MMIC Double-Balanced I/Q Mixer

MMIQ-0205SSM

The MMIQ-0205SSM is a miniaturized, surface-mount multi-octave 1.75-5.0 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

- 5mm QFN Surface-Mount Package
- CAD Optimized for Superior Isolation, Spurious Response, and Image Rejection/Sideband Suppression
- Broadband Performance
- Excellent Unit-to-Unit Repeatability
- 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 **LO drive level** (dBm)
Conversion Loss (dB) (Combined IF with Test Hybrid)	1.75-5.0		DC-0.2 0.2-2.0		8.5 11	11	+19.5 to +24
Image Rejection (dB) (Combined IF with Test Hybrid)			DC-2.0		See Plots		
I/Q Amplitude Balance (dB)					0.15		
I/Q Quadrature Phase Balance (Degrees)					5		
Isolation (dB) LO-RF LO-IF RF-IF					See Plots		
Input 1 dB Compression (dBm) (Combined IF with Test Hybrid)					+16		
Input Two-Tone Intercept (dBm) (Combined IF with Test Hybrid)					+25		

Part Number Options

Model Number	Description
MMIQ-0205SSM-2 [1]	Surface Mount
EVAL-MMIQ-0205S	Connectorized Evaluation Fixture

[1] For port locations and I/O designations, refer to the drawing on page 3 of this document.

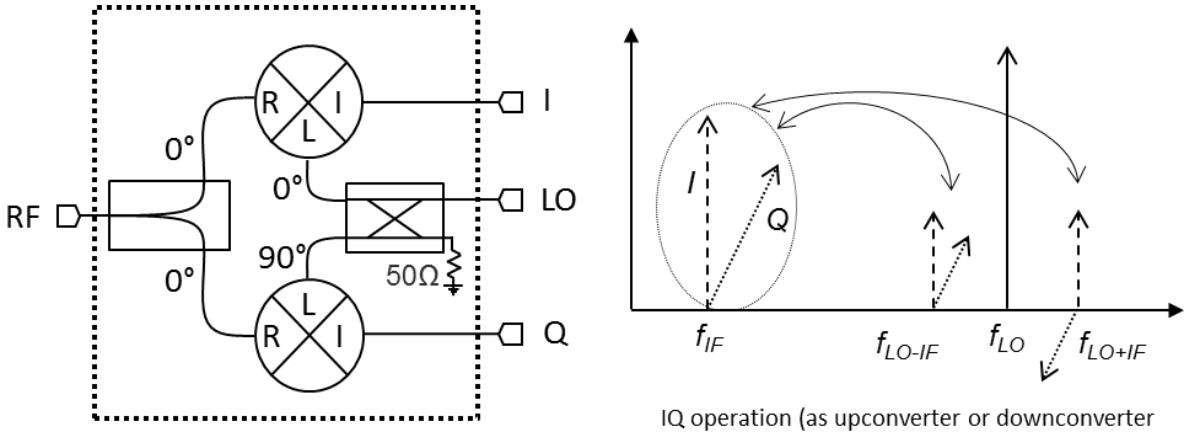


Figure 1a. I/Q Mixer Schematic

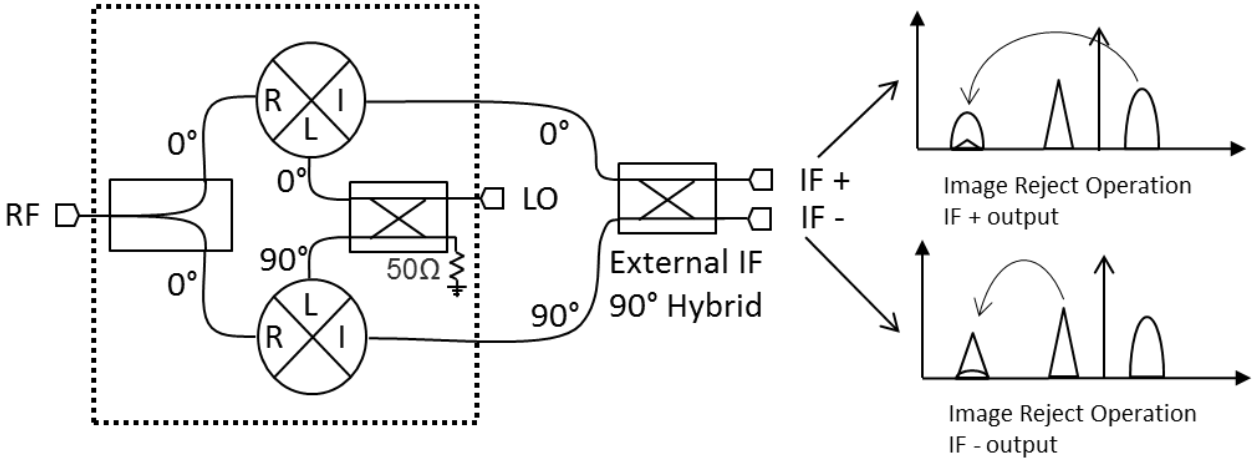
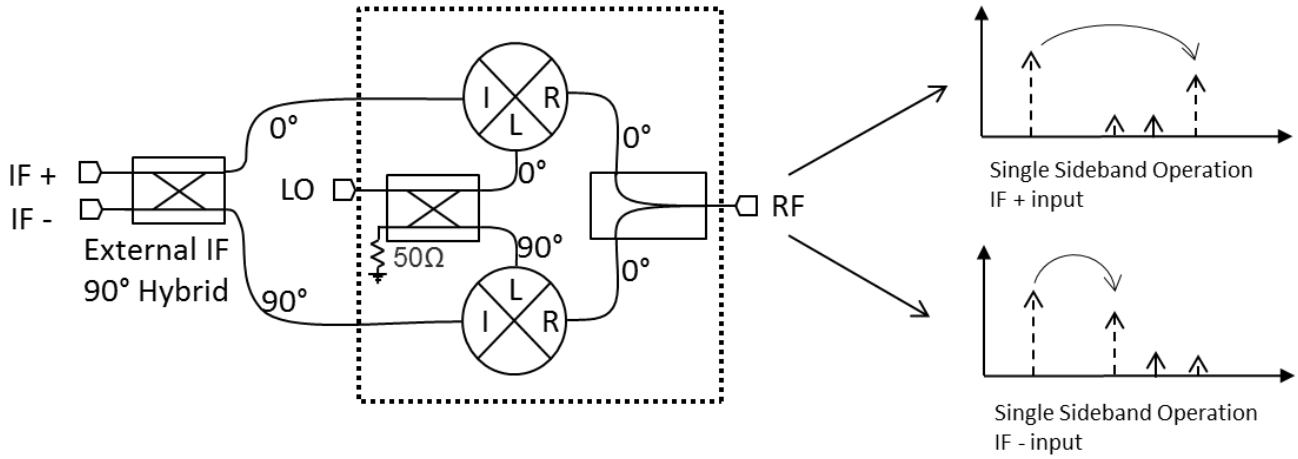
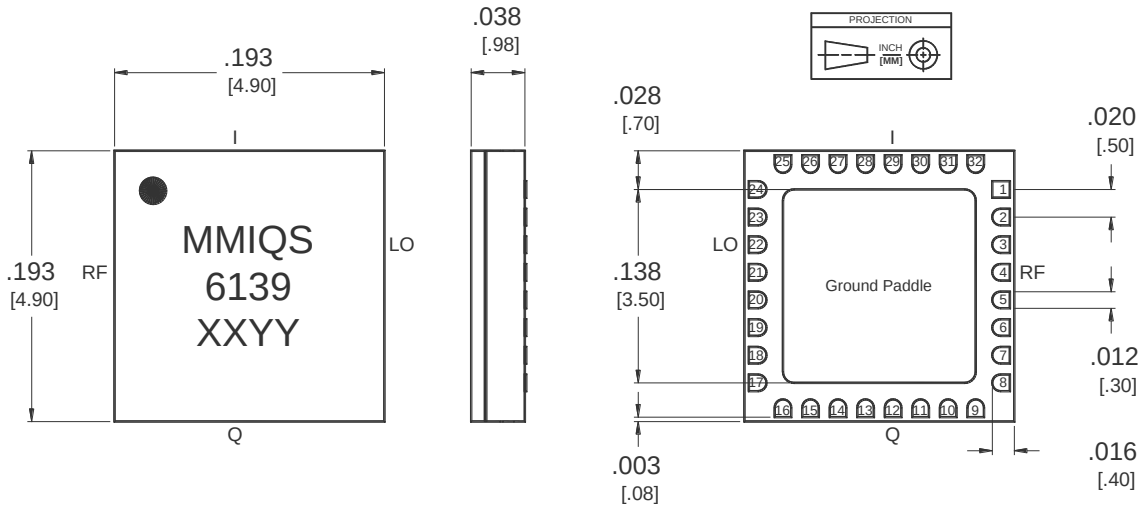


Figure 1b. Image Reject Mixer Schematic

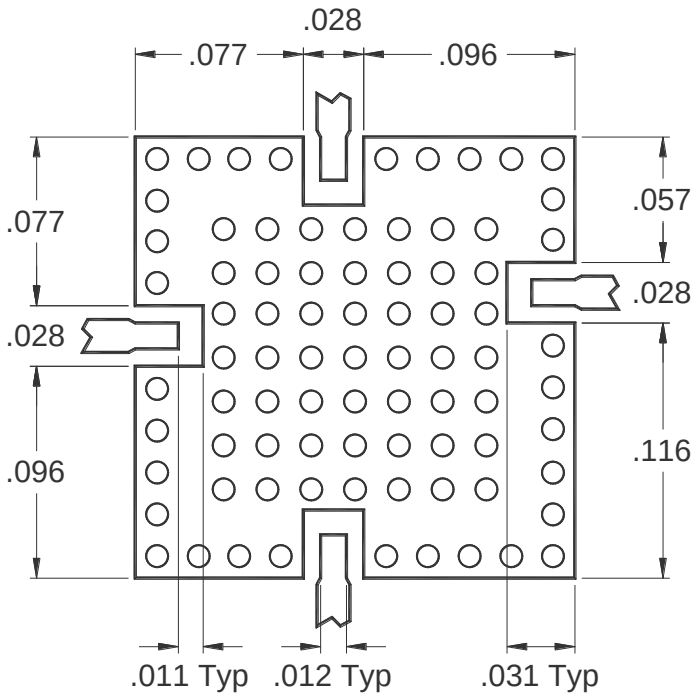




Pad #	Function
1	N/C
2	N/C
3	N/C
4	RF
5	N/C
6	N/C
7	N/C
8	N/C
9	N/C
10	N/C
11	N/C
12	IF-Q
13	N/C
14	N/C
15	N/C
16	N/C
17	N/C
18	N/C
19	N/C
20	N/C
21	N/C
22	LO
23	N/C
24	N/C
25	N/C
26	N/C
27	N/C
28	N/C
29	IF-I
30	N/C
31	N/C
32	N/C

Outline Drawing – 5mm QFN Package

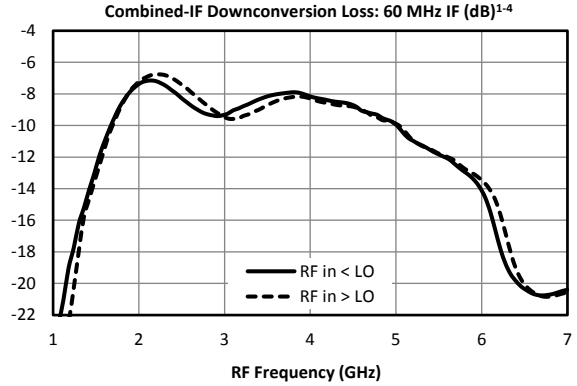
Substrate material is Ceramic.
I/O Leads and Ground Paddle are 1.4±0.6 microns (55±24 micro-inches) Au over 1.3 microns (51 micro-inches) Ni.
All unconnected pads should be connected to PCB RF ground.



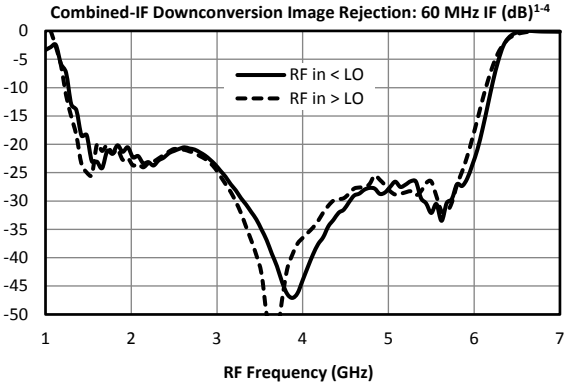
QFN-Package Surface-Mount Landing Pattern
Click here for a DXF of the above layout.
Click here for leaded solder reflow. Click here for lead-free solder reflow

Typical Performance

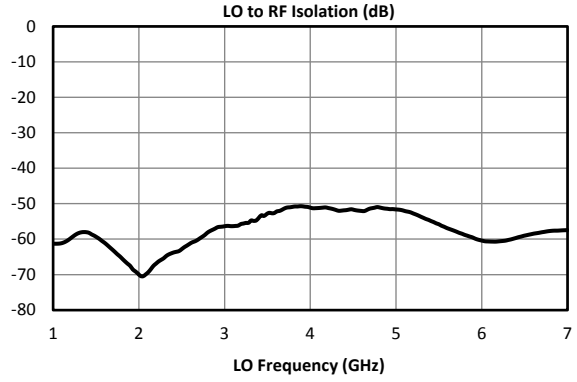
Combined-IF Downconversion Loss: 60 MHz IF (dB)[1-4]



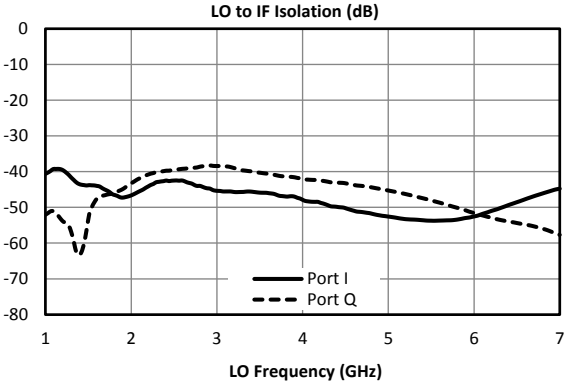
Combined-IF Downconversion Image Rejection: 60 MHz IF (dB)[1-4]



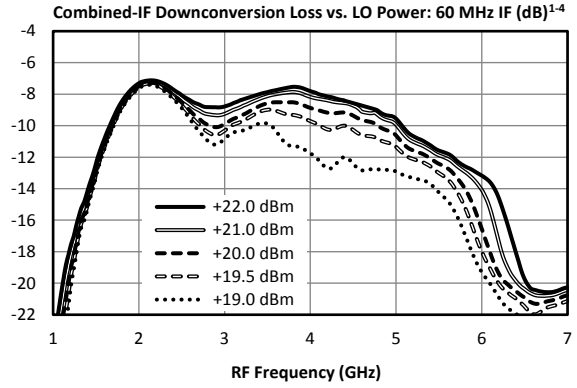
LO to RF Isolation (dB)



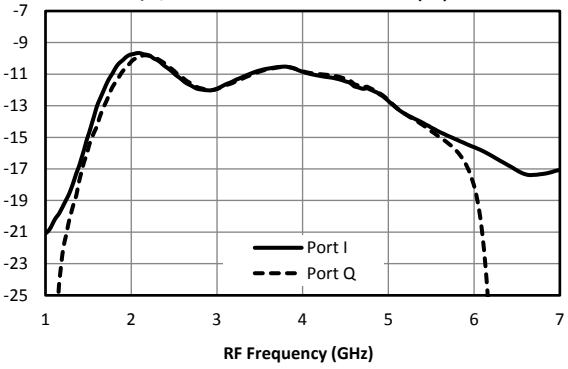
LO to IF Isolation (dB)



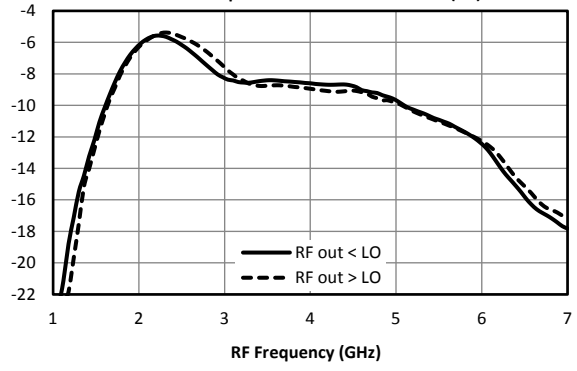
Combined-IF Downconversion Loss vs. LO Power: 60 MHz IF (dB)[1-4]



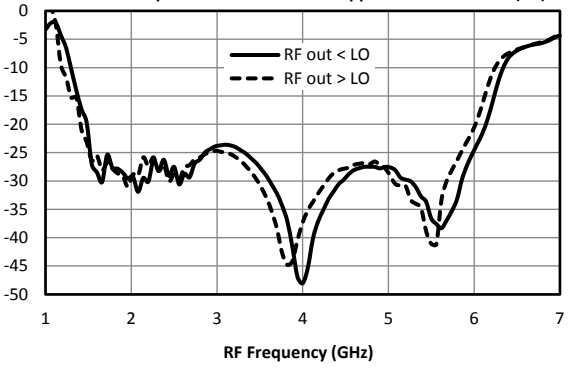
I/Q Port Conversion Loss: 60 MHz IF (dB)[1-4]



Combined-IF Upconversion Loss: 60 MHz IF (dB)[1-4]

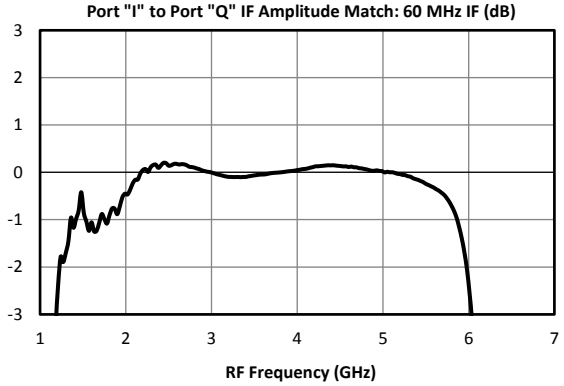


Combined-IF Upconversion Sideband Suppression: 60 MHz IF (dB)[1-4]

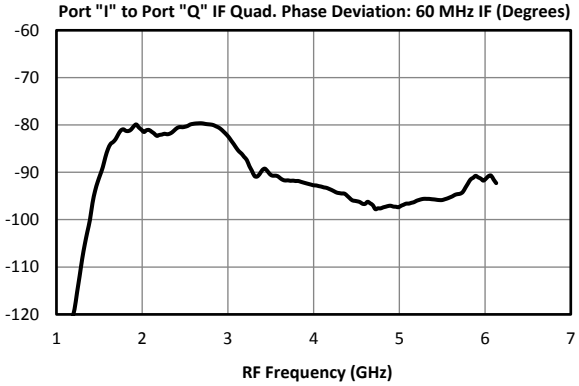


Typical Performance

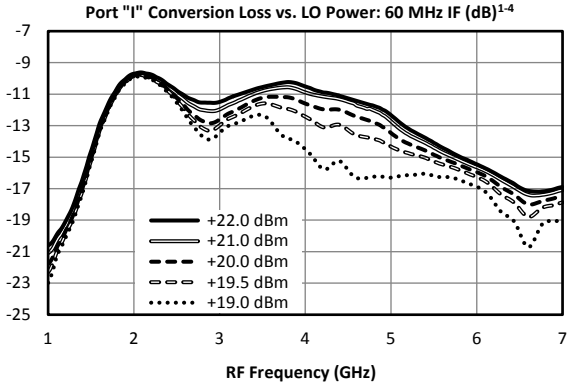
Port "I" to Port "Q" IF Amplitude Match: 60 MHz IF (dB)



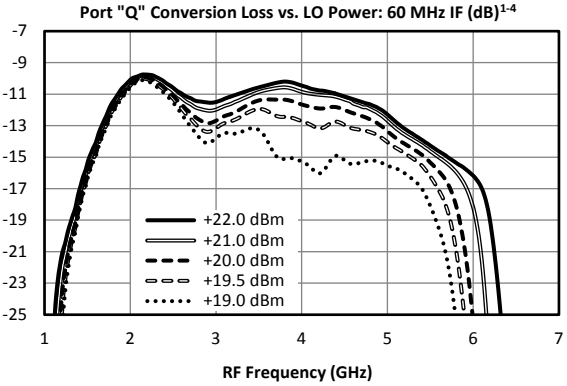
Port "I" to Port "Q" IF Quad. Phase Deviation: 60 MHz IF (Degrees)



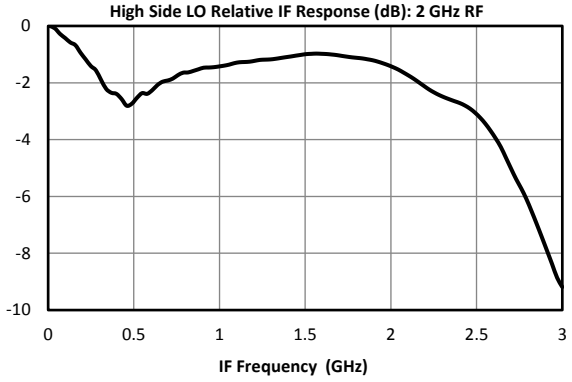
Port "I" Conversion Loss vs. LO Power: 60 MHz IF (dB)[1-4]



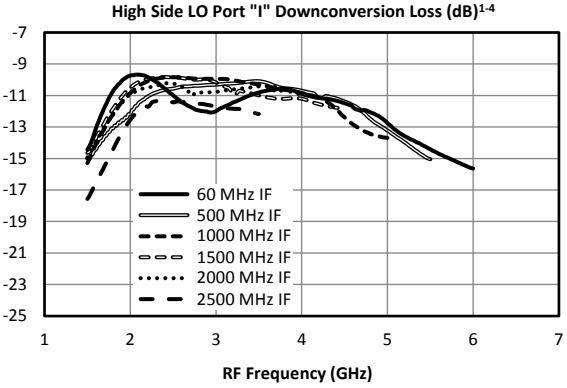
Port "Q" Conversion Loss vs. LO Power: 60 MHz IF (dB)[1-4]



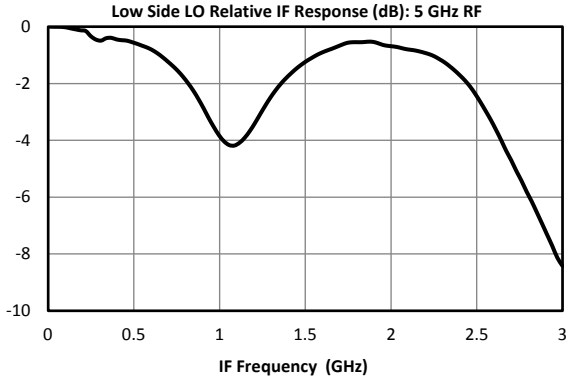
High Side LO Relative IF Response (dB): 2 GHz RF



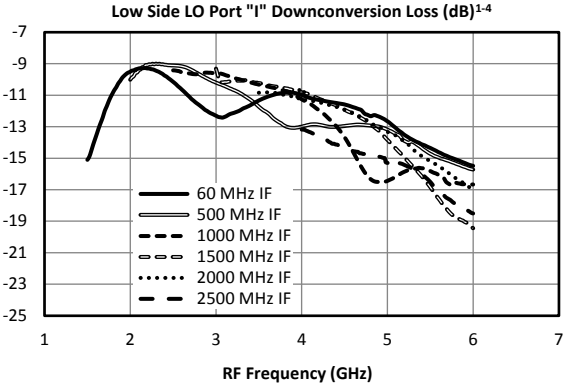
High Side LO Port "I" Downconversion Loss (dB)[1-4]



Low Side LO Relative IF Response (dB): 5 GHz RF

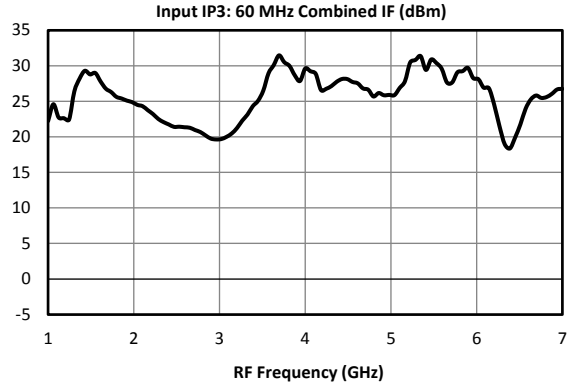


Low Side LO Port "I" Downconversion Loss (dB)[1-4]

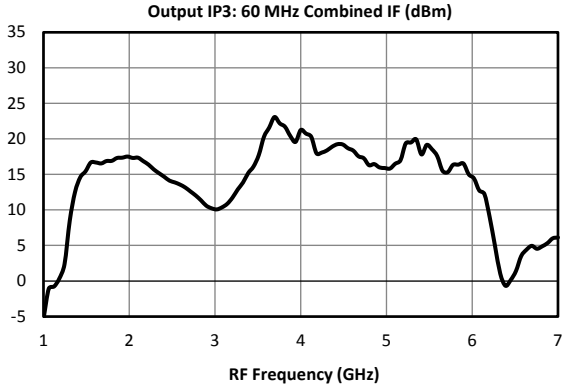


Typical Performance

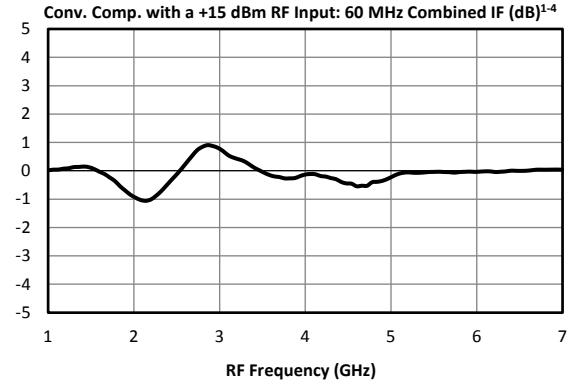
Input IP3: 60 MHz Combined IF (dBm)



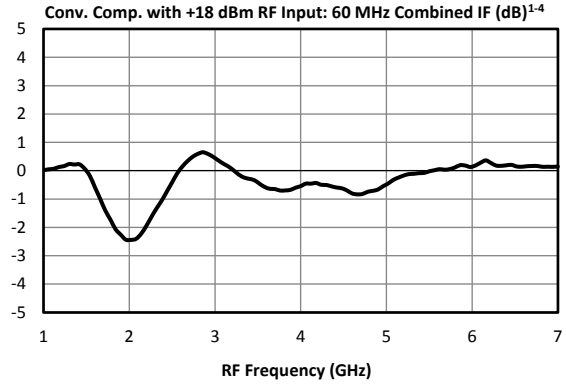
Output IP3: 60 MHz Combined IF (dBm)



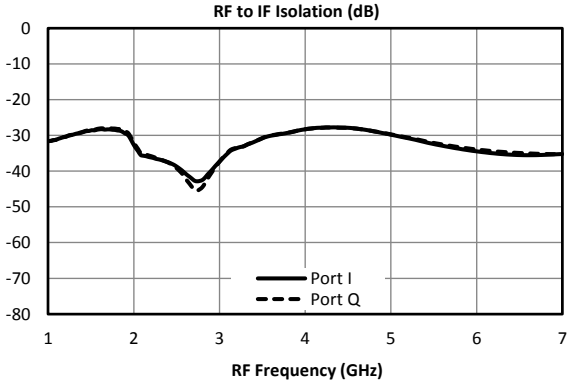
Conv. Comp. with a +15 dBm RF Input: 60 MHz Combined IF (dB)[1-4]



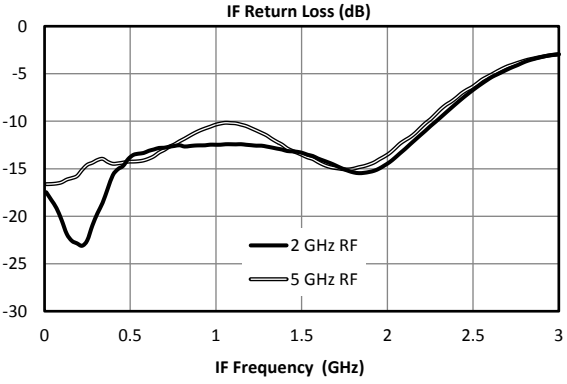
Conv. Comp. with +18 dBm RF Input: 60 MHz Combined IF (dB)[1-4]



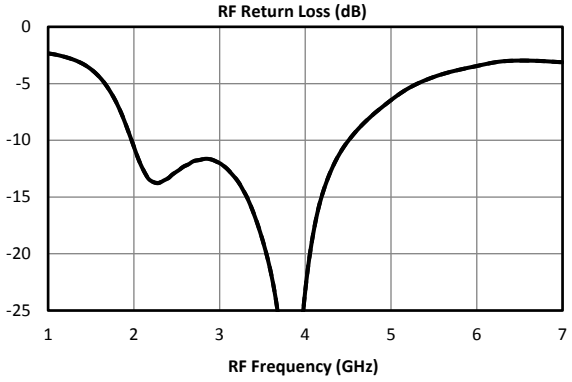
RF to IF Isolation (dB)



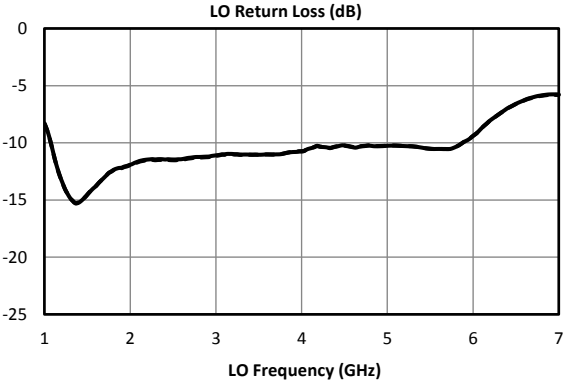
IF Return Loss (dB)



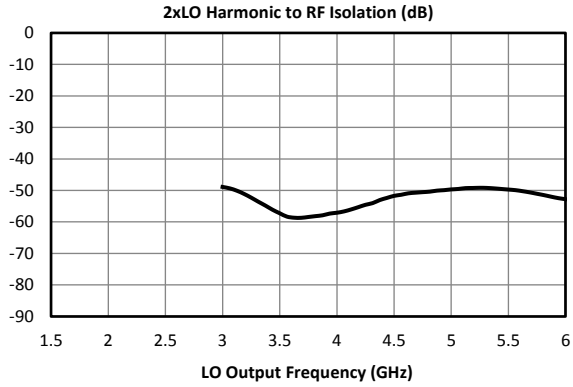
RF Return Loss (dB)

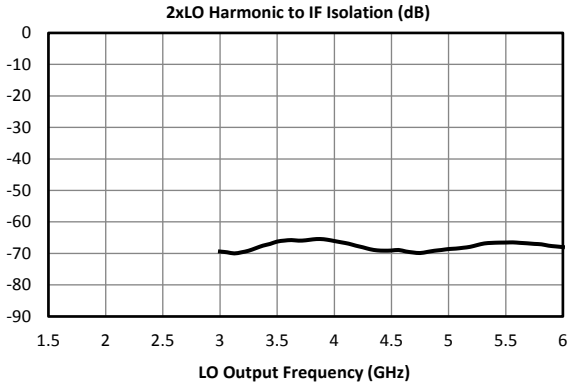


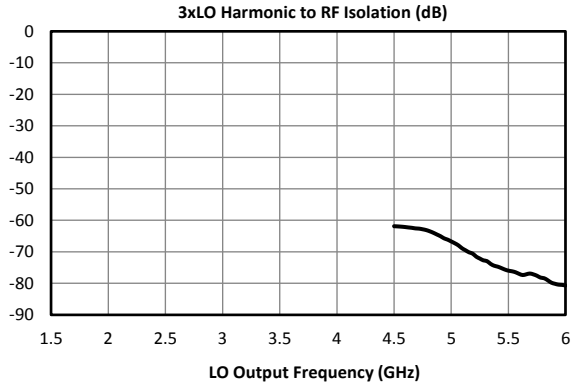
LO Return Loss (dB)

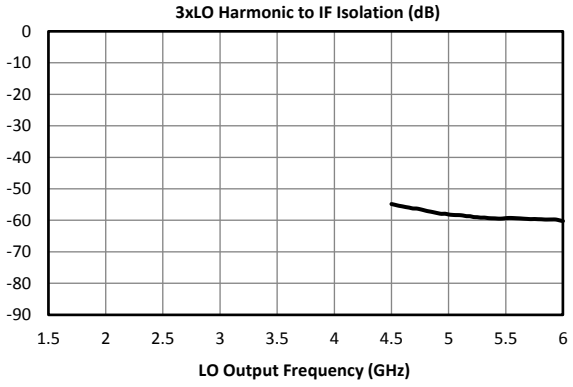


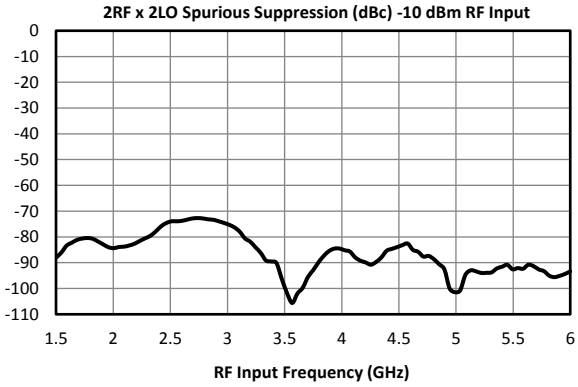
Typical Performance

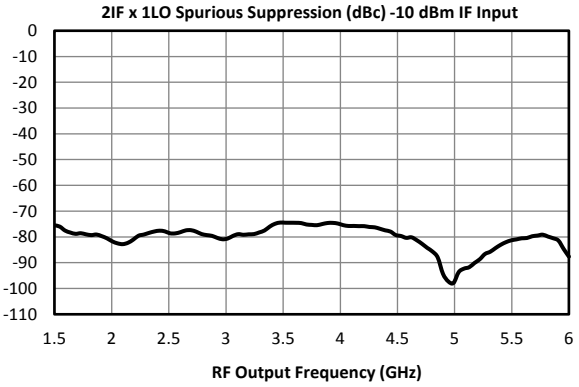












Downconversion Spurious Suppression

Spurious data is taken by selecting RF and LO frequencies (±mLO±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 is 85 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 95 dBc.

Typical Downconversion Spurious Suppression (dBc) [4]

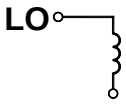
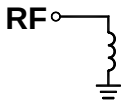
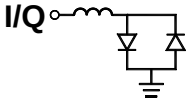
-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xRF	23	Reference	38	17	46	17
2xRF	90	67	85	67	81	70
3xRF	93	85	93	79	93	80
4xRF	N/A	118	120	116	121	118
5xRF	N/A	N/A	131	128	130	130

Upconversion Spurious Suppression [4]

Spurious data is taken by mixing an input within the IF band, with LO frequencies (±mLO±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 IF input. 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 79 dBc for the A configuration for a -10 dBm input, so a -20 dBm IF input creates a spur that is (2-1) x (-10 dB) dB lower, or 89 dBc.

Typical Upconversion Spurious Suppression (dBc)

-10 dBm IF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xIF	22	Reference	38	10	47	N/A
2xIF	66	79	64	92	63	86
3xIF	92	70	93	64	91	70
4xIF	124	124	113	121	111	122
5xIF	142	118	131	121	129	117

Port	Description	DC Interface Schematic
LO	The LO port is DC open and AC matched to 50 Ohms from 1.75 to 5 GHz. Blocking capacitor is optional.	
RF	The RF port is DC short to ground and AC matched to 50 Ohms from 1.75 to 5 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	30 mA
LO DC Current	N/A
IF DC Current[1]	30 mA
RF Power Handling (RF+LO)	+29 dBm at +25°C, derated linearly to +24 dBm at +100°C
Operating Temperature	-55ºC to +100ºC
Storage Temperature	-65ºC to +125ºC

[1]Application of DC current has been known to damage mixer diodes. Any application of DC current >30 mA could cause field damage and void the warranty.

DATA SHEET NOTES:
1. Mixer Conversion Loss, Rejection, Sideband Suppression, and IP3 plot 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 at +100°C and improves less than 0.5 dB at -55°C.
4. Unless otherwise specified S diode data taken with +21 dBm LO drive
5. Specifications are subject to change without notice. Contact Marki Microwave for the most recent specifications and data sheets.
6. Catalog mixer circuits are continually improved. Configuration control requires custom mixer model numbers and specifications.