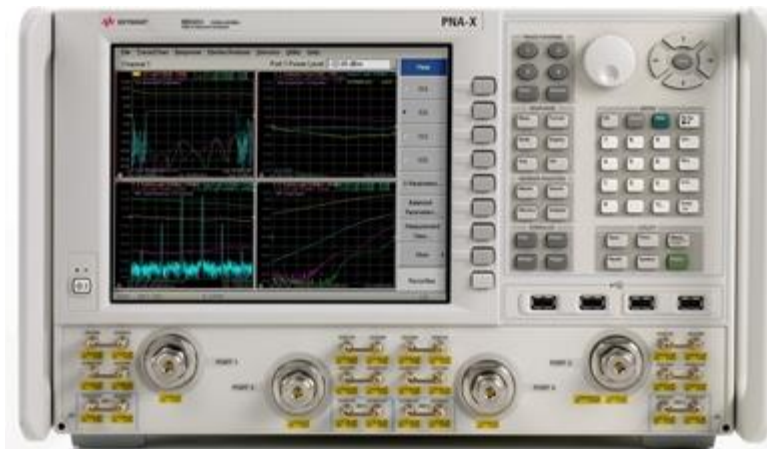


# Keysight 2-Port and 4-Port PNA-X Network Analyzer

N5249A - 10 MHz to 8.5 GHz

N5241A - 10 MHz to 13.5 GHz

N5242A - 10 MHz to 26.5 GHz



Data Sheet and  
Technical  
Specifications

## Documentation Warranty

THE MATERIAL CONTAINED IN THIS DOCUMENT IS PROVIDED "AS IS," AND IS SUBJECT TO BEING CHANGED, WITHOUT NOTICE, IN FUTURE EDITIONS. FURTHER, TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, KEYSIGHT DISCLAIMS ALL WARRANTIES, EITHER EXPRESS OR IMPLIED WITH REGARD TO THIS MANUAL AND ANY INFORMATION CONTAINED HEREIN, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. KEYSIGHT SHALL NOT BE LIABLE FOR ERRORS OR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH THE FURNISHING, USE, OR PERFORMANCE OF THIS DOCUMENT OR ANY INFORMATION CONTAINED HEREIN. SHOULD KEYSIGHT AND THE USER HAVE A SEPARATE WRITTEN AGREEMENT WITH WARRANTY TERMS COVERING THE MATERIAL IN THIS DOCUMENT THAT CONFLICT WITH THESE TERMS, THE WARRANTY TERMS IN THE SEPARATE AGREEMENT WILL CONTROL.

## U.S. Government Rights

U.S. Government Rights. The Software is "commercial computer software," as defined by Federal Acquisition Regulation ("FAR") 2.101. Pursuant to FAR 12.212 and 27.405-3 and Department of Defense FAR Supplement ("DFARS") 227.7202, the U.S. government acquires commercial computer software under the same terms by which the software is customarily provided to the public. Accordingly, Keysight provides the Software to U.S. government customers under its standard commercial license, which is embodied in its End User License Agreement (EULA), a copy of which can be found at <http://www.keysight.com/find/sweula>. The license set forth in the EULA represents the exclusive authority by which the U.S. government may use, modify, distribute, or disclose the Software. The EULA and the license set forth therein, does not require or permit, among other things, that Keysight: (1) Furnish technical information related to commercial computer software or commercial computer software documentation that is not customarily provided to the public; or (2) Relinquish to, or otherwise provide, the government rights in excess of these rights customarily provided to the public to use, modify, reproduce, release, perform, display, or disclose commercial computer software or commercial computer software documentation. No additional government requirements beyond those set forth in the EULA shall apply, except to the extent that those terms, rights, or licenses are explicitly required from all providers of commercial computer software pursuant to the FAR and the DFARS and are set forth specifically in writing elsewhere in the EULA. Keysight shall be under no obligation to update, revise or otherwise modify the Software. With respect to any technical data as defined by FAR 2.101, pursuant to FAR 12.211 and 27.404.2 and DFARS 227.7102, the U.S. government acquires no greater than Limited Rights as defined in FAR 27.401 or DFAR 227.7103-5 (c), as applicable in any technical data.

<b>Corrected System Performance .....</b>	<b>8</b>
System Dynamic Range and Receiver Dynamic Range.....	8
Table 1. System Dynamic Range, Options 200 or 400, and Receiver Dynamic Range, All Options .....	9
Table 2a. System Dynamic Range at Test Port (dB), Options 200 or 400.....	9
Table 2b. System Dynamic Range at Test Port (dB), Options 219 or 419 .....	10
Table 2c. System Dynamic Range at Test Port (dB), Option 224 .....	10
Table 2d. System Dynamic Range at Test Port (dB), Options 224 or 423 .....	11
Table 3a. Extended Dynamic Range at Direct Receiver Access Input (dB) - Typical .....	11
Table 3b. Extended Dynamic Range at Direct Receiver Access Input (dB) - Typical .....	12
<b>Corrected System Performance with 3.5mm Connectors, All Opts .....</b>	<b>13</b>
Table 4. 85052B Calibration Kit .....	13
Table 5. N4433A 4-Port Electronic Calibration Module .....	15
Table 6. N4691B 2-Port Electronic Calibration Module .....	17
<b>Uncorrected System Performance .....</b>	<b>19</b>
Table 7a. Directivity (dB) .....	19
Table 7b. Source Match (dB).....	20
Table 7c. Load Match (dB) .....	20
Table 7d. Transmission Tracking, Reflection Tracking, Crosstalk (dB), All Options, All Ports - Typical .....	21
<b>Test Port Output.....</b>	<b>22</b>
Table 8. Frequency Information, All Options.....	22
Table 9a. Maximum Leveled Power (dBm), Options 200 or 400 .....	23
Table 9b. Maximum Leveled Power (dBm), Options 219 or 419 .....	24
Table 9c. Maximum Leveled Power (dBm), Option 219 or 419 with 029 <sup>1</sup> .....	24
Table 9d. Maximum Leveled Power (dB), Options 224 or 423 .....	25
Table 9e. Maximum Leveled Power (dBm), Options 224 or 423, Combine Mode - Typical .....	25
Table 9f. Maximum Leveled Power (dBm), Option 224 .....	26
Table 9g. Maximum Leveled Power (dB), Options 224 or 423 with 029 <sup>1</sup> .....	26
Table 9h. Maximum Leveled Power (dBm), Options 224 or 423 with 029 <sup>1</sup> , Combine Mode - Typical .....	27
Table 10. Power Level Accuracy (dB) at Nominal Power <sup>1</sup> , All Options .....	27
Table 11a. Power Level Linearity <sup>1</sup> (dB), All Options - Specification .....	28
Table 11b. Power Level Linearity <sup>1</sup> (dB), All Options - Specification.....	28
Table 11c. Power Level Linearity <sup>1</sup> (dB), Option 224 - Specification.....	28
Table 12a. Power Sweep Range (dB), Options 200 or 400.....	29
Table 12b. Power Sweep Range (dB), Options 219 or 419 .....	29

Table 12c. Power Sweep Range (dB), Options 219 or 419 with 029 <sup>1</sup> .....	30
Table 12d. Power Sweep Range (dB), Options 224 or 423 .....	30
Table 12e. Power Sweep Range (dB), Option 224 .....	31
Table 12f. Power Sweep Range (dB), Options 224 or 423 with 029 <sup>1</sup> .....	31
Table 13. Nominal Power (Preset Power, dBm) .....	32
Table 14. Power Resolution and Maximum/Minimum Settable Power, All Ports <sup>1</sup> .....	32
Table 15. Harmonics at Max Specified Power (dBc), All Options - Typical .....	32
Table 16. Non-Harmonic Spurs (dBc) at Nominal Power, All Options, All Ports - Typical .....	33
Table 17. Phase Noise (dBc/Hz), All Options, All Ports - Typical .....	33
<b>Test Port Input .....</b>	<b>34</b>
Table 18. Noise Floor <sup>1</sup> (dBm) at 10 Hz IFBW, All Options, All Ports .....	34
Table 19. 0.1 dB Compression at Test Port (dBm), All Options, All Ports - Typical .....	34
Table 20. Test Port Compression (dB) at 8 dBm Test Port Power, All Options, All Ports, - Specification .....	35
Table 21a. Trace Noise <sup>1</sup> Magnitude (dB rms), All Options, All Ports .....	35
Table 21b. Trace Noise <sup>1</sup> Phase (deg rms), All Options, All Ports .....	35
Table 22. Reference Level - Specification .....	36
Table 23. Stability <sup>1</sup> - Typical .....	36
Table 24. Damage Input Level - Specification .....	36
<b>Noise Receiver Input (Option 029 only) .....</b>	<b>37</b>
Table 25. Noise Receiver Bandwidth .....	37
Table 26. Receiver Noise Figure (dB), Port 2, at All BW, High Gain Setting .....	37
Table 27. Noise Figure Trace Noise <sup>1</sup> (dB rms) at 4 MHz BW .....	37
Table 28. Noise Receiver Linearity (dB) at 4 MHz BW - Specification .....	38
Table 29. Noise Receiver Input Range - Specification .....	38
<b>Dynamic Accuracy .....</b>	<b>39</b>
Table 30. Dynamic Accuracy - Specification .....	39
Table 31. Test Port Input (Group Delay) <sup>1</sup> .....	42
<b>General Information .....</b>	<b>43</b>
Table 32. Miscellaneous Information .....	43
Table 33. Front Panel Information, All Options .....	43
Table 33. (Continued) Front Panel Information, All Options .....	44
Table 34. Rear Panel Information, All Options .....	44
Table 34. (Continued) Rear Panel Information, All Options .....	45
Table 34. (Continued) Rear Panel Information, All Options .....	46
Table 34. (Continued) Rear Panel Information, All Options .....	47

Table 35. Analyzer Dimensions and Weight .....	48
Regulatory and Environmental information .....	48
<b>Measurement Throughput Summary .....</b>	<b>49</b>
Table 36a. Cycle Time (ms) for Measurement Completion, All Options - Typical.....	49
Table 36b. Cycle Time (ms) for Full-Span Measurement Completion - Typical .....	50
Table 37. Cycle Time vs. IF Bandwidth - Typical .....	50
Table 38. Cycle Time vs. Number of Points .....	51
Table 39. Data Transfer Time <sup>1</sup> (ms) - Typical.....	52
<b>Specifications: Front-Panel Jumpers .....</b>	<b>53</b>
Table 40. Measurement Receiver Inputs (dBm) - Typical.....	53
Table 41a. Reference Receiver Inputs and Reference Source Outputs (dBm) - Typical .....	54
Table 41b. Reference Receiver Inputs and Reference Source Outputs (dBm) - Typical .....	55
Table 41c. Reference Receiver Inputs and Reference Source Outputs (dBm) - Typical .....	56
Table 42a. Source Outputs (dBm) - Typical.....	57
Table 42b. Source Outputs (dBm) - Typical.....	58
Table 43. Coupler Inputs (dB) - Typical .....	58
Table 44. Damage Level - Typical.....	59
<b>Test Set Block Diagrams.....</b>	<b>60</b>
Figure 1. 2-Port N5241A, N5242A, and N5249A Base Unit Option 200.....	60
Figure 2. 2-Port N5241A, N5242A, and N5249A Option 219 .....	60
Figure 3. 2-Port N5241A, N5242A, and N5249A Option 224 .....	61
Figure 4. 2-Port N5241A, N5242A, and N5249A Option 224 with 029 .....	61
Figure 5. 4-Port N5241A, N5242A, and N5249A Base Unit Option 400.....	62
Figure 6. 4-Port N5241A, N5242A, and N5249A Option 419 .....	62
Figure 7. 4-Port N5241A, N5242A, and N5249A Option 423 .....	63
Figure 8. 4-Port N5241A, N5242A, and N5249A Option 423 with 029 .....	63
Figure 9. Receiver Block Diagram.....	64

This is a complete list of the technical specifications for the N5241A, N5242A, and N5249A with the following options:

**Option 029**, adds hardware and firmware for high-accuracy noise figure measurements. It requires one of option 219, 224, 419, or 423. [See the block diagram.](#)

**Option 200**, 2-port standard test set (includes six front-panel access loops) and power range. [See the block diagram.](#)

**Option 219**, adds 2-port extended power range, source and receiver attenuators, and bias-tees (requires Option 200). [See the block diagram.](#)

**Option 224**, adds an internal second source, a combiner, and mechanical switches to the 2-port analyzer (requires Option 200, 219, and 080). [See the block diagram.](#)

**Option 400**, 4-port standard test set (includes twelve front-panel access loops), power range, and an internal second source (Option 080 recommended). [See the block diagram.](#)

**Option 419**, adds 4-port extended power range, source and receiver attenuators, and bias-tees (requires Option 400). [See the block diagram.](#)

**Option 423**, adds an internal combiner, and mechanical switches to the 4-port analyzer (requires Option 400, 419, and 080). [See the block diagram.](#)

#### NOTE

Specifications for the N5241AS, N5242AS, and N5249AS Option H85, when configured in standard configuration, are the same as those of closest N5241A, N5242A, and N5249A option configuration.

[The Corrected System Performance with Cal Kits](#) and [Dynamic Accuracy Charts](#) apply ONLY N5241A, N5242A, and N5249A models with serial numbers starting with MY5241/42/49, SG5241/42/49, and US5241/42/49, and above. This document provides technical specifications only for the 85052B calibration kit, the N4433A 4-Port ECal module, and the N4691B 2-Port ECal module. Please download our free Uncertainty Calculator from [http://www.keysight.com/find/na\\_calculator](http://www.keysight.com/find/na_calculator) to generate the curves for your calibration kit and PNA setup.

For all tables in this data sheet, the specified performance at the exact frequency of a break is the degraded value of the two specifications at that frequency.

## 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.

**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.

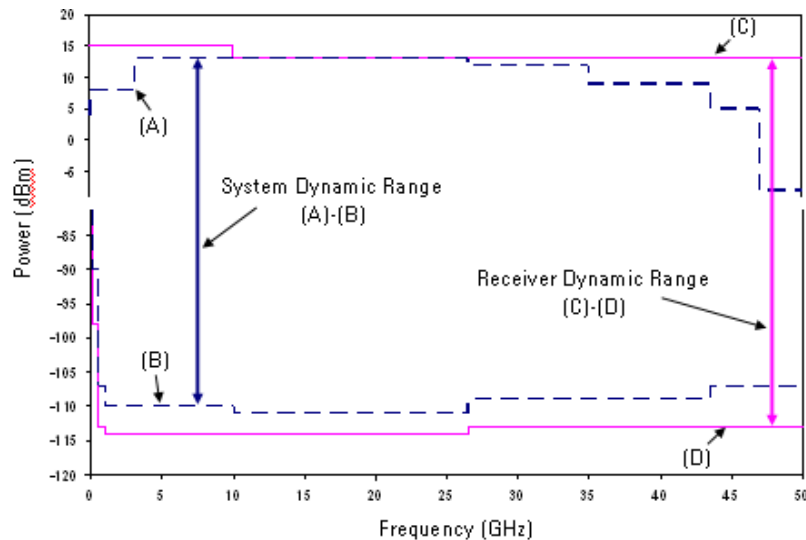
## Corrected System Performance

The specifications in this section apply for measurements made with the N5241A, N5242A, and N5249A analyzer with the following conditions:

- 10 Hz IF bandwidth
- No averaging applied to data
- Isolation calibration with an averaging factor of 8
- Source in filtered mode where applicable

### System Dynamic Range and Receiver Dynamic Range

- **System Dynamic Range** is defined as the max leveled output power (spec) minus the noise floor (spec).
- **Extended Dynamic Range at Direct Access Input** is defined as the specified source maximum output power (typical) minus the direct receiver access input noise floor (typical).
- **Receiver Dynamic Range** is defined as the test port compression at 0.1 dB (typical) minus the noise floor (typical).



#### NOTE

The effective dynamic range must take measurement uncertainties and interfering signals into account.

The direct receiver access input extended dynamic range is calculated as the difference between the direct receiver access input noise floor and the source maximum output power. This set-up should only be used when the receiver input will never exceed its maximum receiver input. When the analyzer is in segment sweep mode, it can have predefined frequency segments which will output a higher power level when the extended dynamic range is required (i.e. devices with high insertion loss), and reduced power when the maximum receiver input level will occur (i.e. devices with low insertion loss). The extended range is only available in one-path transmission measurements.

It may typically be degraded at particular frequencies below 500 MHz due to spurious receiver residuals.



Table 1. System Dynamic Range, Options 200 or 400, and Receiver Dynamic Range, All Options

Description	Specification, Options 200, 400			Typical, All Options		
	System Dynamic Range (dB) (A)-(B)	Max Levelled Output Power (dBm) (A)	Test Port Noise Floor (dBm) (B)	Receiver Dynamic Range (dB) (C)-(D)	Test Port Compression at 0.1 dB (dBm) (C)	Test Port Noise Floor (dBm) (D)
	Ports 1,3 <sup>1</sup>	Ports 1,3 <sup>1</sup>	All Ports	All Ports	All Ports	All Ports
10 MHz to 50 MHz	93	13	-80	--	--	-87
50 MHz to 100 MHz	103	13	-90	--	--	-95
100 MHz to 500 MHz	117	13	-104	125	15	-110
500 MHz to 3.2 GHz	124	10	-114	130	13	-117
3.2 GHz to 8.5 GHz	127	13	-114	130	13	-117
8.5 GHz to 13.5 GHz	127	13	-114	130	13	-117
13.5 GHz to 16 GHz	127	13	-114	130	13	-117
16 GHz to 20 GHz	127	13	-114	129	12	-117
20 GHz to 24 GHz	122	12	-110	125.5	10.5	-115
24 GHz to 26.5 GHz	112	5	-107	123	10	-113

<sup>1</sup> Either port can be used as the source port. Any other port can be used as the receiver port.

Table 2a. System Dynamic Range at Test Port (dB), Options 200 or 400

Description	Specification		Typical	
	Ports 1, 31	Ports 2, 41	Ports 1, 31	Ports 2, 41
10 MHz to 50 MHz	93	93	106	104
50 MHz to 100 MHz	103	103	116	115
100 MHz to 500 MHz	117	117	131	130
500 MHz to 3.2 GHz	124	127	130	135
3.2 GHz to 8.5 GHz	127	127	137	136
8.5 GHz to 10 GHz	127	127	137	136
10 GHz to 13.5 GHz	127	127	134	133
13.5 GHz to 16 GHz	127	127	134	133
16 GHz to 20 GHz	127	124	133	129
20 GHz to 24 GHz	122	117	130	126
24 GHz to 26.5 GHz	112	109	124	120

<sup>1</sup> Either port can be used as the source port. Any other port can be used as the receiver port.

Table 2b. System Dynamic Range at Test Port (dB), Options 219 or 419

Description	Specification		Typical	
	Ports 1, 3 <sup>1</sup>	Ports 2, 4 <sup>1</sup>	Ports 1, 3 <sup>1</sup>	Ports 2, 4 <sup>1</sup>
10 MHz to 50 MHz	93	93	106	104
50 MHz to 100 MHz	103	103	115	114
100 MHz to 500 MHz	117	117	130	129
500 MHz to 3.2 GHz	124	127	130	135
3.2 GHz to 8.5 GHz	127	127	135	134
8.5 GHz to 10 GHz	127	127	135	134
10 GHz to 13.5 GHz	126	125	132	131
13.5 GHz to 16 GHz	126	125	132	131
16 GHz to 20 GHz	124	122	130	127
20 GHz to 24 GHz	118	117	127	124
24 GHz to 26.5 GHz	110	106	121	117

<sup>1</sup> Either port can be used as the source port. Any other port can be used as the receiver port.

Table 2c. System Dynamic Range at Test Port (dB), Option 224

Description	Specification		Typical	
	Source 2 Out 1	Source 2 Out 2	Source 2 Out 1	Source 2 Out 2
10 MHz to 50 MHz	98	93	108	105
50 MHz to 100 MHz	108	107	117	116
100 MHz to 500 MHz	122	121	132	131
500 MHz to 3.2 GHz	128	128	134	136
3.2 GHz to 8.5 GHz	132	132	139	139
8.5 GHz to 10 GHz	132	132	139	139
10 GHz to 13.5 GHz	130	130	138	137
13.5 GHz to 16 GHz	130	130	138	137
16 GHz to 20 GHz	129	127	136	134
20 GHz to 24 GHz	123	122	133	132
24 GHz to 26.5 GHz	114	112	127	124

Table 2d. System Dynamic Range at Test Port (dB), Options 224 or 423

Description	Specification		Typical			
	Ports 1, 3 <sup>1</sup>	Ports 2, 4 <sup>1</sup>	Ports 1, 3 <sup>1</sup>	Ports 2, 4 <sup>1</sup>	Source 1 Port 1 Combine Mode	Source 2 Port 1 Combine Mode
10 MHz to 50 MHz	93	93	106	104	104	80
50 MHz to 100 MHz	103	103	115	115	112	90
100 MHz to 500 MHz	117	117	130	130	121	99
500 MHz to 3.2 GHz	124	127	130	134	127	112
3.2 GHz to 8.5 GHz	127	127	136	134	132	119
8.5 GHz to 10 GHz	127	127	136	134	132	119
10 GHz to 13.5 GHz	126	124	132	131	128	115
13.5 GHz to 16 GHz	126	124	132	131	128	115
16 GHz to 20 GHz	124	121	130	127	125	113
20 GHz to 24 GHz	117	115	127	124	121	109
24 GHz to 26.5 GHz	107	105	121	117	115	102

<sup>1</sup> Either port can be used as the source port. Any other port can be used as the receiver port.

Table 3a. Extended Dynamic Range at Direct Receiver Access Input (dB) - Typical

Description	Options 200, 400		Options 219, 419	
	Ports 1, 3 <sup>1</sup>	Ports 2, 4 <sup>1</sup>	Ports 1, 3 <sup>1</sup>	Ports 2, 4 <sup>1</sup>
10 MHz to 50 MHz	128	128	128	128
50 MHz to 100 MHz	115	115	115	115
100 MHz to 500MHz	129	129	129	129
500 MHz to 3.2 GHz	136	139	136	139
3.2 GHz to 8.5 GHz	139	139	139	139
8.5 GHz to 10 GHz	139	139	139	139
10 GHz to 13.5 GHz	139	139	138	137
13.5 GHz to 16 GHz	139	139	138	137
16 GHz to 20 GHz	139	136	136	134
20 GHz to 24 GHz	134	129	130	129
24 GHz to 26.5 GHz	124	121	122	118

<sup>1</sup> Either port can be used as the source port. Any other port can be used as the receiver port.

Table 3b. Extended Dynamic Range at Direct Receiver Access Input (dB) - Typical

Description	Option 224		Options 224, 423			
	Source 2 Out 1	Source 2 Out 2	Ports 1, 3 <sup>1</sup>	Ports 2, 4 <sup>1</sup>	Source 1 Port 1 Combine Mode	Source 2 Port 1 Combine Mode
10 MHz to 50 MHz	133	128	128	128	139	115
50 MHz to 100 MHz	120	119	115	115	124	102
100 MHz to 500MHz	134	133	129	129	133	111
500 MHz to 3.2 GHz	140	140	136	139	139	124
3.2 GHz to 8.5 GHz	144	144	139	139	144	131
8.5 GHz to 10 GHz	144	144	139	139	144	131
10 GHz to 13.5 GHz	142	142	138	136	140	127
13.5 GHz to 16 GHz	142	142	138	136	140	127
16 GHz to 20 GHz	141	139	136	133	137	125
20 GHz to 24 GHz	135	134	129	127	133	121
24 GHz to 26.5 GHz	126	124	119	121	127	114

<sup>1</sup> Either port can be used as the source port. Any other port can be used as the receiver port.

## Corrected System Performance with 3.5mm Connectors, All Opts

For any  $S_{ii}$  reflection measurement:

- $S_{jj} = 0$ .

For any  $S_{ij}$  transmission measurement:

- $S_{ji} = S_{ij}$  when  $S_{ij} \leq 1$
- $S_{ji} = 1/S_{ij}$  when  $S_{ij} > 1$
- $S_{kk} = 0$  for all  $k$

Applies to the N5241A, N5242A, and N5249A Option 200 or 219 or 224 or 400 or 419 or 423 analyzers with serial numbers listed below, 85131F flexible test port cable set, and a full 2-port calibration.

N5241A and N5241AS: MY5241/SG5241/US5241 and above

N5242A and N5242AS: MY5242/SG5242/US5242 and above

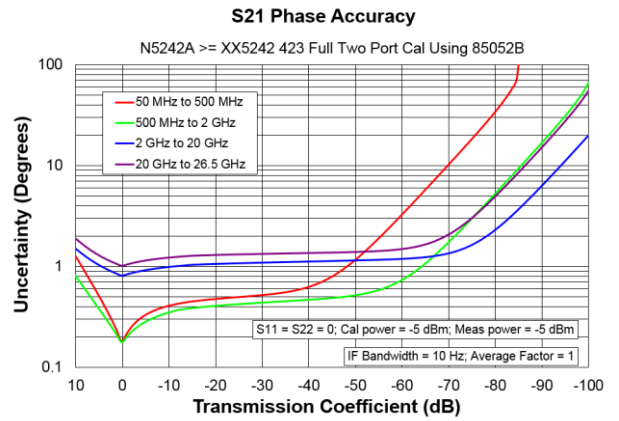
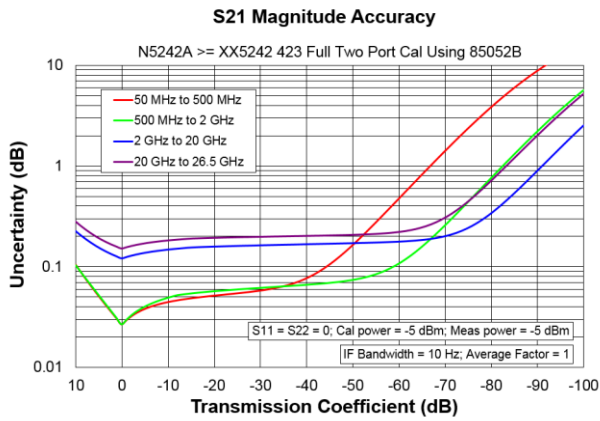
Also applies to the following condition: Environmental temperature  $23^\circ \pm 3^\circ \text{C}$ , with  $< 1^\circ \text{C}$  deviation from calibration temperature. This document does not present specifications for the 85052C or 85052D Calibration Kit. The uncertainty charts were generated for Option 423, although they are applicable for any option without Option 029. Please download our free Uncertainty Calculator from [http://www.keysight.com/find/na\\_calculator](http://www.keysight.com/find/na_calculator) to generate the curves for your calibration kit and PNA setup.

Table 4. 85052B Calibration Kit

Description	Specification (dB)						
	10 MHz to 50 MHz	50 MHz to 500 MHz	500 MHz to 2 GHz	2 GHz to 8.5 GHz	8.5 GHz to 13.5 GHz	13.5 GHz to 20 GHz	20 GHz to 26.5 GHz
Directivity	48	48	48	44	44	44	44
Source Match	40	40	40	31	31	31	31
Load Match	48	48	48	44	44	44	44
Reflection Tracking <sup>1</sup>							
Mag	$\pm 0.003$	$\pm 0.003$	$\pm 0.003$	$\pm 0.006$	$\pm 0.006$	$\pm 0.006$	$\pm 0.006$
Phase ( $^\circ$ )	$\pm 0.020$	$\pm 0.020$	$\pm 0.020$	$\pm 0.040$	$\pm 0.040$	$\pm 0.040$	$\pm 0.040$
Transmission Tracking without Option 029							
Mag	$\pm 0.034$	$\pm 0.034$	$\pm 0.017$	$\pm 0.091$	$\pm 0.091$	$\pm 0.104$	$\pm 0.119$
Phase ( $^\circ$ )	$\pm 0.225$	$\pm 0.225$	$\pm 0.110$	$\pm 0.602$	$\pm 0.602$	$\pm 0.688$	$\pm 0.788$
$S_{21}$ Transmission Tracking with Option 029 <sup>1</sup>							
Mag	$\pm 0.034$	$\pm 0.034$	$\pm 0.017$	$\pm 0.091$	$\pm 0.091$	$\pm 0.104$	$\pm 0.119$
Phase ( $^\circ$ )	$\pm 0.225$	$\pm 0.225$	$\pm 0.110$	$\pm 0.602$	$\pm 0.602$	$\pm 0.688$	$\pm 0.788$
$S_{12}$ Transmission Tracking with Option 029 <sup>1</sup>							
Mag	$\pm 0.017$	$\pm 0.017$	$\pm 0.017$	$\pm 0.091$	$\pm 0.091$	$\pm 0.104$	$\pm 0.119$
Phase ( $^\circ$ )	$\pm 0.110$	$\pm 0.110$	$\pm 0.110$	$\pm 0.602$	$\pm 0.602$	$\pm 0.688$	$\pm 0.788$

The port 1 noise tuner switch set to the bypass position, and port 2 noise receiver switch set to the normal position.

## Transmission Uncertainty



## Reflection Uncertainty

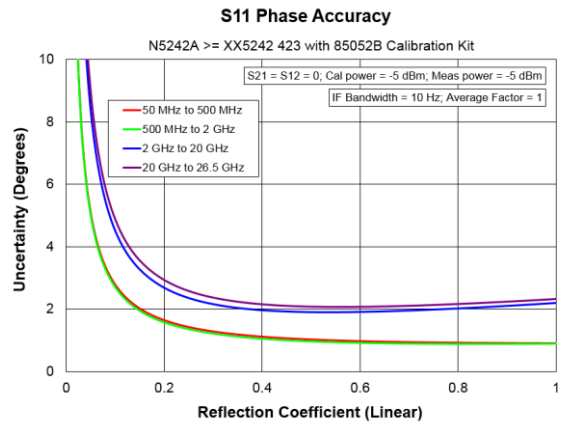
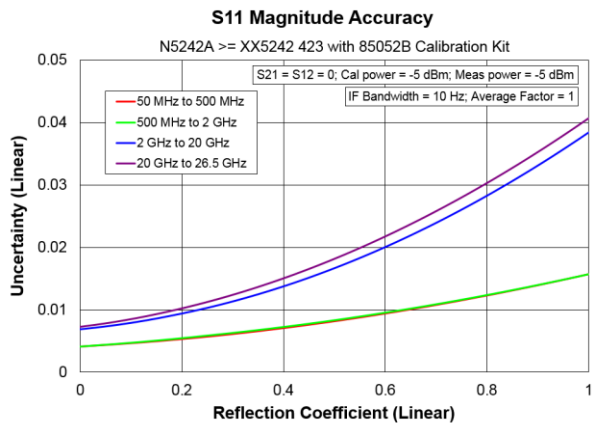


Table 5. N4433A 4-Port Electronic Calibration Module

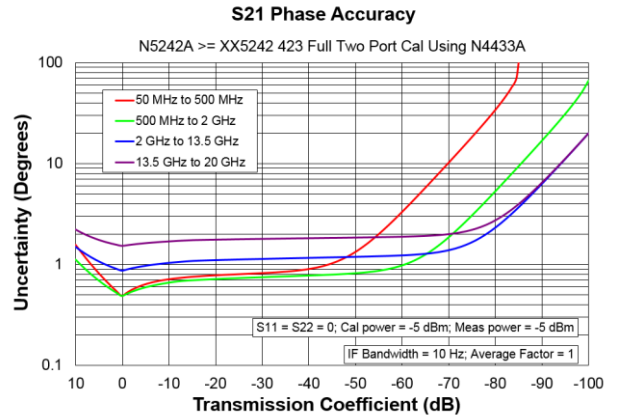
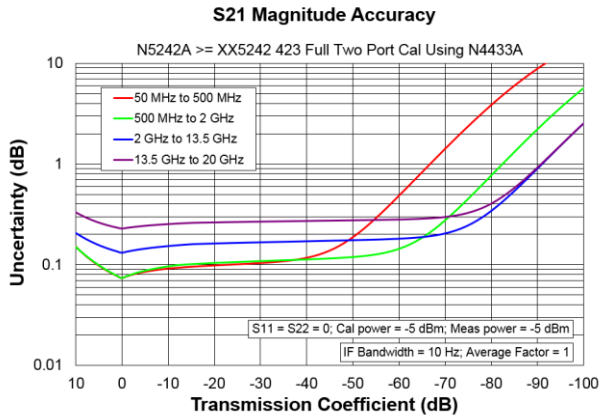
**NOTE**

Uncertainty curves for the N4433A are created using a 2-port calibration. Multipoint uncertainties are not supported at this time.

Description	Specification (dB)					
	10 MHz to 50 MHz	50 MHz to 500 MHz	500 MHz to 2 GHz	2 GHz to 8.5 GHz	8.5 GHz to 13.5 GHz	13.5 GHz to 20 GHz
Directivity	50	50	50	45	45	40
Source Match	42	42	42	37	37	31
Load Match	40	41	41	35	35	29
Reflection Tracking <sup>1</sup>						
Mag	±0.060	±0.060	±0.060	±0.100	±0.100	±0.180
Phase (°)	±0.396	±0.396	±0.396	±0.660	±0.660	±1.188
Transmission Tracking without Option 029						
Mag	±0.068	±0.064	±0.064	±0.115	±0.115	±0.210
Phase (°)	±0.447	±0.421	±0.421	±0.761	±0.761	±1.387
S <sub>21</sub> Transmission Tracking with Option 029 <sup>1</sup>						
Mag	±0.070	±0.066	±0.070	±0.126	±0.126	±0.225
Phase (°)	±0.460	±0.436	±0.460	±0.829	±0.829	±1.485
S <sub>12</sub> Transmission Tracking with Option 029 <sup>1</sup>						
Mag	±0.082	±0.071	±0.072	±0.123	±0.123	±0.227
Phase (°)	±0.541	±0.469	±0.472	±0.812	±0.812	±1.496

The port 1 noise tuner switch set to the bypass position, and port 2 noise receiver switch set to the normal position.

## Transmission Uncertainty



## Reflection Uncertainty

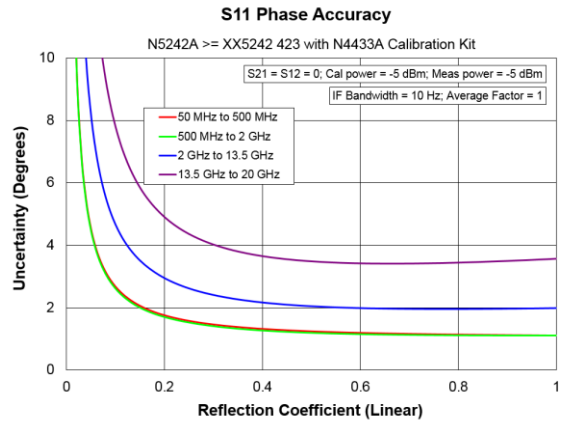
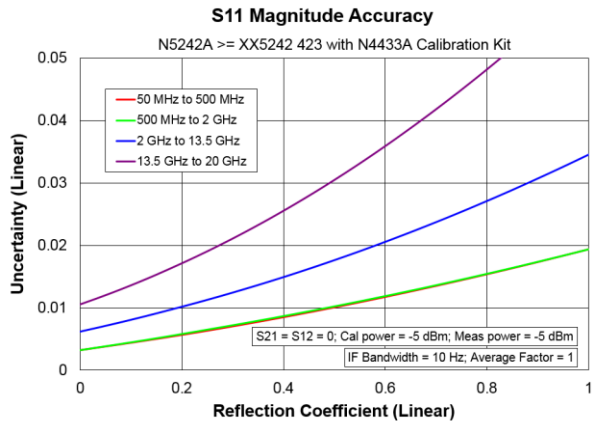


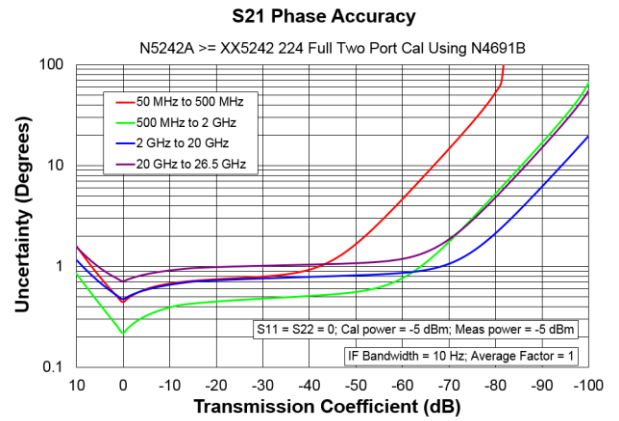
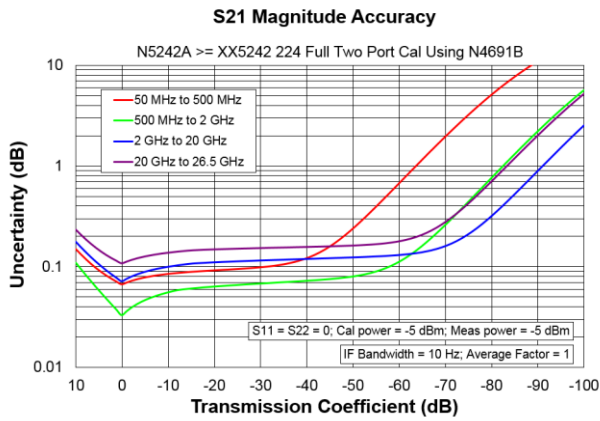


Table 6. N4691B 2-Port Electronic Calibration Module

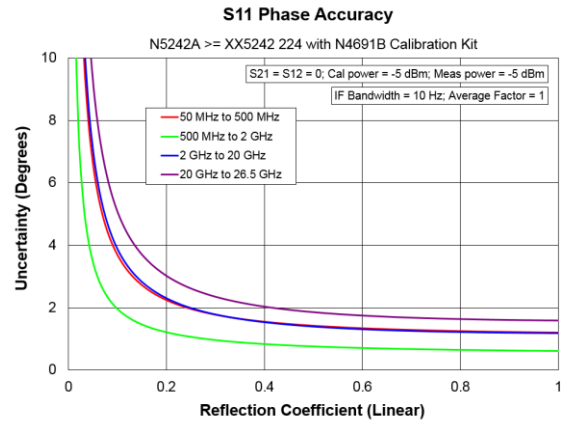
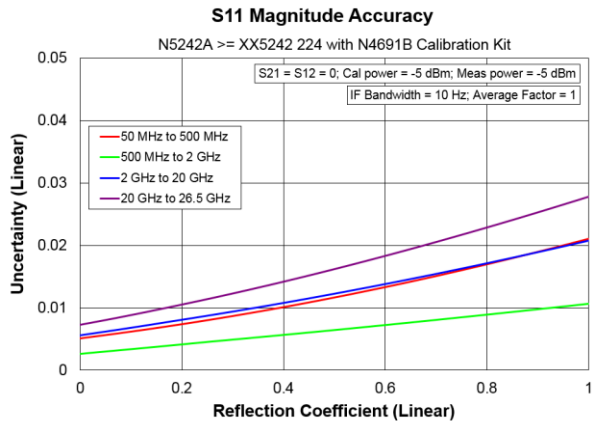
Description	Specification (dB)						
	10 MHz to 50 MHz	50 MHz to 500 MHz	500 MHz to 2 GHz	2 GHz to 8.5 GHz	8.5 GHz to 13.5 GHz	13.5 GHz to 20 GHz	20 GHz to 26.5 GHz
Directivity	46	46	52	46	46	46	44
Source Match	41	41	47	42	42	42	40
Load Match	40	40	46	41	41	40	38
Reflection Tracking							
Mag	±0.050	±0.050	±0.020	±0.040	±0.040	±0.040	±0.050
Phase (°)	±0.330	±0.330	±0.132	±0.264	±0.264	±0.264	±0.330
Transmission Tracking without Option 029							
Mag	±0.062	±0.056	±0.023	±0.054	±0.054	±0.055	±0.072
Phase (°)	±0.410	±0.370	±0.152	±0.354	±0.354	±0.365	±0.473
S <sub>21</sub> Transmission Tracking with Option 029 <sup>1</sup>							
Mag	±0.065	±0.060	±0.028	±0.063	±0.063	±0.063	±0.079
Phase (°)	±0.431	±0.394	±0.183	±0.416	±0.416	±0.416	±0.521
S <sub>12</sub> Transmission Tracking with Option 029 <sup>1</sup>							
Mag	±0.085	±0.068	±0.029	±0.061	±0.061	±0.064	±0.078
Phase (°)	±0.559	±0.446	±0.193	±0.400	±0.400	±0.421	±0.517

The port 1 noise tuner switch set to the bypass position, and port 2 noise receiver switch set to the normal position.

## Transmission Uncertainty



## Reflection Uncertainty



## Uncorrected System Performance

Specifications apply to following conditions:

- Over environmental temperature of 25 °C ±5 °C, with less than 1°C variation from the calibration temperature.
- Cable loss not included in Transmission Tracking.
- Crosstalk measurement conditions: normalized to a thru, measured with shorts on all ports, 10 Hz IF bandwidth, averaging factor of 8, alternate mode, source power set to the specified maximum power.
- With option 029, port 1 impedance tuner switch is in external position and port 2 noise receiver switch is in noise receiver position unless specified. Refer to Options 200, 219, 224, 400, 419, 423 for performance of Option 029 Port 1 with impedance tuner switch in internal position, Port 2 noise receiver switch in normal position, Ports 3 and 4.

Table 7a. Directivity (dB)

Description	Specification		Typical	
	Options 200, 219, 224, 400, 419, 423	Option 029	Options 200, 219, 224, 400, 419, 423	Option 029
	All Ports	Ports 1, 2	All Ports	Ports 1, 2
10 MHz to 50 MHz	16	16	23	22
50 MHz to 500 MHz	24	24	28	28
500 MHz to 3.2 GHz	24	24	32	32
3.2 GHz to 8.5 GHz	23	23	25	25
8.5 GHz to 10 GHz	23	23	25	25
10 GHz to 13.5 GHz	16	16	22	20
13.5 GHz to 16 GHz	16	16	22	20
16 GHz to 20 GHz	16	15	22	20
20 GHz to 24 GHz	16	15	22	20
24 GHz to 26.5 GHz	16	15	22	20

Table 7b. Source Match (dB)

Description	Specification			Typical		
	Options 200, 219, 224, 400, 419, 423	Option 029		Options 200, 219, 224, 400, 419, 423	Option 029	
	All Ports	Port 1	Port 2	All Ports	Port 1	Port 2
10 MHz to 50 MHz	11	9	9	14	13	12
50 MHz to 500 MHz	18	18	13	28	28	15
500 MHz to 3.2 GHz	18	17	9	22	22	12
3.2 GHz to 8.5 GHz	14	12	6	18	18	7
8.5 GHz to 10 GHz	14	12	6	18	18	7
10 GHz to 13.5 GHz	12	11	6	16	16	8
13.5 GHz to 16 GHz	12	11	6	16	16	8
16 GHz to 20 GHz	10	9	7	15	13	9
20 GHz to 24 GHz	10	8	6	14	13	9
24 GHz to 26.5 GHz	8	7	6	12	12	9

Table 7c. Load Match (dB)

Description	Specification			Typical		
	Options 200, 219, 224, 400, 419, 423	Option 029		Options 200, 219, 224, 400, 419, 423	Option 029	
	All Ports	Port 1	Port 2	All Ports	Port 1	Port 2
10 MHz to 50 MHz	11	11	9	18	18	12
50 MHz to 500 MHz	17	17	13	25	24	15
500 MHz to 3.2 GHz	17	15	9	22	19	12
3.2 GHz to 8.5 GHz	13	10	5.5	17	15	7.5
8.5 GHz to 10 GHz	13	10	5.5	17	15	7.5
10 GHz to 13.5 GHz	10	9	5.5	15	15	7.5
13.5 GHz to 16 GHz	10	9	5.5	15	15	7.5
16 GHz to 20 GHz	9	8	5.5	14	13	7.5
20 GHz to 24 GHz	9	7	5.5	14	13	7.5
24 GHz to 26.5 GHz	8	7	5.5	13	11	7.5

Table 7d. Transmission Tracking, Reflection Tracking, Crosstalk (dB), All Options, All Ports - Typical

	<b>Transmission Tracking</b>	<b>Reflection Tracking</b>	<b>Crosstalk</b>
10 MHz to 50 MHz	+/-1.5	+/-1.5	-84
50 MHz to 100 MHz	+/-1.5	+/-1.5	-90
100 MHz to 500 MHz	+/-1.5	+/-1.5	-110
500 MHz to 3.2 GHz	+/-1.5	+/-1.5	-120
3.2 GHz to 8.5 GHz	+/-1.5	+/-1.5	-122
8.5 GHz to 13.5 GHz	+/-1.5	+/-1.5	-122
13.5 GHz to 20 GHz	+/-1.5	+/-1.5	-122
20 GHz to 24 GHz	+/-1.5	+/-1.5	-117
24 GHz to 26.5 GHz	+/-1.5	+/-1.5	-114

## Test Port Output

See Block diagrams for all models and options.

With option 029, port 1 noise tuner switch is in internal position and port 2 noise receiver switch is in normal position unless specified.

Table 8. Frequency Information, All Options

Description	Specification (dB)	Typical (dB)
N5249A Frequency Range	10 MHz to 8.5 GHz	--
N5241A Frequency Range	10 MHz to 13.5 GHz	--
N5242A Frequency Range	10 MHz to 26.5 GHz	--
Frequency Resolution	1 Hz	--
Frequency Accuracy	+/- 1 ppm	--
Frequency Stability	--	+/-0.05 ppm, -10° to 70° C <sup>1</sup> +/-0.1 ppm/yr maximum <sup>2</sup>

<sup>1</sup> Assumes no variation in time.

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

Table 9a. Maximum Leveled Power (dBm), Options 200 or 400

Description	Specification			Typical		
	Ports 1, 3 <sup>1</sup>		Ports 2, 4 <sup>1</sup>	Ports 1, 3 <sup>1</sup>		Ports 2, 4 <sup>1</sup>
	Filtered Mode <sup>2</sup>	Hi Power Mode <sup>2</sup>		Filtered Mode <sup>2</sup>	Hi Power Mode <sup>2</sup>	
10 MHz to 50 MHz	8	13	13	10	19	17
50 MHz to 500 MHz	10	13	13	11	21	20
500 MHz to 3.2 GHz	10	10	13	12	13	18
3.2 GHz to 8.5 GHz	13	13	13	20	20	19
8.5 GHz to 10 GHz	13	13	13	20	20	19
10 GHz to 13.5 GHz	13	13	13	17	17	16
13.5 GHz to 16 GHz	13	13	13	17	17	16
16 GHz to 20 GHz	13	13	10	16	16	12
20 GHz to 24 GHz	12	12	7	15	15	11
24 GHz to 26.5 GHz	5	5	2	11	11	7

<sup>1</sup> Either port can be used as the source port.

<sup>2</sup> In Filtered Mode, the signal path goes through filters to minimize harmonics below 3.2 GHz. In Hi Power Mode, the signal bypasses the filters to maximize output power.

Table 9b. Maximum Levelled Power (dBm), Options 219 or 419

Description	Specification			Typical		
	Ports 1, 3 <sup>1</sup>		Ports 2, 4 <sup>1</sup>	Ports 1, 3 <sup>1</sup>		Ports 2, 4 <sup>1</sup>
	Filt. Mode <sup>2</sup>	Hi Pwr Mode <sup>2</sup>		Filt. Mode <sup>2</sup>	Hi Pwr Mode <sup>2</sup>	
10 MHz to 50 MHz	8	13	13	10	19	17
50 MHz to 500 MHz	10	13	13	11	20	19
500 MHz to 3.2 GHz	10	10	13	11	13	18
3.2 GHz to 8.5 GHz	13	13	13	18	18	17
8.5 GHz to 10 GHz	13	13	13	18	18	17
10 GHz to 13.5 GHz	12	12	11	15	15	14
13.5 GHz to 16 GHz	12	12	11	15	15	14
16 GHz to 20 GHz	10	10	8	13	13	10
20 GHz to 24 GHz	8	8	7	12	12	9
24 GHz to 26.5 GHz	3	3	-1	8	8	4

<sup>1</sup> Either port can be used as the source port.

<sup>2</sup> In Filtered Mode, the signal path goes through filters to minimize harmonics below 3.2 GHz. In Hi Power Mode, the signal bypasses the filters to maximize output power.

Table 9c. Maximum Levelled Power (dBm), Option 219 or 419 with 029<sup>1</sup>

Description	Specification			Typical		
	Port 1		Port 2	Port 1		Port 2
	Filt. Mode <sup>2</sup>	Hi Pwr Mode <sup>2</sup>		Filt. Mode <sup>2</sup>	Hi Pwr Mode <sup>2</sup>	
10 MHz to 50 MHz	7	12	13	9	18	17
50 MHz to 500 MHz	9	12	13	10	19	19
500 MHz to 3.2 GHz	9	9	13	10	12	18
3.2 GHz to 8.5 GHz	12	12	13	17	17	17
8.5 GHz to 10 GHz	12	12	13	17	17	17
10 GHz to 13.5 GHz	12	12	9	15	15	12
13.5 GHz to 16 GHz	12	12	9	15	15	12
16 GHz to 20 GHz	10	10	5	13	13	7
20 GHz to 24 GHz	8	8	2	12	12	4
24 GHz to 26.5 GHz	3	3	-2	8	8	3

<sup>1</sup> Option 029 affects port 1 and port 2 maximum levelled power. Refer to Table 9b for other ports.

<sup>2</sup> In Filtered Mode, the signal path goes through filters to minimize harmonics below 3.2 GHz. In Hi Power Mode, the signal bypasses the filters to maximize output power.



Table 9d. Maximum Levelled Power (dB), Options 224 or 423

Description	Specification			Typical		
	Ports 1, 3 <sup>1</sup>		Ports 2, 4 <sup>1</sup>	Ports 1, 3 <sup>1</sup>		Ports 2, 4 <sup>1</sup>
	Filtered Mode <sup>2</sup>	Hi Power Mode <sup>2</sup>		Filtered Mode <sup>2</sup>	Hi Power Mode <sup>2</sup>	
10 MHz to 50 MHz	7	13	13	9	19	17
50 MHz to 500 MHz	8	13	13	11	20	20
500 MHz to 3.2 GHz	8	10	13	11	13	17
3.2 GHz to 8.5 GHz	13	13	13	19	19	17
8.5 GHz to 10 GHz	13	13	13	19	19	17
10 GHz to 13.5 GHz	12	12	10	15	15	14
13.5 GHz to 16 GHz	12	12	10	15	15	14
16 GHz to 20 GHz	10	10	7	13	13	10
20 GHz to 24 GHz	7	7	5	12	12	9
24 GHz to 26.5 GHz	0	0	-2	8	8	4

<sup>1</sup> Either port can be used as the source port.

<sup>2</sup> In Filtered Mode, the signal path goes through filters to minimize harmonics below 3.2 GHz. In Hi Power Mode, the signal bypasses the filters to maximize output power.

Table 9e. Maximum Levelled Power (dBm), Options 224 or 423, Combine Mode - Typical

Description	Source 1 Port 1		Source 2 Port 1	
	Filtered Mode <sup>1</sup>	Hi Power Mode <sup>1</sup>	Filtered Mode <sup>1</sup>	Hi Power Mode <sup>1</sup>
10 MHz to 50 MHz	7	17	-7	3
50 MHz to 500 MHz	9	17	-5	4
500 MHz to 3.2 GHz	9	10	-5	-4
3.2 GHz to 8.5 GHz	15	15	2	2
8.5 GHz to 10 GHz	15	15	2	2
10 GHz to 13.5 GHz	11	11	-2	-2
13.5 GHz to 16 GHz	11	11	-2	-2
16 GHz to 20 GHz	8	8	-4	-4
20 GHz to 24 GHz	6	6	-6	-6
24 GHz to 26.5 GHz	2	2	-11	-11

<sup>1</sup> In Filtered Mode, the signal path goes through filters to minimize harmonics below 3.2 GHz. In Hi Power Mode, the signal bypasses the filters to maximize output power.

Table 9f. Maximum Levelled Power (dBm), Option 224

Description	Specification			Typical		
	Source 2 Out 1		Source 2 Out 2	Source 2 Out 1		Source 2 Out 2
	Filt. Mode <sup>2</sup>	Hi Pwr Mode <sup>2</sup>		Filt. Mode <sup>2</sup>	Hi Pwr Mode <sup>2</sup>	
10 MHz to 50 MHz	9	18	13	12	21	18
50 MHz to 500 MHz	11	18	17	13	22	21
500 MHz to 3.2 GHz	10	14	14	13	17	19
3.2 GHz to 8.5 GHz	18	18	18	22	22	22
8.5 GHz to 10 GHz	18	18	18	22	22	22
10 GHz to 13.5 GHz	16	16	16	21	21	20
13.5 GHz to 16 GHz	16	16	16	21	21	20
16 GHz to 20 GHz	15	15	13	19	19	17
20 GHz to 24 GHz	13	13	12	18	18	17
24 GHz to 26.5 GHz	7	7	5	14	14	11

<sup>1</sup> In Filtered Mode, the signal path goes through filters to minimize harmonics below 3.2 GHz. In Hi Power Mode, the signal bypasses the filters to maximize output power.

Table 9g. Maximum Levelled Power (dB), Options 224 or 423 with 029<sup>1</sup>

Description	Specification			Typical		
	Port 1		Ports 2	Port 1		Ports 2
	Filt. Mode <sup>2</sup>	Hi Pwr Mode <sup>2</sup>		Filt. Mode <sup>2</sup>	Hi Pwr Mode <sup>2</sup>	
10 MHz to 50 MHz	6	12	13	8	18	17
50 MHz to 500 MHz	8	13	13	11	20	20
500 MHz to 3.2 GHz	8	10	12	11	13	16
3.2 GHz to 8.5 GHz	13	13	13	19	19	17
8.5 GHz to 10 GHz	13	13	13	19	19	17
10 GHz to 13.5 GHz	12	12	10	15	15	14
13.5 GHz to 16 GHz	12	12	10	15	15	14
16 GHz to 20 GHz	10	10	6	13	13	9
20 GHz to 24 GHz	6	6	4	11	11	8
24 GHz to 26.5 GHz	0	0	-2	8	8	4

<sup>1</sup> Option 029 affects port 1 and port 2 maximum levelled power. Refer to Table 9c for other ports.

<sup>2</sup> In Filtered Mode, the signal path goes through filters to minimize harmonics below 3.2 GHz. In Hi Power Mode, the signal bypasses the filters to maximize output power.

Table 9h. Maximum Levelled Power (dBm), Options 224 or 423 with 029<sup>1</sup>, Combine Mode - Typical

Description	Source 1 Port 1		Source 2 Port 1	
	Filtered Mode <sup>2</sup>	Hi Power Mode <sup>2</sup>	Filtered Mode <sup>2</sup>	Hi Power Mode <sup>2</sup>
10 MHz to 50 MHz	6	16	-8	2
50 MHz to 500 MHz	9	17	-5	4
500 MHz to 3.2 GHz	9	10	-5	-4
3.2 GHz to 8.5 GHz	15	15	2	2
8.5 GHz to 10 GHz	15	15	2	2
10 GHz to 13.5 GHz	11	11	-2	-2
13.5 GHz to 16 GHz	11	11	-2	-2
16 GHz to 20 GHz	8	8	-4	-4
20 GHz to 24 GHz	5	5	-7	-7
24 GHz to 26.5 GHz	0	0	-11	-11

<sup>1</sup> Option 029 affects port 1 and port 2 maximum levelled power.

<sup>2</sup> In Filtered Mode, the signal path goes through filters to minimize harmonics below 3.2 GHz. In Hi Power Mode, the signal bypasses the filters to maximize output power.

Table 10. Power Level Accuracy (dB) at Nominal Power<sup>1</sup>, All Options

Description	Specification		Typical	
	Ports 1, 2, 3, 4 <sup>2</sup>	Source 2 Out 1 Source 2 Out 2	Ports 1, 2, 3, 4 <sup>2</sup>	Source 2 Out 1 Source 2 Out 2
10 MHz to 50 MHz	+/-1.5	+/-2.5	+/-0.40	+/-0.55
50 MHz to 500 MHz	+/-1.0	+/-2.0	+/-0.20	+/-0.25
500 MHz to 3.2 GHz	+/-1.0	+/-2.0	+/-0.25	+/-0.25
3.2 GHz to 8.5 GHz	+/-1.0	+/-2.0	+/-0.40	+/-0.25
8.5 GHz to 10 GHz	+/-1.0	+/-2.0	+/-0.40	+/-0.25
10 GHz to 13.5 GHz	+/-1.2	+/-2.0	+/-0.60	+/-0.25
13.5 GHz to 18 GHz	+/-2.0	+/-2.5	+/-0.60	+/-1.00
18 GHz to 26.5 GHz	+/-2.5	+/-2.5	+/-0.80	+/-0.90

<sup>1</sup> Level accuracy at power other than nominal power, Power Level Accuracy (dB) at Nominal Power + Power Level Linearity (dB)

<sup>2</sup> Any port can be used as the source port. Source in filtered mode where applicable.

Table 11a. Power Level Linearity<sup>1</sup> (dB), All Options - Specification

Description	Ports 1, 3 <sup>2</sup>	Ports 1, 3 <sup>2</sup>	Ports 1, 3 <sup>2</sup>
	-25 dBm ≤ P < -20 dBm	-20 dBm ≤ P < -15 dBm	P ≥ -15 dBm
10 MHz to 50 MHz	+/-2.0	+/-1.5	+/-1.0
50 MHz to 500 MHz	+/-1.5	+/-1.0	+/-1.0
500 MHz to 8.5 GHz	+/-1.0	+/-1.0	+/-1.0
8.5 GHz to 13.5 GHz	+/-1.0	+/-1.0	+/-1.0
13.5 GHz to 26.5 GHz	+/-1.0	+/-1.0	+/-1.0

<sup>1</sup> Referenced to nominal power.

<sup>2</sup> Either port can be used as the source port. Source in filtered mode.

Table 11b. Power Level Linearity<sup>1</sup> (dB), All Options - Specification

Description	Ports 2, 4 <sup>2</sup>	Ports 2, 4 <sup>2</sup>	Ports 2, 4 <sup>2</sup>
	-25 dBm ≤ P < -20 dBm	-20 dBm ≤ P < -15 dBm	P ≥ -15 dBm
10 MHz to 50 MHz	+/-5.0	+/-2.0	+/-1.5
50 MHz to 500 MHz	+/-4.0	+/-2.0	+/-1.5
500 MHz to 3.2 GHz	+/-2.5	+/-1.0	+/-1.0
3.2 GHz to 8.5 GHz	+/-2.0	+/-1.0	+/-1.0
8.5 GHz to 10 GHz	+/-2.0	+/-1.0	+/-1.0
10 GHz to 13.5 GHz	+/-1.5	+/-1.5	+/-1.5
13.5 GHz to 16 GHz	+/-1.5	+/-1.5	+/-1.5
16 GHz to 26.5 GHz	+/-1.0	+/-1.0	+/-1.0

<sup>1</sup> Referenced to nominal power.

<sup>2</sup> Either port can be used as the source port.

Table 11c. Power Level Linearity<sup>1</sup> (dB), Option 224 - Specification

Description	Source 2 Out 1 <sup>2</sup>	Source 2 Out 2	Source 2 Out 2
	P ≥ -15 dBm	-15 dBm ≤ P < -10 dBm	P ≥ -10 dBm
10 MHz to 500 MHz	+/-1.0	+/-1.5	+/-1.0
500 MHz to 8.5 GHz	+/-1.0	+/-1.0	+/-1.0
8.5 GHz to 13.5 GHz	+/-1.0	+/-1.0	+/-1.0
13.5 GHz to 26.5 GHz	+/-1.0	+/-1.0	+/-1.0

<sup>1</sup> Referenced to nominal power.

<sup>2</sup> Source in filtered mode.

Table 12a. Power Sweep Range (dB), Options 200 or 400

Description	Specification		Typical	
	Ports 1, 3 <sup>1</sup>	Ports 2, 4 <sup>1</sup>	Ports 1, 3 <sup>1</sup>	Ports 2, 4 <sup>1</sup>
10 MHz to 50 MHz	33	38	46	44
50 MHz to 500 MHz	35	38	48	47
500 MHz to 3.2 GHz	35	38	40	45
3.2 GHz to 8.5 GHz	38	38	47	46
8.5 GHz to 10 GHz	38	38	47	46
10 GHz to 13.5 GHz	38	38	44	43
13.5 GHz to 16 GHz	38	38	44	43
16 GHz to 20 GHz	38	35	43	39
20 GHz to 24 GHz	37	32	42	38
24 GHz to 26.5 GHz	30	27	38	34

<sup>1</sup> Either port can be used as the source port. Source in filtered mode where applicable.

Table 12b. Power Sweep Range (dB), Options 219 or 419

Description	Specification		Typical	
	Ports 1, 3 <sup>1</sup>	Ports 2, 4 <sup>1</sup>	Ports 1, 3 <sup>1</sup>	Ports 2, 4 <sup>1</sup>
10 MHz to 50 MHz	33	38	46	44
50 MHz to 500 MHz	35	38	47	46
500 MHz to 3.2 GHz	35	38	40	45
3.2 GHz to 8.5 GHz	38	38	45	44
8.5 GHz to 10 GHz	38	38	45	44
10 GHz to 13.5 GHz	37	36	42	41
13.5 GHz to 16 GHz	37	36	42	41
16 GHz to 20 GHz	35	33	40	37
20 GHz to 24 GHz	33	32	39	36
24 GHz to 26.5 GHz	28	24	35	31

<sup>1</sup> Either port can be used as the source port. Source in filtered mode where applicable.

Table 12c. Power Sweep Range (dB), Options 219 or 419 with 029<sup>1</sup>

Description	Specification		Typical	
	Port 1 <sup>2</sup>	Port 2 <sup>2</sup>	Port 1 <sup>2</sup>	Port 2 <sup>2</sup>
10 MHz to 50 MHz	32	38	45	44
50 MHz to 500 MHz	34	38	46	46
500 MHz to 3.2 GHz	34	38	39	45
3.2 GHz to 8.5 GHz	37	38	44	44
8.5 GHz to 10 GHz	37	38	44	44
10 GHz to 13.5 GHz	37	34	42	39
13.5 GHz to 16 GHz	37	34	42	39
16 GHz to 20 GHz	35	30	40	34
20 GHz to 24 GHz	33	27	39	31
24 GHz to 26.5 GHz	28	23	35	30

<sup>1</sup> Option 029 affects port 1 and port 2 power sweep ranges. Refer to Table 12b for other ports.

<sup>2</sup> Source in filtered mode where applicable.

Table 12d. Power Sweep Range (dB), Options 224 or 423

Description	Specification		Typical	
	Ports 1, 3 <sup>1</sup>	Ports 2, 4 <sup>1</sup>	Ports 1, 3 <sup>1</sup>	Ports 2, 4 <sup>1</sup>
10 MHz to 50 MHz	32	38	46	44
50 MHz to 500 MHz	33	38	47	47
500 MHz to 3.2 GHz	33	38	40	44
3.2 GHz to 8.5 GHz	38	38	46	44
8.5 GHz to 10 GHz	38	38	46	44
10 GHz to 13.5 GHz	37	35	42	41
13.5 GHz to 16 GHz	37	35	42	41
16 GHz to 20 GHz	35	32	40	37
20 GHz to 24 GHz	32	30	39	36
24 GHz to 26.5 GHz	25	23	35	31

<sup>1</sup> Either port can be used as the source port. Source in filtered mode where applicable.

Table 12e. Power Sweep Range (dB), Option 224

Description	Specification		Typical	
	Source 2 Out 1 <sup>1</sup>	Source 2 Out 2	Source 2 Out 1 <sup>1</sup>	Source 2 Out 2
10 MHz to 50 MHz	24	28	38	35
50 MHz to 500 MHz	26	32	39	38
500 MHz to 3.2 GHz	25	29	34	36
3.2 GHz to 8.5 GHz	33	33	39	39
8.5 GHz to 10 GHz	33	33	39	39
10 GHz to 13.5 GHz	31	31	38	37
13.5 GHz to 16 GHz	31	31	38	37
16 GHz to 20 GHz	30	28	36	34
20 GHz to 24 GHz	28	27	35	34
24 GHz to 26.5 GHz	22	20	31	28

<sup>1</sup> Source in filtered mode where applicable.

Table 12f. Power Sweep Range (dB), Options 224 or 423 with 029<sup>1</sup>

Description	Specification		Typical	
	Port 1 <sup>2</sup>	Port 2 <sup>2</sup>	Port 1 <sup>2</sup>	Port 2 <sup>2</sup>
10 MHz to 50 MHz	31	38	45	44
50 MHz to 500 MHz	33	38	47	47
500 MHz to 3.2 GHz	33	37	40	43
3.2 GHz to 8.5 GHz	38	38	46	44
8.5 GHz to 10 GHz	38	38	46	44
10 GHz to 13.5 GHz	37	35	42	41
13.5 GHz to 16 GHz	37	35	42	41
16 GHz to 20 GHz	35	31	39	36
20 GHz to 24 GHz	31	29	37	35
24 GHz to 26.5 GHz	25	23	35	31

<sup>1</sup> Option 029 affects port 1 and port 2 power sweep ranges. Refer to Table 12d for other ports.

<sup>2</sup> Source in filtered mode where applicable.

Table 13. Nominal Power (Preset Power, dBm)

Description	Options 200, 400	Options 219, 224, 419, 423	Option 224		Options 224, 423	
	All Ports <sup>1</sup>	Ports 1, 2, 3, 4 <sup>1</sup>	Source 2 Out 1	Source 2 Out 2	Source 1 Port 1 Combine Mode	Source 2 Port 1 Combine Mode
N5241A	0	-5	-5	-5	-5	-5
N5242A	0	-5	-5	-5	-5	-5
N5249A	0	-5	-5	-5	-5	-5

<sup>1</sup> Any port can be used as the source port.

Table 14. Power Resolution and Maximum/Minimum Settable Power, All Ports<sup>1</sup>

Description	Specification (dB)	Typical (dBm)		
	All Options	All Options	Options 200, 400	Options 219, 419, 224, 423
Power Resolution	0.01	--	--	--
Maximum Settable Power	--	30	--	--
Minimum Settable Power	--	--	-30	-95

<sup>1</sup> Any port can be used as the source port.

Table 15. Harmonics at Max Specified Power (dBc), All Options - Typical

Description <sup>1</sup>	2 <sup>nd</sup> and 3 <sup>rd</sup> Harmonics		1/2 and 1/4 Sub-Harmonics	
	Ports 1, 3 <sup>2</sup>	Ports 2, 4 <sup>2</sup>	Ports 1 3 <sup>2</sup>	Ports 2, 4 <sup>2</sup>
	Source 2 Out 1 <sup>3</sup>	Source 2 Out 2	Source 2 Out 1 <sup>3</sup>	Source 2 Out 2
10 MHz to 2 GHz	-51	-13	-73	-73
2 GHz to 3.2 GHz	-60	-21	-73	-73
3.2 GHz to 8.5 GHz	-60	-21	-66	-63
8.5 GHz to 13.5 GHz	-60	-21	-66	-63
13.5 GHz to 20 GHz	-60	-21	-66	-63
20 GHz to 26.5 GHz	-60	-21	-61	-52

<sup>1</sup> Listed frequency is fundamental frequency; test at max specified power

<sup>2</sup> Any port can be used as the source port. Source in Filtered mode where applicable.

<sup>3</sup> At port 1 max specified power.



Table 16. Non-Harmonic Spurs (dBc) at Nominal Power, All Options, All Ports - Typical

Description	Based on 8 kHz offset Frac-N
10 MHz to 500 MHz	-50
500 MHz to 2 GHz	-60
2 GHz to 4 GHz	-57
4 GHz to 8 GHz	-51
8 GHz to 8.5 GHz	-45
8.5 GHz to 13.5 GHz	-45
13.5 GHz to 16 GHz	-45
16 GHz to 24 GHz	-39
24 GHz to 26.5 GHz	-33

Table 17. Phase Noise (dBc/Hz), All Options, All Ports - Typical

Description	1 kHz Offset	10 kHz Offset	100 kHz Offset	1 MHz Offset
10 MHz to 500 MHz	-85	-85	-85	-120
500 MHz to 1 GHz	-105	-115	-110	-127
1 GHz to 2 GHz	-100	-110	-105	-121
2 GHz to 4 GHz	-95	-105	-100	-115
4 GHz to 8 GHz	-89	-100	-94	-110
8 GHz to 8.5 GHz	-83	-94	-88	-105
8.5 GHz to 13.5 GHz	-83	-94	-88	-105
13.5 GHz to 16 GHz	-83	-94	-88	-105
16 GHz to 26.5 GHz	-78	-89	-82	-100

## Test Port Input

Table 18. Noise Floor<sup>1</sup> (dBm) at 10 Hz IFBW, All Options, All Ports

Description	Specification		Typical	
	Test Port	Direct Receiver Access Input	Test Port	Direct Receiver Access Input
10 MHz to 50 MHz <sup>2</sup>	-80	--	-87	-130
50 MHz to 100 MHz <sup>2</sup>	-90	--	-95	-128
100 MHz to 500 MHz <sup>2</sup>	-104	--	-110	-132
500 MHz to 2 GHz	-114	--	-117	-133
2 GHz to 8.5 GHz	-114	--	-117	-129
8.5 GHz to 13.5 GHz	-114	--	-117	-129
13.5 GHz to 20 GHz	-114	--	-117	-129
20 GHz to 24 GHz	-110	--	-115	-122
24 GHz to 26.5 GHz	-107	--	-113	-119

<sup>1</sup> Total average (rms) noise power calculated as the mean value of a linear magnitude trace expressed in dBm.

<sup>2</sup> May typically be degraded at particular frequencies below 500 MHz due to spurious receiver residuals.

Table 19. 0.1 dB Compression at Test Port (dBm), All Options, All Ports - Typical

Description	Typical
10 MHz to 500 MHz <sup>1</sup>	--
500 MHz to 8.5 GHz	13
8.5 GHz to 13.5 GHz	13
13.5 GHz to 16 GHz	13
16 GHz to 20 GHz	12
20 GHz to 24 GHz	10.5
24 GHz to 26.5 GHz	10

<sup>1</sup> Test port receiver compression at specified input levels below 500 MHz is negligible due to coupler roll.

Table 20. Test Port Compression (dB) at 8 dBm Test Port Power, All Options, All Ports, - Specification

Description	Specification
10 MHz to 500 MHz <sup>1</sup>	--
500 MHz to 8.5 GHz	<0.17
8.5 GHz to 13.5 GHz	<0.17
13.5 GHz to 16 GHz	<0.17
16 GHz to 24 GHz	<0.23
24 GHz to 26.5 GHz	<0.29

<sup>1</sup> Test port receiver compression at specified input levels below 500 MHz is negligible due to coupler roll.

Table 21a. Trace Noise<sup>1</sup> Magnitude (dB rms), All Options, All Ports

Description	Specification	Typical		
	1 kHz IFBW	1 kHz IFBW	100 kHz IFBW	600 kHz IFBW
10 MHz to 100 MHz	0.007	0.0039	0.040	0.140
100 MHz to 8.5 GHz	0.002	0.0005	0.005	0.011
8.5 GHz to 13.5 GHz	0.002	0.0005	0.005	0.011
13.5 GHz to 16 GHz	0.002	0.0005	0.005	0.011
16 GHz to 22.5 GHz	0.002	0.0006	0.005	0.012
22.5 GHz to 24 GHz	0.003	0.0014	0.008	0.020
24 GHz to 26.5 GHz	0.005	0.0020	0.008	0.020

<sup>1</sup> Ratioed measurement, nominal power at test port.

Table 21b. Trace Noise<sup>1</sup> Phase (deg rms), All Options, All Ports

Description	Specification	Typical		
	1 kHz IFBW	1 kHz IFBW	100 kHz IFBW	600 kHz IFBW
10 MHz to 100 MHz	0.051	0.0261	0.266	1.053
100 MHz to 8.5 GHz	0.015	0.0041	0.030	0.075
8.5 GHz to 13.5 GHz	0.015	0.0041	0.030	0.075
13.5 GHz to 16 GHz	0.042	0.0124	0.030	0.075
16 GHz to 22.5 GHz	0.042	0.0135	0.033	0.082
22.5 GHz to 26.5 GHz	0.054	0.0225	0.057	0.139

<sup>1</sup> Ratioed measurement, nominal power at test port.

Table 22. Reference Level - Specification

Description	Magnitude (dB)	Phase (°)
Range	+/-500	+/-500
Resolution	0.001	0.01

Table 23. Stability<sup>1</sup> - Typical

Description	Magnitude (dB/°C)	Phase (°/°C)
10 MHz to 50 MHz	0.01	0.29
50 MHz to 500 MHz	0.01	0.06
500 MHz to 3.2 GHz	0.01	0.07
3.2 GHz to 8.5 GHz	0.02	0.13
8.5 GHz to 10 GHz	0.02	0.13
10 GHz to 13.5 GHz	0.02	0.13
13.5 GHz to 16 GHz	0.02	0.13
16 GHz to 20 GHz	0.03	0.40
20 GHz to 24 GHz	0.03	0.54
24 GHz to 26.5 GHz	0.04	0.56

<sup>1</sup> Stability is defined as a ratio measurement made at the test port.

Table 24. Damage Input Level - Specification

Description	RF (dBm)	DC (V)
Test Port 1, 2, 3, 4 (All Options)	> +30	40
Source 2 Out 1, Source 2 Out 2 (Option 224 only)	> +30	0
Test Port 2, Noise Mode <sup>1</sup> (Option 029 only)	> +27	40

<sup>1</sup> Noise mode sets port 2 noise receiver switch to noise receiver position.

## Noise Receiver Input (Option 029 only)

Table 25. Noise Receiver Bandwidth

Description	Bandwidth
10 MHz to 25 MHz	800 kHz, 2 MHz
25 MHz to 60 MHz	800 kHz, 2/4 MHz
60 MHz to 150 MHz	800 kHz, 2/4/8 MHz <sup>1</sup>
150 MHz to 26.5 GHz	800 kHz, 2/4/8/24 MHz <sup>1</sup>

<sup>1</sup> 8 and 24 MHz bandwidths are available only with calibration using noise source.

Table 26. Receiver Noise Figure (dB), Port 2, at All BW, High Gain Setting

Description	Specification	Typical
10 MHz to 200 MHz	11.0	--
200 MHz to 1.3 GHz	12.0	--
1.3 GHz to 2.0 GHz	14.0	--
2.0 GHz to 8.5 GHz	14.5	--
8.5 GHz to 13.5 GHz	14.5	--
13.5 GHz to 20 GHz	14.5	--
20 GHz to 26.5 GHz	17.0 <sup>1</sup>	--

<sup>1</sup> Degraded by 1.5 dB with 24 MHz BW.

Table 27. Noise Figure Trace Noise<sup>1</sup> (dB rms) at 4 MHz BW

Frequency	Specification			Typical		
	Low Gain Setting	Medium Gain Setting	High Gain Setting	Low Gain Setting	Medium Gain Setting	High Gain Setting
10 MHz to 15 MHz	0.30	0.30	0.10	0.15	0.15	0.07
15 MHz to 3 GHz	0.10	0.10	0.10	0.07	0.07	0.07
3 GHz to 8.5 GHz	0.11	0.10	0.10	0.07	0.07	0.07
8.5 GHz to 13.5 GHz	0.11	0.10	0.10	0.07	0.07	0.07
13.5 GHz to 26.5 GHz	0.11	0.10	0.10	0.07	0.07	0.07

<sup>1</sup> Trace noise magnitude performance on noise figure trace or sometime called noise jitter, 201 points, 1 noise average, port 2 terminated. May typically be degraded at frequencies below 500 MHz due to spurious noise receiver residuals.

Table 28. Noise Receiver Linearity (dB) at 4 MHz BW - Specification

Power Range (dBm)			Specification
Low Gain Setting Reference to -60 dBm	Medium Gain Setting Reference to -70 dBm	High Gain Setting Reference to -80 dBm	
-36 to -64	-48 to -76	-58 to -84	+/-0.05
-64 to -70	-76 to -86	-84 to -92	+/-0.10

Table 29. Noise Receiver Input Range - Specification

Description	Max DUT NF + Gain (dB) <sup>1</sup>			Max Input Power (dBm) for <0.1 dB Compression <sup>2</sup>		
	High Gain Setting	Medium Gain Setting	Low Gain Setting	High Gain Setting	Medium Gain Setting	Low Gain Setting
500 MHz to 3 GHz	32	44	55	<=-57	<=-45	<=-34
3 GHz to 8.5 GHz	46	57	68	<=-43	<=-32	<=-21
8.5 GHz to 13.5 GHz	46	57	68	<=-43	<=-32	<=-21
13.5 GHz to 26.5 GHz	46	57	68	<=-43	<=-32	<=-21

<sup>1</sup> Limited by 0.1 dB receiver compression. Applies to devices with bandwidth < 400 MHz. For devices with higher bandwidths, calculate the DUT output noise power as  $-174 \text{ dBm} + 10 \cdot \log_{10}(B) + \text{Gain (dB)} + \text{NF (dB)}$ , where B is the bandwidth of the DUT in Hz, and use the Max Input Power specification.

<sup>2</sup> Derived from ensuring < 0.25 dB compression with a CW signal 5 dB higher than the stated max input power value for 0.1 dB compression. Referenced to test port 2.

## Dynamic Accuracy

Table 30. Dynamic Accuracy - Specification

Standard receiver accuracy of the test port input power reading relative to the reference input power level. It is verified with the following measurements:

- Compression over frequency
- IF linearity at a single frequency of 1.998765 GHz using a reference level of -20 dBm for an input power range of 0 to -60 dBm. For value below -60 dBm, refer to “VNA Receiver Dynamic Accuracy Specifications and Uncertainties”.

Applies to N5249A (all serial numbers) and N5241A, N5242A with following serial numbers:

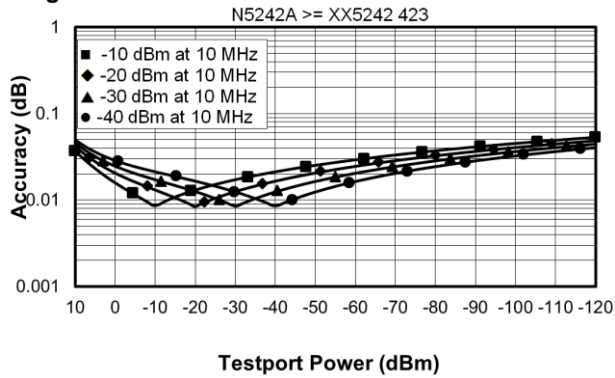
N5241A and N5241AS: MY5241/SG5241/US5241 and above

N5242A and N5242AS: MY5242/SG5242/US5242 and above

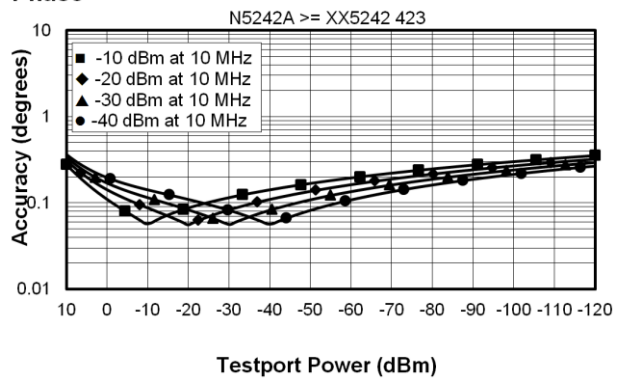
Please download our free Uncertainty Calculator from [http://www.keysight.com/find/na\\_calculator](http://www.keysight.com/find/na_calculator) to generate the curves for your PNA.

### Dynamic Accuracy, 0.010 GHz

#### Magnitude

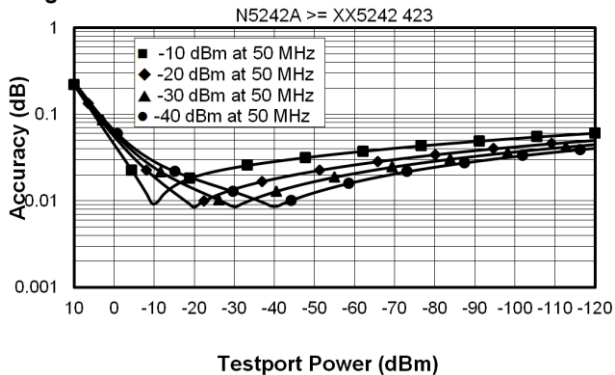


#### Phase

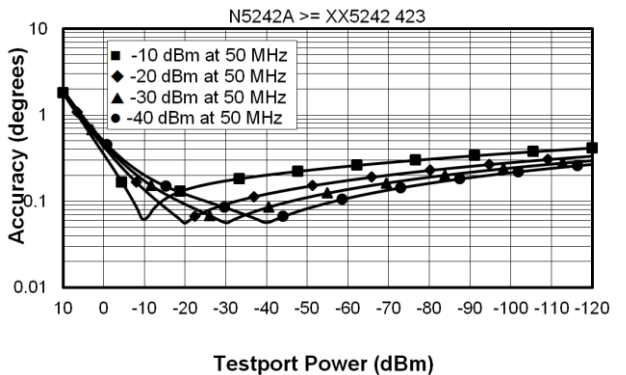


### Dynamic Accuracy, 0.050 GHz

#### Magnitude

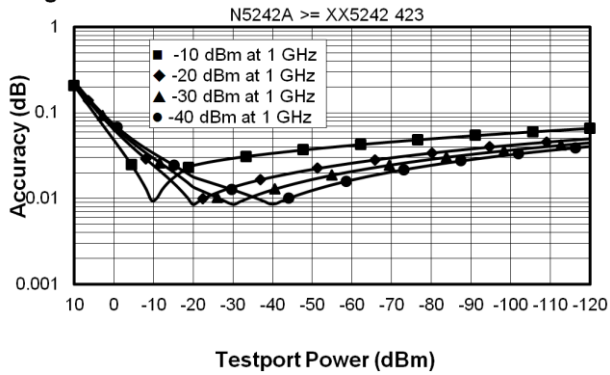


#### Phase

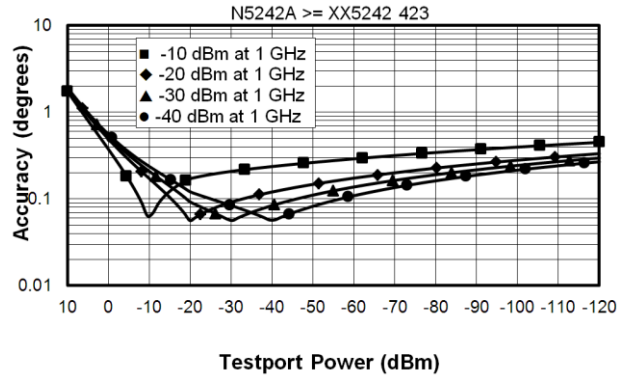


## Dynamic Accuracy, 1 GHz

### Magnitude

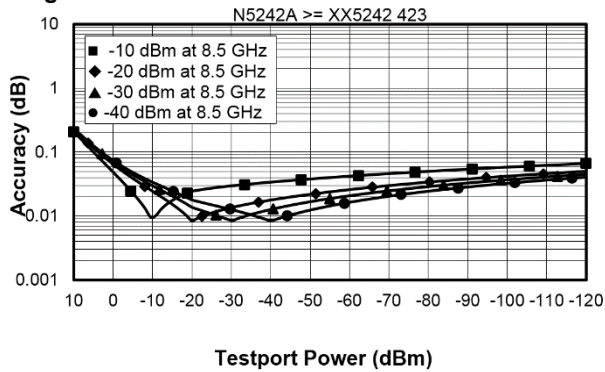


### Phase

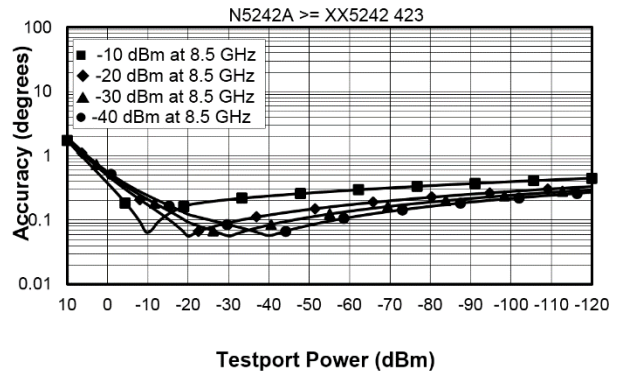


## Dynamic Accuracy, 8.5 GHz

### Magnitude

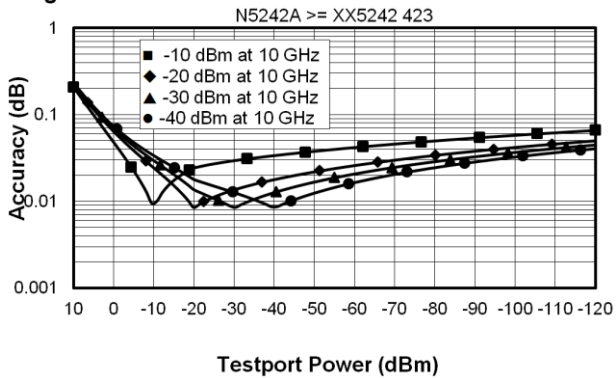


### Phase

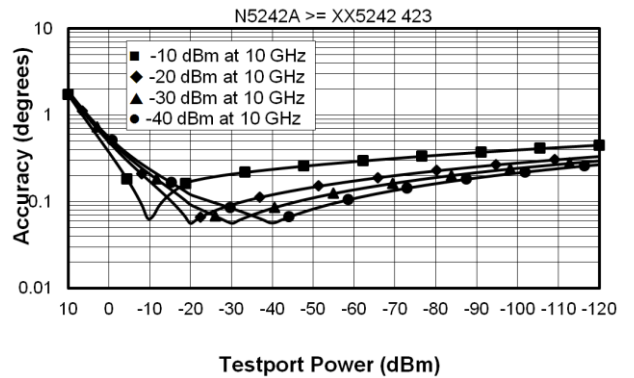


## Dynamic Accuracy, 10 GHz

### Magnitude



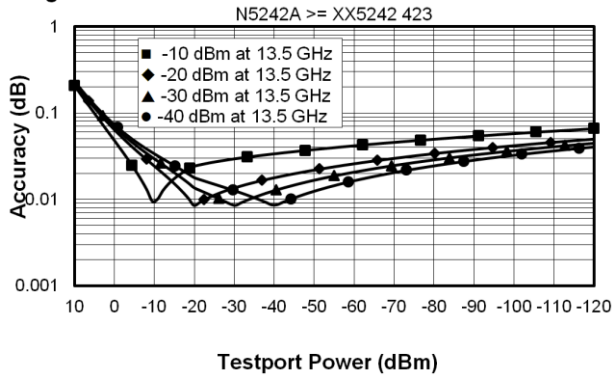
### Phase



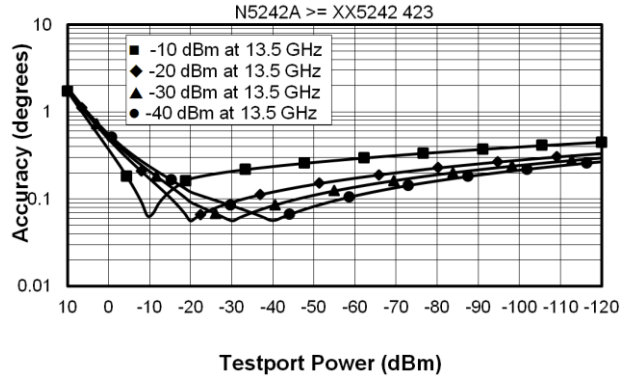


## Dynamic Accuracy, 13.5 GHz

### Magnitude

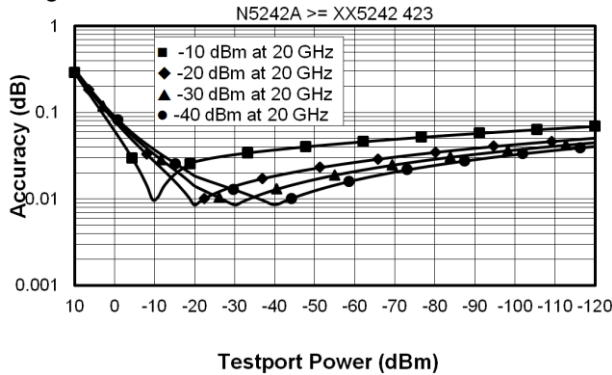


### Phase

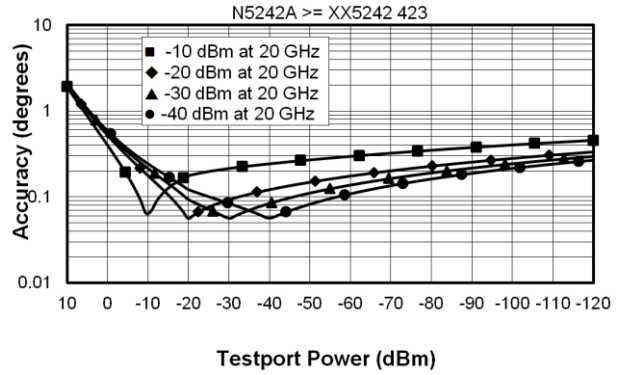


## Dynamic Accuracy, 20 GHz

### Magnitude

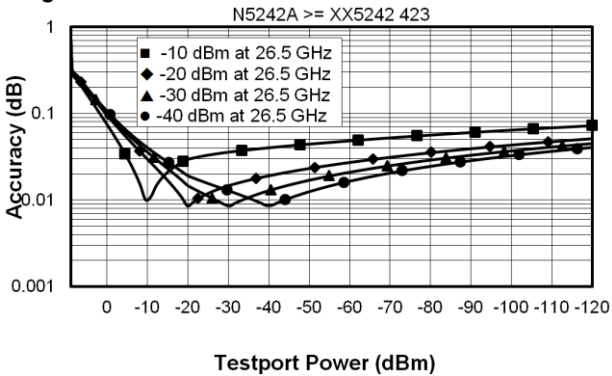


### Phase



## Dynamic Accuracy, 26.5 GHz

### Magnitude



### Phase

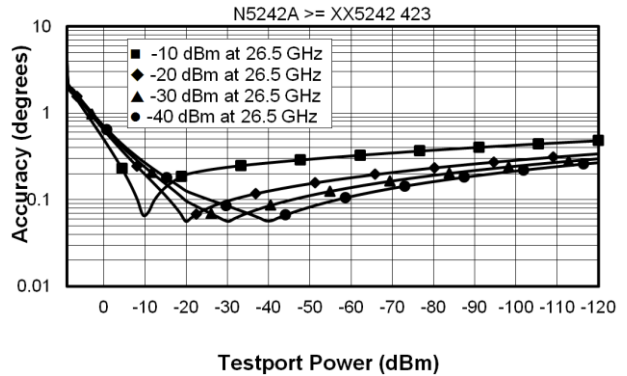


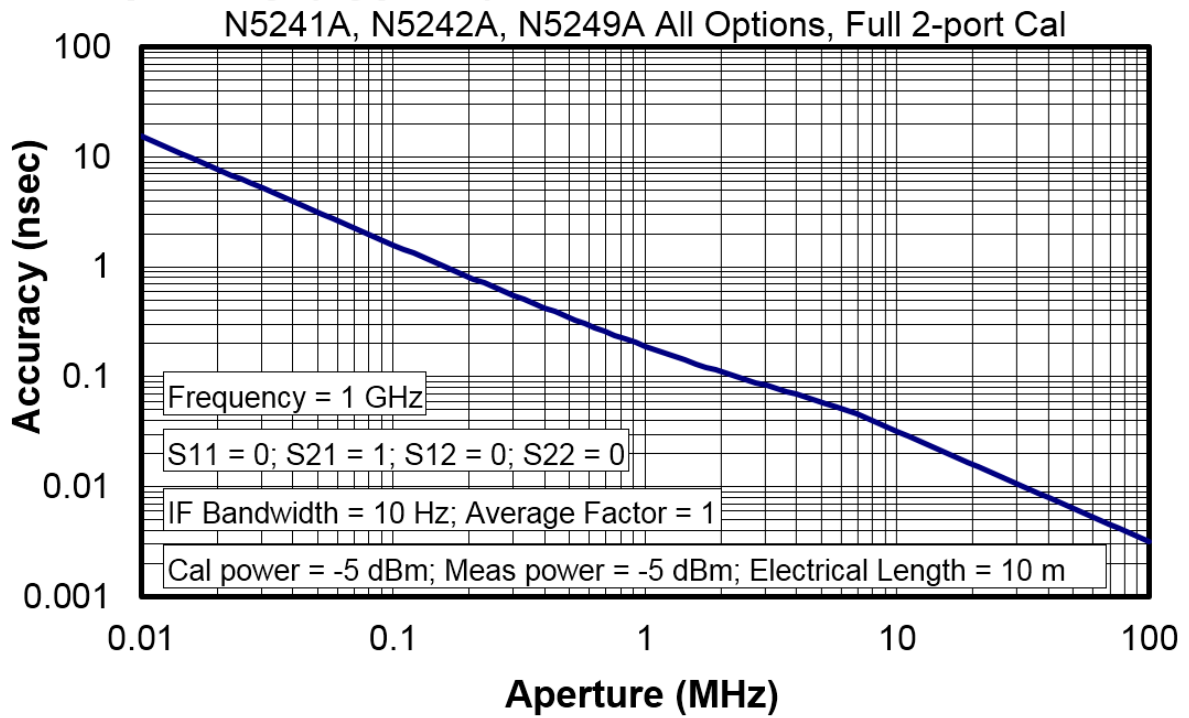
Table 31. Test Port Input (Group Delay)<sup>1</sup>

Description	Typical Performance
Aperture (selectable)	(frequency span)/(number of points -1)
Maximum Aperture	20% of frequency span
Range	0.5 x (1/minimum aperture)
Maximum Delay	Limited to measuring no more than 180° of phase change within the minimum aperture.)
Accuracy	See graph below. Char.

The following graph shows characteristic group delay accuracy with full 2-port calibration and a 10 Hz IF bandwidth. Insertion loss is assumed to be < 2 dB and electrical length to be ten meters.

For any  $S_{ij}$  Group Delay measurement,  $S_{ii} = 0$ ,  $S_{ij} = 1$ ,  $S_{ji} = 0$ ,  $S_{kl} = 0$  for all  $kl \neq ij$

## Group Delay (Typical)



In general, the following formula can be used to determine the accuracy, in seconds, of specific group delay measurement:

$$\pm \text{Phase Accuracy (deg)} / [360 \times \text{Aperture (Hz)}]$$

Depending on the aperture and device length, the phase accuracy used is either incremental phase accuracy or worst-case phase accuracy.

<sup>1</sup> Group delay is computed by measuring the phase change within a specified frequency step (determined by the frequency span and the number of points per sweep).

## General Information

- Miscellaneous Information
- Front Panel
- Rear Panel
- Environment and Dimensions

Table 32. Miscellaneous Information

Description	Supplemental Information
System IF Bandwidth Range	1 Hz to 15 MHz, nominal (7 MHz, 10 MHz, and 15 MHz IFBW are available ONLY with FW A.09.42 and later, and with DSP version 5)
CPU	For the latest information on CPUs and associated hard drives, visit: <a href="http://na.support.keysight.com/pna/hdnumbers.html">http://na.support.keysight.com/pna/hdnumbers.html</a>
LXI	Class C (only applies to N5241A, N5242A, and N5249A models that are shipped with firmware revision A.08.20 and higher)

Table 33. Front Panel Information, All Options

Description	Typical Performance
<b>RF Connectors</b>	
Test Ports	3.5 mm (male), 50 ohm (nominal), 0.002 in. Center Pin Recession (characteristic)
Jumpers	3.5 mm (female) connectors with SMA (male) jumper cables
<b>USB 2.0 Ports - Master (4 ports)</b>	
Standard	Compatible with USB 2.0
Connector	USB Type-A female
<b>Display</b>	
Size	26.3 cm (10.4 in) diagonal color active matrix LCD; 1024 (horizontal) X 768 (vertical) resolution
Refresh Rate	Vertical 60 Hz; Horizontal 46.08 kHz
Pixels	<ul style="list-style-type: none"> <li>• A display is considered faulty if:</li> <li>• A complete row or column consists of “stuck” or “dark” pixels.</li> <li>• More than six “stuck on” pixels (but not more than three green) or more than 0.002% of the total pixels are within the LCD specifications.</li> <li>• More than twelve “dark” pixels (but no more than seven of the same color) or more than 0.004% of the total pixels are within the LCD specifications.</li> <li>• Two or more consecutive “stuck on” pixels or three or more consecutive “dark” pixel (but no more than one set of two consecutive dark pixels)</li> <li>• “Stuck on” “dark” pixels are less than 6.5 mm apart (excluding consecutive pixels)</li> </ul>

Table 33. (Continued) Front Panel Information, All Options

Description	Typical Performance
<b>Display Range</b>	
Magnitude	+/-2500 dB (at 500 dB/div), max
Phase	+/-2500° (at 500 dB/div), max
Polar	10 pUnits, min 10,000 Units, max
<b>Display Resolution</b>	
Magnitude	0.001 dB/div, min
Phase	0.01°/div, min
<b>Marker Resolution</b>	
Magnitude	0.001 dB, min
Phase	0.01°, min
Polar	10 pUnit, min

Table 34. Rear Panel Information, All Options

Description	Typical Performance
<b>10 MHz Reference In</b>	
Connector	BNC, female
Input Frequency	10 MHz ± 10 ppm
Input Level	-15 dBm to +20 dBm
Input Impedance	200 Ω, nom.
<b>10 MHz Reference Out</b>	
Connector	BNC, female
Output Frequency	10 MHz ± 1 ppm
Signal Type	Sine Wave
Output Level	+10 dBm ± 4 dB into 50 Ω
Output Impedance	50 Ω, nominal
Harmonics	<-40 dBc, typical

Table 34. (Continued) Rear Panel Information, All Options

Description	Typical Performance			
<b>External IF Inputs</b>				
Function	Allows use of external IF signals from remote mixers, bypassing the PNA's first converters			
Connectors	SMA (female); A, B, C, D, R (4-port); A, B, R1, R2 (2-port)			
Frequency				
Path	DSP Version	IF Bandwidth	RF Frequency	IF Frequency
Normal IF path:	4	All	< 53 MHz	2.535211 MHz
		All	>= 53 MHz	7.605634 MHz
	5	<= 600 kHz	< 53 MHz	2.479339 MHz
			>= 53 MHz	7.438017 MHz
		1 MHz	All	7.692 MHz
		1.5 MHz	All	7.368 MHz
		2 MHz	All	8.450 MHz
		3 MHz	All	8.163 MHz
		5 MHz	All	6.897 MHz
		7 MHz	All	10.53 MHz
10 MHz	All	15.38 MHz		
15 MHz	All	22.22 MHz		
Narrowband IF path:	4 or 5	All	All	10.70 MHz
Input Impedance	50 $\Omega$			
RF Damage Level	+23 dBm			
DC Damage Level	5.5 VDC			
0.1 dB Compression Point				
Normal IF path	-9.0 dBm at 7.438 MHz			
Narrowband IF path	-17 dBm at 10.70 MHz			
<b>Pulse Inputs (IF Gates)</b>				
Function	Internal receiver gates used for point-in-pulse and pulse-profile measurements			
Connectors	15-pin mini D-sub			
Input Impedance	1 K Ohm			
Source Modulators	20 ns minimum pulse width			
Receiver Gates	20 ns minimum pulse width			
DC Damage Level	5.5 VDC			
Drive Voltage	0 V (off), +3.3 V (on), nominal			

Table 34. (Continued) Rear Panel Information, All Options

Description	Typical Performance	
<b>RF Pulse Modulator Input (Source Modulator)</b>		
<b>On/Off Ratio</b>		
10 MHz to 3.2 GHz	-64 dB	
3.2 GHz to 8.5 GHz	-80 dB	
8.5 GHz to 13.5 GHz	-80 dB	
13.5 GHz to 26.5 GHz	-80 dB	
<b>Pulse Period</b>		
Minimum	20 ns	
Maximum	70 s	
<b>Pulse Outputs</b>		
Voltage (TTL)	High: 3.3 V to 3.5 V Low: <1 V	
Impedance	50 Ohm	
<b>External Test Set Driver</b>		
Function	Used for driving remote mixers	
Connections	SMA (female)	
RF, LO Output Frequency Range <sup>1</sup>	1.7 to 13.5 GHz (N5241A) 1.7 to 26.5 GHz (N5242A)	
<b>Rear Panel LO Power</b>	<b>Upper Limit (dBm)</b>	<b>Lower Limit (dBm)</b>
1.7 GHz to 8.5 GHz	0	-10
8.5 GHz to 13.5 GHz	0	-10
13.5 GHz to 18 GHz	0	-10
18 GHz to 22.5 GHz	2	-8
22.5 GHz to 26.5 GHz	6	-5
<b>Rear Panel RF Power</b>	<b>Upper Limit (dBm)</b>	<b>Lower Limit (dBm)</b>
3.2 GHz to 13.5 GHz	-3	-8
13.5 GHz to 20 GHz	-3	-8
20 GHz to 26.5 GHz	-8	-14

<sup>1</sup> Full LO frequency range is: 12.535 MHz to 13.5 GHz. (N5241A), 12.535 MHz to 26.5 GHz. (N5242A)

Table 34. (Continued) Rear Panel Information, All Options

Description	Typical Performance
<b>Devices Supported:</b>	<b>Resolutions:</b>
Flat Panel (TFT)	1024 X 768, 800 X 600, 640 X 480
Flat Panel (DSTN)	800 X 600, 640 X 480
CRT Monitor	1280 X 1024, 1024 X 768, 800 X 600, 640 X 480
Simultaneous operation of the internal and external displays is allowed, but with 640 X 480 resolution only. If you change resolution, you can only view the external display (internal display will "white out").	
<b>Bias Tee Inputs</b>	
Connectors	BNC(f) for ports 1, 2, 3 and 4
Fuse	500 mA, bi-pin style
Maximum Bias Current	+/-200 mA with no degradation of RF specifications
Maximum Bias Voltage	+/-40 VDC
Trigger Inputs/Outputs	BNC(f), TTL/CMOS compatible
Test Set IO	25-pin D-Sub connector, available for external test set control
Power IO	9-pin D-Sub, female; analog and digital IO
Handler IO	36-pin parallel I/O port; all input/output signals are default set to negative logic; can be reset to positive logic via GPIB command
Pulse I/O	15-pin D connector provides access to Pulse Modulators and Generators
GPIB	Two ports - dedicated controller and dedicated talker/listener. 24-pin D-sub (Type D-24), female; compatible with IEEE-488
PCIe	Cabled PCIe x4 connector is a 4-lane slot (not currently used)
USB Port	Two SuperSpeed USB ports (900 mA each), one USB port below LAN connector, and one USB device port. There are also four USB ports (500 mA each) on the front panel. The total current limit for all rear panel USB ports is 2.3 amps. The total current limit for all front panel USB ports is 2 amps.
LAN	10/100/1000 BaseT Ethernet, 8-pin configuration; auto selects between the data rates
VGA Video Output	15-pin mini D-Sub; Drives VGA compatible monitors
Mini DisplayPort	Miniature DisplayPort connector for connection to external displays
<b>Line Power</b>	
Frequency, Voltage	50/60/400 Hz for 100 to 120 VAC 50/60 Hz for 220 to 240 VAC
	Power supply is auto switching
Max	450 watts

**Table 35. Analyzer Dimensions and Weight**

All N5241A, N5242A, and N5249A models are shipped with bottom feet, handles, and front and rear hardware.

See detailed PNA dimension drawings at: <http://na.support.keysight.com/pna/PNADimensions.pdf>

<b>Cabinet Dimensions</b>	<b>Metric (mm)</b>	<b>Imperial (inches)</b>
<b>Height</b>		
Without bottom feet: EIA RU <sup>1</sup> = 6	266.1	10.5
With bottom feet	279.1	11.0
<b>Width</b>		
Without handles or rack-mount flanges	425.6	16.8
With handles, without rack-mount flanges	458.7	18.1
With handles and rack-mount flanges	482.9	19.0
<b>Depth</b>		
Without front and rear panel hardware	533.0	21.0
With front and rear panel hardware, handles	578.0	22.7
<b>Weight (nominal)</b>		
	<b>Net</b>	<b>Shipping</b>
2-port models	27 kg (60 lb)	43 kg (95 lb)
4-port models	37 kg (82 lb)	53 kg (117 lb)

<sup>1</sup>Electronics Industry Association rack units. 1 RU = 1.75 in.

#### Regulatory and Environmental information

For Regulatory and Environmental information, refer to the PNA Series Installation and Quick Start Guide, located online at <http://literature.cdn.keysight.com/litweb/pdf/E8356-90001.pdf>.



## Measurement Throughput Summary

- Typical Cycle Time for Measurement Completion
- Cycle Time vs. IF Bandwidth
- Cycle Time vs. Number of Points
- Data Transfer Time

Cycle time Includes sweep time, retrace time and band-crossing time. Analyzer display turned off with DISPLAY:ENABLE OFF. Add 21 ms for display on. Data for one trace (S<sub>11</sub>) measurement.

Table 36a. Cycle Time (ms) for Measurement Completion, All Options - Typical

Sweep Range	IF Bandwidth		Number of Points			
			201	401	1601	16001
7 GHz to 8 GHz	600 kHz	Uncorrected	6	6.3	9.6	56
		2-Port cal	20	21	28	134
	10 kHz	Uncorrected	36	53	200	1945
		2-Port cal	80	115	405	3900
	1 kHz	Uncorrected	227	444	1740	17000
		2-Port cal	460	900	3484	34000
9 GHz to 10 GHz	600 kHz	Uncorrected	6	6.3	9.6	56
		2-Port cal	20	21	28	134
	10 kHz	Uncorrected	36	53	200	1945
		2-Port cal	80	115	405	3900
	1 kHz	Uncorrected	227	444	1740	17000
		2-Port cal	460	900	3484	34000
10 GHz to 13.5 GHz	600 kHz	Uncorrected	26	33	54	85
		2-Port cal	62	77	121	190
	10 kHz	Uncorrected	70	118	273	1958
		2-Port cal	149	245	553	3922
	1 kHz	Uncorrected	236	459	1780	17300
		2-Port cal	400	926	3565	34600
13.5 GHz to 20 GHz	600 kHz	Uncorrected	26	33	54	85
		2-Port cal	62	77	121	190
	10 kHz	Uncorrected	70	118	273	1958
		2-Port cal	149	245	553	3922
	1 kHz	Uncorrected	236	459	1780	17300
		2-Port cal	400	926	3565	34600

Table 36b. Cycle Time (ms) for Full-Span Measurement Completion - Typical

10 MHz to 26.5 GHz		Number of Points			
		201	401	1601	16001
IF Bandwidth					
600 kHz	Uncorrected	59	69	118	350
	2-Port cal	125	147	244	707
10 kHz	Uncorrected	94	156	480	2333
	2-Port cal	196	320	968	4674
1 kHz	Uncorrected	277	504	1873	17950
	2-Port cal	561	1015	3756	35900

Table 37. Cycle Time vs. IF Bandwidth - Typical

Applies to the Preset condition (201 points, correction off) except for the following changes:

- CF = 10 GHz
- Span = 100 MHz
- Display off (add 21 ms for display on)

Cycle time includes sweep and retrace time.

Description	Typical Performance	
	Cycle Time (ms)	Trace Noise
600,000	5.00	0.009
100,000	6.84	0.003
30,000	11.6	0.002
10,000	29.0	0.001
3,000	71.8	0.0007
1,000	222	0.0004
300	640	0.0003
100	1826	0.0002
30	5982	<0.0002
10	17830	<0.0002
3	60000	<0.0002

**Table 38. Cycle Time vs. Number of Points**

Applies to the Preset condition (correction off) except for the following changes:

- CF = 10 GHz
- Span = 100 MHz
- Display off (add 21 ms for display on)

Cycle time includes sweep and retrace time.

<b>Description</b>	<b>IF Bandwidth (Hz)</b>			
	<b>1,000</b>	<b>10,000</b>	<b>30,000</b>	<b>600,000</b>
<b>Number of Points</b>				
3	7.7	5.44	5.7	5.4
11	16.6	7.90	5.9	5.4
51	60	10.7	6.5	5.5
101	115	16.8	8.2	5.6
201	222	29.0	11.8	5.9
401	436	53.0	18.8	6.3
801	860	102	32.8	7.2
1,601	1,700	199	60.5	9.6
6,401	6,700	780	228	25
16,001	16,000	1950	566	56

Table 39. Data Transfer Time<sup>1</sup> (ms) - Typical

Description	Number of Points			
	201	401	1601	16,001
SCPI over GPIB (Program executed on external PC <sup>2</sup> )				
32-bit floating point	5.6	10.5	39.9	400
64-bit floating point	10.5	20.3	79.2	788
ASCII	46	92.5	370	3702
SCPI over SICT/LAN or TCP/IP Socket (Program executed in the analyzer)				
32-bit floating point	0.18	0.21	0.5	3.6
64-bit floating point	0.22	0.28	0.62	5.3
ASCII	6.3	12.3	47.3	470
COM <sup>3</sup> (Program executed in the analyzer)				
32-bit floating point	<0.15	0.15	0.2	0.7
Variant type	0.75	1.2	4.5	50
DCOM over LAN <sup>3</sup> (Program executed on external PC)				
32-bit floating point	<1.0	1.2	2.1	13
Variant type	2.7	4.5	15	150

<sup>1</sup> Measured with the analyzer display off. Values will increase slightly if the analyzer display is on.

<sup>2</sup> Measured when using the SCPI command DISPlay: VISible OFF.

<sup>3</sup> Values are for real and imaginary pairs, with the analyzer display off.

**NOTE**

Specifications for Recall & Sweep Speed are not provided for the N5241A, N5242A, and N5249A analyzers.

## Specifications: Front-Panel Jumpers

**NOTE**

All PNA-X options have the following front-panel jumpers for each port.



- Measurement Receiver Inputs
- Reference Receiver Inputs and Reference Source Outputs
- Source Outputs
- Coupler Inputs
- Damage Level

Table 40. Measurement Receiver Inputs (dBm) - Typical

(RCVR A, B, C, D IN) @ 0.1 dB Typical Compression

Description	All Options
10 MHz to 50 MHz	-4
50 MHz to 500 MHz	-3
500 MHz to 8.5 GHz	-2
8.5 GHz to 13.5 GHz	-2
13.5 GHz to 16 GHz	-2
16 GHz to 20 GHz	-2.5
20 GHz to 26.5 GHz	-4

Table 41a. Reference Receiver Inputs and Reference Source Outputs (dBm) - Typical

(RCVR R1 IN, REF 1 SOURCE OUT) @ Max Specified Output Power

Description	Options 200, 400		Options 219, 419		Options 224, 423	
	Filtered Mode <sup>1</sup>	Hi Power Mode <sup>1</sup>	Filtered Mode <sup>1</sup>	Hi Power Mode <sup>1</sup>	Filtered Mode <sup>1</sup>	Hi Power Mode <sup>1</sup>
10 MHz to 50 MHz	-8	-3	-8	-3	-9	-6
50 MHz to 500 MHz	-6	-3	-6	-3	-7	-5
500 MHz to 3.2 GHz	-6	-6	-5	-5	-7	-5
3.2 GHz to 8.5 GHz	-3	-3	-2	-2	-2	-2
8.5 GHz to 10 GHz	-3	-3	-2	-2	-2	-2
10 GHz to 13.5 GHz	-4	-4	-3	-3	-3	-3
13.5 GHz to 16 GHz	-4	-4	-3	-3	-3	-3
16 GHz to 20 GHz	-5	-5	-6	-6	-6	-6
20 GHz to 24 GHz	-7	-7	-8	-8	-9	-9
24 GHz to 26.5 GHz	-16	-16	-15	-15	-18	-18

<sup>1</sup> In Filtered Mode, the signal path goes through filters to minimize harmonics below 3.2 GHz. In Hi Power Mode, the signal bypasses the filters to maximize output power.

Table 41b. Reference Receiver Inputs and Reference Source Outputs (dBm) – Typical

(RCVR R2, R3, R4 IN, REF 2, 3, 4 SOURCE OUT) @ Max Specified Output Power

Description	Option 400		Options 200, 400	Option 419		Options 219, 419
	RCVR R3 IN, REF 3 SOURCE OUT	RCVR R3 IN, REF 3 SOURCE OUT	RCVR R2, R4 IN, REF 2, 4 SOURCE OUT	RCVR R3 IN, REF 3 SOURCE OUT	RCVR R3 IN, REF 3 SOURCE OUT	RCVR R2, R4 IN, REF 2, 4 SOURCE OUT
	Filtered Mode1	Hi Power Mode1		Filtered Mode1	Hi Power Mode1	
10 MHz to 50 MHz	-6	-1	-1	-6	-1	-1
50 MHz to 500 MHz	-4	-1	-1	-4	-1	-1
500 MHz to 3.2 GHz	-4	-4	0	-3	-3	-1
3.2 GHz to 8.5 GHz	0	0	0	1	1	0
8.5 GHz to 10 GHz	0	0	0	1	1	0
10 GHz to 13.5 GHz	1	1	0	1	1	1
13.5 GHz to 16 GHz	1	1	0	1	1	1
16 GHz to 20 GHz	1	1	-3	0	0	-3
20 GHz to 24 GHz	0	0	-6	-1	-1	-4
24 GHz to 26.5 GHz	-8	-8	-12	-7	-7	-13

<sup>1</sup> In Filtered Mode, the signal path goes through filters to minimize harmonics below 3.2 GHz. In Hi Power Mode, the signal bypasses the filters to maximize output power.

Table 41c. Reference Receiver Inputs and Reference Source Outputs (dBm) – Typical  
 (RCVR R2, R3, R4 IN, REF 2, 3, 4 SOURCE OUT) @ Max Specified Output Power

Description	Option 423		Options 224, 423
	RCVR R3 IN, REF 3 SOURCE OUT	RCVR R3 IN, REF 3 SOURCE OUT	RCVR R2, R4 IN, REF 2, 4 SOURCE OUT
	Filtered Mode <sup>1</sup>	Hi Power Mode <sup>1</sup>	
10 MHz to 50 MHz	-7	-4	-1
50 MHz to 500 MHz	-6	-4	-1
500 MHz to 3.2 GHz	-5	-3	-1
3.2 GHz to 8.5 GHz	1	1	0
8.5 GHz to 10 GHz	1	1	0
10 GHz to 13.5 GHz	1	1	-2
13.5 GHz to 16 GHz	1	1	-2
16 GHz to 20 GHz	0	0	-4
20 GHz to 24 GHz	-2	-2	-6
24 GHz to 26.5 GHz	-10	-10	-10

<sup>1</sup>In Filtered Mode, the signal path goes through filters to minimize harmonics below 3.2 GHz. In Hi Power Mode, the signal bypasses the filters to maximize output power.



Table 42a. Source Outputs (dBm) - Typical

(PORT 1, 2, 3, 4 SOURCE OUT) @ Max Specified Output Power

Description	Options 200, 400			Options 219, 419		
	PORT 1, 3 SOURCE OUT		PORT 2, 4 SOURCE OUT	PORT 1, 3 SOURCE OUT		PORT 2, 4 SOURCE OUT
	Filtered Mode <sup>1</sup>	Hi Power Mode <sup>1</sup>		Filtered Mode <sup>1</sup>	Hi Power Mode <sup>1</sup>	
10 MHz to 50 MHz	8	13	13	8	13	13
50 MHz to 500 MHz	10	13	13	10	13	13
500 MHz to 3.2 GHz	11	11	13	11	11	14
3.2 GHz to 8.5 GHz	14	14	14	14	14	14
8.5 GHz to 10 GHz	14	14	14	14	14	14
10 GHz to 13.5 GHz	14	14	14	14	14	13
13.5 GHz to 16 GHz	14	14	14	14	14	13
16 GHz to 20 GHz	14	14	11	12	12	10
20 GHz to 24 GHz	13	13	9	10	10	9
24 GHz to 26.5 GHz	7	7	4	5	5	2

<sup>1</sup> In Filtered Mode, the signal path goes through filters to minimize harmonics below 3.2 GHz. In Hi Power Mode, the signal bypasses the filters to maximize output power.

Table 42b. Source Outputs (dBm) - Typical

(PORT 1, 2, 3, 4 SOURCE OUT) @ Max Specified Output Power

Description	Options 224, 423		
	PORT 1, 3 SOURCE OUT		PORT 2, 4 SOURCE OUT
	Filtered Mode <sup>1</sup>	Hi Power Mode <sup>1</sup>	
10 MHz to 50 MHz	7	10	13
50 MHz to 500 MHz	8	10	13
500 MHz to 3.2 GHz	9	11	14
3.2 GHz to 8.5 GHz	14	14	14
8.5 GHz to 10 GHz	14	14	14
10 GHz to 13.5 GHz	14	14	12
13.5 GHz to 16 GHz	14	14	12
16 GHz to 20 GHz	12	12	9
20 GHz to 24 GHz	9	9	7
24 GHz to 26.5 GHz	2	2	4

<sup>1</sup> In Filtered Mode, the signal path goes through filters to minimize harmonics below 3.2 GHz. In Hi Power Mode, the signal bypasses the filters to maximize output power.

Table 43. Coupler Inputs (dB) - Typical

(PORT 1, 2, 3, 4 CPLR THRU) Insertion Loss of Coupler Thru

Description	Options 200, 400		Options 219, 419, 224, 423	
10 MHz to 50 MHz	0		-0.5	
50 MHz to 500 MHz	-0.25		-0.75	
500 MHz to 3.2 GHz	-0.5		-1.0	
3.2 GHz to 8.5 GHz	-0.75		-1.25	
8.5 GHz to 10 GHz	-0.75		-1.25	
10 GHz to 13.5 GHz	-1.0		-1.75	
13.5 GHz to 16 GHz	-1.0		-1.75	
16 GHz to 20 GHz	-1.5		-2.25	
20 GHz to 24 GHz	-1.5		-2.5	
24 GHz to 26.5 GHz	-1.75		-2.5	

Table 44. Damage Level - Typical

Description	RF (dBm)	DC (V)
RCVR A, B, C, D IN	15	0
RCVR R1 IN	15	7
RCVR R2, R3, R4 IN	15	15
REF 1 SOURCE OUT	15	7
REF 2, 3, 4 SOURCE OUT	30	0
PORT 1, 2, 3, 4 SOURCE OUT	15	0
PORT 1, 2, 3, 4 CPLR THRU	30	40
PORT 1, 2, 3, 4 CPLR ARM	30	7

# Test Set Block Diagrams

**NOTE** For best readability, use a color printer for printing the following graphics.

## Legend

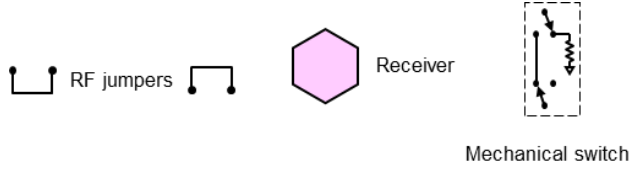


Figure 1. 2-Port N5241A, N5242A, and N5249A Base Unit Option 200

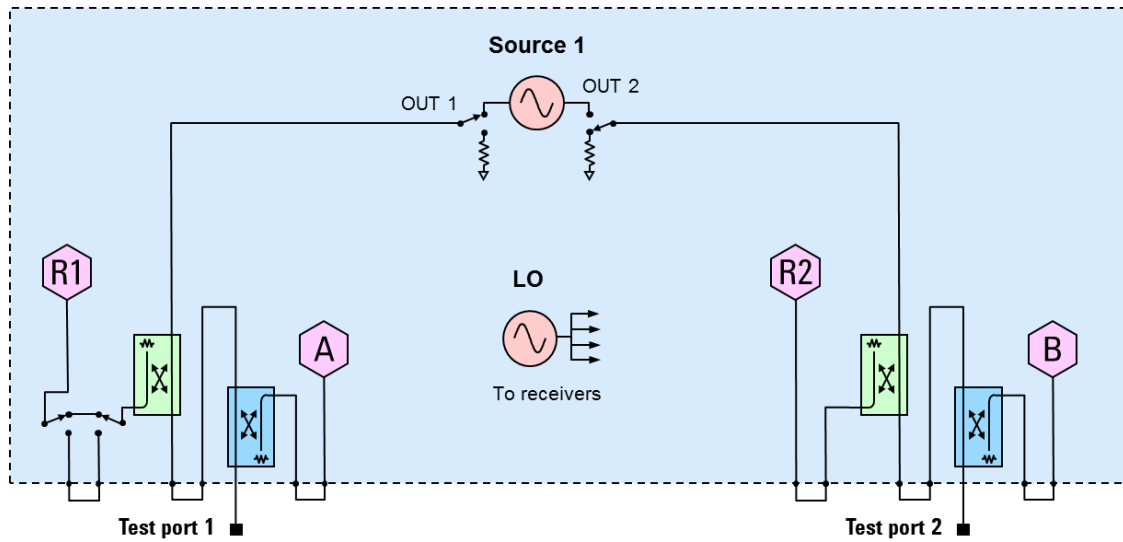


Figure 2. 2-Port N5241A, N5242A, and N5249A Option 219

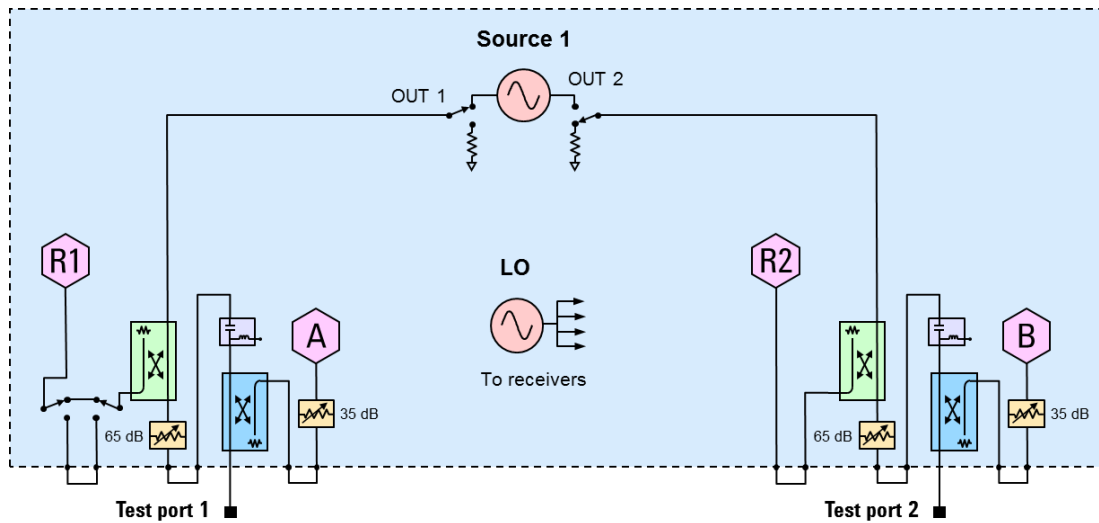


Figure 3. 2-Port N5241A, N5242A, and N5249A Option 224

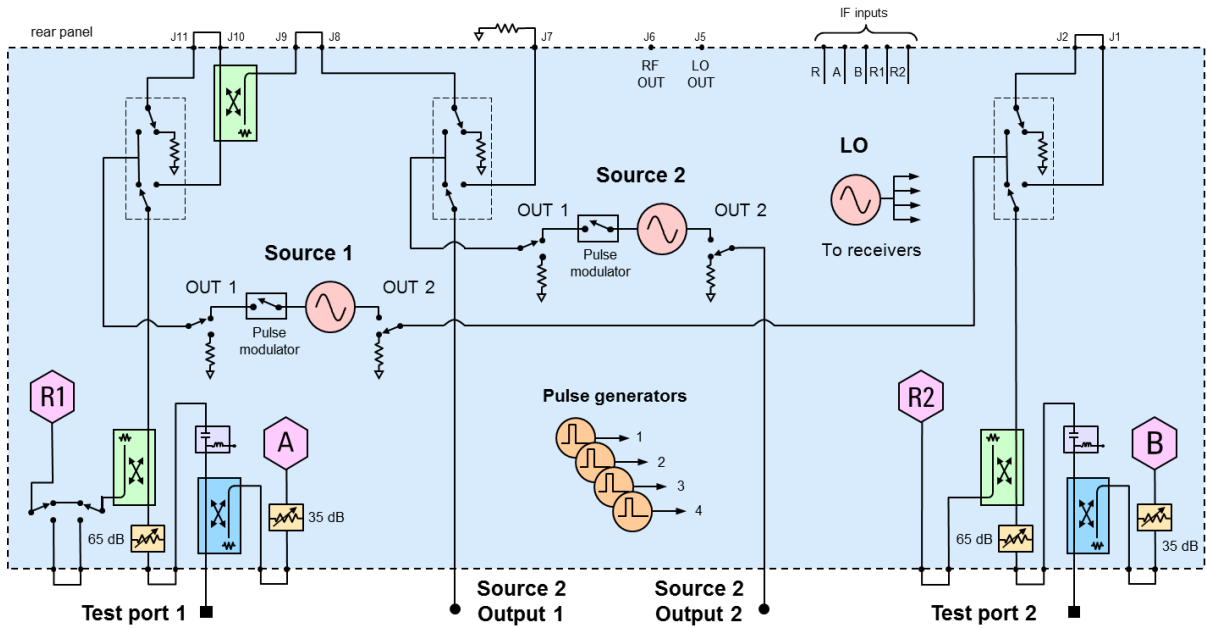


Figure 4. 2-Port N5241A, N5242A, and N5249A Option 224 with 029

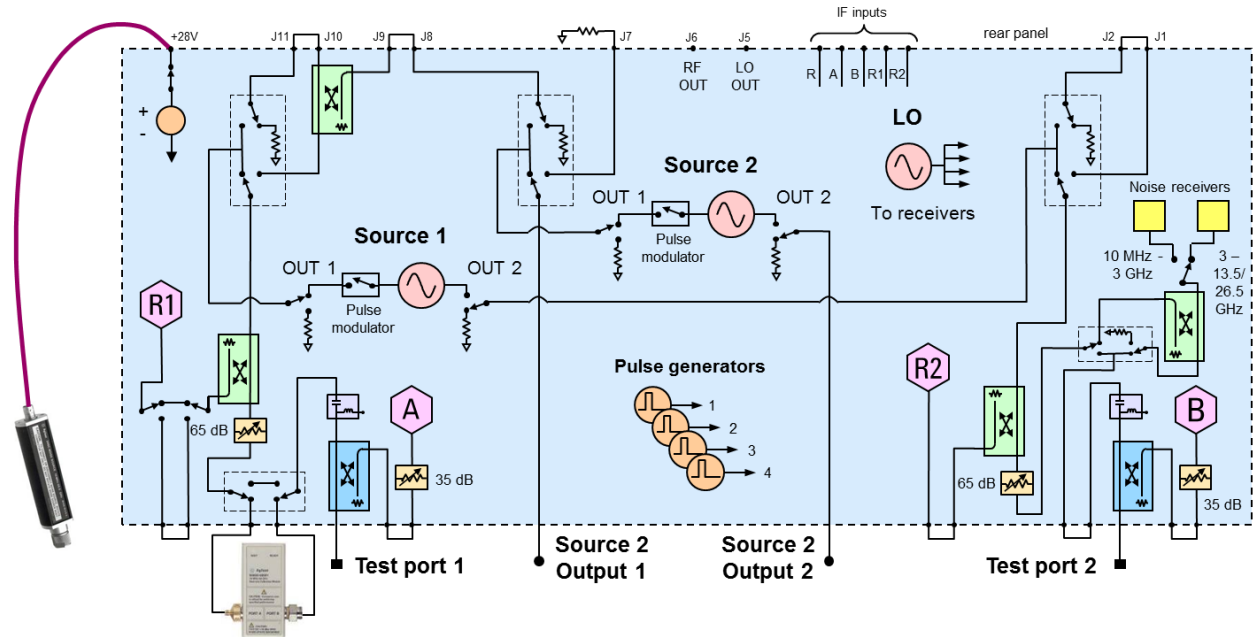


Figure 5. 4-Port N5241A, N5242A, and N5249A Base Unit Option 400

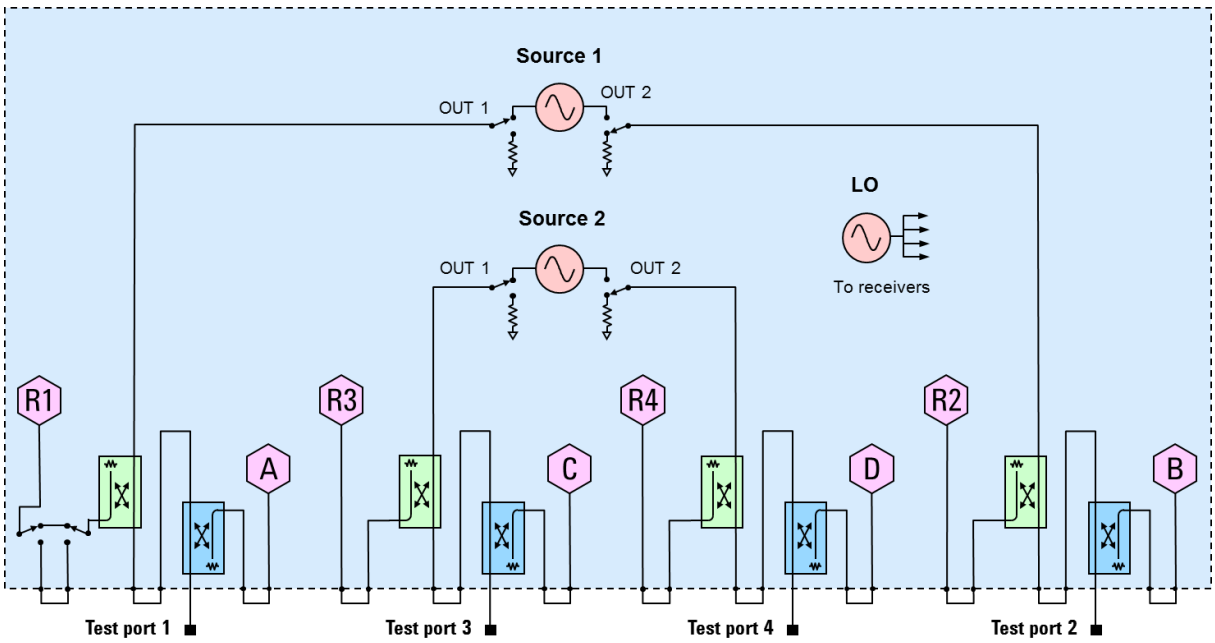


Figure 6. 4-Port N5241A, N5242A, and N5249A Option 419

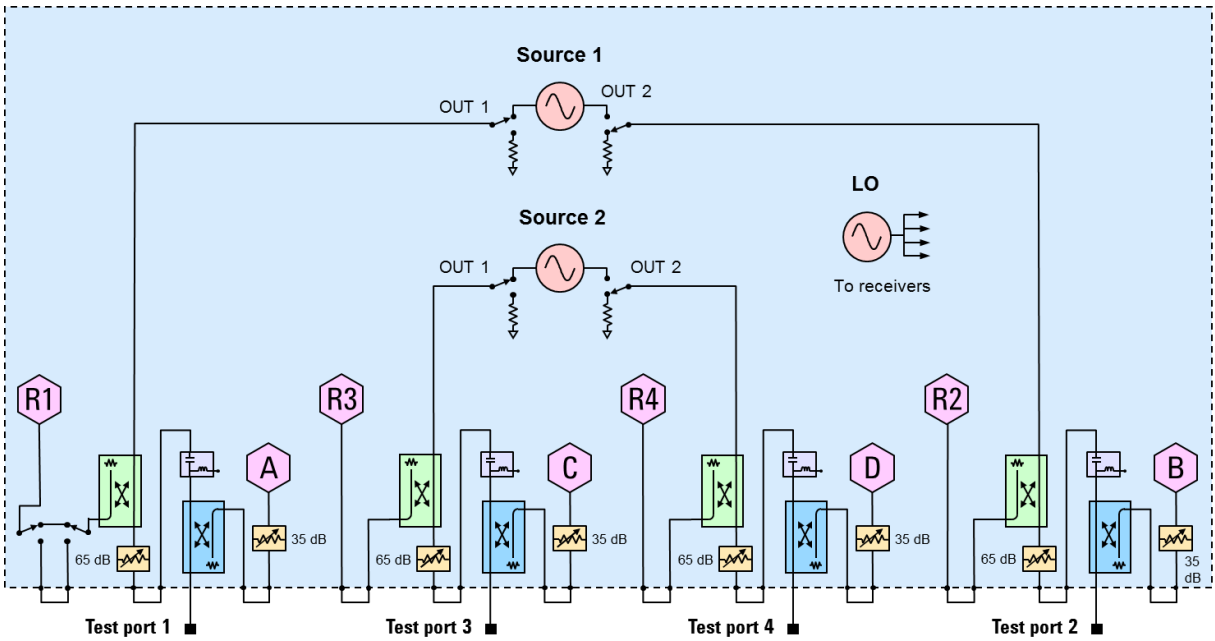


Figure 7. 4-Port N5241A, N5242A, and N5249A Option 423

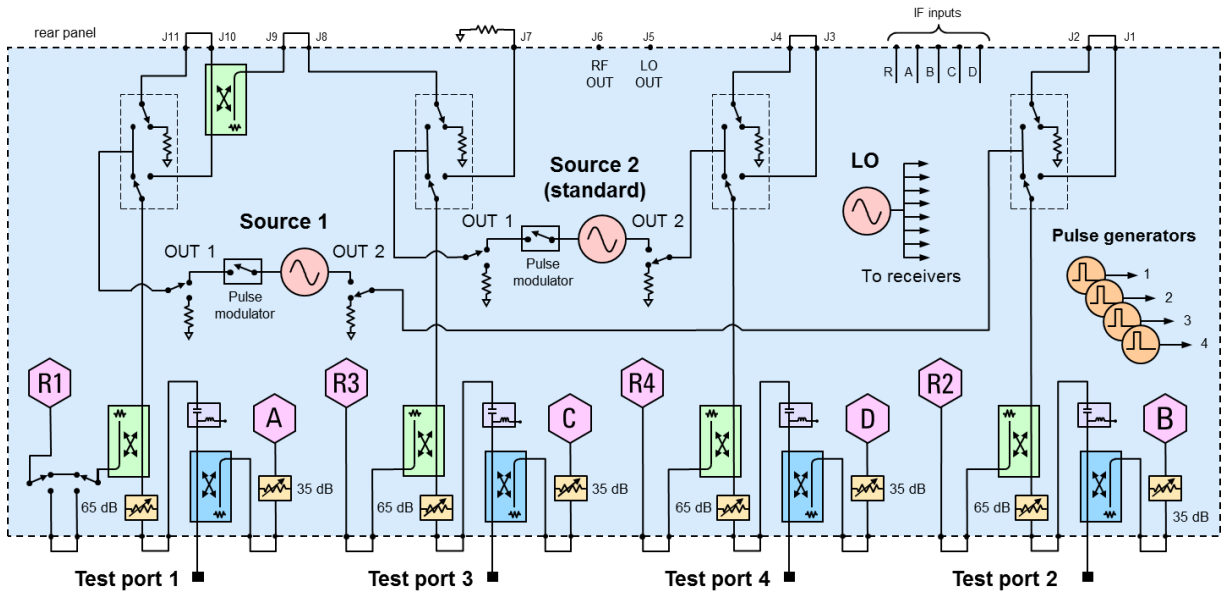


Figure 8. 4-Port N5241A, N5242A, and N5249A Option 423 with 029

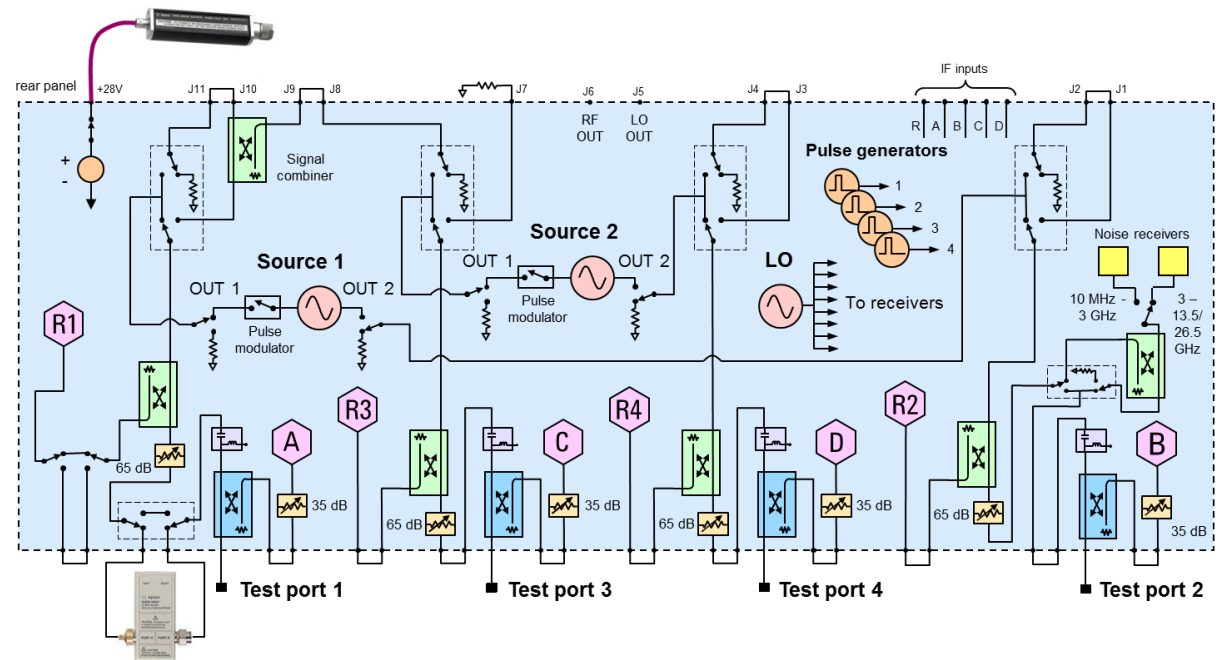
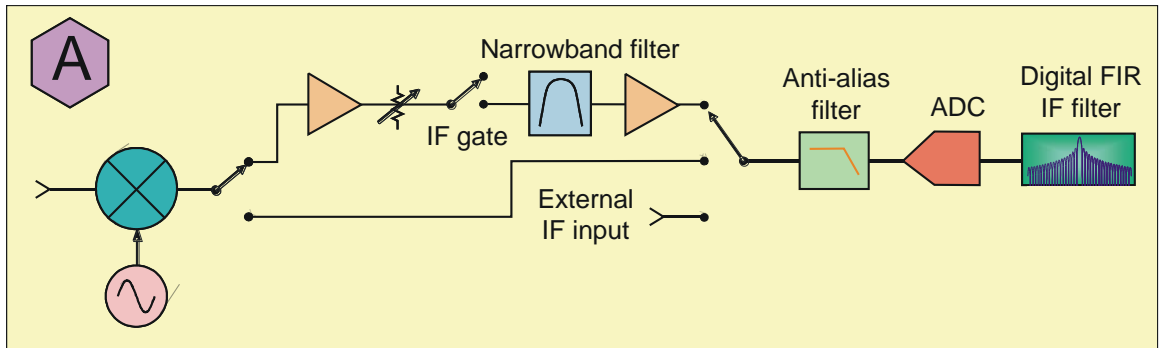


Figure 9. Receiver Block Diagram







This information is subject to change without notice.

© Keysight Technologies 2014 - 2017

Print Date: February 22, 2017



N5242-90007

[www.keysight.com](http://www.keysight.com)