Keysight N9000B CXA Signal Analyzer

KEYSIGHT TECHNOLOGIES

Specification Guide

Notices

Trademark Acknowledgments

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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.keysight.com/find/cxa

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Information on preventing analyzer damage can be found at:

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1 Keysight CXA 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 = 0 to 55°C, also referred to as "Full temperature range" or "Full range", unless otherwise noted.
- 95th percentile values indicate the breadth of the population (»2s) of performance tolerances expected to be met in 95% 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.

Conditions Required to Meet Specifications

The following conditions must be met for the analyzer to meet its 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 < 10 MHz, DC coupling applied (*Option 513/526* only).
- 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. If Auto Align is set to Light, performance is not warranted, and nominal performance will degrade to become a factor of 1.4 wider for any specification subject to alignment, such as amplitude tolerances.

Certification

Keysight Technologies certifies that this product met its published specifications at the time of shipment from the factory. Keysight 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			3.0 GHz		
Option 507			7.5 GHz		
Option 513			13.6 GHz		
Option 526			26.5 GHz		
Preamp Option P03			3.0 GHz		
Preamp Option P07			7.5 GHz		
Preamp Option P13			13.6 GHz		
Preamp Option P26			26.5 GHz		
Minimum Frequency					*Option 503, or 507*
Preamp					
Off			9 kHz		
On			100 kHz		
Minimum Frequency					*Option 513, or 526*
Preamp			AC Coupled	DC coupled	
Off			10 MHz	9 kHz	
On			10 MHz	100 kHz	
Band			**LO Multiple (N[a])**		Band Overlaps[b]
		Option 513, or *526*			
	Option 503, or *507*				
0 (9 kHz to 3.0 GHz)	x		1		
0 (9 kHz to 3.08 GHz)		x	1		
1 (2.95 to 3.8 GHz)	x		1		
2 (3.7 to 4.55 GHz)	x		1		
3 (4.45 to 5.3 GHz)	x		1		
4 (5.2 to 6.05 GHz)	x		1		
5 (5.95 to 6.8 GHz)	x		1		
6 (6.7 to 7.5 GHz)	x		1		
1 (2.95 to 7.58 GHz)		x	2		
2 (7.45 to 9.55 GHz)		x	2		
3 (9.45 to 12.6 GHz)		x	2		
4 (12.5 to 13.05 GHz)		x	2		
4 (12.95 to 13.8 GHz)		x	4		
5 (13.4 to 15.55 GHz)		x	4		
6 (15.45 to 19.35 GHz)		x	4		
7 (19.25 to 21.05 GHz)		x	4		

Description			Specifications	Supplemental Information
8 (20.95 to 22.85 GHz)		x	4	
9 (22.75 to 24.25 GHz)		x	4	
10 (24.15 to 26.55 GHz)		x	4	

a. N is the LO multiplication factor.

b. In the band overlap regions, take option 513/526 for example, 2.95 to 7.5 GHz, the analyzer may use either band for measurements, in this example Band 0 or Band 1. The analyzer gives preference to the band with the better overall specifications, but will choose the other band if doing so is necessary to achieve a sweep having minimum band crossings. For example, with CF = 2.98 GHz, with a span of 40 MHz or less, the analyzer uses Band 0, because the stop frequency is 3.0 GHz or less, allowing a span without band crossings in the preferred band. If the span is between 40 and 60 MHz, the analyzer uses Band 1, because the start frequency is above 2.95 GHz, allowing the sweep to be done without a band crossing in Band 1, though the stop frequency is above 3.0 GHz, preventing a Band 0 sweep without band crossing. With a span greater than 60 MHz, a band crossing will be required: the analyzer sweeps up to 3.0 GHz in Band 0; then executes a band crossing and continues the sweep in Band 1.
Specifications are given separately for each band in the band overlap regions. One of these specifications is for the preferred band, and one for the alternate band. Continuing with the example from the previous paragraph (2.98 GHz), the preferred band is band 0 (indicated as frequencies under 3.0 GHz) and the alternate band is band 1 (2.95 to 7.5 GHz). The specifications for the preferred band are warranted. The specifications for the alternate band are not warranted in the band overlap region, but performance is nominally the same as those warranted specifications in the rest of the band. Again, in this example, consider a signal at 2.98 GHz. If the sweep has been configured so that the signal at 2.98 GHz is measured in Band 1, the analysis behavior is nominally as stated in the Band 1 specification line (2.95 to 7.5 GHz) but is not warranted. If warranted performance is necessary for this signal, the sweep should be reconfigured so that analysis occurs in Band 0. Another way to express this situation in this example Band0/Band 1 crossing is this: The specifications given in the "Specifications" column which are described as "2.95 to 7.5 GHz" represent nominal performance from 2.95 to 3.0 GHz, and warranted performance from 3.0 to 7.5 GHz.

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	$\pm 2 \times 10^{-6}$	
Full temperature range	$\pm 2 \times 10^{-6}$	
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) p-p in 20 ms (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.

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	$\pm 1.5 \times 10^{-8}$	
Full temperature range	$\pm 5 \times 10^{-8}$	
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 900 s after turn on		Nominal $\pm 1 \times 10^{-7}$ of final frequency $\pm 1 \times 10^{-8}$ of final frequency
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) p-p in 20 ms (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 15 minutes.
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

Description	Specifications	Supplemental Information
Frequency Readout Accuracy	±(marker freq. × freq. ref. accy. + 0.25% × span + 5% × RBW[a] + 2 Hz + 0.5 × horizontal resolution[b])	Single detector only
Example for EMC[c]		±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 4% of RBW for RBWs from 1 Hz to 3 MHz (the widest autocoupled RBW), and 30% of RBW for the (manually selected) 4, 5, 6 and 8 MHz RBWs. *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. In most cases, the frequency readout accuracy of the analyzer can be exceptionally good. As an example, Keysight 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		
Option 503	0 Hz, 10 Hz to 3 GHz	
Option 507	0 Hz, 10 Hz to 7.5 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 and Trigger		
Sweep Time Range		
Span = 0 Hz	1 μs to 6000 s	
Span ≥ 10 Hz	1 ms to 4000 s	
Sweep Time Accuracy		
Span ≥ 10 Hz, swept		±0.01% (nominal)
Span ≥ 10 Hz, FFT		±40% (nominal)
Span = 0 Hz		±1% (nominal)
Sweep Trigger	Free Run, Line, Video, External 1, 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
Triggers		Additional information on some of the triggers and gate sources
Video		Independent of Display Scaling and Reference Level
Minimum settable level	–170 dBm	Useful range limited by noise
Maximum usable level		Highest allowed mixer level[a] + 2 dB (nominal)
Detector and Sweep Type relationships		
Sweep Type = Swept		
Detector = Normal, Peak, Sample or Negative Peak		Triggers on the signal before detection, which is similar to the displayed signal
Detector = Average		Triggers on the signal before detection, but with a single-pole filter added to give similar smoothing to that of the average detector
Sweep Type = FFT		Triggers on the signal envelop in a bandwidth wider than the FFT width
RF Burst		
Level Range		-50 to -10 dBm plus attenuation (nominal)[b]
Level Accuracy		±2 dB + Absolute Amplitude Accuracy (nominal)
Bandwidth (–10 dB)		18 MHz (nominal)
Frequency Limitations		If the start or center frequency is too close to zero, LO feedthrough can degrade or prevent triggering. How close is too close depends on the bandwidth.
External Triggers		See "Inputs/Outputs" on page 47.

a. The highest allowed mixer level depends on the attenuation and IF Gain. It is nominally –10 dBm + input attenuation for Preamp Off and IF Gain = Low.

b. Noise will limit trigger level range at high frequencies, such as above 13 GHz.

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 (Except Method = FFT)	100.0 ns to 5.0 s	Gate length for the FFT method is fixed at 1.83/RBW, with nominally 2% tolerance.
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 Line RF Burst Periodic	Pos or neg edge triggered

Description	Specifications	Supplemental Information
Number of Frequency Display Trace Points (buckets)		
Factory preset	1,001	
Range	1 to 40,001	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		
1 Hz to 750 kHz		±1.0% (±0.044 dB) (nominal)
820 kHz to 1.2 MHz		±2.0% (±0.088 dB) (nominal)
1.3 to 2.0 MHz		±0.07 dB (nominal)
2.2 to 3 MHz		±0.15 dB (nominal)
4 to 8 MHz		±0.25 dB (nominal)
Accuracy (–3.01 dB bandwidth)[b]		
RBW Range		
1 Hz to 1.3 MHz		±2% (nominal)
1.5 to 3.0 MHz		±7% (nominal)
4 to 8 MHz		±15% (nominal)
Selectivity[c] (–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.

c. The RBW filters are implemented digitally, and the selectivity is designed to be 4.1:1. Verifying the selectivity with RBWs above 100 kHz becomes increasing problematic due to SNR affecting the –60 dB measurement.

Description	Specification	Supplemental information
Analysis Band width[a]		
Standard	10 MHz	
With *Option B25*	25 MHz	

a. Analysis bandwidth is the instantaneous bandwidth available around 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 Band wid th (VBW)		
Range	Same as Resolution Band wid th 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 equival lay 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	Option 503 or 507	Option 513 or 526	Specifications	Supplemental Information
Measurement Range				
Preamp Off				
100 kHz to 1 MHz	x		Displayed Average Noise Level to +20 dBm	
1 MHz to 7.5 GHz	x		Displayed Average Noise Level to +23 dBm	
100 kHz to 26.5 GHz		x	Displayed Average Noise Level to +23 dBm	
Preamp On				
100 kHz to 7.5 GHz	x		Displayed Average Noise Level to +15 dBm	
100 kHz to 26.5 GHz		x	Displayed Average Noise Level to +23 dBm	
Input Attenuation Range				
Standard	x		0 to 50 dB, in 10 dB steps	
Standard		x	0 to 70 dB, in 10 dB steps	
With *Option FSA*	x		0 to 50 dB, in 2 dB steps	
With *Option FSA*		x	0 to 70 dB, in 2 dB steps	

Description	Specifications	Supplemental Information
Maximum Safe Input Level		
Average Total Power (input attenuation ≥ 20 dB)	+30 dBm (1 W)	*Option 503/507*
Average Total Power (input attenuation ≥ 10 dB)	+30 dBm (1 W)	*Option 513/526*
Peak Pulse Power (<10 μs pulse width, <1% duty cycle input attenuation ≥ 30 dB)	+50 dBm (100 W)	
AC Coupled	±50 Vdc	
DC Coupled	±0.2 Vdc	*Option 513/526*

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	
Linear Scale	Ten divisions	
Scale units	dBm, dBmV, dBµV, dBmA, dBµA, V, W, A	

Description	Specifications	Supplemental Information
Marker Readout[a]		
Resolution		
Log units resolution		
Trace Averaging Off, on-screen	0.01 dB	
Trace Averaging 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 previous analyzers (except PSA) in a way that makes the Keysight CXA Signal Analyzer more flexible. In previous analyzers, the RL controlled how the measurement was performed as well as how it was displayed. Because the logarithmic amplifier in previous analyzers had both range and resolution limitations, this behavior was necessary for optimum measurement accuracy. The logarithmic amplifier in the CXA signal analyzer, however, is implemented digitally such that the range and resolution greatly exceed other instrument limitations. Because of this, the CXA 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	*Option 503* or *507*	*Option 513* or *526*	Specifications		Supplemental Information
Frequency Response (Maximum error relative to reference condition (50 MHz) Swept operation[b] Attenuation 10 dB)					Refer to the footnote for "Band Overlaps" on page 11. Freq Option 526 only: Modes above 18 GHz[a]
			20 to 30°C	**Full Range**	**95th Percentile (≈2σ)**
9 kHz to 10 MHz	x		±0.6 dB	±0.65 dB	±0.45 dB
9 kHz to 10 MHz		x	±0.8 dB	±0.85 dB	±0.5 dB
10 MHz to 3 GHz	x		±0.75 dB	±1.75 dB	±0.55 dB

Description			Specifications		Supplemental Information
10 MHz to 3 GHz		x	±0.65 dB	±0.85 dB	±0.4 dB
3 to 5.25 GHz	x		±1.45 dB	±2.5 dB	±1.0 dB
5.25 to 7.5 GHz	x		±1.65 dB	±2.60 dB	±1.2 dB
3 to 7.5 GHz		x	±1.5 dB	±2.5 dB	±0.5 dB
7.5 to 13.6 GHz		x	±2.0 dB	±2.7 dB	±0.8 dB
13.6 to 19 GHz		x	±2.0 dB	±2.7 dB	±1.0 dB
19 to 26.5 GHz		x	±2.5 dB	±4.5 dB	±1.3 dB

a. Signal frequencies between 18 and 26.5 GHz are prone to additional response errors due to modes in the Type-N connector used with frequency Option 526. With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. The effect of these modes with this connector are included within these specifications.
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.

Description		Specifications	Supplemental Information		
IF Frequency Response[a] (Demodulation and FFT response relative to the center frequency)			Modes above 18 GHz[b]		
Center Freq (GHz)	**Analysis Width** (MHz)	**Max Error**[c] (Exception[d])	**Midwidth Error** (95th Percentile)	**Slope** (dB/MHz) (95th Percentile)	**RMS**[e] (nominal)
≤3.0	≤10	±0.40 dB	±0.15 dB	±0.10	0.03 dB
>3.0, ≤ 26.5	≤10				0.25 dB

a. The IF frequency response includes effects due to RF circuits such as input filters, that are a function of RF frequency, in addition to the IF pass-band effects.
b. Signal frequencies between 18 and 26.5 GHz are prone to additional response errors due to modes in the Type-N connector used with frequency Option 526. With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. These modes cause nominally up to –0.35 dB amplitude change, with phase errors of nominally up to ±1.2°.
c. The maximum error at an offset (f) from the center of the FFT width is given by the expression ± [Midwidth Error + (f × Slope)], but never exceeds ±Max Error. Usually, the span is no larger than the FFT width in which case the center of the FFT width is the center frequency of the analyzer. When the analyzer span is wider than the FFT width, the span is made up of multiple concatenated FFT results, and thus has multiple centers of FFT widths so the f in the equation is the offset from the nearest center. These specifications include the effect of RF frequency response as well as IF frequency response at the worst case center frequency. Performance is nominally three times better than the maximum error at most center frequencies.
d. The specification does not apply for frequencies greater than 3.0 MHz from the center in FFT Widths of 7.2 to 8 MHz.
e. The "RMS" nominal performance is the standard deviation of the response relative to the center frequency, integrated across a 10 MHz span. This performance measure was observed at a single center frequency in each harmonic mixing band, which is representative of all center frequencies; the observation center frequency is not the worst case center frequency.

Description		Specification	Supplemental Information	
IF Phase Linearity			Deviation from mean phase linearity Modes above 18 GHz[a]	
Freq (GHz)	**Span** (MHz)		**Peak-to-Peak** (nominal)	**RMS** (nominal)[b]
≥0.02, ≤ 3.0	≤ 10		0.5°	0.2°
>3.0, ≤ 7.5	≤ 10		2.7°	2.4°
>7.5, ≤ 26.5	≤ 10		1.5°	0.4°

a. Signal frequencies between 18 and 26.5 GHz are prone to additional response errors due to modes in the Type-N connector used with frequency Option 526. With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. These modes cause nominally up to –0.35 dB amplitude change, with phase errors of nominally up to ±1.2°.
b. 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.

Description	Specifications	Supplemental Information
Input Attenuation Switching Uncertainty (Relative to 10 dB (reference setting))		Refer to the footnote for "Band Overlaps" on page 11
50 MHz (reference frequency)	±0.32 dB	±0.15 dB (typical)
Attenuation > 2 dB, preamp off		
100 kHz to 3 GHz		±0.30 dB (nominal)
3 to 7.5 GHz		±0.50 dB (nominal)
7.5 to 13.6 GHz		±0.70 dB (nominal)
13.6 to 26.5 GHz		±0.70 dB (nominal)

Description	Specifications	Supplemental Information
Absolute Amplitude Accuracy		
At 50 MHz[a]		
20 to 30°C	±0.40 dB	±0.30 dB (95th percentile)
5 to 50°C	±0.60 dB	
At all frequencies[a]		
20 to 30°C	±(0.40 dB + frequency response)	
5 to 50°C	±(0.60 dB + frequency response)	
95th Percentile Absolute Amplitude Accuracy[b] (Wide range of signal levels, RBWs, RLs, etc., Atten = 10 dB)		
100 kHz to 10 MHz		±0.6 dB

Description	Specifications	Supplemental Information
Preamp On[c] (*Option P03/P07/P13/P26*)		±(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.

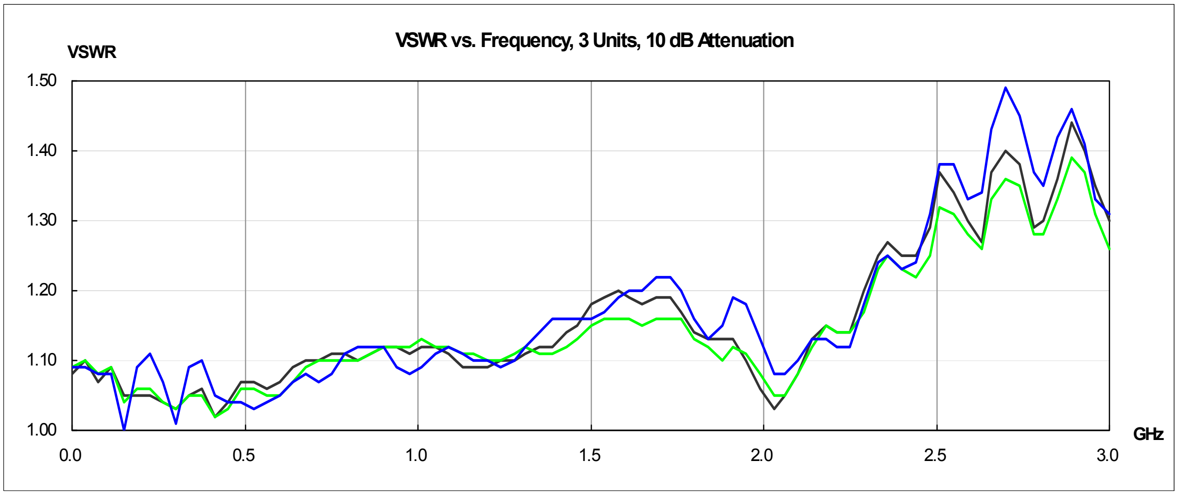
b. Absolute Amplitude Accuracy for a wide range of signal and measurement settings, covers the 95th percentile proportion with 95% confidence. Here are the details of what is covered and how the computation is made:
The wide range of conditions of RBW, signal level, VBW, reference level and display scale are discussed in footnote a. There are 108 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.

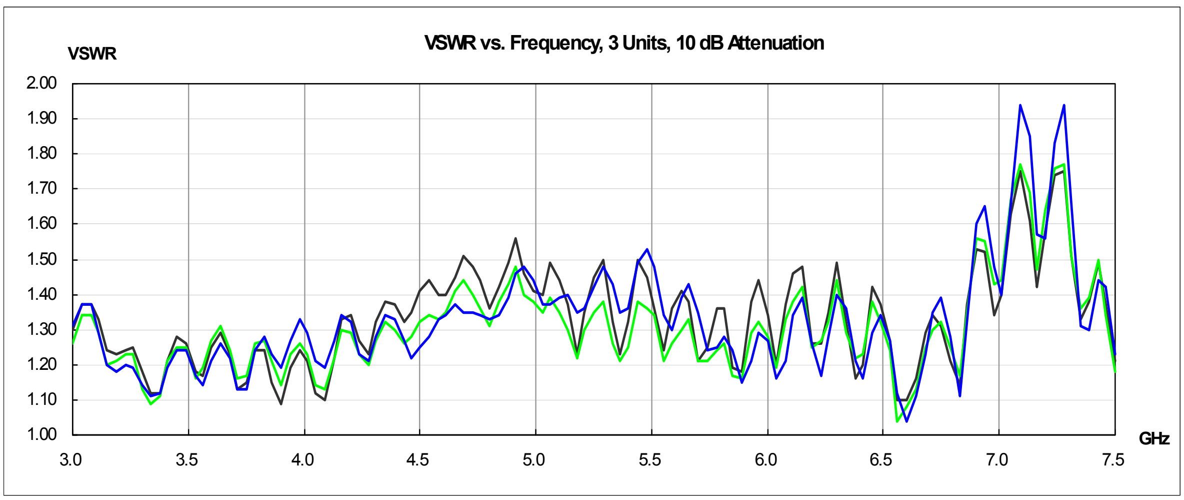
c. Same settings as footnote a, except that the signal level at the preamp input is –40 to –80 dBm. Total power at preamp (dBm) = total power at input (dBm) minus input attenuation (dB). This specification applies for signal frequencies above 100 kHz.

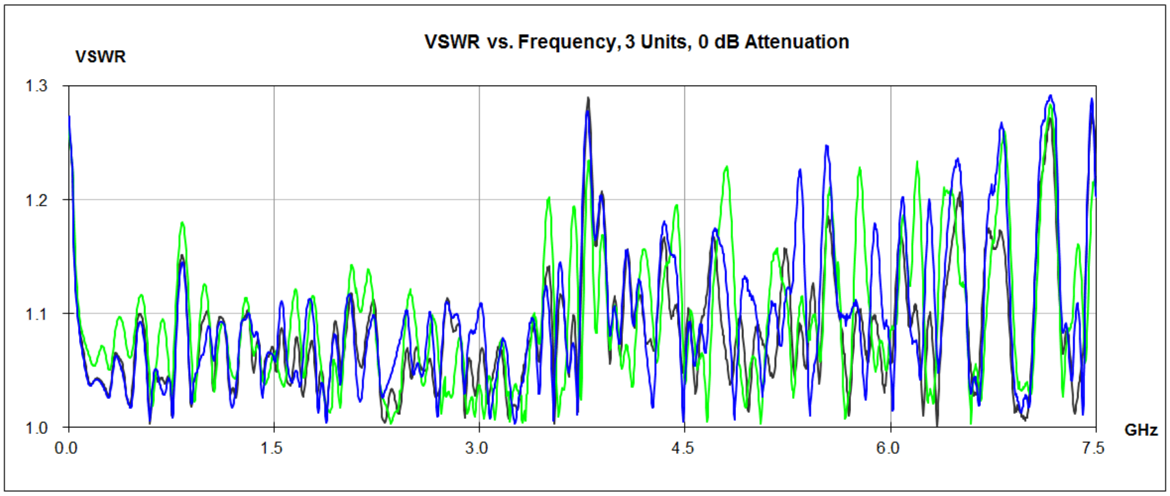
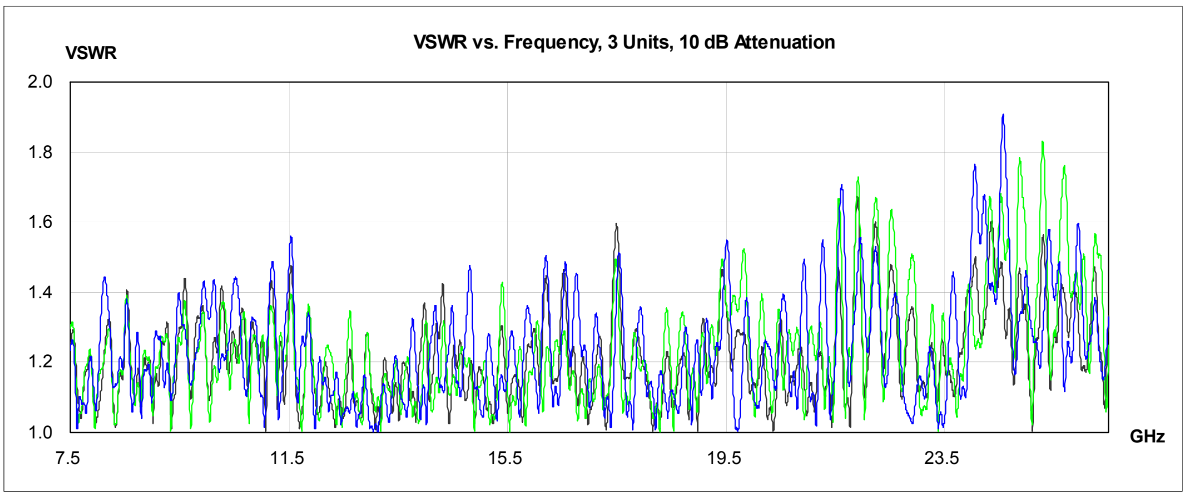
Description	*Option 503* or *507*	*Option 513* or *526*	Specifications	Supplemental Information
RF Input VSWR				Nominal[a]
(Input attenuation 10 dB, 50 MHz)				1.1:1
				Input Attenuation ≥ 10 dB
10 MHz to 3.0 GHz	x			< 1.5:1 (nominal)
10 MHz to 3.0 GHz		x		< 1.3:1 (nominal)
3.0 to 7.5 GHz	x			< 2.0:1 (nominal)
3.0 to 7.5 GHz		x		< 1.4:1 (nominal)
7.5 to 26.5 GHz		x		< 1.9:1 (nominal)

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

Nominal Instrument Input VSWR (Option 503/507)





Nominal Instrument Input VSWR (Option 513/526)



Description	Specifications	Supplemental Information
Resolution Bandwidth Switching Uncertainty		Relative to reference BW of 30 kHz
1 Hz to 3 MHz RBW	±0.15 dB	
Manually selected wide RBWs: 4, 5, 6, 8 MHz	±1.0 dB	

Description	Specifications	Supplemental Information
Reference Level		
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[a]	

a. 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[abc]		
Absolute 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 < –15 dBm	±0.15 dB	
–15 dBm ≤ ML ≤ –10 dBm	±0.30 dB	±0.15 dB (typical)
Relative Fidelity[e]		Applies for mixer level[d] range from –10 to –80 dBm, preamp off, and dither on
Sum of the following terms:		
high level term		Up to ±0.045 dB[f]

Description	Specifications	Supplemental Information
instability term		Up to ±0.018 dB
slope term		From equation[g]

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.

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

T

he 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 Medium. 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 ±0.025 dB. The instability term is ±0.018 dB. The slope term evaluates to ±0.050 dB. The sum of all these terms is ±0.093 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. Pref 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.

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)[abc]		Maximum power at mixer[d]
50 MHz to 7.5 GHz (*Option 503, 507*)		+2.00 dBm (nominal)
50 MHz to 7.5 GHz (*Option 513, 526*)		+7.00 dBm (nominal)
7.5 to 13.6 GHz (*Option 513, 526*)		+3.00 dBm (nominal)
13.6 to 26.5 GHz (*Option 526*)		+0.00 dBm (nominal)

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 1 MHz tone spacing.
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. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).

Displayed Average Noise Level

Description	Option 503 or 507	Option 513 or 526	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		Refer to the footnote for "Band Overlaps" on page 11
			20 to 30°C	**Full range**	**Typical**
9 kHz to 1 MHz	x				–120 dBm (nominal)
9 kHz to 1 MHz		x			-122 dBm
1 to 10 MHz[b]	x		-130 dBm	-129 dBm	-137 dBm
1 to 10 MHz[c]		x	-143 dBm	-143 dBm	-148 dBm
10 MHz to 1.5 GHz	x		-148 dBm	-145 dBm	-150 dBm
10 MHz to 1.5 GHz		x	-147 dBm	-147 dBm	-150 dBm
1.5 to 2.5 GHz	x		-144 dBm	-141 dBm	-147 dBm
2.5 to 2.7 GHz	x		-142 dBm	-139 dBm	-145 dBm
2.7 to 3.0 GHz	x		-139 dBm	-137 dBm	-143 dBm
3 to 4.5 GHz	x		-137 dBm	-136 dBm	-140 dBm
4.5 to 6 GHz	x		-133 dBm	-130 dBm	-136 dBm
1.5 to 6 GHz		x	-143 dBm	-142 dBm	-147 dBm
6 to 7.5 GHz	x		-128 dBm	-125 dBm	-131 dBm
6 to 7.5 GHz		x	-141 dBm	-140 dBm	-145 dBm
7.5 to 13.6 GHz		x	-139 dBm	-138 dBm	-142 dBm
13.6 to 20 GHz		x	-134 dBm	-133 dBm	-140 dBm
20 to 24 GHz		x	-132 dBm	-131 dBm	-138 dBm
24 to 26.5 GHz		x	-124 dBm	-121 dBm	-129 dBm

a. DANL for zero span and swept 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.
b. DANL below 10 MHz is affected by phase noise around the LO feedthrough signal.
c. DANL below 10 MHz is affected 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 Close-in f Noise" for frequencies below 25 kHz, and “Best Wide Offset f Noise" for frequencies above 85 kHz.

Spurious Response

Description	Option 503 or 507	Option 513 or 526	Specifications: Mixer Level[a]	Specifications: Response	Supplemental Information
Spurious Response					See "Band Overlaps" on page 11
			Mixer Level[a]	**Response**	Preamp Off[b]
Residual Responses[c]	x				
200 kHz to 7.5 GHz[d] (swept)				–90 dBm	
Zero span or FFT or other frequencies					–100 dBm (nominal)
Input Related Spurious Response (10 MHz to 7.5 GHz)	x		–30 dBm		–60 dBc (typical)
Image Responses					
10 MHz to 26.5 GHz		x	-10 dBm		-60 dBc (typical)
Other Spurious Responses					
First RF Order (f ³ 10 MHz from carrier)		x	-10 dBm	-65 dBc	
High RF Order (f ³ 10 MHz from carrier)		x	-30 dBm	-65 dBc	
LO-Related Spurious Responses (10 MHz to 3 GHz)		x	-10 dBm		-64 dBc (typical)
Sidebands, offset from CW signal	x	x			
50 to 200 Hz					–50 dBc (nominal)
200 Hz to 3 kHz					–65 dBc (nominal)
3 kHz to 300 kHz					–65 dBc (nominal)
300 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. The stop frequency varies according to the option 503/507/513/526 selected.

Second Harmonic Distortion

Description	Option 503, or 507	Option 513, or 526	Specifications: Distortion	Specifications: SHI[a]	Supplemental Information: Distortion (nominal)	Supplemental Information: SHI (nominal)
Second Harmonic Distortion (Input attenuation 10 dB)						
Preamp Off						
10 MHz to 3.75 GHz (Input level –20 dBm)	x	x	–65 dBc	+35 dBm	–72 dBc	+42 dBm
3.75 to 13.25 GHz (Input level –20 dBm)		x	–75 dBc	+45 dBm	–84 dBc	+54 dBm
Preamp On *(Option P03/P07)* (Input level –40 dBm)	x	x			–60 dBc	+10 dBm

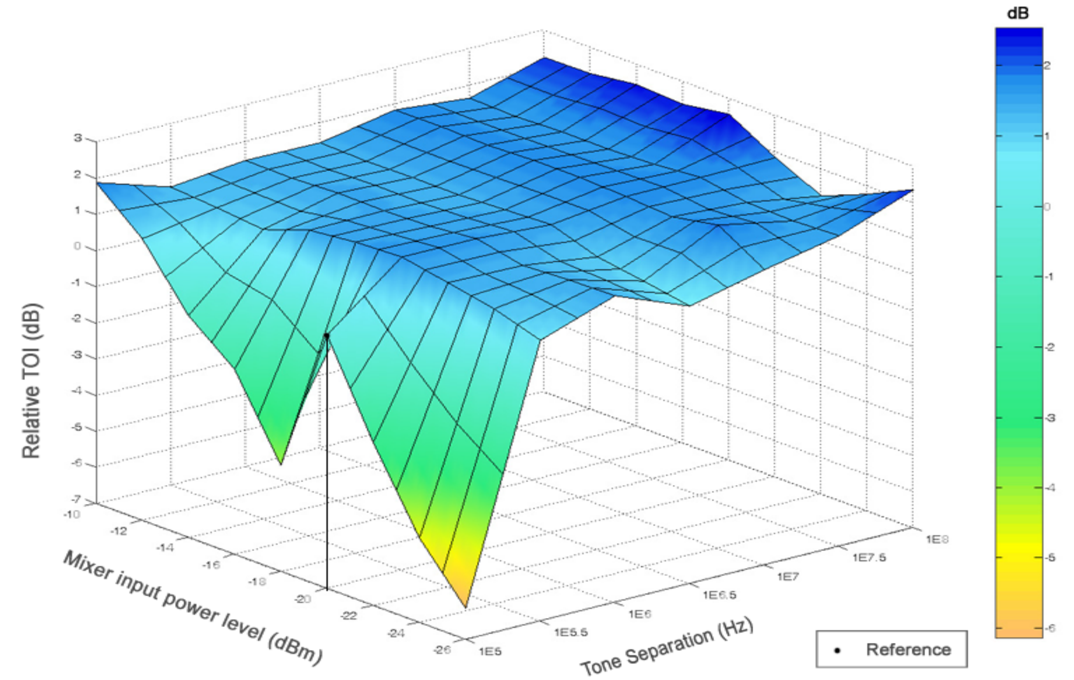
a. SHI = second harmonic intercept. The SHI is given by the mixer power in dBm minus the second harmonic distortion level relative to the mixer tone in dBc.

Third Order Intermodulation

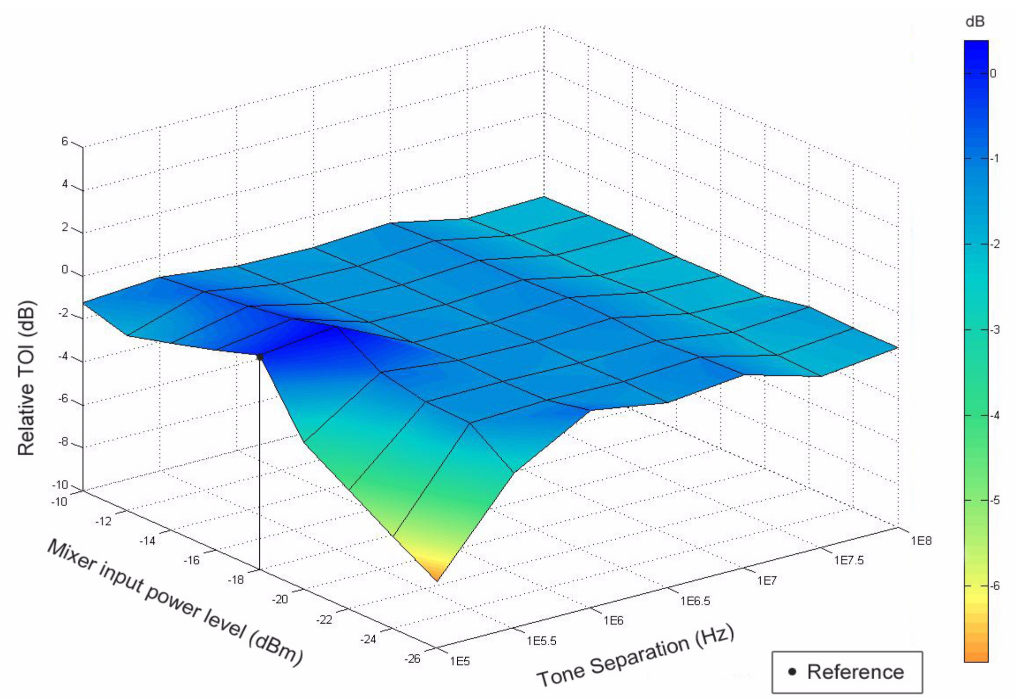
Description	Option 503, or 507	Option 513, or 526	Specifications: Intercept[b]	Supplemental Information: Extrapolated Distortion[c]	Supplemental Information: Intercept (Typical)
Third Order Intermodulation[a] (Two –20 dBm tones at the input, spaced by 100 kHz, input attenuation 0 dB)				Refer to the footnote for "Band Overlaps" on page 11.	
20 to 30°C					
10 to 500 MHz		x	+11 dBm	-62 dBc	+15 dBm
10 to 400 MHz	x		+10 dBm	-60 dBc	+14 dBm
500 MHz to 2 GHz		x	+12 dBm	-64 dBc	+15 dBm
2 to 3 GHz		x	+11 dBm	-62 dBc	+15 dBm
400 MHz to 3 GHz	x		+13 dBm	-66 dBc	+17 dBm
3 to 7.5 GHz		x	+12 dBm	-64 dBc	+17 dBm
3 to 7.5 GHz	x		+13 dBm	-66 dBc	+15 dBm
7.5 to 13.6 GHz		x	+11 dBm	-62 dBc	+15 dBm
13.6 to 26.5 GHz		x	+10 dBm	-60 dBc	+14 dBm
Preamp On *(OptionP03, P07, P13, P26)* (Two –45 dBm tones at the input, spaced by 100 kHz, input attenuation 0 dB)	x	x			–8 dBm (nominal)

a. TOI is verified with IF Gain set to its best case condition, which is IF Gain = Low.
b. Intercept = 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.
c. The distortion shown is computed from the warranted intercept specifications, based on two tones at –20 dBm each, instead of being measured directly.

Nominal TOI vs. Mixer Level and Tone Separation [Plot] (Option 503, 507)



Nominal TOI vs. Mixer Level and Tone Separation [Plot] (Option 513, 526)



Phase Noise

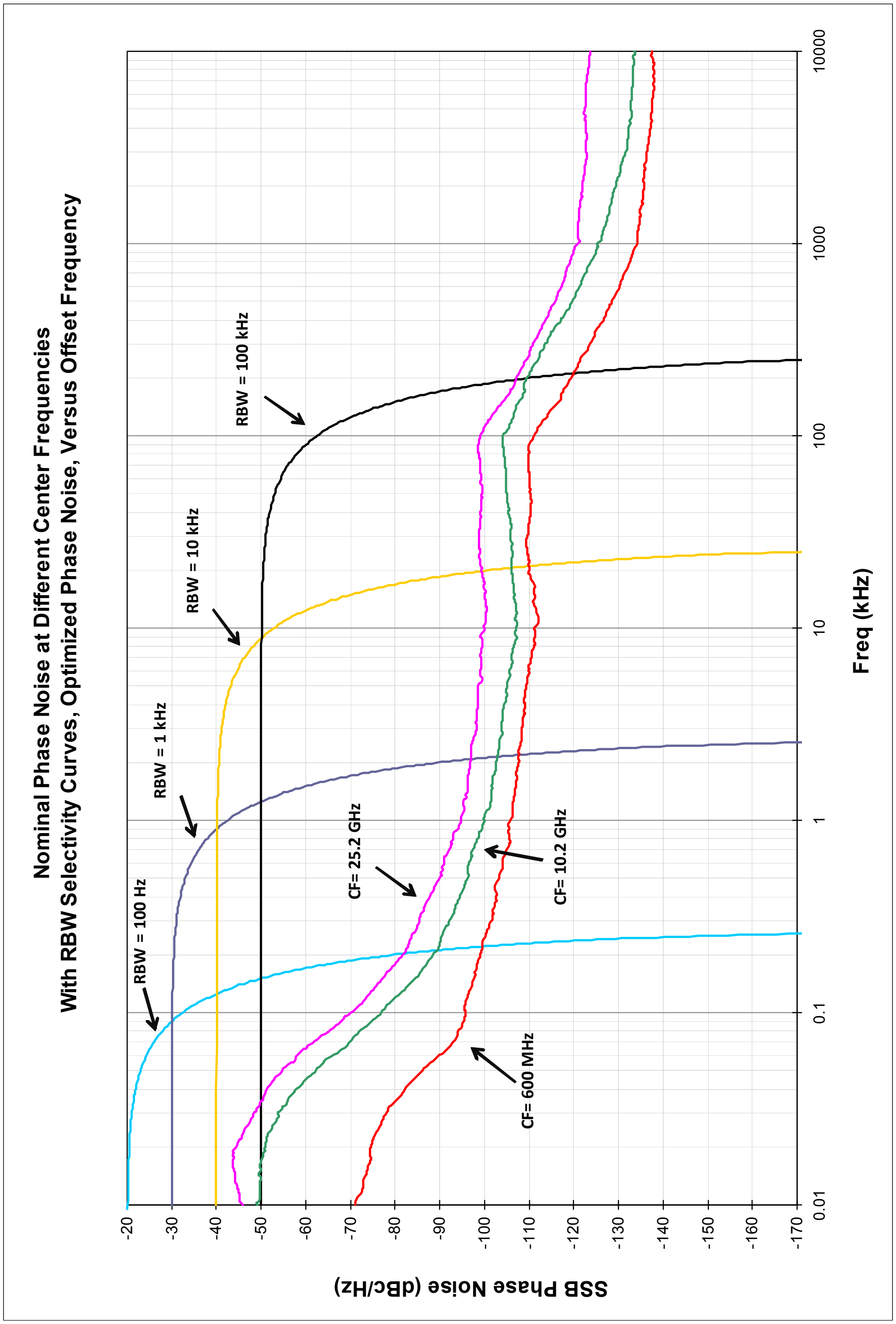
Description	Specifications		Supplemental Information
Phase Noise			Noise Sidebands
(Center Frequency = 1 GHz[a], Best-case Optimization[b] Internal Reference[c])	**20 to 30°C**	**Full range**	**Typical**
1 kHz	–98 dBc/Hz	–97 dBc/Hz	–103 dBc/Hz
10 kHz	–106 dBc/Hz	–105 dBc/Hz	–110 dBc/Hz
100 kHz	–108 dBc/Hz	–107 dBc/Hz	–110 dBc/Hz
1 MHz	–130 dBc/Hz	–129 dBc/Hz	–130 dBc/Hz
10 MHz			–145 dBc/Hz (nominal)

a. The nominal performance of the phase noise at center frequencies different than the one at which the specifications apply (1 GHz) depends on the center frequency, band and the offset. For low offset frequencies, offsets well under 100 Hz, the phase noise increases by $20 \times \log[(f + 0.3225)/1.3225]$. 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 11; f is in GHz units in all these relationships; all increases are in units of decibels.

b. Noise sidebands for lower offset frequencies, for example, 10 kHz, apply with the phase noise optimization (**PhNoise Opt**) set to **Best Close-in ϕ Noise**. Noise sidebands for higher offset frequencies, for example, 1 MHz, as shown apply with the phase noise optimization set to **Best Wide-offset ϕ Noise**.

c. Specifications are given with the internal frequency reference. The phase noise at offsets below 100 Hz is impacted or dominated by noise from the reference. Thus, performance with external references will not follow the curves and specifications. The internal 10 MHz reference phase noise is about –120 dBc/Hz at 10 Hz offset; external references with poorer phase noise than this will cause poorer performance than shown.

Nominal Phase Noise at Different Center Frequencies



Power Suite Measurements

Description	Specifications	Supplemental Information
Channel Power		
Amplitude Accuracy		Amplitude Accuracy[a] + Power Bandwidth Accuracy[bc]
Case: Radio Std = 3GPP W-CDMA, or IS-95		
Absolute Power Accuracy (20 to 30°C, Attenuation = 10 dB)	±1.33 dB	±0.61 dB (95th percentile)

a. See "Absolute Amplitude Accuracy" on page 23.
b. See "Power Bandwidth Accuracy" on page 18.
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[cd]
Accuracy of Carrier Power (dBm), or Carrier Power PSD (dBm/Hz)		Absolute Amplitude Accuracy + Power Bandwidth Accuracy[cd]
Passband width[e]	–3 dB	
Case: Radio Std = 3GPP W-CDMA		(ACPR; ACLR)[f]
Minimum power at RF Input		–36 dBm (nominal)
ACPR Accuracy[g]		RRC weighted, 3.84 MHz noise bandwidth, method = IBW or Fast[h]
Radio / **Offset Freq**		
MS (UE) / 5 MHz	±0.76 dB	At ACPR range of –30 to –36 dBc with optimum mixer level[i]
MS (UE) / 10 MHz	±0.73 dB	At ACPR range of –40 to –46 dBc with optimum mixer level[j]
BTS / 5 MHz	±1.72 dB[h]	At ACPR range of –42 to –48 dBc with optimum mixer level[k]
BTS / 10 MHz	±1.96 dB	At ACPR range of –47 to –53 dBc with optimum mixer level[j]
BTS / 5 MHz	±0.87 dB	At –48 dBc non-coherent ACPR[l]
Dynamic Range		RRC weighted, 3.84 MHz noise bandwidth

Noise Correction	Offset Freq	*Option 503*, or *507*	*Option 513*, or *526*	Specifications	**ACLR** (typical)[m]
Off	5 MHz	x			–63.0 dB
Off	5 MHz		x		–66.0 dB
Off	10 MHz	x			–67.0 dB
Off	10 MHz		x		–69.0 dB
On	5 MHz	x	x		–73.0 dB
On	10 MHz	x	x		–78.0 dB

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 –20 dBm, so the input attenuation must be set as close as possible to the average input power – (–20 dBm). For example, if the average input power is –6 dBm, set the attenuation to 14 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 –10 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 –18 dBm, so the input attenuation must be set as close as possible to the average input power – (–18 dBm). For example, if the average input power is –5 dBm, set the attenuation to 13 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 –13 dBm.
m. Keysight 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, Keysight 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 Keysight 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.

Description	Specifications	Supplemental Information
Case: Radio Std = IS-95 or J-STD-008		
Method		RBW method[a]
ACPR Relative Accuracy		
Offsets < 750 kHz[b]	±0.19 dB	
Offsets > 1.98 MHz[c]	±0.2 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 cdmaOne 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.

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	
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[a], relative (RBW=1MHz) (1 to 2.7 GHz)	70.7 dB	75.9 dB (typical)
Sensitivity[b], absolute (RBW=1 MHz) (1 to 2.9 GHz)	–76.5 dBm	–82.5 dBm (typical)
Accuracy		Attenuation = 10 dB
100 kHz to 3.0 GHz		±0.81 dB (95th percentile)
3.0 to 7.5 GHz		±1.80 dB (95th percentile)

a. The dynamic is specified at 12.5 MHz offset from center frequency with the mixer level of 1 dB of compression point, which will degrade accuracy 1 dB.
b. The sensitivity is specified at far offset from carrier, where phase noise does not contribute. You can derive the dynamic range at far offset 1 dB compression mixer level and sensitivity.

Description	Specifications	Supplemental Information
Spectrum Emission Mask		Table-driven spurious signals; measurement near carriers
Case: Radio Std = cdma2000		
Dynamic Range, relative (750 kHz offset[ab])	67.4 dB	72.7 dB (typical)
Sensitivity, absolute (750 kHz offset[c])	–93.7 dBm	–99.7 dBm (typical)
Accuracy (750 kHz offset)		
Relative[d]	±0.11 dB	

Description	Specifications	Supplemental Information
Absolute[e] (20 to 30°C)	±1.53 dB	±0.65 dB (95th percentile)
Case: Radio Std = 3GPP W-CDMA		
Dynamic Range, relative (2.515 MHz offset[ad])	73.4 dB	80.2 dB (typical)
Sensitivity, absolute (2.515 MHz offset[c])	–91.7 dBm	–97.7 dBm (typical)
Accuracy (2.515 MHz offset)		
Relative[d]	±0.11 dB	
Absolute[e] (20 to 30°C)	±1.53 dB	±0.65 dB (95th percentile)

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 offset s 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 "Amplitude Accuracy and Range" on page 20 for more information. The numbers shown are for 0 to 3.0 GHz, with attenuation set to 10 dB.

Options

The following options and applications affect instrument specifications.

Option 503:	Frequency range, 9 kHz to 3 GHz
Option 507:	Frequency range, 9 kHz to 7.5 GHz
Option 513:	Frequency range, 9 kHz to 13.6 GHz
Option 526:	Frequency range, 9 kHz to 26.5 GHz
Option P03:	Preamplifier, 3 GHz
Option P07:	Preamplifier, 7.5 GHz
Option P13:	Preamplifier, 13.6 GHz
Option P26:	Preamplifier, 26.5 GHz
Option T03:	Tracking Generator, 3 GHz
Option T06:	Tracking Generator, 6 GHz
Option B25:	Analysis Bandwidth, 25 MHz
Option PFR:	Precision Frequency Reference
Option ESC:	External Source Control
Option EMC:	Basic EMC Functionality
Option FSA:	Fine Step Attenuator
Option C75:	Connector Front, 75 Ohm Additional RF Input, 1.5 GHz
Option CR3:	Connector Rear, Second IF Out
Option SSD:	Additional Removable Solid State Drive
N9063C:	Analog Demodulation measurement application
N9068C:	Phase Noise measurement application
N9069C:	Noise Figure measurement application
N9073C:	W-CDMA/HSPA/HSPA+ measurement application
N9080C:	LTE-FDD measurement application
N9082C:	LTE-TDD measurement application

General

Description	Specifications	Supplemental Information
Calibration Cycle	1 year	

Description	Specifications	Supplemental Information
Temperature Range		
Operating	0 to 55°C	Standard
Storage	–40 to 70°C	
Altitude	3000 meters (approx. 10,000 feet)	
Humidity		
Relative Humidity		Type tested at 95%, +40°C (non-condensing)

Description	Specifications	Supplemental Information
Environmental and Military Specifications		Samples of this product have been type tested in accordance with the Keysight Environmental Test Manual and verified to be robust against the environmental stresses of Storage, Transportation and End-use; those stresses include but are not limited to temperature, humidity, shock, vibration, altitude and power line conditions. Test methods are aligned with IEC 60068-2 and levels are similar to MIL-PRF-28800F Class 3.

Description	Specifications
EMC	Complies with the essential requirements of the European EMC Directive as well as current editions of the following standards (dates and editions are cited in the Declaration of Conformity): – IEC/EN 61326-1 or IEC/EN 61326-2-1 – CISPR 11, Group 1, Class A – AS/NZS CISPR 11 – ICES/NMB-001 This ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB-001 du Canada.

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

Description	Specifications	Supplemental Information
Acoustic Noise-Further Information		Values given are per ISO 7779 standard in the "Operator Sitting" position
Ambient Temperature		
< 40°C		Nominally under 55 dBA Sound Pressure. 55 dBA is generally considered suitable for use in quiet office environments.
≥ 40°C		Nominally under 65 dBA Sound Pressure. 65 dBA is generally considered suitable for use in noisy office environments. (The fan speed, and thus the noise level, increases with increasing ambient temperature.)

Description	Specifications
Safety	Complies with European Low Voltage Directive 2006/95/EC – IEC/EN 61010-1 2nd Edition – Canada: CSA C22.2 No. 61010-1 – USA: UL 61010-1 2nd Edition1

Description	Specification	Supplemental Information
Power Requirements		
Low Range		
Voltage	100/120 Vac	
Frequency	50/60/400 Hz	
High Range		
Voltage	220/240 Vac	
Frequency	50/60 Hz	
Power Consumption, On	270 W	Fully loaded with options
Power Consumption, Standby	20 W	Standby power is not supplied to frequency reference oscillator.

Description	Specifications	Supplemental Information
Display[a]		
Resolution	1280 × 768	XGA
Size	1280× 768	269 mm (10.6 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	

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

Description	Supplemental Information
Measurement Speed[a]	Nominal
Local measurement and display update rate[bc]	11 ms (90/s)
Remote measurement and LAN transfer rate[bc]	6 ms (167/s)
Marker Peak Search	5 ms
Center Frequency Tune and Transfer	22 ms
Measurement/Mode Switching	75 ms

a. Sweep Points = 101
b. Factory preset, fixed center frequency, RBW = 1 MHz, and span >10 MHz and ≤ 600 MHz, Auto Align Off.
c. Phase Noise Optimization set to Fast Tuning, Display Off, 32 bit integer format, markers Off, single sweep, Keysight 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
Data Storage		
Standard		
Internal Total		Removable solid state drive (≥ 80 GB)
Internal User		≥ 9 GB available for user data.

Description	Specifications	Supplemental Information
Weight		Weight without options
Net		15.4 kg (34.0 lbs) (nominal)
Shipping		27.4 kg (60.4 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		50Ω (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 Host Ports		See Rear Panel for other ports
Host (3 ports)		
Connector	USB Type "A" (female)	
Output Current		
Port marked with lightning bolt		1.2 A (nominal)
Port not marked with lightning bolt	0.5 A	

Description	Specifications	Supplemental Information
Headphone Jack		
Connector		3.5 mm (1/8 inch) miniature stereo audio jack
Output Power		90 mW per channel into 16Ω (nominal)

Rear Panel

Description	Specifications	Supplemental Information
10 MHz Out		
Connector	BNC female	
Impedance		50Ω (nominal)
Output Amplitude		≥ 0 dBm (nominal)
Frequency	10 MHz × (1 + 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		50Ω (nominal)
Input Amplitude Range		–5 to +10 dBm (nominal)
Input Frequency		10 MHz (nominal) (Selectable to 1 Hz resolution)
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		
(Trigger 1 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)		
Connector	BNC female	
Impedance		50Ω (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	1280 × 768	

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

Description	Specifications	Supplemental Information
SNS Series Noise Source		For use with Keysight Technologies SNS Series noise sources

Description	Specifications	Supplemental Information
Analog Out		
Connector	BNC female	
Impedance		50Ω (nominal)

Description	Specifications	Supplemental Information
USB Ports		See Front Panel for additional ports
Host, super speed		2 ports (stacked with each other)
Connector	USB Type “A” (female)	Compatible with USB 3.0
Output Current		0.9 A (nominal)
Host		1 ports (stacked with LAN)
Standard	USB 2.0	
Connector	USB Type “A” (female)	
Output Current		0.5 A (nominal)
Device		Compatible with USB 3.0
Connector	USB Type “B” (female)	

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
Mode		Controller or device

Description	Specifications	Supplemental Information
LAN TCP/IP Interface	RJ45 Ethertwist	1000BaseT

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 Keysight office, or see for more http://www.keysight.com/environment/product/index.shtml information.
	Indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.
	This equipment is Class A suitable for professional use and is for use in electromagnetic environments outside of the home. To return unwanted products, contact your local Agilent office, or see http://www.keysight.com/environment/product/ 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 Keysight Technologies sales representative.

2 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	The "Spurious Response" on page 31 of core specifications still apply. Additional bandwidth-option-dependent spurious responses are given in the Analysis Bandwidth chapter for any optional bandwidths in use.
IF Amplitude Flatness	See "IF Frequency Response" on page 22 of the core specifications for the 10 MHz bandwidth. Specifications for wider bandwidths are given in the Analysis Bandwidth chapter for any optional bandwidths in use.
IF Phase Linearity	See "IF Frequency Response" on page 22 of the core specifications for the 10 MHz bandwidth. Specifications for wider bandwidths are given in the Analysis Bandwidth chapter for any optional bandwidths in use.
Data Acquisition	See "Data Acquisition" on page 57 in this chapter for the 10 MHz bandwidth. Specifications for wider bandwidths are given in the Analysis Bandwidth chapter for any optional bandwidths in use.

Frequency

Description	Specifications	Supplemental Information
Frequency Span Standard instrument *Option B25*	 10 Hz to 10 MHz 10 Hz to 25 MHz	
Resolution Bandwidth (Spectrum Measurement)		
Range		
Overall	100 mHz 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)		
Standard instrument *Option B25*	10 Hz to 10 MHz 10 Hz to 25 MHz	

Clipping-to-Noise Dynamic Range

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		–12 dBm (nominal)
IF Gain = High		–22 dBm (nominal)
Noise Density at Mixer at center frequency[b]	DANL[c] + 2.25 dB[d]	

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 30.
d. 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.

Data Acquisition

Description	Specifications	Supplemental Information
Time Record Length		
Complex Spectrum	131,072 samples (max)	Res BW = 540 Hz for 10 MHz (standard) span
Waveform	4,000,000 samples (max)	4,000,000 samples ≈ 335 ms at 10 MHz span
Sample Rate		30 MSa/s for 10 MHz (standard) span
ADC Resolution	14 Bits	10 MHz (standard) span

3 Option CR3 - Connector Rear, Second IF Output

This chapter contains specifications for the CXA Signal Analyzer Option CR3, Second IF Output.

This option is only available for Frequency Option 503 or 507.

Specifications Affected by Connector Rear, Second IF Output

No other analyzer specifications are affected by the presence or use of this option. New specifications are given in the following page.

Other Connector Rear, Second IF Output Specifications

Second IF Out Port

Description	Specifications	Supplemental Information
Connector	SMA female	
Impedance		50 Ω (nominal)

Second IF Out

Description	Specifications	Supplemental Information
Second IF Out		
Output Center Frequency		322.5 MHz
Conversion Gain at 2nd IF output center frequency		-4 to +7 dB (nominal) plus RF frequency response[a]
Bandwidth		
Low band		Up to 120 MHz (nominal) at −6 dB
High band		Up to 40 MHz (nominal) at −6 dB
Residual Output Signals		-60 dBm or lower (nominal)[b]

a. "Conversion Gain" is defined from RF input to IF Output with 0 dB attenuation. The nominal performance applies with zero span.

b. Measured from 262.5 to 382.5 MHz for low band or 302.5 to 342.5 MHz for high band.

4 Option C75 - Connector Front, 75 Ohm Additional RF Input, 1.5 GHz

This chapter contains the specifications for Option C75, Connector Front, 75Ω Additional RF Input, 1.5 GHz.

This option is only available for Frequency Option 503 or 507.

Specifications Affected by Connector, 75 Ohm Additional RF Input, 1.5 GHz

Description	Specifications	Supplemental Information
Maximum Safe Input Level		
Average continuous power or peak pulse power		
(Input attenuation ≥ 20 dB) Preamp Off Preamp On *(Option P03, P07)*	 +72.5 dBmV (0.25 W) +63 dBmV (25 mW)	
DC voltage		
AC Coupled	±50 Vdc	

Description	Specifications	Supplemental Information	
Second Harmonic Distortion		**Distortion** (nominal)	**SHI**[a] (nominal)
(Source frequency, 10 to 750 MHz, input attenuation 10 dB)			
Preamp Off		–76.25 dBc	+95 dBmV
(Input level = +28.75 dBmV)			
Preamp On *(Option P03, P07)*		–64.25 dBc	+63 dBmV
(Input level = +8.75 dBmV)			

a. 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.

Description	Specifications	Supplemental Information
Third Order Intermodulation		**Intercept**
Preamp Off (10 MHz to 1.5 GHz, two +28.75 dBmV tones at the input, spaced by 100 kHz, input attenuation 0 dB)		+62 dBmV (nominal)
Preamp On *(Option P03, P07)* (10 MHz to 1.5 GHz, two +3.75 dBmV tones at the input, spaced by 100 kHz, input attenuation 0 dB)		+40 dBmV (nominal)

Description	Specifications	Supplemental Information
RF Input VSWR		**nominal**[a]
10 dB attenuation, 50 MHz		1.1:1
Frequency		**Input Attenuation**
Preamp Off		**10 dB**
1 MHz to 1.5 GHz		< 1.4:1
Preamp On *(Option P03, P07)*		**0 dB**
1 MHz to 1.5 GHz		< 1.4:1

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

Description	Specifications	Supplemental Information
Frequency Response (Maximum error relateive to reference condition (50 MHz), input attenuation 10 dB)		
1 to 10 MHz		±0.6 dB (nominal)
10 MHz to 1.5 GHz		±0.75 dB (nominal)

Description	Specifications	Supplemental Information
1 dB Gain Compression Point (two tone)[abc]		Maximum power at mixer[d]
Preamp Off		
50 MHz to 1.5 GHz		+57 dBmV (nominal)
Preamp On *(Option P03, P07)*		
50 MHz to 1.5 GHz		+35 dBmV (nominal)

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 1 MHz tone spacing.
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. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).

Description	Specifications	Supplemental Information
Displayed Average Noise Level (DANL)[a]	Input terminated Sample or Average detector, Average type = Log 0 dB attenuation IF Gain = High 1 Hz Resolution Bandwidth	
Preamp Off		
1 to 10 MHz		–89 dBmV (nominal)
10 MHz to 1.5 GHz		–97 dBmV (nominal)
Preamp On *(Option P03, P07)*		
1 to 10 MHz		–108 dBmV(nominal)
10 MHz to 1.5 GHz		–113 dBmV(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.

Other Connector, 75 Ohm Additional RF Input, 1.5 GHz Specifications

Description	Specifications	Supplemental Information
Frequency Range		
Option C75	1 MHz to 1.5 GHz	

Description	Specifications	Supplemental Information
RF Input 2		
Connector		
Standard	Type-N female	
Impedance		75Ω (nominal)

5 Option EMC - Precompliance EMI Features

This chapter contains specifications for the *Option EMC* precompliance EMI feature.

Frequency

Description	Specifications	Supplemental information
Frequency Range		9 kHz to 3.0, 7.5, 13.6, 26.5 GHz depending on the frequency options.
EMI Resolution Bandwidths		See Table 5-1and Table 5-2
CISPR		Available when the EMC Standard is CISPR
200 Hz, 9 kHz, 120 kHz, 1 MHz		–6 dB bandwidths, subject to masks; as specified by CISPR 16-1-1
Non-CISPR bandwidths	10, 30, 100, 300 Hz, 1, 3, 30, 300 kHz, 3, 10 MHz	–6 dB bandwidths
MIL STD		Available when the EMC Standard is MIL
10, 100 Hz, 1, 10, 100 kHz, 1 MHz		–6 dB bandwidths; as specified by MIL-STD-461
Non-MIL STD bandwidths	30, 300 Hz, 3, 30, 300 kHz, 3, 10 MHz	–6 dB bandwidths

Table 5-1 CISPR Band Settings

CISPR Band	Frequency Range	CISPR RBW	Default Data Points
Band A	9 – 150 kHz	200 Hz	1413
Band B	150 kHz – 30 MHz	9 kHz	6637
Band C	30 – 300 MHz	120 kHz	4503
Band D	300 MHz – 1 GHz	120 kHz	11671
Band C/D	30 MHz – 1 GHz	120 kHz	16171
Band E	1 – 18 GHz	1 MHz	34001

Table 5-2 MIL-STD 461D/E/F Frequency Ranges and Bandwidths

Frequency Range	6 dB Bandwidth	Minimum Measurement Time
30 Hz to 1 kHz	10 Hz	0.015 s/Hz
1 kHz to 10 kHz	100 Hz	0.15 s/kHz
10 kHz to 150 kHz	1 kHz	0.015 s/kHz
150 kHz to 30 MHz	10 kHz	1.5 s/MHz
30 MHz to 1 GHz	100 kHz	0.15 s/MHz
Above 1 GHz	1 MHz	15 s/GHz

Amplitude

Description	Specifications	Supplemental Information
EMI Average Detector		Used for CISPR-compliant average measurements and, with 1 MHz RBW, for frequencies above 1 GHz
Default Average Type		All filtering is done on the linear (voltage) scale even when the display scale is log.
Quasi-Peak Detector		Used with CISPR-compliant RBWs, for frequencies ≤ 1 GHz
Absolute Amplitude Accuracy for reference spectral intensities		As specified by CISPR 16-1-1
Relative amplitude accuracy versus pulse repetition rate		As specified by CISPR 16-1-1
Quasi-Peak to average response ratio		As specified by CISPR 16-1-1
RMS Average Detector		As specified by CISPR 16-1-1

6 Option B25 (25 MHz) - Analysis Bandwidth

This chapter contains specifications for the Option B25 (25 MHz) Analysis Bandwidth, and are unique to this IF Path.

Specifications Affected by Analysis Bandwidth

The specifications in this chapter apply when the 25 MHz path is in use. In IQ Analyzer, this will occur when the IF Path is set to 25 MHz, whether by Auto selection (depending on Span) or manually.

Specification Name	Information
IF Frequency Response	See specifications in this chapter.
IF Phase Linearity	See specifications in this chapter.
Spurious and Residual Responses	The "Spurious Response" on page 31 still apply. Further, bandwidth-option-dependent spurious responses are contained within this chapter.
Displayed Average Noise Level, Third-Order Intermodulation and Phase Noise	The performance of the analyzer will degrade by an unspecified extent when using this bandwidth option. This extent is not substantial enough to justify statistical process control.

Other Analysis Bandwidth Specifications

Description				Specification	Supplemental Information
IF Spurious Response[a]					Preamp Off[b]
IF Second Harmonic					
Apparent Freq	**Excitation Freq**	**Mixer Level**[c]	**IF Gain**		
Any on-screen f	$(f + f_c + 22.5)/2$	–15 dBm	Low		–50 dBc (nominal)
		–25 dBm	High		–50 dBc (nominal)
IF Conversion Image					
Apparent Freq	**Excitation Freq**	**Mixer Level**[c]	**IF Gain**		
Any on-screen f	$2 \times f_c - f + 45$ MHz	–10 dBm	Low		–68 dBc (nominal)
		–20 dBm	High		–68 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. 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. Mixer Level = Input Level - Input Attenuation.

Description		Specifications	Supplemental Information		
IF Frequency Response[a] (Demodulation and FFT response relative to the center frequency)			Modes above 18 GHz[b]		
Center Freq (GHz)	**Analysis Width** (MHz)	**Max Error**[c] (Exceptions[d])	**Midwidth Error** (95th Percentile)	**Slope** (dB/MHz) (95th Percentile)	**RMS**[e] (nominal)
≤3.0	10 to ≤25	±0.45 dB	±0.15 dB	±0.1	0.03 dB
>3.0, ≤26.5	10 to ≤25				0.65 dB

a. The IF frequency response includes effects due to RF circuits such as input filters, that are a function of RF frequency, in addition to the IF pass-band effects.

b. Signal frequencies between 18 and 26.5 GHz are prone to additional response errors due to modes in the Type-N connector used with frequency Option 526. With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. These modes cause nominally up to –0.35 dB amplitude change, with phase errors of nominally up to ±1.2°.

c. The maximum error at an offset (f) from the center of the FFT width is given by the expression ± [Midwidth Error + (f × Slope)], but never exceeds ±Max Error. Usually, the span is no larger than the FFT width in which case the center of the FFT width is the center frequency of the analyzer. When the analyzer span is wider than the FFT width, the span is made up of multiple concatenated FFT results, and thus has multiple centers of FFT widths so the f in the equation is the offset from the nearest center. These specifications include the effect of RF frequency response as well as IF frequency response at the worst case center frequency. Performance is nominally three times better than the maximum error at most center frequencies.

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

e. The "RMS" nominal performance is the standard deviation of the response relative to the center frequency, integrated across a 10 MHz span. This performance measure was observed at a single center frequency in each harmonic mixing band, which is representative of all center frequencies; the observation center frequency is not the worst case center frequency.

Description		Specifications	Supplemental Information	
IF Phase Linearity			Deviation from mean phase linearity Modes above 18 GHz[a]	
Center Freq (GHz)	**Span** (MHz)		**Peak-to-Peak** (nominal)	**RMS** (nominal)[b]
≥0.02, ≤ 3.0	10 to ≤25		2.7°	0.9°
>3.0, ≤ 7.5	10 to ≤25		4.7°	2.2°
>7.5, ≤ 26.5	10 to ≤25		3.5°	1.0°

a. Signal frequencies between 18 and 26.5 GHz are prone to additional response errors due to modes in the Type-N connector used with frequency Option 526. With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. These modes cause nominally up to –0.35 dB amplitude change, with phase errors of nominally up to ±1.2°.

b. The listed performance is the standard deviation of the phase deviation relative to the mean phase deviation from a linear phase condition, where the RMS is computed across the span shown.

Description	Specifications	Supplemental Information
Full Scale (ADC Clipping)[a]		
Default settings, signal at CF		
(IF Gain = Low)		
Band 0		–7 dBm mixer level[b] (nominal)
Band 1 through 4		–6 dBm mixer level[b] (nominal)
High Gain setting, signal at CF (IF Gain = High)		
Band 0		–17 dBm mixer level[b] (nominal), subject to gain limitations[c]
Band 1 through 4		–15 dBm mixer level[b] (nominal), subject to gain limitations[c]
Effect of signal frequency ≠ CF		Up to ±3 dB (nominal)

a. This table is meant to help predict the full-scale level, defined as the signal level for which ADC overload (clipping) occurs. The prediction is imperfect, but can serve as a starting point for finding that level experimentally. A SCPI command is also available for that purpose.

b. Mixer level is signal level minus input attenuation.

c. The available gain to reach the predicted mixer level will vary with center frequency. Combinations of high gains and high frequencies will not achieve the gain required, increasing the full scale level.

Data Acquisition

Description	Specifications	Supplemental Information
Time Record Length		
Complex Spectrum	131,072 samples (max)	ResBW ≈ 1.3 kHz for 25 MHz span
Waveform	4,000,000 samples (max)	4,000,000 samples ≈ 88.89 ms at 25 MHz span
Sample Rate	100 MSa/s (ADC Samples)	90 MSa/s (IF Samples)
ADC Resolution	14 bits	

7 Option P03, P07, P13 and P26 - Preamplifiers

This chapter contains specifications for the CXA Signal Analyzer *Options P03, P07, P13* and *P26* preamplifiers.

Specifications Affected by Preamp

Specification Name	Information
Frequency Range	See "Frequency Range" on page 11 of the core specifications.
Nominal Dynamic Range vs. Offset Frequency vs. RBW	The graphic from the core specifications does not apply with Preamp On.
Measurement Range	The measurement range depends on DANL. See "Measurement Range" on page 20 of the core specifications.
Gain Compression	See specifications in this chapter.
DANL	See specifications in this chapter.
Frequency Response	See specifications in this chapter.
RF Input VSWR	See plot in this chapter.
Absolute Amplitude Accuracy	See "Absolute Amplitude Accuracy" on page 23 of the core specifications.
Display Scale Fidelity	See "Display Scale Fidelity" on page 27 of the core specifications.
Second Harmonic Distortion	See "Second Harmonic Distortion" on page 32 of the core specifications.
Third Order Intermodulation Distortion	See "Third Order Intermodulation" on page 32 of the core specifications.
Gain	See specifications in this chapter.

Other Preamp Specifications

Description	Specifications	Supplemental Information
Preamplifier *(Option P03, P07, P13, P26)*		
Gain 100 kHz to 26.5 GHz		Maximum +20 dB (nominal)
Noise figure 100 kHz to 26.5 GHz		Noise Figure is DANL + 176.24 dB (nominal)[a] Note on DC coupling[b]

a. 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 (Refer to page 83 for DANL with Preamp),
K is kTB (.173.98 dBm 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.

b. 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.

Description	Specifications	Supplemental Information
Maximum Safe Input Level – Preamp On		
Average Total Power (input attenuation ≥ 20 dB)	+10 dBm (10 mW)	*Option P03/P07*
Average Total Power (input attenuation ≥ 20 dB)	+30 dBm (1 W)	*Option P13/P26*

Description	Specifications	Supplemental Information
1 dB Gain Compression Point (Two-tone)[a][b][c]		
(Preamp On *(Option P03, P07, P13, P26)* Maximum power at the preamp[d] for 1 dB gain compression)		
50 MHz to 7.5 GHz (*Option P03, P07, P13, P26*)		−19 dBm (nominal)
7.5 to 26.5 GHz (*Option P13, P26*)		−19 dBm (nominal)

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 1 MHz tone spacing.

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

Description	Option 503 or 507	Option 513 or 526	Specifications 20 to 30°C	Specifications Full range	Supplemental Information
Displayed Average Noise Level (DANL) Preamp On[a]			Input terminated Sample or Average detector Averaging type = Log 0 dB input attenuation IF Gain = High 1 Hz Resolution Bandwidth		Refer to the footnote for "Band Overlaps" on page 11.
Option P03, P07, P13, P26			**20 to 30°C**	**Full range**	**Typical**
100 kHz to 1 MHz	x				–139dBm
100 kHz to 1 MHz		x			-144 dBm
1 to 10 MHz[b]	x		-149 dBm	-148 dBm	-157 dBm
1 to 10 MHz[c]		x	-153 dBm	-152 dBm	-158 dBm
10 MHz to 1.5 GHz	x		-161 dBm	-159 dBm	-163 dBm
10 MHz to 1.5 GHz		x	-160 dBm	-159 dBm	-163 dBm
1.5 to 2.2 GHz	x		-160 dBm	-159 dBm	-163 dBm
2.2 to 3 GHz	x		-158 dBm	-157 dBm	-161 dBm
1.5 to 3 GHz		x	-158 dBm	-157 dBm	-161 dBm
Option P07, P13, P26					
3 to 4.5 GHz	x		-155 dBm	-154 dBm	-159 dBm
4.5 to 6 GHz	x		-152 dBm	-150 dBm	-156 dBm
3 to 6 GHz		x	-158 dBm	-157 dBm	-161 dBm
6 to 7.5 GHz	x		-148 dBm	-146 dBm	-152 dBm
6 to 7.5 GHz		x	-155 dBm	-154 dBm	-160 dBm
Option P13, P26					
7.5 to 13.6 GHz		x	-155 dBm	-154 dBm	-160 dBm
Option P13, P26					
13.6 to 20 GHz		x	-153 dBm	-152 dBm	-157 dBm
20 to 24 GHz		x	-151 dBm	-149 dBm	-155 dBm
24 to 26.5 GHz		x	-142 dBm	-139 dBm	-147 dBm

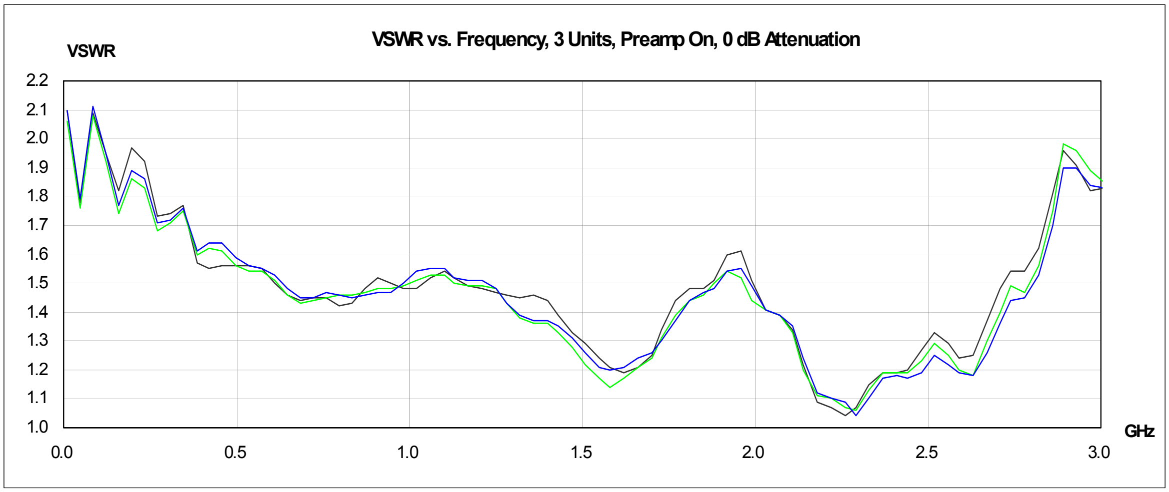
a. DANL for zero span and swept is measured in a 1 kHz RBW and normalized to the narrowest available RBW, because the noise figure does not depend on RBW and 1 kHz measurements are faster. Specificatons for 10 MHz to 3 GHz apply with AC coupled.
b. DANL below 10 MHz is affected by phase noise around the LO feedthrough signal.
c. DANL below 10 MHz is affected 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 Close-in f Noise" for frequencies below 25 kHz, and “Best Wide Offset f Noise" for frequencies above 85 kHz.

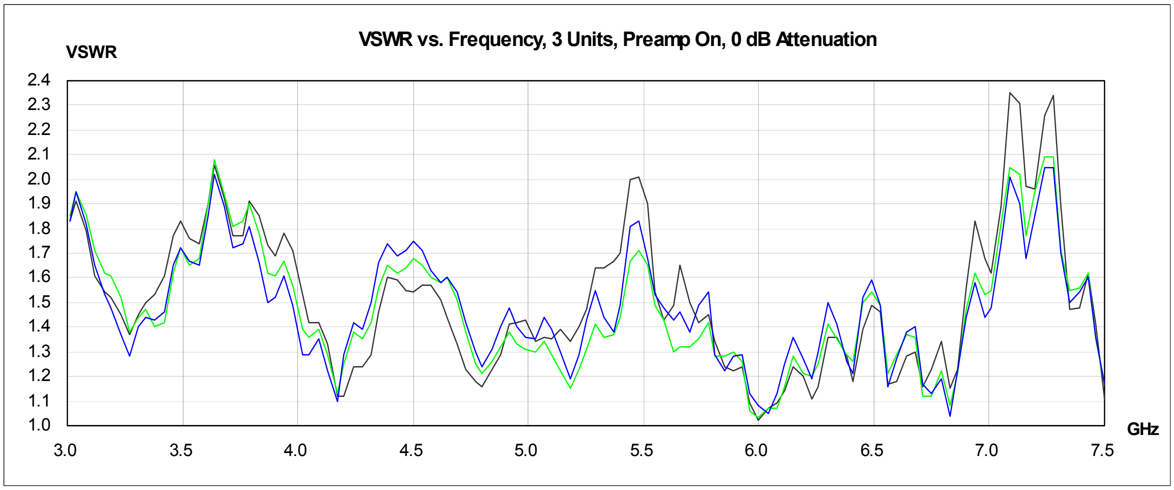
Description	Option 503 or 507	Option 513 or 526	Specifications	Supplemental Information
Frequency Response – Preamp On (Option P03, P07, P13, P26) (Maximum error relative to reference condition (50 MHz) Swept operation[a] Attenuation 0 dB)				
Option P03, P07, P13, P26				**95th Percentile**
100 kHz to 3 GHz	x	x		±0.7 dB
Option P07, P13, P26				
3 to 5.25 GHz	x			±0.85 dB
5.25 to 7.5 GHz	x			±1.35 dB
3 to 7.5 GHz		x		±1.0 dB
Option P13, P26				
7.5 to 13.6 GHz		x		±1.0 dB
Option P26				
13.6 to 19 GHz		x		±1.1 dB
19 to 26.5 GHz		x		±2.5 dB

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.

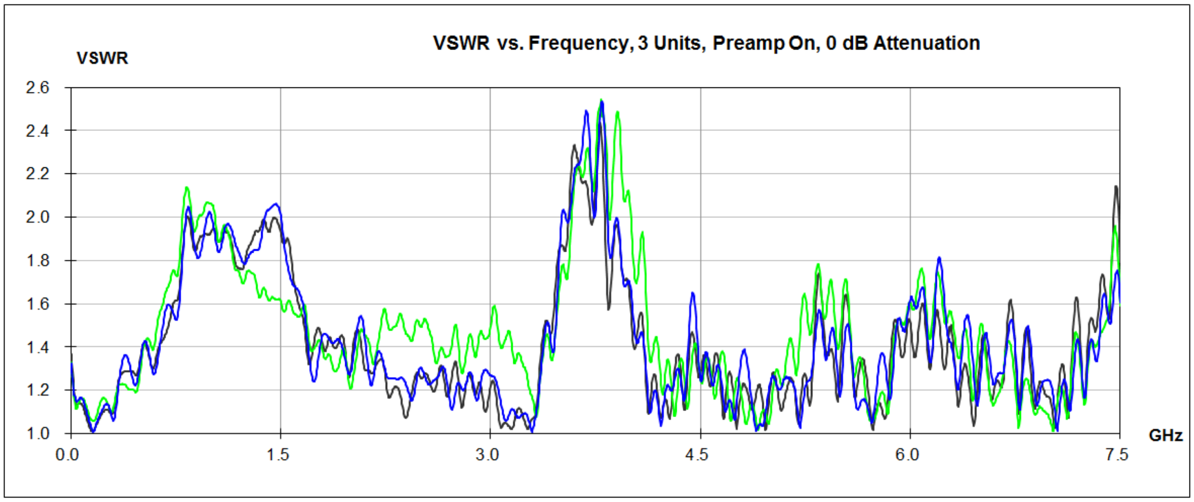
Description	Option 503 or 507	Option 513 or 526	Specifications	Supplemental Information
RF Input VSWR - Preamp On				
				Input Attenuation 0 dB
10 MHz to 3.0 GHz	x			< 2.2:1
10 MHz to 3.0 GHz		x		< 3:1
3.0 to 7.5 GHz	x			< 2.4:1
3.0 to 7.5 GHz		x		< 3:1
7.5 to 26.5 GHz		x		< 2.5:1

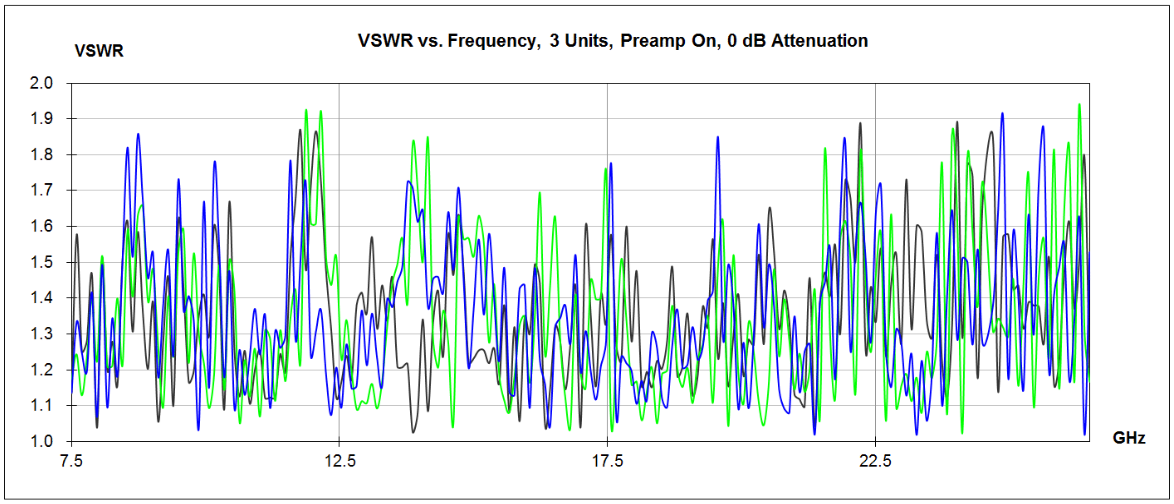
Nominal Instrument Input VSWR (Opton 503/507)





Nominal Instrument Input VSWR (Opton 513/526)





8 Options T03 and T06 - Tracking Generators

This chapter contains specifications for the CXA Signal Analyzer *Option T03* and *T06* tracking generators.

This option is only available for Frequency *Option 503* or *507*.

General Specifications

Description	Specifications	Supplemental Information
Output Frequency Range		
Option T03	9 kHz to 3 GHz	
Option T06	9 kHz to 6 GHz	

Description	Specifications	Supplemental Information
Frequency Resolution	1 Hz	

Description	Specifications		Supplemental Information
Output Power Level			
Range	–50 to 0 dBm		
Resolution	0.1 dB		
	20 to 30°C	**Full range**	
Absolute Accuracy (at 50 MHz, –10 dBm)	±0.55 dB	±0.70 dB	
Output Flatness (Referenced to 50 MHz, –10 dBm)			
9 kHz to 100 kHz	±1.5 dB	±2.5 dB	±1.2 dB (95th percentile)
100 kHz to 3.0 GHz	±1.2 dB	±1.5 dB	±0.8 dB (95th percentile)
3.0 GHz to 6.0 GHz	±1.5 dB	±2.5 dB	±1.2 dB (95th percentile)
Level Accuracy			
9 kHz to 100 kHz			±1.0 dB (Nominal)
100 kHz to 3.0 GHz			±0.5 dB (Nominal)
3.0 GHz to 6.0 GHz			±0.8 dB (Nominal)

Description	Specifications	Supplemental Information
Maximum Safe Reverse Level		
Average Total Power	+30 dBm (1 W)	
AC Coupled	±50 Vdc	

Description	Specifications	Supplemental Information
Output Power Sweep		
Range	–50 to 0 dBm	
Resolution	0.1 dB	
Accuracy (zero span)	<1.0 dB peak-to-peak	

Description	Specifications	Supplemental Information
Phase Noise		
Noise Sidebands (Center Frequency = 1 GHz[a] Internal Reference[b])		
Offset		**Nominal**
10 kHz		-102 dBc/Hz
100 kHz		-104 dBc/Hz
1 MHz		-117 dBc/Hz

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.
b. Specifications are given with the internal frequency reference.

Description	Specifications	Supplemental Information
Dynamic Range	Maximum Output Power Level – Displayed Average Noise Level	110 dBc[a] (nominal)

a. Center Frequency = 1 GHz, RBW = 1 kHz, 10 dB attenuation.

Description	Specifications	Supplemental Information
Spurious Outputs		
(0 dBm output)		
Harmonic Spurs		
9 kHz to 20 kHz		–15 dBc (nominal)
20 kHz to 100 kHz		–25 dBc (nominal)
100 kHz to 3 GHz	–35 dBc	
3 GHz to 6 GHz	–30 dBc	
Non-harmonic Spurs		
9 kHz to 10 MHz		–35 dBc (nominal)
10 MHz to 6 GHz	–35 dBc	

Description	Specifications	Supplemental Information
RF Power-Off Residuals		
100 kHz to 6 GHz		< –80 dBm (nominal)

Description	Specifications	Supplemental Information
Output VSWR		< 1.5:1 (nominal)

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

9 Option ESC - External Source Control

This chapter contains specifications for the *Option ESC*, External Source Control.

This option is only avaiable for Frequency *Option 503* or *507*.

KEYSIGHT TECHNOLOGIES

Frequency

Description	Specifications	Supplemental Information
Frequency Range		
SA Operating range	9 kHz to 3 GHz 9 kHz to 7.5 GHz	N9000B-503 N9000B-507
Source Operating range	9 kHz to 1 GHz 9 kHz to 3 GHz 9 kHz to 6 GHz 100 kHz to 3 GHz 100 kHz to 6 GHz	N5171B-501 N5171B/N5181B-503 N5171B/N5181B-506 N5181A/N5182A-503 N5181A/N5182A-506
Span Limitations Span limitations due to source range		Limited by the source and SA operating range
Offset Sweep Sweep offset setting range		Limited by the source and SA operating range
Sweep offset setting resolution	1 Hz	
Resolution Bandwidth		
Harmonic sweep setting range[a] Multiplier numerator Multiplier denominator		 N = 1 to 1000 N = 1 to 1000
Sweep Direction[b]		Normal, Reversed

a. Limited by the frequency range of the source to be controlled.
b. The analyzer always sweeps in a positive direction, but the source may be configured to sweep in the opposite direction. This can be useful for analyzing negative mixing products in a mixer under test, for example.

Description		Specification	Supplemental Information
Dynamic Range (10 MHz to 3 GHz, Input terminated, sample detector, average type = log, 20 to 30°C)			Dynamic Range = −10 dBm − DANL − 10×log(RBW)[a]
SA Span	**SA RBW**		
1 MHz	2 kHz	97.0 dB	
10 MHz	6.8 kHz	91.7 dB	
100 MHz	20 kHz	87.0 dB	
1000 MHz	68 kHz	81.7 dB	
Amplitude Accuracy			Multiple contributors[b] Linearity[c] Source and Analyzer Flatness[d] VSWR effects[e]

a. The dynamic range is given by this computation: −10 dBm − DANL − 10×log(RBW) where DANL is the displayed average noise level specification, normalized to 1 Hz RBW, and the RBW used in the measurement is in hertz units. The dynamic range can be increased by reducing the RBW at the expense of increased sweep time.
b. The following footnotes discuss the biggest contributors to amplitude accuracy.
c. One amplitude accuracy contributor is the linearity with which amplitude levels are detected by the analyzer. This is called "scale fidelity" by most spectrum analyzer users, and "dynamic amplitude accuracy" by most network analyzer users. This small term is documented in the Amplitude section of the Specifications Guide. It is negligibly small in most cases.
d. The amplitude accuracy versus frequency in the source and the analyzer can contribute to amplitude errors. This error source is eliminated when using normalization.
e. VSWR interaction effects, caused by RF reflections due to mismatches in impedance, are usually the dominant error source. These reflections can be minimized by using 10 dB or more attenuation in the analyzer, and using well-matched attenuators in the measurement configuration.

Description	Specification	Supplemental Information
Power sweep range		Limited by source amplitude range[a]

a. Relative to the original power level and limited by the source to be controlled.

Description	Specifications	Supplemental Information
Measurement Time (RBW setting of the SA determined by the default for Option ESC)		Nominal[a] **MXG,[b] Band 0**
201 Sweep points (default setting)		391 ms
601 Sweep points		1.1 s

a. These measurement times were observed with a span of 100 MHz, RBW of 20 kHz and the point triggering method being set to EXT TRIG1. The measurement times will not change significantly with span when the RBW is automatically selected. If the RBW is decreased, the sweep time increase would be approximately 23.8 times Npoints/RBW.
b. Based on MXG firmware version A.01.51.

Description	Specifications	Supplemental Information
Supported External Source		
Keysight EXG		N5171B (firmware B.01.01 or later) N5181B (firmware B.01.01 or later)
Keysight MXG		N5181A (firmware A.01.80 or later) N5182A (firmware A.01.80 or later) N5183A (firmware A.01.80 or later)
Keysight PSG		E8257D (firmware C.06.15 or later) E8267D (firmware C.06.15 or later)
IO interface connection between MXG and SA between PSG and SA		 LAN, GPIB, or USB LAN or GPIB

10 Options PFR - Precision Frequency Reference

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

Specifications Affected by Precision Frequency Reference

Specification Name	Information
Frequency Range	See "Precision Frequency Reference" on page 13 of the core specifications.

11 Analog Demodulation Measurement Application

This chapter contains specifications for the N9063C Analog Demodulation Measurement Application.

Additional Definitions and Requirements

The warranted specifications shown apply to Band 0 operation (up to 3.0 GHz), unless otherwise noted, for all analyzer's. The application functions, with nominal (non-warranted) performance, at any frequency within the frequency range set by the analyzer frequency options (see table). In practice, the lowest and highest frequency of operation may be further limited by AC coupling; by "folding" near 0 Hz; by DC feedthrough; and by Channel BW needed. Phase noise and residual FM generally increase in higher bands.

Warranted specifications shown apply when Channel BW ≤ 1 MHz, unless otherwise noted. (Channel BW is an important user-settable control.) The application functions, with nominal (non-warranted) performance, at any Channel BW up to the analyzer's bandwidth options (see table). The Channel BW required for a measurement depends on: the type of modulation (AM, FM, PM); the rate of modulation; the modulation depth or deviation; and the spectral contents (e.g. harmonics) of the modulating tone.

Many specs require that the Channel BW control is optimized; neither too narrow nor too wide.

Many warranted specifications (rate, distortion) apply only in the case of a single, sinusoidal modulating tone; without excessive harmonics, non-harmonics, spurs, or noise. Harmonics, which are included in most distortion results, are counted up to the 10th harmonic of the dominant tone, or as limited by SINAD BW or post-demod filters. Note that SINAD will include Carrier Frequency Error (the "DC term") in FM by default; it can be eliminated with a HPF or Auto Carrier Frequency feature.

Warranted specifications apply to results of the software application; the hardware demodulator driving the Analog Out line is described separately.

Warranted specifications apply over an operating temperature range of 20 to 30°C; and mixer level −24 to −18 dBm (mixer level = Input power level − Attenuation). Additional conditions are listed at the beginning of the FM, AM, and PM sections, in specification tables, or in footnotes.

Refer to the footnote for "Definitions of terms used in this chapter" on page 98.

Definitions of terms used in this chapter

Let P_{signal}(S)= Power of the signal; P_{noise}(N)=Power of the noise; $P_{distortion}$(D) = Power of the harmonic distortion (P_{H2} +P_{H3} + ... + P_{Hi} where H_i is the ith harmonic that counts up to the 10th harmonic); P_{total} = Total power of the signal, noise and distortion components.

Term	Short Hand	Definition
Distortion	$\frac{N+D}{S+N+D}$	$(P_{total}-P_{signal})^{1/2}/(P_{total})^{1/2}$ ×100%
THD	$\frac{D}{S}$	$(P_{total}-P_{signal})^{1/2}/(P_{total})^{1/2}$ × 100% Where THD is the total harmonic distortion
SINAD	$\frac{S+N+D}{N+D}$	$20 \times \log_{10} [1/(P_{distortion})]^{1/2} = 20 \times \log_{10} [(P_{total})^{1/2} / (P_{total} - P_{signal})1/2]$ Where SINAD is Signal-to-Noise-And-Distortion ratio
SNR	$\frac{S+N+D}{N}$	$P_{signal} / P_{noise} \sim (P_{signal} + P_{noise} + P_{distortion}) / P_{noise}$ Where SNR is the Signal-to-Noise Ratio. The approximation is per the implementations defined with the HP/Keysight 8903A.

NOTE

P_{Noise} must be limited to the bandwidth of the applied filters.

The harmonic sequence is limited to the 10th harmonic unless otherwise indicated. In practice, the term P_{noise} includes Spurs, IMD, Hum, etc. (All but harmonics.)

RF Carrier Frequency and Bandwidth

Description	Specifications	Supplemental Information
Carrier Frequency		
Maximum Frequency		
Option 503	3.0 GHz	RF/μW frequency option
Option 507	7.5 GHz	RF/μW frequency option
Option 513	13.6 GHz	RF/μW frequency option
Option 526	26.5 GHz	RF/μW frequency option
Minimum Frequency		
Option 503, 507	9 kHz	
Option 513, 526		
AC Coupled	10 MHz	
DC Coupled	9 kHz	In practice, limited by the need to keep modulation sidebands from folding, and by the interference from LO feedthrough.
Maximum Infromation Bandwidth (Info BW)[a]		
Standard	8 MHz	
Option B25	25 MHz	
Capture Memory *(sample rate* demod time)*	3.6 MSa	Each sample is an I/Q pair. See note [b]

a. The maximum InfoBW indicates the maximum operational BW, which depends on the analysis BW option equipped with the analyzer. However, the demodulation specifications only apply to the BW indicated in the following sections.

b. Sample rate is set indirectly by the user, with the Span and Channel BW controls (viewed in RF Spec- trum). The Info BW (also called Demodulation BW) is based on the larger of the two; specifically, InfoBW = max [Span, Channel BW]. The sample interval is 1/(1.25 × Info BW); e.g. if InfoBW = 200 kHz, then sample interval is 4 us. The sample rate is 1.25 × InfoBW, or 1.25 × max [Span, Channel BW]. These values are approximate, to estimate memory usage. Exact values can be queried via SCPI while the application is running.
Demod Time is a user setting. Generally, it should be 3- to 5-times the period of the lowest-frequency modulating tone.

Post-Demodulation

Description	Specifications	Supplemental Information
Maximum Audio Frequency Span		1/2 × Channel BW
Filters		
High Pass	20 Hz	2-Pole Butterworth
	50 Hz	2-Pole Butterworth
	300 Hz	2-Pole Butterworth
	400 Hz	10-Pole Butterworth; used to attenuate sub-audible signaling tones
Low Pass	300 Hz	5-Pole Butterworth
	3 kHz	5-Pole Butterworth
	15 kHz	5-Pole Butterworth
	30 kHz	3-Pole Butterworth
	80 kHz	3-Pole Butterworth
	300 kHz	3-Pole Butterworth
	100 kHz (> 20 kHz Bessel)	9-Pole Bessel; provides linear phase response to reduce distortion of square-wave modulation, such as FSK or BPSK
	Manual	Manually tuned by user, range 300 Hz to 20 MHz; 5-Pole Butterworth; for use with high modulation rates
Band Pass	CCITT	ITU-T O.41, or ITU-T P.53; known as "psophometric"
	A-Weighted	ANSI IEC rev 179
	C-Weighted	Roughly equivalent to 50 Hz HPF with 10 kHz LPF
	C-Message	IEEE 743, or BSTM 41004; similar in shape to CCITT, sometimes called "psophometric"
	CCIR-1k Weighted[a]	ITU-R 468, CCIR 468-2 Weighted, or DIN 45 405
	CCIR-2k Weighted[a]	ITU 468 ARM or CCIR/ARM (Average Responding Meter), commonly referred to as "Dolby" filter
	CCIR Unweighted	ITU-R 468 Unweighted[a]
De-emphasis (FM only)	25 μs	Equivalent to 1-pole LPF at 6366 Hz
	50 μs	Equivalent to 1-pole LPF at 3183 Hz; broadcast FM for most of world
	75 μs	Equivalent to 1-pole LPF at 2122 Hz; broadcast FM for U.S.
	750 μs	Equivalent to 1-pole LPF at 212 Hz; 2-way mobile FM radio.
SINAD Notch		Tuned automatically by application to highest AF response, for use in SINAD, SNR, and Dist'n calculations; complies with TI-603 and IT-O.132; stop bandwidth is ±13% of tone frequency.
Signaling Notch		FM only; manually tuned by user, range 50 to 300 Hz; used to eliminate CTCSS or CDCSS signaling tone; complies with TIA-603 and ITU-O.132; stop bandwidth is ±13% of tone frequency.

a. ITU standards specify that CCIR-1k Weighted and CCIR Unweighted filters use Quasi-Peak-Detection (QPD). However, the implementation in N9063C is based on true-RMS detection, scaled to respond as QPD. The approximation is valid when measuring amplitude of Gaussian noise, or SINAD of a single continuous sine tone (e.g. 1 kHz), with harmonics, combined with Gaussian noise. The results may not be consistent with QPD if the input signal is bursty, clicky, or impulsive; or contains non-harmonically related tones (multi-tone, intermods, spurs) above the noise level. Use the AF Spectrum trace to vali- date these assumptions. Consider using Keysight U8903A Audio Analyzer if true QPD is required.

Frequency Modulation

Conditions required to meet specification

- Peak deviation[*]: ≥ 200 Hz
- Modulation index (ModIndex) =PeakDeviation/Rate = Beta: 0.2 to 2000
- Channel BW: ≤ 50 kHz
- Rate: 20 Hz to 50 kHz
- SINAD bandwidth: (Channel BW) / 2
- Single tone - sinusoid modulation

Description	Specifications	Supplemental Information
FM Deviation Accuracy[abc]		±0.4% × (rate + deviation) (nominal)
FM Rate Accuracy[d]		±(0.01% × Reading) (nominal)
Carrier Frequency Error (ModIndex ≤ 100)		±0.5 Hz (nominal)
Carrier Power		Same as "Absolute Amplitude Accuracy" on page 23 at all frequencies (nominal)

a. This specification applies to the result labeled "(Pk-Pk)/2".
b. 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.
c. Reading is a measured frequency peak deviation in Hz, and Rate is a modulation rate in Hz.
d. Reading is a measured modulation rate in Hz.

*.Peak deviation, modulation index ("beta"), and modulation rate are related by PeakDeviation = ModIndex × Rate. Each of these has an allowable range, but all conditions must be satisfied at the same time. For example, PeakDeviation = 80 kHz at Rate = 20 Hz is not allowed, since ModIndex = PeakDeviation/Rate would be 4000, but ModIndex is limited to 2000. In addition, all significant sidebands must be contained in Channel BW. For FM, an approximate rule-of-thumb is 2 × [PeakDeviation + Rate] < Channel BW; this implies that PeakDeviation might be large if the Rate is small, but both cannot be large at the same time.

Frequency Modulation

Description	Specifications	Supplemental Information
Post-Demod Distortion Residual[a]		
Distortion (SINAD)[b]		0.30% (nominal)
THD		$0.4\%/(\text{ModIndex})^{1/2}$ (nominal)
Post-Demod Distortion Accuracy		
(Rate: 1 to 10 kHz, ModIndex: 0.2 to10)		
Distortion (SINAD)[b]		$\pm$(2% × Reading + DistResidual)[c] (nominal)
THD[d]		$\pm$(2% × Reading + DistResidual) (nominal)
Distortion Measurement Range		
Distortion (SINAD)		Residual to 100% (nominal)
THD		Residual to 100% (nominal)
AM Rejection[e]		The applied AM signal (Rate = 1 kHz, Depth = 50%)
(50 Hz HPF, 3 kHz LPF, 15 kHz Channel BW)		4.0 Hz FM peak
Residual FM[f]		
(50 Hz HPF, 3 kHz LPF, any Channel BW)		2.0 Hz rms (nominal)
(50 Hz HPF, 3 kHz LPF, 15 kHz Channel BW)		1.0 Hz rms (nominal)
Hum & Noise		
(50 Hz HPF, 3 kHz LPF, 15 kHz Channel BW, 750 µS de-emph; relateive to 3 kHz pk deviation)		72 dB (nominal)

a. For optimum measurement, ensure that the Channel BW is set wide enough to capture the significant RF energy. Setting the Channel BW too wide will result in measurement errors.
b. SINAD [dB] can be derived by 20 × log10(1/Distortion).
c. The DistResidual term of the Distortion Accuracy specification contributes when the Reading term is small.
d. The measurement includes at most 10^{th} harmonics.
e. AM rejection describes the instrument's FM reading for an input that is strongly AMed (with no FM); this specification includes contributions from residual FM.
f. Residual FM describes the instrument's FM reading for an input that has no FM and no AM; this specification includes contributions from FM deviation accuracy.

Amplitude Modulation

Conditions required to meet specification

- Depth: 1% to 99%
- Channel BW: ≤ 1 MHz
- Rate: 50 Hz to 100 kHz
- SINAD bandwidth: (Channel BW) / 2
- Single tone - sinusoid modulation

Description	Specifications	Supplemental Information
AM Depth Accuracy[a][b]		±0.2% + 0.002 × measured value (nominal)
AM Rate Accuracy (Rate: 1 kHz to 100 kHz)		±0.05 Hz (nominal)
Carrier Power		Same as "Absolute Amplitude Accuracy" on page 23 at all frequencies (nominal)

a. This specification applies to the result labeled "(Pk-Pk)/2".
b. Reading is a measured AM depth in %.

Amplitude Modulation

Description	Specifications	Supplemental Information
Post-Demod Distortion Residual[a]		
Distortion (SINAD)[b] THD		0.3% (nominal) 0.16% (nominal)
Post-Demod Distortion Accuracy (Depth: 5 to 90% Rate: 1 to 10 kHz)		
Distortion (SINAD)[b] THD		±(1% × Reading + DistResidual) (nominal) ±(1% × Reading + DistResidual) (nominal)
Distortion Measurement Range		
Distortion (SINAD)[b] THD		Residual to 100% (nominal) Residual to 100% (nominal)
FM Rejection[c]		0.5% (nominal)
Residual AM[d]		0.2% (nominal)

a. Channel BW is set to 15 times of Rate (Rate ≤ 50 kHz) or 10 times the Rate (50 kHz < Rate ≤ 100 kHz).
b. SINAD [dB] can be derived by 20 × log10(1/Distortion).
c. FM rejection describes the instrument's AM reading for an input that is strongly FMed (and no AM); this specification includes contributions from residual AM
d. Residual AM describes the instrument's AM reading for an input that has no AM and no FM; this specification includes contributions from AM depth accuracy.

Phase Modulation

Conditions erquired to meet specification

- Peak deviation[*]: 0.2 to 100 rad
- Channel BW: ≤ 1 MHz
- Rate: 20 Hz to 50 kHz
- SINAD bandwidth: (Channel BW) / 2
- Single tone - sinusoid modulation

Description	Specifications	Supplemental Information
PM Deviation Accuracy[abc] (Rate: 1 to 20 kHz, Deviation: 0.2 to 6 rad)		± (1 rad × (0.005 + (rate/1 MHz))) (nominal)
PM Rate Accuracy[b] (Rate: 1 to 10 kHz)		±0.2 Hz (nominal)
Carrier Frequency Error[b]		±0.02 Hz (nominal) Assumes signal still visible in channel BW with offset.
Carrier Power		Same as "Absolute Amplitude Accuracy" on page 23 at all frequencies (nominal)

a. This specification applies to the result labeled "(Pk-Pk)/2".
b. For optimum measurement, ensure that the Channel BW is set wide enough to capture the significant RF energy. Setting the Channel BW too wide will result in measurement errors.
c. Reading is the measured peak deviation in radians.

*.PeakDeviation (for phase, in rads) and Rate are jointly limited to fit within Channel BW. For PM, an approximate rule-of-thumb is 2 × [PeakDeviation + 1]×Rate < Channel BW; such that most of the sideband energy is within the Channel BW.

Phase Modulation

Description	Specifications	Supplemental Information
Post-Demod Distortion Residual[a]		
Distortion (SINAD)[b]		0.8% (nominal)
THD		0.1% (nominal)
Post-Demod Distortion Accuracy		
(Rate: 1 to 10 kHz, Deviation: 0.2 to 100 rad)		
Distortion (SINAD)[b]		±(2% × Reading + DistResidual)
THD		±(2% × Reading + DistResidual)
Distortion Measurement Range		
Distortion (SINAD)[b]		Residual to 100% (nominal)
SINAD		Residual to 100% (nominal)
AM Rejection[c]		4 mrad peak (nominal)
Residual PM[d]		4 mrad rms (nominal)

a. For optimum measurement, ensure that the Channel BW is set wide enough to capture the significant RF energy. Setting the Channel BW too wide will result in measurement errors.

b. SINAD [dB] can be derived by 20 × log10(1/Distortion).

c. AM rejection describes the instrument's PM reading for an input that is strongly AMed (with no PM); this specification includes contributions from residual PM.

d. Residual PM describes the instrument's PM reading for an input that has no PM and no AM; this specification includes contributions from PM deviation accuracy.

Analog Out

The "Analog Out" connector (BNC) is located at the analyzer's rear panel. It is a multi-purpose output, whose function depends on options and operating mode (active application). When the N9063C Analog Demod application is active, this output carries a voltage waveform reconstructed by a real-time hardware demodulator (designed to drive the "Demod to Speaker" function for listening). The processing path and algorithms for this output are entirely separate from those of the N9063C application itself; the Analog Out waveform is not necessarily identical the application's Demod Waveform.

Description	Specifications	Supplemental Information
Output impedance Output range[a] FM range		14 W (nominal) 0 V to +1 V (typical) Deviation up to 40 MHz Rate: between 20 Hz and 20 kHz
FM scaling		(1 / Channel BW) V/Hz (nominal), ± 10% (nominal), where the Channel BW is settable by the user.
Analog out scale adjust		User-settable factor, range from 0.5 to 10, default =1, applied to above V/Hz scaling.
FM offset		If HPF is *off*: 0 V corresponds to SA tuned frequency, and Carrier Frequency Errors (constant frequency offset) are included (DC coupled); If HPF is *on*: 0 V corresponds to the mean of peak-to-peak FM excursions.

a. For AM, the output is the "RF envelope" waveform. For FM, the output is proportional to frequency-deviation; note that Carrier Frequency Error (a constant frequency offset) is included as a devi- ation from the analyzer's tuned center frequency, unless a HPF is used. For PM, the output is proportional the phase-deviation; note that PM is limited to excursions of ±pi, and requires a HPF on to enable a phase-ramp-tracking circuit.

Most controls in the N9063C application do not affect Analog Out. The few that do are:
* choice of AM, FM, or PM (FM Stereo not supported)
* tuned Center Freq
* Channel BW (affects IF filter, sample rate, and FM scaling)
* some post-demod filters and de-emphasis (the hardware demodulator has limited filter choices; it will attempt to inherit the filter settings in the app, but with constraints and approximations)

The FM case has repeatable and deterministic scaling and offset behavior, and is continuous (smooth) through acquisition cycles. See above. The AM and PM cases are not, and should be used with caution.

FM Stereo/Radio Data System (RDS) Measurements

Description	Specifications	Supplemental Information
FM Stereo Modulation Analysis Measurements		
MPX view	RF Spectrum, AF Spectrum, Demod waveform, FM Deviation (Hz) (Peak+, Peak-, (Pk-Pk)/2, RMS), Carrier Power (dBm), Carrier Frequency Error (Hz), SINAD (dB), Distortion (% or dB)	MPX consists of FM signal multiplexing with the mono signal (L+R), stereo signal (L−R), pilot signal (at 19 kHz), and optional RDS signal (at 57 kHz). • SINAD MPX BW, default 53 kHz, range from 1 to 58 kHz • Reference Deviation, default 75 kHz, range from 15 to 150 kHz
Mono (L+R)/ Stereo (L-R) view	Demod Waveform, AF Spectrum, Carrier Power (dBm), Carrier Frequency Error (Hz), Modulation Rate	Mono Signal is Left+Right Stereo Signal is Left−Right
Left/Right view	Demod Waveform, AF Spectrum, Carrier Power (dBm), Carrier Frequency Error (Hz), Modulation Rate, SINAD (dB), Distortion (% or dB), THD (% or dB)	Post-demod settings: • Highpass filter: 20, 50, or 300 Hz • Lowpass filter: 300 Hz, 3, 15, 30, 80, or 300 kHz. • Bandpass filter: A-Weighted, CCITT • De-Emphasis: 25, 50, 75, and 750 µs
RDS/RBDS Decoding Result view	BLER, basic tuning and switching info, radio text, program item number and slow labeling codes, clock time and date	BLER Block Count default 1E+8, range from 1 to 1E+16
Numeric Result view	MPX, Mono, Stereo, Left, Right, Pilot and RDS with FM Deviation result (Hz) of Peak+, (Pk-Pk)/2, RMS, Mod Rate (Hz), SINAD (% or dB), THD (% or dB) Left to Right (dB), Mono to Stereo (dB), RF Carrie Power (dB), RF Carrier Freq Error (Hz), 38 kHz Carrier Freq Error (Hz), 38 kHz Carrier Phase Error (deg)	

Description	Specifications	Supplemental Information
FM Stereo Modulation Analysis Specification		FM Stereo with 67.5 kHz audio deviation at 1 kHz modulation rate plus 6.75 kHz pilot deviation.
SINAD		
A-weighted filter		59 dB (nominal)
with CCITT filter		67 dB (nominal)
Left to Right Ratio		
A-weighted filter		59 dB (nominal)
with CCITT filter		68 dB (nominal)

12 Phase Noise Measurement Application

This chapter contains specifications for the N9068C Phase Noise measurement application.

General Specifications

Description	Specifications	Supplemental Information
Maximum Carrier Frequency		
Option 503	3 GHz	
Option 507	7.5 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		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]	±1.08 dB	
Overdrive On setting		±0.91 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 (No Smoothing, all offsets, default settings, including average = 10)		< 1 dB (nominal)[a]

a. Standard deviation. The repeatability can be improved with the use of smoothing and increasing number of averages.

Description	Specifications	Supplemental Information
Offset Frequency		
Range	3 Hz to (f_{opt} − f_{CF})	f_{opt}: Maximum frequency determined by option[a] f_{CF}: Carrier frequency of signal under test
Accuracy		
Offset < 1 MHz		Negligible error (nominal)
Offset ≥ 1 MHz		±(0.5% of offset + marker resolution) (nominal) 0.5% of offset is equivalent to 0.0072 octave[b]

a. For example, f_{opt} is 3.0 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 42.

13 Noise Figure Measurement Application

This chapter contains specifications for the N9069C Noise Figure Measurement Application.

KEYSIGHT TECHNOLOGIES

General Specification

Description	Specifications		Supplemental Information
Noise Figure			Uncertainty Calculator[a]
≤10 MHz[b]			
10 MHz to 26.5 GHz			Using internal preamp (such as *Option P07*) and RBW = 4 MHz
Noise Source ENR	**Measurement Range**	**Instrument Uncertainty**[c]	
4 to 6.5 dB	0 to 20 dB	±0.05 dB	
12 to 17 dB	0 to 30 dB	±0.05 dB	
20 to 22 dB	0 to 35 dB	±0.1 dB	

a. The figures given in the table are for the uncertainty added by the CXA Signal 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 Keysight web site; go to http://www.keysight.com/find/nfu.

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. "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 Keysight 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 uncompromising accuracy.

Description	Specifications	Supplemental Information
Gain		
Instrument Uncertainty[a]		
<10 MHz[b]		
10 MHz to 26.5 GHz	±0.17 dB	DUT Gain Range −20 to +40 dB

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 Keysight 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 uncompromising accuracy.

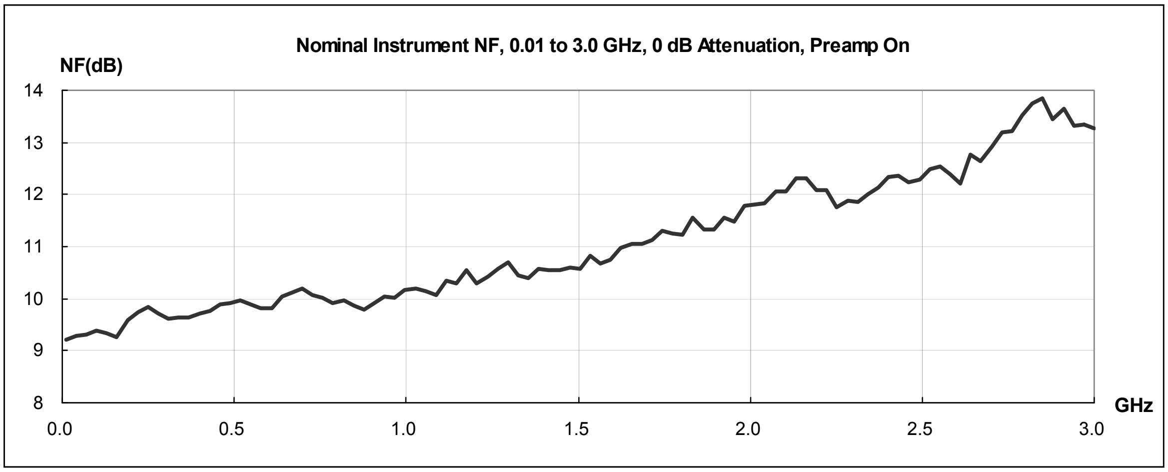
b. Uncertainty performance of the instrument is nominally the same in this frequency range as in the higher frequency range. However, performance is not warranted in this range. There is a paucity of available noise sources in this range, and the analyzer has poorer noise figure, leading to higher uncertainties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

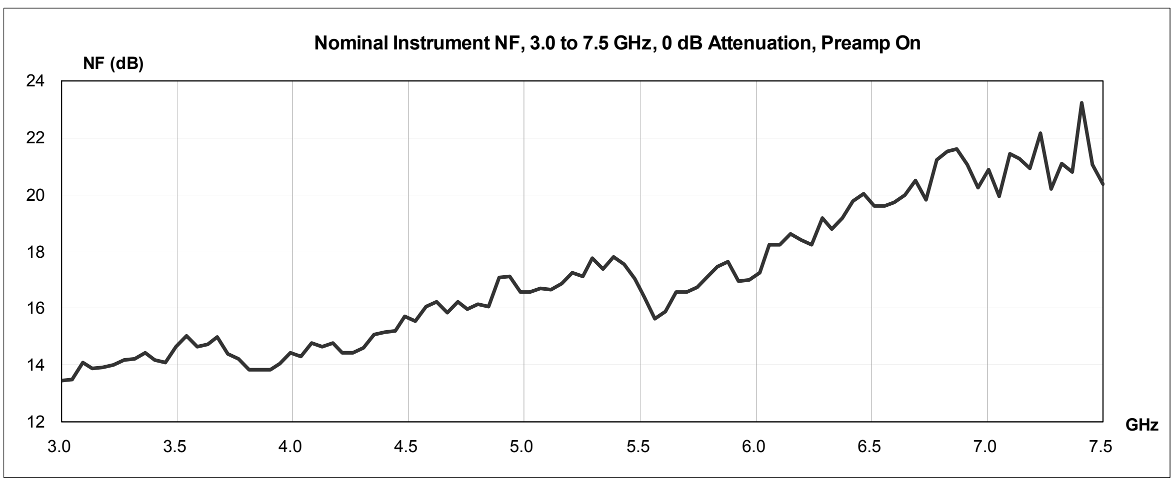
Description	Specifications	Supplemental Information
Noise Figure Uncertainty Calculator[a]		
Instrument Noise Figure Uncertainty	See the Noise Figure table earlier in this chapter	
Instrument Gain Uncertainty	See the Gain table earlier in this chapter	
Instrument Noise Figure		See graphs of “Nominal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

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

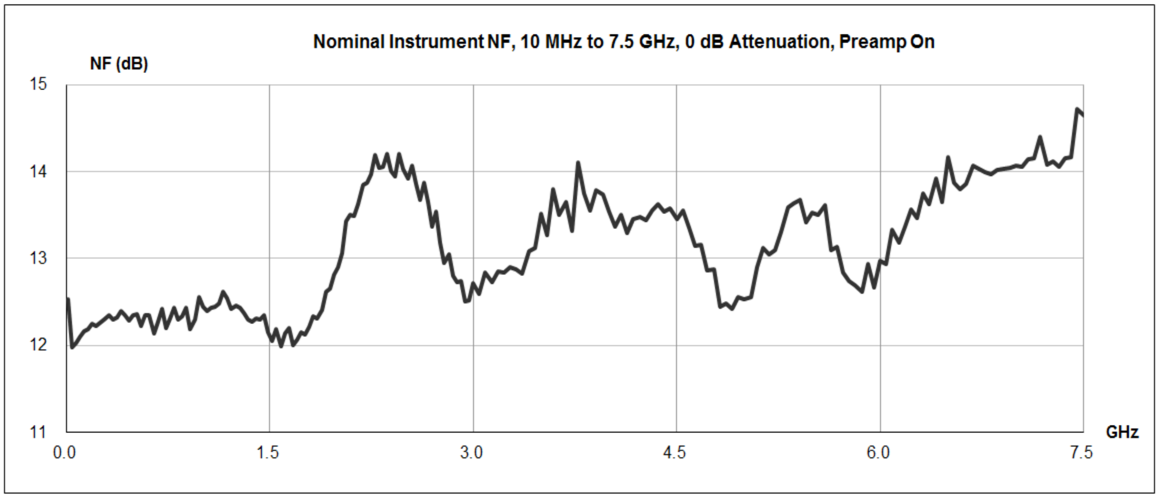
b. Nominally, the noise figure of the spectrum analyzer is given by
$NF = D - (K - L + N - B)$
where D is the DANL (displayed average noise level) specification,
K is kTB (–173.98 dB in a 1 Hz bandwidth at 290 K)
L is 2.51 dB (the effect of log averaging used in DANL verifications)
N is 0.24 dB (the 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.

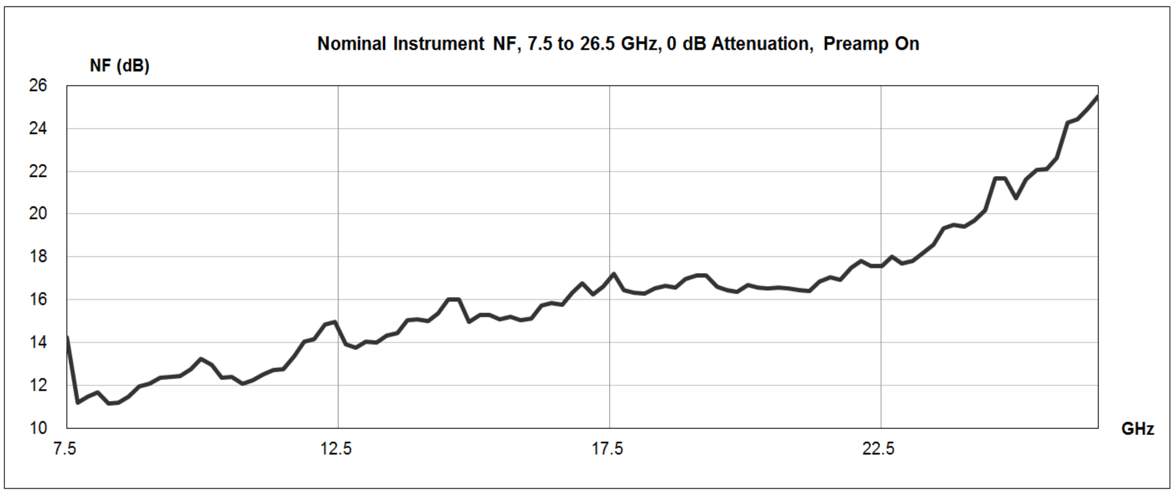
Nominal Instrument Noise Figure (Option 503/507)





Nominal Instrument Noise Figure (Option 513/526)





14 W-CDMA Measurement Application

This chapter contains specifications for the *N9073C* W-CDMA/HSPA/HSPA^{+} measurement application. It contains N9073C-1FP W-CDMA, N9073C-2FP HSPA and N9073C-3FP/HSPA^{+} 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.

KEYSIGHT TECHNOLOGIES

Measurement

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)	±1.33 dB	
95th Percentile Absolute power accuracy (20 to 30°C, Atten = 10 dB)		±0.61 dB
Measurement floor		–76.8 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)					
Singal Carrier					
Minimum power at RF Input					–36 dBm (nominal)
ACPR Accuracy[a]					RRC weighted, 3.84 MHz noise bandwidth, method = IBW
Radio	**Offset Freq**				
MS (UE)	5 MHz			±0.76 dB	At ACPR range of –30 to –36 dBc with optimum mixer level[b]
MS (UE)	10 MHz			±0.73 dB	At ACPR range of –40 to –46 dBc with optimum mixer level[c]
BTS	5 MHz			±1.72 dB	At ACPR range of –42 to –48 dBc with optimum mixer level[d]
BTS	10 MHz			±1.96 dB	At ACPR range of –47 to –53 dBc with optimum mixer level[c]
BTS	5 MHz			±0.87 dB	At –48 dBc non-coherent ACPR[c]
Dynamic Range					RRC weighted, 3.84 MHz noise bandwidth
		Option 503, or *507*	*Option 513*, or *526*		
Noise Correction	**Offset Freq**				**Typical[e] Dynamic Range**
Off	5 MHz	x			–63.0 dB
Off	5 MHz		x		–66.0 dB
Off	10 MHz	x			–67.0 dB
Off	10 MHz		x		–69.0 dB
On	5 MHz	x	x		–73.0 dB
On	10 MHz	x	x		–78.0 dB
RRC Weighting Accuracy[f]					
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. 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 –24 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.

c. ACPR accuracy at 10 MHz offset is warranted when the input attenuator is set to give an average mixer level of –14 dBm (for all alternate channel and non-coherent ACPR).

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 –45 dBc ACPR. This optimum mixer level is –18 dBm, so the input attenuation must be set as close as possible to the average input power – (–18 dBm). For example, if the average input power is –5 dBm, set the attenuation to 13 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. Keysight 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, Keysight 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 Keysight 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.

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 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.

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])	73.4 dB	80.2 dB (typical)
Sensitivity, absolute (2.515 MHz offset[c])	–91.7 dBm	–97.7 dBm (typical)
Accuracy (2.515 MHz offset)		
Relative[d]	±0.11 dB	
Absolute[e] (20 to 30°C)	±1.53 dB	±0.65 dB (95th percentile)

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 23 for more information. The numbers shown are for 100 kHz to 3.0 GHz, with attenuation set to 10 dB.

Description	Specifications	Supplemental Information
Spurious Emissions		Table-driven spurious signals; search across regions
Dynamic Range[a], relative (RBW=1 MHz)	70.7 dB	75.9 dB (typical)
Sensitivity[b], absolute (RBW=1 MHz)	–76.5 dBm	–82.5 dBm (typical)
Accuracy		
(Attenuation = 10 dB)		
Frequency Range		
100 kHz to 3.0 GHz		±0.81 dB (95th percentile)
3.0 GHz to 7.5 GHz		±1.80 dB (95th percentile)

a. This dynamic range is specified at 12.5 MHz offset from center frequency with mixer level of 1 dB compression point, which will degrade accuracy 1 dB.

b. The sensitivity is specified at far offset from carrier, where phase noise dose not contribute. You can derive the dynamic range at far offset from 1 dB compression mixer level and sensitivity.

Description	Specifications	Supplemental Information
Code Domain		RF input power and attenuation are set to meet the Mixer Level range.
(BTS Measurements –25 dBm ≤ ML[a] ≤ –15 dBm 20 to 30°C)		
Code domain power		
Absolute accuracy[b] (–10 dBc CPICH, Atten = 10 dB)		±0.61 dB (95th percentile)
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% (nominal)
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 and successfully synchronized to the signal. 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 = $\text{sqrt}(\text{EVMUUT}^2 + \text{EVMsa}^2) - \text{EVMUUT}$, where EVMUUT is the EVM of the UUT in percent, and EVMsa is the EVM floor of the analyzer in percent.

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% (nominal)
Floor	1.6%	
Accuracy [b]		
Overall	±1.0%[c]	
Limited circumstances (12.5% ≤ EVM ≤ 22.5%, No 16QAM codes nor 64QAM codes)	±0.5%[d]	
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)[e]
Accuracy	±5 Hz + tfa[f]	
Time offset		
Relative offset accuracy (for STTD diff mode)[g]	±1.25 ns	

a. ML (mixer level) is RF input power minus attenuation.
b. For 16 QAM or 64QAM modulation, the relative code domain error (RCDE) must be better than –16 dB and –22 dB respectively.
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 = $[\text{sqrt}(EVMUUT^2 + EVMsa^2)] - EVMUUT$, 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%.
d. If 16 QAM and 64 QAM codes are included, it is not applicable.
e. This specifies a synchronization range with CPICH for CPICH only signal.
f. tfa = transmitter frequency × frequency reference accuracy
g. 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)

In-Band Frequency Range

Operating Band	**UL Frequencies UE transmit, Node B receive**	**DL Frequencies UE transmit, Node B transmit**
I	1920 to 1980 MHz	2110 to 2170 MHz
II	1850 to 1910 MHz	1930 to 1990 MHz
III	1710 to 1785 MHz	1805 to 1880 MHz
IV	1710 to 1755 MHz	2110 to 2155 MHz
V	824 to 849 MHz	869 to 894 MHz
VI	830 to 840 MHz	875 to 885 MHz
VII	2500 to 2570 MHz	2620 to 2690 MHz
VIII	880 to 915 MHz	925 to 960 MHz
IX	1749.9 to 1784.9 MHz	1844.9 to 1879.9 MHz
X	1710 to 1770 MHz	2110 to 2170 MHz
XI	1427.9 to 1452.9 MHz	1475.9 to 1500.9 MHz
XII	698 to 716 MHz	728 to 746 MHz
XIII	777 to 787 MHz	746 to 756 MHz
XIV	788 to 798 MHz	758 to 768 MHz

15 LTE/LTE-Advanced Measurement Application

This chapter contains specifications for the N9080C LTE/LTE-Advanced FDD measurement application and for the N9082C LTE/LTE-Advanced TDD 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.

Supported Air Interface Features

Description	Specifications	Supplemental Information
3GPP Standards Supported	36.211 V10.7.0 (March 2013) 36.212 V10.7.0 (December 2012) 36.213 V10.9.0 (March 2013) 36.214 V10.12.0 (March 2013) 36.141 V11.4.0 (March 2013) 36.5.21-1 V10.5.0 (March 2013)	
Signal Structure	FDD Frame Structure Type 1 TDD Frame Structure Type 2 Special subframe configurations 0-8	N9080C only N9082C only N9082C only
Signal Direction	Uplink and Downlink UL/DL configurations 0-6	 N9082C only
Signal Bandwidth	1.4 MHz (6 RB), 3 MHz (15 RB), 5 MHz (25 RB), 10 MHz (50 RB), 15 MHz (75 RB), 20 MHz (100 RB)	
Modulation Formats and Sequences	BPSK; BPSK with I &Q CDM; QPSK; 16QAM; 64QAM; PRS; CAZAC (Zadoff-Chu)	
Physical Channels		
Downlink	PBCH, PCFICH, PHICH, PDCCH, PDSCH	
Uplink	PUCCH, PUSCH, PRACH	
Physical Signals		
Downlink	P-SS, S-SS, RS, P-PS (positioning), MBSFN-RS	
Uplink	PUCCH-DMRS, PUSCH-DMRS, S-RS (sounding)	

Measurements

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)	±1.33 dB	±0.61 dB (95th percentile)
Measurement floor		–72.7 dBm (nominal) in a 10 MHz bandwidth

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 the measurement floor contribution is negligible.

Description	Specifications	Supplemental Information
Transmit On/Off Power		This table applies only to the N9082C measurement application.
Burst Type		Traffic, DwPTS, UpPTS, SRS, PRACH
Transmit power		Min, Max, Mean, Off
Dynamic Range[a]		119.5 dB (nominal)
Average type		Off, RMS, Log
Measurement time		Up to 20 slots
Trigger source		External 1, External 2, Periodic, RF Burst, IF Envelope

a. This dynamic range expression is for the case of Information BW = 5 MHz; for other Info BW, the dynamic range can be derived. The equation is:

Dynamic Range = Dynamic Range for 5 MHz – 10*$\log_{10}$(Info BW/5.0e6)

Description		Specifications			Supplemental Information	
Adjacent Channel Power					Single Carrier	
Minimum power at RF input					–36 dBm (nominal)	
Accuracy		**Channel Bandwidth**				
Radio	**Offset**	**5 MHz**	**10 MHz**	**20 MHz**	**ACPR Range with optimum mixer level**	
MS	Adjacent[a]	±0.37 dB	±0.73 dB	±1.33 dB	–33 to –27 dBc[b]	
BTS	Adjacent[c]	±2.16 dB	±3.13 dB	±4.89 dB	–48 to –42 dBc[d]	
BTS	Alternate[c]	±1.03 dB	±1.92 dB	±3.50 dB	–48 to –42 dBc[e]	
Dynamic Range E-UTRA					Test conditions[f]	
Offset	**Channel BW**				**Dynamic Range** (nominal)	**Optimum Mixer Level** (nominal)
Adjacent	5 MHz				66.8 dB	–20.3 dBm
Adjacent	10 MHz				67.6 dB	–20.3 dBm
Adjacent	20 MHz				65.0 dB	–20.3 dBm
Alternate	5 MHz				71.1 dB	–20.3 dBm
Alternate	10 MHz				68.0 dB	–20.3 dBm
Alternate	20 MHz				65.0 dB	–20.3 dBm
Dynamic Range UTRA					Test conditions[f]	
Offset	**Channel BW**				**Dynamic Range** (nominal)	**Optimum Mixer Level** (nominal)
2.5 MHz	5 MHz				65.8 dB	–20.3 dBm
2.5 MHz	10 MHz				70.6 dB	–20.3 dBm
2.5 MHz	20 MHz				71.1 dB	–20.3 dBm
7.5 MHz	5 MHz				71.1 dB	–20.3 dBm
7.5 MHz	10 MHz				71.9 dB	–20.3 dBm
7.5 MHz	20 MHz				71.8 dB	–20.3 dBm

a. Measurement bandwidths for mobile stations are 4.5, 9.0 and 18.0 MHz for channel bandwidths of 5, 10 and 20 MHz respectively.
b. The optimum mixer levels (ML) are –23, –23 and –23 dBm for channel bandwidths of 5, 10 and 20 MHz respectively.
c. Measurement bandwidths for base transceiver stations are 4.515, 9.015 and 18.015 MHz for channel bandwidths of 5, 10 and 20 MHz respectively.
d. The optimum mixer levels (ML) are –19, –18 and –18 dBm for channel bandwidths of 5, 10 and 20 MHz respectively.
e. The optimum mixer level (ML) is –14 dBm.
f. E-TM1.1 and E-TM1.2 used for test. Noise Correction set to On.

Description	Specification	Supplemental Information
Occupied Bandwidth		
Minimum carrier 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		Offset from CF = (channel bandwidth + measurement bandwidth) / 2; measurement bandwidth = 100 kHz
Dynamic Range		
Channel Bandwidth		
5 MHz	69.0 dB	75.4 dB (typical)
10 MHz	69.3 dB	75.5 dB (typical)
20 MHz	69.8 dB	76.0 dB (typical)
Sensitivity	–86.5 dBm	–92.5 dBm (typical)
Accuracy		
Relative	±0.23 dB	
Absolute (20 to 30°C)	±1.53 dB	±0.97 dB (95th percentile)

Description	Specifications	Supplemental Information
Spurious Emissions		Table-driven spurious signals; search across regions
Dynamic Range[a], relative (RBW=1 MHz)	70.7 dB	75.9 dB (typical)
Sensitivity[b], absolute (RBW=1 MHz)	–76.5 dBm	–82.5 dBm (typical)
Accuracy		
(Attenuation = 10 dB)		
Frequency Range		
100 kHz to 3.0 GHz		±0.81 dB (95th percentile)
3.0 GHz to 7.5 GHz		±1.80 dB (95th percentile)

a. This dynamic range is specified at 12.5 MHz offset from center frequency with mixer level of 1 dB compression point, which will degrade accuracy 1 dB.
b. The sensitivity is specified at far offset from carrier, where phase noise dose not contribute. You can derive the dynamic range at far offset from 1 dB compression mixer level and sensitivity.

Description	Specifications	Supplemental Information
Modulation Analysis		% and dB expressions[a]
(Signal level within one range step of overload)		
OSTP/RSTP		
Absolute accuracy[b]	±0.61 dB	
EVM Floor for Downlink (OFDMA)		
Signal Bandwidth		
5 MHz	1.33% (–37.5 dB)	0.63% (–44.0 dB) (nominal)
10 MHz	1.34% (–37.5dB)	0.64% (–43.8 dB) (nominal)
20 MHz[c]	1.42% (–37.0 dB)	0.70% (–43.0 dB) (nominal)
EVM Accuracy for Downlink (OFDMA)		
(EVM range: 0 to 8%)[d]		±0.3% (nominal)

Description	Specifications	Supplemental Information
EVM Floor for Uplink (SC-FDMA)		
Signal Bandwidth		
5 MHz	1.32% (–37.6 dB)	0.60% (–44.4 dB) (nominal)
10 MHz	1.33% (–37.5 dB)	0.61% (–44.2 dB) (nominal)
20 MHz[c]	1.41% (–37.0 dB)	0.63% (–44.0 dB) (nominal)
Frequency Error		
Lock range		±2.5 × subcarrier spacing = 37.5 kHz for default 15 kHz subcarrier spacing (nominal)
Accuracy		±1 Hz + tfa[e] (nominal)
Time Offset[f]		
Absolute frame offset accuracy	±20 ns	
Relative frame offset accuracy		±5 ns (nominal)
MIMO RS timing accuracy		±5 ns (nominal)

a. In these specifications, those values with % units are the specifications, while those with decibel units, in parentheses, are conversions from the percentage units to decibels for reader convenience.
b. The accuracy specification applies when EVM is less than 1% and no boost applies for the reference signal.
c. Requires *Option B25* (IF bandwidth above 10 MHz, up to 25 MHz).
d. 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.
e. tfa = transmitter frequency × frequency reference accuracy.
f. The accuracy specification applies when EVM is less than 1% and no boost applies for resource elements

In-Band Frequency Range

Operating Band, FDD	Uplink	Downlink
1	1920 to 1980 MHz	2110 to 2170 MHz
2	1850 to 1910 MHz	1930 to 1990 MHz
3	1710 to 1785 MHz	1805 to 1880 MHz
4	1710 to 1755 MHz	2110 to 2155 MHz
5	824 to 849 MHz	869 to 894 MHz
6	830 to 840 MHz	875 to 885 MHz
7	2500 to 2570 MHz	2620 to 2690 MHz
8	880 to 915 MHz	925 to 960 MHz
9	1749.9 to 1784.9 MHz	1844.9 to 1879.9 MHz
10	1710 to 1770 MHz	2110 to 2170 MHz
11	1427.9 to 1452.9 MHz	1475.9 to 1500.9 MHz
12	698 to 716 MHz	728 to 746 MHz
13	777 to 787 MHz	746 to 756 MHz
14	788 to 798 MHz	758 to 768 MHz
17	704 to 716 MHz	734 to 746 MHz

Operating Band, TDD	Uplink/Downlink
33	1900 to 1920 MHz
34	2010 to 2025 MHz
35	1850 to 1910 MHz
36	1930 to 1990 MHz
37	1910 to 1930 MHz
38	2570 to 2620 MHz
39	1880 to 1920 MHz
40	2300 to 2400 MHz

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