Keysight M9290A
CXA-m PXIe Signal Analyzer

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KEYSIGHT TECHNOLOGIES

Specification Guide

Notices

Manual Part Number

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Warranty

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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-m

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1 Keysight M9290A CXA-m PXIe 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

- Temperatures referred to in this document are defined as follows:
  - Full temperature range = Individual module temperature of 5 to 68°C, as reported by the module, and environment temperature of 0 to 55°C.
  - Controlled temperature range = Individual module temperatture of 25 to 40°C, as reported by the module, and environment temperrature of 20 to 30°C.
- 95th percentile values indicate the breadth of the population ($\approx 2\sigma$) 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.
- 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.

Recommended Best Practices In Use

- Use slot blockers and EMC filter panels in empty module slots to ensure proper operating temeraptures. Keysight chassis and slot blockers optimize module temerature performance and reliability of test.
- Set chassis fan to high at environmental temeratures above 45°C.

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 F03	3.0 GHz		
Option F07	7.5 GHz		
Option F13	13.6 GHz		
Option F26	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			
Preamp	AC Coupled	DC coupled	
Off	10 MHz	10 Hz	
On	10 MHz	100 kHz	
Band	**LO Multiple (N[a])**		Band Overlaps[b]
0 (9 kHz to 3.08 GHz)	1		
1 (2.95 to 7.575 GHz)	2		
2 (7.45 to 9.55 GHz)	2		
3 (9.45 to 12.6 GHz)	2		
4 (12.5 to 13.05 GHz)	2		
4 (12.95 to 13.8 GHz)	4		
5 (13.4 to 15.55 GHz)	4		
6 (15.45 to 19.35 GHz)	4		
7 (19.25 to 21.05 GHz)	4		
8 (20.95 to 22.85 GHz)	4		
9 (22.75 to 24.25 GHz)	4		
10 (24.15 to 26.55 GHz)	4		

a. N is the LO multiplication factor.

b. In the band overlap regions, 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 Band0/1 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 F03	0 Hz, 10 Hz to 3 GHz	
Option F07	0 Hz, 10 Hz to 7.5 GHz	
Option F13	0 Hz, 10 Hz to 13.6 GHz	
Option F26	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, Video, External, 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 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 45.

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 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		±0.13 dB (nominal)
2.2 to 3 MHz		±0.22 dB (nominal)
4 to 8 MHz		±0.32 dB (nominal)
Accuracy (−3.01 dB bandwidth)[b]		
RBW Range		
1 Hz to 1.3 MHz		±2% (nominal)
1.5 to 3.0 MHz		±8% (nominal)
4 to 8 MHz		±16% (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 Bandwidth[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 Bandwidth (VBW)		
Range	Same as Resolution Bandwidth range plus wide-open VBW (labeled 50 MHz)	
Accuracy		±6% (nominal) in swept mode and zero span[a]

a. For FFT processing, the selected VBW is used to determine a number of averages for FFT results. That number is chosen to give roughly 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	Specifications	Supplemental Information
Measurement Range		
Preamp Off		
100 kHz to 1 MHz	Displayed Average Noise Level to +20 dBm	
1 MHz to 26.5 GHz	Displayed Average Noise Level to +30 dBm	
Preamp On		
100 kHz to 26.5 GHz	Displayed Average Noise Level to +23 dBm	
Input Attenuation Range		
Standard	0 to 70 dB, in 10 dB steps	
With *Option FSA*	0 to 70 dB, in 2 dB steps, 7.5 GHz	
	0 to 70 dB, in 10 dB steps, 7.5 to 26.5 GHz	

Description	Specifications	Supplemental Information
Maximum Safe Input Level		
Average Total Power (input attenuation ≥ 10 dB)	+30 dBm (1 W)	
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	

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-m 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-m signal analyzer, however, is implemented digitally such that the range and resolution greatly exceed other instrument limitations. Because of this, the CXA-m signal analyzer can make measurements largely independent of the setting of the RL without compromising accuracy. Because the RL becomes a display function, not a measurement function, a marker can read out results that are off-screen, either above or below, without any change in accuracy. The only exception to the independence of RL and the way in which the measurement is performed is in the input attenuation setting: When the input attenuation is set to auto, the rules for the determination of the input attenuation include dependence on the reference level. Because the input attenuation setting controls the tradeoff between large signal behaviors (third-order intermodulation and compression) and small signal effects (noise), the measurement results can change with RL changes when the input attenuation is set to auto.

Frequency Response

Description	Specifications		Supplemental Information
Frequency Response (Maximum error relative to reference condition (50 MHz) Swept operation[a] Attenuation 10 dB)			Refer to the footnote for "Band Overlaps" on page 12.
	20 to 30°C	**Full Range**	**95th Percentile (≈2σ)**
9 kHz to 10 MHz	±0.5 dB	±0.6 dB	±0.4 dB
10 MHz to 3 GHz	±0.65 dB	±0.8 dB	±0.5 dB
3 to 7.5 GHz	±1.25 dB	±2.0 dB	±0.8 dB
7.5 to 13.6 GHz	±1.3 dB	±2.5 dB	±0.8 dB
13.6 to 19.3 GHz	±1.5 dB	±2.5 dB	±1.0 dB
19.3 to 24.2 GHz	±2.2 dB	±3.5 dB	±1.3 dB
24.2 to 26.5 GHz	±2.5 dB	±4.0 dB	±1.3 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	Specifications	Supplemental Information
IF Frequency Response[a]		

Description		Specifications	Supplemental Information		
(Demodulation and FFT response relative to the center frequency)					
Center Freq (GHz)	**Analysis Width** (MHz)	**Max Error**[b] (Exception[c])	**Midwidth Error** (95th Percentile)	**Slope** (dB/MHz) (95th Percentile)	**RMS**[d] (nominal)
≤3.0	≤10	±0.40 dB	±0.12 dB	±0.10	0.03 dB
>3.0, ≤ 26.5	≤10				0.1 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. 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.

c. The specification does not apply for frequencies greater than 3.0 MHz from the center in FFT Widths of 7.2 to 8 MHz.

d. 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				
Freq (GHz)	**Span** (MHz)		**Peak-to-Peak** (nominal)	**RMS** (nominal)[a]
≥0.02, ≤ 3.0	≤ 10		0.5°	0.2°
>3.0, ≤ 7.5	≤ 10		0.5°	0.4°

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

Description	Specifications	Supplemental Information
Input Attenuation Switching Uncertainty (Relative to 10 dB (reference setting))		Refer to the footnote for "Band Overlaps" on page 12
50 MHz (reference frequency)	±0.30 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 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	±0.34 dB (95th percentile) ±0.22 dB (Typical)
0 to 55°C	±0.45 dB	
At all frequencies[a]		
20 to 30°C	±(0.40 dB + frequency response)	
0 to 55°C	±(0.45 dB + frequency response)	
95th Percentile Absolute Amplitude Accuracy[b] (Wide range of signal levels, RBWs, RLs, etc., Atten = 10 dB)		
100 kHz to 3.0 GHz		±0.60 dB
Preamp On[c]		
At 50 MHz		±0.36 dB (95th percentile)
At all frequencies		±(0.36 dB + frequency response) (95th percentile)

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.

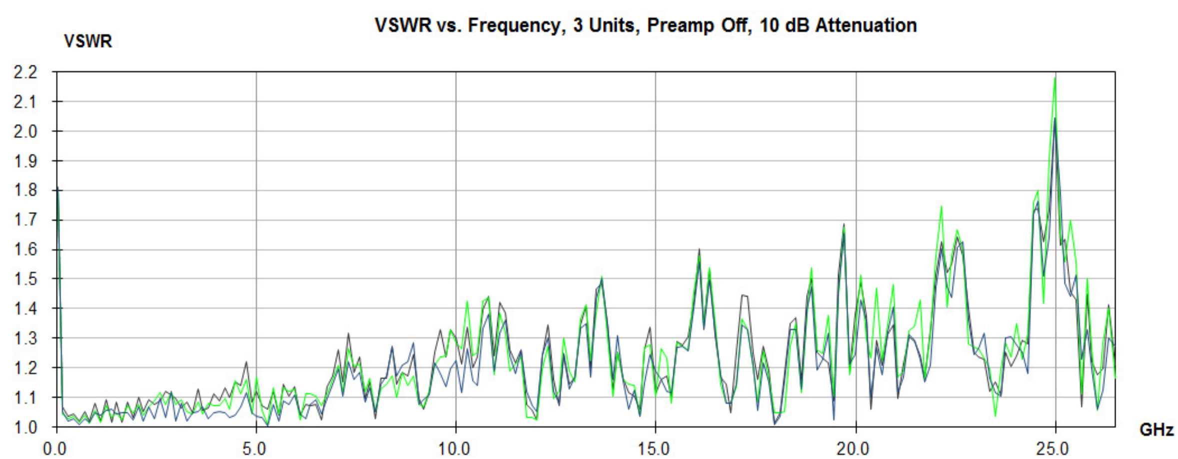
b. Absolute Amplitude Accuracy for a wide range of signal and measurement settings, covers the 95th percentile proportion with 95% confidence. Here are the details of what is covered and how the computation is made:
The wide range of conditions of RBW, signal level, VBW, reference level and display scale 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	Specifications	Supplemental Information
RF Input VSWR		Nominal[a]
(Input attenuation 10 dB, 50 MHz)		1.1:1
Frequency		**Input Attenuation ≥ 10 dB**
10 MHz to 3.0 GHz		< 1.2:1 (nominal)
3.0 to 7.5 GHz		< 1.4:1 (nominal)
7.5 to 13.6 GHz		< 1.6:1 (nominal)
13.6 to 24.2 GHz		< 1.8:1 (nominal)
24.2 to 26.5 GHz		< 2.2:1 (nominal)

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

Nominal Instrument Input VSWR



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 < −10 dBm	±0.15 dB	
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]
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.

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

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

b. The scale fidelity is warranted with ADC dither set to 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]
10 kHz to 7.5 GHz		+6.00 dBm (nominal)
7.5 to 26.5 GHz		+4.00 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	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 12
	20 to 30°C	**Full range**	**Typical**
10 Hz			–95 dBm (nominal)
100 Hz			−110 dBm (nominal)
1 kHz			−115 dBm (nominal)
9 kHz to 1 MHz[b]			−125 dBm
1 to 10 MHz	−144 dBm	−143 dBm	−148 dBm
10 MHz to 1.5 GHz	−148 dBm	−147 dBm	−150 dBm
1.5 to 4.5 GHz	−146 dBm	−145 dBm	−149 dBm
4.5 to 7.0 GHz	−141 dBm	−140 dBm	−145 dBm
7.0 to 9.5 GHz	−144 dBm	−141 dBm	−147 dBm
9.5 to 13 GHz	−136 dBm	−135 dBm	−140 dBm
13 to 14.5 GHz	−142 dBm	−141 dBm	−145 dBm
14.5 to 19.3 GHz	−132 dBm	−131 dBm	−138 dBm
19.3 to 23 GHz	−134 dBm	−132 dBm	−139 dBm
23 to 24 GHz	−132 dBm	−131 dBm	−137 dBm
24 to 26.5 GHz	−128 dBm	−126 dBm	−133 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. Specifications apply with the best setting of the Phase Noise Optimization control, which is to choose the “Best Close-in ϕ Noise" for frequencies below 25 kHz, and “Best Wide Offset ϕ Noise" for frequencies above 85 kHz.

Spurious Response

Description		Specifications		Supplemental Information
Spurious Response (See "Band Overlaps" on page 12)				
Residual Responses[a]				Preamp Off[c]
200 kHz to 26.5 GHz[b] (swept)		–90 dBm		
Zero span or FFT or other frequencies				–100 dBm (nominal)
Image Responses				
Tuned Freq (f)	**Excitation Freq**	**Mixer Level[d]**	**Response**	**Typical**
10 MHz to 3 GHz	f + 9645 MHz	–10 dBm	–60 dBc	–64 dBc
3 GHz to 7.5 GHz	f + 17645 MHz	–10 dBm	–60 dBc	–64 dBc
7.5 GHz to 19.3 GHz	f + 6355 MHz	–10 dBm	–60 dBc	–64 dBc
19.3 GHz to 21 GHz	f – 6355 MHz	–10 dBm	–60 dBc	–64 dBc
21 GHz to 22.8 GHz	f – 9645 MHz	–10 dBm	–60 dBc	–64 dBc
22.8 GHz to 24.2 GHz	f – 6355 MHz	–10 dBm	–60 dBc	–64 dBc
24.2 GHz to 26.5 GHz	f – 9645 MHz	–10 dBm	–60 dBc	–64 dBc
10 MHz to 7.5 GHz	f + 1645 MHz	–10 dBm	–70 dBc	–80 dBc
7.5 GHz to 19.3 GHz	f – 1645 MHz	–10 dBm	–70 dBc	–80 dBc
19.3 GHz to 21 GHz	f + 1645 MHz	–10 dBm	–70 dBc	–80 dBc
21 GHz to 22.8 GHz	f – 1645 MHz	–10 dBm	–70 dBc	–80 dBc
22.8 GHz to 24.2 GHz	f + 1645 MHz	–10 dBm	–70 dBc	–80 dBc
24.2 GHz to 26.5 GHz	f – 1645 MHz	–10 dBm	–70 dBc	–80 dBc
10 MHz to 7.5 GHz	f + 45 MHz	–10 dBm	–70 dBc	–80 dBc
7.5 GHz to 19.3 GHz	f – 45 MHz	–10 dBm	–70 dBc	–80 dBc
19.3 GHz to 21 GHz	f + 45 MHz	–10 dBm	–70 dBc	–80 dBc
21 GHz to 22.8 GHz	f – 45 MHz	–10 dBm	–70 dBc	–80 dBc
22.8 GHz to 24.2 GHz	f + 45 MHz	–10 dBm	–70 dBc	–80 dBc
24.2 GHz to 26.5 GHz	f – 45 MHz	–10 dBm	–70 dBc	–80 dBc
Other Spurious Responses				
IF through (f ≥ 10 MHz from carrier)		–10 dBm	–75 dBc	–80 dBc (typical)
First RF Order[e] (f ≥ 10 MHz from carrier)		–10 dBm	–70 dBc	–80 dBc (nominal)
High RF Order (f ≥ 10 MHz from carrier)		–30 dBm	–70 dBc	–80 dBc (nominal)
LO-Related Spurious Responses (10 MHz to 26.5 GHz)		–10 dBm	-60 dBc	–64 dBc (typical)
Sidebands, offset from CW signal				
100 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. Input terminated, 0 dB input attenuation.

b. The stop frequency varies according to the option F03/F07/F13/F26 selected.
c. The spurious response specifications only apply with the preamp turned off. When the preamp is turned on, performance is nominally the same as long as the mixer level is interpreted to be: Mixer Level = Input Level – Input Attenuation – Preamp Gain.
d. Mixer Level = Input Level - Input Attenuation.
e. The span is less than 10 GHz.

Second Harmonic Distortion

Description	Specifications		Supplemental Information	
Second Harmonic Distortion (Input attenuation 10 dB)	**Distortion**	**SHI**[a]	**Distortion** (nominal)	**SHI** (nominal)
Preamp Off				
10 MHz to 3.75 GHz (Input level –20 dBm)	–68 dBc	+38 dBm	–80 dBc	+50 dBm
3.75 to 13.25 GHz (Input level –20 dBm)	–75 dBc	+45 dBm	–92 dBc	+62 dBm
Preamp On (Input level –40 dBm)			–60 dBc	+10 dBm

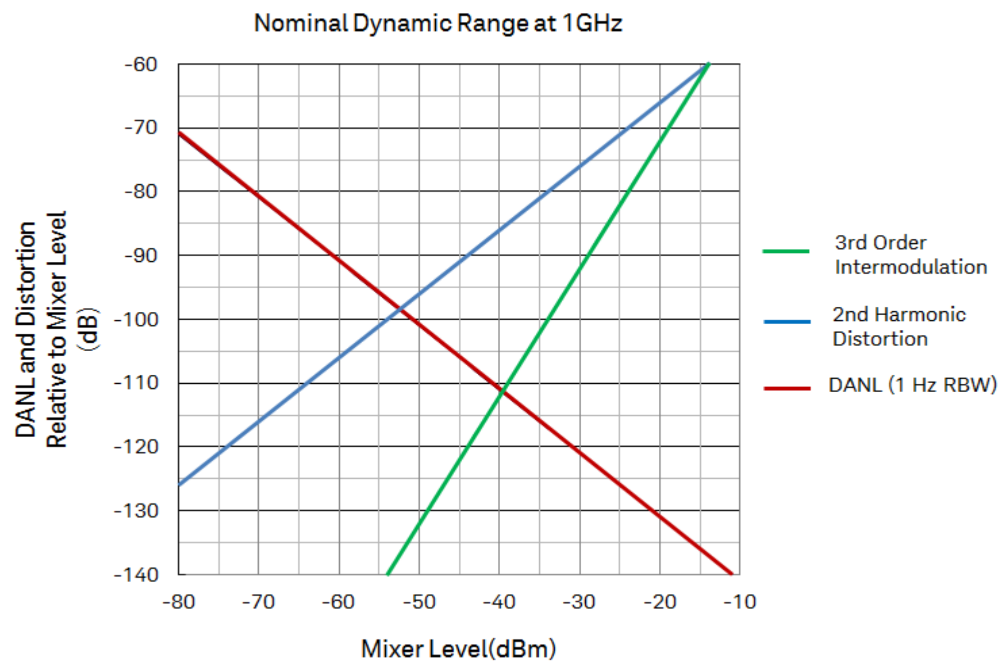
a. SHI = second harmonic intercept. The SHI is given by the mixer power in dBm minus the second harmonic distortion level relative to the mixer tone in dBc.

Third Order Intermodulation

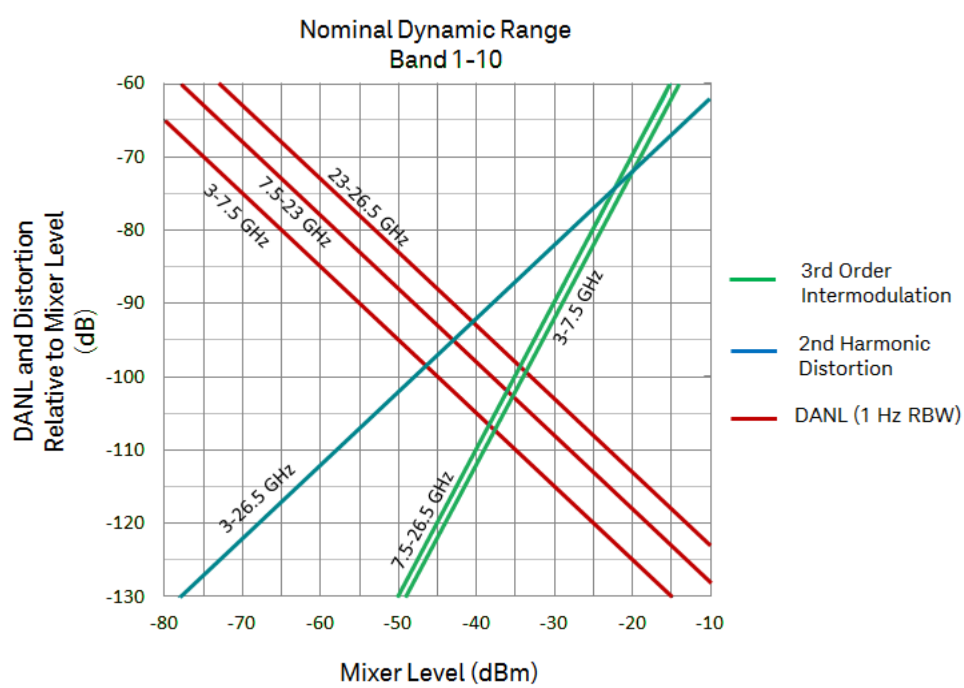
Description	Specifications		Supplemental Information	
Third Order Intermodulation[a] (Two –20 dBm tones at the input, spaced by 100 kHz, input attenuation 0 dB)			Refer to the footnote for "Band Overlaps" on page 12.	
20 to 30°C	**Extrapolated Distortion**[b]	**Intercept**[c]	**Extrapolated Distortion**	**Intercept** (Typical)
10 MHz to 2 GHz	–64 dBc	+12 dBm	–72 dBc	+16 dBm
2 to 3 GHz	–64 dBc	+12 dBm	–74 dBc	+17 dBm
3 to 7.5 GHz	–64 dBc	+12 dBm	–72 dBc	+16 dBm
7.5 to 13.6 GHz	–62 dBc	+11 dBm	–70 dBc	+15 dBm
13.6 to 26.5 GHz	–60 dBc	+10 dBm	–68 dBc	+14 dBm
Preamp On *(OptionP03, P07, P13, P26)* (Two –45 dBm tones at the input, spaced by 100 kHz, input attenuation 0 dB)				–8 dBm (nominal)

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

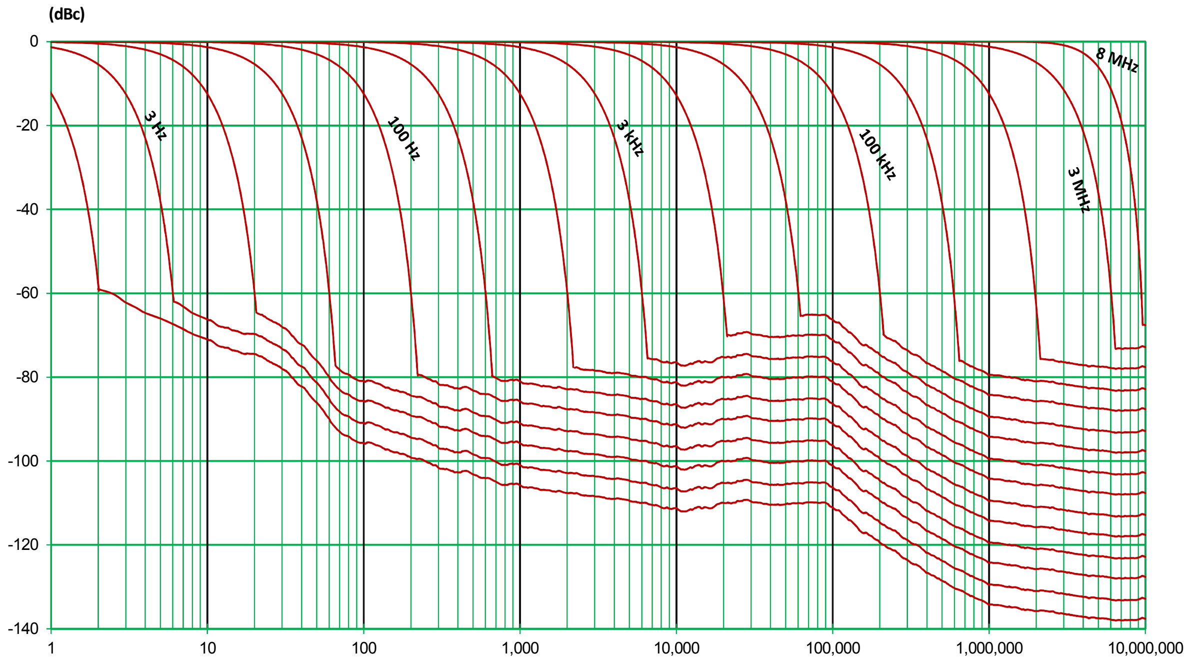
Nominal Dynamic Range at 1 GHz [Plot]



Nominal Dynamic Range Band 1-10 [Plot]

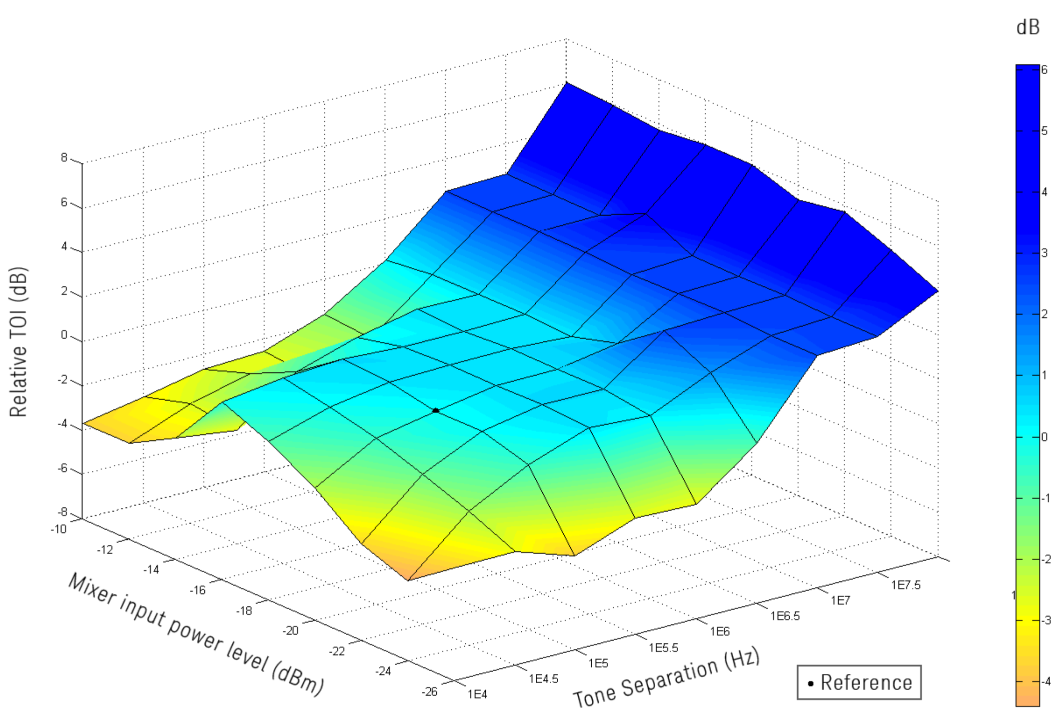


Nominal Dynamic Range vs. Offset Frequency vs. RBW [Plot]



Conditions: CF = 600 MHz; Mixer Level = -10 dBm; Average Type = Log

Nominal TOI vs. Mixer Level and Tone Separation [Plot]



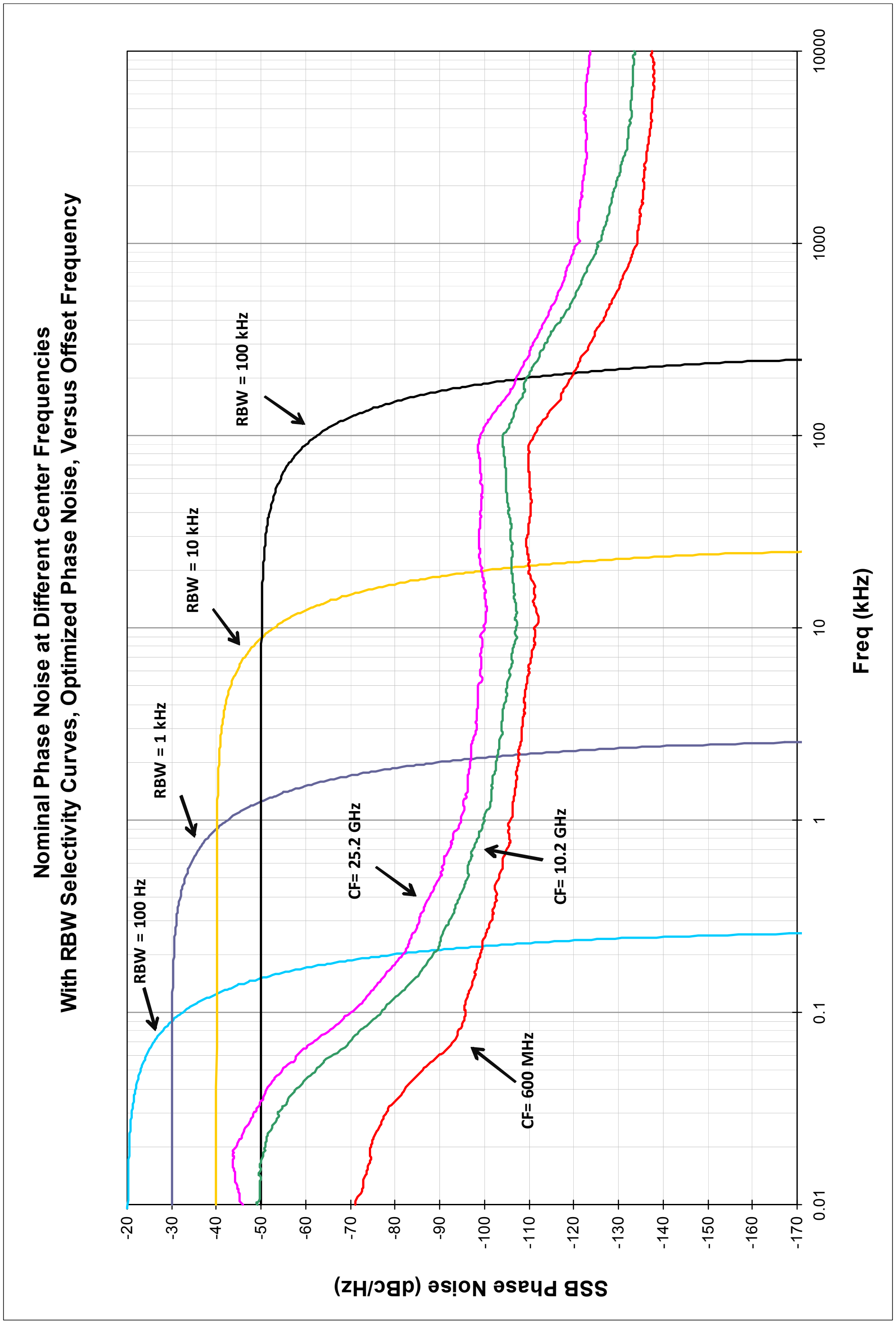
Phase Noise

Description	Specifications		Supplemental Information
Phase Noise (Center Frequency = 1 GHz, Best-case Optimization[a] Internal Reference[b])			Noise Sidebands
Offset Frequency	**20 to 30°C**	**Full range**	**Typical**
100 Hz			–90 dBc/Hz (nominal)
1 kHz	–102 dBc/Hz	–100 dBc/Hz	–105 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	–132 dBc/Hz
10 MHz			–145 dBc/Hz (nominal)

a. 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**.

b. 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 for *Option* ≤ F26



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)	±1.23 dB	±0.62 dB (95th percentile)

a. See "Absolute Amplitude Accuracy" on page 24.
b. See "Power Bandwidth Accuracy" on page 19.
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]
Passbandwidth[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	±0.21 dB	At ACPR range of −30 to −36 dBc with optimum mixer level[i]
MS (UE)	10 MHz	±0.25 dB	At ACPR range of −40 to −46 dBc with optimum mixer level[j]
BTS	5 MHz	±0.89 dB[h]	At ACPR range of −42 to −48 dBc with optimum mixer level[k]
BTS	10 MHz	±0.67 dB	At ACPR range of −47 to −53 dBc with optimum mixer level[j]
BTS	5 MHz	±0.39 dB	At −48 dBc non-coherent ACPR[l]
Dynamic Range			RRC weighted, 3.84 MHz noise bandwidth
Noise Correction	**Offset Freq**		**ACLR** (typical)[m]
Off	5 MHz		−68.0 dB
Off	10 MHz		−72.0 dB
On	5 MHz		−73.0 dB
On	10 MHz		−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 $x - 0.572 \times \text{RBW}$.
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]	±0.20 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=1 MHz) (1 to 3.0 GHz)	75.0 dB	79.1 dB (typical)
Sensitivity[b], absolute (RBW=1 MHz) (1 to 3.0 GHz)	−82.5 dBm	−86.5 dBm (typical)
Accuracy		Attenuation = 10 dB
100 kHz to 3.0 GHz		±1.17 dB (95th percentile)
3.0 to 7.5 GHz		±2.17 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[a][b])	73.0 dB	78.1 dB (typical)
Sensitivity, absolute (750 kHz offset[c])	–99.7 dBm	–102.7 dBm (typical)
Accuracy (750 kHz offset)		
Relative[d]	±0.11 dB	
Absolute[e] (20 to 30°C)	±1.78 dB	±0.66 dB (95th percentile)
Case: Radio Std = 3GPP W-CDMA		
Dynamic Range, relative (2.515 MHz offset[a][d])	77.5 dB	82.4 dB (typical)
Sensitivity, absolute (2.515 MHz offset[c])	–97.7 dBm	–101.7 dBm (typical)
Accuracy (2.515 MHz offset)		
Relative[d]	±0.15 dB	
Absolute[e] (20 to 30°C)	±1.78 dB	±0.66 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 21 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 F03:	Frequency range, 10 Hz to 3 GHz
Option F07:	Frequency range, 10 Hz to 7.5 GHz
Option F13:	Frequency range, 10 Hz to 13.6 GHz
Option F26:	Frequency range, 10 Hz to 26.5 GHz
Option B25:	Analysis Bandwidth, 25 MHz
Option EDP:	Enhanced Display Package
Option EMC:	Basic EMC Functionality
Option FSA:	Fine resolution Step Attenuator, 7.5 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 PAA:	Precision Amplitude Accuracy
Option PFR:	Precision Frequency Reference
N9063A:	Analog Demodulation measurement application
N9068A:	Phase Noise measurement application
N9069A:	Noise Figure 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 European EMC Directive 2004/108/EC — IEC/EN 61326-1 — CISPR Pub 11 Group 1, class A — AS/NZS CISPR 11[a] — ICES/NMB-001 This ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB-001 du Canada.

a. The M9290A is in full compliance with CISPR 11, Class A emission limits and is declared as such.

Description	Specification	Supplemental Information
Power Requirements		
Power Consumption	≤ 65 W	Drawn from chassis

Description	Supplemental Information
Measurement Speed[a]	Nominal
Local measurement and display update rate[b]	11 ms (90/s)
Remote measurement and LAN transfer rate[b]	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.

Description	Specifications	Supplemental Information
Weight		Weight without options
Net		1.9 kg (nominal)
Shipping		4.2 kg (nominal)
Cabinet Dimensions		Cabinet dimensions exclude front protrusions.
Height	132 mm	
Width	82 mm	
Length	202 mm	

Inputs/Outputs

Description	Specifications	Supplemental Information
RF In		
Connector		
Standard	3.5 mm female	
Impedance		50Ω (nominal)

Description	Specifications	Supplemental Information
10 MHz Out		
Connector	SMB male	
Impedance		50Ω (nominal)
Output Amplitude		≥ 0 dBm (nominal)
Frequency	10 MHz × (1 + frequency reference accuracy)	

Description	Specifications	Supplemental Information
10 MHz In		
Connector	SMB male	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
Trigger In		
Connector	SMB male	
Impedance		10 kΩ (nominal)
Trigger Level Range	−5 to +5 V	1.5 V (TTL) factory preset

Description	Specifications	Supplemental Information
Trigger Out		
Connector	SMB male	
Impedance		50Ω (nominal)
Level		5 V TTL

Description	Specifications	Supplemental Information
Analog Out		
Connector	SMB male	
Impedance		50Ω (nominal)

Description	Specifications	Supplemental Information
Noise Source		For use with Keysight 346 and SNS Series noise sources

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)
	All Level 1, 2 or 3 electrical equipment offered for sale in Australiaand New Zealand by Responsible Suppliers must be marked with the Regulatory Compliance Mark.
	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.
	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.
	Korea Certification indicates this equipment is Class A suitable for professional use and is for use in electromagnetic environments outside of the home.

Declaration of Conformity

A copy of the Manufacturer's European Declaration of Conformity for this instrument can be found at the following website:

http://regulations.about.keysight.com/DoC/search.htm

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 30 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 53 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 (DANL)" on page 29.

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	16 Bits	10 MHz (standard) span

3 Options T03, T07, T13 and T26 - Tracking Generators

This chapter contains specifications for the *Option T03, T07, T13* and *T26* tracking generator.

General Specifications

Description	Specifications	Supplemental Information
Output Frequency Range		
Option T03	2 MHz to 3 GHz	
Option T07	2 MHz to 7.5 GHz	
Option T13	2 MHz to 13.6 GHz	
Option T26	2 MHz to 26.5 GHz	

Description	Specifications	Supplemental Information
Frequency Resolution	10 Hz	

Description	Specifications	Supplemental Information
Output Power Level		
Range		
2 MHz to 10 GHz	–35 to 0 dBm	
10 to 20 GHz	–35 to –5 dBm	
20 to 26.5 GHz	–40 to –12 dBm	
Resolution	0.1 dB	
Absolute Accuracy (at 50 MHz, –15 dBm)	±1.0 dB (typical)	±0.3 dB (nominal)
Output Flatness (Referenced to 50 MHz, –15 dBm)		**Nominal**
2 MHz to 7.5 GHz	±1.0 dB (95th percentile)	±0.3 dB
7.5 to 13.6 GHz	±1.2 dB (95th percentile)	±0.3 dB
13.6 to 23 GHz	±1.8 dB (95th percentile)	±0.6 dB
23 to 26 GHz	±2.5 dB (95th percentile)	±1.2 dB
26 to 26.5 GHz		±2.3 dB

Description	Specifications	Supplemental Information
Level Accuracy		**Nominal**
2 MHz to 7.5 GHz		±0.8 dB
7.5 to 13.6 GHz		±0.9 dB
13.6 to 23 GHz		±1.5 dB
23 to 26 GHz		±1.8 dB
26 to 26.5 GHz		±2.9 dB

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

Description	Specifications	Supplemental Information
Phase Noise		
Noise Sidebands (Center Frequency = 1 GHz[a] Internal Reference[b])		
Offset		**Typical**
10 kHz		−100 dBc/Hz
100 kHz		−108 dBc/Hz
1 MHz		−122 dBc/Hz

a. The typical 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		
(Maximum output)		**Nominal**
2nd Harmonic Spurs		–14 dBc
3rd Harmonic Spurs		–9 dBc

Description	Specifications	Supplemental Information
RF Power-Off Residuals		
2 MHz to 26 GHz		< –90 dBm (nominal)

Description	Specifications	Supplemental Information
Output VSWR		**Nominal**
2 MHz to 7 GHz		< 1.7:1
7 to 23 GHz		< 2.5:1
23 to 26.5 GHz		< 3.5:1

Description	Specifications	Supplemental Information
RF Output		
Connector		
Standard	3.5 mm female	
Impedance		50Ω (nominal)

4 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 4-1and Table 4-2
CISPR		Available when the EMC Standard is CISPR
200 Hz, 9 kHz, 120 kHz, 1 MHz		–6 dB bandwidths, subject to masks; meets CISPR standard[a]
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; meets MIL-STD[b]
Non-MIL STD bandwidths	30, 300 Hz, 3, 30, 300 kHz, 3, 10 MHz	–6 dB bandwidths

a. CISPR 16-1-1 (2010)
b. MIL-STD 461 D/E/F (20 Aug, 1999)

Table 4-1 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 4-2 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		Meets CISPR standards[a]
Relative amplitude accuracy versus pulse repetition rate		Meets CISPR standards[a]
Quasi-Peak to average response ratio		Meets CISPR standards[a]
RMS Average Detector		Meets CISPR standards[a]

a. CISPR 16-1-1 (2010)

5 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 30 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)					
Center Freq (GHz)	**Analysis Width** (MHz)	**Max Error**[b] (Exceptions[c])	**Midwidth Error** (95th Percentile)	**Slope** (dB/MHz) (95th Percentile)	**RMS**[d] (nominal)
≤3.0	10 to ≤25	±0.45 dB	±0.12 dB	±0.1	0.03 dB
>3.0, ≤26.5	10 to ≤25				0.2 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. 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.

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

d. 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	
Center Freq (GHz)	**Span** (MHz)		**Peak-to-Peak** (nominal)	**RMS** (nominal)[a]
≥0.02, ≤ 3.0	10 to ≤25		1.0°	0.3°
>3.0, ≤ 7.5	10 to ≤25		1.0°	0.5°

a. 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	16 bits	

6 Option P03, P07, P13 and P26 - Preamplifiers

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

Specifications Affected by Preamp

Specification Name	Information
Frequency Range	See "Frequency Range" on page 12 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 21 of the core specifications.
Gain Compression	See specifications in this chapter.
DANL	See specifications in this chapter.
Frequency Response	See specifications in this chapter.
Input Attenuation Switching Uncertainty	See specifications in this chapter.
RF Input VSWR	See plot in this chapter.
Absolute Amplitude Accuracy	See "Absolute Amplitude Accuracy" on page 24 of the core specifications.
Display Scale Fidelity	See "Display Scale Fidelity" on page 26 of the core specifications.
Second Harmonic Distortion	See "Second Harmonic Distortion" on page 31 of the core specifications.
Third Order Intermodulation Distortion	See "Third Order Intermodulation" on page 31 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 73 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)	+30 dBm (1 W)	

Description	Specifications	Supplemental Information
1 dB Gain Compression Point (Two-tone)[abc]		
(Preamp On *(Option P03, P07, P13, P26)* Maximum power at the preamp[d] for 1 dB gain compression)		
10 to 50 MHz		−15 dBm (nominal)
50 MHz to 26.5 GHz		−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	Specifications	Supplemental Information
Input Attenuation Switching Uncertainty (Relative to 10 dB (reference setting), Preamp On)		Refer to the footnote for "Band Overlaps" on page 12
50 MHz (reference frequency)	±0.30 dB	±0.15 dB (typical)

Description	Specifications		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 12.
Option P03, P07, P13, P26	**20 to 30°C**	**Full range**	**Typical**
100 kHz to 1 MHz			–144 dBm (nominal)
1 to 10 MHz[b]	−154 dBm	−153 dBm	−158 dBm
10 MHz to 1.5 GHz	−160 dBm	−159 dBm	−163 dBm
1.5 to 4.5 GHz	−160 dBm	−159 dBm	−163 dBm
4.5 to 7 GHz	−157 dBm	−156 dBm	−161 dBm
7 to 9.5 GHz	−158 dBm	−156 dBm	−160 dBm
9.5 to 13 GHz	−156 dBm	−155 dBm	−160 dBm
13 to 14.5 GHz	−158 dBm	−157 dBm	−161 dBm
14.5 to 19.3 GHz	−153 dBm	−152 dBm	−157 dBm
19.3 to 23 GHz	−152 dBm	−151 dBm	−157 dBm
23 to 24 GHz	−150 dBm	−149 dBm	−155 dBm
24 to 26.5 GHz	−144 dBm	−142 dBm	−149 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.

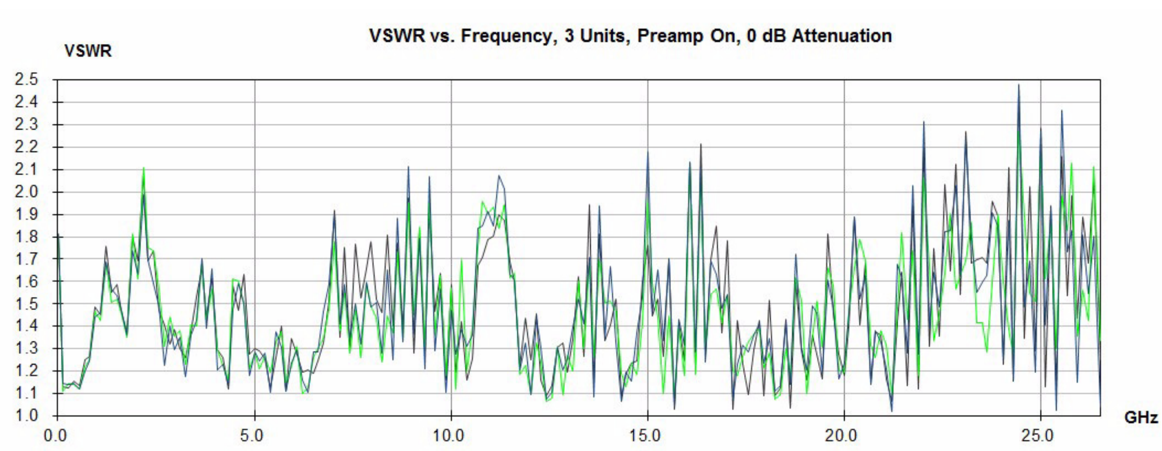
b. DANL below 10 MHz is affected by phase noise around the LO feedthrough signal. Specifications apply with the best setting of the Phase Noise Optimization control, which is to choose the “Best Close-in ϕ Noise" for frequencies below 25 kHz, and “Best Wide Offset ϕ Noise" for frequencies above 85 kHz.

Description	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)		
		95th Percentile
9 kHz to 10 MHz		±0.5 dB
10 MHz to 3 GHz		±1.0 dB
3 to 7.5 GHz		±1.2 dB
7.5 to 13.6 GHz		±1.2 dB
13.6 to 15.5 GHz		±1.1 dB
15.5 to 21 GHz		±1.2 dB
21 to 24.2 GHz		±1.8 dB
24.2 to 26.5 GHz		±2.4 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	Specifications	Supplemental Information
RF Input VSWR - Preamp On		
Frequency		Input Attenuation 0 dB
10 MHz to 13.6 GHz		< 2.2:1
13.6 to 26.5 GHz		< 2.5:1

Nominal Instrument Input VSWR



7 Option PAA - Precision Accuracy Amplitude Feature

This chapter contains specifications for the *Option PAA*, Precision Accuracy Amplitude feature.

Amplitude

Description	Specifications		Supplemental Information
Absolute Amplitude Accuracy			
(Input level: -10 to -50 dBm RBW: 1 Hz to 3 MHz)			
Preamp Off (10 dB Attenuation)	**20 to 30°C**	**Full range**	**Typical**
9 kHz to 10 MHz	±0.70 dB	±0.80 dB	±0.31 dB
10 MHz to 3 GHz	±0.85 dB	±1.00 dB	±0.40 dB
3 to 7.5 GHz	±0.95 dB	±1.10 dB	±0.44 dB
7.5 to 9.55 GHz	±0.90 dB	±1.10 dB	±0.38 dB
9.55 to 12.55 GHz	±0.95 dB	±1.20 dB	±0.44 dB
12.55 to 13.6 GHz	±0.90 dB	±1.20 dB	±0.32 dB
13.6 to 15.55 GHz	±0.95 dB	±1.20 dB	±0.35 dB
15.55 to 22.8 GHz	±1.10 dB	±1.30 dB	±0.50 dB
22.8 to 24.2 GHz	±1.20 dB	±1.40 dB	±0.50 dB
24.2 to 26.5 GHz	±1.30 dB	±1.70 dB	±0.57 dB
Preamp On (0 dB Attenuation)			
100 kHz to 10 MHz			±0.30 dB
10 MHz to 3 GHz			±0.65 dB
3 to 7.5 GHz			±0.73 dB
7.5 to 9.55 GHz			±0.49 dB
9.55 to 12.55 GHz			±0.71 dB
12.55 to 19.3 GHz			±0.65 dB
19.3 to 21 GHz			±0.80 dB
21 to 22.8 GHz			±1.20 dB
22.8 to 24.2 GHz			±1.39 dB
24.2 to 26.5 GHz			±1.66 dB

8 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.

9 Analog Demodulation Measurement Application

This chapter contains specifications for the N9063A 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 80.

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	$\frac{N + D}{S + N + D}$	$(P_{total}-P_{signal})^{1/2}/(P_{total})^{1/2} \times 100\%$
THD	$\frac{D}{S}$	$(P_{total}-P_{signal})^{1/2}/(P_{total})^{1/2} \times 100\%$ 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 10^{th} harmonic unless otherwise indicated. In practice, the term P_{noise} includes Spurs, IMD, Hum, etc. (All but harmonics.)

RF Carrier Frequency and Band wid th

Description	Specifications	Supplemental Information
Carrier Frequency		
Maximum Frequency		
Option F03	3.0 GHz	RF/μW frequency option
Option F07	7.5 GHz	RF/μW frequency option
Option F13	13.6 GHz	RF/μW frequency option
Option F26	26.5 GHz	RF/μW frequency option
Minimum Frequency		
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 Spectrum). 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]

Description	Specifications	Supplemental Information
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 Notchc		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 N9063A 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 validate 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: ≤ 1 MHz
- 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 24 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]		±(2% × Reading + DistResidual)[c] (nominal)
THD[d]		±(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 24 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 24 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] THD		0.8% (nominal) 0.1% (nominal)
Post-Demod Distortion Accuracy		
(Rate: 1 to 10 kHz, Deviation: 0.2 to 100 rad)		
Distortion (SINAD)[b] THD		±(2% × Reading + DistResidual) ±(2% × Reading + DistResidual)
Distortion Measurement Range		
Distortion (SINAD)[b] SINAD		Residual to 100% (nominal) 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 (SMB) is located at the analyzer’s front panel. It is a multi-purpose output, whose function depends on options and operating mode (active application). When the N9063A 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 N9063A 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 N9063A 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)

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)	

*. Requires *Option N9063A-3TP*, which in turn requires that the instrument also has *Option N9063A-2TP* installed and licensed.

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)

10 VXA Vector Signal Analysis Measurement Application

This chapter contains specifications for the N9064A VXA vector signal analysis 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.

Specs & Nominals

These specifications summarize the performance for the CXA-m Signal Analyzer and apply to the VXA vector signal analysis measurement application inside the analyzer. Values shown in the column labeled "Specs & Nominals" are a mix of warranted specifications, guaranteed-by-design parameters, and conservative but not warranted observations of performance of sample instruments.

Vector Signal Analysis Performance (N9064A-1FP)

Frequency

Description	Specs & Nominals	Supplemental Information
Range		See "Frequency Range" on page 12
Center Frequency Tuning Resolution	1 mHz	
Frequency Span	10 MHz (standard)	wider with options, such as 25 MHz (*Option B25*)
Frequency Points per Span	Calibrated points: 51 to 409,601 Displayed points: 51 to 524,288	

Resolution Bandwidth (RBW)

Description	Specs & Nominals			Supplemental Information
Range	RBWs range from less than 1 Hz to greater than 2.8 MHz (standard), or greater than 7 MHz (*Option B25*)			The range of available RBW choices is a function of the selected frequency span and the number of calculated frequency points. Users may step through the available range in a 1-3-10 sequence or directly enter an arbitrarily chosen bandwidth.
RBW Shape Factor				The window choices below allow the user to optimize the RBW shape as needed for best amplitude accuracy, best dynamic range, or best response to transient signal characteristics.
Window	**Selectivity**	**Passband Flatness**	**Rejection**	
Flat Top	0.41	0.01 dB	> 95 dBc	
Gaussian Top	0.25	0.68 dB	> 125 dBc	
Hanning	0.11	1.5 dB	> 31 dBc	
Uniform	0.0014	4.0 dB	> 13 dBc	

Input

Description	Specs & Nominals	Supplemental Information
Range		Full Scale, combines attenuator setting and ADC gain
standard	–20 dBm to 20 dBm, 10 dB steps	
Option FSA	–20 dBm to 22 dBm, 2 dB steps	
Option P03	–40 dBm to 20 dBm, 10 dB steps, up to 3 GHz	
Option P03 and FSA	–40 dBm to 22 dBm, 2 dB steps, up to 3 GHz	
ADC overload	+2 dBfs	

Amplitude Accuracy

Description	Specs & Nominals	Supplemental Information
Absolute Amplitude Accuracy		See "Absolute Amplitude Accuracy" on page 24
Amplitude Linearity		See "Display Scale Fidelity" on page 26
IF Flatness		
Span ≤ 10 MHz		See "IF Frequency Response" on page 22
Span = 25 MHz		See
Sensitivity		
–20 dBm range		Compute from DANL[a]; see "Displayed Average Noise Level (DANL)" on page 29
–40 dBm range		Requires preamp option. Compute from Preamp DANL[a]; see "Displayed Average Noise Level (DANL)" on page 29

a. DANL is specified in the narrowest resolution bandwidth (1 Hz) with log averaging, in accordance with industry and historic standards. The effect of log averaging is to reduce the noise level by 2.51 dB. The effect of using a 1 Hz RBW is to increase the measured noise because the noise bandwidth of the 1 Hz RBW filter is nominally 1.056 Hz, thus adding 0.23 dB to the level. The combination of these effects makes the sensitivity, in units of dBm/Hz, 2.27 dB higher than DANL in units of dBm in a 1 Hz RBW.

Dynamic Range

Description	Specs & Nominals	Supplemental Information
Third-order intermodulation distortion (Two −10 dBfs tones, 10 MHz to 7.5 GHz, tone separation ≥ 100 kHz)		−72 dBc (nominal)
Noise Density at 1 GHz		
Input Range	**Density**	
≥−10 dBm	−137 dBfs/Hz	
−20 dBm to −12 dBm	−127 dBfs/Hz	
−30 dBm to −22 dBm	−130 dBfs/Hz	requires preamp option
−40 dBm to −32 dBm	−120 dBfs/Hz	requires preamp option
Residual Responses		−100 dBm (nominal)
Image Response (10 MHz to 26.5 GHz)		−64 dBc (typical)
LO related spurious (10 MHz to 26.5 GHz)		−64 dBc (typical)
Other spurious 200 Hz < f < 10 MHz from carrier		−65 dBc (nominal)

Analog Modulation Analysis (N9064A-1FP)

Description	Specs & Nominals	Supplemental Information
AM Demodulation (Span ≤ 12 MHz, Carrier ≤ −17 dBfs)		
Demodulator Bandwidth	Same as selected measurement span	
Modulation Index Accuracy	±1%	
Harmonic Distortion	−50 dBc	Relative to 100% modulation index
Spurious	−60 dBc	Relative to 100% modulation index
Cross Demodulation	< 1.1% AM on an FM signal with 50 kHz modulation rate, 200 kHz deviation	
PM Demodulation (Deviation < 180°, modulation rate ≤ 500 kHz)		
Demodulator Bandwidth	Same as selected measurement span, except as noted	
Modulation Index Accuracy	±0.5°	
Harmonic Distortion	−55 dBc	
Spurious	−60 dBc	
Cross Demodulation	1° PM on an 80% modulation index AM signal, modulation rate ≤ 1 MHz	

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

Flexible Digital Modulation Analysis (N9064A-2FP)

Description	Specs & Nominals	Supplemental Information
Accuracy		
Residual Errors		Modulation formats include BPSK, D8PSK, DQPSK, QPSK, (16/32/64/128/256/512/1024)QAM, (16/32/64/128/256)DVBQAM, π/4-DQPSK, 8-PSK. EVM normalization reference set to Constellation Maximum. Transmit filter is Root Raised Cosine with alpha=0.35. Center frequency 1 GHz. Signal amplitude of -16 dBm, analyzer range set to -10 dBm. Result length set to at least 150 symbols, or 3 × {Number of ideal state locations}. RMS style averaging with a count of 10. Phase Noise Optimization adjusted based on symbol rate of measurement. Available span dependent on analyzer hardware bandwidth options.
Residual EVM		
Symbol Rate/Span		
1 Msps/5 MHz	≤0.7% rms	
10 Msps/25 MHz[a]	≤0.8% rms	
Magnitude Error		
Symbol Rate/Span		
1 Msps/5 MHz	≤0.5% rms	
10 Msps/25 MHz[a]	≤0.5% rms	
Phase Error		
Symbol Rate/Span		
1 Msps/5 MHz	≤0.6° rms	
10 Msps/25 MHz[a]	≤0.6° rms	
Frequency Error	≤Symbol rate/500,000	Added to frequency accuracy if applicable
IQ Origin Offset[b]	≤–60 dB	
Residual Errors		Modulation formats include MSK and MSK2. Transmit filter is Gaussian with BT=0.3. Center frequency 1 GHz. Signal amplitude of -16 dBm. Analyzer range set to -10 dBm. Result length set to 150 symbols. RMS style averaging with a count of 10. Available span dependent on analyzer hardware bandwidth options.
Residual EVM		
Symbol Rate/Span		
10 Msps/25 MHz[a]	≤0.9% rms	
Phase Error		
Symbol Rate/Span		
10 Msps/25 MHz[a]	≤0.5° rms	
Residual EVM for Video Modulation Formats		
8 or 16 VSB	1.5% (SNR 36 dB)	Symbol rate = 10.762 MHz, α= 0.115, frequency < 3.0 GHz, 7 MHz span, full-scale signal, range ≥–30 dBm, result length = 800, averages = 10

Description	Specs & Nominals	Supplemental Information
16, 32, 64, 128, 256, 512, or 1024 QAM	1.0% (SNR 40 dB)	Symbol rate = 6.9 MHz, α= 0.15, frequency < 3.0 GHz, 8 MHz span, full-scale signal, range ≥–30 dBm, result length = 800, averages = 10

a. Without Option B25, span is restricted to ≤10 MHz.

b. i+jQ measurements performed signal amplitude and analyzer range near 0 dBm, with a 0 Hz center frequency. I/Q origin offset metric does not include impact of analyzer DC offsets

11 Phase Noise Measurement Application

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

General Specifications

Description	Specifications	Supplemental Information
Maximum Carrier Frequency		
Option F03	3 GHz	
Option F07	7.5 GHz	
Option F13	13.6 GHz	
Option F26	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]	±1.18 dB	
Overdrive On setting		±1.06 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 Offset ≥ 1 MHz		 Negligible error (nominal) ±(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 F03*.

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 36.

12 Noise Figure Measurement Application

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

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-m 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 available on the Keysight web: 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

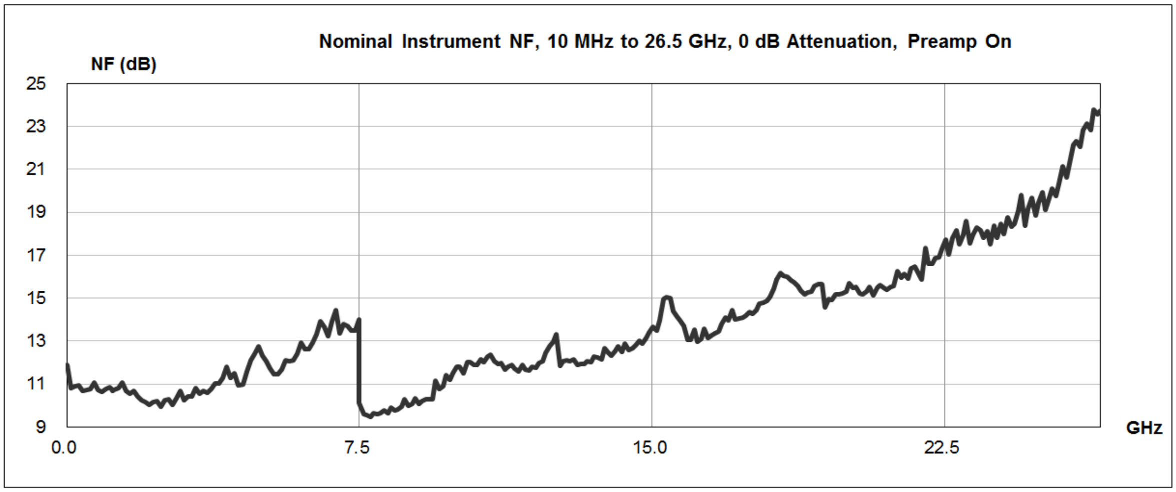
a. The Noise Figure Uncertainty Calculator requires the parameters shown in order to calculate the total uncertainty of a Noise Figure measurement.

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



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