VectorStar®

High Performance, Broadband Network Analysis Solutions

MS4640 Series Microwave Vector Network Analyzers

Introduction

This document provides the specifications for the MS4640A series microwave Vector Network Analyzers (VNAs) listed below, including all related options, and accessories.

Instrument Models and Operating Frequencies[a]

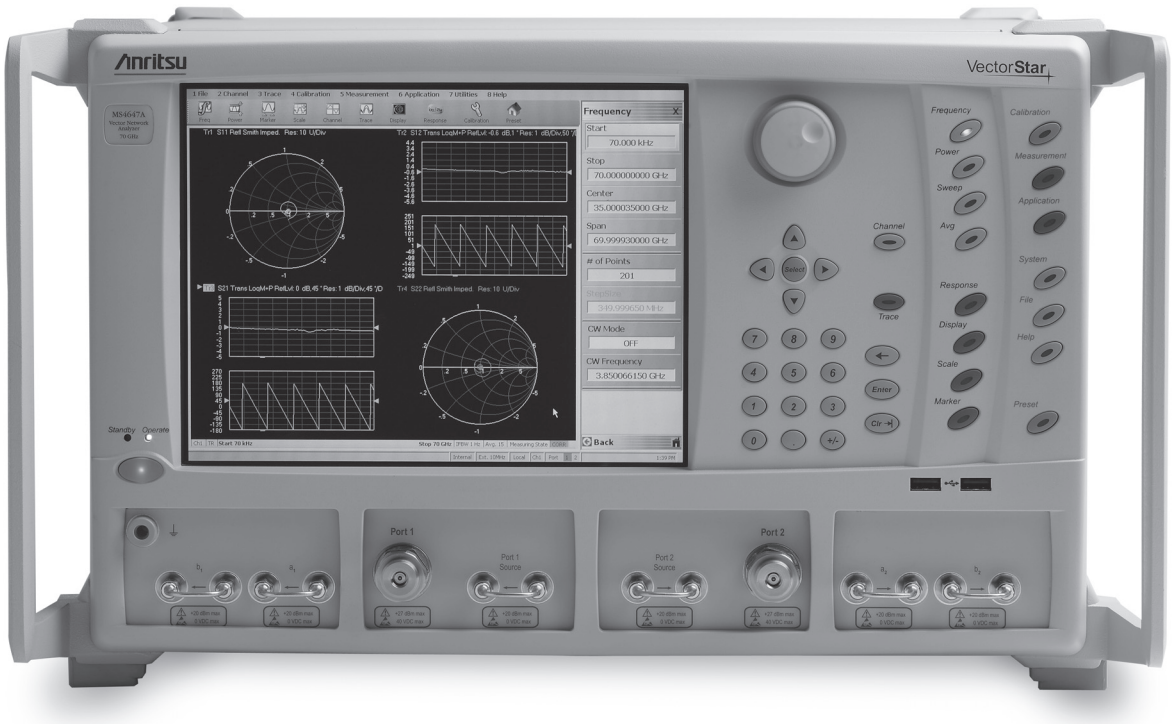
- MS4642A – 10 MHz to 20 GHz[a]
- MS4644A – 10 MHz to 40 GHz[a]
- MS4645A – 10 MHz to 50 GHz[a]
- MS4647A – 10 MHz to 70 GHz[a]

Main Options

- MS4640A-002 – Time Domain
- MS4640A-007 – Receiver Offset
- MS464xA-041 – Noise Figure
- MS464xA-051 – Direct Access Loops
- MS464xA-061 – Active Measurements Suite, 2 Attenuators
- MS464xA-062 – Active Measurements Suite, 4 Attenuators
- MS4640A-070 – 70 kHz Low-End Frequency Extension
- MS4647A-080/081 – Broadband/Millimeter-Wave System
- MS464xA-082/083 – 110 GHz and Millimeter-Wave Extensions

a. See **Operating Frequency** on page 27 for extended operational frequency ranges.

Separate documents found on the Anritsu web site (www.anritsu.com/VectorStar) provide specifications for 110 GHz Broadband Coaxial, Banded Waveguide and Multiport solutions, based on the MS4640A VNA. A color detailed brochure provides in-depth descriptions of the VectorStar family's features and benefits.



VectorStar MS4640A VNA Front Panel

Description Page

1. 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. Error-corrected specifications are warranted and include guard-bands, unless otherwise stated.
User Cables	Specifications do not include effects of any user cables 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.
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
Typical Performance	"Typical" specifications describe expected, but not warranted, performance based on sample testing. They do not guarantee the performance of any individual product. No measurement uncertainty value is accounted for in the specification.
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.
Below 300 kHz	All uncertainties below 300 kHz are typical.
Recommended Calibration Cycle	12 months

2. System Dynamic Range

Calculated as the difference between the maximum rated source power and the specified noise floor at the specified location.

MS4642A, 20 GHz Model, System Dynamic Range (dB)

	at Ports 1 or 2			at b1 or b2	
Frequency Range	**Standard**	**Option 051**	**Option 061 [a] or 062**	**Option 051**	**Option 061 [a] or 062**
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 20 GHz	123	119	115	134	130

a. The Option 061 Dynamic Range reported in this column applies for S_{21} measurements. For S_{12} Dynamic Range, use the figures from the Option 051 column.

MS4644A, 40 GHz Model, System Dynamic Range (dB)

	at Ports 1 or 2			at b1 or b2	
Frequency Range	**Standard**	**Option 051**	**Option 061 [a] or 062**	**Option 051**	**Option 061 [a] or 062**
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

a. The Option 061 Dynamic Range reported in this column applies for S_{21} measurements. For S_{12} Dynamic Range, use the figures from the Option 051 column.

MS4645A & MS4647A, 50 & 70 GHz Models, System Dynamic Range (dB)

	at Ports 1 or 2			at b1 or b2	
Frequency Range	**Standard**	**Option 051**	**Option 061 [a] or 062**	**Option 051**	**Option 061 [a] or 062**
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	107	101	97	116	112
65 to 67 GHz	103	97	91	112	106
67 to 70 GHz	100	91	84	106	99

a. The Option 061 Dynamic Range reported in this column applies for S_{21} measurements. For S_{12} Dynamic Range, use the figures from the Option 051 column.

3. 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 location. Characteristic Performance.

All Models, Receiver Dynamic Range (dB)

	at Ports 1 or 2			at b1 or b2	
Frequency Range	**Standard**	**Option 051**	**Option 061[a] or 062**	**Option 051**	**Option 061[a] or 062**
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[b]	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. The Option 061 Dynamic Range reported in this column applies for S21 measurements. For S12 Dynamic Range, use the figures from the Option 051 column.

b. 20 to 38 GHz for MS4647A

4. 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 trace noise effects. Match not included. Performance is characteristic.

All Models, Compression Levels (dBm)

	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	
Frequency Range	**Standard**	**Option 051**	**Option 061[b] or 062**	**Option 051, 061, or 062**	**Option 051**	**Option 061 or 062**
< 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[c]	+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. 0.17 dB for < 0.3 MHz.

b. The Option 061 compression level reported in this column applies to Port 2 or b_2. For Port 1 or b_1 compression level, use the figures from the appropriate Port X or b_x "Option 051" column.

c. 20 to 38 GHz for MS4647A.

5. High Level Noise

Measured at 1 kHz IF bandwidth, at default power, with either full reflects or through transmission. RMS. Characteristic performance on MS4647A with either Option -051, -061, or -062. Trace noise magnitude may be degraded to 20 mdB RMS (typical) at particular frequencies, due to spurious receiver residuals.

Frequency (GHz)	Magnitude (dB)	Phase (degree)
< 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

6. Noise Floor

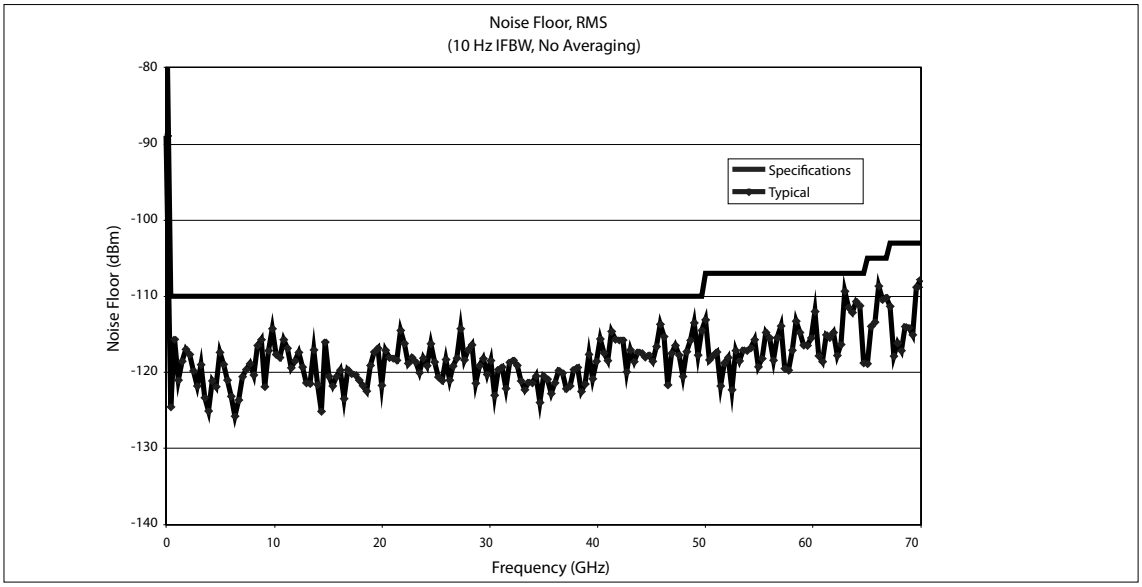
Measured at 10 Hz IF Bandwidth with no averaging, and at –10 dBm port power. RMS, no leakage correction applied. Measurement made with a through line connection, with its effects compensated for. Performance at a_x and b_x loops is characteristic.

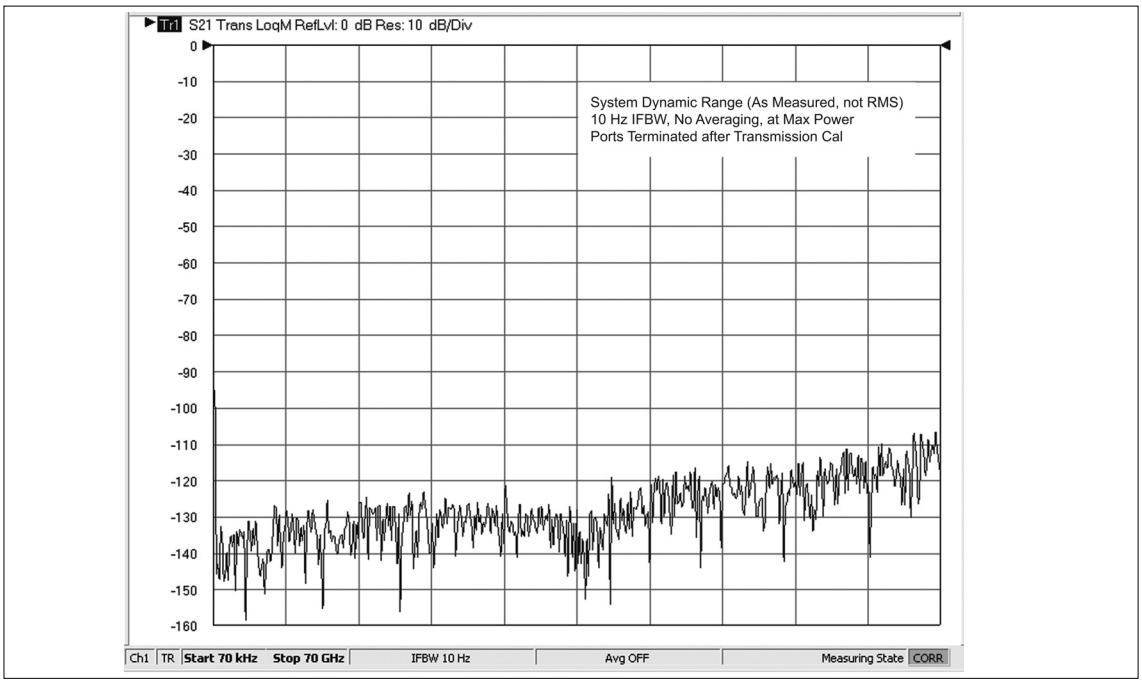
All Models, Noise Floor (dBm)

	At Ports 1 or 2			At a_x Loops	At b_x Loops	
Frequency Range	Standard	Option 051	Option 061[a] or 062	Option 051, 061, or 062	Option 051	Option 061[a] or 062
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[b]	–110	–107	–103	–121	–122	–118
38 to 50 GHz	–110	–106	–103	–121	–121	–118
50 to 65 GHz	–107	–103	–101	–118	–118	–116
65 to 67 GHz	–105	–100	–96	–115	–115	–111
67 to 70 GHz	–103	–97	–94	–112	–112	–109

a. The Option 061 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 051 column.

b. 2.5 to 38 GHz for the MS4647A VNA.


Noise Floor, RMS
(10 Hz IFBW, No Averaging)
Noise Floor (dBm)
-80
-90
-100
-110
-120
-130
-140
0
10
20
30
40
50
60
70
Frequency (GHz)
Specifications
Typical


Tr1 S21 Trans LogM RefLvl: 0 dB Res: 10 dB/Div
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
System Dynamic Range (As Measured, not RMS)
10 Hz IFBW, No Averaging, at Max Power
Ports Terminated after Transmission Cal
Ch1
TR
Start 70 kHz
Stop 70 GHz
IFBW 10 Hz
Avg OFF
Measuring State
CORR

7. Power Range

Maximum Rated Power to minimum level. The difference reflects the ALC range for standard models or with Option 051, and the ALC + Attenuator Range for models with Options 061 or 062.

MS4642A, 20 GHz Model, Power Range (dBm to dBm)

Frequency	Standard (No Options)	Option 051	Option 061[a] or 062
< 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[a] to 20 GHz	+13 to –20	+12 to –20	+11 to –90

a. Typical between 2.5 and 2.7 GHz

MS4644A, 40 GHz Model, Power Range (dBm to dBm)

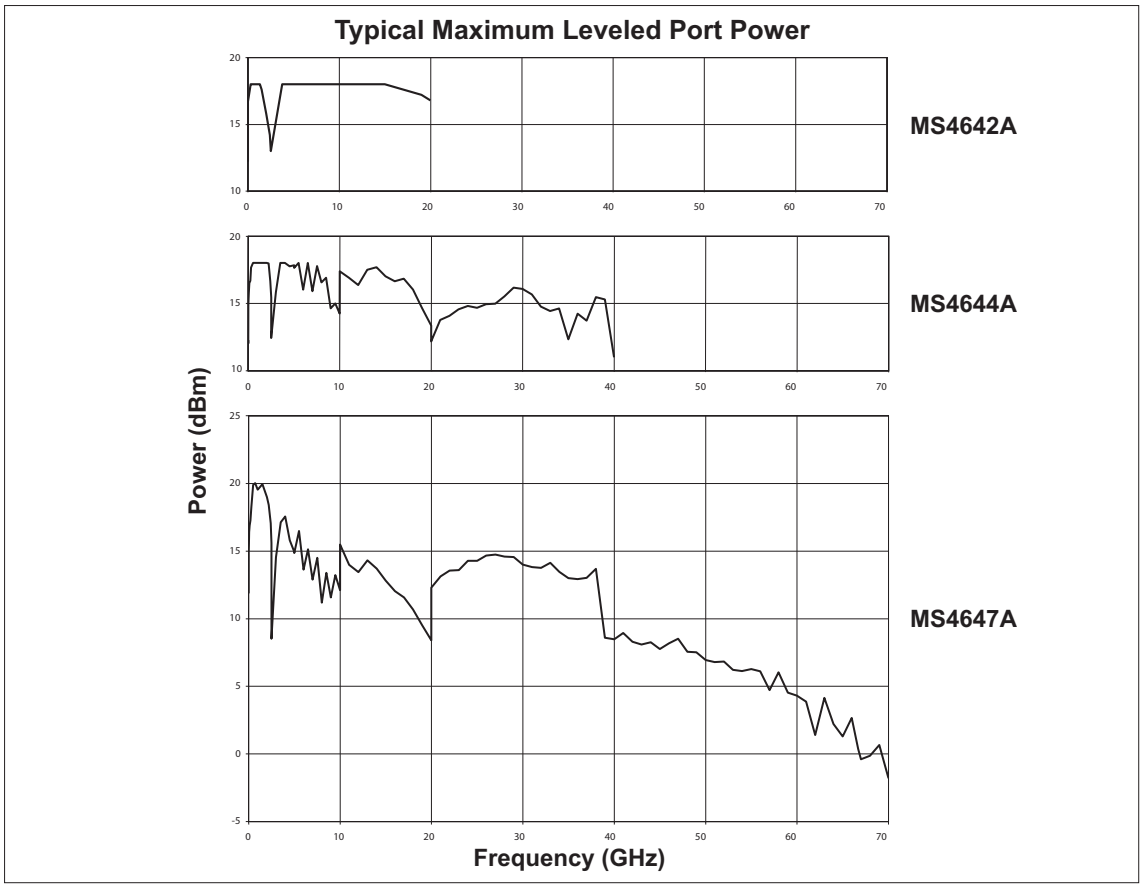
Frequency	Standard (No Options)	Option 051	Option 061[a] or 062
< 0.01 GHz	+10 to –25	+9 to –25	+8 to –95
0.01 to 2.5 GHz	+12 to –25	+11 to –25	+10 to –95
2.5 to 20 GHz	+9 to –20	+8 to –20	+7 to –90
20 to 40 GHz	+9 to –25	+8 to –25	+7 to –95

a. The Option 061 power range reported in this column applies to Port 1. For Port 2, use the figures from the Option 051 column.

MS4645A & MS4647A, 50 & 70 GHz Models, Power Range (dBm to dBm)

Frequency	Standard (No Options)	Option 051	Option 061[a] or 062
< 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	+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

a. The Option 061 power range reported in this column applies to Port 1. For Port 2 Power Range, use the figures from the Option 051 column.



8. Output Default Power

Instrument default power. For maximum rated power, see section **7. Power Range** on page 7 above.

Model	Standard (No Options)	Option 051, 061 or 062
MS4642A, 20 GHz	+5 dBm	+5 dBm
MS4644A, 40 GHz	+5 dBm	+5 dBm
MS4645A, 50 GHz	–3 dBm	–10 dBm
MS4647A, 70 GHz	–3 dBm	–10 dBm

9. Power Accuracy, Linearity, and Resolution

Frequency (GHz)	Accuracy[a] (dB)	Linearity[b] (dB)	Resolution (dB)
< 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.

10. Measurement Stability

Ratio measurement, with ports shorted. Characteristic.

Frequency (GHz)	Magnitude (dB/°C)	Phase (degree/°C)
< 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

11. Frequency Resolution, Accuracy, and Stability

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

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

Measured at default power. Non-Harmonics are characteristic performance.

Frequency (GHz)	SSB Phase Noise (dBc/Hz) at 10 kHz offset	Harmonics (dBc) (second and third)	Non-Harmonic Spurious (dBc) at > 1 kHz offsets
< 0.01	–78	–20	–20
0.01 to 2.5	–84	–20	–30
2.5 to 5	–84	–20[a]	–30
5 to 10	–78	–20	–30
10 to 20	–72	–20	–30
20 to 40	–66	–20	–30
40 to 67	–61	–20	–30
67 to 70	–61	–20	–30

a. May degrade by 3 dB (typical) between 2.5 and 2.7 GHz.

13. Uncorrected (Raw) Port Characteristics

Characteristic performance with either Option -051, -061, or -062.

Frequency Range (GHz)	Directivity (dB)	Port Match[a] (dB)
<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.

14. MS4642A 20 GHz VNA System Performance

14.1 MS4642A – 12-Term SOLT – Sliding Load – 3652A-1 K Calibration Kit

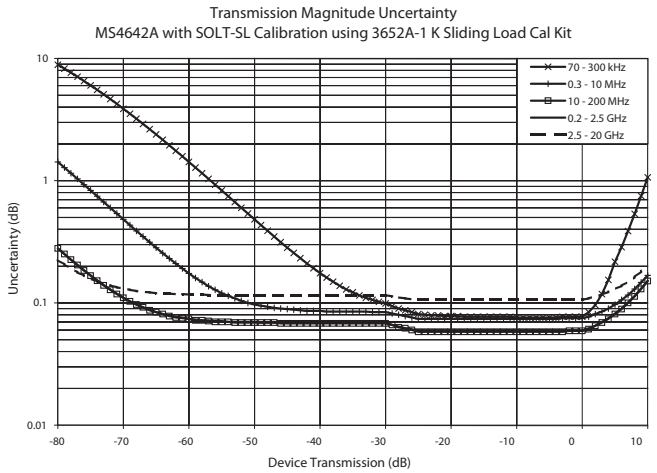
MS4642A 20 GHz Model, with 12-term SOLT with Sliding Load Calibration, using the 3652A-1 K Calibration Kit.

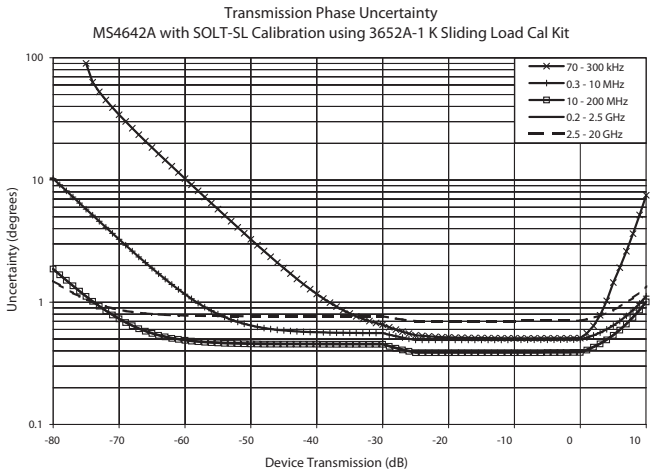
Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match[a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
< 0.01 GHz	> 38	> 36	> 38	± 0.02	± 0.05
0.01 to 2.5 GHz	> 42	> 41	> 42	± 0.005	± 0.03
2.5 to 20 GHz	> 43	> 39	> 43	± 0.006	± 0.07

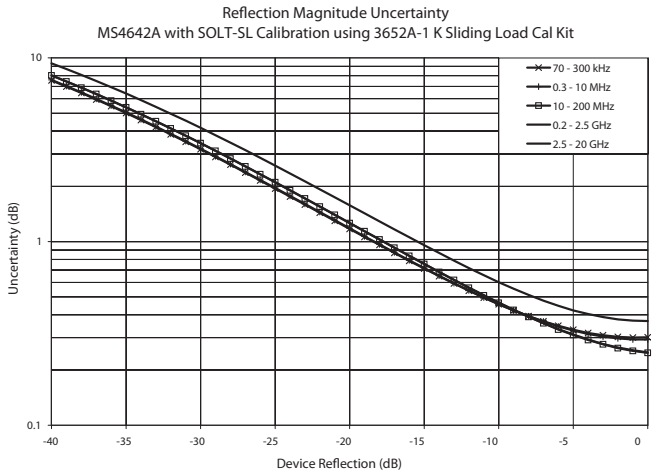
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by ≈ 8 dB for a 3670 Series test port cable, to compensate for effects such as match, repeatability, bend radius, and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

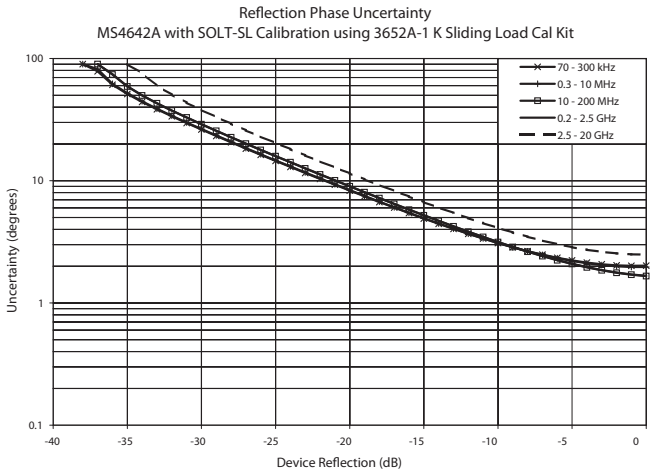
MS4642A Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are worse 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.









14.2 MS4642A – 12-Term SOLT – 3652A or 3652A-1 K Calibration Kit

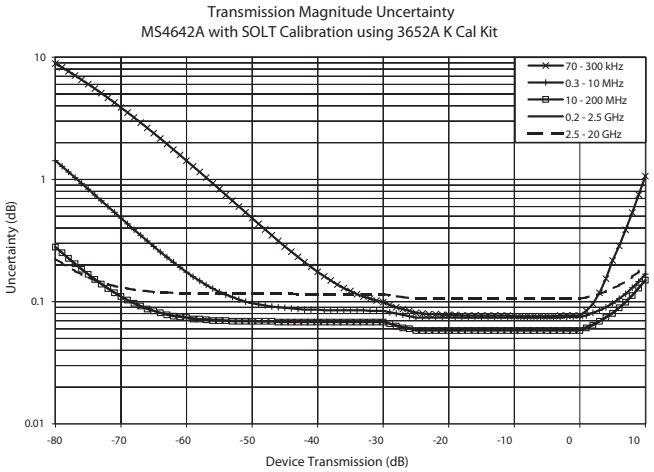
MS4642A 20 GHz Model, with 12-term SOLT Calibration, using 3652A K or 3652A-1 K Cal Kit.

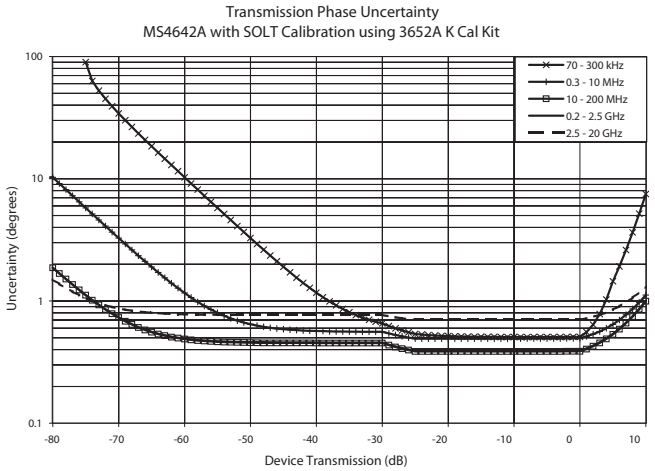
Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match [a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
< 0.01	> 38	> 36	> 38	± 0.02	± 0.05
0.01 to 2.5	> 37	> 41	> 37	± 0.005	± 0.03
2.5 to 20	> 34	> 39	> 35	± 0.006	± 0.07

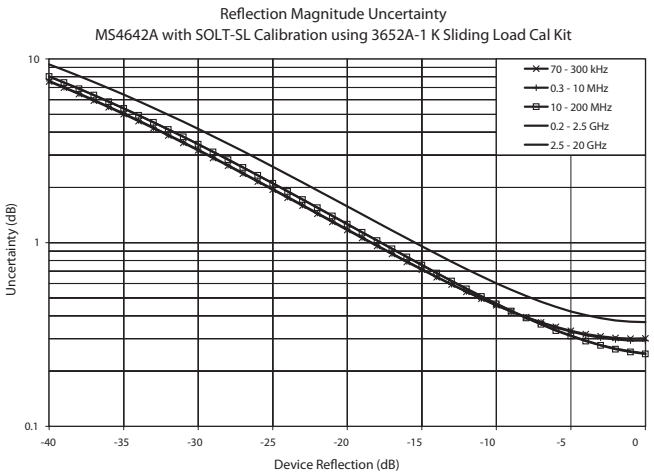
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by ≈ 8 dB for a 3670 Series test port cable, to compensate for effects such as match, repeatability, bend radius, and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

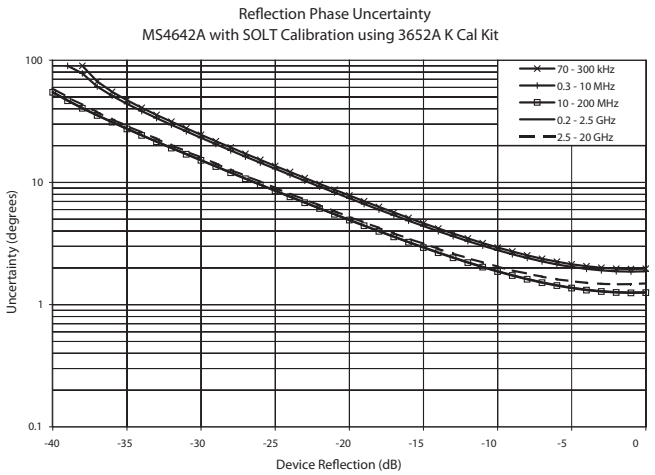
MS4642A Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are worse 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.









14.3 MS4642A – 12-Term SOLT – Sliding Load – 3650A-1 3.5 mm Calibration Kit

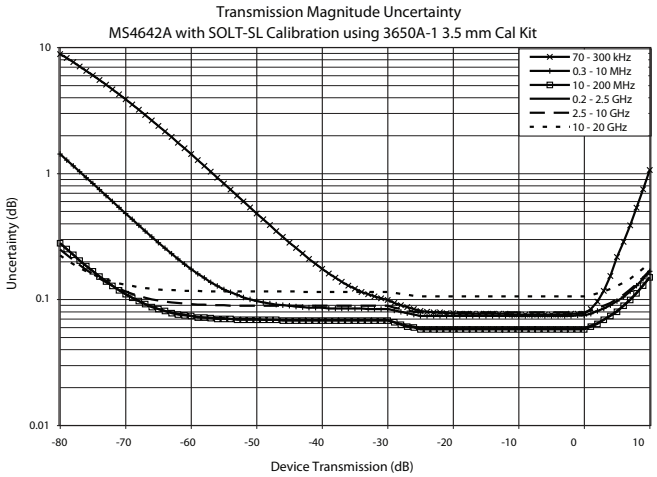
MS4642A 20 GHz Model, with 12-term SOLT Calibration with Sliding Load Calibration, using the 3650A-1 3.5 mm Cal Kit.

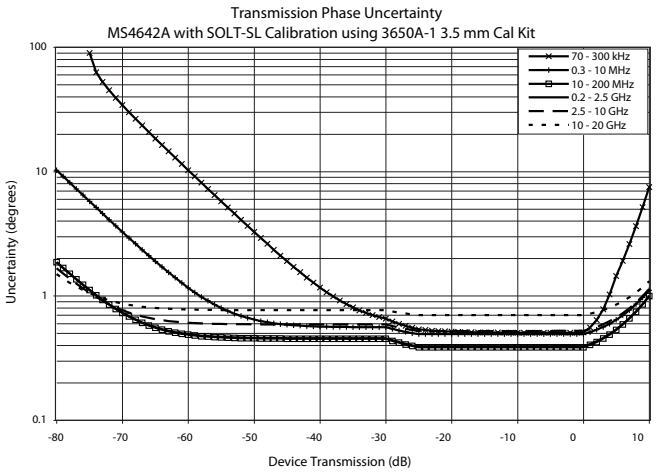
Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match[a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
< 0.01	> 40	> 37	> 40	± 0.02	± 0.05
0.01 to 2.5	> 42	> 41	> 42	± 0.005	± 0.03
2.5 to 10	> 43	> 39	> 43	± 0.005	± 0.03
10 to 20	> 43	> 39	> 43	± 0.006	± 0.07

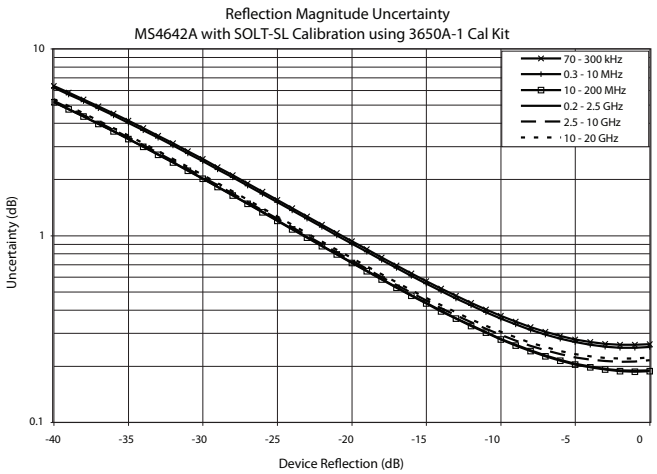
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by ≈ 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and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

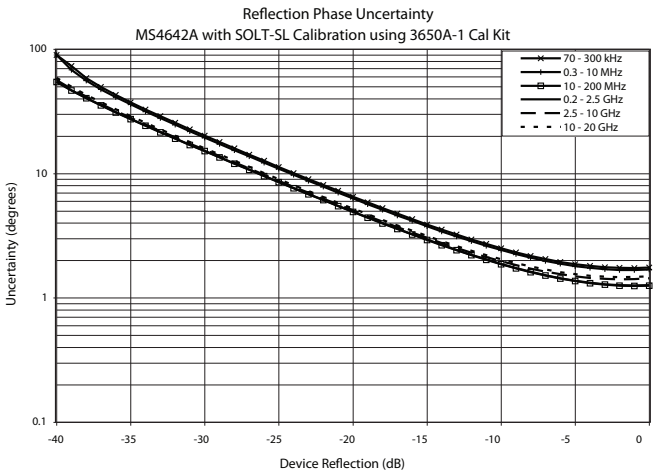
MS4642A Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are worse 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.









14.4 MS4642A – 12-Term SOLT – 3650A or 3650A-1 3.5 mm Calibration Kit

MS4642A 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)
< 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 ≈ 8 dB for a 3670 Series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.

MS4642A Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are worse 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.

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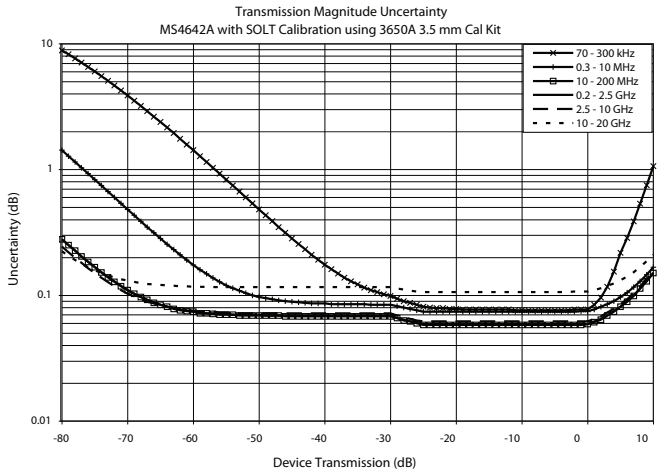
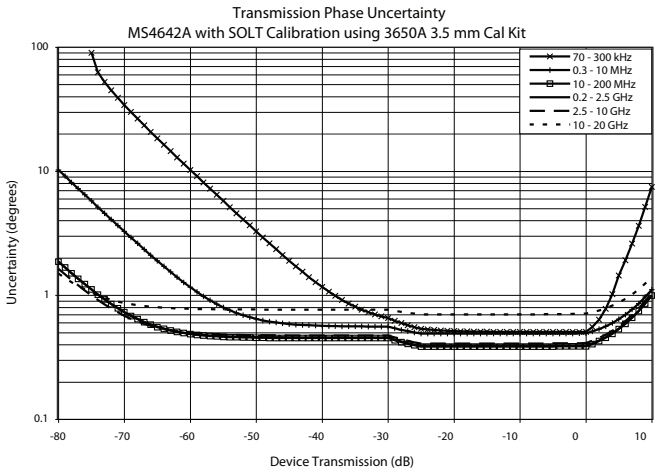
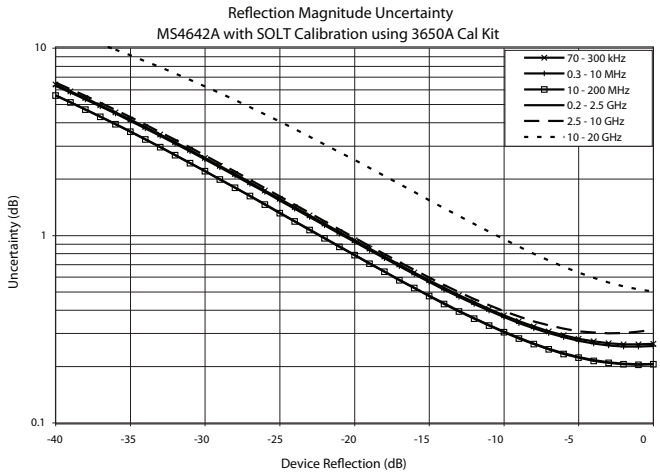
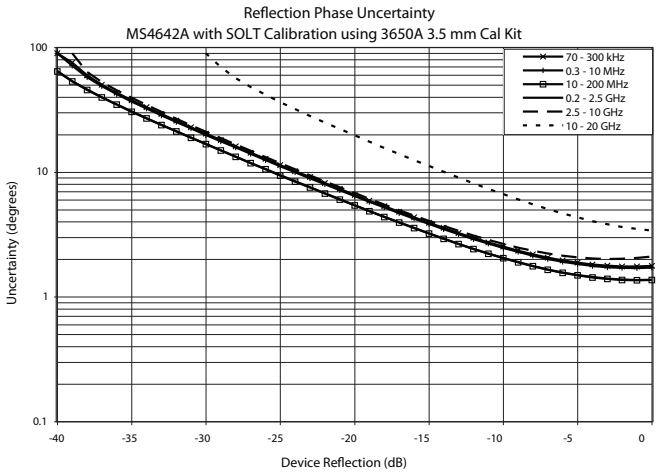








14.5 MS4642A – 12-Term – 36585K K AutoCal™

MS4642A 20 GHz Model, with 12-term Calibration, using the 36585K K Automatic Calibrator (AutoCal)

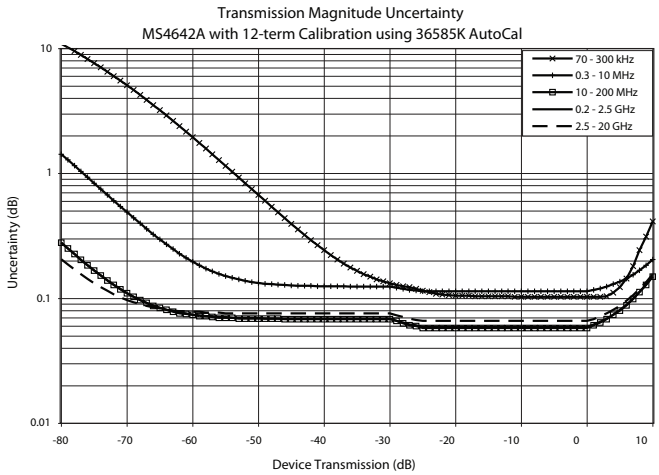
Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match[a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
< 0.01 [b]	> 40	> 40	> 43	± 0.10	± 0.10
0.01 to 2.5	> 43	> 47	> 43	± 0.05	± 0.03
2.5 to 20	> 50	> 47	> 50	± 0.09	± 0.03

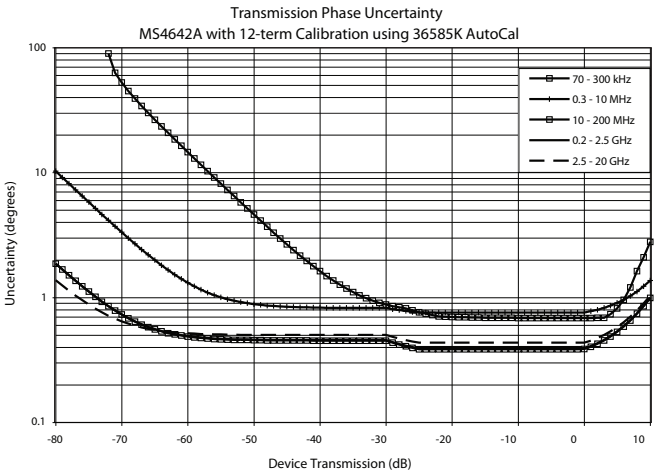
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by ≈ 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and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

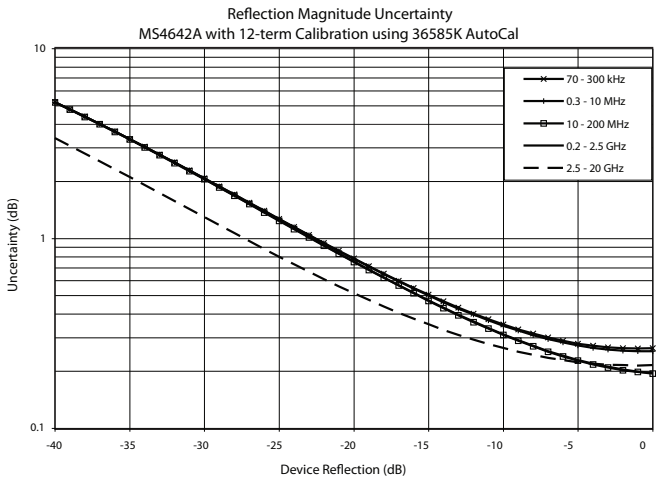
b. Typical performance below 2 MHz.

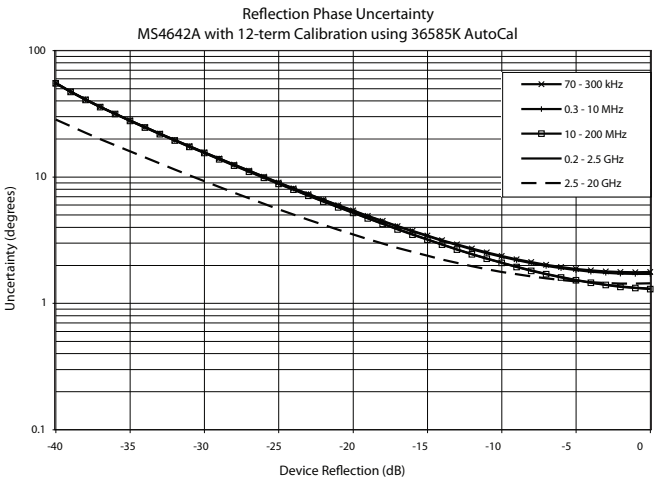
MS4642A Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are worse 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.









15. MS4644A 40 GHz VNA System Performance

15.1 MS4644A – 12-Term SOLT – Sliding Load – 3652A-1 K Calibration Kit

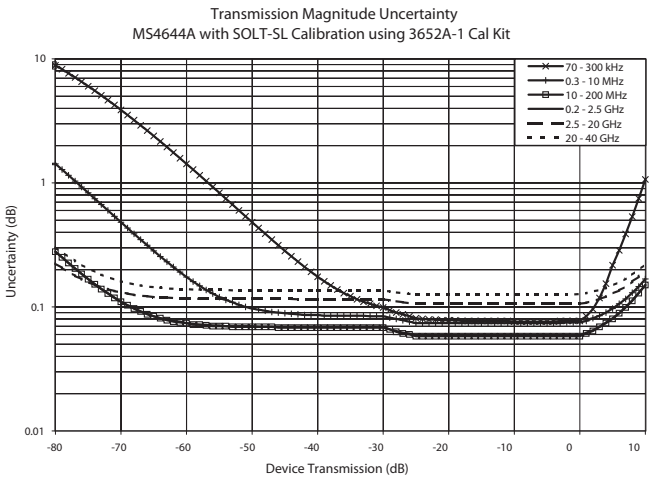
MS4644A 40 GHz Model, with 12-term SOLT with Sliding Load Calibration, using the 3652A-1 K Calibration Kit.

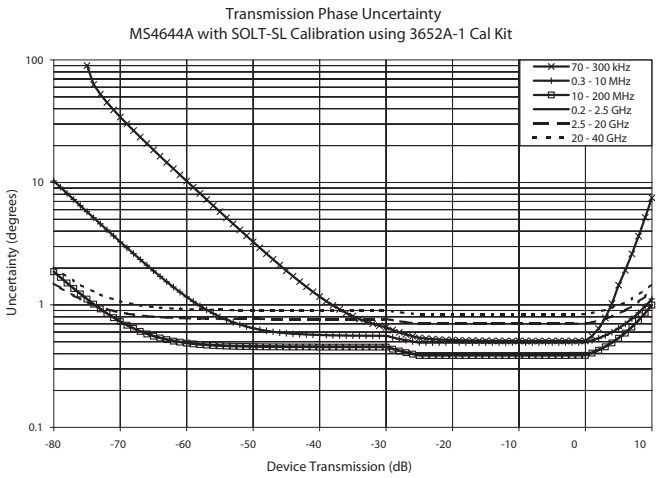
Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match[a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
< 0.01	> 38	> 36	> 38	± 0.02	± 0.05
0.01 to 2.5	> 42	> 41	> 42	± 0.005	± 0.03
2.5 to 20	> 43	> 39	> 43	± 0.006	± 0.07
20 to 40	> 40	> 34	> 40	± 0.006	± 0.08

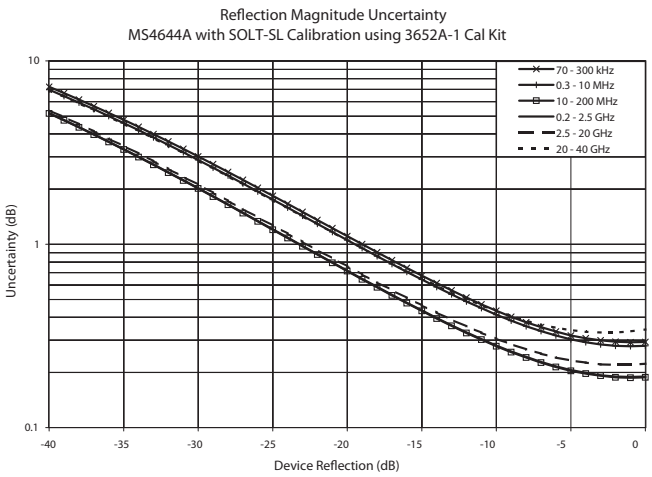
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified at Residual Directivity. For practical considerations, derate it by ≈ 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and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

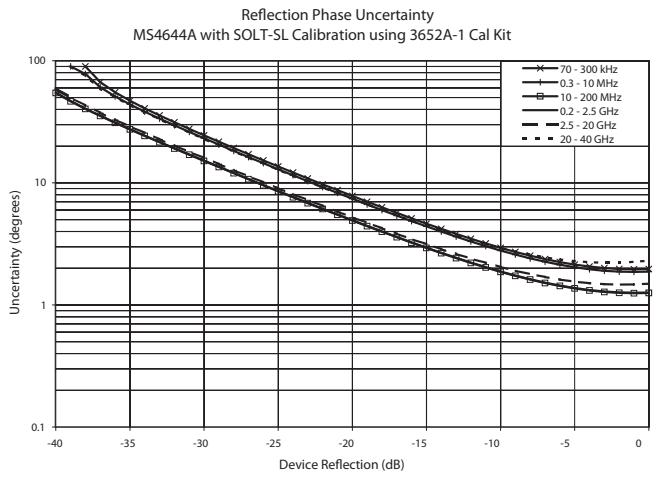
MS4644A Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are worse 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.









15.2 MS4644A – 12-Term SOLT – 3652A or 3652A-1 K Calibration Kit

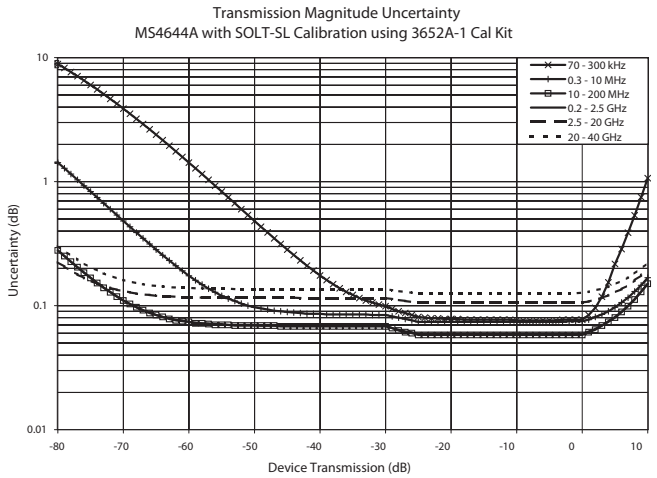
MS4644A 40 GHz Model, with 12-term SOLT Calibration, using the 3652A or 3652A-1 K Calibration Kit.

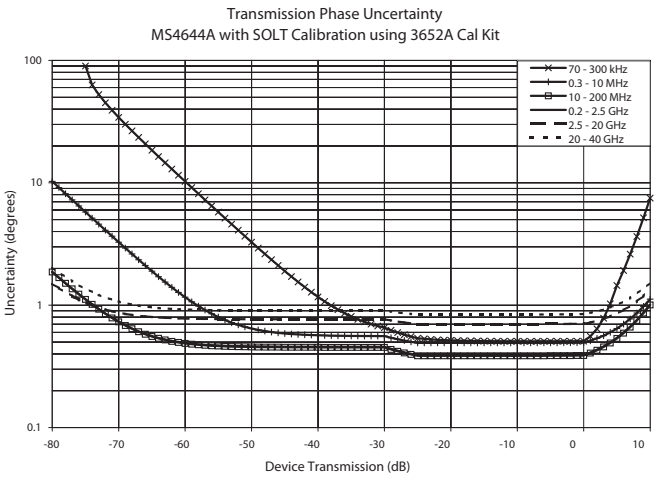
Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match[a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
< 0.01	> 38	> 36	> 38	± 0.02	± 0.05
0.01 to 2.5	> 37	> 41	> 37	± 0.005	± 0.03
2.5 to 20	> 34	> 39	> 35	± 0.006	± 0.07
20 to 40	> 32	> 34	> 32	± 0.006	± 0.08

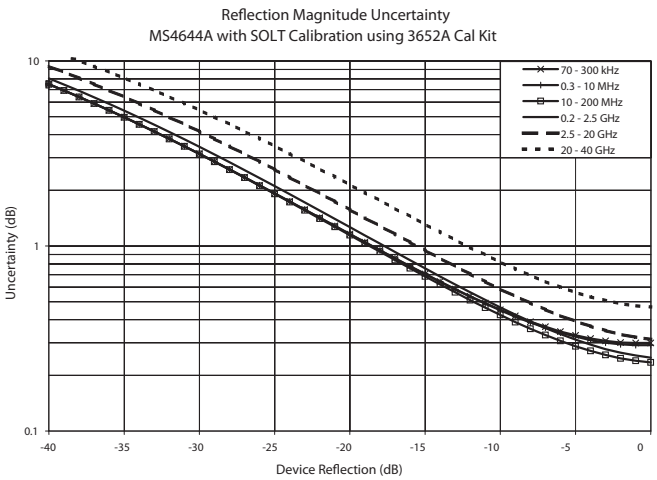
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by ≈ 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and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

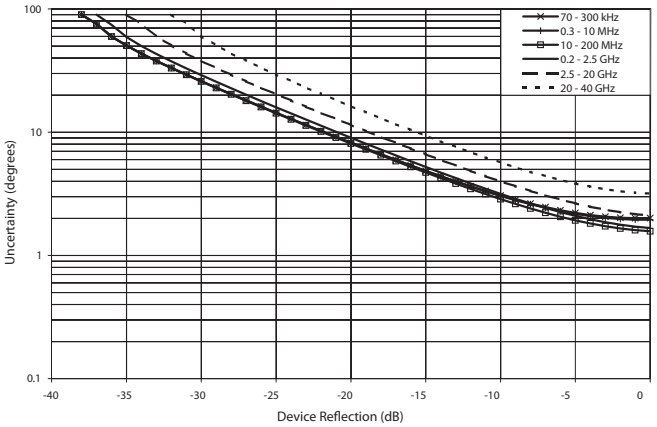
MS4644A Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are worse 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.









15.3 MS4644A – 12-Term – 36585K K AutoCal

MS4644A 40 GHz Model, with 12-term Calibration, using the 36585K K AutoCal.

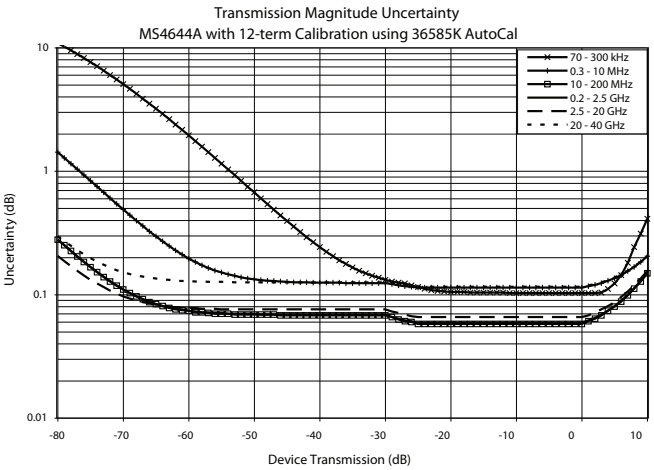
Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match[a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
< 0.01 [b]	> 40	> 40	> 43	± 0.10	± 0.10
0.01 to 2.5	> 43	> 47	> 43	± 0.05	± 0.03
2.5 to 20	> 50	> 47	> 50	± 0.09	± 0.03
20 to 40	> 48	> 47	> 48	± 0.14	± 0.07

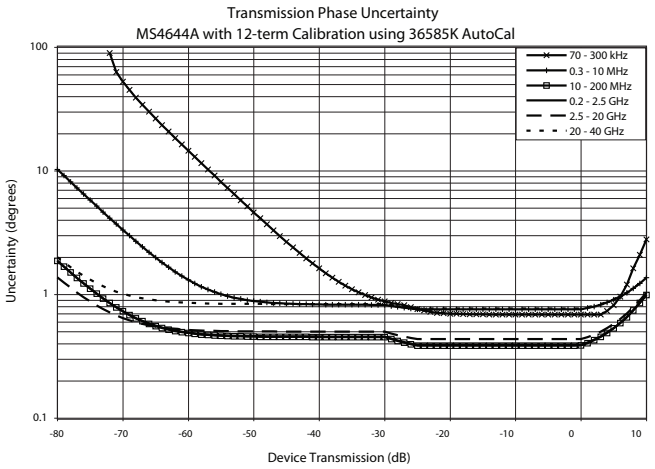
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by ≈ 8 dB for a 3670 Series test port cable, to compensate for effects such as match, repeatability, bend radius, and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

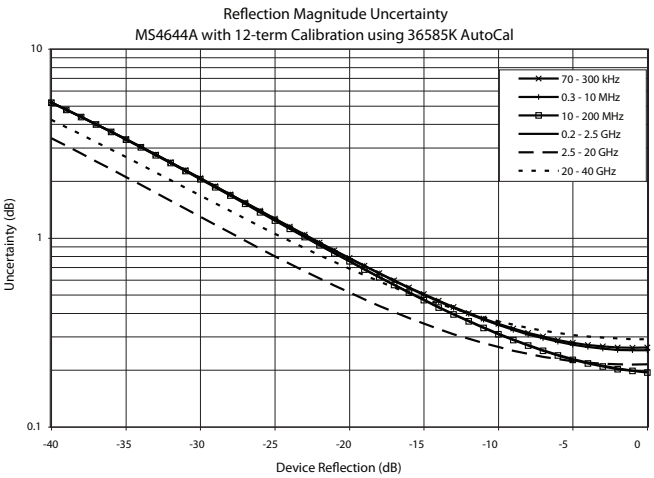
b. Typical performance below 2 MHz.

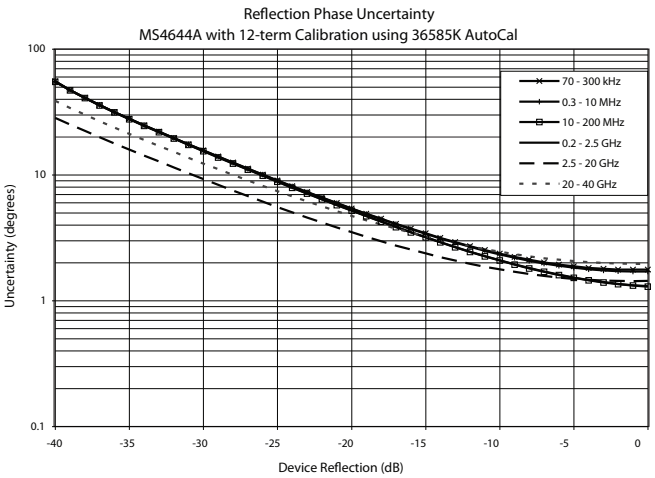
MS4644A Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are worse 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.









16. MS4645A 50 GHz / MS4647A 70 GHz VNA System Performance

16.1 MS4645A/MS4647A VNAs – 12-Term SOLT Sliding Load – 3654D-1 V Calibration Kit

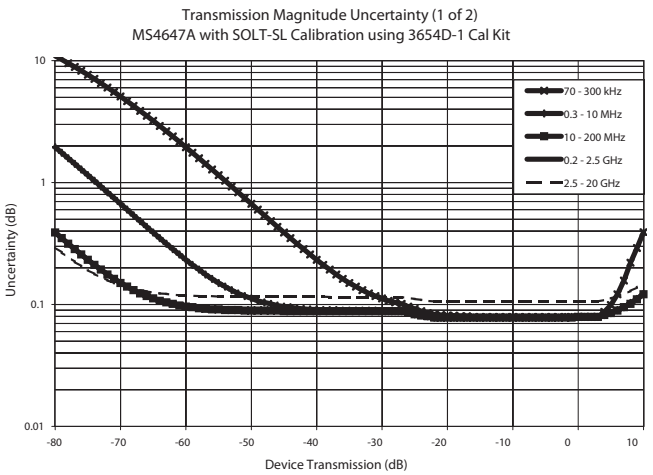
MS4645A 50 GHz and MS4647A 70 GHz VNAs, with 12-term SOLT with Sliding Load Calibration, using the 3654D-1 V Calibration Kit

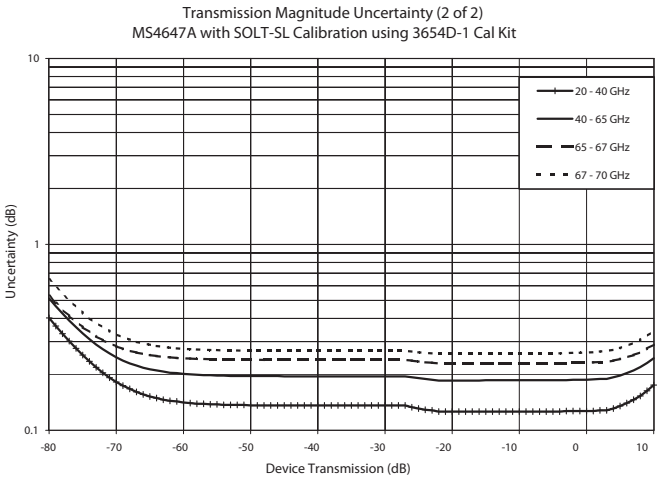
Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match[a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
< 0.01	> 38	> 36	> 38	± 0.02	± 0.05
0.01 to 2.5	> 41	> 39	> 41	± 0.02	± 0.05
2.5 to 20	> 41	> 37	> 41	± 0.02	± 0.07
20 to 40	> 37	> 32	> 37	± 0.02	± 0.08
40 to 65	> 35	> 28	> 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

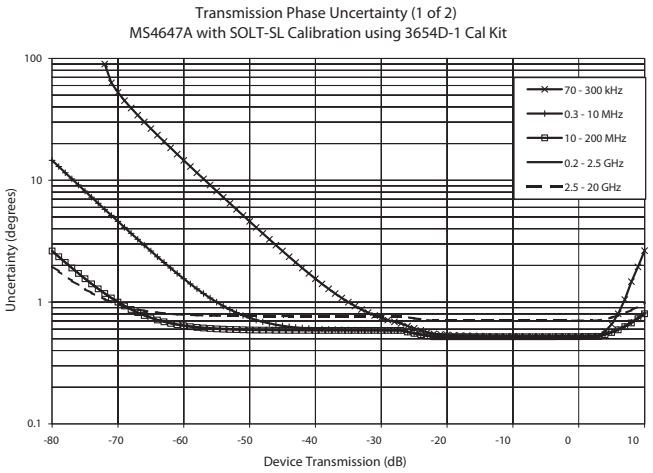
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by ≈ 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and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

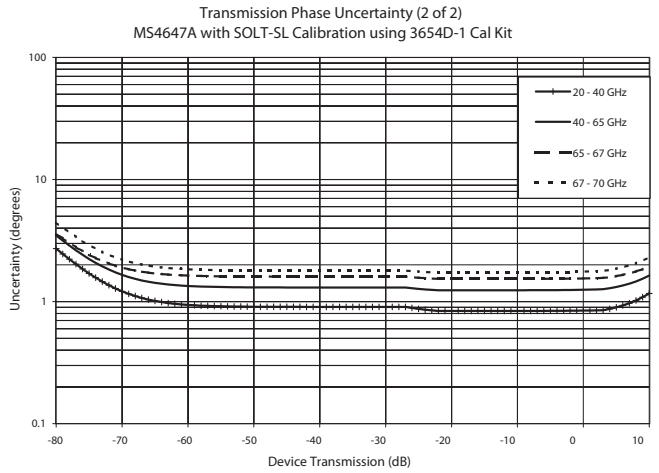
MS4645A/MS4647A Measurement Uncertainties (Transmission)

The graphs give measurement uncertainties after the above calibration. The errors are worse 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.





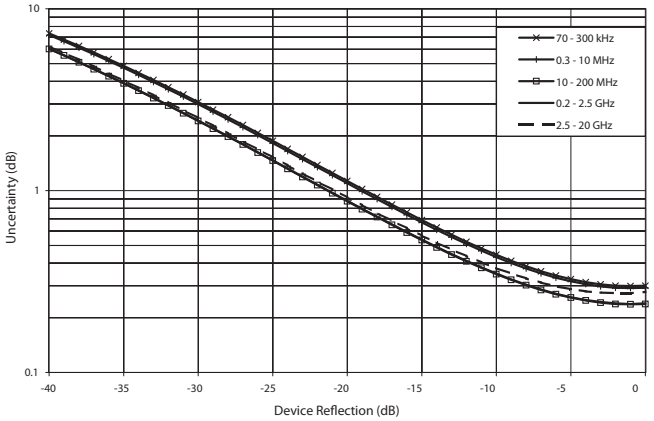




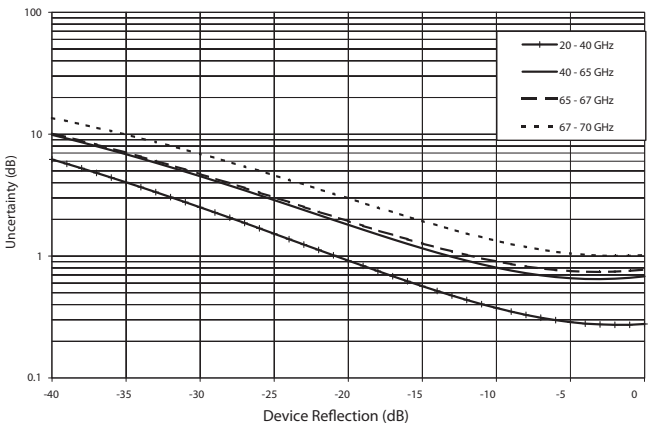
MS4645A/MS4647A Measurement Uncertainties (Reflection)

The graphs give measurement uncertainties after the above calibration. The errors are worse 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.

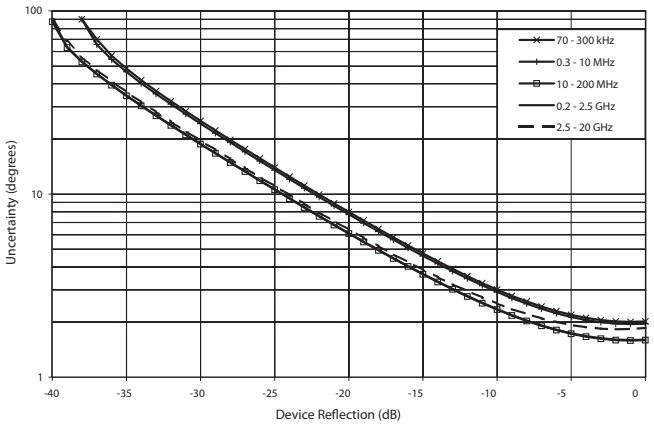
Reflection Magnitude Uncertainty (1 of 2)
MS4647A with SOLT-SL Cal with 3654D-1 Cal Kit



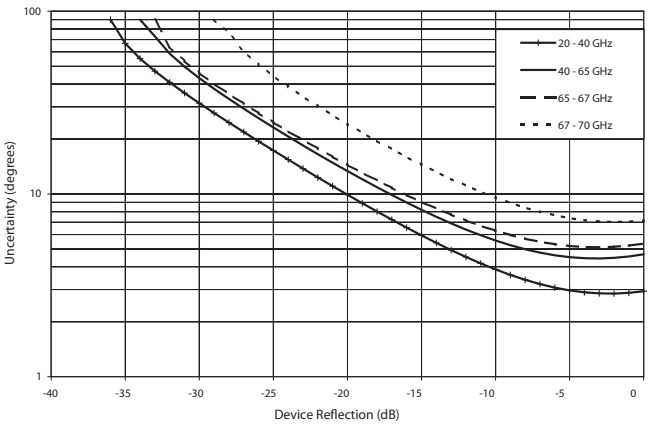
Reflection Magnitude Uncertainty (2 of 2)
MS4647A with SOLT-SL Cal with 3654D-1 Cal Kit



Reflection Phase Uncertainty (1 of 2)
MS4647A with SOLT-SL Cal with 3654D-1 Cal Kit



Reflection Phase Uncertainty (2 of 2)
MS4647A with SOLT-SL Cal with 3654D-1 Cal Kit



16.2 MS4645A/MS4647A VNAs – 12-Term SOLT – 3654D or 3654D-1 V Calibration Kit

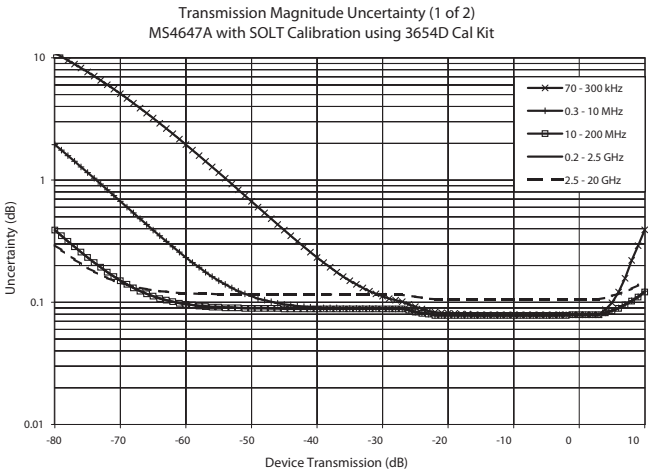
MS4645A 50 GHz and MS4647A 70 GHz VNAs, with 12-term SOLT Calibration, using the 3654D or 3654D-1 V Calibration Kitt

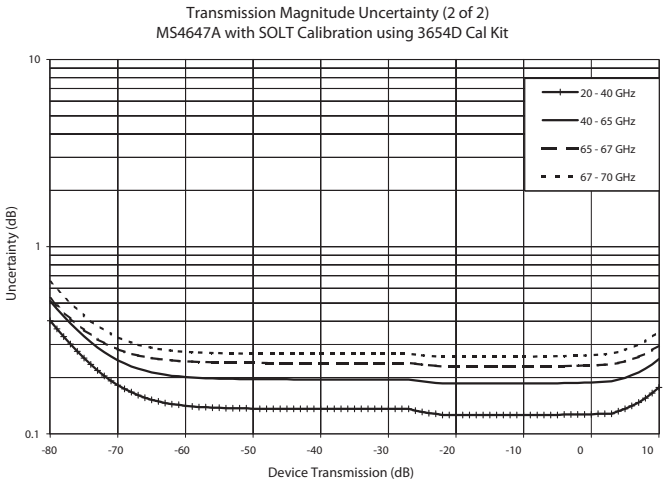
Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match[a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
< 0.01	> 38	> 36	> 38	± 0.02	± 0.05
0.01 to 2.5	> 40	> 39	> 40	± 0.02	± 0.05
2.5 to 20	> 40	> 37	> 40	± 0.02	± 0.07
20 to 40	> 35	> 32	> 35	± 0.02	± 0.08
40 to 65	> 32	> 28	> 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

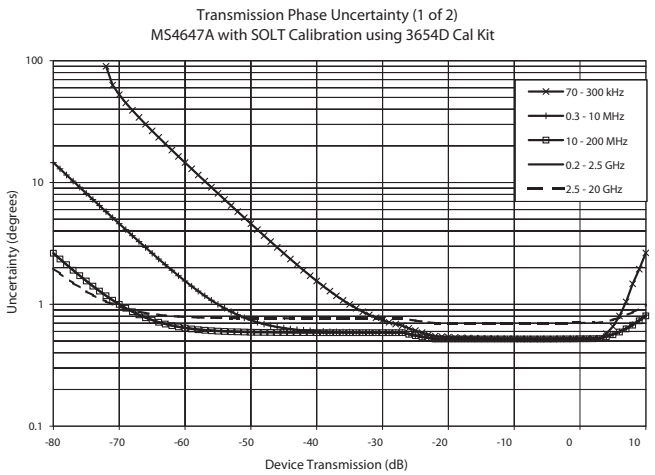
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by ≈ 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and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

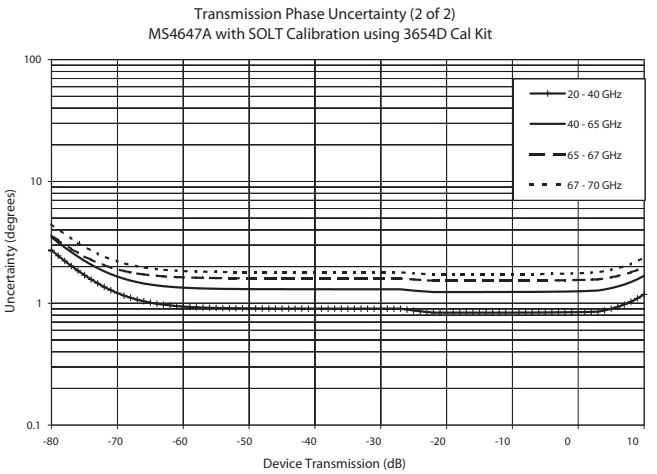
MS4645A/MS4647A Measurement Uncertainties (Transmission)

The graphs give measurement uncertainties after the above calibration. The errors are worse 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.





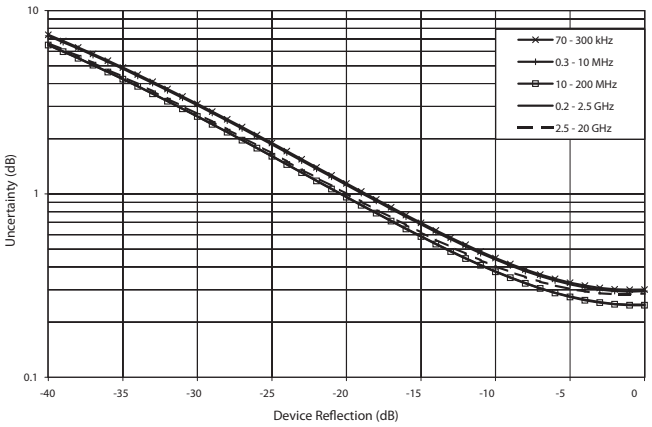




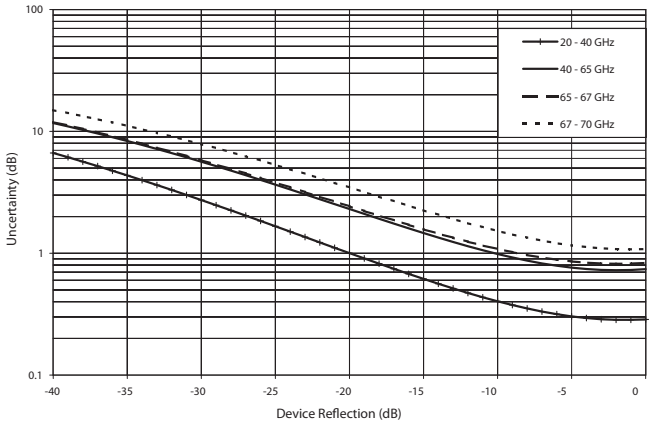
MS4645A/MS4647A Measurement Uncertainties (Reflection)

The graphs give measurement uncertainties after the above calibration. The errors are worse 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.

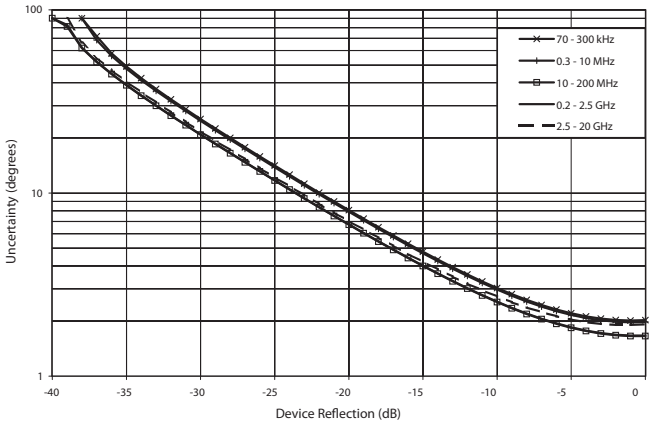
Reflection Magnitude Uncertainty (1 of 2)
MS4647A with SOLT Calibration using 3654D Cal Kit



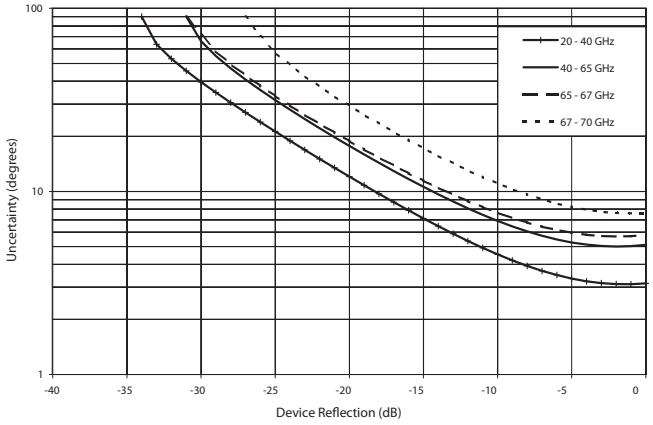
Reflection Magnitude Uncertainty (2 of 2)
MS4647A with SOLT Calibration using 3654D Cal Kit



Reflection Phase Uncertainty (1 of 2)
MS4647A with SOLT Calibration using 3654D Cal Kit



Reflection Phase Uncertainty (2 of 2)
MS4647A with SOLT Calibration using 3654D Cal Kit



16.3 MS4645A/MS4647A VNAs – LRL – 3657-1 V Multi-line Calibration Kit

MS4645A 50 GHz and MS4647A 70 GHz VNAs, 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

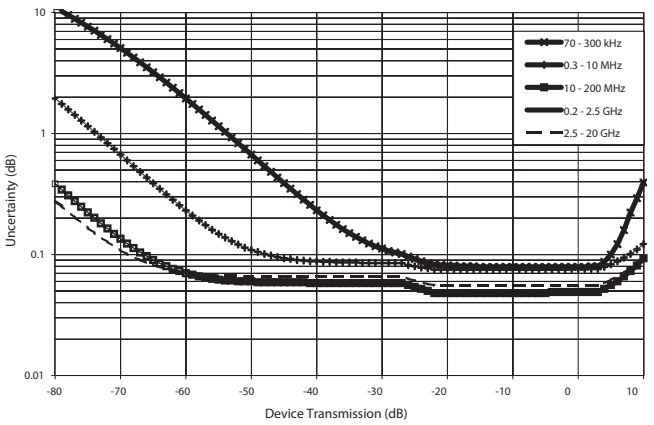
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by ≈ 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and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

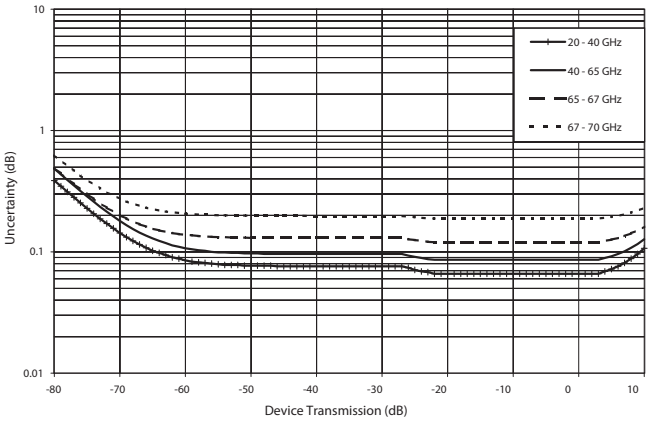
MS4645A/MS4647A Measurement Uncertainties (Transmission)

The graphs give measurement uncertainties after the above calibration. The errors are worse 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.

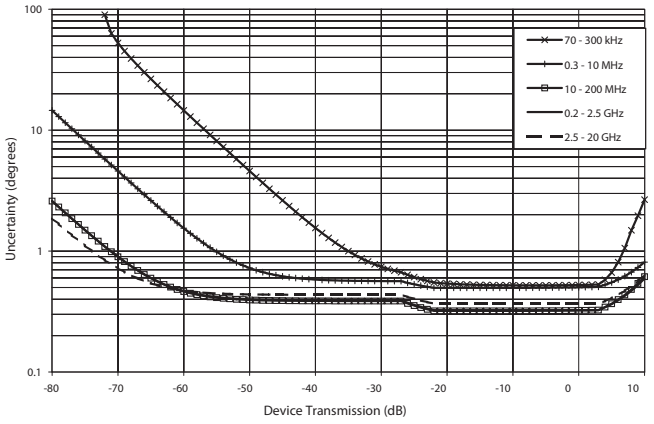
Transmission Magnitude Uncertainty (1 of 2)
MS4647A with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



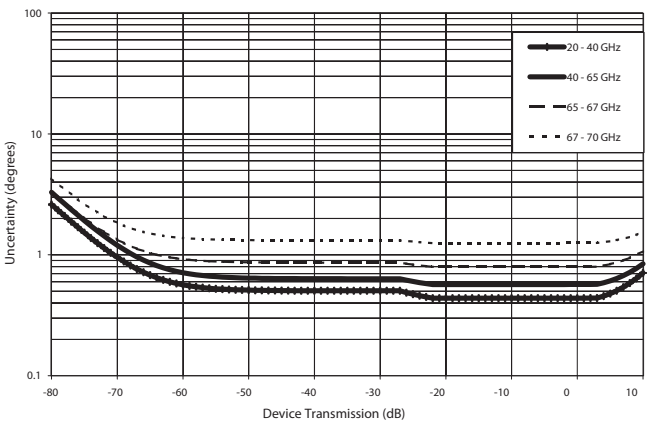
Transmission Magnitude Uncertainty (2 of 2)
MS4647A with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



Transmission Phase Uncertainty (1 of 2)
MS4647A with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



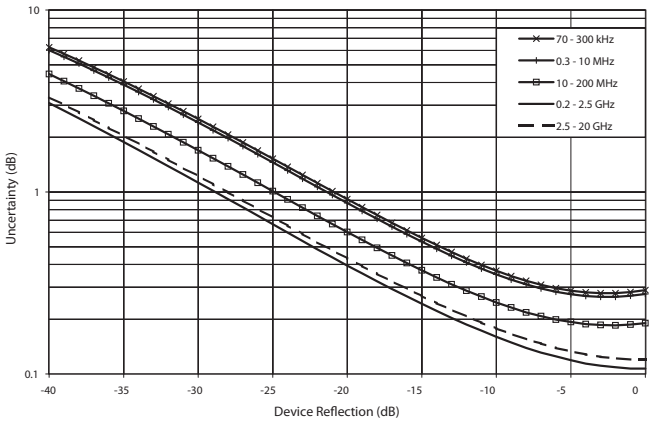
Transmission Phase Uncertainty (2 of 2)
MS4647A with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



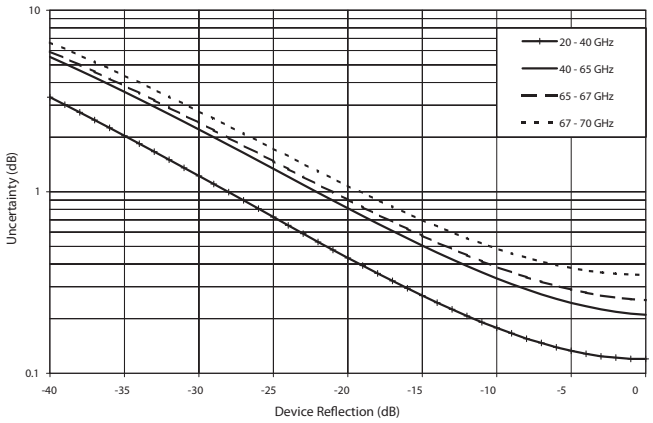
MS4645A/MS4647A Measurement Uncertainties (Reflection)

The graphs give measurement uncertainties after the above calibration. The errors are worse 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.

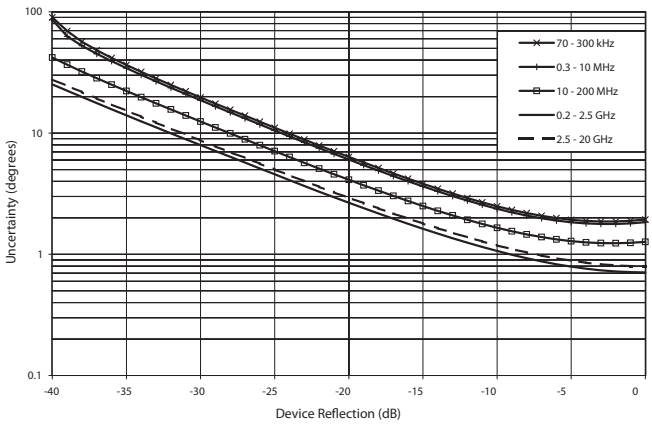
Reflection Magnitude Uncertainty (1 of 2)
MS4647A with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



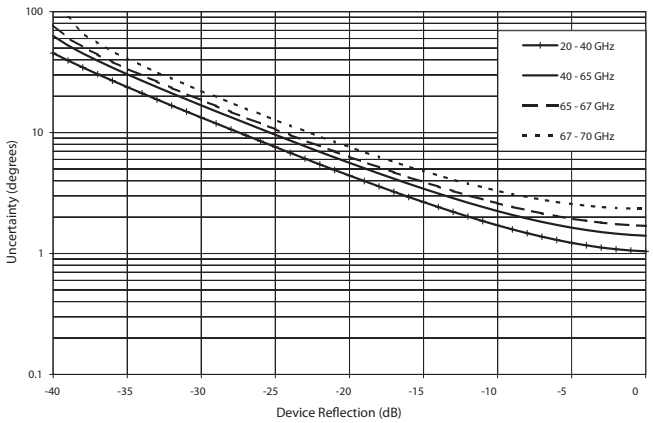
Reflection Magnitude Uncertainty (2 of 2)
MS4647A with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



Reflection Phase Uncertainty (1 of 2)
MS4647A 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)
MS4647A with LRL Calibration using 3657-1 Cal Kit (> 5 GHz)
with LRM Calibration using 3654D Cal Kit (< 5 GHz)



16.4 MS4645A/MS4647A VNAs – 12-Term – 36585V V AutoCal

MS4645A 50 GHz and MS4647A 70 GHz VNAs, 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)
< 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

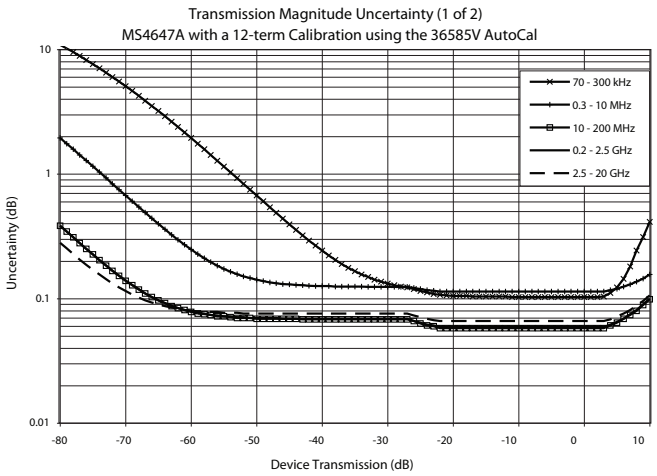
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by ≈ 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and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

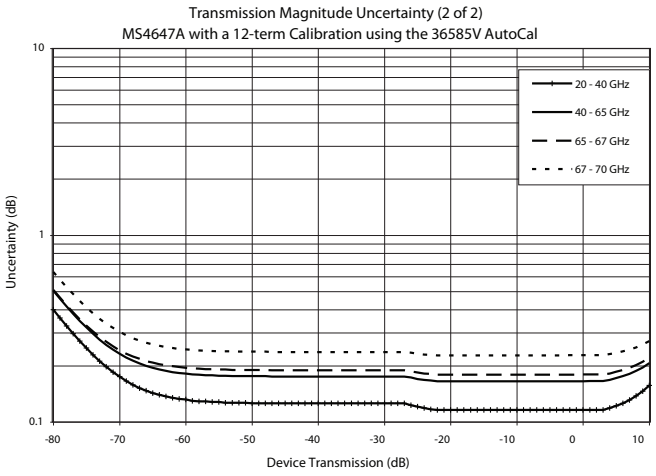
b. Typical performance below 2 MHz.

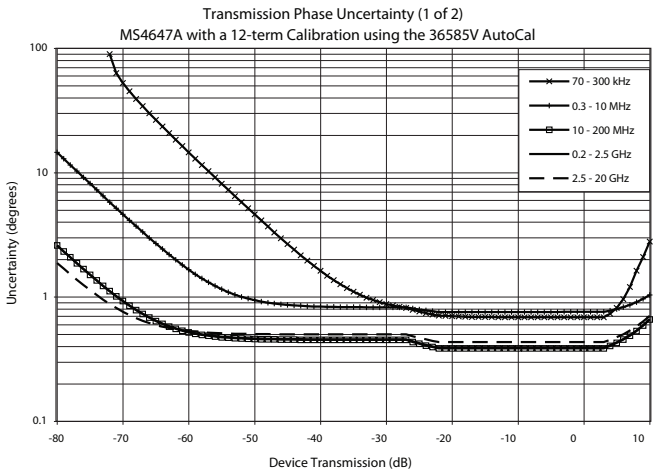
c. ± 0.25 dB from 51 to 55 GHz.

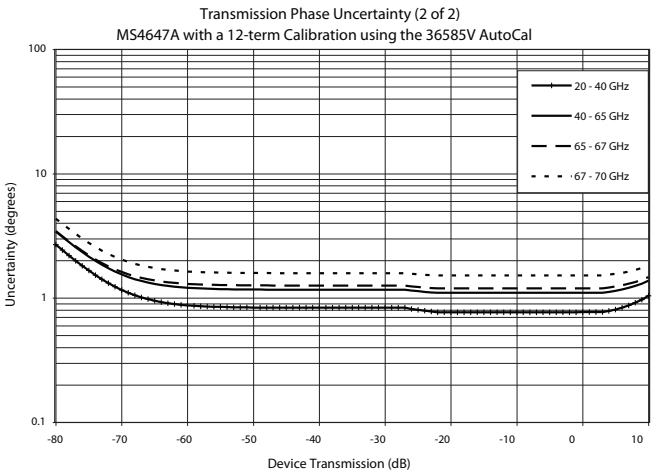
MS4645A/MS4647A Measurement Uncertainties (Transmission)

The graphs give measurement uncertainties after the above calibration. The errors are worse 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.





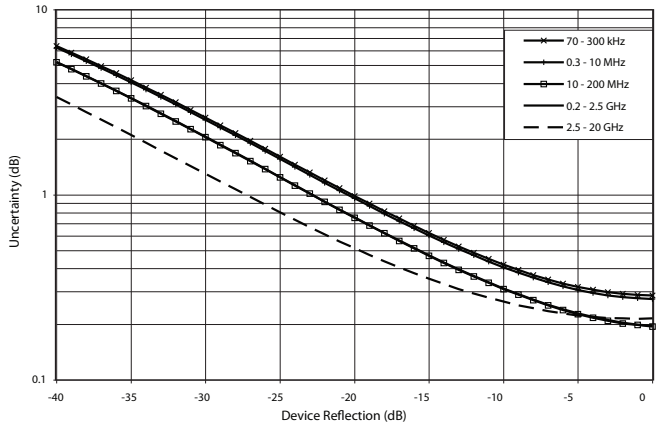




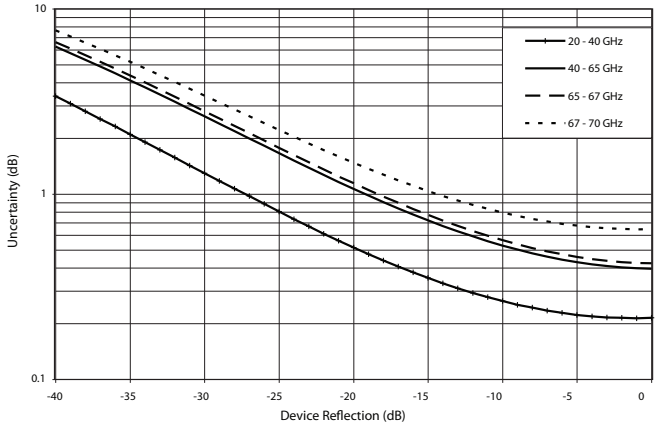
MS4645A/MS4647A Measurement Uncertainties (Reflection)

The graphs give measurement uncertainties after the above calibration. The errors are worse 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.

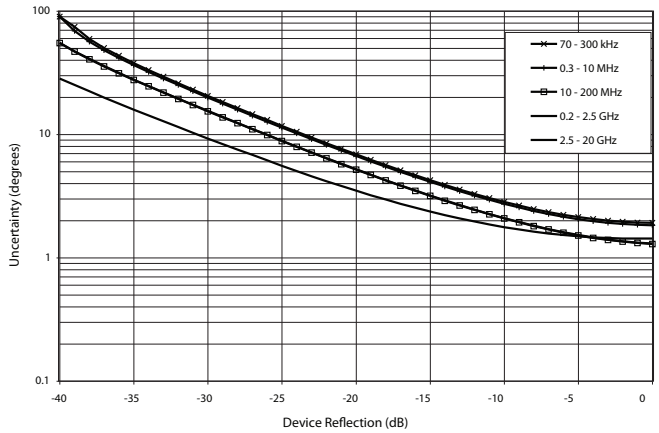
Reflection Magnitude Uncertainty (1 of 2)
MS4647A with a 12-term Calibration using the 36585V AutoCal



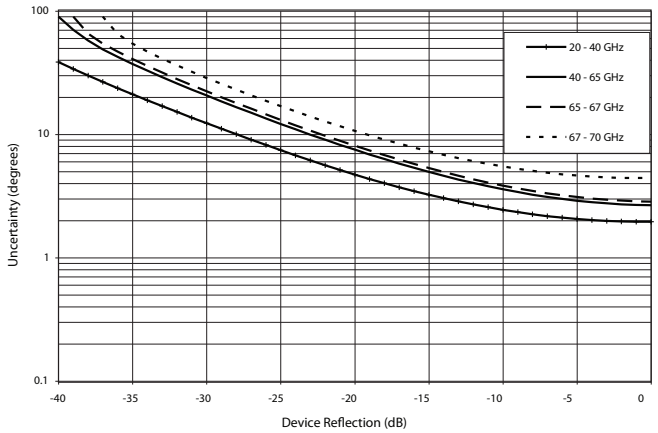
Reflection Magnitude Uncertainty (2 of 2)
MS4647A with a 12-term Calibration using the 36585V AutoCal



Reflection Phase Uncertainty (1 of 2)
MS4647A with a 12-term Calibration using the 36585V AutoCal



Reflection Phase Uncertainty (2 of 2)
MS4647A with a 12-term Calibration using the 36585V AutoCal



17. Measurement Time

Measurement times include sweep time, and band-switching time, in single channel mode. Typical.
20 µs/point is achieved in true swept mode, with 25,000 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[a]			
			401 Points	1,601 Points	25,001 Points	100,000 Points
Uncorrected or 1-port calibration	Narrow (≤ 1 GHz span without bandswitch points)	1 MHz	14	40	510	2,200
		30 kHz	22	90	1,230	4,900
		1 kHz	380	1,600	25,000	100,000
	Wide (70 GHz span)	1 MHz	50	70	570	2,300
		30 kHz	67	120	1,300	5,000
		1 kHz	420	1,670	25,000	100,000
2-port calibration (per sweep)	Narrow (≤ 1 GHz span without bandswitch points)	1 MHz	14	40	510	2,200
		30 kHz	22	90	1,230	4,900
		1 kHz	400	1,610	25,000	100,000
	Wide (70 GHz span)	1 MHz	50	70	570	2,300
		30 kHz	67	120	1,300	5,000
		1 kHz	420	1,670	25,000	100,000

a. Subject to the conditions and including the events specified. Chosen conditions reflect true measurement conditions, based on customers' input on speed environment expectations. Full transparency and disclosure given for best comparisons and decisions.

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

Calibration	Full Band Sweep	Measurement Time[a] 1,601 Points	Achieved Noise Floor at Maximum Frequency (dBm)	IFBW (kHz)
2-port calibration (per sweep)	MS4642A	90	-85	100
		190	-95	10
	MS4644A	95	-80	100
		190	-90	10
	MS4647A	100	-75	100
		190	-85	10

a. Subject to the conditions and including the events specified. Chosen conditions reflect true measurement conditions, based on customers' input on speed environment expectations. Full transparency and disclosure given for best comparisons and decisions.

18. Remote Operability

Communication Type	Data Format	Specification	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 basic but 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. Available for downloads from both the Anritsu and NI 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. Available for download from the Anritsu web site. These drivers require VISA runtime, not provided by Anritsu. NI's VISA version 3.2 or higher is recommended for .NET and USB support.		
Triggering	Internal, External, GPIB Single point, Single Sweep, Single Channel, All Channels 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[a]		
		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

a. Subject to the conditions and including the events specified. Chosen conditions reflect true measurement conditions, based on input from customers on speed environment expectations. Full transparency and disclosure given for best comparisons and decisions.

19. Standard Capabilities

Operating Frequency[a]

MS4642A	10 MHz to 20.2 GHz
MS4644A	10 MHz to 40.5 GHz
MS4645A	10 MHz to 50.5 GHz
MS4647A	10 MHz to 70 GHz
MS4647A-070	Optional for all MS4640A Series VNAs. Provides 40 kHz to 10 MHz Coverage Extension. Provides a lower limit specified to 70 kHz but which is allowed to go to 40 kHz.

a. This is the extended frequency range over which these models and options will operate, but without any implied or warranted performance specifications.

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 MN4690B Series Multiport VNA Measurement System Technical Data Sheet – 11410-00528** which is available at www.anritsu.com/vectorstar.
Domains	Frequency Domain, Power Domain, CW Draw, and Time (Distance) Domain

Sweeps

Frequency Sweep Types	Linear, CW, or Segmented
Power Sweep Types	Linear, Log, or 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, 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, 3, 10, 30, 100, 300 Hz; 1, 3, 10, 30, 100, and 300 kHz; 1 MHz
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.
Attenuations	Attenuations (with frequency slope) and constant phase offsets can also be entered to better describe any reference plane distortions.
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.
Intra-trace Math	Any two traces within a channel can also be combined (via addition, subtraction, multiplication or division) and displayed on another trace.
Scale Resolution	Minimum per division, varies with graph type.
Log Magnitude	0.001 dB
Linear Magnitude	1 pU
Phase	0.01°
Group Delay	0.001 ps
Time	0.001 ps
Distance	0.1 μm
SWR	1 pU
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 x dB bandwidth and frequencies, center frequency, 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.

20. Calibration and Correction Capabilities

Calibration Methods	Short-Open-Load-Through (SOLT) with Fixed or Sliding Load Offset-Short (SSLT) with Fixed or Sliding Load Triple-Offset-Short (SSST) with Fixed or Sliding Load Short-Open-Load-Reciprocal (SOLR) or Unknown Through Method (SSLR, SSSR) Line-Reflect-Line (LRL) / Line-Reflect-Match (LRM) Advanced-LRM (A-LRM™) for improved on-wafer calibrations AutoCal Thru Update available
Correction Models	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)
Merged Calibration	Merge multiple calibrations over bands of frequency points and with different algorithms
Coefficients for Calibration Standards	Use the Anritsu calibration kit USB Memory Device to load kit coefficients and characterization files. Enter manual coefficients into user-defined locations. Use NIST models for Loads.
Reference Impedance	Modify the reference impedance from 50 Ω to any impedance greater than 0 Ω.
Interpolation	Allows interpolation between calibration frequency points.
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 (to usually ≈0.1 dB for short periods of time).
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. Other power levels are then arrived at by offset transfers.
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 MA2438A, MA2488A, MA249xA, Agilent 437 or equivalent) over the Dedicated GPIB port or other suitable control ports.
Embedding/De-embedding	The MS4640A 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.
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.

21. Optional Capabilities

Time Domain Measurements – Option 002

Displays all S-parameters and overlays with Frequency Domain, Low-pass Mode with added harmonics frequency list flexibility, Band-pass Mode, Phasor Impulse Mode, Windowing, Gating (pass-band or reject-band), and Frequency with Time Gate.

Receiver Offset – Option 007

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, 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.

Direct Access Loops – Option 051

Access Loops Per Port	Adds three (3) Access loops per port for Source, Test, and Receive Paths. These loops are included when ordering Option 061/062 shown below. Therefore, Option 051 and Option 061/062 are mutually exclusive.)
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.

Noise Figure – Option 041

Description	Adds VNA 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.
Required Options	Option 051 (above), Option 061, or Option 062 (below) is required.
Compatible Options	Compatible with Option 002 Time Domain, Option 007 Receiver Offset, Option 070 70 kHz Low Frequency Extension, Option 081 Broadband/Millimeter-Wave, and Option 083 Millimeter-Wave Extension.
Incompatible Options	Requires front/rear panel access loops so it cannot be used with Option 080 or 082.
Multiport Systems	Compatible with the MN4690B Series Multiport System on any model VNA but Noise Figure is only when configured as a 2-Port VNA.
Additional Information	For detailed Noise Figure mesurement, theory, description, and operation, see the **VectorStar MS4640A Series VNA Calibration and Measurement Guide – 10410-00269**.

Active Measurements Suite – Option 061/062

Active Measurements Suite	Adds Step Attenuators, Bias Tees, Direct Access Loops, and Gain Compression and Efficiency Measurement Capabilities.
MS4642A and MS4644A Attenuators	70 dB, 10 dB/step
MS4645A and MS4647A Attenuators	60 dB, 10 dB/step
Option 061	Two (2) attenuators: One in Source 1 path, and one in Receive 2 path.
Option 062	Four (4) attenuators: One in each Source path and in each Receive path.
Bias Tees	0.4 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 051 loops, listed above. (Therefore, Option 051, 061, and 062 are mutually exclusive.)
Gain Compression	Swept Power Gain Compression at a CW frequency $P_{x\ dB}$ over Swept Frequency, up to 401 points.

70 kHz Low End Frequency Extension – Option 070

Extends the VNA standard 10 MHz low-end start frequency to 70 kHz, but is allowed to go to 40 kHz, providing 70 kHz to 20, 40, 50, or 70 GHz coverage models.

MS4647A Broadband/Millimeter-Wave Connection Capability – Option 080/081

For a standalone MS4647A VNA instrument. Provides connection capability to the ME7838A Broadband/Millimeter-Wave system.

Option 080	Modular Broadband connection capability for MS4647A VNAs without Option 051, 061, or 062.
Option 081	Modular Broadband connection capability for MS4647A VNAs with Option 051, 061, or 062.
ME7838A Technical Data Sheet	For detailed ME7838A specifications, see the **VectorStar ME7838A Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00593**.

MS4640A Banded Millimeter-Wave Connection Capability – Option 082/083

For standalone MS4642A, MS4644A, MS4645A, and MS4647A VNA instruments. Provides connection capability to the ME7838A Millimeter-Wave system.

Option 082	Millimeter-Wave connection capability for MS4642A, 44A, 45A, or 47A VNAs without Option 051, 061, or 062.
Option 083	Millimeter-Wave connection capability for MS4642A, 44A, 45A, or 47A VNAs with Option 051, 061, or 062.
ME7838A Technical Data Sheet	For detailed ME7838A specifications, see the **VectorStar ME7838A Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00593**.

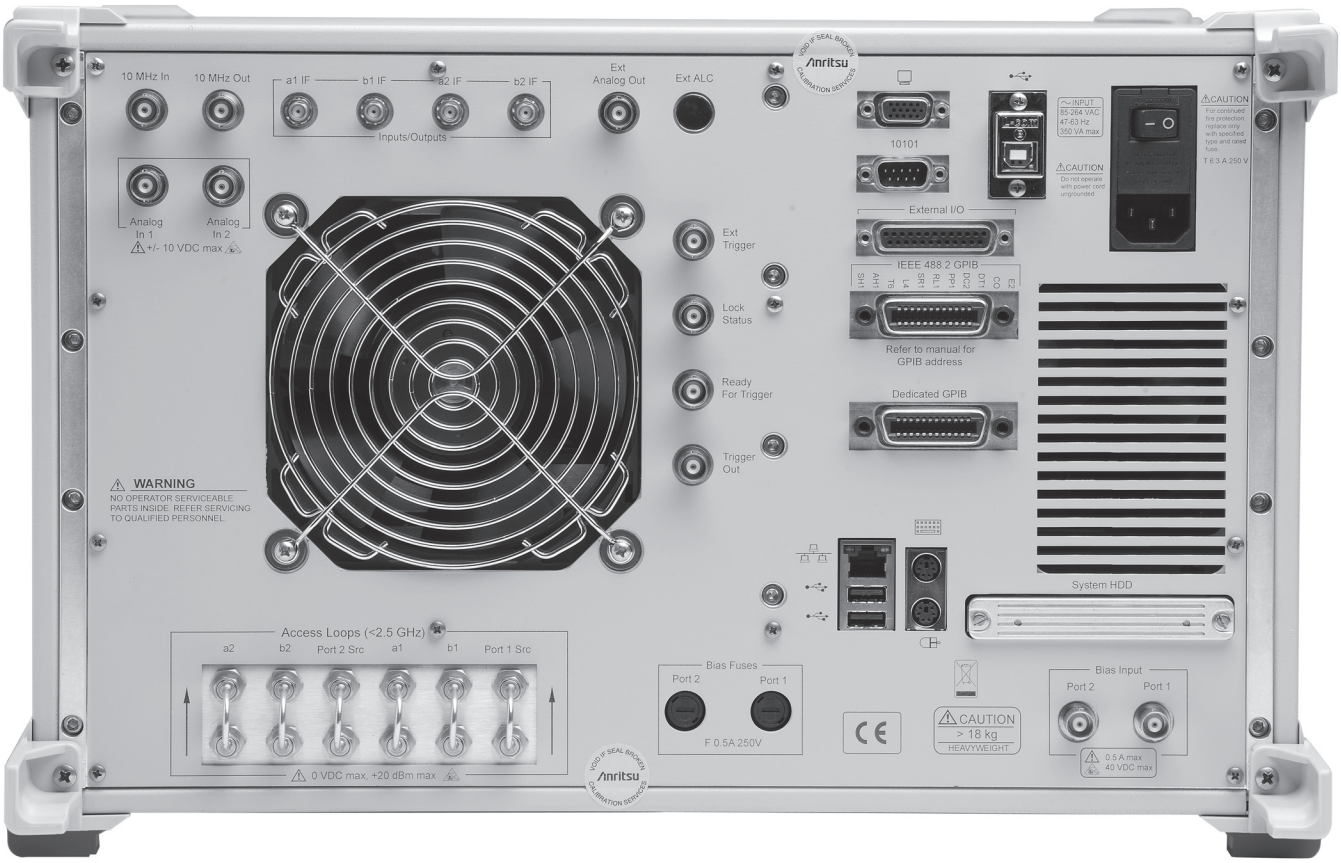
22. veCPU and Related

CPU	Intel I5
Display	26 cm (10.26”) Color XGA Touch-Screen Display
Storage Memory	Serial-ATA (SATA) Solid State Drive (SSD), for OS, Programs, and Data. (> 30 GB)
Security	
Internal Drive	Rear Panel accessible Solid State Drive (SSD).
Removable	Undo two (2) screws and disconnect a single cable to remove SSD.
Additional SSDs	Additional SSDs with installed operating system available (Option 004)
Operating System	Windows XP Professional Environment
Virus Protection	
Best Practices	If the VNA is to be attached to a public-accessible network, best practices recommend a user-installed anti-virus software application. Trend Micro’s Anti-Virus software products have been tested and are recommended by Anritsu for use with the MS4640A Series VNAs.

23. Front Panel Connections

Test Ports 1 and 2	
Type	Universal Test Port Connectors, easily exchangeable in case of damage.
MS4642A and MS4644A	K (male)
MS4645A and MS4647A	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.
MS4642A and MS4644A	K (females)
MS4645A and MS4647A	V (females)
Damage Input Levels	+20 dBm maximum, 0 VDC maximum
USB Ports	Two Type A USB 2.0 Ports for peripherals such as keyboard, mouse, memory stick, hardware key, and similar devices. (Two more Type A USB 2.0 ports located at the rear panel)
Chassis Grounding Port	Banana (female)
Ports to Millimeter-Wave Test Set – Optional	
Type	For RF, LO1, and LO2.
MS4640A	K (females)

24. Rear Panel Connections



MS4640A Rear Panel

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)
System SSD	System Solid State Drive (SSD) Interface
USB, PS/2, and LAN	
USB Control Port	Type B USB 2.0 port for controlling the instrument externally, for remote operation
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)
Keyboard and Mouse Ports	Dedicated PS/2 ports. Can be used for USB peripherals with user-supplied adapters, sparing USB 2.0 ports.
LAN Port	10/100BaseT Ethernet
GPIB Ports	
GPIB Port (Talker/Listener)	Type D-24, female, IEEE 488.2 compatible, for controlling the instrument externally, for remote operation.
GPIB Port (Dedicated Controller)	Type D-24, female, for the control of external instruments such as power meters, external test sets, and similar devices.
External I/O Port	
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.
Pin 1	Limit Pass/Fail
Pins 2, 3, 15, 16	TTL In
Pins 4, 13 14, 21	GND
Pins 5-12, 17-20, 22	TTL Out
Pins 23-25	Reserved
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. Requires Active Measurement Suite Option 061 or 062.
Bias Inputs	BNC (female), one per port
Bias Fuses	0.5A, 250V, one per port.

Direct Access Loops	
Optional	Requires Option 051, 062, or 062.
Connector Type	SMA (females)
Description	For Source, Test, and Receive paths, 3 per port, for < 2.5 GHz frequency coverage
Damage Input Levels	+20 dBm maximum, 0 VDC maximum
IF Inputs/Outputs	a1, a2, b1, b2, IF Inputs/Outputs
Connector Type	SMA (females)
Inputs	Inputs used with external converters such as millimeter-wave modules, or for antenna testing.
Outputs	Outputs used with external IF digitizers and processors.
Nominal Inputs	5 to 20 MHz (mode dependent), 0 dBm for full scale
Nominal Outputs	0.2 to 100 MHz (mode dependent), +10 dBm maximum
10 MHz In	Auto-sensing, better than 1000 ppm accuracy recommended.
Connector Type	BNC (female)
Signal	–10 dBm to +3 dBm, 50 Ω Nominal
10 MHz Out	Derived from the internal reference, unless an external 10 MHz reference input is applied.
Connector Type	BNC (female),
Signal	0 ± 5 dBm sinusoidal, 50 Ω Nominal
Analog In 1 & 2	Two independent inputs for measurements simultaneous with the RF measurements, for current sensing, efficiency computation, power detection, and similar parameters.
Connector Type	BNC (females)
Range	–10 V to +10 V with automatic offset and gain calibrations
Accuracy	2 mV + 2 % for |V| < 5 V; 2 % for |V| > 5 V
Nominal Input Impedance	60 kΩ
Ext Analog Out	For external attenuator control, external switch control, analog triggering assistance, measurement system integration, and other purposes.
Connector Type	BNC (female)
Normal Operating Modes	Sawtooth sync sweep, TTL indication of driving port, open loop level controller.
Range	–10 V to +10 V; low impedance drive
Accuracy	20 mV + 2 % Load: > 5 kΩ
Ext Trigger	
Connector Type	BNC (female)
Voltage Input	0 to 3.3 V input (5 V tolerant)
Impedance	High impedance (> 100 kΩ)
Pulse Width	100 ns minimum input pulse width
Edge Trigger	Programmable edge trigger
Lock Status	
Connector Type	BNC (female)
Voltage Input	0 to 3.3 V input (5 V tolerant)
Impedance	High impedance (> 100 kΩ)
Pulse Width	100 ns minimum input pulse width
Edge Trigger	Positive-edge trigger
Ready for Trigger	
Connector Type	BNC (female)
Voltage Input	0 to 3.3 V latched output
Impedance	Low impedance (≈ 50 Ω)
Voltage	V_{oh} = 2 V min @ -12 mA V_{ol} = 0.8 V max @ +12 mA
Trigger Out	
Connector Type	BNC (female)
Voltage Output	0 to 3.3 V pulse output 1 µsec positive pulse
Impedance	Low impedance (≈ 50 Ω)
Voltage	V_{oh} = 2 V min @ -12 mA V_{ol} = 0.8 V max @ +12 mA

25. Mechanical and Environmental

Dimensions		Without rack mount option.
	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 handles outer edges
	Depth	502 mm body 591 mm between handle and foot outer edges
Weight		< 28 kg (< 60 lbs), Typical weight for a fully-loaded MS4647A 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 95 % at +40 °C, Non-condensing
	Altitude	4,600 m (15,000 feet)
Environmental – Non-Operating		
	Temperature Range	-40 °C to +75 °C
	Relative Humidity	0 % to 90 % at +65 °C, Non-condensing
	Altitude	15,200 m (49,000 feet)
EMI		Meets the emissions and immunity requirements of: EN55011/1991 Class A/CISPR-11 Class A EN50082-1/1993 IEC 801-2/1984 (4 kV CD, 8 kV AD) IEC 1000-4-3/1995 (3 V/m, 80-1000 MHz) IEC 801-4/1988 (500 V SL, 1000 V PL) IEC 1000-4-5/1995 (2 kV L-E, 1 kV L-L)

26. 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, with the longest re-characterization period of 12 months.

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 AutoCals)
Power	DC powered via supplied universal 110/220V 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
EMC	Conforms to the EMC Directive 89/336/EEC per: EN61326, EN55011:1991, EN61000-3-2:1995, EN61000-3-3:1995.
Immunity	EN61000-4-2:1995, EN61000-4-3:1995, EN61000-4-4:1995, EN61000-4-5:1995, EN61000-4-6:1995, EN61000-4-11:1995.

27. Mechanical Calibration Kits

SMA/3.5 mm Calibration Kit, 3650A Series

3650A cal kit provides 50 Ohm 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 ≤ 18.5 GHz) > 30 dB (F > 18.5 GHz)	2	28S50-2
Termination 3.5 mm (female)		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	8 mm (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	–
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

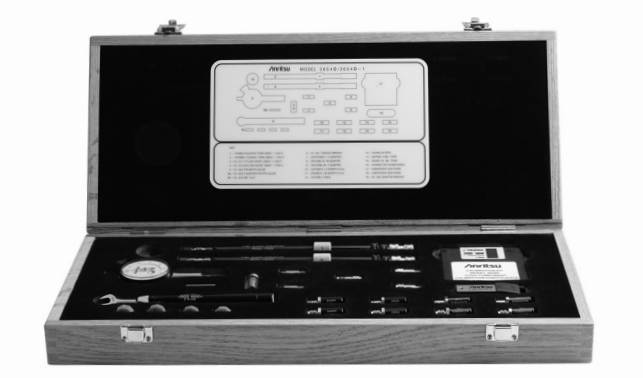
3652A cal kit provides 50 Ohm calibrations, for K devices. 3652A-1 cal kit includes Sliding Loads

3652A Cal Kit contains:	Additional Information (typical)	Quantity	Part Number
Termination K (male)	Return Loss: > 34 dB (F ≤ 18.5 GHz) > 32 dB (F ≤ 40 GHz)	2	28K50A
Termination K (female)		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	8 mm (5/16”), 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	–
3652A-1 Cal Kit adds:	**Additional Information (typical)**	**Quantity**	**Part Number**
Sliding Termination K (male)		1	17K50
Sliding Termination K (female)		1	17KF50
Flush Short (male)		1	01-211
Flush Short (female)		1	01-212

V (1.85 mm) Calibration Kit, 3654D Series

3654D cal kit provides 50 Ohm calibrations, for V devices. 3654D-1 cal kit includes Sliding Loads.

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) > 32 dB (F ≤ 67 GHz) > 28 dB (F ≤ 70 GHz)	2	28V50D
Termination V (female)		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	33VFVF50C
Adapter, V (male) to V (female)		2	33VVF50C
Torque Wrench	8 mm (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-1 Cal Kit adds:	**Additional Information (typical)**	**Quantity**	**Part Number**
Sliding Termination V (male)		1	17V50C
Sliding Termination V (female)		1	17VF50C
Flush Short (male)		1	01-312
Flush Short (female)		1	01-311



3654D Series, V (1.85 mm) Calibration Kit

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

The 3657 Calibration Kit provides 50 Ohm 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		Quantity	Part Number
Line 1	Electrical Length = 15 mm; 50 ohms	Center Conductor	1	65899-1
		Outer Conductor	1	65898-1
Line 2	Electrical Length = 16.7 mm; 50 ohms	Center Conductor	1	65899-2
		Outer Conductor	1	65898-2
Line 3	Electrical Length = 18.4 mm; 50 ohms	Center Conductor	1	65899-3
		Outer Conductor	1	65898-3
Line 4	Electrical Length = 20.1 mm; 50 ohms	Center Conductor	1	65899-4
		Outer Conductor	1	65898-4
Line 5	Electrical Length = 21.8 mm; 50 ohms	Center Conductor	1	65899-5
		Outer Conductor	1	65898-5
Line 6	Electrical Length = 49.84 mm; 50 ohms	Center Conductor	1	65899-6
		Outer Conductor	1	65898-6
Tool, Center Conductor Removal Plug			1	65922
Fixture, Center Conductor Installation, Short	For Lines 1-5		1	65901-1
Fixture, Center Conductor Installation, Long	For Line 6		1	65901-6
Open-Ended Wrench	7 mm		1	783-1243
Torque Wrench	8 mm (5/16 in), 0.9 N·m (8 lbf·in)		1	01-201
3657-1 Cal Kit adds:	**Additional Information**		**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

28. 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 Sliding Loads for the 3666-1, 3668-1, and 3669B-1 Verification Kits. The verification kits are used with the 365x-1 Cal Kits, and 36585X Series AutoCal, male-female version. Cal Kits and AutoCal are purchased separately. Verification is also provided as a service, eliminating the investment in kits. These verification kits are dedicated for the MS4640A Series VNAs, and are not for older VNAs.

VectorStar MS4640A 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

29. 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.us.anritsu.com.

30. Test Port Cables

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

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

a. Typical

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

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

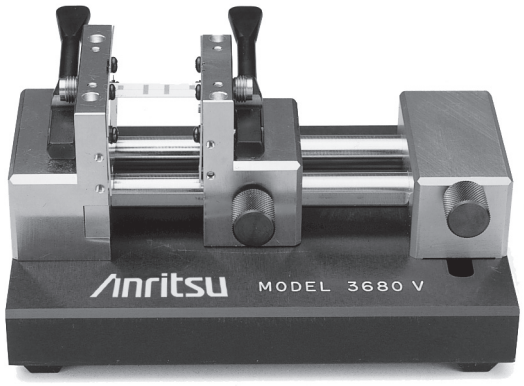
3671-Series Test Port Cables, Flexible, Phase Stable, up to 67 GHz

Description[a]	Frequency Range	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 20 GHz	50 Ω	0.11+ 0.01f + 0.30 √f	≥ 18 dB	≤ (0.5+ 0.13f) (1 coil)	63.5 cm (25 in)	3671S50-1 2 cables
K (female) to K (male or female)	DC to 40 GHz	50 Ω	0.26+ 0.006f + 0.46 √f	≥ 16 dB	(0.5+ 0.08f) (1/2 coil)	63.5 cm (25 in)	3671K50-1 2 cables
K (female) to K (male)	DC to 40 GHz	50 Ω	0.39+ 0.013f + 0.64 √f	≥ 16 dB	≤ (0.5+ 0.17f) (1 coil)	96.5 cm (38 in)	3671K50-2 1 cable
K (female) to K (male) K (female) to K (female)	DC to 40 GHz	50 Ω	0.26+ 0.006f + 0.46 √f	≥ 16 dB	(0.5+ 0.08f) (1/2 coil)	63.5 cm (25 in)	3671K50-3 1 male cable 2 female cable
V (female) to V (male)	DC to 67 GHz	50 Ω	8.5	≥ 14	≤ 8.5 (1/2 coil)	63.5 cm (25 in)	3671V50B-1 2 cables
V (female) to V (male)	DC to 67 GHz	50 Ω	8.5	≥ 14	≤ 10.5 (1 coil)	96.5 cm (38 in)	3671V50B-2 1 cable

a. The initial K or V (female) connector is a ruggedized style connector for VNA test ports. Does not fit standard male connectors.

31. 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 25 mil, 20 GHz, 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 20 to 40 40 to 60	> 17 > 14 > 8	< ± 0.10 < ± 0.20 < ± 0.30	DC to 20 GHz	3680-20
				DC to 40 GHz	3680K
				DC to 60 GHz	3680V
Right Angle Launcher	DC to 20 20 to 40 40 to 60	> 16 > 12 > 7	< ± 0.15 < ± 0.25 < ± 0.40	DC to 40 GHz	36801K
				DC to 60 GHz	36801V

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

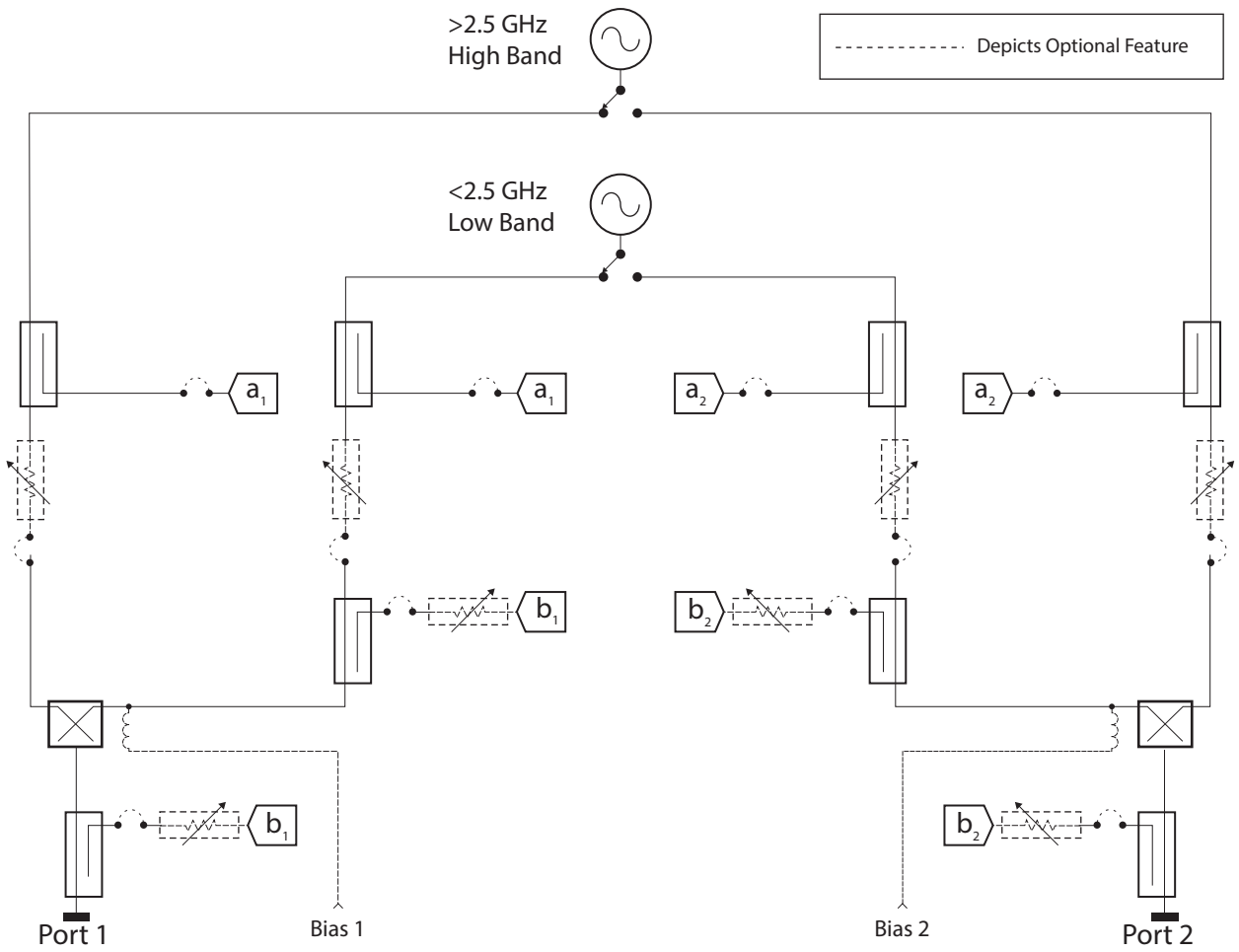
UTF Right Angle Launcher

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)

32. Warranty

Standard Warranty	Standard warranty included free-of-charge.
Additional Warranty Options	Additional warranty available.
Instrument and Built-In Options	3 years from the date of shipment
Calibration Kits and AutoCal modules	1 year from the date of shipment
Test Port Cables	1 year from the date of shipment
All Other Accessories	1 year from the date of shipment

33. Block Diagram



MS4640A Series VNA Block Diagram – Fully Loaded Configuration

34. Ordering Information

Instrument Models	The VectorStar MS4640A Series VNAs are available in four models to meet different frequency range requirements. Refer to section **19. Standard Capabilities** on page 27 above for extended operational frequency ranges.
MS4642A	Vector Network Analyzer 10 MHz to 20 GHz
MS4644A	Vector Network Analyzer 10 MHz to 40 GHz
MS4645A	Vector Network Analyzer 10 MHz to 50 GHz
MS4647A	Vector Network Analyzer 10 MHz to 70 GHz
Included Accessories	Each VNA comes with a set of included accessories.
User Documentation CD	The user documentation CD 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. A standalone copy of the help is included on the user documentation CD.
Peripherals	Optical USB Mouse
Power	Power Cord
Main VNA Options	
MS4640A-001	Rack Mount, Adds handles and removes feet for shelf-mounting into a 19” universal rack.
MS4640A-002	Time Domain
MS4640A-004	Additional Solid State Drive (SSD), Serial-ATA With OS and VectorStar Application Software and is quickly field pluggable at rear panel.
MS4640A-007	Receiver Offset
MS4640A-041	Noise Figure, requires Option 051, 061, or 062.
MS464xA-051	Direct Access Loops, see description below.
MS464xA-061/062	Active Measurement Suite options, see description below.
MS4640A-070	70 kHz Low-End Frequency Extension
Direct Access Loop Options	Direct access loops are not available for VNAs equipped with Options 061 or 062 (which include loops).
MS4642A-051	Direct Access Loops for MS4642A, not available with Options 061 or 062
MS4644A-051	Direct Access Loops for MS4644A, not available with Options 061 or 062
MS4645A-051	Direct Access Loops for MS4645A, not available with Options 061 or 062
MS4647A-051	Direct Access Loops for MS4647A, not available with Options 061 or 062
Active Measurement Suite Options	
MS4642A-061	Active Measurements Suite, For MS4642A, With 2 Step Attenuators
MS4642A-062	Active Measurements Suite, For MS4642A, With 4 Step Attenuators
MS4644A-061	Active Measurements Suite, For MS4644A, With 2 Step Attenuators
MS4644A-062	Active Measurements Suite, For MS4644A, With 4 Step Attenuators
MS4645A-061	Active Measurements Suite, For MS4645A, With 2 Step Attenuators
MS4645A-062	Active Measurements Suite, For MS4645A, With 4 Step Attenuators
MS4647A-061	Active Measurements Suite, For MS4647A, With 2 Step Attenuators
MS4647A-062	Active Measurements Suite, For MS4647A, With 4 Step Attenuators
Multiport VNA Options	The multiport VNA option provides four test ports for all VectorStar MS4640A Series VNAs with the MN4690B Series Multiport 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.
MN4694B	40 kHz to 40 GHz, Use the MN4694B Test Set with MS4642A and MS4644A VNAs.
MN4697B	40 kHz to 70 GHz, Use the MN4697B Test Set with MS4645A and MS4647A VNAs.
Documentation	For detailed MN4690B specifications, see the: **VectorStar MN4690B Series Multiport VNA Technical Data Sheet – 11410-00528**.
Broadband/Millimeter-Wave Options	Provides the MS4647A VNA with the capability to connect with the ME7838A Modular Broadband/Millimeter-Wave VNA System. Option 007 Receiver Offset (described above) is also required.
MS4647A-080	Modular Broadband/Millimeter-Wave Capability. For MS4647A VNAs without Option 051, 061, or 062. If equipped on a MS4647A VNA, Option 082 below cannot be added.
MS4647A-081	Modular Broadband/Millimeter-Wave Capability. For MS4647A VNAs with Option 051, 061, or 062. If equipped on an MS4647A VNA, Option 083 below cannot be added.
Documentation	For detailed ME7838A specifications, see the: **VectorStar ME7838A Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00593**.

Millimeter-Wave Options	Provides millimeter-wave capability for MS4642A, MS4644A, MS4645A, or MS4647A VNAs to connect with the ME7838A Modular/Broadband/Millimeter-Wave VNA System. Option 007 Receiver Offset (described above) is also required.
MS4640A-082	Millimeter-Wave capability for MS4642A, MS4644A, MS4645A, and MS4647A VNAs not equipped with Option 051, 061, or 062. If equipped, Option 080 above cannot be added.
MS4640A-083	Millimeter-Wave capability for MS4642A, MS4644A, MS4645A, and MS4647A VNAs equipped with Option 051, 061, or 062. If equipped, Option 081 above cannot be added.
Documentation	For detailed ME7838A specifications, see the: **VectorStar ME7838A Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00593**.
Calibration Options	
MS4640A-098	Z540/Guide 25 Calibration, No Data
MS4640A-099	Premium Calibration, With Data
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)
Standard Automatic Calibrator Modules (Standard AutoCal)	
36581KKF	K Standard AutoCal Module, 40 MHz to 20 GHz, K (male) to K (female)
36583S	Matched Adapters Set, SMA, For Standard AutoCal
36583L	Matched Adapters Set, 3.5 mm, For Standard AutoCal
36583K	Matched Adapters Set, K, For Standard AutoCal
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, Without Sliding Loads
3652A-1	K Calibration Kit, With Sliding Loads
3654D	V Calibration Kit, Without Sliding Loads
3654D-1	V Calibration Kit, With Sliding Loads
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
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	
3671S50-1	K* (female) to 3.5 mm (male), 2 each 63.5 cm (25 in)
3671K50-1	K* (female) to K (male), 2 each, 63.5 cm (25 in)
3671K50-2	K* (female) to K (male), 1 each, 96.5 cm (38 in)
3671K50-3	K* (female) to K (male), 1 each, 63.5 cm (25 in) K* (female) to K (female), 1 each 63.5 cm (25 in)
3671V50B-1	V* (female) to V (male), 2 each, 63.5 cm (25 in), rated to 67 GHz
3671V50B-2	V* (female) to V (male), 1 each 96.5 cm (38 in), rated to 67 GHz
	* Ruggedized style female connectors for VNA test ports. Does not fit standard male connectors.
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)

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

760-246-R	Transit Case, for all MS4640A Series VNAs, Hard plastic with wheels, 85 cm x 70 cm x 45 cm

Tools

01-201	Torque End Wrench, 8 mm (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”), 0.9 N·m (8 lbf·in), For tightening the VNA test ports to female devices.
01-204	End Wrench, 8 mm (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 W1 connectors.
01-505	6 mm × 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 CD	Soft copies of the manuals as Adobe PDF files are included on the User Documentation CD which 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 at nominal charge.
10410-00266	MS4640A Series VNA Operation Manual (OM)
10410-00307	MS4640A Series VNA User Interface Reference Manual (UI-RM)
10410-00267	MS4640A Series VNA Programming Manual (PM), For IEEE 488.2, System and Troubleshooting, and SCPI Commands
10410-00308	MS4640A Series VNA Programming Manual Supplement (PM-S), For Lightning 37xxxX and HP8510 Commands
10410-00269	MS4640A Series VNA Calibration and Measurement Guide (MG)
10410-00268	MS4640A Series VNA Maintenance Manual (MM)

35. 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	MS4642A	MS4642A-ES311
			MS4644A	MS4644A-ES311
			MS4645A	MS4645A-ES311
			MS4647A	MS4647A-ES311
On-Site	3 Years	Standard Calibration	MS4642A	MS4642A-ES314
			MS4644A	MS4644A-ES314
			MS4645A	MS4645A-ES314
			MS4647A	MS4647A-ES314
On-Site	3 Years	Premium Calibration	MS4642A	MS4642A-ES318
			MS4644A	MS4644A-ES318
			MS4645A	MS4645A-ES318
			MS4647A	MS4647A-ES318
Service Center	3 Years	Standard Calibration	MS4642A	MS4642A-ES312
			MS4644A	MS4644A-ES312
			MS4645A	MS4645A-ES312
			MS4647A	MS4647A-ES312
Service Center	3 Years	Premium Calibration	MS4642A	MS4642A-ES315
			MS4644A	MS4644A-ES315
			MS4645A	MS4645A-ES315
			MS4647A	MS4647A-ES315
Service Center	5 Years	Repair Only	MS4642A	MS4642A-ES510
			MS4644A	MS4644A-ES510
			MS4645A	MS4645A-ES510
			MS4647A	MS4647A-ES510
Service Center	5 Years	Standard Calibration	MS4642A	MS4642A-ES512
			MS4644A	MS4644A-ES512
			MS4645A	MS4645A-ES512
			MS4647A	MS4647A-ES512
Service Center	5 Years	Premium Calibration	MS4642A	MS4642A-ES515
			MS4644A	MS4644A-ES515
			MS4645A	MS4645A-ES515
			MS4647A	MS4647A-ES515
Service Center	5 Years	Repair and Standard Calibration	MS4642A	MS4642A-ES513
			MS4644A	MS4644A-ES513
			MS4645A	MS4645A-ES513
			MS4647A	MS4647A-ES513
Service Center	5 Years	Repair and Premium Calibration	MS4642A	MS4642A-ES516
			MS4644A	MS4644A-ES516
			MS4645A	MS4645A-ES516
			MS4647A	MS4647A-ES516

Post-Delivery Upgrade Options

Contact your local Anritsu service center for adding internal options, or increasing the frequency coverage of your existing MS4640A Series VNA.

Notes

VectorStar®

Find Drivers, Utilities, Software Updates, and other Helpful Tools at the VectorStar Users Site. Visit:
www.anritsu.com/en-us/Products-Solutions/Solution/Welcome-to-the-VectorStar-Users-Site-.aspx

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