



# COAXIAL I/Q Mixer

## ZMIQ-653H-E+

50Ω LO Power +18 dBm 18 to 65 GHz 1.85mm Female/2.92mm Female

### THE BIG DEAL

- Super Wideband RF & LO, 18 to 65 GHz
- Excellent IF bandwidth, DC to 20 GHz
- High L-R Isolation, 42 dB typ.
- Excellent Input IP3, +25 dBm typ.
- Usable as Up & Down Converter

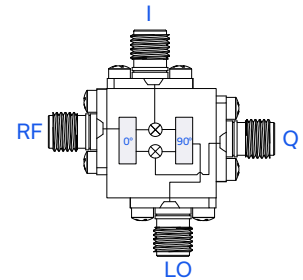


Generic photo used for illustration purposes only

### APPLICATIONS

- 5G mmW and Back Haul Radio
- Test and Measurement
- Satellite Communications
- Radar, EW and ESM Defense Systems

### FUNCTIONAL DIAGRAM



### PRODUCT OVERVIEW

Mini-Circuits' ZMIQ-653H-E+ coaxial frequency mixer provides an RF and LO frequency range from 18 to 65 GHz and an IF frequency range from DC to 20 GHz. This device is usable as I and Q modulator/demodulator, image reject mixer and single-sideband mixer. The mixer comes housed in a rugged, 1.85 mm / 2.92 mm connectorized housing suitable for assembled systems and lab use.

The ZMIQ-653H-E+ contains Mini-Circuits' [SMIQ-653H-DG+](#) and is suitable for performance evaluation of the I/Q mixer die.

### KEY FEATURES

Feature	Advantages
Wide bandwidth, 18 to 65 GHz	Useful in wideband systems and narrowband systems; covers wide variety of standard bands including K, Ka and V band.
Wide I/Q bandwidth, DC to 20 GHz	Usable in first and second down converter applications. Can be used as IQ modulator / demodulator or with external 90 deg hybrids for single sideband up conversion or image reject down conversion.*
High Isolation, L-R, 42 dB typ.	Preserves signal integrity from input to output and reduces undesired signal responses that can interfere with system performance.
High IP3, +25 dBm typ.	Minimizes third order intermodulation distortion and enables high-dynamic range.
1.85mm-F connectorized housing for RF & LO ports and 2.92mm-F for I & Q ports	Ideal for assembled systems and lab use. High-frequency connector mates with 1.85mm and 2.4mm.

\* See application configuration on page #7.





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### ELECTRICAL SPECIFICATIONS<sup>1</sup> AT +25°C AND LO POWER AT +18dBm<sup>2</sup>

Parameter	Frequency (GHz)	Min.	Typ.	Max.	Units
Frequency Range, RF		18	—	65	GHz
Frequency Range, LO		18	—	65	GHz
Frequency Range, I/Q		DC	—	20	GHz
Conversion Loss <sup>3</sup>	18 - 65	—	14	19	dB
LO to RF Isolation	18 - 65	—	42	—	dB
LO to I/Q Isolation	18 - 65	—	33	—	dB
RF Input at 1 dB Compression	18 - 65	—	+10	—	dBm
Single Sideband Rejection <sup>4</sup>	18 - 65	—	24	—	dBc
Amplitude Unbalance	18 - 65	—	0.6	—	dB
Phase Unbalance (relative to 90°)	18 - 65	—	5	—	deg
Input IP3	18 - 65	—	+25	—	dBm

1. Performance measured as a Down Converter unless otherwise specified.
2. LO power range: +17 to +19 dBm. See data plots for performance variation over LO power.
3. Conversion Loss at 200 MHz IF, measured at I and Q ports. Increases with IF frequency.  
Conversion Loss= RF Power (dBm)-Power at I/Q-Port (dBm)
4. Up Converter, I/Q=200 MHz, measured use external I/Q quadrature hybrid ([ADQ-32+](#)).

### ABSOLUTE MAXIMUM RATINGS<sup>5</sup>

Parameter	Ratings
Operating Temperature	-40°C to +85°C
Storage Temperature	-55°C to +100°C
RF/LO Power	24 dBm
DC Current	32 mA

5. Permanent damage may occur if any of these limits are exceeded.





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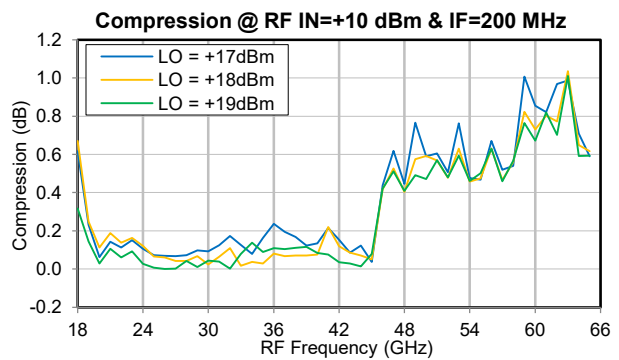
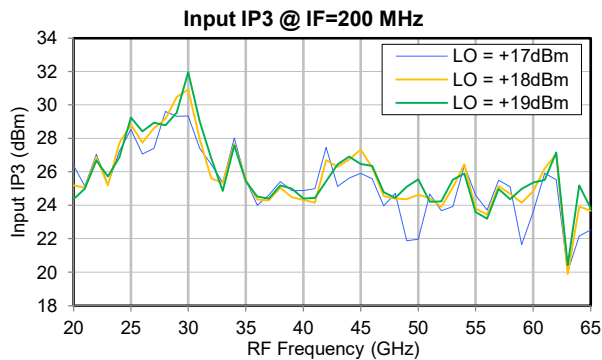
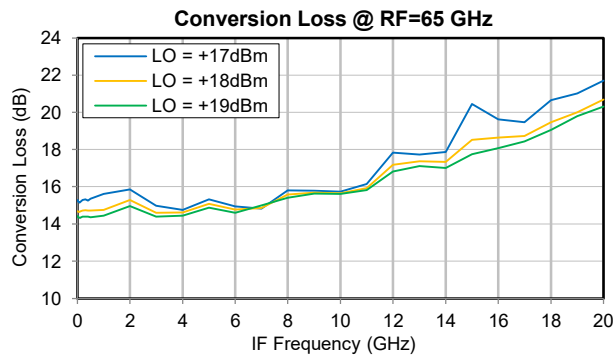
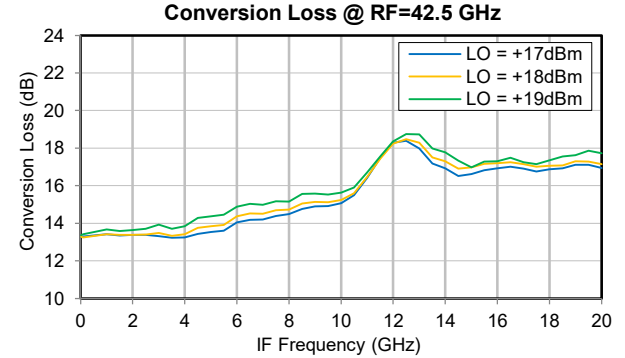
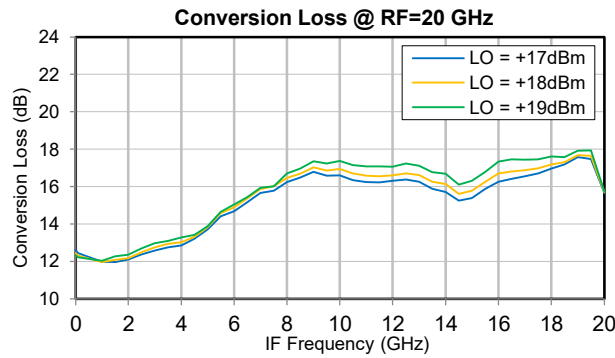
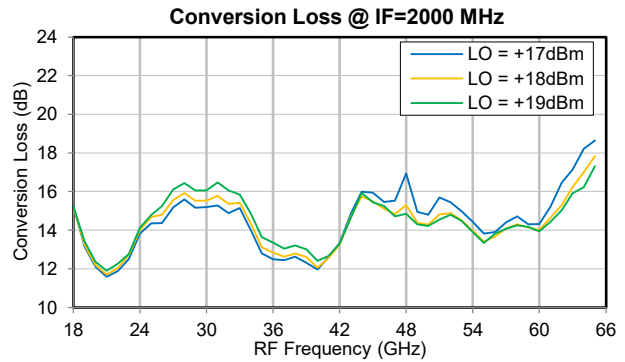
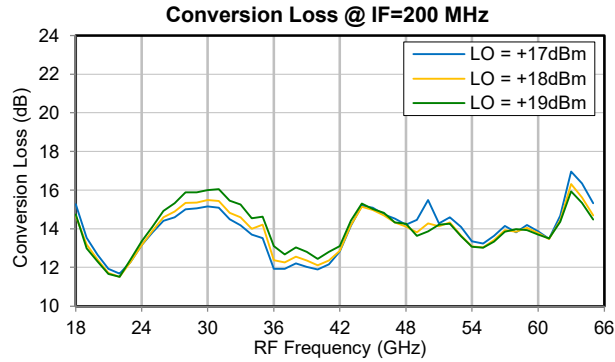
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### TYPICAL PERFORMANCE CHARTS





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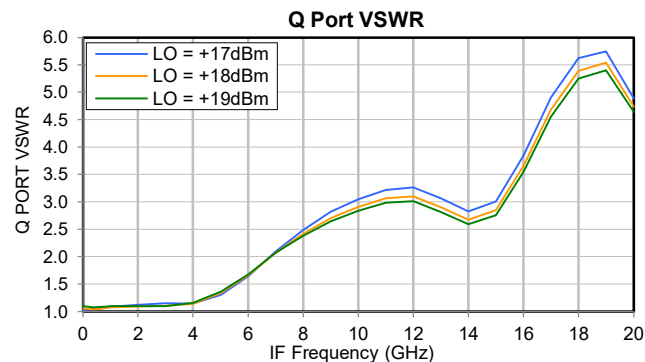
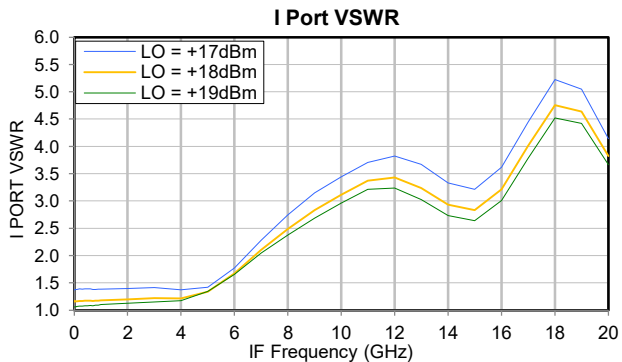
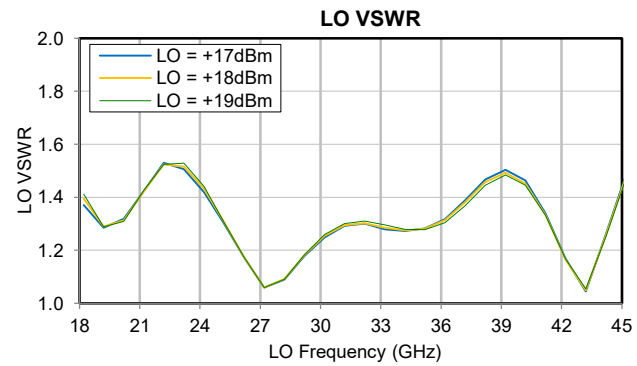
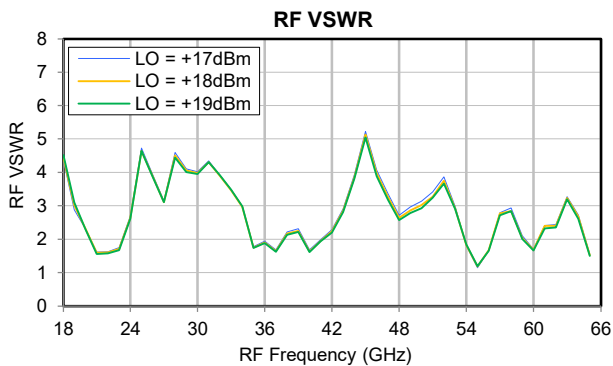
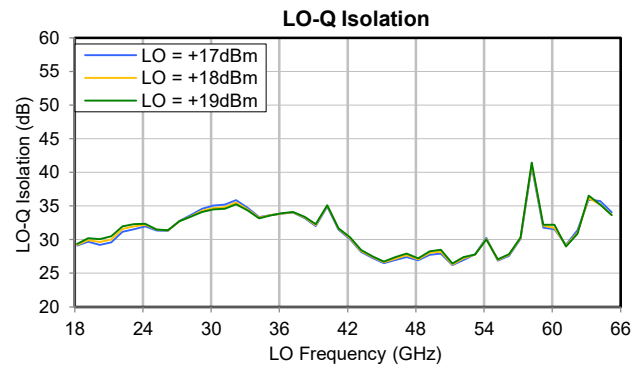
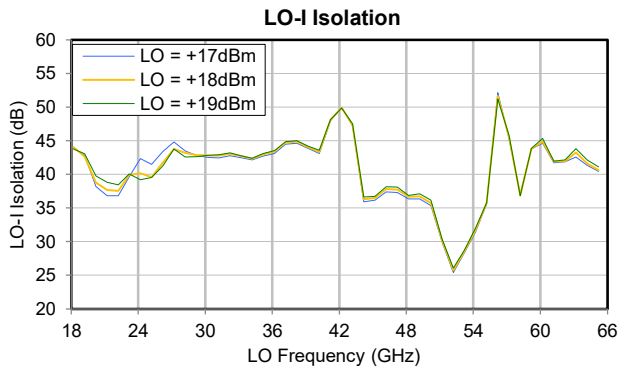
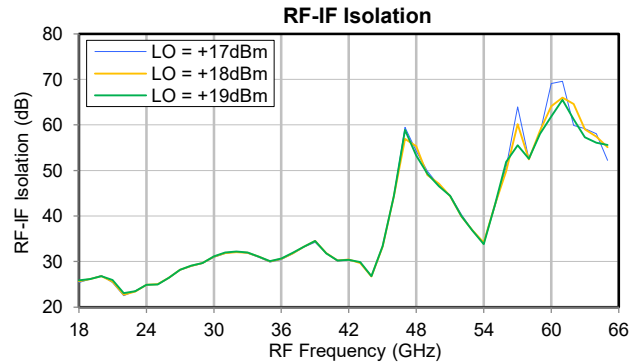
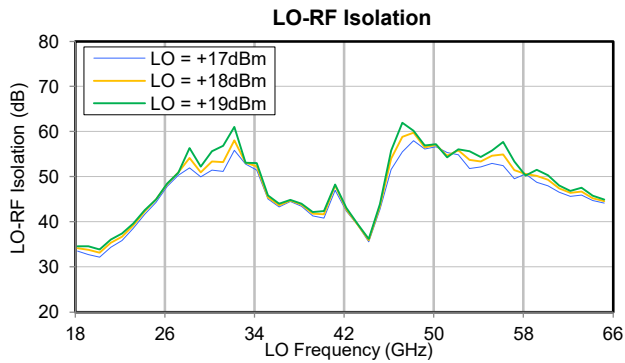
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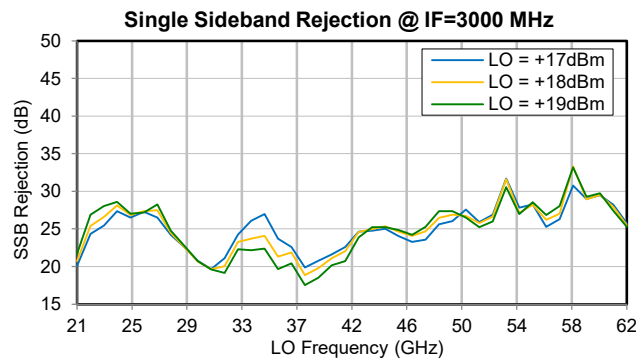
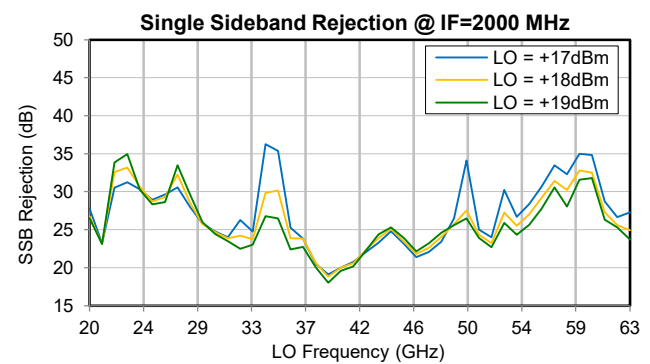
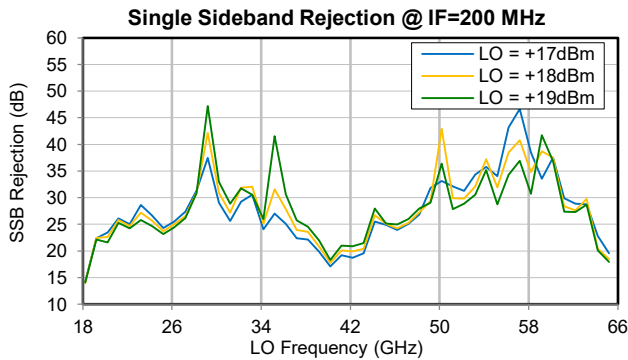
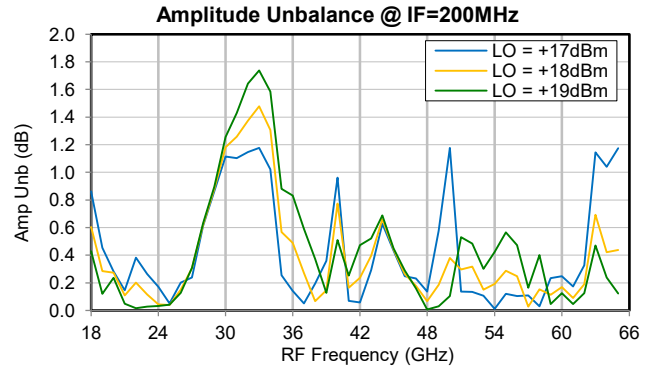
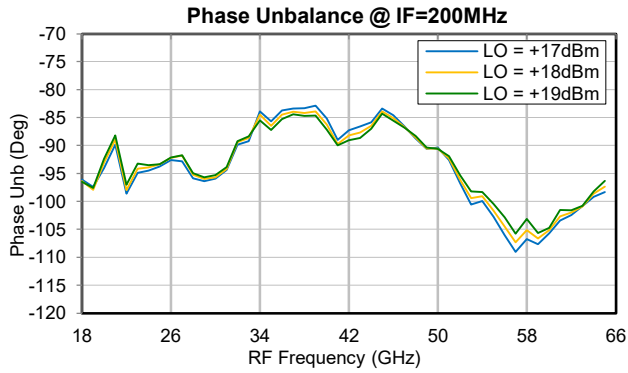
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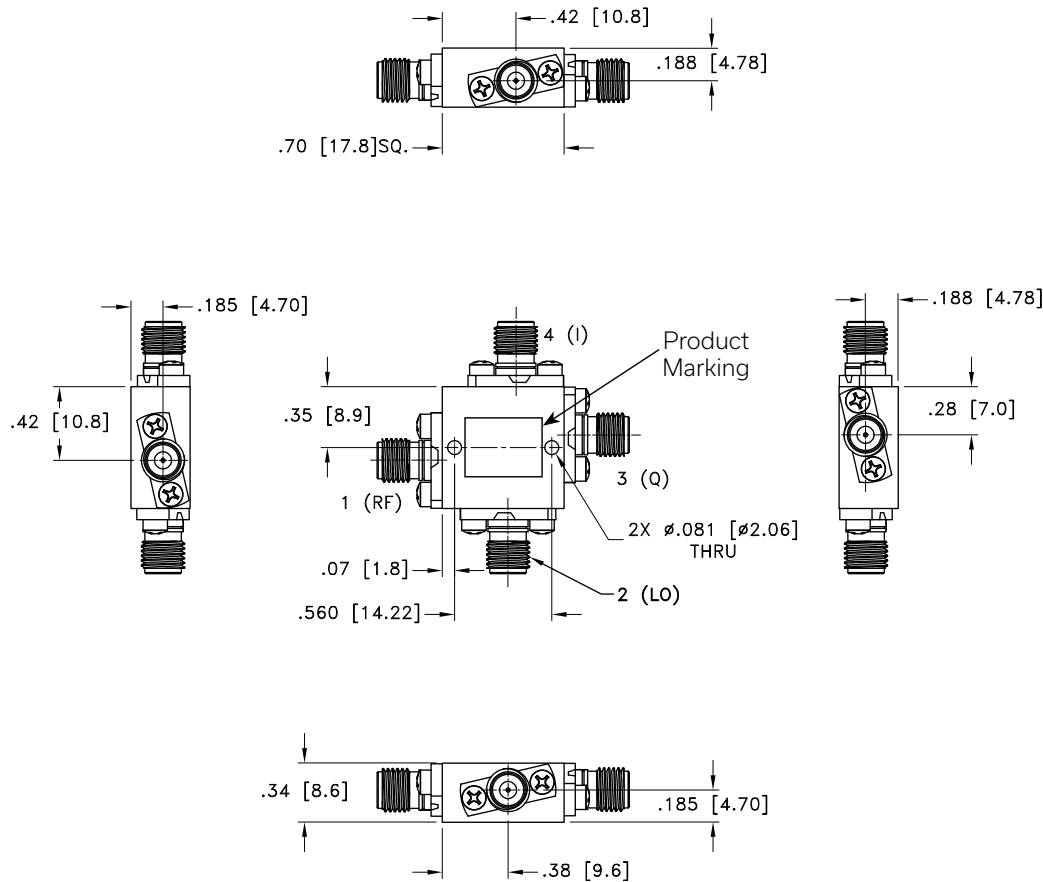
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### COAXIAL CONNECTIONS

Description	RF PORT	LO PORT	Q PORT	I PORT
Connector Type	1.85mm-F	1.85mm-F	2.92mm-F	2.92mm-F
Port Marking on case style drawing	1	2	3	4

### CASE STYLE DRAWING



Weight: 28 grams

Dimensions are in inches [mm]. Tolerances: 2 Pl.  $\pm$ .03; 3 Pl.  $\pm$ .015 inches

**PRODUCT MARKING\*:** ZMIQ-653H-E+

\*Marking may contain other features or characters for internal lot control.

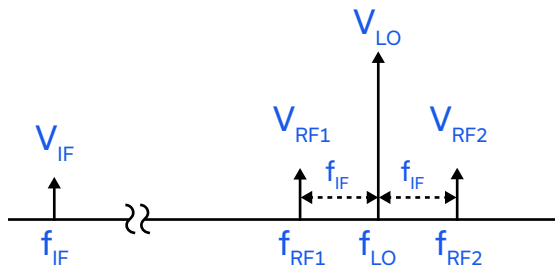




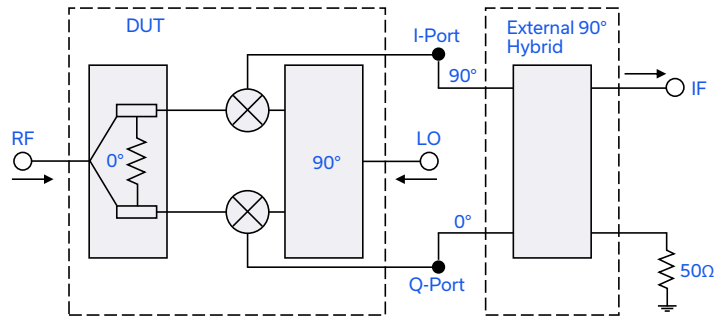
### APPLICATION CONFIGURATION FOR IMAGE REJECT AND SINGLE SIDE BAND MIXER

In Image Reject Downconverter or Single Sideband Upconverter applications an external 90° Hybrid is needed. Refer to Mini-Circuits extensive portfolio of 90° Hybrids.

#### IMAGE REJECT MIXER APPLICATION



Spectral representation of Signals

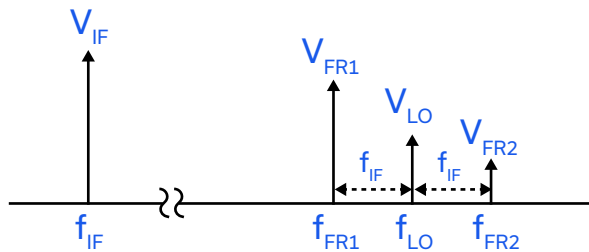


Block Diagram of Image Reject Mixer

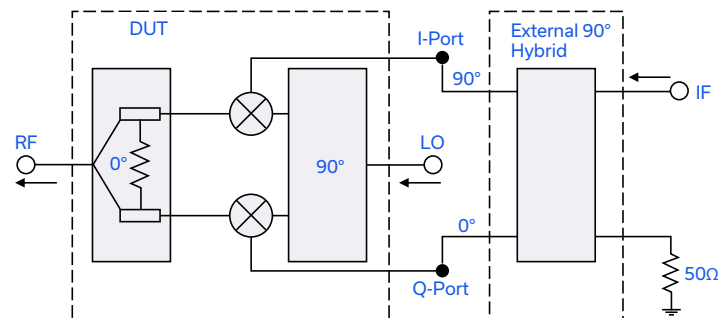
If  $f_{RF1}$  is the desired signal and  $f_{RF2}$  is the image, connect the I port of DUT to the 90° port of the external hybrid and the Q port to the 0° port of the hybrid. This will send the  $f_{RF2} - f_{LO}$  IF signal to the terminated output of the external 90° hybrid and desired IF signal  $f_{LO} - f_{RF1}$  to IF port.

If  $f_{RF2}$  is the desired signal and  $f_{RF1}$  is the image signal, connect the I port of DUT to the 0 deg port of the external 90° hybrid and the Q port to the 90° port of the external hybrid. This will send  $f_{LO} - f_{RF1}$  IF signal to the terminated output of the external 90° hybrid and desired IF signal  $f_{RF2} - f_{LO}$  to IF port.

#### SINGLE SIDE BAND (SSB) UPCONVERTER APPLICATION



Spectral representation of Signals



Block Diagram of Single Sideband Upconverter Mixer

For upper side band ( $f_{RF2} = f_{LO} + f_{IF}$ ) selection connect the I port to the 90° port of the external 90° hybrid and the Q port to the 0° port of the external hybrid. This will send the lower sideband band signal ( $f_{RF1} = f_{LO} - f_{IF}$ ) to the isolation resistor of the 0° RF splitter in DUT and upper sideband ( $f_{RF2} = f_{LO} + f_{IF}$ ) to output RF port.

For lower side band ( $f_{RF1} = f_{LO} - f_{IF}$ ) selection connect the I port to the 0° port of the external 90° hybrid and the Q port to the 90° port of the hybrid. This will send the upper sideband band signal ( $f_{RF2} = f_{LO} + f_{IF}$ ) to the isolation resistor of the 0° RF splitter in DUT and lower sideband ( $f_{RF1} = f_{LO} - f_{IF}$ ) to out of RF port.

Refer to Mini-Circuits blog, [I&Q Mixers, Image Reject Down-Conversion & Single Sideband \(SSB\) Up-Conversion](#) for a detailed explanation.