

MICROLITHIC™ DOUBLE-BALANCED I/Q MIXER

MLIQ-0416SM

Page 1

The MLIQ-0416SM is a miniaturized, multi-octave surface-mount 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 upconversion 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

- Surface-Mount Package
- 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 & Advanced Design System
- RoHS Compliant

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

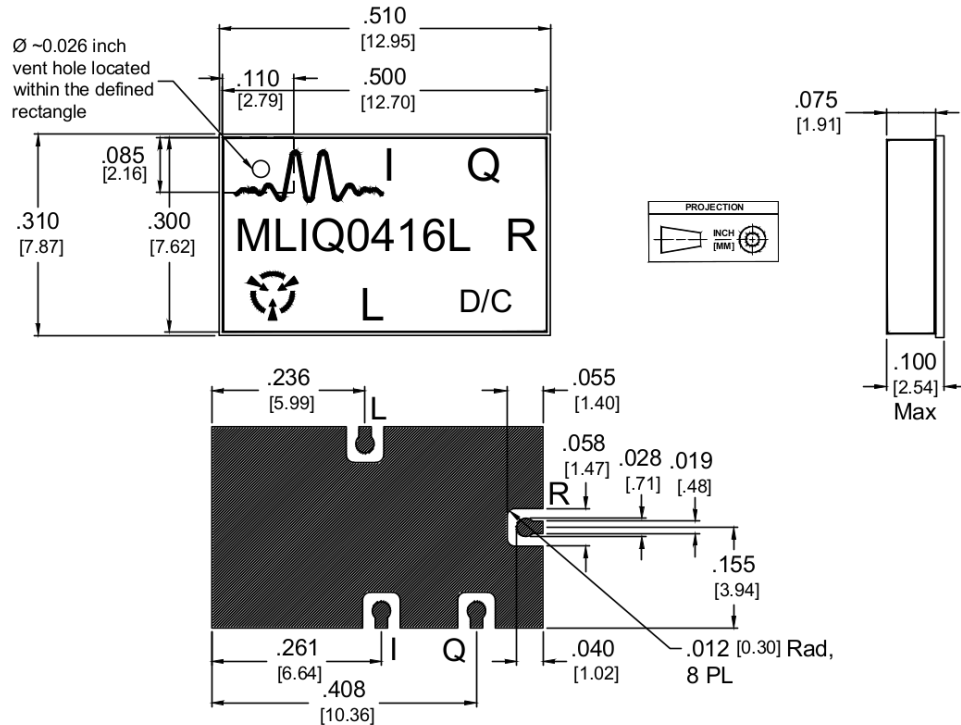
Parameter	LO (GHz)	RF (GHz)	IF (GHz)	Min	Typ	Max	Diode Option ¹ LO drive level (dBm)
Conversion Loss (dB) (Combined IF with Test Hybrid)	4-16		DC-2		8.5	13.5	+15
Image Rejection (dB) (Combined IF with Test Hybrid)			2-3.5		10.5	15.5	L (+11 to +18)
I/Q Amplitude Balance (dB)					See Plots		
I/Q Quadrature Phase Balance (Degrees)					0.18		
Isolation (dB) LO-RF LO-IF RF-IF					5		
Input 1 dB Compression (dBm) (Combined IF with Test Hybrid)					See Plots		
Input Two-Tone Intercept (dBm) (Combined IF with Test Hybrid)					+8		
					+18		

Part Number Options

Please specify diode level and package style by adding to model number.				
Package Style ²		Examples		
		MLIQ-0416LSM-2		
Surface Mount ¹ (RoHS)	SM-2	MLIQ-0416 (Model)	L (Diode Option)	SM-2 (Package)

¹ For port locations and I/O designations, refer to the drawing on page 2 of this document.

² See [MLIQ-0416](#) Data Sheet for connectorized MLIQ-0416SM.



1. SM Substrate material is .008 thick Rogers 4003.
2. I/O Connections & Ground Plane Finish is Gold Flash, 5 to 10 μ -inches, over Solderable Electroless Nickel, 100-200 μ -inches, over Cu.
3. MLIQ-0416SM-2 lid is vented. Baking in a vacuum oven at 120° to 140 C° for one hour after any aqueous wash is recommended.

Figure 2a. Outline Drawing – SM-2

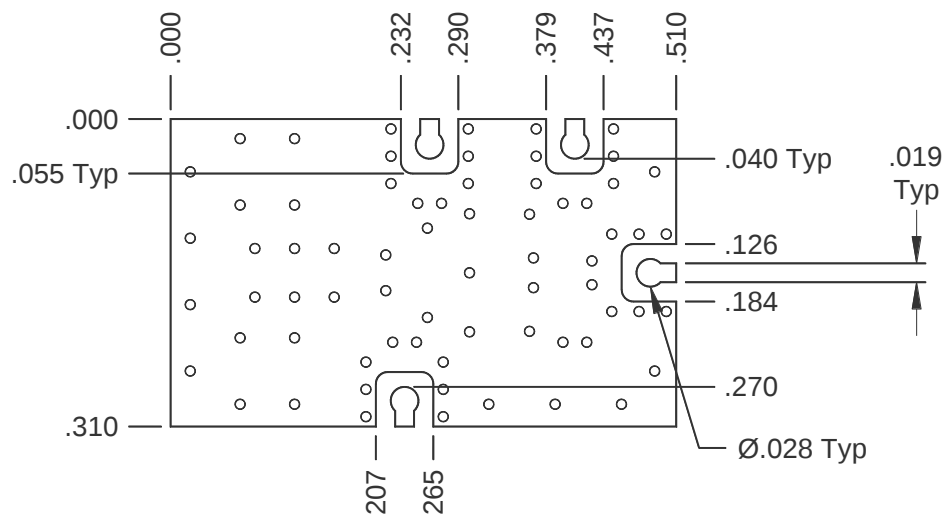


Figure 2b. SM-2 Landing Pattern

[Click here for a DXF of the above layout.](#)

[Click here for leaded solder reflow.](#) [Click here for lead-free solder reflow.](#)

MICROLITHIC™ DOUBLE-BALANCED I/Q MIXER

MLIQ-0416SM

Page 3

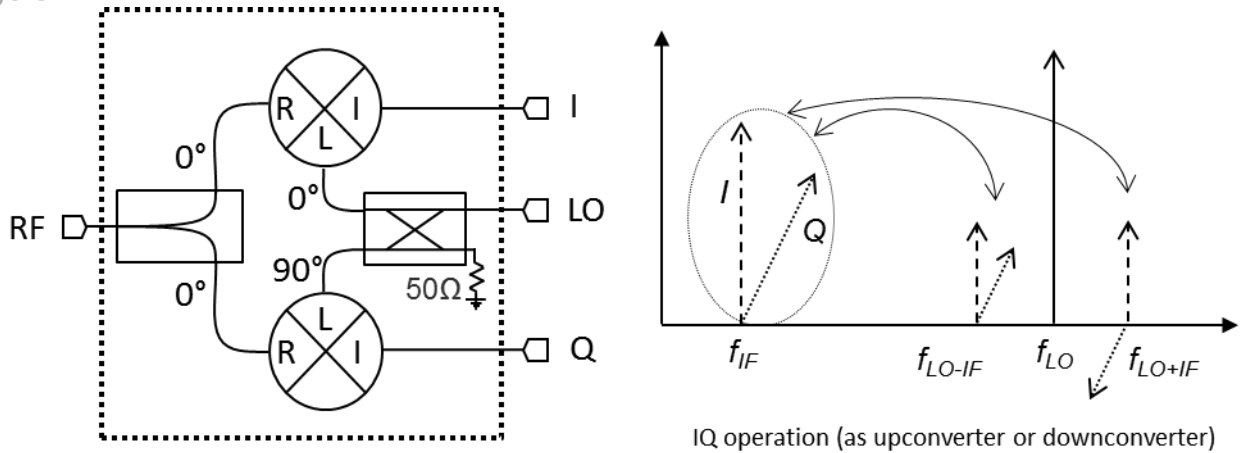


Figure 1a. I/Q Mixer Schematic

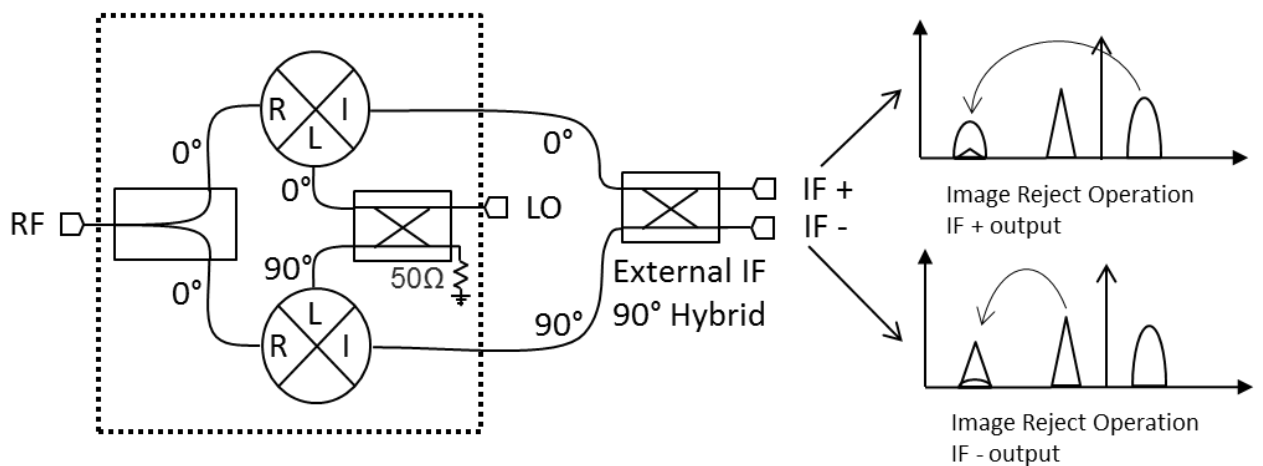


Figure 1b. Image Reject Mixer Schematic

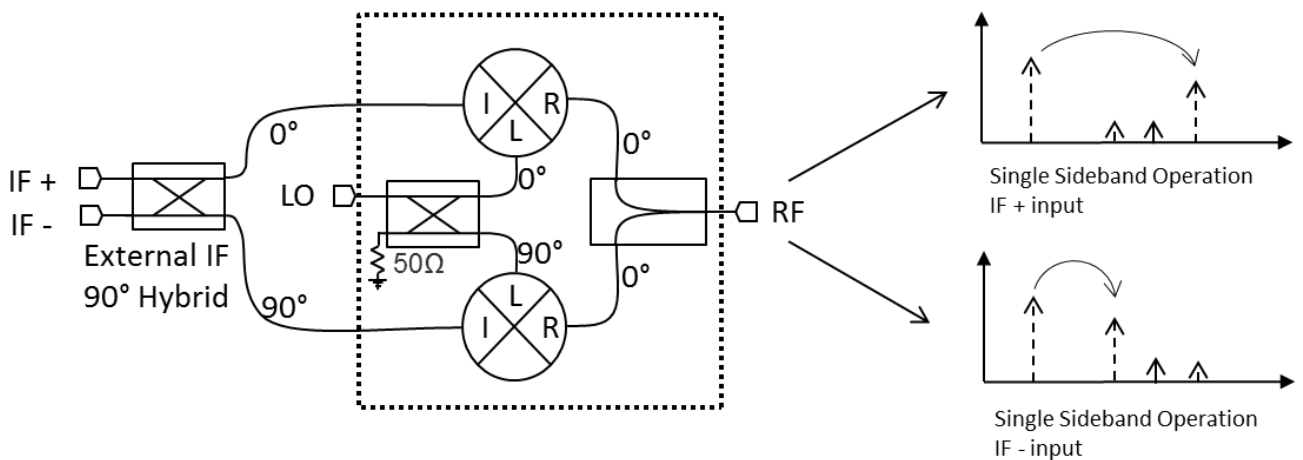


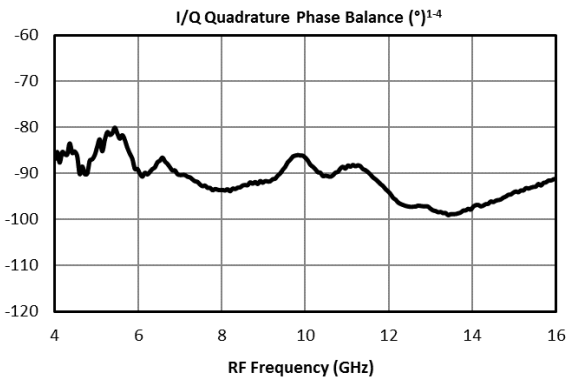
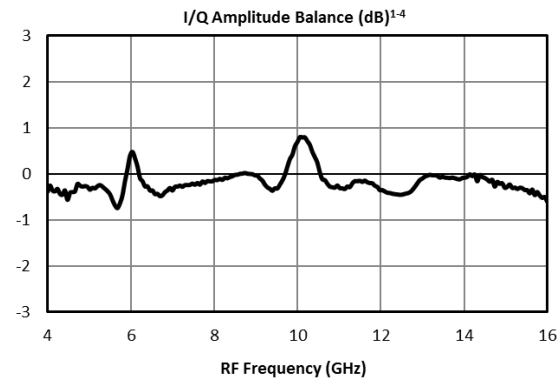
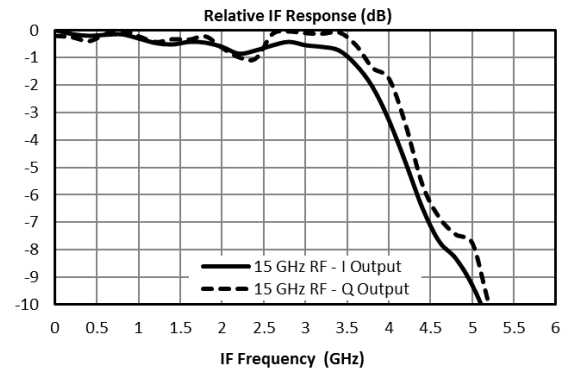
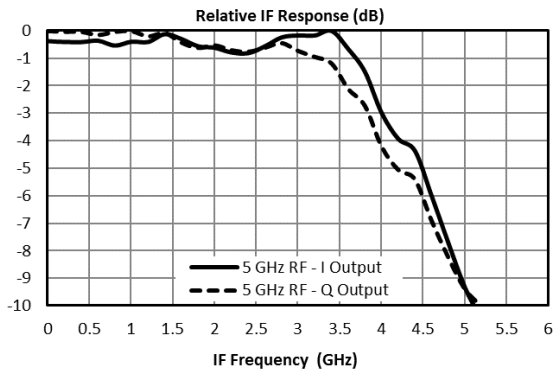
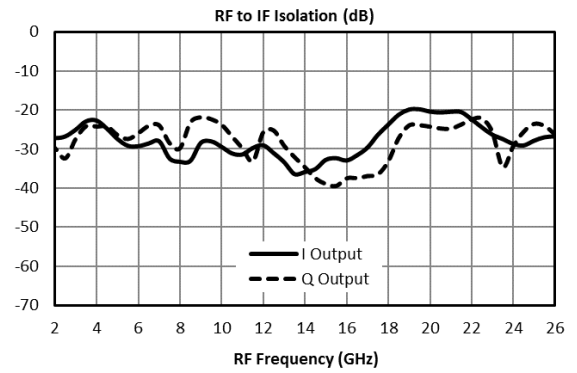
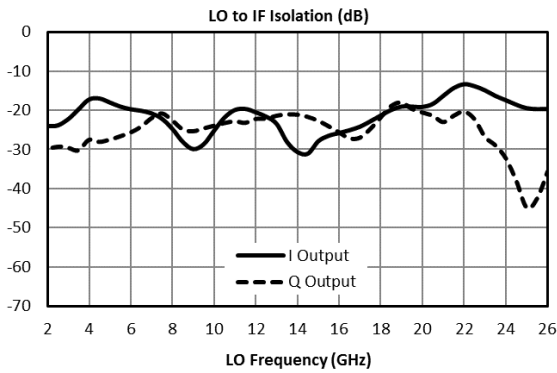
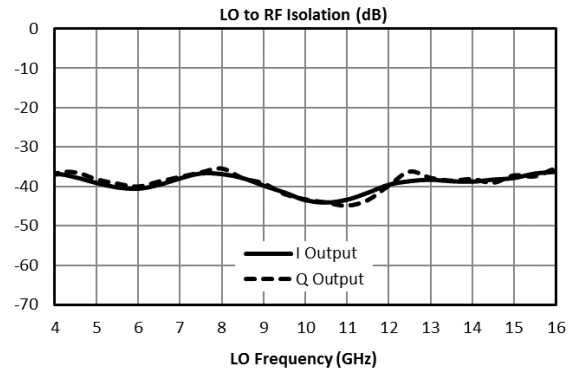
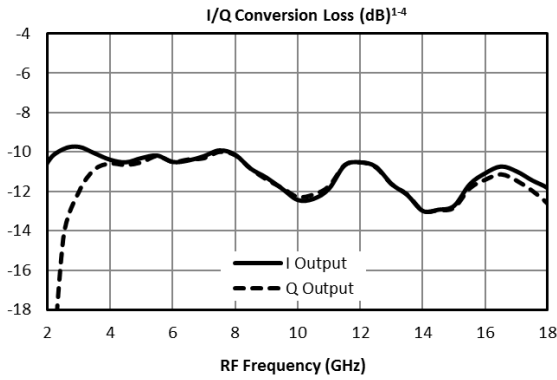
Figure 1c. Single Sideband Mixer Schematic

MICROLITHIC™ DOUBLE-BALANCED I/Q MIXER

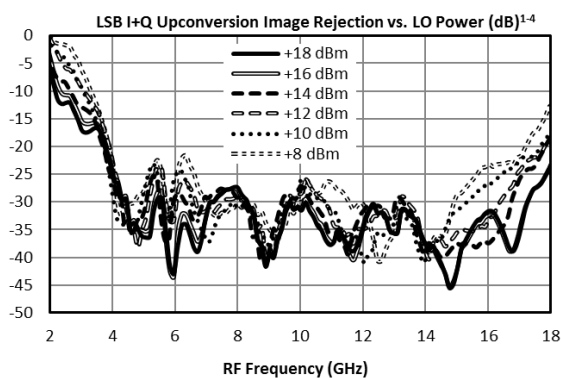
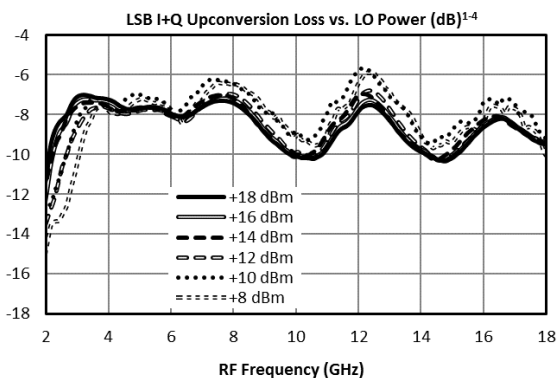
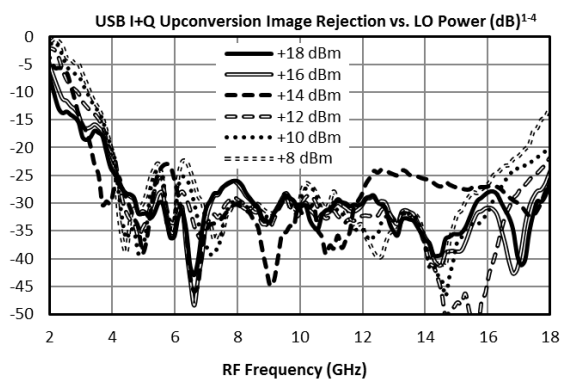
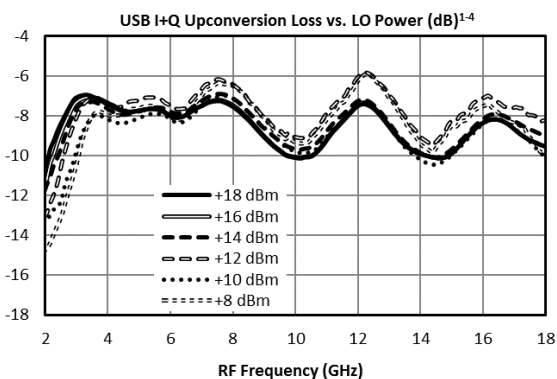
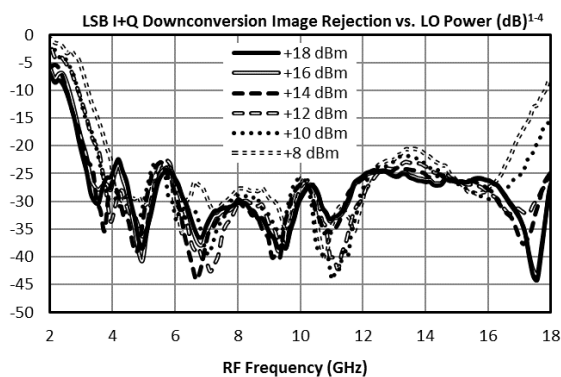
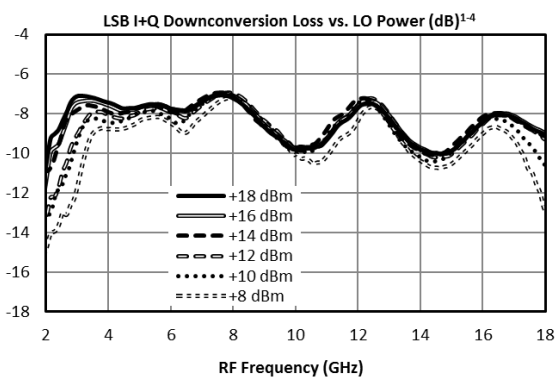
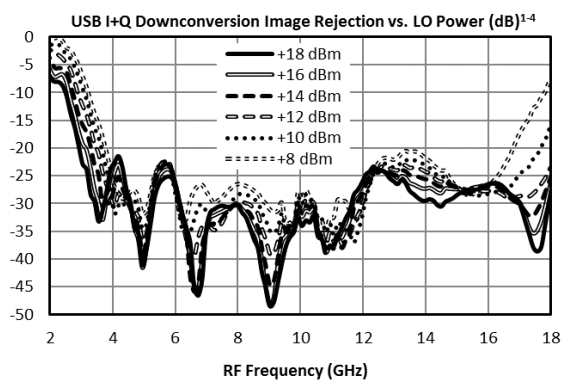
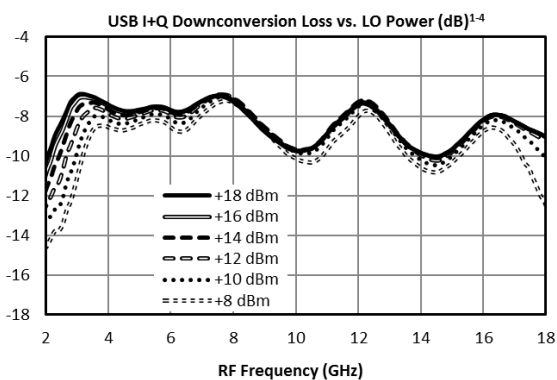
MLIQ-0416SM

Page 4

Typical Performance



Typical Performance

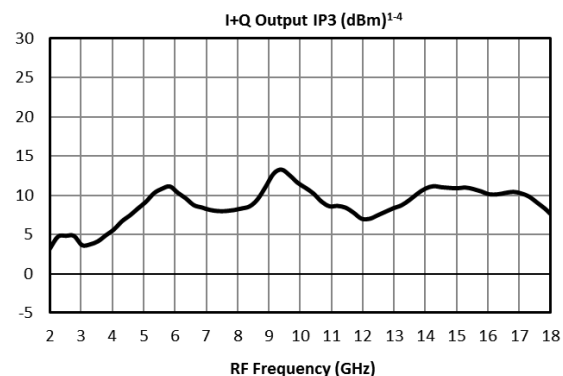
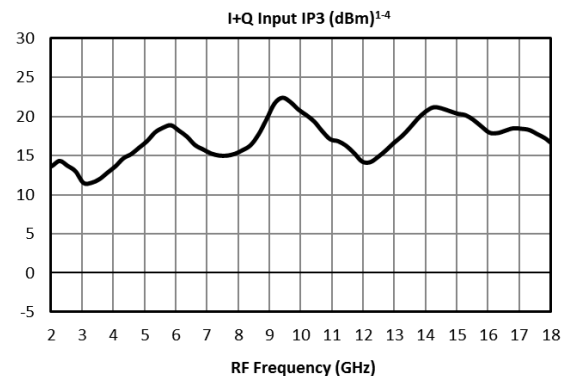
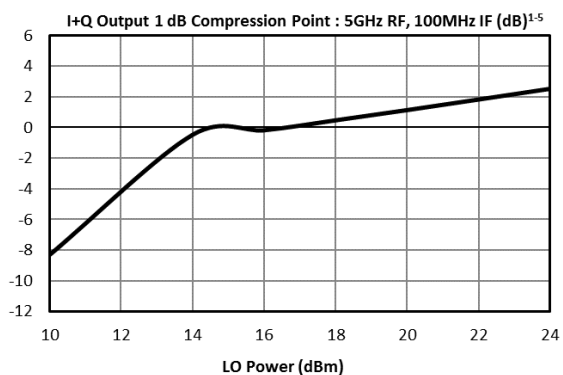
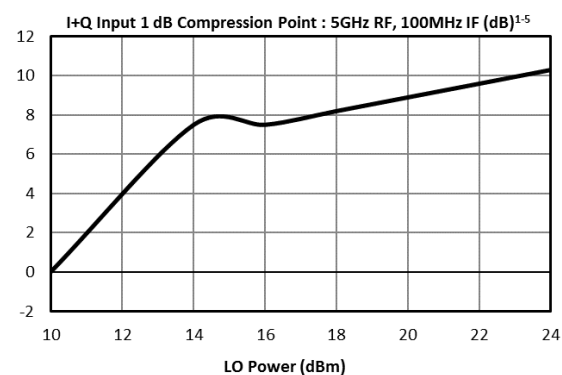
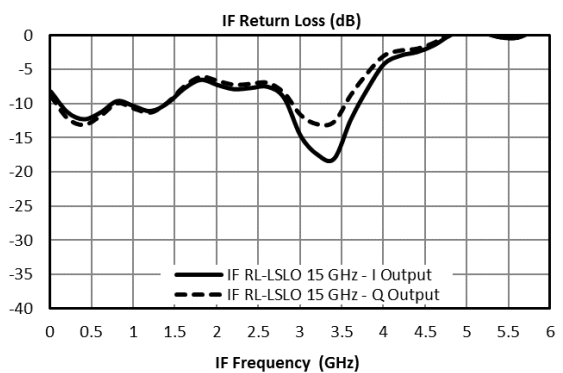
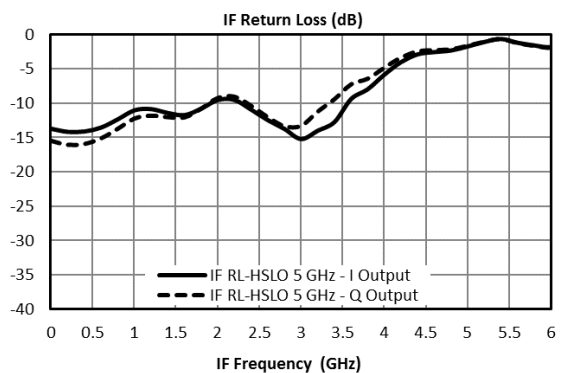
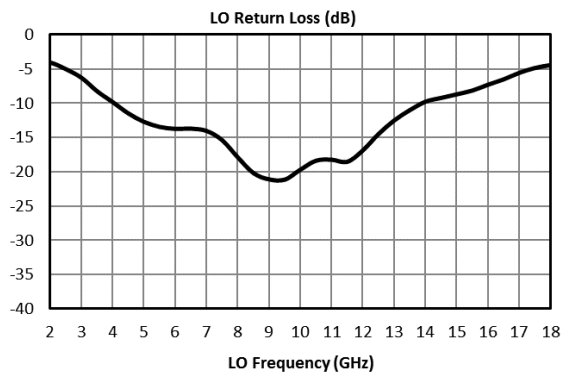
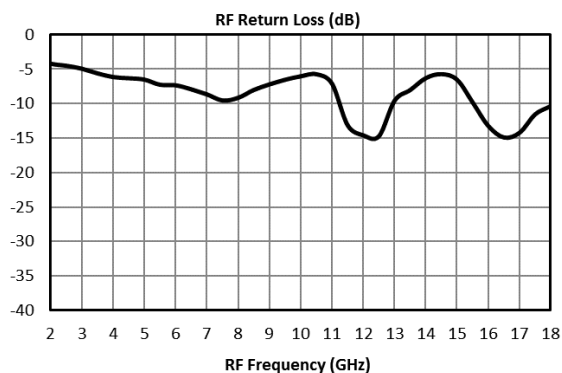


MICROLITHIC™ DOUBLE-BALANCED I/Q MIXER

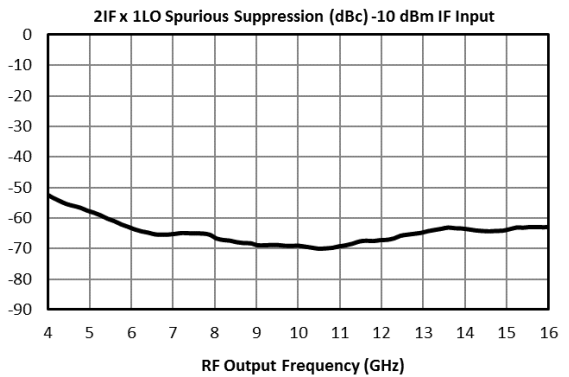
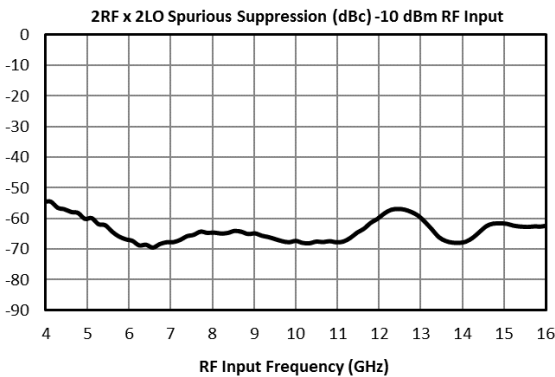
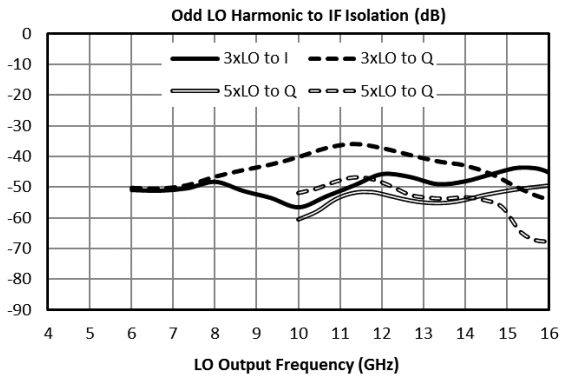
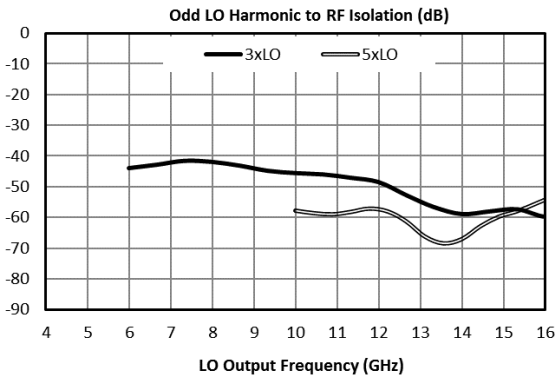
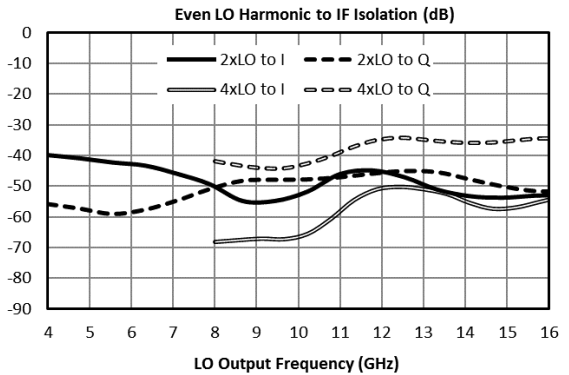
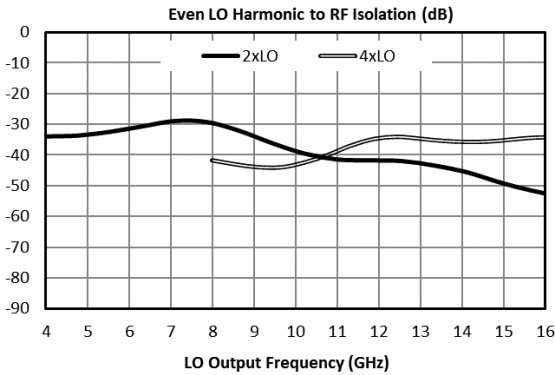
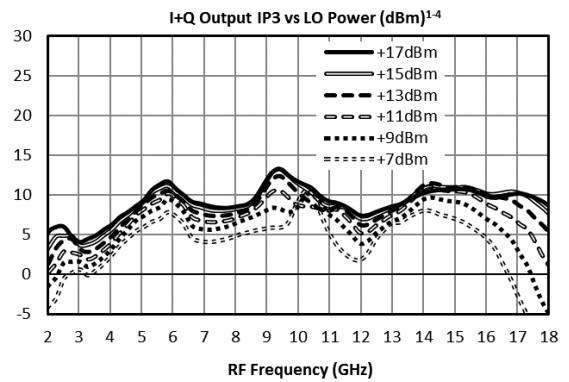
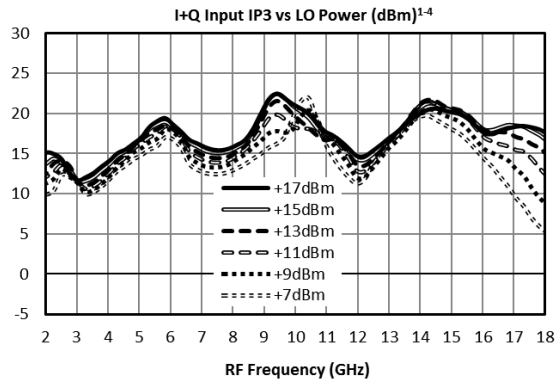
MLIQ-0416SM

Page 6

Typical Performance



Typical Performance



Downconversion Spurious Suppression

Spurious data is taken by selecting RF and LO frequencies ($\pm mLO \pm nRF$) within the RF/LO bands, to create a spurious output within the IF band. 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 for an L-Diode is typically 62 dBc with a -10 dBm input, so a -20 dBm RF input creates a spur that is $(2-1) \times (-10 \text{ dB})$ dB lower, or 72 dBc.

Typical Downconversion Spurious Suppression (dBc): L diode

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xRF	34	Reference	23	31	37	N/A
2xRF	86	35	62	63	59	58
3xRF	99	49	75	81	77	66
4xRF	126	69	96	102	105	103
5xRF	N/A	130	112	123	123	117

Upconversion Spurious Suppression

Spurious data is taken by mixing an input within the IF band, with LO frequencies ($\pm mLO \pm nIF$), to create a spurious output within the RF output 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 for an L-Diode is typically 63 dBc with a -10 dBm input, so a -20 dBm IF input creates a spur that is $(2-1) \times (-10 \text{ dB})$ dB lower, or 73 dBc.

Typical Upconversion Spurious Suppression (dBc): L diode ⁵

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xIF	13	Reference	25	24	40	N/A
2xIF	50	63	50	54	47	54
3xIF	65	84	75	68	77	68
4xIF	94	110	104	100	82	102
5xIF	99	118	120	108	110	107



MICROLITHIC™ DOUBLE-BALANCED I/Q MIXER

MLIQ-0416SM

Page 9

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 ¹	50 mA
RF Power Handling (RF+LO)	+29 dBm at +25°C, derated linearly to +24 dBm at +100°C
IF Power Handling (each IF port, with +24 dBm maximum 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. Unless otherwise specified, IF (combined I and Q) frequency is 91 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.
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.

Note: Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value. Exceeding any of the limits listed here may result in permanent damage to the device.