Keysight Spectrum Analyzer Option (090/S93090xA) for PNA/PNA-L/PNA-X/N5290A/N5291A

Data Sheet and Technical Specifications

KEYSIGHT TECHNOLOGIES

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This is a complete list of the technical specifications for the spectrum analyzer Option 090 (“A” models) or S93090xA (“B” models) on PNA/PNA-L/PNA-X series of network analyzer, including the following models. See model specific data sheet for the network analyzer specifications.

PNA Series Network Analyzer

N5221A/21B 10 MHz to 13.5 GHz
N5222A/22B 10 MHz to 26.5 GHz
N5224A/24B 10 MHz to 43.5 GHz
N5225A/25B 10 MHz to 50 GHz
N5227A/27B 10 MHz to 67 GHz

PNA-L Series Network Analyzer

N5239A/39B 300 kHz to 8.5 GHz
N5231A/31B 300 kHz to 13.5 GHz
N5232A/32B 300 kHz to 20 GHz
N5234A/34B 10 MHz to 43.5 GHz
N5235A/35B 10 MHz to 50 GHz

PNA-X Series Network Analyzer

N5249A/49B 10 MHz to 8.5 GHz
N5241A/41B 10 MHz to 13.5 GHz with serial number MY5201/SG5201/US5201 and above
N5242A/42B 10 MHz to 26.5 GHz with serial number MY5202/SG5202/US5202 and above
N5244A/44B 10 MHz to 43.5 GHz with serial number MY5204/SG5204/US5204 and above
N5245A/45B 10 MHz to 50 GHz with serial number MY5205/SG5205/US5205 and above
N5247A/47B 10 MHz to 67 GHz

For N5241x/42x/44x/45x with earlier serial numbers, SA detector accuracy and DANL are characteristics and all other specifications and performance information are applied.

Spectrum analyzer capability is fully functional after enabling option 090 or S93090xA and performing IF response calibration without returning to Keysight service center. However, performance verification is required to warrant option 090 specified performances. Keysight advises this work to be done in one of Keysight service centers.

Spectrum Analyzer “B” Model Option Structure

S930900A – Spectrum analysis up to 8.5 GHz
S930901A – Spectrum analysis up to 13.5 GHz
S930902A – Spectrum analysis up to 26.5 GHz
S930904A – Spectrum analysis up to 43.5 GHz
S930905A – Spectrum analysis up to 50 GHz
S930907A – Spectrum analysis up to 67 GHz
S930909A – Spectrum analysis up to 90 GHz

Definitions

All specifications and characteristics apply over a 25 °C ±5 °C range (unless otherwise stated) and 90 minutes after the instrument has been turned on.

Specification (spec.): Warranted performance. Specifications include guardbands to account for the expected statistical performance distribution, measurement uncertainties, and changes in performance due to environmental conditions.

Characteristic (char.): A performance parameter that the product is expected to meet before it leaves the factory, but that is not verified in the field and is not covered by the product warranty. A characteristic includes the same guardbands as a specification.

Typical (typ.): Expected performance of an average unit which does not include guardbands. It is not covered by the product warranty.

Nominal (nom.): A general, descriptive term that does not imply a level of performance. It is not covered by the product warranty.

Supplemental Information: A performance parameter that is tested on sampled product during design validation. It does not include guardbands, and is not covered by the product warranty.

Calibration: The process of measuring known standards to characterize a network analyzer's systematic (repeatable) errors.

Corrected (residual): Indicates performance after error correction (calibration). It is determined by the quality of calibration standards and how well "known" they are, plus system repeatability, stability, and noise.

Uncorrected (raw): Indicates instrument performance without error correction. The uncorrected performance affects the stability of a calibration.

Standard: When referring to the analyzer, this includes no options unless noted otherwise.

Frequency and Time Specifications

Table 1a. Frequency Specifications

Description	Specification	Supplemental Information
Frequency Reference[1]		
Accuracy	--	± ±[(time since last adjustment x aging rate) + temperature stability + calibration accuracy], typical
Aging Rate	--	±0.1 ppm/yr maximum[2], typical
Temperature Stability	--	±0.05 ppm, -10° to 70° C[3], typical
Achievable Initial Calibration Accuracy	± 1 ppm	--
Accuracy Example, 1 year after adjustment	--	= ±[(1x0.1 ppm)+0.05 ppm+1 ppm = ±1.15 ppm
Frequency Readout Accuracy (Start, Stop, Center, Marker)	--	±[(readout frequency x frequency reference accuracy) + (<1% x RBW)], nominal
Frequency Span		
Minimum/Maximum	10 Hz/analyzer's full span	--
Resolution	1 Hz	--
Initial Calibration Accuracy	± 2 ppm	--
Sweep (Trace) Point Range	11 to 100,001	--
Resolution Bandwidth (RBW)		
Range (-3 dB Bandwidth)	1.2 Hz to 3 MHz in 10% steps	--
Bandwidth Range Accuracy	--	±1%, all RBW, except below 100 MHz with 3 MHz RBW
Selectivity (-60 dB/-3 dB)	--	Gaussian: 4.5:1, Flat top: 2.47:1, Kaiser: 3.82:1, Blackman: 3.58:1
Video Bandwidth Range[4]	1.2 Hz to 3 MHz	--

[1] Frequency reference accuracy can be improved by using external frequency reference with better accuracy.
[2] Assuming no variation in temperature.
[3] Assuming no variation in time.
[4] VBW is implemented by averaging to achieve a similar variance reduction effect for the same VBW value.

Table 1b. Time Specifications

Description	Specification	Supplemental Information
Sweep Time and Triggering		
Sweep Time Range	Auto	--
Trigger Types	Continuous, Single, Group, Manual, External (MEAS TRIG, AUX1, AUX2)	--
Trigger Delay Range	0 to 3 s	--
Trigger Delay Resolution	1 us	--
Measurement and Display Update Rate		
20 MHz Span, 3 kHz RBW, 3 kHz VBW	--	62 ms
100 MHz Span, Auto RBW, Auto VBW	--	62 ms
1 GHz Span, 3 kHz RBW, 3 kHz VBW		140 ms
1 GHz Span, 300 kHz RBW, 300 kHz VBW		65 ms
10 GHz Span, 3 kHz RBW, 3 kHz VBW		1200 ms
10 GHz Span, 300 kHz RBW, 300 kHz VBW		240 ms
Full Span, RBW/VBW = Preset (300 kHz)	--	N5239x/49x: 210 ms N5221x/31x/41x: 300 ms N5222x/32x/42x: 540 ms N5224x/34x/44x: 800 ms N5225x/35x/45x: 890 ms N5227x/47x: 1170 ms

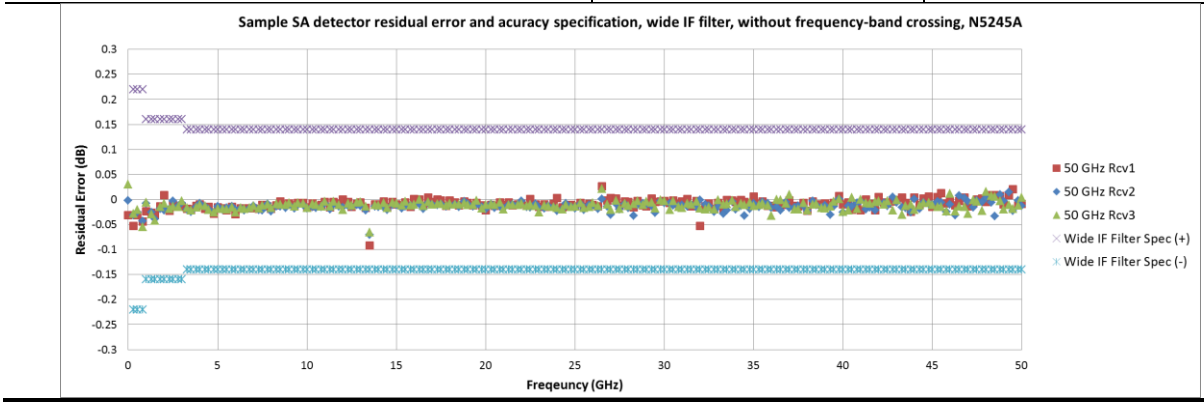
Amplitude Accuracy and Range Specifications

Table 2a. Amplitude Range Specifications

Description	Specification
Amplitude Range	
Measurement Range	DANL to maximum input level
Input Attenuator Range	N523xA/B: none, N5290A/N5291A: none, N5227x/47x: 0 to 50 dB in 10 dB steps, All other models: 0 to 35 dB in 5 dB steps
Maximum Safe Input Level	Vary by analyzer model and option configuration. See maximum test port and receiver input level specifications on individual data sheet.
Display Range	
Log Scale	0.001 to 500 dB/div in 0.001 steps
Linear Scale	10 divisions
Scale Units	dBm, mW
Trace Detectors Types	Average, Sample, Peak, Normal, Negative Peak, Peak sample, Peak average

Table 2b. SA Detector Accuracy[1], Without Frequency-band Crossing (dB) - Specifications

Description	N5221x/22x/ 41x/42x/49x		N5224x/25x/ 44x/45x		N5227x/47x	
	Narrow IF Filter	Wide IF Filter	Narrow IF Filter	Wide IF Filter	Narrow IF Filter	Wide IF Filter
10 MHz to 250 MHz	± 0.2	± 0.25	± 0.5	± 0.5	± 0.5	± 0.5
250 MHz to 800 MHz	± 0.1	± 0.15	± 0.15	± 0.22	± 0.1	± 0.15
800 MHz to 3.2 GHz	± 0.1	± 0.15	± 0.1	± 0.16	± 0.1	± 0.12
3.2 GHz to 10 GHz	± 0.1	± 0.11	± 0.1	± 0.14	± 0.1	± 0.12
10 GHz to 26.5 GHz	± 0.11	± 0.16	± 0.1	± 0.14	± 0.1	± 0.12
26.5 GHz to 40 GHz			± 0.1	± 0.14	± 0.1	± 0.12
40 GHz to 50 GHz			± 0.1	± 0.14	± 0.11	± 0.12
50 GHz to 67 GHz					± 0.11	± 0.16
67 GHz to 70 GHz[2]					± 0.1	± 0.1

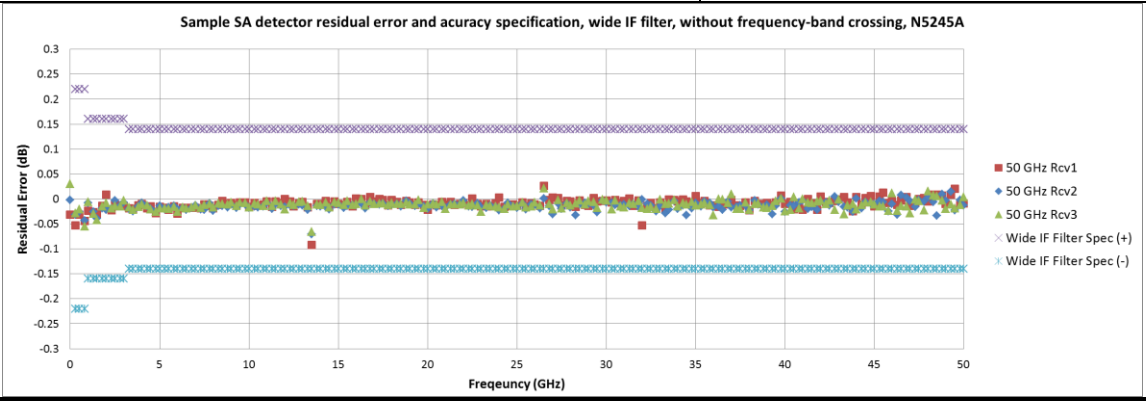


[1] SA detector accuracy is residual error of IF response calibration. IF response is characterized with PNA's standard measurement class after power and S-parameter calibration. Therefore the SA total absolute amplitude accuracy includes power meter, S-parameter and SA detector accuracies. Add input attenuation switching uncertainty if receiver attenuator is changed after user calibration.

[2] Typical for N5227x/47x.

Table 2c. SA Detector Accuracy[1], Without Frequency-band Crossing (dB) - Specifications

Description	N5290A		N5291A	
	Narrow IF Filter	Wide IF Filter	Narrow IF Filter	Wide IF Filter
10 MHz to 250 MHz	± 0.5	± 0.5	± 0.5	± 0.5
250 MHz to 800 MHz	± 0.26	± 0.3	± 0.26	± 0.3
800 MHz to 3.2 GHz	± 0.26	± 0.3	± 0.26	± 0.3
3.2 GHz to 10 GHz	± 0.26	± 0.3	± 0.26	± 0.3
10 GHz to 26.5 GHz	± 0.26	± 0.3	± 0.26	± 0.3
26.5 GHz to 40 GHz	± 0.26	± 0.3	± 0.26	± 0.3
40 GHz to 50 GHz	± 0.26	± 0.3	± 0.26	± 0.3
50 GHz to 67 GHz	± 0.26	± 0.3	± 0.26	± 0.3
67 GHz to 70 GHz	± 0.28	± 0.32	± 0.28	± 0.32
70 GHz to 90 GHz	± 0.28	± 0.32	± 0.28	± 0.32
90 GHz to 120 GHz			± 0.28	± 0.32
120 GHz to 125 GHz[2]			± 0.1	± 0.1



[1] SA detector accuracy is residual error of IF response calibration. IF response is characterized with PNA's standard measurement class after power and S-parameter calibration. Therefore the SA total absolute amplitude accuracy includes power meter, S-parameter and SA detector accuracies. Add input attenuation switching uncertainty if receiver attenuator is changed after user calibration.

[2] Typical for N5291A.

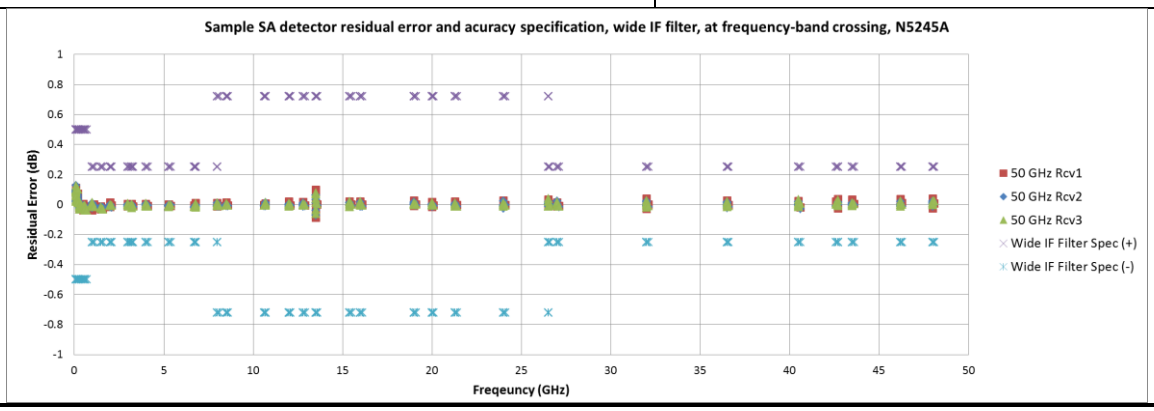
Table 2d. SA Detector Accuracy, At Frequency-band Crossing[1] (dB) - Specifications

Description	N5221x/22x/41x/42x/49x		N5224x/25x/44x/45x		N5227x/47x	
	Narrow IF Filter	Wide IF Filter	Narrow IF Filter	Narrow IF Filter	Narrow IF Filter	Wide IF Filter
50 MHz to 250 MHz	± 0.5	± 0.6	± 0.5	± 0.5	± 0.6	± 0.8
250 MHz to 800 MHz	± 0.5	± 0.6	± 0.5	± 0.5	± 0.6	± 0.8
800 MHz to 3.25 GHz	± 0.5	± 0.6	± 0.25	± 0.25	± 0.25	± 0.25
3.25 GHz to 8 GHz	± 0.25	± 0.25	± 0.25	± 0.25	± 0.25	± 0.25
8 GHz to 10 GHz	± 0.25	± 0.25	± 0.25	± 0.72	± 0.25	± 0.35
10 GHz to 13.5 GHz	± 0.25	± 0.25	± 0.41	± 0.72	± 0.25	± 0.35
13.5 GHz to 26.5 GHz	± 0.25	± 0.25	± 0.41	± 0.72	± 0.25	± 0.35
26.5 GHz to 49.95 GHz			± 0.41	± 0.25	± 0.25	± 0.35
49.95 GHz to 50 GHz			± 0.41	± 0.25	± 1.75	± 2.15
50 GHz to 50.05 GHz					± 1.75	± 2.15
50.05 GHz to 67 GHz					± 0.25	± 0.35

[1] SA detector accuracy with frequency-band crossing is tested at 0 Hz, ± 1 MHz, ± 10 MHz, and ±50 MHz offset from each band-crossing frequency. This residual error is applied to 0 Hz, ± 1 MHz, and ± 10 MHz offset with narrow anti-alias filter path, and to 0 Hz, ± 1 MHz, ±10 MHz, and ±50 MHz offset with wide anti-alias filter path.

Table 2e. SA Detector Accuracy, At Frequency-band Crossing[1] (dB) - Specifications

Description	N5290A		N5291A	
	Narrow[2] IF Filter	Wide[2] IF Filter	Narrow[2] IF Filter	Wide[2] IF Filter
50 MHz to 250 MHz	± 0.6	± 0.8	± 0.6	± 0.8
250 MHz to 800 MHz	± 0.35	± 0.35	± 0.35	± 0.35
800 MHz to 3.25 GHz	± 0.35	± 0.35	± 0.35	± 0.35
3.25 GHz to 8 GHz	± 0.35	± 0.35	± 0.35	± 0.35
8 GHz to 10 GHz	± 0.35	± 0.35	± 0.35	± 0.35
10 GHz to 13.5 GHz	± 0.35	± 0.35	± 0.35	± 0.35
13.5 GHz to 26.5 GHz	± 0.4	± 0.4	± 0.4	± 0.4
26.5 GHz to 49.95 GHz	± 0.4	± 0.4	± 0.4	± 0.4
49.95 GHz to 50 GHz	± 0.4	± 0.4	± 0.4	± 0.4
50 GHz to 50.05 GHz	± 0.4	± 0.4	± 0.4	± 0.4
50.05 GHz to 67 GHz	± 0.4	± 0.5	± 0.4	± 0.5
67 GHz to 90 GHz	± 0.4	± 0.5	± 0.4	± 0.5
90 GHz to 110 GHz			± 0.55	± 0.65
110 GHz to 120 GHz			± 0.55	± 0.65



[1] SA detector accuracy with frequency-band crossing is tested at 0 Hz, ± 1 MHz, ± 10 MHz, and ±50 MHz offset from each band-crossing frequency. This residual error is applied to 0 Hz, ± 1 MHz, and ± 10 MHz offset with narrow anti-alias filter path, and to 0 Hz, ± 1 MHz, ±10 MHz, and ±50 MHz offset with wide anti-alias filter path.

[2] For Band Crossings at 24GHz, 40GHz and 80GHz, specification is ±1dB, and at 63.984GHz, specification is ± 1.75 dB.

Table 2f. SA Detector Accuracy[1], Without Frequency-band Crossing (dB) - Specifications

Description	N5231x/32x/39x		N5234x/35x	
	Narrow IF Filter	Wide IF Filter	Narrow IF Filter	Wide IF Filter
10 MHz to 250 MHz	± 0.1	± 0.1	± 0.25	± 0.3
250 MHz to 800 MHz	± 0.1	± 0.1	± 0.1	± 0.12
800 MHz to 13.51 GHz	± 0.1	± 0.1	± 0.1	± 0.12
13.51 GHz to 20 GHz	± 0.1	± 0.1	± 0.12	± 0.22
20 GHz to 40 GHz			± 0.12	± 0.22
40 GHz to 50 GHz			± 0.15	± 0.28

[1] SA detector accuracy is residual error of IF response calibration. IF response is characterized with PNA's standard measurement class after power and S-parameter calibration. Therefore the SA total absolute amplitude accuracy includes power meter, S-parameter and SA detector accuracies. Add input attenuation switching uncertainty if receiver attenuator is changed after user calibration.

Table 2g. SA Detector Accuracy[1], At Frequency-band Crossing (dB) - Specifications

Description	N5231x/32x/39x		N5234x/35x	
	Narrow IF Filter	Wide IF Filter	Narrow IF Filter	Wide IF Filter
50 MHz to 13.46 GHz	± 0.15	± 0.18	± 0.25	± 0.3
13.46 GHz to 13.5 GHz	± 0.15	± 0.25	± 0.25	± 0.5
13.5 GHz to 13.52 GHz	± 0.2	± 0.25	± 0.45	± 0.5
13.52 GHz to 13.56 GHz	± 0.15	± 0.25	± 0.25	± 0.5
13.56 GHz to 20 GHz	± 0.15	± 0.18	± 0.25	± 0.3
20 GHz to 39.95 GHz			± 0.25	± 0.3
39.95 GHz to 39.99 GHz			± 0.25	± 0.5
39.99 GHz to 40.01 GHz			± 0.45	± 0.5
40.01 GHz to 40.05 GHz			± 0.25	± 0.5
40.05 GHz to 50 GHz			± 0.25	± 0.3

[1] SA detector accuracy with frequency-band crossing is tested at 0 Hz, ± 1 MHz, ± 10 MHz, and ±50 MHz offset from each band-crossing frequency. This residual error is applied to 0 Hz, ± 1 MHz, and ± 10 MHz offset with narrow anti-alias filter path, and to 0 Hz, ± 1 MHz, ±10 MHz, and ±50 MHz offset with wide anti-alias filter path.

Table 2h. Input Attenuation[1] Switching Uncertainty (dB) - Supplemental Information

Description	N5221x/22x/ 41x/42x/49x		N5224x/25x/ 44x/45x		N5227x/47x	
	5 to 30 dB	35 dB	5 to 20 dB	25 to 35 dB	10 to 40 dB	50 dB
10 MHz to 20 MHz	± 1.0	± 1.2	± 0.6	± 1.0	± 1.0	± 1.3
20 GHz to 26.5 GHz	± 1.5	± 1.7	± 0.6	± 1.0	± 1.0	± 1.3
26.5 GHz to 40 GHz			± 0.6	± 1.0	± 1.0	± 1.3
40 GHz to 50 GHz			± 0.7	± 1.1	± 0.15	± 2.2
50 GHz to 67 GHz					± 0.15	± 2.2

[1] For the N5290A and N5291A systems, there are no input attenuators.

Table 2i. Input VSWR[1] – Specifications to 26.5 GHz

Description	N5221x/22x Options 210, 410	N5221x/22x All Other Options	N5241x/42x/49x All Options[2]
10 MHz to 50 MHz	1.135	1.785 (2.1)	1.785 (2.1)
50 MHz to 500 MHz	1.106	1.329 (2.615)	1.329 (2.615)
500 MHz to 3.2 GHz	1.135	1.329 (2.615)	1.329 (2.615)
3.2 GHz to 8 GHz	1.196	1.577 (2.1)	1.577 (2.1)
8 GHz to 10 GHz	1.329	1.577 (2.1)	1.577 (2.1)
10 GHz to 13.5 GHz	1.377	1.925 (2.1)	1.925 (2.1)
13.5 GHz to 16 GHz	1.433	1.925 (2.1)	1.925 (2.1)
16 GHz to 20 GHz	1.499	2.1 (2.615)	2.1 (2.615)
20 GHz to 24 GHz	1.671	2.1 (2.615)	2.1 (3.01)
24 GHz to 26.5 GHz	1.925	2.323 (3.01)	2.323 (3.01)

() With Option 205 or 425 installed.

[1] Tested with 0 dB source attenuator. VSWR is improved by increasing source attenuator value.

[2] Without Option 029 or S93029A.

Table 2j. Input VSWR[1] – Specifications to 50 GHz

Description	N5224x/25x Options 210, 410	N5224x/25x All Other Options	N5244x/45x All Options[2]
10 MHz to 50 MHz	1.329	1.925	1.925 (2.323)
50 MHz to 200 MHz	1.173	1.253	1.377 (2.615)
200 MHz to 500 MHz	1.106	1.289	1.377 (2.615)
500 MHz to 3.2 GHz	1.196	1.377	1.499 (3.01)
3.2 GHz to 10 GHz	1.253	1.577	1.577 (3.01)
10 GHz to 13.5 GHz	1.329	1.785	1.785 (2.323)
13.5 GHz to 16 GHz	1.433	1.925	1.785 (2.323)
16 GHz to 20 GHz	1.433	1.925	1.785 (2.615)
20 GHz to 26.5 GHz	1.433	1.925	1.925 (3.01)
26.5 GHz to 46 GHz	1.577	2.323	2.615 (3.01)
46 GHz to 50 GHz	1.925	2.323	2.615 (3.01)

() With Option 425 installed.
[1] Tested with 0 dB source attenuator. VSWR is improved by increasing source attenuator value.
[2] Without Option 029 or S93029A.

Table 2k. Input VSWR[1] – Specifications to 70 GHz

Description	N5227x Options 210, 410	N5227x All Other Options	N5247x All Options[2]
10 MHz to 50 MHz	1.289	3.01 (3.01)	3.01 (3.01)
50 MHz to 200 MHz	1.135	1.785 (2.615)	1.785 (2.615)
200 MHz to 500 MHz	1.153	1.785 (2.615)	1.785 (2.615)
500 MHz to 3.2 GHz	1.253	2.615 (2.615)	2.615 (2.615)
3.2 GHz to 10 GHz	1.329	2.615 (2.615)	2.615 (2.615)
10 GHz to 13.5 GHz	1.433	3.01 (3.01)	3.01 (3.01)
13.5 GHz to 16 GHz	1.577	3.01 (3.01)	3.01 (3.01)
16 GHz to 20 GHz	1.577	2.615 (2.615)	2.615 (2.615)
20 GHz to 26.5 GHz	1.671	2.615 (2.615)	2.615 (2.615)
26.5 GHz to 43.5 GHz	1.925	3.01 (3.01)	3.01 (3.01)
43.5 GHz to 50 GHz	1.925	3.01 (3.01)	3.01 (3.01)
50 GHz to 60 GHz	2.323	2.615 (2.615)	2.615 (2.615)
60 GHz to 67 GHz	2.323	3.01 (3.01)	3.01 (3.01)
67 GHz to 70 GHz[3]	1.785	1.925 (1.925)	1.925 (1.925)

() With Option 205 or 425 installed.
[1] Tested with 0 dB source attenuator. VSWR is improved by increasing source attenuator value.
[2] Without Option 029 or S93029A.
[3] Typical.

Table 2l. Input VSWR – Specification

Description	N5290A All Options	N5291A All Options
10 MHz to 50 MHz	2.323	2.323
50 MHz to 200 MHz	3.570	3.570
200 MHz to 500 MHz	3.570	3.570
500 MHz to 2 GHz	3.570	3.570
2 GHz to 3.2 GHz	1.925	1.925
3.2 GHz to 10 GHz	2.323	2.323
10 GHz to 13.5 GHz	2.100	2.100
13.5 GHz to 16 GHz	2.100	2.100
16 GHz to 20 GHz	2.615	2.615
20 GHz to 24 GHz	2.323	2.323
24 GHz to 26.5 GHz	2.615	2.615
26.5 GHz to 40 GHz	3.570	3.570
40 GHz to 43.5 GHz	2.615	2.615
43.5 GHz to 50 GHz	3.010	3.010
50 GHz to 60 GHz	3.570	3.570
60 GHz to 64 GHz	3.010	3.010
64 GHz to 67 GHz	3.570	3.570
67 GHz to 90 GHz	3.010	3.010
90 GHz to 100 GHz	--	3.010
100 GHz to 110 GHz	--	4.420
110 GHz to 120 GHz	--	5.849

Table 2m. Input VSWR[1], with Option 029 or S93029A – Specifications

Description	N5241x/42x/49x	N5244x/45x	N5247x
	Port 1, 2	Ports 1, 2	Ports 1, 2
10 MHz to 50 MHz	1.785 (2.1)	1.925	3.57 (3.57)
50 MHz to 500 MHz	1.329 (2.615)	1.377	1.785 (2.615)
500 MHz to 3.2 GHz	1.329 (2.615)	1.577	2.615 (2.615)
3.2 GHz to 10 GHz	1.577 (2.1)	1.785	3.01 (3.01)
10 GHz to 16 GHz	1.925 (2.1)	1.785	3.01 (3.01)
16 GHz to 20 GHz	2.1 (2.615)	1.785	3.01 (3.01)
20 GHz to 24 GHz	2.1 (3.01)	2.323	3.01 (3.01)
24 GHz to 26.5 GHz	2.323 (3.01)	2.323	3.01 (3.01)
26.5 GHz to 46 GHz		2.615	3.01 (3.01)
46 GHz to 50 GHz		3.01	3.01 (3.01)
50 GHz to 67 GHz			3.01 (3.01)

() With Option 425 installed.

[1] Tested with 0 dB source attenuator. VSWR is improved by increasing source attenuator value.

Table 2n. Input VSWR[1] – Specifications

Description	N5231x/32x/39x		N5234x/35x
	Option 200/216	Option 400/416	All Options
300 kHz to 1 MHz	3.01	3.57	
1 MHz to 10 MHz	2.1	1.499	
10 MHz to 45 MHz	2.1	1.223	1.925
45 MHz to 500 MHz	1.173	1.223	1.289
500 MHz to 1 GHz	1.377	1.223	1.289
1 GHz to 2 GHz	1.377	1.289	1.289
2 GHz to 3 GHz	1.925	1.289	1.577
3 GHz to 5 GHz	1.925	1.499	1.577
5 GHz to 8.5 GHz	1.925	1.671	1.577
8.5 GHz to 11.5 GHz	2.323	1.671	1.785
11.5 GHz to 12.5 GHz	2.323	2.615	1.785
12.5 GHz to 20 GHz	2.1	2.615	2.1
20 GHz to 40 GHz			2.323
40 GHz to 50 GHz			3.57

[1] Tested with 0 dB source attenuator. VSWR is improved by increasing source attenuator value.

Table 2o. Other Amplitude Accuracy – Supplemental Information

RBW Switching Uncertainty	< ±0.02 dB, All RBW
Display Scale Fidelity	See dynamic accuracy specification in the analyzer data sheet. Specification applied to SA measurement class with user calibration between -10 dBm and -40 dBm input power and measurement between +10 dBm and -120 dBm input power.

Dynamic Range Specifications

Table 3a. Spurious Response – Supplemental Information

Residual Response[1]	-60 dBm or lower level spurious may appear at 25, 50, 75 or 100 MHz.
Image Response	Mostly eliminated. Intermittent image response may be seen when making multi-tone or modulated signal measurements.
LO Related Spurious	Eliminated

[1] Tested with 1 kHz RBW, source off with test port terminated. Spurious is detected when the signal level is higher than 6-sigma of noise deviation from the noise-mean level.

Table 3b. Displayed Average Noise Level (DANL)[1] (dBm/Hz), At Test Ports – Specification

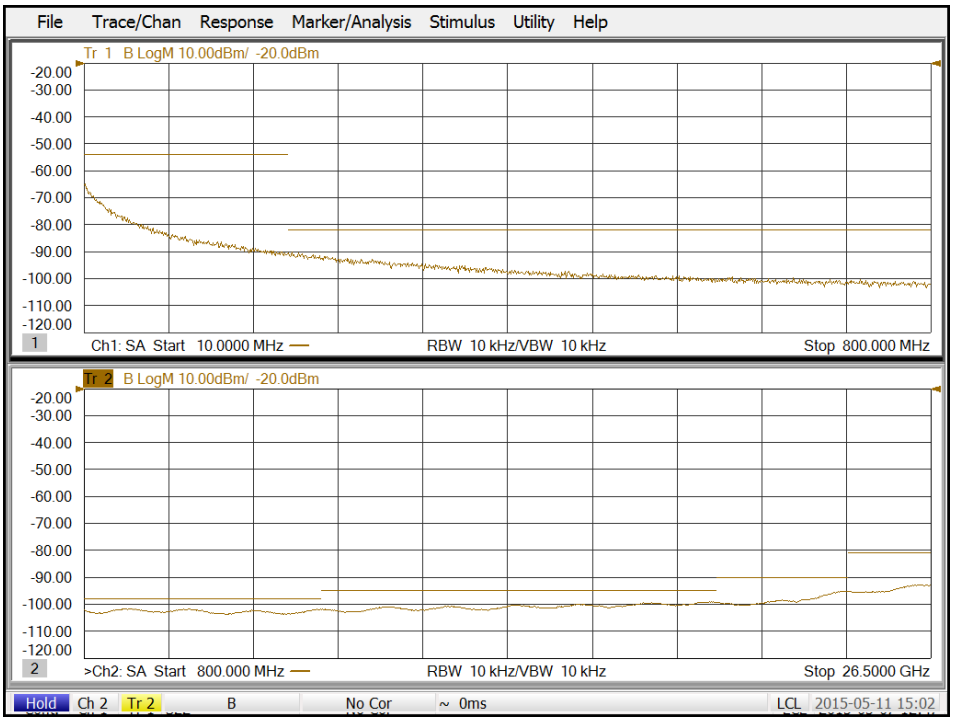
Description	N5221x/ 22x	N5241x/ 42x/49x	N5224x/ 25x	N5244x/ 45x	N5227x	N5247x	N5290A	N5291A
10 MHz to 200 MHz	-94	-94	-84	-84	-84	-84	-81	-81
200 MHz to 800 MHz	-122	-122	-108	-108	-115	-115	-113	-113
800 MHz to 3.2 GHz	-135	-135	-130	-130	-132	-132	-125	-125
3.2 GHz to 8 GHz	-135	-135	-130	-130	-133	-133	-129	-129
8 GHz to 16 GHz	-132	-132	-133	-133	-136	-136	-129	-129
16 GHz to 20 GHz	-132	-132	-130	-130	-136	-136	-129	-129
20 GHz to 24 GHz	-129	-130	-130	-130	-136	-136	-129	-129
24 GHz to 26.5 GHz	-122	-121	-130	-130	-136	-136	-129	-129
26.5 GHz to 34 GHz			-124	-124	-122	-122	-120	-120
34 GHz to 50 GHz			-124	-124	-118	-118	-120	-120
50 GHz to 67 GHz					-116	-116	-120	-120
67 GHz to 70 GHz[2]					-121	-121	-120	-120
70 GHz to 75 GHz							-120	-120
75 GHz to 90 GHz							-115	-115
90 GHz to 110 GHz								-115
110 GHz to 120 GHz								-108

[1] Tested with 10 kHz RBW, test port terminated, average detector, averaging type = Log, 0 dB attenuator, IF gain = max, image rejection = normal, random LO OFF. The specification is normalized to 1.2 Hz minimum available RBW, applied to random LO ON, and improved by approximately 13 dB by reversing test port couplers.

[2] Typical for instruments only.

Table 3c. Displayed Average Noise Level (DANL)[1] (dBm/Hz), At Test Ports - Supplemental Information

N5242x DANL performance example compared to specification



N5245x DANL performance example compared to specification

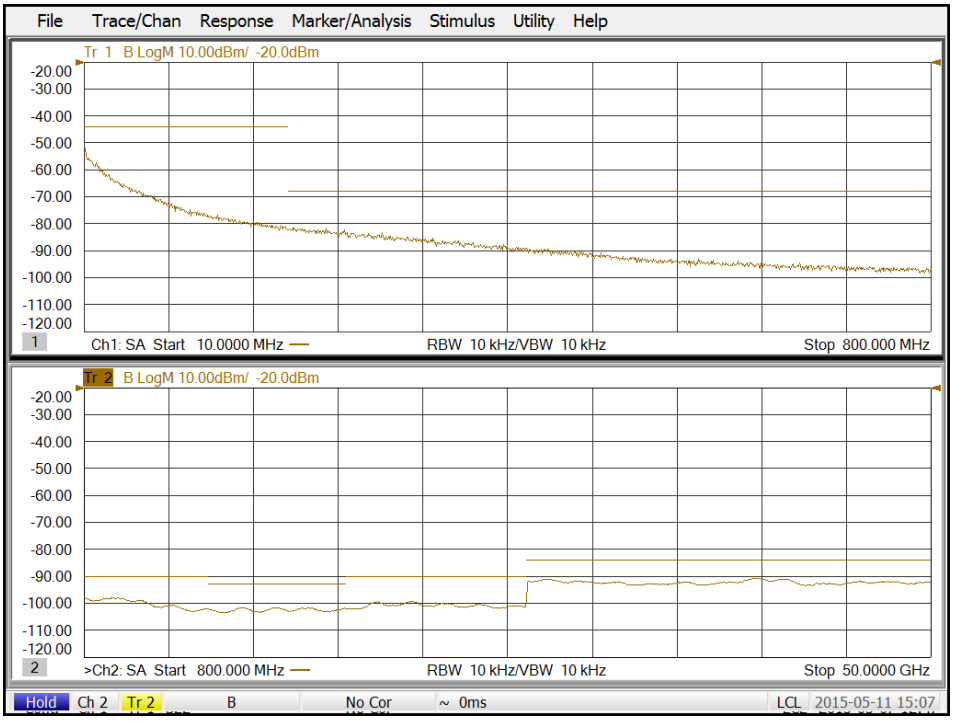


Table 3c. Displayed Average Noise Level (DANL)[1] (dBm/Hz), At Test Ports – Supplemental Information (cont.)

N5227x DANL performance example compared to specification

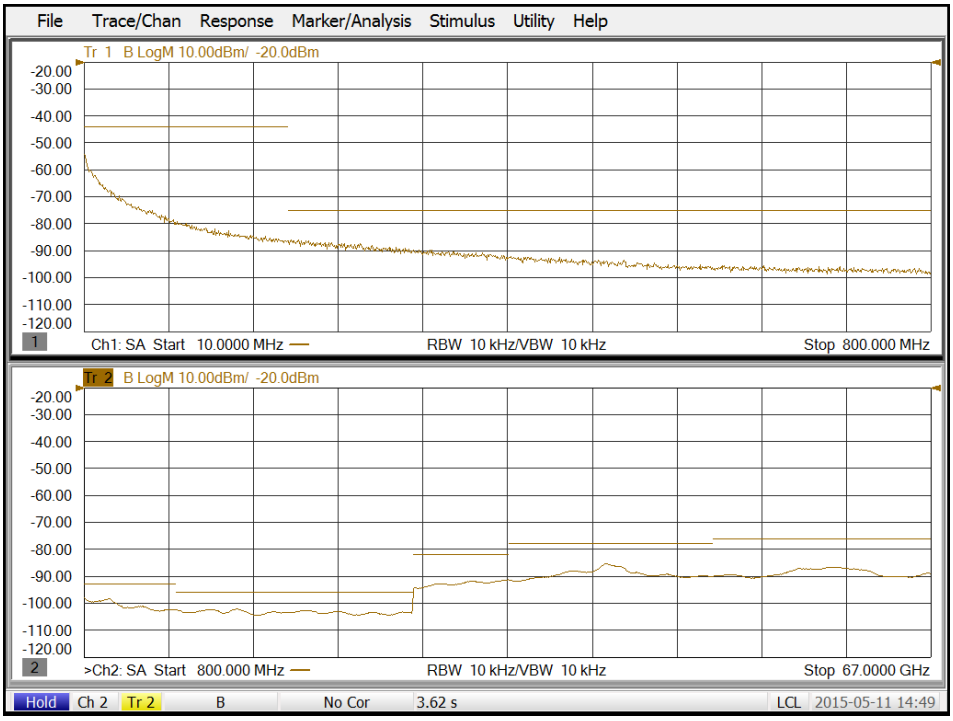


Table 3d. Displayed Average Noise Level (DANL)[1] (dBm/Hz), At Test Ports - Typical

Description	N5221x/ 22x	N5241x/ 42x/49x	N5224x/ 25x	N5244x/ 45x	N5227x	N5247x	N5290A	N5291A
10 MHz to 200 MHz	-97	-97	-87	-87	-87	-87	-92	-92
200 MHz to 800 MHz	-132	-133	-122	-122	-129	-129	-119	-119
800 MHz to 3.2 GHz	-140	-141	-135	-135	-137	-137	-130	-130
3.2 GHz to 8 GHz	-140	-141	-135	-135	-137	-137	-133	-133
8 GHz to 16 GHz	-139	-139	-140	-139	-141	-140	-133	-133
16 GHz to 24 GHz	-139	-139	-137	-137	-141	-140	-133	-133
24 GHz to 26.5 GHz	-136	-137	-137	-137	-141	-140	-133	-133
26.5 GHz to 34 GHz			-130	-130	-129	-129	-133	-133
34 GHz to 50 GHz			-130	-130	-125	-124	-124	-124
50 GHz to 67 GHz					-124	-124	-124	-124
67 GHz to 70 GHz					-121	-121	-124	-124
70 GHz to 90 GHz							-121	-121
90 GHz to 110 GHz								-121
110 GHz to 120 GHz								-115

[1] Tested with 10 kHz RBW, test port terminated, average detector, averaging type = Log, 0 dB attenuator, IF gain = max, image rejection = normal, random LO OFF. The specification is normalized to 1.2 Hz minimum available RBW, applied to random LO ON, and improved by approximately 13 dB by reversing test port couplers.

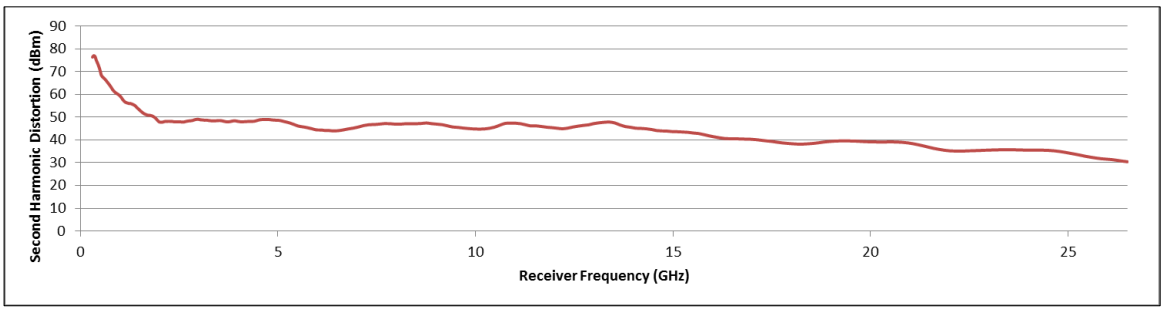
Table 3e. Displayed Average Noise Level (DANL)[1] (dBm/Hz), At Test Ports - Specification

Description	N5231x/32x/39x	N5234x/35x
10 MHz to 200 MHz	-133	-87
200 MHz to 800 MHz	-133	-118
800 MHz to 8.5 GHz	-133	-128
8.5 GHz to 13.51 GHz	-131	-128
13.51 GHz to 20 GHz	-120	-118
20 GHz to 40 GHz		-118
40 GHz to 50 GHz		-107

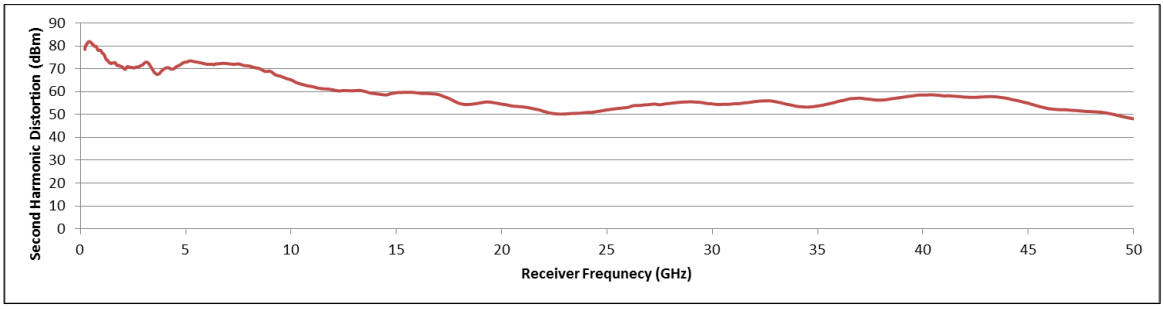
[1] Tested with 10 kHz RBW, test port terminated, average detector, averaging type = Log, 0 dB attenuator, IF gain = Auto, image rejection = normal, random LO OFF. The specification is normalized to 1.2 Hz minimum available RBW, applied to random LO ON, and improved by approximately 13 dB by reversing test port couplers.

Table 3f. Second Harmonic Distortion (SHI) - Supplemental Information

N5221x/22x/41x/42x/49x



N5224x/25x/44x/45x



N5227x/47x

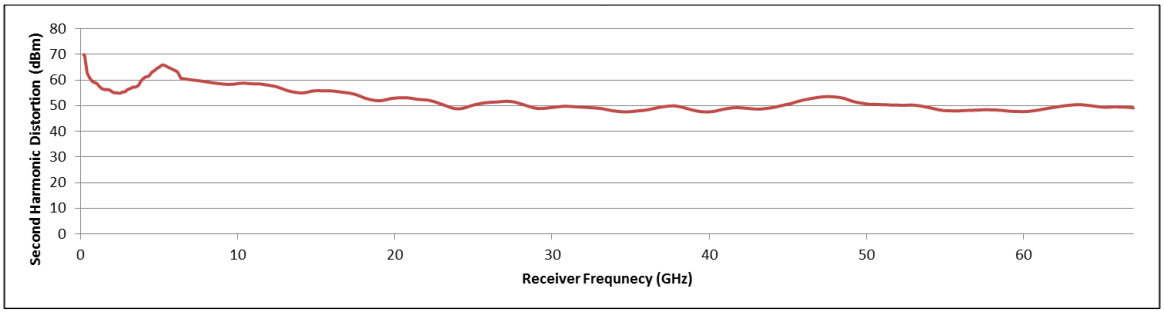


Table 3g. Second Harmonic Distortion (SHI), (dBm) – Supplemental Information

Description	N5231x/32x/39x	N5234x/35x
200 MHz to 8 GHz	35	43
8 GHz to 13.4 GHz	35	33
13.4 GHz to 20 GHz	26	33
20 GHz to 40 GHz		29
40 GHz to 50 GHz		22

Table 3h. Third Order Intermodulation Distortion (TOI)[1] (dBm) - Characteristic

Description	N5221x/22x/ 41x/42x/49x		N5224x/25x/ 44x/45x		N5227x/47x	
	Distortion (dBc)	TOI (dBm)	Distortion (dBc)	TOI (dBm)	Distortion (dBc)	TOI (dBm)
500 MHz to 3.2 GHz	-60	20	-62	21	-64	22
3.2 GHz to 5 GHz	-60	20	-62	21	-62	21
5 GHz to 8 GHz	-56	18	-62	21	-62	21
8 GHz to 10 GHz	-56	18	-62	21	-60	20
10 GHz to 13.5 GHz	-50	15	-62	21	-60	20
13.5 GHz to 20 GHz	-50	15	-56	18	-56	18
20 GHz to 26.5 GHz	-38	9	-56	18	-56	18
26.5 GHz to 40 GHz			-50	15	-52	16
40 GHz to 47 GHz			-40	10	-44	12
47 GHz to 50 GHz			-38	9	-38	9
50 GHz to 60 GHz					-38	9
60 GHz to 67 GHz					-28	4

[1] Tested with -10 dBm input at test port, 10 MHz tone separations, 0 dBm receiver attenuator. Negligible (very high TOI) at < 500 MHz input frequency due to test port coupler roll off.

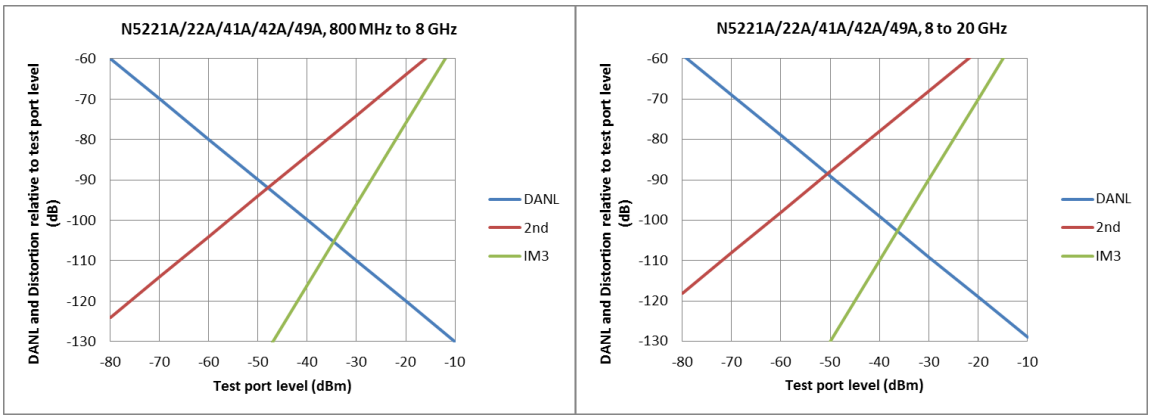
Table 3i. Third Order Intermodulation Distortion (TOI)[1] (dBm) – Characteristic

Description	N5231x/32x/39x		N5234x/35x	
	Distortion (dBc)	TOI (dBm)	Distortion (dBc)	TOI (dBm)
100 MHz to 5 GHz	-62	21	-60	20
5 GHz to 10 GHz	-60	20	-60	20
10 GHz to 15 GHz	-56	18	-52	16
15 GHz to 18 GHz	-50	15	-52	16
18 GHz to 20 GHz	-46	13	-52	16
20 GHz to 30 GHz			-46	13
30 GHz to 40 GHz			-42	11
40 GHz to 50 GHz			-32	6

[1] Tested with -10 dBm input at test port, 10 MHz tone separations, 0 dBm receiver attenuator. Negligible (very high TOI) at < 100 MHz input frequency due to test port coupler roll off.

Table 3j. DANL and Distortion Relative to Test Port Level (dB), All Options - Nominal

N5221x/22x/41x/42x/49x



N5224x/25x/44x/45x

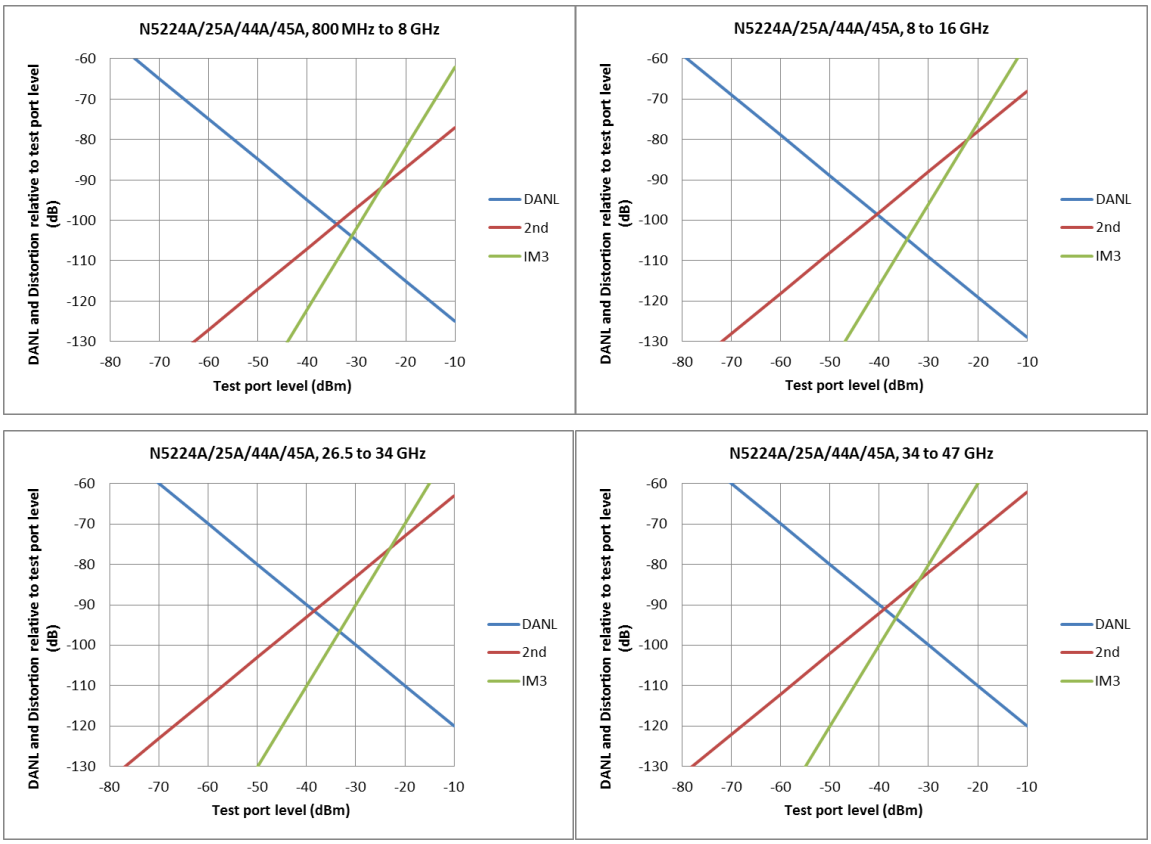
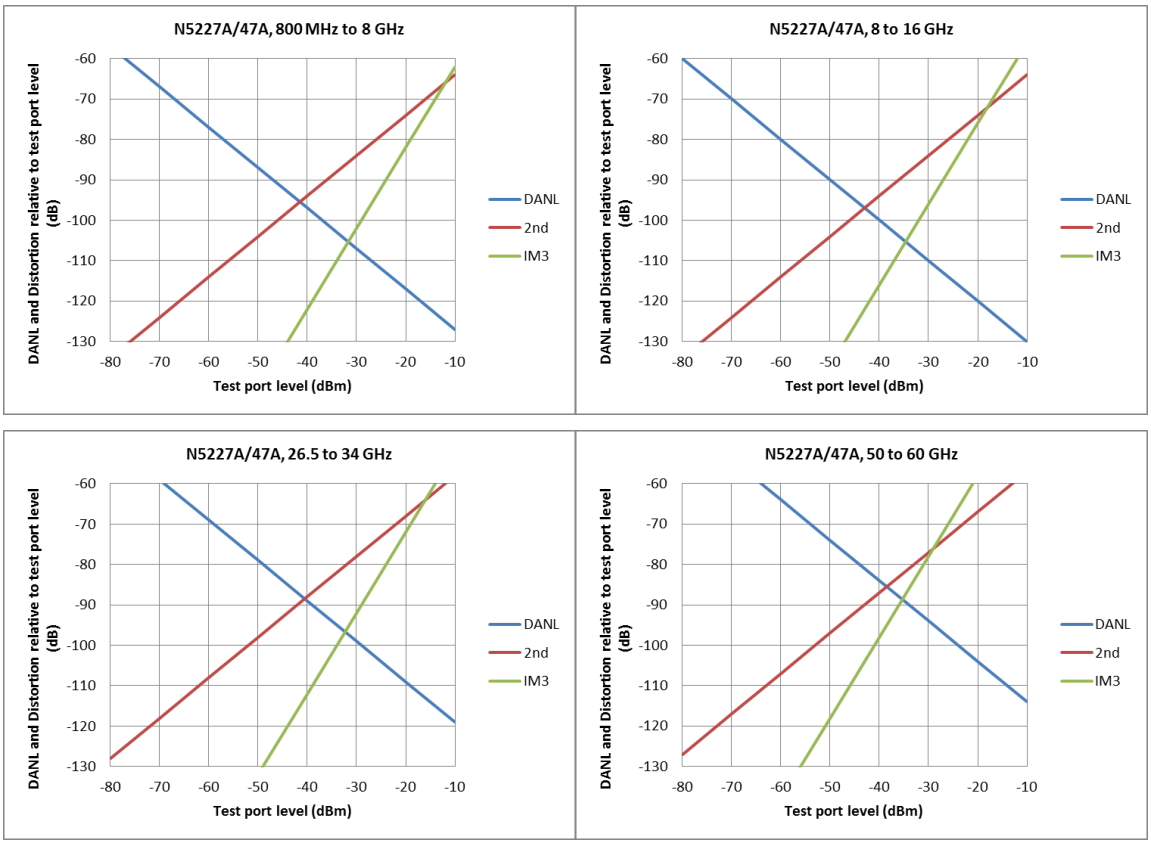


Table 3j. DANL and Distortion Relative to Test Port Level (dB), All Options - Nominal (cont.)

N5227x/47x



N5231x/32x/39x

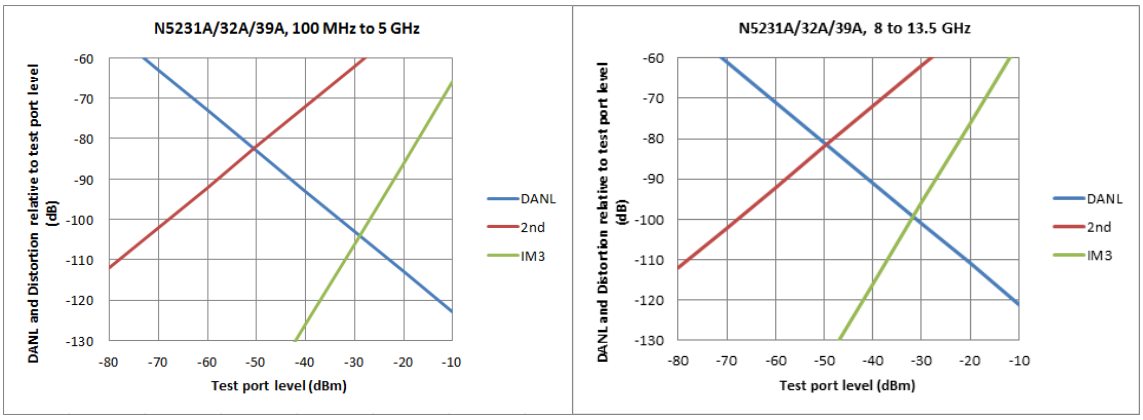


Table 3j. DANL and Distortion Relative to Test Port Level (dB), All Options - Nominal (cont.)

N5234x/35x

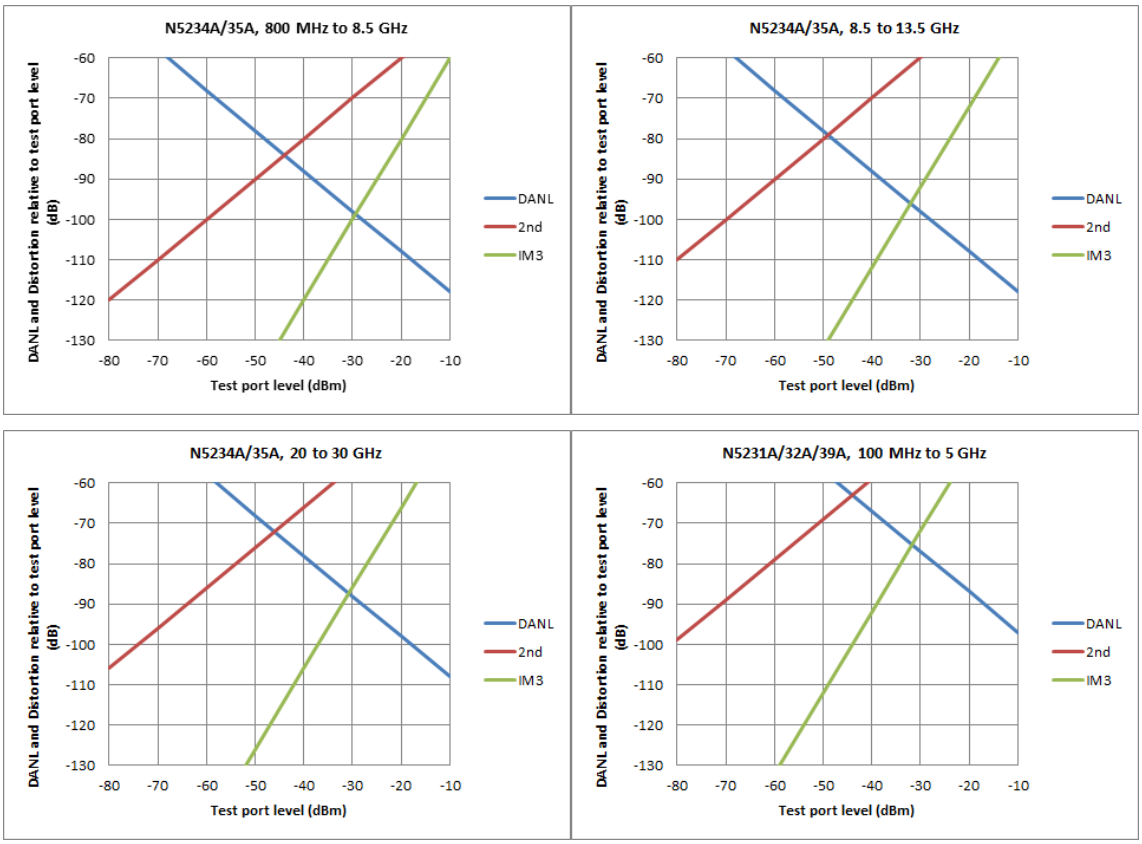


Table 3k. Receiver Phase Noise (dBc/Hz), N5221x/22x/31x/32x/39x/41x/42x/49x - Typical

Offset	CF = 1 GHz	CF = 3 GHz	CF = 10 GHz	CF = 20 GHz
1 kHz	-108	-100	-90	-84
10 kHz	-114	-103	-91	-85
100 kHz	-115	-104	-92	-86
1 MHz	-130	-126	-116	-110
10 MHz	-132	-133	-130	-129

Table 3l. Receiver Phase Noise (dBc/Hz), N5224x/25x/44x/45x - Typical

Offset	CF = 1 GHz	CF = 3 GHz	CF = 10 GHz	CF = 20 GHz
1 kHz	-107	-99	-89	-83
10 kHz	-114	-103	-91	-85
100 kHz	-115	-104	-92	-86
1 MHz	-129	-126	-116	-110
10 MHz	-131	-131	-129	-128

Table 3m. Receiver Phase Noise (dBc/Hz), N5227x/47x - Typical

Offset	CF = 1 GHz	CF = 3 GHz	CF = 10 GHz	CF = 20 GHz
1 kHz	-105	-96	-85	-79
10 kHz	-113	-103	-90	-84
100 kHz	-114	-103	-92	-86
1 MHz	-130	-126	-116	-110
10 MHz	-131	-131	-130	-130

Table 3n. Receiver Phase Noise (dBc/Hz), N5290A - Typical

Offset	CF=1 GHz	CF=3 GHz	CF=10 GHz	CF=20 GHz	CF=50 GHz	CF=80 GHz	CF=90 GHz
1 kHz	-107	-98	-89	-83	-72	-70	-70
10 kHz	-112	-104	-93	-87	-79	-75	-75
100 kHz	-111	-100	-89	-83	-73	-70	-70
1 MHz	-127	-123	-113	-107	-96	-95	-95
10 MHz	-129	-132	-130	-128	-117	-115	-115

Table 3m. Receiver Phase Noise (dBc/Hz), N5291A - Typical

Offset	CF=1 GHz	CF=3 GHz	CF=10 GHz	CF=20 GHz	CF=50 GHz	CF=80 GHz	CF=110 GHz	CF=125 GHz
1 kHz	-107	-98	-89	-83	-72	-70	-67	-66
10 kHz	-112	-104	-93	-87	-79	-75	-72	-72
100 kHz	-111	-100	-89	-83	-73	-70	-67	-67
1 MHz	-127	-123	-113	-107	-96	-95	-91	-90
10 MHz	-129	-132	-130	-128	-117	-115	-112	-105

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