

# Keysight S9309xB PNA Spectrum Analysis Application

(for synthesizer revision 7)



Technical  
Specifications



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## Table of Contents

Table 1. PNA "B" Model Spectrum Analysis Application Software .....	4
Definitions.....	5
Frequency and Time Specifications .....	6
Table 2. Frequency Specifications .....	6
Table 3. Time Specifications .....	7
Amplitude Accuracy and Range Specifications .....	8
Table 4. Amplitude Range Specifications .....	8
Table 5. SA Detector Accuracy <sup>1</sup> , Without Frequency-band Crossing (dB) - Specifications .....	9
Table 6. SA Detector Accuracy <sup>1</sup> , Without Frequency-band Crossing (dB) - Specifications .....	10
Table 7. SA Detector Accuracy, At Frequency-band Crossing <sup>1</sup> (dB) - Specifications .....	11
Table 8. SA Detector Accuracy, At Frequency-band Crossing <sup>1</sup> (dB) - Specifications .....	12
Table 9. Input Attenuation <sup>1</sup> Switching Uncertainty (dB) - Supplemental Performance Data .....	13
Table 10. Input VSWR <sup>1</sup> – Specifications to 26.5 GHz .....	13
Table 11. Input VSWR <sup>1</sup> – Specifications to 50 GHz .....	14
Table 12. Input VSWR <sup>1</sup> – Specifications to 70 GHz .....	14
Table 13. Input VSWR – Specification .....	15
Table 14. Input VSWR <sup>1</sup> , with Option S93029B - Specifications.....	16
Table 15. Other Amplitude Accuracy - Supplemental Performance Data.....	16
Dynamic Range Specifications .....	17
Table 16. Spurious Response - Supplemental Performance Data .....	17
Table 17. Displayed Average Noise Level (DANL) <sup>1</sup> (dBm/Hz), At Test Ports - Specification.....	17
Table 18. Displayed Average Noise Level (DANL) (dBm/Hz), At Test Ports - Supplemental Performance Data .....	18
Table 19. Displayed Average Noise Level (DANL) <sup>1</sup> (dBm/Hz), At Test Ports - Typical.....	20
Table 20. Second Harmonic Distortion (SHI) - Supplemental Performance Data .....	21
Table 21. Third Order Intermodulation Distortion (TOI) <sup>1</sup> (dBm) - Characteristic .....	22
Table 22. DANL and Distortion Relative to Test Port Level (dB), All Options - Nominal .....	23
Table 23. Receiver Phase Noise (dBc/Hz), N5221B/22B/24B/25B/27B/41B/42B/49B/44B/45B/47B – Supplemental Performance Data .....	25
Table 24. Receiver Phase Noise (dBc/Hz), N5290A - Typical.....	25
Table 25. Receiver Phase Noise (dBc/Hz), N5291A - Typical.....	25

This is a complete list of the technical specifications for the spectrum analyzer S9309X/S93090X (PNA “B” models) on PNA/PNA-X series of network analyzer, including the following models. See model specific document for the network analyzer specifications.

**PNA Series Network Analyzer**

- N5221B 10 MHz to 13.5 GHz
- N5222B 10 MHz to 26.5 GHz
- N5224B 10 MHz to 43.5 GHz
- N5225B 10 MHz to 50 GHz
- N5227B 10 MHz to 67 GHz

**PNA-X Series Network Analyzer**

- N5249B 10 MHz to 8.5 GHz
- N5241B 10 MHz to 13.5 GHz with serial number MY5201/SG5201/US5201 and above
- N5242B 10 MHz to 26.5 GHz with serial number MY5202/SG5202/US5202 and above
- N5244B 10 MHz to 43.5 GHz with serial number MY5204/SG5204/US5204 and above
- N5245B 10 MHz to 50 GHz with serial number MY5205/SG5205/US5205 and above
- N5247B 10 MHz to 67 GHz

For N5241B/42B/44B/45B 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 S9309X/S93090X and performing IF response calibration without returning to Keysight service center. However, performance verification is required to warrant option 09x specified performances. Keysight advises this work to be done in one of Keysight service centers.

**Table 1. PNA “B” Model Spectrum Analysis Application Software**

"B" Model Software
S930900B – Spectrum analysis up to 8.5 GHz
S930901B – Spectrum analysis up to 13.5 GHz
S930902B – Spectrum analysis up to 26.5 GHz
S930904B – Spectrum analysis up to 43.5 GHz
S930905B – Spectrum analysis up to 50 GHz
S930907B – Spectrum analysis up to 70 GHz
S930909B – Spectrum analysis up to 90 GHz
S93093B – Spectrum analysis up to 120 GHz
S93094B – Spectrum analysis above 120 GHz

## Definitions

All specifications and characteristics apply over a  $25\text{ °C} \pm 5\text{ °C}$  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 performance data (SPD):** A performance parameter that is tested on a minimal set of products 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.

**LFE (Low Frequency Extension):** LFE is referred to in the tables below. For specific information refer to the Configuration Guide part number 5992-1465EN.

# Frequency and Time Specifications

**Table 2. Frequency Specifications**

Description	Specification	Supplemental Information
Frequency Resolution	1 Hz	--
Frequency Accuracy	± 0.7 ppm	--
Initial Frequency Accuracy <sup>1</sup>	± 0.2 ppm	± 0.1 ppm
Frequency Stability	--	±0.05 ppm, -10° to 70° C <sup>2</sup> ±0.5 ppm (first year) <sup>3</sup>
<b>Frequency Readout Accuracy</b> (Start, Stop, Center, Marker)	--	±[(readout frequency x frequency reference accuracy) + (<1% x RBW)], nominal
<b>Frequency Span</b>		
Minimum/Maximum	10 Hz/analyzer's full span	--
Resolution	1 Hz	--
<b>Sweep (Trace) Point Range</b>	11 to 100,001	--
<b>Resolution Bandwidth (RBW)</b>		
Range (-3 dB Bandwidth)	1.2 Hz to 3 MHz <sup>4</sup> 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
<b>Video Bandwidth Range<sup>5</sup></b>	1.2 Hz to 3 MHz <sup>6</sup>	--

<sup>1</sup> Verified after Factory Frequency Reference adjustment, or after adjustment at a Keysight Service Center.

<sup>2</sup> Assumes no variation in time.

<sup>3</sup> Assumes no variation in temperature. Stability generally improves over time.

<sup>4</sup> Under certain conditions, the RBW range is 0.6 Hz to 8 MHz.

<sup>5</sup> VBW is implemented by averaging to achieve a similar variance reduction effect for the same VBW value.

<sup>6</sup> Under certain conditions, the VBW range is 0.6 Hz to 8 MHz.

**Table 3. Time Specifications**

Description	Specification	Supplemental Information
<b>Sweep Time and Triggering</b>		
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	--
<b>Measurement and Display Update Rate</b>		
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)	--	N5249B: 210 ms N5221B/41B: 300 ms N5222B/42B: 540 ms N5224B/44B: 800 ms N5225B/45B: 890 ms N5227B/47B: 1170 ms

## Amplitude Accuracy and Range Specifications

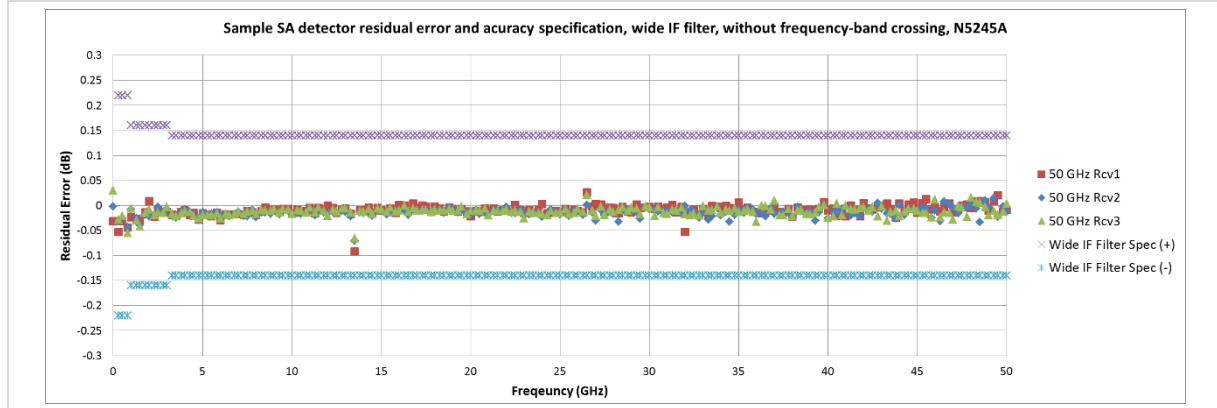
**Table 4. Amplitude Range Specifications**

Description	Specification
<b>Amplitude Range</b>	
Measurement Range	DANL to maximum input level
Input Attenuator Range	N5290A/N5291A: none, N5227B/47B: 0 to 50 dB in 10 dB steps, All other models: 0 to 35 dB in 5 dB steps
<b>Maximum Safe Input Level</b>	Vary by analyzer model and option configuration. See maximum test port and receiver input level specifications on individual technical specifications.
<b>Display Range</b>	
Log Scale	0.001 to 500 dB/div in 0.001 steps
Linear Scale	10 divisions (settable from 2 to 30 divisions)
Scale Units	dB, dBm, dBmV, dBuV, dBmA U (no units), W (Watts), V (volts), A (amps)
<b>Trace Detectors Types</b>	Average, Sample, Peak, Normal, Negative Peak, Peak sample, Peak average, Fast Peak



**Table 5. SA Detector Accuracy<sup>1</sup>, Without Frequency-band Crossing (dB) - Specifications**

Description	N5221B/22B/ 41B/42B/49B		N5224B/25B/ 44B/45B		N5227B/47B	
	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 <sup>2</sup>	± 0.5	± 0.5 <sup>2</sup>	± 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 <sup>3</sup>					± 0.1	± 0.1



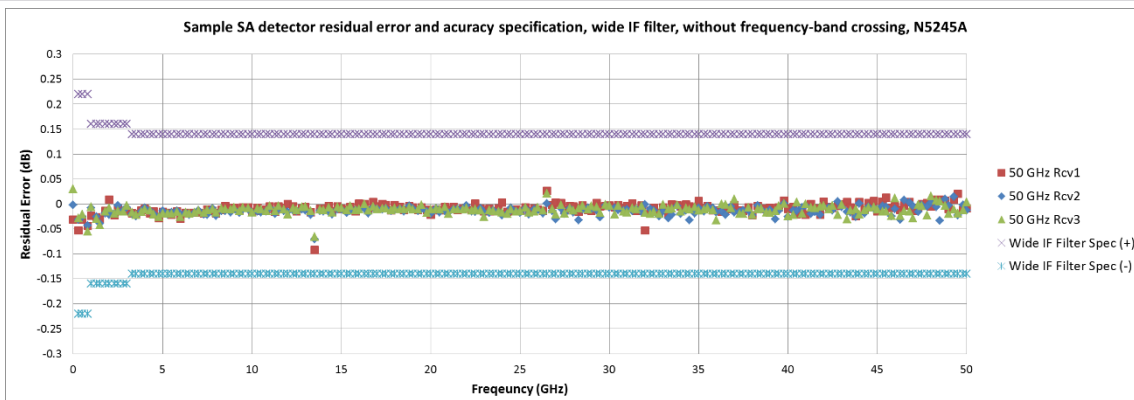
<sup>1</sup> SA detector accuracy is residual error of IF response calibration. IF response is characterized with PNA's standard measurement class after power and S-parameter calibration. Therefore the SA total absolute amplitude accuracy includes power meter, S-parameter and SA detector accuracies.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

<sup>2</sup> 0.3 dB better with N5244B/45B/47B.

<sup>3</sup> Typical for N5227B/47B.

**Table 6. SA Detector Accuracy<sup>1</sup>, 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 <sup>2</sup>			± 0.1	± 0.1

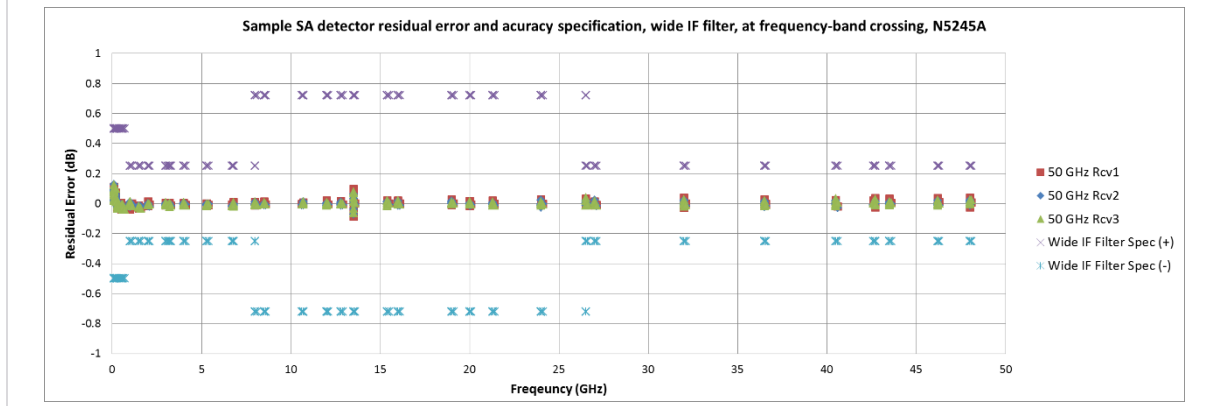


<sup>1</sup> SA detector accuracy is residual error of IF response calibration. IF response is characterized with PNA's standard measurement class after power and S-parameter calibration. Therefore the SA total absolute amplitude accuracy includes power meter, S-parameter and SA detector accuracies.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

<sup>2</sup> Typical for N5291A.

**Table 7. SA Detector Accuracy, At Frequency-band Crossing<sup>1</sup> (dB) - Specifications**

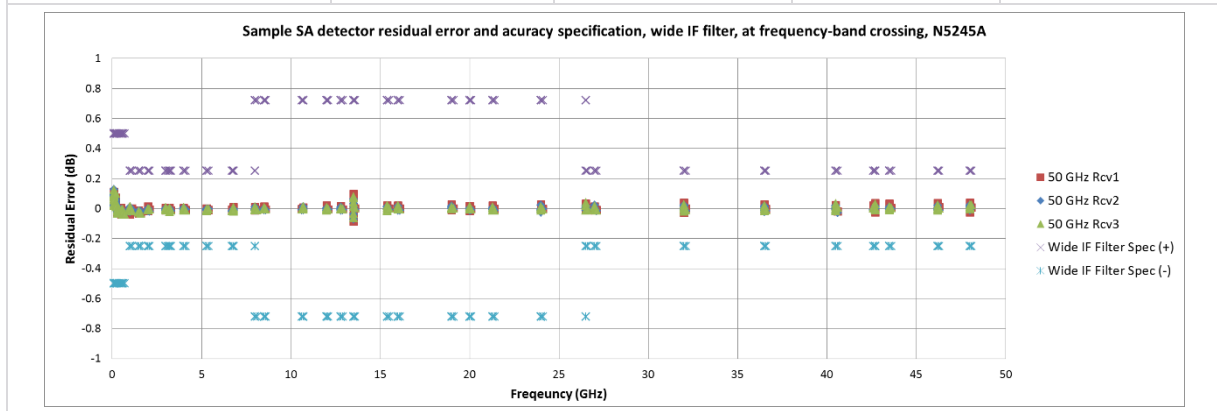
Description	N5221B/22B/ 41B/42B/49B		N5224B/25B/ 44B/45B		N5227B/47B	
	Narrow IF Filter	Wide IF Filter	Narrow IF Filter	Wide IF Filter	Narrow IF Filter	Wide IF Filter
50 MHz to 250 MHz	± 0.5	± 0.6	± 0.5	± 0.5	± 0.6	± 0.8
250 MHz to 800 MHz	± 0.5	± 0.6	± 0.5	± 0.5	± 0.6	± 0.8
800 MHz to 3.25 GHz	± 0.5	± 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



<sup>1</sup> 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 8. SA Detector Accuracy, At Frequency-band Crossing<sup>1</sup> (dB) - Specifications**

Description	N5290A		N5291A	
	Narrow <sup>2</sup> IF Filter	Wide <sup>2</sup> IF Filter	Narrow <sup>2</sup> IF Filter	Wide <sup>2</sup> 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



<sup>1</sup> 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.

<sup>2</sup> For Band Crossings at 24GHz, 40GHz and 80GHz, specification is ±1dB, and at 63.984GHz, specification is ± 1.75 dB.

**Table 9. Input Attenuation<sup>1</sup> Switching Uncertainty (dB) - Supplemental Performance Data**

Description	N5221B/22B/ 41B/42B/49B		N5224B/25B/ 44B/45B		N5227B/47B	
	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

<sup>1</sup> For the N5290A and N5291A systems, there are no input attenuators.

**Table 10. Input VSWR<sup>1</sup> – Specifications to 26.5 GHz**

Description	N5221B/22B Options 210, 410	N5221B/22B All Other Options (Except LFE)	N5221B/22B Options 205, 405	N5221B/22B Options 220, 420	N5241B/42B /49B All Options <sup>2</sup> (Except LFE)	N5241B/42B /49B Options <sup>2</sup> 205, 405, 220, 420
10 MHz to 50 MHz	1.135	1.785	2.1	2.1	1.785	2.1
50 MHz to 500 MHz	1.106	1.329	2.615	2.615	1.329	2.615
500 MHz to 3.2 GHz	1.135	1.329	2.615	2.615	1.329	2.615
3.2 GHz to 8 GHz	1.196	1.577	2.1	2.1	1.577	2.1
8 GHz to 10 GHz	1.329	1.577	2.1	2.1	1.577	2.1
10 GHz to 13.5 GHz	1.377	1.925	2.1	2.1	1.925	2.1
13.5 GHz to 16 GHz	1.433	1.925	2.1	2.1	1.925	2.1
16 GHz to 20 GHz	1.499	2.1	2.615	3.01	2.1	2.615
20 GHz to 24 GHz	1.671	2.1	2.615	3.01	2.1	3.01
24 GHz to 26.5 GHz	1.925	2.323	3.01	3.01	2.323	3.01

<sup>1</sup> Tested with 0 dB source attenuator. VSWR is improved by increasing source attenuator value.

<sup>2</sup> Without Option 029 or S93029A.

**Table 11. Input VSWR<sup>1</sup> – Specifications to 50 GHz**

Description	N5224B/25B Options 210, 410	N5224B/25B All Other Options	N5244B/45B All Options <sup>2</sup>
10 MHz to 50 MHz	1.329	1.925 (2.323)	1.925 (2.323)
50 MHz to 200 MHz	1.173	1.253 (2.615)	1.377 (2.615)
200 MHz to 500 MHz	1.106	1.289 (2.615)	1.377 (2.615)
500 MHz to 3.2 GHz	1.196	1.377 (3.01)	1.499 (3.01)
3.2 GHz to 10 GHz	1.253	1.577 (2.323)	1.577 (3.01)
10 GHz to 13.5 GHz	1.329	1.785 (2.323)	1.785 (2.323)
13.5 GHz to 16 GHz	1.433	1.925 (2.615)	1.785 (2.323)
16 GHz to 20 GHz	1.433	1.925 (2.615)	1.785 (2.615)
20 GHz to 26.5 GHz	1.433	1.925 (3.01)	1.925 (3.01)
26.5 GHz to 46 GHz	1.577	2.323 (3.01)	2.615 (3.01)
46 GHz to 50 GHz	1.925	2.323 (3.01)	2.615 (3.01)

(j) With an LFE option installed.

<sup>1</sup> Tested with 0 dB source attenuator. VSWR is improved by increasing source attenuator value.

<sup>2</sup> Without Option 029 or S93029A.

**Table 12. Input VSWR<sup>1</sup> – Specifications to 70 GHz**

Description	N5227B Options 210, 410	N5227B All Other Options	N5247B All Options <sup>2</sup>
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 <sup>3</sup>	1.785	1.925 (1.925)	1.925 (1.925)

(j) With an LFE option installed.

<sup>1</sup> Tested with 0 dB source attenuator. VSWR is improved by increasing source attenuator value.

<sup>2</sup> Without Option 029 or S93029A.

<sup>3</sup> Typical

**Table 13. 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 14. Input VSWR<sup>1</sup>, with Option S93029B - Specifications**

Description	N5241B/42B/49B	N5244B/45B	N5247B
	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)

(<sup>1</sup>) With an LFE option installed.

<sup>1</sup> Tested with 0 dB source attenuator. VSWR is improved by increasing source attenuator value.

**Table 15. Other Amplitude Accuracy - Supplemental Performance Data**

RBW Switching Uncertainty	< ±0.02 dB, All RBW
Display Scale Fidelity	See dynamic accuracy specification in the analyzer document. 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 16. Spurious Response - Supplemental Performance Data**

Residual Response <sup>1</sup>	-80 dBm
Image Response	Mostly eliminated. Intermittent image response may be seen when making multi-tone or modulated signal measurements.
LO Related Spurious	Eliminated

<sup>1</sup> 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 17. Displayed Average Noise Level (DANL)<sup>1</sup> (dBm/Hz), At Test Ports - Specification**

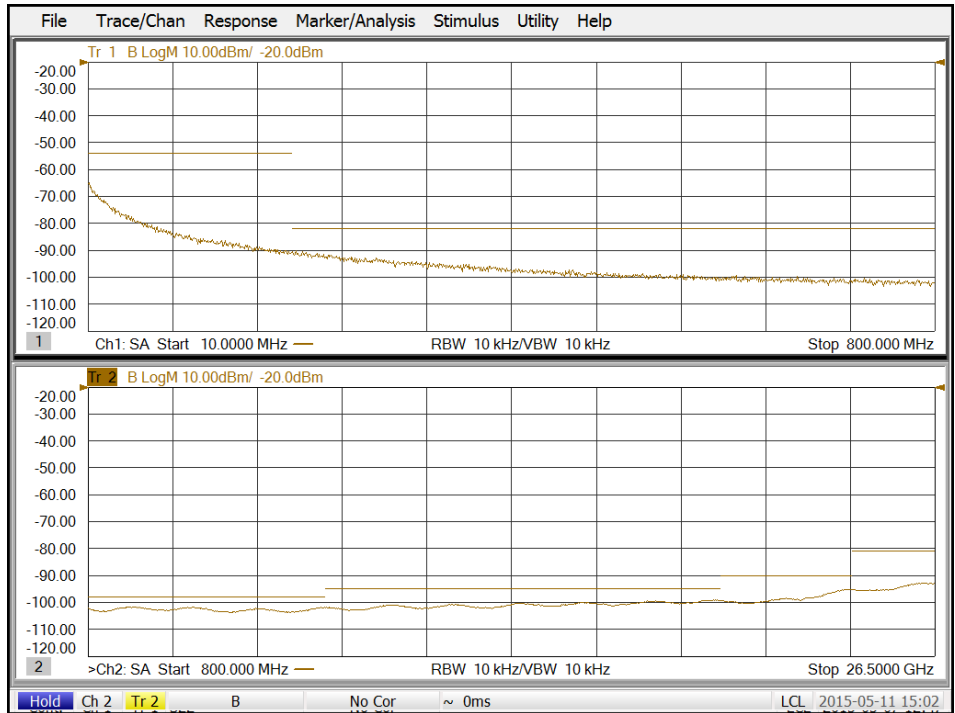
Description	N5221B/ 22B	N5241B/ 42B/49B	N5224B/ 25B	N5244B/ 45B	N5227B	N5247B	N5290A	N5291A
10 MHz to 200 MHz	-94	-94	-84	-84	-84	-84	-81	-81
200 MHz to 800 MHz	-122	-122	-108	-108	-115	-115	-113	-113
800 MHz to 3.2 GHz	-135	-135	-130	-130	-130	-130	-125	-125
3.2 GHz to 8 GHz	-135	-135	-130	-130	-131	-131	-129	-129
8 GHz to 16 GHz	-132	-132	-133	-133	-134	-134	-129	-129
16 GHz to 20 GHz	-132	-132	-130	-130	-134	-134	-129	-129
20 GHz to 24 GHz	-129	-130	-130	-130	-134	-134	-129	-129
24 GHz to 26.5 GHz	-122	-121	-130	-130	-134	-134	-129	-129
26.5 GHz to 34 GHz			-124	-124	-122	-122	-120	-120
34 GHz to 50 GHz			-124	-124	-117	-117	-120	-120
50 GHz to 67 GHz					-116	-116	-120	-120
67 GHz to 70 GHz <sup>2</sup>					-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

<sup>1</sup> 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.

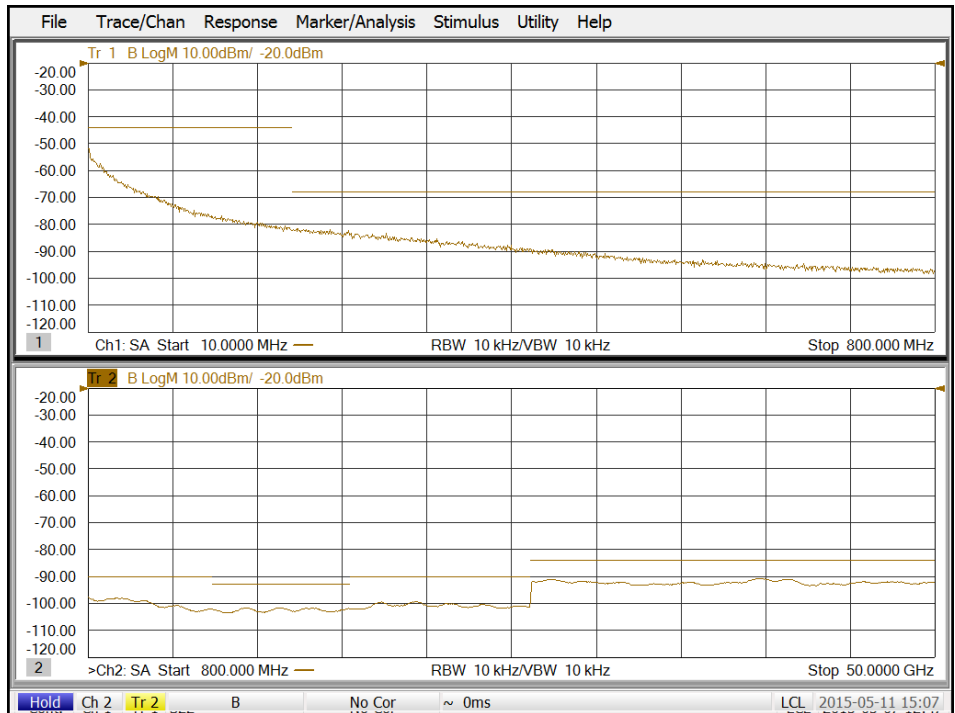
<sup>2</sup> Typical for instruments only.

Table 18. Displayed Average Noise Level (DANL) (dBm/Hz), At Test Ports - Supplemental Performance Data

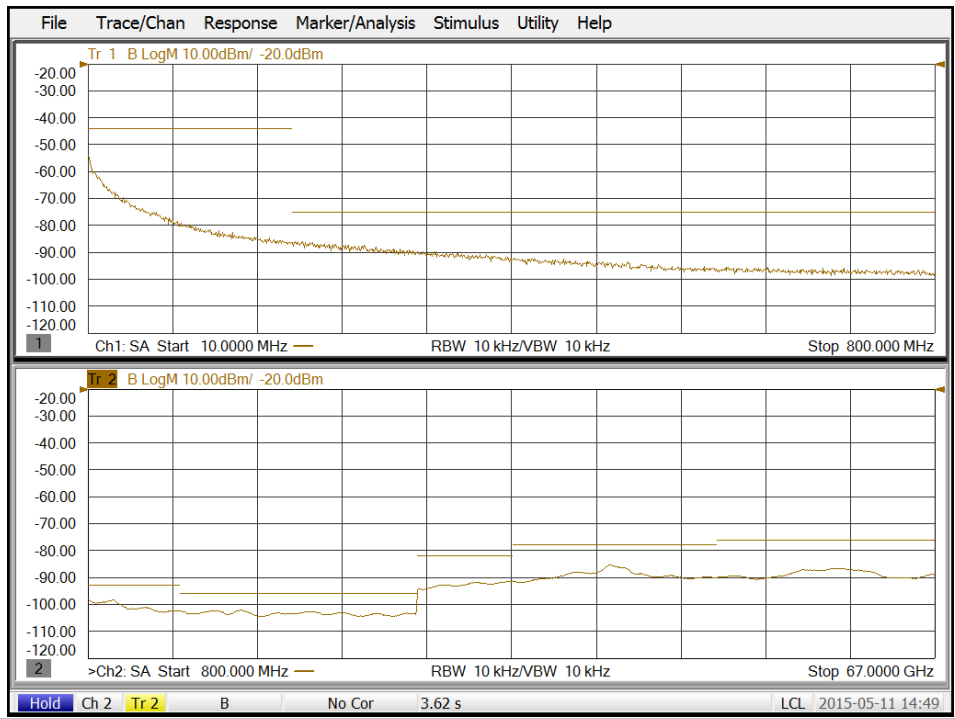
N5242B DANL performance example compared to specification



N5245B DANL performance example compared to specification



N5227B DANL performance example compared to specification



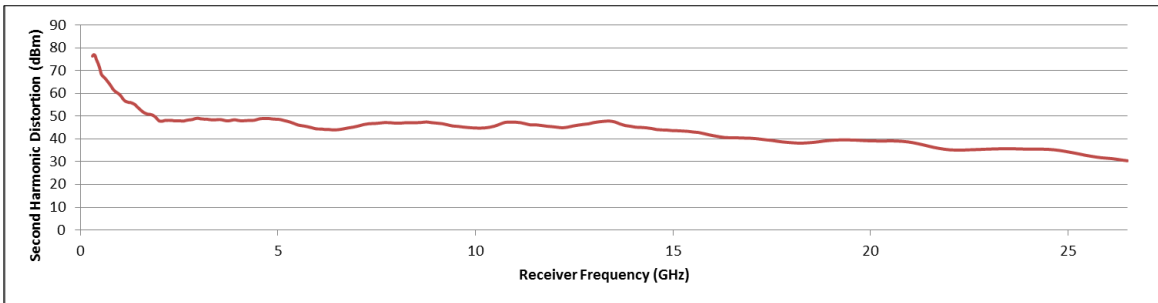
**Table 19. Displayed Average Noise Level (DANL)<sup>1</sup> (dBm/Hz), At Test Ports - Typical**

Description	N5221B/ 22B	N5241B/ 42B/49B	N5224B/ 25B	N5244B/ 45B	N5227B	N5247B	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

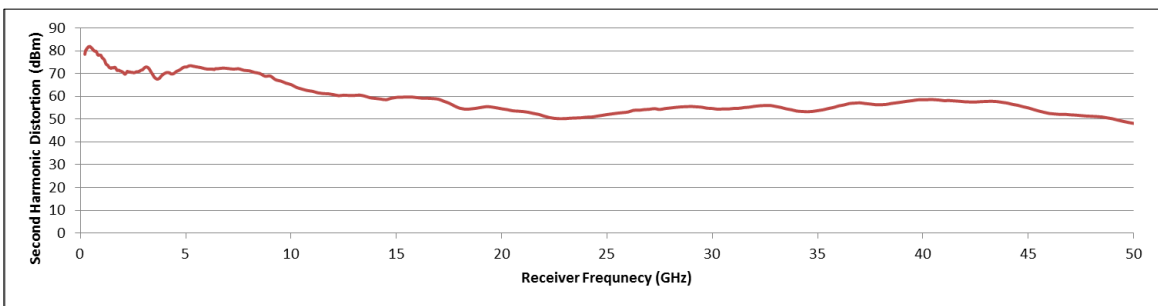
<sup>1</sup> Tested with 10 kHz RBW, test port terminated, average detector, averaging type = Log, 0 dB attenuator, IF gain = max, image rejection = normal, random LO OFF. The specification is normalized to 1.2 Hz minimum available RBW, applied to random LO ON, and improved by approximately 13 dB by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

**Table 20. Second Harmonic Distortion (SHI) - Supplemental Performance Data**

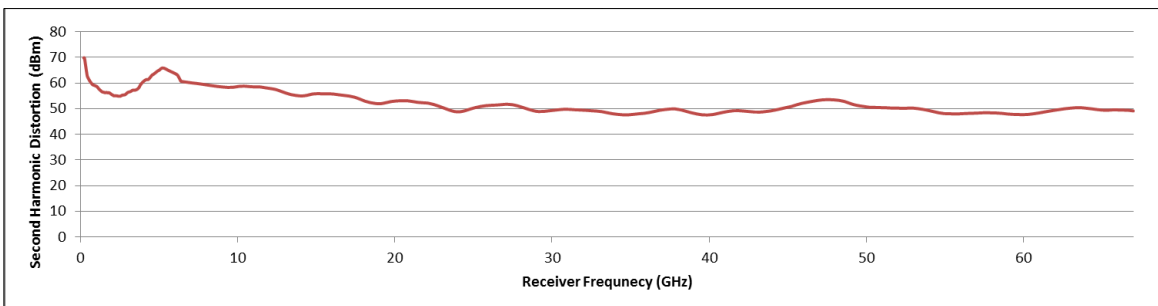
N5221B/22B/41B/42B/49B



N5224B/25B/44B/45B



N5227B/47B



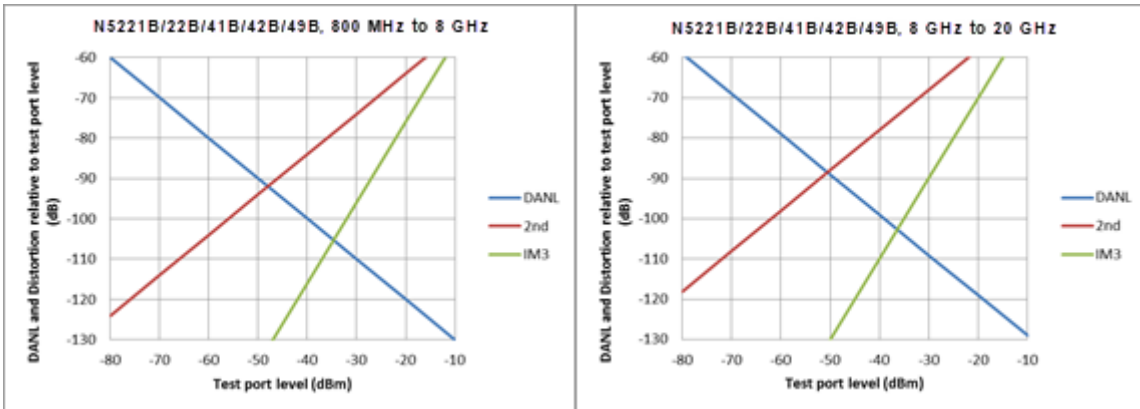
**Table 21. Third Order Intermodulation Distortion (TOI)<sup>1</sup> (dBm) - Characteristic**

Description	N5221B/22B/ 41B/42B/49B		N5224B/25B/ 44B/45B		N5227B/47B	
	Distortion (dBc)	TOI (dBm)	Distortion (dBc)	TOI (dBm)	Distortion (dBc)	TOI (dBm)
500 MHz to 3.2 GHz	-72	20	-74	21	-76	22
3.2 GHz to 5 GHz	-72	20	-74	21	-74	21
5 GHz to 8 GHz	-68	18	-74	21	-74	21
8 GHz to 10 GHz	-68	18	-74	21	-72	20
10 GHz to 13.5 GHz	-62	15	-74	21	-72	20
13.5 GHz to 20 GHz	-62	15	-68	18	-68	18
20 GHz to 26.5 GHz	-50	9	-68	18	-68	18
26.5 GHz to 40 GHz			-62	15	-64	16
40 GHz to 47 GHz			-52	10	-56	12
47 GHz to 50 GHz			-50	9	-50	9
50 GHz to 60 GHz					-50	9
60 GHz to 67 GHz					-40	4

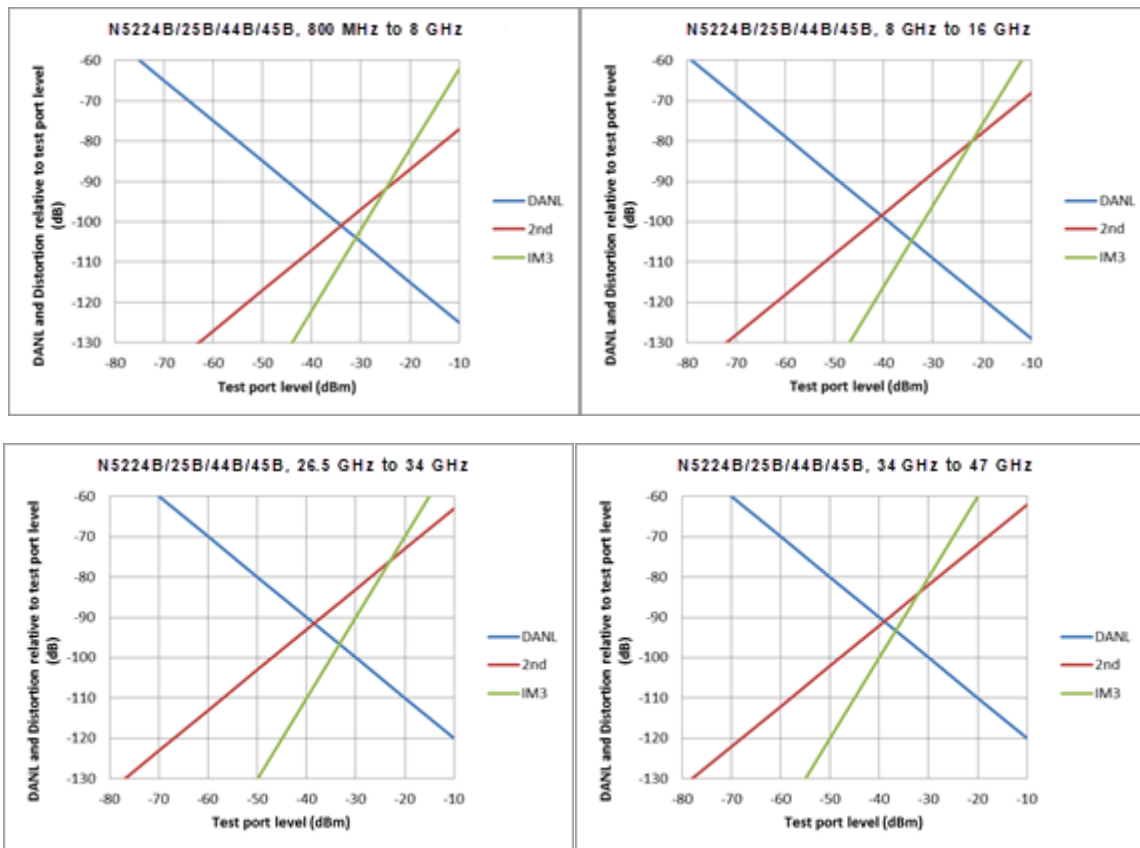
<sup>1</sup> Tested with -16 dBm input at test port, 10 MHz tone separations, 0 dBm receiver attenuator. Negligible (very high TOI) at < 500 MHz input frequency due to test port coupler roll off.

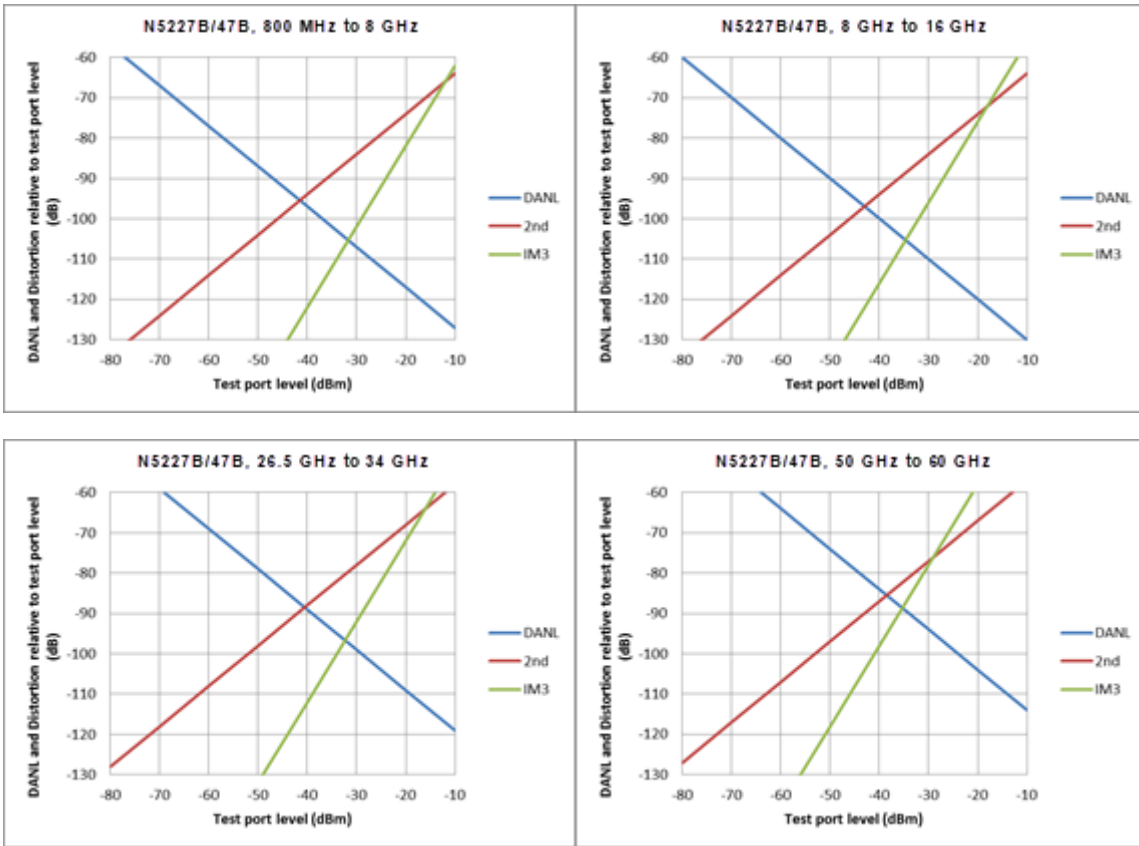
Table 22. DANL and Distortion Relative to Test Port Level (dB), All Options - Nominal

N5221B/22B/41B/42B/49B



N5224B/25B/44B/45B







**Table 23. Receiver Phase Noise (dBc/Hz), N5221B/22B/24B/25B/27B/41B/42B/49B/44B/45B/47B – Supplemental Performance Data**

Offset	CF = 1 GHz	CF = 3 GHz	CF = 10 GHz	CF = 20 GHz
100 Hz	-116	-108	-99	-88
1 kHz	-129	-126	-118	-112
10 kHz	-131	-132	-126	-120
100 kHz	-135	-136	-131	-126
1 MHz	-135	-138	-139	-132
10 MHz	-135	-138	-140	-138

**Table 24. 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 25. 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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