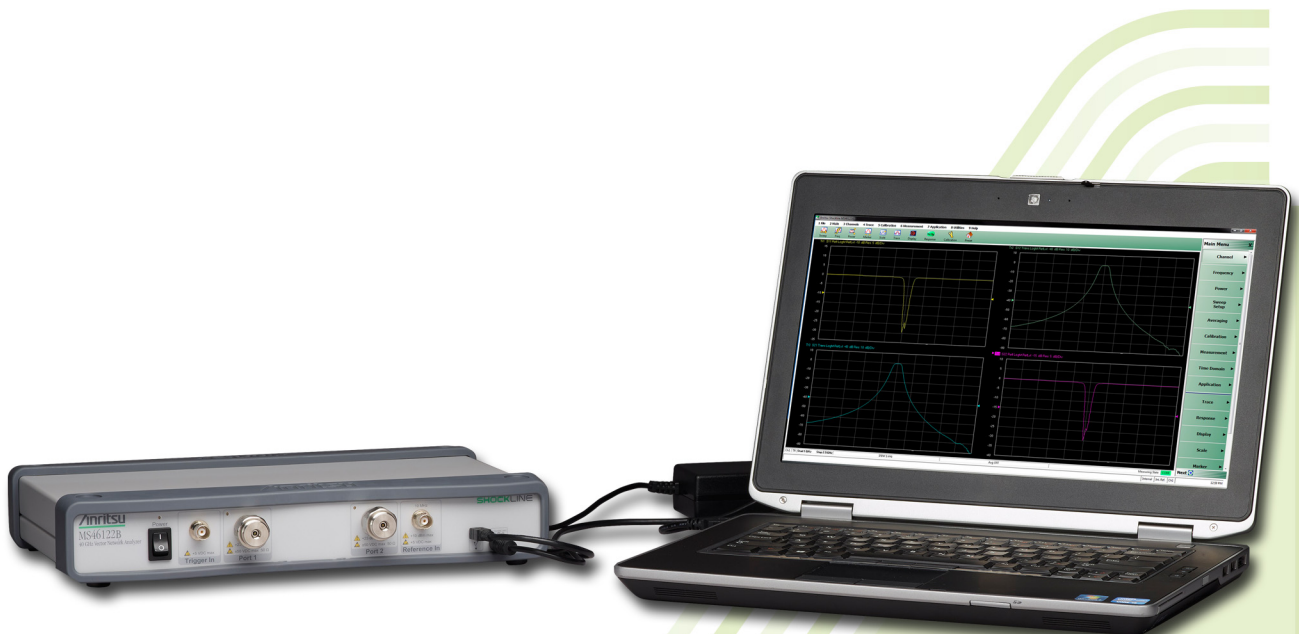


**Anritsu** Advancing beyond

# ShockLine™ Compact Vector Network Analyzers

## MS46122B

1 MHz to 43.5 GHz



## Introduction

The MS46122B 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 (VNAs). It is available in three frequency ranges: 1 MHz to 8/20/43.5 GHz, and is capable of S-parameter and time domain measurements.

The MS46122B 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 43.5 GHz.

The MS46122B series is controlled through USB from an external PC. The MS46122B 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 MS46122B series Vector Network Analyzers and related options.

## Instrument Models and Operating Frequencies

Base Model

- MS46122B, 2-Port ShockLine VNA

Requires one Frequency Option

- MS46122B-010, 1 MHz to 8 GHz, 2-Port
- MS46122B-020, 1 MHz to 20 GHz, 2-Port
- MS46122B-043, 1 MHz to 43.5 GHz, 2-Port

## Principal Options

- MS46122B-002, Time Domain
- MS46122B-024, Universal Fixture Extraction



MS46122B-043 2-Port ShockLine Compact VNA

Table of Contents

Definitions..... 3

System Dynamic Range ..... 4

Receiver Compression Levels ..... 4

High Level Noise ..... 4

Output Power Settings ..... 4

Measurement Stability ..... 4

Frequency Resolution, Accuracy, and Stability ..... 4

Uncorrected (Raw) Port Characteristics ..... 4

MS46122B-010 VNA System Performance with Manual Cal Kits ..... 5

MS46122B-020 VNA System Performance with Manual Cal Kits ..... 6

MS46122B-043 VNA System Performance with Manual Cal Kits ..... 7

MS46122B-043 VNA System Performance with Manual Cal Kits ..... 8

MS46122B-010 VNA System Performance with SmartCal™ ..... 9

MS46122B-010 VNA System Performance with SmartCal™ ..... 10

MS46122B-010 and MS46122B-020 VNA System Performance with SmartCal™ ..... 11

MS46122B-010 and MS46122B-020 VNA System Performance with SmartCal™ ..... 12

MS46122B-043 VNA System Performance with Precision AutoCal™ ..... 13

Measurement Throughput..... 13

Standard Capabilities ..... 14

Calibration and Correction Capabilities ..... 16

Optional Capabilities..... 16

Remote Operability ..... 16

Front Panel Connections ..... 17

Rear Panel Connections ..... 17

Recommended External PC Configuration ..... 17

Mechanical ..... 18

Regulatory Compliance..... 18

Environmental ..... 18

Warranty ..... 18

Ordering Information ..... 19

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. For the most current data sheet, please visit the Anritsu web site: <a href="http://www.anritsu.com">www.anritsu.com</a>

The instrument may be protected by one or more of the following patents: 6894581, 7088111, 7545151, 7683633, 7924024, 8417189, 8718586, 10778592.

## 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 with an isolation calibration.

Frequency Range	Standard (dB)	Typical (dB)
1 MHz to 10 MHz	85	105
> 10 MHz to 8 GHz <sup>a</sup>	100	115
> 8 GHz to 40 GHz <sup>b</sup>	100	110
> 40 GHz to 43.5 GHz	97	110

a. Crosstalk may reduce dynamic range up to 20 dB (typical) at lower IF bandwidths ( $\leq 10$  kHz) when measuring highly reflective DUT's from 4 GHz to 8 GHz. Reflection measurements are not affected.

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

## Receiver Compression Levels

Port power level beyond which the response may be compressed more than 0.1 dB. Performance is characteristic.

Frequency Range	Standard (dBm)
1 MHz to 43.5 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 20 GHz	0.006 (0.001, typical)	< 0.1 (< 0.05 typical)
> 20 GHz to 40 GHz	0.006 (0.001, typical)	< 0.15 (< 0.05 typical)
> 40 GHz to 43.5 GHz	0.009 (0.001, typical)	< 0.18 (< 0.05 typical)

## Output Power Settings

Performance is typical

Power Setting	Standard (dBm)
High (default)	1 MHz to 8 GHz > 8 GHz to 43.5 GHz 5 dBm -3 dBm
Low	1 MHz to 43.5 GHz -20 dBm

## Measurement Stability

Ratio measurement, with ports shorted. Typical.

Frequency	Magnitude (dB/°C)	Phase (deg/°C)
10 MHz to 43.5 GHz	0.02	0.3

## Frequency Resolution, Accuracy, and Stability

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

## Uncorrected (Raw) Port Characteristics

User and System Correction Off. All specifications are typical.

Frequency Range	Directivity (dB)	Port Match (dB)
1 MHz to 43.5 GHz	> 8 dB	> 8 dB

MS46122B-010 VNA System Performance with Manual Cal Kits

**Error-Corrected Specifications**

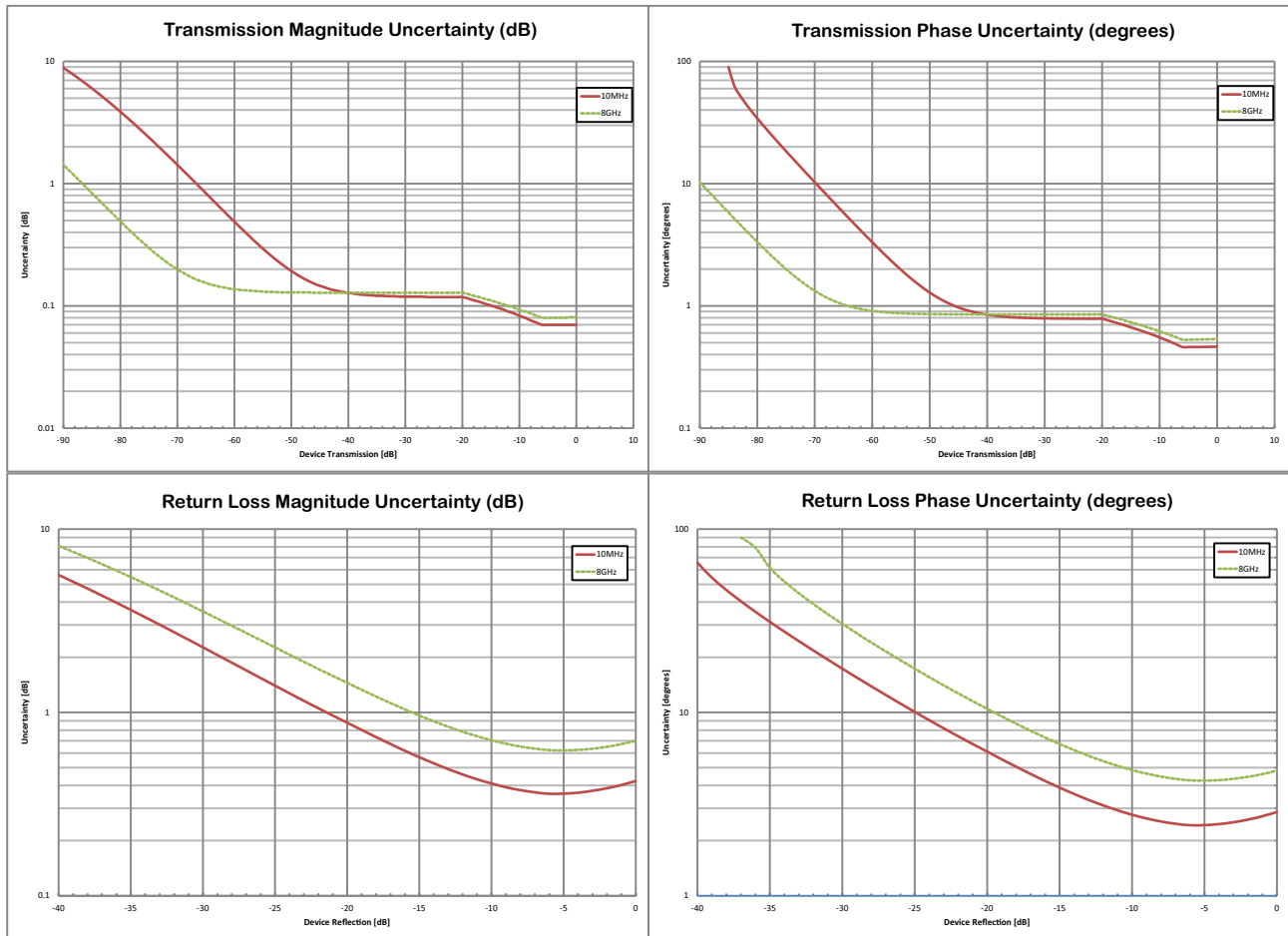
With 12-term SOLT Calibration using TOSLN50A-8 or TOSLNF50A-8 N type connector calibration kits.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match <sup>a</sup> (dB)	Reflection Tracking <sup>a</sup> (dB)	Transmission Tracking <sup>a</sup> (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. Characteristic 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](http://www.anritsu.com).



### MS46122B-020 VNA System Performance with Manual Cal Kits

#### Error-Corrected Specifications

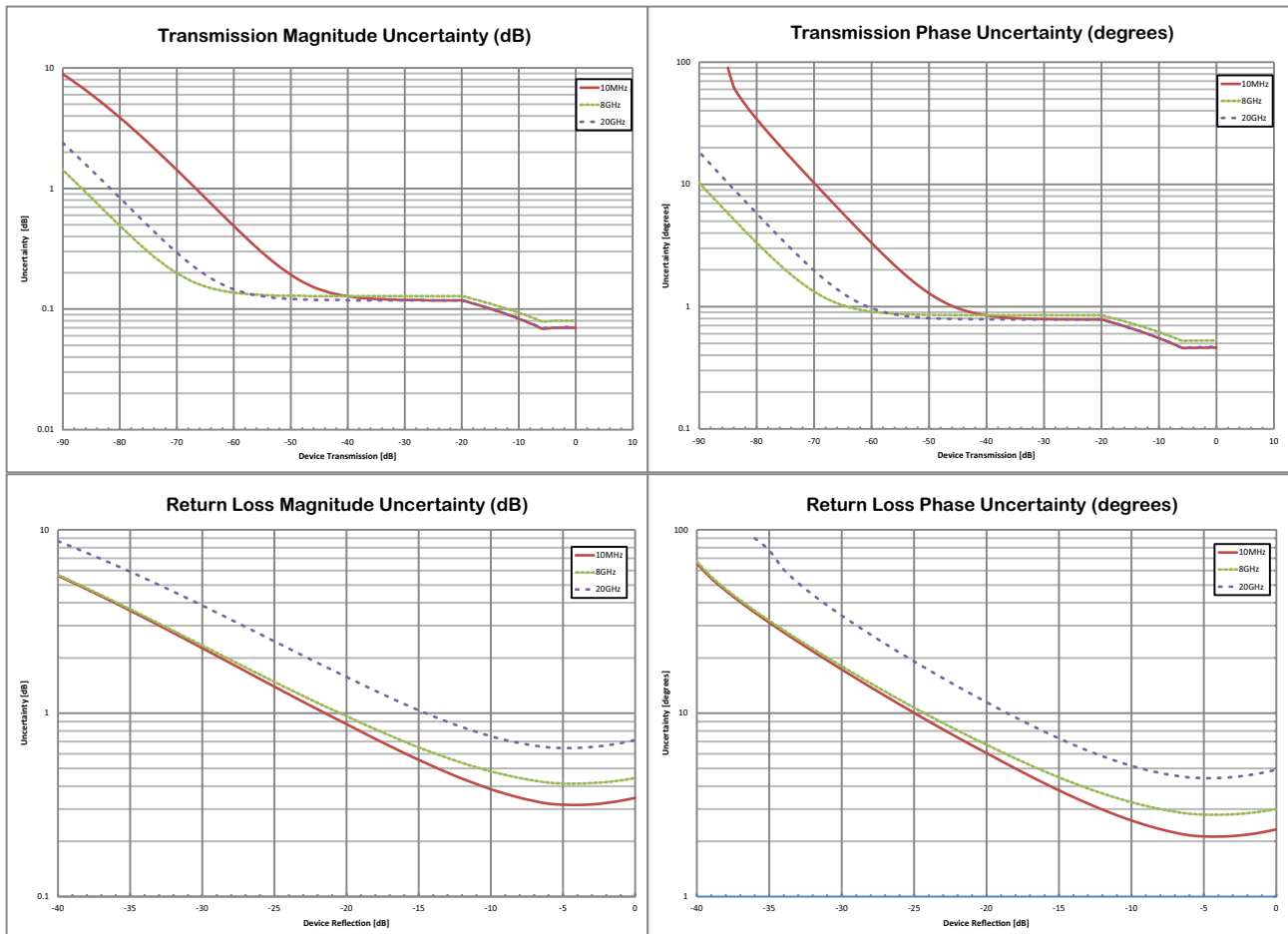
With 12-term SOLT calibration using the TOSLK50A-20 or TOSLKF50A-20 K type connector calibration kits.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match <sup>a</sup> (dB)	Reflection Tracking <sup>a</sup> (dB)	Transmission Tracking <sup>a</sup> (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. Characteristic 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](http://www.anritsu.com).



### MS46122B-043 VNA System Performance with Manual Cal Kits

#### Error-Corrected Specifications

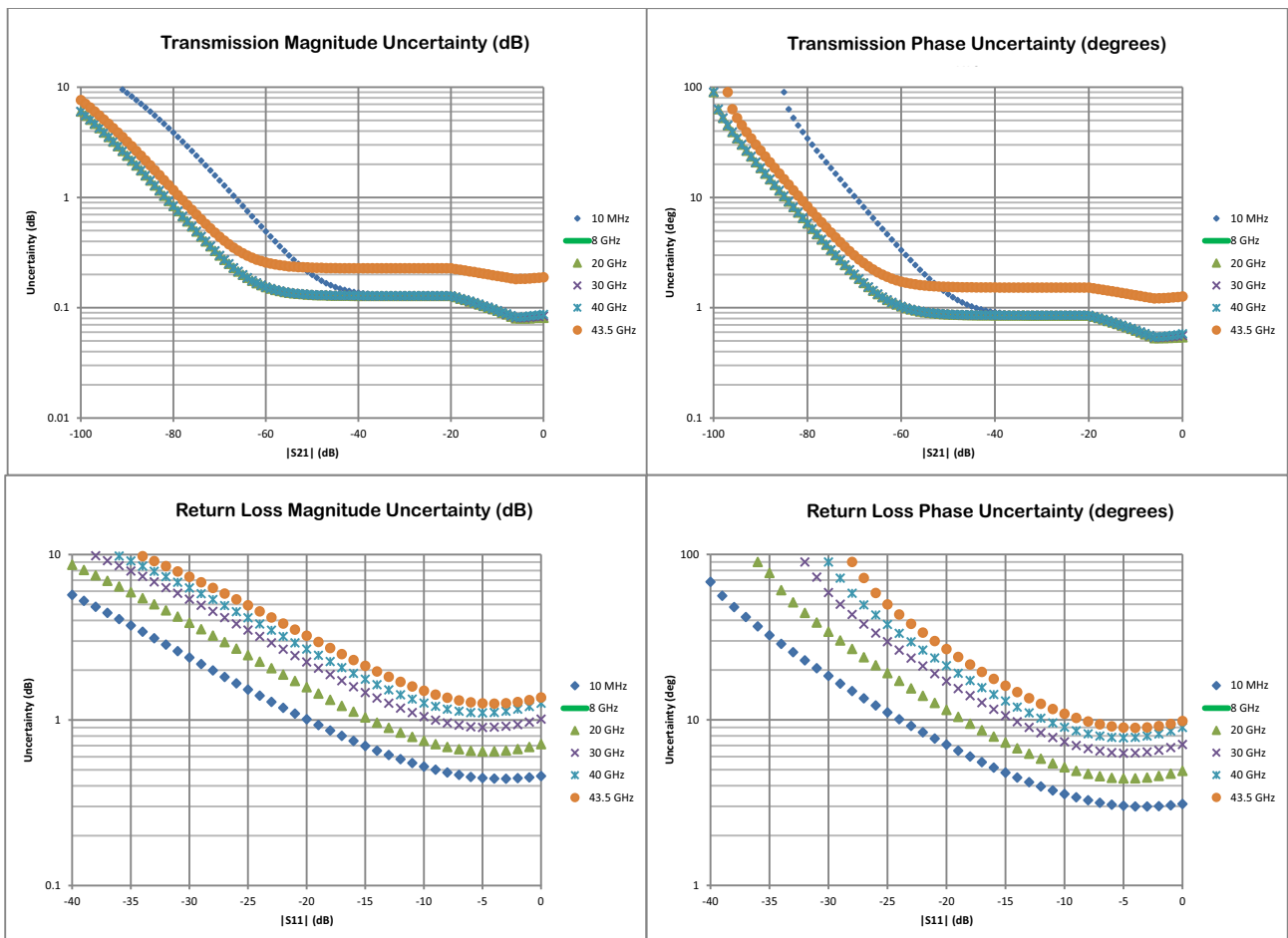
With 12-term SOLT Calibration using TOSLK50A-43.5 or TOSLKF50A-43.5 K type connector calibration kits with generic calibration coefficients.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match <sup>a</sup> (dB)	Reflection Tracking <sup>a</sup> (dB)	Transmission Tracking <sup>a</sup> (dB)
1 MHz to 10 GHz	≥ 42	≥ 33	≥ 42	±0.15	±0.06
> 10 GHz to 20 GHz	≥ 36	≥ 26	≥ 36	±0.15	±0.06
> 20 GHz to 30 GHz	≥ 32	≥ 22	≥ 32	±0.15	±0.06
> 30 GHz to 40 GHz	≥ 30	≥ 20	≥ 30	±0.15	±0.06
> 40 GHz to 43.5 GHz	≥ 28	≥ 20	≥ 28	±0.2	±0.16

a. Characteristic 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](http://www.anritsu.com).



### MS46122B-043 VNA System Performance with Manual Cal Kits

#### Error-Corrected Specifications

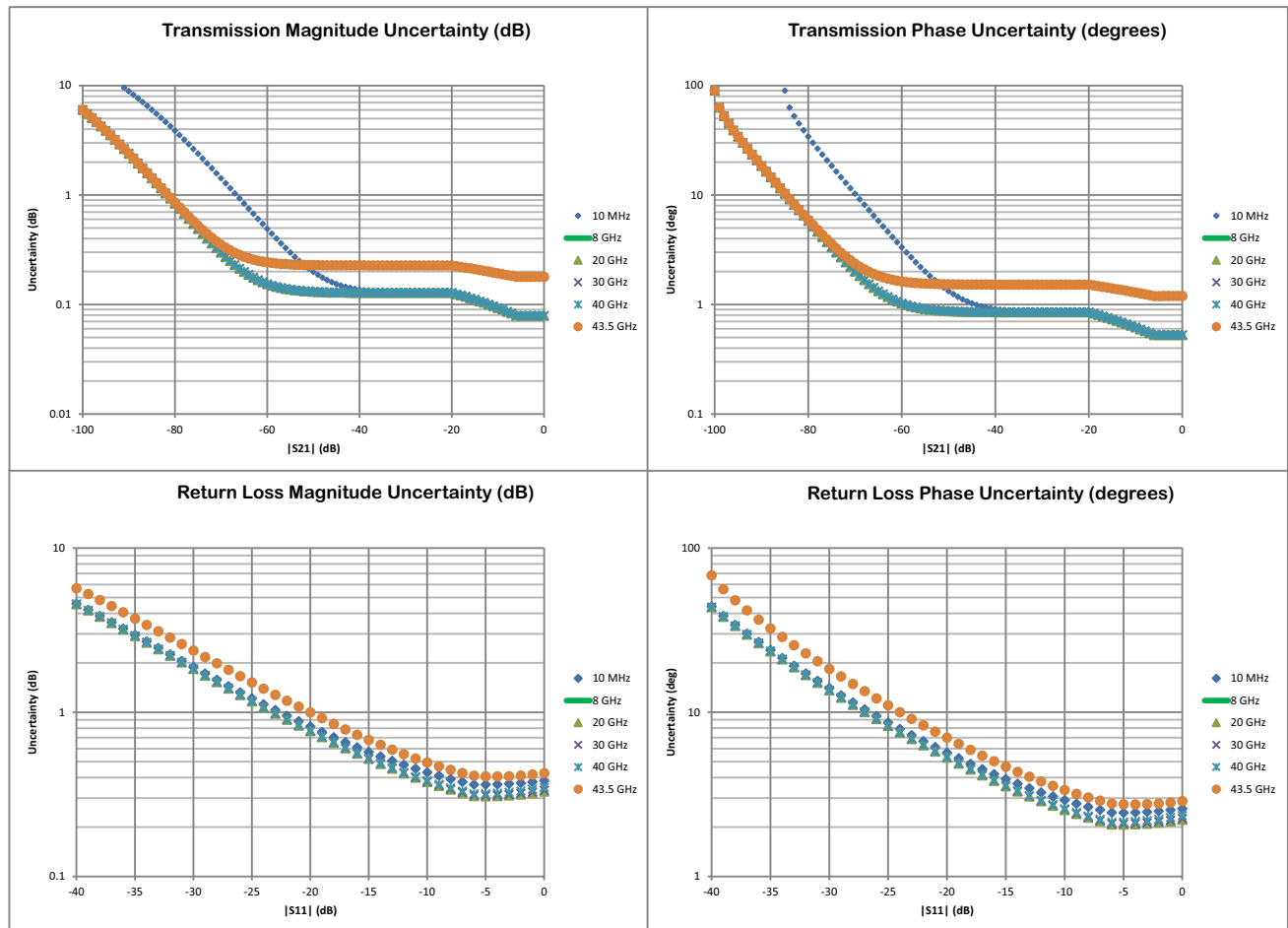
With 12-term SOLT Calibration using TOSLK50A-43.5 or TOSLKF50A-43.5 K type connector calibration kits with .s1p definitions.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match <sup>a</sup> (dB)	Reflection Tracking <sup>a</sup> (dB)	Transmission Tracking <sup>a</sup> (dB)
< 50 MHz	≥ 45	≥ 45	≥ 44	±0.15	±0.06
> 0.05 MHz to 10 GHz	≥ 45	≥ 45	≥ 44	±0.15	±0.06
> 10 GHz to 20 GHz	≥ 45	≥ 45	≥ 44	±0.15	±0.06
> 20 GHz to 30 GHz	≥ 45	≥ 44	≥ 44	±0.15	±0.06
> 30 GHz to 40 GHz	≥ 45	≥ 42	≥ 44	±0.15	±0.06
> 40 GHz to 43.5 GHz	≥ 42	≥ 41	≥ 41	±0.2	±0.16

a. Characteristic 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](http://www.anritsu.com).





MS46122B-010 VNA System Performance with SmartCal™

Error-Corrected Specifications

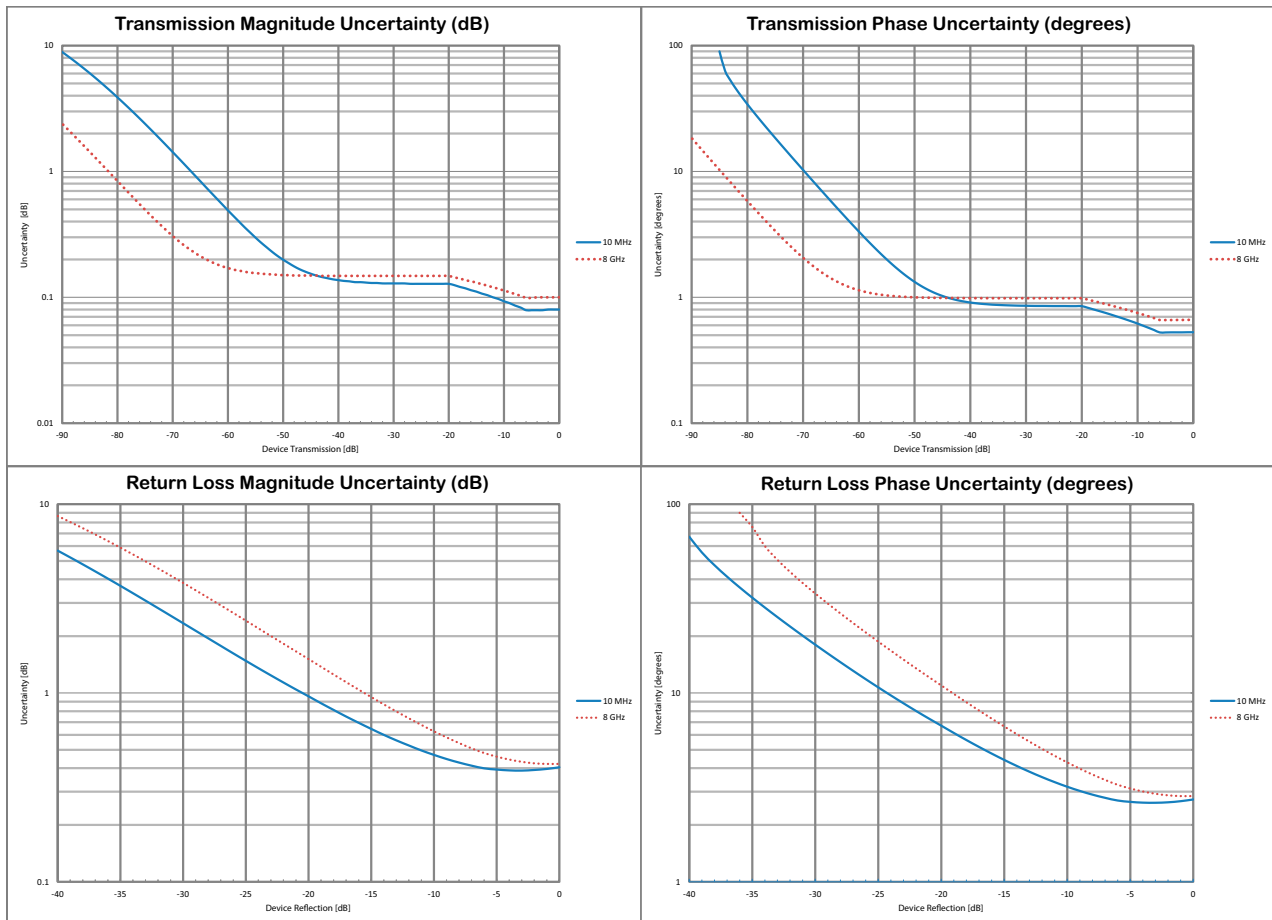
With 12-term calibration using the MN25208A SmartCal™ automatic calibration kit with connector options MN25208A-001, -002, -003

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match <sup>a</sup> (dB)	Reflection Tracking <sup>a</sup> (dB)	Transmission Tracking <sup>a</sup> (dB)
1 MHz to 1 GHz	≥ 42	≥ 35	≥ 42	±0.15	±0.06
> 1 GHz to 5 GHz	≥ 42	≥ 35	≥ 42	±0.08	±0.08
> 5GHz to 8 GHz	≥ 36	≥ 35	≥ 37	±0.1	±0.08

a. Characteristic 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](http://www.anritsu.com).



MS46122B-010 VNA System Performance with SmartCal™

**Error-Corrected Specifications**

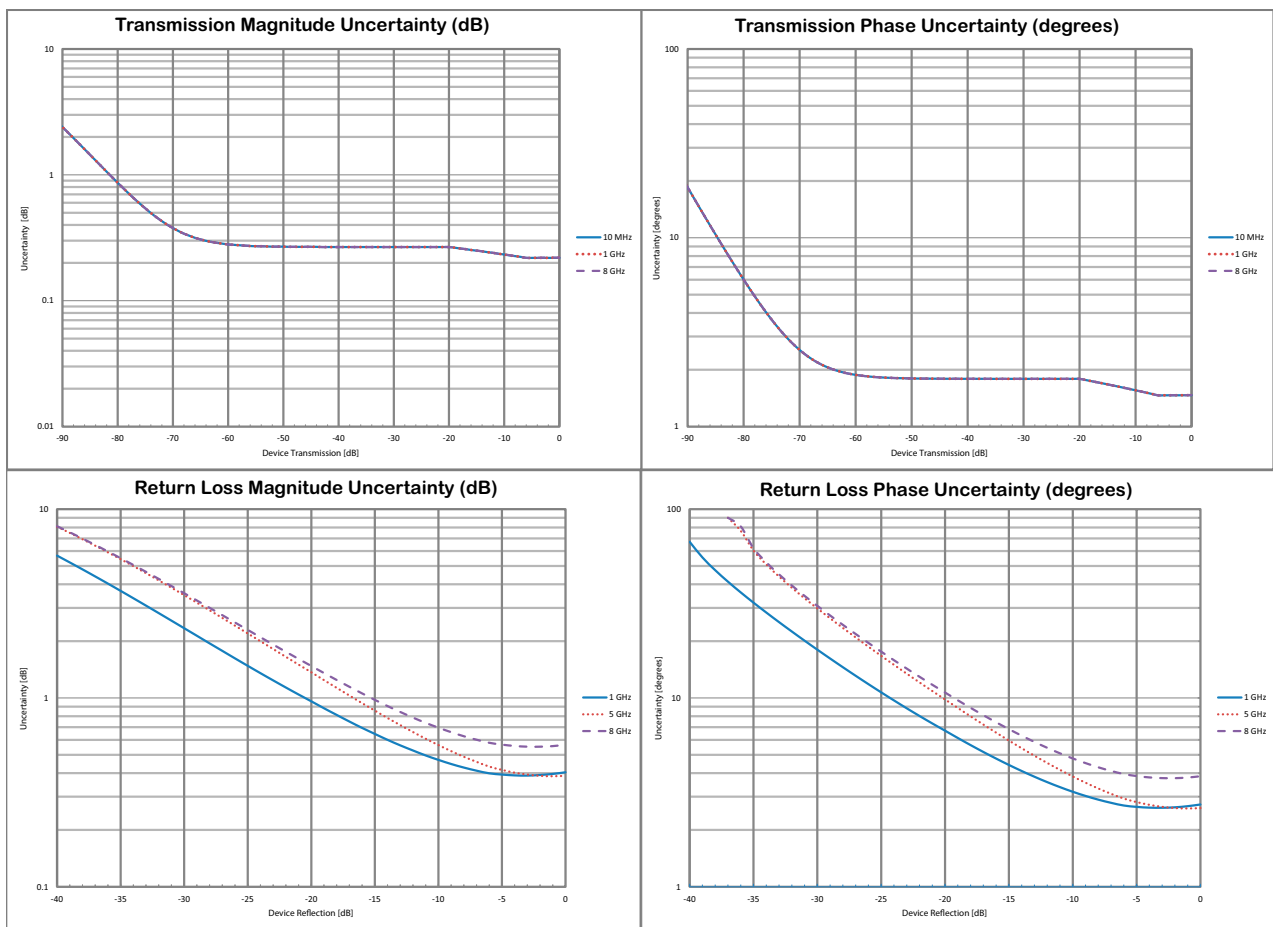
With 12-term calibration using the MN25408A SmartCal™ automatic calibration kit with connector options MN25408A-001, -002, -003

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match <sup>a</sup> (dB)	Reflection Tracking <sup>a</sup> (dB)	Transmission Tracking <sup>a</sup> (dB)
1 MHz to 1 GHz	≥ 42	≥ 35	≥ 42	±0.15	±0.2
>1 GHz - 5 GHz	≥ 37	≥ 35	≥ 37	±0.08	±0.2
>5 GHz - 8 GHz	≥ 37	≥ 32	≥ 37	±0.2	±0.2

a. Characteristic 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](http://www.anritsu.com).



MS46122B-010 and MS46122B-020 VNA System Performance with SmartCal™

**Error-Corrected Specifications**

With 12-term calibration using the MN25218A SmartCal™ automatic calibration kit.

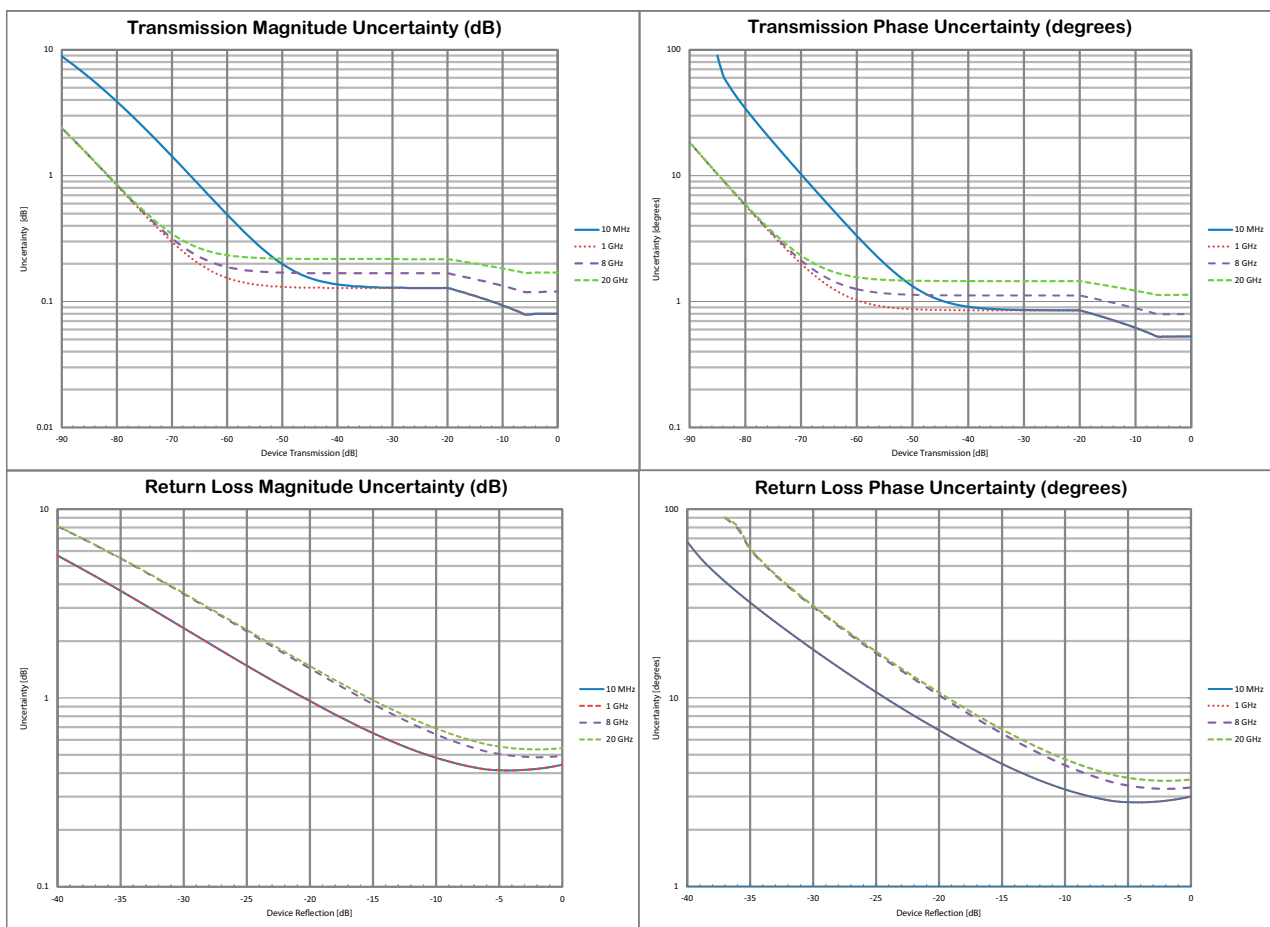
Frequency Range	Directivity (dB)	Source Match (dB)	Load Match <sup>a</sup> (dB)	Reflection Tracking <sup>a</sup> (dB)	Transmission Tracking <sup>a</sup> (dB)
1 MHz to 1 GHz <sup>b</sup>	≥ 42	≥ 33	≥ 42	±0.15	±0.06
> 1 GHz to 10 GHz	≥ 37	≥ 33	≥ 42	±0.15	±0.1
> 10 GHz to 18 GHz	≥ 37	≥ 33	≥ 36	±0.15	±0.1
> 18 GHz to 20 GHz	≥ 37	≥ 33	≥ 36	±0.20	±0.15

a. Characteristic performance.

b. Applies to Rev 2 SmartCal Modules. MN25218A with serial numbers <1817999 operate from 1 MHz to 20 GHz.

**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](http://www.anritsu.com).



MS46122B-010 and MS46122B-020 VNA System Performance with SmartCal™

**Error-Corrected Specifications**

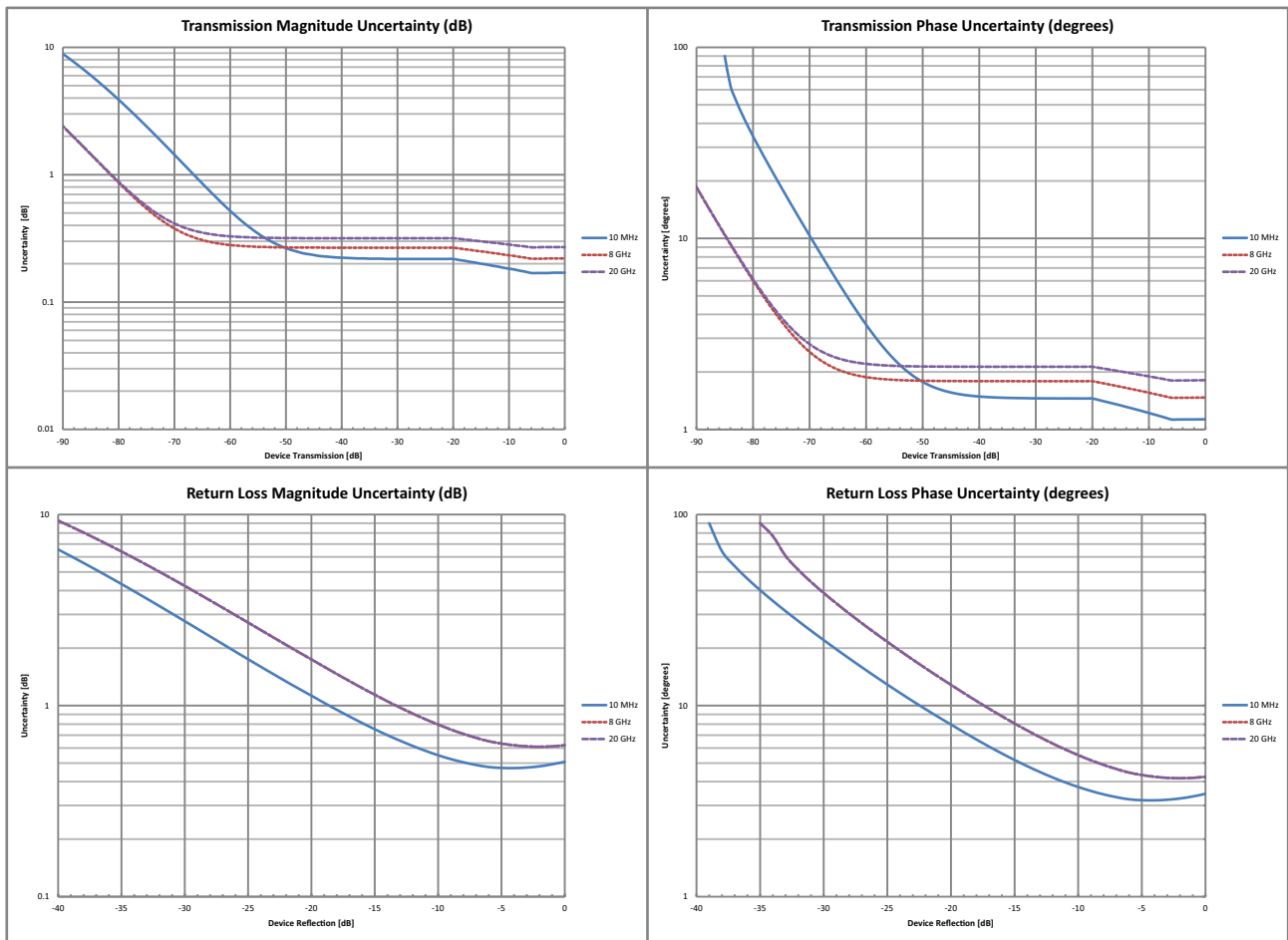
With 12-term calibration using the MN25418A SmartCal™ automatic calibration kit.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match <sup>a</sup> (dB)	Reflection Tracking <sup>a</sup> (dB)	Transmission Tracking <sup>a</sup> (dB)
1 MHz to 10 MHz	≥ 40	≥ 31	≥ 42	±0.15	±0.20
>10 MHz to 6 GHz	≥ 40	≥ 31	≥ 42	±0.15	±0.15
> 6 GHz to 18 GHz	≥ 35	≥ 31	≥ 37	±0.20	±0.20
> 18 GHz to 20 GHz	≥ 35	≥ 31	≥ 34	±0.20	±0.25

a. Characteristic 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](http://www.anritsu.com).



MS46122B-043 VNA System Performance with Precision AutoCal™

**Error-Corrected Specifications**

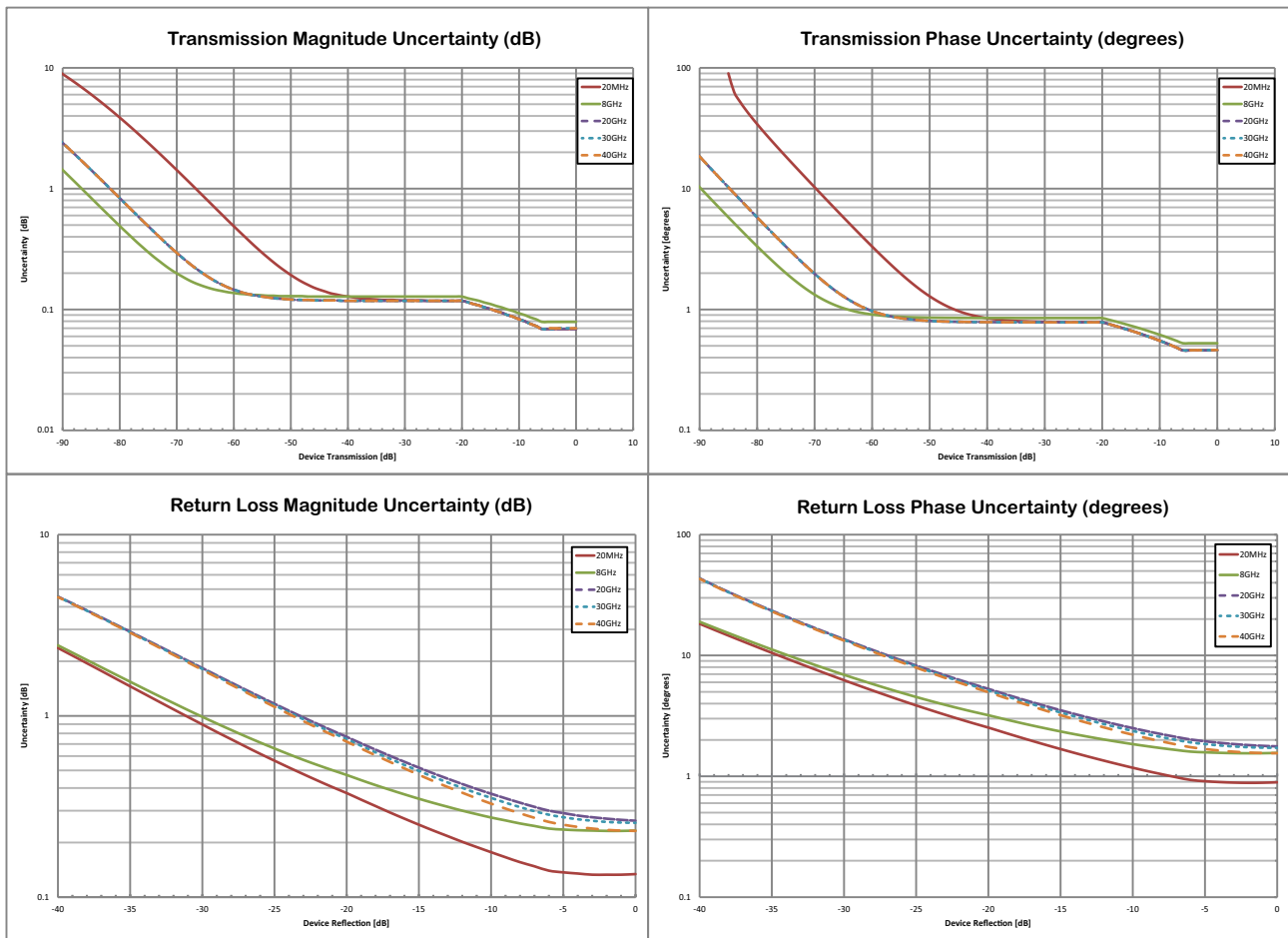
With 12-term calibration using the 36585K automatic calibration kit with type K connectors. Performance is typical.

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match <sup>a</sup> (dB)	Reflection Tracking <sup>a</sup> (dB)	Transmission Tracking <sup>a</sup> (dB)
1 MHz to < 10 GHz	≥ 50	≥ 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

a. Characteristic 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](http://www.anritsu.com).



**Measurement Throughput**

**Measurement Speed**

140 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, 1601 points, 2 port calibrated data measurement. Timing dependent on external computer configuration. Measurements taken with an Intel® Core™ i5-6300U processor running Windows 7 with 4 GB of RAM and 60 GB of free hard disk space.

## Standard Capabilities

<b>Operating Frequencies</b>		
MS46122B-010	1 MHz to 8 GHz	
MS46122B-020	1 MHz to 20 GHz	
MS46122B-043	1 MHz to 43.5 GHz	
<b>Measurement Parameters</b>		
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 Maximum Efficiency Analysis, Mixed-mode SDD, SDC, SCD, SCC	
Domains	Frequency Domain, Time (Distance) Domain (Option 2)	
<b>Sweeps</b>		
Frequency Sweep Types	Linear, Log, CW, or Segmented	
<b>Display Graphs</b>		
Single Rectilinear Graph Types	Log Magnitude, Phase, Group Delay, Linear Magnitude, Real, Imaginary, SWR, Impedance, KQ and $\eta$ Max	
Dual Rectilinear Graph Types	Log Mag and Phase, Linear Mag and Phase, Real and Imaginary, KQ and $\eta$ Max	
Circular Graph Types	Smith Chart (Impedance), Polar	
<b>Measurements Data Points</b>		
Maximum Data Points	2 to 16,001 points	
<b>Limit Lines</b>		
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.	
<b>Ripple Limit Lines</b>		
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.	
<b>Averaging</b>		
Point-by-Point	Point-by-point (default), maximum number of averages = 200	
Sweep-by-Sweep	Sweep-by-sweep, maximum number of averages = 4096	
<b>IF Bandwidth</b>		
	10, 20, 50, 70, 100, 200, 300, 500, 700 Hz 1, 2, 3, 5, 7, 10, 20, 30, 50, 70, 100, 200, 300 kHz	
<b>Reference Plane</b>		
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.	
<b>Measurement Frequency Range</b>		
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.	
<b>Group Delay</b>		
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.
Inter-trace Math	Any two traces within a channel can 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	10 μU
Phase	0.01°
Group Delay	0.1 ps
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

**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

<b>Calibration Methods</b>	<p>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)          Thru-Reflect-Line (TRL) / Thru-Reflect-Match (TRM)          SmartCal™          AutoCal™          Thru Update available          Secondary match correction available for improved low insertion loss measurements</p>
<b>Correction Models</b>	<p>2-Port (Forward, Reverse, or both directions)          1-Port (<math>S_{11}</math>, <math>S_{22}</math>, or both)          Transmission Frequency Response (Forward, Reverse, or both directions)          Reflection Frequency Response (<math>S_{11}</math>, <math>S_{22}</math>, or both)</p>
<b>Coefficients for Calibration Standards</b>	<p>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.</p>
<b>Interpolation</b>	Allows interpolation between calibration frequency points.
<b>Adapter Removal Calibration</b>	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.
<b>Dispersion Compensation</b>	Selectable as Coaxial, other non-dispersive (e.g., for coplanar waveguide), Waveguide, or Microstrip
<b>Embedding/De-embedding</b>	The MS46122B 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.
<b>Optical/Electrical Conversion</b>	
O/E E/O, & O/O	O/E, E/O, and O/O setup wizards are provided
<b>Impedance Conversion</b>	Allows entry of different reference impedances (complex values) for different ports

## 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.
Universal Fixture Extraction, Option 24	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.

## 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 Python 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 $\mu$ s, typical	



Front Panel Connections



MS46122B Front Panel

Test Ports 1 and 2

MS46122B-010	N(f)
MS46122B-020	Ruggedized K(m)
MS46122B-043	Ruggedized Extended-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



MS46122B Series Rear Panel

Recommended External PC Configuration

CPU	Intel® Core™ i5-6300U Processor
RAM	4 GB
Disk	120 GB
DirectX	Version 9 with Windows Display Driver Model (WDDM) installed
	ShockLine software is compatible with Windows® 7, 8, 8.1, 10, or 11; 32- or 64-bit operating systems

## Mechanical

<b>Dimensions</b>		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
<b>Weight</b>		< 2.2 kg (< 5 lb), typical weight for a fully-loaded MS46122B VNA

## Regulatory Compliance

European Union	EMC 2014/30/EU, EN 61326:2013, CISPR 11/EN 55011, IEC/EN 61000-4-2/3/4/5/6/8/11 Low Voltage Directive 2014/35/EU Safety EN 61010-1:2010 RoHS Directive 2011/65/EU & Amendment 2015/863
United Kingdom	EMC SI 2016/1091; BS EN 55011 & BS EN 61000-4-2/3/4/5/6/8/11 Consumer Protection (Safety) SI 2016/1101; BS EN 61010-1:2010 Environmental Protection SI 2012/3032; 2011/65/EU & 2015/863
Canada	CAN ICES-1(A)/NMB-1(A)
Australia and New Zealand	RCM AS/NZS 4417:2012
South Korea	R-R-A2J-1012

## Environmental

	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

## 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	MS46122B, 2-Port ShockLine™ Economy VNA
Required Option	MS46122B-010, 1 MHz to 8 GHz, type N(f) ports
(Select one frequency option only)	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)

**Included Accessories**

Each VNA comes with a set of included accessories	
User Documentation	Getting Started with Anritsu Flier, provides access to all ShockLine web content and services
Power	40-187-R, 12 V, 5 A Power supply (and power cord)
USB Cable	3-2000RS-1815, USB 2.0 A to Mini B cable, 10 ft
Rack Mount	Bracket hardware for shelf-mounting into a 19 inch universal rack

**VNA Options**

Main Options	MS46122B-002, Time Domain with Time Gating
	MS46122B-024, Universal Fixture Extraction
Calibration Options	MS46122B-097, Accredited Calibration, with data
	MS46122B-098, Standard Calibration, ISO 17025 compliant, without data
	MS46122B-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 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 <sup>1</sup>	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)

**Mechanical Calibration Kits**

3650A	SMA/3.5 mm Calibration Kit, Without Sliding Loads, DC to 26.5 GHz, 50 Ω
3652A	K Connector Calibration Kit, Without Sliding Loads, DC to 40 GHz, 50 Ω
3653A	N Connector Calibration Kit, Without Sliding Loads, DC to 18 GHz, 50 Ω
OSLN50A-8	Precision N Male Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50 Ω
OSLNF50A-8	Precision N Female Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50 Ω
TOSLN50A-8	Precision N Male Through/Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50 Ω
TOSLNF50A-8	Precision N Female Through/Open/Short/Load Mechanical Calibration Tee, DC to 8 GHz, 50 Ω
OSLN50A-18	Precision N Male Open/Short/Load Mechanical Calibration Tee, DC to 18 GHz, 50 Ω
OSLNF50A-18	Precision N Female Open/Short/Load Mechanical Calibration Tee, DC to 18 GHz, 50 Ω
TOSLN50A-18	Precision N Male Through/Open/Short/Load Mechanical Calibration Tee, DC to 18 GHz, 50 Ω
TOSLNF50A-18	Precision N Female Through/Open/Short/Load Mechanical Calibration Tee, DC to 18 GHz, 50 Ω
TOSLK50A-20	Precision K Male Through/Open/Short/Load Mechanical Calibration Tee, DC to 20 GHz, 50 Ω
TOSLKF50A-20	Precision K Female Through/Open/Short/Load Mechanical Calibration Tee, DC to 20 GHz, 50 Ω
TOSLK50A-40	Precision K Male Through/Open/Short/Load Mechanical Calibration Tee, DC to 40 GHz, 50 Ω
TOSLKF50A-40	Precision K Female Through/Open/Short/Load Mechanical Calibration Tee, DC to 40 GHz, 50 Ω
TOSLK50A-43.5	Precision K Male Through/Open/Short/Load Mechanical Calibration Tee, DC to 43.5 GHz, 50 Ω
	Includes .s1p files for data-based calibration support
TOSLKF50A-43.5	Precision K Female Through/Open/Short/Load Mechanical Calibration Tee, DC to 43.5 GHz, 50 Ω
	Includes .s1p files for data-based calibration support

**Verification Kit**

3663-3	N Connector Verification Kit
3668-4	K Connector Verification Kit

1. Applies to Rev 2 SmartCal Modules. MN25218A with serial numbers <1817999 operate from 1 MHz to 20 GHz.

**Adapters**

1091-26-R	Adapter, SMA(m) to N(m), DC to 18 GHz, 50 Ω
1091-27-R	Adapter, SMA(f) to N(m), DC to 18 GHz, 50 Ω
1091-80-R	Adapter, SMA(m) to N(f), DC to 18 GHz, 50 Ω
1091-81-R	Adapter, 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 Ω
33KK50C	Calibration Grade Adapter, DC to 43.5 GHz, K(m) to K(m), 50 Ω
33KKF50C	Calibration Grade Adapter, DC to 43.5 GHz, K(m) to K(f), 50 Ω
33KFKF50C	Calibration Grade Adapter, DC to 43.5 GHz, K(f) to K(f), 50 Ω
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
34VK50A	Precision Adapter, DC to 43.5 GHz, V(f) - K(m), 50 Ω
34VKF50A	Precision Adapter, DC to 43.5 GHz, V(f) - K(f), 50 Ω
34VK50A	Precision Adapter, DC to 43.5 GHz, V(m) - K(m), 50 Ω
34VKF50A	Precision Adapter, DC to 43.5 GHz, V(m) - K(f), 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**

15 Series Cable Example

15NNF50-1.0B	Test Port Cable, Flexible, Phase Stable, N(f) to N(m), 1.0 m
15NNF50-1.5B	Test Port Cable, Flexible, Phase Stable, N(f) to N(m), 1.5 m
15NNS50-1.0B	Test Port Cable, Flexible, Phase Stable, N(m) to N(m), 1.0 m
15LL50-1.0A	Test Port Extension Cable, Armored, Phase Stable, DC to 26.5 GHz, 3.5 mm(m) to 3.5 mm(m), 1.0 m, 50 Ω
15LLF50-1.0A	Test Port Extension Cable, Armored, Phase Stable, DC to 26.5 GHz, 3.5 mm(m) to 3.5 mm(f), 1.0 m, 50 Ω
15KK50-1.0A	Test Port Extension Cable, Armored, Phase Stable, DC to 26.5 GHz, K(m) to K(m), 1.0 m, 50 Ω
15KKF50-1.0A	Test Port Extension Cable, Armored, Phase Stable, DC to 26.5 GHz, K(m) to K(f), 1.0 m, 50 Ω

**Phase-Stable 18 GHz and 43.5 GHz Semi-Rigid Cables (Armored)**

3670 Series Cable Example

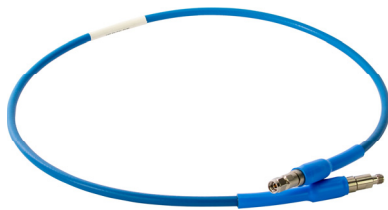
3670N50-1	0.3 m (12"), DC to 18 GHz, N(f) to N(m), 50 Ω
3670NN50-1	0.3 m (12"), DC to 18 GHz, N(m) to N(m), 50 Ω
3670N50-2	0.6 m (24"), DC to 18 GHz, N(f) to N(m), 50 Ω
3670NN50-2	0.6 m (24"), DC to 18 GHz, N(m) to N(m), 50 Ω
3670K50A-1	0.3 m (12"), DC to 43.5 GHz, K(f) to K(m), 50 Ω
3670K50A-2	0.6 m (24"), DC to 43.5 GHz, K(f) to K(m), 50 Ω

Phase-Stable 20 GHz and 40 GHz Test Port Cables (Flexible)



3671 Series Cable Example

3671KFS50-60	60 cm (23.6 in), DC to 20 GHz, K(f) to 3.5 mm(m), 50 Ω
3671KFSF50-60	60 cm (23.6 in), DC to 20 GHz, K(f) to 3.5 mm(f), 50 Ω
3671KFKF50-60	60 cm (23.6 in), DC to 40 GHz, K(f) to K(f), 50 Ω
3671KFK50-100	100 cm (39.4 in), DC to 40 GHz, K(f) to K(m), 50 Ω



806-304-R Cable Example

806-304-R	91.5 cm (36 in), DC to 40 GHz, K(m) to K(f), 50 Ω
-----------	---



806-423-R Cable Example

806-423-R	60 cm (23.6 in), DC to 43.5 GHz, K(f) - K(f), 50 Ω
806-424-R	60 cm (23.6 in), DC to 43.5 GHz, K(m) - K(f), 50 Ω
806-425-R	100 cm (39.4 in), DC to 43.5 GHz, K(f) - K(f), 50 Ω
806-426-R	100 cm (39.4 in), DC to 43.5 GHz, K(m) - K(f), 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)
More Information	Refer to our Precision RF & Microwave Components Catalog for descriptions of adapters and other components.

Documentation

User Documentation	Soft copies of the manuals as Adobe Acrobat PDF files are available for download from the instrument model web page at <a href="http://www.anritsu.com">www.anritsu.com</a> . For more information and product support, please contact <a href="http://www.anritsu.com/contact-us">www.anritsu.com/contact-us</a> .
10100-00067	ShockLine Product Information, Compliance, and Safety
10410-00340	MS46122A/B Series VNA Operation Manual
10410-00337	MS46121A/B, MS46122A/B, MS46131A, and MS46322A/B Series VNA User Interface Reference Manual
10410-00746	ShockLine Programming Manual

## 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](http://www.anritsu.com) and search for training and education.



### • United States

**Anritsu Americas Sales Company**  
450 Century Parkway, Suite 190,  
Allen, TX 75013, U.S.A.  
Phone: +1-800-Anritsu (1-800-267-4878)

### • Canada

**Anritsu Electronics Ltd.**  
**Americas Sales and Support**  
450 Century Parkway, Suite 190,  
Allen, TX 75013, U.S.A.  
Phone: +1-800-Anritsu (1-800-267-4878)

### • Brazil

**Anritsu Elettronica Ltda.**  
Praça Amadeu Amaral, 27 - 1 Andar  
01327-010 - Bela Vista - Sao Paulo - SP, Brazil  
Phone: +55-11-3283-2511  
Fax: +55-11-3288-6940

### • Mexico

**Anritsu Company, S.A. de C.V.**  
Blvd Miguel de Cervantes Saavedra #169 Piso 1,  
Col. Granada, Mexico, Ciudad de Mexico,  
11520, MEXICO  
Phone: +52-55-4169-7104

### • United Kingdom

**Anritsu EMEA Ltd.**  
200 Capability Green,  
Luton, Bedfordshire, LU1 3LU, U.K.  
Phone: +44-1582-433200  
Fax: +44-1582-731303

### • France

**Anritsu S.A.**  
12 avenue du Québec, Immeuble Goyave,  
91140 VILLEBON SUR YVETTE, France  
Phone: +33-1-60-92-15-50

### • Germany

**Anritsu GmbH**  
Nemetschek Haus, Konrad-Zuse-Platz 1,  
81829 München, Germany  
Phone: +49-89-442308-0  
Fax: +49-89-442308-55

### • Italy

**Anritsu S.r.l.**  
Spaces Eur Arte, Viale dell'Arte 25, 00144 Roma, Italy  
Phone: +39-6-509-9711

List Revision Date: 20230901

### • Sweden

**Anritsu AB**  
Kistagången 20 B, 2 tr, 164 40 Kista, Sweden  
Phone: +46-8-534-707-00

### • Finland

**Anritsu AB**  
Technopolis Aviapolis, Teknobulevardi 3-5 (D208.5.),  
FI-01530 Vantaa, Finland  
Phone: +358-20-741-8100

### • Denmark

**Anritsu A/S**  
c/o Regus Winghouse, Ørestads Boulevard 73, 4th floor,  
2300 Copenhagen S, Denmark  
Phone: +45-7211-2200

### • Spain

**Anritsu EMEA Ltd.**  
**Representation Office in Spain**  
Paseo de la Castellana, 141.  
Planta 5, Edificio Cuzco IV  
28046, Madrid, Spain  
Phone: +34-91-572-6761

### • Austria

**Anritsu EMEA GmbH**  
Am Belvedere 10, A-1100 Vienna, Austria  
Phone: +43-(0)1-717-28-710

### • United Arab Emirates

**Anritsu EMEA Ltd.**  
**Anritsu A/S**  
Office No. 164, Building 17, Dubai Internet City  
P. O. Box - 501901, Dubai, United Arab Emirates  
Phone: +971-4-3758479

### • India

**Anritsu India Private Limited**  
6th Floor, Indiqube ETA, No.38/4, Adjacent to EMC2,  
Doddanekundi, Outer Ring Road,  
Bengaluru - 560048, India  
Phone: +91-80-6728-1300  
Fax: +91-80-6728-1301

### • Singapore

**Anritsu Pte. Ltd.**  
1 Jalan Kilang Timor, #07-04/06 Pacific Tech Centre  
Singapore 159303  
Phone: +65-6282-2400  
Fax: +65-6282-2533

### • Vietnam

**Anritsu Company Limited**  
16th Floor, Peakview Tower, 36 Hoang Cau Street,  
O Cho Dua Ward, Dong Da District, Hanoi, Vietnam  
Phone: +84-24-3201-2730

### • P.R. China (Shanghai)

**Anritsu (China) Co., Ltd.**  
Room 2701-2705, Tower A, New Caohejing  
International Business Center No. 391 Gui Ping Road  
Shanghai, 200233, P.R. China  
Phone: +86-21-6237-0898  
Fax: +86-21-6237-0899

### • P.R. China (Hong Kong)

**Anritsu Company Ltd.**  
Unit 1006-7, 10/F., Greenfield Tower, Concordia Plaza,  
No. 1 Science Museum Road, Tsim Sha Tsui East,  
Kowloon, Hong Kong, P.R. China  
Phone: +852-2301-4980  
Fax: +852-2301-3545

### • Japan

**Anritsu Corporation**  
8-5, Tamura-cho, Atsugi-shi, Kanagawa, 243-0016 Japan  
Phone: +81-46-296-6509  
Fax: +81-46-225-8352

### • South Korea

**Anritsu Corporation, Ltd.**  
8F, A TOWER, 20, Gwacheondaero 7-gil, Gwacheon-si,  
Gyeonggi-do, 13840, Republic of Korea  
Phone: +82-2-6259-7300  
Fax: +82-2-6259-7301

### • Australia

**Anritsu Pty. Ltd.**  
Unit 20, 21-35 Ricketts Road,  
Mount Waverley, Victoria 3149, Australia  
Phone: +61-3-9558-8177  
Fax: +61-3-9558-8255

### • Taiwan

**Anritsu Company Inc.**  
7F, No. 316, Sec. 1, NeiHu Rd., Taipei 114, Taiwan  
Phone: +886-2-8751-1816  
Fax: +886-2-8751-1817