Compact Vector Network Analyzers

MS46122A Series ShockLine™ Compact Vector Network Analyzers

Introduction

The MS46122A is part of the ShockLine™ family of Vector Network Analyzers from Anritsu. It is a very low-cost series of 1U high, 2-port Compact Vector Network Analyzers. It is available in three frequency ranges: 1 MHz to 8/20/40 GHz, and is capable of s-parameter and time domain measurements.

The MS46122A is based on patented ShockLine™ VNA-on-chip technology, which simplifies the internal VNA architecture at high frequencies, reduces instrument cost, and enhances accuracy and measurement repeatability. The combination of low cost and good performance make ShockLine™ VNAs ideal candidates for testing RF and Microwave passive devices to 40 GHz.

The MS46122A series is controlled through USB from an external PC. The MS46122A runs the same software as the rest of the ShockLine family, providing a powerful graphical user interface for debugging and manual testing of devices.

This document provides detailed specifications for the MS46122A series Vector Network Analyzers (VNAs) and related options.

Instrument Models and Operating Frequencies

- MS46122A-010, 1 MHz to 8 GHz, 2-port
- MS46122A-020, 1 MHz to 20 GHz, 2-Port
- MS46122A-040, 1 MHz to 40 GHz, 2-Port

Principal Options

- MS46122A-002, Time Domain

MS46122A with Option 40 Economy ShockLine™ VNA

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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	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. 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.
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. Typical specifications are shown in parenthesis, 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.
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.

System Dynamic Range

System dynamic range is calculated as the difference between High source power and the noise floor (RMS) at the specified reference plane at 10 Hz IF Bandwidth.

Frequency Range	Standard (dB)	Typical (dB)[a]
1 MHz[b] to 20 MHz	85	105
> 20 MHz to 8 GHz	100	115
> 8 GHz[c] to 40 GHz	100	110

a. Typical performance obtained by using optional isolation calibration.

b. Decrease specification by 20 dB below 10 MHz.

c. Decrease specification by 5 dB between 8 GHz and 14 GHz.

Receiver Compression Levels

Performance is typical.

Frequency Range	Standard (dBm)
1 MHz to 40 GHz	+5 dBm

High Level Noise

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

Frequency	Magnitude (dB)	Phase (deg)
1 MHz to < 20 MHz	0.03 (0.005, typical)	< 0.2 (< 0.035 typical)
20 MHz to 40 GHz	0.006 (0.001, typical)	< 0.1 (< 0.05 typical)[a]

a. Above 20 GHz, High Level Noise (phase only) is increased by a factor of 1.5.

Output Power Settings

Power Setting	Standard (dBm)
High (default)	-3 dBm, typical
Low	-20 dBm, typical

Measurement Stability

Ratio measurement, with ports shorted. Typical.

Frequency	Magnitude (dB/°C)	Phase (dB/°C)
10 MHz to 40 GHz	0.02	0.3

Frequency Resolution, Accuracy, and Stability

Resolution	Accuracy	Stability	Aging
1 Hz	± 1.0 ppm (at time of calibration)	± 1.0 ppm from -10 °C to +55 °C, typical	± 1.0 ppm/year, typical

Uncorrected (Raw) Port Characteristics

User and System Correction Off. All specifications typical.

Frequency Range	Directivity (dB)	Port Match(dB)
1 MHz to 40 GHz	> 8 dB	> 8 dB

VNA System Performance for the MS46122A-010 (Manual Cal Kits)

Error-Corrected Specifications

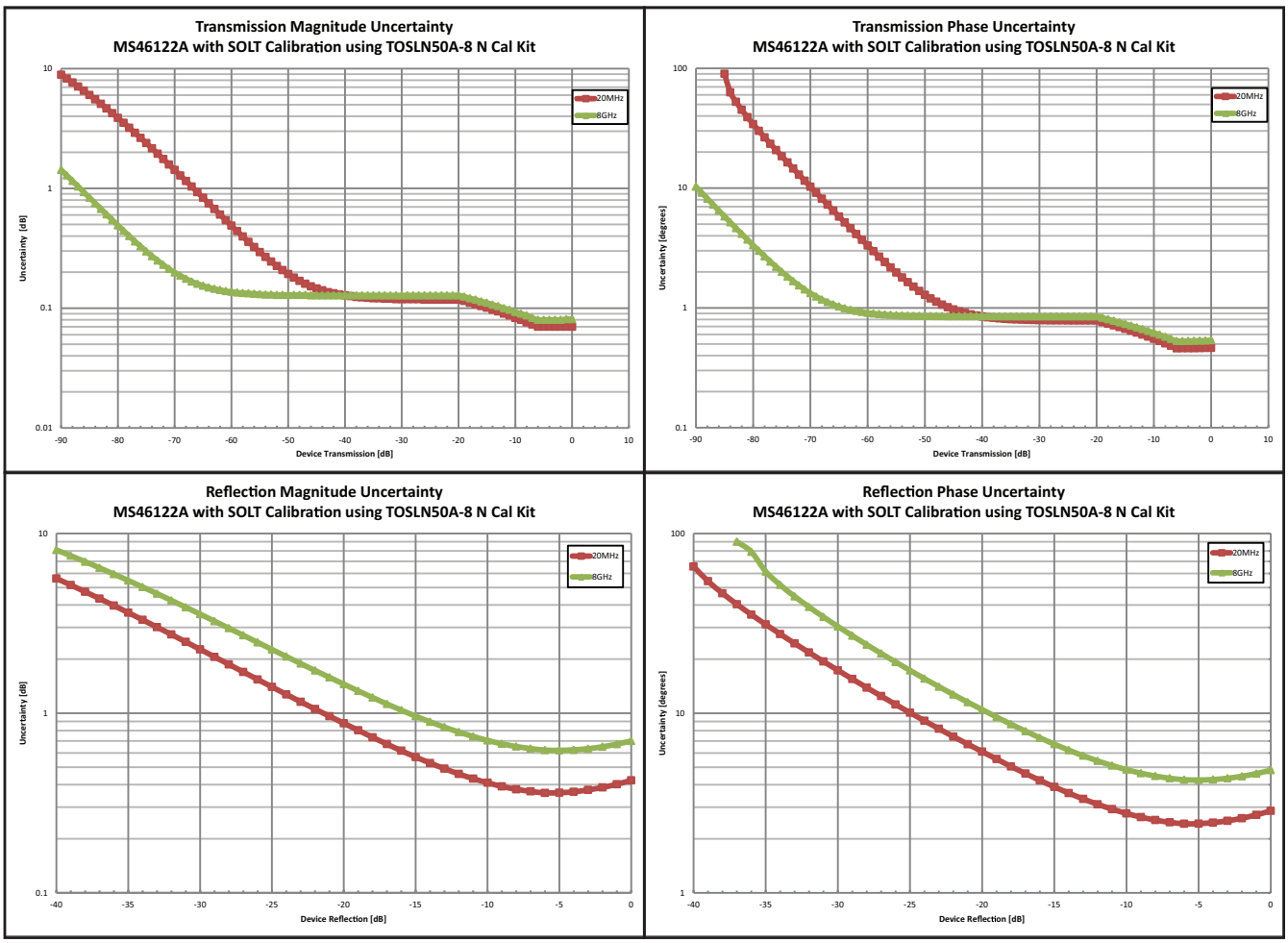
With 12-term SOLT Calibration using TOSLN50A-8 or TOSLNF50A-8 N type connector calibration kits.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match[a] (dB)	Reflection Tracking[a] (dB)	Transmission Tracking[a] (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

a. Typical performance.

Measurement Uncertainties

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



VNA System Performance for the MS46122A-020 (Manual Cal Kits)

Error-Corrected Specifications

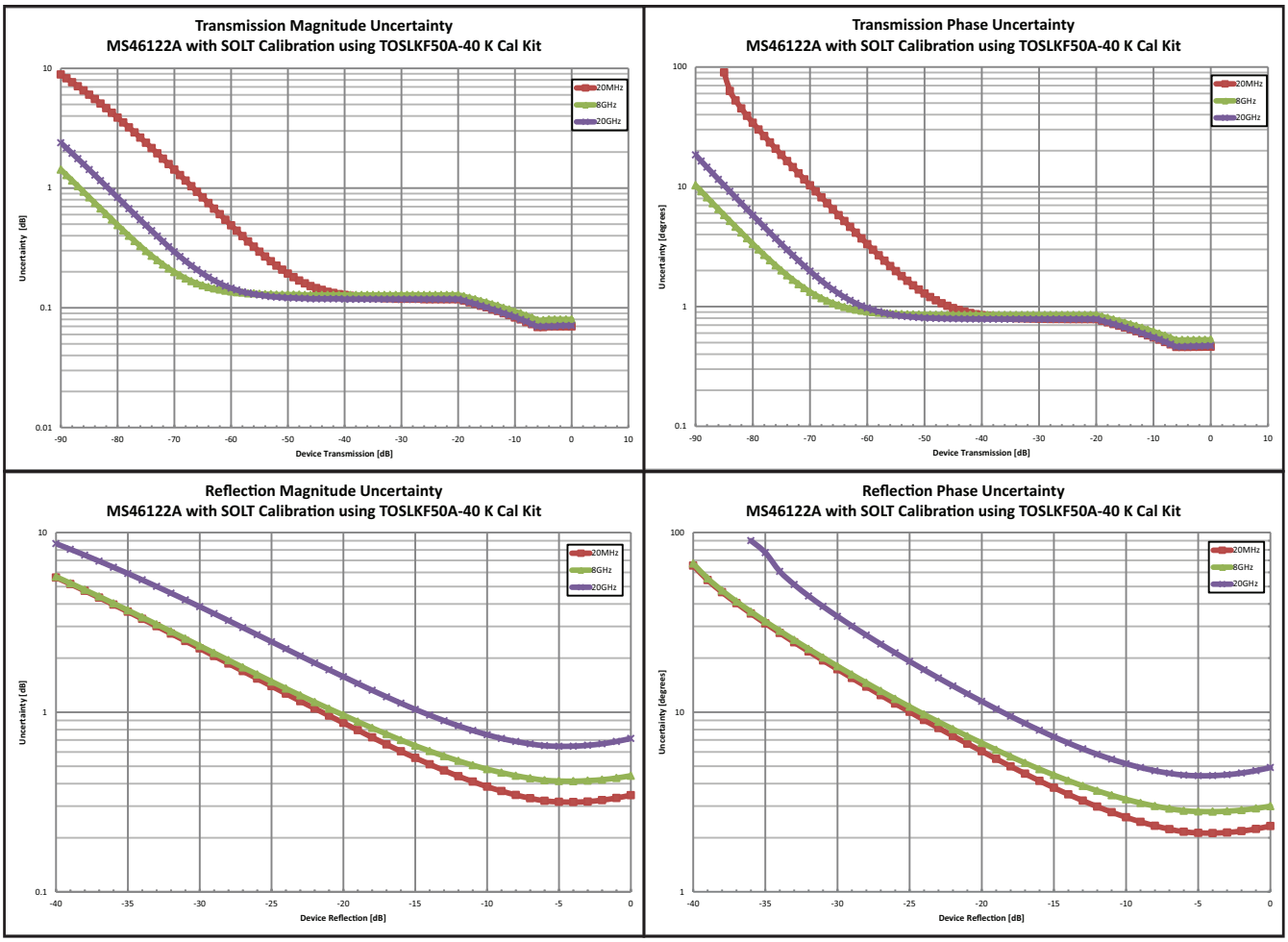
With 12-term SOLT calibration using the TOSLK50A-20 or TOSLKF50A-20 K type connector calibration kits.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match[a] (dB)	Reflection Tracking[a] (dB)	Transmission Tracking[a] (dB)
1 MHz to 10 GHz	≥ 42	≥ 33	≥ 42	±0.15	±0.06
> 10 GHz to 20 GHz	≥ 36	≥ 26	≥ 36	±0.15	±0.05

a. Typical performance.

Measurement Uncertainties

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



VNA System Performance for the MS46122A-040 (Manual Cal Kits)

Error-Corrected Specifications

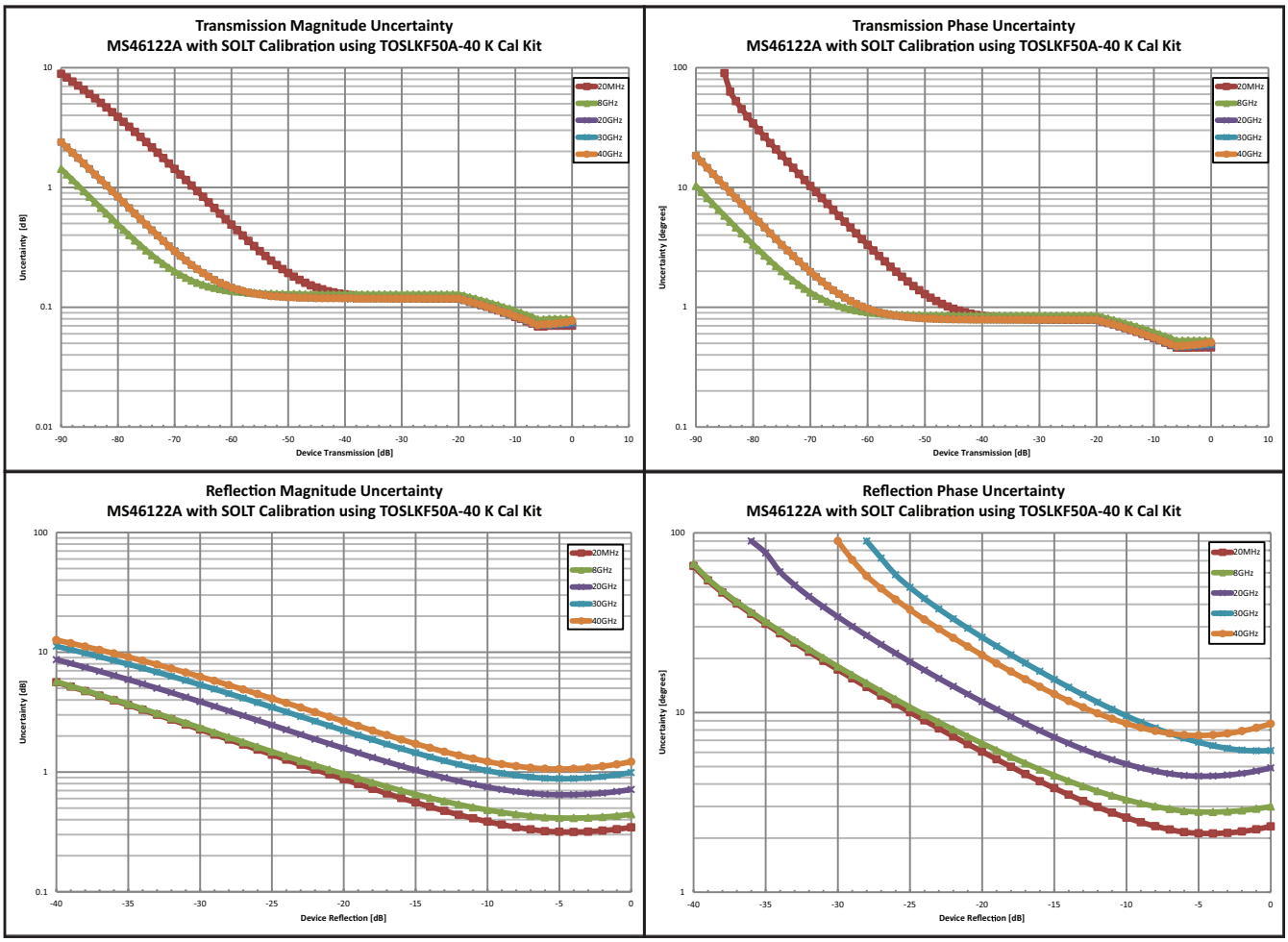
With 12-term SOLT Calibration using TOSLK50A-40 or TOSLKF50A-40 K type connector calibration kits.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match[a] (dB)	Reflection Tracking[a] (dB)	Transmission Tracking[a] (dB)
1 MHz to 10 GHz	≥ 42	≥ 33	≥ 42	±0.15	±0.06
> 10 GHz to 20 GHz	≥ 36	≥ 26	≥ 36	±0.15	±0.05
> 20 GHz to 30 GHz	≥ 36	≥ 22	≥ 36	±0.10	±0.05
> 30 GHz to 40 GHz	≥ 30	≥ 20	≥ 30	±0.10	±0.05

a. Typical performance.

Measurement Uncertainties

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



VNA System Performance for MS46122A-010 (SmartCal™)

Error-Corrected Specifications with 8.5 GHz MN25208A SmartCal™

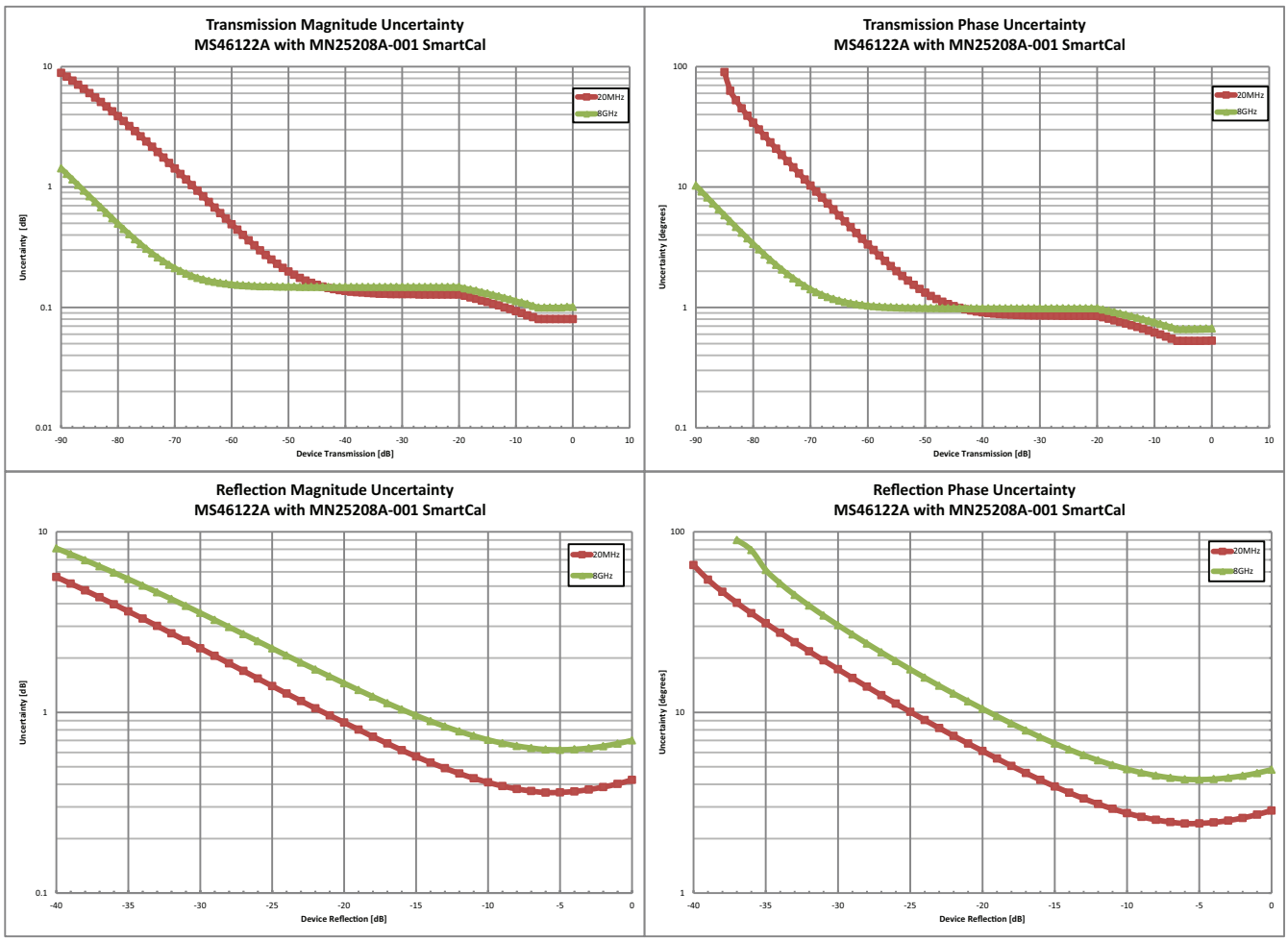
With 12-term calibration using the MN25208A SmartCal™ automatic calibration kit with N(f) type connectors (option -001).

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match[a] (dB)	Reflection Tracking[a] (dB)	Transmission Tracking[a] (dB)
1 MHz to 3 GHz	≥ 42	≥ 33	≥ 42	±0.15	±0.06
3 GHz to 6 GHz	≥ 42	≥ 33	≥ 42	±0.15	±0.08
> 6 GHz to 8 GHz	≥ 37	≥ 33	≥ 37	±0.15	±0.08

a. Typical performance.

Measurement Uncertainties

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



VNA System Performance for the MS46122A-040 (AutoCal)

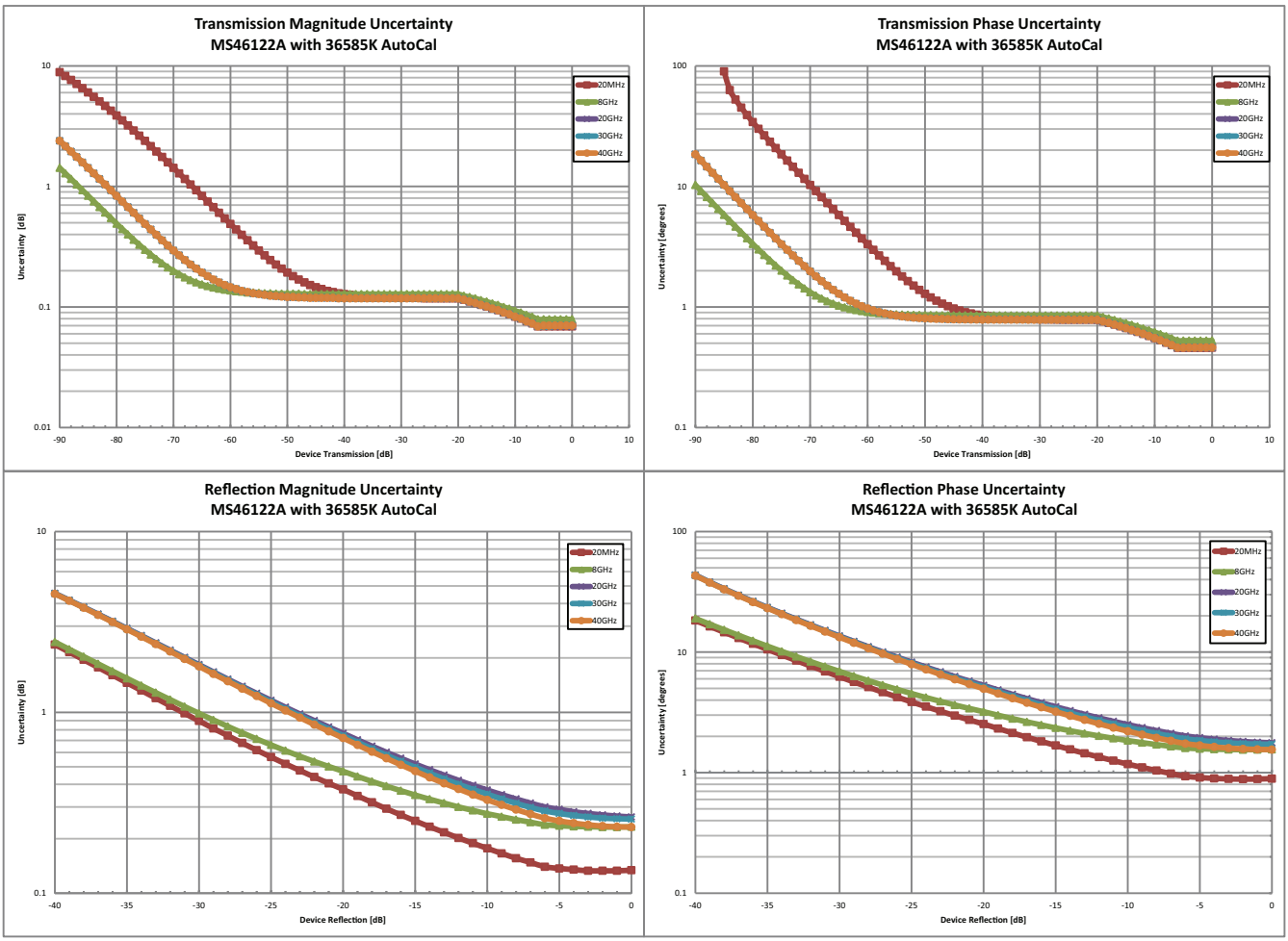
Error-Corrected Specifications with 36585K AutoCal

With 12-term calibration using the 36585K automatic calibrator (AutoCal). Performance is typical.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
1 MHz to < 10 GHz	≥ 54	≥ 49	≥ 42	±0.15	±0.06
10 GHz to < 20 GHz	≥ 45	≥ 49	≥ 36	±0.15	±0.05
20 GHz to < 30 GHz	≥ 45	≥ 45	≥ 36	±0.10	±0.05
30 GHz to 40 GHz	≥ 45	≥ 45	≥ 30	±0.10	±0.05

Measurement Uncertainties

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



Measurement Throughput

Measurement Speed

220 µs/point, typical. Per point single sweep time, including placing measurement data into memory. Average of narrow, mid, and wide frequency span sweeps. 300 kHz IFBW, 201 points, 2 port calibrated data measurement. Timing dependent on external computer configuration. Measurements taken with a 3 GHz CPU running Windows 7 with 4 GB of RAM and 60 GB of free hard disk space.

Standard Capabilities

Operating Frequencies

MS46122A-010 1 MHz to 8 GHz
MS46122A-020 1 MHz to 20 GHz
MS46122A-040 1 MHz to 40 GHz

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, 1.
Domains	Frequency Domain, and Time (Distance) Domain

Sweeps

Frequency Sweep Types	Linear, Log, or Segmented

Display Graphs

Single Rectilinear Graph Types	Log Magnitude, Phase, Group Delay, Linear Magnitude, Real, Imaginary, SWR, and Impedance
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

Maximum Data Points	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.

Averaging

Point-by-Point	Point-by-point (default), maximum number of averages = 4096
Sweep-by-Sweep	Sweep-by-sweep, maximum number of averages = 4096

IF Bandwidth

10, 20, 50, 70, 100, 200, 300, 500, 700 Hz
1, 2, 3, 5, 7, 10, 20, 30, 50, 70, 100, 200, 300 kHz

Reference Plane

Line Length or Time Delay	The reference planes of a calibration or other normalization can be changed by entering a line length or time delay.
Dielectric Constants	Dielectric constants may be entered for different media so the length entry can be physically meaningful.
Dispersion Modeling	Dispersion modeling is used in the cases of microstrip and waveguide to take into account frequency dependent phase velocities.
Attenuations	Attenuations and constant phase offsets can be entered to better describe any reference plane distortions.
De-embedding	For more complete reference plane manipulation, the full de-embedding system can also be used.

Measurement Frequency Range

Frequency Range Change	Frequency range of the measurement can be narrowed within the calibration range without recalibration.
CW Mode	CW mode permits single frequency measurements also without recalibration.
Interpolation Not Activated	If interpolation is not activated, the subset frequency range is forced to use calibration frequency points.
Interpolation Activated	If interpolation is activated, any frequency range that is a subset of the calibration frequency range can be used, but there may be some added interpolation error.

Group Delay

Group Delay Aperture	Defined as the frequency span over which the phase change is computed at a given frequency point.
Aperture	The aperture can be changed without recalibration.
Minimum Aperture	The minimum aperture is the frequency range divided by the number of points in calibration and can be increased to 20 % of the frequency range.
Group Delay Range	< 180° of phase change within the aperture

Channels, Display, and Traces

Channels and Traces	16 channels, each with up to 16 traces
Display Colors	Unlimited colors for data traces, memory, text, markers, graticules, and limit lines
Trace Memory and Math	A separate memory for each trace can be used to store measurement data for later display or subtraction, addition, multiplication or division with current measurement data. The trace data can be saved and recalled.
Intra-trace Math	Any two traces within a channel can be combined (via addition, subtraction, multiplication, or division) and displayed on another trace.

Scale Resolution		
		Minimum per division, varies with graph type.
	Log Magnitude	0.001 dB
	Linear Magnitude	10 U
	Phase	0.01°
	Group Delay	0.1 ps
	Time	0.0001 ps
	Distance	0.1 m
	SWR	10 U
	Power	0.01 dB
Markers		
	Markers	12 markers + 1 reference marker
	Marker Coupling	Coupled or decoupled
	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.

Calibration and Correction Capabilities

Calibration Methods

Short-Open-Load-Through (SOLT)
Offset-Short-Offset-Short-Load-Through (SSLT)
Triple-Offset-Short-Through (SSST)
AutoCal
Thru Update available

Correction Models

2-Port (Forward, Reverse, or both directions)
1-Port (S_{11}, S_{22}, or both)
Transmission Frequency Response (Forward, Reverse, or both directions)
Reflection Frequency Response (S_{11}, S_{22}, or both)

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.

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

Embedding/De-embedding

The MS46122A 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 easier computation of de-embedding files based on additional calibration steps and measurements.

Impedance Conversion

Allows entry of different reference impedances (complex values) for different ports

Optional Capabilities

Time Domain Measurements Option 002	Displays all S-parameters and overlays with Frequency Domain, Low-pass Mode with added harmonics frequency list flexibility, Band-pass Mode, Phasor Impulse Mode, Windowing, Gating (pass-band or reject-band), and Frequency with Time Gate.

Remote Operability

ShockLine supports several remote operability options.

Communication Type	Data Format	Performance	Description
Drivers	IVI-C drivers are available for download from the Anritsu website. The IVI-C package supports National Instruments LabVIEW and LabWindows, C#, .NET, MATLAB, and Python34 programming environments.		
Triggering	Start Trigger	Software and Digital Edge	
	Input Range	+3.3 V logic level (+5 V tolerant)	
	Minimum Trigger Width	50 ns	
	Trigger Delay	6 µs, typical	

Front Panel Connections

MS46122A Front Panel

Test Ports 1 and 2		
	MS46122A-010	N(f)
	MS46122A-020	Ruggedized K(m)
	MS46122A-040	Ruggedized K(m)
	Damage Input Levels	+23 dBm maximum, ±50 VDC maximum
USB Ports		One mini type B USB port for connecting to an external PC controller.
Power Input		Input connector for external power supply.
10 MHz In		Signal presence is auto-sensing (better than 10 ppm frequency accuracy is recommended).
	Connector Type	BNC(f)
	Signal	+0 dBm, typical; 50 Ω, nominal
External Trigger Input		
	Connector Type	BNC(f)
	Voltage Input	0 to 3.3 V input (5 V tolerant)
	Impedance	High impedance (> 100 kΩ)
	Pulse Width	50 ns minimum input pulse width
	Trigger Delay	6 µs typical

Rear Panel Connections

MS46122A Series Rear Panel

Recommended External PC Configuration and Operating System

Operating System	Windows® 7 or 8, 64 bit
CPU	3 GHz
RAM	4 GB
Disk	120 GB
DirectX	Version 9 with Windows Display Driver Model (WDDM) installed

Mechanical

Dimensions		Dimensions listed are for the instrument body without rack mount option attached.
	H x W x D	61.1 mm x 328.1 mm x 197.87 mm
Weight		< 2.2 kg (< 5 lb), typical weight for a fully-loaded MS46122A VNA

Environmental

Operating		Specification Conforms to MIL-PRF-28800F (class 3)
	Temperature Range	0 °C to +50 °C
	Relative Humidity	5 % to 95 % at +40 °C, Non-condensing
Non-Operating		
	Temperature Range	–40 °C to +75 °C
	Relative Humidity	0 % to 90 % at +65 °C, Non-condensing

Electromagnetic Compatibility

EMI Conforms to and meets the requirements of:

EMC Directive	2004/108/EC
Low Voltage Directive	2006/95/EC
Emissions	EN55011:2009+A1:2010 Group 1 Class A
Immunity	EN 61000-4-2-2009, 4 kV CD, 8 kV AD EN 61000-4-3:2006+A2:2010, 3 V/m EN 61000-4-4:2004, 0.5 kV S-L, 1 kV P-L EN 61000-4-5:2006, 0.5 kV S-L, 1 kV L-E EN 61000-4-6:2009, 3 V EN 61000-4-11:2004, 100 % @ 20 ms

Safety

European Union	CE Mark
Standard:	EN 61010-1:2010

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
Warranty Options	Additional warranty available

Ordering Information

Instrument Models

Base Model	MS46122A, 2-Port ShockLine™ Economy VNA
Required Option (Select one frequency option only)	MS46122A-010, 1 MHz to 8 GHz, type N(f) ports MS46122A-020, 1 MHz to 20 GHz, Ruggedized type K(m) ports (compatible with 3.5 mm and SMA connectors) MS46122A-040, 1 MHz to 40 GHz, Ruggedized type K(m) ports (compatible with 3.5 mm and SMA connectors)

Included Accessories

Each VNA comes with a set of included accessories.

User Documentation	The user documentation USB device includes the ShockLine software for controlling the VNA and Adobe Acrobat PDF files for the ShockLine Operation Manual, User Interface Reference Manual, and the Technical Data Sheet.
Power	40-187-R, 12 V, 5 A Power supply (and power cord)
USB Cable	3-2000-1498, USB 2.0 A to Mini B cable, 10 ft
Rack Mount	ND80788, Rack Mount Kit adds handles and removes rubber bumpers for shelf-mounting into a 19 inch universal rack

VNA Options

Main Options	MS46122A-002, Time Domain with Time Gating
Calibration Options	MS46122A-098, Standard Calibration, ISO 17025 compliant, without data MS46122A-099, Premium Calibration, ISO 17025 compliant, with data

Precision Automatic Calibrator Modules

MN25208A	2-port USB SmartCal Module, 300 kHz to 8.5 GHz, (available with various connector options)
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)

Mechanical Calibration Kits

3650	SMA/3.5 mm Calibration Kit
3650A	SMA/3.5 mm Calibration Kit, Without Sliding Loads
3650A-1	SMA/3.5 mm Calibration Kit, With Sliding Loads
3652A	K Calibration Kit, Without Sliding Loads
3652A-1	K Calibration Kit, With Sliding Loads
3653A	N Calibration Kit, Without Sliding Loads
OSLN50A-8	Precision N Male Open/Short/Load Mechanical Calibration Tee
OSLNF50A-8	Precision N Female Open/Short/Load Mechanical Calibration Tee
TOSLN50A-8	Precision N Male Through/Open/Short/Load Mechanical Calibration Tee
TOSLNF50A-8	Precision N Female Through/Open/Short/Load Mechanical Calibration Tee
OSLN50A-18	Precision N Male Open/Short/Load Mechanical Calibration Tee
OSLNF50A-18	Precision N Female Open/Short/Load Mechanical Calibration Tee
TOSLN50A-18	Precision N Male Through/Open/Short/Load Mechanical Calibration Tee
TOSLNF50A-18	Precision N Female Through/Open/Short/Load Mechanical Calibration Tee
TOSLK50A-20	Precision K Male Through/Open/Short/Load Mechanical Calibration Tee
TOSLKF50A-20	Precision K Female Through/Open/Short/Load Mechanical Calibration Tee
TOSLK50A-40	Precision K Male Through/Open/Short/Load Mechanical Calibration Tee
TOSLKF50A-40	Precision K Female Through/Open/Short/Load Mechanical Calibration Tee

Verification Kits

3668-2	K Verification Kit

RF Cables and Adapters

1091-26-R	SMA(m) to N(m), DC to 18 GHz, 50 Ω
1091-27-R	SMA(f) to N(m), DC to 18 GHz, 50 Ω
1091-80-R	SMA(m) to N(f), DC to 18 GHz, 50 Ω
1091-81-R	SMA(f) to N(f), DC to 18 GHz, 50 Ω
71693-R	Ruggedized adapter, K(f) to N(f), DC to 18 GHz, 50 ohm
34NK50	Precision Adapter, N(m) to K(m), DC to 18 GHz, 50 Ω
34NKF50	Precision Adapter, N(m) to K(f), DC to 18 GHz, 50 Ω
34NFK50	Precision Adapter, N(f) to K(m), DC to 18 GHz, 50 Ω
34NFKF50	Precision Adapter, N(f) to K(f), DC to 18 GHz, 50 Ω
K220B	Precision Adapter, DC to 40 GHz, K(m) to K(m), 50 Ω
K222B	Precision Adapter, DC to 40 GHz, K(f) to K(f), 50 Ω
K224B	Precision Adapter, DC to 40 GHz, K(m) to K(f), 50 Ω

Test Port Cables, Flexible, Ruggedized, Phase Stable

14RKFKF50-0.6	0.6 m (24”), DC to 40 GHz, Ruggedized K(f) to K(f), 50 Ω
14RKFKF50-1.0	1.0 m (39”), DC to 40 GHz, Ruggedized K(f) to K(f), 50 Ω
14RKFK50-0.6	0.6 m (24”), DC to 40 GHz, Ruggedized K(f) to K(m), 50 Ω
14RKFK50-1.0	1.0 m (39”), DC to 40 GHz, Ruggedized K(f) to K(m), 50 Ω
14KFKF50-0.6	0.6 m (24”), DC to 40 GHz, K(f) to K(f), 50 Ω
14KFKF50-1.0	1.0 m (39”), DC to 40 GHz, K(f) to K(f), 50 Ω
14KFK50-0.6	0.6 m (24”), DC to 40 GHz, K(f) to K(m), 50 Ω
14KFK50-1.0	1.0 m (39”), DC to 40 GHz, K(f) to K(m), 50 Ω
15LL50-1.0A	Test Port Cable, Armored, Phase Stable, DC to 20 GHz, 3.5 mm(m) to 3.5 mm(m), 1.0 m, 50 Ω
15LLF50-1.0A	Test Port Cable, Armored, Phase Stable, DC to 20 GHz, 3.5 mm(m) to 3.5 mm(f), 1.0 m, 50 Ω
15KK50-1.0A	Test Port Cable, Armored, Phase Stable, DC to 20 GHz, K(m) to K(m), 1.0 m, 50 Ω
15KKF50-1.0A	Test Port Cable, Armored, Phase Stable, DC to 20 GHz, K(m) to K(f), 1.0 m, 50 Ω
SC8267	Cable, 40 GHz, K(m) to K(f), 1 m (36"), 50 Ω

Phase-Stable 18 GHz and 40 GHz Semi-Rigid Cables (Armored)

3670K50-1	0.3 m (12”), DC to 40 GHz, K(f) to K(m), 50 Ω
3670K50-2	0.6 m (24”), DC to 40 GHz, K(f) to K(m), 50 Ω

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
01-203	Torque End Wrench, 13/16 in, 0.9 N.m (8 lbf.in) For tightening ruggedized SMA, 2.4 mm, K and V test port connectors
01-204	End Wrench, 5/16 in, Universal, Circular, Open-ended, For SMA, 3.5 mm, 2.4 mm, K and V connectors

Documentation

User Documentation	Soft copies of the manuals as Adobe Acrobat PDF files are included on the User Documentation USB memory device provided with the instrument. The Maintenance Manual is available from Anritsu Customer Service. For more information, please contact ShockLineVNA.support@Anritsu.com.
10410-00340	MS46122A Series VNA Operation Manual (OM)

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