

# M1970 Series Harmonic Mixer

This manual provides documentation for use with:

X-Series Signal Analyzers (Option EXM)

**User's Guide** 



### **Notices**

© Agilent Technologies, Inc. 2011-2012

No part of this manual may be reproduced in any form or by any means (including electronic storage and retrieval or translation into a foreign language) without prior agreement and written consent from Agilent Technologies, Inc. as governed by United States and international copyright laws.

## Trademark Acknowledgements

Microsoft® is a U.S. registered trademark of Microsoft Corporation.

Windows® and MS Windows® are U.S. registered trademarks of Microsoft Corporation.

Adobe Acrobat® and Reader® are U.S. registered trademarks of Adobe Systems Incorporated.

 $Java^{TM}$  is a U.S. trademark of Sun Microsystems, Inc.

MATLAB® is a U.S. registered trademark of Math Works, Inc.

Norton  $Ghost^{TM}$  is a U.S. trademark of Symantec Corporation.

Wikipedia® is a registered trademark of the Wikimedia Foundation.

#### **Manual Part Number**

M1970-90001

Supersedes: April 2012

#### **Print Date**

August 2012

Printed in USA

Agilent Technologies Inc. 1400 Fountaingrove Parkway Santa Rosa, CA 95403

### Warranty

The material contained in this document is provided "as is," and is subject to being changed, without notice, in future editions. Further, to the maximum extent permitted by applicable law, Agilent disclaims all warranties, either express or implied, with regard to this manual and any information contained herein, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. Agilent shall not be liable for errors or for incidental or consequential damages in connection with the furnishing, use, or performance of this document or of any information contained herein. Should Agilent and the user have a separate written agreement with warranty terms covering the material in this document that conflict with these terms, the warranty terms in the separate agreement shall control.

## **Technology Licenses**

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

### **Restricted Rights Legend**

If software is for use in the performance of a U.S. Government prime contract or subcontract, Software is delivered and licensed

as "Commercial computer software" as defined in DFAR 252.227-7014 (June 1995), or as a "commercial item" as defined in FAR 2.101(a) or as "Restricted computer software" as defined in FAR 52.227-19 (June 1987) or any equivalent agency regulation or contract clause. Use, duplication or disclosure of Software is subject to Agilent Technologies' standard commercial license terms, and non-DOD Departments and Agencies of the U.S. Government will receive no greater than Restricted Rights as defined in FAR 52.227-19(c)(1-2) (June 1987). U.S. Government users will receive no greater than Limited Rights as defined in FAR 52.227-14 (June 1987) or DFAR 252.227-7015 (b)(2) (November 1995), as applicable in any technical data.

# **Safety Notices**

#### **CAUTION**

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

#### WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

# Warranty

This Agilent technologies instrument product is warranted against defects in material and workmanship for a period of one year from the date of shipment. During the warranty period, Agilent Technologies will, at its option, either repair or replace products that prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by Agilent Technologies. Buyer shall prepay shipping charges to Agilent Technologies, and Agilent Technologies shall pay shipping charges to return the product to Buyer. For products returned to Agilent Technologies from another country, Buyer shall pay all shipping charges, duties, and taxes.

## Where to Find the Latest Information

Documentation is updated periodically. For the latest information about these products, including instrument software upgrades, application information, and product information, browse to one of the following URLs, according to the name of your product:

http://www.agilent.com/find/smartmixers

http://www.agilent.com/find/pxa

To receive the latest updates by email, subscribe to Agilent Email Updates at the following URL:

http://www.agilent.com/find/emailupdates

Information on preventing analyzer damage can be found at:

http://www.agilent.com/find/tips

This page is intentionally left blank.

# 1 Overview

Initial Inspection 8	
Shipping Problems? 8	
Mixers Covered by This Guide 9	
Serial numbers 9	
Instrument Options 10	
Spectrum Analyzer Retrofit Requirements 11	
Compliance Notices and Regulatory Information 12	
Compliance with electromagnetic compatibility (EMC) 12	
Regulatory Markings 12	
Declaration of conformity 12	
2 Operation	
Operating Precautions 14	
RF input power 14	
LO input power 14	
Electrostatic discharge 14	
Connect only one mixer at a time 14	
Waveguide protection foam 14	
Provide mechanical support for the mixer 14	
Avoiding waveguide flange damage 15	
Mixer waveguide connections 15	
Using the M1970 Series Mixers with X-Series Signal Analyzers (Option EXM)	16
Equipment set up 16	
Operation 17	
Amplitude calibration 18	
LO adjustment 18	
Viewing the external mixer setup screen 19	
This page is intentionally left blank. 20	

# **3 Troubleshooting and Maintenance**

Troubleshooting 22

## **Contents**

Error Messages 24

Maintenance 25

Replaceable parts 25

Returning an M1970 Series Mixer for Service 26

Calling Agilent Technologies 26

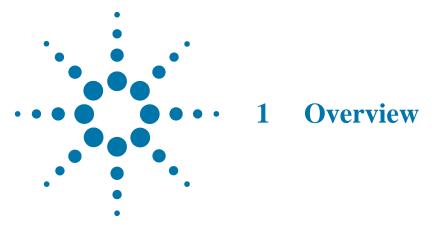
Locations for Agilent Technologies 26

# **4 M1970 Series Specifications**

General

28

Physical Characteristics 30
Environmental Specifications 31



The Agilent M1970V/E/W waveguide harmonic mixer is an un-preselected mixer that is used to extend the frequency range of the Agilent X-Series signal analyzer for high-frequency wireless and millimeter wave applications.

With emphasis on ease-of-use, the embedded features of the mixer will automatically transfer the conversion loss data from the mixer memory to the signal analyzer through the USB plug-and-play feature. It will also auto detect the mixer model and serial number to set the default frequency range.

Once the mixer is connected to the signal analyzer via both the SMA cable connection and the USB connection, the signal analyzer and mixer can perform an LO power adjustment that will compensate for SMA cable loss (cable length <3 meters) and optimize the LO power present at the mixer.

# **Initial Inspection**

Inspect the shipping container and the cushioning material for signs of stress. Retain the shipping materials for future use, as you may wish to ship the instrument to another location or to Agilent Technologies for service.

Item	Deliverable	Description
User's Guide		Provides instructions on usage, retrofit requirements, troubleshooting, specifications, and general information.
SMA cable		1 meter cable required to connect the mixer to the signal analyzer EXT MIXER connector.
USB cable	0	1.8 meter USB cable required to connect the mixer to the signal analyzer.
Calibration certificate		Provides information regarding the instrument calibration.
Waveguide screws	6	Screws required for connection to the waveguide (5 ea).
Ball driver		3/32 inch hex driver for installation of the waveguide screws.
Wrench	2	5/16 inch for SMA cable installation.

# **Shipping Problems?**

If the shipping materials are damaged or the contents of the container are incomplete:

- Contact the nearest Agilent Technologies office.
- Keep the shipping materials for the carrier's inspection.
- If you must return an EMI Receiver to Agilent Technologies, use the original (or comparable) shipping materials. See "Returning an M1970 Series Mixer for Service" on page 26.

# Mixers Covered by This Guide

- M1970V Option 001: 50 to 75 GHz waveguide harmonic mixer
- M1970V Option 002: 50 to 80 GHz waveguide harmonic mixer
- M1970E: 60 to 90 GHz waveguide harmonic mixer
- M1970W: 75 to 110 GHz waveguide harmonic mixer

## **Serial numbers**

A serial number label is attached to your mixer that shows the serial number and country of manufacture.



# **Instrument Options**

The following options are available:

<b>Option Number</b>	Description
M1970V/E/W-101	Cable, SMA, 1 meter, for LO/IF connection
M1970V/E/W-102	Cable, SMA, 3 meter, for LO/IF connection
M1970V/E/W-201	Cable, USB, 1.8 meter
M1970V/E/W-202	Cable, USB, 3 meter
M1970V/E/W-301	Jackstand

## **Spectrum Analyzer Retrofit Requirements**

N9030A Signal Analyzer (Requires Option EXM)

Instruments without Option EXM currently installed can be retrofitted to add the hardware and licensing.

To retrofit Option EXM:

N9030A Frequency Option	Serial Number Prefix		
Frequency Option	<my sg5138<="" th="" us=""><th>≥MY/US/SG5138</th></my>	≥MY/US/SG5138	
550, 544, or 543	N9030AK-EXM		
503, 508, 513, or 526	N9030AK-HL6	N9030AK-EXM	

#### **NOTE**

N9030A software revision must be A.08.52 or later for use with V or W band mixers. N9030A software revision must be A.11.00 or later for use with E band mixers.

### N9010A Signal Analyzer (Requires Option EXM)

Instruments without Option EXM currently installed can be retrofitted to add the hardware and licensing.

To retrofit Option EXM:

N9010A Frequency Option	Upgrade Kit
532 or 544	N9010AK-EXM
503, 507, 513, or 526	N.A.

#### NOTE

N9010A software revision must be A.10.52 or later for use with V or W band mixers. N9010A software revision must be A.11.00 or later for use with E band mixers.

# **Compliance Notices and Regulatory Information**

### **Compliance with electromagnetic compatibility (EMC)**

This product conforms with the protection requirements of EMC Directive 2004/108/EC for Electromagnetic Compatibility.

The product complies to the EMC Directive by assessment according to the IEC/EN61326-1 EMC standard.

In order to preserve the EMC performance of the product, any cable which becomes worn or damaged must be replaced with the same type and specifications.

## **Regulatory Markings**

Œ

The CE mark is a registered trademark of the European Community.

ICES/NMB-001

ICES/NMB-001 indicates that this ISM device complies with Canadian ICES-001.

Cet appareill ISM est conforme a la norme NMB-001 du Canada.

ISM GRP.1 CLASS A

This is the symbol of an Industrial Scientific and Medical Group 1 Class A product.



The C-Tick mark is a registered trademark of the Australian Spectrum Management Agency of Australia. This signifies compliance with the Australian EMC framework Regulations under the terms of the Radio communications Act of 1992.



This symbol indicates separate collection for electrical and electronic equipment mandated under EU law as of August 13, 2005. All electric and electronic equipment are required to be separated from normal waste for disposal (Reference WEEE Directive 2002/96/EC).

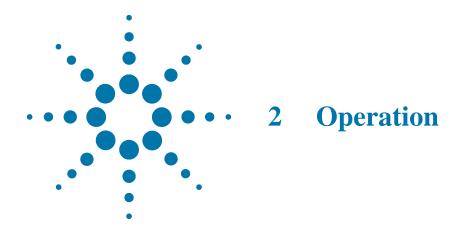


Indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.

## **Declaration of conformity**

A copy of the Manufacturer's European Declaration of Conformity for this mixer can be obtained by contacting your local Agilent Technologies sales representative, or copies can be downloaded from the Agilent Technologies, Inc. web site at:

http://www.agilent-pra.com/doc/search.htm



# **Operating Precautions**

#### WARNING

Do not exceed the maximum ratings listed below or permanent damage to the mixer will result.

### RF input power

Use the following parameters:

CW No greater than 20 dBm

Peak Pulse No greater than 24 dBm at  $<1 \mu s$ 

See the gain compression values for each model mixer. Use an appropriate waveguide attenuator if the output power of the unit under test exceeds the gain compression value.

## LO input power

LO input power is set by the internal signal analyzer LO alignment. However, the LO input must not exceed 20 dBm.

Always use a high quality low loss SMA cable since this will allow the longest cable length, and prevent damage to the mixer SMA female connector.

### Electrostatic discharge

When installing the mixer, always connect the LO/IF SMA cable to the signal analyzer BEFORE connecting to the mixer. This will minimize the danger of an electrostatic discharge damaging the mixer diodes.

### Connect only one mixer at a time

The automatic LO adjustment and mixer ID process assumes only one mixer is connected to the analyzer's USB and SMA EXT MIXER connections.

### Waveguide protection foam

Do not remove, displace or damage the nonconductive foam installed in the open end of the waveguide. This foam keeps small objects from entering the waveguide.

## Provide mechanical support for the mixer

Assure the mixer body is properly supported so it does not present any stress on the waveguide connection. Instrument option 301 provides a jackstand that allows a stable support and height adjustment.

## Avoiding waveguide flange damage

Install the waveguide flange cap whenever the mixer is not connected to a device under test. This will protect the waveguide flange mating surface.

## Mixer waveguide connections

Assure the shoulder of the mixer waveguide flange is properly aligned with the flange of the device under test. To ensure proper mating, it is important to tighten all screws equally. To do this, tighten opposed screws in pairs by a small amount until all are snug. Final torque must not exceed 7 in pounds.

# Using the M1970 Series Mixers with X-Series Signal Analyzers (Option EXM)

Refer to "Spectrum Analyzer Retrofit Requirements" on page 11 for configuration requirement.

The following examples explain how to connect the external mixers to the signal analyzer, and how to use the signal-identification functions.

For additional information regarding use with a particular X-Series analyzer, refer to that analyzer's User's and Programmer's Reference Guide.

## **Equipment set up**

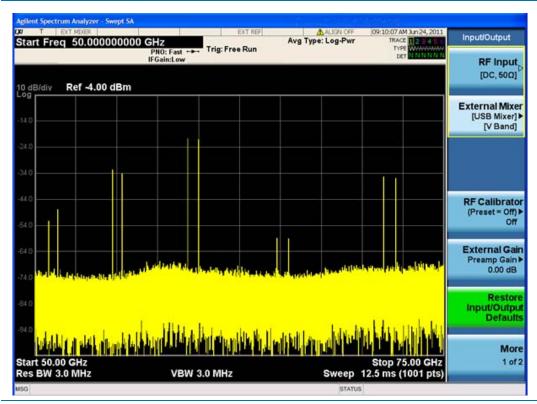
Step	Action	Notes
SMA connection	a. Connect an SMA cable from the mixer to the spectrum analyzer EXT MIXER front panel SMA.	The torque for the SMA cables and adapters should not exceed 8 in-lbs.  The LO/IF connection between the mixer and the signal analyzer must be in place before the USB cable from the mixer is connected. Connecting the USB cable automatically triggers the LO adjustment, and if the LO/IF cable is not connected the adjustment will not complete and an error will occur.
USB connection	a. Connect a USB cable from the mixer to the spectrum analyzer.	When a connection is made, the green LED on the mixer lights up indicating that the mixer has power and the processor inside the mixer is running. The spectrum analyzer is automatically switched to external mixing mode, and the mixer model number and mixer option are used to set the start and stop frequencies for the mixing band.



The spectrum analyzer performs an LO alignment using a detector in the mixer to set the LO Power. During the alignment the yellow Busy LED turns on. Once the alignment completes, the mixer is ready to make calibrated measurements since the conversion loss values stored in the mixer are automatically loaded to the signal analyzer.

## **Operation**

Step	Action	Notes
Tune the analyzer	a. Apply a signal to the mixer input.	
	b. Press FREQ Channel and enter a center frequency or a start and stop frequency	Multiple responses may appear on screen. Most of these responses are images or multiples of the mixing process and not true signals.

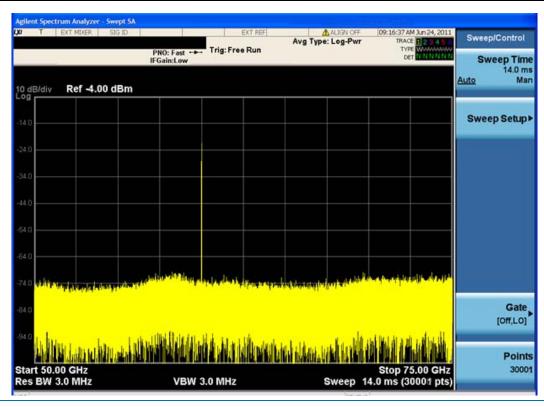


Turn on the signal identification function.

a. Press Input/Output,
 External Mixer, Signal
 ID to On, Signal ID
 Mode, Image Suppress.

This enables you to identify true signals from images and harmonics. Refer to the following graphic.

Using the M1970 Series Mixers with X-Series Signal Analyzers (Option EXM)



Step Action Notes

With wide spans, increasing the number of sweep points may improve the effectiveness of image suppressing. a. Press Sweep/Control,Points, enter the number,and press Enter.

## **Amplitude calibration**

The M1970 Series mixers automatically download a conversion loss file to the signal analyzer, and this conversion loss table is used to correct the measured amplitude. It is not possible to view or edit the conversion loss file. The Certificate of Calibration that is provided with each mixer lists the conversion loss measured at the factory.

## LO adjustment

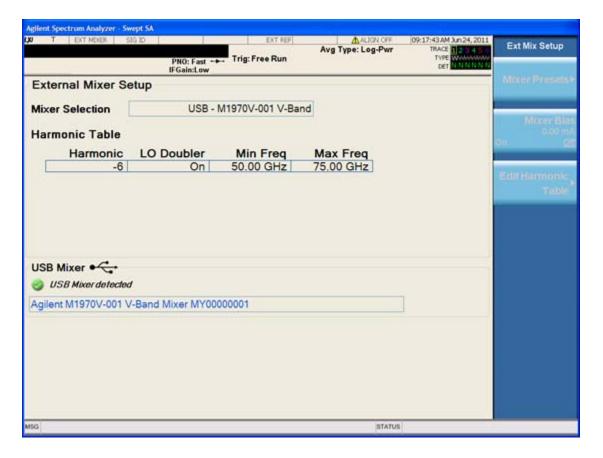
The LO adjustment will run each time the USB connection is made, and if the signal analyzer Alignments are set to Normal, the LO adjustment will be performed based on time and temperature rules similar to the other signal analyzer alignments. Both the mixer and the spectrum analyzer temperature sensors are monitored by the alignment algorithm. If the Alignment is set to OFF, the LO Alignment will not be performed based on time and temperature, and it will be necessary for the user to determine when to perform alignments.

To manually trigger an LO alignment from the front panel, press **System**, **Alignments**, **Align Now**, **External Mixer**.

## Viewing the external mixer setup screen

The mixer setup screen contains information such as mixer serial and model number, harmonic mixing used, and the status of the mixer connection. When the USB mixer is connected, the Mixer Preset, Mixer Bias and Edit Harmonic Table keys are grayed out since these keys do not apply. However, if you unplug the USB cable, the Mixer Presets key will become functional and the connection status will show USB Mixer not connected.

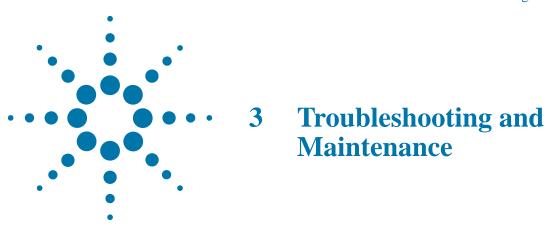
To view the setup screen, press Input /Output, External Mixer, Ext Mix Setup.



## Operation

**Using the M1970 Series Mixers with X-Series Signal Analyzers (Option EXM)** 

This page is intentionally left blank.



**CAUTION** 

The M1970 Series mixers are not field repairable, and require return to Agilent for both repair and calibration. Do not attempt to open the mixer enclosure.

# **Troubleshooting**

Problem	Possible Cause/Troubleshooting Process
Green Active LED does not turn on when mixer is connected to spectrum analyzer through USB cable	Spectrum analyzer not providing power. Faulty or loose USB cable. Faulty mixer
	<b>Troubleshooting:</b> Connect another USB device to the signal analyzer
Red Error LED on mixer lights up (mixer fails the LO alignment routine)	The SMA cable must be attached before the USB cable is plugged in. If the SMA cable was not plugged in first, assure that the SMA cable is connected properly, then disconnect and reconnect the USB cable.
	The SMA cable is damaged or has too much loss (cable length is too long). Replace the SMA cable with one that is < 3 meters.
	Faulty mixer.
	The signal analyzer LO output is faulty:
	To test the LO output, remove the SMA cable from the Ext Mixer connector, and unplug the USB cable.
	1. Press Input/Output, External Mixer, Ext Mix Setup, Mixer Presets
	2. Select Single Harmonic w/doubler, select V-Band
	3. Press Freq key, Center Frequency, 60 GHz. Then press Span, Zero Span
	4. Connect a spectrum analyzer capable of measuring a 13 GHz signal to the Ext Mixer connector
	5. Tune the measuring spectrum analyzer to 10.0537 GHz center frequency, and the LO signal level at the Ext Mixer connector should be +15 dBm +/- 2

dB

Problem	Possible Cause/Troubleshooting Process
Yellow Busy LED does not come on when USB cable is attached and LO Align does not start	Assure that only one mixer is connected. Unplug any other mixer USB connection, then on the desired mixer, remove the USB cable and re-insert the USB cable to initiate the LO adjustment.

# **Error Messages**

The following is a list of error messages that may appear on the signal analyzer screen.

Error Message	Possible Cause/Troubleshooting Process
LO Alignment Failure	The LO power is too low to complete the LO adjustment.
	LO/IF cable not connected at time of LO adjustment routine.

# Maintenance

Preventive maintenance includes covering the wave guide with the waveguide cap when the mixer is not in use, and avoiding rough handling that could damage the SMA and USB connectors.

Do not remove the foam installed in the open end of the waveguide. The foam prevents small objects from entering the waveguide.

## Replaceable parts

Part Number	Description
1390-0671	Socket head cap screw, captive, 4-40 thread, 0.29 inches long (waveguide flange connecting screw for V and W band)
0401-0227	Waveguide cap for V and W band

# Returning an M1970 Series Mixer for Service

## **Calling Agilent Technologies**

Agilent Technologies has offices around the world to provide you with complete support for your mixer. To obtain servicing information or to order replacement parts, contact the nearest Agilent Technologies office listed below. In any correspondence or telephone conversations, refer to your mixer by its product number and full serial number.

## **Locations for Agilent Technologies**

Online assistance: http://www.agilent.com/find/assist

**Americas** 

Canada Latin America United States 1 877 894 4414 (305) 269 7500 1 800 829 4444

**Asia Pacific** 

Australia China Hong Kong 1 800 629 485 800 810 0189 800 938 693

India Japan Korea

1 800 112 929 0 120 (421) 345 080 769 0800

Malaysia Singapore Taiwan 1 800 888 848 1 800 375 8100 0800 047 866

Thailand 1 800226 008

**Europe & Middle East** 

 Austria
 Belgium
 Denmark

 43 (0) 1 360 277 1571
 32 (0) 2 404 93 40
 45 70 13 15 15

Finland France Germany

358 (0) 10 855 2100 0825 010 700\* 49 (0) 7031 464 6333

\*0.125 Euros/minute

Ireland Israel Italy

1890 924 204 972-3-9288-504/544 39 02 92 60 8484

 Netherlands
 Spain
 Sweden

 31 (0) 20 547 2111
 34 (91) 631 3300
 0200-88 22 55

Switzerland United Kingdom 0800 80 53 53 44 (0) 118 9276201

Other European Countries: http://www.agilent.com/find/contactus



Specifications describe warranted performance over the temperature range 0 to +55 °C after one hour of continuous operation unless otherwise noted.

Nominal values indicate expected performance, or describe product performance that is useful in the application of the product, but is not covered by the product warranty.

# General

Description	Specifications	<b>Supplemental Information</b>
Calibration Cycle	1 year	

Description	Specifications	<b>Supplemental Information</b>
LO Amplitude		LO requirements provided by compatible signal analyzers.  Maximum cable loss 10 dB nominal.
USB Requirements		5 V nominal, 500 mA maximum
Maximum CW RF Input Level Maximum RF Peak Pulse Power	20 dBm (100 mW) 24 dBm with <1 µs pulse (avg power: 20 dBm)	
Maximum LO Power	20 dBm	
IF Bandwidth <sup>a</sup>		200 MHz to 500 MHz
EMC	Complies with European EMC Directive 2004/108/EC	
	<ul> <li>IEC/EN 61326-2-1</li> <li>CISPR Pub 11 Group 1, class B</li> <li>AS/NZS CISPR 11</li> <li>ICES/NMB-001     This ISM device complies with Canadian ICES-001.</li> <li>Cet appareil ISM est conforme a la norme NMB-001 du Canada.</li> </ul>	
IF/LO Connector		SMA Female

a. The M1970 series mixers are designed to work with the PXA and EXA IF frequencies. With Option CR3, other IF frequencies can be supported for special applications.

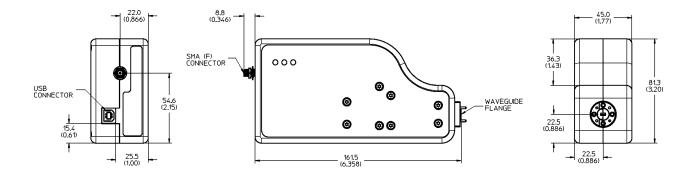
Description	M1970V	M1970V Opt 002	M1970E	M1970W
RF Frequency Range	50 to 75 GHz	50 to 80 GHz	60 to 90 GHz	75 to 110 GHz
LO Harmonic Number <sup>a</sup>	-6	-6	−6 and −8 <sup>b</sup>	-8
LO Frequency Range <sup>c</sup> (GHz)	8.39 to 12.56	8.39 to 13.39	9.42 to 12.56	9.42 to 13.80
Maximum Conversion	23 dB	23 dB	27 dB	25 dB
Loss <sup>d</sup>				
Calibration Accuracy <sup>e</sup>	±2.2 dB (nominal)	±2.2 dB (nominal)	±2.2 dB (nominal)	±2.2 dB (nominal)
Odd Order Mixing Product Suppression	15 dB (nominal)	15 dB (nominal)	15 dB (nominal)	15 dB (nominal)
Gain Compression Level (<1 dB)	0 dBm (nominal)	0 dBm (nominal)	0 dBm (nominal)	0 dBm (nominal)
Input SWR	<2.6:1 (nominal)	<2.6:1 (nominal)	<2.6:1 (nominal)	<2.6:1 (nominal)
Noise Figure <sup>f</sup>	34 dB (nominal)	34 dB (nominal)	38 dB (nominal)	36 dB (nominal)
System Displayed Average Noise Level (DANL) at 1	-141 dBm (nominal)	-141 dBm (nominal)	-136 dBm (nominal)	-138 dBm (nominal)
Hz resolution bandwidth <sup>g</sup>				

- a. "-" signifies that the LO frequency times the LO harmonic number is higher than the RF input frequency.  $LO \times N = RF + IF$ .
- b. Harmonic number is dependent on the start and stop frequencies. Harmonic –6 is used from 60 GHz to 78 GHz and harmonic –8 is used above 77.5 GHz.
- c. Exact LO frequency is dependent on the IF path setting of the signal analyzer.
- d. Conversion loss values shown include the effect of an internal IF amplifier.
- e. Calibration accuracy is the difference between the conversion loss factors measured and programmed into the M1970 at the factory and the actual conversion loss of the mixer experienced when used with an X-Series signal analyzer with option EXM. The values shown include test system uncertainty, interpolation error, and the effects of the difference between the X-Series environment and the factory calibration environment. The system amplitude accuracy is worse than this M1970-only calibration accuracy due to SWR effects between the M1970 and the X-Series IF input, and due to Gain Accuracy at the IF Input in Option EXM of the X-Series analyzer used.
- f. The values shown are the noise figures of the M1970 alone. They include effects of the internal IF amplifier. The system noise figure when connected to an X-Series signal analyzer will be higher, by nominally 0.8 dB.
- g. System DANL includes the effect of an X-Series analyzer and cable as well as the M1970. DANL is defined with log-scale averaging according to industry conventions. The noise density is about 2.25 dB higher than DANL.

# **Physical Characteristics**

Does not include SMA connector.

Model	Flange	Weight	Height	Width	Length
M1970V (001)	UG-385/U WR-15	0.70 kg (1.54 lbs)	45.0 mm (1.7 in)	81.3 mm (3.2 in)	161.5 mm (6.4 in)
M1970V (002)	UG-385/U WR-15	0.70 kg (1.54 lbs)	45.0 mm (1.7 in)	81.3 mm (3.2 in)	161.5 mm (6.4 in)
M1970E	WR-12	0.70 kg (1.54 lbs)	45.0 mm (1.7 in)	81.3 mm (3.2 in)	161.5 mm (6.4 in)
M1970W	UG-387/U- M WR-10	0.70 kg (1.54 lbs)	45.0 mm (1.7 in)	81.3 mm (3.2 in)	161.5 mm (6.4 in)



# **Environmental Specifications**

Agilent M1970V/E/W Series Harmonic Mixers are designed to fully comply with Agilent Technologies' product operating environment specifications. The following are the summarized environmental specifications for these products.

Description	Specifications	<b>Supplemental Information</b>
Temperature Range		
Operating	0 to 55°C	
Storage	−40 to +70°C	
Relative Humidity		
Operating	95% RH at 40°C (non-condensing)	
Shock		
End use handling shock	Half sine wave form	
Transportation shock	30g	
Vibration		
Operating	0.21g rms	
Survival	2.09g rms	
Altitude		
Operating	<4,572 meters (15,000 feet)	
ESD immunity		
Direct discharge	6.0 kV per IEC 61000-4-2	
Air discharge	15 kV per IEC 61000-4-2	