

Keysight Technologies

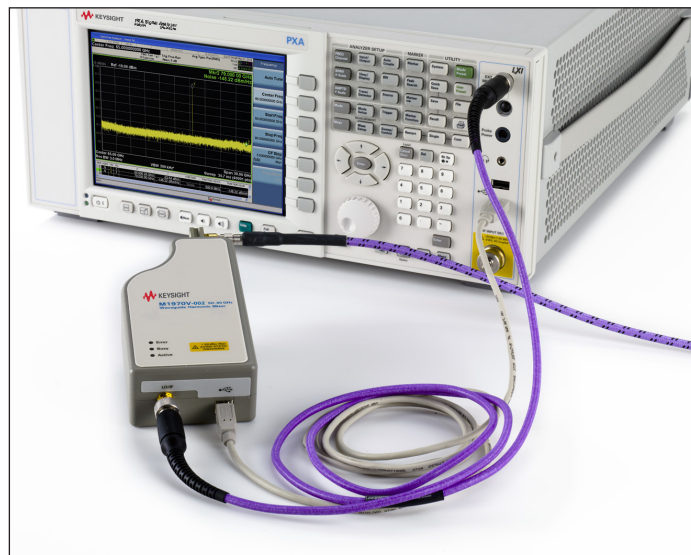
Waveguide Harmonic Mixers

M1970E 60 to 90 GHz

M1970V 50 to 75/80 GHz

M1970W 75 to 110 GHz

Technical Overview



Introduction

The Keysight Technologies, Inc. M1970E/V/W waveguide harmonic mixers are un-preselected mixers designed to extend the frequency range of Keysight's high-performance signal analyzers (N9040B UXA, N9030A PXA, N9020A MXA, and N9010A EXA) for millimeter-wave applications up to 110 GHz.

Embedded with smart features, the smart mixers provide the most efficient test setup and measurement accuracy that's needed in demanding mixer application test environment. These smart mixers use a simple USB plug-and-play connection that can automatically configure the UXA, PXA, MXA and EXA to detect the specific mixer connected, then download conversion loss data and automatically compensate for local oscillator path loss. Therefore, it greatly shortens the overall start up operation and technically improves the overall DANL and TOI of your test systems with excellent conversion loss and amplitude accuracy.

Break free from conventional harmonic mixing test methods and discover the smarter solution using the M1970E/V/W waveguide harmonic mixers and the N9040B UXA, N9030A PXA, N9020A MXA and N9010A EXA signal analyzer solutions.

Go *smart* with harmonic mixing

Most efficient test setup with excellent performance when combined with Keysight's N9040B UXA, N9030A PXA, N9020A MXA and N9010A EXA signal analyzers

Smart Features:

- Automatic amplitude correction and transfer of conversion loss data through USB plug and play features
- Automatic LO amplitude adjustment to compensate for cable loss (up to 3 m or 10 dB loss)
- Auto-detect mixer model/serial number when used with the N9040B UXA, N9030A PXA, N9020A MXA and N9010A EXA signal analyzers:
 - Automatic setting of default frequency range and LO harmonic numbers
 - Automatic LO alignment at start up
- Excellent conversion loss of 27 dB maximum and excellent amplitude calibration accuracy

Specifications

Specifications refer to the performance standards or limits against which the M1970E/V/W waveguide harmonic mixers are tested.

Typical characteristics are included for additional information only and they are not specifications. These are denoted as “typical”, “nominal” or “approximate” and are printed in italic.

Specifications subject to change.

Specification	M1970E	M1970V Option 001	M1970V Option 002	M1970W
Frequency range	60 to 90 GHz	50 to 75 GHz	50 to 80 GHz	75 to 110 GHz
LO harmonic number ¹	-6/-8		-6	-8
LO input frequency range ²	9.42 to 12.56 GHz	8.39 to 12.56 GHz	8.39 to 13.39 GHz	9.42 to 13.80 GHz
Maximum conversion loss ³	27 dB		23 dB	25 dB
Calibration accuracy (<i>nominal</i>) ⁴			± 2.2 dB	
Maximum LO power			20 dBm	
Maximum CW RF input level			20 dBm (100 mW)	
Maximum RF peak pulse power		24 dBm with < 1 µsec pulse (average power: + 20 dBm)		
Odd order mixing product suppression (<i>nominal</i>)			15 dB	
Gain compression level (< 1dB) (<i>nominal</i>)			0 dBm	
Input SWR (<i>nominal</i>)			2.6	
Noise figure (<i>nominal</i>) ⁵	38 dB		34 dB	36 dB
System displayed average noise level (DANL) at 1 Hz resolution bandwidth (<i>nominal</i>) ⁶	-136 dBm		-141 dBm	-138 dBm

Supplemental characteristic	
CE data storage method	EEPROM
Automatic amplitude correction and transfer of conversion loss data	YES
Automatic LO amplitude adjustment	YES
Automatic run calibration when time and temperature changes	YES
LO amplitude	LO requirement provided by compatible signal analyzers. Maximum cable loss 10 dB nominal.
USB requirements	5 V nominal, 500 mA maximum
IF bandwidth ⁷	200 to 500 MHz
IF/LO connector	SMA (f)

1. “-” signifies that the LO frequency times the LO harmonic number is higher than the RF input frequency. $LO \times N = RF + IF$.
2. Exact LO frequency is dependent on the IF path setting of the signal analyzer.
3. Conversion loss value shown includes the effect of an internal IF amplifier.
4. Calibration accuracy is the difference between the conversion loss factors measured and programmed into the M1970E/V/W 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 M1970E/V/W only calibration accuracy due to SWR effects between the M1970E/V/W and the X-series IF input, and due to Gain Accuracy at the IF input in Option EXM of the X-series analyzer used.
5. The values shown are the noise figures of the M1970E/V/W alone. They include effects of the internal IF amplifier. The system noise figure when connected to an X-series analyzer will be higher, by nominally 0.8 dB.
6. System DANL includes the effect of an X-series analyzer and cable as well as the M1970E/V/W. DANL is defined with log-scale averaging according to the industry conventions. The noise density is approximately 2.25 dB higher than DANL.
7. The M1970E/V/W are designed to work with the UXA/PXA/MXA/EXA IF frequencies. With PXA Option CR3, other IF frequencies can be supported for special applications.

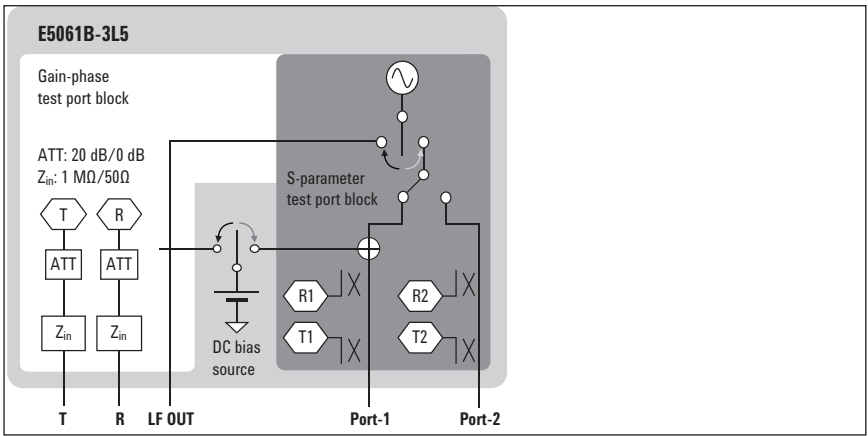


Figure 1. Keysight M1970V conversion efficiency versus frequency (typical)

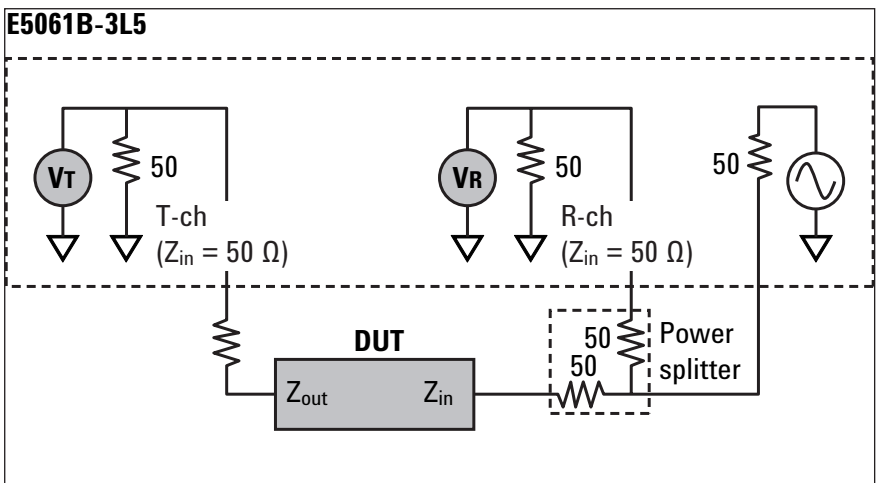


Figure 2. Keysight M1970W conversion efficiency versus frequency (typical)

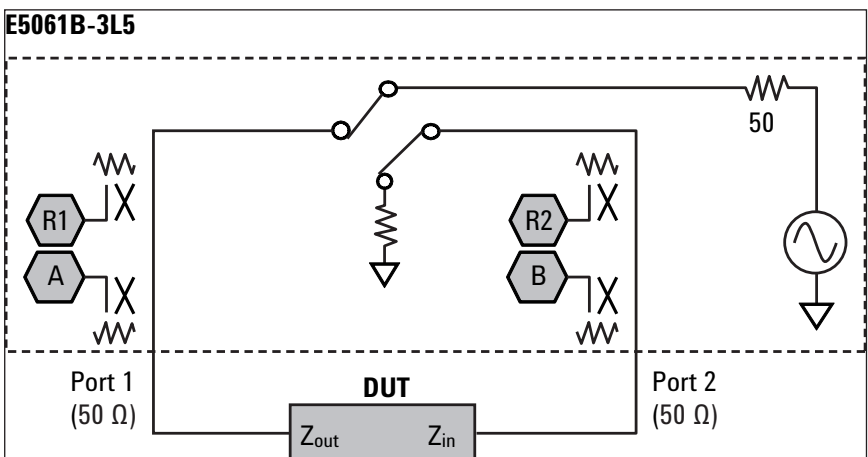


Figure 3. Keysight M1970E conversion efficiency versus frequency (typical)

Environmental Specifications

Keysight M1970E/V/W waveguide harmonic mixers are designed to fully comply with Keysight Technologies' product operating environmental specifications. The following are the summarized environmental specifications for these products.

Temperature range

Operating	0 to 55 °C
Storage	-40 to 70 °C

Relative humidity

Operating	95 % RH at 40 °C (non-condensing)
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Shock

End use handling shock	Half sine wave form
Transportation shock	30 g

Vibration

Operating	0.21 g rms
Survival	2.09 g rms

Altitude

Operating	< 4,572 meters (15,000 feet)
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ESD immunity

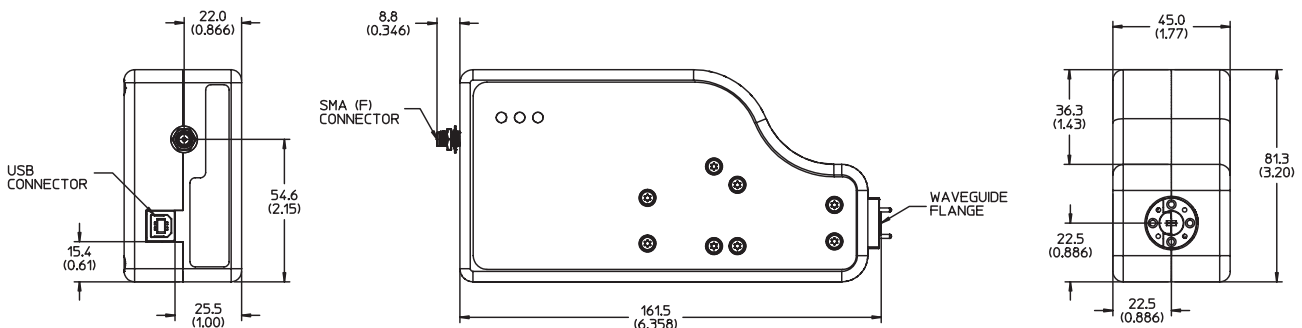
Direct discharge	6.0 kV per IEC 61000-4-2
Air discharge	15 kV per IEC 61000-4-2

Mechanical dimension*

Does not include SMA connector

Model	Flange	Weight	Height	Width	Length
M1970E	UG-387/WR-12				
M1970V (Option 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 (Option 002)					
M1970W	UG-387/U-M WR-10				

*Dimensions are in mm (inches) nominal, unless otherwise specified.



Mechanical dimension for M1970E/V/W

Ordering Information

M1970E 60 to 90 GHz waveguide harmonic mixer

M1970V

Option 001 50 to 75 GHz waveguide harmonic mixer

Option 002 50 to 80 GHz waveguide harmonic mixer

M1970W 75 to 110 GHz waveguide harmonic mixer

LO cable options (optional)¹

Option 101 1 meter LO cable

Option 102 3 meter LO cable

USB cable options (optional)¹

Option 201 1.8 meter USB cable

Option 202 3 meter USB cable

Jackstand

Option 301² Standard jackstand for mixer

Recommended signal analyzers

N9040B UXA signal analyzer, 3 Hz to 26.5 GHz

www.keysight.com/find/uxa

N9030A PXA series signal analyzer, 3 Hz to 50 GHz

www.keysight.com/find/pxa

N9020A MXA series signal analyzer, 10 Hz to 26.5 GHz

www.keysight.com/find/mxa

N9010A EXA series signal analyzer, 10 Hz to 44 GHz

www.keysight.com/find/exa

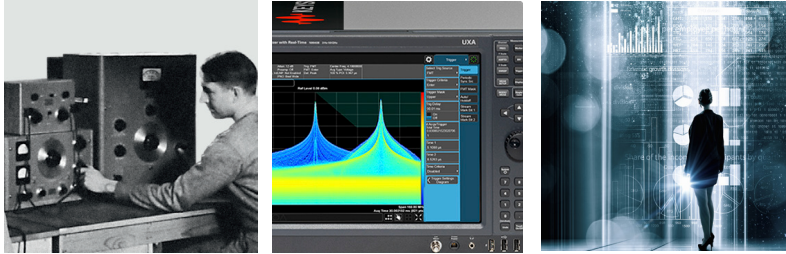
Note:

1. The cable options is defaulted to LO (1 meter) and USB (1.8 meter) if no selection is made.
2. Option 301 is also orderable as standalone products.

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