

# Keysight N5230A/C Options 140/145/146/240/245/246 (4-Port PNA-L)

Technical  
Specifications

## Technical Specifications for the N5230A/C

### Options 140/145/146/240/245/246 (4-Port PNA-L)

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This is a complete list of the N5230A/C Options 140, 145, 146, 240, 245, 246 network analyzer technical specifications.

- To view or print the .pdf version of the specifications, visit our web site at <http://www.keysight.com/find/pna>, and search for "N5230A/C Options 140 or 145 or 146 or 240 or 245 or 246 Specifications"
  - This N5230A/C document provides technical specifications for the 85052B calibration kit and the N4433A ECal module. Please download our free Uncertainty Calculator from [http://www.keysight.com/find/na\\_calculator](http://www.keysight.com/find/na_calculator) to generate the curves for your calibration kit and PNA setup.
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## Definitions

All specifications and characteristics apply over a 25 °C  $\pm$  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 N5230A/C analyzer with the following conditions:
- 10 Hz IF bandwidth
- No averaging applied to data
- Isolation calibration with an averaging factor of 8

**Table 1. System Dynamic Range at Test Port<sup>1</sup>**

| Description                                                                                    | Specification (dB) at Test Port | Typical (dB) at Test Port |
|------------------------------------------------------------------------------------------------|---------------------------------|---------------------------|
| <b>Standard configuration and standard power range (Option 140/240)</b>                        |                                 |                           |
| 300 KHz to 10 MHz <sup>2</sup>                                                                 | --                              | 108 dB                    |
| 10 MHz to 4 GHz <sup>2</sup>                                                                   | 120 dB                          | 128 dB                    |
| 4 GHz to 6 GHz                                                                                 | 118 dB                          | 129 dB                    |
| 6 GHz to 10.5 GHz                                                                              | 115 dB                          | 127 dB                    |
| 10.5 GHz to 13.5 GHz                                                                           | 107 dB                          | 119 dB                    |
| 13.5 GHz to 15 GHz                                                                             | 107 dB                          | 119 dB                    |
| 15 GHz to 20 GHz                                                                               | 103 dB                          | 116 dB                    |
| <b>Configurable test set and extended power range (Option 145/245)</b>                         |                                 |                           |
| <b>Configurable test set, extended power range and internal second source (Option 146/246)</b> |                                 |                           |
| 300 KHz to 10 MHz <sup>2</sup>                                                                 | --                              | 108 dB                    |
| 10 MHz to 4 GHz <sup>2</sup>                                                                   | 120 dB                          | 128 dB                    |
| 4 GHz to 6 GHz                                                                                 | 118 dB                          | 128 dB                    |
| 6 GHz to 10.5 GHz                                                                              | 113 dB                          | 125 dB                    |
| 10.5 GHz to 13.5 GHz                                                                           | 105 dB                          | 117 dB                    |
| 13.5 GHz to 15 GHz                                                                             | 105 dB                          | 117 dB                    |
| 15 GHz to 20 GHz                                                                               | 98 dB                           | 115 dB                    |

<sup>1</sup> The system dynamic range is calculated as the difference between the noise floor and the specified source maximum output power. The effective dynamic range must take measurement uncertainties and interfering signals into account.

<sup>2</sup> May be degraded by 10 dB at particular frequencies (multiples of 5 MHz) below 500 MHz due to spurious receiver residuals. Methods are available to regain the full dynamic range.

**Table 2. Extended Dynamic Range at Direct Receiver Access Input<sup>1</sup>**

| Configurable test set and extended power range (Options 145/245)                         |                    |              |
|------------------------------------------------------------------------------------------|--------------------|--------------|
| Configurable test set, extended power range and internal second source (Options 146/246) |                    |              |
|                                                                                          | Specification (dB) | Typical (dB) |
| 300 KHz to 10 MHz <sup>2</sup>                                                           | --                 | 124 dB       |
| 10 MHz to 4 GHz <sup>2</sup>                                                             | 136 dB             | --           |
| 4 GHz to 6 GHz                                                                           | 134 dB             | --           |
| 6 GHz to 10.5 GHz                                                                        | 129 dB             | --           |
| 10.5 GHz to 13.5 GHz                                                                     | 121 dB             | --           |
| 13.5 GHz to 15 GHz                                                                       | 121 dB             | --           |
| 15 GHz to 20 GHz                                                                         | 114 dB             | --           |

<sup>1</sup> The direct receiver access input extended dynamic range is calculated as the difference between the direct receiver access input noise floor and the source maximum output power. 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 compression or damage level. 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 receiver compression or damage may occur (i.e. devices with low insertion loss). The extended range is only available in one-path transmission measurements.

<sup>2</sup> May be degraded by 10 dB at particular frequencies (multiples of 5 MHz) below 500 MHz due to spurious receiver residuals. Methods are available to regain the full dynamic range.

*Receiver Dynamic Range technical specifications are not provided in this N5230A/C specs document.*

## N5230A/C Corrected System Performance with 3.5mm Connectors<sup>1</sup>

Option 140 or 145 or 146 or 240 or 245 or 246

<sup>1</sup> From 300 kHz to 10 MHz, performance is characterized as "typical". To generate these typical values, please download our free Uncertainty Calculator from [http://www.keysight.com/find/na\\_calculator](http://www.keysight.com/find/na_calculator).

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

- $S_{ij} = 0$ .

For any  $S_{ij}$  transmission measurement:

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

**Table 3. 85052B Calibration Kit**

N5230A/C with

Option 140 or 240 (Standard Test Set and Standard Power Range)

Option 145 or 245 (Configurable Test Set and Extended Power Range)

Option 146 or 246 (Configurable Test Set and Extended Power Range with Internal Second Source)

Applies to the N5230A/C Option 140 or 145 or 146 or 240 or 245 or 246 analyzers, 85052B (3.5mm) calibration kit, 85131F flexible test port cable set, and a full 4-port calibration. Also applies to the following condition:

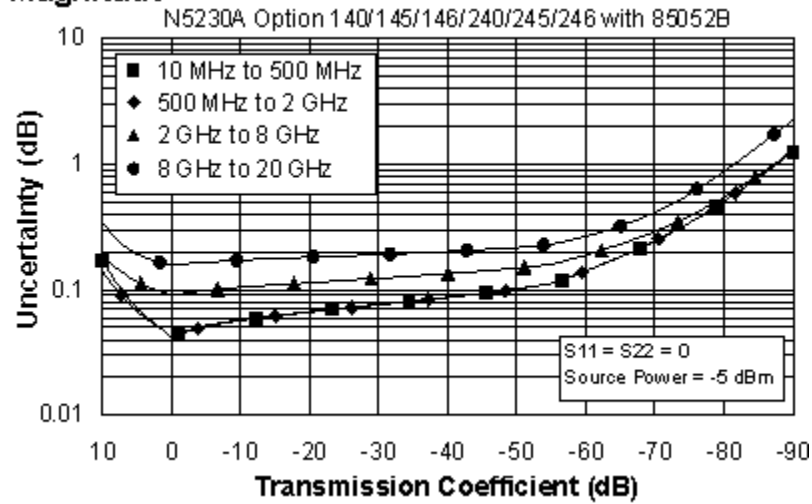
Environmental temperature  $23^\circ \pm 3^\circ \text{C}$ , with  $< 1^\circ \text{C}$  deviation from calibration temperature

| Description           | Specification (dB)                     |                                        |                                        |                                        |                                        |
|-----------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|
|                       | 10 MHz to<br>500 MHz                   | 500 MHz to<br>2 GHz                    | 2 to<br>8 GHz                          | 8 to<br>13.5 GHz                       | 13.5 to<br>20 GHz                      |
| Directivity           | 48                                     | 48                                     | 44                                     | 44                                     | 44                                     |
| Source Match          | 40                                     | 40                                     | 33                                     | 31                                     | 31                                     |
| Load Match            | 48                                     | 48                                     | 44                                     | 44                                     | 44                                     |
| Reflection Tracking   | $\pm 0.003$<br>$+0.010/^\circ\text{C}$ | $\pm 0.003$<br>$+0.010/^\circ\text{C}$ | $\pm 0.003$<br>$+0.020/^\circ\text{C}$ | $\pm 0.006$<br>$+0.030/^\circ\text{C}$ | $\pm 0.006$<br>$+0.030/^\circ\text{C}$ |
| Transmission Tracking | $\pm 0.017$<br>$+0.010/^\circ\text{C}$ | $\pm 0.017$<br>$+0.010/^\circ\text{C}$ | $\pm 0.062$<br>$+0.020/^\circ\text{C}$ | $\pm 0.125$<br>$+0.030/^\circ\text{C}$ | $\pm 0.125$<br>$+0.030/^\circ\text{C}$ |

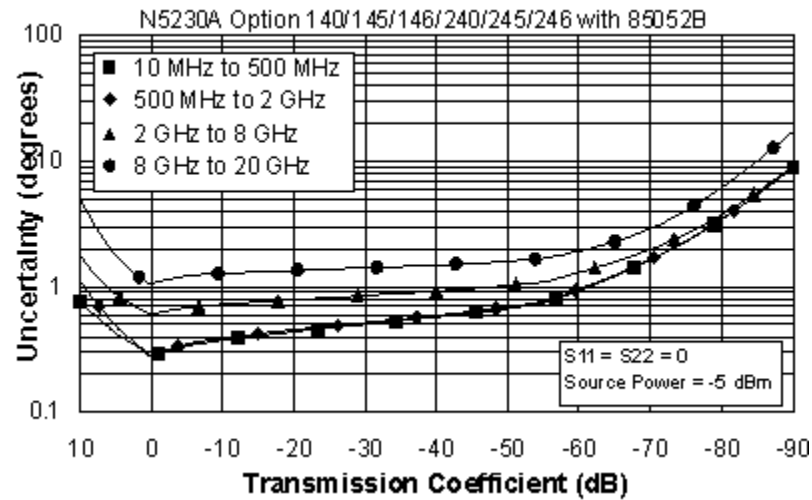
NOTE: The following graphs also apply to the “C” model of the analyzer.

### Transmission Uncertainty (Specifications)

#### Magnitude

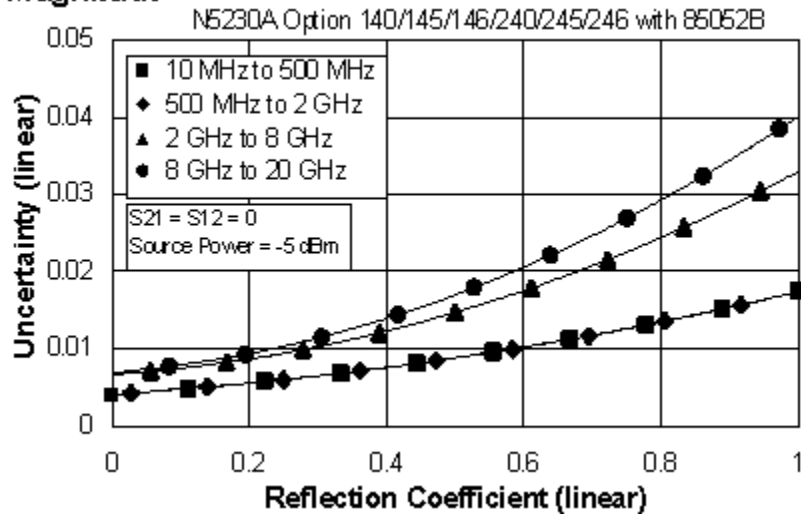


#### Phase

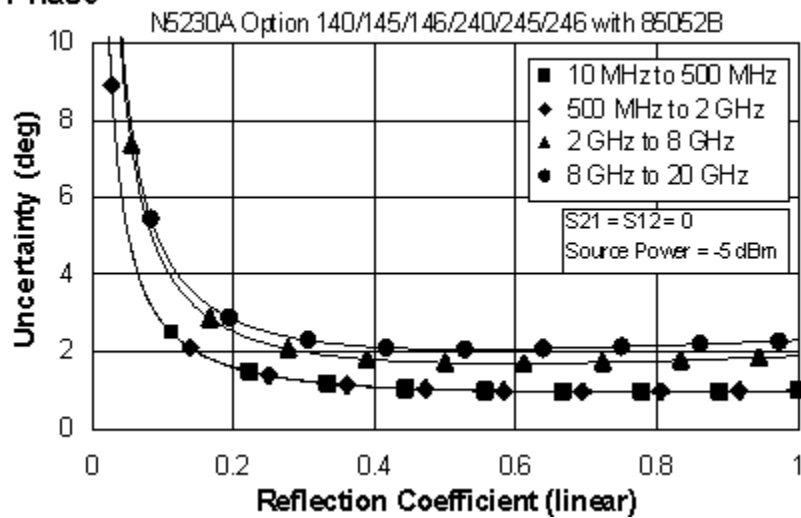


## Reflection Uncertainty (Specifications)

### Magnitude



### Phase



**Table 4. N4433A Electronic Calibration Module**

N5230A/C with:

Option 140 or 240 (Standard Test Set and Standard Power Range)

Option 145 or 245 (Configurable Test Set and Extended Power Range)

Option 146 or 246 (Configurable Test Set and Extended Power Range with Internal Second Source)

Applies to the N5230A/C Option 140 or 145 or 146 or 240 or 245 or 246 analyzers, N4433A (3.5mm) electronic calibration module, 85131F flexible test port cable set, and a full 4-port calibration. Also applies to the following condition:

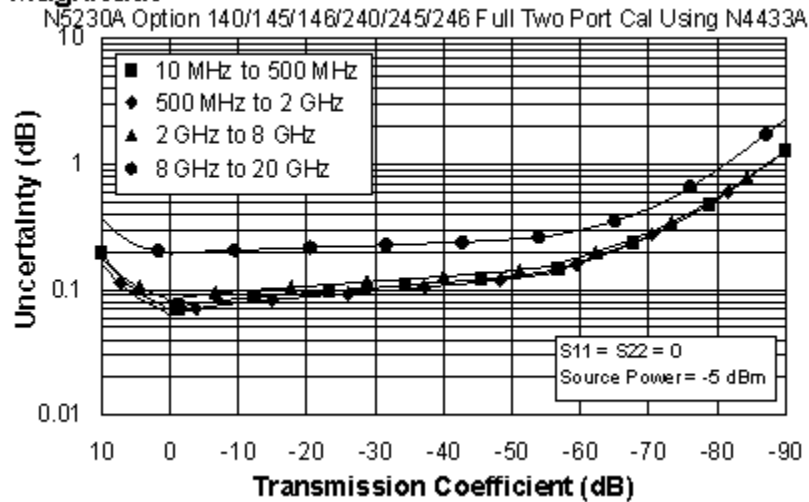
Environmental temperature  $23^{\circ} \pm 3^{\circ} \text{C}$ , with  $< 1^{\circ} \text{C}$  deviation from calibration temperature

| Description           | Specification (dB)                       |                                          |                                          |                                          |                                          |
|-----------------------|------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|
|                       | 10 MHz to<br>500 MHz                     | 500 MHz to<br>2 GHz                      | 2 to<br>8 GHz                            | 8 to<br>13.5 GHz                         | 13.5 to<br>20 GHz                        |
| Directivity           | 52                                       | 52                                       | 47                                       | 45                                       | 45                                       |
| Source Match          | 42                                       | 42                                       | 39                                       | 31                                       | 31                                       |
| Load Match            | 45                                       | 45                                       | 41                                       | 35                                       | 35                                       |
| Reflection Tracking   | $\pm 0.060$<br>$+0.010/^{\circ}\text{C}$ | $\pm 0.060$<br>$+0.010/^{\circ}\text{C}$ | $\pm 0.090$<br>$+0.020/^{\circ}\text{C}$ | $\pm 0.180$<br>$+0.030/^{\circ}\text{C}$ | $\pm 0.180$<br>$+0.030/^{\circ}\text{C}$ |
| Transmission Tracking | $\pm 0.045$<br>$+0.010/^{\circ}\text{C}$ | $\pm 0.039$<br>$+0.010/^{\circ}\text{C}$ | $\pm 0.055$<br>$+0.020/^{\circ}\text{C}$ | $\pm 0.160$<br>$+0.030/^{\circ}\text{C}$ | $\pm 0.160$<br>$+0.030/^{\circ}\text{C}$ |

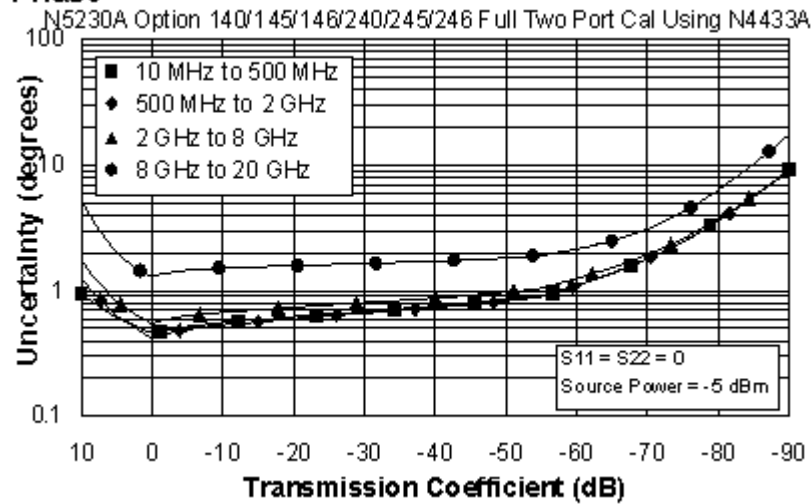
NOTE: The following graphs also apply to the “C” model of the analyzer.

### Transmission Uncertainty (Specifications)

#### Magnitude

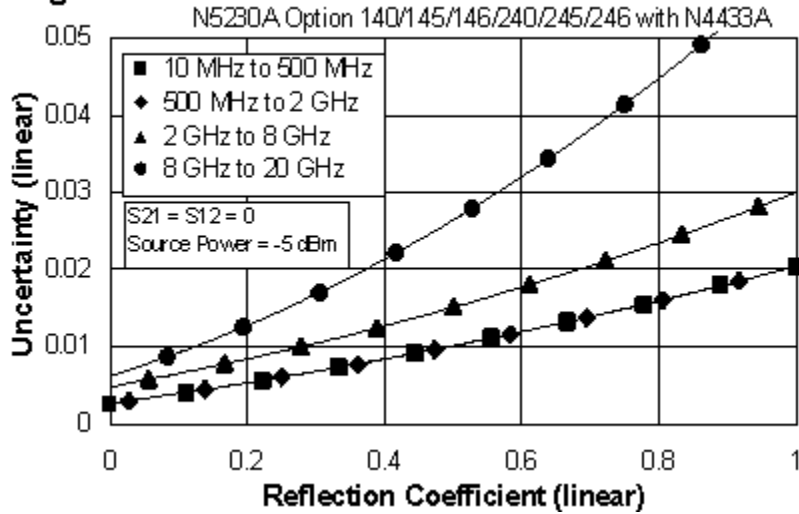


#### Phase

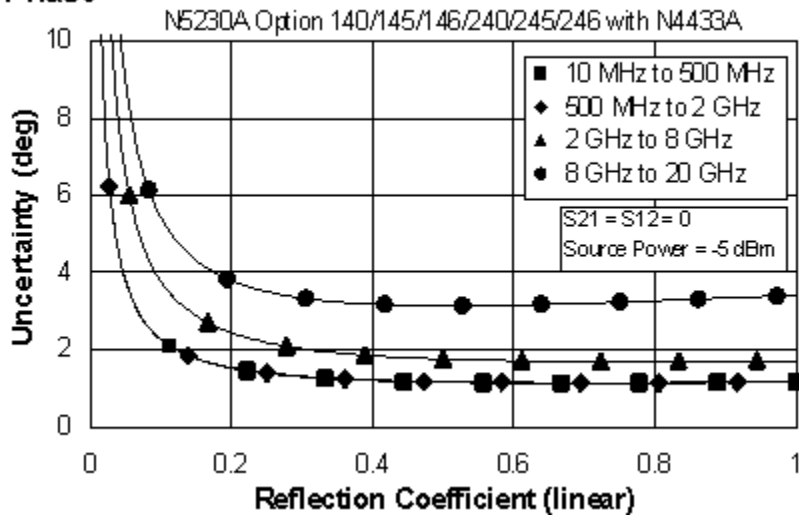


## Reflection Uncertainty (Specifications)

### Magnitude



### Phase



This N5230A/C document does not present specifications for the 85052C or 85052D Calibration Kit. Please download our free Uncertainty Calculator from [http://www.keysight.com/find/na\\_calculator](http://www.keysight.com/find/na_calculator) to generate the data and curves for the 85052C or the 85052D Calibration Kit. View the [equations](#) used to generate the uncertainty curves.

**Table 5. Uncorrected System Performance<sup>1</sup>**

| Description                  | Specification                   | Typical                         |
|------------------------------|---------------------------------|---------------------------------|
|                              | Options 140/145/146/240/245/246 | Options 140/145/146/240/245/246 |
| <b>Directivity</b>           |                                 |                                 |
| 300 KHz to 10 MHz            | --                              | -23 dB                          |
| 10 MHz to 1 GHz              | -28 dB                          | --                              |
| 1 GHz to 3 GHz               | -25 dB                          | --                              |
| 3 GHz to 5 GHz               | -20 dB                          | --                              |
| 5 GHz to 11.5 GHz            | -17 dB                          | --                              |
| 11.5 GHz to 13.5 GHz         | -15 dB                          | --                              |
| 13.5 GHz to 20 GHz           | -15 dB                          | --                              |
| <b>Source Match</b>          |                                 |                                 |
| 300 KHz to 10 MHz            | --                              | -8 dB                           |
| 10 MHz to 1 GHz              | -12 dB                          | --                              |
| 1 GHz to 3 GHz               | -12 dB                          | --                              |
| 3 GHz to 5 GHz               | -12 dB                          | --                              |
| 5 GHz to 10.5 GHz            | -12 dB                          | --                              |
| 10.5 GHz to 11.5 GHz         | -10 dB                          | --                              |
| 11.5 GHz to 13.5 GHz         | -8 dB                           | --                              |
| 13.5 GHz to 20 GHz           | -8 dB                           | --                              |
| <b>Load Match</b>            |                                 |                                 |
| 300 KHz to 10 MHz            | --                              | -9 dB                           |
| 10 MHz to 1 GHz              | -20 dB                          | --                              |
| 1 GHz to 3 GHz               | -20 dB                          | --                              |
| 3 GHz to 5 GHz               | -18 dB                          | --                              |
| 5 GHz to 11.5 GHz            | -12 dB                          | --                              |
| 11.5 GHz to 13.5 GHz         | -7 dB                           | --                              |
| 13.5 GHz to 16 GHz           | -7 dB                           | --                              |
| 16 GHz to 20 GHz             | -7.5 dB                         | --                              |
| <b>Crosstalk<sup>2</sup></b> |                                 |                                 |
| 300 KHz to 5 MHz             | --                              | -70 dB                          |
| 5 MHz to 10 MHz              | --                              | -100 dB                         |
| 10 MHz to 45 MHz             | --                              | -110 dB                         |
| 45 MHz to 4 GHz              | --                              | -122 dB                         |
| 4 GHz to 6 GHz               | --                              | -123 dB                         |
| 6 GHz to 10.5 GHz            | --                              | -120 dB                         |
| 10.5 GHz to 13.5 GHz         | --                              | -115 dB                         |
| 13.5 GHz to 15 GHz           | --                              | -115 dB                         |
| 15 GHz to 20 GHz             | --                              | -110 dB                         |

<sup>1</sup> Specifications apply over environmental temperature of 25 °C ±5 °C, with less than 1°C variation from the calibration temperature.

<sup>2</sup> Measurement conditions: normalized to a thru, measured with two shorts, 10 Hz IF bandwidth, averaging factor of 8, alternate mode, source power set to the lesser of the maximum power-out or the maximum receiver power.

**Table 6. Test Port Output<sup>1</sup>**

| Description                                                                               | Specification       |                     | Typical                                                                         |                     |
|-------------------------------------------------------------------------------------------|---------------------|---------------------|---------------------------------------------------------------------------------|---------------------|
|                                                                                           | Options 140/240     | Opt 145/146/245/246 | Options 140/240                                                                 | Opt 145/146/245/246 |
| Frequency Range                                                                           |                     |                     |                                                                                 |                     |
| Options 140/145/146                                                                       | 300 KHz to 13.5 GHz |                     | --                                                                              |                     |
| Options 240/245/246                                                                       | 300 KHz to 20 GHz   |                     | --                                                                              |                     |
| Nominal Power                                                                             |                     |                     |                                                                                 |                     |
|                                                                                           | -5 dBm              | -8 dBm              | Preset power; attenuator switch point 10 dB below nominal power                 |                     |
| Frequency Resolution                                                                      |                     |                     |                                                                                 |                     |
|                                                                                           | 1 Hz                |                     | --                                                                              |                     |
| CW Accuracy                                                                               |                     |                     |                                                                                 |                     |
|                                                                                           | +/-1 ppm            |                     | --                                                                              |                     |
| Frequency Stability                                                                       |                     |                     |                                                                                 |                     |
|                                                                                           | --                  |                     | +/-0.05 ppm, -10° to 70° C <sup>2</sup> ;<br>+/-0.1 ppm/yr maximum <sup>3</sup> |                     |
| Description                                                                               | Specification       |                     | Typical                                                                         |                     |
|                                                                                           | Options 140/240     | Opt 145/146/245/246 | Options 140/240                                                                 | Opt 145/146/245/246 |
| Power Level Accuracy                                                                      |                     |                     |                                                                                 |                     |
| Variation from nominal power in range 0                                                   |                     |                     |                                                                                 |                     |
| 300 KHz to 10 MHz                                                                         | --                  | --                  | +/-1.0 dB                                                                       | +/-1.0 dB           |
| 10 MHz to 2 GHz                                                                           | +/-1.0 dB           | +/-1.0 dB           | --                                                                              | --                  |
| 2 GHz to 10.5 GHz                                                                         | +/-1.5 dB           | +/-1.5 dB           | --                                                                              | --                  |
| 10.5 GHz to 13.5 GHz                                                                      | +/-2.5 dB           | +/-2.5 dB           | --                                                                              | --                  |
| 13.5 GHz to 20 GHz                                                                        | +/-2.5 dB           | +/-2.5 dB           | --                                                                              | --                  |
| Max Levelled Power                                                                        |                     |                     |                                                                                 |                     |
| 300 KHz to 10 MHz                                                                         | --                  | --                  | +8 dBm                                                                          | +8 dBm              |
| 10 MHz to 4 GHz                                                                           | +8 dBm              | +8 dBm              | +12 dBm                                                                         | +11 dBm             |
| 4 GHz to 6 GHz                                                                            | +6 dBm              | +6 dBm              | +10 dBm                                                                         | +9 dBm              |
| 6 GHz to 10.5 GHz                                                                         | +3 dBm              | +1 dBm              | +8 dBm                                                                          | +6 dBm              |
| 10.5 GHz to 13.5 GHz                                                                      | 0 dBm               | -2 dBm              | +5 dBm                                                                          | +3 dBm              |
| 13.5 GHz to 15 GHz                                                                        | 0 dBm               | -2 dBm              | +5 dBm                                                                          | +3 dBm              |
| 15 GHz to 20 GHz                                                                          | -3 dBm              | -8 dBm              | +2 dBm                                                                          | -1 dBm              |
| Power Level Linearity                                                                     |                     |                     |                                                                                 |                     |
| Refer to footnote 1.                                                                      |                     |                     |                                                                                 |                     |
| 300 KHz to 10 MHz                                                                         | --                  | --                  | +/-2.0 dB                                                                       | +/-2.0 dB           |
| 10 MHz to 1 GHz                                                                           | +/-2.0 dB           | +/-2.0 dB           | --                                                                              | --                  |
| 1 GHz to 13.5 GHz                                                                         | +/-1.5 dB           | +/-1.5 dB           | --                                                                              | --                  |
| 13.5 GHz to 20 GHz                                                                        | +/-1.5 dB           | +/-1.5 dB           | --                                                                              | --                  |
| Power Sweep Range (ALC)                                                                   |                     |                     |                                                                                 |                     |
| ALC range starts at maximum-levelled power and decreases by the dB amount specified here. |                     |                     |                                                                                 |                     |
| 300 KHz to 10 MHz                                                                         | --                  | --                  | 35 dB                                                                           | 35 dB               |
| 10 MHz to 4 GHz                                                                           | 33 dB               | 33 dB               | --                                                                              | --                  |
| 4 GHz to 6 GHz                                                                            | 31 dB               | 31 dB               | --                                                                              | --                  |
| 6 GHz to 10.5 GHz                                                                         | 28 dB               | 26 dB               | --                                                                              | --                  |
| 10.5 GHz to 13.5 GHz                                                                      | 25 dB               | 23 dB               | --                                                                              | --                  |
| 13.5 GHz to 15 GHz                                                                        | 25 dB               | 23 dB               | --                                                                              | --                  |
| 15 GHz to 20 GHz                                                                          | 22 dB               | 17 dB               | --                                                                              | --                  |

| Table 6. Test Port Output (Continued)                              |                 |                     |                                      |                     |
|--------------------------------------------------------------------|-----------------|---------------------|--------------------------------------|---------------------|
| Description                                                        | Specification   |                     | Typical                              |                     |
|                                                                    | Options 140/240 | Opt 145/146/245/246 | Options 140/240                      | Opt 145/146/245/246 |
| <b>Power Resolution</b>                                            |                 |                     |                                      |                     |
|                                                                    | 0.01 dB         | 0.01 dB             | --                                   | --                  |
| <b>Power Range</b>                                                 |                 |                     |                                      |                     |
| 300 KHz to 10 MHz                                                  | --              | --                  | -27 to +5 dBm                        | -87 to +5 dBm       |
| 10 MHz to 45MHz                                                    | --              | --                  | -27 to +12 dBm                       | -87 to +11 dBm      |
| 45 MHz to 4 GHz                                                    | --              | --                  | -27 to +12 dBm                       | -87 to +11 dBm      |
| 4 GHz to 6 GHz                                                     | --              | --                  | -27 to +10 dBm                       | -87 to +9 dBm       |
| 6 GHz to 10.5 GHz                                                  | --              | --                  | -27 to +8 dBm                        | -87 to +6 dBm       |
| 10.5 GHz to 13.5 GHz                                               | --              | --                  | -27 to +5 dBm                        | -87 to +3 dBm       |
| 13.5 GHz to 15 GHz                                                 | --              | --                  | -27 to +5 dBm                        | -87 to +3 dBm       |
| 15 GHz to 20 GHz                                                   | --              | --                  | -27 to +2 dBm                        | -87 to -1 dBm       |
| <b>Power Settings</b>                                              |                 |                     |                                      |                     |
| Minimum Power Setting                                              | --              | --                  | -30 dBm                              | -90 dBm             |
| Maximum Power Setting                                              | --              | --                  | +20 dBm                              | +20 dBm             |
| <b>Harmonics (2nd or 3rd) at Maximum Output Power</b>              |                 |                     |                                      |                     |
| In-band Source Harmonics                                           |                 |                     |                                      |                     |
| 300 KHz to 10 MHz                                                  | --              | --                  | -17 dBc                              |                     |
| 10 MHz to 1 GHz                                                    | --              | --                  | -17 dBc                              |                     |
| 1 GHz to 13.5 GHz                                                  | --              | --                  | -20 dBc                              |                     |
| 13.5 GHz to 20 GHz                                                 | --              | --                  | -20 dBc                              |                     |
| <b>Non-Harmonic Spurious (at Nominal Output Power)<sup>4</sup></b> |                 |                     |                                      |                     |
| 300 KHz to 13.5 GHz                                                | --              | --                  | -50 dBc for offset frequency > 1 KHz |                     |
| 13.5 GHz to 20 GHz                                                 | --              | --                  | -50 dBc for offset frequency > 1 KHz |                     |

| Table 6. Test Port Output (Continued)    |                                 |                |              |
|------------------------------------------|---------------------------------|----------------|--------------|
| Phase Noise (Nominal power at test port) | Typical Performance             |                |              |
|                                          | Options 140/145/146/240/245/246 |                |              |
|                                          | 10 kHz Offset                   | 100 kHz Offset | 1 MHz Offset |
| 300 KHz to 10 MHz                        | -86 dBc/Hz                      | -86 dBc/Hz     | -95 dBc/Hz   |
| 10 MHz to 1.5 GHz                        | -86 dBc/Hz                      | -91 dBc/Hz     | -95 dBc/Hz   |
| 1.5 GHz to 3.125 GHz                     | -83 dBc/Hz                      | -91 dBc/Hz     | -95 dBc/Hz   |
| 3.125 GHz to 6.25 GHz                    | -77 dBc/Hz                      | -85 dBc/Hz     | -89 dBc/Hz   |
| 6.25 GHz to 12.5 GHz                     | -71 dBc/Hz                      | -79 dBc/Hz     | -83 dBc/Hz   |
| 12.5 GHz to 13.5 GHz                     | -65 dBc/Hz                      | -73 dBc/Hz     | -77 dBc/Hz   |
| 13.5 GHz to 20 GHz                       | -65 dBc/Hz                      | -73 dBc/Hz     | -77 dBc/Hz   |

<sup>1</sup> For Options 140/145/240/245, performance is specified on Port 1 only; Ports 2, 3, and 4 performance is typical. For Options 146/246, performance is specified on Ports 1 and 3 only; Ports 2 and 4 performance is typical. Test reference is at the nominal power level.

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

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

<sup>4</sup> Spurious signal levels are valid for a 10 MHz span centered on the carrier frequency. Spurious signals up to -15 dBc may exist outside the span. These signals do not affect the accuracy of the network analyzer measurements.

**Table 7. Test Port Input**

| Description                                                                     | Specification                   | Typical                         |        |             |
|---------------------------------------------------------------------------------|---------------------------------|---------------------------------|--------|-------------|
|                                                                                 | Options 140/145/146/240/245/246 | Options 140/145/146/240/245/246 |        |             |
| Test Port Noise Floor <sup>1</sup>                                              |                                 |                                 |        |             |
| 10 Hz IF Bandwidth <sup>2</sup>                                                 |                                 |                                 |        |             |
| 300 KHz to 10 MHz <sup>3</sup>                                                  | --                              | <-103 dBm                       |        |             |
| 10 MHz to 500 MHz <sup>3</sup>                                                  | <-112 dBm                       | <-116 dBm                       |        |             |
| 500 MHz to 4 GHz                                                                | <-112 dBm                       | <-120 dBm                       |        |             |
| 4 GHz to 10.5 GHz                                                               | <-112 dBm                       | <-119 dBm                       |        |             |
| 10.5 GHz to 13.5 GHz                                                            | <-107 dBm                       | <-114 dBm                       |        |             |
| 13.5 GHz to 15 GHz                                                              | <-107 dBm                       | <-114 dBm                       |        |             |
| 15 GHz to 20 GHz                                                                | <-106 dBm                       | <-114 dBm                       |        |             |
| 1 KHz IF Bandwidth                                                              |                                 |                                 |        |             |
| 300 KHz to 10 MHz <sup>3</sup>                                                  | --                              | <-83 dBm                        |        |             |
| 10 MHz to 500 MHz <sup>3/</sup>                                                 | <-92 dBm                        | <-96 dBm                        |        |             |
| 500 MHz to 4 GHz                                                                | <-92 dBm                        | <-100 dBm                       |        |             |
| 4 GHz to 10.5 GHz                                                               | <-92 dBm                        | <-99 dBm                        |        |             |
| 10.5 GHz to 13.5 GHz                                                            | <-87 dBm                        | <-94 dBm                        |        |             |
| 13.5 GHz to 15 GHz                                                              | <-87 dBm                        | <-94 dBm                        |        |             |
| 15 GHz to 20 GHz                                                                | <-86 dBm                        | <-94 dBm                        |        |             |
| Direct Receiver Access Input Noise Floor <sup>1</sup> (Options 145/146/245/246) |                                 |                                 |        |             |
| 10 Hz IF Bandwidth <sup>2</sup>                                                 |                                 |                                 |        |             |
| 300 KHz to 10 MHz <sup>3</sup>                                                  | --                              | <-119 dBm                       |        |             |
| 10 MHz to 500 MHz <sup>3</sup>                                                  | <-128 dBm                       | <-132 dBm                       |        |             |
| 500 MHz to 4 GHz                                                                | <-128 dBm                       | <-136 dBm                       |        |             |
| 4 GHz to 10.5 GHz                                                               | <-128 dBm                       | <-135 dBm                       |        |             |
| 10.5 GHz to 13.5 GHz                                                            | <-123 dBm                       | <-130 dBm                       |        |             |
| 13.5 GHz to 15 GHz                                                              | <-123 dBm                       | <-130 dBm                       |        |             |
| 15 GHz to 20 GHz                                                                | <-122 dBm                       | <-130 dBm                       |        |             |
| 1 KHz IF Bandwidth                                                              |                                 |                                 |        |             |
| 300 KHz to 10 MHz <sup>3</sup>                                                  | --                              | <-99 dBm                        |        |             |
| 10 MHz to 500 MHz <sup>3</sup>                                                  | <-108 dBm                       | <-112 dBm                       |        |             |
| 500 MHz to 4 GHz                                                                | <-108 dBm                       | <-116 dBm                       |        |             |
| 4 GHz to 10.5 GHz                                                               | <-108 dBm                       | <-115 dBm                       |        |             |
| 10.5 GHz to 13.5 GHz                                                            | <-103 dBm                       | <-110 dBm                       |        |             |
| 13.5 GHz to 15 GHz                                                              | <-103 dBm                       | <-110 dBm                       |        |             |
| 15 GHz to 20 GHz                                                                | <-102 dBm                       | <-110 dBm                       |        |             |
| Description                                                                     | Specification                   | Typical                         |        |             |
|                                                                                 | Options 140/145/146/240/245/246 | Options 140/145/146/240/245/246 |        |             |
| Compression Level (at +8 dBm except as noted)                                   |                                 |                                 |        |             |
|                                                                                 | Power                           | Compression                     | Power  | Compression |
| 300 KHz to 10 MHz                                                               | --                              | --                              | +5 dBm | 0.10 dB     |
| 10 MHz to 50 MHz                                                                | +8 dBm                          | 0.35 dB                         | --     | --          |
| 50 MHz to 1 GHz                                                                 | +8 dBm                          | 0.35 dB                         | --     | --          |
| 1 GHz to 8 GHz                                                                  | +8 dBm                          | 0.25 dB                         | --     | --          |
| 8 GHz to 12.5 GHz                                                               | +8 dBm                          | 0.30 dB                         | --     | --          |
| 12.5 GHz to 13.5 GHz                                                            | +8 dBm                          | 0.55 dB                         | --     | --          |
| 13.5 GHz to 20 GHz                                                              | +8 dBm                          | 0.55 dB                         | --     | --          |

| Table 7. Test Port Input (Continued) |                                 |             |                                 |             |
|--------------------------------------|---------------------------------|-------------|---------------------------------|-------------|
| Description                          | Specification                   |             | Typical                         |             |
|                                      | Options 140/145/146/240/245/246 |             | Options 140/145/146/240/245/246 |             |
| Test Port Compression – 0.1 dB       |                                 |             |                                 |             |
|                                      | Power                           | Compression | Power                           | Compression |
| 300 KHz to 10 MHz                    | --                              | --          | +5 dBm                          | --          |
| 10 MHz to 1 GHz                      | --                              | --          | +9 dBm                          | --          |
| 1 GHz to 12.5 GHz                    | --                              | --          | +10 dBm                         | --          |
| 12.5 GHz to 13.5 GHz                 | --                              | --          | +9 dBm                          |             |
| 13.5 GHz to 20 GHz                   | --                              | --          | +9 dBm                          | --          |

| Table 7. Test Port Input (Continued)             |                 |                |                 |                 |                 |                 |
|--------------------------------------------------|-----------------|----------------|-----------------|-----------------|-----------------|-----------------|
| Description                                      | Specification   |                |                 | Typical         |                 |                 |
|                                                  | Options 140/240 | Option 145/245 | Options 146/246 | Options 140/240 | Options 145/245 | Options 146/246 |
| Trace Noise Magnitude <sup>4</sup>               |                 |                |                 |                 |                 |                 |
| Ratioed measurement, nominal power at test port. |                 |                |                 |                 |                 |                 |
| 100 KHz IF bandwidth                             |                 |                |                 |                 |                 |                 |
| 300 KHz to 10 MHz                                | --              | --             | --              | .015 dB rms     | .030 dB rms     | .050 dB rms     |
| 10 MHz to 10.5 GHz                               | .006 dB rms     | .008 dB rms    | .016 dB rms     | .004 dB rms     | .005 dB rms     | .013 dB rms     |
| 10.5 GHz to 13.5 GHz                             | .010 dB rms     | .014 dB rms    | .038 dB rms     | .007 dB rms     | .009 dB rms     | .026 dB rms     |
| 13.5 GHz to 20 GHz                               | .010 dB rms     | .014 dB rms    | .038 dB rms     | .007 dB rms     | .009 dB rms     | .026 dB rms     |
| 600 KHz IF bandwidth                             |                 |                |                 |                 |                 |                 |
| 300 KHz to 10 MHz                                | --              | --             | --              | .015 dB rms     | .030 dB rms     | .050 dB rms     |
| 10 MHz to 10.5 GHz                               | --              | --             | --              | .013 dB rms     | .015 dB rms     | .032 dB rms     |
| 10.5 GHz to 13.5 GHz                             | --              | --             | --              | .017 dB rms     | .023 dB rms     | .063 dB rms     |
| 13.5 GHz to 20 GHz                               | --              | --             | --              | .017 dB rms     | .023 dB rms     | .063 dB rms     |
| 100 KHz IF bandwidth                             |                 |                |                 |                 |                 |                 |
| Measured at Maximum Specified Power              |                 |                |                 |                 |                 |                 |
| 300 KHz to 10 MHz                                | --              | --             | --              | .005 dB rms     | .010 dB rms     | .012 dB rms     |
| 10 MHz to 2 GHz                                  | --              | --             | --              | .001 dB rms     | .003 dB rms     | .004 dB rms     |
| 2 GHz to 10.5 GHz                                | --              | --             | --              | .002 dB rms     | .003 dB rms     | .004 dB rms     |
| 10.5 GHz to 13.5 GHz                             | --              | --             | --              | .006 dB rms     | .009 dB rms     | .023 dB rms     |
| 13.5 GHz to 20 GHz                               | --              | --             | --              | .006 dB rms     | .009 dB rms     | .023 dB rms     |

| Table 7. Test Port Input (Continued)                               |                    |                    |                    |                    |                    |                   |
|--------------------------------------------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|-------------------|
| Description                                                        | Specification      |                    |                    | Typical            |                    |                   |
|                                                                    | Options<br>140/240 | Options<br>145/245 | Options<br>146/246 | Options<br>140/240 | Options<br>145/245 | Option<br>146/246 |
| <b>Trace Noise Phase<sup>4</sup></b>                               |                    |                    |                    |                    |                    |                   |
| Ratioed measurement, nominal power at test port.                   |                    |                    |                    |                    |                    |                   |
| <b>100 KHz IF bandwidth</b>                                        |                    |                    |                    |                    |                    |                   |
| 300 KHz to 10 MHz                                                  | --                 | --                 | --                 | 0.110 deg<br>rms   | 0.180 deg<br>rms   | 0.280 deg<br>rms  |
| 10 MHz to 10.5 GHz                                                 | 0.05 deg<br>rms    | 0.07 deg<br>rms    | 0.13 deg<br>rms    | 0.025 deg<br>rms   | 0.035 deg<br>rms   | 0.090 deg<br>rms  |
| 10.5 GHz to 13.5 GHz                                               | 0.08 deg<br>rms    | 0.10 deg<br>rms    | 0.250 deg<br>rms   | 0.050 deg<br>rms   | 0.060 deg<br>rms   | 0.170 deg<br>rms  |
| 13.5 GHz to 20 GHz                                                 | 0.08 deg<br>rms    | 0.10 deg<br>rms    | 0.250 deg<br>rms   | 0.050 deg<br>rms   | 0.060 deg<br>rms   | 0.170 deg<br>rms  |
| <b>600 KHz IF bandwidth</b>                                        |                    |                    |                    |                    |                    |                   |
| 300 KHz to 10 MHz                                                  | --                 | --                 | --                 | 0.110 deg<br>rms   | 0.180 deg<br>rms   | 0.300 deg<br>rms  |
| 10 MHz to 10.5 GHz                                                 | --                 | --                 | --                 | 0.080 deg<br>rms   | 0.100 deg<br>rms   | 0.200 deg<br>rms  |
| 10.5 GHz to 13.5 GHz                                               | --                 | --                 | --                 | 0.120 deg<br>rms   | 0.160 deg<br>rms   | 0.430 deg<br>rms  |
| 13.5 GHz to 20 GHz                                                 | --                 | --                 | --                 | 0.120 deg<br>rms   | 0.160 deg<br>rms   | 0.430 deg<br>rms  |
| <b>100 KHz IF bandwidth</b>                                        |                    |                    |                    |                    |                    |                   |
| Measured at Maximum Specified Power                                |                    |                    |                    |                    |                    |                   |
| 300 KHz to 10 MHz                                                  | --                 | --                 | --                 | 0.040 deg<br>rms   | 0.050 deg<br>rms   | 0.075 deg<br>rms  |
| 10 MHz to 2 GHz                                                    | --                 | --                 | --                 | 0.007 deg<br>rms   | 0.012 deg<br>rms   | 0.013 deg<br>rms  |
| 2 GHz to 10.5 GHz                                                  | --                 | --                 | --                 | 0.012 deg<br>rms   | 0.015 deg<br>rms   | 0.030 deg<br>rms  |
| 10.5 GHz to 13.5 GHz                                               | --                 | --                 | --                 | 0.040 deg<br>rms   | 0.060 deg<br>rms   | 0.150 deg<br>rms  |
| 13.5 GHz to 20 GHz                                                 | --                 | --                 | --                 | 0.040 deg<br>rms   | 0.060 deg<br>rms   | 0.150 deg<br>rms  |
| <b>Stability Magnitude<sup>5</sup></b>                             |                    |                    |                    |                    |                    |                   |
| Stability is defined as a ratio measurement made at the test port. |                    |                    |                    |                    |                    |                   |
| 300 KHz to 10 MHz                                                  | --                 | --                 | --                 | +/-0.015 dB/°C     |                    |                   |
| 10 MHz to 2 GHz                                                    | --                 | --                 | --                 | +/-0.010 dB/°C     |                    |                   |
| 2 GHz to 4 GHz                                                     | --                 | --                 | --                 | +/-0.015 dB/°C     |                    |                   |
| 4 GHz to 13.5 GHz                                                  | --                 | --                 | --                 | +/-0.020 dB/°C     |                    |                   |
| 13.5 GHz to 16 GHz                                                 | --                 | --                 | --                 | +/-0.020 dB/°C     |                    |                   |
| 16 GHz to 19 GHz                                                   | --                 | --                 | --                 | +/-0.025 dB/°C     |                    |                   |
| 19 GHz to 20 GHz                                                   | --                 | --                 | --                 | +/-0.030 dB/°C     |                    |                   |

| Table 7. Test Port Input (Continued)                               |                 |                 |                 |                 |                 |                 |
|--------------------------------------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Description                                                        | Specification   |                 |                 | Typical         |                 |                 |
|                                                                    | Options 140/240 | Options 145/245 | Options 146/246 | Options 140/240 | Options 145/245 | Options 146/246 |
| <b>Stability Phase<sup>5</sup></b>                                 |                 |                 |                 |                 |                 |                 |
| Stability is defined as a ratio measurement made at the test port. |                 |                 |                 |                 |                 |                 |
| 300 KHz to 10 MHz                                                  | --              | --              | --              | +/-0.360°/°C    |                 |                 |
| 10 MHz to 45 MHz                                                   | --              | --              | --              | +/-0.020°/°C    |                 |                 |
| 45 MHz to 500 MHz                                                  | --              | --              | --              | +/-0.030°/°C    |                 |                 |
| 500 MHz to 2 GHz                                                   | --              | --              | --              | +/-0.050°/°C    | +/-0.070°/°C    |                 |
| 2 GHz to 4 GHz                                                     | --              | --              | --              | +/-0.100°/°C    | +/-0.150°/°C    |                 |
| 4 GHz to 8 GHz                                                     | --              | --              | --              | +/-0.150°/°C    | +/-0.250°/°C    |                 |
| 8 GHz to 13.5 GHz                                                  | --              | --              | --              | +/-0.300°/°C    | +/-0.500°/°C    |                 |
| 13.5 GHz to 16 GHz                                                 | --              | --              | --              | +/-0.300°/°C    | +/-0.500°/°C    |                 |
| 16 GHz to 20 GHz                                                   | --              | --              | --              | +/-0.350°/°C    | +/-0.650°/°C    |                 |

| Table 7. Test Port Input (Continued) |                 |                     |                 |                     |
|--------------------------------------|-----------------|---------------------|-----------------|---------------------|
| Description                          | Specification   |                     | Typical         |                     |
|                                      | Options 140/240 | Opt 145/146/245/246 | Options 140/240 | Opt 145/146/245/246 |
| <b>Reference Level Magnitude</b>     |                 |                     |                 |                     |
| Range                                | +/-200 dB       | +/-200 dB           | --              | --                  |
| Resolution                           | 0.001dB         | 0.001dB             | --              | --                  |
| <b>Reference Level Phase</b>         |                 |                     |                 |                     |
| Range                                | +/-500°         | +/-500°             | --              | --                  |
| Resolution                           | 0.01°           | 0.01°               | --              | --                  |

| Table 7. Test Port Input (Continued) |                      |                      |
|--------------------------------------|----------------------|----------------------|
|                                      | Typical Performance  |                      |
| Damage Input Level                   | Options 140/240      | Opt 145/146/245/246  |
| Test Port 1,2,3, and 4               | +27 dBm or +/-16 VDC | +27 dBm or +/-16 VDC |
| Receivers R, A, B, C, D              | --                   | +15 dBm or +/-16 VDC |
| Source out (reference)               | --                   | +27 dBm or +/-16 VDC |
| Source out (test ports)              | --                   | +27 dBm or +/-16 VDC |
| Coupler Thru                         | --                   | +27 dBm or +/-16 VDC |
| Coupler Arm                          | --                   | +15 dBm or +/-0 VDC  |

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

<sup>2</sup> 10 Hz IFBW test port noise floor performance is mathematically derived from the 1 kHz IFBW noise floor performance. The performance could be limited by crosstalk below 3 MHz at certain frequencies. The measurement is defined as a single receiver measurement with loads on the ports at a given CW frequency with power set to the minimum plus 5 dB.

<sup>3</sup> May be degraded typically by 10 dB at particular frequencies (multiples of 5 MHz) below 500 MHz due to spurious receiver residuals.

<sup>4</sup> 1 kHz IF BW, ratioed measurement, nominal power at the test port.

<sup>5</sup> Stability is defined as a ratio measurement made at the test port.

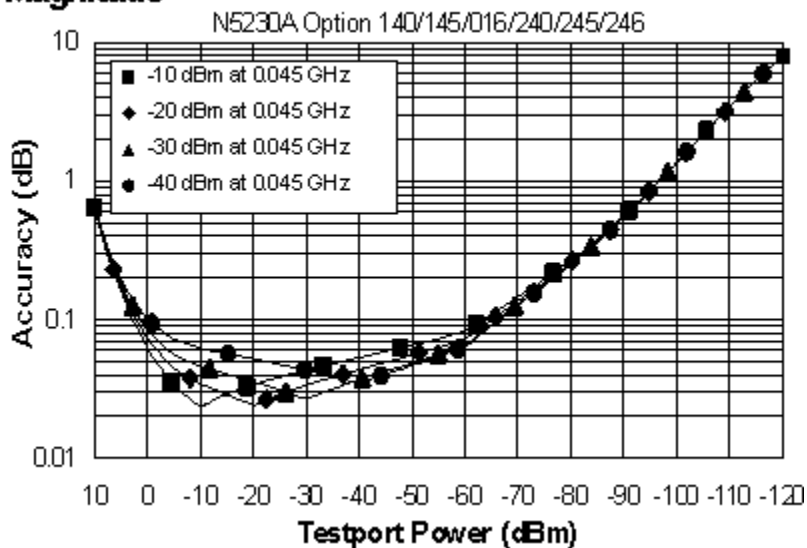
**Table 8. Dynamic Accuracy (Specification<sup>a</sup>)**

Accuracy of the test port input power reading relative to the reference input power level.

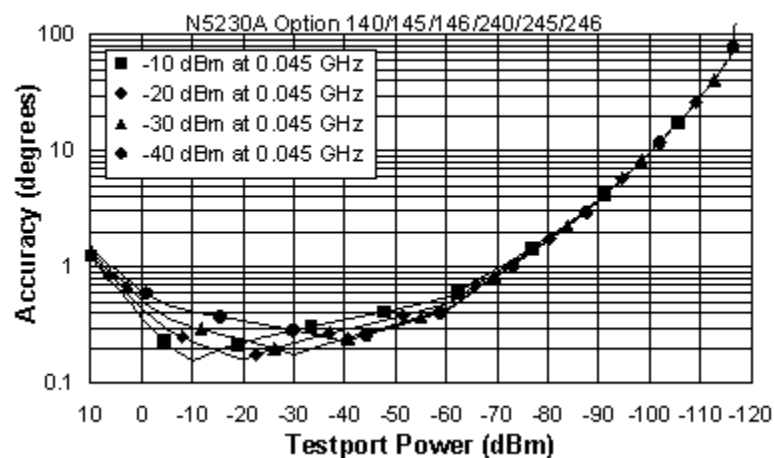
NOTE: The following graphs also apply to the “C” model of the analyzer.

Dynamic Accuracy, 0.045 GHz

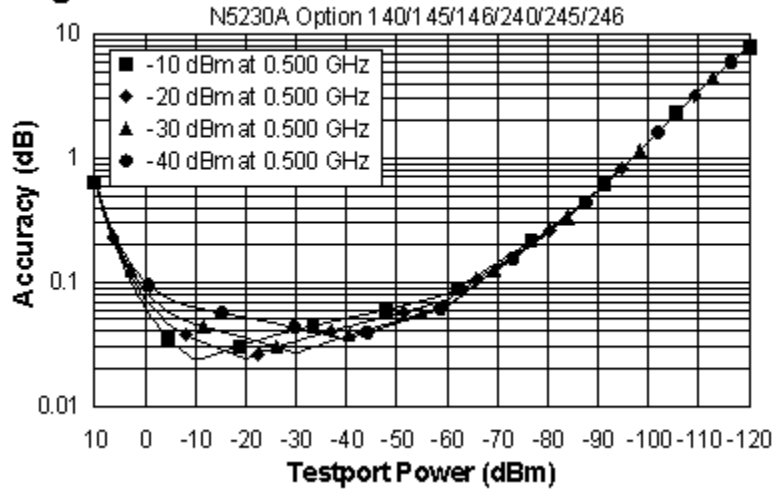
### Magnitude



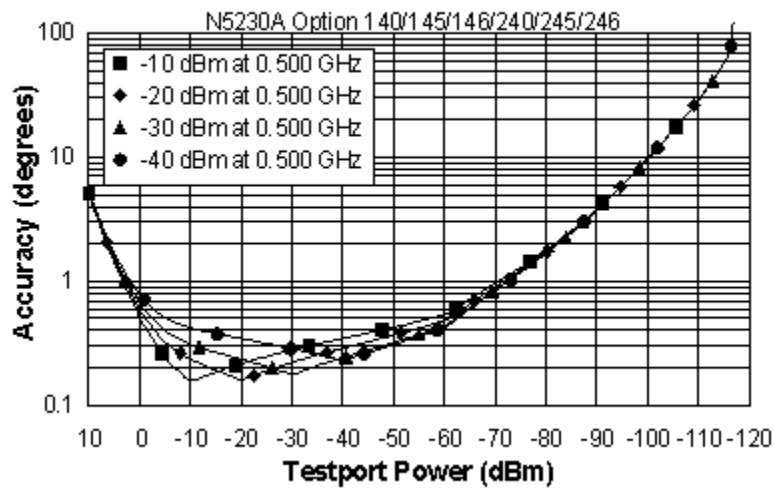
### Phase



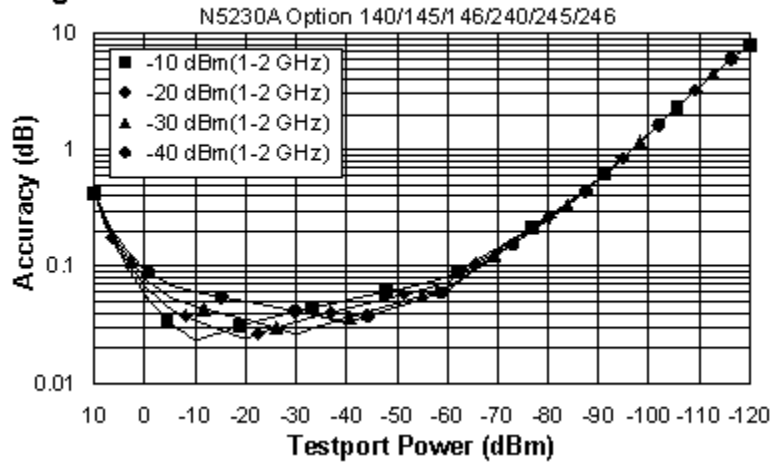
### Magnitude



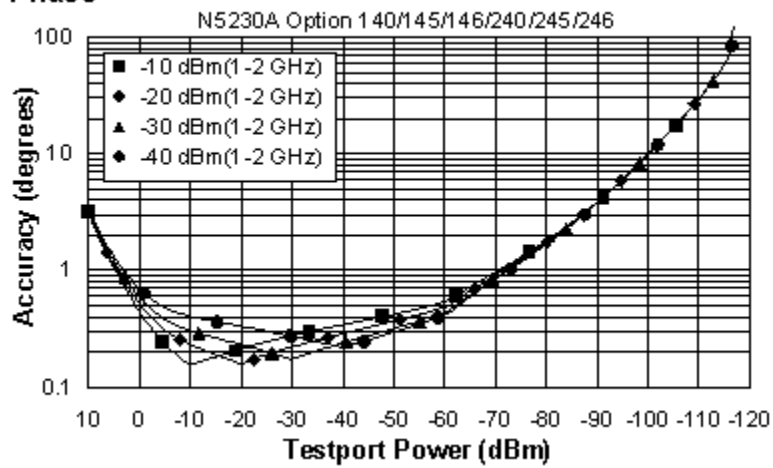
### Phase



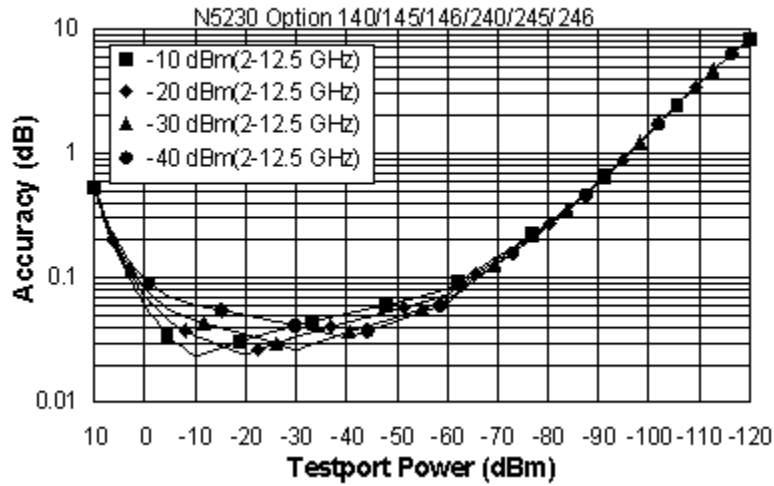
### Magnitude



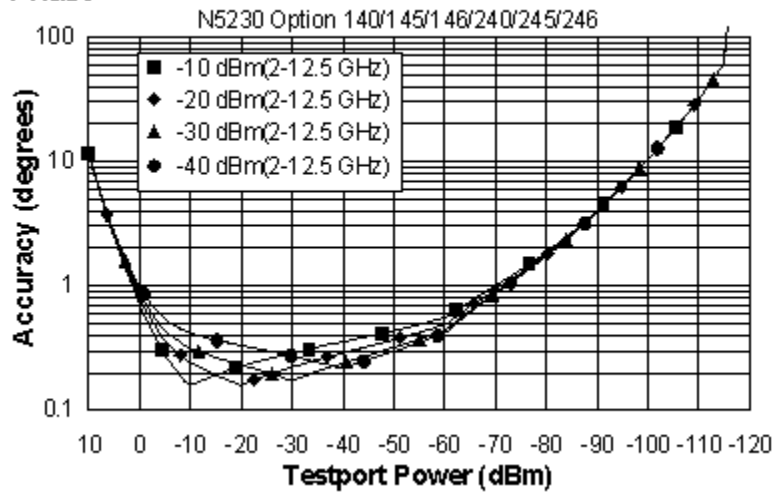
### Phase



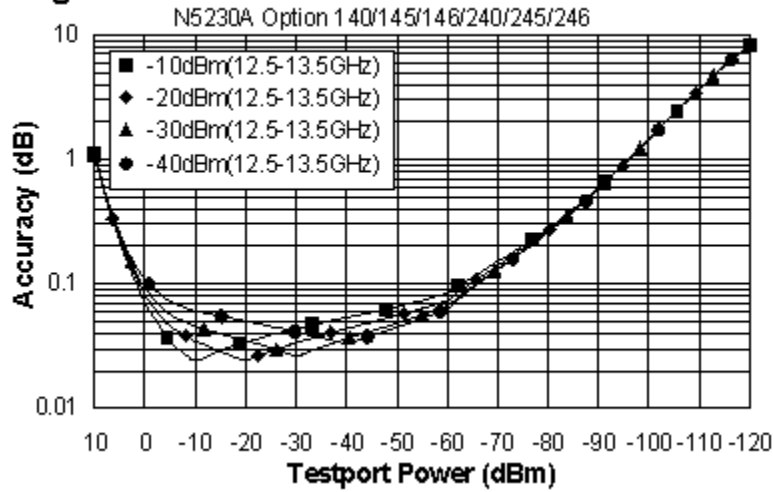
### Magnitude



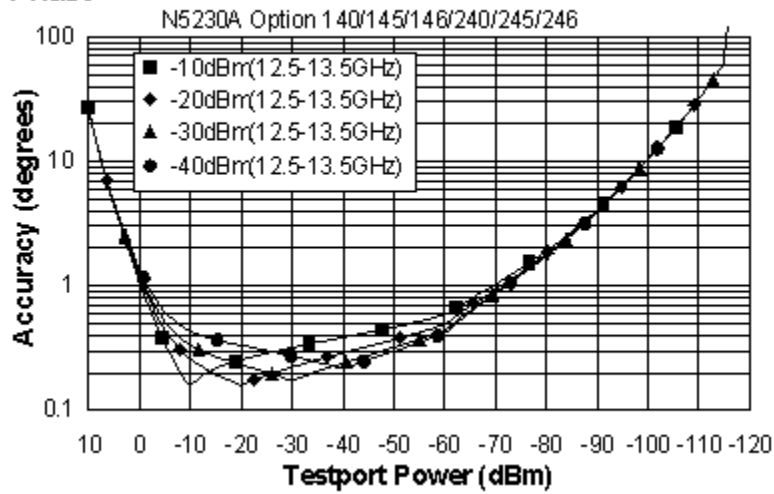
### Phase



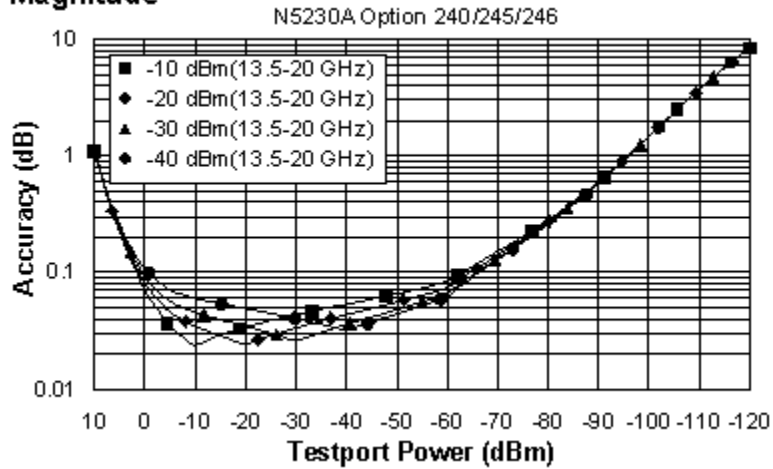
### Magnitude



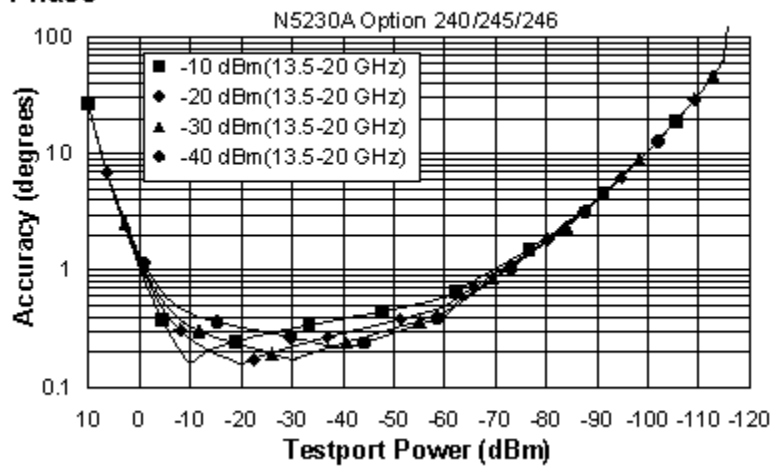
### Phase



### Magnitude



### Phase



<sup>a</sup> Dynamic accuracy is verified with the following measurements:

- Compression over frequency
- IF linearity at a single frequency of 1.195 GHz using a reference level of -20 dBm for an input power range of 0 to -110 dBm.

**Table 9. Test Port Input (Group Delay)<sup>a</sup>**

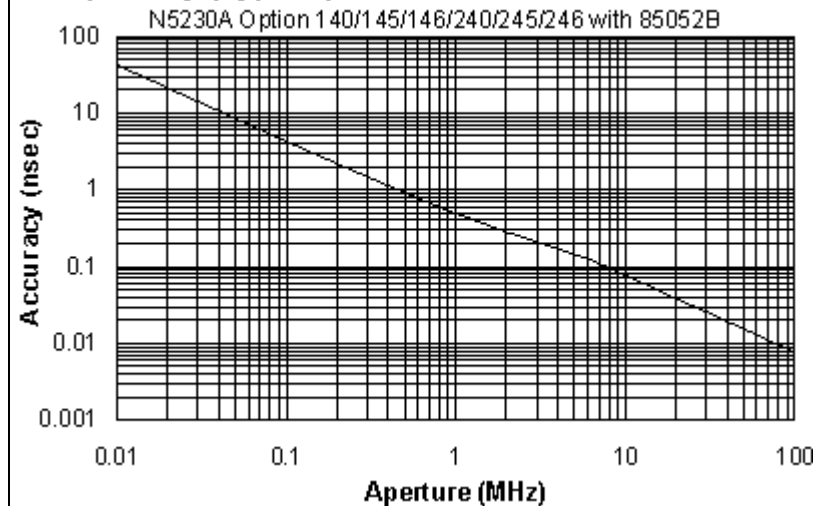
| Description           | Supplemental Information (typ.)                                                      |
|-----------------------|--------------------------------------------------------------------------------------|
| Aperture (selectable) | (frequency span)/(number of points -1)          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

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

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

NOTE: The following graph also applies to the “C” model of the analyzer.

**Group Delay (Typical)**



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

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

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

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

## General Information

**Table 10. Miscellaneous Information**

| Description               | Supplemental Information                   |
|---------------------------|--------------------------------------------|
| System IF Bandwidth Range | 1 Hz to 600 kHz, nominal                   |
| CPU                       | Intel® 1.1 GHz Pentium® M with 1 GByte RAM |

**Table 11. Front Panel Information**

| Description                                                                                                                | Supplemental Information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>RF Connectors</b>                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Type                                                                                                                       | Options 140/145/146/240/245/246: 3.5 mm (male), 50 ohm, (nominal)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Center Pin Recession                                                                                                       | 0.002 in. (characteristic)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Display</b>                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| NOTE: The PNA display must remain in the 16 bit color setting in order to comply with international emissions regulations. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Size                                                                                                                       | 21.3 cm (8.4 in) diagonal color active matrix LCD; 640 (horizontal) X 480 (vertical) resolution                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Refresh Rate                                                                                                               | Vertical 59.83 Hz; Horizontal 31.41 kHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Pixels</b>                                                                                                              | <p>A display is considered faulty if:</p> <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> |
| <b>Display Range</b>                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Magnitude                                                                                                                  | ±500 dB (at 20 dB/div), max                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Phase                                                                                                                      | ±500°, max                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Polar                                                                                                                      | 10 pUnits, min<br>1000 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                                                                                                                      | 0.01 mUnit, min; 0.01°, min                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

**Table 12. Rear Panel Information**

| Description                                                                  | Supplemental Information                                                                                                                                                                                           |
|------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Trigger Inputs/Outputs                                                       | BNC(f), TTL/CMOS compatible                                                                                                                                                                                        |
| <b>10 MHz Reference In</b>                                                   |                                                                                                                                                                                                                    |
| Connector                                                                    | BNC, female                                                                                                                                                                                                        |
| Input Frequency                                                              | 10 MHz $\pm$ 10 ppm, Typical                                                                                                                                                                                       |
| Input Level                                                                  | -15 dBm to +20 dBm, Typical                                                                                                                                                                                        |
| Input Impedance                                                              | 200 $\Omega$ , nom.                                                                                                                                                                                                |
| <b>10 MHz Reference Out</b>                                                  |                                                                                                                                                                                                                    |
| Connector                                                                    | BNC, female                                                                                                                                                                                                        |
| Output Frequency                                                             | 10 MHz $\pm$ 1 ppm, Typical                                                                                                                                                                                        |
| Signal Type                                                                  | Sine Wave, Typical                                                                                                                                                                                                 |
| Output Level                                                                 | +10 dBm $\pm$ 4 dB into 50 $\Omega$ , Typical                                                                                                                                                                      |
| Output Impedance                                                             | 50 $\Omega$ , nominal                                                                                                                                                                                              |
| Harmonics                                                                    | <-40 dBc, Typical                                                                                                                                                                                                  |
| <b>VGA Video Output</b>                                                      |                                                                                                                                                                                                                    |
| Connector                                                                    | 15-pin mini D-Sub; Drives VGA compatible monitors                                                                                                                                                                  |
| <b>Devices Supported</b>                                                     | <b>Resolutions:</b>                                                                                                                                                                                                |
| Flat Panel (TFT)                                                             | 1024 X 768, 800 X 600, 640 X 480                                                                                                                                                                                   |
| Flat Panel (DSTN)                                                            | 800 X 600, 640 X 480                                                                                                                                                                                               |
| CRT Monitor                                                                  | 1280 X 1024, 1024 X 768, 800 X 600, 640 X 480                                                                                                                                                                      |
|                                                                              | Simultaneous operation of the internal and external displays is allowed, but with 640 X 480 resolution only. If you change resolution, you can only view the external display (internal display will "white out"). |
| <b>Test Set IO</b>                                                           |                                                                                                                                                                                                                    |
|                                                                              | 25-pin D-Sub connector, female, available for external test set control                                                                                                                                            |
| <b>Aux IO</b>                                                                |                                                                                                                                                                                                                    |
|                                                                              | 25-pin D-Sub connector, male, analog and digital IO                                                                                                                                                                |
| <b>Handler IO</b>                                                            |                                                                                                                                                                                                                    |
|                                                                              | 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 female.                                                                      |
| <b>GPIB (two ports - dedicated controller and dedicated talker/listener)</b> |                                                                                                                                                                                                                    |
|                                                                              | 24-pin D-sub (Type D-24), female; compatible with IEEE-488.                                                                                                                                                        |
| <b>Parallel Port (LPT1)</b>                                                  |                                                                                                                                                                                                                    |
|                                                                              | 25-pin D-Sub miniature connector, female; provides connection to printers or any other parallel port peripherals                                                                                                   |
| <b>Serial Port (COM 1)</b>                                                   |                                                                                                                                                                                                                    |
|                                                                              | 9-pin D-Sub, male; compatible with RS-232                                                                                                                                                                          |
| <b>USB Port</b>                                                              |                                                                                                                                                                                                                    |
|                                                                              | One port on front panel and five ports on rear panel. Universal Serial Bus jack, Type A configuration (4 contacts inline, contact 1 on left); female                                                               |
| Contact 1                                                                    | Vcc: 4.75 to 5.25 VDC, 500 mA, maximum                                                                                                                                                                             |
| Contact 2                                                                    | -Data                                                                                                                                                                                                              |
| Contact 3                                                                    | +Data                                                                                                                                                                                                              |
| Contact 4                                                                    | Ground                                                                                                                                                                                                             |
| <b>LAN</b>                                                                   |                                                                                                                                                                                                                    |
|                                                                              | 10/100BaseT Ethernet, 8-pin configuration; auto selects between the two data rates                                                                                                                                 |

| Line Power         |                                                                                            |
|--------------------|--------------------------------------------------------------------------------------------|
| Frequency, Voltage | 50/60/400 Hz for 100 – 120 V<br>50/60 Hz for 220 – 240 V<br>Power supply is auto switching |
| Max                | 350 watts                                                                                  |

**Note:** Option H08 and Option H11 are not available with the N5230A/C network analyzer.

**Table 13. Analyzer Dimensions and Weight**

| Description                                                                 | Supplemental Information |                    |                    |
|-----------------------------------------------------------------------------|--------------------------|--------------------|--------------------|
| Cabinet Dimensions                                                          |                          |                    |                    |
|                                                                             | Height                   | Width              | Depth              |
| Excluding front and rear panel hardware and feet                            | 267 mm<br>10.5 in        | 426 mm<br>16.75 in | 427 mm<br>16.8 in  |
| As shipped - includes front panel connectors, rear panel bumpers, and feet. | 280 mm<br>11.0 in        | 435 mm<br>17.1 in  | 470 mm<br>18.5 in  |
| As shipped plus handles                                                     | 280 mm<br>11.0 in        | 458 mm<br>18 in    | 501 mm<br>19.7 in  |
| As shipped plus rack-mount flanges                                          | 280 mm<br>11.0 in        | 483 mm<br>19 in    | 470 mm<br>18.5 in  |
| As shipped plus handles and rack-mount flanges                              | 280 mm<br>11.0 in        | 483 mm<br>19 in    | 501 mm<br>19.70 in |
| Weight                                                                      |                          |                    |                    |
| Net                                                                         | 24.9 kg (55 lb), nominal |                    |                    |
| Shipping                                                                    | 36.3 kg (80 lb), nominal |                    |                    |

**Note:** 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

**Table 14 Typical Cycle Time<sup>a</sup> (ms) for Measurement Completion**

| Description                                      | Typical Performance     |         |         |         |          |                 |     |     |      |        |
|--------------------------------------------------|-------------------------|---------|---------|---------|----------|-----------------|-----|-----|------|--------|
|                                                  | Options 140/145/240/245 |         |         |         |          | Options 146/246 |     |     |      |        |
|                                                  | Number of Points        |         |         |         |          |                 |     |     |      |        |
|                                                  | 201                     | 401     | 801     | 1601    | 16,001   | 201             | 401 | 801 | 1601 | 16,001 |
| Start 8 GHz, Stop 18 GHz, 600 kHz IF bandwidth   |                         |         |         |         |          |                 |     |     |      |        |
| Uncorrected                                      | 21.148                  | 21.743  | 23.01   | 25.198  | 54.836   |                 |     |     |      |        |
| 4-Port cal                                       | 74.597                  | 82.296  | 296.5   | 307.75  | 538.646  |                 |     |     |      |        |
| Start 300 kHz, Stop 10 GHz, 600 kHz IF bandwidth |                         |         |         |         |          |                 |     |     |      |        |
| Uncorrected                                      | 19.814                  | 22.801  | 24.973  | 29.01   | 67.733   |                 |     |     |      |        |
| 4-Port cal                                       | 69.752                  | 85.111  | 100.125 | 129.347 | 480.711  |                 |     |     |      |        |
| Start 300 kHz, Stop 20 GHz, 600 kHz IF bandwidth |                         |         |         |         |          |                 |     |     |      |        |
| Uncorrected                                      | 32.575                  | 34.7    | 39.237  | 43.155  | 69.625   |                 |     |     |      |        |
| 4-Port cal                                       | 121.254                 | 133.626 | 157.506 | 179.223 | 487.779  |                 |     |     |      |        |
| Start 8 GHz, Stop 18 GHz, 100 kHz IF bandwidth   |                         |         |         |         |          |                 |     |     |      |        |
| Uncorrected                                      | 38.083                  | 51.816  | 55.488  | 56.36   | 184.154  |                 |     |     |      |        |
| 4-Port cal                                       | 143.271                 | 201.814 | 215.056 | 230.133 | 934.161  |                 |     |     |      |        |
| Start 300 kHz, Stop 10 GHz, 100 kHz IF bandwidth |                         |         |         |         |          |                 |     |     |      |        |
| Uncorrected                                      | 37.03                   | 42.532  | 45.122  | 46.729  | 198.683  |                 |     |     |      |        |
| 4-Port cal                                       | 137.431                 | 162.37  | 194.13  | 192.182 | 906.768  |                 |     |     |      |        |
| Start 300 kHz, Stop 20 GHz, 100 kHz IF bandwidth |                         |         |         |         |          |                 |     |     |      |        |
| Uncorrected                                      | 44.98                   | 69.408  | 87.161  | 92.475  | 198.792  |                 |     |     |      |        |
| 4-Port cal                                       | 169.041                 | 268.877 | 343.898 | 369.526 | 914.963  |                 |     |     |      |        |
| Start 8 GHz, Stop 18 GHz, 50 kHz IF bandwidth    |                         |         |         |         |          |                 |     |     |      |        |
| Uncorrected                                      | 42.171                  | 70.09   | 88.702  | 90.981  | 371.611  |                 |     |     |      |        |
| 4-Port cal                                       | 157.107                 | 271.791 | 351.517 | 368.02  | 1532.609 |                 |     |     |      |        |
| Start 300 kHz, Stop 10 GHz, 50 kHz IF bandwidth  |                         |         |         |         |          |                 |     |     |      |        |
| Uncorrected                                      | 43.713                  | 61.41   | 66.878  | 69.373  | 385.04   |                 |     |     |      |        |
| 4-Port cal                                       | 163.58                  | 238.267 | 259.687 | 279.816 | 1580.761 |                 |     |     |      |        |
| Start 300 kHz, Stop 20 GHz, 50 kHz IF bandwidth  |                         |         |         |         |          |                 |     |     |      |        |
| Uncorrected                                      | 48.673                  | 80.798  | 124.605 | 147.303 | 388.46   |                 |     |     |      |        |
| 4-Port cal                                       | 184.429                 | 313.392 | 493.142 | 587.548 | 1587.839 |                 |     |     |      |        |

<sup>a</sup> 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 15. Cycle Time vs. IF Bandwidth, Options 140/145/240/245**

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

- CF = 10 GHz
- Span = 100 MHz
- Test Port Power = 6 dBm
- Display off (add 21 ms for display on)

| Description | Typical Performance          |             |
|-------------|------------------------------|-------------|
|             | Cycle Time (ms) <sup>a</sup> | Trace Noise |
| 600,000     | 3.13                         | 0.00544     |
| 360,000     | 3.21                         | 0.00602     |
| 280,000     | 3.17                         | 0.00321     |
| 200,000     | 3.17                         | 0.00259     |
| 150,000     | 3.19                         | 0.00207     |
| 100,000     | 4.05                         | 0.00155     |
| 70,000      | 4.99                         | 0.00144     |
| 50,000      | 6.41                         | 0.00121     |
| 30,000      | 8.78                         | 0.00094     |
| 20,000      | 12.07                        | 0.00080     |
| 15,000      | 14.91                        | 0.00069     |
| 10,000      | 26.02                        | 0.00052     |
| 7000        | 34.54                        | 0.00047     |
| 5000        | 45.87                        | 0.00044     |
| 3000        | 69.91                        | 0.00032     |
| 2000        | 99.69                        | 0.00029     |
| 1500        | 128.18                       | 0.00010     |
| 1000        | 215.62                       | 0.00009     |
| 700         | 291.58                       | 0.00006     |
| 500         | 397.36                       | 0.00007     |
| 300         | 633.86                       | 0.00000     |
| 200         | 930.15                       | 0.00000     |
| 100         | 1824.19                      | 0.00000     |
| 30          | 6001.70                      | 0.00000     |
| 10          | 17899.79                     | 0.00000     |
| 1           | 178391.58                    | 0.00000     |

<sup>a</sup> Cycle time includes sweep and retrace time.

**Table 16. Cycle Time vs. Number of Points, Options 140/145/240/245**

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

- CF = 10 GHz
- Span = 100 MHz
- Test Port Power = 7 dBm
- Display off (add 21 ms for display on)

| Description       | Typical Performance |                              |
|-------------------|---------------------|------------------------------|
| IF Bandwidth (Hz) | Number of Points    | Cycle Time (ms) <sup>a</sup> |
| 30,000            | 3                   | 2.88                         |
|                   | 11                  | 3.50                         |
|                   | 51                  | 3.91                         |
|                   | 101                 | 5.29                         |
|                   | 201                 | 8.75                         |
|                   | 401                 | 15.66                        |
|                   | 801                 | 29.46                        |
|                   | 1,601               | 57.73                        |
|                   | 6,401               | 221.04                       |
|                   | 16,001              | 549.71                       |
| 100,000           | 3                   | 2.87                         |
|                   | 11                  | 2.82                         |
|                   | 51                  | 2.86                         |
|                   | 101                 | 2.96                         |
|                   | 201                 | 4.02                         |
|                   | 401                 | 6.23                         |
|                   | 801                 | 10.65                        |
|                   | 1,601               | 19.49                        |
|                   | 6,401               | 70.96                        |
|                   | 16,001              | 173.78                       |
| 600,000           | 3                   | 2.84                         |
|                   | 11                  | 2.84                         |
|                   | 51                  | 2.87                         |
|                   | 101                 | 3.03                         |
|                   | 201                 | 3.14                         |
|                   | 401                 | 3.51                         |
|                   | 801                 | 4.22                         |
|                   | 1,601               | 6.22                         |
|                   | 6,401               | 19.35                        |
|                   | 16,001              | 45.12                        |

<sup>a</sup> Cycle time includes sweep and retrace time.

**Table 17. Data Transfer Time (ms)**

| Description                                   | Typical Performance |     |      |        |
|-----------------------------------------------|---------------------|-----|------|--------|
|                                               | Number of Points    |     |      |        |
|                                               | 201                 | 401 | 1601 | 16,001 |
| <b>SCPI over GPIB</b>                         |                     |     |      |        |
| (Program executed on external PC)             |                     |     |      |        |
| 32-bit floating point                         | 6                   | 10  | 33   | 313    |
| 64-bit floating point                         | 10                  | 18  | 65   | 622    |
| ASCII                                         | 53                  | 105 | 406  | 4032   |
| <b>SCPI over SICT/LAN or TCP/IP Socket</b>    |                     |     |      |        |
| (Program executed in the analyzer)            |                     |     |      |        |
| 32-bit floating point                         | 1                   | 2   | 2.5  | 7      |
| 64-bit floating point                         | 2                   | 2   | 3    | 10     |
| ASCII                                         | 11                  | 20  | 73   | 720    |
| <b>COM (program executed in the analyzer)</b> |                     |     |      |        |
| 32-bit floating point                         | <0.2                | 0.2 | 0.3  | 0.9    |
| Variant type                                  | 0.6                 | 1   | 3.2  | 32     |
| <b>DCOM over LAN</b>                          |                     |     |      |        |
| (Program executed on external PC)             |                     |     |      |        |
| 32-bit floating point                         | <0.8                | 1   | 1.6  | 7.5    |
| Variant type                                  | 1.9                 | 3   | 8.9  | 82     |

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**Note:** Specifications for Recall & Sweep Speed are not provided for the N5230A/C analyzers.

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## Specifications: Front-Panel Jumpers

Model N5230A/C Option 145/146/245/246

**Table 18: Measurement Receiver Inputs**

(Rcvr A In, Rcvr B In, Rcvr C In, Rcvr D In) 0.1dB Typical Compression

| Description                | Specification | Typical             |
|----------------------------|---------------|---------------------|
|                            |               | Opt 145/146/245/246 |
| <b>Maximum Input Level</b> |               |                     |
| 300 kHz to 10 MHz          | --            | - 11 dBm            |
| 10 MHz to 1 GHz            | --            | - 7 dBm             |
| 1 GHz to 12.5 GHz          | --            | - 6 dBm             |
| 12.5 GHz to 13.5 GHz       | --            | - 7 dBm             |
| 13.5 GHz to 20 GHz         | --            | - 7 dBm             |
| <b>Damage Level</b>        |               |                     |
| N5230A/C                   | --            | + 15 dBm            |
| <b>Maximum DC Level</b>    |               |                     |
| N5230A/C                   | --            | +/- 16 V            |

**Table 19: Reference Receiver Input (Rcvr In)**

@ Max Specified Output Power

| Description          | Specification | Typical         |                 |
|----------------------|---------------|-----------------|-----------------|
|                      |               | Option 145, 245 | Option 146, 246 |
| Maximum Input Level  |               |                 |                 |
| 300 kHz to 10 MHz    | --            | - 18 dBm        | - 28 dBm        |
| 10 MHz to 45 MHz     | --            | - 15 dBm        | - 25 dBm        |
| 45 MHz to 500 MHz    | --            | - 15 dBm        | - 25 dBm        |
| 500 MHz to 4 GHz     | --            | - 15 dBm        | - 26 dBm        |
| 4 GHz to 6 GHz       | --            | - 16 dBm        | - 27 dBm        |
| 6 GHz to 10.5 GHz    | --            | - 20 dBm        | - 30 dBm        |
| 10.5 GHz to 13.5 GHz | --            | - 21 dBm        | - 32 dBm        |
| 13.5 GHz to 15 GHz   | --            | - 21 dBm        | - 32 dBm        |
| 15 GHz to 20 GHz     | --            | - 27 dBm        | - 38 dBm        |
| Damage Level         |               |                 |                 |
| N5230A/C             | --            | + 15 dBm        | + 15 dBm        |
| Maximum DC Level     |               |                 |                 |
| N5230A/C             | --            | +/- 16 V        | +/- 16 V        |

**Table 20: Reference Output (Source Out)**

@ Max Specified Output Power

| Description          | Specification | Typical     |             |
|----------------------|---------------|-------------|-------------|
|                      |               | Opt 145/245 | Opt 146/246 |
| Maximum Output Level |               |             |             |
| 300 kHz to 10 MHz    | --            | - 18 dBm    | - 28 dBm    |
| 10 MHz to 45 MHz     | --            | - 15 dBm    | - 25 dBm    |
| 45 MHz to 500 MHz    | --            | - 15 dBm    | - 25 dBm    |
| 500 MHz to 4 GHz     | --            | - 15 dBm    | - 26 dBm    |
| 4 GHz to 6 GHz       | --            | - 15 dBm    | - 26 dBm    |
| 6 GHz to 10.5 GHz    | --            | - 20 dBm    | - 30 dBm    |
| 10.5 GHz to 13.5 GHz | --            | - 21 dBm    | - 32 dBm    |
| 13.5 GHz to 15 GHz   | --            | - 21 dBm    | - 32 dBm    |
| 15 GHz to 20 GHz     | --            | - 27 dBm    | - 38 dBm    |
| Damage Level         |               |             |             |
| N5230A/C             | --            | + 27 dBm    | + 27 dBm    |
| Maximum DC Level     |               |             |             |
| N5230A/C             | --            | +/- 16 V    | +/- 16 V    |

**Table 21: Source Outputs**

(Port 1 Source Out, Port 2 Source Out, Port 3 Source Out, Port 4 Source Out) @ Max Specified Output Power

| Description          | Specification | Typical             |
|----------------------|---------------|---------------------|
|                      |               | Opt 145/146/245/246 |
| Maximum Output Level |               |                     |
| 300 kHz to 10 MHz    | --            | +7 dBm              |
| 10 MHz to 45 MHz     | --            | + 10 dBm            |
| 45 MHz to 500 MHz    | --            | + 10 dBm            |
| 500 MHz to 4 GHz     | --            | + 10 dBm            |
| 4 GHz to 6 GHz       | --            | + 9 dBm             |
| 6 GHz to 10.5 GHz    | --            | + 4 dBm             |
| 10.5 GHz to 13.5 GHz | --            | + 1 dBm             |
| 13.5 GHz to 15 GHz   | --            | + 1 dBm             |
| 15 GHZ to 20 GHz     | --            | - 4 dBm             |
| Damage Level         |               |                     |
| N5230A/C             | --            | + 27 dBm            |
| Maximum DC Level     |               |                     |
| N5230A/C             | --            | +/- 16V             |

**Table 22: Coupler Inputs**

(Port 1 Cplr Thru, Port 2 Cplr Thru, Port 3 Cplr Thru, Port 4 Cplr Thru) Insertion Loss of Coupler Thru

| Description                        | Specification | Typical             |
|------------------------------------|---------------|---------------------|
|                                    |               | Opt 145/146/245/246 |
| <b>Insertion Loss to Test Port</b> |               |                     |
| 300 kHz to 10 MHz                  | --            | 1.5 dB              |
| 10 MHz to 45 MHz                   | --            | 1.5 dB              |
| 45 MHz to 500 MHz                  | --            | 1.5 dB              |
| 500 MHz to 4 GHz                   | --            | 2.0 dB              |
| 4 GHz to 6 GHz                     | --            | 2.5 dB              |
| 6 GHz to 10.5 GHz                  | --            | 2.5 dB              |
| 10.5 GHz to 13.5 GHz               | --            | 3.0 dB              |
| 13.5 GHz to 15 GHz                 | --            | 3.0 dB              |
| 15 GHz to 20 GHz                   | --            | 3.0 dB              |
| <b>Damage Level</b>                |               |                     |
| N5230A/C                           | --            | + 27 dBm            |
| <b>Maximum DC Level</b>            |               |                     |
| N5230A/C                           | --            | +/- 16 V            |

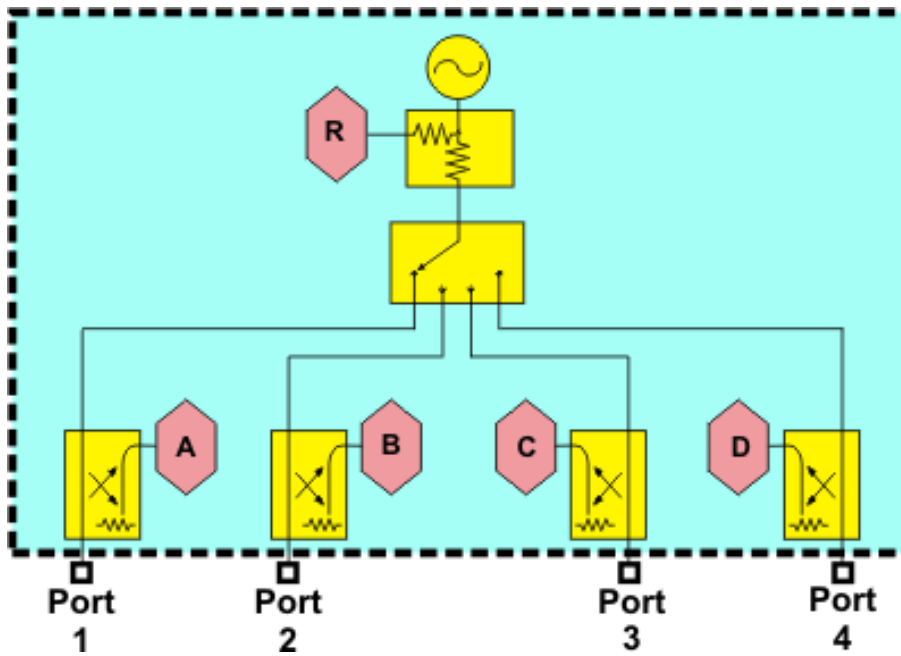
**Table 23: Coupler Outputs**

(Port 1 Cplr Arm, Port 2 Cplr Arm, Port 3 Cplr Arm, Port 4 Cplr Arm)

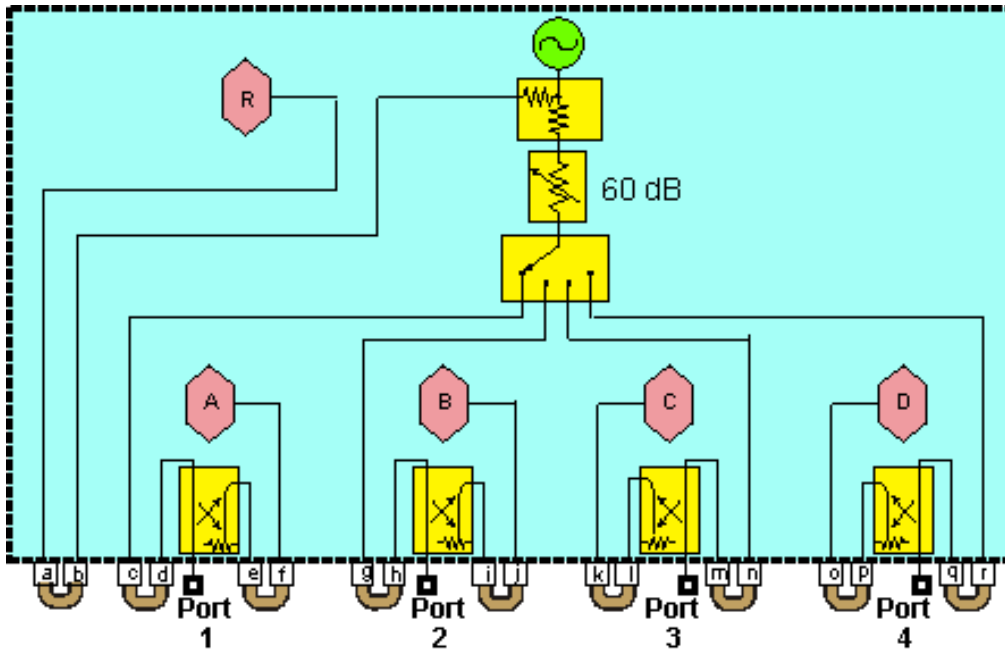
| Description             | Specification | Typical             |
|-------------------------|---------------|---------------------|
|                         |               | Opt 145/146/245/246 |
| <b>Damage Level</b>     |               |                     |
| N5230A/C                | --            | + 15 dBm            |
| <b>Maximum DC Level</b> |               |                     |
| N5230A/C                | --            | 0 V                 |

## Test Set Block Diagrams

N5230A/C Option 140 or 240 Standard Test Set and Standard Power Range

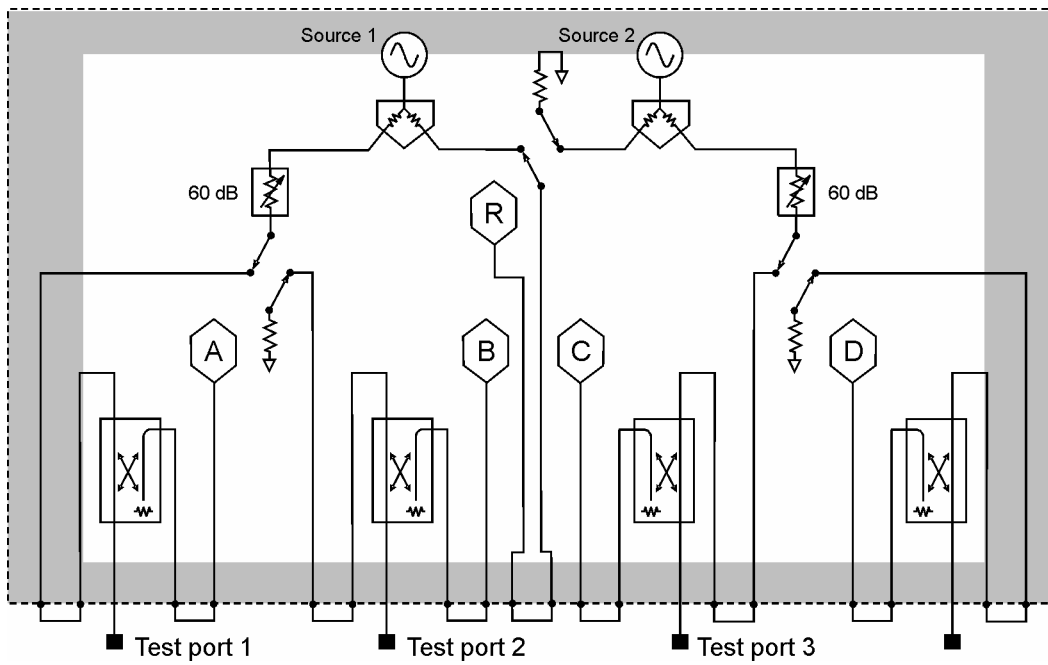


## N5230A/C Option 145 or 245 Configurable Test Set and Extended Power Range



| Item | Description | Item | Description | Item | Description |
|------|-------------|------|-------------|------|-------------|
| a    | RCVR R IN   | h    | CPLR THRU   | o    | RCVR D IN   |
| b    | SOURCE OUT  | i    | CPLR ARM    | p    | CPLR ARM    |
| c    | SOURCE OUT  | j    | RCVR B IN   | q    | CPLR THRU   |
| d    | CPLR THRU   | k    | RCVR C IN   | r    | SOURCE OUT  |
| e    | CPLR ARM    | l    | CPLR ARM    |      |             |
| f    | RCVR A IN   | m    | CPLR THRU   |      |             |
| g    | SOURCE OUT  | n    | SOURCE OUT  |      |             |

## N5230A/C Option 146 or 246 Configurable Test Set and Extended Power Range





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