Specifications Guide

Agilent Technologies
N9010A EXA Signal Analyzer

Agilent Technologies

Manufacturing Part Number: N9010-90008
Supersedes: N9010-90007

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Notice

The information contained in this document is subject to change without notice.

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NOTE *Note* calls out special information for the user's attention. It provides operational information or additional instructions of which the user should be aware.

Where to Find the Latest Information

Documentation is updated periodically. For the latest information about this analyzer, including firmware upgrades, application information, and product information, see the following URL:

http://www.agilent.com/find/exa

Contents

1 Agilent EXA Signal Analyzer

This chapter contains the specifications for the core signal analyzer. The specifications and characteristics for the measurement applications and options are covered in the chapters that follow.

Definitions and Requirements

This book contains signal analyzer specifications and supplemental information. The distinction among specifications, typical performance, and nominal values are described as follows.

Definitions

- Specifications describe the performance of parameters covered by the product warranty (temperature = 5 to 50 °C, unless otherwise noted).
- 95th percentile values indicate the breadth of the population (≈2σ) of performance tolerances expected to be met in 9 of the cases with a 95 % confidence, for any ambient temperature in the range of 20 to 30 °C. In addition to the statistical observations of a sample of instruments, these values include the effects of the uncertainties of external calibration references. These values are not warranted. These values are updated occasionally if a significant change in the statistically observed behavior of production instruments is observed.
- Typical describes additional product performance information that is not covered by the product warranty. It is performance beyond specification that 80% of the units exhibit with a 95% confidence level over the temperature range 20 to 30 °C. Typical performance does not include measurement uncertainty.
- Nominal values indicate expected performance, or describe product performance that is useful in the application of the product, but is not covered by the product warranty.

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

Conditions Required to Meet Specifications

- The analyzer is within its calibration cycle. See the General section of this chapter.
- Under auto couple control, except that Auto Sweep Time Rules = Accy.
- For signal frequencies < 20 MHz, DC coupling applied.
- Any analyzer that has been stored at a temperature range inside the allowed storage range but outside the allowed operating range must be stored at an ambient temperature within the allowed operating range for at least two hours before being turned on.
- The analyzer has been turned on at least 30 minutes with Auto Align set to Normal, or if Auto Align is set to Off or Partial, alignments must have been run recently enough to prevent an Alert message. If the Alert condition is changed from "Time and Temperature" to one of the disabled duration choices, the analyzer may fail to meet specifications without informing the user.

Certification

Agilent Technologies certifies that this product met its published specifications at the time of shipment from the factory. Agilent Technologies further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology, to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.

Frequency and Time

Description	Specifications		Supplemental Information
Frequency Range			
Maximum Frequency			
Option 503	3.6 GHz		
Option 507	7 GHz		
Option 513	13.6 GHz		
Option 526	26.5 GHz		
Preamp Option P03	3.6 GHz		
Minimum Frequency			
Preamp	AC Coupled	DC Coupled	
Off	10 MHz	9 kHz	
On	10 MHz	100 kHz	
	Harmonic Mixing Mode	**LO Multiple (N[a])**	
Band			
0 (9 kHz to 3.6 GHz)	1–	1	*Options 503,507, 513, 526*
1 (3.5 GHz to 8.4 GHz)	1–	1	*Options 513, 526*
1 (3.5 GHz to 7 GHz)	1–	1	*Option 507*
2 (8.3 GHz to 13.6 GHz)	1–	2	*Options 513, 526*
3 (13.5 GHz to 17.1 GHz)	2–	2	*Option 526*
4 (17 GHz to 26.5 GHz)	2–	4	*Option 526*

a. N is the LO multiplication factor. For negative mixing modes (as indicated by the "–" in the "Harmonic Mixing Mode" column), the desired 1st LO harmonic is higher than the tuned frequency by the 1st IF (5.1225 GHz for band 0, 322.5 MHz for all other bands).

Description	Specifications	Supplemental Information
Standard Frequency Reference		
Accuracy	±[(time since last adjustment × aging rate) + temperature stability + calibration accuracy[a]]	
Temperature Stability		
20 to 30 °C	$\pm 2 \times 10^{-6}$	
5 to 50 °C	$\pm 2 \times 10^{-6}$	
Aging Rate	$\pm 1 \times 10^{-6}$/year[b]	
Achievable Initial Calibration Accuracy	$\pm 1.4 \times 10^{-6}$	
Settability	$\pm 2 \times 10^{-8}$	
Residual FM Center Frequency = 1 GHz 10 Hz RBW, 10 Hz VBW		≤10 Hz × N p-p in 20 ms[c], nominal

a. Calibration accuracy depends on how accurately the frequency standard was adjusted to 10 MHz. If the adjustment procedure is followed, the calibration accuracy is given by the specification “Achievable Initial Calibration Accuracy.”
b. For periods of one year or more.
c. N is the LO harmonic mixing mode.

Description	Specifications	Supplemental Information
Precision Frequency Reference		
(*Option PFR*)		
Accuracy	±[(time since last adjustment × aging rate) + temperature stability + calibration accuracy[a]][b]	
Temperature Stability		
20 to 30 °C	$\pm 1.5 \times 10^{-8}$	
5 to 50 °C	$\pm 5 \times 10^{-8}$	
Aging Rate		$\pm 5 \times 10^{-10}$/day (nominal)
Total Aging		
1 Year	$\pm 1 \times 10^{-7}$	
2 Years	$\pm 1.5 \times 10^{-7}$	
Settability	$\pm 2 \times 10^{-9}$	
Warm-up and Retrace[c] 300 s after turn on		$\pm 1 \times 10^{-7}$ of final frequency (nominal)
900 s after turn on		$\pm 1 \times 10^{-8}$ of final frequency (nominal)
Achievable Initial Calibration Accuracy[d]	$\pm 4 \times 10^{-8}$	
Standby power to reference oscillator		Not supplied
Residual FM Center Frequency = 1 GHz 10 Hz RBW, 10 Hz VBW		≤ 0.25 Hz x N p-p in 20 ms[e] (nominal)

a. Calibration accuracy depends on how accurately the frequency standard was adjusted to 10 MHz. If the adjustment procedure is followed, the calibration accuracy is given by the specification “Achievable Initial Calibration Accuracy.”
b. The specification applies after the analyzer has been powered on for four hours.
c. Standby mode does not apply power to the oscillator. Therefore warm-up applies every time the power is turned on. The warm-up reference is one hour after turning the power on. Retracing also occurs every time the power is applied. The effect of retracing is included within the “Achievable Initial Calibration Accuracy” term of the Accuracy equation.

d. The achievable calibration accuracy at the beginning of the calibration cycle includes these effects:
   1) Temperature difference between the calibration environment and the use environment
   2) Orientation relative to the gravitation field changing between the calibration environment and the use environment
   3) Retrace effects in both the calibration environment and the use environment due to turning the instrument power off.
   4) Settability
e. N is the harmonic mixing mode.

Description	Specifications	Supplemental Information
Frequency Readout Accuracy	±(marker freq. × freq. ref. accy. + 0.25% × span + 0.5% × RBW[a] + 2 Hz + 0.5 × horizontal resolution[b])	Single detector only[c]
Example for EMC[d]		±0.0032% (nominal)

a. The warranted performance is only the sum of all errors under autocoupled conditions. Under non-autocoupled conditions, the frequency readout accuracy will nominally meet the specification equation, except for conditions in which the RBW term dominates, as explained in examples below. The nominal RBW contribution to frequency readout accuracy is 2% of RBW for RBWs from 1 Hz to 390 kHz, 4% of RBW from 430 kHz through 3 MHz (the widest autocoupled RBW), and 30% of RBW for the (manually selected) 4, 5, 6 and 8 MHz RBWs.
First example: a 120 MHz span, with autocoupled RBW. The autocoupled ratio of span to RBW is 106:1, so the RBW selected is 1.1 MHz. The 5% × RBW term contributes only 55 kHz to the total frequency readout accuracy, compared to 300 kHz for the 0.25% × span term, for a total of 355 kHz. In this example, if an instrument had an unusually high RBW centering error of 7% of RBW (77 kHz) and a span error of 0.20% of span (240 kHz), the total actual error (317 kHz) would still meet the computed specification (355 kHz).
Second example: a 20 MHz span, with a 4 MHz RBW. The specification equation does not apply because the Span: RBW ratio is not autocoupled. If the equation did apply, it would allow 50 kHz of error (0.25%) due to the span and 200 kHz error (5%) due to the RBW. For this non-autocoupled RBW, the RBW error is nominally 30%, or 1200 kHz.

b. Horizontal resolution is due to the marker reading out one of the trace points. The points are spaced by span/(Npts - 1), where Npts is the number of sweep points. For example, with the factory preset value of 1001 sweep points, the horizontal resolution is span/1000. However, there is an exception: When both the detector mode is "normal" and the span > 0.25 × (Npts - 1) × RBW, peaks can occur only in even-numbered points, so the effective horizontal resolution becomes doubled, or span/500 for the factory preset case. When the RBW is autocoupled and there are 1001 sweep points, that exception occurs only for spans > 750 MHz

c. Specifications apply to traces in two cases: when all active traces use the same detector, and to any trace that uses the peak detector. When multiple simultaneous detectors are in use, additional errors of 0.5, 1.0 or 1.5 display points will occur in some detectors, depending on the combination of detectors in use. In one example, with positive peak, negative peak and average detection, there is an additional error only in the average detection trace, which shifts the apparent signal position left by 0.5 display points.

d. In most cases, the frequency readout accuracy of the analyzer can be exceptionally good. As an example, Agilent has characterized the accuracy of a span commonly used for Electro-Magnetic Compatibility (EMC) testing using a source frequency locked to the analyzer. Ideally, this sweep would include EMC bands C and D and thus sweep from 30 to 1000 MHz. Ideally, the analysis bandwidth would be 120 kHz at –6 dB, and the spacing of the points would be half of this (60 kHz). With a start frequency of 30 MHz and a stop frequency of 1000.2 MHz and a total of 16168 points, the spacing of points is ideal. The detector used was the Peak detector. The accuracy of frequency readout of all the points tested in this span was with ±0.0032% of the span. A perfect analyzer with this many points would have an accuracy of ±0.0031% of span. Thus, even with this large number of display points, the errors in excess of the bucket quantization limitation were negligible.

Description	Specifications	Supplemental Information
Frequency Counter[a]		See note[b]
Count Accuracy	±(marker freq. × freq. Ref. Accy. + 0.100 Hz)	
Delta Count Accuracy	±(delta freq. × freq. Ref. Accy. + 0.141 Hz)	
Resolution	0.001 Hz	

a. Instrument conditions: RBW = 1 kHz, gate time = auto (100 ms), S/N ≥ 50 dB, frequency = 1 GHz
b. If the signal being measured is locked to the same frequency reference as the analyzer, the specified count accuracy is ±0.100 Hz under the test conditions of footnote a. This error is a noisiness of the result. It will increase with noisy sources, wider RBWs, lower S/N ratios, and source frequencies >1 GHz.

Description	Specifications	Supplemental Information
Frequency Span		
Range Swept and FFT		
Option 503	0 Hz, 10 Hz to 3.6 GHz	
Option 507	0 Hz, 10 Hz to 7 GHz	
Option 513	0 Hz, 10 Hz to 13.6 GHz	
Option 526	0 Hz, 10 Hz to 26.5 GHz	
Resolution	2 Hz	
Span Accuracy		
Swept	±(0.25% × span + horizontal resolution[a])	
FFT	±(0.10% × span + horizontal resolution[a])	

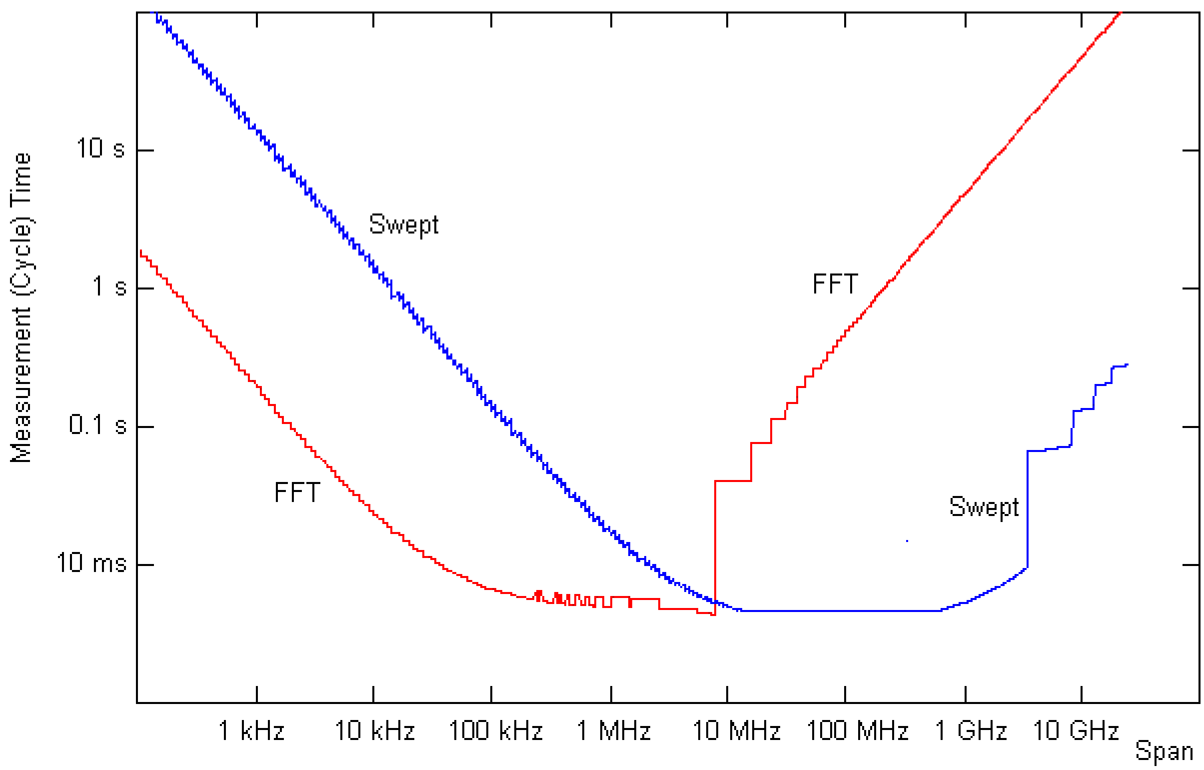
a. Horizontal resolution is due to the marker reading out one of the trace points. The points are spaced by span/(Npts – 1), where Npts is the number of sweep points. For example, with the factory preset value of 1001 sweep points, the horizontal resolution is span/1000. However, there is an exception: When both the detector mode is "normal" and the span > 0.25 × (Npts – 1) × RBW, peaks can occur only in even-numbered points, so the effective horizontal resolution becomes doubled, or span/500 for the factory preset case. When the RBW is auto coupled and there are 1001 sweep points, that exception occurs only for spans > 750 MHz.

Description	Specifications	Supplemental Information
Sweep Time		
Range		
Span = 0 Hz	1 μs to 6000 s	
Span ≥ 10 Hz	1 ms to 4000 s	
Accuracy		
Span ≥ 10 Hz, swept		±0.01% (nominal)
Span ≥ 10 Hz, FFT		±40% (nominal)
Span = 0 Hz		±0.01% (nominal)
Sweep Trigger	Free Run, Line, Video, External 1, External 2, RF Burst, Periodic Timer	
Delayed Trigger[a]		
Range		
Span ≥ 10 Hz, swept	1 μs to 500 ms	
Span = 0 Hz or FFT	–150 ms to +500 ms	
Resolution	0.1 μs	

a. Delayed trigger is available with line, video, RF burst and external triggers.

Description	Specifications	Supplemental Information
Gated Sweep		
Gate Methods	Gated LO Gated Video Gated FFT	
Span Range	Any span	
Gate Delay Range	0 to 100.0 s	
Gate Delay Settability	4 digits, ≥ 100 ns	
Gate Delay Jitter		33.3 ns p-p (nominal)
Gate Length Range	100.0 ns to 5.0 s	
Except Method = FFT		
Gated Frequency and Amplitude Errors		Nominally no additional error for gated measurements when the Gate Delay is greater than the MIN FAST setting
Gate Sources	External 1	Pos or neg edge triggered
	External 2	
	Line	
	RF Burst	
	Periodic	

Nominal Measurement Time vs. Span [Plot]



Description	Specifications	Supplemental Information
Number of Frequency Display Trace Points (buckets)		
Factory preset	1001	
Range	1 to 20001	Zero and non-zero spans

Description		Specifications	Supplemental Information
Resolution Bandwidth (RBW)			
Range (–3.01 dB bandwidth)		1 Hz to 8 MHz Bandwidths above 3 MHz are 4, 5, 6, and 8 MHz. Bandwidths 1 Hz to 3 MHz are spaced at 10% spacing using the E24 series (24 per decade): 1.0, 1.1, 1.2, 1.3, 1.5, 1.6, 1.8, 2.0, 2.2, 2.4, 2.7, 3.0, 3.3, 3.6, 3.9, 4.3, 4.7, 5.1, 5.6, 6.2, 6.8, 7.5, 8.2, 9.1 in each decade.	
Power bandwidth accuracy[a]			
RBW Range	**CF Range**		
1 Hz - 750 kHz	All	±1.0% (0.044 dB)	
820 kHz - 1.2 MHz	<3.6 GHz	±2.0% (0.088 dB)	
1.3 - 2.0 MHz	<3.6 GHz		±0.07 dB (nominal)
2.2 - 3 MHz	<3.6 GHz		±0.15 dB (nominal)
4 - 8 MHz	<3.6GHz		±0.25 dB (nominal)
Accuracy (–3.01 dB bandwidth)[b]			
1 Hz to 1.3 MHz RBW			±2% (nominal)
1.5 MHz to 3 MHz RBW			
(CF ≤ 3.6 GHz)			±7% (nominal)
(CF > 3.6 GHz)			±8% (nominal)
4 MHz to 8 MHz RBW			
(CF ≤ 3.6 GHz)			±15% (nominal)
(CF > 3.6 GHz)			±20% (nominal)
Selectivity (–60 dB/–3 dB)			4.1:1 (nominal)

a. The noise marker, band power marker, channel power and ACP all compute their results using the power bandwidth of the RBW used for the measurement. Power bandwidth accuracy is the power uncertainty in the results of these measurements due only to bandwidth-related errors. (The analyzer knows this power bandwidth for each RBW with greater accuracy than the RBW width itself, and can therefore achieve lower errors.) The warranted specifications shown apply to the Gaussian RBW filters used in swept and zero span analysis. There are four different kinds of filters used in the spectrum analyzer: Swept Gaussian, Swept Flattop, FFT Gaussian and FFT Flattop. While the warranted performance only applies to the swept Gaussian filters, because only they are kept under statistical process control, the other filters nominally have the same performance.

b. Resolution Bandwidth Accuracy can be observed at slower sweep times than auto-coupled conditions. Normal sweep rates cause the shape of the RBW filter displayed on the analyzer screen to widen by nominally 6%. This widening declines to 0.6% nominal when the Swp Time Rules key is set to Accuracy instead of Normal. The true bandwidth, which determines the response to impulsive signals and noise-like signals, is not affected by the sweep rate.

Description	Specification	Supplemental information
Analysis Bandwidth[a]		
Standard	10 MHz	

a. Analysis bandwidth is the instantaneous bandwidth available about a center frequency over which the input signal can be digitized for further analysis or processing in the time, frequency, or modulation domain.

Description	Specifications	Supplemental Information
Video Bandwidth (VBW)		
Range	Same as Resolution Bandwidth range plus wide-open VBW (labeled 50 MHz)	
Accuracy		±6% (nominal) in swept mode and zero span[a]

a. For FFT processing, the selected VBW is used to determine a number of averages for FFT results. That number is chosen to give roughly equivalent display smoothing to VBW filtering in a swept measurement. For example, if VBW=0.1 × RBW, four FFTs are averaged to generate one result.

Amplitude Accuracy and Range

Description	Specifications	Supplemental Information
Measurement Range	Displayed Average Noise Level to +23 dBm	
Preamp On	Displayed Average Noise Level to +23 dBm	*Options P03*
Input Attenuation Range	0 to 60 dB, in 10 dB steps	Standard
Input Attenuation Range	0 to 60 dB, in 2 dB steps	With *Option FSA*

Description	Specifications	Supplemental Information
Maximum Safe Input Level		Applies with or without preamp *(Option P03*
Average Total Power	+30 dBm (1 W)	
Peak Pulse Power	+50 dBm (100 W)	
<10 μs pulse width,		
<1% duty cycle		
input attenuation ≥ 30 dB		
DC volts		
DC Coupled	±0.2 Vdc	
AC Coupled	±70 Vdc	

Description	Specifications	Supplemental Information
Display Range		
Log Scale	Ten divisions displayed; 0.1 to 1.0 dB/division in 0.1 dB steps, and 1 to 20 dB/division in 1 dB steps	

Description	Specifications	Supplemental Information
Linear Scale	Ten divisions	

Description	Specifications	Supplemental Information
Marker Readout[a]		
Log units resolution		
Average Off, on-screen	0.01 dB	
Average On or remote	0.001 dB	
Linear units resolution		≤1% of signal level (nominal)

a. Reference level and off-screen performance: The reference level (RL) behavior differs from some earlier analyzers in a way that makes this analyzer more flexible. In other analyzers, the RL controlled how the measurement was performed as well as how it was displayed. Because the logarithmic amplifier in these analyzers had both range and resolution limitations, this behavior was necessary for optimum measurement accuracy. The logarithmic amplifier in this signal analyzer, however, is implemented digitally such that the range and resolution greatly exceed other instrument limitations. Because of this, the signal analyzer can make measurements largely independent of the setting of the RL without compromising accuracy. Because the RL becomes a display function, not a measurement function, a marker can read out results that are off-screen, either above or below, without any change in accuracy. The only exception to the independence of RL and the way in which the measurement is performed is in the input attenuation setting: When the input attenuation is set to auto, the rules for the determination of the input attenuation include dependence on the reference level. Because the input attenuation setting controls the tradeoff between large signal behaviors (third-order intermodulation and compression) and small signal effects (noise), the measurement results can change with RL changes when the input attenuation is set to auto.

Frequency Response

Description	Specifications		Supplemental Information
Frequency Response			
Maximum error relative to reference condition (50 MHz)			
Mechanical attenuator only[a] Swept operation[b]			
Attenuation 10 dB	**20 to 30 °C**	**5 to 50 °C**	**95th Percentile** (≈2σ)
9 kHz to 10 MHz	±0.8 dB	±1.0 dB	±0.40 dB
10 MHz to 3.6 GHz	±0.6 dB	±0.65 dB	±0.30 dB
3.5 to 7 GHz[c d]	±2.0 dB	±3.0 dB	
6.9 to 13.6 GHz[c d]	±2.5 dB	±3.2 dB	
13.5 to 22.0 GHz[c d]	±3.0 dB	±3.7 dB	
22.0 to 26.5 GHz[c d]	±3.2 dB	±4.2 dB	

a. See the Electronic Attenuator (*Option EA3*) chapter for Frequency Response using the electronic attenuator.
b. For Sweep Type = FFT, add the RF flatness errors of this table to the IF Frequency Response errors. An additional error source, the error in switching between swept and FFT sweep types, is nominally ±0.01 dB and is included within the “Absolute Amplitude Error” specifications.
c. Specifications for frequencies > 3.5 GHz apply for sweep rates ≤100 MHz/ms.
d. Preselector centering applied.

Description		Specifications	Supplemental Information		
IF Frequency Response					
Demodulation and FFT response relative to the center frequency					
				95th Percentile	
Freq (GHz)	**FFT Width**	**Max Error** (Exceptions [a])	**Midwidth Error**	**Slope (dB/MHz)**	**Rms (nominal)**
≤ 3.6	≤ 10 MHz	0.40 dB	0.12 dB	0.10	0.03 dB
> 3.6	≤ 10 MHz				0.25 dB

a. The specification does not apply for frequencies greater than 3.6 MHz from the center in FFT widths of 7.2 to 8 MHz.

Description	Specifications	Supplemental Information
Input Attenuation Switching Uncertainty		
Relative to 10 dB (reference setting) with preamplifier on or off (unless otherwise stated)		
Frequency Range		
50 MHz (reference frequency)	±0.20 dB	±0.08 dB (typical)
Attenuation > 2 dB, preamp off		
9 kHz to 3.6 GHz		±0.3 dB (nominal)
3.5 to 8.4 GHz		±0.5 dB (nominal)
8.3 to 13.6 GHz		±0.7 dB (nominal)
13.5 to 26.5 GHz		±0.7 dB (nominal)

Description	Specifications	Supplemental Information
Absolute Amplitude Accuracy		
At 50 MHz[a] 20 to 30 °C 5 to 50 °C	±0.40 dB ±0.43 dB	±0.15 dB (95^{th} percentile)
At all frequencies[a]		
20 to 30 °C	±(0.4 dB + frequency response)	
5 to 50 °C	±(0.43 dB + frequency response)	
95^{th} Percentile Absolute Amplitude Accuracy[b]		
Wide range of signal levels, RBWs, RLs, etc.		
0 to 3.6 GHz, Atten = 10 dB		±0.30 dB
Amplitude Reference Accuracy		±0.05 dB (nominal)
Preamp On[c] *Option P03*		±(0.39 dB + frequency response) (nominal)

a. Absolute amplitude accuracy is the total of all amplitude measurement errors, and applies over the following subset of settings and conditions: 1 Hz ≤ RBW ≤1 MHz; Input signal –10 to –50 dBm; Input attenuation 10 dB; span <5 MHz (nominal additional error for span ≥ 5 MHz is 0.02 dB); all settings auto-coupled except Swp Time Rules = Accuracy; combinations of low signal level and wide RBW use VBW ≤30 kHz to reduce noise.
This absolute amplitude accuracy specification includes the sum of the following individual specifications under the conditions listed above: Scale Fidelity, Reference Level Accuracy, Display Scale Switching Uncertainty, Resolution Bandwidth Switching Uncertainty, 50 MHz Amplitude Reference Accuracy, and the accuracy with which the instrument aligns its internal gains to the 50 MHz Amplitude Reference.

b. Absolute Amplitude Accuracy for a wide range of signal and measurement settings, covers the 95th percentile proportion with 95% confidence. Here are the details of what is covered and how the computation is made:

   The wide range of conditions of RBW, signal level, VBW, reference level and display scale are discussed in footnote b. There are 44 quasi-random combinations used, tested at a 50 MHz signal frequency. We compute the 95th percentile proportion with 95% confidence for this set observed over a statistically significant number of instruments. Also, the frequency response relative to the 50 MHz response is characterized by varying the signal across a large number of quasi-random verification frequencies that are chosen to not correspond with the frequency response adjustment frequencies. We again compute the 95th percentile proportion with 95% confidence for this set observed over a statistically significant number of instruments. We also compute the 95th percentile accuracy of tracing the calibration of the 50 MHz absolute amplitude accuracy to a national standards organization. We also compute the 95th percentile accuracy of tracing the calibration of the relative frequency response to a national standards organization. We take the root-sum-square of these four independent Gaussian parameters. To that rss we add the environmental effects of temperature variations across the 20 to 30 °C range. These computations and measurements are made with the mechanical attenuator only in circuit, set to the reference state of 10 dB.

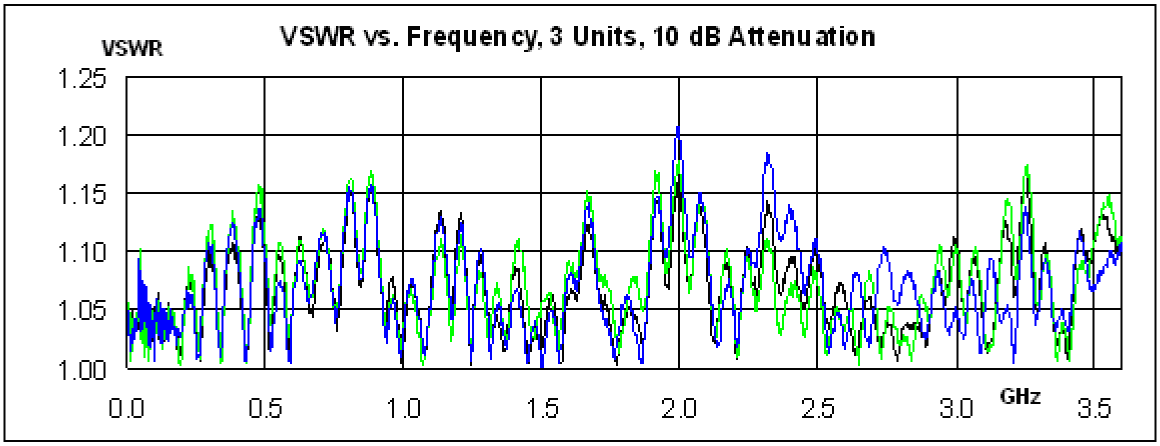
   A similar process is used for computing the result when using the electronic attenuator under a wide range of settings: all even settings from 4 through 24 dB inclusive, with the mechanical attenuator set to 10 dB. Then the worse of the two computed 95th percentile results (they were very close) is shown.

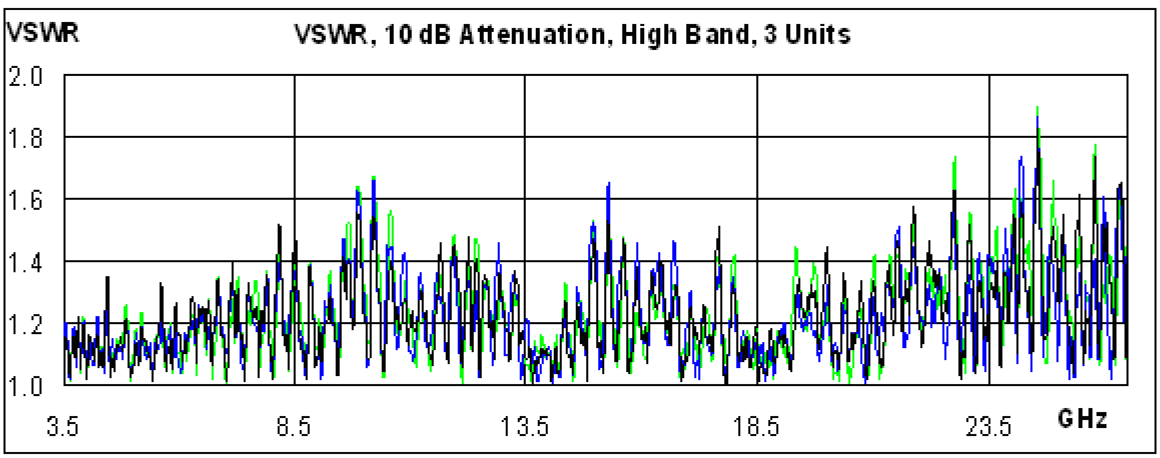
c. Same settings as footnote b, except that the signal level at the preamp input is –40 to –80 dBm. Total power at preamp (dBm) = total power at input (dBm) minus input attenuation (dB). This specification applies for signal frequencies above 100 kHz.

Description	Specifications	Supplemental Information	
RF Input VSWR			
at tuned frequency		Nominal[a]	
10 dB attenuation, 50 MHz		1.07:1	
		Input Attenuation	
Frequency		**0 dB**	**≥10 dB**
10 MHz to 3.6 GHz		< 2.2:1	See nominal VSWR plots
3.6 to 26.5 GHz			See nominal VSWR plots
Internal 50 MHz calibrator is On		Open input	
Alignments running		Open input	

a. The nominal SWR stated is the worst case RF frequency in three representative instruments.

Nominal VSWR [Plot]





Description	Specifications	Supplemental Information
Resolution Bandwidth Switching Uncertainty relative to reference BW of 30 kHz		
1.0 Hz to 3 MHz RBW	±0.10 dB	
Manually selected wide RBWs: 4, 5, 6, 8 MHz	±1.0 dB	

Description	Specifications	Supplemental Information
Reference Level[a]		
Range		
Log Units	–170 to +23 dBm, in 0.01 dB steps	
Linear Units	707 pV to 3.16 V, with 0.01 dB resolution (0.11%)	
Accuracy	0 dB[b]	

a. Reference level and off-screen performance: The reference level (RL) behavior differs from some earlier analyzers in a way that makes this analyzer more flexible. In other analyzers, the RL controlled how the measurement was performed as well as how it was displayed. Because the logarithmic amplifier in these analyzers had both range and resolution limitations, this behavior was necessary for optimum measurement accuracy. The logarithmic amplifier in this signal analyzer, however, is implemented digitally such that the range and resolution greatly exceed other instrument limitations. Because of this, the analyzer can make measurements largely independent of the setting of the RL without compromising accuracy. Because the RL becomes a display function, not a measurement function, a marker can read out results that are off-screen, either above or below, without any change in accuracy. The only exception to the independence of RL and the way in which the measurement is performed is in the input attenuation setting: When the input attenuation is set to auto, the rules for the determination of the input attenuation include dependence on the reference level. Because the input attenuation setting controls the tradeoff between large signal behaviors (third-order intermodulation and compression) and small signal effects (noise), the measurement results can change with RL changes when the input attenuation is set to auto.

b. Because reference level affects only the display, not the measurement, it causes no additional error in measurement results from trace data or markers.

Description	Specifications	Supplemental Information
Display Scale Switching Uncertainty		
Switching between Linear and Log	0 dB[a]	
Log Scale Switching	0 dB[a]	

a. Because Log/Lin and Log Scale Switching affect only the display, not the measurement, they cause no additional error in measurement results from trace data or markers.

Description	Specifications	Supplemental Information
Display Scale Fidelity[a b c]		
Log-Linear Fidelity (relative to the reference condition of –25 dBm input through the 10 dB attenuation, or –35 dBm at the input mixer)		
Input mixer level[d]	**Linearity**	
–80 dBm ≤ ML ≤ –10 dBm	±0.15 dB	
ML < –80 dBm	±0.25 dB	
Relative Fidelity[e]		Applies for mixer level[d] range from –10 to –80 dBm, mechanical attenuator only, preamp off, dither on
Sum of the following terms:		
high level term		Up to ±0.045 dB[f]
instability term		Up to ±0.018 dB
slope term		From equation[g]
prefilter term		Up to ±0.005 dB[h]

a. Supplemental information: The amplitude detection linearity specification applies at all levels below –10 dBm at the input mixer; however, noise will reduce the accuracy of low level measurements. The amplitude error due to noise is determined by the signal-to-noise ratio, S/N. If the S/N is large (20 dB or better), the amplitude error due to noise can be estimated from the equation below, given for the 3-sigma (three standard deviations) level.

$$3\sigma = 3(20dB)\log\langle 1 + 10^{-((S/N + 3dB)/20dB)}\rangle$$

The errors due to S/N ratio can be further reduced by averaging results. For large S/N (20 dB or better), the 3-sigma level can be reduced proportional to the square root of the number of averages taken.

b. The scale fidelity is warranted with ADC dither set to On. Dither increases the noise level by nominally only 0.24 dB for the most sensitive case (preamp Off, best DANL frequencies). With dither Off, scale fidelity for low level signals, around –60 dBm or lower, will nominally degrade by 0.2 dB.

c. Reference level and off-screen performance: The reference level (RL) behavior differs from some earlier analyzers in a way that makes this analyzer more flexible. In other analyzers, the RL controlled how the measurement was performed as well as how it was displayed. Because the logarithmic amplifier in these analyzers had both range and resolution limitations, this behavior was necessary for optimum measurement accuracy. The logarithmic amplifier in this signal analyzer, however, is implemented digitally such that the range and resolution greatly exceed other instrument limitations. Because of this, the analyzer can make measurements largely independent of the setting of the RL without compromising accuracy. Because the RL becomes a display function, not a measurement function, a marker can read out results that are off-screen, either above or below, without any change in accuracy. The only exception to the independence of RL and the way in which the measurement is performed is in the input attenuator setting: When the input attenuator is set to auto, the rules for the determination of the input attenuation include dependence on the reference level. Because the input attenuation setting controls the tradeoff between large signal behaviors (third-order intermodulation and compression) and small signal effects (noise), the measurement results can change with RL changes when the input attenuation is set to auto.

d. Mixer level = Input Level – Input Attenuator

e. The relative fidelity is the error in the measured difference between two signal levels. It is so small in many cases that it cannot be verified without being dominated by measurement uncertainty of the verification. Because of this verification difficulty, this specification gives nominal performance, based on numbers that are as conservatively determined as those used in warranted specifications. We will consider one example of the use of the error equation to compute the nominal performance.
Example: the accuracy of the relative level of a sideband around –60 dBm, with a carrier at –5 dBm, using attenuator = 10 dB, RBW = 3 kHz, evaluated with swept analysis. The high level term is evaluated with P1 = –15 dBm and P2 = –70 dBm at the mixer. This gives a maximum error within ±0.039 dB. The instability term is ±0.018 dB. The slope term evaluates to ±0.050 dB. The prefilter term applies and evaluates to the limit of ±0.005 dB. The sum of all these terms is ±0.112 dB.

f. Errors at high mixer levels will nominally be well within the range of ±0.045 dB × {exp[(P1 – Pref)/(8.69 dB)] – exp[(P2 – Pref)/(8.69 dB)]}. In this expression, P1 and P2 are the powers of the two signals, in decibel units, whose relative power is being measured. Prof is –10 dBm. All these levels are referred to the mixer level.

g. Slope error will nominally be well within the range of ±0.0009 × (P1 – P2). P1 and P2 are defined in footnote f.

h. A small additional error is possible. In FFT sweeps, this error is possible for spans under 4.01 kHz. For non-FFT measurements, it is possible for RBWs of 3.9 kHz or less. The error is well within the range of ±0.0021 × (P1 - P2) subject to a maximum of ±0.005 dB. P1 and P2 are defined in footnote f.

Description	Specifications	Supplemental Information
Available Detectors	Normal, Peak, Sample, Negative Peak, Average	Average detector works on RMS, Voltage and Logarithmic scales

Dynamic Range

Gain Compression

Description		Specifications	Supplemental Information
1 dB Gain Compression Point (Two-tone) [a b c]			Maximum power at mixer[d] (nominal)
20 MHz to 26.5 GHz			+9 dBm (nominal)
Clipping (ADC Over Range)			
Any signal offset		–10 dBm	Low frequency exceptions[d]
Signal offset >5 times IF prefilter bandwidth			+12 dBm (nominal)
IF Prefilter Bandwidth			
Zero Span or Swept:	Sweep Type = FFT:		
RBW	**FFT Width**		**IF Prefilter 3 dB Bandwidth, nominal**
≤ 3.9 kHz	< 4.01 kHz		8.9 kHz
4.3 - 27 kHz	< 28.81 kHz		79 kHz
30 - 160 kHz	< 167.4 kHz		303 kHz
180 - 390 kHz	< 411.9 kHz		966 kHz
430 kHz - 8 MHz	< 7.99 MHz		10.9 MHz

a. Large signals, even at frequencies not shown on the screen, can cause the analyzer to incorrectly measure on-screen signals because of two-tone gain compression. This specification tells how large an interfering signal must be in order to cause a 1 dB change in an on-screen signal.

b. Specified at 1 kHz RBW with 100 kHz tone spacing. The compression point will nominally equal the specification for tone spacing greater than 5 times the prefilter bandwidth. At smaller spacings, ADC clipping may occur at a level lower than the 1 dB compression point.

c. Reference level and off-screen performance: The reference level (RL) behavior differs from some earlier analyzers in a way that makes this analyzer more flexible. In other analyzers, the RL controlled how the measurement was performed as well as how it was displayed. Because the logarithmic amplifier in these analyzers had both range and resolution limitations, this behavior was necessary for optimum measurement accuracy. The logarithmic amplifier in this signal analyzer, however, is implemented digitally such that the range and resolution greatly exceed other instrument limitations. Because of this, the analyzer can make measurements largely independent of the setting of the RL without compromising accuracy. Because the RL becomes a display function, not a measurement function, a marker can read out results that are off-screen, either above or below, without any change in accuracy. The only exception to the independence of RL and the way in which the measurement is performed is in the input attenuation setting: When the input attenuation is set to auto, the rules for the determination of the input attenuation include dependence on the reference level. Because the input attenuation setting controls the tradeoff between large signal behaviors (third-order intermodulation, compression, and display scale fidelity) and small signal effects (noise), the measurement results can change with RL changes when the input attenuation is set to auto.

d. The ADC clipping level declines at low frequencies (below 50 MHz) when the LO feed through (the signal that appears at 0 Hz) is within 5 times the prefilter bandwidth (see table) and must be handled by the ADC. For example, with a 300 kHz RBW and prefilter bandwidth at 966 kHz, the clipping level reduces for signal frequencies below 4.83 MHz. For signal frequencies below 2.5 times the prefilter bandwidth, there will be additional reduction due to the presence of the image signal (the signal that appears at the negative of the input signal frequency) at the ADC.

Displayed Average Noise Level

Description	Specifications		Supplemental Information
Displayed Average Noise Level (DANL)[a]	Input terminated, Sample or Average detector Averaging type = Log 0 dB input attenuation IF Gain = High		
1 Hz Resolution Bandwidth			
	20 to 30 °C	**5 to 50 °C**	**Typical**
Option 503, 507, 513, 526			
1 MHz to 10 MHz[b]	–145 dBm	–143 dBm	–149 dBm
10 MHz to 2.1 GHz	–146 dBm	–144 dBm	–150 dBm
2.1 GHz to 3.6 GHz	–144 dBm	–142 dBm	–148 dBm
Option 507, 513, 526			
3.6 GHz to 7 GHz	–144 dBm	–142 dBm	–149 dBm
Option 513, 526			
7 GHz to 13.6 GHz	–143 dBm	–141 dBm	–147 dBm
Option 526			
13.6 GHz to 17.1 GHz	–137 dBm	–134 dBm	–142 dBm
17.1 GHz to 20.0 GHz	–137 dBm	–134 dBm	–142 dBm
20.0 GHz to 26.5 GHz	–134 dBm	–130 dBm	–140 dBm
Additional DANL, IF Gain=Low[c]			–160.5 dBm (nominal)

a. DANL for zero span and swept is normalized in two ways and for two reasons. DANL is measured in a 1 kHz RBW and normalized to the narrowest available RBW, because the noise figure does not depend on RBW and 1 kHz measurements are faster. The second normalization is that DANL is measured with 10 dB input attenuation and normalized to the 0 dB input attenuation case, because that makes DANL and third order intermodulation test conditions congruent, allowing accurate dynamic range estimation for the analyzer.

b. DANL below 10 MHz is dominated by phase noise around the LO feedthrough signal. Specifications apply with the best setting of the Phase Noise Optimization control, which is to choose the "Best Phase Noise at offset < 20 kHz" for frequencies below 25 kHz, and "Best Phase Noise at offset > 30 kHz" for frequencies above 25 kHz. The difference in sensitivity with Phase Noise Optimization changes is about 10 dB at 10 and 100 kHz, declining to under 1 dB for signals below 400 Hz, above 800 kHz, and near 25 kHz.

c. Setting the IF Gain to Low is often desirable in order to allow higher power into the mixer without overload, better compression and better third-order intermodulation. When the Swept IF Gain is set to Low, either by auto coupling or manual coupling, there is noise added above that specified in this table for the IF Gain = High case. That excess noise appears as an additional noise at the input mixer. This level has sub-decibel dependence on center frequency. To find the total displayed average noise at the mixer for Swept IF Gain = Low, sum the powers of the DANL for IF Gain = High with this additional DANL. To do that summation, compute DANLtotal = 10 × log (10^(DANLhigh/10) + 10^(AdditionalDANL / 10)). In FFT sweeps, the same behavior occurs, except that FFT IF Gain can be set to autorange, where it varies with the input signal level, in addition to forced High and Low settings.

Description		Specifications		Supplemental Information
Spurious Responses		**Mixer Level**[a]	**Response**	Preamp Off[b]
Residual Responses[c]				
200 kHz to 8.4 GHz (swept)		N/A	−100 dBm	
Zero span or FFT or other frequencies				−100 dBm (nominal)
Image Responses				
Tuned Freq. (f)	**Excitation Freq.**			
10 MHz to 26.5 GHz	f+45 MHz	−10 dBm	−75 dBc	−99 dBc (typical)
10 MHz to 3.6 GHz	f+10245 MHz	−10 dBm	−80 dBc	−103 dBc (typical)
10 MHz to 3.6 GHz	f+645 MHz	−10 dBm	−80 dBc	−107 dBc (typical)
3.6 GHz to 13.6 GHz	f+645 MHz	−10 dBm	−75 dBc	−87 dBc (typical
13.6 GHz to 17.1 GHz	f+645 MHz	−10 dBm	−71 dBc	−85 dBc (typical)
17.1 GHz to 22 GHz	f+645 MHz	−10 dBm	−68 dBc	−82 dBc (typical)
22 GHz to 26.5 GHz	f+645 MHz	−10 dBm	−66 dBc	−78 dBc (typical)
LO Related Spurious Responses f > 600 MHz from carrier 10 MHz to 3.6 GHz		−10 dBm	−60 dBc	−90 dBc (typical)
Other Spurious Responses				
First RF Order[d] f ≥ 10 MHz from carrier		−10 dBm	−68 dBc	Includes other LO spurious, IF feedthrough, LO harmonic mixing responses
Higher RF Order[e] f ≥ 10 MHz from carrier		−40 dBm	−80 dBc	Includes higher order mixer responses

Description	Specifications	Supplemental Information
Sidebands, offset from CW signal		
≤ 200 Hz		–60 dBc[f] (nominal)
200 Hz to 3 kHz		–68 dBc[f] (nominal)
3 kHz to 30 kHz		–68 dBc (nominal)
30 kHz to 10 MHz		–80 dBc (nominal)

a. Mixer Level = Input Level – Input Attenuation.
b. The spurious response specifications only apply with the preamp turned off. When the preamp is turned on, performance is nominally the same as long as the mixer level is interpreted to be: Mixer Level = Input Level – Input Attenuation – Preamp Gain
c. Input terminated, 0 dB input attenuation.
d. With first RF order spurious products, the indicated frequency will change at the same rate as the input, with higher order, the indicated frequency will change at a rate faster than the input.
e. RBW=100 Hz. With higher RF order spurious responses, the observed frequency will change at a rate faster than the input frequency.
f. Nominally –40 dBc under large magnetic (0.38 Gauss rms) or vibrational (0.21 g rms) environmental stimuli.

Description	Specifications	Supplemental Information
Second Harmonic Distortion	**Mixer Level**[a]	**SHI**[b] **(Nominal)**
Source Frequency		
10 MHz to 1.8 GHz	–15 dBm	+45 dBm
1.8 to 7 GHz	–15 dBm	+65 dBm
7 GHz to 11 GHz	–15 dBm	+55 dBm
11 to 13.25 GHz	–15 dBm	+50 dBm

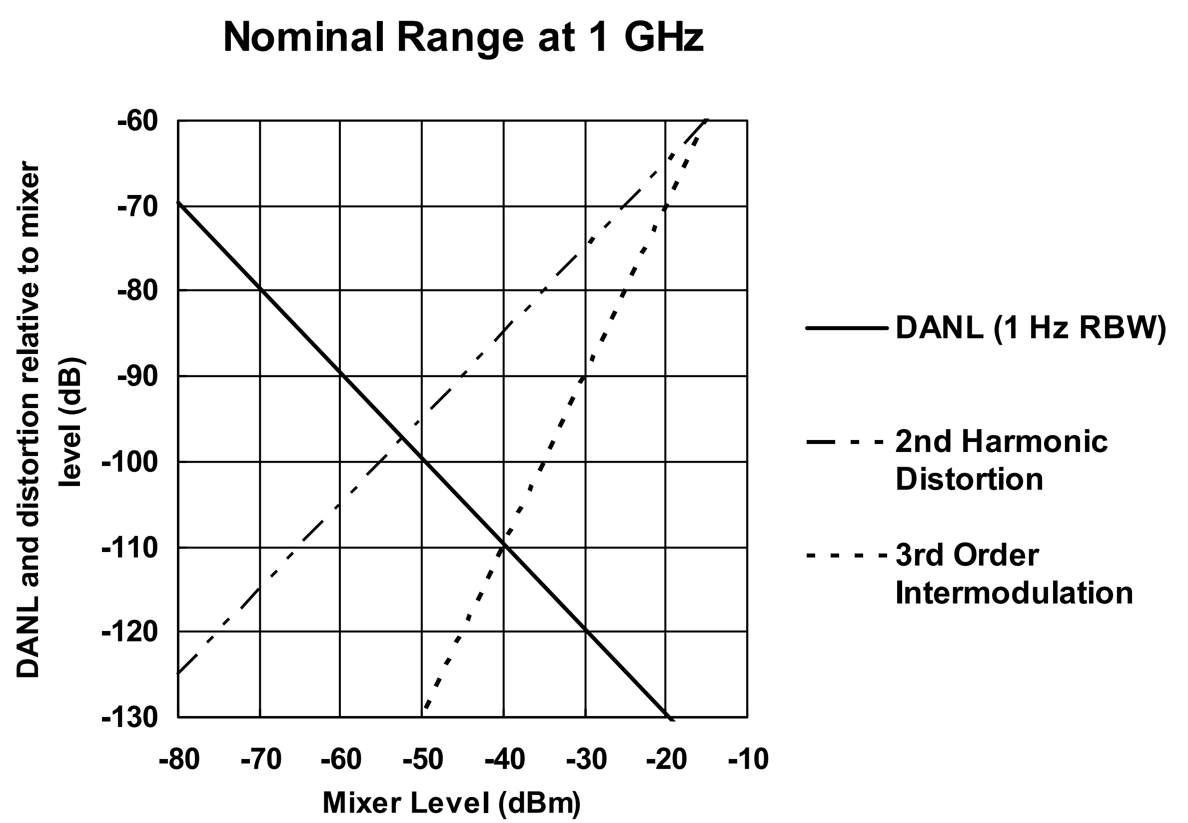
a. Mixer level = Input Level – Input Attenuation
b. SHI = second harmonic intercept. The SHI is given by the mixer power in dBm minus the second harmonic distortion level relative to the mixer tone in dBc.

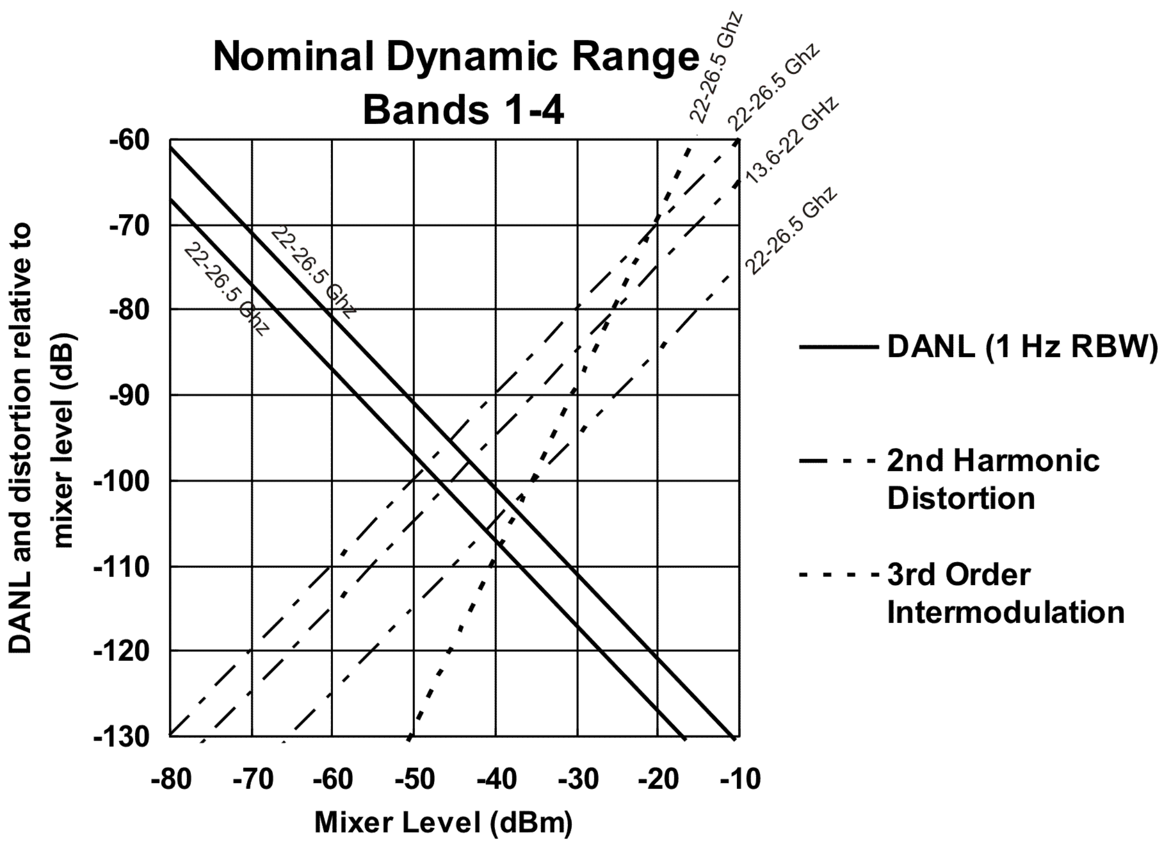
Third Order Intermodulation Distortion

Description	Specifications		Supplemental Information
Third Order Intermodulation Distortion Tone separation > 5 times IF Prefilter Bandwidth[a]			Verification conditions[b]
	Distortion[c]	**TOI**[d]	**TOI** (typical)
20 to 30 °C	Two –30 dBm tones		
100 to 400 MHz	–80 dBc	+10 dBm	+14 dBm
400 MHz to 1.7 GHz	–82 dBc	+11 dBm	+15 dBm
1.7 to 3.6 GHz	–86 dBc	+13 dBm	+17 dBm
3.6 to 7 GHz	–82 dBc	+11 dBm	+15 dBm
7 to 13.6 GHz	–82 dBc	+11 dBm	+15 dBm
13.6 to 26.5 GHz	–78 dBc	+9 dBm	+14 dBm
5 to 50 °C			
10 to 100 MHz			
100 to 400 MHz	–78 dBc	+9 dBm	
400 MHz to 1.7 GHz	–80 dBc	+10 dBm	
1.7 to 3.6 GHz	–84 dBc	+12 dBm	
3.6 to 7 GHz	–80 dBc	+10 dBm	
7 to 13.6 GHz	–80 dBc	+10 dBm	
13.6 to 26.5 GHz	–74 dBc	+7 dBm	

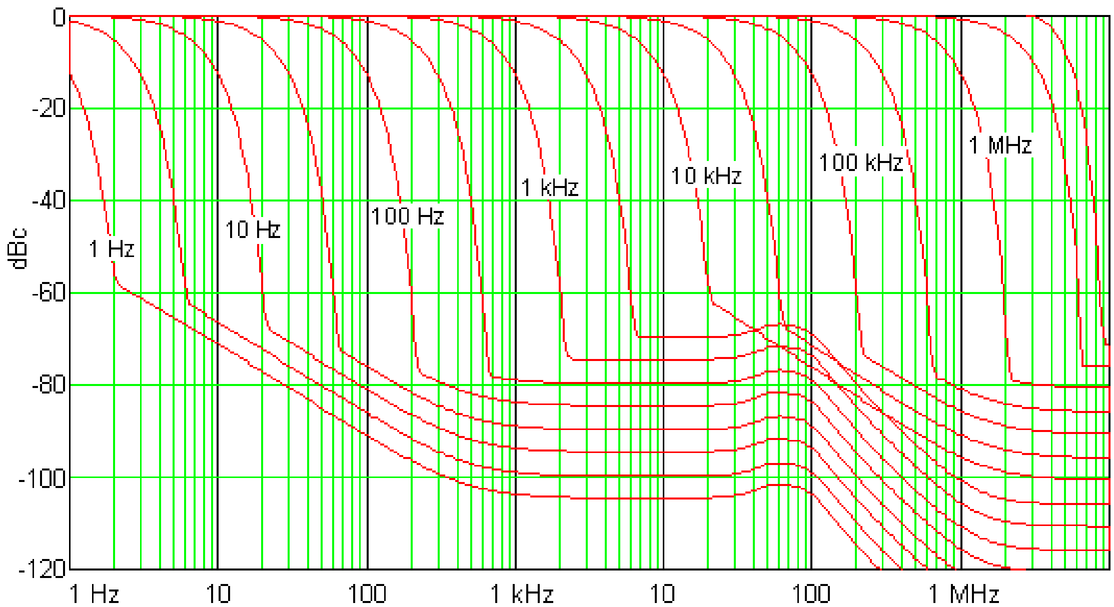
a. See the IF Prefilter Bandwidth table in the Gain Compression specifications on page 40. When the tone separation condition is met, the effect on TOI of the setting of IF Gain is negligible. TOI is verified with IF Gain set to its best case condition, which is IF Gain = Low.
b. TOI is verified with two tones, each at –18 dBm at the mixer, spaced by 100 kHz.
c. Distortion for two tones that are each at –30 dBm is computed from TOI.
d. TOI = third order intercept. The TOI is given by the mixer tone level (in dBm) minus (distortion/2) where distortion is the relative level of the distortion tones in dBc.

Nominal Dynamic Range at 1 GHz [Plot]



Nominal Dynamic Range Bands 1-4 [Plot]


Nominal Dynamic Range vs. Offset Frequency vs. RBW [Plot]



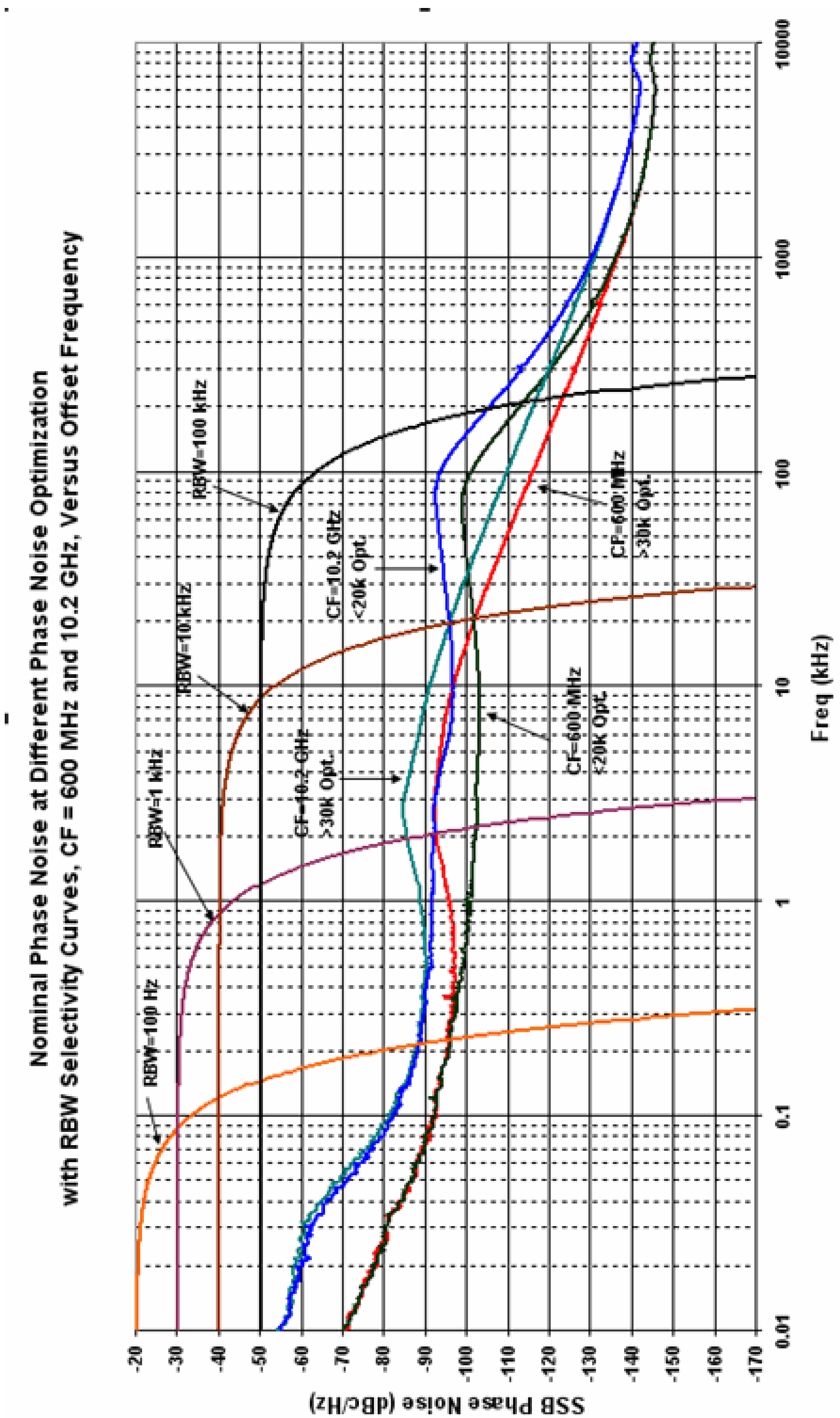
Conditions
CF = 1 GHz
Mixer Level = -10 dBm
Only 2 per decade of the 24/decade RBWs are shown
RBWs 3 kHz and below are shown with phase noise optimized for fm < 20 kHz
RBWs 10 kHz and above are shown with phase noise optimized for fm > 30 kHz
Average Type = Log

Description	Specifications		Supplemental Information
Phase Noise			
Noise Sidebands			
Center Frequency = 1 GHz[a] Best-case Optimization[b]			
	20 to 30 °C	**5 to 50 °C**	
Offset			
100 Hz	–84 dBc/Hz	–82 dBc/Hz	–88 dBc/Hz (typical)
1 kHz			–97 dBc/Hz (nominal)
10 kHz	–99 dBc/Hz	–98 dBc/Hz	–102 dBc/Hz (typical)
100 kHz	–111 dBc/Hz	–111 dBc/Hz	–114 dBc/Hz (typical)
1 MHz	–130 dBc/Hz	–129 dBc/Hz	–134 dBc/Hz (typical)
10 MHz			–143 dBc/Hz (nominal)

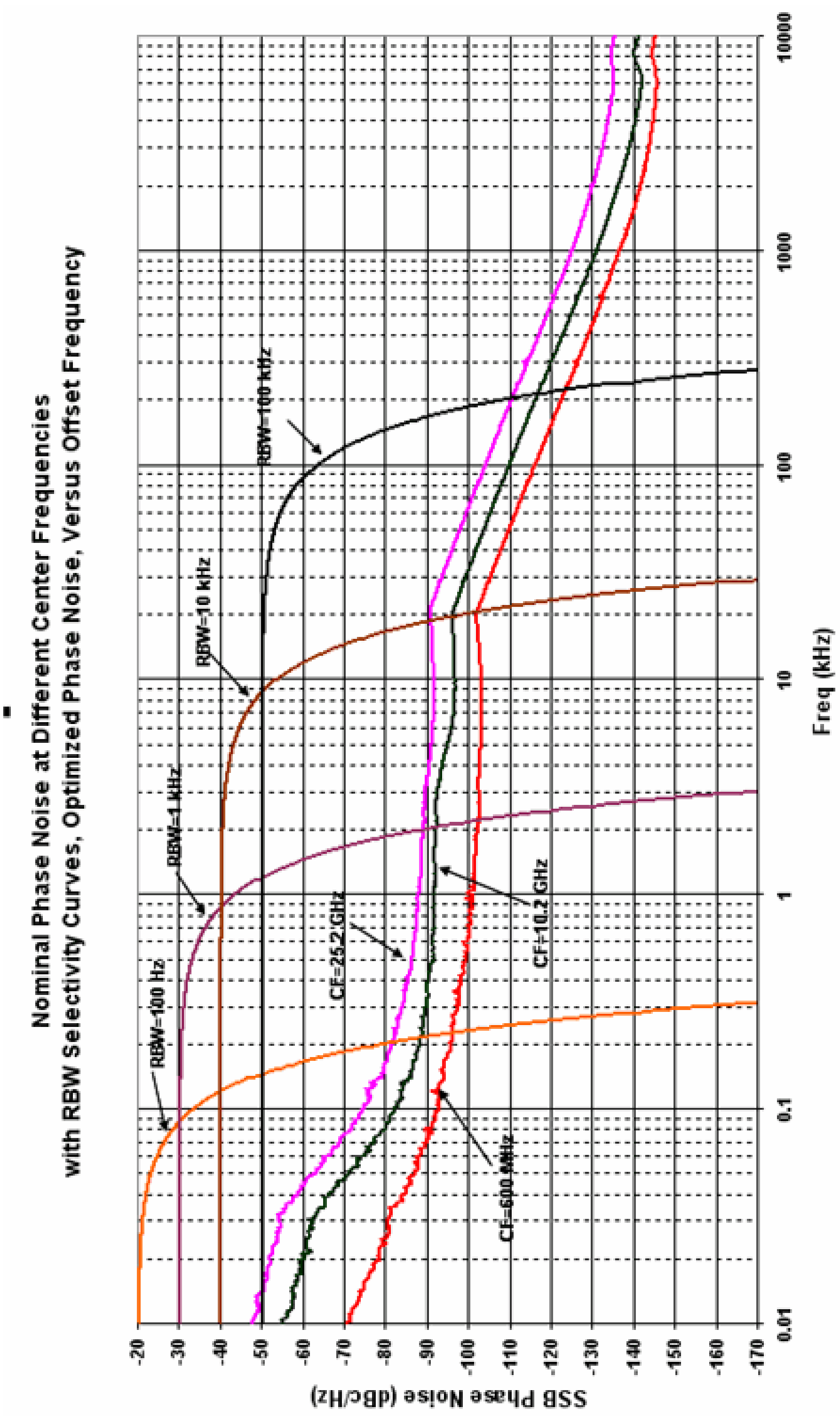
a. The nominal performance of the phase noise at frequencies above the frequency at which the specifications apply (1 GHz) depends on the band and the offset. For low offset frequencies, offsets well under 100 Hz, the phase noise increases by $20 \times \log(f)$. For mid-offset frequencies, such as 10 kHz, band 0 phase noise increases as $20 \times \log[(f + 5.1225)/6.1225]$. For mid-offset frequencies in other bands, phase noise changes as $20 \times \log[(f + 0.3225)/6.1225]$, except f in this expression should never be lower than 5.8. For wide offset frequencies, offsets above about 100 kHz, phase noise increases as $20 \times \log(N)$. N is the LO Multiple as shown on page page 14; f is in GHz units in all these relationships; all increases are in units of decibels.

b. Noise sidebands for offsets of 10 kHz and below are shown for phase noise optimization set to optimize L(f) for f<20 kHz; for offsets of 100 kHz and above, the optimization is set for f>30kHz.

Nominal Phase Noise of Different LO Optimizations



Nominal Phase Noise at Different Center Frequencies



Power Suite Measurements

Description	Specifications	Supplemental Information
Channel Power		
Amplitude Accuracy		Absolute Amplitude Accuracy[a] + Power Bandwidth Accuracy[b c]
Case: Radio Std = 3GPP W-CDMA, or IS-95		
Absolute Power Accuracy 20 to 30 °C Attenuation = 10 dB	±0.94 dB	±0.30 dB (95th percentile)

a. See “Absolute Amplitude Accuracy” on page 32.
b. See “Frequency and Time” on page 14.
c. Expressed in dB.

Description	Specifications	Supplemental Information
Occupied Bandwidth		
Frequency Accuracy		±(Span/1000) (nominal)

Description			Specifications	Supplemental Information	
Adjacent Channel Power (ACP)					
Case: Radio Std = None					
Accuracy of ACP Ratio (dBc)				Display Scale Fidelity[a]	
Accuracy of ACP Absolute Power (dBm or dBm/Hz)				Absolute Amplitude Accuracy[b] + Power Bandwidth Accuracy[c d]	
Accuracy of Carrier Power (dBm), or Carrier Power PSD (dBm/Hz)				Absolute Amplitude Accuracy[b] + Power Bandwidth Accuracy[c d]	
Passbandwidth[e]			–3 dB		
Case: Radio Std = 3GPP W-CDMA				(ACPR; ACLR)[f]	
Minimum power at RF Input				–36 dBm (nominal)	
ACPR Accuracy[g] Radio	Offset Freq			RRC weighted, 3.84 MHz noise bandwidth, method = IBW or Fast[h]	
MS (UE)	5 MHz		±0.22 dB	At ACPR range of –30 to –36 dBc with optimum mixer level[i]	
MS (UE)	10 MHz		±0.34 dB	At ACPR range of –40 to –46 dBc with optimum mixer level[j]	
BTS	5 MHz		±1.07 dB[h]	At ACPR range of –42 to –48 dBc with optimum mixer level[k]	
BTS	10 MHz		±1.00 dB	At ACPR range of –47 to –53 dBc with optimum mixer level[j]	
BTS	5 MHz		±0.44 dB	At –48 dBc non-coherent ACPR[l]	
Dynamic Range				RRC weighted, 3.84 MHz noise bandwidth	
Noise Correction	**Offset Freq**	**Method**		**ACLR (typical)[m]**	**Optimal ML (Nominal)**
Off	5 MHz	Filtered IBW		–68 dB	–8 dBm
Off	5 MHz	Fast		–67 dB	–9 dBm

Description			Specifications	Supplemental Information	
Off	10 MHz	Filtered IBW		–74 dB	–2 dBm
On	5 MHz	Filtered IBW		–73 dB	–8 dBm
On	10 MHz	Filtered IBW		–76 dB	–2 dBm
RRC Weighting Accuracy[n]					
White noise in Adjacent Channel TOI-induced spectrum rms CW error				0.00 dB nominal 0.001 dB nominal 0.012 dB nominal	

a. The effect of scale fidelity on the ratio of two powers is called the relative scale fidelity. The scale fidelity specified in the Amplitude section is an absolute scale fidelity with 35 dBm at the input mixer as the reference point. The relative scale fidelity is nominally only 0.01 dB larger than the absolute scale fidelity.
b. See Amplitude Accuracy and Range section.
c. See Frequency and Time section.
d. Expressed in decibels.
e. An ACP measurement measures the power in adjacent channels. The shape of the response versus frequency of those adjacent channels is occasionally critical. One parameter of the shape is its 3 dB bandwidth. When the bandwidth (called the Ref BW) of the adjacent channel is set, it is the 3 dB bandwidth that is set. The passband response is given by the convolution of two functions: a rectangle of width equal to Ref BW and the power response versus frequency of the RBW filter used. Measurements and specifications of analog radio ACPs are often based on defined bandwidths of measuring receivers, and these are defined by their –6 dB widths, not their –3 dB widths. To achieve a passband whose –6 dB width is x, set the Ref BW to be $x - 0.572 \times \mathrm{RBW}$.
f. Most versions of adjacent channel power measurements use negative numbers, in units of dBc, to refer to the power in an adjacent channel relative to the power in a main channel, in accordance with ITU standards. The standards for W-CDMA analysis include ACLR, a positive number represented in dB units. In order to be consistent with other kinds of ACP measurements, this measurement and its specifications will use negative dBc results, and refer to them as ACPR, instead of positive dB results referred to as ACLR. The ACLR can be determined from the ACPR reported by merely reversing the sign.
g. The accuracy of the Adjacent Channel Power Ratio will depend on the mixer drive level and whether the distortion products from the analyzer are coherent with those in the UUT. These specifications apply even in the worst case condition of coherent analyzer and UUT distortion products. For ACPR levels other than those in this specifications table, the optimum mixer drive level for accuracy is approximately –37 dBm – (ACPR/3), where the ACPR is given in (negative) decibels.
h. The Fast method has a slight decrease in accuracy in only one case: for BTS measurements at 5 MHz offset, the accuracy degrades by ±0.01 dB relative to the accuracy shown in this table.

i. To meet this specified accuracy when measuring mobile station (MS) or user equipment (UE) within 3 dB of the required –33 dBc ACPR, the mixer level (ML) must be optimized for accuracy. This optimum mixer level is –22 dBm, so the input attenuation must be set as close as possible to the average input power – (–22 dBm). For example, if the average input power is –6 dBm, set the attenuation to 16 dB. This specification applies for the normal 3.5 dB peak-to-average ratio of a single code. Note that if the mixer level is set to optimize dynamic range instead of accuracy, accuracy errors are nominally doubled.
j. ACPR accuracy at 10 MHz offset is warranted when the input attenuator is set to give an average mixer level of –14 dBm.
k. In order to meet this specified accuracy, the mixer level must be optimized for accuracy when measuring node B Base Transmission Station (BTS) within 3 dB of the required –45 dBc ACPR. This optimum mixer level is –19 dBm, so the input attenuation must be set as close as possible to the average input power – (–22 dBm). For example, if the average input power is –5 dBm, set the attenuation to 14 dB. This specification applies for the normal 10 dB peak-to-average ratio (at 0.01% probability) for Test Model 1. Note that, if the mixer level is set to optimize dynamic range instead of accuracy, accuracy errors are nominally doubled.
l. Accuracy can be excellent even at low ACPR levels assuming that the user sets the mixer level to optimize the dynamic range, and assuming that the analyzer and UUT distortions are incoherent. When the errors from the UUT and the analyzer are incoherent, optimizing dynamic range is equivalent to minimizing the contribution of analyzer noise and distortion to accuracy, though the higher mixer level increases the display scale fidelity errors. This incoherent addition case is commonly used in the industry and can be useful for comparison of analysis equipment, but this incoherent addition model is rarely justified. This derived accuracy specification is based on a mixer level of –14 dBm.
m..Agilent measures 100% of the signal analyzers for dynamic range in the factory production process. This measurement requires a near-ideal signal, which is impractical for field and customer use. Because field verification is impractical, Agilent only gives a typical result. More than 80% of prototype instruments met this "typical" specification; the factory test line limit is set commensurate with an on-going 80% yield to this typical.
The ACPR dynamic range is verified only at 2 GHz, where Agilent has the near-perfect signal available. The dynamic range is specified for the optimum mixer drive level, which is different in different instruments and different conditions. The test signal is a 1 DPCH signal.
The ACPR dynamic range is the observed range. This typical specification includes no measurement uncertainty.

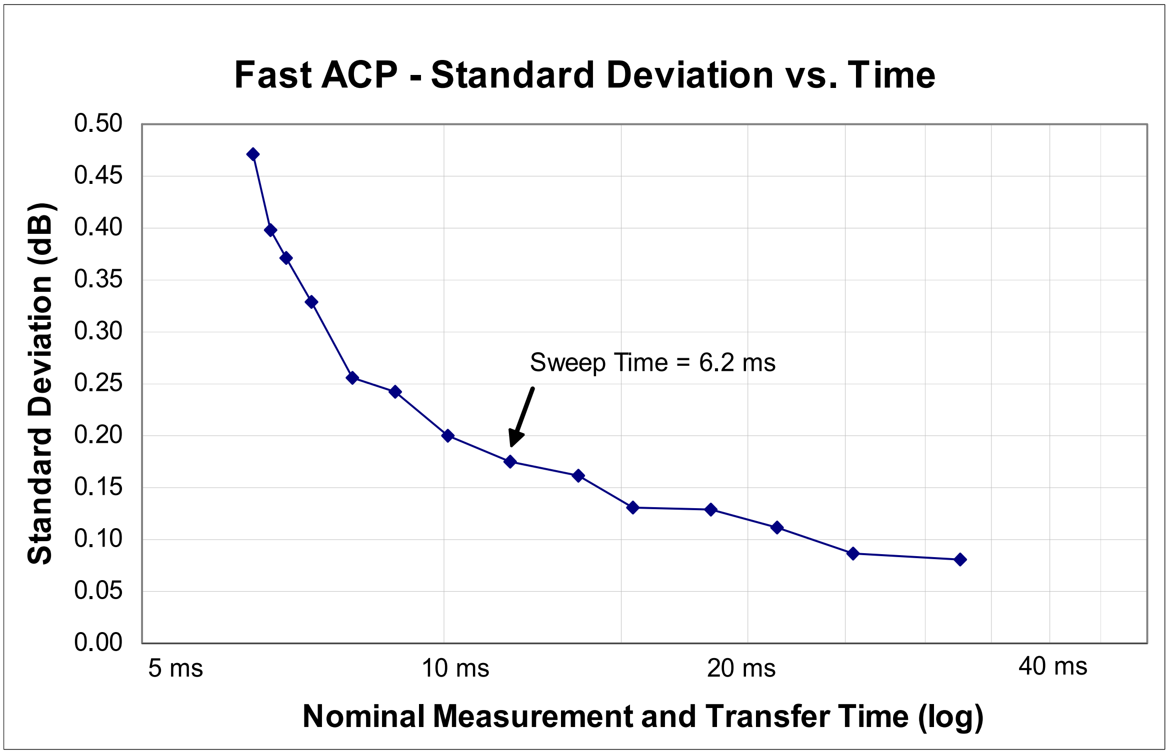
n. 3GPP requires the use of a root-raised-cosine filter in evaluating the ACLR of a device. The accuracy of the passband shape of the filter is not specified in standards, nor is any method of evaluating that accuracy. This footnote discusses the performance of the filter in this instrument. The effect of the RRC filter and the effect of the RBW used in the measurement interact. The analyzer compensates the shape of the RRC filter to accommodate the RBW filter. The effectiveness of this compensation is summarized in three ways:
– White noise in Adj Ch: The compensated RRC filter nominally has no errors if the adjacent channel has a spectrum that is flat across its width.
– TOI–induced spectrum: If the spectrum is due to third–order intermodulation, it has a distinctive shape. The computed errors of the compensated filter are –0.001 dB for the 100 kHz RBW used for UE testing with the IBW method. It is also –0.001 dB for the 390 kHz RBW used with the Fast method, and 0.000 dB for the 27 kHz RBW filter used for BTS testing with the Filtered IBW method. The worst error for RBWs between these extremes is 0.05 dB for a 330 kHz RBW filter.
– rms CW error: This error is a measure of the error in measuring a CW–like spurious component. It is evaluated by computing the root of the mean of the square of the power error across all frequencies within the adjacent channel. The computed rms error of the compensated filter is 0.012 dB for the 100 kHz RBW used for UE testing with the IBW method. It is 0.034 dB for the 390 kHz RBW used with the Fast method and 0.000 dB for the 27 kHz RBW filter used for BTS testing. The worst error for RBWs between 27 kHz and 470 kHz is 0.057 dB for a 430 kHz RBW filter.like spurious component. It is evaluated by computing the root of the mean of the square of the power error across all frequencies within the adjacent channel. The computed rms error of the compensated filter is 0.012 dB for the 100 kHz RBW used for UE testing with the IBW method. It is 0.034 dB for the 390 kHz RBW used with the Fast method and 0.000 dB for the 27 kHz RBW filter used for BTS testing. The worst error for RBWs between 27 kHz and 470 kHz is 0.057 dB for a 430 kHz RBW filter.

Description	Specifications	Supplemental Information
Case: Radio Std = IS-95 or J-STD-008		
Method		RBW method[a]
ACPR Relative Accuracy		
Offsets < 750 kHz[b]	±0.08 dB	
Offsets > 1.98 MHz[c]	±0.10 dB	

a. The RBW method measures the power in the adjacent channels within the defined resolution bandwidth. The noise bandwidth of the RBW filter is nominally 1.055 times the 3.01 dB bandwidth. Therefore, the RBW method will nominally read 0.23 dB higher adjacent channel power than would a measurement using the integration bandwidth method, because the noise bandwidth of the integration bandwidth measurement is equal to that integration bandwidth. For cmdaOne ACPR measurements using the RBW method, the main channel is measured in a 3 MHz RBW, which does not respond to all the power in the carrier. Therefore, the carrier power is compensated by the expected under-response of the filter to a full width signal, of 0.15 dB. But the adjacent channel power is not compensated for the noise bandwidth effect.
The reason the adjacent channel is not compensated is subtle. The RBW method of measuring ACPR is very similar to the preferred method of making measurements for compliance with FCC requirements, the source of the specifications for the cdmaOne Spur Close specifications. ACPR is a spot measurement of Spur Close, and thus is best done with the RBW method, even though the results will disagree by 0.23 dB from the measurement made with a rectangular passband.

b. The specified ACPR accuracy applies if the measured ACPR substantially exceeds the analyzer dynamic range at the specified offset. When this condition is not met, there are additional errors due to the addition of analyzer spectral components to UUT spectral components. In the worst case at these offsets, the analyzer spectral components are all coherent with the UUT components; in a more typical case, one third of the analyzer spectral power will be coherent with the distortion components in the UUT. Coherent means that the phases of the UUT distortion components and the analyzer distortion components are in a fixed relationship, and could be perfectly in-phase. This coherence is not intuitive to many users, because the signals themselves are usually pseudo-random; nonetheless, they can be coherent.
When the analyzer components are 100% coherent with the UUT components, the errors add in a voltage sense. That error is a function of the signal (UUT ACPR) to noise (analyzer ACPR dynamic range limitation) ratio, SN, in decibels.
The function is error = $20 \times \log(1 + 10^{-SN/20})$
For example, if the UUT ACPR is –62 dB and the measurement floor is –82 dB, the SN is 20 dB and the error due to adding the analyzer distortion to that of the UUT is 0.83 dB.

c. As in footnote b, the specified ACPR accuracy applies if the ACPR measured substantially exceeds the analyzer dynamic range at the specified offset. When this condition is not met, there are additional errors due to the addition of analyzer spectral components to UUT spectral components. Unlike the situation in footnote b, though, the spectral components from the analyzer will be non-coherent with the components from the UUT. Therefore, the errors add in a power sense. The error is a function of the signal (UUT ACPR) to noise (analyzer ACPR dynamic range limitation) ratio, SN, in decibels.
The function is error = $10 \times \log(1 + 10^{-SN/10})$.
For example, if the UUT ACPR is –75 dB and the measurement floor is –85 dB, the SN ratio is 10 dB and the error due to adding the analyzer's noise to that of the UUT is 0.41 dB.

Fast ACPR Test [Plot[a]]


a. Observation conditions for ACP speed:
Display Off, signal is Test Model 1 with 64 DPCH, Method set to Fast. Measured with an IBM compatible PC with a 3 GHz Pentium 4 running Windows XP Professional Version 2002. The communications medium was PCI GPIB IEEE 488.2. The Test Application Language was .NET – rms CW error: This error is a measure of the error in measuring a CW–like spurious component. It is evaluated by computing the root of the mean of the square of the power error across all frequencies within the adjacent channel. The computed rms error of the compensated filter is 0.012 dB for the 100 kHz RBW used for UE testing with the IBW method. It is 0.034 dB for the 390 kHz RBW used with the Fast method and 0.000 dB for the 27 kHz RBW filter used for BTS testing. The worst error for RBWs between 27 kHz and 470 kHz is 0.057 dB for a 430 kHz RBW filter.like spurious component. It is evaluated by computing the root of the mean of the square of the power error across all frequencies within the adjacent channel. The computed rms error of the compensated filter is 0.012 dB for the 100 kHz RBW used for UE testing with the IBW method. It is 0.034 dB for the 390 kHz RBW used with the Fast method and 0.000 dB for the 27 kHz RBW filter used for BTS testing. The worst error for RBWs between 27 kHz and 470 kHz is 0.057 dB for a 430 kHz RBW filter. C#. The Application Communication Layer was Agilent T&M Programmer's Toolkit For Visual Studio (Version 1.1), Agilent I/O Libraries (Version M.01.01.41_beta).

Description	Specifications	Supplemental Information
Power Statistics CCDF		
Histogram Resolution[a]	0.01 dB	

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

Description	Specifications	Supplemental Information
Burst Power		
Methods		Power above threshold Power within burst width

Description	Specifications	Supplemental Information
Results		Output power, average Output power, single burst Maximum power Minimum power within burst Burst width

Description	Specifications	Supplemental Information
Spurious Emissions		Table-driven spurious signals; search across regions
Case: Radio Std = 3GPP W-CDMA		
Dynamic Range 1 to 3.6 GHz[a]	91.9 dB	97.1 dB (typical)
Sensitivity, absolute 1 to 3.6 GHz	–79.4 dBm	–85.4 dBm (typical)
Accuracy		
Attenuation = 10 dB		
Frequency Range		
9 kHz to 3.6 GHz		±0.41 dB (95th Percentile)
3.5 GHz to 8.4 GHz		±1.22 dB (95th Percentile)
8.3 GHz to 13.6 GHz		±1.59 dB (95th Percentile)

a. The dynamic is specified with the mixer level at +3 dBm, where up to 1 dB of compression can occur, degrading accuracy by 1 dB.

Description	Specifications	Supplemental Information
Spectrum Emission Mask		Table-driven spurious signals; measurement near carriers
Case: Radio Std = cdma2000		
Dynamic Range, relative 750 kHz offset[a b]	74.0 dB	81.0 dB (typical)
Sensitivity, absolute 750 kHz offset[c]	–94.7 dBm	–100.7 dBm (typical)
Accuracy 750 kHz offset		
Relative[d]	±0.11 dB	
Absolute[e] 20 to 30 °C	±1.05 dB	±0.34 dB (95th Percentile ≈ 2σ)

Description	Specifications	Supplemental Information
Case: Radio Std = 3GPP W–CDMA		
Dynamic Range, relative 2.515 MHz offset[a d]	76.5 dB	83.9 dB (typical)
Sensitivity, absolute 2.515 MHz offset[c]	–94.7 dBm	–100.7 dBm (typical)
Accuracy 2.515 MHz offset		
Relative[d]	±0.12 dB	
Absolute[e] 20 to 30 °C	±1.05 dB	±0.34 dB (95th Percentile ≈ 2σ)

a. The dynamic range specification is the ratio of the channel power to the power in the offset specified. The dynamic range depends on the measurement settings, such as peak power or integrated power. Dynamic range specifications are based on default measurement settings, with detector set to average, and depend on the mixer level. Default measurement settings include 30 kHz RBW.
b. This dynamic range specification applies for the optimum mixer level, which is about –18 dBm. Mixer level is defined to be the average input power minus the input attenuation.
c. The sensitivity is specified with 0 dB input attenuation. It represents the noise limitations of the analyzer. It is tested without an input signal. The sensitivity at this offset is specified in the default 30 kHz RBW, at a center frequency of 2 GHz.
d. This dynamic range specification applies for the optimum mixer level, which is about –16 dBm. Mixer level is defined to be the average input power minus the input attenuation.
e. The absolute accuracy of SEM measurement is the same as the absolute accuracy of the spectrum analyzer. See “Absolute Amplitude Accuracy” on page 32 for more information. The numbers shown are for 0 - 3.6 GHz, with attenuation set to 10 dB.

Options

The following options and applications affect instrument specifications.

Option 503:	Frequency range, 9 kHz to 3.6 GHz
Option 507:	Frequency range, 9 kHz to 7 GHz
Option 513:	Frequency range, 9 kHz to 13.6 GHz
Option 526:	Frequency range, 9 kHz to 26.5 GHz
Option EA3:	Electronic attenuator, 3.6 GHz
Option FSA:	2 dB fine step attenuator
Option P03:	Preamplifier, 3.6 GHz
I/Q Analyzer:	I/Q Analyzer measurement application
Option PFR:	Precision frequency reference
N9068A:	Phase Noise measurement application
N9071A	GSM/EDGE measurement application
N9073A-1FP:	W-CDMA measurement application
N9073A-2FP:	HSDPA/HSUPA measurement application
N9075A:	802.16 OFDMA measurement application

General

Description	Specifications	Supplemental Information
Calibration Cycle	1 year	

Description	Specifications	Supplemental Information
Temperature Range		
Operating	5 to 50 °C	Standard
Storage	–40 to 65 °C	
Altitude	3000 meters (approx. 10,000 feet)	

Description	Specifications	Supplemental Information
Environmental and Military Specifications		Test methods are aligned with IEC 60068-2 and levels are similar to MIL-PRF-28800F Class 3.

Description	Specifications
EMC	Complies with European EMC Directive 89/336/EEC, amended by 93/68/EEC — IEC/EN 61326 — CISPR Pub 11 Group 1, Class A — AS/NZS CISPR 11:2002 — ICES/NMB-001

Acoustic Noise Emission/Geraeuschemission	
LpA <70 dB	LpA <70 dB
Operator position	Am Arbeitsplatz
Normal position	Normaler Betrieb
Per ISO 7779	Nach DIN 45635 t.19

Description	Specifications
Safety	Complies with European Low Voltage Directive 73/23/EEC, amended by 93/68/EEC — IEC/EN 61010-1 — Canada: CSA C22.2 No. 61010-1 — USA: UL 61010-1

Description	Specification	Supplemental Information
Power Requirements		
Voltage (low range)	100/120 V	
Frequency	50/60 Hz	
Voltage (high range)	220/240 V	
Frequency	50/60 Hz	
Power Consumption, On	<260 W	
Power Consumption, Standby	<20 W	Standby power not supplied to frequency reference oscillator.

Description	Specifications	Supplemental Information
Measurement Speed		Nominal
Local measurement and display update rate[a]		
Sweep points = 1001		11 ms (90/s)
Remote measurement and LAN transfer rate[a b]		
Sweep points = 1001		4 ms (250/s)
Marker Peak Search		5 ms
Center Frequency Tune and Transfer (RF)		51 ms
Center Frequency Tune and Transfer (µW)		86 ms
Measurement/Mode Switching		75 ms
W-CDMA ACLR measurement time		See page 54
Measurement Time vs. Span		See page 23

a. Factory preset, fixed center frequency, RBW = 1 MHz, and span >10 MHz and ≤ 600 MHz, and stop frequency ≤ 3.6 GHz, Auto Align Off.

b. Phase Noise Optimization set to Fast Tuning, Display Off, 32 bit integer format, markers Off, single sweep, measured with IBM compatible PC with 2.99 GHz Pentium® 4 with 2 GB RAM running Windows® XP, Agilent I/O Libraries Suite Version 14.1, one meter GPIB cable, National Instruments PCI-GPIB Card and NI-488.2 DLL.

Description	Specifications	Supplemental Information
Display		
Resolution	1024 × 768	XGA
Size		213 mm (8.4 in) diagonal (nominal)
Scale		
Log Scale	0.1, 0.2, 0.3...1.0, 2.0, 3.0...20 dB per division	
Linear Scale	10% of reference level per division	
Units	dBm, dBmV, dBmA, Watts, Volts, Amps, dBµV, dBµA	

Description	Specifications	Supplemental Information
Data Storage		
Internal	Integrated 40 GB HDD	15 GB available on primary partition for applications and secondary data.
External		6 GB available on separate partition for user data.

Description	Specifications	Supplemental Information
Weight (without options)		
Net		16 kg (35 lbs) (nominal)
Shipping		28 kg (62 lbs) (nominal)
Cabinet Dimensions		Cabinet dimensions exclude front and rear protrusions.
Height	177 mm (7.0 in)	
Width	426 mm (16.8 in)	
Length	368 mm (14.5 in)	

Inputs/Outputs

Front Panel

Description	Specifications	Supplemental Information
RF Input		
Connector		
Standard	Type-N female	
Impedance		50 Ω (nominal)

Description	Specifications	Supplemental Information
Probe Power		
Voltage/Current		+15 Vdc, ±7% at 150 mA max (nominal) –12.6 Vdc, ±10% at 150 mA max (nominal) GND

Description	Specifications	Supplemental Information
USB 2.0 Ports		
Master (2 ports)		
Connector	USB Type “A” (female)	
Output Current		0.5 A (nominal)

Description	Specifications	Supplemental Information
Headphone Jack		
Connector	3.5 mm (1/8 inch) miniature audio jack	Not available for demodulation. Available for Windows based applications.
Output Power		90 mW per channel into 16 Ω (nominal)

Rear Panel

Description	Specifications	Supplemental Information
10 MHz Out		
Connector	BNC female	
Impedance		50 Ω (nominal)
Output Amplitude		≥ 0 dBm (nominal)
Output Configuration	AC coupled, sinusoidal	
Frequency	10 MHz ± (10 MHz × frequency reference accuracy)	

Description	Specifications	Supplemental Information
Ext 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		–5 to +10 dBm (nominal)
Input Frequency		10 MHz (nominal)
Lock range	$\pm 5 \times 10^{-6}$ of selected external reference input frequency	

Description	Specifications	Supplemental Information
Sync		Reserved for future use
Connector	BNC female	

Description	Specifications	Supplemental Information
Trigger Inputs		Either trigger source may be selected.
Trigger 1 In, Trigger 2 In		
Connector	BNC female	
Impedance		10 kΩ (nominal)
Trigger Level Range	–5 to +5 V	1.5 V (TTL) factory preset

Description	Specifications	Supplemental Information
Trigger Outputs		
Trigger 1 Out, Trigger 2 Out		
Connector	BNC female	
Impedance		50 Ω (nominal)
Level		5 V TTL

Description	Specifications	Supplemental Information
Monitor Output		
Connector	VGA compatible, 15-pin mini D-SUB	
Format		XGA (60 Hz vertical sync rates, non-interlaced) Analog RGB
Resolution	1024 × 768	

Description	Specifications	Supplemental Information
Noise Source Drive +28 V (Pulsed)		Reserved for future use
Connector	BNC female	

Description	Specifications	Supplemental Information
SNS Series Noise Source		Reserved for future use with Agilent Technologies SNS Series noise sources

Description	Specifications	Supplemental Information
Digital Bus		Reserved for future use
Connector	MDR-80	

Description	Specifications	Supplemental Information
Analog Out		Reserved for future use
Connector	BNC female	

Description	Specifications	Supplemental Information
USB 2.0 Ports		
Master (4 ports)		
Connector	USB Type “A” (female)	
Output Current		0.5 A (nominal)
Slave (1 port)		
Connector	USB Type “B” (female)	
Output Current		0.5 A (nominal)

Description	Specifications	Supplemental Information
GPIB Interface		
Connector	IEEE-488 bus connector	
GPIB Codes		SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3 and C28, DT1, L4, C0
LAN TCP/IP Interface	RJ45 Ethertwist	100BaseT

Regulatory Information

This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 61010 2nd ed, and 664 respectively.

This product has been designed and tested in accordance with accepted industry standards, 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). This product complies with all relevant directives.
ICES/NMB-001	"This ISM device complies with Canadian ICES-001."
	"Cet appareil ISM est conforme a la norme NMB du Canada."
ISM 1-A (GRP.1 CLASS A)	This is a symbol of an Industrial Scientific and Medical Group 1 Class A product. (CISPR 11, Clause 4)
	The CSA mark is the Canadian Standards Association. This product complies with the relevant safety requirements.
N10149	The C-Tick mark is a registered trademark of the Australian/New Zealand Spectrum Management Agency. This product complies with the relevant EMC regulations.
	This symbol indicates separate collection for electrical and electronic equipment mandated under EU law as of August 13, 2005. All electric and electronic equipment are required to be separated from normal waste for disposal (Reference WEEE Directive 2002/96/EC).
	To return unwanted products, contact your local Agilent office, or see http://www.agilent.com/environment/product/index.shtml for more information.

Declaration of Conformity

A copy of the Manufacturer's European Declaration of Conformity for this instrument can be obtained by contacting your local Agilent Technologies sales representative.

2 Option EA3 - Electronic Attenuator, 3.6 GHz

This chapter contains specifications for the *Option EA3* Electronic Attenuator, 3.6 GHz.

Specifications Affected by Electronic Attenuator

Specification Name	Information
Frequency Range	See "Range (Frequency and Attenuation)" specifications in this chapter.
1 dB Gain Compression Point	See "Distortions and Noise" specifications in this chapter.
Displayed Average Noise Level	See "Distortions and Noise" specifications in this chapter.
Frequency Response	See specifications in this chapter.
Attenuator Switching Uncertainty	The recommended operation of the electronic attenuator is with the reference setting (10 dB) of the mechanical attenuator. In this operating condition, the Attenuator Switching Uncertainty specification of the mechanical attenuator in the core specifications does not apply, and any switching uncertainty of the electronic attenuator is included within the "Electronic Attenuator Switching Uncertainty" on page 80.
Absolute Amplitude Accuracy	Use "Frequency" specifications from this chapter and the formula from the ""Absolute Amplitude Accuracy" on page 32 of the core specifications.
Second Harmonic Distortion	See "Distortions and Noise" specifications in this chapter.
Third Order Intermodulation Distortion	See "Distortions and Noise" specifications in this chapter.

Other Electronic Attenuator Specifications

Description	Specifications	Supplemental Information
Range (Frequency and Attenuation)		
Frequency Range	9 kHz to 3.6 GHz	
Attenuation Range		
Electronic Attenuator Range	0 to 24 dB, 1 dB steps	
Calibrated Range	0 to 24 dB, 2 dB steps	Electronic attenuator is calibrated with 10 dB mechanical attenuation
Full Attenuation Range	0 to 84 dB, 1 dB steps	Sum of electronic and mechanical attenuation

Description	Specifications	Supplemental Information
Distortions and Noise		When using the electronic attenuator, the mechanical attenuator is also in-circuit. The full mechanical attenuator range is available[a].
1 dB Gain Compression Point		The 1 dB compression point will be nominally higher with the electronic attenuator “Enabled” than with it not Enabled by the loss[b], except with high settings of electronic attenuation[c].
Displayed Average Noise Level		Instrument Displayed Average Noise Level will nominally be worse with the electronic attenuator “Enabled” than with it not Enabled by the loss[b].
Second Harmonic Distortion		Instrument Second Harmonic Distortion will nominally be better in terms of the second harmonic intercept (SHI) with the electronic attenuator “Enabled” than with it not Enabled by the loss[b].
Third-order Intermodulation Distortion		Instrument TOI will nominally be better with the electronic attenuator “Enabled” than with it not Enabled by the loss[b] except for the combination of high attenuation setting and high signal frequency[d]

a. The electronic attenuator is calibrated for its frequency response only with the mechanical attenuator set to its preferred setting of 10 dB.

b. The loss of the electronic attenuator is nominally given by its attenuation plus its excess loss. That excess loss is nominally 2 dB from 0 – 500 MHz and increases by nominally another 1 dB/GHz for frequencies above 500 MHz.

c. An additional compression mechanism is present at high electronic attenuator settings. The mechanism gives nominally 1 dB compression at +20 dBm at the internal electronic attenuator input. The compression threshold at the RF input is higher than that at the internal electronic attenuator input by the mechanical attenuation. The mechanism has negligible effect for electronic attenuations of 0 through 14 dB.

d. The TOI performance improvement due to electronic attenuator loss is limited at high frequencies, such that the TOI reaches a limit of nominally +45 dBm at 3.6 GHz, with the preferred mechanical attenuator setting of 10 dB, and the maximum electronic attenuation of 24 dB. The TOI will change in direct proportion to changes in mechanical attenuation.

Description	Specifications		Supplemental Information
Frequency Response			
Maximum error relative to reference condition (50 MHz)			
	20 to 30 °C	**5 to 50 °C**	**95th Percentile (≈2σ)**
Attenuation = 4 to 24 dB, even steps			
9 kHz to 10 MHz	±0.75 dB	±0.90 dB	±0.32 dB
10 MHz to 50 MHz	±0.65 dB	±0.69 dB	±0.27 dB
50 MHz to 2.2 GHz	±0.48 dB	±0.60 dB	±0.19 dB
2.2 GHz to 3.6 GHz	±0.55 dB	±0.67 dB	±0.20 dB
Attenuation = 0, 1, 2 and odd steps, 3 to 23 dB			
10 MHz to 3.6 GHz			±0.30 dB

Description	Specifications	Supplemental Information
Electronic Attenuator Switching Uncertainty		
Error relative to reference condition (50 MHz, 10 dB mechanical attenuation, 10 dB electronic attenuation)		
Attenuation = 0 to 24 dB		
9 kHz to 3.6 GHz	See note[a]	

a. The specification is ±0.14 dB. Note that this small relative uncertainty does not apply in estimating absolute amplitude accuracy. It is included within the absolute amplitude accuracy for measurements done with the electronic attenuator. (Measurements made without the electronic attenuator are treated differently; the absolute amplitude accuracy specification for these measurements does not include attenuator switching uncertainty.)

3 Option P03 - Preamplifier

This chapter contains specifications for the EXA Spectrum Analyzer *Option P03* preamplifier.

Specifications Affected by Preamp

Specification Name	Information
Frequency Range	See “Frequency Range” on page 14 of the core specifications.
Nominal Dynamic Range vs. Offset Frequency vs. RBW	Does not apply with Preamp On.
Measurement Range	The measurement range depends on DANL. See “Amplitude Accuracy and Range” on page 27.
Gain Compression	See specifications in this chapter.
DANL	See specifications in this chapter.
Frequency Response	See specifications in this chapter.
Absolute Amplitude Accuracy	See ““Absolute Amplitude Accuracy” on page 32 of the core specifications.
RF Input VSWR	See plot in this chapter.
Input Attenuation Switching Uncertainty	See “Input Attenuation Switching Uncertainty” on page 31 of the core specifications.
Display Scale Fidelity	See “Display Scale Fidelity” on page 37 of the core specifications.
Third Order Intermodulation Distortion	See specifications in this chapter.
Other Input Related Spurious	See “Spurious Responses” on page 43 of the core specifications.
Dynamic Range	See plot in this chapter.

Specification Name	Information
Gain	See “Preamp” specifications in this chapter.
Noise Figure	See “Preamp” specifications in this chapter.

Other Preamp Specifications

Description	Specifications	Supplemental Information
Preamp *(Option P03)*[a]		
Gain		Maximum[b]
100 kHz to 3.6 GHz		+20 dB (nominal)
Noise figure		
100 kHz to 3.6 GHz		15 dB (nominal)

a. The preamp follows the input attenuator, AC/DC coupling switch, and precedes the input mixer. In low-band, it follows the 3.6 GHz low-pass filter.

b. Preamp Gain directly affects distortion and noise performance, but it also affects the range of levels that are free of final IF overload. The user interface has a designed relationship between input attenuation and reference level to prevent on-screen signal levels from causing final IF overloads. That design is based on the maximum preamp gains shown. Actual preamp gains are modestly lower, by up to nominally 5 dB for frequencies from 100 kHz to 3.6 GHz.

Description	Specifications	Supplemental Information
1 dB Gain Compression Point (Two-tone)[a][b]		
Preamp On *(Option P03)* Maximum power at the preamp[c] for 1 dB gain compression		
10 MHz to 3.6 GHz		–10 dBm (nominal)

a. Large signals, even at frequencies not shown on the screen, can cause the analyzer to mismeasure on-screen signals because of two-tone gain compression. This specification tells how large an interfering signal must be in order to cause a 1 dB change in an on-screen signal.

b. Reference level and off-screen performance: The reference level (RL) behavior differs from some earlier analyzers in a way that makes this analyzer more flexible. In other analyzers, the RL controlled how the measurement was performed as well as how it was displayed. Because the logarithmic amplifier in these analyzers had both range and resolution limitations, this behavior was necessary for optimum measurement accuracy. The logarithmic amplifier in this signal analyzer, however, is implemented digitally such that the range and resolution greatly exceed other instrument limitations. Because of this, the analyzer can make measurements largely independent of the setting of the RL without compromising accuracy. Because the RL becomes a display function, not a measurement function, a marker can read out results that are off-screen, either above or below, without any change in accuracy. The only exception to the independence of RL and the way in which the measurement is performed is in the input attenuation setting: When the input attenuation is set to auto, the rules for the determination of the input attenuation include dependence on the reference level. Because the input attenuation setting controls the trade-off between large signal behaviors (third-order intermodulation and compression) and small signal effects (noise), the measurement results can change with RL changes when the input attenuation is set to auto.

c. Total power at the preamp (dBm) = total power at the input (dBm) – input attenuation (dB).

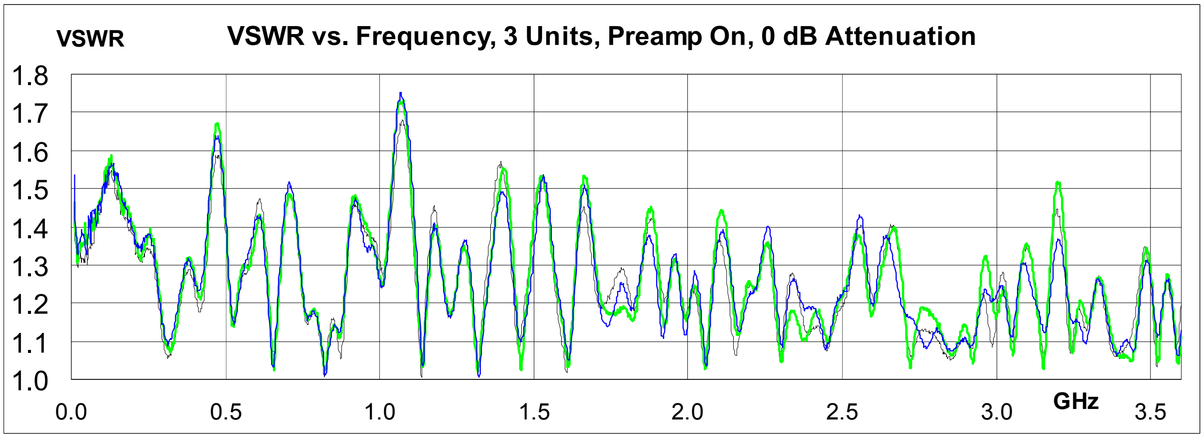
Description	Specifications		Supplemental Information
Displayed Average Noise Level (DANL) – Preamp On *(Option P03)*[a]	Input terminated, Sample or Average detector Averaging type = Log 0 dB input attenuation IF Gain = Any setting		
1 Hz Resolution Bandwidth			
Preamp On			
	20 to 30 °C	**5 to 50 °C**	**Typical**
Option P03			
100 kHz to 1 MHz[b]			–146 dBm (nominal)
1 MHz to 10 MHz			–161 dBm (nominal)
10 MHz to 2.1 GHz	–160 dBm	–158 dBm	–162 dBm
2.1 GHz to 3.6 GHz	–159 dBm	–157 dBm	–160 dBm

a. DANL for zero span and swept is normalized in two ways and for two reasons. DANL is measured in a 1 kHz RBW and normalized to the narrowest available RBW, because the noise figure does not depend on RBW and 1 kHz measurements are faster. The second normalization is that DANL is measured with 10 dB input attenuation and normalized to the 0 dB input attenuation case, because that makes DANL and third order intermodulation test conditions congruent, allowing accurate dynamic range estimation for the analyzer.

b. Specifications apply only when the Phase Noise Optimization control is set to "Best Phase Noise at offset > 30 kHz."

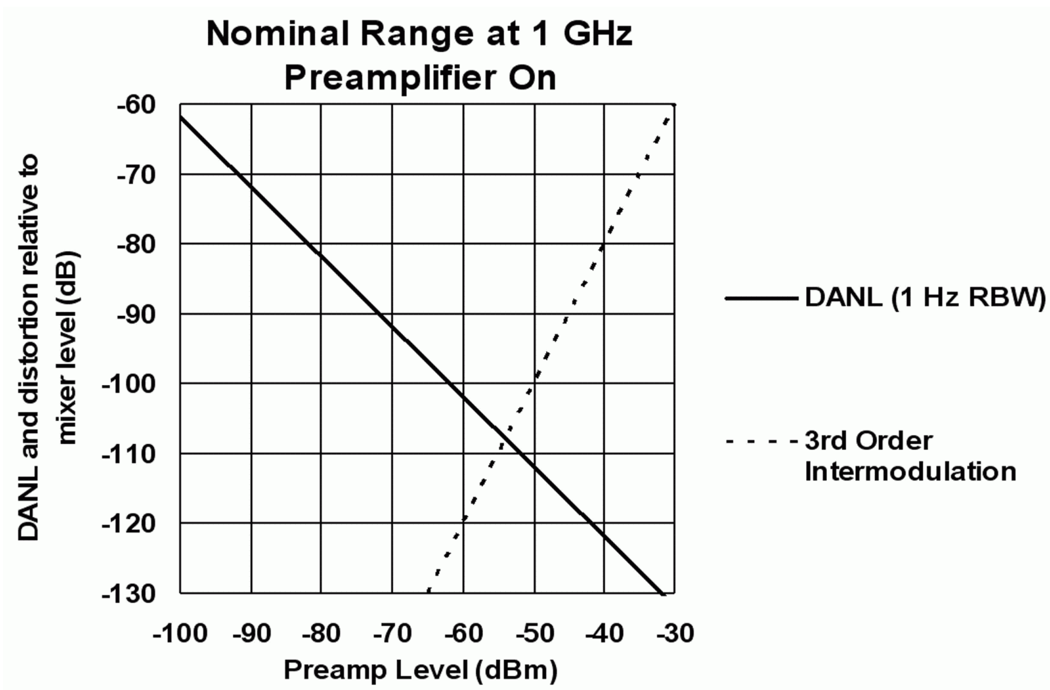
Description	Specifications		Supplemental Information
Frequency Response – Preamp On *(Option P03)* Maximum error relative to reference condition (50 MHz) Input attenuation 0 dB Swept operation[a]			
	20 to 30 °C	**5 to 50 °C**	**95^{th} Percentile (≈2σ) 20 to 30 °C**
100 kHz to 3.6 GHz[b]			±0.28 dB (nominal)

a. For Sweep Type = FFT, add the RF flatness errors of this table to the IF Frequency Response errors. An additional error source, the error in switching between swept and FFT sweep types, is nominally ±0.01 dB and is included within the “Absolute Amplitude Error” specifications.
b. Electronic attenuator (Option EA3) may not be used with preamp on.

Nominal VSWR – Preamp On (Plot)


Description	Specifications	Supplemental Information		
Third Order Intermodulation Distortion				
Tone separation 5 times IF Prefilter Bandwidth[a]				
Sweep type not set to FFT				
Preamp On *(Option P03)*		**Preamp Level**[b]	**Distortion** (nominal)	**TOI**[c] (nominal)
30 MHz to 3.6 GHz		–45 dBm	–90 dBc	0.0 dBm

a. See the IF Prefilter Bandwidth table in the Gain Compression specifications on page 40. When the tone separation condition is met, the effect on TOI of the setting of IF Gain is negligible.
b. Preamp Level = Input Level – Input Attenuation.
c. TOI = third order intercept. The TOI is given by the preamplifier input tone level (in dBc) minus (distortion/2) where distortion is the relative level of the distortion tones in dBc.

Nominal Dynamic Range at 1 GHz, Preamp On (Plot)


4 Option PFR - Precision Frequency Reference

This chapter contains specifications for the Option PFR Precision Frequency Reference.

Specifications Affected by Precision Frequency Reference

Specification Name	Information
Precision Frequency Reference	See "Precision Frequency Reference" on page 16 in the core specifications.

5 Phase Noise Measurement Application

This chapter contains specifications for the N9068A Phase Noise measurement application.

Phase Noise

Description	Specifications	Supplemental Information
Maximum Carrier Frequency		
EXA Signal Analyzers		
Option 503	3.6 GHz	
Option 507	7 GHz	
Option 513	13.6 GHz	
Option 526	26.5 GHz	

Description	Specifications	Supplemental Information
Measurement Characteristics		
Measurements	Log plot	
	RMS noise	
	RMS jitter	
	Residual FM	
	Spot frequency	
Maximum number of decades		This depends on Frequency Offset range.[a]

a. See Frequency Offset – Range.

Description	Specifications	Supplemental Information
Measurement Accuracy		
Phase Noise Density Accuracy[a b]		
Default settings[c]	±0.50 dB	
Overdrive On setting		±0.60 dB (nominal)
RMS Markers		See equation[d]

a. This does not include the effect of system noise floor. This error is a function of the signal (phase noise of the DUT) to noise (analyzer noise floor due to phase noise and thermal noise) ratio, SN, in decibels.

The function is: $error = 10 \times \log(1 + 10^{-SN/10})$

For example, if the phase noise being measured is 10 dB above the measurement floor, the error due to adding the analyzer's noise to the UUT is 0.41 dB.

b. Offset frequency errors also add amplitude errors. See the Offset frequency section, below.

c. The phase noise density accuracy is derived from warranted analyzer specifications. It applies with default settings and a 0 dBm carrier at 1 GHz. Most notable about the default settings is that the Overdrive (in the advanced menu of the Meas Setup menu) is set to Off.

d. The accuracy of an RMS marker such as "RMS degrees" is a fraction of the readout. That fraction, in percent, depends on the phase noise accuracy, in dB, and is given by $100 \times (10^{PhaseNoiseDensityAccuracy / 20} - 1)$. For example, with +0.30 dB phase noise accuracy, and with a marker reading out 10 degrees RMS, the accuracy of the marker would be +3.5% of 10 degrees, or +0.35 degrees.

Description	Specifications	Supplemental Information
Amplitude Repeatability		
		Standard Deviation[a] [b]
No Smoothing		
Offset		
100 Hz		3.2 dB
1 kHz		2.0 dB
10 kHz		1.7 dB
100 kHz		1.6 dB
1 MHz		1.2 dB
4% Smoothing[c]		
Offset		
100 Hz		1.2 dB
1 kHz		0.56 dB
10 kHz		0.42 dB
100 kHz		0.42 dB
1 MHz		0.42 dB

a. Amplitude repeatability is the nominal standard deviation of the measured phase noise. This table comes from an observation of 30 log plot measurements using a 1 GHz, 0 dBm signal with the smoothing settings shown. All other analyzer and measurement settings are set to their factory defaults.
b. The standard deviation can be further reduced by applying averaging. The standard deviation will improve by a factor of the square root of the number of averages. For example, 10 averages will improve the standard deviation by a factor of 3.2.
c. Smoothing can cause additional amplitude errors near rapid transitions of the data, such as with discrete spurious signals and impulsive noise. The effect is more pronounced as the number of points smoothed increases.

Description	Specifications	Supplemental Information
Offset Frequency		
Range	3 Hz to $(f_{opt} - f_{CF})$ Hz	f_{opt}: Maximum frequency determined by option[a] f_{CF}: Carrier frequency of signal under test
Accuracy[b]	% ±0.5%	±0.0072 octave

a. For example, f_{opt} is 3.6 GHz for *Option 503*.

b. The frequency offset error in octaves causes an additional amplitude accuracy error proportional to the product of the frequency error and slope of the phase noise. For example, a 0.01 octave frequency error combined with an 18 dB/octave slope gives 0.18 dB additional amplitude error.

Nominal Phase Noise at Different Center Frequencies
See the plot of basebox Nominal Phase Noise on page 52

6 I/Q Analyzer

This chapter contains specifications for the I/Q Analyzer measurement application (Basic Mode).

Specifications Affected by I/Q Analyzer:

Specification Name	Information
Number of Frequency Display Trace Points (buckets)	Does not apply.
Resolution Bandwidth	See Frequency specifications in this chapter.
Video Bandwidth	Not available.
Clipping-to-Noise Dynamic Range	See Clipping-to-Noise Dynamic Range specifications in this chapter.
Resolution Bandwidth Switching Uncertainty	Not specified because it is negligible.
Available Detectors	Does not apply.
Spurious Responses	See "Spurious Responses" on page 43 of core specifications in addition to "IF Spurious Responses" in this chapter.
IF Amplitude Flatness	See ""Absolute Amplitude Accuracy" on page 32 of core specifications.
IF Phase Linearity	See IF Phase Linearity specifications in this chapter.
Data Acquisition	See Data Acquisition specifications in this chapter.

Frequency

Description	Specifications	Supplemental Information
Frequency Range		
Option 503	9 kHz to 3.6 GHz	
Option 507	9 kHz to 7.0 GHz	
Option 513	9 kHz to 13.6 GHz	
Option 526	9 kHz to 26.5 GHz	
Frequency Span Range		
Standard instrument	10 Hz to 10 MHz	
Option B25	10 Hz to 25 MHz	
Resolution Bandwidth (Spectrum Measurement)		
Range		
Overall	100 mHz to 3 MHz	
Span = 25 MHz	3 kHz to 3 MHz	
Span = 1 MHz	50 Hz to 1 MHz	
Span = 10 kHz	1 Hz to 10 kHz	
Span = 100 Hz	100 mHz to 100 Hz	
Window Shapes	Flat Top, Uniform, Hanning, Hamming, Gaussian, Blackman, Blackman-Harris, Kaiser Bessel (K-B 70 dB, K-B 90 dB & K-B 110 dB)	
Analysis Bandwidth (Span) (Waveform Measurement)		
	10 Hz to 10 MHz	Standard instrument
	10 Hz to 25 MHz	*Option B25*

Description	Specifications	Supplemental Information
Clipping-to-Noise Dynamic Range[a]		Excluding residuals and spurious responses
Clipping Level at Mixer		Center frequency ≥ 20 MHz
IF Gain = Low	–10 dBm	–8 dBm (nominal)
IF Gain = High	–20 dBm	–17.5 dBm (nominal)
Noise Density at Mixer at center frequency[b]	(DANL[c] + IFGainEffect[d]) + 2.25 dB[e]	Example [f]

a. This specification is defined to be the ratio of the clipping level (also known as "ADC Over Range") to the noise density. In decibel units, it can be defined as clipping_level [dBm] – noise_density [dBm/Hz]; the result has units of dBfs/Hz (fs is "full scale").

b. The noise density depends on the input frequency. It is lowest for a broad range of input frequencies near the center frequency, and these specifications apply there. The noise density can increase toward the edges of the span. The effect is nominally well under 1 dB.

c. The primary determining element in the noise density is the "Displayed Average Noise Level" on page 42.

d. DANL is specified with the IF Gain set to High, which is the best case for DANL but not for Clipping-to-noise dynamic range. The core specifications "Displayed Average Noise Level" on page 42, gives a line entry on the excess noise added by using IF Gain = Low, and a footnote explaining how to combine the IF Gain noise with the DANL.

e. DANL is specified for log averaging, not power averaging, and thus is 2.51 dB lower than the true noise density. It is also specified in the narrowest RBW, 1 Hz, which has a noise bandwidth slightly wider than 1 Hz. These two effects together add up to 2.25 dB.

f. As an example computation, consider this: For the case where DANL = –151 dBm in 1 Hz, IF Gain = Low with an excess noise of –157.4 dBm, the total noise density computes to –147.9 dBm/Hz and the Clipping-to-noise ratio for a –10 dBm clipping level is –137.9 dBfs/Hz.

Description				Specification	Supplemental Information
IF Spurious Response[a]					
		Mixer Level[b]	**IF Gain**		**Preamp Off**[c]
IF second harmonic[d]					
Apparent Freq. (f)	**Excitation Freq.**				
Any on-screen f	$(f + f_c + 22.5)/2$	–15 dBm	Low		–54 dBc (nominal)
		–25 dBm	High		–54 dBc (nominal)
IF conversion image[e]					
Apparent Freq. (f)	**Excitation Freq.**				
Any on-screen f	$2 \times f_c - f +$ 45 MHz	–10 dBm	Low		–70 dBc (nominal)
		–20 dBm	High		–70 dBc (nominal)

a. To save test time, the levels of these spurs are not warranted. However, the relationship between the spurious response and its excitation is described so the user can distinguish whether a questionable response is due to these mechanisms or is subject to the specifications in “Spurious Responses” in the core specifications. f is the apparent frequency of the spurious, fc is the measurement center frequency.
b. Mixer Level = Input Level – Input Attenuation.
c. The spurious response specifications only apply with the preamp turned off. When the preamp is turned on, performance is nominally the same as long as the mixer level is interpreted to be: Mixer Level = Input Level – Input Attenuation – Preamp Gain
d. IF second harmonic significant only for Pre-FFT BW ≥10 MHz.
e. IF conversion image significant only for Pre-FFT BW ≥10 MHz.

Amplitude and Phase

Description	Specification	Supplemental Information
IF Amplitude Flatness		See "Absolute Amplitude Accuracy" on page 32"of core specifications.

Description		Specification	Supplemental Information	
IF Phase Linearity				
Relative to mean phase linearity				
Freq (GHz)	**Span** *(MHz)*		**Peak** (nominal)	**rms** (nominal)[a]
≤ 3.6	≤ 10		±0.5 deg	0.2 deg
3.6 to 26.5	≤ 10		±1.5 deg	0.4 deg
≤ 3.6	> 10		±0.8 deg	0.2 deg
3.6 to 26.5	> 10		±2.0 deg	0.6 deg

a. The listed performance is the r.m.s. of the phase deviation relative to the mean phase deviation from a linear phase condition, where the r.m.s. is computed over the range of offset frequencies and center frequencies shown.

Data Acquisition

Description	Specifications	Supplemental Information
Time Record Length	4,000,000 samples (max)	4,000,000 samples ≈ 88.89 ms at 25 MHz span
ADC Resolution	14 Bits	

7 802.16 OFDMA Measurement Application

This chapter contains specifications for the N9075A 802.16 OFDMA measurement application.

Additional Definitions and Requirements:

Because digital communications signals are noise-like, all measurements will have variations. The specifications apply only with adequate averaging to remove those variations.

Information bandwidth is assumed to be 5 or 10 MHz unless otherwise explicitly stated.

Measurements

Description	Specifications	Supplemental Information
Channel Power		
Minimum power at RF Input		–30 dBm (nominal)
Absolute power accuracy[a]		
20 to 30 °C Atten = 10 dB	±0.94 dB	±0.30 dB (95th percentile)
Measurement floor		–75.7 dBm (nominal) at 10 MHz BW

a. Absolute power accuracy includes all error sources for in-band signals except mismatch errors and repeatability due to incomplete averaging. It applies when the mixer level is high enough that measurement floor contribution is negligible.

Description	Specifications	Supplemental Information
Power Statistics CCDF		
Histogram Resolution	0.01 dB[a]	

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

Description	Specifications	Supplemental Information
Occupied Bandwidth		
Minimum power at RF Input		–30 dBm (nominal)
Frequency Accuracy		±20 kHz (nominal) at 10 MHz BW

Description			Specifications	Supplemental Information
Adjacent Channel Power				
Minimum power at RF Input				–36 dBm (nominal)
ACPR Accuracy				
Radio	BW	Offset		
MS	5 MHz	5 MHz	±0.10 dB	At ACPR –24 dBc with optimum mixer level[a]
MS	5 MHz	10 MHz	±0.45 dB	At ACPR –47 dBc with optimum mixer level[b]
MS	10 MHz	10 MHz	±0.17 dB	At ACPR –24 dBc with optimum mixer level[c]
MS	10 MHz	20 MHz	±0.83 dB	At ACPR –47 dBc with optimum mixer level[b]
BS	5 MHz	5 MHz	±0.90 dB	At ACPR –45 dBc with optimum mixer level[d]
BS	5 MHz	10 MHz	±0.72 dB	At ACPR –50 dBc with optimum mixer level[b]
BS	10 MHz	10 MHz	±1.22 dB	At ACPR –45 dBc with optimum mixer level[e]
BS	10 MHz	20 MHz	±1.33 dB	At ACPR –50 dBc with optimum mixer level[b]

a. To meet this specified accuracy when measuring mobile station (MS) at –24 dBc ACPR, the mixer level (ML) must be optimized for accuracy. This optimum mixer level is –25 dBm, so the input attenuation must be set as close as possible to the average input power. For example, if the average input power is –9dBm, set the attenuation to 16 dB. This specification applies for the normal 3.5 dB peak-to-average ratio. Note that if the mixer level is set to optimize dynamic range instead of accuracy, accuracy errors are nominally doubled.

b. ACPR accuracy for this case is warranted when the input attenuator is set to give an average mixer level of –14 dBm.

c. To meet this specified accuracy when measuring mobile station (MS) at –24 dBc ACPR, the mixer level (ML) must be optimized for accuracy. This optimum mixer level is –24 dBm, so the input attenuation must be set as close as possible to the average input power. For example, if the average input power is –4 dBm, set the attenuation to 20 dB. This specification applies for the normal 3.5 dB peak-to-average ratio. Note that if the mixer level is set to optimize dynamic range instead of accuracy, accuracy errors are nominally doubled.

d. To meet this specified accuracy when measuring base station (BS) at –45 dBc ACPR, the mixer level (ML) must be optimized for accuracy. This optimum mixer level is –20 dBm, so the input attenuation must be set as close as possible to the average input power. For example, if the average input power is –4 dBm, set the attenuation to 16 dB. This specification applies for the normal 10 dB peak-to-average ratio (at 0.01% probability). Note that if the mixer level is set to optimize dynamic range instead of accuracy, accuracy errors are nominally doubled.
e. To meet this specified accuracy when measuring base station (BS) at –45 dBc ACPR, the mixer level (ML) must be optimized for accuracy. This optimum mixer level is –18 dBm, so the input attenuation must be set as close as possible to the average input power. For example, if the average input power is –2 dBm, set the attenuation to 16 dB. This specification applies for the normal 10 dB peak-to-average ratio (at 0.01% probability). Note that if the mixer level is set to optimize dynamic range instead of accuracy, accuracy errors are nominally doubled.

Description	Specifications	Supplemental Information
Spectrum Emission Mask		
Dynamic Range, relative		
5.05 MHz offset 10 MHz BW[a] [b]	72.3 dB	78.8 dB (typical)
Sensitivity, absolute		
5.05 MHz offset 10 MHz BW[c]	–89.5 dBm	–95.5 dBm (typical)
Accuracy		
5.05 Hz offset 10 MHz BW		
Relative[d]	±0.11 dB	
Absolute[e]		
20 to 30 °C	±1.05 dB	±0.34 dB (95% confidence)

a. The dynamic range specification is the ratio of the channel power to the power in the offset specified. The dynamic range depends on the measurement settings, such as peak power or integrated power. Dynamic range specifications are based on default measurement settings, with detector set to average, and depend on the mixer level. Default measurement settings include 100 kHz RBW.

b. This dynamic range specification applies for the optimum mixer level, which is about –16 dBm. Mixer level is defined to be the average input power minus the input attenuation.

c. The sensitivity is specified with 0 dB input attenuation. It represents the noise limitations of the analyzer. It is tested without an input signal. The sensitivity at this offset is specified with 100 kHz RBW, at a center frequency of 2 GHz.

d. The relative accuracy is a measure of the ratio of the power at the offset to the main channel power. It applies for spectrum emission levels in the offsets that are well above the dynamic range limitation.

e. The absolute accuracy of SEM measurement is the same as the absolute accuracy of the spectrum analyzer. The numbers shown are for 0 – 3.6 GHz, with attenuation set to 10 dB.

Description	Specifications	Supplemental Information
Spurious Emissions		
Accuracy		
Attenuation = 10dB		
Frequency Range		
9 kHz to 3.6 GHz		±0.41 dB (95th percentile)
3.5 GHz to 8.4 GHz		±1.22 dB (95th percentile)
8.3 GHz to 13.6 GHz		±1.59 dB (95th percentile)

Description	Specifications	Supplemental Information
Modulation Analysis		
20 to 30 °C		Input range within 5 dB of full scale.
Frequency Error		
Accuracy	±1 Hz[a] + tfa[b]	
RCE (EVM)[c]		
Floor	–35.8 dB	at CF=1 GHz –42 dB (nominal) at CF < 3.6 GHz

a. This term includes an error due to the software algorithm. It is verified using a reference signal whose center frequency is intentionally shifted. This specification applies when the center frequency offset is within 5 kHz.
b. tfa = transmitter frequency × frequency reference accuracy
c. RCE(EVM) specification applies when 10 MHz downlink reference signal including QPSK/16QAM/64QAM is tested. This requires that Equalizer Training is set to "PreambleData" and Pilot Tracking is set to Track Timing/Phase/Timing all on state.

Frequency

Description	Specifications	Supplemental Information
In-Band Frequency Range	< 3.6 GHz	

8 W-CDMA Measurement Application

This chapter contains specifications for the *N9073A* W-CDMA measurement application. It contains both *N9073A-1FP* W-CDMA and *N9073A-2FP* HSDPA/HSUPA measurement applications.

Additional Definitions and Requirements

Because digital communications signals are noise-like, all measurements will have variations. The specifications apply only with adequate averaging to remove those variations.

The specifications apply in the frequency range documented in In-Band Frequency Range.

Conformance with 3GPP TS 25.141 Base Station Requirements

Sub-clause	Name	3GPP Required Test Instrument Tolerance (as of 2006-03)	Instrument Tolerance Interval[abc]	Supplemental Information
Standard sections (Measurement Name)				
6.2.1	Maximum Output Power (Channel Power)	±0.7 dB (95%)	±0.30 dB (95%)	
6.2.2	CPICH Power Accuracy (Code Domain)	±0.8 dB (95%)	±0.32 dB (95%)	
6.3	Frequency Error (Modulation Accuracy)	±12 Hz (95%)	±5 Hz (100%)	Excluding timebase error
6.4.2	Power Control Steps[d] (Code Domain)			
	1 dB step	±0.1 dB (95%)	±0.03 dB (100%)	
	Ten 1 dB steps	±0.1 dB (95%)	±0.03 dB (100%)	
6.4.3	Power Dynamic Range	±1.1 dB (95%)	±0.14 dB (100%)	
6.4.4	Total Power Dynamic Range[d] (Code Domain)	±0.3 dB (95%)	±0.06 dB (100%)	
6.5.1	Occupied Bandwidth	±100 kHz (95%)	±10 kHz (100%)	
6.5.2.1	Spectrum Emission Mask	±1.5 dB (95%)	±0.34 dB (95%)	Absolute peak[e]
6.5.2.2	ACLR			
	5 MHz offset	±0.8 dB (95%)	±1.07 dB (100%)	
	10 MHz offset	±0.8 dB (95%)	±1.00 dB (100%)	
6.5.3	Spurious Emissions			
	f ≤ 2.2 GHz	±1.5 dB (95%)	±0.41 dB (95%)	
	2.2 GHz < f ≤ 4 GHz	±2.0 dB (95%)	±1.22 dB (95%)	
	4 GHz < f	±4.0 dB (95%)	±1.59 dB (95%)	
6.7.1	EVM (Modulation Accuracy)	±2.5% (95%)	±0.5% (100%)	EVM in the range of 12.5% to 22.5%

Sub-clause	Name	3GPP Required Test Instrument Tolerance (as of 2006-03)	Instrument Tolerance Interval[abc]	Supplemental Information
6.7.2	Peak Code Domain Error (Modulation accuracy)	±1.0 dB (95%)	±1.0 dB (100%)	
6.7.3	Time alignment error in Tx Diversity (Modulation Accuracy)	±26 ns (95%) [= 0.1 Tc]	±1.25 ns (100%)	

a. Those tolerances marked as 95% are derived from 95th percentile observations with 95% confidence.
b. Those tolerances marked as 100% are derived from 100% limit tested observations. Only the 100% limit tested observations are covered by the product warranty.
c. The computation of the instrument tolerance intervals shown includes the uncertainty of the tracing of calibration references to national standards. It is added, in a root-sum-square fashion, to the observed performance of the instrument.
d. These measurements are obtained by utilizing the code domain power function or general instrument capability. The tolerance limits given represent instrument capabilities.
e. The tolerance interval shown is for the peak absolute power of a CW-like spurious signal. The standards for SEM measurements are ambiguous as of this writing; the tolerance interval shown is based on Agilent's interpretation of the current standards and is subject to change.

Amplitude

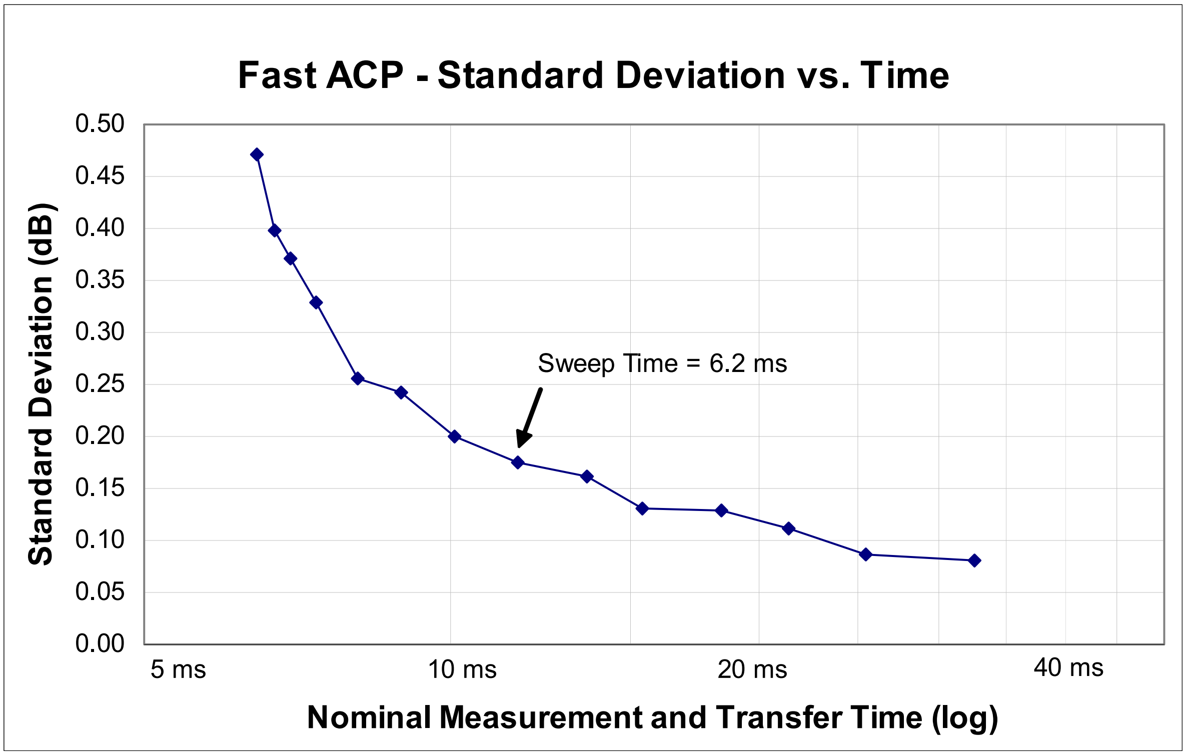
Description	Specifications	Supplemental Information
Channel Power		
Minimum power at RF Input		–50 dBm (nominal)
Absolute power accuracy[a] 20 to 30 °C Atten = 10 dB	±0.94 dB	
95% Confidence Absolute power accuracy		±0.30 dB
20 to 30 °C Atten = 10 dB		
Measurement floor		–79.8 dBm (nominal)

a. Absolute power accuracy includes all error sources for in-band signals except mismatch errors and repeatability due to incomplete averaging. It applies when the mixer level is high enough that measurement floor contribution is negligible.

Description			Specifications	Supplemental Information	
Adjacent Channel Power (ACPR; ACLR)					
Single Carrier					
Minimum power at RF Input				–36 dBm (nominal)	
ACPR Accuracy[a]				RRC weighted, 3.84 MHz noise bandwidth, method = IBW or Fast[b]	
Radio	Offset Freq				
MS (UE)	5 MHz		±0.22 dB	At ACPR range of –30 to –36 dBc with optimum mixer level[c]	
MS (UE)	10 MHz		±0.34 dB	At ACPR range of –40 to –46 dBc with optimum mixer level[d]	
BTS	5 MHz		±1.07 dB	At ACPR range of –42 to –48 dBc with optimum mixer level[e]	
BTS	10 MHz		±1.00 dB	At ACPR range of –47 to –53 dBc with optimum mixer level[d]	
BTS	5 MHz		±0.44 dB	At –48 dBc non-coherent ACPR[d]	
Dynamic Range				RRC weighted, 3.84 MHz noise bandwidth	
Noise Correction	Offset Freq	Method		Dynamic Range (typical)[f]	Optimum ML (nominal)
off	5 MHz	IBW		–68 dB	–8 dBm
off	5 MHz	Fast		–67 dB	–9 dBm
off	10 MHz	IBW		–74 dB	–2 dBm
on	5 MHz	IBW		–73 dB	–8 dBm
on	10 MHz	IBW		–76 dB	–2 dBm
RRC Weighting Accuracy[g]					
White noise in Adjacent Channel				0.00 dB (nominal)	
TOI-induced spectrum				0.001 dB (nominal)	
rms CW error				0.012 dB (nominal)	

a. The accuracy of the Adjacent Channel Power Ratio will depend on the mixer drive level and whether the distortion products from the analyzer are coherent with those in the UUT. These specifications apply even in the worst case condition of coherent analyzer and UUT distortion products. For ACPR levels other than those in this specifications table, the optimum mixer drive level for accuracy is approximately –37 dBm – (ACPR/3), where the ACPR is given in (negative) decibels.
b. The Fast method has a slight decrease in accuracy in only one case: for BTS measurements at 5 MHz offset, the accuracy degrades by ±0.01 dB relative to the accuracy shown in this table.
c. To meet this specified accuracy when measuring mobile station (MS) or user equipment (UE) within 3 dB of the required –33 dBc ACPR, the mixer level (ML) must be optimized for accuracy. This optimum mixer level is –22 dBm, so the input attenuation must be set as close as possible to the average input power – (–22 dBm). For example, if the average input power is –6 dBm, set the attenuation to 16 dB. This specification applies for the normal 3.5 dB peak-to-average ratio of a single code. Note that if the mixer level is set to optimize dynamic range instead of accuracy, accuracy errors are nominally doubled.
d. ACPR accuracy at 10 MHz offset is warranted when the input attenuator is set to give an average mixer level of –14 dBm.
e. In order to meet this specified accuracy, the mixer level must be optimized for accuracy when measuring node B Base Transmission Station (BTS) within 3 dB of the required –45 dBc ACPR. This optimum mixer level is –19 dBm, so the input attenuation must be set as close as possible to the average input power –(–19 dBm). For example, if the average input power is –5 dBm, set the attenuation to 14 dB. This specification applies for the normal 10 dB peak-to-average ratio (at 0.01% probability) for Test Model 1. Note that, if the mixer level is set to optimize dynamic range instead of accuracy, accuracy errors are nominally doubled.
f. Agilent measures 100% of the signal analyzers for dynamic range in the factory production process. This measurement requires a near-ideal signal, which is impractical for field and customer use. Because field verification is impractical, Agilent only gives a typical result. More than 80% of prototype instruments met this "typical" specification; the factory test line limit is set commensurate with an on-going 80% yield to this typical.
The ACPR dynamic range is verified only at 2 GHz, where Agilent has the near-perfect signal available. The dynamic range is specified for the optimum mixer drive level, which is different in different instruments and different conditions. The test signal is a 1 DPCH signal.
The ACPR dynamic range is the observed range. This typical specification includes no measurement uncertainty.

g. 3GPP requires the use of a root-raised-cosine filter in evaluating the ACLR of a device. The accuracy of the passband shape of the filter is not specified in standards, nor is any method of evaluating that accuracy. This footnote discusses the performance of the filter in this instrument. The effect of the RRC filter and the effect of the RBW used in the measurement interact. The analyzer compensates the shape of the RRC filter to accommodate the RBW filter. The effectiveness of this compensation is summarized in three ways:
– White noise in Adj Ch: The compensated RRC filter nominally has no errors if the adjacent channel has a spectrum that is flat across its width.
– TOI-induced spectrum: If the spectrum is due to third-order intermodulation, it has a distinctive shape. The computed errors of the compensated filter are –0.004 dB for the 470 kHz RBW used for UE testing with the IBW method and also used for all testing with the Fast method, and 0.000 dB for the 30 kHz RBW filter used for BTS testing with the IBW method. The worst error for RBWs between these extremes is 0.05 dB for a 330 kHz RBW filter.
– rms CW error: This error is a measure of the error in measuring a CW-like spurious component. It is evaluated by computing the root of the mean of the square of the power error across all frequencies within the adjacent channel. The computed rms error of the compensated filter is 0.023 dB for the 470 kHz RBW used for UE testing with the IBW method and also used for all testing with the Fast method, and 0.000 dB for the 30 kHz RBW filter used for BTS testing. The worst error for RBWs between these extremes is 0.057 dB for a 430 kHz RBW filter.

Fast ACPR Test[a]


a. Observation conditions for ACP speed:
Display Off, signal is Test Model 1 with 64 DPCH, Method set to Fast. Measured with an IBM compatible PC with a 3 GHz Pentium 4 running Windows XP Professional Version 2002. The communications medium was PCI-GPIB IEEE 488.2. The Test Application Language was .NET - C#. The Application Communication Layer was Agilent T&M Programmer's Toolkit For Visual Studio (Version 1.1), Agilent I/O Libraries (Version M.01.01.41_beta).

Description	Specifications	Supplemental Information
Power Statistics CCDF		
Histogram Resolution	0.01 dB[a]	

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

Description	Specifications	Supplemental Information
Occupied Bandwidth		
Minimum power at RF Input		–30 dBm (nominal)
Frequency Accuracy	±10 kHz	RBW = 30 kHz, Number of Points = 1001, span = 10 MHz

Description	Specifications	Supplemental Information
Spectrum Emission Mask		
Dynamic Range, relative 2.515 MHz offset[a b]	76.5 dB	83.9 dB (typical)
Sensitivity, absolute 2.515 MHz offset[c]	–94.7 dBm	–100.7 dBm (typical)
Accuracy 2.515 MHz offset		
Relative[d]	±0.12 dB	
Absolute[e] 20 - 30 °C	±1.05 dB	±0.34 dB (95% confidence)

a. The dynamic range specification is the ratio of the channel power to the power in the offset specified. The dynamic range depends on the measurement settings, such as peak power or integrated power. Dynamic range specifications are based on default measurement settings, with detector set to average, and depend on the mixer level. Default measurement settings include 30 kHz RBW.

b. This dynamic range specification applies for the optimum mixer level, which is about –16 dBm. Mixer level is defined to be the average input power minus the input attenuation.
c. The sensitivity is specified with 0 dB input attenuation. It represents the noise limitations of the analyzer. It is tested without an input signal. The sensitivity at this offset is specified in the default 30 kHz RBW, at a center frequency of 2 GHz.
d. The relative accuracy is a measure of the ratio of the power at the offset to the main channel power. It applies for spectrum emission levels in the offsets that are well above the dynamic range limitation.
e. The absolute accuracy of SEM measurement is the same as the absolute accuracy of the spectrum analyzer. See "Absolute Amplitude Accuracy" on page 32 for more information. The numbers shown are for 0 - 3.6 GHz, with attenuation set to 10 dB.

Description	Specifications	Supplemental Information
Spurious Emissions		Table-driven spurious signals; search across regions
Dynamic Range, relative	91.9 dB	97.1 dB (typical)
Sensitivity, absolute	–79.4 dBm	–85.4 dBm (typical)
Accuracy		
Attenuation = 10dB		
Frequency Range		
9 kHz to 3.6 GHz		±0.41 dB (95% Confidence)
3.5 GHz to 8.4 GHz		±1.22 dB (95% Confidence)
8.3 GHz to 13.6 GHz		±1.59 dB (95% Confidence)

Description	Specifications	Supplemental Information
Code Domain		
BTS Measurements		
−25 dBm ≤ ML[a] ≤ −15 dBm 20 to 30 °C		RF input power and attenuation are set to meet the Mixer Level range.
Code domain power		
Absolute accuracy		
−10 dBc CPICH (Atten = 10 dB)[b]		±0.32 dB (95% confidence)
Relative accuracy		
Code domain power range		
0 to −10 dBc	±0.015 dB	
−10 to −30 dBc	±0.06 dB	
−30 to −40 dBc	±0.07 dB	
Power Control Steps		
Accuracy		
0 to −10 dBc	±0.03 dB	
−10 to −30 dBc	±0.12 dB	
Power Dynamic Range		
Accuracy		
0 to −40 dBc	±0.14 dB	
Symbol power vs. time		
Relative accuracy		
Code domain power range		
0 to −10 dBc	±0.015 dB	
−10 to −30 dBc	±0.06 dB	
−30 to −40 dBc	±0.07 dB	
Symbol error vector magnitude		
Accuracy		
0 to −25 dBc		±1.0% (nominal)

a. ML (mixer level) is RF input power minus attenuation.
b. Code Domain Power Absolute accuracy is calculated as sum of 95% Confidence Absolute Amplitude Accuracy and Code Domain relative accuracy at Code Power level.

Description	Specifications	Supplemental Information
QPSK EVM		
–25 dBm ≤ ML[a] ≤ –15 dBm 20 to 30 °C		RF input power and attenuation are set to meet the Mixer Level range.
EVM		
Range	0 to 25%	
Floor	1.6%	
Accuracy[b]	±1.0%	
I/Q origin offset		
DUT Maximum Offset		–10 dBc (nominal)
Analyzer Noise Floor		–50 dBc (nominal)
Frequency error		
Range		±30 kHz (nominal)[c]
Accuracy	±5 Hz + tfa[d]	

a. ML (mixer level) is RF input power minus attenuation.
b. The accuracy specification applies when the EVM to be measured is well above the measurement floor. When the EVM does not greatly exceed the floor, the errors due to the floor add to the accuracy errors. The errors due to the floor are noise-like and add incoherently with the UUT EVM. The errors depend on the EVM of the UUT and the floor as follows: error = $\mathrm{sqrt}(EVMUUT^2 + EVMsa^2) - EVMUUT$, where EVMUUT is the EVM of the UUT in percent, and EVMsa is the EVM floor of the analyzer in percent.
c. This specifies a synchronization range with CPICH for CPICH only signal.
d. tfa = transmitter frequency × frequency reference accuracy

Description	Specifications	Supplemental Information
Modulation Accuracy (Composite EVM)		
BTS Measurements		
–25 dBm ≤ ML[a] ≤ –15 dBm 20 to 30 °C		RF input power and attenuation are set to meet the Mixer Level range.
Composite EVM		
Range	0 to 25%	
Floor	1.6%	
Accuracy	±1.0%[b]	
	±0.5%	At EVM measurement in the range of 12.5% to 22.5%
Peak Code Domain Error		
Accuracy	±1.0 dB	
I/Q Origin Offset		
DUT Maximum Offset		–10 dBc (nominal)
Analyzer Noise Floor		–50 dBc (nominal)
Frequency Error		
Range		±3 kHz (nominal)[c]
Accuracy	±5 Hz + tfa[d]	
Time offset		
Relative frame offset accuracy		±5.0 ns (nominal)
Relative offset accuracy (for STTD diff mode)[e]	±1.25 ns	

a. ML (mixer level) is RF input power minus attenuation.
b. The accuracy specification applies when the EVM to be measured is well above the measurement floor. When the EVM does not greatly exceed the floor, the errors due to the floor add to the accuracy errors. The errors due to the floor are noise-like and add incoherently with the UUT EVM. The errors depend on the EVM of the UUT and the floor as follows: error = $[\text{sqrt}(EVMUUT^2 + EVMsa^2)] - EVMUUT$, where EVMUUT is the EVM of the UUT in percent, and EVMsa is the EVM floor of the analyzer in percent. For example, if the EVM of the UUT is 7%, and the floor is 2.5%, the error due to the floor is 0.43%.
c. This specifies a synchronization range with CPICH for CPICH only signal.
d. tfa = transmitter frequency × frequency reference accuracy

e. The accuracy specification applies when the measured signal is the combination of CPICH (antenna–1) and CPICH (antenna–2), and where the power level of each CPICH is –3 dB relative to the total power of the combined signal. Further, the range of the measurement for the accuracy specification to apply is ±0.1 chips.

Description	Specifications	Supplemental Information
Power Control		
Absolute power measurement		Using 5 MHz resolution bandwidth
Accuracy		
0 to –20 dBm		±0.7 dB (nominal)
–20 to –60 dBm		±1.0 dB (nominal)
Relative power measurement		
Accuracy		
Step range ±1.5 dB		±0.1 dB (nominal)
Step range ±3.0 dB		±0.15 dB (nominal)
Step range ±4.5 dB		±0.2 dB (nominal)
Step range ±26.0 dB		±0.3 dB (nominal)

Frequency

Description	Specifications			Supplemental Information
In-Band Frequency Range	Operating Band	UL Frequencies UE transmit, Node B receive	DL Frequencies UE receive, Node B transmit	
	I	1920 – 1980 MHz	2110 – 2170 MHz	
	II	1850 –1910 MHz	1930 – 1990 MHz	
	III	1710 –1785 MHz	1805 – 1880 MHz	
	IV	1710 –1755 MHz	2110 – 2155MHz	
	V	824 – 849 MHz	869 – 894 MHz	
	VI	830 – 840 MHz	875 – 885 MHz	
	VII	2500 – 2570 MHz	2620 – 2690 MHz	
	VIII	880 – 915 MHz	925 – 960 MHz	
	IX	1749.9 – 1784.9 MHz	1844.9 – 1879.9 MHz	

9 GSM/EDGE Measurement Application

This chapter contains specifications for the *N9071A* GSM/EDGE Measurement Application.

Additional Definitions and Requirements

Because digital communications signals are noise-like, all measurements will have variations. The specifications apply only with adequate averaging to remove those variations.

Measurements

Description	Specifications	Supplemental Information
EDGE Error Vector Magnitude (EVM)		3p/8 shifted 8PSK modulation Specifications based on 200 bursts
Carrier Power Range at RF Input		+24 to –45 dBm (nominal)
EVM[a], rms		
Operating range		0 to 20% (nominal)
Floor		0.5% (nominal)
Accuracy[b] EVM range 1% to 10%		±0.5% (nominal)
Frequency error[a]		
Initial frequency error range		±80 kHz (nominal)
Accuracy	±5 Hz[c] + tfa[d]	
IQ Origin Offset		
DUT Maximum Offset		–15 dBc (nominal)
Maximum Analyzer Noise Floor		–50 dBc (nominal)
Trigger to T0 Time Offset		
Relative accuracy[e]		±5.0 ns (nominal)

a. EVM and frequency error specifications apply when the Burst Sync is set to Training Sequence.
b. The definition of accuracy for the purposes of this specification is how closely the result meets the expected result. That expected result is 0.975 times the actual RMS EVM of the signal, per 3GPP TS 5.05, annex G.
c. This term includes an error due to the software algorithm. The accuracy specification applies when EVM is less than 1.5%.
d. tfa = transmitter frequency × frequency reference accuracy
e. The accuracy specification applies when the Burst Sync is set to Training Sequence, and Trigger is set to External Trigger.

Description	Specifications	Supplemental Information
Power vs. Time *and* **EDGE Power vs. Time**		GMSK modulation (GSM) 3π/8 shifted 8PSK modulation (EDGE) Measures mean transmitted RF carrier power during the useful part of the burst (GSM method) and the power vs. time ramping. 510 kHz RBW
Minimum carrier power at RF Input for GSM and EDGE		–35 dBm (nominal)
Absolute power accuracy for in-band signal (excluding mismatch error)[a]		–0.11 ±0.30 dB (95th percentile)
Power Ramp Relative Accuracy		Referenced to mean transmitted power
Accuracy	±0.16 dB	
Measurement floor	–87 dBm	

a. The power versus time measurement uses a resolution bandwidth of about 510 kHz. This is not wide enough to pass all the transmitter power unattenuated, leading the consistent error shown in addition to the uncertainty. A wider RBW would allow smaller errors in the carrier measurement, but would allow more noise to reduce the dynamic range of the low-level measurements. The measurement floor will change by 10 × log(RBW/510 kHz). The average amplitude error will be about –0.11 dB × ((510 kHz/RBW)^2). Therefore, the consistent part of the amplitude error can be eliminated by using a wider RBW.

Description	Specifications	Supplemental Information
Phase and Frequency Error		GMSK modulation (GSM) Specifications based on 3GPP essential conformance requirements, and 200 bursts
Carrier power range at RF Input		+27 to –45 dBm (nominal)
Phase error[a], rms		
Floor		0.3 ° (nominal)
Accuracy Phase error range 1 ° to 6 °		±0.3 ° (nominal)
Frequency error[a]		
Initial frequency error range		±80 kHz (nominal)
Accuracy	±5 Hz[b] + tfa [c]	
I/Q Origin Offset		
DUT Maximum Offset		–15 dBc (nominal)
Analyzer Noise Floor		–50 dBc (nominal)
Trigger to T0 time offset Relative accuracy[d]		±5.0 ns (nominal)

a. Phase error and frequency error specifications apply when the Burst Sync is set to Training Sequence.
b. This term includes an error due to the software algorithm. The accuracy specification applies when RMS phase error is less than 1 °.
c. tfa = transmitter frequency × frequency reference accuracy
d. The accuracy specification applies when the Burst Sync is set to Training Sequence, and Trigger is set to External Trigger.

Description	Specifications	Supplemental Information
Output RF Spectrum (ORFS) *and* **EDGE Output RF Spectrum**		GMSK modulation (GSM) 3π/8 shifted 8PSK modulation (EDGE)
Minimum carrier power at RF Input		–5 dBm (nominal)
ORFS Relative RF Power Uncertainty [a] Due to modulation		
Offsets ≤ 1.2 MHz	±0.26 dB	
Offsets ≥ 1.8 MHz	±0.27 dB	
Due to switching[b]		±0.17 dB (nominal)
ORFS Absolute RF Power Accuracy[c]		±0.30 dB (95th percentile)

a. The uncertainty in the RF power ratio reported by ORFS has many components. This specification does not include the effects of added power in the measurements due to dynamic range limitations, but does include the following errors: detection linearity, RF and IF flatness, uncertainty in the bandwidth of the RBW filter, and compression due to high drive levels in the front end.

b. The worst-case modeled and computed errors in ORFS due to switching are shown, but there are two further considerations in evaluating the accuracy of the measurement: First, Agilent has been unable to create a signal of known ORFS due to switching, so we have been unable to verify the accuracy of our models. This performance value is therefore shown as nominal instead of guaranteed. Second, the standards for ORFS allow the use of any RBW of at least 300 kHz for the reference measurement against which the ORFS due to switching is ratioed. Changing the RBW can make the measured ratio change by up to about 0.24 dB, making the standards ambiguous to this level. The user may choose the RBW for the reference; the default 300 kHz RBW has good dynamic range and speed, and agrees with past practices. Using wider RBWs would allow for results that depend less on the RBW, and give larger ratios of the reference to the ORFS due to switching by up to about 0.24 dB.

c. The absolute power accuracy depends on the setting of the input attenuator as well as the signal-to-noise ratio. For high input levels, the use of the electronic attenuator and "Adjust Atten for Min Clip" will result in high signal-to-noise ratios and Electronic Input Atten > 2 dB, for which the absolute power accuracy is best. At moderate levels, manually setting the Input Atten can give better accuracy than the automatic setting. For GSM and EDGE, "high levels" would nominally be levels above +1.7 dBm and –1.3 dBm, respectively.

Description	**Specifications**		**Supplemental Information**	
ORFS and **EDGE ORFS** (continued)				
Dynamic Range, Spectrum due to modulation[a]			5-pole sync-tuned filters[b] Methods: Direct Time[c] and FFT[d]	
Offset Frequency	**GSM**	**EDGE**	**GSM (typical)**	**EDGE (typical)**
100 kHz[e]	60.7 dB	60.7 dB		
200 kHz[e]	66.0 dB	65.9 dB		
250 kHz[e]	67.7 dB	67.5 dB		
400 kHz[e]	71.1 dB	70.6 dB		
600 kHz	73.8 dB	73.0 dB	78.4 dB	77.6 dB
1.2 MHz	77.4 dB	75.7 dB	82.0 dB	80.4 dB
			GSM (nominal)	**EDGE (nominal)**
1.8 MHz[f]	80.9 dB	79.6 dB	87.3 dB	85.6 dB
6.0 MHz[f]	83.2 dB	81.2 dB	88.4 dB	86.4 dB
Dynamic Range, Spectrum due to switching[a]			5-pole sync-tuned filters[g]	
Offset Frequency				
400 kHz	68.9 dB			
600 kHz	71.2 dB			
1.2 MHz	74.0 dB			
1.8 MHz	83.1 dB			

a. Maximum dynamic range requires RF input power above –2 dBm for offsets of 1.2 MHz and below for GSM, and above –5 dBm for EDGE. For offsets of 1.8 MHz and above, the required RF input power for maximum dynamic range is +8 dBm for GSM signals and +5 dBm for EDGE signals.

b. ORFS standards call for the use of a 5-pole, sync-tuned filter; this and the following footnotes review the instrument's conformance to that standard. Offset frequencies can be measured by using either the FFT method or the direct time method. By default, the FFT method is used for offsets of 400 kHz and below, and the direct time method is used for offsets above 400 kHz. The FFT method is faster, but has lower dynamic range than the direct time method.

c. The direct time method uses digital Gaussian RBW filters whose noise bandwidth (the measure of importance to “spectrum due to modulation”) is within ±0.5% of the noise bandwidth of an ideal 5-pole sync-tuned filter. However, the Gaussian filters do not match the 5-pole standard behavior at offsets of 400 kHz and below, because they have *lower* leakage of the carrier into the filter. The lower leakage of the Gaussian filters provides a superior measurement because the leakage of the carrier masks the ORFS due to the UUT, so that less masking lets the test be more sensitive to variations in the UUT spectral splatter. But this superior measurement gives a result that does not conform with ORFS standards. Therefore, the default method for offsets of 400 kHz and below is the FFT method.

d. The FFT method uses an exact 5-pole sync-tuned RBW filter, implemented in software.

e. The dynamic range for offsets at and below 400 kHz is not directly observable because the signal spectrum obscures the result. These dynamic range specifications are computed from phase noise observations.

f. Offsets of 1.8 MHz and higher use 100 kHz analysis bandwidths.

g. The impulse bandwidth (the measure of importance to “spectrum due to switching transients”) of the filter used in the direct time method is 0.8% less than the impulse bandwidth of an ideal 5-pole sync-tuned filter, with a tolerance of ±0.5%. Unlike the case with spectrum due to modulation, the shape of the filter response (Gaussian vs. sync-tuned) does not affect the results due to carrier leakage, so the only parameter of the filter that matters to the results is the impulse bandwidth. There is a mean error of –0.07 dB due to the impulse bandwidth of the filter, which is compensated in the measurement of ORFS due to switching. By comparison, an analog RBW filter with a ±10% width tolerance would cause a maximum amplitude uncertainty of 0.9 dB.

Description	Uplink	Downlink	Supplemental Information
In-Band Frequency Ranges			
P-GSM 900	890 to 915 MHz	935 to 960 MHz	
E-GSM 900	880 to 915 MHz	925 to 960 MHz	
R-GSM 900	876 to 915 MHz	921 to 960 MHz	
DCS1800	1710 to 1785 MHz	1805 to 1880 MHz	
PCS1900	1850 to 1910 MHz	1930 to 1990 MHz	
GSM850	824 to 849 MHz	869 to 894 MHz	
GSM450	450.4 to 457.6 MHz	460.4 to 467.6 MHz	
GSM480	478.8 to 486 MHz	488.8 to 496 MHz	
GSM700	777 to 792 MHz	747 to 762 MHz	

10 Analog Demodulation Measurement Application

This chapter contains specifications for the N9063A Analog Demodulation Measurement Application.

Analog Demodulation Performance – Pre-Demodulation

Description	Specifications	Supplemental Information
Maximum Safe Input Level		
Average Total Power	+30 dBm (1 W)	
Peak Pulse Power	+50 dBm (100 W)	
<10 µs pulse width, <1% duty cycle, Input Attenuation ≥ 30 dB		
Carrier Frequency		
Maximum Frequency *Option 503* *Option 507* *Option 513* *Option 526*	 3.6 GHz 7.0 GHz 13.6 GHz 26.5 GHz	
Minimum Frequency *AC Coupled* *DC Coupled*	 10 MHz 9 kHz	
Demodulation Bandwidth	10 MHz	
Capture Memory *sample rate * demod time*	250 kSa	Each sample is an I/Q pair.

Analog Demodulation Performance – Post-Demodulation

Description	Specifications	Supplemental Information
Maximum Audio Frequency Span		5 MHz
Filters		
Low Pass	300 Hz, 3 kHz, 15 kHz, 30 kHz, 80 kHz, 300 kHz	
High Pass	20 Hz, 50 Hz, 300 Hz	
Band Pass	CCITT	
Deemphasis	25 µs, 50 µs, 75 µs, 750 µs	FM only

Frequency Modulation - Level and Carrier Metrics

Description	Specifications	Supplemental Information
FM Deviation Accuracy		
Rate: 1 kHz - 1 MHz, Deviation: 1 - 100 kHz[a]		±(1% of (rate + deviation) + 20 Hz) (nominal)
FM Rate Accuracy		
Rate: 1 kHz - 1 MHz[ab]		±0.2 Hz (nominal)
Carrier Frequency Error		±0.5 Hz (nominal) Assumes signal still visible in channel BW with offset
Carrier Power		±0.85 dB (nominal)

a. For optimum measurement of rate and deviation, ensure that the channel bandwidth is set wide enough to capture the significant RF energy (as visible in the RF Spectrum window). Setting the channel bandwidth too wide will result in measurement errors.
b. Rate accuracy at high channel bandwidths assumes that the deviation is sufficiently large to overcome channel noise.

Frequency Modulation - Distortion

Description	Specifications	Supplemental Information
Residual		
Rate: 1 - 10 kHz, Deviation: 5 kHz		
THD		0.2% (nominal)
Distortion		3% (nominal)
SINAD		32 dB (nominal)
Absolute Accuracy		
Rate: 1 - 10 kHz, Deviation: 5 kHz		
THD		±2% of measured value + residual (nominal) Measured 2nd and 3rd harmonics
Distortion		±2% of measured value + residual (nominal)
SINAD		±0.4 dB + effect of residual (nominal)
AM Rejection AF 100 Hz - 15 kHz 50% Modulation Depth		150 Hz (nominal)
Residual FM RF 500 kHz - 10 GHz		150 Hz (nominal)

Description	Specifications	Supplemental Information
Measurement Range Rate: 1 - 10 kHz, Deviation: 5 kHz		
THD		residual to 100% (nominal) Measured 2^{nd} and 3^{rd} harmonics Measurement includes at most 10 harmonics
Distortion		residual to 100% (nominal)
SINAD		0 dB to residual (nominal)

Amplitude Modulation - Level and Carrier Metrics

Description	Specifications	Supplemental Information
AM Depth Accuracy		
Rate: 1 kHz - 1 MHz		±0.2% + 0.002 × measured value (nominal)
AM Rate Accuracy		
Rate: 1 kHz - 1 MHz		±0.05 Hz (nominal)
Carrier Power		±0.85 dB (nominal)

Amplitude Modulation - Distortion

Description	Specifications	Supplemental Information
Residual		
Depth: 50% Rate: 1 - 10 kHz		
THD		0.16% (nominal)
Distortion		0.3% (nominal)
SINAD		50 dB (nominal)
Absolute Accuracy		
Depth: 50% Rate: 1 - 10 kHz		
THD		±1% of measured value + residual (nominal) Measured 2nd and 3rd harmonics
Distortion		±1% of measured value + residual (nominal)
SINAD		±0.05 dB + effect of residual (nominal)
FM Rejection		0.5% (nominal) AF + deviation < 0.5 × channel BW AF < 0.1 × channel BW
Residual AM		
RF 500 kHz - 20 GHz		0.2% (nominal)

Description	Specifications	Supplemental Information
Measurement Range Depth: 50% Rate: 1 - 10 kHz		
THD		residual to 100% Measured 2nd and 3rd harmonics Measurement includes at most 10 harmonics
Distortion		residual to 100%
SINAD		0 dB to residual

Phase Modulation - Level and Carrier Metrics

Description	Specifications	Supplemental Information
PM Deviation Accuracy		
Rate: 1 - 20 kHz Deviation: 0.2 to 6 rad		±100% × (0.005 + (rate/1 MHz)) (nominal)
PM Rate Accuracy		
Rate: 1 - 10 kHz[a]		±0.2 Hz (nominal)
Carrier Frequency Error		±0.02 Hz (nominal) Assumes signal still visible in channel BW with offset.
Carrier Power		±0.85 dB (nominal)

a. For optimum measurement of PM rate and deviation, ensure that the channel bandwidth is set wide enough to capture the significant RF energy (as visible in the RF Spectrum window). Setting the channel bandwidth too narrow or too wide will result in measurement errors.

Phase Modulation - Distortion

Description	Specifications	Supplemental Information
Residual Rate: 1 - 10 kHz, Deviation: 628 mrad		
THD		0.1% (nominal)
Distortion		0.8% (nominal)
SINAD		42 dB (nominal)
Absolute Accuracy		Rate: 1 - 10 kHz, Deviation: 628 mrad
THD		±1% of measured value + residual (nominal)
Distortion		±1% of measured value + residual (nominal)
SINAD		±0.1 dB + effect of residual (nominal)
AM Rejection AF 1 kHz - 15 kHz 50% Modulation Depth		4 mrad (nominal)
Residual PM RF = 1 GHz (highpass filter 300 Hz)		4 mrad (nominal)

Description	Specifications	Supplemental Information
Measurement Range		
Rate: 1 - 10 kHz, Deviation: 628 mrad		
THD		residual to 100% Measured 2nd and 3rd harmonics Measurement includes at most 10 harmonics
Distortion		residual to 100%
SINAD		0 dB to residual

11 Noise Figure Measurement Application

This chapter contains specifications for the N9069A Noise Figure Measurement Application.

Noise Figure

Description	Specifications		Supplemental Information
Noise Figure			Uncertainty Calculator[a]
≤10 MHz[b]			
10 MHz to 3.6 GHz			Using internal preamp (*Option P03*) and RBW = 4 MHz
Noise Source ENR	Measurement Range	Instrument Uncertainty[cd]	
4 – 6.5 dB	0 to 20 dB	±0.02 dB	
12 – 17 dB	0 to 30 dB	±0.025 dB	
20 – 22 dB	0 to 35 dB	±0.03 dB	
Above 3.6 GHz			Not Recommended[e]

a. The figures given in the table are for the uncertainty added by the EXA-Series Spectrum Analyzer instrument only. To compute the total uncertainty for your noise figure measurement, you need to take into account other factors including: DUT NF, Gain and Match, Instrument NF, Gain Uncertainty and Match; Noise source ENR uncertainty and Match. The computations can be performed with the uncertainty calculator included with the Noise Figure Measurement Personality. Go to **Mode Setup** then select **Uncertainty Calculator**. Similar calculators are also available on the Agilent web site; go to http://www.agilent.com/find/nfu.

b. Instrument Uncertainty is nominally the same in this frequency range as in the higher frequency range. However, total uncertainty is higher because the analyzer has poorer noise figure, leading to higher uncertainties as computed by the uncertainty calculator. Also, there is a paucity of available noise sources in this range.

c. "Instrument Uncertainty" is defined for noise figure analysis as uncertainty due to relative amplitude uncertainties encountered in the analyzer when making the measurements required for a noise figure computation. The relative amplitude uncertainty depends on, but is not identical to, the relative display scale fidelity, also known as incremental log fidelity. The uncertainty of the analyzer is multiplied within the computation by an amount that depends on the Y factor to give the total uncertainty of the noise figure or gain measurement.
See Agilent App Note 57-2, literature number 5952-3706E for details on the use of this specification.
Jitter (amplitude variations) will also affect the accuracy of results. The standard deviation of the measured result decreases by a factor of the square root of the Resolution Bandwidth used and by the square root of the number of averages. This application uses the 4 MHz Resolution Bandwidth as default since this is the widest bandwidth with uncompromised accuracy.

d. The instrument uncertainties shown are under best-case sweep time conditions, which is a sweep time near to the period of the power line, such as 20 ms for 50 Hz power sources. The behavior can be greatly degraded (uncertainty increased nominally by 0.12 dB) by setting the sweep time per point far from an integer multiple of the period of the line frequency.

e. Noise figure measurements can be made in this range but will often be poor because of the lack of availability of built-in preamplification. For high gain DUTs or with the use of an external preamplifier, this problem can be overcome. In such cases, the Instrument Uncertainty for NF will nominally be the same in this frequency range as listed above. Note, however, that Instrument Uncertainty for Gain is also a contributor (as computed by the Uncertainty Calculator) to the total Noise Figure uncertainty. IU for Gain is higher in this frequency range than in other ranges. IU for Gain is a small contributor when the output noise of the DUT is much higher than the input noise of the next stage.

Description	Specifications	Supplemental Information
Gain		
Instrument Uncertainty[a]		DUT Gain Range = –20 to +40 dB
<10 MHz[b]		
10 MHz to 3.6 GHz	±0.15 dB	
3.6 GHz to 26.5 GHz		±0.11 dB additional[c] 95^{th} percentile, 5 minutes after calibration

a. "Instrument Uncertainty" is defined for gain measurements as uncertainty due to relative amplitude uncertainties encountered in the analyzer when making the measurements required for the gain computation.
See Agilent App Note 57-2, literature number 5952-3706E for details on the use of this specification.
Jitter (amplitude variations) will also affect the accuracy of results. The standard deviation of the measured result decreases by a factor of the square root of the Resolution Bandwidth used and by the square root of the number of averages. This application uses the 4 MHz Resolution Bandwidth as default since this is the widest bandwidth with uncompromised accuracy.
Under difficult conditions (low Y factors), the instrument uncertainty for gain in high band can dominate the NF uncertainty as well as causing errors in the measurement of gain. These effects can be predicted with the uncertainty calculator.

b. Uncertainty performance of the instrument is nominally the same in this frequency range as in the higher frequency range. However, performance is not warranted in this range. There is a paucity of available noise sources in this range, and the analyzer has poorer noise figure, leading to higher uncertainties as computed by the uncertainty calculator.

c. For frequencies above 3.6 GHz, the analyzer uses a YIG-tuned filter (YTF) as a preselector, which adds uncertainty to the gain. When the Y factor is small, such as with low gain DUTs, this uncertainty can be greatly multiplied and dominate the uncertainty in NF (as the user can compute with the Uncertainty Calculator), as well as impacting gain directly. When the Y factor is large, the effect of IU of Gain on the NF becomes negligible.
When the Y-factor is small, the non-YTF mechanism that causes Instrument Uncertainty for Gain is the same as the one that causes IU for NF with low ENR. Therefore, we would recommend the following practice: When using the Uncertainty Calculator for measurements above 3.6 GHz, fill in the IU for Gain parameter with the sum of the IU for NF for 4 - 6.5 dB ENR sources and the shown "additional" IU for gain for this frequency range.
When estimating the IU for Gain for the purposes of a gain measurement for frequencies above 3.6 GHz, use the sum of IU for Gain in the 0.01 - 3.6 GHz range and the "additional" IU shown.
You will find, when using the Uncertainty Calculator, that the IU for Gain is only important when the input noise of the spectrum analyzer is significant compared to the output noise of the DUT. That means that the best devices, those with high enough gain, will have comparable uncertainties for frequencies below and above 3.6 GHz.
The additional uncertainty shown is that observed to be met in 95% of the frequency/instrument combinations tested with 95% confidence. It is not warranted.

Description	Specifications	Supplemental Information
Noise Figure Uncertainty Calculator[a]		
Instrument Noise Figure Uncertainty	See the Noise Figure table earlier in this chapter	
Instrument Gain Uncertainty	See the Gain table earlier in this chapter	
Instrument Noise Figure		See graphs of "Nominal Instrument Noise Figure"; Noise Figure is DANL +176.24 dB (nominal)[b] Note on DC coupling[c]
Instrument Input Match		See graphs: Nominal VSWR Note on DC coupling[d]

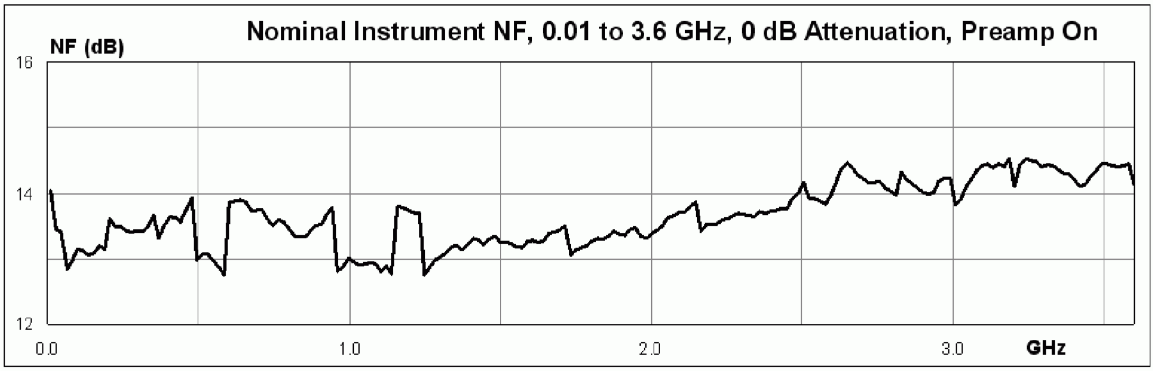
a. The Noise Figure Uncertainty Calculator requires the parameters shown in order to calculate the total uncertainty of a Noise Figure measurement.

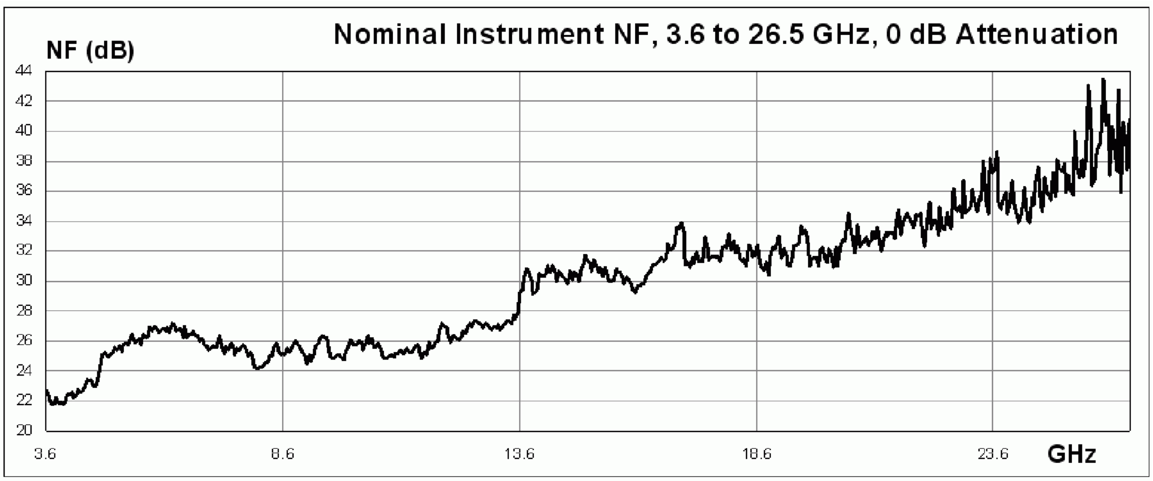
b. Nominally, the noise figure of the spectrum analyzer is given by
$NF = D - (K - L + N + B)$
where D is the DANL (displayed average noise level) specification,
K is kTB (-173.98 dB in a 1 Hz bandwidth at 290 K)
L is 2.51 dB (the effect of log averaging used in DANL verifications)
N is 0.24 dB (the ratio of the noise bandwidth of the RBW filter with which DANL is specified to an ideal noise bandwidth)
B is ten times the base-10 logarithm of the RBW (in hertz) in which the DANL is specified. B is 0 dB for the 1 Hz RBW.
The actual NF will vary from the nominal due to frequency response errors.

c. The effect of AC coupling is negligible for frequencies above 40 MHz. Below 40 MHz, DC coupling is recommended for the best measurements. The instrument NF nominally degrades by 0.2 dB at 30 MHz and 1 dB at 10 MHz with AC coupling.

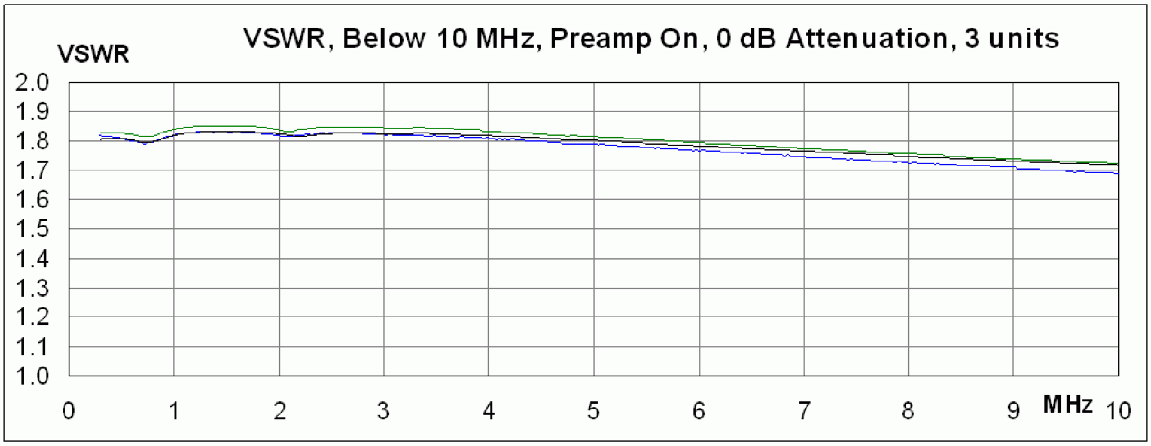
d. The effect of AC coupling is negligible for frequencies above 40 MHz. Below 40 MHz, DC coupling is recommended for the best measurements.

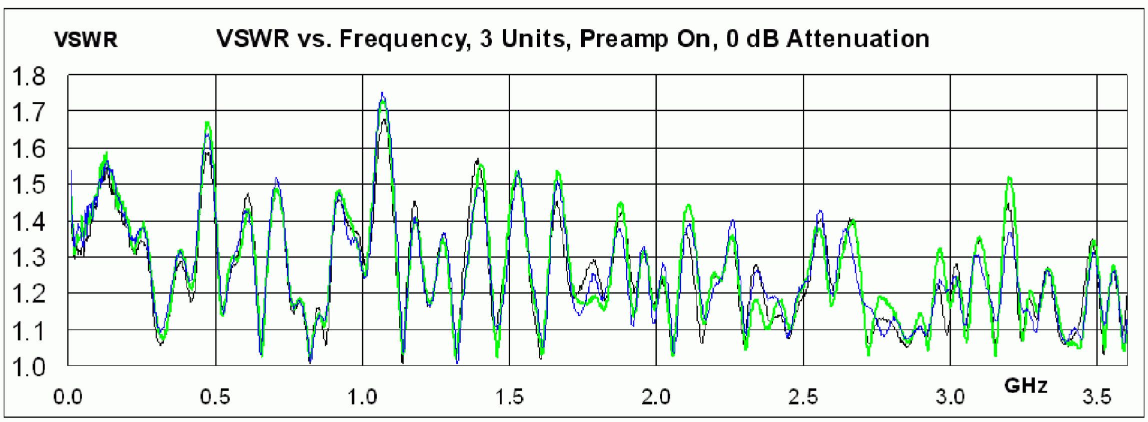
Nominal Instrument Noise Figure

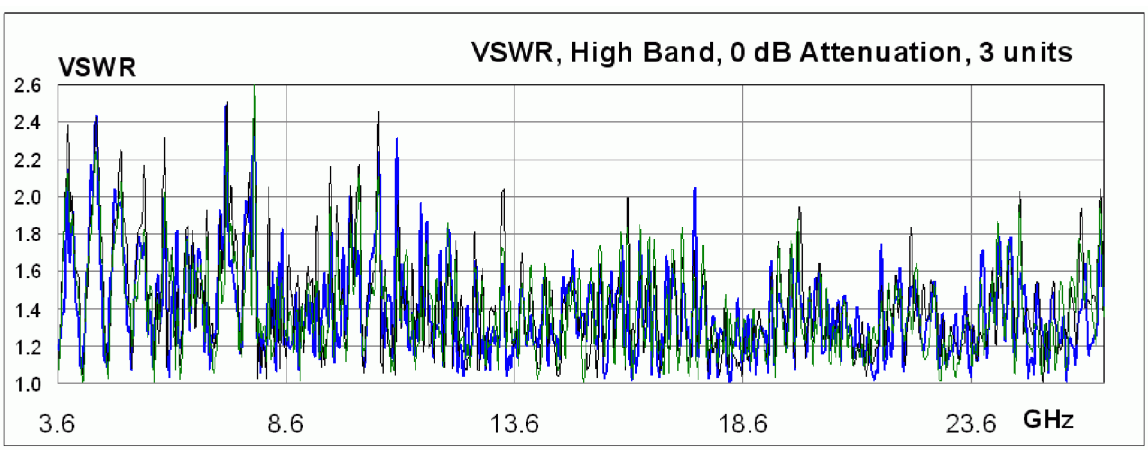




Nominal Instrument Input VSWR, DC Coupled







12 cdma2000 Measurement Application

This chapter contains specifications for the EXA Signal Analyzer N9072A, cdma2000 measurement application.

Additional Definitions and Requirements

Because digital communications signals are noise-like, all measurements will have variations. The specifications apply only with adequate averaging to remove those variations.

The specifications apply in the frequency range documented in In-Band Frequency Range.

This application supports forward link radio configurations 1 to 5 and reverse link radio configurations 1-4. cdmaOne signals can be analyzed by using radio configuration 1 or 2.

Measurements

Description	Specifications	Supplemental Information
Channel Power		
1.23 MHz Integration BW		
Minimum power at RF input		–50 dBm (nominal)
Absolute power accuracy [a] 20 to 30 °C Atten = 10 dB	±0.94 dB	
95% Confidence Absolute power accuracy 20 to 30 °C Atten = 10 dB		±0.30 dB
Measurement floor		–84.8 dBm (typical)

a. Absolute power accuracy includes all error sources for in-band signals except mismatch errors and repeatability due to incomplete averaging. It applies when the mixer level is high enough that measurement floor contribution is negligible.

Description		Specifications	Supplemental Information
Adjacent Channel Power[a]			
Minimum power at RF input			–36 dBm (nominal)
Dynamic range			Referenced to average power of carrier in 1.23 MHz bandwidth
Offset Freq.	Integ. BW		
750 kHz	30 kHz	–73.6 dBc	–81.0 dBc (typical)
1980 kHz	30 kHz	–78.3 dBc	–83.9 dBc (typical)
ACPR Relative Accuracy			RBW method[b]
Offsets < 750 kHz		±0.11 dB	
Offsets > 1.98 MHz		±0.12 dB	
Absolute Accuracy		±1.05 dB	±0.34 dB (at 95% confidence)
Sensitivity		–94.7 dBm	–100.7 dBm (typical)

a. ACP test items compliance the limits of conducted spurious emission specification defined in 3GPP2 standards

b. The RBW method measures the power in the adjacent channels within the defined resolution bandwidth. The noise bandwidth of the RBW filter is nominally 1.055 times the 3.01 dB bandwidth. Therefore, the RBW method will nominally read 0.23 dB higher adjacent channel power than would a measurement using the integration bandwidth method, because the noise bandwidth of the integration bandwidth measurement is equal to that integration bandwidth. For cdma2000 ACP measurements using the RBW method, the main channel is measured in a 3 MHz RBW, which does not respond to all the power in the carrier. Therefore, the carrier power is compensated by the expected under-response of the filter to a full width signal, of 0.15 dB. But the adjacent channel power is not compensated for the noise bandwidth effect.

The reason the adjacent channel is not compensated is subtle. The RBW method of measuring ACP is very similar to the preferred method of making measurements for compliance with FCC requirements, the source of the specifications for the cdma2000 Spur Close specifications. ACP is a spot measurement of Spur Close, and thus is best done with the RBW method, even though the results will disagree by 0.23 dB from the measurement made with a rectangular pass band.

Description	Specification	Supplemental Information
Power Statistics CCDF		
Histogram Resolution[a]	0.01 dB	

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

Description	Specification	Supplemental Information
Occupied Bandwidth		
Minimum carrier power at RF Input		–30 dBm (nominal)
Frequency accuracy		±2 kHz (nominal) RBW = 30 kHz, Number of Points = 1001, Span = 2 MHz

Description	Specifications	Supplemental Information
Spectrum Emission Mask[a]		
Dynamic Range, relative		
750 kHz offset	73.6 dB	81.0 dB (typical)
1980 kHz offset	78.3 dB	83.9 dB (typical)
Sensitivity, absolute [b]		
750 kHz offset	–94.7 dBm	–100.7 dBm (typical)
1980 kHz offset	–94.7 dBm	–100.7 dBm (typical)
Accuracy 750 kHz offset		
Relative[c]	±0.11 dB	
Absolute[d] 20 - 30 °C	±1.05 dB	±0.34 dB (at 95% confidence)
1980 kHz offset		
Relative	±0.12 dB	
Absolute 20 - 30 °C	±1.05 dB	±0.34 dB (at 95% confidence)

a. SEM test items compliance the limits of conducted spurious emission specification defined in 3GPP2 standards

b. The sensitivity is specified with 0 dB input attenuation. It represents the noise limitations of the analyzer. It is tested without an input signal. The sensitivity at this offset is specified for the default 30 kHz RBW, at a center frequency of 2 GHz

c. The relative accuracy is a measure of the ration of the power at the offset to the main channel power. It applies for spectrum emission levels in the offsets that are well above the dynamic range limitation.

d. The absolute accuracy of SEM measurement is the same as the absolute accuracy of the spectrum analyzer. See Absolute Amplitude Accuracy for more information. The numbers shown are for 0 - 3.6 GHz, with attenuation set to 10 dB.

Description	Specifications	Supplemental Information
Code Domain		
BTS Measurements –25 dBm ≤ ML[a] ≤ –15 dBm 20 to 30° C		RF input power range is accordingly determined to meet Mixer level.
Code domain power		
Relative power accuracy		
Code domain power range		
0 to –10 dBc	±0.015 dB	
–10 to –30 dBc	±0.06 dB	
–30 to –40 dBc	±0.07 dB	
Symbol power vs. time		
Relative Accuracy		
Code domain power range		
0 to –10 dBc	±0.015 dB	
–10 to –30 dBc	±0.06 dB	
–30 to –40 dBc	±0.07 dB	
Symbol error vector magnitude		
Accuracy		
0 to –25 dBc		±1.0% (nominal)

a. ML (mixer level) is RF input power minus attenuation

Description	Specifications	Supplemental Information
QPSK EVM		
–25 dBm ≤ ML[a] ≤ –15 dBm 20 to 30° C		RF input power range is accordingly determined to meet Mixer level.
EVM Range	0 to 25%	
Floor	1.6%	
Accuracy [b]	±1.0%	
I/Q origin offset DUT Maximum Offset Analyzer Noise Floor		 –10 dBc (nominal) –50 dBc (nominal)
Frequency Error Range		 ±30 kHz (nominal)
Accuracy	±5 Hz + tfa[c]	500 Hz (nominal)

a. ML (mixer level) is RF input power minus attenuation
b. The accuracy specification applies when the EVM to be measured is well above the measurement floor. When the EVM does not greatly exceed the floor, the errors due to the floor add to the accuracy errors. The errors due to the floor are noise-like and add incoherently with the UUT EVM. The errors depend on the EVM of the UUT and the floor as follows: error = sqrt(EVMUUTP2P + EVMsaP2P)   EVMUUT, where EVMUUT is the EVM of the UUT in percent, and EVMsa is the EVM floor of the analyzer in percent.
c. tfa = transmitter frequency × frequency reference accuracy

Description	Specifications	Supplemental Information
Modulation Accuracy (Composite Rho)		
BTS Measurements –25 dBm ≤ ML[a] ≤ –15 dBm 20 to 30° C		RF input power range is accordingly determined to meet Mixer level. Specifications apply to BTS for 9 active channels as defined in 3GPP2, and where the mixer level (RF input power minus attenuation) is between –25 and –15 dBm.
Composite EVM		
Range	0 to 25%	
Floor	1.6%	
Accuracy [b]	±1.0%	
	0.5%	at EVM measurement in the range of 12.5% to 22.5%
Composite Rho		
Range	0.9 to 1.0	
Floor	0.99974	
Accuracy	±0.0010	at Rho 0.99751 (EVM 5%)
	±0.0030	at Rho 0.94118 (EVM 25%)

a. ML (mixer level) is RF input power minus attenuation

b. The accuracy specification applies when the EVM to be measured is well above the measurement floor. When the EVM does not greatly exceed the floor, the errors due to the floor add to the accuracy errors. The errors due to the floor are noise-like and add incoherently with the UUT EVM. The errors depend on the EVM of the UUT and the floor as follows: floorerror = sqrt($EVMUUT^2$ + $EVMsa^2$) – EVMUUT, where EVMUUT is the EVM of the UUT in percent, and EVMsa is the EVM floor of the analyzer in percent. For example, if the EVM of the UUT is 7%, and the floor is 2.5%, the error due to the floor is 0.43%.

Description	Specifications	Supplemental Information
Pilot time offset Range	−13.33 to +13.33 ms	From even second signal to start of PN sequence
Accuracy	±300 ns	
Resolution	10 ns	
Code domain timing Range	±200 ns	Pilot to code channel time tolerance
Accuracy	±1.25 ns	
Resolution	0.1 ns	
Code domain phase Range	±200 mrad	Pilot to code channel phase tolerance
Accuracy	±10 mrad	
Resolution	0.1 mrad	
Peak code domain error Accuracy		±1.0 dB (nominal) Range from −10 dB to −55 dB
I/Q origin offset DUT Maximum Offset Analyzer Noise Floor		−10 dBc (nominal) −50 dBc (nominal)
Frequency error Range	±900 Hz	
Accuracy	±10 Hz + tfa [a]	

a. tfa = transmitter frequency × frequency reference accuracy

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

13 TD-SCDMA Measurement Application

This chapter contains specifications for the EXA Signal Analyzer N9079A, TD-SCDMA measurement application. It contains both N9079A-1FP TD-SCDMA and N9079A-2FP HSDPA/8PSK measurement application.

Additional Definitions and Requirements

Because digital communications signals are noise-like, all measurements will have variations. The specifications apply only with adequate averaging to remove those variations.

The specifications apply in the frequency range documented in In-Band Frequency Range.

Measurements

Description	Specification	Supplemental Information
Power vs. Time		
Burst Type		Traffic, UpPTS and DwPTS
Transmit power		Min, Max, Mean
Dynamic range		114.3 dB
Averaging type		Off, RMS, Log
Measurement time		Up to 9 slots
Trigger type		External1, External2, RF Burst

Description	Specification	Supplemental Information
Transmit Power		
Burst Type		Traffic, UpPTS, and DwPTS
Measurement results type		Min, Max, Mean
Averaging type		Off, RMS, Log
Average mode		Exponential, Repeat
Measurement time		Up to 18 slots
Power Accuracy 20 to 30° C	±1.01 dB	

Description		Specification	Supplemental Information
Adjacent Channel Power			
Single Carrier			
Minimum Power at RF Input			–36 dBm (nominal)
ACPR Accuracy[a]			RRC weighted, 1.28 MHz noise bandwidth, method = IBW
Radio	Offset Freq		
MS (UE)	1.6 MHz	±0.15 dB	At ACPR range of –30 to –36 dBc with optimum mixer level[b]
MS (UE)	3.2 MHz	±0.16 dB	At ACPR range of –40 to –46 dBc with optimum mixer level[c]
BTS	1.6 MHz	±0.34 dB	At ACPR range of –37 to –43 dBc with optimum mixer level[d]
BTS	3.2 MHz	±0.18 dB	At ACPR range of –42 to –48 dBc with optimum mixer level[e]
BTS	1.6 MHz	±0.14 dB	At –43 dBc non-coherent ACPR[d]
RRC Weighting Accuracy[f]			
White noise in Adjacent Channel			0.00 dB (nominal)
TOI-induced spectrum			0.00 dB (nominal)
rms CW error			0.00 dB (nominal)

a. The accuracy of the Adjacent Channel Power Ratio will depend on the mixer drive level and whether the distortion products from the analyzer are coherent with those in the UUT. These specifications apply even in the worst case condition of coherent analyzer and UUT distortion products. For ACPR levels other than those in this specifications table, the optimum mixer drive level for accuracy is approximately –37 dBm – (ACPR/3),where the ACPR is given in (negative) decibels.

b. To meet this specified accuracy when measuring mobile station (MS) or user equipment (UE) within 3 dB of the required –33 dBc ACPR, the mixer level (ML) must be optimized for accuracy. This optimum mixer level is –25dBm, so the input attenuation must be set as close as possible to the average input power – (–25 dBm). For example, if the average input power is –6 dBm, set the attenuation to 19 dB. This specification applies for the normal 3.5 dB peak-to-average ratio of a single code. Note that if the mixer level is set to optimize dynamic range instead of accuracy, accuracy errors are nominally doubled.

c. ACPR accuracy at 3.2 MHz offset is warranted when the input attenuator is set to give an average mixer level of –13 dBm.

d. In order to meet this specified accuracy, the mixer level must be optimized for accuracy when measuring node B Base Transmission Station (BTS) within 3 dB of the required -40 dBc ACPR. This optimum mixer level is –23 dBm, so the input attenuation must be set as close as possible to the average input power – (–23 dBm). For example, if the average input power is -5 dBm, set the attenuation to 18 dB. This specification applies for the normal 10 dB peak-to-average ratio (at 0.01% probability) for Test Model 1. Note that, if the mixer level is set to optimize dynamic range instead of accuracy, accuracy errors are nominally doubled.

e. ACPR accuracy at 3.2 MHz offset is warranted when the input attenuator is set to give an average mixer level of –12 dBm.

f. 3GPP requires the use of a root-raised-cosine filter in evaluating the ACLR of a device. The accuracy of the passband shape of the filter is not specified in standards, nor is any method of evaluating that accuracy. This footnote discusses the performance of the filter in this instrument. The effect of the RRC filter and the effect of the RBW used in the measurement interact. The analyzer compensates the shape of the RRC filter to accommodate the RBW filter. The effectiveness of this compensation is summarized in three ways:

- White noise in Adj Ch: The compensated RRC filter nominally has no errors if the adjacent channel has a spectrum that is flat across its width.

- TOI-induced spectrum: If the spectrum is due to third-order inter-modulation, it has a distinctive shape. The computed errors of the compensated filter are –0.004 dB for the 470 kHz RBW used for UE testing with the IBW method and also used for all testing with the Fast method, and 0.000 dB for the 30 kHz RBW filter used for BTS testing with the IBW method. The worst error for RBWs between these extremes is 0.05 dB for a 330 kHz RBW filter.

- rms CW error: This error is a measure of the error in measuring a CW-like spurious component. It is evaluated by computing the root of the mean of the square of the power error across all frequencies within the adjacent channel. The computed rms error of the compensated filter is 0.023 dB for the 470 kHz RBW used for UE testing with the IBW method and also used for all testing with the Fast method, and 0.000 dB for the 30 kHz RBW filter used for BTS testing. The worst error for RBWs between these extremes is 0.057 dB for a 430 kHz RBW filter.

Description	Specification	Supplemental Information
Power Statistics CCDF		
Histogram Resolution	0.01 dB[a]	

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

Description	Specification	Supplemental Information
Occupied Bandwidth		
Minimum power at RF Input		–30 dBm (nominal)
Frequency Accuracy	±4.8 kHz	RBW = 30 kHz, Number of Points = 1001, Span = 4.8 MHz

Description	Specification	Supplemental Information
Spectrum Emission Mask		
Dynamic Range, relative 815 kHz offset[a][b]	74.3 dB	81.3 dB (typical)
Sensitivity, absolute 815 kHz offset[c]	-94.7 dBm	-100.7 dBm (typical)
Accuracy 815 kHz offset		
Relative[d]	±0.11 dB	
Absolute[e] 20 to 30° C	±1.05 dB	±0.34 dB (95% confidence)

a. The dynamic range specification is the ratio of the channel power to the power in the offset specified. The dynamic range depends on the measurement settings, such as peak power or integrated power. Dynamic range specifications are based on default measurement settings, with detector set to average, and depend on the mixer level. Default measurement settings include 30 kHz RBW.

b. This dynamic range specification applies for the optimum mixer level, which is about –17 dBm. Mixer level is defined to be the average input power minus the input attenuation.

c. The sensitivity is specified with 0 dB input attenuation. It represents the noise limitations of the analyzer. It is tested without an input signal. The sensitivity at this offset is specified in the default 30 kHz RBW, at a center frequency of 2 GHz.

d. The relative accuracy is a measure of the ratio of the power at the offset to the main channel power. It applies for spectrum emission levels in the offsets that are well above the dynamic range limitation.

e. The absolute accuracy of SEM measurement is the same as the absolute accuracy of the spectrum analyzer.

Description	Specification	Supplemental Information
Spurious Emissions		
Dynamic Range, relative	91.9 dB	97.1 dB (typical)
Sensitivity, absolute	–79.4 dBm	–85.4 dBm (typical)
Accuracy Attenuation = 10 dB Frequency Range		
9 kHz to 3.6 GHz		±0.41 dB (95% confidence)
3.5 GHz to 7.0 GHz		±1.22 dB (95% confidence)
6.9 GHz to 13.6 GHz		±1.59 dB (95% confidence)

Description	Specification	Supplemental Information
Code Domain		
BTS Measurements		
–25 dBm ≤ ML[a] ≤ –15 dBm 20 to 30° C		RF input power range is accordingly determined to meet Mixer level.
Code Domain Power		
Absolute Accuracy		
–10 dBc DPCH (Atten = 10 dB)[b]		±0.32 dB (95% confidence)
–10 dBc HS-PDSCH (Atten = 10 dB)[b]		±0.33 dB (95% confidence)
Relative Accuracy		
Code domain power range[c]		
DPCH Channel		
0 to –10 dBc	±0.02 dB	
–10 to –20 dBc	±0.06 dB	
–20 to –30 dBc	±0.19 dB	
HS-PDSCH Channel		
0 to –10 dBc	±0.03 dB	
–10 to –20 dBc	±0.11 dB	
–20 to –30 dBc	±0.32 dB	
Symbol Power vs Time[b]		
Relative Accuracy		
Code domain power range		
DPCH Channel		
0 to –10 dBc	±0.02 dB	
–10 to –20 dBc	±0.06 dB	
–20 to –30 dBc	±0.19 dB	
HS-PDSCH Channel		
0 to –10 dBc	±0.03 dB	
–10 to –20 dBc	±0.11 dB	

Description	Specification	Supplemental Information
−20 to −30 dBc	±0.32 dB	
Symbol error vector magnitude		
Accuracy		
DPCH Channel		
0 to −25 dBc		±1.1% (nominal)
HS-PDSCH Channel		
0 to −25 dBc		±1.2% (nominal)

a. ML (mixer level) is RF input power minus attenuation.
b. Code Domain Power Absolute accuracy is calculated as sum of 95% Confidence Absolute Amplitude Accuracy and Code Domain relative accuracy at Code Power Level.
c. This is tested for signal with 2 DPCH or 2 HS-PDSCH in TS0.

Description	Specification	Supplemental Information
Modulation Accuracy (Composite EVM)		
BTS Measurements		
–25 dBm ≤ ML[a] ≤ –15 dBm 20 to 30° C		RF input power range is accordingly determined to meet Mixer level.
Composite EVM		
Range		
Test signal with TS0 active and one DPCH in TS0	1.5% to 18%	
Test signal with TS0 active and one HS-PDSCH in TS0		1.5% to 17% (nominal)
Floor[b]	1.5%	
Accuracy		
Test signal with TS0 active and one DPCH in TS0	±0.7%[cd] ±1.1%	When EVM ≤9% When EVM 9%≤EVM≤18%
Test signal with TS0 active and one HS-PDSCH in TS0		±1.1% (nominal)
Peak Code Domain Error		
Accuracy		
Test signal with TS0 active and one DPCH in TS0	±0.3 dB	
Test signal with TS0 active and one HS-PDSCH in TS0	±1.0 dB	
I/Q Origin Offset		
DUT Maximum Offset		–20 dBc (nominal)
Analyzer Noise Floor		–50 dBc (nominal)
Frequency Error		
Range		±7 kHz (nominal)[e]
Accuracy		
Test signal with TS0 active and one DPCH in TS0	±5.7 Hz + tfa[f]	

Description	Specification	Supplemental Information
Test signal with TS0 active and one HS-PDSCH in TS0		±6 Hz + tfa (nominal)

a. ML (mixer level) is RF input power minus attenuation.
b. The EVM floor is derived for signal power –20dBm. The signal has only 1 DPCH or HS-PDSCH in TS0.
c. The accuracy specification applies when the EVM to be measured is well above the measurement floor. When the EVM does not greatly exceed the floor, the errors due to the floor add to the accuracy errors. The errors due to the floor are noise-like and add incoherently with the UUT EVM. The errors depend on the EVM of the UUT and the floor as follows: error = [sqrt(EVMUUT2 + EVMsa2)] – EVMUUT, where EVMUUT is the EVM of the UUT in percent, and EVMsa is the EVM floor of the analyzer in percent. For example, if the EVM of the UUT is 7%, and the floor is 2.5%, the error due to the floor is 0.43%.
d. The accuracy is derived in the EVM range 0 ~ 18%. We choose the maximum EVM variance in the results as the accuracy.
e. This specifies a synchronization range with Midamble.
f. tfa = transmitter frequency x frequency reference accuracy

Frequency

Description	Specification		Supplemental Information
In-Band Frequency Range	Operating Band	Frequencies	
	I	1900 to 1920 MHz	
		2010 to 2025 MHz	
	II	1850 to 1910 MHz	
		1930 to 1990 MHz	
	III	1910 to 1930 MHz	

14 VXA Measurement Application

This chapter contains specifications for the VXA Measurement Application.

Additional Definitions and Requirements

Because digital communications signals are noise-like, all measurements will have variations. The specifications apply only with adequate averaging to remove those variations.

Specifications

These specifications summarize the performance for the N9010A EXA signal analyzer and apply to the VXA measurement application inside the EXA. Unless stated otherwise, these are typical values, not warranted. Please refer to the EXA signal analyzer specification guide for spectrum analysis performance.

EXA Signal Analyzer Performance (Option 205)

Frequency

Description	Specifications		Supplemental Information
Range			
Maximum Frequency			
Option 503	3.6 GHz		
Option 507	7 GHz		
Option 513	13.6 GHz		
Option 526	26.5 GHz		
Preamp Option P03	3.6 GHz		
Minimum Frequency			
Preamp	AC Coupled	DC Coupled	
Off	10 MHz	9 kHz	
On	10 MHz	100 kHz	
Center Frequency Tuning Resolution	1 mHz		
Frequency Span	10 MHz		
Frequency Points per Span	Calibrated points: 51 to 409,601 Displayed points: 51 to 524,288		

Resolution Bandwidth (RBW)

Description	Specifications			Supplemental Information
Range	RBWs range from less than 1 Hz to greater than 2.8 MHz			The range of available RBW choices is a function of the selected frequency span and the number of calculated frequency points. Users may step through the available range in a 1-3-10 sequence or directly enter an arbitrarily chosen bandwidth.
RBW Shape Factor				The window choices below allow the user to optimize the RBW shape as needed for best amplitude accuracy, best dynamic range, or best response to transient signal characteristics.
	Selectivity	Passband Flatness	Rejection	
Flat Top	0.41	0.01 dB	>95 dBc	
Gaussian Top	0.25	0.68 dB	>125 dBc	
Hanning	0.11	1.5 dB	>31 dBc	
Uniform	0.0014	4.0 dB	>13 dBc	

Input

Description	Specifications	Supplemental Information
Range		Full Scale, combines attenuator setting and ADC gain
	–20 dBm to 20 dBm, 10 dB steps	standard
	–20 dBm to 22 dBm, 2 dB steps	Option FSA or EA3
	–40 dBm to 20 dBm, 10 dB steps, up to 3.6 GHz	Option P03
	–40 dBm to 22 dBm, 2 dB steps, up to 3.6 GHz	Options P03 and either FSA or EA3
ADC overload	+2 dBfs	

Amplitude Accuracy

Description	Specifications	Supplemental Information
Absolute Amplitude Accuracy		
Frequency <3.6 GHz		*95% confidence accuracy* ±0.40 dB
Amplitude Linearity		
Level –70 dBfs to 0 dBfs < –70 dBfs	*Linearity* ±0.15 dB ±0.20 dB	
IF Flatness		
Frequency ≤3.6 GHz	*Flatness* ±0.40 dB	*Rms (nominal)* 0.02 dB
>3.6 GHz		0.25 dB
Sensitivity	–147 dBm/Hz 10 MHz to 2.1 GHz, –20 dBm range –159 dBm/Hz 10 MHz to 2.1 GHz, –40 dBm range (requires P03 preamp option)	

Dynamic Range

Description	Specifications	Supplemental Information
Third-order intermodulation distortion	–84 dBc Two –20 dBfs tones, 10 dBm input range, 400 MHz to 13.6 GHz, tone separation > 5x IF Prefilter BW	
Noise Density at 1 GHz		
Input Range ≥–10 dBm –20 dBm to –12 dBm –30 dBm to –22 dBm –40 dBm to –32 dBm	*Density* –137 dBfs/Hz –127 dBfs/Hz –129 dBfs/Hz (requires P03 preamp option) –119 dBfs/Hz (requires P03 preamp option)	
Residual Responses	–90 dBfs (nominal) for range ≥ –10 dBm	
Image Responses		
10 MHz to 13.6 GHz, <8 MHz span	–75 dBc	
LO related spurious		
10 MHz to 3.6 GHz, f > 600 MHz from carrier	–60 dBc	
Other spurious		
100 Hz < f < 10 MHz from carrier <8 MHz span	–70 dBc (nominal)	
f ≥ 10 MHz from carrier <8 MHz span	–70 dBc	

Analog Modulation Analysis (Option 205)

Description	Specifications	Supplemental Information
AM Demodulation	Carrier ≤–17 dBfs	
Demodulator Bandwidth	Same as selected measurement span	
Modulation Index Accuracy	±1%	
Harmonic Distortion	–55 dBc relative to 100% modulation index	
Spurious	–60 dBc relative to 100% modulation index	
Cross Demodulation	< 0.5% AM on an FM signal with 50 kHz modulation rate, 200 kHz deviation	
PM Demodulation	Deviation < 180°, modulation rate ≤500 kHz	
Demodulator Bandwidth	Same as selected measurement span, except as noted	
Modulation Index Accuracy	±0.5°	
Harmonic Distortion	–55 dBc	
Spurious	–60 dBc	
Cross Demodulation	1° PM on an 80% modulation index AM signal, modulation rate ≤1 MHz	

Description		Specifications	Supplemental Information
FM Demodulation			
Demodulator Bandwidth		Same as selected measurement span	
Modulation Index Accuracy		±0.1% of span, deviation < 2 MHz, modulation rate ≤500 kHz	
Harmonic Distortion			
Modulation Rate	*Deviation*	*Distortion*	
< 50 kHz	≤200 kHz	–50 dBc	
≤500 kHz	≤2 MHz	–45 dBc	
Spurious			
Modulation Rate	*Deviation*	*Distortion*	
≤50 kHz	≤200 kHz	–50 dBc	
≤500 kHz	≤2 MHz	–45 dBc	
Cross Demodulation		< 0.5% of span of FM on an 80% modulation index AM signal, modulation rate ≤1 MHz	

Vector Modulation Analysis (Option AYA)

Description	Specifications	Supplemental Information
Accuracy		Formats other than FSK, 8/16VSB, 16/32 APSK, and OQPSK; Conditions: Full scale signal, fully contained in the measurement span, frequency < 3.6 GHz, random data sequence, range ≥ –30 dBm, start frequency ≥ 15% of span, alpha/BT ≥ 0.3 (0.3 to 0.7 for OQPSK), and symbol rate ≥ 1 kHz. For symbol rates < 1 kHz, accuracy may be limited by phase noise. Averaging = 10
Residual Errors	Result = 150 symbols averages = 10	
Residual EVM		
Span	*EVM*	
≤100 kHz[a]	<0.50% rms	
≤1 MHz	<0.50% rms	
≤10 MHz	<1.00% rms	
Magnitude Error		
Span	*Error*	
≤100 kHz	<0.30% rms	
≤1 MHz	<0.50% rms	
≤10 MHz	<1.00% rms	
Phase Error		
Span	*Error*	
≤100 kHz[a]	0.3° rms	
≤1 MHz	0.4° rms	
≤10 MHz	0.6° rms	
Frequency Error	Symbol rate/500,000	Added to frequency accuracy if applicable
IQ Origin Offset	–60 dB or better	

Description	Specifications	Supplemental Information
Video Modulation Formats		
Residual EVM 8/16 VSB	≤1.5% (SNR ≥36 dB)	Symbol rate = 10.762 MHz, α= 0.115, frequency < 3.6 GHz, 7 MHz span, full-scale signal, range ≥–30 dBm, result length = 800, averages = 10
Residual EVM 16, 32, 64, 128, 256, 512, or 1024 QAM	≤1.0% (SNR ≥40 dB)	Symbol rate = 6.9 MHz, α= 0.15, frequency < 3.6 GHz, 8 MHz span, full-scale signal, range ≥–30 dBm, result length = 800, averages = 10

a. 1.0% rms EVM and 0.8 deg RMS phase error for frequency > 3 GHz