

Specifications Guide

Agilent Technologies ESA Spectrum Analyzers

This manual provides documentation for the following instruments:

Agilent Technologies 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 Technologies ESA-L Series

E4403B (9 kHz - 6.7 GHz)

E4408B (9 kHz - 26.5 GHz)

E4411B (9 kHz - 1.5 GHz)



Agilent Technologies

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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.

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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 Agilent 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 ^a	0 Hz (zero span), 100 Hz to 1.5 GHz 2 Hz $\pm(0.5\% \text{ of span} + 2 \times \frac{\text{span}}{\text{sweep points} - 1})$	

a. Applies to each sweep segment.

	Specifications	Supplemental Information
Sweep Time		
Range		
Span > 0 Hz	1 ms to 4000 s ^a	$\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ to 4000 s
Span = 0 Hz	10 μs to 4000 s ^{ab}	
Tracking Generator On (Option 1DN or 1DQ)		50 ms is the minimum sweep time
Fast Time-domain Sweep (Option AYZ) (For Span = 0 Hz, RBW ≥ 1 kHz)	50 ns to 4000 s ^{cd}	$\frac{\text{sweep points} - 1}{20 \text{ MHz}}$ to 4000 s
Accuracy (Span = 0 Hz)		
10 μs to 4000 s ^{ab}	±1%	
(Option AYZ)	±1%	
50 ns to 4000 s ^{cd}		
Sweep Trigger ^{ef}	Free Run, Single, Line, Video, External, Delayed, Offset ^g	
(Option 1D6)	Add Gate	
(Option B7B)	Add TV	
Delayed Trigger ^{fh}		
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 ^g		
Resolution	$\frac{\text{sweep time}}{\text{sweep points} - 1}$	
Range	±327 ms to ±12.3 ks	Where ST = sweep time and SP = sweep points $\frac{-32766 \times \text{ST}}{\text{SP} - 1}$ to $\frac{(32766 - \text{SP}) \times \text{ST}}{\text{SP} - 1}$

	Specifications	Supplemental Information
Fast Time-domain sweep <i>(Option AYX)</i> (For sweep times $\frac{\text{sweep points} - 1}{20 \text{ MHz}}$ to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$)	±1.23 ms to ±245 ms	$\frac{-32766 \times ST}{SP - 1}$ to $\frac{(32766 - SP) \times ST}{SP - 1}$

- a. For firmware revisions prior to A.04.00, 5 ms to 2000 s.
- b. For firmware revisions prior to A.05.00, 1 ms to 4000 s.
- c. For firmware revisions prior to A.04.00, 20 μs to 2000 s.
- d. For firmware revisions prior to A.05.00, 5 μs to 4000 s.
- e. Gate cannot be used simultaneously with delayed or TV trigger *(Option B7B)*.
- f. Auto align is suspended in video, external, gate, and delayed trigger modes while waiting for a trigger event to occur.
- g. For firmware revision A.04.00 or later.
- h. Delayed trigger is available with line, external trigger, and TV trigger *(Option B7B)*.

	Specifications	Supplemental Information
Sweep (trace) Points Range Span > 0 Hz Span = 0 Hz	 101 to 8192 ^a 2 to 8192 ^{ab}	

- a. For firmware revisions prior to A.04.00, 401 points.
- b. For firmware revisions prior to A.05.00, 101 to 8192 points.

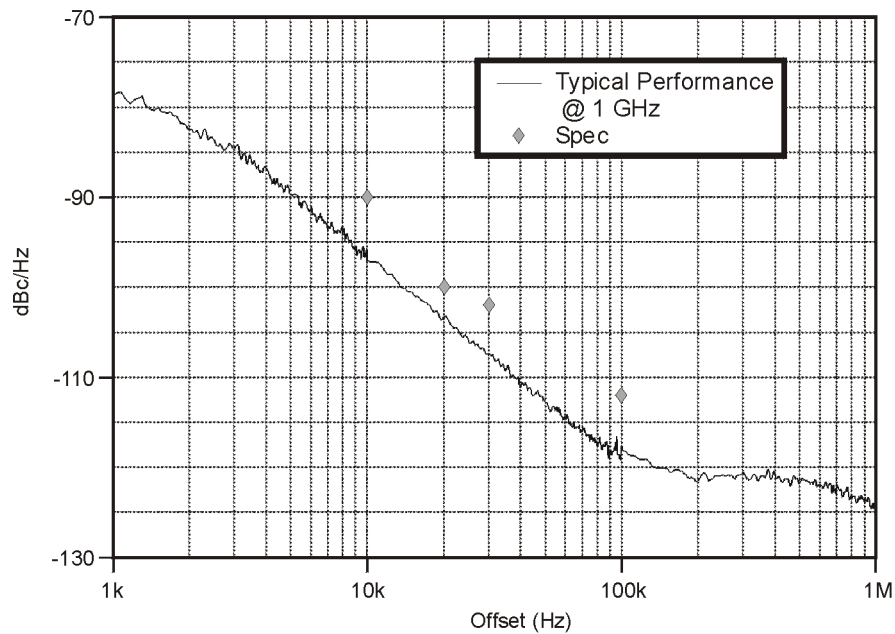
	Specifications	Supplemental Information
Resolution Bandwidth (RBW) Range -3 dB bandwidth -6 dB bandwidth (EMI) <i>(Option 1DR)</i> -3 dB bandwidth -6 dB bandwidth (EMI)	 1 kHz to 3 MHz, in 1-3-10 sequence, 5 MHz 9 kHz and 120 kHz Adds 10, 30, 100, 300 Hz Add 200 Hz	 Only available in spans ≤ 5 MHz, sweep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

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

	Specifications	Supplemental Information
Video Bandwidth (VBW) (-3 dB)		
Range	30 Hz to 1 MHz in 1-3-10 sequence	3 MHz, characteristic
(<i>Option 1DR</i>)	Adds 1, 3, 10 Hz for RBW's <1 kHz	
Accuracy		±30%, characteristic
Shape		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	≤ -100 dBc/Hz	
≥30 kHz	≤ -102 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



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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.
Average Continuous Power or Peak Pulse Power		
50 Ω	+30 dBm (1 W)	
75 Ω (<i>Option 1DP</i>)	+75 dBmV (0.4 W)	75 Ω : signals $> +79$ dBmV (1 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.
Average Continuous Power or Peak Pulse Power		
50 Ω	+3 dBm (2 mW)	
75 Ω (<i>Option 1DP</i>)	+59 dBmV (10 mW)	75 Ω : signals $> +61$ dBmV (15 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 75 Ω (<i>Option 1DP</i>) Preamp On (<i>Option 1DS</i>) Total power at the preamp ^c 50 Ω 75 Ω	0 dBm +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 ≤ 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*).
 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 400 kHz to 10 MHz 10 MHz to 500 MHz 500 MHz to 1.0 GHz 1.0 GHz to 1.5 GHz	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW (<i>Option 1DR</i>)	
	≤ -115 dBm	≤ -134 dBm	
	≤ -119 dBm	≤ -138 dBm	
	≤ -117 dBm	≤ -136 dBm	
	≤ -113 dBm	≤ -132 dBm	

	Specifications		Supplemental Information
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	
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	dBm, dBmV, dB μ V, V, and W	
(Option BAA)	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
<p>Marker Readout Resolution</p> <p>Log scale</p> <p>RBW \geq 1 kHz</p> <p>0 to -85 dB from ref level</p> <p>RBW \leq 300 Hz (<i>Option 1DR</i>)</p> <p>0 to -120 dB from ref level</p> <p>Linear scale</p> <p>Fast Sweep Times for Zero Span</p> <p>(<i>Option AYY</i>)^a</p> <p>For sweep times</p> <p>$\frac{\text{sweep points} - 1}{20 \text{ MHz}}$ to</p> <p>$\frac{\text{sweep points} - 1}{100 \text{ kHz}}$</p> <p>Log</p> <p>0 to -85 dB from ref level</p> <p>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>	

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</p> <p>9 kHz to 1.5 GHz</p> <p>10 dB attenuation</p> <p>20 to 30 °C</p> <p>0 to 55 °C</p> <p>0 dB, 5 dB, 15 to 60 dB attenuation</p>	<p>± 0.5 dB</p> <p>± 1.0 dB</p>	<p>± 1.0 dB, characteristic</p>

	Specifications	Supplemental Information
50 Ω , Absolute ^a /Relative Preamp On (<i>Option 1DS</i>)		
100 kHz to 1.5 GHz		
0 dB attenuation		
20 to 30 °C	± 1.0 dB	
0 to 55 °C	± 1.5 dB	
5 dB to 20 dB attenuation		± 1.5 dB, characteristic
75 Ω , Absolute ^a /Relative (<i>Option 1DP</i>)		
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
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 and 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 (Option 1DS)		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 (Option 1DS)	±0.5 dB	
Overall Amplitude Accuracy ^c		
20 to 30 °C	± (0.54 dB + Absolute Frequency Response)	

- 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.
- 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.
- For reference level 0 to -50 dBm; input attenuation 10 dB; dc coupled; 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 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		$\leq 1.55:1$, characteristic $\leq 1.35:1$, characteristic $\leq 1.55:1$, characteristic $\leq 1.35:1$, characteristic $\leq 2.0:1$, 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 10 Hz to 300 Hz RBW (Option 1DR)	Reference ± 0.3 dB ± 0.6 dB ± 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 (<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	
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>)))		
Reference Level (dBmV) – input attenuator setting (dB) + preamp gain (dB)		
38.75 dBmV to > -11.25 dBmV	±0.3 dB	
-11.25 dBmV to > -26.25 dBmV	±0.5 dB	
-26.25 dBmV to -41.25 dBmV	±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 ≤ 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)

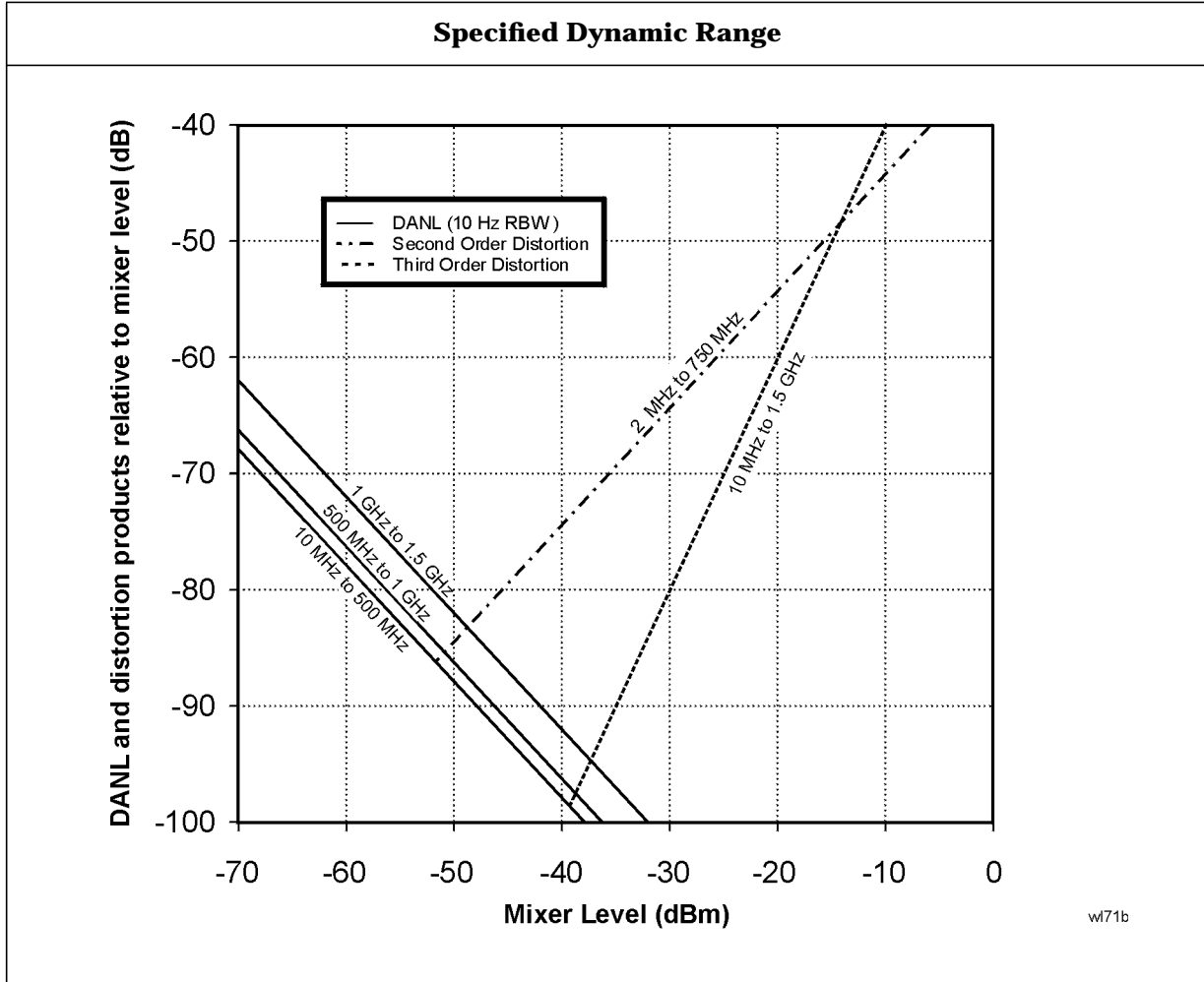
b. 0 to -50 dB for RBWs ≤ 300 Hz and span = 0 Hz, or when auto ranging is off.

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



	Specifications	Supplemental Information
Residual Responses (Input terminated and 0 dB attenuation) 50 Ω 150 kHz to 1.5 GHz 75 Ω , (Option 1DP) 1 MHz to 1.5 GHz	< -90 dBm < -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	± 0.2 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	

	Specifications	Supplemental Information
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	

	Specifications	Supplemental Information
Maximum Safe Reverse Level		
50 Ω (Option 1DN) ^a		+20 dBm (0.1 W), 100 Vdc, characteristic
75 Ω (Option 1DQ) ^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 (Option 1DN)	(-15 to 0 dBm) – (Source Attenuator Setting)	
75 Ω (Option 1DQ)	(27.75 to 42.75 dBmV) – (Source Attenuator Setting)	
Resolution	0.1 dB	
Accuracy (zero span)		
50 Ω (Option 1DN)	<1.5 dB peak-to-peak	
75 Ω (Option 1DQ)	<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 75 Ω (<i>Option 1DQ</i>) 1 MHz to 10 MHz ± 2.5 dB 10 MHz to 1.5 GHz ± 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 dBc 20 MHz to 1.5 GHz < -25 dBc Non-harmonic Spurs < -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 (Option 1DN) 100 kHz to 1.5 GHz 75 Ω (Option 1DQ) 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) 75 Ω (Option 1DQ)		<2.5:1, characteristic <2.0:1, characteristic

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

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, segmented sweep Off, fixed center frequency, RBW = 1 MHz, and spans >102 MHz and ≤400 MHz.
- b. Sweeping through 425.6 MHz or 914.6 MHz will cause the measurement speed to degrade.
- c. 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-488.2 DLL.

- d. Factory preset, auto align Off, segmented sweep 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.

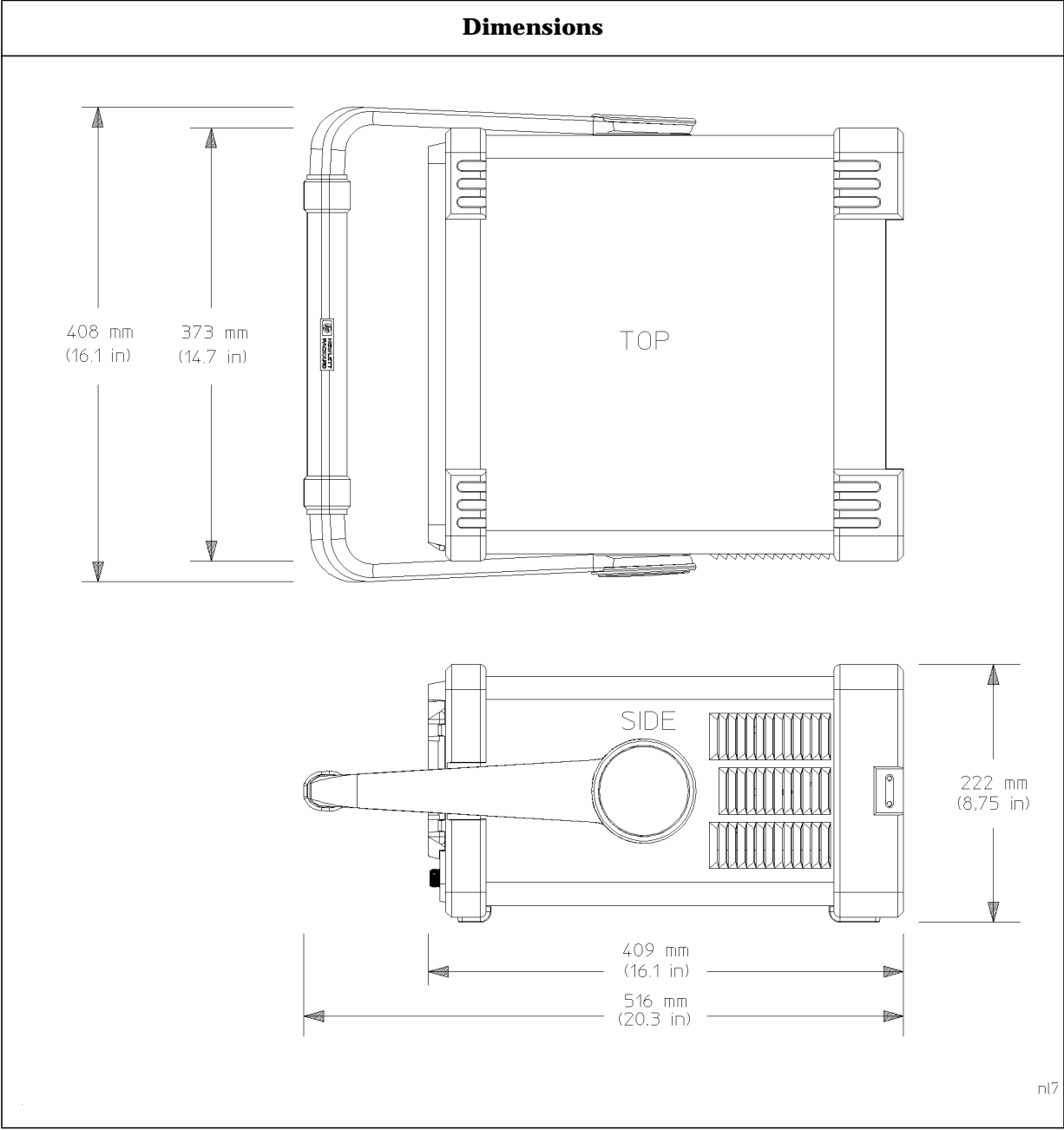
	Specifications	Supplemental Information
Data Storage		
Internal		200 Traces or States ^a
External (10 to 40 °C) 3.5" 1.44 MB, MS-DOS [®] compatible floppy disk		200 Traces or States ^a

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		Internal speaker, front-panel earphone jack and front-panel volume control.
Demod	AM	
<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		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

- Turn the amplitude reference signal on/off by pressing the keys: **Input/Output, Amptd Ref**.
- Frequency reference error = (aging rate \times period of time since adjustment + settability + temperature stability).
- 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)
Gate Trigger Input (Option 1D6)		
Minimum Pulse Width		>30 ns (5 V TTL)

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

a. High sweep may be high longer than the indicated sweep times.

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

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

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

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

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

a. High sweep may be high longer than the indicated sweep times.

	Specifications	Supplemental Information
SWP OUT <i>(Option A4J or AYZ)</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>		
Connector	25-pin D-SUB female	Printer port only

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

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</p> <p>(<i>Option B7B or BAA</i>)</p> <p>Connector</p> <p>Impedance</p> <p>(<i>Option BAA without Option B7B</i>)</p> <p>Amplitude</p> <p>(<i>Option BAA with Option B7B</i>)</p> <p>Amplitude</p> <p>TV Source: SA</p> <p>TV Source and EXT VIDEO IN</p>	<p>BNC female (75 Ω)</p>	<p>Baseband video output</p> <p>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>

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: E4401B, E4402B, E4403B, E4404B,
E4405B, E4407B, E4408B, 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 17 April 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 Agilent 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.
 - When **Align Now All** is run:
 - Every hour

1. 10 °C if Preamp (*Option 1DS*) is active.

- 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 Preamp (*Option 1DS*) is active.

Frequency

	Specifications	Supplemental Information
Frequency Range	9 kHz to 3 GHz	
<i>(Option UKB)</i>		
dc Coupled	100 Hz to 3 GHz	
ac Coupled	100 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 ^a	0 Hz (zero span), 100 Hz to 3 GHz 2 Hz $\pm(0.5\% \text{ of span} + 2 \times \frac{\text{span}}{\text{sweep points} - 1})$	

a. Applies to each sweep segment.

	Specifications	Supplemental Information
Sweep Time		
Range		
Span > 0 Hz	1 ms to 4000 s ^a	$\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ to 4000 s
Span = 0 Hz	10 μs to 4000 s ^{ab}	
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)		
50 ns to 4000 s ^{cd}		
DSP and fast ADC (Option B7D) (For Span = 0 Hz, RBW ≥ 1 kHz)		
25 ns to 4000 s ^e		
Accuracy (Span = 0 Hz)		
10 μs to 4000 s ^{ab}	±1%	
(Option AYX)	±1%	
50 ns to 4000 s ^{cd}		
(Option B7D)	±1%	
25 ns to 4000 s ^e		
Sweep Trigger ^{fg}		
Free Run, Single, Line, Video, External, Delayed, Offset ^h		
(Option 1D6)	Add Gate	
(Option B7B)	Add TV	
Delayed Trigger ^{gi}		
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 ^h		
Resolution		
$\frac{\text{sweep time}}{\text{sweep points} - 1}$		

	Specifications	Supplemental Information
Range	± 327 ms to ± 12.3 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 $\frac{\text{sweep points} - 1}{20 \text{ MHz}}$ to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$)	± 1.23 ms to ± 245 ms	$\frac{-32766 \times ST}{SP - 1}$ to $\frac{(32766 - SP) \times ST}{SP - 1}$
DSP and fast ADC (Option B7D) (For sweep times $\frac{\text{sweep points} - 1}{40 \text{ MHz}}$ to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$)	± 13 ms to ± 5.15 s	$\frac{-524031 \times ST}{SP - 1}$ to $\frac{(524031 - SP) \times ST}{SP - 1}$

- For firmware revisions prior to A.04.00, 5 ms to 2000 s.
- For firmware revisions prior to A.05.00, 1 ms to 4000 s.
- For firmware revisions prior to A.04.00, 20 μ s to 2000 s.
- For firmware revisions prior to A.05.00, 5 μ s to 4000 s.
- For firmware revisions prior to A.05.00, 2.5 μ s to 4000 s.
- Gate cannot be used simultaneously with delayed or TV trigger (Option B7B).
- Auto align is suspended in video, external, gate, and delayed trigger modes while waiting for a trigger event to occur.
- For firmware revision A.04.00 or later.
- Delayed trigger is available with line, external trigger, and TV trigger (Option B7B).

	Specifications	Supplemental Information
Sweep (trace) Points		
Range		
Span > 0 Hz	101 to 8192 ^a	
Span = 0 Hz	2 to 8192 ^{ab}	

- For firmware revisions prior to A.04.00, 401 points.
- For firmware revisions prior to A.05.00, 101 to 8192 points.

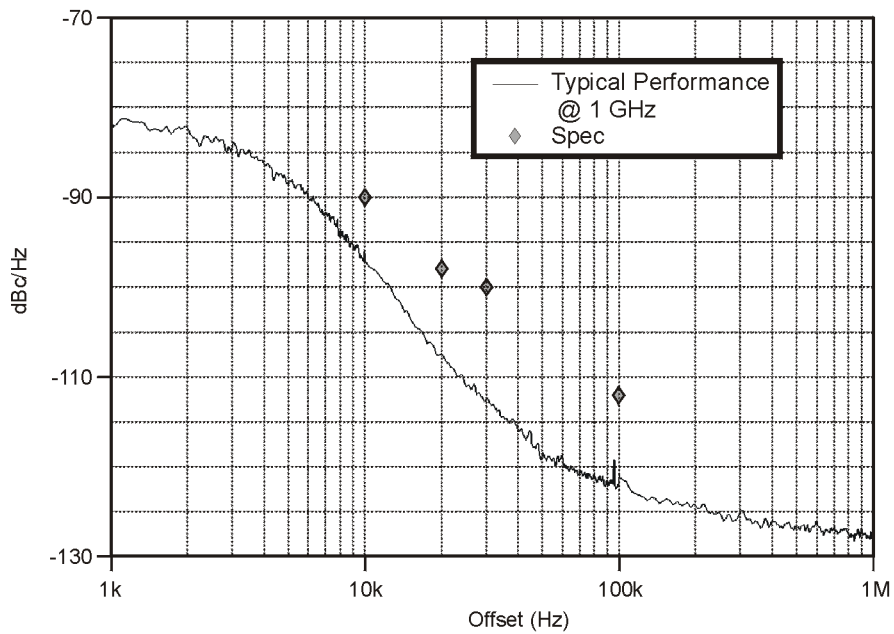
	Specifications	Supplemental Information
Resolution Bandwidth (RBW)		
Range		
-3 dB bandwidth	1 kHz to 3 MHz, in 1-3-10 sequence, 5 MHz	
-6 dB bandwidth (EMI)	9 kHz and 120 kHz	
<i>(Option 1DR)</i>		
-3 dB bandwidth	Adds 10, 30, 100, 300 Hz	Only available in spans ≤ 5 MHz, sweep times $\geq \frac{\text{sweep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

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

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

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 (Option UKB)	100 Vdc	
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	
Preamp On (Option 1DS)		
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).

	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 (Option 1DR)	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW (Option 1DR)
	30 Hz to 9 kHz (Option UKB)				≤ -85 dBm, characteristic
	9 kHz to 100 kHz				≤ -105 dBm, characteristic
	100 kHz to 1 MHz				≤ -131 dBm, characteristic
	1 MHz to 10 MHz			≤ -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
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 (<i>Option 1DR</i>)	Calibrated 0 to -120 dB ^a from Reference Level	
Linear Scale	Ten divisions	
Scale Units	dBm, dBmV, dB μ V, V, and W	
(<i>Option BAA</i>)	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 (<i>Option 1DR</i>)		
0 to -120 dB from ref level	0.04 dB	
Linear scale	0.01% of Reference Level	
Fast Sweep Times for Zero Span		
(<i>Option AYY</i>) ^a		
For sweep times		
$\frac{\text{sweep points} - 1}{20 \text{ MHz}}$ to		
$\frac{\text{sweep points} - 1}{100 \text{ kHz}}$		
Log		
0 to -85 dB from ref level	0.3 dB	
Linear	0.3% of Reference Level for linear scale	

	Specifications	Supplemental Information
<p><i>(Option B7D)</i> For sweep times $\frac{\text{sweep points} - 1}{40 \text{ MHz}}$ $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ Log 0 to -85 dB from ref level Linear</p>	<p>0.2 dB 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 Absolute^a/Relative 10 dB attenuation 9 kHz to 3.0 GHz 20 to 30 °C 0 to 55 °C <i>(Option UKB)</i> 100 Hz to 3.0 GHz (dc coupled) 20 to 30 °C 0 to 55 °C 30 Hz to 3.0 GHz (dc coupled) 20 to 30 °C 0 to 55 °C 100 kHz to 3.0 GHz (ac coupled) 20 to 30 °C 0 to 55 °C</p>	<p>$\pm 0.5 \text{ dB}$ $\pm 1.0 \text{ dB}$ $\pm 0.5 \text{ dB}$ $\pm 1.0 \text{ dB}$</p>	<p>$\pm 0.5 \text{ dB}$, characteristic $\pm 1.0 \text{ dB}$, characteristic $\pm 0.5 \text{ dB}$, characteristic $\pm 1.0 \text{ dB}$, characteristic</p>

	Specifications	Supplemental Information
Absolute ^a /Relative Preamp On (<i>Option 1DS</i>) 1 MHz to 3.0 GHz 0 dB attenuation	±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	dc-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	

Attenuation Accuracy Relative to the 10 dB Attenuator Setting, Characteristic		
	Frequency Range	
Attenuation	dc-3.0 GHz	
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.

	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)	

- Settings are: reference level -20 dBm; input attenuation 10 dB; dc coupled (*Option UKB*); 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.
- Settings are: reference level -30 dBm; input attenuation 0 dB; dc coupled (*Option UKB*); center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, signal at reference level.
- For reference level 0 to -50 dBm; input attenuation 10 dB; dc coupled (*Option UKB*); 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		characteristic ≤3.0:1	
Attenuator setting 5 dB 100 kHz to 3 GHz		≤1.6:1	
Attenuator setting 10 to 65 dB 9 kHz to 100 kHz		≤2.0:1	
100 kHz to 3 GHz		≤1.4:1	
<i>(Option UKB)</i>		characteristic	characteristic
Attenuator setting 0 dB		(dc coupled)	(ac coupled)
100 Hz to 100 kHz		≤1.1:1	
100 kHz to 3 GHz		≤3.0:1	≤3.0:1
Attenuator setting 5 dB		(dc coupled)	(ac coupled)
100 Hz to 100 kHz		≤1.1:1	
100 kHz to 300 kHz		≤1.1:1	≤2.3:1
300 kHz to 1.0 MHz		≤1.1:1	≤1.6:1
1.0 MHz to 3.0 GHz		≤1.4:1	≤1.4:1
Attenuator setting 10 to 65 dB		(dc coupled)	(ac coupled)
100 Hz to 100 kHz		≤1.1:1	
100 kHz to 300 kHz		≤1.1:1	≤2.1:1
300 kHz to 1.0 MHz		≤1.1:1	≤1.5:1
1.0 MHz to 3.0 GHz		≤1.2:1	≤1.2:1

	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	$\pm 0.12\%$ 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		$\pm 2.0 \text{ dB, characteristic}$
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	

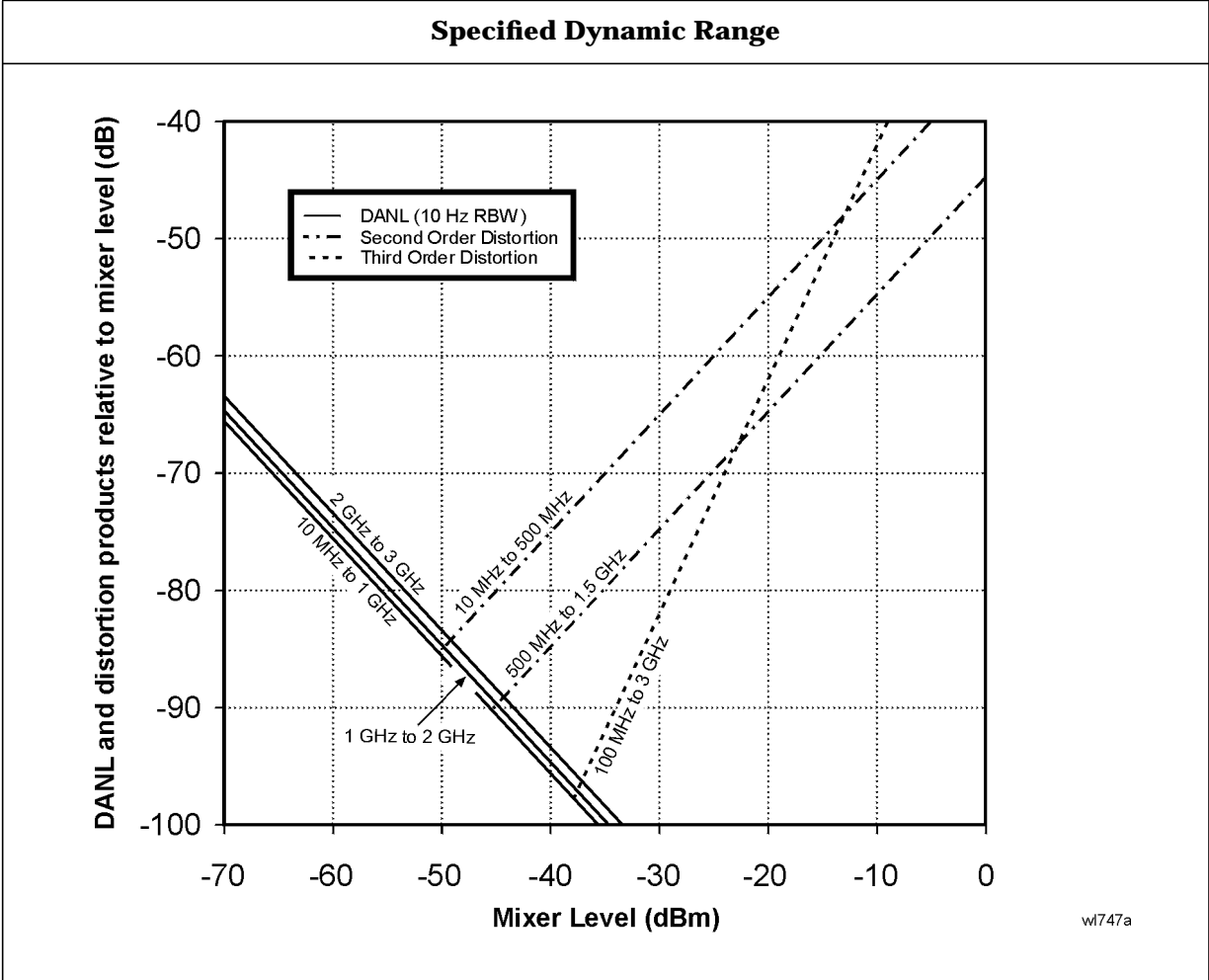
a. or when auto ranging is off: (:DISPlay:WINDow:TRACe:Y[:SCALE]:LOG:RANGE:AUTO OFF)

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	
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).



	Specifications	Supplemental Information
<p>Residual Responses (Input terminated and 0 dB attenuation)</p> <p>150 kHz to 3 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

	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	±0.78 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 ^a	±0.23 dB ^a , typical
0 to 55 °C	±1.00 dB ^a	
-5 to -25 dBm 20 to 30 °C	±0.63 dB ^a	±0.21 dB ^a , typical
0 to 55 °C	±0.94 dB ^a	
-25 to -45 dBm 20 to 30 °C	±0.63 dB ^a	±0.21 dB ^a , typical
0 to 55 °C	±0.88 dB ^a	
-45 to -55 dBm 20 to 30 °C	±0.70 dB ^a	±0.28 dB ^a , typical
0 to 55 °C	±0.89 dB ^a	
-55 to -70 dBm 20 to 30 °C	±0.82 dB ^a	±0.38 dB ^a , typical
0 to 55 °C	±1.14 dB ^a	

a. For Option UKB, add 0.10 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 ^a	±0.42 dB ^a , typical
0 to -85 dBm	±1.76 dB ^a	±0.94 dB ^a , typical
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

a. For Option UKB, add 0.10 dB.

	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 Power (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	
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	

	Specifications	Supplemental Information
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	0.15 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	

	Specifications	Supplemental Information
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	3.3%	2.9%, typical
Accuracy ^c	$\pm 0.8\%$	$\pm 0.6\%$, typical
Displayed Resolution	0.01%	
Carrier feedthrough		
Floor	-51 dBc	
Accuracy (Carrier feedthrough ≥ -43 dBc)	± 2.3 dB	
Displayed resolution	0.01 dB	
Magnitude error		
Floor	3.3%	
Accuracy ^c	$\pm 0.8\%$	
Displayed resolution	0.01%	
Phase error		
Accuracy ^c	± 0.45 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	$\pm(2.7 \text{ dB} + 0.01 \times (\text{dB from reference level}))$	$\pm(0.3 \text{ dB} + 0.01 \times (\text{dB from reference level}))$, 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	$\pm 2.6 \text{ dB}^a$	$\pm 1.7 \text{ dB}^a$, typical
-60 to -83 dBm	$\pm 4.3 \text{ dB}^a$	$\pm 3.4 \text{ dB}^a$, typical
Preamp On (<i>Option 1DS</i>)		
-40 to -70 dBm	$\pm 3.6 \text{ dB}$	$\pm 2.6 \text{ dB}$, typical
-70 to -101 dBm	$\pm 5.0 \text{ dB}$	$\pm 3.9 \text{ dB}$, typical

a. For Option UKB, add 0.10 dB.

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

	Specifications	Supplemental Information
Trigger Trigger source (Actual available choices dependent on measurement) <i>(Option B7D and B7E)</i> Delay trigger Range Resolution RF burst trigger level <i>(Option B7E)</i> Trigger slope (External and RF burst) Frame timing period Frame synchronizing source Frame synchronizing slope	Free run, external Add RF Burst, frame 0 to 500 ms 300 ns 0 to -25 dBc Positive/Negative 50 ns to 13.6533 s External frame sync Positive/Negative	 Rear panel connector labelled EXT FRAME SYNC <i>(Option B7D)</i>

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

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 ^a	±0.28 dB ^a , typical
0 to 55 °C	±1.26 dB ^a	
-20 to -30 dBm 20 to 30 °C	±0.66 dB ^a	±0.27 dB ^a , typical
0 to 55 °C	±1.06 dB ^a	
-30 to -40 dBm 20 to 30 °C	±0.71 dB ^a	±0.26 dB ^a , typical
0 to 55 °C	±1.00 dB ^a	
-40 to -50 dBm 20 to 30 °C	±0.90 dB ^a	±0.44 dB ^a , typical
0 to 55 °C	±1.13 dB ^a	
-50 to -60 dBm 20 to 30 °C	±1.03 dB ^a	±0.57 dB ^a , typical
0 to 55 °C	±1.24 dB ^a	

a. For Option UKB, add 0.10 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

	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
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	±0.1 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 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 ^b , characteristic ±2.5 dB ^b , 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.
 b. For Option UKB, add 0.10 dB.

	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 AYZ 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		≥ 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

- Factory preset, auto align Off, segmented sweep Off, fixed center frequency, RBW = 1 MHz, and spans >10 MHz and ≤600 MHz.
- 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-488.2 DLL.
- Factory preset, auto align Off, segmented sweep Off, RBW = 1 MHz, span= 20 MHz, fixed center frequency, average of 100 measurements.
- Factory preset, auto align Off, segmented sweep Off, RBW = 1 MHz, span= 20 MHz, and center frequency tune step size = 50 MHz.

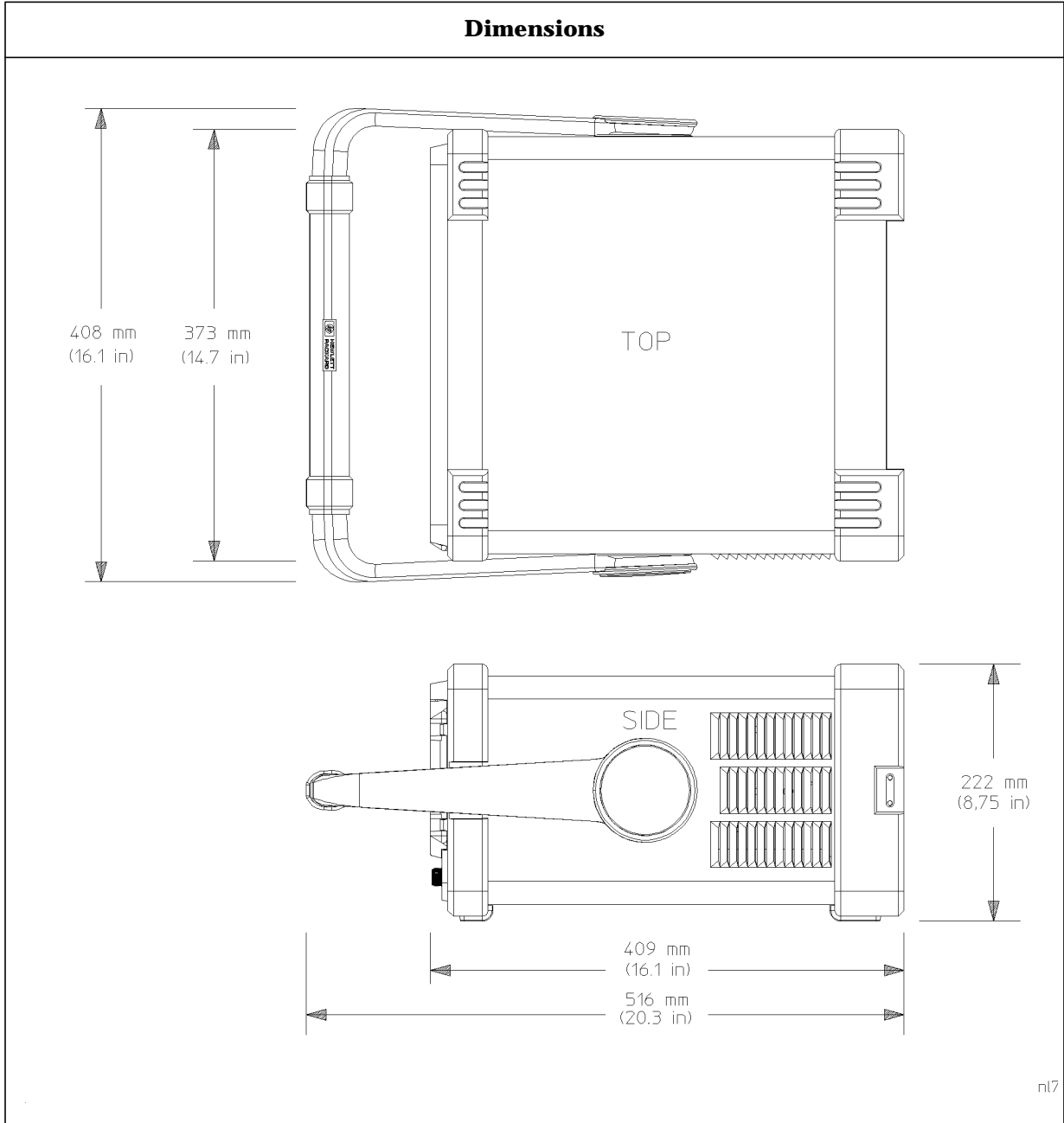
	Specifications	Supplemental Information
Data Storage		
Internal		200 Traces or States ^a
External (10 to 40 °C) 3.5" 1.44 MB, MS-DOS [®] compatible floppy disk		200 Traces or States ^a

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		Internal speaker, front-panel earphone jack and front-panel volume control.
Demod	AM	
<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



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

	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 ^a ; Low = retrace (5 V TTL)
Gate Output (<i>Option 1D6</i>) Level		High = gate on; Low = gate off (5 V TTL)

a. High sweep may be high longer than the indicated sweep times.

	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 AYY</i>)		RBW ≥ 1 kHz
Connector	BNC female	
Frequency		21.4 MHz, nominal
Amplitude (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> Connector Amplitude Range (into >10 kΩ)	BNC female	RBW ≥ 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 ^a , Low = retrace (5 V TTL)

a. High sweep may be high longer than the indicated sweep times.

	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>		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.

	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: E4401B, E4402B, E4403B, E4404B,
E4405B, E4407B, E4408B, 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 17 April 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 Agilent 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	$\pm 2 \times 10^{-6}/\text{year}$	$\pm 1.0 \times 10^{-7}/\text{day}$, characteristic
Settability	$\pm 5 \times 10^{-7}$	
Temperature Stability	$\pm 5 \times 10^{-6}$	

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

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	$\pm(\text{marker frequency} \times \text{frequency reference error}^{\text{b}} + \text{counter resolution})$	

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	±327 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 E4403B Specifications and Characteristics
Frequency

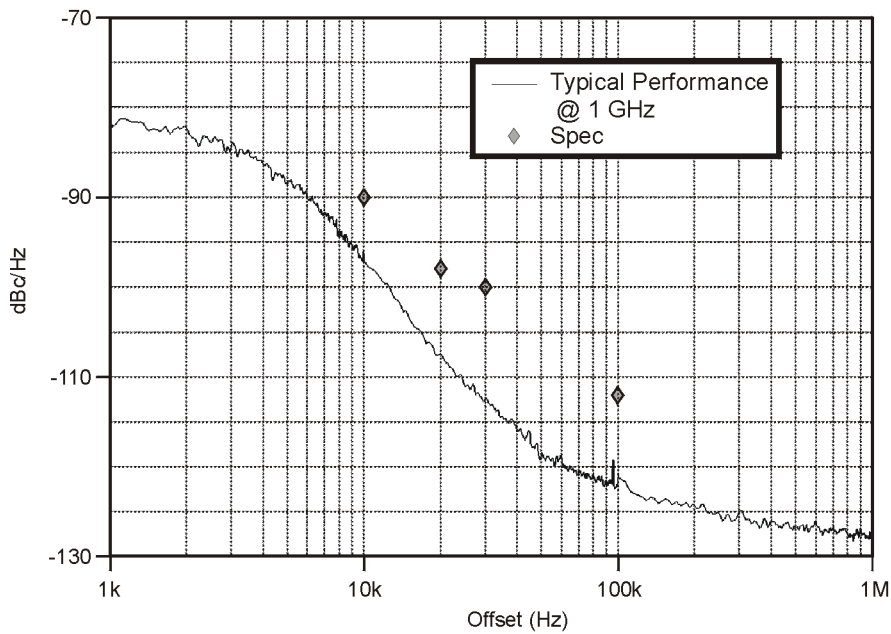
	Specifications	Supplemental Information
Resolution Bandwidth (RBW) Range –3 dB bandwidth –6 dB bandwidth (EMI) Accuracy 1 kHz to 3 MHz RBW 5 MHz RBW Shape 1 kHz to 5 MHz RBW Selectivity (60 dB/3 dB bandwidth ratio) 1 kHz to 5 MHz RBW	1 kHz to 3 MHz, in 1-3-10 sequence, 5 MHz 9 kHz and 120 kHz ±15% ±30%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

	Specifications	Supplemental Information
Video Bandwidth (VBW) (-3 dB) Range Accuracy Shape	30 Hz to 1 MHz in 1-3-10 sequence	3 MHz, characteristic ±30%, characteristic 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 ≥20 kHz ≥30 kHz	≤ –90 dBc/Hz ≤ –98 dBc/Hz ≤ –100 dBc/Hz	

	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



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

	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	

Agilent E4403B Specifications and Characteristics
Amplitude

	Specifications	Supplemental Information
Frequency Response		
Absolute ^a /Relative		
10 dB attenuation		
9 kHz to 3.0 GHz		
20 to 30 °C	±0.5 dB	
0 to 55 °C	±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	±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	dc-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	dc-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; dc coupled; 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	

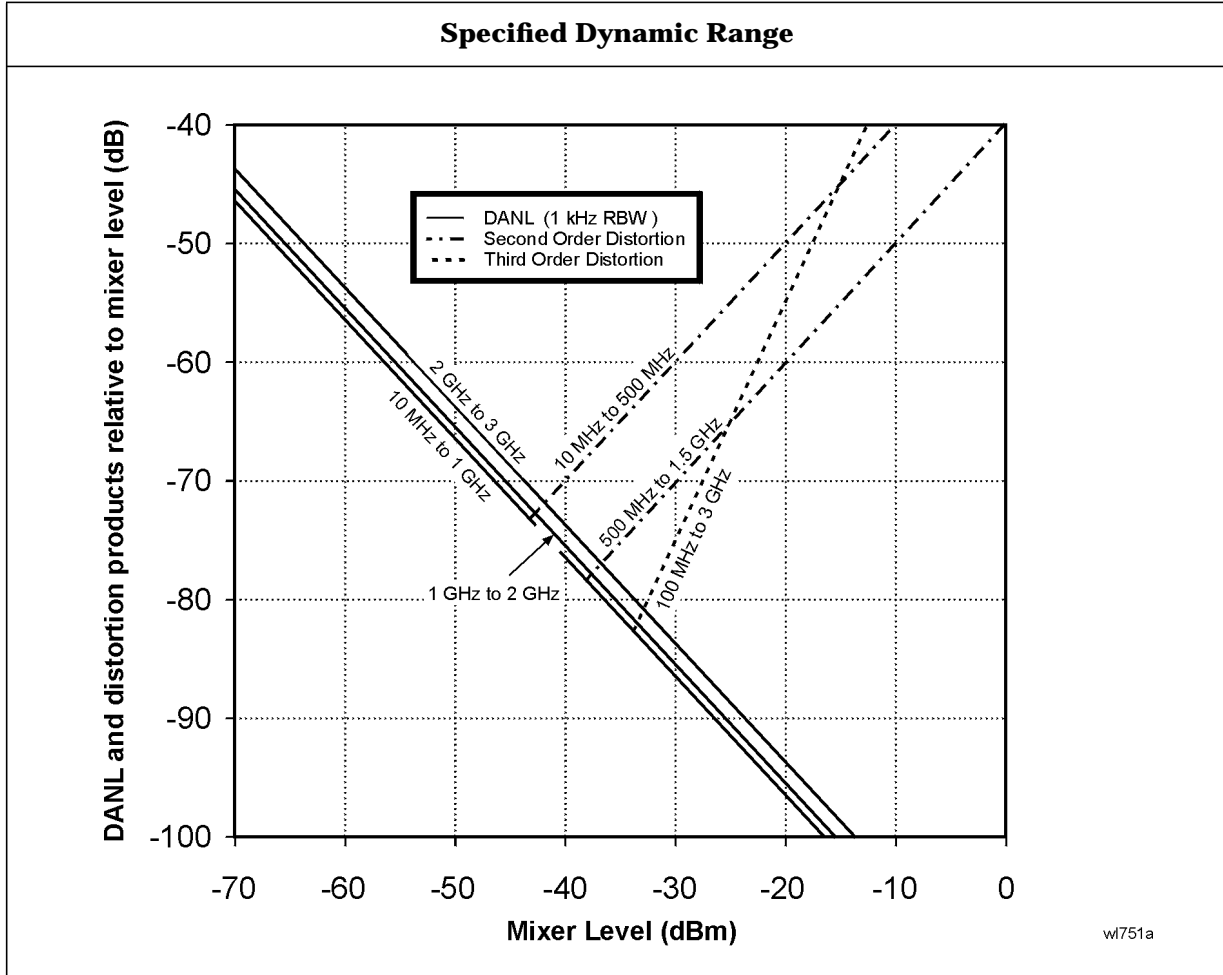
	Specifications	Supplemental Information
Reference Level		
Range	-149.9 dBm to maximum mixer level + attenuator setting	
Resolution		
Log Scale	±0.1 dB	
Linear Scale	±0.12% of Reference Level	
Accuracy (at a fixed frequency, a fixed attenuator, and referenced to -30 dBm)		
Reference Level (dBm) – input 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.

	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

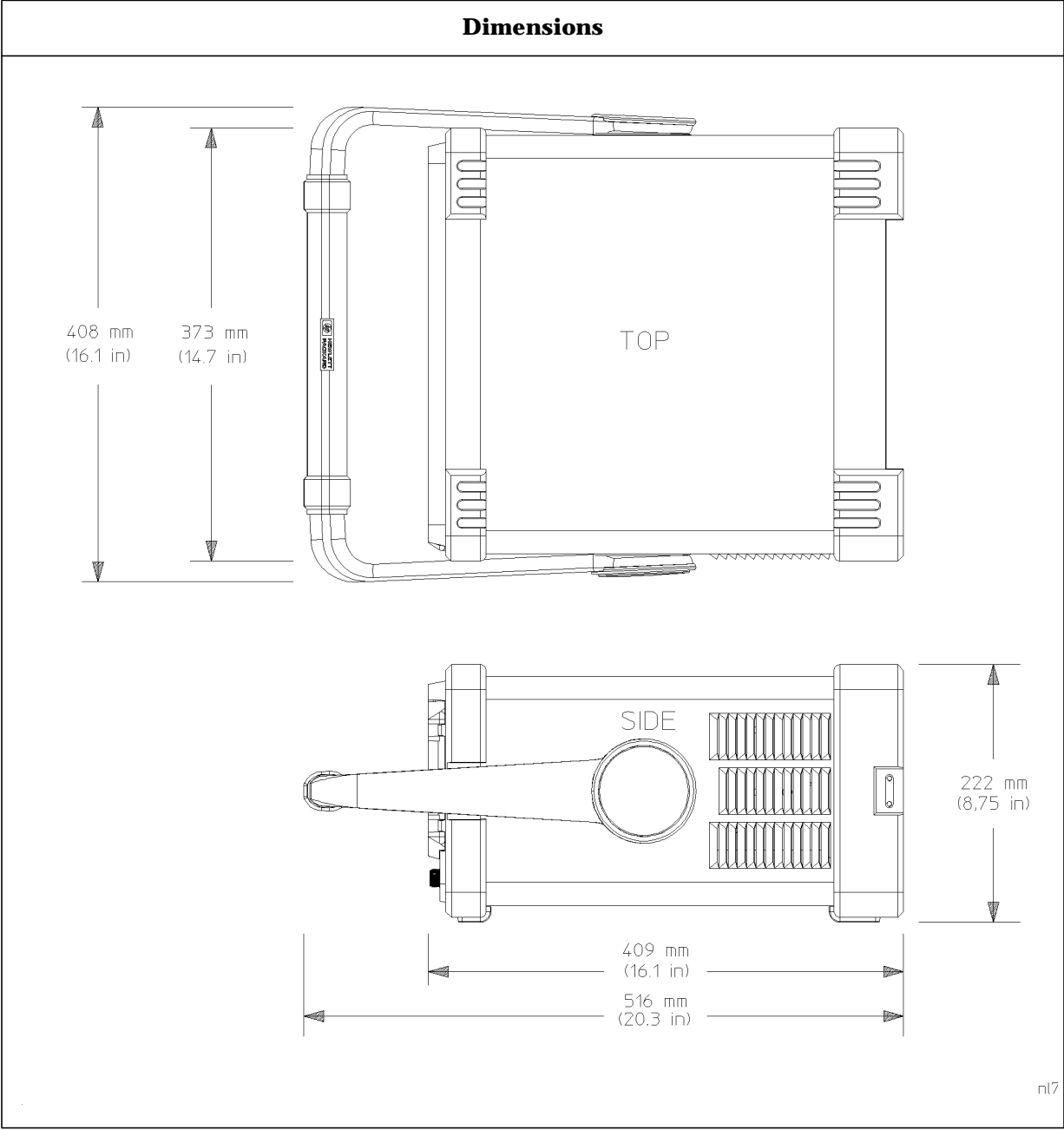
- a. Factory preset, auto align Off, fixed center frequency, RBW = 1 MHz, and spans >10 MHz and ≤600 MHz.
- b. Display Off (:DISPlay:ENABle OFF), and 32-bit integer data format (:FORMat:DATA INT,32), if *Option A4J* is installed, disable sweep ramp, (:SYSTem:PORTs:IFVSweep:ENABle OFF), markers Off, single 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-488.2 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

- 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 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

	Specifications	Supplemental Information
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 ^a ; Low = retrace (5 V TTL)

a. High sweep may be high longer than the indicated sweep times.

	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)</i>		
Connector	BNC female	
Frequency		21.4 MHz, nominal

Agilent E4403B Specifications and Characteristics
Inputs and Outputs

	Specifications	Supplemental Information
Amplitude (for signal at reference level and for reference levels – input attenuation of –10 to –70 dBm)		–10 dBm (uncorrected), characteristic
Impedance		50 Ω nominal

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

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

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

a. High sweep may be high longer than the indicated sweep times.

	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.



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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: E4401B, E4402B, E4403B, E4404B,
E4405B, E4407B, E4408B, 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 17 April 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 Agilent 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:
 - Every hour

1. 10 °C if Preamp (*Option 1DS*) is active.

- 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 Preamp (*Option 1DS*) is active.

Frequency

	Specifications	Supplemental Information
Frequency Range		
dc Coupled	9 kHz to 6.7 GHz	
<i>(Option UKB)</i>	100 Hz to 6.7 GHz	
ac Coupled	100 kHz to 6.7 GHz	
Band		
0	9 kHz to 3.0 GHz	
<i>(Option UKB)</i>	100 Hz to 3.0 GHz	
1	2.85 GHz to 6.7 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	$\pm 5 \times 10^{-8}$	

	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)	$\pm((\text{frequency indication} \times \text{frequency reference error}^a)$ $+ 0.5\% \text{ of span}$ $+ \frac{\text{span}}{\text{sweep points} - 1}$ $+ 15\% \text{ of RBW}$ $+ 10 \text{ Hz}$	

a. Frequency reference error = (aging rate \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	$\pm(\text{marker frequency} \times \text{frequency reference error}^b + \text{counter resolution})$	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).

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

a. Applies to each sweep segment.

	Specifications	Supplemental Information
Sweep Time		
Range		
Span > 0 Hz	1 ms to 4000 s ^a	$\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ to 4000 s
Span = 0 Hz	10 μs to 4000 s ^{ab}	
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)	50 ns to 4000 s ^{cd}	$\frac{\text{sweep points} - 1}{20 \text{ MHz}}$ to 4000 s
DSP and fast ADC (Option B7D) (For Span = 0 Hz, RBW ≥ 1 kHz)	25 ns to 4000 s ^e	$\frac{\text{sweep points} - 1}{40 \text{ MHz}}$ to 4000 s
Accuracy (Span = 0 Hz)		
10 μs to 4000 s ^{ab} (Option AYX)	±1%	
50 ns to 4000 s ^{cd} (Option B7D)	±1%	
25 ns to 4000 s ^e	±1%	
Sweep Trigger ^{fg}	Free Run, Single, Line, Video, External, Delayed, Offset ^h	
(Option 1D6)	Add Gate	
(Option B7B)	Add TV	

	Specifications	Supplemental Information
Delayed Trigger ^{gi}		
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 ^h		
Resolution	$\frac{\text{sweep time}}{\text{sweep points} - 1}$	
Range	±327 ms to ±12.3 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 $\frac{\text{sweep points} - 1}{20 \text{ MHz}}$ to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$)	±1.23 ms to ±245 ms	$\frac{-32766 \times ST}{SP - 1}$ to $\frac{(32766 - SP) \times ST}{SP - 1}$
DSP and fast ADC (Option B7D) (For sweep times $\frac{\text{sweep points} - 1}{40 \text{ MHz}}$ 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.05.00, 1 ms to 4000 s.
- c. For firmware revisions prior to A.04.00, 20 μs to 2000 s.
- d. For firmware revisions prior to A.05.00, 5 μs to 4000 s.
- e. For firmware revisions prior to A.05.00, 2.5 μs to 4000 s.
- f. Gate cannot be used simultaneously with delayed or TV trigger (Option B7B).
- g. Auto align is suspended in video, external, gate, and delayed trigger modes while waiting for a trigger event to occur.
- h. For firmware revision A.04.00 or later.
- i. Delayed trigger is available with line, external trigger, and TV trigger (Option B7B).

	Specifications	Supplemental Information
Sweep (trace) Points		
Range		
Span > 0 Hz	101 to 8192 ^a	
Span = 0 Hz	2 to 8192 ^{ab}	

- a. For firmware revisions prior to A.04.00, 401 points.
b. For firmware revisions prior to A.05.00, 101 to 8192 points.

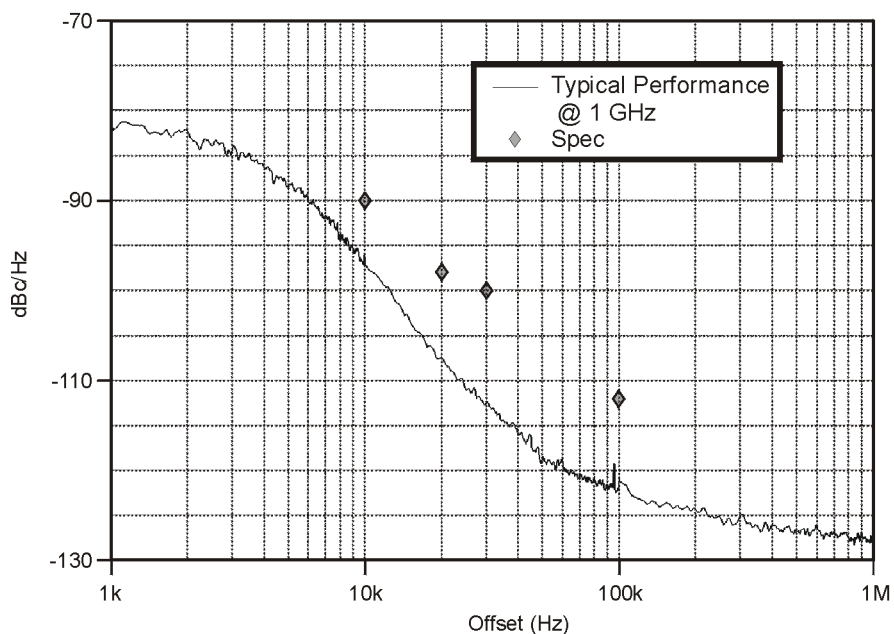
	Specifications	Supplemental Information
Resolution Bandwidth (RBW)		
Range		
-3 dB bandwidth	1 kHz to 3 MHz, in 1-3-10 sequence, 5 MHz	
-6 dB bandwidth (EMI)	9 kHz and 120 kHz	
<i>(Option 1DR)</i>		
-3 dB bandwidth	Adds 10, 30, 100, 300 Hz	Only available in spans ≤ 5 MHz, sweep times $\geq \frac{\text{sweep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

	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>≤ -90 dBc/Hz</p> <p>≤ -98 dBc/Hz</p> <p>≤ -100 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
Line-Related Sidebands, offset from CW signal <i>(Option 1DR)</i> <300 Hz >300 Hz to 30 kHz		≤ -50 dBc, characteristic ≤ -55 dBc, characteristic

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	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).

	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 (Option 1DR)	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW (Option 1DR)
	30 Hz to 9 kHz (Option UKB)				≤ -85 dBm, characteristic
	9 kHz to 100 kHz				≤ -105 dBm, characteristic
	100 kHz to 1 MHz				≤ -131 dBm, characteristic
	1 MHz to 10 MHz			≤ -116 dBm, characteristic	≤ -135 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 (Option 1DS)	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW (Option 1DR)	1 kHz RBW 30 Hz VBW	10 kHz RBW 1 Hz VBW (Option 1DR)
	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
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 (<i>Option 1DR</i>)	Calibrated 0 to -120 dB ^a from Reference Level	
Linear Scale	Ten divisions	
Scale Units	dBm, dBmV, dB μ V, V, and W	
(<i>Option BAA</i>)	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 (<i>Option 1DR</i>)		
0 to -120 dB from ref level	0.04 dB	
Linear scale	0.01% of Reference Level	
Fast Sweep Times for Zero Span		
(<i>Option AYY</i>) ^a		
For sweep times		
$\frac{\text{sweep points} - 1}{20 \text{ MHz}}$ to		
$\frac{\text{sweep points} - 1}{100 \text{ kHz}}$		
Log		
0 to -85 dB from ref level	0.3 dB	
Linear	0.3% of Reference Level for linear scale	

	Specifications	Supplemental Information
<p><i>(Option B7D)</i> For sweep times $\frac{\text{sweep points} - 1}{40 \text{ MHz}}$ 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</p> <p>10 dB attenuation</p> <p>9 kHz to 3.0 GHz (dc coupled)</p> <p>20 to 30 °C</p> <p>0 to 55 °C</p> <p>100 kHz to 3.0 GHz (ac coupled)</p> <p>20 to 30 °C</p> <p>0 to 55 °C</p> <p><i>(Option UKB)</i> (dc coupled)</p> <p>100 Hz to 3.0 GHz</p> <p>20 to 30 °C</p> <p>0 to 55 °C</p> <p>30 Hz to 3.0 GHz</p> <p>20 to 30 °C</p> <p>0 to 55 °C</p>	<p>± 0.5 dB</p> <p>± 1.0 dB</p> <p>± 0.5 dB</p> <p>± 1.0 dB</p>	<p>± 0.5 dB, characteristic</p> <p>± 1.0 dB, characteristic</p> <p>± 0.5 dB, characteristic</p> <p>± 1.0 dB, characteristic</p>

	Specifications	Supplemental Information
Absolute ^a /Relative Preamp On (<i>Option 1DS</i>)		
1 MHz to 3.0 GHz	(dc coupled)	(ac coupled)
0 dB attenuation	±2.0 dB	±2.0 dB, characteristic
Preselector centered for frequency >3.0 GHz		
10 dB attenuation		
3.0 GHz to 6.7 GHz	(dc coupled)	(ac coupled)
Absolute ^a		
20 to 30 °C	±1.5 dB	±1.5 dB, characteristic
0 to 55 °C	±2.5 dB	±2.5 dB, characteristic
Relative		
20 to 30 °C	±1.3 dB	±1.3 dB, characteristic
0 to 55 °C	±1.5 dB	±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	±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	dc–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

	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; dc coupled; 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; dc coupled; 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; dc coupled; 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
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	
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 ≤ 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	

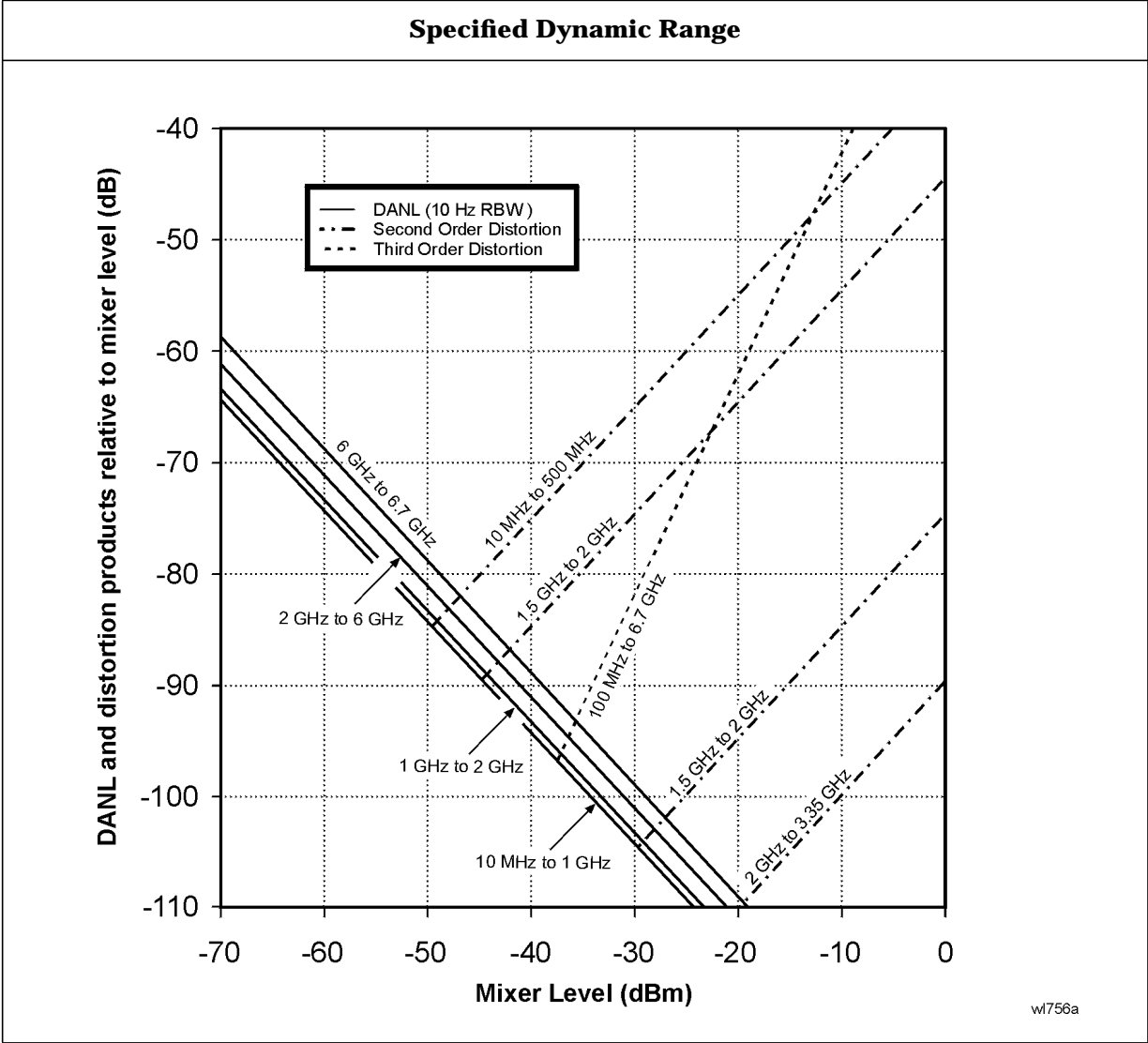
a. or when auto ranging is off: (:DISPlay:WINDow:TRACe:Y[:SCALe]:LOG:RANGe:AUTO OFF)

b. 0 to -50 dB for RBWs ≤ 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
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

	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	

	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 Power (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.

- 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	0.15 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	3.3%	2.9%, typical
Accuracy ^c	$\pm 0.8\%$	$\pm 0.6\%$, 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	3.3%	
Accuracy ^c	±0.8%	
Displayed resolution	0.01%	
Phase error		
Accuracy ^c	±0.45 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	

	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	

	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
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	±0.1 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 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	

	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 (Actual available choices dependent on measurement) <i>(Option B7D and B7E)</i>	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

- a. Factory preset, auto align Off, segmented sweep Off, fixed center frequency, RBW = 1 MHz, spans >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, (:SYSem: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-488.2 DLL.
- c. Factory preset, auto align Off, segmented sweep 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, segmented sweep Off, RBW = 1 MHz, span= 20 MHz, stop frequency ≤3 GHz, center frequency tune step size = 50 MHz.

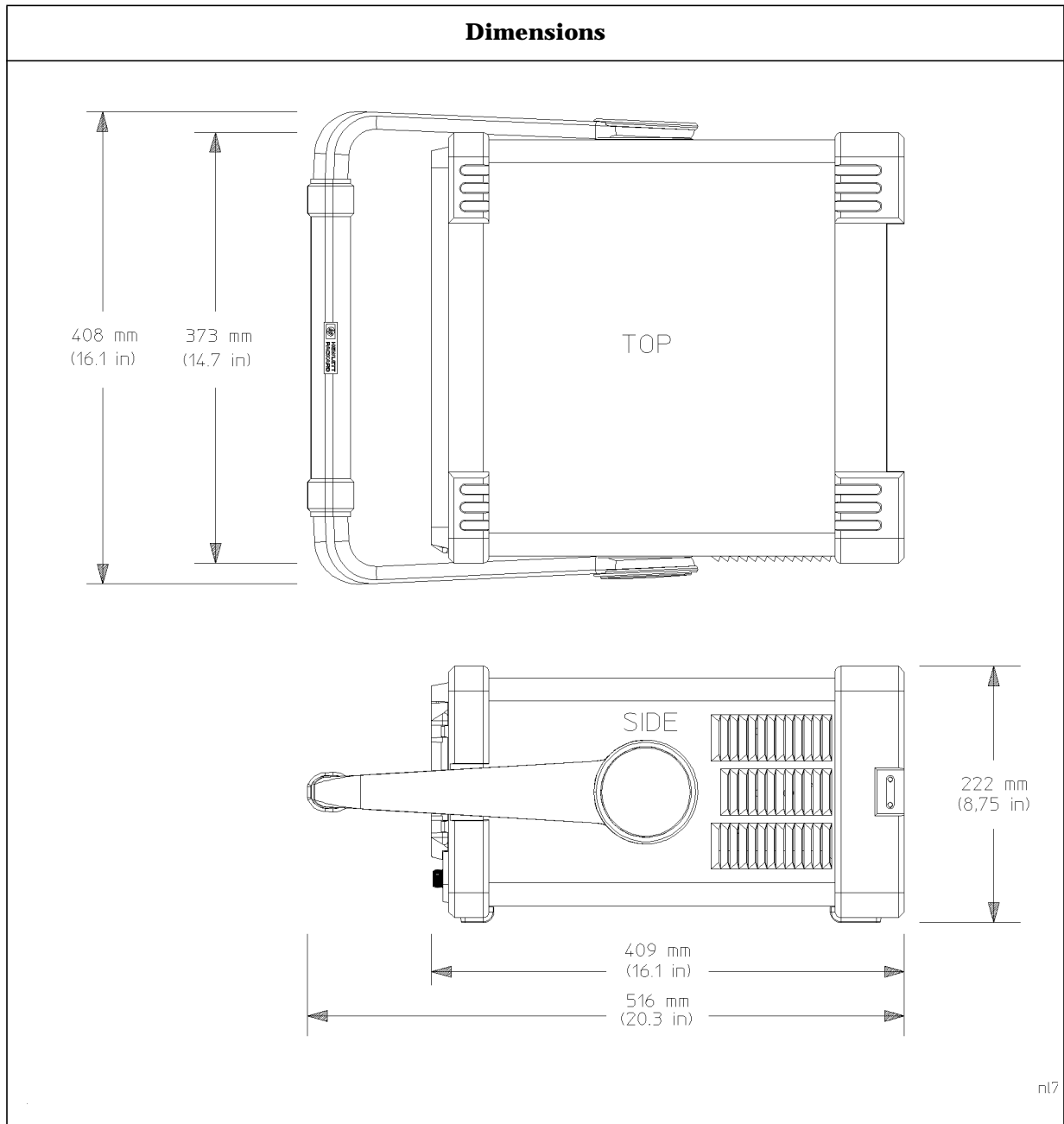
	Specifications	Supplemental Information
Data Storage		
Internal		200 Traces or States ^a
External (10 to 40 °C) 3.5" 1.44 MB, MS-DOS [®] compatible floppy disk		200 Traces or States ^a

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		Internal speaker, front-panel earphone jack and front-panel volume control.
Demod	AM	
<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		31.9 kg (70.3 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

	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 ^a ; Low = retrace (5 V TTL)
Gate Output (<i>Option 1D6</i>) Level		High = gate on; Low = gate off (5 V TTL)

a. High sweep may be high longer than the indicated sweep times.

	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 AYY</i>)		RBW ≥ 1 kHz
Connector	BNC female	
Frequency		21.4 MHz, nominal
Amplitude (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> 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 ^a , Low = retrace (5 V TTL)

a. High sweep may be high longer than the indicated sweep times.

	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	BNC female	> 10 k Ω , nominal 0 to +10 V, characteristic 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.
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.

	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: E4401B, E4402B, E4403B, E4404B,
E4405B, E4407B, E4408B, 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 17 April 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 Agilent 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:
 - Every hour

1. 10 °C if Preamp (*Option 1DS*) is active.

- 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 Preamp (*Option 1DS*) is active.

Frequency

	Specifications	Supplemental Information
Frequency Range		
dc Coupled	9 kHz to 13.2 GHz	
<i>(Option UKB)</i>	100 Hz 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–
<i>(Option UKB)</i>	100 Hz 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).

	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)	$\pm((\text{frequency indication} \times \text{frequency reference error}^{\text{a}}) + 0.5\% \text{ of span} + \frac{\text{span}}{\text{sweep points} - 1} + 15\% \text{ of RBW} + 10 \text{ Hz} + 1 \text{ Hz} \times N^{\text{b}})$	

- 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.

	Specifications	Supplemental Information
Frequency Span		
Range	0 Hz (zero span), 100 Hz to 13.2 GHz	

	Specifications	Supplemental Information
Resolution	2 Hz x N ^a	
Accuracy ^b	±(0.5% of span + 2 × $\frac{\text{span}}{\text{sweep points} - 1}$)	

a. N is the harmonic mixing mode.

b. Applies to each sweep segment.

	Specifications	Supplemental Information
Sweep Time		
Range		
Span > 0 Hz	1 ms to 4000 s ^a	$\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ to 4000 s
Span = 0 Hz	10 μs to 4000 s ^{ab}	
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)	50 ns to 4000 s ^{cd}	$\frac{\text{sweep points} - 1}{20 \text{ MHz}}$ to 4000 s
DSP and fast ADC (Option B7D) (For Span = 0 Hz, RBW ≥ 1 kHz)	25 ns to 4000 s ^e	$\frac{\text{sweep points} - 1}{40 \text{ MHz}}$ to 4000 s
Accuracy (Span = 0 Hz)		
10 μs to 4000 s ^{ab}	±1%	
(Option AYX)	±1%	
50 ns to 4000 s ^{cd}		
(Option B7D)	±1%	
25 ns to 4000 s ^e		
Sweep Trigger ^{fg}	Free Run, Single, Line, Video, External, Delayed, Offset ^h	
(Option 1D6)	Add Gate	
(Option B7B)	Add TV	
Delayed Trigger ^{gi}		
Range	1 μs to 400 s	

	Specifications	Supplemental Information
Resolution	$\frac{\text{delay in seconds}}{65000}$ rounded up to nearest μs	
Accuracy	$\pm(500 \text{ ns} + (0.01\% \text{ of delay}))$	
Offset Trigger ^h		
Resolution	$\frac{\text{sweep time}}{\text{sweep points} - 1}$	
Range	$\pm 327 \text{ ms}$ to $\pm 12.3 \text{ ks}$	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 AXX) (For sweep times $\frac{\text{sweep points} - 1}{20 \text{ MHz}}$ to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$)	$\pm 1.23 \text{ ms}$ to $\pm 245 \text{ ms}$	$\frac{-32766 \times \text{ST}}{\text{SP} - 1}$ to $\frac{(32766 - \text{SP}) \times \text{ST}}{\text{SP} - 1}$
DSP and fast ADC (Option B7D) (For sweep times $\frac{\text{sweep points} - 1}{40 \text{ MHz}}$ 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.05.00, 1 ms to 4000 s.
- c. For firmware revisions prior to A.04.00, 20 μs to 2000 s.
- d. For firmware revisions prior to A.05.00, 5 μs to 4000 s.
- e. For firmware revisions prior to A.05.00, 2.5 μs to 4000 s.
- f. Gate cannot be used simultaneously with delayed or TV trigger (Option B7B).
- g. Auto align is suspended in video, external, gate, and delayed trigger modes while waiting for a trigger event to occur.
- h. For firmware revision A.04.00 or later.
- i. Delayed trigger is available with line, external trigger, and TV trigger (Option B7B).

	Specifications	Supplemental Information
Sweep (trace) Points		
Range		
Span > 0 Hz	101 to 8192 ^a	
Span = 0 Hz	2 to 8192 ^{ab}	

- a. For firmware revisions prior to A.04.00, 401 points.
b. For firmware revisions prior to A.05.00, 101 to 8192 points.

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

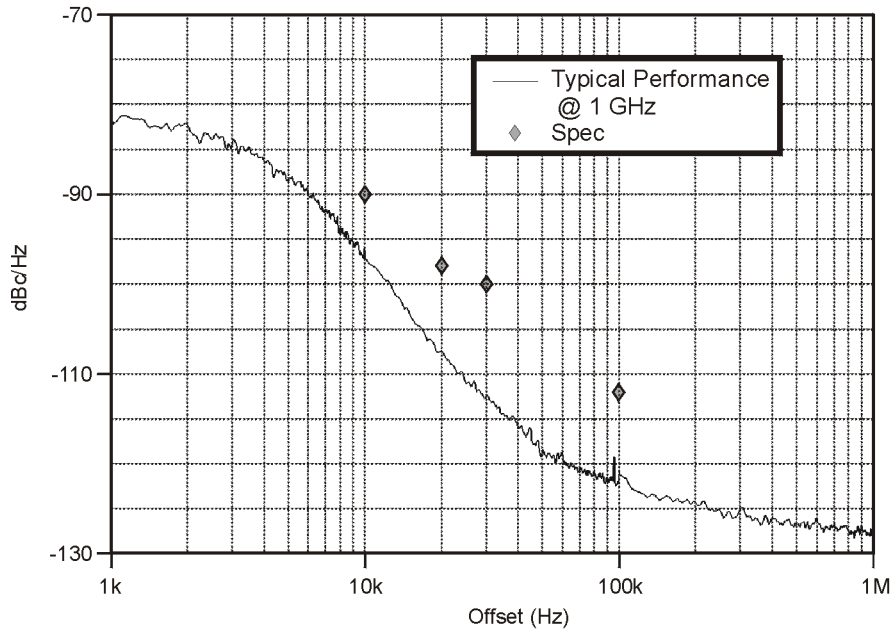
	Specifications	Supplemental Information
Video Bandwidth (VBW) (-3 dB)		
Range	30 Hz to 1 MHz in 1-3-10 sequence	3 MHz, characteristic
<i>(Option 1DR)</i>	Adds 1, 3, 10 Hz for RBW's <1 kHz	
Accuracy		±30%, characteristic
Shape		Post detection, single pole low-pass filter used to average displayed noise 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 ^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	
<i>(Option 1D5)</i>	≤100 Hz × N p-p in 100 ms	
10 Hz RBW, 10 Hz VBW	≤2 Hz × N p-p in 20 ms	
<i>(Option 1DR and 1D5)</i>		
10 Hz RBW, 10 Hz VBW		≤10 Hz × N p-p in 20 ms, characteristic
<i>(Option 1DR)</i>		
System-Related Sidebands, offset from CW signal		
≥30 kHz	≤ -65 dBc ^a	

	Specifications	Supplemental Information
Line-Related Sidebands, offset from CW signal <i>(Option 1DR)</i> <300 Hz >300 Hz to 30 kHz		$\leq -50 \text{ dBc}^a$, characteristic $\leq -55 \text{ dBc}^a$, characteristic

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

- 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).

	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 (Option 1DR)	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW (Option 1DR)
	30 Hz to 9 kHz (Option UKB)				≤ -85 dBm, characteristic
	9 kHz to 100 kHz				≤ -105 dBm, characteristic
	100 kHz to 1 MHz				≤ -131 dBm, characteristic
	1 MHz to 10 MHz			≤ -116 dBm, characteristic	≤ -135 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 (Option 1DS)	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW (Option 1DR)	1 kHz RBW 30 Hz VBW	10 kHz RBW 1 Hz VBW (Option 1DR)
	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
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 (<i>Option 1DR</i>)	Calibrated 0 to -120 dB ^a from Reference Level	
Linear Scale	Ten divisions	
Scale Units	dBm, dBmV, dB μ V, V, and W	
(<i>Option BAA</i>)	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 (<i>Option 1DR</i>)	0 to -120 dB from ref level	0.04 dB
Linear scale		0.01% of Reference Level
Fast Sweep Times for Zero Span		
(<i>Option AYY</i>) ^a		
For sweep times		
$\frac{\text{sweep points} - 1}{20 \text{ MHz}}$ to		
$\frac{\text{sweep points} - 1}{100 \text{ kHz}}$		
Log	0 to -85 dB from ref level	0.3 dB
Linear		0.3% of Reference Level for linear scale

	Specifications	Supplemental Information
<p><i>(Option B7D)</i> For sweep times $\frac{\text{sweep points} - 1}{40 \text{ MHz}}$ $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$</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</p> <p>10 dB attenuation</p> <p>9 kHz to 3.0 GHz (dc coupled)</p> <p>20 to 30 °C</p> <p>0 to 55 °C</p> <p>100 kHz to 3.0 GHz (ac coupled)</p> <p>20 to 30 °C</p> <p>0 to 55 °C</p> <p><i>(Option UKB)</i> (dc coupled)</p> <p>100 Hz to 3.0 GHz</p> <p>20 to 30 °C</p> <p>0 to 55 °C</p> <p>30 Hz to 3.0 GHz</p> <p>20 to 30 °C</p> <p>0 to 55 °C</p> <p>Absolute^a/Relative Preamp On <i>(Option 1DS)</i></p> <p>1 MHz to 3.0 GHz</p>	<p>± 0.5 dB</p> <p>± 1.0 dB</p> <p>± 0.5 dB</p> <p>± 1.0 dB</p> <p>± 0.5 dB</p> <p>± 1.0 dB</p> <p>(dc coupled)</p>	<p>± 0.5 dB, characteristic</p> <p>± 1.0 dB, characteristic</p> <p>± 0.5 dB, characteristic</p> <p>± 1.0 dB, characteristic</p> <p>(ac coupled)</p>

	Specifications	Supplemental Information
0 dB attenuation Preselector centered for frequency >3.0 GHz	±2.0 dB	±2.0 dB, characteristic
10 dB attenuation 3.0 GHz to 6.7 GHz	(dc coupled)	(ac coupled)
Absolute ^a		
20 to 30 °C	±1.5 dB	±1.5 dB, characteristic
0 to 55 °C	±2.5 dB	±2.5 dB, characteristic
Relative		
20 to 30 °C	±1.3 dB	±1.3 dB, characteristic
0 to 55 °C	±1.5 dB	±1.5 dB, characteristic
6.7 GHz to 13.2 GHz	(dc coupled)	(ac coupled)
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	dc–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
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	

	Specifications	Supplemental Information
Overall Amplitude Accuracy ^c 20 to 30 °C	$\pm (0.54 \text{ dB} + \text{Absolute Frequency Response})$	

- a. Settings are: reference level -20 dBm; input attenuation 10 dB; dc coupled; 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; dc coupled; 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; dc coupled; 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		$\leq 3.0:1$	$\leq 3.0:1$
100 Hz to 100 kHz (Option UKB)		$\leq 1.1:1$	
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		$\leq 1.7:1$	$\leq 1.9:1$
100 Hz to 100 kHz (Option UKB)		$\leq 1.1:1$	
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		$\leq 1.3:1$	$\leq 1.5:1$

	Specifications	Supplemental Information	
6.7 GHz to 13.2 GHz		≤1.5:1	≤1.7:1
100 Hz to 100 kHz (Option UKB)		≤1.1:1	

	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	
Accuracy (at a fixed frequency, a fixed attenuator, and referenced to –30 dBm (–10 dBm, Preamp On (Option 1DS)))		

	Specifications	Supplemental Information
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 ≤ 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	

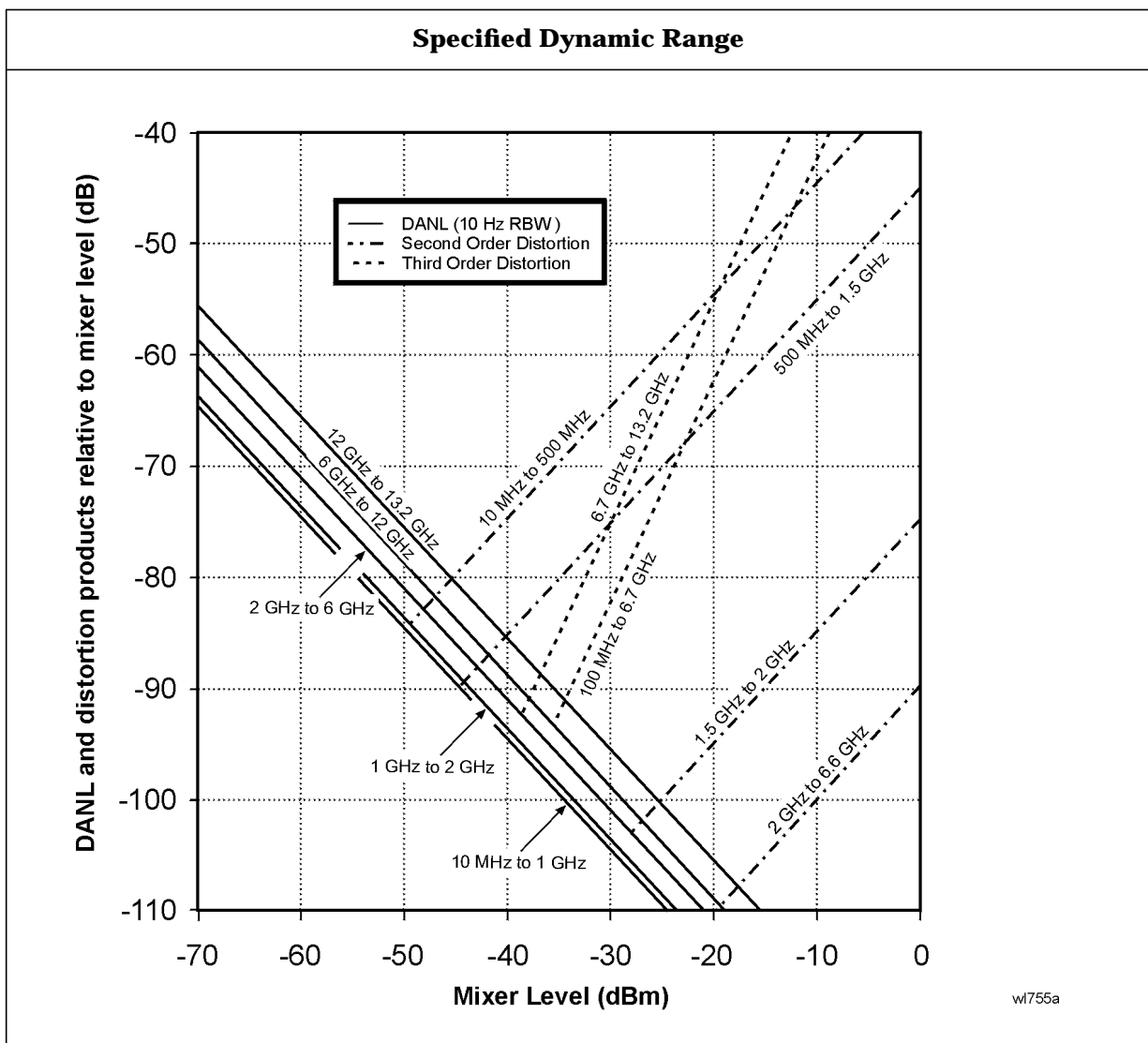
a. or when auto ranging is off: (:DISPlay:WINDow:TRACe:Y[:SCALE]:LOG:RANGe:AUTO OFF)

b. 0 to –50 dB for RBWs ≤ 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
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

	Specifications	Supplemental Information
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
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	

	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

	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 Power (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.

- 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	0.15 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	3.3%	2.9%, typical
Accuracy ^c	$\pm 0.8\%$	$\pm 0.6\%$, 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	3.3%	
Accuracy ^c	$\pm 0.8\%$	
Displayed resolution	0.01%	
Phase error		
Accuracy ^c	± 0.45 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	

	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	

	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

	Specifications	Supplemental Information
Swept Mode Dynamic Range		70 dB, characteristic
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
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	±0.1 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 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	

	Specifications	Supplemental Information
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 AYZ 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

- a. Factory preset, auto align Off, segmented sweep Off, fixed center frequency, RBW = 1 MHz, spans >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 A4H is installed, disable sweep ramp. (:SYSem: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-488.2 DLL.
- c. Factory preset, auto align Off, segmented sweep 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, segmented sweep Off, RBW = 1 MHz, span= 20 MHz, stop frequency ≤3 GHz, center frequency tune step size = 50 MHz.

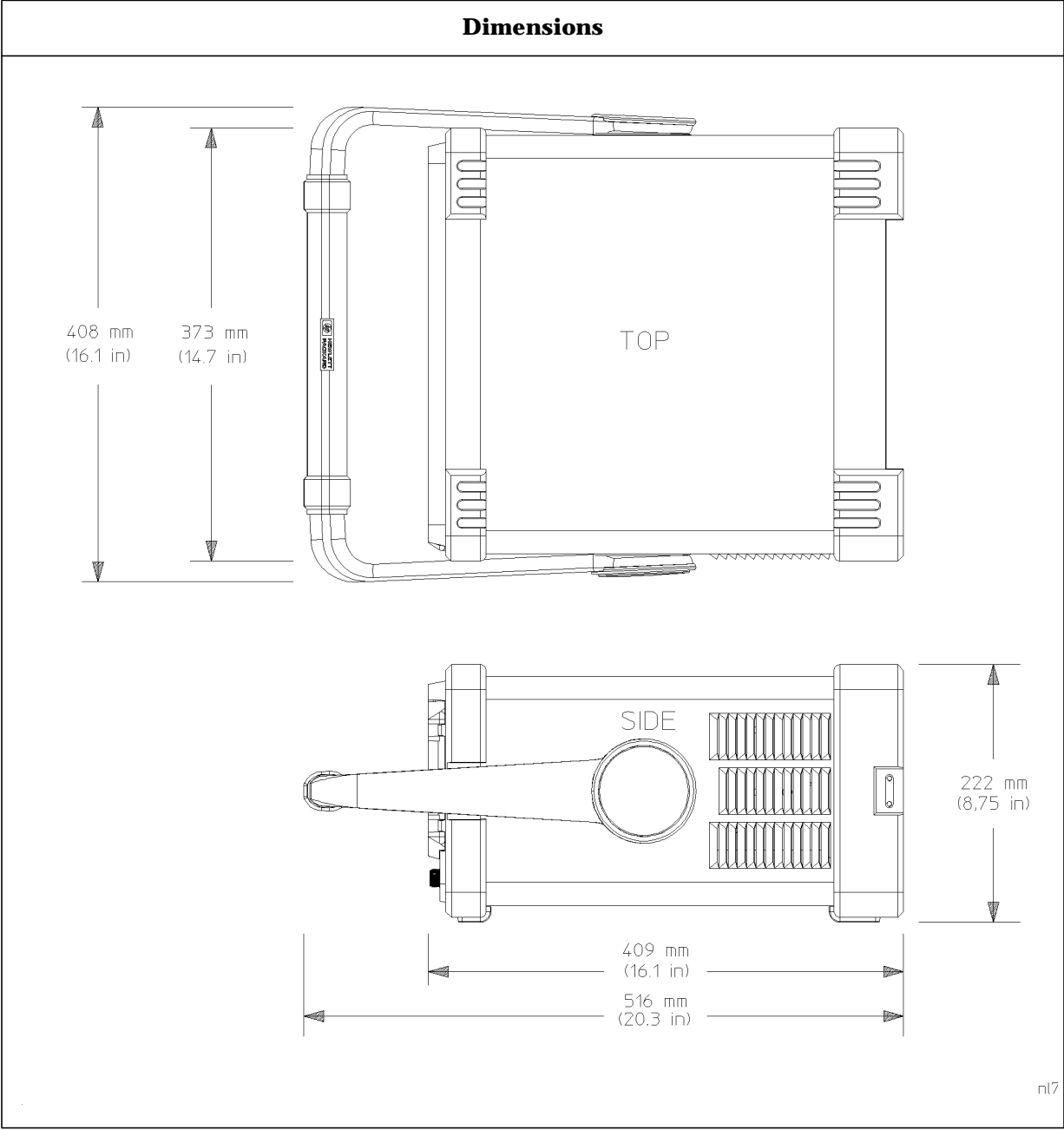
	Specifications	Supplemental Information
Data Storage		
Internal		200 Traces or States ^a
External (10 to 40 °C) 3.5" 1.44 MB, MS-DOS [®] compatible floppy disk		200 Traces or States ^a

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		Internal speaker, front-panel earphone jack and front-panel volume control.
Demod	AM	
<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		31.9 kg (70.3 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 \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

	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	
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 ^a ; Low = retrace (5 V TTL)
Gate Output (<i>Option 1D6</i>) Level		High = gate on; Low = gate off (5 V TTL)

a. High sweep may be high longer than the indicated sweep times.

	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 (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 \geq 1 kHz
Connector	BNC female	
Amplitude Range (into >10 k Ω)		0 to 1 V (uncorrected), characteristic

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

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

a. High sweep may be high longer than the indicated sweep times.

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

	Specifications	Supplemental Information
<p>EXT VIDEO OUT (<i>Option B7B or BAA</i>)</p> <p>Connector</p> <p>Impedance</p> <p><i>Option BAA</i> without <i>Option B7B</i> Amplitude</p> <p><i>Option BAA</i> with <i>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: E4401B, E4402B, E4403B, E4404B,
E4405B, E4407B, E4408B, 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 17 April 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 Agilent 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:
 - Every hour

1. 10 °C if Preamp (*Option 1DS*) is active.

- 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 Preamp (*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	$\pm 2 \times 10^{-6}$ /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 (Option 1D5)		
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)	$\pm((\text{frequency indication} \times \text{frequency reference error}^{\text{a}})$ $+ 0.5\% \text{ of span}$ $+ \frac{\text{span}}{\text{sweep points} - 1}$ $+ 15\% \text{ of RBW}$ $+ 10 \text{ Hz} + 1 \text{ Hz} \times N^{\text{b}})$	

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

b. N is the harmonic mixing mode.

	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 ^b	$\pm(0.5\% \text{ of span} + 2 \times \frac{\text{span}}{\text{sweep points} - 1})$	

- a. N is the harmonic mixing mode.
b. Applies to each sweep segment.

	Specifications	Supplemental Information
Sweep Time		
Range		
Span > 0 Hz	1 ms to 4000 s ^a	$\frac{\text{sweep points} - 1}{100 \text{ kHz}}$ to 4000 s
Span = 0 Hz	10 μ s to 4000 s ^{ab}	
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)	50 ns to 4000 s ^{cd}	$\frac{\text{sweep points} - 1}{20 \text{ MHz}}$ to 4000 s

	Specifications	Supplemental Information
DSP and fast ADC (Option B7D) (For Span = 0 Hz, RBW ≥ 1 kHz)	25 ns to 4000 s ^e	$\frac{\text{sweep points} - 1}{40 \text{ MHz}}$ to 4000 s
Accuracy (Span = 0 Hz)		
10 μs to 4000 s ^{ab}	±1%	
(Option AYX)	±1%	
50 ns to 4000 s ^{cd}		
(Option B7D)	±1%	
25 ns to 4000 s ^e		
Sweep Trigger ^{fg}	Free Run, Single, Line, Video, External, Delayed, Offset ^h	
(Option 1D6)	Add Gate	
(Option B7B)	Add TV	
Delayed Trigger ^{gi}		
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 ^h		
Resolution	$\frac{\text{sweep time}}{\text{sweep points} - 1}$	
Range	±327 ms to ±12.3 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 $\frac{\text{sweep points} - 1}{20 \text{ MHz}}$ to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$)	±1.23 ms to ±245 ms	$\frac{-32766 \times ST}{SP - 1}$ to $\frac{(32766 - SP) \times ST}{SP - 1}$

	Specifications	Supplemental Information
DSP and fast ADC (Option B7D) (For sweep times $\frac{\text{sweep points} - 1}{40 \text{ MHz}}$ to $\frac{\text{sweep points} - 1}{100 \text{ kHz}}$)	$\pm 13 \text{ ms}$ to $\pm 5.15 \text{ s}$	$\frac{-524031 \times ST}{SP - 1}$ to $\frac{(524031 - SP) \times ST}{SP - 1}$

- For firmware revisions prior to A.04.00, 5 ms to 2000 s.
- For firmware revisions prior to A.05.00, 1 ms to 4000 s.
- For firmware revisions prior to A.04.00, 20 μs to 2000 s.
- For firmware revisions prior to A.05.00, 5 μs to 4000 s.
- For firmware revisions prior to A.05.00, 2.5 μs to 4000 s.
- Gate cannot be used simultaneously with delayed or TV trigger (Option B7B).
- Auto align is suspended in video, external, gate, and delayed trigger modes while waiting for a trigger event to occur.
- For firmware revision A.04.00 or later.
- Delayed trigger is available with line, external trigger, and TV trigger (Option B7B).

	Specifications	Supplemental Information
Sweep (trace) Points Range Span > 0 Hz Span = 0 Hz	101 to 8192 ^a 2 to 8192 ^{ab}	

- For firmware revisions prior to A.04.00, 401 points.
- For firmware revisions prior to A.05.00, 101 to 8192 points.

	Specifications	Supplemental Information
Resolution Bandwidth (RBW) Range -3 dB bandwidth -6 dB bandwidth (EMI) (Option 1DR) -3 dB bandwidth -6 dB bandwidth (EMI)	1 kHz to 3 MHz, in 1-3-10 sequence, 5 MHz 9 kHz and 120 kHz Adds 10, 30, 100, 300 Hz 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. (Option 1DN)

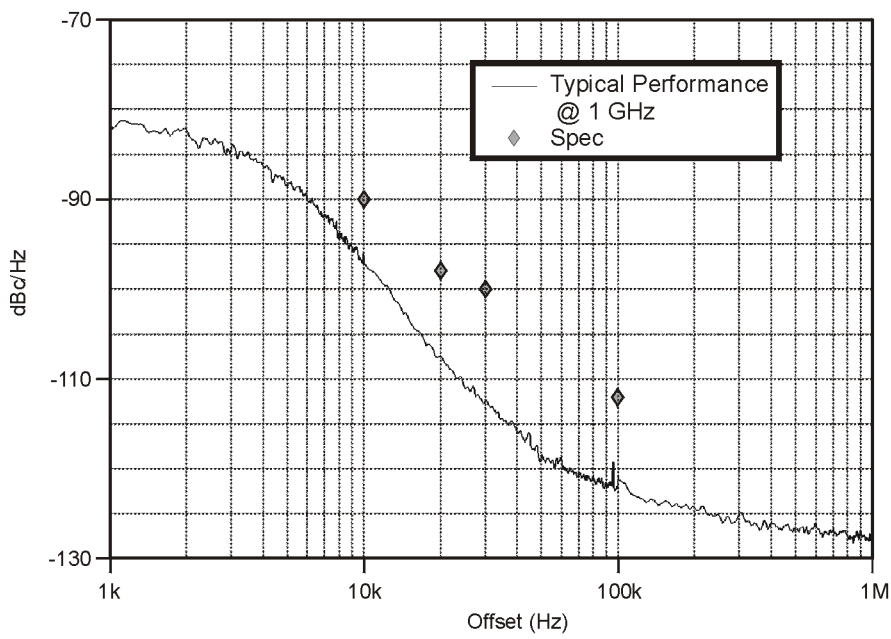
	Specifications	Supplemental Information
Accuracy 1 kHz to 3 MHz RBW 5 MHz RBW 10 Hz to 300 Hz RBW (<i>Option 1DR</i>) Shape 1 kHz to 5 MHz RBW 10 Hz to 300 Hz RBW (<i>Option 1DR</i>) Selectivity (60 dB/3 dB bandwidth ratio) 1 kHz to 5 MHz RBW 10 Hz to 300 Hz RBW (<i>Option 1DR</i>)	±15% ±30% ±10%	Synchronously 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 ^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 <i>(Option 1D5)</i>	≤150 Hz × N p-p in 100 ms ≤100 Hz × N p-p in 100 ms	
10 Hz RBW, 10 Hz VBW <i>(Option 1DR and 1D5)</i>	≤2 Hz × N p-p in 20 ms	
10 Hz RBW, 10 Hz VBW <i>(Option 1DR)</i>		≤10 Hz × N p-p in 20 ms, characteristic
System-Related Sidebands, offset from CW signal		
≥30 kHz	≤ -65 dBc ^a	
Line-Related Sidebands, offset from CW signal		
<i>(Option 1DR)</i>		
<300 Hz		≤ -50 dBc ^a , characteristic
>300 Hz to 30 kHz		≤ -55 dBc ^a , characteristic

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

Noise Sidebands Normalized to 1 Hz Versus Offset From Carrier



wl74b

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

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).

	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 (Option 1DR)	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW (Option 1DR)
9 kHz to 100 kHz				≤ -105 dBm, characteristic
100 kHz to 1 MHz				≤ -131 dBm, characteristic
1 MHz to 10 MHz			≤ -116 dBm, characteristic	≤ -135 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 (Option 1DS)	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW (Option 1DR)	1 kHz RBW 30 Hz VBW	10 kHz RBW 1 Hz VBW (Option 1DR)
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 (<i>Option 1DR</i>)			
0 to -120 dB from ref level		0.04 dB	

	Specifications	Supplemental Information
Absolute ^a /Relative Preamp On (<i>Option 1DS</i>)		
1 MHz to 3.0 GHz		
0 dB attenuation	±2.0 dB	
Preselector centered for frequency >3.0 GHz		
10 dB attenuation		
3.0 GHz to 6.7 GHz		
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		
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		
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	
External Mixer (<i>Option AYZ</i>)	IF INPUT absolute amplitude accuracy + external mixer conversion loss accuracy ^c	
Overall Amplitude Accuracy ^d		
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. 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		≤3.0:1, characteristic
Attenuator setting 5 dB		
9 kHz to 100 kHz		≤2.0:1, characteristic
100 kHz to 6.7 GHz		≤1.4:1, characteristic
6.7 GHz to 13.2 GHz		≤1.7:1, characteristic

	Specifications	Supplemental Information
13.2 GHz to 22.0 GHz		≤2.3:1, characteristic
22.0 GHz to 26.5 GHz		≤2.6:1, characteristic
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	
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	

	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</p> <p>-60 dBm to > -85 dBm</p> <p>-85 dBm to -90 dBm</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 ≤ 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>Span = 0 Hz^a</p> <p>0 to -60 dB from Reference Level</p> <p>-60 to -70 dB from Reference Level</p>	<p>±(0.3 dB + 0.01 × dB from Reference Level)</p> <p>±(0.3 dB + 0.01 × dB from Reference Level)</p> <p>±(0.3 dB + 0.015 × dB from Reference Level)</p> <p>±1.5 dB</p>	<p>±2.0 dB, characteristic</p>

	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)

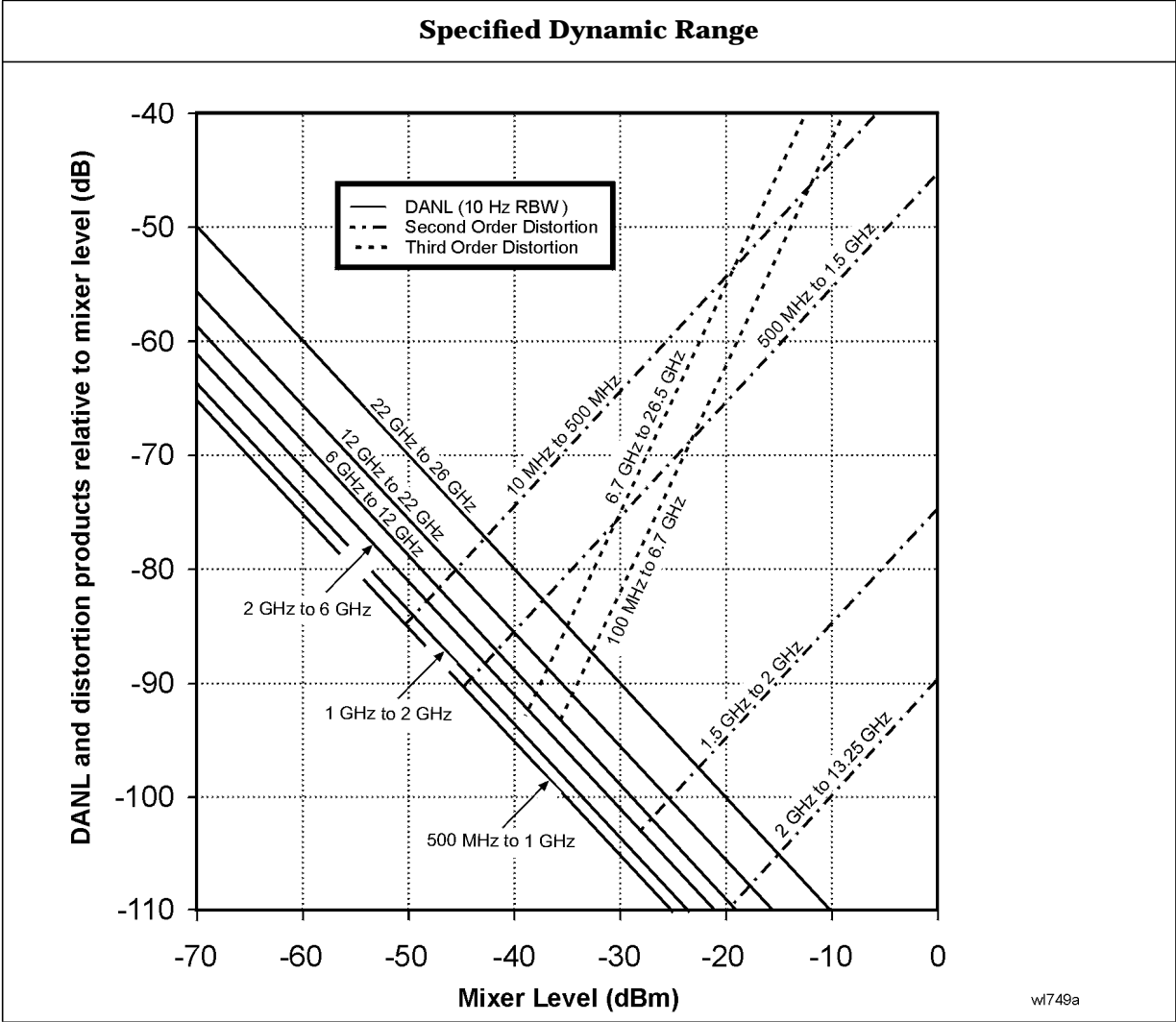
b. 0 to -50 dB for RBWs ≤ 300 Hz and span = 0 Hz, or when auto ranging is off.

	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
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

	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
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		
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

	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

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	15.5 to 17 dBm		
20 to 30°C	15 to 17.5 dBm		
0 to 55°C	13 to 17.5 dBm		
2.9 to 7.1 GHz			
VSWR			<1.9:1, characteristic
IF INPUT			
Frequency Range			321.4 MHz ±5 MHz, characteristic
Maximum Safe Input Level			
ac			10 dBm, characteristic
dc			±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 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	

	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 Power (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.

- 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	0.15 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	3.3%	2.9%, typical
Accuracy ^c	$\pm 0.8\%$	$\pm 0.6\%$, 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	3.3%	
Accuracy ^c	±0.8%	
Displayed resolution	0.01%	
Phase error		
Accuracy ^c	±0.45 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	

	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) (Option B7D and B7E)	Free run, external Add RF Burst, frame	
Delay trigger Range	0 to 500 ms	
Resolution	300 ns	
RF burst trigger level (Option B7E)	0 to -25 dBc	
Trigger slope (External and RF burst)	Positive/Negative	
Frame timing period	50 ns to 13.6533 s	
Frame synchronizing source	External frame sync	Rear panel connector labelled EXT FRAME SYNC (Option B7D)
Frame synchronizing slope	Positive/Negative	

	Specifications	Supplemental Information
Demod Trigger Source		
Even second input (Frame trigger only, Option B7D and B7E)		Rear panel connector labelled EXT FRAME SYNC
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	

	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, 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	±0.1 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 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	
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 (Requires <i>Option AYX</i> or <i>B7D</i>)		
Source (Actual available choices dependent on measurement) <i>(Option B7D and B7E)</i>	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

- a. Factory preset, auto align Off, segmented sweep Off, fixed center frequency, RBW = 1 MHz, spans >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 A $\overline{Y}X$ or A4 \overline{J} is installed, disable sweep ramp, (:SYSem: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-488.2 DLL.
- c. Factory preset, auto align Off, segmented sweep 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, segmented sweep Off, RBW = 1 MHz, span= 20 MHz, stop frequency ≤3 GHz, center frequency tune step size = 50 MHz.

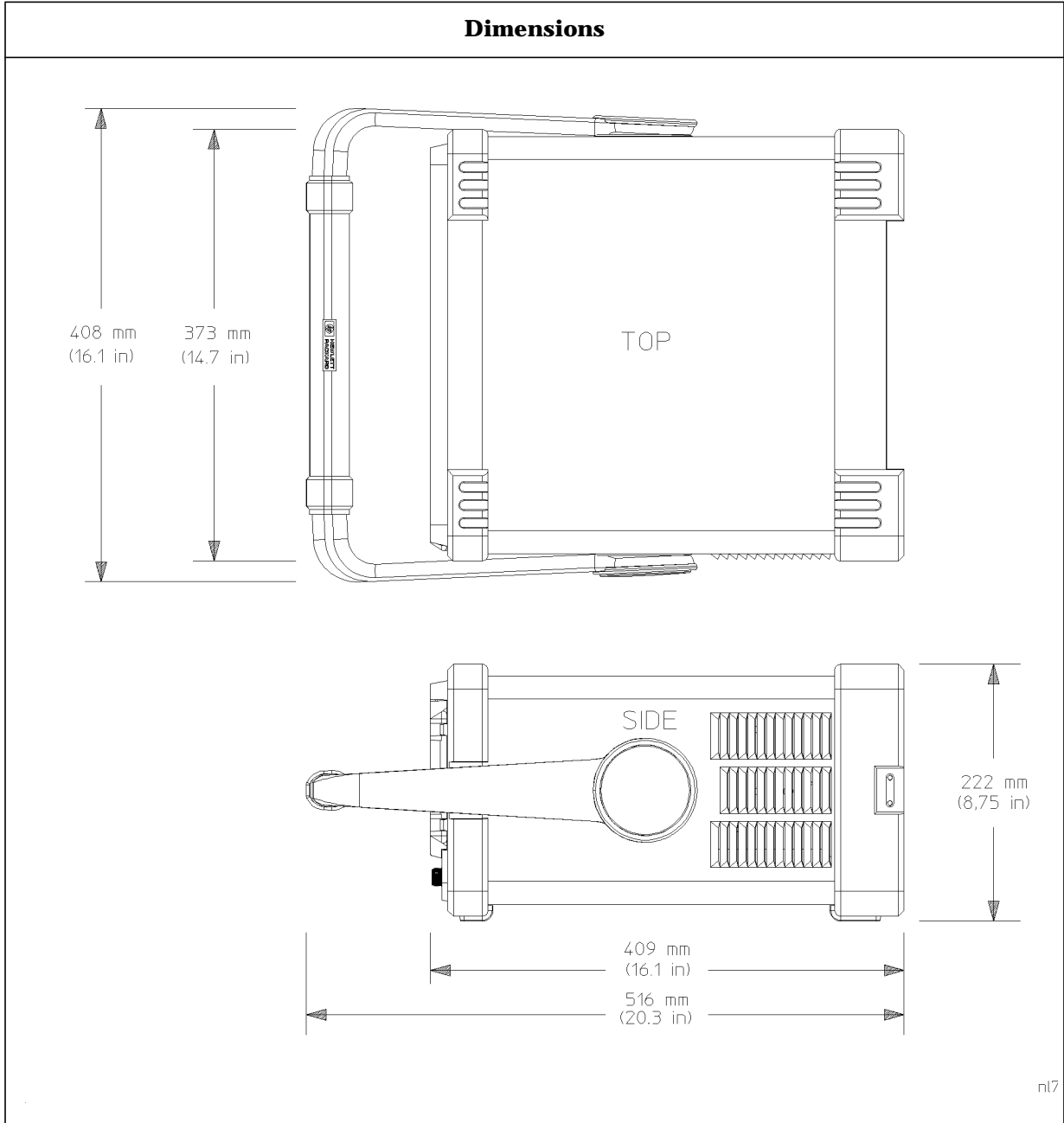
	Specifications	Supplemental Information
Data Storage		
Internal		200 Traces or States ^a
External (10 to 40 °C) 3.5" 1.44 MB, MS-DOS [®] compatible floppy disk		200 Traces or States ^a

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		Internal speaker, front-panel earphone jack and front-panel volume control.
Demod	AM	
<i>(Option BAA)</i>	Add FM	
<i>(Option A4J, AYZ, 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		31.9 kg (70.3 lb), characteristic



Inputs and Outputs

Front Panel

	Specifications	Supplemental Information
INPUT 50 Ω		
Connector <i>(Option BAB)</i>	Type-N female APC 3.5 male	
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 \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

	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	

	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 ^a ; Low = retrace (5 V TTL)
Gate Output (<i>Option 1D6</i>)		
Level		High = gate on; Low = gate off (5 V TTL)

a. High sweep may be high longer than the indicated sweep times.

	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 AYY</i>)		RBW ≥ 1 kHz
Connector	BNC female	
Frequency		21.4 MHz, nominal

	Specifications	Supplemental Information
Amplitude (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 AYX)</i>		
Connector	BNC female	
Input		Open collector, low resets and holds the sweep (5 V TTL)

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

a. High sweep may be high longer than the indicated sweep times.

	Specifications	Supplemental Information
SWP OUT <i>(Option A4J or AYX)</i>		
Connector	BNC female	
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		
Internal Mixer		0.33 V/GHz of tuned frequency > 3 GHz, characteristic
External Mixer (<i>Option AYZ</i>)		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

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

- 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 ≥ 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: E4401B, E4402B, E4403B, E4404B,
E4405B, E4407B, E4408B, 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 17 April 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 Agilent 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 °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 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).

	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	$\pm(500 \text{ ns} + (0.01\% \text{ of delay}))$	

	Specifications	Supplemental Information
Offset Trigger ^c		
Resolution	$\frac{\text{sweep time}}{400}$	
Range	$\pm 327 \text{ ms to } \pm 323 \text{ ks}$	Where ST = sweep time $\frac{-32766 \times \text{ST}}{400}$ to $\frac{32365 \times \text{ST}}{400}$

- 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	

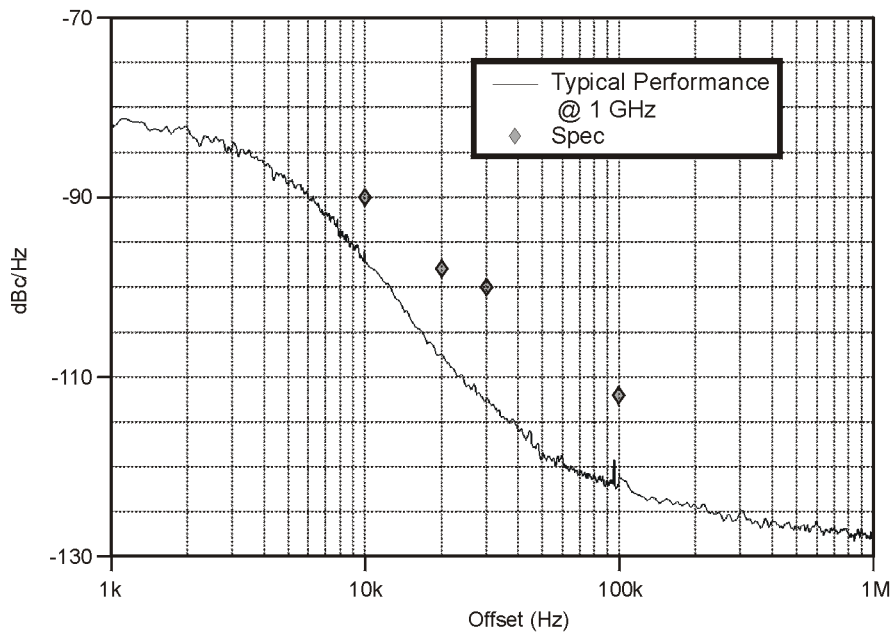
	Specifications	Supplemental Information
Resolution Bandwidth (RBW)		
Range		
-3 dB bandwidth	1 kHz to 3 MHz, in 1-3-10 sequence, 5 MHz	
-6 dB bandwidth (EMI)	9 kHz and 120 kHz	
Accuracy		
1 kHz to 3 MHz RBW	$\pm 15\%$	
5 MHz RBW	$\pm 30\%$	
Shape		
1 kHz to 5 MHz RBW		Synchronously tuned four poles, 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 (Option 1D5)	≤150 Hz × N p-p in 100 ms ≤100 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.

	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>3.0 GHz to 6.0 GHz</p> <p>6.0 GHz to 12 GHz</p> <p>12 GHz to 22 GHz</p> <p>22 GHz to 26.5 GHz</p>	<p>1 kHz RBW, 30 Hz VBW</p> <p>≤ -116 dBm</p> <p>≤ -115 dBm</p> <p>≤ -112 dBm</p> <p>≤ -112 dBm</p> <p>≤ -110 dBm</p> <p>≤ -107 dBm</p> <p>≤ -101 dBm</p>	<p>1 kHz RBW, 30 Hz VBW</p> <p>≤ -116 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>	

	Specifications	Supplemental Information
Frequency Response		
Absolute ^a /Relative		
10 dB attenuation		
9 kHz to 3.0 GHz		
20 to 30 °C	±0.5 dB	
0 to 55 °C	±1.0 dB	
Preselector centered for frequency >3.0 GHz		
10 dB attenuation		
3.0 GHz to 6.7 GHz		
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		
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		
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					
Attenuation	Frequency Range				
	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
Absolute Amplitude Accuracy		
At reference settings ^a	± 0.4 dB	
Overall Amplitude Accuracy ^b		
20 to 30 °C	$\pm (0.6 \text{ dB} + \text{Absolute Frequency Response})$	

- 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, signal at reference level.
- b. For reference level 0 to -50 dBm; input attenuation 10 dB; dc coupled; 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		$\leq 3.0:1$, characteristic
Attenuator setting 5 dB		
9 kHz to 100 kHz		$\leq 2.0:1$, characteristic
100 kHz to 6.7 GHz		$\leq 1.4:1$, characteristic
6.7 GHz to 13.2 GHz		$\leq 1.7:1$, characteristic
13.2 GHz to 22.0 GHz		$\leq 2.3:1$, characteristic
22.0 GHz to 26.5 GHz		$\leq 2.6:1$, characteristic
Attenuator setting 10 to 65 dB		
9 kHz to 6.7 GHz		$\leq 1.3:1$, characteristic
6.7 GHz to 13.2 GHz		$\leq 1.5:1$, characteristic
13.2 GHz to 22.0 GHz		$\leq 2.0:1$, characteristic
22.0 GHz to 26.5 GHz		$\leq 2.2:1$, 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	$\pm 0.12\%$ 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	

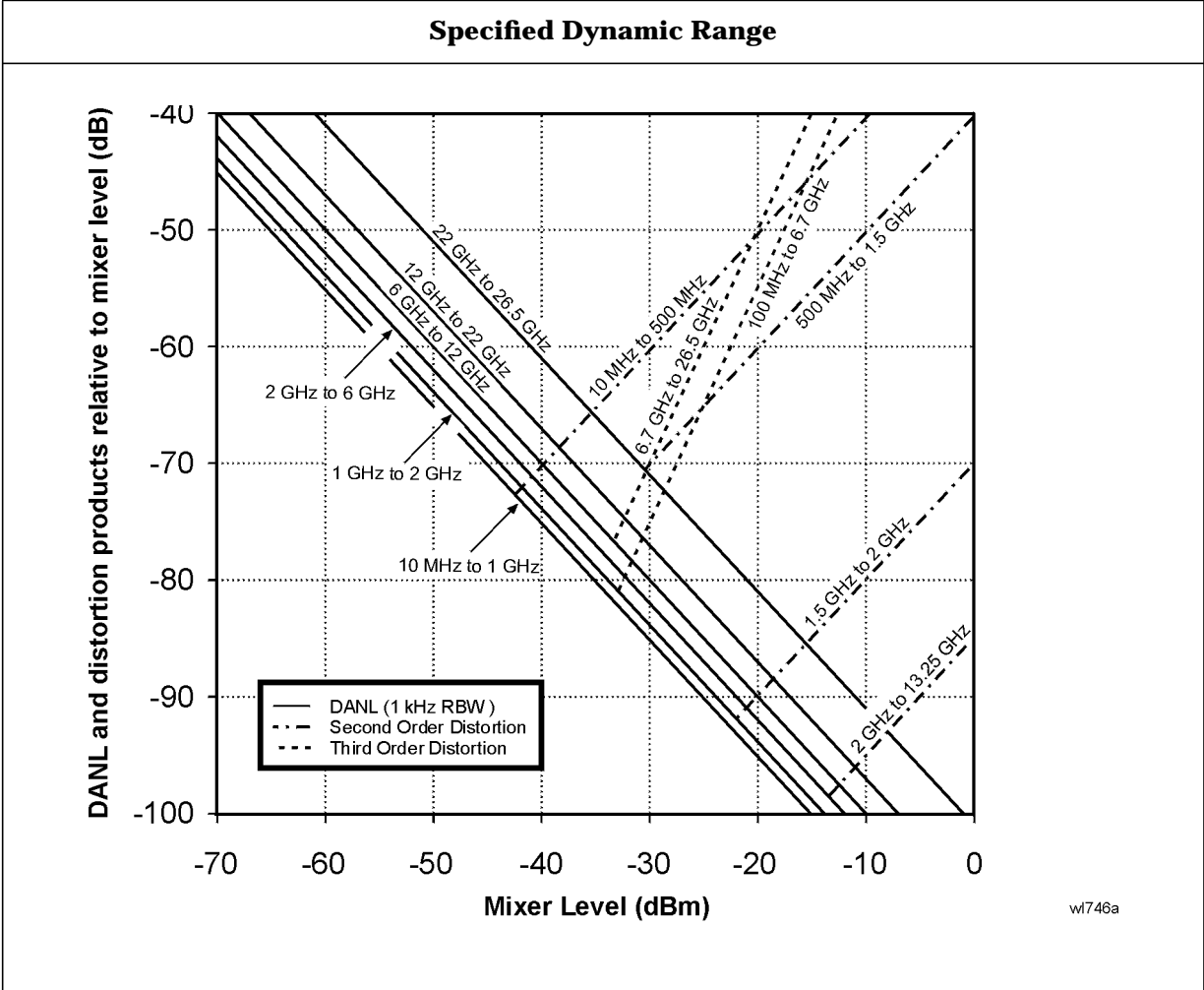
	Specifications	Supplemental Information
Display Scale Fidelity		
Log Maximum Cumulative 0 to -85 dB from Reference Level	$\pm(0.3 \text{ dB} + 0.01 \times \text{dB from Reference Level})$	
Log Incremental Accuracy 0 to -80 dB from reference level	$\pm 0.4 \text{ dB}/4 \text{ dB}$	
Linear Accuracy	$\pm 2\%$ 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
1.5 GHz to 2.0 GHz	$< -80 \text{ dBc}$ for -10 dBm signal at input mixer ^a	+70 dBm SHI
2.0 GHz to 3.35 GHz	$< -95 \text{ dBc}^b$ for -10 dBm signal at input mixer ^a	+85 dBm SHI
3.35 GHz to 6.6 GHz	$< -95 \text{ dBc}^b$ for -10 dBm signal at input mixer ^a	+85 dBm SHI
6.6 GHz to 13.25 GHz	$< -95 \text{ dBc}^b$ for -10 dBm signal at input mixer ^a	+85 dBm SHI

	Specifications	Supplemental Information
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	

	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.

	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	

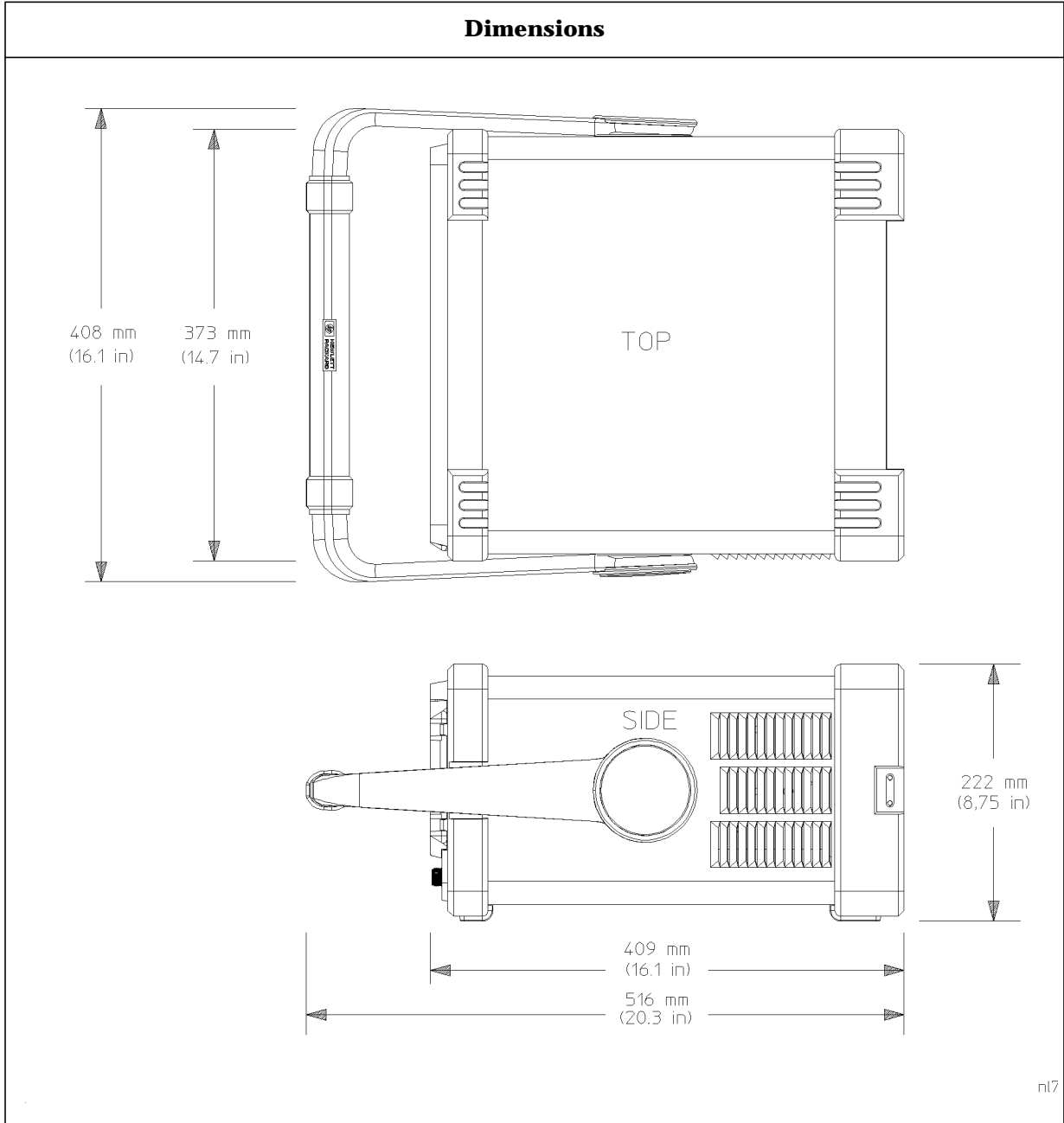
	Specifications	Supplemental Information
Measurement Speed		
Local Measurement and Display Update rate ^a		≥ 28/s, characteristic
Remote Measurement and GPIB Transfer Rate ^{bc} (Option A4H)		≥ 28/s, characteristic
RF Center Frequency Tune, Measure, and GPIB Transfer Time ^{bd} (Option A4H)		≤ 90 ms,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

- a. Factory preset, auto align Off, fixed center frequency, RBW = 1 MHz, spans >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-488.2 DLL
- c. Factory preset, auto align Off, fixed center frequency, RBW = 1 MHz, and span = 20 MHz, 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 External (10 to 40 °C) 3.5" 1.44 MB, MS-DOS® compatible floppy disk		200 Traces or States 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 Shipping		17.1 kg (37.7 lb), characteristic 31.9 kg (70.3 lb), characteristic



Inputs and Outputs

Front Panel

	Specifications	Supplemental Information
INPUT 50 Ω		
Connector <i>(Option BAB)</i>	Type-N female APC 3.5 male	
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

	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.

	Specifications	Supplemental Information
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 ^a ; Low = retrace (5 V TTL)

a. High sweep may be high longer than the indicated sweep times.

	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	

	Specifications	Supplemental Information
AUX IF OUT (Option A4J)		
Connector	BNC female	
Frequency		21.4 MHz, nominal

	Specifications	Supplemental Information
Amplitude (for signal at reference level and for reference levels – input attenuation of –10 to –70 dBm)		–10 dBm (uncorrected), characteristic
Impedance		50 Ω , nominal

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

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

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

a. High sweep may be high longer than the indicated sweep times.

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

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: E4401B, E4402B, E4403B, E4404B,
E4405B, E4407B, E4408B, 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 17 April 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 Agilent 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	±327 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.

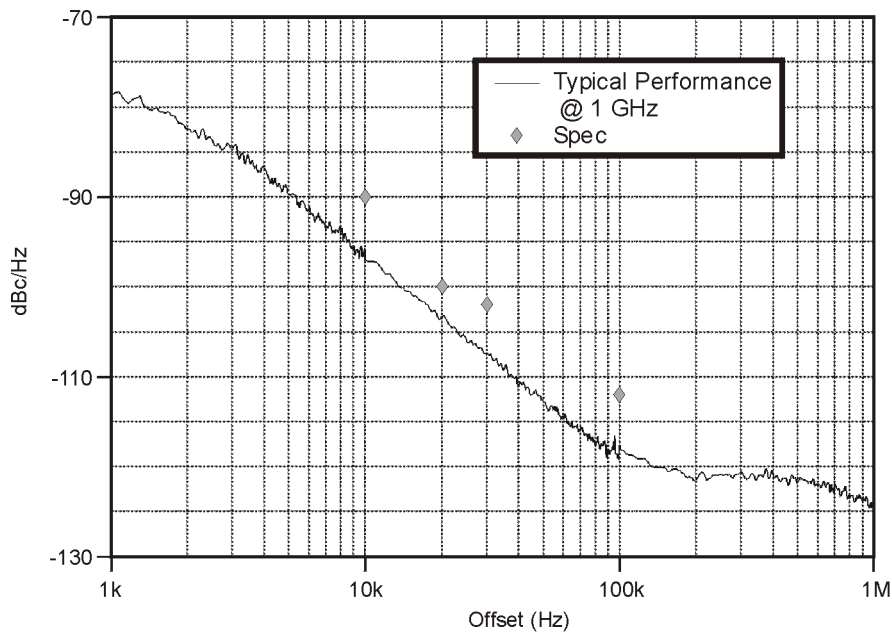
	Specifications	Supplemental Information
Sweep (trace) Points	401	

	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
<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</p> <p>≥20 kHz ≤ -100 dBc/Hz</p> <p>≥30 kHz ≤ -102 dBc/Hz</p> <p>≥100 kHz ≤ -112 dBc/Hz</p> <p>Residual FM</p> <p>1 kHz RBW, 1 kHz VBW ≤150 Hz p-p in 100 ms</p> <p>System-Related Sidebands, offset from CW signal</p> <p>≥30 kHz ≤ -65 dBc</p>		

Noise Sidebands Normalized to 1 Hz Versus Offset From Carrier



w173b

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.
Average Continuous Power or Peak Pulse Power		
50 Ω	+30 dBm (1 W)	
75 Ω (Option 1DP)	+75 dBmV (0.4 W)	75 Ω : signals $> +79$ dBmV (1 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.
Average Continuous Power or Peak Pulse Power		
50 Ω	+3 dBm (2 mW)	
75 Ω (Option 1DP)	+59 dBmV (10 mW)	75 Ω : signals $> +61$ dBmV (15 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 75 Ω (<i>Option 1DP</i>)	0 dBm +46.75 dBmV	

- 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
Displayed Average Noise Level (Input terminated, 0 dB attenuation, sample detector, Reference Level = -70 dBm) (75 Ω: Reference Level = -21.24 dBmV)		
50 Ω 400 kHz to 10 MHz 10 MHz to 500 MHz 500 MHz to 1.0 GHz 1.0 GHz to 1.5 GHz	1 kHz RBW, 30 Hz VBW ≤ -115 dBm ≤ -119 dBm ≤ -117 dBm ≤ -113 dBm	
75 Ω, (<i>Option 1DP</i>) 1 MHz to 10 MHz 10 MHz to 500 MHz 500 MHz to 1.0 GHz 1.0 GHz to 1.5 GHz	1 kHz RBW, 30 Hz VBW ≤ -63 dBmV ≤ -65 dBmV ≤ -60 dBmV ≤ -53 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	
	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

	Specifications	Supplemental Information
<p>75 Ω, Absolute^a/Relative (Option 1DP)</p> <p>1 MHz to 1.5 GHz</p> <p>10 dB attenuation</p> <p>20 to 30 °C</p> <p>0 to 55 °C</p> <p>0, 5, 15 to 50 dB attenuation</p> <p>55 to 60 dB attenuation</p> <p>1 MHz to 1 GHz</p> <p>1 GHz to 1.5 GHz</p> <p>75 Ω, Absolute^a/Relative Preamp On (Option 1DS and 1DP)</p> <p>1 MHz to 1.5 GHz</p> <p>0 dB attenuation</p> <p>20 to 30 °C</p> <p>0 to 55 °C</p> <p>5 dB to 20 dB attenuation</p>	<p>±0.5 dB</p> <p>±1.0 dB</p>	<p>±1.0 dB, characteristic</p> <p>±1.0 dB, characteristic</p> <p>±1.25 dB, characteristic</p> <p>±2.0 dB, characteristic</p>

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

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

	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 -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; dc coupled; 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

	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	$\pm 0.12\%$ of Reference Level	
50 Ω , Accuracy (at a fixed frequency, a fixed attenuator, and referenced to -35 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	
75 Ω (Option 1DP), Accuracy (at a fixed frequency, a fixed attenuator, and referenced to 18.75 dBmV)		
Reference Level (dBmV) – input attenuator setting (dB)		
38.75 dBmV to > -11.25 dBmV	± 0.3 dB	
-11.25 dBmV to > -26.25 dBmV	± 0.5 dB	
-26.25 dBmV to -41.25 dBmV	± 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	± 0.4 dB/4 dB	
Linear Accuracy	$\pm 2\%$ of Reference Level	

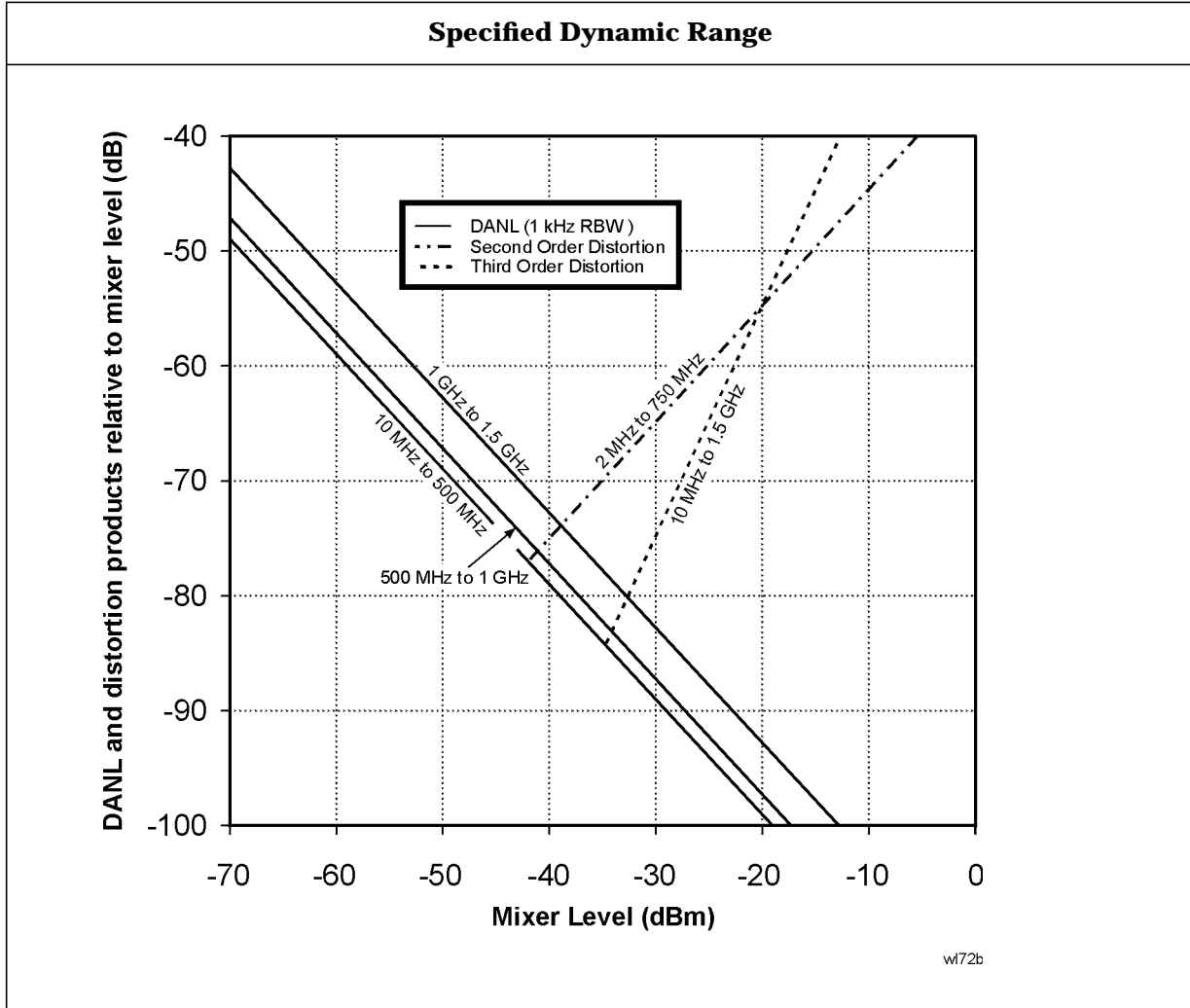
	Specifications	Supplemental Information
Spurious Responses		
50 Ω		
Second Harmonic Distortion		
Input Signal		
2 MHz to 750 MHz	< -75 dBc for -40 dBm signal at input mixer ^a	+35 dBm SHI (second harmonic intercept)
Third Order Intermodulation Distortion		
2 MHz to 10 MHz		+5 dBm TOI (third order intercept), 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

	Specifications	Supplemental Information
Other Input Related Spurious		
30 kHz ≤ 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 ± 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	
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 ≤ 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 ± RBW		< -62 dBc, for +3.75 dBmV signal at input mixer ^a

a. Mixer Power Level (dBmV) = Input Power (dBmV) – 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 (<i>Option 1DN</i>)	9 kHz to 1.5 GHz	
75 Ω (<i>Option 1DQ</i>)	1 MHz to 1.5 GHz	

	Specifications	Supplemental Information
Output Power Level		
20 to 30 °C		
Range		
50 Ω (<i>Option 1DN</i>)	0 to -70 dBm	
75 Ω (<i>Option 1DQ</i>)	+42.75 to -27.25 dBmV	
Resolution	0.1 dB	
Absolute Accuracy (at 50 MHz with coupled source attenuator)		
50 Ω (<i>Option 1DN</i>) referenced to 0 dBm	± 0.5 dB	
75 Ω (<i>Option 1DQ</i>) referenced to +42.75 dBmV	± 1.5 dB	
Vernier		
Range	10 dB	
Accuracy (with coupled source attenuator)		
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 (Option 1DN) ^a		+20 dBm (0.1 W), 100 Vdc, characteristic
75 Ω (Option 1DQ) ^a		+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)	(-15 to 0 dBm) – (Source Attenuator Setting)	
75 Ω (Option 1DQ)	(27.75 to 42.75 dBmV) – (Source Attenuator Setting)	
Resolution	0.1 dB	
Accuracy (zero span)		
50 Ω (Option 1DN)	<1.5 dB peak-to-peak	
75 Ω (Option 1DQ)	<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	± 2 dB	
10 MHz to 1.5 GHz	± 1.5 dB	
75 Ω (Option 1DQ)		
1 MHz to 10 MHz	± 2.5 dB	
10 MHz to 1.5 GHz	± 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) 75 Ω (Option 1DQ)		<2.5:1, characteristic <2.0:1, characteristic

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

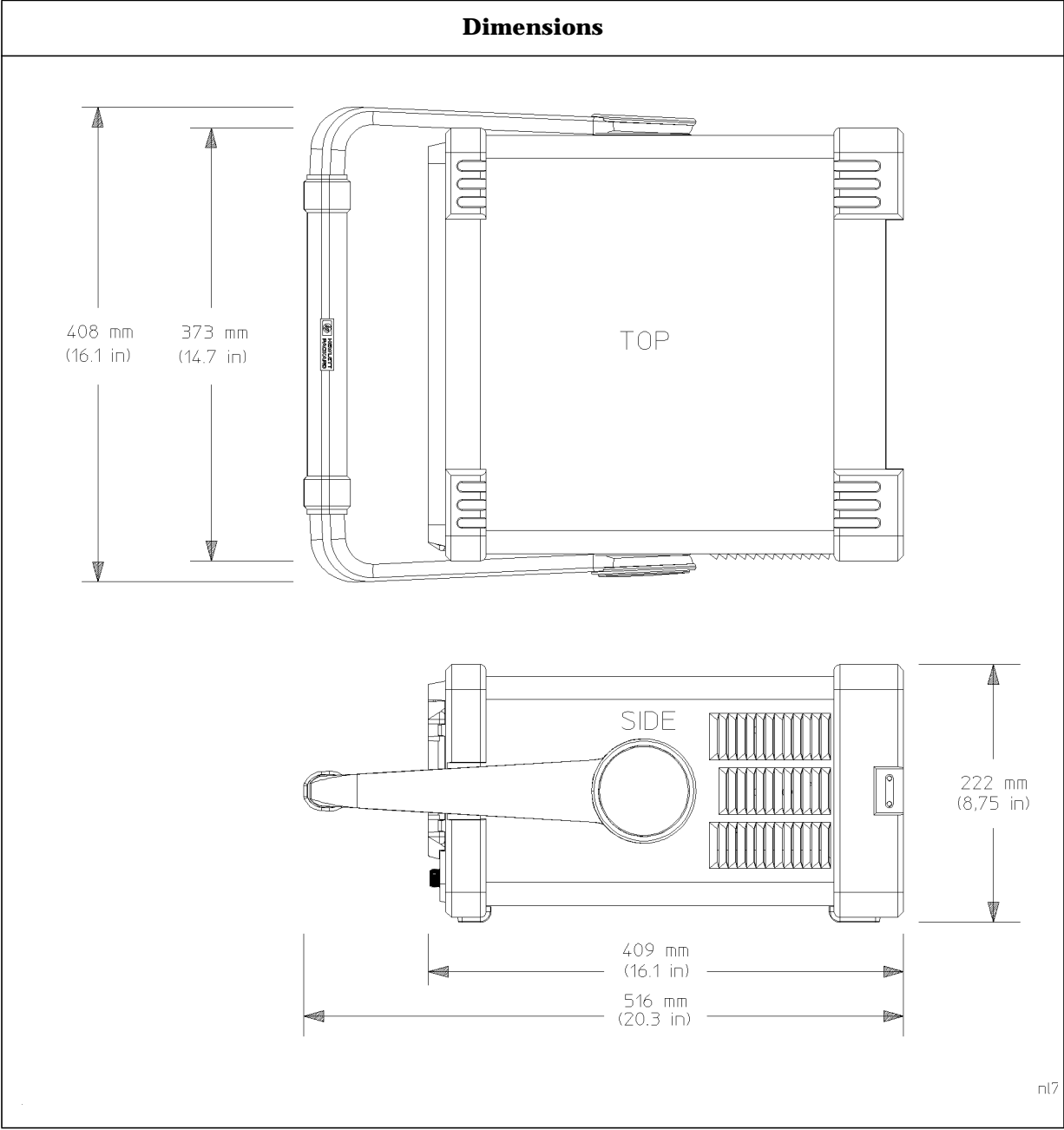
	Specifications	Supplemental Information
Measurement Speed		
Local Measurement and Display Update rate ^{ab}		≥ 35/s, characteristic
Remote Measurement and GPIB Transfer Rate ^{bcd} (Option A4H)		≥ 30/s, characteristic
RF Center Frequency Tune, Measure, and GPIB Transfer Time ^{bce} (Option A4H)		≤ 90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

- a. Factory preset, auto align Off, fixed center frequency, RBW = 1 MHz, and spans >102 MHz and ≤400 MHz.
- b. Sweeping through 425.6 MHz or 914.6 MHz will cause the 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, 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-488.2 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 × 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 ^a ; Low = retrace (5 V TTL)

a. High sweep may be high longer than the indicated sweep times.

	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	

	Specifications	Supplemental Information
AUX IF OUT <i>(Option A4J)</i> Connector Frequency Amplitude (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 ^a , Low = retrace (5 V TTL)

a. High sweep may be high longer than the indicated sweep times.

	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: E4401B, E4402B, E4403B, E4404B,
E4405B, E4407B, E4408B, 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 17 April 2000

Greg Pfeiffer/Quality Engineering Manager

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