Keysight X-Series PXE EMI Receiver

This manual provides documentation for the following:

N9048B PXE EMI Receiver

N9048B PXE Specifications Guide (Comprehensive Reference Data)

KEYSIGHT TECHNOLOGIES

Notices

Trademark Acknowledgments

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1 Keysight PXE EMI Receiver

This chapter contains the specifications for the EMI receiver. The specifications and characteristics for the measurement applications and options are covered in the chapters that follow.

Definitions and Requirements

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

Definitions

- Specifications describe the performance of parameters covered by the product warranty (temperature = 0° to 55°C, unless otherwise noted).
- 95th percentile values indicate the breadth of the population (≈2σ) 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 receiver to meet its specifications.

- The receiver 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 receiver 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 receiver 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 receiver may fail to meet specifications without informing the user. If Auto Align is set to Light, performance is not warranted, and nominal performance will degrade to become a factor of 1.4 wider for any specification subject to alignment, such as amplitude tolerances.

Certification

Keysight Technologies certifies that this product met its published specifications at the time of shipment from the factory. Keysight Technologies further certifies that its calibration measurements are traceable to the International System of Units (SI) via national metrology institutes (www.keysight.com/find/NMI) that are signatories to the CIPM Mutual Recognition Arrangement.

Frequency and Time

Description	Specifications		Supplemental Information
Frequency Range			
Maximum Frequency			
RF Input 1			
Option 503	3.6 GHz		
Option 508	8.4 GHz		
Option 526	26.5 GHz		
RF Input 2	1.0 GHz		
Minimum Frequency			
RF Preselector Off	AC Coupled[a]	DC Coupled	
Preamp Off	10 MHz	2 Hz	
Preamp On	10 MHz	9 kHz	
Preamp Off, LNA On	10 MHz	150 kHz	
RF Preselector On	AC Coupled[a]	DC Coupled	
Preamp Off	10 MHz	2 Hz	
Preamp On	10 MHz	1 kHz	
Preamp Off, LNA On	10 MHz	150 kHz	
Band	**Harmonic Mixing Mode**	**LO Multiple (N[b])**	**Band Overlaps[c]**
0 (2 Hz to 3.6 GHz)	1–	1	*Options 503, 508, 526*
1 (3.5 GHz to 8.4 GHz)	1–	1	*Options 508, 526*
2 (8.3 GHz to 13.6 GHz)	1–	2	*Options 526*
3 (13.5 to 17.1 GHz)	2–	2	*Option 526*
4 (17.0 to 26.5 GHz)	2–	4	*Option 526*

a. AC Coupled only applicable to Freq *Options 503, 508* and *526*.
b. N is the LO multiplication factor. For negative mixing modes (as indicated by the "–" in the "Harmonic Mixing Mode" column), the desired 1st LO harmonic is higher than the tuned frequency by the 1st IF (5.1225 GHz for band 0, 322.5 MHz for all other bands).

c. In the band overlap regions, for example, 3.5 to 3.6 GHz, the receiver may use either band for measurements, in this example Band 0 or Band 1. The receiver gives preference to the band with the better overall specifications (which is the lower numbered band for all frequencies below 26 GHz), but will choose the other band if doing so is necessary to achieve a sweep having minimum band crossings. For example, with CF = 3.58 GHz, with a span of 40 MHz or less, the receiver uses Band 0, because the stop frequency is 3.6 GHz or less, allowing a span without band crossings in the preferred band. If the span is between 40 and 160 MHz, the receiver uses Band 1, because the start frequency is above 3.5 GHz, allowing the sweep to be done without a band crossing in Band 1, though the stop frequency is above 3.6 GHz, preventing a Band 0 sweep without band crossing. With a span greater than 160 MHz, a band crossing will be required: the receiver scans up to 3.6 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 (3.58 GHz), the preferred band is band 0 (indicated as frequencies under 3.6 GHz) and the alternate band is band 1 (3.5 to 8.4 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 3.58 GHz. If the sweep has been configured so that the signal at 3.58 GHz is measured in Band 1, the analysis behavior is nominally as stated in the Band 1 specification line (3.5 to 8.4 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 Band 0/Band 1 crossing is this: The specifications given in the “Specifications” column which are described as “3.5 to 8.4 GHz” represent nominal performance from 3.5 to 3.6 GHz, and warranted performance from 3.6 to 8.4 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 × N[c] p-p in 20 ms (nominal)
Precision Frequency Reference		
(Option PFR)		
Accuracy	±[(time since last adjustment × aging rate) + temperature stability + calibration accuracy[a]][d]	
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[e]		Nominal
300 s after turn on		$\pm 1 \times 10^{-7}$ of final frequency
900 s after turn on		$\pm 1 \times 10^{-8}$ of final frequency
Achievable Initial Calibration Accuracy[f]	$\pm 4 \times 10^{-8}$	

Description	Specifications	Supplemental Information
Standby power to reference oscillator		Not supplied
Residual FM (Center Frequency = 1 GHz 10 Hz RBW, 10 Hz VBW)		≤0.25 Hz × N[c] 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.
c. N is the LO multiplication factor.
d. The specification applies after the receiver has been powered on for four hours.
e. 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 warm-up occurs. The effect of retracing is included within the "Achievable Initial Calibration Accuracy" term of the Accuracy equation.
f. 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[c]
Example for EMC[d]		±0.0032% (nominal)

a. The warranted performance is only the sum of all errors under autocoupled conditions. Under non-autocoupled conditions, the frequency readout accuracy will nominally meet the specification equation, except for conditions in which the RBW term dominates, as explained in examples below. The nominal RBW contribution to frequency readout accuracy is 2% of RBW for RBWs from 1 Hz to 390 kHz, 4% of RBW from 430 kHz through 3 MHz (the widest autocoupled RBW), and 30% of RBW for the (manually selected) 4, 5, 6 and 8 MHz RBWs.
First example: a 120 MHz span, with autocoupled RBW. The autocoupled ratio of span to RBW is 106:1, so the RBW selected is 1.1 MHz. The 5% × RBW term contributes only 55 kHz to the total frequency readout accuracy, compared to 300 kHz for the 0.0.25% × span term, for a total of 355 kHz. In this example, if an instrument had an unusually high RBW centering error of 7% of RBW (77 kHz) and a span error of 0.20% of span (240 kHz), the total actual error (317 kHz) would still meet the computed specification (355 kHz).
Second example: a 20 MHz span, with a 4 MHz RBW. The specification equation does not apply because the Span: RBW ratio is not autocoupled. If the equation did apply, it would allow 50 kHz of error (0.25%) due to the span and 200 kHz error (5%) due to the RBW. For this non-autocoupled RBW, the RBW error is nominally 30%, or 1200 kHz.

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

c. Specifications apply to traces in most cases, but there are exceptions. Specifications always apply to the peak detector. Specifications apply when only one detector is in use and all active traces are set to Clear Write. Specifications also apply when only one detector is in use in all active traces and the "Restart" key has been pressed since any change from the use of multiple detectors to a single detector. In other cases, such as when multiple simultaneous detectors are in use, additional errors of 0.5, 1.0 or 1.5 sweep points will occur in some detectors, depending on the combination of detectors in use.

d. In most cases, the frequency readout accuracy of the receiver 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 receiver. 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 receiver 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 receiver, the specified count accuracy is ±0.100 Hz under the test conditions of footnote a. This error is a noisiness of the result. It will increase with noisy sources, wider RBWs, lower S/N ratios, and source frequencies > 1 GHz.

Description	Specifications	Supplemental Information
Frequency Span		
Range		
Swept and FFT		
Option 503	0 Hz, 10 Hz to 3.6 GHz	
Option 508	0 Hz, 10 Hz to 8.4 GHz	
Option 526	0 Hz, 10 Hz to 26.5 GHz	
Resolution	2 Hz	
Span Accuracy		
Stepped	±(0.25% × span + horizontal resolution[a])	
Swept	±(0.25% × span + horizontal resolution[a])	
FFT	±(0.1% × span + horizontal resolution[a])	

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

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

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

Description	Specifications	Supplemental Information
Triggers		Additional information on some of the triggers and gate sources
Video		Independent of Display Scaling and Reference Level
Minimum settable level	–170 dBm	Useful range limited by noise
Maximum usable level		Highest allowed mixer level[a] + 2 dB (nominal)
Detector and Sweep Type relationships		
Sweep Type = Swept		
Detector = Normal, Peak, Sample or Negative Peak		Triggers on the signal before detection, which is similar to the displayed signal
Detector = Average		Triggers on the signal before detection, but with a single-pole filter added to give similar smoothing to that of the average detector
Sweep Type = FFT		Triggers on the signal envelope in a bandwidth wider than the FFT width
RF Burst		
Level Range		–50[b] to –10 dBm plus attenuation (nominal)
Level Accuracy		±2 dB + Absolute Amplitude Accuracy (nominal)
Bandwidth (–10 dB)		
Most cases		16 MHz (nominal)
Sweep Type = FFT; FFT Width = 25 MHz; Span ≥ 8 MHz		30 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 listed above.
External Triggers		See "Trigger Inputs (Trigger 1 In, Trigger 2 In)" on page 65

a. The highest allowed mixer level depends on the IF Gain. It is nominally –10 dBm for Preamp Off and IF Gain = Low.
b. Noise will limit trigger level range at high frequencies, such as above 15 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)	1 μs 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 1 External 2 Line RF Burst Periodic	Pos or neg edge triggered

Description	Specifications	Supplemental Information
Number of Frequency Sweep/Step Points (buckets)		
Factory preset	1001	
Range	1 to 100,001	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.	
CISPR Standard Bandwidths		200 Hz, 9 kHz, 120 kHz, 1 MHz	–6 dB, subject to CISPR mask
MIL Standard Bandwidths		10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz	–6 dB
Power bandwidth accuracy[a]			
RBW Range	**CF Range**		
1 Hz to 750 kHz	All	±1.0% (0.044 dB)	
820 kHz to 1.2 MHz	< 3.6 GHz	±2.0% (0.088 dB)	
1.3 to 2.0 MHz	< 3.6 GHz		±0.07 dB (nominal)
2.2 to 3 MHz	< 3.6 GHz		±0.15 dB (nominal)
4 to 8 MHz	< 3.6 GHz		±0.25 dB (nominal)
Accuracy (–3.01 dB bandwidth)[b]			
1 Hz to 1.3 MHz RBW			±2% (nominal)
1.5 MHz to 3 MHz RBW CF ≤ 3.6 GHz CF > 3.6 GHz			 ±7% (nominal) ±8% (nominal)
4 MHz to 8 MHz RBW CF ≤ 3.6 GHz CF > 3.6 GHz			 ±15% (nominal) ±20% (nominal)
Selectivity (–60 dB/–3 dB)			4.1:1 (nominal)

a. The noise marker, band power marker, channel power and ACP all compute their results using the power bandwidth of the RBW used for the measurement. Power bandwidth accuracy is the power uncertainty in the results of these measurements due only to bandwidth-related errors. (The receiver 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 receiver: 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 receiver screen to widen by nominally 6%. This widening declines to 0.6% nominal when the Swp Time Rules key is set to Accuracy instead of Normal. The true bandwidth, which determines the response to impulsive signals and noise-like signals, is not affected by the sweep rate.

Description	Specifications	Supplemental Information
RF Preselector Filters		
Filter Band	**Filter Type**	**6 dB Bandwidth (Nominal)**
150 kHz	Fixed lowpass	289 kHz (–3 dB corner frequency)
30 MHz	Fixed lowpass	37 MHz (–3 dB corner frequency)
30 to 52 MHz	Fixed bandpass	28 MHz
52 to 75 MHz	Fixed bandpass	39 MHz
75 to 120 MHz	Fixed bandpass	63 MHz
120 to 165 MHz	Fixed bandpass	71 MHz
165 to 210 MHz	Fixed bandpass	69 MHz
210 to 255 MHz	Fixed bandpass	71 MHz
255 to 300 MHz	Fixed bandpass	68MHz
300 to 475 MHz	Fixed bandpass	284 MHz
475 to 650 MHz	Fixed bandpass	305 MHz
650 to 825 MHz	Fixed bandpass	302 MHz
825 to 1000 MHz	Fixed bandpass	314 MHz
1 GHz	Fixed highpass	912 MHz (–3 dB corner frequency)
1.7 GHz	Fixed highpass	1.56 GHz (–3 dB corner frequency)
2.9 GHz	Fixed highpass	2.29 GHz (–3 dB corner frequency)
Notch Filter		
Reject band		2400 to 2500 MHz
Reject attenuation		20 dB (nominal)

Description	Specifications	Supplemental Information
Microwave Preselector Bandwidth		Relevant to many options, such as B25 Wide IF Bandwidth, in Bands 1 and higher. Nominal.
Mean Bandwidth at CF[a]		**Freq option** ≤ 526
5 GHz		58 MHz
10 GHz		57 MHz
15 GHz		59 MHz
20 GHz		64 MHz
25 GHz		74 MHz
Standard Deviation		9%
–3 dB Bandwidth		–7.5% relative to –4 dB bandwidth, nominal

a. The microwave preselector can have a passband ripple up to 3 dB. To avoid ambiguous results, the –4 dB bandwidth is characterized.

Description	Specification	Supplemental information
Analysis Bandwidth[a]		
Standard	10 MHz	
With *Option B25*	25 MHz	
With *Option B40*	40 MHz	

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

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

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

Amplitude Accuracy and Range

Description	Specifications	Supplemental Information
Measurement Range		
Preamp Off	Displayed Average Noise Level to +30 dBm	
Preamp On	Displayed Average Noise Level to +30 dBm	
Input Attenuation Range	0 to 70 dB, in 2 dB steps	

Description	Specifications		Supplemental Information
Maximum Safe Input Level	RF Input 1	RF Input 2	Applies with or without preamp
RF Input			
Average Total Power	+30 dBm (1 W)	+30 dBm (1 W)	
Peak Pulse Power	+50 dBm (100 W)	+50 dBm (100 W)	(≤10 μs pulse width, ≤1% duty cycle, input attenuation ≥ 30 dB)
Surge Power		2 kW (10 μs pulse width)	
DC voltage			
DC Coupled	±0.2 Vdc	±0.2 Vdc	
AC Coupled	±100 Vdc	±100 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	

Description	Specifications	Supplemental Information
Marker Readout		
Resolution		
Log (decibel) units		
Trace Averaging Off, on-screen	0.01 dB	
Trace Averaging On or remote	0.001 dB	
Linear units resolution		≤1% of signal level (nominal)

Frequency Response

Description	Specifications		Supplemental Information
Frequency Response (Maximum error relative to reference condition (50 MHz) Mechanical attenuator only Non-FFT operation only[b] Preamp off: 10 dB atten)	RF Input 1: to 26.5 GHz RF Input 2: to 1 GHz		Refer to the footnote for Band Overlaps on page 12. Modes above 18 GHz[a]
RF Preselector Off	**20 to 30°C**	**0 to 55°C**	**95th Percentile** (≈2σ)
2 Hz[c] to 9 kHz[de]	±0.45 dB	±0.60 dB	±0.16 dB
9 kHz to 10 MHz[de]	±0.45 dB	±0.60 dB	±0.25 dB
10 to 50 MHz[de]	±0.40 dB	±0.50 dB	±0.25 dB
50 MHz to 1 GHz[e]	±0.40 dB	±0.60 dB	±0.25 dB
1 to 3.6 GHz[e]	±0.60 dB	±0.90 dB	±0.25 dB
3.5 to 8.4 GHz[fgh]	±1.00 dB	±1.90 dB	±0.50 dB
8.3 to 13.6 GHz[fgh]	±1.00 dB	±1.90 dB	±0.50 dB
13.5 to 17.1 GHz[fgh]	±1.00 dB	±1.90 dB	±0.50 dB
17.0 to 22 GHz[fgh]	±1.20 dB	±2.20 dB	±0.55 dB
22.0 to 26.5 GHz[fgh]	±1.40 dB	±2.50 dB	±0.60 dB
RF Preselector On			
2 Hz to 20 Hz[de]			±0.20 dB (nominal)
20 Hz to 9 kHz[de]	±0.50 dB	±0.60 dB	±0.20 dB
9 kHz to 10 MHz[de]	±0.60 dB	±0.85 dB	±0.25 dB
10 to 30 MHz[de]	±0.50 dB	±0.70 dB	±0.23 dB
30 MHz to 1 GHz[e]	±0.50 dB	±0.70 dB	±0.23 dB
1 to 3.6 GHz[ei]	±0.60 dB	±0.90 dB	±0.25 dB
3.5 to 8.4 GHz[fgh]	±1.00 dB	±1.90 dB	±0.50 dB
8.3 to 13.6 GHz[fgh]	±1.00 dB	±1.90 dB	±0.50 dB
13.5 to 17.1 GHz[fgh]	±1.00 dB	±1.90 dB	±0.50 dB
17.0 to 22 GHz[fgh]	±1.20 dB	±2.20 dB	±0.55 dB
22.0 to 26.5 GHz[fgh]	±1.40 dB	±2.50 dB	±0.60 dB

a. Signal frequencies above 18 GHz are prone to response errors due to modes in the Type-N connector used. With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. The effect of these modes with this connector are included within these specifications.
b. For FFT based measurements, Frequency Response errors are more complicated. One case is where the input signal is at the center frequency of the FFT measurement. In this case, the Frequency Response errors are given by this table. The total absolute amplitude accuracy is given by the combination of the absolute amplitude accuracy at 50 MHz with the Frequency Response from this table. The other case is when the input signal is not at the center frequency of the FFT measurement. In this case, the total frequency response error is computed by adding the RF flatness errors of this table to the IF Frequency Response. The total absolute amplitude accuracy is given by the combination of the absolute amplitude accuracy at 50 MHz with this total frequency response error. An additional error source, the relative error in switching between swept and FFT-based measurements, is nominally ±0.01 dB. The effect of this relative error on absolute measurements is included with the "Absolute Amplitude Accuracy" specifications.
c. In the EMI Receiver mode, the lowest frequency is 20 Hz.
d. Specifications apply with DC coupling at all frequencies. With AC coupling, specifications apply at frequencies of 50 MHz and higher. Statistical observations at 10 MHz show that most instruments meet the specifications, but a few percent of instruments can be expected to have errors exceeding 0.5 dB at10 MHz at the temperature extreme. The effect at 20 to 50 MHz is negligible, but not warranted.
e. In the EMI Receiver Mode, there is an additional error of 0.10 dB.
f. In the EMI Receiver Mode, there is an additional error of 0.20 dB.
g. Specification for frequencies > 3.5 GHz apply for sweep rates ≤100 MHz/ms.
h. Microwave preselector centering applied.
i. When the notch filter is selected, the specifications between 2.3 to 2.6 GHz is not applicable.

Description		Specifications	Supplemental Information		
IF Frequency Response[a] (Demodulation and FFT response relative to the center frequency)			Modes above 18 GHz[b]		
Freq (GHz)	**Analysis Width**[c] **(MHz)**	**Max Error**[d] (Exception[e])	**Midwidth Error (95th Percentile)**	**Slope (dB/MHz) (95th Percentile)**	**RMS**[f] **(nominal)**
<3.6[g]	≤10	±0.40 dB	±0.12 dB	±0.10	0.04 dB
≥3.6, ≤ 44 GHz	≤10 Preselected				0.25 dB

a. The IF frequency response includes effects due to RF circuits such as input filters, that are a function of RF frequency, in addition to the IF passband effects.
b. Signal frequencies above 18 GHz are prone to additional response errors due to modes in the Type-N connector used. With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. These modes cause nominally up to –0.35 dB amplitude change, with phase errors of nominally up to ±1.2°.
c. This column applies to the instantaneous analysis bandwidth in use. In the Spectrum Analyzer Mode, this would be the FFT width.
d. 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. Here the Midwidth Error is the error at the center frequency for a given FFT span. 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 using the Spectrum Analyzer mode with an 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; in this case the f in the equation is the offset from the nearest center. Performance is nominally three times better at most center frequencies.
e. The specification does not apply for frequencies greater than 3.6 MHz from the center in FFT widths of 7.2 to 8 MHz.
f. The “rms” nominal performance is the standard deviation of the response relative to the center frequency, integrated across the span. This performance measure was observed at a center frequency in each harmonic mixing band, which is representative of all center frequencies; it is not the worst case frequency.
g. The Frequency Response with the RF Preselector on is verified at the analyzer center frequency in zero span. The effect of the RF Preselector is included in this Frequency Response specification. .

Description		Specifications	Supplemental Information	
IF Phase Linearity			Deviation from mean phase linearity Modes above 18 GHz[a] RF preselector off only	
Center Freq (GHz)	**Span (MHz)**		**Nominal**	**RMS** (nominal)[b]
≥0.02, <3.6	≤10		±0.5°	0.2°
≥3.6, ≤26.5	≤10		±1.5°	0.4°

a. Signal frequencies above 18 GHz are prone to additional response errors due to modes in the Type-N connector used. With the use Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. These modes cause nominally up to –0.35 dB amplitude change, with phase errors of nominally up to ±1.2°.
b. The listed performance is the standard deviation of the phase deviation relative to the mean phase deviation from a linear phase condition, where the rms is computed across the span shown and over the range of center frequencies shown.

Description	Specifications	Supplemental Information
Absolute Amplitude Accuracy RF Preselector on/off Preamp off	RF Input 1: to 26.5 GHz RF Input 2: to 1 GHz	
RF Input 1		95th percentile
At 50 MHz[a][b]		
20 to 30°C	±0.30 dB	±0.17 dB
0 to 55°C	±0.35 dB	
At all frequencies[a][b]		
20 to 30°C	±(0.30 dB + frequency response)	
0 to 55°C	±(0.35 dB+ frequency response)	
RF Input 2		
At 50 MHz[a][b]		
20 to 30°C	±0.35 dB	±0.21 dB
0 to 55°C	±0.40 dB	
At all frequencies[a][b]		
20 to 30°C	±(0.35 dB + frequency response)	
0 to 55°C	±(0.40 dB + frequency response)	
CISPR requirements	This instrument meets or exceeds the current CISPR 16-1-1 sine wave accuracy requirements from 15 to 35°C	
Amplitude Reference Accuracy		±0.05 dB (nominal)

a. Absolute amplitude accuracy is the total of all amplitude measurement errors, and applies over the following subset of settings and conditions: 1 Hz ≤ RBW ≤ 1 MHz; Input signal –10 to –50 dBm; Input attenuation 10 dB; span < 5 MHz (nominal additional error for span ≥ 5 MHz is 0.02 dB); all settings auto-coupled except Swp Time Rules = Accuracy; combinations of low signal level and wide RBW use VBW ≤ 30 kHz to reduce noise. When using FFT sweeps, the signal must be at the center frequency.
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. When using Time Domain scan, only the 95th percentile specification applies.
b. In the EMI Receiver Mode (Discete Scan), add 0.10 dB to the absolute amplitude accuracy specifications.

Description	Specifications	Supplemental Information
Input Attenuation Switching Uncertainty		Refer to the footnote for Band Overlaps on page 12
Atten >2 dB, preamp off (Relative to 10 dB (reference setting))		
50 MHz (reference setting)	±0.20 dB	±0.08 dB (typical)

Description	Specifications		Supplemental Information
RF Input VSWR - RF Preselector Off[a]	RF Input 1: to 26.5 GHz		
at tuned frequency	RF Input 2: to 1 GHz		
10 dB Atten, 50 MHz			1.07:1 (nominal)
Preamp Off	Input Attenuation		Typical
	0 dB	**≥ 10 dB**	
DC Coupled			≥ 10 dB Attenuation
9 kHz to 1 GHz	---	---	
1 to 18 GHz[b]	3.0:1	2.0:1	1.8:1
18 to 26.5 GHz	3.0:1	2.0:1	1.8:1
AC Coupled			
55 MHz to 1 GHz	---	---	
1 to 18 GHz	3.0:1	2.0:1	1.8:1
18 to 26.5 GHz	3.0:1	2.4:1	2.0:1

a. X-Series analyzers have a reflection coefficient that is excellently modeled with a Rayleigh probability distribution. Keysight recommends using the methods outlined in Application Note 1449-3 and companion Average Power Sensor Measurement Uncertainty Calculator to compute mismatch uncertainty.
b. When the notch filter is selected the specs between 2.3 GHz – 2.6 GHz is not applicable.

Description	Specifications		Supplemental Information
RF Input VSWR - RF Preselector On[a]	RF Input 1: to 26.5 GHz		
at tuned frequency	RF Input 2: to 1 GHz		
Preamp Off	Input Attenuation		Typical
	0 dB	**≥ 10 dB**	
DC Coupled			
9 kHz to 1 GHz	2.0:1	1.2:1	1.1:1
1 to 26.5 GHz[b]	3.0:1	2.0:1	1.5:1
AC Coupled			
55 MHz to 1 GHz	2.0:1	1.2:1	
1 to 18 GHz	3.0:1	2.0:1	1.8:1
18 to 26.5 GHz	3.0:1	2.4:1	2.0:1

a. X-Series analyzers have a reflection coefficient that is excellently modeled with a Rayleigh probability distribution. Keysight recommends using the methods outlined in Application Note 1449-3 and companion Average Power Sensor Measurement Uncertainty Calculator to compute mismatch uncertainty.
b. When the notch filter is selected the specs between 2.3 GHz – 2.6 GHz is not applicable.

Description	Specifications	Supplemental Information
Resolution Bandwidth Switching Uncertainty		Relative to reference BW of 30 kHz
1.0 Hz to 1.5 MHz RBW	±0.05 dB	
1.6 MHz to 3 MHz RBW	±0.10 dB	
Manually selected wide RBWs: 4, 5, 6, 8 MHz	±1.0 dB	

Description	Specifications	Supplemental Information
Reference Level		
Range		
Log Units	–170 to +30 dBm, in 0.01 dB steps	
Linear Units	707 pV to 7.07 V, with 0.01 dB resolution (0.11%)	
Accuracy	0 dB	

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	
Total Measurement Uncertainty			
Signal level 0 to 90 dB below reference point, RF attenuation 0 to 40 dB, RBW ≤ 1 MHz, 20º to 30º C: AC coupled 10 MHz to 26.5 GHz DC coupled 9 kHz to 26.5 GHz			
		95th Percentile (≈2σ)	
		Spectrum Analyzer Mode	**EMI Receiver Mode**
RF Preselector Off, Preamp Off			
9 kHz to 10 MHz		± 0.35 dB	± 0.40 dB
10 MHz to 3.6 GHz		± 0.25 dB	± 0.30 dB
3.6 to 18 GHz		± 0.50 dB	± 0.65 dB
18 to 26.5 GHz		± 0.80 dB	± 0.95 dB
RF Preselector On, Preamp Off			
9 kHz to 10 MHz		± 0.31 dB	± 0.44 dB
10 MHz to 1 GHz		± 0.20 dB	± 0.31 dB
1 to 3.6 GHz		± 0.20 dB	± 0.31 dB
3.6 to 18 GHz		± 0.50 dB	± 0.65 dB
18 to 26.5 GHz		± 0.80 dB	± 0.95 dB

Description	Specifications	Supplemental Information
Display Scale Fidelity[a][b]		
Absolute Log-Linear Fidelity (Relative to the reference condition for Input 1: –25 dBm input through 10 dB attenuation, thus –35 dBm at the input mixer)		
Input mixer level[c]	**Linearity**	
–80 dBm ≤ ML ≤ –10 dBm	±0.10 dB	
ML < –80 dBm	±0.15 dB	
Relative Fidelity[d]		Applies for mixer level[c] range from –10 to –80 dBm, mechanical attenuator only, preamp off, and dither on.
Sum of the following terms:		**Nominal**
high level term		Up to ±0.045 dB[e]
instability term		Up to ±0.018 dB
slope term		From equation[f]
prefilter term		Up to ±0.005 dB[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.

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

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

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

c. Mixer level = Input Level – Input Attenuation

d. 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 attenuation = 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 prefilter term applies and evaluates to the limit of ±0.005 dB. The sum of all these terms is ±0.098 dB.

e. 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)]} (exp is the natural exponent function, e^x). 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 (–10 dBm is the highest power for which linearity is specified). All these levels are referred to the mixer level.

f. Slope error will nominally be well within the range of ±0.0009 × (P1 – P2). P1 and P2 are defined in footnote e.
g. A small additional error is possible. In FFT sweeps, this error is possible for spans under 4.01 kHz. For non-FFT measurements, it is possible for RBWs of 3.9 kHz or less. The error is well within the range of ±0.0021 × (P1 - P2) subject to a maximum of ±0.005 dB. (The maximum dominates for all but very small differences.) P1 and P2 are defined in footnote e.

Description	Specifications	Supplemental Information
Display Units	dBm, dBμV, dBmV, dBμA, dBmA, Watts, Volts, Amps, dBμV/m, dBμA/m, dBpT, dBG, dBpW	

Description	Specifications	Supplemental Information
Available Detectors	Normal, Peak, Sample, Negative Peak, Average	Average detector works on RMS, Voltage and Logarithmic scales
	Quasi-Peak, EMI-Average, RMS-Average	Meet CISPR 16-1-1 requirements

Description	Specifications	Supplemental Information
Amplitude Probability Distribution		Meets CISPR16-1-1 requirements.
Dynamic Range	> 70 dB	
Amplitude Accuracy		<± 2.7 dB
Maximum Measureable Time Period (no dead time)	2 minutes	
Minimum Measureable Probability	10^{-7}	
Amplitude Level Assignment	1000 levels	
Sampling Rate	≥ 10 MSa/s	Within a 1 MHz RBW
Amplitude Resolution	0.1881 dB	

Dynamic Range

Gain Compression

Description	Specifications	Supplemental Information
1 dB Gain Compression Point (Two-tone)[abcd]	Maximum power at mixer[e]	
(RF Input 1[f])		
RF Preselector On/Off, Preamp Off		
9 kHz to 10 MHz		2 dB (nominal)
10 to 40 MHz	–2 dBm	1 dBm (typical)
40 MHz to 1 GHz	2 dBm	4 dBm (typical)
1 to 3.6 GHz[g]	0 dBm	4 dBm (typical)
3.6 to 16 GHz	2 dBm	7 dBm (typical)
16 to 26.5 GHz	0 dBm	5 dBm (typical)

a. Large signals, even at frequencies not shown on the screen, can cause the receiver to incorrectly measure on-screen signals because of two-tone gain compression. This specification tells how large an interfering signal must be in order to cause a 1 dB change in an on-screen signal.
b. Specified at 1 kHz RBW with 100 kHz tone spacing. Discrete scan nominal values are verified at 1 kHz RBW with 50 MHz tone spacing. The compression point will nominally equal the specification for tone spacing greater than 5 times the prefilter bandwidth. At smaller spacings, ADC clipping may occur at a level lower than the 1 dB compression point.
c. Reference level and off-screen performance: The reference level (RL) behavior differs from some earlier receivers in a way that makes this receiver more flexible. In other receivers, the RL controlled how the measurement was performed as well as how it was displayed. Because the logarithmic amplifier in these receivers had both range and resolution limitations, this behavior was necessary for optimum measurement accuracy. The logarithmic amplifier in this receiver, however, is implemented digitally such that the range and resolution greatly exceed other instrument limitations. Because of this, the receiver 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. When using EMI Receiver Mode, all indicated values shown here are nominal values. It has been verified at 1 kHz RBW with 50 MHz tone spacing.
e. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).
f. RF Input 2 operates to 1 GHz. The 1 dB gain compression is nominally 9 dB higher.
g. When the notch filter is selected the specs between 2.2 GHz – 2.7 GHz is nominally specified.

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

a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB) (–9 dB for RF Input 2).
b. The ADC clipping level declines at low frequencies (below 50 MHz) when the LO feed through (the signal that appears at 0 Hz) is within 5 times the prefilter bandwidth (see table) and must be handled by the ADC. For example, with a 300 kHz RBW and prefilter bandwidth at 966 kHz, the clipping level reduces for signal frequencies below 4.83 MHz. For signal frequencies below 2.5 times the prefilter bandwidth, there will be additional reduction due to the presence of the image signal (the signal that appears at the negative of the input signal frequency) at the ADC.

Displayed Average Noise Level

Description	Specifications		Supplemental Information
Displayed Average Noise Level (DANL)[a] - **RF Preselector Off** (Spectrum Analyzer Mode)	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.
(RF Input 1[b])			
	20 to 30°C	**0 to 55°C**	**Typical DANL including NFE**[c]
2 Hz to 10 Hz			–110dBm (nominal, no NFE)
20 Hz[d]	–120 dBm	–110 dBm	
100 Hz[d]	–125 dBm	–115 dBm	
1 kHz[d]	–130 dBm	–120 dBm	
9 kHz to 150 kHz[d]	–142 dBm	–141 dBm	
150 kHz to 1 MHz[d]	–153 dBm	–152 dBm	
1 to 10 MHz[d]	–154 dBm	–153 dBm	
10 MHz to 1 GHz	–154 dBm	–153 dBm	–164 dBm
1 to 2.5 GHz	–151 dBm	–150 dBm	–161 dBm
2.5 to 3.6 GHz	–148 dBm	–147 dBm	–158 dBm
3.5 GHz to 8.4 GHz	–153 dBm	–152 dBm	–163 dBm
8.3 GHz to 13.6 GHz	–152 dBm	–151 dBm	–162 dBm
13.5 to 18 GHz	–150 dBm	–149 dBm	–160 dBm
18 to 25 GHz	–146 dBm	–145 dBm	–155 dBm
25 to 26.5 GHz	–143 dBm	–142 dBm	–155 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. RF Input 2 operates to 1 GHz. The DANL is nominally 11 dB higher for RF Input 2.
c. NFE = Noise Floor Extension. Typical DANL including NFE = (Typical DANL – DANL improvement with NFE).
d. 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 25 kHz.

Description	Specifications		Supplemental Information
Displayed Average Noise Level (DANL)[a] - **RF Preselector On**[b] (Spectrum Analyzer Mode)	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.
(RF Input 1[c])			
	20 to 30°C	**0 to 55°C**	**Typical DANL including NFE**[d]
2 Hz to 10 Hz			–110dBm (nominal, no NFE)
20 Hz[e]	–120 dBm	–110 dBm	
100 Hz[d]	–125 dBm	–115 dBm	
1 kHz[d]	–130 dBm	–120 dBm	
9 to 100 kHz[d]	–141 dBm	–140 dBm	–143 dBm
100 to 150 kHz[d]	–142 dBm	–141 dBm	–163 dBm
150 to 500 kHz[d]	–149 dBm	–148 dBm	–161 dBm
500 kHz to 30 MHz[d]	–153 dBm	–151 dBm	–163 dBm
1 to 10 MHz[d]	–154 dBm	–152 dBm	–165 dBm
10 MHz to 1 GHz	–156 dBm	–154 dBm	–166 dBm
1 to 2.5 GHz	–153 dBm	–151 dBm	–163 dBm
2.5 to 3.6 GHz	–151 dBm	–149 dBm	–161 dBm
3.5 GHz to 8.4 GHz	–153 dBm	–152 dBm	–163 dBm
8.3 GHz to 13.6 GHz	–152 dBm	–151 dBm	–162 dBm
13.5 to 18 GHz	–150 dBm	–149 dBm	–160 dBm
18 to 25 GHz	–146 dBm	–145 dBm	–155 dBm
25 to 26.5 GHz	–143 dBm	–142 dBm	–155 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. When the notch filter is selected, the DANL specifications between 2.2 – 2.9 GHz is nominally specified.
c. RF Input 2 operates to 1 GHz. The DANL is nominally 11 dB higher for RF Input 2.
d. NFE = Noise Floor Extension. Typical DANL including NFE = (Typical DANL – DANL improvement with NFE).
e. 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 25 kHz.

Description	Specifications	Supplemental Information
Indicated Noise (EMI Receiver Mode)[a]		Input terminated
(RF Input 1[b])		EMI Average detector 0 dB input attenuation All indicated RBW are CISPR BW, except as noted.
RF Preselector On, Preamp Off		**Typical Indicated Noise including NFE**[c]
20 Hz (1 Hz RBW)[d]		−19 dBμV[e]
100 Hz (10 Hz RBW)[d]		−11 dBμV[e]
1 kHz (100 Hz RBW)[d]		−9 dBμV[e]
9 to 150 kHz (200 Hz RBW)		−14 dBμV
150 kHz to 1 MHz (9 kHz RBW)		−8 dBμV
1 to 30 MHz (9 kHz RBW)		−12 dBμV
30 MHz to 1 GHz (120 kHz)		−3 dBμV
1 to 2.5 GHz (1 MHz RBW)		+8 dBμV
2.5 to 3.6 GHz (1 MHz RBW)		+11 dBμV
3.6 to 8.4 GHz (1 MHz RBW)		+8 dBμV
8.3 to 13.6 GHz (1 MHz RBW)		+11 dBμV
13.5 to 17.1 GHz (1 MHz RBW)		+12 dBμV
17.0 to 25 GHz (1 MHz RBW)		+14 dBμV
25 to 26.5 GHz (1 MHz RBW)		+18 dBμV

a. When the notch filter is selected, the Indicated Noise specifications between 2.2 – 2.9 GHz is nominally specified.
b. RF Input 2 operates to 1 GHz. The DANL is nominally 11 dB higher for RF Input 2.
c. Typical Indicated Noise including NFE = Typical DANL + RBW correction − DANL Improvement with NFE +107.
d. Indicated RBW is a 6 dB bandwidth.
e. NFE is not part of the difference between warranted and typical specifications at this frequency.

Description	Specifications	Supplemental Information	
DANL and Indicated Noise Improvement with Noise Floor Extension[a][b]		95th Percentile (≈ 2 σ)	
RF Preselector Off		**Spectrum Analyzer Mode**	**EMI Receiver Mode**
RF Input 1			
10 MHz[c] to 3.6 GHz		9 dB	4 dB
3.5 to 8.4 GHz		10 dB	5 dB
8.3 to 13.6 GHz		10 dB	4 dB
13.5 to 17.1 GHz		9 dB	4 dB
17.0 to 26.5 GHz		10 dB	4 dB
RF Input 2			
10 MHz[c] to 1 GHz		9 dB	4 dB
RF Preselector On			
RF Input 1			
150 kHz[d] to 30 MHz		10 dB	3 dB
30 MHz to 1 GHz		10 dB	5 dB
1 to 3.6 GHz		9 dB	4 dB
3.5 to 8.4 GHz		10 dB	5 dB
8.3 to 13.6 GHz		10	4 dB
13.5 to 17.1 GHz		9 dB	4 dB
17 to 26.5 GHz		10 dB	4 dB
RF Input 2			
150 kHz[d] to 1 GHz		10 dB	3 dB

a. This statement on the improvement in DANL is based on the statistical observations of the error in the effective noise floor after NFE is applied. That effective noise floor can be a negative or a positive power at any frequency. These 95th percentile values are based on the absolute value of that effective remainder noise power.
b. Unlike other 95th percentiles, these table values do not include delta environment effects. NFE is aligned in the factory at room temperature. For best performance, in an environment that is different from room temperature, such as an equipment rack with other instruments, we recommend running the "Characterize Noise Floor" operation after the first time the analyzer has been installed in the environment, and given an hour to stabilize.
c. NFE does not apply to the low frequency sensitivity. At frequencies below about 0.5 MHz, the sensitivity is dominate by phase noise surrounding the LO feedthrough. The NFE is not designed to improve that performance. At frequencies between 0.5 and 10 MHz the NFE effectiveness increases from nearly none to near its maximum

d. For RF Preselector path, NFE does not apply at frequencies below 100 kHz. At frequencies between 100 kHz and 150 kHz, the NFE effectiveness is not measured, but is designed to be nominally the same as frequencies above 150 kHz.

Spurious Responses

Description		Specifications		Supplemental Information
Spurious Responses RF Preselector on and off		RF Input 1: to 26.5 GHz RF Input 2: to 1 GHz		Preamp Off[a] (see Band Overlaps on page 12)
Residual Responses[bc] 200 kHz to 8.4 GHz (swept) Zero span or FFT or other frequencies		–100 dBm		 –100 dBm (nominal)
Image Responses				
Tuned Freq (f)	**Excitation Freq**	**Mixer Level**[d]	**Response**	
10 MHz to 26.5 GHz	f+45 MHz	–10 dBm	–80 dBc	–113 dBc (typical)
10 MHz to 3.6 GHz	f+10245 MHz	–10 dBm	–80 dBc	–107 dBc (typical)
10 MHz to 3.6 GHz	f+645 MHz	–10 dBm	–80 dBc	–108 dBc (typical)
3.5 to 13.6 GHz	f+645 MHz	–10 dBm	–81 dBc	–85 dBc (typical)
13.5 to 17.1 GHz	f+645 MHz	–10 dBm	–81 dBc	–86 dBc (typical)
17.0 to 22 GHz	f+645 MHz	–10 dBm	–76 dBc	–81 dBc (typical)
22 to 26.5 GHz	f+645 MHz	–10 dBm	–69 dBc	–76 dBc (typical)
Other Spurious Responses				
Carrier Frequency ≤26.5 GHz				
First RF Order[e] (f ≥ 10 MHz from carrier)		–10 dBm	–80 dBc + 20 × log(N[f])	Includes IF feedthrough, LO harmonic mixing responses
Higher RF Order[g] (f ≥ 10 MHz from carrier)		–40 dBm	–80 dBc + 20 × log(N[f])	Includes higher order mixer responses
LO-Related Spurious Responses (f > 600 MHz from carrier 10 MHz to 3.6 GHz)		–10 dBm	–60 dBc + 20 × log(N[f])	–90 dBc + 20 × log(N) (typical)
Sidebands, offset from CW signal				
≤200 Hz				–76 dBc[h] (nominal)
200 Hz to 3 kHz				–66 dBc[h] (nominal)
3 kHz to 30 kHz				–65 dBc (nominal)
30 kHz to 10 MHz				–58 dBc (nominal)

a. 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. Mixer Level for RF Input 2 = Input Level – 9 dB – Input Attenuation + Preamp Gain.
b. Input terminated, 0 dB input attenuation.

c. RF Input 2 performance = RF Input 1 performance + 11 dB for Residual Responses.
d. Input Mixer Level = Input Level – Input Attenuation.
e. With first RF order spurious products, the indicated frequency will change at the same rate as the input, with higher order, the indicated frequency will change at a rate faster than the input.
f. N is the LO multiplication factor.
g. RBW=100 Hz. With higher RF order spurious responses, the observed frequency will change at a rate faster than the input frequency.
h. Nominally –40 dBc under large magnetic (0.38 Gauss rms) or vibrational (0.21 g rms) environmental stimuli.

Second Harmonic Distortion

Description	Specifications	Supplemental Information
Second Harmonic Distortion (Input power = –9 dBm Input attenuation = 6 dB RF Input 1[a])		
RF Preselector Off, Preamp Off	**SHI**[b]	**Typical**
Source Frequency		
10 to 500 MHz	+54 dBm	+61 dBm
500 MHz to 1.8 GHz	+45 dBm	+54 dBm
1.8 to 4 GHz	+60 dBm	+67 dBm
4 to 11 GHz	+65 dBm	+74 dBm
11 to 13.25 GHz	+65 dBm	+73 dBm
RF Preselector On, Preamp Off		
Source Frequency		
10 to 30 MHz	+45 dBm	+50 dBm
30 to 500 MHz	+54 dBm	+58 dBm
500 MHz to 1 GHz	+70 dBm	+78 dBm
1 to 1.6 GHz[c]	+62 dBm	+70 dBm
1.6 to 1.8 GHz	+70 dBm	+82 dBm
1.8 to 4 GHz	+60 dBm	+67 dBm
4 to 11 GHz	+65 dBm	+74 dBm
11 to 13.25 GHz	+65 dBm	+73 dBm

a. RF Input 2 operates to 1 GHz. The second harmonic distortion intercept is nominally 9 dB higher for RF Input 2.
b. SHI = second harmonic intercept.
c. When the notch filter is selected the specs between source frequency 1.15 GHz to 1.30 GHz is not applicable.

Third Order Intermodulation

Description	Specifications		Supplemental Information
Third Order Intermodulation[ab] (Tone separation > 5 times IF Prefilter Bandwidth[c] Verification conditions[ab] RF Input 1[d])			
	Intercept[e]		
RF Preselector Off, Preamp Off	**20 to 30°C**	**5 to 50°C**	**Typical**
10 to 100 MHz	+12 dBm	+10 dBm	+17 dBm
100 to 400 MHz	+15 dBm	+13 dBm	+18 dBm
400 MHz to 3.6 GHz	+17 dBm	+15 dBm	+20 dBm
3.5 to 8.4 GHz	+15 dBm	+13 dBm	+20 dBm
8.3 to 13.6 GHz	+16 dBm	+14 dBm	+20 dBm
13.5 to 26.5 GHz	+12 dBm	+8 dBm	+16 dBm
RF Preselector On, Preamp Off			
10 to 30 MHz	+16.5 dBm	+15 dBm	+18 dBm
30 to 100 MHz	+13.5 dBm	+13 dBm	+15.5 dBm
100 MHz to1 GHz	+15 dBm	+14 dBm	+17 dBm
1 to 1.5 GHz	+16 dBm	+15.5 dBm	+17.5 dBm
1.5 to 3.6 GHz[f]	+17 dBm	+16 dBm	+19.5 dBm
3.5 to 8.4 GHz	+15 dBm	+13 dBm	+20 dBm
8.3 to 13.6 GHz	+16 dBm	+14 dBm	+20 dBm
13.5 to 26.5 GHz	+12 dBm	+8 dBm	+16 dBm

a. Specified with two tones measurement in Spectrum Analyzer mode, each at –14 dBm at the input with 4 dB input attenuation, spaced by 100 kHz.
b. When using EMI Receiver Mode, all indicated values shown here are nominal values. It has been verified with two tones, each at-14 dBm at the input with 4 dB input attenuation, spaced by 50 MHz.
c. See the IF Prefilter Bandwidth table in the Gain Compression specifications on page 38. When the tone separation condition is met, the effect on TOI of the setting of IF Gain is negligible. TOI is verified with IF Gain set to its best case condition, which is IF Gain = Low.
d. RF Input 2 operates to 1 GHz. The intercept is nominally 9 dB higher for RF Input 2.
e. 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.
f. When the notch filter is selected the specs between source frequency 2.3 GHz to 2.6 GHz is not applicable.

Phase Noise

Description	Specifications		Supplemental Information
Phase Noise			Noise Sidebands
(Center Frequency = 1 GHz[a] Best-case Optimization[b] Internal Reference[c])			
Offset Frequency	**20 to 30°C**	**Full range**	
10 Hz			–80 dBc/Hz (nominal)
100 Hz	–91 dBc/Hz	–90 dBc/Hz	–100 dBc/Hz (typical)
1 kHz	–109 dBc/Hz	–108 dBc/Hz	–112 dBc/Hz (typical)
10 kHz	–113 dBc/Hz	–113 dBc/Hz	–114 dBc/Hz (typical)
100 kHz	–116 dBc/Hz	–115 dBc/Hz	–117 dBc/Hz (typical)
1 MHz[d]	–135 dBc/Hz	–134 dBc/Hz	–136 dBc/Hz (typical)
10 MHz[d]			–148 dBc/Hz (nominal)

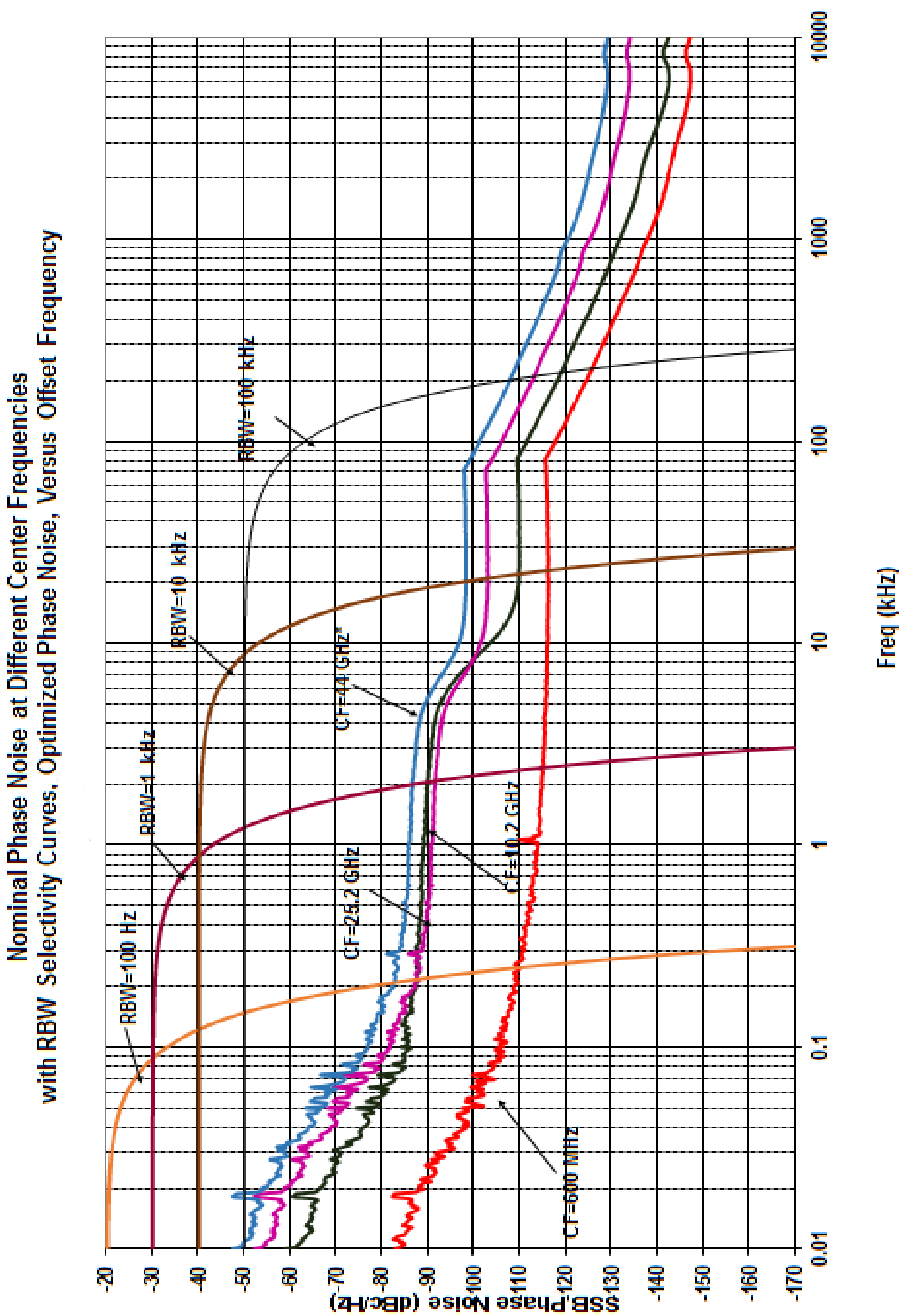
a. The nominal performance of the phase noise at center frequencies different than the one at which the specifications apply (1 GHz) depends on the center frequency, band and the offset. For low offset frequencies, offsets well under 100 Hz, the phase noise increases by $20 \times \log[(f + 0.3225)/1.3225]$. For mid-offset frequencies such as 10 kHz, band 0 phase noise changes as $20 \times \log[(f + 5.1225)/6.1225]$. For mid-offset frequencies in other bands, phase noise changes as $20 \times \log[(f + 0.3225)/6.1225]$ except f in this expression should never be lower than 5.8. For wide offset frequencies, offsets above about 100 kHz, phase noise increases as $20 \times \log(N)$. N is the LO Multiple as shown on page 12; f is in GHz units in all these relationships; all increases are in units of decibels.

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

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

d. Analyzer-contributed phase noise at the low levels of this offset requires advanced verification techniques because broadband noise would otherwise cause excessive measurement error. Keysight uses a high level low phase noise CW test signal and sets the input attenuator so that the mixer level will be well above the normal top-of-screen level (-10 dBm) but still well below the 1 dB compression level. This improves dynamic range (carrier to broadband noise ratio) at the expense of amplitude uncertainty due to compression of the phase noise sidebands of the analyzer. (If the mixer level were increased to the "1 dB Gain Compression Point," the compression of a single sideband is specified to be 1 dB or lower. At lower levels, the compression falls off rapidly. The compression of phase noise sidebands is substantially less than the compression of a single-sideband test signal, further reducing the uncertainty of this technique.) Keysight also measures the broadband noise of the analyzer without the CW signal and subtracts its power from the measured phase noise power. The same techniques of overdrive and noise subtraction can be used in measuring a DUT.

Nominal Phase Noise at Different Center Frequencies [Plot]



Power Suite Measurements (RF Preselector off only)

Description	Specifications	Supplemental Information
Channel Power		
Amplitude Accuracy		Absolute 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)	±0.82 dB	±0.23 dB (95th percentile)

a. See "Absolute Amplitude Accuracy" on page 29.
b. See "Frequency and Time" on page 12.
c. Expressed in dB.

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

Description			Specifications	Supplemental Information	
Adjacent Channel Power (ACP)				RF Input 1, RF Preselector Off	
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[b] + Power Bandwidth Accuracy[cd]	
Passband Width[e]			–3 dB		
Case: Radio Std = 3GPP W-CDMA				(ACPR; ACLR)[f]	
Minimum power at RF Input				–36 dBm (nominal)	
ACPR Accuracy[g]				RRC weighted, 3.84 MHz noise bandwidth, method ≠ RBW	
Radio	**Offset Freq**				
MS (UE)	5 MHz		±0.14 dB	At ACPR range of –30 to –36 dBc with optimum mixer level[h]	
MS (UE)	10 MHz		±0.21 dB	At ACPR range of –40 to –46 dBc with optimum mixer level[i]	
BTS	5 MHz		±0.49 dB[h]	At ACPR range of –42 to –48 dBc with optimum mixer level[j]	
BTS	10 MHz		±0.44 dB	At ACPR range of –47 to –53 dBc with optimum mixer level[i]	
BTS	5 MHz		±0.21 dB	At –48 dBc non-coherent ACPR[k]	
Dynamic Range				RRC weighted, 3.84 MHz noise bandwidth	
Noise Correction	Offset Freq	**Method**		**ACLR (typical)**[l]	**Optimum ML**[m] **(Nominal)**
Off	5 MHz	Filtered IBW		–73 dB	–8 dBm
Off	5 MHz	Fast		–72 dB	–9 dBm
Off	10 MHz	Filtered IBW		–79 dB	–2 dBm
On	5 MHz	Filtered IBW		–78 dB	–8 dBm
On	5 MHz	Filtered IBW		–78 dB[n]	–8 dBm
On	10 MHz	Filtered IBW		–82 dB	–2 dBm

Description	Specifications	Supplemental Information
RRC Weighting Accuracy[o]		
White noise in Adjacent Channel		0.00 dB nominal
TOI-induced spectrum		0.001 dB nominal
rms CW error		0.012 dB nominal

a. The 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 × 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. To meet this specified accuracy when measuring mobile station (MS) or user equipment (UE) within 3 dB of the required –33 dBc ACPR, the mixer level (ML) must be optimized for accuracy. This optimum mixer level is –22 dBm, so the input attenuation must be set as close as possible to the average input power – (–22 dBm). For example, if the average input power is –6 dBm, set the attenuation to 16 dB. This specification applies for the normal 3.5 dB peak-to-average ratio of a single code. Note that, if the mixer level is set to optimize dynamic range instead of accuracy, accuracy errors are nominally doubled.
i. ACPR accuracy at 10 MHz offset is warranted when the input attenuator is set to give an average mixer level of –14 dBm.
j. In order to meet this specified accuracy, the mixer level must be optimized for accuracy when measuring node B Base Transmission Station (BTS) within 3 dB of the required –45 dBc ACPR. This optimum mixer level is –19 dBm, so the input attenuation must be set as close as possible to the average input power – (–19 dBm). For example, if the average input power is –7 dBm, set the attenuation to 12 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.
k. Accuracy can be excellent even at low ACPR levels assuming that the user sets the mixer level to optimize the dynamic range, and assuming that the analyzer and UUT distortions are incoherent. When the errors from the UUT and the analyzer are incoherent, optimizing dynamic range is equivalent to minimizing the contribution of analyzer noise and distortion to accuracy, though the higher mixer level increases the display scale fidelity errors. This incoherent addition case is commonly used in the industry and can be useful for comparison of analysis equipment, but this incoherent addition model is rarely justified. This derived accuracy specification is based on a mixer level of –14 dBm.

l. 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.

m. ML is Mixer Level, which is defined to be the input signal level minus attenuation.

n. All three production units hand-measured had performance better than 88 dB with a test signal even better than the "near-ideal" one used for statistical process control in production mentioned in the footnote[l] above. Therefore, this value can be considered "Nominal" not "Typical" by the definitions used within this document. These observations were done near 2 GHz because that is a common W-CDMA operating region in which the analyzer third-order dynamic range is near its best.

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

Description				Specifications	Supplemental Information	
Multi-Carrier Adjacent Channel Power					RF Input 1, RF Preselector Off	
Case: Radio Std = 3GPP W-CDMA					RRC weighted, 3.84 MHz noise bandwidth	
ACPR Dynamic Range (5 MHz offset, Two carriers)					–70 dB (nominal)	
ACPR Accuracy (Two carriers, 5 MHz offset, –48 dBc ACPR)					±0.42 dB (nominal)	
ACPR Accuracy (4 carriers)						
Radio	**Offset**	**Coher**[a]	**NC**		**UUT ACPR Range**	**MLOpt**[b]
BTS	5 MHz	no	Off	±0.39 dB	–42 to –48 dB	–18 dBm
BTS	5 MHz	no	On	±0.15 dB	–42 to –48 dB	–21 dBm
ACPR Dynamic Range (4 carriers, 5 MHz offset)					**Nominal DR**	Nominal MLOpt[c]
Noise Correction (NC) off Noise Correction (NC) on					–64 dB –72 dB	–18 dBm –21 dBm

a. Coher = no means that the specified accuracy only applies when the distortions of the device under test are not coherent with the third-order distortions of the analyzer. Incoherence is often the case with advanced multi-carrier amplifiers built with compensations and predistortions that mostly eliminate coherent third-order effects in the amplifier.
b. Optimum mixer level (MLOpt). The mixer level is given by the average power of the sum of the four carriers minus the input attenuation.
c. Optimum mixer level (MLOpt). The mixer level is given by the average power of the sum of the four carriers minus the input attenuation.

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
TOI (Third Order Intermodulation)		Measures TOI of a signal with two dominant tones
Results	Relative IM tone powers (dBc)	
	Absolute tone powers (dBm)	
	Intercept (dBm)	

Description	Specifications	Supplemental Information
Harmonic Distortion		
Maximum harmonic number	10th	
Results	Fundamental Power (dBm)	
	Relative harmonics power (dBc)	
	Total harmonic distortion (%, dBc)	

Description	Specifications	Supplemental Information
Spurious Emissions		Table-driven spurious signals; search across regions
Case: Radio Std = 3GPP W-CDMA		
Dynamic Range[a] (1 to 3.6 GHz)	96.7 dB	101.7 dB (typical)
Sensitivity, absolute (1 to 3.6 GHz)	–85.4 dBm	
Accuracy		Attenuation = 10 dB
20 Hz to 3.6 GHz		±0.29 dB (95th Percentile)
3.5 to 8.4 GHz		±1.17 dB (95th Percentile)
8.3 to 13.6 GHz		±1.54 dB (95th Percentile)

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

Description	Specifications	Supplemental Information
Spectrum Emission Mask		Table-driven spurious signals; measurement near carriers
Case: Radio Std = cdma2000		
Dynamic Range, relative (750 kHz offset[a][b])	78.9 dB	85.0 dB (typical)
Sensitivity, absolute (750 kHz offset[c])	–100.7 dBm	
Accuracy (750 kHz offset)		
Relative[d]	±0.12 dB	
Absolute[e] (20 to 30°C)	±0.88 dB	±0.27 dB (95th Percentile ≈ 2σ)
Case: Radio Std = 3GPP W–CDMA		
Dynamic Range, relative (2.515 MHz offset[a][d])	81.9 dB	88.2 dB (typical)
Sensitivity, absolute (2.515 MHz offset[c])	–100.7 dBm	
Accuracy (2.515 MHz offset)		
Relative[d]	±0.12 dB	
Absolute[e] (20 to 30°C)	±0.86 dB	±0.27 dB (95th Percentile ≈ 2σ)

a. The dynamic range specification is the ratio of the channel power to the power in the offset specified. The dynamic range depends on the measurement settings, such as peak power or integrated power. Dynamic range specifications are based on default measurement settings, with detector set to average, and depend on the mixer level. Default measurement settings include 30 kHz RBW.
b. This dynamic range specification applies for the optimum mixer level, which is about –18 dBm. Mixer level is defined to be the average input power minus the input attenuation.
c. The sensitivity is specified with 0 dB input attenuation. It represents the noise limitations of the analyzer. It is tested without an input signal. The sensitivity at this offset is specified in the default 30 kHz RBW, at a center frequency of 2 GHz.
d. The relative accuracy is a measure of the ratio of the power at the offset to the main channel power. It applies for spectrum emission levels in the offsets that are well above the dynamic range limitation.
e. The absolute accuracy of SEM measurement is the same as the absolute accuracy of the spectrum analyzer. See “Absolute Amplitude Accuracy” on page 29 for more information. The numbers shown are for 0 to 3.6 GHz, with attenuation set to 10 dB.

Options

The following options and applications affect instrument specifications.

Option 503:	Frequency range, 2 Hz to 3.6 GHz
Option 508:	Frequency range, 2 Hz to 8.4 GHz
Option 526:	Frequency range, 2 Hz to 26.5 GHz
Option B25:	Analysis bandwidth, 25 MHz
Option B40:	Analysis bandwidth, 40 MHz
Option C35:	APC 3.5 mm connector (for Freq *Option 526* only)
Option CR3:	Connector Rear, 2nd IF output
Option ESC:	External Source Control
Option EXM:	External Mixing
Option P03	Preamplifier, 3.6 GHz
Option P08:	Preamplifier, 8.4 GHz
Option P26:	Preamplifier, 26.5 GHz
Option SF1:	Security Features, Exclude Launching Programs
Option SF2:	Security Features, Prohibit Saving Results
*Option SS*1:	Additional Removable Solid State Drive, Win 10
Option YAS:	Y-Axis Screen Video output
N9063EM0E:	Analog Demodulation measurement application
N90EMESCB:	External Source Control

General

Description	Specifications	Supplemental Information
Calibration Cycle	1 year	

Description	Specifications	Supplemental Information
Environmental		
Indoor use		
Temperature Range		
Operating		
Altitude ≤ 2,300 m	0 to 55°C	
Altitude = 4,500 m	0 to 47°C	
Derating[a]		
Storage	–40 to +70°C	
Altitude	4,500 m (approx 15,000 feet)	
Humidity		
Relative humidity		Type tested at 95%, +40°C (non-condensing)

a. The maximum operating temperature derates linearly from altitude of 4,500 m to 2,300 m.

Description	Specifications	Supplemental Information
Environmental		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	Supplemental Information
Screening Effectiveness	Instrument meets CISPR requirements for Screening Effectiveness with exceptions at f = finput	

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

Description	Specification	Supplemental Information
Power Requirements		
Low Range		
Voltage	100/120 V	
Frequency	50, 60 or 400 Hz	
High Range		
Voltage	220/240 V	
Frequency	50 or 60 Hz	
Power Consumption, On	630 W	Fully loaded with options
Power Consumption, Standby	20 W	Standby power is not supplied to frequency reference oscillator.

Description	Supplemental Information	
Measurement Speed[a]	Nominal	
Local measurement and display update rate[bc]	10 ms (100/s)	
Remote measurement and LAN transfer rate[bc]	16 ms (62.5/s)	
Marker Peak Search	9 ms	
Center Frequency Tune and Transfer (RF)	33 ms	
Center Frequency Tune and Transfer (μW)	63 ms	
Measurement/Mode Switching	120 ms	
W-CDMA ACLR measurement time	See page 51	
Measurement Time vs. Span	See page 18	

a. Sweep Points = 101.
b. Factory preset, fixed center frequency, RBW = 1 MHz, 10 MHz < span ≤ 600 MHz, stop frequency ≤ 3.6 GHz, Auto Align Off, RF Preselector Off.
c. Phase Noise Optimization set to Fast Tuning, Display Off, 64 bit REAL, markers Off, single sweep, measured with IBM compatible PC (memory 500 Gb, Windows 7. Intel® Core™ i5-6500 CPU 3.20 GHz), Agilent I/O Libraries Suite Version 16.3.16603.3, one meter GPIB cable, Keysight GPIB Card.

Description	Specifications	Supplemental Information
Radio Disturbance Measuring Apparatus	CISPR 16-1-1 (2015)	The features in this instrument comply with the performance requirements of this basic standard.[a]

a. Tested in EMI Receiver mode. The use of Noise Floor Extension (NFE) is required to meet the CISPR requirements in Bands B, C and D.

Description	Specifications	Supplemental Information
Display[a]		
Resolution	1280 × 800	Capacitive multi-touch screen
Size		269 mm (10.6 in) diagonal (nominal)

a. The LCD display is manufactured using high precision technology. However, if a static image is displayed for a lengthy period of time (~2 hours) you might encounter "image sticking" that may last for approximately 2 seconds. This is normal and does not affect the measurement integrity of the product in any way.

Description	Specifications	Supplemental Information
Data Storage		
Internal Total		Removable solid state drive (> 160 GB)
Internal User		> 9 GB available on separate partition for user data

Description	Specifications	Supplemental Information
Weight		Weight without options
Net		24 kg (52 lbs) (nominal)
Shipping		36 kg (79 lbs) (nominal)
Cabinet Dimensions		Cabinet dimensions exclude front and rear protrusions.
Height	177 mm (7 inches)	
Width	426 mm (16.8 inches)	
Length	556 mm (21.9 inches)	

Inputs/Outputs

Front Panel

Description	Specifications	Supplemental Information
RF Input Connector		
RF Input 1	Type-N female (standard)	
	3.5 mm male (Option C35)	*Option C35* is only available with *Option 526*
Impedance		50Ω (nominal)
RF Input 2	Type-N female only	
Impedance		50Ω (nominal)

Description	Specifications	Supplemental Information
Probe Power		
Voltage/Current		+15 Vdc, ±7% at 0 to 150 mA (nominal)
		–12.6 Vdc, ±10% at 0 to 150 mA (nominal)
		GND

Description	Specifications	Supplemental Information
USB Ports		
Master (3 ports)		Compliant with USB 2.0
Connector	USB Type “A” (female)	
Output Current		
Port marked with Lightning Bolt		1.2 A (nominal)
Port not marked with Lightning Bolt	0.5 A	

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

Rear Panel

Description	Specifications	Supplemental Information
10 MHz Out		
Connector	BNC female	
Impedance		50Ω (nominal)
Output Amplitude		≥0 dBm (nominal)
Output Configuration	AC coupled, sinusoidal	
Frequency	10 MHz × (1 + frequency reference accuracy)	

Description	Specifications	Supplemental Information
Ext Ref In		
Connector	BNC female	Note: Receiver noise sidebands and spurious response performance may be affected by the quality of the external reference used. See footnote [c] in the Phase Noise specifications within the Dynamic Range section on page 48.
Impedance		50Ω (nominal)
Input Amplitude Range sine wave square wave		 –5 to +10 dBm (nominal) 0.2 to 1.5 V peak-to-peak (nominal)
Input Frequency		1 to 50 MHz (nominal) (selectable to 1 Hz resolution)
Lock range	$\pm 2 \times 10^{-6}$ of ideal external reference input frequency	

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

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

Description	Specifications	Supplemental Information
Trigger Outputs (Trigger 1 Out, Trigger 2 Out)		
Connector	BNC female	
Impedance		50Ω (nominal)
Level		0 to 5 V (CMOS)

Description	Specifications	Supplemental Information
Monitor Output 1 VGA compatible		
Connector	15-pin mini D-SUB	
Format		XGA (60 Hz vertical sync rates, non-interlaced) Analog RGB
Monitor Output 2		
Mini DisplayPort		

Description	Specifications	Supplemental Information
Analog Out		Refer to Chapter 9, “Option YAS - Y-Axis Screen Video Output”, on page 129 for more information.
Connector	BNC female	
Impedance		<140Ω (nominal)

Description	Specifications	Supplemental Information
Noise Source Drive +28 V (Pulsed)		
Connector	BNC female	
Output voltage on	28.0 ± 0.1 V	60 mA maximum current
Output voltage off	< 1.0 V	

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

Description	Specifications	Supplemental Information
USB Ports		
Host, Super Speed		2 ports
Compatibility	USB 3.0	
Connector	USB Type “A” (female)	
Output Current	0.9 A	
Host, stacked with LAN		1 port
Compatibility	USB 2.0	
Connector	USB Type “A” (female)	
Output Current	0.5 A	
Device		1 port
Compatibility	USB 3.0	
Connector	USB Type “B” (female)	

Description	Specifications	Supplemental Information
GPIB Interface		
Connector	IEEE-488 bus connector	
GPIB Codes		SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3 and C28, DT1, L4, C0
Mode		Controller or device

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

Description	Specifications	Supplemental Information
Aux I/O Connector	25-pin D-SUB	

Regulatory Information

This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 61010 3rd 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.

This product is intended for indoor use.

	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.
ccr.keysight@keysight.com	The Keysight email address is required by EU directives applicable to our product.
ICES/NMB-001	"This ISM device complies with Canadian ICES-001." "Cet appareil ISM est conforme a la norme NMB du Canada."
ISM 1-B (GRP.1 CLASS B)	This is a symbol of an Industrial Scientific and Medical Group 1 Class B product. (CISPR 11, Clause 4)
	The CSA mark is a registered trademark of the CSA International.
	The RCM mark is a registered trademark of the Australian Communications and Media Authority.
	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).
	China RoHS regulations include requirements related to packaging, and require compliance to China standard GB18455-2001.
	This symbol indicates compliance with the China RoHS regulations for paper/fiberboard packaging.
	South Korean Certification (KC) mark; includes the marking's identifier code which follows this format: R-R-Kst--ZZZZZZZZZZZZZ.

EMC: Complies with the essential requirements of the European EMC Directive as well as current editions of the following standards (dates and editions are cited in the Declaration of Conformity):

– IEC/EN 61326-1
– CISPR 11, Group 1, class B
– AS/NZS CISPR 11
– ICES/NMB-001

This ISM device complies with Canadian ICES-001.

Cet appareil ISM est conforme a la norme NMB-001 du Canada.

NOTE This is a sensitive measurement apparatus by design and may have some performance loss (up to 25 dB above the Spurious Responses, Residual specification of -100 dBm) when exposed to ambient continuous electromagnetic phenomenon in the range of 80 MHz -2.7 GHz when tested per IEC 61326-1.

South Korean Class B EMC declaration:

This equipment is Class B suitable for home electromagnetic environments and is suitable for use in all areas..

B 급 기기 (가정용 방송통신기자재)
이 기기는 가정용(B 급) 전자파적합기기로서 주로 가정에서 사용하는 것을 목적으로 하며, 모든 지역에서 사용할 수 있습니다.

SAFETY: Complies with the essential requirements of the European Low Voltage Directive as well as current editions of the following standards (dates and editions are cited in the Declaration of Conformity):

– IEC/EN 61010-1
– Canada: CSA C22.2 No. 61010-1
– USA: UL std no. 61010-1

Acoustic statement: (European Machinery Directive)

Acoustic noise emission

LpA <70 dB

Operator position

Normal operation mode per ISO 7779

To find a current **Declaration of Conformity** for a specific Keysight product, go to: http://www.keysight.com/go/conformity

2 I/Q Analyzer

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

Specifications Affected by I/Q Analyzer:

The specifications in this chapter apply for RF Input 1 and RF Preselector off.

Specification Name	Information
Number of Frequency Display Trace Points (buckets)	Does not apply.
Resolution Bandwidth	See “Frequency” on page 73 in this chapter.
Video Bandwidth	Not available.
Clipping-to-Noise Dynamic Range[a]	See “Clipping-to-Noise Dynamic Range” on page 74 in this chapter.
Resolution Bandwidth Switching Uncertainty	Not specified because it is negligible.
Available Detectors	Does not apply.
Spurious Responses[a]	The “Spurious Responses” on page 44 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[a]	See “IF Frequency Response” on page 28 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[a]	See “IF Phase Linearity” on page 28 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[a]	See “Data Acquisition” on page 75 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.

a. This specification addresses the performance of the IQ Analyzer using the 10 MHz analysis bandwidth. For IQ Analyzer performance specifications in the optional 25 MHz or 85 MHz analysis bandwidths, see the *Option B25* or *Option B85* chapter.

Frequency

Description	Specifications	Supplemental Information
Frequency Span		
Standard instrument	10 Hz to10 MHz	
Option B25	10 Hz to 25 MHz	
Option B40	10 Hz to 40 MHz	
Resolution Bandwidth (Spectrum Measurement) Range		
Overall Span = 1 MHz Span = 10 kHz Span = 100 Hz	100 mHz to 3 MHz 50 Hz to 1 MHz 1 Hz to 10 kHz 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	10 Hz to 10 MHz	
Option B25	10 Hz to 25 MHz	
Option B40	10 Hz to 40 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	–10 dBm	–8 dBm (nominal)
IF Gain = High	–20 dBm	–17.5 dBm (nominal)
Noise Density at Mixer at center frequency[b]	(DANL[c] + IFGainEffect[d]) + 2.25 dB[e]	Example[f]

a. This specification is defined to be the ratio of the clipping level (also known as "ADC Over Range") to the noise density. In decibel units, it can be defined as clipping_level [dBm] – noise_density [dBm/Hz]; the result has units of dBfs/Hz (fs is "full scale").
b. The noise density depends on the input frequency. It is lowest for a broad range of input frequencies near the center frequency, and these specifications apply there. The noise density can increase toward the edges of the span. The effect is nominally well under 1 dB.
c. The primary determining element in the noise density is the "Displayed Average Noise Level" on page 39.
d. DANL is specified with the IF Gain set to High, which is the best case for DANL but not for Clipping-to-noise dynamic range. The core specifications "Displayed Average Noise Level" on page 39, gives a line entry on the excess noise added by using IF Gain = Low, and a footnote explaining how to combine the IF Gain noise with the DANL.
e. DANL is specified for log averaging, not power averaging, and thus is 2.51 dB lower than the true noise density. It is also specified in the narrowest RBW, 1 Hz, which has a noise bandwidth slightly wider than 1 Hz. These two effects together add up to 2.25 B.
f. As an example computation, consider this: For the case where DANL = –151 dBm in 1 Hz, IF Gain is set to low, and the "Additional DANL" is –160 dBm, the total noise density computes to –148.2 dBm/Hz and the Clipping-to-noise ratio for a –10 dBm clipping level is –138.2 dBfs/Hz.

Data Acquisition

Description	Specifications	Supplemental Information
Time Record Length	4,000,000 IQ sample pairs	≈ 335 ms at 10 MHz span
Sample Rate	100 MSa/s	IF Path ≤25 MHz
Option B40	200 MSa/s	IF Path = 40 MHz
IQ Pairs		Integer submultiples of 15Mpairs/s depending on the span for spans of 8 MHz or narrower
ADC Resolution	16 Bits	IF Path ≤25 MHz
Option B40	12 Bits	IF Path = 40 MHz

3 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.

KEYSIGHT TECHNOLOGIES

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.

The specifications in this chapter apply for RF Input 1 and RF Preselector off.

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 Responses" on page 44 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				Specifications	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	$(f + f_c + 22.5\ \text{MHz})/2$	–15 dBm	Low		–54 dBc (nominal)
		–25 dBm	High		–54 dBc (nominal)
IF Conversion Image					
Apparent Freq	Excitation Freq	Mixer Level[c]	IF Gain		
Any on-screen f	$2 \times f_c - f + 45\ \text{MHz}$	–10 dBm	Low		–70 dBc (nominal)
		–20 dBm	High		–70 dBc (nominal)

a. The level of these spurs is not warranted. The relationship between the spurious response and its excitation is described in order to make it easier for the user to distinguish whether a questionable response is due to these mechanisms. f is the apparent frequency of the spurious signal, fc is the measurement center frequency.

b. The spurious response specifications only apply with the preamp turned off. When the preamp is turned on, performance is nominally the same as long as the mixer level is interpreted to be Mixer Level = Input Level – Input Attenuation – Preamp Gain.

c. Mixer Level = Input Level - Input Attenuation.

Description		Specifications		Supplemental Information		
IF Frequency Response[a] (Demodulation and FFT response relative to the center frequency)				Modes above 18 GHz[b]		
Freq (GHz)	**Analysis Width**[c] **(MHz)**	**Max Error**[d] (Exceptions[e]) **20 to 30°C**	**Full range**	**Midwidth Error (95th Percentile)**	**Slope (dB/MHz) (95th Percentile)**	**RMS**[f] **(nominal)**
≤3.6	10 to ≤25	±0.45 dB	±0.45 dB	±0.12 dB	±0.10	0.051 dB
3.6 to 26.5	10 to ≤25[g]					0.45 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 passband effects.
b. Signal frequencies above 18 GHz are prone to additional response errors due to modes in the Type-N connector used. With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. These modes cause nominally up to –0.35 dB amplitude change, with phase errors of nominally up to ±1.2°. The effect of these modes is not included within the Max Error
specification. The effect on the RMS is negligible, except to note that the modes make the ratio of worst-case error to RMS error unusually high.
c. This column applies to the instantaneous analysis bandwidth in use. In the Spectrum Analyzer Mode, this would be the FFT width.
d. 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. Here the Midwidth Error is the error at the center frequency for the given FFT span. 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. In the Spectrum Analyzer mode, 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 at most center frequencies.
e. The specification does not apply for frequencies greater than 3.6 MHz from the center in FFT widths of 7.2 to 8 MHz.
f. The "RMS" nominal performance is the standard deviation of the response relative to the center frequency, integrated across the span. This performance measure was observed at a center frequency in each harmonic mixing band, which is representative of all center frequencies; it is not the worst case frequency.
g. For information on the microwave preselector which affects the passband for frequencies above 3.6 GHz, see "Microwave Preselector Bandwidth" on page 23.

Description			Specifications	Supplemental Information	
IF Phase Linearity				Deviation from mean phase linearity	
Center Freq (GHz)	**Span (MHz)**	**Microwave Preselector**		**Nominal**	**RMS** (nominal)[a]
≥0.02, <3.6	≤25	N/A		±0.5°	0.2°
≥3.6, ≤26.5	≤25	Off		±1.5°	0.4°

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	Specification	Supplemental Information
Full Scale (ADC Clipping)[a]		
Default settings, signal at CF		
(IF Gain = Low)		
Band 0		–8 dBm mixer level[b] (nominal)
Band 1 through 4		–7 dBm mixer level[b] (nominal)
High Gain setting, signal at CF		
(IF Gain = High)		
Band 0		–19.5 dBm mixer level[b] (nominal), subject to gain limitations[c]
Band 1 through 4		–18.5 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			
IQ Analyzer	4,999,999 IQ sample pairs		Waveform measurement[a]
Advanced Tools	**Data Packing**		Fast Capture[b]
	32-bit	**64-bit**	
Length (IQ sample pairs)	536 MSa (2^{29} Sa)	268 MSa (2^{28} Sa)	2 GB total memory
Maximum IQ Capture Time	**Data Packing**		
(Fast Capture)	**32-bit**	**64-bit**	Calculated by: Length of IQ sample pairs/Sample Rate (IQ Pairs)[c]
10 MHz IFBW	42.94 s	21.47 s	
25 MHz IFBW	17.17 s	8.58 s	
Sample Rate (IQ Pairs)	1.25 × IFBW		
ADC Resolution	16 bits		

a. This can also be accessed with the remote programming command of "read:wav0?".
b. This can only be accessed with the remote programming command of "init:fcap" in the IQ Analyzer (Basic) waveform measurement.
c. For example, using 32-bit data packing at 10 MHz IF bandwidth (IFBW) the Maximum Capture Time is calculated using the formula: "Max Capture Time = $(2^{29})/(10\text{ MHz} \times 1.25)$".

4 Option B40 - 40 MHz Analysis Bandwidth

This chapter contains specifications for the *Option B40* 40 MHz Analysis Bandwidth, and are unique to this IF Path.

Specifications Affected by Analysis Bandwidth

The specifications in this chapter apply when the 40 MHz path is in use. In IQ Analyzer, this will occur when the IF Path is set to 40 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 Responses	There are three effects of the use of Option B40 on spurious responses. Most of the warranted elements of the "Spurious Responses" on page 44 still apply without changes, but the revised-version of the table on page 44, modified to reflect the effect of Option B40, is shown in its place in this chapter. The image responses part of that table have the same warranted limits, but apply at different frequencies as shown in the table. The "higher order RF spurs" line is slightly degraded. Also, spurious-free dynamic range specifications are given in this chapter, as well as IF Residuals.
Displayed Average Noise Level	See specifications in this chapter.
Third-Order Intermodulation	This bandwidth option can create additional TOI products to those that are created by other instrument circuitry. These products do not behave with typical analog third-order behavior, and thus cannot be specified in the same manner. Nominal performance statements are given in this chapter, but they cannot be expected to decrease as the cube of the voltage level of the signals.
Phase Noise	The performance of the analyzer will degrade by an unspecified extent when using wideband analysis. This extent is not substantial enough to justify statistical process control.
Absolute Amplitude Accuracy	Nominally 0.5 dB degradation from base instrument absolute amplitude accuracy. (Refer to Absolute Amplitude Accuracy on page 29.)
Frequency Range Over Which Specifications Apply	Specifications on this bandwidth only apply with center frequencies of 30 MHz and higher.

Other Analysis Bandwidth Specifications

Description	Specifications	Supplemental Information
SFDR (Spurious-Free Dynamic Range)		Test conditions[a]
Signal Frequency within ±12 MHz of center		–80 dBc (nominal)
Signal Frequency anywhere within analysis BW		
Spurious response within ±18 MHz of center		–79 dBc (nominal)
Response anywhere within analysis BW		–77 dBc (nominal)

a. Signal level is –6 dB relative to full scale at the center frequency. See the Full Scale table.

Description		Specifications		Supplemental Information
Spurious Responses: Residual and Image[a] (see Band Overlaps on page 12)				Preamp Off[b]
Residual Responses[c]				–100 dBm (nominal)
Image Responses				
Tuned Freq (f)	**Excitation Freq**	Mixer Level[d]	**Response**	**Response** (nominal)
10 MHz to 3.6 GHz	f+10100 MHz	–10 dBm	–80 dBc	–120 dBc
10 MHz to 3.6 GHz	f+500 MHz	–10 dBm	–80 dBc	–100 dBc
3.5 to 13.6 GHz	f+500 MHz	–10 dBm	–78 dBc	–86 dBc
13.5 to 17.1 GHz	f+500 MHz	–10 dBm	–74 dBc	–85 dBc
17.0 to 22 GHz	f+500 MHz	–10 dBm	–70 dBc	–81 dBc
22 to 26.5 GHz	f+500 MHz	–10 dBm	–68 dBc	–78 dBc

a. Preselector enabled for frequencies >3.6 GHz.
b. The spurious response specifications only apply with the preamp turned off. When the preamp is turned on, performance is nominally the same as long as the mixer level is interpreted to be: Mixer Level = Input Level – Input Attenuation – Preamp Gain
c. Input terminated, 0 dB input attenuation.
d. Mixer Level = Input Level – Input Attenuation. Verify with mixer levels no higher than –12 dBm if necessary to avoid ADC overload.

Description	Specifications		Supplemental Information
Spurious Responses: Other[a] (see Band Overlaps on page 12)			
	Mixer Level[b]	**Response**	**Response** (nominal)
First RF Order[c] (f ≥ 10 MHz from carrier)	–10 dBm	-80 dBc + $20 \times \log(N^{d})$	–97 dBc
Higher RF Order[e] (f ≥ 10 MHz from carrier)	–40 dBm	-78 dBc + $20 \times \log(N^{d})$	–103 dBc
LO-Related Spurious Response (Offset from carrier 200 Hz to 10 MHz)	–10 dBm	-68 dBc+ $20 \times \log(N^{d})$	
Close-in Sidebands Spurious Response (LO Related, offset < 200 Hz)			–73 dBc[f] + $20 \times \log(N^{d})$

a. Preselector enabled for frequencies >3.6 GHz.
b. Mixer Level = Input Level – Input Attenuation. Verify with mixer levels no higher than –12 dBm if necessary to avoid ADC overload.
c. With first RF order spurious products, the indicated frequency will change at the same rate as the input, with higher order, the indicated frequency will change at a rate faster than the input.
d. N is the LO multiplication factor.
e. RBW=100 Hz. With higher RF order spurious responses, the observed frequency will change at a rate faster than the input frequency.
f. Nominally –40 dBc under large magnetic (0.38 Gauss rms) or vibrational (0.21 g rms) environmental stimuli.

Description	Specification	Supplemental Information
IF Residual Responses		Relative to full scale; see the Full Scale table for details
Band 0		–112 dBFS (nominal)

Description			Specifications	Supplemental Information	
IF Frequency Response[a]				Relative to center frequency Freq *Option 526* only:Modes above 18 GHz[b]	
Center Freq (GHz)	**Span (MHz)**	**Preselector**		**Typical**	**RMS** (nominal)[c]
≥ 0.03, < 3.6	≤40	n/a	±0.4 dB	±0.25 dB	0.07 dB
≥ 3.6, ≤ 26.5	≤40	On		See footnote[d]	

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 passband effects.
b. Signal frequencies above 18 GHz are prone to response errors due to modes in the Type-N connector. Only analyzers with frequency *Option 526* that do not also have input connector *Option C35* will have these modes.With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. These modes cause nominally up to –0.35 dB amplitude change, with phase errors of nominally up to ±1.2°.
c. The listed performance is the rms of the amplitude deviation from the mean amplitude response of a span/CF combination. 50% of the combinations of prototype instruments, center frequencies and spans had performance better than the listed values.
d. The passband shape will be greatly affected by the preselector. See “Microwave Preselector Bandwidth” on page 23.

Description			Specifications	Supplemental Information	
IF Phase Linearity				Deviation from mean phase linearity Modes above 18 GHz[a]	
Center Freq (GHz)	**Span (MHz)**	**Preselector**		**Peak-to-peak** (nominal)	**RMS** (nominal)[b]
≥ 0.02, < 3.6	40	n/a		0.5°	0.12°

a. Signal frequencies above 18 GHz are prone to response errors due to modes in the Type-N connector. Only analyzers with frequency *Option 526* that do not also have input connector *Option C35* will have these modes.With the use of Type-N to APC 3.5 mm adapter part number 1250-1744, there are nominally six such modes. These modes cause nominally up to –0.35 dB amplitude change, with phase errors of nominally up to ±1.2°.
b. The listed performance is the standard deviation of the phase deviation relative to the mean phase deviation from a linear phase condition, where the RMS is computed across the span shown.

Description	Specification	Supplemental Information		
Full Scale (ADC Clipping) [a]				
Default settings, signal at CF				
(IF Gain = Low; IF Gain Offset = 0 dB)		**Mixer Level** (nominal)[b]		
Band 0		–8 dBm		
High Gain setting, signal at CF		Mixer level[b] (nominal), subject to gain limitations[c]		
(IF Gain = High; IF Gain Offset = 0 dB)				
Band 0		–18 dBm		
IF Gain Offset ≠ 0 dB, signal at CF		See formula[d], subject to gain limitations[c]		
Effect of signal frequency ≠ CF		up to ±4 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.
d. The mixer level for ADC clipping is nominally given by that for the default settings, minus IF Gain Offset, minus 10 dB if IF Gain is set to High.

Description	Specification	Supplemental Information
EVM		
(EVM measurement floor for an 802.11g OFDM signal, MCS7, using 89600 VSA software equalization on channel estimation sequence and data, pilot tracking on)		
2.4 GHz		0.25% (nominal)

Description	Specifications	Supplemental Information
Third Order Intermodulation Distortion		Two tones of equal level 1 MHz tone separation Each tone –13 dB relative to full scale (ADC clipping) IF Gain = High IF Gain Offset = 0 dB
Band 0		–85 dBc (nominal)

Description		Specifications	Supplemental Information
Noise Density			0 dB attenuation; center of IF bandwidth[a], IF Gain = Low
Band	**Freq (GHz)**[b]		
0	1.80	–144 dBm/Hz	

a. The noise level in the IF will change for frequencies away from the center of the IF. Usually, the IF part of the total noise will get worse by nominally up to 3 dB as the edge of the IF bandwidth is approached.
b. Specifications apply at the center of each band. IF Noise dominates the system noise, therefore the noise density will not change substantially with center frequency.

Description	Specification	Supplemental Information
Signal to Noise Ratio		Ratio of clipping level[a] to noise level
Example: 1.8 GHz		136 dBc/Hz, IF Gain = Low, IF Gain Offset = 0 dB

a. For the clipping level, see the table above, "Full Scale." Note that the clipping level is not a warranted specification, and has particularly high uncertainty at high microwave frequencies.

Data Acquisition

Description	Specifications		Supplemental Information
Time Record Length			
IQ Analyzer	4,999,999 IQ sample pairs		Waveform measurement[a]
Advanced Tools	**Data Packing**		Fast Capture[b]
	32-bit	**64-bit**	
Length (IQ sample pairs)	536 MSa (2^{29} Sa)	268 MSa (2^{28} Sa)	2 GB total memory
Maximum IQ Capture Time	**Data Packing**		
(Fast Capture)	**32-bit**	**64-bit**	Calculated by: Length of IQ sample pairs/Sample Rate (IQ Pairs)[c]
10 MHz IFBW	42.94 s	21.47 s	
25 MHz IFBW	17.17 s	8.58 s	
40 MHz IFBW	10.73 s	5.36 s	
Sample Rate (IQ Pairs)	1.25 × IFBW		
ADC Resolution	12 bits		

a. This can also be accessed with the remote programming command of "read:wav0?".
b. This can only be accessed with the remote programming command of "init:fcap" in the IQ Analyzer (Basic) waveform measurement.
c. For example, using 32-bit data packing at 10 MHz IF bandwidth (IFBW) the Maximum Capture Time is calculated using the formula: "Max Capture Time = $(2^{29})/(10\ \text{MHz} \times 1.25)$".

5 Option CR3 - Connector Rear, 2nd IF Output

This chapter contains specifications for *Option CR3*, Connector Rear, 2nd IF Output.

Specifications Affected by Connector Rear, 2nd IF Output

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

Other Connector Rear, 2nd IF Output Specifications

Aux IF Out Port

Description	Specifications	Supplemental Information
Connector	SMA female	Shared with other options
Impedance		50Ω (nominal)

Second IF Out

Description	Specifications	Supplemental Information
Second IF Out		
Output Center Frequency		
SA Mode, EMI Receiver Mode		322.5 MHz
I/Q Analyzer Mode		
IF Path ≤ 25 MHz		322.5 MHz
Conversion Gain at 2nd IF output center frequency		–1 to +4 dB (nominal) plus RF frequency response[a]
Bandwidth		
Low band		Up to 140 MHz (nominal)[b]
High band		
With microwave preselector		Depends on RF center frequency[c]
Residual Output Signals		–94 dBm or lower (nominal)

a. “Conversion Gain” is defined from RF input to IF Output with 0 dB mechanical attenuation and the electronic attenuator off. The nominal performance applies in zero span.
b. The passband width at –3 dB nominally extends from IF frequencies of 230 to 370 MHz.
c. The YIG-tuned microwave preselector bandwidth nominally varies from 55 MHz for a center frequencies of 3.6 GHz through 57 MHz at 15 GHz to 75 MHz at 26.5 GHz. (Refer to page 23 for details.) The microwave pre-selector effect will dominate the passband width.

6 Option ESC - External Source Control

This chapter contains specifications for the N90EMESCB, External Source Control.

General Specifications

Description	Specification	Supplemental Information
Frequency Range		
SA Operating range	2 Hz to 3.6 GHz 2 Hz to 8.4 GHz 2 Hz to 26.5 GHz	N9048B-503 N9048B-508 N9048B-526
Source Operating range	9 kHz to 3 GHz 9 kHz to 6 GHz	N5171B/72B/81B/82B-503 N5171B/72B/81B/82B-506
	100 kHz to 3 GHz 100 kHz to 6 GHz 100 kHz to 20 GHz	N5161A/N5162A/N5181A/N5182A-503 N5161A/N5162A/N5181A/N5182A-506 N5183A-520
	9 kHz to 20 GHz	N5173B/N5183B-520
Span Limitations		
Span limitations due to source range		Limited by the source and SA operating range
Offset Sweep		
Sweep offset setting range		Limited by the source and SA operating range
Sweep offset setting resolution	1 Hz	
Harmonic Sweep		
Harmonic sweep setting range[a] Multiplier numerator Multiplier denominator		 N = 1 to 1000 N = 1 to 1000
Sweep Direction[b]		Normal, Reversed

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

Description		Specification	Supplemental Information
Dynamic Range (10 MHz to 3 GHz, Input terminated, sample detector, average type = log, 20 to 30°C)			Dynamic Range = –10 dBm – DANL – 10 × log (RBW)[a]
SA span	**SA RBW**		
1 MHz	2 kHz	105.0 dB	
10 MHz	6.8 kHz	99.7 dB	
100 MHz	20 kHz	95.0 dB	
1000 MHz	68 kHz	89.7 dB	
Amplitude Accuracy			Multiple contributors[b] Linearity[c] Source and Analyzer Flatness[d] YTF Instability[e] VSWR effects[f]

a. The dynamic range is given by this computation: –10 dBm – DANL – 10×log(RBW) where DANL is the displayed average noise level specification, normalized to 1 Hz RBW, and the RBW used in the measurement is in hertz units. The dynamic range can be increased by reducing the RBW at the expense of increased sweep time.
b. The following footnotes discuss the biggest contributors to amplitude accuracy.
c. One amplitude accuracy contributor is the linearity with which amplitude levels are detected by the analyzer. This is called "scale fidelity" by most spectrum analyzer users, and "dynamic amplitude accuracy" by most network analyzer users. This small term is documented in the Amplitude section of the Specifications Guide. It is negligibly small in most cases.
d. The amplitude accuracy versus frequency in the source and the analyzer can contribute to amplitude errors. This error source is eliminated when using normalization in low band (0 to 3.6 GHz). In high band the gain instability of the YIG-tuned microwave preselector in the analyzer keeps normalization errors nominally in the 0.25 to 0.5 dB range.
e. In the worst case, the center frequency of the YIG-tuned microwave preselector can vary enough to cause very substantial errors, much higher than the nominal 0.25 to 0.5 dB nominal errors discussed in the previous footnote. In this case, or as a matter of good practice, the microwave preselector should be centered. See the user's manual for instructions on centering the microwave preselector.
f. VSWR interaction effects, caused by RF reflections due to mismatches in impedance, are usually the dominant error source. These reflections can be minimized by using 10 dB or more attenuation in the analyzer, and using well-matched attenuators in the measurement configuration.

Description	Specification	Supplemental Information
Power Sweep Range		Limited by source amplitude range

Description	Specification	Supplemental Information	
Measurement Time		Nominal[a]	
(RBW setting of the SA determined by the default for *Option ESC*)			
		RF MXG (N5181A/N5182A)[b]	
		Band 0	**Band 1**
201 Sweep points (default setting)		450 ms	1.1s
601 Sweep points		1.1 s	3.3 s
		μW MXG (N5183A)[b]	
		Band 0	**Band 1**
201 Sweep points (default setting)		470 ms	1.2 s
601 Sweep points		1.1 s	3.9 s

a. These measurement times were observed with a span of 100 MHz, RBW of 20 kHz and the point triggering method being set to EXT TRIG1. The measurement times will not change significantly with span when the RBW is automatically selected. If the RBW is decreased, the sweep time increase would be approximately 23.8 times Npoints/RBW.
b. Based on MXG firmware version A.01.80 and *Option UNZ* installed.

Description	Specification	Supplemental Information
Supported External Sources[a]		
Keysight EXG		N5171B/72B/73B
Keysight MXG		N5161A/62A N5181A/82A/83A N5181B/82B/83B
IO interface connection between:		
EXG/MXG and MXE		LAN, GPIB, or USB

a. Firmware revision A.19.50 or later is required for the signal analyzer.

7 Option EXM - External Mixing

This chapter contains specifications for the *Option EXM* External Mixing.

Specifications Affected by External mixing

Specification Name	Information
RF-Related Specifications, such as TOI, DANL, SHI, Amplitude Accuracy, and so forth.	Specifications do not apply; some related specifications are contained in IF Input in this chapter
IF-Related Specifications, such as RBW range, RBW accuracy, RBW switching uncertainty, and so forth.	Specifications unchanged, except IF Frequency Response - see specifications in this chapter.
New specifications: IF Input Mixer Bias LO Output	See specifications in this chapter.

Other External Mixing Specifications

Description		Specifications	Supplemental Information
Connection Port EXT MIXER			
Connector		SMA, female	
Impedance			50Ω (nominal) at IF and LO frequencies
Functions		Triplexed for Mixer Bias, IF Input and LO output	
Mixer Bias			
Bias Current			Short circuit current
Range		±10 mA	
Resolution		10 μA	
Accuracy			±20 μA (nominal)
Output impedance			477Ω (nominal)
Bias Voltage			Open circuit
Range			±3.7 V (nominal)
IF Input			
Maximum Safe Level		+7 dBm	
Center Frequency			
IF BW ≤25 MHz		322.5 MHz	includes swept
IF BW = 40 MHz		250.0 MHz	
Bandwidth			Supports all optional IFs
ADC Clipping Level[a]			
IF BW ≤25 MHz			−14.5 ±2.0 dBm (nominal)
IF BW = 40 MHz			−20 dBm (nominal)
1 dB Gain Compression[a]			
IF BW ≤25 MHz			−2 dBm (nominal)
IF BW = 40 MHz			−2 dBm (nominal)

Description		Specifications		Supplemental Information
Gain Accuracy[b]		20 to 30°C	Full Range	
IF BW ≤25 MHz		±1.2 dB	±2.5 dB	
Wider IF BW				±1.2 dB (nominal)
IF Frequency Response				RMS (nominal)
CF	**Width**			
322.5 MHz	±12.5 MHz			0.072 dB
250.0 MHz	±20.0 MHz			0.109 dB
Noise Figure (322.5 MHz, swept operation)				9 dB (nominal)
VSWR				1.3:1 (nominal)

a. These specifications apply at the IF input port. The on-screen and mixer-input levels scale with the conversion loss and corrections values.
b. The amplitude accuracy of a measurement includes this term and the accuracy with which the settings of corrections model the loss of the external mixer.

Description	Specifications	Supplemental Information
LO Output		
Frequency Range	3.75 to 14.1 GHz	
Output Power[a]		
3.75 to 7.0 GHz[b]		+16.2 to 16.7 dBm (nominal)
7.0 to 8.72 GHz[b]		+16.4 to 16.7 dBm (nominal)
7.8 to 14.1 GHz[c]		+16.4 to 16.7 dBm (nominal)
Second Harmonic		−20 dB (nominal)
Fundamental Feedthrough and Undesired Harmonics[c]		−15 dB (nominal)
VSWR		< 2.2:1 (nominal)

a. The LO output port power is compatible with Keysight M1970 and 11970 Series mixers except for the 11970K. The power is specified at the connector. Cable loss will affect the power available at the mixer. With non-Keysight mixer units, supplied loss calibration data may be valid only at a specified LO power that may differ from the power available at the mixer. In such cases, additional uncertainties apply.
b. LO Doubler = Off settings.
c. LO Doubler = On setting. Fundamental frequency = 3.9 to 7.0 GHz.

8 Options P03, P08, P26 - Preamplifiers

This chapter contains specifications for the PXE EMI Receiver *Options P03, P08*, and *P26* preamplifiers.

Specifications Affected by Preamp

Specification Name	Information
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 displayed average noise level (DANL). See "Amplitude Accuracy and Range" on page 24.
Gain Compression	See specifications in this chapter.
DANL with NFE Off	See specifications in this chapter.
DANL with NFE (Noise Floor Extension)	See "DANL and Indicated Noise Improvement with Noise Floor Extension" on page 42 of the core specifications.
Frequency Response	See specifications in this chapter.
Absolute Amplitude Accuracy	See "Absolute Amplitude Accuracy" on page 29 of the core specifications.
RF Input VSWR	See plot in this chapter.
Display Scale Fidelity	See Display Scale Fidelity on page 35 of the core specifications. Then, adjust the mixer levels given downward by the preamp gain given in this chapter.
Second Harmonic Distortion	See specifications in this chapter.
Third Order Intermodulation Distortion	See specifications in this chapter.
Other Input Related Spurious	See "Spurious Responses" on page 44 of the core specifications. Preamp performance is not warranted but is nominally the same as non-preamp performance.
Dynamic Range	See plot in this chapter.
Gain	See "Preamp" specifications in this chapter.
Noise Figure	See "Preamp" specifications in this chapter.

Other Preamp Specification

Description	Specifications	Supplemental Information
Preamplifier Gain (*Options P03, P08, and P26***)**		
RF Preselector Off[a], Preamp On, LNA Off		**Maximum[b]**
100 kHz to 3.6 GHz		+20 dB (nominal)
3.6 to 26.5 GHz		+28 dB (nominal)
RF Preselector On, Preamp On, LNA Off		
1 to 150 kHz		+20 dB (nominal)
150 kHz to 3.6 GHz		+15 dB (nominal)
RF Preselector On/Off, Preamp Off, LNA On		
150 kHz to 3.6 GHz		+20 dB (nominal)
3.6 to 26.5 GHz		+35 dB (nominal)
RF Preselector On/Off, Preamp On, LNA On		
150 kHz to 3.6 GHz		+20 dB (nominal)
3.6 to 26.5 GHz		+35 dB (nominal)

a. For best possible sensitivity, the LNA can be turned on together with the Internal Preamp, although when operating both preamps together, the user should note that the TOI (distortion) specifications are impacted.
b. Preamplifier Gain is the combined gain from the Preamp and LNA. It directly affects distortion and noise performance, but it also affects the range of levels that are free of final IF overload. The user interface has a designed relationship between input attenuation and reference level to prevent on-screen signal levels from causing final IF overloads. That design is based on the maximum preamplifier gains shown. Actual amplifier gains are modestly lower, by up to nominally 5 dB.

Description	Specifications	Supplemental Information
1 dB Gain Compression Point		
(Two-tone)[a][b]		
(RF Input1)[c] (*Options P03, P08,or P26)* Maximum power at the amplifier[d] for 1 dB gain compression)		
RF Preselector Off, Preamp On, LNA Off		
10 MHz to 3.6 GHz		–13 dBm (nominal)
3.6 to 26.5 GHz		
Tone spacing 100 kHz to 20 MHz		–23 dBm (nominal)
Tone spacing >70 MHz		–16 dBm (nominal)
RF Preselector On, Preamp On, LNA Off		
9 to 150 kHz		–17 dBm (nominal)
150 kHz to 10 MHz		–11 dBm (nominal)
10 to 50 MHz		–13 dBm (nominal)
50 MHz to 3.6 GHz		–10 dBm (nominal)
3.6 to 26.5 GHz		
Tone spacing 100 kHz to 20 MHz		–23 dBm (nominal)
Tone spacing >70 MHz		–16 dBm (nominal)
RF Preselector On/Off, Preamp Off, LNA On		
30 MHz to 3.6 GHz		–16 dBm (nominal)
3.6 to 26.5 GHz		
Tone spacing 100 kHz to 20 MHz		–13 dBm (nominal)
Tone spacing >70 MHz		–7 dBm (nominal)
RF Preselector On/Off, Preamp On, LNA On		
30 MHz to 3.6 GHz		–16 dBm (nominal)
3.6 to 26.5 GHz		
Tone spacing 100 kHz to 20 MHz		–30 dBm (nominal)
Tone spacing >70 MHz		–26 dBm (nominal)

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

b. Spectrum Analyzer Mode values are verified at 1 kHz RBW with 100 kHz tone spacing. EMI Receiver Mode values are verified at 1 kHz RBW with 50 MHz tone spacing.
c. RF Input 2 operates to 1 GHz. The 1 dB gain compression is nominally 9 dB higher.
d. Total power at the amplifier (dBm) = total power at the input (dBm) – input attenuation (dB).

Description	Specifications	Supplemental Information
Absolute Amplitude Accuracy RF Preselector On/Off Preamp on LNA On/Off	RF Input 1: to 26.5 GHz RF Input 2: to 1 GHz	
RF Input 1		95th percentile
At 50 MHz[abc]		
20 to 30°C	±0.30 dB	±0.17 dB
0 to 55°C	±0.35 dB	
At all frequencies[abc]		
20 to 30°C	±(0.30 dB + frequency response)	
0 to 55°C	±(0.35 dB+ frequency response)	
RF Input 2		
At 50 MHz[abc]		
20 to 30°C	±0.35 dB	±0.21 dB
0 to 55°C	±0.40 dB	
At all frequencies[abc]		
20 to 30°C	±(0.35 dB + frequency response)	
0to 55°C	±(0.40 dB + frequency response)	
CISPR requirements	This instrument meets or exceeds the current CISPR 16-1-1 sine wave accuracy requirements from 15 to 35°C	
Amplitude Reference Accuracy		±0.05 dB (nominal)

a. Absolute amplitude accuracy is the total of all amplitude measurement errors, and applies over the following subset of settings and conditions: 1 Hz ≤ RBW ≤ 1 MHz; Input signal –10 to –50 dBm; Input attenuation 10 dB; span < 5 MHz (nominal additional error for span ≥ 5 MHz is 0.02 dB); all settings auto-coupled except Swp Time Rules = Accuracy; combinations of low signal level and wide RBW use VBW ≤ 30 kHz to reduce noise. When using FFT sweeps, the signal must be at the center frequency.
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. Same settings as footnote a, except that the signal level at the amplifier input is –40 to –80 dBm. Total power at the amplifier (dBm) = total power at the input (dBm) minus input attenuation (dB).
c. In the EMI Receiver Mode, add 0.10 dB to the absolute amplitude accuracy specifications.

Description	Specifications		Supplemental Information
Frequency Response - LNA ON (Maximum error relative to reference condition (50 MHz) Mechanical attenuator only Non-FFT operation only[b] 0 dB atten)	RF Input 1: to 26.5 GHz RF Input 2: to 1 GHz		Refer to the footnote for Band Overlaps on page 12. Modes above 18 GHz[a]
RF Preselector Off, Preamp On/Off	**20 to 30°C**	**0 to 55°C**	**95th Percentile** (≈2σ)
30 to 50 MHz[c]	±0.50 dB	±0.70 dB	±0.25 dB
50 to 1 GHz[c]	±0.50 dB	±0.70 dB	±0.25 dB
1 to 3.6 GHz[c]	±0.60 dB	±1.00 dB	±0.30 dB
RF Preselector On, Preamp On/Off			
10 to 30 MHz[c]			±0.35 dB
30 MHz to 1 GHz[c]	±0.50 dB	±0.70 dB	±0.22 dB
1 to 3.6 GHz[cd]	±0.60 dB	±0.80 dB	±0.27 dB
RF Preselector On/Off, Preamp Off			
3.5 to 8.4 GHz[efg]	±1.60 dB	±2.50 dB	±0.75 dB
8.3 to 13.6 GHz[efg]	±1.60 dB	±2.50 dB	±0.85 dB
13.5 to 17.1 GHz[efg]	±1.60 dB	±2.50 dB	±0.85 dB
17.0 to 22 GHz[efg]	±1.90 dB	±2.90 dB	±0.95 dB
22.0 to 26.5 GHz[efg]	±1.90 dB	±2.90 dB	±0.95 dB
RF Preselector On/Off, Preamp On			
3.5 to 8.4 GHz[efg]	±1.60 dB	±2.40 dB	±0.75 dB
8.3 to 13.6 GHz[efg]	±1.60 dB	±2.40 dB	±0.75 dB
13.5 to 17.1 GHz[efg]	±1.60 dB	±2.40 dB	±0.85 dB
17.0 to 22 GHz[efg]	±1.80 dB	±2.80 dB	±0.95 dB
22.0 to 26.5 GHz[efg]	±2.00 dB	±3.20 dB	±0.95 dB

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

b. For FFT based measurements, Frequency Response errors are more complicated. One case is where the input signal is at the center frequency of the FFT measurement. In this case, the Frequency Response errors are given by this table. The total absolute amplitude accuracy is given by the combination of the absolute amplitude accuracy at 50 MHz with the Frequency Response from this table. The other case is when the input signal is not at the center frequency of the FFT measurement. In this case, the total frequency response error is computed by adding the RF flatness errors of this table to the IF Frequency Response. The total absolute amplitude accuracy is given by the combination of the absolute amplitude accuracy at 50 MHz with this total frequency response error. An additional error source, the relative error in switching between swept and FFT-based measurements, is nominally ±0.01 dB. The effect of this relative error on absolute measurements is included with the "Absolute Amplitude Accuracy" specifications.
c. In the EMI Receiver Mode, there is an additional error of 0.10 dB.
d. When the notch filter is selected, the specifications between 2.3 to 2.6 GHz is not applicable.
e. In the EMI Receiver Mode, there is an additional error of 0.20 dB.
f. Specification for frequencies > 3.5 GHz apply for sweep rates ≤100 MHz/ms.
g. Microwave preselector centering applied.

Description	Specifications		Supplemental Information
Frequency Response - LNA OFF (Maximum error relative to reference condition (50 MHz) Mechanical attenuator only Non-FFT operation only[b] Preamp on, 0 dB atten)	RF Input 1: to 26.5 GHz RF Input 2: to 1 GHz		Refer to the footnote for Band Overlaps on page 12. Modes above 18 GHz[a]
RF Preselector Off	**20 to 30°C**	**0 to 55°C**	**95th Percentile** (≈2σ)
100 kHz to 10 MHz[cd]	±0.70 dB	±0.80 dB	±0.36 dB
10 to 50 MHz[cd]	±0.60 dB	±0.70 dB	±0.25 dB
50 to 1 GHz[cd]	±0.60 dB	±0.70 dB	±0.25 dB
1 to 3.6 GHz[d]	±0.70 dB	±1.00 dB	±0.30 dB
3.5 to 8.4 GHz[efg]	±1.50 dB	±2.40 dB	±0.75 dB
8.3 to 13.6 GHz[efg]	±1.50 dB	±2.40 dB	±0.75 dB
13.5 to 17.1 GHz[efg]	±1.50 dB	±2.40 dB	±0.75 dB
17.0 to 22 GHz[efg]	±1.80 dB	±2.80 dB	±0.95 dB
22.0 to 26.5 GHz[efg]	±2.00 dB	±3.20 dB	±0.95 dB
RF Preselector On			
1 to 9 kHz[cd]	±0.50 dB	±0.60 dB	±0.20 dB
9 kHz to 10 MHz[cd]	±0.80 dB	±1.00 dB	±0.31 dB
10 to 30 MHz[cd]	±0.80 dB	±0.90 dB	±0.32 dB
30 MHz to 1 GHz[d]	±0.50 dB	±0.70 dB	±0.23 dB
1 to 3.6 GHz[dh]	±0.60 dB	±0.90 dB	±0.23 dB
3.5 to 8.4 GHz[efg]	±1.50 dB	±2.40 dB	±0.75 dB
8.3 to 13.6 GHz[efg]	±1.50 dB	±2.40 dB	±0.75 dB
13.5 to 17.1 GHz[efg]	±1.50 dB	±2.40 dB	±0.75 dB
17.0 to 22 GHz[efg]	±1.80 dB	±2.80 dB	±0.90 dB
22.0 to 26.5 GHz[efg]	±2.00 dB	±3.20 dB	±0.95 dB

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

b. For FFT based measurements, Frequency Response errors are more complicated. One case is where the input signal is at the center frequency of the FFT measurement. In this case, the Frequency Response errors are given by this table. The total absolute amplitude accuracy is given by the combination of the absolute amplitude accuracy at 50 MHz with the Frequency Response from this table. The other case is when the input signal is not at the center frequency of the FFT measurement. In this case, the total frequency response error is computed by adding the RF flatness errors of this table to the IF Frequency Response. The total absolute amplitude accuracy is given by the combination of the absolute amplitude accuracy at 50 MHz with this total frequency response error. An additional error source, the relative error in switching between swept and FFT-based measurements, is nominally ±0.01 dB. The effect of this relative error on absolute measurements is included with the "Absolute Amplitude Accuracy" specifications.
c. Specifications apply with DC coupling at all frequencies. With AC coupling, specifications apply at frequencies of 50 MHz and higher. Statistical observations at 10 MHz show that most instruments meet the specifications, but a few percent of instruments can be expected to have errors exceeding 0.5 dB at10 MHz at the temperature extreme. The effect at 20 to 50 MHz is negligible, but not warranted.
d. In the EMI Receiver Mode, there is an additional error of 0.10 dB.
e. In the EMI Receiver Mode, there is an additional error of 0.20 dB.
f. Specification for frequencies > 3.5 GHz apply for sweep rates ≤100 MHz/ms.
g. Microwave preselector centering applied.
h. When the notch filter is selected, the specifications between 2.3 to 2.6 GHz is not applicable.

Description	Specifications		Supplemental Information
RF Input VSWR[a] **- Preselector Off**	RF Input 1: to 26.5 GHz		
at tuned frequency	RF Input 2: to 1 GHz		
10 dB Atten, 50 MHz			1.07:1 (nominal)
Preamp On	Input Attenuation		Typical
	0 dB	**≥ 10 dB**	
DC Coupled			≥ 10 dB Attenuation
9 kHz to 1 GHz	---	---	
1 to 18 GHz[b]	3.0:1	2.0:1	1.8:1
18 to 26.5 GHz	3.0:1	2.0:1	1.8:1
AC Coupled			
55 MHz to 1 GHz	---	---	
1 to 18 GHz	3.0:1	2.0:1	1.8:1
18 to 26.5 GHz	3.0:1	2.4:1	2.0:1
Preamp On, LNA On	Input Attenuation		
	0 dB	**≥ 10 dB**	
DC Coupled			
50 MHz to 1 GHz	---	---	
1 to 18 GHz[b]	3.0:1	2.0:1	1.1:1
18 to 26.5 GHz	3.0:1	2.0:1	1.5:1
AC Coupled			
55 MHz to 1 GHz	---	---	
1 to 18 GHz	3.0:1	2.0:1	1.8:1
18 to 26.5 GHz	3.0:1	2.4:1	2.0:1

a. X-Series analyzers have a reflection coefficient that is excellently modeled with a Rayleigh probability distribution. Keysight recommends using the methods outlined in Application Note 1449-3 and companion Average Power Sensor Measurement Uncertainty Calculator to compute mismatch uncertainty.
b. When the notch filter is selected the specs between 2.3 GHz – 2.6 GHz is not applicable.

Description	Specifications		Supplemental Information
RF Input VSWR[a] **- Preselector On**	RF Input 1: to 26.5 GHz		
at tuned frequency	RF Input 2: to 1 GHz		
Preamp On	Input Attenuation		Typical
	0 dB	**≥ 10 dB**	
DC Coupled			
9 kHz to 1 GHz	2.0:1	1.2:1	1.1:1
1 to 26.5 GHz[b]	3.0:1	2.0:1	1.5:1
AC Coupled			
55 MHz to 1 GHz	2.0:1	1.2:1	
1 to 18 GHz	3.0:1	2.0:1	1.8:1
18 to 26.5 GHz	3.0:1	2.4:1	2.0:1
Preamp On, LNA On	Input Attenuation		
	0 dB	**≥ 10 dB**	
DC Coupled			
50 MHz to 1 GHz	2.0:1	1.2:1	1.1:1
1 to 26.5 GHz[b]	3.0:1	2.0:1	1.5:1
AC Coupled			
55 MHz to 1 GHz	2.0:1	1.2:1	
1 to 18 GHz	3.0:1	2.0:1	1.8:1
18 to 26.5 GHz	3.0:1	2.4:1	2.0:1

a. X-Series analyzers have a reflection coefficient that is excellently modeled with a Rayleigh probability distribution. Keysight recommends using the methods outlined in Application Note 1449-3 and companion Average Power Sensor Measurement Uncertainty Calculator to compute mismatch uncertainty.
b. When the notch filter is selected the specs between 2.3 GHz – 2.6 GHz is not applicable.

Description	Specifications	Supplemental Information	
Total Measurement Uncertainty			
Signal level 0 to 90 dB below reference point, RF attenuation 0 to 40 dB, RBW ≤ 1 MHz, 20º to 30º C: AC coupled 10 MHz to 26.5 GHz DC coupled 9 kHz to 26.5 GHz			
		95th Percentile (≈2σ)	
		Spectrum Analyzer Mode	**EMI Receiver Mode**
RF Preselector Off, Preamp On, LNA Off			
100 kHz to 10 MHz		± 0.40 dB	± 0.45 dB
10 MHz to 3.6 GHz		± 0.30 dB	± 0.30 dB
3.6 to 18 GHz		± 0.65 dB	± 0.65 dB
18 to 26.5 GHz		± 0.90dB	± 0.95 dB
RF Preselector On, Preamp On, LNA Off			
9 kHz to 10 MHz		± 0.36 dB	± 0.41 dB
10 MHz to 1 GHz		± 0.20 dB	± 0.34 dB
1 to 3.6 GHz		± 0.20 dB	± 0.34 dB
3.6 to 18 GHz		± 0.65 dB	± 0.65 dB
18 to 26.5 GHz		± 0.90 dB	± 0.95 dB
RF Preselector Off, Preamp On/Off, LNA On			
2 to 10 MHz		± 0.45 dB	± 0.50 dB
10 MHz to 3.6 GHz		± 0.30 dB	± 0.30 dB
RF Preselector On, Preamp On/Off, LNA On			
10 MHz to 1 GHz		± 0.27 dB	± 0.33 dB
1 to 3.6 GHz		± 0.27 dB	± 0.33 dB
18 to 26.5 GHz		± 0.90 dB	± 0.95 dB
RF Preselector Off/On, Preamp Off, LNA On			
3.6 to 18 GHz		± 0.65 dB	± 0.65 dB
18 to 26.5 GHz		± 0.90 dB	± 0.95 dB
RF Preselector Off/On, Preamp On, LNA On			
3.6 to 18 GHz		± 0.65 dB	± 0.65 dB
18 to 26.5 GHz		± 0.90 dB	± 0.90 dB

Description	Specifications		Supplemental Information
Displayed Average Noise Level (DANL)[a] **- LNA Off**	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.
(RF Input 1[b])			
	20 to 30°C	**0 to 55°C**	Typical DANL including NFE[c]
RF Preselector Off, Preamp On			
100 kHz to 1 MHz[d]	−157 dBm	−155 dBm	
1 to 10 MHz[d]	–165 dBm	–163 dBm	
10 MHz to 1 GHz	–165 dBm	–163 dBm	–174 dBm
1 to 3.6 GHz	–161 dBm	–160 dBm	–172 dBm
3.5 GHz to 13.6 GHz	–164 dBm	–163 dBm	–174 dBm
13.5 to 26.5 GHz	–160 dBm	–159 dBm	–170 dBm
RF Preselector On[e]**, Preamp On**			
1 kHz[d]	−145 dBm	−140 dBm	–150 dBm
9 to 100 kHz[d] (100 kHz)	–160 dBm	–158 dBm	–161 dBm
100 kHz to 1 MHz[d] (1MHz)	–160 dBm	–158 dBm	–171 dBm
1 to 30 MHz[d] (30 MHz)	–163 dBm	–162 dBm	–173 dBm
30 MHz to 1 GHz (1000 MHz)	–164 dBm	–163 dBm	–174 dBm
1 to 1.7 GHz (1700 MHz)	–165 dBm	–164 dBm	–174 dBm
1.7 to 2.5 GHz (2500 MHz)	−164 dBm	−163 dBm	–174 dBm
2.5 to 3.6 GHz (3600 MHz)	–161 dBm	–160 dBm	–172 dBm
3.5 GHz to 13.6 GHz (13600 MHz)	–164 dBm	–163 dBm	–174 dBm
13.5 to 26.5 GHz (26500 MHz)	–160 dBm	–159 dBm	–170 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. Does not apply to Time Domain scan.
b. RF Input 2 operates to 1 GHz. The DANL is nominally 11 dB higher for RF Input 2.
c. NFE = Noise Floor Extension. Typical DANL including NFE = (Typical DANL – DANL improvement with NFE).
d. 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 25 kHz.

e. When the notch filter is selected the DANL specs between 2.2 GHz – 2.9 GHz is nominally specified.

Description	Specifications		Supplemental Information
Displayed Average Noise Level (DANL)[a] - LNA On	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.
(RF Input 1[b])			
	20 to 30°C	**0 to 55°C**	**Typical DANL including NFE[c]**
RF Preselector Off, Preamp On/Off			
150 kHz to 1 MHz[d]			–92 dBm
1 to 5 MHz[d]			–119 dBm
5 to 30 MHz[d]			–148 dBm
30 to 50 MHz	–161 dBm	–160 dBm	–172 dBm
50 to 150 MHz	–165 dBm	–164 dBm	–172 dBm
150 MHz to 2 GHz	–167 dBm	–166 dBm	–172 dBm
2 GHz to 3.6 GHz	–164 dBm	–162 dBm	–172 dBm
RF Preselector On[e], Preamp On/Off			
150 kHz to 1 MHz[d]			–100 dBm
1 to 10 MHz[d]			–125 dBm
10 to 30 MHz[d]			–165 dBm
30 to 50 MHz	–163 dBm	–162 dBm	–174 dBm
50 to 100 MHz	–165 dBm	–164 dBm	–174 dBm
100 to 150 MHz	–166 dBm	–165 dBm	–174 dBm
150 MHz to 2 GHz	–166 dBm	–165 dBm	–174 dBm
2 GHz to 3.6 GHz	–165 dBm	–164 dBm	–174 dBm

Description	Specifications		Supplemental Information
RF Preselector On/Off[e], Preamp Off			
3.5 to 8.4 GHz	–165 dBm	–164 dBm	–172 dBm
8.3 to 13.6 GHz	–164 dBm	–163 dBm	–171 dBm
13.5 to 19 GHz	–163 dBm	–162 dBm	–170 dBm
19 to 22 GHz	–161 dBm	–160 dBm	–170 dBm
22.0 to 26.5 GHz	–157 dBm	–156 dBm	–168 dBm
RF Preselector On/Off, Preamp On			
3.5 to 8 GHz	–167 dBm	–166 dBm	–174 dBm
8 to 13.6 GHz	–166 dBm	–165 dBm	–174 dBm
13.5 to 19 GHz	–165 dBm	–164 dBm	–173 dBm
19 to 22 GHz	–164 dBm	–163 dBm	–173 dBm
22.0 to 26.5 GHz	–163 dBm	–162 dBm	–172 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. Does not apply to Time Domain scan.
b. RF Input 2 operates to 1 GHz. The DANL is nominally 11 dB higher for RF Input 2.
c. NFE = Noise Floor Extension. Typical DANL including NFE = (Typical DANL – DANL improvement with NFE).
d. 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 25 kHz.
e. When the notch filter is selected the DANL specs between 2.2 GHz – 2.9 GHz is nominally specified.

Description	Specifications	Supplemental Information
Indicated Noise (EMI Receiver Mode)[a]		Input terminated
(RF Input 1[b])		EMI Average detector 0 dB input attenuation All indicated RBW are CISPR BW, except as noted.
RF Preselector On, Preamp On, LNA Off		**Typical Indicated Noise including NFE**[c]
1 kHz (100 Hz RBW)[d]		−24 dBμV[e]
9 to 150 kHz (200 Hz RBW)		−31 dBμV
150 kHz to 1 MHz (9 kHz RBW)		−17 dBμV
1 to 30 MHz (9 kHz RBW)		−20 dBμV
30 MHz to 1 GHz (120 kHz RBW)		−11 dBμV
1 to 2.5 GHz (1 MHz RBW)		−2 dBμV
2.5 to 3.6 GHz (1 MHz RBW)		0 dBμV
3.6 to 8.4 GHz (1 MHz RBW)		−2 dBμV
8.3 to 13.6 GHz (1 MHz RBW)		−2 dBμV
13.5 to 17.1 GHz (1 MHz RBW)		−3 dBμV
17.1 to 25 GHz (1 MHz RBW)		+1 dBμV
25 to 26.5 GHz (1 MHz RBW)		+2 dBμV
RF Preselector On, Preamp Off, LNA On		
30 MHz to 1 GHz (120 kHz RBW)		−11 dBμV
1 to 2.5 GHz (1 MHz RBW)		−5 dBμV
2.5 to 3.6 GHz (1 MHz RBW)		−3 dBμV
3.6 to 8.4 GHz (1 MHz RBW)		−4 dBμV
8.3 to 13.6 GHz (1 MHz RBW)		−3 dBμV
13.5 to 17.1 GHz (1 MHz RBW)		−2 dBμV
17.1 to 25 GHz (1 MHz RBW)		+1 dBμV
25 to 26.5 GHz (1 MHz RBW)		+3 dBμV

Description	Specifications	Supplemental Information
RF Preselector On/Off, Preamp On, LNA On		**Typical Indicated Noise including NFE**[c]
3.6 to 8.4 GHz (1 MHz RBW)		−5 dBμV
8.3 to 13.6 GHz (1 MHz RBW)		−4 dBμV
13.5 to 17.1 GHz (1 MHz RBW)		−4 dBμV
17.1 to 25 GHz (1 MHz RBW)		0 dBμV
25 to 26.5 GHz (1 MHz RBW)		0 dBμV

a. When the notch filter is selected, the Indicated Noise specifications between 2.2 – 2.9 GHz is nominally specified.
b. RF Input 2 operates to 1 GHz. The DANL is nominally 11 dB higher for RF Input 2.
c. Typical Indicated Noise including NFE = Typical DANL + RBW correction – DANL Improvement with NFE +107.
d. Indicated RBW is a 6 dB bandwidth.
e. NFE is not part of the difference between warranted and typical specifications at this frequency.

Description	Specifications	Supplemental Information	
DANL and Indicated Noise Improvement with Noise Floor Extension[a]		95th Percentile (≈ 2 σ)	
RF Preselector Off, Preamp On[b]		**Spectrum Analyzer Mode**	**EMI Receiver Mode**
RF Input 1			
10 MHz[c] to 3.6 GHz		10 dB	4 dB
3.5 to 8.4 GHz		9 dB	4 dB
8.3 to 13.6 GHz		10 dB	5 dB
13.5 to 17.1 GHz		9 dB	5 dB
17.0 to 26.5 GHz		8 dB	4 dB
RF Input 2			
10 MHz[c] to 1 GHz		10 dB	4 dB
RF Preselector On, Preamp On[b]			
RF Input 1			
150 kHz[d] to 30 MHz		10 dB	3 dB
30 MHz to 1 GHz		10 dB	4 dB
1 to 3.6 GHz		10 dB	4 dB
3.5 to 8.4 GHz		9 dB	4 dB
8.3 to 13.6 GHz		10 dB	5 dB
13.5 to 17.1 GHz		9 dB	5 dB
17 to 26.5 GHz		8 dB	4 dB
RF Input 2			
150 kHz[d] to 1 GHz		10 dB	3 dB

a. This statement on the improvement in DANL is based on the accuracy of the fit of the noise floor model to the measured values of that noise. This measure of the performance correlates well with improvement versus fre-quency. The improvement actually measured and specified in "Examples of Effective DANL" usually meet these limits as well, but not with the confidence in some cases. Does not apply to Time Domain scan.

b. DANL of the preamp is specified with a 50 Ω source impedance. Like all amplifiers, the noise varies with the source impedance. When NFE compensates for the noise with an ideal source impedance, the variation in the remaining noise level with the actual source impedance is greatly multiplied in a decibel sense.

c. NFE does not apply to the low frequency sensitivity. At frequencies below about 0.5 MHz, the sensitivity is domi-nate by phase noise surrounding the LO feedthrough. The NFE is not designed to improve that performance. At frequencies between 0.5 and 10 MHz the NFE effectiveness increases from nearly none to near its maximum

d. For RF Preselector path, NFE does not apply at frequencies below 100 kHz. At frequencies between 100 kHz and 150 kHz, the NFE effectiveness is not measured, but is designed to be nominally the same as frequencies above 150 kHz.

Description	Specifications	Supplemental Information	
DANL and Indicated Noise Improvement with Noise Floor Extension[a][b] **- LNA on**		95th Percentile (≈ 2 σ)	
RF Preselector Off, Preamp On/Off		**Spectrum Analyzer Mode**	**EMI Receiver Mode**
RF Input 1			
10 MHz[c] to 3.6 GHz		10 dB	4 dB
RF Input 2			
10 MHz[c] to 3.6 GHz		10 dB	4 dB
RF Preselector On, Preamp On/Off[b]			
RF Input 1			
150 kHz[d] to 30 MHz		10 dB	2 dB
30 MHz to 3.6 GHz		10 dB	4 dB
RF Input 2			
150 kHz[c] to 30 MHz		10 dB	2 dB
RF Preselector On/Off, Preamp Off			
RF Input 1			
3.6 to 8.4 GHz		10 dB	5 dB
8.3 to 13.6 GHz		10 dB	5 dB
13.5 to 17.1 GHz		10 dB	5 dB
17 to 26.5 GHz		9 dB	4 dB
RF Preselector On/Off, Preamp On[e]			
RF Input 1			
3.6 to 8.4 GHz		9 dB	5 dB
8.3 to 13.6 GHz		9 dB	5 dB
13.5 to 17.1 GHz		9 dB	5 dB
17 to 26.5 GHz		8 dB	3 dB

a. This statement on the improvement in DANL is based on the statistical observations of the error in the effective noise floor after NFE is applied. That effective noise floor can be a negative or a positive power at any frequency. These 95th percentile values are based on the absolute value of that effective remainder noise power.
b. Unlike other 95th percentiles, these table values do not include delta environment effects. NFE is aligned in the factory at room temperature. For best performance, in an environment that is different from room temperature, such as an equipment rack with other instruments, we recommend running the "Characterize Noise Floor" operation after the first time the analyzer has been installed in the environment, and given an hour to stabilize.
c. NFE does not apply to the low frequency sensitivity. At frequencies below about 0.5 MHz, the sensitivity is dominate by phase noise surrounding the LO feedthrough. The NFE is not designed to improve that performance. At frequencies between 0.5 and 10 MHz the NFE effectiveness increases from nearly none to near its maximum
d. For RF Preselector path, NFE does not apply at frequencies below 100 kHz. At frequencies between 100 kHz and 150 kHz, the NFE effectiveness is not measured, but is designed to be nominally the same as frequencies above 150 kHz.
e. DANL of the preamp is specified with a 50Ω source impedance. Like all amplifiers, the noise varies with the source impedance. When NFE compensates for the noise with an ideal source impedance, the variation in the remaining noise level with the actual source impedance is greatly multiplied in a decibel sense.

Description	Specifications	Supplemental Information
Second Harmonic Distortion[a]		
RF Preselector Off, Preamp On, LNA Off[b]		**Nominal**
Source Frequency		
10 MHz to 1.8 GHz (Preamp level = –45 dBm)		+33 dBm
1.8 to 13.25 GHz (Preamp level = –50 dBm)		+10 dBm
RF Preselector On, Preamp On, LNA Off[bc]		
Source Frequency (Preamp level = –35 dBm)		
10 to 30 MHz		+43 dBm
30 to 500 MHz		+56 dBm
500 MHz to 1 GHz		+61 dBm
1 to 1.6 GHz		+57 dBm
1.6 to 1.8 GHz		+57 dBm
1.8 to 13.25 GHz		+10 dBm
RF Preselector Off, Preamp On/Off, LNA On[b]		
Source Frequency (Preamp level = –45 dBm)		
30 MHz to 1.8 GHz		+15 dBm
RF Preselector On, Preamp On/Off, LNA On[bc]		
Source Frequency (Preamp level = –35 dBm)		
30 to 300 MHz		+17 dBm
300 to 500 MHz		+17 dBm
500 MHz to 1 GHz		+17 dBm
1 to 1.6 GHz		+15 dBm
1.6 to 8 GHz		+15 dBm

Description	Specifications	Supplemental Information
RF Preselector On/Off, Preamp On, LNA On[b]		
Source Frequency (Preamp level = –50 dBm)		
1.8 to 13.25 GHz		+15 dBm
RF Preselector On/Off, Preamp On, LNA On[b]		
Source Frequency (Preamp level = –50 dBm)		
1.8 to 13.25 GHz		–5 dBm

a. RF Input 2 operates to 1 GHz. The second harmonic distortion intercept is nominally 9 dB higher for RF Input 2.
b. Preamp level = Input level – Input Attenuation
c. When the notch filter is selected the specs between source frequency 1.15 GHz to 1.30 GHz is not applicable.

Description	Specifications		Supplemental Information
Third Order Intermodulation[ab]			
(Tone separation > 5 times IF Prefilter Bandwidth[c] Verification conditions[ab] RF Input 1[d])			
	Intercept[e]		
RF Preselector Off, Preamp On, LNA Off[f]	**20 to 30°C**	**0 to 50°C**	**Typical**
(Preamp level = –36 dBm)			
10 to 500 MHz			+1 dBm (nominal)
500 MHz to 3.6 GHz			+3 dBm (nominal)
(Preamp level = –50 dBm)			
3.6 to 26.5 GHz			–10 dBm (nominal)
RF Preselector On, Preamp On, LNA Off[fg]			
(Preamp level = –36 dBm)			
10 to 30 MHz	+1 dBm	0 dBm	+3 dBm
30 MHz to 1 GHz	–3 dBm	–5 dBm	–1 dBm
1 to 2 GHz	–1 dBm	–2 dBm	+1 dBm
2 to 3.6 GHz	–1 dBm	–2 dBm	+2 dBm
(Preamp level = –50 dBm)			
3.6 to 26.5 GHz			–10 dBm (nominal)
RF Preselector Off, Preamp On/Off, LNA On[f]			
(Preamp level = –36 dBm)			
30 to 500 MHz			0 dBm (nominal)
500 MHz to 3.6 GHz			+1 dBm (nominal)
RF Preselector On, Preamp On/Off, LNA On[fg]			
(Preamp level = –36 dBm)			
30 MHz to 1 GHz	–8 dBm	–9 dBm	–6 dBm
1 to 2 GHz	–6 dBm	–7 dBm	–4 dBm
2 to 3.6 GHz	–4 dBm	–5 dBm	–2 dBm

Description	Specifications	Supplemental Information
RF Preselector On/Off, Preamp Off, LNA On[f]		
(Preamp level = –36 dBm)		
3.6 to 13.6 GHz		+5 dBm (nominal)
13.6 to 26.5 GHz		+1 dBm (nominal)
RF Preselector On/Off, Preamp On, LNA On[f]		
(Preamp level = –50 dBm)		
3.6 to 13.6 GHz		–14 dBm (nominal)
13.6 to 26.5 GHz		–20 dBm (nominal)

a. Specified with two tones measurement in Spectrum Analyzer mode. Verfied with two tones, each at –14 dBm at the input with 4 dB input attenuation, spaced by 100 kHz.
b. When using EMI Receiver Mode, all indicated values shown here are nominal values. It has been verified with two tones, each at-14 dBm at the input with 4 dB input attenuation, spaced by 50 MHz
c. See the IF Prefilter Bandwidth table in the Gain Compression specifications on page 37. When the tone separation condition is met, the effect on TOI of the setting of IF Gain is negligible. TOI is verified with IF Gain set to its best case condition, which is IF Gain = Low.
d. RF Input 2 operates to 1 GHz. The intercept is nominally 9 dB higher for RF Input 2.
e. 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.
f. Preamp level = Input level – Input Attenuation.
g. When the notch filter is selected the specs between source frequency 2.3 GHz to 2.6 GHz is not applicable.

Keysight X-Series MXE EMI Receiver
N9038A

Specification Guide

9 Option YAS - Y-Axis Screen Video Output

This chapter contains specifications for *Option YAS*, Y-Axis Screen Video Output.

KEYSIGHT TECHNOLOGIES

Specifications Affected by Y-Axis Screen Video Output

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

Other Y-Axis Screen Video Output Specifications

General Port Specifications

Description	Specifications	Supplemental Information
Connector	BNC female	Shared with other options
Impedance		<140Ω (nominal)

Screen Video

Description	Specifications	Supplemental Information
Operating Conditions		
Display Scale Types	All (Log and Lin)	“Lin” is linear in voltage
Log Scales	All (0.1 to 20 dB/div)	
Modes	Spectrum Analyzer only	
FFT & Sweep	Select sweep type = Swept.	
Gating	Gating must be off.	
Output Signal		
Replication of the RF Input Signal envelope, as scaled by the display settings		
Differences between display effects and video output		
Detector = Peak, Negative, Sample, or Normal	The output signal represents the input envelope excluding display detection	
Average Detector	The effect of average detection in smoothing the displayed trace is approximated by the application of a low-pass filter	Nominal bandwidth: $LPFBW = \frac{Npoints - 1}{SweepTime \cdot \pi}$
EMI Detectors	The output will not be useful.	
Trace Averaging	Trace averaging affects the displayed signal but does not affect the video output	
Amplitude Range		Range of represented signals
Minimum	Bottom of screen	
Maximum	Top of Screen + Overrange	
Overrange		Smaller of 2 dB or 1 division, (nominal)
Output Scaling[a]	0 to 1.0 V open circuit, representing bottom to top of screen respectively	
Offset		±1% of full scale (nominal)
Gain accuracy		±1% of output voltage (nominal)

Description	Specifications	Supplemental Information
Delay		
RF Input to Analog Out		
Without Option B40		1.67 μs + 2.56/RBW + 0.159/VBW (nominal)

a. The errors in the output can be described as offset and gain errors. An offset error is a constant error, expressed as a fraction of the full-scale output voltage. The gain error is proportional to the output voltage. Here's an example. The reference level is –10 dBm, the scale is log, and the scale is 5 dB/division. Therefore, the top of the display is –10 dBm, and the bottom is –60 dBm. Ideally, a –60 dBm signal gives 0 V at the output, and –10 dBm at the input gives 1 V at the output. The maximum error with a –60 dBm input signal is the offset error, ±1% of full scale, or ±10 mV; the gain accuracy does not apply because the output is nominally at 0 V. If the input signal is –20 dBm, the nominal output is 0.8 V. In this case, there is an offset error (±10 mV) plus a gain error (±1% of 0.8 V, or ±8 mV), for a total error of ±18 mV.

Continuity and Compatibility

Description	Specifications	Supplemental Information
Continuity and Compatibility		
Output Tracks Video Level		
During sweep	Yes	Except band breaks in swept spans
Between sweeps	See supplemental information	Before sweep interruption[a] Alignments [b] Auto Align = Partial[cd]
External trigger, no trigger[d]	Yes	
HP 8566/7/8 Compatibility[e]		Recorder output labeled “Video”
Continuous output		Alignment differences[f]
Output impedance		Two variants[g]
Gain calibration		LL and UR not supported[h]
RF Signal to Video Output Delay		See footnote[i]

a. There is an interruption in the tracking of the video output before each sweep. During this interruption, the video output holds instead of tracks for a time period given by approximately 1.8/RBW.
b. There is an interruption in the tracking of the video output during alignments. During this interruption, the video output holds instead of tracking the envelope of the RF input signal. Alignments may be set to prevent their interrupting video output tracking by setting Auto Align to Off.
c. Setting Auto Align to Off usually results in a warning message soon thereafter. Setting Auto Align to Partial results in many fewer and shorter alignment interruptions, and maintains alignments for a longer interval.
d. If video output interruptions for Partial alignments are unacceptable, setting the analyzer to External Trigger without a trigger present can prevent these from occurring, but will prevent there being any on-screen updating. Video output is always active even if the analyzer is not sweeping.
e. Compatibility with the HP/Keysight 8560 and 8590 families, and the ESA and PSA, is similar in most respects.
f. The HP 8566 family did not have alignments and interruptions that interrupted video outputs, as discussed above.
g. Early HP 8566-family spectrum analyzers had a 140Ω output impedance; later ones had 190Ω. The specification was <475Ω. The Analog Out port has a 50Ω impedance if the analyzer has *Option B40*, *DP2*, or *MPB*. Otherwise, the Analog Out port impedance is nominally 140Ω.
h. The HP 8566 family had LL (lower left) and UR (upper right) controls that could be used to calibrate the levels from the video output circuit. These controls are not available in this option.
i. The delay between the RF input and video output shown in Delay on page 133 is much higher than the delay in the HP 8566 family spectrum analyzers. The latter has a delay of approximately 0.554/RBW + 0.159/VBW.

10 Analog Demodulation Measurement Application

This chapter contains specifications for the N9063EM0E Analog Demodulation Measurement Application.

Additional Definitions and Requirements

The warranted specifications shown apply to Band 0 operation (up to 3.6 GHz), unless otherwise noted, for all analyzers. 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 specifications 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
–23 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.

See “Definitions of terms used in this chapter” on page 136.

KEYSIGHT TECHNOLOGIES

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 Hi is the i^{th} harmonic up to i =10);
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	$\frac{D}{S}$	**$(P_{distortion})^{1/2} / (P_{signal})^{1/2}$** $\times$ 100% where THD is the total harmonic distortion
SINAD	$\frac{S+N+D}{N+D}$	**$20 \times \log10\ [1/(P_{distortion})]^{1/2} = 20 \times \log10\ [(P_{total})^{1/2} / (P_{total} - P_{signal})^{1/2}]$** 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/Agilent/Keysight 8903A.

NOTE

P_{noise} must be limited to the bandwidth of the applied filters.
The harmonic sequence is limited to the 10th harmonic unless otherwise indicated.
P_{noise} includes all spectral energy that is not near harmonic frequencies, such as spurious signals, power line interference, etc.

RF Carrier Frequency and Bandwidth

Description	Specifications	Supplemental Information
Carrier Frequency		
Maximum Frequency		
Option 503	3.6 GHz	RF/μW frequency option
Option 508	8.4 GHz	RF/μW frequency option
Option 513	13.6 GHz	RF/μW frequency option
Option 526	26.5 GHz	RF/μW frequency option
Option 532	32 GHz	mmW frequency option
Option 544	44 GHz	mmW frequency option
Option 550	50 GHz	mmW frequency option
Minimum Frequency AC Coupled DC Coupled	 10 MHz 10 Hz	 In practice, limited by the need to keep modulation sidebands from folding, and by the interference from LO feedthrough.
Maximum Information Bandwidth (Info BW)[a]		
Option B25 (Standard)	25 MHz	
Option B40	40 MHz	
Option B85	85 MHz	
Option B1A	125 MHz	
Option B1X	160 MHz	
Capture Memory (Sample Rate × Acq Time)	3.6 MSa	Each sample is an I/Q pair. See note [b]

a. The maximum Info BW indicates the maximum operational BW, which depends on the analysis BW option equipped with the analyzer. However, the demodulation specifications only apply to the Channel 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,
Info BW = max [Span, Channel BW]. The sample interval is 1/(1.25 × Info BW); e.g. if Info BW = 200 kHz, then sample interval is 4 us. The sample rate is 1.25 × Info BW, 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.
Acq Time (acquisition time) is set by the largest of 4 controls:
Acq Time = max[2.0 / (RF RBW), 2.0 /(AF RBW), 2.2 × Demod Wfm Sweep Time, Demod Time]

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 Notch[b]		Tuned automatically by application to highest AF response, for use in SINAD, SNR, and Distortion calculations; complies with TI-603 and IT-O.132; stop bandwidth is ±13% of tone frequency.
Signaling Notch[b]		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 N9063EM0E 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 Agilent/Keysight U8903A Audio Analyzer if true QPD is required.

b. The Signaling Notch filter does not visibly affect the AF Spectrum trace.

Frequency Modulation

Conditions required to meet specification

- Peak deviation: ≥ 200 Hz to 400 kHz
- 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
- Center Frequency (CF): 2 MHz to 3.5 GHz, DC coupled for CF < 20 MHz

Description	Specifications	Supplemental Information
FM Measurement Range		
Modulation Rate Range[abc]	1 Hz to (max info BW)/2	
Peak Deviation Range[abc]	< (max info BW)/2	

a. ((Modulation Rate) + (Peak Deviation)) < (max Info BW)/2
b. The measurement range is also limited by max capture memory. Specifically, SamplingRate × AcqTime <3.6 MSa, where SamplingRate = 1.25 × Info BW. For example, if the modulation rate is 1 Hz, then the period of the waveform is 1 second. Suppose AcqTime = 72 seconds, then the max SamplingRate is 50 kHz, which leads to 40 kHz max Info BW. Under such condition, the peak deviation should be less than 20 kHz.
c. Max info BW: See “Maximum Information Bandwidth (Info BW)” on page 137.

Description	Specifications	Supplemental Information
FM Deviation Accuracy[a,b,c]	±(1.0% × Reading + 0.2% × Rate)	
FM Rate Accuracy[d,e]		
0.2 ≤ ModIndex < 10	±(0.02% × Reading) + rfa	
ModIndex ≥ 10	±(0.005% × Reading) + rfa	
Carrier Frequency Error[f,g]	±(6 ppm × Deviation + 50 ppm × Rate) + tfa	

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 a measured frequency peak deviation in Hz, and Rate is a modulation rate in Hz.
d. Reading is a measured modulation rate in Hz.
e. rfa = Modulation Rate × Frequency reference accuracy
f. tfa = transmitter frequency × frequency reference accuracy.
g. Deviation is peak frequency deviation in Hz, and Rate is a modulation rate in Hz.

Frequency Modulation

Description	Specifications	Supplemental Information
Post-Demod Distortion Residual[a]		
Distortion (SINAD)[b]	1.8% / (ModIndex)1/2 + 0.25%	
THD	0.4% / (ModIndex)1/2 + 0.02%	

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 $20 \times \log_{10}(1/ \text{Distortion})$.

Description	Specifications	Supplemental Information
Post-Demod Distortion Accuracy		
(Rate: 1 to 10 kHz, ModIndex: 0.2 to 100)		
Distortion	±(2% × Reading + DistResidual)	
THD	±(2% × Reading + DistResidual)	2nd and 3rd harmonics

Amplitude Modulation

Conditions required to meet specification

- Depth: 1% to 99%
- Channel BW: ≤ 1 MHz
- Channel BW:15 × Rate (Rate ≤ 50 kHz) or
  10 × Rate (50 kHz < Rate ≤ 100 kHz)
- Rate: 50 Hz to 100 kHz
- SINAD bandwidth: (Channel BW) / 2
- Single tone - sinusoid modulation
- Center Frequency (CF): 2 MHz to 3.5 GHz, DC coupled for CF < 20 MHz

Description	Specifications	Supplemental Information
AM Measurement Range		
Modulation Rate Range[a]	1 Hz to (max info BW)/2	
Peak Deviation Range	0% to 100%	

a. Max info BW: See "Maximum Information Bandwidth (Info BW)" on page 137.

Description	Specifications	Supplemental Information
AM Depth Accuracy[a][b]	±(0.15% × Reading + 0.06%)	
AM Rate Accuracy[c] (Rate: 1 to 100 kHz)	±[(3 ppm × Reading) × (100% / Depth)]	

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

Amplitude Modulation

Description	Specifications	Supplemental Information
Post-Demod Distortion Residual		
Distortion (SINAD)[a]	0.13% × (100% / Depth) + 0.05%	
THD	0.018% × (100% / Depth) + 0.06%	

a. SINAD [dB] can be derived by $20 \times \log_{10}(1/\text{Distortion})$.

Description	Specifications	Supplemental Information
Post-Demod Distortion Accuracy (Rate: 1 to 10 kHz, Depth: 5 to 90%)		
Distortion	±(1% × Reading + DistResidual)	
THD	±(1% × Reading + DistResidual)	

Description	Specifications	Supplemental Information
FM Rejection[a] (300 Hz HPF, 3 kHz LPF, 420 kHz Channel BW)		Applied FM signal Rate = 1 kHz, Deviation = 50 kHz
Instruments without *Option B40*		0.1% AM peak (nominal)
Instruments with *Option B40*	0.05% AM peak	

a. 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.

Phase Modulation

Conditions required to meet specification

- Peak deviation[1]: 0.2 to 100 rad
- Channel BW: ≤ 1 MHz
- Rate: 50 Hz to 50 kHz
- SINAD bandwidth: (Channel BW)/2
- Single tone - sinusoid modulation
- Center Frequency (CF): 2 MHz to 3.5 GHz, DC coupled for CF < 20 MHz

Description	Specifications	Supplemental Information
FM Measurement Range		
Modulation Rate Range[abc]	1 Hz to (max info BW)/2	
Peak Deviation Range[abc]	< (max info BW) / (2 × (Modulation Rate))	

a. ((Modulation Rate) + (Peak Deviation)) < (max Info BW)/2
b. The measurement range is also limited by max capture memory. Specifically, SamplingRate × AcqTime <3.6 MSa, where SamplingRate = 1.25 × Info BW.
c. Max info BW: See "Maximum Information Bandwidth (Info BW)" on page 137.

1. PeakDeviation (for phase, in rads) and Rate are jointly limited to fit within the 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.

Description	Specifications	Supplemental Information
PM Deviation Accuracy[a,b,c]		
Rate: 100 Hz to 50 kHz	±(0.1% × Reading + 2 mrad)	
PM Rate Accuracy[d,e,b]		
Rate ≤ 200 Hz	±(0.012 Hz / Deviation) + rfa	
200 Hz < Rate ≤ 50 kHz	±(0.5 Hz / Deviation) + rfa	
Carrier Frequency Error[b,f,g]	±(8 ppm × Deviation + 3 ppm) × Rate + tfa	

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.
d. Deviation is the peak deviation in radians.
e. rfa = Modulation Rate Frequency reference accuracy.
f. Rate is a Modulation Rate in Hz.
g. tfa = transmitter frequency × frequency reference accuracy.

Phase Modulation

Description	Specifications	Supplemental Information
Post-Demod Distortion Residual[a]		
Distortion (SINAD)[bc]	0.7% / Deviation + 0.01%	
THD[b]	0.09% / Deviation + 0.01%	

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. Deviation is a peak deviation in radians.
c. SINAD [dB] can be derived by $20 \times \log_{10}(1/\text{Distortion})$.

Description	Specifications	Supplemental Information
Post-Demod Distortion Accuracy		
(Rate: 1 to 10 kHz)		
Distortion (SINAD)[c]	$\pm(2\% \times \text{Reading} + \text{DistResidual})$	
THD	$\pm(2\% \times \text{Reading} + \text{DistResidual})$	2^{nd} and 3^{rd} harmonics

Analog Out

The "Analog Out" connector (BNC) is located at the analyzer's rear panel. It is a multi-purpose output, whose function depends on options and operating mode (active application). When the N9063EM0E 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 N9063EM0E application itself; the Analog Out waveform is not necessarily identical the application's Demod Waveform.

Condition of "Open Circuit" is assumed for all voltage terms such as "Output range".

Description	Specifications	Supplemental Information	
		Instruments without B40	**Instruments with B40**
Bandwidth		≤ 8 MHz	≤ 8 MHz
Output impedance		140Ω (nominal)	50Ω (nominal)
Output range[a]		0 V to +1 V (nominal)	–1 V to +1 V (nominal)
AM scaling			
AM scaling factor		2.5 mV/%AM (nominal)	5 mV/%AM (nominal)
AM scaling tolerance		±10% (nominal)	±10% (nominal)
AM offset		0.5 V corresponds to carrier power as measured at setup[b]	0 V corresponds to carrier power as measured at setup[b]
FM scaling			
FM scaling factor		1 V/Channel BW (nominal), where Channel BW is settable by the user	2 V/Channel BW (nominal), where Channel BW is settable by the user
FM scaling tolerance		±10% (nominal)	±10% (nominal)
FM scale adjust		User-settable factor, range from 0.5 to 10, default =1, applied to above FM scaling	User-settable factor, range from 0.5 to 10, default =1, applied to above FM scaling
FM offset			
HPF off		0.5 V corresponds to SA tuned frequency, and Carrier Frequency Errors (constant frequency offset) are included (DC coupled)	0 V corresponds to SA tuned frequency, and Carrier Frequency Errors (constant frequency offset) are included (DC coupled)
HPF on		0.5 V corresponds to the mean of peak-to-peak FM excursions	0 V corresponds to the mean of the waveform

Description	Specifications	Supplemental Information	
PM scaling			
PM scaling factor		$(1/2\pi)$ V/rad (nominal)	$(1/\pi)$ V/rad (nominal)
PM scaling tolerance		±10% (nominal)	±10% (nominal)
PM offset		0.5 V corresponds to mean phase	0 V corresponds to mean phase

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 deviation from the analyzer's tuned center frequency, unless a HPF is used. For PM, the output is proportional the phase-deviation; note that PM is limited to excursions of ±pi, and requires a HPF on to enable a phase-ramp-tracking circuit.
Most controls in the N9063C application do not affect Analog Out. The few that do are:
-choice of AM, FM, or PM (FM Stereo not supported)
- tuned Center Freq
-Channel BW (affects IF filter, sample rate, and FM scaling)
-some post-demod filters and de-emphasis (the hardware demodulator has limited filter choices; it will attempt to inherit the filter settings in the app, but with constraints and approximations)

b. For AM, the reference “unmodulated” carrier level is determined by a single “invisible” power measurement, of 2 ms duration, taken at setup. “Setup” occurs whenever a core parameter is changed, such as Center Frequency, modulation type, Demod Time, etc. Ideally, the RF input signal should be un-modulated at this time. However, if the AM modulating (audio) waveform is evenly periodic in 2 ms (i.e. multiples of 500 Hz, such as 1 kHz), the reference power measurement can be made with modulation applied. Likewise, if the AM modulating period is very short compared to 2ms (e.g. >5000 Hz), the reference power measurement error will be small.

FM Stereo/Radio Data System (RDS) Measurements[1]

Description	Specifications	Supplemental Information
FM Stereo Modulation Analysis Measurements		
MXP 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 kHz to 58 kHz. – Reference Deviation, default 75 kHz, range from 15 kHz 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, 80, or 300 kHz – Bandpass filter: A-Weighted, CCITT – De-Emphasis: 25, 50, 75 and 750 μs
RDS / RBDS Decoding Results view	BLER basic tuning and switching information, 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, Modulation Rate (Hz), SINAD (% or dB), THD (% or dB), Left to Right (dB), Mono to Stereo (dB), RF Carrier Power (dBm), RF Carrier Frequency Error (Hz), 38 kHz Carrier Phase Error (deg)	

1. Requires *Option N9063C-3FP*, which in turn requires that the instrument also has *Option N9063C-2FP* installed and licensed.

Description	Specifications	Supplemental Information
FM Stereo Modulation Analysis Measurements		FM Stereo with 67.5 kHz audio deviation at 1 kHz modulation rate plus 6.75 kHz pilot deviation.
SINAD (with A-Weighted filter)		62 dB (nominal)
SINAD (with CCITT filter)		69 dB (nominal)
Left to Right Ratio (with A-Weighted filter)		63 dB (nominal)
Left to Right Ratio (with CCITT filter)		72 dB (nominal)

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