VECTOR NETWORK ANALYZERS

Selection Guide

Group	Model	Frequency Band	Measurement Function									
			S-Parameter	Power Sweep Mode	Receiver Offset Mode (Option)	Multiple-source Control (Option)	Time Domain (Option)	Mixer Measurement (Option)	Pulse (Option)	Internal Second Source (Option)	Spectrum Analyzer	Distance-to-Fault (DTF)
VectorStar	MS4642B	70 kHz to 20 GHz	✓	✓	✓	✓	✓	✓	✓	✓		
	MS4644B	10 MHz to 40 GHz*1	✓	✓	✓	✓	✓	✓	✓	✓		
	MS4647B	10 MHz to 70 GHz*1	✓	✓	✓	✓	✓	✓	✓	✓		
	ME7838A/AX	70 kHz to 110 GHz/125 GHz (1.1 THz)	✓	✓	✓	✓	✓	✓	✓	✓		
	ME7838A4/A4X	70 kHz to 110/125/145 GHz (1.1 THz)	✓	✓	✓	✓	✓	✓	✓	✓		
	ME7838D	70 kHz to 145 GHz (1.1 THz)	✓	✓	✓	✓	✓	✓	✓	✓		
	ME7838D4	70 kHz to 140 GHz/150 GHz (1.1 THz)	✓	✓			✓		✓			
	ME7838E/EX	70 kHz to 110 GHz (1.1 THz)	✓	✓	✓	✓	✓	✓	✓	✓		
	ME7838E4/E4X	70 kHz to 110 GHz (1.1 THz)	✓	✓			✓		✓			
	ME7838G	70 kHz to 220 GHz										
	ME7838G4	70 kHz to 220 GHz										
	ME7848A	10 MHz to 110 GHz										
ShockLine	MS46121B	150 kHz to 6 GHz	✓				✓					
	MS46122B	1 MHz to 8 GHz 1 MHz to 20 GHz 1 MHz to 43.5 GHz	✓				✓					
	MS46131A	1 MHz to 43.5 GHz	✓				✓					
	MS46322B	1 MHz to 8 GHz 1 MHz to 20 GHz 1 MHz to 43.5 GHz	✓				✓					
	MS46522B	50 kHz to 8.2/20/43.5 GHz, E-band	✓	✓		✓	✓					
	MS46524B	50 kHz to 8.5/20/43.5 GHz	✓	✓		✓	✓					
	ME7868A	1 MHz to 43.5 GHz	✓				✓					
VNA Master	MS2036C	5 kHz to 6 GHz 9 kHz to 9 GHz	✓				✓				✓	✓
	MS2037C	5 kHz to 15 GHz 9 kHz to 15 GHz	✓				✓				✓	✓
	MS2038C	5 kHz to 20 GHz 9 kHz to 20 GHz	✓				✓				✓	✓
	MS2024B	500 kHz to 4 GHz	✓*2									✓
	MS2025B	500 kHz to 6 GHz	✓*2									✓
	MS2034B	500 kHz to 4 GHz 9 kHz to 4 GHz	✓*2								✓	✓
	MS2035B	500 kHz to 6 GHz 9 kHz to 6 GHz	✓*2								✓	✓

*1: Requires Option 070 (70 kHz Frequency Extension)
*2: S_{11}/S_{21} measurement by 1 path 2 ports calibration can be performed.

Selection Guide (Frequency Range)

Group	Model	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	2 MHz	5 MHz	10 MHz	20 MHz	50 MHz	100 MHz	200 MHz	500 MHz	1 GHz	2 GHz	5 GHz	10 GHz	20 GHz	50 GHz	100 GHz	500 GHz	750 GHz	1 THz	Remarks
VectorStar	MS4642B																								70 kHz to 20 GHz
	MS4644B																								10 MHz to 40 GHz*1
	MS4647B																								10 MHz to 70 GHz*1
	ME7838A/AX																								70 kHz to 110 GHz/125 GHz (1.1 THz)
	ME7838A4/A4X																								70 kHz to 110/125/145 GHz (1.1 THz)
	ME7838D																								70 kHz to 145 GHz (1.1 THz)
	ME7838D4																								70 kHz to 145/150 GHz (1.1 THz)
	ME7838E/EX																								70 kHz to 110 GHz (1.1 THz)
	ME7838E4/E4X																								70 kHz to 110 GHz (1.1 THz)
	ME7838G																								70 kHz to 220 GHz
	ME7838G4																								70 kHz to 220 GHz
	ME7848A																								10 MHz to 110 GHz
ShockLine	MS46121B																								150 kHz to 6 GHz
	MS46122B																								1 MHz to 8 GHz/20 GHz/ 43.5 GHz
	MS46131A																								1 MHz to 43.5 GHz
	MS46322B																								1 MHz to 8 GHz/20 GHz/ 43.5 GHz
	MS46522B																								50 kHz to 8.5 GHz/20 GHz/ 43.5 GHz, 55 GHz to 92 GHz*3
	MS46524B																								50 kHz to 8.5 GHz/20 GHz/ 43.5 GHz
	ME7868A																								1 MHz to 43.5 GHz

*1: Requires Option 070 (70 kHz Frequency Extension)
*2: Requires Option 2 (2 MHz Frequency Extension)
*3: Requires Option 082 or 083

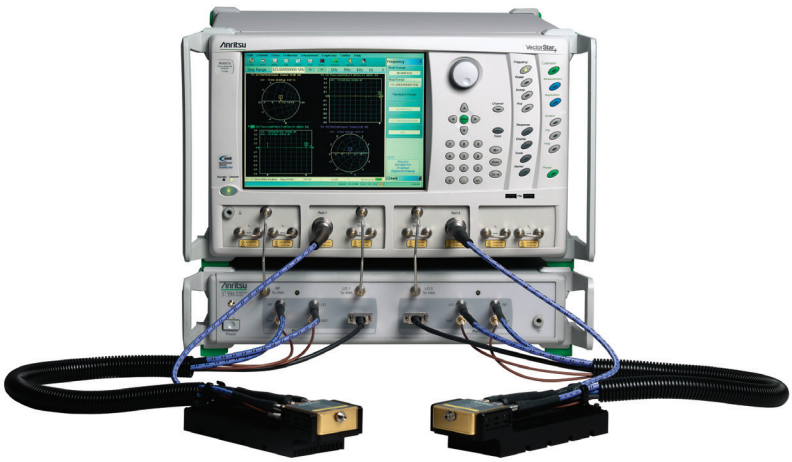
VectorStar™ Broadband Vector Network Analyzers

ME7838A/AX/E/EX/D/G Series

Broadband Coaxial and Millimeter Waveguide VNA System, 70 kHz to 1.1 THz

Remote Control
GPIB | Ethernet

High Performance, Broadband Network Analysis Solutions



VectorStar®

The VectorStar ME7838 Broadband series system provides high performance in a compact mmWave module with industry-best calibration stability. While other broadband systems continue to provide raw performance with negative directivity in critical frequency bands, the ME7838 series is the only broadband system with positive raw directivity in all bands. The result is better calibration stability and better measurement stability with significantly longer time between calibrations for accurate measurements and improved productivity. The VectorStar ME7838 VNA series delivers 94 dB dynamic range at 145 GHz for high-sensitivity measurements across 70 kHz to 110, 125, and 145 GHz (up to 1.1 THz with mmWave modules) with typical performance better than 0.01 dB and 0.1 degrees S_{21} stability over 24 hours at 25°C. This stable broadband performance means you can make high-accuracy measurements all day, with the confidence that your calibration remains rock solid! Spend less time calibrating and more time measuring.

Broadband/Millimeter-Wave System Options

- MS4640B-002 – Time Domain
- MS4640B-021 – Universal Fixture Extraction
- MS464xB-031 – Dual Source Architecture
- MS464xB-032 – Internal RF Combiner
- MS4640B-035 – IF Digitizer
- MS4640B-036 – Extended IF Digitizer Memory
- MS4640B-041 – Noise Figure
- MS4640B-042 – PulseView™
- MS4640B-043 – DifferentialView™
- MS4640B-044 – IMDView™
- MS4640B-046 – Fast CW
- MS4640B-047 – Eye Diagram
- MS4640B-048 – Differential Noise Figure
- MS464xB-051 – External VNA Direct Access Loops
- MS464xB-061 – Active Measurement Suite, with 2 Attenuators
- MS464xB-062 – Active Measurement Suite, with 4 Attenuators
- SC8215 and SC7287 – Kelvin Bias Tees

Definitions

All specifications and characteristics apply under the following conditions, unless otherwise stated:

Warm-Up Time	After 90 minutes of warm-up time, where the instrument is left in the ON state.
Temperature Range	Over the 25°C±5°C temperature range.
Error-Corrected Specifications	For error-corrected specifications, over 23°C±3°C, with <1°C variation from calibration temperature. For error-corrected specifications are warranted and include guard bands, unless otherwise stated.
Typical Performance	"Typical" specifications describe expected, but not warranted, performance based on sample testing. Typical performance indicates the measured performance of an average unit and do not guarantee the performance of any individual product. "Typical" specifications do not account for measurement uncertainty and are shown in parenthesis, such as (–102 dB), or noted as Typical.
User Cables/Adapters	Specifications do not include effects of any user cables adapters, fixtures, or other structures 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.
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
Interpolation Mode	All specifications are with Interpolation Mode Off.
Specifications Subject to Change	All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site at www.anritsu.com.

Specifications for Broadband Configuration

ME7838A/AX/E/EX Broadband System 70 kHz to 110/125 GHz, ME7838D Broadband System 70 kHz to 145 GHz (150 GHz), ME7838G Broadband System 70 kHz to 220 GHz

System and Receiver Dynamic Range, Noise Floor

System dynamic range is measured as the difference between maximum port power and the RMS noise floor in a 10 Hz bandwidth and no averaging (ports terminated).
Noise floor is calculated as the difference between maximum rated port power and system dynamic range.
Receiver Dynamic Range is calculated as the difference between the receiver compression level and the noise floor at Ports 1 or 2.
Normalizing measurement made with a through line connection, with its effects compensated for. The cables between the VNA and the 3743A modules are assumed to be the 806-206-R 1.85 mm cable (61 cm, 24 in long) or the 806-209-R 1.85 mm cable (91.5 cm, 36 in long).
All values are typical.

Frequency Range (GHz)	System Dynamic Range (dB)*1								Receiver Dynamic Range (dB)*1							
	ME7838A*2	ME7838A Option 62*3	ME7838E*2	ME7838E Option 62*3	ME7838D	ME7838D Option 62	ME7838G	ME7838G Option 62	ME7838A*2	ME7838A Option 62*3	ME7838E*2	ME7838E Option 62*3	ME7838D	ME7838D Option 62	ME7838G	ME7838G Option 62
70 kHz to 300 kHz	93	90	93	90	93	90	93	90	89	86	89	86	89	86	89	88
>0.3 MHz to 2 MHz	103	100	103	100	103	100	103	100	103	102	103	102	103	102	103	104
>2 MHz to 10 MHz	115	112	115	112	115	112	115	112	115	114	115	114	115	114	115	114
>0.01 to 2.5 GHz	120	116	120	116	120	116	120	116	121	122	121	122	121	122	121	122
>2.5 to 24	110	105	110	105	110	105	110	105	121	121	121	121	121	121	121	122
>24 to 54	108	105	108	105	110	107	110	107	124	123	124	123	125	125	126	126
>54 to 60	112	112	112	112	110	110	112	112	122	122	122	122	124	124	126	126
>60 to 65	108	108	108	108					117	117	117	117	123	123		
>60 to 67					110	110	109	109					123	123	122	122
>65 to 80	108	108	108	108					120	120	120	120				
>67 to 80					108	108	109	109					121	121	122	122
>80 to 85	110	110	110	110	106	106	106	106	123	123	123	123	123	123	123	123
>85 to 90	108	108	108	108	106	106	106	106	121	121	121	121	122	122	122	122
>90 to 95	112	112	111	111	106	106	106	106	121	121	121	121	121	121	122	122
>95 to 100	108	108	107	107					117	117	117	117				
>95 to 105					106	106	106	106					121	121	122	122
>100 to 110	109	109	109	109					122	122	122	122				
>105 to 110					109	109	106	106					125	125	122	122
>110 to 120	107	107			108	108	109	109	115	115			118	118	123	123
>120 to 125	104	104			104	104	109	109	112	112			116	116	123	123
>125 to 140					92	92	100	100					109	109	122	122
>140 to 145					94	94							107	107		
>140 to 150							100	100							122	122
>150 to 160							97	97							119	119
>160 to 180							102	102							122	122
>180 to 200							103	103							123	123
>200 to 220							100	100							122	122

Frequency Range (GHz)	Nose Figure (dBm)*1							
	ME7838A*2	ME7838A Option 62*3	ME7838E*2	ME7838E Option 62*3	ME7838D	ME7838D Option 62	ME7838G	ME7838G Option 62
70 kHz to 300 kHz	–83	–82	–83	–82	–83	–82	–83	–82
>0.3 MHz to 2 MHz	–93	–92	–93	–92	–93	–92	–93	–92
>2 MHz to 10 MHz	–105	–102	–105	–102	–105	–102	–105	–102
>0.01 to 2.5 GHz	–110	–109	–110	–109	–110	–109	–110	–109
>2.5 to 24	–110	–108	–110	–108	–110	–108	–110	–109
>24 to 54	–114	–113	–114	–113	–115	–115	–116	–116
>54 to 60	–112	–112	–112	–112	–114	–114	–116	–116
>60 to 65	–107	–107	–107	–107				
>60 to 67					–113	–113	–112	–112
>65 to 80	–110	–110	–110	–110				
>67 to 80					–111	–111	–112	–112
>80 to 85	–113	–113	–113	–113	–113	–113	–113	–113
>85 to 90	–111	–111	–111	–111	–112	–112	–112	–112
>90 to 95	–111	–111	–111	–111	–111	–111	–112	–112
>95 to 100	–107	–107	–107	–107				
>95 to 105					–111	–111	–112	–112
>100 to 110	–112	–112	–112	–112				
>105 to 110					–115	–115	–112	–112
>110 to 120	–110	–110			–111	–111	–116	–116
>120 to 125	–107	–107			–109	–109	–116	–116
>125 to 140					–102	–102	–115	–115
>140 to 145					–100	–100		
>140 to 150							–115	–115
>150 to 160							–112	–112
>160 to 180							–115	–115
>180 to 200							–116	–116
>200 to 220							–115	–115

*1: Excludes localized spurious responses and crosstalk
*2: Also ME7838A/AX/E/EX Option 61, S_{12} values
*3: Also ME7838A/AX/E/EX Option 61, S_{21} values

Frequency Range (GHz)	System Dynamic Range (dB)*1				Receiver Dynamic Range (dB)*1				Nose Figure (dBm)*1			
	ME7838A	ME7838AX Option 61 or 62	ME7838E	ME7838EX Option 61 or 62	ME7838A	ME7838AX Option 61 or 62	ME7838E	ME7838EX Option 61 or 62	ME7838A	ME7838AX Option 61 or 62	ME7838E	ME7838EX Option 61 or 62
70 kHz to 300 kHz	95	95	95	95	91	94	91	94	–85	–88	–85	–88
>0.3 MHz to 2 MHz	107	107	107	107	107	112	107	112	–97	–100	–97	–100
>2 MHz to 10 MHz	130	130	130	130	128	132	128	132	–118	–120	–118	–120
>0.01 to 2.5 GHz	119	117	119	117	120	122	120	122	–109	–109	–109	–109
>2.5 to 10	117	113	117	113	124	124	124	124	–113	–111	–113	–111
>10 to 24	109	113	109	113	1021	128	121	128	–110	–115	–110	–115
>24 to 40	107	103	107	103	119	117	119	117	–109	–107	–109	–107
>40 to 54	107	103	107	103	124	124	124	124	–114	–114	–114	–114
>54 to 60	107	107	107	107	119	119	119	119	–109	–109	–109	–109
>60 to 65	107	107	107	107	119	119	119	119	–109	–109	–109	–109
>65 to 70					122	122	122	122	–112	–112	–112	–112
>65 to 80	106	106	106	106								
>70 to 80					120.5	121	120.5	120.5	–110.5	–110.5	–110.5	–110.5
>80 to 90	104	104	104	104	120.5	120.5	12035	120.5	–110.5	–110.5	–110.5	–110.5
>90 to 100	104	104	104	104	116.5	116.5	116.5	116.5	–106.5	–106.5	–106.5	–106.5
>100 to 110	104	104	104	104	120.5	120.5	120.5	120.5	–110.5	–110.5	–110.5	–109.5
>110 to 115	103	103			120	120			–110	–110		
>115 to 120	97	97			105	105			–100	–100		
>120 to 125	97	97			105	105			–100	–100		

*1: Excludes localized spurious responses and crosstalk

Test Port Power, Receiver Compression*1

Port power control is provided by the base VNA for frequencies below 54 GHz, and by the 3743A mmWave module for frequencies greater than 54 GHz. Receiver compression point is defined as the port power level beyond which the response may be compressed more than 0.2 dB relative to normalization level. 10 Hz IF bandwidth used to remove trace noise effects. All typical.

Frequency Range (GHz)	Port Power											
	Max. Power ME7838A	Max. Power ME7838A Option 62*2	Max. Power ME7838AX	Max. Power ME7838AX Option 61 or 62	Max. Power ME7838E	Max. Power ME7838E Option 62*2	Max. Power ME7838EX	Max. Power ME7838EX Option 61 or 62	Max. Power ME7838D	Max. Power ME7838D Option 62*2	Max. Power ME7838G	Max. Power ME7838G Option 62*2
70 kHz to 300 kHz	10	8	10	7	10	8	10	7	10	8	10	8
>0.3 MHz to 2 MHz	10	8	10	7	10	8	10	7	10	8	10	8
>2 MHz to 10 MHz	10	10	12	10	10	10	12	10	10	10	10	10
>0.01 to 2.5	10	7	10	8	10	7	10	8	10	7	10	7
>2.5 to 10			4	2			4	2				
>2.5 to 24	0	–3			0	–3			0	–3	0	–4
>10 to 24			–1	–2			–1	–2				
>24 to 40			–2	–4			–2	–4				
>24 to 54	–6	–8			–6	–8			–5	–8	–6	–9
>40 to 54			–7	–11			–7	–11				
>54 to 60	0	0	–2	–2	0	0	–2	–2	–4	–4	–4	–4
>60 to 65	1	1	–2	–2	1	1	–2	–2				
>60 to 67									–3	–3	–3	–3
>65 to 70			–6	–6			–6	–6				
>65 to 80	–2	–2			–2	–2						
>67 to 80									–3	–3	–3	–3
>70 to 80			–4.5	–4.5			–4.5	–4.5				
>80 to 85	–3	–3	–6.5	–6.5	–3	–3	–6.5	–6.5	–7	–7	–7	–7
>85 to 90	–3	–3	–6.5	–6.5	–3	–3	–6.5	–6.5	–6	–6	–6	–6
>90 to 95	1	1	–2.5	–2.5	0	0	–2.5	–2.5	–5	–5	–6	–6
>95 to 100	1	1	–2.5	–2.5	0	0	–2.5	–2.5				
>95 to 105									–5	–5	–6	–6
>100 to 110	–3	–3	–6.5	–6.5	–3	–3	–6.5	6.5				
>105 to 110									–6	–6	–6	–6
>110 to 115			–7	–7								
>110 to 120	–3	–3							–3	–3	–7	–7
>115 to 120			–3	–3								
>120 to 125	–3	–3	–3	–3					–5	–5	–7	–7
>125 to 140									–10	–10	–15	–15
>140 to 145									–6	–6		
>140 to 150											–15	–15
>150 to 160											–15	–15
>160 to 180											–13	–13
>180 to 200											–13	–13
>200 to 220											–15	–15
>220 to 226											–18	–18

Frequency Range (GHz)	Receiver Compression											
	Compression ME7838A	Compression ME7838A Option 62	Compression ME7838AX	Compression ME7838AX Option 61 or 62	Compression ME7838E	Compression ME7838E Option 62	Compression ME7838EX	Compression ME7838EX Option 61 or 62	Compression ME7838D	Compression ME7838D Option 62	Compression ME7838G	Compression ME7838G Option 62
70 kHz to 300 kHz	6	6	6	6	6	6	6	6	6	6	6	6
>0.3 MHz to 2 MHz	10	12	10	12	10	12	10	12	10	12	10	12
>2 MHz to 10 MHz	10	12	10	12	10	12	10	12	10	12	10	12
>0.01 to 2.5	11	13	11	13	11	13	11	13	11	13	11	13
>2.5 to 24	11	13	11	13	11	13	11	13	11	13	11	13
>24 to 40			10	10			10	10				
>24 to 54	10	10			10	10			10	10	10	10
>40 to 54			10	10			10	10				
>54 to 60	10	10	10	10	10	10	10	10	10	10	10	10
>60 to 65	10	10	10	10	10	10	10	10				
>60 to 67									10	10	10	10
>65 to 80	10	10	10	10	10	10	10	10				
>67 to 80									10	10	10	10
>80 to 85	10	10			10	10			10	10	10	10
>80 to 90			10	10			10	10				
>85 to 90	10	10			10	10			10	10	10	10
>90 to 95	10	10			10	10			10	10	10	10
>90 to 100			10	10			10	10				
>95 to 100	10	10			10	10						
>95 to 105									10	10	10	10
>100 to 110	10	10	10	10	10	10	10	10				
>105 to 110									10	10	10	10
>110 to 115			10	10								
>110 to 120	5	5							7	7	7	7
>115 to 120			5	5								
>120 to 125	5	5	5	5					7	7	7	7
>125 to 140									7	7	7	7
>140 to 145									7	7		
>140 to 150											7	7
>150 to 160											7	7
>160 to 180											7	7
>180 to 200											7	7
>200 to 220											7	7
>220 to 226											5	5

*1: Using the 806-206-R 1.85 mm (61 cm, 24 in long), and 806-209-R 1.85 mm (91.5 cm, 36 in long) (only ME7838G) test port cables between the VNA and the 3743A mmWave modules.

*2: Use this column also for Options 51 and 61 although the performance between 10 MHz and 54 GHz will characteristically be better by 1 dB or more for Option 51, and will characteristically be better by 1 dB or more for Option 61 (with port 1 driving and port 2 receiving).

Power Range, Accuracy, Linearity, and Resolution

Accuracy is defined at –10 dBm or max. rated power, whichever is lower. Linearity is defined as the incremental error between the accuracy test power level and 5 dB below. Typical.

Frequency Range (GHz)	Power Range (dB)		Accuracy (dB)	Linearity (dB)	Resolution (dB)
	ME7838A	ME7838A Option 62			
70 kHz to 300 kHz	10 to –25	8 to –85	±1.5	±1.5	0.01
>0.3 MHz to 2 MHz	10 to –25	8 to –85	±1.5	±1.5	0.01
>2 MHz to 10 MHz	10 to –25	10 to –85	±1.5	±1.5	0.01
>0.1 to 2.5	10 to –25	8 to –85	±1.0	±1.0	0.01
>2.5 to 24	0 to –25	–3 to –85	±1.0	±1.0	0.01
>24 to 54	–6 to –30	–8 to –90	±1.5	±1.0	0.01
>54 to 60	0 to –55	0 to –55	±2.0	±1.5	0.01
>60 to 65	1 to –55	1 to –55	±2.0	±1.5	0.01
>65 to 80	–2 to –55	–2 to –55	±2.0	±1.5	0.01
>80 to 85	–3 to –55	–3 to –55	±2.0	±1.5	0.01
>85 to 90	–3 to –55	–3 to –55	±2.0	±1.5	0.01
>90 to 95	1 to –55	1 to –55	±2.0	±1.5	0.01
>95 to 100	1 to –55	1 to –55	±3.0	±2.0	0.01
>100 to 110	–3 to –50	–3 to –55	±3.0	±2.0	0.01
>110 to 120	–3 to –40	–3 to –40	±4.0	±3.0	0.01
>120 to 125	–3 to –40	–3 to –40	±4.0	±3.0	0.01

Frequency Range (GHz)	Power Range (dB)		Accuracy (dB)	Linearity (dB)	Resolution (dB)
	ME7838AX	ME7838AX Option 61 or 62			
70 kHz to 300 kHz	10 to –25	7 to –85	±0.3	±0.2	0.01
>0.3 MHz to 2 MHz	10 to –25	7 to –85	±0.3	±0.2	0.01
>2 MHz to 10 MHz	12 to –25	10 to –85	±0.3	±0.2	0.01
>0.1 to 2.5	10 to –25	8 to –85	±0.4	±0.3	0.01
>2.5 to 10	4 to –25	2 to –85	±0.5	±0.3	0.01
>10 to 24	–1 to –25	–2 to –85	±0.5	±0.3	0.01
>24 to 40	–2 to –30	–4 to –90	±0.9	±0.3	0.01
>40 to 54	–7 to –30	–11 to –90	±0.9	±0.3	0.01
>54 to 60	–2 to –55	–2 to –55	±1.3	±0.5	0.01
>60 to 65	–2 to –55	–2 to –55	±1.3	±0.5	0.01
>65 to 70	–6 to –55	–6 to –55	±1.3	±0.5	0.01
>70 to 80	–4.5 to –55	–4.5 to –55	±1.3	±0.5	0.01
>80 to 90	–6.5 to –55	–6.5 to –55	±1.7	±0.6	0.01
>90 to 100	–2.5 to –55	–2.5 to –55	±2.3	±0.6	0.01
>100 to 110	–6.5 to –55	–6.5 to –55	±2.3	±1.0	0.01
>110 to 115	–7 to –50	–7 to –50	±2.3	±2.0	0.01
>115 to 120	–3 to –40	–3 to –40	±2.3	±2.0	0.01
>120 to 125	–3 to –40	–3 to –40	±3.0	±2.0	0.01

Frequency Range (GHz)	Power Range (dBm)		Accuracy (dB)	Linearity (dB)	Resolution (dB)
	ME7838E	ME7838E Option 62			
70 kHz to 300 kHz	10 to –25	8 to –85	±1.5	±1.5	0.01
>0.3 MHz to 2 MHz	10 to –25	8 to –85	±1.5	±1.5	0.01
>2 MHz to 10 MHz	10 to –25	10 to –85	±1.5	±1.5	0.01
>0.01 to 2.5	10 to –25	8 to –85	±1.0	±1.0	0.01
>2.5 to 24	0 to –25	–3 to –85	±1.0	±1.0	0.01
>24 to 54	–6 to –30	–8 to –90	±1.5	±1.0	0.01
>54 to 60	0 to –55	0 to –55	±2.0	±1.5	0.01
>60 to 65	1 to –55	1 to –55	±2.0	±1.5	0.01
>65 to 80	–2 to –55	–2 to –55	±2.0	±1.5	0.01
>80 to 85	–3 to –55	–3 to –55	±2.0	±1.5	0.01
>85 to 90	–3 to –55	–3 to –55	±2.0	±1.5	0.01
>90 to 95	0 to –55	0 to –55	±2.0	±1.5	0.01
>95 to 100	0 to –55	0 to –55	±3.0	±2.0	0.01
>100 to 110	–3 to –50	–3 to –55	±3.0	±2.0	0.01

Frequency Range (GHz)	Power Range (dBm)		Accuracy (dB)	Linearity (dB)	Resolution (dB)
	ME7838EX	ME7838EX Option 61 or 62			
70 kHz to 300 kHz	10 to –25	7 to –85	±0.3	±0.2	0.01
>0.3 MHz to 2 MHz	10 to –25	7 to –85	±0.3	±0.2	0.01
>2 MHz to 10 MHz	12 to –25	10 to –85	±0.3	±0.2	0.01
>0.01 to 2.5	10 to –25	8 to –85	±0.4	±0.3	0.01
>2.5 to 10	4 to –25	2 to –85	±0.5	±0.3	0.01
>10 to 24	–1 to –25	–2 to –85	±0.5	±0.3	0.01
>24 to 40	–2 to –30	–4 to –90	±0.9	±0.3	0.01
>40 to 54	–7 to –30	–11 to –90	±0.9	±0.3	0.01
>54 to 60	–2 to –55	–2 to –55	±1.3	±0.5	0.01
>60 to 65	–2 to –55	–2 to –55	±1.3	±0.5	0.01
>65 to 70	–6 to –55	–6 to –55	±1.3	±0.5	0.01
>70 to 80	–4.5 to –55	–4.5 to –55	±1.3	±0.5	0.01
>80 to 90	–6.5 to –55	–6.5 to –55	±1.7	±0.6	0.01
>90 to 100	–2.5 to –55	–2.5 to –55	±2.3	±0.6	0.01
>100 to 110	–6.5 to –55	–6.5 to –55	±2.3	±1.0	0.01

Frequency Range (GHz)	Power Range (dBm)		Accuracy (dB)	Linearity (dB)	Resolution (dB)
	ME7838D	ME7838D Option 62			
70 kHz to 300 kHz	–25 to 10	–85 to 8	±1.5	±1.5	0.01
>0.3 MHz to 2 MHz	–25 to 10	–85 to 8	±1.5	±1.5	0.01
>2 MHz to 10 MHz	–25 to 10	–85 to 10	±1.5	±1.5	0.01
>0.01 to 2.5	–25 to 10	–85 to 8	±1.0	±1.0	0.01
>2.5 to 24	–25 to 0	–85 to –3	±1.0	±1.0	0.01
>24 to 54	–30 to –5	–90 to –8	±1.5	±1.0	0.01
>54 to 60	–55 to –4	–55 to –4	±2.0	±1.5	0.01
>60 to 67	–55 to –3	–55 to –3	±2.0	±1.5	0.01
>67 to 80	–55 to –3	–55 to –3	±2.0	±1.5	0.01
>80 to 85	–55 to –7	–55 to –7	±2.0	±1.5	0.01
>85 to 90	–55 to –6	–55 to –6	±2.0	±1.5	0.01
>90 to 95	–55 to –5	–55 to –5	±2.0	±1.5	0.01
>90 to 105	–55 to –5	–55 to –5	±3.0	±2.0	0.01
>105 to 110	–55 to –6	–55 to –6	±3.0	±2.0	0.01
>110 to 120	–55 to –3	–55 to –3	±4.0	±3.0	0.01
>120 to 125	–55 to –5	–55 to –5	±4.0	±3.0	0.01
>125 to 140	–50 to –10	–50 to –10	±5.0	±4.0	0.01
>140 to 145	–50 to –6	–50 to –6	±5.0	±4.0	0.01

Frequency Range (GHz)	Power Range (dBm)		Accuracy (dB)	Linearity (dB)	Resolution (dB)
	ME7838G	ME7838G Option 62			
70 kHz to 300 kHz	–25 to 10	–85 to 8	±1.5	±1.5	0.01
>0.3 MHz to 2 MHz	–25 to 10	–85 to 8	±1.5	±1.5	0.01
>2 MHz to 10 MHz	–25 to 10	–85 to 10	±1.5	±1.5	0.01
>0.01 to 2.5	–25 to 10	–85 to 7	±1.5	±1.0	0.01
>2.5 to 24	–25 to 0	–85 to –4	±1.5	±1.0	0.01
>24 to 54	–30 to –6	–90 to –9	±1.5	±1.0	0.01
>54 to 60	–55 to –4	–55 to –4	±2.0	±1.5	0.01
>60 to 67	–55 to –3	–55 to –3	±2.0	±1.5	0.01
>67 to 80	–55 to –3	–55 to –3	±2.0	±1.5	0.01
>80 to 85	–55 to –7	–55 to –7	±2.0	±1.5	0.01
>85 to 90	–55 to –6	–55 to –6	±2.0	±1.5	0.01
>90 to 95	–55 to –6	–55 to –6	±2.0	±1.5	0.01
>90 to 105	–55 to –6	–55 to –6	±3.0	±2.0	0.01
>105 to 110	–55 to –6	–55 to –6	±3.0	±2.0	0.01
>110 to 120	–55 to –7	–55 to –7	±4.0	±3.0	0.01
>120 to 125	–55 to –7	–55 to –7	±4.0	±3.0	0.01
>125 to 140	–50 to –15	–50 to –15	±4.0	±4.0	0.01
>140 to 150	–50 to –15	–50 to –15	±4.0	±4.0	0.01
>150 to 160	–50 to –15	–50 to –15	±4.0	±4.0	0.01
>160 to 180	–50 to –13	–50 to –13	±4.0	±4.0	0.01
>180 to 200	–50 to –13	–50 to –13	±4.0	±4.0	0.01
>200 to 220	–50 to –15	–50 to –15	±4.0	±4.0	0.01
>220 to 226	–50 to –18	–50 to –18	±5.0	±4.0	0.01

High Level Noise

Noise measured at 1 kHz IF bandwidth, at maximum power or compression limit (whichever is less), with through transmission. RMS. Typical.

Frequency Range (GHz)	ME7838A		ME7838AX		ME7838E		ME7838EX		ME7838D	
	Magnitude (dB)	Phase (deg.)	Magnitude (dB)	Phase (deg.)	Magnitude (dB)	Phase (deg.)	Magnitude (dB)	Phase (deg.)	Magnitude (dB)	Phase (deg.)
70 kHz to 300 kHz					<0.04	<0.4				
70 kHz to 500 kHz	<0.04	<0.4	0.040	0.3			0.040	0.3	<0.04	<0.4
>0.3 MHz to 2 MHz					<0.005	<0.05				
>0.5 MHz to 2 MHz	<0.005	<0.05	0.006	0.03			0.006	0.03	<0.005	<0.05
>2 MHz to 10 MHz	<0.005	<0.05	0.0045	0.03	<0.005	<0.05	0.0045	0.03	<0.005	<0.05
>0.01 to 2.5	<0.005	<0.05	0.0045	0.03	<0.005	<0.05	0.0045	0.03	<0.005	<0.05
>2.5 to 10			0.005	0.035			0.005	0.035		
>2.5 to 24	<0.006	<0.06			<0.006	<0.06			<0.006	<0.06
>10 to 24			0.005	0.045			0.005	0.045		
>24 to 54	<0.005	<0.06	0.005	0.06	<0.005	<0.06	0.005	0.06	<0.005	<0.06
>54 to 80	<0.005	<0.06	0.0045	0.075	<0.005	<0.06	0.0045	0.075	<0.005	<0.06
>80 to 110	<0.008	<0.09	0.006	0.105	<0.008	<0.09	0.006	0.105	<0.008	<0.09
>110 to 120	<0.010	<0.20	0.007	0.115					<0.008	<0.09
>120 to 125	<0.025	<0.30	0.0075	0.13					<0.011	<0.11
>125 to 140									<0.016	<0.16
>140 to 145									<0.016	<0.16

Frequency Range (GHz)	ME7838G 1 kHz IF bandwidth		ME7838G 100 Hz IF bandwidth	
	Magnitude (dB)	Phase (deg.)	Magnitude (dB)	Phase (deg.)
70 kHz to 300 kHz	<0.04	<0.4	<0.02	<0.2
>0.5 MHz to 2 MHz	<0.005	<0.05	<0.003	<0.03
>2 MHz to 10 MHz	<0.005	<0.05	<0.003	<0.03
>0.01 to 2.5	<0.005	<0.05	<0.003	<0.03
>2.5 to 24	<0.006	<0.06	<0.003	<0.03
>24 to 54	<0.007	<0.08	<0.005	<0.05
>54 to 80	<0.007	<0.09	<0.005	<0.06
>80 to 110	<0.008	<0.09	<0.005	<0.06
>110 to 120	<0.008	<0.09	<0.006	<0.06
>120 to 125	<0.011	<0.11	<0.006	<0.07
>125 to 140	<0.015	<0.15	<0.006	<0.07
>140 to 150	<0.015	<0.15	<0.006	<0.07
>150 to 160	<0.020	<0.20	<0.001	<0.01
>160 to 180	<0.025	<0.25	<0.009	<0.09
>180 to 200	<0.025	<0.25	<0.009	<0.09
>200 to 220	<0.070	<0.50	<0.004	<0.03
>220 to 226	<0.020	<0.80	<0.005	<0.05

Stability

Rationed measurement at max. leveled power and with nominally a full coaxial reflect or a stable coaxial thru over the normal specified temperature range. (23°C±3°C Typical)

Frequency Range (GHz)	ME7838A		ME7838AX		ME7838E		ME7838EX		ME7838D	
	Magnitude (dB/°C)	Phase (deg./°C)	Magnitude (dB/°C)	Phase (deg./°C)	Magnitude (dB/°C)	Phase (deg./°C)	Magnitude (dB/°C)	Phase (deg./°C)	Magnitude (dB/°C)	Phase (deg./°C)
70 kHz to 300 kHz	<0.015	<0.1	<0.015	<0.1	<0.015	<0.1	0.015	0.1	<0.015	<0.1
>0.3 MHz to 2 MHz	<0.015	<0.05	<0.015	<0.05	<0.015	<0.05	0.015	0.05	<0.015	<0.05
>2 MHz to 10 MHz	<0.01	<0.05	<0.01	<0.05	<0.01	<0.05	0.01	0.05	<0.01	<0.05
>0.01 to 2.5	<0.01	<0.05	<0.01	<0.05	<0.01	<0.05	0.01	0.05	<0.01	<0.05
>2.5 to 30	<0.01	<0.09	<0.01	<0.09	<0.01	<0.09	0.01	0.09	<0.01	<0.09
>30 to 54	<0.01	<0.07	<0.01	<0.07	<0.01	<0.07	0.301	0.07	<0.01	<0.07
>54 to 80	<0.015	<0.1	<0.015	<0.1	<0.015	<0.1	0.015	0.1	<0.015	<0.1
>80 to 110	<0.015	<0.15	<0.015	<0.15	<0.015	<0.15	0.015	0.15	<0.015	<0.15
>110 to 120	<0.02	<0.2	<0.02	<0.2					<0.02	<0.2
>120 to 125	<0.04	<0.25	<0.04	<0.25					<0.025	<0.2
>125 to 140									<0.03	<0.35
>140 to 145									<0.04	<0.5

Frequency Range (GHz)	ME7838G	
	Magnitude (dB/°C)	Phase (deg./°C)
70 kHz to 300 kHz	<0.015	<0.1
>0.3 MHz to 2 MHz	<0.015	<0.05
>2 MHz to 10 MHz	<0.01	<0.05
>0.01 to 2.5	<0.01	<0.05
>2.5 to 30	<0.01	<0.09
>30 to 54	<0.01	<0.07
>54 to 80	<0.015	<0.1
>80 to 110	<0.015	<0.15
>110 to 120	<0.02	<0.2
>120 to 125	<0.025	<0.2
>125 to 140	<0.025	<0.3
>140 to 150	<0.025	<0.5
>150 to 160	<0.04	<0.5
>160 to 180	<0.04	<0.5
>180 to 200	<0.04	<0.5
>200 to 220	<0.04	<0.5
>220 to 226	<0.06	<0.7

Frequency Resolution, Accuracy and Stability - ME7838A/ME7838AX/ME7827E/ME7827EX/ME7838D/ME7838G

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

Uncorrected (Raw) Port Characteristics

Typical performance with either ME7838A/AX or ME7838A/AX with Option 62, ME7838E/EX or ME7838E/EX with Option 62.

Frequency Range (GHz)	Directivity (dB)	Port Match (dB)
≤10 MHz	10*	8
>0.01 to 2.5	9*	10
>2.5 to 30	5*	12
>30 to 40	5*	5
>40 to 54	10	5
>54 to 80	10	10
>80 to 110	5	7
>110 to 120 (ME7838A/AX or ME7838A/AX with Option 62, only)	5	7
>120 to 125 (ME7838A/AX or ME7838A/AX with Option 62, only)	5	7

*: Raw directivity is degraded below 300 kHz, 2.2 GHz to 2.5 GHz and in narrow bands within 10 GHz to 34 GHz

Typical performance with either ME7838D or ME7838D with Option 62.

Frequency Range (GHz)	Directivity (dB)	Port Match (dB)
70 kHz to 10 MHz	10*	8
>0.01 to <2.5	9*	10
2.5 to 30	5*	11
>30 to 40	9*	11
>40 to 54	9*	11
>54 to 80	9	10
>80 to 110	5	7
>110 to 120	5	7
>120 to 125	5	7
>125 to 140	5	7
>140 to 145	5	6

*: Raw directivity is degraded below 300 kHz, 2.2 GHz to 2.5 GHz and in narrow bands within 10 GHz to 34 GHz

Typical performance with either ME7838G or ME7838G with Option 62.

Frequency Range (GHz)	Port Match (dB)
70 kHz to 10 MHz	8
>0.01 to <2.5	10
2.5 to 30*	11
>30 to 40*	11
>40 to 54	11
>54 to 80	10
>80 to 110	7
>110 to 120	7
>120 to 125	7
>125 to 140	7
>140 to 150	5
>150 to 160	5
>160 to 180	5
>180 to 200	5
>200 to 220	5

*: Port match is degraded in narrow bands between 20 GHz and 40 GHz.

Corrected System Performance and Uncertainties

With 12-term concatenated SOLT and Triple Offset Short Calibration (SSST), using the 3656B W1 Calibration Kit. Typical. (ME7838A and ME7838E only.)

Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
70 kHz to 10 MHz	36	36	36	±0.1	±0.1
>0.01 to 2.5	40	41	40	±0.05	±0.05
>2.5 to 20	40	41	40	±0.05	±0.05
>20 to 67	38	41	36	±0.05	±0.07
>67 to 95	37	40	35	±0.05	±0.07
>95 to 110	35	35	33	±0.05	±0.07

With 12-term concatenated SOLT and Triple Offset Short Calibration (SSST), using the 3656C W1 Calibration Kit. Typical. (ME7838AX and ME7838EX only.)

Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
70 kHz to 10 MHz	40	40	38	±0.10	±0.10
>0.01 to 2.5	40	40	38	±0.05	±0.05
>2.5 to 20	40	40	38	±0.05	±0.05
>20 to 40	36	38	33	±0.05	±0.07
>40 to 67	30	36	27	±0.05	±0.07
>67 to 90	30	34	30	±0.07	±0.07
>90 to 110	30	34	28	±0.07	±0.07
>110 to 120	30	30	28	±0.10	±0.10
>120 to 125	28	30	26	±0.12	±0.12

With 12-term concatenated SOLT and Triple Offset Short Calibration (SSST), using the 3659 0.8 mm Calibration Kit. Typical for ME7838D.

Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
70 kHz to 10 MHz	36	36	36	±0.1	±0.1
>0.01 to 2.5	38	41	38	±0.05	±0.05
>2.5 to 20	40	41	40	±0.05	±0.05
>20 to 67	35	41	35	±0.05	±0.07
>67 to 80	35	38	35	±0.05	±0.07
>80 to 95	35	40	35	±0.05	±0.07
>95 to 110	34	37	34	±0.05	±0.07
>110 to 125	30	34	30	±0.07	±0.09
>125 to 140	28	28	28	±0.09	±0.11
>140 to 145	26	28	26	±0.11	±0.13

With 12-term concatenated SOLT and Triple Offset Short Calibration (SSST), using the 3659 0.8 mm Calibration Kit. Typical for ME7838G.

Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
70 kHz to 10 MHz	36	36	36	±0.1	±0.1
>0.01 to <2.5	38	41	38	±0.05	±0.05
2.5 to 20	40	41	40	±0.05	±0.05
>20 to 67	35	41	35	±0.05	±0.07
>67 to 80	35	38	35	±0.05	±0.07
>80 to 95	35	40	35	±0.05	±0.07
>95 to 110	34	37	34	±0.05	±0.07
>110 to 125	30	34	30	±0.07	±0.09
>125 to 140	28	28	28	±0.09	±0.11
>140 to 145	26	28	26	±0.11	±0.13

Measurement Time

Measurement times include sweep time, retrace time, and band-switching time. Typical.

Measurement Time (ms)

Full Band, 70 kHz to 110 GHz (ME7838A/AX/E/EX), 70 kHz to 145 GHz (ME7838D), 70 kHz to 220 GHz (ME7838G), Display ON, and ALC ON.

Calibration	IFBW	401 Points						1,601 Points					
		ME7838A	ME7838AX	ME7838E	ME7838EX	ME7838D	ME7838G	ME7838A	ME7838AX	ME7838E	ME7838EX	ME7838D	ME7838G
1-port calibration	1 MHz	80	230	80	210	80	280	100	290	100	270	100	280
	30 kHz	90	270	90	250	90	290	160	340	160	320	160	290
	10 kHz	110	285	110	265	110	310	240	450	240	430	240	310
	1 kHz	470	550	470	530	470	650	1600	1700	1600	1680	1600	650
	10 Hz	47,000	48,000	47,000	48,000	47,000	39,000	160,000	160,000	160,000	160,000	160,000	39,000
2-port calibration*	1 MHz	160	460	160	420	160	560	200	580	200	540	200	560
	30 kHz	180	540	180	500	180	580	320	680	320	640	320	580
	10 kHz	220	570	220	530	220	620	480	900	480	860	480	620
	1 kHz	940	1100	940	1060	940	1300	3200	3400	3200	3360	3200	1300
	10 Hz	94,000	96,000	94,000	96,000	94,000	78,000	320,000	320,000	320,000	320,000	320,000	78,000

Calibration	IFBW	10,001 Points						25,000 Points					
		ME7838A	ME7838AX	ME7838E	ME7838EX	ME7838D	ME7838G	ME7838A	ME7838AX	ME7838E	ME7838EX	ME7838D	ME7838G
1-port calibration	1 MHz	350	800	350	780	350	800	700	1400	700	1380	700	2000
	30 kHz	600	1200	600	1180	600	1250	1500	3000	1500	2980	1500	2500
	10 kHz	1100	1950	1100	1930	1100	1800	2600	4400	2600	4380	2600	3600
	1 kHz	10,000	11,000	10,000	11,000	10,000	10,000	25,000	27,000	25,000	27,000	25,000	25,000
	10 Hz	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	950,000	2,500,000	2,500,000	2,500,000	1,000,000	2,500,000	2,400,000
2-port calibration*	1 MHz	700	1600	700	1560	700	1600	1400	2800	1400	2760	1400	4000
	30 kHz	1200	2400	1200	2360	1200	2500	3000	6000	3000	5960	3000	5000
	10 kHz	2200	3900	2200	3860	2200	3600	5200	8800	5200	8760	5200	7200
	1 kHz	20,000	22,000	20,000	22,000	20,000	20,000	50,000	54,000	50,000	54,000	50,000	50,000
	10 Hz	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	1,900,000	5,000,000	5,000,000	5,000,000	5,000,000	5,000,000	4,800,000

*: Times for only those parameters in the calibration. Times are double for 1-2 calibrations and 3-4 calibrations. (ME7838AX only)

Measurement Time (ms) vs. System Dynamic Range (dB)

Full Band, Display ON, and ALC ON.

Calibration		401 Points Measurement Time	Achieved System Dynamic Range (Option 062 at 54 GHz)	IFBW and Averaging Used
Uncorrected or 1-port calibration	ME7838A, ME7838E	110	77	10 kHz/no avg.
		470	87	1 kHz/no avg.
	ME7838AX, ME7838EX	285	77	10 kHz/no avg.
		550	87	1 kHz/no avg.
	ME7838D	110	77	10 kHz/no avg.
		470	87	1 kHz/no avg.
	ME7838G	310	80	10 kHz/no avg.
		650	90	1 kHz/no avg.
2-port calibration*	ME7838A, ME7838E	220	77	10 kHz/no avg.
		940	87	1 kHz/no avg.
	ME7838AX, ME7838EX	570	77	10 kHz/no avg.
		1100	87	1 kHz/no avg.
	ME7838D	220	77	10 kHz/no avg.
		940	87	1 kHz/no avg.
	ME7838G	620	80	10 kHz/no avg.
		1300	90	1 kHz/no avg.

*: 2-port calibration (excluding 1-2 and 3-4). (ME7838AX only)

Waveguide Band Specifications

Port Power, Noise Floor, Dynamic Range – 3744A-EE/3744A-EW mmWave Modules for ME7838A/AX, ME7838E/EX, ME7838D, and ME7838G

System dynamic range is defined as the ratio of the source power to the noise floor. Maximum Receiver Power is defined as the 0.2 dB compression point of the receiver at the waveguide port. Receiver dynamic range is defined as the ratio of maximum receive power to the noise floor. Noise Floor measurements are RMS, are made with no average in a 10 Hz IF bandwidth, and include an isolation calibration.
All figures are typical.

3744A-EE Extended-E Band (WR-12) Waveguide

Frequency Range (GHz)	Source Power (dBm)	Max. Receive Power (0.2 dB comp. pt.) (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)	Receiver Dynamic Range (dB)
56 to 60	–2	11	–111	109	122
>60 to 65	0	11	–106	106	117
>65 to 80	–3	11	–109	106	120
>80 to 85	–4	11	–112	108	123
>85 to 90	–4	11	–110	106	121
>90 to 94*	0	12	–109 (ME7838A/AX) –105 (ME7838E/EX/D)	109 (ME7838A/AX) 105 (ME7838E/EX/D)	117

*: Operational to 95 GHz.

3744A-EW Extended-W Band (WR-10) Waveguide

Frequency Range (GHz)	Source Power (dBm)	Max. Receive Power (0.2 dB comp. pt.) (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)	Receiver Dynamic Range (dB)
65 to 67	0	11	–106	106	117
>67 to 80	–3	11	–109	106	120
>80 to 85	–4	11	–112	108	123
>85 to 90	–4	11	–110	106	121
>90 to 100	0	12	–109 (ME7838A/AX) –105 (ME7838E/EX/D)	109 (ME7838A/AX) 105 (ME7838E/EX/D)	121 117 (ME7838E/EX/D)
>100 to 110	–5	12	–110	105	122

Power Range, Accuracy, Linearity, and Resolution

Accuracy is defined at –10 dBm or max rated power, whichever is lower. Linearity is defined as the incremental error between the accuracy test power level and 5 dB below. Typical.

Frequency Range (GHz)	Range (dBm)		Accuracy (dB)	Linearity (dB)	Resolution (dB)
	ME7838A/AX	ME7838A/AX Option 62			
54 to 60	–55 to –2	–55 to –2	±2.0	±1.5	0.01
>60 to 65	–55 to 0	–55 to 0	±2.0	±1.5	0.01
>65 to 80	–55 to–3	–55 to –3	±2.0	±1.5	0.01
>80 to 85	–55 to –4	–55 to –4	±2.0	±1.5	0.01
>85 to 90	–55 to –4	–55 to –4	±2.0	±1.5	0.01
>90 to 100	–55 to 0	–55 to 0	±3.0	±2.0	0.01
>100 to 110	–50 to –5	–50 to –5	±3.0	±2.0	0.01
>110 to 120*	–40 to –12	–40 to –12	±4.0	±3.0	0.01
>120 to 125*	–40 to –15	–40 to –15	±4.0	±3.0	0.01

*: 110 GHz to 125 GHz frequency range is available as operational.

Frequency Range (GHz)	Range (dBm)		Accuracy (dB)	Linearity (dB)	Resolution (dB)
	ME7838E/EX/ME7838D	ME7838E/EX Option 62/ ME7838D Option 62			
54 to 60	–55 to –2	–55 to –2	±2.0	±1.5	0.01
>60 to 65	–55 to 0	–55 to 0	±2.0	±1.5	0.01
>65 to 80	–55 to –3	–55 to –3	±2.0	±1.5	0.01
>80 to 85	–55 to –4	–55 to –4	±2.0	±1.5	0.01
>85 to 90	–55 to –4	–55 to –4	±2.0	±1.5	0.01
>90 to 100	–55 to 0	–55 to 0	±3.0	±2.0	0.01
>100 to 110	–50 to –5	–50 to –5	±3.0	±2.0	0.01
>110 to 120* (ME7838D only)	–40 to –12	–40 to –12	±4.0	±3.0	0.01
>120 to 125* (ME7838D only)	–40 to –15	–40 to –15	±4.0	±3.0	0.01

*: 110 GHz to 125 GHz frequency range is available as operational.

Alternatively, the V, E, and W bands can be supported using external millimeter-wave modules such as the 3740/41A series modules available from Anritsu. For further description and specifications please refer to the VectorStar ME7828A Technical Data Sheet – 11410-00452 available at www.anritsu.com.

Waveguide Bands from 50 GHz to 1.1 THz

VectorStar ME7838A/AX, ME7838E/EX, ME7838D, ME7838G Millimeter-Wave System with VDI Modules

This section provides the specifications for the VectorStar MS4640B series microwave Vector Network Analyzers (VNAs) when configured with the Virginia Diodes, Inc. millimeter-wave (mmWave) frequency extension modules. The following frequency bands are supported:

Waveguide Band	WR15	WR10	WR8.0	WR6.5	WR5.1	WR4.3	WR3.4	WR2.8	WR2.2	WR1.5	WR1.0*
Frequency Range (GHz)	50 to 75	75 to 110	90 to 140	110 to 170	140 to 220	170 to 260	220 to 330	260 to 400	330 to 500	500 to 750	750 to 1100

*: Contact Anritsu

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

ME7838A/AX Broadband System, 70 kHz to 125 GHz; ME7838E/EX Broadband System, 70 kHz to 110 GHz; ME7838D Broadband System, 70 kHz to 145 GHz

Action	Part Number and Description	Additional Information
Order the base VectorStar model with the listed components and options:	MS4647B, 70 kHz to 70 GHz VNA MS4640B-007, receiver offset MS4640B-070, 70 kHz frequency coverage 3739C, Broadband Test Set with 36 inch interface cables 3743A/AX/E/EX, Millimeter-Wave Module, 2 each M25300A, Millimeter-Wave Module, 2 each (ME7838D)) ME7838A/AX/E/EX/D-SS020, On-site system assembly and verification	
Include one of the following:	MS4647B-080, MS4647B with ME7838A/AX system option MS4647B-086, MS4647B with ME7838E/EX system option MS4647B-080, MS4647B with ME7838D system option	MS4647B-084 is ordered when Option 31 is included MS4647B-088 is ordered when Option 31 is included (ME7838E/EX) MS4647B-084 is ordered when Option 31 is included (ME7838D)
	MS4647B-081, MS4647B with ME7838A/AX system option and Option 51 or 61 or 62 MS4647B-087, MS4647B with ME7838E/EX system option and Option 51, or 61, or 62 MS4647B-081, MS4647B with ME7838D system option and Option 51 or 61 or 62.	MS4647B-085 is ordered when Option 31 is included MS4647B-089 is ordered when Option 31 is included (ME7838E/EX)
Include one of the following:	806-206-R, 1.85 mm coaxial VNA RF cables, 24", M-F, 2 each	
	806-209-R, 1.85 mm coaxial VNA RF cables, 36", M-F, 2 each	
Add options if desired:	Option 51, 61, or 62: MS4647B-051 – External VNA Loops MS4647B-061 – Active Measurement Suite, 2 Attenuators MS4647B-062 – Active Measurement Suite, 4 Attenuators	
	MS4640B-070 – for 70 kHz operation in base VNA (ME7838E/EX) MS4640B-002 – Time domain MS464xB-031 – Dual Source Architecture MS4640B-035 – IF Digitizer MS4640B-041 – Noise Figure MS4640B-042 – PulseView™ MS4640B-043 – DifferentialView™ MS4640B-048 – Differential Noise Figure	MS464xB-031 requires Option 84 or 85 instead of Option 80 or 81 (ME7838A/AX and ME7838D only). MS464xB-031 requires Option 88 or 89 (ME7838E/EX). For other available options, see "ME7838A/AX/E/EX/D Broadband/ Millimeter-Wave System Options"
Calibration Options	ME7838A/AX/E/EX/D-098 - Standard Calibration, ISO 17025 compliant, without data ME7838A/AX/E/EX/D-099 - Premium Calibration, ISO 17025 compliant, with data	
Accessories	MS4640B-001, MS4640B rack mount 3739C-001, 3739C rack mount	

ME7838G Broadband System, 70 kHz to 220 GHz

Action	Part Number and Description	Additional Information
Order the base VectorStar model with the listed options:	MS4647B, 70 kHz to 70 GHz VNA MS4640B-007, receiver offset MS4640B-070, 70 kHz frequency coverage 3739C, Broadband Test Set with 36 inch interface cables MA25400A, Millimeter-Wave Module, 2 each ME7838G-SS020, On-site system assembly and verification	
Include one of the following:	MS4647B-080, MS4647B with ME7838G system option	MS4647B-084 is ordered when Option 31 is included.
	MS4647B-081, MS4647B with ME7838G system option and Option 51 or 61 or 62	MS4647B-085 is ordered when Option 31 is included.
Include the following:	806-209-R, 1.85 mm phase stable VNA RF cables, 36", M-F, 2 each	
Add options if desired:	Option 51, or 61, or 62: MS4647B-051 – External VNA Loops MS4647B-061 – Active Measurement Suite, 2 Attenuators MS4647B-062 – Active Measurement Suite, 4 Attenuators	
	MS4640B-002 – for Time Domain MS4640B-021 – UFX, Universal Fixture Extraction MS464xB-031 – Dual Source Architecture MS4640B-035 – IF Digitizer MS4640B-041 – Noise Figure MS4640B-042 – PulseView™ MS4640B-043 – DifferentialView™	MS464xB-031 requires Option 84 or 85. For other available options, see "ME7838G Broadband/Millimeter-Wave System Options"
Calibration Options	ME7838G-098 - Standard Calibration, ISO 17025 compliant, without data ME7838G-099 - Premium Calibration, ISO 17025 compliant, with data	
Accessories	MS4640B-001, MS4640B rack mount 3739C-001, 3739C rack mount	

ME7838A/AX, and ME7838D Waveguide-Band System to 110 GHz – 3744A-EE or 3744A-EW mmWave Modules

Configurator for ME7838A/AX, and ME7838D Millimeter-Wave System using 3744A-EE or 3744A-EW mmWave Modules:

Action	Part Number and Description	Additional Information
Choose and order one of the two base VectorStar models with options listed:	MS4644B VNA, 10 MHz to 40 GHz MS4640B-007 MS4644B-082 or MS4644B-083 or -084 or -085	MS4644B-083 is ordered when Option 51, 61, or 62 are included. MS4644B-084 is ordered when Option 31 is included and Option 51, 61, or 62 are excluded. MS4644B-085 is ordered when Option 31 and Option 51, 61, or 62 are included.
	MS4647B VNA, 10 MHz to 70 GHz MS4647B-007 MS4647B-080 or MS4647B-081 or -084 or -085	MS4647B-081 is ordered when Option 51, 61, or 62 are included. MS4647B-084 is ordered when Option 31 is included and Option 51, 61, or 62 are excluded. MS4647B-085 is ordered when Option 31 and Option 51, 61, or 62 are included.
Order Test Set	3739C mmWave Test Set	
Choose and order Extended-E or Extended-W Band Modules:	3744A-EE, 56 GHz to 94 GHz Extended E Band module, 2 each	
	3744A-EW, 65 GHz to 110 GHz Extended W Band module, 2 each	
Add options if desired:	Option 51, 61, or 62: MS464xB-051 – External VNA Loops MS464xB-061 – Active Measurement Suite, 2 Attenuators MS464xB-062 – Active Measurement Suite, 4 Attenuators	
	MS4640B-070 – for 70 kHz operation in base VNA MS4640B-002 – for Time Domain MS464xB-031 – Dual Source Architecture MS4640B-035 – IF Digitizer MS4640B-041 – Noise Figure MS4640B-042 – PulseView™ MS4640B-043 – DifferentialView™ MS4640B-048 – Differential Noise Figure	MS464xB-031 requires Option 84 or 85 instead of Option 80 or 81. For other available options, see "ME7838A/AX/D Broadband/ Millimeter-Wave System Options"
	MS4640B-001, MS4640B Rack Mount 3739C-001, 3739C Rack Mount	
	ME7838AX Waveguide-Band System with OML/VDI Modules	
Accessories	35WR12WF-EE – Precision Waveguide to Coax Adapter Kit, 56 GHz to 94 GHz, WR-12 to W1 (f)	
	35WR10WF-EW – Precision Waveguide to Coax Adapter Kit, 65 GHz to 110 GHz, WR-10 to W1 (f)	

ME7838E/EX Waveguide-Band System to 110 GHz – 3744E-EE or 3744E-EW mmWave Modules

Configuration for ME7838E/EX Millimeter-Wave System using 3744E-EE or 3744E-EW mmWave Modules:

Action	Part Number and Description	Additional Information
Choose and order one of the two base VectorStar models with options listed:	MS4644B VNA, 10 MHz to 40 GHz MS4644B-007 MS4644B-086 or -087 or -088 or -089	MS4644B-087 is ordered when Option 51, 61, or 62 is included. MS4644B-088 is ordered when Option 31 is included and Option 51, or 61, or 62 is excluded. MS4644B-089 is ordered when Option 31 and Option 51, 61, or 62 is included.
	MS4647B VNA, 10 MHz to 70 GHz MS4647B-007 MS4647B-086 or -087 or -088 or -089	MS4647B-087 is ordered when Options 51, 61, or 62 are included. MS4647B-088 is ordered when Option 31 is included and Option 51, 61, or 62 is excluded. MS4647B-089 is ordered when Option 31 and Option 51, 61, or 62 is included.
Order Test Set	3739C mmWave Test Set	
Choose and order Extended-E or Extended-W Band Modules:	3744A-EE, 56 GHz to 94 GHz Extended E Band module, 2 each	
	3744A-EW, 65 GHz to 110 GHz Extended W Band module, 2 each	
Add options if desired:	Option 51, or 61, or 62: MS464xB-051 – External VNA Loops MS464xB-061 – Active Measurement Suite, 2 Attenuators MS464xB-062 – Active Measurement Suite, 4 Attenuators	
	MS4640B-070 – for 70 kHz operation in base VNA MS4640B-002 – for Time Domain MS464xB-031 – Dual Source Architecture MS4640B-035 – IF Digitizer MS4640B-041 – Noise Figure MS4640B-042 – PulseView™ MS4640B-043 – DifferentialView™ MS4640B-048 – Differential Noise Figure	MS464xB-031 requires Option 88 or 89. For other available options, see "ME7838E/EX Broadband/Millimeter-Wave System Options"
	MS4640B-001, MS4640B Rack Mount 3739C-001, 3739C Rack Mount	
Accessories	35WR12WF-EE – Precision Waveguide to Coax Adapter Kit, 56 GHz to 94 GHz, WR-12 to W1 (f)	
	35WR10WF-EW – Precision Waveguide to Coax Adapter Kit, 65 GHz to 110 GHz, WR-10 to W1 (f)	

ME7838G Waveguide-Band System to 110 GHz - 3744A-EE or 3744A-EW mmWave Modules

Configurator for ME7838G Millimeter-Wave System using 3744A-EE or 3744A-EW mmWave Modules:

Action	Part Number and Description	Additional Information
Choose and order one of the two base VectorStar models with options listed:	MS4644B VNA, 10 MHz to 40 GHz MS4640B-007 MS4644B-082 or -083 or -084 or -085	MS4644B-083 is ordered when Options 51, 61, or 62 are included. MS4644B-084 is ordered when Option 31 is included and Options 51, 61, or 62 are excluded. MS4644B-085 is ordered when Option 31 is included and Options 51, 61, or 62 are included
	MS4647B VNA, 10 MHz to 70 GHz MS4640B-007 MS4647B-080 or -081 or -084 or -085	MS4647B-081 is ordered when Options 51, 61, or 62 are included MS4647B-084 is ordered when Option 31 is included and Options 51, 61, or 62 are excluded. MS4647B-085 is ordered when Option 31 is included and Options 51, 61, or 62 are included.
Order Test Set	3739C mmWave Test Set	
Choose and order Extended-E or Extended-W Band Modules:	3744A-EE, 56 GHz to 94 GHz Extended E Band module, 2 each	
	3744A-EW, 65 GHz to 110 GHz Extended W Band module, 2 each	
Add options if desired:	Option 51, or 61, or 62: MS464xB-051 – External VNA Loops MS464xB-061 – Active Measurement Suite, 2 Attenuators MS464xB-062 – Active Measurement Suite, 4 Attenuators	
	MS4640B-070 – for 70 kHz operation in base VNA MS4640B-002 – for Time Domain MS464xB-031 – Dual Source Architecture MS4640B-035 – IF Digitizer MS4640B-041 – Noise Figure MS4640B-042 – PulseView™ MS4640B-043 – DifferentialView™	MS464xB-031 requires Option 84 or 85. For other available options, see "ME7838G Broadband/Millimeter-Wave System Options"
	MS4640B-001, MS4640B Rack Mount 3739C-001, 3739C Rack Mount	
Accessories	35WR12WF-EE – Precision Waveguide to Coax Adapter Kit, 56 GHz to 94 GHz, WR-12 to W1 (f)	
	35WR10WF-EW – Precision Waveguide to Coax Adapter Kit, 65 GHz to 110 GHz, WR-10 to W1 (f)	

ME7838A/AX, ME7838E/EX, and ME7838D Waveguide-Band System – OML/VDI mmWave Modules

ME7838A/AX, ME7838E/EX, and ME7838D Waveguide-band System using OML or VDI Millimeter-Wave modules:

Action	Part Number and Description	Additional Information
Choose and order one of the three base VectorStar models with options listed:	MS4642B VNA, 70 kHz to 20 GHz MS4642B-061 or MS4642B-062 MS4642B-083 (ME7838A/AX and ME7838D only) MS4642B-087 or MS4642B-089 (ME7838E/EX only)	MS4642B-061 includes Active Device Measurements, with 2 Step Attenuators MS4642B-062 includes Active Device Measurements, with 4 Step Attenuators MS4642B-085 is ordered when Option 31 is included. (ME7838A/AX and ME7838D only) MS4642B-089 is ordered when Option 31 is included. (ME7838E only)
	MS4644B VNA, 10 MHz to 40 GHz MS4640B-007 Receiver Offset MS4644B-082 or MS4644B-083 or -084 (ME7838A/AX and ME7838D only) MS4644B-086 or -087 or -088 or -089 (ME7838E/EX only)	MS4644B-083 (ME7838A/AX and ME7838D only) MS4644B-087 (ME7838E/EX) is ordered when Option 51, 61, or 62 are included. MS4644B-084 (ME7838A/AX and ME7838D only) MS4644B-088 (ME7838E/EX) is ordered when Option 31 is included and Option 51, 61, or 62 are excluded. MS4644B-085 (ME7838A/AX and ME7838D only) MS4644B-089 (ME7838E/EX only) is ordered when Option 31 and Option 51, 61, or 62 are included.
	MS4647B VNA, 10 MHz to 70 GHz MS4647B-007 Receiver Offset MS4647B-080 or MS4647B-081 or -085 (ME7838A/AX and ME7838D only) MS4644B-086 or -087 or -088 or -089 (ME7838E/EX only)	MS4647B-081 (ME7838A/AX and ME7838D only) MS4647B-087 (ME7838E/EX only) is ordered when Option 51, 61, or 62 are included. MS4647B-084 (ME7838A/AX and ME7838D only) MS4647B-088 (ME7838E/EX and ME7838D only) is ordered when Option 31 is included and Option 51, 61, or 62 are excluded. MS4647B-085 (ME7838A/AX and ME7838D only) MS4644B-089 (ME7838E/EX) is ordered when Option 31 and Option 51, 61, or 62 are included.
Order:	3739C mmWave Test Set	
	SM6537 Interface Cables (2) for OML/VDI mmWave Modules	Does not include DC cable. DC supply is provided by mmWave module power supply.
Choose and order one of the two appropriate millimeter-wave module combinations:	2 each TxRx transmission and reflection millimeter-Wave Modules	Choose appropriate OML or VDI modules. Contact Anritsu Company for ordering information.
	1 each TxRx transmission and reflection module, and 1 each Tx transmission only module	
Add options if desired:	Option 51, or 61, or 62: MS464xB-051 – External VNA Loops MS464xB-061 – Active Measurement Suite, 2 Attenuators MS464xB-062 – Active Measurement Suite, 4 Attenuators	
	MS4640B-070 – for 70 kHz operation in base VNA MS4640B-002 – for Time Domain MS464xB-031 – Dual Source Architecture MS4640B-035 – IF Digitizer MS4640B-041 – Noise Figure MS4640B-042 – PulseView™ MS4640B-043 – DifferentialView™ MS4640B-048 – Differential Noise Figure	MS464xB-031 requires Option 84 or Option 85 (ME7838A/AX and ME7838D only) Option 88 or 89 (ME7838E/EX only) For other available options, see "ME7838A Broadband/Millimeter-Wave System Options"

ME7838G Waveguide-Band System - OML/VDI mmWave Modules

ME7838G Waveguide-band System using OML or VDI Millimeter-Wave modules:

Action	Part Number and Description	Additional Information
Choose and order one of the three base VectorStar models with options listed:	MS4642B VNA, 10 MHz to 20 GHz MS4640B-007 Receiver Offset MS4642B-061 or MS4642B-062 MS4642B-083 or -085	MS4642B-061 includes Active Device Measurements, with 2 Step Attenuators MS4642B-062 includes Active Device Measurements, with 4 Step Attenuators MS4642B-085 is ordered when Option 31 is included.
	MS4644B VNA, 10 MHz to 40 GHz MS4640B-007 Receiver Offset MS4644B-082 or -083 or -084 or -085	MS4644B-083 is ordered when Options 51, 61, or 62 are included. MS4644B-084 is ordered when Option 31 is included and Options 51, 61, or 62 are excluded. MS4644B-085 is ordered when Option 31 is included and Options 51, 61, or 62 are included.
	MS4647B VNA, 10 MHz to 70 GHz MS4640B-007 Receiver Offset MS4647B-080 or -081 or -084 or -085	MS4647B-081 is ordered when Options 51, 61, or 62 are included. MS4647B-084 is ordered when Option 31 is included and Options 51, 61, or 62 are excluded. MS4647B-085 is ordered when Option 31 is included and Options 51, 61, or 62 are included.
Order:	3739C mmWave Test Set	
	SM6537 Interface Cables (2) for OML/VDI mmWave Modules	Does not include DC cable. DC supply is provided by mmWave module power supply.
Choose and order one of the two appropriate millimeter-wave module combinations:	2 each TxRx transmission and reflection millimeter-wave modules	Choose appropriate OML or VDI modules. Contact Anritsu Company for ordering information.
	1 each TxRx transmission and reflection module, and 1 each Tx transmission only module	
Add options if desired:	Option 51, or 61, or 62: MS464xB-051 – External VNA Loops MS464xB-061 – Active Measurement Suite, 2 Attenuators MS464xB-062 – Active Measurement Suite, 4 Attenuators	
	MS4640B-070 – for 70 kHz operation in base VNA MS4640B-002 – for Time Domain MS464xB-031 – Dual Source Architecture MS4640B-035 – IF Digitizer MS4640B-041 – Noise Figure MS4640B-042 – PulseView™ MS4640B-043 – DifferentialView™	MS464xB-031 requires Option 84 or Option 85 For other available options, see “ME7838G Broadband/Millimeter-Wave System Options"

Model/Order No.	Name
	Calibration/Verification Kits
3656C	W1 (1 mm) Calibration/Verification Kit
3656C-3	W1 (1 mm) Calibration/Verification Kit, With .s1p Characterization Files
3656C-5	W1 (1 mm) Calibration Kit (ME7838AX only)
3656C-6	W1 (1 mm) Calibration Kit, With .s1p Characterization Files (ME7838AX only)
3655V	WR-15 Waveguide Calibration Kit, Without Sliding Loads
3655V-1	WR-15 Waveguide Calibration Kit, With Sliding Loads
3655E	WR-12 Waveguide Calibration Kit, Without Sliding Loads
3655E-1	WR-12 Waveguide Calibration Kit, With Sliding Loads
3655W	WR-10 Waveguide Calibration Kit, Without Sliding Loads
3655W-1	WR-10 Waveguide Calibration Kit, With Sliding Loads
3650A	SMA/3.5 mm Calibration Kit, Without Sliding Loads
3650A-1	SMA/3.5 mm Calibration Kit, With Sliding Loads
3652A	K Calibration Kit, With Pin Depth Gauge
3652A-1	K Calibration Kit, With Sliding Loads (ME7838G only)
3652A-2	K Calibration Kit, With No Pin Depth Gauge
3652A-3	K Calibration Kit, With Pin Depth Gauge and .s1p Characterization Files
3652A-4	K Calibration Kit, With .s1p Characterization Files
3654D	V Calibration Kit, With Pin Depth Gauge
3654D-1	V Calibration Kit, With Pin Depth Gauge and Sliding Loads (ME7838G only)
3654D-2	V Calibration Kit, With No Pin Depth Gauge
3654D-3	V Calibration Kit, With Pin Depth Gauge and .s1p Characterization Files
3654D-4	V Calibration Kit, With .s1p Characterization Files
3657	V Multi-Line Calibration Kit, Without Shorts
3657-1	V Multi-Line Calibration Kit, With Shorts
3659	0.8 mm Calibration/Verification Kit (ME7838D and ME7838G only)
	External Power Meters/Sensors
ML243xA	CW Power Meter, Single Input or Dual Input Recommended Power Sensors: SC7770, MA247xD, MA244xD, MA248xD, MA2400xA
ML248xB	Wideband Power Meter, Single Input or Dual Input Recommended Power Sensors: MA249xA, MA2411B
ML249xA	Pulse Power Meter, Single Input or Dual Input Recommended Power Sensors: MA249xA, MA2411B
MA24106A	USB Power Sensor, 50 MHz to 6 GHz
MA24108A	USB Power Sensor, 10 MHz to 8 GHz
MA24118A	USB Power Sensor, 10 MHz to 18 GHz
MA24126A	USB Power Sensor, 10 MHz to 26 GHz
MA24330A	USB Power Sensor, 10 MHz to 33 GHz
MA24340A	USB Power Sensor, 10 MHz to 40 GHz
MA24350A	USB Power Sensor, 10 MHz to 50 GHz
MA24507A	Power Master™ Frequency Selectable mmWave Power Analyzer, 9 kHz to 70 GHz
MA24510A	Power Master™ Frequency Selectable mmWave Power Analyzer, 9 kHz to 110 GHz Note that usage of the MA24507A or MA24510A Power Master™ sensor requires connection to two USB ports to supply needed current draw.
	Test Port Cables, Flexible, High Performance
3671W1-50-1	W1 (m) to W1 (f), 1 each, 10.0 cm (3.9 in)
3671W1-50-2	W1 (m) to W1 (f), 1 each, 13.0 cm (5.1 in)
3671W1-50-3	W1 (m) to W1 (f), 1 each, 16.0 cm (6.3 in)
3671KFS50-60	K (f) to 3.5 mm (m) cable, 60 cm (one cable)
3671KFK50-60	K (f) to K (m) cable, 60 cm (one cable)
3671KFK50-100	K (f) to K (m) cable, 1 each, 100 cm (one cable)
3671KFKF50-60	K (f) to K (f) cable, 1 each, 60 cm (once cable)
3671VFV50-60	V (f) to V (m) cable, 1 each, 60 cm (one cable)
3671VFV50-100	V (f) to V (m) cable, 1 each, 100 cm (one cable)
3671KFSF50-60	K (f) to 3.5 mm (f) cable, 1 each, 60 cm (one cable)
3671VFVF50-60	V (f) to V (f) cable, 1 each, 60 cm (one cable)
3671VFVF50-100	V (f) to V (m) cable, 1 each, 60 cm (one cable) (ME7838D and ME7838G only)
3670.850-1	0.8 mm (m) to 0.8 mm (f), 1 each, 10.0 cm (3.9 in) (ME7838D and ME7838G only)
3670.850-2	0.8 mm (m) to 0.8 mm (f), 1 each, 16.0 cm (6.3 in) (ME7838D and ME7838G only)
3670W50-1	DC to 110 GHz, W1(m) to W1(f), 10.0 cm (ME7838D only)
3670W50-2	DC to 110 GHz, W1(m) to W1(f), 16.0 cm (ME7838D only)

Model/Order No.	Name
	Adapters and More
0.8-105F	0.8 mm (f) Sparkplug Launcher Connector, DC to 145 GHz (ME7838D and ME7838G only)
0.8-105M	0.8 mm (m) Sparkplug Launcher Connector, DC to 145 GHz (ME7838D and ME7838G only)
34WV50	W1 (m) to V (m) Adapter, W1 (1 mm) to V, Coaxial
34WVF50	W1 (m) to V (f) Adapter, W1 (1 mm) to V, Coaxial
34WFV50	W1 (f) to V (m) Adapter, W1 (1 mm) to V, Coaxial
34WFVF50	W1 (f) to V (f) Adapter, W1 (1 mm) to V, Coaxial
33WW50A	W1 (m) to W1 (m) Adapter, W1 (1 mm) in-series, Coaxial
33WWF50A	W1 (m) to W1 (f) Adapter, W1 (1 mm) in-series, Coaxial
33WFWF50A	W1 (f) to W1 (f) Adapter, W1 (1 mm) in-series, Coaxial
33WG50	MA25400A Flange Interface to 1 mm (male) Adapter (ME7838G only)
33.8WG50	MA25400A Flange Interface to 0.8 mm (male) Adapter (ME7838G only)
35WR5G	MA25400A Flange Interface to WR5 Waveguide Adapter (ME7838G only)
35WR10W	WR10 to W1 (m) Adapter, W1 (1 mm) to WR10 Waveguide
35WR10WF	WR10 to W1 (f) Adapter, W1 (1 mm) to WR10 Waveguide
SC7260	WR12 to W1 (m) Adapter, W1 (1 mm) to WR12 Waveguide
SC7442	WR12 to W1 (f) Adapter, W1 (1 mm) to WR12 Waveguide
35WR15V	WR15 to V (m) Adapter, V (1.85 mm) to WR15 Waveguide
35WR15VF	WR15 to V (f) Adapter, V (1.85 mm) to WR15 Waveguide
For More Information	Refer to our Precision RF & Microwave Components Catalog for descriptions of adapters and other components.
	Miscellaneous Components
41W-3	Attenuator, DC to 110 GHz, 0.2 W, 3 dB, W1 (m) to W1 (f), 50Ω
41W-6	Attenuator, DC to 110 GHz, 0.2 W, 6 dB, W1 (m) to W1 (f), 50Ω
41W-10	Attenuator, DC to 110 GHz, 0.2 W, 10 dB, W1 (m) to W1 (f), 50Ω
W240A	Precision Power Divider, DC to 110 GHz, W1 (f) input, W1 (f) outputs, 3 resistor, 50Ω
W241A	Precision Power Splitter, DC to 110 GHz, W1 (m) input, W1 (f) outputs, 2 resistor, 50Ω
MN25110A	Precision Directional Coupler, 20 GHz to 110 GHz, W1 (f) input, W1 (f) output, W1 (f) coupled port, 50Ω (ME7838D only)
W255MF	Precision Ultra Wide Band Bias Tee, 50 kHz to 110 GHz, W1(m) input, W1 (f) output, SMC (m) bias (ME7838D only)
W255FM	Precision Ultra Wide Band Bias Tee, 50 kHz to 110 GHz, W1 (f) input, W1 (m) output, SMC (m) bias (ME7838D only)
W265	Precision Ultra Wide Band DC Block, 50 kHz to 110 GHz (ME7838D only)
W252MF	Precision Ultra Wide Band Bias Tee, 100 MHz to 110 GHz, W1 (m) input, W1 (f) output, SMC (m) bias (ME7838D only)
W252FM	Precision Ultra Wide Band Bias Tee, 100 MHz to 110 GHz, W1 (f) input, W1 (m) output, SMC (m) bias (ME7838D only)
33GG50	MA25400 Flange Interface 50 mm Thru Line (male-male)
	Accessories
SC8215	Kelvin Bias Tee, low frequency limit: 70 kHz, Max Voltage: 16 VDC, Max Current: 100 mA
SC7287	Kelvin Bias Tee, low frequency limit: 100 kHz, Max Voltage: 50 VDC, Max Current: 500 mA
SC8218	Triax (m) to SMC (f) Cable, (Inner-shield floating at SMC end), 1.5 m (60 in) long two (2) needed per Kelvin Bias Tee
SM6494	System floor console. Includes larger size writing table
2100-1-R	GPIB cable, 1 m (39 in) long
2100-2-R	GPIB cable, 2 m (79 in) long
2100-4-R	GPIB cable, 4 m (157 in) long
806-206-R	Flexible Coaxial Cable, DC to 70 GHz, 24 in (61 cm), V (m) - V (f), 50Ω (ME7838A/AX and ME7838D and ME7838G only)
806-209-R	Flexible Coaxial Stable Cable, DC to 70 GHz, 36in (91.5 cm), V (m) - V (f), 50Ω (ME7838A/AX and ME7838D and ME7838G only)
806-396-R	Flexible Phase Stable Coaxial Cable, DC to 70 GHz, 36 in (91.5 cm), V (m) to V (f), 50Ω (ME7838G only)
01-201	Torque Wrench (for tightening male devices), 8 mm (5/16 in), 0.9 N·m (8 lbf·in) for SMA, 3.5 mm, 2.4 mm, K, and V connectors
01-202	Universal Test Port Connector Wrench
01-203	Torque Wrench (for tightening the VNA test ports to female devices) 20.6 mm (13/16 in), 0.9 N·m (8 lbf·in)
01-204	Anritsu Stainless Steel Connector Wrench, circular, open-ended for SMA, 3.5 mm, 2.4 mm, K and V connectors
01-504	Torque wrench (for tightening male devices) 6 mm, 0.45 N-m (4 lbf-in) for 1.0 mm and 0.8 mm connectors
01-524	Low profile Torque Wrench (for tightening male devices), 6 mm, 0.45 N-m (lbf-in), 126 mm long for 1.0 mm and 0.8 mm connectors
01-529-R	Torque Wrench, 4 mm (5/32 in), 0.17 N·m (1.5 lbf·in) (for tightening the test and reference IF connectors on the mmWave modules)
	Additional Accessories
	DC-220 GHz probes available from MPI Corporation:
2000-1972-R	T220A-GSG050, 220 GHz Probe, 50 µm pitch (ME7838G only)
2000-1973-R	T220A-GSG075, 220 GHz Probe, 75 µm pitch (ME7838G only)
2000-1974-R	T220A-GSG100, 220 GHz Probe, 100 µm pitch (ME7838G only)

VectorStar™ Broadband Vector Network Analyzers

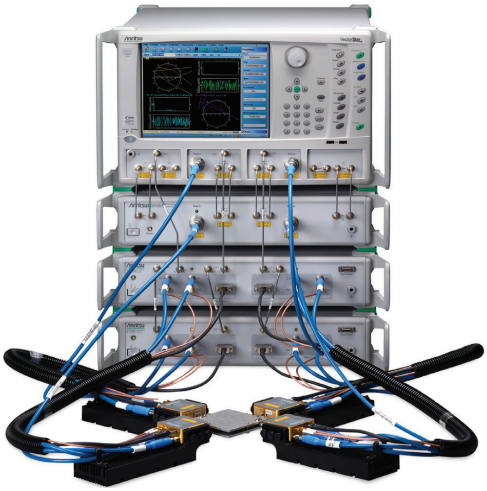
ME7838A4/A4X/E4/E4X/D4/G4 4-Port Broadband Vector Network Analyzers

Remote Control
GPIB | Ethernet

4-Port Broadband VNA System, 70 kHz to 110 (125) GHz (ME7838A4/A4X/E4/E4X), to 145 (150) GHz (ME7838D4), to 220 GHz (ME7838DG4)
4-Port Millimeter Waveguide VNA System, 50 GHz to 1.1 THz

High Performance, Broadband Network Analysis Solutions

VectorStar®



Broadband VNA System 70 kHz to 110 (125) GHz

The VectorStar ME7838A4/A4X/E4/E4X/D4/G4 broadband systems provide high-performance 4-port measurements utilizing compact mmWave modules with industry-best calibration stability. While other broadband systems continue to provide raw performance with negative directivity in critical frequency bands, the ME7838 series, which includes the 4-port systems, is the only broadband system with positive raw directivity in all bands. The result is better calibration and measurement stability with significantly longer time between calibrations for accurate measurements and improved productivity. The ME7838D4 takes high-performance 4-port broadband measurements to a new level by incorporating the Anritsu MA25300A mmWave module. The MA25300A module combines Anritsu developed Nonlinear Transmission Line (NLTL) technology in a small, compact high-performance mmWave module with a 0.8 mm test port connector for measurements up to 145 GHz.
All VectorStar broadband systems include an RF VNA architecture using bridges instead of couplers to extend frequencies down to the RF bands (operational to 40 kHz) for near-DC analysis with excellent dynamic range.

VectorStar 4 Port Broadband VNA ME7838E4/A4/D4/G4

The VectorStar ME7838E4, ME7838A4, ME7838D4, and ME7838G4 series offer the widest available 4-port single sweep measurements from 70 kHz to 110, 125, 145, and 150 GHz with mmWave bands up to 1.1 THz.

Broadband/Millimeter-Wave System Features

- The ME7838E4 4-port system sweeps from 70 kHz to 110 GHz
- The ME7838A4 4-port system sweeps from 70 kHz to 110/125 GHz
- The ME7838D4 4-port system sweeps from 70 kHz to 145/150 GHz
- The ME7838DG 4-port system sweeps from 70 kHz to 220 GHz
- All systems may be configured to include banded millimeter-wave modules up to 1.1 THz
- Industry-best calibration and measurement stability: 0.1 dB vs 0.6 dB over 24 hrs
- All systems also supports the 3744x-Rx receiver for noise figure measurements to 125 GHz
- Compact, lightweight mmWave modules offer low cost installation with industry-best performance

Definitions

All specifications and characteristics apply under the following conditions, unless otherwise stated:

Warm-Up Time	After 90 minutes of warm-up time, where the instrument is left in the ON state.
Temperature Range	Over the 25°C±5°C temperature range.
Error Corrected Specifications	For error-corrected specifications, over 23°C±3°C, with <1°C variation from calibration temperature. For error-corrected specifications are warranted and include guard bands, unless otherwise stated.
Typical Performance	"Typical" specifications describe expected, but not warranted, performance based on sample testing. Typical performance indicates the measured performance of an average unit and do not guarantee the performance of any individual product. "Typical" specifications do not account for measurement uncertainty and are shown in parenthesis, such as (–102 dB), or noted as Typical.
User Cables/Adapters	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.
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
Interpolation Mode	All specifications are with Interpolation Mode Off.
Specifications Subject to Change	All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site at www.anritsu.com.

Specifications for Broadband Configuration

System and Receiver Dynamic Range, Noise Floor

(Excludes localized spurious responses and crosstalk)

System Dynamic Range	System dynamic range is measured as the difference between maximum port power and the RMS noise floor in a 10 Hz bandwidth and no averaging (ports terminated).
Noise Floor	Noise floor is calculated as the difference between maximum rated port power and system dynamic range.
Receiver Dynamic Range	Receiver Dynamic Range is calculated as the difference between the receiver compression level and the noise floor at the appropriate port.
Normalizing Measurement	Normalizing measurement made with a through line connection, with its effects compensated for. The cables between the VNA and the 3743A modules (ME7838A4 and ME7838E4 only) MA25300A modules (ME7838D4 only) are assumed to be the 806-206 1.85 mm cable (61 cm, 24 in long) or the 806-209 1.85 mm cable (91 cm, 36 in long). All figures are typical.

Frequency Range	System Dynamic Range (dB)								Receiver Dynamic Range (dB)*1							
	ME7838A4 Option 51 *1, *3	ME7838A4 Options 31/51 *1, *3	ME7838E4 Option 51 *1, *3	ME7838E4 Options 31/51 *1, *3	ME7838D4 Option 51 *1, *2	ME7838D4 Options 31/51 *1, *2	ME7838G4 Option 51 *1, *3	ME7838G4 Options 31/51 *1, *3	ME7838A4 Option 51	ME7838A4 Option 62	ME7838E4 Option 51	ME7838E4 Option 62	ME7838D4 Option 51	ME7838D4 Option 62	ME7838G4 Option 51 *1	ME7838G4 Option 62 *1
70 to 300 kHz	76	78	76	78	76	78	76	78	78	79	78	79	78	79	78	79
>0.3 to 2 MHz	86	88	86	88	86	88	86	88	94	94	94	94	94	94	92	93
>2 to 10 MHz	100	102	100	102	100	102	100	102	106	105	106	105	106	105	104	104
>0.01 to 2.5 GHz	111	115	111	115	111	115	111	115	115	115	115	115	115	115	114	114
>2.5 to 24 GHz	96	97	96	97	96	97	96	97	114	114	114	114	114	114	113	113
>24 to 54 GHz	90	91	90	91	90	91	90	91	114	113	114	113	114	113	115	113
>54 to 60 GHz	112	112	112	112	110	110	112	112	122	122	122	122	124	124	126	126
>60 to 65 GHz	108	108	108	108					117	117	117	117				
>60 to 67 GHz					110	110	109	109					123	123	122	122
>65 to 80 GHz	108	108	108	108					120	120	120	120				
>67 to 80 GHz					108	108	109	109					121	121	122	122
>80 to 85 GHz	110	110	110	110	106	106	106	106	123	123	123	123	123	123	123	123
>85 to 90 GHz	108	108	108	108	106	106	106	106	121	121	121	121	122	122	122	122
>90 to 95 GHz	112	112	111	111	106	106	106	106	121	121	121	121	121	121	122	122
>95 to 100 GHz	108	108	107	107					117	117	117	117				
>95 to 105 GHz					106	106	106	106					121	121	122	122
>100 to 110 GHz	109	109	109	109					122	122	122	122				
>105 to 110 GHz					109	109	106	106					125	125	122	122
>110 to 120 GHz*2	107	107			108	108	109	109	115	115			118	118	123	123
>120 to 125 GHz*2	104	104			104	104	109	109	112	112			116	116	123	123
>125 to 140 GHz					92	92	100	100					109	109	122	122
>140 to 145 GHz					94	94							107	107		
>140 to 150 GHz							100	100							122	122
>145 to 150 GHz*4					94	94							107	107		
>150 to 160 GHz							97	97							119	119
>160 to 180 GHz							102	102							122	122
>180 to 200 GHz							103	103							123	123
>200 to 220 GHz							98	98							120	120
>220 to 226 GHz							85	85							108	108

Frequency Range	Noise Floor (dBm)*1							
	ME7838A4 Option 51	ME7838A4 Option 62	ME7838E4 Option 51	ME7838E4 Option 62	ME7838D4 Option 51	ME7838D4 Option 62	ME7838G4 Option 51	ME7838G4 Option 62
70 to 300 kHz	–72	–73	–72	–73	–72	–73	–72	–73
>0.3 to 2 MHz	–82	–81	–82	–81	–82	–81	–82	–81
>2 to 10 MHz	–94	–92	–94	–92	–94	–92	–94	–92
>0.01 to 2.5 GHz	–103	–101	–103	–101	–103	–101	–103	–101
>2.5 to 24 GHz	–102	–100	–102	–100	–102	–100	–102	–100
>24 to 54 GHz	–104	–103	–104	–103	–104	–103	–105	–103
>54 to 60 GHz	–112	–112	–112	–112	–114	–114	–116	–116
>60 to 65 GHz	–107	–107	–107	–107				
>60 to 67 GHz					–113	–113	–112	–112
>65 to 80 GHz	–110	–110	–110	–110				
>67 to 80 GHz					–111	–111	–112	–112
>80 to 85 GHz	–113	–113	–113	–113	–113	–113	–113	–113
>85 to 90 GHz	–111	–111	–111	–111	–112	–112	–112	–112
>90 to 95 GHz	–111	–111	–111	–111	–111	–111	–112	–112
>95 to 100 GHz	–107	–107	–107	–107				
>95 to 105 GHz					–111	–111	–112	–112
>100 to 110 GHz	–112	–112	–112	–112				
>105 to 110 GHz					–115	–115	–112	–112
>110 to 120 GHz*2	–110	–110			–111	–111	–116	–116
>120 to 125 GHz*2	–107	–107			–109	–109	–116	–116
>125 to 140 GHz					–102	–102	–115	–115
>140 to 145 GHz					–100	–100		
>140 to 150 GHz							–115	–115
>145 to 150 GHz*4					–100	–100		
>150 to 160 GHz							–112	–112
>160 to 180 GHz							–115	–115
>180 to 200 GHz							–116	–116
>200 to 220 GHz							–113	–113
>220 to 226 GHz							–103	–103

*1: Excludes localized spurious responses and crosstalk.
*2: 110 GHz to 125 GHz frequency range is available as operational.
*3: Table represents dynamic range with Ports 1 and/or 3 driving. With Port 2 driving, dynamic range may be up to 4 dB (ME7838A/E4/D4) 7 dB (ME7838G4) lower in the 2.5-54 GHz band.
With Port 4 driving, dynamic range may be up to 3 dB higher in the 24 (2.5 ME7838G4)-54 GHz band.
*4: 145 GHz to 150 GHz available as operational.

Frequency Range	System Dynamic Range (dB)*1, *2								Receiver Dynamic Range (dB)*1							
	ME7838A4X Option 51	ME7838A4X Options 61/62	ME7838A4X Options 31/51	ME7838A4X Options 31/61/62	ME7838E4X Option 51	ME7838E4X Options 61/62	ME7838E4X Options 31/51	ME7838E4X Options 31/61/62	ME7838A4X Option 51	ME7838A4X Options 61/62	ME7838A4X Options 31/51	ME7838A4X Options 31/61/62	ME7838E4X Option 51	ME7838E4X Options 61/62	ME7838E4X Options 31/51	ME7838E4X Options 31/61/62
70 to 300 kHz	82	82	84	84	82	82	84	84	82	83	82	82	82	83	82	82
>0.3 to 2 MHz	92	92	94	94	92	92	94	94	98	100	98	99	98	100	98	99
>2 to 10 MHz	100	100	102	102	100	100	102	102	107	108	106	107	107	108	106	107
>0.01 to 2.5 GHz	108	108	111	110	108	108	111	110	115	117	115	117	115	117	115	117
>2.5 to 10 GHz	107	104	110	104	107	104	110	104	122	122	124	121	122	122	124	121
>10 to 24 GHz	98	92	102	95	98	92	102	95	117	115	120	116	117	115	120	116
>24 to 40 GHz	95	90	100	95	95	90	100	95	115	112	119	115	115	112	119	115
>40 to 54 GHz	94	87	99	93	94	87	99	93	121	117	122	118	121	117	122	118
>54 to 60 GHz	107	107	107	107	107	107	107	107	119	119	119	119	119	119	119	119
>60 to 65 GHz	107	107	107	107	107	107	107	107	119	119	119	119	119	119	119	119
>65 to 70 GHz									122	122	122	122	122	122	122	122
>65 to 80 GHz	106	106	106	106	106	106	106	106								
>70 to 80 GHz									120.5	120.5	120.5	120.5	120.5	120.5	120.5	120.5
>80 to 90 GHz	104	104	104	104	104	104	104	104	1205	120.5	120.5	120.5	120.5	120.5	120.5	120.5
>90 to 100 GHz	104	104	104	104	104	104	104	104	116.5	116.5	116.5	116.5	116.5	116.5	116.5	116.5
>100 to 110 GHz	104	104	104	104	104	104	104	104	120.5	120.5	120.5	120.5	120.5	120.5	120.5	120.5
>110 to 115 GHz	103	103	103	103					120	120	120	120				
>115 to 120 GHz	95	95	95	95					103	103	103	103				
>120 to 125 GHz	95	95	95	95					103	103	103	103				

*1: Option 51 is the minimum required option for 4-port baseband VNAs.

*2: Table represents dynamic range with Ports 1 and/or 3 driving. With Port 2 driving, dynamic range may be up to 7 dB lower in the 2.5-54 GHz bands. With Port 4 driving, dynamic range may be up to 3 dB higher in the 2.5-54 GHz bands.

Test Port Power

Port power control is provided by the base VNA for frequencies below 54 GHz, and by the 3743A mmWave module for frequencies greater than 54 GHz. Port Power and Power Range tables represent powers available at Ports 1 and 3. Max Power may be up to 4 dB lower on Port 2 in the 24-54 GHz band (only for option 31 systems). Max Power may be up to 3 dB higher on Port 4 in the 24-54 GHz band. All typical.

Frequency Range	Port Power*1								Port Power*1 W/MS4647B Opt 31 Dual Source Architecture							
	Max Power ME7838A4 Option 51	Max Power ME7838A4 Option 62	Max Power ME7838E4 Option 51	Max Power ME7838E4 Option 62	Max Power ME7838D4 Option 51	Max Power ME7838D4 Option 62	Max Power ME7838G4 Option 51	Max Power ME7838G4 Option 62*2	Max Power ME7838A4 Options 31/51	Max Power ME7838A4 Options 31/62	Max Power ME7838E4 Options 31/51	Max Power ME7838E4 Options 31/62	Max Power ME7838D4 Options 31/51	Max Power ME7838D4 Options 31/62	Max Power ME7838G4 Options 31/51	Max Power ME7838G4 Options 31/62
70 to 300 kHz	4	6	4	6	4	6	4	3	6	8	6	8	6	8	6	5
>0.3 to 2 MHz	4	6	4	6	4	6	4	3	6	8	6	8	6	8	6	5
>2 to 10 MHz	6	6	6	6	6	6	6	5	8	8	8	8	8	8	8	6
>0.01 to 2.5 GHz	8	6	8	6	8	6	8	7	12	10	12	10	12	10	12	9
>2.5 to 24 GHz	–6	–8	–6	–8	–6	–8	–6	–8	–5	–7	–5	–7	–5	–7	–5	–7
>24 to 54 GHz	–14	–16	–14	–16	–14	–16	–15	–18	–13	–15	–13	–15	–13	–15	–14	–17
>54 to 60 GHz	0	0	0	0	–4	–4	–4	–4	0	0	0	0	–4	–4	–4	–4
>60 to 65 GHz	1	1	1	1					1	1	1	1				
>60 to 67 GHz					–3	–3	–3	–3					–3	–3	–3	–3
>65 to 80 GHz	–2	–2	–2	–2					–2	–2	–2	–2				
>67 to 80 GHz					–3	–3	–3	–3					–3	–3	–3	–3
>80 to 85 GHz	–3	–3	–3	–3	–7	–7	–7	–7	–3	–3	–3	–3	–7	–7	–7	–7
>85 to 90 GHz	–3	–3	–3	–3	–6	–6	–6	–6	–3	–3	–3	–3	–6	–6	–6	–6
>90 to 95 GHz	1	1	0	0	–5	–5	–6	–6	1	1	0	0	–5	–5	–6	–6
>95 to 100 GHz	1	1	0	0					1	1	0	0				
>95 to 105 GHz					–5	–5	–6	–6					–5	–5	–6	–6
>100 to 110 GHz	–3	–3	–3	–3					–3	–3	–3	–3				
>105 to 110 GHz					–6	–6	–6	–6					–6	–6	–6	–6
>110 to 120 GHz*3	–3	–3			–3	–3	–7	–7	–3	–3			–3	–3	–7	–7
>120 to 125 GHz*3	–3	–3			–5	–5	–7	–7	–3	–3			–5	–5	–7	–7
>125 to 140 GHz					–10	–10	–15	–15					–10	–10	–15	–15
>140 to 145 GHz					–6	–6							–6	–6		
>140 to 150 GHz							–15	–15							–15	–15
>145 to 150 GHz*3					–6	–6							–6	–6		
>150 to 160 GHz							–15	–15							–15	–15
>160 to 180 GHz							–13	–13							–13	–13
>180 to 200 GHz							–13	–13							–13	–13
>200 to 220 GHz							–15	–15							–15	–15
>220 to 226 GHz							–18	–18							–18	–18

*1: Using the 806–206 1.85 mm (61 cm, 24 in long) test port cables between the VNA and the MA25300A mmWave modules.

*2: Use this column also for Options 51 and 61 although the performance between 10 MHz and 54 GHz will characteristically be better by 1 dB or more for Option 51, and will characteristically be better by 1 dB or more for Option 61 (with port 1 driving and port 2 receiving).

*3: 110 GHz to 125 GHz (ME7838A4), 145 GHz to 150 GHz (ME7838D4) available as operational.

Frequency Range	Port Power*1				Port Power*1 W/MS4647B Opt 31 Dual Source Architecture			
	Max Power ME7838A4X Option 51	Max Power ME7838A4X Options 61 or 62	Max Power ME7838E4X Option 51	Max Power ME7838E4X Options 61 or 62	Max Power ME7838A4X Options 31/51	Max Power ME7838A4X Options 31/61 or 62	Max Power ME7838E4X Options 31/51	Max Power ME7838E4X Options 31/61 or 62
70 to 300 kHz	6	5	6	5	8	8	8	8
>0.3 to 2 MHz	6	5	6	5	8	8	8	8
>2 to 10 MHz	5	5	5	5	8	8	8	8
>0.01 to 2.5 GHz	5	5	5	5	8	7	8	7
>2.5 to 10 GHz	–3	–4	–3	–4	–2	–3	–2	–3
>10 to 24 GHz	–7	–9	–7	–9	–6	–7	–6	–7
>24 to 40 GHz	–10	–12	–10	–12	–9	–10	–9	–10
>40 to 54 GHz	–17	–20	–17	–20	–13	–15	–13	–15
>54 to 60 GHz	–2	–2	–2	–2	–2	–2	–2	–2
>60 to 65 GHz	–2	–2	–2	–2	–2	–2	–2	–2
>65 to 70 GHz	–6	–6	–6	–6	–6	–6	–6	–6
>70 to 80 GHz	–4.5	–4.5	–4.5	–4.5	–4.5	–4.5	–4.5	–4.5
>80 to 90 GHz	–6.5	–6.5	–6.5	–6.5	–6.5	–6.5	–6.5	–6.5
>90 to 100 GHz	–2.5	–2.5	–2.5	–2.5	–2.5	–2.5	–2.5	–2.5
>100 to 110 GHz	–6.5	–6.5	–6.5	–6.5	–6.5	–6.5	–6.5	–6.5
>110 to 115 GHz	–7	–7			–7	–7		
>115 to 120 GHz	–3	–3			–3	–3		
>120 to 125 GHz	–3	–3			–3	–3		

*1: Using the 806–206-R 1.85 mm (61 cm, 24 in long) test port cables between the VNA and the 3743AX mmWave modules.

Power Range, Accuracy, Linearity and Resolution

Accuracy is defined at –10 dBm or max rated power, whichever is lower. Linearity is defined as the incremental error between the accuracy test power level and 5 dB below. Typical.

Frequency Range	Range (dB)		Accuracy*1 (dB)	Linearity (dB)	Resolution (dB)
	ME7838A4 Option 51	ME7838A4 Option 62			
70 kHz to 300 kHz	4 to –25	6 to –85	±1.5	±1.5	0.01
>0.3 MHz to 2 MHz	4 to –25	6 to –85	±1.5	±1.5	0.01
>2 MHz to 10 MHz	6 to –25	6 to –85	±1.5	±1.5	0.01
>0.01 GHz to 2.5 GHz	8 to –25	6 to –85	±1.0	±1.0	0.01
>2.5 GHz to 24 GHz	–6 to –25	–8 to –85	±1.0	±1.0	0.01
>24 GHz to 54 GHz	–14 to –30	–16 to –90	±1.5	±1.0	0.01
>54 GHz to 60 GHz	0 to –55	0 to –55	±2.0	±1.5	0.01
>60 GHz to 65 GHz	1 to –55	1 to –55	±2.0	±1.5	0.01
>65 GHz to 80 GHz	–2 to –55	–2 to –55	±2.0	±1.5	0.01
>80 GHz to 85 GHz	–3 to –55	–3 to –55	±2.0	±1.5	0.01
>85 GHz to 90 GHz	–3 to –55	–3 to –55	±2.0	±1.5	0.01
>90 GHz to 95 GHz	1 to –55	1 to –55	±2.0	±1.5	0.01
>95 GHz to 100 GHz	1 to –55	1 to –55	±3.0	±2.0	0.01
>100 GHz to 110 GHz	–3 to –55	–3 to –55	±3.0	±2.0	0.01
>110 GHz to 120 GHz*2	–3 to –40	–3 to –40	±4.0	±3.0	0.01
>120 GHz to 125 GHz*2	–3 to –40	–3 to –40	±4.0	±3.0	0.01

*1: Accuracy does not include effects of the MN4697C test set (affects < 54 GHz).
*2: 110 GHz to 125 GHz frequency range is available as operational.

Frequency Range	Range (dB)				Accuracy*1 (dB)	Resolution (dB)
	ME7838A4X Option 51	ME7838A4X Option 61 or 62	ME7838A4X Option 31/51	ME7838A4X Option 31/61 or 62		
70 kHz to 300 kHz	6 to –25	5 to –85	8 to –25	8 to –85	±0.3	0.01
>0.3 MHz to 2 MHz	6 to –25	5 to –85	8 to –25	8 to –85	±0.3	0.01
>2 MHz to 10 MHz	5 to –25	5 to –85	8 to –25	8 to –85	±0.3	0.01
>0.01 GHz to 2.5 GHz	5 to –25	5 to –85	8 to –25	7 to –85	±0.4	0.01
>2.5 GHz to 10 GHz					±0.5	0.01
>2.5 GHz to 24 GHz	–3 to –25	–4 to –85	–2 to –25	–3 to –85		
>10 GHz to 24 GHz	–7 to –25	–9 to –85	–6 to –25	–7 to –85	±0.5	0.01
>24 GHz to 40 GHz	–10 to –30	–12 to –90	–9 to –30	–10 to –90	±0.9	0.01
>40 GHz to 54 GHz	–17 to –30	–20 to –90	–13 to –30	–15 to –90	±0.9	0.01
>54 GHz to 60 GHz	–2 to –55	–2 to –55	–2 to –55	–2 to –55	±1.3	0.01
>60 GHz to 65 GHz	–2 to –55	–2 to –55	–2 to –55	–2 to –55	±1.3	0.01
>65 GHz to 70 GHz	–6 to –55	–6 to –55	–6 to –55	–6 to –55		
>65 GHz to 80 GHz					±1.3	0.01
>70 GHz to 80 GHz	–4.5 to –55	–4.5 to –55	–4.5 to –55	–4.5 to –55		
>80 GHz to 90 GHz	–6.5 to –55	–6.5 to –55	–6.5 to –55	–6.5 to –55	±1.7	0.01
>90 GHz to 100 GHz	–2.5 to –55	–2.5 to –55	–2.5 to –55	–2.5 to –55	±2.3	0.01
>100 GHz to 110 GHz	–6.5 to –55	–6.5 to –55	–6.5 to –55	–6.5 to –55	±2.3	0.01
>110 GHz to 115 GHz	–7 to –55	–7 to –55	–7 to –55	–7 to –55	±2.3	0.01
>115 GHz to 120 GHz	–3 to –40	–3 to –40	–3 to –40	–3 to –40	±2.3	0.01
>120 GHz to 125 GHz	–3 to –40	–3 to –40	–3 to –40	–3 to –40	±3.0	0.01

Frequency Range	Power Range (dBm)		Accuracy (dB)*	Linearity (dB)	Resolution (dB)
	ME7838E4 Option 51	ME7838E4 Option 62			
70 kHz to 300 kHz	4 to –25	6 to –85	±1.5	±1.5	0.01
>0.3 MHz to 2 MHz	4 to –25	6 to –85	±1.5	±1.5	0.01
>2 MHz to 10 MHz	6 to –25	6 to –85	±1.5	±1.5	0.01
>0.01 GHz to 2.5 GHz	8 to –25	6 to –85	±1.0	±1.0	0.01
>2.5 GHz to 24 GHz	–6 to –25	–8 to –85	±1.0	±1.0	0.01
>24 GHz to 54 GHz	–14 to –30	–16 to –90	±1.5	±1.0	0.01
>54 GHz to 60 GHz	0 to –55	0 to –55	±2.0	±1.5	0.01
>60 GHz to 65 GHz	1 to –55	1 to –55	±2.0	±1.5	0.01
>65 GHz to 80 GHz	–2 to –55	–2 to –55	±2.0	±1.5	0.01
>80 GHz to 85 GHz	–3 to –55	–3 to –55	±2.0	±1.5	0.01
>85 GHz to 90 GHz	–3 to –55	–3 to –55	±2.0	±1.5	0.01
>90 GHz to 95 GHz	0 to –55	0 to –55	±2.0	±1.5	0.01
>95 GHz to 100 GHz	0 to –55	0 to –55	±3.0	±2.0	0.01
>100 GHz to 110 GHz	–3 to –55	–3 to –55	±3.0	±2.0	0.01

*: Accuracy does not include effects of the MN4697B test set (affects <54 GHz).

Frequency Range	Range (dB)				Accuracy*1 (dB)	Resolution (dB)
	ME7838E4X Option 51	ME7838E4X Option 61 or 62	ME7838E4X Option 31/51	ME7838E4X Option 31/61 or 62		
70 kHz to 300 kHz	6 to –25	5 to –85	8 to –25	8 to –85	±0.3	0.01
>0.3 MHz to 2 MHz	6 to –25	5 to –85	8 to –25	8 to –85	±0.3	0.01
>2 MHz to 10 MHz	5 to –25	5 to –85	8 to –25	8 to –85	±0.3	0.01
>0.01 GHz to 2.5 GHz	5 to –25	5 to –85	8 to –25	7 to –85	±0.4	0.01
>2.5 GHz to 10 GHz	–3 to –25	–4 to –85	–2 to –25	–3 to –85	±0.5	0.01
>10 GHz to 24 GHz	–7 to –25	–9 to –85	–6 to –25	–7 to –85	±0.5	0.01
>24 GHz to 40 GHz	–10 to –30	–12 to –90	–9 to –30	–10 to –90	±0.9	0.01
>40 GHz to 54 GHz	–17 to –30	–20 to –90	–13 to –30	–15 to –90	±0.9	0.01
>54 GHz to 60 GHz	–2 to –55	–2 to –55	–2 to –55	–2 to –55	±1.3	0.01
>60 GHz to 65 GHz	–2 to –55	–2 to –55	–2 to –55	–2 to –55	±1.3	0.01
>65 GHz to 70 GHz	–6 to –55	–6 to –55	–6 to –55	–6 to –55		
>65 GHz to 80 GHz					±1.3	0.01
>70 GHz to 80 GHz	–4.5 to –55	–4.5 to –55	–4.5 to –55	–4.5 to –55		
>80 GHz to 90 GHz	–6.5 to –55	–6.5 to –55	–6.5 to –55	–6.5 to –55	±1.7	0.01
>90 GHz to 100 GHz	–2.5 to –55	–2.5 to –55	–2.5 to –55	–2.5 to –55	±2.3	0.01
>100 GHz to 110 GHz	–6.5 to –55	–6.5 to –55	–6.5 to –55	–6.5 to –55	±2.3	0.01

Frequency Range	Power Range (dBm)		Accuracy (dB)*	Linearity (dB)	Resolution (dB)
	ME7838D4 Option 51	ME7838D4 Option 62			
70 kHz to 300 kHz	4 to –25	6 to –85	±1.5	±1.5	0.01
>0.3 MHz to 2 MHz	4 to –25	6 to –85	±1.5	±1.5	0.01
>2 MHz to 10 MHz	6 to –25	6 to –85	±1.5	±1.5	0.01
>0.01 GHz to 2.5 GHz	8 to –25	6 to –85	±1.0	±1.0	0.01
>2.5 GHz to 24 GHz	–6 to –25	–8 to –85	±1.0	±1.0	0.01
>24 GHz to 54 GHz	–14 to –30	–16 to –90	±1.5	±1.0	0.01
>54 GHz to 60 GHz	–4 to –55	–4 to –55	±2.0	±1.5	0.01
>60 GHz to 67 GHz	–3 to –55	–3 to –55	±2.0	±1.5	0.01
>67 GHz to 80 GHz	–3 to –55	–3 to –55	±2.0	±1.5	0.01
>80 GHz to 85 GHz	–7 to –55	–7 to –55	±2.0	±1.5	0.01
>85 GHz to 90 GHz	–6 to –55	–6 to –55	±2.0	±1.5	0.01
>90 GHz to 95 GHz	–5 to –55	–5 to –55	±2.0	±1.5	0.01
>95 GHz to 105 GHz	–5 to –55	–5 to –55	±3.0	±2.0	0.01
>105 GHz to 110 GHz	–6 to –55	–6 to –55	±3.0	±2.0	0.01
>110 GHz to 120 GHz	–3 to –55	–3 to –55	±4.0	±3.0	0.01
>120 GHz to 125 GHz	–5 to –55	–5 to –55	±4.0	±3.0	0.01
>125 GHz to 140 GHz	–10 to –50	–10 to –50	±5.0	±4.0	0.01
>140 GHz to 145 GHz	–6 to –50	–6 to –50	±5.0	±4.0	0.01

*: Accuracy does not include effects of the MN4697B test set (affects <54 GHz).

Frequency Range	Power Range (dBm)		Accuracy (dB)	Linearity (dB)	Resolution (dB)
	ME7838G4 Option 51	ME7838G4 Option 62			
70 kHz to 300 kHz	–25 to 4	–85 to 3	±1.5	±1.5	0.01
>0.3 MHz to 2 MHz	–25 to 4	–85 to 3	±1.5	±1.5	0.01
>2 MHz to 10 MHz	–25 to 6	–85 to 5	±1.5	±1.5	0.01
>0.01 GHz to 2.5 GHz	–25 to 8	–85 to 7	±1.5	±1.0	0.01
>2.5 GHz to 24 GHz	–25 to –6	–85 to –8	±1.5	±1.0	0.01
>24 GHz to 54 GHz	–30 to –15	–90 to –18	±1.5	±1.0	0.01
>54 GHz to 60 GHz	–55 to –4	–55 to –4	±2.0	±1.5	0.01
>60 GHz to 67 GHz	–55 to –3	–55 to –3	±2.0	±1.5	0.01
>67 GHz to 80 GHz	–55 to –3	–55 to –3	±2.0	±1.5	0.01
>80 GHz to 85 GHz	–55 to –7	–55 to –7	±2.0	±1.5	0.01
>85 GHz to 90 GHz	–55 to –6	–55 to –6	±2.0	±1.5	0.01
>90 GHz to 95 GHz	–55 to –6	–55 to –6	±2.0	±1.5	0.01
>95 GHz to 105 GHz	–55 to –6	–55 to –6	±3.0	±2.0	0.01
>105 GHz to 110 GHz	–55 to –6	–55 to –6	±3.0	±2.0	0.01
>110 GHz to 120 GHz	–55 to –7	–55 to –7	±4.0	±3.0	0.01
>120 GHz to 125 GHz	–55 to –7	–55 to –7	±4.0	±3.0	0.01
>125 GHz to 140 GHz	–50 to –15	–50 to –15	±4.0	±4.0	0.01
>140 GHz to 150 GHz	–50 to –15	–50 to –15	±4.0	±4.0	0.01
>150 GHz to 160 GHz	–50 to –15	–50 to –15	±4.0	±4.0	0.01
>160 GHz to 180 GHz	–50 to –13	–50 to –13	±4.0	±4.0	0.01
>180 GHz to 200 GHz	–50 to –13	–50 to –13	±4.0	±4.0	0.01
>200 GHz to 220 GHz	–50 to –15	–50 to –15	±4.0	±4.0	0.01
>220 GHz to 226 GHz	–50 to –18	–50 to –18	±5.0	±4.0	0.01

Receiver Compression*1

Receiver compression point is defined as the port power level beyond which the response may be compressed more than 0.2 dB relative to normalization level. 10 Hz IF bandwidth used to remove trace noise effects. All typical.

Frequency	ME7838A4 Option 51	ME7838A4 Option 62	ME7838A4X Option 51	ME7838A4X Option 61/62	ME7838D4 Option 51	ME7838D4 Option 62	ME7838G4 Option 51	ME7838G4 Option 62
70 kHz to 300 kHz	6	6	6	6	6	6	6	6
>0.3 MHz to 10 MHz	12	13	12	13	12	13	10	12
>0.01 GHz to 24 GHz	12	14	12	14	12	14	11	13
>24 GHz to 110 GHz*2	10	10			10	10	10	10
>24 GHz to 115 GHz			10	10				
>110 GHz to 125 GHz*2	5	5			7	7	7	7
>115 GHz to 125 GHz			5	5				
>125 GHz to 145 GHz					7	7	7	7
>145 GHz to 220 GHz							7	7
>220 GHz to 226 GHz							5	5

*1: Using the 806–206-R 1.85 mm (61 cm, 24 in long) (91.5 cm, 36 in long, ME7838G4 only) test port cables between the VNA and the 3743A mmWave modules.
*2: 110 GHz to 125 GHz frequency range is available as operational (ME7838A4 only).

Frequency	ME7838E4 Option 51	ME7838E4 Option 62	ME7838E4X Option 51	ME7838E4X Option 61/62
70 kHz to 300 kHz	6	6	6	6
>0.3 MHz to 10 MHz	12	13	12	13
>0.01 GHz to 24 GHz	12	14	12	14
>24 GHz to 110 GHz	10	10	10	10

*1: Using the 806–206 1.85 mm (61 cm, 24 in long) test port cables between the VNA and the 3743E mmWave modules.

High Level Noise

Noise measured at 1 kHz IF bandwidth, at maximum power or compression limit (whichever is less), with through transmission. RMS. Typical.

Frequency Range	System Dynamic Range (dB)											
	Magnitude (dB)						Phase (deg.)					
	ME7838A4	ME7838A4X	ME7838E4	ME7838E4X	ME7838D4	ME7838G4	ME7838A4	ME7838A4X	ME7838E4	ME7838E4X	ME7838D4	ME7838G4
70 kHz to 500 kHz	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.4	<0.3	<0.4	<0.3	<0.4	<0.4
>0.5 MHz to 2 MHz	<0.006	<0.009	<0.006	<0.009	<0.006	<0.006	<0.06	<0.05	<0.06	<0.05	<0.06	<0.06
>2 MHz to 10 MHz	<0.006	<0.0055	<0.006	<0.0055	<0.006	<0.006	<0.06	<0.045	<0.06	<0.045	<0.06	<0.06
>0.01 GHz to 10 GHz		<0.0055		<0.0055				<0.055		<0.055		
>0.01 GHz to 24 GHz	<0.006		<0.006		<0.006	<0.006	<0.06		<0.06		<0.06	<0.06
>10 GHz to 24 GHz		<0.0055		<0.0055				<0.0065		<0.065		
>24 GHz to 54 GHz	<0.005	<0.0055	<0.005	<0.0055	<0.005	<0.005	<0.06	<0.0065	<0.06	<0.065	<0.06	<0.06
>54 GHz to 80 GHz	<0.005	<0.0045	<0.005	<0.0045	<0.005	<0.005	<0.06	<0.075	<0.06	<0.075	<0.06	<0.06
>80 GHz to 110 GHz	<0.008	<0.006	<0.008	<0.006	<0.008	<0.008	<0.09	<0.105	<0.09	<0.105	<0.09	<0.09
>110 GHz to 120 GHz*	<0.010	<0.007			<0.008	<0.008	<0.20	<0.115			<0.09	<0.09
>120 GHz to 125 GHz*	<0.025	<0.0075			<0.011	<0.011	<0.30	<0.13			<0.11	<0.11
>125 GHz to 140 GHz					<0.016	<0.016					<0.16	<0.16
>140 GHz to 145 GHz					<0.016	<0.016					<0.16	<0.16

*: 110 GHz to 125 GHz frequency range is available as operational (ME7838A4 only).

Frequency Range	1 kHz IF bandwidth		100 Hz IF bandwidth	
	ME7838G4 Magnitude (dB)	ME7838G4 Phase (deg.)	ME7838G4 Magnitude (dB)	ME7838G4 Phase (deg.)
70 kHz to 500 kHz	<0.04	<0.4	<0.02	<0.2
>0.5 MHz to 2 MHz	<0.006	<0.06	<0.004	<0.04
>2 MHz to 10 MHz	<0.006	<0.06	<0.004	<0.04
>0.01 GHz to 2.5 GHz	<0.006	<0.06	<0.004	<0.04
>2.5 GHz to 24 GHz	<0.007	<0.07	<0.004	<0.04
>24 GHz to 54 GHz	<0.009	<0.09	<0.007	<0.07
>54 GHz to 80 GHz	<0.008	<0.09	<0.006	<0.06
>80 GHz to 110 GHz	<0.008	<0.09	<0.006	<0.06
>110 GHz to 120 GHz	<0.008	<0.09	<0.006	<0.06
>120 GHz to 125 GHz	<0.011	<0.11	<0.006	<0.07
>125 GHz to 140 GHz	<0.017	<0.17	<0.006	<0.07
>140 GHz to 150 GHz	<0.017	<0.17	<0.006	<0.07
>150 GHz to 160 GHz	<0.022	<0.22	<0.01	<0.1
>160 GHz to 180 GHz	<0.030	<0.25	<0.009	<0.09
>180 GHz to 200 GHz	<0.030	<0.25	<0.009	<0.09
>200 GHz to 220 GHz	<0.07	<0.5	<0.04	<0.3
>220 GHz to 226 GHz	<0.2	<0.8	<0.05	<0.5

Stability

Rationed measurement at maximum leveled power with nominally a full reflect or a stable thru over the normal specified temperature range. Typical.

Frequency Range	Magnitude (dB/°C)					Phase (deg./°C)				
	ME7838A4	ME7838A4X	ME7838E4	ME7838D4	ME7838G4	ME7838A4	ME7838A4X	ME7838E4	ME7838D4	ME7838G4
70 kHz to 300 kHz	<0.015	<0.015	<0.015	<0.015	<0.015	<0.15	<0.15	<0.15	<0.15	<0.15
>0.3 MHz to 2 MHz	<0.015	<0.015	<0.015	<0.015	<0.015	<0.1	<0.1	<0.1	<0.1	<0.1
>2 MHz to 10 MHz	<0.02	<0.02	<0.02	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1	<0.1
>0.01 GHz to 2.5 GHz	<0.02	<0.02	<0.02	<0.02	<0.02	<0.05	<0.08	<0.05	<0.05	<0.05
>2.5 GHz to 30 GHz	<0.02	<0.02	<0.02	<0.02	<0.02	<0.09	<0.09	<0.09	<0.09	<0.1
>30 GHz to 54 GHz	<0.01	<0.02	<0.01	<0.01	<0.02	<0.07	<0.1	<0.07	<0.07	<0.07
>54 GHz to 80 GHz	<0.015	<0.015	<0.015	<0.015	<0.015	<0.1	<0.1	<0.1	<0.1	<0.1
>80 GHz to 110 GHz	<0.015	<0.015	<0.015	<0.015	<0.015	<0.15	<0.15	<0.15	<0.15	<0.15
>110 GHz to 120 GHz*	<0.02	<0.02		<0.02	<0.02	<0.2	<0.2		<0.2	<0.2
>120 GHz to 125 GHz*	<0.04	<0.04		<0.025	<0.025	<0.25	<0.25		<0.2	<0.2
>125 GHz to 140 GHz				<0.03	<0.025				<0.35	<0.3
>140 GHz to 145 GHz				<0.04					<0.5	
>140 GHz to 150 GHz					<0.025					<0.5
>150 GHz to 160 GHz					<0.04					<0.5
>160 GHz to 180 GHz					<0.04					<0.5
>180 GHz to 200 GHz					<0.04					<0.5
>200 GHz to 220 GHz					<0.04					<0.5
>220 GHz to 226 GHz					<0.06					<0.7

*: 110 GHz to 125 GHz frequency range is available as operational (ME7838A4 only).

Frequency Resolution, Accuracy and Stability

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

Uncorrected (Raw) Port Characteristics

Typical performance

Frequency Range	System Dynamic Range (dB)						
	ME7838A4 ME7838A4X Directivity (dB)	ME7838A4 ME7838A4X Port Match (dB)	ME7838E4 ME7838E4X Directivity (dB)	ME7838E4 ME7838E4X Port Match (dB)	ME7838D4 ME7838D4X Directivity (dB)	ME7838D4 ME7838D4X Port Match (dB)	ME7838G4 Port Match (dB)
70 kHz to 0.01 MHz	10*1	8	10*1	8	10*1	8	8
>0.1 MHz to <2.5 MHz	9*1	10	9*1	10	9*1	10	10
>2.5 MHz to 30 MHz*2	5*1	12	5*1	12	5*1	12	10
>30 GHz to 40 GHz*2	5*1	5	5*1	5	5*1	10	10
>40 GHz to 54 GHz	10	5	10	5	9	10	10
>54 GHz to 80 GHz	10	10	10	10	9	10	10
>80 GHz to 110 GHz*3	5	7	5	7	5	7	7
>110 GHz to 120 GHz*3	5	7			5	7	7
>120 GHz to 125 GHz	5	7			5	7	7
>125 GHz to 140 GHz							7
>140 GHz to 145 GHz					5	6	
>140 GHz to 220 GHz							5

*1: Raw directivity is degraded below 300 kHz, 2.2 GHz to 2.5 GHz and in narrow bands within 10 GHz to 34 GHz.
*2: Port match is degraded in narrow bands between 20 and 40 GHz.
*3: 110 GHz to 125 GHz frequency range is available as operational (ME7838A4, ME7838A4X only).

Corrected System Performance and Uncertainties – SOLT/SSST

With 12-term concatenated SOLT and Triple Offset Short Calibration (SSST), using the 3656B W1 Calibration Kit. Typical.

Frequency Range	ME7838A4 Directivity (dB)	ME7838A4 Source Match (dB)	ME7838A4 Load Match (dB)	ME7838A4 Reflection Tracking (dB)	ME7838A4 Transmission Tracking (dB)
70 kHz to 10 MHz	36	36	36	±0.10	±0.10
>0.01 GHz to <2.5 GHz	40	41	40	±0.05	±0.05
2.5 GHz to 20 GHz	40	41	40	±0.05	±0.05
>20 GHz to 67 GHz	38	41	36	±0.05	±0.07
>67 GHz to 95 GHz	37	40	35	±0.05	±0.07
>95 GHz to 110 GHz	35	35	33	±0.05	±0.07

Frequency Range	ME7838A4X Directivity (dB)	ME7838A4X Source Match (dB)	ME7838A4X Load Match (dB)	ME7838A4X Reflection Tracking (dB)	ME7838A4X Transmission Tracking (dB)
70 kHz to 10 MHz	40	40	38	±0.10	±0.10
>0.01 GHz to <2.5 GHz	40	40	38	±0.05	±0.05
2.5 GHz to 20 GHz	40	40	38	±0.05	±0.05
>20 GHz to 40 GHz	36	38	33	±0.05	±0.07
>40 GHz to 67 GHz	30	36	27	±0.05	±0.07
>67 GHz to 90 GHz	30	34	28	±0.07	±0.07
>90 GHz to 110 GHz	30	34	28	±0.07	±0.07
>110 GHz to 120 GHz	30	30	28	±0.10	±0.10
>120 GHz to 125 GHz	28	30	26	±0.12	±0.12

Frequency Range	ME7838E4 Directivity (dB)	ME7838E4 Source Match (dB)	ME7838E4 Load Match (dB)	ME7838E4 Reflection Tracking (dB)	ME7838E4 Tracking (dB)
70 kHz to 10 MHz	36	36	36	±0.10	±0.10
>0.01 GHz to 2.5 GHz	40	41	40	±0.05	±0.05
>2.5 GHz to 20 GHz	40	41	40	±0.05	±0.05
>20 GHz to 67 GHz	38	41	36	±0.05	±0.07
>67 GHz to 95 GHz	37	40	35	±0.05	±0.07
>95 GHz to 110 GHz	35	35	33	±0.05	±0.07

Frequency Range	ME7838E4X Directivity (dB)	ME7838E4X Source Match (dB)	ME7838E4X Load Match (dB)	ME7838E4X Reflection Tracking (dB)	ME7838E4X Tracking (dB)
70 kHz to 10 MHz	40	40	38	±0.10	±0.10
>0.01 GHz to 2.5 GHz	40	40	38	±0.05	±0.05
>2.5 GHz to 20 GHz	40	40	38	±0.05	±0.05
>20 GHz to 40 GHz	36	38	33	±0.05	±0.07
>40 GHz to 67 GHz	30	37	27	±0.05	±0.07
>67 GHz to 90 GHz	30	34	30	±0.07	±0.07

Frequency Range	ME7838D4 Directivity (dB)	ME7838D4 Source Match (dB)	ME7838D4 Load Match (dB)	ME7838D4 Reflection Tracking (dB)	ME7838D4 Tracking (dB)
70 kHz to 10 MHz	36	36	36	±0.10	±0.10
>0.01 MHz to <2.5 MHz	38	41	38	±0.05	±0.05
2.5 MHz to 20 MHz	40	41	40	±0.05	±0.05
>20 GHz to 67 GHz	35	41	35	±0.05	±0.07
>67 GHz to 80 GHz	35	38	35	±0.05	±0.07
>80 GHz to 95 GHz	35	40	35	±0.05	±0.07
>95 GHz to 110 GHz	34	37	34	±0.05	±0.07
>110 GHz to 125 GHz	30	34	30	±0.07	±0.09
>125 GHz to 140 GHz	28	28	28	±0.09	±0.11
>140 GHz to 145 GHz	26	28	26	±0.11	±0.13

Frequency Range	ME7838G4 Directivity (dB)	ME7838G4 Source Match (dB)	ME7838G4 Load Match (dB)	ME7838G4 Reflection Tracking (dB)	ME7838G4 Tracking (dB)
70 kHz to 10 MHz	36	36	36	±0.10	±0.10
>0.01 MHz to <2.5 MHz	38	41	38	±0.05	±0.05
2.5 MHz to 20 MHz	40	41	40	±0.05	±0.05
>20 GHz to 67 GHz	35	41	35	±0.05	±0.07
>67 GHz to 80 GHz	35	38	35	±0.05	±0.07
>80 GHz to 95 GHz	35	40	35	±0.05	±0.07
>95 GHz to 110 GHz	34	37	34	±0.05	±0.07
>110 GHz to 125 GHz	30	34	30	±0.07	±0.09
>125 GHz to 140 GHz	28	28	28	±0.09	±0.11
>140 GHz to 145 GHz	26	28	26	±0.11	±0.13

Warranty

The ME7838A4/ME7838A4X/ME7838E4/ME7838E4X/ME7838D4/ME7838G4 4-Port BB/mmWave VNA and related accessories offer a 3 year warranty from the date of shipment (excluding OML and VDI modules). Please contact your local service center for additional warranty coverage.

Ordering Information

The ME7838A4 4-Port Broadband/Millimeter-Wave VNA System provides single sweep coverage from 70 kHz to 110 GHz and consists of the following standard components and optional accessories, which are described in the sections below:

ME7838A4/ME7838A4X/ME7838E4/ME7838E4X 4-Port Broadband System, 70 kHz to 110 (125) GHz, ME7838D4 4-Port Broadband System, 70 kHz to 145 GHz, ME7838G4 Broadband System, 70 kHz to 220 GHz

Action	Part Number and Description	Additional Information
Order the base VectorStar model with the listed components and options:	MS4647B, 70 kHz to 70 GHz VNA MS4640B-007, receiver offset MS4640B-070, 70 kHz frequency coverage MN4697C, 4-Port Test Set 3739C, Broadband Test Set with 36 inch interface cables 3736B Broadband/Millimeter-Wave Test Set 3743A, 3743AX, 3743E, 3743EX, Millimeter-Wave Module, 4 each 806-209-R, 1.85 mm phase stable VNA RF cables, 36 in, (m-f) 4 each (ME7838A4, ME7838A4X, ME7838E, ME7838EX, ME7838E4, ME7838E4X, ME7838D4, ME7838G4)-SS020, On-site system assembly and verification	
Include the following:	MS4647B-081, MS4647B with ME7838A4, ME7838A4X, ME7838E4X, ME7838G4 system option and Option 51, 61, or 62: MS4647B-087, MS4647B with ME7838E4 system option and Option 51, 61, or 62 (only ME7838E4): MS4647B-051 – External VNA Loops MS4647B-061 – Active Measurement Suite, 2 Attenuators MS4647B-062 – Active Measurement Suite, 4 Attenuators	MS4647B-085 is ordered when Option 31 is included (ME7838A4, ME7838A4X, ME7838D4, and ME7838G4) MS4647B-089 is ordered when Option 31 is included (ME7838E4)
Add options if desired	MS4640B-070 – for 70 kHz operation in base VNA MS4640B-002 – for Time Domain MS464xB-031 – Dual Source Architecture MS4640B-035 – IF Digitizer MS4640B-041 – Noise Figure MS4640B-042 – PulseView™ MS4640B-043 – DifferentialView™ MS4640B-044 - IMDView™ (ME7838E4 and ME7838E4X) MS4640B-048 – Differential Noise Figure (ME7838A4X, ME7838E4X, and ME7838D4)	MS464xB-031 requires Option 85 (ME7838A4, ME7838A4X, ME7838D4, and ME7838G4) MS464xB-031 requires Option 89 (ME7838E4 and ME7838E4X) For other available options, see "ME7838A4, ME7838A4X, ME7838E4, ME7838E4X, ME7838D4, ME7838AG4 Broadband/Millimeter-Wave System Options"
Calibration Options	ME7838A4-098 - Standard Calibration, ISO 17025 compliant, without data (ME7838A4X, ME7838E4X, and ME7838G4) ME7838A4-099 - Premium Calibration, ISO 17025 compliant, with data (ME7838A4X, ME7838E4X, and ME7838G4)	

ME7838A4/ME7838A4X/ME7838E4/ME7838E4X/ME7838D4/ME7838G4 4-Port Waveguide-Band System to 110 GHz – 3744A-EE or 3744A-EW mmWave Modules

Configurator for ME7838A4/ME7838A4X/ME7838E4/ME7838E4X/ME7838D4/ME7838G4 Millimeter-Wave System using 3744A-EE or 3744A-EW mmWave Modules:

Action	Part Number and Description	Additional Information
Choose and order one of the two base VectorStar models with options listed:	MS4644B VNA, 10 MHz to 40 GHz MS4640B-007 MS4644B-083 or MS4644B-085 MS4644B-087 or MS4644B-089 (only ME7838E4 and ME7838E4X)	MS4644B-085 is ordered when Option 31 and Option 51 is included MS4644B-089 is ordered when Option 31 and Option 51 is included (ME7838E4, ME7838E4X and ME7838G4)
	MS4647B VNA, 10 MHz to 70 GHz MS4647B-007 MS4647B-081 or MS4647B-085 (ME7838A4, ME7838A4X, ME7838D4, and ME7838G4) MS4647B-087 or MS4647B-089 (ME7838E4 and ME7838E4X)	MS4647B-085 is ordered when Option 31 and Option 51 is included MS4644B-089 is ordered when Option 31 and Option 51 is included (ME7838E4, ME7838E4X and ME7838G4)
Order:	MN4697C, 4-Port Test Set 3736B Broadband/Millimeter-Wave Test Set 3739C Broadband/Millimeter-Wave Test Set	
Choose and order Extended-E or Extended-W Band Modules:	3744A-EE, 56 GHz to 94 GHz Extended E Band module, 4 each	If you order the 3744A-EE, then you can get the EW adapter kit to allow conversion of the moduleto both bands.
	3744A-EW, 65 GHz to 110 GHz Extended W Band module, 4 each	
Order one of the following:	Option 51, 61, or 62: MS4647B-051 – External VNA Loops MS4647B-061 – Active Measurement Suite, 2 Attenuators MS4647B-062 – Active Measurement Suite, 4 Attenuators	ME7838A4, ME7838A4X, ME7838EX, ME783E4X, ME7838D4 requires Option 51, or 61, or 62
Add options if desired:	MS4640B-070 – for 70 kHz operation in base VNA MS4640B-002 – for Time Domain MS464xB-031 – Dual Source Architecture MS4640B-035 – IF Digitizer MS4640B-041 – Noise Figure MS4640B-042 – PulseView™ MS4640B-043 – DifferentialView™ MS4640B-048 – Differential Noise Figure	MS464xB-031 requires Option 85 (ME7838A4, ME7838A4X, ME7838D4, and ME7838G4) MS464xB-031 requires Option 89 (ME7838E4 and ME7838E4X) For other available options, see "ME7838A4, ME7838A4X, ME7838EX, ME7838E4X, ME7838D4, ME7838G4 Broadband/Millimeter-Wave System Options"
Accessories	35WR12WF-EE – Precision Waveguide to Coax Adapter Kit, 56 GHz to 94 GHz, WR-12 to W1 (f)	
	35WR10WF-EW – Precision Waveguide to Coax Adapter Kit, 65 GHz to 110 GHz, WR-10 to W1 (f)	

ME7838A4 4-Port Waveguide-Band System – OML/VDI mmWave Modules

ME7838A4, ME7838A4X, ME7838E4, ME7838D4, ME7838G4 4-Port Waveguide-Band System using OML or VDI Millimeter-Wave modules:

Action	Part Number and Description	Additional Information
Choose and order one of the three base VectorStar models with options listed:	MS4642B VNA, 70 kHz to 20 GHz MS4642B-051 (ME7838G4) MS4642B-061 or MS4642B-062 MS4642B-083 (ME7838A4, ME7838A4X, and ME7838D4) MS4642B-085 (ME7838G4) MS4642B-087 (ME7838E4)	MS4642B-061 includes Active Device Measurements, with 2 Step Attenuators MS4642B-062 includes Active Device Measurements, with 4 Step Attenuators MS4642B-085 is ordered when Option 31 is included (ME7838A4, ME7838A4X, ME7838D4, and ME7838G4) MS4644B-089 is ordered when Option 31 is included (ME7838E4)
	MS4644B VNA, 10 MHz to 40 GHz MS4640B-007 Receiver Offset MS4644B-083 MS4644B-085 (ME7838G4) MS4644B-087 (ME7838E4)	MS4644B-085 is ordered when Option 31 is included (ME7838A4, ME7838A4X, ME7838D4, and ME7838G4) MS4644B-089 is ordered when Option 31 is included (ME7838E4)
	MS4647B VNA, 10 MHz to 70 GHz (ME7838A4, ME7838A4X, ME7838D4, and ME7838G4) MS4640B-007 Receiver Offset (ME7838A4, ME7838A4X, ME7838D4, and ME7838G4) MS4647B-081 (ME7838A4, ME7838A4X, ME7838D4 and ME7838G4) MS4647B-085 (ME7838G4)	MS4647B-085 is ordered when Option 31 is included (ME7838A4, ME7838A4X, ME7838D4, and ME7838G4)
Order:	MN469xC, 4-port Test Set 3739C Broadband/Millimeter-Wave Test Set 3736B Broadband/Millimeter-Wave Test Set	
	SM6537 Interface Cables (4) for OML/VDI mmWave Modules	Does not include DC cable. DC supply is provided by mmWave module power supply
Choose and order one of the two appropriate millimeter-wave module combinations:	4 each TxRx transmission and reflection millimeter-wave modules	Choose appropriate OML or VDI modules Contact Anritsu Company for ordering information
For MS4644B or MS4647B, order:	Option 51, 61, or 62: MS4647B-051 – External VNA Loops MS4647B-061 – Active Measurement Suite, 2 Attenuators MS4647B-062 – Active Measurement Suite, 4 Attenuators	ME7838A4, ME7838A4X, ME7838E4, and ME7838D4 requires Option 51, 61, or 62
Add options if desired:	MS4640B-070 – for 70 kHz operation in base VNA MS4640B-002 – for Time Domain MS464xB-031 – Dual Source Architecture MS4640B-035 – IF Digitizer MS4640B-041 – Noise Figure MS4640B-042 – PulseView™ MS4640B-043 – DifferentialView™ MS4640B-048 – Differential Noise Figure	MS464xB-031 requires Option 85 (ME7838A4, ME7838A4X, and ME7838D4) MS464xB-031 requires Option 84 or Option 85 (ME7838G4) MS464xB-031 requires Option 89 (ME7838E4) For other available options, see “ME7838A4, ME7838A4X, ME7838E4, ME7838D4, ME7838G4, Broadband/Millimeter-Wave System Options”

Model/Order No.	Name
	Calibration/Verification Kits
3659	0.8 mm Calibration/Verification Kit (ME7838D4, ME7838G4)
3656C	W1 (1 mm) Calibration/Verification Kit
3656C-3	W1 (1 mm) Calibration/Verification Kit, With .s1p Characterization Files
3656C-5	W1 (1 mm) Calibration Kit (ME7838A4X, ME7838E4X)
3656C-6	W1 (1 mm) Calibration Kit, With .s1p Characterization Files (ME7838A4X, ME7838E4X)
3655V	WR-15 Waveguide Calibration Kit, Without Sliding Loads
3655V-1	WR-15 Waveguide Calibration Kit, With Sliding Loads
3655E	WR-12 Waveguide Calibration Kit, Without Sliding Loads
3655E-1	WR-12 Waveguide Calibration Kit, With Sliding Loads
3655W	WR-10 Waveguide Calibration Kit, Without Sliding Loads
3655W-1	WR-10 Waveguide Calibration Kit, With Sliding Loads
3650A	SMA/3.5 mm Calibration Kit, Without Sliding Loads
3650A-1	SMA/3.5 mm Calibration Kit, With Sliding Loads
3652A	K Calibration Kit, With Pin Depth Gauge
3652A-1	K Calibration Kit, With Sliding Loads (ME7838G4)
3652A-2	K Calibration Kit, With No Pin Depth Gauge
3652A-3	K Calibration Kit, With Pin Depth Gauge and .s1p Characterization Files
3652A-4	K Calibration Kit, With .s1p Characterization Files
3654D	V Calibration Kit, With Pin Depth Gauge
3654D-1	V Calibration Kit, With Pin Depth Gauge and Sliding Loads (ME7838G4)
3654D-2	V Calibration Kit, With No Pin Depth Gauge
3654D-3	V Calibration Kit, With Pin Depth Gauge and .s1p Characterization Files
3654D-4	V Calibration Kit, With .s1p Characterization Files
3657	V Multi-Line Calibration Kit, Without Shorts
3657-1	V Multi-Line Calibration Kit, With Shorts
	External Power Meters/Sensors
ML243xA	CW Power Meter, Single Input or Dual Input Recommended Power Sensors: SC7770, MA247xD, MA244xD, MA248xD, MA2400xA
ML248xB	Wideband Power Meter, Single Input or Dual Input Recommended Power Sensors: MA249xA, MA2411B
ML249xA	Pulse Power Meter, Single Input or Dual Input Recommended Power Sensors: MA249xA, MA2411B
MA24106A	USB Power Sensor, 50 MHz to 6 GHz
MA24108A	USB Power Sensor, 10 MHz to 8 GHz
MA24118A	USB Power Sensor, 10 MHz to 18 GHz
MA24126A	USB Power Sensor, 10 MHz to 26 GHz
MA24330A	USB Power Sensor, 10 MHz to 33 GHz
MA24340A	USB Power Sensor, 10 MHz to 40 GHz
MA24350A	USB Power Sensor, 10 MHz to 50 GHz
MA24507A	Power Master™ Frequency Selectable mmWave Power Analyzer, 9 kHz to 70 GHz
MA24510A	Power Master™ Frequency Selectable mmWave Power Analyzer, 9 kHz to 110 GHz Note that usage of the MA24507A or MA24510A Power Master™ sensor requires connection to two USB ports to supply needed current draw.
	Test Port Cables, Flexible, High Performance
3671W1-50-1	W1 (m) to W1 (f), 1 each, 10.0 cm (3.9 in)
3671W1-50-2	W1 (m) to W1 (f), 1 each, 13.0 cm (5.1 in)
3671W1-50-3	W1 (m) to W1 (f), 1 each, 16.0 cm (6.3 in)
3671KFS50-60	K (f) to 3.5 mm (m) cable, 60 cm (one cable)
3671KFK50-60	K (f) to K (m) cable, 60 cm (one cable)
3671KFK50-100	K (f) to K (m) cable, 1 each, 100 cm (one cable)
3671KFKF50-60	K (f) to K (f) cable, 1 each, 60 cm (once cable)
3671VFV50-60	V (f) to V (m) cable, 1 each, 60 cm (one cable)
3671VFV50-100	V (f) to V (m) cable, 1 each, 100 cm (one cable)
3671KFSF50-60	K (f) to 3.5 mm (f) cable, 1 each, 60 cm (one cable)
3671VFVF50-60	V (f) to V (f) cable, 1 each, 60 cm (one cable)
3671VFV50-100	V (f) to V (m) cable, 1 each, 60 cm (one cable) (ME7838D4, ME7838G4)
3670.850-1	0.8 mm (m) to 0.8 mm (f), 1 each, 10.0 cm (3.9 in) (ME7838D4, ME7838G4)
3670.850-2	0.8 mm (m) to 0.8 mm (f), 1 each, 16.0 cm (6.3 in) (ME7838D4, ME7838G4)

Model/Order No.	Name
	Adapters and More
0.8-105F	0.8 mm (f) Sparkplug Launcher Connector, DC to 145 GHz (ME7838D4, ME7838G4)
0.8-105M	0.8 mm (m) Sparkplug Launcher Connector, DC to 145 GHz (ME7838D4, ME7838G4)
34WV50	W1 (m) to V (m) Adapter, W1 (1 mm) to V, Coaxial
34WVF50	W1 (m) to V (f) Adapter, W1 (1 mm) to V, Coaxial
34WFV50	W1 (f) to V (m) Adapter, W1 (1 mm) to V, Coaxial
34WFVF50	W1 (f) to V (f) Adapter, W1 (1 mm) to V, Coaxial
33WW50A	W1 (m) to W1 (m) Adapter, W1 (1 mm) in-series, Coaxial
33WWF50A	W1 (m) to W1 (f) Adapter, W1 (1 mm) in-series, Coaxial
33WFWF50A	W1 (f) to W1 (f) Adapter, W1 (1 mm) in-series, Coaxial
33WG50	MA25400A Flange Interface to 1 mm (male) Adapter (ME7838G4)
33.8WG50	MA25400A Flange Interface to 0.8 mm (male) Adapter (ME7838G4)
35WR5G	MA25400A Flange Interface to WR5 Waveguide Adapter (ME7838G4)
35WR10W	WR10 to W1 (m) Adapter, W1 (1 mm) to WR10 Waveguide
35WR10WF	WR10 to W1 (f) Adapter, W1 (1 mm) to WR10 Waveguide
SC7260	WR12 to W1 (m) Adapter, W1 (1 mm) to WR12 Waveguide
SC7442	WR12 to W1 (f) Adapter, W1 (1 mm) to WR12 Waveguide
35WR15V	WR15 to V (m) Adapter, V (1.85 mm) to WR15 Waveguide
35WR15VF	WR15 to V (f) Adapter, V (1.85 mm) to WR15 Waveguide
For More Information	Refer to our Precision RF & Microwave Components Catalog for descriptions of adapters and other components.
	Accessories
SC8215	Kelvin Bias Tee, low frequency limit: 70 kHz, Max Voltage: 16 VDC, Max Current: 100 mA
SC7287	Kelvin Bias Tee, low frequency limit: 100 kHz, Max Voltage 50 VDC, Max Current: 500 mA
SC8218	Triax (m) to SMC (f) Cable, (Inner-shield floating at SMC end), 1.5 m (60 in) long two (2) needed per Kelvin Bias Tee
SM6494	System floor console. Includes larger size writing table
2100-1-R	GPIB cable, 1 m (39 in) long
2100-2-R	GPIB cable, 2 m (79 in) long
2100-4-R	GPIB cable, 4 m (157 in) long
806-206-R	Flexible Coaxial Cable, DC to 70 GHz, 24 in (61 cm), V(m) – V(f), 50Ω
806-209-R	Flexible Coaxial Cable, DC to 70 GHz, 36 in (91.5 cm), V(m) – V(f), 50Ω
806-396-R	Flexible Phase Stable Coaxial Cable, DC to 70 GHz, 36 in (91.5 cm), V(m) – V(f), 50Ω (ME7838G4)
01-201	Torque Wrench (for tightening male devices), 8 mm (5/16 in), 0.9 N·m (8 lbf·in) for SMA, 3.5 mm, 2.4 mm, K, and V connectors
01-202	Universal Test Port Connector Wrench
01-203	Torque Wrench (for tightening the VNA test ports to female devices) 20.6 mm (13/16 in), 0.9 N·m (8 lbf·in)
01-204	Anritsu Stainless Steel Connector Wrench, circular, open-ended for SMA, 3.5 mm, 2.4 mm, K and V connectors
01-504	Torque wrench (for tightening male devices) 6 mm, 0.45 N-m (4 lbf-in) for 1.0 mm and 0.8 mm connectors
01-524	Low profile Torque Wrench (for tightening male devices), 6 mm, 0.45 N-m (4 lbf-in), 126 mm long for 1.0 mm and 0.8 mm connectors
01-529-R	Torque wrench, 4 mm (5/32 in), 0.17 N·m (1.5 lbf·in) (for tightening the test and reference IF connectors on the mmWave modules)
	Miscellaneous Components
41W-3	Attenuator, DC to 110 GHz, 0.2 W, 3 dB, W1 (m) to W1 (f), 50Ω
41W-6	Attenuator, DC to 110 GHz, 0.2 W, 6 dB, W1 (m) to W1 (f), 50Ω
41W-10	Attenuator, DC to 110 GHz, 0.2 W, 10 dB, W1 (m) to W1 (f), 50Ω
W240A	Precision Power Divider, DC to 110 GHz, W1 (f) input, W1 (f) outputs, 3 resistor, 50Ω
W241A	Precision Power Splitter, DC to 110 GHz, W1 (m) input, W1 (f) outputs, 2 resistor, 50Ω
MN25110A	Precision Directional Coupler, 20 GHz to 110 GHz, W1 (f) input, W1 (f) output, W1 (f) coupled port, 50Ω
33GG50	MA25400 Flange Interface 50 mm Thru Line (m - m) (ME7838G4)

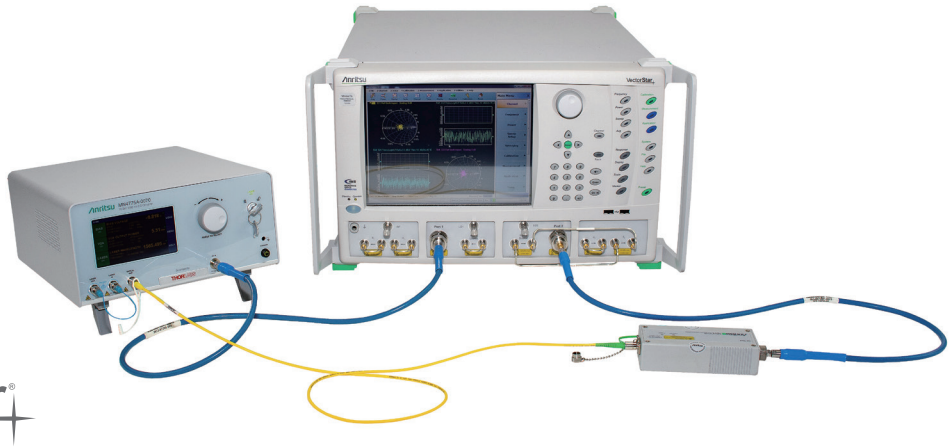
Contact Anritsu regarding rack mount options www.anritsu.com.

VectorStar™ Opto-Electronic Network Analyzer

ME7848A

Remote Control
GPIB | Ethernet | USB

Specified, Traceable Measurements of O/E, E/O, and O/O Devices Operating at 850/1310/1550 nm Wavelengths at 40/70/110 GHz



VectorStar

The VectorStar Opto-Electronic Network Analyzer (ONA) ME7848A system includes the VectorStar VNA combined with a traceable calibration optical-to-electrical (O/E) detector module and an electrical-to-optical (E/O) converter. The ME7848A ONA with the E/O converter and O/E calibration module detector enables the measurement of domain-transfer devices such as optical modulators, modulated lasers, optical transmitters, photodiodes, photo-receivers, and transceivers.
The ONA system facilitates the measurement of E/O and O/E transfer function in terms of bandwidth, flatness, and phase linearity (group delay). The ME7848A-01xx systems have all of the potential functionality of the -02xx systems but do not include an E/O converter. Three system options provide the ability to measure optical devices at the 850, 1310, and 1550 nm wavelengths. System modularity offers the ability to add detectors and/or converters with different wavelengths to expand system capabilities without the need for additional VNAs.
The O/E Calibration Module MN4765B is the base and when combined with appropriate options can be used with the Anritsu VNAs to perform accurate, flexible, and cost-effective characterization of optoelectronic devices. Option 40 offers optoelectronic measurements of devices from 70 kHz to 40 GHz in the 850 nm range. The 1550 and 1310 nm wavelengths are supported with the Option 70 and 71 respectively. The built-in de-embedding software (accessed through the VNA's measurement menu) provides full on screen direction, thus, simplifying calibration and speeding measurement throughput.
The E/O Converter MN4775A offer wavelength support of 850 nm at 40 GHz and 1310 and 1550 nm with frequency response to 70 GHz. Each converter incorporates a telecommunication grade lithium niobate (LiNbO3) modulator this is stabilized by an automatic bias controller and a tunable or fixed-wavelength laser source (all specifications assume this bias controller is in quadrature mode). The converter also includes a tunable or fixed-wavelength laser source. The 1310 nm and 1550 nm versions also have loopback access for operation using an external laser.

Key Features and Benefits

- **Fast and accurate optoelectronic measurements** — when calibrated using the MN4765B O/E module, enables error-corrected transfer function, group delay, and return loss measurements of E/O and O/E components and subsystems.
- **MN4765B O/E calibration module** — this photodiode reference standard detector is thermally stabilized to minimize drift over temperature. Available 40/70/110 GHz.
- **MN4775A E/O converter** — excellent converter stability ensures characteristics remain consistent during measurement of O/E DUT detectors and receivers.
- **National Institute of Standards and Technology (NIST) derived characterization** — Magnitude and phase characterization of the O/E calibration module is obtained using a primary standard characterized by NIST and held in the Anritsu calibration lab.
- **Internal biasing** — Accurate bias voltage to the photodiode is maintained internally.
- **Excellent stability and repeatability** — use of full 12-term calibration with de-embedding results in stable and repeatable measurements of optoelectronic devices using the VectorStar VNA.
- **Modularity and upgradeability** — easily modify ME7838A ONA to a different wavelength by adding the appropriate MN4775A E/O converter and MN4765B O/E calibration detector. The ME7838A-100 series can be upgraded to a 200 series by including the appropriate MN4775A E/O converter.
- **Measurement flexibility** — easily switch between electrical and O/E measurements. Only one 12-term calibration is required, which can be applied to E/E, E/O, and O/E set-ups. This makes it flexible and easy to use for all high-speed device measurements.

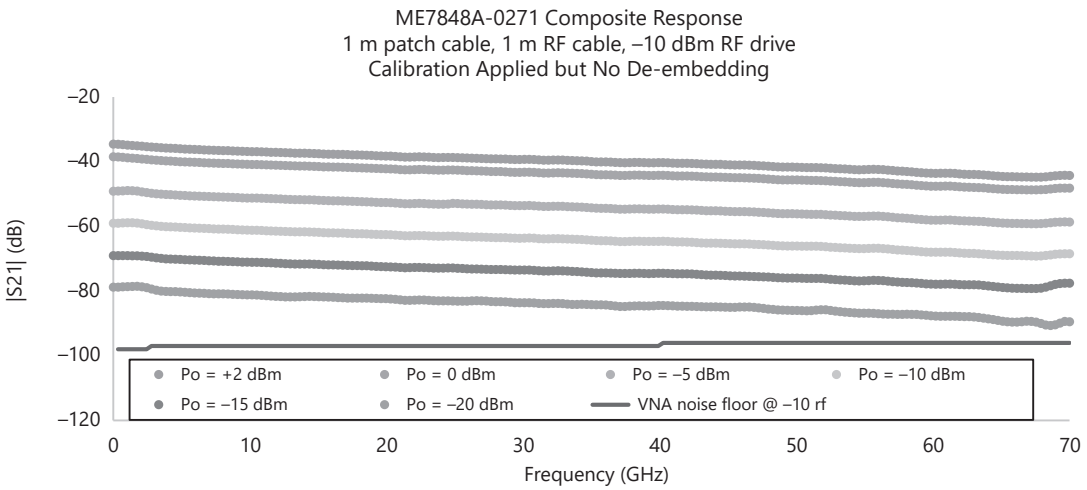
Basic Specifications of ME7848A Systems*1

	ME7848A-0240	ME7848A-0271	ME7848A-0270
RF Frequency Range*2	70 kHz to 40 GHz	70 kHz to 70 GHz	70 kHz to 70 GHz
RF Connector Type	K (2.92 mm)	V (1.85 mm)	V (1.85 mm)
Optical Source Input Connector Type (polarization-maintaining fiber recommended)	FC/PC	FC/PC	FC/PC
Optical Output and Modulated Input Connector Type	FC/APC	FC/APC	FC/APC
Receiver Wavelength Range	800 nm to 1700 nm	1300 nm to 1330 nm	1480 nm to 1620 nm
Receiver DC Responsivity	>0.2 A/W (850 ±20 nm)	>0.45 A/W (1319 ±10 nm)	>0.7 A/W (1550 ±20 nm)
Maximum Linear Optical Power to Receiver (<0.5 dB variance in frequency response shape)	2 dBm	6 dBm	6 dBm
Maximum Safe Optical Power (average) to Receiver	6 dBm	10 dBm	10 dBm
Optical Return Loss (modulation output and detection ports)	>24 dB	>24 dB	>24 dB
Average Optical Power Uncertainty (transmit)	± 0.5 dB	± 0.5 dB	± 0.5 dB
Optical Modulation Sensitivity (RF V_π at 1 GHz, typical)	2.3 V pk-pk	5.5 V pk-pk	5.5 V pk-pk
Transmit Wavelength	850 nm	1310 nm	15270 nm to 1565 nm
Average Output Power Range (typical)	–17 to –1*3 dBm	–17 to +2 dBm	–15 to +5 dBm
Output Power Stability (over 4 hours and 3°C temperature range)	±0.1 dB	±0.1 dB	±0.1 dB
Optical Modulation Path Loss (quadrature bias, typical)	8 dB	10 dB	8 dB
0.1 dB Compression Point of RF Receiver (at port)*2 (characteristic)	>+5 dBm for 70 kHz to 300 kHz >+11 dBm above 300 kHz	>+5 dBm for 70 kHz to 300 kHz >+11 dBm above 300 kHz	>+5 dBm for 70 kHz to 300 kHz >+11 dBm above 300 kHz
0.1 dB Compression Point of RF Receiver (at reversed port)*2 (characteristic)	>–15 dBm 70 kHz to 300 kHz >–10 dBm 300 kHz to 2.5 GHz >–5 dBm above 2.5 GHz	>–15 dBm 70 kHz to 300 kHz >–10 dBm 300 kHz to 2.5 GHz >–5 dBm above 2.5 GHz	>–15 dBm 70 kHz to 300 kHz >–10 dBm 300 kHz to 2.5 GHz >–5 dBm above 2.5 GHz
Modulation Port Return Loss (raw)*2	>10 dB for <20 GHz >7.5 dB for 20 GHz to 40 GHz	>10 dB for <20 GHz >7.5 dB for 20 GHz to <50 GHz >3 dB for 50 GHz to 70 GHz	>10 dB for <20 GHz >7.5 dB for 20 GHz to <50 GHz >3 dB for 50 GHz to 70 GHz
Detection Port Return Loss (raw)*2	>10 dB for <18 GHz >3 dB for 18 GHz to 40 GHz	>8 dB for <50 GHz >5 dB for 50 GHz to 70 GHz	> 8 dB for <50 GHz > 5 dB for 50 GHz to 70 GHz

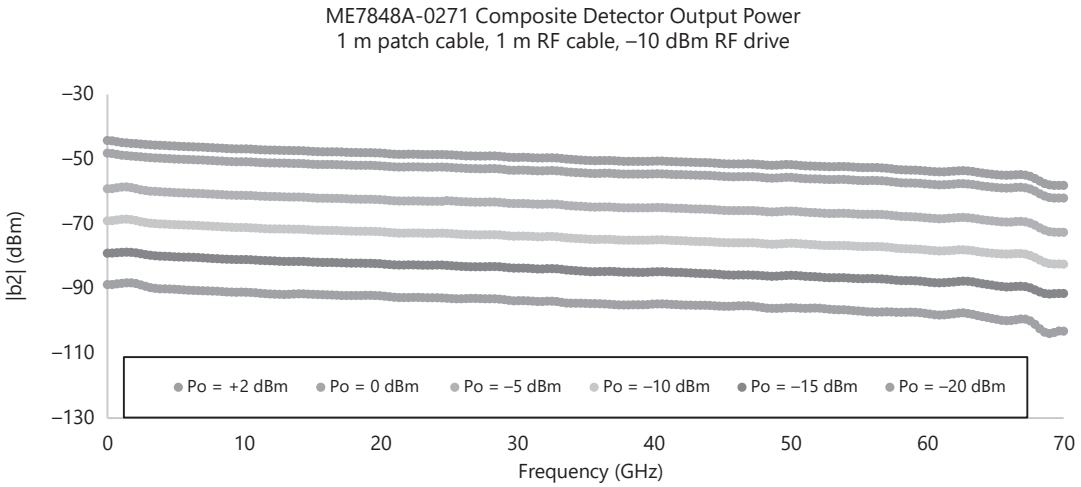
*1: All system specifications are based on the modulator being biased in quadrature mode.
*2: These line entries assume the presence of VNA option 070 (70 kHz lower frequency limit). Without option 070, the minimum frequency is 10 MHz.
*3: Recommended operation at –3 dBm and below for optimal modulator performance.

Example Plots

Example plots of the response dependence on optical power are shown below for the ME7848A-0271 (1310 nm) system. Transmission (|S21|) is shown first with an RF drive of –10 dBm (default power for the 70 GHz systems) and 10 Hz IF bandwidth. This measurement is of the integral E/O and O/E modules (and internal laser) connected by a 1 m patch cable and with a 1 m RF cable from the VNA to the E/O input. The O/E output is connected directly to port 2 of the VNA in its normal (not reversed) configuration. A full 2-port calibration is applied but no de-embedding has been performed (of either the O/E or E/O components). The specified VNA noise floor for this bandwidth and power level is also shown.
Higher RF power levels are possible (native and with external amplification) as long as compression limits are observed. When user E/O and O/E devices are inserted, the responses may go up or down from these plots depending on the relative responsivities. In an O/O measurement, optical loss will shift the curves lower. The ME7848A-0270 system will have curves nominally 4 dB higher (higher detector responsivity) and higher optical powers are generally available in those systems. ME7848A-0240 systems will have curves generally 6-7 dB lower (lower responsivities) to 40 GHz.



The absolute O/E output power is plotted below for the same setup. This measurement is achieved by first performing an RF power calibration and a receiver calibration at port 2 (for the b2 receiver).



Specifications

Noise Floor for O/E Measurements

Expressed in terms of dBm (RMS) in a 10 Hz IFBW. Based on maximum nominal optical power from modulator (+5 dBm for -0270, +2 dBm for -0271, or –3 dBm for -0240) and derived from de-embedding the absolute E/O response. Interconnecting fiber loss (1 m) neglected. 1 m VNA cable loss is included. 'Normal' refers to the conventional VNA coupler configuration. 'Reversed' refers to the use of the loop access to reverse the orientation of the port 2 test couplers (requires changing front and rear panel access loop configuration). The table below assumes the presence of VNA option 070 (70 kHz operation); otherwise the minimum frequency is 10 MHz.

Frequency Range (GHz)	ME7848A-0240 (dBm)				ME7848A-0271 (dBm)				ME7848A-0270 (dBm)			
	051 Normal	051 Reversed	062 Normal	062 Reversed	051 Normal	051 Reversed	062 Normal	062 Reversed	051 Normal	051 Reversed	062 Normal	062 Reversed
70 kHz to 300 kHz	–54	–64	–54	–64	–66	–76	–66	–76	–66	–76	–66	–76
>300 kHz to 2 MHz	–59	–69	–59	–69	–71	–81	–71	–81	–71	–81	–71	–81
>2 MHz to 10 MHz	–64	–74	–64	–74	–76	–86	–76	–86	–76	–86	–76	–86
>0.01 to <2.5	–72	–79	–72	–79	–86	–93	–86	–93	–86	–93	–86	–93
2.5 to 5	–75	–82	–75	–82	–87	–94	–87	–94	–87	–94	–87	–94
>5 to 20	–74	–81	–74	–81	–84	–91	–84	–91	–84	–91	–84	–91
>20 to 38/40*	–64	–81	–63	–65	–80	–82	–80	–81	–80	–82	–79	–81
>38 to 50	—	—	—	—	–75	–77	–74	–75	–75	–76	–74	–75
>50 to 65	—	—	—	—	–71	–69	–71	–69	–71	–69	–69	–67
>65 to 67	—	—	—	—	–68	–65	–65	–62	–68	–65	–65	–62
>67 to 70	—	—	—	—	–64	–61	–60	–58	–64	–61	–60	–58

*: 38 GHz applies for -027x systems; 40 GHz applies for -0240 system.

Frequency Response Repeatability for E/O, O/O Measurements

Typical and in dB terms, 10 Hz IFBW at various composite response levels (P1-P4) at the receiving VNA port (assumed normal (not reversed)), excludes fiber connector effects. The composite response is affected by the optical power level and the E/O responsivity. Assumes nominal 90 minute warm-up time and ignores DUT bias system stability effects. The corresponding low frequency E/O $V_{\pi,rf}$ values below are based on default RF power, +5 dBm optical power (-0270) or +2 dBm optical power (-0271), or –3 dBm optical power (-0240), and Anritsu O/E module specified low frequency responsivities. At higher frequencies, values scale with the roll-off. The table below assumes the presence of VNA option 070 (70 kHz operation); otherwise the minimum frequency is 10 MHz.

P1 received level	–30 dBm (at low freq, $V_{\pi,rf}$ of 0.6 V, 0.4 V, or 1.1 V for -0240, -0271, or -0270, respectively)
P2 received level	–40 dBm (at low freq, $V_{\pi,rf}$ of 1.8 V, 1.1 V, or 3.5 V for -0240, -0271, or -0270, respectively)
P3 received level	–50 dBm (at low freq, $V_{\pi,rf}$ of 6 V, 3.6 V, or 11 V for -0240, -0271, or -0270, respectively)
P4 received level	–60 dBm (at low freq, $V_{\pi,rf}$ of 18 V, 11 V, or 35 V for -0240, -0271, or -0270, respectively)

Frequency Range (GHz)	ME7848A-0240 (dBm)				ME7848A-0271 (dBm)				ME7848A-0270 (dBm)			
	P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4
70 kHz to 300 kHz	±0.07	±0.1	±0.15	±0.2	±0.07	±0.1	±0.15	±0.2	±0.07	±0.1	±0.15	±0.2
>300 kHz to 2 MHz	±0.05	±0.07	±0.1	±0.15	±0.05	±0.07	±0.1	±0.15	±0.05	±0.07	±0.1	±0.15
>2 MHz to 10 MHz	±0.05	±0.05	±0.05	±0.07	±0.05	±0.05	±0.05	±0.05	±0.03	±0.03	±0.03	±0.03
>0.01 to < 2.5	±0.05	±0.05	±0.05	±0.07	±0.05	±0.05	±0.05	±0.05	±0.03	±0.03	±0.03	±0.03
2.5 to 5	±0.03	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.03	±0.03	±0.03	±0.03
>5 to 20	±0.03	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.03	±0.03	±0.03	±0.03
>20 to 38/40*	±0.05	±0.07	±0.07	±0.09	±0.05	±0.05	±0.05	±0.05	±0.03	±0.05	±0.05	±0.05
>38 to 50	—	—	—	—	±0.05	±0.05	±0.05	±0.05	±0.03	±0.05	±0.05	±0.05
>50 to 65	—	—	—	—	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05
>65 to 67	—	—	—	—	±0.05	±0.05	±0.05	±0.07	±0.05	±0.05	±0.05	±0.05
>67 to 70	—	—	—	—	±0.07	±0.07	±0.07	±0.1	±0.07	±0.07	±0.07	±0.07

*: 38 GHz applies for -027x systems; 40 GHz applies for -0240 system.

Noise Floor for O/O Measurements

Expressed in terms of dBm (RMS) in a 10 Hz IFBW. Based on maximum nominal optical power from modulator (+5 dBm for -0270, +2 dBm for -0271, or –3 dBm for -0240) and derived from de-embedding both the absolute E/O and O/E responses. Interconnecting fiber loss (1 m) neglected. 1 m VNA cable loss is included. 'Normal' refers to the conventional VNA coupler configuration. 'Reversed' refers to the use of the loop access to reverse the orientation of the port 2 test couplers (requires changing front and rear panel access loop configuration). The table below assumes the presence of VNA option 070 (70 kHz operation); otherwise the minimum frequency is 10 MHz.

Frequency Range (GHz)	ME7848A-0240 (dBm)				ME7848A-0271 (dBm)				ME7848A-0270 (dBm)			
	051 Normal	051 Reversed	062 Normal	062 Reversed	051 Normal	051 Reversed	062 Normal	062 Reversed	051 Normal	051 Reversed	062 Normal	062 Reversed
70 kHz to 300 kHz	–32	–42	–32	–42	–49	–59	–49	–59	–56	–66	–56	–66
>300 kHz to 2 MHz	–37	–47	–37	–47	–54	–64	–54	–64	–61	–71	–61	–71
>2 MHz to 10 MHz	–42	–52	–42	–52	–59	–69	–59	–69	–66	–76	–66	–76
>0.01 to <2.5	–50	–57	–50	–57	–69	–76	–69	–76	–76	–83	–76	–83
2.5 to 5	–52	–59	–52	–59	–69	–76	–69	–76	–76	–83	–76	–83
>5 to 20	–47	–54	–47	–54	–65	–72	–65	–72	–72	–79	–72	–78
>20 to 38/40*	–32	–34	–32	–33	–62	–64	–62	–63	–69	–71	–69	–70
>38 to 50	—	—	—	—	–54	–55	–53	–54	–61	–62	–60	–61
>50 to 65	—	—	—	—	–49	–47	–47	–45	–56	–53	–53	–52
>65 to 67	—	—	—	—	–46	–43	–43	–40	–53	–50	–50	–47
>67 to 70	—	—	—	—	–41	–37	–38	–34	–48	–45	–44	–42

*: 38 GHz applies for -027x systems; 40 GHz applies for -0240 system.

Definitions

Specifications (and related definitions) and stated values are based on certain conditions:

Warm-Up Time	After 90 minutes of warm-up time, where the instruments are left in their 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
User Cables/Adapters	Specifications and typical values do not include effects of any user cables, adapters, fixtures, or other structures attached to the instrument unless noted.
Discrete Spurious Response	Specifications may exclude discrete spurious responses.
Internal Reference Signal	All specifications apply when the internal 10 MHz reference is used.
Interpolation Mode	All specification are with interpolation mode OFF.
Typical Performance	"Typical" specifications describe expected, but not warranted, performance based on analysis of a statistically significant set of samples. Typical performance indicates measured performance of an average unit and does not guarantee the performance of an individual unit and is show in parenthesis (e.g., (-102 dB)) or noted as Typical.
Characteristic Performance	Characteristic performance indicates a level of performance that is designed in and verified during the design phase. These values are not covered by the product warranty.
Below 300 kHz	All uncertainties below 300 kHz are typical.
Other Information	Recommended calibration cycle 12 months on components (or system as a whole for -02xx cases). Uncertainties are dependent on calibration kit residual performance, so the calibration kit calibration cycle should be adhered to as well.
Specifications Subject to Change	All specifications are subject to change without notice. For the most current data sheet, please visit the Anritsu website at www.anritsu.com.

Standard Capabilities

Operating Frequency	ME7848A-0240 (uses the MS4644B VNA)	10 MHz to 40.5 GHz
	ME7848A-027x (uses the MS4647B VNA)	10 MHz to 70 GHz
	MS4640B-070	Optional for MS4640B series VNAs. Provides 40 kHz to 10 MHz Coverage Extension. Provides a lower limit specified to 70 kHz, which is allowed to extend to 40 kHz.
Measurement Parameters	2-Port Measurements	S_{11}, S_{21}, S_{22}, S_{12}, and any user-defined combination of a_1, a_2, b_1, b_2, and 1.
	4-Port Measurements	Refer to the separate VectorStar MN469xC Series Multiport VNA Measurement System Technical Data Sheet 11410-00777, available at http://www.anritsu.com/en-US/test-measurement/products/ms4640b-series
	Domains	Frequency Domain, Power Domain, CW Draw, and Time (Distance) Domain
Sweeps	Frequency Sweep Types	Linear, Log, CW, or Segmented
	Power Sweep Types	Linear, constant power sweeps, or constant power slope (dB/GHz) over frequency sweep
Display Graphs	Single Rectilinear Graph Types	Log Magnitude, Phase, Group Delay, Linear Magnitude, Real, Imaginary, Inductance, Capacitance, SWR, Power Out, Impedance, and Power In
	Dual Rectilinear Graph Types	Log Magnitude and Phase, Linear Magnitude and Phase, and Real and Imaginary
	Circular Graph Types	Smith Chart (Impedance), Smith Chart (Admittance), Linear Polar, and Log Polar
Measurements Data Points	25,000 Data Points	2 to 25,000 points in up to 16 channels
	100,000 Data Points	2 to 100,000 points in single channel
	Limit Lines	Single or segmented. 2 limit lines per trace. 50 segments per limit line. Single Limit Readouts: Uses interpolation to determine the intersection frequency. Test Limits: Both single and segmented limits can be used for PASS/FAIL testing.
Averaging	Point-by-Point	Point-by-point (default), max. Averaging = IF Bandwidth/1 Hz
	Sweep-by-Sweep	Sweep-by-sweep (no limit)
	IF Bandwidth	1, 2, 3, 5, 7, 10, 20, 30, 50, 70, 100, 200, 300, 500, 700 Hz; 1, 2, 3, 5, 7, 10, 20, 30, 50, 70, 100, 200, 300, 500, 700 kHz; 1 MHz

Continued on next page

Reference Plane	Line Length or Time Delay	The reference planes of a calibration or other normalization can be changed by entering a line length or time delay.
	Dielectric Constants	Dielectric constants may be entered for different media so the length entry can be physically meaningful.
	Dispersion Modeling	Dispersion modeling is used in the cases of microstrip and waveguide to take into account frequency dependent phase velocities.
	Attenuation	Attenuation (with frequency slope) and constant phase offsets can be entered to better describe any reference plane distortions. The frequency dependence exponent is changeable.
	Auto Modes	Automatic reference plane finding tools are available for phase alone or phase + magnitude. These routines do a fitting process on phase or phase and magnitude to estimate the reference plane location and enter correcting values.
	De-embedding	For more complete reference plane manipulation, the full de-embedding system can also be used.
Measurement Frequency Range	Frequency Range Change	Frequency range of the measurement can be narrowed within the calibration range without recalibration.
	CW Mode	CW mode permits single frequency measurements also without recalibration.
	Interpolation Not Activated	If interpolation is not activated, the subset frequency range is forced to use calibration frequency points.
	Interpolation Activated	If interpolation is activated, any frequency range that is a subset of the calibration frequency range can be used, but there may be some added interpolation error.
Group Delay	Group Delay Aperture	Defined as the frequency span over which the phase change is computed at a given frequency point.
	Aperture	The aperture can be changed without recalibration.
	Minimum Aperture	The minimum aperture is the frequency range divided by the number of points in calibration and can be increased to 20% of the frequency range.
	Group Delay Range	<180° of phase change within the aperture
Channels, Display, and Traces	Channels and Traces	16 channels, each with up to 16 traces
	Display	Color touch screen LCD, 26.4 cm (10.4") diagonal
	Display Colors	Unlimited colors for data traces, memory, text, markers, graticules and limit lines.
	Trace Memory and Math	A separate memory for each trace can be used to store measurement data for later display or subtraction, addition, multiplication or division with current measurement data. The trace data can be saved and recalled.
	Inter-trace Math	Any two traces within a channel can also be combined (via addition, subtraction, multiplication or division) and displayed on another trace. An equation editor mode is also available that allows the combination of trace data, trace memory and S-parameter data in more complex equations. Over 30 built-in functions are available. Simple editing tools and the ability to save/recall equations are also provided.

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Opto-Electronic Network Analyzer ME7848A The ME7848A series systems are available to meet different frequency range requirements.
ME7848A-0240	40 GHz, 850 nm system
ME7848A-0270	70 GHz, 1550 nm system
ME7848A-0271	70 GHz, 1310 nm system
ME7848A-0140	40 GHz, 850 nm system (VNA and O/E module only)
ME7848A-0170	70 GHz, 1550 nm system (VNA and O/E module only)
ME7848A-0171	70 GHz, 1310 nm system (VNA and O/E module only)
	Included Accessories Each system comes with a set of included accessories.
Online Help	The instrument is equipped with context-sensitive help built from the VectorStar Operation Manual, User Interface Reference Manual, Programming Manual, Programming Manual Supplement, and Calibration and Measurement Guide.
Peripherals	Optical USB Mouse
Power	Power Cord
2000-1957-R	Accessory Kit, 40 GHz (-0x40 systems) 2 one meter F-M K RF cables 1 one meter FC/PC-FC/APC fiber patch cord 2 semi-rigid K cables to allow VNA coupler reversal for increasing for-ward dynamic range 1 F-F K adapter Optical connector cleaning accessories (for both fiber ends and fer-rule-based connectors)
2000-1958-R	Accessory Kit, 70 GHz (-0x7x systems) 2 one meter F-M V RF cables 1 one meter FC/PC-FC/APC fiber patch cord 2 semi-rigid V cables to allow VNA coupler reversal for increasing for-ward dynamic range 1 F-F V adapter Optical connector cleaning accessories (for both fiber ends and fer-rule-based connectors)

Model/Order No.	Name
	ME7848A Available Options
ME7848A-0002	Time Domain Measurements
ME7848A-0007	Receiver Offset
ME7848A-0021	Universal Fixture Extraction
ME7848A-0031	Dual Source Architecture
ME7848A-0032	Internal RF Combiner
ME7848A-0035	IF Digitizer
ME7848A-0036	Extended IF Digitizer Memory
ME7848A-0041	Noise Figure
ME7848A-0042	PulseView™
ME7848A-0043	DifferentialView™
ME7848A-0044	IMDView™
ME7848A-0046	Fast CW
ME7848A-0047	Eye Diagram
ME7848A-0048	Differential Noise Figure
ME7848A-0051	Direct Access Loops
ME7848A-0053	External ALC
ME7848A-0061	Active Measurements Suite
ME7848A-0062	Active Measurements Suite
ME7848A-0070	70 kHz Low End Frequency Extension
	MN4765B Configuration Option
MN4765B-0040	70 kHz to 40 GHz range, with 850 wavelength coverage
MN4765B-0042	70 kHz to 40 GHz range, with 850 nm and 1060 nm wavelength coverage
MN4765B-0043	70 kHz to 40 GHz range, with 850/1060/1310/1550 nm wavelength coverage
MN4765B-0070	70 kHz to 70 GHz range, with 1550 nm wavelength coverage
MN4765B-0071	70 kHz to 70 GHz range, with 1310 nm wavelength coverage
MN4765B-0072	70 kHz to 70 GHz range, with 1310 nm and 1550 nm wavelength coverage
MN4765B-0110	70 kHz to 110 GHz range, with 1550 nm wavelength coverage
MN4765B-0111	70 kHz to 110 GHz range, with 1310 nm wavelength coverage
MN4765B-0112	70 kHz to 110 GHz range, with 1310 nm and 1550 nm wavelength coverage
MN4765B-0098	Standard Calibration – Includes Certificate of Calibration
MN4765B-0099	Premium Calibration – Includes Certificate of Calibration and Test Data
	MN4775A Configuration Options
MN4775A-0040	40 GHz modulation bandwidth and internal 850 nm laser
MN4775A-0070	70 GHz modulation bandwidth and internal C-band laser set to 1550 nm
MN4775A-0071	70 GHz modulation bandwidth and internal 1310 nm fixed laser

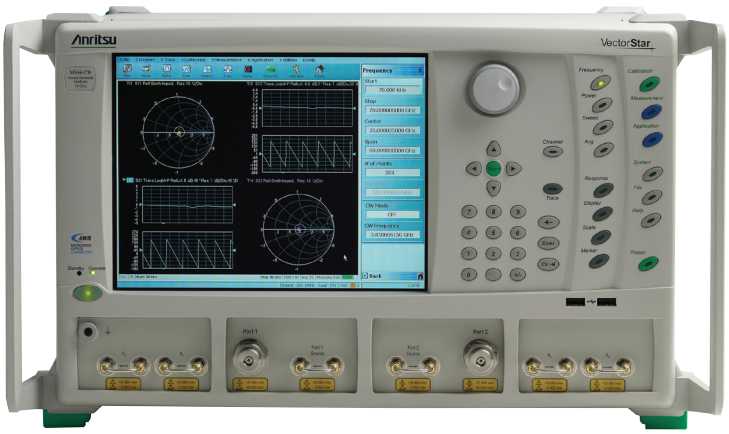
VectorStar™ Microwave Vector Network Analyzers

MS4640B Series

70 kHz to 20 GHz, 40 GHz, 70 GHz

Remote Control
Ethernet | USB

High Performance, Broadband Network Analysis Solutions



VectorStar®

The VectorStar™ family is Anritsu's Premium VNA line, providing the highest overall performance on a modern platform. The MS4640B VectorStar VNA offers the broadest coverage in a single instrument, 70 kHz to 70 GHz. The additional two decades at the low end are even more impressive than the guaranteed 70 GHz coverage on the high end. PulseView™, when combined with the innovative IF digitizing option, offers industry-leading 2.5 ns pulse resolution and 100 dB dynamic range with no compromises or trade-offs due to varying duty cycles. PulseView provides real time display of pulse measurements while dynamically modifying pulse parameters for immediate design validation. DifferentialView™, when combined with the dual internal source option, offers real time display analysis of differential devices, drivers, and components while actively modifying phase and magnitude relationships of the internal dual sources.

The noise figure option is based on a cold source technique for improved noise figure measurement accuracy. VectorStar is the only VNA platform capable of measuring noise figure from 70 kHz to 125 GHz and available with an optimized noise receiver for measurements from 30 GHz to 125 GHz.

IMDView, when combined with the dual source option and internal switch and combiner, VectorStar provides the only VNA platform with a choice of all 3 most common IMD configuraitons: IMD software only, IMD software with internal 2nd source, and IMD software with internal 2nd source and switch with combiner. The internal switch and combiner provides the ability to perform single connection IMD measurements. Using the multiple channel capabilities of VectorStar allows automatic switching from S-parameter measurements, power sweep gain compression measurements, spectrum view of intermodulation products, and frequency sweeping of intermodulation products for complete active device characterization.

The IMD measurements are also supported in the broadband systems up to 220 GHz and mmWave bands up to 1.1 THz.

For broadband applications, the ME7838 Series offers superior performance and coverage spanning a range from 70 kHz to 110/125/145/220 GHz in a single coaxial test port. The Anritsu developed Non-linear Transmission Line mmWave module is compact while providing high performance up to 0 GHz.

The Anritsu MS4640B Vector Network Analyzer offers a new level of performance for device modeling engineers struggling to accurately and reliably characterize their devices, for R&D engineers pushing the last fraction of a dB out of their state-of-the-art designs, and for the manufacturing engineer trying to maximize throughput without sacrificing accuracy. Backed by a 3-year warranty and the most responsive sales support team, the MS4640B is the VNA of choice for the discerning engineer.

Key Features

- Broadest frequency span from a single coaxial test port covering 70 kHz to 70 GHz in a single instrument and 70 kHz to 110/125/145/220 GHz in the broadband configuration
- Highest performance pulse measurements – PulseView™ offers 2.5 ns pulse resolution with 100 dB dynamic range
- 4-port single-ended or balanced measurements using DifferentialView™ analysis
- Superior Dynamic Range – up to 142 dB
- High available power – up to +14 dBm
- Best test port characteristic performance – up to 50 dB in Directivity, Source Match and Load Match
- Most convenient automatic calibration system with best accuracy
- Best time domain analysis

Instrument Models and Operating Frequencies

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

Principal Options

- MS4640B-002 – Time Domain
- MS4640B-007 – Receiver Offset
- MS4640B-021 – Universal Fixture Extraction
- MS4640B-031 – Dual Source Architecture
- MS4640B-032 – Internal RF Combiner
- MS4640B-035 – IF Digitizer
- MS4640B-036 – Extended IF Digitizer Memory
- MS4640B-041 – Noise Figure
- MS4640B-042 – PulseView™
- MS4640B-043 – DifferentialView™
- MS4640B-044 – IMDView™
- MS4640B-046 – Fast CW
- MS4640B-047 – Eye Diagram
- MS4640B-048 – Differential Noise Figure
- MS4640B-05x – Direct Access Loops
- MS4640B-053 – External ALC
- MS4640B-06x – Active Measurements Suite
- MS4640B-070 – 70 kHz Low-End Frequency Extension
- MS4640B-08x – Broadband/Millimeter-Wave Interface

A detailed color brochure available on the Anritsu web site provides descriptions and examples of the VectorStar family's features and benefits. The web site also provides detailed information on 110/125/145/220 GHz Broadband Coaxial, Banded Waveguide, and Multiport solutions based on the MS4640B VNA.

Definitions

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

System Dynamic Range

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

MS4642B 20 GHz Model, System Dynamic Range (dB)		
	at Ports 1 or 2	at b_1 or b_2
Frequency Range	Option 61* or 62	Option 61* or 62
0.07 MHz to 0.3 MHz	81	112
>0.3 MHz to 2 MHz	98	124
>2 MHz to 10 MHz	111	132
>0.01 GHz to 2.5 GHz	114	135
>2.5 GHz to 20 GHz	115	130
With Option 31		
0.07 MHz to 0.3 MHz	83	114
>0.3 MHz to 2 MHz	100	126
>2 MHz to 10 MHz	113	134
>0.01 GHz to 2.5 GHz	116	137
>2.5 GHz to 20 GHz	116	131

*: The option 61 dynamic range reported in this column corresponds to S_{21}. For S_{12}, add 2 dB.

MS4644B 40 GHz Model, System Dynamic Range (dB)					
	at Ports 1 or 2			at b_1 or b_2	
Frequency Range	Standard	Option 51	Option 61* or 62	Option 51	Option 61* or 62
0.07 MHz to 0.3 MHz	85	83	81	114	112
>0.3 MHz to 2 MHz	102	100	98	126	124
>2 MHz to 10 MHz	115	113	111	134	132
>0.01 GHz to 2.5 GHz	122	119	114	140	135
>2.5 GHz to 40 GHz	119	115	110	130	125
With Option 31					
0.07 MHz to 0.3 MHz	87	85	83	116	114
>0.3 MHz to 2 MHz	104	102	100	128	126
>2 MHz to 10 MHz	117	115	113	136	134
>0.01 GHz to 2.5 GHz	129	121	116	142	137
>2.5 GHz to 40 GHz	122	118	113	133	128

*: The Option 61 Dynamic Range reported in this column applies for S_{21} measurements. For S_{12} Dynamic Range, use the figures from the Option 51 column.

MS4647B 70 GHz Model, System Dynamic Range (dB)					
	at Ports 1 or 2			at b_1 or b_2	
Frequency Range	Standard	Option 51	Option 61* or 62	Option 51	Option 61* or 62
0.07 MHz to 0.3 MHz	85	83	81	114	112
>0.3 MHz to 2 MHz	102	100	98	126	124
>2 MHz to 10 MHz	115	113	111	134	132
>0.01 GHz to 2.5 GHz	122	119	114	140	135
>2.5 GHz to 5 GHz	116	112	106	127	121
>5 GHz to 20 GHz	115	111	105	126	120
>20 GHz to 38 GHz	116	111	105	126	120
>38 GHz to 50 GHz	115	109	104	124	119
>50 GHz to 65 GHz	110	104	99	119	115
>65 GHz to 67 GHz	108	103	95	117	111
>67 GHz to 70 GHz	107	100	90	110	106
With Option 31					
0.07 MHz to 0.3 MHz	87	85	83	116	114
>0.3 MHz to 2 MHz	104	102	100	128	126
>2 MHz to 10 MHz	117	115	113	136	134
>0.01 GHz to 2.5 GHz	124	121	116	142	137
>2.5 GHz to 5 GHz	118	114	108	129	123
>5 GHz to 20 GHz	118	114	108	129	123
>20 GHz to 38 GHz	118	113	107	128	122
>38 GHz to 50 GHz	117	111	106	126	121
>50 GHz to 65 GHz	117	111	106	126	122
>65 GHz to 67 GHz	116	111	103	125	119
>67 GHz to 70 GHz	114	107	97	120	113

*: The Option 61 Dynamic Range reported in this column applies for S_{21} measurements. For S_{12} Dynamic Range, use the figures from the Option 51 column.

Receiver Dynamic Range

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

All Models, Receiver Dynamic Range (dB)					
	at Ports 1 or 2			at b_1 or b_2	
Frequency Range	Standard*1	Option 51*1	Option 61*2, *3, *4 or 62	Option 51*1	Option 61*3, *4 or 62
0.07 MHz to 0.3 MHz	80	79	78	90	89
>0.3 MHz to 2 MHz	102	102	102	107	107
>2 MHz to 10 MHz	115	115	115	115	115
>0.01 GHz to 2.5 GHz	120	119	116	119	116
>2.5 GHz to 5 GHz	120	118	115	117	114
>5 GHz to 20 GHz	120	118	115	118	115
>20 GHz to 40 GHz*5	120	118	115	118	116
>38 GHz to 50 GHz	120	118	117	117	117
>50 GHz to 65 GHz	117	115	115	113	114
>65 GHz to 67 GHz	115	113	111	110	109
>67 GHz to 70 GHz	113	110	109	107	108

*1: Not applicable to MS4642B.
*2: The Option 61 dynamic range reported in this column applies for S_{21} measurements. For S_{12} dynamic range, use the figures from the Option 51 column.
*3: Option 8 or 9 for MS4642B.
*4: The Option 8 dynamic range reported in this column corresponds to S_{21}. For S_{12}, add 2 dB.
*5: 20 GHz to 38 GHz for MS4647B.

Receiver Compression

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

All Models, Compression Levels (dBm)						
	0.1 dB Compression Levels in dBm relative to the Normalization Level*1					
	at Ports 1 or 2			at a_x loops	at b_x loops	
Frequency Range	Standard*2	Option 51*2	Option 61*3, *4, *5 or 62	Option 51, 061*5, or 62	Option 51*2	Option 61*3, *4, *5 or 62
0.07 MHz to 0.3 MHz	+5	+5	+5	–15	–15	–15
>0.3 MHz to 10 MHz	+10	+11	+12	–10	–10	–9
>0.01 GHz to 2.5 GHz	+10	+11	+12	–10	–10	–9
>2.5 GHz to 5 GHz	+10	+11	+12	–5	–5	–4
>5 GHz to 20 GHz	+10	+11	+12	–4	–4	–3
>20 GHz to 40 GHz*6	+10	+11	+12	–4	–4	–2
>38 GHz to 50 GHz	+10	+12	+14	–4	–4	–1
>50 GHz to 65 GHz	+10	+12	+14	–5	–5	–2
>65 GHz to 67 GHz	+10	+13	+15	–5	–5	–2
>67 GHz to 70 GHz	+10	+13	+15	–5	–5	–1

*1: 0.3 dB for <0.3 MHz.
*2: Not applicable to MS4642B.
*3: The Option 61 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 bx Option 51 column.
*4: Option 8 or 9 for MS4642B.
*5: For Option 8, the value in this column corresponds to that for port 2 or b_2. For port 1 or b_1, subtract 1 dB.
*6: 20 GHz to 38 GHz for MS4647B.

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

All Models, Third Order Intercept Point (IP3, dBm)	
Frequency Range	At Ports 2 (nom.)
0.07 MHz to 0.3 MHz	+20
>0.3 MHz to 1 GHz	+25
>1 GHz to 20/40/70 GHz (max. frequency of the models)	+35

High Level Noise

Measured at 1 kHz IF bandwidth, at default power, with either full reflects or through transmission. RMS. Characteristic performance on MS4647B with either Option 51, 61, or 62. High level noise magnitude may be degraded to 20 dBm RMS (typ.) at particular frequencies due to receiver residuals.

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

Noise Floor

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

	At Ports 1 or 2			At a_x Loops	At b_x Loops	
Frequency Range	Standard*1	Option 51*1	Option 61*2, *3, *4 or 62	Option 51, 61*3, or 62	Option 51*1	Option 61*2, *3, *4 or 62
0.07 MHz to 0.3 MHz	–75	–74	–73	–105	–105	–104
>0.3 MHz to 2 MHz	–92	–91	–90	–117	–117	–116
>2 MHz to 10 MHz	–105	–104	–103	–125	–125	–124
>0.01 GHz to 2.5 GHz	–110	–108	–104	–129	–129	–125
>2.5 GHz to 40 GHz*5	–110	–107	–103	–121	–122	–118
>38 GHz to 50 GHz	–110	–106	–103	–121	–121	–118
>50 GHz to 65 GHz	–110	–106	–103	–121	–121	–119
>65 GHz to 67 GHz	–110	–106	–100	–120	–120	–116
>67 GHz to 70 GHz	–110	–106	–100	–115	–119	–116

*1: Not applicable to MS4642B.
*2: The Option 61 noise floor reported in this column applies to Port 2 or b_2. For Port 1 or b_1 noise floor, use the figures from the appropriate Portx or bx Option 51 column.
*3: Option 8 or 9 for MS4642B.
*4: For Option 8, the value in this column applies to port 2 or b_2. For port 1 or b_1, the appropriate value is 1 dB more negative.
*5: 2.5 GHz to 38 GHz for MS4647B.

Power Range

Maximum Rated Power to minimum level. The difference reflects the ALC range for standard models or with Option 51, and the ALC + Attenuator Range for models with Options 61 or 62. Maximum Rated Power is typical from 2.4 GHz to 2.7 GHz.

MS4642B, 20 GHz Model, Power Range (dBm)	
Frequency Range	Option 61* or 62
70 kHz to 0.01 GHz	+8 to –95
>0.01 GHz to 2.5 GHz	+10 to –95
>2.5 GHz to 20 GHz	+11 to –90
With Option 31	
70 kHz to 0.01 GHz	+10 to –95
>0.01 GHz to 2.5 GHz	+12 to –95
>2.5 GHz to 20 GHz	+12 to –90

*: For Option 61, the power range reported in this column applies to Port 1. For Port 2, add 1 dB to the maximum (minimum unchanged).

MS4644B, 40 GHz Model, Power Range (dBm)			
Frequency Range	Standard	Option 51	Option 61*1 or 62
70 kHz to 0.01 GHz	+10 to –25	+9 to –25	+8 to –95
>0.01 GHz to 2.5 GHz	+12 to –25	+11 to –25	+10 to –95
>2.5 GHz to 20 GHz	+9 to –20	+8 to –20	+7 to –90
>20 GHz to 40 GHz	+9 to –25	+8 to –25	+7 to –95
With Option 31*2			
70 kHz to 0.01 GHz	+12 to –25	+11 to –25	+10 to –95
>0.01 GHz to 2.5 GHz	+14 to –25	+13 to –25	+12 to –95
>2.5 GHz to 20 GHz	+12 to –20	+11 to –20	+10 to –90
>20 GHz to 40 GHz	+12 to –25	+11 to –25	+10 to –95

*1: The Option 61 power range reported in this column applies to Port 1. For Port 2, use the figures from the Option 51 column.
*2: With Option 8x, Test Port 2 maximum power is equivalent to the non-option 31 range (typ.).

MS4647B, 70 GHz Model, Power Range (dBm)			
Frequency Range	Standard	Option 51	Option 61*1 or 62
70 kHz to 0.01 GHz	+10 to –25	+9 to –25	+8 to –85
>0.01 GHz to 2.5 GHz	+12 to –25	+11 to –25	+10 to –85
>2.5 GHz to 5 GHz	+6 to –20	+5 to –20	+3 to –80
>5 GHz to 20 GHz	+5 to –20	+4 to –20	+2 to –80
>20 GHz to 38 GHz	+6 to –25	+4 to –25	+2 to –85
>38 GHz to 50 GHz*2	+5 to –25	+3 to –25	+1 to –85
>50 GHz to 65 GHz	0 to –25	–2 to –25	–4 to –85
>65 GHz to 67 GHz	–2 to –25	–3 to –25	–5 to –85
>67 GHz to 70 GHz	–3 to –25	–6 to –25	–10 to –85
With Option 31*3			
70 kHz to 0.01 GHz	+12 to –25	+11 to –25	+10 to –85
>0.01 GHz to 2.5 GHz	+14 to –25	+13 to –25	+12 to –85
>2.5 GHz to 5 GHz	+8 to –20	+7 to –20	+5 to –80
>5 GHz to 20 GHz	+8 to –20	+7 to –20	+5 to –80
>20 GHz to 38 GHz	+8 to –25	+6 to –25	+4 to –85
>38 GHz to 50 GHz	+7 to –25	+5 to –25	+3 to –85
>50 GHz to 65 GHz	+7 to –25	+5 to –25	+3 to –85
>65 GHz to 67 GHz	+6 to –25	+4 to –25	+2 to –85
>67 GHz to 70 GHz	+4 to –25	+1 to –25	–3 to –85

*1: The Option 61 power range reported in this column applies to Port 1. For Port 2, use the figures from the Option 51 column.
*2: Rated power is typical 49 GHz to 50 GHz.
*3: With Option 8x, Test Port 2 maximum power is equivalent to the non-option 31 range (typ.). 38 GHz to 50 GHz range may degrade by up to 3 dB.

Output Default Power

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

Model	Standard (No Options)	Option 51, 61 or 62*1
MS4642B, 20 GHz	NA	+5 dBm
MS4644B, 40 GHz	+5 dBm	+5 dBm
MS4647B, 70 GHz	–3 dBm*2	–10 dBm

*1: Measured at default power.
*2: Measured between default and 5 dB below default port power.

Power Accuracy, Linearity and Resolution

Frequency Range	Accuracy*1 (dB)	Linearity*2 (dB)	Resolution (dB)
70 kHz to 0.01 GHz	±1.5	±1.5	0.01
>0.01 GHz to 40 GHz	±1.5	±1.0	0.01
>40 GHz to 67 GHz	±3.0	±1.0	0.01
>67 GHz to 70 GHz	±4.0 (±3.0)	±2.0 (±1.0)	0.01

*1: Measured at default power.
*2: Measured between default and 5 dB below default port power.

Measurement Stability

Ratio measurement, with ports shorted. Characteristic.

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

Frequency Resolution, Accuracy, and Stability

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

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

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

Frequency Range	SSB Phase Noise (dBc/Hz) at 1 kHz Offset	SSB Phase Noise (dBc/Hz) at 10 kHz Offset	SSB Phase Noise (dBc/Hz) at 100 kHz Offset	Harmonics (dBc) (second and third)	Non-Harmonic Spurious (dBc) at > 1 kHz Offsets
70 kHz to 0.01 GHz	–86	–83	–88*1	–20	–20
>0.01 GHz to 2.5 GHz	–90	–92	–96	–20	–30
>2.5 GHz to 5 GHz	–93	–94	–95	–20*2	–30
>5 GHz to 10 GHz	–86	–90	–90	–20	–30
>10 GHz to 20 GHz	–81	–84	–84	–20	–30
>20 GHz to 26.5 GHz	–78	–81	–81	–20	–30
>26.5 GHz to 40 GHz	–72	–76	–78	–20*2	–30
>40 GHz to 50 GHz	–70	–75	–75	–20	–30
>50 GHz to 70 GHz	–69	–71	–71	–20	–30

*1: Only applies for source frequencies >300 kHz.
*2: Typical from 2.5 GHz to 2.7 GHz on MS4642B systems and from 20.0 GHz to 21.0 GHz on MS4647B systems.

Uncorrected (Raw) Port Characteristics

Characteristic performance with Options 31, 51, 61, or 62.

Frequency Range	Directivity (dB)	Port Match*1 (dB)
70 kHz to 0.01 GHz	>10*2	>8
>0.01 GHz to 2.5 GHz	>9*2	>10
>2.5 GHz to 5 GHz	>20	>10
>5 GHz to 20 GHz	>17	>9
>20 GHz to 40 GHz	>14	>7
>40 GHz to 65 GHz	>11	>7
>65 GHz to 67 GHz	>11	>7
>67 GHz to 70 GHz	>5 (>10)	>7

*1: Port Match is defined as the worst of source and load match.
*2: Raw Directivity degraded to 4 dB (typ.) below 300 kHz and in a 300 MHz window below 2.5 GHz.

Power Range with Option 32

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

SOURCE1 to PORT1 POWER RANGE (dBm)

Frequency Range	Standard	Option 51	Option 61 or 62
MS4642B, 20 GHz with Option 31 and Option 32			
70 kHz to 0.01 GHz	—	—	+8 to –95
>0.01 GHz to 2.5 GHz	—	—	+10 to –95
>2.5 GHz to 20 GHz	—	—	+10 to –90
MS4644B, 40 GHz with Option 31 and Option 32			
70 kHz to 0.01 GHz	+10 to –25	+9 to –25	+8 to –95
>0.01 GHz to 2.5 GHz	+12 to –25	+11 to –25	+10 to –95
>2.5 GHz to 20 GHz	+10 to –20	+9 to –20	+8 to –90
>20 GHz to 40 GHz	+10 to –25	+9 to –25	+8 to –95
MS4647B, 70 GHz with Option 31 and Option 32			
70 kHz to 0.01 GHz	+10 to –25	+9 to –25	+8 to –85
>0.01 GHz to 2.5 GHz	+12 to –25	+11 to –25	+10 to –85
>2.5 GHz to 5 GHz	+6 to –20	+5 to –20	+3 to –80
>5 GHz to 20 GHz	+6 to –20	+5 to –20	+3 to –80
>20 GHz to 38 GHz	+6 to –25	+4 to –25	+2 to –85
>38 GHz to 50 GHz	+5 to –25	+3 to –25	+1 to –85
>50 GHz to 65 GHz	+5 to –25	+3 to –25	+1 to –85
>65 GHz to 67 GHz	+3 to –25	+1 to –25	–1 to –85
>67 GHz to 70 GHz	+2 to –25	–1 to –25	–5 to –85

SOURCE2 to PORT2 POWER RANGE (dBm)

Frequency Range	Standard	Option 51	Option 61 or 62
MS4642B, 20 GHz with Option 31 and Option 32			
70 kHz to 0.01 GHz	—	—	+6 to –95
>0.01 GHz to 2.5 GHz	—	—	+8 to –95
>2.5 GHz to 20 GHz	—	—	+9 to –90
MS4644B, 40 GHz with Option 31 and Option 32			
70 kHz to 0.01 GHz	+8 to –25	+7 to –25	+6 to –95
>0.01 GHz to 2.5 GHz	+10 to –25	+9 to –25	+8 to –95
>2.5 GHz to 20 GHz	+7 to –20	+6 to –20	+5 to –90
>20 GHz to 40 GHz	+7 to –25	+6 to –25	+5 to –95
MS4647B, 70 GHz with Option 31 and Option 32			
70 kHz to 0.01 GHz	+8 to –25	+7 to –25	+6 to –85
>0.01 GHz to 2.5 GHz	+10 to –25	+9 to –25	+8 to –85
>2.5 GHz to 5 GHz	+4 to –20	+3 to –20	+1 to –80
>5 GHz to 20 GHz	+3 to –20	+2 to –20	0 to –80
>20 GHz to 38 GHz	+4 to –25	+2 to –25	0 to –85
>38 GHz to 50 GHz*	+3 to –25	+1 to –25	–1 to –85
>50 GHz to 65 GHz	–2 to –25	–4 to –25	–6 to –85
>65 GHz to 67 GHz	–4 to –25	–5 to –25	–7 to –85
>67 GHz to 70 GHz	–5 to –25	–8 to –25	–12 to –85

*: Rated power is typical 49 GHz to 50 GHz.

SOURCE2 to PORT1 POWER RANGE (dBm, typical performance)

Frequency Range	Standard	Option 51 or 61	Option 62
MS4642B, 20 GHz with Option 31 and Option 32			
70 kHz to 0.01 GHz	—	—	–22 to –95
>0.01 to 2.5 GHz	—	—	–15 to –95
>2.5 to 20 GHz	—	—	–11 to –95
MS4644B, 40 GHz with Option 31 and Option 32			
70 kHz to 0.01 GHz	–20 to –25	–21 to –25	–22 to –95
>0.01 GHz to 2.5 GHz	–13 to –25	–14 to –25	–15 to –95
>2.5 GHz to 20 GHz	–9 to –25	–10 to –25	–11 to –95
>20 GHz to 40 GHz	–8 to –25	–9 to –25	–10 to –95
MS4647B, 70 GHz with Option 31 and Option 32			
70 kHz to 0.01 GHz	–20 to –25	–21 to –25	–22 to –85
>0.01 GHz to 2.5 GHz	–13 to –25	–14 to –25	–15 to –85
>2.5 GHz to 5 GHz	–12 to –25	–13 to –25	–15 to –85
>5 GHz to 20 GHz	–11 to –25	–12 to –25	–14 to –85
>20 GHz to 38 GHz	–11 to –25	–13 to –25	–15 to –85
>38 GHz to 50 GHz	–12 to –25	–14 to –25	–16 to –85
>50 GHz to 65 GHz	–16 to –25	–18 to –25	–20 to –85
>65 GHz to 67 GHz	–17 to –25	–18 to –25	–20 to –85
>67 GHz to 70 GHz	–20 to –25	–23 to –25	–27 to –85

MS4642B 20 GHz VNA System Performance

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

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

Frequency Range	Directivity	Source Match	Load Match*1	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz	>38 dB	>36 dB	>38 dB	±0.02 dB	±0.05 dB
>0.01 GHz to 2.5 GHz	>42 dB	>41 dB	>42 dB	±0.005 dB	±0.03 dB
>2.5 GHz to 20 GHz	>43 dB	>39 dB	>43 dB	±0.006 dB	±0.07 dB

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

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

Frequency Range	Directivity	Source Match	Load Match*1	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz	>38 dB	>36 dB	>38 dB	±0.02 dB	±0.05 dB
>0.01 GHz to 2.5 GHz	>37 dB	>41 dB	>37 dB	±0.005 dB	±0.03 dB
>2.5 GHz to 20 GHz	>34 dB	>39 dB	>35 dB	±0.006 dB	±0.07 dB

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

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

Frequency Range	Directivity	Source Match	Load Match*1	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz	>47 dB	>45 dB	>46 dB	±0.02 dB	±0.05 dB
>0.01 GHz to 2.5 GHz	>47 dB	>45 dB	>46 dB	±0.005 dB	±0.03 dB
>2.5 GHz to 20 GHz	>46 dB	>45 dB	>46 dB	±0.006 dB	±0.07 dB

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

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

Frequency Range	Directivity	Source Match	Load Match*1	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz	>40 dB	>37 dB	>40 dB	±0.02 dB	±0.05 dB
>0.01 GHz to 2.5 GHz	>42 dB	>41 dB	>42 dB	±0.005 dB	±0.03 dB
>2.5 GHz to 10 GHz	>43 dB	>39 dB	>43 dB	±0.005 dB	±0.03 dB
>10 GHz to 20 GHz	>43 dB	>39 dB	>43 dB	±0.006 dB	±0.07 dB

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

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

Frequency Range	Directivity	Source Match	Load Match*1	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz	>40 dB	>37 dB	>40 dB	±0.02 dB	±0.05 dB
>0.01 GHz to 2.5 GHz	>42 dB	>40 dB	>42 dB	±0.005 dB	±0.03 dB
>2.5 GHz to 10 GHz	>40 dB	>34 dB	>40 dB	±0.005 dB	±0.03 dB
>10 GHz to 20 GHz	>30 dB	>34 dB	>30 dB	±0.006 dB	±0.07 dB

MS4642B – 12-Term – 36585K K AutoCal™

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

Frequency Range	Directivity	Source Match	Load Match*1	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz*2	>40 dB	>40 dB	>43 dB	±0.10 dB	±0.10 dB
>0.01 GHz to 2.5 GHz	>43 dB	>47 dB	>43 dB	±0.05 dB	±0.03 dB
>2.5 GHz to 20 GHz	>50 dB	>47 dB	>50 dB	±0.09 dB	±0.03 dB

*1: Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.
*2: Typical performance below 2 MHz.

MS4644B 40 GHz VNA System Performance

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

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

Frequency Range	Directivity	Source Match	Load Match*1	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz	>38 dB	>36 dB	>38 dB	±0.02 dB	±0.05 dB
>0.01 GHz to 2.5 GHz	>42 dB	>41 dB	>42 dB	±0.005 dB	±0.03 dB
>2.5 GHz to 20 GHz	>43 dB	>39 dB	>43 dB	±0.006 dB	±0.07 dB
>20 GHz to 40 GHz	>40 dB	>34 dB	>40 dB	±0.006 dB	±0.08 dB

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

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

Frequency Range	Directivity	Source Match	Load Match*1	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz	>38 dB	>36 dB	>38 dB	±0.02 dB	±0.05 dB
>0.01 GHz to 2.5 GHz	>37 dB	>41 dB	>37 dB	±0.005 dB	±0.03 dB
>2.5 GHz to 20 GHz	>34 dB	>39 dB	>35 dB	±0.006 dB	±0.07 dB
>20 GHz to 40 GHz	>32 dB	>34 dB	>32 dB	±0.006 dB	±0.08 dB

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

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

Frequency Range	Directivity	Source Match	Load Match*1	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz	>47 dB	>45 dB	>46 dB	±0.02 dB	±0.05 dB
>0.01 GHz to 2.5 GHz	>47 dB	>45 dB	>46 dB	±0.005 dB	±0.03 dB
>2.5 GHz to 20 GHz	>46 dB	>45 dB	>46 dB	±0.006 dB	±0.07 dB
>20 GHz to 40 GHz	>42 dB	>38 dB	>42 dB	±0.006 dB	±0.07 dB

MS4644B – 12-Term – 36585K K AutoCal

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

Frequency Range	Directivity	Source Match	Load Match*1	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz*2	>40 dB	>40 dB	>43 dB	±0.10 dB	±0.10 dB
>0.01 GHz to 2.5 GHz	>43 dB	>47 dB	>43 dB	±0.05 dB	±0.03 dB
>2.5 GHz to 20 GHz	>50 dB	>47 dB	>50 dB	±0.09 dB	±0.03 dB
>20 GHz to 40 GHz	>48 dB	>47 dB	>48 dB	±0.14 dB	±0.07 dB

*1: Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 Series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.
*2: Typical performance below 2 MHz.

MS4647B 70 GHz VNA System Performance

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

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

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

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

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

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

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

Frequency Range*1	Directivity	Source Match	Load Match*2	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz	>47 dB	>47 dB	>46 dB	±0.02 dB	±0.05 dB
>0.01 GHz to 2.5 GHz	>47 dB	>47 dB	>46 dB	±0.01 dB	±0.05 dB
>2.5 GHz to 20 GHz	>46 dB	>42 dB	>46 dB	±0.01 dB	±0.07 dB
>20 GHz to 35 GHz	>44 dB	>42 dB	>44 dB	±0.01 dB	±0.07 dB
>35 GHz to 40 GHz	>44 dB	>41 dB	>44 dB	±0.03 dB	±0.08 dB
>40 GHz to 50 GHz	>42 dB	>37 dB	>42 dB	±0.05 dB	±0.1 dB
>50 GHz to 65 GHz	>42 dB	>34 dB	>42 dB	±0.06 dB	±0.1 dB
>65 GHz to 67 GHz	>40 dB	>34 dB	>40 dB	±0.1 dB	±0.12 dB
>67 GHz to 70 GHz	>37 dB	>34 dB	>37 dB	±0.15 dB	±0.12 dB

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

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

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

Frequency Range	Directivity	Source Match	Load Match*1	Reflection Tracking	Transmission Tracking
0.24 GHz*2 to 2.5 GHz	>50 dB	>50 dB	>50 dB	±0.005 dB	±0.02 dB
>2.5 GHz to 20 GHz	>50 dB	>50 dB	>50 dB	±0.005 dB	±0.02 dB
>20 GHz to 40 GHz	>50 dB	>50 dB	>50 dB	±0.005 dB	±0.02 dB
>40 GHz to 65 GHz	>45 dB	>50 dB	>45 dB	±0.015 dB	±0.02 dB
>65 GHz to 67 GHz	>45 dB	>50 dB	>45 dB	±0.03 dB	±0.04 dB
>67 GHz to 70 GHz	>45 dB	>45 dB	>45 dB	±0.10 dB	±0.08 dB

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

MS4647B VNA – 12-Term – 36585V V AutoCal

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

Frequency Range	Directivity	Source Match	Load Match*1	Reflection Tracking	Transmission Tracking
70 kHz to 0.01 GHz*2	>40 dB	>40 dB	>40 dB	±0.10 dB	±0.10 dB
>0.01 GHz to 2.5 GHz	>43 dB	>47 dB	>43 dB	±0.05 dB	±0.03 dB
>2.5 GHz to 20 GHz	>50 dB	>47 dB	>50 dB	±0.09 dB	±0.03 dB
>20 GHz to 40 GHz	>48 dB	>47 dB	>48 dB	±0.14 dB	±0.07 dB
>40 GHz to 65 GHz	>43 dB	>45 dB	>43 dB	±0.17 dB*3	±0.10 dB
>65 GHz to 67 GHz	>43 dB	>45 dB	>43 dB	±0.17 dB	±0.10 dB
>67 GHz to 70 GHz	>42 dB	>40 dB	>42 dB	±0.30 dB	±0.12 dB

*1: Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by approximately 8 dB for a 3670 series test port cable, to compensate for effects such as match, repeatability, bend radius, and similar parameters.
*2: Limited to about 240 MHz, due to the longest line delta of 34.84 mm in the 3657 Series Multi-Line Calibration Kit.
*3: ±0.25 dB from 51 GHz to 55 GHz.

Measurement Times

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

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

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

Standard Capabilities

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

Continued on next page

Group Delay	Group Delay Aperture	Defined as the frequency span over which the phase change is computed at a given frequency point.
	Aperture	The aperture can be changed without recalibration.
	Minimum Aperture	The minimum aperture is the frequency range divided by the number of points in calibration and can be increased to 20% of the frequency range.
	Group Delay Range	<180° of phase change within the aperture
Channels, Display, and Traces	Channels and Traces	16 channels, each with up to 16 traces
	Display	Color touch screen LCD, 26.4 cm (10.4") diagonal
	Display Colors	Unlimited colors for data traces, memory, text, markers, graticules and limit lines.
	Trace Memory and Math	A separate memory for each trace can be used to store measurement data for later display or subtraction, addition, multiplication or division with current measurement data. The trace data can be saved and recalled.
	Inter-trace Math	Any two traces within a channel can also be combined (via addition, subtraction, multiplication or division) and displayed on another trace. An equation editor mode is also available that allows the combination of trace data, trace memory and S-parameter data in more complex equations. Over 30 built-in functions are available. Simple editing tools and the ability to save/recall equations are also provided.
Scale Resolution Minimum per division, varies with graph type.	Log Magnitude	0.001 dB
	Linear Magnitude	1 *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 (× 16 traces × 16 channels, for a total of 3,072)
	Marker Coupling	Coupled or decoupled within a channel
	Marker Data	Data displayed in graph area or in table form
	Reference Marker	Additional marker per trace for reference
	Marker Statistics	Mean, maximum, minimum, standard deviation Per trace or over a marker region.
	Marker Search and Tracking	Search and/or track for minimum, maximum, peak, or target value.
Other	Filter Parameters	Display bandwidth (user-selectable loss value), corner and center frequencies, loss, Q, and shape factors.
	Blank Frequency Information	Blanking function removes all references to frequencies on the display. Frequency references can only be restored through a system preset or GPIB command.

Calibration and Correction Capabilities

Calibration Methods	Short-Open-Load-Through (SOLT) with Fixed or Sliding Load and supporting .s1p-defined cal kits Offset-Short-Offset-Short-Load-Through (SSLT) with Fixed or Sliding Load Triple-Offset-Short-Through (SSST) Short-Open-Load-Reciprocal (SOLR) or Unknown Through Method (SSLR, SSSR) Line-Reflect-Line (LRL)/Line-Reflect-Match (LRM) – (up to 5 bands supported) Thru-Reflect-Line (TRL)-(up to 5 bands supported) Advanced-LRM (A-LRM™) for improved on-wafer calibrations AutoCal Thru Update available Secondary match correction available for improved low insertion loss measurements
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. Complex load models are available. Full .s1p definitions of calibration standards can be loaded.
Reference Impedance	Modify the reference impedance from 50Ω to any impedance greater than 0Ω.
Interpolation	Allows interpolation between calibration frequency points. Accuracy will be reduced at non-calibration frequencies and that degradation is dependent on the frequency step size in the initial calibration and the electrical length of the user's setup.
Adapter Removal Calibration	Characterizes and "removes" an adapter that is used during calibration that will not be used for subsequent device measurements; for accurate measurement of non-insertable devices.
Dispersion Compensation	Selectable as Coaxial, other non-dispersive (e.g., for coplanar waveguide), Waveguide, or Microstrip.

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Power	Power Meter Correction	Different power meter calibrations are available to enhance power accuracy at the desired reference plane. The source power will match the target calibration power, as read by the power meter, to within ~0.1 dB for short periods of time (determined by thermal drift of the system and the power meter). The absolute accuracy of the calibrated power will be dependent on the power meter and sensor used.
	Flat Power Calibrations	A flat power calibration (when in frequency sweep mode) is available at a user-selectable power level, if it is within the power adjustment range of the internal source. The flat power correction is applied to other power levels.
	Linear Power Calibrations	A linear power calibration is performed over a range of power levels for use in power sweep mode and is performed at a specified frequency or frequency range.
	External Power Meter	Both calibrations are performed using an external power meter (Anritsu ML2438A, ML248xB, ML249xA, Agilent 437, or equivalent) over the Dedicated GPIB port, or a USB power sensor (Anritsu MA24106A, MA24108A, MA24118A, MA24208A, MA24218A, MA24330A, MA24340A, MA24350A, MA24507A, or MA24510A) connected to a USB port. Note: Usage of the MA24500A or MA24510A sensor requires connection to two USB ports to supply needed current draw.
Embedding/ De-embedding	The MS4640B is equipped with an Embedding/De-embedding system.	
	De-embedding	De-embedding is generally used for removal of test fixture contributions, modeled networks and other networks described by S-parameters (s2p files) from measurements.
	Embedding	Similarly, the Embedding function can be used to simulate matching circuits for optimizing amplifier designs or simply adding effects of a known structure to a measurement.
	Multiple Networks	Multiple networks can be embedded/de-embedded and changing the port and network orientations is handled easily.
	Extraction Utility	An extraction utility is part of this package that allows the easier computation of deembedding files based on some additional calibration steps and measurements.
Impedance Conversion	Allows entry of different reference impedances (complex values) for different ports	
Mixer Setup	Mixer setup provides assistance to configure common mixer measurements including a simple, yet accurate, calibration methodology.	
	Mixer Setup – Single Channel	The prime objective of the guided Mixer Setup Single Channel is to help configure the frequency plan of the measurement using easy-to-understand diagrams. Mixers using harmonics of the LO are supported as are mm-wave configurations (see ME7838x documentation).
	Mixer Setup – Multiple Channel	The Mixer Setup Multiple Channels helps configure measurement channels to handle any of a suite of possible mixer measurements and to list the required calibration steps.
	Mixer Calibration	Both of these tools are coupled with the mixer calibration menu system that enables both scalar and vector-corrected measurements. The user can be directed to power calibrations that are automatically set up based on the mixer configuration.
	Dual Source Mixer	Allows easier external mixer setups and can take advantage of the flexibility of having two independent internal sources within the VNA.

Remote Operability

VectorStar supports several remote operability options.

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

Throughput Time

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

Communication Type	Data Format	Measurement Time		
		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

Optional Capabilities

Time Domain Measurements — Option 2	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. Low-pass mode requires a harmonically related frequency list (step size = start frequency). A harmonic sweep tool is available to help with this setup. In low-pass mode, the impulse or step response can be displayed (the latter for a TDR-like presentation). When applying gating, the impedance levels at gate edges can be changed to simplify de-embedding operations.	
Receiver Offset — Option 7	Independent Source/Receive Functions	Allows for independent source and receive functions for Mixer, Harmonics, IMD and other measurements, where the source and receive frequencies are offset.
	Multiple Source Control Mode	To independently control the frequencies of up to four external sources, in addition to the internal source, 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.
Universal Fixture Extraction — Option 21	Description	Provides a suite of additional network extraction techniques for different de-embedding problems, particularly those when only partial interface information is available at the DUT plane. These are often useful for on-wafer and fixtured environments with more complex DUT interfaces where traditional standards may not be available. In most cases, .s1p definition/model of reflect standards is allowed and generally automatic fixture length detection is available. In addition, a sequential extraction (peeling) of isolated fixture defects is possible and allows one to generate sNp files for portions of the fixture for design analysis.
Dual Source Architecture — Option 31	Description	Adds a second internal source to the VNA structure and removes the transfer switch. This architecture results in higher test port power and improved dynamic range. Combined with Option 7 Receiver Offset, allows two sources and the receiver to be active at the same time and at independent frequencies. When both sources are active and at the same frequency, a relative phase shift can be set between them. When combined with Option 43 DifferentialView™, adds the ability to perform true mode stimulus measurements of differential devices. The dual source mixer capability allows the flexibility of two independent sources within the VNA to allow external mixer measurements.
	Required Options	None, except with the dual source mixer applications which require Option 7.
	System Compatible Options	Option 2 Time Domain Option 7 Receiver Offset Option 21 Universal Fixture Extraction Option 32 Internal RF Combiner Option 35 IF Digitizer Option 36 Extended IF Digitizer Memory Option 41 Noise Figure Option 42 PulseView™ Option 43 DifferentialView™ Option 44 IMDView™ Option 46 Fast CW Option 47 Eye Diagram Option 48 Differential Noise Figure Option 51 Direct Access Loops Option 53 External ALC Option 53 External ALC Options 61/62 Active Measurements Suite Option 70 70 kHz Low Frequency Extension Options 84/85 Broadband/Banded/Millimeter-Wave Extension Options 88/89 Broadband/Banded/Millimeter-Wave Extension. Maximum frequency available is 110 GHz
	Incompatible	Options 80/81 Broadband/Millimeter-Wave Options 82/83 Banded Millimeter-Wave Extension Options 86/87 Broadband/Millimeter-Wave. Maximum frequency available is 110 GHz.
Internal RF Combiner — Option 32	Description	Adds an internal combiner to combine Source 2 of the Dual Source Architecture option (Option 31) with Source 1 and routes to Port 1 of the VectorStar front panel. When combined with IMDView Option 44 the configuration provides optimized intermodulation distortion (IMD) measurements. The Frequency Offset (Option 7) and Dual Source (Option 31) must be ordered with the combiner option. If IMDView Option 44 is not included, switching of the combiner is activated using the Multiple Source Control menus supplied with the frequency offset option.
	Required Options	Option 7 Receiver Offset and Option 31 Dual Source Architecture
	System Compatible Options	Option 2 Time Domain Option 21 Universal Fixture Extraction Option 35 IF Digitizer Option 36 Extended IF Digitizer Memory Option 41 Noise Figure Option 42 PulseView™ Option 43 DifferentialView™ Option 44 IMDView™ Option 46 Fast CW Option 47 Eye Diagram Option 48 Differential Noise Figure Option 51 Direct Access Loops Option 53 External ALC Option 61/62 Active Measurements Suite Option 70 70 kHz Low Frequency Extension Options 84/85 Broadband/Banded/Millimeter-Wave Extension Options 88/89 Broadband/Banded/Millimeter-Wave Extension. Maximum frequency available is 110 GHz
	Incompatible Options	Options 80/81 Broadband/Millimeter-Wave Options 82/83 Banded/Millimeter-Wave Extension Options 86/87 Broadband/Millimeter-Wave. Maximum frequency available is 110 GHz

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IF Digitizer — Option 35	Description	When combined with Option 42 PulseView™, adds the capability to generate and measure pulsed signals. Four internal signal generators are included enabling singlet, doublet, triplet, quadruplet, and/or burst signal generation. Pulse measurements include pulse profile, point-inpulse, and pulse-to-pulse capability.
	Required Options	None
	System Compatible Options	All
	Incompatible Options	None
	Multiport Systems	Compatible with the MN469xC Series Multiport System on any model VNA. Fast CW (non-pulsed) Captures up to 400 million data points per measurement channel with variable acquisition rates from 80 MHz to 400 MHz. This capability enables long time records (0.5 s to 2.5 s, depending on acquisition rate) stored in files retrievable via USB or a local area network.
	Additional Information	For detailed pulse measurement theory, description, and operational information, see the VectorStar MS464xB Series VNA Calibration and Measurement Guide, 10410-00318.
Extended IF Digitizer Memory — Option 36	Description	Provides additional memory for the IF digitizer option to allow for longer record lengths. This option increases the maximum record length from 0.5 seconds to 2.5 seconds at the maximum sampling rate (minimum time resolution) with proportionate increases in record length increases at other sampling rates.
	Required Options	Option 35 IF Digitizer
	System Compatible Options	All
	Incompatible Options	None
Noise Figure — Option 41	Description	Adds the capability to measure degradation of the signal-to-noise ratio caused by components in a signal chain. The Noise Figure measurement is based on a cold source technique for improved accuracy. Various levels of match and fixture correction are available for additional enhancement. Mixer noise figure measurements are supported. Compatible with mmWave measurements in the ME7838X family with the use of receiver-only modules (e.g., 3744A-Rx).
	Required Options	Option 51, Option 61, or Option 62
	System Compatible Options	Option 2 Time Domain Option 7 Receiver Offset Option 21 Universal Fixture Extraction Option 31 Dual Source Architecture Option 32 Internal RF Combiner Option 35 IF Digitizer Option 36 Extended IF Digitizer Memory Option 42 PulseView™ Option 43 DifferentialView™ Option 44 IMDView™ Option 46 Fast CW Option 47 Eye Diagram Option 53 External ALC Option 70 70 kHz Low Frequency Extension Options 81/87 Broadband/Millimeter-Wave Option 83 Millimeter-Wave Extension Options 85/89 Broadband/Banded/Millimeter-Wave Extension
	Incompatible Options	Option 48 Differential Noise Figure Options 80/86 Broadband/Millimeter-Wave Option 82 Banded Millimeter-Wave Extension Option 84 Broadband/Banded/Millimeter-Wave Extension Option 86 Broadband/Millimeter-Wave Option 88 Broadband/Banded/Millimeter-Wave Extension
	Multiport System	MN469xC Series Multiport System on any model VNA; Noise Figure is only available when configured as a 2-Port VNA.
	Additional Information	For detailed Noise Figure measurement theory, description, and operational information, see the VectorStar MS464xB Series VNA Calibration and Measurement Guide, 10410-00318.

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PulseView™ — Option 42	Description	When combined with Option 35 IF Digitizer, adds the capability to generate and measure pulsed signals. Four internal signal generators are included enabling singlet, doublet, triplet, quadruplet, and/or burst signal generation. Pulse measurements include pulse profile, point-in-pulse, and pulse-to-pulse capability. Allows pulsed leveling of source power at an external point (e.g., after a preamplifier).
	Required Options	Option 35 IF Digitizer
	System Compatible Options	All
	Incompatible Options	None
	Multiport Systems	Compatible with the MN469xC Series Multiport System on any model VNA
	Additional Information	For detailed pulse generation and measurement capability theory, description, and operation information, see the VectorStar MS464xB Series VNA Calibration and Measurement Guide - 10410-00318.
	Pulse Measurements	Pulse profile (PP), point-in-pulse (PIP), pulse-to-pulse (P2P), continuous pulse profiling (Cprof), and continuous point-in-pulse (CPIP)
	Minimum Profile Width	2.5 ns (5 ns minimum for continuous profiling)
	Minimum PIP Measurement Width	2.5 ns (5 ns minimum for continuous point-in-pulse)
	P2P Measurement Width	Minimum 5 ns
	Record Length	0.5 s
	Pulse Repetition Frequency (PRF)	4 Hz to 67 MHz in Pulse mode; PRFs slower than 4 Hz can be measured in standard Transmission/ Reflection mode with triggering.
	Duty Cycle (DC) Dynamic Range Reduction (characteristic)	
	1% DC	0 dB
	0.1% DC	0 dB
	0.01% DC	0 dB
	Pulse Generation	Four (4) internal pulse generators: PG1-PG4.
	Pulse Formats	Singlet, doublet, triplet, quadruplet, and burst
	Pulse Repetition Frequency (PRF) Range	4 Hz to 67 MHz
	Maximum Pulse Width	0.25 s
	Minimum Pulse Width	5 ns
	RF Modulation	Requires a SM6628, SM6629, SM6630, or SM6631 Pulse Modulator Test Set (see next section)
RF Modulation (Pulse Modulator Test Sets for use with Option 42 PulseView™)	Description	Pulse Modulator Test Sets are available to pulse the RF stimulus and/or provide receiver gating (modulation). Receiver gating generally required only for higher power antenna and related applications where undesired pulses could saturate the VNA receiver. The Test Set frequency range is limited to that of the VNA with which it is used. Test Sets include necessary cabling and installation documentation.
	Required Options	Option 35 IF Digitizer Option 42 PulseView™ Option 51 Direct Access Loops or Options 61/62 Active Measurements Suite
	Requires one of the following compatible Pulse Modulator Test Sets	SM6628, 70 kHz to 40 GHz. Provides the MS4642B and MS4644B VNA with source modulation. SM6629, 70 kHz to 40 GHz. Provides the MS4642B and MS4644B VNA with source and receiver modulation. SM6630, 70 kHz to 70 GHz. Provides the MS4647B VNA with source modulation. SM6631, 70 kHz to 70 GHz. Provides the MS4647B VNA with source and receiver modulation.
	Polarity	Low (<1 V) = RF ON High (3.3 V ±10%) = RF OFF
	Pulse Rise/Fall Time (typ.)	5 ns (10 to 90%)
	Insertion Loss (typ.)	<10 dB, to 20 GHz <12 dB, 20 GHz to 40 GHz <15 dB, 40 GHz to 60 GHz <20 dB, 60 GHz to 70 GHz
	On/Off Ratio (typ.)	>100 dB, to 20 GHz >95 dB, 20 GHz to 60 GHz >90 dB, 60 GHz to 70 GHz
	Max Input Power	+20 dBm max, 0 VDC max
	Latency (typ.)	35 ns
DifferentialView™ — Option 43	Description	When combined with Option 31 Dual Source Architecture, provides dual source control and calibrations required for stimulating and measuring differential devices. Allows true differential and common mode device drives. Corrects mismatch introduced error of the DUT to VNA interface via real and time calibration. This mode supports balanced in/out or combined balanced and single source drive configurations. In addition, it provides the ability to control amplitude and phase offsets of the drive conditions as well as swept phase offset for custom characterization.
	Required Options	Option 31 Dual Source Architecture
	Compatible Options	All
	Incompatible Options	None
	Multiport Systems	Requires an MN469xC Series Multiport System for full differential characterization of a multiport device.

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IMDView™ — Option 44	Description	When combined with Options 31, 32, and 7, IMDView provides user interface for setting up and performing IMD measurements. Interface configures and controls source routing, power and receiver calibrations, for baseband or mmWave VectorStar systems. Frequency Offset Option 7 required. If Options 31 and/or 32 are not included, the IMDView software will control external sources and perform power calibrations of external combiners.
	Required Options	Option 7 Receiver Offset
	System Compatible Options	Option 2 Time Domain Option 7 Receiver Offset Option 21 Universal Fixture Extraction Option 31 Dual Source Architecture Option 32 Internal RF Combiner Option 35 IF Digitizer Option 36 Extended IF Digitizer Memory Option 42 PulseView™ Option 43 DifferentialView™ Option 46 Fast CW Option 47 Eye Diagram Option 51 Direct Access Loops Option 53 External ALC Options 61/62 Active Measurements Suite Option 70 70 kHz Low Frequency Extension Options 84/85 Broadband/Banded/Millimeter-Wave Extension Options 88/89 Broadband/Banded/Millimeter-Wave Extension. Maximum frequency available is 110 GHz Options 80/81 Broadband/Millimeter-Wave Options 82/83 Banded/Millimeter-Wave Extension Options 86/87 Broadband/Millimeter-Wave. Maximum frequency available is 110 GHz Option 88 Broadband/Banded/Millimeter-Wave Extension
	Multiport System	Compatible with the MN469xC Series Multiport System on any model VNA; IMDView measurements can only be performed when the system is configured as a 2-Port VNA.
	Additional Information	For detailed IMD measurement theory, description and operational information, see the VectorStar MS464xB Series VNA Calibration and Measurement Guide - 10410-00318.
Fast CW — Option 46	Description: Standard Mode Fast CW	If Option 35 is not installed then Standard Mode Fast CW operations are available in T/R mode via remote commands. Standard Option CW supports both continuous data streaming and buffered data collection maximum data rates of ~200,000 measurements/second. The maximum buffer size is up to 60 million measurements with transfer blocks of up to 5 million measurements. Fast transfers are available for both streaming and buffered modes. Data extraction at corrected and final formatted layers is permitted.
	Description: Advanced Fast CW	With Options 35 and 46 installed, Advanced Fast CW becomes available that allows data rates of up to 100,000,000 measurements/second on all receivers at once and buffers of up to 800,000,000 measurements deep (with Option 36). Advanced Fast CW is available in the user interface as well as remotely and has on-board synchronization choices and data reduction functionality.
	Required Options	Option 35 IF Digitizer (required for Advanced Fast CW only)
	System Compatible Options	All
	Incompatible Options	None
Eye Diagram — Option 47	Description	Adds the capability to calculate an eye diagram representation of what the currently measured trace data would do to a digital data stream (that can be configured by the user). This is particularly valuable in seeing the data stream signal integrity issues that could occur with a given transmission path and can help with building up subsystem simulation results. Since the eye diagram computation is per-trace, one can configure a single channel having frequency domain, time domain impulse response, TDR-like and eye diagram traces simultaneously and all responding to the same live data.
	Required Options	Option 2 Time Domain
	System Compatible Options	All
	Incompatible Options	None
	Additional Information	For detailed Eye Diagram measurement theory, description and operational information, see the VectorStar MS4640B Series VNA Calibration and Measurement Guide - 10410-00318.

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Differential Noise Figure — Option 48	Description	Includes all the functionality of Option 41 and allows measurement of differential and common-mode noise properties with the cold source method. Three operating modes (uncorrelated, correlated, and combiner-based) are available for measurement efficiency and accuracy optimization. Full treatment of output port correlation is available for 3- and 4-port DUTs. Mixer noise figure measurements are supported. Various levels of vector correction are available, as is full fixture/probe embedding and de-embedding. Compatible with mm-wave measurements in the ME7838X family with the use of receiver-only modules (e.g., 3744A-Rx).
	Required Options	Option 51 or Option 61 or Option 62
	System Compatible Options	Option 2 Time Domain Option 7 Receiver Offset Option 21 Universal Fixture Extraction Option 31 Dual Source Architecture Option 32 Internal RF Combiner Option 35 IF Digitizer Option 36 Extended IF Digitizer Memory Option 42 PulseView™ Option 43 DifferentialView™ Option 44 IMDView™ Option 46 Fast CW Option 47 Eye Diagram Option 53 External ALC Option 70 70 kHz Low Frequency Extension Option 81 Broadband/Millimeter-Wave Option 83 Millimeter-Wave Extension Option 85 Broadband/Banded/Millimeter-Wave Extension Option 87 Broadband/Millimeter-Wave Option 89 Broadband/Banded/Millimeter-Wave Extension
	Incompatible Options	Option 41 Noise Figure Option 80 Broadband/Millimeter-Wave Option 82 Banded Millimeter-Wave Extension Option 84 Broadband/Banded/Millimeter-Wave Extension Option 86 Broadband/Millimeter-Wave Option 88 Broadband/Banded/Millimeter-Wave Extension
	Multiport System	MN469xC Series Multiport System on any model VNA; Differential Noise Figure measurements can be performed when the system is configured as a 2-Port VNA or a 4-Port VNA.
	Additional Information	For detailed Differential Noise Figure measurement theory, description, and operational information, see the VectorStar MS4640B Series VNA Calibration and Measurement Guide, 10410-00318.
Direct Access Loops — Option 51	Access Loops Per Port	Adds three (3) Access loops per port for Source, Test, and Receive Paths. Note: Direct access loops are not available for VNAs equipped with Option 61 or 62, which include access loops.
	Front Panel Loops	≥2.5 GHz Frequency Coverage loops, located at front panel.
	Rear Panel Loops	<2.5 GHz Frequency Coverage loops, located at rear panel.
External ALC — Option 53	External ALC access allows leveling of source power at an external point (e.g., after a preamplifier). The connector is also installed with Option 8x for use with the modular broadband and mm-wave functions (when in a 3739 mode, the broadband/mm-wave functionality takes precedence).	
	Required Options	Option 61 or 62
	System Compatible Options	All
	Incompatible Options	None
Active Measurements Suite — Options 61/62	Adds Step Attenuators, Bias Tees, Direct Access Loops, and Gain Compression and Efficiency Measurement Capabilities.	
	MS4642B Attenuators	70 dB, 10 dB/step
	MS4644B Attenuators	70 dB, 10 dB/step
	MS4647B Attenuators	60 dB, 10 dB/step
	Option 61	Two (2) attenuators: One in Source 1 path, and one in Receive 2 path.
	Option 62	Four (4) attenuators: One in each Source path and in each Receive path.
	Bias Tees	0.5 A max., 40 VDC max. 3 kHz BW (nominal), looking into a High Impedance 10MΩ to Ground for DUT Static Discharge Protection located at rear panel.
	Access Loops	Includes Option 51 loops, listed above. (Option 51, 61, and 62 are mutually exclusive)
	Gain Compression	Swept Power Gain Compression at a CW frequency Px dB over Swept Frequency, up to 401 points.
70 kHz Low End Frequency Extension — Option 70	Extends the VNA standard 10 MHz low-end start frequency to 70 kHz, providing 70 kHz to 20, 40, or 70 GHz coverage models. The low-end is allowed to extend to 40 kHz.	
Broadband/Banded/ Millimeter-Wave Systems	For details on the MS464xB-08x series of options, see the: VectorStar ME7838A Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00593 (For 70 kHz to 125 GHz) VectorStar ME7838D Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00778 (For 70 kHz to 145 GHz) VectorStar ME7838E Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00767 (For 70 kHz to 110 GHz) VectorStar ME7838G Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-01060 (For 70 kHz to 220 GHz) VectorStar ME7838A4 4-Port Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00704 (For 70 kHz to 125 GHz) VectorStar ME7838D4 4-Port Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-01099 (For 70 kHz to 145 GHz) VectorStar ME7838E4 4-Port Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-01100 (For 70 kHz to 110 GHz)	

CPU, OS, Memory, and Security Features

CPU	Intel Core™ i5	
O/S	The Microsoft® Windows® 7 operating system on the MS4640B Series VNA is configured for optimum performance when the instrument leaves the factory.	
Display	26.4 cm (10.4") Color XGA Touch-Screen Display	
Storage	Serial-ATA (SATA) Solid State Drive (SSD), for OS, Programs, and Data. (>30 GB)	
Security Features	Display Blanking	For security, VectorStar™ software can obscure frequency and power levels on the system display for security.
	Removable Internal Drive	Rear Panel accessible Solid State Drive (SSD) is quickly removable and easy to secure.
	Option 4 Spare SSD	A bootable SSD module is available as a spare for VectorStar units used in multiple or compartmentalized locations. The VectorStar's operating system and software are preinstalled on each Option 4 SSD.
	Virus Protection, Best Practices	If the VNA is attached to a network, best practices recommend installing anti-virus software.

Front Panel Connections

Test Ports 1 and 2	Type	Universal Test Port Connectors, easily exchangeable in case of damage.
	MS4642B and MS4644B	K (m)
	MS4647B	V (m)
	Damage Input Levels	+27 dBm maximum, 40 VDC maximum
Direct Access Loops (optional)	Type	For Source, Test and Receive paths, 3 per port, for ≥2.5 GHz frequency coverage.
	MS4642B and MS4644B	K (f)
	MS4647B	V (f)
	Damage Input Levels	+20 dBm maximum, 0 VDC maximum (+27 dBm maximum on source loop ports)
USB Ports	Four type A USB 2.0 Ports (two each on the front and rear panel) for peripherals such as keyboard, mouse, memory stick, hardware key, and similar devices.	
Chassis Grounding Port	Banana (f)	
Ports to Millimeter-Wave Test Set (optional)	Connector Type	K (f) (LO1, and LO2 for RF; One with single source; Two with Option 31 Dual Source)

Rear Panel Connections

AC Power Input	AC Input connector, with On/Off switch, and fuses 350 VA maximum, 90 VAC to 264 VAC, 47 Hz to 63 Hz (power factor controlled)	
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.
	LAN Port	10/100BASE-T 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 × 768 minimum resolution.	
Bias Inputs	Optional	Requires Active Measurement Suite, Option 61 or 62
	Bias Inputs	BNC (f), one per port
	Bias Fuses	0.5 A, 250 V, one per port
Direct Access Loops	Required Options	Options 51, 61, or 62
	Connector Type	SMA (f)
	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 (+27 dBm maximum on source loop ports)
IF Inputs/Outputs	a_1, a_2, b_1, b_2, IF Inputs/Outputs	
	Connector Type	SMA (f)
	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 MHz to 200 MHz (mode dependent), 0 dBm for full scale
	Nominal Outputs	0.2 MHz to 200 MHz (mode dependent), +10 dBm maximum
10 MHz In	Signal presence is auto-sensing (better than 1000 ppm frequency accuracy is recommended).	
	Connector Type	BNC (f)
	Signal	–10 to +3 dBm, 50Ω (nom.)

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10 MHz Out	Derived from the internal reference, unless an external 10 MHz reference input is applied.	
	Connector Type	BNC (f)
	Signal	0 ±5 dBm sinusoidal, 50Ω (nom.)
Analog In 1 and 2	Two independent inputs for measurements simultaneous with the RF measurements, for current sensing, efficiency computation, power detection, and similar parameters.	
	Connector Type	BNC (f)
	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	60kΩ
Ext In ALC 1 and ALC 2	For external automatic level control of the internal signal source generators. The input assumes 0 V represents no RF power and a larger negative value represents increasing RF power. The maximum range is 0 to –1.3 V.	
	Optional	ALC 1 is available with Options 80/81, 82/83, 86/87. ALC 1 and ALC 2 are both available with Options 31 and 84/85, 88/89.
	Connector Type	BNC (f)
Ext Analog Out	For external attenuator control, external switch control, analog triggering assistance, measurement system integration, and other purposes.	
	Connector Type	BNC (f)
	Normal Operating Modes	Sawtooth synch sweep, TTL indication of driving port, open loop level controller
	Range	–10 V to +10 V; low impedance drive
	Accuracy	20 mV + 2% (Load: >5kΩ)
Ext Trigger	Connector Type	BNC (f)
	Voltage Input	0 to 3.3 V input (5 V tolerant) Low threshold = 0.8 V High threshold = 2 V
	Impedance	High impedance (>100kΩ)
	Pulse Width	100 ns minimum input pulse width
	Edge Trigger	Programmable edge trigger
Lock Status	Connector Type	BNC (f)
	Voltage Input	0 to 3.3 V input (5 V tolerant) Low threshold = 0.8 V High threshold = 2 V
	Impedance	High impedance (>100kΩ)
	Pulse Width	100 ns minimum input pulse width
	Edge Trigger	Positive-edge trigger
Ready for Trigger	Connector Type	BNC (f)
	Voltage Input	0 to 3.3 V latched output
	Impedance	Low impedance (approximately 50Ω)
	Voltage	$V_{(output\ high)}$ = 2 V min @ –12 mA $V_{(output\ low)}$ = 0.8 V max @ +12 mA
Trigger Out	Connector Type	BNC (f)
	Voltage Output	0 to 3.3 V pulse output 1 µs positive pulse
	Voltage	$V_{(output\ high)}$ = 2 V min @ –12 mA $V_{(output\ low)}$ = 0.8 V max @ +12 mA
	Impedance	Low impedance (approximately 50Ω)
Pulse Generator Outputs	All values listed are nominal.	
	Optional	Requires Options 35 and 42 PulseView™
	Connector Type	SMA (f)
	Pulse Generator Outputs	P GEN 1, P GEN 2, P GEN 3, and P GEN 4
	Voltage	High: 3.3 V ±10% Low: <1 V
	Drive Impedance	Low impedance (approximately 50Ω)
	Load Impedance	50Ω or higher impedance
Pulse Synch Input	All values listed are nominal.	
	Optional	Requires Options 35 and 42 PulseView™
	Connector Type	SMA (f)
	Voltage Input	High threshold: 2.2 V Low threshold: 1 V
	Signal	5.5 VDC damage level
	Latency	55 ns delay from received synch to T0 (typ.)
	Impedance	High impedance input
Pulse Synch Output	All values listed are nominal.	
	Optional	Requires Options 35 and 42 PulseView™
	Connector Type	SMA (f)
	Voltage Output	High: 3.3 V ±10% Low: <1 V
	Signal	5.5 VDC damage level
	Latency	<5 ns delay from T0 to providing an external synch (typ.)
	Drive Impedance	Low impedance (approximately 50Ω)
	Load Impedance	50Ω or higher impedance

Mechanical and Environmental

Dimensions	Dimensions listed are for the instrument without rack mount option (MS4640B-001) attached.	
	Width	426 mm body 457 mm between feet outer edges 487 mm between front panel handle outer edges
	Height	267 mm body (6U) 286 mm between feet outer edges
	Depth	502 mm body 591 mm between handle and foot outer edges
Mass	<30 kg (<66 lb), Typical weight for a fully-loaded MS4647B VNA	
Environmental – Operating	Specification	Conforms to MIL-PRF-28800F (class 3)
	Temperature Range	0°C to +50°C without error codes Except for 'unleveled' error messages that may occur at the extreme edges of the temperature range.
	Relative Humidity	5 to 90% at +30°C, Non-condensing
	Altitude	4,600 m (15,000 ft)
Environmental – Non-Operating	Temperature Range	–40°C to +71°C
	Relative Humidity	0 to 95% at +30°C, Non-condensing
	Altitude	4,600 m (15,000 ft)
CE	EMC	2014/30/EU, EN61326-1, EN61000-4-2
	LVD	2014/35/EU, EN61010-1
	RoHS	2011/65/EU, (EU) 2015/863
RCM	Australia and New Zealand	RCM AS/NZS 4417:2012
KCC	South Korea	KCC-REM-A21-0004
Warranty	Instrument and Built-In Options	3 years from the date of shipment (standard warranty)
	Calibration Kits	Typically 1 year from the date of shipment
	Test Port Cables	Typically 1 year from the date of shipment
	Additional Warranty Options	Additional warranty available

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Instrument Models
MS4642B	Vector Network Analyzer 10 MHz to 20 GHz
MS4644B	Vector Network Analyzer 10 MHz to 40 GHz
MS4647B	Vector Network Analyzer 10 MHz to 70 GHz
	Included Accessories Each VNA comes with a set of included accessories: Online Help – The instrument is equipped with context-sensitive help built from the VectorStar Operation Manual, User Interface Reference Manual, Programming Manual, Programming Manual Supplement, and Calibration and Measurement Guide. Peripherals – Optical USB Mouse Power – Power Cord
	Main VNA Options
MS4640B-001	Rack Mount, adds handles and removes feet for shelf-mounting into a 19" universal rack
MS4640B-002	Time Domain
MS4640B-004	Additional Serial-ATA (SATA) Solid State Drive (SSD) with OS and VectorStar Application Software
MS4640B-007	Receiver Offset
MS4640B-021	Universal Fixture Extraction
MS464xB-031	Dual Source Architecture
MS464xB-032	Internal RF Combiner, requires Option 31
MS4640B-035	IF Digitizer
MS464xB-036	Extended IF Digitizer Memory
MS4640B-041	Noise Figure, requires Option 51, 61, or 62
MS4640B-042	PulseView™, requires Option 35
MS4640B-043	DifferentialView™
MS4640B-044	IMDView™
MS4640B-046	Fast CW software, requires Option 35
MS4640B-047	Eye Diagram requires Option 2
MS4640B-048	Differential Noise Figure, requires Option 51 or Option 61 or Option 62
MS464xB-051	Direct Access Loops, see description below
MS464xB-053	External ALC
MS464xB-061/062	Active Measurement Suite options, see description below
MS4640B-070	70 kHz Low-End Frequency Extension

Model/Order No.	Name
	Direct Access Loop Options Note: Direct access loops are not available for VNAs equipped with Options 61 or 62, which include loops.
MS4644B-051	Direct Access Loops for MS4644B, not available with Options 61 or 62
MS4647B-051	Direct Access Loops for MS4647B, not available with Options 61 or 62
	Active Measurement Suite Options
MS4642B-061	Active Device Measurements, For MS4642B, with 2 Step Attenuators
MS4642B-062	Active Device Measurements, For MS4642B, with 4 Step Attenuators
MS4644B-061	Active Measurements Suite, For MS4644B, with 2 Step Attenuators
MS4644B-062	Active Measurements Suite, For MS4644B, with 4 Step Attenuators
MS4647B-061	Active Measurements Suite, For MS4647B, with 2 Step Attenuators
MS4647B-062	Active Measurements Suite, For MS4647B, with 4 Step Attenuators
	Pulse Modulator Test Set Note: Pulse Modulator Test Set options require the VNA to be equipped with Options 35, 42, and Option 51, 61, or 62)
SM6628	Pulse Modulator Test Set, 70 kHz to 40 GHz, for source modulation with an MS4642B or MS4644B
SM6629	Pulse Modulator Test Set, 70 kHz to 40 GHz, for source and receiver modulation with an MS4642B or MS4644B
SM6630	Pulse Modulator Test Set, 70 kHz to 70 GHz, for source modulation with an MS4647B
SM6631	Pulse Modulator Test Set, 70 kHz to 70 GHz, for source and receiver modulation with an MS4647B

Continued on next page

Model/Order No.	Name
	Multiport VNA Options The multiport VNA option provides four test ports for all VectorStar MS4640B Series VNAs with the MN4690C 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.
MN4694C	70 kHz to 40 GHz, Use the MN4694C Test Set with MS4642B and MS4644B VNAs
MN4697C	70 kHz to 70 GHz, Use the MN4697C Test Set with MS4647B VNA
Documentation	For detailed MN469xC specifications, refer to the VectorStar MN469xC Series Multiport VNA Technical Data Sheet – 11410-00777
	Broadband/Banded/Millimeter-Wave Systems For details on the MS464xB-08x series of options, see the: VectorStar ME7838A Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00593 (For 70 kHz to 125 GHz) VectorStar ME7838D Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00778 (For 70 kHz to 145 GHz) VectorStar ME7838E Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00767 (For 70 kHz to 110 GHz) VectorStar ME7838G Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-01060 (For 70 kHz to 220 GHz) VectorStar ME7838A4 4-Port Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-00704 (For 70 kHz to 125 GHz) VectorStar ME7838D4 4-Port Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-01099 (For 70 kHz to 145 GHz) VectorStar ME7838E4 4-Port Modular Broadband/Millimeter-Wave Technical Data Sheet – 11410-01100 (For 70 kHz to 110 GHz)
	Calibration Options
MS4640B-097	Accredited Calibration, With Data
MS4640B-098	Z540/Guide 25 Calibration, No Data
MS4640B-099	Premium Calibration, With Data
	Precision Automatic Calibrator Modules (Precision AutoCal)
36585K-2M	K Precision AutoCal Module, 70 kHz to 40 GHz, K (m) to K (m)
36585K-2F	K Precision AutoCal Module, 70 kHz to 40 GHz, K (f) to K (f)
36585K-2MF	K Precision AutoCal Module, 70 kHz to 40 GHz, K (m) to K (f)
36585V-2M	V Precision AutoCal Module, 70 kHz to 70 GHz, V (m) to V (m)
36585V-2F	V Precision AutoCal Module, 70 kHz to 70 GHz, V (f) to V (f)
36585V-2MF	V Precision AutoCal Module, 70 kHz to 70 GHz, V (m) to V (f)
	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-2	K Calibration Kit, Without additional options
3652A-3	K Calibration Kit, With Pin Depth Gauge and .s1p Characterization Files
3652A-4	K Calibration Kit, With .s1p Characterization Files
3654D	V Calibration Kit, Without Sliding Loads
3654D-2	V Calibration Kit Without additional options
3654D-3	V Calibration Kit, With Pin Depth Gauge and .s1p Characterization Files
3654D-4	V Calibration Kit, With .s1p Characterization Files
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 (f) to K (m), 1 each, 30.5 cm (12 in)
3670K50-2	Test Port Cable, K (f) to K (m), 1 each, 61.0 cm (24 in)
3670V50A-1	Test Port Cable, V (f) to V (m), 1 each, 30.5 cm (12 in), rated to 70 GHz
3670V50A-2	Test Port Cable, V (f) to V (m), 1 each, 61.0 cm (24 in), rated to 70 GHz

Model/Order No.	Name
	Test Port Cables, Flexible, Ruggedized-Style Female Connectors, Phase Stable Ruggedized style female connectors for VNA test ports.
3671KFS50-60	K (f) to 3.5 mm (m), 1 each 63.5 cm (25 in)*
3671KFK50-60	K (f) to K (m), 1 each, 63.5 cm (25 in)*
3671KFK50-100	K (f) to K (m), 1 each, 96.5 cm (38 in)
3671KFKF50-60	K (f) to K (m), 1 each, 63.5 cm (25 in)
3671KFK50-60	K (f) to K m), 1 each 63.5 cm (25 in)*
3671VFV50-60	V (f) to V (m), 1 each, 63.5 cm (25 in), rated to 70 GHz*
3671VFV50-100	V (f) to V (m), 1 each 96.5 cm (38 in), rated to 70 GHz
	Test Port Converters To change or replace VNA test ports.
34YK50C	Universal Test Port Connector to K (m), Installation requires wrench 01-202 (not included)
34YV50C	Universal Test Port Connector to V (m), Installation requires wrench 01-202 (not included)
34YS50A	Universal Test Port Connector to 3.5 mm (m), Installation requires wrench 01-202 (not included)
34YQ50A	Universal Test Port Connector to 2.4 mm (m), 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 MS4640B Series VNAs, Hard plastic with wheels, 85 × 70 × 45 cm
	Tools
01-201	Torque End Wrench, 5/16 in, 0.9 N·m (8 lbf·in), For tightening male devices, For SMA, 3.5 mm, 2.4 mm, K, and V connectors.
01-202	Torque End Wrench, 1/2 in, 60 lbf ·in, For servicing the universal test port, For the removal or installation of a test port.
01-203	Torque End Wrench, 20.6 mm (13/16 in), 0.9 N·m (8 lbf·in), For tightening the VNA test ports to female devices.
01-204	End Wrench, 5/16 in, Universal, Circular, Open-ended, For SMA, 3.5 mm, 2.4 mm, K and V connectors.
01-504	Torque End Wrench, 6 mm, 0.45 N·m (4 lbf·in), For tightening 1 mm connectors.
01-505	6 mm × 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 at www.anritsu.com. Printed manuals in 3-ring binders are available for a nominal charge.
10410-00317	MS4640B Series VNA Operation Manual (OM)
10410-00318	MS4640B Series VNA Calibration and Measurement Guide (MG)
10410-00319	MS4640B Series VNA User Interface Reference Manual (UIRM)
10410-00320	MS4640B Series VNA Maintenance Manual (MM)
10410-00322	MS4640B Series VNA Programming Manual (PM), for IEEE 488.2, System, and SCPI Commands
10410-00323	MS4640B Series VNA Programming Manual Supplement (PMS), for Lightning 37xxxx and HP8510 Emulation
10410-00774	MN4775A E/O Converter Operations Manual
11410-01144	MN4775A E/O Converter Technical Data Sheet
10410-00777	ME7848A Opto-electronic Network Analyzer Quick Start Guide
10410-00778	ME7848A Opto-electronic Network Analyzer Maintenance Manual
11410-01145	ME7848A Opto-electronic Network Analyzer Technical Data Sheet

*: Due to length, two (2) cables are required for each system

ShockLine™ Family

MS46121B, MS46122B, MS46131A, MS46322B, MS46522B, MS46524B, ME7868A

Frequency coverage from 50 kHz to 43.5 GHz, with banded E-band 55 GHz to 92 GHz (ME7868A: 1 MHz to 43.5 GHz)

Bringing Simplicity and Value to High-Performance RF and Microwave VNA Measurements

SHOCKLINE™

The ShockLine family of vector network analyzers (VNAs) achieve a new level of capability, flexibility, and value for RF and microwave network analysis applications. ShockLine VNAs deliver excellent performance for measurements from 50 kHz up to 43.5 GHz and banded E-band measurements from 55 GHz to 92 GHz. These instruments are ideal for testing passive and many active components with general purpose VNA requirements.
The ShockLine family employs advanced Anritsu technology and design expertise to attain outstanding dynamic range, calibration and measurement stability, and speed performance in efficiently packaged, compact, and robust VNA instruments.
ShockLine VNAs provide S-parameter, time domain, and signal integrity measurement capabilities in 1-, 2-, and 4-port configurations.

Instrument Models and Operating Frequencies

- MS46121B, 1-Port USB VNA,
  40 MHz to 4 GHz, 150 kHz to 6 GHz N (m) connector
- MS46122B, 2-Port USB VNA,
  1 MHz to 8/20/43.5 GHz N (f) and K (m) connectors
- MS46131A, 1-Port USB VNA,
  1 MHz to 43.5 GHz
- MS46322B, 2-Port Economy VNA,
  1 MHz to 8/20/43.5 GHz N (f) and K (m) connectors
- MS46522B, 2-Port Performance VNA,
  50 kHz to 8.5/20/43.5 GHz N (f), K (m) connectors,
  E-band WR12 waveguide
- MS46524B, 4-Port Performance VNA,
  50 kHz to 8.5/20/43.5 GHz N (f) and K (m) connectors
- ME7868A, 2-Port USB VNA,
  1 MHz to 43.5 GHz

Definitions

All specifications and characteristics apply under the following conditions, unless otherwise stated:

Warm-Up Time	After 30 minutes of warm-up time, where the instrument is left in the ON state.
Temperature Range	Specifications apply over the 25°C±5°C temperature range.
Error-Corrected Specifications	Specifications are valid over 23°C±3°C, with <1°C variation from calibration temperature.
Frequency Bands in Tables	When a frequency is listed in two rows of the same table, the specification for the common frequency is taken from the lower frequency band.
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.
Interpolation Mode	All specifications are with Interpolation Mode Off.
Standard	Refers to instruments without Options.
Typical Performance	Typical performance indicates the measured performance of an average unit. It does not include guard-bands and is not covered by the product warranty.
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.
Recommended Calibration Cycle	12 months (Residual specifications also require calibration kit calibration cycle adherence.)
Specifications Subject to Change	All specifications are typical unless otherwise noted and are subject to change without notice.

High Level Noise

Measured at 100 Hz IF bandwidth and at default power level, RMS. Performance is characteristic.

Product	Frequency Range	Magnitude (dB)	Phase Noise (deg RMS)
MS46121B	150 kHz to 6 GHz	0.02	0.2
MS46122B MS46322B	1 MHz to <20 MHz 20 MHz to 20 GHz >20 GHz to 40 GHz >40 GHz to 43.5 GHz	0.03 (0.005, typ.) 0.006 (0.001, typ.) 0.006 (0.001, typ.) 0.009 (0.001, typ.)	<0.2 (<0.035 typ.) <0.1 (<0.05 typ.) <0.15 (<0.05 typ.) <0.18 (<0.05 typ.)
MS46522B MS46524B	50 kHz to 300 kHz >300 kHz to 1 GHz >1 GHz to 25 GHz >25 GHz to 43.5 GHz	0.02 (0.01, typ.) 0.004 (0.003, typ.) 0.004 (0.002, typ.) 0.004 (0.002, typ.)	0.15 (0.08, typ.) 0.04 (0.02, typ.) 0.05 (0.02, typ.) 0.05 (0.04, typ.)

	Magnitude (dB)			Phase (deg)		
	MS46131A-010	MS46131A-020/043	ME7868A	MS46131A-010	MS46131A-020/043	ME7868A
1 MHz to 4 GHz			0.007 (0.0015 typ.)			0.21 (0.02 typ.)
1 MHz to 6 GHz		0.009 (0.003 typ.)			0.12 (0.03 typ.)	
1 MHz to 8 GHz	0.009 (0.003 typ.)			0.12 (0.03 typ.)		
>4 GHz to 8 GHz			0.011 (0.003 typ.)			0.41 (0.08 typ.)
>6 GHz to 8 GHz		0.022 (0.01 typ.)			0.15 (0.08 typ.)	
>8 GHz to 20 GHz			0.006 (0.0015 typ.)			0.41 (0.08 typ.)
>8 GHz to 40 GHz		0.006 (0.001 typ.)			0.1 (0.02 typ.)	
>20 GHz to 43.5 GHz			0.011 (0.0025 typ.)			0.56 (0.25 typ.)
>40 GHz to 43.5 GHz		0.009 (0.002 typ.)			0.12 (0.03 typ.)	

Measurement Stability

Ratio measurement, with ports shorted. Typical.

Product		Frequency Range	Magnitude (dB/°C)	Phase (deg./°C)
MS46121B		150 kHz to 1 MHz >1 MHz to 4 GHz >4 GHz to 6 GHz	0.1 0.01 0.05	0.1 0.1 0.2
MS46122B MS46322B		10 MHz to 43.5 GHz	0.02	0.3
MS46522B MS46524B		50 kHz to 8.5 GHz >8.5 GHz to 40 GHz >40 GHz to 43.5 GHz	0.02 0.01 0.02	0.5 1.0 1.5
MS46131A/ ME7868A	1-Port	1 MHz to 43.5 GHz	0.02	0.3
	2-Port	1 MHz to 8 GHz	0.015	0.3
		>8 GHz to 20 GHz	0.015	0.5
		>20 GHz to 43.5 GHz	0.02	0.8

Frequency Resolution, Accuracy and Stability

Product	Resolution	Accuracy	Stability	Aging
MS46121B	1 Hz*1	±0.5 ppm (at time of calibration)	±1.0 ppm from –10°C to +55°C	±1.0 ppm/year
MS46122B MS46322B	1 Hz	±1.0 ppm (at time of calibration)	±1.0 ppm from –10°C to +55°C (typ.)	±1.0 ppm/year (typ.)
MS46522B MS46524B	1 Hz	±0.1 ppm (at time of calibration)	±0.1 ppm/+10°C to +50°C	±0.02 ppm/24 hours ±0.2 ppm/1 month ±1.0 ppm/1 year ±2.0 ppm/3 years
MS46131A/ME7868A	1 Hz	+1.0 ppm (at time of calibration)	±1.0 ppm from –10°C to +55°C (typ.)	±1.0 ppm/year (typ.)

*1: Frequency resolution is 10 kHz when using an external reference.

Uncorrected (Raw) Port Characteristics

User and System Correction Off.

Product	Frequency Range	Directivity (dB)	Port Match (dB)
MS46121B	150 kHz to 6 GHz	10 dB*2	10 dB*3
MS46122B MS46322B	1 MHz to 43.5 GHz	>8 dB	>8 dB
MS46522B MS46524B	50 kHz to 1 GHz >1 GHz to 4 GHz >4 GHz to 8.5 GHz >8.5 GHz to 43.5 GHz	>21 >21 >15 >15	>17 >17 >15 >15
MS46131A/ME7868A	1 MHz to 6 GHz >6 GHz to 8 GHz >8 GHz to 43.5 GHz	>6 >5 >10	>6 >6 >10

*2: Raw directivity specification degrades by 2 dB above 4 GHz.
*3: Raw port match specification degrades by 5 dB above 4 GHz.

VNA System Performance

Error-Corrected Specifications

With 12-term SOLT calibration using TOSLN50A-XX or TOSLNF50A-XX N- or K-type connector manual calibration kits or the MN25208A SmartCal™ automatic calibration kit.

MS46121B Frequency Range	Directivity (dB)	Source Match (dB)	Reflection Tracking (dB)
150 kHz to 4 GHz	42	35	±0.1
>4 GHz to 6 GHz	42	35	±0.2

MS46122B and MS46322B Frequency Range	Directivity (dB)	Source Match (dB)	Load Match*4 (dB)	Reflection Tracking*4 (dB)	Transmission Tracking*4 (dB)
1 MHz to 6 GHz	≥42	≥33	≥42	±0.15	±0.06
>6 GHz to 8 GHz	≥37	≥33	≥37	±0.15	±0.06

MS46522B and MS46524B Frequency Range	Directivity (dB)	Source Match (dB)	Load Match*4 (dB)	Reflection Tracking*4 (dB)	Transmission Tracking*4 (dB)
50 kHz to 50 MHz	>40	>35	>38	±0.15	±0.09
>50 MHz to 6 GHz	>40	>35	>38	±0.08	±0.05
>6 GHz to 8 GHz	≥36	>35	≥34	±0.08	±0.05
>8 GHz to 8.5 GHz	>36	>35	>34	±0.10	±0.08

With calibration using TOSLK50A-XX or TOSLKF50A-XX N or K type connector calibration kits.

Frequency Range		Directivity (dB)	Source Match (dB)	Load Match*4 (dB)	Reflection Tracking*4 (dB)	Transmission Tracking*4 (dB)
MS46131A-010/ ME7868A	1 MHz to 6 GHz	≥42	≥33	≥41	±0.15	±0.06
	>6 GHz to 8 GHz	≥37	≥33	≥36	±0.15	±0.06
MS46131A-020	1 MHz to 10 GHz	≥42	≥33	>41	±0.15	±0.06
	>10 GHz to 20 GHz	≥36	≥26	>35	±0.15	±0.06
MS46131A-043	1 MHz to 10 GHz	≥42	≥33	>41	±0.15	±0.06
	>10 GHz to 20 GHz	≥36	≥26	>35	±0.15	±0.06
	>20 GHz to 30 GHz	≥32	≥22	>31	±0.15	±0.06
	>30 GHz to 40 GHz	≥30	≥20	>29	±0.15	±0.06
	>40 GHz to 43.5 GHz	≥28	≥20	>27	±0.2	±0.16

*4: Characteristic performance.

** there are many variations of the Error-Corrected Specification. We also have data with various SmartCals and Precision AutoCals. Please let me know if you would like other data.

Standard Capabilities

Operating Frequencies

Product	Operating Frequency
MS46121B-006	150 kHz to 6 GHz
MS46122B-010 MS46122B-020 MS46122B-043	1 MHz to 8 GHz 1 MHz to 20 GHz 1 MHz to 43.5 GHz
MS46322B-010 MS46322B-020 MS46322B-043	1 MHz to 8 GHz 1 MHz to 20 GHz 1 MHz to 43.5 GHz
MS46522B-010 MS46522B-020 MS46522B-043 MS46522B-082 MS46522B-083	50 kHz to 8.5 GHz 50 kHz to 20 GHz 50 kHz to 43.5 GHz 55 GHz to 92 GHz, one meter tethers 55 GHz to 92 GHz, five meter tethers
MS46524B-010 MS46524B-020 MS46524B-043	50 kHz to 8.5 GHz 50 kHz to 20 GHz 50 kHz to 43.5 GHz
MS46131A/ME7868A-010 MS46131A/ME7868A-020 MS46131A/ME7868A-043	1 MHz to 8 GHz 1 MHz to 20 GHz 1 MHz to 43.5 GHz

Sweeps

Frequency Sweep Types	Linear, Log, CW (MS46131A/ME7868A only) or Segmented

Display Graphs

Single Rectilinear Graph Types	Log Magnitude, Phase, Linear Magnitude, Real, Imaginary, SWR, Impedance and Group Delay (MS46131A/ME7868A only)
Dual Rectilinear Graph Types	Log Mag and Phase, Linear Mag and Phase, Real and Imaginary
Circular Graph Types	Smith Chart (Impedance), Polar

Measurements Data Points

Product	Measurement Data Points
MS46121B MS46522B MS46524B	Maximum Data Point 2 to 20,001 points
MS46122B MS46322B MS46131A/ME7686A	Maximum Data Point 2 to 16,001 points

Limit Lines

Limit Lines	Single or segmented. 2 limit lines per trace. 50 segments per trace.
Single Limit Readouts	Uses interpolation to determine the intersection frequency.
Test Limits	Both single and segmented limits can be used for PASS/FAIL testing.

Ripple Limit Lines

Limit Lines	Single or segmented. 2 limit lines per trace. 50 segments per trace.
Ripple Value	Absolute Value or Margin
Test Limits	Both single and segmented limits can be used for PASS/FAIL testing.

Averaging

Product	Averaging
MS46121B MS46522B MS46524B	Point-by-point (default), maximum number of averages = 4096 Sweep-by-sweep, maximum number of averages = 4096
MS46122B MS46322B MS46131A/ME7868A	Point-by-point (default), maximum number of averages = 200 Sweep-by-sweep, maximum number of averages = 4096

IF Bandwidth

MS46121B	10, 20, 30, 50, 70, 100, 200, 300, 500, 700 Hz 1, 2, 3, 5, 7, 10, 20, 30, 50, 100 kHz
MS46122B MS46322B MS46131A ME7868A	10, 20, 50, 70, 100, 200, 300, 500, 700 Hz 1, 2, 3, 5, 7, 10, 20, 30, 50, 70, 100, 200, 300 kHz
MS46522B MS46524B	10, 20, 30, 50, 70, 100, 200, 300, 500, 700 Hz 1, 2, 3, 5, 7, 10, 20, 30, 70, 100, 200, 300, 500 kHz

Scale Resolution

	Minimum per division, varies with graph type.
Log Magnitude	0.001 dB
Linear Magnitude	10 µU
Phase	0.01°
Time	0.0001 ps
Distance	0.1 µm
SWR	10 µU
Power	0.01 dB

Markers

Markers	12 markers + 1 reference marker
Marker Coupling	Coupled or decoupled
Marker Overlay	Display markers on active trace only or on all traces when multiple trace responses are present on the same trace.
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. Multiple marker search ranges per trace are available.

Other

Filter Parameters	Display bandwidth (user-selectable loss value), corner and center frequencies, loss, Q and shape factors.
S-Parameter Conversion	Z Reflection Impedance Z Transmission Impedance Y Reflection Admittance Y Transmission Admittance 1/S

Calibration and Correction Capabilities

Calibration Methods

Product	Calibration Methods
MS46121B	Open Short Load (OSL) Offset Short (SSL) Triple Offset Short (SSS) SmartCal™, AutoCal™
MS46122B MS46322B MS46131A/ME7868A	Short-Open-Load-Through (SOLT) Offset-Short-Offset-Short-Load-Through (SSLT) Triple-Offset-Short-Through (SSST) Short-Open-Load-Reciprocal (SOLR) Line-Reflect-Line (LRL) / Line-Reflect-Match (LRM) SmartCal™ AutoCal™ Thru Update available Secondary match correction available for improved low insertion loss measurements
MS46522B MS46524B	Short-Open-Load-Through (SOLT) Short-Open-Load-Reciprocal (SOLR) Offset-Short-Offset-Short-Load-Through (SSLT) Triple-Offset-Short-Through (SSST) Line-Reflect-Line (LRL) / Line-Reflect-Match (LRM) Source Calibration Receiver Calibration SmartCal™, AutoCal™ Thru Update available Secondary match correction available for improved low insertion loss measurements

Coefficients for Calibration Standards

Use the Anritsu calibration kit USB memory device to load kit coefficients and characterization files.
Enter coefficients into user-defined locations.
Use complex load models.

Interpolation

Allows interpolation between calibration frequency points.

Dispersion Compensation

Selectable as Coaxial, other non-dispersive (e.g., for coplanar waveguide), Waveguide, or Microstrip

Embedding/De-embedding

The MS46121B, MS46131A/ME7868A are 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 easier computation of de-embedding files based on additional calibration steps and measurements.

Regulatory Compliance

CE	EMC: 2014/30/EU, EN61326-1, EN61000-4-2 LVD: 2014/35/EU, EN61010-1 RoHS: (EU) 2015/863
Australia and New Zealand	RCM AS/NZS 4417:2012
South Korea	KCC-REM-A21-0004

Environmental

MS46121B MS46131A, ME7868A, MIL-PRF-28800F Class 2

Operating Temperature Range	–10°C to +55°C
Storage Temperature Range	–51°C to +71°C
Maximum Relative Humidity	95% RH at 30°C, non-condensing
Vibration, Sinusoidal	5 Hz to 55 Hz
Vibration, Random	10 Hz to 500 Hz
Half Sine Shock	30 gn
Altitude	4600 meters, operating and non-operating

MS46122B, MS46322B, MIL-PRF-28800F Class 3

Operating Temperature Range	0°C to +50°C
Storage Temperature Range	–40°C to +71°C
Maximum Relative Humidity	95% RH at 30°C, non-condensing
Altitude	4600 meters, operating and non-operating

MS46522B, MS46524B, MIL-PRF-28800F Class 3

Operating Temperature Range	0°C to +50°C
Storage Temperature Range	–40°C to +71°C
Maximum Relative Humidity	95% RH at +30°C, non-condensing
Vibration, Sinusoidal	5 Hz to 55 Hz
Vibration, Random	10 Hz to 500 Hz
Half Sine Shock	30 gn
Altitude	4600 meters, operating and non-operating

Warranty

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

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Instrument Models
MS46121B	ShockLine 1-Port USB VNA MS46121B-006, 150 kHz to 6 GHz, type N (m) port - Base Model Required Option (Select one frequency option only)
MS46122B	2-Port ShockLine Economy VNA – Base Model Select one Frequency Option Only. MS46122B-010, 1 MHz to 8 GHz, type N (f) ports – Required Option MS46122B-020, 1 MHz to 20 GHz, Ruggedized type K (m) ports (compatible with 3.5 mm and SMA connectors) MS46122B-043, 1 MHz to 43.5 GHz, Ruggedized type Extended-K™ (m) ports (compatible with standard K (2.92 mm), 3.5 mm, and SMA connectors)
MS46131A	1-Port Modular VNA MS46131A-010, 1 MHz to 8 GHz, type N (f) port MS46131A-020, 1 MHz to 20 GHz, Ruggedized type K (m) port (compatible with 3.5 mm and SMA connectors) MS46131A-043, 1 MHz to 43.5 GHz, Ruggedized type Extended-K™ (m) port (compatible with standard K (2.92 mm), 3.5 mm, and SMA connectors)
MS46322B	2-Port ShockLine™ Economy VNA (base model) Requires One Frequency Option. MS46322B-010 1 MHz to 8 GHz, type N (f) ports MS46322B-020 1 MHz to 20 GHz, type Ruggedized K (m) ports (compatible with 3.5 mm and SMA connectors) MS46322B-043 1 MHz to 43.5 GHz, type Ruggedized Extended-K™ (m) ports (compatible with standard K (2.92 mm), 3.5 mm and SMA connectors)
MS46522B	ShockLine 2-Port Vector Network Analyzer (base model) Requires One Frequency Option. MS46522B-010 50 kHz to 8.5 GHz, type N (f) ports MS46522B-020 50 kHz to 20 GHz, type K (m) Ruggedized ports (compatible with 3.5 mm and SMA connectors) MS46522B-043 50 kHz to 43.5 GHz, type Extended-K™ (m) Ruggedized ports (compatible with standard K (2.92 mm), 3.5 mm, and SMA connectors) MS46522B-082 55 GHz to 92 GHz, WR12 waveguide flange, one meter tethers MS46522B-083 55 GHz to 92 GHz, WR12 waveguide flange, five meter tethers
MS46524B	ShockLine 4-Port Vector Network Analyzer (base model) Requires One Frequency Option. MS46524B-010 50 kHz to 8.5 GHz, type N (f) ports MS46524B-020 50 kHz to 20 GHz, type K (m) Ruggedized ports (compatible with 3.5 mm and SMA connectors) MS46524B-043 50 kHz to 43.5 GHz, type Extended-K™ (m) Ruggedized ports (compatible with standard K (2.92 mm), 3.5 mm, and SMA connectors)
ME7868A	
2 meter	ME7868A-010-2: 2-port Modular ME7868A Vector Network Analyzer, 1 MHz to 8 GHz ME7868A-020-2: 2-port Modular ME7868A Vector Network Analyzer, 1 MHz to 20 GHz ME7868A-043-2: 2-port Modular ME7868A Vector Network Analyzer, 1 MHz to 43.5 GHz
5 meter	ME7868A-010-5: 2-port Modular ME7868A Vector Network Analyzer, 1 MHz to 8 GHz ME7868A-020-5: 2-port Modular ME7868A Vector Network Analyzer, 1 MHz to 20 GHz ME7868A-043-5: 2-port Modular ME7868A Vector Network Analyzer, 1 MHz to 43.5 GHz
25 meter*	ME7868A-010-25: 2-port Modular ME7868A Vector Network Analyzer, 1 MHz to 8 GHz ME7868A-020-25: 2-port Modular ME7868A Vector Network Analyzer, 1 MHz to 20 GHz ME7868A-043-25: 2-port Modular ME7868A Vector Network Analyzer, 1 MHz to 43.5 GHz
	Included Accessories
USB Cable	Getting Started with Anritsu Flier, provides access to all ShockLine web content and services.

*: All 25 meter configurations come with additional components to enable long distance usage. These items include two MN25131A multi-function extenders, USB monitor, keyboard, mouse, headset, and additional cabling to allow for communication and control from either side of the 25 meter setup.

Model/Order No.	Name
	Main/Calibration VNA Options
MS46121B-002	Low Pass Time Domain
MS46121B-021	Scalar Transmission Measurement
MS46122B-002	Time Domain with Time Gating
MS46122B-024	Universal Fixture Extraction
MS46122B-097	Accredited Calibration, with data
MS46122B-098	Standard Calibration, ISO 17025 compliant, without data
MS46122B-099	Premium Calibration, ISO 17025 compliant, with data
MS46131A-002	Time Domain with Time Gating
MS46131A-012	PhaseLync option
MS46131A-098	Standard Calibration, ISO 17025 compliant, without data
MS46131A-099	Premium Calibration, ISO 17025 compliant, with data
MS46322B-001	Rack Mount, adds handles and removes feet for shelf-mounting into a 19 inch universal rack
MS46322B-002	Time Domain with Time Gating
MS46322B-024	Universal Fixture Extraction
MS46522B-001	Rack Mount, adds handles and removes feet for shelf-mounting into a 19 inch universal rack
MS46522B-002	Time Domain with Time Gating
MS46522B-022	Advanced Time Domain
MS46522B-024	Universal Fixture Extraction
MS46522B-061	Bias Tee (Only available with Option 10)
MS46524B-001	Rack Mount, adds handles and removes feet for shelf-mounting into a 19 inch universal rack
MS46524B-002	Time Domain with Time Gating
MS46524B-022	Advanced Time Domain
MS46524B-024	Universal Fixture Extraction
MS46524B-061	Bias Tee (Only available with Option 10)
	Precision Automatic Calibrator Module
MN25208A	2-port USB SmartCal Module, 300 kHz to 8.5 GHz (available with connector Options -001 N (f), -002 K (f), -003 3.5 mm (f))
MN25408A	4-port USB SmartCal Module, 300 kHz to 8.5 GHz (available with connector Options -001 N (f), -002 K (f), -003 3.5 mm (f))
MN25218A*	2-port USB SmartCal Module, 300 kHz to 20 GHz (available with connector Option -002 K (f))
MN25418A	4-port USB SmartCal Module, 300 kHz to 20 GHz (available with connector Option -002 K (f))
36585K-2M	K Connector Precision AutoCal Module, 70 kHz to 40 GHz, K (m) to K (m)
36585K-2F	K Connector Precision AutoCal Module, 70 kHz to 40 GHz, K (f) to K (f)
36585K-2MF	K Connector Precision AutoCal Module, 70 kHz to 40 GHz, K (m) to K (f)
2000-1809-R	Serial to USB Adapter (required for use with 36585 AutoCal module if control PC does not have a serial port)

Continued on next page

Model/Order No.	Name
	RF Cables and Adapters
N120-6 RF	Cables, Semi-Rigid, N (m) to N (m), 1 each, 0.01 GHz to 18 GHz, 50Ω, 15 cm (5.9 in) (MS46322B, MS46522B, and MS46524B only)
NS120MF-6 RF	Cables, Semi-Rigid, N (f) to N (f), 1 each, 0.01 GHz to 18 GHz, 50Ω,15 cm (5.9 in) (MS46322B, MS46522B, and MS46524B only)
1091-26-R	Adapter, SMA (m) to N (m), DC to 18 GHz, 50Ω
1091-27-R	Adapter, SMA (f) to N (m), DC to 18 GHz, 50Ω
1091-80-R	Adapter, SMA (m) to N (f), DC to 18 GHz, 50Ω
1091-81-R	Adapter, SMA (f) to N (f), DC to 18 GHz, 50Ω
71693-R	Ruggedized adapter, K (f) to N (f), DC to 18 GHz, 50Ω
33KK50C	Calibration Grade Adapter, DC to 43.5 GHz, K (m) to K (m), 50Ω (MS46122B, MS46322B, MS46522B, and MS46524B only)
33KKF50C	Calibration Grade Adapter, DC to 43.5 GHz, K (m) to K (f), 50Ω (MS46122B, MS46322B, MS46522B, and MS46524B only)
33KFKF50C	Calibration Grade Adapter, DC to 43.5 GHz, K (f) to K (f), 50Ω (MS46122B, MS46322B, MS46522B, and MS46524B only)
34NK50	Precision Adapter, N (m) to K (m), DC to 18 GHz, 50Ω
34NKF50	Precision Adapter, N (m) to K (f), DC to 18 GHz, 50Ω
34NFK50	Precision Adapter, N (f) to K (m), DC to 18 GHz, 50Ω
34NFKF50	Precision Adapter, N (f) to K (f), DC to 18 GHz, 50Ω
34VFK50A	Precision Adapter, DC to 43.5 GHz, V (f) - K (m), 50Ω (MS46122B, MS46322B, MS46522B, and MS46524B only)
34VFKF50A	Precision Adapter, DC to 43.5 GHz, V (f) - K (f), 50Ω (MS46122B, MS46322B, MS46522B, and MS46524B only)
34VK50A	Precision Adapter, DC to 43.5 GHz, V (m) - K (m), 50Ω (MS46122B, MS46322B, MS46522B, and MS46524B only)
34VKF50A	Precision Adapter, DC to 43.5 GHz, V (m) - K (f), 50Ω (MS46122B, MS46322B, MS46522B, and MS46524B only)
K220B	Precision Adapter, K (m) to K (m), DC to 40 GHz, 50Ω
K222B	Precision Adapter, K (f) to K (f), DC to 40 GHz, 50Ω
K224B	Precision Adapter, K (m) to K (f), DC to 40 GHz, 50Ω
SC7260	WR12 to W1 (m) Adapter, W1 (1 mm) to WR12 Waveguide (MS46522B and MS46524B only)
SC7442	WR12 to W1 (f) Adapter, W1 (1 mm) to WR12 Waveguide (MS46522B and MS46524B only)
35WR12WF-EE	Precision Waveguide to Coax Adapter Kit, 56 GHz to 94 GHz, WR-12 to 1.0 mm (f) (MS46522B and MS46524B only)
	Test Port Cables, Flexible, Ruggedized, Phase Stable
15NNF50-1.0B	1.0 m (39"), DC to 18 GHz, Test Port Cable, Flexible, Phase Stable, N (f) to N (m), 50Ω
15NNF50-1.5B	1.5 m (59"), DC to 18 GHz, Test Port Cable, Flexible, Phase Stable, N (f) to N (m), 50Ω
15NN50-1.0B	1.0 m (39"), DC to 18 GHz, Test Port Cable, Flexible, Phase Stable, N (m) to N (m), 50Ω
15LL50-1.0A	1.0 m (39"), DC to 20 GHz, Test Port Cable, Armored, Phase Stable, 3.5 mm (m) to 3.5 mm (m), 50Ω
15LLF50-1.0A	1.0 m (39"), DC to 20 GHz, Test Port Cable, Armored, Phase Stable, 3.5 mm (m) to 3.5 mm (f), 50Ω
15KK50-1.0A	1.0 m (39"), DC to 20 GHz, Test Port Cable, Armored, Phase Stable, K (m) to K (m), 50Ω
15KKF50-1.0A	1.0 m (39"), DC to 20 GHz, Test Port Cable, Armored, Phase Stable, K (m) to K (f), 50Ω
	Tools
01-200	Calibrated Torque End Wrench, GPC-7 and Type N
01-201	Torque End Wrench, 5/16 in, 0.9 N·m (8 lbf·in) For tightening male devices, for SMA, 3.5 mm, 2.4 mm, K and V connectors
01-203	Torque End Wrench, 13/16 in, 0.9 N.m (8 lbf.in) For tightening ruggedized SMA, 2.4 mm, K and V connectors (MS46121B, MS46122B and MS46322B only)
01-204	End Wrench, 5/16 in, Universal, Circular, Open-ended, For SMA, 3.5 mm, 2.4 mm, K and V connectors
More Information	Refer to our Precision RF & Microwave Components Catalog for descriptions of adapters and other components.

Model/Order No.	Name
	Documentation
User Documentation	Soft copies of the manuals as Adobe Acrobat PDF files are available for download from the instrument model web page at www.anritsu.com. For more information and product support, please contact ShockLineVNA.support@Anritsu.com.
10100-00067	Product information, compliance, and safety
10410-00344	MS46121A/B Series VNA User Guide (MS46121B only)
10410-00337	MS46121A/B, MS46122A/B, and MS46322A/B Series VNA User Interface Reference Manual
10410-00340	MS46122A/B Series VNA Operation Manual (MS46122B only)
10410-00335	MS46322A/B Series VNA Operation Manual (MS46322B only)
10410-00336	MS46322A/B Series VNA Calibration and Measurement Guide (MS46322B only)
10410-00743	MS46522B/524B VNA Operation Manual (MS46522B and MS46524B only)
10410-00744	MS46522B/524B VNA User Interface Reference Manual (MS46522B and MS46524B only)
10410-00746	ShockLine Series VNA Programming Manual, for IEEE 488.2 and SCPI Commands (MS46122B, MS46322B, MS46522B, and MS46524B only)
10410-00753	MS46522B/524B VNA Calibration and Measurement Guide (MS46522B and MS46524B only)
10410-00780	MS46131A Series VNA Operation Manual
10410-00782	ME7868A Quick Start Guide

VNA Master

MS2036C/MS2037C/MS2038C

5 kHz to 6 GHz 5 kHz to 15 GHz 5 kHz to 20 GHz
9 kHz to 9 GHz 9 kHz to 15 GHz 9 kHz to 20 GHz

Remote Control
Ethernet | USB

The Ultimate Handheld Vector Network + Spectrum Analyzer for Cable, Antenna and Signal Analysis Anytime, Anywhere

High Performance Handheld S-Parameters

Anritsu introduces the VNA Master + Spectrum Analyzer MS203xC, the industry's broadest frequency handheld solution to address cable, antenna, component, and signal analysis needs in the field: with frequency coverage from 5 kHz up to 20 GHz. Equally impressive, this broadband measurement tool offers the industry's first 12-term error correction algorithm in a truly handheld, battery-operated, rugged multi-function instrument. Optional Time Domain with Low Pass Step response and Real Impedance graph delivers standard TDR-type display results. Time Domain also includes a standard gating function.
The VNA Master MS203xC models include a powerful spectrum analyzer that enhances user convenience by combining spectrum analysis with the VNA into a single measurement powerhouse for the harsh RF and physical environments of field test. Whether it is for spectrum monitoring, broadcast proofing, interference analysis, RF and microwave measurements, regulatory compliance, or 3G/4G and wireless data network measurements, this VNA/Spectrum Analyzer combination is the ideal instrument for making fast and reliable measurements in the field.

Performance and Functional Highlights

VNA Master

- Broadband coverage of 5 kHz up to 20 GHz
- True 2-port, 2-path Vector Network Analyzer
- Ultimate accuracy with 12-term error correction
- High performance handheld S-parameters
- User-defined Quad Display for viewing all 4 S-Parameters
- Arbitrary data points up to 4001
- IF Bandwidth selections of 10 Hz to 100 kHz
- Directivity:
  >42 dB up to 6 GHz (all models)
  >36 dB > 6 GHz up to 20 GHz (all models)
- Supports Reciprocal Through Calibration types (SOLR, SSLR, SSSR)
- All models support waveguide measurements
- 350 µs/data point sweep speed
- USB/Ethernet for PC data transfer and control
- Automate repetitive tasks via Ethernet & USB
- PIM Hunting
- Field upgradable firmware
- Operation to +55°C: full performance on AC or battery
- Store more than 4000 traces and setups in memory
- Portable: 4.5 kg/4.8 kg (9.9 lb/10.5 lb)
- Time Domain (with gating) option
- Internal Bias Tee option
- Vector Voltmeter option
- High Accuracy Power Meter option
- Differential option (S_{d1d1}, S_{c1c1}, S_{d1c1} and S_{c1d1})
- Secure Data Operation option for safe use in high security environments
- GPS Receiver option
- Low Pass Stepped Response and Real Impedance graph type provide TDR functionality (standard capability with Time Domain option)
- Multiple display formats including Polar and Real Impedance
- Supports Anritsu USB Power Sensors
- 8.4 in, 800 × 600 high resolution, daylight-viewable TFT color display
- Complies with MIL-PRF-28800F Class 2, Certified for use in Explosive Atmosphere per MIL-PRF-28800F and MIL-STD-810G

Spectrum Analyzer Performance and Functional Highlights

- Measure: Occupied Bandwidth, Channel Power, ACPR, C/I
- Dynamic Range: >106 dB in 1 Hz RBW
- DANL: –164 dBm in 1 Hz RBW
- Phase Noise: –106 dBc/Hz @ 10 kHz offset at 1 GHz
- GPS-Enhanced Frequency Accuracy: <±25 ppb with GPS On and locked. GPS-Enhanced Frequency Accuracy is retained after GPS unlock at <50 ppb for 72 hours, 0°C to 50°C
- 1 Hz to 10 MHz Resolution Bandwidth (RBW)
- Traces: Normal, Max Hold, Min Hold, Average, # of Averages
- Detectors: Peak, Negative, Sample, Quasi-peak, and true RMS
- Markers: 6, each with a Delta Marker, or 1 Reference with 6 Deltas
- Limit Lines: up to 40 segments with one-button envelope creation
- Trace Save-on-Event: crossing limit line or sweep complete
- Option to automatically optimize sweep-RBW-VBW trade-off for best possible display
- Interference Analyzer Option: Spectrogram, Signal Strength, RSSI
- Standard Burst Detect: 1000X faster sweep with spans up to 15 MHz. Captures intermittent signals as narrow as 200 µs every time
- GPS tagging of stored traces
- Internal Preamplifier standard
- High Accuracy Power Meter Option
- AM/FM/SSB Demodulation (audio only)
- Optional AM/FM/PM Analyzer
- Optional Coverage Mapping
- Optional Channel Scanner

VNA Master Functional Specifications

Definitions

- All specifications and characteristics apply to Revision 2 instruments under the following conditions, unless otherwise stated:
- Warm-up time — After 15 minutes of warm-up time in VNA mode, where the instrument is left in the ON state.
- Temperature range is 23°C±5°C.
- Reference Signal — When using internal reference signal.
- Spectrum Analyzer — After 5 minutes of warm-up time, where the instrument is left in the ON state and Sweep Mode set to Performance.
- Typical Performance — Typical specifications that are not in parenthesis are not tested and not warranted. They are generally representative of characteristic performance. Typical specifications in parenthesis ( ) represent the mean value of measured units and do not include any guard-bands or uncertainties. They are not warranted.
- Uncertainty — A coverage factor of x1 is applied to the "VNA" or "corrected system" measurement uncertainties to facilitate comparison with other industry handheld analyzers.
- Calibration Cycle — Calibration is within the recommended 12 month period (residual specifications also require calibration kit calibration cycle adherence.)

All specifications subject to change without notice.
For the most current data sheet, please visit the Anritsu website:
www.anritsu.com

Frequency

Frequency Range	MS2036C	MS2037C	MS2038C
	5 kHz to 6 GHz	5 kHz to 15 GHz	5 kHz to 20 GHz
Frequency Accuracy	±1.5 ppm		
Frequency Resolution	1 Hz to 375 MHz, 10 Hz to 6 GHz, and 100 Hz to 20 GHz		

Test Port Power (All values are Typical)

VNA Master supports selection of either High (default) or Low test port power. Changing power after calibration can degrade the calibrated performance. Typical power by bands is shown in the following table.

Frequency Range	High Port Power	Low Port Power
5 kHz to 3 GHz	+3 dBm	–25 dBm
>3 GHz to 6 GHz	–3 dBm	–25 dBm
>6 GHz to 20 GHz	–3 dBm	–15 dBm

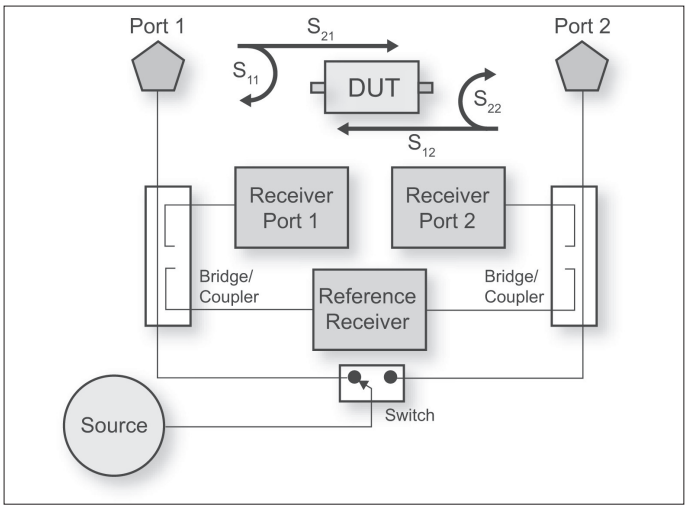
Transmission Dynamic Range

The transmission dynamic range (the difference between test port power and noise floor) using 10 Hz IF Bandwidth and High Port Power is shown in the following table.

Frequency Range	Dynamic Range
5 kHz to 2 MHz	85 dB
>2 MHz to 3 GHz	100 dB
>3 GHz to 6 GHz	90 dB
>6 GHz to 20 GHz	85 dB

Block Diagram

As shown in the following block diagram, the VNA Master has a 2-port, 2-path architecture that automatically measures four S-parameters with a single connection.



The above illustration is a simplified block diagram of VNA Master's 2-port, 2-path architecture.

Sweep Speed

The typical sweep speed in µs/point for IF Bandwidth of 100 kHz, 1001 data points, and single display is shown for the following frequencies. The three receiver architecture will simultaneously collect S_{21} and S_{11} (or S_{12} and S_{22}) in a single sweep.

Frequency Range	Typical Sweep Speed
5 kHz to 6 GHz	350 µs/point
>6 GHz to 20 GHz	650 µs/point

High-Level Noise

S_{11} or S_{22}, Short, Power = High, IFBW = 200 Hz (typ.)

Frequency Range	Magnitude	Phase
5 kHz to 6 GHz	0.004 dB (rms)	0.040 deg
>6 GHz to 20 GHz	0.010 dB (rms)	0.050 deg

Noise Floor

10 Hz IFBW

Frequency Range	Noise Floor
5 kHz to 2 MHz	–85 dBm (typ.)
>2 MHz to 3 GHz	–100 dBm (typ.)
>3 GHz to 6 GHz	–96 dBm (typ.)
>6 GHz to 20 GHz	–91 dBm (typ.)

Temperature Stability

S_{11} or S_{22}, Short, 23°C±5°C (typ.)

Frequency Range	Magnitude	Phase
5 kHz to 10 GHz	0.018 dB/°C	0.160 deg/°C
>10 GHz to 20 GHz	0.070 dB/°C	0.800 deg/°C

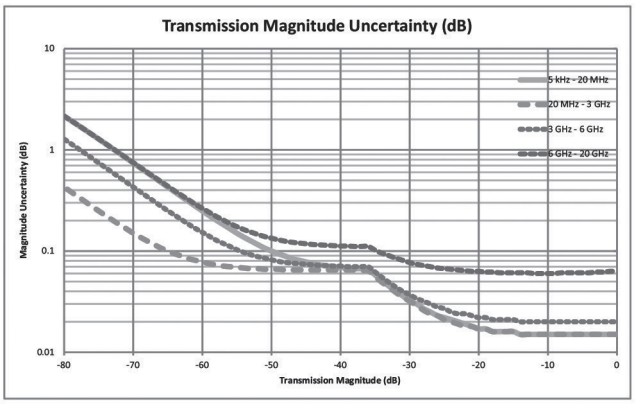
Corrected System Performance and Uncertainties — High Port Power

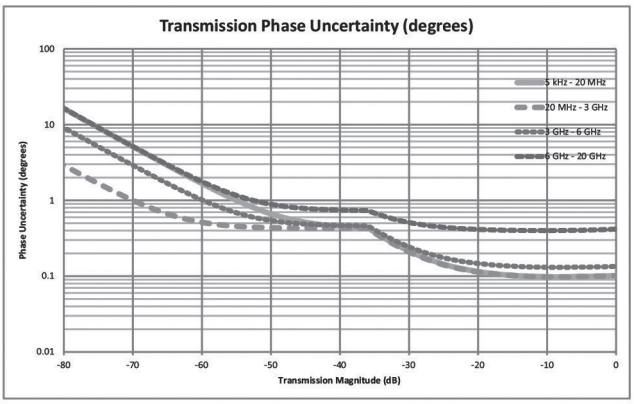
Measurement Accuracy (OSLN50A-18 or TOSLN50A-18)
Full 2-Port calibration, Default Power, 10 Hz IFBW, No averaging, 10 minute warm-up. OSLN50A-18 or TOSLN50A-18 calibration kit.
Load match specification applicable directly at corrected port only. De-rate by approximately 8 dB if using a 3670 series test port cable.
Reflection and Transmission Tracking are typical.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
5 kHz to 20 MHz	≥42	≥30	≥42	±0.02	±0.01
>20 MHz to 3 GHz	≥42	≥30	≥42	±0.07	±0.01
>3 GHz to 6 GHz	≥42	≥30	≥42	±0.05	±0.02
>6 GHz to 20 GHz*	≥33	≥24	≥33	±0.2	±0.1

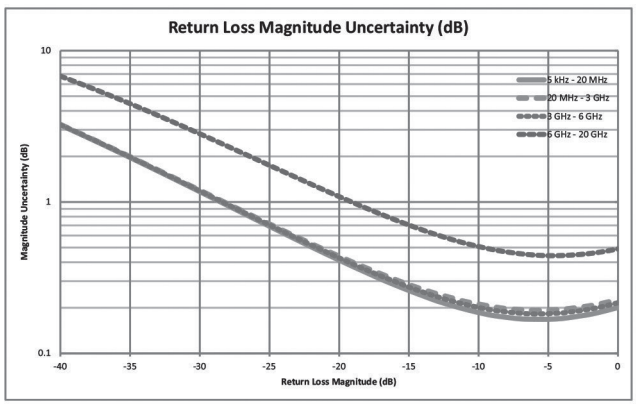
*: Specified only to 18 GHz, typical above 18 GHz.

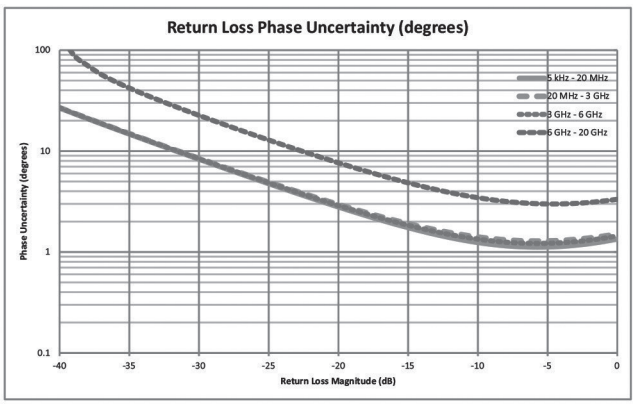
Transmission Uncertainty (S_{21}, S_{12})*





Reflection Uncertainty (S_{11}, S_{22})*





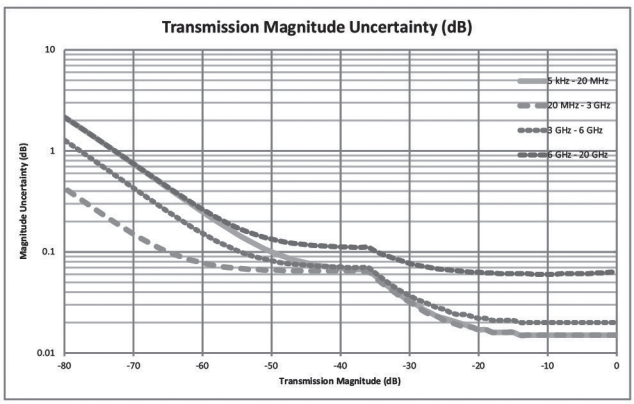
Measurement Accuracy (OSLNF50A-18 or TOSLNF50A-18)

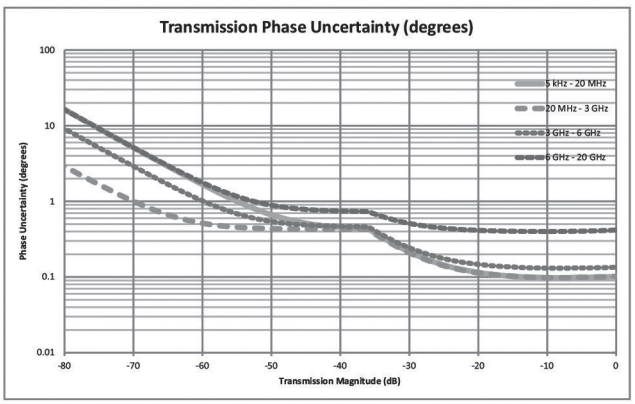
Full 2-Port calibration, Default Power, 10 Hz IFBW, No averaging, 10 minute warm-up. OSLNF50A-18 or TOSLNF50A-18 calibration kit. Load match specification applicable directly at corrected port only. De-rate by approximately 8 dB if using a 3670 series test port cable. Reflection and Transmission Tracking are typical.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
5 kHz to 20 MHz	≥42	≥30	≥42	±0.02	±0.01
>20 MHz to 3 GHz	≥42	≥30	≥42	±0.07	±0.01
>3 GHz to 6 GHz	≥42	≥30	≥42	±0.05	±0.02
>6 GHz to 20 GHz*	≥33	≥24	≥33	±0.2	±0.1

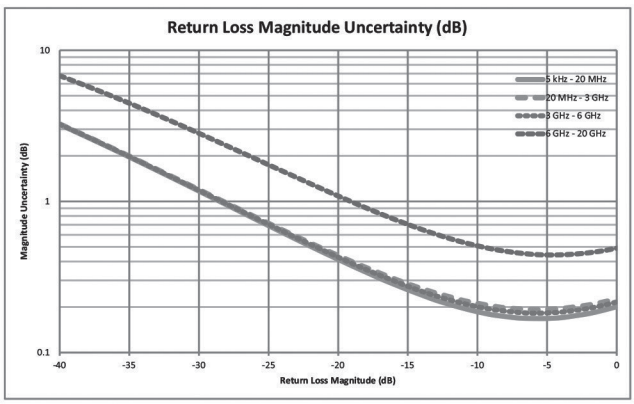
*: Specified only to 18 GHz, typical above 18 GHz.

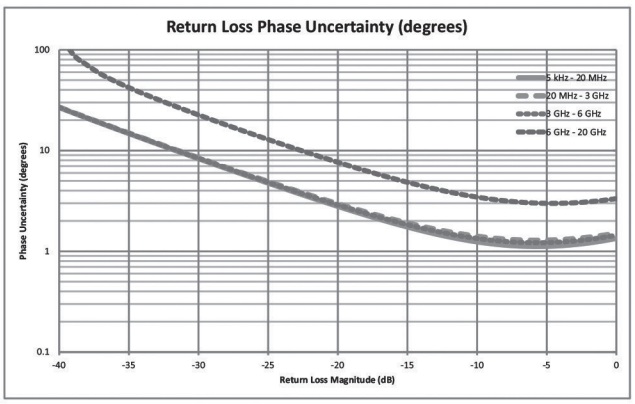
Transmission Uncertainty (S_{21}, S_{12})*





Reflection Uncertainty (S_{11}, S_{22})*



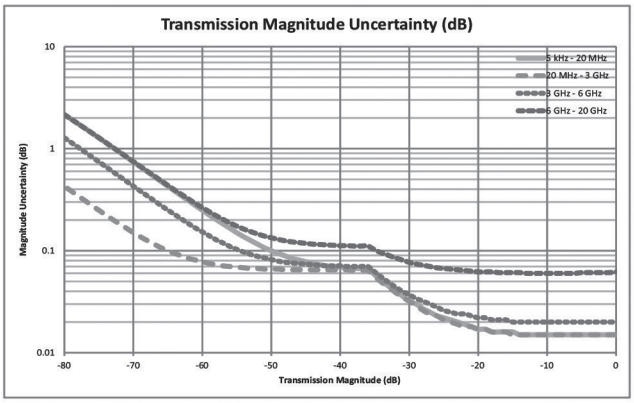


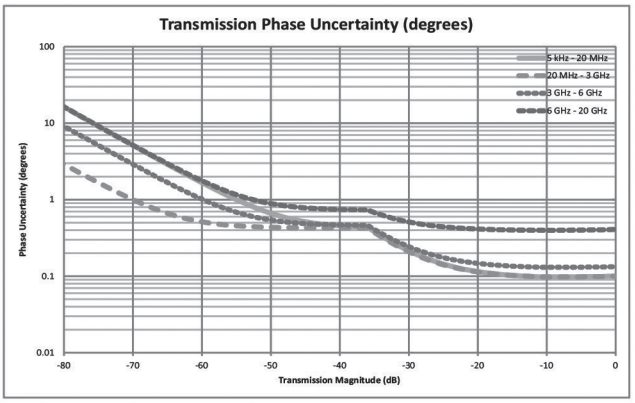
Measurement Accuracy (TOSLK50A-20 or TOSLK50A-40)

Full 2-Port calibration, Default Power, 10 Hz IFBW, No averaging, 10 minute warm-up. TOSLK50A-20 or TOSLK50A-40 calibration kit.
Load match specification applicable directly at corrected port only. De-rate by approximately 8 dB if using a 3670 series test port cable.
Reflection and Transmission Tracking are typical.

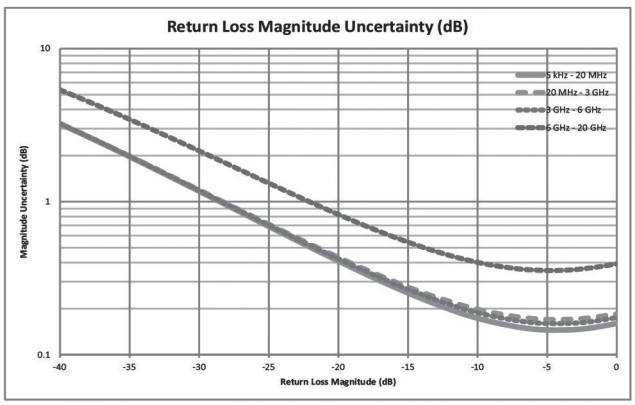
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
5 kHz to 20 MHz	≥42	≥33	≥42	±0.02	±0.01
>20 MHz to 3 GHz	≥42	≥33	≥42	±0.07	±0.01
>3 GHz to 6 GHz	≥42	≥33	≥42	±0.05	±0.02
>6 GHz to 20 GHz	≥36	≥26.5	≥36	±0.2	±0.1

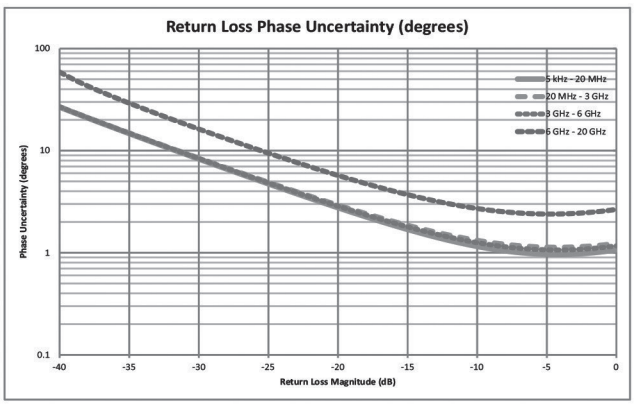
Transmission Uncertainty (S_{21}, S_{12})





Reflection Uncertainty (S_{11}, S_{22})



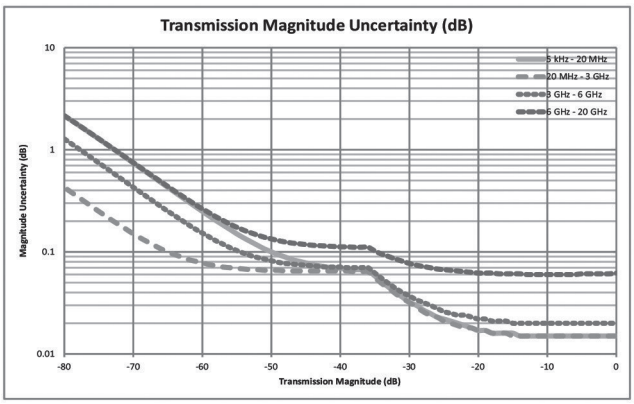


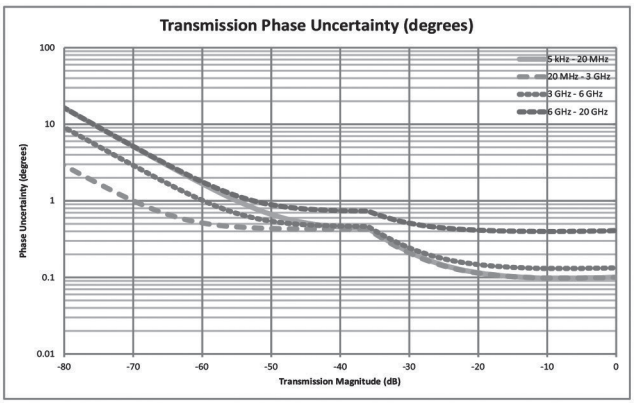
Measurement Accuracy (TOSLKF50A-20 or TOSLKF50A-40)

Full 2-Port calibration, Default Power, 10 Hz IFBW, No averaging, 10 minute warm-up. TOSLKF50A-20 or TOSLKF50A-40 calibration kit. Load match specification applicable directly at corrected port only. De-rate by approximately 8 dB if using a 3670 series test port cable. Reflection and Transmission Tracking are typical.

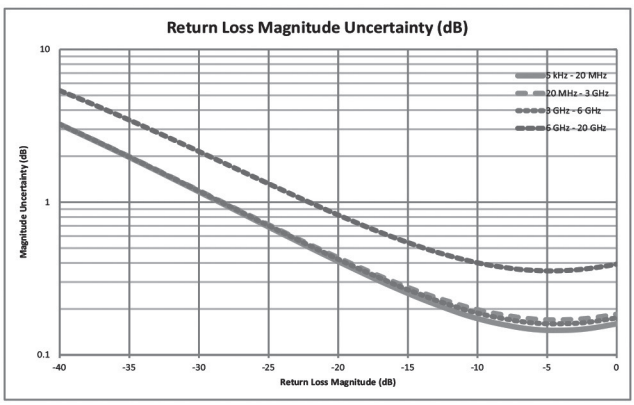
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
5 kHz to 20 MHz	≥42	≥33	≥42	±0.02	±0.01
>20 MHz to 3 GHz	≥42	≥33	≥42	±0.07	±0.01
>3 GHz to 6 GHz	≥42	≥33	≥42	±0.05	±0.02
>6 GHz to 20 GHz	≥36	≥26.5	≥36	±0.2	±0.1

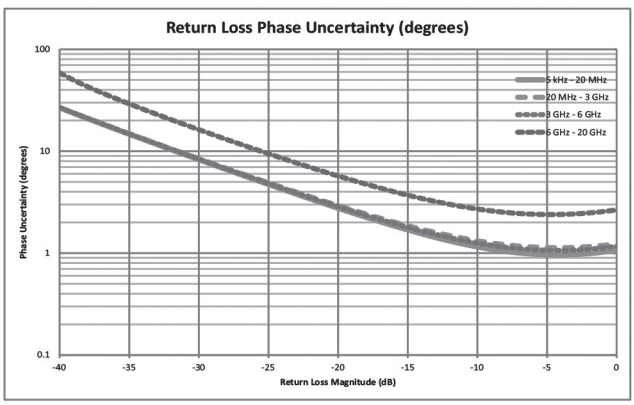
Transmission Uncertainty (S_{21}, S_{12})





Reflection Uncertainty (S_{11}, S_{22})





VNA Functional Specifications

Measurement Parameters	S_{11}, S_{21}, S_{22}, S_{12}, (optionally: S_{d1d1}, S_{c1c1}, S_{d1c1}, S_{c1d1})
Number of Traces	Four: TR1, TR2, TR3, TR4
Trace Format	Single, Dual, Tri, Quad, with Trace overlay capabilities
Graph Types	Log Magnitude, SWR, Phase, Real, Imaginary, Group Delay, Smith Chart, Inverted Smith Chart (Admittance), Log Mag/2 (1-Port Cable Loss), Linear Polar, Log Polar, Real Impedance, Imaginary Impedance
Domains	Frequency Domain, Distance Domain, Time Domain with gating (Time Domain optional)
Frequency	Start Frequency, Stop Frequency, Center Frequency, Span
Distance	Start Distance, Stop Distance
Time	Start Time, Stop Time
Frequency Sweep Type: Linear	Single Sweep, Continuous
Data Points	2 to 4001 (arbitrary setting); data points can be reduced without recalibration.
Limit Lines	Upper, Lower, 10-segmented Upper, 10-segmented Lower
Test Limits	Pass/Fail for Upper, Pass/Fail for Lower, Limit Audible Alarm
Data Averaging	Sweep-by-sweep
Smoothing	0 to 20%
IF Bandwidth	10, 20, 50, 100, 200, 500 Hz, 1, 2, 5, 10, 20, 50, 100 kHz
Reference Plane	The reference planes of a calibration (or other normalization) can be changed by entering a line length. Assumes no loss, flat magnitude, linear phase,and constant impedance.

Continued on next page

Auto Reference Plane Extension	Instead of manually entering a line length, this feature automatically adjusts phase shift from the current calibration (or other normalization) to compensate for external cables (or test fixtures). Assumes no loss, flat magnitude, linear phase, and constant impedance.
Group Delay Aperture	Defined as the frequency span over which the phase change is computed at a given frequency point. The aperture can be changed without recalibration. 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.
Trace Memory	A separate memory for each trace can be used to store measurement data for later display. The trace data can be saved and recalled.
Trace Math	Complex trace math operations of subtraction, addition, multiplication, or division are provided.
Number of Markers	Twelve, arbitrary assignments to any trace
Marker Types	Reference, Delta
Marker Readout Styles	Log Mag, Cable Loss (Log Mag/2), Log Mag and Phase, Phase, Real and Imaginary, SWR, Impedance, Admittance, Normalized Impedance, Normalized Admittance, Polar Impedance, Group Delay, Linear Mag, Linear Mag and Phase
Marker Search	Peak Search, Valley Search, Find Marker Value
Correction Models	Full 2-Port, Full S_{11}, Full S_{22}, Full S_{11} & S_{22}, Response S_{21}, Response S_{12}, Response S_{21} & S_{12}, Response S_{11}, Response S_{22}, Response S_{11} & S_{22}, One-Path Two-Port (S_{11}, S_{21}), One-Path Two-Port (S_{22}, S_{12})
Calibration Types	Flex, Standard
Calibration Methods	Short-Open-Load-Through (SOLT), Offset-Short (SSLT), and Triple-Offset-Short (SSST), Short-Open-Load-Reciprocal (SOLR), Double-Offset-Short-Load-Reciprocal (SSLR), Triple-Offset-Short-Reciprocal (SSSR)
Calibration Standard Coefficients	Coax: N-Connector, K-Connector, 7/16, TNC, SMA, and four User Defined coax types Waveguide: WG11A, WG12, WG13, WG14, WG15, WG16, WG17, WG18, WG20, and four User Defined rectangular waveguide types
Cal Correction Toggle	On/Off
Interpolation	On/Off
Dispersion Compensation	Waveguide correction that improves accuracy of distance-to-fault data by compensating for different wavelengths propagating at different speeds.
Impedance Conversion	Support for 50Ω and 75Ω are provided.
Units	Meters, Feet
Bias Tee Settings	Internal, External, Off
Timebase Reference	Internal, External
File Storage Types	Measurement (.mna), Setup (.stp, with or without CAL), S2P (Real/Imag), S2P (Lin Mag/Phase), S2P (Log Mag/Phase), Text (VNA Only), CSV (VNA Only), JPEG
Ethernet Configuration	DHCP or Manual (Static) IP configuration, 10/100 Base-T, RJ45 jack
Languages	English, French, German, Spanish, Chinese, Japanese, Korean, Italian, Russian, Portuguese

Measurement Options Specifications

Distance Domain (formerly Option 501, now standard with firmware revision v1.16 or higher)

Distance Domain Analysis is a powerful field test tool to analyze cables for faults, including minor discontinuities that may occur due to a loose connection, corrosion, or other aging effects. By using Frequency Domain Reflectometry (FDR), the VNA Master exploits a user-specified band of full power operational frequencies (instead of DC pulses from TDR approaches) to more precisely identify cable discontinuities. The VNA Master converts S-parameters from frequency domain into distance domain on the horizontal display axis, using a mathematical computation called Inverse Fourier Transform. Connect a reflection at the opposite end of the cable, and the discontinuities appear versus distance to reveal any potential maintenance issues. When access to both ends of the cable is convenient, a similar distance domain analysis is available on transmission measurements. Distance Domain will improve your productivity with displays of the cable in terms of discontinuities versus distance. This readout can then be compared against previous measurements (from stored data) to determine whether any degradations have occurred since installation (or the last maintenance activity). More importantly, you will know precisely where to go to fix the problem and so minimize or prevent downtime of the system.

Round-Trip (reflection) Fault Resolution (meters)	(0.5 × c × Vp)/ΔF; (c is speed of light = 299,792,458 m/s, ΔF is F2 – F1 in Hz)
One-Way (transmission) Fault Resolution (meters)	(c × Vp)/ΔF; (c is speed of light = 299,792,458 m/s, ΔF is F2 – F1 in Hz)
Horizontal Range (meters)	0 to (data points – 1) × Fault Resolution to a maximum of 3000 m (9843 ft.)
Windowing	Rectangular, Nominal Side Lobe (NSL), Low Side Lobe (LSL), and Minimum Side Lobe (MSL)

Time Domain (Option 2) (includes Distance Domain)

The VNA Master can display the S-parameter measurements in the time or distance domain using lowpass or bandpass processing analysis modes. The broadband frequency coverage coupled with 4001 data points means you can measure discontinuities both near and far with unprecedented clarity for a handheld tool. With this option, you can simultaneously view S-parameters in frequency, time, and distance domain to quickly identify faults in the field. Advanced features available with this option include step response, phasor impulse, gating, and frequency gated in time. The option includes computational routines that further enhance the Distance Domain results by compensating for cable loss, relative velocity of propagation, and dispersion compensation in waveguide. See the Distance Domain Specifications above.

Option Comparison Table (Distance Domain and Time Domain)

Measurement	Distance Domain (formerly Option 501)	Option 2 Time Domain
Distance-to-Fault	×	×
Distance Domain Display	×	×
Windowing	×	×
Distance of Waveguide		×
Time Domain Display		×
One Way vs. Round Trip Reflection		×
Phasor Impulse		×
Impulse Response		×
Step Response		×
Low Pass vs. Bandpass		×
Frequency Gated by Time		×
Frequency Gated by Distance		×

Secure Data Operation (Option 7)

For highly secure data handling requirements, this software option prevents the storing of measurement setup or data information onto any internal file storage location. Instead, setup and measurement information is stored ONLY to the external USB memory location.
A simple factory preset prepares the VNA Master for transportation while the USB memory remains behind in the secure environment.
The VNA Master cannot be switched between secure and non-secure operation by the user once configured for secure data operation.
With this option enabled, the user can also choose to blank the frequency values displayed on the screen.

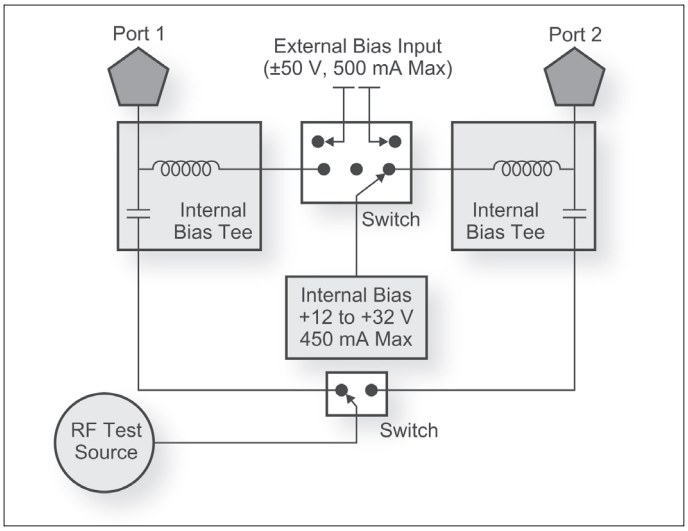
Balanced/Differential S-Parameters, 1-port (Option 77)

As an alternative to a sampling oscilloscope, verifying the performance and identifying discontinuities in high-data-rate differential cables is now possible with the VNA Master. After a full two-port calibration, connect your differential cable directly to the two test ports and reveal the S_{d1d1} performance, which is essentially differential return loss, or any of the other differential S-Parameters, S_{c1c1}, S_{d1c1}, or S_{c1d1}. With optional time domain, you can convert frequency sweeps to distance. This capability is especially valuable for applications in high data rate cables where balanced data formats are used to isolate noise and interference.

Bias Tee (Option 10)

For tower mounted amplifier tests, the MS203xC series with optional internal bias tees can supply both DC and RF signals on the center conductor of the cable during measurements. For frequency sweeps in excess of 2 MHz, the VNA Master can supply internal voltage control from +12 V to +32 V in 0.1 V steps up to 450 mA.
To extend battery life, an external power supply can substitute for the internal supply by using the included external bias ports.
Both test ports can be configured to supply voltage via this integrated bias tees option. Bias can be directed to VNA Port 1 or Port 2.
The VNA Master offers optional integrated bias tee for supplying DC plus RF to the DUT as shown in the simplified block diagram.
Connectivity is also provided for external supply (instead of internal) to preserve battery consumption.

Frequency Range	2 MHz to 6 GHz (MS2036C) 2 MHz to 15 GHz (MS2037C) 2 MHz to 20 GHz (MS2038C)
Internal Voltage/Current	+12 V to +32 V at 450 mA steady rate
Internal Resolution	0.1 V
External Voltage/Current	±50 V at 500 mA steady rate
Bias Tee Selections	Internal, External, Off



Vector Voltmeter (Option 15)

A phased array system relies on phase matched cables for nominal performance. For this class of application, the VNA Master offers this special software mode to simplify phase matching cables at a single frequency. The similarity between the popular vector voltmeter and this software mode ensures minimal training is required to phase match cables. Operation is as simple as configuring the display for absolute or relative measurements.
The easy-to-read large fonts show either reflection or transmission measurements using impedance, magnitude, or VSWR readouts. For instrument landing system (ILS) or VHF Omni-directional Range (VOR) applications, a table view improves operator efficiency when phase matching up to twelve cables. The MS203xC solution is superior because the signal source is included internally, precluding the need for an external signal generator.

CW Frequency Range	5 kHz to 6 GHz (MS2036C) 5 kHz to 15 GHz (MS2037C) 5 kHz to 20 GHz (MS2038C)
Measurement Display	CW, Table (Twelve Entries, Plus Reference)
Measurement Types	Return Loss, Insertion
Measurement Format	dB/VSWR/Impedance

Spectrum Analyzer Performance Specifications

Measurements	Field Strength	dBm/m², dBV/m, dBmV/m, dBµV/m, V/m, Watt/m², dBW/m², A/m, dBA/m, or Watt/cm²
	Occupied Bandwidth	Measures 99 % to 1 % power channel of a signal, or N dB from center of signal
	Channel Power	Measures the total power in a specified bandwidth
	ACPR	Adjacent channel power ratio
	Emission Mask	Recall limit lines as emission mask
	Spurious Emissions	Measures up to 32 segments with independent setups and limits
	C/I	Carrier-to-interference ratio
	AM/FM/SSB Demodulation	AM, wide/narrow FM, upper/lower SSB (audio only)
	PIM Hunting	
Setup Parameters	Frequency	Center/Start/Stop, Span, Frequency Step, Signal Standard, Channel #, Channel Increment
	Amplitude	Reference Level (RL), Scale, Attenuation Auto/Level, RL Offset, Units (dBm, dBV, dBmV, dBµV, Volt, Watt, dBW, A, dBA), Pre-Amp On/Off, Detection (Peak, RMS/Avg, Negative Peak, Sample, Quasi-Peak)
	Span	Span, Span Up/Down (1-2-5), Full Span, Zero Span, Last Span
	Bandwidth	RBW, Auto RBW, VBW, Auto VBW, VBW/Avg Type (Linear, Log), RBW/VBW Ratio, Span/RBW Ratio
	Impedance	50Ω, 75Ω; external pad required for 75Ω operation
Sweep Functions	Sweep	Single/Continuous, Sweep Time
	Sweep Mode	Fast (up to 100x faster than Performance), Performance, No FFT, Burst Detect (1000x Fast in 15 MHz span)
	Triggers	Free Run, External, Video, IF Power, Force Trigger Once
	Trigger Parameters	Delay, Level, Slope, Hysteresis, Holdoff (availability varies with trigger)
Trace Functions	Traces	Up to three Traces (A, B, C), View/Blank, Write/Hold, Trace A/B/C Operations
	Trace A Operations	Normal, Max Hold, Min Hold, Average, # of Averages, (always the live trace)
	Trace B Operations	A → B, B ↔ C, Max Hold, Min Hold
	Trace C Operations	A → C, B ↔ C, Max Hold, Min Hold, A – B → C, B – A → C, Relative Reference (dB), Scale
Marker Functions	Markers	Markers 1-6 each with a Delta Marker, or Marker 1 Reference with Six Delta Markers, Marker Table (On/Off/Large), All Markers Off
	Marker Types	Style (Fixed/Tracking), Noise Marker, Frequency Counter Marker
	Marker Auto-Position	Peak Search, Next Peak (Right/Left), Peak Threshold %, Set Marker to Channel, Marker Frequency to Center, Delta Marker to Span, Marker to Reference Level
	Marker Table	1-6 markers frequency and amplitude plus delta markers frequency offset and amplitude
Limit Line Functions	Available Spans	>0 Hz
	Limit Lines	Upper/Lower, On/Off, Edit, Move, Envelope, Advanced, Limit Alarm, Default Limit
	Limit Line Edit	Frequency, Amplitude, Add Point, Add Vertical, Delete Point, Next Point Left/Right
	Limit Line Move	To Current Center Frequency, By dB or Hz, To Marker 1, Offset from Marker 1
	Limit Line Envelope	Create Envelope, Update Amplitude, Number of Points (2 to 41), Offset, Shape Square/Slope
	Limit Line Advanced	Type (Absolute/Relative), Mirror, Save/Recall
	Save on Event	When Limit Crossed
Frequency	Frequency Range	(usable to 0 Hz) MS2036C: 9 kHz to 9 GHz MS2037C: 9 kHz to 15 GHz MS2038C: 9 kHz to 20 GHz
	Tuning Resolution	1 Hz
	Frequency Reference	Aging: ± 1.0 × 10^{-6} per year for 10 years Accuracy: ± 0.3 × 10^{-6} (25°C ±25°C) plus aging (see Option 31 for improved frequency reference aging and accuracy)
	External Frequency Reference	1, 1.2288, 1.544, 2.048, 2.4576, 4.8, 4.9152, 5, 9.8304, 10, 13, 19.6608 MHz (auto-sensing)
	Sweep Time	7 µs to 3600 seconds in zero span
	Sweep Time Accuracy	±2% in zero span
Bandwidth	Resolution Bandwidth (RBW)	1 Hz to 10 MHz in 1–3 sequence ±10% (–3 dB bandwidth)
	Video Bandwidth (VBW)	1 Hz to 10 MHz in 1–3 sequence (–3 dB bandwidth)
	RBW with Quasi-Peak Detection	200 Hz, 9 kHz, 120 kHz (–6 dB bandwidth)
	VBW with Quasi-Peak Detection	Auto VBW is On, RBW/VBW = 1
	VBW/Average	Type Linear/Log
Spectral Purity – SSB Phase Noise		Offset from 1 GHz

	Maximum	Typical
10 kHz	–102 dBc/Hz	–106 dBc/Hz
100 kHz	–106 dBc/Hz	–110 dBc/Hz
1 MHz	–111 dBc/Hz	–116 dBc/Hz
10 MHz	–123 dBc/Hz	–129 dBc/Hz

Continued on next page

Amplitude Ranges	Dynamic Range	>106 dB @ 2.4 GHz, 2/3 (TOI-DANL) in 1 Hz RBW
	Measurement Range	DANL to +30 dBm
	Display Range	1 to 15 dB/div in 1 dB steps, ten divisions displayed
	Reference Level Range	–150 to +30 dBm
	Reference Level Offset	99.9 dB External Loss to 99.9 dB External Gain
	Attenuator Resolution	0 to 65 dB, 5.0 dB steps
	Amplitude Units	Log Scale Modes: dBW, dBm, dBµW, dBV, dBmV, dBµV, dBA, dBmA, dBµA Linear Scale Modes: fV, nV, µV, mV, V, fW, pW, nW, µW, mW, W, pA, nA, µA, mA, A
	Maximum Continuous Input (typ.)	+30 dBm Peak, ±50 VDC (≥10 dB Attn) +23 dBm Peak, ±50 VDC (<10 dB Attn) +13 dBm Peak, ±50 VDC (Preamp On)

Amplitude Accuracy (excluding effects of VSWR, noise and spurs)

Frequency Range	+20°C to +30°C (after 30 minute warm-up)		–10°C to +55°C (after 60 minute warm-up)	
	Maximum	Typical	Maximum	Typical
9 kHz to 100 kHz*	±2.3 dB	±0.5 dB	±2.3 dB	±0.5 dB
>100 kHz to 13 GHz	±1.3 dB	±0.5 dB	±2.3 dB	±0.5 dB
>13 GHz to 18 GHz	±2.3 dB	±0.5 dB	±3.3 dB	±0.5 dB
>18 GHz to 20 GHz	—	±1.0 dB	—	±1.0 dB

*: Values below 100 kHz are with the preamplifier turned off.

Displayed Average Noise Level (DANL) (RMS detection, VBW/Avg type = Log., Ref Level = –20 dBm for preamp Off and –50 dBm for preamp On, Auto Attenuation, Performance Sweep Mode)

Frequency Range	Preamp = Off		Preamp = On	
	Maximum	Typical	Maximum	Typical
10 MHz to 4 GHz	–145 dBm	–148 dBm	–161 dBm	–164 dBm
>4 GHz to 9 GHz	–142 dBm	–145 dBm	–159 dBm	–162 dBm
>9 GHz to 13 GHz	–136 dBm	–139 dBm	–156 dBm	–159 dBm
>13 GHz to 20 GHz	–136 dBm	–142 dBm	–155 dBm	–161 dBm

Spurs (0 dB input attenuation)	Residual Spurs (RF input terminated)	Preamp Off: –90 dBm (<13 GHz), –85 dBm (13 GHz to 20 GHz) Preamp On: –100 dBm (<13 GHz, 13 GHz to 20 GHz)
	Input-Related Spurious (–30 dBm input)	Preamp Off: –60 dBc (Instrument centered on single signal, span <1.7 GHz) Preamp On: –70 dBc (typ.)
Third-Order Intercept (TOI)		(–20 dBm tones 100 kHz apart, –20 dBm Ref level, 0 dB input attenuation, preamp Off) 2.4 GHz: +14 dBm minimum 50 MHz to 20 GHz: 20 dBm (typ.)
P1dB		<4 GHz: +5 dBm (nom.) 4 GHz to 20 GHz: +12 dBm (nom.)
Second Harmonic Distortion (0 dB input attenuation, –30 dBm input)		50 MHz: –54 dBc (max.) <4 GHz: –60 dBc (typ.) ≥4 GHz: –75 dBc (typ.)
VSWR (≥10 dB input attenuation)		≤20 GHz: 1:5:1 (typ.)

High Accuracy Power Meter (Option 19)

Requires external USB power sensor.

Amplitude	Maximum, Minimum, Offset, Relative On/Off, Units, Auto Scale
Average	# of Running Averages, Max Hold
Zero/Cal	Zero On/Off, Cal Factor (Center Frequency, Signal Standard)
Limits	Limit On/Off, Limit Upper/Lower

Power Sensors (Ordered separately):

Power Sensor Model	MA24105A	MA24106A	MA24108A/18A/26A	MA24208A/18A	MA24330A/40A/50A
Description	Inline High Power Sensor	High Accuracy RF Power Sensor	Microwave USB Power Sensor	Microwave Universal USB Power Sensor	Microwave CW USB Power Sensor
Frequency Range	350 MHz to 4 GHz	50 MHz to 6 GHz	10 MHz to 8/18/26 GHz	10 MHz to 8 GHz/18 GHz	10 MHz to 33/40/50 GHz
Connector	Type N (f), 50Ω	Type N (m), 50Ω	Type N (m), 50Ω (8 GHz/18 GHz) Type K (m), 50Ω (26 GHz)	Type N (m), 50Ω	Type K (m), 50Ω (33 GHz/40 GHz) Type V (m), 50Ω (50 GHz)
Dynamic Range	+3 to +51.76 dBm (2 mW to 150 W)	–40 to +23 dBm (0.1 µW to 200 mW)	–40 to +20 dBm (0.1 µW to 100 mW)	–60 to +20 dBm (1 nW to 100 mW)	–70 to +20 dBm (0.1 nW to 100 mW)
Measurand	True-RMS	True-RMS	True-RMS, Slot Power, Burst Average Power	True-RMS, Slot Power, Burst Average Power	Average Power
Measurement Uncertainty	± 0.17 dB*1	± 0.16 dB*2	± 0.18 dB*3	± 0.17 dB*4	± 0.17 dB*5
Data sheet (for complete specifications)	11410-00621	11410-00424	11410-00504	11410-00841	11410-00906

*1: Expanded uncertainty with K = 2 for power measurements of a CW signal greater than +20 dBm with a matched load. Measurement results referenced to the input side of the sensor.
*2: Total RSS measurement uncertainty (0°C to 50°C) for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.
*3: Expanded uncertainty with K = 2 for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.
*4: Power uncertainty expressed with two sigma confidence level for CW measurement after zero operation. Includes calibration factor and linearity over temperature uncertainties, but not the effects of mismatch, zero set and drift, or noise.
*5: Includes linearity over temperature uncertainties, but not the effects of calibration factor, mismatch, zero set and drift, and noise.

Interference Analyzer (Option 25)

Spectrum	Field Strength Occupied Bandwidth Channel Power Adjacent Channel Power (ACPR) AM/FM/SSB Demodulation (Wide/Narrow FM, Upper/Lower SSB), (audio out only) Carrier-to-Interference ratio (C/I)
Spectrogram	Collect data up to 3 days
Signal Strength	Gives visual and aural indication of signal strength
Received Signal Strength Indicator (RSSI)	Collect data up to 168 hours (one week)
Interference Mapping	Draw multiple bearings of signal strength from GPS location on on-screen map Pan and Zoom on-screen maps Support for Anritsu MA2700A Handheld Interference Hunter
Impedance	50Ω, 75Ω; external pad required for 75Ω operation

Channel Scanner (Option 27)

Number of Channels	1 to 20 Channels (Power Levels)
Measurements	Graph/Table, Max Hold (On/5 sec/Off), Frequency/Channel, Current/Maximum, Dual Color
Scanner	Scan Channels, Scan Frequencies, Scan Custom List, Scan Script Master™
Amplitude	Reference Level, Scale
Custom Scan	Number of Channels, Signal Standard & Channel, Frequency, Bandwidth
Frequency Range	9 kHz to 9, 15, or 20 GHz
Frequency Accuracy	±10 Hz + frequency reference error
Measurement Range	–110 to +30 dBm
Impedance	50Ω, 75Ω; external pad required for 75Ω operation

GPS Receiver (Option 31)

Setup	On/Off, Antenna Voltage 3.3 V/5.0 V, GPS Info Note: 2000-1528-R GPS antenna requires +5 VDC 2000-1652-R GPS antenna requires +3.3 VDC or +5 VDC 2000-1760-R GPS antenna requires +2.5 VDC to +3.7 VDC
GPS Time/ Location Indicator	UTC Time, Latitude, Longitude, and Altitude on display (UTC Time and Altitude on GPS Info display) UTC Time, Latitude, Longitude, and Altitude with trace storage
High Frequency Accuracy	$<\pm 2.5 \times 10^{-8}$ Hz/Hz with GPS On, 3 minutes after satellite lock in selected mode (GPS Antenna connected) $<\pm 5.0 \times 10^{-8}$ Hz/Hz for 3 days after GPS lock, 0°C to 50°C (GPS Antenna disconnected)
Connector	SMA (f)

Coverage Mapping (Option 431)

Measurements	Indoor Mapping	RSSI, ACPR
	Outdoor Mapping	RSSI, ACPR
Setup Parameters	Mode	Spectrum Analyzer
	Frequency	Center, Span (ACPR only), Freq Step, Signal Standard, Channel #, Channel Increment
	Amplitude	Reference Level (RL), Attenuation Auto/Level, RL Offset, Pre-Amp On/Off, Detection
	Span	RSSI Mode: Zero Span ACPR Mode: Span, Span Up/Down (1-2-5), Full Span, Last Span
	BW	RBW, Auto RBW, VBW, Auto VBW, RBW/VBW Ratio, Span/RBW Ratio
	Measurement Setup	RSSI: Mapping color thresholds
	Mapping Colors	ACPR: Main Ch BW, Adj Ch BW, Ch Spacing, Adjacent Ch dB Offset, Thresholds for Good and Poor main channel levels RSSI: Dark Green (Excellent), Light Green (Very Good), Yellow (Good), Orange (Fair), Dark Red (Poor) ACPR: Dark Green (Good), Yellow (between Good and Poor), Dark Red (Poor)
	Point Distance or Time Setup	Repeat Type: Time (100 ms to 16 s), Distance (1 m to 10,000 m) Distance Units: m, ft
	Save Points Map	Save KML, JPEG, Tab Delimited
	Recall Points Map	Recall Map, Recall KML Points only, Recall KML Points with Map, Recall Default Grid
	Map Types	Outdoor (GPS embedded), Indoor (non-GPS embedded). Import maps using the Anritsu easyMap Tools. Zoomable (.azm) maps are usable, but cannot be zoomed.

AM/FM/PM Signal Analyzer (Option 509)

Measurements							
Display Type	RF Spectrum AM/FM/PM	Audio Spectrum (AM)	Audio Spectrum (FM/PM)	Audio Waveform (AM)	Audio Waveform (FM/PM)	Summary (AM)	Summary (FM/PM)
Graphic Display	Power (dBm) vs. Frequency	Depth (%) vs. Modulation Frequency	Deviation (kHz/rad) vs. Modulation Frequency	Depth (%) vs. Time	Deviation (kHz/rad) vs. Time	None	None
Numerical Displays	Carrier Power Carrier Frequency Occupied Bandwidth	AM Rate RMS Depth (Pk-Pk)/2 Depth SINAD* THD* Distortion/Total Vrms*	FM/PM Rate RMS Deviation (Pk-Pk)/2 Deviation SINAD* THD* Distortion/Total Vrms*	AM Rate RMS Depth (Pk-Pk)/2 Depth SINAD* THD* Distortion/Total Vrms*	FM/PM Rate RMS Depth (Pk-Pk)/2 Depth SINAD* THD* Distortion/Total Vrms*	RMS Depth Peak + Depth Peak – Depth (Pk-Pk)/2 Depth Carrier Power Carrier Frequency Occupied Bandwidth AM Rate SINAD* THD* Distortion/Total Vrms*	RMS Deviation Peak + Deviation Peak – Deviation (Pk-Pk)/2 Deviation Carrier Power Carrier Frequency Occupied Bandwidth FM/PM Rate SINAD* THD* Distortion/Total Vrms*

*: Requires sine wave modulation

Setup Parameters	Frequency	Center Freq, Span, Freq Step, Signal Standard, Channel, Channel Increment, Set (measured) Carrier Freq to Center
	Amplitude Setu	Scale, Power Offset, Adjust Range
	Measurements	RF Spectrum, Audio Spectrum (demodulated), Audio Waveform (demodulated), Summary, Coverage Mapping (Option 431 required), Audio Demod (AM/FM only)
	Measurement Setup	All Measurements: Demod Type (AM, FM, PM), IFBW, Auto IFBW, Squelch Units, Distortion Measurements (Sinewave or Broadcast) RF Spectrum: OBW Method, OBW %, OBW dBC Audio Spectrum: Span, Scale, Squelch Power Audio Waveform: Sweep Time, Scale, Squelch Power Summary: Average count, Squelch Power Coverage Mapping: Measurement (SINAD, Carrier Power, Multiple), Thresholds, Point Distance/Time Audio Demod: Demod Type (AM, USB, LSB, Widband FM, Narrowband FM), Volume, Squelch
	Mapping Colors	Dark Green (Excellent), Light Green (Very Good), Orange (Good), Yellow (Fair), Dark Red (Poor)
	Marker	Six markers with Delta for each, Peak Search, Marker Freq to Center, Marker to Ref Lvl, Marker Table
RF and Modulation Measurements	AM	Modulation Rate: ±1 Hz (<100 Hz), ±2% (>100 Hz) Depth: ±5% for (Modulation rates 10 Hz to 100 kHz)
	FM	Modulation Rate: ±1 Hz (<100 Hz); ±2% (100 Hz to 100 kHz) Deviation Accuracy: ±5% (100 Hz to 100 kHz)*
	PM	Modulation Rate: ±1 Hz (<100 Hz); ±2% (100 Hz to 100 kHz) Deviation Accuracy: ±5% (deviation 0 to 93 Rad, rate 10 Hz to 5 kHz)*
	IF Bandwidth	1 kHz to 300 kHz in 1-3 sequence
	Frequency Span	RF Spectrum: 10 kHz to 10 MHz Audio Spectrum: 2, 5, 10, 20, 70, 140 kHz
	RBW/VBW	30
	Span/RBW	100
	Sweep Time	50 µs to 50 ms (Audio Waveform) IFBW must be greater than 95% occupied BW

*: IFBW must be greater than 95% occupied BW

General Specifications

Setup Parameters	System	Status (Temperature, Battery Info, S/N, Firmware Ver, IP Address, Options Installed) Self Test, Application Self Test, GPS (see Option 31)
	System Options	Name, Date and Time, Ethernet Configuration, Brightness, Volume Language (English, French, German, Spanish, Chinese, Japanese, Korean, Italian, Russian, Portuguese) Reset (Factory Defaults, Master Reset, Update Firmware)
	File	Save, Recall, Delete, Directory Management
	Save/Recall	Setups, Measurements, Screen Shots Jpeg (save only)
	Delete	Selected File, All Measurements, All Mode Files, All Content
	Directory Management	Sort Method (Name/Type/Date), Ascend/Descend, Internal/USB, Copy
	Internal Trace/Setup Memory	Store more than 4000 traces and setups in memory
	External Trace/Setup Memory	Limited by size of USB Flash drive
	Mode Switching	Auto-Stores/Recalls most recently used setup parameters for the mode
Connectors	Maximum Input (Damage Level)	Vector Network Analyzer Input: +23 dBm, ±50 VDC (all models) Spectrum Analyzer Input: +30 dBm, ±50 VDC
	VNA Connectors	Type N (f) (or ruggedized K (f) with Option 11, MS2037C or MS2038C only) (× 2)
	Spectrum Analyzer Connectors	Type N (f) (or ruggedized K (f) with Option 11, MS2037C or MS2038C only)
	Bias Tee	Type BNC (f) (enabled with Option 10) (× 2)
	Ext Ref	Type BNC (f), 10 MHz, ±10 dBm
	Ethernet	RJ45, 10/100 Mbps, Connect to PC or LAN for Remote Access
	GPS	SMA (f) (available with Option 31 GPS)
	External Power	5.5 mm barrel connector, 12 to 14.5 VDC, <5.0 A
	LAN Connection	RJ48C, 10/100 Mbps, Connect to PC or LAN for Remote Access
	USB Interface (2)	Type A, Connect Flash Drive and Power Sensor
	USB Interface	5-pin mini-B, Connect to PC for data transfer
	Headset Jack	3.5 mm 3-wire headset jack
	External Trigger	BNC (f), TTL 3.3 V or 5 V triggers on positive edge, Maximum Input +5 VDC
	10 MHz Out	SMA (f), 50Ω
Display	Size	8.4 in, daylight viewable color LCD
	Resolution	800 × 600
	Pixel Defects	No more than five defective pixels (99.9989% good pixels)
Power	Field Replaceable Li-Ion Battery	40 W when powered by factory 7500 mAh Li-Ion battery (part number: 633-75)
	AC/DC Power Adapter	55 W when powered by supplied universal 110 V/220 V AC/DC adaptor while charging battery
	Life Time Charging Cycles	>300 (80% of initial capacity)
	Battery Operation	3.0 hours, (typ.)
	Battery Charging Limits	0°C to +45°C, Relative Humidity ≤80%, non-condensing
Regulatory Compliance	CE	EMC: 2014/30/EU, EN61326-1, EN61000-4-2 LVD 2014/35/EU, EN61010-1 RoHS: (EU) 2015/863
	Australia and New Zealand	RCM AS/NZS 4417:2012
	South Korea	KCC-REM-A21-0004
Environmental	MIL-PRF-28800F, Class 2	
	Operating Temperature Range	–10°C to +55°C
	Storage Temperature Range	–51°C to +71°C
	Maximum Relative Humidity	95% RH at +30°C, non-condensing
	Vibration, Sinusoidal	5 Hz to 55 Hz
	Vibration, Random	10 Hz to 500 Hz
	Half Sine Shock	30 gn
	Altitude	4600 meters, operating and non-operating
	Explosive Atmosphere	MIL-PRF-28800F Section 4.5.6.3 MIL-STD-810G, Method 511.5, Procedure 1
Dimensions and Mass	Dimensions	Width: 315 mm (12.4 in) Height: 211 mm (8.3 in) Depth: 97 mm (3.8 in)
	Mass, Including Battery	4.8 kg (10.5 lb)
Warranty		Standard three-year warranty (one year warranty on battery)

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	VNA Master™ 2-Port, 1-Path VNA + Spectrum Analyzer
MS2036C	VNA: 5 kHz to 6 GHz, S/A: 9 kHz to 9 GHz
MS2037C	VNA: 5 kHz to 15 GHz, S/A: 9 kHz to 15 GHz
MS2038C	VNA: 5 kHz to 20 GHz, S/A: 9 kHz to 20 GHz
	MS2036C VNA Master, + Spectrum Analyzer Options
MS2036C-0002	Time Domain (includes Distance Domain capabilities)
MS2036C-0007	Secure Data Operation
MS2036C-0010	Built-in Bias-Tee
MS2036C-0015	Vector Voltmeter
MS2036C-0019	High Accuracy Power Meter (requires external USB sensor)
MS2036C-0025	Interference Analysis, 9 kHz to 9/15/20 GHz*1
MS2036C-0027	Channel Scanner, 9 kHz to 9/15/20 GHz*1
MS2036C-0031	GPS Receiver (requires GPS antenna, 2000-1528-R, 2000-1652-R, or 2000-1760-R)
MS2036C-0077	Balanced/Differential S-Parameters, 1-port
MS2036C-0431	Coverage Mapping*2
MS2036C-0098	Standard Calibration (ISO 17025 and Z540.1)
MS2036C-0099	Premium Calibration (ISO 17025 and Z540.1 plus test data)
MS2036C-0509	AM/FM/PM Analyzer*3
	MS2037C VNA Master, + Spectrum Analyzer Options
MS2037C-0002	Time Domain (includes Distance Domain capabilities)
MS2037C-0007	Secure Data Operation
MS2037C-0010	Built-in Bias-Tee
MS2037C-0011	K (f) Test Port Connectors (MS2037C/MS2038C only)
MS2037C-0015	Vector Voltmeter
MS2037C-0019	High Accuracy Power Meter (requires external USB sensor)
MS2037C-0025	Interference Analysis, 9 kHz to 9/15/20 GHz*1
MS2037C-0027	Channel Scanner, 9 kHz to 9/15/20 GHz*1
MS2037C-0031	GPS Receiver (requires GPS antenna, 2000-1528-R, 2000-1652-R, or 2000-1760-R)
MS2037C-0077	Balanced/Differential S-Parameters, 1-port
MS2037C-0431	Coverage Mapping*2
MS2037C-0098	Standard Calibration (ISO 17025 and Z540.1)
MS2037C-0099	Premium Calibration (ISO 17025 and Z540.1 plus test data)
MS2037C-0509	AM/FM/PM Analyzer*3
	MS2038C VNA Master, + Spectrum Analyzer Options
MS2038C-0002	Time Domain (includes Distance Domain capabilities)
MS2038C-0007	Secure Data Operation
MS2038C-0010	Built-in Bias-Tee
MS2038C-0011	K (f) Test Port Connectors (MS2037C/MS2038C only)
MS2038C-0015	Vector Voltmeter
MS2038C-0019	High Accuracy Power Meter (requires external USB sensor)
MS2038C-0025	Interference Analysis, 9 kHz to 9/15/20 GHz*1
MS2038C-0027	Channel Scanner, 9 kHz to 9/15/20 GHz*1
MS2038C-0031	GPS Receiver (requires GPS antenna, 2000-1528-R, 2000-1652-R, or 2000-1760-R)
MS2038C-0077	Balanced/Differential S-Parameters, 1-port
MS2038C-0431	Coverage Mapping*2
MS2038C-0098	Standard Calibration (ISO 17025 and Z540.1)
MS2038C-0099	Premium Calibration (ISO 17025 and Z540.1 plus test data)
MS2038C-0509	AM/FM/PM Analyzer*3
	Standard Accessories
2000-1686-R	Soft Carrying Case
40-187-R	AC-DC Adapter
806-141-R	Automotive Power Adapter, 12 VDC, 60 W
3-2000-1498	USB A/5-pin Mini-B Cable, 3.05 m (10 ft)
2000-1371-R	Ethernet Cable, 2.13 m (7 ft)
	Certificate of Calibration and Conformance

*1: Option 31 (GPS) is recommended.
*2: Requires Option 31 (GPS) for full functionality.
*3: Requires Option 431 (Coverage Mapping) for full functionality.

Model/Order No.	Name
	Optional Accessories
	GPS Antennas (active)
2000-1528-R	Magnet Mount, SMA (m), 3 VDC to 5 VDC with 4.6 m (15 ft) extension cable
2000-1652-R	Magnet Mount, SMA (m), 3 VDC to 5 VDC with 1 ft cable
2000-1760-R	Mini GPS Antenna, SMA (m), 25 dB gain, 2.5 VDC to 3.7 VDC
	Power Sensor
MA24105A	Inline Peak Power Sensor, 350 MHz to 4 GHz, +3 to +51.76 dBm
MA24106A	RF USB Power Sensor, 50 MHz to 6 GHz, +23 dBm
MA24108A	Microwave USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24118A	Microwave USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24126A	Microwave USB Power Sensor, 10 MHz to 26 GHz, +20 dBm
MA24208A	Microwave Universal USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24218A	Microwave Universal USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24330A	Microwave CW USB Power Sensor, 10 MHz to 33 GHz, +20 dBm
MA24340A	Microwave CW USB Power Sensor, 10 MHz to 40 GHz, +20 dBm
MA24350A	Microwave CW USB Power Sensor, 10 MHz to 50 GHz, +20 dBm
MA25100A	RF Power Indicator
	Directional Antennas
2000-1411-R	824 MHz to 896 MHz, N (f), 12.3 dBd, Yagi
2000-1412-R	885 MHz to 975 MHz, N (f), 12.6 dBd, Yagi
2000-1413-R	1710 MHz to 1880 MHz, N (f), 12.3 dBd. Yagi
2000-1414-R	1850 MHz to 1990 MHz, N (f), 11.4 dBd, Yagi
2000-1415-R	2400 MHz to 2500 MHz, N (f), 14.1 dBd, Yagi
2000-1416-R	1920 MHz to 2170 MHz, N (f), 14.3 dBd, Yagi
2000-1659-R	698 MHz to 787 MHz, N (f), 10.1 dBi, Yagi
2000-1660-R	1425 MHz to 1535 MHz, N (f), 14.3 dBi, Yagi
2000-1715-R	698 MHz to 2500 MHz, N (f), gain of 2 dBi to 10 dBi, typical
2000-1726-R	Antenna, 2500 MHz to 2700 MHz, N (f), 14.1 dBi, Yagi
2000-1747-R	Antenna, Log Periodic, 300 MHz to 7000 MHz, N (f), 5.1 dBi, typical
2000-1748-R	Antenna, Log Periodic, 1 GHz to 18 GHz, N (f), 6 dBi, typical
2000-1777-R	Portable Directional Antenna, 9 kHz to 20 MHz, N (f)
2000-1778-R	Portable Directional Antenna, 20 MHz to 200 MHz, N (f)
2000-1779-R	Portable Directional Antenna, 200 MHz to 500 MHz, N (f)
2000-1812-R	Portable Yagi Antenna, 450 MHz to 512 MHz, N (f), 7.1 dBi
2000-1825-R	Portable Yagi Antenna, 380 MHz to 430 MHz, N (f), 7.1 dBi
	Portable Antennas
2000-1200-R	806 MHz to 866 MHz, SMA (m), 50Ω
2000-1473-R	870 MHz to 960 MHz, SMA (m), 50Ω
2000-1035-R	896 MHz to 941 MHz, SMA (m), 50Ω (1/2 wave)
2000-1030-R	1710 MHz to 1880 MHz, SMA (m), 50Ω (1/2 wave)
2000-1474-R	1710 MHz to 1880 MHz with knuckle elbow (1/2 wave)
2000-1031-R	1850 MHz to 1990 MHz, SMA (m), 50Ω (1/2 wave)
2000-1475-R	1920 MHz to 1980 MHz and 2110 MHz to 2170 MHz, SMA (m), 50Ω
2000-1032-R	2400 MHz to 2500 MHz, SMA (m), 50Ω (1/2 wave)
2000-1361-R	2400 MHz to 2500 MHz, 5000 MHz to 6000 MHz, SMA (m), 50Ω
2000-1751-R	698 MHz to 960 MHz, 1710 MHz to 2100 MHz, 2500 MHz to 2700 MHz, SMA (m), 2 dB typical, 50Ω
2000-1636-R	Antenna Kit (Consists of: 2000-1030-R, 2000-1031-R, 2000-1032-R, 2000-1200-R, 2000-1035-R, 2000-1361-R, and carrying pouch)
2000-1487-R	VHF/UHF, Telescopic Whip antenna, straight or 90°, BNC (m), 50Ω

Continued on next page

Model/Order No.	Name
	Bandpass Filters
1030-114-R	806 MHz to 869 MHz, N (m) to SMA (f), 50Ω
1030-109-R	824 MHz to 849 MHz, N (m) to SMA (f), 50Ω
1030-110-R	880 MHz to 915 MHz, N (m) to SMA (f), 50Ω
1030-111-R	1850 MHz to 1910 MHz, N (m) to SMA (f), 50Ω
1030-112-R	2400 MHz to 2484 MHz, N (m) to SMA (f), 50Ω
1030-105-R	890 MHz to 915 MHz, N (m) to N (f), 50Ω
1030-106-R	1710 MHz to 1790 MHz, N (m) to N (f), 50Ω
1030-107-R	1910 MHz to 1990 MHz, N (m) to N (f), 50Ω
1030-149-R	High Pass, 150 MHz, N (m) to N (f), 50Ω
1030-150-R	High Pass, 400 MHz, N (m) to N (f), 50Ω
1030-151-R	High Pass, 700 MHz, N (m) to N (f), 50Ω
1030-152-R	Low Pass, 200 MHz, N (m) to N (f), 50Ω
1030-153-R	Low Pass, 550 MHz, N (m) to N (f), 50Ω
1030-155-R	2500 MHz to 2700 MHz, N (m) to N (f), 50Ω
1030-178-R	1920 MHz to 1980 MHz, N (m) to N (f), 50Ω
1030-179-R	777 MHz to 798 MHz, N (m) to N (f), 50Ω
1030-180-R	2500 MHz to 2570 MHz, N (m) to N (f), 50Ω
2000-1684-R	791 MHz to 821 MHz, N (m) to N (f), 50Ω
2000-1734-R	699 MHz to 715 MHz, N (m) and N (f), 50Ω
2000-1735-R	776 MHz to 788 MHz, N (m) and N (f), 50Ω
2000-1736-R	815 MHz to 850 MHz, N (m) and N (f), 50Ω
2000-1737-R	1711 MHz to 1756 MHz, N (m) and N (f), 50Ω
2000-1738-R	1850 MHz to 1910 MHz, N (m) and N (f), 50Ω
2000-1739-R	880 MHz to 915 MHz, N (m) and N (f), 50Ω
2000-1740-R	1710 MHz to 1785 MHz, N (m) and N (f), 50Ω
2000-1741-R	1920 MHz to 1980 MHz, N (m) and N (f), 50Ω
2000-1742-R	832 MHz to 862 MHz, N (m) and N (f), 50Ω
2000-1743-R	2500 MHz to 2570 MHz, N (m) and N (f), 50Ω
2000-1799-R	2305 MHz to 2320 MHz, N (m) and N (f), 50Ω
2000-1911-R	703 MHz to 748 MHz, N (m) and N (f), 50Ω
2000-1912-R	788 MHz to 798 MHz, N (m) and N (f), 50Ω
2000-1925-R	663 MHz to 698 MHz, N (m) and N (f), 50Ω
2000-1926-R	776 MHz to 806 MHz, N (m) and N (f), 50Ω
	Attenuators N Type (up to 18 GHz)
3-1010-122	20 dB, 5 W, DC to 12.4 GHz, N (m) to N (f)
42N50-20	20 dB, 5 W, DC to 18 GHz, N (m) to N (f)
42N50A-30	30 dB, 5 W, DC to 18 GHz, N (m) to N (f)
3-1010-123	30 dB, 50 W, DC to 8.5 GHz, N (m) to N (f)
1010-127-R	30 dB, 150 W, DC to 3 GHz, N (m) to N (f)
3-1010-124	40 dB, 100 W, DC to 8.5 GHz, N (m) to N (f), Uni-directional
1010-121-R	40 dB, 100 W, DC to 18 GHz, N (m) to N (f), Uni-directional
1010-128-R	40 dB, 150 W, DC to 3 GHz, N (m) to N (f)
	Related Literature, Application Notes
10100-00065	Product Information, Compliance, and Safety
10580-00349	Spectrum Analyzer Measurement Guide
10580-00240	Power Meter Measurement Guide
10580-00289	VNA Measurement Guide
10580-00305	VNA Master User Guide
10580-00306	VNA Master Programming Manual
10580-00307	VNA Master Maintenance Manual
11410-00387	Primer on Vector Network Analysis
11410-00424	USB Power Sensor MA24106A
11410-00472	Measuring Interference
11410-00504	Microwave USB Power Sensor MA241x8A
11410-00531	Practical Tips on Making "Vector Voltmeter (VVM)" Phase Measurements using VNA Master (Option 15)
11410-00545	VNA Master + Spectrum Analyzer Brochure
11410-00549	VNA Master + Spectrum Analyzer Technical Data Sheet
11410-00700	Evaluation of RF Network Testing

Model/Order No.	Name
	Adapters
1091-26-R	SMA (m) to N (m), DC to 18 GHz, 50Ω
1091-27-R	SMA (f) to N (m), DC to 18 GHz, 50Ω
1091-80-R	SMA (m) to N (f), DC to 18 GHz, 50Ω
1091-81-R	SMA (f) to N (f), DC to 18 GHz, 50Ω
1091-172-R	BNC (f) to N (m), DC to 1.3 GHz, 50Ω
1091-465-R	DC to 6 GHz, 4.3-10(f) to N(f), 50Ω
1091-467-R	DC to 6 GHz, 4.3-10(m) to N(f), 50Ω
510-90-R	7/16 DIN (f) to N (m), DC to 7.5 GHz, 50Ω
510-91-R	7/16 DIN (f) to N (f), DC to 7.5 GHz, 50Ω
510-92-R	7/16 DIN (m) to N (m), DC to 7.5 GHz, 50Ω
510-93-R	7/16 DIN (m) to N (f), DC to 7.5 GHz, 50Ω
510-96-R	7/16 DIN (m) to 7/16 DIN (m), DC to 7.5 GHz, 50Ω
510-97-R	7/16 DIN (f) to 7/16 DIN (f), DC to 7.5 GHz, 50Ω
513-62-R	TNC (f) to N (f), DC to 18 GHz, 50Ω
1091-315-R	TNC (m) to N (f), DC to 18 GHz, 50Ω
1091-324-R	TNC (f) to N (m), DC to 18 GHz, 50Ω
1091-325-R	TNC (m) to N (m), DC to 18 GHz, 50Ω
1091-317-R	TNC (m) to SMA (f), DC to 18 GHz, 50Ω
1091-318-R	TNC (m) to SMA (m), DC to 18 GHz, 50Ω
1091-323-R	TNC (m) to TNC (f), DC to 18 GHz, 50Ω
1091-326-R	TNC (m) to TNC (m), DC to 18 GHz, 50Ω
34RKNF50	Ruggedized K (m) to N (f), DC to 18 GHz, 50Ω
510-102-R	N (m) to N (m), DC to 11 GHz, 50Ω, 90 degrees right angle
	Precision Adapters
34NN50A	N (m) to N (m), DC to 18 GHz, 50Ω
34NFNF50	N (f) to N (f), DC to 18 GHz, 50Ω
34NK50	DC to 18 GHz, N (m) to K (m), 50Ω
34NFKF50	DC to 18 GHz, N (m) to K (f), 50Ω
K220B	DC to 40 GHz, K (m) to K (m), 50Ω
K222B	DC to 40 GHz, K (f) to K (f), 50Ω
K224B	DC to 40 GHz, K (m) to K (f), 50Ω
	NEON® MA8100A Signal Mapper
MA8100A-001	NEON Signal Mapper with Anritsu Integration and Tracking Unit. Includes 1 year NEON Software License with 1 year of maintenance and support and 1 year of Cloud Service.
MA8100A-003	NEON Signal Mapper with Anritsu Integration and Tracking Unit. Includes 3 year NEON Software License with 3 years of maintenance and support and 3 years of Cloud Service.
MA8100A-005	NEON Signal Mapper with Anritsu Integration and Tracking Unit. Includes 5 year NEON Software License with 5 years of maintenance and support and 5 years of Cloud Service.
MA8100A-100	NEON Signal Mapper with Anritsu Integration and Tracking Unit. Includes Perpetual NEON Software License with 3 years of maintenance and support and 3 years of Cloud Service.
2300-606	Perpetual NEON Software License with 3 years of maintenance and support and 3 years of Cloud Service. Part number can also be used to order a perpetual license after a limited term license has expired.
2300-612	Renewal of 1 year NEON Software License with 1 year of maintenance and support and 1 year of Cloud Service.
2300-613	Renewal of 3 year NEON Software License with 3 years of maintenance and support and 3 years of Cloud Service.
2300-614	Renewal of 5 year NEON Software License with 5 years of maintenance and support and 5 years of Cloud Service.

Waveguide Calibration Components and WG/Coaxial Adapters, Rectangular Type 50Ω

Recommended waveguide calibration procedure requires two offset shorts and a precise load. The waveguide/coax adapter, shown attached to test port #1, adapts the VNA Master test ports to the waveguide under test.

Frequency Range (GHz)	1/8 Offset	3/8 Offset	Termination	Coax to Waveguide Adapter	Compatible Flanges
3.95 to 5.85	23UA187-R	24UA187-R	26UA187-R	35UA187N-R	CPR187F-R, CPR187G-R, UG-1352/U-R, UG-1353/U-R, UG-1728/U-R, UG-1729/U-R, UG-148/U-R, UG-149A/U-R
5.85 to 8.20	23UA137-R	24UA137-R	26UA137-R	35UA137N-R	CPR137F-R, CPR137G-R, UG-1356/U-R, UG-1357/U-R, UG-1732/U-R, UG-1733/U-R, UG-343B/U-R, UG-344/U-R, UG-440B/U-R, UG-441/U-R
7.05 to 10.00	23UA112-R	24UA112-R	26UA112-R	35UA112N-R	CPR112F-R, CPR112G-R, UG-1358/U-R, UG-1359/U-R, UG-1734/U-R, UG-1735/U-R, UG-52B/U-R, UG-51/U-R, UG-137B/U-R, UG-138/U-R
8.20 to 12.40	23UA90-R	24UA90-R	26UA90-R	35UA90N-R	CPR90F-R, CPR90G-R, UG-1360/U-R, UG-1361/U-R, UG-1736/U-R, UG-1737/U-R, UG-40B/U-R, UG-39/U-R, UG-135/U-R, UG-136B/U-R
12.40 to 18.00	23UA62-R	24UA62-R	26UA62-R	35UA62N-R	UG-541A/U-R, UG-419/U-R, UG-1665/U-R, UG1666/U-R
17.00 to 26.50	23UA42-R	24UA42-R	26UA42-R	35UA42K-R	UG-596A/U-R, UG-595/U-R, UG-597/U-R, UG-598A/U-R
26.50 to 40.00	23UA28-R	24UA28-R	26UA28-R	35UA28K-R	UG-599/U-R
3.30 to 4.90	23UM40-R	24UM40-R	26UM40-R	35UM40N-R	PDR40-R
3.95 to 5.85	23UM48-R	24UM48-R	26UM48-R	35UM48N-R	CAR48-R, PAR48-R, UAR48-R, PDR48-R
5.85 to 8.20	23UM70-R	24UM70-R	26UM70-R	35UM70N-R	CAR70-R, PAR70-R, UAR 70-R, PDR70-R
7.05 to 10.00	23UM84-R	24UM84-R	26UM84-R	35UM84N-R	CBR84-R, UBR84-R, PBR84-R, PDR84-R
8.20 to 12.40	23UM100-R	24UM100-R	26UM100-R	35UM100N-R	CBR100-R, UBR100-R, PBR100-R, PDR100-R
10.00 to 15.00	23UM120-R	24UM120-R	26UM120-R	35UM120N-R	CBR120-R, UBR120-R, PBR120-R, PDR120-R
12.40 to 18.00	23UM140-R	24UM140-R	26UM140-R	35UM140N-R	CBR140-R, UBR140-R, PBR140-R, PDR140-R
17.00 to 26.50	23UM220-R	24UM220-R	26UM220-R	35UM220K-R	CBR220-R, UBR220-R, PBR220-R, PDR220-R

*: For Coaxial/Waveguide Adapter part numbers, N designates Type N and K designates K-Connector

VNA Master™ Handheld Vector Network Analyzer + Spectrum Analyzer

MS202xB VNAs/MS203xB VNAs + Spectrum Analyzers

VNA: 500 kHz to 6 GHz/Spectrum Analyzer: 9 kHz to 6 GHz

Affordable Handheld Vector Network + Spectrum Analyzer for Cable, Antenna, and Signal Analysis Anytime, Anywhere

Anritsu proudly offers the VNA Master + Spectrum Analyzer MS202xB/MS203xB, the industry's most affordable and compact handheld solution to address cable, antenna, component, and signal analysis needs in the field. All VNA Master MS202xB/3xB models offer benchtop accuracy and high performance S-parameter measurements in portable form. With frequency coverage from 500 kHz up to 4 GHz or 6 GHz in a truly handheld, battery-operated, rugged, multi-function instrument, the VNA Master also provides a field-friendly touchscreen user interface. VNA Master MS2034B/35B models include a powerful spectrum analyzer which multiplies user convenience by combining both a VNA and a separate spectrum analyzer into a single measurement powerhouse for the harsh RF and physical environments of field test. Whether it is for spectrum monitoring, broadcast proofing, interference analysis, RF and microwave measurements, regulatory compliance, 3G/4G, Land Mobile Radio, or wireless data network measurements, this VNA/Spectrum Analyzer combination is the ideal instrument for making fast and reliable measurements in the field.

Vector Network Analyzer Performance and Functional Highlights (All Models)

- Broadband coverage of 500 kHz to 4 GHz/6 GHz
- 1-path, 2-port Vector Network Analyzer
- Intuitive Graphical User Interface (GUI) with convenient Touch Screen
- VNA-quality error correction for directivity and source match
- 2-port Transmission Measurements: High/Default/Low Power
- Outstanding calibration stability, minimal drift error
- Calibration Interpolation feature adds flexibility
- User-defined overlays for viewing multiple S-Parameters
- Arbitrary data points up to 4001
- IF Bandwidth selections of 10 Hz to 100 kHz
- 100 dB Transmission Dynamic Range
- 850 µs/data point sweep speed
- Greater than 3 hour battery life
- USB and (Optional) Ethernet for data transfer and instrument control
- User-selectable menu options: Choose either VNA or Field Mode for simplified Cable & Antenna analysis
- Field upgradable firmware
- Internal Flash Memory: 2 GB — Store more than 4000 traces and setups in memory
- Portable: 3.5 kg (7.6 lb)
- Full Speed USB Memory support
- Automate repetitive tasks via optional Ethernet and USB
- High resolution daylight-viewable TFT color display
- "Glove Friendly" Resistive Touchscreen Display
- Distance Domain (Standard with firmware V1.20 and above)
- Internal Bias Tee Option
- Vector Voltmeter Option, ideal for cable phase matching
- High Accuracy Power Meter Option
- GPS Receiver Option
- Polar Format Impedance Display
- Complies with MIL-PRF-28800F Class 2.
- Certified for use in Explosive Atmosphere per MIL-PRF-28800F and MIL-STD-810G

Spectrum Analyzer Performance and Functional (MS203xB Models Only)

- Measure: Occupied Bandwidth, Channel Power, ACPR, C/I
- Interference Analyzer: Spectrogram, Signal Strength, RSSI, Signal ID
- Dynamic Range: >95 dB in 10 Hz RBW
- DANL: –162 dBm in 1 Hz RBW (normalized)
- Phase Noise: –100 dBc/Hz max @ 10 kHz offset at 1 GHz
- Frequency Accuracy: <±50 ppb 3 minutes after GPS lock
- Traces: Normal, Max Hold, Min Hold, Average, # of Averages
- Detectors: Peak, Negative, Sample, Quasi-peak, and RMS
- Markers: 6, each with a Delta Marker, or
  1 Reference Marker with 6 Delta Markers
- Trace Save-on-Event: crossing limit line or sweep complete
- PIM Hunting
- Limit Lines: up to 41 segments with one-button envelope creation
- AM/FM/SSB Audio-only Demodulation
- Optional AM/FM/PM Demodulation Analyzer
- Store thousands of traces internally
- Channel Scanner Option
- GPS tagging of stored traces
- Internal Preamplifier standard
- High Accuracy Power Meter Option
- Coverage Mapping Option

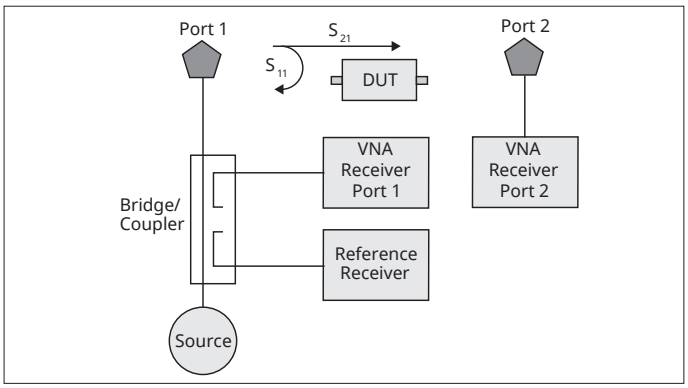
Definitions

All specifications and characteristics apply under the following conditions, unless otherwise noted:

Specifications	All specifications and characteristics apply under the following conditions, unless otherwise stated:
Temperature Range	Over the 23°C±5°C temperature range.
Warm-Up Time	After 10 minutes of warm-up time in VNA mode, where the instrument is left in the ON state.
Reference Signal	When using internal reference signal.
Typical Performance	Typical specifications that are not in parenthesis are not tested and not warranted. They are generally representative of characteristic performance. Typical specifications in parenthesis () represent the mean value of measured units and do not include any guard-bands or uncertainties. They are not warranted.
Uncertainty	A coverage factor of x1 is applied to the measurement uncertainties to facilitate comparison with other industry handheld analyzers.
Time Base Error	Input Frequency × Frequency Reference Error
Calibration Cycle	Calibration is within the recommended 12 month period (residual specifications also require calibration kit calibration cycle adherence.) All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site: www.anritsu.com

Block Diagram

As shown in the following block diagram, the VNA Master has a 2-port, 1-path architecture that automatically measures 2 S-parameters with error-correction precision inherent to VNA operation. The above illustration is a simplified block diagram of the VNA Master 2-port, 1-path architecture. The magnitude AND phase information gained from Vector Network data enables the VNA Master to provide improved field measurements with greater accuracy.



Frequency Range	MS2024/34B: 500 kHz to 4 GHz MS2025/35B: 500 kHz to 6 GHz Frequency Accuracy: 2.5 ppm Frequency Resolution: 1 Hz
Test Port Power (typ.)	VNA Master supports selection of High, Default, or Low test port power. Changing power after calibration can degrade the calibrated performance. Typical power by bands:

Frequency Range	High Port Power (dBm)	Default Port Power (dBm)	Low Port Power (dBm)
500 kHz to <3 GHz	+3	–5	–25
3 GHz to 6 GHz	0	–5	–25

Transmission Dynamic Range	The transmission dynamic range (the difference between test port power and noise floor) using 10 Hz IF Bandwidth and High Port Power: 2 MHz to ≤4 GHz: 100 dB 4 GHz to ≤6 GHz: 90 dB
Sweep Speed (typ.)	Sweep speed in µs/point for IF Bandwidth of 100 kHz, 1001 data points, and single display. The two-receiver architecture will simultaneously collect S_{21} and S_{11} in a single sweep. 500 kHz to 6 GHz : 850 µs/point
Noise Floor	

Frequency Range	Noise Floor (typ.)
500 kHz to 3 GHz	–100 dBm
3 GHz to 4 GHz	–103 dBm
4 GHz to 6 GHz	–93 dBm

Temperature Stability	(S_{11} or S_{21}, Short, 23°C±5°C)

Frequency Range	Magnitude (typ.)	Phase (typ.)
500 kHz to 6 GHz	0.020 dB/°C	0.200 deg/°C

Interference Immunity	On-Channel: +17 dBm at >1.0 MHz from carrier frequency On-Frequency: 0 dBm within ±10 kHz of the carrier frequency

VNA Functional Specifications

Measurements	Measurement Parameters	S_{11}, S_{21}
	Number of Traces	Four: TR1, TR2, TR3, TR4
	Trace Format	Single, Dual, Tri, Quad. When used with Number of Traces, overlays are possible including a Single Format with Four trace overlays.
	Graph Types	Log Magnitude, SWR, Phase, Real, Imaginary, Group Delay, Smith Chart, Log Mag/2 (1-Port Cable Loss), Linear Polar, Log Polar, Real Impedance, Imaginary Impedance
	Domains	Frequency Domain, Distance Domain
	Frequency	Start Frequency, Stop Frequency, Center Frequency, Span
	Distance	Start Distance, Stop Distance
	Frequency Sweep Type: Linear	Single Sweep, Continuous
	Data Points	2 to 4001 (arbitrary setting); data points can be reduced without recalibration.
	Limit Lines	Upper, Lower, 10 segmented Upper, 10 segmented Lower
	Test Limits	Pass/Fail for Upper, Pass/Fail for Lower, Limit Audible Alarm
	Data Averaging	Sweep-by-sweep
	Smoothing	0 to 20%
	IF Bandwidth	10, 20, 50, 100, 200, 500, 1 k, 2 k, 5 k, 10 k, 20 k, 50 k, 100 k (Hz)
	Reference Plane	The reference planes of a calibration (or other normalization) can be changed by entering a line length. Assumes no loss, flat magnitude, linear phase, and constant impedance.
	Auto Reference Plane Extension	Instead of manually entering a line length, this feature automatically adjusts phase shift from the current calibration (or other normalization) to compensate for external cables (or test fixtures). Assumes no loss, flat magnitude, linear phase, and constant impedance.
	Frequency Range	Frequency range of the measurement can be narrowed (reduces number of data points) within the calibration range without recalibration. When Interpolation is On, narrowed frequency range will retain original number of data points.
	Group Delay Aperture	Defined as the frequency span over which the phase change is computed at a given frequency point. The aperture can be changed without recalibration. 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
	Trace Memory	A separate memory for each trace can be used to store measurement data for later display. The trace data can be saved and recalled.
	Trace Math	Complex trace math operations of subtraction, addition, multiplication, or division are provided.
	Number of Markers	12, arbitrary assignments to any trace
	Marker Types	Reference, Delta
	Marker Readout Styles	Log Mag, Cable Loss (Log Mag/2), Log Mag and Phase, Phase, Real and Imaginary, SWR, Impedance, Admittance, Normalized Impedance, Normalized Admittance, Polar Impedance, and Group Delay
	Marker Search	Peak Search, Valley Search, Find Marker Value
	Calibration Type	Full S_{11}, 1-Path, 2-Port (S_{11} and S_{21}), Response S_{11}, Response S_{21}
	Calibration Methods	Short-Open-Load-Through (SOLT)
	Calibration Standards' Coefficients	Coax: N-Connector, K-Connector, 7/16, TNC, SMA, and four User Defined
	Cal Correction Toggle	On/Off
	Interpolation	On/Off (Interpolation may be activated before or after calibration)
	Impedance Conversion (Smith Chart)	Support for 50Ω and 75Ω are provided.
	Units	Meters, Feet
	Bias Tee Settings	Internal, Off
	Timebase Reference	Internal
	File Storage Types	Measurement, Setup (with CAL), Setup (without CAL), S2P (Real/Imag), S2P (Lin Mag/Phase), S2P (Log Mag/Phase), JPEG
	Ethernet Configuration	DHCP or Manual (Static); IP, Gateway, Subnet entries
	Languages	English, French, German, Spanish, Chinese, Japanese, Korean, Italian, Russian plus one User Defined

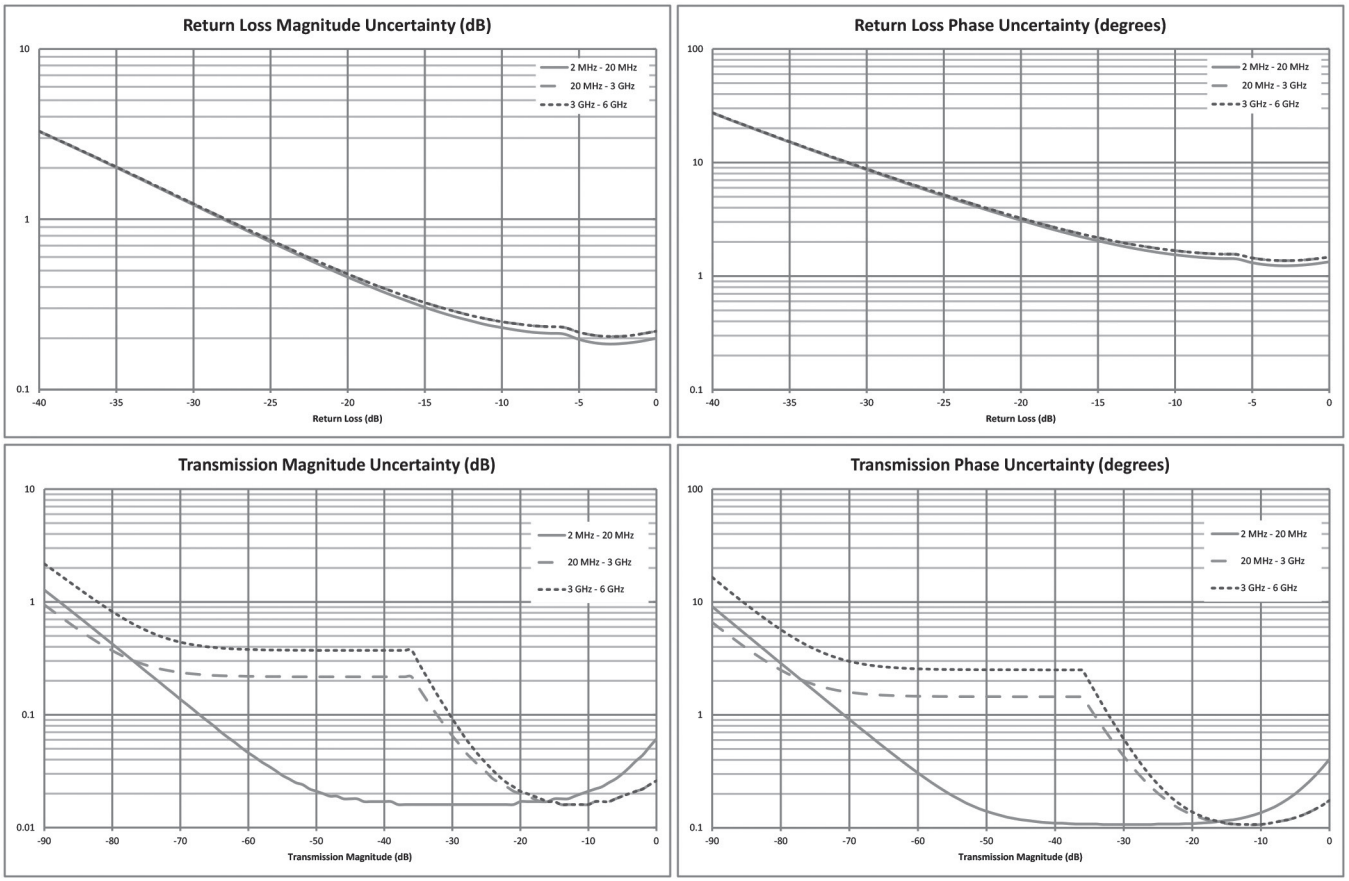
Corrected System Performance and Uncertainties — High Port Power, N-Type

Measurement Accuracy OSLN50A-8 or OSLNF50A-8, TOSLN50A-8 or TOSLNF50A-8.

Full 1-path, 2-port forward path calibration with isolation, high power, 10 Hz IFBW, no averaging, 10 minute warm-up.
OSLN50A-8, OSLNF50A-8, TOSLN50A-8, or TOSLNF50A-8 calibration kit. Reflection and Transmission Tracking are typical.

Frequency Range	Directivity (dB)	Source Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
<20 MHz	≥42	≥30	±0.01	±0.01
20 MHz to <3 GHz	≥42	≥30	±0.05	±0.01
3 GHz to 6 GHz	≥42	≥30	±0.05	±0.01

Corrected Measurement Uncertainty (Transmission from Port 1 to Port 2)



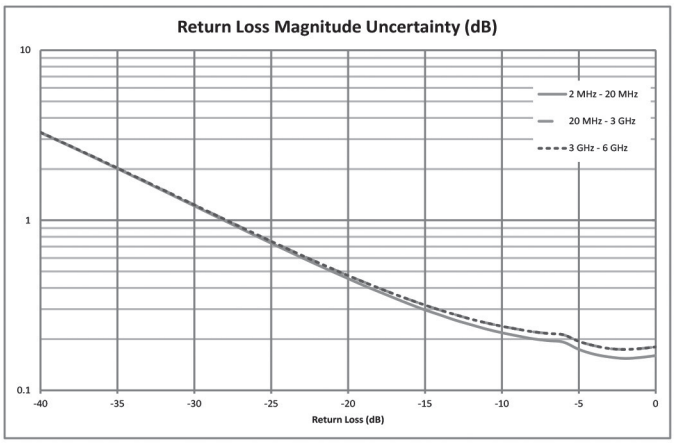
Corrected System Performance and Uncertainties — High Port Power, K-Type

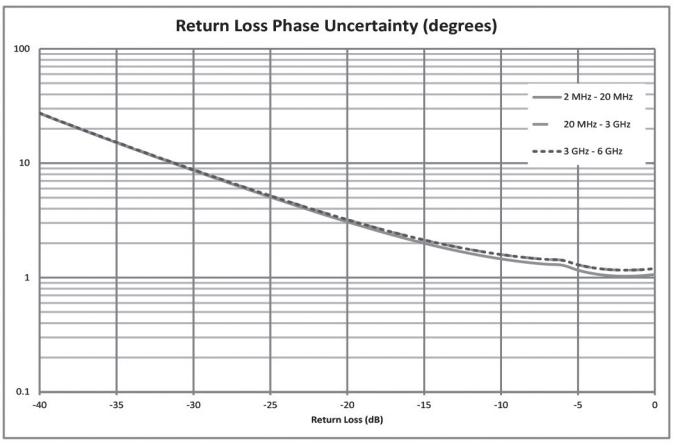
Measurement Accuracy TOSLK50A-20 or TOSLKF50A-20. Compatible with 3.5 mm and SMA connectors.

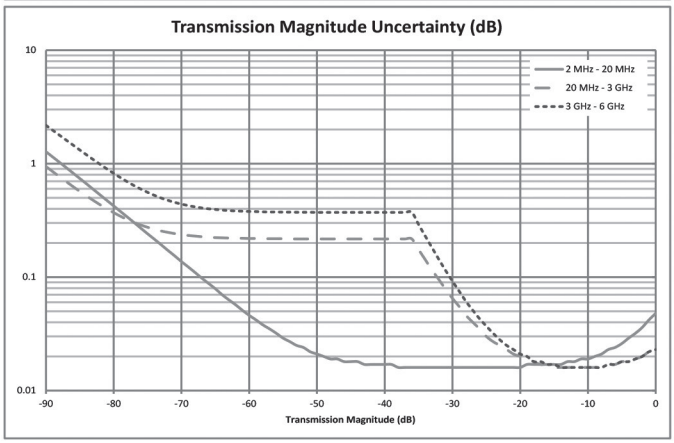
Full 1-path, 2-port forward path calibration with isolation, high power, 10 Hz IFBW, no averaging, 10 minute warm-up.
TOSLK50A-20, TOSLKF50A-20 calibration kit. Reflection and Transmission Tracking are typical.

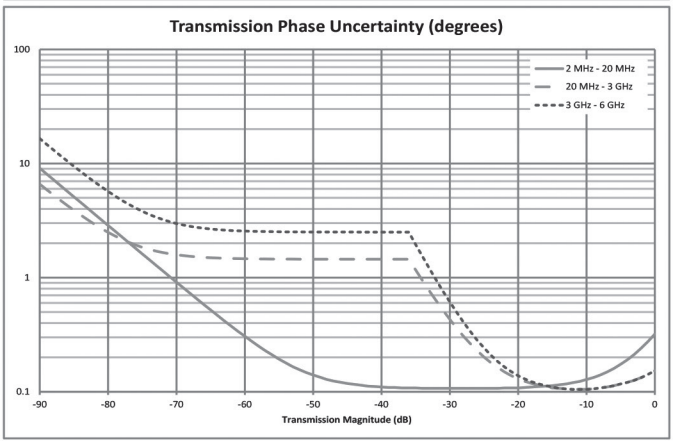
Frequency Range	Directivity (dB)	Source Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
<20 MHz	≥42	≥33	±0.01	±0.01
20 MHz to <3 GHz	≥42	≥33	±0.05	±0.01
3 GHz to 6 GHz	≥42	≥33	±0.05	±0.01

Corrected Measurement Uncertainty (Transmission from Port 1 to Port 2)









Spectrum Analyzer Performance Specifications (Models MS203xB only)

Frequency	Frequency Range	MS2034B: 9 kHz to 4 GHz, (tunable to 0 Hz) MS2035B: 9 kHz to 6 GHz, (tunable to 0 Hz)
	Frequency Span	MS2034B: 10 Hz to 4 GHz including zero span MS2035B: 10 Hz to 6 GHz including zero span
	Tuning Resolution	1 Hz
	Frequency Reference	Aging: ±1.0 ppm/year Accuracy: ±1.5 ppm (25°C±25°C) + aging, <±50 ppb with GPS On
	Sweep Time	Minimum 100 ms, 7 µs to 600 seconds in zero span
	Sweep Time Accuracy	±2% in zero span
Bandwidth	Resolution Bandwidth (RBW)	10 Hz to 3 MHz in 1–3 sequence ±10% (1 MHz max in zero-span) (–3 dB bandwidth)
	Video Bandwidth (VBW)	1 Hz to 3 MHz in 1–3 sequence (–3 dB bandwidth) (auto or manually selectable)
	RBW with Quasi-Peak Detection	200 Hz, 9 kHz, 120 kHz (–6 dB bandwidth)
	VBW with Quasi-Peak Detection	Auto VBW is On, RBW/VBW = 1
Spectral Purity	SSB Phase Noise @ 1 GHz	–100 dBc/Hz, –110 dBc/Hz (typ.) @ 10 kHz offset –105 dBc/Hz, –112 dBc/Hz (typ.) @ 100 kHz offset –115 dBc/Hz, –121 dBc/Hz (typ.) @ 1 MHz offset
Amplitude	Dynamic Range	>102 dB (2.4 GHz), 2/3 (TOI-DANL) in 1 Hz RBW
	Measurement Range	DANL to +26 dBm (≥ 50 MHz) DANL to 0 dBm (<50 MHz)
	Maximum Continuous Input	+30 dBm Peak
	Display Range	1 to 15 dB/div in 1 dB steps, ten divisions displayed
	Reference Level Range	–150 to +30 dBm
	Attenuator Resolution	0 to 55 dB, 5.0 dB steps
	Amplitude Units	Log Scale Modes: dBW, dBm, dBµW, dBV, dBmV, dBµV, dBA, dBmA, dBµA
	Linear Scale Modes	nV, mV, mV, V, kV, nW, mW, mW, W, kW, nA, mA, mA, A
Displayed Average Noise Level (DANL)		(RBW Normalized to 1 Hz, 0 dB attenuation)

	Preamp Off (Reference level –20 dBm)		Preamp On (Reference level –50 dBm)	
	Maximum	Typical	Maximum	Typical
10 MHz to 2.4 GHz	–141 dBm	–146 dBm	–157 dBm	–162 dBm
>2.4 GHz to 4 GHz	–137 dBm	–141 dBm	–154 dBm	–159 dBm
>4 GHz to 5 GHz	–134 dBm	–138 dBm	–150 dBm	–155 dBm
>5 GHz to 6 GHz	–126 dBm	–131 dBm	–143 dBm	–150 dBm

Spurs	Residual Spurious	<–90 dBm (RF input terminated, 0 dB input attenuation, >10 MHz)
	Input-Related Spurious	<–75 dBc (0 dB attenuation, –30 dBm input, span <1.7 GHz, carrier offset >4.5 MHz)
	Exceptions (typ.)	<–70 dBc @ <2.5 GHz with 2072.5 MHz Input <–68 dBc @ F1 – 280 MHz with F1 Input <–70 dBc @ F1 + 190.5 MHz with F1 Input <–52 dBc @ 7349 – 2F2 MHz, with F2 Input, where F2 <2437.5 MHz <–55 dBc @ 190.5 ± (F1/2) MHz, F1 <1 GHz
Second Harmonic Distortion	Preamp Off, 0 dB input attenuation, –30 dBm input	
	50 MHz	–56 dBc
	>50 MHz to 200 MHz	–60 dBc (typ.)
	>200 MHz to 3000 MHz	–70 dBc (typ.)
	VSWR	2:1 (typ.)
Third-Order Intercept (TOI)	Preamp Off, –20 dBm tones 100 kHz apart, 10 dB attenuation	
	800 MHz	+16 dBm
	2400 MHz	+20 dBm
	200 MHz to 2200 MHz	+25 dBm (typ.)
	>2.2 GHz to 5.0 GHz	+28 dBm (typ.)
	>5.0 GHz to 6.0 GHz	+33 dBm (typ.)

Spectrum Analyzer Functional Specifications (Models MS203xB only)

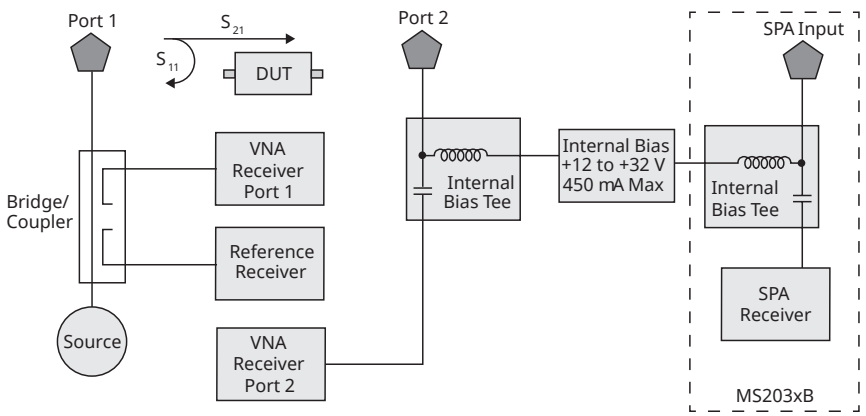
Measurements	Smart Measurements	Field Strength (uses antenna calibration tables to measure dBm/m², dBmV/m, dBV/m, dBµV/m, Volt/m, Watt/m², dBW/m², A/m, dBA/m and Watt/cm²) Occupied Bandwidth (measures 99 to 1% power channel of a signal) Channel Power (measures the total power in a specified bandwidth) ACPR (Adjacent Channel Power Ratio) AM/FM/SSB Demodulation (Wide/Narrow FM, AM, Upper/Lower SSB), (audio out only) C/I (carrier-to-interference ratio) Emission Mask Coverage Mapping (requires Option 431 and Option 31) PIM Alert Application (available for download) PIM Hunting
Setup Parameters	Frequency	Center/Start/Stop, Span, Frequency Step, Signal Standard, Channel #, Channel Increment
	Amplitude	Reference Level (RL), Scale, Attenuation Auto/Level, RL Offset, Pre-Amp On/Off, Detection
	Span	Span, Span Up/Down (1-2-5), Full Span, Zero Span, Last Span
	Bandwidth	RBW, Auto RBW, VBW, Auto VBW, RBW/VBW, Span/RBW
	File	Save, Recall, Delete, Directory Management
	Save/Recall	Setups, Measurements, Limit Lines, Screen Shots JPEG (save only), Save-on-Event
	Save-on-Event	Crossing Limit Line, Sweep Complete, Save-then-Stop, Clear All
	Application Options	Bias-Tee (On/Off), Impedance (50Ω, 75Ω, Other)
Sweep Functions	Sweep	Single/Continuous, Sweep Mode (Fast, Performance, No FFT), Reset, Detection, Minimum Sweep Time, Trigger Type, Gated Sweep (see Option 90)
	Detection	Peak, RMS, Negative, Sample, Quasi-peak
	Triggers	Free Run, External, Video, Change Position, Manual
Trace Functions	Traces	Up to three Traces (A, B, C), View/Blank, Write/Hold, Trace A/B/C Operations
	Trace A	Operations Normal, Max Hold, Min Hold, Average, # of Averages, (always the live trace)
	Trace B	Operations A → B, B ↔ C, Max Hold, Min Hold
	Trace C	Operations A → C, B ↔ C, Max Hold, Min Hold, A – B → C, B – A → C, Relative Reference (dB), Scale
Marker Functions	Markers	Markers 1–6 each with a Delta Marker, or Marker 1 Reference with Six Delta Markers, Marker Table (On/Off), All Markers Off
	Marker Types	Style (Fixed/Tracking), Noise Marker, Frequency Counter Marker
	Marker Auto-Position	Peak Search, Next Peak (Right/Left), Peak Threshold%, Set Marker to Channel, Marker Frequency to Center, Delta Marker to Span, Marker to Reference Level
	Marker Table	1–6 markers frequency and amplitude plus delta markers frequency offset and amplitude
Limit Line Functions	Limit Lines	Upper/Lower, On/Off, Edit, Move, Envelope, Advanced, Limit Alarm, Default Limit
	Limit Line Edit	Frequency, Amplitude, Add Point, Add Vertical, Delete Point, Next Point Left/Right
	Limit Line Move	To Current Center Frequency, By dB or Hz, To Marker 1, Offset from Marker 1
	Limit Line Envelope	Create Envelope, Update Amplitude, Number of Points (41 max), Offset, Shape Square/Slope
	Limit Line Advanced	Type (Absolute/Relative), Mirror, Save/Recall

Bias Tee (Option 10)

Bias Tee Measurements
For tower mounted amplifier tests, the MS202xB/MS203xB series with optional internal bias tees can supply both DC and RF signals on the center conductor of the cable during measurements. For frequency sweeps in excess of 2 MHz, the VNA Master can supply internal voltage control from +12 V to +32 V in 0.1 V steps up to 450 mA. Bias can be directed to VNA Port 2 or to the Spectrum Analyzer Input Port (MS203xB).

Frequency Range	MS20x4B: 2 MHz to 4 GHz MS20x5B: 2 MHz to 6 GHz
Internal Voltage/Current	+12 V to +32 V at 450 mA (1 A surge for 100 ms)
Internal Resolution	0.1 V
Bias Tee Selections	Internal, Off

The Compact VNA Master offers optional integrated bias tee for supplying DC plus RF to the DUT as shown in this simplified block diagram.



Vector Voltmeter (Option 15)

A phased array system relies on phase matched cables for nominal performance. For this class of application, the VNA Master offers this special software mode to simplify phase matching cables at a single frequency. The similarity between the popular vector voltmeter and this software mode ensures minimal training is required to phase match cables. Operation is as simple as configuring the display for absolute or relative measurements. The easy-to-read large fonts show either reflection or transmission measurements using impedance, magnitude, or VSWR readouts. For instrument landing system (ILS) or VHF Omnidirectional Range (VOR) applications, a table view improves operator efficiency when phase matching up to twelve cables. The MS202xB/MS203xB solution is superior because the signal source is included internally, precluding the need for an external signal generator.

VVM Specifications	CW Frequency Range	500 kHz to 4 GHz/6 GHz
	Source Power	High, Default, Low
	IFBW	10 Hz to 100 kHz in 1-2-5 sequence
	Measurement Display	CW, Table (twelve entries, plus reference)
	Measurement Types	Return Loss, Insertion
	Measurement Format	dB/VSWR/Impedance

High Accuracy Power Meter (Option 19) (Requires external USB power sensor)

Conduct precise measurements of CW and digitally modulated transmitters in the field using this VNA Master software mode with a separately purchased Anritsu USB power sensor. After specifying the center frequency and zeroing the sensor to ensure accuracy at low power levels, the software offers intuitive operation for absolute and relative readouts in dBm or Watts.

Amplitude	Maximum, Minimum, Offset, Relative On/Off, Units, Auto Scale
Average	# of Running Averages, Max Hold
Zero/Cal	Zero On/Off, Cal Factor (Center Frequency, Signal Standard)
Limits	Limit On/Off, Limit Upper/Lower

Power Sensor Model	MA24105A	MA24106A	MA24108A/18A/26A	MA24208A/18A	MA24330A/40A/50A
Description	Inline High Power Sensor	High Accuracy RF Power Sensor	Microwave USB Power Sensor	Microwave Universal USB Power Sensor	Microwave CW USB Power Sensor
Frequency Range	350 MHz to 4 GHz	50 MHz to 6 GHz	10 MHz to 8/18/26 GHz	10 MHz to 8 GHz/18 GHz	10 MHz to 33/40/50 GHz
Connector	Type N (f), 50Ω	Type N (m), 50Ω	Type N (m), 50Ω (8 GHz/18 GHz) Type K (m), 50Ω (26 GHz)	Type N (m), 50Ω	Type K (m), 50Ω (33 GHz/40 GHz) Type V (m), 50Ω (50 GHz)
Dynamic Range	+3 to +51.76 dBm (2 mW to 150 W)	–40 to +23 dBm (0.1 µW to 200 mW)	–40 to +20 dBm (0.1 µW to 100 mW)	–60 to +20 dBm (1 nW to 100 mW)	–70 to +20 dBm (0.1 nW to 100 mW)
Measurand	True-RMS	True-RMS	True-RMS, Slot Power, Burst Average Power	True-RMS, Slot Power, Burst Average Power	Average Power
Measurement Uncertainty	± 0.17 dB*1	± 0.16 dB*2	± 0.18 dB*3	± 0.17 dB*4	± 0.17 dB*5
Data sheet (for complete specifications)	11410-00621	11410-00424	11410-00504	11410-00841	11410-00906

*1: Expanded uncertainty with K = 2 for power measurements of a CW signal greater than +20 dBm with a matched load. Measurement results referenced to the input side of the sensor.
*2: Total RSS measurement uncertainty (0°C to 50°C) for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.
*3: Expanded uncertainty with K = 2 for power measurements of a CW signal greater than –20 dBm with zero mismatch errors.
*4: Power uncertainty expressed with two sigma confidence level for CW measurement after zero operation. Includes calibration factor and linearity over temperature uncertainties, but not the effects of mismatch, zero set and drift, or noise.
*5: Includes linearity over temperature uncertainties, but not the effects of calibration factor, mismatch, zero set and drift, and noise.

Interference Analyzer (Option 25) (Models MS203xB only, GPS Option 31 recommended)

Measurements	Spectrum	Field Strength Occupied Bandwidth Channel Power Adjacent Channel Power (ACPR) AM/FM/SSB Demodulation (Wide/Narrow FM, Upper/Lower SSB – audio out only) Carrier-to-Interference ratio (C/I)
	Spectrogram	Collect data up to 72 Hours
	Signal Strength	Gives visual and aural indication of signal strength
	Received Signal Strength Indicator (RSSI)	Collect data up to 168 Hours
	Signal ID	Up to 12 signals Center Frequency Bandwidth Signal Type: FM, GSM, W-CDMA, CDMA, Wi-Fi Closest Channel Number Number of Carriers
	Signal-to-Nose Ratio (SNR)	>10 dB
	Interference Mapping	Triangulate location of interference with on-display maps
	Application Options	Bias-Tee (On/Off), Impedance (50Ω, 75Ω, Other)

Channel Scanner (Option 27) (Models MS203xB only, GPS Option 31 recommended)

General	Number of Channels	1 to 20 Channels
	Measurements	Graph/Table, Max Hold (On/5 s/Off), Freq/Channel, Current/Max, Single/Dual Color
	Scanner	Scan Channels, Scan Frequencies, Scan Customer List, Scan Script Master™
	Amplitude	Reference Level, Scale
	Custom Scan	Scan Signal Standard, Channel, # of Channels, Channel Step Size, Custom Scan
	Frequency Range	9 kHz to 4 GHz (MS2034B), 9 kHz to 6 GHz (MS2035B)
	Frequency Accuracy	±10 Hz + Time base error
	Measurement Range	–110 to +26 dBm
	Application Options	Bias-Tee (On/Off), Impedance (50Ω, 75Ω, Other)

GPS (Option 31) (requires external GPS antenna, sold separately)

Built-in GPS provides location information (latitude, longitude, altitude) and Universal Time (UT) information for storage along with trace data so that you can later verify that measurements were taken at the right location. The GPS option requires a separately ordered Anritsu GPS antenna. Frequency accuracy is enhanced for the Spectrum Analyzer (on MS203xB models) when GPS is active and has achieved satellite lock.

Setup	On/Off, Antenna Voltage 3.3 V/5.0 V, GPS Info
GPS Time/Location Indicator	Time, Latitude, Longitude and Altitude on display Time, Latitude, Longitude and Altitude with trace storage
High Frequency Accuracy	Spectrum Analyzer, Interference Analyzer, CW Signal Analyzers <±50 ppb with GPS On, GPS antenna connected, 3 minutes after satellite lock in selected mode
Connector	SMA, Female

Ethernet Connectivity (Formerly Option 411)

Connector	RJ45
LAN Speed	10 Mbps
Mode	Static, DHCP
Static IP settings	IP address Subnet Mask IP Gateway
Remote Control	Fully remote programmable via SCPI commands and/or remote access utility provided with Master Software Tools
Data Upload	With Line Sweep Tools or Master Software Tools through a LAN connection

Distance Domain (Formerly Option 501, now standard with firmware v1.20 or greater)

Distance-to-Fault Analysis (standard with firmware v1.20 and above) is a powerful field test tool to analyze cables for faults, including minor discontinuities that may occur due to a loose connection, corrosion, or other aging effects. By using Frequency Domain Reflectometry (FDR), the Compact VNA Master exploits a user-specified band of full power operational frequencies (instead of DC pulses from TDR approaches) to more precisely identify discontinuities. The Compact VNA Master converts S-parameters from frequency domain into distance domain on the horizontal display axis, using a mathematical computation called Inverse Fourier Transform. Connect a reflection at the opposite end of the cable, and the discontinuities appear versus distance to reveal any potential maintenance issues. When access to both ends of the cable is convenient, a similar distance domain analysis is available on transmission measurements.

Distance Domain, will improve your productivity with displays of the cable in terms of discontinuities versus distance. This readout can then be compared against previous measurements (from stored data) to determine whether any degradations have occurred since installation (or the last maintenance activity). More importantly, you will know precisely where to go to fix the problem and so minimize or prevent downtime of the system.

Coverage Mapping (Option 431) (Models MS203xB only. Requires GPS)

Measurements	Indoor Mapping	RSSI and ACPR
	Outdoor Mapping	RSSI and ACPR
Setup Parameters	Frequency	Center/Start/Stop, Span, Freq Step, Signal Standard, Channel #, Channel Increment
	Amplitude	Reference Level (RL), Scale, Attenuation Auto/Level, RL Offset, Pre-Amp On/Off, Detection
	Span	Span, Span Up/Down (1-2-5), Full Span, Zero Span, Last Span
	BW	RBW, Auto RBW, VBW, Auto VBW, RBW/VBW, Span/VBW
	Measurement Setup	ACPR, RSSI
	Point Distance/Time Setup	Repeat Type Time Distance
	Save Points Map	Save KML, JPEG, Tab Delimited
	Recall Points Map	Recall Map, Recall KML Points only, Recall KML Points with Map, Recall Default Grid

AM/FM/PM Demodulation Analyzer (Option 509) (Models MS203xB only)

Measurements							
Display Type	RF Spectrum AM/FM/PM	Audio Spectrum (AM)	Audio Spectrum (FM/PM)	Audio Waveform (AM)	Audio Waveform (FM/PM)	Summary (AM)	Summary (FM/PM)
Graphic Display	Power (dBm) vs. Frequency	Depth (%) vs. Modulation Frequency	Deviation (kHz/rad) vs. Modulation Frequency	Depth (%) vs. Time	Deviation (kHz/rad) vs. Time	None	None
Numerical Displays	Carrier Power Carrier Frequency Occupied Bandwidth	AM Rate RMS Depth (Pk-Pk)/2 Depth SINAD* THD* Distortion/Total Vrms*	FM/PM Rate RMS Deviation (Pk-Pk)/2 Deviation SINAD* THD* istortion/Total Vrms*	AM Rate RMS Depth (Pk-Pk)/2 Depth SINAD* THD* Distortion/Total Vrms*	FM/PM Rate RMS Depth (Pk-Pk)/2 Depth SINAD* THD* Distortion/Total Vrms*	RMS Depth (AM) Peak + Depth Peak – Depth (Pk-Pk)/2 Depth Carrier Power Carrier Frequency Occupied Bandwidth AM Rate SINAD* THD* Distortion/Total Vrms*	RMS Deviation (FM/PM) Peak + Depth Peak – Depth (Pk-Pk)/2 Depth Carrier Power Carrier Frequency Occupied Bandwidth AM Rate SINAD* THD* Distortion/Total Vrms*

*: Requires Sinewave modulation

Setup Parameters	Frequency	Center Freq, Span, Freq Step, Signal Standard, Channel, Channel Increment, Set Carrier Freq
	Amplitude	Scale, Power Offset, Adjust Range
	Setup	Demod Type (AM, FM, PM), IFBW, Auto IFBW
	Measurements	RF Spectrum AM/FM/PM, Audio Spectrum (AM/FM/PM), Audio Waveform (AM/FM/PM), Summary (AM/FM/PM), Average
	Marker	On/Off, Delta, Peak Search, Marker Freq to Center, Marker to Ref Lvl, Marker Table, All Markers Off
Specifications	AM	Modulation Rate: ±1 Hz (<100 Hz), ±2% (>100 Hz) Depth: ±5% for (Modulation rates 10 Hz to 100 kHz)
	FM	Modulation Rate: ±1 Hz (<100 Hz); ±2% (100 Hz to 100 kHz) Deviation Accuracy: ±5% (100 Hz to 100 kHz)*
	PM	Modulation Rate: ±1 Hz (<100 Hz); ±2% (100 Hz to 100 kHz) Deviation Accuracy: ±5% (deviation 0 to 93 rad, rate 10 Hz to 5 kHz)*
	IF bandwidth	1 kHz to 300 kHz in 1-3 sequence
	Frequency Span	RF Spectrum: 10 kHz to 10 MHz Audio Spectrum: 2 kHz, 5 kHz, 10 kHz, 20 kHz, 70 kHz, 140 kHz
	RBW/VBW	30
	Span/RBW	100
	Sweep time	50 µs to 50 ms (Audio Waveform)

*: IFBW must be greater than 95% occupied BW

Line Sweep Tools (for your PC)

Trace Capture	Browse to Instrument	View and copy traces from the test equipment to your PC using Windows Explorer
	Open Legacy Files	Open DAT files captured with Hand Held Software Tools v6.61
	Open Current Files	Open VNA or DAT files
	Capture plots To	The Line Sweep Tools screen, DAT files, Database, or JPEG
Traces	Trace Types	Return Loss, VSWR, DTF-RL, DTF-VSWR, Cable Loss, Smith and Smith Chart
	Trace Formats	DAT, VNA, CSV, PNG, BMP, JPG, HTML, Data Base, and PDF
Report Generation	Report Generator	Includes GPS location along with measurements
	Report Format	Create reports in HTML or PDF format
	Report Setup	Report Title, Company, Prepared for, Location, Date and Time, Filename, Company logo
	Trace Setup	1 trace Portrait Mode, 2 Trace Portrait Mode, 1 Trace Landscape Mode
Trace Validation	Presets	7 presets allow “one click” setting of up to 6 markers and one limit line
	Marker Controls	6 regular Markers, Marker Peak, Marker valley, Marker between, and frequency entry
	Delta Markers	6 Delta markers
	Limit Line	Enable and drag or value entry. Also works with presets
	Next Trace Button	Next Trace and Previous trace arrow keys allow quick switching between traces
Tools	Cable Editor	Allows creation of custom cable parameters
	Distance to Fault	Converts a Return Loss trace to a Distance to Fault trace
	Measurement Calculator	Converts Real, Imaginary, Magnitude, Phase, RL, VSWR, Rho, and Transmit power
	Signal Standard Editor	Creates new band and channel tables
	Renaming Grid	36 user definable phrases for creation of file names, trace titles, and trace subtitles
Connectivity	Connections	Ethernet, USB cable, USB Memory Stick (Ethernet requires Option 411)

Master Software Tools (for your PC)

Mapping (GPS Required)	Spectrum Analyzer Mode	MapInfo, MapPoint
	Mobile WiMAX OTA, LTE OTA Options	Google Earth, Google Maps, MapInfo
Spectrogram	(Spectrum Monitoring for Interference Analysis and Spectrum Clearing)	
	Source	Recorded Spectrogram or multiple spectrum traces
	Folder Spectrogram	2D View creates a composite file of multiple traces
	Available Displays	Spectrogram, Peak Power vs. Time, Variation in Total Power vs. Time, Peak Frequency vs. Time, Number of Traces Saved vs. Time (useful with Save on Limit Exceeded), Maximum/Average/Minimum Power vs. Time File Filter (Violations over limit lines or deviations from averages) Playback
	Display Functions per Trace	Markers, GPS location altitude and time (when recorded), instrument time Filename per trace for Folder Spectrogram
	Export to Video	Create AVI file of 2D Spectrogram for management review/reports
	Export to 3D Spectrogram	Views (Set Threshold, Markers) - 3D (Rotate X, Y, Z Axis, Level Scale, Signal ID) - 2D (Frequency or Time Domain, Signal ID) - Top Down Playback (Frequency and/or Time Domain)
List/Parameter Editors	Antennas, Cables, Signal Standards	Modify instrument's Antenna, Cable, and Signal Standard List
	Pass/Fail	Create, download, or edit Signal Analysis Pass/Fail Limits
	Script Master	Create Script Master files for GSM/WCDMA or Channel Scanner
	Languages	Modify non-English language menus
	Mobile WiMAX	DL-MAP Parameters
Connectivity	Connections	Connect to PC using USB, LAN, or Direct Ethernet connection (LAN and Ethernet require Option 411)
	Network Search	Find all Anritsu handheld instruments on local network
	Download	Download measurements and live traces to PC for storage and analysis
	Upload	Upload measurements and other files from PC to instrument
	Export	Measurements can be saved in various formats, depending on the measurement type, including JPEG, CSV, and Anritsu DAT format
	Printing	Print individual or all measurement screens

General Specifications

Maximum Input		(Damage Level)
	VNA Port 1 or 2	+23 dBm, ±50 VDC
	Spectrum Analyzer Port	+30 dBm peak, ±50 VDC, Maximum Continuous Input, ≥10 dB attenuation (Models MS203xB, spectrum analyzer input port only)
System Parameters and File Management	System	Status (Temperature, Battery Info, Serial Number, Firmware Version, Options Installed) Self Test, Application Self Test GPS (see Option 31)
	System Options	Name, Date and Time, Ethernet Configuration, Brightness, Volume, Language (English, French, German, Spanish, Chinese, Japanese, Korean, Italian, Russian, Portuguese), Reset (Factory Defaults, Master Reset, Update Firmware)
	File	Save, Recall, Copy, Delete, Directory Management
	Save/Recall	Setups, Measurements, Screen Shots JPEG (save only), Limit Lines
	Copy	Setups, Measurements, Screen Shots JPEG
	Delete	Selected File, All Measurements, All Mode Files, All Content
	Directory Management	Sort Method (Name/Type/Date), Ascend/Descend, Internal/USB, Copy, Format USB
	Internal Trace/Setup Memory	2000 traces, 2000 setups
	External Trace/Setup Memory	Limited by size of USB Flash drive
Connectors	VNA Port 1 or 2	Type N (f), 50Ω
	Spectrum Analyzer Port	Type N (f), 50Ω (MS203xB only)
	GPS	SMA (f)
	External Power	5.5 mm barrel connector, 12.5 VDC to 15 VDC, <4.0 Amps
	USB Interface (2)	Type A, Connect Flash Drive and Power Sensor
	USB Interface	5-pin mini-B, Connect to PC for data transfer
	Headset Jack	3.5 mm barrel connector
	External Reference In	BNC (f), Maximum Input ±5 VDC 1, 5, 10, 13 MHz
	External Trigger/Clock Recovery	BNC (f), Maximum Input ±5 VDC
	Ethernet	RJ45 connector for Ethernet 10/100-BaseT
Display	Type	Resistive Touch Screen
	Size	8.4 in, daylight viewable color LCD
	Resolution	800 × 600
	Pixel Defects	No more than five defective pixels (99.9989% good pixels)

Continued on next page

Power	Field replaceable Battery	Li-Ion, 633-75, 7500 mAh
	DC Power	40 W on battery power only Universal 110 V/220 V AC/DC Adapter 55 W running off AC/DC adaptor while charging battery
	Life time charging cycles	>300 (80% of initial capacity)
	Battery Operation	3.6 hours (typ.)
	Battery Charging Limits	0°C to +45°C, Relative Humidity ≤80%
CE	EMC	2014/30/EU, EN61326-1, EN61000-4-2
	LVD	2014/35/EU, EN61010-1
	RoHS	(EU) 2015/863
RCM	Australia and New Zealand	RCM AS/NZS 4417:2012
KCC	South Korea	KCC-REM-A21-0004
Environmental (MS202xB/3xB) MIL-PRF-28800F, Class 2	Operating Temperature Range	–10°C to +55°C
	Storage Temperature Range	–51°C to +71°C
	Maximum Relative Humidity	95% RH at +30°C, non-condensing
	Vibration, Sinusoidal	5 Hz to 55 Hz
	Vibration, Random	10 Hz to 500 Hz
	Half Sine Shock	30 g_n
	Altitude	4600 meters, operating and non-operating
	Explosive Atmosphere	MIL-PRF-28800F Section 4.5.6.3 MIL-STD-810G, Method 511.5, Procedure 1
Dimensions and Mass	Dimensions	273 (W) × 199 (H) × 91 (D) mm [10.7 (W) × 7.8 (H) × 3.6 (D) in]
	Mass, Including Battery	3.5 kg (7.6 lb)
Warranty	Duration	Standard three-year warranty (battery one-year warranty)

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names. The actual name of the item may differ from the Order Name.

Instrument Options

VNA Master Handheld Vector Network Analyzer + Spectrum Analyzer

Includes standard three-year warranty and Certificate of Calibration and Conformance.

MS2024B	MS2025B	MS2034B	MS2035B	Description
500 kHz to 4 GHz	500 kHz to 6 GHz	500 kHz to 4 GHz	500 kHz to 6 GHz	Vector Network Analyzer
—	—	9 kHz to 4 GHz	9 kHz to 6 GHz	Spectrum Analyzer
MS2024B-0010	MS2025B-0010	MS2034B-0010	MS2035B-0010	Built-in Bias-Tee, +12 V to +32 V variable
MS2024B-0015	MS2025B-0015	MS2034B-0015	MS2035B-0015	Vector Voltmeter
MS2024B-0019	MS2025B-0019	MS2034B-0019	MS2035B-0019	High Accuracy Power Meter (requires external USB sensor, sold separately)
—	—	MS2034B-0025	MS2035B-0025	Interference Analyzer*1
—	—	MS2034B-0027	MS2035B-0027	Channel Scanner*1
MS2024B-0031	MS2025B-0031	MS2034B-0031	MS2035B-0031	GPS Receiver*2
MS2024B-0098	MS2025B-0098	MS2034B-0098	MS2035B-0098	Standard Calibration to ISO17025 and ANSI/NCSL Z540-1. Includes calibration certificate.
MS2024B-0099	MS2025B-0099	MS2034B-0099	MS2035B-0099	Premium Calibration to ISO17025 and ANSI/NCSL Z540-1. Includes calibration certificate, test report, and uncertainty data.
—	—	MS2034B-0431	MS2035B-0431	Coverage Mapping*3
—	—	MS2034B-0509	MS2035B-0509	AM/FM/PM Demodulation Analyzer

*1: GPS Option 31 recommended.
*2: Requires external GPS antenna (sold separately).
*3: Requires GPS Option 31.

Model/Order No.	Name
	Standard Accessories (Included with instrument)
2000-1654-R	Soft Carrying Case
2000-1691-R	Stylus with Coiled Tether
2000-1797-R	Screen Protector Film (x2, one factory installed, one spare)
2000-1371-R	Ethernet Cable, 2.1 m (7 ft)
633-75	Rechargeable Li-Ion Battery, 7500 mAh
40-187-R	AC-DC Adapter
806-141-R	Automotive Power Adapter, 12 VDC, 60 W
3-2000-1498	USB A/5-pin mini-B Cable, 10 ft/305 cm
	- Certificate of Calibration and Conformance
	Optional Accessories
	Miscellaneous Accessories
MA2700A	Handheld Interference Hunter (For full specifications, refer to the Technical Data Sheet 11410-00692)
2000-1371-R	Ethernet Cable, 2.13 m (7 ft)
3-806-152	Cat 5e Crossover Patch Cable, 2.13 m (7 ft)
633-75	Rechargeable Li-Ion Battery, 7500 mAh
2000-1374	External Dual Charger for Li-Ion Batteries
2000-1689-R	EMI Near Field Probe Kit
66864	Rack Mount Kit

Model/Order No.	Name
	Backpack and Transit Case
67135	Anritsu Backpack (For Handheld Instrument and PC)
760-243-R	Transit Case with Wheels and Handle 56 × 45.5 × 26.5 cm (22.07 × 17.92 × 10.42")
760-261-R	Large Transit Case with Wheels and Handle 63.1 × 50 × 30 cm (24.83 × 19.69 × 11.88"), space for MA2700A, antennas, filters, instrument inside soft case, and other interference hunting accessories/tools
760-262-R	Transit Case for MA2700A, several Yagi antennas and filters
760-271-R	Transit Case for Portable Directional Antennas and Port Extender 52.4 × 42.8 × 20.6 cm (20.62 × 16.87 × 8.12") (for 2000-1777-R, 2000-1778-R, 2000-1779-R, 2000-1798-R)
760-286-R	Compact Transit Case with Wheels and Handle 55.6 × 35.5 × 22.9 cm (21.89" × 13.98" × 9.01")
	GPS Antennas (Active)
2000-1652-R	Magnet Mount, SMA (m), 3 VDC to 5 VDC with 1 ft cable
2000-1528-R	Magnet Mount, SMA (m), 3 VDC to 5 VDC with 4.6 m (15 ft) extension cable
2000-1760-R	Mini GPS Antenna, SMA (m), 25 dB gain, 2.5 VDC to 3.7 VDC

Continued on next page

Model/Order No.	Name
	Power Sensors
	(For complete ordering information see the respective datasheets of each sensor)
MA24105A	Inline Peak Power Sensor, 350 MHz to 4 GHz, +3 to +51.76 dBm
MA24106A	RF USB Power Sensor, 50 MHz to 6 GHz, +23 dBm
MA24108A	Microwave USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24118A	Microwave USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24126A	Microwave USB Power Sensor, 10 MHz to 26 GHz, +20 dBm
MA24208A	Microwave Universal USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24218A	Microwave Universal USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24330A	Microwave CW USB Power Sensor, 10 MHz to 33 GHz, +20 dBm
MA24340A	Microwave CW USB Power Sensor, 10 MHz to 40 GHz, +20 dBm
MA24350A	Microwave CW USB Power Sensor, 10 MHz to 50 GHz, +20 dBm
MA25100A	RF Power Indicator
	Full Temperature N-Type Coaxial Calibration Kits –10°C to +55°C
	(see individual data sheets on www.anritsu.com)
OSLN50A-8	High Performance Type N (m), DC to 8 GHz, 50Ω
OSLNF50A-8	High Performance Type N (f), DC to 8 GHz, 50Ω
TOSLN50A-8	High Performance with Through, Type N (m), DC to 8 GHz, 50Ω
TOSLNF50A-8	High Performance with Through, Type N (f), DC to 8 GHz, 50Ω
OSLN50A-18	High Performance Type N (m), DC to 18 GHz, 50Ω
OSLNF50A-18	High Performance Type N (f), DC to 18 GHz, 50Ω
TOSLN50A-18	High Performance with Through Type N (m), DC to 18 GHz, 50Ω
TOSLNF50A-18	High Performance with Through Type N (f), DC to 18 GHz, 50Ω
TOSLK50A-20	High Performance with Through Type K (m), DC to 20 GHz, 50Ω
TOSLKF50A-20	High Performance with Through Type K (f), DC to 20 GHz, 50Ω
TOSLK50A-40	High Performance with Through Type K (m), DC to 40 GHz, 50Ω
TOSLKF50A-40	High Performance with Through Type K (f), DC to 40 GHz, 50Ω
	Coaxial Calibration Components, other 50Ω, 75Ω
2000-1618-R	Open/Short/Load, 7/16 DIN (m), DC to 6.0 GHz 50Ω
2000-1619-R	Open/Short/Load, 7/16 DIN (f), DC to 6.0 GHz 50Ω
2000-1914-R	Precision Open/Short/Load, 4.3-10 (f), DC to 6 GHz, 50Ω
2000-1915-R	Precision Open/Short/Load, 4.3-10 (m), DC to 6 GHz, 50Ω
12N50-75B	Matching Pad, DC to 3 GHz, 50Ω to 75Ω
22N75	Open/Short, N (m), DC to 3 GHz, 75Ω
22NF75	Open/Short, N (f), DC to 3 GHz, 75Ω
26N75A	Precision Termination, N (m), DC to 3 GHz, 75Ω
26NF75A	Precision Termination, N (f), DC to 3 GHz, 75Ω
SM/PL-1	Precision N (m) Load, 42 dB, 6 GHz
SM/PLNF-1	Precision N (f) Load, 42 dB, 6 GHz
1091-55-R	Open, TNC (f), DC to 18 GHz
1091-53-R	Open, TNC (m), DC to 18 GHz
1091-56-R	Short, TNC (f), DC to 18 GHz
1091-54-R	Short, TNC (m), DC to 18 GHz
1015-54-R	Termination, TNC (f), DC to 18 GHz
1015-55-R	Termination, TNC (m), DC to 18 GHz
	Phase-Stable Test Port Cables, Armored
15NNF50-1.5C	1.5 m, DC to 6 GHz, N (m) to N (f), 50Ω
15NN50-1.5C	1.5 m, DC to 6 GHz, N (m) to N (m), 50Ω
15NDF50-1.5C	1.5 m, DC to 6 GHz, N (m) to 7/16 DIN (f), 50Ω
15ND50-1.5C	1.5 m, DC to 6 GHz, N (m) to 7/16 DIN (m), 50Ω
15NNF50-3.0C	3.0 m, DC to 6 GHz, N (m) to N (f), 50Ω
15NN50-3.0C	3.0 m, DC to 6 GHz, N (m) to N (m), 50Ω
15NNF50-5.0C	5.0 m, DC to 6 GHz, N (m) to N (f), 50Ω
15NN50-5.0C	5.0 m, DC to 6 GHz, N (m) to N (m), 50Ω
15N43M50-1.5C	Test Port Extension Cable, 1.5 m, DC to 6 GHz, N (m) to 4.3-10 (m)
15N43F50-1.5C	Test Port Extension Cable, 1.5 m, DC to 6 GHz, N (m) to 4.3-10 (f)
15N43M50-3.0C	Test Port Extension Cable, 3 m, DC to 6 GHz, N (m) to 4.3-10 (m)
15N43F50-3.0C	Test Port Extension Cable, 3 m, DC to 6 GHz, N (m) to 4.3-10 (f)

Model/Order No.	Name
	Directional Antennas
2000-1411-R	824 MHz to 896 MHz, N (f), 12.3 dBi, Yagi
2000-1412-R	885 MHz to 975 MHz, N (f), 12.6 dBi, Yagi
2000-1413-R	1710 MHz to 1880 MHz, N (f), 12.3 dBi, Yagi
2000-1414-R	1850 MHz to 1990 MHz, N (f), 11.4 dBi, Yagi
2000-1415-R	2400 MHz to 2500 MHz, N (f), 14.1 dBi, Yagi
2000-1416-R	1920 MHz to 2170 MHz, N (f), 14.3 dBi, Yagi
2000-1659-R	698 MHz to 787 MHz, N (f), 10.1 dBi, Yagi
2000-1660-R	1425 MHz to 1535 MHz, N (f), 14.3 dBi, Yagi
2000-1715-R	698 MHz to 2500 MHz, N (f), gain of 2 dBi to 10 dBi, typical
2000-1726-R	Antenna, 2500 MHz to 2700 MHz, N (f), 14.1 dBi, Yagi
2000-1747-R	Antenna, Log Periodic, 300 MHz to 7000 MHz, N (f), 5.1 dBi, typical
2000-1748-R	Antenna, Log Periodic, 1 GHz to 18 GHz, N (f), 6 dBi, typical
2000-1777-R	Portable Directional Antenna, 9 kHz to 20 MHz, N (f)
2000-1778-R	Portable Directional Antenna, 20 MHz to 200 MHz, N (f)
2000-1779-R	Portable Directional Antenna, 200 MHz to 500 MHz, N (f)
2000-1812-R	Portable Yagi Antenna, 450 MHz to 512 MHz, N (f), 7.1 dBi
2000-1825-R	Portable Yagi Antenna, 380 MHz to 430 MHz, N (f), 7.1 dBi
	Portable Antennas
2000-1200-R	806 MHz to 866 MHz, SMA (m), 50Ω
2000-1473-R	870 MHz to 960 MHz, SMA (m), 50Ω
2000-1035-R	896 MHz to 941 MHz, SMA (m), 50Ω (1/2 wave)
2000-1030-R	1710 MHz to 1880 MHz, SMA (m), 50Ω (1/2 wave)
2000-1474-R	1710 MHz to 1880 MHz with knuckle elbow (1/2 wave)
2000-1031-R	1850 MHz to 1990 MHz, SMA (m), 50Ω (1/2 wave)
2000-1475-R	1920 MHz to 1980 MHz and 2110 MHz to 2170 MHz, SMA (m), 50Ω
2000-1032-R	2400 MHz to 2500 MHz, SMA (m), 50Ω (1/2 wave)
2000-1361-R	2400 MHz to 2500 MHz, 5000 MHz to 6000 MHz, SMA (m), 50Ω
2000-1751-R	698 MHz to 960 MHz, 1710 MHz to 2100 MHz, 2500 MHz to 2700 MHz, SMA (m), 2 dB (typ.), 50Ω
2000-1636-R	Antenna Kit (Consists of: 2000-1030-R, 2000-1031-R, 2000-1032-R, 2000-1200-R, 2000-1035-R, 2000-1361-R, and carrying pouch)
2000-1487-R	VHF/UHF, Telescopic Whip antenna, straight or 90°, BNC (m), 50Ω
	Bandpass Filters
1030-114-R	806 MHz to 869 MHz, N (m) to SMA (f), 50Ω
1030-109-R	824 MHz to 849 MHz, N (m) to SMA (f), 50Ω
1030-110-R	880 MHz to 915 MHz, N (m) to SMA (f), 50Ω
1030-111-R	1850 MHz to 1910 MHz, N (m) to SMA (f), 50Ω
1030-112-R	2400 MHz to 2484 MHz, N (m) to SMA (f), 50Ω
1030-105-R	890 MHz to 915 MHz, N (m) to N (f), 50Ω
1030-106-R	1710 MHz to 1790 MHz, N (m) to N (f), 50Ω
1030-107-R	1910 MHz to 1990 MHz, N (m) to N (f), 50Ω
1030-149-R	High Pass, 150 MHz, N (m) to N (f), 50Ω
1030-150-R	High Pass, 400 MHz, N (m) to N (f), 50Ω
1030-151-R	High Pass, 700 MHz, N (m) to N (f), 50Ω
1030-152-R	Low Pass, 200 MHz, N (m) to N (f), 50Ω
1030-153-R	Low Pass, 550 MHz, N (m) to N (f), 50Ω
1030-155-R	2500 MHz to 2700 MHz, N (m) to N (f), 50Ω
1030-178-R	1920 MHz to 1980 MHz, N (m) to N (f), 50Ω
1030-179-R	777 MHz to 798 MHz, N (m) to N (f), 50Ω
1030-180-R	2500 MHz to 2570 MHz, N (m) to N (f), 50Ω
2000-1684-R	791 MHz to 821 MHz, N (m) to N (f), 50Ω
2000-1734-R	699 MHz to 715 MHz, N (m) and N (f), 50Ω
2000-1735-R	776 MHz to 788 MHz, N (m) and N (f), 50Ω
2000-1736-R	815 MHz to 850 MHz, N (m) and N (f), 50Ω
2000-1737-R	1711 MHz to 1756 MHz, N (m) and N (f), 50Ω
2000-1738-R	1850 MHz to 1910 MHz, N (m) and N (f), 50Ω
2000-1739-R	880 MHz to 915 MHz, N (m) and N (f), 50Ω
2000-1740-R	1710 MHz to 1785 MHz, N (m) and N (f), 50Ω
2000-1741-R	1920 MHz to 1980 MHz, N (m) and N (f), 50Ω
2000-1742-R	832 MHz to 862 MHz, N (m) and N (f), 50Ω
2000-1743-R	2500 MHz to 2570 MHz, N (m) and N (f), 50Ω
2000-1799-R	2305 MHz to 2320 MHz, N (m) and N (f), 50Ω
2000-1911-R	703 MHz to 748 MHz, N (m) and N (f), 50Ω
2000-1912-R	788 MHz to 798 MHz, N (m) and N (f), 50Ω
2000-1925-R	663 MHz to 698 MHz, N (m) and N (f), 50Ω
2000-1926-R	776 MHz to 806 MHz, N (m) and N (f), 50Ω

Continued on next page

Model/Order No.	Name
	Miscellaneous Adapters
1091-26-R	SMA (m) to N (m), DC to 18 GHz, 50Ω
1091-27-R	SMA (f) to N (m), DC to 18 GHz, 50Ω
1091-80-R	SMA (m) to N (f), DC to 18 GHz, 50Ω
1091-81-R	SMA (f) to N (f), DC to 18 GHz, 50Ω
1091-172-R	BNC (f) to N (m), DC to 1.3 GHz, 50Ω
1091-465-R	Adapter, DC to 6 GHz, 4.3-10 (f) to N (f), 50Ω
1091-467-R	Adapter, DC to 6 GHz, 4.3-10(m) to N (f), 50Ω
510-90-R	7/16 DIN (f) to N (m), DC to 7.5 GHz, 50Ω
510-91-R	7/16 DIN (f) to N (f), DC to 7.5 GHz, 50Ω
510-92-R	7/16 DIN (m) to N (m), DC to 7.5 GHz, 50Ω
510-93-R	7/16 DIN (m) to N (f), DC to 7.5 GHz, 50Ω
510-96-R	7/16 DIN (m) to 7/16 DIN (m), DC to 7.5 GHz, 50Ω
510-97-R	7/16 DIN (f) to 7/16 DIN (f), DC to 7.5 GHz, 50Ω
513-62-R	TNC (f) to N (f), DC to 18 GHz, 50Ω
1091-315-R	Adapter, DC to 18 GHz, TNC (f) to N (f), 50Ω
1091-324-R	Adapter, DC to 18 GHz, TNC (m) to N (f), 50Ω
1091-325-R	Adapter, DC to 18 GHz, TNC (f) to N (m), 50Ω
1091-317-R	Adapter, DC to 18 GHz, TNC (m) to N (m), 50Ω
1091-318-R	Adapter, DC to 18 GHz, TNC (m) to SMA (f), 50Ω
1091-323-R	Adapter, DC to 18 GHz, TNC (m) to SMA (m), 50Ω Adapter, DC to 18 GHz, TNC (m) to TNC (f), 50Ω
1091-326-R	Adapter, DC to 18 GHz, TNC (m) to TNC (m), 50Ω
510-102-R	N (m) to N (m), DC to 11 GHz, 50Ω, 90 degrees right angle
34RKNF50	Ruggedized K (m) to N (f), DC to 18 GHz, 50Ω
	Precision Adapters
34NN50A	Precision Adapter, N (m) to N (m), DC to 18 GHz, 50Ω
34NFNF50	Precision Adapter, N (f) to N (f), DC to 18 GHz, 50Ω
34NK50	Precision Adapter, DC to 18 GHz, N (m) to K (m), 50Ω
34NFKF50	Precision Adapter, DC to 18 GHz, N (m) to K (f), 50Ω
K220B	Precision Adapter, DC to 40 GHz, K (m) to K (m), 50Ω
K222B	Precision Adapter, DC to 40 GHz, K (f) to K (f), 50Ω
K224B	Precision Adapter, DC to 40 GHz, K (m) to K (f), 50Ω
	Attenuators N Type (up to 18 GHz)
3-1010-122	20 dB, 5 W, DC to 12.4 GHz, N (m) to N (f)
42N50-20	20 dB, 5 W, DC to 18 GHz, N (m) to N (f)
42N50A-30	30 dB, 50 W, DC to 18 GHz, N (m) to N (f)
3-1010-123	30 dB, 50 W, DC to 8.5 GHz, N (m) to N (f)
1010-127-R	30 dB, 150 W, DC to 3 GHz, N (m) to N (f)
3-1010-124	40 dB, 100 W, DC to 8.5 GHz, N (f) to N (m), Uni-directional
1010-121-R	40 dB, 100 W, DC to 18 GHz, N (f) to N (m), Uni-directional
1010-128-R	40 dB, 150 W, DC to 3 GHz, N (m) to N (f)
	Attenuators K Type (up to 40 GHz)
41KB-3	Precision Fixed Attenuator, K (m) to K (f), 3 dB, DC to 26.5 GHz, 50Ω
41KB-6	Precision Fixed Attenuator, K (m) to K (f), 6 dB, DC to 26.5 GHz, 50Ω
41KB-10	Precision Fixed Attenuator, K (m) to K (f), 10 dB, DC to 26.5 GHz, 50Ω
41KB-20	Precision Fixed Attenuator, K (m) to K (f), 20 dB, DC to 26.5 GHz, 50Ω
41KC-3	Precision Fixed Attenuator, K (m) to K (f), 3 dB, DC to 40 GHz, 50Ω
41KC-6	Precision Fixed Attenuator, K (m) to K (f), 6 dB, DC to 40 GHz, 50Ω
41KC-10	Precision Fixed Attenuator, K (m) to K (f), 10 dB, DC to 40 GHz, 50Ω
41KC-20	Precision Fixed Attenuator, K (m) to K (f), 20 dB, DC to 40 GHz, 50Ω

Calibration Kits

For Performing Precise Calibrations of Vector Network Analyzers

3652A

The Anritsu Calibration Kits contain all the precision components and tools required to calibrate your VNA or VNMS for 12-term error-corrected measurements in the connector style of your choice. Components are included for calibrating male and female test ports as required. The kits support calibration with opens, shorts, an broadband loads.
The following kits are for use with 27xxx Lightning VNAs, MS464xB VectorStar, ShockLine Series VNAs, and MS20xxx VNA Master.
For more information about included components with each calibration kit, please refer to the respective referenced VNA's technical data sheet.

3650A SMA/3.5 mm Calibration Kit
- 350A-1 Sliding Terminations

3651B GPC-7 Calibration Kit
- 3651B-1 Sliding Terminations

3652A K Connector™ Calibration Kit
- 3652A-2 Pin Depth Gauge
- 3652A-3 .s1p Database Calibration
- 3652A-4 .s1p Datatbase Calibration
  Removes pin depth gauge
- 3653A Type N Calibration Kit
- 3654D V Connector Calibration Kit
- 3655E WR12 Waveguide Calibration Kit
- 3655V WR15 Waveguide Calibration Kit
- 3655W WR10 Waveguide Calibration Kit
- 3656C W1Valibration/Verification Kit
- 3659 0.8 mm Calibration/Verification Kit

3653A Type N Calibration Kit
- 23NF50 Female Short
- 23N50 Male Short
- 24NF50 Female Open
- 24N50 Male Open
- 28N50-2 Broadband Male Termination (2)
- 28NF50-2 Broadband Female Termination (2)
- 34AN50-2 Male Adapter (2)
- 34ANF50-2 Female Adapter (2)
- 01-213 Reference Gauge
- 01-224 Pin Depth Gauge
- Calibration coefficients diskette
- Calibration coefficients memory stick

3654D V Connector™ Calibration Kit
- 23V50C-5.1 Male Short 5.1 mm
- 23VF50C-5.1 Female Short 5.1 mm
- 24V50C Male Open
- 24VF50C Female Open
- 28V50D Male Broadband Termination (2)
- 28VF50D Female Broadband Termination (2)
- 33VV50C Male-Male Adapter*
- 33VFVF50C Female-Female Adapter (2)*
- 33VVF50C Male-Female Adapter (2)*
- Calibration coefficients diskette
- Connector thumb wheel (4)
- 01-201 Torque Wrench
- 01-210 Reference Flat
- 01-322 Pin Depth Gauge
- 01-323 Female Adapter for pin gauge
- 01-204 Adapter Wrench
- 01-312 Male Flush Short
- 01-311 Female Flush Short
- Calibration coefficients memory stick

Option 2 removes the following:
- 01-322 Pin Depth Gage
- 01-323 Pin Depth Gage

Option 3 Adds the following:
- .s1p Database calibration

Option 4 adds the following:
- .s1p Database calibration

Option 4 removes the following:
- 01-322 Pin Depth Gage
- 01-323 Pin Depth Gage

3655 Series Waveguide Calibration Kit

The 3655 Series Calibration Kit contains all of the precision components and tools required to calibrate your VNA for 12-term error-corrected measurements of test devices with the appropriate waveguide designation. Components are included for calibrating both module ports. The kit supports calibration with offset shorts and broadband loads. Option 1 adds a sliding termination.

Consisting of:

- 3-1091-302 Short, Flush (2)
- 3-1091-223 SHORT, OFFSET, 3/8WAVE
- 3-1091-222 SHORT, OFFSET, 1/8WAVE
- 3-B27394-3 Terminations, Fixed (2)
- Test Port Sections (2)

Option 1 adds the following:

- Sliding Termination

3656B W1 Calibration/Verification Kit

- 23W50-1 Male Offset Short (2.02 mm)
- 23W50-2 Male Offset Short (2.65 mm)
- 23W50-3 Male Offset Short (3.180 mm)
- 24W50 Male Open (1.510 mm)
- 28W50 Male Broadband Termination
- 23WF50-1 Female Offset Short 1 (2.02 mm)
- 23WF50-2 Female Offset Short 2 (2.65 mm)
- 23WF50-3 Female Offset Short 3 (3.180 mm)
- 28WF50 Female Broadband Termination
- 24WF50 Female Open (1.930 mm)
- 33WSC50 Fixed Male SC Connector
- 33WFSC50 Fixed Female SC Connector
- Interchangeable Sliders, SC Connectors
- Locking Keys, SC Connectors
- 01-402 Interchange Adapter Fixed Male
- 33WWF50 Male-Female Adapter
- 33WW50 Male-Male Adapter
- 33WFWF50 Female-Female Adapter
- 01-504 6 mm Torque Wrench
- 01-505 6-7 mm End Wrench
- 18WWF50-1B Stepped Impedance Thruline (Verification Device)
- 18WWF50-1 50Ω Matched Thruline (Verification Device)
- Calibration coefficients diskette
- Calibration coefficients memory stick
- .s1p Database Calibration

Verification Kits

For Confirming Accuracy of Vector Network Analyzers

3669B

The Anritsu Verification Kits contain precision components with characteristics that are traceable to NIST. Used primarily by the metrology laboratory, these components provide the most dependable means of determining the system accuracy of your VNA. A USB memory device containing factory measured test data for all components is supplied for comparison with customer-measured data.

3666-1 SMA/3.5 mm Verification Kit consisting of:
- 19S50-7, 7.5 cm airline
- 19S50-7B, 7.5 cm stepped impedance airline (Beatty standard)
- 42S-50, 50 dB offset attenuator
- 42S-20, 20 dB offset attenuator
- USB memory device

3668-1 K Connector™ Verification Kit consisting of:
- 19K50-7, 7.5 cm airline
- 42K-50, 50 dB offset attenuator
- 42K-20, 20 dB offset attenuator
- 19K50-7B, 7.5 cm stepped impedance airline (Beatty standard)
- USB memory device

3669B-1 V Connector™ Verification Kit consisting of:
- 42V-50, 50 dB offset attenuator
- 42V-20, 20 dB offset attenuator
- 19V50-5, 5 cm airline
- 19V50-5B, 5 cm stepped impedance airline (Beatty standard)
- USB memory device

The following kits are for use with 37XXX Lightning VNAs.

3663 Type N Verification Kit consisting of:
- 42N-50, 50 dB Attenuator
- 18N50-10, 10 cm Airline
- 42N20, 20 dB Attenuator
- 18N50-10B, 10 cm Stepped Impedance Airline (Beatty standard)
- Verification kit disks

3666 SMA/3.5 mm Verification Kit consisting of:
- 19S50-7, 7.5 cm Airline
- 19S50-7B, 7.5 cm Stepped Impedance Airline (Beatty standard)
- 42S-50, 50 dB Attenuator
- 42S-20, 20 dB Attenuator
- Verification kit disks

3667 GPC-7 Verification Kit consisting of:
- 42A-50, 50 dB Attenuator
- 18A50-10, 10 cm Airline
- 42A-20, 20 dB Attenuator
- 18A50-10B, 10 cm Stepped Impedance Airline (Beatty standard)
- Verification kit disks

3668 K Connector® Verification Kit consisting of:
- 19K50-7, 7.5 cm Airline
- 42K-50, 50 dB Attenuator
- 42K-20, 20 dB Attenuator
- 19K50-7B, 7.5 cm Stepped Impedance Airline (Beatty standard)
- Verification kit disks

3669B V Connector® Verification Kit consisting of:
- 42V-40, 40 dB Attenuator
- 42V-20, 20 dB Attenuator
- 19V50-5, 5 cm Airline
- 19V50-5B, 5 cm Stepped Impedance Airline (Beatty standard)
- Verification kit disks

W1 (1.0 mm) Verification Components are included in W1 Calibration and Verification Kit (3656B).

See previous section for details.

EU Standards (CE Marking)

(EU) 2015/863

O/E Calibration Module

MN4765B

70 kHz to 110 GHz range, with 1310 nm and 1550 nm wavelength coverage

Fast and Accurate Optoelectronic Measurements

The O/E Calibration Module MN4765B is a characterized, unamplified photodiode module. It is used as an optical receiver with the VectorStar™ VNAs MS4640B Series VNA and MS4652xB Series VNA to perform highly accurate and stable optoelectronic measurements of both modulators (E/O) and photoreceivers (O/E). Model MN4765B is the base calibration module part number only. Customers are required to also order an option to configure the bandwidth and wavelength coverage. These options consist of an InGaAs photodiode that converts modulated optical signals to electrical signals, and includes additional circuitry for temperature and bias stability. Available configuration options are:

- MN4765B-0040 (Option 40) Configured for 70 kHz to 40 GHz range, with 850 wavelength coverage
- MN4765B-0042 (Option 42) Configured for 70 kHz to 40 GHz range, with 850 nm and 1060 nm wavelength coverage
- MN4765B-0043 (Option 43) Configured with 70 kHz to 40 GHz range, with 850/1060/1310/1550 nm wavelength coverage
- MN4765B-0070 (Option 70) Configured for 70 kHz to 70 GHz range, with 1550 nm wavelength coverage
- MN4765B-0071 (Option 71) Configured for 70 kHz to 70 GHz range, with 1310 nm wavelength coverage
- MN4765B-0072 (Option 72) Configured for 70 kHz to 70 GHz range, with 1310 and 1550 nm wavelength coverage
- MN4765B-0110 (Option 110) Configured for 70 kHz to 110 GHz range, with 1550 nm wavelength coverage
- MN4765B-0111 (Option 111) Configured for 70 kHz to 110 GHz range, with 1310 nm wavelength coverage
- MN4765B-0112 (Option 112) Configured for 70 kHz to 110 GHz range, with 1310 nm and 1550 nm wavelength coverage

Calibration Options

MN4765B-0098 (Option 98) Standard Calibration

Standard Calibrations provide a Certificate of Calibration which certifies that the product has been calibrated in compliance with a quality system registered to ISO 9001:2000, and in compliance with ISO/IEC 17025-2005 and ANSI/NCSL Z540-1-1994 (R2002). It lists the measurement standards used in the calibration of the new equipment, the test procedure and its revision, as well as the environmental conditions.

MN4765B-0099 (Option 99) Premium Calibration

Premium calibration includes everything provided with a Standard Calibration plus Test Data showing actual measured values.
The test data provided varies by product complexity.

Key Features

Fast and Accurate Optoelectronic Measurements
The VectorStar and Shockline VNA Series, when calibrated using the MN4765B module, enable error-corrected Transfer Function, Group Delay, and Return Loss measurements of E/O, O/E and O/O components and subsystems.

National Institute of Standards and Technology Derived Characterization
Magnitude and phase characterization is obtained using a primary standard characterized by NIST or other National Metrology Institutes and held in the Anritsu Calibration Lab. The magnitude and phase data is provided on a USB drive with the module.

Temperature Stable
The MN4765B is thermally stabilized to eliminate drift in photodiode performance over temperature.

Internal Biasing
Accurate bias voltage to the photodiode is maintained internally.
An external, multi-country, AC adapter is included for easy operation.

High Linearity
Linear operating range to +6 dBm (+2 dBm for MN4765B-004x) for transfer function measurement uncertainties of:
<0.5 dB at 40 GHz
(Typical specifications for MN4765B-0043 at 1550 nm or 1310 nm)
<1 dB at 40 GHz (Typical specifications for MN4765B-004x at 850 nm)
<2 dB at 40 GHz
(Typical specifications for MN4765B-0042 and MN4765B-0043 at 1060 nm)
<0.45 dB at 50 GHz and <0.7 dB at 70 GHz
(Typical specifications for MN4765B-0070 and MN4765B-0072 at 1550 nm)
<0.35 dB at 40 GHz and <1 dB at 70GHz
(Typical specifications for MN4765B-0071 and MN4765B-0072 at 1310 nm)
<0.5 dB at 70 GHz and <0.75 dB at 110 GHz
(Typical specifications for MN4765B-0110 and MN4765B-0112 at 1550 nm)
<0.6 dB at 70 GHz and <0.9 dB at 110 GHz
(Typical specifications for MN4765B-0111 and MN4765B-0112 at 1310 nm)

High Responsivity
>0.2 A/W for MN4765B-0040 at 850 nm (Typical specification)
>0.2 A/W for MN4765B-0042 at 850 nm and >0.6 A/W at 1060 nm (Typical specification)
>0.2 A/W for MN4765B-0043 at 850 nm, >0.6 A/W at 1060 nm, >0.7 A/W at 1310 nm and >0.8 A/W at 1550 nm (Typical specification)
>0.7 A/W for MN4765B-0070 (Typical specification)
>0.45 A/W for MN4765B-0071 (Typical specification)
>0.45 A/W for MN4765B-0072 at 1310 nm (Typical specification)
>0.65 A/W for MN4765B-0072 at 1550 nm (Typical specification)
>0.5 A/W for MN4765B-0110 and MN4765B-0112 at 1550 nm (Typical specification)
>0.4 A/W for MN4765B-0111 and MN4765B-0112 at 1310 nm (Typical specification)

Typical Specifications*1

MN4765B-0040	Frequency Range	70 kHz to 40 GHz
	Operating Wavelength Range	800 nm to 900 nm
	Characterized Wavelength	850 nm ±20 nm
	Linear Optical Input Power	<2 dBm
	Maximum Optical Input PTD-SCDMA Simulation Softwareower	7 dBm
	Electrical Return Loss	<–10 dB at <18GHz <–3 dB from 18 GHz to 40 GHz
	Optical Return Loss	<–20 dB
	DC Responsivity	>0.2 A/W (850 nm ±20 nm)
	RF OUT Connector	K male (2.92 mm)
MN4765B-0042	Frequency Range	70 kHz to 40 GHz
	Operating Wavelength Range	800 nm to 1100 nm
	Characterized Wavelength	850 nm ±20 nm, 1060 nm ±20 nm
	Linear Optical Input Power	<2 dBm
	Maximum Optical Input Power	7 dBm
	Electrical Return Loss	<–10 dB at <18 GHz < –3 dB from 18 GHz to 40 GHz
	Optical Return Loss	<–20 dB
	DC Responsivity	>0.2 A/W (850 nm ±20 nm), > 0.6 A/W (1060 nm ±20 nm)
	RF OUT Connector	K male (2.92 mm)
MN4765B-0043	Frequency Range	70 kHz to 40 GHz
	Operating Wavelength Range	800 nm to 1700 nm
	Characterized Wavelength	850 nm ±20 nm, 1060 nm ±20 nm, 1319 nm ±20 nm, and 1550 nm ±20 nm
	Linear Optical Input Power	<2 dBm
	Maximum Optical Input Power	7 dBm
	Electrical Return Loss	<–10 dB at <18 GHz <–3 dB from 18 GHz to 40 GHz
	Optical Return Loss	<–20 dB
	DC Responsivity	>0.2 A/W (850 nm ±20 nm), >0.6 A/W (1060 nm ±20 nm), >0.7 A/W (1310 nm ±20 nm), and >0.8 A/W (1550 nm ±20 nm)
	RF OUT Connector	K male (2.92 mm)
MN4765B-0070	Frequency Range	70 kHz to 70 GHz
	Operating Wavelength Range	1480 nm to 1620 nm
	Characterized Wavelength	1550 nm ±20 nm
	Linear Optical Input Power	<6 dBm
	Maximum Optical Input Power	10 dBm
	Electrical Return Loss	<–8 dB at <50 GHz <–5 dB from 50 GHz to 70 GHz
	Optical Return Loss	<–24 dB
	DC Responsivity	>0.7 A/W (1550 nm ±20 nm)
	RF OUT Connector	V male (1.85 mm)
MN4765B-0071	Frequency Range	70 kHz to 70 GHz
	Operating Wavelength Range	1300 nm to 1330 nm
	Characterized Wavelength	1319 nm ±10 nm
	Linear Optical Input Power	<6 dBm
	Maximum Optical Input Power	10 dBm
	Electrical Return Loss	<–8 dB at <50 GHz <–5 dB from 50 GHz to 70 GHz
	Optical Return Loss	<–24 dB
	DC Responsivity	>0.45 A/W (1319 nm ±10 nm)
	RF OUT Connector	V male (1.85 mm)
MN4765B-0072	Frequency Range	70 kHz to 70 GHz
	Operating Wavelength Range	1300 nm to 1330 nm and 1530 nm to 1620 nm
	Characterized Wavelength	1319 nm ±10 nm and 1550 nm ±20 nm
	Linear Optical Input Power	<6 dBm
	Maximum Optical Input Power	10 dBm
	Electrical Return Loss	<–8 dB at <50 GHz <–5 dB from 50 GHz to 70 GHz
	Optical Return Loss	<–24 dB
	DC Responsivity	>0.45 A/W (1319 nm ±10 nm) and >0.65 A/W (1550 nm ±20 nm)
	RF OUT Connector	V male (1.85 mm)

Continued on next page

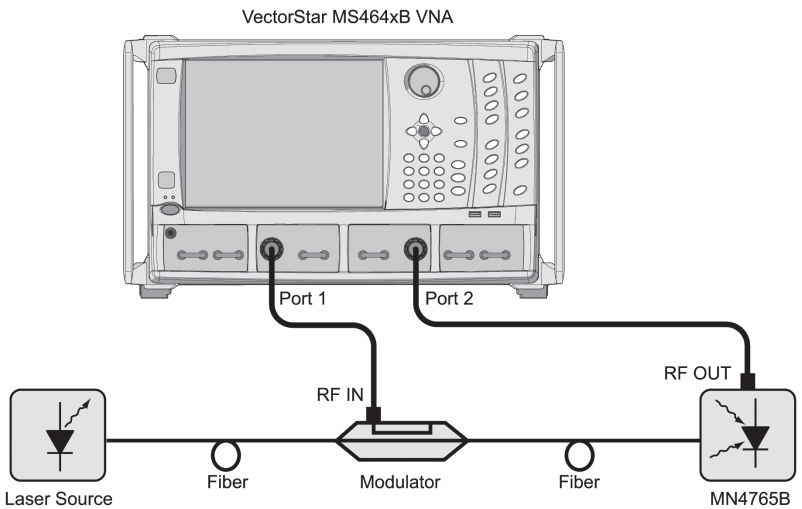
MN4765B-0110	Frequency Range	70 kHz to 110 GHz
	Operating Wavelength Range	1480 nm to 1620 nm
	Characterized Wavelength	1550 nm ±20 nm
	Linear Optical Input Power	<6 dBm
	Maximum Optical Input Power	10 dBm
	Electrical Return Loss	<–6 dB at <50 GHz <–4 dB from 50 GHz to 110 GHz
	Optical Return Loss	<–24 dB
	DC Responsivity	>0.5 A/W (1550 nm ±20 nm)
	RF OUT Connector	W male (1.0 mm)
MN4765B-0111	Frequency Range	70 kHz to 110 GHz
	Operating Wavelength Range	1300 nm to 1330 nm
	Characterized Wavelength	1319 ±10 nm
	Linear Optical Input Power	<6 dBm
	Maximum Optical Input Power	10 dBm
	Electrical Return Loss	<–6 dB at <50 GHz <–4 dB from 50 GHz to 110 GHz
	Optical Return Loss	<–24 dB
	DC Responsivity	>0.4 A/W (1319 ±10 nm) and >0.5 A/W (1550 ±20 nm)
	RF OUT Connector	W male (1.0 mm)
MN4765B-0112	Frequency Range	70 kHz to 110 GHz
	Operating Wavelength Range	1300 nm to 1330 nm and 1480 nm to 1620 nm
	Characterized Wavelength	1319 ±10 nm and 1550 ±20 nm
	Linear Optical Input Power	<6 dBm
	Maximum Optical Input Power	10 dBm
	Electrical Return Loss	<–6 dB at <50 GHz <–4 dB from 50 GHz to 110 GHz
	Optical Return Loss	<–24 dB
	DC Responsivity	>0.4 A/W (1319 ±10 nm) and > 0.5 A/W (1550 ±20 nm)
	RF OUT Connector	W male (1.0 mm)
General Specifications	Optical IN	FC/APC
	AC Adapter	100 V to 240 V (50 Hz to 60 Hz) input, +12 VDC output
	Power LED	On when the AC adapter is plugged in and the internal photodiode is properly biased
	Operate LED	On when the module's internal temperature has stabilized at an optimum temperature for accurate calibrations and measurements
	Dimensions	51 (W) × 33 (H) × 127 (D) mm (2.0 (W) × 1.3 (H) × 5.0 (D) in)
Environmental Specifications	Calibrated temperature	23°C±3°C
	Operating Temperature	+18°C to +28°C
	Storage Temperature	–20°C to +70°C (–15°C to +60°C for -004x)
	Relative Humidity	5 to 95%
	CE	EMC: 2014/30/EU, EN61326-1, EN61000-4-2 LVD: 2014/35/EU, EN61010-1 RoHS: 2011/65/EU, (EU) 2015/863

*1: Typical specifications represent the measured performance of an average unit. They do not include guard-bands and are not covered by the product warranty.

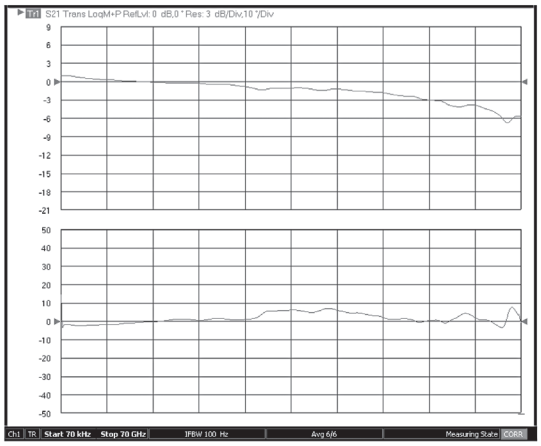
MN4765B Example Measurement Setup and Module Frequency Response

Full frequency use of the Option 70/71/72 module requires a MS4647B 70 GHz VNA although lower frequency VNAs can be used for their portion of the MN4765B-0070/-0071/-0072 frequency range and for all of the MN4765B-0040/0042/0043 frequency range. Full use of the frequency range of the Option 110 /111/112 module requires a ME7838x broadband system. Below is an example of the general E/O or O/E measurement setup. Frequency response traces for the different options are shown on the following pages.

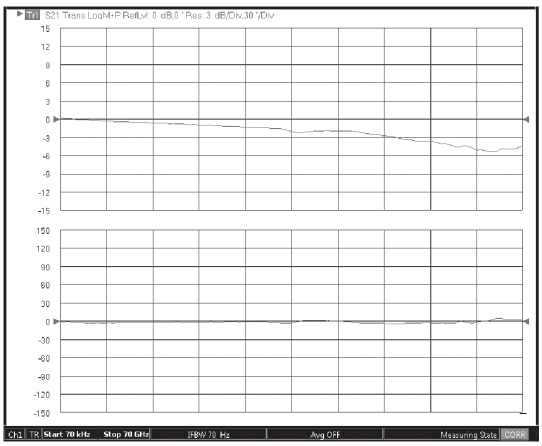
Note Frequency response of individual modules will vary in shape but will have same stability and general immunity from the noise floor.



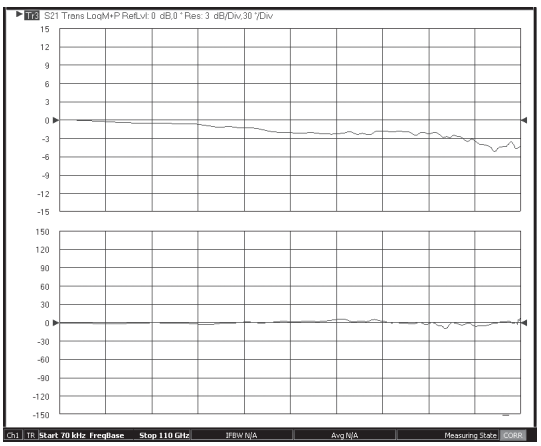
MN4765B Frequency Response Measurement Setup (Refer to Application Note 11410-00798)



Example of Frequency Response –
Option 70, 1550 nm (MN4765B-0070)



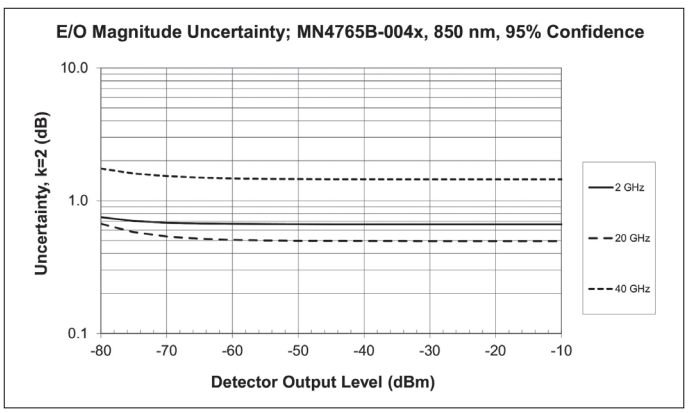
Example of Frequency Response –
Option 71 or Option 72 at 1310 nm (MN4765B-0071/0072)

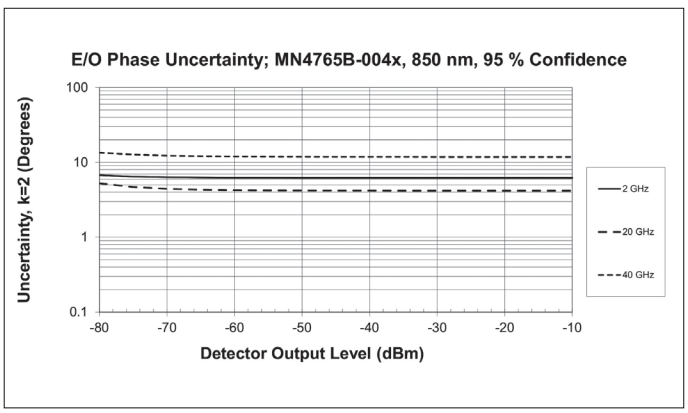


Example of Frequency Response –
Option 110, 1550 nm (MN4765B-0110)

Measurement Uncertainties for Option 40, Option 42, or Option 43 (850 nm)

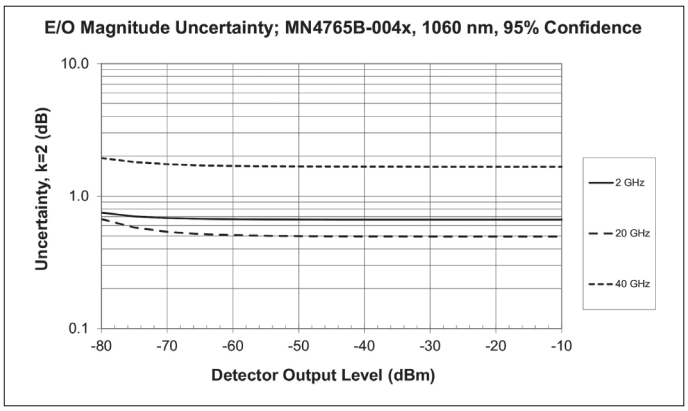
Uncertainty curves apply for temperatures of 23°C±3°C (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95% confidence interval. Analysis based on a 9 µm fiber connecting devices.
See the section: "Notes on Multimode Operation" for information on use with large core diameters.

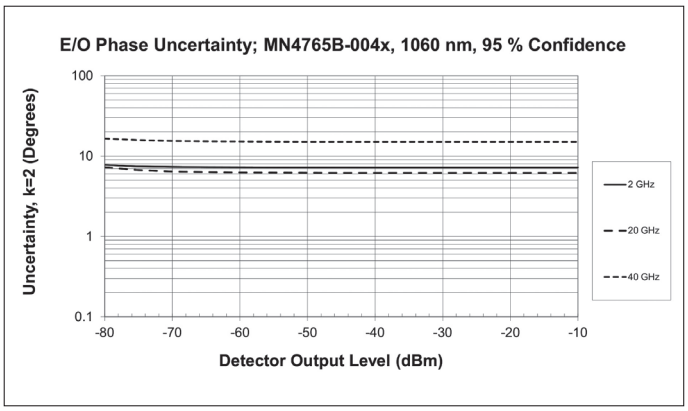




Measurement Uncertainties for Option 42, or Option 43 (1060 nm)

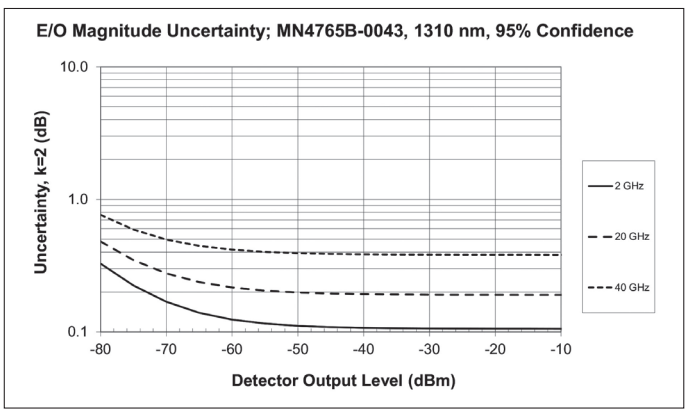
Uncertainty curves apply for temperatures of 23°C±3°C (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95% confidence interval. Derived from interpolation and wavelength dependence information. Analysis based on a 9 µm fiber connecting devices. See the section: "Notes on Multimode Operation" for information on use with large core diameters.

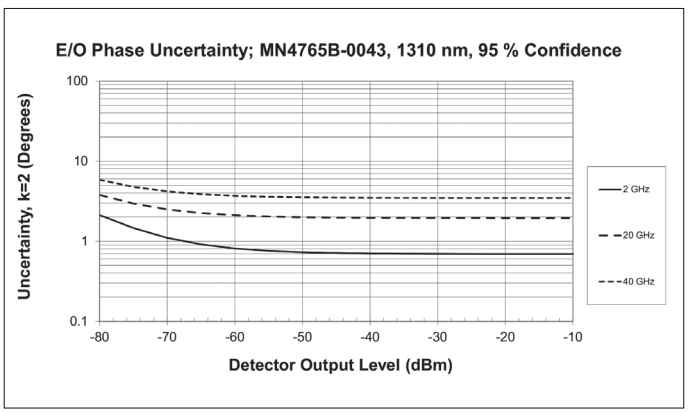




Measurement Uncertainties for Option 43 (1310 nm)

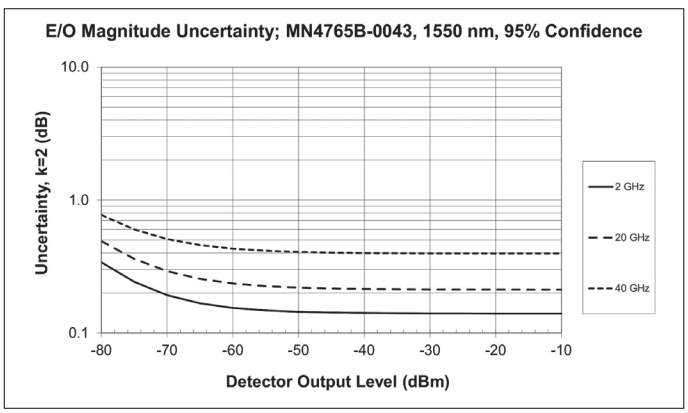
Uncertainty curves apply for temperatures of 23°C±3°C (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95% confidence interval.

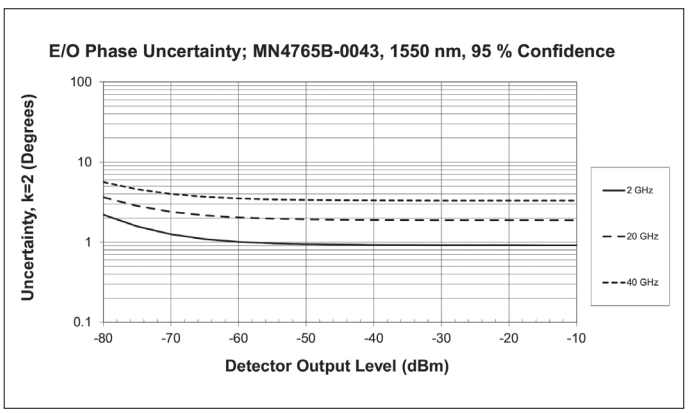




Measurement Uncertainties for Option 43 (1550 nm)

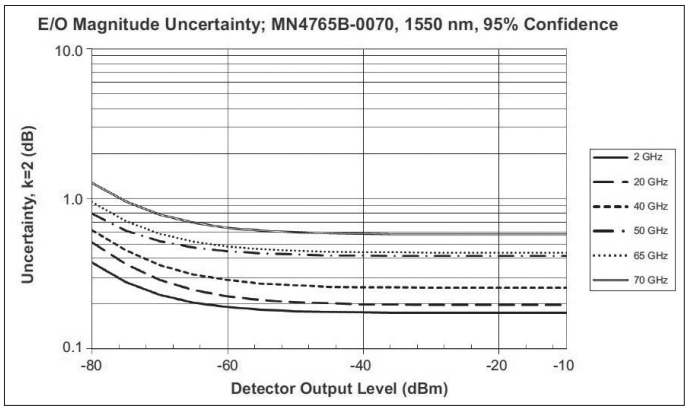
Uncertainty curves apply for temperatures of 23°C±3°C (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95% confidence interval.

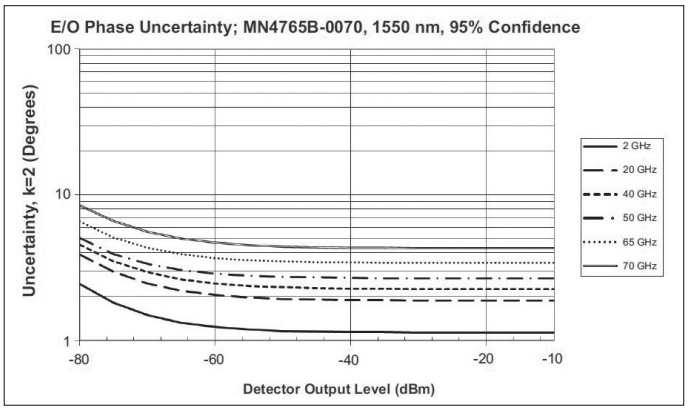




Measurement Uncertainties for Option 70 or Option 72 (at 1550 nm)

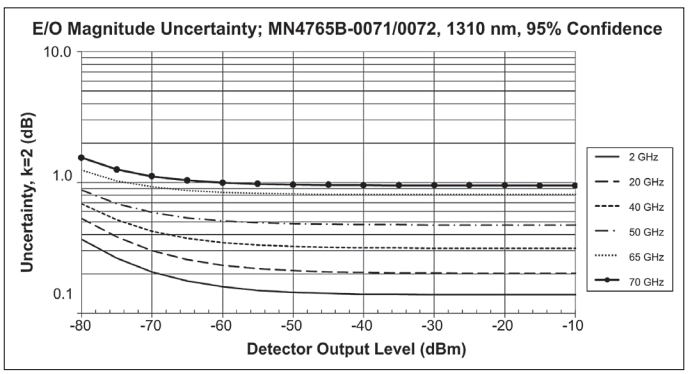
Uncertainty curves apply for temperatures of 23°C±3°C (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95% confidence interval.

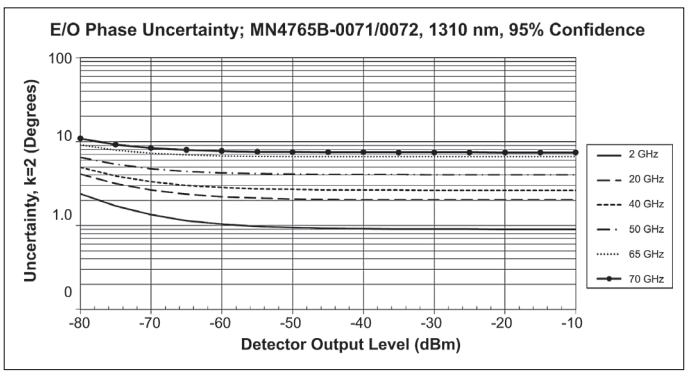




Measurement Uncertainties for Option 71 or Option 72 (at 1310 nm)

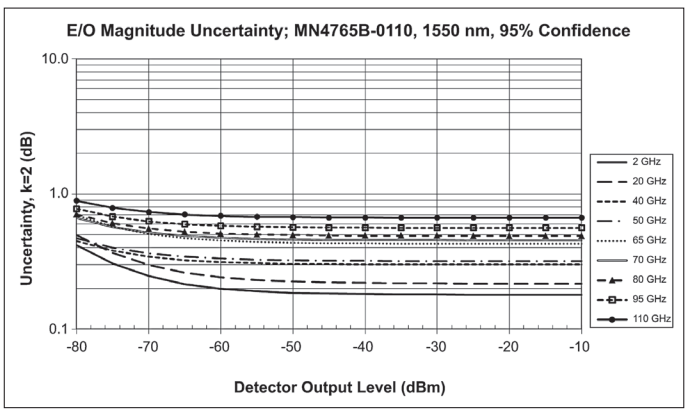
Uncertainty curves apply for temperatures of 23°C±3°C (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95% confidence interval. Magnitude uncertainty values above 40 GHz and phase uncertainty values are based on a 1550-1310 nm transfer model.

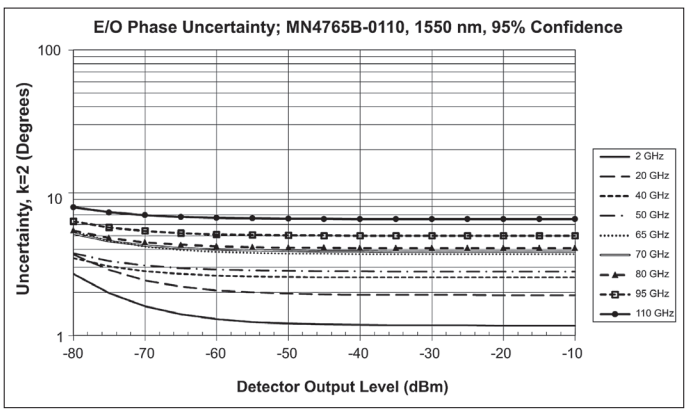




Measurement Uncertainties for Option 110 or Option 112 (at 1550 nm)

Uncertainty curves apply for temperatures of 23°C±3°C (and measurements within 1 degree of calibration temperature) and are based on a coverage factor of 2 for a 95% confidence interval.





Find Drivers, Utilities, Software Updates, and other Helpful Tools at the VectorStar Users Site visit:
https://www.anritsu.com/en-us/test-measurement/products/users-site

Training at Anritsu

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

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Model/Order No.	Name
	Options
MN4765B-0040	Configured for 70 kHz to 40 GHz range, with 850 nm wavelength coverage.
MN4765B-0042	Configured for 70 kHz to 40 GHz range, with 800 nm wavelength coverage.
MN4765B-0043	Configured for 70 kHz to 40 GHz range, with 800 nm wavelength coverage.
MN4765B-0070	Configured for 70 kHz to 70 GHz range, with 1550 nm wavelength coverage.
MN4765B-0071	Configured for 70 kHz to 70 GHz range, with 1310 nm wavelength coverage.
MN4765B-0072	Configured for 70 kHz to 70 GHz range, with 1310 nm and 1550 nm wavelength coverage.
MN4765B-0110	Configured for 70 kHz to 110 GHz range, with 1550 nm wavelength coverage.
MN4765B-0111	Configured for 70 kHz to 110 GHz range, with 1310 nm wavelength coverage
MN4765B-0112	Configured for 70 kHz to 110 GHz range, with 1310 nm and 1550 nm wavelength coverage

ShockLine™ 2-Port and 4-Port SmartCal Calibration Units

MN252x8A SmartCal™ and MN254x8A SmartCal™

Remote Control
USB

MN25208A: 300 kHz to 8.5 GHz, 2-Port Auto Calibration Module, MN25218A: 300 kHz to 20 GHz, 2-Port Auto Calibration Module
MN25408A: 300 kHz to 8.5 GHz, 4-Port Auto Calibration Module, MN25418A: 300 kHz to 20 GHz, 4-Port Auto Calibration Module

Low Cost USB Automatic Calibration Units

SHOCKLINE™

The MN252x8A and MN254x8A SmartCal's are a series of 2-port and 4-port automatic calibration units covering a frequency range from 300 kHz to 20 GHz.
The MN252x8A and MN254x8A deliver automatic, fast and error-free calibrations for any ShockLine VNA. The SmartCals automatically powers on via an USB connection and loads calibration kit coefficients from on-board memory into the ShockLine software. The SmartCals are ready to use immediately after detection by the VNA because it doesn't require warm-up. The SmartCal's improve productivity by providing easier and faster single connection calibrations. Port auto sense and port mapping feature reduce errors and make multi-port calibrations easier.
The MN252x8A and MN254x8A, along with easyTest, can also be used in guided graphical test procedures to further simplify complex calibrations.

MN252x8A and MN254x8A SmartCal™ Highlights

- Auto load of calibration kit coefficients speeds up setups and reduces calibration error.
- Auto sense determines the number of VNA ports connected preventing poor connections and calibration.
- VNA to SmartCal Port mapping increases flexibility and simplifies multiport calibrations.
- ShockLine software auto detects SmartCal providing simple and easy calibrations.
- No internal heater eliminates warm up time speeding calibration time.
- USB power and control provides the convenience of a one plug interface without an external power supply.
- Single connection calibrations reduce wear and tear on connectors and cables over manual calibrations.
- Supports all ShockLine VNAs with 1-, 2-, 4-port calibration available.
- SCPI command set allows for easy integration into automated test environments.
- Automatic and fast calibrations at a low price.
- Small size provides easier use when moving between VNAs.
- Supports ShockLine Vector Network Analyzer A and B models.

VNA System Performance

Error-Corrected Specifications

With 12-term SOLT calibration using TOSLN50A-XX or TOSLNF50A-XX N- or K-type connector manual calibration kits or the MN25208A SmartCal™ automatic calibration kit.

MS46121B Frequency Range	Directivity (dB)	Source Match (dB)	Reflection Tracking (dB)
150 kHz to 4 GHz	42	35	±0.1
>4 GHz to 6 GHz	42	35	±0.2

MS46122B and MS46322B Frequency Range	Directivity (dB)	Source Match (dB)	Load Match*4 (dB)	Reflection Tracking*4 (dB)	Transmission Tracking*4 (dB)
1 MHz to 6 GHz	≥42	≥33	≥42	±0.15	±0.06
>6 GHz to 8 GHz	≥37	≥33	≥37	±0.15	±0.06

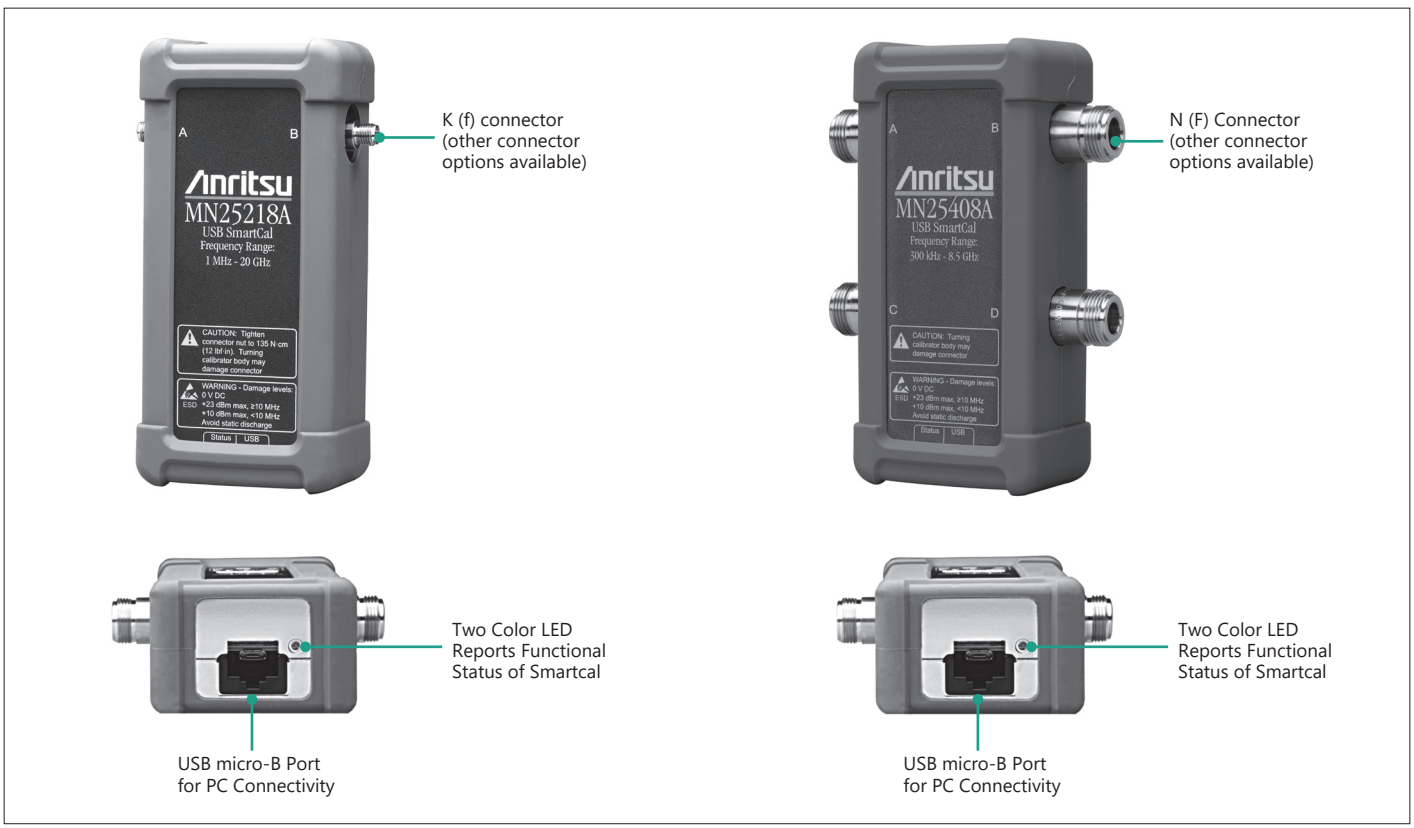
MS46522B and MS46524B Frequency Range	Directivity (dB)	Source Match (dB)	Load Match*4 (dB)	Reflection Tracking*4 (dB)	Transmission Tracking*4 (dB)
50 kHz to 50 MHz	>40	>35	>38	±0.15	±0.09
>50 MHz to 6 GHz	>40	>35	>38	±0.08	±0.05
>6 GHz to 8 GHz	≥36	>35	≥34	±0.08	±0.05
>8 GHz to 8.5 GHz	≥36	>35	≥34	±0.10	±0.08

With calibration using TOSLK50A-XX or TOSLKF50A-XX N or K type connector calibration kits.

Frequency Range		Directivity (dB)	Source Match (dB)	Load Match*4 (dB)	Reflection Tracking*4 (dB)	Transmission Tracking*4 (dB)
MS46131A-010/ ME7868A	1 MHz to 6 GHz	>42	>33	>41	±0.15	±0.06
	>6 GHz to 8 GHz	>37	>33	>36	±0.15	±0.06
MS46131A-020	1 MHz to 10 GHz	>42	>33	>41	±0.15	±0.06
	>10 GHz to 20 GHz	>36	>26	>35	±0.15	±0.06
MS46131A-043	1 MHz to 10 GHz	>42	>33	>41	±0.15	±0.06
	>10 GHz to 20 GHz	>36	>26	>35	±0.15	±0.06
	>20 GHz to 30 GHz	>32	>22	>31	±0.15	±0.06
	>30 GHz to 40 GHz	>30	>20	>29	±0.15	±0.06
	>40 GHz to 43.5 GHz	>28	>20	>27	±0.2	±0.16

*4: Characteristic performance.

** there are many variations of the Error-Corrected Specification. We also have data with various SmartCals and Precision AutoCals. Please let me know if you would like other data.



EU Standards (CE Marking)

EMC: 2014/30/EU, EN61326-1, EN61000-4-2
LVD: 2014/35/EU, EN61010-1
RoHS: (EU) 2015/863

MN252x8A SmartCal – Automatic Calibration Unit

Product Options

Analyzer Performance

Option Number	Description
MN25208A-001	Option 1, N (f) - N (f) Connectors
MN25208A-002	Option 2, K (f) - K (f) Connectors
MN25208A-003	Option 3, 3.5 mm (f) - 3.5 mm (f) Connectors

Included Accessories

Part Number	Description
2000-1606-R	1.8 m USB A/Micro-B latch cable

Recommended Accessories

Part Number	Description
01-200	Torque Wrench, 3/4 in. 0.9 N*m (8 lbf*in), Type N
01-201	Torque Wrench, 5/16 in, 0.9 N*m (8 lbf*in)
34NN50A	Precision Adapter, DC to 18 GHz, N (m) - N (m), 50Ω
33NNF50B	Calibration Grade Adapter, DC to 18 GHz, N (m) - N (f), 50Ω
33SS50	Calibration Grade Adapter, DC to 26.5 GHz, 3.5 mm (m) - 3.5 mm (m), 50Ω
K220B	Precision Adapter, DC to 40 GHz, K (m) - K (m), 50Ω

Ordering Information

Please specify the model/order number, name and quantity when ordering.
The names listed in the chart below are Order Names.
The actual name of the item may differ from the Order Name.

Model/Order No.	Name
MN25208A	**SmartCal** 2-port USB SmartCal Module, 300 kHz to 8.5 GHz (available with connector Options -001 N (f), -002 K (f), -003 3.5 mm (f))
MN25218A	2-port USB SmartCal Module, 300 kHz to 20 GHz (available with connector Option -002 K (f))
MN25408A	4-port USB SmartCal Module, 300 kHz to 8.5 GHz (available with connector Options -001 N (f), -002 K (f), -003 3.5 mm (f))
MN25418A	4-port USB SmartCal Module, 300 kHz to 20 GHz (available with connector Option -002 K (f))