DATA SHEET

# M980xA Series
# PXIe Vector Network Analyzer
## 9 kHz to 20 GHz/100 kHz to 53 GHz

### Drive down the size of test

| | |
|---|---|
| M9800A | 9 kHz to 4.5 GHz |
| M9801A | 9 kHz to 6.5 GHz |
| M9802A | 9 kHz to 9 GHz |
| M9803A | 9 kHz to 14 GHz |
| M9804A | 9 kHz to 20 GHz |
| M9805A | 100 kHz to 26.5 GHz |
| M9806A | 100 kHz to 32 GHz |
| M9807A | 100 kHz to 44 GHz |
| M9808A | 100 kHz to 53 GHz |


KEYSIGHT TECHNOLOGIES

# M980xA Series PXIe Vector Network Analyzer

As the margins for multiport devices become tighter, your test equipment needs to be one step ahead. The Keysight M980xA PXIe Vector Network Analyzer (VNA) meets the most demanding multiport challenges with a true multiport architecture that offers exceptional performance no matter how many ports you use. Gain deeper insights into your devices with the widest available portfolio of measurement applications for PXI VNAs, including spectrum analysis, noise figure measurements, and more.

The M980xA Series offers the performance required for testing passive components, amplifiers, mixers or frequency converters. It provides best-in-class key PXI VNA specifications such as dynamic range, measurement speed, trace noise and temperature stability. Each module is a completely independent vector network analyzer with 2-, 4- or 6-ports up to 20 GHz, or 2-ports up to 53 GHz. The modules are easily configured as a true multiport VNA by using additional modules installed in the same chassis, and a VNA with up to 50-ports can be configured in a single chassis for multiport applications. All test ports are fully synchronous, so multiple ports can be measured simultaneously with multiport error correction applied.

The M980xA utilizes the same measurement science as other Keysight VNAs such as the PNA, ENA and Keysight 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.

# Table of Contents

## Definitions

**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 °C ± 5 °C range (unless otherwise stated).

The following conditions must be met:

- Module temperature is between 37 to 50 °C (2-port option), 40 to 53 °C (4-port option) and 43 to 56 °C (6-port option).
- Instrument has been turned on for 60 minutes with VNA application running.
- Instrument is within its calibration cycle.
- Instrument remains at a stable surrounding environment temperature (between -10 °C to 55 °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 °C ± 5 °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 M980xA vector network analyzer under the following conditions:

- No averaging applied to data

**Table 1. System Dynamic Range at Test Port (dB)[1]**

M9800A, M9801A, M9802A, M9803A, M9804A

| 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 |

M9805A, M9806A, M9807A, M9808A

| 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 | 100 | 115 |
| 50 GHz to 53 GHz | 72 | 101 |

1. System dynamic range = source maximum output power minus receiver noise floor at 10 Hz IF bandwidth. Does not include crosstalk effects.
2. It may typically be degraded at 25 MHz.

## Corrected System Performance

This section provides specifications for the corrected performance of the M980xA PXIe VNA using either of the 85032F, 85052D, 85058B Mechanical Calibration Kit or the N4691D, N4694D Electronic Calibration (ECal) Module. To determine transmission and reflection uncertainty curves with other calibration kits, please download Uncertainty Calculator from http://www.keysight.com/find/na_calculator to generate the curves for your specific calibration kit.

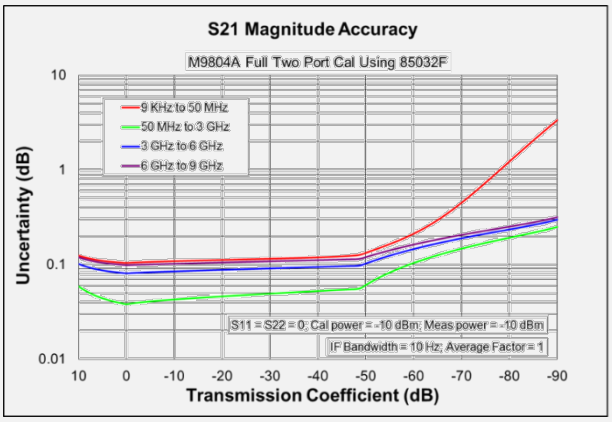
Measured with 10 Hz IF bandwidth, no averaging applied to data, environmental temperature = 23 °C (± 3 °C) with < 1 °C deviation from calibration temperature.

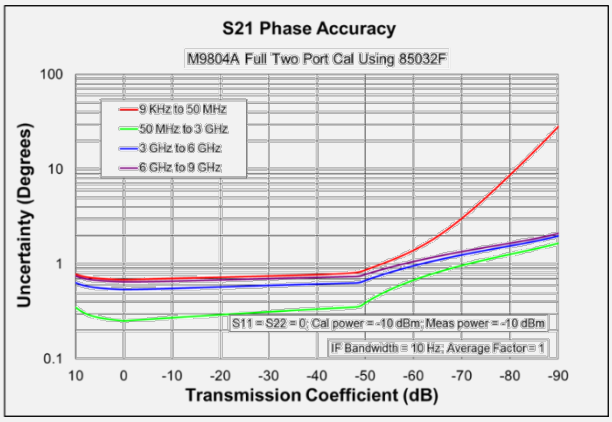
**Table 2. M9800A, M9801A, M9802A, M9803A or M9804A with 85032F Standard Mechanical Calibration Kit**

**Corrected error terms (dB) – Specifications**

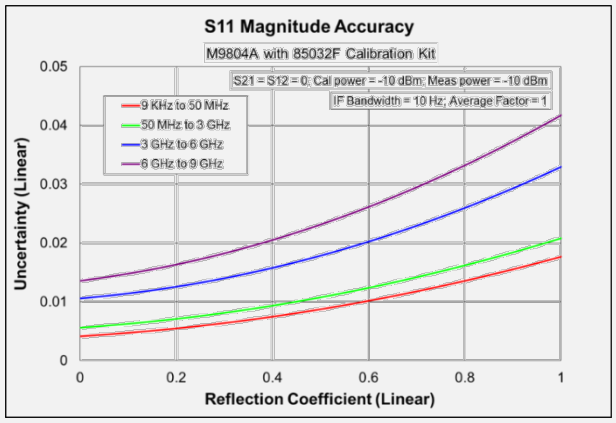
| Description | 9 kHz to 50 MHz | 50 MHz to 3 GHz | 3 GHz to 6 GHz | 6 GHz to 9 GHz |
|---|---|---|---|---|
| Directivity | 49 | 46 | 40 | 38 |
| Source match | 41 | 40 | 36 | 35 |
| Load match | 47 | 46 | 40 | 38 |
| Reflection tracking | ± 0.011 | ± 0.021 | ± 0.032 | ± 0.054 |
| Transmission tracking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

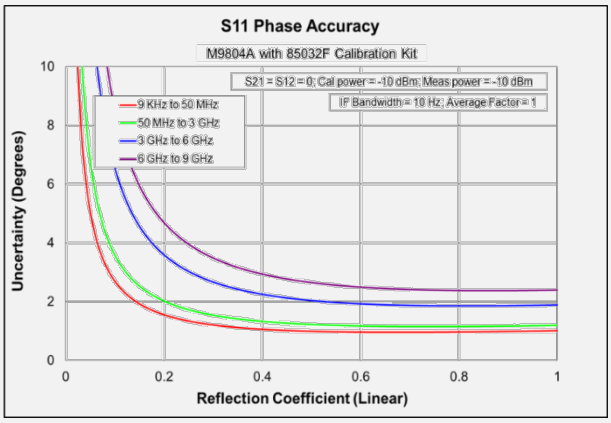
**Transmission Uncertainty (magnitude and phase)**



## Reflection Uncertainty (magnitude and phase)



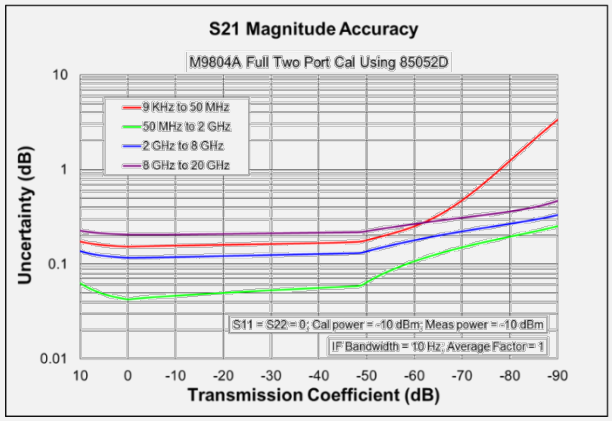



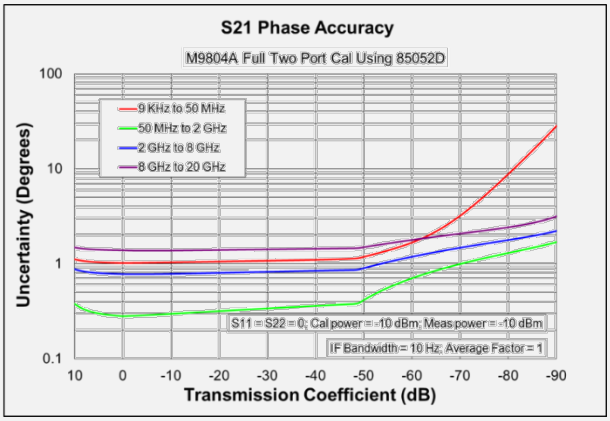

## Table 3. M9800A, M9801A, M9802A, M9803A or M9804A with 85052D Economy Mechanical Calibration Kit

### Corrected error terms (dB) – Specifications

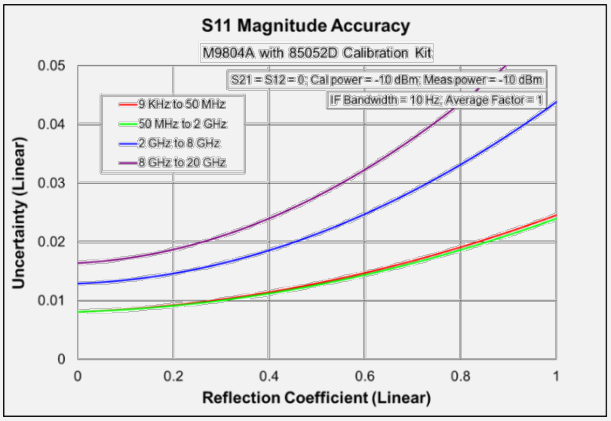
| Description | 9 kHz to 50 MHz | 50 MHz to 2 GHz | 2 GHz to 8 GHz | 8 GHz to 20 GHz |
|---|---|---|---|---|
| Directivity | 42 | 42 | 38 | 36 |
| Source match | 37 | 37 | 31 | 28 |
| Load match | 42 | 42 | 38 | 36 |
| Reflection tracking | ± 0.003 | ± 0.003 | ± 0.004 | ± 0.008 |
| Transmission tracking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

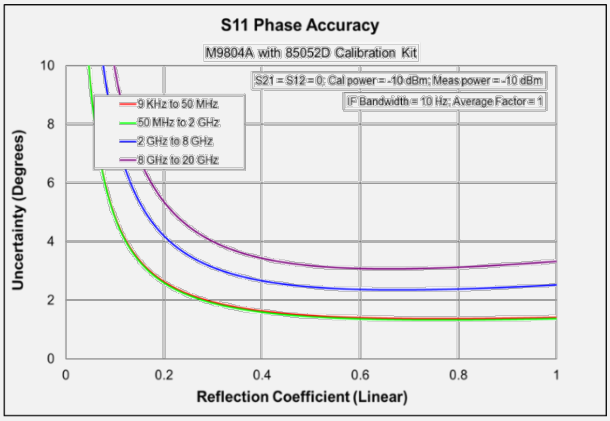
## Transmission Uncertainty (magnitude and phase)



## Reflection Uncertainty (magnitude and phase)



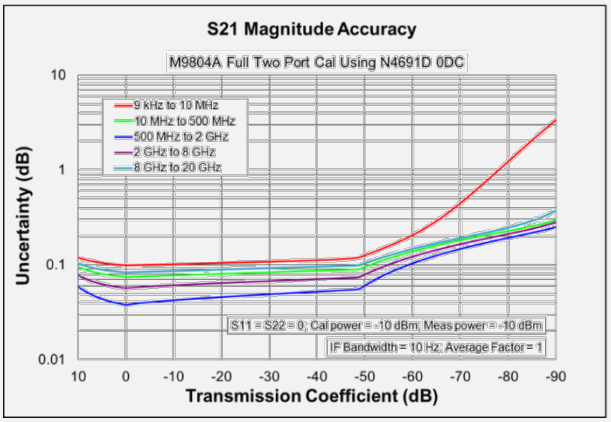



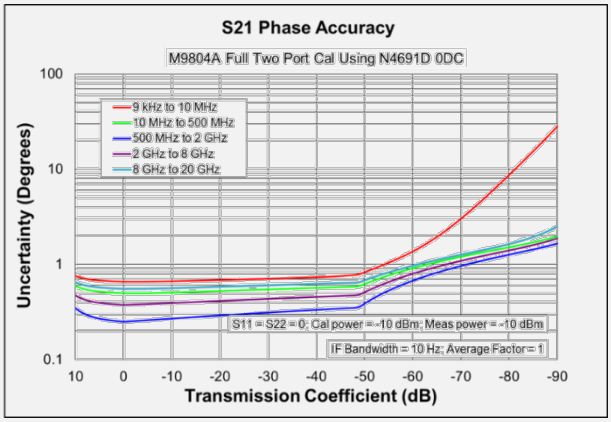

## Table 4. M9800A, M9801A, M9802A, M9803A or M9804A with N4691D Electronic Calibration (ECal) Module with Option 0DC

### Corrected Error Terms (dB) – Specifications

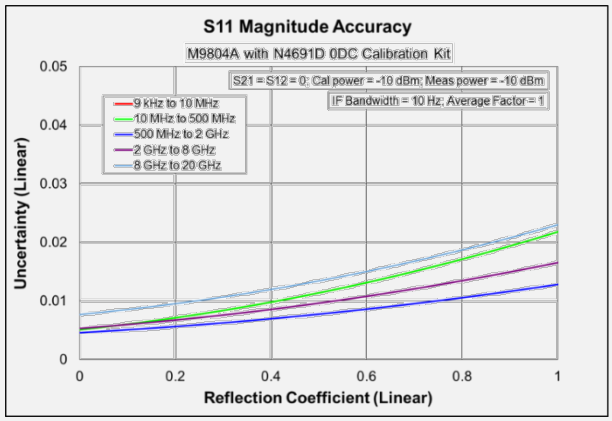
| Description | 9 kHz to 10 MHz | 10 MHz to 500 MHz | 500 MHz to 2 GHz | 2 GHz to 8 GHz | 8 GHz to 20 GHz |
|---|---|---|---|---|---|
| Directivity | 46 | 46 | 47 | 46 | 43 |
| Source match | 41 | 41 | 47 | 45 | 42 |
| Load match | 38 | 40 | 46 | 44 | 40 |
| Reflection tracking | ± 0.05 | ± 0.05 | ±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

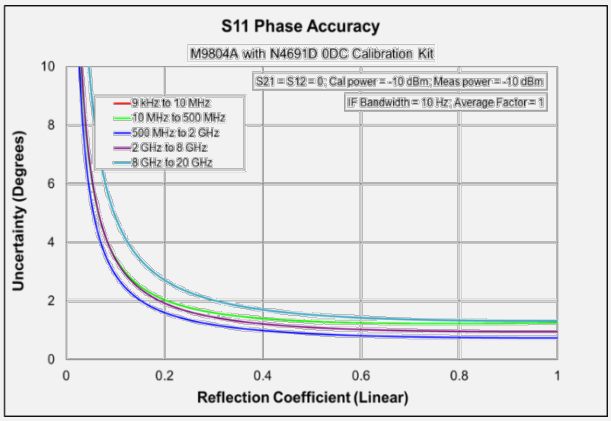
## Transmission Uncertainty (magnitude and phase)



## Reflection Uncertainty (magnitude and phase)



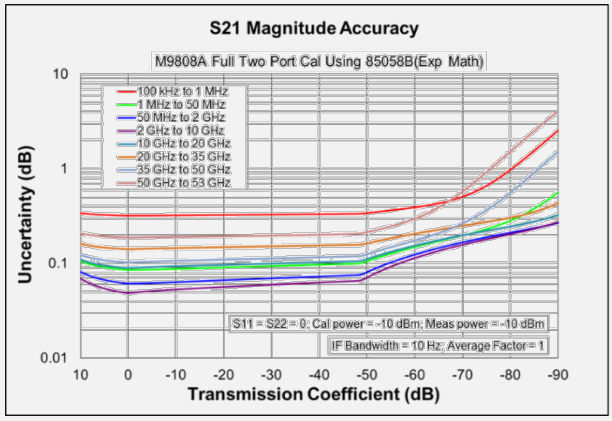



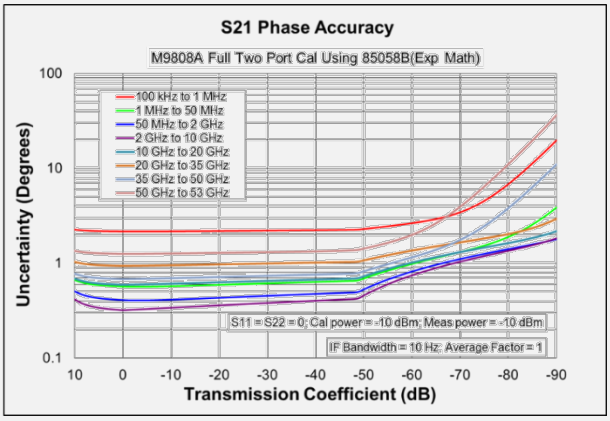

## Table 5. M9805A, M9806A, M9807A or M9808A with 85058B Standard Mechanical Calibration Kit

### Corrected error terms (dB) – Specifications

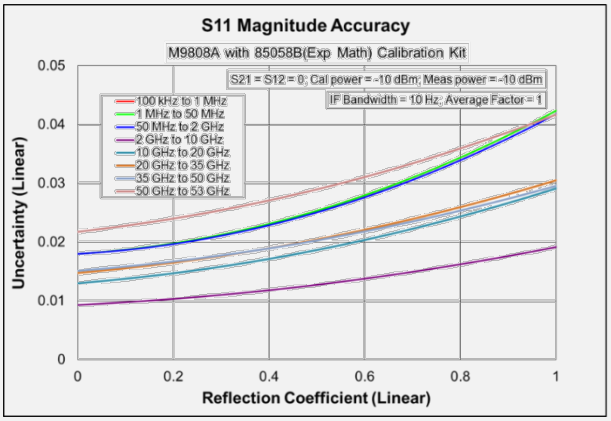
| Description | 100 kHz to 1 MHz | 1 MHz to 50 MHz | 50 MHz to 2 GHz | 2 GHz to 10 GHz | 10 GHz to 20 GHz | 20 GHz to 35 GHz | 35 GHz to 50 GHz | 50 GHz to 53 GHz |
|---|---|---|---|---|---|---|---|---|
| Directivity | 35 | 35 | 35 | 41 | 38 | 37 | 37 | 34 |
| Source match | 34 | 34 | 34 | 44 | 40 | 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 |

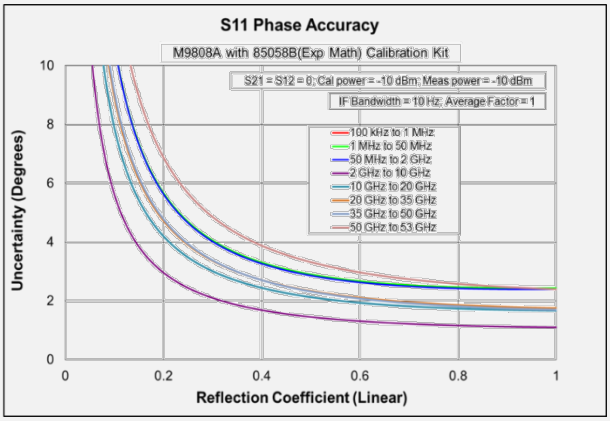
## Transmission Uncertainty (magnitude and phase)



## Reflection Uncertainty (magnitude and phase)



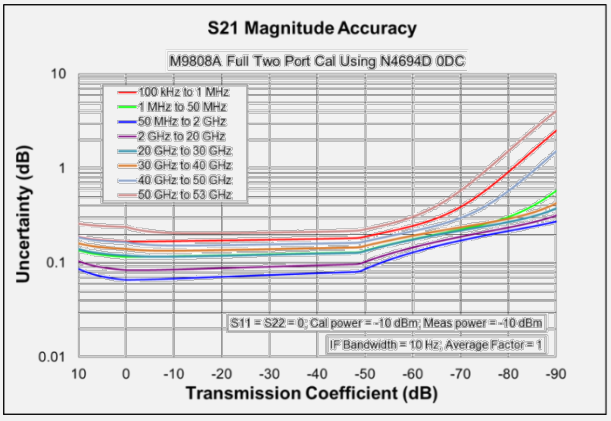



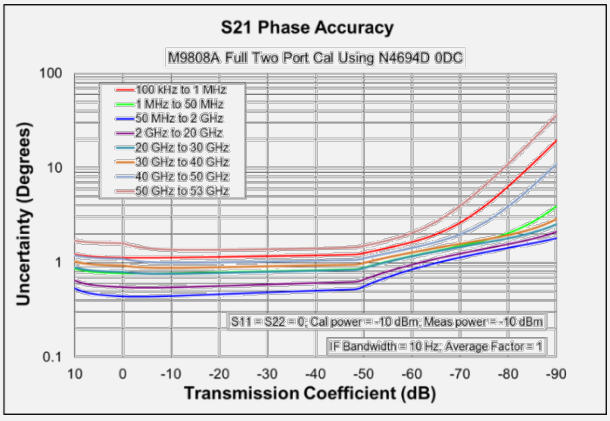

## Table 6. M9805A, M9806A, M9807A or M9808A with N4694D Electronic Calibration (ECal) Module with Option 0DC

### Corrected error terms (dB) – Specifications

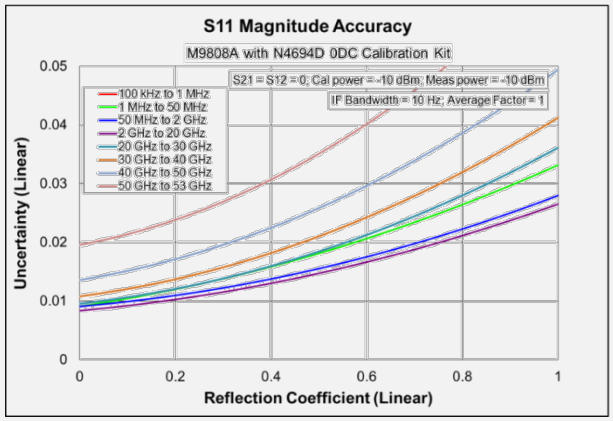
| Description | 100 kHz to 1 MHz | 1 MHz to 50 MHz | 50 MHz to 2 GHz | 2 GHz to 20 GHz | 20 GHz to 30 GHz | 30 GHz to 40 GHz | 40 GHz to 50 GHz | 50 GHz to 53 GHz |
|---|---|---|---|---|---|---|---|---|
| Directivity | 41 | 41 | 41 | 42 | 41 | 40 | 38 | 35 |
| Source match | 38 | 38 | 38 | 39 | 35 | 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 | ± 0.065 | ± 0.093 | ± 0.108 | ± 0.123 | ± 0.166 |

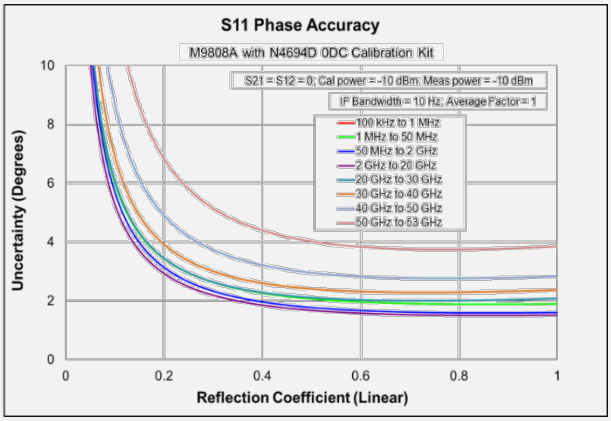
## Transmission Uncertainty (magnitude and phase)



## Reflection Uncertainty (magnitude and phase)



## Uncorrected System Performance

**Table 7. Uncorrected Error Terms (dB) – Specification[1]**

M9800A, M9801A, M9802A, M9803A, M9804A

| 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 | - | - | - |

M9805A, M9806A, M9807A, M9808A

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

**Table 8. Uncorrected Error Terms (dB) – Typical**

M9800A, M9801A, M9802A, M9803A, M9804A

| 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 |

M9805A, M9806A, M9807A, M9808A

| 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 9. Frequency Resolution, Accuracy, Stability**

All models

| Description | Specification | Typical |
|---|---|---|
| Frequency resolution | 1 Hz | - |
| Frequency accuracy | ± 7 ppm (25 ± 5 ºC) | - |
| Frequency stability | - | ± 7 ppm[2] |
| | | ± 3 ppm/year maximum[3] |

1. The specifications do not apply to parallel measurements of multiple devices under test (DUT).
2. 0 to 50 ºC. Assumes no variation in time.
3. Assumes no variation in temperature.

**Table 10. Maximum Output Port Power (dBm)**

M9800A, M9801A, M9802A, M9803A, M9804A

| 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 |

M9805A, M9806A, M9807A, M9808A

| 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 | -5 | 0 |
| 50 GHz to 53 GHz | -23 | -12 |

**Table 11. Power Sweep Range (dBm)[1]**

M9800A, M9801A, M9802A, M9803A, M9804A

| 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 6 GHz | - | -60 to +12 |
| 6 GHz to 9 GHz | - | -60 to +12 |
| 9 GHz to 16 GHz | - | -60 to +10 |
| 16 GHz to 20 GHz | - | -60 to +7 |

M9805A, M9806A, M9807A, M9808A

| Description | Specification | Typical |
|---|---|---|
| 100 kHz to 300 kHz | - | -60 to +1 |
| 300 kHz to 1 MHz | - | -60 to +10 |
| 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 12. Power Level Accuracy (dB)[1]**

M9800A, M9801A, M9802A, M9803A, M9804A

| 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 |

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

M9805A, M9806A, M9807A, M9808A

| 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 | ± 2.5 | ± 0.5 |
| 50 GHz to 53 GHz | - | ± 1.0 |

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

**Table 13. Power Level Linearity (dB)**

M9800A, M9801A, M9802A, M9803A, M9804A[1]

| Description | Specification[2] | Typical[3, 4] |
|---|---|---|
| 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. Stepped sweep mode. -20 dBm ≤ P ≤ maximum specified power.
3. Stepped sweep mode. -60 dBm ≤ P < -20 dBm.
4. Swept sweep mode. -60 dBm ≤ P ≤ maximum specified power.

M9805A, M9806A, M9807A, M9808A[1]

| Description | Specification[2] | Typical |
|---|---|---|
| 100 kHz to 10 GHz | ± 0.75 | ± 1.0[3, 5] |
| 10 GHz to 20 GHz | ± 1.0 | ± 1.0[3, 5] |
| 20 GHz to 50 GHz | ± 2.0 | ± 1.0[4 ,6] |

1. Level linearity given is relative to -15 dBm.
2. Stepped sweep mode. -20 dBm ≤ P ≤ maximum specified power.
3. Swept sweep mode. -60 dBm ≤ P ≤ maximum specified power.
4. Swept sweep mode. -65 dBm ≤ P ≤ maximum specified power.
5. Stepped sweep mode. -60 dBm ≤ P < -20 dBm.
6. Stepped sweep mode. -50 dBm ≤ P < -20 dBm.

**Table 14. 2nd and 3rd Harmonics at 0 dBm (dBc)[1]**

M9800A, M9801A, M9802A, M9803A, M9804A

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

M9805A, M9806A, M9807A, M9808A

| 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.

### Table 15. Sub-harmonics at Nominal Power (dBc)

M9800A, M9801A, M9802A, M9803A, M9804A[1]

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

1. Listed frequency is fundamental frequency; tested at power of 0 dBm.

M9805A, M9806A, M9807A, M9808A[2]

| 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 |

2. Listed frequency is fundamental frequency; tested at power of -15 dBm.

### Table 16. Non-harmonic Spurs at Nominal Power (dBc)

M9800A, M9801A, M9802A, M9803A, M9804A[1]

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

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

M9805A, M9806A, M9807A, M9808A[2]

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

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

**Table 17. Nominal Power (Preset Power Level)**

| Description | Specification |
|---|---|
| M9800A, M9801A, M9802A, M9803A, M9804A | 0 dBm |
| M9805A, M9806A, M9807A, M9808A | -15 dBm |

**Table 18. Power Resolution, Maximum/minimum Settable Power**

All models

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

# Test Port Input

**Table 19. Test Port Noise Floor (dBm)[1]**

M9800A, M9801A, M9802A, M9803A, M9804A

| 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 |

M9805A, M9806A, M9807A, M9808A

| 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 20. Receiver Compression at Test Port**

M9800A, M9801A, M9802A, M9803A, M9804A

| | | Specification | | Typical | |
|---|---|---|---|---|---|
| Description | 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 |

M9805A, M9806A, M9807A, M9808A

| | | 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 | -5 | 0.2 | 5 | 0.05 | 1.0 |
| 50 GHz to 53 GHz | -23 | 0.2 | 5 | 0.05 | 1.0 |

**Table 21. Trace Noise Magnitude (dB rms)[1]**

M9800A, M9801A, M9802A, M9803A, M9804A

| 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[2] | 0.0015 | 0.0005 |
| 6 GHz to 10 GHz | 0.002 | 0.0006 |
| 10 GHz to 20 GHz | 0.003 | 0.001 |

M9805A, M9806A, M9807A, M9808A

| 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[2] | 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 for ≥ 10 MHz. At maximum specified power.
2. It may typically be degraded at particular frequencies such as 25 MHz, 54 MHz, 58.5 MHz, 156 MHz, 108 MHz, 120 MHz or 132 MHz.

**Table 22. Trace Noise Phase (degree rms)[1]**

M9800A, M9801A, M9802A, M9803A, M9804A

| 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[2] | 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 |

M9805A, M9806A, M9807A, M9808A

| 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[2] | 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 | 0.018 |
| 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 for ≥ 10 MHz. At maximum specified power.
2. It may typically be degraded at particular frequencies such as 25 MHz, 54 MHz, 58.5 MHz, 156 MHz, 108 MHz, 120 MHz or 132 MHz.

**Table 23. Temperature Stability – Typical**

M9800A, M9801A, M9802A, M9803A, M9804A

| 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 |

M9805A, M9806A, M9807A, M9808A

| 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 24. Damage Input Level**

All models

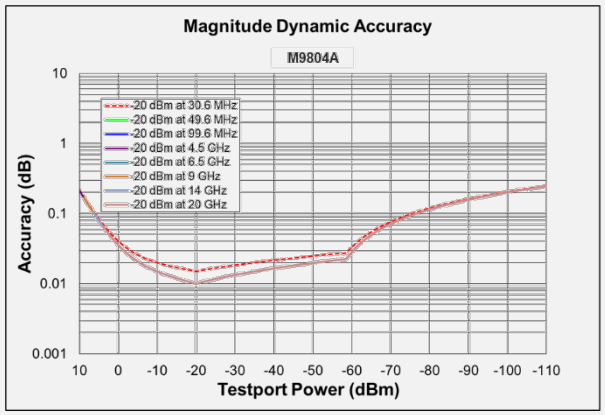
| Description | |
|---|---|
| Damage Input Level | +27 dBm or ± 35 VDC (Warranted) |

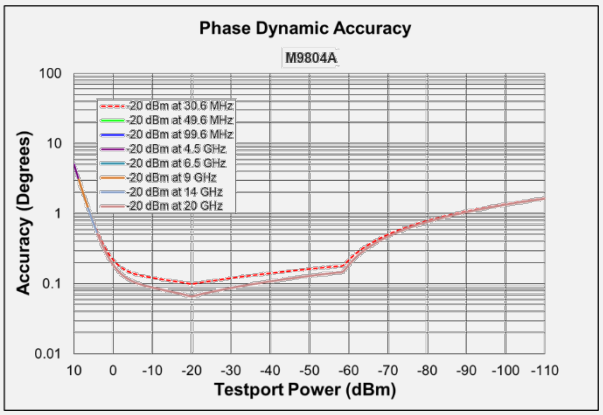
# Dynamic Accuracy

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

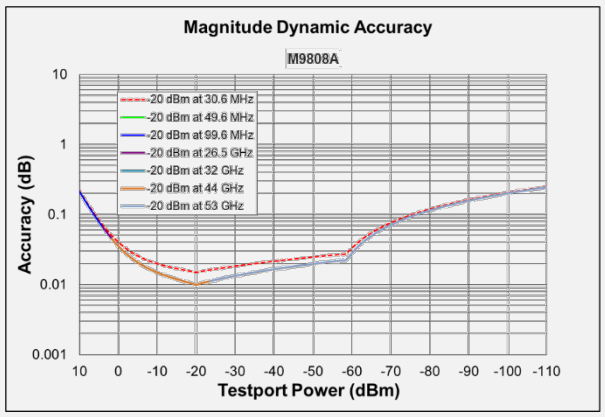
### Dynamic accuracy[1] – specification

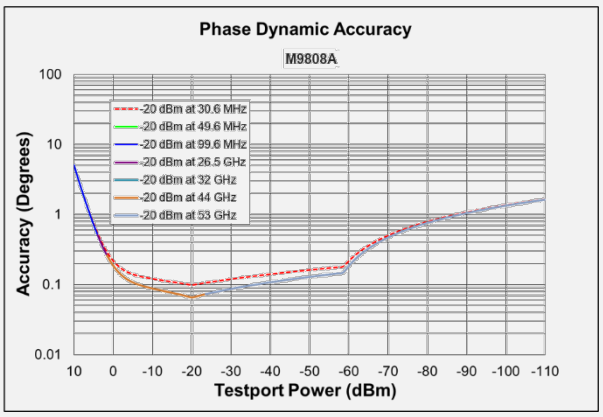
M9800A, M9801A, M9802A, M9803A, M9804A




M9805A, M9806A, M9807A, M9808A




1. 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 (30.6MHz, 49.6MHz and 99.6MHz) 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.
2. Download Uncertainty Calculator from http://www.keysight.com/find/na_calculator to generate the curves of dynamic accuracy.

# Spectrum Analysis (with Option 090/190 and S95090B/A)

This section provides specifications for the spectrum analysis Option 090/190 on the M980xA Series PXIe VNA. The S95090B/A Software is required to enable spectrum analysis functions of the M980xA.

**Table 25. Frequency Specifications**

All models

| Description | Specification | Supplemental information |
|---|---|---|
| **Frequency Reference[1]** | | |
| Accuracy | - | ± [(time since last adjustment x aging rate) + temperature stability + calibration accuracy], typical |
| Aging rate | - | ± 3 ppm/year maximum, typical |
| Temperature stability | - | ± 7 ppm (0 to 50 °C) |
| Achievable initial calibration accuracy | ± 7 ppm (25 ± 5 °C) | - |
| 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 100,001 | - |
| **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 26. 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 us | - |
| **Measuring and Display Update Rate (milliseconds)[1]** | | |
| 20 MHz Span, 3 kHz RBW, 3 kHz VBW | - | 63 |
| 100 MHz Span, Auto RBW, Auto VBW | - | 63 |
| 1 GHz Span, 3 kHz RBW, 3 kHz VBW | - | 344 |
| 1 GHz Span, 300 kHz RBW, 300 kHz VBW | - | 63 |
| 10 GHz Span, 3 kHz RBW, 3 kHz VBW | - | 3286 |
| 10 GHz Span, 300 kHz RBW, 300 kHz VBW | - | 373 |
| 10 MHz to 20 GHz, RBW/VBW = 1 MHz | - | 782 |
| 10 MHz to 50 GHz, RBW/VBW = 1 MHz | - | 1807 |

1. Measured with a 2-port module with firmware revision A.14.10.08.

### Table 27. Amplitude Accuracy and Range Specifications

All models

| 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 28. SA Detector Accuracy (dB)[1] – Specifications

M9800A, M9801A, M9802A, M9803A, M9804A

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

1. With high attenuation. SA detector accuracy is residual error of IF response calibration. IF response is characterized with M980xA'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.

M9805A, M9806A, M9807A, M9808A

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

**Table 29. Input Attenuation Switching Uncertainty (dB) – Supplemental Information**

M9800A, M9801A, M9802A, M9803A, M9804A

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

M9805A, M9806A, M9807A, M9808A

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

**Table 30. Input VSWR[1] – Specifications**

M9800A, M9801A, M9802A, M9803A, M9804A

| 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 |

M9805A, M9806A, M9807A, M9808A

| 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 7). $VSWR = \frac{1+10^{(-1*load\ match/20)}}{1-10^{(-1*load\ match/20)}}$

**Table 31. Other Amplitude Accuracy – Supplemental Information**

All models

| 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 32. Spurious Response – Supplemental Information**

All models

| 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 33. Displayed Average Noise Level (DANL) at Test Ports with Low Attenuation (dBm/Hz)[1] – Specifications**

M9800A, M9801A, M9802A, M9803A, M9804A

| Description | Specification | Typical |
|---|---|---|
| 9 kHz to 100 kHz | -114 | -122 |
| 100 kHz to 300 kHz | -125 | -132 |
| 300 kHz to 1 MHz | -133 | -138 |
| 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 | -144 | -149 |
| 6.5 GHz to 9 GHz | -141 | -148 |
| 9 GHz to 14 GHz | -140 | -146 |
| 14 GHz to 16 GHz | -137 | -144 |
| 16 GHz to 20 GHz | -136 | -144 |

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.

M9805A, M9806A, M9807A, M9808A

| 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 |

2. A residual spurious response may be observed around 600 kHz.

**Table 34. Displayed Average Noise Level (DANL) at Test Ports with High Attenuation (dBm/Hz)[1] – Typical**

M9800A, M9801A, M9802A, M9803A, M9804A

| Description | Specification | Typical |
|---|---|---|
| 9 kHz to 100 kHz | - | -100 |
| 100 kHz to 300 kHz | - | -110 |
| 300 kHz to 1 MHz | - | -116 |
| 1 MHz to 10 MHz | - | -116 |
| 10 MHz to 100 MHz | - | -116 |
| 100 MHz to 4.5 GHz | - | -127 |
| 4.5 GHz to 6.5 GHz | - | -127 |
| 6.5 GHz to 9 GHz | - | -126 |
| 9 GHz to 14 GHz | - | -124 |
| 14 GHz to 16 GHz | - | -122 |
| 16 GHz to 20 GHz | - | -122 |

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.

M9805A, M9806A, M9807A, M9808A

| 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 10 MHz | - | -112 |
| 10 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 |

2. A residual spurious response may be observed around 600 kHz.

**Table 35. Second Harmonic Distortion with High Attenuation[1] – Supplemental Information**

M9800A, M9801A, M9802A, M9803A, M9804A

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

M9805A, M9806A, M9807A, M9808A

| 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 36. Second Harmonic Distortion with Low Attenuation[1] – Supplemental Information**

M9800A, M9801A, M9802A, M9803A, M9804A

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

M9805A, M9806A, M9807A, M9808A

| 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 37. Third Order Intermodulation Distortion with High Attenuation[1] – Characteristic**

M9800A, M9801A, M9802A, M9803A, M9804A

| 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 |

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.

M9805A, M9806A, M9807A, M9808A

| 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 |

**Table 38. Third Order Intermodulation Distortion with Low Attenuation[1] – Characteristic**

M9800A, M9801A, M9802A, M9803A, M9804A

| 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 |

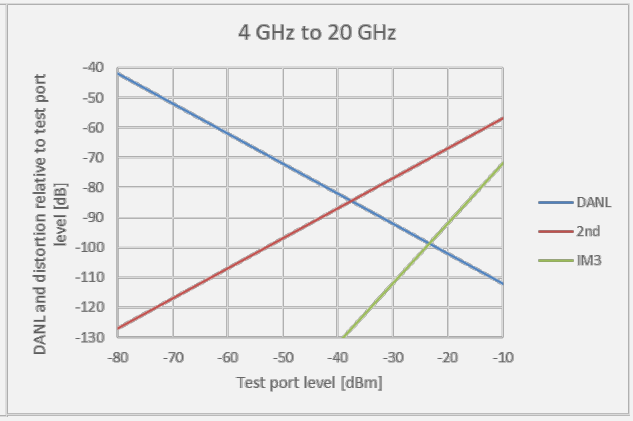
M9805A, M9806A, M9807A, M9808A

| 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.

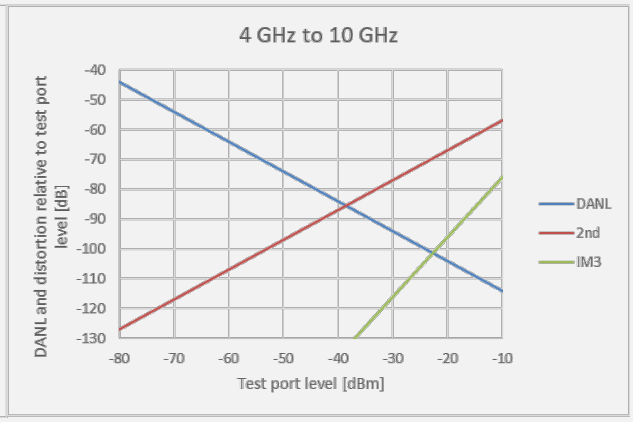
## DANL and Distortion Relative to Test Port Level (dB) – Nominal

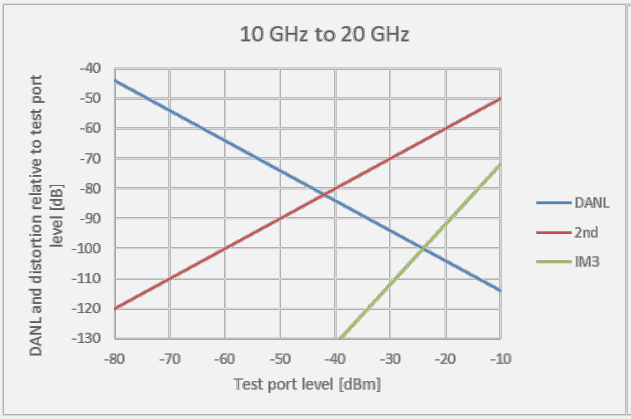
M9800A, M9801A, M9802A, M9803A, M9804A[1]


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

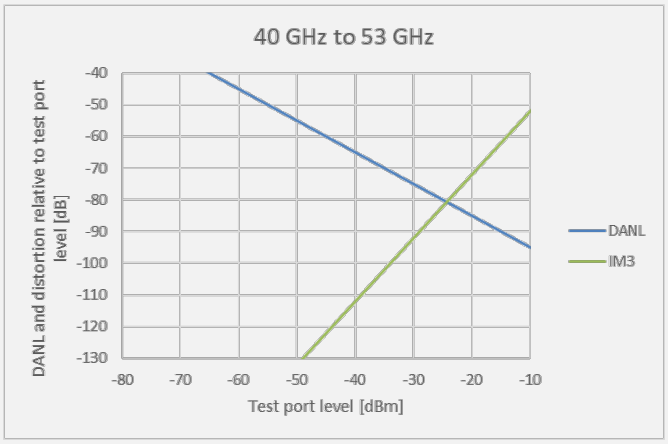
M9805A, M9806A, M9807A, M9808A[2]



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




### Table 39. Receiver Phase Noise (dBc/Hz)[1] – Typical

All models

| 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. 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 and S95025B/A)

This section provides specifications for the pulse modulation hardware (Option 021) on the M980xA Series PXIe VNA. The S95025B/A Software is required to enable pulsed-RF measurement functions of the M980xA.

**Table 40. Pulse Modulation On/Off Ratio (dB) – Typical**

M9800A, M9801A, M9802A, M9803A, M9804A

| 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 |

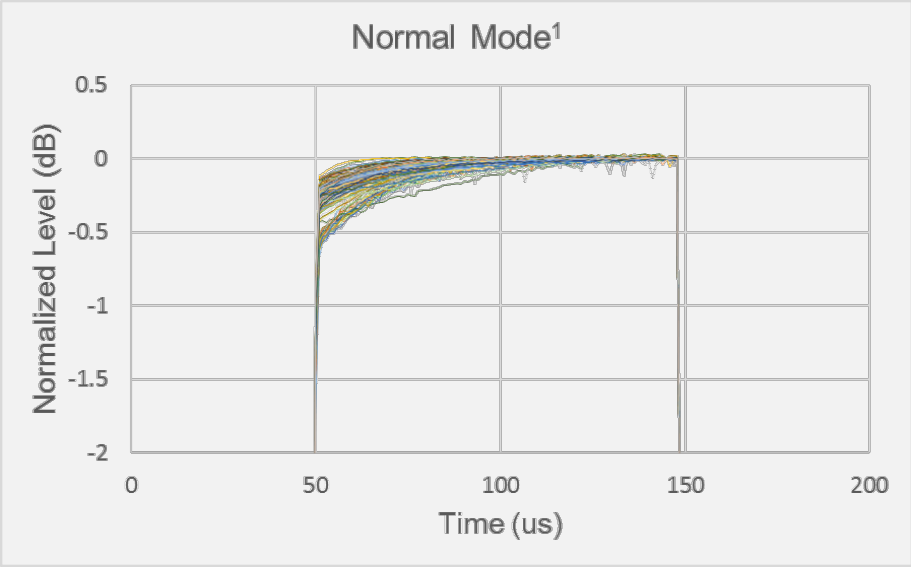
M9805A, M9806A, M9807A, M9808A

| 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 |

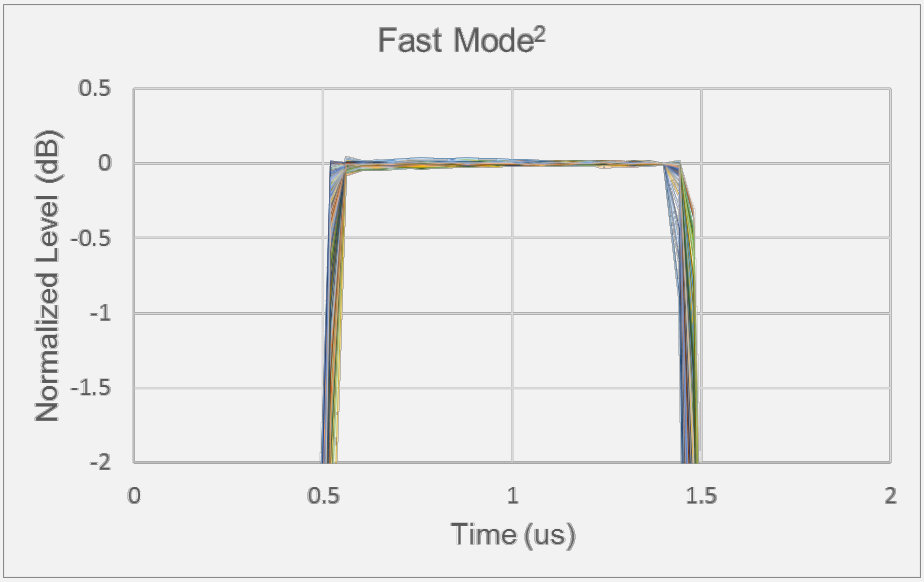
1. At power of > -20 dBm.

**Pulse Modulation Shape Examples**

M9800A, M9801A, M9802A, M9803A, M9804A




1. Measured with a 500 kHz IF bandwidth, no averaging (Average Type = Point). With 100 us pulse width setting. 50 usec/div.



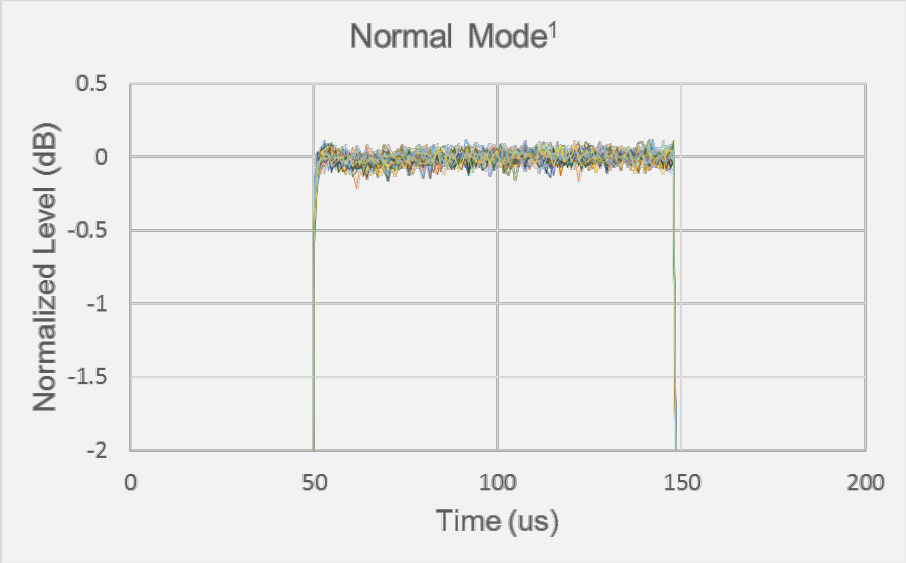

2. Measured with a 15 MHz IF bandwidth, averaging factor of 16 (Average Type = Point). With 1 us pulse width setting. 500 nsec/div.

M9805A, M9806A, M9807A, M9808A

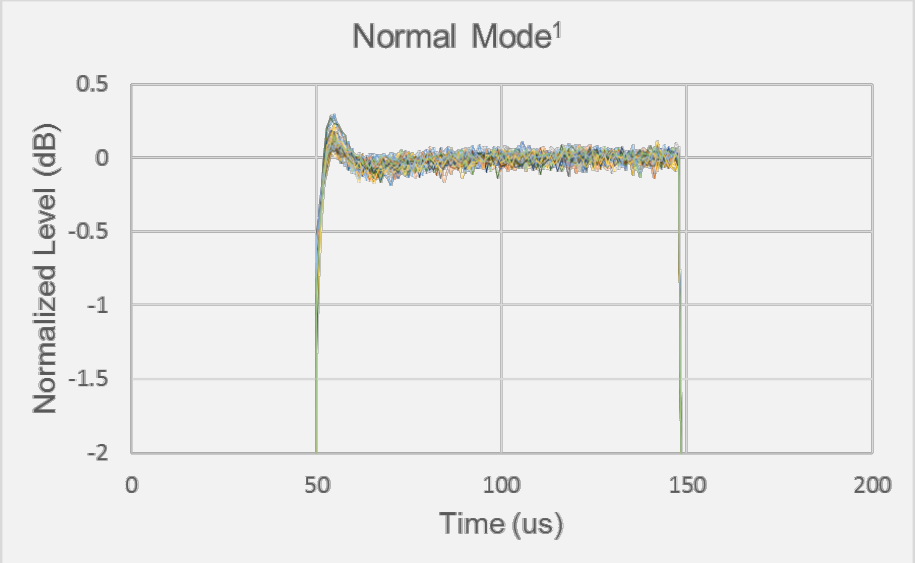
1 GHz to 26.5 GHz


1. Measured with a 500 kHz IF bandwidth, no averaging (Average Type = Point). With 100 us pulse width setting. 50 usec/div.

32 GHz

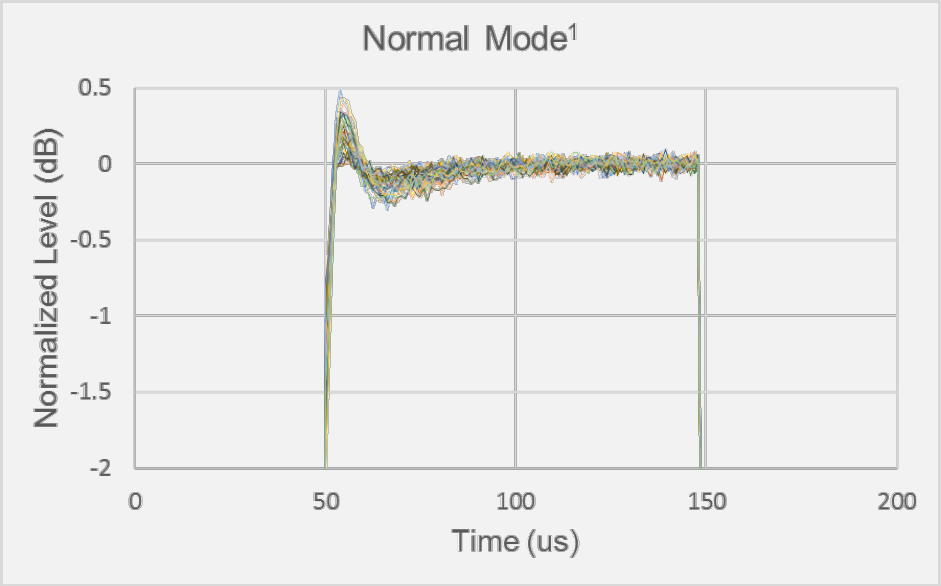



44 GHz



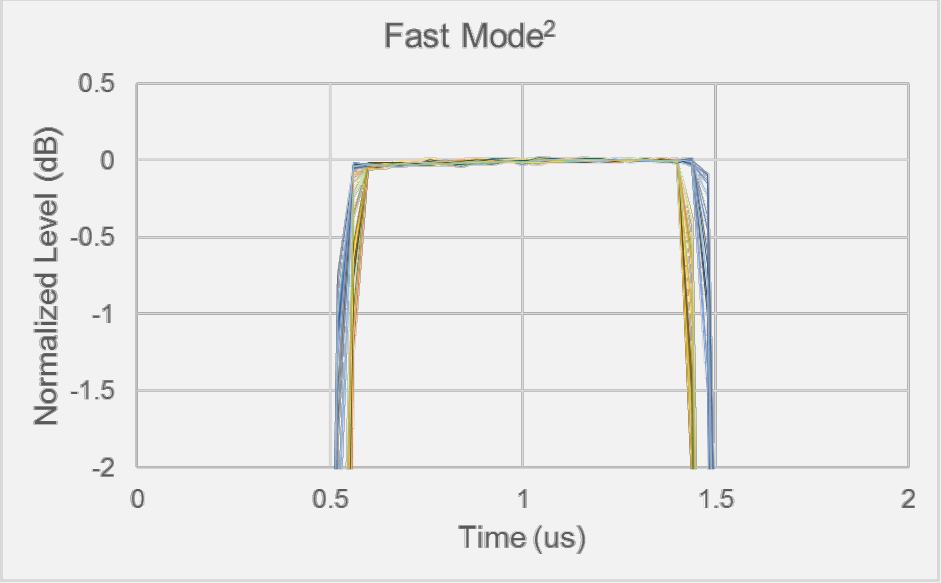

1. Measured with a 500 kHz IF bandwidth, averaging factor of 16 (Average Type = Point). With 100 us pulse width setting. 50 usec/div.

50 GHz



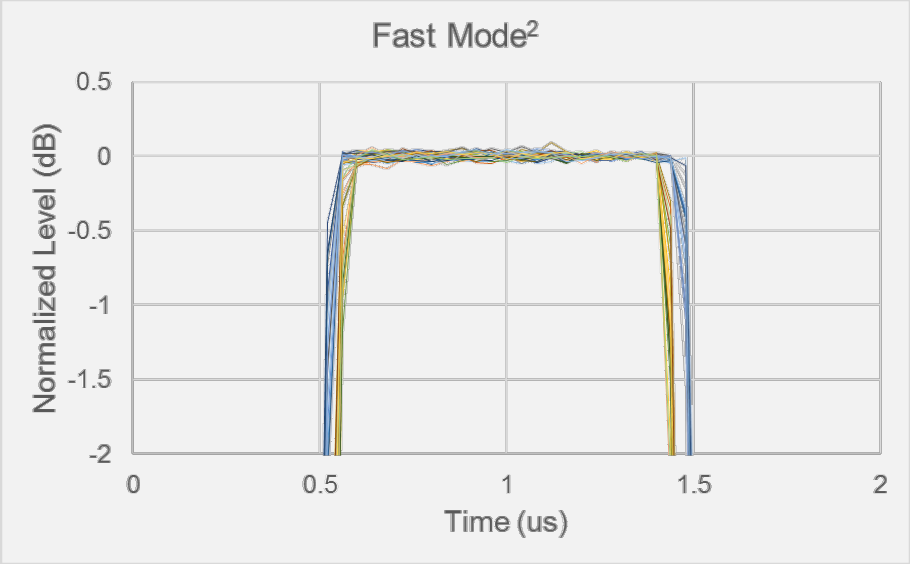

1. Measured with a 500 kHz IF bandwidth, averaging factor of 16 (Average Type = Point). With 100 us pulse width setting. 50 usec/div.

1 GHz to 26.5 GHz

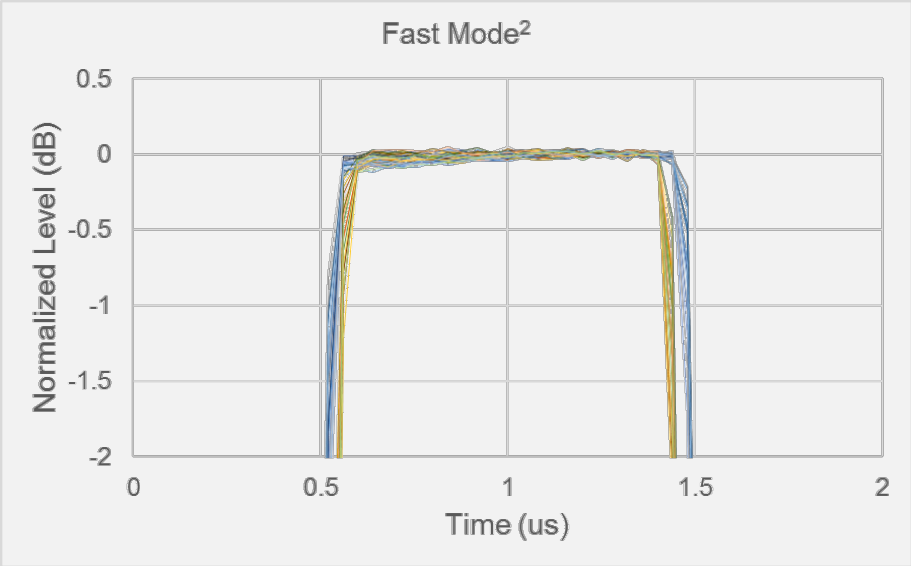



2. Measured with a 15 MHz IF bandwidth, averaging factor of 16 (Average Type = Point). With 1 us pulse width setting. 500 nsec/div.

32 GHz

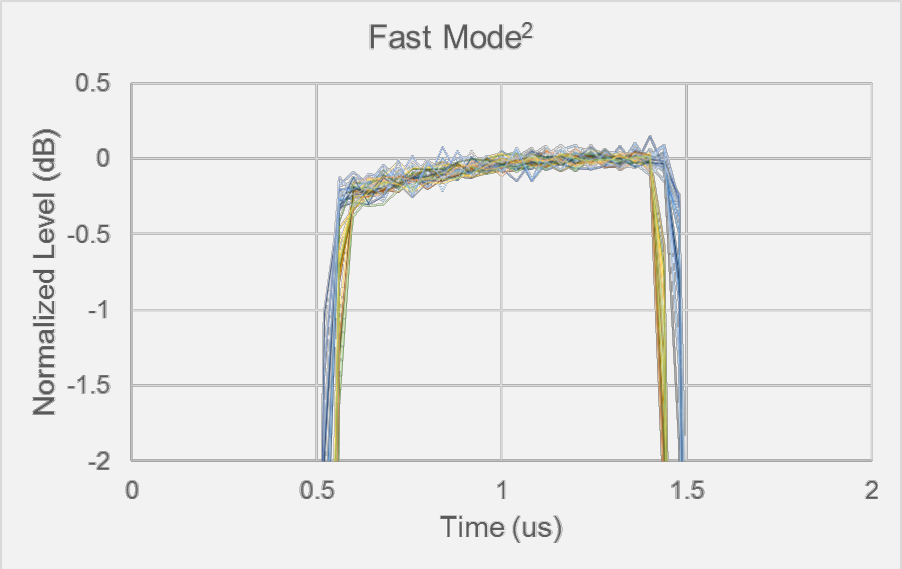



44 GHz




2. Measured with a 15 MHz IF bandwidth, averaging factor of 16 (Average Type = Point). With 1 us pulse width setting. 500 nsec/div.

50 GHz




2. Measured with a 15 MHz IF bandwidth, averaging factor of 16 (Average Type = Point). With 1 us pulse width setting. 500 nsec/div.

**Table 41. Pulse Modulation (Source Modulators) - Typical**

All models

| Description | Typical |
|---|---|
| Minimum pulse width | 200 nsec |
| Minimum pulse period | 1 usec |
| Maximum pulse period | 10 sec |

# Enhanced Time Domain Analysis wit TDR (S95011B)

This section provides specifications for the enhanced time domain analysis on the M980xA Series PXIe VNA. The S95011B Software is required to enable enhanced time domain analysis functions of the M980xA.

**Table 42. Key Specifications of Enhanced Time Domain Analysis**

M9800A, M9801A, M9802A, M9803A, M9804A

| Description | | M9804A | M9803A | M9802A | M9801A | M9800A |
|---|---|---|---|---|---|---|
| Bandwidth | spec. | 20 GHz | 14 GHz | 9 GHz | 6.5 GHz | 4.5 GHz |
| Input impedance | nom. | 50 ohm | | | | |
| DC damage level at test port | spec. | 35 V | | | | |
| Maximum test port input voltage (Hot TDR mode) | typ. | 1.5 Vpp | | | | |
| TDR stimulus[1] | nom. | Step, Impulse | | | | |
| TDR step amplitude[2] | nom. | 1 mV to 5 V | | | | |
| TDR step rise time[3] (min) (10% to 90%) | spec. | 22.3 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 | 4.8 mm | 7.4 mm | 10.3 mm | 14.9 mm |
| TDR impulse width (min)[3] | spec. | 30.2 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 |
| DUT length (max)[6] | spec. | 13.8 µs | 13.8 µs | 13.8 µs | 13.8 µs | 13.8 µs |
| TDR stimulus repetition rate (max) | spec. | 19.9 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 |
| Eye diagram data rate (max)[8] | spec. | 16 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 S95011B 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 S95011B 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.
7. RMS noise level with 50 Ω DUT and default setup.
8. Maximum values may be limited by the DUT length setting.

M9805A, M9806A, M9807A, M9808A

| Description | | M9808A | M9807A | M9806A | M9805A |
|---|---|---|---|---|---|
| Bandwidth | spec. | 53 GHz | 44 GHz | 32 GHz | 26.5 GHz |
| Input impedance | nom. | 50 ohm | | | |
| DC damage level at test port | spec. | 35 V | | | |
| Maximum test port input voltage (Hot TDR mode) | typ. | 1.5 V (100 kHz to 20 GHz)<br>0.9 V (20 GHz to 30 GHz)<br>0.7 V (30 GHz to 40 GHz)<br>0.5 V (40 GHz to 53 GHz) | 1.5 V (100 kHz to 20 GHz)<br>0.9 V (20 GHz to 30 GHz)<br>0.7 V (30 GHz to 40 GHz)<br>0.5 V (40 GHz to 44 GHz) | 1.5 V (100 kHz to 20 GHz)<br>0.9 V (20 GHz to 30 GHz)<br>0.7 V (30 GHz to 32 GHz) | 1.5 V (100 kHz to 20 GHz)<br>0.9 V (20 GHz to 26.5 GHz) |
| TDR stimulus[1] | nom. | Step, Impulse | | | |
| TDR step amplitude[2] | nom. | 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] (εr = 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 µs | 1.25 µs | 1.25 µs | 1.25 µs |
| TDR stimulus repetition rate (max) | spec. | 52.9 MHz | 43.9 MHz | 31.9 MHz | 26.4 MHz |
| RMS noise level[7] | typ. | 120 µVrms | 80 µVrms | 80 µVrms | 80 µVrms |
| 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 S95011B 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 S95011B 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.
7. RMS noise level with 50 Ω DUT and default setup.
8. Maximum values may be limited by the DUT length setting.

## Multi-module Measurements with S95551B/A Software

When the S95551B/A software is installed, the M980xA PXIe VNA have the ability to be configured into a multiport network analyzer with multiple PXI modules. Adding a second module to the PXI chassis would provide additional test ports to the VNA. This configuration provides a full featured multiport vector network analyzer capability with full crossbar S-parameter measurement capability.

Multiport configurations using up to 17 modules (ex. 34-ports with 2-port modules) or maximum 66 test ports (11x 6-port modules) have been evaluated.

For multi-module operation, all single-module specifications apply except trace noise, test port noise floor, system dynamic range, Displayed Average Noise Level (DANL) and SA detector accuracy. The other performance of multi-module configurations will meet the single-module specifications in the data sheet.

The guidance provided here is given as general reference based on Keysight's internal evaluation of multiport PXIe VNA configurations. Not all multiport setups using multiple PXIe VNAs are tested as a multiport instrument in the factory. Interconnect cables included in the Y1730A must be used for connection among multiple M980xA modules. For more detail of multi-module configurations, refer to "M980xA Multi-module Installation Guide" at www.keysight.com/find/m980xa-mm.

**Table 43. Multi-module Performance**

- A check mark, ✓, indicates the performance parameter is the same as the corresponding single-module performance.
- An empty diamond, ◊, indicates that the performance parameter may be degraded as the number of modules increases.

| Description | Setups with 2 to 17 modules |
|---|---|
| System dynamic range | ◊ (see Table 44) |
| Frequency accuracy | ✓ |
| Uncorrected directivity | ✓ |
| Uncorrected load match | ✓ |
| Uncorrected source match | ✓ |
| Maximum output port power | ✓ |
| Power level accuracy | ✓ |
| Power level linearity | ✓ |
| Noise floor | ◊ (see Table 45) |
| Receiver compression | ✓ |
| Trace noise | ◊ (see Table 46 and 47) |
| Dynamic accuracy | ✓ |
| Crosstalk | ✓ |

**Table 44. System Dynamic Range of Multi-module Configurations (dB)[1]**

M9800A, M9801A, M9802A, M9803A, M9804A

| | 2 to 4 modules | | 5 to 17 modules | |
|---|---|---|---|---|
| **Description** | **Char.** | **Typical** | **Char.** | **Typical** |
| 9 kHz to 100 kHz | 101 | 111 | 94 | 110 |
| 100 kHz to 300 kHz | 117 | 126 | 114 | 126 |
| 300 kHz to 1 MHz | 125 | 136 | 114 | 126 |
| 1 MHz to 10 MHz | 130 | 141 | 127 | 139 |
| 10 MHz to 50 MHz[2] | 137 | 147 | 134 | 147 |
| 50 MHz to 3 GHz | 140 | 150 | 137 | 150 |
| 3 GHz to 4.5 GHz | 140 | 149 | 137 | 149 |
| 4.5 GHz to 5 GHz | 140 | 149 | 135 | 147 |
| 5 GHz to 6.5 GHz | 140 | 148 | 135 | 147 |
| 6.5 GHz to 9 GHz | 136 | 146 | 133 | 146 |
| 9 GHz to 14 GHz | 133 | 142 | 125 | 139 |
| 14 GHz to 16 GHz | 127 | 140 | 122 | 137 |
| 16 GHz to 20 GHz | 124 | 137 | 119 | 134 |

M9805A, M9806A, M9807A, M9808A

| | 2 to 12 modules | | 13 to 17 modules | |
|---|---|---|---|---|
| **Description** | **Char.** | **Typical** | **Char.** | **Typical** |
| 100 kHz to 300 kHz | 95 | 106 | 95 | 106 |
| 300 kHz to 500 kHz | 104 | 120 | 104 | 120 |
| 500 kHz to 1 MHz | 117 | 130 | 117 | 130 |
| 1 MHz to 10 MHz | 125 | 138 | 125 | 138 |
| 10 MHz to 50 MHz[2] | 137 | 147 | 137 | 147 |
| 50 MHz to 6.5 GHz | 140 | 150 | 140 | 150 |
| 6.5 GHz to 8 GHz | 138 | 150 | 138 | 150 |
| 8 GHz to 9 GHz | 138 | 147 | 138 | 147 |
| 9 GHz to 16 GHz | 137 | 147 | 137 | 147 |
| 16 GHz to 17 GHz | 137 | 143 | 137 | 143 |
| 17 GHz to 20 GHz | 132 | 143 | 132 | 143 |
| 20 GHz to 24 GHz | 130 | 143 | 130 | 143 |
| 24 GHz to 25 GHz | 130 | 141 | 130 | 141 |
| 25 GHz to 26 GHz | 127 | 141 | 127 | 141 |
| 26 GHz to 30 GHz | 127 | 137 | 127 | 137 |
| 30 GHz to 35 GHz | 122 | 137 | 122 | 137 |
| 35 GHz to 40 GHz | 122 | 134 | 122 | 134 |
| 40 GHz to 45 GHz | 122 | 132 | 122 | 132 |
| 45 GHz to 50 GHz | 100 | 115 | 100 | 115 |
| 50 GHz to 53 GHz | 72 | 101 | 72 | 101 |

1. System dynamic range = source maximum output power minus receiver noise floor at 10 Hz IF bandwidth. Does not include crosstalk effects.
2. It may typically be degraded at 25 MHz.

**Table 45. Test Port Noise Floor of Multi-module Configurations (dBm)[1]**

M9800A, M9801A, M9802A, M9803A, M9804A

| | 2 to 4 modules | | 5 to 17 modules | |
|---|---|---|---|---|
| **Description** | **Char.** | **Typical** | **Char.** | **Typical** |
| 9 kHz to 100 kHz | -101 | -109 | -94 | -108 |
| 100 kHz to 300 kHz | -112 | -119 | -109 | -119 |
| 300 kHz to 1 MHz | -120 | -127 | -109 | -119 |
| 1 MHz to 10 MHz | -125 | -132 | -122 | -132 |
| 10 MHz to 50 MHz[2] | -127 | -134 | -124 | -134 |
| 50 MHz to 3 GHz | -130 | -137 | -127 | -137 |
| 3 GHz to 4.5 GHz | -130 | -136 | -127 | -136 |
| 4.5 GHz to 6.5 GHz | -130 | -135 | -125 | -135 |
| 6.5 GHz to 9 GHz | -127 | -134 | -124 | -134 |
| 9 GHz to 14 GHz | -126 | -132 | -118 | -129 |
| 14 GHz to 16 GHz | -120 | -130 | -115 | -127 |
| 16 GHz to 20 GHz | -120 | -130 | -115 | -127 |

M9805A, M9806A, M9807A, M9808A

| | 2 to 12 modules | | 13 to 17 modules | |
|---|---|---|---|---|
| **Description** | **Char.** | **Typical** | **Char.** | **Typical** |
| 100 kHz to 300 kHz | -97 | -105 | -97 | -105 |
| 300 kHz to 500 kHz | -97 | -110 | -97 | -110 |
| 500 kHz to 1 MHz | -110 | -120 | -110 | -120 |
| 1 MHz to 10 MHz | -115 | -124 | -115 | -124 |
| 10 MHz to 50 MHz[2] | -127 | -133 | -127 | -133 |
| 50 MHz to 200 MHz | -130 | -133 | -130 | -133 |
| 200 MHz to 3 GHz | -130 | -137 | -130 | -137 |
| 3 GHz to 6.5 GHz | -130 | -135 | -130 | -135 |
| 6.5 GHz to 9 GHz | -128 | -134 | -128 | -134 |
| 9 GHz to 17 GHz | -127 | -133 | -127 | -133 |
| 17 GHz to 25 GHz | -125 | -131 | -125 | -131 |
| 25 GHz to 30 GHz | -122 | -129 | -122 | -129 |
| 30 GHz to 45 GHz | -120 | -127 | -120 | -127 |
| 45 GHz to 50 GHz | -105 | -115 | -105 | -115 |
| 50 GHz to 53 GHz | -95 | -113 | -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 46. Trace Noise Magnitude of Multi-module Configurations (dB rms)[1]**

M9800A, M9801A, M9802A, M9803A, M9804A

| | 2 to 4 modules | | 5 to 17 modules | |
|---|---|---|---|---|
| **Description** | **Char.** | **Typical** | **Char.** | **Typical** |
| 9 kHz to 30 kHz | 0.005 | 0.0025 | 0.01 | 0.0025 |
| 30 kHz to 100 kHz | 0.003 | 0.001 | 0.006 | 0.001 |
| 100 kHz to 10 MHz | 0.0025 | 0.0005 | 0.003 | 0.0005 |
| 10 MHz to 6 GHz[2] | 0.002 | 0.0005 | 0.003 | 0.0005 |
| 6 GHz to 10 GHz | 0.002 | 0.0006 | 0.004 | 0.0006 |
| 10 GHz to 13.5 GHz | 0.003 | 0.001 | 0.006 | 0.001 |
| 13.5 GHz to 20 GHz | 0.004 | 0.001 | 0.007 | 0.001 |

M9805A, M9806A, M9807A, M9808A

| | 2 to 12 modules | | 13 to 17 modules | |
|---|---|---|---|---|
| **Description** | **Char.** | **Typical** | **Char.** | **Typical** |
| 100 kHz to 300 kHz | 0.005 | 0.002 | 0.005 | 0.002 |
| 300 kHz to 1 MHz | 0.003 | 0.001 | 0.003 | 0.001 |
| 1 MHz to 4.5 GHz[2] | 0.0015 | 0.0005 | 0.0015 | 0.0005 |
| 4.5 GHz to 10 GHz | 0.0015 | 0.0007 | 0.0015 | 0.0007 |
| 10 GHz to 17 GHz | 0.002 | 0.001 | 0.002 | 0.001 |
| 17 GHz to 30 GHz | 0.003 | 0.0013 | 0.003 | 0.0013 |
| 30 GHz to 45 GHz | 0.006 | 0.0022 | 0.006 | 0.0022 |
| 45 GHz to 50 GHz | 0.018 | 0.006 | 0.018 | 0.006 |

1. Reflection trace noise in a 1 kHz IF bandwidth for < 10 MHz, 10 kHz IF bandwidth for ≥ 10 MHz. At maximum specified power.
2. It may typically be degraded at particular frequencies such as 25 MHz, 54 MHz, 58.5 MHz, 156 MHz, 108 MHz, 120 MHz or 132 MHz.

**Table 47. Trace Noise Phase of Multi-module Configurations (degree rms)[1]**

M9800A, M9801A, M9802A, M9803A, M9804A

| | 2 to 4 modules | | 5 to 17 modules | |
|---|---|---|---|---|
| **Description** | **Char.** | **Typical** | **Char.** | **Typical** |
| 9 kHz to 30 kHz | 0.07 | 0.025 | 0.07 | 0.025 |
| 30 kHz to 100 kHz | 0.05 | 0.017 | 0.05 | 0.017 |
| 100 kHz to 300 kHz | 0.035 | 0.006 | 0.035 | 0.006 |
| 300 kHz to 10 MHz | 0.015 | 0.003 | 0.02 | 0.006 |
| 10 MHz to 6 GHz[2] | 0.015 | 0.003 | 0.04 | 0.006 |
| 6 GHz to 10 GHz | 0.025 | 0.006 | 0.06 | 0.012 |
| 10 GHz to 13.5 GHz | 0.036 | 0.006 | 0.09 | 0.012 |
| 13.5 GHz to 20 GHz | 0.045 | 0.01 | 0.12 | 0.02 |

M9805A, M9806A, M9807A, M9808A

| | 2 to 12 modules | | 13 to 17 modules | |
|---|---|---|---|---|
| **Description** | **Char.** | **Typical** | **Char.** | **Typical** |
| 100 kHz to 300 kHz | 0.07 | 0.015 | 0.07 | 0.015 |
| 300 kHz to 1 MHz | 0.03 | 0.01 | 0.03 | 0.01 |
| 1 MHz to 6 GHz[2] | 0.02 | 0.003 | 0.02 | 0.003 |
| 6 GHz to 10 GHz | 0.02 | 0.004 | 0.02 | 0.004 |
| 10 GHz to 17 GHz | 0.02 | 0.006 | 0.02 | 0.006 |
| 17 GHz to 30 GHz | 0.02 | 0.01 | 0.02 | 0.01 |
| 30 GHz to 45 GHz | 0.04 | 0.018 | 0.04 | 0.018 |
| 45 GHz to 50 GHz | 0.18 | 0.03 | 0.18 | 0.03 |

1. Reflection trace noise in a 1 kHz IF bandwidth for < 10 MHz, 10 kHz IF bandwidth for ≥ 10 MHz. At maximum specified power.
2. It may typically be degraded at particular frequencies such as 25 MHz, 54 MHz, 58.5 MHz, 156 MHz, 108 MHz, 120 MHz or 132 MHz.

# General Information

**Table 48. Miscellaneous Information**

| Description | Specification |
|---|---|
| System IF bandwidth range | 1 Hz to 15 MHz |
| Number of points | 1 to 100,003 |

**Table 49. System Requirements**

| PC System Requirement | |
|---|---|
| Hardware requirements | M9037A PXIe High performance embedded controller recommended |
| Operating systems | Windows 10 (64-bit) |
| Recommended CPU | Intel Core i7 10th Generation or later recommended |
| Available memory | 16 GB recommended, 4 GB minimum |
| Available disk space | 4 GB minimum |
| Display resolution | 1024 x 768 minimum |
| **Instrument Drivers** | |
| Keysight IO libraries | Keysight IO Libraries Suite 2022 Update 1 (18.2.28014.7) or later |

**Table 50. Environmental and Physical Specifications**

| Descriptions | | |
|---|---|---|
| Descriptions | 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.<br>Test Methods are aligned with IEC 60068-2 and levels are similar to MIL-PRF-28800F Class 3. | |
| Temperature | Operating | 0 to 50 °C ambient |
| | | 10 to 70 °C module temperature |
| | Non-operating | -40 to 70 °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 | 0.3 G maximum, 5 Hz to 500 Hz |
| | Non-operating | 0.75 G maximum, 5 Hz to 500 Hz |
| Instrument protection | | IP 30 IEC/EN 60529 |
| Warm-up time | | 60 minutes |

**Table 51. 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). | |
| CE ISM 1-A | 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.<br>• IEC 61326-1<br>• CISPR 11 Group 1, Class A |
| UK CA | 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.<br>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.<br>• AS/NZS CISPR 11 |
| | South Korean Certification (KC) mark; includes the marking's identifier code: R-R-Kst-xxxxxxx<br><br>South Korean Class A EMC declaration:<br>Information to the user:<br>This equipment has been conformity assessed for use in business environments. In a residential environment this equipment may cause radio interference.<br>※ This EMC statement applies to the equipment only for use in business environment.<br><br>사 용 자 안 내 문<br>이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.<br><br>※ 사용자 안내문은 "업무용 방송통신기자재"에만 적용한다. |
| Instrument calibration cycle | 1 year |

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

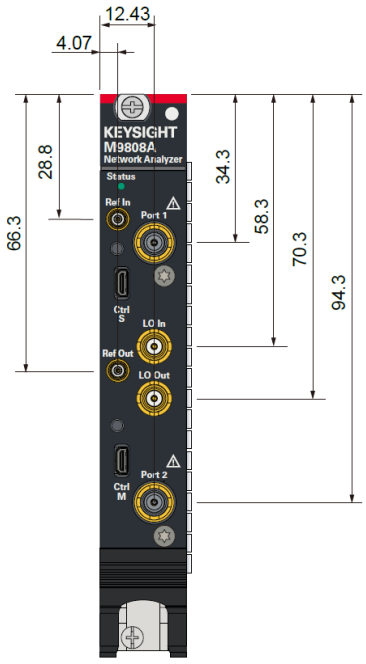
**Table 52. Physical Size and Weight**

M9800A, M9801A, M9802A, M9803A, M9804A

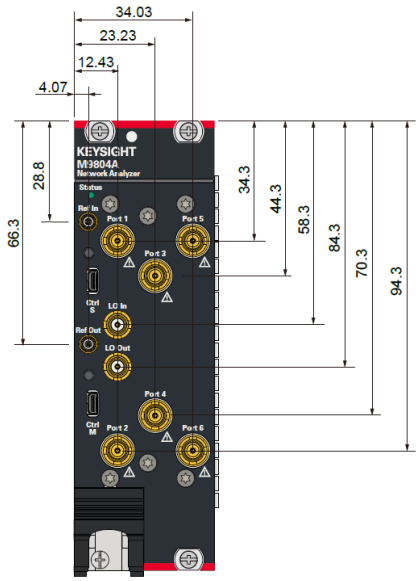
| Description | 2-port (Option 200) | 4/6-port (Option 400/600) | Note |
|---|---|---|---|
| Width | 22 mm (0.87 in.) | 42 mm (1.65 in.) | Including the backplane connector alignment tabs, and front panel ground clip in free state |
| Height | 130 mm (5.12 in.) | 130 mm (5.12 in.) | Including the ejector hook |
| Depth | 210 mm (8.27 in.) | 210 mm (8.27 in.) | From tip of ejector to tip of backplane connector |
| Weight | 540 g (1.2 lbs) | 4-port: 1,010 g (2.2 lbs) | |
| | | 6-port: 1,170 g (2.6 lbs) | |

M9805A, M9806A, M9807A, M9808A

| Description | 2-port (Option 200) | 4/6-port (Option 400/600) | Note |
|---|---|---|---|
| Width | 22 mm (0.87 in.) | - | Including the backplane connector alignment tabs, and front panel ground clip in free state |
| Height | 130 mm (5.12 in.) | - | Including the ejector hook |
| Depth | 210 mm (8.27 in.) | - | From tip of ejector to tip of backplane connector |
| Weight | 685 g (1.5 lbs) | - | |




Dimensions (front view, M9800A/01A/02A/03A/04A/05A/06A/07A/08A with option 200, in millimeters)




Dimensions (front view, M9800A/01A/02A/03A/04A with option 600, in millimeters)

**Table 53. Electrical Power**

M9800A, M9801A, M9802A, M9803A, M9804A

| Description | | | | |
|---|---|---|---|---|
| **2-port (Option 200)** | | | | |
| Total power dissipation | 37.8 watts (maximum) | | | |
| Supply voltage | +3.3 V | +5 V | +12 V | -12 V |
| Nominal current | 3.1 amps | 0 amps | 2.3 amps | 0 amps |
| **4-port (Option 400)** | | | | |
| Total power dissipation | 59.3 watts (maximum) | | | |
| Supply voltage | +3.3 V | +5 V | +12 V | -12 V |
| Nominal current | 4.9 amps | 0 amps | 3.6 amps | 0 amps |
| **6-port (Option 600)** | | | | |
| Total power dissipation | 79.7 watts (maximum) | | | |
| Supply voltage | +3.3 V | +5 V | +12 V | -12 V |
| Nominal current | 6.7 amps | 0 amps | 4.8 amps | 0 amps |

M9805A, M9806A, M9807A, M9808A

| Description | | | | |
|---|---|---|---|---|
| **2-port (Option 200)** | | | | |
| Total power dissipation | 36.8 watts (maximum) | | | |
| Supply voltage | +3.3 V | +5 V | +12 V | -12 V |
| Nominal current | 2.9 amps | 0 amps | 2.3 amps | 0 amps |

**Table 54. Front Panel Information**

| Description | |
|---|---|
| **Test Port** | |
| Connector type | 3.5 mm female (M9800A, M9801A, M9802A, M9803A, M9804A, M9805A) |
| | 2.4 mm female (M9806A, M9807A) |
| | 1.85 mm female (M9808A) |
| Impedance | 50 ohm (nominal) |
| **External Reference Input** | |
| Connector type | MCX |
| Input amplitude range | -3 to +10 dBm |
| Input frequency[1] | 10 MHz ± 10 ppm |
| Impedance | 50 ohm (nominal) |
| **External Reference Output** | |
| Connector type | MCX |
| Output amplitude range | 0 to ± 3 dBm |
| Output frequency | 10 MHz ± 7 ppm |
| Impedance | 50 ohm (nominal) |

1. Input frequency reference of 100 MHz is also acceptable with some limitations. See M980xA webhelp for more details.

# Measurement Throughput Summary

**Table 55. Cycle Time for Measurement Completion (milliseconds) [1] – Typical**

M9800A, M9801A, M9802A, M9803A, M9804A

| Description | Sweep mode: Auto | | | Sweep mode: Stepped | | |
|---|---|---|---|---|---|---|
| **10 MHz – 9 GHz frequency span, 1 MHz IF bandwidth** | | | | | | |
| Number of points | 201 | 401 | 1601 | 201 | 401 | 1601 |
| Uncorrected | 3.3 | 4.3 | 7.4 | 3.3 | 4.8 | 11.1 |
| 2-port calibration | 5.9 | 8.1 | 14.3 | 5.9 | 9.0 | 21.9 |
| 4-port calibration | 11.4 | 15.8 | 28.4 | 11.4 | 17.6 | 43.3 |
| 6-port calibration | 17.5 | 24.9 | 44.6 | 17.6 | 27.5 | 65.8 |
| 24-port calibration [2] | 101.8 | 157.6 | 347.4 | 102.3 | 164.7 | 341.8 |
| **10 MHz – 20 GHz frequency span, 1 MHz IF bandwidth** | | | | | | |
| Number of points | 201 | 401 | 1601 | 201 | 401 | 1601 |
| Uncorrected | 3.9 | 5.6 | 8.0 | 3.9 | 5.6 | 14.2 |
| 2-port calibration | 7.2 | 10.6 | 15.5 | 7.2 | 10.5 | 27.9 |
| 4-port calibration | 14.0 | 20.7 | 30.6 | 14.0 | 20.6 | 55.4 |
| 6-port calibration | 21.5 | 32.2 | 47.4 | 21.5 | 32.2 | 84.4 |
| 24-port calibration [2] | 116.3 | 186.2 | 355.0 | 116.3 | 183.2 | 408.6 |
| **800 MHz – 1 GHz frequency span, 1 MHz IF bandwidth** | | | | | | |
| Number of points | 201 | 401 | 1601 | 201 | 401 | 1601 |
| Uncorrected | 1.5 | 1.6 | 3.7 | 1.6 | 2.1 | 4.5 |
| 2-port calibration | 1.9 | 2.7 | 6.9 | 2.6 | 3.7 | 8.5 |
| 4-port calibration | 3.4 | 4.9 | 13.8 | 4.7 | 7.0 | 16.7 |
| 6-port calibration | 6.6 | 9.8 | 26.1 | 7.7 | 11.6 | 27.3 |
| 24-port calibration [2] | 78.1 | 129.2 | 339.8 | 84.0 | 130.5 | 346.0 |
| **9 GHz – 10 GHz frequency span, 1 MHz IF bandwidth** | | | | | | |
| Number of points | 201 | 401 | 1601 | 201 | 401 | 1601 |
| Uncorrected | 1.4 | 1.6 | 3.9 | 1.8 | 2.5 | 6.2 |
| 2-port calibration | 1.9 | 2.6 | 6.9 | 3.0 | 4.6 | 12.0 |
| 4-port calibration | 3.5 | 4.9 | 13.7 | 5.8 | 8.9 | 23.8 |
| 6-port calibration | 6.7 | 9.9 | 26.3 | 8.9 | 14.4 | 36.9 |
| 24-port calibration [2] | 83.9 | 129.8 | 342.9 | 78.5 | 133.9 | 341.8 |

M9805A, M9806A, M9807A, M9808A

| 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 | 1.5 | 2.0 | 5.6 | 1.8 | 2.5 | 6.2 |
| 2-port calibration | 2.4 | 3.5 | 10.7 | 3.0 | 4.5 | 12.0 |
| 4-port calibration [3] | 5.0 | 7.0 | 21.4 | 5.7 | 8.8 | 23.8 |
| 24-port calibration [4] | 90.3 | 149.6 | 362.5 | 80.7 | 123.1 | 301.6 |
| **10 MHz – 26.5 GHz frequency span, 1 MHz IF bandwidth** | | | | | | |
| Number of points | 201 | 401 | 1601 | 201 | 401 | 1601 |
| Uncorrected | 4.5 | 6.2 | 9.4 | 4.5 | 6.2 | 15.5 |
| 2-port calibration | 8.3 | 11.8 | 18.3 | 8.4 | 11.8 | 30.5 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4-port calibration [3] | 16.3 | 23.4 | 36.9 | 16.3 | 23.4 | 61.0 |
| 24-port calibration [4] | 132.5 | 207.4 | 359.5 | 132.3 | 204.5 | 467.6 |
| **10 MHz – 40 GHz frequency span, 1 MHz IF bandwidth** | | | | | | |
| Number of points | 201 | 401 | 1601 | 201 | 401 | 1601 |
| Uncorrected | 4.9 | 6.8 | 11.6 | 4.9 | 6.8 | 16.7 |
| 2-port calibration | 9.0 | 13.1 | 22.6 | 9.0 | 13.0 | 32.9 |
| 4-port calibration [3] | 17.9 | 26.0 | 45.4 | 17.9 | 26.0 | 65.5 |
| 24-port calibration [4] | 141.3 | 222.6 | 367.6 | 141.2 | 217.3 | 489.4 |
| **10 MHz – 53 GHz frequency span, 1 MHz IF bandwidth** | | | | | | |
| Number of points | 201 | 401 | 1601 | 201 | 401 | 1601 |
| Uncorrected | 5.3 | 7.3 | 14.3 | 5.3 | 7.3 | 17.8 |
| 2-port calibration | 9.8 | 13.9 | 28.0 | 9.8 | 13.9 | 35.1 |
| 4-port calibration [3] | 19.4 | 27.7 | 56.1 | 19.4 | 27.9 | 70.0 |
| 24-port calibration [4] | 148.2 | 228.8 | 435.0 | 147.2 | 226.5 | 522.0 |

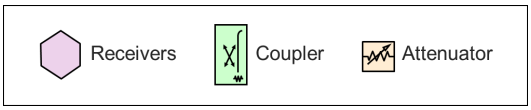
1. Analyzer display turned off with DISPlay:VISible OFF. Measured using a Keysight M9019A PXIe chassis, and an M9037A embedded controller with Intel Core i7-4700EQ 2.40 GHz CPU and 16 GB RAM running Windows 10 (64-bit), with firmware revision A.14.10.08. Data for one trace (S11) measurement. Uncorrected measurements are for one sweep direction.
2. With four 6-port M980xA modules.
3. With two 2-port M980xA modules.
4. With twelve 2-port M980xA modules.

**Table 56. Software**

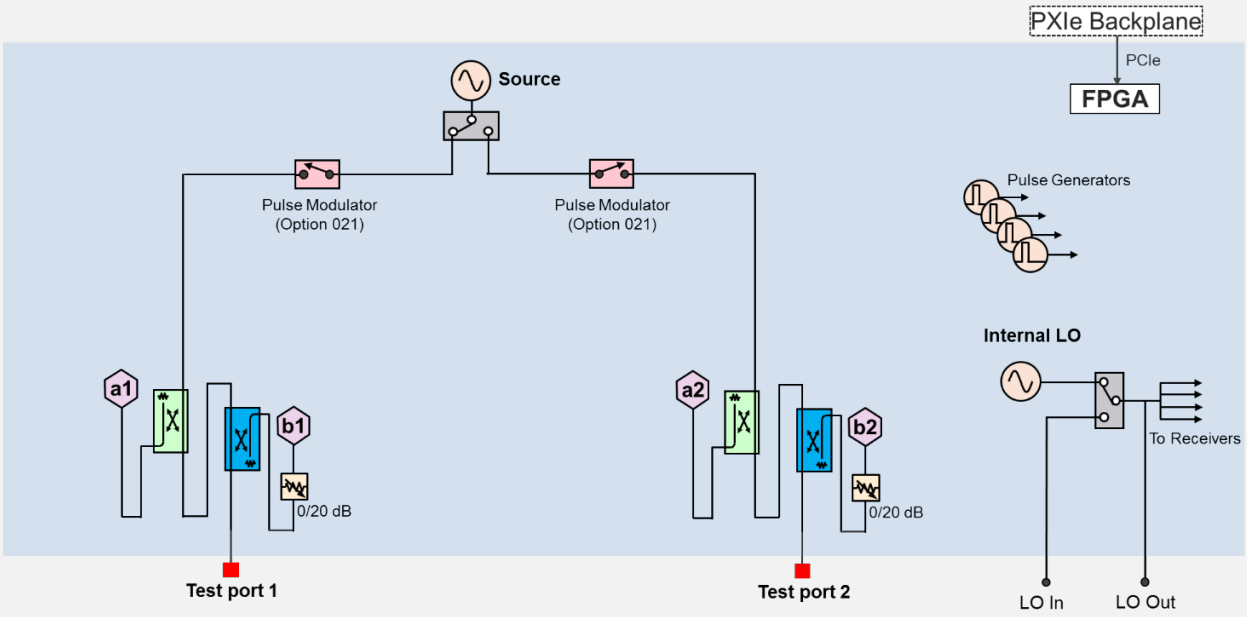
| Description | Information |
|---|---|
| Keysight IO library | The IO library suite offers a single entry point for connection to the most common instruments including AXIe, PXI, GPIB, USB, Ethernet/LAN, RS-232, and VXI test instrument from Keysight and other vendors. It automatically discovers interfaces, chassis, and instruments. The graphical user interface allows you to search for, verify, and update IVI instrument and soft front panel drivers for modular and traditional instruments. The IO suite safely installs in side-by-side mode with NI I/O software. Free software download at www.keysight.com/find/iosuite |
| Keysight soft front panel | The PXI module includes a soft front panel (SFP), a software based graphical user interface (GUI) which enables the instrument's capabilities from your PC. |
| Command Expert | Assists in finding the right instrument commands and setting correct parameters. A simple interface includes documentation, examples, syntax checking, command execution, and debug tools to build sequences for integration in Excel, MATLAB, LabVIEW, VEE, and System VUE. Free software download at www.keysight.com/find/commandexpert |
| Example programs | Setting up a measurement |
| | Guided calibration |
| | Data acquisition |
| | Data transfer |
| Example programming languages | C, C++, C#, VB, LabVIEW |

# Test Set Block Diagrams

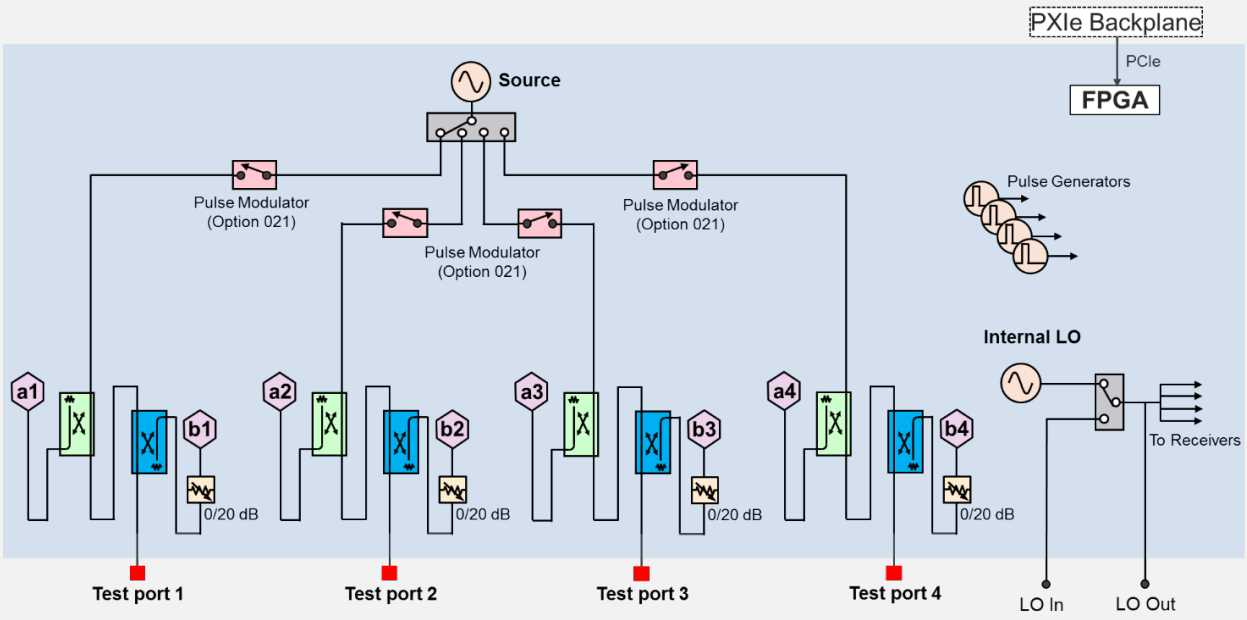
## Legend



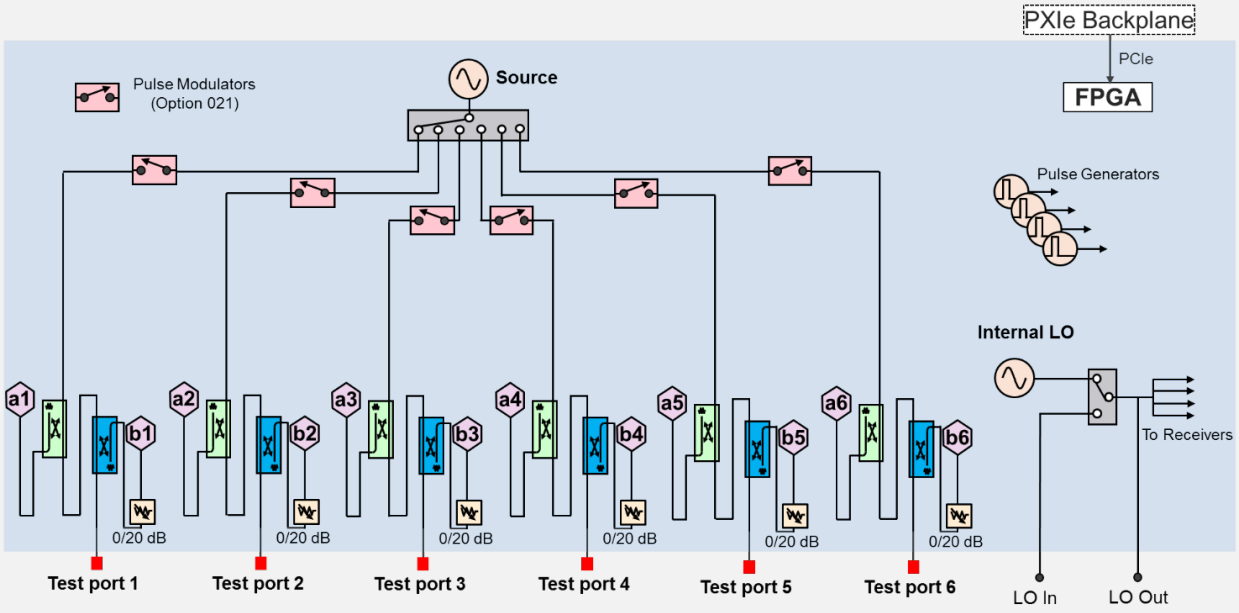

## M980xA Series Option 200 (2-port base model)




## M980xA Series Option 400 (4-port base model)



M980xA Series Option 600 (6-port base model)



## Literature Information

- M980xA PXIe Vector Network Analyzer – Configuration Guide, 5992-3597EN
- Keysight Network Analyzer – Selection Guide, 5989-7603EN
- Electronic Calibration (ECal) Modules for Network Analyzer –Technical Overview, 5963-3743E

## Web Resources

- www.keysight.com/find/pxivna
- www.keysight.com/find/na
- www.keysight.com/find/vnasoftware
- www.keysight.com/find/ecal

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