

Ihr Spezialist für  
Mess- und Prüfgeräte



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

N5224B 900 Hz to 43.5 GHz

N5225B 900 Hz to 50 GHz

Data Sheet and  
Technical  
Specifications

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This is a complete list of the technical specifications for the N5224B and N5225B PNA network analyzers with the following options. See block diagrams on page 51 for all models and options.

## 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 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.

## Low Frequency Extension (LFE) Options

| Option               | Description                                                                                                                                                                                          |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>2-Port Model</b>  |                                                                                                                                                                                                      |
| <b>205</b>           | 2-port standard test set (includes six front-panel access loops), R1 receiver switch, and low frequency extension (LFE) hardware.                                                                    |
| <b>220</b>           | 2-port standard test set (includes six front-panel access loops), R1 receiver switch, source and receiver attenuators (extended power range), bias-tees, and low frequency extension (LFE) hardware. |
| <b>4-Port Models</b> |                                                                                                                                                                                                      |
| <b>405</b>           | 4-port standard test set (includes six front-panel access loops), R1 receiver switch, and low frequency extension (LFE) hardware.                                                                    |
| <b>420</b>           | 4-port standard test set (includes six front-panel access loops), R1 receiver switch, source and receiver attenuators (extended power range), bias-tees, and low frequency extension (LFE) hardware. |

## Notes

This document provides technical specifications for the 85056A and N4693A calibration kits.

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  $25\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$  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.

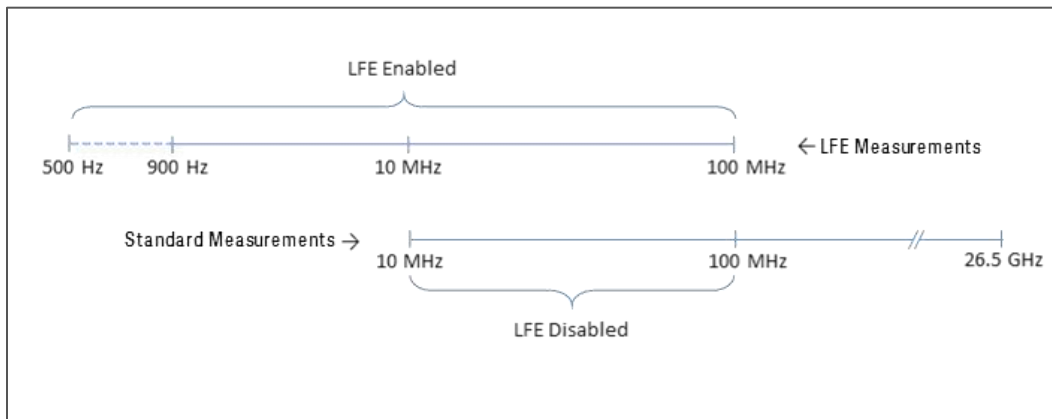
**Calibration:** The process of measuring known standards to characterize a network analyzer's systematic (repeatable) errors.

**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 an LFE option, 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.

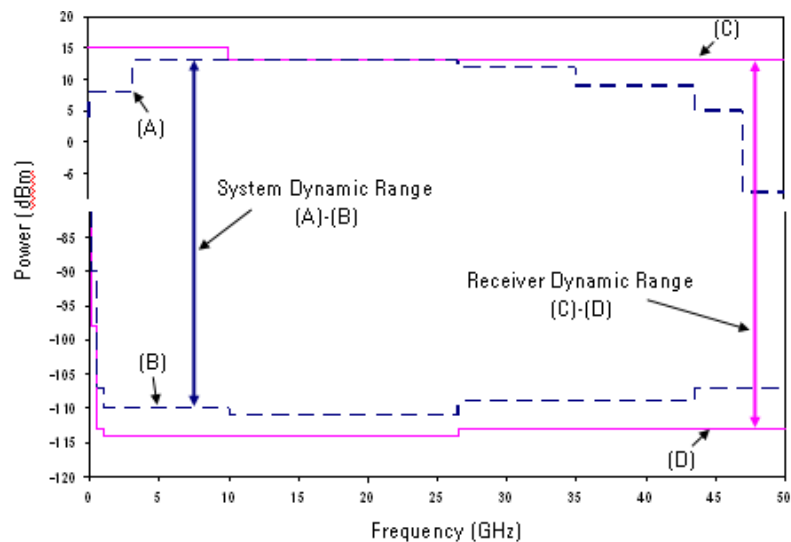




## Dynamic Range

The specifications in this section apply for measurements made with the N5224B and N5225B 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 measured source maximum output power (spec) minus the measured noise floor (spec).
- **Extended Dynamic Range at Direct Access Input** is defined as the system dynamic range (typical) less the nominal loss associated with the test port coupler.
- **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. 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.

## System Dynamic Range

Table 1a. System Dynamic Range at Test Port (dB), Options 200 or 400

| Description        | Specification           |                         | Typical                 |                         |
|--------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                    | Ports <sup>1</sup> 1, 3 | Ports <sup>1</sup> 2, 4 | Ports <sup>1</sup> 1, 3 | Ports <sup>1</sup> 2, 4 |
| 10 MHz to 50 MHz   | 87                      | 85                      | 95                      | 94                      |
| 50 MHz to 100 MHz  | 103                     | 101                     | 111                     | 110                     |
| 100 MHz to 250 MHz | 110                     | 110                     | 125                     | 125                     |
| 250 MHz to 500 MHz | 119                     | 119                     | 128                     | 128                     |
| 500 MHz to 1 GHz   | 127                     | 128                     | 136                     | 137                     |
| 1 GHz to 2 GHz     | 133                     | 134                     | 141                     | 141                     |
| 2 GHz to 3.2 GHz   | 131                     | 132                     | 138                     | 140                     |
| 3.2 GHz to 10 GHz  | 135                     | 132                     | 142                     | 139                     |
| 10 GHz to 13.5 GHz | 130                     | 130                     | 138                     | 137                     |
| 13.5 GHz to 16 GHz | 130                     | 130                     | 138                     | 140                     |
| 16 GHz to 20 GHz   | 130                     | 130                     | 138                     | 140                     |
| 20 GHz to 24 GHz   | 132                     | 132                     | 140                     | 140                     |
| 24 GHz to 26.5 GHz | 132                     | 131                     | 139                     | 139                     |
| 26.5 GHz to 30 GHz | 127                     | 127                     | 136                     | 136                     |
| 30 GHz to 32 GHz   | 128                     | 128                     | 136                     | 136                     |
| 32 GHz to 35 GHz   | 128                     | 128                     | 136                     | 137                     |
| 35 GHz to 40 GHz   | 123                     | 124                     | 132                     | 132                     |
| 40 GHz to 43.5 GHz | 123                     | 124                     | 132                     | 133                     |
| 43.5 GHz to 47 GHz | 123                     | 124                     | 133                     | 133                     |
| 47 GHz to 50 GHz   | 114                     | 116                     | 127                     | 128                     |

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

Table 1b. System Dynamic Range at Test Port (dB), Options 201 or 401

| Description        | Specification           |                         | Typical                 |                         |
|--------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                    | Ports <sup>1</sup> 1, 3 | Ports <sup>1</sup> 2, 4 | Ports <sup>1</sup> 1, 3 | Ports <sup>1</sup> 2, 4 |
| 10 MHz to 50 MHz   | 87                      | 86                      | 95                      | 94                      |
| 50 MHz to 100 MHz  | 102                     | 101                     | 110                     | 110                     |
| 100 MHz to 250 MHz | 109                     | 109                     | 123                     | 123                     |
| 250 MHz to 500 MHz | 117                     | 117                     | 127                     | 127                     |
| 500 MHz to 1 GHz   | 127                     | 128                     | 135                     | 137                     |
| 1 GHz to 2 GHz     | 132                     | 132                     | 140                     | 140                     |
| 2 GHz to 3.2 GHz   | 130                     | 132                     | 137                     | 140                     |
| 3.2 GHz to 10 GHz  | 135                     | 132                     | 141                     | 139                     |
| 10 GHz to 13.5 GHz | 128                     | 128                     | 137                     | 137                     |
| 13.5 GHz to 16 GHz | 128                     | 128                     | 137                     | 137                     |
| 16 GHz to 20 GHz   | 128                     | 128                     | 137                     | 137                     |
| 20 GHz to 24 GHz   | 130                     | 130                     | 139                     | 138                     |
| 24 GHz to 26.5 GHz | 129                     | 129                     | 137                     | 138                     |
| 26.5 GHz to 30 GHz | 124                     | 125                     | 134                     | 134                     |
| 30 GHz to 32 GHz   | 126                     | 126                     | 135                     | 134                     |
| 32 GHz to 35 GHz   | 127                     | 127                     | 135                     | 135                     |
| 35 GHz to 40 GHz   | 121                     | 122                     | 130                     | 131                     |
| 40 GHz to 43.5 GHz | 122                     | 122                     | 131                     | 131                     |
| 43.5 GHz to 47 GHz | 122                     | 122                     | 131                     | 132                     |
| 47 GHz to 50 GHz   | 113                     | 114                     | 125                     | 125                     |

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

Table 1c. System Dynamic Range at Test Port (dB), Options 217, 417, 219, 419

| Description        | Specification           |                         | Typical                 |                         |
|--------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                    | Ports <sup>1</sup> 1, 3 | Ports <sup>1</sup> 2, 4 | Ports <sup>1</sup> 1, 3 | Ports <sup>1</sup> 2, 4 |
| 10 MHz to 50 MHz   | 86                      | 85                      | 95                      | 93                      |
| 50 MHz to 100 MHz  | 102                     | 101                     | 110                     | 109                     |
| 100 MHz to 250 MHz | 110                     | 110                     | 125                     | 125                     |
| 250 MHz to 500 MHz | 121                     | 120                     | 129                     | 128                     |
| 500 MHz to 1 GHz   | 126                     | 129                     | 135                     | 138                     |
| 1 GHz to 2 GHz     | 132                     | 132                     | 140                     | 140                     |
| 2 GHz to 3.2 GHz   | 129                     | 131                     | 137                     | 139                     |
| 3.2 GHz to 10 GHz  | 135                     | 132                     | 142                     | 139                     |
| 10 GHz to 13.5 GHz | 132                     | 128                     | 141                     | 137                     |
| 13.5 GHz to 16 GHz | 130                     | 128                     | 139                     | 136                     |
| 16 GHz to 20 GHz   | 128                     | 128                     | 136                     | 136                     |
| 20 GHz to 24 GHz   | 130                     | 130                     | 138                     | 138                     |
| 24 GHz to 26.5 GHz | 129                     | 129                     | 137                     | 137                     |
| 26.5 GHz to 30 GHz | 123                     | 122                     | 131                     | 131                     |
| 30 GHz to 32 GHz   | 121                     | 123                     | 131                     | 131                     |
| 32 GHz to 35 GHz   | 124                     | 124                     | 132                     | 132                     |
| 35 GHz to 40 GHz   | 117                     | 118                     | 126                     | 127                     |
| 40 GHz to 43.5 GHz | 117                     | 118                     | 126                     | 126                     |
| 43.5 GHz to 47 GHz | 117                     | 116                     | 126                     | 126                     |
| 47 GHz to 50 GHz   | 108                     | 105                     | 119                     | 118                     |

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

Table 1d. System Dynamic Range at Test Port (dB), Option 205, 405

| Description                    | Specification           |                         | Typical                 |                         |
|--------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                                | Ports <sup>2</sup> 1, 3 | Ports <sup>2</sup> 2, 4 | Ports <sup>2</sup> 1, 3 | Ports <sup>2</sup> 2, 4 |
| 10 MHz to 50 MHz <sup>1</sup>  | 80                      | 79                      | 88                      | 87                      |
| 50 MHz to 100 MHz <sup>1</sup> | 98                      | 97                      | 106                     | 106                     |
| 100 MHz to 250 MHz             | 105                     | 105                     | 119                     | 119                     |
| 250 MHz to 500 MHz             | 113                     | 113                     | 123                     | 123                     |
| 500 MHz to 1 GHz               | 124                     | 125                     | 132                     | 134                     |
| 1 GHz to 2 GHz                 | 129                     | 129                     | 137                     | 137                     |
| 2 GHz to 3.2 GHz               | 127                     | 129                     | 134                     | 137                     |
| 3.2 GHz to 10 GHz              | 133                     | 130                     | 139                     | 137                     |
| 10 GHz to 13.5 GHz             | 126                     | 126                     | 135                     | 135                     |
| 13.5 GHz to 16 GHz             | 126                     | 126                     | 135                     | 135                     |
| 16 GHz to 20 GHz               | 123                     | 126                     | 135                     | 135                     |
| 20 GHz to 24 GHz               | 125                     | 128                     | 137                     | 136                     |
| 24 GHz to 26.5 GHz             | 124                     | 127                     | 135                     | 136                     |
| 26.5 GHz to 30 GHz             | 122                     | 123                     | 132                     | 132                     |
| 30 GHz to 32 GHz               | 124                     | 124                     | 133                     | 132                     |
| 32 GHz to 35 GHz               | 125                     | 125                     | 133                     | 133                     |
| 35 GHz to 40 GHz               | 119                     | 120                     | 128                     | 129                     |
| 40 GHz to 43.5 GHz             | 120                     | 120                     | 129                     | 129                     |
| 43.5 GHz to 47 GHz             | 120                     | 120                     | 127                     | 130                     |
| 47 GHz to 50 GHz               | 113                     | 114                     | 125                     | 125                     |

<sup>1</sup> With Option 205, 405 installed and LFE disabled, applied to frequencies <= 100 MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled.

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

Table 1e. System Dynamic Range at Test Port (dB), Option 220, 420

| Description                    | Specification           |                         | Typical                 |                         |
|--------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                                | Ports <sup>2</sup> 1, 3 | Ports <sup>2</sup> 2, 4 | Ports <sup>2</sup> 1, 3 | Ports <sup>2</sup> 2, 4 |
| 10 MHz to 50 MHz <sup>1</sup>  | 79                      | 78                      | 88                      | 86                      |
| 50 MHz to 100 MHz <sup>1</sup> | 98                      | 97                      | 106                     | 105                     |
| 100 MHz to 250 MHz             | 106                     | 106                     | 121                     | 121                     |
| 250 MHz to 500 MHz             | 117                     | 116                     | 125                     | 124                     |
| 500 MHz to 1 GHz               | 123                     | 126                     | 132                     | 135                     |
| 1 GHz to 2 GHz                 | 129                     | 129                     | 137                     | 137                     |
| 2 GHz to 3.2 GHz               | 126                     | 128                     | 134                     | 136                     |
| 3.2 GHz to 10 GHz              | 133                     | 129                     | 140                     | 137                     |
| 10 GHz to 13.5 GHz             | 130                     | 126                     | 139                     | 135                     |
| 13.5 GHz to 16 GHz             | 128                     | 126                     | 137                     | 134                     |
| 16 GHz to 20 GHz               | 126                     | 126                     | 134                     | 134                     |
| 20 GHz to 24 GHz               | 128                     | 128                     | 136                     | 136                     |
| 24 GHz to 26.5 GHz             | 127                     | 127                     | 135                     | 135                     |
| 26.5 GHz to 30 GHz             | 121                     | 120                     | 129                     | 129                     |
| 30 GHz to 32 GHz               | 120                     | 122                     | 130                     | 130                     |
| 32 GHz to 35 GHz               | 123                     | 123                     | 131                     | 131                     |
| 35 GHz to 40 GHz               | 116                     | 117                     | 125                     | 126                     |
| 40 GHz to 43.5 GHz             | 116                     | 117                     | 125                     | 125                     |
| 43.5 GHz to 47 GHz             | 116                     | 115                     | 125                     | 125                     |
| 47 GHz to 50 GHz               | 107                     | 104                     | 118                     | 117                     |

<sup>1</sup> With Option 220, 420 installed and LFE disabled, applied to frequencies <= 100 MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled.

Table 1f. System Dynamic Range at Test Port (dB), All LFE Options (LFE Enabled)

| Description       | Specification |            | Typical    |            |
|-------------------|---------------|------------|------------|------------|
|                   | Ports 1, 3    | Ports 2, 4 | Ports 1, 3 | Ports 2, 4 |
| 500 Hz to 900 Hz  | --            | --         | 105        | 105        |
| 900 Hz to 1 kHz   | 100           | 102        | 109        | 110        |
| 1 kHz to 10 kHz   | 103           | 105        | 110        | 111        |
| 10 kHz to 100 kHz | 113           | 115        | 120        | 121        |
| 100 kHz to 1 MHz  | 120           | 121        | 124        | 125        |
| 1 MHz to 5 MHz    | 121           | 122        | 126        | 127        |
| 5 MHz to 10 MHz   | 112           | 114        | 118        | 119        |
| 10 MHz to 50 MHz  | 110           | 112        | 116        | 117        |
| 50 MHz to 100 MHz | 110           | 112        | 116        | 117        |

## Extended Dynamic Range

Table 2a. Extended Dynamic Range at Direct Receiver Access Input (dB) – Typical

| Description        | 201, 401                |                         | 217, 417, 219, 419      |                         |
|--------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                    | Ports <sup>1</sup> 1, 3 | Ports <sup>1</sup> 2, 4 | Ports <sup>1</sup> 1, 3 | Ports <sup>1</sup> 2, 4 |
| 10 MHz to 50 MHz   | 139                     | 138                     | 139                     | 137                     |
| 50 MHz to 100 MHz  | 140                     | 140                     | 140                     | 139                     |
| 100 MHz to 250 MHz | 153                     | 153                     | 155                     | 155                     |
| 250 MHz to 500 MHz | 147                     | 147                     | 149                     | 148                     |
| 500 MHz to 1 GHz   | 150                     | 152                     | 150                     | 153                     |
| 1 GHz to 2 GHz     | 155                     | 155                     | 155                     | 155                     |
| 2 GHz to 3.2 GHz   | 152                     | 155                     | 152                     | 154                     |
| 3.2 GHz to 10 GHz  | 156                     | 154                     | 157                     | 154                     |
| 10 GHz to 13.5 GHz | 152                     | 152                     | 156                     | 152                     |
| 13.5 GHz to 16 GHz | 152                     | 152                     | 154                     | 151                     |
| 16 GHz to 20 GHz   | 152                     | 152                     | 151                     | 151                     |
| 20 GHz to 24 GHz   | 153                     | 152                     | 152                     | 152                     |
| 24 GHz to 26.5 GHz | 151                     | 152                     | 151                     | 151                     |
| 26.5 GHz to 30 GHz | 148                     | 148                     | 145                     | 145                     |
| 30 GHz to 32 GHz   | 149                     | 148                     | 145                     | 145                     |
| 32 GHz to 35 GHz   | 149                     | 149                     | 146                     | 146                     |
| 35 GHz to 40 GHz   | 144                     | 145                     | 140                     | 141                     |
| 40 GHz to 43.5 GHz | 143                     | 143                     | 138                     | 138                     |
| 43.5 GHz to 47 GHz | 143                     | 144                     | 138                     | 138                     |
| 47 GHz to 50 GHz   | 137                     | 137                     | 131                     | 130                     |

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



Table 2b. Extended Dynamic Range at Direct Receiver Access Input (dB) – Typical

| Description        | 205, 405                |                         | 220, 420                |                         |
|--------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                    | Ports <sup>1</sup> 1, 3 | Ports <sup>1</sup> 2, 4 | Ports <sup>1</sup> 1, 3 | Ports <sup>1</sup> 2, 4 |
| 10 MHz to 50 MHz   | 132                     | 131                     | 132                     | 130                     |
| 50 MHz to 100 MHz  | 136                     | 136                     | 136                     | 135                     |
| 100 MHz to 250 MHz | 149                     | 149                     | 151                     | 151                     |
| 250 MHz to 500 MHz | 143                     | 143                     | 145                     | 144                     |
| 500 MHz to 1 GHz   | 147                     | 149                     | 147                     | 150                     |
| 1 GHz to 2 GHz     | 152                     | 152                     | 152                     | 152                     |
| 2 GHz to 3.2 GHz   | 149                     | 152                     | 149                     | 151                     |
| 3.2 GHz to 10 GHz  | 154                     | 152                     | 155                     | 152                     |
| 10 GHz to 13.5 GHz | 150                     | 150                     | 154                     | 150                     |
| 13.5 GHz to 16 GHz | 150                     | 150                     | 152                     | 149                     |
| 16 GHz to 20 GHz   | 150                     | 150                     | 149                     | 149                     |
| 20 GHz to 24 GHz   | 151                     | 150                     | 150                     | 150                     |
| 24 GHz to 26.5 GHz | 149                     | 150                     | 149                     | 149                     |
| 26.5 GHz to 30 GHz | 146                     | 146                     | 144                     | 144                     |
| 30 GHz to 32 GHz   | 147                     | 146                     | 144                     | 144                     |
| 32 GHz to 35 GHz   | 147                     | 147                     | 145                     | 145                     |
| 35 GHz to 40 GHz   | 142                     | 143                     | 139                     | 140                     |
| 40 GHz to 43.5 GHz | 141                     | 141                     | 137                     | 137                     |
| 43.5 GHz to 47 GHz | 141                     | 142                     | 137                     | 137                     |
| 47 GHz to 50 GHz   | 137                     | 137                     | 130                     | 129                     |

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

## Receiver Dynamic Range

Table 3a. Receiver Dynamic Range, N5224B, Option 200 or 400

| Description        | Typical |
|--------------------|---------|
| 10 MHz to 50 MHz   | 90      |
| 50 MHz to 100 MHz  | 106     |
| 100 MHz to 250 MHz | 112     |
| 250 MHz to 500 MHz | 119     |
| 500 MHz to 1 GHz   | 124     |
| 1 GHz to 10 GHz    | 130     |
| 10 GHz to 26.5 GHz | 132     |
| 26.5 GHz to 35 GHz | 128     |
| 35 GHz to 40 GHz   | 128     |
| 40 GHz to 43.5 GHz | 124     |

Table 3b. Receiver Dynamic Range, N5225B, Option 200 or 400

| Description        | Typical |
|--------------------|---------|
| 10 MHz to 50 MHz   | 90      |
| 50 MHz to 100 MHz  | 106     |
| 100 MHz to 250 MHz | 112     |
| 250 MHz to 500 MHz | 119     |
| 500 MHz to 1 GHz   | 124     |
| 1 GHz to 10 GHz    | 130     |
| 10 GHz to 26.5 GHz | 132     |
| 26.5 GHz to 35 GHz | 128     |
| 35 GHz to 40 GHz   | 128     |
| 40 GHz to 43.5 GHz | 124     |
| 43.5 GHz to 47 GHz | 126     |
| 47 GHz to 50 GHz   | 126     |

Table 3c. Receiver Dynamic Range (dB), All Ports, All LFE Options (LFE Enabled)

| Description       | Typical |
|-------------------|---------|
| 500 Hz to 900 Hz  | 106     |
| 900 Hz to 1 kHz   | 109     |
| 1 kHz to 10 kHz   | 109     |
| 10 kHz to 100 kHz | 118     |
| 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 N5224B/5A Option 200, 201, 205, 217, 219, 400, 401, 405, 417, 419, or 420 analyzers, 85133F flexible test port cable set, and a full 2-port calibration. Also applies to the following condition:

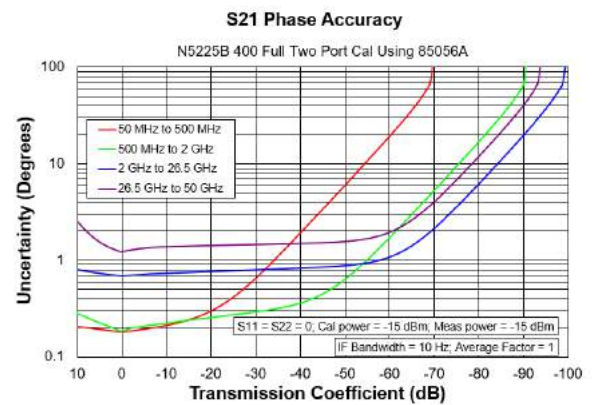
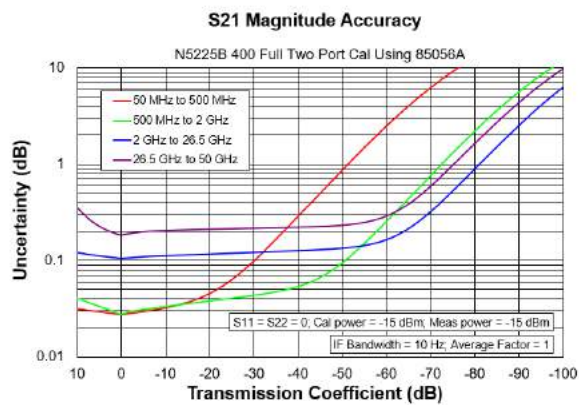
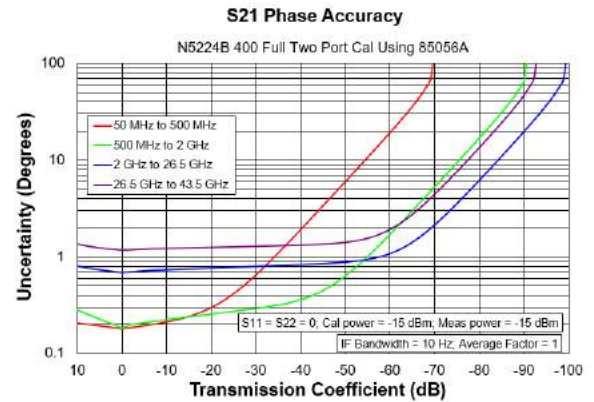
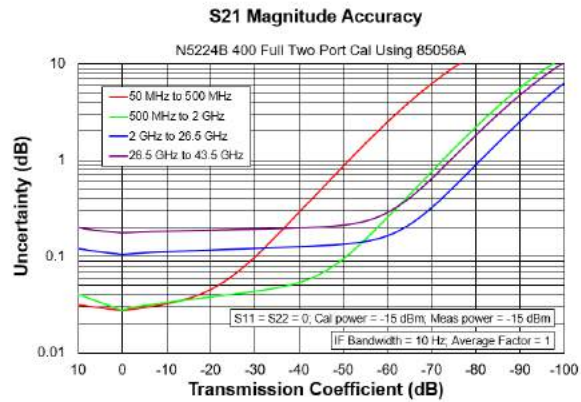
Environmental temperature  $23^\circ \pm 3^\circ \text{C}$ , with  $< 1^\circ \text{C}$  deviation from calibration temperature

Table 4a. N5224B and N5225B with 85056A Calibration Kit

| Description                  | Specification (dB)                  |                                    |                       |                        |                        |                        |                        |
|------------------------------|-------------------------------------|------------------------------------|-----------------------|------------------------|------------------------|------------------------|------------------------|
|                              | 10 MHz<br>to<br>50 MHz <sup>1</sup> | 50 MHz<br>to<br>2 GHz <sup>1</sup> | 2 GHz<br>to<br>10 GHz | 10 GHz<br>to<br>20 GHz | 20 GHz<br>to<br>30 GHz | 30 GHz<br>to<br>40 GHz | 40 GHz<br>to<br>50 GHz |
| Directivity                  | 41                                  | 41                                 | 41                    | 41                     | 37                     | 37                     | 35                     |
| Source Match                 | 41                                  | 41                                 | 37                    | 37                     | 33                     | 33                     | 31                     |
| Load Match                   | 41                                  | 41                                 | 41                    | 41                     | 37                     | 37                     | 35                     |
| Reflection Tracking<br>Mag   | $\pm 0.0015$                        | $\pm 0.0015$                       | $\pm 0.0082$          | $\pm 0.0082$           | $\pm 0.021$            | $\pm 0.021$            | $\pm 0.028$            |
| Phase (°)                    | $\pm 0.0093$                        | $\pm 0.0093$                       | $\pm 0.055$           | $\pm 0.055$            | $\pm 0.14$             | $\pm 0.14$             | $\pm 0.19$             |
| Transmission Tracking<br>Mag | $\pm 0.046$                         | $\pm 0.021$                        | $\pm 0.036$           | $\pm 0.052$            | $\pm 0.13$             | $\pm 0.13$             | $\pm 0.17$             |
| Phase (°)                    | $\pm 0.31$                          | $\pm 0.14$                         | $\pm 0.24$            | $\pm 0.34$             | $\pm 0.82$             | $\pm 0.82$             | $\pm 1.1$              |

<sup>1</sup> With an LFE option installed and LFE disabled, applied to frequencies  $\leq 100$  MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled.

## Transmission Uncertainty, All Options



## Reflection Uncertainty, All Options

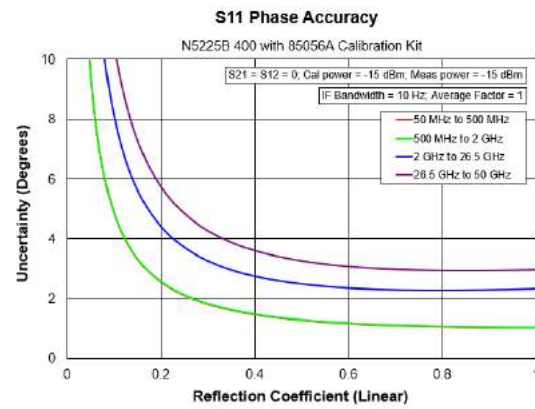
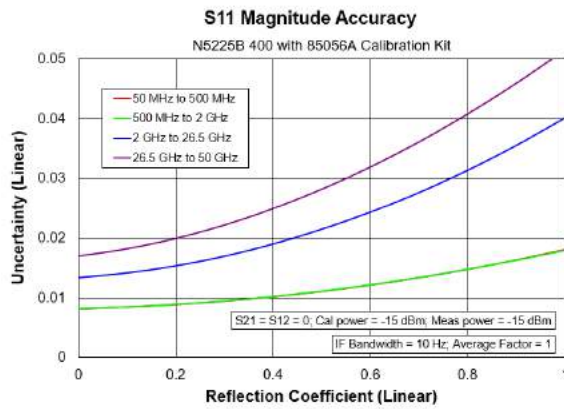
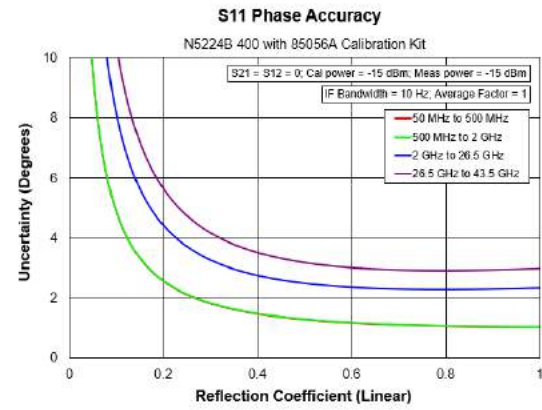
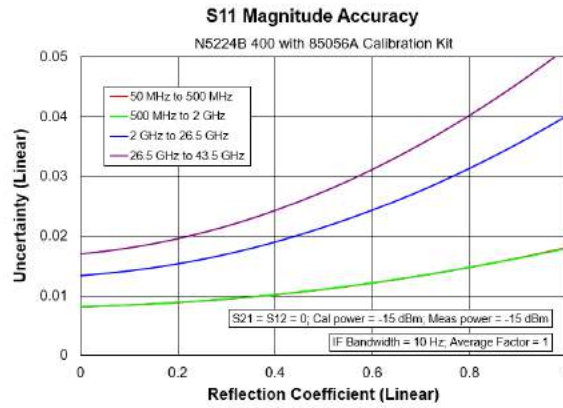
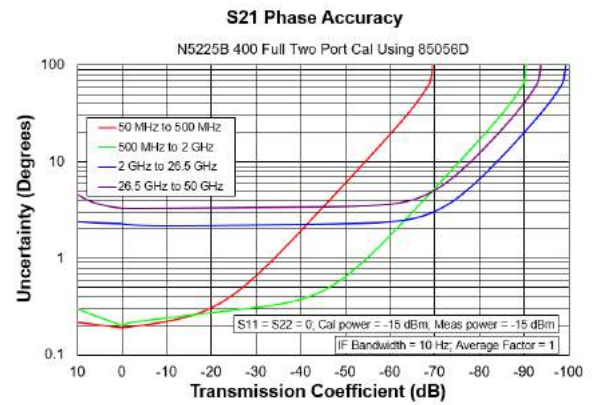
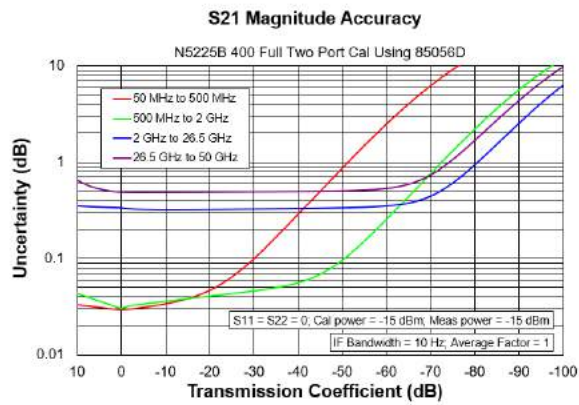
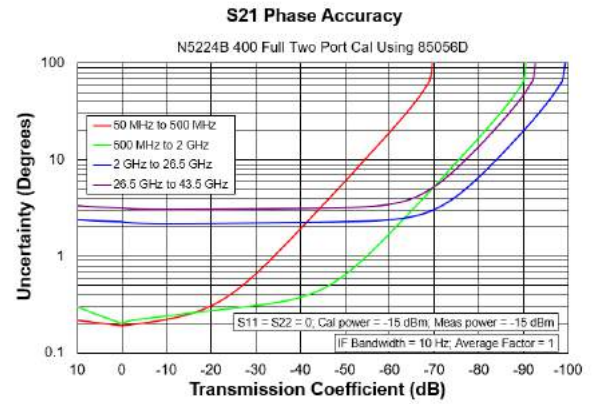
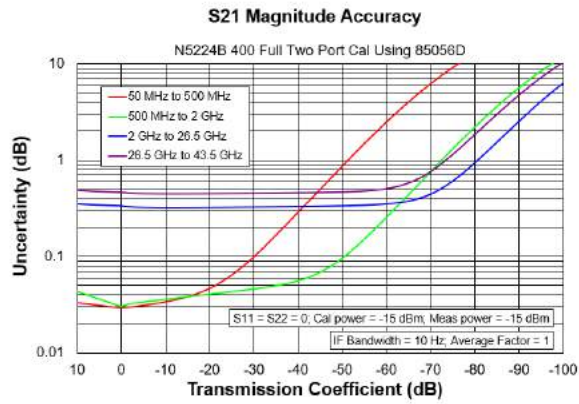


Table 4b. N5224B and N5225B with 85056D Calibration Kit

| Description                  | Specification (dB)                  |                                    |                       |                        |                        |                        |                        |
|------------------------------|-------------------------------------|------------------------------------|-----------------------|------------------------|------------------------|------------------------|------------------------|
|                              | 10 MHz<br>to<br>50 MHz <sup>1</sup> | 50 MHz<br>to<br>2 GHz <sup>1</sup> | 2 GHz<br>to<br>10 GHz | 10 GHz<br>to<br>20 GHz | 20 GHz<br>to<br>30 GHz | 30 GHz<br>to<br>40 GHz | 40 GHz<br>to<br>50 GHz |
| Directivity                  | 41                                  | 41                                 | 33                    | 33                     | 25                     | 25                     | 25                     |
| Source Match                 | 39                                  | 39                                 | 30                    | 30                     | 23                     | 23                     | 23                     |
| Load Match                   | 41                                  | 41                                 | 33                    | 33                     | 25                     | 25                     | 25                     |
| Reflection Tracking<br>Mag   | ±0.0025                             | ±0.0025                            | ±0.029                | ±0.029                 | ±0.080                 | ±0.080                 | ±0.075                 |
| Phase (°)                    | ±0.016                              | ±0.016                             | ±0.19                 | ±0.19                  | ±0.53                  | ±0.53                  | ±0.50                  |
| Transmission Tracking<br>Mag | ±0.051                              | ±0.024                             | ±0.088                | ±0.13                  | ±0.41                  | ±0.41                  | ±0.45                  |
| Phase (°)                    | ±0.34                               | ±0.16                              | ±0.58                 | ±0.84                  | ±2.8                   | ±2.8                   | ±3.1                   |

<sup>1</sup> With an LFE option 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

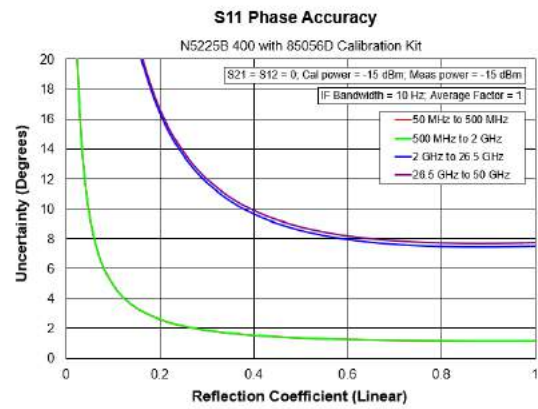
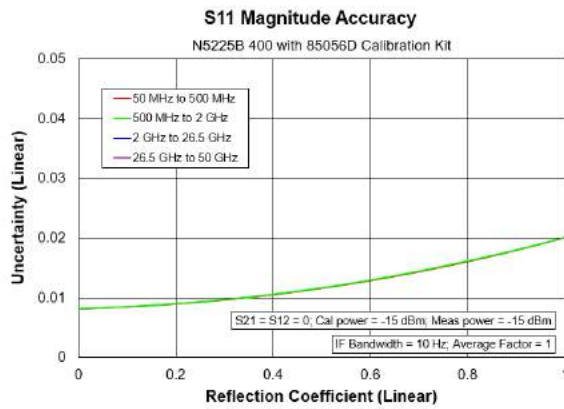
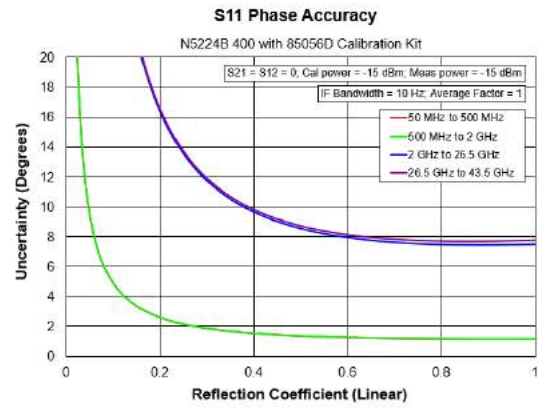
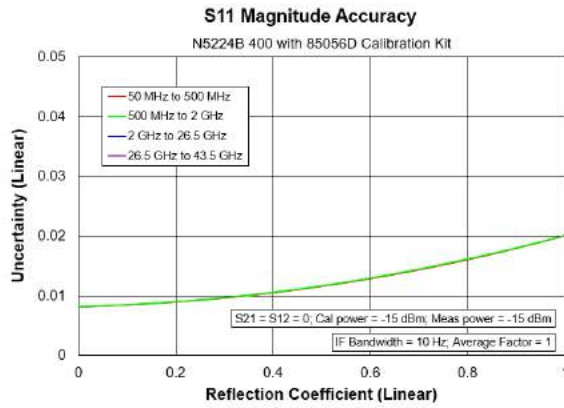
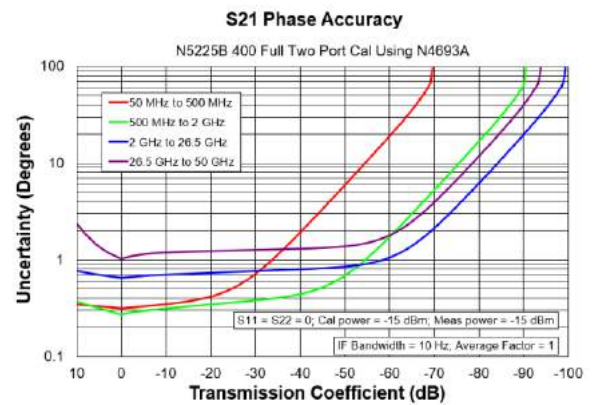
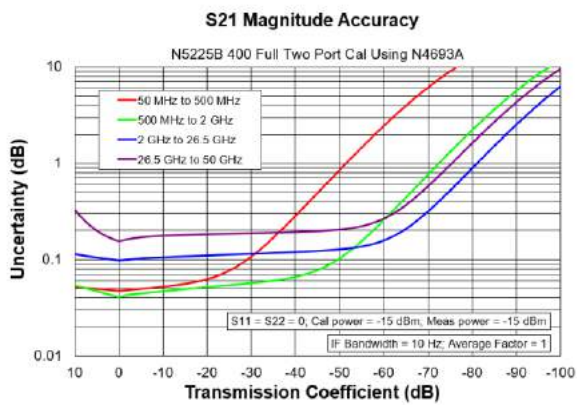
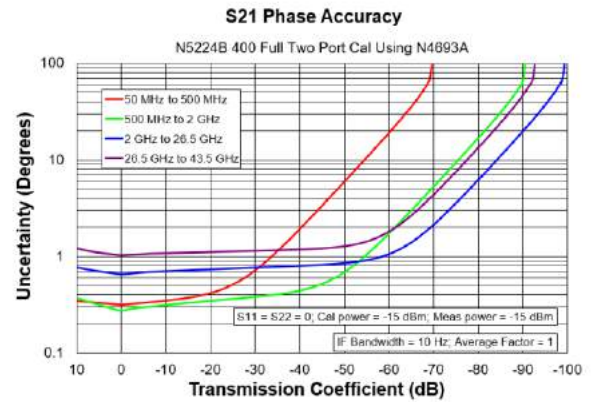
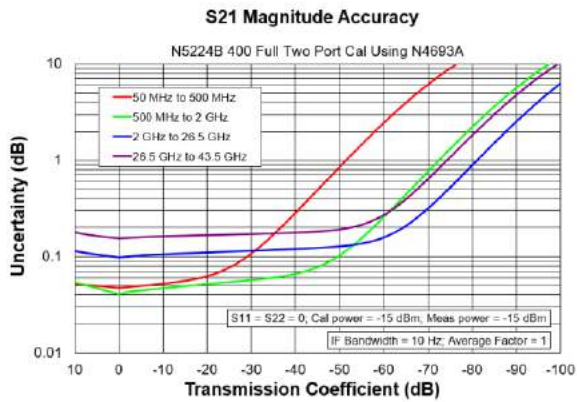


Table 4c. N5224B and N5225B with N4693A 2-Port Electronic Calibration Module

| Description                  | Specification (dB)                  |                                    |                       |                        |                        |                        |                        |
|------------------------------|-------------------------------------|------------------------------------|-----------------------|------------------------|------------------------|------------------------|------------------------|
|                              | 10 MHz<br>to<br>50 MHz <sup>1</sup> | 50 MHz<br>to<br>2 GHz <sup>1</sup> | 2 GHz<br>to<br>10 GHz | 10 GHz<br>to<br>20 GHz | 20 GHz<br>to<br>30 GHz | 30 GHz<br>to<br>40 GHz | 40 GHz<br>to<br>50 GHz |
| Directivity                  | 32                                  | 42                                 | 49                    | 45                     | 41                     | 41                     | 36                     |
| Source Match                 | 25                                  | 44                                 | 42                    | 37                     | 35                     | 35                     | 32                     |
| Load Match                   | 24                                  | 43                                 | 40                    | 35                     | 33                     | 33                     | 30                     |
| Reflection Tracking<br>Mag   | ±0.051                              | ±0.031                             | ±0.041                | ±0.051                 | ±0.061                 | ±0.061                 | ±0.081                 |
| Phase (°)                    | ±0.34                               | ±0.20                              | ±0.27                 | ±0.34                  | ±0.40                  | ±0.40                  | ±0.54                  |
| Transmission Tracking<br>Mag | ±0.12                               | ±0.038                             | ±0.047                | ±0.066                 | ±0.091                 | ±0.091                 | ±0.14                  |
| Phase (°)                    | ±0.79                               | ±0.25                              | ±0.31                 | ±0.44                  | ±0.61                  | ±0.61                  | ±0.90                  |

<sup>1</sup> With an LFE option 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

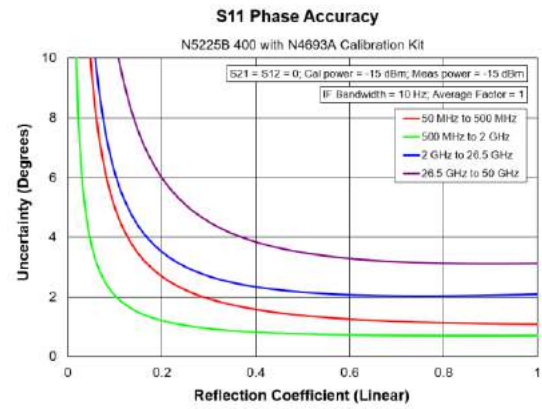
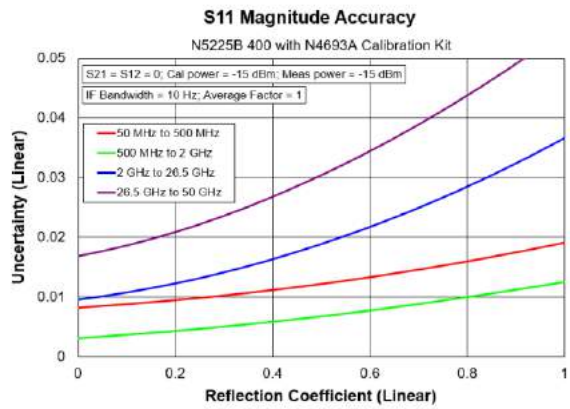
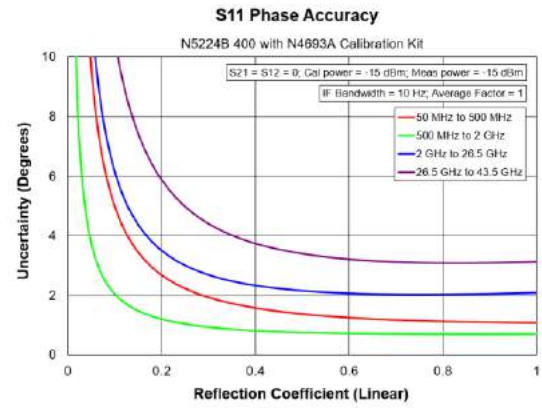
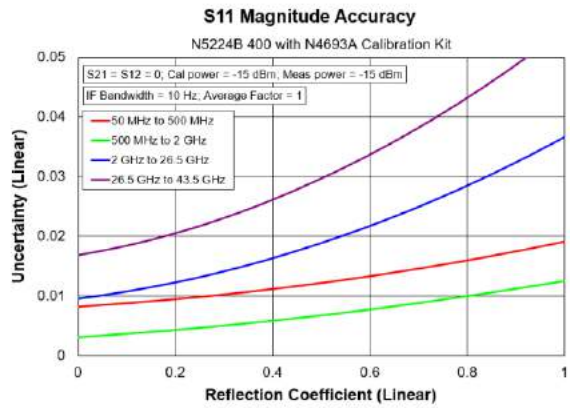
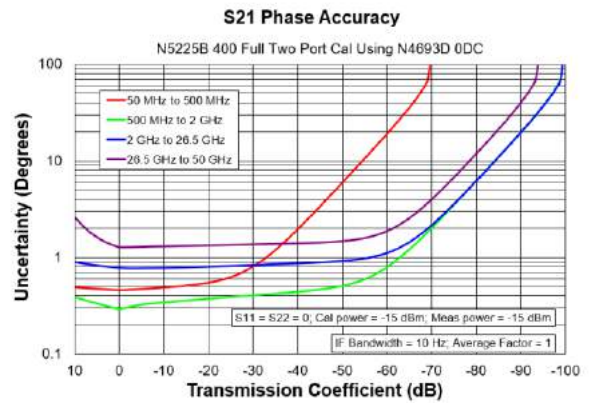
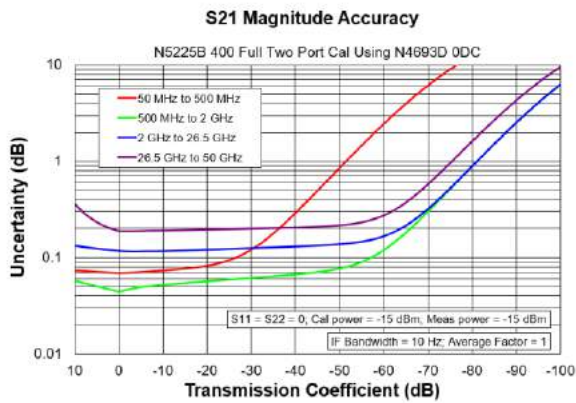
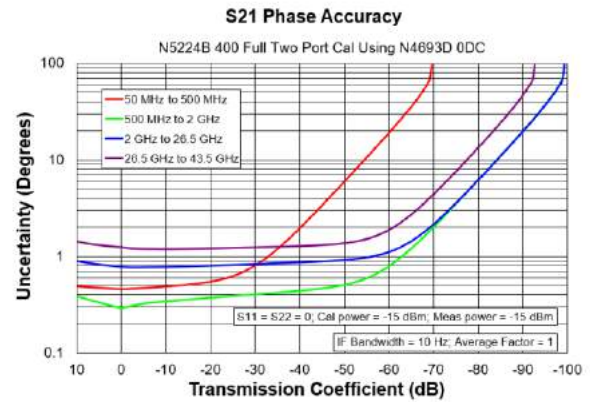
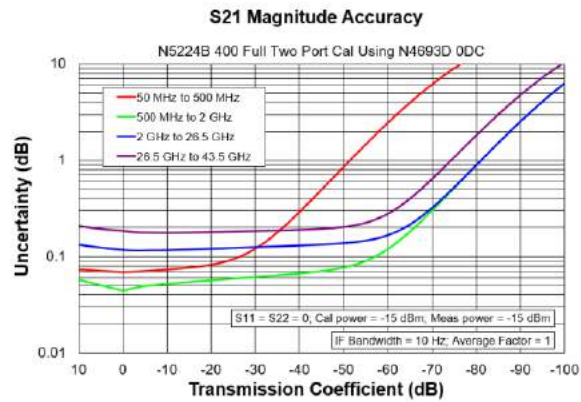


Table 4d. N5224B and N5225B with N4693D 2-Port Electronic Calibration Module

| Description                  | Specification (dB)                  |                                    |                       |                        |                        |                        |                        |
|------------------------------|-------------------------------------|------------------------------------|-----------------------|------------------------|------------------------|------------------------|------------------------|
|                              | 10 MHz<br>to<br>50 MHz <sup>1</sup> | 50 MHz<br>to<br>2 GHz <sup>1</sup> | 2 GHz<br>to<br>10 GHz | 10 GHz<br>to<br>20 GHz | 20 GHz<br>to<br>30 GHz | 30 GHz<br>to<br>40 GHz | 40 GHz<br>to<br>50 GHz |
| Directivity                  | 40                                  | 40                                 | 47                    | 44                     | 38                     | 38                     | 34                     |
| Source Match                 | 38                                  | 44                                 | 42                    | 37                     | 35                     | 35                     | 32                     |
| Load Match                   | 36                                  | 43                                 | 40                    | 35                     | 33                     | 33                     | 30                     |
| Reflection Tracking<br>Mag   | ±0.051                              | ±0.051                             | ±0.041                | ±0.051                 | ±0.061                 | ±0.061                 | ±0.081                 |
| Phase (°)                    | ±0.34                               | ±0.34                              | ±0.27                 | ±0.34                  | ±0.40                  | ±0.40                  | ±0.54                  |
| Transmission Tracking<br>Mag | ±0.078                              | ±0.060                             | ±0.049                | ±0.068                 | ±0.11                  | ±0.11                  | ±0.15                  |
| Phase (°)                    | ±0.52                               | ±0.40                              | ±0.33                 | ±0.45                  | ±0.69                  | ±0.69                  | ±0.99                  |

<sup>1</sup> With an LFE option 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

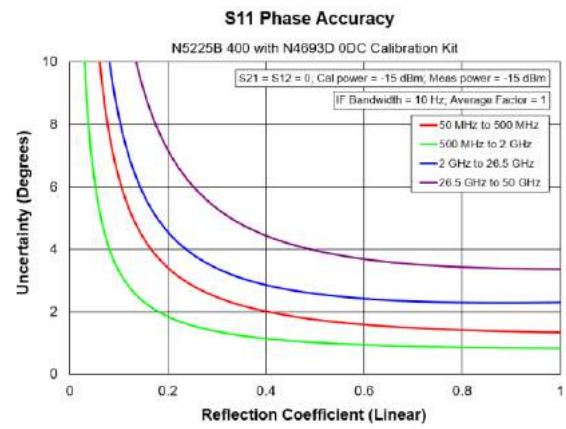
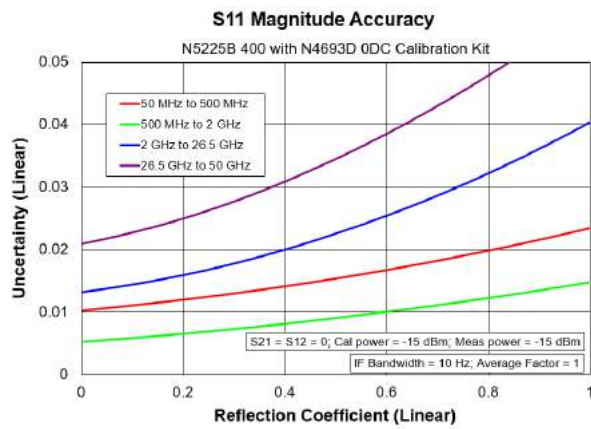
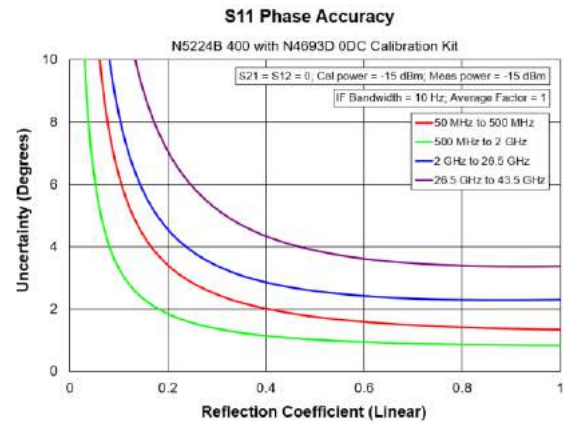
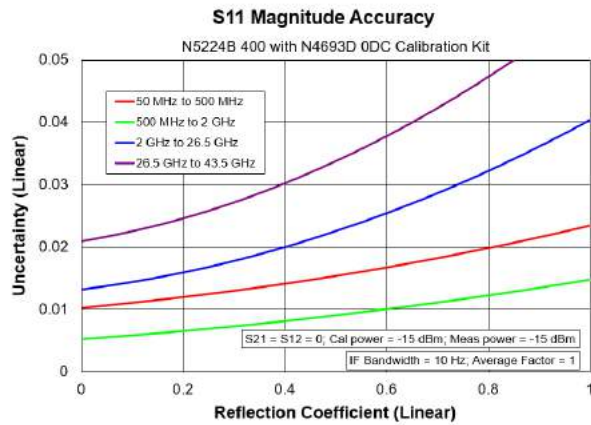




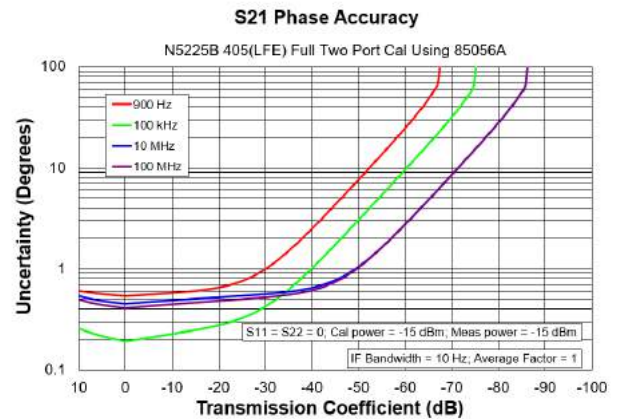
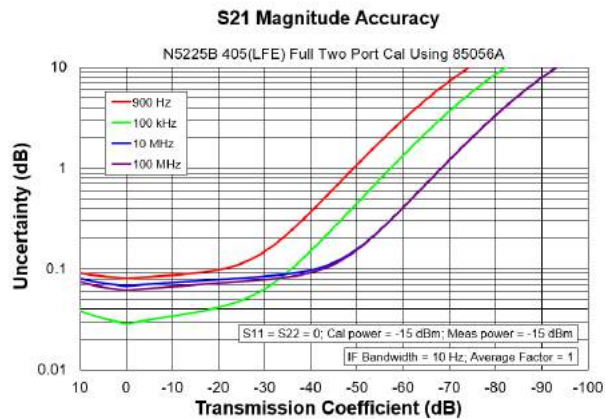
Table 4e. N5224B and N5225B with 85056A Calibration Kit, All LFE Options (LFE Enabled)

| 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               | 41                 | 41              | 41             | 41              | 41                |
| Source Match              | 41                 | 41              | 41             | 41              | 41                |
| Load Match                | 41                 | 41              | 41             | 41              | 41                |
| Reflection Tracking Mag   | $\pm 0.0015$       | $\pm 0.0015$    | $\pm 0.0015$   | $\pm 0.0015$    | $\pm 0.0015$      |
| Phase (°)                 | $\pm 0.0093$       | $\pm 0.0093$    | $\pm 0.0093$   | $\pm 0.0093$    | $\pm 0.0093$      |
| Transmission Tracking Mag | $\pm 0.065$        | $\pm 0.021$     | $\pm 0.046$    | $\pm 0.061$     | $\pm 0.055$       |
| Phase (°)                 | $\pm 0.43$         | $\pm 0.14$      | $\pm 0.31$     | $\pm 0.41$      | $\pm 0.36$        |

### Transmission Uncertainty, All LFE Options

**NOTE**

The plots are valid for all LFE options.





## Reflection Uncertainty, All LFE Options

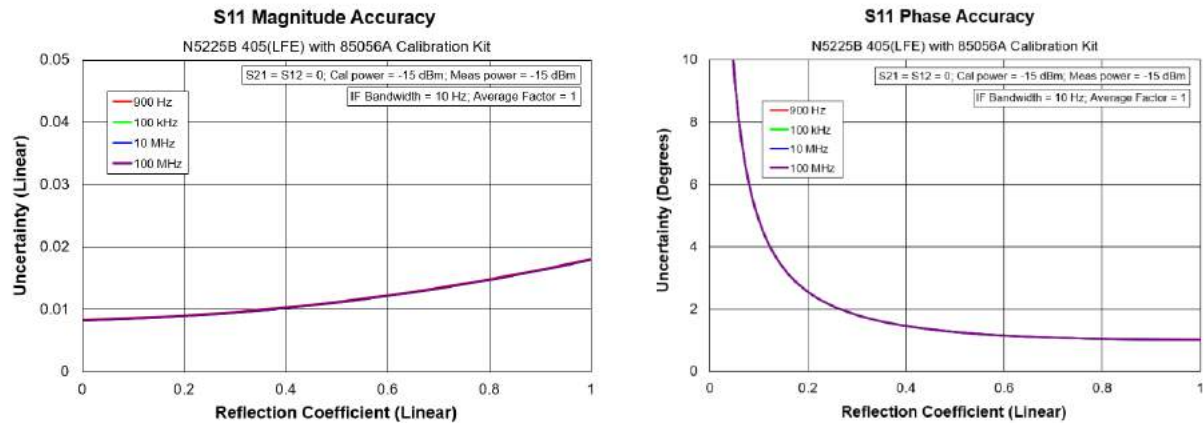
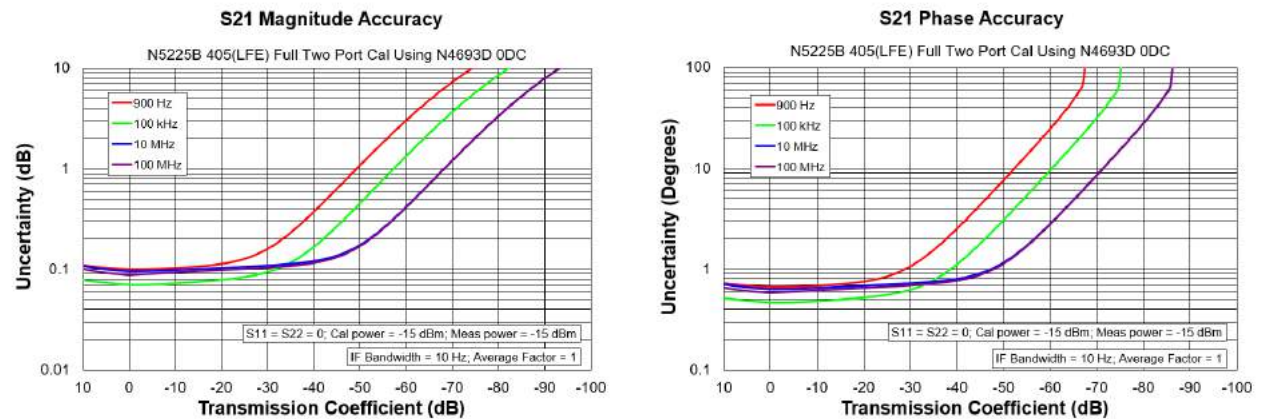


Table 4f. N5224B and N5225B with N4693D Calibration Kit, All LFE Options (LFE Enabled)

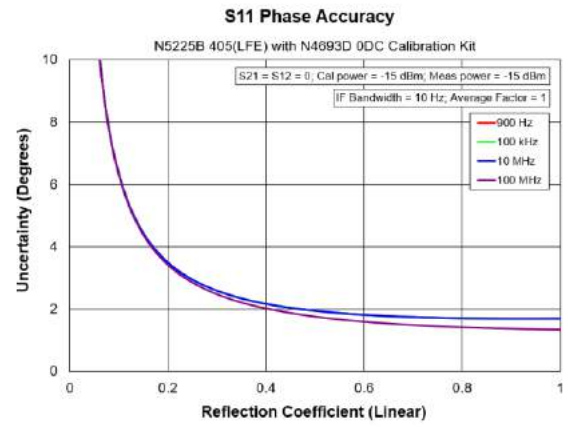
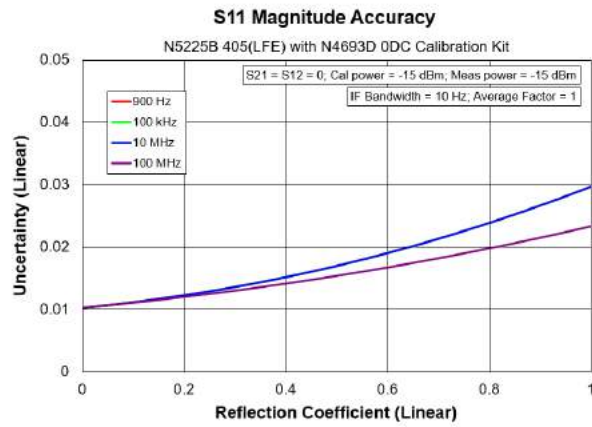
| Description               | Specification (dB) |                 |                |                 |                   |
|---------------------------|--------------------|-----------------|----------------|-----------------|-------------------|
|                           | 1 kHz to 10 kHz    | 10 kHz to 1 MHz | 1 MHz to 5 MHz | 5 MHz to 50 MHz | 50 MHz to 100 MHz |
| Directivity               | 40                 | 40              | 40             | 40              | 40                |
| Source Match              | 38                 | 38              | 38             | 38              | 44                |
| Load Match                | 36                 | 37              | 36             | 36              | 41                |
| Reflection Tracking Mag   | ±0.051             | ±0.051          | ±0.051         | ±0.051          | ±0.051            |
| Phase (°)                 | ±0.34              | ±0.34           | ±0.34          | ±0.34           | ±0.34             |
| Transmission Tracking Mag | ±0.089             | ±0.060          | ±0.075         | ±0.085          | ±0.081            |
| Phase (°)                 | ±0.59              | ±0.40           | ±0.50          | ±0.56           | ±0.54             |

## Transmission Uncertainty, All LFE Options

**NOTE** The plots are valid for all LFE options.



## Reflection Uncertainty, All LFE Options



## Uncorrected System Performance

Specifications apply to following conditions:

- 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 <sup>1</sup>  | 18 (18)     | 10 (8)       | 10 (8)     | --                    | --                  | --        |
| 50 MHz to 200 MHz <sup>1</sup> | 22 (22)     | 21 (6)       | 19 (7)     | --                    | --                  | --        |
| 200 MHz to 500 MHz             | 24 (24)     | 21 (6)       | 18 (7)     | --                    | --                  | --        |
| 500 MHz to 3.2 GHz             | 25 (25)     | 18 (7)       | 16 (6)     | --                    | --                  | --        |
| 3.2 GHz to 10 GHz              | 22 (22)     | 16 (9)       | 13 (8)     | --                    | --                  | --        |
| 10 GHz to 13.5 GHz             | 18 (18)     | 13 (10)      | 11 (8)     | --                    | --                  | --        |
| 13.5 GHz to 20 GHz             | 18 (18)     | 13 (9)       | 10 (7)     | --                    | --                  | --        |
| 20 GHz to 26.5 GHz             | 16 (16)     | 12 (7)       | 10 (6)     | --                    | --                  | --        |
| 26.5 GHz to 43.5 GHz           | 16 (16)     | 8 (7)        | 8 (6)      | --                    | --                  | --        |
| 43.5 GHz to 50 GHz             | 15 (15)     | 7 (6)        | 8 (6)      | --                    | --                  | --        |

( ) With an LFE option installed.

<sup>1</sup> With an LFE option 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 5b.

Table 5b. Error Terms (dB), All Ports, All LFE Options (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 <sup>1</sup>  | 21          | 15 (11)      | 15 (11)    | ±1.0                  | ±0.7                | -82       |
| 50 MHz to 200 MHz <sup>1</sup> | 28          | 31 (10)      | 26 (10)    | ±1.0                  | ±0.7                | -85       |
| 200 MHz to 500 MHz             | 33          | 29 (8)       | 24 (9)     | ±1.0                  | ±0.7                | -110      |
| 500 MHz to 3.2 GHz             | 30          | 25 (8)       | 20 (8)     | ±1.0                  | ±0.7                | -120      |
| 3.2 GHz to 10 GHz              | 25          | 22 (13)      | 17 (12)    | ±1.0                  | ±0.7                | -120      |
| 10 GHz to 13.5 GHz             | 23          | 21 (13)      | 15 (12)    | ±1.0                  | ±0.7                | -120      |
| 13.5 GHz to 16 GHz             | 20          | 20 (13)      | 14 (12)    | ±1.0                  | ±0.7                | -120      |
| 16 GHz to 20 GHz               | 19          | 18 (13)      | 16 (12)    | ±1.0                  | ±0.7                | -120      |
| 20 GHz to 24 GHz               | 20          | 17 (10)      | 14 (10)    | ±1.0                  | ±0.7                | -120      |
| 24 GHz to 26.5 GHz             | 21          | 17 (10)      | 15 (10)    | ±1.0                  | ±0.7                | -120      |
| 26.5 GHz to 35 GHz             | 19          | 15 (10)      | 13 (10)    | ±1.0                  | ±0.7                | -120      |
| 35 GHz to 43.5 GHz             | 19          | 15 (9)       | 13 (9)     | ±1.0                  | ±0.7                | -115      |
| 43.5 GHz to 46 GHz             | 19          | 14 (9)       | 14 (9)     | ±1.0                  | ±0.7                | -105      |
| 46 GHz to 50 GHz               | 19          | 13 (9)       | 13 (9)     | ±1.0                  | ±0.7                | -100      |

( ) With an LFE option installed.

<sup>1</sup> With an LFE option 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), All Ports, All LFE Options (LFE Enabled) – Typical

| Description       | Directivity | Source Match | Load Match | Transmission Tracking | Reflection Tracking | Crosstalk |
|-------------------|-------------|--------------|------------|-----------------------|---------------------|-----------|
| 500 Hz to 900 Hz  | --          | --           | --         | --                    | --                  | -102      |
| 900 Hz to 1 kHz   | 4           | 8            | 9          | ±1.5                  | ±1.5                | -106      |
| 1 kHz to 10 kHz   | 5           | 9            | 8          | ±1.5                  | ±1.5                | -100      |
| 10 kHz to 100 kHz | 23          | 19           | 23         | ±1.5                  | ±1.5                | -106      |
| 100 kHz to 1 MHz  | 23          | 19           | 23         | ±1.5                  | ±1.5                | -126      |
| 1 MHz to 5 MHz    | 26          | 13           | 14         | ±1.5                  | ±1.5                | -121      |
| 5 MHz to 10 MHz   | 11          | 9            | 10         | ±1.5                  | ±1.5                | -121      |
| 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                | -117      |

## Test Port Output

See Block diagrams for all models and options.

Table 6. Frequency Information, All Options

| Description                                       | Specification      | Typical                                                                   |
|---------------------------------------------------|--------------------|---------------------------------------------------------------------------|
| N5224B Frequency Range                            | 10 MHz to 43.5 GHz | --                                                                        |
| N5225B Frequency Range                            | 10 MHz to 50 GHz   | --                                                                        |
| N5224B Frequency Range (LFE Options) <sup>1</sup> | 900 Hz to 43.5 GHz | 500 Hz to 900 Hz                                                          |
| N5225B Frequency Range (LFE Options) <sup>1</sup> | 900 Hz to 50 GHz   | 500 Hz to 900 Hz                                                          |
| Frequency Resolution                              | 1 Hz               | --                                                                        |
| Frequency Accuracy                                | ±1 ppm             | --                                                                        |
| Frequency Stability                               | --                 | ±0.05 ppm, -10° to 70° C <sup>2</sup><br>±0.1 ppm/yr maximum <sup>3</sup> |

<sup>1</sup> Extended frequency down to 500 Hz.

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

<sup>3</sup> Assumes no variation in temperature.

Table 7a. Maximum Levelled Power (dBm), All Ports – Specification

| Description        | Option 200, 400 | Option 201, 401 | Option 217, 417, 219, 419 |
|--------------------|-----------------|-----------------|---------------------------|
| 10 MHz to 50 MHz   | 12              | 12              | 10                        |
| 50 MHz to 16 GHz   | 13              | 13              | 11                        |
| 16 GHz to 26.5 GHz | 13              | 13              | 10                        |
| 26.5 GHz to 30 GHz | 13              | 12              | 9                         |
| 30 GHz to 32 GHz   | 13              | 11              | 7                         |
| 32 GHz to 35 GHz   | 13              | 12              | 9                         |
| 35 GHz to 43.5 GHz | 10              | 9               | 4                         |
| 43.5 GHz to 47 GHz | 6               | 5               | -1                        |
| 47 GHz to 50 GHz   | -2              | -5              | -11                       |

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

| Description        | Option 200, 400 | Option 201, 401 | Option 217, 417, 219, 419 |
|--------------------|-----------------|-----------------|---------------------------|
| 10 MHz to 1 GHz    | 18              | 18              | 18                        |
| 1 GHz to 2 GHz     | 19              | 19              | 19                        |
| 2 GHz to 3.2 GHz   | 18              | 18              | 17                        |
| 3.2 GHz to 10 GHz  | 20              | 20              | 20                        |
| 10 GHz to 13.5 GHz | 18              | 18              | 17                        |
| 13.5 GHz to 16 GHz | 20              | 19              | 18                        |
| 16 GHz to 20 GHz   | 18              | 18              | 17                        |
| 20 GHz to 24 GHz   | 18              | 18              | 16                        |
| 24 GHz to 26.5 GHz | 18              | 17              | 15                        |
| 26.5 GHz to 30 GHz | 19              | 18              | 16                        |
| 30 GHz to 35 GHz   | 18              | 17              | 14                        |
| 35 GHz to 43.5 GHz | 15              | 14              | 11                        |
| 43.5 GHz to 47 GHz | 12              | 10              | 7                         |
| 47 GHz to 50 GHz   | 8               | 5               | 4                         |

Table 7c. Maximum Leveled Power (dBm) – All LFE Options – Specification

| Description                   | Option 205, 405 | Option 220, 420 |
|-------------------------------|-----------------|-----------------|
| 10 MHz to 50 MHz <sup>1</sup> | 5               | 3               |
| 50 MHz to 16 GHz <sup>1</sup> | 9               | 7               |
| 16 GHz to 26.5 GHz            | 8               | 8               |
| 26.5 GHz to 30 GHz            | 10              | 8               |
| 30 GHz to 32 GHz              | 9               | 6               |
| 32 GHz to 35 GHz              | 10              | 8               |
| 35 GHz to 43.5 GHz            | 7               | 3               |
| 43.5 GHz to 47 GHz            | 3               | -2              |
| 47 GHz to 50 GHz              | -5              | -12             |

<sup>1</sup> With an LFE option 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 7e.



Table 7d. Maximum Leveled Power (dBm) –All LFE Options – Typical

| Description        | Option 205, 405 | Option 220, 420 |
|--------------------|-----------------|-----------------|
| 10 MHz to 1 GHz    | 11              | 11              |
| 1 GHz to 2 GHz     | 16              | 16              |
| 2 GHz to 3.2 GHz   | 15              | 14              |
| 3.2 GHz to 10 GHz  | 18              | 18              |
| 10 GHz to 13.5 GHz | 16              | 15              |
| 13.5 GHz to 16 GHz | 17              | 16              |
| 16 GHz to 20 GHz   | 16              | 15              |
| 20 GHz to 24 GHz   | 16              | 14              |
| 24 GHz to 26.5 GHz | 15              | 13              |
| 26.5 GHz to 30 GHz | 16              | 15              |
| 30 GHz to 35 GHz   | 15              | 13              |
| 35 GHz to 43.5 GHz | 12              | 10              |
| 43.5 GHz to 47 GHz | 8               | 6               |
| 47 GHz to 50 GHz   | 5               | 3               |

<sup>1</sup> With an LFE option 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 7e.

Table 7e. Maximum Power (dBm), All Ports – All LFE Options (LFE Enabled)

| Description       | Specification | Typical <sup>1</sup> |
|-------------------|---------------|----------------------|
| 500 Hz to 900 Hz  | --            | 12                   |
| 900 Hz to 1 kHz   | 10            | 13                   |
| 1 kHz to 10 kHz   | 12            | 13                   |
| 10 kHz to 100 kHz | 12            | 14                   |
| 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                   |

<sup>1</sup> Values apply to all ports. Ports 2 and 4 typically 1 dB higher.

Table 8a. Power Level Accuracy (dB) at Nominal Power<sup>1</sup>, All Options

| Description                   | Specification | Typical |
|-------------------------------|---------------|---------|
| 10 MHz to 50 MHz <sup>2</sup> | ±1.5          | ±0.5    |
| 50 MHz to 1 GHz <sup>2</sup>  | ±1.0          | ±0.4    |
| 1 GHz to 3.2 GHz              | ±1.2          | ±0.1    |
| 3.2 GHz to 13.5 GHz           | ±1.5          | ±0.3    |
| 13.5 GHz to 20 GHz            | ±1.5          | ±0.2    |
| 20 GHz to 26.5 GHz            | ±1.8          | ±0.2    |
| 26.5 GHz to 43.5 GHz          | ±2.2          | ±0.3    |
| 43.5 GHz to 50 GHz            | ±3.2          | ±0.5    |

<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> With an LFE option 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), All Ports, All LFE Options (LFE Enabled)

| Description       | Specification | Typical |
|-------------------|---------------|---------|
| 500 Hz to 900 Hz  | --            | ±0.1    |
| 900 Hz to 1 kHz   | ±1.0          | ±0.1    |
| 1 kHz to 10 kHz   | ±1.0          | ±0.1    |
| 10 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 Linearity<sup>1</sup> (dB), All Options - Specification

| Description                    | Port 1 or 3 <sup>2</sup><br>-25dBm ≤ P < -20dBm | Port 1 or 3 <sup>2</sup><br>-20dBm ≤ P < -15dBm | Port 1 or 3 <sup>2</sup><br>P ≥ -15dBm |
|--------------------------------|-------------------------------------------------|-------------------------------------------------|----------------------------------------|
| 10 MHz to 50 MHz <sup>3</sup>  | ±2.5                                            | ±1.5                                            | ±1.5                                   |
| 50 MHz to 500 MHz <sup>3</sup> | ±2.0                                            | ±1.5                                            | ±1.5                                   |
| 500 MHz to 50 GHz              | ±1.5                                            | ±1.5                                            | ±1.5                                   |

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

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

<sup>3</sup> With an LFE option 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 Linearity<sup>1</sup> (dB), All Options - Specification

| Description                    | Port 2 or 4 <sup>2</sup><br>-25dBm ≤ P < -20dBm | Port 2 or 4 <sup>2</sup><br>-20dBm ≤ P < -15dBm | Port 2 or 4 <sup>2</sup><br>P ≥ -15dBm |
|--------------------------------|-------------------------------------------------|-------------------------------------------------|----------------------------------------|
| 10 MHz to 50 MHz <sup>3</sup>  | ±2.5                                            | ±1.5                                            | ±1.5                                   |
| 50 MHz to 3.2 GHz <sup>3</sup> | ±2.0                                            | ±1.5                                            | ±1.5                                   |
| 3.2 GHz to 50 GHz              | ±1.5                                            | ±1.5                                            | ±1.5                                   |

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

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

<sup>3</sup> With an LFE option 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 Linearity<sup>1</sup> (dB), All Ports, All LFE Options (LFE Enabled)

| Description       | Specification |
|-------------------|---------------|
| 500 Hz to 900 Hz  | --            |
| 900 Hz to 100 MHz | ±1.0          |

<sup>1</sup> Referenced to nominal power, from -25 dBm to max power.

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

| Description        | Option 200, 400 | Option 201, 401 | Option 217, 219, 417, 419 |
|--------------------|-----------------|-----------------|---------------------------|
| 10 MHz to 50 MHz   | 37              | 37              | 35                        |
| 50 MHz to 16 GHz   | 38              | 38              | 36                        |
| 16 GHz to 26.5 GHz | 38              | 38              | 35                        |
| 26.5 GHz to 30 GHz | 38              | 37              | 34                        |
| 30 GHz to 32 GHz   | 38              | 36              | 32                        |
| 32 GHz to 35 GHz   | 38              | 37              | 34                        |
| 35 GHz to 43.5 GHz | 35              | 34              | 29                        |
| 43.5 GHz to 47 GHz | 31              | 30              | 24                        |
| 47 GHz to 50 GHz   | 23              | 20              | 14                        |

Table 10b. N5224 and N5225B Power Sweep Range (dB), All Ports - Typical

| Description        | Option 200, 400 | Option 201, 401 | Option 217, 219, 417, 419 |
|--------------------|-----------------|-----------------|---------------------------|
| 10 MHz to 1 GHz    | 45              | 45              | 45                        |
| 1 GHz to 2 GHz     | 46              | 46              | 46                        |
| 2 GHz to 3.2 GHz   | 45              | 45              | 44                        |
| 3.2 GHz to 10 GHz  | 47              | 47              | 47                        |
| 10 GHz to 13.5 GHz | 45              | 45              | 44                        |
| 13.5 GHz to 16 GHz | 47              | 46              | 45                        |
| 16 GHz to 20 GHz   | 45              | 45              | 44                        |
| 20 GHz to 24 GHz   | 45              | 45              | 43                        |
| 24 GHz to 26.5 GHz | 45              | 44              | 42                        |
| 26.5 GHz to 30 GHz | 46              | 45              | 43                        |
| 30 GHz to 35 GHz   | 45              | 44              | 41                        |
| 35 GHz to 43.5 GHz | 42              | 41              | 38                        |
| 43.5 GHz to 47 GHz | 39              | 37              | 34                        |
| 47 GHz to 50 GHz   | 35              | 32              | 31                        |

Table 10c. Power Sweep Range (dB) – All LFE Options – Specification

| Description                   | Option 205, 405 | Option 220, 420 |
|-------------------------------|-----------------|-----------------|
| 10 MHz to 50 MHz <sup>1</sup> | 30              | 28              |
| 50 MHz to 16 GHz <sup>1</sup> | 34              | 32              |
| 16 GHz to 26.5 GHz            | 33              | 33              |
| 26.5 GHz to 30 GHz            | 35              | 32              |
| 30 GHz to 32 GHz              | 34              | 30              |
| 32 GHz to 35 GHz              | 35              | 32              |
| 35 GHz to 43.5 GHz            | 32              | 28              |
| 43.5 GHz to 47 GHz            | 28              | 23              |
| 47 GHz to 50 GHz              | 20              | 13              |

<sup>1</sup> With an LFE option 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 10e.

Table 10d. Power Sweep Range (dB) – All LFE Options – Typical

| Description                  | Option 205, 405 | Option 220, 420 |
|------------------------------|-----------------|-----------------|
| 10 MHz to 1 GHz <sup>1</sup> | 38              | 38              |
| 1 GHz to 2 GHz               | 43              | 43              |
| 2 GHz to 3.2 GHz             | 42              | 41              |
| 3.2 GHz to 10 GHz            | 45              | 45              |
| 10 GHz to 13.5 GHz           | 43              | 42              |
| 13.5 GHz to 16 GHz           | 44              | 43              |
| 16 GHz to 20 GHz             | 43              | 42              |
| 20 GHz to 24 GHz             | 43              | 41              |
| 24 GHz to 26.5 GHz           | 42              | 40              |
| 26.5 GHz to 30 GHz           | 43              | 42              |
| 30 GHz to 35 GHz             | 42              | 40              |
| 35 GHz to 43.5 GHz           | 39              | 37              |
| 43.5 GHz to 47 GHz           | 35              | 33              |
| 47 GHz to 50 GHz             | 32              | 30              |

<sup>1</sup> With an LFE option 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 10e.

Table 10e. Power Sweep Range (dB) – All LFE Options (LFE Enabled)

| Description       | Specification | Typical |
|-------------------|---------------|---------|
| 500 Hz to 900 Hz  | --            | 39      |
| 900 Hz to 1 kHz   | 35            | 40      |
| 1 kHz to 10 kHz   | 37            | 40      |
| 10 kHz to 100 kHz | 37            | 41      |
| 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                         | N5224B | N5225B |
|-------------------------------------|--------|--------|
| Option 200, 201, 205, 400, 401, 405 | 0      | -5     |
| Option 217, 219, 220, 417, 419, 420 | -5     | -15    |

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

| Description                         | Specification (dB) | Typical (dBm) |
|-------------------------------------|--------------------|---------------|
| Power Resolution                    | 0.01               |               |
| Maximum Settable Power              | --                 | 30            |
| Minimum Settable Power              |                    |               |
| Option 200, 201, 205, 400, 401, 405 | --                 | -30           |
| Option 217, 219, 220, 417, 419, 420 | --                 | -90           |



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

Listed frequency is harmonic frequency; test at max specified power

| Description                  | N5224B | N5225B |
|------------------------------|--------|--------|
| 20 MHz to 4 GHz <sup>1</sup> | -15    | -15    |
| 4 GHz to 6 GHz               | -18    | -18    |
| 6 GHz to 24 GHz              | -19    | -19    |
| 24 GHz to 27 GHz             | -21    | -21    |
| 27 GHz to 40.5 GHz           | -29    | -29    |
| 40.5 GHz to 43.5 GHz         | -60    | -60    |
| 43.5 GHz to 50 GHz           | --     | -60    |

<sup>1</sup> With an LFE option 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 13b.

Table 13b. 2<sup>nd</sup> and 3<sup>rd</sup> Harmonics at Max Specified Power (dBc), All Ports, All LFE Options (LFE Enabled) - Typical

Listed frequency is fundamental frequency; test at max specified power

| Description       | N5224B<br>(2 <sup>nd</sup> Harmonic) | N5224B<br>(3 <sup>rd</sup> Harmonic) |
|-------------------|--------------------------------------|--------------------------------------|
| 500 Hz to 900 Hz  | -32                                  | -31                                  |
| 900 Hz to 1 kHz   | -22                                  | -23                                  |
| 1 kHz to 10 kHz   | -22                                  | -23                                  |
| 10 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 Models and Options - Typical

| Description                    | Based on 100 kHz offset Frac-N |
|--------------------------------|--------------------------------|
| 10 MHz to 500 MHz <sup>1</sup> | -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 32 GHz               | -27                            |
| 32 GHz to 50 GHz               | -21                            |

<sup>1</sup> Non-harmonic spurs are negligible with an LFE option 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 50 MHz | -100         | -95           | -95            | -120         |
| 50 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 32 GHz | -77          | -87           | -82            | -97          |
| 32 GHz to 50 GHz | -71          | -81           | -76            | -91          |

Table 15b. Phase Noise (dBc/Hz) All Ports, All LFE Options (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 |        |
|--------------------------------|---------------|--------|---------|--------|
|                                | N5224B        | N5225B | N5224B  | N5225B |
| 10 MHz to 50 MHz <sup>1</sup>  | -70           | -70    | -75     | -75    |
| 50 MHz to 100 MHz <sup>1</sup> | -85           | -85    | -91     | -91    |
| 100 MHz to 250 MHz             | -95           | -95    | -100    | -100   |
| 250 MHz to 500 MHz             | -102          | -102   | -107    | -107   |
| 500 MHz to 1 GHz               | -106          | -106   | -112    | -112   |
| 1 GHz to 10 GHz                | -114          | -114   | -118    | -118   |
| 10 GHz to 26.5 GHz             | -114          | -114   | -120    | -120   |
| 26.5 GHz to 35 GHz             | -110          | -110   | -116    | -116   |
| 35 GHz to 40 GHz               | -108          | -108   | -116    | -116   |
| 40 GHz to 43.5 GHz             | -108          | -108   | -114    | -114   |
| 43.5 GHz to 50 GHz             | --            | -109   | --      | -116   |

<sup>1</sup> With an LFE option 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, All LFE Options (LFE Enabled)

| Description       | Specification | Typical |
|-------------------|---------------|---------|
| 500 Hz to 900 Hz  | --            | -93     |
| 900 Hz to 1 kHz   | -90           | -96     |
| 1 kHz to 10 kHz   | -91           | -96     |
| 10 kHz to 100 kHz | -101          | -105    |
| 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), Option 201, 205, 217, 219, 220, 401, 405, 417, 419, 420

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 |        |
|--------------------|---------------|--------|---------|--------|
|                    | N5224B        | N5225B | N5224B  | N5225B |
| 10 MHz to 50 MHz   | -105          | -105   | -119    | -119   |
| 50 MHz to 100 MHz  | -105          | -105   | -121    | -121   |
| 100 MHz to 250 MHz | -107          | -107   | -121    | -121   |
| 250 MHz to 500 MHz | -114          | -114   | -128    | -128   |
| 500 MHz to 1 GHz   | -118          | -118   | -133    | -133   |
| 1 GHz to 10 GHz    | -126          | -126   | -133    | -133   |
| 10 GHz to 20 GHz   | -126          | -126   | -135    | -135   |
| 20 GHz to 26.5 GHz | -124          | -124   | -134    | -134   |
| 26.5 GHz to 35 GHz | -120          | -120   | -130    | -130   |
| 35 GHz to 40 GHz   | -118          | -118   | -130    | -130   |
| 40 GHz to 43.5 GHz | -116          | -116   | -125    | -125   |
| 43.5 GHz to 50 GHz | --            | -117   | --      | -127   |

Table 18a. 0.1 dB Receiver Compression at Test Port (dBm), Option 201, 217, 219, 401, 417, 419, and All LFE Options - Typical

| Description                    | N5224B | N5225B |
|--------------------------------|--------|--------|
| 10 MHz to 100 MHz <sup>1</sup> | 15     | 15     |
| 100 MHz to 40 GHz              | 12     | 12     |
| 40 GHz to 43.5 GHz             | 10     | 10     |
| 43.5 GHz to 50 GHz             | --     | 10     |

<sup>1</sup> With an LFE option 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 18b.

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

| Description       | Test Port Power (dBm) |
|-------------------|-----------------------|
| 500 Hz to 900 Hz  | 13                    |
| 900 Hz to 1 kHz   | 13                    |
| 1 kHz to 10 kHz   | 13                    |
| 10 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. Receiver Compression at Test Power - Specification

| Description                    | Test Port Power (dBm) |                           |                 |                           | Receiver Compression |                 |
|--------------------------------|-----------------------|---------------------------|-----------------|---------------------------|----------------------|-----------------|
|                                | Option 200, 400       | Option 201, 205, 401, 405 | Option 217, 417 | Option 219, 220, 419, 420 | Magnitude (dB)       | Phase (degrees) |
| 10 MHz to 500 MHz <sup>1</sup> | --                    | --                        | --              | --                        | --                   | --              |
| 500 MHz to 10 GHz              | 11                    | 13                        | 11              | 11                        | 0.15                 | 1.5             |
| 10 GHz to 16 GHz               | 10                    | 13                        | 11              | 11                        | 0.15                 | 1.5             |
| 16 GHz to 20 GHz               | 10                    | 13                        | 10              | 10                        | 0.15                 | 1.5             |
| 20 GHz to 26.5 GHz             | 9                     | 13                        | 10              | 10                        | 0.18                 | 1.5             |
| 26.5 GHz to 30 GHz             | 9                     | 12                        | 9               | 9                         | 0.18                 | 1.5             |
| 30 GHz to 32 GHz               | 9                     | 11                        | 8               | 8                         | 0.18                 | 1.5             |
| 32 GHz to 35 GHz               | 9                     | 10                        | 9               | 9                         | 0.18                 | 1.5             |
| 35 GHz to 43.5 GHz             | 5                     | 9                         | 8               | 8                         | 0.18                 | 1.5             |
| 43.5 GHz to 47 GHz             | 1                     | 8                         | 8               | 8                         | 0.2                  | 1.5             |
| 47 GHz to 50 GHz               | -5                    | 8                         | 8               | 8                         | 0.2                  | 1.5             |

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

Table 18d. Compression, All Ports, All LFE Options (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 10 kHz   | 12                    | 0.2                  | 1               |
| 10 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<sup>1</sup> Magnitude (dB rms)

| Description                    | Specification | Typical    |              |              |
|--------------------------------|---------------|------------|--------------|--------------|
|                                |               | 1 kHz IFBW | 100 kHz IFBW | 600 kHz IFBW |
| 10 MHz to 50 MHz <sup>2</sup>  | 0.200         | 0.071      | 0.667        | 1.612        |
| 50 MHz to 100 MHz <sup>2</sup> | 0.020         | 0.009      | 0.088        | 0.209        |
| 100 MHz to 500 MHz             | 0.020         | 0.004      | 0.040        | 0.098        |
| 500 MHz to 1 GHz               | 0.003         | 0.001      | 0.009        | 0.022        |
| 1 GHz to 26.5 GHz              | 0.003         | 0.001      | 0.006        | 0.015        |
| 26.5 GHz to 43.5 GHz           | 0.003         | 0.001      | 0.009        | 0.021        |
| 43.5 GHz to 50 GHz             | 0.004         | 0.002      | 0.007        | 0.018        |

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

<sup>2</sup> With an LFE option installed and LFE disabled, applied to frequencies  $\leq 100$  MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled.

Table 19b. Trace Noise<sup>1</sup> Magnitude (dB rms), All Ports, All LFE Options (LFE Enabled)

| 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        |

<sup>1</sup> Ratioed measurement, -5 dBm at test port.

Table 20a. Trace Noise<sup>1</sup> Phase (deg rms)

| Description                    | Specification | Typical    |              |              |
|--------------------------------|---------------|------------|--------------|--------------|
|                                |               | 1 kHz IFBW | 100 kHz IFBW | 600 kHz IFBW |
| 10 MHz to 50 MHz <sup>2</sup>  | 1.000         | 0.485      | 4.681        | 11.310       |
| 50 MHz to 100 MHz <sup>2</sup> | 1.000         | 0.062      | 0.614        | 1.456        |
| 100 MHz to 500 MHz             | 0.500         | 0.029      | 0.276        | 0.680        |
| 500 MHz to 1 GHz               | 0.020         | 0.006      | 0.061        | 0.149        |
| 1 GHz to 26.5 GHz              | 0.020         | 0.008      | 0.040        | 0.100        |
| 26.5 GHz to 43.5 GHz           | 0.030         | 0.014      | 0.067        | 0.159        |
| 43.5 GHz to 50 GHz             | 0.030         | 0.015      | 0.061        | 0.142        |

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

<sup>2</sup> With an LFE option installed and LFE disabled, applied to frequencies <= 100 MHz. Above 100 MHz, performance is the same for both LFE enabled or disabled.



Table 20b. Trace Noise<sup>1</sup> Phase (deg rms), All Ports, All LFE Options (LFE Enabled)

| 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        |

<sup>1</sup> Ratioed measurement, -5 dBm at test port.

Table 21. Reference Level Magnitude, All Models and 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 <sup>1</sup>  | 0.020             | 0.200        |
| 50 MHz to 3.2 GHz <sup>1</sup> | 0.010             | 0.100        |
| 3.2 GHz to 10 GHz              | 0.010             | 0.200        |
| 10 GHz to 16 GHz               | 0.010             | 0.250        |
| 16 GHz to 20 GHz               | 0.015             | 0.300        |
| 20 GHz to 26.5 GHz             | 0.015             | 0.400        |
| 26.5 GHz to 35 GHz             | 0.020             | 0.600        |
| 35 GHz to 43.5 GHz             | 0.020             | 0.650        |
| 43.5 GHz to 47 GHz             | 0.025             | 0.700        |
| 47 GHz to 50 GHz               | 0.027             | 0.750        |

<sup>1</sup> With an LFE option 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 22b.

Table 22b. Stability<sup>1</sup>, All LFE Options (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 10 kHz   | 0.010             | 0.2          |
| 10 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          |

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

Table 23. Damage Input Level, All ports

| Description | Option 200, 201, 219, 400, 401, 419 | Option 217, 417 | All LFE Options |
|-------------|-------------------------------------|-----------------|-----------------|
| RF, DC      | 27 dBm, 40 V                        | 27 dBm, 7 V     | 20 dBm, 50 V    |

## Dynamic Accuracy

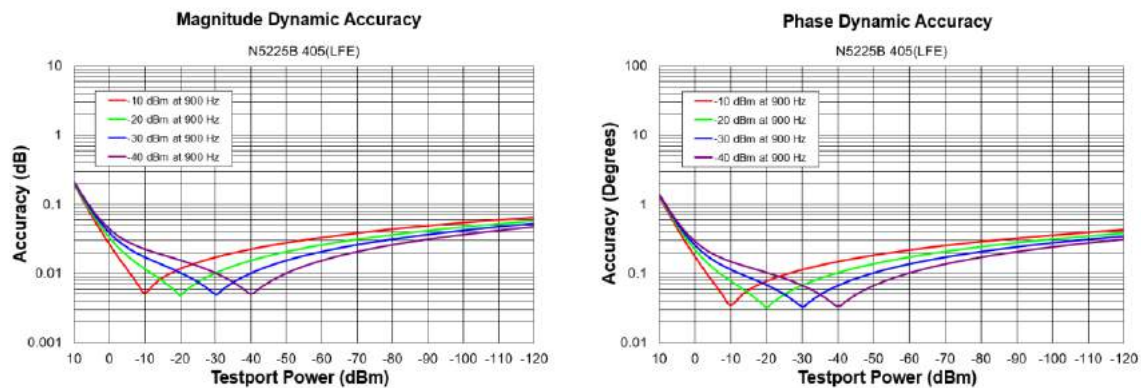
Dynamic accuracy is verified with the following measurements:

Compression over frequency

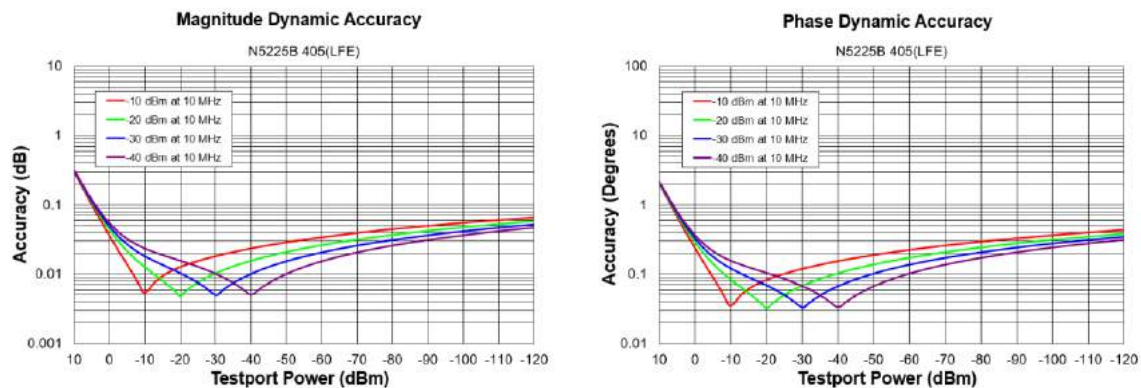
IF linearity at a single frequency of 1.998765GHz using a reference level of -20 dBm for an input power range of 0 to -60 dBm. For values below -60 dBm, refer to [VNA Receiver Dynamic Accuracy Specifications and Uncertainties](#).

Table 24. N5224B and N5225B Dynamic Accuracy

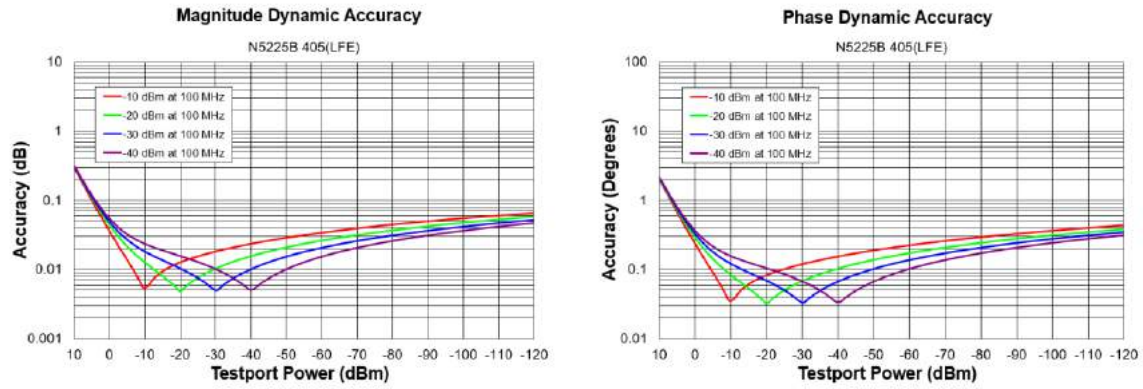
### N5224B/25B Dynamic Accuracy, 900 Hz, All LFE Options (LFE Enabled) - Specification



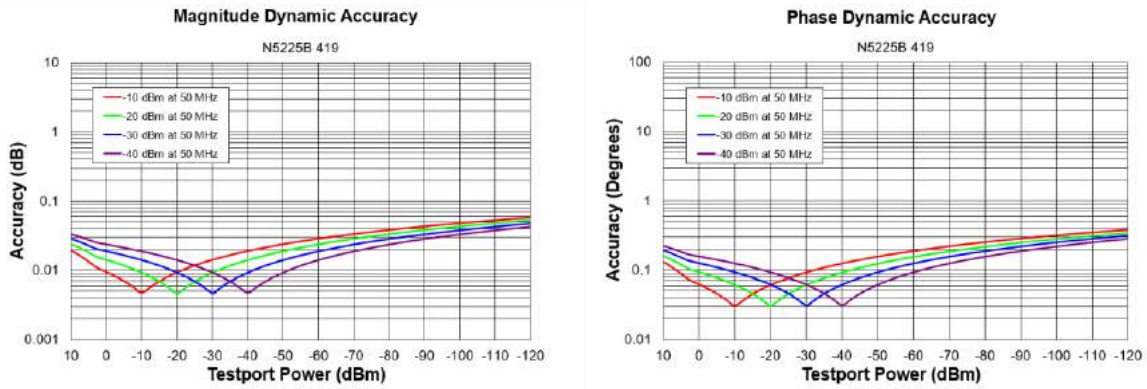
### N5224B/25B Dynamic Accuracy, 10 MHz, All LFE Options (LFE Enabled) - Specification



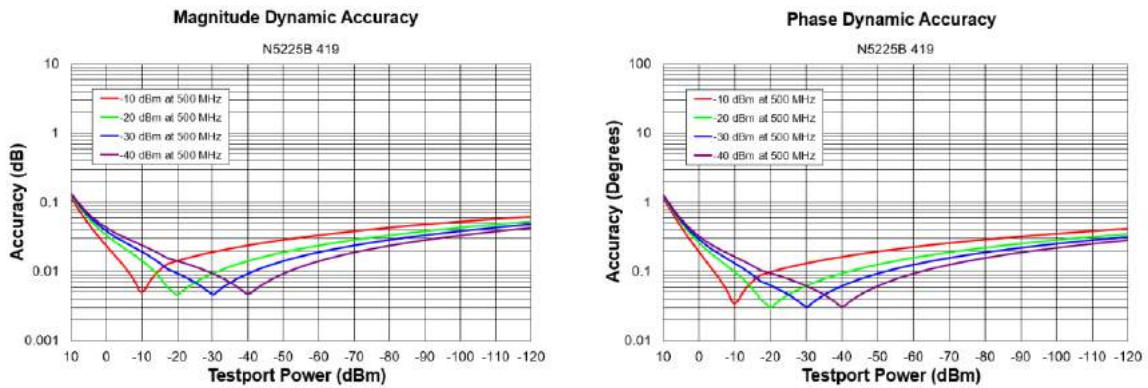
## N5224B/25B Dynamic Accuracy, 100 MHz, All LFE Options (LFE Enabled) - Specification



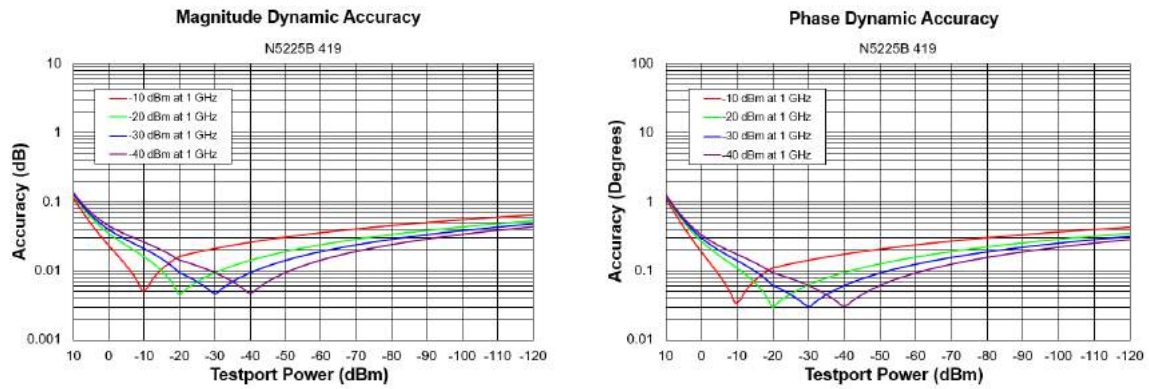
## N5224B/25B Dynamic Accuracy, 50 MHz - Specification



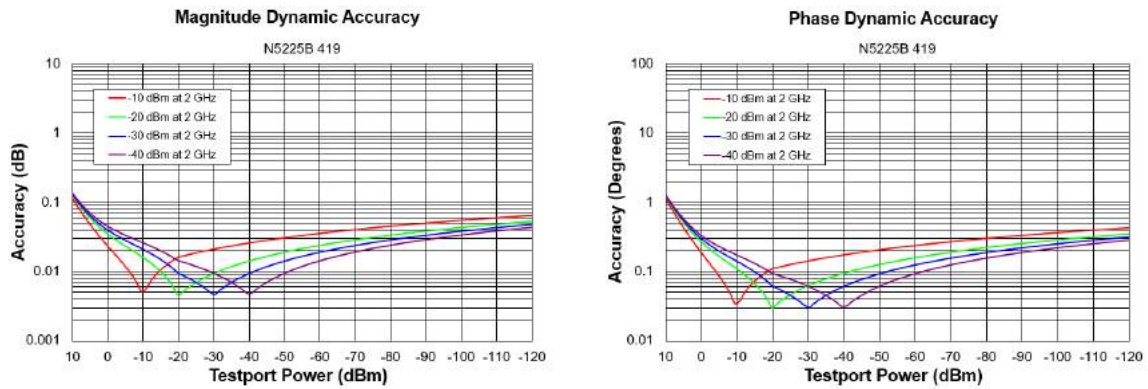
## N5224B/25B Dynamic Accuracy, 500 MHz - Specification



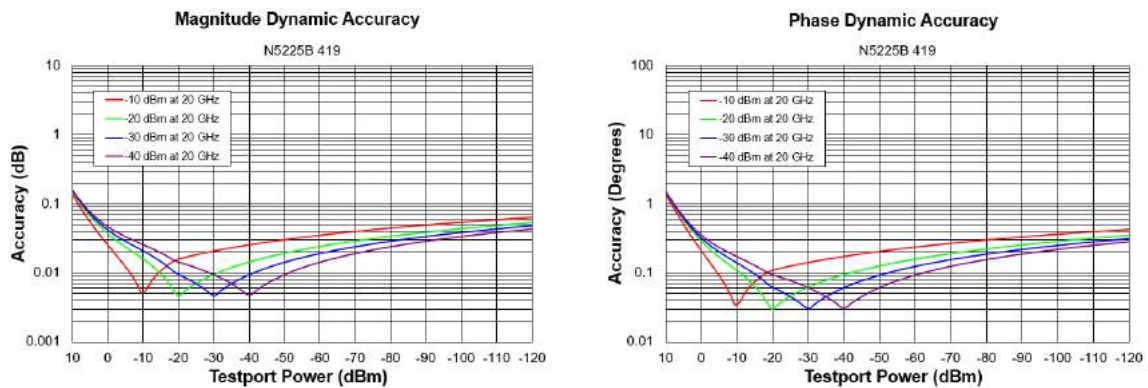
## N5224B/25B Dynamic Accuracy, 1 GHz - Specification



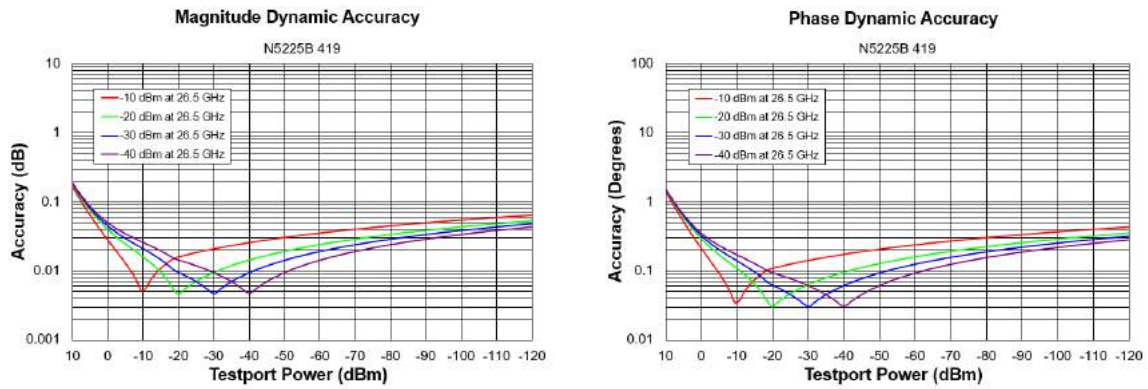
## N5224B/25B Dynamic Accuracy, 2 GHz - Specification



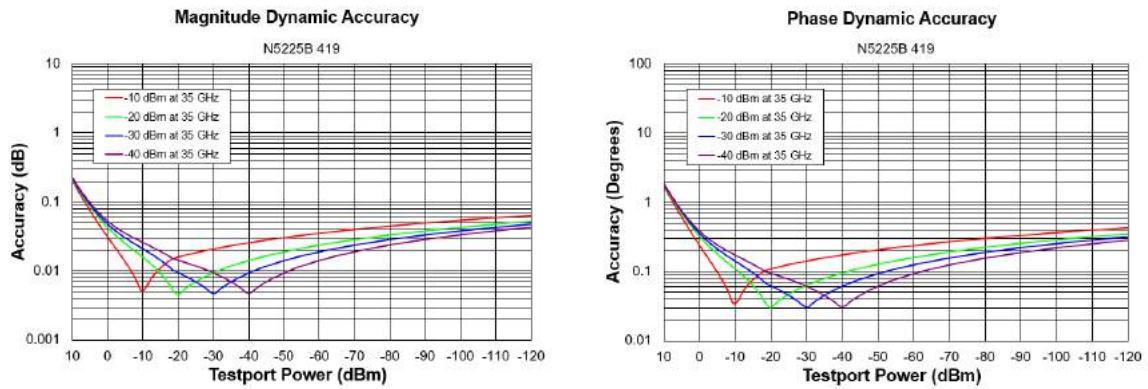
## N5224B/25B Dynamic Accuracy, 20 GHz - Specification



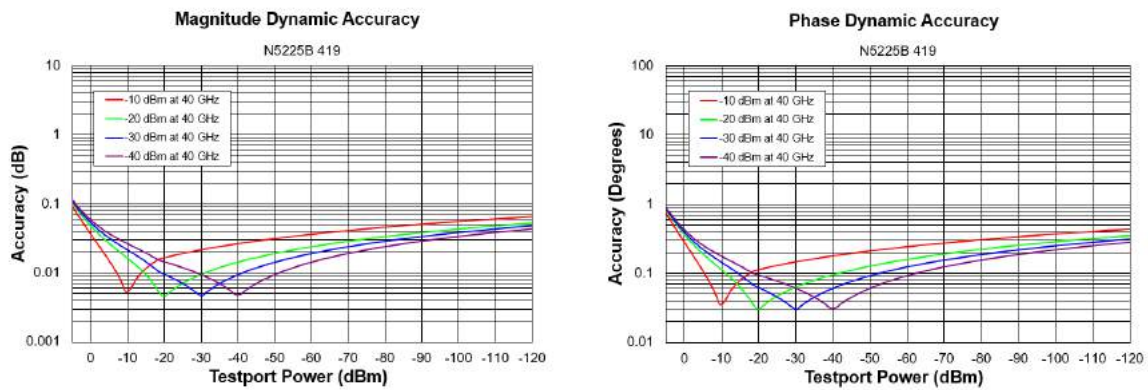
## N5224B/25B Dynamic Accuracy, 26.5 GHz - Specification



## N5224B/25B Dynamic Accuracy, 35 GHz - Specification



## N5224B/25B Dynamic Accuracy, 40 GHz - Specification





## N5224B/25B Dynamic Accuracy, 50 GHz - Specification

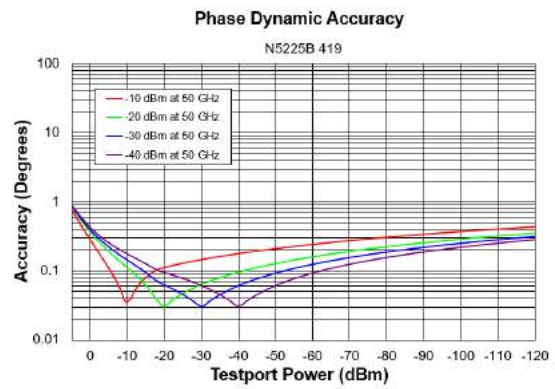
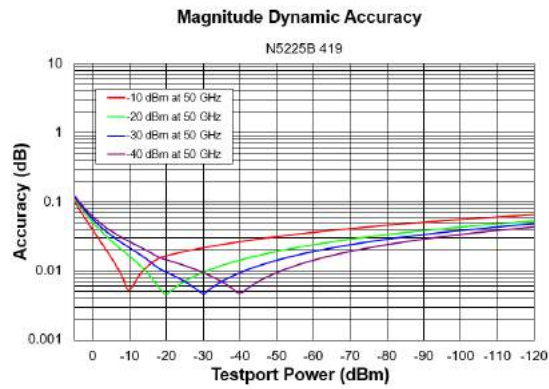


Table 25. Group Delay – Typical

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:

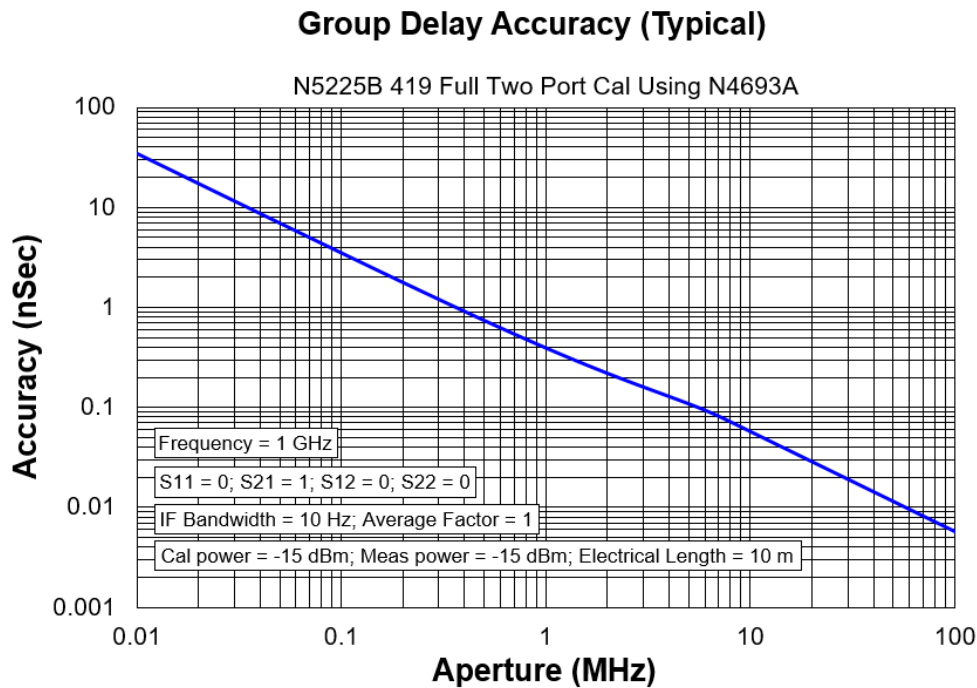
$$\pm \text{Phase Accuracy (deg)} / [360 \times \text{Aperture (Hz)}]$$

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,  $S_{ji} = 0$ ,  $S_{ij} = 1$ ,  $S_{ji} = 0$ ,  $S_{kl} = 0$  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:<br><a href="http://na.support.keysight.com/pna/hdnumbers.html">http://na.support.keysight.com/pna/hdnumbers.html</a> |
| LXI                       | Class C                                                                                                                                                                                    |

Table 27. Front Panel Information, All Options

| Description                             | Typical Performance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>RF Connectors</b>                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Type                                    | 2.4 mm (male), 50 ohm, (nominal)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Center Pin<br>Recession                 | 0.002 in. (characteristic)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>USB 2.0 Ports - Master (4 ports)</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Standard                                | Compatible with USB 2.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Connector                               | USB Type-A female                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Display</b>                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 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"><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” pixels or more than two “dark” pixels less than 6.5 mm apart (excluding consecutive pixels).</li></ul> |

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

| Description               | Typical Performance                        |
|---------------------------|--------------------------------------------|
| <b>Display Range</b>      |                                            |
| Magnitude                 | $\pm 2500$ dB (at 500 dB/div), max         |
| Phase                     | $\pm 2500^\circ$ (at 500 degrees/div), max |
| Polar                     | 10 pUnits, min<br>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 28. Rear Panel Information, All Options

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

Table 28. (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)                                |
| Input Frequency                                    |                                                                                            |
| Normal IF path                                     | RF < 53 MHz: IF = 826.446 KHz<br>RF >= 53 MHz: IF = 7.438 MHz                              |
| Narrowband IF path                                 | IF = 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                                                                                    |
| Minimum Pulse Width,<br>Source Modulators          | 33 ns                                                                                      |
| Minimum Pulse Width,<br>Receiver Gates             | 20 ns                                                                                      |
| DC Damage Level                                    | 5.5 VDC                                                                                    |
| Drive Voltage                                      | 0 V (off), +3.3 V (on), nominal                                                            |
| <b>RF Pulse Modulator Input (Source Modulator)</b> |                                                                                            |
| <b>On/Off Ratio</b>                                |                                                                                            |
| 10 MHz to 3.2 GHz                                  | -64                                                                                        |
| 3.2 GHz to 50 GHz                                  | -80                                                                                        |
| <b>Pulse Period</b>                                |                                                                                            |

|         |       |
|---------|-------|
| 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<br>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        | 0.01 GHz to 26.5 GHz                          |                            |
| Rear Panel LO Power <sup>1</sup> |                                               |                            |
|                                  | Upper Limit, Typical (dBm)                    | Lower Limit, Typical (dBm) |
| 1.7 GHz to 6.78 GHz              | 5                                             | -3                         |
| 6.78 GHz to 15.4 GHz             | 0                                             | -6                         |
| 15.4 GHz to 26.5 GHz             | 4                                             | -5                         |
| 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").

<sup>1</sup> 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                                                                                                                                                                                                                                                                                   |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <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 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                                                                                                                                                                                                                                   |
| <b>Line Power</b>      |                                                                                                                                                                                                                                                                                                       |
| Frequency, Voltage     | 50/60/400 Hz for 100 to 120 VAC<br>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) |
|-------------------------------------------------|-------------|-------------------|
| <b>Height</b>                                   |             |                   |
| Without bottom feet:<br><sup>1</sup> EIA RU = 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           | 582.3       | 22.9              |
| With front and rear panel hardware, handles     | 649.6       | 25.6              |

<sup>1</sup> Electronics 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         |
|-------------------|-----------------|------------------|
| All 2-port models | 39.1 kg (86 lb) | 55 kg (121 lb)   |
| All 4-port models | 41.8 kg (92 lb) | 58.2 kg (128 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 ( $S_{11}$ ) measurement. LF Auto BW off.

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

| Sweep Range      | IF Bandwidth |             | Number of Points |      |      |       |       |
|------------------|--------------|-------------|------------------|------|------|-------|-------|
|                  |              |             | 201              | 401  | 1601 | 16001 | 32001 |
| 9 GHz to 10 GHz  | 600 kHz      | Uncorrected | 5.5              | 5.5  | 9.4  | 59.4  | 116   |
|                  |              | 2-Port cal  | 18.0             | 19.0 | 26   | 132   | 250   |
|                  | 10 kHz       | Uncorrected | 28.1             | 53.1 | 203  | 1995  | 3988  |
|                  |              | 2-Port cal  | 65.6             | 116  | 414  | 4003  | 7991  |
|                  | 1 kHz        | Uncorrected | 227              | 445  | 1744 | 17028 | 33828 |
|                  |              | 2-Port cal  | 461              | 898  | 3150 | 30669 | 67680 |
| 10 GHz to 20 GHz | 600 kHz      | Uncorrected | 17.2             | 18.8 | 23.4 | 68.8  | 120   |
|                  |              | 2-Port cal  | 43.8             | 46.9 | 56.3 | 155   | 259   |
|                  | 10 kHz       | Uncorrected | 67.2             | 127  | 259  | 2003  | 3995  |
|                  |              | 2-Port cal  | 144              | 261  | 523  | 4016  | 8003  |
|                  | 1 kHz        | Uncorrected | 233              | 456  | 1781 | 17375 | 34516 |
|                  |              | 2-Port cal  | 475              | 922  | 3570 | 34758 | 69055 |

Table 30b. N5224B Typical Cycle Time (ms) for Full-Span Measurement Completion

| 10 MHz to 43.5 GHz |             | Number of Points |      |      |       |       |
|--------------------|-------------|------------------|------|------|-------|-------|
| IF Bandwidth       |             | 201              | 401  | 1601 | 16001 | 32001 |
| 600 kHz            | Uncorrected | 48.4             | 59.4 | 78.1 | 156   | 206   |
|                    | 2-Port cal  | 105              | 127  | 164  | 317   | 428   |
| 10 kHz             | Uncorrected | 84.4             | 147  | 505  | 2172  | 4188  |
|                    | 2-Port cal  | 175              | 302  | 1016 | 4350  | 8384  |
| 1 kHz              | Uncorrected | 250              | 477  | 1822 | 17617 | 34984 |
|                    | 2-Port cal  | 505              | 959  | 3647 | 35250 | 69992 |

Table 30c. N5225B Typical Cycle Time (ms) for Full-Span Measurement Completion

| 10 MHz to 50 GHz |             | Number of Points |      |      |       |       |
|------------------|-------------|------------------|------|------|-------|-------|
| IF Bandwidth     |             | 201              | 401  | 1601 | 16001 | 32001 |
| 600 kHz          | Uncorrected | 55.5             | 67.2 | 85.9 | 166   | 223   |
|                  | 2-Port cal  | 116              | 141  | 175  | 334   | 443   |
| 10 kHz           | Uncorrected | 87.5             | 151  | 512  | 2182  | 4203  |
|                  | 2-Port cal  | 180              | 307  | 1027 | 4364  | 8422  |
| 1 kHz            | Uncorrected | 252              | 480  | 1825 | 17648 | 35031 |
|                  | 2-Port cal  | 509              | 966  | 3656 | 35305 | 70086 |



**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.

| <b>Description</b>       |                        | <b>N5224B/25B</b>                     |  |
|--------------------------|------------------------|---------------------------------------|--|
| <b>IF Bandwidth (Hz)</b> | <b>Cycle Time (ms)</b> | <b>Trace Noise Magnitude (dB rms)</b> |  |
| 600,000                  | 5.5                    | 0.005                                 |  |
| 100,000                  | 5.5                    | 0.0024                                |  |
| 30,000                   | 8.6                    | 0.0017                                |  |
| 10,000                   | 28.9                   | 0.0014                                |  |
| 3,000                    | 70.3                   | 0.001                                 |  |
| 1,000                    | 223                    | 0.0008                                |  |
| 300                      | 642                    | 0.0006                                |  |
| 100                      | 1823                   | 0.0005                                |  |
| 30                       | 5977                   | 0.0005                                |  |
| 10                       | 17836                  | 0.0005                                |  |
| 3                        | 59289                  | 0.0004                                |  |

**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) |        |        |         |
|------------------|-------------------|--------|--------|---------|
| Number of Points | 1,000             | 10,000 | 30,000 | 600,000 |
| 3                | 6.3               | 4.7    | 4.7    | 4.7     |
| 11               | 15.6              | 5.5    | 4.7    | 4.7     |
| 51               | 59.4              | 10.2   | 4.7    | 4.7     |
| 101              | 113               | 15.6   | 6.3    | 4.7     |
| 201              | 222               | 28.1   | 8.6    | 4.7     |
| 401              | 436               | 53.1   | 14.1   | 5.5     |
| 801              | 859               | 103    | 23.4   | 6.3     |
| 1,601            | 1706              | 203    | 43.8   | 9.4     |
| 6,401            | 6719              | 800    | 166    | 26.6    |
| 16,001           | 16656             | 1995   | 408    | 60.2    |
| 32,001           | 33086             | 3988   | 812    | 116     |

Table 33. Data Transfer Time (ms) – Typical

Measured with the analyzer display off.

Values will increase slightly if the analyzer display is on.

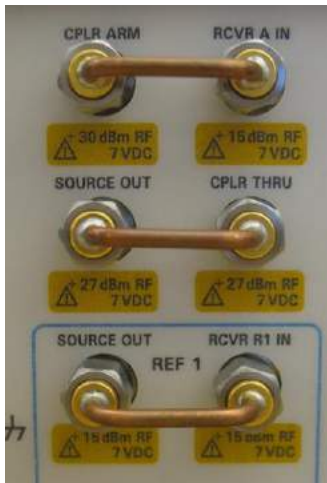
| Description                                                                                | Number of Points |      |      |        |        |
|--------------------------------------------------------------------------------------------|------------------|------|------|--------|--------|
|                                                                                            | 201              | 401  | 1601 | 16,001 | 32,001 |
| <b>SCPI over GPIB</b> (Program executed on external PC <sup>2</sup> )                      |                  |      |      |        |        |
| 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   |
| <b>SCPI over SICL/LAN or TCP/IP Socket</b> <sup>1</sup> (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    |
| <b>COM</b> <sup>1</sup> (Program executed in the analyzer)                                 |                  |      |      |        |        |
| 32-bit floating point                                                                      | <1               | <1   | <1   | <1     | <1     |
| Variant type                                                                               | <1               | <1   | 1.4  | 12.4   | 25.5   |
| <b>DCOM over LAN</b> <sup>1</sup> (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  |

<sup>1</sup> 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, 205, 217, 219, 220, 401, 405, 417, 419, 420

- 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  | -3          |
| 500 MHz to 1 GHz   | -3          |
| 1 GHz to 2 GHz     | -2          |
| 2 GHz to 3.2 GHz   | -1          |
| 3.2 GHz to 10 GHz  | -2          |
| 10 GHz to 26.5 GHz | -4          |
| 26.5 GHz to 35 GHz | -5          |
| 35 GHz to 50 GHz   | -6          |

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   | -30             | -30                       |
| 50 MHz to 100 MHz  | -16             | -16                       |
| 100 MHz to 500 MHz | -16             | -16                       |
| 500 MHz to 1 GHz   | -8              | -8                        |
| 1 GHz to 10 GHz    | -7              | -8                        |
| 10 GHz to 16 GHz   | -8              | -8                        |
| 16 GHz to 26.5 GHz | -8              | -9                        |
| 26.5 GHz to 30 GHz | -9              | -10                       |
| 30 GHz to 32 GHz   | -10             | -11                       |
| 32 GHz to 35 GHz   | -9              | -11                       |
| 35 GHz to 43.5 GHz | -11             | -12                       |
| 43.5 GHz to 47 GHz | -15             | -16                       |
| 47GHz to 50 GHz    | -24             | -24                       |

Table 36. Reference Receiver Inputs and Reference Receiver 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 401                      | Option 217, 219, 417, 419                                           |                                 |
|--------------------|---------------------------------------------------------------------|---------------------------------|---------------------------------------------------------------------|---------------------------------|
|                    | RCVR R2 IN,<br>RCVR R4 IN,<br>REF 2 SOURCE OUT,<br>REF 4 SOURCE OUT | RCVR R3 IN,<br>REF 3 SOURCE OUT | RCVR R2 IN,<br>RCVR R4 IN,<br>REF 2 SOURCE OUT,<br>REF 4 SOURCE OUT | RCVR R3 IN,<br>REF 3 SOURCE OUT |
| 10 MHz to 50 MHz   | -25                                                                 | -25                             | -25                                                                 | -25                             |
| 50 MHz to 100 MHz  | -20                                                                 | -20                             | -20                                                                 | -20                             |
| 100 MHz to 500 MHz | -6                                                                  | -6                              | -10                                                                 | -10                             |
| 500 MHz to 3.2 GHz | -2                                                                  | -2                              | -3                                                                  | -3                              |
| 3.2 GHz to 10 GHz  | -1                                                                  | -1                              | -2                                                                  | -2                              |
| 10 GHz to 30 GHz   | -1                                                                  | -1                              | -1                                                                  | -1                              |
| 30 GHz to 32 GHz   | -1                                                                  | -1                              | -3                                                                  | -3                              |
| 32 GHz to 35 GHz   | 0                                                                   | 0                               | -1                                                                  | -1                              |
| 35 GHz to 43.5 GHz | -2                                                                  | -2                              | -4                                                                  | -4                              |
| 43.5 GHz to 47 GHz | -5                                                                  | -5                              | -7                                                                  | -7                              |
| 47 GHz to 50 GHz   | -14                                                                 | -14                             | -15                                                                 | -15                             |

**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 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                                   | 10                                   | 10                                   |
| 50 MHz to 1 GHz    | 13                                   | 13                                   | 11                                   | 11                                   |
| 1 GHz to 10 GHz    | 14                                   | 14                                   | 12                                   | 12                                   |
| 10 GHz to 16 GHz   | 14                                   | 14                                   | 13                                   | 13                                   |
| 16 GHz to 26.5 GHz | 15                                   | 15                                   | 13                                   | 13                                   |
| 26.5 GHz to 30 GHz | 14                                   | 14                                   | 12                                   | 12                                   |
| 30 GHz to 32 GHz   | 13                                   | 13                                   | 10                                   | 10                                   |
| 32 GHz to 35 GHz   | 14                                   | 14                                   | 12                                   | 12                                   |
| 35 GHz to 43.5 GHz | 11                                   | 11                                   | 8                                    | 8                                    |
| 43.5 GHz to 47 GHz | 8                                    | 8                                    | 4                                    | 4                                    |
| 47 GHz to 50 GHz   | -2                                   | -2                                   | -5                                   | -5                                   |

Table 38. Coupler Inputs (dB) - Typical

(PORT 1, 2, 3, 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 MHz to 500 MHz  | -0.25           | -0.25                     |
| 500 MHz to 1 GHz   | -0.50           | -0.50                     |
| 1 GHz to 2 GHz     | -0.50           | -1                        |
| 2 GHz to 3.2 GHz   | -0.75           | -1                        |
| 3.2 GHz to 10 GHz  | -1              | -1.5                      |
| 10 GHz to 16 GHz   | -1.2            | -2                        |
| 16 GHz to 26.5 GHz | -1.8            | -2.5                      |
| 26.5 GHz to 35 GHz | -2              | -3                        |
| 35 GHz to 43.5 GHz | -2.5            | -4                        |
| 43.5 GHz to 47 GHz | -3              | -5                        |
| 47 GHz to 50 GHz   | -3              | -6                        |

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 | 27                    | 7                                       |
| PORT 1, 2, 3, 4 CPLR THRU  | 27 (20 <sup>1</sup> ) | 40 (50 <sup>1</sup> ) (7 <sup>2</sup> ) |
| PORT 1, 2, 3, 4 CPLR ARM   | 30                    | 7                                       |

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

<sup>2</sup> 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..

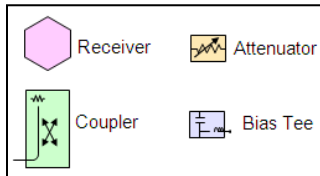


## Test Set Block Diagrams

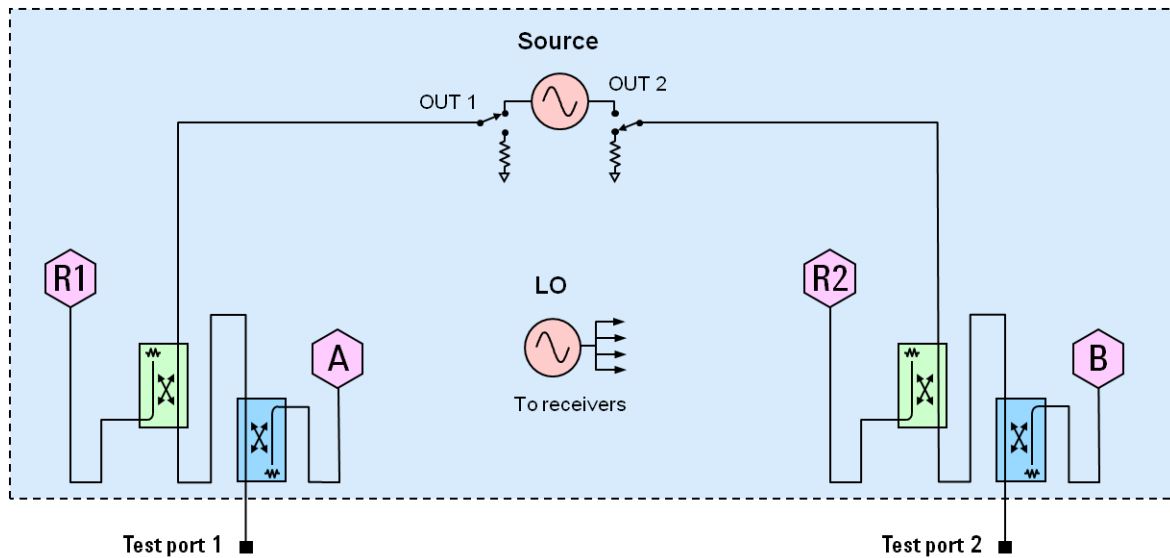
### NOTE

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

### Legend

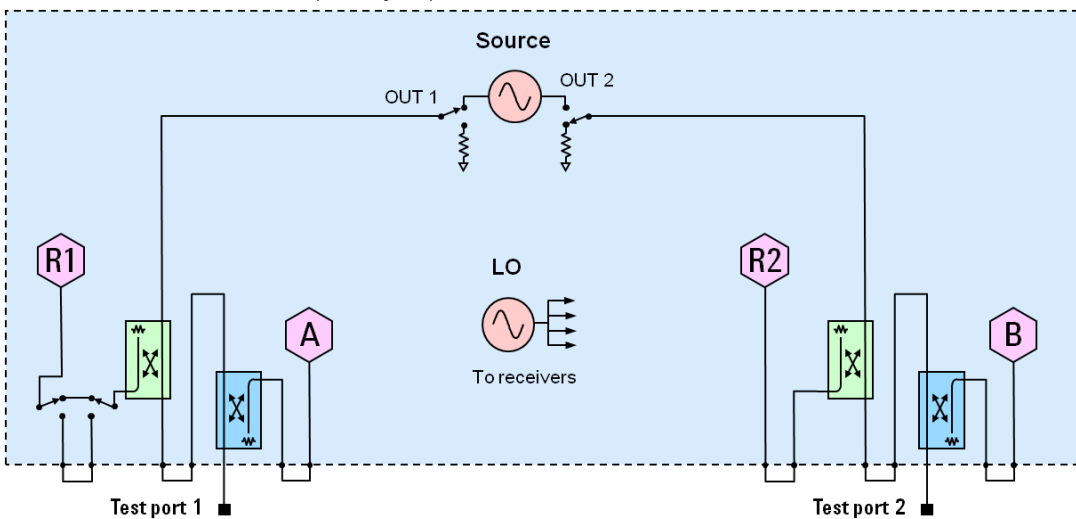


### N5224B and N5225B Option 200 (2-port base model)



### N5224B and N5225B Option 201

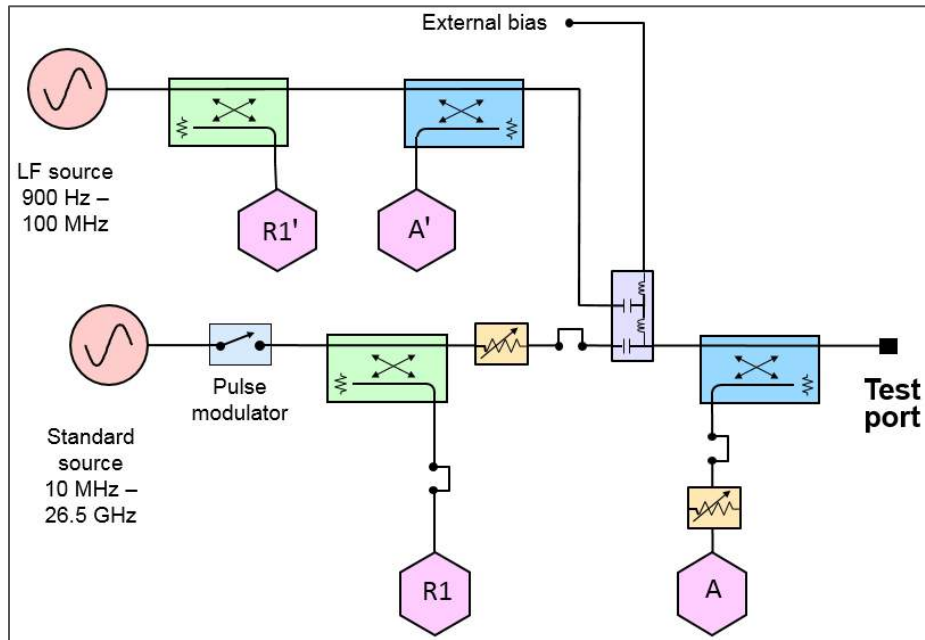
To base model, adds front-panel jumpers and R1 receiver switch



## N5224B and N5225B LFE Options

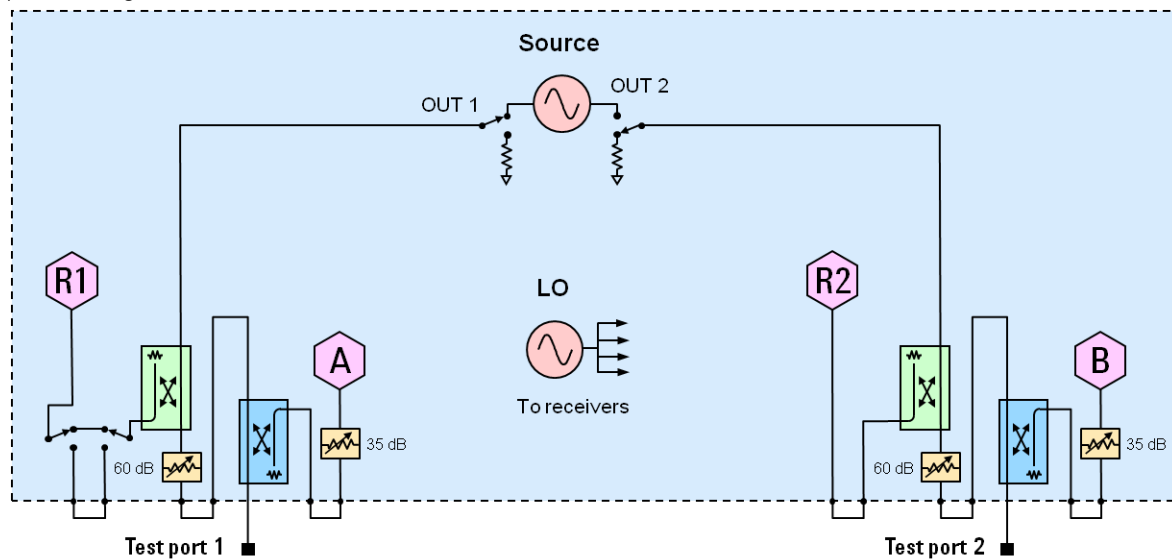
The following LFE block diagram shows how the low-frequency hardware is configured for a single test port. The other ports are configured similarly.

**NOTE** The attenuators do not apply to Options 205 and 405.



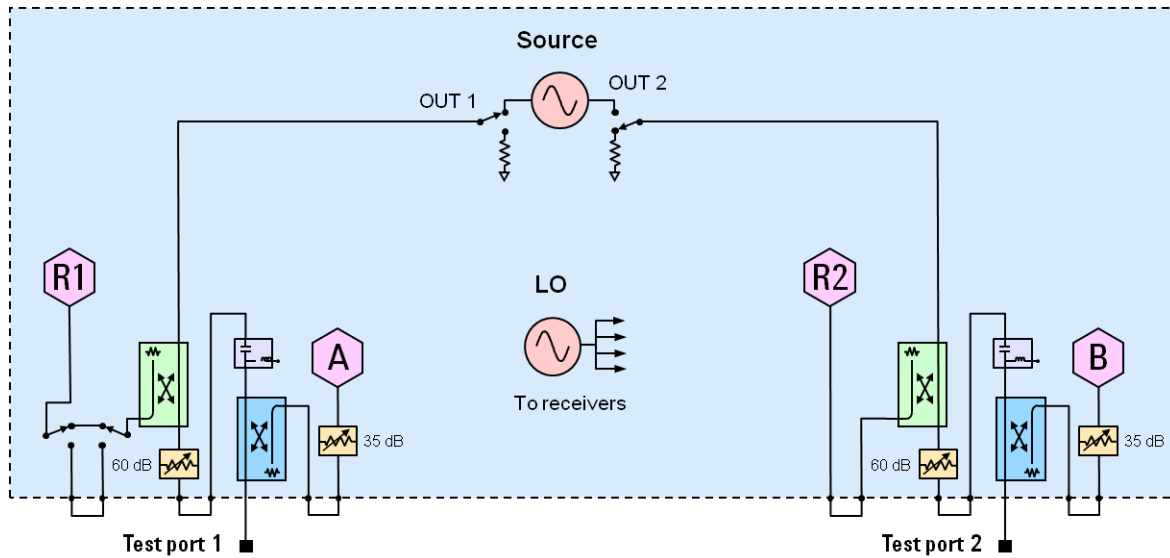
## N5224B and N5225B Option 217

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

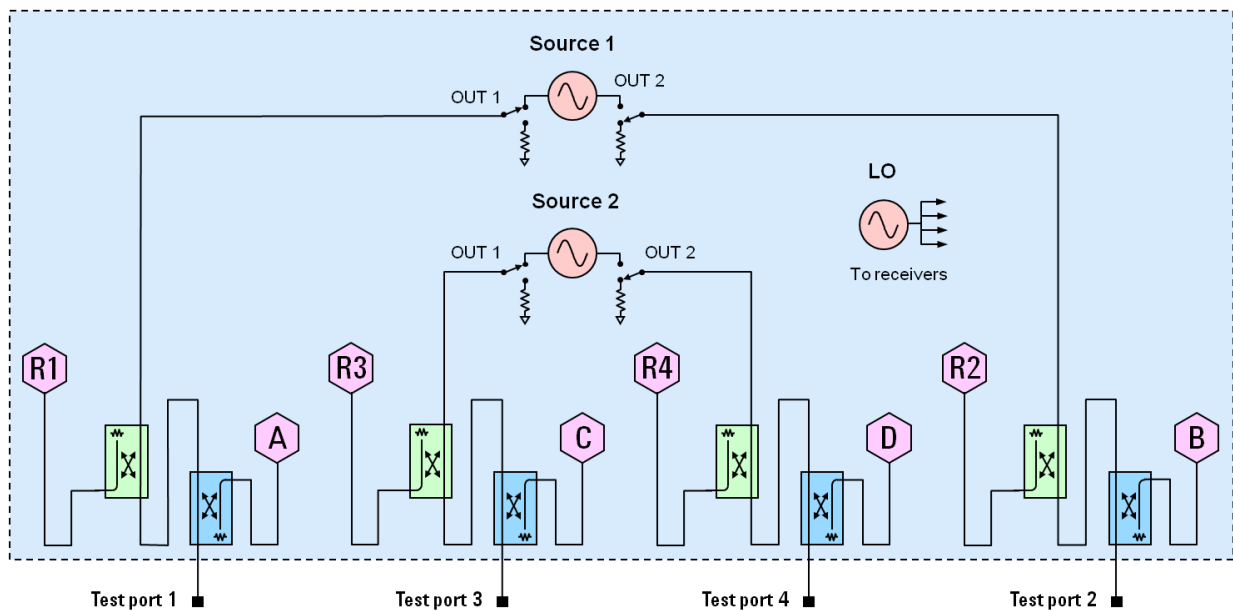


## N5224B and N5225B Option 219

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

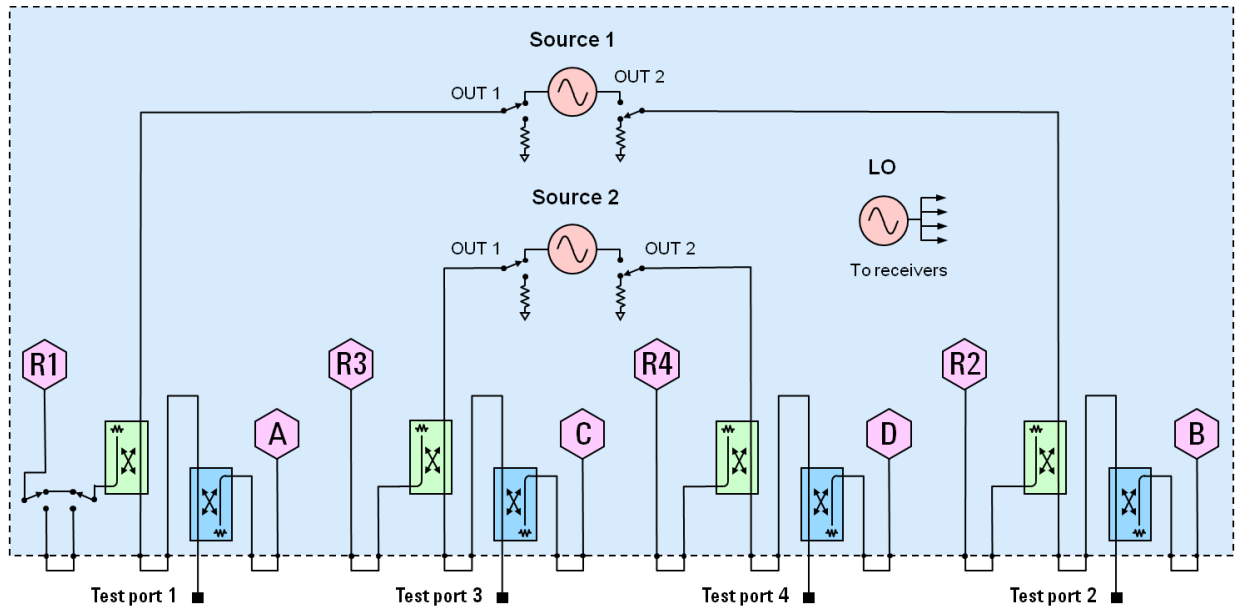


## N5224B and N5225B Option 400 (4-port base model)



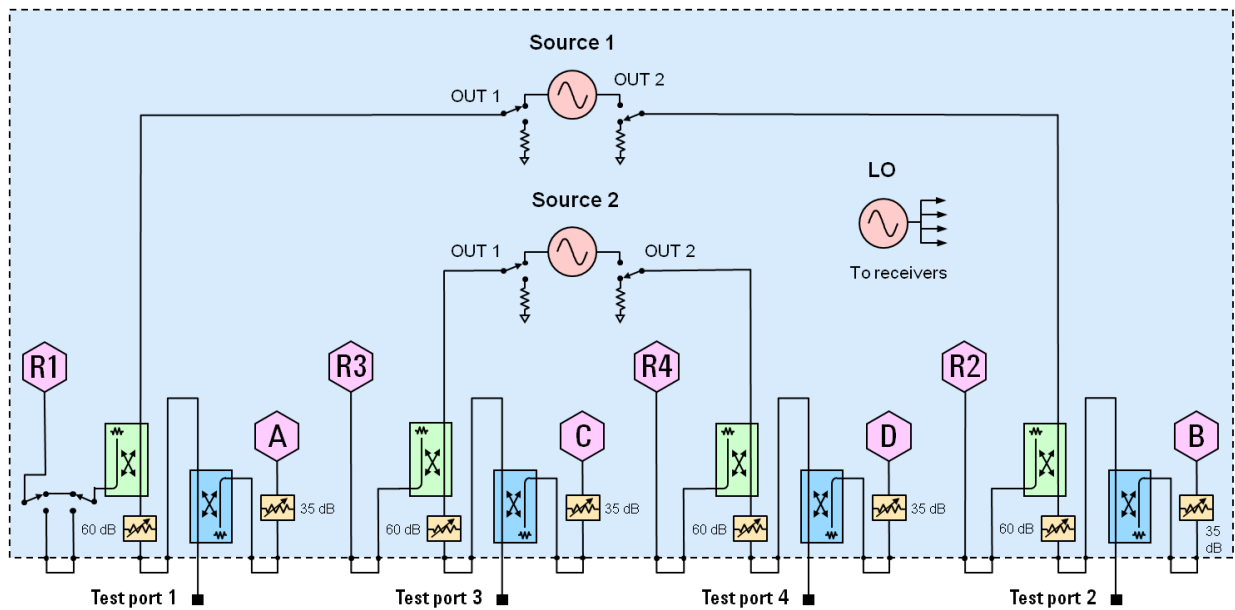
## N5224B and N5225B Option 401

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



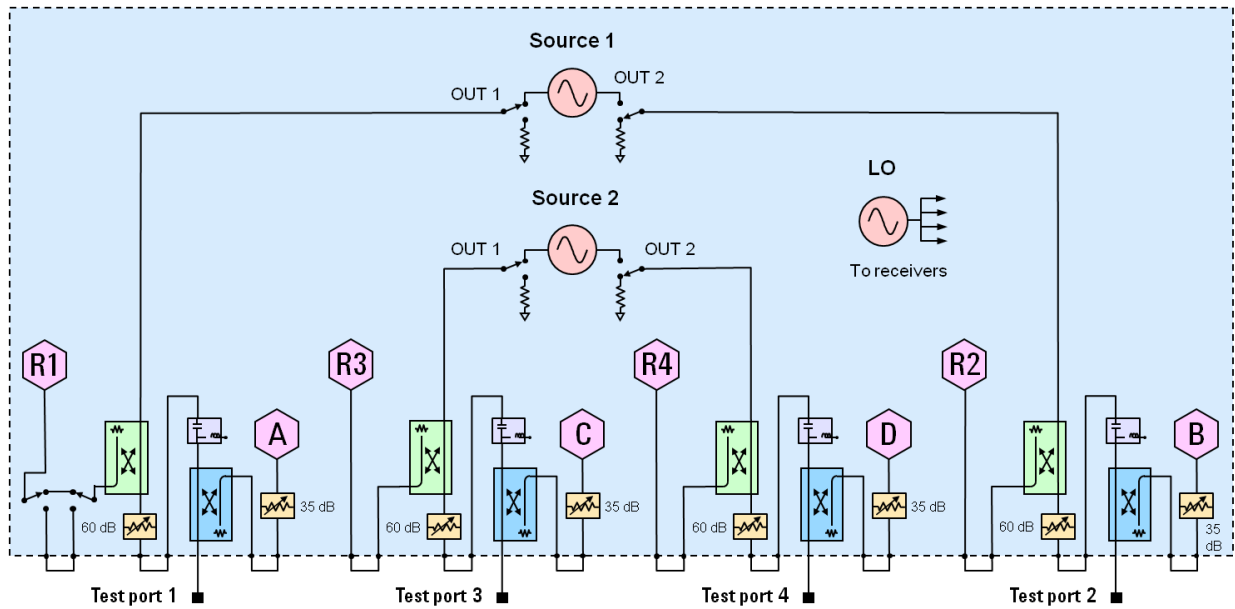
## N5224B and N5225B Option 417

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

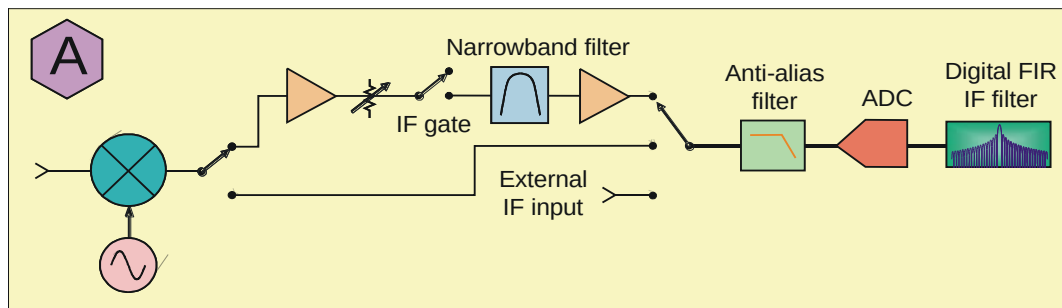


## N5224B and N5225B Option 419

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



## Receiver Block Diagram



**Ihr Spezialist für  
Mess- und Prüfgeräte**



This information is subject to change without notice.

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