

ENA Series Vector Network Analyzer

E5080B: 9 kHz to 53 GHz, 2/4-port

Introduction

As devices become highly integrated, complete characterization requires a complete RF and microwave measurement solution. The E5080B brings R&D performance up to 53 GHz and flexibility to a midrange platform. Best-in-class dynamic range, trace noise, and temperature stability guarantee reliability and repeatability. Test consistently across your entire workflow with the same UI and SCPI commands as high-end PNAs.

The E5080B enables complete device characterization for passive components, amplifiers, mixers, and frequency converters. You can perform more tests with one box with integrated features such as DC sources, bias tees, pulse generators, pulse modulators, and internal second source. Gain deeper insights with software applications including spectrum analysis, mixer measurements, and noise figure. Choose from a 2- or 4-port option with frequency coverage from 9 kHz up to 20 GHz or for higher frequencies, 100 kHz up to 53 GHz.

The E5080B utilizes the same measurement science as other Keysight vector network analyzers (VNAs) such as the PNA, PXI, and Streamline Series VNA. A common software platform makes it easy to choose the right level of performance to match budget and measurement needs. This commonality guarantees measurement consistency, repeatability, and a common remote-programming interface across multiple instruments in R&D and manufacturing.



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Definition

Specification (spec)¹

Warranted performance. Specifications include guardbands to account for the expected statistical performance distribution, measurement uncertainties, and changes in performance due to environmental conditions. All specifications and characteristics apply over a $25\text{ °C} \pm 5\text{ °C}$ (unless otherwise stated).

The following conditions must be met:

- Instrument has been turned on for 90 minutes with VNA application running.
- Instrument is within its calibration cycle.
- Instrument remains at a stable surrounding environment temperature (between 0 °C to 40 °C) for 60 minutes prior to turn-on.

Characteristics (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 at a stable temperature between $25\text{ °C} \pm 5\text{ °C}$ for 60 minutes prior to turn-on and during operation; does not include guardbands. It is not covered by the product warranty. The instrument must be within its calibration cycle.

Nominal (nom.)

A general, descriptive term or design parameter. It is not tested, and not covered by the product warranty.

Supplemental Information

A performance parameter that is tested on sampled product during design validation. It does not include guardbands and is not covered by the product warranty.

Calibration

The process of measuring known standards to characterize an instrument'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.

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

Dynamic Range

The specifications in this section apply to measurements made with the Keysight E5080B ENA Series vector network analyzer under the following conditions:

- 10 Hz IF bandwidth
- No averaging applied to data
- Does not include crosstalk effects

Table 1. System dynamic range at test port (dB) ¹

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 without bias tee options (Option 120 or 140)

| Description | Specification | Typical |
|-------------------------------|---------------|---------|
| 9 kHz to 100 kHz | 101 | 111 |
| 100 kHz to 300 kHz | 117 | 126 |
| 300 kHz to 1 MHz | 125 | 136 |
| 1 MHz to 10 MHz | 130 | 141 |
| 10 MHz to 50 MHz ² | 137 | 147 |
| 50 MHz to 3 GHz | 140 | 150 |
| 3 GHz to 5 GHz | 140 | 149 |
| 5 GHz to 6.5 GHz | 140 | 148 |
| 6.5 GHz to 9 GHz | 136 | 146 |
| 9 GHz to 14 GHz | 133 | 142 |
| 14 GHz to 16 GHz | 130 | 140 |
| 16 GHz to 20 GHz | 126 | 137 |

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 with bias tee options (Option 120 or 140)

| Description | Specification | Typical |
|-------------------------------|---------------|---------|
| 9 kHz to 100 kHz | 99 | 110 |
| 100 kHz to 300 kHz | 116 | 125 |
| 300 kHz to 1 MHz | 124 | 135 |
| 1 MHz to 10 MHz | 129 | 140 |
| 10 MHz to 50 MHz ² | 136 | 146 |
| 50 MHz to 2 GHz | 138 | 150 |
| 2 GHz to 3 GHz | 138 | 148 |
| 3 GHz to 4.5 GHz | 138 | 147 |
| 4.5 GHz to 6.5 GHz | 136 | 145 |
| 6.5 GHz to 9 GHz | 133 | 144 |
| 9 GHz to 14 GHz | 130 | 140 |
| 14 GHz to 16 GHz | 126 | 137 |
| 16 GHz to 20 GHz | 121 | 133 |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2

| Description | Specification | Typical |
|-------------------------------|---------------|---------|
| 100 kHz to 300 kHz | 95 | 106 |
| 300 kHz to 500 kHz | 104 | 120 |
| 500 kHz to 1 MHz | 117 | 130 |
| 1 MHz to 10 MHz | 125 | 138 |
| 10 MHz to 50 MHz ² | 137 | 147 |
| 50 MHz to 6.5 GHz | 140 | 150 |
| 6.5 GHz to 8 GHz | 138 | 150 |
| 8 GHz to 9 GHz | 138 | 147 |
| 9 GHz to 16 GHz | 137 | 147 |
| 16 GHz to 17 GHz | 137 | 143 |
| 17 GHz to 20 GHz | 132 | 143 |
| 20 GHz to 24 GHz | 130 | 143 |
| 24 GHz to 25 GHz | 130 | 141 |
| 25 GHz to 26 GHz | 127 | 141 |
| 26 GHz to 30 GHz | 127 | 137 |
| 30 GHz to 35 GHz | 122 | 137 |
| 35 GHz to 40 GHz | 122 | 134 |
| 40 GHz to 45 GHz | 122 | 132 |
| 45 GHz to 50 GHz | 99 | 114 |
| 50 GHz to 53 GHz | 71 | 100 |

1. System dynamic range = source maximum output power minus receiver noise floor.

2. It may typically be degraded at 25 MHz.

Corrected System Performance

This section provides specifications for the corrected performance of the E5080B ENA Series VNA using either of 85032F, 85052D, 85058B Mechanical Calibration Kit or N4691D, N4694D Electronic Calibration (ECal) Module. To determine transmission and reflection uncertainty curves with other calibration kits, please download the Uncertainty Calculator from http://www.keysight.com/find/na_calculator to generate the curves for your specific calibration kit.

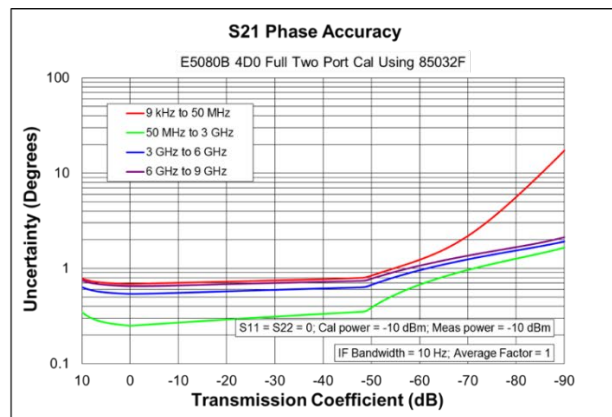
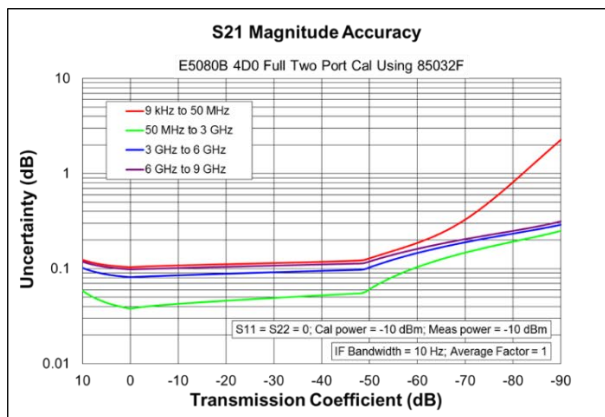
Measured with 10 Hz IF bandwidth, no averaging applied to data, environmental temperature = 23 °C (± 3 °C) with < 1 °C deviation from calibration temperature.

Table 2. E5080B Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 (without bias tee options) with 85032F standard mechanical calibration kit

Corrected error terms (dB) – Specifications

| Description | 9 kHz to 50 MHz | 50 MHz to 3 GHz | 3 GHz to 6 GHz | 6 GHz to 9 GHz |
|-----------------------|-----------------|-----------------|----------------|----------------|
| Directivity | 49 | 46 | 40 | 38 |
| Source match | 41 | 40 | 36 | 35 |
| Load match | 47 | 46 | 40 | 38 |
| Reflection tracking | ± 0.011 | ± 0.021 | ± 0.032 | ± 0.054 |
| Transmission tracking | ± 0.082 | ± 0.021 | ± 0.063 | ± 0.074 |

Transmission uncertainty (magnitude and phase)



Reflection uncertainty (magnitude and phase)

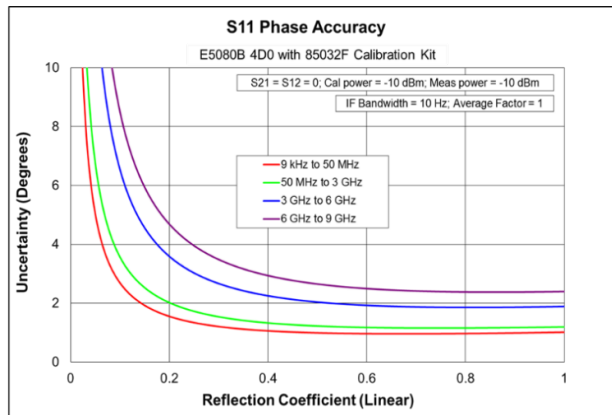
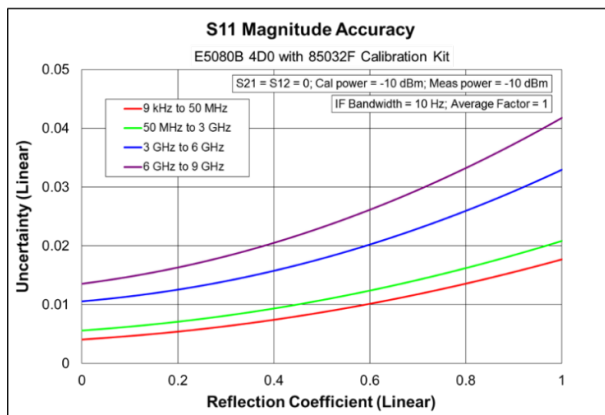
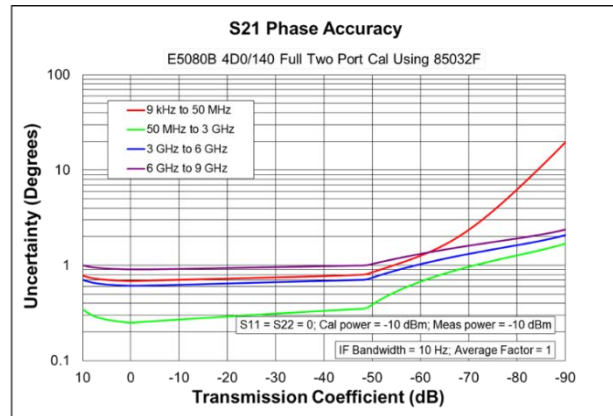
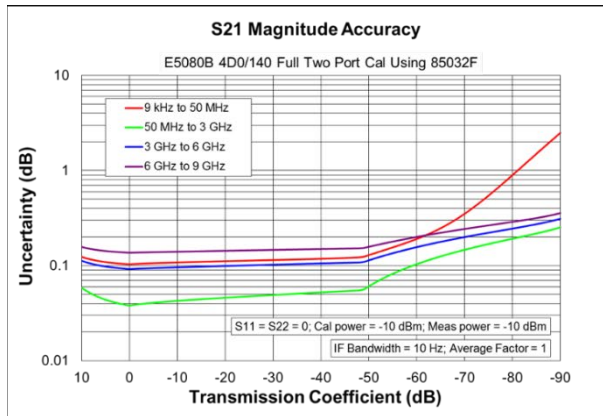


Table 3. E5080B Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 with bias tee options (Option 120 or 140) with 85032F standard mechanical calibration kit

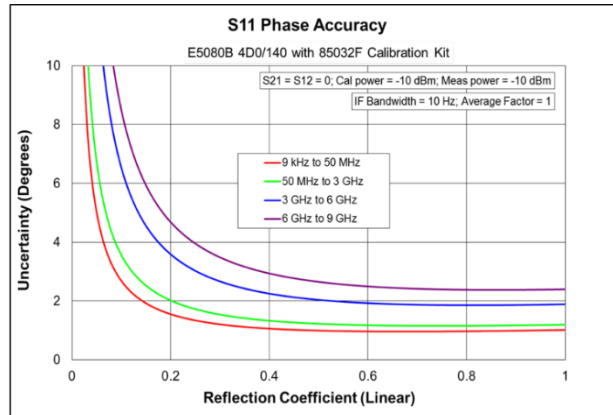
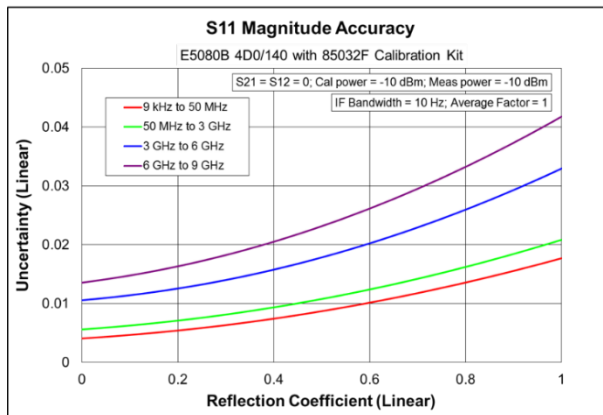
Corrected error terms (dB) – Specifications

| Description | 9 kHz to 50 MHz | 50 MHz to 3 GHz | 3 GHz to 6 GHz | 6 GHz to 9 GHz |
|-----------------------|-----------------|-----------------|----------------|----------------|
| Directivity | 49 | 46 | 40 | 38 |
| Source match | 41 | 40 | 36 | 35 |
| Load match | 47 | 46 | 39 | 36 |
| Reflection tracking | ± 0.011 | ± 0.021 | ± 0.032 | ± 0.054 |
| Transmission tracking | ± 0.082 | ± 0.021 | ± 0.074 | ± 0.113 |

Transmission uncertainty (magnitude and phase)



Reflection uncertainty (magnitude and phase)

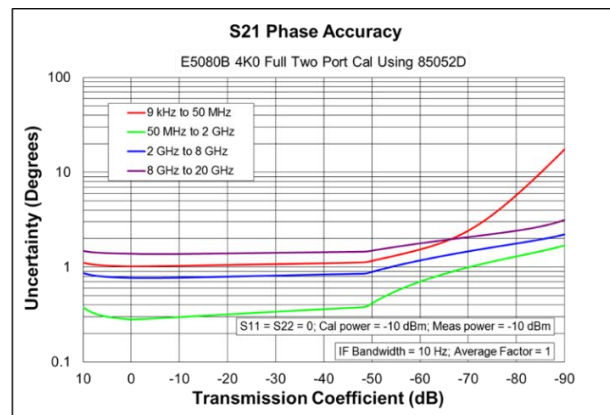
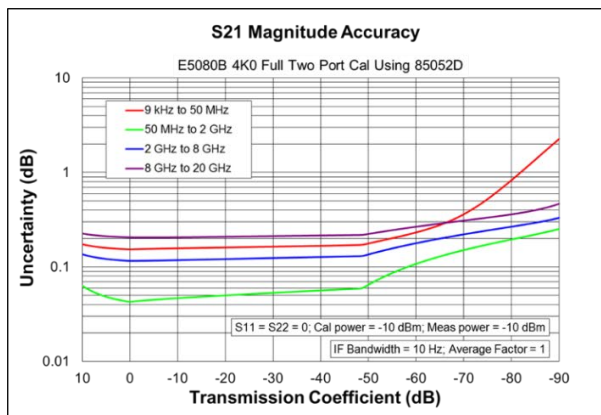


**Table 4. E5080B Option
240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/
4H2/4K2 (without bias tee options) with 85052D economy
mechanical calibration kit**

Corrected error terms (dB) – Specifications

| Description | 9 kHz to 50 MHz | 50 MHz to 2 GHz | 2 GHz to 8 GHz | 8 GHz to 20 GHz |
|-----------------------|-----------------|-----------------|----------------|-----------------|
| Directivity | 42 | 42 | 38 | 36 |
| Source match | 37 | 37 | 31 | 28 |
| Load match | 42 | 42 | 38 | 36 |
| Reflection tracking | ± 0.003 | ± 0.003 | ± 0.004 | ± 0.008 |
| Transmission tracking | ± 0.136 | ± 0.03 | ± 0.1 | ± 0.185 |

Transmission uncertainty (magnitude and phase)



Reflection uncertainty (magnitude and phase)

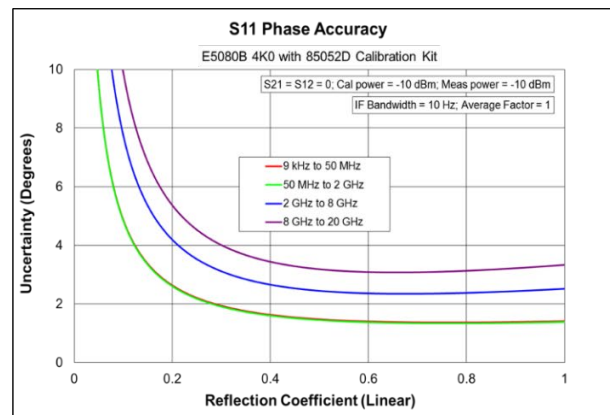
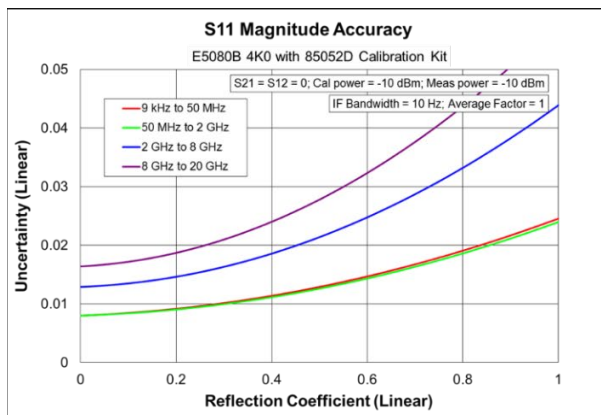
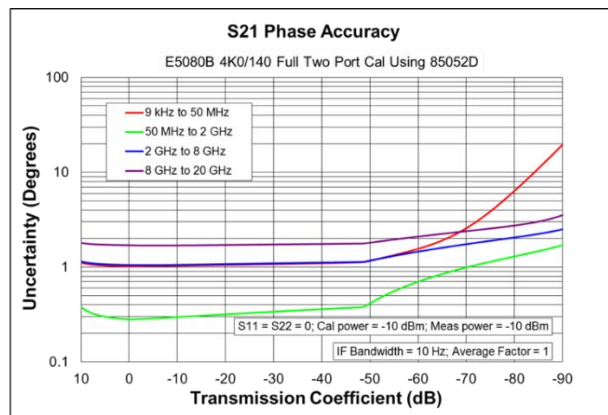
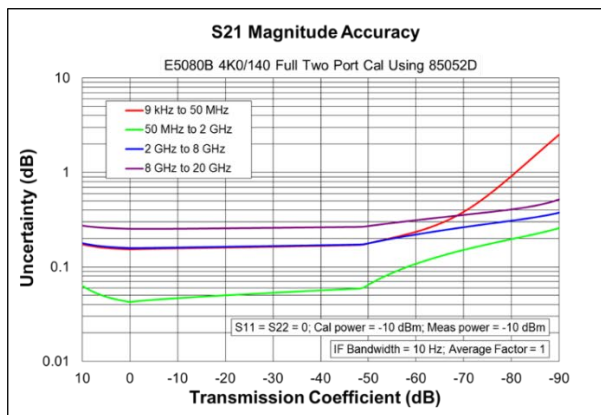


Table 5. E5080B Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 with bias tee options (Option 120 or 140) with 85052D economy mechanical calibration kit

Corrected error terms (dB) – Specifications

| Description | 9 kHz to 50 MHz | 50 MHz to 2 GHz | 2 GHz to 8 GHz | 8 GHz to 20 GHz |
|-----------------------|-----------------|-----------------|----------------|-----------------|
| Directivity | 42 | 42 | 38 | 36 |
| Source match | 37 | 37 | 31 | 28 |
| Load match | 42 | 42 | 38 | 36 |
| Reflection tracking | ± 0.003 | ± 0.003 | ± 0.004 | ± 0.008 |
| Transmission tracking | ± 0.136 | ± 0.03 | ± 0.141 | ± 0.233 |

Transmission uncertainty (magnitude and phase)



Reflection uncertainty (magnitude and phase)

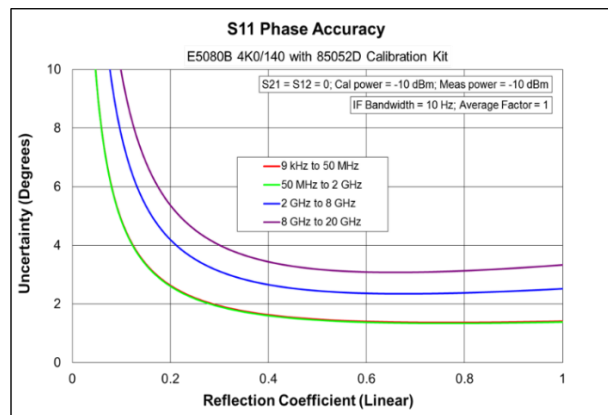
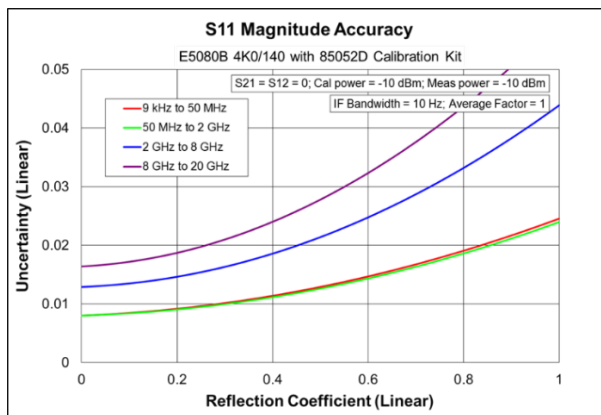
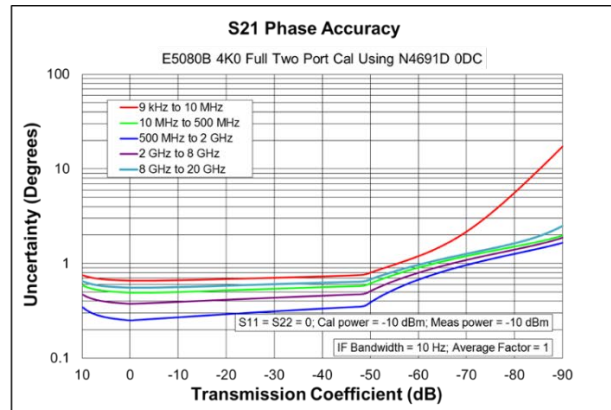
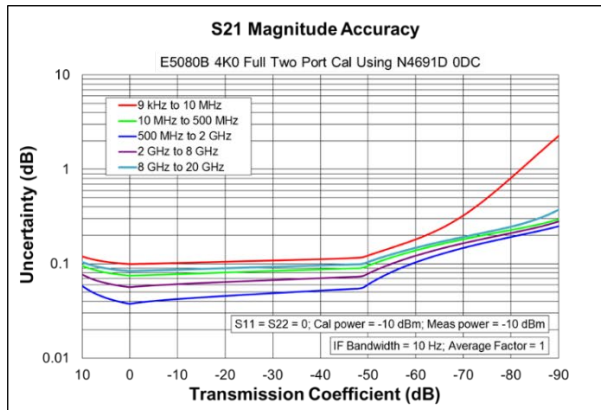


Table 6. E5080B Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 (without bias tee options) with N4691D Electronic Calibration (ECal) module with Option 0DC

Corrected error terms (dB) – Specifications

| Description | 9 kHz to 10 MHz | 10 MHz to 500 MHz | 500 MHz to 2 GHz | 2 GHz to 8 GHz | 8 GHz to 20 GHz |
|-----------------------|-----------------|-------------------|------------------|----------------|-----------------|
| Directivity | 46 | 46 | 47 | 46 | 43 |
| Source match | 41 | 41 | 47 | 45 | 42 |
| Load match | 38 | 40 | 46 | 44 | 40 |
| Reflection tracking | ± 0.05 | ± 0.05 | ± 0.002 | ± 0.03 | ± 0.04 |
| Transmission tracking | ± 0.081 | ± 0.056 | ± 0.026 | ± 0.042 | ± 0.064 |

Transmission uncertainty (magnitude and phase)



Reflection uncertainty (magnitude and phase)

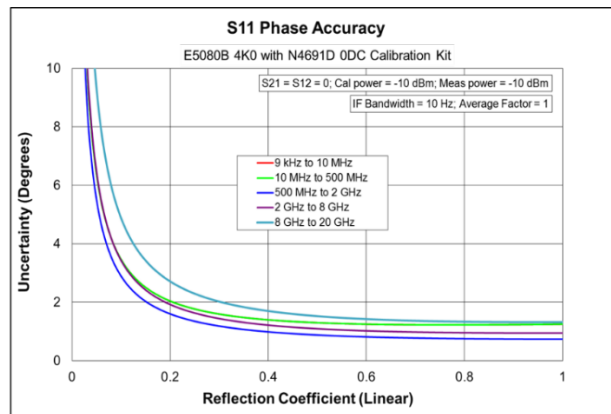
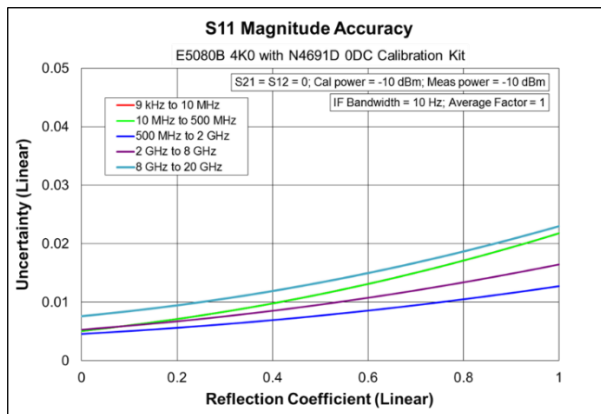
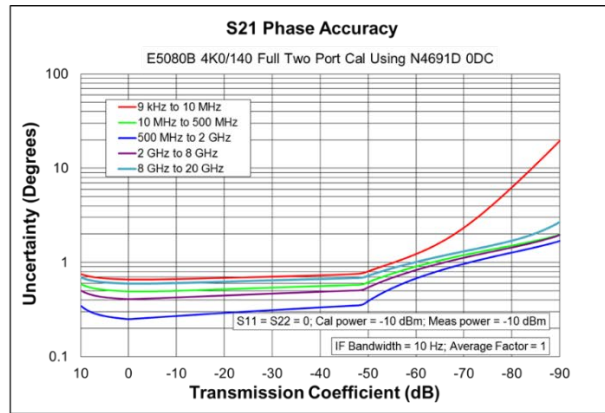
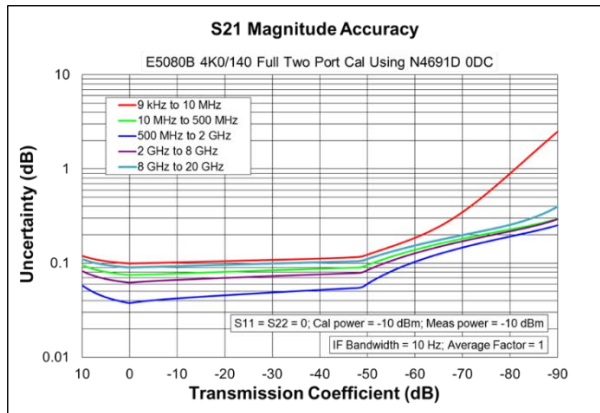


Table 7. E5080B Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 with bias tee options (Option 120 or 140) with N4691D Electronic Calibration (ECal) module with Option 0DC

Corrected error terms (dB) – Specifications

| Description | 9 kHz to 10 MHz | 10 MHz to 500 MHz | 500 MHz to 2 GHz | 2 GHz to 8 GHz | 8 GHz to 20 GHz |
|-----------------------|-----------------|-------------------|------------------|----------------|-----------------|
| Directivity | 46 | 46 | 47 | 46 | 43 |
| Source match | 41 | 41 | 47 | 45 | 42 |
| Load match | 38 | 40 | 46 | 43 | 40 |
| Reflection tracking | ± 0.05 | ± 0.05 | ± 0.002 | ± 0.03 | ± 0.04 |
| Transmission tracking | ± 0.081 | ± 0.058 | ± 0.026 | ± 0.047 | ± 0.071 |

Transmission uncertainty (magnitude and phase)



Reflection uncertainty (magnitude and phase)

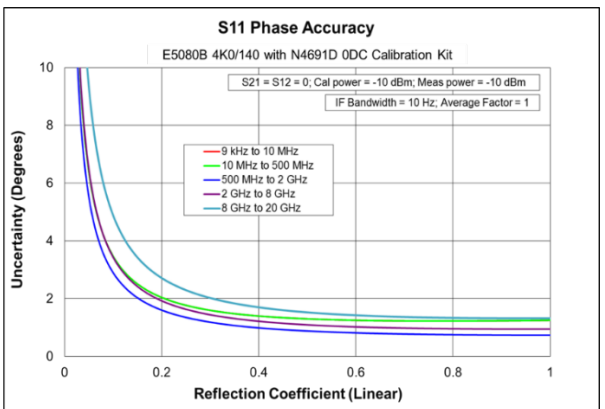
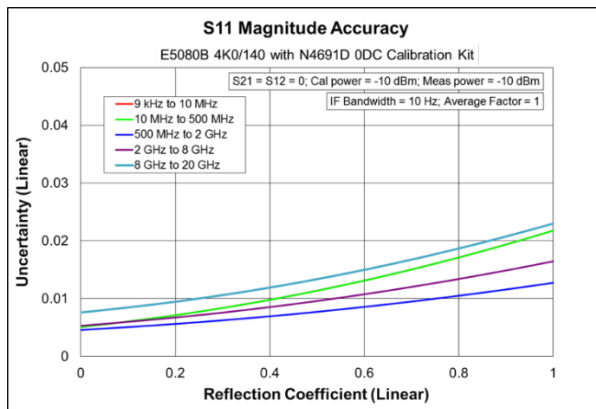
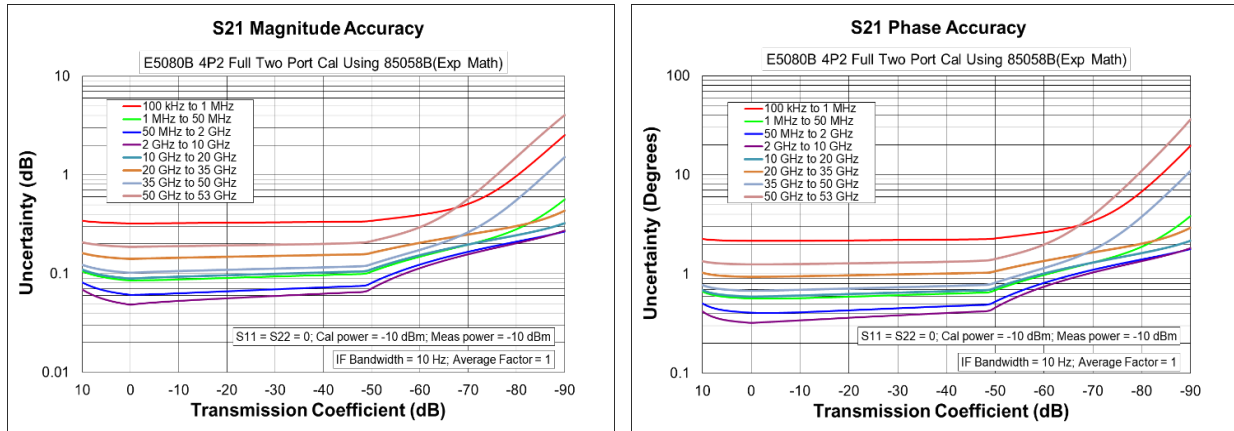


Table 8. E5080B Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2 with 85058B standard mechanical calibration kit

Corrected error terms (dB) – Specifications

| Description | 100 kHz to 1 MHz | 1 MHz to 50 MHz | 50 MHz to 2 GHz | 2 GHz to 10 GHz | 10 GHz to 20 GHz | 20 MHz to 35 GHz | 35 GHz to 50 GHz | 50 GHz to 53 GHz |
|-----------------------|------------------|-----------------|-----------------|-----------------|------------------|------------------|------------------|------------------|
| Directivity | 35 | 35 | 35 | 41 | 38 | 37 | 37 | 34 |
| Source match | 34 | 34 | 34 | 44 | 40 | 41 | 42 | 40 |
| Load match | 34 | 35 | 35 | 41 | 37 | 36 | 36 | 33 |
| Reflection tracking | ± 0.019 | ± 0.019 | ± 0.019 | ± 0.01 | ± 0.033 | ± 0.033 | ± 0.02 | ± 0.03 |
| Transmission tracking | ± 0.302 | ± 0.065 | ± 0.046 | ± 0.033 | ± 0.073 | ± 0.122 | ± 0.079 | ± 0.154 |

Transmission uncertainty (magnitude and phase)



Reflection uncertainty (magnitude and phase)

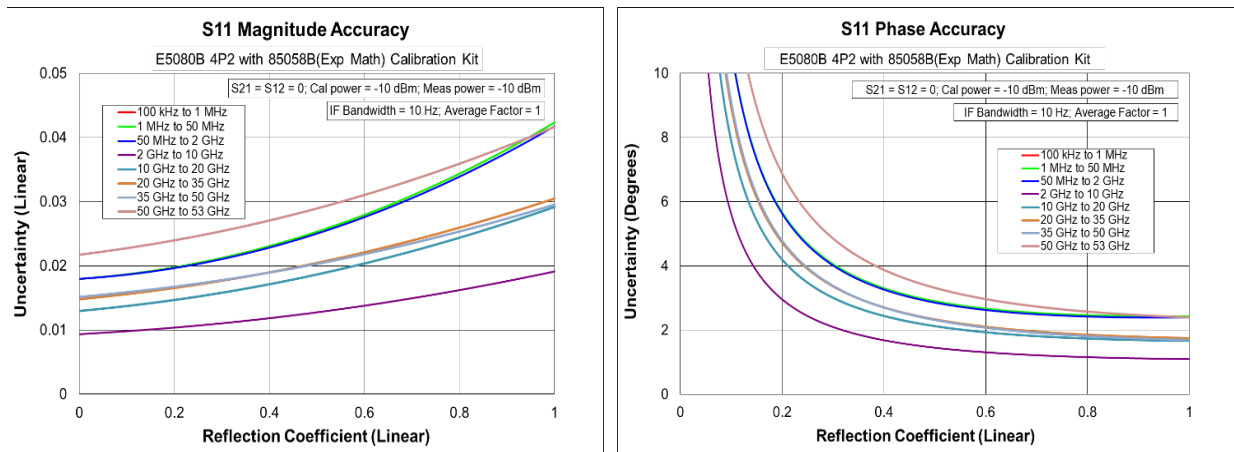
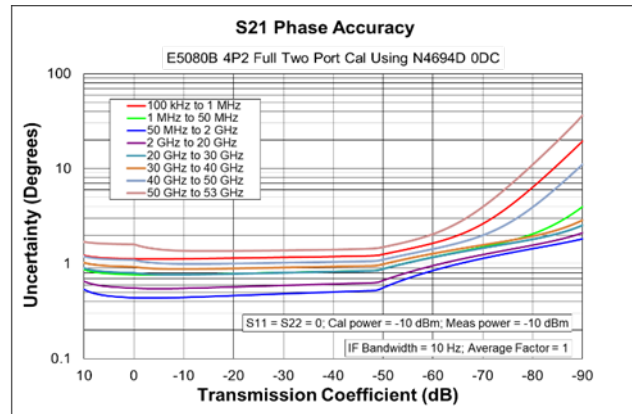
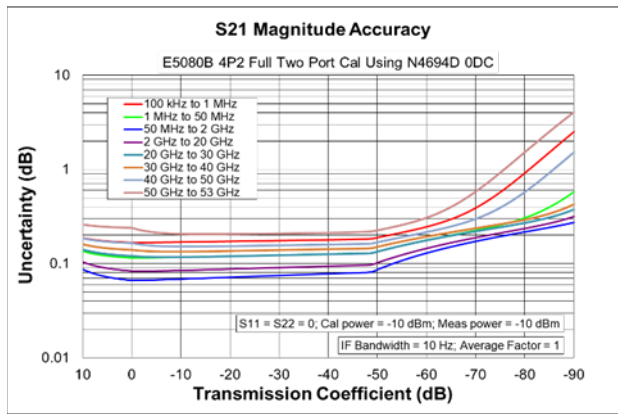


Table 9. E5080B Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2 with N4694D Electronic Calibration (ECal) module with Option 0DC

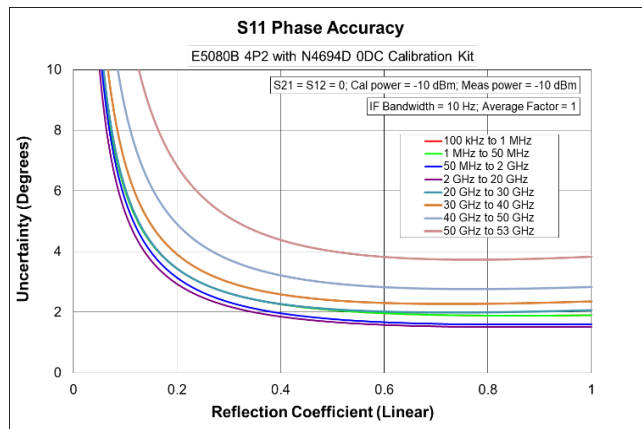
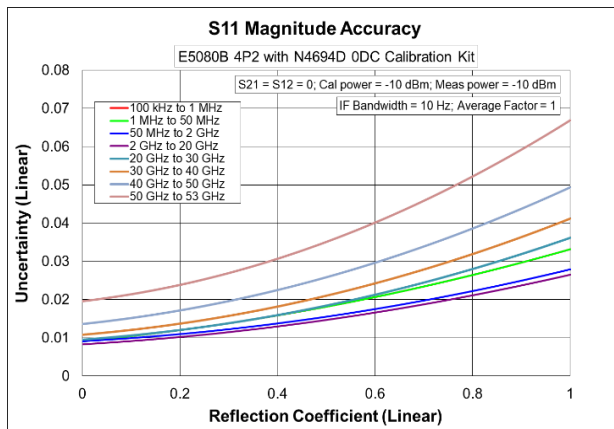
Corrected error terms (dB) – Specifications

| Description | 100 kHz to 1 MHz | 1 MHz to 50 MHz | 50 MHz to 2 GHz | 2 GHz to 20 GHz | 20 GHz to 30 GHz | 30 MHz to 40 GHz | 40 GHz to 50 GHz | 50 GHz to 53 GHz |
|-----------------------|------------------|-----------------|-----------------|-----------------|------------------|------------------|------------------|------------------|
| Directivity | 41 | 41 | 41 | 42 | 41 | 40 | 38 | 35 |
| Source match | 38 | 38 | 38 | 39 | 35 | 34 | 33 | 30 |
| Load match | 34 | 37 | 38 | 38 | 34 | 32 | 32 | 29 |
| Reflection tracking | ± 0.08 | ± 0.08 | ± 0.04 | ± 0.04 | ± 0.05 | ± 0.06 | ± 0.08 | ± 0.08 |
| Transmission tracking | ± 0.148 | ± 0.095 | ± 0.051 | ± 0.064 | ± 0.093 | ± 0.108 | ± 0.123 | ± 0.166 |

Transmission uncertainty (magnitude and phase)



Reflection uncertainty (magnitude and phase)



Uncorrected System Performance

Table 10. Uncorrected Error Terms (dB)¹ – Specification

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 (without bias tee options)

| Description | Directivity | Source match | Load match | Transmission tracking | Reflection tracking | Crosstalk |
|-------------------|-------------|--------------|------------|-----------------------|---------------------|-----------|
| 300 kHz to 10 MHz | 20 | 20 | 15 | -- | -- | -- |
| 10 MHz to 1.5 GHz | 25 | 25 | 17 | -- | -- | -- |
| 1.5 GHz to 3 GHz | 25 | 25 | 16 | -- | -- | -- |
| 3 GHz to 6 GHz | 25 | 25 | 11 | -- | -- | -- |
| 6 GHz to 10 GHz | 20 | 20 | 11 | -- | -- | -- |
| 10 GHz to 16 GHz | 15 | 15 | 11 | -- | -- | -- |
| 16 GHz to 20 GHz | 15 | 15 | 8 | -- | -- | -- |

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 with bias tee options (Option 120 or 140)

| Description | Directivity | Source match | Load match | Transmission tracking | Reflection tracking | Crosstalk |
|-------------------|-------------|--------------|------------|-----------------------|---------------------|-----------|
| 300 kHz to 10 MHz | 20 | 20 | 15 | -- | -- | -- |
| 10 MHz to 1.5 GHz | 25 | 25 | 17 | -- | -- | -- |
| 1.5 GHz to 3 GHz | 25 | 25 | 16 | -- | -- | -- |
| 3 GHz to 6 GHz | 25 | 25 | 10 | -- | -- | -- |
| 6 GHz to 10 GHz | 20 | 20 | 8 | -- | -- | -- |
| 10 GHz to 16 GHz | 15 | 15 | 8 | -- | -- | -- |
| 16 GHz to 20 GHz | 15 | 15 | 6 | -- | -- | -- |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2

| Description | Directivity | Source match | Load match | Transmission tracking | Reflection tracking | Crosstalk |
|------------------|-------------|--------------|------------|-----------------------|---------------------|-----------|
| 300 kHz to 1 MHz | 20 | 20 | 1 | -- | -- | -- |
| 1 MHz to 3 MHz | 20 | 20 | 14 | -- | -- | -- |
| 3 MHz to 10 MHz | 20 | 20 | 17 | -- | -- | -- |
| 10 MHz to 4 GHz | 25 | 25 | 17 | -- | -- | -- |
| 4 GHz to 6 GHz | 25 | 25 | 12 | -- | -- | -- |
| 6 GHz to 10 GHz | 20 | 20 | 12 | -- | -- | -- |
| 10 GHz to 20 GHz | 15 | 15 | 9 | -- | -- | -- |
| 20 GHz to 27 GHz | 15 | 15 | 8 | -- | -- | -- |
| 27 GHz to 40 GHz | 15 | 15 | 5 | -- | -- | -- |
| 40 GHz to 50 GHz | 15 | 15 | 8 | -- | -- | -- |
| 50 GHz to 53 GHz | 10 | 10 | 5 | -- | -- | -- |

1. Specifications apply to following conditions: Factory correction is turned on. Cable loss not included in transmission tracking.

Table 11. Uncorrected error terms (dB) – Typical

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 (without bias tee options)

| Description | Directivity | Source match | Load match | Transmission tracking | Reflection tracking | Crosstalk |
|--------------------|-------------|--------------|------------|-----------------------|---------------------|-------------------|
| 9 kHz to 30 kHz | 40 | 40 | 5 | ± 0.5 | ± 0.5 | -110 |
| 30 kHz to 100 kHz | 40 | 40 | 10 | ± 0.5 | ± 0.5 | -110 |
| 100 kHz to 300 kHz | 40 | 40 | 18 | ± 0.2 | ± 0.2 | -120 |
| 300 kHz to 3 MHz | 40 | 40 | 23 | ± 0.2 | ± 0.2 | -120 |
| 3 MHz to 10 MHz | 40 | 40 | 23 | ± 0.2 | ± 0.2 | -139 |
| 10 MHz to 50 MHz | 40 | 40 | 23 | ± 0.2 | ± 0.2 | -147 ¹ |
| 50 MHz to 1.5 GHz | 40 | 40 | 23 | ± 0.2 | ± 0.2 | -150 |
| 1.5 GHz to 3 GHz | 40 | 40 | 20 | ± 0.2 | ± 0.2 | -150 |
| 3 GHz to 4.5 GHz | 40 | 40 | 15 | ± 0.2 | ± 0.2 | -149 |
| 4.5 GHz to 6 GHz | 40 | 40 | 15 | ± 0.2 | ± 0.2 | -147 |
| 6 GHz to 9 GHz | 35 | 35 | 15 | ± 0.3 | ± 0.3 | -146 |
| 9 GHz to 10 GHz | 35 | 35 | 15 | ± 0.3 | ± 0.3 | -142 |
| 10 GHz to 13 GHz | 35 | 35 | 15 | ± 0.5 | ± 0.5 | -142 |
| 13 GHz to 16 GHz | 35 | 35 | 15 | ± 0.5 | ± 0.5 | -140 |
| 16 GHz to 20 GHz | 35 | 35 | 12 | ± 0.5 | ± 0.5 | -137 |

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 with bias tee options (Option 120 or 140)

| Description | Directivity | Source match | Load match | Transmission tracking | Reflection tracking | Crosstalk |
|-------------------|-------------|--------------|------------|-----------------------|---------------------|-------------------|
| 9 kHz to 30 kHz | 40 | 40 | 5 | ± 0.5 | ± 0.5 | -109 |
| 30 kHz to 100 kHz | 40 | 40 | 10 | ± 0.5 | ± 0.5 | -109 |
| 100 kHz to 3 MHz | 40 | 40 | 18 | ± 0.2 | ± 0.2 | -120 |
| 3 MHz to 10 MHz | 40 | 40 | 18 | ± 0.2 | ± 0.2 | -138 |
| 10 MHz to 50 MHz | 40 | 40 | 23 | ± 0.2 | ± 0.2 | -146 ¹ |
| 50 MHz to 1.5 GHz | 40 | 40 | 23 | ± 0.2 | ± 0.2 | -148 |
| 1.5 GHz to 3 GHz | 40 | 40 | 20 | ± 0.2 | ± 0.2 | -148 |
| 3 GHz to 4.5 GHz | 40 | 40 | 12 | ± 0.2 | ± 0.2 | -147 |
| 4.5 GHz to 6 GHz | 40 | 40 | 12 | ± 0.2 | ± 0.2 | -144 |
| 6 GHz to 9 GHz | 35 | 35 | 11 | ± 0.3 | ± 0.3 | -143 |
| 9 GHz to 10 GHz | 35 | 35 | 11 | ± 0.3 | ± 0.3 | -139 |
| 10 GHz to 13 GHz | 35 | 35 | 11 | ± 0.5 | ± 0.5 | -139 |
| 13 GHz to 14 GHz | 35 | 35 | 11 | ± 0.5 | ± 0.5 | -136 |
| 14 GHz to 16 GHz | 35 | 35 | 11 | ± 0.5 | ± 0.5 | -136 |
| 16 GHz to 20 GHz | 35 | 35 | 10 | ± 0.5 | ± 0.5 | -132 |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2

| Description | Directivity | Source match | Load match | Transmission tracking | Reflection tracking | Crosstalk |
|--------------------|-------------|--------------|------------|-----------------------|---------------------|-------------------|
| 100 kHz to 300 kHz | 40 | 40 | 2 | ± 0.5 | ± 0.5 | -106 |
| 300 kHz to 500 kHz | 40 | 40 | 2 | ± 0.5 | ± 0.5 | -120 |
| 500 kHz to 1 MHz | 40 | 40 | 2 | ± 0.5 | ± 0.5 | -130 |
| 1 MHz to 3 MHz | 40 | 40 | 16 | ± 0.5 | ± 0.5 | -130 |
| 3 MHz to 10 MHz | 40 | 40 | 20 | ± 0.5 | ± 0.5 | -138 |
| 10 MHz to 50 MHz | 40 | 40 | 20 | ± 0.2 | ± 0.2 | -147 ¹ |
| 50 MHz to 4 GHz | 40 | 40 | 20 | ± 0.2 | ± 0.2 | -150 |
| 4 GHz to 6 GHz | 40 | 40 | 15 | ± 0.2 | ± 0.2 | -150 |
| 6 GHz to 8 GHz | 35 | 35 | 15 | ± 0.2 | ± 0.2 | -150 |
| 8 GHz to 10 GHz | 35 | 35 | 15 | ± 0.2 | ± 0.2 | -147 |
| 10 GHz to 16 GHz | 35 | 35 | 11 | ± 0.3 | ± 0.3 | -147 |
| 16 GHz to 20 GHz | 35 | 35 | 11 | ± 0.3 | ± 0.3 | -143 |
| 20 GHz to 24 GHz | 25 | 25 | 10 | ± 0.3 | ± 0.3 | -143 |
| 24 GHz to 26 GHz | 25 | 25 | 10 | ± 0.3 | ± 0.3 | -141 |
| 26 GHz to 27 GHz | 25 | 25 | 10 | ± 0.3 | ± 0.3 | -137 |
| 27 GHz to 35 GHz | 25 | 25 | 7 | ± 0.3 | ± 0.3 | -137 |
| 35 GHz to 40 GHz | 25 | 25 | 7 | ± 0.3 | ± 0.3 | -134 |
| 40 GHz to 45 GHz | 20 | 20 | 11 | ± 0.5 | ± 0.5 | -132 |
| 45 GHz to 50 GHz | 20 | 20 | 11 | ± 0.5 | ± 0.5 | -115 |
| 50 GHz to 53 GHz | 15 | 15 | 8 | ± 1 | ± 1 | -101 |

1. It may typically be degraded at 25 MHz.

Test Port Output ¹

Table 12. Frequency resolution, accuracy, stability

| Description | Specification | Typical |
|----------------------|------------------------------------|---|
| Frequency resolution | 1 Hz | -- |
| Frequency accuracy | ± 7 ppm ± 0.45 ppm (Option 1E5) | -- |
| Frequency stability | -- | ± 7 ppm ² ± 0.05 ppm (Option 1E5) ² ± 3 ppm/year maximum ³ ± 0.1 ppm/year maximum (Option 1E5) ³ |

1. The specifications do not apply to parallel measurements of multiple devices under test (DUT).
2. 0 to 40 °C. Assumes no variation in time.
3. Assumes no variation in temperature.

Table 13. Maximum output port power (dBm)

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 (without bias tee options)

| Description | Specification | Typical |
|--------------------|---------------|---------|
| 9 kHz to 100 kHz | 0 | 2 |
| 100 kHz to 10 MHz | 5 | 7 |
| 10 MHz to 4.5 GHz | 10 | 13 |
| 4.5 GHz to 6.5 GHz | 10 | 12 |
| 6.5 GHz to 9 GHz | 9 | 12 |
| 9 GHz to 16 GHz | 7 | 10 |
| 16 GHz to 20 GHz | 4 | 7 |

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 with bias tee options (Option 120 or 140)

| Description | Specification | Typical |
|--------------------|---------------|---------|
| 9 kHz to 100 kHz | -1 | 2 |
| 100 kHz to 10 MHz | 4.5 | 7 |
| 10 MHz to 50 MHz | 9.5 | 12 |
| 50 MHz to 4.5 GHz | 9 | 12 |
| 4.5 GHz to 6.5 GHz | 8 | 11 |
| 6.5 GHz to 9 GHz | 7.5 | 11 |
| 9 GHz to 14 GHz | 5.5 | 9 |
| 14 GHz to 16 GHz | 5 | 9 |
| 16 GHz to 20 GHz | 1.5 | 5 |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2

| Description | Specification | Typical |
|--------------------|---------------|---------|
| 100 kHz to 300 kHz | -2 | 1 |
| 300 kHz to 1 MHz | 7 | 10 |
| 1 MHz to 17 GHz | 10 | 13 |
| 17 GHz to 20 GHz | 7 | 11 |
| 20 GHz to 24 GHz | 5 | 11 |
| 24 GHz to 30 GHz | 5 | 8 |
| 30 GHz to 38 GHz | 2 | 8 |
| 38 GHz to 45 GHz | 2 | 5 |
| 45 GHz to 50 GHz | -6 | -1 |
| 50 GHz to 53 GHz | -24 | -13 |

Table 14. Power sweep range (dBm) ¹

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 (without bias tee options)

| Description | Specification | Typical |
|-------------------|---------------|-----------|
| 9 kHz to 100 kHz | -- | -60 to 2 |
| 100 kHz to 10 MHz | -- | -60 to 7 |
| 10 MHz to 4.5 GHz | -- | -60 to 13 |
| 4.5 GHz to 9 GHz | -- | -60 to 12 |
| 9 GHz to 16 GHz | -- | -60 to 10 |
| 16 GHz to 20 GHz | -- | -60 to 7 |

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 with bias tee options (Option 120 or 140)

| Description | Specification | Typical |
|-------------------|---------------|-----------|
| 9 kHz to 100 kHz | -- | -60 to 2 |
| 100 kHz to 10 MHz | -- | -60 to 7 |
| 10 MHz to 4.5 GHz | -- | -60 to 12 |
| 4.5 GHz to 9 GHz | -- | -60 to 11 |
| 9 GHz to 16 GHz | -- | -60 to 9 |
| 16 GHz to 20 GHz | -- | -60 to 5 |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2

| Description | Specification | Typical |
|--------------------|---------------|-----------|
| 100 kHz to 300 kHz | -- | -60 to 1 |
| 300 kHz to 1 MHz | -- | -60 to 10 |

| Description | Specification | Typical |
|------------------|---------------|------------|
| 1 MHz to 17 GHz | -- | -60 to 13 |
| 17 GHz to 20 GHz | -- | -60 to 11 |
| 20 GHz to 24 GHz | -- | -50 to 11 |
| 24 GHz to 38 GHz | -- | -50 to 8 |
| 38 GHz to 45 GHz | -- | -50 to 5 |
| 45 GHz to 50 GHz | -- | -50 to 0 |
| 50 GHz to 53 GHz | -- | -50 to -12 |

1. When set to source power below -50 dBm, spurious related to LO signal may be observed.

Table 15. Power level accuracy (dB)

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 ^{1, 2}

| Description | Specification | Typical |
|-------------------|---------------|---------|
| 9 kHz to 100 kHz | ± 4.0 | ± 1.0 |
| 100 kHz to 15 GHz | ± 1.5 | ± 0.2 |
| 15 GHz to 20 GHz | ± 2.0 | ± 0.3 |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2 ³

| Description | Specification | Typical |
|-------------------------------|---------------|---------|
| 100 kHz to 10 MHz | ± 3.0 | ± 0.5 |
| 10 MHz to 15 GHz | ± 1.5 | ± 0.2 |
| 15 GHz to 30 GHz | ± 2.0 | ± 0.2 |
| 30 GHz to 40 GHz | ± 2.5 | ± 0.3 |
| 40 GHz to 50 GHz ⁴ | ± 2.5 | ± 0.5 |
| 50 GHz to 53 GHz ⁴ | -- | ± 1.0 |

1. At nominal power of 0 dBm, stepped sweep mode.

2. At nominal power of -1 dBm, stepped sweep mode with option 120 or 140 for 9 kHz to 100 kHz.

3. At nominal power of -15 dBm, stepped sweep mode.

4. If using a power sensor (wideband power detector) to measure or calibrate the power level above 45 GHz, an external filter is required to reduce sub-harmonics. Refer to [VNA webhelp](#) for more details.

Table 16. Power level linearity (dB)

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 ^{1, 2}

| Description | Specification ³ | Typical ^{4, 5} |
|------------------|----------------------------|-------------------------|
| 9 kHz to 10 GHz | ± 0.75 | ± 1.0 |
| 10 GHz to 20 GHz | ± 1.0 | ± 1.0 |

1. Level linearity given is relative to 0 dBm.

2. Level linearity given is relative to -1 dBm with option 120 or 140 for 9 kHz to 100 kHz.

3. Stepped sweep mode. -20 dBm ≤ P ≤ maximum specified power.

4. Swept sweep mode. -60 dBm ≤ P ≤ maximum specified power.

5. Stepped sweep mode. -60 dBm ≤ P < -20 dBm.

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2⁶

| Description | Specification ⁷ | Typical |
|-------------------|----------------------------|------------------------|
| 100 kHz to 10 GHz | ± 0.75 | ± 1.0 ^{8,9} |
| 10 GHz to 20 GHz | ± 1.0 | ± 1.0 ^{8,9} |
| 20 GHz to 50 GHz | ± 2.0 | ± 1.0 ^{10,11} |

6. Level linearity given is relative to -15 dBm.

7. Stepped sweep mode. $-20 \text{ dBm} \leq P \leq$ maximum specified power.

8. Swept sweep mode. $-60 \text{ dBm} \leq P \leq$ maximum specified power.

9. Stepped sweep mode. $-60 \text{ dBm} \leq P < -20 \text{ dBm}$.

10. Swept sweep mode. $-65 \text{ dBm} \leq P \leq$ maximum specified power.

11. Stepped sweep mode. $-50 \text{ dBm} \leq P < -20 \text{ dBm}$.

Table 17. 2nd and 3rd harmonics (dBc)

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2¹

| Description | Specification | Typical |
|------------------|---------------|---------|
| 30 kHz to 10 MHz | -- | -20 |
| 10 MHz to 20 GHz | -- | -25 |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2^{1,2}

| Description | Specification | Typical |
|------------------|---------------|---------|
| 300 kHz to 1 MHz | -- | -20 |
| 1 MHz to 20 GHz | -- | -25 |
| 20 GHz to 25 GHz | -- | -17 |
| 25 GHz to 40 GHz | -- | -20 |
| 40 GHz to 47 GHz | -- | -15 |
| 47 GHz to 53 GHz | -- | -17 |

1. Listed frequency is harmonic frequency. Tested at power of 0 dBm.

2. Listed frequency is harmonic frequency. Tested at power of -2 dBm at 100 kHz to 200 kHz.

Table 18. Sub-harmonics (dBc)

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2¹

| Description | Specification | Typical |
|------------------|---------------|---------|
| 9 kHz to 10 MHz | -- | -50 |
| 10 MHz to 20 GHz | -- | -35 |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2²

| Description | Specification | Typical |
|-------------------|---------------|---------|
| 100 kHz to 10 GHz | -- | -50 |
| 10 GHz to 20 GHz | -- | -35 |
| 20 GHz to 40 GHz | -- | -30 |
| 40 GHz to 47 GHz | -- | -20 |
| 47 GHz to 50 GHz | -- | -10 |
| 50 GHz to 53 GHz | -- | -2 |

1. Listed frequency is fundamental frequency. Tested at power of 0 dBm.
2. Listed frequency is fundamental frequency. Tested at power of -15 dBm.

Table 19. Non-harmonic spurs at nominal power (dBc)¹

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2

| Description | Specification | Typical |
|------------------|---------------|---------|
| 9 kHz to 10 GHz | -- | -50 |
| 10 GHz to 20 GHz | -- | -45 |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2

| Description | Specification | Typical |
|-------------------|---------------|---------|
| 100 kHz to 10 GHz | -- | -50 |
| 10 GHz to 20 GHz | -- | -45 |
| 20 GHz to 53 GHz | -- | -35 |

1. Listed frequency is fundamental frequency. Includes spurious related to LO signal and frac-N.

Table 20. Nominal power (preset power level)

| Description | Specification |
|---|---------------|
| Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/ 492/4D2/4H2/4K2 | 0 dBm |
| Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2 | -15 dBm |

Table 21. Power resolution, maximum/minimum settable power

| Description | Specification | Typical |
|------------------------|---------------|----------|
| Settable resolution | -- | 0.01 dB |
| Maximum settable power | -- | +20 dBm |
| Minimum settable power | -- | -100 dBm |

Test Port Input

Table 22. Test port noise floor (dBm) ¹

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 (without bias tee options)

| Description | Specification | Typical |
|-------------------------------|---------------|---------|
| 9 kHz to 100 kHz | -101 | -109 |
| 100 kHz to 300 kHz | -112 | -119 |
| 300 kHz to 1 MHz | -120 | -127 |
| 1 MHz to 10 MHz | -125 | -132 |
| 10 MHz to 50 MHz ² | -127 | -134 |
| 50 MHz to 3 GHz | -130 | -137 |
| 3 GHz to 4.5 GHz | -130 | -136 |
| 4.5 GHz to 6.5 GHz | -130 | -135 |
| 6.5 GHz to 9 GHz | -127 | -134 |
| 9 GHz to 14 GHz | -126 | -132 |
| 14 GHz to 16 GHz | -123 | -130 |
| 16 GHz to 20 GHz | -122 | -130 |

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 with bias tee options (Option 120 or 140)

| Description | Specification | Typical |
|-------------------------------|---------------|---------|
| 9 kHz to 100 kHz | -100 | -108 |
| 100 kHz to 300 kHz | -112 | -119 |
| 300 kHz to 1 MHz | -120 | -127 |
| 1 MHz to 10 MHz | -125 | -132 |
| 10 MHz to 50 MHz ² | -127 | -134 |
| 50 MHz to 2 GHz | -129 | -137 |
| 2 GHz to 3 GHz | -129 | -136 |
| 3 GHz to 4.5 GHz | -129 | -135 |
| 4.5 GHz to 6 GHz | -127 | -134 |
| 6 GHz to 6.5 GHz | -127 | -133 |
| 6.5 GHz to 9 GHz | -126 | -133 |
| 9 GHz to 14 GHz | -125 | -131 |
| 14 GHz to 16 GHz | -121 | -128 |
| 16 GHz to 20 GHz | -120 | -128 |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2

| Description | Specification | Typical |
|-------------------------------|---------------|---------|
| 100 kHz to 300 kHz | -97 | -105 |
| 300 kHz to 500 kHz | -97 | -110 |
| 500 kHz to 1 MHz | -110 | -120 |
| 1 MHz to 10 MHz | -115 | -124 |
| 10 MHz to 50 MHz ² | -127 | -133 |
| 50 MHz to 200 MHz | -130 | -133 |
| 200 MHz to 3 GHz | -130 | -137 |
| 3 GHz to 6.5 GHz | -130 | -135 |
| 6.5 GHz to 9 GHz | -128 | -134 |
| 9 GHz to 17 GHz | -127 | -133 |
| 17 GHz to 25 GHz | -125 | -131 |
| 25 GHz to 30 GHz | -122 | -129 |
| 30 GHz to 45 GHz | -120 | -127 |
| 45 GHz to 50 GHz | -105 | -115 |
| 50 GHz to 53 GHz | -95 | -113 |

1. Noise floor in a 10 Hz IF Bandwidth. Measured with 1 kHz IF bandwidth for 9 kHz to < 100 kHz, and 30 kHz IF bandwidth for 100 kHz to 53 GHz. Test port terminated.

2. It may typically be degraded at 25 MHz.

Table 23. Receiver compression at test port ¹

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 (without bias tee options)

| Description | Specification | | | Typical | |
|-------------------|--------------------------------|----------------|-----------|----------------|-----------|
| | Input power at test port (dBm) | Magnitude (dB) | Phase (°) | Magnitude (dB) | Phase (°) |
| 9 kHz to 100 kHz | 0 | 0.5 | 5 | 0.10 | 1.5 |
| 100 kHz to 10 MHz | +5 | 0.2 | 5 | 0.05 | 1.0 |
| 10 MHz to 6.5 GHz | +10 | 0.2 | 5 | 0.05 | 1.0 |
| 6.5 GHz to 9 GHz | +9 | 0.2 | 5 | 0.05 | 1.0 |
| 9 GHz to 16 GHz | +7 | 0.2 | 5 | 0.05 | 1.0 |
| 16 GHz to 20 GHz | +4 | 0.2 | 5 | 0.05 | 1.0 |

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 with bias tee options (Option 120 or 140)

| Description | Specification | | | Typical | |
|-------------------|--------------------------------|----------------|-----------|----------------|-----------|
| | Input power at test port (dBm) | Magnitude (dB) | Phase (°) | Magnitude (dB) | Phase (°) |
| 9 kHz to 100 kHz | -1 | 0.5 | 5 | 0.10 | 1.5 |
| 100 kHz to 10 MHz | +4.5 | 0.2 | 5 | 0.05 | 1.0 |

| | | Specification | | | Typical | |
|--------------------|------|---------------|---|------|---------|--|
| 10 MHz to 50 MHz | +9.5 | 0.2 | 5 | 0.05 | 1.0 | |
| 50 MHz to 4.5 GHz | +9 | 0.2 | 5 | 0.05 | 1.0 | |
| 4.5 GHz to 6.5 GHz | +8 | 0.2 | 5 | 0.05 | 1.0 | |
| 6.5 GHz to 9 GHz | +7.5 | 0.2 | 5 | 0.05 | 1.0 | |
| 9 GHz to 14 GHz | +5.5 | 0.2 | 5 | 0.05 | 1.0 | |
| 14 GHz to 16 GHz | +5 | 0.2 | 5 | 0.05 | 1.0 | |
| 16 GHz to 20 GHz | +1.5 | 0.2 | 5 | 0.05 | 1.0 | |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2

| | | Specification | | | Typical | |
|--------------------|--------------------------------|----------------|-----------|----------------|-----------|--|
| Description | Input power at test port (dBm) | Magnitude (dB) | Phase (°) | Magnitude (dB) | Phase (°) | |
| 100 kHz to 300 kHz | -2 | 0.2 | 5 | 0.10 | 1.0 | |
| 300 kHz to 1 MHz | +7 | 0.2 | 5 | 0.10 | 1.0 | |
| 1 MHz to 17 GHz | +10 | 0.2 | 5 | 0.05 | 1.0 | |
| 17 GHz to 20 GHz | +7 | 0.2 | 5 | 0.05 | 1.0 | |
| 20 GHz to 30 GHz | +5 | 0.2 | 5 | 0.05 | 1.0 | |
| 30 GHz to 45 GHz | +2 | 0.2 | 5 | 0.05 | 1.0 | |
| 45 GHz to 50 GHz | -6 | 0.2 | 5 | 0.05 | 1.0 | |
| 50 GHz to 53 GHz | -24 | 0.2 | 5 | 0.05 | 1.0 | |

1. Tested with receiver gain AUTO. (High receiver attenuator is selected for measurements).

Table 24. Trace noise magnitude (dB rms) ^{1, 2}

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 (without bias tee options)

| Description | Specification | Typical |
|-------------------------------|---------------|---------|
| 9 kHz to 30 kHz | 0.005 | 0.0025 |
| 30 kHz to 100 kHz | 0.003 | 0.001 |
| 100 kHz to 6 GHz ³ | 0.0015 | 0.0005 |
| 6 GHz to 10 GHz | 0.002 | 0.0006 |
| 10 GHz to 20 GHz | 0.003 | 0.001 |

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 with bias tee options (Option 120 or 140)

| Description | Specification | Typical |
|------------------------------|---------------|---------|
| 9 kHz to 30 kHz | 0.006 | 0.003 |
| 30 kHz to 100 kHz | 0.003 | 0.001 |
| 100 kHz to 10 MHz | 0.0015 | 0.0005 |
| 10 MHz to 6 GHz ³ | 0.002 | 0.0005 |
| 6 GHz to 10 GHz | 0.003 | 0.0006 |
| 10 GHz to 16 GHz | 0.0035 | 0.001 |
| 16 GHz to 20 GHz | 0.004 | 0.001 |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2

| Description | Specification | Typical |
|-------------------------------|---------------|---------|
| 100 kHz to 300 kHz | 0.005 | 0.002 |
| 300 kHz to 1 MHz | 0.003 | 0.001 |
| 1 MHz to 4.5 GHz ³ | 0.0015 | 0.0005 |
| 4.5 GHz to 10 GHz | 0.0015 | 0.0007 |
| 10 GHz to 17 GHz | 0.002 | 0.001 |
| 17 GHz to 30 GHz | 0.003 | 0.0013 |
| 30 GHz to 45 GHz | 0.006 | 0.0022 |
| 45 GHz to 50 GHz | 0.018 | 0.006 |

1. Transmission and reflection trace noise in a 1 kHz IF bandwidth for < 10 MHz, 10 kHz IF bandwidth ≥ 10 MHz.

2. At maximum specified power (Table 13).

3. It may typically be degraded at particular frequencies such as 25 MHz, 54 MHz, 58.5 MHz, 108 MHz, 120 MHz, 132 MHz, 143 MHz or 156 MHz.

Table 25. Trace noise phase (degree rms)^{1, 2}

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 (without bias tee options)

| Description | Specification | Typical |
|-------------------------------|---------------|---------|
| 9 kHz to 30 kHz | 0.07 | 0.025 |
| 30 kHz to 100 kHz | 0.05 | 0.017 |
| 100 kHz to 300 kHz | 0.035 | 0.006 |
| 300 kHz to 6 GHz ³ | 0.01 | 0.003 |
| 6 GHz to 10 GHz | 0.02 | 0.006 |
| 10 GHz to 13.5 GHz | 0.03 | 0.006 |
| 13.5 GHz to 20 GHz | 0.03 | 0.01 |

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 with bias tee options (Option 120 or 140)

| Description | Specification | Typical |
|------------------------------|---------------|---------|
| 9 kHz to 30 kHz | 0.08 | 0.03 |
| 30 kHz to 100 kHz | 0.05 | 0.017 |
| 100 kHz to 300 kHz | 0.035 | 0.006 |
| 300 kHz to 10 MHz | 0.01 | 0.003 |
| 10 MHz to 6 GHz ³ | 0.015 | 0.003 |
| 6 GHz to 10 GHz | 0.025 | 0.006 |
| 10 GHz to 13.5 GHz | 0.03 | 0.006 |
| 13.5 GHz to 16 GHz | 0.03 | 0.01 |
| 16 GHz to 20 GHz | 0.035 | 0.01 |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2

| Description | Specification | Typical |
|-----------------------------|----------------------------|---------|
| 100 kHz to 300 kHz | 0.07 | 0.015 |
| 300 kHz to 1 MHz | 0.03 | 0.01 |
| 1 MHz to 6 GHz ³ | 0.02 | 0.003 |
| 6 GHz to 10 GHz | 0.02 | 0.004 |
| 10 GHz to 17 GHz | 0.02 | 0.006 |
| 17 GHz to 30 GHz | 0.02 | 0.01 |
| 30 GHz to 45 GHz | 0.04 (0.046 ⁴) | 0.027 |
| 45 GHz to 50 GHz | 0.18 | 0.03 |

1. Transmission and reflection trace noise in a 1 kHz IF bandwidth for < 10 MHz, 10 kHz IF bandwidth ≥ 10 MHz.
2. At maximum specified power (Table 13).
3. It may typically be degraded at particular frequencies such as 25 MHz, 54 MHz, 58.5 MHz, 108 MHz, 120 MHz, 132 MHz, 143 MHz or 156 MHz.
4. Only in the reflection measurement.

Table 26. Temperature stability – Typical

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2

| Description | Magnitude (dB/°C) | Phase (degree/°C) |
|--------------------|-------------------|-------------------|
| 9 kHz to 300 kHz | 0.03 | 0.2 |
| 300 kHz to 4.5 GHz | 0.005 | 0.1 |
| 4.5 GHz to 6 GHz | 0.01 | 0.1 |
| 6 GHz to 6.5 GHz | 0.01 | 0.2 |
| 6.5 GHz to 10 GHz | 0.015 | 0.2 |
| 10 GHz to 14 GHz | 0.015 | 0.3 |
| 14 GHz to 20 GHz | 0.02 | 0.4 |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2

| Description | Magnitude (dB/°C) | Phase (degree/°C) |
|-------------------|-------------------|-------------------|
| 100 kHz to 1 MHz | 0.03 | 1.0 |
| 1 MHz to 10 MHz | 0.005 | 0.2 |
| 10 MHz to 4.5 GHz | 0.005 | 0.1 |
| 4.5 GHz to 10 GHz | 0.01 | 0.1 |
| 10 GHz to 20 GHz | 0.01 | 0.2 |
| 20 GHz to 30 GHz | 0.01 | 0.25 |
| 30 GHz to 40 GHz | 0.01 | 0.3 |
| 40 GHz to 50 GHz | 0.03 | 0.8 |
| 50 GHz to 53 GHz | 0.06 | 1.0 |

Table 27. Damage input level

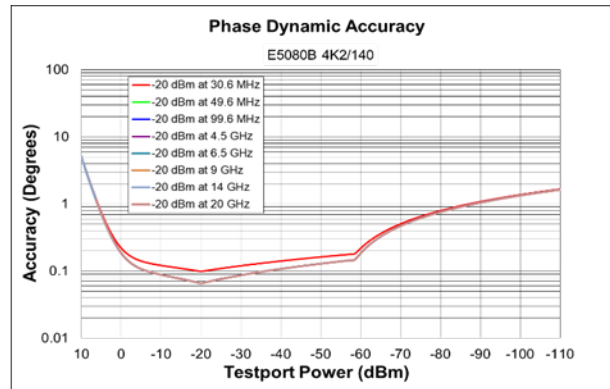
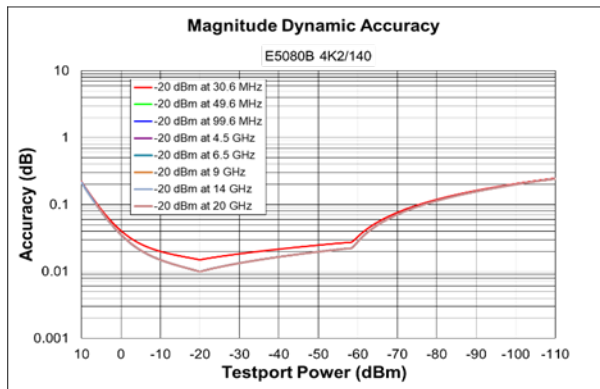
| Description | |
|--------------------|-------------------------------------|
| Damage Input Level | +27 dBm or \pm 35 VDC (Warranted) |

Dynamic Accuracy

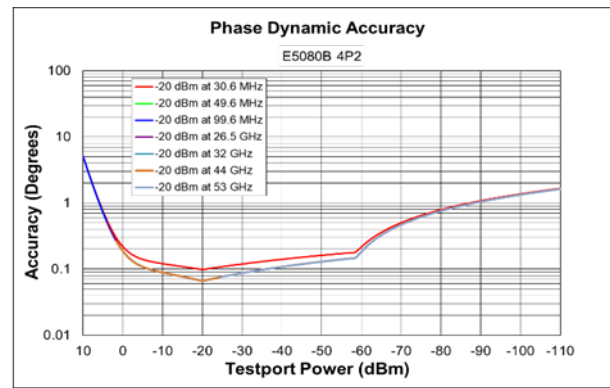
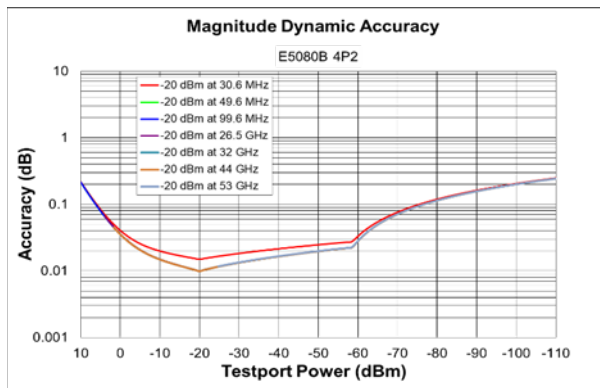
Accuracy of the test port input power relative to the reference input power level. Measured with 10 Hz IF bandwidth.

Dynamic accuracy¹ – specification

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2



Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2



- Dynamic accuracy is verified with the following measurements:
 - Compression over frequency.
 - IF linearity using a reference level of -20 dBm for an input power range of 0 to -60 dBm. Tested at three single frequencies (30.6 MHz, 49.6 MHz and 99.6 MHz) to cover the whole frequency range. The VNA receiver is linear by design when signal levels are below -60 dBm. For more details, refer to [VNA Receiver Dynamic Accuracy Specifications and Uncertainties](#).
- Download Uncertainty Calculator from http://www.keysight.com/find/na_calculator to generate the curves of dynamic accuracy.

Spectrum Analysis (with Option 09x and S96090B)

This section provides specifications for spectrum analysis hardware (Option 090 to 098) on the E5800B ENA. S96090B software is required to enable spectrum analysis functionality of the E5800B.

Table 28. Frequency specifications

| Description | Specification | Typical |
|--|--|---|
| Frequency reference ¹ | | |
| Accuracy | -- | ± [(time since last adjustment x aging rate) + temperature stability + calibration accuracy], typical |
| Aging rate | -- | ± 3 ppm/year maximum, typical ± 0.1 ppm/year maximum, typical (Option 1E5) |
| Temperature stability | -- | ± 7 ppm (0 to 40 °C) ±0.45 ppm (0 to 40 °C) (Option 1E5) |
| Achievable initial calibration accuracy | ± 7 ppm (25 ± 5 °C) ± 0.45 ppm (Option 1E5) | -- |
| Frequency readout accuracy (Start, Stop, Center, Marker) | -- | ± [(readout frequency x frequency reference accuracy) + (< 1% x RBW)], nominal |
| Frequency span | | |
| Minimum/Maximum | Analyzer's full span | -- |
| Resolution | 1 Hz | -- |
| Sweep (Trace) point range | 11 to 100,003 | -- |
| Resolution Bandwidth (RBW) | | |
| Range (-3 dB bandwidth) | 10 Hz to 3 MHz in 10% steps | -- |
| Bandwidth range accuracy | -- | ± 1%, all RBW, except below 100 MHz with 3 MHz RBW |
| Selectivity (-60 dB/-3 dB) | -- | Gaussian: 4.5:1, Flat top: 2.47:1, Kaiser: 3.82:1, Blackman: 3.58:1 |
| Video Bandwidth (VBW) | | |
| Range | 10 Hz to 3 MHz | -- |

1. Frequency reference accuracy can be improved by using external frequency reference with better accuracy.

Table 29. Time specifications

| Description | Specification | Supplemental information |
|----------------------------------|---|--------------------------|
| Sweep time and triggering | | |
| Sweep time range | Auto | -- |
| Trigger types | Continuous, Single, Group, Manual, External | -- |
| Trigger delay range | 0 to 3 s | -- |

| | | |
|--|-----------|-------|
| Trigger delay resolution | 1 μ s | -- |
| Measuring and display update rate (milliseconds) ¹ | | |
| 20 MHz Span, 3 kHz RBW, 3 kHz VBW | -- | 61 |
| 100 MHz Span, Auto RBW, Auto VBW | -- | 61 |
| 1 GHz Span, 3 kHz RBW, 3 kHz VBW | -- | 266 |
| 1 GHz Span, 300 kHz RBW, 300 kHz VBW | -- | 61 |
| 10 GHz Span, 3 kHz RBW, 3 kHz VBW | -- | 2,462 |
| 10 GHz Span, 300 kHz RBW, 300 kHz VBW | -- | 432 |
| 10 MHz to 20 GHz, RBW/VBW = 1 MHz | -- | 811 |
| 10 MHz to 50 GHz, RBW/VBW = 1 MHz | -- | 1,998 |

1. Measured with a 2-port option with firmware revision A.14.10.03.

Table 30. Amplitude accuracy and range specifications

| Description | Specification |
|--------------------------|---|
| Amplitude range | |
| Measurement range | DANL to maximum input level |
| Input attenuator range | High attenuation or Low attenuation |
| Maximum safe input level | +27 dBm |
| Display range | |
| Log scale | 0.001 to 500 dB/div in 0.001 steps |
| Linear scale | 10 divisions (default) |
| Scale units | dBm, mW |
| Trace detectors types | Average, Sample, Peak, Normal, Negative Peak, Peak sample, Peak average |

Table 31. SA detector accuracy (dB) ¹ – Specifications

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2

| Description | Specification |
|-------------------------------|---------------|
| 9 kHz to 10 MHz | ± 0.15 |
| 10 MHz to 20 GHz ² | ± 0.1 |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2

| Description | Specification |
|-------------------|---------------|
| 100 kHz to 10 MHz | ± 0.15 |
| 10 MHz to 20 GHz | ± 0.1 |
| 20 GHz to 53 GHz | ± 0.15 |

1. With high attenuation. SA detector accuracy is residual error of IF response calibration. IF response is characterized with E5080B's standard measurement class after power and S-parameter calibration. Therefore, the SA total absolute amplitude accuracy includes power meter, S-parameter and SA detector accuracies. Add input attenuation switching uncertainty if receiver attenuator is changed after user calibration.

2. Tested up to 19.99 GHz

Table 32. Input attenuation switching uncertainty (dB) – Supplemental information

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2

| Description | Supplemental information |
|------------------|--------------------------|
| 9 kHz to 50 MHz | ± 0.5 |
| 50 MHz to 20 GHz | ± 1.0 |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2

| Description | Supplemental information |
|-------------------|--------------------------|
| 100 kHz to 50 MHz | ± 0.5 |
| 50 MHz to 53 GHz | ± 1.0 |

Table 33. Input VSWR ¹ – Specifications

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 (without bias tee options)

| Description | Specification |
|-------------------|---------------|
| 300 kHz to 10 MHz | 1.433 |
| 10 MHz to 1.5 GHz | 1.329 |
| 1.5 GHz to 3 GHz | 1.377 |
| 3 GHz to 10 GHz | 1.785 |
| 10 GHz to 16 GHz | 1.785 |
| 16 GHz to 20 GHz | 2.323 |

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 with bias tee options (Option 120 or 140)

| Description | Specification |
|-------------------|---------------|
| 300 kHz to 10 MHz | 1.433 |
| 10 MHz to 1.5 GHz | 1.329 |
| 1.5 GHz to 3 GHz | 1.377 |
| 3 GHz to 6 GHz | 1.925 |
| 6 GHz to 16 GHz | 2.323 |
| 16 GHz to 20 GHz | 3.010 |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2

| Description | Specification |
|------------------|---------------|
| 1 MHz to 3 MHz | 1.499 |
| 3 MHz to 4 GHz | 1.329 |
| 4 GHz to 10 GHz | 1.671 |
| 10 GHz to 20 GHz | 2.100 |
| 20 GHz to 27 GHz | 2.323 |
| 27 GHz to 40 GHz | 3.570 |
| 40 GHz to 50 GHz | 2.323 |
| 50 GHz to 53 GHz | 3.570 |

1. Calculated by load match of uncorrected error terms (Table 10). $VSWR = \frac{1+10^{(-1+load\ match/20)}}{1-10^{(-1+load\ match/20)}}$

Table 34. Other amplitude accuracy – Supplemental information

| Description | Supplemental information |
|---------------------------|---|
| RBW switching uncertainty | 0.02 dB |
| Display scale fidelity | See dynamic accuracy specification. Specification applied to SA measurement class with user calibration between -10 dBm and -40 dBm input power and measurement between +10 dBm and -120 dBm input power. |

Table 35. Spurious response – Supplemental information

| Description | Supplemental information |
|---------------------|---|
| Image response | Mostly eliminated. Intermittent image response may be seen when making multi-tone or modulated signal measurements. |
| LO related spurious | Eliminated |

Table 36. Displayed Average Noise Level (DANL) at test ports with low attenuation (dBm/Hz) ¹

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 (without bias tee options)

| Description | Specification | Typical |
|--------------------|---------------|---------|
| 9 kHz to 100 kHz | -114 | -122 |
| 100 kHz to 1 MHz | -125 | -132 |
| 1 MHz to 10 MHz | -138 | -145 |
| 10 MHz to 100 MHz | -140 | -147 |
| 100 MHz to 4.5 GHz | -144 | -150 |
| 4.5 GHz to 6.5 GHz | -142 | -149 |
| 6.5 GHz to 9 GHz | -141 | -148 |
| 9 GHz to 14 GHz | -140 | -146 |

| Description | Specification | Typical |
|------------------|---------------|---------|
| 14 GHz to 16 GHz | -137 | -144 |
| 16 GHz to 20 GHz | -136 | -144 |

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 with bias tee options (Option 120 or 140)

| Description | Specification | Typical |
|--------------------|---------------|---------|
| 9 kHz to 100 kHz | -113 | -121 |
| 100 kHz to 300 kHz | -125 | -132 |
| 300 kHz to 1 MHz | -125 | -138 |
| 1 MHz to 10 MHz | -138 | -145 |
| 10 MHz to 100 MHz | -140 | -147 |
| 100 MHz to 4.5 GHz | -144 | -149 |
| 4.5 GHz to 6.5 GHz | -141 | -148 |
| 6.5 GHz to 9 GHz | -140 | -147 |
| 9 GHz to 14 GHz | -139 | -145 |
| 14 GHz to 16 GHz | -135 | -142 |
| 16 GHz to 20 GHz | -134 | -142 |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2

| Description | Specification | Typical |
|-------------------------------|---------------|---------|
| 100 kHz to 300 kHz | -110 | -118 |
| 300 kHz to 500 kHz | -110 | -120 |
| 500 kHz to 1 MHz ² | -123 | -130 |
| 1 MHz to 10 MHz | -128 | -134 |
| 10 MHz to 100 MHz | -136 | -142 |
| 100 MHz to 200 MHz | -144 | -146 |
| 200 MHz to 3 GHz | -144 | -150 |
| 3 GHz to 6.5 GHz | -144 | -148 |
| 6.5 GHz to 9 GHz | -142 | -147 |
| 9 GHz to 17 GHz | -141 | -146 |
| 17 GHz to 20 GHz | -139 | -146 |
| 20 GHz to 25 GHz | -139 | -143 |
| 25 GHz to 30 GHz | -136 | -143 |
| 30 GHz to 45 GHz | -134 | -141 |
| 45 GHz to 50 GHz | -119 | -129 |
| 50 GHz to 53 GHz | -109 | -127 |

1. Tested with 1 kHz RBW up to 50 MHz and 10 kHz RBW for above 50 MHz, test port terminated, average detector, averaging type = Log, IF gain = AUTO, image rejection = normal, random LO OFF.
2. A residual spurious response may be observed around 600 kHz.

Table 37. Displayed Average Noise Level (DANL) at test ports with high attenuation (dBm/Hz)¹ - Typical

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 (without bias tee options)

| Description | Specification | Typical |
|--------------------|---------------|---------|
| 9 kHz to 100 kHz | -- | -100 |
| 100 kHz to 300 kHz | -- | -110 |
| 300 kHz to 100 MHz | -- | -116 |
| 100 MHz to 6.5 GHz | -- | -127 |
| 6.5 GHz to 9 GHz | -- | -126 |
| 9 GHz to 14 GHz | -- | -124 |
| 14 GHz to 20 GHz | -- | -122 |

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 with bias tee options (Option 120 or 140)

| Description | Specification | Typical |
|--------------------|---------------|---------|
| 9 kHz to 100 kHz | -- | -99 |
| 100 kHz to 300 kHz | -- | -110 |
| 300 kHz to 100 MHz | -- | -116 |
| 100 MHz to 6.5 GHz | -- | -126 |
| 6.5 GHz to 9 GHz | -- | -125 |
| 9 GHz to 14 GHz | -- | -123 |
| 14 GHz to 20 GHz | -- | -120 |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2

| Description | Specification | Typical |
|-------------------------------|---------------|---------|
| 100 kHz to 300 kHz | -- | -96 |
| 300 kHz to 500 kHz | -- | -98 |
| 500 kHz to 1 MHz ² | -- | -108 |
| 1 MHz to 100 MHz | -- | -112 |
| 100 MHz to 200 MHz | -- | -124 |
| 200 MHz to 3 GHz | -- | -128 |
| 3 GHz to 6.5 GHz | -- | -126 |
| 6.5 GHz to 9 GHz | -- | -125 |
| 9 GHz to 20 GHz | -- | -124 |
| 20 GHz to 30 GHz | -- | -121 |
| 30 GHz to 45 GHz | -- | -119 |
| 45 GHz to 50 GHz | -- | -107 |
| 50 GHz to 53 GHz | -- | -105 |

1. Tested with 1 kHz RBW up to 50 MHz and 10 kHz RBW for above 50 MHz, test port terminated, average detector, averaging type = Log, IF gain = AUTO, image rejection = normal, random LO OFF.
2. A residual spurious response may be observed around 600 kHz.

Table 38. Second harmonic distortion with high attenuation ¹ – Supplemental information

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2

| Description | SHI (dBm) |
|-----------------|-----------|
| 50 MHz to 1 GHz | 30 |
| 1 GHz to 4 GHz | 38 |
| 4 GHz to 10 GHz | 47 |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2

| Description | SHI (dBm) |
|--------------------|-----------|
| 50 MHz to 1 GHz | 30 |
| 1 GHz to 4 GHz | 38 |
| 4 GHz to 10 GHz | 47 |
| 10 GHz 15 GHz | 44 |
| 15 GHz to 26.5 GHz | 40 |

1. Tested with 0 dBm for 50 MHz to 10 GHz, and -5 dBm for 10 GHz to 26.5 GHz input at test port, 10 MHz tone separations.

Table 39. Second harmonic distortion with low attenuation ¹ – Supplemental information

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2

| Description | SHI (dBm) |
|-----------------|-----------|
| 50 MHz to 1 GHz | 10 |
| 1 GHz to 4 GHz | 20 |
| 4 GHz to 10 GHz | 30 |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2

| Description | SHI (dBm) |
|--------------------|-----------|
| 50 MHz to 1 GHz | 10 |
| 1 GHz to 4 GHz | 20 |
| 4 GHz to 10 GHz | 30 |
| 10 GHz 15 GHz | 26 |
| 15 GHz to 20 GHz | 21 |
| 20 GHz to 26.5 GHz | 16 |

1. Tested with -25 dBm input at test port, 10 MHz tone separations.

**Table 40. Third order intermodulation distortion with high attenuation
¹ – Characteristic**

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2

| Description | Distortion (dBc) | TOI (dBm) |
|-------------------|------------------|-----------|
| 50 MHz to 200 MHz | -40 | 20 |
| 200 MHz to 2 GHz | -44 | 22 |
| 2 GHz to 5 GHz | -46 | 23 |
| 5 GHz to 10 GHz | -50 | 25 |
| 10 GHz to 15 GHz | -60 | 25 |
| 15 GHz to 20 GHz | -54 | 22 |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2

| Description | Distortion (dBc) | TOI (dBm) |
|-------------------|------------------|-----------|
| 50 MHz to 200 MHz | -40 | 20 |
| 200 MHz to 2 GHz | -44 | 22 |
| 2 GHz to 5 GHz | -46 | 23 |
| 5 GHz to 10 GHz | -50 | 25 |
| 10 GHz to 15 GHz | -56 | 23 |
| 15 GHz to 20 GHz | -52 | 21 |
| 20 GHz to 30 GHz | -42 | 16 |
| 30 GHz to 40 GHz | -48 | 14 |
| 40 GHz to 53 GHz | -52 | 11 |

1. Tested with 0 dBm for 50 MHz to 10 GHz, -5 dBm for 10 GHz to 30 GHz, -10 dBm for 30 GHz to 40 GHz, and -15 dBm for 40 GHz to 53 GHz input at test port, 10 MHz tone separations.

Table 41. Third order intermodulation distortion with low attenuation ¹ – Characteristic

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2

| Description | Distortion (dBc) | TOI (dBm) |
|------------------|------------------|-----------|
| 50 MHz to 5 GHz | -56 | 3 |
| 5 GHz to 10 GHz | -52 | 1 |
| 10 GHz to 20 GHz | -66 | 8 |

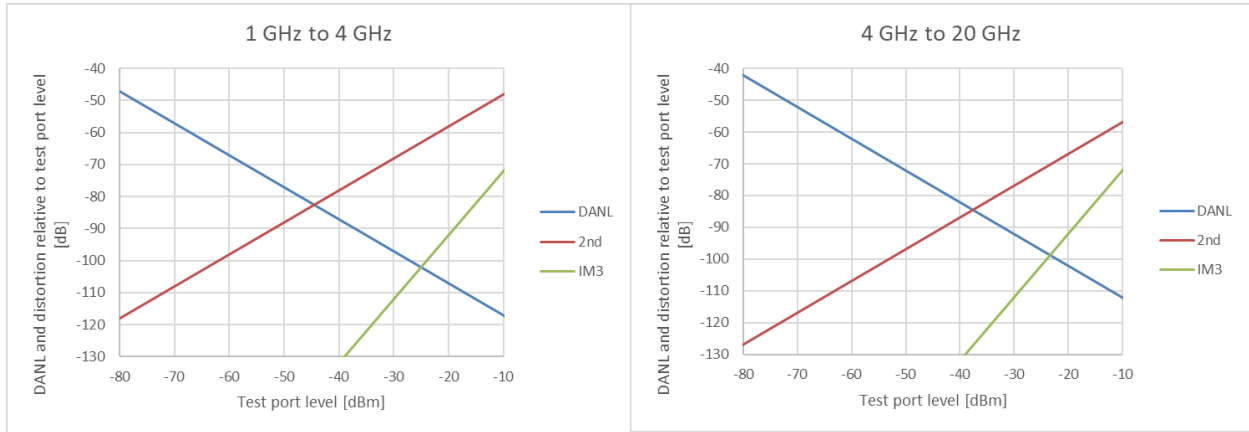
Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2

| Description | Distortion (dBc) | TOI (dBm) |
|------------------|------------------|-----------|
| 50 MHz to 5 GHz | -56 | 3 |
| 5 GHz to 10 GHz | -52 | 1 |
| 10 GHz to 20 GHz | -66 | 7 |
| 20 GHz to 30 GHz | -66 | 5 |
| 30 GHz to 53 GHz | -66 | 2 |

1. Tested with -25 dBm input at test port, 10 MHz tone separations.

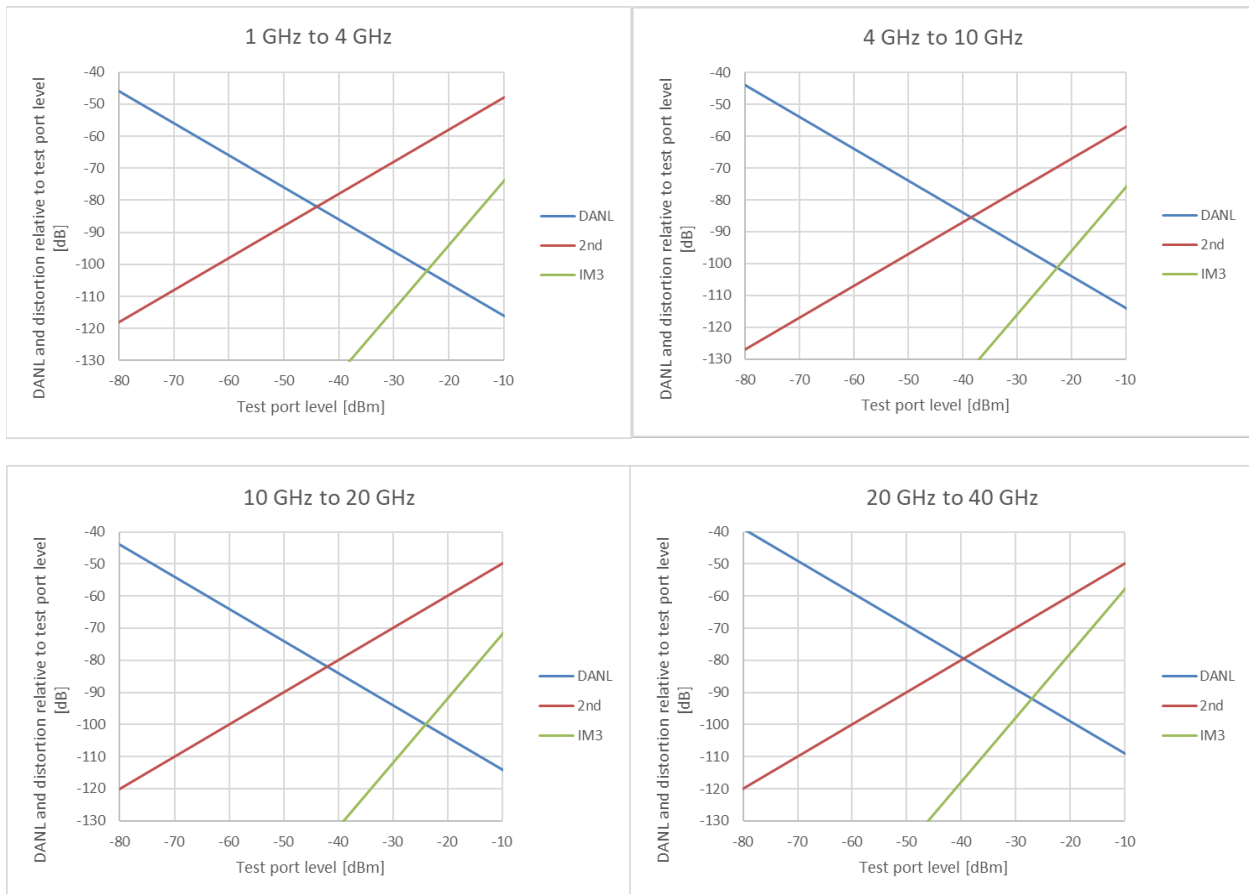
DANL and distortion relative to test port level (dB) – Nominal

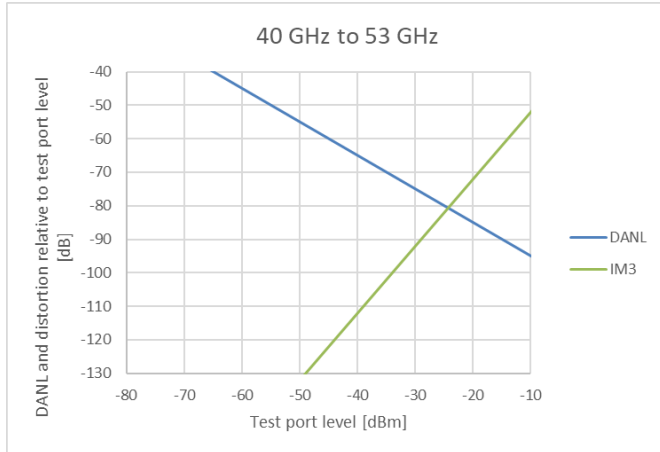
Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 ¹



1. With High Attenuation. 2nd harmonic distortion applies up to 10 GHz.

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2 ²





1. With High Attenuation. 2nd harmonic distortion applies up to 26.5 GHz.

Table 42. Receiver phase noise (dBc/Hz) ¹ – Typical

| Description | 1 kHz | 10 kHz | 100 kHz | 1 MHz | 10 MHz |
|--------------------------|-------|--------|---------|-------|--------|
| CF = 1 GHz | -103 | -103 | -103 | -128 | -130 |
| CF = 3 GHz | -96 | -96 | -96 | -120 | -130 |
| CF = 10 GHz | -83 | -83 | -83 | -116 | -127 |
| CF = 20 GHz ² | -76 | -76 | -76 | -110 | -121 |

1. Tested at maximum specified power. Spurious signals are excluded. With the SA class, phase noise of VNA's source is equivalent to the receiver phase noise.

2. Tested at 19.99 GHz.

Pulsed-RF Measurements (with Option 021/022 and S96024B/S96025B)

This section provides specifications for the pulse modulation hardware (Option 021/022) on the E5080B ENA Series VNA. The S96024B or S96025B Software is required to enable pulsed-RF measurement functions of the E5080B.

Table 43. Pulse modulation On/Off ratio (dB) – Typical

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2

| Description | Normal mode ¹ | Fast mode |
|-------------------|--------------------------|-----------|
| 9 kHz to 4.5 GHz | 80 | 50 |
| 4.5 GHz to 15 GHz | 70 | 40 |
| 15 GHz to 20 GHz | 70 | 35 |

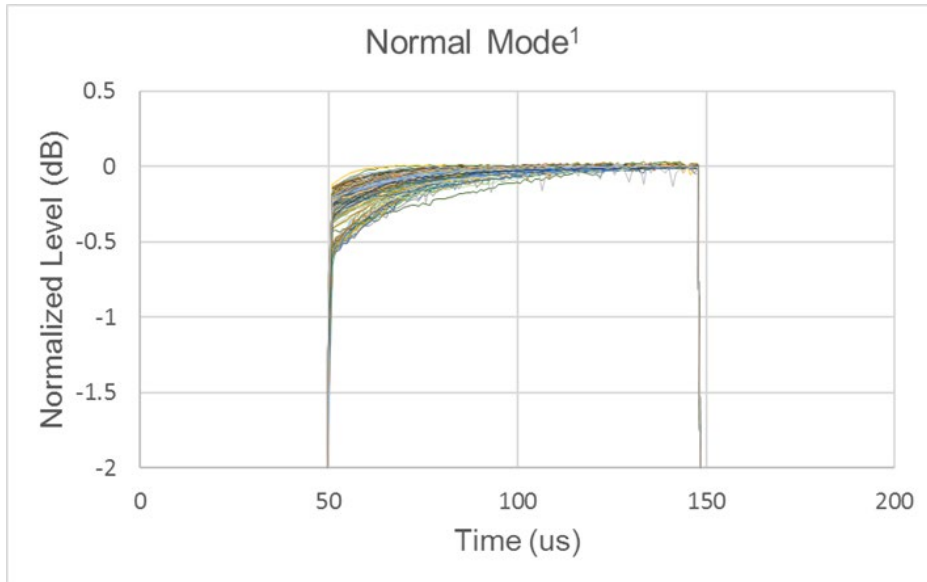
Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2

| Description | Normal mode ¹ | Fast mode |
|------------------|--------------------------|-----------|
| 100 kHz to 3 GHz | 80 | 50 |
| 3 GHz to 8 GHz | 80 | 40 |
| 8 GHz to 20 GHz | 80 | 38 |
| 20 GHz to 40 GHz | 70 | 30 |
| 40 GHz to 50 GHz | 70 | 25 |

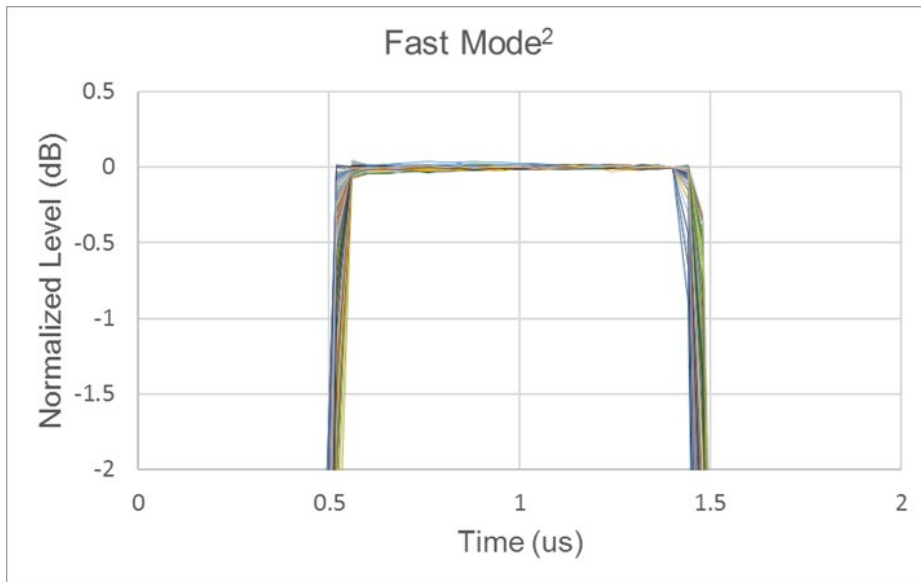
1. At power of > -20 dBm.

Pulse modulation shape examples

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2



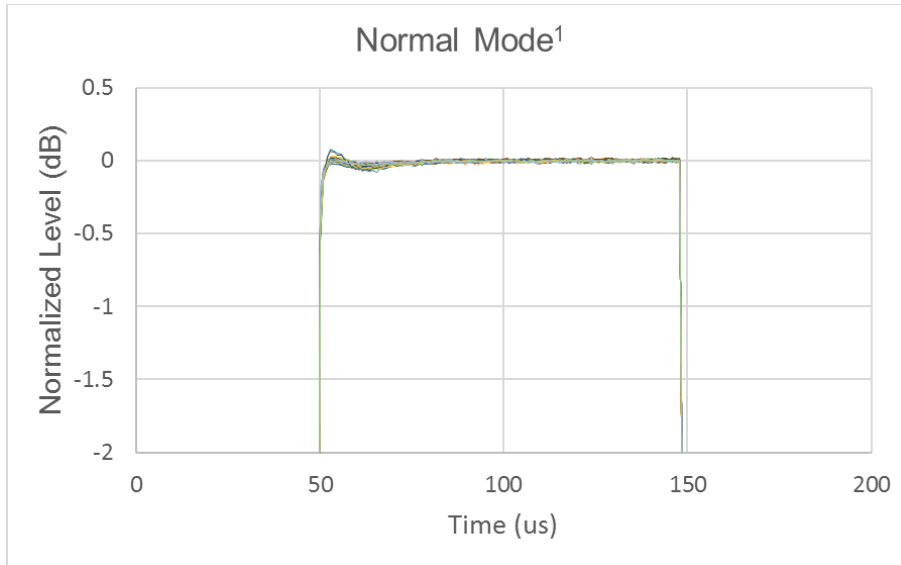
1. Measured with a 500 kHz IF bandwidth, no averaging. With 100 μ s pulse width setting.



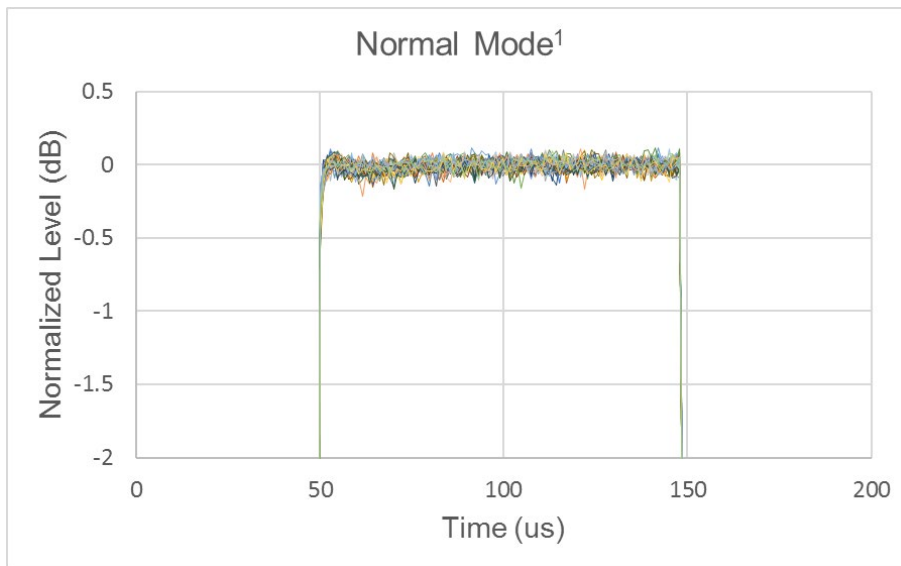
2. Measured with a 15 MHz IF bandwidth, averaging factor of 16 (Average Type = Point). With 1 μ s pulse width setting. S96025B software is required. (Minimum pulse width with S96024B is 50 μ s.)

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2

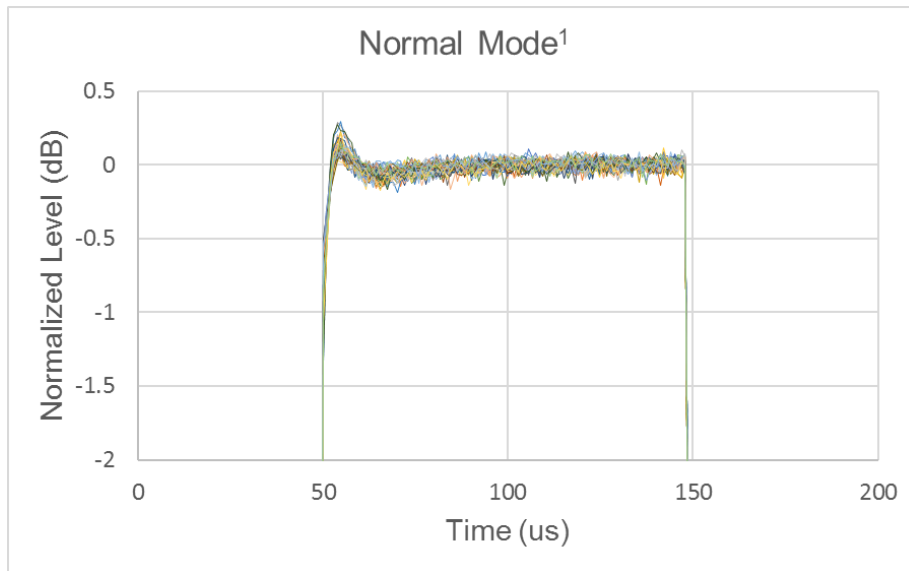
1 GHz to 26.5 GHz



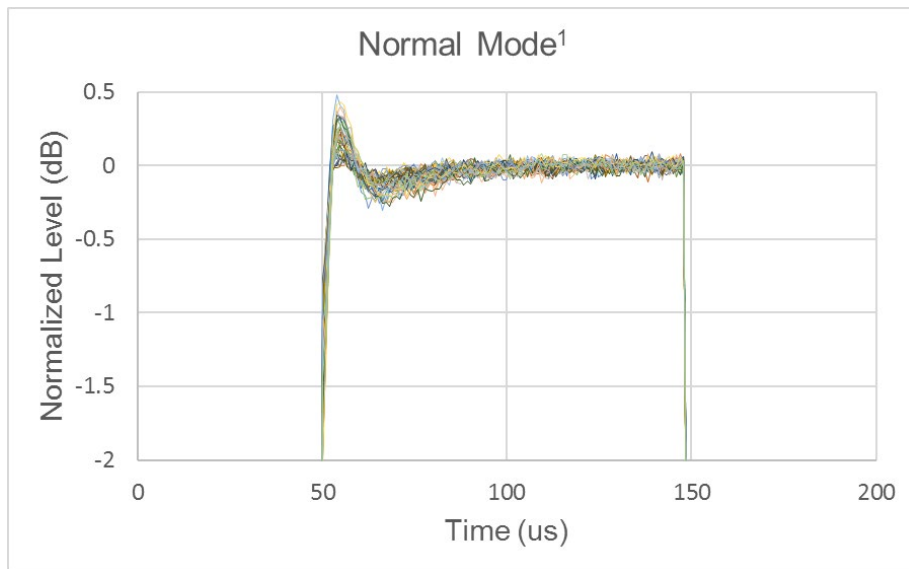
32 GHz



44 GHz

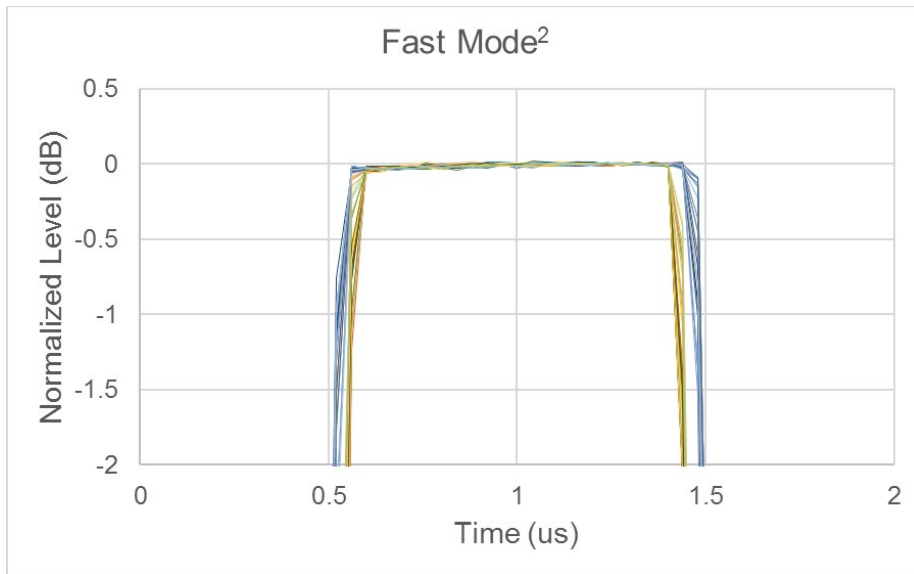


50 GHz

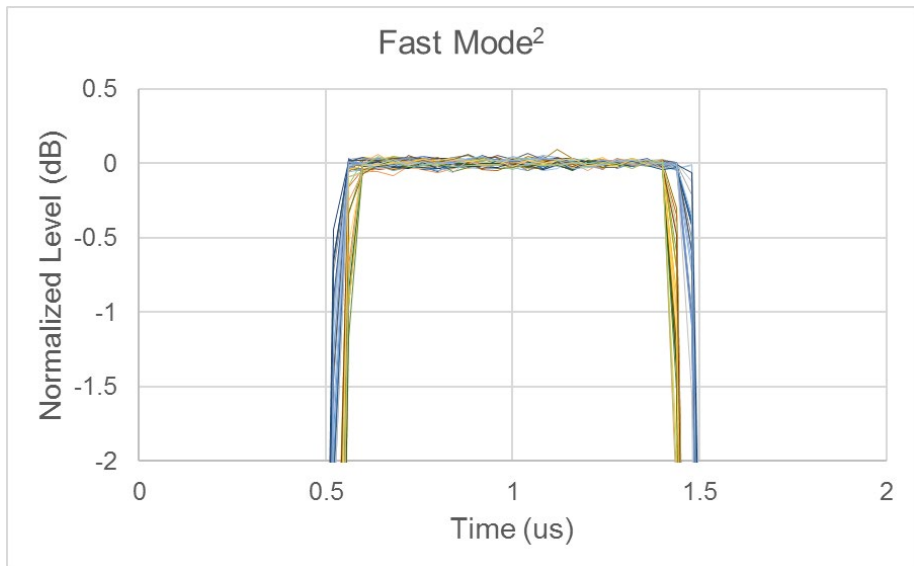


1. Measured with a 500 kHz IF bandwidth, averaging factor of 16 (Average Type = Point). With 100 μs pulse width setting.

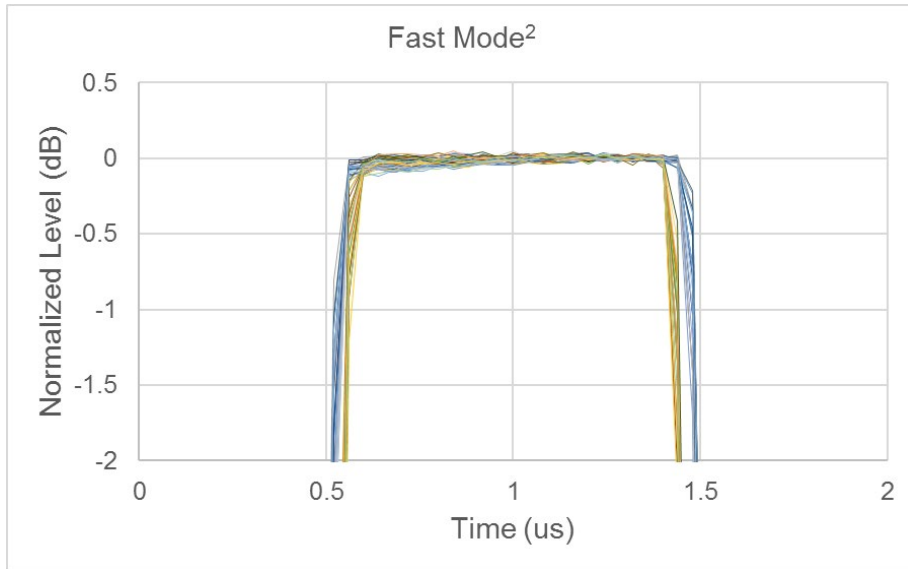
1 GHz to 26.5 GHz



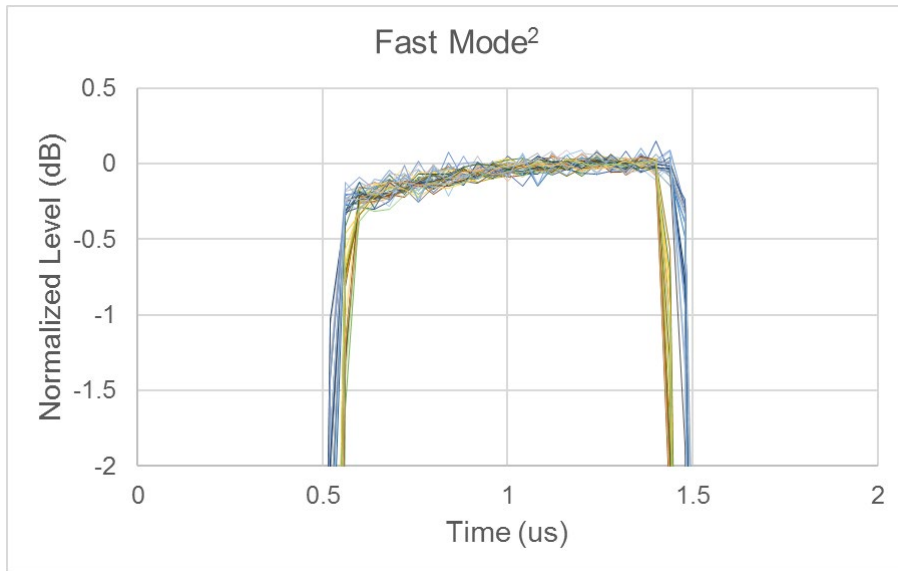
32 GHz



44 GHz



50 GHz



2. Measured with a 15 MHz IF bandwidth, averaging factor of 16 (Average Type = Point). With 1 μ s pulse width setting. S96025B software is required. (Minimum pulse width with S96024B is 50 μ s.)

Table 44. Pulse modulation (source modulators) – Typical

| Description | Typical |
|----------------------|-----------|
| Minimum pulse width | 200 ns |
| Minimum pulse period | 1 μ s |
| Maximum pulse period | 10 s |

Enhanced Time Domain Analysis with TDR (with S96011B)

This section provides specifications for the enhanced time domain analysis on the E5080B ENA. The S96011B Software is required to enable enhanced time domain analysis functions of the E5080B.

Table 45. Key specifications of enhanced time domain analysis

| Description | | Option 2K0/4K0/4 K2 | Option 2H0/4H0/4 H2 | Option 2D0/4D0/4 D2 | Option 290/490/49 2 | Option 260/460/46 2 | Option 240/440/442 |
|--|-------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|-----------------------|
| Bandwidth | Spec. | 20 GHz | 18 GHz | 14 GHz | 9 GHz | 6.5 GHz | 4.5 GHz |
| Input impedance | Nom. | 50 Ω | 50 Ω | 50 Ω | 50 Ω | 50 Ω | 50 Ω |
| DC damage level at test port | Spec. | 35 V | 35 V | 35 V | 35 V | 35 V | 35 V |
| Maximum test port input voltage (Hot TDR mode) | Typ. | 1.5 Vpp | 1.5 Vpp | 1.5 Vpp | 1.5 Vpp | 1.5 Vpp | 1.5 Vpp |
| TDR stimulus ¹ | Nom. | Step, Impulse | Step, Impulse | Step, Impulse | Step, Impulse | Step, Impulse | Step, Impulse |
| TDR step amplitude ² | Nom. | 1 mV to 5 V | 1 mV to 5 V | 1 mV to 5 V | 1 mV to 5 V | 1 mV to 5 V | 1 mV to 5 V |
| TDR step rise time ³ (min) (10% to 90%) | Spec. | 22.3 ps | 24.8 ps | 31.9 ps | 49.6 ps | 68.6 ps | 99.1 ps |
| TDR step response resolution in free space ⁴ (εr = 1) (min) | Nom. | 3.3 mm | 3.7 mm | 4.8 mm | 7.4 mm | 10.3 mm | 14.9 mm |
| TDR impulse width (min) ³ | Spec. | 30.2 ps | 33.6 ps | 43.1 ps | 67.1 ps | 92.9 ps | 135 ps |
| TDR deskew range (max) ⁵ (test cable length) | Typ. | 50 ns | 50 ns | 50 ns | 50 ns | 50 ns | 50 ns |
| DUT length (max) ⁶ | Spec. | 13.8 μs | 13.8 μs | 13.8 μs | 13.8 μs | 13.8 μs | 13.8 μs |
| TDR stimulus repetition rate (max) | Spec. | 19.9 MHz | 17.9 MHz | 13.9 MHz | 8.9 MHz | 6.4 MHz | 4.4 MHz |
| RMS noise level ⁷ | Typ. | 60 μVrms | 60 μVrms | 60 μVrms | 60 μVrms | 60 μVrms | 60 μVrms |
| Eye diagram data rate (max) ⁸ | Spec. | 16 Gb/s | 14.4 Gb/s | 11.2 Gb/s | 7.2 Gb/s | 5.2 Gb/s | 3.6 Gb/s |

1. The time domain function of the S96011B is similar to the time domain reflectometry (TDR) measurement on a TDR oscilloscope in that it displays the response in the time domain. In the TDR oscilloscope measurement, a pulse or step stimulus is input to the DUT and the change of the reflected wave over time is measured. In the S96011B TDR measurement, a sine wave stimulus is input to the DUT and the change of the reflected wave over frequency is measured. Then, the frequency domain response is transformed to the time domain using the Inverse Fourier Transform.
2. The TDR step amplitude setting does not vary the actual stimulus level input to the device but is used when calculating the Inverse Fourier Transform.
3. Minimum values may be limited by the DUT length setting.
4. To convert from rise time to response resolution, multiply the rise time by c, the speed of light in free space. To calculate the actual physical length, multiply this value in free space by vf, the relative velocity of propagation in the transmission medium. (Most cables have a relative velocity of 0.66 for a polyethylene dielectric or 0.7 for a PTFE dielectric.)
5. Using high quality cables to connect the DUT is recommended in order to minimize measurement degradation. The cables should have low loss, low reflections, and minimum performance variation when flexed.
6. Maximum DUT length is the sum of the DUT and test cable lengths. Settable DUT length (max) is 1.25 μs.
7. RMS noise level with 50 Ω DUT and default setup.
8. Maximum values may be limited by the DUT length setting.

| Description | | Option 2P0/4P0/4P2 | Option 2N0/4N0/4N2 | Option 2M0/4M0/4M2 | Option 2L0/4L0/4L2 |
|--|-------|---|---|---|---|
| Bandwidth | Spec. | 53 GHz | 44 GHz | 32 GHz | 26.5 GHz |
| Input impedance | Nom. | 50 Ω | 50 Ω | 50 Ω | 50 Ω |
| DC damage level at test port | Spec. | 35 V | 35 V | 35 V | 35 V |
| Maximum test port input voltage (Hot TDR mode) | Typ. | 1.5 V (100 kHz to 20 GHz) 0.9 V (20 GHz to 30 GHz) 0.7 V (30 GHz to 40 GHz) 0.5 V (40 GHz to 53 GHz) | 1.5 V (100 kHz to 20 GHz) 0.9 V (20 GHz to 30 GHz) 0.7 V (30 GHz to 40 GHz) 0.5 V (40 GHz to 44 GHz) | 1.5 V (100 kHz to 20 GHz) 0.9 V (20 GHz to 30 GHz) 0.7 V (30 GHz to 32 GHz) | 1.5 V (100 kHz to 20 GHz) 0.9 V (20 GHz to 26.5 GHz) |
| TDR stimulus ¹ | Nom. | Step, Impulse | Step, Impulse | Step, Impulse | Step, Impulse |
| TDR step amplitude ² | Nom. | 1 mV to 5 V | 1 mV to 5 V | 1 mV to 5 V | 1 mV to 5 V |
| TDR step rise time ³ (min) (10% to 90%) | Spec. | 8.42 ps | 10.2 ps | 14 ps | 16.9 ps |
| TDR step response resolution in free space ⁴ ($\epsilon_r = 1$) (min) | Nom. | 1.3 mm | 1.5 mm | 2.1 mm | 2.5 mm |
| TDR impulse width (min) ³ | Spec. | 11.4 ps | 13.8 ps | 18.9 ps | 22.8 ps |
| TDR deskew range (max) ⁵ (test cable length) | Typ. | 50 ns | 50 ns | 50 ns | 50 ns |
| DUT length (max) ⁶ | Spec. | 1.25 μ s | 1.25 μ s | 1.25 μ s | 1.25 μ s |
| TDR stimulus repetition rate (max) | Spec. | 52.9 MHz | 43.9 MHz | 31.9 MHz | 26.4 MHz |
| RMS noise level ⁷ | Typ. | 120 μ Vrms | 80 μ Vrms | 80 μ Vrms | 80 μ Vrms |
| Eye diagram data rate (max) ⁸ | Spec. | 42.4 Gb/s | 35.2 Gb/s | 25.6 Gb/s | 21.2 Gb/s |

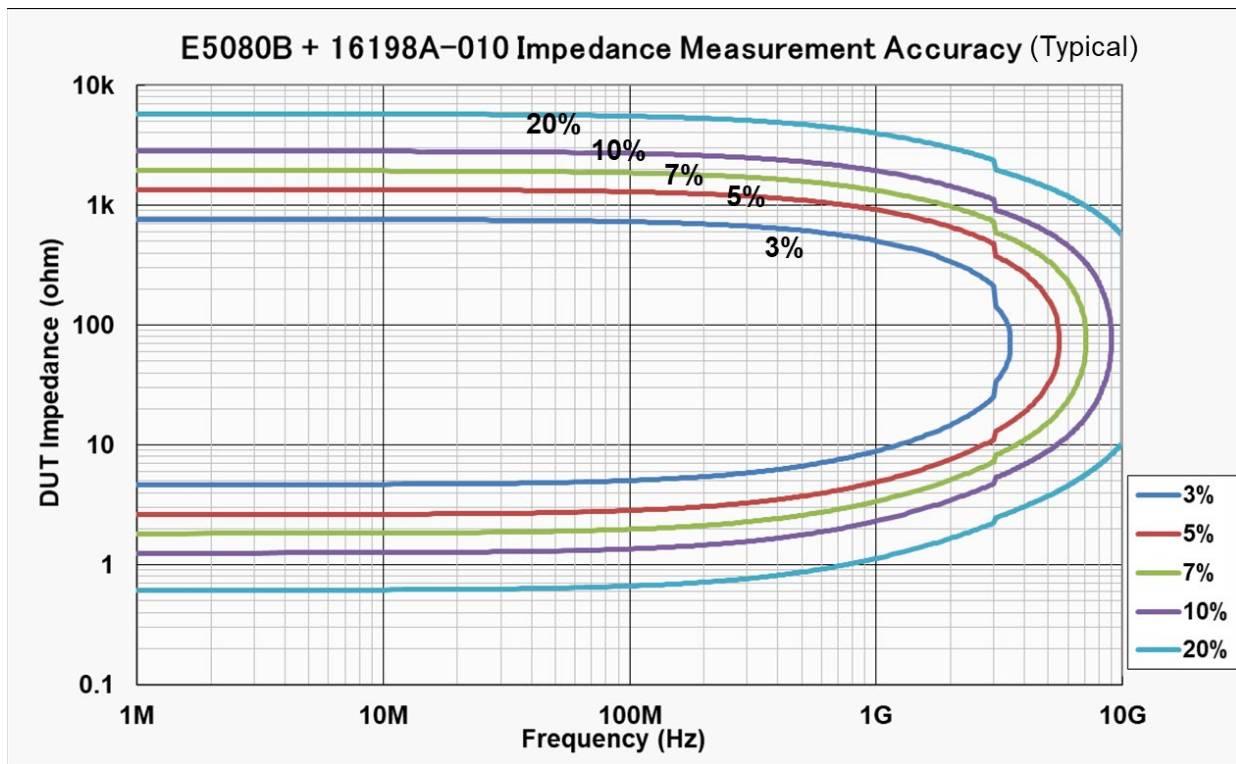
1. The time domain function of the S96011B is similar to the time domain reflectometry (TDR) measurement on a TDR oscilloscope in that it displays the response in the time domain. In the TDR oscilloscope measurement, a pulse or step stimulus is input to the DUT and the change of the reflected wave over time is measured. In the S96011B TDR measurement, a sine wave stimulus is input to the DUT and the change of the reflected wave over frequency is measured. Then, the frequency domain response is transformed to the time domain using the Inverse Fourier Transform.
2. The TDR step amplitude setting does not vary the actual stimulus level input to the device but is used when calculating the Inverse Fourier Transform.
3. Minimum values may be limited by the DUT length setting.
4. To convert from rise time to response resolution, multiply the rise time by c , the speed of light in free space. To calculate the actual physical length, multiply this value in free space by v_f , the relative velocity of propagation in the transmission medium. (Most cables have a relative velocity of 0.66 for a polyethylene dielectric or 0.7 for a PTFE dielectric.)
5. Using high quality cables to connect the DUT is recommended in order to minimize measurement degradation. The cables should have low loss, low reflections, and minimum performance variation when flexed.
6. Maximum DUT length is the sum of the DUT and test cable lengths. Settable DUT length (max) is 1.25 μ s.
7. RMS noise level with 50 Ω DUT and default setup.
8. Maximum values may be limited by the DUT length setting.

Impedance Analysis (with S96041B)

This section provides typical measurement accuracy for impedance analysis on the E5080B ENA with 16198A option 010 10 GHz test fixture. The 16198A option 010 is connected with the E5080B's options up to 20 GHz with either Type-N or 3.5-mm connectors. The S96041B Software is required to enable impedance analysis functions of the E5080B.

Impedance measurement accuracy¹ – Typical

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0/442/462/492/4D2/4H2/4K2 (without bias tee options)



1. At source power of -18 to -16 dBm, ≤ 100 Hz IF bandwidth, without bias-tee options (option 120 or 140). Full 1-port calibration is performed with 85052DH02 cal kit at the 3.5-mm coaxial connector of 16198A-010's adapter, and open/short fixture compensation is performed on the 16198A-010's measurement surface. Typical performance is valid for calibration temperatures of $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ and $< 1^{\circ}\text{C}$ deviation from the calibration temperature.

General Information

Table 46. Miscellaneous information

| Description | Specification |
|---------------------------|---|
| System IF bandwidth range | 1 Hz to 15 MHz |
| Number of points | 1 to 100,003 |
| Operating System | Windows 10 (Supports both 32-bit and 64-bit applications) |

Table 47. Front panel information

| Description | Specification |
|----------------------|--|
| RF connectors | |
| Connector type | Type-N female (Option 240/260/290/440/460/490/442/462/492, 2D0/2H0/4D0/4H0/4D2/4H2 with option 1NC) 3.5 mm male (Option 2D0/2H0/2K0/2L0/4D0/4H0/4K0/4L0/4D2/4H2/4K2/4L2) 2.4 mm male (Option 2M0/2N0/4M0/4N0/4M2/4N2) 1.85 mm male (Option 2P0/4P0/4P2) |
| Impedance | 50 Ω (nominal) |
| USB ports | |
| Standard | Compatible with USB 2.0 |
| Connector | USB Type-A female |
| Display | |
| Size | 31 cm (12.1 inch) diagonal color active matrix LCD with multi-touch screen |
| Resolution | 1280 (horizontal) X 800 (vertical) resolution ¹ |

1. Valid pixels are 99.99% and more. Below 0.02% of fixed points of black, blue, green or red are not regarded as failure.

Table 48. Side panel information

| Description | Specification |
|-------------------|--|
| Display output | DisplayPort and VGA (supports up to two simultaneous displays) |
| GPIB (Option 172) | 24-pin D-Sub (Type D-24), female; compatible with IEEE-488 |
| USB ports | Four USB ports, one USB device port ¹ |
| LAN | Two Gigabit Ethernet, RJ-45 LAN ports |

1. USB Test and Measurement Class (TMC) interface that communicates over USB, complying with the IEEE 488.1 and IEEE 488.2 standards.

Table 49. Rear panel information

| Description | Specification |
|-------------------------------|---------------|
| External trigger input | |
| Connector | BNC female |

| Description | Specification |
|--|--|
| Input level | Low threshold voltage: 0.5 V, High threshold voltage: 2.1 V. Input level range: 0 to +5 V. |
| Pulse width | $\geq 2 \mu\text{s}$ |
| Polarity | Positive or negative |
| External trigger output / Meas trig ready output | |
| Connector | BNC female |
| Maximum output current | 50 mA |
| Output level | Low level voltage: 0 V, High level voltage: 5 V |
| Pulse width | 1 μs (External Trigger Output only) |
| Polarity | Positive or negative |
| External reference input – Typical | |
| Connector | BNC female |
| Input frequency | 10 MHz \pm 10 ppm |
| Input level | -3 to +10 dBm |
| Input impedance | 50 Ω (nominal) |
| Internal reference output – Typical | |
| Connector | BNC female |
| Output frequency | 10 MHz \pm 7 ppm |
| Output level | 0 dBm \pm 3 dB into 50 Ω |
| Output impedance | 50 Ω (nominal) |
| Internal reference signal oven (Option 1E5) – Typical | |
| Connector | BNC female |
| Output frequency | 10 MHz \pm 0.45 ppm |
| Output level | 0 dBm minimum |
| Application I/O port | |
| Connector | 15-pin D-sub connector (female), Provides access to pulse modulators and generators |
| Device test I/O port | |
| Connector | 25-pin D-sub connector (female), Provides serial and parallel digital signals for controlling device under test. Two independent 8-bit I/O |
| Power Supply (VIO1, VIO2) | |
| Output voltage | +0.9 to +3.5 V, 0.05 V step |
| Voltage accuracy | $\pm 5 \%$ |
| Maximum output current | 100 mA/group |
| Input signal | |
| Input voltage range | 0 V to VIO (V) |
| Minimum high-level input voltage | +2.0V (at VIO = +3.3 V), +1.17 V (at VIO = +1.8 V) +0.78 V (at VIO = +1.2 V) |
| Maximum high-level input voltage | +0.8 V (at VIO = +3.3 V), +0.63 V (at VIO = +1.8 V) +0.42 V (at VIO = +1.2 V) |
| Output signal | |
| Minimum high-level input voltage | VIO – 0.1 V (at I _o = -100 μA) |

| Description | Specification |
|--|--|
| Maximum high-level input voltage | +0.1 V (at I _o = 100 μA) |
| Bias tee inputs (Option 120 or 140) - Typical | |
| Connector | BNC female |
| Damage level | ± 35 V, 500 mA DC (with internal resettable fuse) |
| Maximum bias current ¹ | ± 300 mA |
| Maximum bias voltage ¹ | ± 0 VDC at 9 kHz to 300 kHz ± 10 VDC at 300 kHz to 1 MHz ± 15 VDC at 1 MHz to 10 MHz ± 20 VDC at 10 MHz to 20 GHz ± 10 VDC at 300 kHz to 1 MHz |
| Handler I/O port | |
| Connector | 36-pin Centronics, female; provides connection to handler system |
| Line power | |
| Frequency, voltage | 50/60 Hz for 100 to 240 VAC |
| Maximum power | 350 W |
| Typical power consumption ² | 120 W (Option 240/260/290/2D0/2K0) 145 W (Option 440/460/490/4D0/4K0) 172 W (Option 442/462/492/4D2/4K2) 129 W (Option 2L0/2M0/2N0/2P0) 172 W (Option 4L0/4M0/4N0/4P0/4L2/4M2/4N2/4P2) |

1. No degradation in RF specifications.

2. At preset.

Table 50. AUX Input and Output Information (Option 175)

| Description | Specification | Typical |
|--------------------------------------|---------------|------------|
| AUX input | | |
| Number of ports | | 4 |
| Connector type | | BNC female |
| Input voltage range | | ± 10 V |
| Damage voltage level | | ± 15 V |
| Accuracy ¹ | 1% ± 10 mV | |
| AUX output | | |
| Number of ports | | 2 |
| Connector type | | BNC female |
| Output voltage range | | ± 10 V |
| Output voltage resolution | | 5.4 mV |
| Output voltage accuracy ² | 1% ± 20 mV | |
| Maximum output current | ± 200 mA | |

1. When IF Bandwidth is set to ≥ 300 kHz.





2. The specification does not meet when current overload occurs.

Table 51. Environmental and physical specifications

| Description | | |
|-----------------------|---|--|
| Description | Samples of this product have been type tested in accordance with the Keysight Environmental Test Manual and verified to be robust against the environmental stresses of Storage, Transportation and End-use; those stresses include, but are not limited to, temperature, humidity, shock, vibration, altitude, and power line conditions. Test Methods are aligned with IEC 60068-2 and levels are similar to MIL-PRF-28800F Class 3. | |
| Temperature | Operating | 0 to 40 °C ambient |
| | Non-operating | -10 to 60 °C |
| Humidity | Operating | Type tested at 20 to 80 %, wet bulb temperature < 29 °C (non-condensing) |
| | Non-operating | Type tested at 20 to 90 %, wet bulb temperature < 40 °C (non-condensing) |
| Altitude | Operating | Up to 2,000 meters (6,561 feet) |
| | Non-operating | Up to 4,572 meters (15,000 feet) |
| Vibration | Operating | 0.21 G maximum, 5 Hz to 500 Hz |
| | Non-operating | 0.5 G maximum, 5 Hz to 500 Hz |
| Instrument protection | IP 30 IEC/EN 60529 | |
| Warm-up time | 90 minutes | |

Table 52. Regulatory and safety compliance

EMC ¹

| | |
|--|--|
| Complies with the essential requirements of the European EMC Directive as well as current editions of the following standards (dates and editions are cited in the Declaration of Conformity). | |
|  | The CE mark is a registered trademark of the European Community (if accompanied by a year, it is the year when the design was proven). This product complies with all relevant directives. <ul style="list-style-type: none"> • IEC 61326-1 • CISPR 11 Group 1, Class A |
|  | UK conformity mark is a UK government owned mark. When affixed to the product is declaring all applicable Directives and Regulations have been met in full. |
| CAN ICES/NMB-001(A) | This ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB du Canada. |
|  | The RCM mark is a registered trademark of the Australian Communications and Media Authority. <ul style="list-style-type: none"> • AS/NZS CISPR 11 |
|  | South Korean Certification (KC) mark; includes the marking's identifier code: R-R-Kst-WN18530 South Korean Class A EMC declaration: Information to the user: This equipment has been conformity assessed for use in business environments. In a residential environment this equipment may cause radio interference. ※ This EMC statement applies to the equipment only for use in business environment. |

EMC ¹

사용자 안내문

이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.

※ 사용자 안내문은 “업무용 방송통신기자재”에만 적용한다.

Instrument calibration cycle

1 year

Safety ¹

Complies with the essential requirements of the European Low Voltage Directive as well as current editions of the following standards (dates and editions are cited in the Declaration of Conformity).

This product is designed for use in INSTALLATION CATEGORY II and POLLUTION DEGREE 2 and MEASUREMENT CATEGORY NONE per IEC standards.

This product is intended for indoor use.



ISM 1-A

- IEC/EN 61010-1



c us

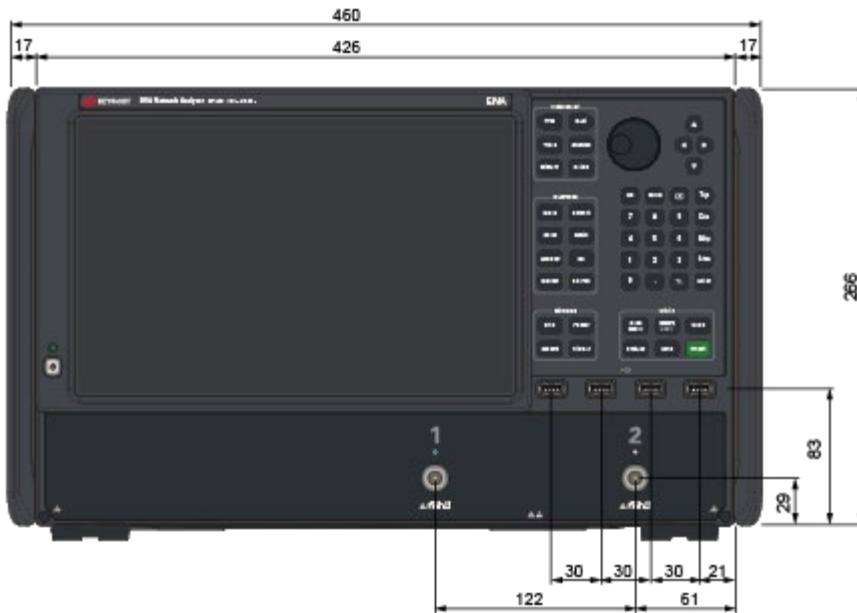
The CSA mark is a registered trademark of the CSA International.

- Canada: CSA C22.2 No. 610610-1
- USA: UL std no. 61010-1

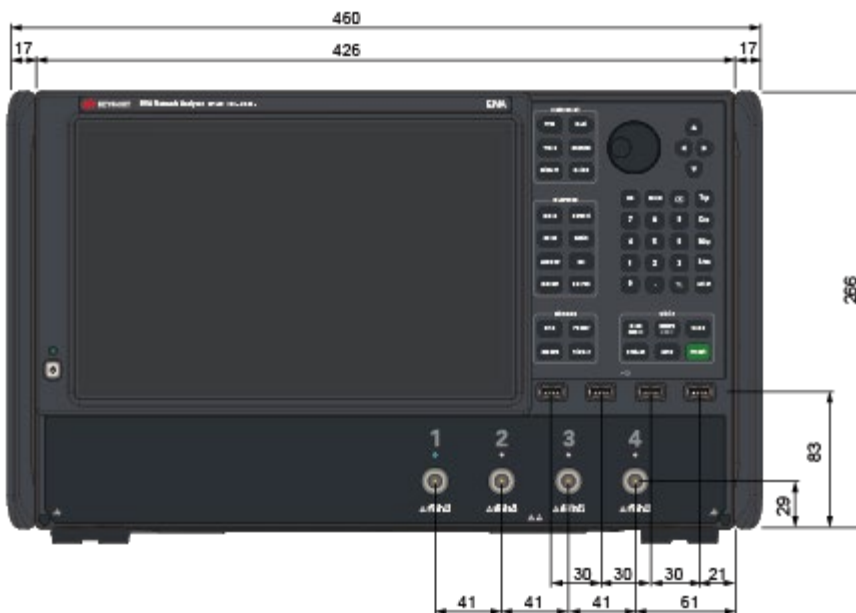
1. To find a current Declaration of Conformity for a specific Keysight product, go to: <http://www.keysight.com/go/conformity>

Table 53. Physical size and weight

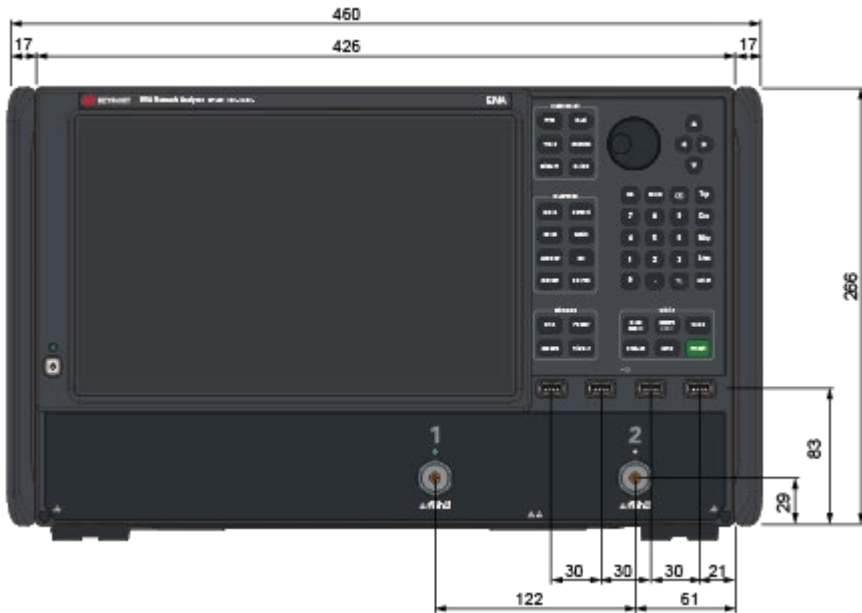
| Description | Characteristics | Note |
|-------------|--|-----------------|
| Weight | Option 240/260/290/2D0/2H0/2K0/2L0/2M0/2N0/2P0: 14 kg Option 440/460/490/4D0/4H0/4K0/4L0/4M0/4N0/4P0/ 442/462/492/4D2/4H2/4K2/4L2/4M2/4N2/4P2: 15 kg | Without handles |



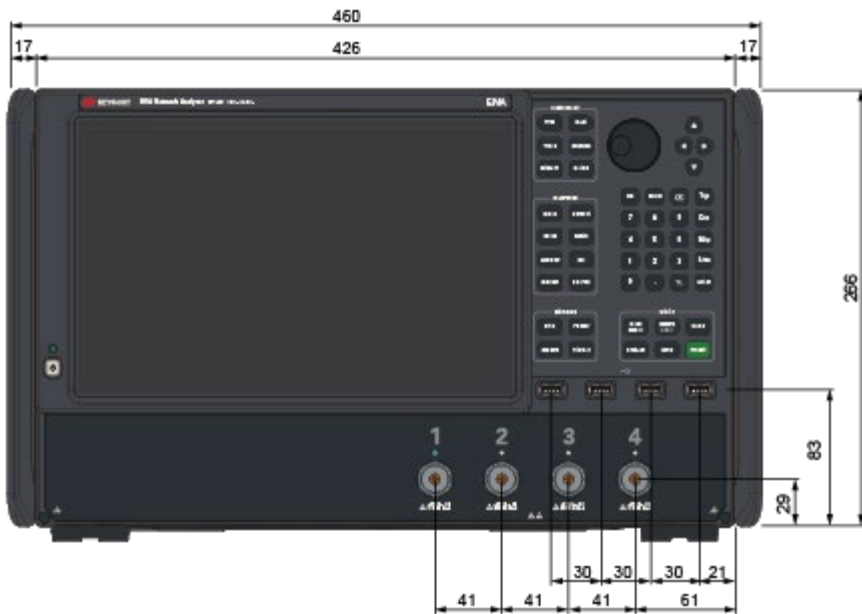
Dimensions (front view, E5080B with option 240/260/290, 2D0/2H0 + option 1NC (Type-N connectors), in millimeters)



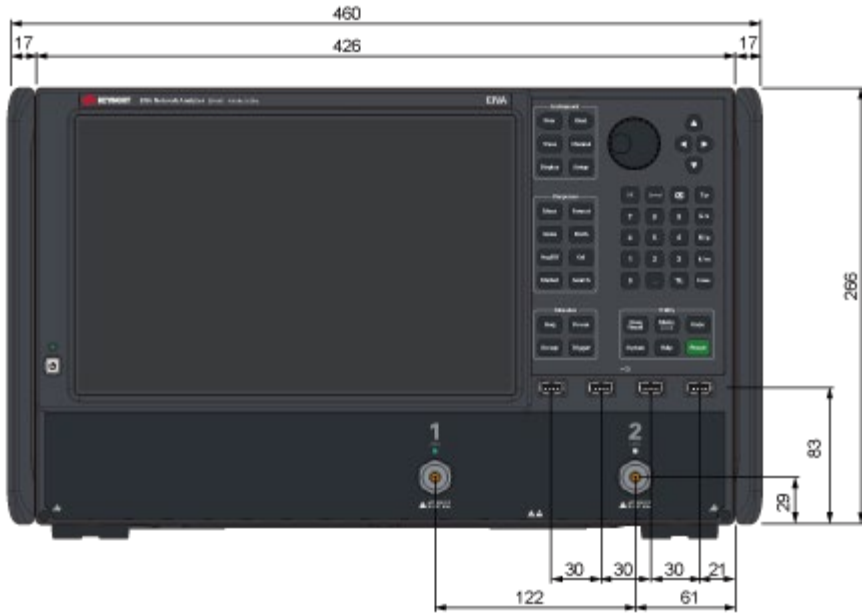
Dimensions (front view, E5080B with option 440/460/490/442/462/492, 4D0/4H0/4D2/4H2 + option 1NC (Type-N connectors), in millimeters)



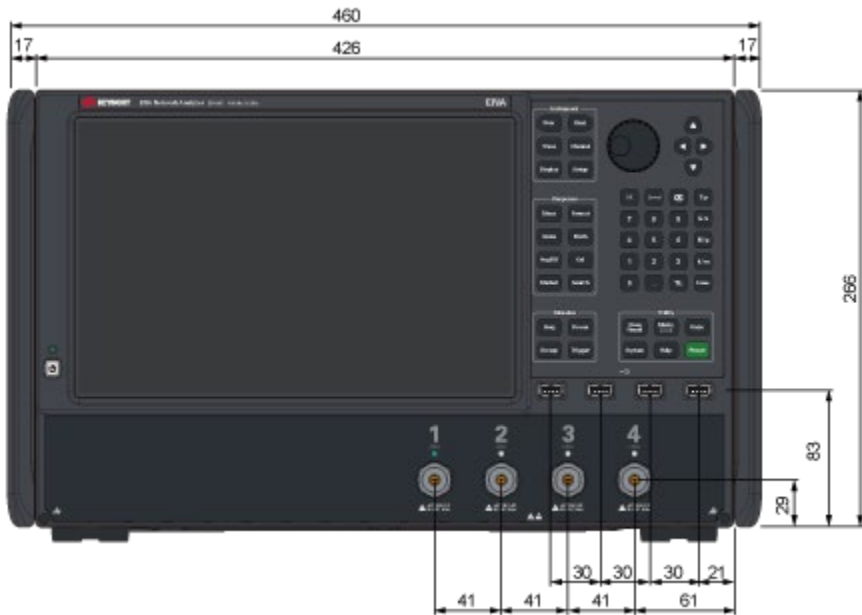
Dimensions (front view, E5080B with option 2D0/2H0/2K0/2L0 (3.5 mm connectors), in millimeters)



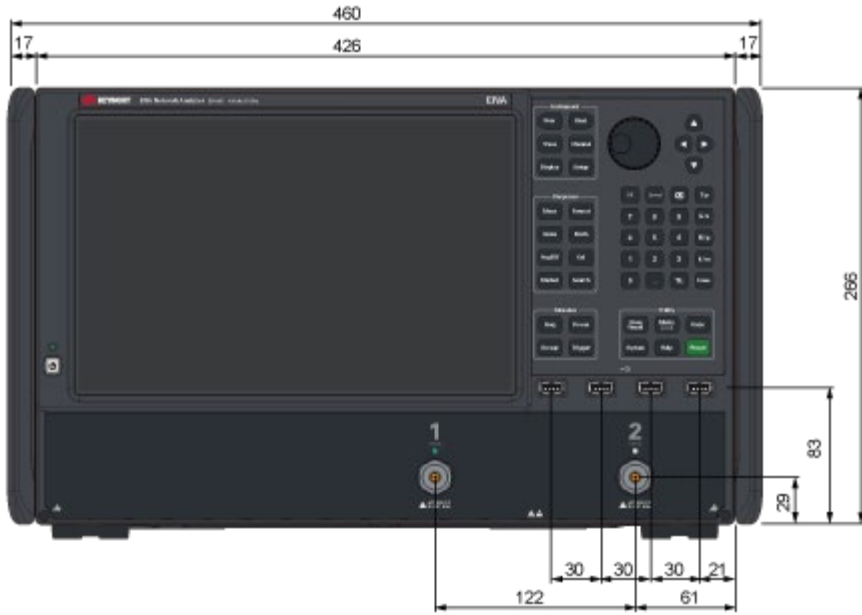
Dimensions (front view, E5080B with option 4D0/4H0/4K0/4L0/4D2/4H2/4K2/4L2 (3.5 mm connectors), in millimeters)



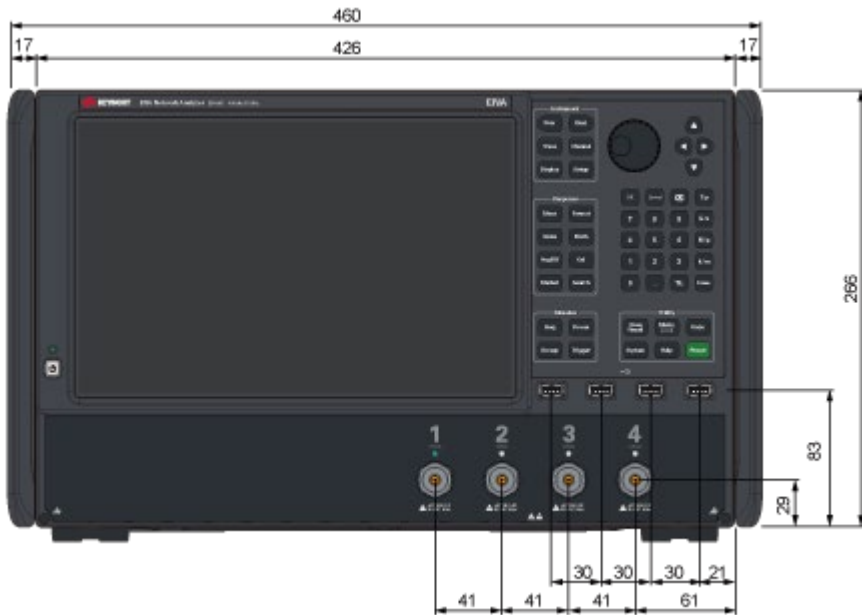
Dimensions (front view, E5080B with option 2M0/2N0 (2.4 mm connectors), in millimeters)



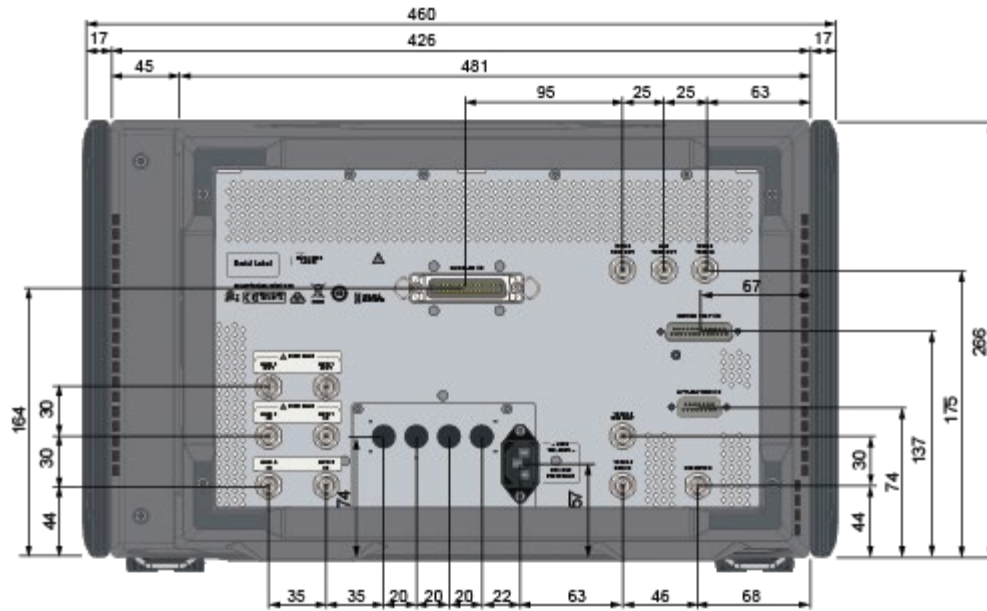
Dimensions (front view, E5080B with option 4M0/4N0/4M2/4N2 (2.4 mm connectors), in millimeters)



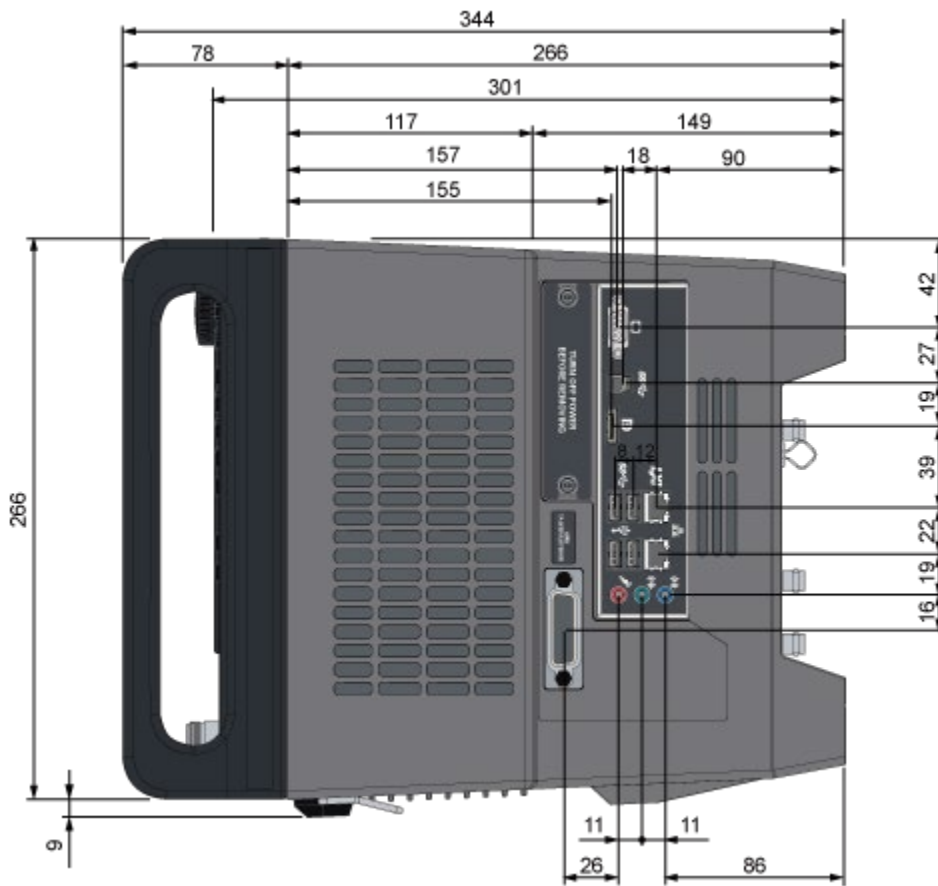
Dimensions (front view, E5080B with option 2P0 (1.85 mm connectors), in millimeters)



Dimensions (front view, E5080B with option 4P0/4P2 (1.85 mm connectors), in millimeters)



Dimensions (rear view, E5080B with option 1E5/175, in millimeters)



Dimensions (side view, E5080B with option 172 in millimeters)

Measurement Throughput

Table 54. Cycle time for measurement completion (milliseconds) ¹ – Typical

Option 240/260/290/2D0/2H0/2K0/440/460/490/4D0/4H0/4K0

| Description | Sweep mode: Auto | | | Sweep mode: Stepped | | |
|---|------------------|------|------|---------------------|------|------|
| 800 MHz – 1 GHz frequency span, 1 MHz IF bandwidth | | | | | | |
| Number of points | 201 | 401 | 1601 | 201 | 401 | 1601 |
| Uncorrected | 1.7 | 2.1 | 4.2 | 2.0 | 2.6 | 5.0 |
| 2-port calibration | 2.4 | 3.1 | 7.4 | 3.1 | 4.2 | 9.0 |
| 4-port calibration | 4.0 | 5.5 | 14.5 | 5.2 | 7.5 | 17.0 |
| 9 GHz – 10 GHz frequency span, 1 MHz IF bandwidth | | | | | | |
| Number of points | 201 | 401 | 1601 | 201 | 401 | 1601 |
| Uncorrected | 1.7 | 2.1 | 4.2 | 1.7 | 2.1 | 4.2 |
| 2-port calibration | 2.4 | 3.1 | 7.4 | 3.6 | 5.1 | 12.6 |
| 4-port calibration | 4.0 | 5.5 | 14.0 | 6.1 | 9.3 | 24.1 |
| 10 MHz – 9 GHz frequency span, 1 MHz IF bandwidth | | | | | | |
| Number of points | 201 | 401 | 1601 | 201 | 401 | 1601 |
| Uncorrected | 3.8 | 4.8 | 7.9 | 3.7 | 5.3 | 11.7 |
| 2-port calibration | 6.4 | 8.7 | 14.9 | 6.4 | 9.5 | 22.3 |
| 4-port calibration | 11.9 | 16.3 | 28.7 | 11.9 | 18.0 | 43.5 |
| 10 MHz – 20 GHz frequency span, 1 MHz IF bandwidth | | | | | | |
| Number of points | 201 | 401 | 1601 | 201 | 401 | 1601 |
| Uncorrected | 4.4 | 6.0 | 8.5 | 4.4 | 6.0 | 14.7 |
| 2-port calibration | 7.8 | 11.1 | 16.0 | 7.8 | 11.1 | 28.5 |
| 4-port calibration | 14.7 | 21.2 | 31.0 | 14.5 | 21.1 | 55.8 |

Option 2L0/2M0/2N0/2P0/4L0/4M0/4N0/4P0

| Description | Sweep mode: Auto | | | Sweep mode: Stepped | | |
|---|------------------|------|------|---------------------|------|------|
| 9 GHz – 10 GHz frequency span, 1 MHz IF bandwidth | | | | | | |
| Number of points | 201 | 401 | 1601 | 201 | 401 | 1601 |
| Uncorrected | 2.0 | 2.5 | 6.1 | 2.2 | 3.0 | 6.7 |
| 2-port calibration | 2.8 | 4.0 | 11.2 | 3.5 | 5.0 | 12.4 |
| 4-port calibration | 4.9 | 7.4 | 21.7 | 6.2 | 9.4 | 24.2 |
| 10 MHz – 26.5 GHz frequency span, 1 MHz IF bandwidth | | | | | | |
| Number of points | 201 | 401 | 1601 | 201 | 401 | 1601 |
| Uncorrected | 4.9 | 6.7 | 9.9 | 4.9 | 6.7 | 16.2 |
| 2-port calibration | 8.8 | 12.3 | 18.8 | 8.8 | 12.3 | 31.0 |

| Description | Sweep mode: Auto | | | Sweep mode: Stepped | | |
|---|------------------|------|------|---------------------|------|------|
| | | | | | | |
| 4-port calibration | 17.9 | 24.9 | 38.1 | 17.9 | 24.9 | 62.2 |
| 10 MHz – 40 GHz frequency span, 1 MHz IF bandwidth | | | | | | |
| Number of points | 201 | 401 | 1601 | 201 | 401 | 1601 |
| Uncorrected | 5.3 | 7.3 | 12.0 | 5.3 | 7.3 | 17.2 |
| 2-port calibration | 9.5 | 13.5 | 23.1 | 9.5 | 13.5 | 33.4 |
| 4-port calibration | 19.8 | 27.8 | 47.0 | 19.9 | 27.8 | 67.3 |
| 10 MHz – 53 GHz frequency span, 1 MHz IF bandwidth | | | | | | |
| Number of points | 201 | 401 | 1601 | 201 | 401 | 1601 |
| Uncorrected | 5.7 | 7.7 | 14.8 | 5.7 | 7.7 | 18.3 |
| 2-port calibration | 10.3 | 14.3 | 28.5 | 10.3 | 14.3 | 35.6 |
| 4-port calibration | 21.9 | 30.0 | 58.1 | 21.8 | 30.1 | 72.3 |

1. Analyzer display turned off with DISPlay:VISible OFF. Measured with firmware revision A.14.10.03. Data for one trace (S11) measurement. Uncorrected measurements are for one sweep direction. 2-port calibration is measured with a 2-port option. 4-port calibration is measured with a 4-port option.

Table 55. Data transfer time, all options (milliseconds) ¹ – Typical

| Number of points | 201 | 401 | 1601 |
|---|-----|-----|-------|
| SCPI over GPIB ² | | | |
| 64-bit floating point | 7.9 | 14 | 52 |
| 32-bit floating point | 4.8 | 8.0 | 27 |
| ASCII | 19 | 37 | 144 |
| SCPI over 1 Gbps LAN (socket) ² | | | |
| REAL 64 | 0.8 | 0.9 | 1.5 |
| REAL 32 | 1.0 | 0.8 | 1.1 |
| ASCII | 12 | 24 | 94 |
| SCPI over 1 Gbps (HiSLIP) ² | | | |
| REAL 64 | 1.3 | 1.3 | 2.0 |
| REAL 32 | 1.3 | 1.4 | 1.8 |
| ASCII | 3.4 | 5.2 | 14.8 |
| SCPI over USB (SICL-USB) ² | | | |
| REAL 64 | 1.7 | 1.9 | 2.3 |
| REAL 32 | 1.6 | 1.7 | 2.1 |
| ASCII | 1.7 | 2.6 | 9.3 |
| SCPI over GPIB/USB (82357B) | | | |
| REAL 64 | 11 | 18 | 53 |
| REAL 32 | 8.6 | 12 | 30 |
| ASCII | 140 | 281 | 1,125 |

1. Data transfer time varies depending on the type of PC and control software.

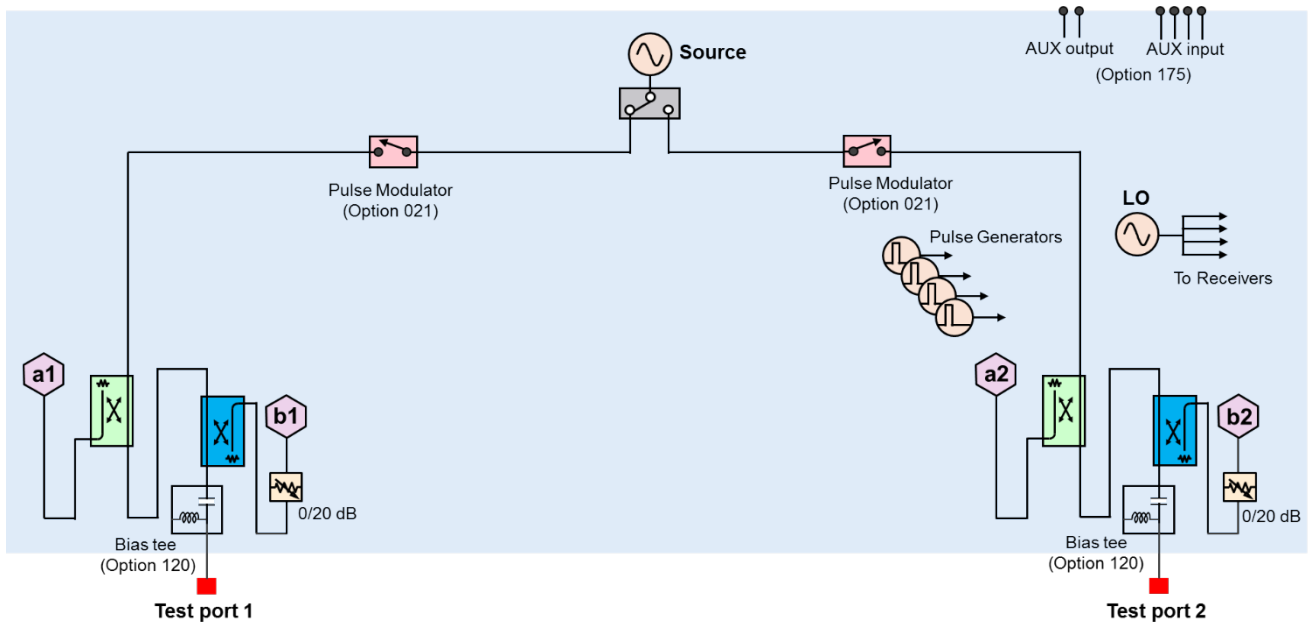
2. Transferred LogMag S11 data using :CALC:MEAS:DATA:FDAT?

Test Set Block Diagrams

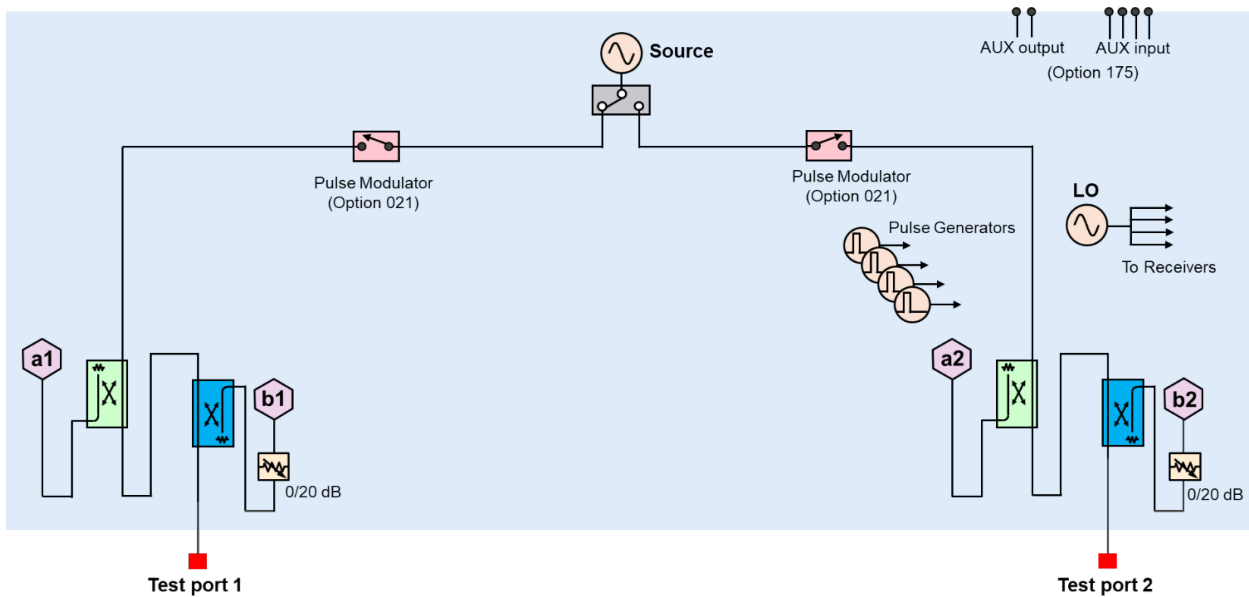
Legend



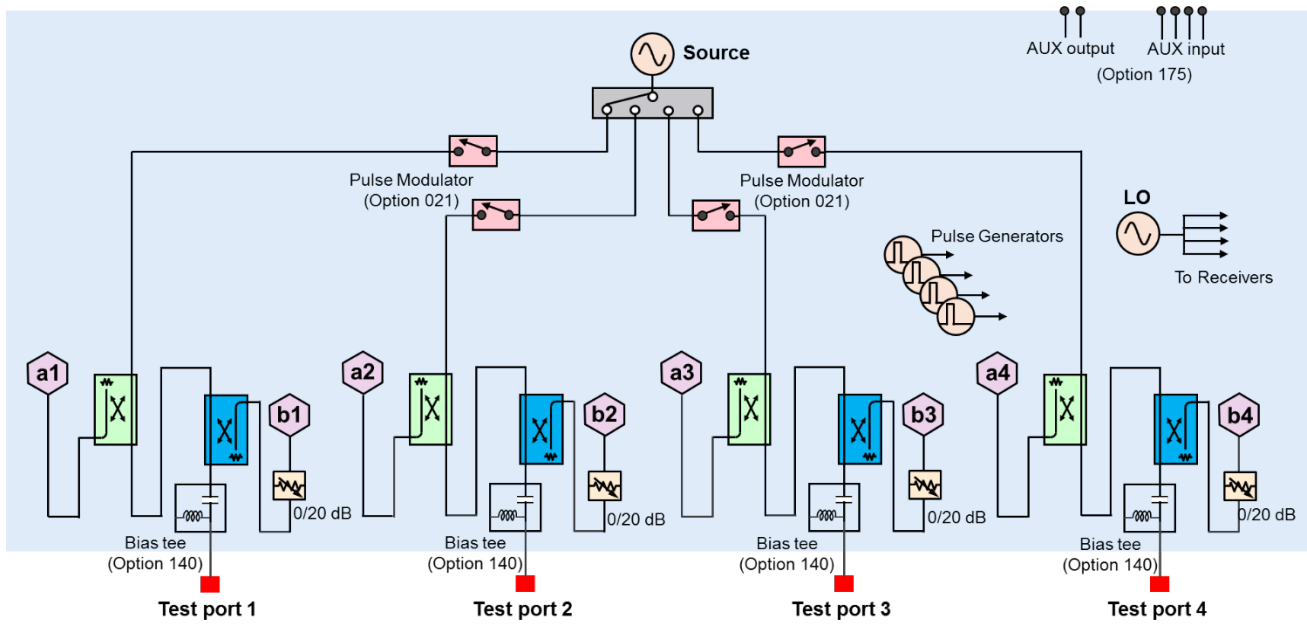
E5080B Option 240/260/290/2D0/2K0 (2-port base options)



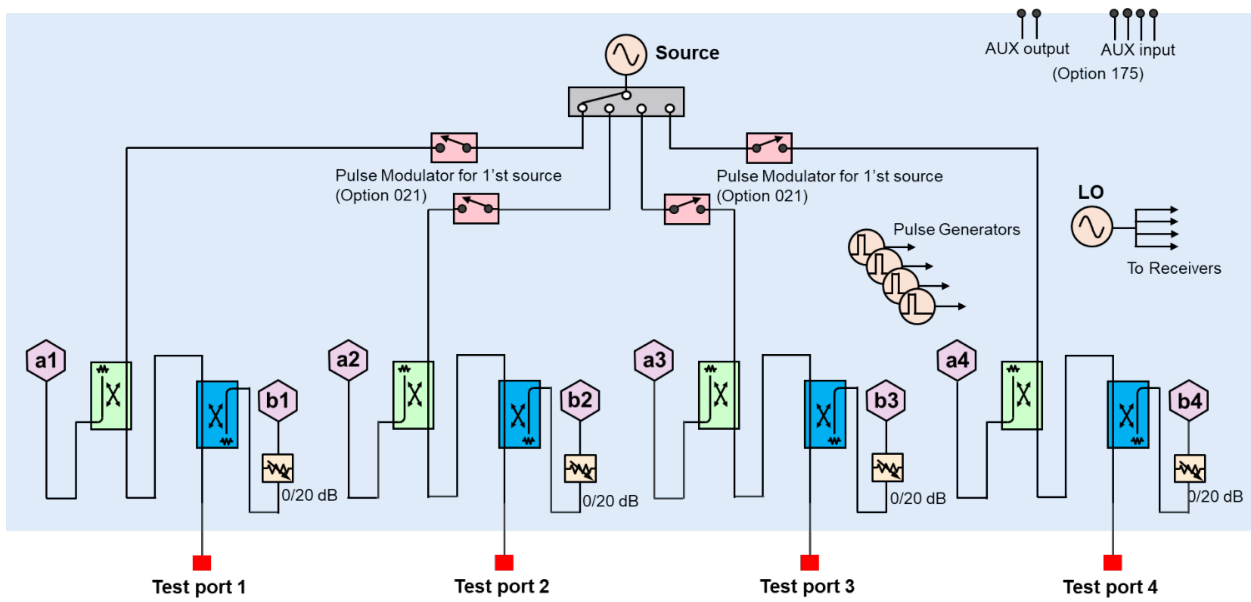
E5080B Option 2L0/2M0/2N0/2P0 (2-port base options)



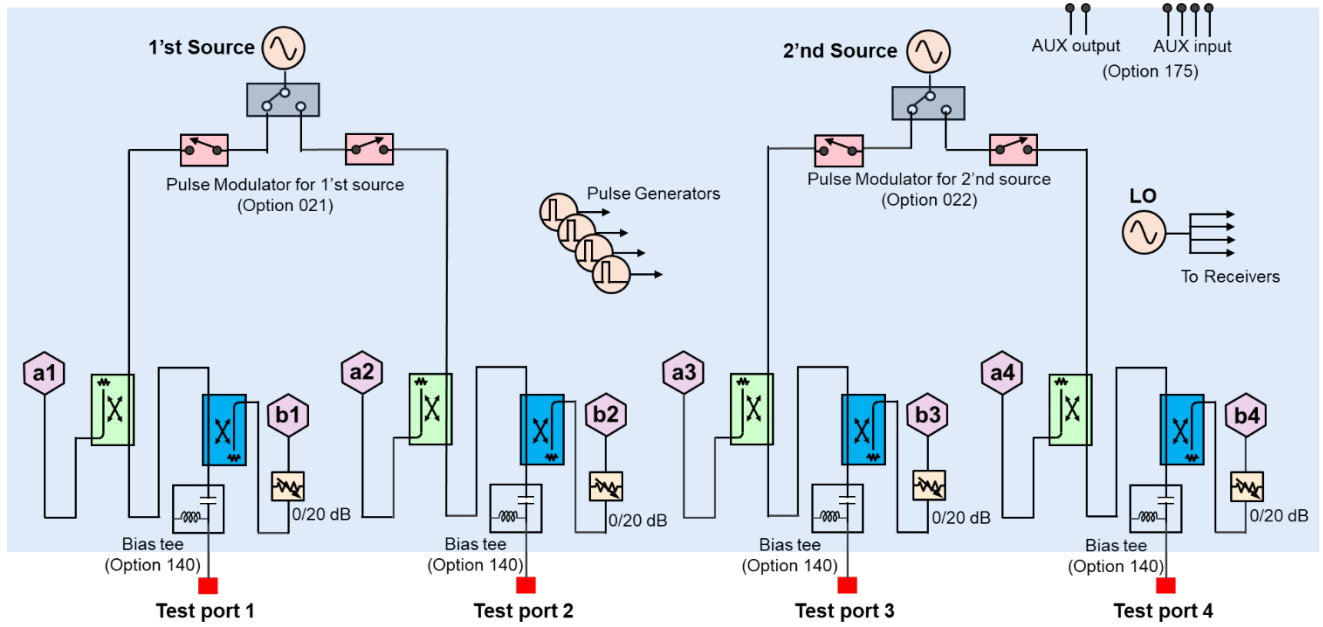
E5080B Option 440/460/490/4D0/4K0 (4-port base options)



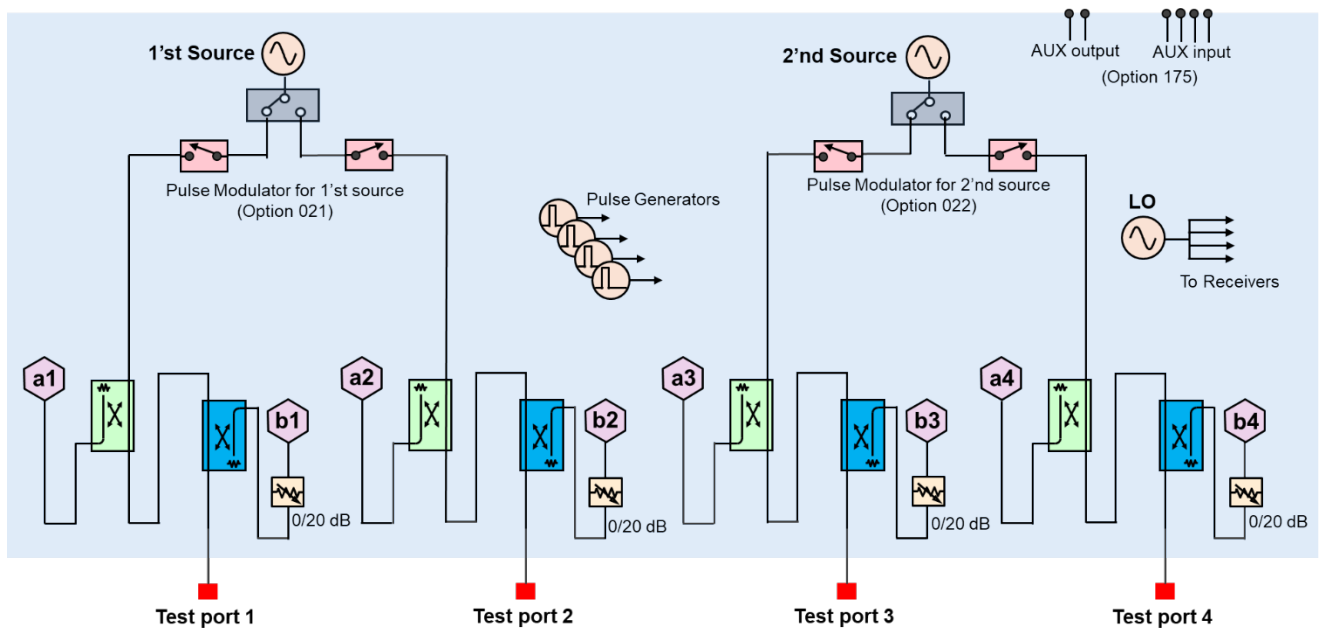
E5080B Option 4L0/4M0/4N0/4P0 (4-port base options)



E5080B Option 442/462/492/4D2/4K2 (4-port second source option)



E5080B Option 4L2/4M2/4N2/4P2 (4-port second source options)



E5092A Configurable Multiport Test Set

This section provides specifications of the E5092A configurable multiport test set. Regulatory and safety compliance for E5092A is same as E5080B (Table 52).

Table 56. Test set input/output performance

| Description | Specification | Typical |
|-----------------|------------------|------------------|
| Frequency range | 50 MHz to 20 GHz | -- |
| Damage level | -- | 20 dBm, ± 35 VDC |

Table 57. Port performance – Specification

| Description | SPDT switch ¹ | SP4T switch ² |
|---|--------------------------|--------------------------|
| Load match (selected port, dB) | | |
| 50 MHz to 2 GHz | 17 | 17 |
| 2 GHz to 3 GHz | 11 | 11 |
| 3 GHz to 4 GHz | 11 | 8 |
| 4 GHz to 8 GHz | 8 | 8 |
| 8 GHz to 10 GHz | 7 | 7 |
| 10 GHz to 20 GHz | 4 | 4 |
| Load match (unselected port, dB) | | |
| 50 MHz to 3 GHz | 17 | 17 |
| 3 GHz to 10 GHz | 11 | 11 |
| 10 GHz to 16 GHz | 8 | 8 |
| 16 GHz to 18 GHz | 6 | 6 |
| 18 GHz to 20 GHz | 4 | 4 |
| Load match (common port, dB) | | |
| 50 MHz to 1.3 GHz | 16 | 16 |
| 1.3 GHz to 2 GHz | 16 | 11 |
| 2 GHz to 4 GHz | 11 | 11 |
| 4 GHz to 8 GHz | 8 | 8 |
| 8 GHz to 10 GHz | 7 | 7 |
| 10 GHz to 20 GHz | 4 | 4 |
| Insertion Loss (dB) | | |
| 50 MHz to 100 MHz | 4 | 4 |
| 100 MHz to 2 GHz | 3.5 | 3.5 |
| 2 GHz to 3 GHz | 4.5 | 4.5 |
| 3 GHz to 4 GHz | 5 | 5.5 |
| 4 GHz to 6 GHz | 5.5 | 6 |
| 6 GHz to 8 GHz | 7 | 7.5 |
| 8 GHz to 10 GHz | 8 | 8.5 |

| Description | SPDT switch ¹ | SP4T switch ² |
|------------------|--------------------------|--------------------------|
| 10 GHz to 14 GHz | 8.5 | 9.5 |
| 14 GHz to 18 GHz | 10 | 10.5 |
| 18 GHz to 20 GHz | 11.5 | 12 |

1. SPDT: Single-pole-double-through switches.
2. SP4T: Single-pole-four-throw switches.

Description

| Stability per switch (dB/°C) | | |
|------------------------------|--------------------|--------------------|
| 50 MHz to 4 GHz | 0.003 ¹ | 0.007 ² |
| 4 GHz to 12 GHz | 0.005 ¹ | 0.012 ² |
| 12 GHz to 20 GHz | 0.008 ¹ | 0.017 ² |

1. Environment temperature +23 °C ± 3 °C and internal DC source: ≤ 100 mA (Sum of 4 channels), no heat source and no wall close to the unit.
2. Besides the above condition.

Description

| Isolation (dB) ¹ | |
|-----------------------------|-----------------|
| 50 MHz to 500 MHz | 65 |
| 500 MHz to 1 GHz | 80 |
| 1 GHz to 2 GHz | 85 |
| 2 GHz to 6 GHz | 90 |
| 6 GHz to 10 GHz | 85 |
| 10 GHz to 18 GHz | 75 |
| 18 GHz to 20 GHz | 65 ² |

1. This specification is defined when all ports are terminated with a 50 Ω load.
2. Over arbitrary test ports.

Table 58. Control line

| Description | Specification | Typical |
|----------------------------------|---|---|
| Number of groups | 4 Group A: 8 bits Group B, C, D: 4 bits | |
| Input voltage range ¹ | 0 to +5 V (positive input) -5 to 0 V (negative input) | |
| Maximum current | Group A, B: 50 mA in total of each group Group C, D: 500 μA in total of each group | |
| Impedance | | Group A, B: < 10 Ω, Group C, D: < 200 Ω |

1. Input voltage will be clipped at about ± 5.2 V when over this range.

Table 59. DC source

| Description | Specification | Typical |
|-------------------------|---|------------------------------------|
| Number of sources | 4 | |
| Output voltage range | | 0 to +5.2 V (nominal) ¹ |
| Output voltage accuracy | ± 3% of setting (+1 V to +5 V) at 1 MΩ load impedance | |
| Voltage resolution | | 10 mV (nominal) ² |
| Maximum current | 150 mA for each source | |
| Output impedance | | < 5 Ω |

1. The output voltage can be set in this range.

2. The output voltage resolution becomes effective between 0 V to 5.2 V.

Table 60. Storage environment

| Description | Typical | |
|-------------|---------------|--|
| Temperature | Operating | +5 to +40 °C ambient |
| | Non-operating | -10 to 60 °C |
| Humidity | Operating | 20 to 80 % at wet bulb temperature < +29 °C (non-condensing) |
| | Non-operating | 20 to 90% at wet bulb temperature < +40 °C (non-condensing) |
| Altitude | Operating | 0 to 2,000 meters (6,561 feet) |
| | Non-operating | 0 to 4,572 meters (15,000 feet) |
| Vibration | Operating | 0.21 G maximum, 5 Hz to 500 Hz |
| | Non-operating | 0.5 G maximum, 5 Hz to 500 Hz |

Table 61. Front panel information

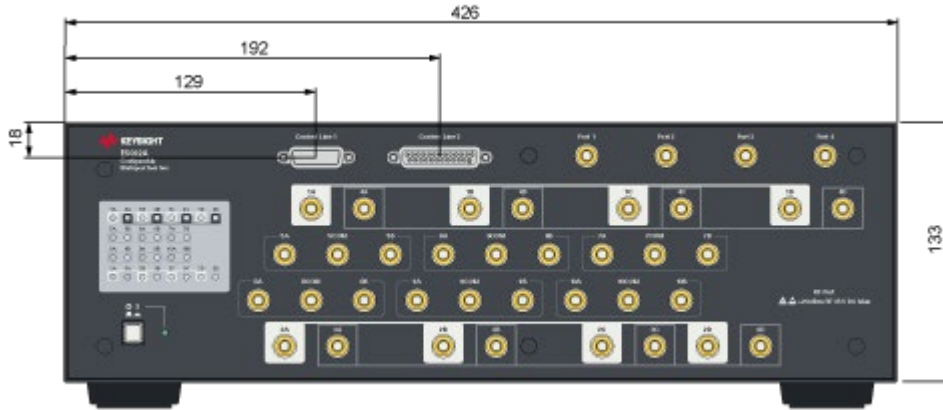
| Description | Typical |
|--------------|--|
| Connector | SMA female |
| Test ports | 38 ports |
| Control line | 15-pin D-sub female 25-pin D-sub female |

Table 62. Rear panel information

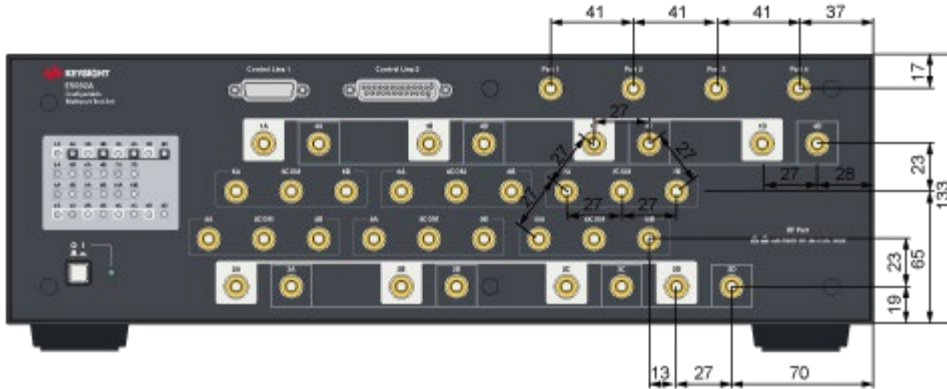
| Description | Typical |
|-------------------|---|
| USB port | Type B-receptacle, provide connection to the E5080B |
| Line power | |
| Frequency | 47 to 63 Hz |
| Voltage | 90 to 132 VAC, or 198 to 264 VAC (automatically switched) |
| VA max | 300 VA maximum |

Table 63. Physical size and weight

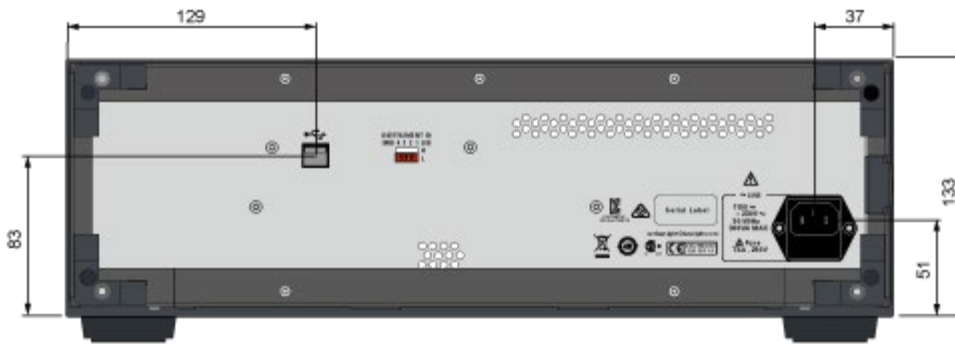
| Description | Typical |
|-------------|---------|
| Weight | 9 kg |



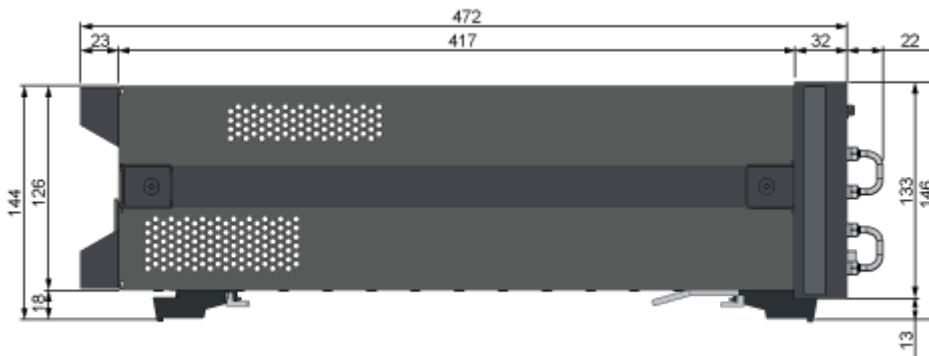
Dimensions (front view, E5092A with option 020, in millimeters)



Dimensions (pitch between switches, E5092A with option 020, in millimeters)



Dimensions (rear view, E5092A with option 020, in millimeters)



Dimensions (side view, E5092A with option 020, in millimeters)

Literature Information

- ENA and ENA-X Vector Network Analyzer – Configuration Guide, [5992-3842EN](#)
- Keysight Network Analyzer – Selection Guide, [5989-7603EN](#)
- Use the Right Vector Network Analyzer for the Job – Product Fact Sheet, [3121-1316.EN](#)
- 10 GHz Impedance Measurement on E5080B – Solution Brief, [3122-1166.EN](#)
- Keysight E5071C to E5080B Code Migration Guide, [5992-3873EN](#)
- Electronic Calibration (ECal) Modules for Network Analyzer – Technical Overview, [5963-3743E](#)

Web Resources

- Keysight Vector Network Analyzer Page - www.keysight.com/find/na
- Keysight ENA/ENA-X Vector Network Analyzer Page - www.keysight.com/find/ena
- Keysight Vector Network Analyzer Software Page - www.keysight.com/find/vnasoftware
- Keysight Electronic Calibration (ECal) Module Page - www.keysight.com/find/ecal

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