spurious | | |
| Carrier power range at RF Input | | 30 to -12 dBm, typical |
| Dynamic range | | |
| Upper and lower adjacent segments | | 55 dB, characteristic |
| Upper and lower segments | | 44 dB, characteristic |
| Relative accuracy | | $\pm(0.3 \text{ dB} + 0.01 \times (\text{dB from reference level}))$, characteristic |
| Displayed resolution | 0.01 dB | |

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| Out-of-Band Spurious^a | | |
| Absolute Spurious Power Accuracy | | Refer to the Amplitude specifications section in this guide. |
| Sensitivity ^b | | |
| RBW | | |
| 1 kHz | | -95 dBm, characteristic |
| 3 kHz | | -90 dBm, characteristic |
| 10 kHz | | -85 dBm, characteristic |
| 30 kHz | | -78 dBm, characteristic |
| 100 kHz | | -71 dBm, characteristic |
| 300 kHz | | -64 dBm, characteristic |
| 1 MHz | | -57 dBm, characteristic |
| 3 MHz | | -50 dBm, characteristic |

a. The out-of-band spurious measurement is made in accordance with the tables defined in the appropriate GSM specification document. The measurement is made over several frequency ranges (up to 10 spurs per range, 100 spurs maximum).

b. With input attenuation of 5 dB. For all other attenuation settings, add (input attenuation - 5) dB.

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| Receive Band Spurious | | |
| Spurious emission power range ^a | | -20 to -73 dBm, characteristic |

Agilent E4405B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| Preamp On (<i>Option 1DS</i>) Absolute spurious emission power accuracy -20 to -60 dBm -60 to -73 dBm Preamp on (<i>Option 1DS</i>) -40 to -70 dBm -70 to -91 dBm | | -40 to -91 dBm, characteristic ±1.9 dB, characteristic ±2.5 dB, characteristic ±2.8 dB, characteristic ±4.1 dB, characteristic |

- a. Requires bandpass filter centered on receive band, peak detector mode, 0 dB attenuation, 100 kHz RBW. Does not include insertion loss of bandpass filter.

| | Specifications | Supplemental Information |
|--------------------------------|-----------------------|---|
| Amplitude Range Control | | RF Input Autorange, Manually set Max Total Pwr Manually set Input Atten |

| | Specifications | Supplemental Information |
|--|---|---------------------------------|
| External Gain/Attenuation Correction Base gain, base attenuation, mobile gain, mobile attenuation Range Resolution | 0 to 81.9 dB 0.01 dB | |

| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| Trigger | | |
| Trigger source (Actual available choices dependent on measurement) (Option B7D and B7E) | Free run, external Add RF Burst and frame | |
| RF burst trigger (Option B7E) | | |
| Peak carrier power range ^a | 30 to -25 dBm | 30 to -30 dBm, typical |
| Preamp On (Option 1DS) | 30 to -45 dBm | 30 to -50 dBm, typical |
| Trigger level range | 0 to -25 dB relative to signal peak | |

a. With trigger level set to -6 dB.

| | Specifications | Supplemental Information |
|--|---|---|
| Burst Sync (Requires Option AYX or B7D) | | |
| Source (Actual available choices dependent on measurement) (Option B7D and B7E) | RF amplitude, none Add training sequence | |
| Training sequence code | | GSM defined 0 to 7 Auto (search) or Manual |
| Burst type | | Normal (TCH and CCH) Sync (SCH) Access (RACH) |

General

| | Specifications | Supplemental Information |
|--------------------------|----------------|--------------------------|
| Temperature Range | | |
| Operating | 0 to 55 °C | Floppy disk 10 to 40 °C |
| Storage | -40 to 75 °C | |

| | Specifications | Supplemental Information |
|---------------------------------|----------------|----------------------------|
| Audible Noise (ISO 7779) | | |
| Sound Pressure at 25 °C | | <40 dBa, (<4.6 Bels power) |

| | Specifications | Supplemental Information |
|-------------------------------|---|--------------------------|
| Military Specification | Has been type tested to the environmental specifications of MIL-PRF-28800F class 3. | |

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

| | Specifications | Supplemental Information |
|-------------------------|----------------|--|
| Immunity Testing | | |
| Radiated Immunity | | Testing was done at 3 V/m according to IEC 801-3/1984. When the analyzer tuned frequency is identical to the immunity test signal frequency there may be signals of up to -60 dBm displayed on the screen. |
| Electrostatic Discharge | | Air discharges of up to 8 kV were applied according to IEC 801-2/1991. Discharges to center pins of any of the connectors may cause damage to the associated circuitry. |

| | Specifications | Supplemental Information |
|----------------------------|--|---|
| Power Requirements | | Uses CUKonverter® topology in the power supply. |
| ac Operation | | |
| Voltage, frequency | 90 to 132 V rms, 47 to 440 Hz 195 to 250 V rms, 47 to 66 Hz | |
| Power Consumption, On | <300 W | |
| Power Consumption, Standby | <5 W | |
| dc Operation | | |
| Voltage | 12 to 20 Vdc | |
| Power Consumption | <200 W | |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| Measurement Speed | | |
| Local Measurement and Display Update rate ^a | | |
| Sweep points = 101 | | ≥ 40/s, characteristic |
| Sweep points = 401 | | ≥ 28/s, characteristic |
| Remote Measurement and GPIB Transfer Rate ^{bc} (Option A4H) | | |
| Sweep points = 101 | | ≥ 40/s, characteristic |
| Sweep points = 401 | | ≥ 28/s, characteristic |
| RF Center Frequency Tune, Measure, and GPIB Transfer Time ^{bd} (Option A4H) | | |
| Sweep points = 101 | | ≤ 75 ms, characteristic |
| Sweep points = 401 | | ≤ 90 ms, characteristic |

- Factory preset, auto align Off, fixed center frequency, RBW = 1 MHz, span >10 MHz and ≤600 MHz, and stop frequency ≤3 GHz.
- Display Off (:DISPlay:ENABle OFF), and 32-bit integer data format (:FORMat:DATA INT,32), if Option A1X or A4J is installed, disable sweep ramp, (:SYSTem:PORTs:IFVSwEEP:ENABle OFF), markers Off, single sweep, measured with IBM compatible PC with 550 MHz Pentium® III running Windows® NT 4.0, one meter GPIB cable, National Instruments PCI-GPIB card and NI-48.2 DLL.
- Factory preset, auto align Off, fixed center frequency, RBW = 1 MHz, and span = 20 MHz, fixed center frequency, stop frequency ≤3 GHz, average of 100 measurements.
- Factory preset, auto align Off, RBW = 1 MHz, span= 20 MHz, stop frequency ≤3 GHz, center frequency tune step size = 50 MHz.

Agilent E4405B Specifications and Characteristics
General

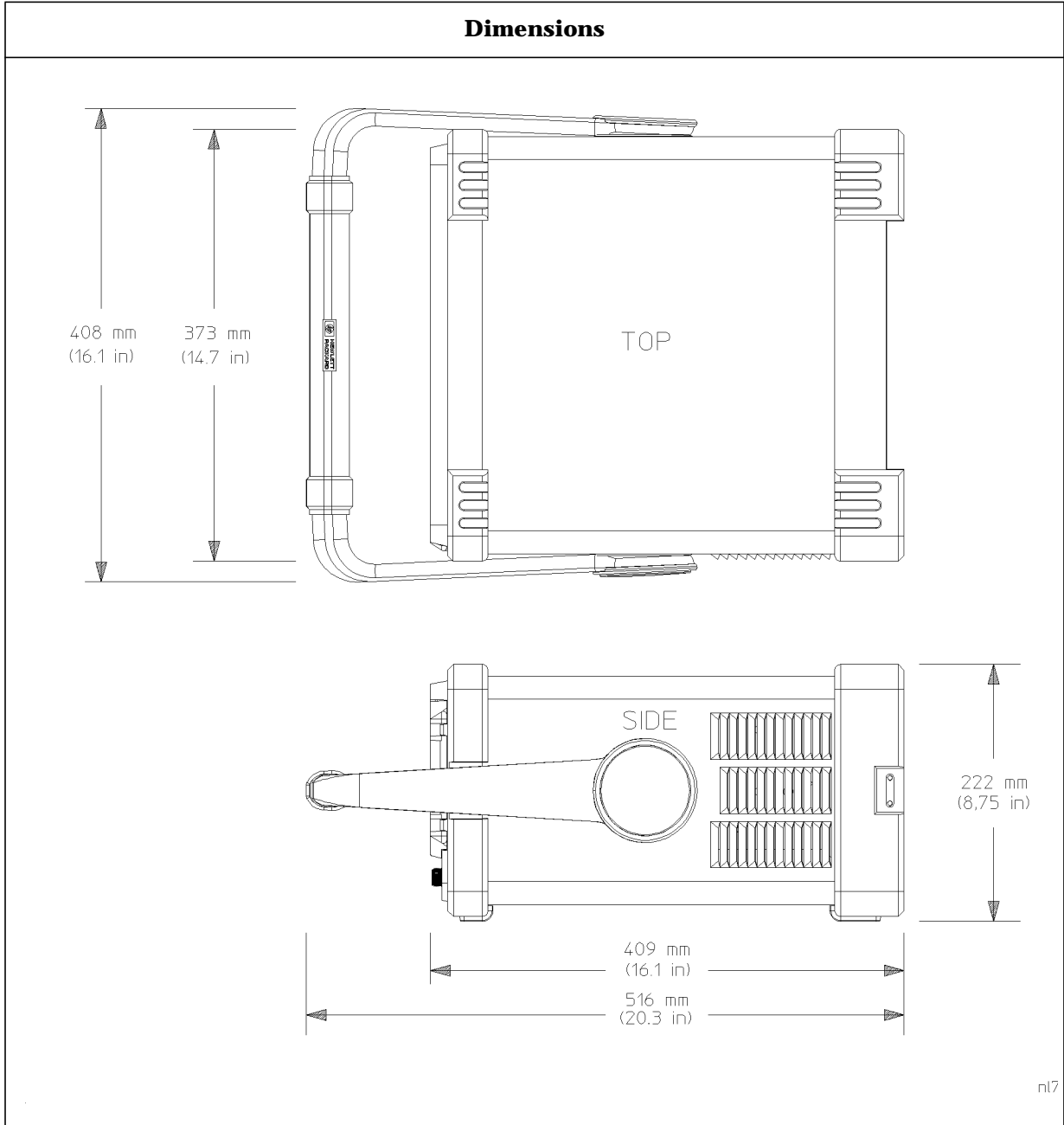
| | Specifications | Supplemental Information |
|--|-----------------------|--|
| Data Storage Internal External (10 to 40 °C) 3.5" 1.44 MB, MS-DOS® compatible floppy disk | | 200 Traces or States ^a 200 Traces or States ^a |

a. When storing traces set to 401 points.

| | Specifications | Supplemental Information |
|---|-----------------------|---|
| Downloadable Program Memory <i>(Option B72)</i> | | 2 MB available memory 10 MB available memory |

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| Demod Tune and Listen Demod <i>(Option BAA)</i> <i>(Option A4J, AYX, or BAA)</i> | AM Add FM | Internal speaker, front-panel earphone jack and front-panel volume control. An uncalibrated demodulated signal is available on the AUX VIDEO OUT or EXT VIDEO OUT connectors at the rear panel. |

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| Weight (without options) Net Shipping | | 17.1 kg (37.7 lb), characteristic 29.0 kg (64 lb), characteristic |



Inputs and Outputs

Front Panel

| | Specifications | Supplemental Information |
|-------------------|----------------|--------------------------|
| INPUT 50 Ω | | |
| Connector | Type-N female | |
| Impedance | | 50 Ω, nominal |

| | Specifications | Supplemental Information |
|----------------------------------|----------------|--------------------------|
| RF OUT 50 Ω, (Option 1DN) | | |
| Connector | Type-N female | |
| Impedance | | 50 Ω, nominal |

| | Specifications | Supplemental Information |
|----------------------------------|----------------|--|
| AMPTD REF OUT^a | | Amplitude Reference |
| Connector | BNC female | |
| Impedance | | 50 Ω, nominal |
| Frequency | | 50 MHz |
| Frequency Accuracy | | Frequency reference error ^b |
| 50 Ω Amplitude ^c | | -20 dBm, nominal |

- Turn the amplitude reference on/off by pressing the keys: **Input/Output**, **Amptd Ref Out**.
- Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).
- The internal amplitude reference actual power is stored internally.

| | Specifications | Supplemental Information |
|--------------------|----------------|--|
| PROBE POWER | | |
| Voltage/Current | | +15 Vdc, ±7% at 150 mA max., characteristic -12.6 Vdc ±10% at 150 mA max., characteristic |

| | Specifications | Supplemental Information |
|---------------------------------|-----------------------|---|
| EXT KEYBOARD^a | | Used for entering screen titles and filenames only. Interface compatible with most IBM-compatible PC keyboards. |
| Connector | 6-pin mini-DIN | |

a. The feature is not implemented in firmware revisions prior to A.04.00.

| | Specifications | Supplemental Information |
|----------------|-----------------------|----------------------------------|
| Speaker | | Front panel knob controls volume |

| | Specifications | Supplemental Information |
|------------------|--|--|
| Headphone | | Front panel knob controls volume |
| Connector | 3.5 mm (1/8 inch) miniature audio jack | |
| Power Output | | 0.2 W into 4 Ω , characteristic |

Rear Panel

| | Specifications | Supplemental Information |
|-----------------------|-----------------------|---------------------------------|
| 10 MHz REF OUT | | |
| Connector | BNC female | |
| Impedance | | 50 Ω , nominal |
| Output Amplitude | | >0 dBm, characteristic |

Agilent E4405B Specifications and Characteristics
Inputs and Outputs

| | Specifications | Supplemental Information |
|-----------------------|-----------------------|---|
| 10 MHz REF IN | | |
| Connector | BNC female | Note: Analyzer noise sidebands and spurious response performance may be affected by the quality of the external reference used. |
| Impedance | | 50 Ω, nominal |
| Input Amplitude Range | | -15 to +10 dBm, characteristic |
| Frequency | | 10 MHz, nominal |

| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| EXT REF IN <i>(Option B7E)</i> | | |
| Connector | BNC, female | |
| Impedance | | 50 Ω, nominal |
| Input amplitude range | -5 to 10 dBm | |
| Frequency | 1 to 30 MHz, selectable | |
| Frequency lock range | $\pm 5 \times 10^{-6}$ of specified external reference input frequency | |

| | Specifications | Supplemental Information |
|--|-----------------------|------------------------------------|
| 10 MHz OUT <i>(Option B7E)</i> | | |
| Connector | BNC, female | |
| Impedance | | 50 Ω, nominal |
| Frequency | | 10 MHz, nominal |
| Level | | 0 dBm when Option 10 MHz Out is On |

| | Specifications | Supplemental Information |
|---|-----------------------|---|
| GATE TRIG/EXT TRIG IN | | |
| Connector | BNC female | |
| External Trigger Input | | |
| Trigger Level | | Selectable positive or negative edge initiates sweep in EXT TRIG mode (5 V TTL) |
| Gate Trigger Input <i>(Option 1D6)</i> | | |
| Minimum Pulse Width | | >30 ns (5 V TTL) |

| | Specifications | Supplemental Information |
|---------------------------------|-----------------------|--|
| GATE/HI SWP OUT | | |
| Connector | BNC female | |
| High Sweep Output | | |
| Level | | High = sweep; Low = retrace (5 V TTL) |
| Gate Output <i>(Option 1D6)</i> | | |
| Level | | High = gate on; Low = gate off (5 V TTL) |

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

Agilent E4405B Specifications and Characteristics
Inputs and Outputs

| | Specifications | Supplemental Information |
|--|-----------------------|---|
| AUX IF OUT <i>(Option A4J or AYX)</i> Connector Frequency Amplitude Range (for signal at reference level and for reference levels – input attenuation + preamp gain of –10 to –70 dBm) Impedance | BNC female | RBW \geq 1 kHz 21.4 MHz, nominal –10 dBm (uncorrected), characteristic 50 Ω nominal |

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| AUX VIDEO OUT <i>(Option A4J or AYX)</i> Connector Amplitude Range (into >10 k Ω) | BNC female | RBW \geq 1 kHz 0 to 1 V (uncorrected), characteristic |

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| HI SWP IN <i>(Option A4J or AYX)</i> Connector Input | BNC female | Open collector, low resets and holds the sweep (5 V TTL) |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------------|
| HI SWP OUT <i>(Option A4J or AYX)</i> Connector Output | BNC female | High = sweep, Low = retrace (5 V TTL) |

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| SWP OUT <i>(Option A4J or AYX)</i> Connector | BNC female | |

| | Specifications | Supplemental Information |
|-----------|----------------|---------------------------------|
| Amplitude | | 0 to +10 V ramp, characteristic |

| | Specifications | Supplemental Information |
|-----------------------------|----------------|--|
| PRESEL TUNE OUTPUT | | |
| Connector | BNC female | |
| Load Impedance (dc coupled) | | > 10 k Ω , nominal |
| Range | | 0 to +10 V, characteristic |
| Sensitivity | | 0.33 V/GHz of tuned frequency > 3 GHz, characteristic |

| | Specifications | Supplemental Information |
|--|------------------------|--|
| GPIB Interface <i>(Option A4H)</i> | | |
| Connector | IEEE-488 bus connector | |
| GPIB Codes | | SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3 and C28 |

| | Specifications | Supplemental Information |
|--|------------------|--------------------------|
| Serial Interface <i>(Option 1AX)</i> | | |
| Connector | 9-pin D-SUB male | RS-232 |

| | Specifications | Supplemental Information |
|---|---------------------|--------------------------|
| Parallel Interface <i>(Option A4H or 1AX)</i> | | Printer port only |
| Connector | 25-pin D-SUB female | |

| | Specifications | Supplemental Information |
|--|----------------|--|
| EXT VIDEO IN/TV TRIG OUT^a <i>(Option B7B or BAA)</i> | | EXT VIDEO IN is the Baseband composite video input for TV trigger and picture on screen. TV TRIG OUT is the TV trigger output. |

Agilent E4405B Specifications and Characteristics
Inputs and Outputs

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| Connector Impedance <i>(Option BAA without Option B7B)</i> <i>(Option BAA with Option B7B)</i> External Video Input Video Amplitude TV Trigger Output Amplitude | BNC Female (75 Ω) | 75 Ω, nominal Feature not implemented 1 V _{p-p} , nominal, characteristic Positive edge indicates start of selected TV line after sync. pulse TTL (0 V and 3.4 V with 75 Ω series resistance), characteristic |

- a. This connector is labelled EXT VIDEO IN on older spectrum analyzers and EXT VIDEO IN/TV TRIG OUT on newer spectrum analyzers.

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| EXT VIDEO OUT <i>(Option B7B or BAA)</i> Connector Impedance <i>(Option BAA without Option B7B)</i> Amplitude <i>(Option BAA with Option B7B)</i> Amplitude TV Source: SA TV Source and EXT VIDEO IN | BNC female (75 Ω) | Baseband video output RBW ≥ 1 kHz 75 Ω, nominal 0 to 1 V (uncorrected), characteristic 0 to 1 V (uncorrected), characteristic Same as level at EXT VIDEO IN/TV TRIG OUT, characteristic |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| EXT FRAME SYNC <i>(Option B7D)</i> Connector Level | BNC, female | 5 V TTL |

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 (if accompanied by a year, it is the year when the design was proven).



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)

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 products

Product Name: Spectrum Analyzer

Model Number: HP E4401B, HP E4402B, HP E4403B,
HP E4404B, HP E4405B, HP E4407B,
HP E4408B, HP E4411B

Product Options: This declaration covers all options of the above products.

Conform 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 products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.



Santa Rosa, CA, USA 4 Feb. 2000

Greg Pfeiffer/Quality Engineering Manager

For further information, please contact your local Agilent Technologies sales office, agent or distributor.

About This Chapter

This chapter contains specifications and characteristics for the E4407B spectrum analyzer. The distinction between specifications and characteristics is described as follows.

- Specifications describe the performance of parameters covered by the product warranty. (The temperature range is 0 °C to 55 °C, unless otherwise noted.)
- Characteristics describe product performance that is useful in the application of the product, but is not covered by the product warranty.
- Typical performance describes additional product performance information that is not covered by the product warranty. It is performance beyond an indicated specification, that most units will exhibit.
- Nominal values indicate the expected, but not warranted, value of a parameter.

The following conditions must be met for the analyzer to meet its specifications.

- The analyzer is within the one year calibration cycle.
- If **Auto Align All** is selected:
 - After 2 hours of storage within the operating temperature range.
 - 5 minutes after the analyzer is turned on with sweep times less than 4 seconds.
 - After the front-panel amplitude reference is connected to the INPUT, and **Align Now RF** has been run, after the analyzer is turned on. And, once every 24 hours, or if ambient temperature changes more than 30 °C¹.
- If **Auto Align Off** is selected:
 - When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.
 - After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now All** has been run.
 - When **Align Now All** is run:

1. 10 °C if Option 1DS is active.

- Every hour
- If the ambient temperature changes more than 3 °C
- If the 10 MHz reference changes
- When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):
 - Every 24 hours
 - If the ambient temperature changes more than 30 °C¹
- If **Auto Align All but RF** is selected:
 - When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.
 - After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now RF** has been run.
 - When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):
 - Every hour
 - If the ambient temperature changes more than 3 °C

1. 10 °C if Option 1DS is active.

Frequency

| | Specifications | Supplemental Information | |
|---------------------------------------|------------------------|--|---------------|
| Frequency Range | 9 kHz to 26.5 GHz | | |
| Band | | Harmonic Mixing Mode (N ^a) | |
| 0 | 9 kHz to 3.0 GHz | 1– | |
| 1 | 2.85 GHz to 6.7 GHz | 1– | |
| 2 | 6.2 GHz to 13.2 GHz | 2– | |
| 3 | 12.8 GHz to 19.2 GHz | 4– | |
| 4 | 18.7 GHz to 26.5 GHz | 4– | |
| Preamp On (<i>Option 1DS</i>) | 1 MHz to 3 GHz | | |
| External Mixing (<i>Option AYZ</i>) | 18 GHz to 325 GHz | | |
| Band | | Harmonic Mixing Mode (N ^a) | |
| | | Preselected | Unpreselected |
| K | 18.0 GHz to 26.5 GHz | n/a | 6– |
| A | 26.5 GHz to 40.0 GHz | 8+ | 8– |
| Q | 33.0 GHz to 50.0 GHz | 10+ | 10– |
| U | 40.0 GHz to 60.0 GHz | 10+ | 10– |
| V | 50.0 GHz to 75.0 GHz | 14+ | 14– |
| E | 60.0 GHz to 90.0 GHz | n/a | 16– |
| W | 75.0 GHz to 110.0 GHz | n/a | 18– |
| F | 90.0 GHz to 140.0 GHz | n/a | 20– |
| D | 110.0 GHz to 170.0 GHz | n/a | 24– |
| G | 140.0 GHz to 220.0 GHz | n/a | 32– |
| Y | 170.0 GHz to 260.0 GHz | n/a | 38– |
| J | 220.0 GHz to 325.0 GHz | n/a | 46– |

a. N is the harmonic mixing mode. For negative mixing modes (as indicated by the “–”), the desired 1st LO harmonic is higher than the tuned frequency by the 1st IF (3.9214 for the 9 kHz to 3 GHz band, 321.4 MHz for all other bands) For positive mixing modes, the desired 1st LO harmonic is lower than the tuned frequency by 321.4 MHz.

| | Specifications | Supplemental Information |
|----------------------------|------------------------------------|--|
| Frequency Reference | | |
| Aging Rate | $\pm 2 \times 10^{-6}/\text{year}$ | $\pm 1.0 \times 10^{-7}/\text{day}$, characteristic |
| Settability | $\pm 5 \times 10^{-7}$ | |
| Temperature Stability | $\pm 5 \times 10^{-6}$ | |

| | Specifications | Supplemental Information |
|--|------------------------------------|--|
| High Stability Frequency Reference (Option 1D5) | | |
| Aging Rate | $\pm 1 \times 10^{-7}/\text{year}$ | $\pm 5 \times 10^{-10}/\text{day}$, 7-day average after being powered on for 7 days, characteristic |
| Settability | $\pm 1 \times 10^{-8}$ | |
| Temperature Stability | | |
| 20 to 30 °C | $\pm 1 \times 10^{-8}$ | |
| 0 to 55 °C | $\pm 5 \times 10^{-8}$ | |
| Warm-Up (Internal frequency reference selected) | | |
| After 5 minutes | | $< \pm 1 \times 10^{-7}$ of final frequency, ^a characteristic |
| After 15 minutes | | $< \pm 1 \times 10^{-8}$ of final frequency, ^a characteristic |

a. Final frequency is defined as frequency 60 minutes after power-on with analyzer set to internal frequency reference.

| | Specifications | Supplemental Information |
|-----------------------------------|--|---------------------------------|
| Frequency Readout Accuracy | | |
| (Start, Stop, Center, Marker) | $\pm((\text{frequency indication} \times \text{frequency reference error}^{\text{a}})$ $+ 0.5\% \text{ of span}$ $+ \frac{\text{span}}{\text{sweep points} - 1}$ $+ 15\% \text{ of RBW}$ $+ 10 \text{ Hz} + 1 \text{ Hz} \times N^{\text{b}})$ | |

a. Frequency reference error = (aging rate \times period of time since adjustment + settability) + temperature stability).

b. N is the harmonic mixing mode.

Agilent E4407B Specifications and Characteristics
Frequency

| | Specifications | Supplemental Information |
|---------------------------------|--|--------------------------|
| Marker Frequency Counter | | |
| Resolution | Selectable from 1 Hz to 100 kHz | |
| Accuracy ^a | $\pm(\text{marker frequency} \times \text{frequency reference error}^b + \text{counter resolution})^c$ | For RBW \geq 1 kHz |

- a. Marker level to displayed noise level > 25 dB, RBW/ Span \geq 0.002, frequency offset = 0 Hz.
b. Frequency reference error = (aging rate \times period of time since adjustment + settability + temperature stability).
c. For firmware revisions prior to A.03.00, add 1 Hz \times N, where N is the harmonic mixing mode.

| | Specifications | Supplemental Information |
|--|---|--------------------------|
| Frequency Span | | |
| Range | | |
| Internal Mixing | 0 Hz (zero span), 100 Hz to 26.5 GHz | |
| External Mixing (<i>Option AYZ</i>) | 0 Hz (zero span), Minimum span = 100 Hz | |
| Resolution | 2 Hz \times N ^a | |
| Accuracy | $\pm(0.5\% \text{ of span} + 2 \times \frac{\text{span}}{\text{sweep points} - 1})$ | |

- a. N is the harmonic mixing mode.

| | Specifications | Supplemental Information |
|---|----------------------------------|---|
| Sweep Time | | |
| Range | 1 ms to 4000 s ^a | $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ to 4000 s |
| Tracking Generator On (<i>Option 1DN</i>) | | 50 ms is the minimum sweep time |
| Fast Time-domain Sweep (<i>Option AYX</i>) (For Span = 0 Hz, RBW \geq 1 kHz) | 5 μ s to 4000 s ^b | $\frac{\text{sweep points} - 1}{20 \text{ MHz}}$ to 4000 s |

| | Specifications | Supplemental Information |
|---|--|--|
| DSP and fast ADC (Option B7D) (For Span = 0 Hz, RBW ≥ 1 kHz) | 2.5 μs to 4000 s | $\frac{\text{sweep points} - 1}{40 \text{ MHz}}$ to 4000 s |
| Accuracy (Span = 0 Hz) | | |
| 1 ms to 4000 s ^a | ±1% | |
| (Option AYX) | ±1% | |
| 5 μs to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ | | |
| (Option B7D) | ±1% | |
| 2.5 μs to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ | | |
| Sweep Trigger ^{cd} | Free Run, Single, Line, Video, External, Delayed, Offset ^e | |
| (Option 1D6) | Add Gate | |
| (Option B7B) | Add TV | |
| Delayed Trigger ^{cf} | | |
| Range | 1 μs to 400 s | |
| Resolution | $\frac{\text{delay in seconds}}{65000}$ rounded up to nearest μs | |
| Accuracy | ±(500 ns +(0.01% of delay)) | |
| Offset Trigger ^e | | |
| Resolution | $\frac{\text{sweep time}}{\text{sweep points} - 1}$ | |
| Range | ±320 ms to ±323 ks | Where ST = sweep time and SP = sweep points $\frac{-32766 \times ST}{SP - 1}$ to $\frac{(32766 - SP) \times ST}{SP - 1}$ |
| Fast Time-domain sweep (Option AYX) (For sweep times 5.0 μs to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$) | ±1.64 ms to ±249 ms | $\frac{-32766 \times ST}{SP - 1}$ to $\frac{(32766 - SP) \times ST}{SP - 1}$ |

Agilent E4407B Specifications and Characteristics
Frequency

| | Specifications | Supplemental Information |
|---|---|---|
| DSP and fast ADC (<i>Option B7D</i>) (For sweep times 2.5 μ s to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$) | $\pm 13 \text{ ms}$ to $\pm 5.15 \text{ s}$ | $\frac{-524031 \times \text{ST}}{\text{SP} - 1}$ to $\frac{(524031 - \text{SP}) \times \text{ST}}{\text{SP} - 1}$ |

- a. For firmware revisions prior to A.04.00, 5 ms to 2000 s.
- b. For firmware revisions prior to A.04.00, 20 μ s to 2000 s.
- c. Gate cannot be used simultaneously with delayed or TV trigger.
- d. Auto align is suspended in video, external, gate, and delayed trigger modes while waiting for a trigger event to occur.
- e. For firmware revision A.04.00 or later.
- f. Delayed trigger is available with line, external trigger, and TV trigger (*Option B7B*).

| | Specifications | Supplemental Information |
|-----------------------------|-----------------------|---------------------------------|
| Sweep (trace) Points | | |
| Range | 101 to 8192 | |

| | Specifications | Supplemental Information |
|--|---|--|
| Resolution Bandwidth (RBW) | | |
| Range | | |
| -3 dB bandwidth | 1 kHz to 3 MHz, in 1-3-10 sequence, 5 MHz | |
| -6 dB bandwidth (EMI) | 9 kHz and 120 kHz | |
| (<i>Option 1DR</i>) | | |
| -3 dB bandwidth | Adds 10, 30, 100, 300 Hz | |
| -6 dB bandwidth (EMI) | Add 200 Hz | |
| Accuracy | | |
| 1 kHz to 3 MHz RBW | $\pm 15\%$ | |
| 5 MHz RBW | $\pm 30\%$ | |
| 10 Hz to 300 Hz RBW (<i>Option 1DR</i>) | $\pm 10\%$ | |
| Shape | | |
| 1 kHz to 5 MHz RBW | | Synchronously tuned four poles, approximately Gaussian shape |

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| <p>10 Hz to 300 Hz RBW <i>(Option 1DR)</i></p> <p>Selectivity (60 dB/3 dB bandwidth ratio)</p> <p>1 kHz to 5 MHz RBW</p> <p>10 Hz to 300 Hz RBW <i>(Option 1DR)</i></p> | | <p>Digital, approximately Gaussian shape</p> <p><15:1, characteristic</p> <p><5:1, characteristic</p> |

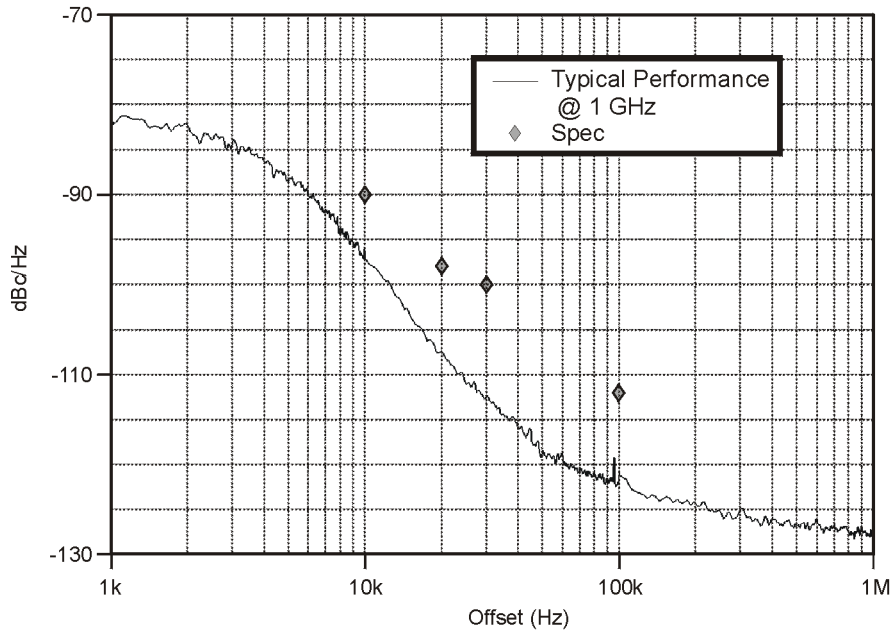
| | Specifications | Supplemental Information |
|--|--|---|
| <p>Video Bandwidth (VBW) (-3 dB)</p> <p>Range</p> <p><i>(Option 1DR)</i></p> <p>Accuracy</p> <p>Shape</p> | <p>30 Hz to 1 MHz in 1-3-10 sequence</p> <p>Adds 1, 3, 10 Hz for RBW's <1 kHz</p> | <p>3 MHz, characteristic</p> <p>±30%, characteristic</p> <p>Post detection, single pole low-pass filter used to average displayed noise</p> <p>Video bandwidths below 30 Hz are digital bandwidths with anti-aliasing filtering.</p> |

| | Specifications | Supplemental Information |
|--|---|---------------------------------|
| <p>Stability</p> <p>Noise Sidebands (Offset from CW signal with 1 kHz RBW, 30 Hz VBW and sample detector)</p> <p>≥10 kHz</p> <p>≥20 kHz</p> <p>≥30 kHz</p> <p>≥100 kHz</p> <p>Residual FM</p> <p>1 kHz RBW, 1 kHz VBW</p> | <p>≤ -90 dBc/Hz^a</p> <p>≤ -98 dBc/Hz^a</p> <p>≤ -100 dBc/Hz^a</p> <p>≤ -112 dBc/Hz^a</p> <p>≤150 Hz × N p-p in 100 ms</p> | |

| | Specifications | Supplemental Information |
|---|--|---|
| <p>(Option 1D5)</p> <p>10 Hz RBW, 10 Hz VBW (Option 1DR)</p> <p>10 Hz RBW, 10 Hz VBW (Option 1DR)</p> <p>System-Related Sidebands, offset from CW signal</p> <p>≥30 kHz</p> <p>Line-Related Sidebands, offset from CW signal (Option 1DR)</p> <p><300 Hz</p> <p>>300 Hz to 30 kHz</p> | <p>≤100 Hz × N p-p in 100 ms</p> <p>≤2 Hz × N p-p in 20 ms</p> <p>≤ -65 dBc^a</p> | <p>≤10 Hz × N p-p in 20 ms, characteristic</p> <p>≤ -50 dBc^a, characteristic</p> <p>≤ -55 dBc^a, characteristic</p> |

a. Add 20 Log(N) for frequencies > 6.7 GHz

Noise Sidebands Normalized to 1 Hz Versus Offset From Carrier



w/74b

Amplitude

Amplitude specifications do not apply for the negative peak detector mode.

| | Specifications | Supplemental Information |
|--------------------------|---|--------------------------|
| Measurement Range | Displayed Average Noise Level to Maximum Safe Input Level | |
| Input Attenuator Range | 0 to 65 dB, in 5 dB steps | |

| | Specifications | Supplemental Information |
|--|-----------------|--------------------------|
| Maximum Safe Input Level | | |
| Average Continuous Power (Input attenuator setting ≥ 5 dB) | +30 dBm (1 W) | |
| Peak Pulse Power (for <10 μ sec pulse width, $<1\%$ duty cycle, and input attenuation ≥ 30 dB) | +50 dBm (100 W) | |
| dc | 0 Vdc | |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| 1 dB Gain Compression | | |
| Total power at input mixer ^{ab} | | |
| 50 MHz to 3.0 GHz | 0 dBm | |
| 3.0 GHz to 6.7 GHz | 0 dBm | |
| 6.7 GHz to 13.2 GHz | -3 dBm | |
| 13.2 GHz to 26.5 GHz | -5 dBm | |
| Preamp On (<i>Option 1DS</i>) | | |
| Total power at the preamp ^c | | -20 dBm, characteristic |

- Mixer power level (dBm) = input power (dBm) – input attenuation (dB).
- For resolution bandwidths 1 kHz to 30 kHz, the maximum input signal amplitude must be \leq reference level +10 dB.
- Total power at the preamp (dBm) = total power at the input (dBm) – input attenuation (dB).

Agilent E4407B Specifications and Characteristics
Amplitude

| | Specifications | | Supplemental Information | | |
|--|-------------------------------|------------------------|--|-------------------------------|---|
| Displayed Average Noise Level (Input terminated, 0 dB attenuation, sample detector, Reference Level = -70 dBm) | | | | | |
| | | 1 kHz RBW 30 Hz VBW | 10 Hz RBW 1 Hz VBW <i>(Option 1DR)</i> | 1 kHz RBW 30 Hz VBW | 10 Hz RBW 1 Hz VBW <i>(Option 1DR)</i> |
| | 1 MHz to 10 MHz | | | ≤ -116 dBm, characteristic | ≤ -134 dBm, characteristic |
| | 10 MHz to 1.0 GHz | ≤ -116 dBm | ≤ -135 dBm | | |
| | 1.0 GHz to 2.0 GHz | ≤ -115 dBm | ≤ -134 dBm | | |
| | 2.0 GHz to 3.0 GHz | ≤ -112 dBm | ≤ -131 dBm | | |
| | 3.0 GHz to 6.0 GHz | ≤ -112 dBm | ≤ -131 dBm | | |
| | 6.0 GHz to 12 GHz | ≤ -110 dBm | ≤ -129 dBm | | |
| | 12 GHz to 22 GHz | ≤ -107 dBm | ≤ -126 dBm | | |
| | 22 GHz to 26.5 GHz | ≤ -101 dBm | ≤ -120 dBm | | |
| | Preamp On <i>(Option 1DS)</i> | 1 kHz RBW 30 Hz VBW | 10 Hz RBW 1 Hz VBW <i>(Option 1DR)</i> | 1 kHz RBW 30 Hz VBW | 10 kHz RBW 1 Hz VBW <i>(Option 1DR)</i> |
| | 0 to 55 °C | | | | |
| | 1 MHz to 10 MHz | | | ≤ -131 dBm, characteristic | ≤ -149 dBm, characteristic |
| | 10 MHz to 1.0 GHz | ≤ -131 dBm | ≤ -149 dBm | | |
| 1.0 GHz to 2.0 GHz | ≤ -129 dBm | ≤ -147 dBm | | | |
| 2.0 GHz to 3.0 GHz | ≤ -127 dBm | ≤ -145 dBm | | | |
| 20 to 30 °C | | | | | |
| 10 MHz to 1.0 GHz | ≤ -132 dBm | ≤ -150 dBm | | | |
| 1.0 GHz to 2.0 GHz | ≤ -131 dBm | ≤ -149 dBm | | | |
| 2.0 GHz to 3.0 GHz | ≤ -130 dBm | ≤ -148 dBm | | | |

| | Specifications | Supplemental Information | |
|--------------------------------------|-----------------------|--|--|
| External Mixer (<i>Option AYZ</i>) | | 1 kHz RBW 30 Hz VBW ≤ -134 dBm + external mixer conversion loss, characteristic | 10 Hz RBW 1 Hz VBW (<i>Option 1DR</i>) ≤ -153 dBm + external mixer conversion loss, characteristic |

| | Specifications | Supplemental Information |
|--------------------------------------|--|---------------------------------|
| Display Range | | |
| Log Scale | Ten divisions displayed; 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps | |
| RBW ≥ 1 kHz | Calibrated 0 to -85 dB from Reference Level | |
| RBW ≤ 300 Hz (<i>Option 1DR</i>) | Calibrated 0 to -120 dB ^a from Reference Level | |
| Linear Scale | Ten divisions | |
| Scale Units (<i>Option BAA</i>) | dBm, dBmV, dBμV, V, and W Add Hz | |

a. 0 to -70 dB range when span = 0 Hz, or when auto ranging is off:
(:DISPlay:WINDow:TRACe:Y[:SCALe]:LOG:RANGe:AUTO OFF).

| | Specifications | Supplemental Information |
|---|--------------------------|---------------------------------|
| Marker Readout Resolution | | |
| Log scale | | |
| RBW ≥ 1 kHz 0 to -85 dB from ref level | 0.04 dB | |
| RBW ≤ 300 Hz 0 to -120 dB from ref level | 0.04 dB | |
| Linear scale | 0.01% of Reference Level | |
| Fast Sweep Times for Zero Span | | |

Agilent E4407B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|--|---|---------------------------------|
| <p><i>(Option AXX)^a</i> 5 μs to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$</p> <p>Log 0 to -85 dB from ref level</p> <p>Linear</p> | <p>0.3 dB</p> <p>0.3% of Reference Level for linear scale</p> | |
| <p><i>(Option B7D)</i> 2.5 μs to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$</p> <p>Log 0 to -85 dB from ref level</p> <p>Linear</p> | <p>0.2 dB</p> <p>0.2% of Reference Level for linear scale</p> | |

a. For firmware revisions prior to A.04.00, 20 μ s to <5 ms.

| | Specifications | Supplemental Information |
|---|--|---------------------------------|
| <p>Frequency Response</p> <p>50 Ω, Absolute^a/Relative 9 kHz to 3.0 GHz 10 dB attenuation</p> <p>20 to 30 °C</p> <p>0 to 55 °C</p> <p>50 Ω, Absolute^a/Relative Preamp On (<i>Option 1DS</i>) 1 MHz to 3.0 GHz 0 dB attenuation</p> <p>Preselector centered for frequency >3.0 GHz 3.0 GHz to 6.7 GHz 10 dB attenuation</p> <p>Absolute^a</p> <p>20 to 30 °C</p> <p>0 to 55 °C</p> | <p>± 0.5 dB</p> <p>± 1.0 dB</p> <p>± 2.0 dB</p> <p>± 1.5 dB</p> <p>± 2.5 dB</p> | |

| | Specifications | Supplemental Information |
|-----------------------|----------------|--------------------------|
| Relative | | |
| 20 to 30 °C | ±1.3 dB | |
| 0 to 55 °C | ±1.5 dB | |
| 6.7 GHz to 13.2 GHz | | |
| 10 dB attenuation | | |
| Absolute ^a | | |
| 20 to 30 °C | ±2.0 dB | |
| 0 to 55 °C | ±3.0 dB | |
| Relative | | |
| 20 to 30 °C | ±1.8 dB | |
| 0 to 55 °C | ±2.0 dB | |
| 13.2 GHz to 26.5 GHz | | |
| 10 dB attenuation | | |
| Absolute ^a | | |
| 20 to 30 °C | ±2.0 dB | |
| 0 to 55 °C | ±3.0 dB | |
| Relative | | |
| 20 to 30 °C | ±1.8 dB | |
| 0 to 55 °C | ±2.0 dB | |

a. Absolute flatness values are referenced to the amplitude at 50 MHz.

| | Specifications | Supplemental Information |
|--|---------------------------------------|--------------------------|
| Input Attenuation Switching Uncertainty at 50 MHz | | |
| Attenuator Setting | | |
| 0 dB to 5 dB | ±0.3 dB | |
| 10 dB | Reference | |
| 15 dB | ±0.3 dB | |
| 20 to 65 dB attenuation | ±(0.1 dB + 0.01 × Attenuator Setting) | |

| Attenuation Accuracy Relative to the 10 dB Attenuator Setting, Characteristic | | | | | |
|---|-----------------|--------------|-------------|-----------|-------------|
| | Frequency Range | | | | |
| Attenuation | 9 kHz–3 GHz | 3.0–13.2 GHz | 13.2–19 GHz | 19–22 GHz | 22–26.5 GHz |
| 0 dB | ±0.3 dB | ±0.5 dB | ±0.8 dB | ±0.9 dB | ±1.0 dB |
| 5 dB | ±0.3 dB | ±0.5 dB | ±0.8 dB | ±0.9 dB | ±1.0 dB |
| 10 dB | Reference | Reference | Reference | Reference | Reference |
| 15 dB | ±0.4 dB | ±0.5 dB | ±0.8 dB | ±1.0 dB | ±1.5 dB |
| 20 dB | ±0.4 dB | ±0.5 dB | ±0.8 dB | ±1.0 dB | ±1.5 dB |
| 25 dB | ±0.5 dB | ±0.6 dB | ±0.8 dB | ±1.2 dB | ±2.0 dB |
| 30 dB | ±0.5 dB | ±0.6 dB | ±0.8 dB | ±1.2 dB | ±2.0 dB |
| 35 dB | ±0.6 dB | ±0.7 dB | ±1.0 dB | ±1.8 dB | ±3.0 dB |
| 40 dB | ±0.6 dB | ±0.7 dB | ±1.0 dB | ±1.8 dB | ±3.0 dB |
| 45 dB | ±0.7 dB | ±1.0 dB | ±1.3 dB | ±2.2 dB | ±3.4 dB |
| 50 dB | ±0.7 dB | ±1.0 dB | ±1.3 dB | ±2.2 dB | ±3.4 dB |
| 55 dB | ±0.9 dB | ±1.1 dB | ±1.6 dB | ±2.7 dB | ±3.5 dB |
| 60 dB | ±0.9 dB | ±1.1 dB | ±1.6 dB | ±2.7 dB | ±3.5 dB |
| 65 dB | ±1.0 dB | ±1.6 dB | ±2.0 dB | ±3.2 dB | ±3.8 dB |

| | Specifications | Supplemental Information |
|-------------------------------------|----------------|---|
| Preamp (<i>Option 1DS</i>) | | Refer also to Displayed Average Noise Level specification |
| Gain | | +20 dB, nominal ^a |
| Noise figure | | 5 dB, characteristic |

a. Amplifier is between the input attenuator and the input mixer.

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| Absolute Amplitude Accuracy | | |
| At reference settings ^a | ±0.34 dB | |
| Preamp On ^b (<i>Option 1DS</i>) | ±0.5 dB | |

| | Specifications | Supplemental Information |
|--|---|---------------------------------|
| External Mixer (<i>Option AYZ</i>) Overall Amplitude Accuracy ^d 20 to 30 °C | IF INPUT absolute amplitude accuracy + external mixer conversion loss accuracy ^c $\pm (0.54 \text{ dB} + \text{Absolute Frequency Response})$ | |

- a. Settings are: reference level -20 dBm; input attenuation 10 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, sample detector, signal at reference level.
- b. Settings are: reference level -30 dBm; input attenuation 0 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, signal at reference level.
- c. Preselector centered with HP/Agilent 11974-Series mixers.
- d. For reference level 0 to -50 dBm; input attenuation 10 dB; RBW 1 kHz; VBW 1 kHz; scale log, log range 0 to -50 dB from reference level; sweep time coupled; signal input 0 to -50 dBm; span ≤ 20 kHz; internal mixing.

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| RF Input VSWR (at tuned frequency) Attenuator setting 0 dB 9 kHz to 26.5 GHz Attenuator setting 5 dB 9 kHz to 100 kHz 100 kHz to 6.7 GHz 6.7 GHz to 13.2 GHz 13.2 GHz to 22.0 GHz 22.0 GHz to 26.5 GHz Attenuator setting 10 to 65 dB 9 kHz to 6.7 GHz 6.7 GHz to 13.2 GHz 13.2 GHz to 22.0 GHz 22.0 GHz to 26.5 GHz | | $\leq 3.0:1$, characteristic $\leq 2.0:1$, characteristic $\leq 1.4:1$, characteristic $\leq 1.7:1$, characteristic $\leq 2.3:1$, characteristic $\leq 2.6:1$, characteristic $\leq 1.3:1$, characteristic $\leq 1.5:1$, characteristic $\leq 2.0:1$, characteristic $\leq 2.2:1$, characteristic |

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Amplitude

| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| Auto Alignment^a Sweep-to-sweep variation | | ±0.1 dB, characteristic |

a. Set Auto Align to Off and use Align Now, All to eliminate this variation.

| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| Resolution Bandwidth Switching Uncertainty (at Reference Level) | | |
| 1 kHz RBW | Reference | |
| 3 kHz to 3 MHz RBW | ±0.3 dB | |
| 5 MHz RBW | ±0.6 dB | |
| 10 Hz to 300 Hz RBW (Option 1DR) | ±0.3 dB | |

| | Specifications | Supplemental Information |
|--|--|--------------------------|
| Reference Level | | |
| Range | -149.9 dBm to maximum mixer level + attenuator setting | |
| Resolution | | |
| Log Scale | ±0.1 dB | |
| Linear Scale | ±0.12% of Reference Level | |
| Accuracy (at a fixed frequency, a fixed attenuator, and referenced to -30 dBm (-10 dBm, Preamp On (Option 1DS))) | | |
| Reference Level (dBm) – input attenuator setting (dB) + preamp gain (dB) | | |
| -10 dBm to > -60 dBm | ±0.3 dB | |
| -60 dBm to > -85 dBm | ±0.5 dB | |
| -85 dBm to -90 dBm | ±0.7 dB | |

| | Specifications | Supplemental Information |
|--|----------------------------------|---------------------------------|
| Display Scale Switching Uncertainty | | |
| Switching between Linear and Log | ± 0.15 dB at Reference Level | |
| Log Scale Switching | No error | |

| | Specifications | Supplemental Information |
|---|---|---------------------------------|
| Display Scale Fidelity | | |
| Log Maximum Cumulative | | |
| 0 to -85 dB from Reference Level | $\pm(0.3 \text{ dB} + 0.01 \times \text{dB from Reference Level})$ | |
| RBW \leq 300 Hz (<i>Option 1DR</i>) | | |
| Span > 0 Hz | | |
| 0 to -98 dB from Reference Level | $\pm(0.3 \text{ dB} + 0.01 \times \text{dB from Reference Level})$ | |
| -98 to -120 dB from Reference Level | | ± 2.0 dB, characteristic |
| Span = 0 Hz ^a | | |
| 0 to -60 dB from Reference Level | $\pm(0.3 \text{ dB} + 0.015 \times \text{dB from Reference Level})$ | |
| -60 to -70 dB from Reference Level | ± 1.5 dB | |
| Log Incremental Accuracy | | |
| 0 to -80 dB ^b from reference level | ± 0.4 dB/4 dB | |
| Linear Accuracy | $\pm 2\%$ of Reference Level | |

a. or when auto ranging is off: (:DISPlay:WINDow:TRACe:Y[:SCALE]:LOG:RANGe:AUTO OFF)

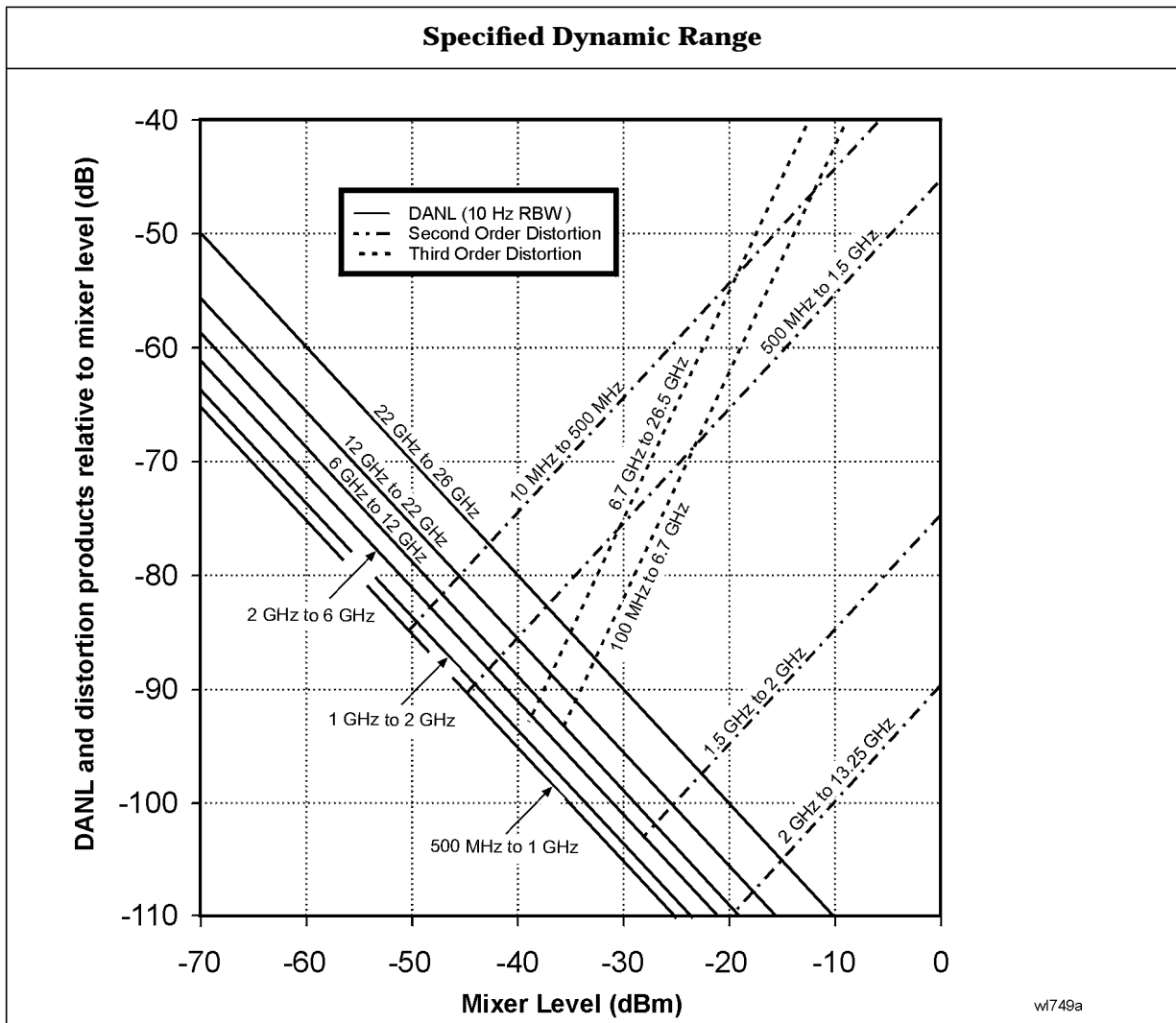
b. 0 to -50 dB for RBWs \leq 300 Hz and span = 0 Hz, or when auto ranging is off.

Agilent E4407B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|--|--|--|
| Spurious Responses | | |
| Second Harmonic Distortion | | |
| Input Signal | | |
| 10 MHz to 500 MHz | < -65 dBc for -30 dBm signal at input mixer ^a | +35 dBm SHI (second harmonic intercept) |
| 500 MHz to 1.5 GHz | < -75 dBc for -30 dBm signal at input mixer ^a | +45 dBm SHI |
| 1.5 GHz to 2.0 GHz | < -85 dBc for -10 dBm signal at input mixer ^a | +75 dBm SHI |
| 2.0 GHz to 3.35 GHz | < -100 dBc ^b for -10 dBm signal at input mixer ^a | +90 dBm SHI |
| 3.35 GHz to 6.6 GHz | < -100 dBc ^b for -10 dBm signal at input mixer ^a | +90 dBm SHI |
| 6.6 GHz to 13.25 GHz | < -100 dBc ^b for -10 dBm signal at input mixer ^a | +90 dBm SHI |
| Preamp On (<i>Option 1DS</i>) 10 MHz to 1.5 GHz | | -5 dBm SHI, characteristic |
| Third Order Intermodulation Distortion | | |
| 10 MHz to 100 MHz | | +7 dBm TOI (third order intercept), characteristic |
| 100 MHz to 3 GHz | < -82 dBc for two -30 dBm signals at input mixer ^a and >50 kHz separation | +11 dBm TOI +16 dBm TOI, typical, 20 to 30 °C |
| 3.0 GHz to 6.7 GHz | < -82 dBc for two -30 dBm signals at input mixer ^a and >50 kHz separation | +11 dBm TOI +18 dBm TOI, typical, 20 to 30 °C |
| 6.7 GHz to 13.2 GHz | < -75 dBc for two -30 dBm signals at input mixer ^a and >50 kHz separation | +7.5 dBm TOI +12 dBm TOI, typical, 20 to 30 °C |
| 13.2 GHz to 26.5 GHz | < -75 dBc for two -30 dBm signals at input mixer ^a and >50 kHz separation | +7.5 dBm TOI +11 dBm TOI, typical, 20 to 30 °C |
| Preamp On (<i>Option 1DS</i>) 10 MHz to 3 GHz, | | -16 dBm TOI, characteristic |
| Other Input Related Spurious | | |

| | Specifications | Supplemental Information |
|-----------------------|--|--------------------------|
| Inband Responses | | |
| >30 kHz offset | < -65 dBc for -20 dBm signal at input mixer ^a | |
| Out-of-band Responses | < -80 dBc for -10 dBm signal at input mixer ^a | |

- a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).
b. or signal below displayed average noise level.



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Amplitude

| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| Residual Responses (Input terminated and 0 dB attenuation) 150 kHz to 6.7 GHz | < -90 dBm | |

Options

Time Gated Spectrum Analysis (Option 1D6)

| | Specifications | Supplemental Information |
|---|---|---|
| Gate Delay | | |
| Range | 1 μ s to 400 s | |
| Accuracy | $\pm(500 \text{ ns} + (0.01\% \times (\text{maximum of gate delay or length})))$ | From gate trigger input to positive edge of gate output |
| Gate Length | | |
| Range | 1 μ s to 400 s | |
| Accuracy | $\pm(500 \text{ ns} + (0.01\% \times (\text{maximum of gate delay or length})))$ | From positive edge to negative edge of gate output |
| Resolution | $((\text{maximum of gate delay or length in seconds})/65000)$ rounded up to nearest μ s | Dependent on the greater of gate delay or gate length |
| Additional Amplitude Error^a | | |
| Log Scale | ± 0.2 dB | |
| Linear Scale | $\pm 0.1\%$ of reference level | |

a. While in gate mode.

Tracking Generator (Option 1DN)

The spectrum analyzer tracking generator combination will meet its specification after a cable (8120-5148) and adapter are connected between RF OUT and INPUT and **Align Now**, TG has been run.

| | Specifications | Supplemental Information |
|----------------|----------------|--------------------------|
| Warm-Up | 5 minutes | |

| | Specifications | Supplemental Information |
|-------------------------------|------------------|--------------------------|
| Output Frequency Range | 9 kHz to 3.0 GHz | |

| | Specifications | Supplemental Information |
|------------------------------|----------------|--|
| Minimum Resolution BW | 1 kHz | Not usable with resolution bandwidths ≤ 300 Hz (<i>Option 1DR</i>) |

| | Specifications | Supplemental Information |
|---|--------------------------|--------------------------|
| Output Power Level | | |
| Range | -2 to -66 dBm | |
| Resolution | 0.1 dB | |
| Absolute Accuracy (at 50 MHz with coupled source attenuator, referenced to -20 dBm) | ± 0.75 dB | |
| Vernier | | |
| Range | 8 dB | |
| Accuracy (with coupled source attenuator, 50 MHz, -20 dBm) | | |
| Incremental | ± 0.2 dB/dB | |
| Cumulative | ± 0.5 dB, total | |
| Output Attenuator Range | 0 to 56 dB in 8 dB steps | |

| | Specifications | Supplemental Information |
|-----------------------------------|----------------|---------------------------------------|
| Maximum Safe Reverse Level | | +30 dBm (1 W), 50 Vdc, characteristic |

| | Specifications | Supplemental Information |
|---------------------------|---|---------------------------------|
| Output Power Sweep | | |
| Range | (-10 to -2 dBm) – (Source Attenuator Setting) | |
| Resolution | 0.1 dB | |
| Accuracy (zero span) | <1 dB peak-to-peak | |

| | Specifications | Supplemental Information |
|----------------------------------|-----------------------|---------------------------------|
| Output Flatness | | |
| Referenced to 50 MHz, -20 dBm | | |
| 9 kHz to 10 MHz | ±3 dB | |
| 10 MHz to 3 GHz | ±2 dB | |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| Spurious Outputs | | |
| (-2 dBm output) | | |
| Harmonic Spurs | | |
| TG Output 9 kHz to 20 kHz | ≤ -15 dBc | |
| TG Output 20 kHz to 3 GHz | ≤ -25 dBc | |
| Non-harmonic Spurs | | |
| TG Output 9 kHz to 2 GHz | ≤ -27 dBc | |
| TG Output 2 GHz to 3 GHz | ≤ -23 dBc | |
| LO Feedthrough | | |
| LO Frequency 3.921409 to 6.9214 GHz | ≤ -16 dBm | |

| | Specifications | Supplemental Information |
|----------------------|--|---------------------------------|
| Dynamic Range | Maximum Output Power Level – Displayed Average Noise Level | |

Agilent E4407B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|------------------------|-----------------------|--|
| Output Tracking | | |
| Drift | | 1.5 kHz/5 minute, characteristic |
| Swept Tracking Error | | Usable in 1 kHz RBW after 5 minutes of warm-up |

| | Specifications | Supplemental Information |
|-------------------------------|-----------------------|---------------------------------|
| RF Power-Off Residuals | | |
| 9 kHz to 3 GHz | | < -120 dBm, characteristic |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| Output Attenuator Repeatability | | |
| 9 kHz to 300 MHz | | ±0.1 dB, characteristic |
| 300 MHz to 2.0 GHz | | ±0.2 dB, characteristic |
| 2.0 GHz to 3 GHz | | ±0.3 dB, characteristic |

| | Specifications | Supplemental Information |
|--------------------|-----------------------|---------------------------------|
| Output VSWR | | |
| 0 dB attenuation | | <2.0:1, characteristic |
| ≥ 8 dB attenuation | | <1.5:1, characteristic |

| | Specifications | Supplemental Information |
|-----------------------------------|-----------------------|---------------------------------|
| Output Attenuator Accuracy | | |
| 0 dB | Reference | ±0.5 dB, characteristic |
| 8 dB | | ±0.5 dB, characteristic |
| 16 dB | | |
| 24 dB | | ±0.5 dB, characteristic |
| 32 dB | | ±0.6 dB, characteristic |
| 40 dB | | ±0.8 dB, characteristic |
| 48 dB | | ±1.0 dB, characteristic |
| 56 dB | | ±1.1 dB, characteristic |

| |
|--|
| Tracking Generator Output Accuracy |
| Relative Accuracy (Referred to -20 dBm) = Output Attenuator Accuracy + Vernier Accuracy + Output Flatness |
| Absolute Accuracy = Relative Accuracy (Referred to -20 dBm) + Absolute Accuracy at 50 MHz |

External Mixing (Option AYZ)

| | Specifications | | Supplemental Information |
|--|----------------|-----------|---|
| LO OUTPUT | | | |
| Frequency Range | 2.9 to 7.1 GHz | | |
| Power | | | When connected to external mixers with an HP/Agilent 5061-5458 cable, provides 14.5 to 16 dBm at the mixer, characteristic. |
| 2.9 to 6.1 GHz 20 to 30°C | 15.5 to 17 dBm | | |
| 0 to 55°C | 15 to 17.5 dBm | | |
| 2.9 to 7.1 GHz | 13 to 17.5 dBm | | |
| VSWR | | | <1.9:1, characteristic |
| IF INPUT | | | |
| Frequency Range | | | 321.4 MHz \pm 5 MHz, characteristic |
| Maximum Safe Input Level | | | |
| ac | | | 10 dBm, characteristic |
| dc | | | \pm 10 V, characteristic |
| VSWR | | | <1.9:1, characteristic |
| Absolute Amplitude Accuracy ^a | | | |
| For Reference Levels from -10 to -60 dB | | | |
| Amplitude Corrections | 20 to 30°C | 0 to 55°C | |
| 15 to 30 dB | 1.0 dB | 1.5 dB | |
| >30 to 50 dB | 1.2 dB | 1.7 dB | |
| >50 to 60 dB | 1.4 dB | 1.9 dB | |
| 1 dB Gain Compression Level ^b | | | -20 dBm, characteristic with -10 dBm reference level |

| | Specifications | Supplemental Information |
|------------------------------|-----------------------|------------------------------------|
| Mixer Bias (IF INPUT) | | |
| Voltage | | |
| Maximum Range | | ±3.3 V, characteristic |
| Linear Compliant Range | | ±2 V, characteristic |
| Current (0 Ω load) | | |
| Range | ±10 mA | |
| Resolution | | < 20 μA, characteristic |
| Accuracy | ±10 mA | ±(3% + Resolution), characteristic |
| Output Impedance | | 490 Ω, nominal |

- a. Settings are: RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, sample detector, signal at reference level.
- b. With amplitude corrections 0 dB.

FM Demodulation (Option BAA)

The FM demodulation characteristics will be met after an **Align Now**, **FM Demod** has been run.

| | Specifications | Supplemental Information |
|---|----------------|--|
| Input Level | | $\geq (-60 \text{ dBm} + \text{attenuator setting} - \text{preamp gain})$, characteristic |
| Signal Level | | 0 to -30 dB below reference level, characteristic |
| FM Deviation | | |
| Range | | 10 kHz to 1 MHz |
| Resolution | | Provides 1 Hz display annotation resolution |
| FM Deviation Range | | |
| 10 kHz to 40 kHz | | 12 Hz, characteristic |
| $>40 \text{ kHz}$ to 200 kHz | | 60 Hz, characteristic |
| $>200 \text{ kHz}$ to 1 MHz | | 300 Hz, characteristic |
| Accuracy ^a | | |
| FM Rate $< \text{FM BW}/100$, | | $< (2\% \text{ of FM deviation range} + 2 \times \text{Resolution})$, characteristic |
| VBW $\geq (30 \times \text{FM Rate})$, | | |
| RBW $>$ the maximum of | | |
| $(30 \times \text{FM deviation})$ or | | |
| $(30 \times \text{FM Rate})$ | | |
| Offset Error ^a | | 5% of FM Deviation Range + 300 Hz, characteristic |
| FM Bandwidth (-3 dB) | | |
| FM Deviation Range | | |
| 10 kHz to 40 kHz | | $7.5 \times \text{FM deviation range}$, characteristic |
| $>40 \text{ kHz}$ to 200 kHz | | $1.3 \times \text{FM deviation range}$, characteristic |
| $>200 \text{ kHz}$ to 1 MHz | | $0.3 \times \text{FM deviation range}$, characteristic |

a. In time domain sweeps (span = 0 Hz).

TV Trigger and Picture On Screen (Option B7B)

Option BAA is required.

| | Specifications | Supplemental Information |
|---|---|--|
| TV Trigger and Picture On Screen | | TV Trigger initiates a sweep of the analyzer after the sync pulse of a selected line of a TV video field. Picture On Screen displays the TV picture on the analyzer display. |
| Amplitude Requirements TV Source: SA | | Top 50% of linear display, characteristic |
| TV Source: EXT VIDEO IN | | 500 mVp-p to 2 Vp-p, characteristic |
| Compatible Standards | NTSC-M, NTSC-Japan, PAL-M, PAL-B,D,G,H,I, PAL-N, PAL-N Combination, SECAM-L | |
| Field Selection | Entire frame, even, odd | |
| Sync Polarity | Positive or negative | |
| TV Trigger | | |
| Line Selection | 1 to 525, or 1 to 625, standard dependent | |

cdmaOne Measurement Personality (Option BAC)

Unless otherwise noted, all specifications are with RF input range auto, default cdmaOne measurement settings, and in the in-band frequency range. *Option B72* is required.

| | Specifications | Supplemental Information |
|--------------------------------|--|--------------------------|
| In-Band Frequency Range | | |
| Cellular bands | 824 to 870 MHz 869 to 925 MHz | |
| PCS bands | 1715 to 1780 MHz 1805 to 1870 MHz 1850 to 1910 MHz 1930 to 1990 MHz | |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------------------|
| Channel Power (1.23 MHz Integration BW) | | Integration BW range 1 kHz to 10 MHz |
| Range at RF Input | 30 to -70 dBm | |
| Absolute power accuracy for in-band signal (Mean channel power at RF Input, plus any external attenuation, excluding mismatch error) | | |
| Cellular Bands | | |
| 30 to -5 dBm 20 to 30 °C | ±0.80 dB | ±0.36 dB, typical |
| 0 to 55 °C | ±1.13 dB | |
| -5 to -25 dBm 20 to 30 °C | ±0.77 dB | ±0.33 dB, typical |
| 0 to 55 °C | ±1.10 dB | |
| -25 to -45 dBm 20 to 30 °C | ±0.65 dB | ±0.29 dB, typical |
| 0 to 55 °C | ±1.00 dB | |
| -45 to -55 dBm 20 to 30 °C | ±0.72 dB | ±0.36 dB, typical |
| 0 to 55 °C | ±1.01 dB | |

| | Specifications | Supplemental Information |
|-------------------------------|----------------|--------------------------|
| -55 to -70 dBm 20 to 30 °C | ±0.86 dB | ±0.47 dB, typical |
| 0 to 55 °C | ±1.28 dB | |
| PCS Bands | | |
| 30 to -5 dBm 20 to 30 °C | ±0.70 dB | ±0.29 dB, typical |
| 0 to 55 °C | ±1.15 dB | |
| -5 to -25 dBm 20 to 30 °C | ±0.67 dB | ±0.26 dB, typical |
| 0 to 55 °C | ±1.11 dB | |
| -25 to -45 dBm 20 to 30 °C | ±0.66 dB | ±0.27 dB, typical |
| 0 to 55 °C | ±0.97 dB | |
| -45 to -55 dBm 20 to 30 °C | ±0.73 dB | ±0.34 dB, typical |
| 0 to 55 °C | ±0.98 dB | |
| -55 to -70 dBm 20 to 30 °C | ±0.87 dB | ±0.45 dB, typical |
| 0 to 55 °C | ±1.25 dB | |

| | Specifications | Supplemental Information |
|---|----------------------------|--------------------------|
| Channel power relative power accuracy (same channel, different Tx power, input attenuator fixed, RF input range manual). | See Display Scale Fidelity | |

| | Specifications | Supplemental Information |
|--------------------------------|----------------|--------------------------|
| Receive Channel Power | | |
| Absolute Power Accuracy | | |
| Cellular bands | | |
| 30 to 0 dBm | ±0.98 dB | ±0.55 dB, typical |
| 0 to -85 dBm | ±2.02 dB | ±1.33 dB, typical |
| PCS bands | | |
| 30 to 0 dB | ±1.00 dB | ±0.60 dB, typical |
| 0 to -85 dBm | ±1.52 dB | ±0.84 dB, typical |

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| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| Preamp (<i>Option 1DS</i>) Cellular and PCS bands 30 to -80 dBm | ±2.45 dB | ±1.70 dB, typical |
| -80 to -100 dBm | ±3.20 dB | ±2.30 dB, typical |

| | Specifications | Supplemental Information |
|--|-----------------------|---|
| Occupied Bandwidth | | |
| Carrier power range | 30 to -70 dBm | |
| Frequency resolution of occupied BW | 1.88 kHz | |
| Frequency accuracy of occupied BW (1.23 MHz channel BW) | | ±15 kHz, characteristic |
| Frequency resolution of delta frequency | 3.75 kHz | |
| Frequency accuracy of delta frequency | | ±(35 kHz + frequency reference error × carrier frequency), characteristic |

| | Specifications | Supplemental Information |
|--|-----------------------|---|
| Code Domain (Requires <i>Options 1D5, B7D,</i> and <i>B7E</i> . Measurement interval ≥1.25 ms unless otherwise noted.) | | |
| Carrier power range at RF Input (Pilot channel power > -11 dBc) | 30 to -13 dBm | 30 to -65 dBm ^a , characteristic |
| Preamp (<i>Option 1DS</i>) | 30 to -30 dBm | 30 to -82 dBm ^a , characteristic |
| Measurement interval range | 0.5 ms to 26.67 ms | |
| Code domain power | | |
| Display dynamic range | 50 dB | |
| Accuracy (Walsh channel power within 20 dB of total power) | ±0.2 dB | |
| Displayed resolution | 0.01 dB | |

| | Specifications | Supplemental Information |
|---|------------------------|--|
| 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 interval ≥ 2.5 ms) | | Excludes frequency reference error. |
| Input frequency error range | ± 100 kHz | ± 200 kHz, typical |
| Accuracy | ± 10 Hz | ± 7 Hz, typical |
| Displayed resolution | Four digits | |
| Estimated Rho | | |
| Range | 0.9 to 1.0 | 0.5 to 1.0 ^b |
| Accuracy (With 9 channels active over the specified range) ^c | | ± 0.02 , characteristic |
| Displayed resolution | 0.0001 | |
| Pilot time offset | | From even second signal to start of PN sequence |
| Range | -13.33 ms to +13.33 ms | |
| Accuracy | ± 150 ns | |
| Displayed resolution | Four digits | |
| Code domain timing | | Pilot to code channel time tolerance |
| Range | ± 200 ns | |
| Accuracy (IS-97A nominal power levels) ^d | ± 15 ns | ± 7 ns, typical |
| Code domain phase | | Pilot to code channel phase tolerance |
| Range | ± 200 mrad | |
| Accuracy (IS-97A nominal power levels) ^d | ± 15 mrad | ± 10 mrad, typical |
| Displays | | Power Graph and Metrics, or Power, Timing, and Phase Graphs |

- a. Performance may degrade outside of the specified carrier power range at RF input listed in the specifications column.
- b. Performance may degrade outside of the estimated rho range listed in the specifications column.

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- c. The Active Set Threshold is less than all active channels, but greater than -20 dBc.
d. IS-97A nominal base station test model levels (fraction of carrier power); Pilot: 0.20 (-7.0 dBc), Sync: 0.0471 (-13.3 dBc), Paging: 0.1882 (-7.3 dBc), 6 Traffic channels: 0.09412 (-10.3 dBc)

| | Specifications | Supplemental Information |
|---|----------------------------|---|
| Modulation Accuracy (Rho) (Requires <i>Options 1D5, B7D, and B7E</i> . Measurement interval ≥ 1.25 ms unless otherwise noted.) | | |
| Carrier power range at RF Input | 30 to -28 dBm | 30 to -70 dBm ^a , characteristic |
| Preamp (<i>Option 1DS</i>) | 30 to -45 dBm | 30 to -87 dBm ^a , characteristic |
| Measurement interval range | 0.5 ms to 26.67 ms | |
| Rho (waveform quality) | | |
| Range | 0.9 to 1.0 | 0.5 to 1.0 ^b , characteristic |
| Accuracy | ± 0.0015 | ± 0.0007 , typical |
| Displayed resolution | 0.0001 | |
| Carrier frequency error (Measurement interval ≥ 2.5 ms) | | |
| Input frequency error range | ± 100 kHz | ± 200 kHz, typical |
| Accuracy | ± 10 Hz | ± 7 Hz, typical |
| Displayed resolution | Four digits | |
| Pilot time offset | | |
| Range | -13.33 ms to $+13.33$ ms | From even second signal to start of PN sequence |
| Accuracy | ± 150 ns | |
| Displayed resolution | Four digits | |
| EVM | | |
| Floor | 3.0% | 2.6%, typical |
| Accuracy ^c | $\pm 0.65\%$ | $\pm 0.46\%$, typical |
| Displayed Resolution | 0.01% | |

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| Carrier feedthrough | | |
| Floor | -51 dBc | |
| Accuracy (Carrier feedthrough ≥ -43 dBc) | ±2.3 dB | |
| Displayed resolution | 0.01 dB | |
| Magnitude error | | |
| Floor | 3.0% | |
| Accuracy ^c | ±0.65% | |
| Displayed resolution | 0.01% | |
| Phase error | | |
| Accuracy ^c | ±0.4 degrees | |
| Displayed resolution | 0.01 degrees | |
| Displays | | Numeric results or Numeric results and IQ graph |

- a. Performance may degrade outside of the specified carrier power range at RF input listed in the specifications column.
- b. Performance may degrade outside of the rho range listed in the specifications column.
- c. Accuracy does not include the effects of the EVM floor. The measurement variance increases as the result approaches the EVM floor.

| | Specifications | Supplemental Information |
|------------------------------------|---|--|
| Spur Close (In Band) | | |
| Carrier power range at RF Input | 30 to -12 dBm | |
| Dynamic range | | |
| Input power | | |
| 30 to 25 dBm | 55 dB | |
| 25 to 20 dBm | 50 dB | |
| 20 to -12 dBm | 46 dB | |
| Relative accuracy | ±(2.7 dB + 0.01 × (dB from reference level)) | ±(0.3 dB + 0.01 × (dB from reference level)), typical |
| Displayed resolution | 0.01 dB | |

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| | Specifications | Supplemental Information |
|---|----------------|--|
| Out-of-Band Spurious^a | | Refer to the Amplitude specifications section in this guide. |

- a. The out-of-band measurement is made with the user-defined tables with 20 frequency ranges each (up to the top 10 spurs per range, 100 spurs maximum). Table parameters include frequency range, RBW, video BW, detector type, and amplitude test limits.

| | Specifications | Supplemental Information |
|---|-----------------|--------------------------|
| Receiver Spurious Emissions | | |
| Spurious emission power range | -20 to -83 dBm | |
| Preamp On (<i>Option 1DS</i>) | -40 to -101 dBm | |
| Absolute spurious emission power accuracy | | |
| -20 to -60 dBm | ±2.6 dB | ±1.7 dB, typical |
| -60 to -83 dBm | ±4.3 dB | ±3.4 dB, typical |
| Preamp On (<i>Option 1DS</i>) | | |
| -40 to -70 dBm | ±3.6 dB | ±2.6 dB, typical |
| -70 to -101 dBm | ±5.0 dB | ±3.9 dB, typical |

| | Specifications | Supplemental Information |
|-------------------------------------|----------------|--------------------------|
| External Correction | | |
| External attenuation, external gain | | |
| Range | -90 to 90 dB | |
| Resolution | 0.01 dB | |

| | Specifications | Supplemental Information |
|---|---------------------|--------------------------|
| Trigger | | |
| Trigger source (Actual available choices dependent on measurement) | Free run, external | |
| (<i>Option B7D and B7E</i>) | Add RF Burst, frame | |
| Delay trigger | | |
| Range | 0 to 500 ms | |
| Resolution | 300 ns | |

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| RF burst trigger level <i>(Option B7E)</i> | 0 to -25 dBc | Rear panel connector labelled EXT FRAME SYNC <i>(Option B7D)</i> |
| Trigger slope (External and RF burst) | Positive/Negative | |
| Frame timing period | 50 ns to 13.6533 s | |
| Frame synchronizing source | External frame sync | |
| Frame synchronizing slope | Positive/Negative | |

| | Specifications | Supplemental Information |
|--|-----------------------|---|
| Demod Trigger Source | | Rear panel connector labelled EXT FRAME SYNC |
| Even second input (Frame trigger only, <i>Option B7D and B7E</i>) | | |
| PN offset range | 0 to 511 x 64 [chips] | |

GSM Measurement Personality (Option BAH)

Unless otherwise noted, all specifications are with RF input range auto, default GSM measurement settings, and in the in-band frequency range. *Option 1D6* and *Option B72* are required.

| | Specifications | Supplemental Information |
|--------------------------------|--------------------------------------|--------------------------|
| In-Band Frequency Range | | |
| GSM 900, P-GSM bands | 890 to 915 MHz 935 to 960 MHz | |
| GSM 900, E-GSM bands | 880 to 915 MHz 925 to 960 MHz | |
| GSM 900, R-GSM bands | 876 to 915 MHz 921 to 960 MHz | |
| DCS 1800 bands | 1710 to 1785 MHz 1805 to 1880 MHz | |
| PCS 1900 bands | 1850 to 1910 MHz 1930 to 1990 MHz | |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| Transmitter Power (Requires <i>Option B7D</i> or <i>AYX</i>) | | |
| Range at RF Input | 30 to -60 dBm | |
| Absolute power accuracy for in-band signal (Mean channel power at RF Input, plus any external attenuation, excluding mismatch error) | | |
| P-GSM, E-GSM, and R-GSM Bands | | |
| 30 to -20 dBm 20 to 30 °C | ±0.81 dB | ±0.38 dB, typical |
| 0 to 55 °C | ±1.31 dB | |
| -20 to -30 dBm 20 to 30 °C | ±0.74 dB | ±0.37 dB, typical |
| 0 to 55 °C | ±1.14 dB | |

| | Specifications | Supplemental Information |
|------------------------------------|-----------------------|---------------------------------|
| -30 to -40 dBm 20 to 30 °C | ±0.79 dB | ±0.37 dB, typical |
| 0 to 55 °C | ±1.11 dB | |
| -40 to -50 dBm 20 to 30 °C | ±0.95 dB | ±0.53 dB, typical |
| 0 to 55 °C | ±1.21 dB | |
| -50 to -60 dBm 20 to 30 °C | ±1.09 dB | ±0.66 dB, typical |
| 0 to 55 °C | ±1.33 dB | |
| DCS 1800 and PCS 1900 Bands | | |
| 30 to -20 dBm 20 to 30 °C | ±0.68 dB | ±0.28 dB, typical |
| 0 to 55 °C | ±1.30 dB | |
| -20 to -30 dBm 20 to 30 °C | ±0.61 dB | ±0.27 dB, typical |
| 0 to 55 °C | ±1.12 dB | |
| -30 to -40 dBm 20 to 30 °C | ±0.66 dB | ±0.27 dB, typical |
| 0 to 55 °C | ±0.99 dB | |
| -40 to -50 dBm 20 to 30 °C | ±0.82 dB | ±0.43 dB, typical |
| 0 to 55 °C | ±1.09 dB | |
| -50 to -60 dBm 20 to 30 °C | ±0.96 dB | ±0.56 dB, typical |
| 0 to 55 °C | ±1.21 dB | |

| | Specifications | Supplemental Information |
|--|----------------------------|---------------------------------|
| Transmitter Power Relative Power Accuracy (same channel, different Tx power, input attenuator fixed, RF input range manual). | See Display Scale Fidelity | |

Agilent E4407B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|---|----------------|---|
| Power versus Time (Requires <i>Option B7D</i> or <i>AYX</i>) | | |
| Carrier power range at RF Input | 30 to -23 dBm | 30 to -55 dBm ^a , characteristic |
| Preamp On (<i>Option 1DS</i>) | 30 to -40 dBm | 30 to -72 dBm ^a , characteristic |
| Time resolution accuracy | | ±1% of sweep time, characteristic |
| Maximum record length | 8 time slots | |
| Burst to mask uncertainty (Requires <i>Option B7D</i> and <i>B7E</i>) | ±1.0 bit | |

a. Performance may degrade outside of the specified carrier power range at RF input listed in the specifications column.

| | Specifications | Supplemental Information |
|--|---------------------------------------|------------------------------|
| Output RF Spectrum | | |
| Carrier power range at RF Input | | |
| Offsets ≤1800 kHz, 30 kHz RBW | | 30 to -5 dBm, characteristic |
| Offsets >1800 kHz, 100 kHz RBW | | 30 to -4 dBm, characteristic |
| Reference power accuracy | Same as Transmitter Power measurement | |
| Relative accuracy ^a | See Display Scale Fidelity | |
| Spectrum due to modulation displayed dynamic range ^{bc} | | |
| 100 kHz offset | | 30 dB, characteristic |
| 200 kHz offset | | 60 dB, characteristic |
| 250 kHz offset | | 60 dB, characteristic |
| 400 kHz offset | | 70 dB, characteristic |
| 600 kHz to 1.8 MHz offset | | 79 dB, characteristic |
| 1.8 to 6.0 MHz offset | | 75 dB, characteristic |
| >6 MHz offset | | 76 dB, characteristic |
| Swept Mode Dynamic Range | | 70 dB, characteristic |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| Spectrum due to switching transients displayed dynamic range ^{bc} | | |
| 400 kHz offset | | 62 dB, characteristic |
| 600 kHz offset | | 79 dB, characteristic |
| 1200 kHz offset | | 79 dB, characteristic |
| 1800 kHz offset | | 80 dB, characteristic |
| Swept Mode Dynamic Range | | 70 dB, characteristic |

- a. Does not include uncertainty due to noise.
- b. Displayed dynamic range for specific frequency offsets - applies to CW signal at the specified offset. Dynamic range with a GSM signal may differ.
- c. Using default settings, the RBW filter has a corrected noise BW and impulse BW equivalent to five-pole synchronously tuned filter.

| | Specifications | Supplemental Information |
|--|----------------|---|
| Phase and Frequency Error (Requires <i>Option 1D5</i> , <i>B7D</i> , and <i>B7E</i>) | | |
| Carrier power range at RF Input | 30 to -23 dBm | 30 to -55 dBm ^a , characteristic |
| Preamp On (<i>Option 1DS</i>) | 30 to -40 dBm | 30 to -72 dBm ^a , characteristic |
| Phase error | | |
| Range | 0 to 180° | |
| Displayed resolution | 0.01° | |
| Accuracy (Averages ≥10) | | |
| Peak | ±2.1° | ±1.5°, typical |
| RMS | ±1.1° | ±0.6°, typical |
| Frequency error | | Excludes frequency reference error |
| Initial frequency error range | ±100 kHz | |
| Accuracy (Averages ≥10) | ±10 Hz | ±5 Hz, typical |
| I/Q offset range | -10 to -46 dBc | |
| Burst sync time uncertainty | ±1.0 bit | |
| Displays | | Numeric summary |

- a. Performance may degrade outside of the specified carrier power range at RF input listed in the specifications column.

Agilent E4407B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|-----------------------------------|----------------|---|
| Transmit Band Spurious | | |
| Carrier power range at RF Input | | 30 to -12 dBm, typical |
| Dynamic range | | |
| Upper and lower adjacent segments | | 55 dB, characteristic |
| Upper and lower segments | | 44 dB, characteristic |
| Relative accuracy | | $\pm(0.3 \text{ dB} + 0.01 \times (\text{dB from reference level}))$, characteristic |
| Displayed resolution | 0.01 dB | |

| | Specifications | Supplemental Information |
|---|----------------|--|
| Out-of-Band Spurious^a | | |
| Absolute Spurious Power Accuracy | | Refer to the Amplitude specifications section in this guide. |
| Sensitivity ^b | | |
| RBW | | |
| 1 kHz | | -95 dBm, characteristic |
| 3 kHz | | -90 dBm, characteristic |
| 10 kHz | | -85 dBm, characteristic |
| 30 kHz | | -78 dBm, characteristic |
| 100 kHz | | -71 dBm, characteristic |
| 300 kHz | | -64 dBm, characteristic |
| 1 MHz | | -57 dBm, characteristic |
| 3 MHz | | -50 dBm, characteristic |

a. The out-of-band spurious measurement is made in accordance with the tables defined in the appropriate GSM specification document. The measurement is made over several frequency ranges (up to 10 spurs per range, 100 spurs maximum).

b. With input attenuation of 5 dB. For all other attenuation settings, add (input attenuation - 5) dB.

| | Specifications | Supplemental Information |
|---|----------------|--|
| Receive Band Spurious Spurious emission power range ^a Preamp On (<i>Option 1DS</i>) Absolute spurious emission power accuracy –20 to –60 dBm –60 to –73 dBm Preamp on (<i>Option 1DS</i>) –40 to –70 dBm –70 to –91 dBm | | –20 to –73 dBm, characteristic –40 to –91 dBm, characteristic ±1.9 dB, characteristic ±2.5 dB, characteristic ±2.8 dB, characteristic ±4.1 dB, characteristic |

a. Requires bandpass filter centered on receive band, peak detector mode, 0 dB attenuation, 100 kHz RBW. Does not include insertion loss of bandpass filter.

| | Specifications | Supplemental Information |
|--------------------------------|----------------|---|
| Amplitude Range Control | | RF Input Autorange, Manually set Max Total Pwr Manually set Input Atten |

| | Specifications | Supplemental Information |
|--|-------------------------|--------------------------|
| External Gain/Attenuation Correction Base gain, base attenuation, mobile gain, mobile attenuation Range Resolution | 0 to 81.9 dB 0.01 dB | |

| | Specifications | Supplemental Information |
|--|--|--------------------------|
| Trigger Trigger source (Actual available choices dependent on measurement) (<i>Option B7D and B7E</i>) | Free run, external Add RF Burst and frame | |

Agilent E4407B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|---|-------------------------------------|---------------------------------|
| RF burst trigger <i>(Option B7E)</i> | | |
| Peak carrier power range ^a | 30 to -25 dBm | 30 to -30 dBm, typical |
| Preamp On <i>(Option 1DS)</i> | 30 to -45 dBm | 30 to -50 dBm, typical |
| Trigger level range | 0 to -25 dB relative to signal peak | |

a. With trigger level set to -6 dB.

| | Specifications | Supplemental Information |
|--|-----------------------|---|
| Burst Sync <i>(Requires Option AYX or B7D)</i> | | |
| Source <i>(Actual available choices dependent on measurement)</i> | RF amplitude, none | |
| <i>(Option B7D and B7E)</i> | Add training sequence | |
| Training sequence code | | GSM defined 0 to 7 Auto (search) or Manual |
| Burst type | | Normal (TCH and CCH) Sync (SCH) Access (RACH) |

General

| | Specifications | Supplemental Information |
|--------------------------|----------------|--------------------------|
| Temperature Range | | |
| Operating | 0 to 55 °C | Floppy disk 10 to 40 °C |
| Storage | -40 to 75 °C | |

| | Specifications | Supplemental Information |
|---------------------------------|----------------|----------------------------|
| Audible Noise (ISO 7779) | | |
| Sound Pressure at 25 °C | | <40 dBa, (<4.6 Bels power) |

| | Specifications | Supplemental Information |
|-------------------------------|---|--------------------------|
| Military Specification | Has been type tested to the environmental specifications of MIL-PRF-28800F class 3. | |

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

| | Specifications | Supplemental Information |
|-------------------------|----------------|--|
| Immunity Testing | | |
| Radiated Immunity | | Testing was done at 3 V/m according to IEC 801-3/1984. When the analyzer tuned frequency is identical to the immunity test signal frequency there may be signals of up to -60 dBm displayed on the screen. |
| Electrostatic Discharge | | Air discharges of up to 8 kV were applied according to IEC 801-2/1991. Discharges to center pins of any of the connectors may cause damage to the associated circuitry. |

Agilent E4407B Specifications and Characteristics
General

| | Specifications | Supplemental Information |
|----------------------------|--|---|
| Power Requirements | | Uses CUKonverter® topology in the power supply. |
| ac Operation | | |
| Voltage, frequency | 90 to 132 V rms, 47 to 440 Hz 195 to 250 V rms, 47 to 66 Hz | |
| Power Consumption, On | <300 W | |
| Power Consumption, Standby | <5 W | |
| dc Operation | | |
| Voltage | 12 to 20 Vdc | |
| Power Consumption | <200 W | |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| Measurement Speed | | |
| Local Measurement and Display Update rate ^a | | |
| Sweep points = 101 | | ≥ 40/s, characteristic |
| Sweep points = 401 | | ≥ 28/s, characteristic |
| Remote Measurement and GPIB Transfer Rate ^{bc} (Option A4H) | | |
| Sweep points = 101 | | ≥ 40/s, characteristic |
| Sweep points = 401 | | ≥ 28/s, characteristic |
| RF Center Frequency Tune, Measure, and GPIB Transfer Time ^{bd} (Option A4H) | | |
| Sweep points = 101 | | ≤ 75 ms, characteristic |
| Sweep points = 401 | | ≤ 90 ms, characteristic |

- a. Factory preset, auto align Off, fixed center frequency, RBW = 1 MHz, span >10 MHz and ≤600 MHz, and stop frequency ≤3 GHz.
- b. Display Off (:DISPlay:ENABle OFF), and 32-bit integer data format (:FORMat:DATA INT,32), if Option AYX or A4J is installed, disable sweep ramp, (:SYStem:PORTs:IFVSweep:ENABle OFF), markers Off, single sweep, measured with IBM compatible PC with 550 MHz Pentium® III running Windows® NT 4.0, one meter GPIB cable, National Instruments PCI-GPIB card and NI-48.2 DLL.
- c. Factory preset, auto align Off, fixed center frequency, RBW = 1 MHz, and span = 20 MHz, fixed center frequency, stop frequency ≤3 GHz, average of 100 measurements.
- d. Factory preset, auto align Off, RBW = 1 MHz, span= 20 MHz, stop frequency ≤3 GHz, center frequency tune step size = 50 MHz.

| | Specifications | Supplemental Information |
|---|----------------|-----------------------------------|
| Data Storage | | |
| Internal | | 200 Traces or States ^a |
| External (10 to 40 °C) 3.5" 1.44 MB, MS-DOS [®] compatible floppy disk | | 200 Traces or States ^a |

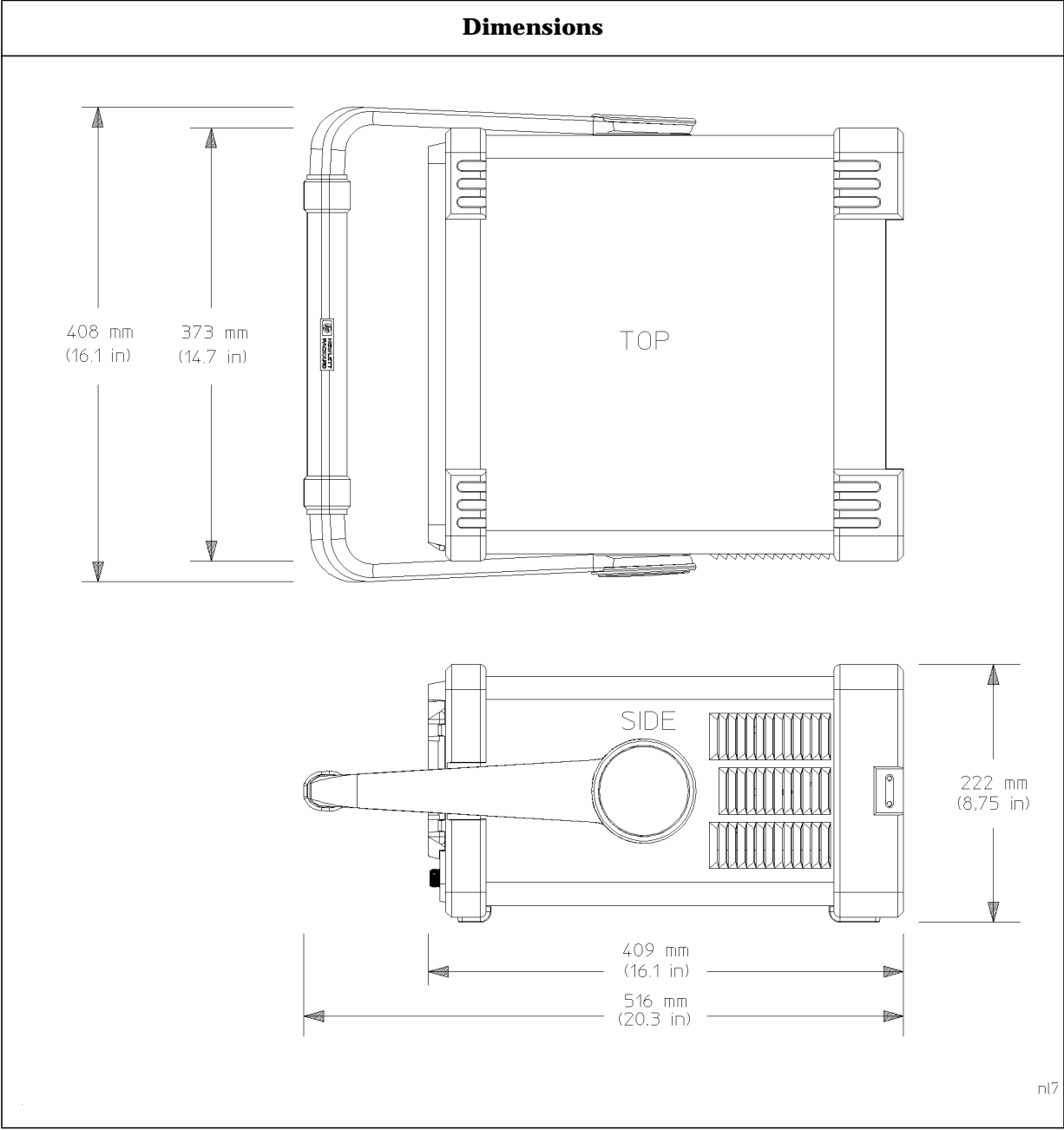
a. When storing traces set to 401 points.

| | Specifications | Supplemental Information |
|------------------------------------|----------------|--------------------------|
| Downloadable Program Memory | | 2 MB available memory |
| <i>(Option B72)</i> | | 10 MB available memory |

| | Specifications | Supplemental Information |
|-----------------------------------|----------------|---|
| Demod Tune and Listen | | |
| Demod | AM | Internal speaker, front-panel earphone jack and front-panel volume control. |
| <i>(Option BAA)</i> | Add FM | |
| <i>(Option A4J, AYX, or BAA)</i> | | An uncalibrated demodulated signal is available on the AUX VIDEO OUT or EXT VIDEO OUT connectors at the rear panel. |

| | Specifications | Supplemental Information |
|---------------------------------|----------------|-----------------------------------|
| Weight (without options) | | |
| Net | | 17.1 kg (37.7 lb), characteristic |
| Shipping | | 29.0 kg (64 lb), characteristic |

Agilent E4407B Specifications and Characteristics
General



Inputs and Outputs

Front Panel

| | Specifications | Supplemental Information |
|--|-------------------------------|--------------------------|
| INPUT 50 Ω Connector <i>(Option BAB)</i> Impedance | Type-N female APC 3.5 male | 50 Ω , nominal |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| RF OUT 50 Ω, (Option 1DN) Connector Impedance | Type-N female | 50 Ω , nominal |

| | Specifications | Supplemental Information |
|---|----------------|--|
| AMPTD REF OUT^a Connector Impedance Frequency Frequency Accuracy 50 Ω Amplitude ^c | BNC female | Amplitude Reference 50 Ω , nominal 50 MHz Frequency reference error ^b -20 dBm, nominal |

a. Turn the amplitude reference on/off by pressing the keys: **Input/Output**, **Amptd Ref Out**.

b. Frequency reference error = (aging rate \times period of time since adjustment + settability + temperature stability).

c. The internal amplitude reference actual power is stored internally.

| | Specifications | Supplemental Information |
|---------------------------------------|----------------|--|
| PROBE POWER Voltage/Current | | +15 Vdc, $\pm 7\%$ at 150 mA max., characteristic -12.6 Vdc $\pm 10\%$ at 150 mA max., characteristic |

Agilent E4407B Specifications and Characteristics
Inputs and Outputs

| | Specifications | Supplemental Information |
|---------------------------------|-----------------------|---|
| EXT KEYBOARD^a | | Used for entering screen titles and filenames only. Interface compatible with most IBM-compatible PC keyboards. |
| Connector | 6-pin mini-DIN | |

a. The feature is not implemented in firmware revisions prior to A.04.00.

| | Specifications | Supplemental Information |
|----------------|-----------------------|----------------------------------|
| Speaker | | Front panel knob controls volume |

| | Specifications | Supplemental Information |
|------------------|--|--|
| Headphone | | Front panel knob controls volume |
| Connector | 3.5 mm (1/8 inch) miniature audio jack | |
| Power Output | | 0.2 W into 4 Ω , characteristic |

| | Specifications | Supplemental Information |
|---------------------------------------|-----------------------|---------------------------------|
| IF INPUT (<i>Option AYZ</i>) | | |
| Connector | SMA female | |
| Impedance | | 50 Ω , nominal |
| Frequency | | 321.4 MHz, characteristic |

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| LO OUTPUT (<i>Option AYZ</i>) | | |
| Connector | SMA female | |
| Impedance | | 50 Ω , nominal, Must be terminated with 50 Ω |

Rear Panel

| | Specifications | Supplemental Information |
|-----------------------|----------------|--------------------------|
| 10 MHz REF OUT | | |
| Connector | BNC female | |
| Impedance | | 50 Ω, nominal |
| Output Amplitude | | >0 dBm, characteristic |

| | Specifications | Supplemental Information |
|-----------------------|----------------|---|
| 10 MHz REF IN | | |
| Connector | BNC female | Note: Analyzer noise sidebands and spurious response performance may be affected by the quality of the external reference used. |
| Impedance | | 50 Ω, nominal |
| Input Amplitude Range | | -15 to +10 dBm, characteristic |
| Frequency | | 10 MHz, nominal |

| | Specifications | Supplemental Information |
|--|--|--------------------------|
| EXT REF IN <i>(Option B7E)</i> | | |
| Connector | BNC, female | |
| Impedance | | 50 Ω, nominal |
| Input amplitude range | -5 to 10 dBm | |
| Frequency | 1 to 30 MHz, selectable | |
| Frequency lock range | $\pm 5 \times 10^{-6}$ of specified external reference input frequency | |

Agilent E4407B Specifications and Characteristics
Inputs and Outputs

| | Specifications | Supplemental Information |
|--|----------------|------------------------------------|
| 10 MHz OUT <i>(Option B7E)</i> | | |
| Connector | BNC, female | |
| Impedance | | 50 Ω , nominal |
| Frequency | | 10 MHz, nominal |
| Level | | 0 dBm when Option 10 MHz Out is On |

| | Specifications | Supplemental Information |
|--|----------------|---|
| GATE TRIG/EXT TRIG IN | | |
| Connector | BNC female | |
| External Trigger Input | | |
| Trigger Level | | Selectable positive or negative edge initiates sweep in EXT TRIG mode (5 V TTL) |
| Gate Trigger Input <i>(Option 1D6)</i> | | |
| Minimum Pulse Width | | >30 ns (5 V TTL) |

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| GATE/HI SWP OUT | | |
| Connector | BNC female | |
| High Sweep Output Level | | High = sweep; Low = retrace (5 V TTL) |
| Gate Output (<i>Option 1D6</i>) Level | | High = gate on; Low = gate off (5 V TTL) |

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

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------------|
| AUX IF OUT (<i>Option A4J or AYX</i>) | | RBW ≥ 1 kHz |
| Connector | BNC female | |
| Frequency | | 21.4 MHz, nominal |
| Amplitude Range (for signal at reference level and for reference levels – input attenuation + preamp gain of –10 to –70 dBm) | | –10 dBm (uncorrected), characteristic |
| Impedance | | 50 Ω, nominal |

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| AUX VIDEO OUT (<i>Option A4J or AYX</i>) | | RBW ≥ 1 kHz |
| Connector | BNC female | |
| Amplitude Range (into >10 kΩ) | | 0 to 1 V (uncorrected), characteristic |

Agilent E4407B Specifications and Characteristics
Inputs and Outputs

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| HI SWP IN <i>(Option A4J or AYX)</i> Connector Input | BNC female | Open collector, low resets and holds the sweep (5 V TTL) |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------------|
| HI SWP OUT <i>(Option A4J or AYX)</i> Connector Output | BNC female | High = sweep, Low = retrace (5 V TTL) |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| SWP OUT <i>(Option A4J or AYX)</i> Connector Amplitude | BNC female | 0 to +10 V ramp, characteristic |

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| PRESEL TUNE OUTPUT Connector Load Impedance (dc coupled) Range Sensitivity Internal Mixer External Mixer <i>(Option AYZ)</i> | BNC female | > 10 k Ω , nominal 0 to +10 V, characteristic 0.33 V/GHz of tuned frequency > 3 GHz, characteristic 1.5 V/GHz of tuned L.O. frequency, characteristic |

| | Specifications | Supplemental Information |
|---|------------------------|--|
| GPIB Interface <i>(Option A4H)</i> | | |
| Connector | IEEE-488 bus connector | |
| GPIB Codes | | SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3 and C28 |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| Serial Interface <i>(Option 1AX)</i> | | |
| Connector | 9-pin D-SUB male | RS-232 |

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| Parallel Interface <i>(Option A4H or 1AX)</i> | | Printer port only |
| Connector | 25-pin D-SUB female | |

| | Specifications | Supplemental Information |
|--|-----------------------|--|
| EXT VIDEO IN/TV TRIG OUT^a <i>(Option B7B or BAA)</i> | | EXT VIDEO IN is the Baseband composite video input for TV trigger and picture on screen. TV TRIG OUT is the TV trigger output. |
| Connector | BNC Female (75 Ω) | |
| Impedance | | 75 Ω, nominal |
| <i>(Option BAA without Option B7B)</i> | | Feature not implemented |
| <i>(Option BAA with Option B7B)</i> | | |
| External Video Input Video Amplitude | | 1 V _{p-p} , nominal, characteristic |
| TV Trigger Output | | Positive edge indicates start of selected TV line after sync. pulse |
| Amplitude | | TTL (0 V and 3.4 V with 75 Ω series resistance), characteristic |

a. This connector is labelled EXT VIDEO IN on older spectrum analyzers and EXT VIDEO IN/TV TRIG OUT on newer spectrum analyzers.

Agilent E4407B Specifications and Characteristics
Inputs and Outputs

| | Specifications | Supplemental Information |
|---|--------------------------|--|
| <p>EXT VIDEO OUT <i>(Option B7B or BAA)</i></p> <p>Connector</p> <p>Impedance</p> <p><i>Option BAA without Option B7B</i> Amplitude</p> <p><i>Option BAA with Option B7B</i> Amplitude TV Source: SA</p> <p>TV Source and EXT VIDEO IN</p> | <p>BNC female (75 Ω)</p> | <p>Baseband video output RBW ≥ 1 kHz</p> <p>75 Ω, nominal</p> <p>0 to 1 V (uncorrected), characteristic</p> <p>0 to 1 V (uncorrected), characteristic</p> <p>Same as level at EXT VIDEO IN/TV TRIG OUT, characteristic</p> |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| <p>EXT FRAME SYNC <i>(Option B7D)</i></p> <p>Connector</p> <p>Level</p> | <p>BNC, female</p> | <p>5 V TTL</p> |

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 (if accompanied by a year, it is the year when the design was proven).



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)

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 products

Product Name: Spectrum Analyzer

Model Number: HP E4401B, HP E4402B, HP E4403B,
HP E4404B, HP E4405B, HP E4407B,
HP E4408B, HP E4411B

Product Options: This declaration covers all options of the above products.

Conform 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 products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.



Santa Rosa, CA, USA 4 Feb. 2000

Greg Pfeiffer/Quality Engineering Manager

For further information, please contact your local Agilent Technologies sales office, agent or distributor.

About This Chapter

This chapter contains specifications and characteristics for the E4408B spectrum analyzer. The distinction between specifications and characteristics is described as follows.

- Specifications describe the performance of parameters covered by the product warranty. (The temperature range is 0 °C to 55 °C, unless otherwise noted.)
- Characteristics describe product performance that is useful in the application of the product, but is not covered by the product warranty.
- Typical performance describes additional product performance information that is not covered by the product warranty. It is performance beyond an indicated specification, that most units will exhibit.
- Nominal values indicate the expected, but not warranted, value of a parameter.

The following conditions must be met for the analyzer to meet its specifications.

- The analyzer is within the one year calibration cycle.
- If **Auto Align All** is selected:
 - After 2 hours of storage within the operating temperature range.
 - 5 minutes after the analyzer is turned on with sweep times less than 4 seconds.
 - After the front-panel amplitude reference is connected to the INPUT, and **Align Now RF** has been run, after the analyzer is turned on. And, once every 24 hours, or if ambient temperature changes more than 30 °C.
- If **Auto Align Off** is selected:
 - When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.
 - After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now All** has been run.
 - When **Align Now All** is run:
 - Every hour
 - If the ambient temperature changes more than 3 °C
 - If the 10 MHz reference changes

- When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):
 - Every 24 hours
 - If the ambient temperature changes more than 30 °C¹
- If **Auto Align All but RF** is selected:
 - When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.
 - After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now RF** has been run.
 - When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):
 - Every hour
 - If the ambient temperature changes more than 3 °C

1. 10 °C if Option 1DS is active.

Frequency

| | Specifications | Supplemental Information |
|------------------------|----------------------|--|
| Frequency Range | 9 kHz to 26.5 GHz | |
| Band | | Harmonic Mixing Mode (N ^a) |
| 0 | 9 kHz to 3.0 GHz | 1– |
| 1 | 2.85 GHz to 6.7 GHz | 1– |
| 2 | 6.2 GHz to 13.2 GHz | 2– |
| 3 | 12.8 GHz to 19.2 GHz | 4– |
| 4 | 18.7 GHz to 26.5 GHz | 4– |

- a. N is the harmonic mixing mode. For negative mixing modes (as indicated by the “–”), the desired 1st LO harmonic is higher than the tuned frequency by the 1st IF (3.9214 for the 9 kHz to 3 GHz band, 321.4 MHz for all other bands) For positive mixing modes, the desired 1st LO harmonic is lower than the tuned frequency by 321.4 MHz

| | Specifications | Supplemental Information |
|----------------------------|------------------------------|---|
| Frequency Reference | | |
| Aging Rate | $\pm 2 \times 10^{-6}$ /year | $\pm 1.0 \times 10^{-7}$ /day, characteristic |
| Settability | $\pm 5 \times 10^{-7}$ | |
| Temperature Stability | $\pm 5 \times 10^{-6}$ | |

| | Specifications | Supplemental Information |
|-----------------------------------|---|--------------------------|
| Frequency Readout Accuracy | | |
| (Start, Stop, Center, Marker) | $\pm((\text{frequency indication} \times \text{frequency reference error}^{\text{a}}) + 0.75\% \text{ of span} + 15\% \text{ of RBW} + 10 \text{ Hz} + 1 \text{ Hz} \times N^{\text{b}})$ | |

- a. Frequency reference error = (aging rate \times period of time since adjustment + settability + temperature stability).
b. N is the harmonic mixing mode.

| | Specifications | Supplemental Information |
|---------------------------------|--|---------------------------------|
| Marker Frequency Counter | | |
| Resolution | Selectable from 1 Hz to 100 kHz | |
| Accuracy ^a | $\pm(\text{marker frequency} \times \text{frequency reference error}^b + \text{counter resolution})^c$ | |

- a. Marker level to displayed noise level > 25 dB, RBW/ Span \geq 0.002, frequency offset = 0 Hz.
 b. Frequency reference error = (aging rate \times period of time since adjustment + settability + temperature stability).
 c. For firmware revisions prior to A.03.00, add 1 Hz \times N, where N is the harmonic mixing mode.

| | Specifications | Supplemental Information |
|-----------------------|--------------------------------------|---------------------------------|
| Frequency Span | | |
| Range | 0 Hz (zero span), 100 Hz to 26.5 GHz | |
| Resolution | 2 Hz \times N ^a | |
| Accuracy | $\pm 1.0\%$ of span | |

- a. N is the harmonic mixing mode.

| | Specifications | Supplemental Information |
|---------------------------------------|--|---------------------------------|
| Sweep Time | | |
| Range | 4 ms to 4000 s ^a | |
| Tracking Generator On (Option 1DN) | | 50 ms is the minimum sweep time |
| 4 ms to 4000 s ^a | $\pm 1\%$ | |
| Sweep Trigger ^b | Free Run, Single, Line, Video, External, Delayed, Offset ^c | |
| Delayed Trigger ^d | | |
| Range | 1 μ s to 400 s | |
| Resolution | $\frac{\text{delay in seconds}}{65000}$ rounded up to nearest μ s | |
| Accuracy | $\pm(500 \text{ ns} + (0.01\% \text{ of delay}))$ | |

Agilent E4408B Specifications and Characteristics
Frequency

| | Specifications | Supplemental Information |
|-----------------------------------|---|--|
| Offset Trigger^c | | |
| Resolution | $\frac{\text{sweep time}}{400}$ | |
| Range | $\pm 320 \text{ ms to } \pm 323 \text{ ks}$ | Where ST = sweep time $\frac{-32766 \times ST}{400}$ to $\frac{32365 \times ST}{400}$ |

- a. For firmware revisions prior to A.04.00, 5 ms to 2000 s.
- b. Auto align is suspended in video, external, and delayed trigger modes while waiting for a trigger event to occur.
- c. For firmware revision A.04.00 or later.
- d. Delayed trigger is available with line and external trigger.

| | Specifications | Supplemental Information |
|-----------------------------|-----------------------|---------------------------------|
| Sweep (trace) Points | 401 | |

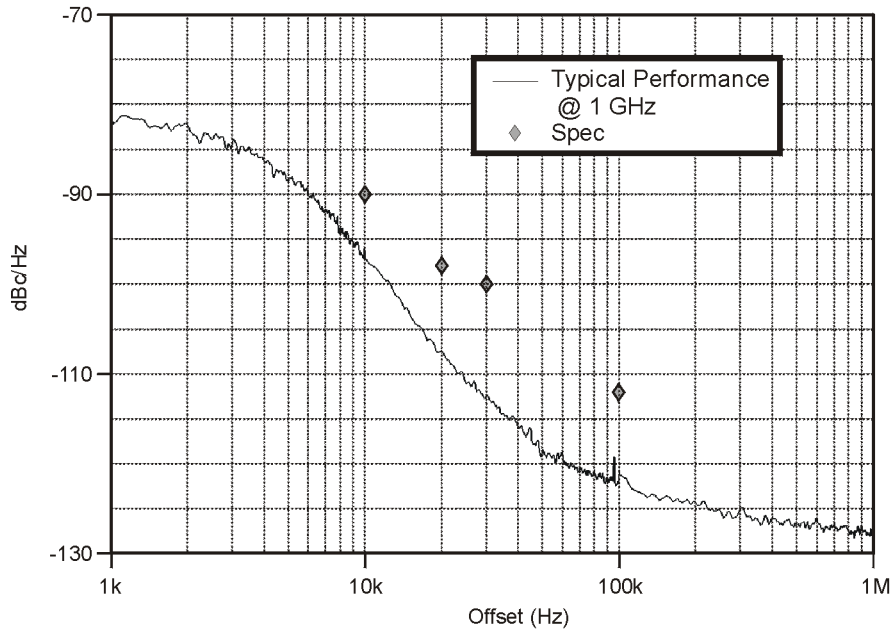
| | Specifications | Supplemental Information |
|--|---|--|
| Resolution Bandwidth (RBW) | | |
| Range | | |
| -3 dB bandwidth | 1 kHz to 3 MHz, in 1-3-10 sequence, 5 MHz | |
| -6 dB bandwidth (EMI) | 9 kHz and 120 kHz | |
| Accuracy | | |
| 1 kHz to 3 MHz RBW | $\pm 15\%$ | |
| 5 MHz RBW | $\pm 30\%$ | |
| Shape | | |
| 1 kHz to 5 MHz RBW | | Synchronously tuned four poles, approximately Gaussian shape |
| Selectivity (60 dB/3 dB bandwidth ratio) | | |
| 1 kHz to 5 MHz RBW | | $<15:1$, characteristic |

| | Specifications | Supplemental Information |
|--|-----------------------------------|---|
| Video Bandwidth (VBW) (-3 dB) | | |
| Range | 30 Hz to 1 MHz in 1-3-10 sequence | 3 MHz, characteristic |
| Accuracy | | ±30%, characteristic |
| Shape | | Post detection, single pole low-pass filter used to average displayed noise |

| | Specifications | Supplemental Information |
|--|----------------------------|---------------------------------|
| Stability | | |
| Noise Sidebands (Offset from CW signal with 1 kHz RBW, 30 Hz VBW and sample detector) | | |
| ≥10 kHz | ≤ -90 dBc/Hz ^a | |
| ≥20 kHz | ≤ -98 dBc/Hz ^a | |
| ≥30 kHz | ≤ -100 dBc/Hz ^a | |
| ≥100 kHz | ≤ -112 dBc/Hz ^a | |
| Residual FM | | |
| 1 kHz RBW, 1 kHz VBW | ≤150 Hz × N p-p in 100 ms | |
| System-Related Sidebands, offset from CW signal | | |
| ≥30 kHz | ≤ -65 dBc ^a | |

a. Add 20 Log(N) for frequencies > 6.7 GHz

Noise Sidebands Normalized to 1 Hz Versus Offset From Carrier



w174b

Amplitude

Amplitude specifications do not apply for the negative peak detector mode.

| | Specifications | Supplemental Information |
|--------------------------|---|--------------------------|
| Measurement Range | Displayed Average Noise Level to Maximum Safe Input Level | |
| Input Attenuator Range | 0 to 65 dB, in 5 dB steps | |

| | Specifications | Supplemental Information |
|--|-----------------|--------------------------|
| Maximum Safe Input Level | | |
| Average Continuous Power (Input attenuator setting ≥ 5 dB) | +30 dBm (1 W) | |
| Peak Pulse Power (for <10 μ sec pulse width, $<1\%$ duty cycle, and input attenuation ≥ 30 dB) | +50 dBm (100 W) | |
| dc | 0 Vdc | |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| 1 dB Gain Compression | | |
| Total power at input mixer ^{ab} | | |
| 50 MHz to 3.0 GHz | 0 dBm | |
| 3.0 GHz to 6.7 GHz | 0 dBm | |
| 6.7 GHz to 13.2 GHz | -3 dBm | |
| 13.2 GHz to 26.5 GHz | -5 dBm | |

- a. Mixer power level (dBm) = input power (dBm) - input attenuation (dB).
b. For resolution bandwidths 1 kHz to 30 kHz, the maximum input signal amplitude must be \leq reference level +10 dB.

Agilent E4408B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|---|------------------------|---------------------------------|
| <p>Displayed Average Noise Level</p> <p>(Input terminated, 0 dB attenuation, sample detector, Reference Level = -70 dBm)</p> | | |
| 1 MHz to 10 MHz | 1 kHz RBW 30 Hz VBW | 1 kHz RBW 30 Hz VBW |
| 10 MHz to 1.0 GHz | ≤ -116 dBm | ≤ -116 dBm, characteristic |
| 1.0 GHz to 2.0 GHz | ≤ -115 dBm | |
| 2.0 GHz to 3.0 GHz | ≤ -112 dBm | |
| 3.0 GHz to 6.0 GHz | ≤ -112 dBm | |
| 6.0 GHz to 12 GHz | ≤ -110 dBm | |
| 12 GHz to 22 GHz | ≤ -107 dBm | |
| 22 GHz to 26.5 GHz | ≤ -101 dBm | |

| | Specifications | Supplemental Information |
|-----------------------------|---|---------------------------------|
| <p>Display Range</p> | | |
| Log Scale | Ten divisions displayed; 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps | |
| Linear Scale | Calibrated 0 to -85 dB from Reference Level | |
| Scale Units | Ten divisions dBm, dBmV, dBμV, V, and W | |

| | Specifications | Supplemental Information |
|---|--------------------------|---------------------------------|
| <p>Marker Readout Resolution</p> | | |
| Log scale | | |
| 0 to -85 dB from ref level | 0.04 dB | |
| Linear scale | 0.01% of Reference Level | |

| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| Frequency Response | | |
| 50 Ω Absolute ^a /Relative | | |
| 9 kHz to 3.0 GHz | | |
| 10 dB attenuation | | |
| 20 to 30 °C | ± 0.5 dB | |
| 0 to 55 °C | ± 1.0 dB | |
| Preselector centered for frequency >3.0 GHz | | |
| 3.0 GHz to 6.7 GHz | | |
| 10 dB attenuation | | |
| Absolute ^a | | |
| 20 to 30 °C | ± 1.5 dB | |
| 0 to 55 °C | ± 2.5 dB | |
| Relative | | |
| 20 to 30 °C | ± 1.3 dB | |
| 0 to 55 °C | ± 1.5 dB | |
| 6.7 GHz to 13.2 GHz | | |
| 10 dB attenuation | | |
| Absolute ^a | | |
| 20 to 30 °C | ± 2.0 dB | |
| 0 to 55 °C | ± 3.0 dB | |
| Relative | | |
| 20 to 30 °C | ± 1.8 dB | |
| 0 to 55 °C | ± 2.0 dB | |
| 13.2 GHz to 26.5 GHz | | |
| 10 dB attenuation | | |
| Absolute ^a | | |
| 20 to 30 °C | ± 2.0 dB | |
| 0 to 55 °C | ± 3.0 dB | |

Agilent E4408B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|-------------|----------------|--------------------------|
| Relative | | |
| 20 to 30 °C | ±1.8 dB | |
| 0 to 55 °C | ±2.0 dB | |

a. Absolute flatness values are referenced to the amplitude at 50 MHz.

| | Specifications | Supplemental Information |
|--|---------------------------------------|--------------------------|
| Input Attenuation Switching Uncertainty at 50 MHz | | |
| Attenuator Setting | | |
| 0 dB to 5 dB | ±0.3 dB | |
| 10 dB | Reference | |
| 15 dB | ±0.3 dB | |
| 20 to 65 dB attenuation | ±(0.1 dB + 0.01 × Attenuator Setting) | |

| Attenuation Accuracy Relative to the 10 dB Attenuator Setting, Characteristic | | | | | |
|---|-----------------|--------------|-------------|-----------|-------------|
| | Frequency Range | | | | |
| Attenuation | 9 kHz–3 GHz | 3.0–13.2 GHz | 13.2–19 GHz | 19–22 GHz | 22–26.5 GHz |
| 0 dB | ±0.3 dB | ±0.5 dB | ±0.8 dB | ±0.9 dB | ±1.0 dB |
| 5 dB | ±0.3 dB | ±0.5 dB | ±0.8 dB | ±0.9 dB | ±1.0 dB |
| 10 dB | Reference | Reference | Reference | Reference | Reference |
| 15 dB | ±0.4 dB | ±0.5 dB | ±0.8 dB | ±1.0 dB | ±1.5 dB |
| 20 dB | ±0.4 dB | ±0.5 dB | ±0.8 dB | ±1.0 dB | ±1.5 dB |
| 25 dB | ±0.5 dB | ±0.6 dB | ±0.8 dB | ±1.2 dB | ±2.0 dB |
| 30 dB | ±0.5 dB | ±0.6 dB | ±0.8 dB | ±1.2 dB | ±2.0 dB |
| 35 dB | ±0.6 dB | ±0.7 dB | ±1.0 dB | ±1.8 dB | ±3.0 dB |
| 40 dB | ±0.6 dB | ±0.7 dB | ±1.0 dB | ±1.8 dB | ±3.0 dB |
| 45 dB | ±0.7 dB | ±1.0 dB | ±1.3 dB | ±2.2 dB | ±3.4 dB |

| Attenuation Accuracy Relative to the 10 dB Attenuator Setting, Characteristic | | | | | |
|--|------------------------|---------------------|--------------------|------------------|--------------------|
| | Frequency Range | | | | |
| Attenuation | 9 kHz–3 GHz | 3.0–13.2 GHz | 13.2–19 GHz | 19–22 GHz | 22–26.5 GHz |
| 50 dB | ±0.7 dB | ±1.0 dB | ±1.3 dB | ±2.2 dB | ±3.4 dB |
| 55 dB | ±0.9 dB | ±1.1 dB | ±1.6 dB | ±2.7 dB | ±3.5 dB |
| 60 dB | ±0.9 dB | ±1.1 dB | ±1.6 dB | ±2.7 dB | ±3.5 dB |
| 65 dB | ±1.0 dB | ±1.6 dB | ±2.0 dB | ±3.2 dB | ±3.8 dB |

| | Specifications | Supplemental Information |
|--|---|---------------------------------|
| Absolute Amplitude Accuracy At reference settings ^a Overall Amplitude Accuracy ^b 20 to 30 °C | ±0.4 dB ± (0.6 dB + Absolute Frequency Response) | |

- a. Settings are: reference level –20 dBm; input attenuation 10 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, signal at reference level.
- b. For reference level 0 to –50 dBm; input attenuation 10 dB; RBW 1 kHz; VBW 1 kHz; scale log, log range 0 to –50 dB from reference level; sweep time coupled; signal input 0 to –50 dBm; span ≤20 kHz.

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| RF Input VSWR (at tuned frequency) Attenuator setting 0 dB 9 kHz to 26.5 GHz Attenuator setting 5 dB 9 kHz to 100 kHz 100 kHz to 6.7 GHz 6.7 GHz to 13.2 GHz 13.2 GHz to 22.0 GHz 22.0 GHz to 26.5 GHz | | ≤3.0:1, characteristic ≤2.0:1, characteristic ≤1.4:1, characteristic ≤1.7:1, characteristic ≤2.3:1, characteristic ≤2.6:1, characteristic |

Agilent E4408B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|--------------------------------|-----------------------|---------------------------------|
| Attenuator setting 10 to 65 dB | | |
| 9 kHz to 6.7 GHz | | ≤1.3:1, characteristic |
| 6.7 GHz to 13.2 GHz | | ≤1.5:1, characteristic |
| 13.2 GHz to 22.0 GHz | | ≤2.0:1, characteristic |
| 22.0 GHz to 26.5 GHz | | ≤2.2:1, characteristic |

| | Specifications | Supplemental Information |
|-----------------------------------|-----------------------|---------------------------------|
| Auto Alignment^a | | |
| Sweep-to-sweep variation | | ±0.1 dB, characteristic |

a. Set Auto Align to Off and use Align Now, All to eliminate this variation.

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| Resolution Bandwidth Switching Uncertainty (at Reference Level) | | |
| 1 kHz RBW | Reference | |
| 3 kHz to 3 MHz RBW | ±0.3 dB | |
| 5 MHz RBW | ±0.6 dB | |

| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| Reference Level | | |
| Range | -149.9 dBm to maximum mixer level + attenuator setting | |
| Resolution | | |
| Log Scale | ±0.1 dB | |
| Linear Scale | ±0.12% of Reference Level | |
| Accuracy (at a fixed frequency, a fixed attenuator, and referenced to -30 dBm) | | |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| Reference Level (dBm) – input attenuator setting (dB) | | |
| –10 dBm to > –60 dBm | ±0.3 dB | |
| –60 dBm to > –85 dBm | ±0.5 dB | |
| –85 dBm to –90 dBm | ±0.7 dB | |

| | Specifications | Supplemental Information |
|--|-----------------------------|---------------------------------|
| Display Scale Switching Uncertainty | | |
| Switching between Linear and Log | ±0.15 dB at Reference Level | |
| Log Scale Switching | No error | |

| | Specifications | Supplemental Information |
|-------------------------------------|---|---------------------------------|
| Display Scale Fidelity | | |
| Log Maximum Cumulative | | |
| 0 to –85 dB from Reference Level | ±(0.3 dB + 0.01 × dB from Reference Level) | |
| Log Incremental Accuracy | | |
| 0 to –80 dB from reference level | ±0.4 dB/4 dB | |
| Linear Accuracy | ±2% of Reference Level | |

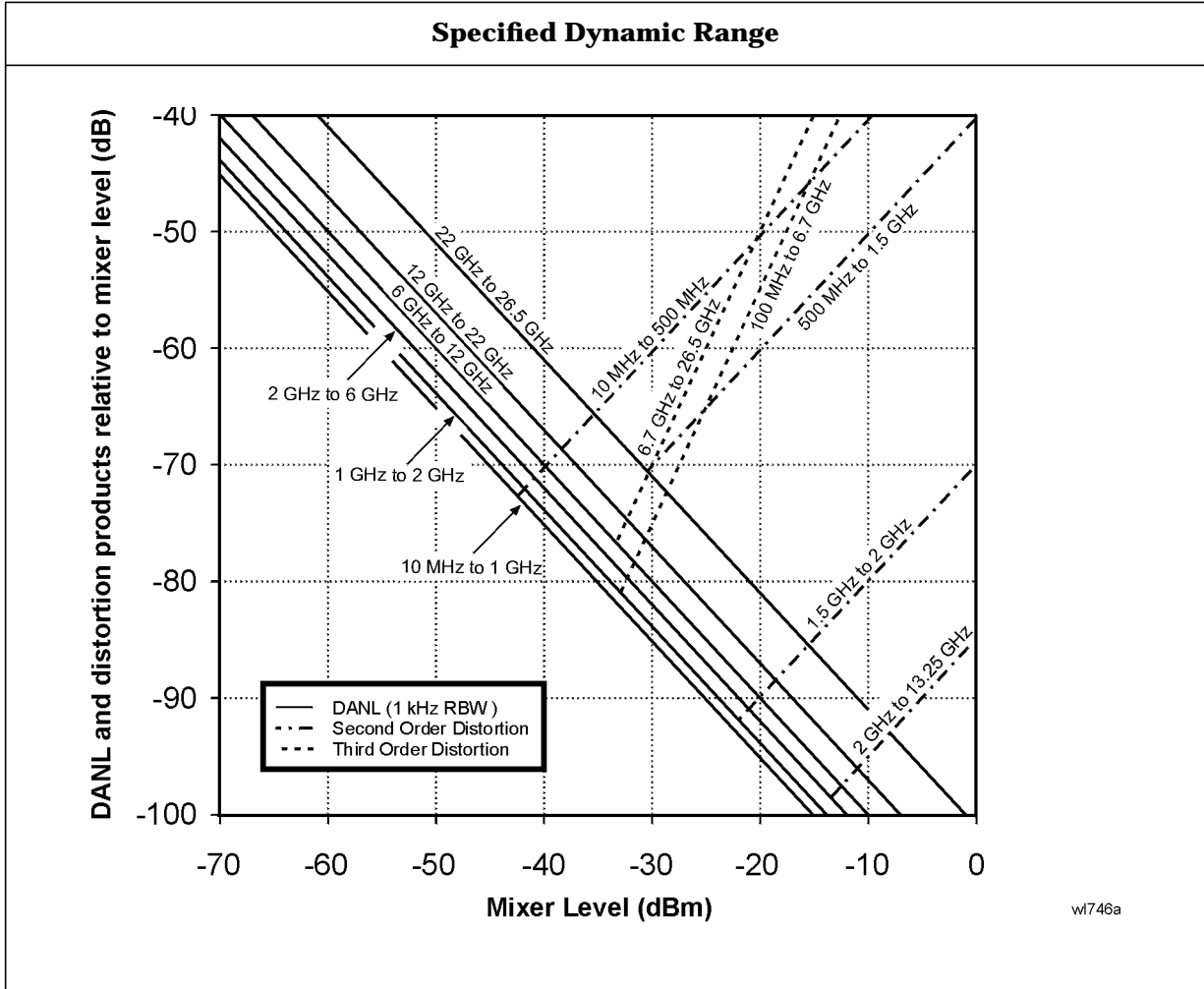
| | Specifications | Supplemental Information |
|----------------------------|---|--|
| Spurious Responses | | |
| Second Harmonic Distortion | | |
| Input Signal | | |
| 10 MHz to 500 MHz | < –60 dBc for –30 dBm signal at input mixer ^a | +30 dBm SHI (second harmonic intercept) |
| 500 MHz to 1.5 GHz | < –70 dBc for –30 dBm signal at input mixer ^a | +40 dBm SHI |
| 1.5 GHz to 2.0 GHz | < –80 dBc for –10 dBm signal at input mixer ^a | +70 dBm SHI |

Agilent E4408B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|---|--|--|
| 2.0 GHz to 3.35 GHz | < -95 dBc ^b for -10 dBm signal at input mixer ^a | +85 dBm SHI |
| 3.35 GHz to 6.6 GHz | < -95 dBc ^b for -10 dBm signal at input mixer ^a | +85 dBm SHI |
| 6.6 GHz to 13.25 GHz | < -95 dBc ^b for -10 dBm signal at input mixer ^a | +85 dBm SHI |
| Third Order Intermodulation Distortion | | |
| 10 MHz to 100 MHz | | +5 dBm TOI (third order intercept), characteristic |
| 100 MHz to 3 GHz | < -75 dBc for two -30 dBm signals at input mixer ^a and >50 kHz separation | +7.5 dBm TOI |
| 3.0 GHz to 6.7 GHz | < -75 dBc for two -30 dBm signals at input mixer ^a and >50 kHz separation | +7.5 dBm TOI |
| 6.7 GHz to 13.2 GHz | < -70 dBc for two -30 dBm signals at input mixer ^a and >50 kHz separation | +5.0 dBm TOI |
| 13.2 GHz to 26.5 GHz | < -70 dBc for two -30 dBm signals at input mixer ^a and >50 kHz separation | +5.0 dBm TOI |
| Other Input Related Spurious | | |
| Inband Responses | | |
| >30 kHz offset | < -65 dBc for -20 dBm signal at input mixer ^a | |
| Out-of-band Responses | | |
| | < -80 dBc for -10 dBm signal at input mixer ^a | |

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

b. or signal below displayed average noise level.



| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| <p>Residual Responses (Input terminated and 0 dB attenuation)</p> <p>150 kHz to 6.7 GHz</p> | <p>< -90 dBm</p> | |

Options

Tracking Generator (Option 1DN)

The spectrum analyzer tracking generator combination will meet its specification after a cable (8120-5148) and adapter are connected between RF OUT and INPUT and **Align Now**, **TG** has been run.

| | Specifications | Supplemental Information |
|----------------|----------------|--------------------------|
| Warm-Up | 5 minutes | |

| | Specifications | Supplemental Information |
|-------------------------------|------------------|--------------------------|
| Output Frequency Range | 9 kHz to 3.0 GHz | |

| | Specifications | Supplemental Information |
|---|--------------------------|--------------------------|
| Output Power Level | | |
| Range | -2 to -66 dBm | |
| Resolution | 0.1 dB | |
| Absolute Accuracy (at 50 MHz with coupled source attenuator, referenced to -20 dBm) | ± 0.75 dB | |
| Vernier | | |
| Range | 8 dB | |
| Accuracy (with coupled source attenuator, 50 MHz, -20 dBm) | | |
| Incremental | ± 0.2 dB/dB | |
| Cumulative | ± 0.5 dB, total | |
| Output Attenuator Range | 0 to 56 dB in 8 dB steps | |

| | Specifications | Supplemental Information |
|-----------------------------------|----------------|---------------------------------------|
| Maximum Safe Reverse Level | | +30 dBm (1 W), 50 Vdc, characteristic |

| | Specifications | Supplemental Information |
|---------------------------|---|---------------------------------|
| Output Power Sweep | | |
| Range | (-10 to -2 dBm) – (Source Attenuator Setting) | |
| Resolution | 0.1 dB | |
| Accuracy (zero span) | <1 dB peak-to-peak | |

| | Specifications | Supplemental Information |
|----------------------------------|-----------------------|---------------------------------|
| Output Flatness | | |
| Referenced to 50 MHz, -20 dBm | | |
| 9 kHz to 10 MHz | ±3 dB | |
| 10 MHz to 3 GHz | ±2 dB | |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| Spurious Outputs | | |
| (-2 dBm output) | | |
| Harmonic Spurs | | |
| TG Output 9 kHz to 20 kHz | ≤ -15 dBc | |
| TG Output 20 kHz to 3 GHz | ≤ -25 dBc | |
| Non-harmonic Spurs | | |
| TG Output 9 kHz to 2 GHz | ≤ -27 dBc | |
| TG Output 2 GHz to 3 GHz | ≤ -23 dBc | |
| LO Feedthrough | | |
| LO Frequency 3.921409 to 6.9214 GHz | ≤ -16 dBm | |

| | Specifications | Supplemental Information |
|----------------------|--|---------------------------------|
| Dynamic Range | Maximum Output Power Level – Displayed Average Noise Level | |

Agilent E4408B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|------------------------|----------------|--|
| Output Tracking | | |
| Drift | | 1.5 kHz/5 minute, characteristic |
| Swept Tracking Error | | Usable in 1 kHz RBW after 5 minutes of warm-up |

| | Specifications | Supplemental Information |
|-------------------------------|----------------|----------------------------|
| RF Power-Off Residuals | | |
| 9 kHz to 3 GHz | | < -120 dBm, characteristic |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| Output Attenuator Repeatability | | |
| 9 kHz to 300 MHz | | ±0.1 dB, characteristic |
| 300 MHz to 2.0 GHz | | ±0.2 dB, characteristic |
| 2.0 GHz to 3 GHz | | ±0.3 dB, characteristic |

| | Specifications | Supplemental Information |
|--------------------|----------------|--------------------------|
| Output VSWR | | |
| 0 dB attenuation | | <2.0:1, characteristic |
| ≥ 8 dB attenuation | | <1.5:1, characteristic |

| |
|--|
| Tracking Generator Output Accuracy |
| Relative Accuracy (Referred to -20 dBm) = Output Attenuator Accuracy + Vernier Accuracy + Output Flatness |
| Absolute Accuracy = Relative Accuracy (Referred to -20 dBm) + Absolute Accuracy at 50 MHz |

General

| | Specifications | Supplemental Information |
|--------------------------|----------------|--------------------------|
| Temperature Range | | |
| Operating | 0 to 55 °C | Floppy disk 10 to 40 °C |
| Storage | -40 to 75 °C | |

| | Specifications | Supplemental Information |
|---------------------------------|----------------|----------------------------|
| Audible Noise (ISO 7779) | | |
| Sound Pressure at 25 °C | | <40 dBa, (<4.6 Bels power) |

| | Specifications | Supplemental Information |
|-------------------------------|---|--------------------------|
| Military Specification | Has been type tested to the environmental specifications of MIL-PRF-28800F class 3. | |

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

| | Specifications | Supplemental Information |
|-------------------------|----------------|--|
| Immunity Testing | | |
| Radiated Immunity | | Testing was done at 3 V/m according to IEC 801-3/1984. When the analyzer tuned frequency is identical to the immunity test signal frequency there may be signals of up to -60 dBm displayed on the screen. |
| Electrostatic Discharge | | Air discharges of up to 8 kV were applied according to IEC 801-2/1991. Discharges to center pins of any of the connectors may cause damage to the associated circuitry. |

Agilent E4408B Specifications and Characteristics
General

| | Specifications | Supplemental Information |
|--|--|---|
| Power Requirements ac Operation Voltage, frequency Power Consumption, On Power Consumption, Standby dc Operation Voltage Power Consumption | 90 to 132 V rms, 47 to 440 Hz 195 to 250 V rms, 47 to 66 Hz <300 W <5 W 12 to 20 Vdc <200 W | Uses CUKonverter® topology in the power supply. |

| | Specifications | Supplemental Information |
|--|----------------|---|
| Measurement Speed Local Measurement and Display Update rate ^a Remote Measurement and GPIB Transfer Rate ^{bc} (Option A4H) RF Center Frequency Tune, Measure, and GPIB Transfer Time ^{bd} (Option A4H) | | ≥ 28/s, characteristic ≥ 28/s, characteristic ≤ 90 ms, characteristic |

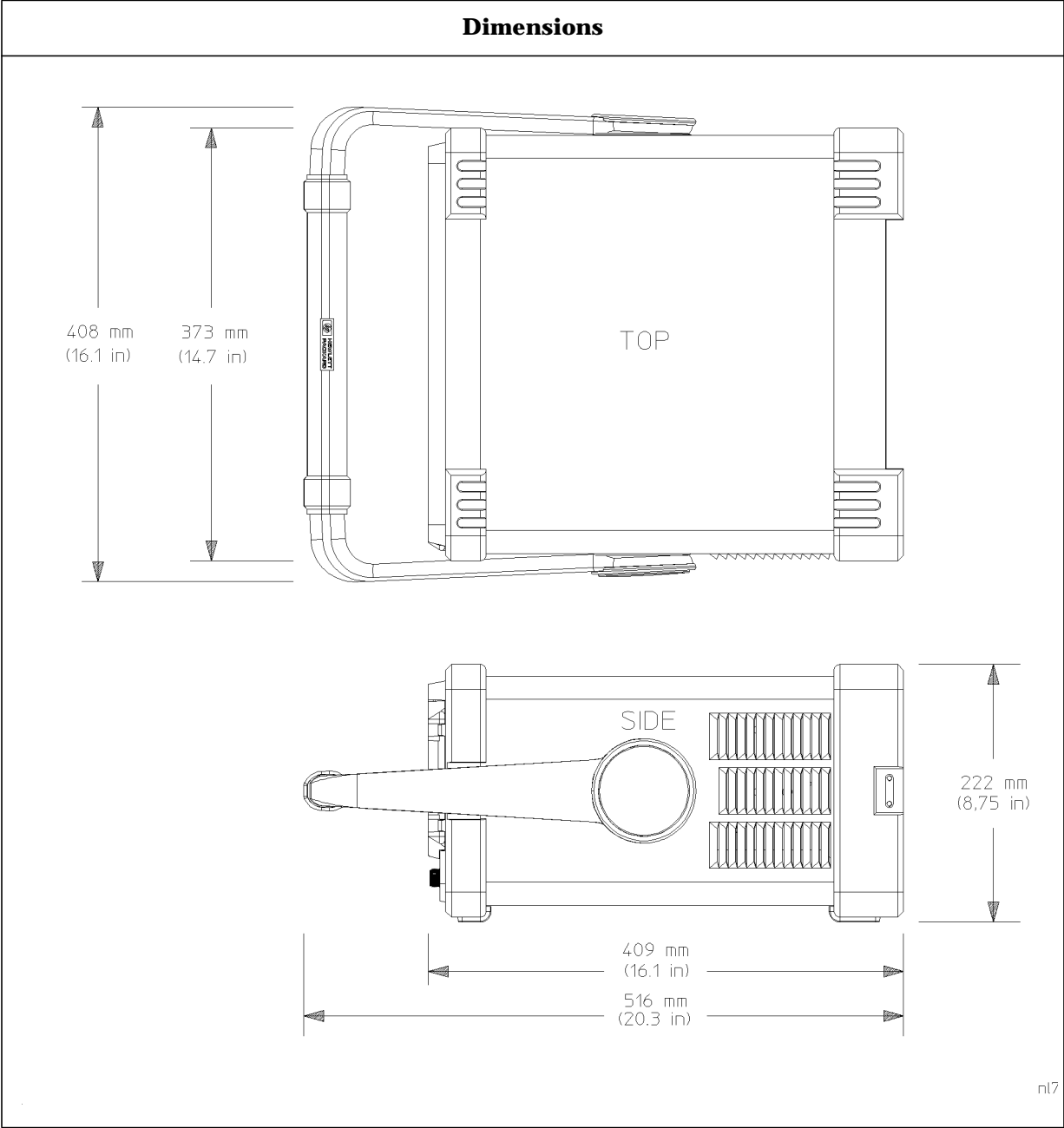
- a. Factory preset, auto align Off, fixed center frequency, RBW = 1 MHz, span >10 MHz and ≤600 MHz, and stop frequency ≤3 GHz.
- b. Display Off (:DISPlay:ENABle OFF), and 32-bit integer data format (:FORMat:DATA INT,32), if Option A4J is installed, disable sweep ramp, (:SYSTem:PORTs:IFVSweep:ENABle OFF), markers Off, single sweep, measured with IBM compatible PC with 550 MHz Pentium® III running Windows® NT 4.0, one meter GPIB cable, National Instruments PCI-GPIB card and NI-48.2 DLL.
- c. Factory preset, auto align Off, fixed center frequency, RBW = 1 MHz, and span = 20 MHz, fixed center frequency, stop frequency ≤3 GHz, average of 100 measurements.
- d. Factory preset, auto align Off, RBW = 1 MHz, span= 20 MHz, stop frequency ≤3 GHz, center frequency tune step size = 50 MHz.

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| Data Storage | | |
| Internal | | 200 Traces or States |
| External (10 to 40 °C) 3.5" 1.44 MB, MS-DOS® compatible floppy disk | | 200 Traces or States |

| | Specifications | Supplemental Information |
|----------------------------------|-----------------------|--|
| Demod Tune and Listen | | |
| Demod <i>(Option A4J)</i> | AM | Internal speaker, front-panel earphone jack and front-panel volume control. An uncalibrated demodulated signal is available on the AUX VIDEO OUT connector at the rear panel. |

| | Specifications | Supplemental Information |
|---------------------------------|-----------------------|-----------------------------------|
| Weight (without options) | | |
| Net | | 17.1 kg (37.7 lb), characteristic |
| Shipping | | 29.0 kg (64 lb), characteristic |

Agilent E4408B Specifications and Characteristics
General



Inputs and Outputs

Front Panel

| | Specifications | Supplemental Information |
|--|-------------------------------|--------------------------|
| INPUT 50 Ω Connector <i>(Option BAB)</i> Impedance | Type-N female APC 3.5 male | 50 Ω , nominal |

| | Specifications | Supplemental Information |
|--|----------------|--------------------------|
| RF OUT 50 Ω, (Option 1DN) Connector Impedance | Type-N female | 50 Ω , nominal |

| | Specifications | Supplemental Information |
|---|----------------|--|
| AMPTD REF OUT^a Connector Impedance Frequency Frequency Accuracy 50 Ω Amplitude ^c | BNC female | Amplitude Reference 50 Ω , nominal 50 MHz Frequency reference error ^b -20 dBm, nominal |

- Turn the amplitude reference on/off by pressing the keys: **Input/Output**, **Amptd Ref Out**.
- Frequency reference error = (aging rate \times period of time since adjustment + settability + temperature stability).
- The internal amplitude reference actual power is stored internally.

| | Specifications | Supplemental Information |
|---------------------------------------|----------------|--|
| PROBE POWER Voltage/Current | | +15 Vdc, $\pm 7\%$ at 150 mA max., characteristic -12.6 Vdc $\pm 10\%$ at 150 mA max., characteristic |

Agilent E4408B Specifications and Characteristics
Inputs and Outputs

| | Specifications | Supplemental Information |
|---------------------------------|----------------|---|
| EXT KEYBOARD^a | | Used for entering screen titles and filenames only. Interface compatible with most IBM-compatible PC keyboards. |
| Connector | 6-pin mini-DIN | |

a. The feature is not implemented in firmware revisions prior to A.04.00.

| | Specifications | Supplemental Information |
|----------------|----------------|----------------------------------|
| Speaker | | Front panel knob controls volume |

| | Specifications | Supplemental Information |
|------------------|--|--|
| Headphone | | Front panel knob controls volume |
| Connector | 3.5 mm (1/8 inch) miniature audio jack | |
| Power Output | | 0.2 W into 4 Ω , characteristic |

Rear Panel

| | Specifications | Supplemental Information |
|-----------------------|----------------|--------------------------|
| 10 MHz REF OUT | | |
| Connector | BNC female | |
| Impedance | | 50 Ω , nominal |
| Output Amplitude | | >0 dBm, characteristic |

| | Specifications | Supplemental Information |
|-----------------------|-----------------------|---|
| 10 MHz REF IN | | |
| Connector | BNC female | Note: Analyzer noise sidebands and spurious response performance may be affected by the quality of the external reference used. |
| Impedance | | 50 Ω , nominal |
| Input Amplitude Range | | -15 to +10 dBm, characteristic |
| Frequency | | 10 MHz, nominal |

| | Specifications | Supplemental Information |
|------------------------------|-----------------------|---|
| GATE TRIG/EXT TRIG IN | | |
| Connector | BNC female | |
| External Trigger Input | | |
| Trigger Level | | Selectable positive or negative edge initiates sweep in EXT TRIG mode (5 V TTL) |

| | Specifications | Supplemental Information |
|------------------------|-----------------------|---------------------------------------|
| GATE/HI SWP OUT | | |
| Connector | BNC female | |
| High Sweep Output | | |
| Level | | High = sweep; Low = retrace (5 V TTL) |

| | Specifications | Supplemental Information |
|-------------------|-----------------------------------|---|
| VGA OUTPUT | | |
| Connector | VGA compatible, 15-pin mini D-SUB | |
| Format | | VGA (31.5 kHz horizontal, 60 Hz vertical sync rates, non-interlaced) Analog RGB |
| Resolution | 640 \times 480 | |

Agilent E4408B Specifications and Characteristics
Inputs and Outputs

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| AUX IF OUT <i>(Option A4J)</i> Connector Frequency Amplitude Range (for signal at reference level and for reference levels – input attenuation of –10 to –70 dBm) Impedance | BNC female | 21.4 MHz, nominal –10 dBm (uncorrected), characteristic 50 Ω nominal |

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| AUX VIDEO OUT <i>(Option A4J)</i> Connector Amplitude Range (into >10 kΩ) | BNC female | 0 to 1 V (uncorrected), characteristic |

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| HI SWP IN <i>(Option A4J)</i> Connector Input | BNC female | Open collector, low resets and holds the sweep (5 V TTL) |

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------------|
| HI SWP OUT <i>(Option A4J)</i> Connector Output | BNC female | High = sweep, Low = retrace (5 V TTL) |

| | Specifications | Supplemental Information |
|---|-----------------------|------------------------------------|
| SWP OUT <i>(Option A4J)</i> Connector Amplitude | BNC female | 0 to +10 V ramp, characteristic |

| | Specifications | Supplemental Information |
|---|-----------------------|---|
| PRESEL TUNE OUTPUT Connector Load Impedance (dc coupled) Range Sensitivity | BNC female | > 10 k Ω , nominal 0 to +10 V, characteristic 0.33 V/GHz of tuned frequency > 3 GHz, characteristic |

| | Specifications | Supplemental Information |
|---|------------------------|---|
| GPIO Interface <i>(Option A4H)</i> Connector GPIO Codes | IEEE-488 bus connector | SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3 and C28 |

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| Serial Interface <i>(Option 1AX)</i> Connector | 9-pin D-SUB male | RS-232 |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| Parallel Interface <i>(Option A4H or 1AX)</i> Connector | 25-pin D-SUB female | Printer port only |

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 (if accompanied by a year, it is the year when the design was proven).



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)

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 products

Product Name: Spectrum Analyzer

Model Number: HP E4401B, HP E4402B, HP E4403B,
HP E4404B, HP E4405B, HP E4407B,
HP E4408B, HP E4411B

Product Options: This declaration covers all options of the above products.

Conform 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 products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.



Santa Rosa, CA, USA 4 Feb. 2000

Greg Pfeiffer/Quality Engineering Manager

For further information, please contact your local Agilent Technologies sales office, agent or distributor.

About This Chapter

This chapter contains specifications and characteristics for the E4411B spectrum analyzer. The distinction between specifications and characteristics is described as follows.

- Specifications describe the performance of parameters covered by the product warranty. (The temperature range is 0 °C to 55 °C, unless otherwise noted.)
- Characteristics describe product performance that is useful in the application of the product, but is not covered by the product warranty.
- Typical performance describes additional product performance information that is not covered by the product warranty. It is performance beyond an indicated specification, that most units will exhibit.
- Nominal values indicate the expected, but not warranted, value of a parameter.

The following conditions must be met for the analyzer to meet its specifications.

- The analyzer is within the one year calibration cycle.
- If **Auto Align All** is selected:
 - After 2 hours of storage within the operating temperature range.
 - 5 minutes after the analyzer is turned on with sweep times less than 4 seconds.
- If **Auto Align Off** is selected:
 - When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.
 - After the analyzer is turned on for a minimum of 90 minutes, and **Align Now All** has been run.
 - When **Align Now All** is run:
 - Every hour
 - If the ambient temperature changes more than 3 °C
 - If the 10 MHz reference changes

- If **Auto Align All but RF** is selected:
 - When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.
 - After the analyzer is turned on for a minimum of 90 minutes, and **Align Now RF** has been run.
 - When **Align Now RF** is run:
 - Every hour
 - If the ambient temperature changes more than 3 °C

Frequency

| | Specifications | Supplemental Information |
|--------------------------|------------------|--------------------------|
| Frequency Range | | |
| 50 Ω | 9 kHz to 1.5 GHz | |
| 75 Ω (Option 1DP) | 1 MHz to 1.5 GHz | |

| | Specifications | Supplemental Information |
|----------------------------|------------------------------|---|
| Frequency Reference | | |
| Aging Rate | $\pm 2 \times 10^{-6}$ /year | $\pm 1.0 \times 10^{-7}$ /day, characteristic |
| Settability | $\pm 5 \times 10^{-7}$ | |
| Temperature Stability | $\pm 5 \times 10^{-6}$ | |

| | Specifications | Supplemental Information |
|-----------------------------------|--|--------------------------|
| Frequency Readout Accuracy | | |
| (Start, Stop, Center, Marker) | \pm ((frequency indication \times frequency reference error ^a) + 0.75% of span + 15% of RBW + 10 Hz) | |

a. Frequency reference error = (aging rate \times period of time since adjustment + settability + temperature stability).

| | Specifications | Supplemental Information |
|---------------------------------|---|--------------------------|
| Marker Frequency Counter | | |
| Resolution | Selectable from 1 Hz to 100 kHz | |
| Accuracy ^a | \pm (marker frequency \times frequency reference error ^b + counter resolution) | |

a. Marker level to displayed noise level > 25 dB, RBW/ Span \geq 0.002, frequency offset = 0 Hz.

b. Frequency reference error = (aging rate \times period of time since adjustment + settability + temperature stability).

| | Specifications | Supplemental Information |
|-----------------------|-------------------------------------|---------------------------------|
| Frequency Span | | |
| Range | 0 Hz (zero span), 100 Hz to 1.5 GHz | |
| Resolution | 2 Hz | |
| Accuracy | ±1.0% of span | |

| | Specifications | Supplemental Information |
|--|---|--|
| Sweep Time | | |
| Range | 4 ms to 4000 s ^a | |
| Tracking Generator On (Option 1DN or 1DQ) | | 50 ms is the minimum sweep time |
| 4 ms to 4000 s ^a | ±1% | |
| Sweep Trigger ^b | Free Run, Single, Line, Video, External, Delayed, Offset ^c | |
| Delayed Trigger ^d | | |
| Range | 1 μs to 400 s | |
| Resolution | $\frac{\text{delay in seconds}}{65000}$ rounded up to nearest μs | |
| Accuracy | ±(500 ns +(0.01% of delay)) | |
| Offset Trigger ^c | | |
| Resolution | $\frac{\text{sweep time}}{400}$ | |
| Range | ±320 ms to ±323 ks | Where ST = sweep time $\frac{-32766 \times ST}{400}$ to $\frac{32365 \times ST}{400}$ |

- a. For firmware revisions prior to A.04.00, 5 ms to 2000 s.
- b. Auto align is suspended in video, external, and delayed trigger modes while waiting for a trigger event to occur.
- c. For firmware revision A.04.00 or later.
- d. Delayed trigger is available with line and external trigger.

| | Specifications | Supplemental Information |
|-----------------------------|-----------------------|---------------------------------|
| Sweep (trace) Points | 401 | |

Agilent E4411B Specifications and Characteristics
Frequency

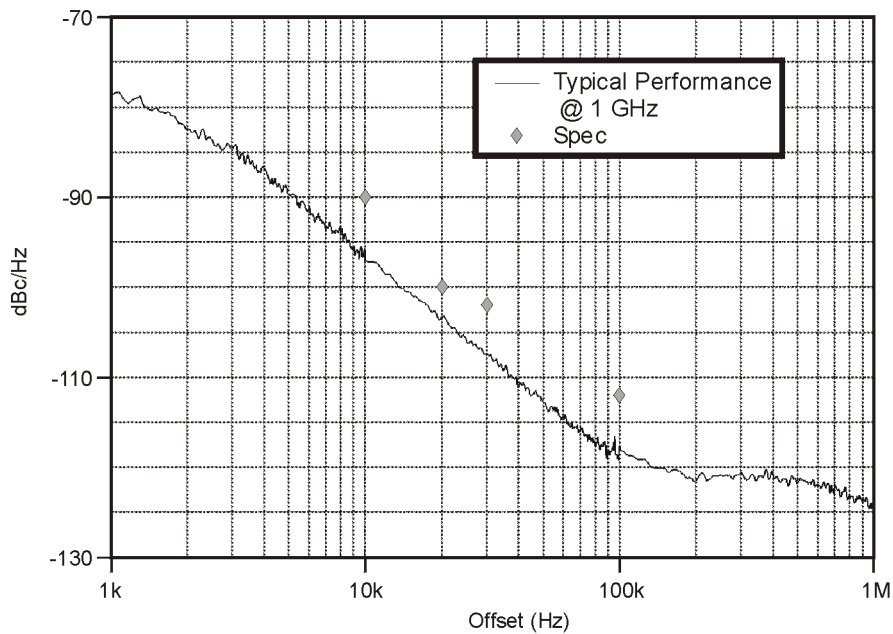
| | Specifications | Supplemental Information |
|---|---|---|
| <p>Resolution Bandwidth (RBW)</p> <p>Range</p> <p> –3 dB bandwidth</p> <p> –6 dB bandwidth (EMI)</p> <p>Accuracy</p> <p> 1 kHz to 3 MHz RBW</p> <p> 5 MHz RBW</p> <p>Shape</p> <p> 1 kHz to 5 MHz RBW</p> <p>Selectivity (60 dB/3 dB bandwidth ratio)</p> <p> 1 kHz to 5 MHz RBW</p> | <p>1 kHz to 3 MHz, in 1-3-10 sequence, 5 MHz</p> <p>9 kHz and 120 kHz</p> <p>±15%</p> <p>±30%</p> | <p>Synchronously tuned four poles, approximately Gaussian shape</p> <p><15:1, characteristic</p> |

| | Specifications | Supplemental Information |
|---|--|---|
| <p>Video Bandwidth (VBW) (–3 dB)</p> <p>Range</p> <p>Accuracy</p> <p>Shape</p> | <p>30 Hz to 1 MHz in 1-3-10 sequence</p> | <p>3 MHz, characteristic</p> <p>±30%, characteristic</p> <p>Post detection, single pole low-pass filter used to average displayed noise</p> |

| | Specifications | Supplemental Information |
|---|---|--------------------------|
| <p>Stability</p> <p>Noise Sidebands (Offset from CW signal with 1 kHz RBW, 30 Hz VBW and sample detector)</p> <p> ≥10 kHz</p> <p> ≥20 kHz</p> <p> ≥30 kHz</p> | <p>≤ –90 dBc/Hz</p> <p>≤ –100 dBc/Hz</p> <p>≤ –102 dBc/Hz</p> | |

| | Specifications | Supplemental Information |
|--|---|--------------------------|
| ≥ 100 kHz Residual FM 1 kHz RBW, 1 kHz VBW System-Related Sidebands, offset from CW signal ≥ 30 kHz | ≤ -112 dBc/Hz ≤ 150 Hz p-p in 100 ms ≤ -65 dBc | |

Noise Sidebands Normalized to 1 Hz Versus Offset From Carrier



wl73b

Amplitude

Amplitude specifications do not apply for the negative peak detector mode.

| | Specifications | Supplemental Information |
|--------------------------|---|--------------------------|
| Measurement Range | Displayed Average Noise Level to Maximum Safe Input Level | |
| Input Attenuator Range | 0 to 60 dB, in 5 dB steps | |

| | Specifications | Supplemental Information |
|--|------------------|--|
| Maximum Safe Input Level | | |
| Input attenuator setting ≥ 15 dB | | Signals $> +33$ dBm (2 W) nominal may trigger input protection, which disconnects the input path. (75 Ω : signals $> +79$ dBmV (1 W)) |
| Average Continuous Power or Peak Pulse Power | | |
| 50 Ω | +30 dBm (1 W) | |
| 75 Ω (Option 1DP) | +75 dBmV (0.4 W) | |
| dc | 100 Vdc | dc transients may momentarily trigger input protection |
| Input attenuator setting < 15 dB | | Signals $> +6$ dBm (4 mW) nominal may trigger input protection, which automatically increases input attenuation to 15 dB. (75 Ω : signals $> +61$ dBmV (15 mW)) |
| Average Continuous Power or Peak Pulse Power | | |
| 50 Ω | +3 dBm (2 mW) | |
| 75 Ω (Option 1DP) | +59 dBmV (10 mW) | |
| dc | 100 Vdc | dc transients may trigger input protection |

| | Specifications | Supplemental Information |
|--|---------------------------------|---------------------------------|
| <p>1 dB Gain Compression</p> <p>Total power at input mixer ^{ab}</p> <p>50 MHz to 1.5 GHz</p> <p>50 Ω</p> <p>75 Ω (<i>Option 1DP</i>)</p> | <p>0 dBm</p> <p>+46.75 dBmV</p> | |

- a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).
- b. For resolution bandwidths 1 kHz to 30 kHz, the maximum input signal amplitude must be ≤ reference level +10 dB. (*Option 1DP: For resolution bandwidths 1 kHz to 30 kHz, the maximum input signal amplitude must be ≤ reference level +5 dB*).

| | Specifications | Supplemental Information |
|--|---|---------------------------------|
| <p>Displayed Average Noise Level</p> <p>(Input terminated, 0 dB attenuation, sample detector, Reference Level = -70 dBm) (75 Ω: Reference Level = -21.24 dBmV)</p> <p>50 Ω</p> <p>400 kHz to 10 MHz</p> <p>10 MHz to 500 MHz</p> <p>500 MHz to 1.0 GHz</p> <p>1.0 GHz to 1.5 GHz</p> <p>75 Ω, (<i>Option 1DP</i>)</p> <p>1 MHz to 10 MHz</p> <p>10 MHz to 500 MHz</p> <p>500 MHz to 1.0 GHz</p> <p>1.0 GHz to 1.5 GHz</p> | <p>1 kHz RBW 30 Hz VBW</p> <p>≤ -115 dBm</p> <p>≤ -119 dBm</p> <p>≤ -117 dBm</p> <p>≤ -113 dBm</p> <p>1 kHz RBW 30 Hz VBW</p> <p>≤ -63 dBmV</p> <p>≤ -65 dBmV</p> <p>≤ -60 dBmV</p> <p>≤ -53 dBmV</p> | |

Agilent E4411B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|----------------------|--|---------------------------------|
| Display Range | | |
| Log Scale | Ten divisions displayed; 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps Calibrated 0 to –85 dB from Reference Level | |
| Linear Scale | Ten divisions | |
| Scale Units | dBm, dBmV, dB μ V, V, and W | |

| | Specifications | Supplemental Information |
|----------------------------------|--------------------------|---------------------------------|
| Marker Readout Resolution | | |
| Log scale | | |
| 0 to –85 dB from ref level | 0.04 dB | |
| Linear scale | 0.01% of Reference Level | |

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| Frequency Response | | |
| 50 Ω , Absolute ^a /Relative | | |
| 9 kHz to 1.5 GHz | | |
| 10 dB attenuation | | |
| 20 to 30 °C | ± 0.5 dB | |
| 0 to 55 °C | ± 1.0 dB | |
| 0 dB, 5 dB, 15 to 60 dB attenuation | | ± 1.0 dB, characteristic |
| 75 Ω , Absolute ^a /Relative (Option 1DP) | | |
| 1 MHz to 1.5 GHz | | |
| 10 dB attenuation | | |
| 20 to 30 °C | ± 0.5 dB | |
| 0 to 55 °C | ± 1.0 dB | |
| 0, 5, 15 to 50 dB attenuation | | ± 1.0 dB, characteristic |

| | Specifications | Supplemental Information |
|---|-----------------------|---|
| 55 to 60 dB attenuation 1 MHz to 1 GHz 1 GHz to 1.5 GHz | | ±1.0 dB, characteristic ±1.25 dB, characteristic |

a. Absolute flatness values are referenced to the amplitude at 50 MHz.

| | Specifications | Supplemental Information |
|---|--|---------------------------------|
| Input Attenuation Switching Uncertainty at 50 MHz Attenuator Setting 0 dB to 5 dB 10 dB 15 dB 20 to 60 dB attenuation | ±0.3 dB Reference ±0.3 dB ±(0.1 dB + 0.01 × Attenuator Setting) | |

| | Specifications | Supplemental Information |
|--|---|---------------------------------|
| Absolute Amplitude Accuracy At reference settings ^a Overall Amplitude Accuracy ^b 20 to 30 °C | ±0.4 dB ± (0.6 dB + Absolute Frequency Response) | |

- a. Settings are: reference level -25 dBm; (75 Ω reference level +28.75 dBmV); input attenuation 10 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, signal at reference level.
- b. For reference level 0 to -50 dBm; input attenuation 10 dB; RBW 1 kHz; VBW 1 kHz; scale log, log range 0 to -50 dB from reference level; sweep time coupled; signal input 0 to -50 dBm; span ≤20 kHz.

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| RF Input VSWR (at tuned frequency) Attenuator setting 50 Ω 0 to 5 dB attenuation | | ≤1.55:1, characteristic |

Agilent E4411B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| 10 to 60 dB attenuation 75 Ω 1 MHz to 1.1 GHz 0 to 5 dB attenuation 10 to 60 dB attenuation 1.1 GHz to 1.5 GHz 0 to 60 dB attenuation Input protection is tripped Amptd Ref is On Auto Align All is selected | | ≤1.35:1, characteristic ≤1.55:1, characteristic ≤1.35:1, characteristic ≤2.0:1, characteristic Open input, characteristic Open input, characteristic Open input momentarily during retrace, characteristic |

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| Auto Alignment^a Sweep-to-sweep variation | | ±0.1 dB, characteristic |

a. Set Auto Align to Off and use Align Now, All to eliminate this variation.

| | Specifications | Supplemental Information |
|---|---|---------------------------------|
| Resolution Bandwidth Switching Uncertainty (at Reference Level) 1 kHz RBW 3 kHz to 3 MHz RBW 5 MHz RBW | Reference ±0.3 dB ±0.6 dB | |

| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| Reference Level Range Resolution Log Scale Linear Scale | -149.9 dBm to maximum mixer level + attenuator setting ±0.1 dB ±0.12% of Reference Level | |

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| <p>50 Ω Accuracy (at a fixed frequency, a fixed attenuator, and referenced to -35 dBm)</p> <p>Reference Level (dBm) – input attenuator setting (dB)</p> <p style="padding-left: 20px;">-10 dBm to > -60 dBm ± 0.3 dB</p> <p style="padding-left: 20px;">-60 dBm to > -85 dBm ± 0.5 dB</p> <p style="padding-left: 20px;">-85 dBm to -90 dBm ± 0.7 dB</p> <p>75 Ω (<i>Option 1DP</i>), Accuracy (at a fixed frequency, a fixed attenuator, and referenced to 18.75 dBmV)</p> <p>Reference Level (dBmV) – input attenuator setting (dB)</p> <p style="padding-left: 20px;">38.75 dBmV to > -11.25 dBmV ± 0.3 dB</p> <p style="padding-left: 20px;">-11.25 dBmV to > -26.25 dBmV ± 0.5 dB</p> <p style="padding-left: 20px;">-26.25 dBmV to -41.25 dBmV ± 0.7 dB</p> | | |

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| <p>Display Scale Switching Uncertainty</p> <p>Switching between Linear and Log ± 0.15 dB at Reference Level</p> <p>Log Scale Switching No error</p> | | |

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| <p>Display Scale Fidelity</p> <p>Log Maximum Cumulative</p> <p style="padding-left: 20px;">0 to -85 dB from Reference Level $\pm(0.3 \text{ dB} + 0.01 \times \text{dB from Reference Level})$</p> <p>Log Incremental Accuracy</p> <p style="padding-left: 20px;">0 to -80 dB from reference level ± 0.4 dB/4 dB</p> | | |

Agilent E4411B Specifications and Characteristics
Amplitude

| | Specifications | Supplemental Information |
|-----------------|------------------------------|---------------------------------|
| Linear Accuracy | $\pm 2\%$ of Reference Level | |

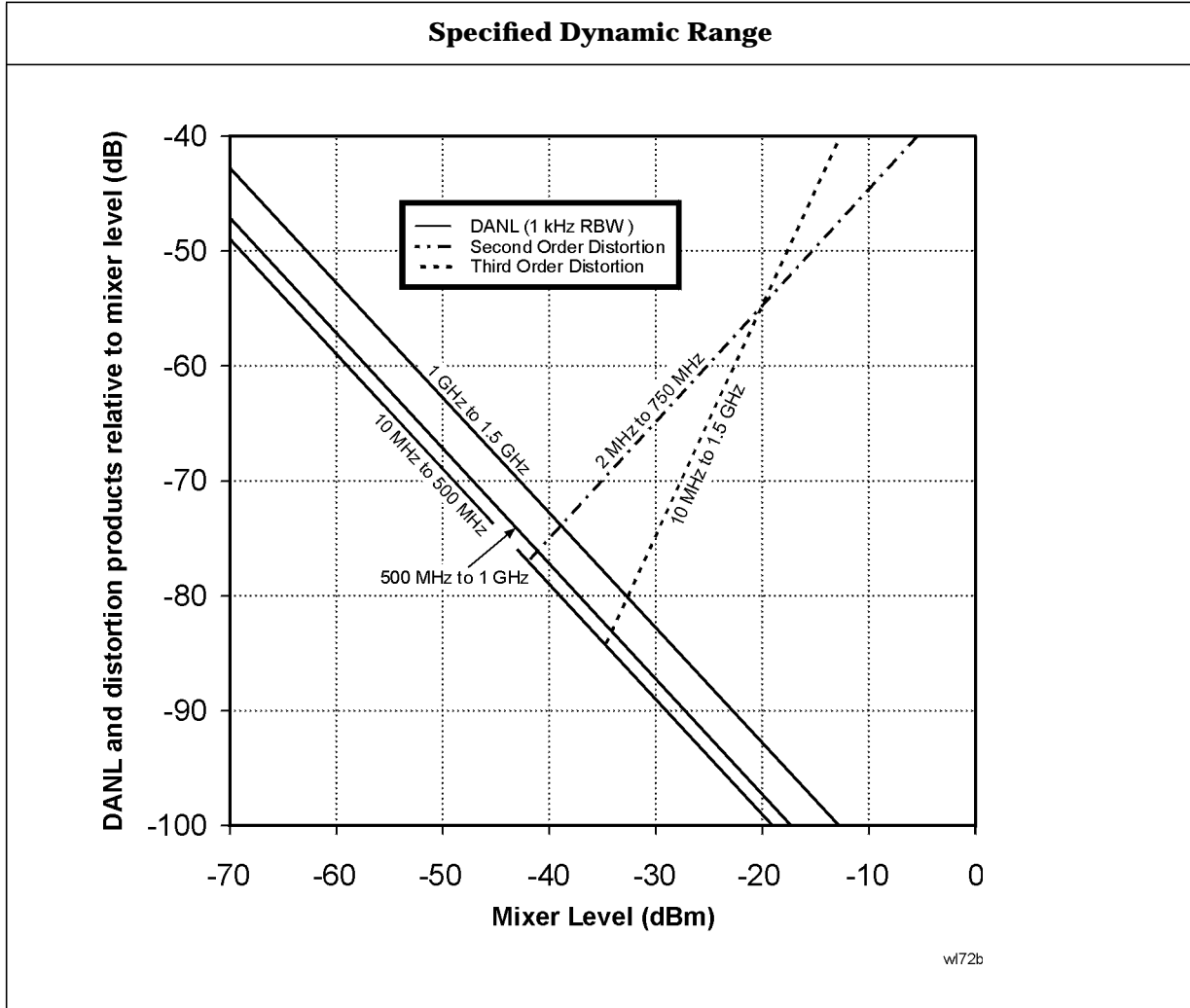
| | Specifications | Supplemental Information |
|--|---|--|
| Spurious Responses 50 Ω Second Harmonic Distortion Input Signal 2 MHz to 750 MHz | < -75 dBc for -40 dBm signal at input mixer. ^a | $+35$ dBm SHI (second harmonic intercept) |
| Third Order Intermodulation Distortion 2 MHz to 10 MHz | < -75 dBc for two -30 dBm signals at input mixer ^a and >50 kHz separation. | $+5$ dBm TOI (third order intercept), characteristic |
| 10 MHz to 1.5 GHz | < -75 dBc for two -30 dBm signals at input mixer ^a and >50 kHz separation. | $+7.5$ dBm TOI |
| Other Input Related Spurious 30 kHz \leq offset ≤ 1200 MHz | < -65 dBc for -20 dBm signals at input mixer ^a ≤ 1.5 GHz. | |
| Offset >1200 MHz | < -45 dBc for -20 dBm signal at input mixer ^a ≤ 1.5 GHz. | |
| Noise Floor Degradation Input frequency = 1210.7 MHz \pm RBW | | < -62 dBc for -45 dBm signal at input mixer ^a |

a. Mixer Power Level (dBm) = Input Power (dBm) – Input Attenuation (dB).

| | Specifications | Supplemental Information |
|---|--|---------------------------------|
| Spurious Responses 75 Ω , (Option 1DP) Second Harmonic Distortion Input signal 2 MHz to 750 MHz | < -75 dBc for $+8.75$ dBmV signal at input mixer. ^a | |

| | Specifications | Supplemental Information |
|---|---|--|
| Third Order Intermodulation Distortion 10 MHz to 1.5 GHz | < -75 dBc for two +18.75 dBmV signals at input mixer ^a and >50 kHz separation. | |
| Other Input Related Spurious 30 kHz \leq offset ≤ 1200 MHz | < -65 dBc for +28.75 dBmV signal at input mixer ^a ≤ 1.5 GHz. | |
| Offset >1200 MHz | < -45 dBc, for +28.75 dBmV signal at input mixer ^a ≤ 1.5 GHz. | |
| Noise Floor Degradation Input frequency = 1210.7 MHz \pm RBW | | < -62 dBc, for +3.75 dBmV signal at input mixer ^a |

a. Mixer Power Level (dBm) = Input Power (dBm) – Input Attenuation (dB)



| | Specifications | Supplemental Information |
|--|--|---------------------------------|
| <p>Residual Responses (Input terminated and 0 dB attenuation)</p> <p>50 Ω</p> <p>150 kHz to 1.5 GHz</p> <p>75 Ω, (Option 1DP)</p> <p>1 MHz to 1.5 GHz</p> | <p>< -90 dBm</p> <p>< -36 dBmV</p> | |

Options

Tracking Generator (Option 1DN or 1DQ)

| | Specifications | Supplemental Information |
|----------------|----------------|--------------------------|
| Warm-Up | 5 minutes | |

| | Specifications | Supplemental Information |
|-------------------------------|------------------|--------------------------|
| Output Frequency Range | | |
| 50 Ω (Option 1DN) | 9 kHz to 1.5 GHz | |
| 75 Ω (Option 1DQ) | 1 MHz to 1.5 GHz | |

| | Specifications | Supplemental Information |
|---|---|--------------------------|
| Output Power Level | | |
| 20 to 30 °C | | |
| Range | | |
| 50 Ω (Option 1DN) | 0 to -70 dBm | |
| 75 Ω (Option 1DQ) | +42.75 to -27.25 dBmV | |
| Resolution | 0.1 dB | |
| Absolute Accuracy (at 50 MHz with coupled source attenuator) | | |
| 50 Ω (Option 1DN) referenced to 0 dBm | ± 0.5 dB | |
| 75 Ω (Option 1DQ) referenced to +42.75 dBmV | ± 1.5 dB | |
| Vernier | | |
| Range | 10 dB | |
| Accuracy (with coupled source attenuator) | | |
| 50 Ω (Option 1DN) referenced to 0 dBm | ± 0.75 dB, for 0 to -10 dBm | |
| 75 Ω (Option 1DQ) referenced to 42.75 dBmV | ± 0.9 dB, for +42.75 to +32.75 dBmV | |
| Output Attenuator Range | 0 to 60 dB in 10 dB steps | |

Agilent E4411B Specifications and Characteristics
Options

| | Specifications | Supplemental Information |
|---|----------------|---|
| Maximum Safe Reverse Level 50 Ω (Option 1DN) ^a 75 Ω (Option 1DQ) ^a | | +20 dBm (0.1 W), 100 Vdc, characteristic +69 dBmV (0.1 W), 100 Vdc, characteristic |

a. dc transients may trigger reverse power protection.

| | Specifications | Supplemental Information |
|---|---|--------------------------|
| Output Power Sweep 20 to 30 °C Range 50 Ω (Option 1DN) 75 Ω (Option 1DQ) Resolution Accuracy (zero span) 50 Ω (Option 1DN) 75 Ω (Option 1DQ) | (–15 to 0 dBm) – (Source Attenuator Setting) (27.75 to 42.75 dBmV) – (Source Attenuator Setting) 0.1 dB <1.5 dB peak-to-peak <1.8 dB peak-to-peak | |

| | Specifications | Supplemental Information |
|---|--|--------------------------|
| Output Flatness Referenced to 50 MHz, 0 dB attenuator 50 Ω (Option 1DN) 9 kHz to 10 MHz 10 MHz to 1.5 GHz 75 Ω (Option 1DQ) 1 MHz to 10 MHz 10 MHz to 1.5 GHz | ±2 dB ±1.5 dB ±2.5 dB ±2 dB | |

| | Specifications | Supplemental Information |
|--|---|---------------------------------|
| Spurious Outputs 50 Ω (<i>Option 1DN</i>) (0 dBm output), 75 Ω (<i>Option 1DQ</i>) (+42.75 dBmV output) Harmonic Spurs 9 kHz to 20 MHz 20 MHz to 1.5 GHz Non-harmonic Spurs | < -20 dBc < -25 dBc < -35 dBc | |

| | Specifications | Supplemental Information |
|----------------------|--|---------------------------------|
| Dynamic Range | Maximum Output Power Level – Displayed Average Noise Level | |

| | Specifications | Supplemental Information |
|---|-----------------------|---|
| Output Tracking Drift Swept Tracking Error | | No error No error for coupled sweep times |

| | Specifications | Supplemental Information |
|---|-----------------------|---|
| RF Power-Off Residuals 50 Ω (<i>Option 1DN</i>) 100 kHz to 1.5 GHz 75 Ω (<i>Option 1DQ</i>) 1 MHz to 1.5 GHz | | < -120 dBm, characteristic < 65 dBmV, characteristic |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| Output Attenuator Repeatability | | ± 0.2 dB, characteristic |

| | Specifications | Supplemental Information |
|--------------------------|----------------|--------------------------|
| Output VSWR | | |
| 50 Ω (Option 1DN) | | <2.5:1, characteristic |
| 75 Ω (Option 1DQ) | | <2.0:1, characteristic |

| | Specifications | Supplemental Information |
|-----------------------------------|----------------|------------------------------|
| Output Attenuator Accuracy | | |
| 0 dB | Reference | |
| 10 dB | | ± 0.6 dB, characteristic |
| 20 dB | | ± 0.9 dB, characteristic |
| 30 dB | | ± 1.2 dB, characteristic |
| 40 dB | | ± 1.5 dB, characteristic |
| 50 dB | | ± 1.8 dB, characteristic |
| 60 dB | | ± 2.1 dB, characteristic |

Tracking Generator Output Accuracy 50 Ω (Option 1DN)

Relative Accuracy (Referred to 0 dBm) =
Output Attenuator Accuracy + Vernier Accuracy + Output Flatness

Absolute Accuracy =
Relative Accuracy (Referred to 0 dBm) + Absolute Accuracy at 50 MHz

Tracking Generator Output Accuracy 75 Ω (Option 1DQ)

Relative Accuracy (Referred to +42.75 dBmV) =
Output Attenuator Accuracy + Vernier Accuracy + Output Flatness

Absolute Accuracy =
Relative Accuracy (Referred to +42.75 dBmV) + Absolute Accuracy at 50 MHz

General

| | Specifications | Supplemental Information |
|--------------------------|----------------|--------------------------|
| Temperature Range | | |
| Operating | 0 to 55 °C | Floppy disk 10 to 40 °C |
| Storage | -40 to 75 °C | |

| | Specifications | Supplemental Information |
|---------------------------------|----------------|----------------------------|
| Audible Noise (ISO 7779) | | |
| Sound Pressure at 25 °C | | <40 dBa, (<4.6 Bels power) |

| | Specifications | Supplemental Information |
|-------------------------------|---|--------------------------|
| Military Specification | Has been type tested to the environmental specifications of MIL-PRF-28800F class 3. | |

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

| | Specifications | Supplemental Information |
|-------------------------|----------------|--|
| Immunity Testing | | |
| Radiated Immunity | | Testing was done at 3 V/m according to IEC 801-3/1984. When the analyzer tuned frequency is identical to the immunity test signal frequency there may be signals of up to -60 dBm displayed on the screen. |
| Electrostatic Discharge | | Air discharges of up to 8 kV were applied according to IEC 801-2/1991. Discharges to center pins of any of the connectors may cause damage to the associated circuitry. |

| | Specifications | Supplemental Information |
|----------------------------|--|---|
| Power Requirements | | Uses CUKonverter® topology in the power supply. |
| ac Operation | | |
| Voltage, frequency | 90 to 132 V rms, 47 to 440 Hz 195 to 250 V rms, 47 to 66 Hz | |
| Power Consumption, On | <300 W | |
| Power Consumption, Standby | <5 W | |
| dc Operation | | |
| Voltage | 12 to 20 Vdc | |
| Power Consumption | <200 W | |

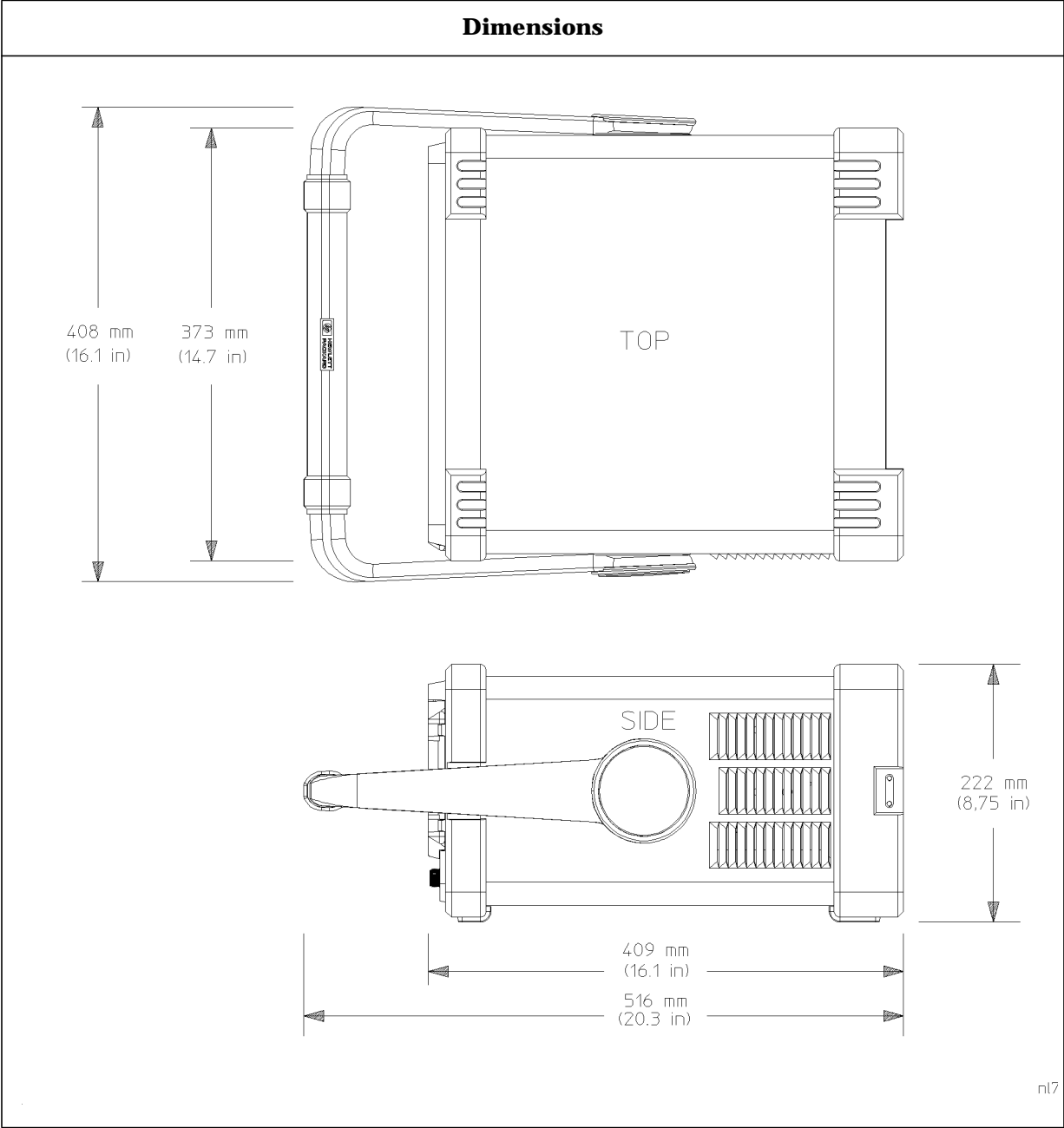
| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| Measurement Speed | | |
| Local Measurement and Display Update rate ^{ab} | | ≥ 35/s, characteristic |
| Remote Measurement and GPIB Transfer Rate ^{bcd} (Option A4H) | | ≥ 30/s, characteristic |
| RF Center Frequency Tune, Measure, and GPIB Transfer Time ^{bce} (Option A4H) | | ≤ 90 ms, characteristic |

- a. Factory preset, auto align Off, fixed center frequency, RBW = 1 MHz, and span ≤400 MHz.
- b. Sweeping through 425.6 MHz or 914.6 MHz will cause measurement speed to degrade
- c. Display Off (:DISPlay:ENABle OFF), and 32-bit integer data format (:FORMat:DATA INT,32), if Option A4J is installed, disable sweep ramp, (:SYSTem:PORTs:IFVSweep:ENABle OFF), markers off, markers Off, single sweep, measured with IBM compatible PC with 550 MHz Pentium® III running Windows® NT 4.0, one meter GPIB cable, National Instruments PCI-GPIB card and NI-48.2 DLL.
- d. Factory preset, auto align Off, RBW = 1 MHz, span= 20 MHz, fixed center frequency, average of 100 measurements.
- e. Factory preset, auto align Off, RBW = 1 MHz, span= 20 MHz, and center frequency tune step size = 50 MHz.

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| Data Storage | | |
| Internal | | 200 Traces or States |
| External (10 to 40 °C) 3.5" 1.44 MB, MS-DOS® compatible floppy disk | | 200 Traces or States |

| | Specifications | Supplemental Information |
|----------------------------------|-----------------------|--|
| Demod Tune and Listen | | |
| Demod <i>(Option A4J)</i> | AM | Internal speaker, front-panel earphone jack and front-panel volume control. An uncalibrated demodulated signal is available on the AUX VIDEO OUT connector at the rear panel. |

| | Specifications | Supplemental Information |
|---------------------------------|-----------------------|-----------------------------------|
| Weight (without options) | | |
| Net | | 13.2 kg (29.1 lb), characteristic |
| Shipping | | 25.1 kg (55.4 lb), characteristic |



Inputs and Outputs

Internal

| | Specifications | Supplemental Information |
|---|----------------|--|
| Amptd Ref^a | | Amplitude reference |
| Frequency | | 50 MHz |
| Frequency Accuracy | | Frequency reference error ^b |
| 50 Ω Amplitude | | -25 dBm ^c , nominal |
| 75 Ω Amplitude (<i>Option 1DP</i>) | | +28.75 dBmV ^c , nominal |

- a. Turn the amplitude reference signal on/off by pressing the keys: **Input/Output**, **Amptd Ref**.
- b. Frequency reference error = (aging rate \times period of time since adjustment + settability + temperature stability).
- c. The internal amplitude reference actual power is stored internally.

Front Panel

| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| INPUT 50 Ω | | |
| Connector | Type-N female | |
| Impedance | | 50 Ω , nominal |
| INPUT 75 Ω (<i>Option 1DP</i>) | | |
| Connector | BNC female | |
| Impedance | | 75 Ω , nominal |

| | Specifications | Supplemental Information |
|---|----------------|--------------------------|
| RF OUT 50 Ω, (<i>Option 1DN</i>) | | |
| Connector | Type-N female | |
| Impedance | | 50 Ω , nominal |
| RF OUT 75 Ω, (<i>Option 1DQ</i>) | | |
| Connector | BNC female | |
| Impedance | | 75 Ω , nominal |

| | Specifications | Supplemental Information |
|---------------------------------------|----------------|--|
| PROBE POWER Voltage/Current | | +15 Vdc, $\pm 7\%$ at 150 mA max., characteristic -12.6 Vdc $\pm 10\%$ at 150 mA max., characteristic |

| | Specifications | Supplemental Information |
|--|----------------|---|
| EXT KEYBOARD^a Connector | 6-pin mini-DIN | Used for entering screen titles and filenames only. Interface compatible with most IBM-compatible PC keyboards. |

a. The feature is not implemented in firmware revisions prior to A.04.00.

| | Specifications | Supplemental Information |
|----------------|----------------|----------------------------------|
| Speaker | | Front panel knob controls volume |

| | Specifications | Supplemental Information |
|---|--|--|
| Headphone Connector Power Output | 3.5 mm (1/8 inch) miniature audio jack | Front panel knob controls volume 0.2 W into 4 Ω , characteristic |

Rear Panel

| | Specifications | Supplemental Information |
|---|----------------|---|
| 10 MHz REF OUT Connector Impedance Output Amplitude | BNC female | 50 Ω , nominal >0 dBm, characteristic |

| | Specifications | Supplemental Information |
|-----------------------|-----------------------|---|
| 10 MHz REF IN | | |
| Connector | BNC female | Note: Analyzer noise sidebands and spurious response performance may be affected by the quality of the external reference used. |
| Impedance | | 50 Ω , nominal |
| Input Amplitude Range | | -15 to +10 dBm, characteristic |
| Frequency | | 10 MHz, nominal |

| | Specifications | Supplemental Information |
|------------------------------|-----------------------|---|
| GATE TRIG/EXT TRIG IN | | |
| Connector | BNC female | |
| External Trigger Input | | |
| Trigger Level | | Selectable positive or negative edge initiates sweep in EXT TRIG mode (5 V TTL) |

| | Specifications | Supplemental Information |
|------------------------|-----------------------|---------------------------------------|
| GATE/HI SWP OUT | | |
| Connector | BNC female | |
| High Sweep Output | | |
| Level | | High = sweep; Low = retrace (5 V TTL) |

| | Specifications | Supplemental Information |
|-------------------|-----------------------------------|---|
| VGA OUTPUT | | |
| Connector | VGA compatible, 15-pin mini D-SUB | |
| Format | | VGA (31.5 kHz horizontal, 60 Hz vertical sync rates, non-interlaced) Analog RGB |
| Resolution | 640 \times 480 | |

Agilent E4411B Specifications and Characteristics
Inputs and Outputs

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| AUX IF OUT <i>(Option A4J)</i> Connector Frequency Amplitude Range (for signal at reference level and for reference levels – input attenuation of –10 to –70 dBm) Impedance | BNC female | 21.4 MHz, nominal –10 dBm (uncorrected), characteristic 50 Ω nominal |

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| AUX VIDEO OUT <i>(Option A4J)</i> Connector Amplitude Range (into >10 kΩ) | BNC female | 0 to 1 V (uncorrected), characteristic |

| | Specifications | Supplemental Information |
|---|-----------------------|--|
| HI SWP IN <i>(Option A4J)</i> Connector Input | BNC female | Open collector, low resets and holds the sweep (5 V TTL) |

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------------|
| HI SWP OUT <i>(Option A4J)</i> Connector Output | BNC female | High = sweep, Low = retrace (5 V TTL) |

| | Specifications | Supplemental Information |
|---------------------------------------|-----------------------|------------------------------------|
| SWP OUT <i>(Option A4J)</i> | | |
| Connector | BNC female | |
| Amplitude | | 0 to +10 V ramp, characteristic |

| | Specifications | Supplemental Information |
|--|------------------------|---|
| GPIB Interface <i>(Option A4H)</i> | | |
| Connector | IEEE-488 bus connector | |
| GPIB Codes | | SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3 and C28 |

| | Specifications | Supplemental Information |
|--|-----------------------|---------------------------------|
| Serial Interface <i>(Option 1AX)</i> | | |
| Connector | 9-pin D-SUB male | RS-232 |

| | Specifications | Supplemental Information |
|---|-----------------------|---------------------------------|
| Parallel Interface <i>(Option A4H or 1AX)</i> | | Printer port only |
| Connector | 25-pin D-SUB female | |

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 (if accompanied by a year, it is the year when the design was proven).



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)

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 products

Product Name: Spectrum Analyzer

Model Number: HP E4401B, HP E4402B, HP E4403B,
HP E4404B, HP E4405B, HP E4407B,
HP E4408B, HP E4411B

Product Options: This declaration covers all options of the above products.

Conform 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 products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.



Santa Rosa, CA, USA 4 Feb. 2000

Greg Pfeiffer/Quality Engineering Manager

For further information, please contact your local Agilent Technologies sales office, agent or distributor.

