



MICROLITHIC™ DOUBLE-BALANCED I/Q MIXER

MLIQ-0416

The MLIQ-0416 is a miniaturized, multi-octave 4-16 GHz IQ mixer. It features matched double balanced mixers connected with an integrated LO hybrid and RF power divider. It can be used for either up or downconversion. Applications include communications or radar systems with advanced digital modulation formats and phase modulated signals, test and measurement, or electronic warfare. Image reject or single sideband modulation with excellent suppression is possible with use of an external IF quadrature (90°) hybrid.



Features

- Compact Chip Style Package (0.280" x 0.160"x0.010")
- CAD Optimized for Superior Isolation and Spurious Response
- Broadband Performance
- Excellent Unit-to-Unit Repeatability
- Fully nonlinear software models available with Marki PDK for Microwave Office
- RoHS Compliant

Mixer Line	Suitable Alternative for Models
I/Q	IQ-0307, IQ-0318, IQ-4509, IQ-0618, IQ-0714, IQ-0917

Electrical Specifications - Specifications guaranteed from -55 to +100°C, measured in a 50Ω system.

Parameter	LO (GHz)	RF (GHz)	IF (GHz)	Min	Typ	Max	Diode Option ¹ LO drive level (dBm)
Conversion Loss (dB) (Combined IF with Test Hybrid)	4-16		DC-2		8.5	10.5	
Image Rejection (dB) (Combined IF with Test Hybrid)			2-3.5		10.5	12.5	
I/Q Amplitude Balance (dB)					See Plots		
I/Q Quadrature Phase Balance (Degrees)					0.13		
Isolation (dB) LO-RF LO-IF RF-IF					3.5		
Input 1 dB Compression (dBm)					See Plots		
Input Two-Tone Intercept (dBm)					+8		L (+11 to +18)
					+18		L (+11 to +18)

¹Contact factory for other diode options.

Part Number Options

Model Number	Description
MLIQ-0416LCH-2 ^{1, 3}	Low Barrier Diode, I Port Configuration -2
MLIQ-0416L ^{2, 3}	Low Barrier Diode, Connectorized

¹ Chip package connects to external circuit through wire bondable gold pads. See page 5 for plating details.

² Connectorized package consists of chip package wire bonded to a substrate, equivalent to an evaluation board.

³ Note: For port locations and I/O designations, refer to the drawing on page 5 of this document.

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LO/RF 4 to 16 GHz
IF DC to 3.5 GHz

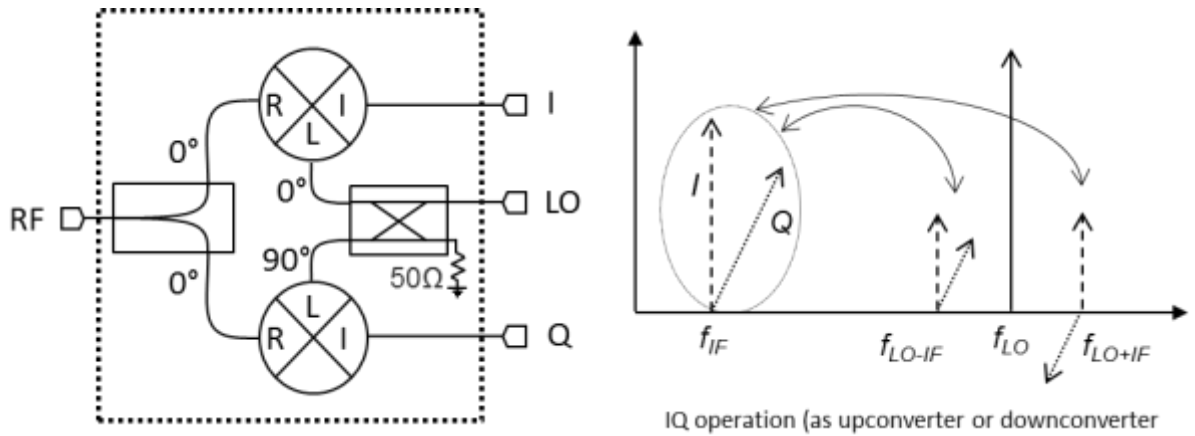


Figure 1a. I/Q Mixer Schematic

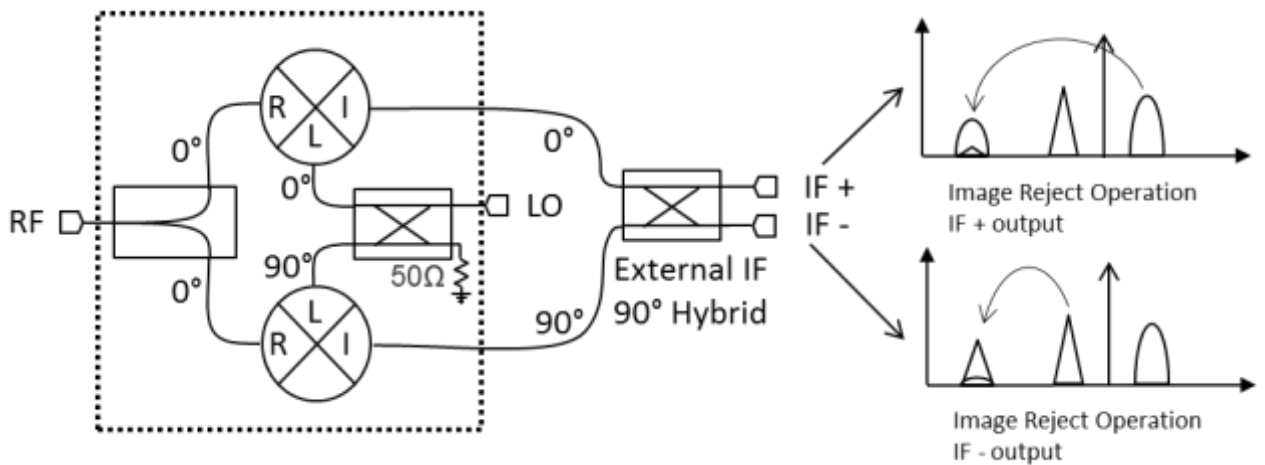


Figure 1b. Image Reject Mixer Schematic

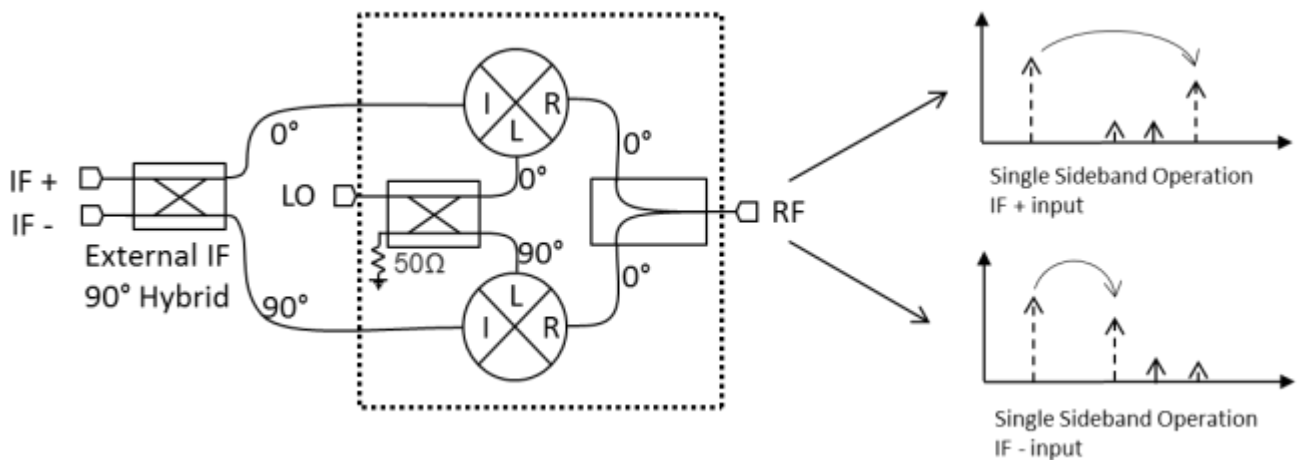


Figure 1c. Single Sideband Mixer Schematic



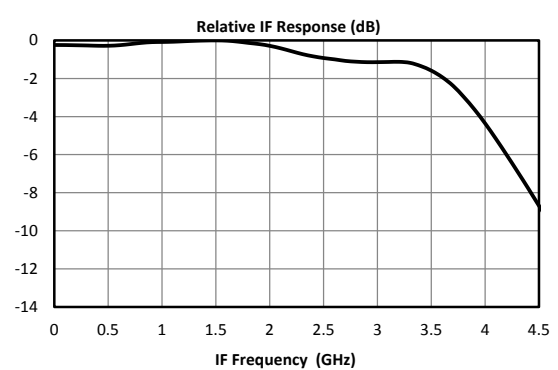
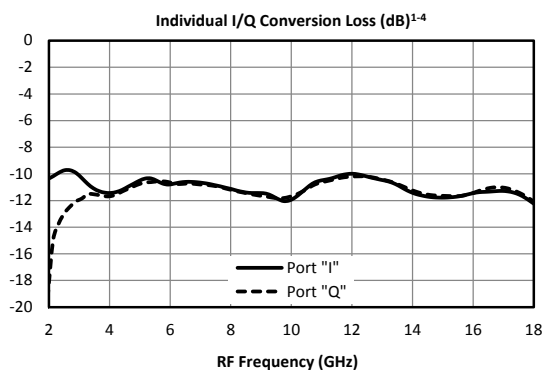
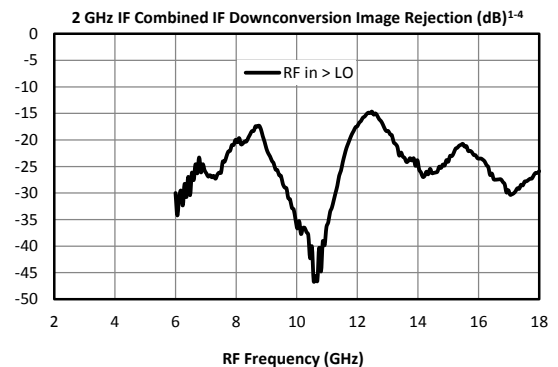
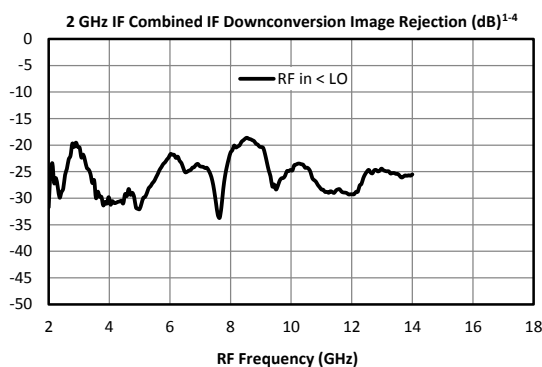
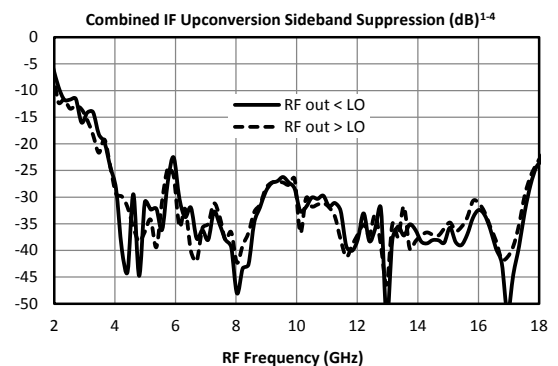
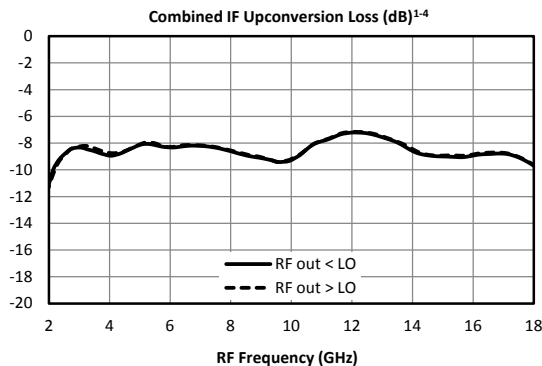
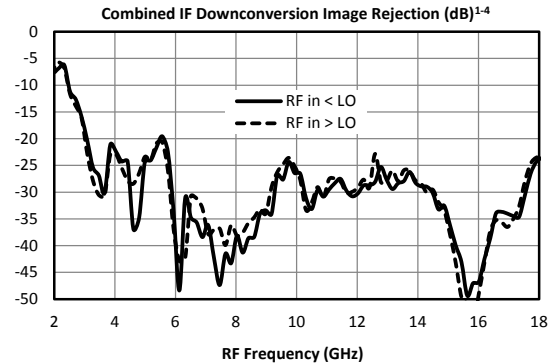
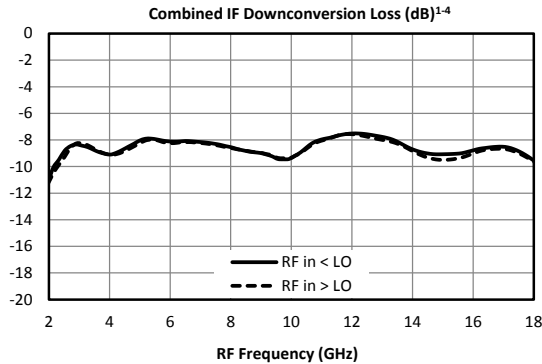
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LO/RF 4 to 16 GHz
IF DC to 3.5 GHz

Typical Performance





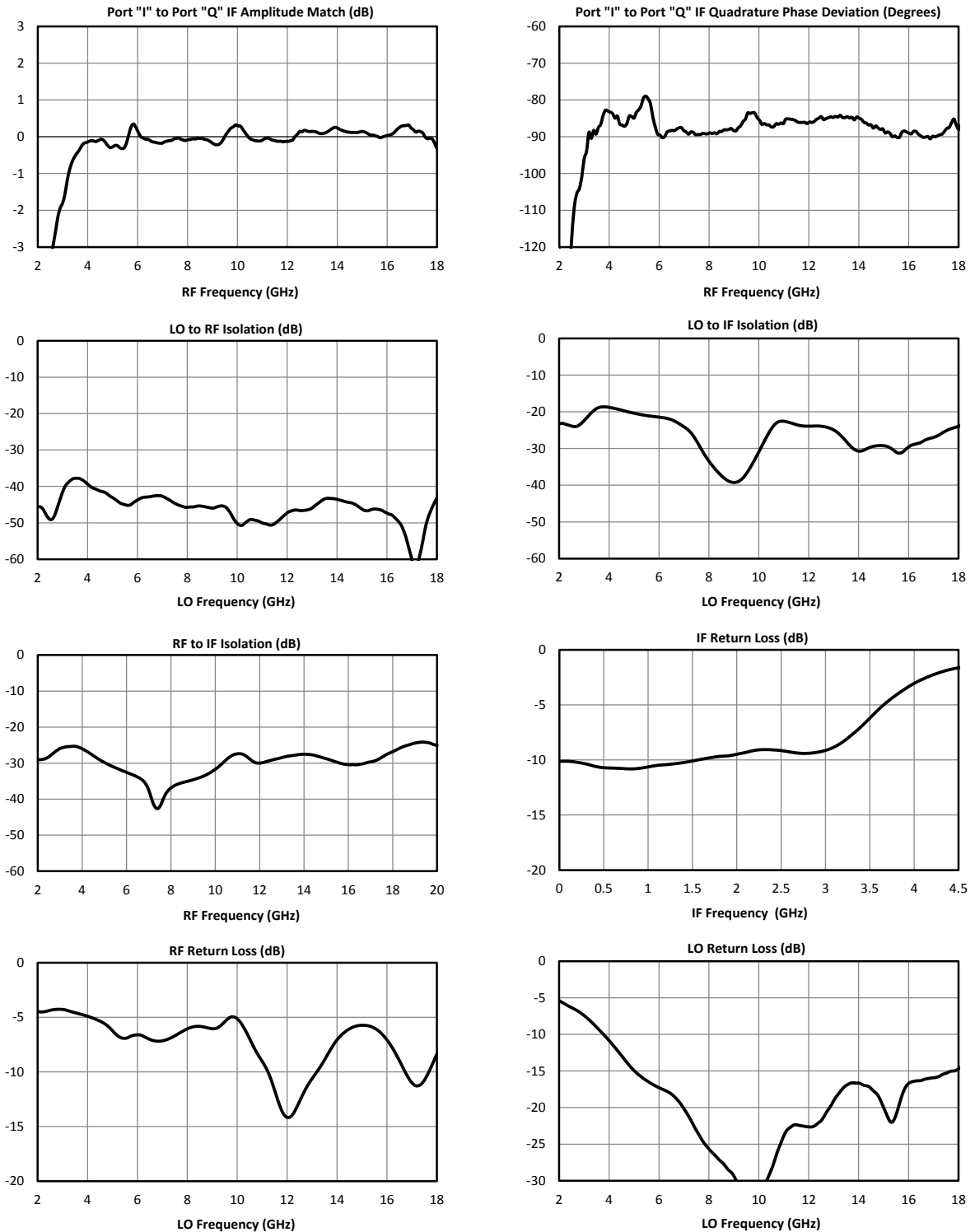
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LO/RF 4 to 16 GHz
IF DC to 3.5 GHz

Typical Performance (cont.)





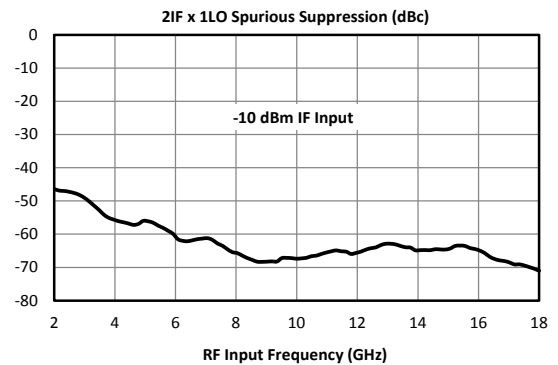
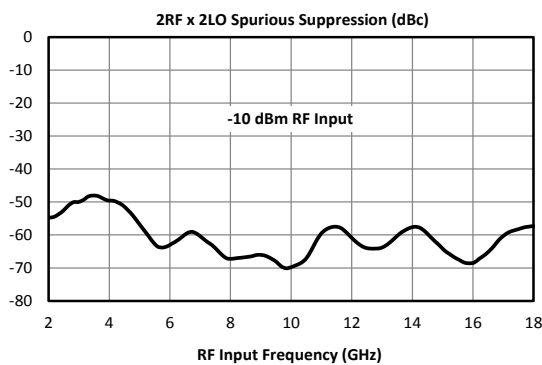
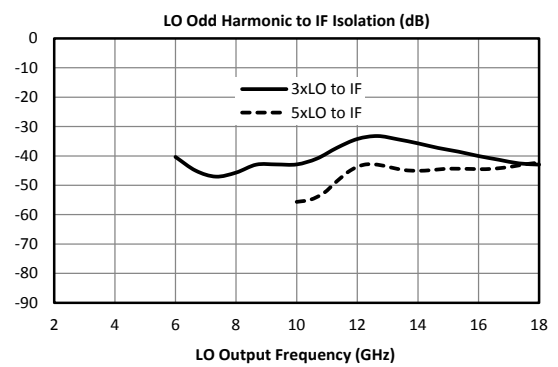
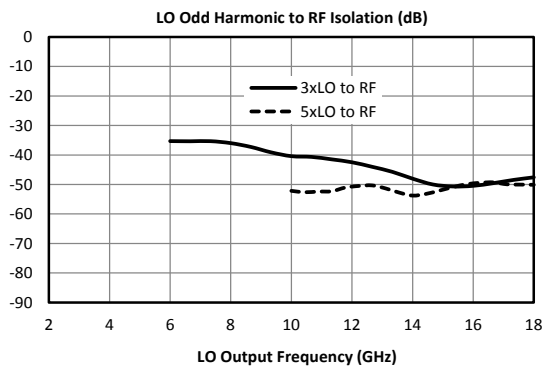
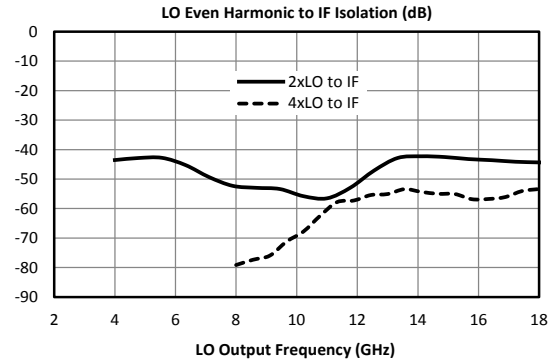
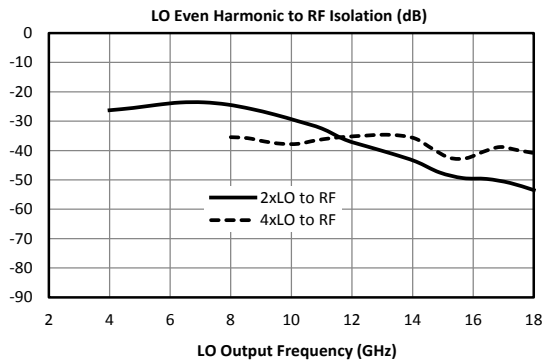
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LO/RF 4 to 16 GHz
IF DC to 3.5 GHz

Typical Performance (cont.)



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LO/RF 4 to 16 GHz
IF DC to 3.5 GHz

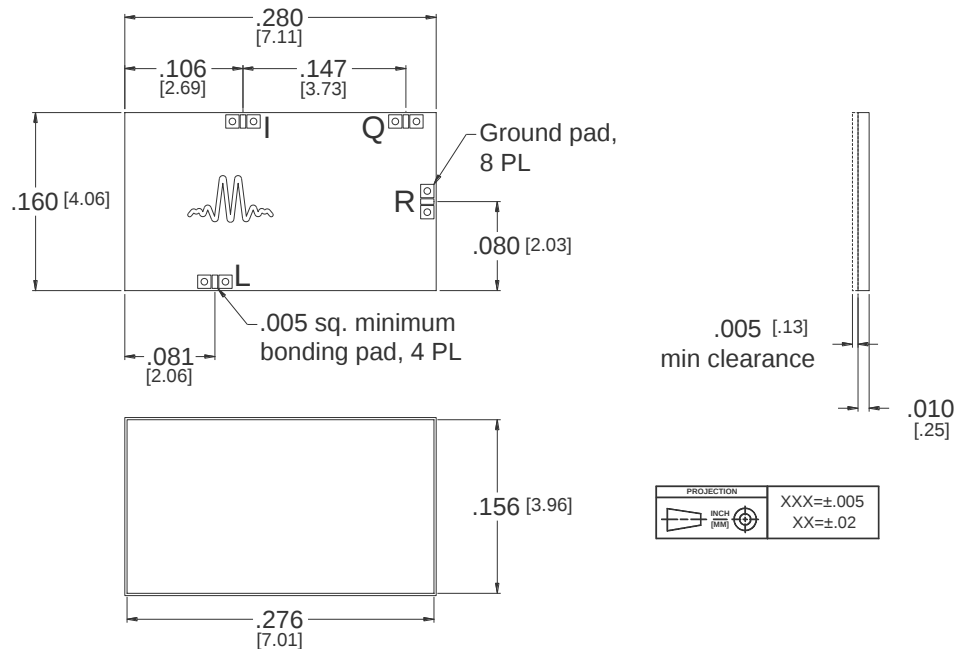


Figure 2a. Outline Drawing – CH-2

*CH Substrate material is .010 thick Ceramic.

I/O traces and ground plane finish is 2.5 microns Au over .05 microns WTi.

Wire Bonding - Ball or wedge bond with 0.025 mm (1 mil) diameter pure gold wire. Thermosonic wirebonding with a nominal stage temperature of 150 °C and a ball bonding force of 40 to 50 grams or wedge bonding force of 18 to 22 grams is recommended. Use the minimum level of ultrasonic energy to achieve reliable wirebonds. Wirebonds should be started on the chip and terminated on the package or substrate. All bonds should be as short as possible <0.31 mm (12 mils).

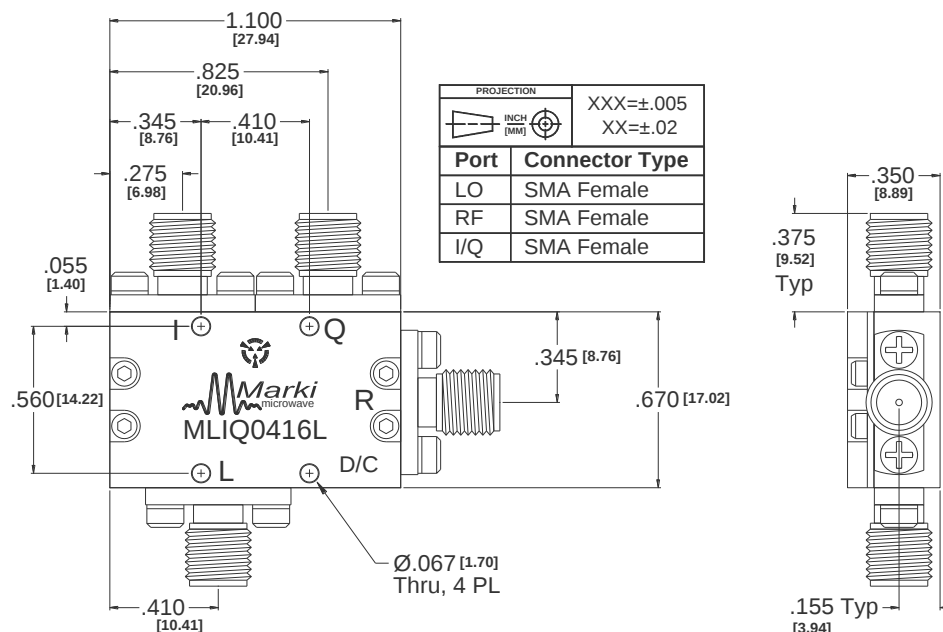


Figure 2b. Outline Drawing - Connectorized



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**LO/RF 4 to 16 GHz
IF DC to 3.5 GHz**

Downconversion Spurious Suppression

Spurious data is taken by selecting RF and LO frequencies ($\pm mLO \pm nRF$) within the 4 to 16 GHz RF/LO bands, which create a 100 MHz IF spurious output. The mixer is swept across the full spurious band and the mean is calculated. The numbers shown in the table below are for a -10 dBm RF input. Spurious suppression is scaled for different RF power levels by (n-1), where “n” is the RF spur order. For example, the 2RFx2LO spur is 62 dBc for a -10 dBm input, so a -20 dBm RF input creates a spur that is (2-1) x (-10 dB) dB lower, or 72 dBc.

Typical Downconversion Spurious Suppression (dBc): L-diode⁵

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xRF	18	Reference	19	10	30	18
2xRF	70	53	62	54	57	51
3xRF	80	61	74	67	72	69
4xRF	118	102	102	101	105	101
5xRF	128	106	112	112	119	117

Upconversion Spurious Suppression

Spurious data is taken by mixing a 100 MHz IF with LO frequencies ($\pm mLO \pm nIF$), which creates an RF within the 4 to 16 GHz RF band. The mixer is swept across the full spurious output band and the mean is calculated. The numbers shown in the table below are for a -10 dBm individual IF input, with the unused port terminated in 50 ohms. Spurious suppression is scaled for different IF input power levels by (n-1), where “n” is the IF spur order. For example, the 2IFx1LO spur is typically 64 dBc for a -10 dBm input, so a -20 dBm IF input creates a spur that is (2-1) x (-10 dB) dB lower, or 74 dBc.

Typical Upconversion Spurious Suppression (dBc): L-diode⁵

-10 dBm IF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xIF	17	Reference	23	10	30	18
2xIF	57	64	53	60	47	60
3xIF	72	64	66	59	68	55
4xIF	108	101	93	95	81	89
5xIF	118	103	109	98	107	93



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LO/RF 4 to 16 GHz
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Port	Description	DC Interface Schematic
LO	The LO port is DC short to ground and AC matched to 50 Ohms from 4 to 16 GHz. Blocking capacitor is optional.	
RF	The RF port is DC short to ground and AC matched to 50 Ohms from 4 to 16 GHz. Blocking capacitor is optional.	
I/Q	The I/Q ports are DC coupled to the diodes. Blocking capacitor is optional.	

Absolute Maximum Ratings	
Parameter	Maximum Rating
RF DC Current	1 Amp
LO DC Current	1 Amp
IF DC Current	50 mA
RF Power Handling (RF+LO)	+25 dBm at +25°C, derated linearly to +20 dBm at +100°C
Operating Temperature	-55°C to +100°C
Storage Temperature	-65°C to +125°C

DATA SHEET NOTES:

1. Mixer Conversion Loss and Rejection plots IF frequency is 60 MHz.
2. Mixer Noise Figure typically measures within 0.5 dB of conversion loss for IF frequencies greater than 5 MHz.
3. Conversion Loss typically degrades less than 0.5 dB for LO drives 2 dB below the lowest and 3 dB above highest nominal LO drive levels.
4. Conversion Loss typically degrades less than 0.5 dB at +100°C and improves less than 0.5 dB at -55°C.
5. Unless otherwise specified L diode data taken with +15 dBm LO drive.
6. Specifications are subject to change without notice. Contact Marki Microwave for the most recent specifications and data sheets.
7. Catalog mixer circuits are continually improved. Configuration control requires custom mixer model numbers and specifications.

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