

Keysight 2-Port and 4-Port PNA Network Analyzer

N5221B 10 MHz to 13.5 GHz

N5222B 10 MHz to 26.5 GHz

Data Sheet and
Technical
Specifications

Documentation Warranty

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This is a complete list of the technical specifications for the N5221B and N5222B PNA Series network analyzers with the following options. See block diagrams for all models and options beginning on page 57.

2-Port Models

Option 200 - 2-port base model with standard test set.

Option 201 - To base model, adds front-panel jumpers and R1 receiver switch.

Option 205 - To base model (N5222B only), adds front-panel jumpers, R1 receiver switch, and low frequency extension (LFE) hardware.

Option 217 - To base model, adds front-panel jumpers, R1 receiver switch, and source and receiver attenuators (extended power range).

Option 219 - To base model, adds front-panel jumpers, R1 receiver switch, source and receiver attenuators (extended power range), and bias-tees.

4-Port Models

Option 400 - 4-port base model with standard test set.

Option 401 - To base model, adds front-panel jumpers and R1 receiver switch.

Option 417 - To base model, adds front-panel jumpers, R1 receiver switch, and source and receiver attenuators (extended power range).

Option 419 - To base model, adds front-panel jumpers, R1 receiver switch, source and receiver attenuators (extended power range), and bias-tees.

Notes

This document provides technical specifications for the 85052B calibration kit, N4691B ECal module, and N4433A ECal module.

Please download our free Uncertainty Calculator from 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 $25\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ 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.

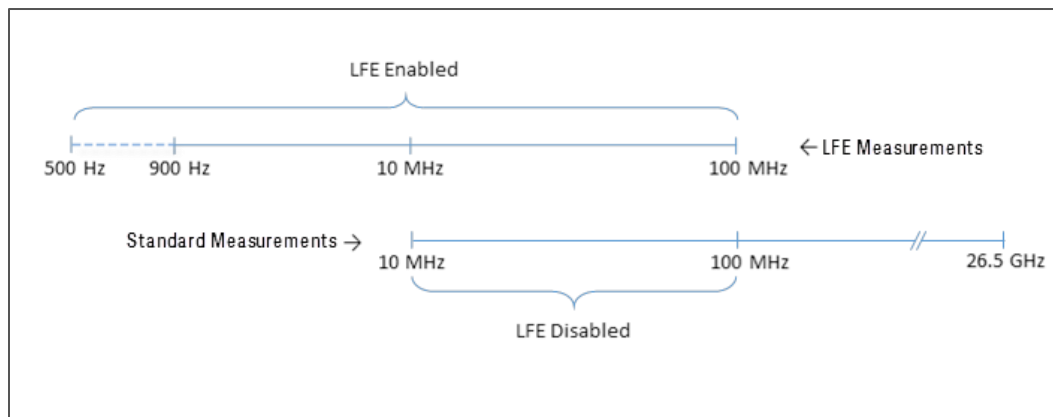
Calibration: The process of measuring known standards to characterize a network analyzer's systematic (repeatable) errors.

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.

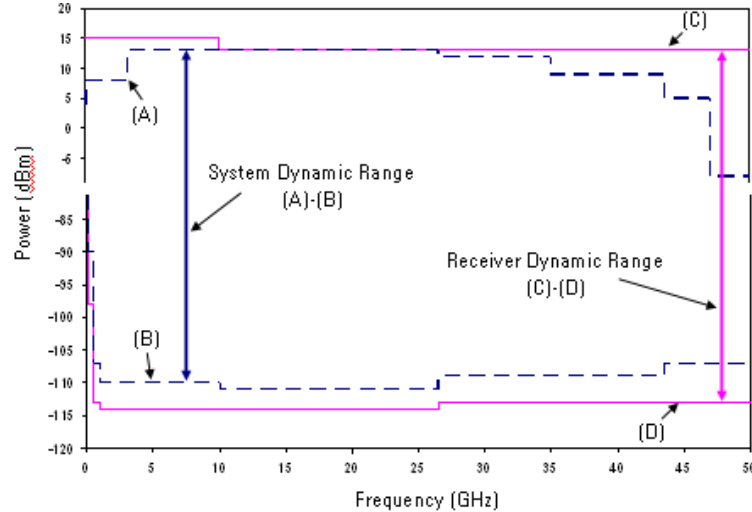
Standard and LFE measurements: With option 205, which adds low frequency extension (LFE) hardware, the LFE measurement range overlaps with the standard measurement range from 10 MHz to 100 MHz. With LFE Enabled, measurements from 500 Hz to 100 MHz use LFE hardware. With LFE Disabled, measurements from 10 MHz to 100 MHz use standard hardware. To measure below 10 MHz, LFE must be enabled. All measurements above 100 MHz use standard hardware, regardless of the LFE Enabled/Disabled setting.



Dynamic Range

The specifications in this section apply for measurements made with the N5221B and N5222B PNA network analyzers with the following conditions:

- 10 Hz IF bandwidth
- No averaging applied to data
- Isolation calibration with an averaging factor of 8
- **System Dynamic Range** is defined as the specified source maximum output power (A) minus the specified noise floor (B).
- **Extended Dynamic Range at Direct Access Input** is defined as the specified source maximum output power (A) minus the specified direct receiver access input noise floor (not shown).
- **Receiver Dynamic Range** is defined as the typical test port 0.1 dB compression (C) minus the typical noise floor (D).



System Dynamic Range

Table 1a. System Dynamic Range at Test Port (dB)

Description	Specification			Typical		
	Option 200, 201, 400, 401	Option 217, 219, 417, 419	Option 205	Option 200, 201, 400, 401	Option 217, 219, 417, 419	Option 205
10 MHz to 50 MHz ¹	94	94	87	108	108	101
50 MHz to 100 MHz ¹	108	108	103	123	123	118
100 MHz to 500 MHz	118	118	113	130	130	125
500 MHz to 2 GHz	127	127	123	138	138	133
2 GHz to 3.2 GHz	127	127	123	139	139	134
3.2 GHz to 10 GHz	127	127	125	141	141	139
10 GHz to 13.5 GHz	127	127	125	141	140	139
13.5 GHz to 16 GHz	127	127	124	140	139	137
16 GHz to 20 GHz	127	124	123	140	138	137
20 GHz to 24 GHz	124	121	118	136	134	133
24 GHz to 26.5 GHz	114	111	109	130	128	128

¹ With Option 205 installed and LFE disabled, applied to frequencies ≤ 100 MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled.

Table 1b. System Dynamic Range at Test Port (dB), N5222B, Option 205 (LFE Enabled)

Description	Specification	Typical	Effective Dynamic Range ¹ (Typical)
500 Hz to 900 Hz	--	105	103
900 Hz to 1 kHz	93	109	105
1 kHz to 100 kHz	103	109	99
100 kHz to 1 MHz	119	124	124
1 MHz to 5 MHz	118	125	119
5 MHz to 10 MHz	111	117	117
10 MHz to 50 MHz	110	116	116
50 MHz to 100 MHz	110	116	116

¹ Effective dynamic range is when the crosstalk is greater than the noise floor, and thus crosstalk limits the dynamic range. Crosstalk only limits the dynamic range for IF bandwidths < 1 kHz.

Extended Dynamic Range

Table 2. Extended Dynamic Range at Direct Receiver Access Input (dB) - Specification

Description	Option 201, 205, 401	Option 217, 219, 417, 419
10 MHz to 50 MHz	130	130
50 MHz to 100 MHz	120	120
100 MHz to 500 MHz	130	130
500 MHz to 19 GHz	139	139
19 GHz to 20 GHz	139	136
20 GHz to 24 GHz	136	133
24 GHz to 26.5 GHz	126	123

Receiver Dynamic Range

Table 3a. Receiver Dynamic Range (dB), All Options

Description	Typical
10 MHz to 50 MHz ¹	103
50 MHz to 100 MHz ¹	118
100 MHz to 500 MHz	122
500 MHz to 2 GHz	130
2 GHz to 13.5 GHz	131
13.5 GHz to 20 GHz	132
20 GHz to 24 GHz	128
24 GHz to 26.5 GHz	126

¹ With Option 205 installed and LFE disabled, applied to frequencies ≤ 100 MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled.

Table 3b. Receiver Dynamic Range (dB), N5222B, All Ports, Option 205 (LFE Enabled)

Description	Typical
500 Hz to 900 Hz	106
900 Hz to 1 kHz	109
1 kHz to 100 kHz	109
100 kHz to 1 MHz	123
1 MHz to 5 MHz	123
5 MHz to 10 MHz	119
10 MHz to 50 MHz	120
50 MHz to 100 MHz	120

Corrected System Performance, All Options

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 N5221B/2B Option 200, 201, 217, 219, 400, 401, 417 or 419 analyzers, 85131F flexible test port cable set, and a full 2-port calibration. Also applies to the following condition:

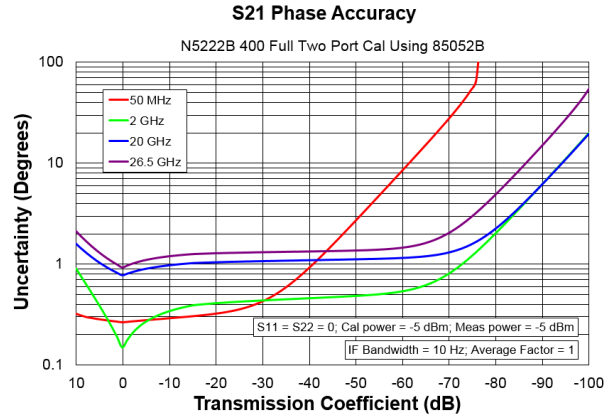
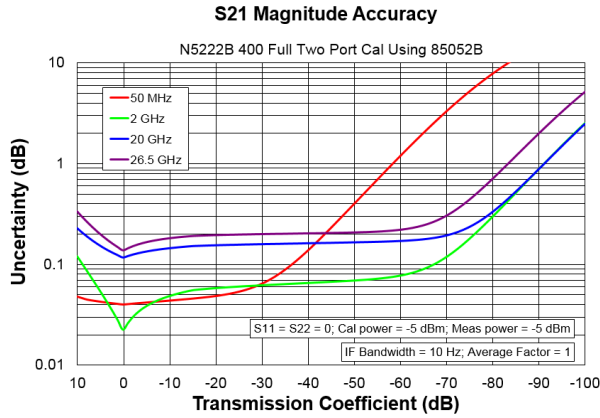
Environmental temperature $23^\circ \pm 3^\circ \text{C}$, with $< 1^\circ \text{C}$ deviation from calibration temperature

Table 4a. N5221B and N5222B with 85052B Calibration Kit

Description	Specification (dB)					
	10 MHz to 50 MHz ¹	50 MHz to 500 MHz ¹	500 MHz to 2 GHz	2 GHz to 13.5 GHz	13.5 GHz to 20 GHz	20 GHz to 26.5 GHz
Directivity	48	48	48	44	44	44
Source Match	40	40	40	31	31	31
Load Match	48	48	48	44	44	44
Reflection Tracking						
Mag	± 0.003	± 0.003	± 0.003	± 0.006	± 0.006	± 0.006
Phase (°)	± 0.020	± 0.020	± 0.020	± 0.040	± 0.040	± 0.040
Transmission Tracking						
Mag	± 0.034	± 0.017	± 0.017	± 0.091	± 0.104	± 0.119
Phase (°)	± 0.225	± 0.110	± 0.110	± 0.602	± 0.688	± 0.788

¹ With Option 205 installed and LFE disabled, applied to frequencies ≤ 100 MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled.

Transmission Uncertainty, All Options



Reflection Uncertainty, All Options

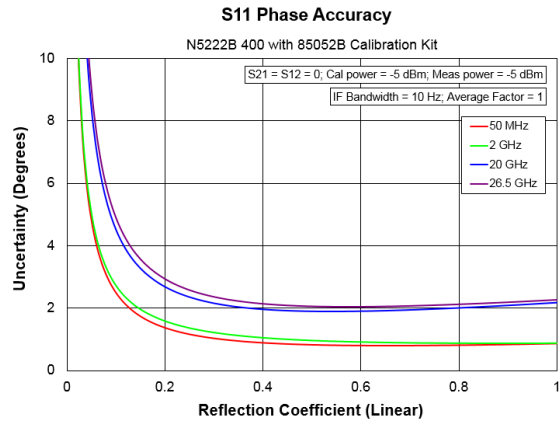
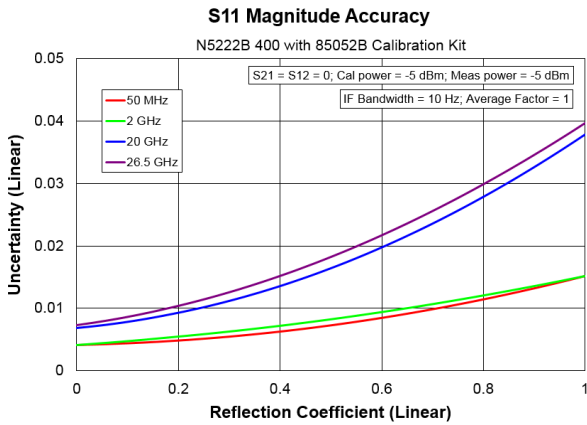
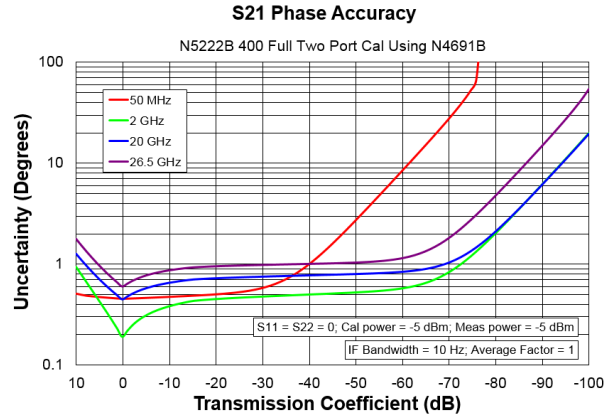
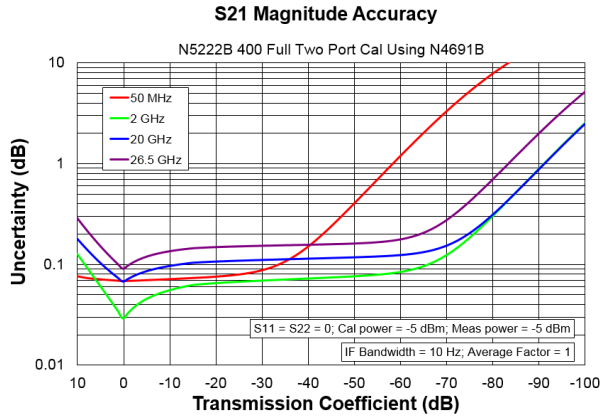


Table 4b. N5221B and N5222B with N4691B 2-Port Electronic Calibration Module

Description	Specification (dB)					
	10 MHz to 50 MHz ¹	50 MHz to 500 MHz ¹	500 MHz to 2 GHz	2 GHz to 13.5 GHz	13.5 GHz to 20 GHz	20 GHz to 26.5 GHz
Directivity	46	46	52	46	46	44
Source Match	41	41	47	42	42	40
Load Match	40	40	46	41	40	38
Reflection Tracking						
Mag	±0.050	±0.050	±0.020	±0.040	±0.040	±0.050
Phase (°)	±0.330	±0.330	±0.132	±0.264	±0.264	±0.330
Transmission Tracking						
Mag	±0.062	±0.056	±0.023	±0.054	±0.055	±0.072
Phase (°)	±0.410	±0.370	±0.152	±0.354	±0.365	±0.473

¹ With Option 205 installed and LFE disabled, applied to frequencies <= 100 MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled.

Transmission Uncertainty, All Options



Reflection Uncertainty, All Options

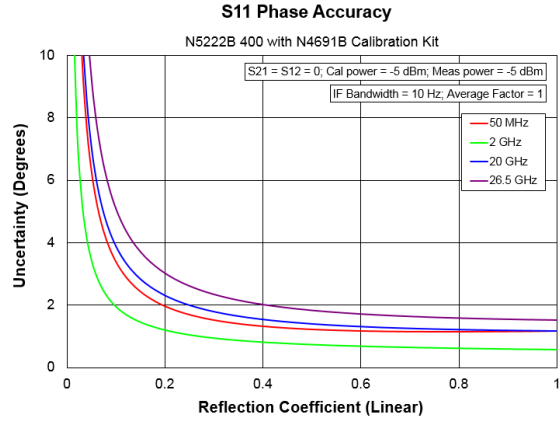
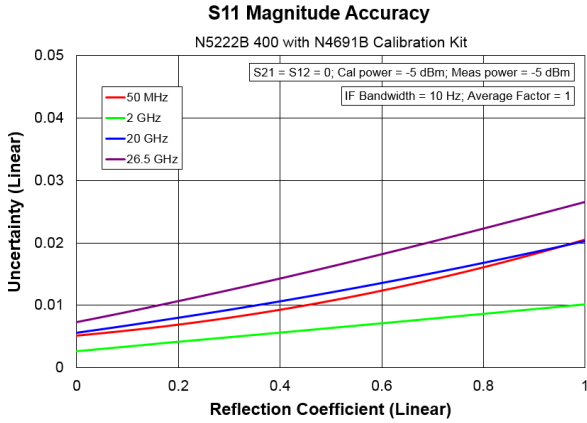


Table 4c. N5221B and N5222B with N4433A 4-Port Electronic Calibration Module

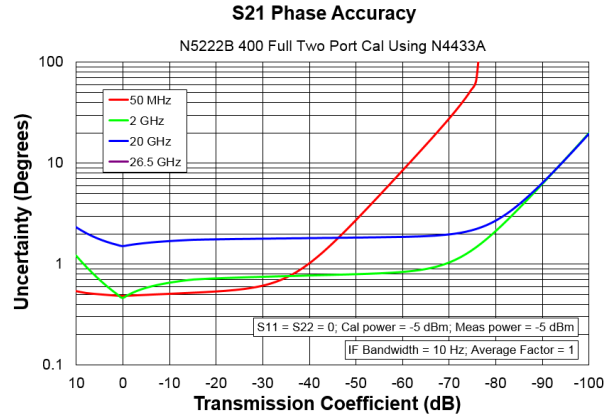
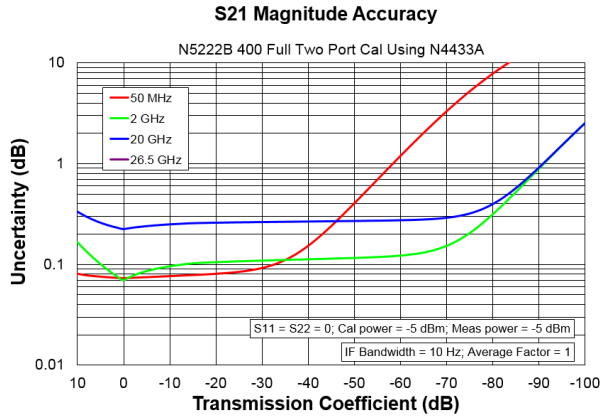
NOTE

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

Description	Specification (dB)				
	10 MHz to 50 MHz ¹	50 MHz to 500 MHz ¹	500 MHz to 2 GHz	2 GHz to 13.5 GHz	13.5 GHz to 20 GHz
Directivity	50	50	50	45	40
Source Match	42	42	42	37	31
Load Match	40	41	41	35	29
Reflection Tracking					
Mag	±0.060	±0.060	±0.060	±0.100	±0.180
Phase (°)	±0.396	±0.396	±0.396	±0.660	±1.188
Transmission Tracking					
Mag	±0.068	±0.064	±0.064	±0.115	±0.210
Phase (°)	±0.447	±0.421	±0.421	±0.761	±1.387

¹ With Option 205 installed and LFE disabled, applied to frequencies <= 100 MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled. For LFE enabled performance <= 100 MHz, see Table 4d.

Transmission Uncertainty, All Options



Reflection Uncertainty, All Options

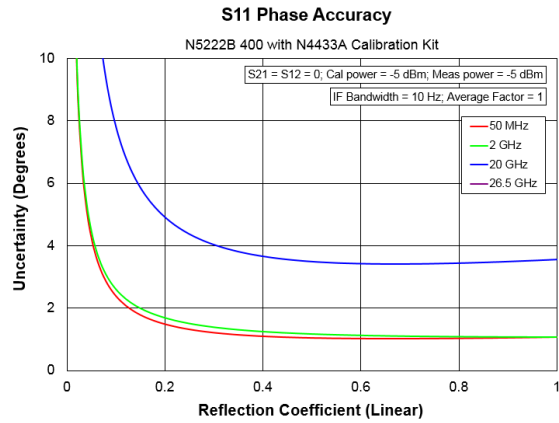
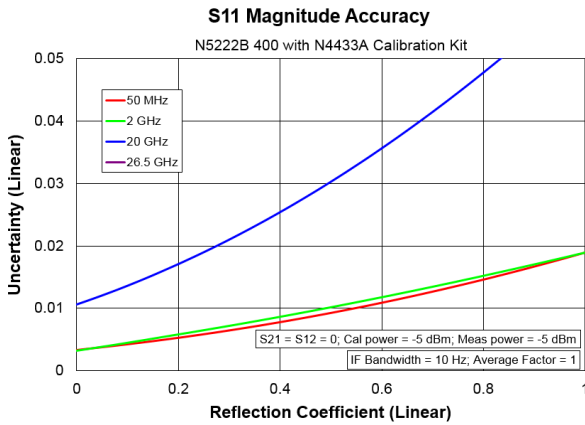
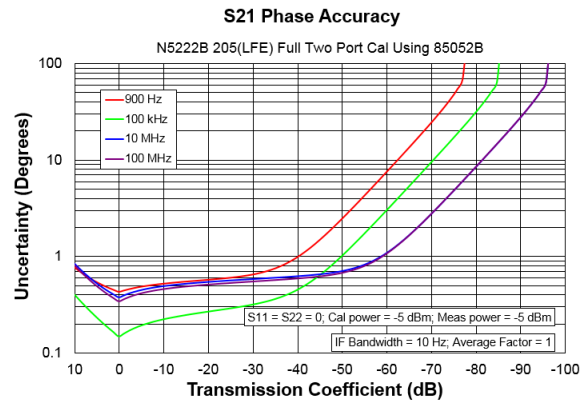
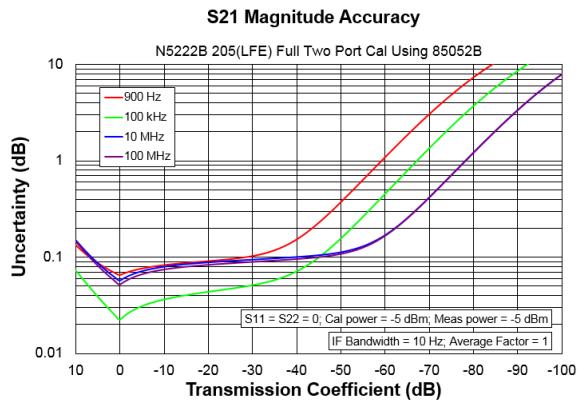


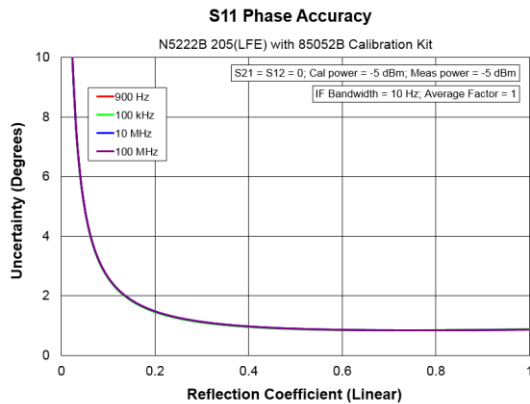
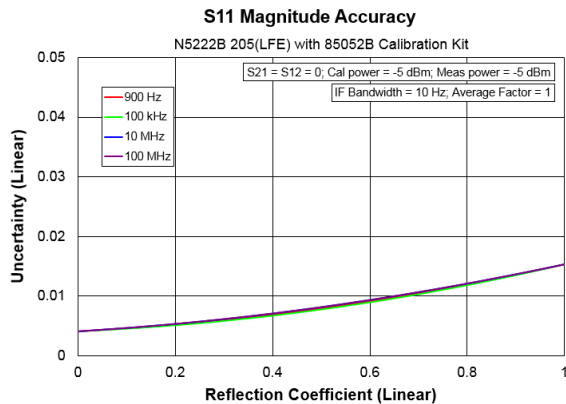
Table 4d. N5222B with 85052B Calibration Kit, Option 205 (LFE Enabled)

Description	Specification (dB)				
	1 kHz to 10 kHz	10 kHz to 1 MHz	1 MHz to 5 MHz	5 MHz to 50 MHz	50 MHz to 100 MHz
Directivity	48	48	48	48	48
Source Match	40	40	40	40	40
Load Match	48	48	48	48	48
Reflection Tracking					
Mag	±0.003	±0.003	±0.003	±0.003	±0.003
Phase (°)	±0.020	±0.020	±0.020	±0.020	±0.020
Transmission Tracking					
Mag	±0.055	±0.016	±0.050	±0.045	±0.045
Phase (°)	±0.361	±0.105	±0.333	±0.296	±0.296

Transmission Uncertainty, Option 205



Reflection Uncertainty, Option 205



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.

Table 5a. Error Terms (dB), All Ports, All Options - Specifications

Description	Directivity	Source Match	Load Match	Transmission Tracking	Reflection Tracking	Crosstalk
10 MHz to 50 MHz ¹	16 (16)	11 (9)	11 (9)	--	--	--
50 MHz to 3.2 GHz ¹	24 (24)	18 (7)	17 (7)	--	--	--
3.2 GHz to 10 GHz	23 (22)	14 (9)	13 (9)	--	--	--
10 GHz to 16 GHz	16 (16)	12 (9)	10 (9)	--	--	--
16 GHz to 24 GHz	16 (16)	10 (6)	9 (7)	--	--	--
24 GHz to 26.5 GHz	16 (16)	8 (6)	8 (6)	--	--	--

() With Option 205 installed.

¹ With Option 205 installed and LFE disabled, applied to frequencies <= 100 MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled. For LFE enabled performance <= 100 MHz, see Table 5b.

Table 5b. Error Terms (dB), N5222B, All Ports, Option 205 (LFE Enabled) - Specifications

Description	Directivity	Source Match	Load Match	Transmission Tracking	Reflection Tracking	Crosstalk
1 kHz to 10 kHz	1	7	7	--	--	--
10 kHz to 1 MHz	16	15	19	--	--	--
1 MHz to 5 MHz	16	9	11	--	--	--
5 MHz to 50 MHz	5	7	8	--	--	--
50 MHz to 100 MHz	5	8	9	--	--	--

Table 5c. Error Terms (dB), All Ports, All Options - Typical

Description	Directivity	Source Match	Load Match	Transmission Tracking	Reflection Tracking	Crosstalk
10 MHz to 50 MHz ¹	23 (23)	17 (10)	16 (10)	+/- 1.5	+/- 1.5	-84
50 MHz to 100 MHz ¹	29 (29)	29 (11)	28 (11)	+/- 1.5	+/- 1.5	-90
100 MHz to 500 MHz	29 (29)	29 (8)	28 (8)	+/- 1.5	+/- 1.5	-110
500 MHz to 3.2 GHz	31 (31)	24 (8)	22 (8)	+/- 1.5	+/- 1.5	-120
3.2 GHz to 10 GHz	25 (25)	19 (14)	17 (14)	+/- 1.5	+/- 1.5	-122
10 GHz to 13.5 GHz	21 (21)	17 (13)	15 (13)	+/- 1.5	+/- 1.5	-122
13.5 GHz to 16 GHz	20 (20)	16 (16)	15 (14)	+/- 1.5	+/- 1.5	-122
16 GHz to 20 GHz	20 (20)	15 (12)	15 (12)	+/- 1.5	+/- 1.5	-122
20 GHz to 24 GHz	19 (19)	13 (11)	13 (11)	+/- 1.5	+/- 1.5	-117
24 GHz to 26.5 GHz	20 (20)	13 (10)	13 (11)	+/- 1.5	+/- 1.5	-114

() With Option 205 installed.

¹ With Option 205 installed and LFE disabled, applied to frequencies <= 100 MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled. For LFE enabled performance <= 100 MHz, see Table 5d.

Table 5d. Error Terms (dB), N5222B, All Ports, Option 205 (LFE Enabled) - Typical

Description	Directivity	Source Match	Load Match	Transmission Tracking	Reflection Tracking	Crosstalk
500 Hz to 900 Hz	--	--	--	--	--	-103
900 Hz to 1 kHz	4	8	9	+/- 1.5	+/- 1.5	-105
1 kHz to 10 kHz	5	9	8	+/- 1.5	+/- 1.5	-99
10 kHz to 100 kHz	23	19	23	+/- 1.5	+/- 1.5	-105
100 kHz to 1 MHz	23	19	23	+/- 1.5	+/- 1.5	-125
1 MHz to 5 MHz	26	13	14	+/- 1.5	+/- 1.5	-119
5 MHz to 10 MHz	11	9	10	+/- 1.5	+/- 1.5	-120
10 MHz to 50 MHz	11	9	10	+/- 1.5	+/- 1.5	-117
50 MHz to 100 MHz	11	11	11	+/- 1.5	+/- 1.5	-118

Test Port Output

See Block diagrams for all models and option beginning on page 41.

Table 6. Frequency Information, All Options

Description	Specification	Typical
N5221B Frequency Range	10 MHz to 13.5 GHz	--
N5222B Frequency Range	10 MHz to 26.5 GHz	--
N5222B Frequency Range (Option 205) ¹	900 Hz to 26.5 GHz	500 Hz to 900 Hz
Frequency Resolution	1 Hz	--
Frequency Accuracy	+/- 1 ppm	--
Frequency Stability	--	+/-0.05 ppm, -10° to 70° C ² +/-0.1 ppm/yr maximum ³

¹ Extended frequency down to 500 Hz.

² Assumes no variation in time.

³ Assumes no variation in temperature.

Extended (typical)

Table 7a. Maximum Levelled Power (dBm) - Specification

Description	Option 200, 400, 201, 401		Option 217, 417, 219, 419	
	Port 1, Port 3	Port 2, Port 4	Port 1, Port 3	Port 2, Port 4
10 MHz to 50 MHz	12	12	12	12
50 MHz to 16 GHz	13	13	13	13
16 GHz to 20 GHz	13	12	10	10
20 GHz to 24 GHz	13	10	10	7
24 GHz to 26.5 GHz	7	5	4	2

Table 7b. Maximum Leveled Power (dBm) - Typical

Description	Option 200, 400, 201, 401		Option 217, 417, 219, 419	
	Port 1, Port 3	Port 2, Port 4	Port 1, Port 3	Port 2, Port 4
10 MHz to 50 MHz	20	17	20	17
50 MHz to 500 MHz	20	18	20	18
500 MHz to 1 GHz	20	20	19	20
1 GHz to 3.2 GHz	19	20	19	20
3.2 GHz to 10 GHz	22	21	22	21
10 GHz to 13.5 GHz	22	19	21	18
13.5 GHz to 16 GHz	20	18	19	17
16 GHz to 20 GHz	20	16	18	14
20 GHz to 24 GHz	18	14	16	12
24 GHz to 26.5 GHz	14	11	12	9

Table 7c. Maximum Leveled Power (dBm), N5222B – Option 205

Description	Specification		Typical	
	Port 1	Port 2	Port 1	Port 2
10 MHz to 50 MHz ¹	5	5	13	10
50 MHz to 500 MHz ¹	8	8	15	13
500 MHz to 3.2 GHz	9	9	15	16
3.2 GHz to 10 GHz	11	11	20	19
10 GHz to 13.5 GHz	11	11	20	17
13.5 GHz to 16 GHz	10	10	17	15
16 GHz to 20 GHz	10	9	17	13
20 GHz to 24 GHz	10	7	15	11
24 GHz to 26.5 GHz	5	2	12	8

¹ With Option 205 installed and LFE disabled, applied to frequencies <= 100 MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled. For LFE enabled performance <= 100 MHz, see Table 7d.

Table 7d. Maximum Power (dBm), N5222B, All Ports – Option 205 (LFE Enabled)

Description	Specification	Typical
500 Hz to 900 Hz	--	12
900 Hz to 1 kHz	10	13
1 kHz to 100 kHz	12	13
100 kHz to 1 MHz	12	14
1 MHz to 5 MHz	10	13
5 MHz to 10 MHz	9	11
10 MHz to 50 MHz	8	10
50 MHz to 100 MHz	8	10

Table 8a. Power Level Accuracy (dB) at Nominal Power¹, All Options

Description	Specification	Typical
10 MHz to 50 MHz ²	+/- 1.5	+/- 0.5
50 MHz to 500 MHz ²	+/- 1.0	+/- 0.2
500 MHz to 3.2 GHz	+/- 1.0	+/- 0.1
3.2 GHz to 10 GHz	+/- 1.0	+/- 0.2
10 GHz to 13.5 GHz	+/- 1.2	+/- 0.2
13.5 GHz to 18 GHz	+/- 2.0	+/- 0.3
18 GHz to 26.5 GHz	+/- 2.5	+/- 0.4

¹ Level accuracy at power other than nominal power, Power Level Accuracy (dB) at Nominal Power + Power Level Linearity (dB).

² With Option 205 installed and LFE disabled, applied to frequencies <= 100 MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled. For LFE enabled performance <= 100 MHz, see Table 8b.

Table 8b. Power Level Accuracy (dB), N5222B, All Ports, Option 205 (LFE Enabled)

Description	Specification	Typical
500 Hz to 900 Hz	--	+/- 0.1
900 Hz to 1 kHz	+/- 1.0	+/- 0.1
1 kHz to 100 kHz	+/- 1.0	+/- 0.1
100 kHz to 1 MHz	+/- 1.0	+/- 0.15
1 MHz to 5 MHz	+/- 1.0	+/- 0.15
5 MHz to 10 MHz	+/- 1.0	+/- 0.2
10 MHz to 50 MHz	+/- 1.0	+/- 0.2
50 MHz to 100 MHz	+/- 1.0	+/- 0.2

Table 9a. Power Level Linearity¹ (dB), All Options - Specification

Description	Port 1 or 3 ² -25dBm ≤ P < -20dBm	Port 1 or 3 ² -20dBm ≤ P < -15dBm	Port 1 or 3 ² P ≥ -15dBm
10 MHz to 50 MHz ³	+/-2.0	+/-1.5	+/-1.5
50 MHz to 26.5 GHz ³	+/-1.5	+/-1.5	+/-1.5

¹ Referenced to nominal power.

² Either port can be used as the source port.

³ With Option 205 installed and LFE disabled, applied to frequencies ≤ 100 MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled. For LFE enabled performance ≤ 100 MHz, see Table 9c.

Table 9b. Power Level Linearity¹ (dB), All Options - Specification

Description	Port 2 or 4 ² -25dBm ≤ P < -20dBm	Port 2 or 4 ² -20dBm ≤ P < -15dBm	Port 2 or 4 ² P ≥ -15dBm
10 MHz to 50 MHz ³	+/-2.5	+/-1.5	+/-1.5
50 MHz to 500 MHz ³	+/-2.0	+/-1.5	+/-1.5
500 MHz to 26.5 GHz	+/-1.5	+/-1.5	+/-1.5

¹ Referenced to nominal power.

² Either port can be used as the source port.

³ With Option 205 installed and LFE disabled, applied to frequencies ≤ 100 MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled. For LFE enabled performance ≤ 100 MHz, see Table 9c.

Table 9c. Power Level Linearity¹ (dB), N5222B, All Ports, Option 205 (LFE Enabled)

Description	Specification
500 Hz to 900 Hz	--
900 Hz to 100 MHz	+/-1.0

¹ Referenced to nominal power, from -25 dBm to max power.

Table 10a. Power Sweep Range (dB) - Specification

Description	Option 200, 400, 201, 401		Option 217, 417, 219, 419	
	Port 1, Port 3	Port 2, Port 4	Port 1, Port 3	Port 2, Port 4
10 MHz to 50 MHz	37	37	37	37
50 MHz to 16 GHz	38	38	38	38
16 GHz to 20 GHz	38	37	35	35
20 GHz to 24 GHz	38	35	35	32
24 GHz to 26.5 GHz	32	30	29	27

Table 10b. Power Sweep Range (dB), All Options - Typical

Description	Option 200, 400, 201, 401		Option 217, 417, 219, 419	
	Port 1, Port 3	Port 2, Port 4	Port 1, Port 3	Port 2, Port 4
10 MHz to 50 MHz	47	44	47	44
50 MHz to 500 MHz	47	45	47	45
500 MHz to 1 GHz	47	47	46	47
1 GHz to 3.2 GHz	46	47	46	47
3.2 GHz to 10 GHz	49	48	49	48
10 GHz to 13.5 GHz	49	46	48	45
13.5 GHz to 16 GHz	47	45	46	44
16 GHz to 20 GHz	47	43	45	41
20 GHz to 24 GHz	45	41	43	39
24 GHz to 26.5 GHz	41	38	39	36

Table 10c. Power Sweep Range (dB), N5222B – Option 205

Description	Specification		Typical	
	Port 1	Port 2	Port 1	Port 2
10 MHz to 50 MHz ¹	30	30	40	37
50 MHz to 500 MHz ¹	33	33	42	40
500 MHz to 3.2 GHz	34	34	42	43
3.2 GHz to 10 GHz	36	36	47	46
10 GHz to 13.5 GHz	36	36	47	44
13.5 GHz to 16 GHz	35	35	44	42
16 GHz to 20 GHz	35	34	44	40
20 GHz to 24 GHz	35	32	42	38
24 GHz to 26.5 GHz	30	27	39	35

¹ With Option 205 installed and LFE disabled, applied to frequencies \leq 100 MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled. For LFE enabled performance \leq 100 MHz, see Table 10d.

Table 10d. Power Sweep Range (dB), N5222B – Option 205 (LFE Enabled)

Description	Specification	Typical
500 Hz to 900 Hz	--	39
900 Hz to 1 kHz	35	40
1 kHz to 100 kHz	37	40
100 kHz to 1 MHz	37	41
1 MHz to 5 MHz	35	40
5 MHz to 10 MHz	34	38
10 MHz to 50 MHz	33	37
50 MHz to 100 MHz	33	37

Table 11. Nominal (Preset) Power (dBm)

Description	Option 200, 201, 205, 400, 401	Option 217, 219, 417, 419
Preset Power	0	-5

Table 12. Power Resolution and Maximum/Minimum Settable Power, All Options

Description	Specification (dB)	Typical (dBm)
Power Resolution	0.01	--
Maximum Settable Power	--	30
Minimum Settable Power		
Option 200, 201, 205, 400, 401	--	-30
Option 217, 219, 417, 419	--	-95

Table 13a. 2nd and 3rd Harmonics at Max Specified Power (dBc) All Options - Typical

Listed frequency is harmonic frequency; test at max specified power

Description	N5221B	N5222B
20 MHz to 4 GHz ¹	-15	-15
4 GHz to 13.5 GHz	-19	-19
13.5 GHz to 24 GHz	--	-19
24 GHz to 26.5 GHz	--	-21

¹ With Option 205 installed and LFE disabled, applied to frequencies <= 100 MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled. For LFE enabled performance <= 100 MHz, see Table 13b.

Table 13b. 2nd and 3rd Harmonics at Max Specified Power (dBc), N5222B, All Ports, Option 205 (LFE Enabled) - Typical

Listed frequency is fundamental frequency; test at max specified power

Description	N5222B (2 nd Harmonic)	N5222B (3 rd Harmonic)
500 Hz to 900 Hz	-32	-31
900 Hz to 1 kHz	-22	-23
1 kHz to 100 kHz	-22	-23
100 kHz to 1 MHz	-25	-22
1 MHz to 5 MHz	-28	-24
5 MHz to 10 MHz	-27	-22
10 MHz to 33 MHz	-28	-21
33 MHz to 50 MHz	-28	--

Table 14. Non-Harmonic Spurs at Nominal Power (dBc), All Options - Typical

Offset frequency = 30 kHz to 5 MHz

Description	Based on 100kHz offset Frac-N
10 MHz to 500 MHz ¹	-50
500 MHz to 2 GHz	-42
2 GHz to 4 GHz	-45
4 GHz to 8 GHz	-39
8 GHz to 16 GHz	-33
16 GHz to 26.5 GHz	-27

¹ Non-harmonic spurs are negligible with Option 205 installed and LFE enabled.

Table 15a. Phase Noise (dBc/Hz), All Options - Typical

Description	1 kHz Offset	10 kHz Offset	100 kHz Offset	1 MHz Offset
10 MHz to 500 MHz ¹	-100	-95	-95	-120
500 MHz to 1 GHz	-107	-117	-112	-127
1 GHz to 2 GHz	-101	-111	-106	-121
2 GHz to 4 GHz	-95	-105	-100	-115
4 GHz to 8 GHz	-89	-99	-94	-109
8 GHz to 16 GHz	-83	-93	-88	-103
16 GHz to 26.5 GHz	-77	-87	-82	-97

¹ With Option 205 installed and LFE disabled, applied to frequencies <= 100 MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled. For LFE enabled performance <= 100 MHz, see Table 15b.

Table 15b. Phase Noise (dBc/Hz), N5222B, All Ports, Option 205 (LFE Enabled) - Typical

Description	1 kHz Offset	10 kHz Offset	100 kHz Offset	1 MHz Offset
500 Hz to 100 MHz	-120	-130	-125	-135

Test Port Input

Table 16a. Test Port Noise Floor (dBm) @ 10 Hz IFBW, All Options

Total average (rms) noise power calculated as the mean value of a linear magnitude trace expressed in dBm. May typically be degraded at particular frequencies below 500 MHz due to spurious receiver residuals.

Description	Specification		Typical	
	N5221B	N5222B	N5221B	N5222B
10 MHz to 50 MHz ¹	-82	-82	-88	-88
50 MHz to 100 MHz ¹	-95	-95	-103	-103
100 MHz to 500 MHz	-105	-105	-110	-110
500 MHz to 2 GHz	-114	-114	-118	-118
2 GHz to 13.5 GHz	-114	-114	-119	-119
13.5 GHz to 20 GHz	--	-114	--	-120
20 GHz to 24 GHz	--	-111	--	-118
24 GHz to 26.5 GHz	--	-107	--	-116

¹ With Option 205 installed and LFE disabled, applied to frequencies <= 100 MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled. For LFE enabled performance <= 100 MHz, see Table 16b.

Table 16b. Test Port Noise Floor (dBm) @ 10 Hz IFBW, N5222B, Option 205 (LFE Enabled)

Description	Specification	Typical
500 Hz to 900 Hz	--	-93
900 Hz to 1 kHz	-83	-96
1 kHz to 100 kHz	-91	-96
100 kHz to 1 MHz	-107	-110
1 MHz to 5 MHz	-108	-112
5 MHz to 10 MHz	-102	-106
10 MHz to 50 MHz	-102	-106
50 MHz to 100 MHz	-102	-106

Table 17. Direct Receiver Access Input Noise Floor (dBm), Options 201, 205, 217, 219, 401, 417, 419

Total average (rms) noise power calculated as the mean value of a linear magnitude trace expressed in dBm. May typically be degraded at particular frequencies below 500 MHz due to spurious receiver residuals.

Description	Specification		Typical	
	N5221B	N5222B	N5221B	N5222B
10 MHz to 50 MHz	-118	-118	-133	-133
50 MHz to 100 MHz	-107	-107	-129	-129
100 MHz to 250 MHz	-117	-117	-136	-136
250 MHz to 500 MHz	-117	-117	-130	-130
500 MHz to 2 GHz	-126	-126	-133	-133
2 GHz to 13.5 GHz	-126	-126	-134	-134
13.5 GHz to 20 GHz	--	-126	--	-135
20 GHz to 24 GHz	--	-123	--	-133
24 GHz to 26.5 GHz	--	-119	--	-131

Table 18a. 0.1 dB Compression, Option 201, 205, 217, 219, 401, 417, 419 - Typical

Description	N5221B	N5222B
	Test Port Power (dBm)	Test Port Power (dBm)
10 MHz to 100 MHz ¹	15	15
100 MHz to 13.5 GHz	12	12
13.5 GHz to 20 GHz	--	12
20 GHz to 26.5 GHz	--	10

¹ With Option 205 installed and LFE disabled, applied to frequencies <= 100 MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled. For LFE enabled performance <= 100 MHz, see Table 18b.

Table 18b. 0.1 dB Compression, N5222B, All Ports, Option 205 (LFE Enabled) - Typical

Description	Test Port Power (dBm)
500 Hz to 900 Hz	13
900 Hz to 1 kHz	13
1 kHz to 100 kHz	13
100 kHz to 1 MHz	13
1 MHz to 5 MHz	11
5 MHz to 10 MHz	13
10 MHz to 50 MHz	14
50 MHz to 100 MHz	14

Table 18c. Compression - Specification

Description	Test Port Power (dBm)	Receiver Compression	
	Option 200, 400	Magnitude (dB)	Phase (degrees)
10 MHz to 500 MHz ¹	--	--	--
500 MHz to 16 GHz	8	0.21	1.60
16 GHz to 24 GHz	8	0.24	1.73
24 GHz to 26.5 GHz	8	0.42	2.51

¹Test port receiver compression at specified input levels below 500 MHz due to coupler roll off in this frequency range.

Table 18d. Compression - Specification

Description	Test Port Power (dBm)			Receiver Compression	
	Option 201, 205, 401	Option 217, 417	Option 219, 419	Magnitude (dB)	Phase (degrees)
10 MHz to 500 MHz ¹	--	--	--	--	--
500 MHz to 16 GHz	8	8	8	0.17	0.97
16 GHz to 24 GHz	8	8	8	0.23	1.20
24 GHz to 26.5 GHz	8	8	8	0.29	1.74

¹ Test port receiver compression at specified input levels below 500 MHz due to coupler roll off in this frequency range.

Table 18e. Compression, N5222B, All Ports, Option 205 (LFE Enabled) - Specification

Description	Test Port Power (dBm)	Receiver Compression	
		Magnitude (dB)	Phase (degrees)
500 Hz to 900 Hz	--	--	--
900 Hz to 1 kHz	10	0.2	1
1 kHz to 100 kHz	12	0.2	1
100 kHz to 1 MHz	12	0.2	1
1 MHz to 5 MHz	10	0.2	1
5 MHz to 10 MHz	9	0.2	1
10 MHz to 50 MHz	8	0.2	1
50 MHz to 100 MHz	8	0.2	1

Table 19a. Trace Noise Magnitude (dB rms), All Options

Ratioed measurement, nominal power at test port.

Description	Specification	Typical		
		1 kHz IFBW	100 kHz IFBW	600 kHz IFBW
10 MHz to 100 MHz ¹	0.007	0.0036	0.053	0.103
100 MHz to 13.5 GHz ¹	0.002	0.0005	0.004	0.010
13.5 GHz to 16 GHz	0.002	0.0003	0.003	0.007
16 GHz to 22.5 GHz	0.002	0.0005	0.003	0.007
22.5 GHz to 24 GHz	0.003	0.0008	0.004	0.011
24 GHz to 26.5 GHz	0.005	0.0012	0.007	0.017

¹ With Option 205 installed and LFE disabled, applied to frequencies <= 100 MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled.

Table 19b. Trace Noise Magnitude (dB rms), N5222B, All Ports, Option 205 (LFE Enabled)

Ratioed measurement, nominal power at test port.

Description	Specification		Typical			
	100 Hz IFBW	1 kHz IFBW	100 Hz IFBW	1 kHz IFBW	100 kHz IFBW	600 kHz IFBW
500 Hz to 900 Hz	--	--	0.002	--	--	--
900 Hz to 4 kHz	0.004	--	0.001	--	--	--
4 kHz to 300 kHz	--	0.004	--	0.002	--	--
300 kHz to 2 MHz	--	0.004	--	0.001	0.01	--
2 MHz to 100 MHz	--	0.004	--	0.001	0.01	0.025

Table 20a. Trace Noise Phase (deg rms), All Options

Ratioed measurement, nominal power at test port.

Description	Specification	Typical		
		1 kHz IFBW	100 kHz IFBW	600 kHz IFBW
10 MHz to 100 MHz ¹	0.051	0.0237	0.341	0.663
100 MHz to 13.5 GHz ¹	0.015	0.0045	0.027	0.067
13.5 GHz to 16 GHz	0.042	0.0045	0.019	0.042
16 GHz to 22.5 GHz	0.042	0.0075	0.024	0.050
22.5 GHz to 24 GHz	0.054	0.0080	0.031	0.073
24 GHz to 26.5 GHz	0.054	0.0128	0.049	0.118

¹ With Option 205 installed and LFE disabled, applied to frequencies <= 100 MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled. For LFE enabled performance <= 100 MHz, see Table 20b.

Table 20b. Trace Noise Phase (deg rms), N5222B, All Ports, Option 205 (LFE Enabled)

Ratioed measurement, nominal power at test port.

Description	Specification		Typical			
	100 Hz IFBW	1 kHz IFBW	100 Hz IFBW	1 kHz IFBW	100 kHz IFBW	600 kHz IFBW
500 Hz to 900 Hz	--	--	0.012	--	--	--
900 Hz to 4 kHz	0.03	--	0.008	--	--	--
4 kHz to 300 kHz	--	0.03	--	0.014	--	--
300 kHz to 2 MHz	--	0.03	--	0.007	0.064	--
2 MHz to 100 MHz	--	0.03	--	0.007	0.068	0.166

Table 21. Reference Level Magnitude, All Options - Specification

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

Table 22a. Stability, All Options - Typical

Description	Magnitude (dB/°C)	Phase (°/°C)
10 MHz to 50 MHz ¹	0.010	0.180
50 MHz to 500 MHz ¹	0.010	0.060
500 MHz to 3.2 GHz	0.010	0.080
3.2 GHz to 10 GHz	0.020	0.130
10 GHz to 13.5 GHz	0.020	0.160
13.5 GHz to 16 GHz	0.020	0.300
16 GHz to 20 GHz	0.020	0.400
20 GHz to 24 GHz	0.030	0.500
24 GHz to 26.5 GHz	0.030	0.560

¹ With Option 205 installed and LFE disabled, applied to frequencies <= 100 MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled. For LFE enabled performance <= 100 MHz, see Table 22b.

Table 22b. Stability¹, N5222B, Option 205 (LFE Enabled)- Typical

Description	Magnitude (dB/°C)	Phase (°/°C)
500 Hz to 900 Hz	0.010	0.2
900 Hz to 1 kHz	0.010	0.2
1 kHz to 100 kHz	0.010	0.2
100 kHz to 1 MHz	0.010	0.1
1 MHz to 5 MHz	0.010	0.1
5 MHz to 10 MHz	0.010	0.1
10 MHz to 50 MHz	0.010	0.1
50 MHz to 100 MHz	0.020	0.1

¹ Stability is defined as a ratio measurement made at the test port.

Table 23. Damage Input Level

Description	Option 200, 201, 219, 400, 401, 419	Option 217, 417	Option 205
RF, DC	30 dBm, 40 V	30 dBm, 7 V	20 dBm, 50 V

Dynamic Accuracy

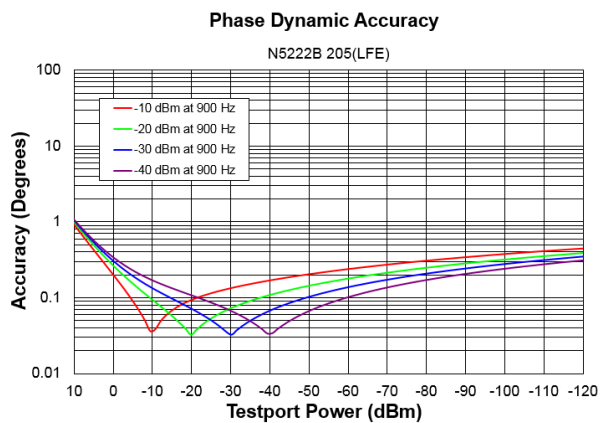
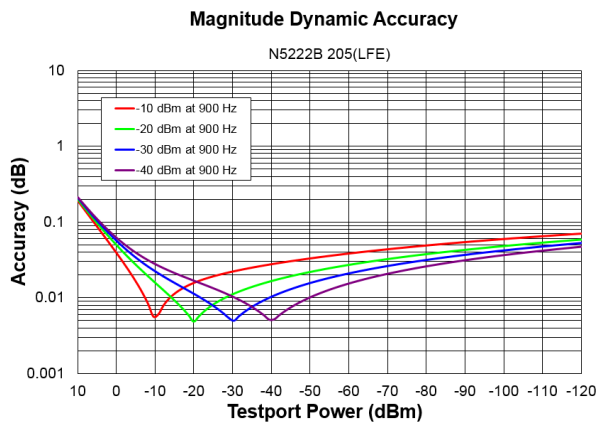
Dynamic accuracy is verified with the following measurements:

Compression over frequency

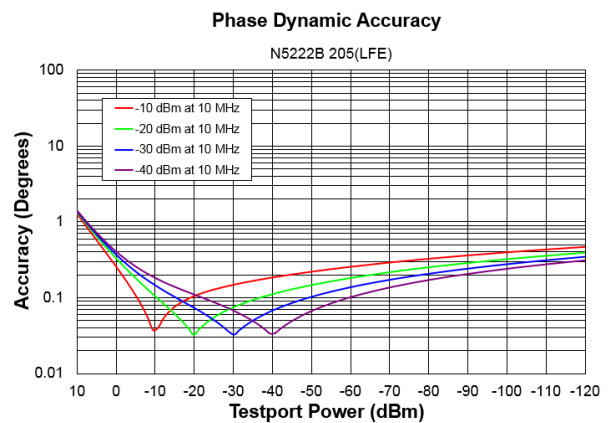
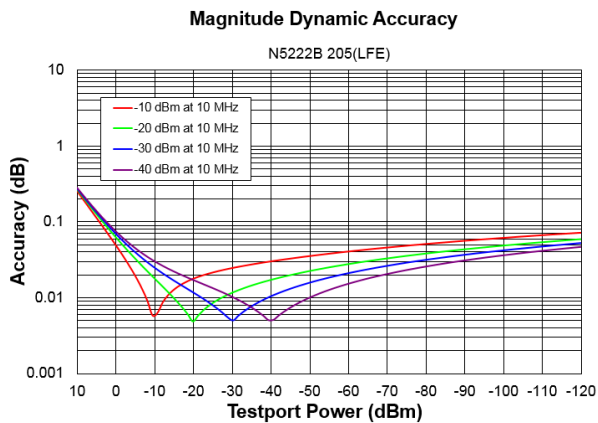
IF linearity at a single frequency of 1.998765GHz using a reference level of -20 dBm for an input power range of 0 to -60 dBm. For values below -60 dBm, refer to [VNA Receiver Dynamic Accuracy Specifications and Uncertainties](#)

Table 24. N5221B and N5222B Dynamic Accuracy

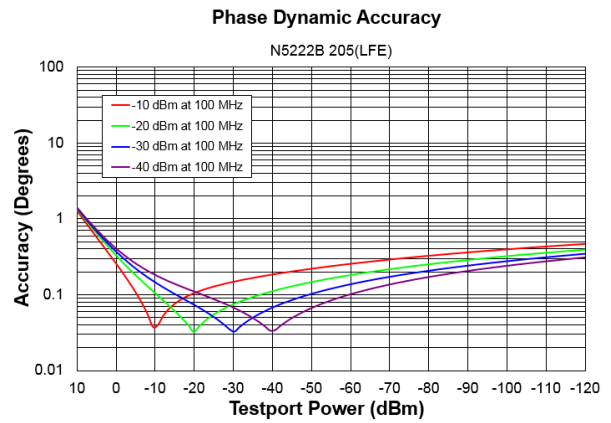
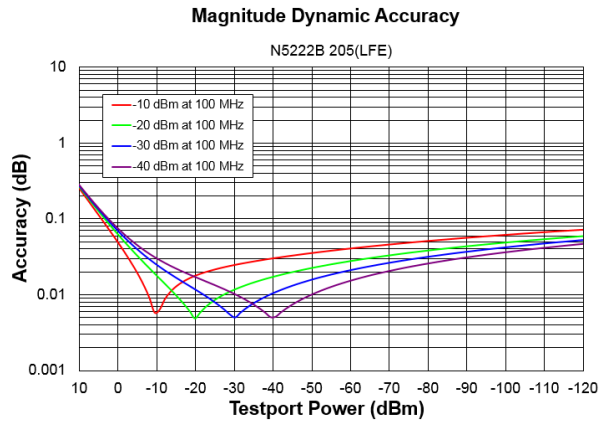
N5222B Dynamic Accuracy, 900 Hz (LFE Enabled) - Specification



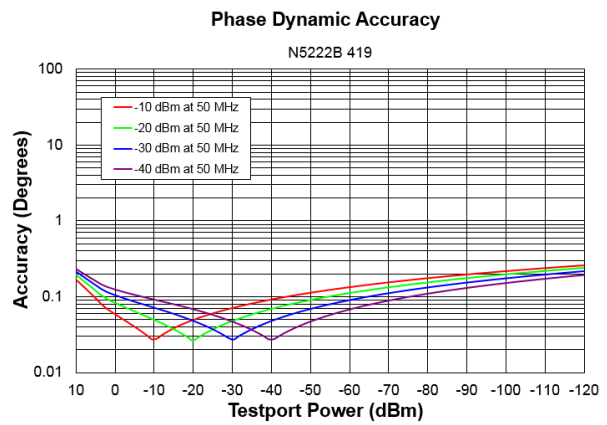
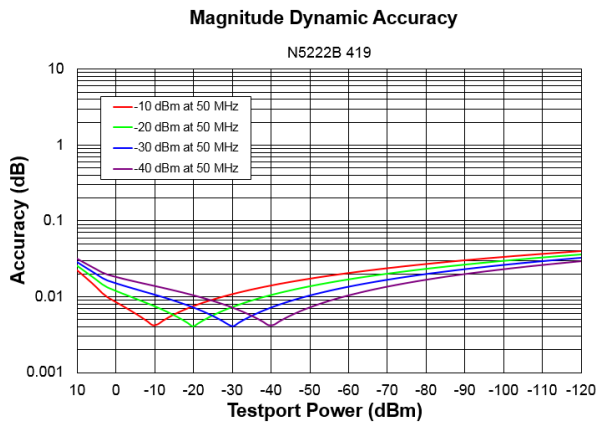
N5222B Dynamic Accuracy, 10 MHz (LFE Enabled) - Specification



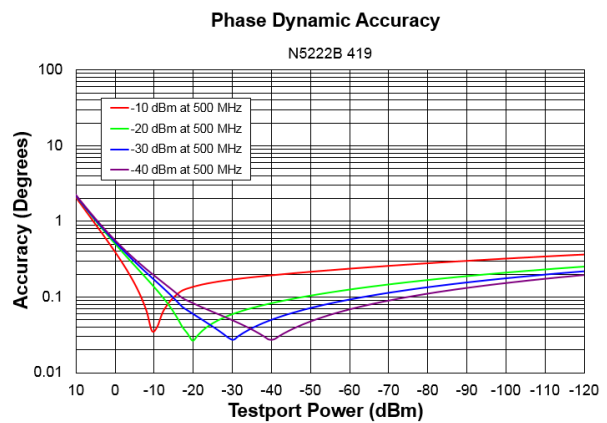
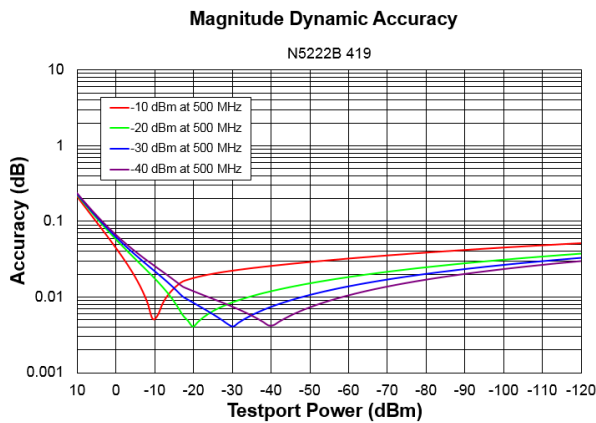
N5222B Dynamic Accuracy, 100 MHz (LFE Enabled) - Specification



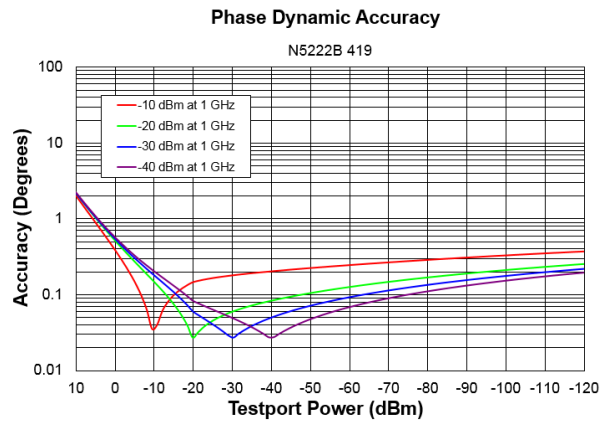
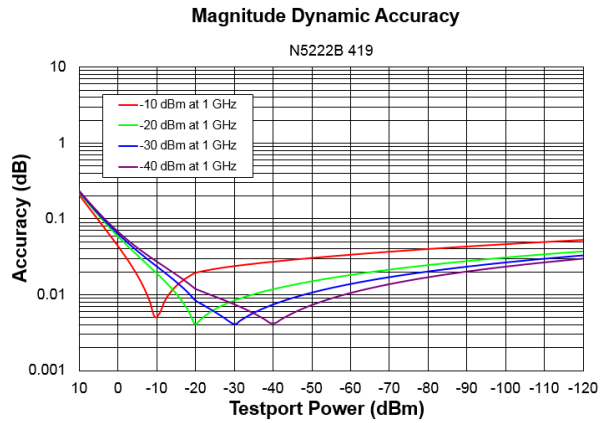
N5221B/22B Dynamic Accuracy, 10 MHz to 50 MHz - Specification



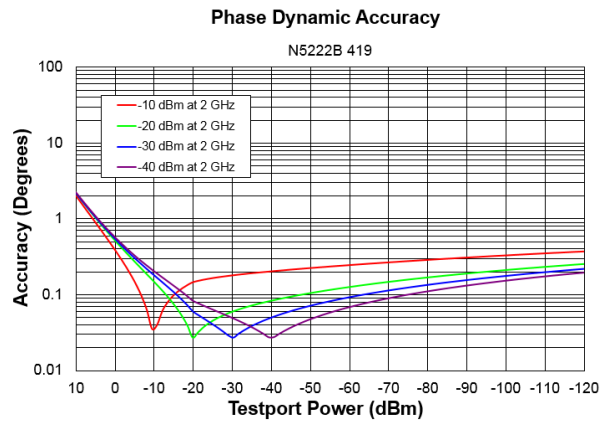
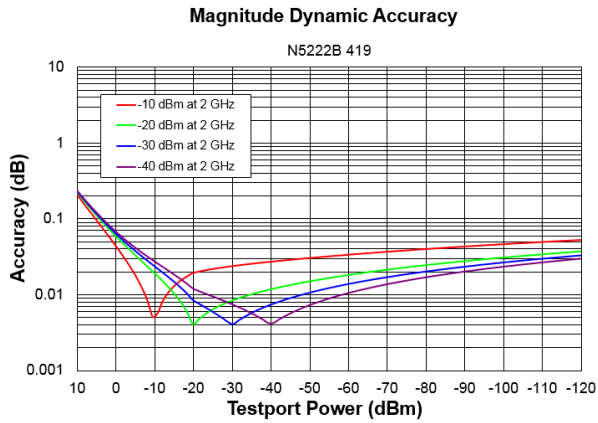
N5221B/22B Dynamic Accuracy, 50 MHz to 500 MHz - Specification



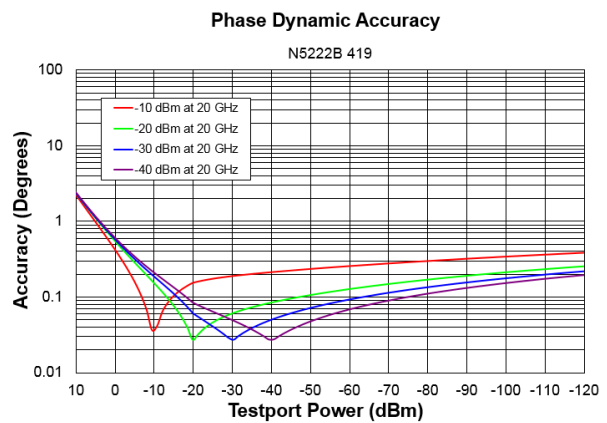
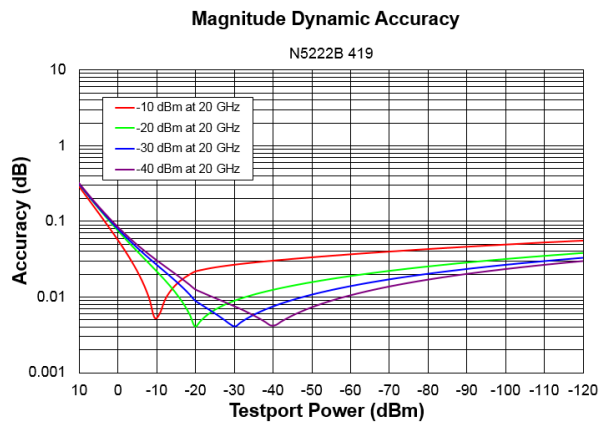
N5221B/22B Dynamic Accuracy, 500 MHz to 1 GHz - Specification



N5221B/22B Dynamic Accuracy, 1 GHz to 2 GHz - Specification



N5221B/22B Dynamic Accuracy, 2 GHz to 20 GHz - Specification



N5221B/22B Dynamic Accuracy, 20 GHz to 26.5 GHz - Specification

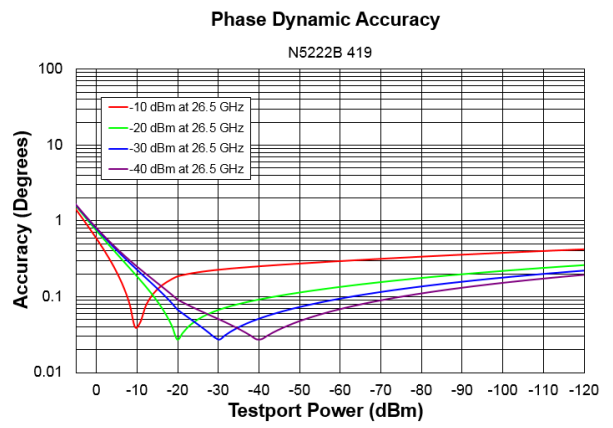
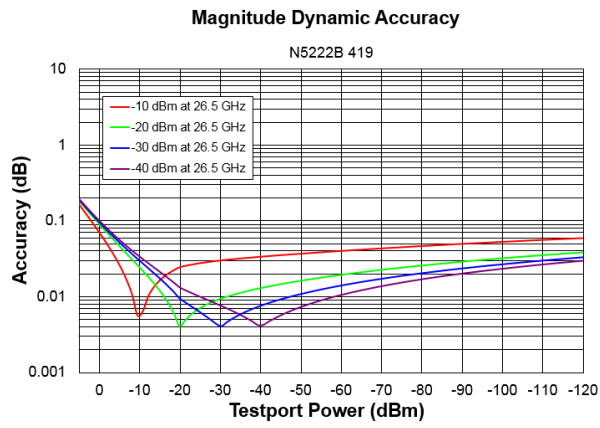


Table 25. Group Delay - Typical

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

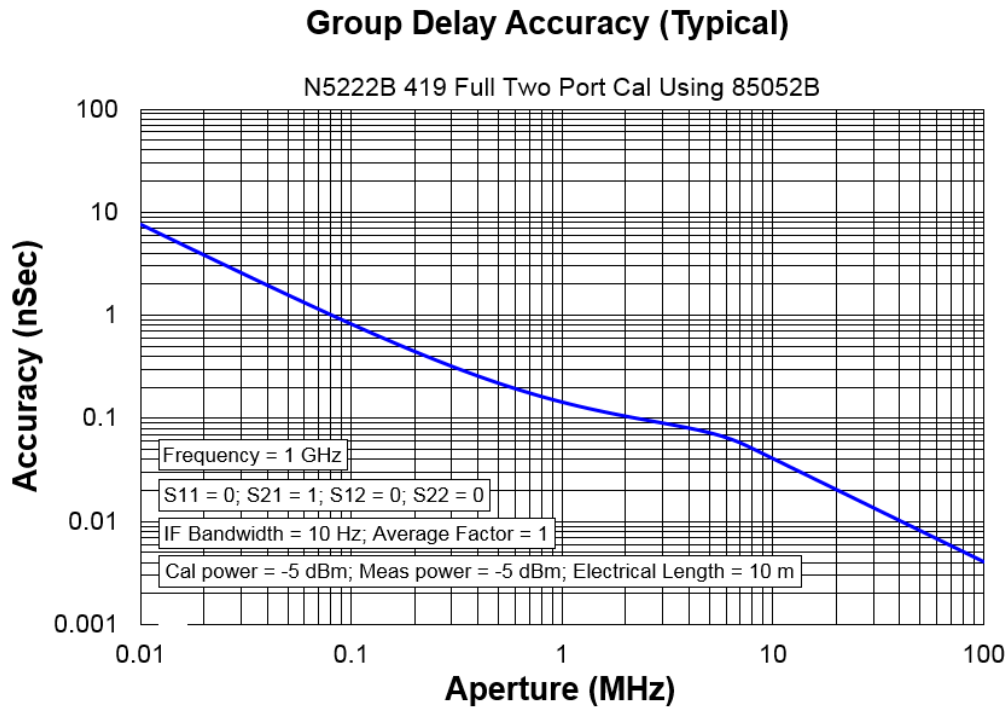
$$\pm \text{Phase Accuracy (deg)} / [360 \times \text{Aperture (Hz)}]$$

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

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.)

The following graphs show 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 $kl \neq ij$



General Information

- [Miscellaneous Information](#)
- [Front Panel](#)
- [Rear Panel](#)
- [Environment and Dimensions](#)

Table 26. Miscellaneous Information

Description	Supplemental Information
System IF Bandwidth Range	1 Hz to 15 MHz, nominal
CPU	For the latest information on CPUs and associated hard drives, visit: http://na.support.keysight.com/pna/hdnumbers.html
LXI	Class C

Table 27. Front Panel Information, All Options

Description	Typical Performance
RF Connectors	
Type	3.5 mm (male), 50 ohm, (nominal)
Center Pin Recession	0.002 in. (characteristic)
USB 2.0 Ports - Master (4 ports)	
Standard	Compatible with USB 2.0
Connector	USB Type-A female
Display	
Size	31 cm (12.1 in) diagonal color active matrix LCD; 1280 (horizontal) X 800 (vertical) resolution
Refresh Rate	Vertical 60 Hz; Horizontal 49.31 kHz
Pixels	Any of the following would cause a display to be considered faulty: <ul style="list-style-type: none"> • A complete row or column consists of “stuck” or “dark” pixels. • 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. • 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. • 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). • “Stuck on” pixels or more than two “dark” pixels less than 6.5 mm apart (excluding consecutive pixels).

Table 27. (Continued) Front Panel Information, All Options

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

Table 28. Rear Panel Information, All Options

Description	Typical Performance
10 MHz Reference In	
Connector	BNC, female
Input Frequency	10 MHz ± 10 ppm
Input Level	-15 dBm to +20 dBm
Input Impedance	200 Ω, nom.
10 MHz Reference Out	
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 28. (Continued) Rear Panel Information, All Options

Description	Typical Performance
External IF Inputs	
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)
Input Frequency	
Normal IF path	RF < 53 MHz: IF = 826.446 KHz RF >= 53 MHz: IF = 7.438 MHz
Narrowband IF path	IF = 10.70 MHz
Input Impedance	50 Ω
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
Pulse Inputs (IF Gates)	
Function	Internal receiver gates used for point-in-pulse and pulse-profile measurements
Connectors	15-pin mini D-sub
Input Impedance	1 K Ohm
Minimum Pulse Width, Source Modulators	33 ns
Minimum Pulse Width, Receiver Gates	20 ns
DC Damage Level	5.5 VDC
Drive Voltage	0 V (off), +3.3 V (on), nominal
RF Pulse Modulator Input (Source Modulator)	
On/Off Ratio	
10 MHz to 3.2 GHz	-64
3.2 GHz to 26.5 GHz	-80
Pulse Period	
Minimum	33 ns
Maximum	70 s

Table 28. (Continued) Rear Panel Information, All Options

Description	Typical Performance	
Pulse Outputs		
Voltage (TTL)	High: 3.3V to 3.5V Low: <1V	
Impedance	50 Ohm	
External Test Set Driver		
Function	Used for driving remote mixers	
Connections	3.5 mm (female)	
RF Output Frequency Range	3.2 GHz to 19 GHz	
LO Output Frequency Range	1.76 GHz to 26.5 GHz	
Rear Panel LO Power¹		
	Upper Limit, Typical (dBm)	Lower Limit, Typical (dBm)
1.7 GHz to 16 GHz	0	-10
16 GHz to 21 GHz	4	-6
21 GHz to 26.5 GHz	6	-4
Rear Panel RF Power		
	Upper Limit, Typical (dBm)	Lower Limit, Typical (dBm)
3.2 GHz to 19 GHz	-3	-8
Devices Supported		
	Resolutions	
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").

¹ LO output available in full analyzer's frequency range. The power is tested only from 3.2 GHz to 26.5 GHz.

Table 28. (Continued) Rear Panel Information, All Options

Description	Typical Performance
Bias Tee Inputs	
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 Ports	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
Line Power	
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 29. Analyzer Dimensions and Weight

All models are shipped with handles.

Cabinet Dimensions	Metric (mm)	Imperial (inches)
Height		
Without bottom feet: ¹ EIA RU = 6	266.1	10.5
With bottom feet	279.1	11.0
Width		
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
Depth		
Without front and rear panel hardware	533.0	21.0
With front and rear panel hardware, handles	578.0	22.7

¹Electronics Industry Association rack units. 1 RU = 1.75 in.

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

Weight (nominal)	Net	Shipping
2-port models (Option 200, 201, 217 or 219)	27 kg (60 lb)	43 kg (95 lb)
4-port models (Option 400, 401, 417 or 419)	36.7 kg (81 lb)	51 kg (112 lb)

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 (S₁₁) measurement.

Table 30a. Typical Cycle Time (ms) for Measurement Completion, All Models / Options

Sweep Range	IF Bandwidth		Number of Points				
			201	401	1601	16001	32001
50 kHz to 100 MHz	10kHz	Uncorrected	75	141	515	4726	9243
		2-Port cal	155	285	1050	9505	18440
	1kHz	Uncorrected	306	599	2339	23000	46003
		2-Port cal	611	1200	4715	46185	91960
	100Hz	Uncorrected	2543	5085	20293	202691	405085
		2-Port cal	5120	10200	40640	405200	809800
9 GHz to 10 GHz	600 kHz	Uncorrected	6.3	6.3	10.9	68	132
		2-Port cal	18.8	20.3	30	145	275
	10 kHz	Uncorrected	29.7	54.7	205	2000	4000
		2-Port cal	67	117	417	4031	8047
	1 kHz	Uncorrected	227	445	1742	17031	33844
		2-Port cal	462	900	3500	34102	67734
10 GHz to 20 GHz	600 kHz	Uncorrected	18.8	18.8	23	70	133
		2-Port cal	45.3	46.9	55	180	313
	10 kHz	Uncorrected	69	127	270	2009	4009
		2-Port cal	145	263	548	4030	8055
	1 kHz	Uncorrected	234	458	1781	17383	34531
		2-Port cal	477	922	3578	34789	69109

Table 30b. N5221B Typical Cycle Time (ms) for Full-Span Measurement Completion

10 MHz to 13.5 GHz		Number of Points				
IF Bandwidth		201	401	1601	16001	32001
600 kHz	Uncorrected	6.9	7.2	11.9	69	132
	2-Port cal	22.2	23.1	32.2	148	275
10 kHz	Uncorrected	59	61	205	2004	4003
	2-Port cal	126	130	418	4019	8020
1 kHz	Uncorrected	204	402	1593	15877	31751
	2-Port cal	416	813	3194	31766	63539

Table 30c. N5222B Typical Cycle Time (ms) for Full-Span Measurement Completion

10 MHz to 26.5 GHz		Number of Points				
IF Bandwidth		201	401	1601	16001	32001
600 kHz	Uncorrected	43	50	68	141	198
	2-Port cal	93	107	141	284	405
10 kHz	Uncorrected	80	142	480	2184	4125
	2-Port cal	168	291	964	4378	8297
1 kHz	Uncorrected	245	472	1809	17508	34773
	2-Port cal	498	950	3622	35047	69609

Table 31. 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		N5221B/22B	
IF Bandwidth (Hz)	Cycle Time (ms)	Trace Noise Magnitude (dB rms)	
600,000	5.6	0.0045	
100,000	6.9	0.0018	
30,000	10	0.0011	
10,000	26.7	0.0006	
3,000	72	0.0004	
1,000	223	0.0003	
300	641	0.0002	
100	1825	0.0002	
30	5984	0.0002	
10	17836	0.0002	
3	59281	0.0002	

Table 32. Cycle Time vs. Number of Points - Typical

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.

Description	IF Bandwidth (Hz)			
	1,000	10,000	30,000	600,000
3	7.5	5.9	5.9	5.9
11	15.6	6.6	5.9	5.9
51	60	10.6	5.9	5.9
101	114	16.9	7.2	6.3
201	223	29.4	9.7	6.3
401	437	54.7	15	6.9
801	862	105	25.3	7.8
1,601	1706	203	45.9	11
6,401	6728	803	169	30
16,001	16669	2003	416	68
32,001	33106	4003	828	130

Table 33. Data Transfer Time (ms) - Typical

Measured with the analyzer display off.

Values will increase slightly if the analyzer display is on.

Description	Number of Points				
	201	401	1601	16,001	32,001
SCPI over GPIB (Program executed on external PC ²)					
32-bit floating point	4.6	9.3	38	352	720
64-bit floating point	9.4	18.8	73.4	730	1455
ASCII	36.7	72.5	288	2882	5762
SCPI over SICT/LAN or TCP/IP Socket¹ (Program executed in the analyzer)					
32-bit floating point	<1	<1	<1	1.2	2.4
64-bit floating point	<1	<1	<1	2.3	4.6
ASCII	2.1	4	15	148	295
COM¹ (Program executed in the analyzer)					
32-bit floating point	<1	<1	<1	<1	<1
Variant type	<1	<1	1.4	12.4	25.5
DCOM over LAN¹ (Program executed on external PC)					
32-bit floating point	<1	<1	<1	2.3	4.4
Variant type	<1	1.6	5.3	52	105.5

¹ Values are for real and imaginary pairs, with the analyzer display off, using Gigabit Ethernet.

NOTE

Specifications for Recall & Sweep Speed are not provided for the N522xB analyzers.

Specifications: Front-Panel Jumpers



The following options have front-panel jumpers for each port:
201, 217, 219, 401, 417, 419

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

Table 34. Measurement Receiver Inputs (dBm) – Typical
(RCVR A, B, C, D IN) @ 0.1dB Typical Compression

Description	All Options
10 MHz to 500 MHz	-4
500 MHz to 3.2 GHz	-2
3.2 GHz to 10 GHz	-3
10 GHz to 13.5 GHz	-4
13.5 GHz to 26.5 GHz	-5

Table 35. Reference Receiver Inputs and Reference Source Outputs (dBm) - Typical

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

Description	Option 201, 401	Option 217, 219, 417, 419
10 MHz to 50 MHz	-4	-4
50 MHz to 10 GHz	-3	-2
10 GHz to 16 GHz	-4	-2
16 GHz to 20 GHz	-5	-6
20 GHz to 24 GHz	-6	-7
24 GHz to 26.5 GHz	-14	-14

Table 36. Reference Receiver Inputs and Reference Source Outputs (dBm) - Typical

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

Description	Option 201, 401		Option 217, 219, 417, 419	
	RCVR R2 IN, RCVR R4 IN, REF 2 SOURCE OUT, REF 4 SOURCE OUT	RCVR R3 IN, REF 3 SOURCE OUT	RCVR R2 IN, RCVR R4 IN, REF 2 SOURCE OUT, REF 4 SOURCE OUT	RCVR R3 IN, REF 3 SOURCE OUT
10 MHz to 50 MHz	-2	-2	-2	-2
50 MHz to 500 MHz	-1	-1	-1	-1
500 MHz to 3.2 GHz	-1	-1	0	0
3.2 GHz to 10 GHz	0	0	+1	+1
10 GHz to 16 GHz	0	0	+2	+2
16 GHz to 20 GHz	0	+1	-1	-1
20 GHz to 24 GHz	-2	+1	-3	0
24 GHz to 26.5 GHz	-8	-6	-9	-7

Table 37. Source Outputs (dBm) – Typical

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

Description	Option 201, 401		Option 217, 219, 417, 419	
	PORT 1 SOURCE OUT, PORT 3 SOURCE OUT	PORT 2 SOURCE OUT, PORT 4 SOURCE OUT	PORT 1 SOURCE OUT, PORT 3 SOURCE OUT	PORT 2 SOURCE OUT, PORT 4 SOURCE OUT
10 MHz to 50 MHz	+12	+12	+12	+12
50 MHz to 500 MHz	+13	+13	+13	+13
500 MHz to 3.2 GHz	+13	+13	+14	+14
3.2 GHz to 10 GHz	+14	+14	+14	+14
10 GHz to 16 GHz	+14	+14	+15	+15
16 GHz to 20 GHz	+14	+13	+12	+12
20 GHz to 24 GHz	+14	+11	+12	+9
24 GHz to 26.5 GHz	+8	+6	+6	+4

Table 38. Coupler Inputs (dB) – Typical

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

Description	Option 201, 401	Option 217, 219, 417, 419
10 MHz to 50 MHz	0	-0.50
50 MHz to 100 MHz	-0.25	-0.50
100 MHz to 500 MHz	-0.25	-1.00
500 MHz to 3.2 GHz	-0.50	-1.00
3.2 GHz to 10 GHz	-0.75	-1.25
10 GHz to 13.5 GHz	-1.00	-1.75
13.5 GHz to 16 GHz	-1.00	-2.00
16 GHz to 20 GHz	-1.20	-2.00
20 GHz to 24 GHz	-1.30	-2.50
24 GHz to 26.5 GHz	-1.50	-2.50

Table 39. Damage Level - Typical

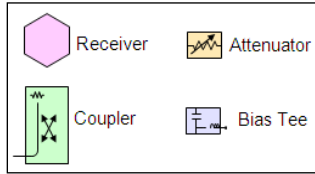
Description	RF (dBm)	DC (V)
RCVR A, B, C, D IN	15	7
RCVR R1, R2, R3, R4 IN	15	7
REF 1 SOURCE OUT	15	7
REF 2, 3, 4 SOURCE OUT	30	7
PORT 1, 2, 3, 4 SOURCE OUT	30	7
PORT 1, 2, 3, 4 CPLR THRU	30	40 (7 ¹)
PORT 1, 2, 3, 4 CPLR ARM	30	7

¹ With a thru connection between test ports of option 217 or 417 configuration, 7 VDC input to CPLR THRU ports damages the source attenuator on the connected port.

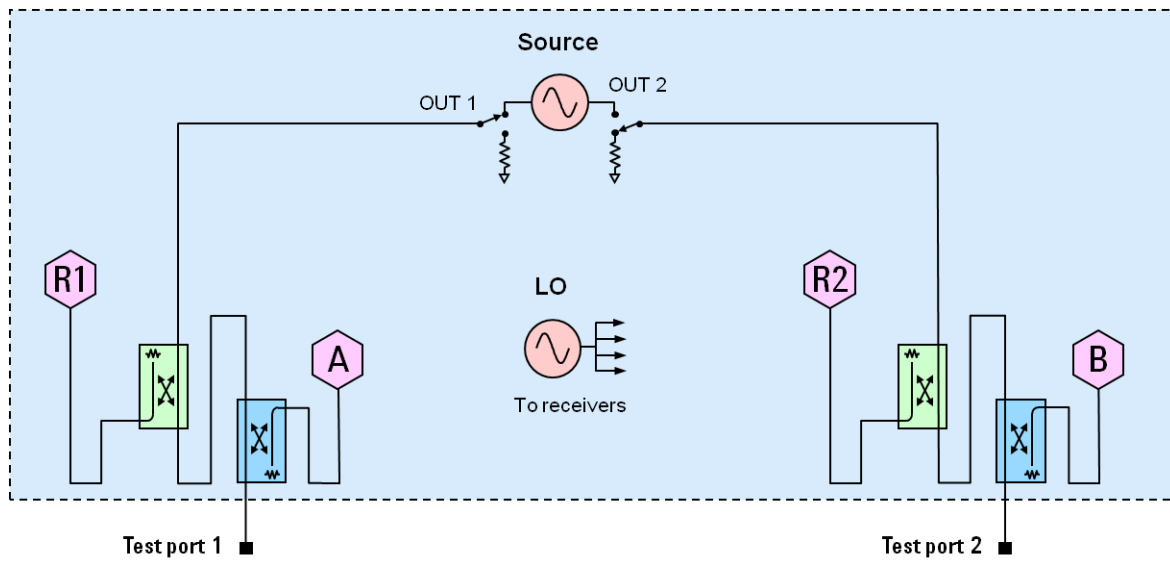
Test Set Block Diagrams

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

Legend

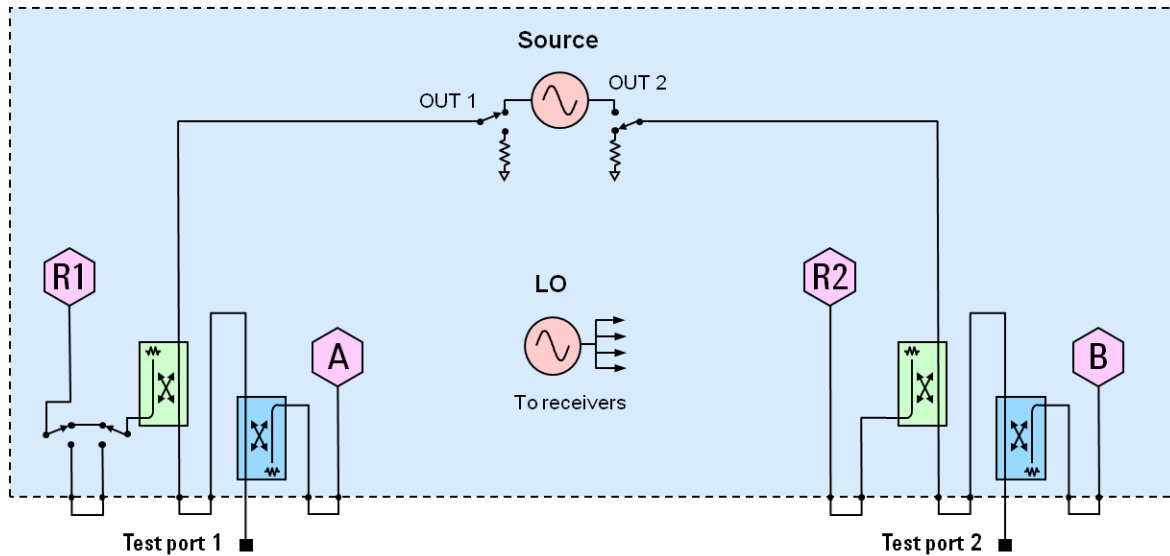


N5221B and N5222B Option 200 (2-port base model)



N5221B and N5222B Option 201

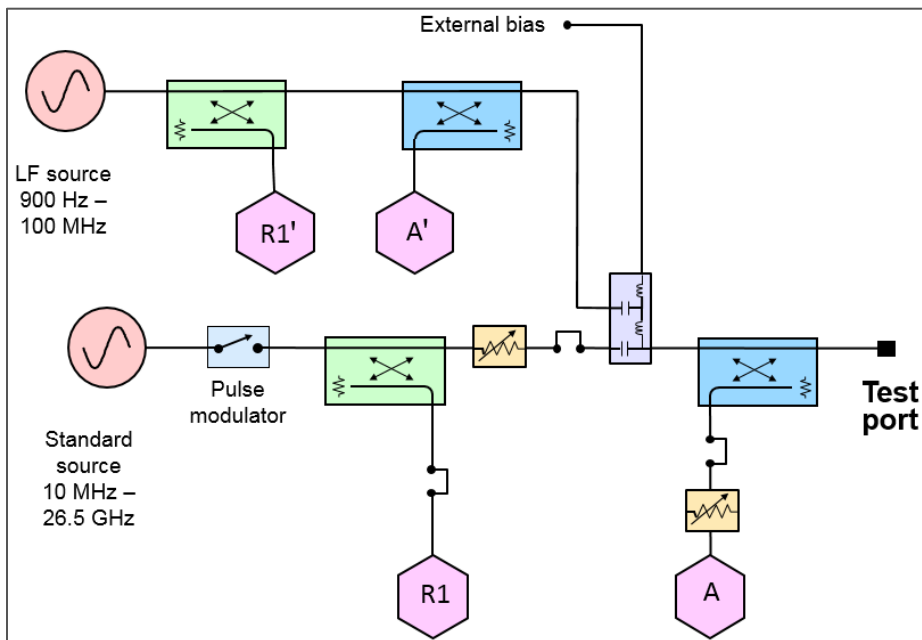
To base model, adds front-panel jumpers and R1 receiver switch



N5222B Option 205

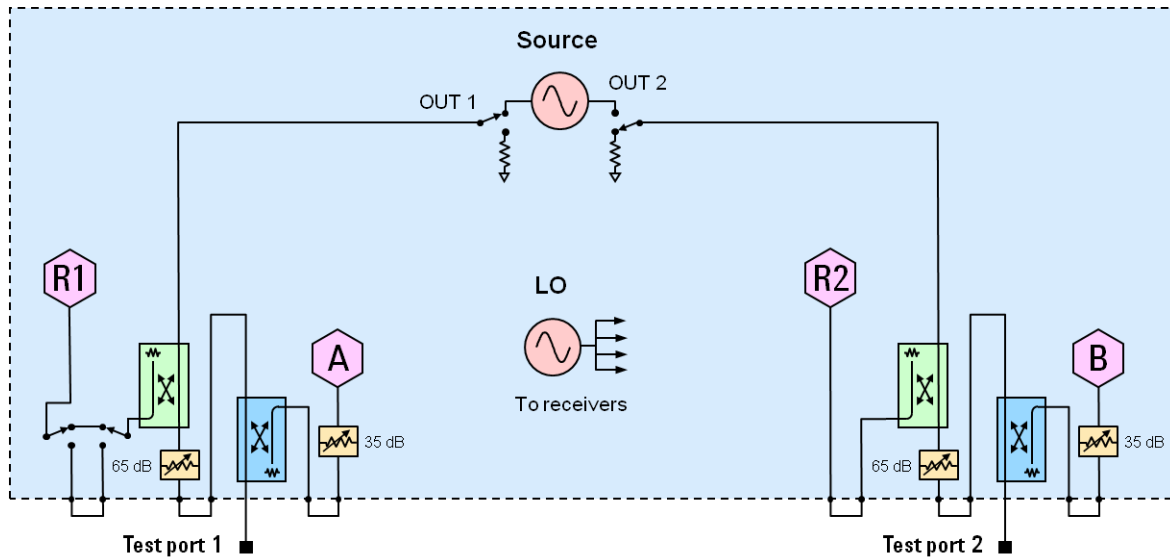
To Opt 200, adds front-panel jumpers, R1 receiver switch, and low frequency extension (LFE).

The following LFE block diagram shows how the low-frequency hardware is configured for a single test port. The other ports are configured similarly.



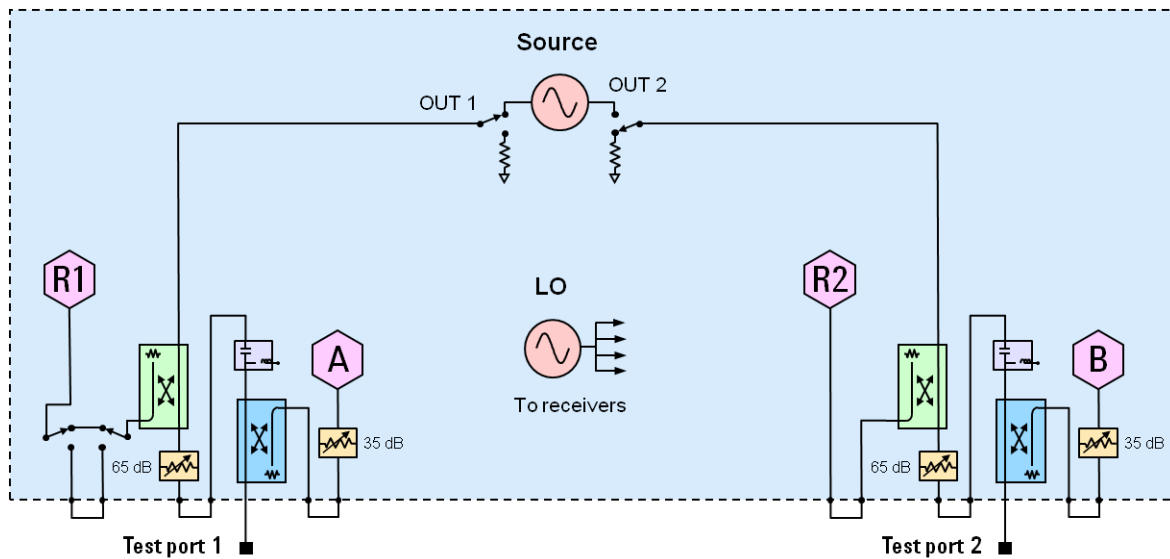
N5221B and N5222B Option 217

To base model, adds front-panel jumpers, R1 receiver switch, and source and receiver attenuators (extended power range).

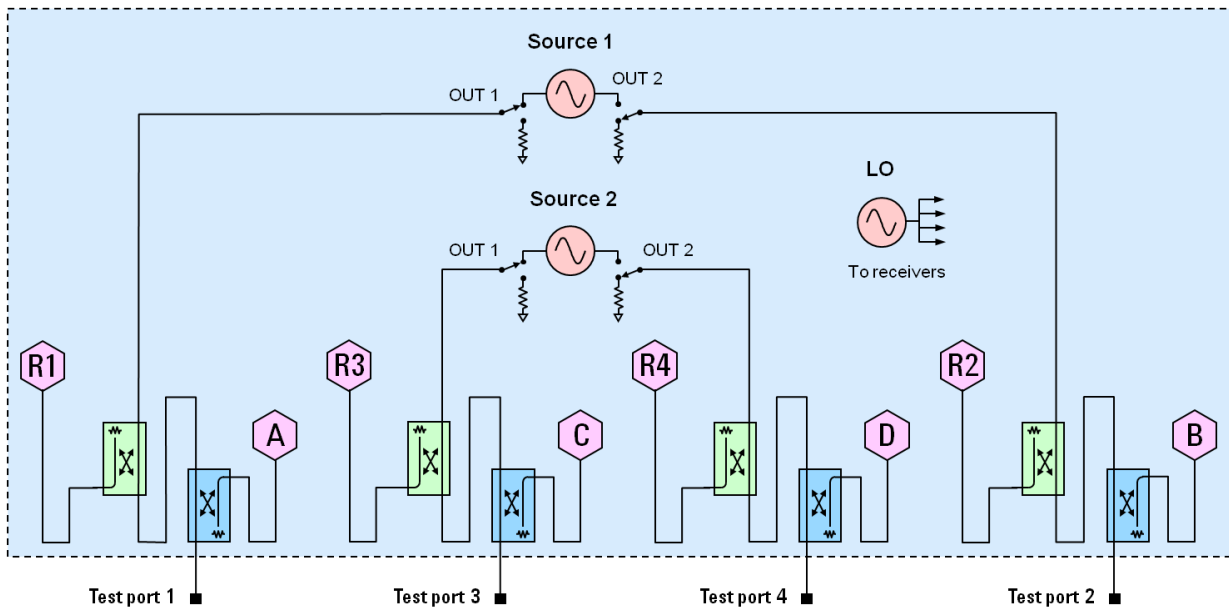


N5221B and N5222B Option 219

To base model, adds front-panel jumpers, R1 receiver switch, source and receiver attenuators (extended power range), and bias-tees.

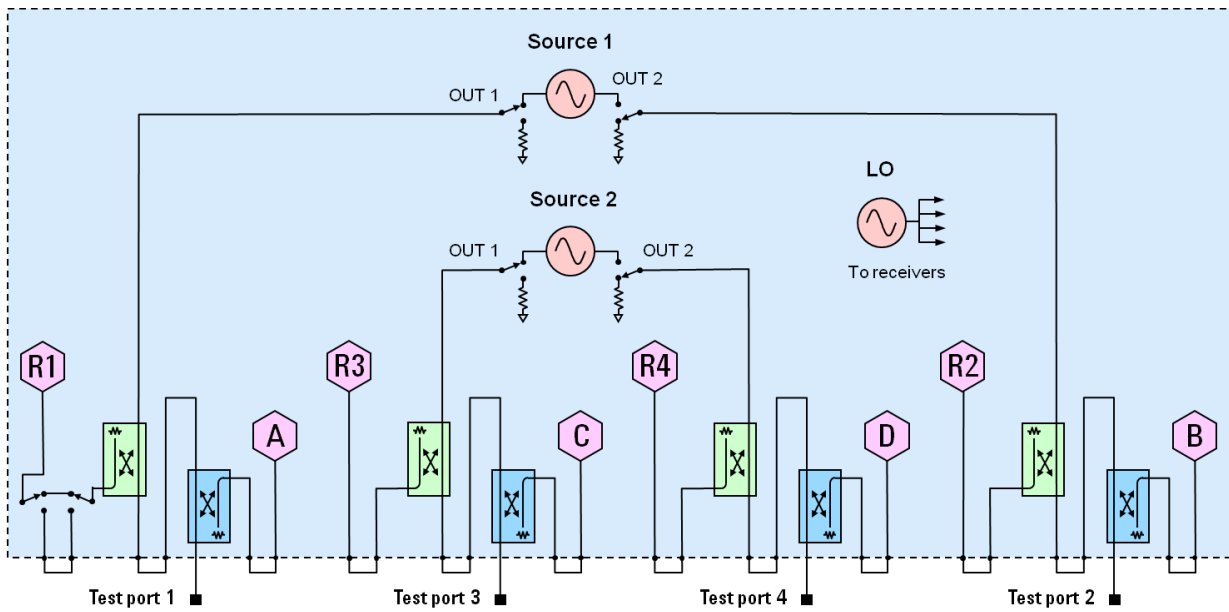


N5221B and N5222B Option 400 (4-port base model)



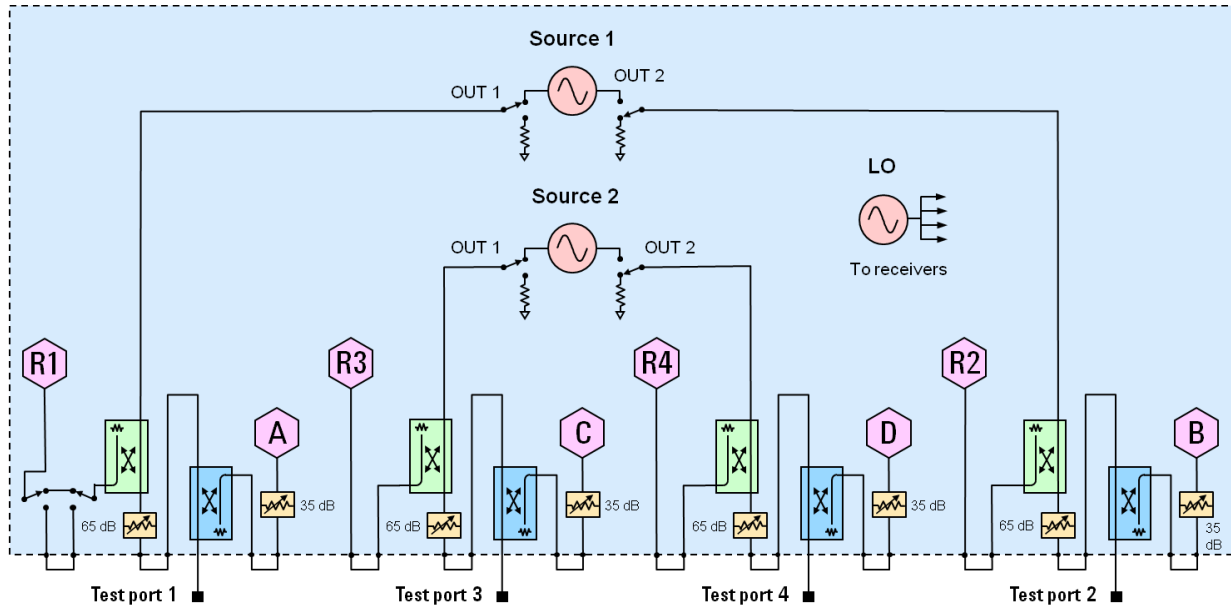
N5221B and N5222B Option 401

To base model, adds front-panel jumpers and R1 receiver switch



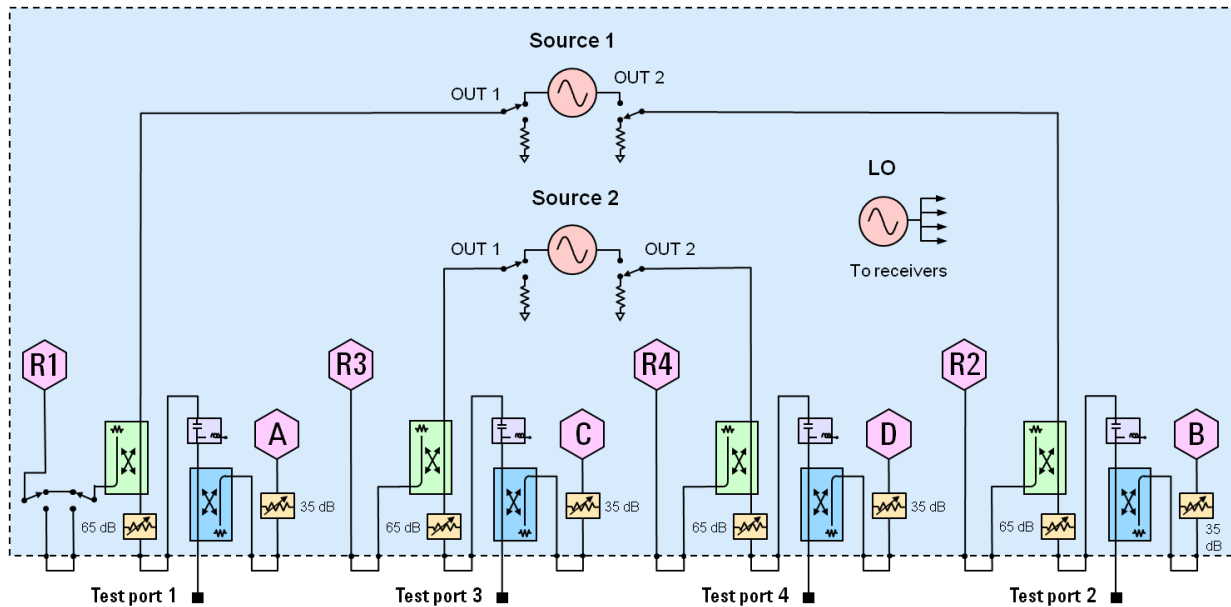
N5221B and N5222B Option 417

To base model, adds front-panel jumpers, R1 receiver switch, and source and receiver attenuators (extended power range).

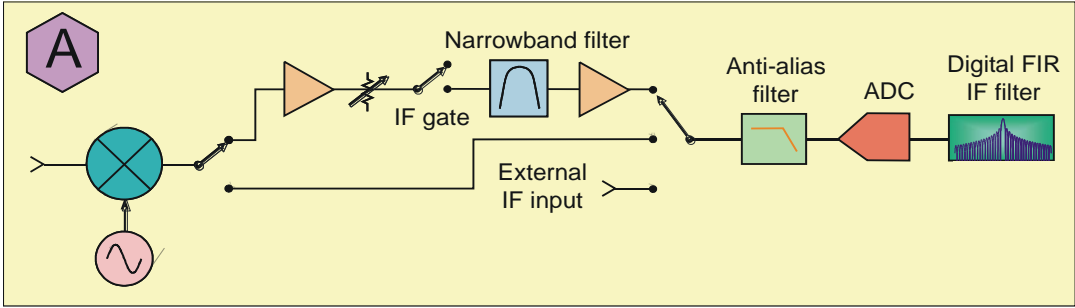


N5221B and N5222B Option 419

To base model, adds front-panel jumpers, R1 receiver switch, source and receiver attenuators (extended power range), and bias-tees.



Receiver Block Diagram





This information is subject to change without notice.
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