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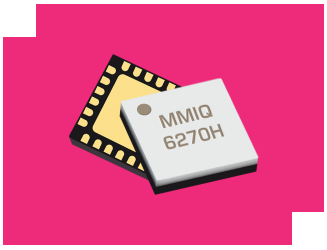
MMIQ-0626HSM-2

Passive GaAs MMIC IQ Mixer

DEVICE OVERVIEW

General Description

MMIQ-0626HSM is a high linearity, passive GaAs MMIC IQ mixer. This is an ultra-broadband mixer spanning 6 to 26 GHz on the RF and LO ports with an IF from DC to 6 GHz. Up to 40 dB of image rejection is available due to the excellent phase and amplitude balance of its on-chip LO quadrature hybrid. Both surface QFNs and evaluation boards are available.



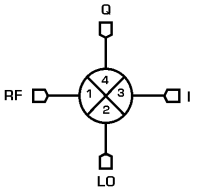
Features

Parameter	Typical	Unit
RF/LO Frequency Range	6 - 26	GHz
IF Frequency Range	DC - 6	GHz
I+Q Conversion Loss	9	dB
Image Rejection	35	dB
LO-RF Isolation	36	dB

Applications

- Single Sideband and Image Rejection Mixing
- IQ Modulation / Demodulation
- Vector Amplitude Modulation
- Band Shifting

Functional Block Diagram



Part Ordering Options

Part Number	Description	Package	Packing Size	Green Status	Product Lifecycle	Export Classification
EVAL-MMIQ-0626H	Evaluation Board, Passive GaAs MMIC 6 - 26 GHz IQ Mixer	-	-	RoHS	Released	EAR99
MMIQ-0626HSM-2	Passive GaAs MMIC IQ Mixer	QFN	-	RoHS	Released	EAR99
MMIQ-0626H-2-TR	Tape and Reel, Passive GaAs MMIC IQ Mixer	QFN	7"	RoHS	Released	EAR99

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Table Of Contents

Revision History

Revision Code	Revision Date	Comment
-	2018-08-01	Datasheet Initial Release
A	2019-08-01	Changed I/Q Max Current Rating
B	2019-10-01	Updated Max Power Rating
C	2022-02-01	I/Q Port Functions, Plots Updated

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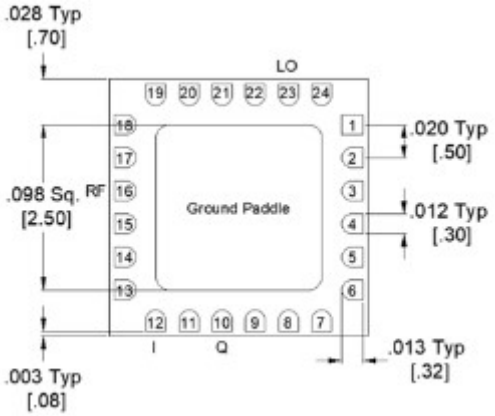
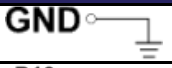
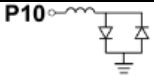
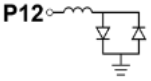
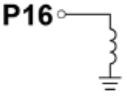
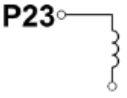
Port Configuration and Functions

Port Diagram

A bottom-up view of the MMIQ-0626H's SM package outline drawing is shown below. The mixer may be operated as either a downconverter or an upconverter. Use of the RF or IF as the input or output port will depend on the application.



Port Functions

Port	Function	Description	Equivalent Circuit for Package
GND	Ground	SM package ground path is provided through the ground paddle.	
Pin 10	Q Input / Output	Pin 10 is diode coupled and AC matched to 50Ω over the specified I port frequency range.	
Pin 12	I Input / Output	Pin 12 is diode coupled and AC matched to 50Ω over the specified Q port frequency range.	
Pin 16	RF Input / Output	Pin 16 is DC short and AC matched to 50Ω over the specified RF frequency range.	
Pin 23	LO Input	Pin 23 is DC open and AC matched to 50Ω over the specified LO frequency range.	

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Specifications

Absolute Maximum Ratings

The Absolute Maximum Ratings indicate limits beyond which damage may occur to the device. If these limits are exceeded, the device may be inoperable or have a reduced lifetime.

Parameter	Maximum Rating	Unit
Maximum Operating Temperature	100	°C
Maximum Storage Temperature	125	°C
Minimum Operating Temperature	-55	°C
Minimum Storage Temperature	-65	°C
Pin 10 DC Current	30	mA
Pin 12 DC Current	30	mA
Power Handling, at any Port	26	dBm

Package Information

Parameter	Details	Rating
ESD	250 to < 500 Volts	HBM Class 1A
Weight	Package name: QFN	13.4g
Dimensions	-	3.9 x 3.9 mm

Recommended Operating Conditions

The Recommended Operating Conditions indicate the limits, inside which the device should be operated, to guarantee the performance given in Electrical Specifications Operating outside these limits may not necessarily cause damage to the device, but the performance may degrade outside the limits of the electrical specifications.

Parameter	Min	Nominal	Max	Unit
RF/IF Input Power	-	-	11	dBm
Ambient Temperature	-55	25	100	°C
LO Input Power	13	19	23	dBm

Sequencing Requirements

There is no requirement to apply power to the ports in a specific order. However, it is recommended to provide a 50Ω termination to each port before applying power. This is a passive diode mixer that requires no DC bias.

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Electrical Specifications

The electrical specifications apply at TA=+25°C in a 50Ω system. Typical data shown is for a down conversion application with a +19dBm sine wave LO input. Min and Max limits apply only to our connectorized units and are guaranteed at TA=+25°C. All bare die are 100% DC tested and visually inspected.

Parameter	Test Conditions	Minimum Frequency (GHz)	Maximum Frequency (GHz)	Min	Typ	Max	Unit
RF Frequency Range	-	-	-	6	-	26	GHz
LO Frequency Range	-	-	-	6	-	26	GHz
Conversion Loss [1]	RF/LO = 6 - 24 GHz I = DC -0.2 GHz	6	24	-	12	16	dB
Conversion Loss [2]	RF/LO = 6 - 24 GHz Q = DC – 0.2 GHz	6	24	-	12	14	dB
Conversion Loss [3]	RF/LO = 6 - 26 GHz I = 0.2 - 6 GHz	6	26	-	12	-	dB
Conversion Loss [4]	RF/LO = 6 - 26 GHz Q = 0.2 - 6 GHz	6	26	-	13	-	dB
Conversion Loss [5]	RF/LO = 24 - 26 GHz Q = DC – 0.2 GHz	24	26	-	14	17	dB
Conversion Loss [6]	RF/LO = 24 - 26 GHz I = DC - 0.2 GHz	24	26	-	12	14	dB
Noise Figure [7]	RF/LO = 6 - 24 GHz I = DC – 0.2 GHz	6	24	-	12	-	dB
Noise Figure [8]	RF/LO = 6 - 24 GHz Q = DC – 0.2 GHz	6	26	-	12	-	dB
Image Rejection [9]	RF/LO = 6 - 26 GHz I+Q = DC – 0.2 GHz	6	26	-	35	-	dB
Input IP3 [10]	RF/LO = 6 - 26 GHz I+Q = DC – 0.2 GHz	6	26	-	25	-	dBm
Amplitude Balance [11]	-	-	-	-	0.5	-	dB
Phase Balance	-	-	-	-	3	-	°
IF Frequency Range	-	-	-	0	-	6	GHz
Input 1 dB Gain Compression Point (P1dB), I	-	-	-	-	11	-	dBm
Input 1 dB Gain Compression Point, Q	-	-	-	-	11	-	dBm
Q (Port 4) Frequency Range	-	-	-	0	-	6	GHz
Isolation, LO to IF	IF/LO = 6 - 26 GHz	6	26	-	43	-	dB
Isolation, LO to RF	RF/LO = 6 - 26 GHz	6	26	-	36	-	dB
Isolation, RF to IF	RF/IF = 6 - 26 GHz	6	26	-	34	-	dB

[1][2][3][4][5][6] Measured as an I/Q down converter. (i.e., I and Q powers are not combined)

[7][8] Mixer Noise Figure typically measures within 0.5 dB of conversion loss for IF frequencies greater than 5 MHz.

[9] Image Rejection and Single sideband performance plots are defined by the upper sideband (USB) or lower sideband (LSB) with respect to the LO signal. Plots are defined by which sideband is selected by the external IF quadrature hybrid.

[10] Typical IIP3 measured with I and Q ports combined with an external quadrature hybrid coupler in a down conversion.

[11] Amplitude and phase balance measured in a down conversion.

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Typical Performance Plots

Parameter		Pin	Start	Nominal	Stop	Units
RF Input Frequency		16	0		26	GHz
RF Input Power				-10		dBm
LO Input Frequency		23	0.091		26.091	GHz
LO Input Power				+19		dBm
IF Output Frequency	Q	10		91		MHz
	I	12		91		
	I+Q[8]	3+4		91		
T_A, Ambient Temperature				+25		°C
Z_0, System Impedance				50		Ω

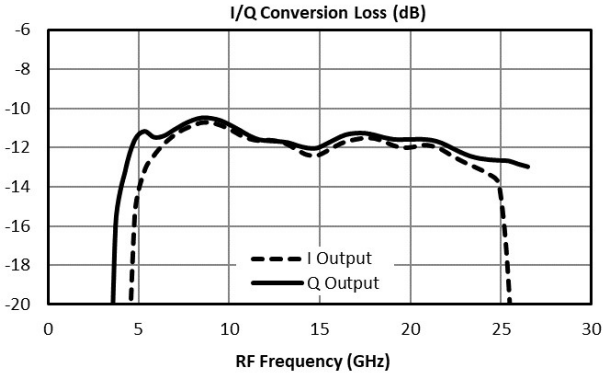
I output means that the IF output signal is measured at the I port of the mixer and the Q port is loaded. Q output means the IF output signal is measured at the Q port of the mixer while the I port is loaded.

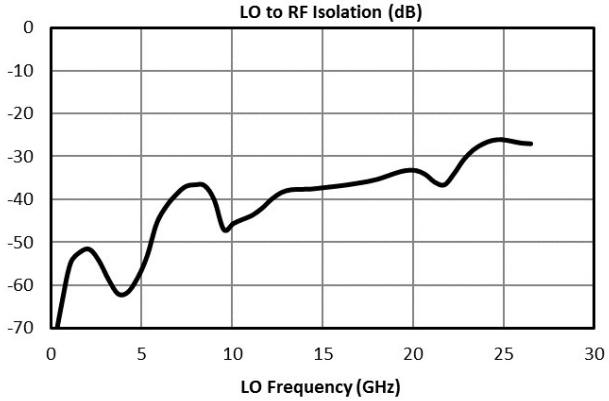
[4]Image Rejection and Single sideband performance plots are defined by the upper sideband (USB) or lower sideband (LSB) with respect to the LO signal. Plots are defined by which sideband is selected by the external IF quadrature hybrid.

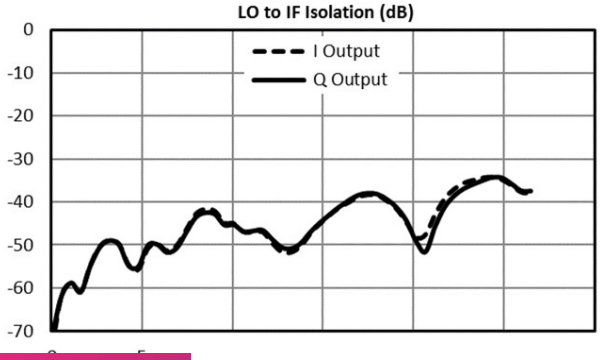
[5] Amplitude and phase balance measured in a down conversion.

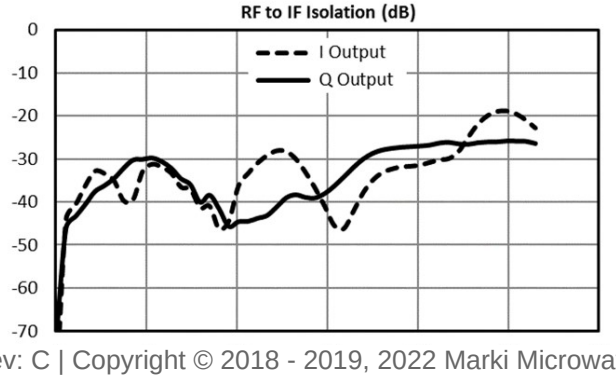
[6] Typical IIP3 measured with I and Q ports combined with an external quadrature hybrid coupler in a down conversion.

[8]I+Q measurements taken with an external quadrature hybrid attached to the I and Q ports of the mixer. Orientation depends on up conversion or down conversion measurement.









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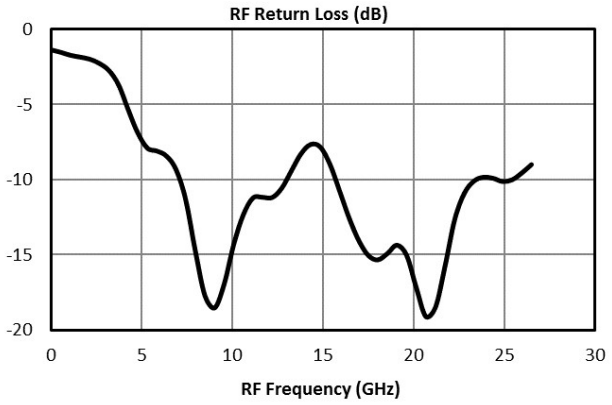

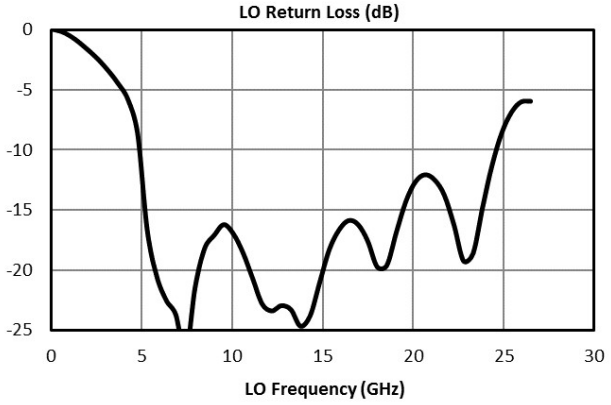

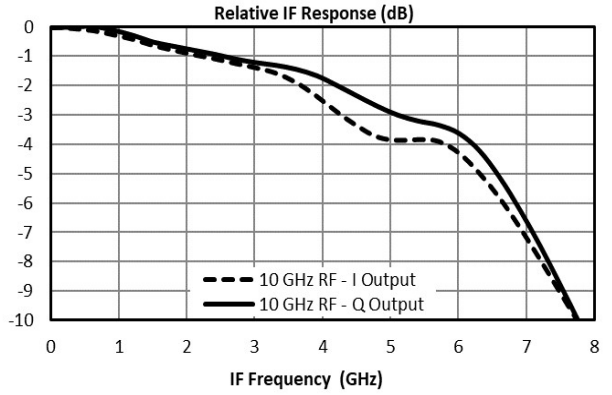

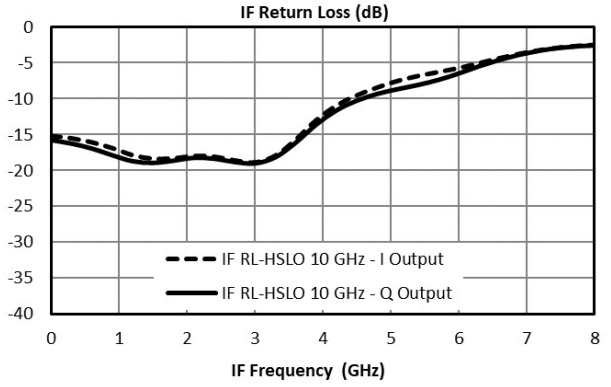

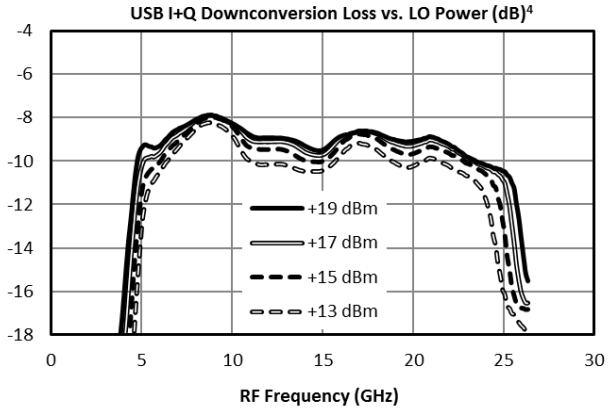

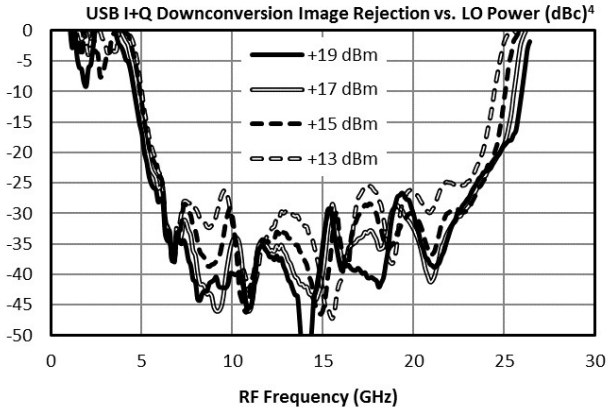

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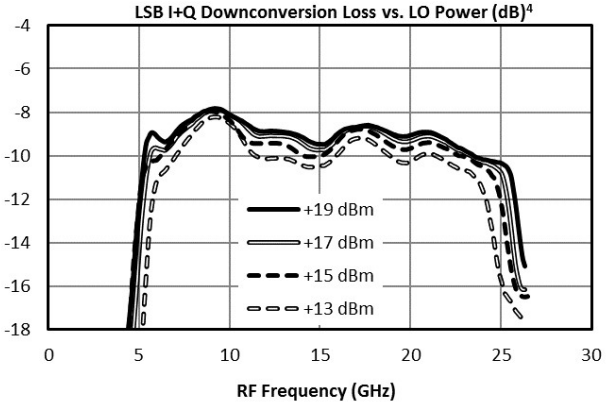
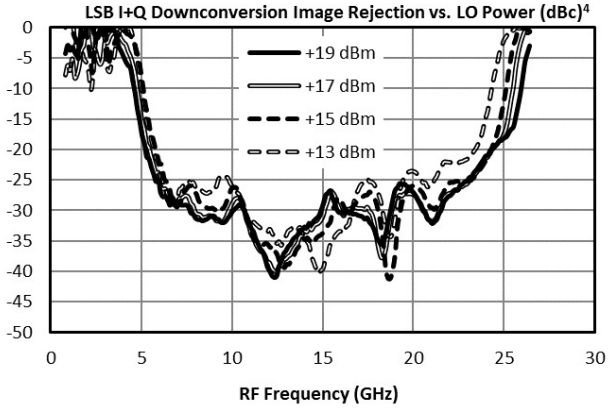
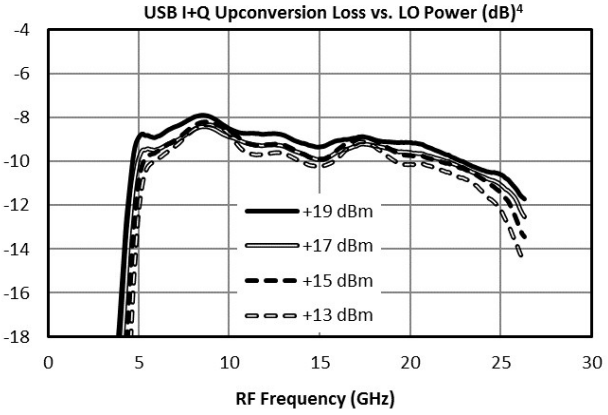
LSB I+Q Downconversion Loss vs. LO Power (dB)[4]



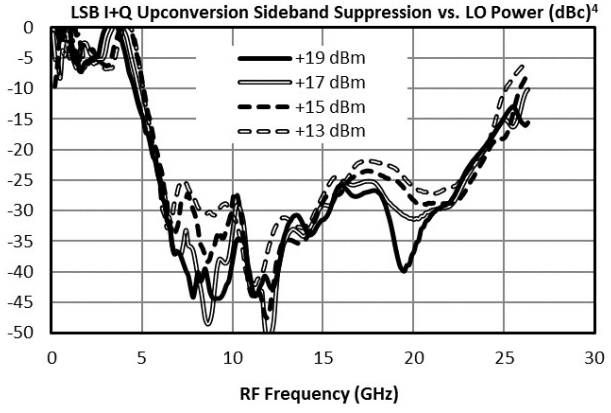
LSB I+Q Downconversion Image Rejection vs. LO Power (dBc)[4]



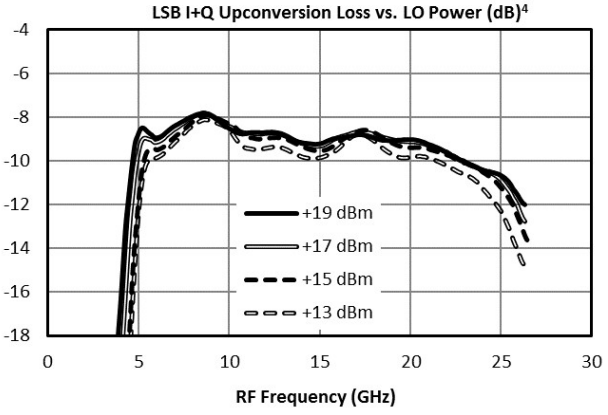
USB I+Q Upconversion Loss vs. LO Power (dB)[4]



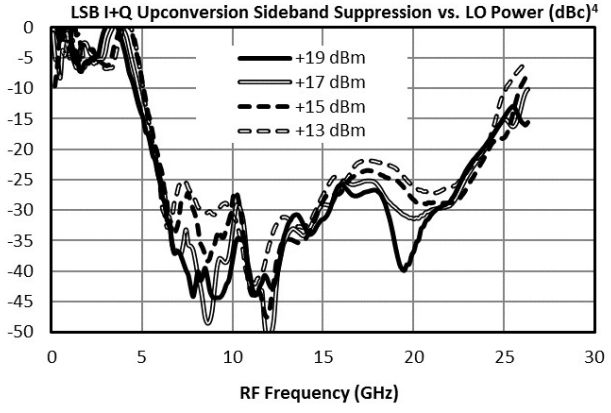
LSB I+Q Upconversion Sideband Suppression vs. LO Power (dBc)[4]



LSB I+Q Upconversion Loss vs. LO Power (dB)[4]



LSB I+Q Upconversion Sideband Suppression vs. LO Power (dBc)[4]



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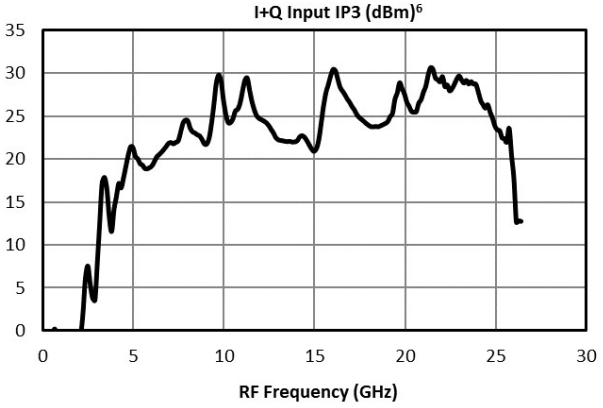
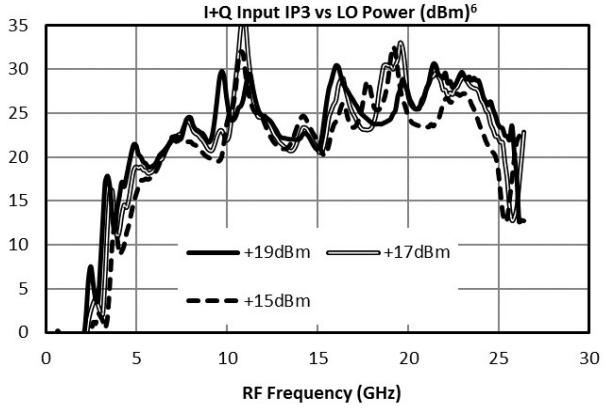
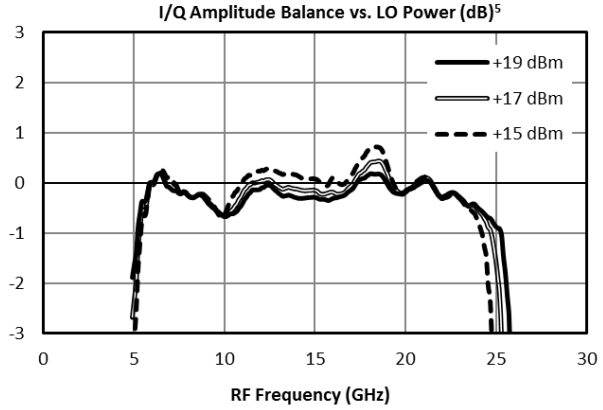
I+Q Input IP3 (dBm)[6]



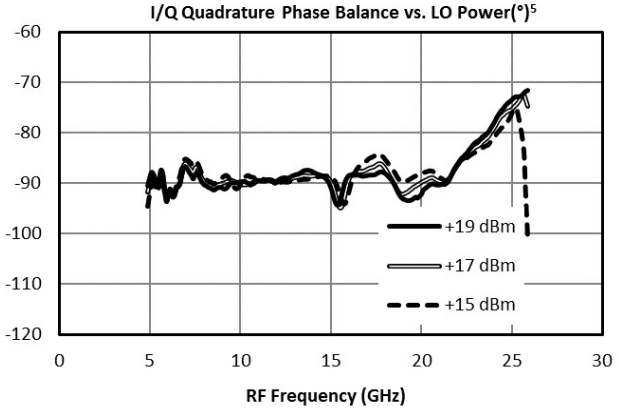
I+Q Input IP3 vs LO Power (dBm)[6]



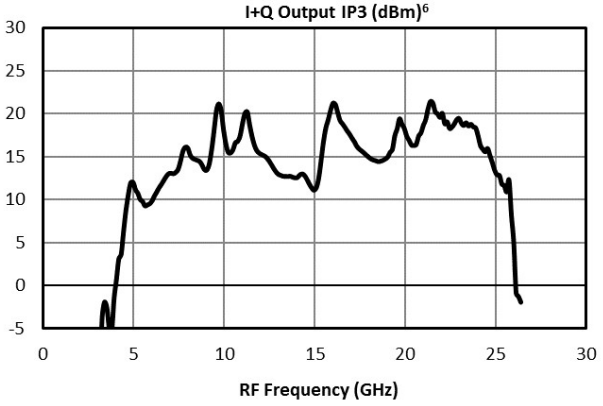
I/Q Amplitude Balance vs. LO Power (dB)[5]



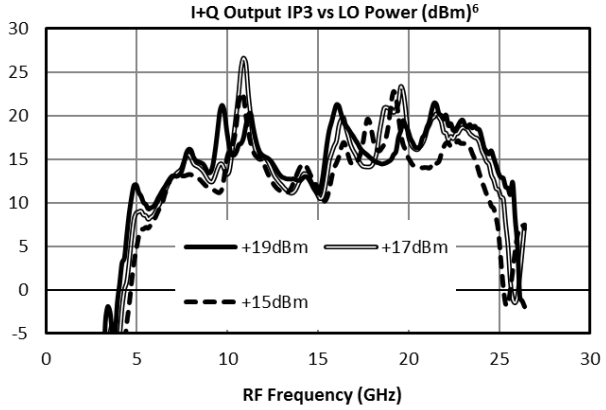
I/Q Quadrature Phase Balance vs. LO Power(°)[5]



I+Q Output IP3 (dBm)[6]



I+Q Output IP3 vs LO Power (dBm)[6]



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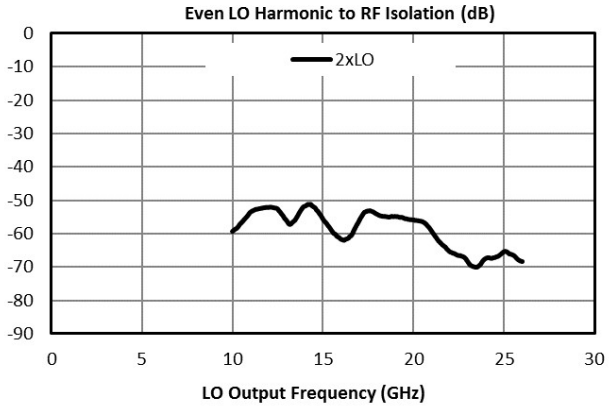

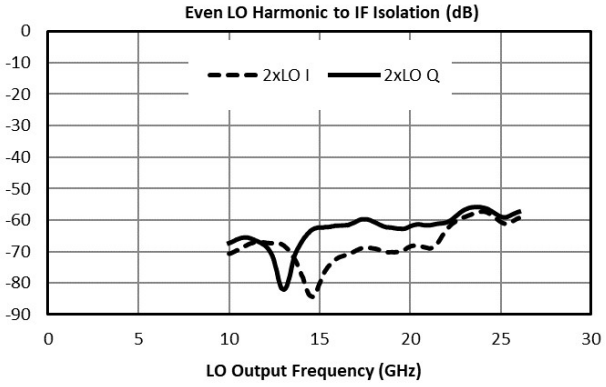

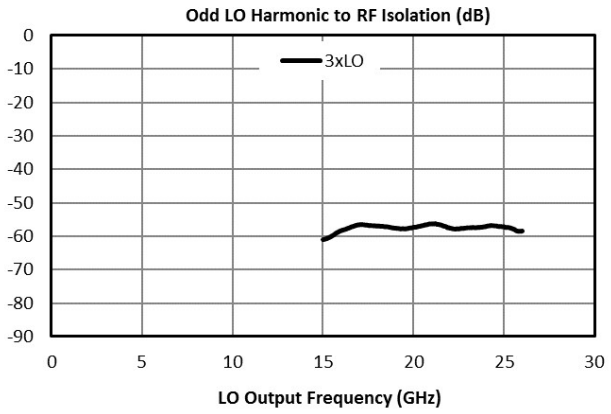

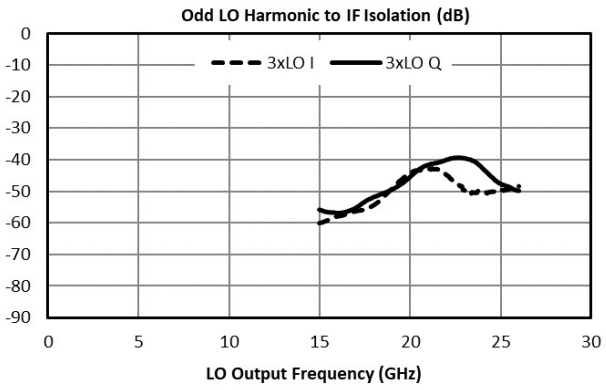

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Spur Table

Typical Spurious Performance: Down-Conversion

Typical spurious data is provided by selecting RF and LO frequencies (± m*LO ± n*RF) 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 2RF x 2LO spur is 80 dBc for a -10 dBm input, so a -20 dBm RF input creates a spur that is (2-1) x (-10 dB) lower, or 90 dBc isolation.

Typical Down-conversion spurious suppression (dBc): Q Port (I Port)

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
0xRF	-	49 (50)	60 (60)	57 (56)	74 (75)	N/A
1xRF	33 (39)	Reference	47 (36)	60 (52)	51 (60)	N/A
2xRF	73 (77)	54 (56)	80 (74)	63 (64)	79 (77)	78 (70)
3xRF	96 (95)	69 (69)	83 (86)	79 (81)	99 (99)	72 (74)
4xRF	131 (131)	103 (109)	119 (120)	100 (110)	122 (121)	115 (115)
5xRF	N/A	N/A	135 (137)	131 (131)	126 (134)	131 (133)

Typical Spurious Performance: Up-Conversion

Typical spurious data is taken by mixing an input within the IF band, with LO frequencies (± m*LO ± n*IF), 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 41 dBc for a -10 dBm input with a sine-wave LO, so a -20 dBm IF input creates a spur that is (2-1) x (-10 dB) lower, or 51 dBc.

-10 dBm IF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
0xIF	-	39 (44)	59 (59)	67 (67)	66 (66)	N/A
1xIF	33 (39)	Reference	36 (33)	22 (26)	58 (49)	N/A
2xIF	54 (55)	41 (41)	65 (66)	64 (56)	100 (101)	89 (75)
3xIF	88 (85)	54 (55)	83 (84)	66 (59)	101 (91)	90 (84)
4xIF	112 (113)	84 (84)	103 (107)	95 (89)	110 (106)	121 (104)
5xIF	131 (132)	108 (109)	128 (129)	104 (103)	126 (127)	125 (110)

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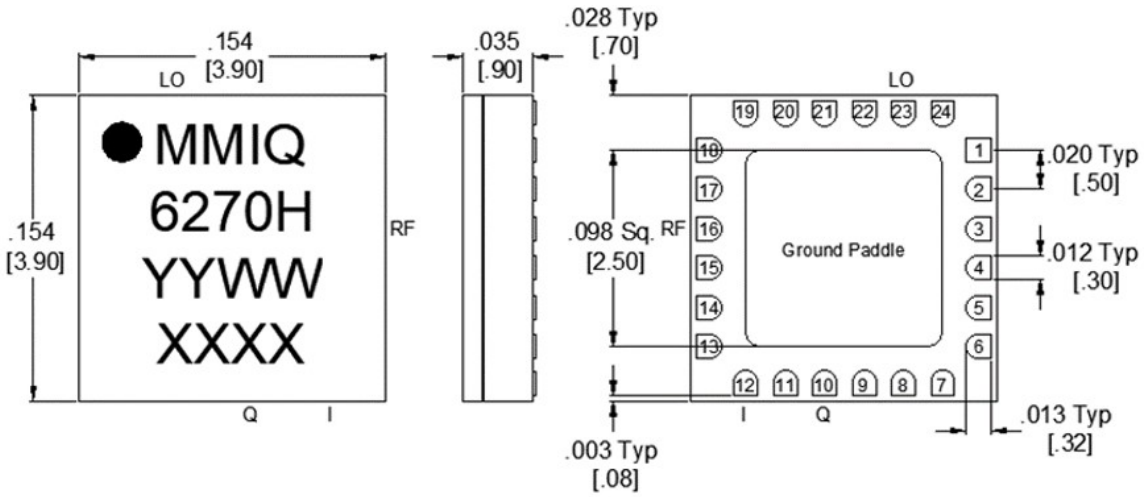
Mechanical Data

Outline Drawing



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

1. Substrate material is ceramic.
2. I/O Leads and Ground Paddle plating is (from base to finish):

Ni:	8.89um MAX	1.27um MIN
Pd:	0.17um MAX	0.07um MIN
Au	0.254um MAX	0.03um MIN

3. All unconnected pads should be connected to PCB RF ground.

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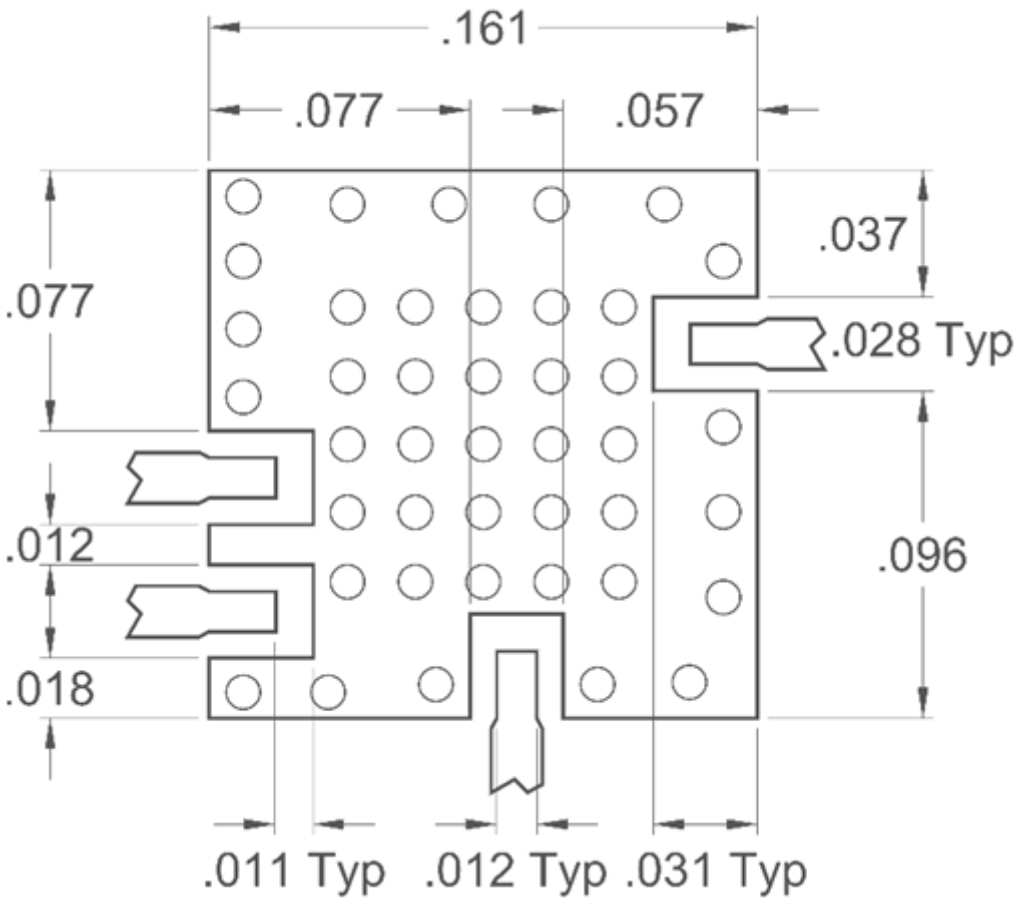
Footprint Image



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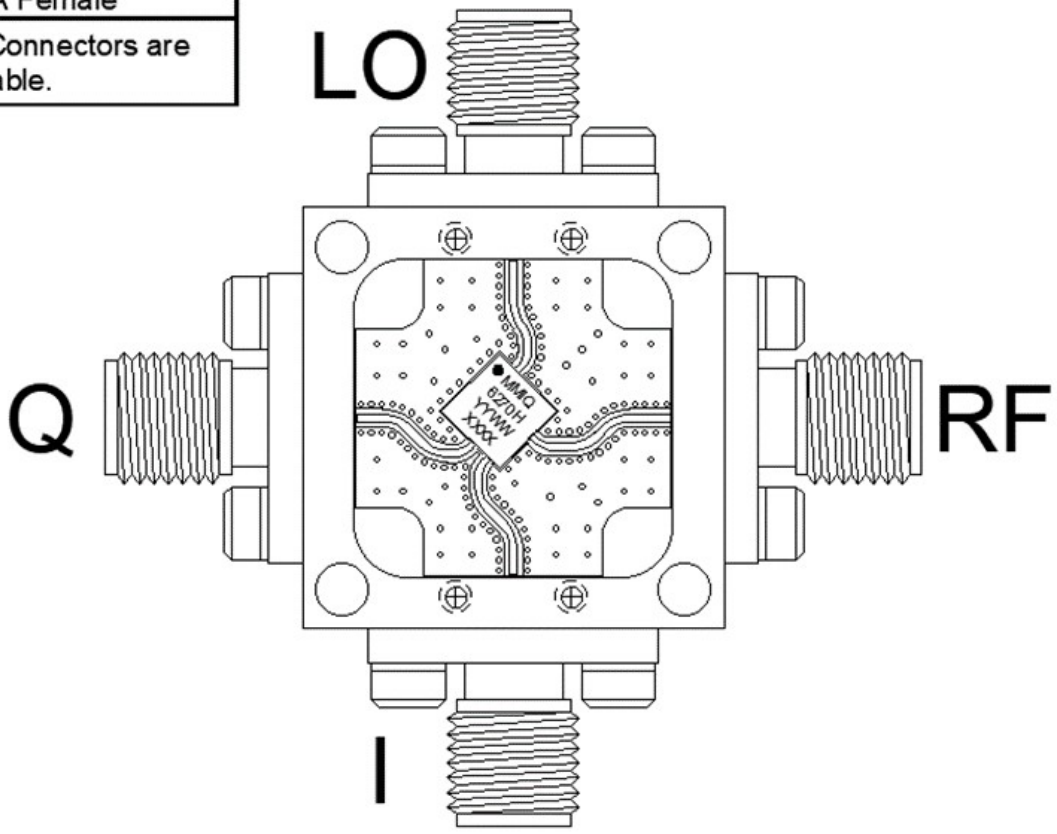
Port	Connector Type
LO	SMA Female
RF	SMA Female
I/Q	SMA Female
Note: Eval Connectors are not removeable.	



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