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VectorStar™

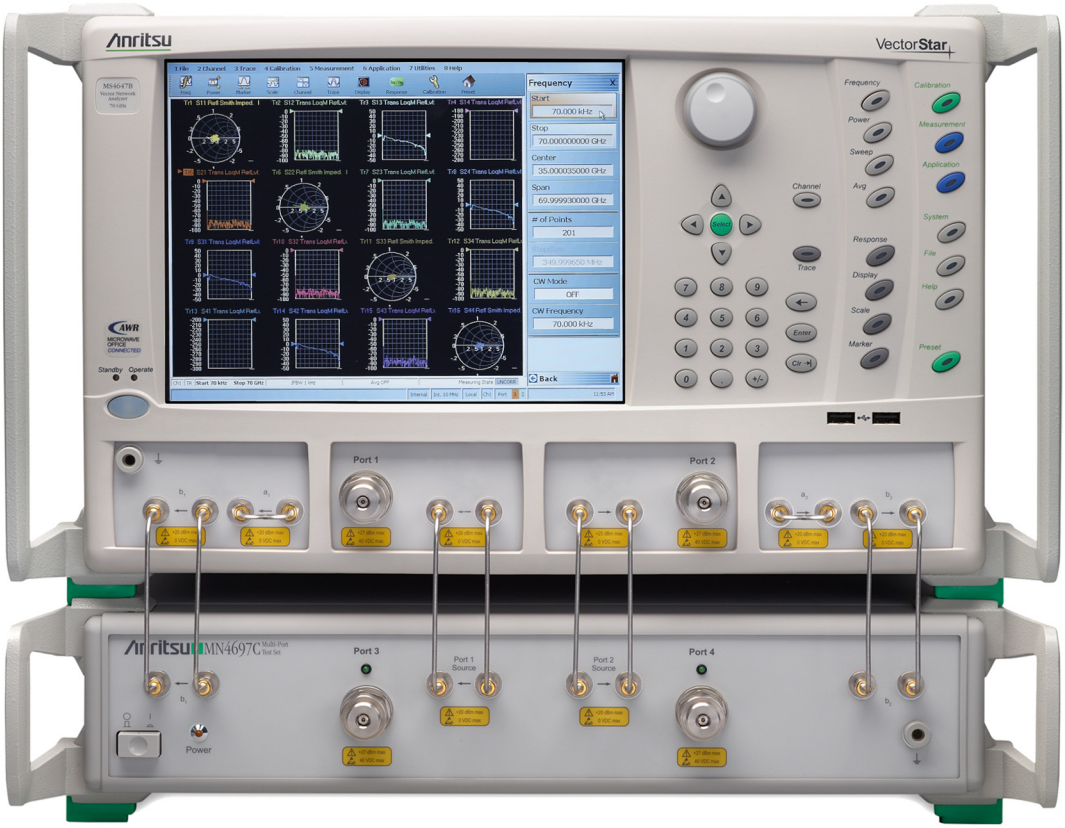
Multiport, High Performance, Broadband Network Analysis Solutions

MN469xC Series

Vector Network Analyzer Multiport Test Sets

MN4694C 4-port, K (2.92 mm), 70 kHz* to 20/40 GHz
MN4697C 4-port, V (1.85 mm), 70 kHz* to 50/70 GHz

*Operational to 40 kHz



Introduction

This document provides the specifications for the MN469xC series Multiport Vector Network Analyzer (VNA) test sets when used in conjunction with the 2-port MS464xA/B series VectorStar VNA. These MN469xC specifications are based upon the MS464xA/B series VNA specifications, which are referenced throughout this document. The MS464xA/B specifications can be found at: http://www.anritsu.com/en-us/products-solutions/products/ms4640b-series.aspx.

Minimum MS464xA/B Series 2-port VNA Configuration Required for the MN469xC

MS464xA/B VNA with Option 51, Direct Access Loops

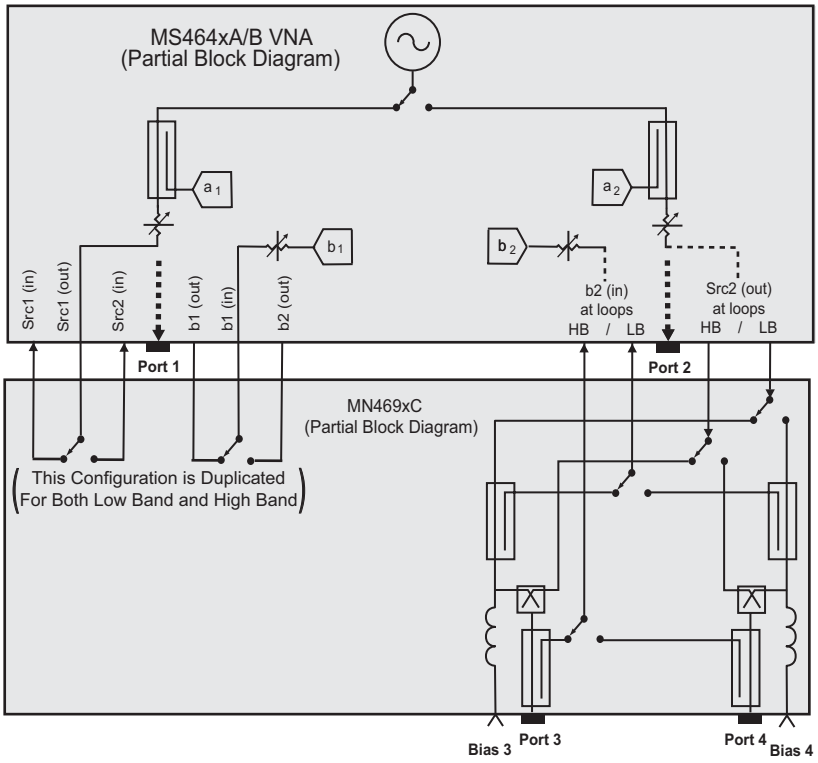
Table of Contents

Definitions

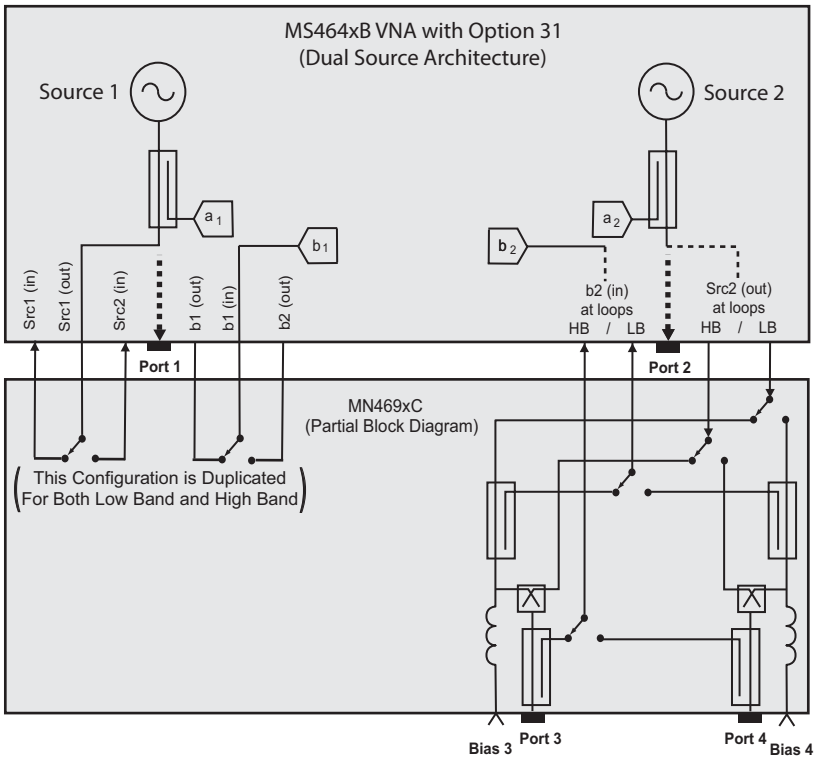
All specifications and characteristics apply under the following conditions, unless otherwise stated:

Warm-Up Time	After 90 minutes of warm-up time, where the instrument is left in the ON state.
Temperature Range	Within 25 °C ± 5 °C.
Error-Corrected Specifications	For error-corrected specifications, at 23 °C ± 3 °C, with < 1 °C variation from calibration temperature. Error-corrected specifications are warranted and include guard bands, unless otherwise stated.
Typical Performance	"Typical" specifications describe expected, but not warranted, performance based on sample testing. Typical performance indicates the measured performance of an average unit and do not guarantee the performance of any individual product. "Typical" specifications do not account for measurement uncertainty and are shown in parenthesis, such as (-102 dB), or noted as Typical.
User Cables	Specifications do not include effects of any user cables attached to the instrument.
Discrete Spurious Responses	Specifications may exclude discrete spurious responses.
Internal Reference Signal	All specifications apply with internal 10 MHz Crystal Oscillator Reference Signal.
Characteristic Performance	Characteristic performance indicates a performance designed-in and verified during the design phase. It does include guard-bands and is not covered by the product warranty.
Below 300 kHz	All uncertainties below 300 kHz are typical.
Recommended Calibration Cycle	12 months
Interpolation Mode	All specifications are with Interpolation Mode Off.
Specifications Subject to Change	All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site at www.anritsu.com.All specifications subject to change without notice. For the most current data sheet, please visit the Anritsu web site: www.anritsu.com

System Block Diagrams



MN469xC and MS464xA/B VNA



MN469xC and MS464xB VNA With Option 31 Dual Source Architecture

System Performance

System performance is specified when connected to a base 2-port VNA with option 051 (Direct Access Loops). If additional options are added to the base VNA that affects its port performance, those effects must also be added to these system specifications. For example, adding option 06x, Active Measurements Suite, will affect available test port power and dynamic range.

The MN469xC series test sets only contribute loss to the source and test paths, and uncorrected (raw) port directivity and match. Therefore, a limited set of system performance parameters are shown below as specifications verified on each system. All other parameters are listed as Characteristic Performance. They are tested and verified during the design phase. Some of these parameters are solely a contribution of the base VNA and not affected by the test set.

Test Port Power, Noise Floor, System Dynamic Range

MN4694C with MS4642A/B or MS4644A/B, 20 GHz or 40 GHz Models

Frequency Range (GHz)	Power [a,b] (dBm)	Noise Floor [c] (dBm)	System Dynamic Range [d] (dB)
0.07 to 2 MHz	+4	–72	76
> 2 to 10 MHz	+6	–94	100
> 0.01 to < 2.5	+7	–102	109
2.5 to 18	+8	–106	114
> 18 to 26	+4	–104	108
> 26 to 40	+5	–106	111
MS464xB with Option 031			
0.07 to 2 MHz	+6	–72	78
> 2 to 10 MHz	+8	–94	102
> 0.01 to < 2.5	+12	–102	114
2.5 to 18	+11	–106	117
> 18 to 26	+8	–104	112
> 26 to 40	+10	–106	116

a. Power measured at the test set port, not the VNA set power. Maximum Rated Power is typical from 2.4 GHz to 2.7 GHz.

b. Typical for Port 1 and 2.

c. Measured at 10 Hz IF bandwidth with no averaging and at a –10 dBm power setting, RMS. Leakage correction applied below 200 MHz. Measurement is made with a through line connection, compensating for its effects. Typical test set insertion loss used in noise floor measurements.

d. Calculated as the difference between the maximum test port power and the specified noise floor.

MN4697C with MS4645A/B or MS4647A/B, 50 GHz or 70 GHz Models

Frequency Range (GHz)	Power [a,b] (dBm)	Noise Floor [c] (dBm)	System Dynamic Range [d] (dB)
0.07 to 2 MHz	+4	–72	76
> 2 to 10 MHz	+6	–94	100
> 0.01 to < 2.5	+8	–102	110
2.5 to 16	+3	–106	109
> 16 to 24	–2	–104	102
> 24 to 38	+1	–106	107
> 38 to 46	–3	–100	97
> 46 to 50	–8	–98	90
> 50 to 60	–8	–98	90
> 60 to 67	–12	–94	82
> 67 to 70	–16	–86	70
MS464xB with Option 031			
0.07 to 2 MHz	+6	–72	78
> 2 to 10 MHz	+8	–94	102
> 0.01 to < 2.5	+12	–102	114
2.5 to 16	+7	–106	113
> 16 to 24	+4	–104	108
> 24 to 38	+4	–106	110
> 38 to 46	–1	–100	99
> 46 to 50	–2	–98	96
> 50 to 60	–2	–98	96
> 60 to 67	–6	–94	88
> 67 to 70	–7	–86	79

a. Power measured at the test set port, not the VNA set power. Maximum Rated Power is typical from 2.4 GHz to 2.7 GHz.

b. Typical for Port 1 and 2.

c. Measured at 10 Hz IF bandwidth with no averaging and at a –10 dBm power setting, RMS. Leakage correction applied below 200 MHz. Measurement is made with a through line connection, compensating for its effects. Typical test set insertion loss used in noise floor measurements.

d. Calculated as the difference between the maximum test port power and the specified noise floor.

Receiver Compression, Receiver Dynamic Range (All Models)

Frequency Range (GHz)	Receiver 0.1 dB Compression [a] (dBm)	Receiver Dynamic Range [b] (dB)
0.07 to 0.5 MHz	+5	77
> 0.5 to 2 MHz	+10	85
> 2 to 10 MHz	+13	107
> 0.01 to < 2.5	+13	115
2.5 to 20	+14	119
> 20 to 40	+15	115
> 40 to 50	+15	113
> 50 to 65	+15	109
> 65 to 70	+15	101

a.Port power level beyond which the response maybe compressed by more than 0.1 dB relative to the normalization level (0.17 dB, < 300 kHz). 10 Hz IFBW is used to remove any trace noise affects. Match not included. Performance is characteristic.

b.Calculated as the difference between the maximum receiver input level for 0.1 dB compression and the specified noise floor. Performance is characteristic.

High Level Noise

Measured at 1 kHz IFBW at default power with either full reflects or through transmission, RMS. Performance is characteristic.

	MN4694C		MN4697C	
Frequency Range (GHz)	Magnitude[a] (dB)	Phase (degrees)	Magnitude [a] (dB)	Phase (degrees)
0.07 to 0.5 MHz	0.040	0.40	0.040	0.40
> 0.5 MHz to 40	0.005	0.05	0.006	0.06
> 40 to 50	n/a	n/a	0.007	0.07
> 50 to 65	n/a	n/a	0.008	0.08
> 65 to 70	n/a	n/a	0.030	0.30

a. Some degradation may occur in systems that have Option 031 combined with Option 084 or Option 085. For a description of Option 031, 084, and 085, refer to the Technical Data Sheet 11410-00611.

Measurement Stability

Ratio measurement with ports shorted. Performance is characteristic.

Frequency Range (GHz)	Magnitude (dB/°C)	Phase (degrees/°C)
0.07 to 10 MHz	< 0.04	< 0.4
> 0.01 to < 2.5	< 0.03	< 0.4
2.5 to 20	< 0.04	< 0.5
> 20 to 50	< 0.06	< 0.8
> 50 to 65	< 0.07	< 1.1
> 65 to 70	< 0.10	< 1.1

Phase Noise, Harmonics and Non-Harmonics (Spurious)

Measured at default power. Performance is characteristic.

Frequency Range (GHz)	SSB Phase Noise at 10 kHz offset (dBc/Hz)	Harmonics [a] (second and third) (dBc)	Non-Harmonic Spurious at > 1 kHz offset (dBc)
0.07 to 10 MHz	–78	–20	–20
> 0.01 to < 2.5	–84	–20	–30
2.5 to 20	–84	–20	–30
> 20 to 40	–66	–20	–30
> 40 to 50	–61	–20	–30
> 50 to 65	–61	–20	–30
> 65 to 70	–61	–20	–30

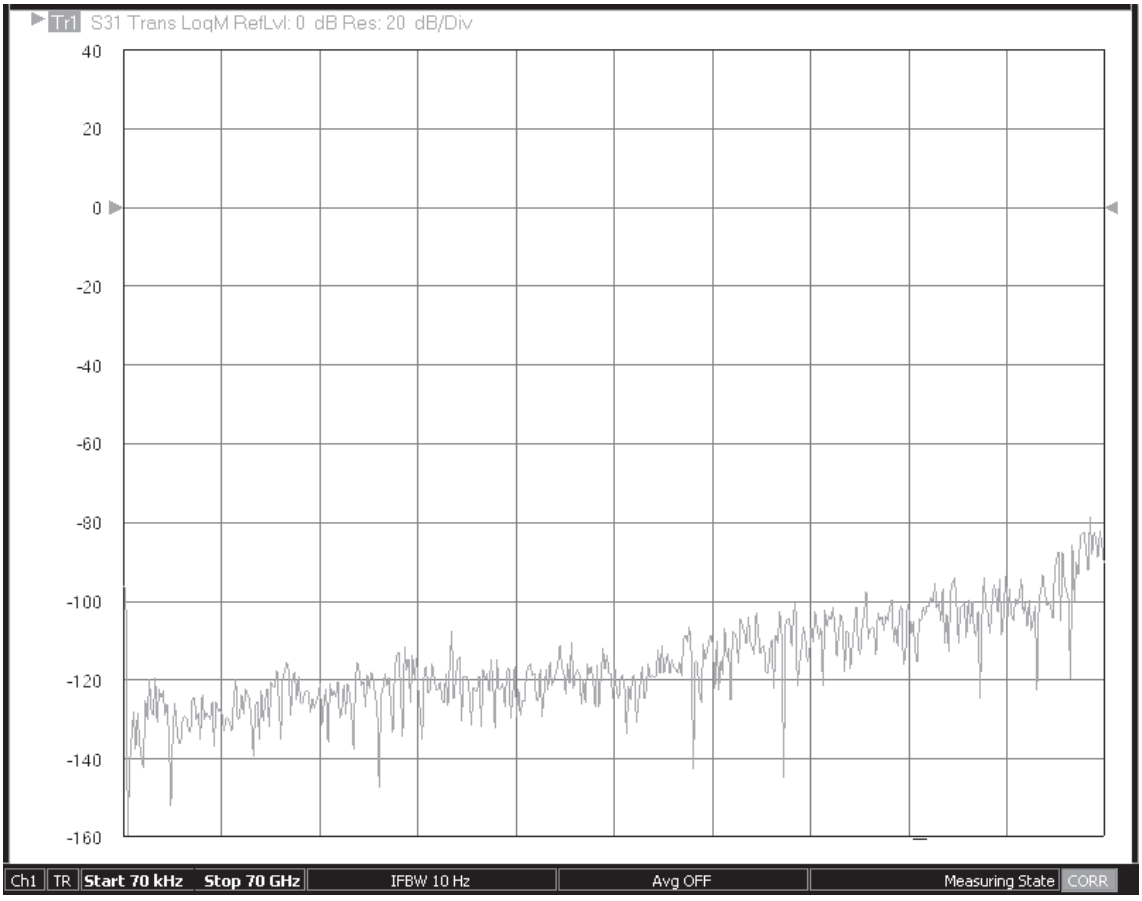
a. May degrade from 2.5 to 2.7 GHz on 20 GHz systems and from 20 to 21 GHz on 70 GHz systems

Uncorrected (Raw) Port Characteristics

Performance is characteristic.

Frequency Range (GHz)	Directivity (dB)	Port Match [a] (dB)
0.07 to 10 MHz	> 10 [b]	> 8
> 0.01 to < 2.5	> 9 [b]	> 10
2.5 to 20	> 17	> 9
> 20 to 40	> 15	> 7
> 40 to 50	> 13	> 7
> 50 to 65	> 11	> 7
> 65 to 70	> 8	> 7

a.Port Match is defined as the worst of source and load match.
b.< 300 kHz and 200 MHz below 2.5 GHz: 4 dB (typical).



System Dynamic Range (as measured, not RMS). 10 Hz IFBW, no averaging, at max power, ports terminated after transmission calibration.

Corrected System Performance and Uncertainties

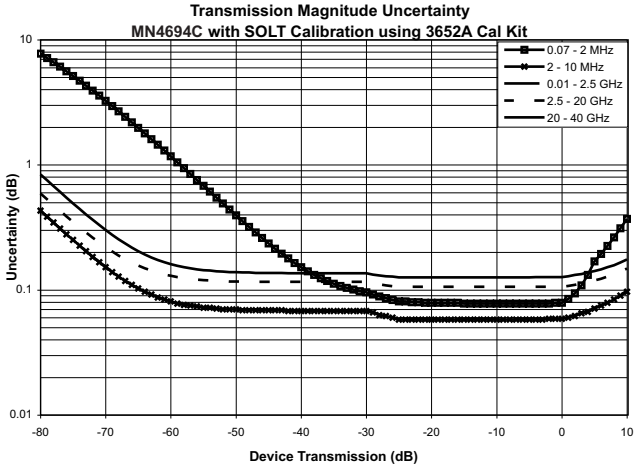
MN4694C with MS4642A/B or MS4644A/B, 20 GHz or 40 GHz Models with full SOLT Cal (3 Thrus) using the 3652A K Cal Kit

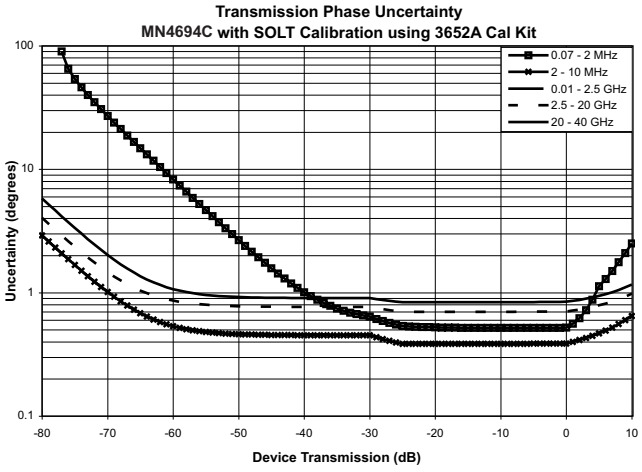
Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match [a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
≤ 0.01	> 38	> 36	> 38	±0.02	±0.05
> 0.01 to < 2.5	> 37	> 41	> 37	±0.005	±0.03
2.5 to 20	> 34	> 39	> 35	±0.006	±0.07
> 20 to 40	> 32	> 34	> 32	±0.006	±0.08

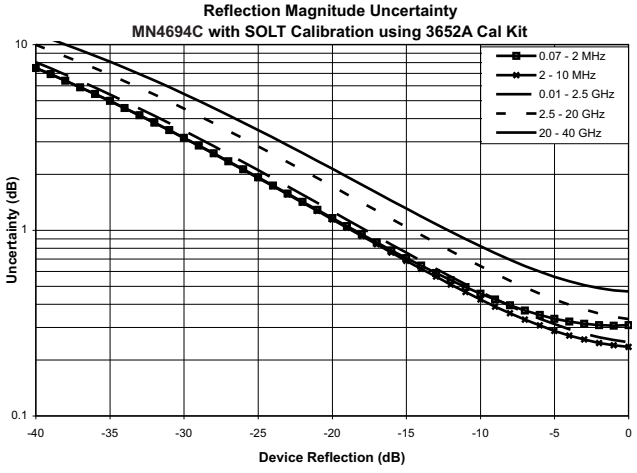
a.Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by ~ 8 dB for a 3670 series test port cable to compensate for affects such as match, repeatability, bend radius, etc.

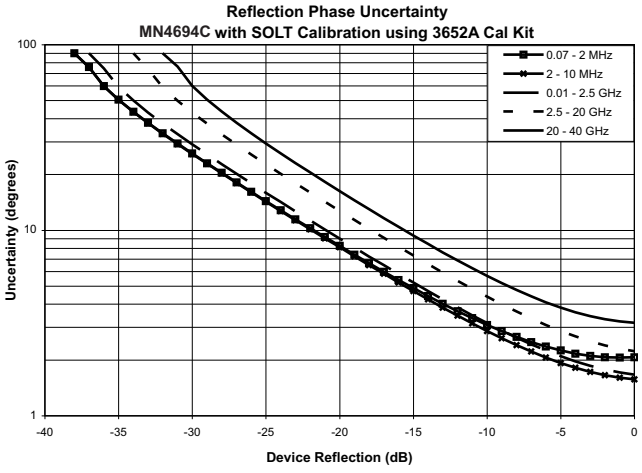
Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are worst case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. An IF bandwidth of 10 Hz 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 from www.anritsu.com.









MN4694C with MS4642A/B or MS4644A/B, 20 GHz or 40 GHz Models, with full cal using two precision AutoCal steps and an external thru using the 36585K K AutoCal.

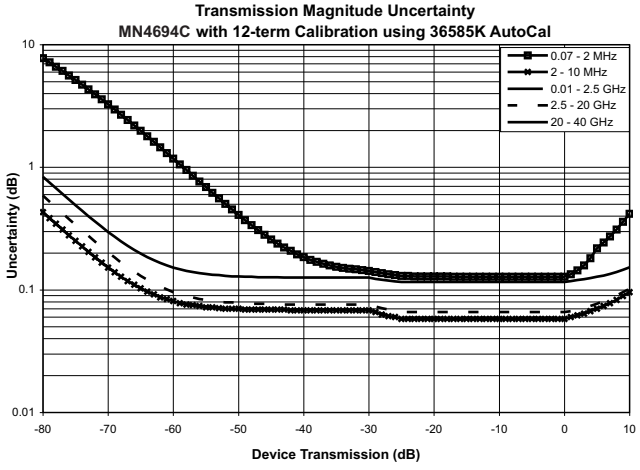
Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match [a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
≤ 0.01 [b]	> 40	> 43	> 43	±0.10	±0.10
> 0.01 to < 2.5	> 43	> 47	> 43	±0.05	±0.03
2.5 to 20	> 50	> 47	> 50	±0.09	±0.03
> 20 to 40	> 48	> 47	> 48	±0.14	±0.07

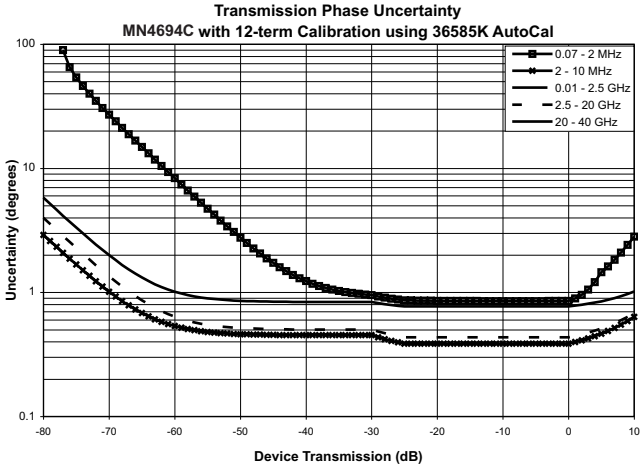
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by ~ 8 dB for a 3670 series test port cable to compensate for affects such as match, repeatability, bend radius, etc.

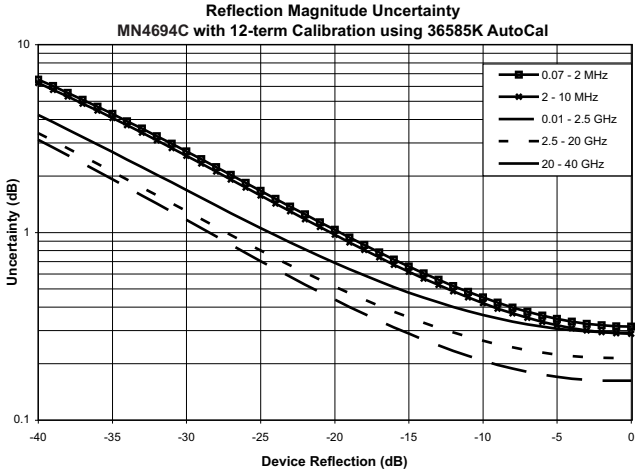
b. Typical performance below 2 MHz.

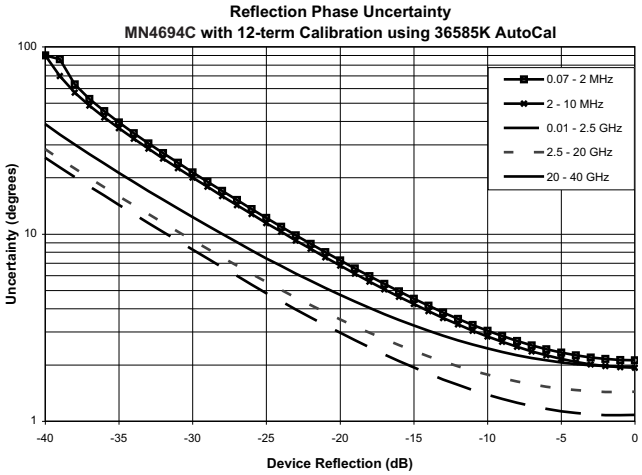
Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are worst case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. An IF bandwidth of 10 Hz is used. For transmission uncertainties, it is assumed that s11 = s22 = 0. For reflection uncertainties, it is assumed that s21 = s12 = 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 from www.anritsu.com.









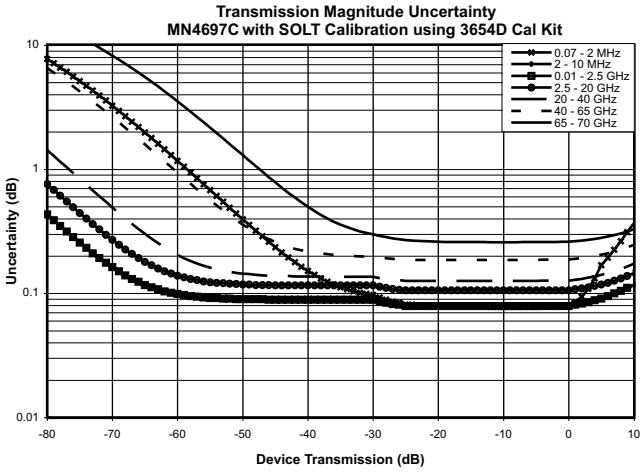
MN4697C with MS4645A/B or MS4647A/B, 50 GHz or 70 GHz Models with full SOLT Cal (3 Thrus) using the 3654D V Cal Kit.

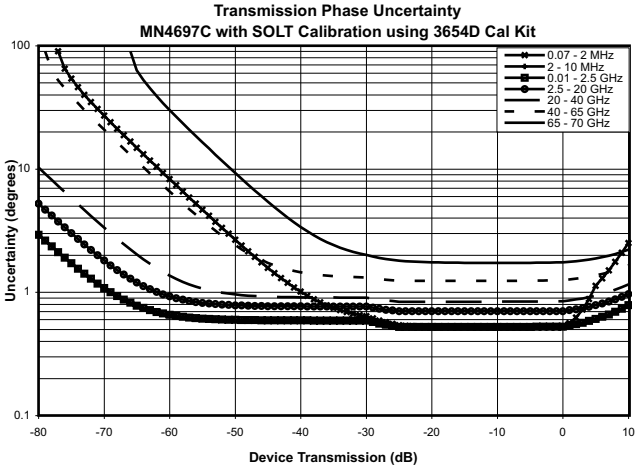
Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match [a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
≤ 0.01	> 38	> 36	> 38	±0.02	±0.05
> 0.01 to < 2.5	> 40	> 39	> 40	±0.02	±0.05
2.5 to 20	> 40	> 37	> 40	±0.02	±0.07
> 20 to 40	> 35	> 32	> 35	±0.02	±0.08
> 40 to 65	> 32	> 28	> 32	±0.08	±0.12
> 65 to 67	> 32	> 28	> 32	±015	±0.15
> 67 to 70	> 28	> 26	> 28	±0.30	±0.15

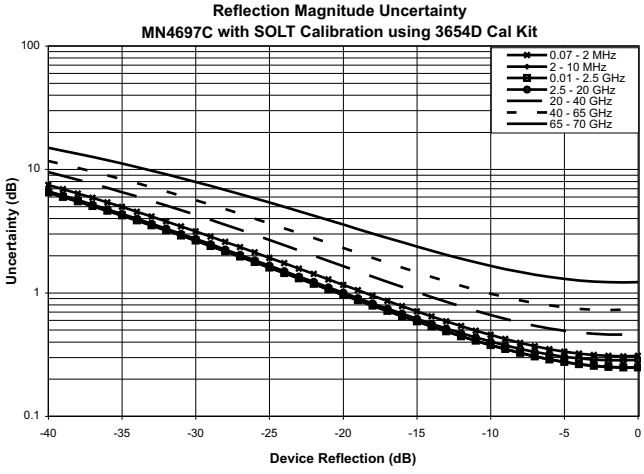
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by ~ 8 dB for a 3670 series test port cable to compensate for effects such as match, repeatability, bend radius, etc.

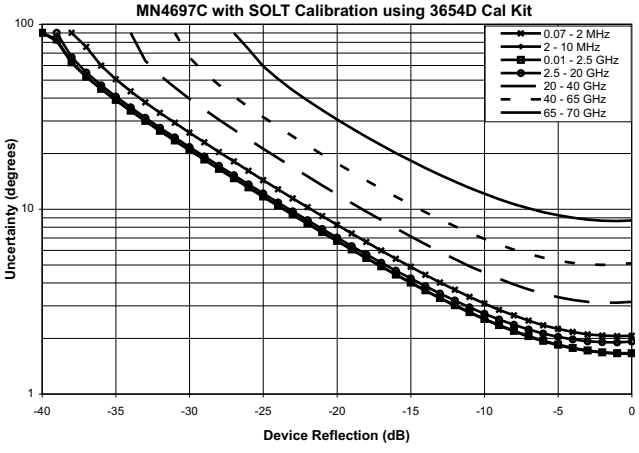
Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are worst case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. An IF bandwidth of 10 Hz 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 from www.anritsu.com.









MN4697C with MS4645A/B or MS4647A/B, 50 GHz or 70 GHz Models with full calibration using two precision AutoCal steps and an external thru using the 36585V V AutoCal.

Frequency Range (GHz)	Directivity (dB)	Source Match (dB)	Load Match [a] (dB)	Reflection Tracking (dB)	Transmission Tracking (dB)
≤ 0.01 [b]	> 40	> 40	> 40	±0.10	±0.10
> 0.01 to < 2.5	> 43	> 45	> 43	±0.05	±0.03
2.5 to 20	>45	> 45	> 45	±0.09	±0.03
> 20 to 40	> 48	> 45	> 48	±0.14	±0.07
> 40 to 65	> 43	> 45	> 43	±0.17 [c]	±0.10
> 65 to 67	> 43	> 45	> 43	±017	±0.10
> 67 to 70	> 42	> 40	> 42	±0.30	±0.12

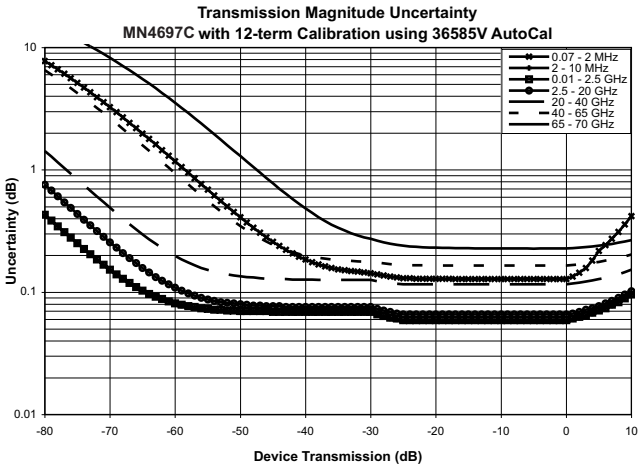
a. Since Residual Load Match is limited by Residual Directivity and the user test port cable, it can only be specified as Residual Directivity. For practical considerations, derate it by ~ 8 dB for a 3670 series test port cable to compensate for effects such as match, repeatability, bend radius, etc.

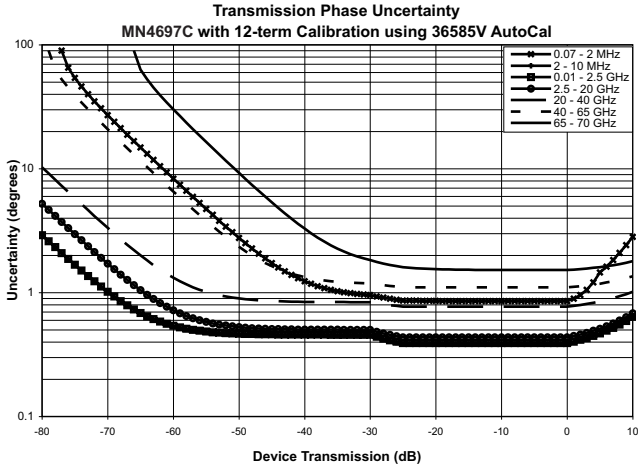
b. Typical performance below 2 MHz.

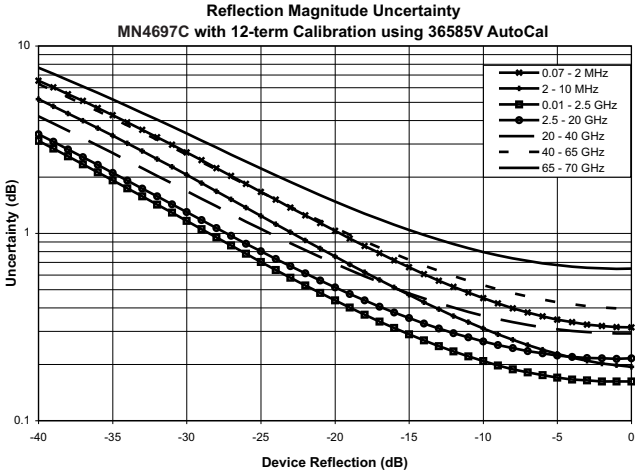
c. ±0.25 dB between 51 GHz to 55 GHz.

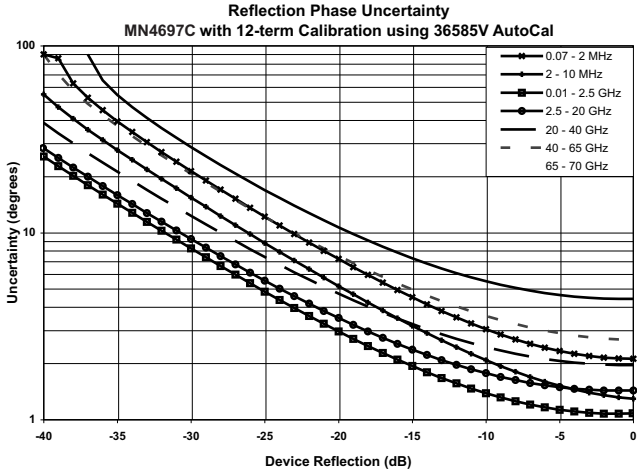
Measurement Uncertainties

The graphs give measurement uncertainties after the above calibration. The errors are worst case contribution of residual directivity, load and source match, frequency response and isolation, network analyzer dynamic accuracy, and connector repeatability. An IF bandwidth of 10 Hz 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 from www.anritsu.com.









Remote Operability

Check the base MS464xA/B VNA data sheet for remote operability. The 4-port system is controllable via GPIB, LAN, and USB through the base VNA. The test set itself is controlled via GPIB by the base VNA and not intended to be controlled directly by the user.

Capabilities and Calibrations Added to the Base 2-Port VNA

When the VNA application detects an MN469xC series test set on its GPIB bus upon loading, it automatically goes into 4-port mode making available the following capabilities:

Measurement Parameters	16 single-ended S-parameters and any user-defined combination of a1-4, b1-4, and 1. 16 mixed-mode S-parameters (DD, CC, DC, CD); Uses the superposition technique, which is ideal and highly accurate for linear devices and measurements.
Correction Models	Using 2-port precision AutoCal: • 1-port Cals (ports 1 to 4) • 2-port Cals (single, double, full, 1 path 2 ports) • 4-port Cals (uses two AutoCal steps and up to 4 external thru/reciprocals, minimum of 1) Using standard Cal kits: • Transmission Frequency Response (between any 2 ports and any direction) • Reflection Frequency Response (ports 1 to 4) • 1-port Cals (ports 1 to 4) • 2-port Cals (single, double, full, 1 path 2 ports) • 3-port Cals (uses one full 2-port cal, a full 1-port cal, and up to 2 additional thru/reciprocals, minimum of 1) • 4-port Cals (uses two full 2-port cals and up to 4 additional thru/reciprocals, minimum of 1)
Calibration Methods	All existing calibration methods are available: SOLT, SSLT, SSST, SOLR, SSLR, SSSR, LRL, LRM, A-LRM, with one exception that LRL, LRM, and Reciprocal cannot be used for ports 1 to 2 and ports 3 to 4 combinations when using the external 4-port test set.
Bias Tees	Bias tees are available in the source path of each port 3 and port 4 0.4 A max, 40 VDC 3 kHz BW (nominal), looking into a high impedance 10 M ohms to ground for static discharge protection Located at rear panel

Front Panel Connections

Test Ports 3, and 4	Universal test port connectors are easily exchangeable in case of damage. K (male) for MN4694C; V (male) for MN4697C Damage Input Levels: +20 dBm max, 40 VDC max
Source Inputs from VNA	Interconnects to VNA port 1 source and port 2 source (4 each) K (female) for MN4694C; V (female) for MN4697C B reference outputs to VNA
High Band	Interconnects to VNA front panel high band b1 and b2 (4 each) K (female) for MN4694C; V (female) for MN4697C

MN469xC Test Set Front Panel and Connections to Base VNA

Rear Panel Connections

B Reference Outputs to VNA (Low Band)	Interconnects to VNA rear panel low band b1 and b2 (4 each) SMA (female) Interconnects to VNA rear panel port 1 source and port 2 source (4 each)
Bias Inputs	For ports 3 to 4, respectively; BNC (female) (2 each + fuses)
GPIB Port	Type D-24, female, IEEE 488.2 compatible (controllable only by the base VNA)
Aux IO	DB 9, 9 pin connector for system interfacing
AC Power Input	AC input connector, fused (250 V, 2 A) 150 VA max, 85 to 240 VAC, 47 to 63 Hz

MN469xC Test Set Rear Panel and Connections to Base VNA

Mechanical and Environmental

Dimensions	Height	89 mm (2U)
		108 mm between feet outer edges
	Width	426 mm body
		457 mm between feet outer edges
	Depth	502 mm body
		591 mm between handle and foot outer edges
	Weight Fully Loaded	< 10 kg
Environmental (Operating)		Conforms to MIL-PRF-28800F (Class 3)
	Temperature Range	0 °C to +50 °C without error codes[a]
	Relative Humidity	5 % to 95 % at +40 °C
	Altitude	4,600 m

a. Except for 'unleveled' error messages that may occur at temperatures outside of the specified performance temperature range of 25 °C ± 5 °C.

Environmental (Non-Operating)		
	Temperature Range	–40 °C to +75 °C
	Relative Humidity	0 % to 90 % at +65 °C (non-condensing)
	Altitude	15,200 m
Emissions Conformity		
	EMI	Meets the emissions and immunity requirements of: • EN55011/1991 Class A/CISPR-11 Class A • EN50082-1/1993 • IEC 801-2/1984 (4 kV CD, 8 kV AD) • IEC 1000-4-3/1995 (3 V/m, 80-1000 MHz) IEC 801-4/1988 (500 V SL, 1000 V PL) IEC 1000-4-5/1995 (2 kV L-E, 1 kV L-L)

Warranty

Three (3) year warranty is standard on the MN469xC series test sets. Additional warranty is available.

Ordering Information

MN4694C		
	Description	4-port test set, K connectors
	Coverage	For use with MS4642A/B*: 70 kHz** to 20 GHz
		For use with MS4644A/B*: 70 kHz** to 40 GHz
	Standard Accessories	Interface cables to base VNA (6 each)
		GPIB cable to base VNA
		Power cord
		Installation instructions (manuals are covered in the base VNA manuals)
MN4697C		
	Description	4-port test set, V connectors
	Coverage	For use with MS4645A/B*: 70 kHz** to 50 GHz
		For use with MS4647A/B*: 70 kHz** to 70 GHz
	Standard Accessories	Interface cables to base VNA (6 each)
		GPIB cable to base VNA
		Power cord
		Installation instructions (manuals are covered in the base VNA manuals)

* Base VNA must include the optional Direct Access Loops, available with option 051 or 06x.
** Operational to 40 kHz; Requires Base VNA to include Option 070, otherwise cannot be operated below 10 MHz.

For accessories such as calibration solutions and test port cables, please refer to the base VNA data sheet and configuration guide. All calibration kits that are available for the 2-port VNA are usable with the 4-port solution, including the 2-port precision AutoCal. The available verification kits only support the verification of the 2-port base VNA.

Configuration Guide

Minimum 20 GHz 4-Port System Configuration (10 MHz to 20 GHz)

Part Number	Description	More Information
MS4642A/B	VectorStar 2-port VNA, 10 MHz to 20 GHz	
MS4642A/B-051	Adds Direct Access Loops to base MS4642A/B VNA	Additional options available
MN4694C	4-port test set, K connectors	
	Additional items that may be needed:	
MS464xA/B-070	70 kHz low end on base VNA	Allows 4-port measurements to 70 kHz (operational to 40 kHz)
3670K50-1	Test port cable, 30 cm, K male to K female	4 pieces recommended (other types exist)
36585K Series	Precision 2-port AutoCal, K connectors	Different connector variations exist
3650A	Cal Kit, SMA/3.5 mm connectors	Different variations exist
33SS50	Adapter: Precision 3.5 mm male to 3.5 mm male	Phase equal series (as many as needed)
33SFSF50	Adapter: Precision 3.5 mm female to 3.5 mm female	Phase equal series (as many as needed)
33SSF50	Adapter: Precision 3.5 mm male to 3.5 mm female	Phase equal series (as many as needed)

Minimum 40 GHz 4-Port System Configuration (10 MHz to 40 GHz)

Part Number	Description	More Information
MS4644A/B	VectorStar 2-port VNA, 10 MHz to 40 GHz	
MS4644A/B-051	Adds Direct Access Loops to base MS4644A/B VNA	Additional options available
MN4694C	4-port test set, K connectors	
	Additional items that may be needed:	
MS464xA/B-070	70 kHz low end on base VNA	Allows 4-port measurements to 70 kHz (operational to 40 kHz)
3670K50-1	Test port cable, 30 cm, K male to K female	4 pieces recommended (other types exist)
36585K Series	Precision AutoCal 2-port, K	Different connector variations exist
3652A	Cal Kit, K connectors	Different variations exist
33KK50	Adapter: Precision K male to K male	Phase equal series (as many as needed)
33KFKF50	Adapter: Precision K female to K female	Phase equal series (as many as needed)
33KKF50	Adapter: Precision K male to K female	Phase equal series (as many as needed)

Minimum 50 GHz 4-Port System Configuration (10 MHz to 50 GHz)

Part Number	Description	More Information
MS4645A/B	VectorStar 2-port VNA, 10 MHz to 50 GHz	
MS4645A/B-051	Adds Direct Access Loops to base MS4645A/B VNA	Additional options available
MN4697C	4-port test set, V connectors	
	Additional items that may be needed:	
MS464xA/B-070	70 kHz low end on base VNA	Allows 4-port measurements to 70 kHz (operational to 40 kHz)
3670V50A-1	Test port cable, 30 cm, V male to V female	4 pieces recommended (other types exist)
36585V Series	Precision 2-port AutoCal, V connectors	Different connector variations exist
3654D	Cal Kit, V connectors	Different variations exist
33VV50C	Adapter: Precision V male to V male	Phase equal series (as many as needed)
33VFVF50C	Adapter: Precision V female to V female	Phase equal series (as many as needed)
33VVF50C	Adapter: Precision V male to V female	Phase equal series (as many as needed)

Minimum 70 GHz 4-Port System Configuration (10 MHz to 70 GHz)

Part Number	Description	More Information
MS4647A/B	VectorStar 2-port VNA, 10 MHz to 70 GHz	
MS4647A/B-051	Adds Direct Access Loops to base MS4647A/B VNA	Additional options available
MN4697C	4-port Test Set, V connectors	
	Additional items that may be needed:	
MS464xB-070	70 kHz low end on base VNA	Allows 4-port measurements to 70 kHz (operational to 40 kHz)
3670V50A-1	Test port cable, 30 cm, V male to V female	4 pieces recommended (other types exist)
36585V Series	Precision AutoCal 2-port, V connectors	Different connector variations exist
3654D	Cal Kit, V connectors	Different variations exist
33VV50C	Adapter: Precision V male to V male	Phase equal series (as many as needed)
33VFVF50C	Adapter: Precision V female to V female	Phase equal series (as many as needed)
33VVF50C	Adapter: Precision V male to V female	Phase equal series (as many as needed)

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