



# Vector Network Analyzers

## MS46524A Series ShockLine™ Vector Network Analyzers

### Introduction

The MS46524A is part of the ShockLine™ family of Vector Network Analyzers from Anritsu. It is a low-cost series of 4-port RF Vector Network Analyzers. It is available in two frequency ranges: 50 kHz to 4.5 GHz and 50 kHz to 8.5 GHz. It is capable of measuring 16 single-ended and mixed-mode s-parameters of passive multiport and differential devices.

The MS46524A series supports SCPI command programming and has software driver support for the most common programming environments. The MS46524A use industry standard LAN communications for robust remote control in test applications. ShockLine™ VNAs provide a powerful graphical user interface for manual testing of devices. The full-featured user interface is enabled by attaching a (user-supplied) touchscreen monitor, keyboard, and mouse.

This document provides detailed specifications for the MS46524A series Vector Network Analyzers (VNAs) and related options.

### Instrument Models and Operating Frequencies

- Base Model: MS46524A, 4-Port ShockLine™ VNA
- Requires one Frequency Option:
  - MS46524A-004, 50 kHz to 4.5 GHz
  - MS46524A-010, 50 kHz to 8.5 GHz

### Principal Options

- MS46524A-002, Time Domain
- MS46524A-005, Handler Interface



MS46524A 4-Port ShockLine™ VNA

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**Definitions**

	All specifications and characteristics apply under the following conditions, unless otherwise stated:
Warm-Up Time	After 45 minutes of warm-up time, where the instrument is left in the ON state.
Temperature Range	Over the 25 °C ± 5 °C temperature range.
Frequency Range	The instrument operates from 50 kHz to 300 kHz without any implied or warranted specifications.
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.
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 the maximum specified source power and the noise floor (RMS) at the specified reference plane at 10 Hz IF Bandwidth.

Frequency Range	Standard (dB)	Typical (dB)
300 kHz to < 500 kHz	95	105
500 kHz to < 3 MHz	100	110
3 MHz to < 6 GHz	110	118
6 GHz to 7 GHz	105	115
> 7 GHz to 8.5 GHz	75	80

## Receiver Compression Levels

Port power level beyond which the response may be compressed more than 0.3 dB relative to the normalization level. Measured at 300 Hz IF bandwidth. Match not included. Performance is typical.

Frequency Range	Standard (dBm)
300 kHz to 8.5 GHz	+10

## High Level Noise

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

Frequency	Magnitude (dB)	Phase (deg)
300 kHz to 7 GHz	< 0.006 (< 0.003, typical)	< 0.05, typical
> 7 GHz to 8.5 GHz	< 0.060 (< 0.058, typical)	< 0.120, typical

## Output Power Range

Minimum to maximum rated power level. Performance is characteristic.

Frequency	Standard (dBm)
300 kHz to < 6 GHz	-30 to +15
6 GHz to < 8 GHz	-30 to +12
8 GHz to 8.5 GHz	-30 to +10

## Output Default Power

Instrument default power is +5 dBm. For maximum rated power, refer to Output Power Range above.

## Power Accuracy

Performance is typical.

Output Power	Accuracy (dB)
At +5 dBm	± 1.0
At 0 dBm	± 1.0
At -30 dBm	± 3.0

## Setting Resolution

Frequency	Setting Resolution (dB)
300 kHz to 8.5 GHz	0.01

## Measurement Stability

Ratio measurement, with ports shorted. Typical.

Frequency	Magnitude (dB/°C)
300 kHz to 7 GHz	0.01

## Frequency Resolution, Accuracy, and Stability

All specifications typical.

Resolution	Accuracy	Stability/Temperature	Stability/Time
1 Hz	± 1.0 ppm (at time of calibration)	± 0.1 ppm/10 °C to 70 °C	± 0.02 ppm/24 hours ± 0.2 ppm/1 month ± 1.0 ppm/1 year ± 2.0 ppm/3 years

## Source Harmonics and Non-Harmonics (Spurious)

Measured at 0 dBm. All specifications typical.

Frequency	Harmonics (second and third) (dBc)	Non-Harmonic Spurious (dBc)	Phase Noise @ 10 kHz Offset (dBc/Hz)
300 kHz to < 50 MHz	< -20	< -30	> 60
50 MHz to 8.5 GHz	< -30	< -30	> 60

**Uncorrected (Raw) Port Characteristics** All specifications typical. User and system correction off.

Frequency Range	Directivity (dB)	Port Match (dB) <sup>a</sup>
300 kHz to < 1 GHz	> 9	> 15
1 GHz to < 4 GHz	> 7	> 7
4 GHz to 8.5 GHz	> 4	> 7

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

**VNA System Performance for MS46524A-004 and MS46524A-010 Frequency Options**

**Error-Corrected Specifications**

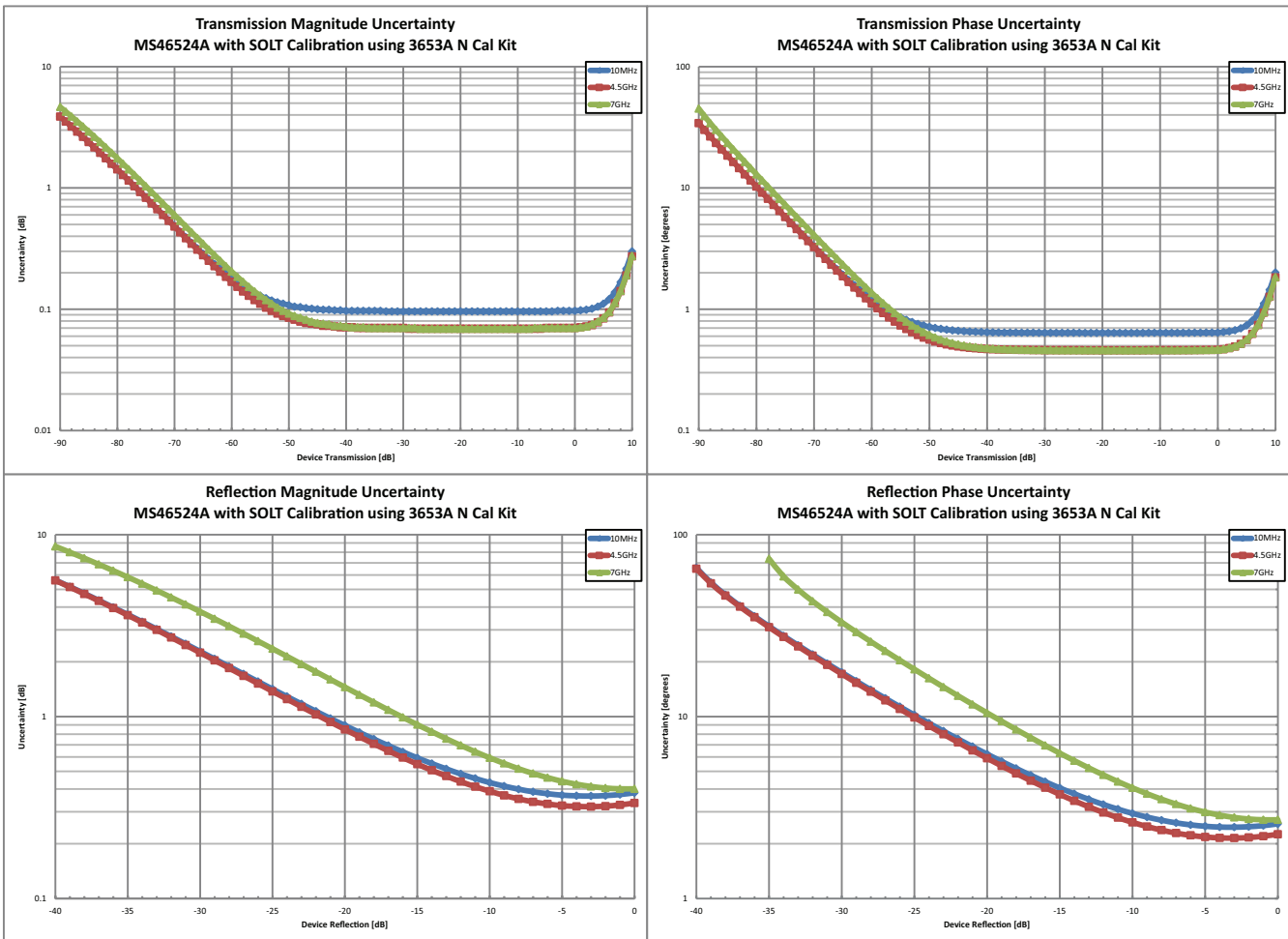
With 12-term SOLT Calibration using the 3653A N Type Connector Calibration Kit.

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)
300 kHz to < 30 MHz	> 42	> 35	> 38	±0.15	±0.09
30 MHz to < 5 GHz	> 42	> 35	> 38	±0.08	±0.05
5 GHz to < 8 GHz	> 36	> 35	> 33	±0.08	±0.05
8 GHz to 8.5 GHz	> 36	> 35	> 33	±0.10	±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 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at [www.anritsu.com](http://www.anritsu.com).



**MS46524A VNA System Performance with 8.5 GHz MN25208A SmartCal™**

**Error-Corrected Specifications**

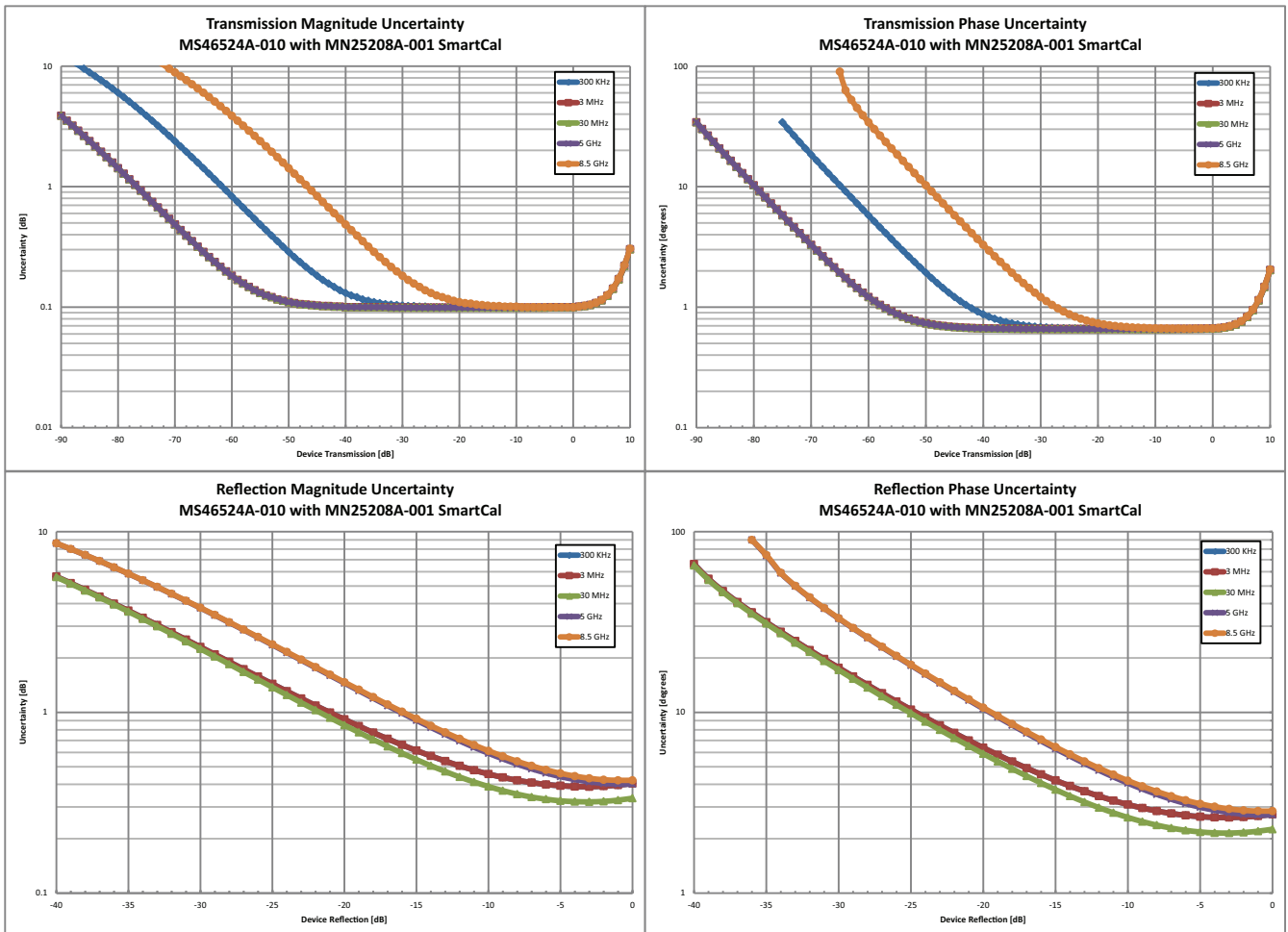
With 12-term calibration using the MN25208A SmartCal™ automatic calibration kit with N(f) type connectors (option -001).

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match <sup>a</sup> (dB)	Reflection Tracking <sup>a</sup> (dB)	Transmission Tracking <sup>a</sup> (dB)
300 kHz to < 30 MHz	> 42	> 35	> 38	±0.15	±0.08
30 MHz to < 5 GHz	> 42	> 35	> 38	±0.08	±0.08
5 GHz to < 8 GHz	> 36	> 35	> 33	±0.08	±0.08
8 GHz to 8.5 GHz	> 36	> 35	> 33	±0.10	±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 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at [www.anritsu.com](http://www.anritsu.com).



**MS46524A VNA System Performance with 36585K AutoCal**

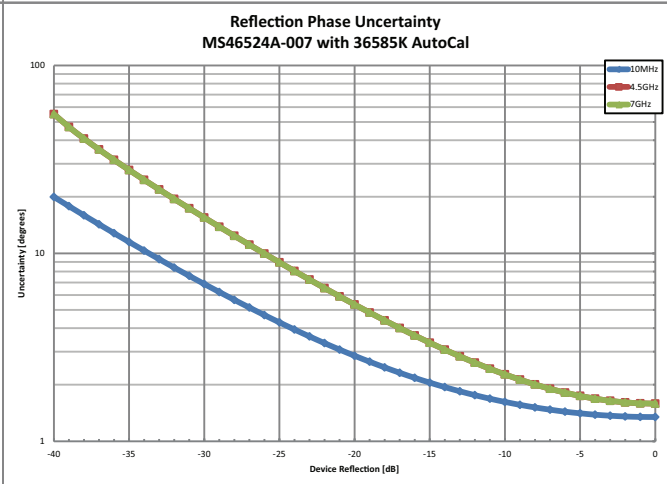
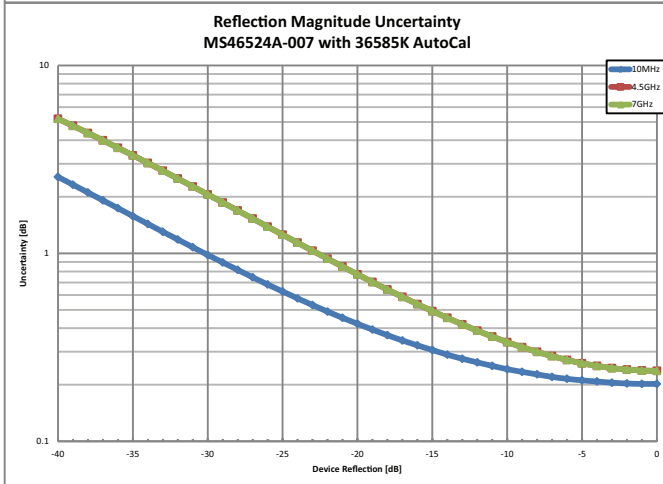
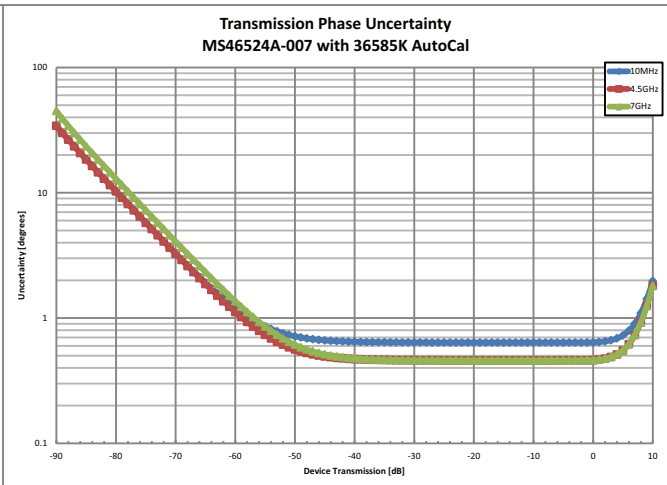
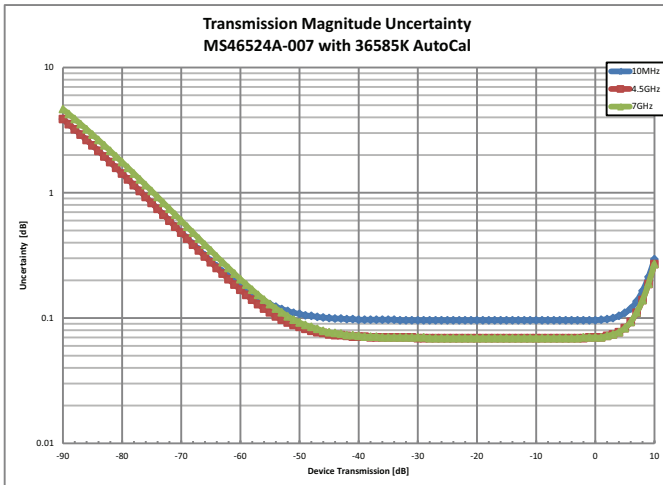
**Error-Corrected Specifications**

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

Frequency Range	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
300 kHz to < 30 MHz	> 53	> 36	> 38	±0.15	±0.09
30 MHz to < 5 GHz	> 43	> 44	> 38	±0.08	±0.05
5 GHz to 8.5 GHz	> 43	> 44	> 33	±0.08	±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 0 dBm or default port power, whichever is less. For other conditions, please use our free Exact Uncertainty Calculator software, available for download from the Anritsu web site at [www.anritsu.com](http://www.anritsu.com).



## Measurement Throughput Summary

### Cycle Time for Measurement Completion (ms)

Number of traces = 1; system error correction on. Typical performance data.

Number of Points	500 kHz IF Bandwidth				100 kHz IF Bandwidth				1 kHz IF Bandwidth			
	51	201	401	1601	51	201	401	1601	51	201	401	1601
<b>Start 1 GHz, Stop 1.2 GHz</b>												
Uncorrected	6	17	31	116	7	18	34	130	61	229	454	1810
2-Port Cal	12	32	60	232	12	35	67	258	121	460	911	3623
4-Port Cal	25	67	125	466	28	72	134	512	241	919	1822	7247
<b>Start 10 MHz, Stop 4.5 GHz</b>												
Uncorrected	9	19	33	118	8	21	36	132	61	231	457	1811
2-Port Cal	15	36	64	234	14	40	71	261	124	464	916	3626
4-Port Cal	30	74	131	473	30	79	143	520	248	928	1832	7253
<b>Start 10 MHz, Stop 8.5 GHz</b>												
Uncorrected	9	20	33	117	9	22	37	133	66	231	457	1812
2-Port Cal	15	37	65	236	15	40	72	262	125	465	917	3628
4-Port Cal	31	75	143	475	32	81	145	522	249	929	1834	7255

### Data Transfer Time (ms)

Transferred complex S11 data, using "CALC:DATA:SDATA?" command. Typical performance data.<sup>a</sup>

Number of Points	51	201	401	1601
<b>SCPI over LAN</b>				
REAL 64	4	4	4	8
REAL 32	4	4	4	8
ASCII	14	34	60	209

a. Data transfer time varies depending on the PC and control software used with the VNA.

## Standard Capabilities

### Operating Frequencies

MS46524A-004	50 kHz to 4.5 GHz
MS46524A-010	50 kHz to 8.5 GHz

### Measurement Parameters

4-Port Measurements	16 single-ended S-parameters, and any user-defined combination of $a_{1-4}$ , $b_{1-4}$ , and 1. 16 mixed-mode S-parameters (DD, CC, DC, CD); uses the superposition technique.
Domains	Frequency Domain, and Time (Distance) Domain

### Sweeps

Sweep Configurations	Standard or Simultaneous
Frequency Sweep Types	Linear, Log, or Segmented
Power Sweep Types	Linear

### 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 20,001 points
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### 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

<b>IF Bandwidth</b>	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 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.
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.
<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
<b>Channels, Display, and Traces</b>	
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.
<b>Scale Resolution</b>	
	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
<b>Markers</b>	
Markers	12 markers + 1 reference marker per trace
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
<b>Other</b>	
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)  
 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)  
 AutoCal  
 Thru Update available

### Correction Models

4-port Cals (uses two Full 2-port Cals and up to 4 additional Thru/Reciprocals, minimum of 1)  
 3-port Cals (uses one Full 2-port Cal, one Full 1-port Cal, and up to 2 additional Thru/Reciprocals, minimum of 1)  
 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 MS46524A is equipped with an Embedding/De-embedding system.

De-embedding is generally used for removal of test fixture contributions, modeled networks, and other networks described by S-parameters (s2p files) from measurements.

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.

## 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
Via LAN	Using VXI-11 Protocol	Gigabit Data Transfer Speed	Use SCPI commands
Drivers for LAN	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 $\mu$ s, typical	

## Front Panel Connections



MS46524A Front Panel

## Test Ports 1 through 4

MS46524A-004	N(f)
MS46524A-010	N(f)
Damage Input Levels	+27 dBm maximum, 50 VDC maximum

## USB Ports

Two type A USB 2.0 Ports for peripherals such as keyboard, mouse, memory stick, hardware key, and similar devices.

## Chassis Grounding Port

Banana(f)

## Rear Panel Connections



MS46524A Rear Panel

## AC Power Input

AC Input connector, with On/Off switch, and fuses 350 VA maximum, 90 to 264 VAC, 47 to 63 Hz (power factor controlled)

## USB and LAN

USB Ports	Two type A USB 2.0 ports and two type A USB 3.0 ports for peripherals such as keyboard, mouse, flash drive, USB monitor, and hardware key.
LAN Port	Gigabit Ethernet

## HDMI Port

Video output, touchscreen compatible

## 10 MHz In

Connector Type	BNC(f)
Signal	+0 dBm, typical; 50 $\Omega$ , nominal

## 10 MHz Out

Connector Type	BNC(f)
Signal	+8 dBm, typical; 50 $\Omega$ , nominal

## External Trigger Input

Connector Type	BNC(f)
Voltage Input	0 to 3.3 V input (5 V tolerant)
Impedance	High impedance (> 100 k $\Omega$ )
Pulse Width	50 ns minimum input pulse width
Trigger Delay	6 $\mu$ s typical

**External Trigger Output**

Connector type	BNC(f)
Voltage Output	0 to 3.3 V (HCMOS logic)
Drive Current	24 mA maximum
Pulse Width	1 $\mu$ s, typical

**CPU, Memory, and Security Features**

CPU	Intel Core™ i5
Storage	Serial-ATA (SATA) Solid State Drive (SSD, removable), for OS, Programs, and Data (> 30 GB).

**Security Features**

Virus Protection, Best Practices	If the VNA is attached to a network, best practices recommend installing anti-virus software.
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**Mechanical****Dimensions**

	Dimensions listed are for the instrument body without rack mount option attached.
W x H x D	484 mm x 108 mm x 590 mm

**Weight**

< 13.6 kg (< 30 lb), typical weight for a fully-loaded MS46524A-010 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

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**Ordering Information**


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**Instrument Models**

Base Model	MS46524A, 4-Port ShockLine™ VNA
Requires One Frequency Option	MS46524A-004, 50 kHz to 4.5 GHz MS46524A-010, 50 kHz to 8.5 GHz

**Included Accessories**

	Each VNA comes with a set of included accessories.
User Documentation	The user documentation USB flash drive includes Adobe Acrobat PDF files for the ShockLine Operation Manual, User Interface Reference Manual, Programming Manual, and the Technical Data Sheet.
Power	Power Cord

**Main VNA Options**

MS46524A-001	Rack Mount, adds handles and removes feet for shelf-mounting into a 19 inch universal rack
MS46524A-002	Time Domain with Time Gating
MS46524A-005	Handler Interface

**Calibration Options**

MS46524A-098	Standard Calibration, ISO 17025 compliant, without data
MS46524A-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
3653A	N Calibration Kit, Without Sliding Loads
TOSLN50A-8	Precision N Male Through/Open/Short/Load Mechanical Calibration Tee
TOSLNF50A-8	Precision N Female Through/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

**RF Cables and Adapters**

N120-6	RF Cables, Semi-Rigid, N(m) to N(m), 1 each, 0.01 to 18 GHz, 50 Ω, 15 cm (5.9 in)
NS120MF-6	RF Cables, Semi-Rigid, N(f) to N(f), 1 each, 0.01 to 18 GHz, 50 Ω, 15 cm (5.9 in)
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
34NN50A	Precision Adapter, N(m) to N(m), DC to 18 GHz, 50 Ω
34NFN50	Precision Adapter, N(f) to N(f), DC to 18 GHz, 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

**Test Port Cables, Flexible, Ruggedized, Phase Stable**

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
15NN50-1.0B	Test Port Cable, Flexible, Phase Stable, N(m) to N(m), 1.0 m
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, K(m) to K(f), 40 GHz, 36 inches

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

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

**Transit Case**

760-269	ShockLine™ VNA Transit Case, Hard plastic with wheels
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**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
01-204	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 flash drive provided with the instrument. The Maintenance Manual is available from Anritsu Customer Service. For more information, please contact <a href="mailto:ShockLineVNA.support@Anritsu.com">ShockLineVNA.support@Anritsu.com</a> .
10410-00330	MS46522A/524A Series VNA Operation Manual (OM)
10410-00332	MS46522A/524A Series VNA User Interface Reference Manual (UIRM)
10410-00333	MS46522A/524A Series VNA Programming Manual (PM), for IEEE 488.2 and SCPI Commands

**Notes**

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**Notes**



# Anritsu

## • United States

### Anritsu Company

1155 East Collins Blvd, Suite 100  
Richardson, TX 75081, U.S.A.  
Toll Free: 1-800-267-4878  
Phone: +1-972-644-1777  
Fax: +1-972-671-1877

## • Canada

### Anritsu Electronics Ltd.

700 Silver Seven Road, Suite 120  
Kanata, Ontario K2V 1C3, Canada  
Phone: +1-613-591-2003  
Fax: +1-613-591-1006

## • Brazil

### Anritsu Eletrônica Ltda.

Praça Amadeu Amaral, 27 - 1 Andar  
01327-010 Bela Vista, São Paulo, Brazil  
Phone: +55-11-3283-2511  
Fax: +55-11-3288-6940

## • Mexico

### Anritsu Company, S.A. de C.V.

Av. Ejército Nacional No. 579 Piso 9, Col. Granada  
11520 México, D.F., México  
Phone: +52-55-1101-2370  
Fax: +52-55-5254-3147

## • United Kingdom

### Anritsu EMEA Ltd.

200 Capability Green  
Luton, Bedfordshire LU1 3LU  
United Kingdom  
Phone: +44-1582-433280  
Fax: +44-1582-731303

## • France

### Anritsu S.A.

12 Avenue du Québec  
Bâtiment Iris 1-Silic 612  
91140 Villebon-sur-Yvette, France  
Phone: +33-1-60-92-15-50  
Fax: +33-1-64-46-10-65

## • 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.

Via Elio Vittorini 129  
00144 Roma, Italy  
Phone: +39-06-509-9711  
Fax: +39-06-502-2425

## • Sweden

### Anritsu AB

Kistagången 20B  
164 40 KISTA, Sweden  
Phone: +46-8-534-707-00  
Fax: +46-8-534-707-30

## • Finland

### Anritsu AB

Teknobulevardi 3-5  
FI-01530 Vantaa, Finland  
Phone: +358-20-741-8100  
Fax: +358-20-741-8111

## • Denmark

### Anritsu A/S

Kay Fiskers Plads 9  
2300 Copenhagen S, Denmark  
Phone: +45-7211-2200  
Fax: +45-7211-2210

## • Russia

### Anritsu EMEA Ltd.

**Representation Office in Russia**  
Tverskaya str. 16/2, bld. 1, 7th floor  
Russia, 125009, Moscow  
Phone: +7-495-363-1694  
Fax: +7-495-935-8962

## • United Arab Emirates

### Anritsu EMEA Ltd.

#### Dubai Liaison Office

P O Box 500413 - Dubai Internet City  
Al Thuraya Building, Tower 1, Suite 701, 7th Floor  
Dubai, United Arab Emirates  
Phone: +971-4-3670352  
Fax: +971-4-3688460

## • Singapore

### Anritsu Pte. Ltd.

11 Chang Charn Road, #04-01, Shriro House  
Singapore 159640  
Phone: +65-6282-2400  
Fax: +65-6282-2533

## • India

### Anritsu India Private Limited

2nd & 3rd Floor, #837/1, Binnamangla 1st Stage  
Indiranagar, 100ft Road, Bangalore - 560038, India  
Phone: +91-80-4058-1300  
Fax: +91-80-4058-1301

## • P.R. China (Shanghai)

### Anritsu (China) Co., Ltd.

27th Floor, Tower A  
New Caohejing International Business Center  
No. 391 Gui Ping Road Shanghai, Xu Hui Di District  
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: +81-46-296-1221  
Fax: +81-46-296-1238

## • Korea

### Anritsu Corporation, Ltd.

5FL, 235 Pangyoyeok-ro, Bundang-gu  
Seongnam-si  
Gyeonggi-do, 463-400 Korea  
Phone: +82-31-696-7750  
Fax: +82-31-696-7751

## • Australia

### Anritsu Pty Ltd.

Unit 21/270 Ferntree Gully Road  
Notting Hill, Victoria, 3168, 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

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