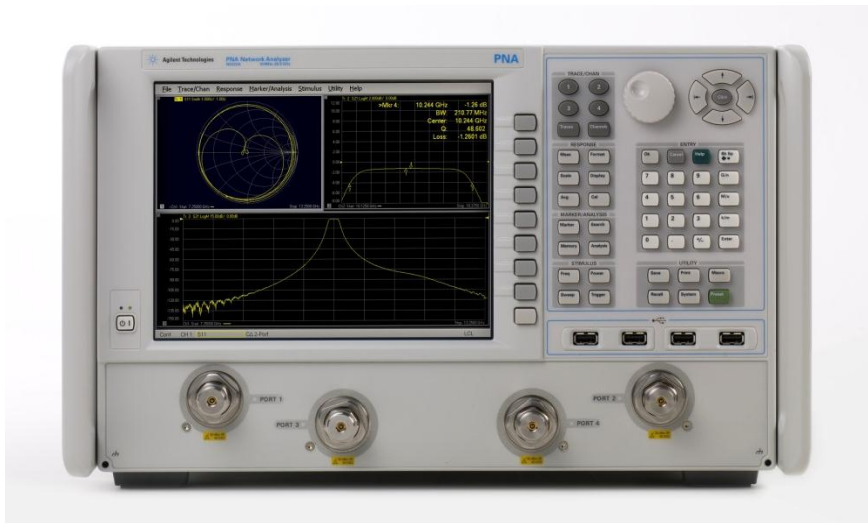


# Keysight 2-Port and 4-Port PNA Network Analyzer

N5221A 10 MHz to 13.5 GHz

N5222A 10 MHz to 26.5 GHz



Data Sheet and  
Technical  
Specifications

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This is a complete list of the technical specifications for the N5221A and N5222A PNA Series network analyzers with the following options. See block diagrams for all models and options beginning on page 42.

## 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.

### Notes

This document provides technical specifications for the 85052B, N4691B and N4433A 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 °C ±5 °C range (unless otherwise stated) and 90 minutes after the instrument has been turned on.

**Specification (spec.):** Warranted performance. Specifications include guardbands to account for the expected statistical performance distribution, measurement uncertainties, and changes in performance due to environmental conditions.

**Characteristic (char.):** A performance parameter that the product is expected to meet before it leaves the factory, but that is not verified in the field and is not covered by the product warranty. A characteristic includes the same guardbands as a specification.

**Typical (typ.):** Expected performance of an average unit which does not include guardbands. It is not covered by the product warranty.

**Nominal (nom.):** A general, descriptive term that does not imply a level of performance. It is not covered by the product warranty.

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

**Corrected (residual):** Indicates performance after error correction (calibration). It is determined by the quality of calibration standards and how well "known" they are, plus system repeatability, stability, and noise.

**Uncorrected (raw):** Indicates instrument performance without error correction. The uncorrected performance affects the stability of a calibration.

**Standard:** When referring to the analyzer, this includes no options unless noted otherwise.

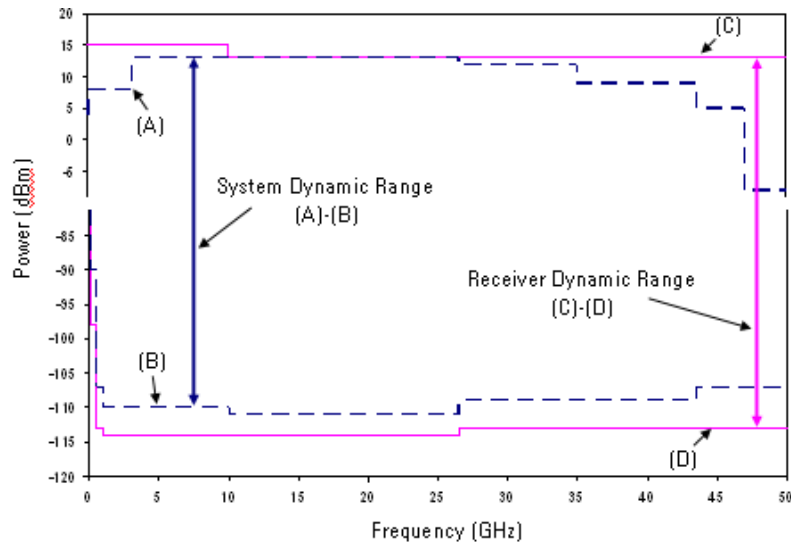
## Corrected System Performance

The specifications in this section apply for measurements made with the N5221A and N5222A 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 and Receiver Dynamic Range

- **System Dynamic Range** is defined as the specified source maximum output power (spec) minus the noise floor (spec).
- **Extended Dynamic Range at Direct Access Input** is defined as the specified source maximum output power (spec) minus the direct receiver access input noise floor (spec).
- **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.

**Table 1a. System Dynamic Range and Receiver Dynamic Range, N5221A, Option 200 or 400**

| Description        | Specification                     |                                    |                                 | Typical                             |   |                                 |
|--------------------|-----------------------------------|------------------------------------|---------------------------------|-------------------------------------|---|---------------------------------|
|                    | System Dynamic Range (dB) (A)-(B) | Max Leveled Output Power (dBm) (A) | Test Port Noise Floor (dBm) (B) | Receiver Dynamic Range (dB) (C)-(D) | 0.1 dB Compression at Test Port (dBm) (C) | Test Port Noise Floor (dBm) (D) |
| 10 MHz to 50 MHz   | 94                                | 12                                 | -82                             | 103                                 | 15  | -88                             |
| 50 MHz to 100 MHz  | 108                               | 13                                 | -95                             | 118                                 | 15  | -103                            |
| 100 MHz to 500 MHz | 118                               | 13                                 | -105                            | 122                                 | 12  | -110                            |
| 500 MHz to 2 GHz   | 127                               | 13                                 | -114                            | 130                                 | 12  | -118                            |
| 2 GHz to 13.5 GHz  | 127                               | 13                                 | -114                            | 131                                 | 12  | -119                            |

**Table 1b. System Dynamic Range and Receiver Dynamic Range, N5222A, Option 200 or 400**

| Description        | Specification                     |                                    |                                 | Typical                             |   |                                 |
|--------------------|-----------------------------------|------------------------------------|---------------------------------|-------------------------------------|---|---------------------------------|
|                    | System Dynamic Range (dB) (A)-(B) | Max Leveled Output Power (dBm) (A) | Test Port Noise Floor (dBm) (B) | Receiver Dynamic Range (dB) (C)-(D) | 0.1 dB Compression at Test Port (dBm) (C) | Test Port Noise Floor (dBm) (D) |
| 10 MHz to 50 MHz   | 94                                | 12                                 | -82                             | 103                                 | 15  | -88                             |
| 50 MHz to 100 MHz  | 108                               | 13                                 | -95                             | 118                                 | 15  | -103                            |
| 100 MHz to 500 MHz | 118                               | 13                                 | -105                            | 122                                 | 12  | -110                            |
| 500 MHz to 2 GHz   | 127                               | 13                                 | -114                            | 130                                 | 12  | -118                            |
| 2 GHz to 13.5 GHz  | 127                               | 13                                 | -114                            | 131                                 | 12  | -119                            |
| 13.5 GHz to 20 GHz | 127                               | 13                                 | -114                            | 132                                 | 12  | -120                            |
| 20 GHz to 24 GHz   | 124                               | 13                                 | -111                            | 128                                 | 10  | -118                            |
| 24 GHz to 26.5 GHz | 114                               | 7                                  | -107                            | 126                                 | 10  | -116                            |



**Table 2. System Dynamic Range at Test Port (dB)**

| Description        | Specification   |                 |                           | Typical         |                 |                           |
|--------------------|-----------------|-----------------|---------------------------|-----------------|-----------------|---------------------------|
|                    | Option 200, 400 | Option 201, 401 | Option 217, 219, 417, 419 | Option 200, 400 | Option 201, 401 | Option 217, 219, 417, 419 |
| 10 MHz to 50 MHz   | 94              | 94              | 94                        | 108             | 108             | 108                       |
| 50 MHz to 100 MHz  | 108             | 108             | 108                       | 123             | 123             | 123                       |
| 100 MHz to 500 MHz | 118             | 118             | 118                       | 130             | 130             | 130                       |
| 500 MHz to 2 GHz   | 127             | 127             | 127                       | 138             | 138             | 138                       |
| 2 GHz to 3.2 GHz   | 127             | 127             | 127                       | 139             | 139             | 139                       |
| 3.2 GHz to 10 GHz  | 127             | 127             | 127                       | 141             | 141             | 141                       |
| 10 GHz to 13.5 GHz | 127             | 127             | 127                       | 141             | 141             | 140                       |
| 13.5 GHz to 16 GHz | 127             | 127             | 127                       | 140             | 140             | 139                       |
| 16 GHz to 20 GHz   | 127             | 127             | 124                       | 140             | 140             | 138                       |
| 20 GHz to 24 GHz   | 124             | 124             | 121                       | 136             | 136             | 134                       |
| 24 GHz to 26.5 GHz | 114             | 114             | 111                       | 130             | 130             | 128                       |

**Table 3. Extended Dynamic Range at Direct Receiver Access Input (dB) - Specification**

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

## Corrected System Performance, All Options

Note: For any  $S_{ii}$  reflection measurement:

- $S_{jj} = 0$ .

For any  $S_{ij}$  transmission measurement:

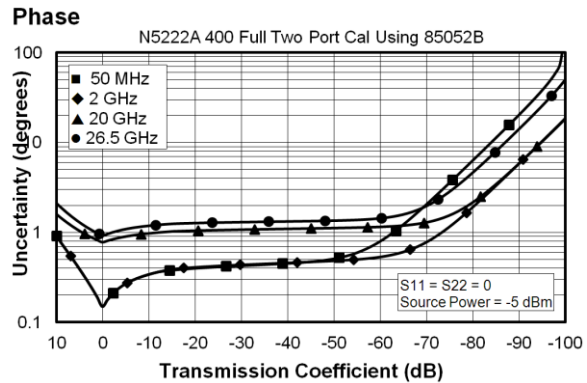
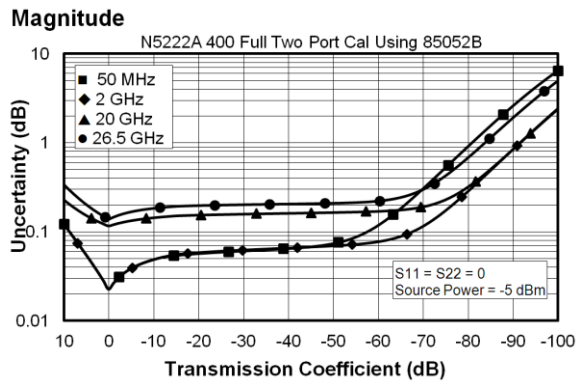
- $S_{ji} = S_{ij}$  when  $S_{ij} \leq 1$
- $S_{ji} = 1/S_{ij}$  when  $S_{ij} > 1$
- $S_{kk} = 0$  for all  $k$

Applies to the N5221A/2A Option 200, 201, 217, 219, 400, 401, 417 or 419 analyzers, 85131F flexible test port cable set, and a full 2-port calibration. Also applies to the following condition:  
Environmental temperature  $23^\circ \pm 3^\circ \text{C}$ , with  $< 1^\circ \text{C}$  deviation from calibration temperature

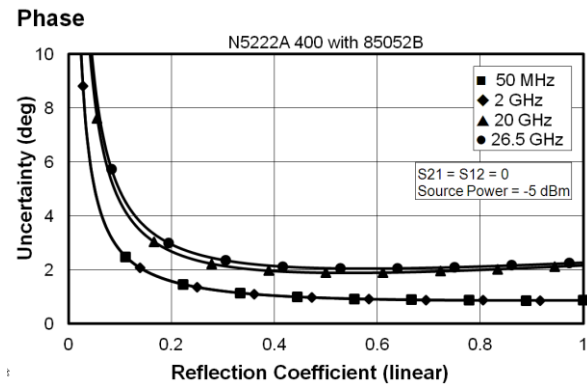
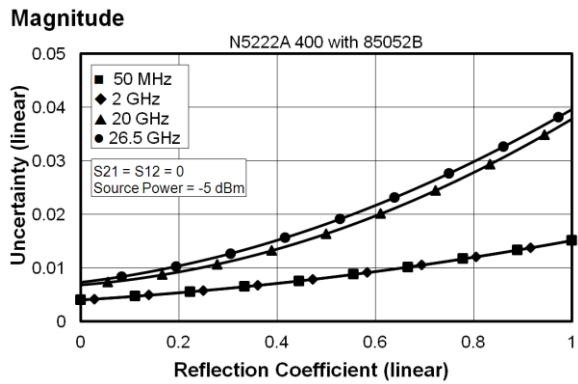
**Table 4a. N5221A and N5222A with 85052B Calibration Kit - Specification**

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

**Transmission Uncertainty, All Options**



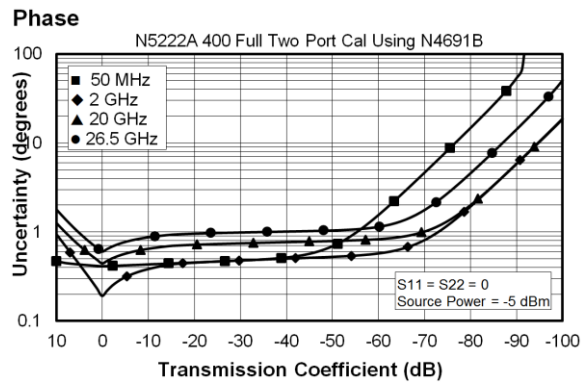
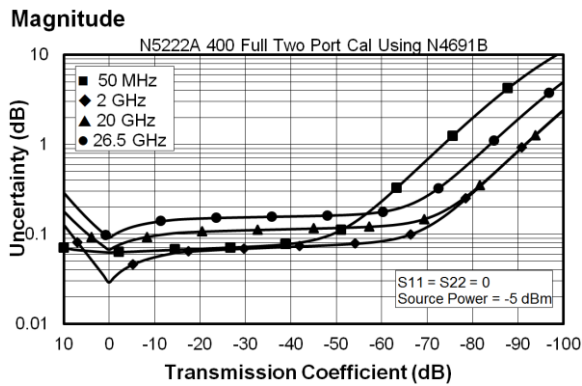
**Reflection Uncertainty, All Options**



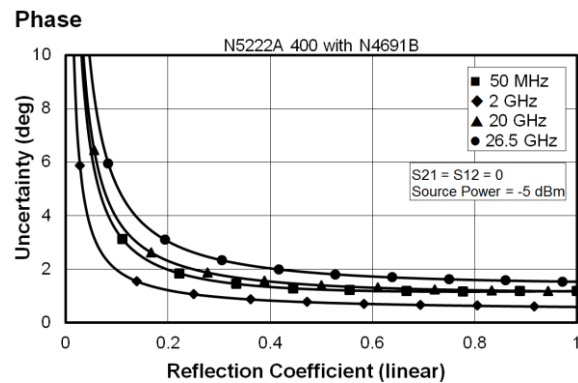
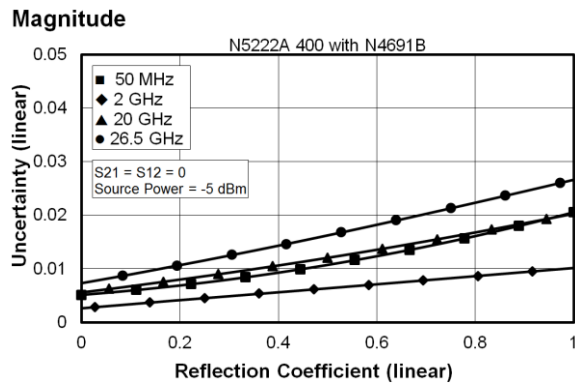
**Table 4b. N5221A and N5222A with N4691B 2-Port Electronic Calibration Module**

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

**Transmission Uncertainty, All Options**



**Reflection Uncertainty, All Options**

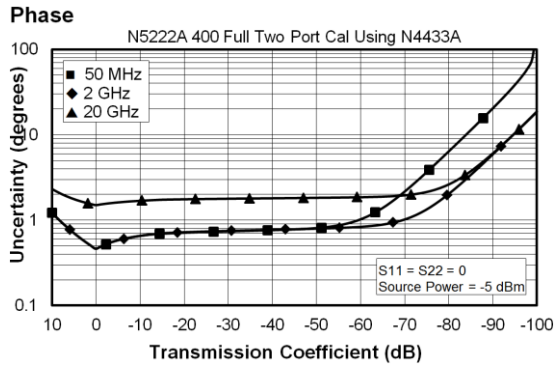
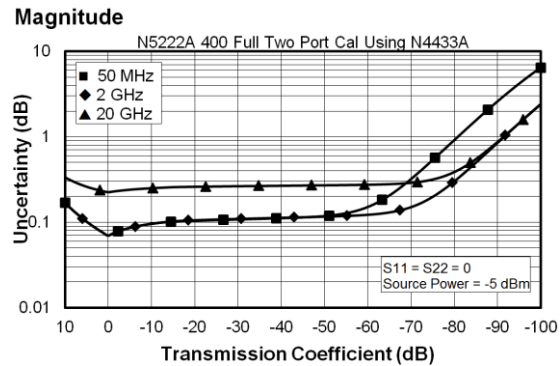


**Table 4c. N5221A and N5222A with N4433A 4-Port Electronic Calibration Module**

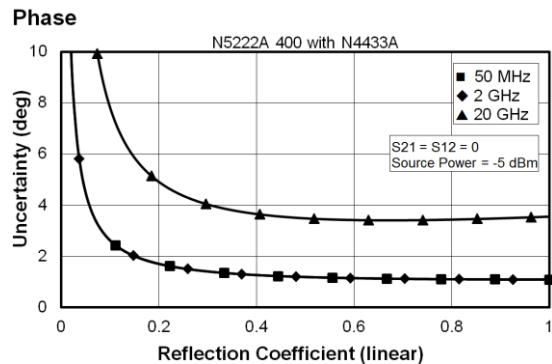
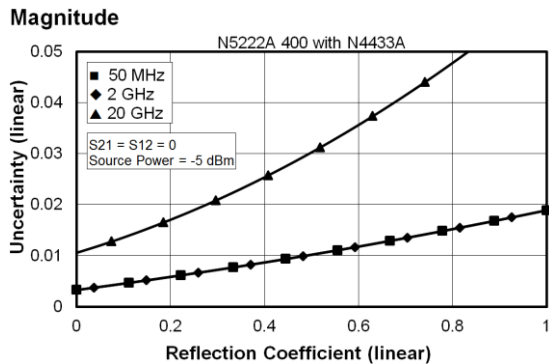
Note: Uncertainty curves for the N4433A are created using a 2-port calibration. Multiport uncertainties are not supported at this time.

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

**Transmission Uncertainty, All Options**



**Reflection Uncertainty, All Options**



## Uncorrected System Performance

Specifications apply to following conditions:

- Over environmental temperature of 25 °C  $\pm$ 5 °C, with less than 1°C variation from the calibration temperature.
- Cable loss not included in Transmission Tracking.
- Crosstalk measurement conditions: normalized to a thru, measured with shorts on all ports, 10 Hz IF bandwidth, averaging factor of 8, alternate mode, source power set to the specified maximum power.

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

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

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

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

## Test Port Output

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

**Table 6. Frequency Information, All Options**

| Description            | Specification      | Typical   |
|------------------------|--------------------|---|
| N5221A Frequency Range | 10 MHz to 13.5 GHz | --  |
| N5222A Frequency Range | 10 MHz to 26.5 GHz | --  |
| Frequency Resolution   | 1 Hz               | --  |
| Frequency Accuracy     | +/- 1 ppm          | --  |
| Frequency Stability    | --                 | +/-0.05 ppm, -10° to 70° C <sup>1</sup><br>+/-0.1 ppm/yr maximum <sup>2</sup> |

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

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

**Table 7a. Maximum Leveled Power (dBm) - Specification**

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

**Table 7b. Maximum Levelled Power (dBm) - Typical**

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

**Table 8. Power Level Accuracy (dB), All Options**

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

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

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

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



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

| Description         | Port 2 or 4 <sup>1</sup> |                     | Port 2 or 4 <sup>1</sup> |
|---------------------|--------------------------|---------------------|--------------------------|
|                     | -25dBm ≤ P < -20dBm      | -20dBm ≤ P < -15dBm | P ≥ -15dBm               |
| 10 MHz to 50 MHz    | +/-2.5                   | +/-1.5              | +/-1.5                   |
| 50 MHz to 500 MHz   | +/-2.0                   | +/-1.5              | +/-1.5                   |
| 500 MHz to 26.5 GHz | +/-1.5                   | +/-1.5              | +/-1.5                   |

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

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

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

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

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

**Table 11. Nominal (Preset) Power (dBm)**

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

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

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

**Table 13. 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        | N5221A | N5222A |
|--------------------|--------|--------|
| 20 MHz to 4 GHz    | -15    | -15    |
| 3Hz to 13.5 GHz    | -19    | -19    |
| 13.5 GHz to 24 GHz | --     | -19    |
| 24 GHz to 26.5 GHz | --     | -21    |

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

Offset frequency = 30 kHz to 5 MHz

| Description        | Based on 8kHz offset Frac-N | Based on 100kHz offset Frac-N |
|--------------------|-----------------------------|-------------------------------|
| 10 MHz to 500 MHz  | -50                         | -50                           |
| 500 MHz to 2 GHz   | -60                         | -42                           |
| 2 GHz to 4 GHz     | -57                         | -45                           |
| 4 GHz to 8 GHz     | -51                         | -39                           |
| 8 GHz to 16 GHz    | -45                         | -33                           |
| 16 GHz to 26.5 GHz | -39                         | -27                           |

**Table 15. 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 26.5 GHz | -77          | -87           | -82            | -97          |

## Test Port Input

**Table 16. 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 |        |
|--------------------|---------------|--------|---------|--------|
|                    | N5221A        | N5222A | N5221A  | N5222A |
| 10 MHz to 50 MHz   | -82           | -82    | -88     | -88    |
| 50 MHz to 100 MHz  | -95           | -95    | -103    | -103   |
| 100 MHz to 500 MHz | -105          | -105   | -110    | -110   |
| 500 MHz to 2 GHz   | -114          | -114   | -118    | -118   |
| 2 GHz to 13.5 GHz  | -114          | -114   | -119    | -119   |
| 13.5 GHz to 20 GHz | --            | -114   | --      | -120   |
| 20 GHz to 24 GHz   | --            | -111   | --      | -118   |
| 24 GHz to 26.5 GHz | --            | -107   | --      | -116   |

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

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

| Description        | Specification |        | Typical |        |
|--------------------|---------------|--------|---------|--------|
|                    | N5221A        | N5222A | N5221A  | N5222A |
| 10 MHz to 50 MHz   | -118          | -118   | -133    | -133   |
| 50 MHz to 100 MHz  | -107          | -107   | -129    | -129   |
| 100 MHz to 250 MHz | -117          | -117   | -136    | -136   |
| 250 MHz to 500 MHz | -117          | -117   | -130    | -130   |
| 500 MHz to 2 GHz   | -126          | -126   | -133    | -133   |
| 2 GHz to 13.5 GHz  | -126          | -126   | -134    | -134   |
| 13.5 GHz to 20 GHz | --            | -126   | --      | -135   |
| 20 GHz to 24 GHz   | --            | -123   | --      | -133   |
| 24 GHz to 26.5 GHz | --            | -119   | --      | -131   |

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

| Description         | N5221A | N5222A |
|---------------------|--------|--------|
| 10 MHz to 100 MHz   | 15     | 15     |
| 100 MHz to 13.5 GHz | 12     | 12     |
| 13.5 GHz to 20 GHz  | --     | 12     |
| 20 GHz to 26.5 GHz  | --     | 10     |

**Table 18b. Receiver Compression at Test Port Power - Specification**

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

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

**Table 18c. Receiver Compression at Test Port Power - Specification**

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

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

**Table 19. Trace Noise Magnitude (dB rms)**

Ratioed measurement, nominal power at test port.

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

**Table 20. Trace Noise Phase (deg rms)**

Ratioed measurement, nominal power at test port.

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

**Table 21. Reference Level Magnitude, All Options - Specification**

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

**Table 22. Stability, All Options - Typical**

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

**Table 23. Damage Input Level**

| Description | Option 200, 201, 219, 400, 401, 419 | Option 217, 417 |
|-------------|-------------------------------------|-----------------|
| RF , DC     | 30 dBm, 40 V                        | 30 dBm, 7 V     |

## Dynamic Accuracy

Dynamic accuracy is verified with the following measurements:

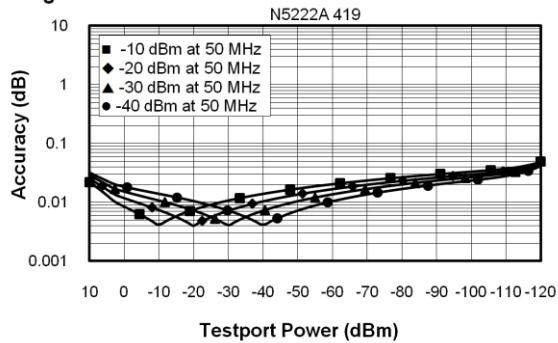
Compression over frequency

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](#)

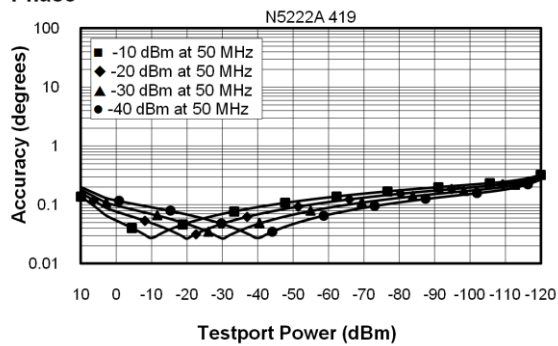
**Table 24. N5221A and N5222A Dynamic Accuracy**

### N5221A/22A Dynamic Accuracy, 10 MHz to 50 MHz - Specification

#### Magnitude

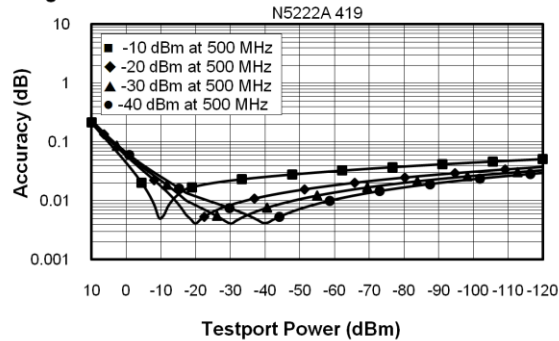


#### Phase

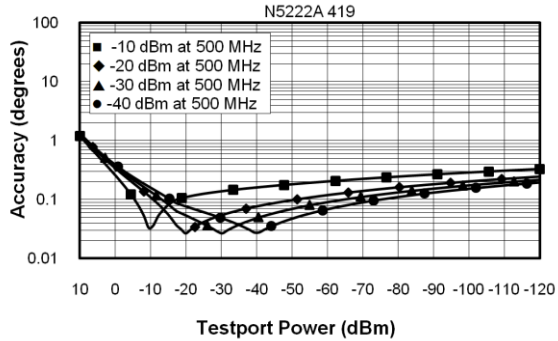


### N5221A/22A Dynamic Accuracy, 50 MHz to 500 MHz - Specification

#### Magnitude



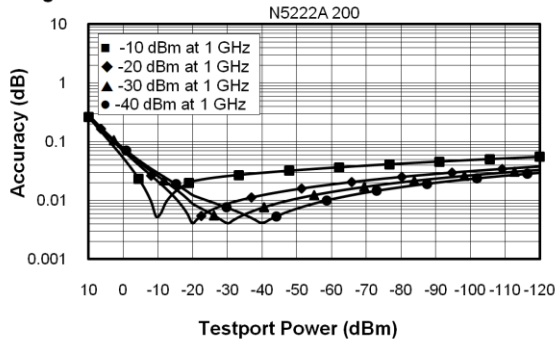
#### Phase



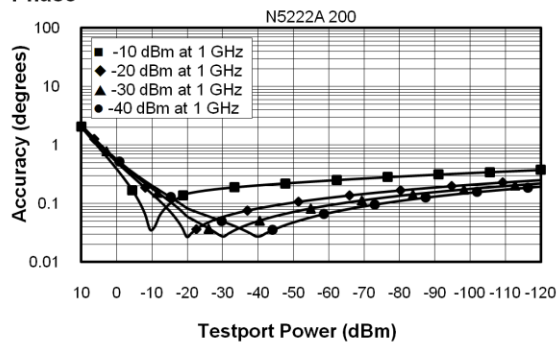


## N5221A/22A Dynamic Accuracy, 500 MHz to 1 GHz - Specification

**Magnitude**

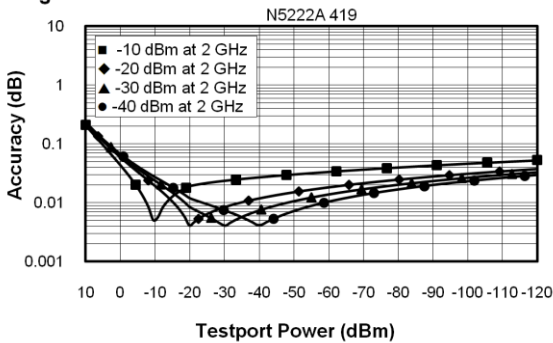


**Phase**

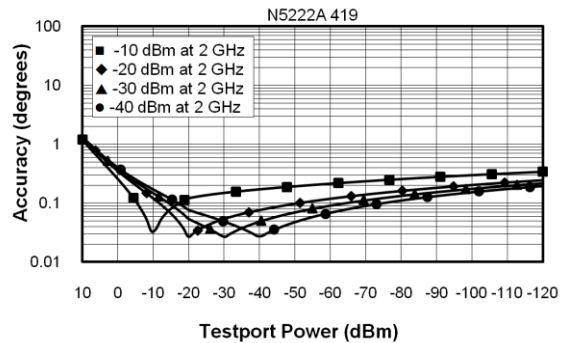


## N5221A/22A Dynamic Accuracy, 1 GHz to 2 GHz - Specification

**Magnitude**

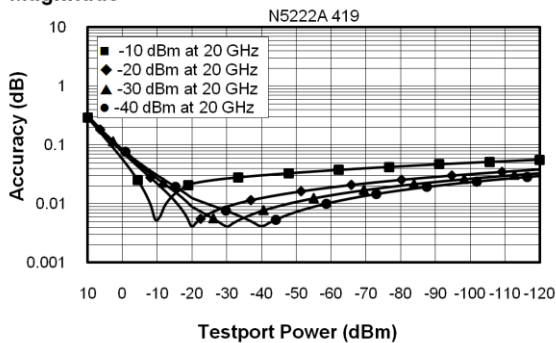


**Phase**

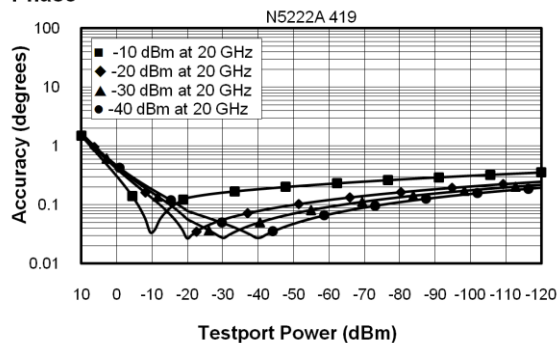


## N5221A/22A Dynamic Accuracy, 2 GHz to 20 GHz - Specification

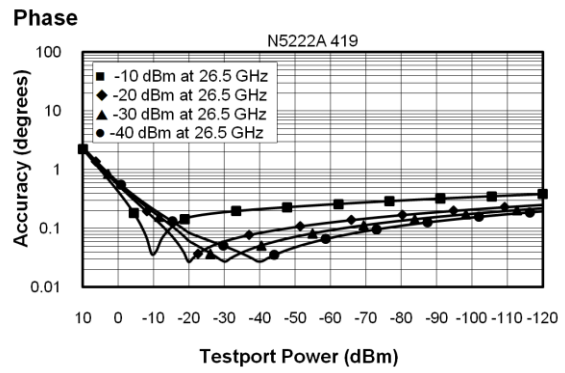
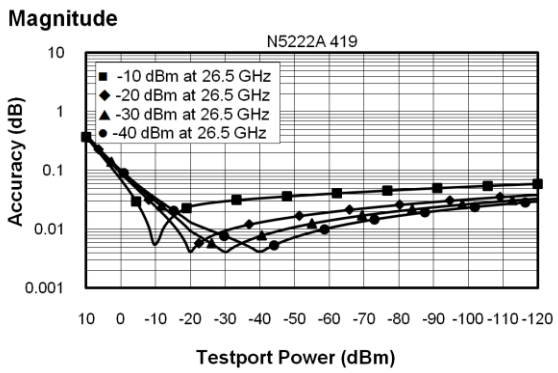
**Magnitude**



**Phase**



# N5221A/22A Dynamic Accuracy, 20 GHz to 26.5 GHz - Specification



**Table 25. Group Delay - Typical**

Group delay is computed by measuring the phase change within a specified frequency step (determined by the frequency span and the number of points per sweep). In general, the following formula can be used to determine the accuracy, in seconds, of specific group delay measurement:

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

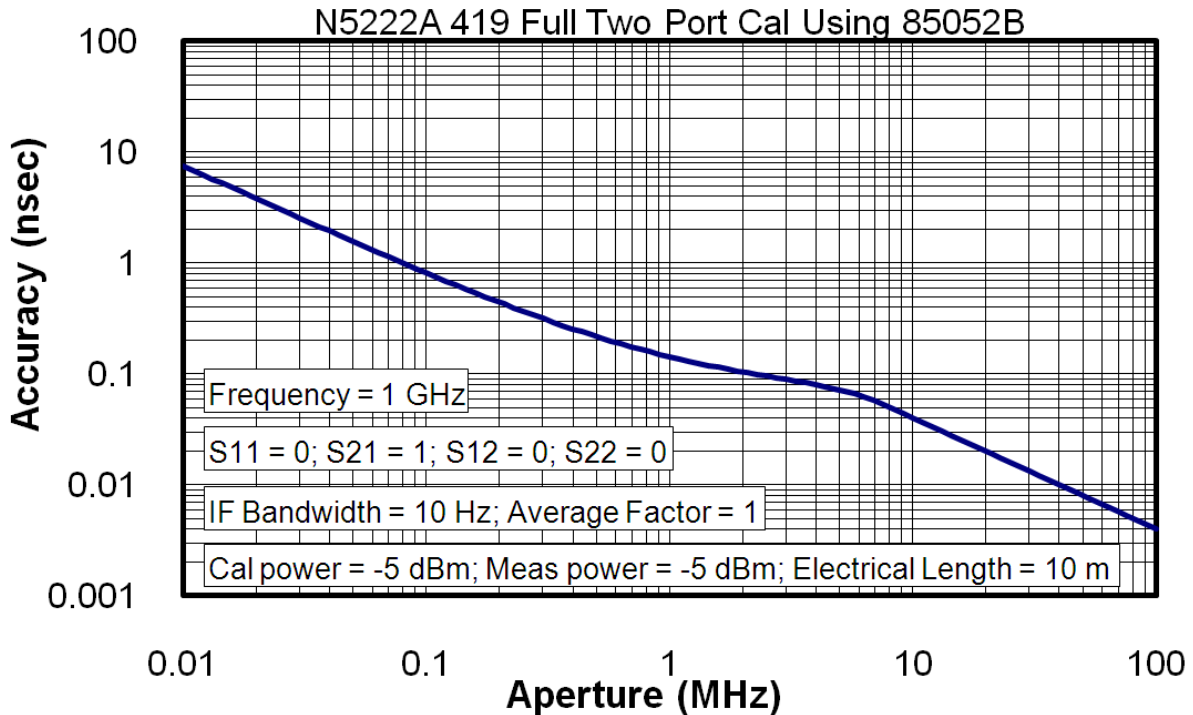
Depending on the aperture and device length, the phase accuracy used is either incremental phase accuracy or worst-case phase accuracy

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

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

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

### Group Delay (Typical)



## 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                       | Intel ® 2.0 GHz Core ® i7 - <b>Note:</b> Some instruments may have a more advanced microprocessor than listed here. For the latest information on CPUs and associated hard drives, visit <a href="http://na.support.keysight.com/pna/hdnumbers.html">http://na.support.keysight.com/pna/hdnumbers.html</a> |
| LXI                       | Class C  |

**Table 27. Front Panel Information, All Options**

| Description                             | Typical Performance   |
|---|---|
| <b>RF Connectors</b>                    |   |
| Type                                    | 3.5 mm (male), 50 ohm, (nominal)  |
| Center Pin 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                                    | 26.3 cm (10.4 in) diagonal color active matrix LCD; 1024 (horizontal) X 768 (vertical) resolution   |
| Refresh Rate                            | Vertical 60 Hz; Horizontal 46.08 kHz  |
| Pixels                                  | 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” “dark” pixels are 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                 | +/-2500 dB (at 500 dB/div), max     |
| Phase                     | +/-2500° (at 500 dB/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 ± 10 ppm          |
| Input Level                 | -15 dBm to +20 dBm       |
| Input Impedance             | 200 Ω, nom.              |
| <b>10 MHz Reference Out</b> |                          |
| Connector                   | BNC, female              |
| Output Frequency            | 10 MHz ± 1 ppm           |
| Signal Type                 | Sine Wave                |
| Output Level                | +10 dBm ± 4 dB into 50 Ω |
| Output Impedance            | 50 Ω, nominal            |
| Harmonics                   | <-40 dBc, typical        |

Table 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 Ω   |
| RF Damage Level                                    | +23 dBm  |
| DC Damage Level                                    | 5.5 VDC  |
| 0.1 dB Compression Point                           |  |
| Normal IF path                                     | -9.0 dBm at 7.438 MHz  |
| Narrowband IF path                                 | -17 dBm at 10.70 MHz   |
| <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, Source Modulators             | 33 ns  |
| Minimum Pulse Width, Receiver Gates                | 20 ns  |
| DC Damage Level                                    | 5.5 VDC  |
| Drive Voltage                                      | 0 V (off), +3.3 V (on), nominal  |
| <b>RF Pulse Modulator Input (Source Modulator)</b> |  |
| <b>On/Off Ratio</b>                                |  |
| 10 MHz to 3.2 GHz                                  | -64  |
| 3.2 GHz to 26.5 GHz                                | -80  |
| <b>Pulse Period</b>                                |  |
| Minimum  | 33 ns  |
| Maximum  | 70 s   |

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

| Description  | Typical Performance                               |                            |
|--|---|----------------------------|
| <b>Pulse Outputs</b>   |   |                            |
| Voltage (TTL)  | High: 3.3V to 3.5V<br>Low: <1V                    |                            |
| Impedance  | 50 Ohm  |                            |
| <b>External Test Set Driver</b>  |   |                            |
| Function   | Used for driving remote mixers                    |                            |
| Connections  | 3.5 mm (female)                                   |                            |
| RF Output Frequency Range  | 3.2 GHz to 19 GHz                                 |                            |
| LO Output Frequency Range  | 1.76 GHz to 26.5 GHz                              |                            |
| <b>Rear Panel LO Power<sup>1</sup></b>   |   |                            |
|  | Upper Limit, Typical (dBm)                        | Lower Limit, Typical (dBm) |
| 1.7 GHz to 16 GHz  | 0   | -10                        |
| 16 GHz to 21 GHz   | 4   | -6                         |
| 21 GHz to 26.5 GHz   | 6   | -4                         |
| <b>Rear Panel RF Power</b>   |   |                            |
|  | Upper Limit, Typical (dBm)                        | Lower Limit, Typical (dBm) |
| 3.2 GHz to 19 GHz  | -3  | -8                         |
| <b>VGA Video Output</b>  |   |                            |
| Connector  | 15-pin mini D-Sub; Drives VGA compatible monitors |                            |
| <b>Devices Supported</b>   |   |                            |
|  | 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.  |
| GPIB                   | Two ports - dedicated controller and dedicated talker/listener. 24-pin D-sub (Type D-24), female; compatible with IEEE-488.   |
| Parallel Port (LPT1)   | 25-pin D-Sub miniature connector, female; provides connection to printers or any other parallel port peripherals  |
| USB Ports              | Four ports on front panel (all Host) and five ports (four Host and one Device) on rear panel. Type A configuration (eight Host) and Type B configuration (one Device), USB 2.0 compatible. The total current limit for all rear panel USB ports is 2.0 amps. The total current limit for all front panel USB is 0.9 amps. |
| LAN                    | 10/100BaseT Ethernet, 8-pin configuration; auto selects between the two data rates  |
| <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           | 533.0       | 21.0              |
| With front and rear panel hardware, handles     | 578.0       | 22.7              |

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

### Regulatory and Environmental Information

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

## Measurement Throughput Summary

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

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

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

| Sweep Range      | IF Bandwidth |             | Number of Points |      |      |       |       |
|------------------|--------------|-------------|------------------|------|------|-------|-------|
|                  |              |             | 201              | 401  | 1601 | 16001 | 32001 |
| 9 GHz to 10 GHz  | 600 kHz      | Uncorrected | 6.3              | 6.3  | 10.9 | 68    | 132   |
|                  |              | 2-Port cal  | 18.8             | 20.3 | 30   | 145   | 275   |
|                  | 10 kHz       | Uncorrected | 29.7             | 54.7 | 205  | 2000  | 4000  |
|                  |              | 2-Port cal  | 67               | 117  | 417  | 4031  | 8047  |
|                  | 1 kHz        | Uncorrected | 227              | 445  | 1742 | 17031 | 33844 |
|                  |              | 2-Port cal  | 462              | 900  | 3500 | 34102 | 67734 |
| 10 GHz to 20 GHz | 600 kHz      | Uncorrected | 18.8             | 18.8 | 23   | 70    | 133   |
|                  |              | 2-Port cal  | 45.3             | 46.9 | 55   | 180   | 313   |
|                  | 10 kHz       | Uncorrected | 69               | 127  | 270  | 2009  | 4009  |
|                  |              | 2-Port cal  | 145              | 263  | 548  | 4030  | 8055  |
|                  | 1 kHz        | Uncorrected | 234              | 458  | 1781 | 17383 | 34531 |
|                  |              | 2-Port cal  | 477              | 922  | 3578 | 34789 | 69109 |

**Table 30b. N5221A Typical Cycle Time (ms) for Full-Span Measurement Completion**

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

**Table 30c. N5222A Typical Cycle Time (ms) for Full-Span Measurement Completion**

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

**Table 31. Cycle Time vs. IF Bandwidth - Typical**

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

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

Cycle time includes sweep and retrace time.

| Description       |                 | N5221A/22A                     |  |
|-------------------|-----------------|--------------------------------|--|
| IF Bandwidth (Hz) | Cycle Time (ms) | Trace Noise Magnitude (dB rms) |  |
| 600,000           | 5.6             | 0.0045                         |  |
| 100,000           | 6.9             | 0.0018                         |  |
| 30,000            | 10              | 0.0011                         |  |
| 10,000            | 26.7            | 0.0006                         |  |
| 3,000             | 72              | 0.0004                         |  |
| 1,000             | 223             | 0.0003                         |  |
| 300               | 641             | 0.0002                         |  |
| 100               | 1825            | 0.0002                         |  |
| 30                | 5984            | 0.0002                         |  |
| 10                | 17836           | 0.0002                         |  |
| 3                 | 59281           | 0.0002                         |  |

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

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

- CF = 10 GHz
- Span = 100 MHz

- Display off (add 21 ms for display on)

Cycle time includes sweep and retrace time.

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

**Table 33. Data Transfer Time (ms) - Typical**

Measured with the analyzer display off.

Values will increase slightly if the analyzer display is on.

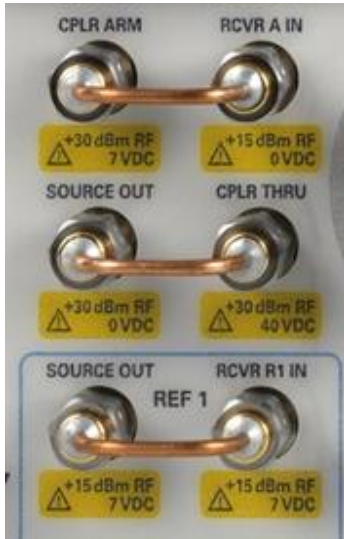
| Description   | Number of Points |      |      |        |        |
|---|------------------|------|------|--------|--------|
|   | 201              | 401  | 1601 | 16,001 | 32,001 |
| <b>SCPI over GPIB</b> (Program executed on external PC <sup>2</sup> )                     |                  |      |      |        |        |
| 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<sup>1</sup></b> (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<sup>1</sup></b> (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<sup>1</sup></b> (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 N522xA analyzers.

## Specifications: Front-Panel Jumpers



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

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

**Table 34. Measurement Receiver Inputs (dBm) – Typical**

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

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

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

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

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

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

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

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

**Table 37. Source Outputs (dBm) - Typical**

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

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

**Table 38. Coupler Inputs (dB) - Typical**

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

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



**Table 39. Damage Level - Typical**

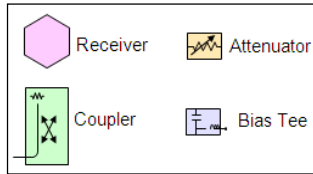
| Description                | RF (dBm) | DC (V)               |
|----------------------------|----------|----------------------|
| RCVR A, B, C, D IN         | 15       | 7                    |
| RCVR R1, R2, R3, R4 IN     | 15       | 7                    |
| REF 1 SOURCE OUT           | 15       |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

<sup>1</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..

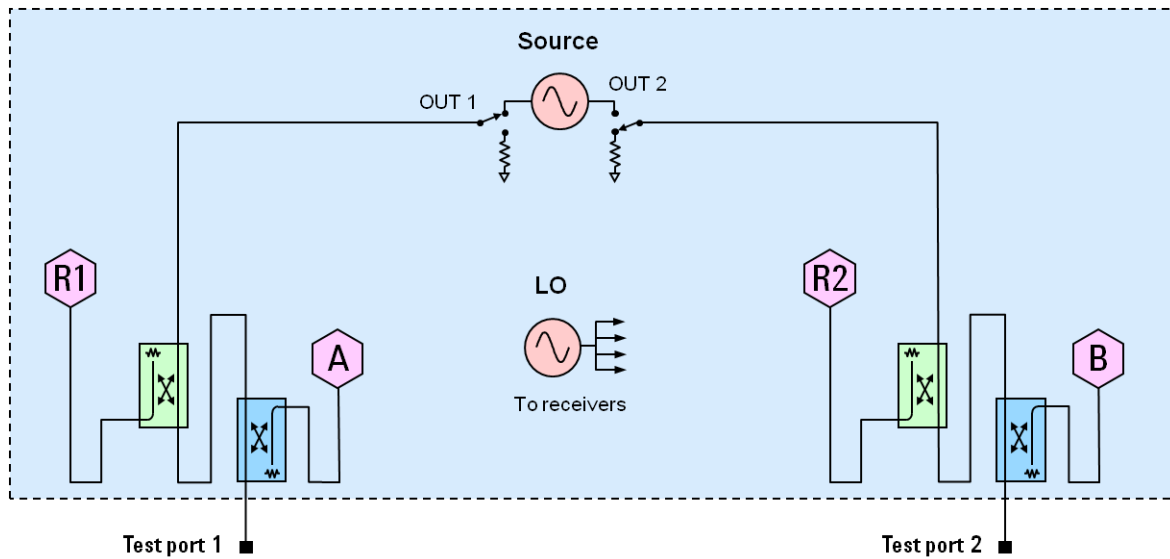
## Test Set Block Diagrams

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

Legend

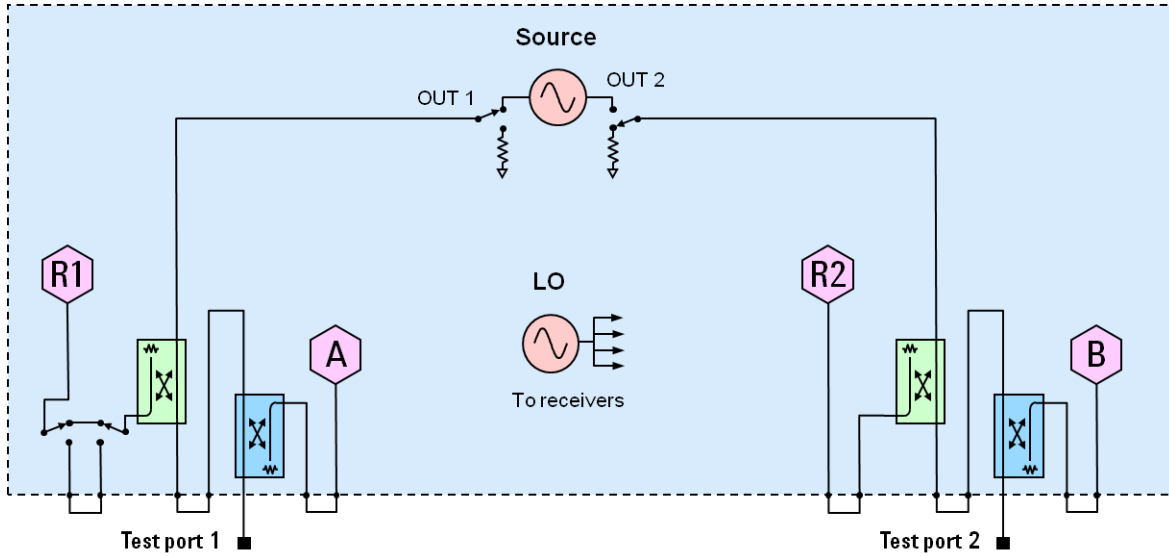


### N5221A and N5222A Option 200 (2-port base model)



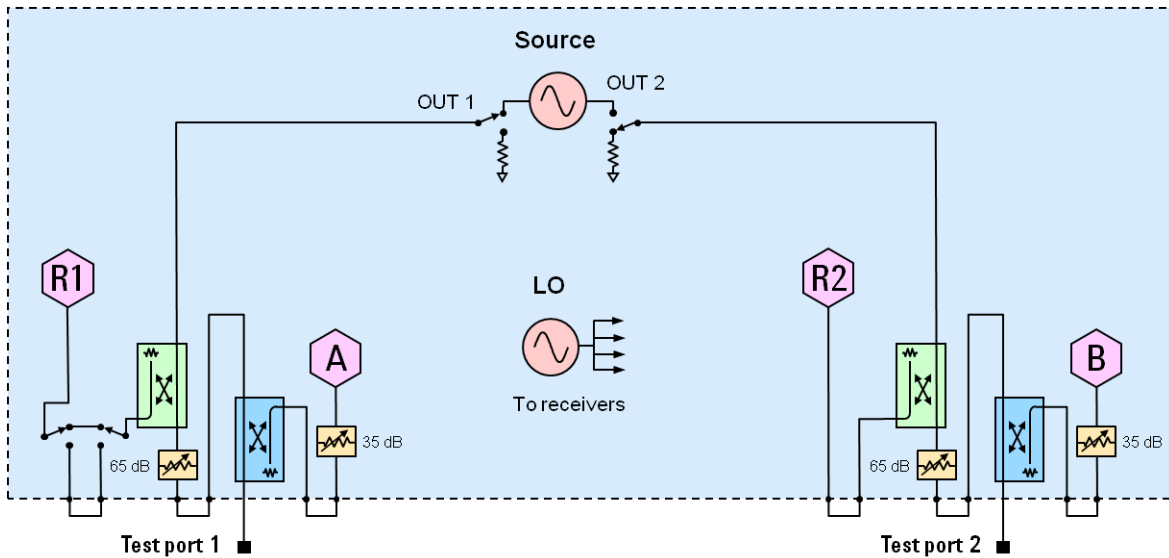
### N5221A and N5222A Option 201

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



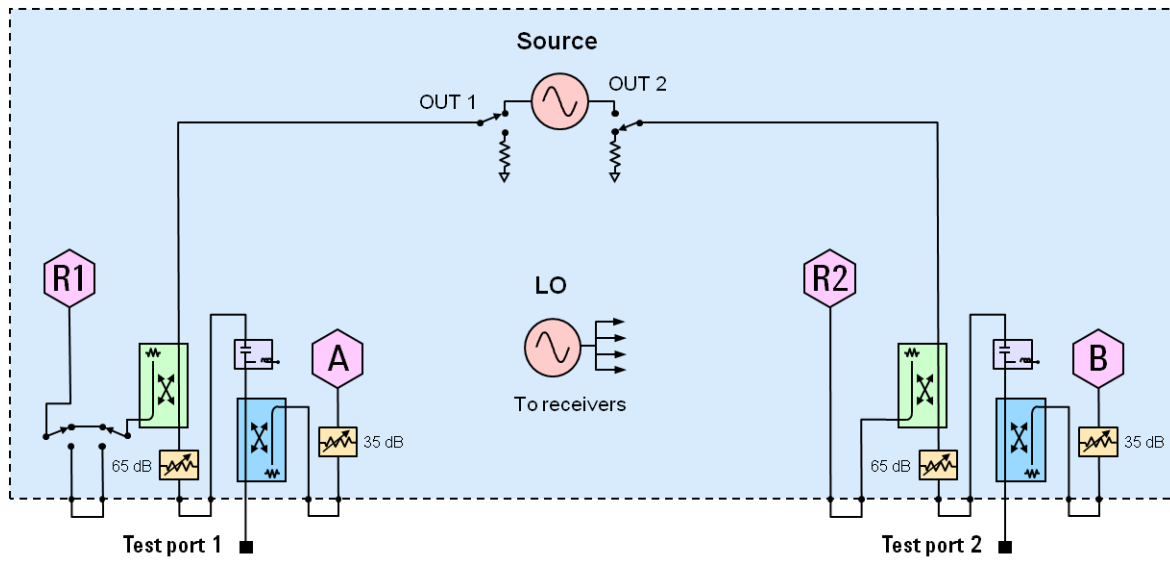
### N5221A and N5222A Option 217

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

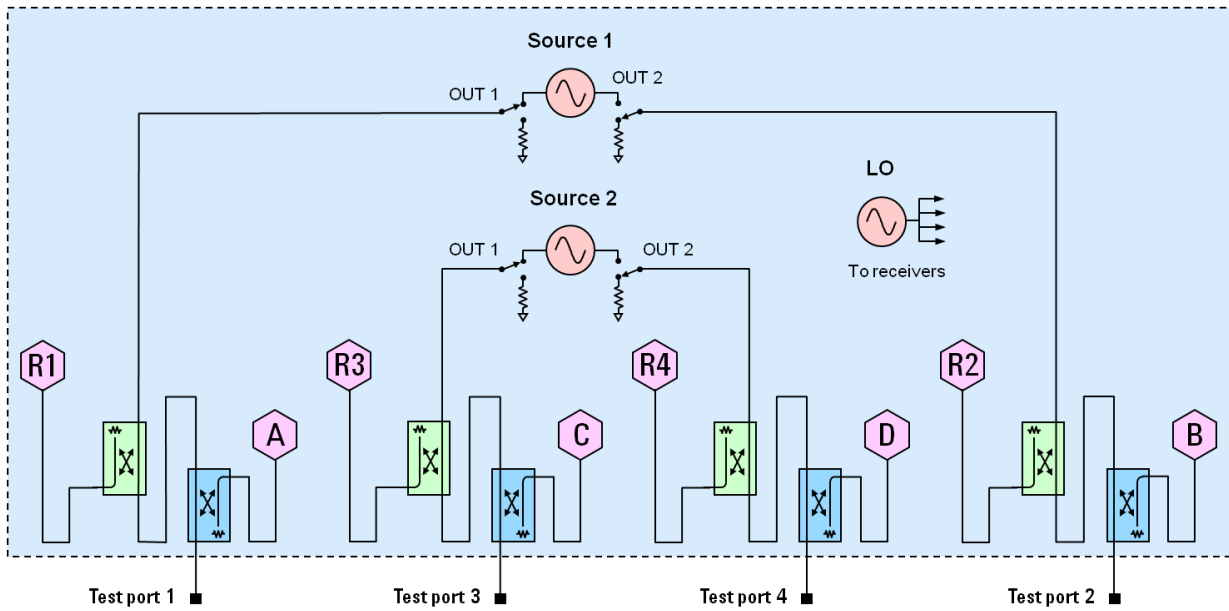


## N5221A and N5222A Option 219

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

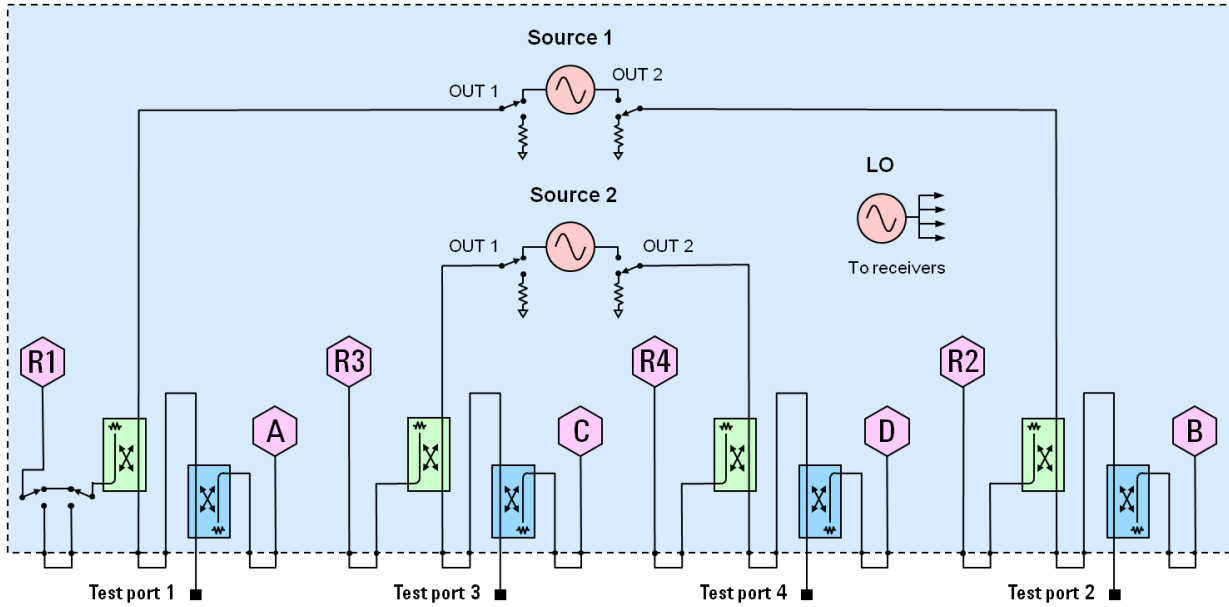


## N5221A and N5222A Option 400 (4-port base model)



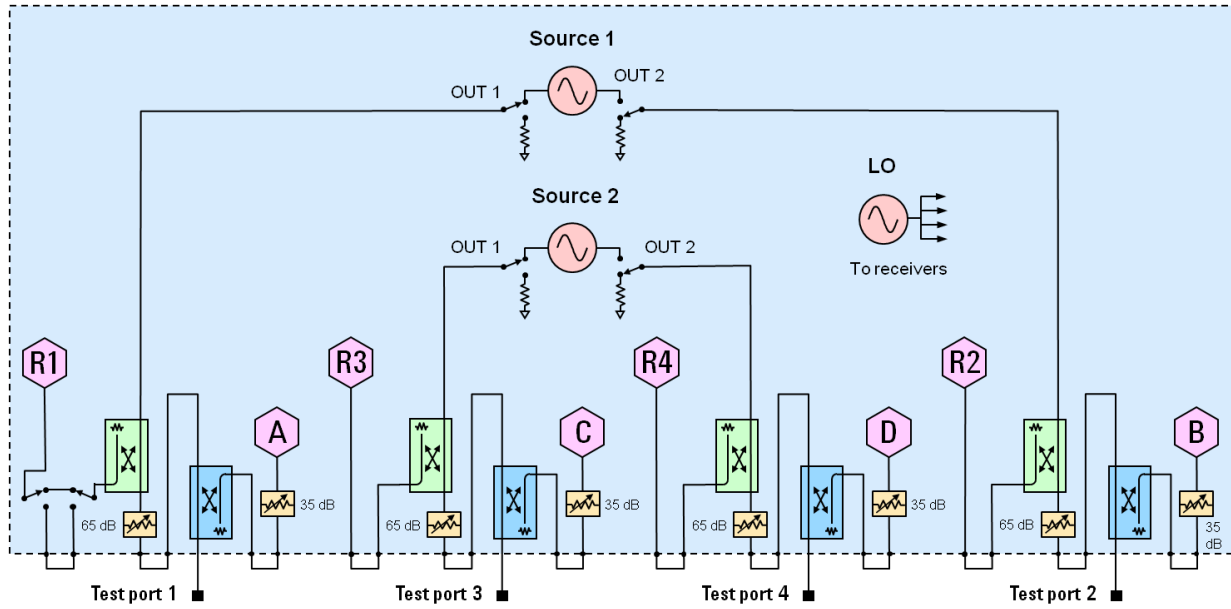
## N5221A and N5222A Option 401

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



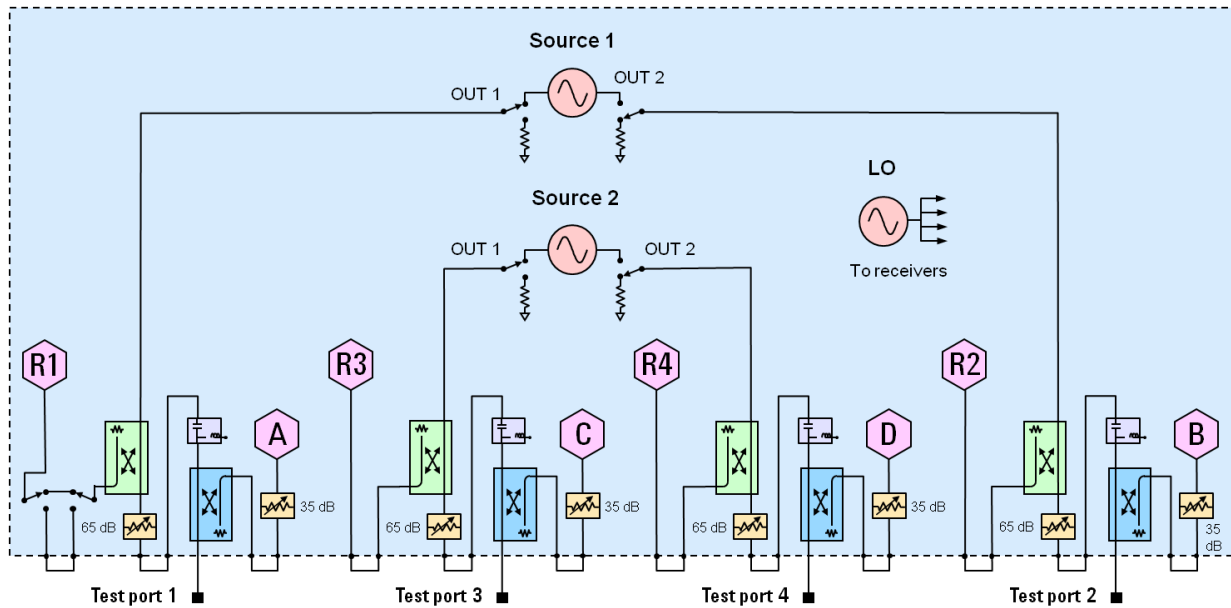
### N5221A and N5222A Option 417

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

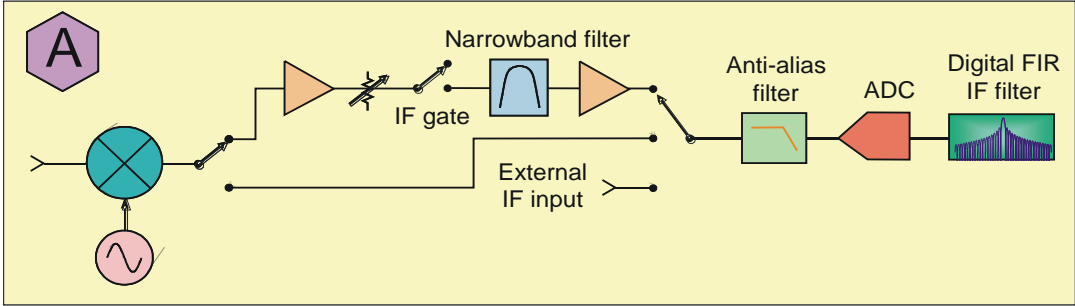


### N5221A and N5222A Option 419

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



Receiver Block Diagram





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