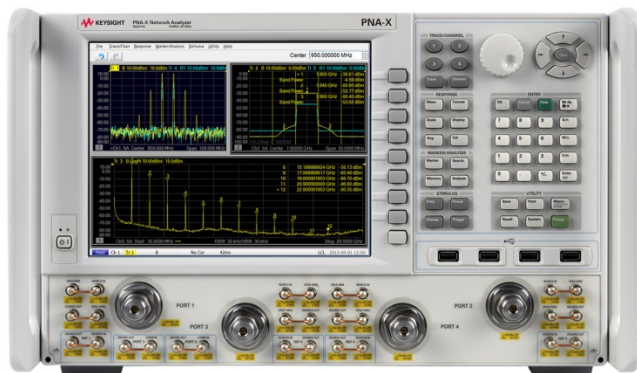


# Keysight Spectrum Analyzer Option (090) for PNA/PNA-L/PNA-X



Data Sheet and  
Technical  
Specifications

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This is a complete list of the technical specifications for the spectrum analyzer option (Option 090) 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 10 MHz to 13.5 GHz
- N5222A 10 MHz to 26.5 GHz
- N5224A 10 MHz to 43.5 GHz
- N5225A 10 MHz to 50 GHz
- N5227A 10 MHz to 67 GHz

**PNA-L Series Network Analyzer**

- N5239A 300 kHz to 8.5 GHz
- N5231A 300 kHz to 13.5 GHz
- N5232A 300 kHz to 20 GHz
- N5234A 10 MHz to 43.5 GHz
- N5235A 10 MHz to 50 GHz

**PNA-X Series Network Analyzer**

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

For N5241A/42A/44A/45A 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 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.

## 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 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
<b>Frequency Reference<sup>1</sup></b>		
Accuracy	--	+/-[(time since last adjustment x aging rate) + temperature stability + calibration accuracy], typical
Aging Rate	--	+/-0.1 ppm/yr maximum <sup>2</sup> , typical
Temperature Stability	--	+/-0.05 ppm, -10° to 70° C <sup>3</sup> , typical
Achievable Initial Calibration Accuracy	+/- 1 ppm	--
Accuracy Example, 1 year after adjustment	--	= +/-[(1x0.1 ppm)+0.05 ppm+1 ppm = +/-1.15 ppm
<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	--
Initial Calibration Accuracy	+/- 2 ppm	--
<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 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>4</sup></b>	1.2 Hz to 3 MHz	--

<sup>1</sup> Frequency reference accuracy can be improved by using external frequency reference with better accuracy.

<sup>2</sup> Assuming no variation in temperature.

<sup>3</sup> Assuming no variation in time.

<sup>4</sup> 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
<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)	--	N5239A/49A: 210 ms N5221A/31A/41A: 300 ms N5222A/32A/42A: 540 ms N5224A/34A/44A: 800 ms N5225A/35A/45A: 890 ms N5227A/47A: 1170 ms

## Amplitude Accuracy and Range Specifications

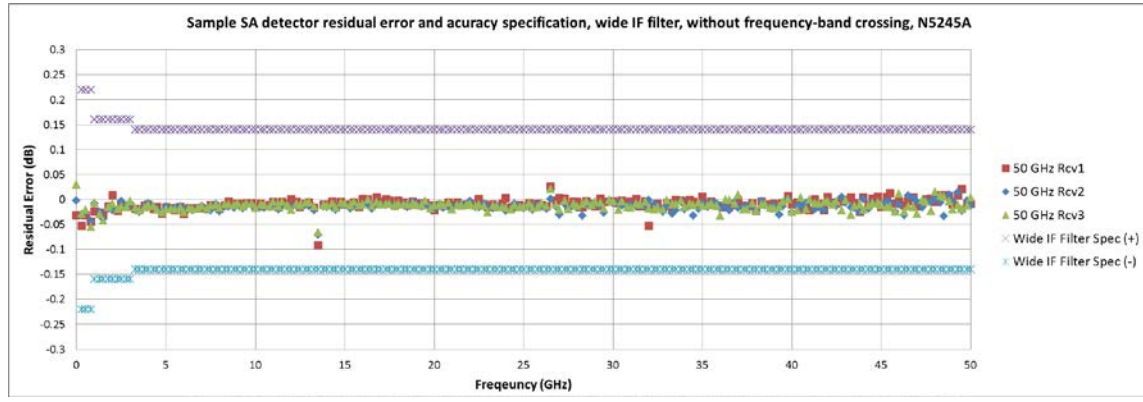
Table 2a. Amplitude Range Specifications

Description	Specification
<b>Amplitude Range</b>	
Measurement Range	DANL to maximum input level
Input Attenuator Range	N523xA: none, N5227A/47A: 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 data sheet.
<b>Display Range</b>	
Log Scale	0.001 to 500 dB/div in 0.001 steps
Linear Scale	10 divisions
Scale Units	dBm, mW
<b>Trace Detectors Types</b>	Average, Sample, Peak, Normal, Negative Peak, Peak sample, Peak average



**Table 2b. SA Detector Accuracy<sup>1</sup>, Without Frequency-band Crossing (dB) - Specifications**

Description	N5221A/22A/ 41A/42A/49A		N5224A/25A/ 44A/45A		N5227A/47A	
	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



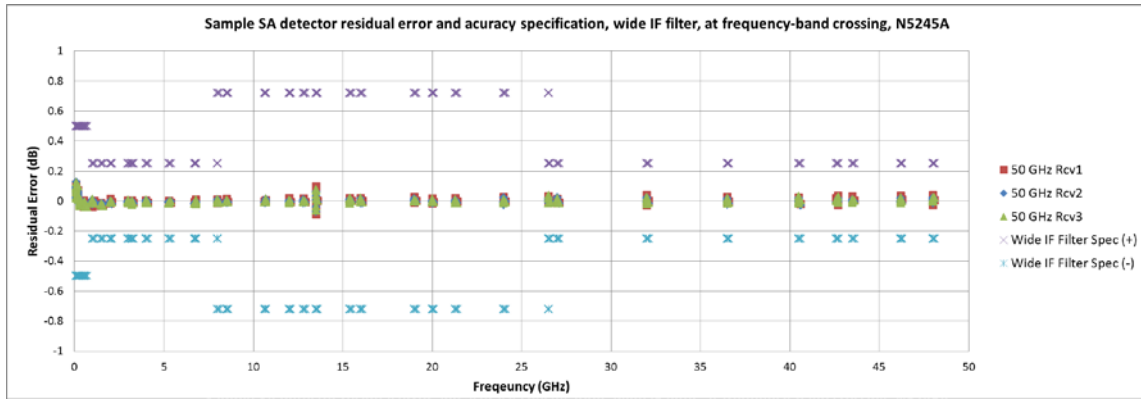
<sup>1</sup> SA detector accuracy is residual error of IF response calibration. IF response is characterized with PNA's standard measurement class after power and S-parameter calibration. Therefore the SA total absolute amplitude accuracy includes power meter, S-parameter and SA detector accuracies.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

<sup>2</sup> 0.3 dB better with N5244A/45A/47A.

<sup>3</sup> Typical.

**Table 2c. SA Detector Accuracy, At Frequency-band Crossing<sup>1</sup> (dB) - Specifications**

Description	N5221A/22A/41A/42A/49A		N5224A/25A/44A/45A		N5227A/47A	
	Narrow IF Filter	Wide IF Filter	Narrow IF Filter	Wide IF Filter	Narrow IF Filter	Wide IF Filter
50 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 2d. SA Detector Accuracy<sup>1</sup>, Without Frequency-band Crossing (dB) - Specifications**

Description	N5231A/32A/39A		N5234A/35A	
	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

<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.

**Table 2e. SA Detector Accuracy<sup>1</sup>, At Frequency-band Crossing (dB) - Specifications**

Description	N5231A/32A/39A		N5234A/35A	
	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

<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 2f. Input Attenuation Switching Uncertainty (dB) - Supplemental Information**

Description	N5221A/22A/ 41A/42A/49A		N5224A/25A/ 44A/45A		N5227A/47A	
	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

**Table 2g. Input VSWR<sup>1</sup>, without Option 029 - Specifications**

Description	N5221A/22A Options 210, 410	N5221A/22A All Other Options	N5241A/42A/49A All Options
10 MHz to 50 MHz	1.135	1.785	1.785
50 MHz to 500 MHz	1.106	1.329	1.329
500 MHz to 3.2 GHz	1.135	1.329	1.329
3.2 GHz to 8 GHz	1.196	1.577	1.577
8 GHz to 10 GHz	1.329	1.577	1.577
10 GHz to 13.5 GHz	1.377	1.925	1.925
13.5 GHz to 16 GHz	1.433	1.925	1.925
16 GHz to 20 GHz	1.499	2.1	2.1
20 GHz to 24 GHz	1.671	2.1	2.1
24 GHz to 26.5 GHz	1.925	2.323	2.323

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

**Table 2h. Input VSWR<sup>1</sup>, without Option 029 - Specifications**

Description	N5224A/25A Options 210, 410	N5224A/25A All Other Options	N5244A/45A All Options
10 MHz to 50 MHz	1.329	1.925	1.925
50 MHz to 200 MHz	1.173	1.253	1.377
200 MHz to 500 MHz	1.106	1.289	1.377
500 MHz to 3.2 GHz	1.196	1.377	1.499
3.2 GHz to 10 GHz	1.253	1.577	1.577
10 GHz to 13.5 GHz	1.329	1.785	1.785
13.5 GHz to 20 GHz	1.433	1.925	1.785
20 GHz to 26.5 GHz	1.433	1.925	1.925
26.5 GHz to 46 GHz	1.577	2.323	2.615
46 GHz to 50 GHz	1.925	2.323	2.615

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

**Table 2i. Input VSWR<sup>1</sup>, without Option 029 - Specifications**

Description	N5227A Options 210, 410	N5227A All Other Options	N5247A All Options
10 MHz to 50 MHz	1.289	3.01	3.01
50 MHz to 200 MHz	1.135	1.785	1.785
200 MHz to 500 MHz	1.153	1.785	1.785
500 MHz to 3.2 GHz	1.253	2.615	2.615
3.2 GHz to 10 GHz	1.329	2.615	2.615
10 GHz to 13.5 GHz	1.433	3.01	3.01
13.5 GHz to 16 GHz	1.577	3.01	3.01
16 GHz to 20 GHz	1.577	2.615	2.615
20 GHz to 26.5 GHz	1.671	2.615	2.615
26.5 GHz to 43.5 GHz	1.925	3.01	3.01
43.5 GHz to 50 GHz	1.925	3.01	3.01
50 GHz to 60 GHz	2.323	2.615	2.615
60 GHz to 67 GHz	2.323	3.01	3.01
67 GHz to 70 GHz <sup>2</sup>	1.785	1.925	1.925

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

<sup>2</sup> Typical.

**Table 2j. Input VSWR<sup>1</sup>, with Option 029 - Specifications**

Description	N5241A/42A/49A		N5244A/45A	N5247A
	Port 1	Port 2	Ports 1, 2	Ports 1, 2
10 MHz to 50 MHz	1.785	2.1	1.925	3.57
50 MHz to 500 MHz	1.329	1.577	1.377	1.785
500 MHz to 3.2 GHz	1.433	2.1	1.577	2.615
3.2 GHz to 10 GHz	1.925	3.264	1.785	3.01
10 GHz to 16 GHz	2.1	3.264	1.785	3.01
16 GHz to 20 GHz	2.323	3.264	1.785	3.01
20 GHz to 26.5 GHz	2.615	3.264	2.323	3.01
26.5 GHz to 46 GHz			2.615	3.01
46 GHz to 50 GHz			3.01	3.01
50 GHz to 67 GHz				3.01

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

**Table 2k. Input VSWR<sup>1</sup> - Specifications**

Description	N5231A/32A/39A		N5234A/35A
	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

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

**Table 2l. Other Amplitude Accuracy - Supplemental Information**

<b>RBW Switching Uncertainty</b>	< +/-0.02 dB, All RBW
<b>Display Scale Fidelity</b>	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 <sup>1</sup>	-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

<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 3b. Displayed Average Noise Level (DANL)<sup>1</sup> (dBm/Hz), At Test Ports - Specification**

Description	N5221A/ 22A	N5241A/ 42A/49A	N5224A/ 25A	N5244A/ 45A	N5227A	N5247A
10 MHz to 200 MHz	-94	-94	-84	-84	-84	-84
200 MHz to 800 MHz	-122	-122	-108	-108	-115	-115
800 MHz to 3.2 GHz	-135	-135	-130	-130	-133	-133
3.2 GHz to 8 GHz	-135	-135	-130	-130	-133	-133
8 GHz to 16 GHz	-132	-132	-133	-133	-136	-136
16 GHz to 20 GHz	-132	-132	-130	-130	-136	-136
20 GHz to 24 GHz	-129	-130	-130	-130	-136	-136
24 GHz to 26.5 GHz	-122	-121	-130	-130	-136	-136
26.5 GHz to 34 GHz			-124	-124	-122	-122
34 GHz to 50 GHz			-124	-124	-118	-118
50 GHz to 67 GHz					-116	-116
67 GHz to 70 GHz <sup>2</sup>					-121	-121

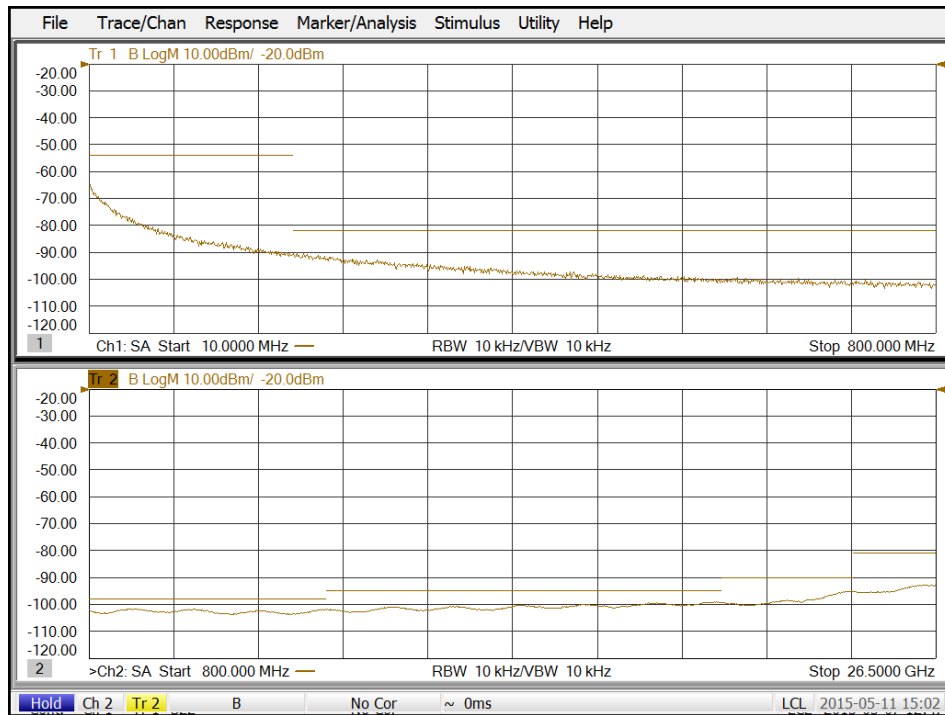
<sup>1</sup> Tested with 10 kHz RBW, test port terminated, average detector, averaging type = Log, 0 dB attenuator, IF gain = max, image rejection = normal, random LO OFF. The specification is normalized to 1.2 Hz minimum available RBW, applied to random LO ON, and improved by approximately 13 dB by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

<sup>2</sup> Typical.

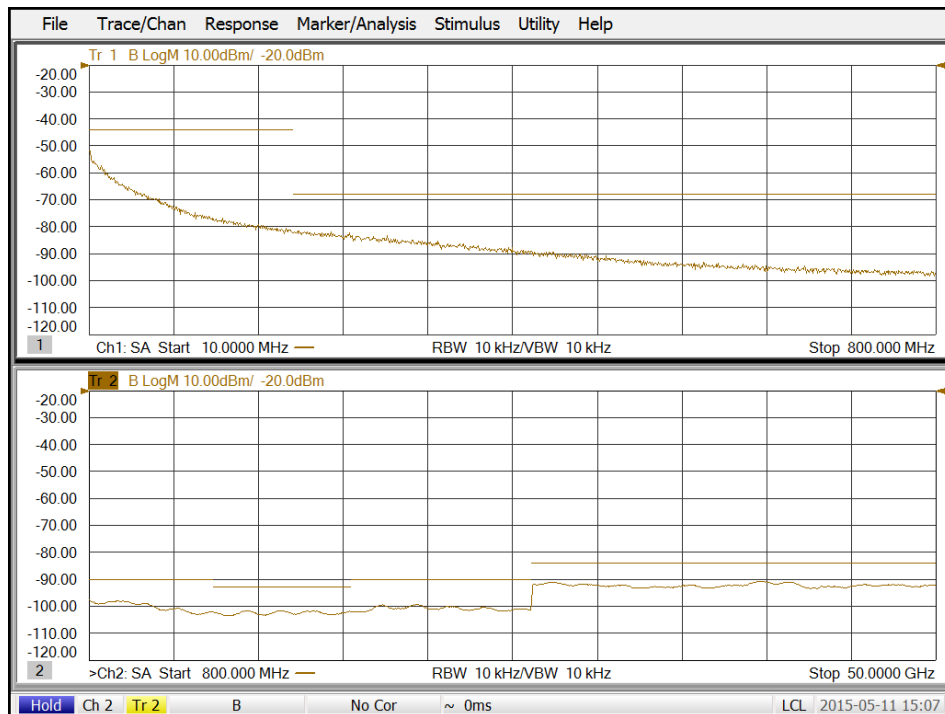


**Table 3c. Displayed Average Noise Level (DANL)<sup>1</sup> (dBm/Hz), At Test Ports - Supplemental Information**

**N5242A DANL performance example compared to specification**

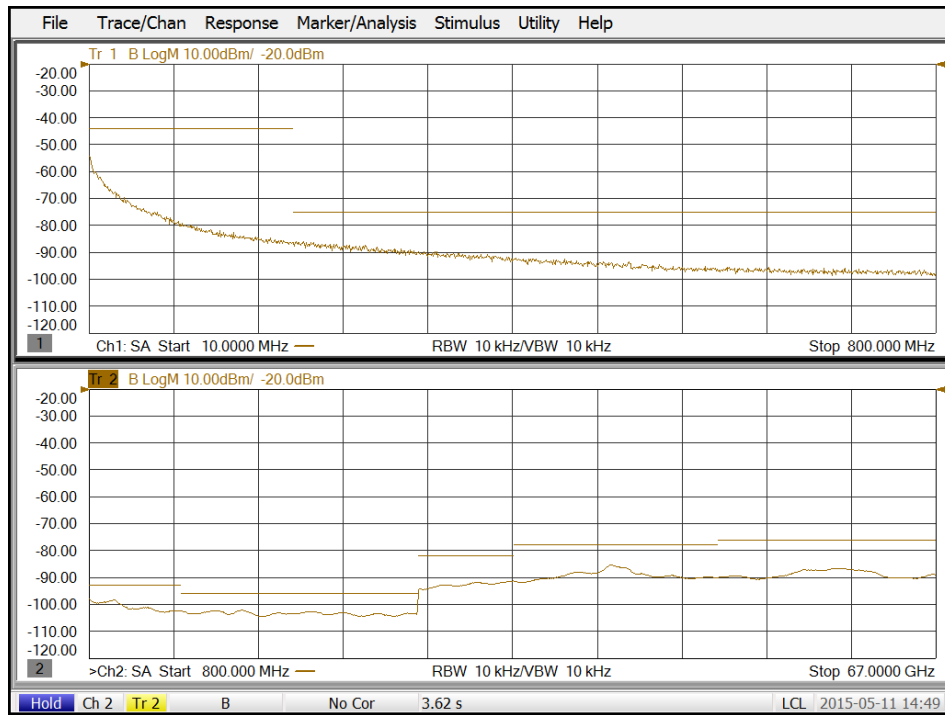


**N5245A DANL performance example compared to specification**



**Table 3c. Displayed Average Noise Level (DANL)<sup>1</sup> (dBm/Hz), At Test Ports - Supplemental Information (cont.)**

N5227A DANL performance example compared to specification



**Table 3d. Displayed Average Noise Level (DANL)<sup>1</sup> (dBm/Hz), At Test Ports - Typical**

Description	N5221A/ 22A	N5241A/ 42A/49A	N5224A/ 25A	N5244A/ 45A	N5227A	N5247A
10 MHz to 200 MHz	-97	-97	-87	-87	-87	-87
200 MHz to 800 MHz	-132	-133	-122	-122	-129	-129
800 MHz to 8 GHz	-140	-141	-135	-135	-137	-137
8 GHz to 16 GHz	-139	-139	-140	-139	-141	-140
16 GHz to 24 GHz	-139	-139	-137	-137	-141	-140
24 GHz to 26.5 GHz	-136	-137	-137	-137	-141	-140
26.5 GHz to 34 GHz			-130	-130	-129	-129
34 GHz to 50 GHz			-130	-130	-125	-124
50 GHz to 67 GHz					-124	-124
67 GHz to 70 GHz					-121	-121

<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.

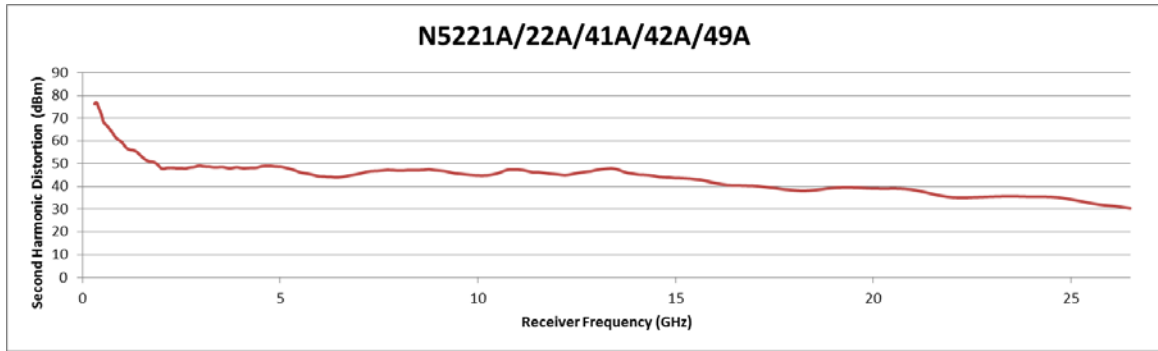
**Table 3e. Displayed Average Noise Level (DANL)<sup>1</sup> (dBm/Hz), At Test Ports - Specification**

Description	N5231A/32A/39A	N5234A/35A
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

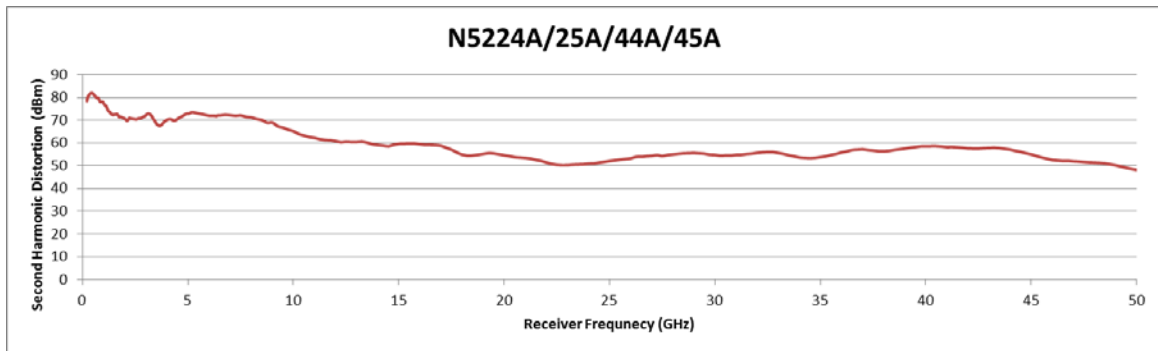
<sup>1</sup> Tested with 10 kHz RBW, test port terminated, average detector, averaging type = Log, 0 dB attenuator, IF gain = Auto, image rejection = normal, random LO OFF. The specification is normalized to 1.2 Hz minimum available RBW, applied to random LO ON, and improved by approximately 13 dB by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

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

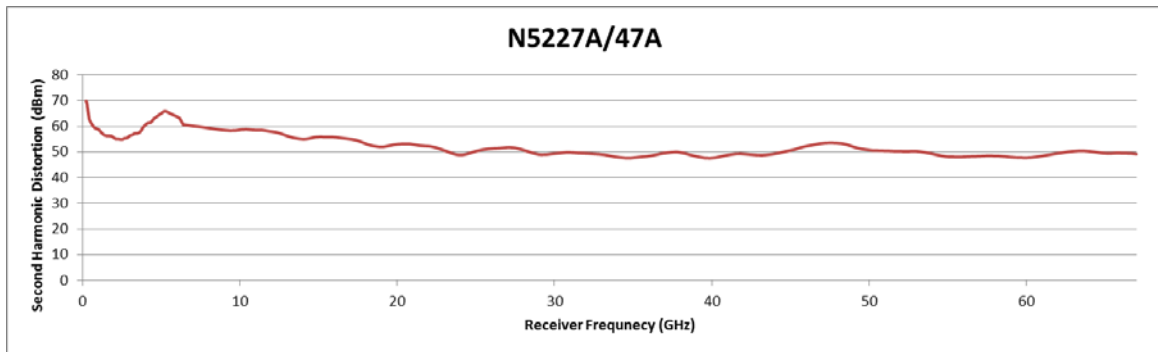
N5221A/22A/41A/42A/49A



N5224A/25A/44A/45A



N5227A/47A



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

Description	N5231A/32A/39A	N5234A/35A
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)<sup>1</sup> (dBm) - Characteristic**

Description	N5221A/22A/ 41A/42A/49A		N5224A/25A/ 44A/45A		N5227A/47A	
	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

<sup>1</sup> 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.

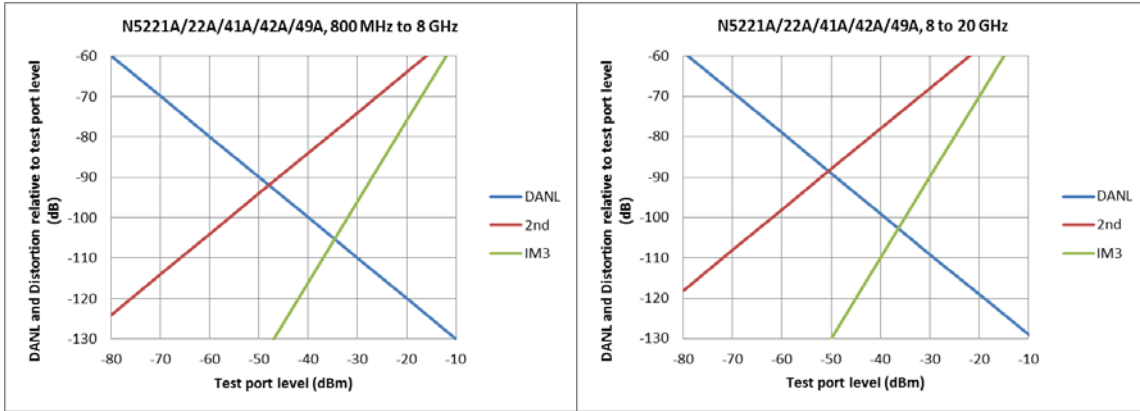
**Table 3i. Third Order Intermodulation Distortion (TOI)<sup>1</sup> (dBm) - Characteristic**

Description	N5231A/32A/39A		N5234A/35A	
	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

<sup>1</sup> 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

N5221A/22A/41A/42A/49A



N5224A/25A/44A/45A

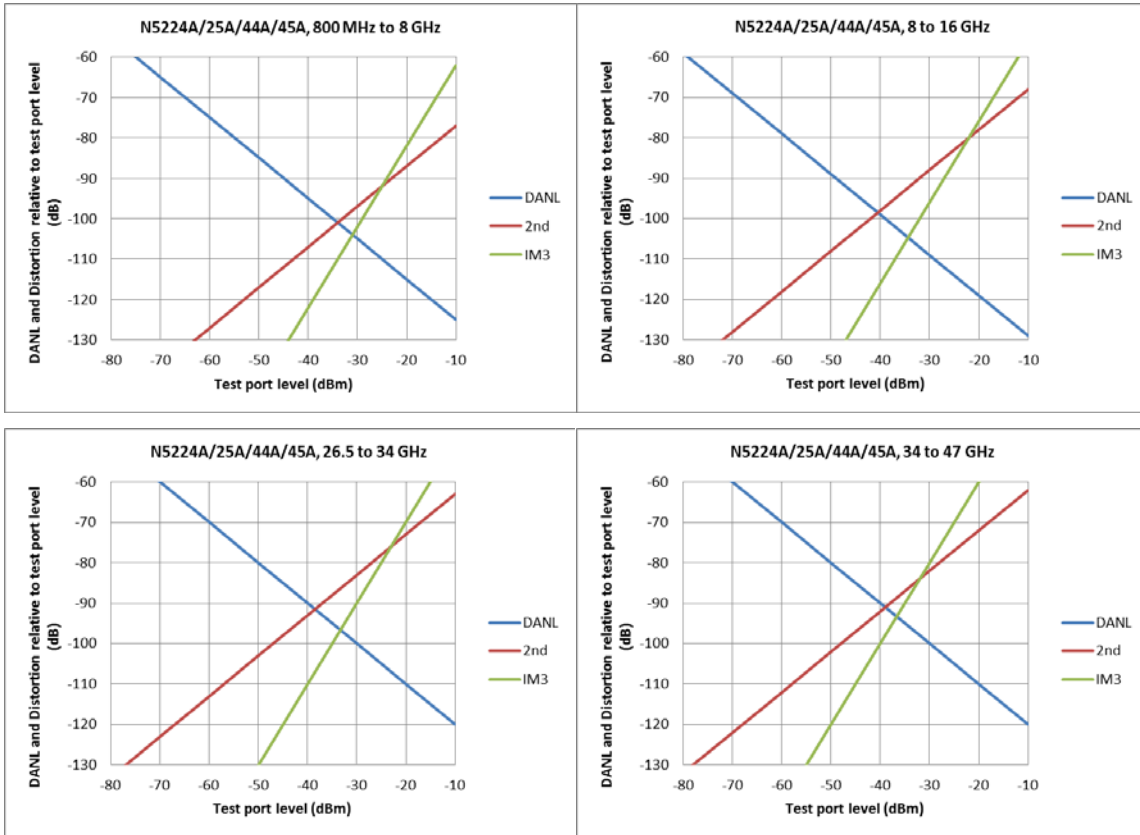
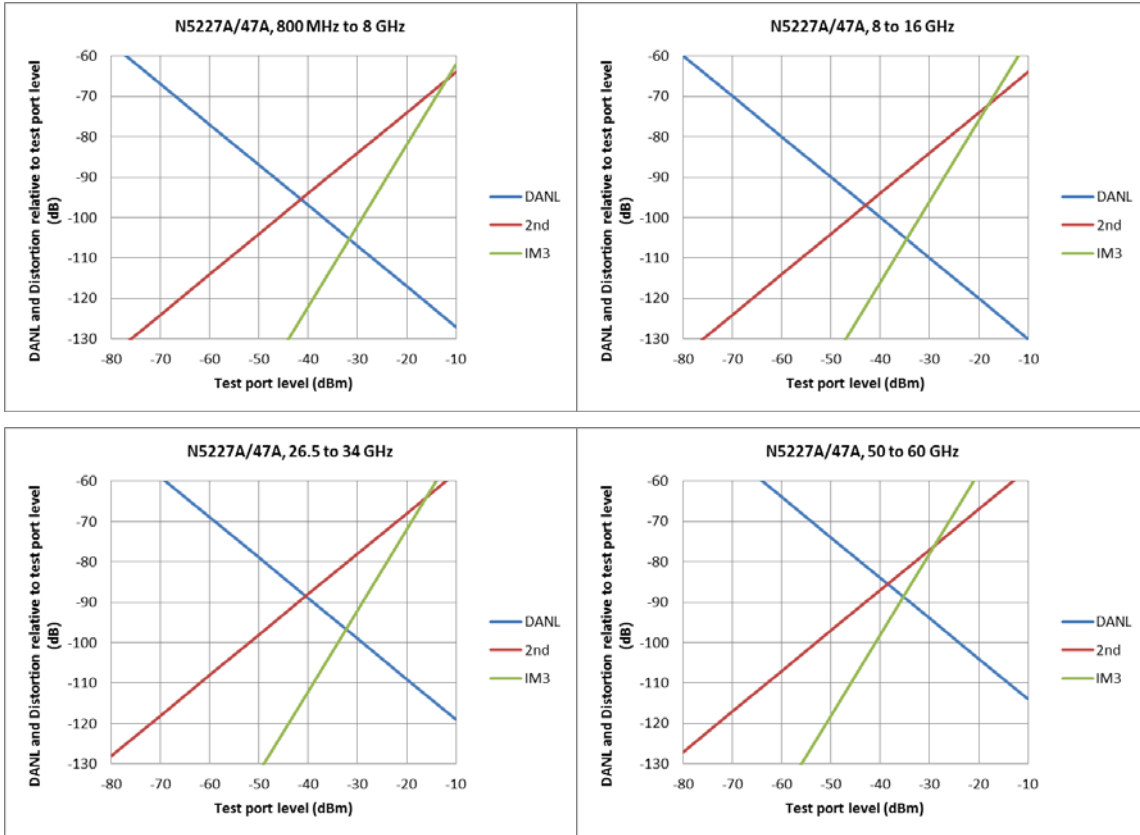


Table 3j. DANL and Distortion Relative to Test Port Level (dB), All Options - Nominal (cont.)

N5227A/47A



N5231A/32A/39A

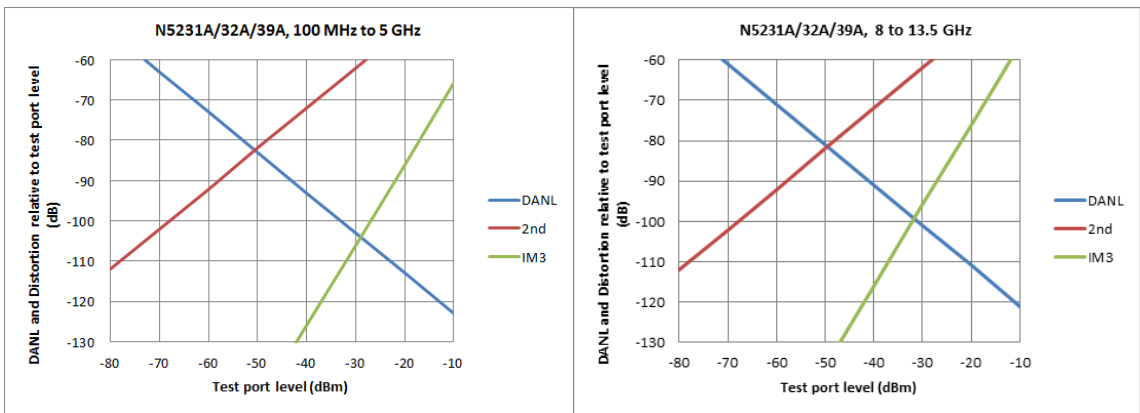
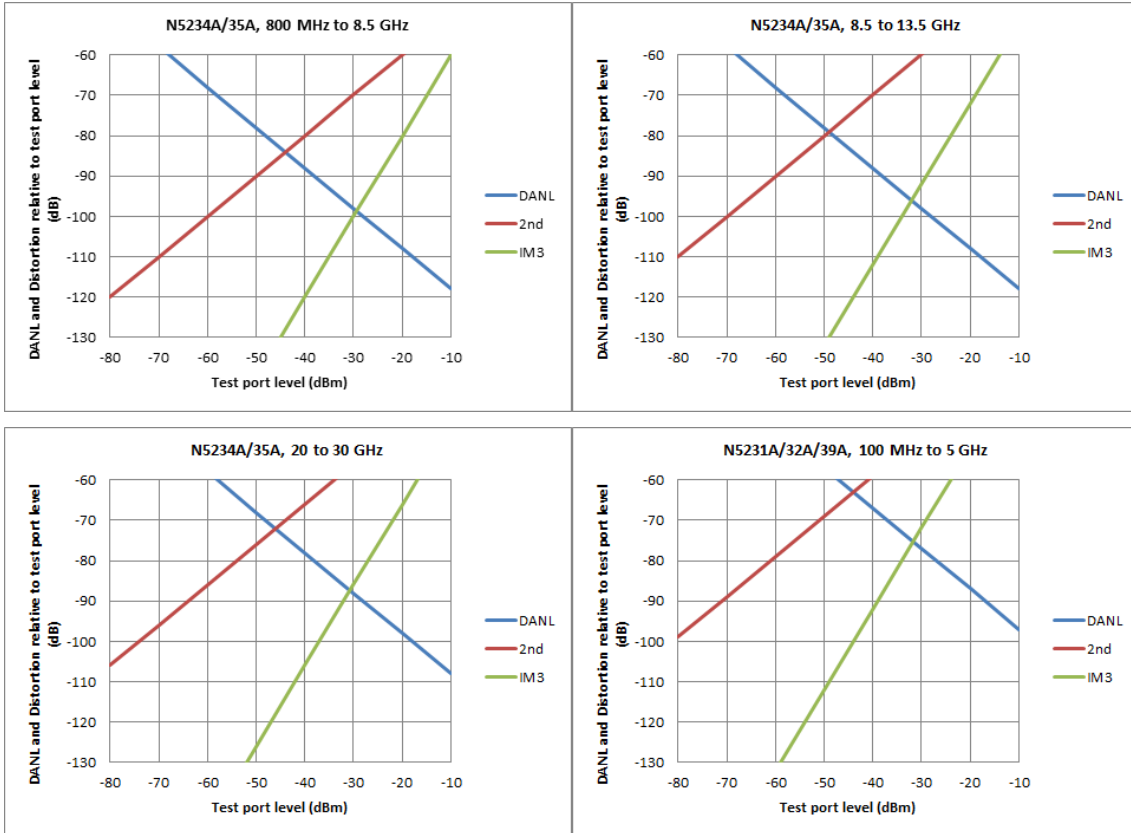




Table 3j. DANL and Distortion Relative to Test Port Level (dB), All Options - Nominal (cont.)

N5234A/35A



**Table 3k. Receiver Phase Noise (dBc/Hz), N5221A/22A/31A/32A/39A/41A/42A/49A - 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), N5224A/25A/44A/45A - 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), N5227A/47A - 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



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