

Anritsu envision : ensure

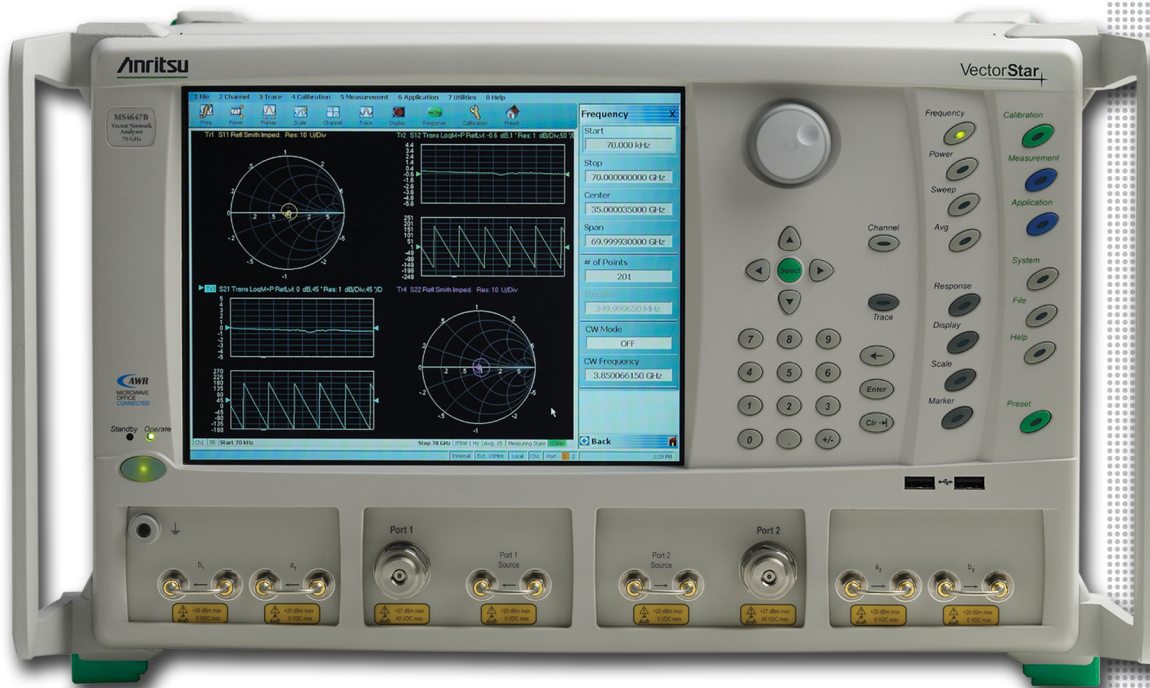
VectorStar[®]

High Performance, Broadband Network Analysis Solutions

MS4640B Series

Microwave Vector Network Analyzers

- MS4642B 70 kHz to 20 GHz
- MS4644B (Optional 70 kHz) 10 MHz to 40 GHz
- MS4647B (Optional 70 kHz) 10 MHz to 70 GHz



Introduction

This document provides detailed specifications for the MS4640B series microwave Vector Network Analyzers (VNAs) listed below, including all related options, and accessories.

Instrument Models and Operating Frequencies

- MS4642B – 70 kHz to 20 GHz
- MS4644B – (Optional 70 kHz) 10 MHz to 40 GHz
- MS4647B – (Optional 70 kHz) 10 MHz to 70 GHz
- Extended Operating Frequency Details Inside

Principal Options

- MS4640B-002 – Time Domain
- MS4640B-007 – Receiver Offset
- MS4640B-021 – Universal Fixture Extraction
- MS4640B-031 – Dual Source Architecture
- MS4640B-032 – Internal RF Combiner
- MS4640B-035 – IF Digitizer
- MS4640B-036 – Extended IF Digitizer Memory
- MS4640B-041 – Noise Figure
- MS4640B-042 – PulseView™
- MS4640B-043 – DifferentialView™
- MS4640B-044 – IMDView™
- MS4640B-046 – Fast CW
- MS4640B-047 – Eye Diagram
- MS4640B-048 – Differential Noise Figure
- MS4640B-051 – Direct Access Loops
- MS4640B-053 – External ALC
- MS4640B-061/062 – Active Measurements Suite
- MS4640B-070 – 70 kHz Low-End Frequency Extension

A detailed color brochure available on the Anritsu web site provides descriptions and examples of the VectorStar family's features and benefits. The web site also provides detailed information on 110 /125/145 GHz Broadband Coaxial, Banded Waveguide, and Multiport solutions based on the MS4640B VNA:

(<https://www.anritsu.com/en-us/test-measurement/products/ms4640b-series>)

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Definitions

| | |
|----------------------------------|---|
| | All specifications and characteristics apply under the following conditions, unless otherwise stated: |
| Warm-Up Time | After 90 minutes of warm-up time, where the instrument is left in the ON state. |
| Temperature Range | Over the 25 °C ± 5 °C temperature range. |
| Error-Corrected Specifications | For error-corrected specifications, over 23 °C ± 3 °C, with < 1 °C variation from calibration temperature. For error-corrected specifications are warranted and include guard-bands, unless otherwise stated. |
| Frequency Bands in Tables | When a frequency is listed in two rows of the same table, the specification for the common frequency is taken from the lower frequency band, except when the band edge is less than 5 GHz. |
| User Cables | Specifications do not include effects of any user cables, adapters, or fixtures attached to the instrument. |
| Discrete Spurious Responses | Specifications may exclude discrete spurious responses. |
| Internal Reference Signal | All specifications apply with internal 10 MHz Crystal Oscillator Reference Signal. |
| Interpolation Mode | All specifications are with Interpolation Mode Off. |
| Standard | Refers to instruments without Option 51, 61, or 62. |
| Typical Performance | Typical performance indicates the measured performance of an average unit. It does not include guard-bands and is not covered by the product warranty. Typical specifications are shown in parentheses, such as (-102 dB), or noted as typical. |
| Characteristic Performance | Characteristic performance indicates a performance designed-in and verified during the design phase. It does include guard-bands and is not covered by the product warranty. |
| Nominal Performance | Nominal performance indicates a performance designed in and observed during the design phase. It does not include guard bands, is not production tested, and is not covered by the product warranty. |
| Below 300 kHz | All uncertainties below 300 kHz are typical. |
| Recommended Calibration Cycle | 12 months (Residual specifications also require calibration kit calibration cycle adherence.) |
| Specifications Subject to Change | All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site: www.anritsu.com |

System Dynamic Range

System dynamic range is calculated as the difference between the maximum rated source power and the specified noise floor at the specified reference plane. Option 31 System Dynamic Range is listed in alternating tables. Note that Option 32 System Dynamic Range differs by the delta in max power.

MS4642B 20 GHz Model, System Dynamic Range (dB)

| Frequency Range | at Ports 1 or 2 | | at b ₁ or b ₂ | |
|-----------------------|----------------------------|--|-------------------------------------|--|
| | Option 8 ^a or 9 | | Option 8 ^a or 9 | |
| 0.07 to 0.3 MHz | 81 | | 112 | |
| > 0.3 to 2 MHz | 98 | | 124 | |
| > 2 to 10 MHz | 111 | | 132 | |
| > 0.01 to 2.5 GHz | 114 | | 135 | |
| > 2.5 to 20 GHz | 115 | | 130 | |
| With Option 31 | | | | |
| 0.07 to 0.3 MHz | 83 | | 114 | |
| > 0.3 to 2 MHz | 100 | | 126 | |
| > 2 to 10 MHz | 113 | | 134 | |
| > 0.01 to 2.5 GHz | 116 | | 137 | |
| > 2.5 to 20 GHz | 116 | | 131 | |

MS4644B 40 GHz Model, System Dynamic Range (dB)

| Frequency Range | at Ports 1 or 2 | | | at b ₁ or b ₂ | |
|-----------------------|-----------------|-----------|------------------------------|-------------------------------------|------------------------------|
| | Standard | Option 51 | Option 61 ^b or 62 | Option 51 | Option 61 ^b or 62 |
| 0.07 to 0.3 MHz | 85 | 83 | 81 | 114 | 112 |
| > 0.3 to 2 MHz | 102 | 100 | 98 | 126 | 124 |
| > 2 to 10 MHz | 115 | 113 | 111 | 134 | 132 |
| > 0.01 to 2.5 GHz | 122 | 119 | 114 | 140 | 135 |
| > 2.5 to 40 GHz | 119 | 115 | 110 | 130 | 125 |
| With Option 31 | | | | | |
| 0.07 to 0.3 MHz | 87 | 85 | 83 | 116 | 114 |
| > 0.3 to 2 MHz | 104 | 102 | 100 | 128 | 126 |
| > 2 to 10 MHz | 117 | 115 | 113 | 136 | 134 |
| > 0.01 to 2.5 GHz | 129 | 121 | 116 | 142 | 137 |
| > 2.5 to 40 GHz | 122 | 118 | 113 | 133 | 128 |

MS4647B 70 GHz Model, System Dynamic Range (dB)

| Frequency Range | at Ports 1 or 2 | | | at b ₁ or b ₂ | |
|-----------------------|-----------------|-----------|------------------------------|-------------------------------------|------------------------------|
| | Standard | Option 51 | Option 61 ^b or 62 | Option 51 | Option 61 ^b or 62 |
| 0.07 to 0.3 MHz | 85 | 83 | 81 | 114 | 112 |
| > 0.3 to 2 MHz | 102 | 100 | 98 | 126 | 124 |
| > 2 to 10 MHz | 115 | 113 | 111 | 134 | 132 |
| > 0.01 to 2.5 GHz | 122 | 119 | 114 | 140 | 135 |
| > 2.5 to 5 GHz | 116 | 112 | 106 | 127 | 121 |
| > 5 to 20 GHz | 115 | 111 | 105 | 126 | 120 |
| > 20 to 38 GHz | 116 | 111 | 105 | 126 | 120 |
| > 38 to 50 GHz | 115 | 109 | 104 | 124 | 119 |
| > 50 to 65 GHz | 110 | 104 | 99 | 119 | 115 |
| > 65 to 67 GHz | 108 | 103 | 95 | 117 | 111 |
| > 67 to 70 GHz | 107 | 100 | 90 | 110 | 106 |
| With Option 31 | | | | | |
| 0.07 to 0.3 MHz | 87 | 85 | 83 | 116 | 114 |
| > 0.3 to 2 MHz | 104 | 102 | 100 | 128 | 126 |
| > 2 to 10 MHz | 117 | 115 | 113 | 136 | 134 |
| > 0.01 to 2.5 GHz | 124 | 121 | 116 | 142 | 137 |
| > 2.5 to 5 GHz | 118 | 114 | 108 | 129 | 123 |
| > 5 to 20 GHz | 118 | 114 | 108 | 129 | 123 |
| > 20 to 38 GHz | 118 | 113 | 107 | 128 | 122 |
| > 38 to 50 GHz | 117 | 111 | 106 | 126 | 121 |
| > 50 to 65 GHz | 117 | 111 | 106 | 126 | 122 |
| > 65 to 67 GHz | 116 | 111 | 103 | 125 | 119 |
| > 67 to 70 GHz | 114 | 107 | 97 | 120 | 113 |

a. The Option 8 dynamic range reported in this column corresponds to S₂₁. For S₁₂, add 2 dB.

b. The Option 61 dynamic range reported in this column applies for S₂₁ measurements. For S₁₂ dynamic range, use the figures from the Option 51 column.

Receiver Dynamic Range

Calculated as the difference between the maximum receiver input level for 0.1 dB compression and the specified noise floor at the specified reference plane. Characteristic Performance.

All Models, Receiver Dynamic Range (dB)

| Frequency Range | at Ports 1 or 2 | | | at b ₁ or b ₂ | |
|-----------------------------|-----------------------|------------------------|----------------------------------|-------------------------------------|--------------------------------|
| | Standard ^a | Option 51 ^a | Option 61 ^{b,c,d} or 62 | Option 51 ^a | Option 61 ^{c,d} or 62 |
| 0.07 to 0.3 MHz | 80 | 79 | 78 | 90 | 89 |
| > 0.3 to 2 MHz | 102 | 102 | 102 | 107 | 107 |
| > 2 to 10 MHz | 115 | 115 | 115 | 115 | 115 |
| > 0.01 to 2.5 GHz | 120 | 119 | 116 | 119 | 116 |
| > 2.5 to 5 GHz | 120 | 118 | 115 | 117 | 114 |
| > 5 to 20 GHz | 120 | 118 | 115 | 118 | 115 |
| > 20 to 40 GHz ^e | 120 | 118 | 115 | 118 | 116 |
| > 38 to 50 GHz | 120 | 118 | 117 | 117 | 117 |
| > 50 to 65 GHz | 117 | 115 | 115 | 113 | 114 |
| > 65 to 67 GHz | 115 | 113 | 111 | 110 | 109 |
| > 67 to 70 GHz | 113 | 110 | 109 | 107 | 108 |

- a. Not applicable to MS4642B.
- b. The Option 61 dynamic range reported in this column applies for S21 measurements. For S12 dynamic range, use the figures from the Option 51 column.
- c. Option 8 or 9 for MS4642B.
- d. The Option 8 dynamic range reported in this column corresponds to S21. For S12, add 2 dB.
- e. 20 to 38 GHz for MS4647B.

Receiver Compression

Port power level beyond which the response may be compressed more than 0.1 dB relative to the normalization level. 10 Hz IF bandwidth used to remove any high level noise effects. Match not included. Performance is characteristic. In pulse modes (Option 42), compression is measured with 1 kHz IF bandwidth and the compression level is 0.3 dB below 1 GHz.

All Models, Compression Levels (dBm)

| Frequency Range | 0.1 dB Compression Levels in dBm relative to the Normalization Level ^a | | | | | |
|-----------------------------|---|------------------------|----------------------------------|------------------------------------|-------------------------|----------------------------------|
| | at Ports 1 or 2 | | | at a _x loops | at b _x loops | |
| | Standard ^b | Option 51 ^b | Option 61 ^{c,d,e} or 62 | Option 51, 61 ^d , or 62 | Option 51 ^b | Option 61 ^{c,d,e} or 62 |
| 0.07 to 0.3 MHz | +5 | +5 | +5 | -15 | -15 | -15 |
| > 0.3 to 10 MHz | +10 | +11 | +12 | -10 | -10 | -9 |
| > 0.01 to 2.5 GHz | +10 | +11 | +12 | -10 | -10 | -9 |
| > 2.5 to 5 GHz | +10 | +11 | +12 | -5 | -5 | -4 |
| > 5 to 20 GHz | +10 | +11 | +12 | -4 | -4 | -3 |
| > 20 to 40 GHz ^f | +10 | +11 | +12 | -4 | -4 | -2 |
| > 38 to 50 GHz | +10 | +12 | +14 | -4 | -4 | -1 |
| > 50 to 65 GHz | +10 | +12 | +14 | -5 | -5 | -2 |
| > 65 to 67 GHz | +10 | +13 | +15 | -5 | -5 | -2 |
| > 67 to 70 GHz | +10 | +13 | +15 | -5 | -5 | -1 |

- a. 0.3 dB for < 0.3 MHz.
- b. Not applicable to MS4642B.
- c. The Option 61 compression level reported in this column applies to Port 2 or b₂. For Port 1 or b₁ compression level, use the figures from the appropriate Port X or b_x Option 51 column.
- d. Option 8 or 9 for MS4642B.
- e. For Option 8, the value in this column corresponds to that for port 2 or b₂. For port 1 or b₁, subtract 1 dB.
- f. 20 to 38 GHz for MS4647B.

During intermodulation measurements it is useful to know the linearity of the receiver. In addition to considering the receiver compression point, it is helpful to understand the third order Intercept Point (IP3) of the receiver. IP3 can therefore be used as a figure of merit to describe the range and quality of IMD measurements. The nominal IP3 performance provided is valid with or without the Option 32 combiner and represents the receiver performance at the input of the test port. Minimal degradation of IP3 at different tone spacings. For the approximate IP3 of the receiver at the sampler input, deduct ~13 dB from the numbers below. The spec values below were derived by using -10 dBm/tone power incident at the receive port, a tone spacing of 3 MHz (reducing to frequency/10 for frequencies under 30 MHz) and an IF bandwidth of no more than 10 Hz.

All Models, Third Order Intercept Point (IP3, dBm)

| Frequency Range | At Port 2 (Nominal) |
|---|---------------------|
| 0.07 MHz to 0.3 MHz | +20 |
| 0.3 MHz to 1.0 GHz | +25 |
| > 1.0 GHz to 20/40/70 GHz (max frequency of the models) | +35 |

High Level Noise

Measured at 1 kHz IF bandwidth, at default power, with either full reflects or through transmission. RMS.

Characteristic performance on MS4647B with either Option 51, 61, or 62.

High level noise magnitude may be degraded to 20 mdB RMS (typical) at particular frequencies due to receiver residuals.

| Frequency (GHz) | Magnitude (dB) | Phase (degree) |
|-------------------|-------------------|----------------|
| 70 kHz to 500 kHz | < 0.04 | < 0.4 |
| > 500 kHz to 2.5 | < 0.0045 | < 0.05 |
| > 2.5 to 5 | < 0.0045 | < 0.05 |
| > 5 to 20 | < 0.0045 | < 0.05 |
| > 20 to 40 | < 0.006 | < 0.06 |
| > 40 to 67 | < 0.006 | < 0.08 |
| > 67 to 70 | < 0.008 (< 0.006) | < 0.08 |

Noise Floor

Measured at 10 Hz IF Bandwidth with no averaging, and at -10 dBm port power. RMS, no leakage correction applied. Measurement made with a through line connection, with its effects compensated for. Performance at a_x and b_x loops is characteristic.

| All Models, Noise Floor (dBm) | | | | | | |
|-------------------------------|-----------------------|------------------------|----------------------------------|------------------------------------|------------------------|----------------------------------|
| Frequency Range | At Ports 1 or 2 | | | At a_x Loops | At b_x Loops | |
| | Standard ^a | Option 51 ^a | Option 61 ^{b,c,d} or 62 | Option 51, 61 ^c , or 62 | Option 51 ^a | Option 61 ^{b,c,d} or 62 |
| 0.07 to 0.3 MHz | -75 | -74 | -73 | -105 | -105 | -104 |
| > 0.3 to 2 MHz | -92 | -91 | -90 | -117 | -117 | -116 |
| > 2 to 10 MHz | -105 | -104 | -103 | -125 | -125 | -124 |
| > 0.01 to 2.5 GHz | -110 | -108 | -104 | -129 | -129 | -125 |
| > 2.5 to 40 GHz ^e | -110 | -107 | -103 | -121 | -122 | -118 |
| > 38 to 50 GHz | -110 | -106 | -103 | -121 | -121 | -118 |
| > 50 to 65 GHz | -110 | -106 | -103 | -121 | -121 | -119 |
| > 65 to 67 GHz | -110 | -106 | -100 | -120 | -120 | -116 |
| > 67 to 70 GHz | -110 | -106 | -100 | -115 | -119 | -116 |

a. Not applicable to MS4642B.

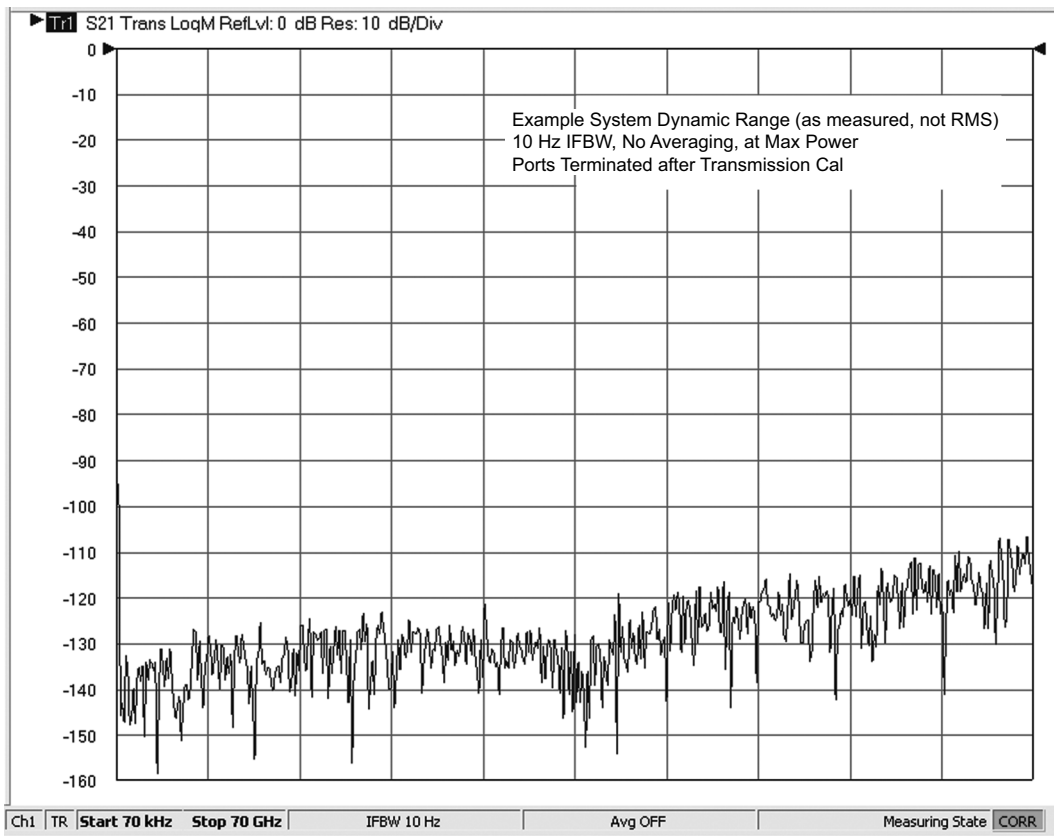
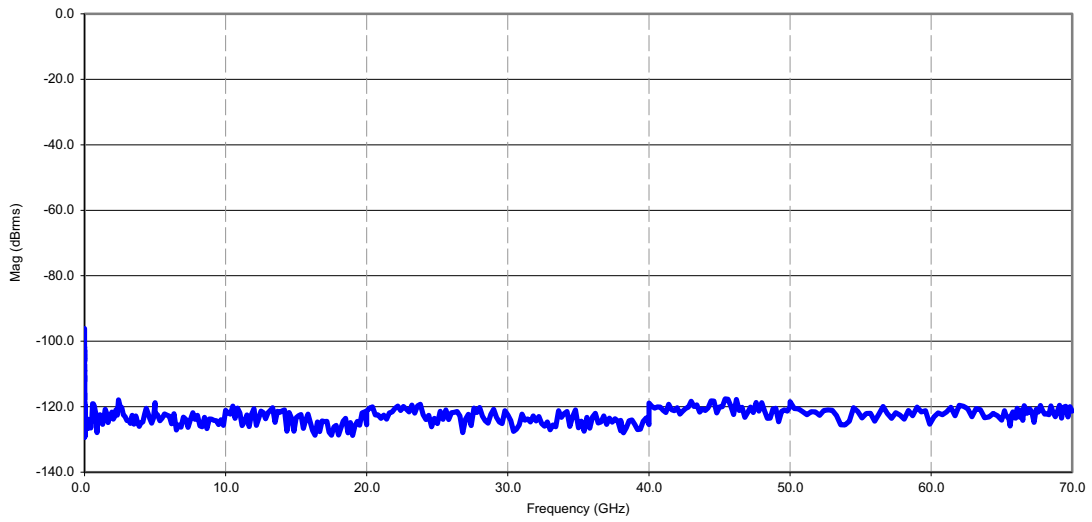
b. The Option 61 noise floor reported in this column applies to Port 2 or b_2 . For Port 1 or b_1 noise floor, use the figures from the appropriate Port_x or b_x Option 51 column.

c. Option 8 or 9 for MS4642B.

d. For Option 8, the value in this column applies to port 2 or b_2 . For port 1 or b_1 , the appropriate value is 1 dB more negative.

e. 2.5 GHz to 38 GHz for MS4647B.

MS4647B Example Noise Floor (Standard Configuration)



Example System Dynamic Range

Power Range

Maximum rated power to minimum level. The difference reflects the ALC range for standard models or with Option 51, and the ALC + attenuator range for models with Option 61 or 62, or Option 8 or 9 for MS4642B. Maximum Rated Power is typical from 2.4 GHz to 2.7 GHz.

MS4642B, 20 GHz Model, Power Range (dBm)

| Frequency | Option 8 ^a or 9 |
|-----------------------|----------------------------|
| 70 kHz to 0.01 GHz | +8 to -95 |
| > 0.01 to 2.5 GHz | +10 to -95 |
| > 2.5 to 20 GHz | +11 to -90 |
| With Option 31 | |
| 70 kHz to 0.01 GHz | +10 to -95 |
| > 0.01 to 2.5 GHz | +12 to -95 |
| > 2.5 to 20 GHz | +12 to -90 |

a. For Option 8, the power range reported in this column applies to Port 1. For Port 2, add 1 dB to the maximum (minimum unchanged).

MS4644B, 40 GHz Model, Power Range (dBm)

| Frequency | Standard | Option 51 | Option 61 ^a or 62 |
|-----------------------------------|------------|------------|------------------------------|
| 70 kHz to 0.01 GHz | +10 to -25 | +9 to -25 | +8 to -95 |
| > 0.01 to 2.5 GHz | +12 to -25 | +11 to -25 | +10 to -95 |
| > 2.5 to 20 GHz | +9 to -20 | +8 to -20 | +7 to -90 |
| > 20 to 40 GHz | +9 to -25 | +8 to -25 | +7 to -95 |
| With Option 31^b | | | |
| 70 kHz to 0.01 GHz | +12 to -25 | +11 to -25 | +10 to -95 |
| > 0.01 to 2.5 GHz | +14 to -25 | +13 to -25 | +12 to -95 |
| > 2.5 to 20 GHz | +12 to -20 | +11 to -20 | +10 to -90 |
| > 20 to 40 GHz | +12 to -25 | +11 to -25 | +10 to -95 |

a. The Option 61 power range reported in this column applies to Port 1. For Port 2, use the figures from the Option 51 column.

b. With Option 8x, Test Port 2 maximum power is equivalent to the non-option 31 range (typical).

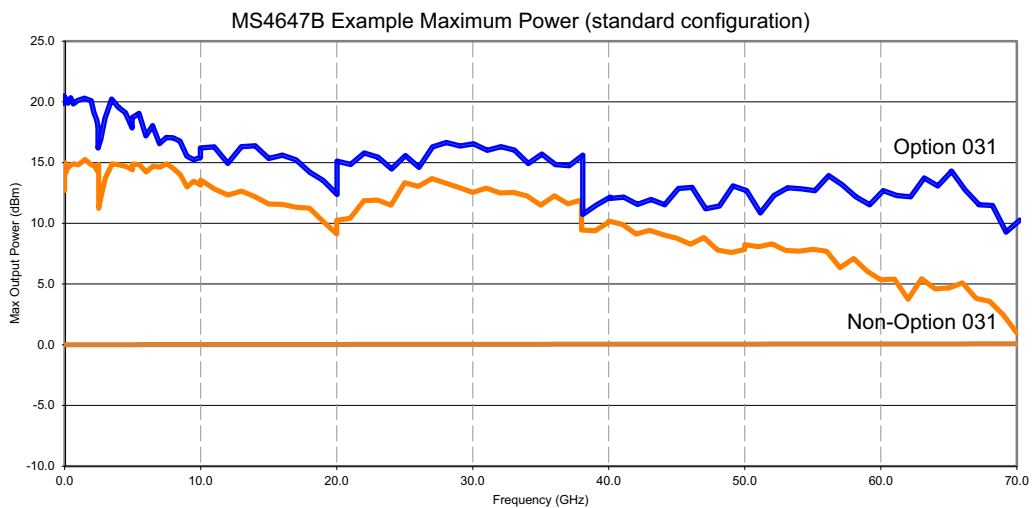
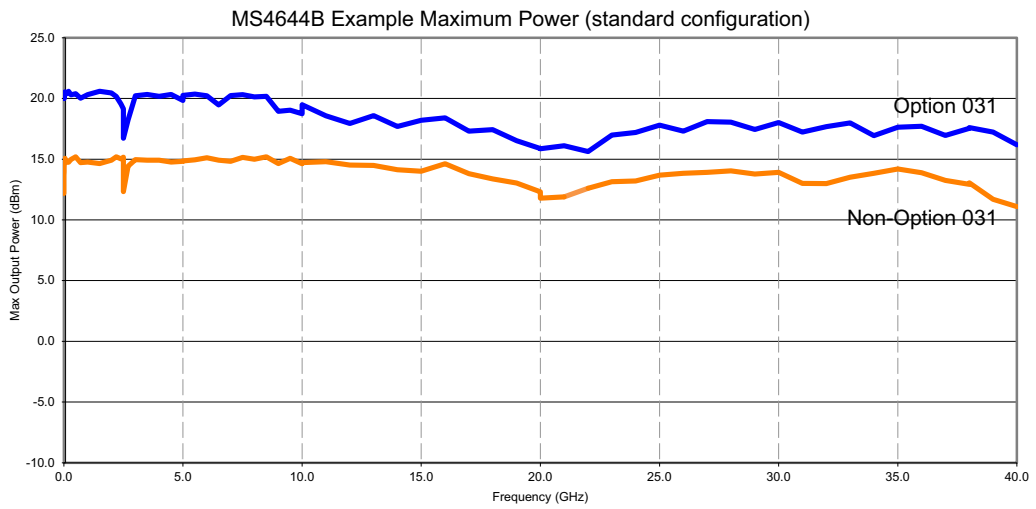
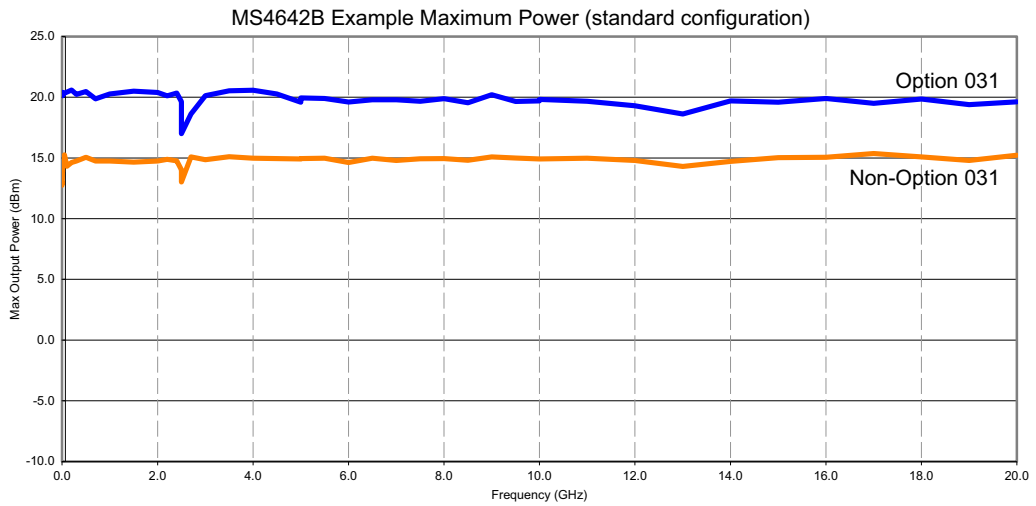
MS4647B, 70 GHz Model, Power Range (dBm)

| Frequency | Standard | Option 51 | Option 61 ^a or 62 |
|-----------------------------------|------------|------------|------------------------------|
| 70 kHz to 0.01 GHz | +10 to -25 | +9 to -25 | +8 to -85 |
| > 0.01 to 2.5 GHz | +12 to -25 | +11 to -25 | +10 to -85 |
| > 2.5 to 5 GHz | +6 to -20 | +5 to -20 | +3 to -80 |
| > 5 to 20 GHz | +5 to -20 | +4 to -20 | +2 to -80 |
| > 20 to 38 GHz | +6 to -25 | +4 to -25 | +2 to -85 |
| > 38 to 50 GHz ^b | +5 to -25 | +3 to -25 | +1 to -85 |
| > 50 to 65 GHz | 0 to -25 | -2 to -25 | -4 to -85 |
| > 65 to 67 GHz | -2 to -25 | -3 to -25 | -5 to -85 |
| > 67 to 70 GHz | -3 to -25 | -6 to -25 | -10 to -85 |
| With Option 31^c | | | |
| 70 kHz to 0.01 GHz | +12 to -25 | +11 to -25 | +10 to -85 |
| > 0.01 to 2.5 GHz | +14 to -25 | +13 to -25 | +12 to -85 |
| > 2.5 to 5 GHz | +8 to -20 | +7 to -20 | +5 to -80 |
| > 5 to 20 GHz | +8 to -20 | +7 to -20 | +5 to -80 |
| > 20 to 38 GHz | +8 to -25 | +6 to -25 | +4 to -85 |
| > 38 to 50 GHz | +7 to -25 | +5 to -25 | +3 to -85 |
| > 50 to 65 GHz | +7 to -25 | +5 to -25 | +3 to -85 |
| > 65 to 67 GHz | +6 to -25 | +4 to -25 | +2 to -85 |
| > 67 to 70 GHz | +4 to -25 | +1 to -25 | -3 to -85 |

a. The Option 61 power range reported in this column applies to Port 1. For Port 2, use the figures from the Option 51 column.

b. Rated power is typical 49 GHz to 50 GHz.

c. With Option 8x, Test Port 2 maximum power is equivalent to the non-option 31 range (typical). 38 to 50 GHz range may degrade by up to 3 dB.



Output Default Power

Instrument default power. For maximum rated power, refer to “Power Range” above.

| Model | Standard (No Options) | Option 51, 61, or 62 ^a |
|-----------------|-----------------------|-----------------------------------|
| MS4642B, 20 GHz | NA | +5 dBm |
| MS4644B, 40 GHz | +5 dBm | +5 dBm |
| MS4647B, 70 GHz | -3 dBm ^b | -10 dBm |

a. Option 8 or 9 for MS4642B.

b. -5 dBm for MS4647B Option 8x systems.

Power Accuracy, Linearity, and Resolution

| Frequency (GHz) | Accuracy ^a (dB) | Linearity ^b (dB) | Resolution (dB) |
|-----------------|----------------------------|-----------------------------|-----------------|
| 70 kHz to 0.01 | ± 1.5 | ± 1.5 | 0.01 |
| > 0.01 to 40 | ± 1.5 | ± 1.0 | 0.01 |
| > 40 to 67 | ± 3.0 | ± 1.0 | 0.01 |
| > 67 to 70 | ± 4.0 (± 3.0) | ± 2.0 (± 1.0) | 0.01 |

a. Measured at default power.

b. Measured between default and 5 dB below default port power.

Measurement Stability

Ratio measurement, with ports shorted. Characteristic.

| Frequency (GHz) | Magnitude (dB/°C) | Phase (degree/°C) |
|-----------------|-------------------|-------------------|
| 70 kHz to 0.01 | < 0.04 | < 0.4 |
| > 0.01 to 20 | < 0.02 | < 0.2 |
| > 20 to 40 | < 0.03 | < 0.5 |
| > 40 to 67 | < 0.03 | < 0.7 |
| > 67 to 70 | < 0.04 | < 0.8 |

Frequency Resolution, Accuracy, and Stability

| Resolution | Accuracy | Stability |
|------------|---|---|
| 1 Hz | ± 5 × 10 ⁻⁷ Hz/Hz (at time of calibration) | < 5 × 10 ⁻⁹ /°C over 0 °C to 50 °C temperature < 1 × 10 ⁻⁹ /day aging, instrument on |

Phase Noise, Harmonics, and Non-Harmonics (Spurious)

Measured at default power. Phase Noise values are typical. Non-Harmonics are characteristic performance.

| Frequency (GHz) | SSB Phase Noise (dBc/Hz) at 1 kHz Offset | SSB Phase Noise (dBc/Hz) at 10 kHz Offset | SSB Phase Noise (dBc/Hz) at 100 kHz Offset | Harmonics (dBc) (second and third) | Non-Harmonic Spurious (dBc) at > 1 kHz Offsets |
|-----------------|--|---|--|------------------------------------|--|
| 70 kHz to 0.01 | -86 | -83 | -88 ^a | -20 | -20 |
| > 0.01 to 2.5 | -90 | -92 | -96 | -20 | -30 |
| > 2.5 to 5 | -93 | -94 | -95 | -20 ^b | -30 |
| > 5 to 10 | -86 | -90 | -90 | -20 | -30 |
| > 10 to 20 | -81 | -84 | -84 | -20 | -30 |
| > 20 to 26.5 | -78 | -81 | -81 | -20 | -30 |
| > 26.5 to 40 | -72 | -76 | -78 | -20 ^b | -30 |
| > 40 to 50 | -70 | -75 | -75 | -20 | -30 |
| > 50 to 70 | -69 | -71 | -71 | -20 | -30 |

a. Only applies for source frequencies > 300 kHz.

b. Typical from 2.5 to 2.7 GHz on MS4642B systems and from 20.0 to 21.0 GHz on MS4647B systems.

Uncorrected (Raw) Port Characteristics

Characteristic performance with Option 31, 51, 61, or 62 (and Option 8 or 9 for MS4642B).

| Frequency Range (GHz) | Directivity (dB) | Port Match ^a (dB) |
|-----------------------|-------------------|------------------------------|
| 70 kHz to 0.01 | > 10 ^b | > 8 |
| > 0.01 to 2.5 | > 9 ^b | > 10 |
| > 2.5 to 5 | > 20 | > 10 |
| > 5 to 20 | > 17 | > 9 |
| > 20 to 40 | > 14 | > 7 |
| > 40 to 65 | > 11 | > 7 |
| > 65 to 67 | > 11 | > 7 |
| > 67 to 70 | > 5 (> 10) | > 7 |

a. Port Match is defined as the worst of source and load match.

b. Raw Directivity degraded to 4 dB (typical) below 300 kHz and in a 300 MHz window below 2.5 GHz.

Power Range with Option 32

Maximum rated power to minimum level. Option 32 System Dynamic range differs by the delta in max power.

SOURCE1 to PORT1 POWER RANGE (dBm)

MS4642B, 20 GHz with Option 31 and Option 32

| Frequency | Option 8 or 9 |
|--------------------|---------------|
| 70 kHz to 0.01 GHz | +8 to -95 |
| > 0.01 to 2.5 GHz | +10 to -95 |
| > 2.5 to 20 GHz | +10 to -90 |

MS4644B, 40 GHz with Option 31 and Option 32

| Frequency | Standard | Option 51 | Option 61 or 62 |
|--------------------|------------|------------|-----------------|
| 70 kHz to 0.01 GHz | +10 to -25 | +9 to -25 | +8 to -95 |
| > 0.01 to 2.5 GHz | +12 to -25 | +11 to -25 | +10 to -95 |
| > 2.5 to 20 GHz | +10 to -20 | +9 to -20 | +8 to -90 |
| > 20 to 40 GHz | +10 to -25 | +9 to -25 | +8 to -95 |

MS4647B, 70 GHz with Option 31 and Option 32

| Frequency | Standard | Option 51 | Option 61 or 62 |
|--------------------|------------|------------|-----------------|
| 70 kHz to 0.01 GHz | +10 to -25 | +9 to -25 | +8 to -85 |
| > 0.01 to 2.5 GHz | +12 to -25 | +11 to -25 | +10 to -85 |
| > 2.5 to 5 GHz | +6 to -20 | +5 to -20 | +3 to -80 |
| > 5 to 20 GHz | +6 to -20 | +5 to -20 | +3 to -80 |
| > 20 to 38 GHz | +6 to -25 | +4 to -25 | +2 to -85 |
| > 38 to 50 GHz | +5 to -25 | +3 to -25 | +1 to -85 |
| > 50 to 65 GHz | +5 to -25 | +3 to -25 | +1 to -85 |
| > 65 to 67 GHz | +3 to -25 | +1 to -25 | -1 to -85 |
| > 67 to 70 GHz | +2 to -25 | -1 to -25 | -5 to -85 |

Power Range with Option 32 (Continued)

SOURCE2 to PORT2 POWER RANGE (dBm)

MS4642B, 20 GHz with Option 31 and Option 32

| Frequency | Option 8 or 9 |
|--------------------|---------------|
| 70 kHz to 0.01 GHz | +6 to -95 |
| > 0.01 to 2.5 GHz | +8 to -95 |
| > 2.5 to 20 GHz | +9 to -90 |

MS4644B, 40 GHz with Option 31 and Option 32

| Frequency | Standard | Option 51 | Option 61 or 62 |
|--------------------|------------|-----------|-----------------|
| 70 kHz to 0.01 GHz | +8 to -25 | +7 to -25 | +6 to -95 |
| > 0.01 to 2.5 GHz | +10 to -25 | +9 to -25 | +8 to -95 |
| > 2.5 to 20 GHz | +7 to -20 | +6 to -20 | +5 to -90 |
| > 20 to 40 GHz | +7 to -25 | +6 to -25 | +5 to -95 |

MS4647B, 70 GHz with Option 31 and Option 32

| Frequency | Standard | Option 51 | Option 61 or 62 |
|-----------------------------|------------|-----------|-----------------|
| 70 kHz to 0.01 GHz | +8 to -25 | +7 to -25 | +6 to -85 |
| > 0.01 to 2.5 GHz | +10 to -25 | +9 to -25 | +8 to -85 |
| > 2.5 to 5 GHz | +4 to -20 | +3 to -20 | +1 to -80 |
| > 5 to 20 GHz | +3 to -20 | +2 to -20 | 0 to -80 |
| > 20 to 38 GHz | +4 to -25 | +2 to -25 | 0 to -85 |
| > 38 to 50 GHz ^a | +3 to -25 | +1 to -25 | -1 to -85 |
| > 50 to 65 GHz | -2 to -25 | -4 to -25 | -6 to -85 |
| > 65 to 67 GHz | -4 to -25 | -5 to -25 | -7 to -85 |
| > 67 to 70 GHz | -5 to -25 | -8 to -25 | -12 to -85 |

a. Rated power is typical 49 GHz to 50 GHz.

SOURCE2 to PORT1 POWER RANGE (dBm, typical performance)

MS4642B, 20 GHz with Option 31 and Option 32

| Frequency | Option 8 or 9 |
|--------------------|---------------|
| 70 kHz to 0.01 GHz | -22 to -95 |
| > 0.01 to 2.5 GHz | -15 to -95 |
| > 2.5 to 20 GHz | -11 to -95 |

MS4644B, 40 GHz with Option 31 and Option 32

| Frequency | Standard | Option 51 or 61 | Option 62 |
|--------------------|------------|-----------------|------------|
| 70 kHz to 0.01 GHz | -20 to -25 | -21 to -25 | -22 to -95 |
| > 0.01 to 2.5 GHz | -13 to -25 | -14 to -25 | -15 to -95 |
| > 2.5 to 20 GHz | -9 to -25 | -10 to -25 | -11 to -95 |
| > 20 to 40 GHz | -8 to -25 | -9 to -25 | -10 to -95 |

MS4647B, 70 GHz with Option 31 and Option 32

| Frequency | Standard | Option 51 or 61 | Option 62 |
|--------------------|------------|-----------------|------------|
| 70 kHz to 0.01 GHz | -20 to -25 | -21 to -25 | -22 to -85 |
| > 0.01 to 2.5 GHz | -13 to -25 | -14 to -25 | -15 to -85 |
| > 2.5 to 5 GHz | -12 to -25 | -13 to -25 | -15 to -85 |
| > 5 to 20 GHz | -11 to -25 | -12 to -25 | -14 to -85 |
| > 20 to 38 GHz | -11 to -25 | -13 to -25 | -15 to -85 |
| > 38 to 50 GHz | -12 to -25 | -14 to -25 | -16 to -85 |
| > 50 to 65 GHz | -16 to -25 | -18 to -25 | -20 to -85 |
| > 65 to 67 GHz | -17 to -25 | -18 to -25 | -20 to -85 |
| > 67 to 70 GHz | -20 to -25 | -23 to -25 | -27 to -85 |

MS4642B 20 GHz VNA System Performance

MS4642B – 12-Term SOLT – Sliding Load – 3652A-1 K Calibration Kit

MS4642B 20 GHz Model, with 12-term SOLT with Sliding Load Calibration, using the 3652A-1 K Calibration Kit.

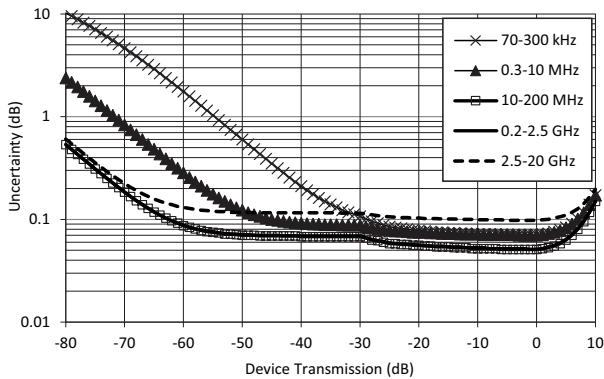
| Frequency Range (GHz) | Directivity (dB) | Source Match (dB) | Load Match ^a (dB) | Reflection Tracking (dB) | Transmission Tracking (dB) |
|-----------------------|------------------|-------------------|------------------------------|--------------------------|----------------------------|
| 70 kHz to 0.01 | > 38 | > 36 | > 38 | ± 0.02 | ± 0.05 |
| > 0.01 to 2.5 | > 42 | > 41 | > 42 | ± 0.005 | ± 0.03 |
| > 2.5 to 20 | > 43 | > 39 | > 43 | ± 0.006 | ± 0.07 |

a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 Series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

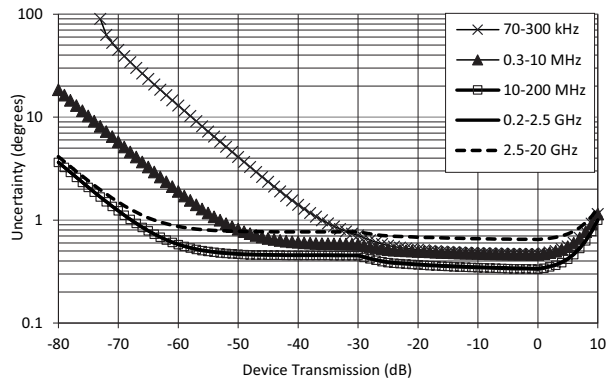
MS4642B Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.

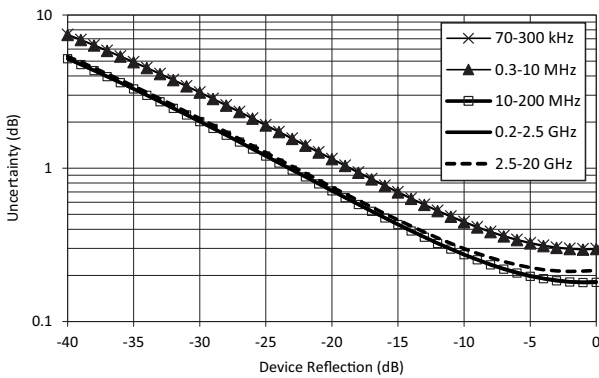
Transmission Magnitude Uncertainty; MS4642B (Opt. 8/9); SOLTSL Calibration using 3652A -1 K kit



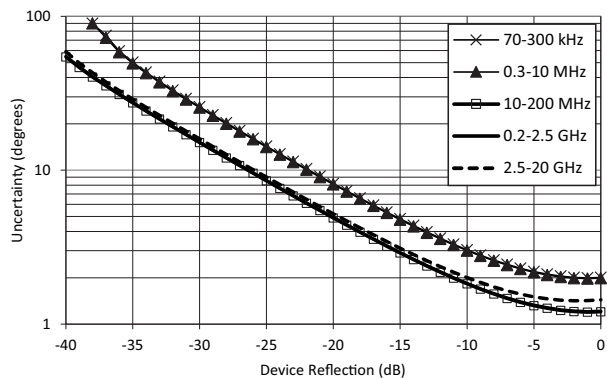
Transmission Phase Uncertainty; MS4642B (Opt. 8/9); SOLT- SL Calibration using 3652A -1 K kit



Reflection Magnitude Uncertainty; MS4642B (Opt. 8/9); SOLT-SL Calibration using 3652A-1 K Cal Kit



Reflection Phase Uncertainty; MS4642B (Opt. 8/9); SOLT-SL Calibration using 3652A-1 K Cal Kit



MS4642B – 12-Term SOLT – 3652A or 3652A-1 K Calibration Kit

MS4642B 20 GHz Model, with 12-term SOLT Calibration, using 3652A K or 3652A-1 K Cal Kit.

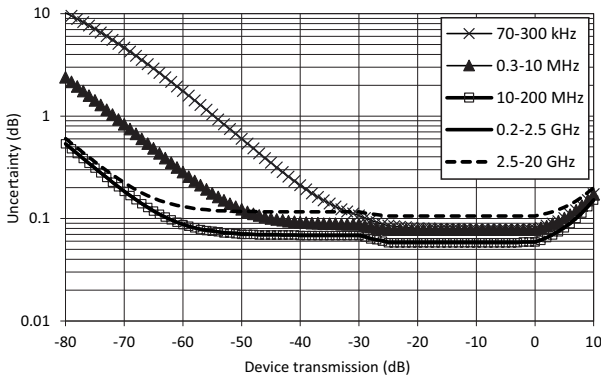
| Frequency Range (GHz) | Directivity (dB) | Source Match (dB) | Load Match ^a (dB) | Reflection Tracking (dB) | Transmission Tracking (dB) |
|-----------------------|------------------|-------------------|------------------------------|--------------------------|----------------------------|
| 70 kHz to 0.01 | > 38 | > 36 | > 38 | ± 0.02 | ± 0.05 |
| > 0.01 to 2.5 | > 37 | > 41 | > 37 | ± 0.005 | ± 0.03 |
| > 2.5 to 20 | > 34 | > 39 | > 35 | ± 0.006 | ± 0.07 |

a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 Series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

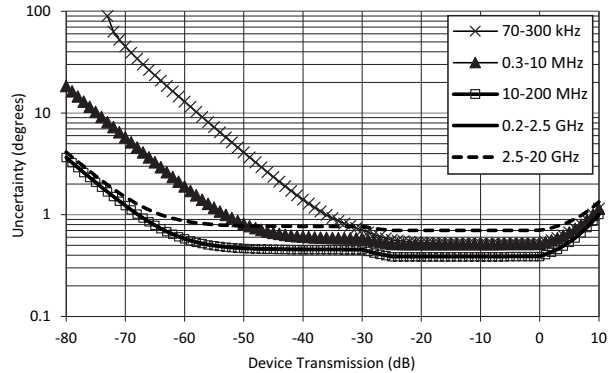
MS4642B Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.

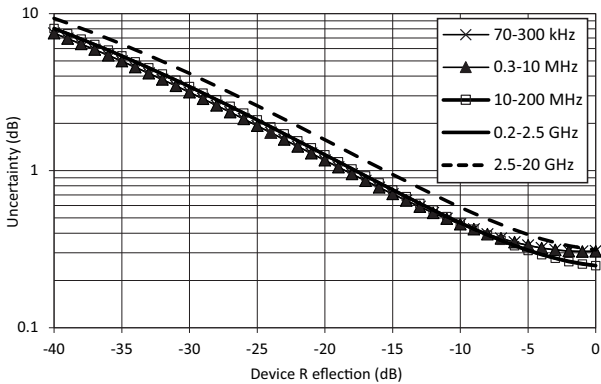
Transmission Magnitude Uncertainty; MS4642B (Opt. 8/9); SOLT Calibration using 3652A K Cal Kit



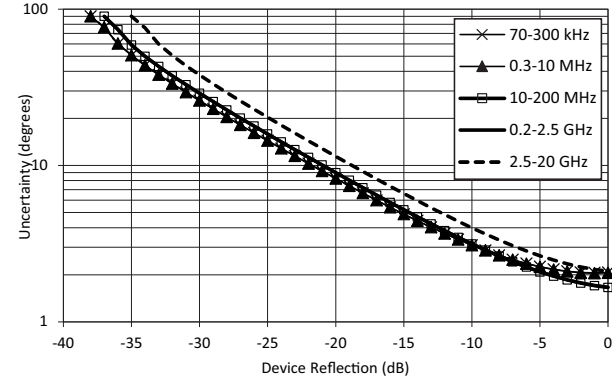
Transmission Phase Uncertainty; MS4642B (Opt. 8/9); SOLT Calibration using 3652A K Cal Kit



Reflection Magnitude Uncertainty; MS4642B (Opt. 8/9); SOLT Calibration using 3652A K Cal Kit



Reflection Phase Uncertainty; MS4642B (Opt. 8/9); SOLT Calibration using 3652A K Cal Kit



MS4642B with .s1p Calibration and 3652A-3 or 3652A-4 K Calibration Kit

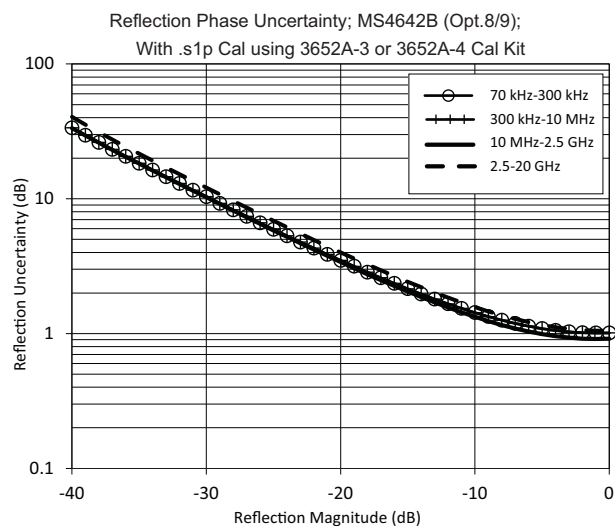
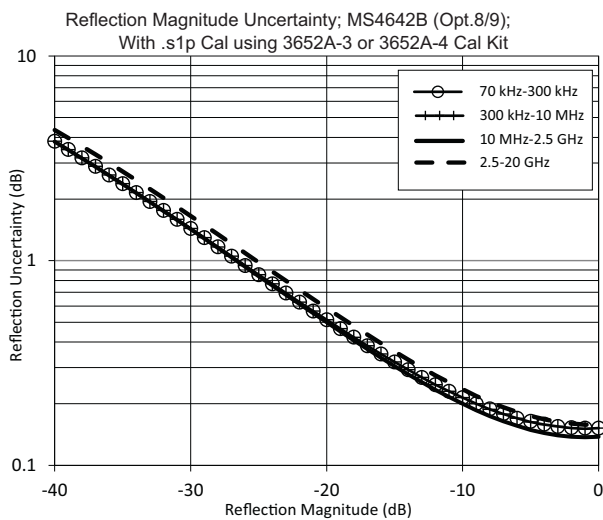
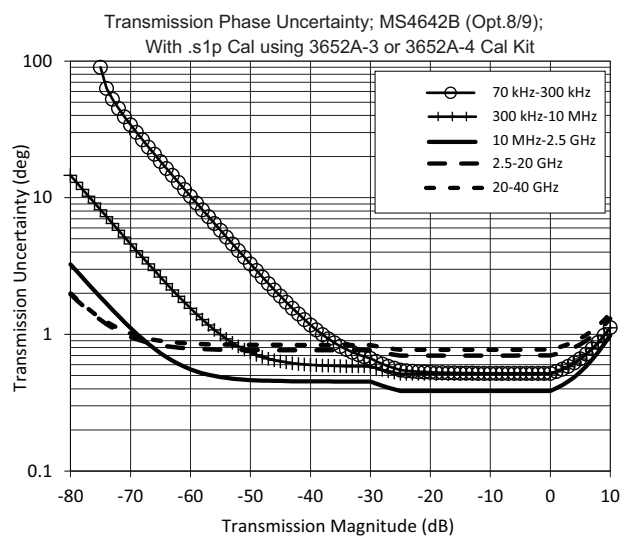
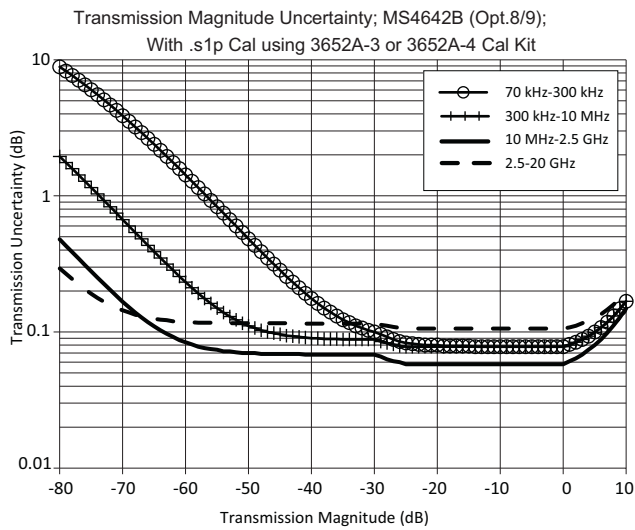
MS4642B 20 GHz Model, with .s1p Calibration, using the 3652A-3 or 3652A-4 K Calibration Kit.

| Frequency Range (GHz) ^a | Directivity (dB) | Source Match (dB) | Load Match ^b (dB) | Reflection Tracking (dB) | Transmission Tracking (dB) |
|------------------------------------|------------------|-------------------|------------------------------|--------------------------|----------------------------|
| <.01 GHz | > 47 | > 45 | > 46 | ± 0.02 | ± 0.05 |
| .01-2.5 GHz | > 47 | > 45 | > 46 | ± 0.005 | ± 0.03 |
| 2.5-20 GHz | > 46 | > 45 | > 46 | ± 0.006 | ± 0.07 |

- a. The performance levels for the s1p calibration processes are contingent on the pin depth of the connector at the reference plane (and of any DUT connector) meeting Anritsu specifications.
- b. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified at Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

MS4642B Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using Options 51, 61, or 62. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.



MS4642B – 12-Term SOLT – Sliding Load – 3650A-1 3.5 mm Calibration Kit

MS4642B 20 GHz Model, with 12-term SOLT Calibration with Sliding Load Calibration, using the 3650A-1 3.5 mm Cal Kit.

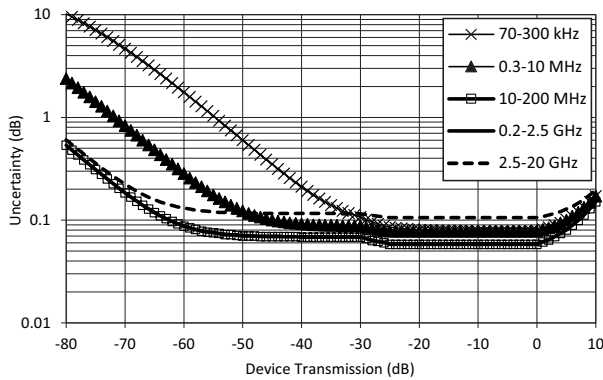
| Frequency Range (GHz) | Directivity (dB) | Source Match (dB) | Load Match ^a (dB) | Reflection Tracking (dB) | Transmission Tracking (dB) |
|-----------------------|------------------|-------------------|------------------------------|--------------------------|----------------------------|
| 70 kHz to 0.01 | > 40 | > 37 | > 40 | ± 0.02 | ± 0.05 |
| > 0.01 to 2.5 | > 42 | > 41 | > 42 | ± 0.005 | ± 0.03 |
| > 2.5 to 10 | > 43 | > 39 | > 43 | ± 0.005 | ± 0.03 |
| > 10 to 20 | > 43 | > 39 | > 43 | ± 0.006 | ± 0.07 |

a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

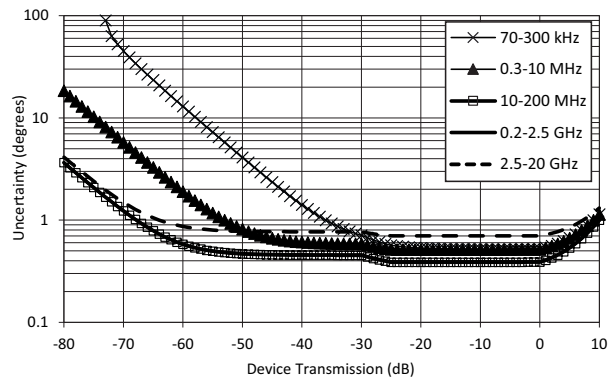
MS4642B Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.

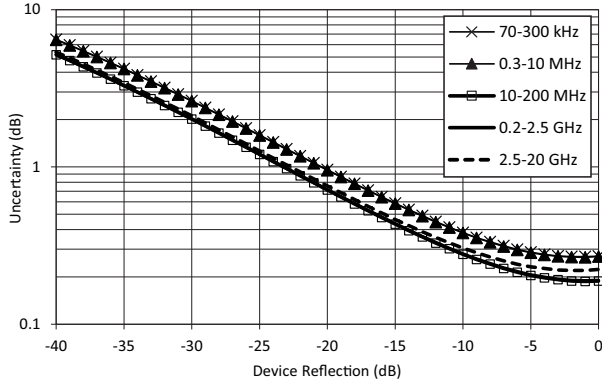
Transmission Magnitude Uncertainty; MS4642B (Opt. 8/9); SOLT-SL Calibration using 3650A-1 3.5 mm Cal Kit



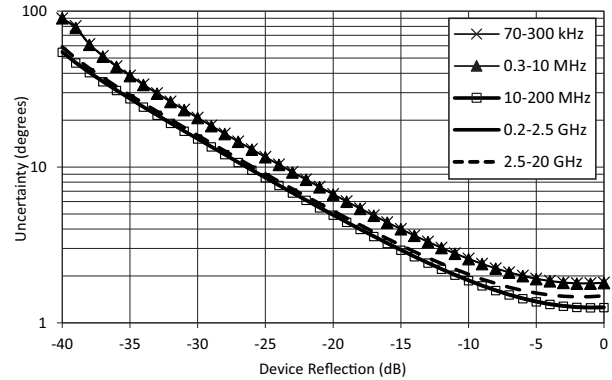
Transmission Phase Uncertainty; MS4642B (Opt. 8/9); SOLT-SL Calibration using 3650A-1 3.5 mm Cal Kit



Reflection Magnitude Uncertainty; MS4642B (Opt. 8/9); SOLT-SL Calibration using 3650A-1 3.5 mm Cal Kit



Reflection Phase Uncertainty; MS4642B (Opt. 8/9); SOLT-SL Calibration using 3650A-1 3.5 mm Cal Kit



MS4642B – 12-Term SOLT – 3650A or 3650A-1 3.5 mm Calibration Kit

MS4642B 20 GHz Model, with 12-term SOLT Calibration, using the 3650A or 3650A-1 3.5 mm Cal Kit.

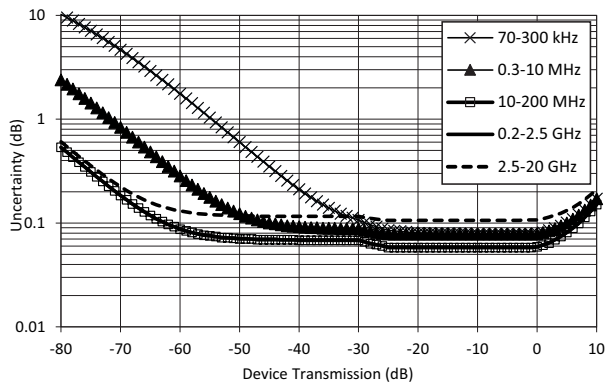
| Frequency Range (GHz) | Directivity (dB) | Source Match (dB) | Load Match ^a (dB) | Reflection Tracking (dB) | Transmission Tracking (dB) |
|-----------------------|------------------|-------------------|------------------------------|--------------------------|----------------------------|
| 70 kHz to 0.01 | > 40 | > 37 | > 40 | ± 0.02 | ± 0.05 |
| > 0.01 to 2.5 | > 42 | > 40 | > 42 | ± 0.005 | ± 0.03 |
| > 2.5 to 10 | > 40 | > 34 | > 40 | ± 0.005 | ± 0.03 |
| > 10 to 20 | > 30 | > 34 | > 30 | ± 0.006 | ± 0.07 |

a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 Series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

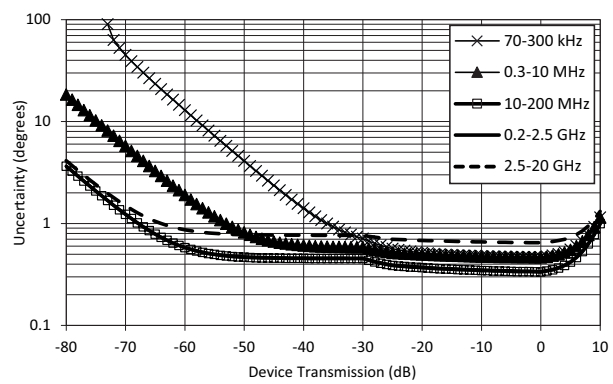
MS4642B Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.

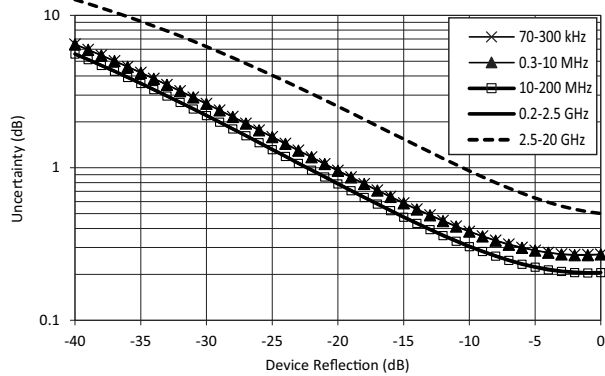
Transmission Magnitude Uncertainty; MS4642B (Opt. 8/9); SOLT Calibration using 3650A 3.5 mm Cal Kit



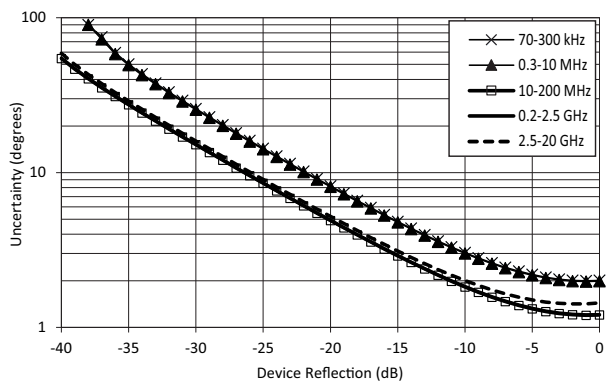
Transmission Phase Uncertainty; MS4642B (Opt. 8/9); SOLT Calibration using 3650A 3.5 mm Cal Kit



Reflection Magnitude Uncertainty; MS4642B (Opt. 8/9); SOLT Calibration using 3650A 3.5mm Cal Kit



Reflection Phase Uncertainty; MS4642B (Opt. 8/9); SOLT Calibration using 3650A 3.5 mm Cal Kit



MS4642B – 12-Term – 36585K K AutoCal™

MS4642B 20 GHz Model, with 12-term Calibration, using the 36585K K Automatic Calibrator (AutoCal)

| Frequency Range (GHz) | Directivity (dB) | Source Match (dB) | Load Match ^a (dB) | Reflection Tracking (dB) | Transmission Tracking (dB) |
|-----------------------------|------------------|-------------------|------------------------------|--------------------------|----------------------------|
| 70 kHz to 0.01 ^b | > 40 | > 40 | > 43 | ± 0.10 | ± 0.10 |
| > 0.01 to 2.5 | > 43 | > 47 | > 43 | ± 0.05 | ± 0.03 |
| > 2.5 to 20 | > 50 | > 47 | > 50 | ± 0.09 | ± 0.03 |

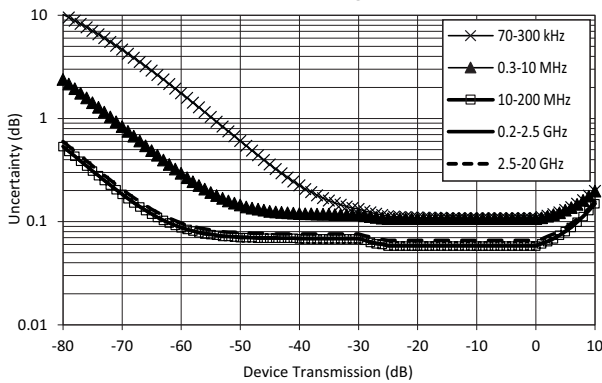
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

b. Typical performance below 2 MHz.

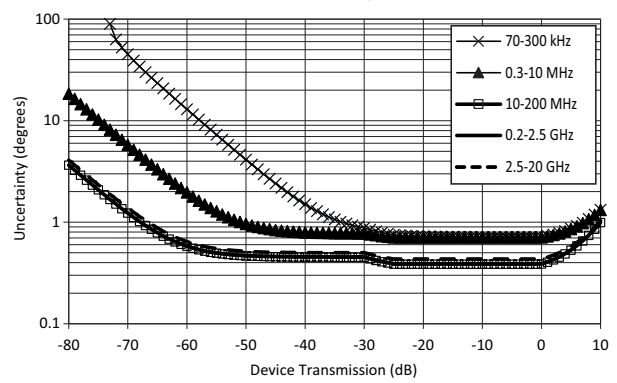
MS4642B Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{21} = S_{12} = 0$. For reflection uncertainties, it is assumed that $S_{11} = S_{22} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.

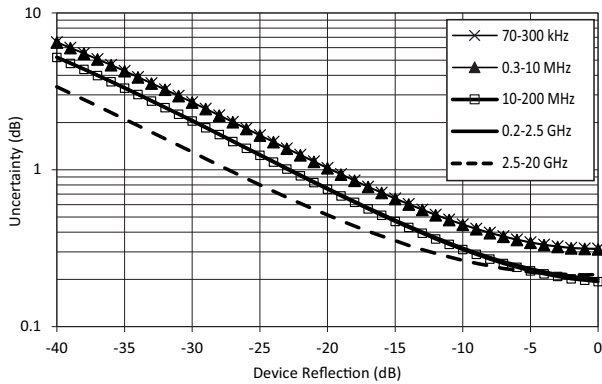
Transmission Magnitude Uncertainty; MS4642B (Opt. 8/9);
12-term Calibration using 36585K AutoCal



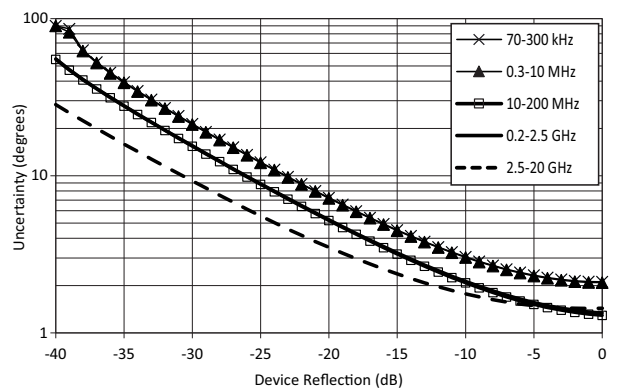
Transmission Phase Uncertainty; MS4642B (Opt. 8/9);
12-term Calibration using 36585K AutoCal



Reflection Magnitude Uncertainty; MS4642B (Opt. 8/9);
12-term Calibration using 36585K AutoCal



Reflection Phase Uncertainty; MS4642B (Opt. 8/9);
12-term Calibration using 36585K AutoCal



MS4644B 40 GHz VNA System Performance

MS4644B – 12-Term SOLT – Sliding Load – 3652A-1 K Calibration Kit

MS4644B 40 GHz Model, with 12-term SOLT with Sliding Load Calibration, using the 3652A-1 K Calibration Kit.

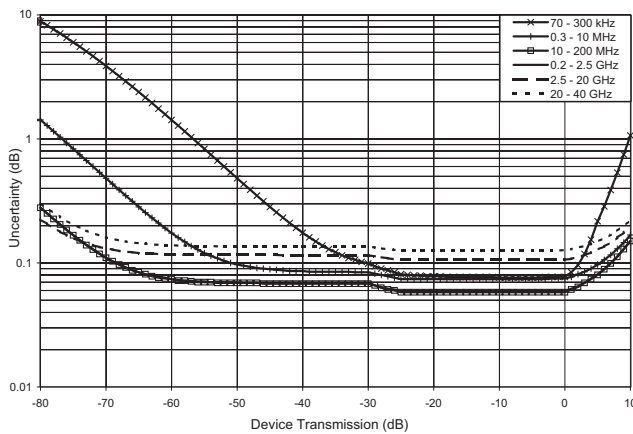
| Frequency Range (GHz) | Directivity (dB) | Source Match (dB) | Load Match ^a (dB) | Reflection Tracking (dB) | Transmission Tracking (dB) |
|-----------------------|------------------|-------------------|------------------------------|--------------------------|----------------------------|
| 70 kHz to 0.01 | > 38 | > 36 | > 38 | ± 0.02 | ± 0.05 |
| > 0.01 to 2.5 | > 42 | > 41 | > 42 | ± 0.005 | ± 0.03 |
| > 2.5 to 20 | > 43 | > 39 | > 43 | ± 0.006 | ± 0.07 |
| > 20 to 40 | > 40 | > 34 | > 40 | ± 0.006 | ± 0.08 |

a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified at Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

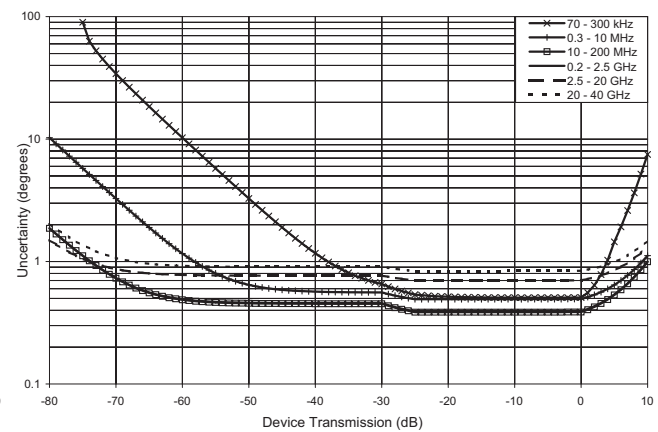
MS4644B Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using Options 51, 61, or 62. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.

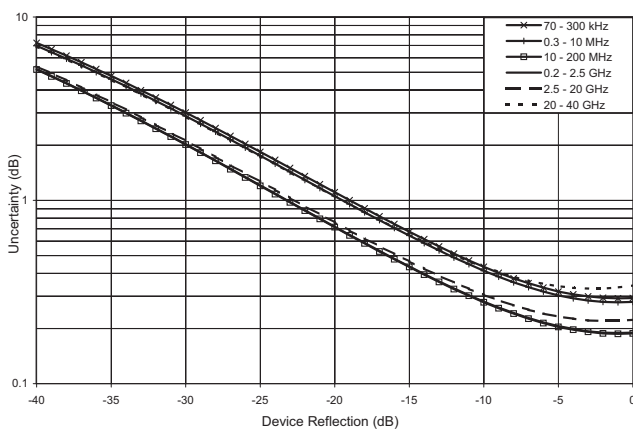
Transmission Magnitude Uncertainty
MS4644B with SOLT-SL Calibration using 3652A-1 Cal Kit



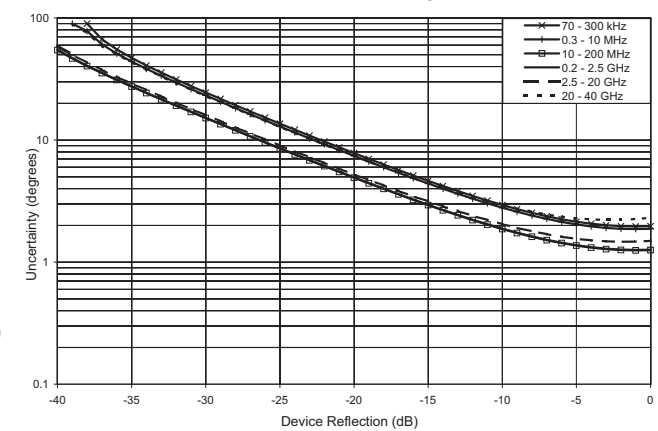
Transmission Phase Uncertainty
MS4644B with SOLT-SL Calibration using 3652A-1 Cal Kit



Reflection Magnitude Uncertainty
MS4644B with SOLT-SL Calibration using 3652A-1 Cal Kit



Reflection Phase Uncertainty
MS4644B with SOLT-SL Calibration using 3652A-1 Cal Kit



MS4644B – 12-Term SOLT – 3652A or 3652A-1 K Calibration Kit

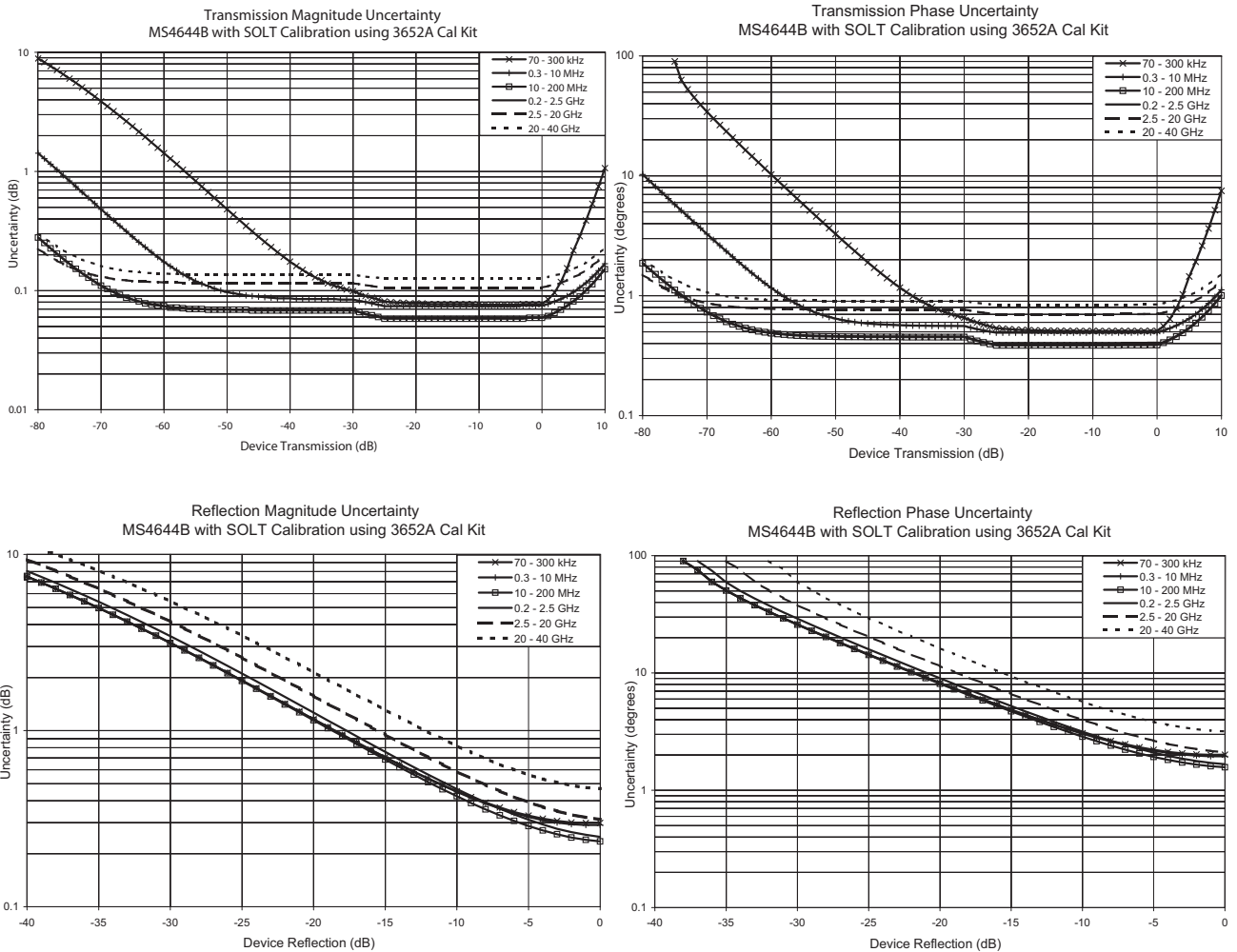
MS4644B 40 GHz Model, with 12-term SOLT Calibration, using the 3652A or 3652A-1 K Calibration Kit.

| Frequency Range (GHz) | Directivity (dB) | Source Match (dB) | Load Match ^a (dB) | Reflection Tracking (dB) | Transmission Tracking (dB) |
|-----------------------|------------------|-------------------|------------------------------|--------------------------|----------------------------|
| 70 kHz to 0.01 | > 38 | > 36 | > 38 | ± 0.02 | ± 0.05 |
| > 0.01 to 2.5 | > 37 | > 41 | > 37 | ± 0.005 | ± 0.03 |
| > 2.5 to 20 | > 34 | > 39 | > 35 | ± 0.006 | ± 0.07 |
| > 20 to 40 | > 32 | > 34 | > 32 | ± 0.006 | ± 0.08 |

a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

MS4644B Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using Options 51, 61, or 62. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.



MS4644B with .s1p Calibration and 3652A-3 or 3652A-4 K Calibration Kit

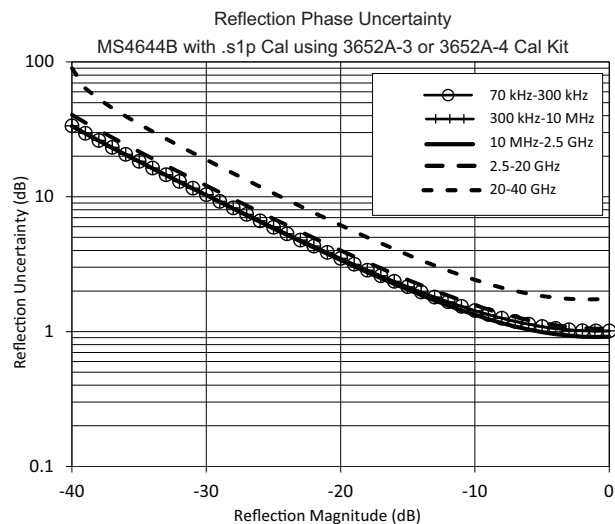
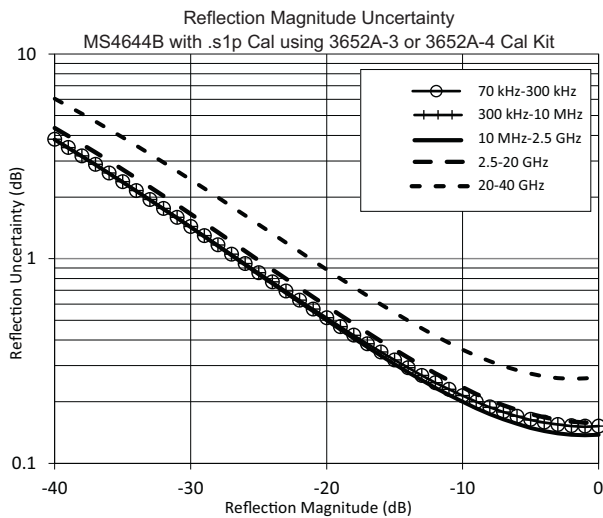
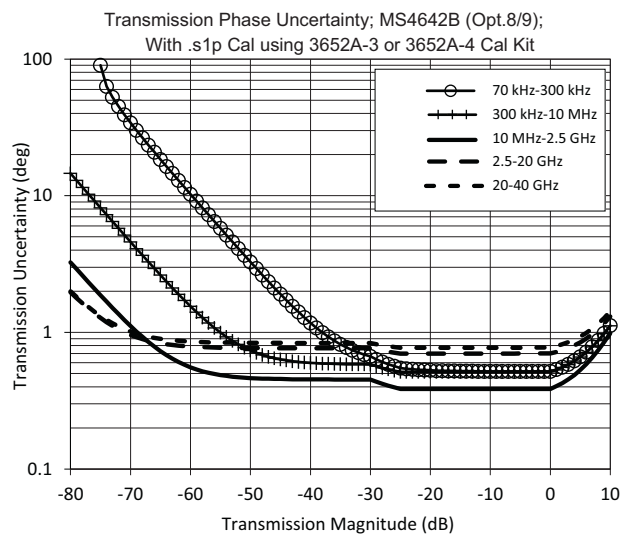
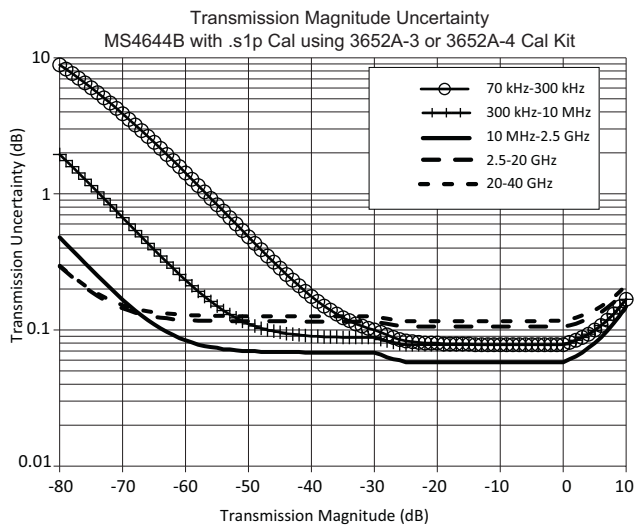
MS4644B 40 GHz Model, with .s1p Calibration, using the 3652A-3 or 3652A-4 K Calibration Kit.

| Frequency Range (GHz) ^a | Directivity (dB) | Source Match (dB) | Load Match ^b (dB) | Reflection Tracking (dB) | Transmission Tracking (dB) |
|------------------------------------|------------------|-------------------|------------------------------|--------------------------|----------------------------|
| <.01 GHz | > 47 | > 45 | > 46 | ± 0.02 | ± 0.05 |
| .01-2.5 GHz | > 47 | > 45 | > 46 | ± 0.005 | ± 0.03 |
| 2.5-20 GHz | > 46 | > 45 | > 46 | ± 0.006 | ± 0.07 |
| 20-40 GHz | > 42 | > 38 | > 42 | ± 0.006 | ± 0.07 |

- a. The performance levels for the .s1p calibration processes are contingent on the pin depth of the connector at the reference plane (and of any DUT connector) meeting Anritsu specifications.
- b. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified at Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

MS4644B Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using Options 51, 61, or 62. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.



MS4644B – 12-Term – 36585K K AutoCal

MS4644B 40 GHz Model, with 12-term Calibration, using the 36585K K AutoCal.

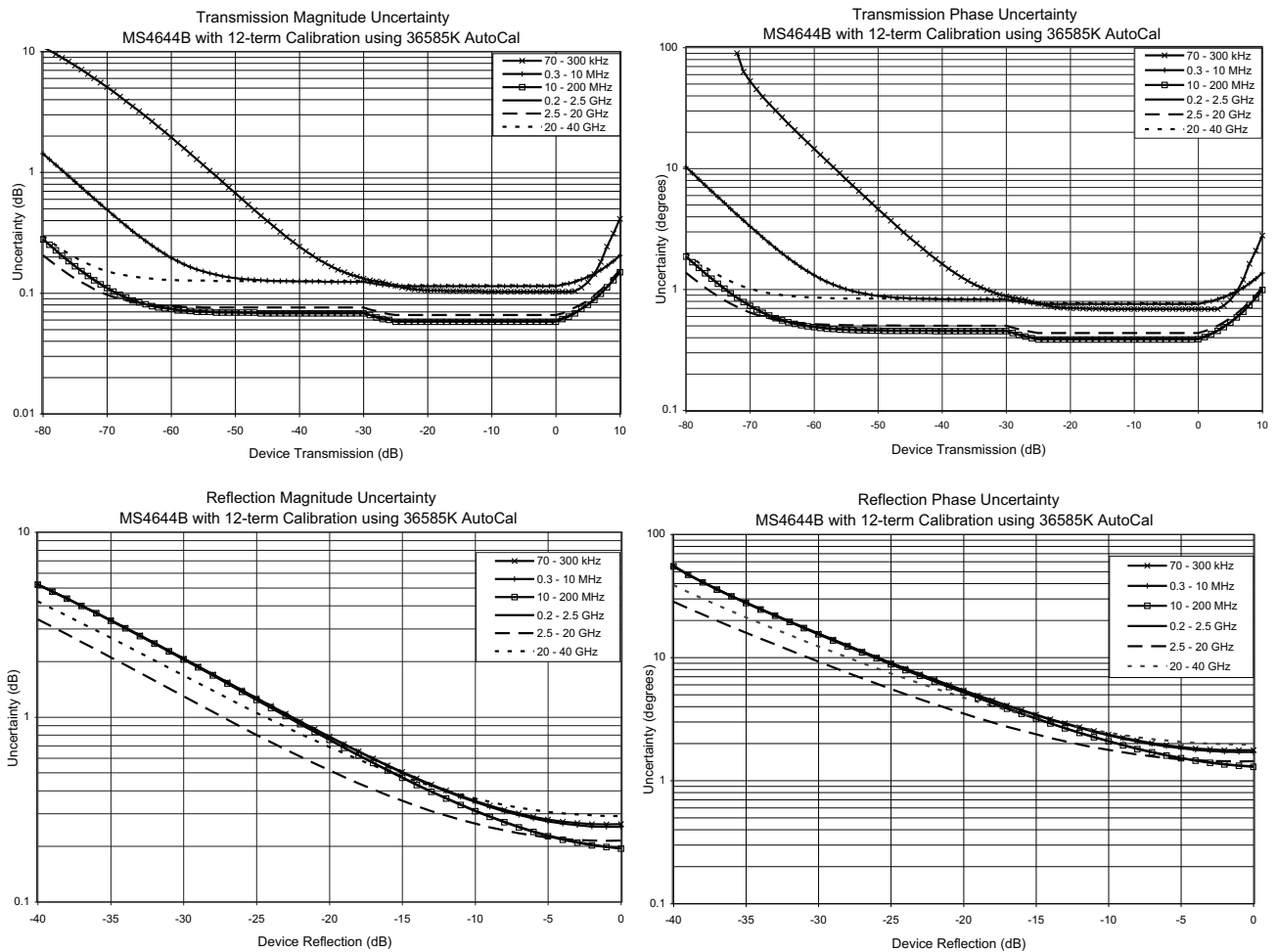
| Frequency Range (GHz) | Directivity (dB) | Source Match (dB) | Load Match ^a (dB) | Reflection Tracking (dB) | Transmission Tracking (dB) |
|-----------------------------|------------------|-------------------|------------------------------|--------------------------|----------------------------|
| 70 kHz to 0.01 ^b | > 40 | > 40 | > 43 | ± 0.10 | ± 0.10 |
| > 0.01 to 2.5 | > 43 | > 47 | > 43 | ± 0.05 | ± 0.03 |
| > 2.5 to 20 | > 50 | > 47 | > 50 | ± 0.09 | ± 0.03 |
| > 20 to 40 | > 48 | > 47 | > 48 | ± 0.14 | ± 0.07 |

a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 Series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

b. Typical performance below 2 MHz.

MS4644B Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using Options 51, 61, or 62. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.



MS4647B 70 GHz VNA System Performance

MS4647B VNA - 12-Term SOLT Sliding Load - 3654D-1 V Calibration Kit

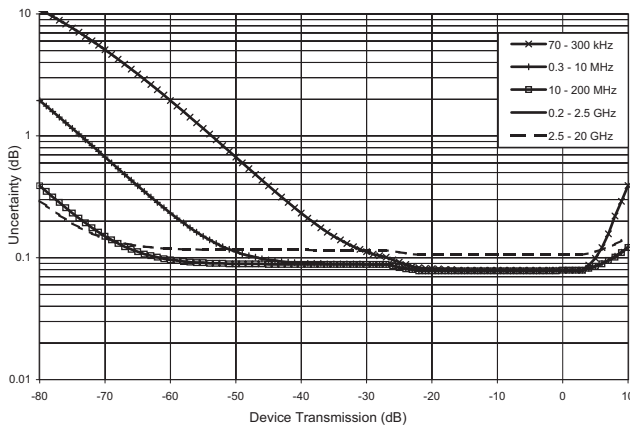
| Frequency Range (GHz) | Directivity (dB) | Source Match (dB) | Load Match ^a (dB) | Reflection Tracking (dB) | Transmission Tracking (dB) |
|-----------------------|------------------|-------------------|------------------------------|--------------------------|----------------------------|
| 70 kHz to 0.01 | > 38 | > 36 | > 38 | ± 0.02 | ± 0.05 |
| > 0.01 to 2.5 | > 41 | > 39 | > 41 | ± 0.02 | ± 0.05 |
| > 2.5 to 20 | > 41 | > 37 | > 41 | ± 0.02 | ± 0.07 |
| > 20 to 40 | > 37 | > 32 | > 37 | ± 0.02 | ± 0.08 |
| > 40 to 65 | > 35 | > 28 | > 35 | ± 0.08 | ± 0.12 |
| > 65 to 67 | > 35 | > 28 | > 35 | ± 0.15 | ± 0.15 |
| > 67 to 70 | > 30 | > 26 | > 30 | ± 0.30 | ± 0.15 |

a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

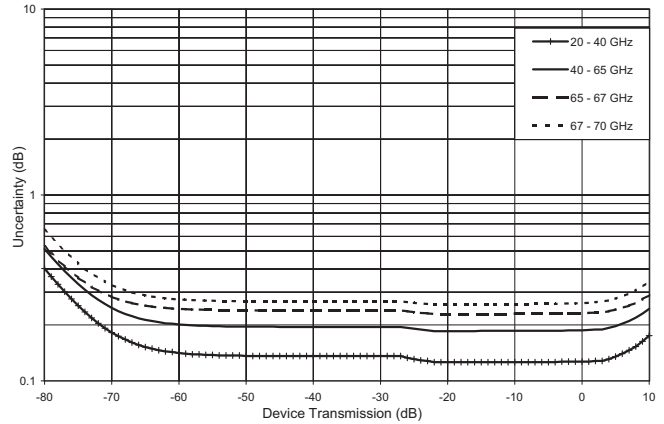
MS4647B Measurement Uncertainties (Transmission)

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using Options 51, 61, or 62. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.

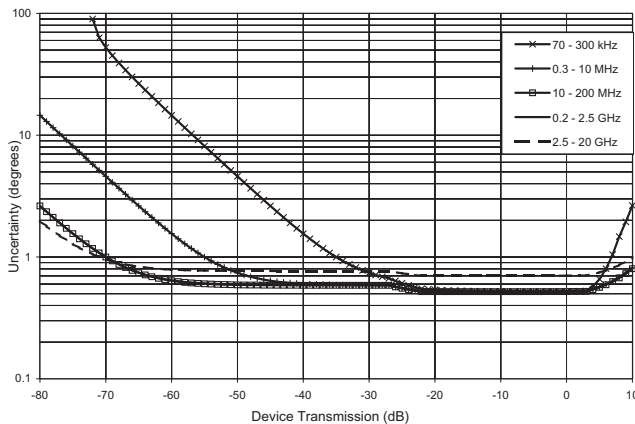
Transmission Magnitude Uncertainty (1 of 2)
MS4647B with SOLT-SL Calibration using 3654D-1 Cal Kit



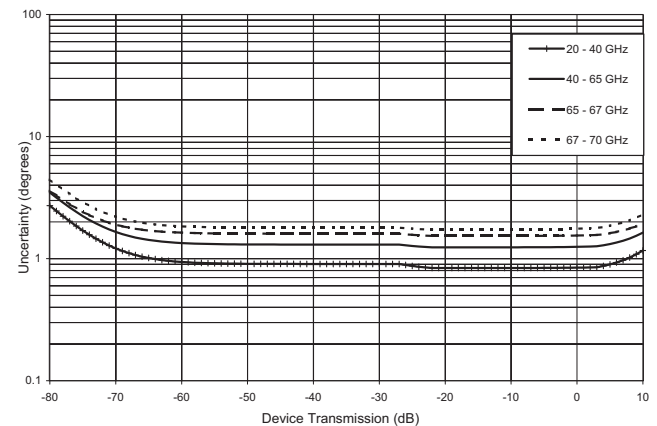
Transmission Magnitude Uncertainty (2 of 2)
MS4647B with SOLT-SL Calibration using 3654D-1 Cal Kit



Transmission Phase Uncertainty (1 of 2)
MS4647B with SOLT-SL Calibration using 3654D-1 Cal Kit



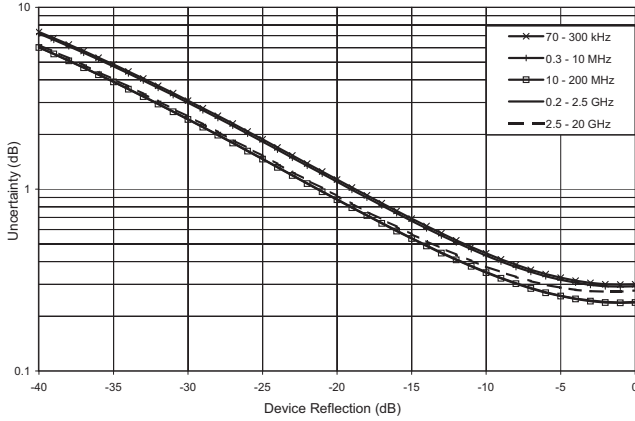
Transmission Phase Uncertainty (2 of 2)
MS4647B with SOLT-SL Calibration using 3654D-1 Cal Kit



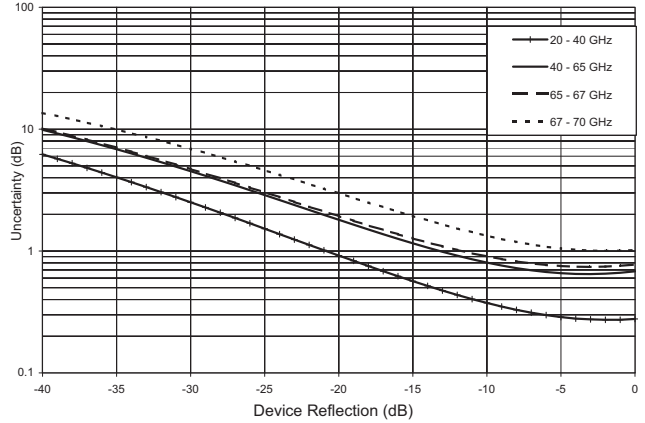
MS4647B Measurement Uncertainties (Reflection)

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using Options 51, 61, or 62. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.

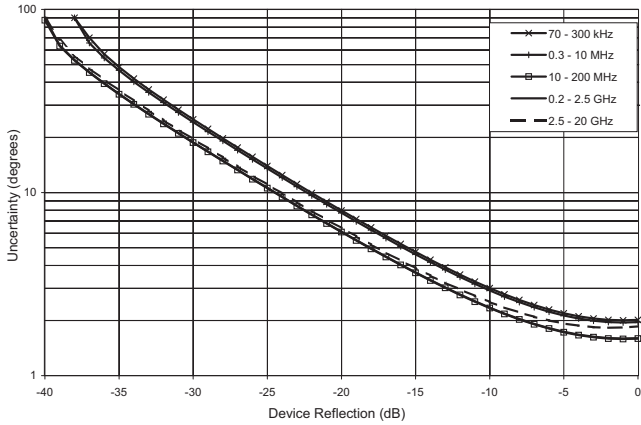
Reflection Magnitude Uncertainty (1 of 2)
MS4647B with SOLT-SL Cal with 3654D-1 Cal Kit



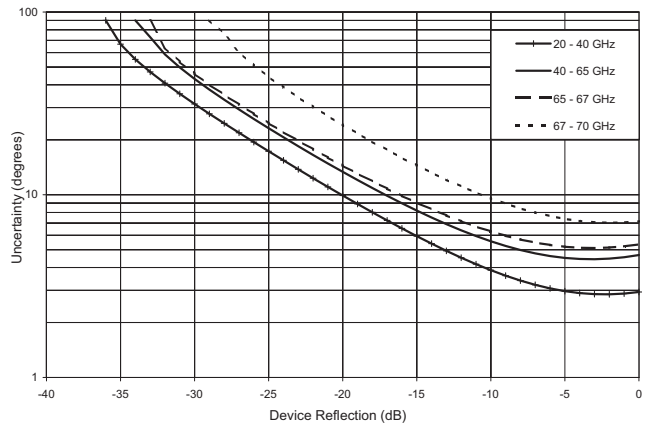
Reflection Magnitude Uncertainty (2 of 2)
MS4647B with SOLT-SL Cal with 3654D-1 Cal Kit



Reflection Phase Uncertainty (1 of 2)
MS4647B with SOLT-SL Cal with 3654D-1 Cal Kit



Reflection Phase Uncertainty (2 of 2)
MS4647B with SOLT-SL Cal with 3654D-1 Cal Kit



MS4647B VNA – 12-Term SOLT – 3654D or 3654D-1 V Calibration Kit

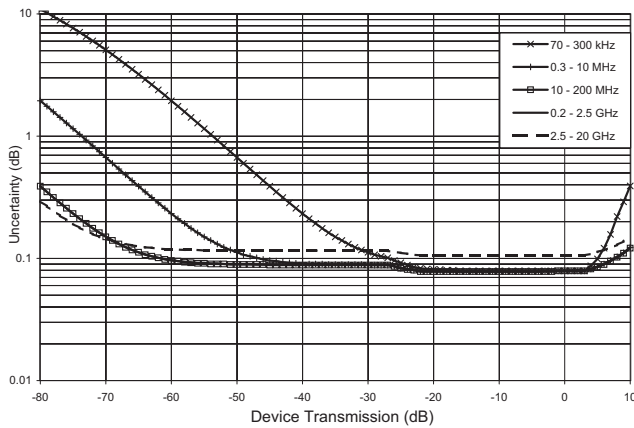
| Frequency Range (GHz) | Directivity (dB) | Source Match (dB) | Load Match ^a (dB) | Reflection Tracking (dB) | Transmission Tracking (dB) |
|-----------------------|------------------|-------------------|------------------------------|--------------------------|----------------------------|
| 70 kHz to 0.01 | > 38 | > 36 | > 38 | ± 0.02 | ± 0.05 |
| > 0.01 to 2.5 | > 40 | > 39 | > 40 | ± 0.02 | ± 0.05 |
| > 2.5 to 20 | > 40 | > 37 | > 40 | ± 0.02 | ± 0.07 |
| > 20 to 40 | > 35 | > 32 | > 35 | ± 0.02 | ± 0.08 |
| > 40 to 65 | > 32 | > 28 | > 32 | ± 0.08 | ± 0.12 |
| > 65 to 67 | > 32 | > 28 | > 32 | ± 0.15 | ± 0.15 |
| > 67 to 70 | > 28 | > 26 | > 28 | ± 0.30 | ± 0.15 |

a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

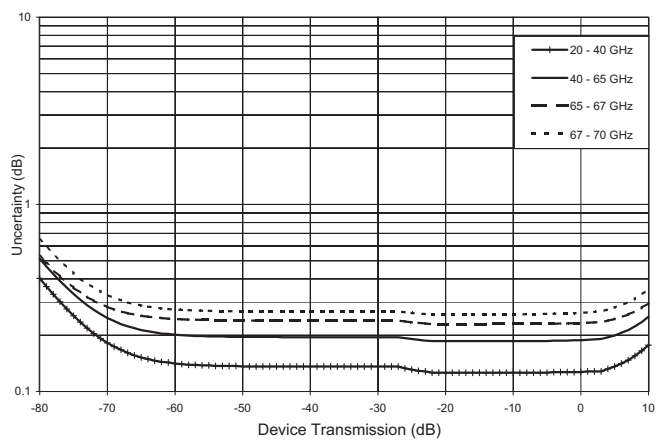
MS4647B Measurement Uncertainties (Transmission)

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using Options 51, 61, or 62. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.

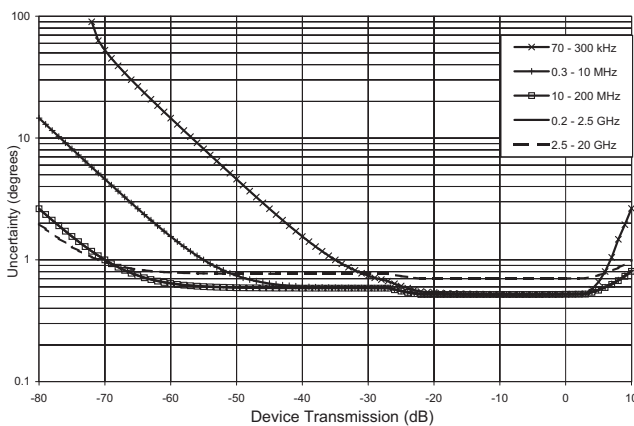
Transmission Magnitude Uncertainty (1 of 2)
MS4647B with SOLT Calibration using 3654D Cal Kit



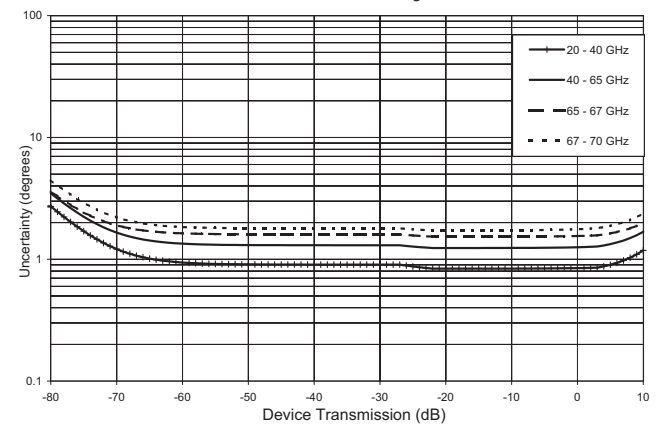
Transmission Magnitude Uncertainty (2 of 2)
MS4647B with SOLT Calibration using 3654D Cal Kit



Transmission Phase Uncertainty (1 of 2)
MS4647B with SOLT Calibration using 3654D Cal Kit



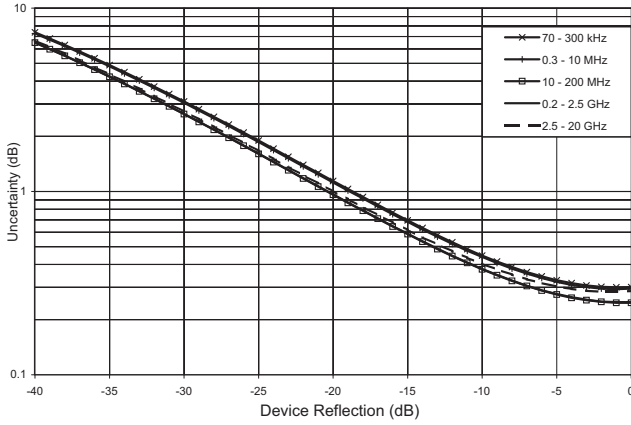
Transmission Phase Uncertainty (2 of 2)
MS4647B with SOLT Calibration using 3654D Cal Kit



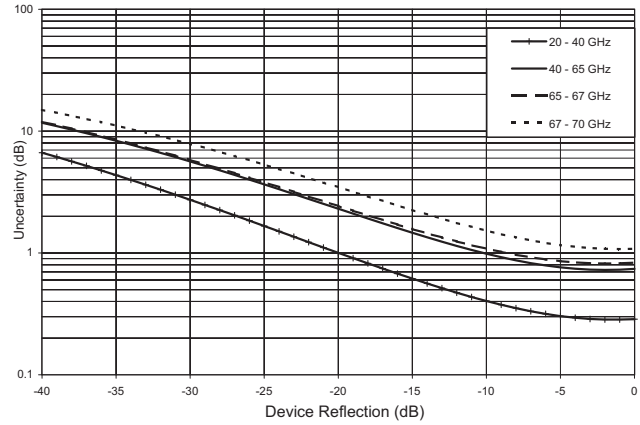
MS4647B Measurement Uncertainties (Reflection)

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using Options 51, 61, or 62. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.

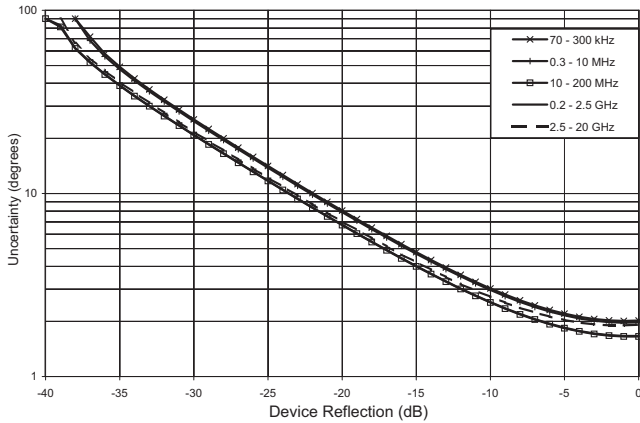
Reflection Magnitude Uncertainty (1 of 2)
MS4647B with SOLT Calibration using 3654D Cal Kit



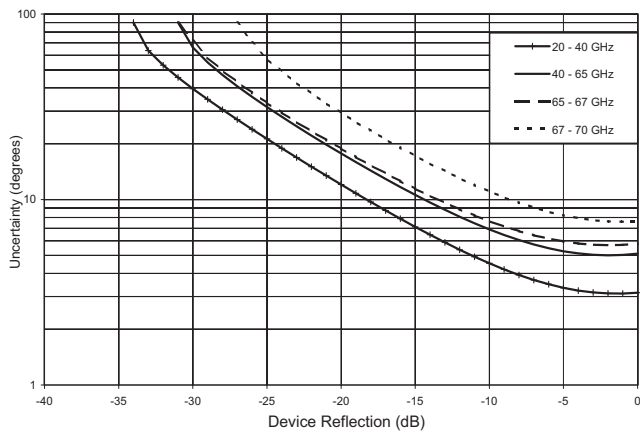
Reflection Magnitude Uncertainty (2 of 2)
MS4647B with SOLT Calibration using 3654D Cal Kit



Reflection Phase Uncertainty (1 of 2)
MS4647B with SOLT Calibration using 3654D Cal Kit



Reflection Phase Uncertainty (2 of 2)
MS4647B with SOLT Calibration using 3654D Cal Kit



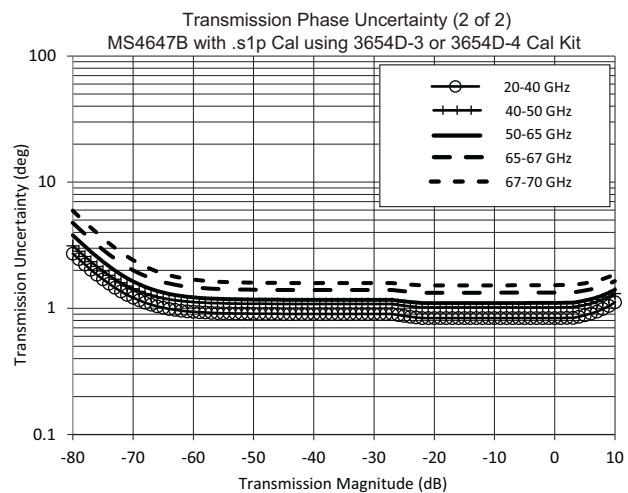
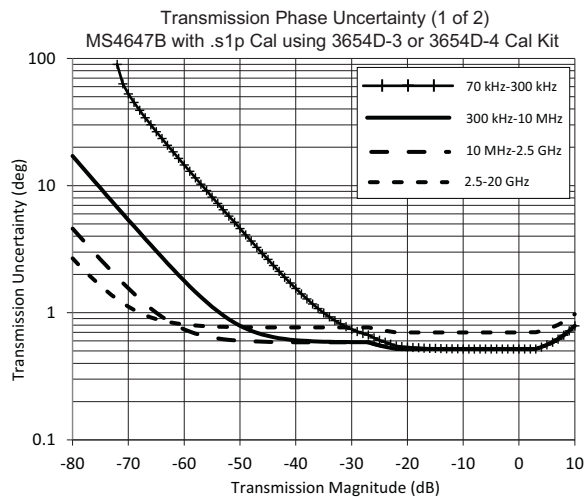
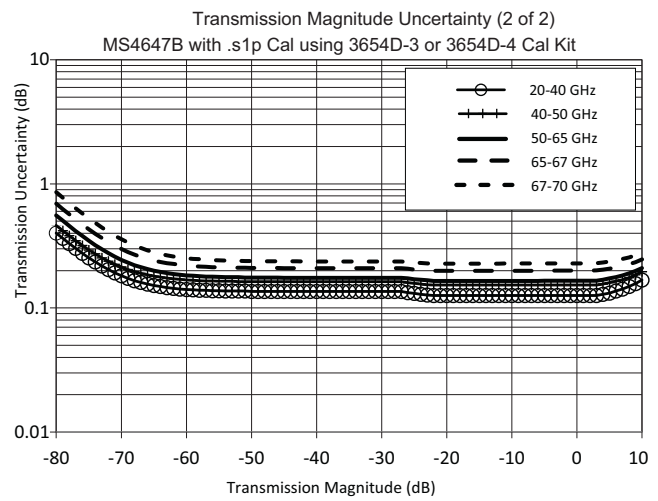
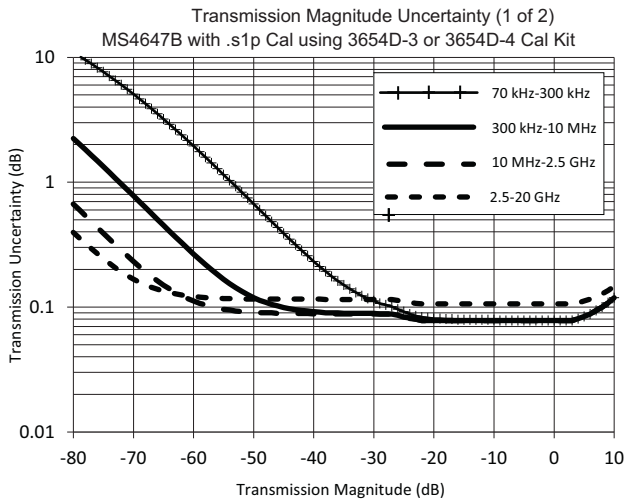
MS4647B VNA with .s1p Calibration and 3654D-3 or 3654D-4 Calibration Kit

| Frequency Range (GHz) ^a | Directivity (dB) | Source Match (dB) | Load Match ^b (dB) | Reflection Tracking (dB) | Transmission Tracking (dB) |
|------------------------------------|------------------|-------------------|------------------------------|--------------------------|----------------------------|
| 70 kHz-0.01 GHz | > 47 | > 47 | > 46 | ± 0.02 | ± 0.05 |
| .01-2.5 GHz | > 47 | > 47 | > 46 | ± 0.01 | ± 0.05 |
| 2.5-20 GHz | > 46 | > 42 | > 46 | ± 0.01 | ± 0.07 |
| 20-35 GHz | > 44 | > 42 | > 44 | ± 0.01 | ± 0.07 |
| 35-40 GHz | > 44 | > 41 | > 44 | ± 0.03 | ± 0.08 |
| 40-50 GHz | > 42 | > 37 | > 42 | ± 0.05 | ± 0.1 |
| 50-65 GHz | > 42 | > 34 | > 42 | ± 0.06 | ± 0.1 |
| 65-67 GHz | > 40 | > 34 | > 40 | ± 0.1 | ± 0.12 |
| 67-70 GHz | > 37 | > 34 | > 37 | ± 0.15 | ± 0.12 |

- a. The performance levels for the s1p calibration processes are contingent on the pin depth of the connector at the reference plane (and of any DUT connector) meeting Anritsu specifications.
- b. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

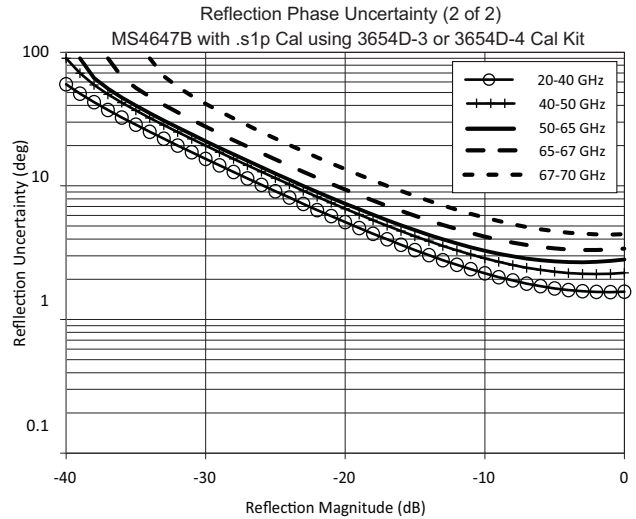
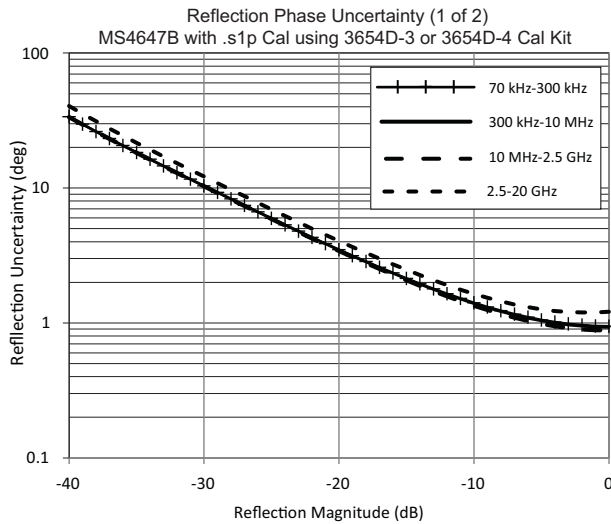
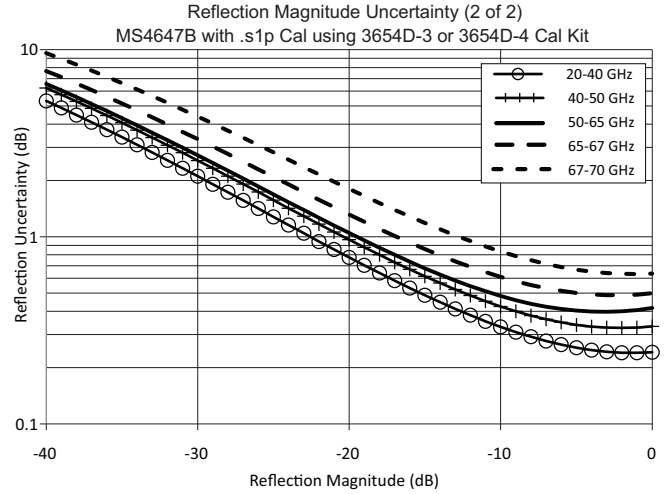
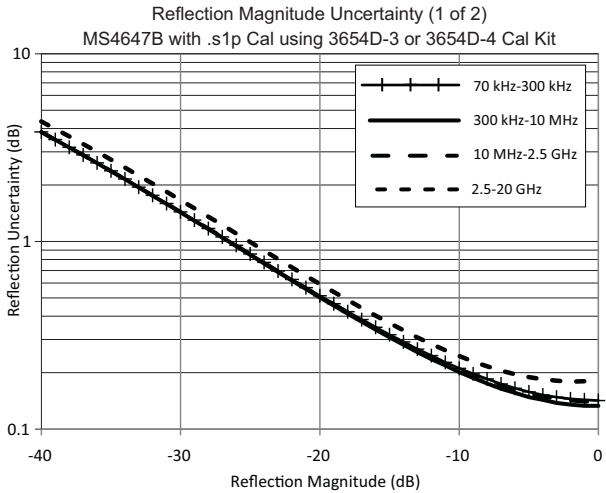
MS4647B Measurement Uncertainties (Transmission)

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using Options 51, 61, or 62. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.



MS4647B Measurement Uncertainties (Reflection)

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using Options 51, 61, or 62. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.



MS4647B VNA – LRL – 3657-1 V Multi-Line Calibration Kit

MS4647B 70 GHz VNA, with an LRL Calibration, using the 3657-1 V Multi-Line Calibration Kit, with symmetric reflects.

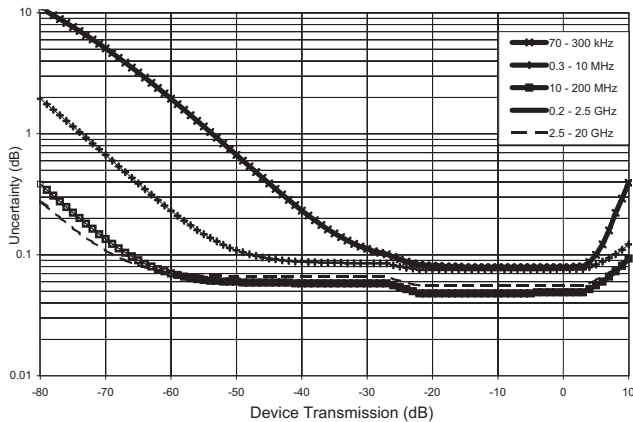
| Frequency Range (GHz) | Directivity (dB) | Source Match (dB) | Load Match ^a (dB) | Reflection Tracking (dB) | Transmission Tracking (dB) |
|--------------------------|------------------|-------------------|------------------------------|--------------------------|----------------------------|
| 0.24 ^b to 2.5 | > 50 | > 50 | > 50 | ± 0.005 | ± 0.02 |
| > 2.5 to 20 | > 50 | > 50 | > 50 | ± 0.005 | ± 0.02 |
| > 20 to 40 | > 50 | > 50 | > 50 | ± 0.005 | ± 0.02 |
| > 40 to 65 | > 45 | > 50 | > 45 | ± 0.015 | ± 0.02 |
| > 65 to 67 | > 45 | > 50 | > 45 | ± 0.03 | ± 0.04 |
| > 67 to 70 | > 45 | > 45 | > 45 | ± 0.10 | ± 0.08 |

- a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.
- b. Limited to about 240 MHz, due to the longest line delta of 34.84 mm in the 3657 Series Multi-Line Calibration Kit.

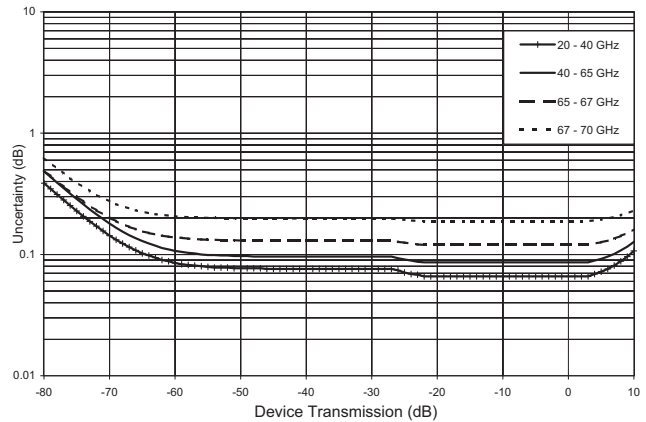
MS4647B Measurement Uncertainties (Transmission)

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using Options 51, 61, or 62. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.

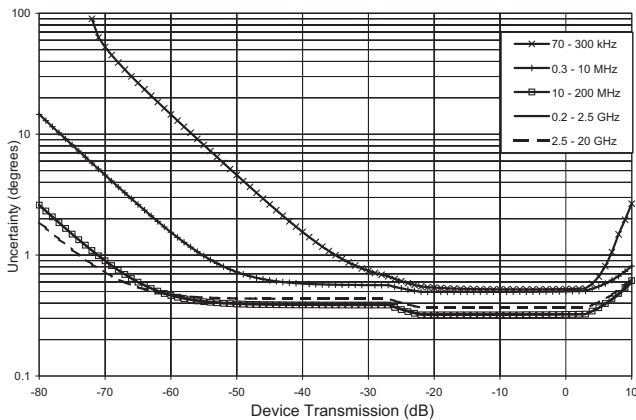
Transmission Magnitude Uncertainty (1 of 2)
MS4647B with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



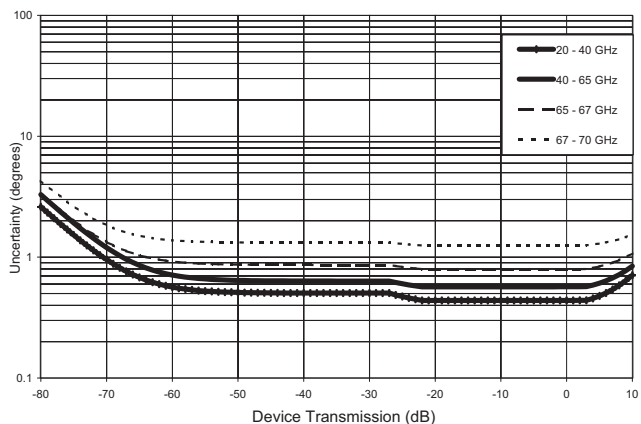
Transmission Magnitude Uncertainty (2 of 2)
MS4647B with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



Transmission Phase Uncertainty (1 of 2)
MS4647B with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



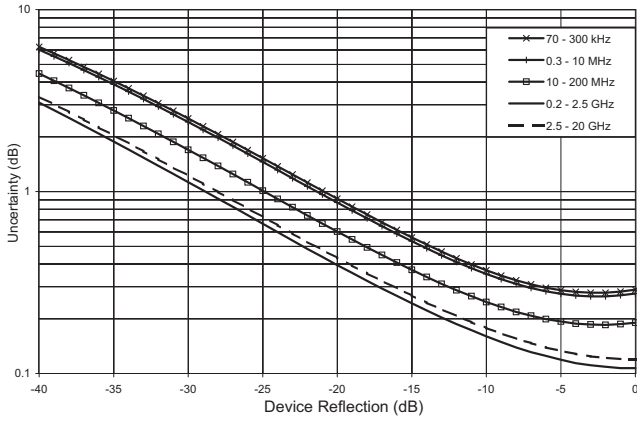
Transmission Phase Uncertainty (2 of 2)
MS4647B with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



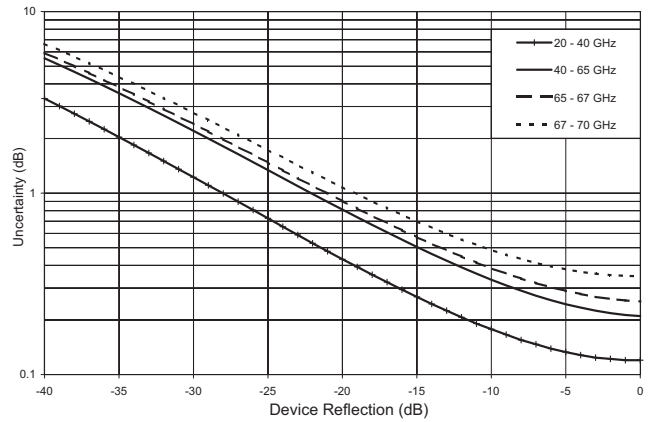
MS4647B Measurement Uncertainties (Reflection)

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using Options 51, 61, or 62. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.

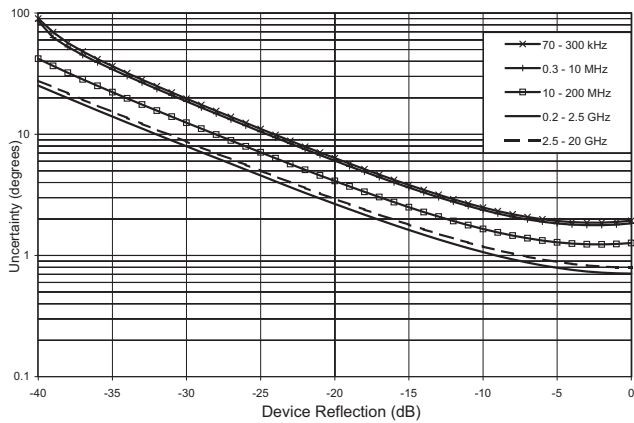
Reflection Magnitude Uncertainty (1 of 2)
MS4647B with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



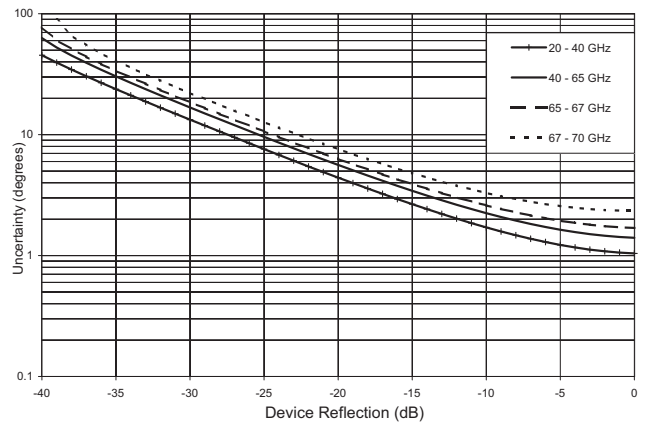
Reflection Magnitude Uncertainty (2 of 2)
MS4647B with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



Reflection Phase Uncertainty (1 of 2)
MS4647B with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



Reflection Phase Uncertainty (2 of 2)
MS4647B with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



MS4647B VNAs – 12-Term – 36585V V AutoCal

MS4647B 70 GHz VNA, with 12-term Calibration, using the 36585V V AutoCal.

| Frequency Range (GHz) | Directivity (dB) | Source Match (dB) | Load Match ^a (dB) | Reflection Tracking (dB) | Transmission Tracking (dB) |
|-----------------------------|------------------|-------------------|------------------------------|--------------------------|----------------------------|
| 70 kHz to 0.01 ^b | > 40 | > 40 | > 40 | ± 0.10 | ± 0.10 |
| > 0.01 to 2.5 | > 43 | > 47 | > 43 | ± 0.05 | ± 0.03 |
| > 2.5 to 20 | > 50 | > 47 | > 50 | ± 0.09 | ± 0.03 |
| > 20 to 40 | > 48 | > 47 | > 48 | ± 0.14 | ± 0.07 |
| > 40 to 65 | > 43 | > 45 | > 43 | ± 0.17 ^c | ± 0.10 |
| > 65 to 67 | > 43 | > 45 | > 43 | ± 0.17 | ± 0.10 |
| > 67 to 70 | > 42 | > 40 | > 42 | ± 0.30 | ± 0.12 |

a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

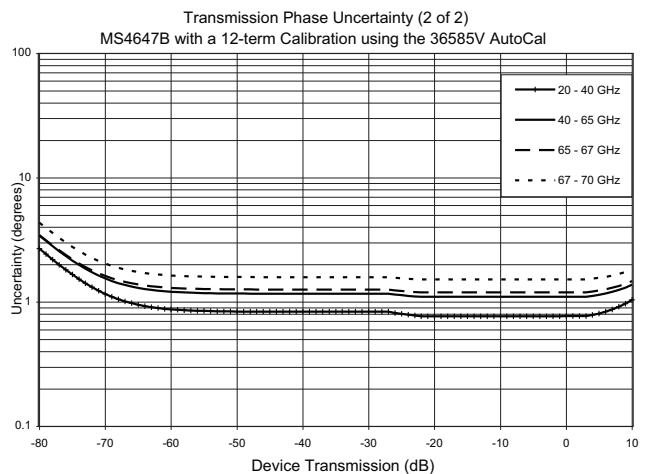
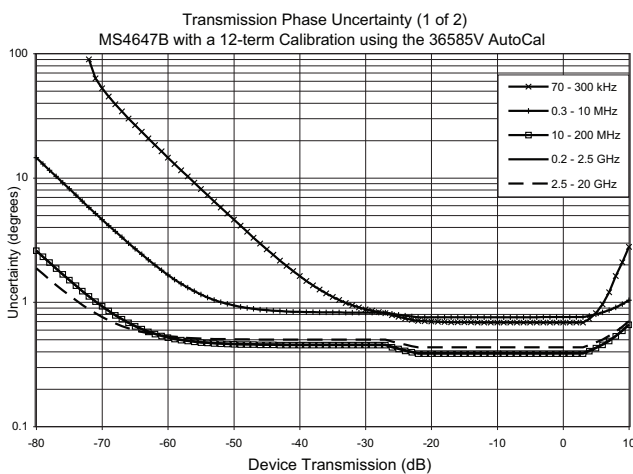
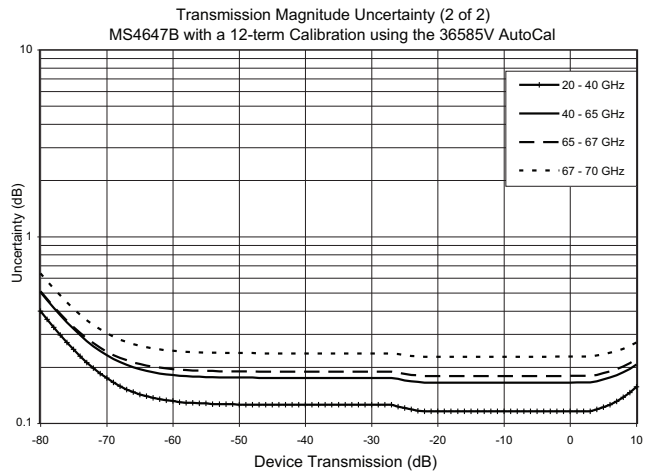
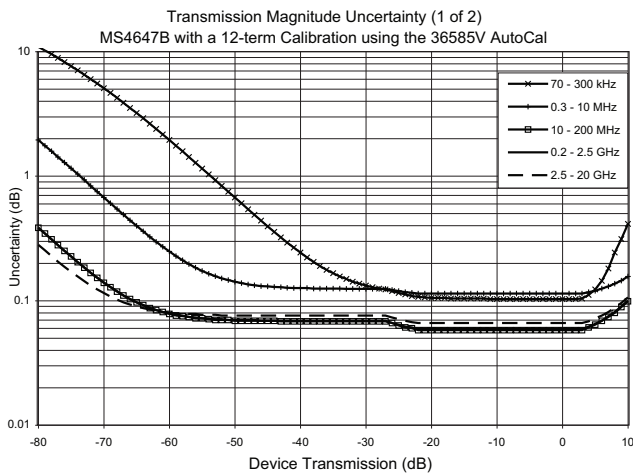
b. Typical performance below 2 MHz.

c. ± 0.25 dB from 51 to 55 GHz.

MS4647B Measurement Uncertainties (Transmission)

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used.

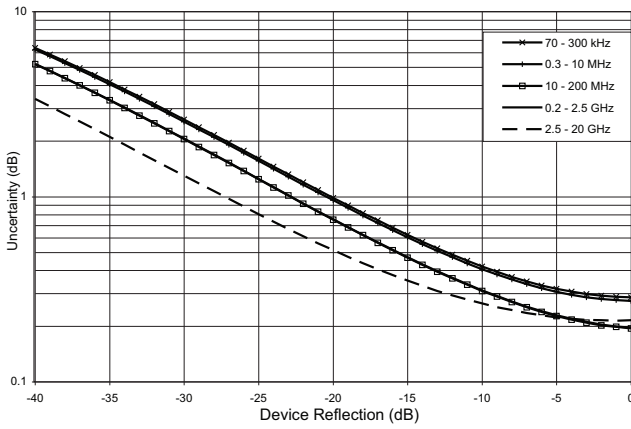
For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using Options 51, 61, or 62. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.



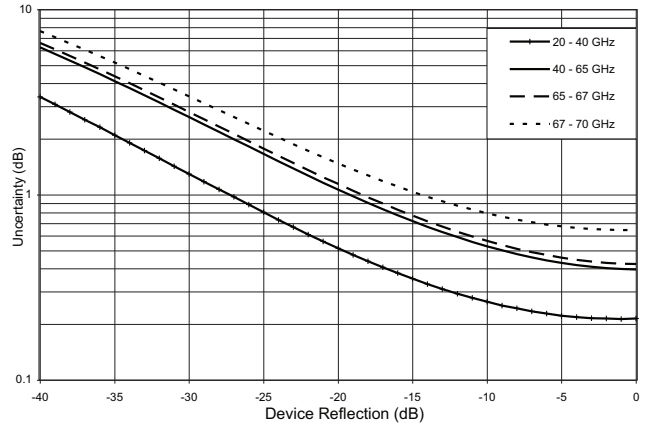
MS4647B Measurement Uncertainties (Reflection)

The graphs give measurement uncertainties after the above calibration. The errors are a worst-case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. 10 Hz IF Bandwidth is used. For transmission uncertainties, it is assumed that $S_{11} = S_{22} = 0$. For reflection uncertainties, it is assumed that $S_{21} = S_{12} = 0$. All calibrations and measurements were performed at 0 dBm or default port power, whichever is less. Graphs calculated not using Options 51, 61, or 62. Those options affect noise floor and will shift the low transmission uncertainties accordingly. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at www.anritsu.com.

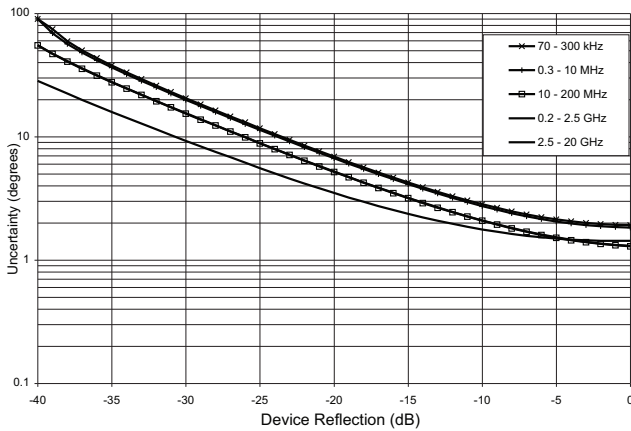
Reflection Magnitude Uncertainty (1 of 2)
MS4647B with a 12-term Calibration using the 36585V AutoCal



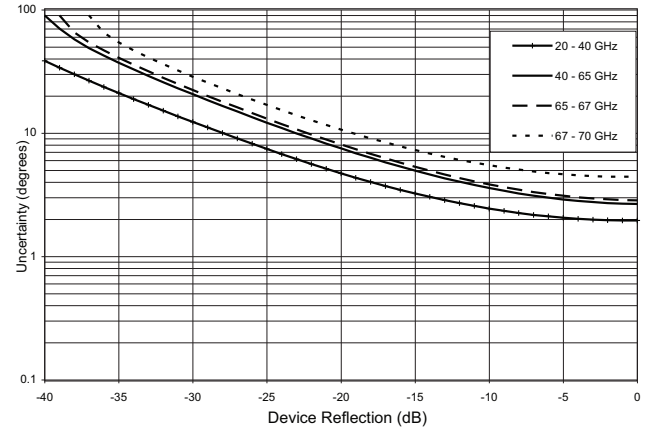
Reflection Magnitude Uncertainty (2 of 2)
MS4647B with a 12-term Calibration using the 36585V AutoCal



Reflection Phase Uncertainty (1 of 2)
MS4647B with a 12-term Calibration using the 36585V AutoCal



Reflection Phase Uncertainty (2 of 2)
MS4647B with a 12-term Calibration using the 36585V AutoCal



Measurement Times

Measurement times include sweep time, and band-switching time, in single channel mode. (typical performance)

~30 μ s/point is achieved in true swept mode, with 100,000 points, with ALC turned on for level accuracy, with display turned-on for tuning purposes, with locking turned-on for frequency accuracy and repeatability, with correction turned on to meet published residual specifications, and over the full span of the product with all band-switch points to fully characterize a device.

Measurement Time (ms), SYNTHESIZED Sweep, Display ON and ALC ON

| Calibration | Sweep Width | IFBW | Measurement Time (ms) | | | |
|-----------------------------------|--|--------|-----------------------|--------------|---------------|----------------|
| | | | 401 Points | 1,601 Points | 25,000 Points | 100,000 Points |
| Uncorrected or 1-port calibration | Narrow (\leq 1 GHz span without band-switch points) | 1 MHz | 20 | 60 | 890 | 3,300 |
| | | 30 kHz | 30 | 110 | 1,600 | 6,100 |
| | | 1 kHz | 380 | 1,600 | 25,000 | 100,000 |
| | Wide (70 GHz span) | 1 MHz | 50 | 90 | 1,000 | 3,400 |
| | | 30 kHz | 60 | 140 | 1,700 | 6,200 |
| | | 1 kHz | 420 | 1,670 | 25,000 | 100,000 |
| 2-port calibration (per sweep) | Narrow (\leq 1 GHz span without band-switch points) | 1 MHz | 20 | 60 | 890 | 3,300 |
| | | 30 kHz | 30 | 110 | 1,600 | 6,100 |
| | | 1 kHz | 400 | 1,610 | 25,000 | 100,000 |
| | Wide (70 GHz span) | 1 MHz | 50 | 90 | 1,000 | 3,400 |
| | | 30 kHz | 60 | 140 | 1,700 | 6,200 |
| | | 1 kHz | 420 | 1,670 | 25,000 | 100,000 |

Measurement Time (ms) vs. Noise Floor (dBm), SYNTHESIZED Sweep, Display ON and ALC ON

| Calibration | Full Band Sweep | Measurement Time 1,601 Points | Achieved Noise Floor at Maximum Frequency (dBm) | IFBW (kHz) |
|--------------------------------|-----------------|-------------------------------|---|------------|
| 2-port calibration (per sweep) | MS4642B | 110 | -85 | 100 |
| | | 210 | -95 | 10 |
| | MS4644B | 115 | -80 | 100 |
| | | 210 | -90 | 10 |
| | MS4647B | 120 | -75 | 100 |
| | | 210 | -85 | 10 |

Standard Capabilities

| | |
|------------------------------------|---|
| Operating Frequency | |
| MS4642B | 40 kHz to 20.2 GHz |
| MS4644B | 10 MHz to 40.5 GHz |
| MS4647B | 10 MHz to 70 GHz |
| MS4640B-070 | Optional for MS4644B and MS4647B VNAs. Provides 40 kHz to 10 MHz Coverage Extension. Provides a lower limit specified to 70 kHz, which is allowed to extend to 40 kHz. |
| Measurement Parameters | |
| 2-Port Measurements | S_{11} , S_{21} , S_{22} , S_{12} , and any user-defined combination of a_1 , a_2 , b_1 , b_2 , and 1. |
| 4-Port Measurements | Refer to the separate VectorStar MN469xC Series Multiport VNA Measurement System Technical Data Sheet 11410-00777, available at http://www.anritsu.com/en-US/test-measurement/products/ms4640b-series |
| Domains | Frequency Domain, Power Domain, CW Draw, and Time (Distance) Domain |
| Sweeps | |
| Frequency Sweep Types | Linear, Log, CW, or Segmented |
| Power Sweep Types | Linear, constant power sweeps, or constant power slope (dB/GHz) over frequency sweep |
| Display Graphs | |
| Single Rectilinear Graph Types | Log Magnitude, Phase, Group Delay, Linear Magnitude, Real, Imaginary, Inductance, Capacitance, SWR, Power Out, Impedance, and Power In |
| Dual Rectilinear Graph Types | Log Magnitude and Phase, Linear Magnitude and Phase, and Real and Imaginary |
| Circular Graph Types | Smith Chart (Impedance), Smith Chart (Admittance), Linear Polar, and Log Polar |
| Measurements Data Points | |
| 25,000 Data Points | 2 to 25,000 points in up to 16 channels |
| 100,000 Data Points | 2 to 100,000 points in single channel |
| Limit Lines | |
| Limit Lines | Single or segmented. 2 limit lines per trace. 50 segments per limit line. |
| Single Limit Readouts | Uses interpolation to determine the intersection frequency. |
| Test Limits | Both single and segmented limits can be used for PASS/FAIL testing. |
| Averaging | |
| Point-by-Point | Point-by-point (default), max Averaging = IF Bandwidth/1 Hz |
| Sweep-by-Sweep | Sweep-by-sweep (no limit) |
| IF Bandwidth | |
| | 1, 2, 3, 5, 7, 10, 20, 30, 50, 70, 100, 200, 300, 500, 700 Hz; 1, 2, 3, 5, 7, 10, 20, 30, 50, 70, 100, 200, 300, 500, 700 kHz; 1MHz |
| Reference Plane | |
| Line Length or Time Delay | The reference planes of a calibration or other normalization can be changed by entering a line length or time delay. |
| Dielectric Constants | Dielectric constants may be entered for different media so the length entry can be physically meaningful. |
| Dispersion Modeling | Dispersion modeling is used in the cases of microstrip and waveguide to take into account frequency dependent phase velocities. |
| Attenuation | Attenuation (with frequency slope) and constant phase offsets can be entered to better describe any reference plane distortions. The frequency dependence exponent is changeable. |
| Auto Modes | Automatic reference plane finding tools are available for phase alone or phase + magnitude. These routines do a fitting process on phase or phase and magnitude to estimate the reference plane location and enter correcting values. |
| De-embedding | For more complete reference plane manipulation, the full de-embedding system can also be used. |
| Measurement Frequency Range | |
| Frequency Range Change | Frequency range of the measurement can be narrowed within the calibration range without recalibration. |
| CW Mode | CW mode permits single frequency measurements also without recalibration. |
| Interpolation Not Activated | If interpolation is not activated, the subset frequency range is forced to use calibration frequency points. |
| Interpolation Activated | If interpolation is activated, any frequency range that is a subset of the calibration frequency range can be used, but there may be some added interpolation error. |
| Group Delay | |
| Group Delay Aperture | Defined as the frequency span over which the phase change is computed at a given frequency point. |
| Aperture | The aperture can be changed without recalibration. |
| Minimum Aperture | The minimum aperture is the frequency range divided by the number of points in calibration and can be increased to 20 % of the frequency range. |
| Group Delay Range | < 180° of phase change within the aperture |

Channels, Display, and Traces

| | |
|-----------------------|---|
| Channels and Traces | 16 channels, each with up to 16 traces |
| Display | Color touch screen LCD, 26.4 cm (10.4") diagonal |
| Display Colors | Unlimited colors for data traces, memory, text, markers, graticules and limit lines. |
| Trace Memory and Math | A separate memory for each trace can be used to store measurement data for later display or subtraction, addition, multiplication or division with current measurement data. The trace data can be saved and recalled. |
| Inter-trace Math | Any two traces within a channel can also be combined (via addition, subtraction, multiplication or division) and displayed on another trace. An equation editor mode is also available that allows the combination of trace data, trace memory and S-parameter data in more complex equations. Over 30 built-in functions are available. Simple editing tools and the ability to save/recall equations are also provided. |

Scale Resolution

| | |
|------------------|---|
| | Minimum per division, varies with graph type. |
| Log Magnitude | 0.001 dB |
| Linear Magnitude | 1 μ |
| Inductance | 1 fH |
| Capacitance | 1 fF |
| Phase | 0.01° |
| Group Delay | 0.001 ps |
| Time | 0.001 ps |
| Distance | 0.1 μ m |
| SWR | 1 μ |
| Power | 0.01 dB |

Markers

| | |
|----------------------------|--|
| Markers | 12 markers per trace (x 16 traces x 16 channels, for a total of 3,072) |
| Marker Coupling | Coupled or decoupled within a channel |
| Marker Data | Data displayed in graph area or in table form |
| Reference Marker | Additional marker per trace for reference |
| Marker Statistics | Mean, maximum, minimum, standard deviation |
| | Per trace or over a marker region. |
| Marker Search and Tracking | Search and/or track for minimum, maximum, peak, or target value. |

Other

| | |
|-----------------------------|--|
| Filter Parameters | Display bandwidth (user-selectable loss value), corner and center frequencies, loss, Q, and shape factors. |
| Blank Frequency Information | Blanking function removes all references to frequencies on the display. Frequency references can only be restored through a system preset or GPIB command. |

Saving Data

| | |
|----------------------|--|
| .sNp | <i>(Where N=1 or 2 for two port systems, and N=1 to 4 for four port systems)</i> The traditional Touchstone® file format for loading into simulators and other tools. Tools are available for re-assigning ports and selecting the units (Hz to GHz for frequency; linear magnitude-and-phase, real-and-imaginary or log magnitude-and-phase for data; these units are listed in the file header). Selections are available to put the outputs of frequency-with-time-gating (part of Option 2), or trace math in lieu of just the calibrated S-parameter. It is also possible to enforce passivity or causality on the parameters saved in these files. Only those parameters indicated by the file extension will be saved. |
| .mNp | <i>(Where N=2 for two port systems, and N= 2 or 4 for four port systems)</i> This is the mixed-mode version of the Touchstone® format with mixed-mode parameters substituted for the single-ended S-parameters. Differential and common-mode port pair assignments can be changed. |
| .txt and .csv | These are the familiar tab-delimited and comma-delimited file formats often used in spreadsheets. All traces in the current channel will be saved using whatever trace formats are currently enabled. Frequency and time domain traces will be saved in the same file and each trace will be saved with its own frequency/time vector. An extensive header in these files denotes instrument settings. |
| .bmp, .png, and .jpg | These are the familiar graphics files formats. The graph area, the marker table (if active), the segmented sweep, limit line or multiple source tables (if active) and the bottom status bar are saved as part of the image. The top and side menu bars are not saved. |
| .tdf and .tdu | These are internal trace data formats (formatted data using the current graph type or unformatted) that can be used to recall data into trace memory at a later time. |

Remote Operability

VectorStar supports several remote operability options.

| Communication Type | Data Format | Performance | Description |
|-------------------------------|--|------------------------------|--|
| Via GPIB | Using IEEE 488.2 | 1 MB/s Data Transfer Speed | Use SCPI or previous generation Lightning VNA commands. Also compatible with a fundamental set of HP/Agilent 8510x VNA commands. |
| Via LAN | Using VXI-11 Protocol | 2.5 MB/s Data Transfer Speed | |
| Via USB | Using USBTMC Protocol | 5.5 MB/s Data Transfer Speed | |
| Drivers for GPIB, LAN, or USB | National Instruments LabVIEW and LabWindows/CVI drivers are available for download from both the Anritsu and National Instruments web sites. .NET/COM driver for Windows™ Applications such as Visual Studio 6 thru VS 2005, VB6, C#, C++, C, Visual C, HP Vee, and more are available for download from the Anritsu web site. These drivers require VISA runtime, not provided by Anritsu. NI VISA version 3.2 or higher is recommended for .NET and USB support. | | |
| Triggering | Internal, External, GPIB Single point, Single Sweep, and Single Channel. All Channels are hand-shaking for optimum tandem sweeps (check rear panel connections). | | |

Throughput Time

Throughput Time (ms), Synthesized Sweep, Display ON and ALC ON, single 20 GHz sweep, 30 kHz IFBW, including trigger and data transfer time.

| Communication Type | Data Format | Measurement Time (typical) | | |
|--------------------|------------------------|----------------------------|--------------|----------------|
| | | 401 points | 1,601 points | 100,000 points |
| GPIB (IEEE-488.2) | 32- or 64-bit Floating | 380 | 410 | 6,400 |
| | ASCII | 290 | 370 | 7,400 |
| LAN (VXI-11) | 32- or 64-bit Floating | 280 | 320 | 6,300 |
| | ASCII | 290 | 350 | 7,400 |
| USB (USBTMC class) | 32- or 64-bit Floating | 280 | 310 | 6,000 |
| | ASCII | 290 | 350 | 6,800 |

Calibration and Correction Capabilities

| | |
|---|---|
| Calibration Methods | <p>Short-Open-Load-Through (SOLT) with Fixed or Sliding Load and supporting .s1p-defined cal kits Offset-Short-Offset-Short-Load-Through (SSLT) with Fixed or Sliding Load Triple-Offset-Short-Through (SSST) Short-Open-Load-Reciprocal (SOLR) or Unknown Through Method (SSLR, SSSR) Line-Reflect-Line (LRL) / Line-Reflect-Match (LRM) – (up to 5 bands supported for multi-line configurations) Advanced-LRM (A-LRM™) for improved on-wafer calibrations Multiline Through-Reflect-Line (mTRL) AutoCal Thru Update available Secondary match correction available for improved low insertion loss measurements</p> |
| Correction Models | <p>2-Port (Forward, Reverse, or both directions) 1-Port (S_{11}, S_{22}, or both) Transmission Frequency Response (Forward, Reverse, or both directions) Reflection Frequency Response (S_{11}, S_{22}, or both)</p> |
| Merged Calibration | Merge multiple calibrations over bands of frequency points and with different algorithms |
| Coefficients for Calibration Standards | <p>Use the Anritsu calibration kit USB Memory Device to load kit coefficients and characterization files. Enter manual coefficients into user-defined locations. Complex load models are available. Full .s1p definitions of calibration standards can be loaded.</p> |
| Reference Impedance | Modify the reference impedance from 50 Ω to any impedance greater than 0 Ω . |
| Interpolation | Allows interpolation between calibration frequency points. Accuracy will be reduced at non-calibration frequencies and that degradation is dependent on the frequency step size in the initial calibration and the electrical length of the user's setup. |
| Adapter Removal Calibration | Characterizes and “removes” an adapter that is used during calibration that will not be used for subsequent device measurements; for accurate measurement of non-insertable devices. |
| Dispersion Compensation | Selectable as Coaxial, other non-dispersive (e.g., for coplanar waveguide), Waveguide, or Microstrip. |
| Power | |
| Power Meter Correction | Different power meter calibrations are available to enhance power accuracy at the desired reference plane. The source power will match the target calibration power, as read by the power meter, to within -0.1 dB for short periods of time (determined by thermal drift of the system and the power meter). The absolute accuracy of the calibrated power will be dependent on the power meter and sensor used. |
| Flat Power Calibrations | A flat power calibration (when in frequency sweep mode) is available at a user-selectable power level, if it is within the power adjustment range of the internal source. The flat power correction is applied to other power levels. |
| Linear Power Calibrations | A linear power calibration is performed over a range of power levels for use in power sweep mode and is performed at a specified frequency or frequency range. |
| External Power Meter | Both calibrations are performed using an external power meter (Anritsu ML2438A, ML248xB, ML249xA, Agilent 437, or equivalent) over the Dedicated GPIB port, or a USB power sensor (Anritsu MA24106A, MA24108A, MA24118A, MA24126A, MA24208A, MA24218A, MA24330A, MA24340A, MA24350A, MA24507A, or MA24510A) connected to a USB port. Note: Usage of the MA24500A series sensor requires a dual USB Type A male to single USB Type A female cable to supply needed current draw. |
| Embedding/De-embedding | The MS4640B is equipped with an Embedding/De-embedding system. |
| De-embedding | De-embedding is generally used for removal of test fixture contributions, modeled networks and other networks described by S-parameters (s2p files) from measurements. |
| Embedding | Similarly, the Embedding function can be used to simulate matching circuits for optimizing amplifier designs or simply adding effects of a known structure to a measurement. |
| Multiple Networks | Multiple networks can be embedded/de-embedded and changing the port and network orientations is handled easily. |
| Extraction Utility | An extraction utility is part of this package that allows the easier computation of de-embedding files based on some additional calibration steps and measurements. |
| Impedance Conversion | Allows entry of different reference impedances (complex values) for different ports |

| | |
|--------------------------------|--|
| Mixer Setup | Mixer setup provides assistance to configure common mixer measurements including a simple, yet accurate, calibration methodology. |
| Mixer Setup – Single Channel | The prime objective of the guided Mixer Setup Single Channel is to help configure the frequency plan of the measurement using easy-to-understand diagrams. Mixers using harmonics of the LO are supported as are mm-wave configurations (see ME7838x documentation). |
| Mixer Setup – Multiple Channel | The Mixer Setup Multiple Channels helps configure measurement channels to handle any of a suite of possible mixer measurements and to list the required calibration steps. |
| Mixer Calibration | Both of these tools are coupled with the mixer calibration menu system that enables both scalar and vector-corrected measurements. The user can be directed to power calibrations that are automatically set up based on the mixer configuration. |
| Dual Source Mixer | Allows easier external mixer setups and can take advantage of the flexibility of having two independent internal sources within the VNA. |

Optional Capabilities

Time Domain Measurements — Option 2

Displays all S-parameters and overlays with Frequency Domain, Low-pass Mode, Band-pass Mode, Phasor Impulse Mode, Windowing, Gating (pass-band or reject-band), and Frequency with Time Gate. Low-pass mode requires a harmonically related frequency list (step size = start frequency). A harmonic sweep tool is available to help with this setup. In low-pass mode, the impulse or step response can be displayed (the latter for a TDR-like presentation). When applying gating, the impedance levels at gate edges can be changed to simplify de-embedding operations.

Receiver Offset — Option 7

| | |
|--------------------------------------|--|
| Independent Source/Receive Functions | Allows for independent source and receive functions for Mixer, Harmonics, IMD and other measurements, where the source and receive frequencies are offset. |
| Multiple Source Control Mode | To independently control the frequencies of up to four external sources, in addition to the internal source(s), and the receiver, in a synchronized manner. |
| NxN Frequency-Translated Devices | Provides calibration and measurements capability for NxN Frequency-translated devices. For accurate and absolute magnitude and phase measurements of match, gain/loss, and group delay of devices such as mixers and converters. |

Active Device Measurements — Option 8 (MS4642B Minimum configuration requirement – with two attenuators)

| | |
|--|--|
| Option 8 (ordered as MS4642B-008) configures the MS4642B for active device measurements which includes the following features: | |
| Frequency Offset Control | For measurements of harmonics, spurious, etc. See <i>Receiver Offset — Option 7</i> for details. |
| 70 kHz Frequency Coverage | See <i>70 kHz Low End Frequency Extension — Option 70</i> for details. |
| Active Measurement Suite | Adds two 70 dB attenuators and bias tees See <i>Active Measurements Suite — Option 61/62</i> for details) |
| Noise Figure Measurements | If MS4642B-008 ordered, see <i>Noise Figure — Option 41</i> for details. If MS4642B-008D ordered, see <i>Differential Noise Figure — Option 48</i> for details. |

Active Device Measurements — Option 9 (MS4642B Minimum configuration requirement – with four attenuators)

| | |
|--|--|
| Option 9 (ordered as MS4642B-009) configures the MS4642B for active device measurements which includes the following features: | |
| Frequency Offset Control | For measurements of harmonics, spurious, etc. See <i>Receiver Offset — Option 7</i> for details. |
| 70 kHz Frequency Coverage | See <i>70 kHz Low End Frequency Extension — Option 70</i> for details. |
| Active Measurement Suite | Adds four 70 dB attenuators and bias tees See <i>Active Measurements Suite — Option 61/62</i> for details. |
| Noise Figure Measurements | If MS4642B-009 ordered, see <i>Noise Figure — Option 41</i> for details. If MS4642B-009D ordered, see <i>Differential Noise Figure — Option 48</i> for details. |

Universal Fixture Extraction — Option 21

Provides a suite of additional network extraction techniques for different de-embedding problems, particularly those when only partial interface information is available at the DUT plane. These are often useful for on-wafer and fixtured environments with more complex DUT interfaces where traditional standards may not be available. In most cases, .s1p definition/model of reflect standards is allowed and generally automatic fixture length detection is available. In addition, a sequential extraction (peeling) of isolated fixture defects is possible and allows one to generate sNp files for portions of the fixture for design analysis.

Dual Source Architecture — Option 31

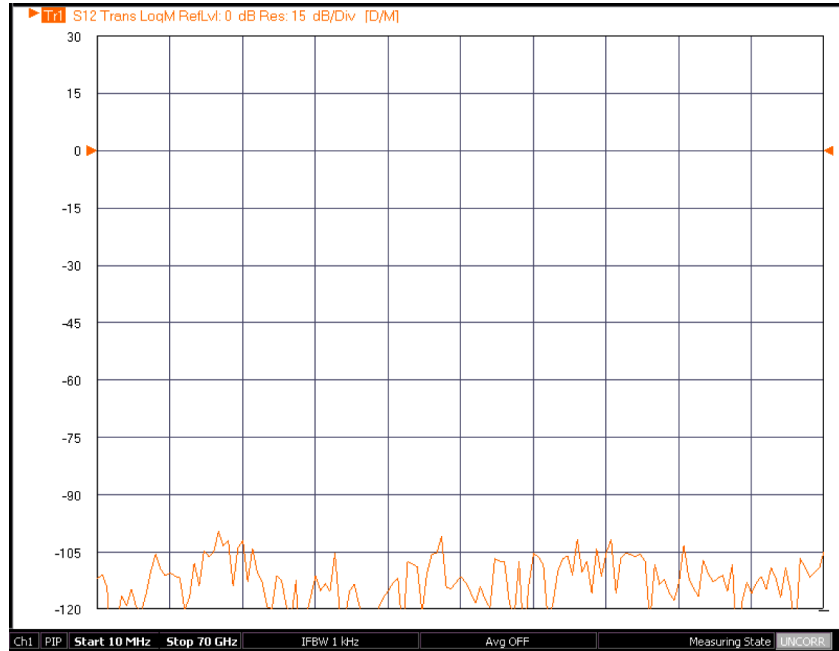
| | |
|---------------------------|---|
| Description | Adds a second internal source to the VNA structure and removes the transfer switch. This architecture results in higher test port power and improved dynamic range. Combined with Option 7 Receiver Offset, allows two sources and the receiver to be active at the same time and at independent frequencies. When both sources are active and at the same frequency, a relative phase shift can be set between them. When combined with Option 43 DifferentialView™, adds the ability to perform true mode stimulus measurements of differential devices. The dual source mixer capability allows the flexibility of two independent sources within the VNA to allow external mixer measurements. |
| Required Options | None, except with the dual source mixer applications which require Option 7. |
| System Compatible Options | Option 2 Time Domain Option 7 Receiver Offset Option 21 Universal Fixture Extraction Option 32 Internal RF Combiner Option 35 IF Digitizer Option 36 Extended IF Digitizer Memory Option 41 Noise Figure Option 42 PulseView™ Option 43 DifferentialView™ Option 44 IMDView™ Option 46 Fast CW Option 47 Eye Diagram Option 48 Differential Noise Figure Option 51 Direct Access Loops Option 53 External ALC Options 61/62 Active Measurements Suite Option 70 70 kHz Low Frequency Extension Options 84/85 Broadband/Banded/Millimeter-Wave Extension Options 88/89 Broadband/Banded/Millimeter-Wave Extension. Maximum frequency available is 110 GHz. |
| Incompatible Options | Options 80/81 Broadband/Millimeter-Wave Options 82/83 Banded/Millimeter-Wave Extension Options 86/87 Broadband/Millimeter-Wave. Maximum frequency available is 110 GHz. |

Internal RF Combiner — Option 32

| | |
|---------------------------|--|
| Description | Adds an internal combiner to combine Source 2 of the Dual Source Architecture option (Option 31) with Source 1 and routes to Port 1 of the VectorStar front panel. When combined with IMDView Option 44 the configuration provides optimized intermodulation distortion (IMD) measurements. The Frequency Offset (Option 7) and Dual Source (Option 31) must be ordered with the combiner option. If IMDView Option 44 is not included, switching of the combiner is activated using the Multiple Source Control menus supplied with the frequency offset option. |
| Required Options | Option 7 Receiver Offset and Option 31 Dual Source Architecture |
| System Compatible Options | Option 2 Time Domain Option 21 Universal Fixture Extraction Option 35 IF Digitizer Option 36 Extended IF Digitizer Memory Option 41 Noise Figure Option 42 PulseView™ Option 43 DifferentialView™ Option 44 IMDView™ Option 46 Fast CW Option 47 Eye Diagram Option 48 Differential Noise Figure Option 51 Direct Access Loops Option 53 External ALC Option 61/62 Active Measurements Suite (or Option 8/9 for MS4642B) Option 70 70 kHz Low Frequency Extension Options 84/85 Broadband/Banded/Millimeter-Wave Extension Options 88/89 Broadband/Banded/Millimeter-Wave Extension. Maximum frequency available is 110 GHz. |
| Incompatible Options | Options 80/81 Broadband/Millimeter-Wave Options 82/83 Banded/Millimeter-Wave Extension Options 86/87 Broadband/Millimeter-Wave. Maximum frequency available is 110 GHz |

IF Digitizer — Option 35

| | |
|---------------------------|---|
| Description | When combined with Option 42 PulseView™, adds the capability to generate and measure pulsed signals. Four internal signal generators are included enabling singlet, doublet, triplet, quadruplet, and/or burst signal generation. Pulse measurements include pulse profile, point-in-pulse, and pulse-to-pulse capability. |
| Required Options | None |
| System Compatible Options | All |
| Incompatible Options | None |
| Multiport Systems | Compatible with the MN469xC Series Multiport System on any model VNA. Fast CW (non-pulsed) Captures up to 400 million data points per measurement channel with variable acquisition rates from 80 MHz to 400 MHz. This capability enables long time records (0.5 s to 2.5 s, depending on acquisition rate) stored in files retrievable via USB or a local area network. |
| Additional Information | For detailed pulse measurement theory, description, and operational information, see the VectorStar MS4640B Series VNA Calibration and Measurement Guide, 10410-00318. |



Typical plot of dynamic range with Option 35 activated.

Extended IF Digitizer Memory — Option 36

| | |
|---------------------------|--|
| Description | Provides additional memory for the IF digitizer option to allow for longer record lengths. This option increases the maximum record length from 0.5 seconds to 2.5 seconds at the maximum sampling rate (minimum time resolution) with proportionate increases in record length increases at other sampling rates. |
| Required Options | Option 35 IF Digitizer |
| System Compatible Options | All |
| Incompatible Options | None |

Noise Figure — Option 41

| | |
|---------------------------|--|
| Description | Adds the capability to measure degradation of the signal-to-noise ratio caused by components in a signal chain. The Noise Figure measurement is based on a cold source technique for improved accuracy. Various levels of match and fixture correction are available for additional enhancement. Mixer noise figure measurements are supported. Compatible with mm-wave measurements in the ME7838X family with the use of receiver-only modules (e.g., 3744A-Rx). |
| Required Options | Option 51 or Option 61 or Option 62 |
| System Compatible Options | Option 2 Time Domain Option 7 Receiver Offset Option 21 Universal Fixture Extraction Option 31 Dual Source Architecture Option 32 Internal RF Combiner Option 35 IF Digitizer Option 36 Extended IF Digitizer Memory Option 42 PulseView™ Option 43 DifferentialView™ Option 44 IMDView™ Option 46 Fast CW Option 47 Eye Diagram Option 53 External ALC Option 70 70 kHz Low Frequency Extension Option 81 Broadband/Millimeter-Wave Option 83 Millimeter-Wave Extension Option 85 Broadband/Banded/Millimeter-Wave Extension Option 87 Broadband/Millimeter-Wave Option 89 Broadband/Banded/Millimeter-Wave Extension |
| Incompatible Options | Option 48 Differential Noise Figure Option 80 Broadband/Millimeter-Wave Option 82 Banded Millimeter-Wave Extension Option 84 Broadband/Banded/Millimeter-Wave Extension Option 86 Broadband/Millimeter-Wave Option 88 Broadband/Banded/Millimeter-Wave Extension |
| Multiport System | MN469xC Series Multiport System on any model VNA; Noise Figure measurements can only be performed when the system is configured as a 2-Port VNA. |
| Additional Information | For detailed Noise Figure measurement theory, description, and operational information, see the VectorStar MS4640B Series VNA Calibration and Measurement Guide, 10410-00318. |

PulseView™ — Option 42

| | |
|--|--|
| Description | When combined with Option 35 IF Digitizer, adds the capability to generate and measure pulsed signals. Four internal signal generators are included enabling singlet, doublet, triplet, quadruplet, and/or burst signal generation. Pulse measurements include pulse profile, point-in-pulse, and pulse-to-pulse capability. Allows pulsed leveling of source power at an external point (e.g., after a preamplifier). |
| Required Options | Option 35 IF Digitizer |
| System Compatible Options | All |
| Incompatible Options | None |
| Multiport Systems | Compatible with the MN469xC Series Multiport System on any model VNA |
| Additional Information | For detailed pulse generation and measurement capability theory, description, and operation information, see the VectorStar MS4640B Series VNA Calibration and Measurement Guide - 10410-00318. |
| Pulse Measurements | |
| Pulse Profile | Pulse profile (PP), point-in-pulse (PIP), pulse-to-pulse (P2P), continuous pulse profiling, (Cprof), and continuous point-in-pulse (CPIP) |
| Minimum Profile Width | 2.5 ns (5 ns minimum for continuous profiling) |
| Minimum PIP Measurement Width | 2.5 ns (5 ns minimum for continuous point-in-pulse) |
| P2P Measurement Width | Minimum 5 ns |
| Record Length | 0.5 s |
| Pulse Repetition Frequency (PRF) | 4 Hz to 67 MHz in Pulse mode; PRFs slower than 4 Hz can be measured in standard Transmission/Reflection mode with triggering. |
| Duty Cycle (DC) Dynamic Range Reduction (characteristic) | |
| 1 % DC | 0 dB |
| 0.1 % DC | 0 dB |
| 0.01 % DC | 0 dB |
| Pulse Generation | |
| Pulse Formats | Four (4) internal pulse generators: PG1-PG4. Singlet, doublet, triplet, quadruplet, and burst |
| Pulse Repetition Frequency (PRF) Range | 4 Hz to 67 MHz |
| Maximum Pulse Width | 0.25 s |
| Minimum Pulse Width | 5 ns |
| RF Modulation | Requires an SM6628, SM6629, SM6630, or SM6631 Pulse Modulator Test Set (see next section) |

RF Modulation (Pulse Modulator Test Sets for use with Option 42 PulseView™)

| | |
|--|---|
| Description | Pulse Modulator Test Sets are available to pulse the RF stimulus and/or provide receiver gating (modulation). Receiver gating generally required only for higher power antenna and related applications where undesired pulses could saturate the VNA receiver. The Test Set frequency range is limited to that of the VNA with which it is used. Test Sets include necessary cabling and installation documentation. |
| Required Options | Option 35 IF Digitizer Option 42 PulseView™ Option 51 Direct Access Loops or Option 61/62 Active Measurements Suite |
| Requires one of the following compatible Pulse Modulator Test Sets | SM6628, 70 kHz to 40 GHz. Provides the MS4642B and MS4644B VNA with source modulation. SM6629, 70 kHz to 40 GHz. Provides the MS4642B and MS4644B VNA with source and receiver modulation. SM6630, 70 kHz to 70 GHz. Provides the MS4647B VNA with source modulation. SM6631, 70 kHz to 70 GHz. Provides the MS4647B VNA with source and receiver modulation. |
| Polarity | Low (< 1 V) = RF ON High (3.3 V ± 10 %) = RF OFF |
| Pulse Rise/Fall Time (typical) | 5 ns (10 % to 90 %) |
| Insertion Loss (typical) | < 10 dB, to 20 GHz < 12 dB, 20 to 40 GHz < 15 dB, 40 to 60 GHz < 20 dB, 60 to 70 GHz |
| On/Off Ratio (typical) | > 100 dB, to 20 GHz > 95 dB, 20 to 60 GHz > 90 dB, 60 to 70 GHz |
| Max Input Power | +20 dBm max, 0 VDC max |
| Latency (typical) | 35 ns |

DifferentialView™ — Option 43

| | |
|---------------------------|--|
| Description | When combined with Option 31 Dual Source Architecture, provides dual source control and calibrations required for stimulating and measuring differential devices. Allows true differential and common mode device drives. Corrects mismatch introduced error of the DUT to VNA interface via real and time calibration. This mode supports balanced in/out or combined balanced and single source drive configurations. In addition, it provides the ability to control amplitude and phase offsets of the drive conditions as well as swept phase offset for custom characterization. |
| Required Options | Option 31 Dual Source Architecture |
| System Compatible Options | All |
| Incompatible Options | None |
| Multiport Systems | Requires an MN469xC Series Multiport System for full differential characterization of a multiport device. |

IMDView™ — Option 44

| | |
|---------------------------|---|
| Description | When combined with Option 31, 32, and 7, IMDView provides user interface for setting up and performing IMD measurements. Interface configures and controls source routing, power and receiver calibrations, for baseband or mmWave VectorStar systems. Frequency Offset Option 7 required. If Option 31 and/or 32 are not included, the IMDView software will control external sources and perform power calibrations of external combiners. |
| Required Options | Option 7 Receiver Offset |
| System Compatible Options | Option 2 Time Domain Option 7 Receiver Offset Option 21 Universal Fixture Extraction Option 31 Dual Source Architecture Option 32 Internal RF Combiner Option 35 IF Digitizer Option 36 Extended IF Digitizer Memory Option 42 PulseView™ Option 43 DifferentialView™ Option 46 Fast CW Option 47 Eye Diagram Option 48 Differential Noise Figure Option 51 Direct Access Loops Option 53 External ALC Option 61/62 Active Measurements Suite (or Option 8/9 for MS4642B) Option 70 70 kHz Low Frequency Extension Option 84/85 Broadband/Banded/Millimeter-Wave Extension Option 88/89 Broadband/Banded/Millimeter-Wave Extension. Maximum frequency available is 110 GHz. Option 80/81 Broadband/Millimeter-Wave Option 82/83 Banded/Millimeter-Wave Extension Option 86/87 Broadband/Millimeter-Wave. Maximum frequency available is 110 GHz Option 88 Broadband/Banded/Millimeter-Wave Extension |
| Multiport System | Compatible with the MN469xC Series Multiport System on any model VNA; IMDView measurements can only be performed when the system is configured as a 2-Port VNA. |
| Additional Information | For detailed IMD measurement theory, description and operational information, see the VectorStar MS4640B Series VNA Calibration and Measurement Guide - 10410-00318. |

Fast CW — Option 46

| | |
|------------------------------------|---|
| Description: Standard Mode Fast CW | If Option 35 is not installed then Standard Mode Fast CW operations are available in T/R mode via remote commands. Standard Option CW supports both continuous data streaming and buffered data collection maximum data rates of ~200,000 measurements/second. The maximum buffer size is up to 60 million measurements with transfer blocks of up to 5 million measurements. Fast transfers are available for both streaming and buffered modes. Data extraction at corrected and final formatted layers is permitted. |
| Description: Advanced Fast CW | With Options 35 and 46 installed, Advanced Fast CW becomes available that allows data rates of up to 100,000,000 measurements/second on all receivers at once and buffers of up to 800,000,000 measurements deep (with Option 36). Advanced Fast CW is available in the user interface as well as remotely and has on-board synchronization choices and data reduction functionality. |
| Required Options | Option 35 IF Digitizer (required for Advanced Fast CW only) |
| System Compatible Options | All |
| Incompatible Options | None |

Eye Diagram — Option 47

| | |
|---------------------------|---|
| Description | Adds the capability to calculate an eye diagram representation of what the currently measured trace data would do to a digital data stream (that can be configured by the user). This is particularly valuable in seeing the data stream signal integrity issues that could occur with a given transmission path and can help with building up subsystem simulation results. Since the eye diagram computation is per-trace, one can configure a single channel having frequency domain, time domain impulse response, TDR-like and eye diagram traces simultaneously and all responding to the same live data. Both NRZ and PAM-4 signaling available. |
| Required Options | Option 2 Time Domain |
| System Compatible Options | All |
| Incompatible Options | None |
| Additional Information | For detailed Eye Diagram measurement theory, description and operational information, see the VectorStar MS4640B Series VNA Calibration and Measurement Guide - 10410-00318. |

Differential Noise Figure — Option 48

| | |
|---------------------------|--|
| Description | Includes all the functionality of Option 41 and allows measurement of differential and common-mode noise properties with the cold source method. Three operating modes (uncorrelated, correlated, and combiner-based) are available for measurement efficiency and accuracy optimization. Full treatment of output port correlation is available for 3- and 4-port DUTs. Mixer noise figure measurements are supported. Various levels of vector correction are available, as is full fixture/probe embedding and de-embedding. Compatible with mm-wave measurements in the ME7838X family with the use of receiver-only modules (e.g., 3744A-Rx). |
| Required Options | Option 51 or Option 61 or Option 62 |
| System Compatible Options | Option 2 Time Domain Option 7 Receiver Offset Option 21 Universal Fixture Extraction Option 31 Dual Source Architecture Option 32 Internal RF Combiner Option 35 IF Digitizer Option 36 Extended IF Digitizer Memory Option 42 PulseView™ Option 43 DifferentialView™ Option 44 IMDView™ Option 46 Fast CW Option 47 Eye Diagram Option 53 External ALC Option 70 70 kHz Low Frequency Extension Option 81 Broadband/Millimeter-Wave Option 83 Millimeter-Wave Extension Option 85 Broadband/Banded/Millimeter-Wave Extension Option 87 Broadband/Millimeter-Wave Option 89 Broadband/Banded/Millimeter-Wave Extension |
| Incompatible Options | Option 41 Noise Figure Option 80 Broadband/Millimeter-Wave Option 82 Banded Millimeter-Wave Extension Option 84 Broadband/Banded/Millimeter-Wave Extension Option 86 Broadband/Millimeter-Wave Option 88 Broadband/Banded/Millimeter-Wave Extension |
| Multiport System | MN469xC Series Multiport System on any model VNA; Differential Noise Figure measurements can be performed when the system is configured as a 2-Port VNA or a 4-Port VNA. |
| Additional Information | For detailed Differential Noise Figure measurement theory, description, and operational information, see the VectorStar MS4640B Series VNA Calibration and Measurement Guide, 10410-00318. |

Direct Access Loops — Option 51

| | |
|-----------------------|--|
| Access Loops Per Port | Adds three (3) Access loops per port for Source, Test, and Receive Paths. Note: Direct access loops are not available for VNAs equipped with Option 61 or 62, which include access loops. |
| Front Panel Loops | ≥ 2.5 GHz Frequency Coverage loops, located at front panel. |
| Rear Panel Loops | < 2.5 GHz Frequency Coverage loops, located at rear panel. |

External ALC — Option 53

External ALC access allows leveling of source power at an external point (e.g., after a preamplifier). The connector and functionality are included with Option 8x for use with the modular broadband and mm-wave functions (when in a 3739 mode, the broadband/mm-wave functionality takes precedence).

| | |
|---------------------------|-----------------|
| Required Options | Option 61 or 62 |
| System Compatible Options | All |
| Incompatible Options | None |

Active Measurements Suite — Option 61/62

Adds Step Attenuators, Bias Tees, Direct Access Loops, and Gain Compression and Efficiency Measurement Capabilities.

| | |
|---------------------|--|
| MS4644B Attenuators | 70 dB, 10 dB/step |
| MS4647B Attenuators | 60 dB, 10 dB/step |
| Option 61 | Two (2) attenuators: One in Source 1 path, and one in Receive 2 path. |
| Option 62 | Four (4) attenuators: One in each Source path and in each Receive path. |
| Bias Tees | 0.5 A maximum, 40 VDC maximum 3 kHz BW (nominal), looking into a High Impedance 10 MΩ to Ground for DUT Static Discharge Protection located at rear panel. |
| Access Loops | Includes Option 51 loops, listed above. (Options 51, 61, and 62 are mutually exclusive) |
| Gain Compression | Swept Power Gain Compression at a CW frequency $P_{x\text{ dB}}$ over Swept Frequency, up to 401 points. |

70 kHz Low End Frequency Extension — Option 70

Extends the VNA standard 10 MHz low-end start frequency to 70 kHz, providing 70 kHz to 20, 40, or 70 GHz coverage models. The low-end is allowed to extend to 40 kHz.

Broadband/Banded/Millimeter-Wave Systems For details on the MS464xB-08x series of options, see the: VectorStar ME7838A Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00593 (For 70 kHz to 125 GHz) VectorStar ME7838D Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00778 (For 70 kHz to 145 GHz) VectorStar ME7838E Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00767 (For 70 kHz to 110 GHz)

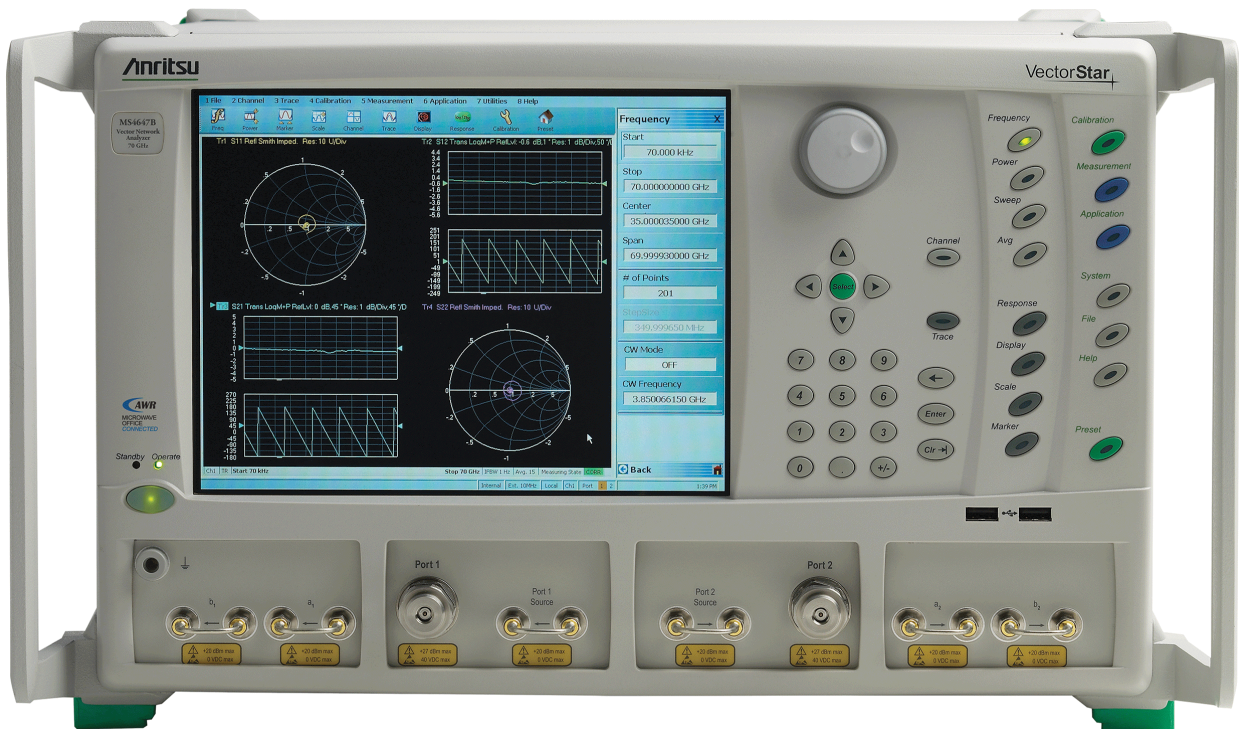
CPU, OS, Memory, and Security Features

| | |
|---------|--|
| CPU | Intel Core™ i5 |
| O/S | The Microsoft® Windows® 7 operating system on the MS4640B Series VNA is configured for optimum performance when the instrument leaves the factory. |
| Display | 26.4 cm (10.4") Color XGA Touch-Screen Display |
| Storage | Serial-ATA (SATA) Solid State Drive (SSD), for OS, Programs, and Data. (> 30 GB) |

Security Features

| | |
|----------------------------------|--|
| Display Blanking | For security, VectorStar™ software can obscure frequencies displayed on the system UI. |
| Removable Internal Drive | Rear Panel accessible Solid State Drive (SSD) is quickly removable and easy to secure. |
| Option 4 Spare SSD | A bootable SSD module is available as a spare for VectorStar units used in multiple or compartmentalized locations. The VectorStar's operating system and software are pre-installed on each Option 4 SSD. |
| Virus Protection, Best Practices | If the VNA is attached to a network, best practices recommend installing anti-virus software. |

Front Panel Connections



MS4640B Front Panel

Test Ports 1 and 2

| | |
|---------------------|--|
| Type | Universal Test Port Connectors, easily exchangeable in case of damage. |
| MS4642B and MS4644B | K (male) |
| MS4647B | V (male) |
| Damage Input Levels | +27 dBm maximum, 40 VDC maximum |

Direct Access Loops (optional)

| | |
|---------------------|---|
| Type | For Source, Test and Receive paths, 3 per port, for ≥ 2.5 GHz frequency coverage. |
| MS4642B and MS4644B | K (females) |
| MS4647B | V (females) |
| Damage Input Levels | +20 dBm maximum, 0 VDC maximum (+27 dBm maximum on source loop ports) |

| | |
|---|--|
| USB Ports | Four type A USB 2.0 Ports (two each on the front and rear panel) for peripherals such as keyboard, mouse, memory stick, hardware key, and similar devices. |
| Chassis Grounding Port | Banana (female) |
| Ports to Millimeter-Wave Test Set (optional) | Connector Type K (female) (LO1, and LO2 for RF; One with single source; Two with Option 31 Dual Source) |

Rear Panel Connections



MS4640B Series Rear Panel (with Option 35)

| | |
|---------------------------|--|
| AC Power Input | AC Input connector, with On/Off switch, and fuses 350 VA maximum, 90 to 264 VAC, 47 to 63 Hz (power factor controlled) |
| USB, PS/2, and LAN | <p>USB Control Port Type B USB 2.0 port for controlling the instrument externally, for remote operation</p> <p>USB Ports Two Type A USB 2.0 Ports for peripherals such as keyboard, mouse, memory stick, hardware key, etc. (Two more USB ports at the front panel)</p> <p>Keyboard and Mouse Ports Dedicated PS/2 ports.</p> <p>LAN Port 10/100BaseT Ethernet</p> |
| GPIB Ports | <p>GPIB Port (Talker/Listener) Type D-24, female, IEEE 488.2 compatible, for controlling the instrument externally, for remote operation.</p> <p>GPIB Port (Dedicated Controller) Type D-24, female, for the control of external instruments such as power meters, external test sets, and similar devices.</p> |
| External I/O Port | <p>Type 25-pin D-Sub, female, User-defined I/O for custom external test set interface, to synchronize with different sweep states, such as Start, Stop, Driven Port, and similar parameters.</p> <p>Pin 1 Limit Pass/Fail</p> <p>Pins 2, 3, 15, 16 TTL In</p> <p>Pins 4, 13 14, 21 GND</p> <p>Pins 5-12, 17-20, 22 TTL Out</p> <p>Pins 23-25 Reserved</p> |
| Serial Port | 9-pin D-Sub, male, compatible with RS-232, provides control for AutoCal modules and similar devices. |

| | | |
|-------------------------------|---|--|
| VGA Port | | 15-pin mini D-Sub, for simultaneously projecting the instrument's screen display onto an external VGA monitor, with 1024 x 768 minimum resolution. |
| Bias Inputs | Optional Bias Inputs Bias Fuses | Requires Active Measurement Suite, Option 61 or 62 BNC (female), one per port 0.5 A, 250 V, one per port |
| Direct Access Loops | Description Required Options Connector Type Damage Input Levels | For Source, Test, and Receive paths, 3 per port, for < 2.5 GHz frequency coverage. Option 51, 61, or 62 SMA (female) +20 dBm maximum, 0 VDC maximum (+27 dBm maximum on source loop ports) |
| IF Inputs/Outputs | Connector Type Inputs Outputs Nominal Inputs Nominal Outputs | a_1, a_2, b_1, b_2 , IF Inputs/Outputs SMA (female) Inputs used with external converters such as millimeter-wave modules, or for antenna testing. (Requires Option 08x) Outputs used with external IF digitizers and processors. (Used for service.) 5 to 200 MHz (mode dependent), 0 dBm for full scale 0.2 to 200 MHz (mode dependent), +10 dBm maximum |
| 10 MHz In | Connector Type Signal | Signal presence is auto-sensing (better than 1000 ppm frequency accuracy is recommended). BNC (female) -10 dBm to +3 dBm, 50 Ω Nominal |
| 10 MHz Out | Connector Type Signal | Derived from the internal reference, unless an external 10 MHz reference input is applied. BNC (female) 0 \pm 5 dBm sinusoidal, 50 Ω Nominal |
| Analog In 1 and 2 | Connector Type Range Accuracy Nominal Input Impedance | Two independent inputs for measurements simultaneous with the RF measurements, for current sensing, efficiency computation, power detection, and similar parameters. BNC (female) -10 V to +10 V with automatic offset and gain calibrations 2 mV + 2 % for $ V < 5$ V; 2 % for $ V > 5$ V 60 k Ω |
| Ext In ALC 1 and ALC 2 | Optional Connector Type | For external automatic level control of the internal signal source generators. The input assumes 0 V represents no RF power and a larger negative value represents increasing RF power. The maximum range is 0 to -1.3V. ALC 1 is available with Option 53/80/81/82/83/86/87 ALC 1 and ALC 2 are both available with Options 31 and 53/84/85/88/89 BNC (female) |
| Ext Analog Out | Connector Type Normal Operating Modes Range Accuracy | For external attenuator control, external switch control, analog triggering assistance, measurement system integration, and other purposes. BNC (female) Sawtooth synch sweep, TTL indication of driving port, open loop level controller -10 V to +10 V; low impedance drive 20 mV + 2 % (Load: > 5 k Ω) |
| Ext Trigger | Connector Type Voltage Input Impedance Pulse Width Edge Trigger | BNC (female) 0 to 3.3 V input (5 V tolerant) Low threshold = 0.8 V High threshold = 2 V High impedance (> 100 k Ω) 100 ns minimum input pulse width Programmable edge trigger |
| Lock Status | Connector Type Voltage Input Impedance Pulse Width Edge Trigger | BNC (female) 0 to 3.3 V input (5 V tolerant) Low threshold = 0.8 V High threshold = 2 V High impedance (> 100 k Ω) 100 ns minimum input pulse width Positive-edge trigger |

Ready for Trigger

| | |
|----------------|---|
| Connector Type | BNC (female) |
| Voltage Input | 0 to 3.3 V latched output |
| Impedance | Low impedance (approximately 50 Ω) |
| Voltage | $V_{(output\ high)} = 2\ V\ min\ @\ -12\ mA$ $V_{(output\ low)} = 0.8\ V\ max\ @\ +12\ mA$ |

Trigger Out

| | |
|----------------|---|
| Connector Type | BNC (female) |
| Voltage Output | 0 to 3.3 V pulse output 1 μs positive pulse |
| Voltage | $V_{(output\ high)} = 2\ V\ min\ @\ -12\ mA$ $V_{(output\ low)} = 0.8\ V\ max\ @\ +12\ mA$ |
| Impedance | Low impedance (approximately 50 Ω) |

Pulse Generator Outputs All values listed are nominal.

| | |
|-------------------------|--|
| Optional | Requires Option 35 and 42 PulseView™ |
| Connector Type | SMA (female) |
| Pulse Generator Outputs | P GEN 1, P GEN 2, P GEN 3, and P GEN 4 |
| Voltage | High: 3.3 V ± 10 % Low: < 1 V |
| Drive Impedance | Low impedance (approximately 50 Ω) |
| Load Impedance | 50 Ω or higher impedance |

Pulse Synch Input All values listed are nominal.

| | |
|----------------|--|
| Optional | Requires Option 35 and 42 PulseView™ |
| Connector Type | SMA (female) |
| Voltage Input | High threshold: 2.2 V Low threshold: 1 V |
| Signal | 5.5 VDC damage level |
| Latency | 55 ns delay from received synch to T_0 (typical) |
| Impedance | High impedance input |

Pulse Synch Output All values listed are nominal.

| | |
|-----------------|--|
| Optional | Requires Option 35 and 42 PulseView™ |
| Connector Type | SMA (female) |
| Voltage Output | High: 3.3 V ± 10 % Low: < 1 V |
| Signal | 5.5 VDC damage level |
| Latency | < 5 ns delay from T_0 to providing an external synch (typical) |
| Drive Impedance | Low impedance (approximately 50 Ω) |
| Load Impedance | 50 Ω or higher impedance |

Mechanical and Environmental

Dimensions

| | |
|--------|---|
| | Dimensions listed are for the instrument without rack mount option (MS4640B-001) attached. |
| Height | 267 mm body (6U) 286 mm between feet outer edges |
| Width | 426 mm body 457 mm between feet outer edges 487 mm between front panel handle outer edges |
| Depth | 502 mm body 591 mm between handle and foot outer edges |

Weight

< 30 kg (< 66 lb) (typical weight for a fully-loaded MS4647B VNA)

Environmental – Operating

| | |
|-------------------|---|
| Specification | Conforms to MIL-PRF-28800F (class 3) |
| Temperature Range | 0 °C to +50 °C without error codes Except for 'unleveled' error messages that may occur at the extreme edges of the temperature range. |
| Relative Humidity | 5 % to 90 % at +30 °C, Non-condensing |
| Altitude | 4,600 m (15,000 ft) |

Environmental – Non-Operating

| | |
|-------------------|---------------------------------------|
| Temperature Range | -40 °C to +71 °C |
| Relative Humidity | 0 % to 95 % at +30 °C, Non-condensing |
| Altitude | 4,600 m (15,000 ft) |

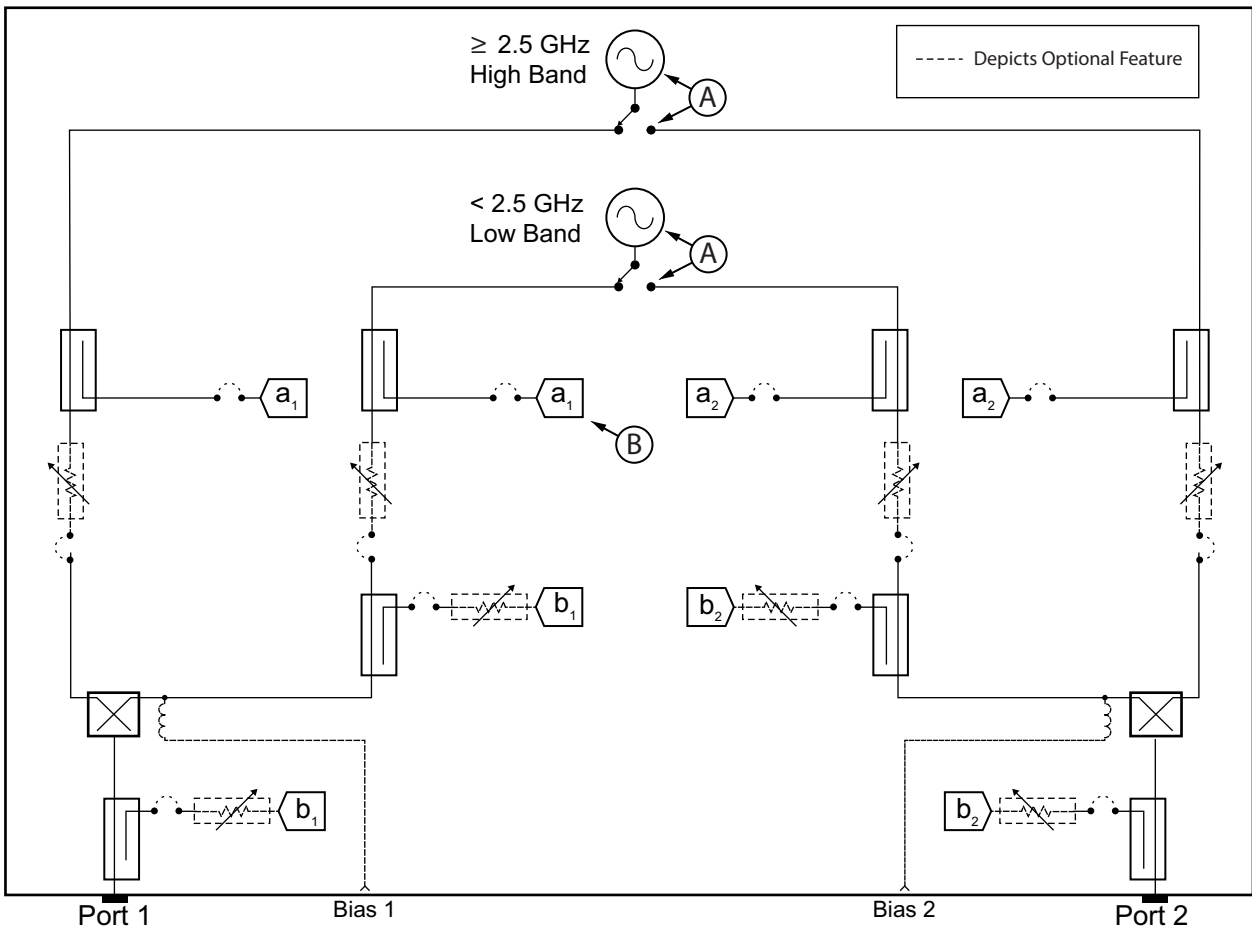
Regulatory Compliance

| | |
|---------------------------|---|
| European Union | EMC 2014/30/EU, EN 61326:2013, CISPR 11/EN 55011, IEC/EN 61000-4-2/3/4/5/6/8/11 Low Voltage Directive 2014/35/EU Safety EN 61010-1:2010 RoHS Directive 2011/65/EU applies to instruments with CE marking placed on the market after July 22, 2017. |
| Australia and New Zealand | RCM AS/NZS 4417:2012 |
| South Korea | KCC-REM-A21-0004 |

Warranty

| | |
|---------------------------------|---|
| Instrument and Built-In Options | 3 years from the date of shipment (standard warranty) |
| Calibration Kits | Typically 1 year from the date of shipment |
| Test Port Cables | Typically 1 year from the date of shipment |
| Additional Warranty Options | Additional warranty available |

Block Diagram



- A. With Option 31 Dual Source Architecture, second low-band and high-band sources are added and the two switches are removed. One set of sources is dedicated to each of the VNA test port paths.
- B. With Option 35 IF Digitizer, high speed digitizers are added to the receiver paths (a1, b1, a2, b2) for fast IF detection.
- C. With Option 32, Internal RF Combiner (requires Option 31 Dual Source Architecture) a switch is added that can redirect the source 2 drive signal over to a coupler embedded in the source 1 path. Option 32 adds a switch in the source 2 path after the source attenuator (after the source loop). The switch output is connected to a coupler at the input to the Port 1 test coupler. Thus two tones (one from source 1 and one from source 2) can be delivered to port 1.

MS4640B Series VNA Block Diagram – Fully Loaded Configuration

MN4765B O/E Calibration Module

The MN4765B is a characterized, unamplified photodiode module. It is used as an optical receiver with the Anritsu MS4640B Series VectorStar™ VNAs to perform highly accurate and stable optoelectronic measurements of both modulators (E/O) and photoreceivers (O/E). Model MN4765B is the base calibration module part number only. Customers are required to also order an option to configure the bandwidth and wavelength coverage. These options consist of an InGaAs photodiode that converts modulated optical signals to electrical signals, and includes additional circuitry for temperature and bias stability. For more details on the MN4765B module, see the Technical Data Sheet 11410-00843.



MN4765B O/E Calibration Module

| Configuration Option | Description | Additional Information | Part Number |
|----------------------|---|------------------------|--------------|
| 40 | 70 kHz to 40 GHz range, with 850 wavelength coverage | RF Out K (male) | MN4765B-0040 |
| 42 | 70 kHz to 40 GHz range, with 850 and 1060 nm wavelength coverage | RF Out K (male) | MN4765B-0042 |
| 43 | 70 kHz to 40 GHz range, with 850/1060/1310/1550 nm wavelength coverage | RF Out K (male) | MN4765B-0043 |
| 70 | 70 kHz to 70 GHz range, with 1550 nm wavelength coverage. | RF Out V (male) | MN4765B-0070 |
| 71 | 70 kHz to 70 GHz range, with 1310 nm wavelength coverage. | RF Out V (male) | MN4765B-0071 |
| 72 | 70 kHz to 70 GHz range, with 1310 and 1550 nm wavelength coverage. | RF Out V (male) | MN4765B-0072 |
| 110 | 70 kHz to 110 GHz range, with 1550 nm wavelength coverage. | RF Out W1 (male), 1 mm | MN4765B-0110 |
| Calibration Option | Description | | Part Number |
| 98 | Standard Calibration – Includes Certificate of Calibration | | MN4765B-0098 |
| 99 | Premium Calibration – Includes Certificate of Calibration and Test Data | | MN4765B-0099 |

MN4765B O/E Calibration Module Features

| | |
|---------------------------------|---|
| Fast and Accurate Measurements | The MS4640B Series VectorStar series VNAs, when calibrated using the MN4765B module, enable error-corrected Transfer Function, Group Delay, and Return Loss measurements of E/O, O/E, and O/O components and subsystems. |
| National Institute of Standards | Magnitude and phase characterization is obtained either using a primary standard characterized by NIST or other National Metrology Institutes and held by the Anritsu calibration lab, or based on model transfer and interpolation from primary-derived characterizations at other wavelengths. The magnitude and phase data is provided on a USB drive with the module. |
| Temperature Stable | The MN4765B is thermally stabilized to eliminate drift in photodiode performance over temperature. |
| Internal Biasing | Accurate bias voltage to the photodiode is maintained internally. An external, multi-country, AC adapter is included for easy operation. |
| High Linearity | Linear operating range to +6 dBm for transfer function measurement uncertainties of: < 0.5 dB at 40 GHz (typical specifications for MN4765B-0043 at 1550 or 1310 nm) < 1 dB at 40 GHz (typical specifications for MN4765B-004x at 850 nm) < 2 dB at 40 GHz (typical specifications for MN4765B-0042 and MN4765B-0043 at 1060 nm) < 0.45 dB at 50 GHz and < 0.7 dB at 70 GHz (typical spec for MN4765B-0070 and MN4765B-0072 at 1550nm) < 0.35 dB at 40 GHz and < 1 dB at 70 GHz (typical spec for MN4765B-0071 and MN4765B-0072 at 1310 nm) < 0.5 dB at 70 GHz and < 0.75 dB at 110 GHz (typical specifications for MN4765B-0110) |
| High Responsivity | > 0.2 A/W for MN4765B-0040 (850 ± 20 nm) (typical specification) > 0.2 A/W for MN4765B-0042 (850 ± 20 nm), > 0.6 A/W (1060 ± 20 nm) (typical specification) > 0.2 A/W for MN4765B-0043 (850 ± 20 nm), >0.6 A/W (1060 ± 20 nm), >0.7 A/W (1310 ± 20 nm), and > 0.8 A/W (1550 nm ± 20 nm) (typical specification) > 0.7 A/W for MN4765B-0070 (typical specification) > 0.45 A/W for MN4765B-0071 (typical specification) > 0.45 A/W for MN4765B-0072 at 1310 nm (typical specification) > 0.65 A/W for MN4765B-0072 at 1550 nm (typical specification) > 0.5 A/W for MN4765B-0110 (typical specification) |

MN4765B O/E Calibration Module (continued)

MN4765B O/E Calibration Module General and Environmental

| | |
|------------------------|---|
| Optical Input | FC/APC |
| Dimensions | 33 H x 51 W x 127 D mm (1.3 H x 2.0 W x 5.0 D in) |
| AC Adapter | 100 V to 240 V (50 Hz to 60 Hz) input, +12 VDC output |
| Power LED | On when the AC adapter is plugged in and the internal photodiode is properly biased |
| Operate LED | On when the module's internal temperature has stabilized at an optimum temperature for accurate calibrations and measurements |
| Calibrated Temperature | 23 °C ± 3 °C |
| Operating Temperature | 18 °C to 28 °C |
| Storage Temperature | -20 °C to 70 °C (-15 °C to 60 °C for -004x) |
| Relative Humidity | 5 % to 95 % |
| EMI | Conforms to and meets the requirements of the following: |
| EMC Directive | Conforms to the EMC Directive, 2004/108/EC per EN 61326-1:2013 |
| Low Voltage Directive | 2006/95/EC |
| Emissions | EN 55011:2009 +A 1:2010 Group 1 Class A |
| Immunity | EN61000-4-2/3/4/5/6/11 |

36585-Series Automatic Calibrators (AutoCal)

The 36585-Series Precision Automatic Calibrator (AutoCal) Module provides industry-leading performance in corrected characteristics using over-determined algorithms, and transferring characteristics from a highly accurate LRL type calibration. The resulting accuracies will even out perform a Sliding Load SOLT calibration. In order to remove the effects of matched adapters, the Precision 36585-Series AutoCal comes in a variety of connector gender types (m-m, f-f, and m-f). Adapter Removal Calibration routine is still available in the VectorStar software. With coverage from 70 kHz to 70 GHz, the 36585-series Precision AutoCal offers not only the fastest and most reliable calibration, but also the most accurate broadband coaxial VNA calibration method.



36585V Series Precision AutoCal Module

36585 Series Precision AutoCal Calibration Kit

| Description | Additional Information | Part Number |
|--|--------------------------|-------------|
| Precision AutoCal, K 70 kHz to 40 GHz, 2-port | K (male) to K (male) | 36585K-2M |
| | K (female) to K (female) | 36585K-2F |
| | K (male) to K (female) | 36585K-2MF |
| Precision AutoCal, V 70 kHz to 70 GHz, 2-port | V (male) to V (male) | 36585V-2M |
| | V (female) to V (female) | 36585V-2F |
| | V (male) to V (female) | 36585V-2MF |

AutoCal General and Environmental

| | |
|-------------------------|--|
| 36581-Series Dimensions | 65 mm H x 155 mm W x 90 mm D body (excluding connectors) |
| 36585-Series Dimensions | 42 mm H x 64 mm W x 140 mm D body (excluding connectors) |
| Control | Serial RS-232 control by the VNA via supplied 9-pin D-Sub cable (allowing forward-compatibility to legacy AutoCal) |
| Power | DC powered via supplied universal 110/220 V AC/DC adapter (with enough power to maintain optimum stability) |
| Operating Temperature | 18 to 28 °C |
| Storage Temperature | -20 to 70 °C |
| Relative Humidity | 5 % to 95 % at 40 °C, Non-condensing |
| EMI | Conforms to and meets the requirements of: |
| EMC Directive | 2004/108/EC |
| Low Voltage Directive | 2006/95/EC |
| Emissions | EN55011:2009+A1:2010 Group 1 Class A |
| Immunity | EN 61000-4-2:2009, 4 kV CD, 8 kV AD EN 61000-4-3:2006+A2:2010, 3 V/m EN 61000-4-4:2004, 0.5 kV S-L, 1 kV P-L EN 61000-4-5:2006, 0.5 kV S-L, 1 kV L-E EN 61000-4-6:2009, 3 V EN 61000-4-11:2004, 100 % @ 20 ms |

Mechanical Calibration Kits

SMA/3.5 mm Calibration Kit, 3650A Series

3650A cal kit provides 50 Ω calibrations for 3.5 mm or SMA devices using 3.5 mm standards. 3650A-1 cal kit includes Sliding Loads.

| 3650A Cal Kit contains: | Additional Information (typical) | Quantity | Part Number |
|---|--|-----------------|--------------------|
| Termination 3.5 mm (male) | Return Loss: > 37 dB (F \leq 18.5 GHz) | 2 | 28S50-2 |
| Termination 3.5 mm (female) | > 30 dB (F > 18.5 GHz) | 2 | 28SF50-2 |
| Open 3.5 mm (male) | Offset: 5 mm | 1 | 24S50 |
| Open 3.5 mm (female) | Offset: 5 mm | 1 | 24SF50 |
| Short 3.5 mm (male) | Offset: 5 mm | 1 | 23S50 |
| Short 3.5 mm (female) | Offset: 5 mm | 1 | 23SF50 |
| Adapter, 3.5 mm (male) to 3.5 mm (male) | | 1 | 33SS50 |
| Adapter, 3.5 mm (female) to 3.5 mm (female) | | 2 | 33SFSF50 |
| Adapter, 3.5 mm (male) to 3.5 mm (female) | | 2 | 33SSF50 |
| Torque Wrench | 5/16 in, 0.9 N·m (8 lbf·in) | 1 | 01-201 |
| Wrench, Universal | For SMA, 3.5 mm, 2.4 mm, K and V Connectors | 1 | 01-204 |
| Pin Depth Gauge | | 1 | 01-222 |
| Adapter (female) for Pin Gauge | | 1 | 01-223 |
| Reference Flat | | 1 | 01-210 |
| Connector Thumb Wheel | | 4 | A18311 |
| Coefficients for standards | Provided on a memory device and 3.5 in floppy disk | 1 | - |
| 3650A-1 Cal Kit adds: | Additional Information (typical) | Quantity | Part Number |
| Sliding Termination 3.5 mm (male) | | 1 | 17S50 |
| Sliding Termination 3.5 mm (female) | | 1 | 17SF50 |
| Flush Short (male) | | 1 | 01-211 |
| Flush Short (female) | | 1 | 01-212 |

K (2.92 mm) Calibration Kit, 3652A Series

3652A cal kit provides 50 Ω calibrations for K devices.

| 3652A Cal Kit contains: | Additional Information (typical) | Quantity | Part Number |
|-----------------------------------|--|-----------------|--------------------|
| Termination K (male) | Return Loss: > 34 dB (F \leq 18.5 GHz) | 2 | 28K50A |
| Termination K (female) | > 32 dB (F \leq 40 GHz) | 2 | 28KF50A |
| Open K (male) | Offset: 5 mm | 1 | 24K50 |
| Open K (female) | Offset: 5 mm | 1 | 24KF50 |
| Short K (male) | Offset: 5 mm | 1 | 23K50 |
| Short K (female) | Offset: 5 mm | 1 | 23KF50 |
| Adapter, K (male) to K (male) | | 1 | 33KK50B |
| Adapter, K (female) to K (female) | | 2 | 33KFKF50B |
| Adapter, K (male) to K (female) | | 2 | 33KKF50B |
| Torque Wrench | 5/16 in, 0.9 N·m (8 lbf·in) | 1 | 01-201 |
| Wrench, Universal | For SMA, 3.5 mm, 2.4 mm, K, and V Connectors | 1 | 01-204 |
| Pin Depth Gauge | | 1 | 01-222 |
| Adapter (female) for Pin Gauge | | 1 | 01-223 |
| Reference Flat | | 1 | 01-210 |
| Connector Thumb Wheel | | 4 | A18311 |
| Coefficients for standards | Provided on a USB memory device and 3.5 in floppy disk | 1 | - |

Mechanical Calibration Kits (continued)

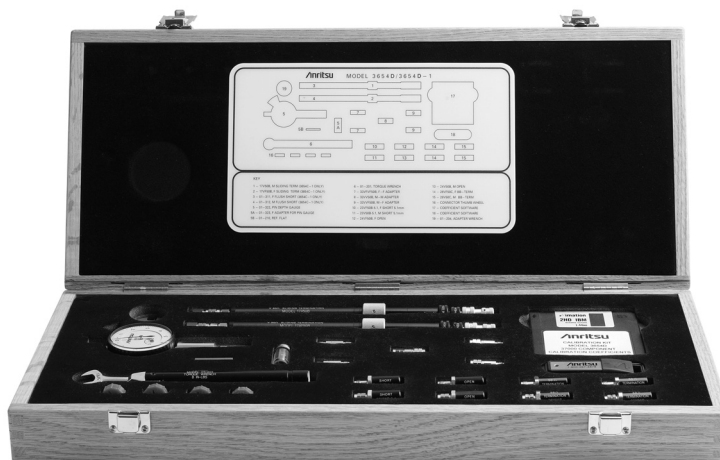
K (2.92 mm) Calibration Kit, 3652A Series (continued)

| | : Additional Information (typical) | Quantity | Part Number |
|--|------------------------------------|----------|-------------|
| 3652A-2 Cal Kit adds: | | | |
| No Additional Options | | NA | NA |
| Removes Pin Depth Gauge | | NA | 01-222 |
| Removes Female Adapter for Pin Depth Gauge | | NA | 01-223 |
| Removes Reference Flat | | NA | 01-210 |
| 3652A-3 Cal Kit adds: | | | |
| .s1p Characterization | | 1 | NA |
| 3652A-4 Cal Kit adds: | | | |
| .s1p Characterization | | 1 | NA |
| Removes Pin Depth Gauge | | NA | 01-222 |
| Removes Female Adapter for Pin Depth Gauge | | NA | 01-223 |
| Removes Reference Flat | | NA | 01-210 |

V (1.85 mm) Calibration Kit, 3654D Series

3654D cal kit provides 50 Ω calibrations for V devices.

| | 3654D Cal Kit contains: | Additional Information (typical) | Quantity | Part Number |
|--|--|--|-----------------|--------------------|
| | Termination V (male) | Return Loss: > 40 dB (F ≤ 20 GHz); > 35 dB (F ≤ 40 GHz) | 2 | 28V50D |
| | Termination V (female) | > 32 dB (F ≤ 67 GHz); > 28 dB (F ≤ 70 GHz) | 2 | 28VF50D |
| | Open V (male) | Offset: 4.75 mm | 1 | 24V50C |
| | Open V (female) | Offset: 4.75 mm | 1 | 24VF50C |
| | Short V (male) | Offset: 5.1 mm | 1 | 23V50C |
| | Short V (female) | Offset: 5.1 mm | 1 | 23VF50C |
| | Adapter, V (male) to V (male) | | 1 | 33VV50C |
| | Adapter, V (female) to V (female) | | 2 | 33VVF50C |
| | Adapter, V (male) to V (female) | | 2 | 33VVF50C |
| | Torque Wrench | 5/16 in, 0.9 N-m (8 lbf-in) | 1 | 01-201 |
| | Wrench, Universal | For SMA, 3.5 mm, 2.4 mm, K, and V Connectors | 1 | 01-204 |
| | Pin Depth Gauge | | 1 | 01-322 |
| | Adapter (female) for Pin Gauge | | 1 | 01-323 |
| | Reference Flat | | 1 | 01-210 |
| | Connector Thumb Wheel | | 4 | A18311 |
| | Coefficients for standards | Provided on a USB memory device and 3.5 in floppy disk | 1 | - |
| | 3654D-2 Cal Kit adds: | | Quantity | Part Number |
| | No Additional Options | | NA | NA |
| | Removes Pin Depth Gauge | | NA | 01-322 |
| | Removes Female Adapter for Pin Depth Gauge | | NA | 01-323 |
| | Removes Reference Flat | | NA | 01-210 |
| | 3654D-3 Cal Kit adds: | | Quantity | Part Number |
| | .s1p Characterization | | 1 | NA |
| | 3654D-4 Cal Kit adds: | | Quantity | Part Number |
| | .s1p Characterization | | 1 | NA |
| | Removes Pin Depth Gauge | | NA | 01-322 |
| | Removes Female Adapter for Pin Depth Gauge | | NA | 01-323 |
| | Removes Reference Flat | | NA | 01-210 |



3654D Series, V (1.85 mm) Calibration Kit

V (1.85 mm) Multi-Line Calibration Kit, 3657 Series

The 3657 Calibration Kit provides 50 Ω beadless V (male to male) lines for metrology applications. The 3657-1 Calibration Kit includes Shorts for LRL-type coaxial calibrations.

| 3657 Cal Kit contains: | | Additional Information (typical) | | Quantity | Part Number |
|---|------------------------------------|---|--|-----------------|--------------------|
| Line 1 | Electrical Length = 15 mm; 50 Ω | Center Conductor | | 1 | 65899-1 |
| | | Outer Conductor | | 1 | 65898-1 |
| Line 2 | Electrical Length = 16.7 mm; 50 Ω | Center Conductor | | 1 | 65899-2 |
| | | Outer Conductor | | 1 | 65898-2 |
| Line 3 | Electrical Length = 18.4 mm; 50 Ω | Center Conductor | | 1 | 65899-3 |
| | | Outer Conductor | | 1 | 65898-3 |
| Line 4 | Electrical Length = 20.1 mm; 50 Ω | Center Conductor | | 1 | 65899-4 |
| | | Outer Conductor | | 1 | 65898-4 |
| Line 5 | Electrical Length = 21.8 mm; 50 Ω | Center Conductor | | 1 | 65899-5 |
| | | Outer Conductor | | 1 | 65898-5 |
| Line 6 | Electrical Length = 49.84 mm; 50 Ω | Center Conductor | | 1 | 65899-6 |
| | | Outer Conductor | | 1 | 65898-6 |
| Tool, Center Conductor Removal Plug | | | | 1 | 65922 |
| Fixture, Center Conductor Installation, Short | | For Lines 1 to 5 | | 1 | 65901-1 |
| Fixture, Center Conductor Installation, Long | | For Line 6 | | 1 | 65901-6 |
| Open-Ended Wrench | | 7 mm | | 1 | 783-1243 |
| Torque Wrench | | 5/16 in, 0.9 N·m (8 lbf·in) | | 1 | 01-201 |
| 3657-1 Cal Kit adds: | | Additional Information (typical) | | Quantity | Part Number |
| Short V (male) | | Offset: 5.1 mm | | 2 | 23V50B |
| Short V (female) | | Offset: 5.1 mm | | 2 | 23VF50B |



3657 Series, V (1.85 mm) Multi-Line Calibration Kit

Verification Kits

Verification kits include characterized traceable standards (two attenuators, an airline, and a stepped impedance airline Beatty Standard) that can be used with the provided Performance Verification Software (PVS) and data to verify the calibration and resulting performance of your VNA.

The applicable calibrations are Short-Open-Load-Through (SOLT) with and without Sliding Loads for the 3666-1, 3668-1, and 3669B-1 Verification Kits. The verification kits are used with the 365x and 365x-1 Cal Kits, and 36585x Series AutoCal, male-female version. Cal Kits and AutoCal are purchased separately. These verification kits are dedicated for the MS4640B Series VNAs, and are not for older VNAs.

Verification is also provided as a service, eliminating the investment in kits.

VectorStar MS4640B VNA Verification Kits

| | |
|---------|---------------------------------------|
| 3666-1 | SMA/3.5 mm Connector Verification Kit |
| 3668-1 | K Connector Verification Kit |
| 3669B-1 | V Connector Verification Kit |



366X-X Verification Kit



Precision Adapters, Attenuators, and More

Precision Adapters, Attenuators, and Other Components

Anritsu carries a complete line of precision adapters and attenuators. For more information, please visit our web site at www.anritsu.com.

Test Port Cables

3670-Series Test Port Cables, Ruggedized Semi-Rigid, up to 70 GHz

Note: Connector torque for 3670-Series cables is 8 lbf-in (0.9 N·m).

| Description | Frequency Range | Nominal Impedance | Insertion Loss (dB, typical) | Return Loss (dB, typical) | Length | Part Number |
|------------------------|-----------------|-------------------|------------------------------|---------------------------|-----------------|-------------|
| K (female) to K (male) | DC to 40 GHz | 50 Ω | 2.3 dB/m @ 20 GHz | ≥ 16 | 30.5 cm (12 in) | 3670K50-1 |
| | | | 4.7 dB/m @ 40 GHz | | 61.0 cm (24 in) | 3670K50-2 |
| V (female) to V (male) | DC to 70 GHz | 50 Ω | 3.6 dB/m @ 20 GHz | ≥ 16 | 30.5 cm (12 in) | 3670V50A-1 |
| | | | 5.2 dB/m @ 40 GHz | | 61.0 cm (24 in) | 3670V50A-2 |
| | | | 7.2 dB/m @ 70 GHz | | | |



70 GHz Phase Stable Flexible Test Port Cables, 3671-Series



70 GHz Ruggedized Semi-Rigid Test Cables, 3670-Series

3671-Series Test Port Cables, Flexible, Phase Stable, up to 70 GHz

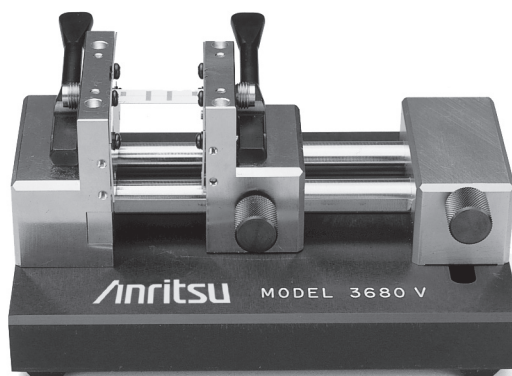
Note: Connector torque for 3671-Series cables is 8 lbf-in (0.9 N·m).

| Description | Frequency Range | Nominal Impedance | Insertion Loss (dB, f in GHz) | Return Loss (dB) | Phase Stability (± degrees, f in GHz) | Length | Part Number |
|----------------------------------|-----------------|-------------------|-------------------------------|------------------|---------------------------------------|------------------|---------------|
| K (female) to 3.5 mm (male) | DC to 26.5 GHz | 50 Ω | ≤ 1.8 | ≥ 18 | ≤ ± 4.0 (1 coil) | 60 cm (23.5 in) | 3671KFS50-60 |
| K (female) to K (male or female) | DC to 40 GHz | 50 Ω | ≤ 3.4 | ≥ 16 | ≤ ± 3.7 (1/2 coil) | 60 cm (23.5 in) | 3671KFK50-60 |
| K (female) to K (male) | DC to 40 GHz | 50 Ω | ≤ 5.0 | ≥ 16 | ≤ ± 7.3 (1 coil) | 100 cm (39.3 in) | 3671KFK50-100 |
| K (female) to K (female) | DC to 40 GHz | 50 Ω | ≤ 3.4 | ≥ 16 | ≤ ± 3.7 (1/2 coil) | 60 cm (23.5 in) | 3671KFKF50-60 |
| V (female) to V (male) | DC to 70 GHz | 50 Ω | ≤ 6.0 | ≥ 14 | ≤ ± 8.5 (1/2 coil) | 60 cm (23.5 in) | 3671VfV50-60 |
| V (female) to V (male) | DC to 70 GHz | 50 Ω | ≤ 9.3 | ≥ 14 | ≤ ± 10.5 (1 coil) | 100 cm (39.3 in) | 3671VfV50-100 |

Universal Test Fixture (UTF)

The 3680-series UTF provide an accurate, repeatable solution for measuring microstrip and coplanar substrate devices.

- Input and output connections are made to the substrate device by two spring-loaded jaws that include coax-to-microstrip/coplanar launchers.
- One jaw is movable in two dimensions to accommodate substrates of different lengths and offsets.
- Right angle launchers are available for right angle devices.
- Microstrip calibration/verification kits are available for substrate thicknesses of 10 mil (60 GHz), 15 mil (30 GHz), and 25 mil (20 GHz).
- A coplanar waveguide calibration/verification kit is also available.



3680 Series Universal Test Fixture (UTF)

UTF Electrical Specifications

| Type | Frequency Range (GHz) | Return Loss (dB) | Repeatability (dB) | Frequency Coverage | Part Number |
|----------------------|-----------------------|------------------|--------------------|--------------------|-------------|
| UTF | DC to 20 | > 17 | < 0.10 | DC to 20 GHz | 3680-20 |
| | 20 to 40 | > 14 | < 0.20 | DC to 40 GHz | 3680K |
| | 40 to 60 | > 8 | < 0.30 | DC to 60 GHz | 3680V |
| Right Angle Launcher | DC to 20 | > 16 | < 0.15 | DC to 40 GHz | 36801K |
| | 20 to 40 | > 12 | < 0.25 | DC to 60 GHz | 36801V |
| | 40 to 60 | > 7 | < 0.40 | | |

UTF General Information

| | |
|-----------------------------|--|
| Substrate Length | 3680-20, 0.5 cm (min) to 10 cm (max) 3680K, 0.5 cm (min) to 5 cm (max) 3680V, 0.5 cm (min) to 5 cm (max) |
| Maximum Substrate Width | All UTF models, No Limit |
| Substrate Thickness | All UTF models, 0.12 mm (min), 1.9 mm (max) |
| Maximum Line Offset | 3680-20, ± 2.5 cm 3680K, ± 1.2 cm 3680V, ± 1.2 cm |
| Input and Output Connectors | 3680-20, 3.5 mm (females) 3680K, K (females) 3680V, V (females) |
| Overall Size | All UTF models, 10 cm x 12.7 cm x 6.4 cm |

UTF Right Angle Launcher

| | |
|---|--|
| Distance from in-line connector, axial | All UTF models, 1 cm (min), 4 cm (max) |
| Distance from in-line connector, offset | All UTF models, 0 cm (min), 2 cm (max) |

Ordering Information

| | | |
|---|------------------------|---|
| Instrument Models | | The VectorStar MS4640B Series VNAs are available to meet different frequency range requirements. Refer to “Standard Capabilities” for extended operational frequency ranges. |
| | MS4642B | Vector Network Analyzer 70 kHz to 20 GHz (Minimum configuration requires one of Options 8 or 9) |
| | MS4644B | Vector Network Analyzer 10 MHz to 40 GHz |
| | MS4647B | Vector Network Analyzer 10 MHz to 70 GHz |
| Included Accessories | | Each VNA comes with a set of included accessories. |
| | User Documentation USB | The user documentation USB includes PDF files for the VectorStar Operation Manual, User Interface Reference Manual, Programming Manual, Programming Manual Supplement, Calibration and Measurement Guide, Technical Data Sheet and Configuration Guide, and Maintenance Manual. |
| | Online Help | The instrument is equipped with context-sensitive help built from the first five documents above. |
| | Peripherals | Optical USB Mouse |
| | Power | Power Cord |
| Main VNA Options | | |
| | MS4640B-001 | Rack Mount, adds handles and removes feet for shelf-mounting into a 19” universal rack |
| | MS4640B-002 | Time Domain |
| | MS4640B-004 | Additional Serial-ATA (SATA) Solid State Drive (SSD) with OS and VectorStar Application Software |
| | MS4640B-007 | Receiver Offset |
| | MS4642B-008 | Active Device Measurements, with 2 Step Attenuators |
| | MS4642B-009 | Active Device Measurements, with 4 Step Attenuators |
| | MS4640B-021 | Universal Fixture Extraction |
| | MS464xB-031 | Dual Source Architecture |
| | MS464xB-032 | Internal RF Combiner, requires Option 31 |
| | MS4640B-035 | IF Digitizer |
| | MS4640B-036 | Extended IF Digitizer Memory |
| | MS4640B-041 | Noise Figure, requires Option 51 or Option 61 or Option 62 |
| | MS4640B-042 | PulseView™, requires Option 35 |
| | MS4640B-043 | DifferentialView™ |
| | MS4640B-044 | IMDView™ |
| | MS4640B-046 | Fast CW, requires Option 35 |
| | MS4640B-047 | Eye Diagram, requires Option 2 |
| | MS4640B-048 | Differential Noise Figure, requires Option 51 or Option 61 or Option 62 |
| | MS464xB-051 | Direct Access Loops, see description below |
| | MS464xB-053 | External ALC |
| | MS464xB-061/062 | Active Measurement Suite options, see description below (or Option 8/9 for MS4642B) |
| | MS4640B-070 | 70 kHz Low-End Frequency Extension |
| Direct Access Loop Options | | Note: Direct access loops are not available for VNAs equipped with Option 61 or 62, which include loops. |
| | MS4644B-051 | Direct Access Loops for MS4644B, not available with Option 61 or 62 |
| | MS4647B-051 | Direct Access Loops for MS4647B, not available with Option 61 or 62 |
| Active Measurement Suite Options | | |
| | MS4642B-008 | Active Device Measurements, with 2 Step Attenuators |
| | MS4642B-009 | Active Device Measurements, with 4 Step Attenuators |
| | MS4644B-061 | Active Measurements Suite, For MS4644B, with 2 Step Attenuators |
| | MS4644B-062 | Active Measurements Suite, For MS4644B, with 4 Step Attenuators |
| | MS4647B-061 | Active Measurements Suite, For MS4647B, with 2 Step Attenuators |
| | MS4647B-062 | Active Measurements Suite, For MS4647B, with 4 Step Attenuators |
| Pulse Modulator Test Sets | | |
| | SM6628 | Pulse Modulator Test Set, 70 kHz to 40 GHz, for source modulation with an MS4642B or MS4644B |
| | SM6629 | Pulse Modulator Test Set, 70 kHz to 40 GHz, for source and receiver modulation with an MS4642B or MS4644B |
| | SM6630 | Pulse Modulator Test Set, 70 kHz to 70 GHz, for source modulation with an MS4647B |
| | SM6631 | Pulse Modulator Test Set, 70 kHz to 70 GHz, for source and receiver modulation with an MS4647B |
| Multipoint VNA Options | | |
| | | The multipoint VNA option provides four test ports for all VectorStar MS4640B Series VNAs with the MN469xC Series Multipoint Test Sets. The option provides the Test Set, necessary cabling, and installation documentation. The Test Set frequency range is limited to that of the attached VNA. |
| | MN4694C | 70 kHz to 40 GHz, Use the MN4694C Test Set with MS4642B and MS4644B VNAs |
| | MN4697C | 70 kHz to 70 GHz, Use the MN4697C Test Set with MS4647B VNAs |
| | Documentation | For detailed MN469xC specifications, refer to the VectorStar MN469xC Series Multipoint VNA Technical Data Sheet – 11410-00777 |

Broadband/Banded/Millimeter-Wave Systems For details on the MS464xB-08x series of options, see the:

VectorStar ME7838A Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00593
 VectorStar ME7838D Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00778
 VectorStar ME7838E Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00767
 VectorStar ME7838A4 4-Port Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00704

Calibration Options

| | |
|-------------|------------------------------------|
| MS4640B-097 | Accredited Calibration, With Data |
| MS4640B-098 | Z540/Guide 25 Calibration, No Data |
| MS4640B-099 | Premium Calibration, With Data |

OE Calibration Module

| | |
|--------------|---|
| MN4765B-0040 | Configured for 70 kHz to 40 GHz range, with 850 nm wavelength coverage |
| MN4765B-0042 | Configured for 70 kHz to 40 GHz range, with 850 and 1060 nm wavelength coverage |
| MN4765B-0043 | Configured for 70 kHz to 40 GHz range, with 850/1060/1310/1550 nm wavelength coverage |
| MN4765B-0070 | Configured for 70 kHz to 70 GHz range, with 1550 nm wavelength coverage |
| MN4765B-0071 | Configured for 70 kHz to 70 GHz range, with 1310 nm wavelength coverage |
| MN4765B-0072 | Configured for 70 kHz to 70 GHz range, with 1310 and 1550 nm wavelength coverage. |
| MN4765B-0110 | Configured for 70 kHz to 110 GHz range, with 1550 nm wavelength coverage. |

Precision Automatic Calibrator Modules (Precision AutoCal)

| | |
|------------|--|
| 36585K-2M | K Precision AutoCal Module, 70 kHz to 40 GHz, K (male) to K (male) |
| 36585K-2F | K Precision AutoCal Module, 70 kHz to 40 GHz, K (female) to K (female) |
| 36585K-2MF | K Precision AutoCal Module, 70 kHz to 40 GHz, K (male) to K (female) |
| 36585V-2M | V Precision AutoCal Module, 70 kHz to 70 GHz, V (male) to V (male) |
| 36585V-2F | V Precision AutoCal Module, 70 kHz to 70 GHz, V (female) to V (female) |
| 36585V-2MF | V Precision AutoCal Module, 70 kHz to 70 GHz, V (male) to V (female) |

Mechanical Calibration Kits

| | |
|---------|--|
| 3650A | SMA/3.5 mm Calibration Kit, Without Sliding Loads |
| 3650A-1 | SMA/3.5 mm Calibration Kit, With Sliding Loads |
| 3652A | K Calibration Kit, With Pin Depth Gauge |
| 3652A-2 | K Calibration Kit, With No Pin Depth Gauge |
| 3652A-3 | K Calibration Kit, With Pin Depth Gauge and .s1p Characterization Files |
| 3652A-4 | K Calibration Kit, With .s1p Characterization Files |
| 3654D | V Calibration Kit, With Pin Depth Gauge |
| 3654D-2 | V Calibration Kit With No Pin Depth Gauge |
| 3654D-3 | V Calibration Kit, With Pin Depth Gauge and .s1p Characterization Files |
| 3654D-4 | V Calibration Kit, With .s1p Characterization Files and No Pin Depth Gauge |
| 3657 | V Multi-Line Calibration Kit, Without Shorts |
| 3657-1 | V Multi-Line Calibration Kit, With Shorts |

Verification Kits

| | |
|---------|-----------------------------|
| 3666-1 | SMA/3.5 mm Verification Kit |
| 3668-1 | K Verification Kit |
| 3669B-1 | V Verification Kit |

External Power Meters/Sensors

| | |
|----------|--|
| ML243xA | CW Power Meter, Single Input or Dual Input Recommended Power Sensors: SC7770, MA247xD, MA244xD, MA248xD, MA2400xA |
| ML248xB | Wideband Power Meter, Single Input or Dual Input Recommended Power Sensors: MA249xA, MA2411B |
| ML249xA | Pulse Power Meter, Single Input or Dual Input Recommended Power Sensors: MA249xA, MA2411B |
| MA24106A | USB Power Sensor, 50 MHz to 6 GHz |
| MA24108A | USB Power Sensor, 10 MHz to 8 GHz |
| MA24118A | USB Power Sensor, 10 MHz to 18 GHz |
| MA24126A | USB Power Sensor, 10 MHz to 26 GHz |
| MA24208A | USB Power Sensor, True-RMS, 10 MHz to 8 GHz |
| MA24218A | USB Power Sensor, True-RMS, 10 MHz to 18 GHz |
| MA24330A | USB Power Sensor, 10 MHz to 33 GHz |
| MA24340A | USB Power Sensor, 10 MHz to 40 GHz |
| MA24350A | USB Power Sensor, 10 MHz to 50 GHz |
| MA24507A | Power Master™ Frequency Selectable mm-Wave Power Analyzer, 9 kHz to 70 GHz |
| MA24510A | Power Master™ Frequency Selectable mm-Wave Power Analyzer, 9 kHz to 110 GHz Note that usage of the MA24507A and MA24510A Power Master™ sensors require connection to two USB ports to supply needed current draw. |

Test Port Cables, Ruggedized Semi-Rigid

| | |
|------------|---|
| 3670K50-1 | Test Port Cable, K (female) to K (male), 1 each, 30.5 cm (12 in) |
| 3670K50-2 | Test Port Cable, K (female) to K (male), 1 each, 61.0 cm (24 in) |
| 3670V50A-1 | Test Port Cable, V (female) to V (male), 1 each, 30.5 cm (12 in), rated to 70 GHz |
| 3670V50A-2 | Test Port Cable, V (female) to V (male), 1 each, 61.0 cm (24 in), rated to 70 GHz |

Test Port Cables, Flexible, Ruggedized-Style Female Connectors, Phase Stable

Ruggedized style female connectors for VNA test ports.

| | |
|---------------|--|
| 3671KFS50-60 | K (female) to 3.5 mm (male), 1 each 63.5 cm (25 in) Note: Due to length, two (2) cables are required for each system |
| 3671KFK50-60 | K (female) to K (male), 1 each, 63.5 cm (25 in) Note: Due to length, two (2) cables are required for each system |
| 3671KFK50-100 | K (female) to K (male), 1 each, 96.5 cm (38 in) |
| 3671KFKF50-60 | K (female) to K (female), 1 each 63.5 cm (25 in) Note: Due to length, two (2) cables are required for each system |
| 3671KFK50-60 | K (female) to K (male), 1 each 63.5 cm (25 in) Note: Due to length, two (2) cables are required for each system |
| 3671VVF50-60 | V (female) to V (male), 1 each, 63.5 cm (25 in), rated to 70 GHz Note: Due to length, two (2) cables are required for each system |
| 3671VVF50-100 | V (female) to V (male), 1 each 96.5 cm (38 in), rated to 70 GHz |

Test Port Converters To change or replace VNA test ports.

| | |
|---------|--|
| 34YK50C | Universal Test Port Connector to K (male), Installation requires wrench 01-202 (not included) |
| 34YV50C | Universal Test Port Connector to V (male), Installation requires wrench 01-202 (not included) |
| 34YS50A | Universal Test Port Connector to 3.5 mm (male), Installation requires wrench 01-202 (not included) |
| 34YQ50A | Universal Test Port Connector to 2.4 mm (male), Installation requires wrench 01-202 (not included) |

Universal Test Fixture (UTF)

| | |
|------------|---|
| 3680-20 | UTF, DC to 20 GHz |
| 3680K | UTF, DC to 40 GHz |
| 3680V | UTF, DC to 60 GHz |
| 36801K | UTF Right Angle Launcher, DC to 30 GHz |
| 36801V | UTF Right Angle Launcher, DC to 50 GHz |
| 36803 | Bias Probe |
| 36804B-10M | Microstrip Calibration/Verification Kit, 10 mil, DC to 50 GHz |
| 36804B-15M | Microstrip Calibration/Verification Kit, 15 mil, DC to 30 GHz |
| 36804B-25M | Microstrip Calibration/Verification Kit, 25 mil, DC to 15 GHz |

Precision Fixed Attenuators, Adapters (in and out of series, waveguide to coaxial), and more

Refer to our extensive Precision RF & Microwave Components Catalog - 11410-00235

GPIB Cables

| | |
|--------|------------------------|
| 2100-5 | GPIB Cable, 0.5 m long |
| 2100-1 | GPIB Cable, 1 m long |
| 2100-2 | GPIB Cable, 2 m long |
| 2100-4 | GPIB Cable, 4 m long |

Transit Case

| | |
|-----------|--|
| 760-267-R | Transit Case, for all MS4640B Series VNAs, Hard plastic with wheels, 85 cm x 70 cm x 45 cm |
|-----------|--|

Tools

| | |
|--------|---|
| 01-201 | Torque End Wrench, 5/16 in, 0.9 N-m (8 lbf-in), For tightening male devices, For SMA, 3.5 mm, 2.4 mm, K, and V connectors. |
| 01-202 | Torque End Wrench, 1/2 in, 60 lbf-in, For servicing the universal test port, For the removal or installation of a test port. |
| 01-203 | Torque End Wrench, 20.6 mm (13/16 in), 0.9 N-m (8 lbf-in), For tightening the VNA test ports to female devices. |
| 01-204 | End Wrench, 5/16 in, Universal, Circular, Open-ended, For SMA, 3.5 mm, 2.4 mm, K and V connectors. |
| 01-504 | Torque End Wrench, 6 mm, 0.45 N-m (4 lbf-in), For tightening 1 mm connectors. |
| 01-505 | 6 mm x 7 mm Open End Wrench, Backing wrench for 6 mm torque wrench above for W1 connectors. |
| 01-511 | Torque End Wrench, 4 mm (5/32 in), 0.22 N-m (2 lbf-in), For tightening the SSMC TEST and REF connectors on 3743A Modules. |

Documentation

| | |
|--------------------------------|--|
| User Documentation: USB Device | Soft copies of the manuals as Adobe PDF files are included on the User Documentation USB Storage Device that is provided with the instrument. The Maintenance Manual PDF is available from Anritsu Customer Service. All other manuals available as free downloads at www.anritsu.com . Printed manuals in 3-ring binders are available for a nominal charge. |
| 10410-00317 | MS4640B Series VNA Operation Manual (OM) |
| 10410-00318 | MS4640B Series VNA Calibration and Measurement Guide (MG) |
| 10410-00319 | MS4640B Series VNA User Interface Reference Manual (UIRM) |
| 10410-00320 | MS4640B Series VNA Maintenance Manual (MM) |
| 10410-00322 | MS4640B Series VNA Programming Manual (PM), for IEEE 488.2, System, and SCPI Commands |
| 10410-00323 | MS4640B Series VNA Programming Manual Supplement (PMS), for Lightning 37xxxx and HP8510 Emulation |

Extended Service Options

Use the table below to select the service location, service period, type of service, and the VectorStar instrument model number.

| Service Location | Service Period | Type of Service | VNA Model | Part Number |
|------------------|----------------|---------------------------------|-----------|---------------|
| On-Site | 3 Years | Repair Only | MS4642B | MS4642B-ES311 |
| | | | MS4644B | MS4644B-ES311 |
| | | | MS4647B | MS4647B-ES311 |
| On-Site | 3 Years | Standard Calibration | MS4642B | MS4642B-ES314 |
| | | | MS4644B | MS4644B-ES314 |
| | | | MS4647B | MS4647B-ES314 |
| On-Site | 3 Years | Premium Calibration | MS4642B | MS4642B-ES318 |
| | | | MS4644B | MS4644B-ES318 |
| | | | MS4647B | MS4647B-ES318 |
| Service Center | 3 Years | Standard Calibration | MS4642B | MS4642B-ES312 |
| | | | MS4644B | MS4644B-ES312 |
| | | | MS4647B | MS4647B-ES312 |
| Service Center | 3 Years | Premium Calibration | MS4642B | MS4642B-ES315 |
| | | | MS4644B | MS4644B-ES315 |
| | | | MS4647B | MS4647B-ES315 |
| Service Center | 5 Years | Repair Only | MS4642B | MS4642B-ES510 |
| | | | MS4644B | MS4644B-ES510 |
| | | | MS4647B | MS4647B-ES510 |
| Service Center | 5 Years | Standard Calibration | MS4642B | MS4642B-ES512 |
| | | | MS4644B | MS4644B-ES512 |
| | | | MS4647B | MS4647B-ES512 |
| Service Center | 5 Years | Premium Calibration | MS4642B | MS4642B-ES515 |
| | | | MS4644B | MS4644B-ES515 |
| | | | MS4647B | MS4647B-ES515 |
| Service Center | 5 Years | Repair and Standard Calibration | MS4642B | MS4642B-ES513 |
| | | | MS4644B | MS4644B-ES513 |
| | | | MS4647B | MS4647B-ES513 |
| Service Center | 5 Years | Repair and Premium Calibration | MS4642B | MS4642B-ES516 |
| | | | MS4644B | MS4644B-ES516 |
| | | | MS4647B | MS4647B-ES516 |

Post-Delivery Upgrade Options

If your needs change, it's reassuring to know that your Anritsu product can grow with you. Contact your local Anritsu service center for adding internal options or increasing the frequency coverage of your existing MS4640B Series VNA.

Notes

Training at Anritsu

Anritsu has designed courses to help you stay up to date with technologies important to your job. For available training courses, visit: www.anritsu.com/training



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