

# ME7808C

## Broadband and Millimeter Wave VNA

40 MHz to 110 GHz (expandable to 500 GHz)



# Measurement Solutions from 40 MHz to 500 GHz

The ME7808C Broadband Vector Network Analyzer (VNA) is a high performance measurement solution that covers 40 MHz to 110 GHz in a single fast sweep. Built on the advanced technology of the Anritsu Lightning 65 GHz VNA, the ME7808C is ideal for making accurate S-parameter measurements of components and devices to 110 GHz. The flexible system architecture of the ME7808C makes it easy to adapt to multiple measurement applications.

An alternate configuration is the ME7808C Millimeter Wave VNA, a high performance measurement solution that covers specific millimeter wave bands from 50 GHz to 500 GHz. Any of the two-port Lightning VNA models can be used as the foundation for the Millimeter Wave VNA.

## Key Features

- Continuous Broadband Frequency Coverage from 40 MHz to 110 GHz or Banded Millimeter Wave Operation (up to 500 GHz)\*
- Highly Reliable and Stable Lightning Platform
- Supports On-Wafer Device Characterization, Broadband Coaxial and Waveguide Measurements
- Optimum Time Domain resolution
- Offers Total Flexibility and Upgradeability
- Easy-to-Use Lightning Navigator Software Facilitates Calibration and Measurement
- Outstanding Technical Support

\*with VNA2 Frequency Extension Modules from OML, Inc.

## Applications

- Broadband Characterization
- Parameter Extraction
- Device Modeling
- Millimeter Wave Measurements

## System Configurations

The ME7808C Broadband VNA consists of:

- Lightning 37397D 65 GHz VNA
- Two Millimeter Wave Modules (3742A Series)
  - Extended W Band (WR-10), 65 to 110 GHz
  - Includes micrometer attenuator on both the source and receiver modules
- Broadband Test Set
- Two 20 GHz Ultra-Low Phase Noise Frequency Sources
- Two Multiplexing Couplers with Kelvin Bias Tees
- Equipment Console with Table

The ME7808C Millimeter Wave VNA consists of:

- Any Lightning 37200D or 37300D series VNA
- Two Millimeter Wave Modules (3740A or 3741A Series)
  - V Band (WR-15), 50 to 75 GHz
  - E Band (WR-12), 60 to 90 GHz
  - Extended E Band (WR-12), 56 to 94 GHz
  - W Band (WR-10), 75 to 110 GHz
  - Extended W Band (WR-10), 65 to 110 GHz
  - Higher frequency bands (up to 500 GHz)\*
- Broadband Test Set
- Two 20 GHz Ultra-Low Phase Noise Frequency Sources
- Equipment Console with Table

\*with VNA2 Frequency Extension Modules from OML, Inc.

## Vector Network Analyzer

The Lightning high performance VNA (with Rear Panel IF Inputs) is the foundation of the ME7808C Broadband and Millimeter Wave VNAs. The Rear Panel IF inputs provide a path back into the VNA for the downconverted IF signals from the Millimeter Wave (mmW) modules. The Lightning VNA also controls the two synthesizers that are used for the LO and RF drive to the mmW modules. In addition to S-parameter measurements, the VNA also supports time domain and swept power gain compression measurements. The internal test port attenuators, bias tees, and wide ALC range provide flexibility for active device measurements. Multiple storage formats and ample hard disk space make it convenient to save test results and measurement set-ups.

## Broadband Test Set and Millimeter-Wave Modules

The broadband test set drives the two external mmW modules that enable frequency coverage up to 110 GHz and beyond. The test set performs band switching between the VNA source and the mmW module source. In addition, the test set routes the IF outputs from the mmW modules back to the VNA. The mmW modules use the latest in component technology for optimum output power and dynamic range. A 20 dB variable attenuator is built into each 3742A Transmission/Reflection module that provides output power control and leveling of the broadband sweep using Anritsu's ML2437A Power Meter and SC6230 65 GHz power sensor.

The banded Millimeter Wave VNA offers two versions of millimeter wave modules to meet your exact measurement needs. The 3740A Transmission/Reflection modules have simultaneous transmission and reflection capability (just like the 3742A modules), while the 3741A Transmission-only modules are used with the 3740A modules when only forward transmission and reflection measurements are required. A pair of 3740A modules allows measurement of all four S-parameters of a two-port device. A 3740A combined with a 3741A allows measurement of one-path/two-port S-parameters ( $S_{11}$  and  $S_{21}$ ). A single 3740A series module can be used for reflection-only measurements ( $S_{11}$ ).

The Anritsu mmW modules are compact, low-profile, and lightweight which facilitates mounting on the micropositioners associated with semi-automatic or manual probe stations.

## Ultra-Low Phase Noise Frequency Sources

The ME7808C Broadband and Millimeter Wave VNAs use two 20 GHz synthesized sources with ultra low phase noise (Option 3). They provide the LO and RF drive to the mmW modules which translates to the lowest measurement trace noise available in a millimeter wave VNA. These synthesizers are members of the MG3690B family of Anritsu synthesizers and offer a full range of capabilities. The two synthesizers may be upgraded at any time to add features such as expanded modulation or higher frequency coverage for use in other general purpose applications (i.e., intermodulation distortion, harmonic, and mixer measurements).

## Single Pair of Coaxial Test Ports For Broadband Sweep

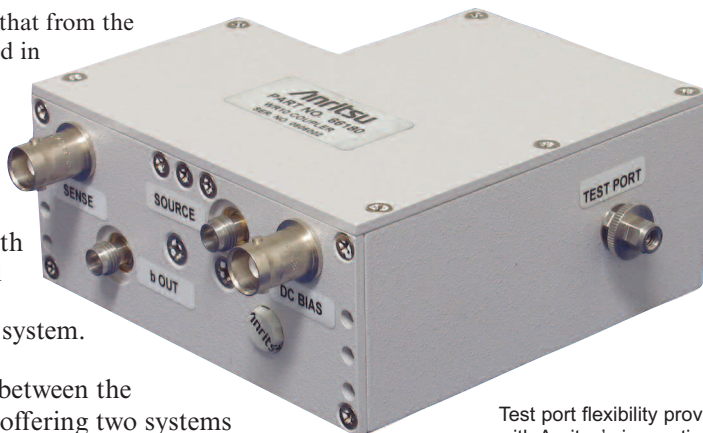
The ME7808C Broadband VNA combines the 40 MHz to 65 GHz output from the VNA and the 65 GHz to 110 GHz output from the mmW modules using a unique multiplexing coupler design. The effective system test ports for the broadband configuration are therefore two W1 coax connectors. The Anritsu W1 Connector™ is compliant with the IEEE standard 1.0 mm connector. This design provides a DC path that permits bias injection from the VNA front panel bias inputs directly to the W1 coax test ports.

# Up to Three Systems in One

## Up to Three Systems in One

Using the approach of coupling the 65 GHz VNA output with that from the mmW modules, the ME7808C Broadband VNA can be operated in any of the following configurations:

- 1) as a broadband VNA (40 MHz to 110 GHz) with W1 Connector™ coaxial interface
- 2) as a stand-alone 65 GHz VNA with V Connector® coaxial interface
- 3) as a millimeter wave VNA (65 GHz to 110 GHz) with a WR-10 waveguide connector interface. Additional discrete mmW bands are easily supported by substituting other available mmW modules into the system.



Test port flexibility provided with Anritsu's innovative multiplexing coupler

The ME7808C Millimeter Wave VNA permits switching between the stand-alone coaxial and the millimeter wave modes, thus offering two systems in one.

Reconfiguration of the system is fast and simple using an internal software menu.

When operating either the stand-alone VNA or mmW systems independently, higher output power and increased dynamic range are achievable. Wafer probe tips can be connected to any of the three interfaces to make on-wafer measurements.

The ME7808C Broadband system incorporates a new multiplexing combiner module containing the reflection coupler, waveguide to coax transition, and bias tee next to the W1 1 mm coaxial output port. This new design dramatically improves optimum raw directivity performance and calibration stability. The 65 GHz test set is configured for direct sampler access allowing the signal to bypass the internal couplers. This configuration eliminates the insertion loss of the internal couplers and thereby maximizes dynamic range for best possible performance.

Also included in the new multiplexing combiners are the Kelvin bias tees providing both sensing and forcing close to the DUT. Locating the bias tees close to the DUT minimizes the large IR drop found when forcing from inside the VNA. The Kelvin design is also a more accurate method of sensing the properties of the DUT on a real-time basis.

## Accurate W1 Coaxial Calibration

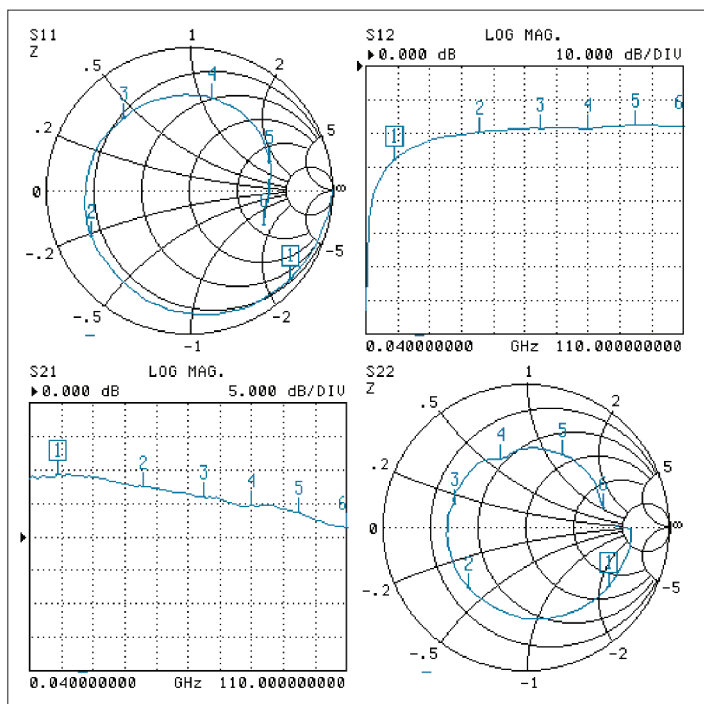
The 3656 W1 Calibration/Verification Kit consists of precision components that are used to calibrate the ME7808C Broadband VNA from 40 MHz to 110 GHz at its W1 coax test ports. The kit supports SOLT calibrations with opens, shorts and loads from 40 MHz to 65 GHz, and Triple Offset Short calibrations from 65 to 110 GHz. The two, banded calibrations are then concatenated in the VNA, resulting in a continuous, broadband calibration. Two innovative adapters with interchangeable, male or female ends, are provided to facilitate calibrations for measuring non-insertable devices. The kit also includes verification devices for confirming system accuracy of the VNA.



3656 W1 Calibration/Verification Kit

## On-Wafer Calibration Methods

Device characterization and parameter extraction are most commonly performed on a wafer probe system, requiring specific on-wafer calibration methods. The Anritsu VNAs provide an easy interface for entering the parameters for SOLT, LRL, and LRM calibrations. Other external calibration techniques, optimized for wafer probing applications, are also supported for users of Suss MicroTec and Cascade Microtech probe systems.



On-wafer broadband measurement of an InP HEMT using the ME7808C

## Compatibility with Probe Stations

Anritsu's VNAs are fully compatible with Suss MicroTec and Cascade Microtech wafer probe stations. Probe tip compatibility includes GGB Industries Pricoprobe® and Cascade's Infinity Probe, both providing measurements up to 110 GHz. Both SussCal and WinCal™ calibration programs support the Lightning series VNAs. Contact your local sales representative to schedule a factory demonstration of on-wafer measurements with the ME7808C, the Suss MicroTec PA200 semi-automatic probe system, SussCal Calibration Software, GGB Industries 110 GHz probes and calibration substrates. For parameter extraction and device modeling, an instrument driver for the ME7808C is available in Agilent EEsof's IC-CAP 2006B.



Complete on-wafer measurement solution: ME7808C integrated with Suss MicroTec PA200 probe system

# ME7808C Broadband VNA System Specifications

## Dynamic Range

System dynamic range is defined as the ratio of the typical power at Port 1 and the system noise floor. The noise floor measurement is made using 512 averages in a 10 Hz IF bandwidth, including isolation calibration.

### W1 Coax

Frequency <sup>1</sup> (GHz)	Max Signal into Port 2 (dBm)	Port 1 Power, Typical (dBm)	Noise Floor <sup>2</sup> (dBm)	System Dynamic Range (dB)	Receiver Dynamic Range (dB)
0.04	+30	+10	-88	98	118
2	+30	+4	-109	113	139
20	+30	-2	-102	100	132
40	+30	-6	-91	85	121
50	+30	-9	-86	77	116
<65	+30	-12	-72	60	102
>65	+16	-13	-77	64	93
75	+14	-7	-88	81	102
85	+13	-5	-91	86	104
100	+12	-6	-88	82	100
110	+12	-8	-85	77	97

Note: 1. Specifications between the stated frequencies are to be linearly interpolated as typical values.  
 2. RMS values – compensated for loss in available source power from test port cable connected between Port 1 and Port 2.

### V Coax

Frequency <sup>1</sup> (GHz)	Max Signal into Port 2 (dBm)	Port 1 Power, Typical (dBm)	Noise Floor <sup>2</sup> (dBm)	System Dynamic Range (dB)	Receiver Dynamic Range (dB)
0.04	+30	+10	-88	98	118
2	+30	+5	-110	115	140
20	+30	+2	-106	108	136
40	+30	+1	-98	99	128
50	+30	-1	-94	93	124
65	+30	-2	-82	80	112

Note: 1. Specifications between the stated frequencies are to be linearly interpolated as typical values.  
 2. RMS values – compensated for loss in available source power from test port cable connected between Port 1 and Port 2.

### Extended W Band (WR-10) Waveguide (3742A-EW Modules)

Frequency <sup>1</sup> (GHz)	Max Signal into Port 2 (dBm)	Port 1 Power, Typical (dBm)	Noise Floor <sup>2</sup> (dBm)	System Dynamic Range (dB)	Receiver Dynamic Range (dB)
65	+8	-5	-85	80	93
75	+8	-1	-94	93	102
85	+8	0	-96	96	104
100	+8	-2	-92	90	100
110	+8	-4	-89	85	97

Note: 1. Specifications between the stated frequencies are to be linearly interpolated as typical values.  
 2. RMS values – compensated for loss in available source power from test port cable connected between Port 1 and Port 2.

## Measurement Time for 101 Data Points

Measurement time is based on a single 40 MHz to 110 GHz sweep with 10 kHz IF bandwidth (no averages) after full 12-term calibration. Sweep time includes retrace and band switch times.

Frequency Span: 40 MHz to 110 GHz
Time: 1.5 s

## Test Port Characteristics

The specifications in the table below apply when the proper W1 Test Port Adapters are connected to the mux coupler test ports and calibrated with the 3656 W1 calibration kit at 23°C ± 3°C using the two-band, concatenated SOLT and Triple Offset Short calibration methods to achieve 12-term error correction (90 minutes warm-up time is recommended).

### W1 Coax

Frequency (GHz)	Female Test Port			Male Test Port			Reflection Frequency Tracking (dB)	Transmission Frequency Tracking (dB)	Isolation (dB)
	Directivity (dB)	Source Match (dB)	Load Match (dB)	Directivity (dB)	Source Match (dB)	Load Match (dB)			
0.04	31	34	31	31	31	31	±0.05	±0.03	105
2	31	34	31	31	31	31	±0.05	±0.05	115
20	31	34	31	31	31	31	±0.06	±0.07	110
40	29	34	29	29	31	29	±0.06	±0.08	100
50	29	34	29	29	31	29	±0.08	±0.10	90
<65	29	34	29	29	31	29	±0.1	±0.12	80
>65	32	33	30	30	30	32	±0.08	±0.10	100
75	32	33	30	30	30	32	±0.08	±0.10	100
85	32	33	30	30	30	32	±0.08	±0.10	100
100	32	33	30	30	30	32	±0.08	±0.10	100
110	32	33	30	30	30	32	±0.08	±0.10	100

### V Coax

The specifications in the table below apply when the proper V Connector Test Port Adapters are connected, with or without phase equal insertables, to the test set ports and calibrated with the 3654B V calibration kit at 23°C ± 3°C using the SOLT calibration method with a sliding load to achieve 12-term error correction (90 minutes warm-up time is recommended).

Frequency (GHz)	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Frequency Tracking (dB)	Transmission Frequency Tracking (dB)	Isolation (dB)
0.04	40	36	40	±0.050	±0.030	105
2	40	36	40	±0.050	±0.050	115
20	40	36	40	±0.060	±0.070	110
40	36	32	36	±0.060	±0.080	100
50	34	30	34	±0.080	±0.100	90
65	34	28	34	±0.100	±0.120	80

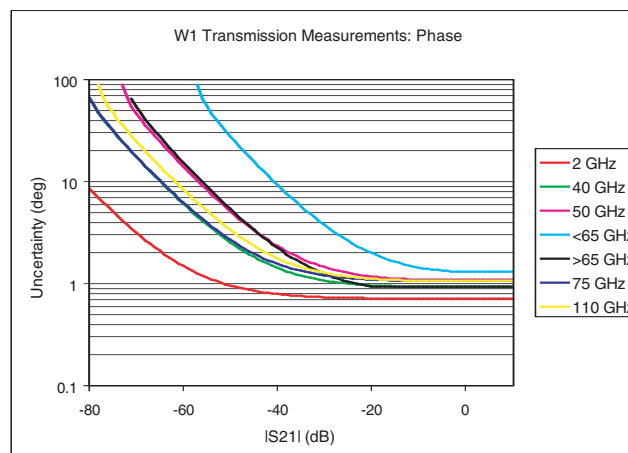
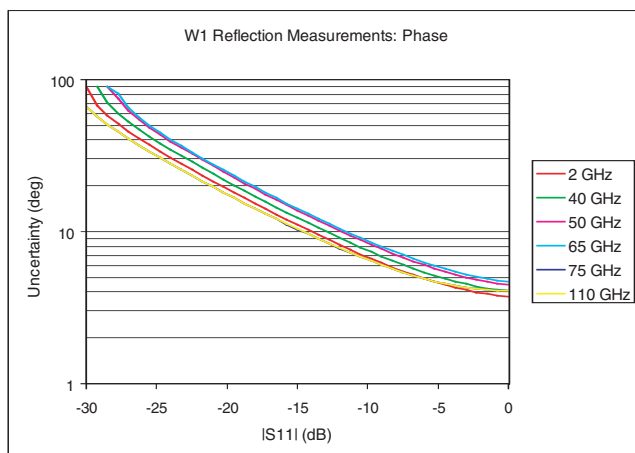
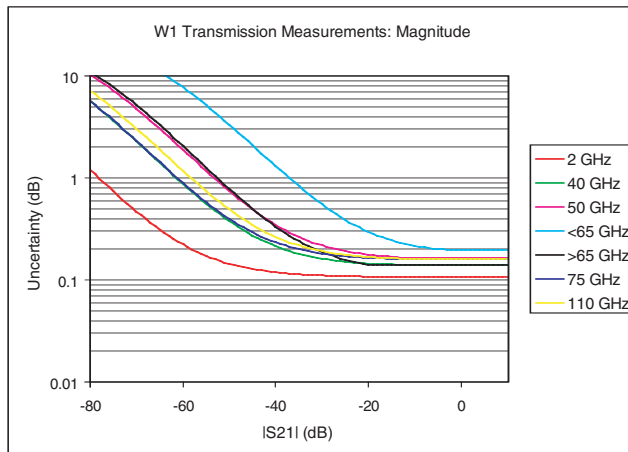
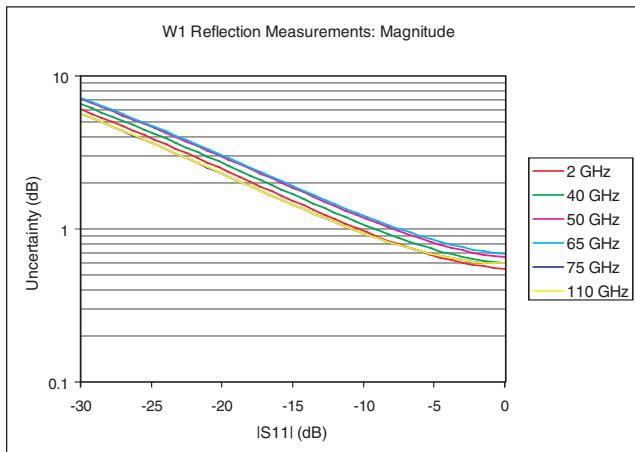
### Extended W Band (WR-10) Waveguide (3742A-EW Modules)

The specifications in the table below apply when the proper high precision waveguide adapters are connected to the module ports and calibrated with the 3655W-1 WR-10 calibration kit at 23°C ± 3°C using the offset short calibration method with a sliding load to achieve 12-term error correction (90 minutes warm-up time is recommended).

Frequency (GHz)	Directivity (dB)	Source Match (dB)	Load Match (dB)	Reflection Frequency Tracking (dB)	Transmission Frequency Tracking (dB)	Isolation (dB)
65 to 75	37	30	37	±0.080	±0.100	100
75 to 110	40	30	40	±0.080	±0.100	100

# Measurement Uncertainty Curves for W1 Coax

For the ME7808C Broadband VNA with 3742A series millimeter wave modules (EW Band) using concatenated SOLT and triple offset short calibration methods. For reflection measurements,  $S_{21}$  is assumed to be zero. For transmission measurements,  $S_{11}$  and  $S_{22}$  are assumed to be zero.





# ME7808C Millimeter Wave VNA System Specifications

## Dynamic Range

System dynamic range is defined as the ratio of the typical power at Port 1 and the system noise floor. The noise floor measurement is made using 512 averages in a 100 Hz IF bandwidth, including isolation calibration.

### V Band (WR-15) Waveguide (3740A-V or 3741A-V Modules):

Frequency Range (GHz)	Max Signal into Port 2 (dBm)	Port 1 Power; Typical (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)	Receiver Dynamic Range (dB)
50 to 75	+8	+7	-90	97	98

### E Band (WR-12) Waveguide (3740A-E or 3741A-E Modules):

Frequency Range (GHz)	Max Signal into Port 2 (dBm)	Port 1 Power; Typical (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)	Receiver Dynamic Range (dB)
60 to 90	+8	+6	-90	96	98

### Extended E Band (WR-12) Waveguide (3740A-EE or 3741A-EE Modules):

Frequency Range (GHz)	Max Signal into Port 2 (dBm)	Port 1 Power; Typical (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)	Receiver Dynamic Range (dB)
56 to 60	+8	+5	-85	90	93
60 to 85	+8	+6	-90	96	98
85 to 94	+8	+4	-76	80	84

### W Band (WR-10) Waveguide (3740A-W or 3741A-W Modules):

Frequency Range (GHz)	Max Signal into Port 2 (dBm)	Port 1 Power; Typical (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)	Receiver Dynamic Range (dB)
75 to 100	+6	+5	-90	95	96
100 to 110	+6	+2	-90	92	96

### Extended W Band (WR-10) Waveguide (3740A-EW or 3741A-EW Modules):

Frequency Range (GHz)	Max Signal into Port 2 (dBm)	Port 1 Power; Typical (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)	Receiver Dynamic Range (dB)
65 to 75	+6	-5	-90	85	96
75 to 100	+6	+5	-89	94	95
100 to 110	+6	+2	-87	89	93

## Test Port Characteristics

The specifications apply when the proper high precision waveguide adapters are connected to the module ports and calibrated with the appropriate waveguide calibration kit at 23°C ± 3°C using the offset short calibration method with a sliding load or LRL calibration method to achieve 12-term error correction (90 minutes warm-up time is recommended).

### V Band (WR-15) Waveguide (3740A-V or 3741A-V Modules):

Calibration Method	Offset Short	LRL
Frequency Range (GHz)	50 to 75	50 to 75
Directivity (dB)	>46	>46
Source Match (dB)	>37	>46
Load Match (dB)	>46	>46
Reflection Frequency Tracking (dB)	±0.030	±0.002
Transmission Frequency Tracking (dB)	±0.060	±0.002
Isolation (dB)	>90	>90

### E Band (WR-12) Waveguide (3740A-E or 3741A-E Modules):

Calibration Method	Offset Short	LRL
Frequency Range (GHz)	60 to 90	60 to 90
Directivity (dB)	>46	>46
Source Match (dB)	>36	>46
Load Match (dB)	>46	>46
Reflection Frequency Tracking (dB)	±0.040	±0.002
Transmission Frequency Tracking (dB)	±0.060	±0.002
Isolation (dB)	>90	>90

### Extended E Band (WR-12) Waveguide (3740A-EE or 3741A-EE Modules):

Calibration Method	Offset Short	LRL
Frequency Range (GHz)	56 to 94	56 to 94
Directivity (dB)	>44	>44
Source Match (dB)	>33	>43
Load Match (dB)	>44	>44
Reflection Frequency Tracking (dB)	±0.080	±0.006
Transmission Frequency Tracking (dB)	±0.100	±0.006
Isolation (dB)	>80	>80

### W Band (WR-10) Waveguide (3740A-W or 3741A-W Modules):

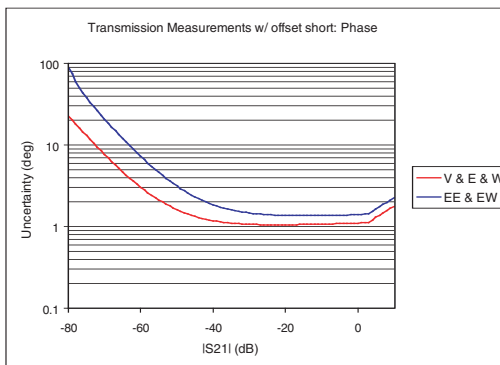
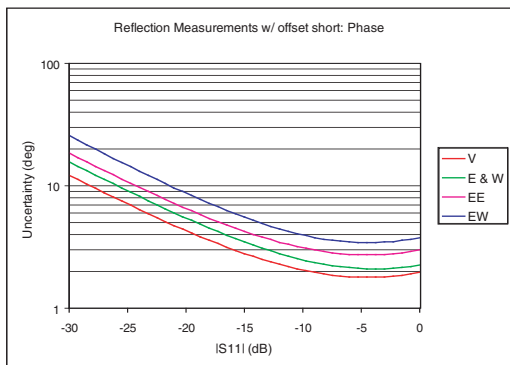
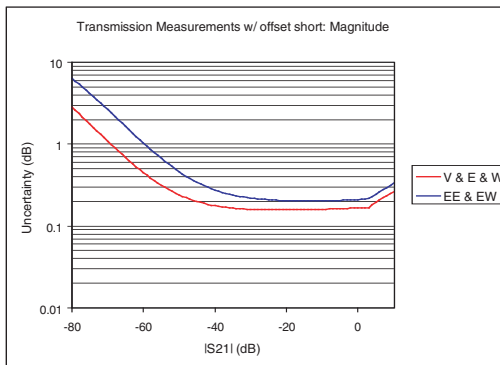
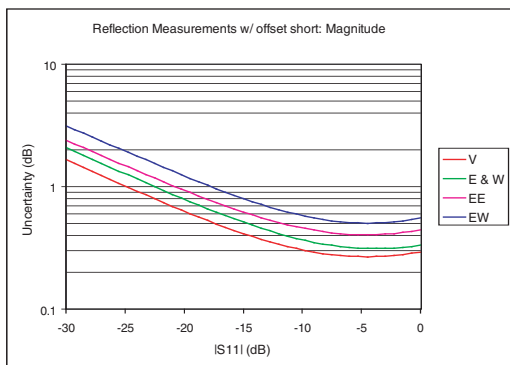
Calibration Method	Offset Short	LRL
Frequency Range (GHz)	75 to 110	75 to 110
Directivity (dB)	>46	>46
Source Match (dB)	>36	>46
Load Match (dB)	>46	>46
Reflection Frequency Tracking (dB)	±0.040	±0.002
Transmission Frequency Tracking (dB)	±0.070	±0.002
Isolation (dB)	>90	>90

### Extended W Band (WR-10) Waveguide (3740A-EW or 3741A-EW Modules):

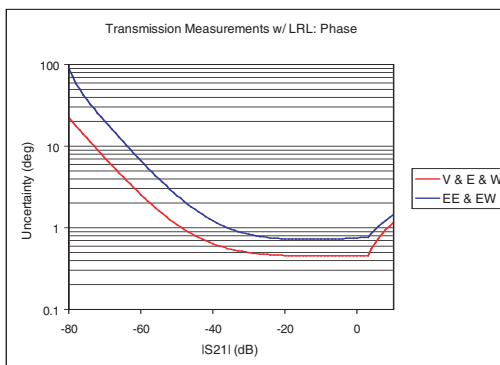
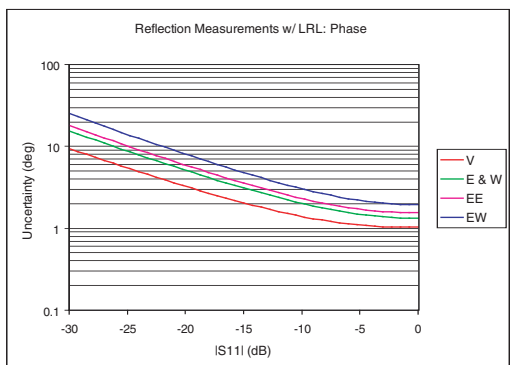
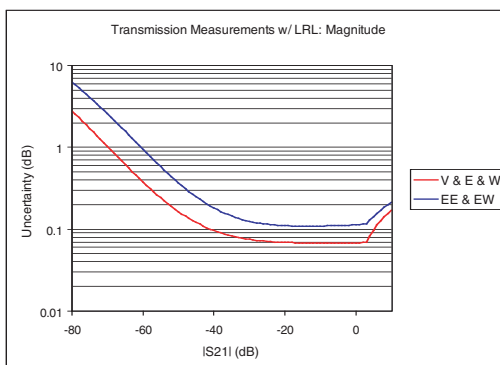
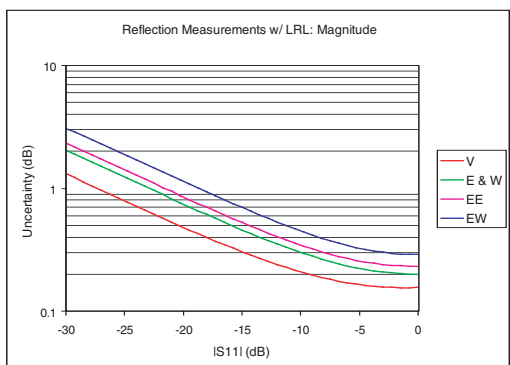
Calibration Method	Offset Short	LRL
Frequency Range (GHz)	65 to 110	65 to 110
Directivity (dB)	>40	>40
Source Match (dB)	>30	>40
Load Match (dB)	>40	>40
Reflection Frequency Tracking (dB)	±0.080	±0.006
Transmission Frequency Tracking (dB)	±0.100	±0.006
Isolation (dB)	>80	>80

# Measurement Uncertainty Curves for Waveguide

For the ME7808C Millimeter Wave VNA with 3740A and 3741A series millimeter wave modules (V, E, EE, W, and EW bands) using offset short calibration method with a sliding load. For reflection measurements,  $S_{21}$  is assumed to be zero. For transmission measurements,  $S_{11}$  and  $S_{22}$  are assumed to be zero.



For the ME7808C Millimeter Wave VNA with 3740A and 3741A series millimeter wave modules (V, E, EE, W, and EW bands) using LRL calibration method.



# Ordering Information

## ME7808C-Broadband VNA, Single Sweep Coverage from 40 MHz to 110 GHz

Consisting of the following:

- 37397D VNA, 40 MHz to 65 GHz (with Options 15V, 1A, and 2A)
- 3738A Broadband Test Set
- MG3692B Synthesized Source, 2 to 20 GHz (with Options 1B, 3) (2 each)
- 3742A-EW Millimeter Wave Modules (two are required)
- 66670-2, Multiplexing Coupler (left)
- 66671-2, Multiplexing Coupler (right)
- 806-158, V Male to V Male Interconnect Cables (four are required)
- 3700C3 Console
- ME7808C-SS020, On-site system assembly and verification

## ME7808C, Millimeter Wave VNA, Discrete Band Coverage to 500 GHz (with Waveguide Test Ports)

Consisting of the following:

- Any 372xxD or 373xxD VNA (with Options 1A and 2A)
- 3738A Broadband Test Set
- MG3692B Synthesized Source, 2 to 20 GHz (with options 1B, 3) (2 each)
- Any 3740A-x or 3741A-x Millimeter Wave Modules (two are required)\*
- 3700C3 Console

### Millimeter-Wave Modules\*

3740A-V	Transmission/Reflection Module, 50 to 75 GHz
3740A-E	Transmission/Reflection Module, 60 to 90 GHz
3740A-EE	Transmission/Reflection Module, 56 to 94 GHz
3740A-W	Transmission/Reflection Module, 75 to 110 GHz
3740A-EW	Transmission/Reflection Module, 65 to 110 GHz
3741A-V	Transmission Module, 50 to 75 GHz
3741A-E	Transmission Module, 60 to 90 GHz
3741A-EE	Transmission Module, 56 to 94 GHz
3741A-W	Transmission Module, 75 to 110 GHz
3741A-EW	Transmission Module, 65 to 110 GHz

\* Higher frequency bands to 500 GHz are supported with VNA2 Frequency Extension Modules from OML, Inc. ([www.oml-mmw.com](http://www.oml-mmw.com)).

## Calibration Kits

3656	W1 Calibration/Verification Kit
3655W	WR-10 Waveguide Calibration Kit
3655W-1	WR-10 Waveguide Calibration Kit with Sliding Terminations
3654C	V Connector Calibration Kit, no Sliding Terminations
3654C-1	V Connector Calibration Kit with Sliding Terminations
3652	K Connector Calibration Kit
3652-1	K Connector Calibration Kit with Sliding Terminations

## Test Port Cables

3671W1-50-1, W1 Female to W1 Male High Performance Cable, 10 cm (1 each)
3671W1-50-2, W1 Female to W1 Male High Performance Cable, 13 cm (1 each)
3671W1-50-3, W1 Female to W1 Male High Performance Cable, 16 cm (1 each)
3671V50-3, V Female to V Male High Performance Cable, 25 inches (2 each)
3671K50-1, K Female to K Male High Performance Cable, 25 inches (2 each)

## Adapters

Coaxial	
34WV50	W1 Male to V Male Adapter
34WVF50	W1 Male to V Female Adapter
34WV50	W1 Female to V Male Adapter
34WVVF50	W1 Female to V Female Adapter
33WW50	W1 Male to W1 Male Adapter
33WWF50	W1 Male to W1 Female Adapter
33WVVF50	W1 Female to W1 Female Adapter

## Waveguide to Coaxial

35WR10W	WR-10 to W1 Male Adapter
35WR10WF	WR-10 to W1 Female Adapter
SC7260	WR-12 to W1 Male Adapter
SC7442	WR-12 to W1 Female Adapter

## Power Meter and Sensor

ML2437A	Power Meter, Single Input
SC6230	MA2425B Thermal Sensor Characterized to 65 GHz



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