

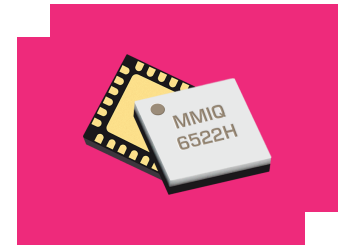
# MMIQ-0416HSM-2

## Passive GaAs MMIC IQ Mixer

### DEVICE OVERVIEW

#### General Description

MMIQ-0416HSM is a high linearity, passive GaAs MMIC IQ mixer. This is an ultra-broadband mixer spanning 4 to 16 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. The MMIQ 0416HSM is available in a 4x4 mm QFN package. Evaluation boards are available.



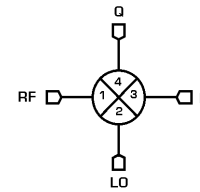
#### Features

N/A

#### Applications

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

#### Functional Block Diagram



#### Part Ordering Options

Part Number	Description	Package	Green Status	Product Lifecycle	Export Classification
MMIQ-0416HSM-2	Passive GaAs MMIC IQ Mixer	QFN	REACH RoHS	Released	EAR99
EVAL-MMIQ-0416H	Evaluation Board, Passive GaAs MMIC 4 - 16 GHz IQ Mixer	EVAL	REACH RoHS	Released	EAR99

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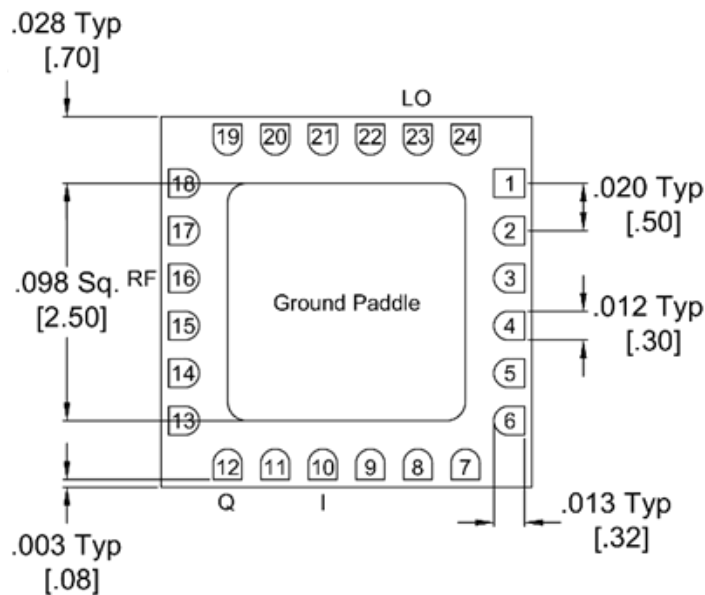
## Revision History

Revision Code	Revision Date	Comment
-	2019-03-01	Datasheet Initial Release
A	2019-08-01	Changed I/Q Max Current Rating
B	2019-10-01	Updated Max Power Handling Spec

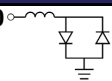
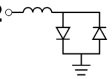
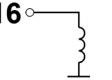
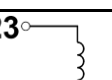
## Port Configuration and Functions

### Port Diagram

A bottom-up view of the MMIQ-0416H'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
Pin 10	I Input / Output	Pin 10 is diode coupled and AC matched to 50Ω over the specified I port frequency range.	<b>P10</b> 
Pin 12	Q Input / Output	Pin 12 is diode coupled and AC matched to 50Ω over the specified Q port frequency range.	<b>P12</b> 
Pin 16	RF Input / Output	Pin 16 is DC short and AC matched to 50Ω over the specified RF frequency range.	<b>P16</b> 
Pin 23	LO Input	Pin 23 is DC open and AC matched to 50Ω over the specified LO frequency range.	<b>P23</b> 

## 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
Dimensions	-	4 x 4 mm
Moisture Sensitivity Level	-	MSL 1

### 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. For limits, above which damage may occur, see Absolute Maximum Ratings.

Parameter	Min	Nominal	Max	Unit
LO Input Power	13	20	22	dBm
Ambient Temperature	-55	25	100	°C
RF/IF Input Power	-	-	11	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.

**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 +20 dBm 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
Balance <sup>1</sup>	-	-	-	-	0.5	-	dB
Conversion Loss <sup>2</sup>	RF/LO = 4 - 15 GHz I = 0.2 - 6 GHz	4	15	-	14	-	dB
Conversion Loss <sup>3</sup>	RF/LO = 4 - 15 GHz I = DC - 0.2 GHz	4	15	-	11.7	15	dB
Conversion Loss <sup>4</sup>	RF/LO = 4 - 15 GHz Q = 0.2 - 6 GHz	4	15	-	14	-	dB
Conversion Loss <sup>5</sup>	RF/LO = 4 - 15 GHz Q = DC - 0.2 GHz	4	15	-	11.4	15	dB
IF Frequency Range	-	-	-	0	-	6	GHz
Image Rejection <sup>6</sup>	RF/LO = 4 - 16 GHz I+Q = DC - 0.2 GHz	4	16	-	31	-	dBc
Input 1 dB Gain Compression Point, I	-	-	-	-	10	-	dBm
Input 1 dB Gain Compression Point, Q	-	-	-	-	11	-	dBm
Input IP3 <sup>7</sup>	RF/LO = 4 - 6 GHz I = DC - 0.2 GHz	4	6	-	25	-	dBm
Isolation, LO to IF	IF/LO = 4 - 16 GHz	4	16	-	39	-	dB
Isolation, LO to RF	RF/LO = 4 - 16 GHz	4	16	-	51	-	dB
Isolation, RF to IF	RF/IF = 4 - 16 GHz	4	16	-	31	-	dB
LO Frequency Range	-	-	-	4	-	16	GHz
Noise Figure <sup>8</sup>	RF/LO = 4 - 16 GHz I = DC - 0.2 GHz	4	16	-	12	-	dB
Noise Figure <sup>9</sup>	RF/LO = 4 - 16 GHz Q = DC - 0.2 GHz	4	16	-	12	-	dB
Phase Balance	-	-	-	-	2	-	°
Q (Port 4) Frequency Range	-	-	-	0	-	6	GHz
RF Frequency Range	-	-	-	4	-	16	GHz

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

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

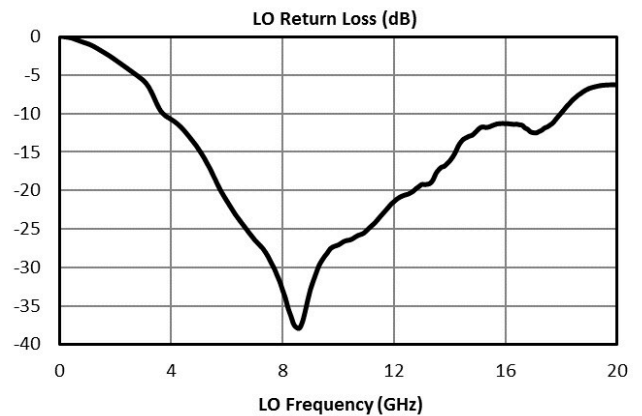
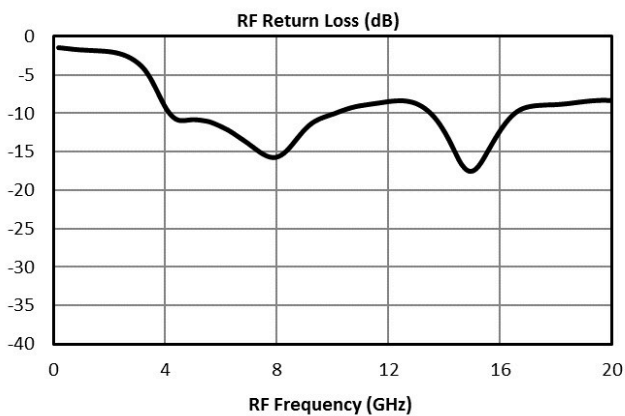
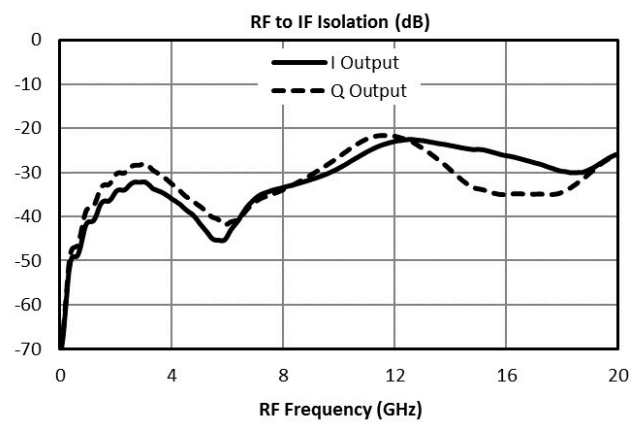
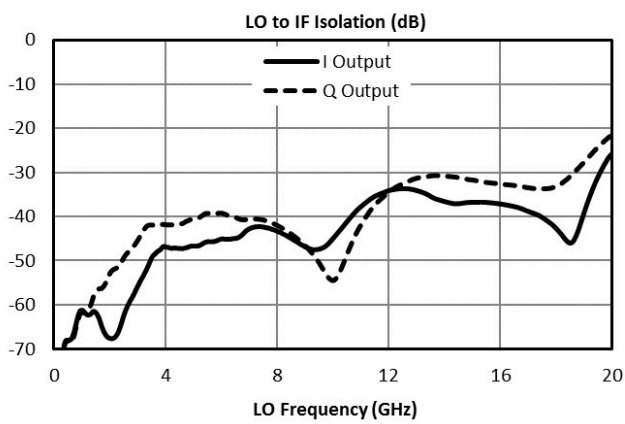
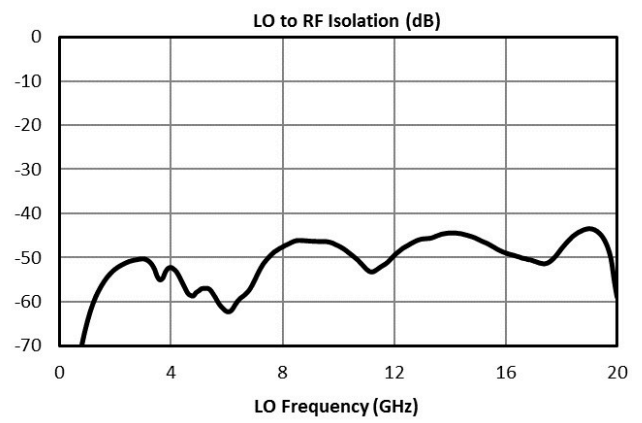
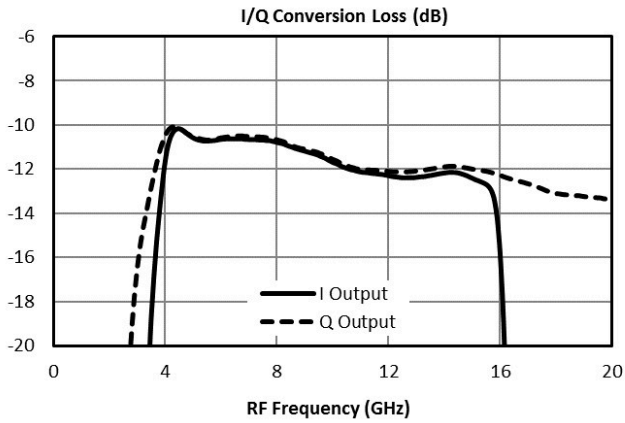
[6] Image Rejection and Single sideband performance plots are defined by the upper sideband (USB) or lower sideband (LSB) with respect to the LO signal. Plots are defined by which sideband is selected by the external IF quadrature hybrid.

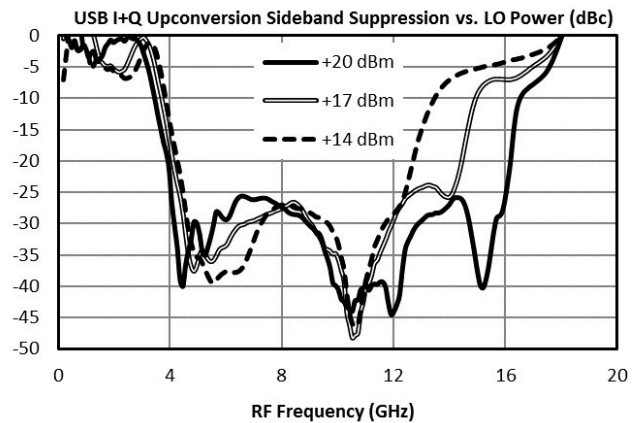
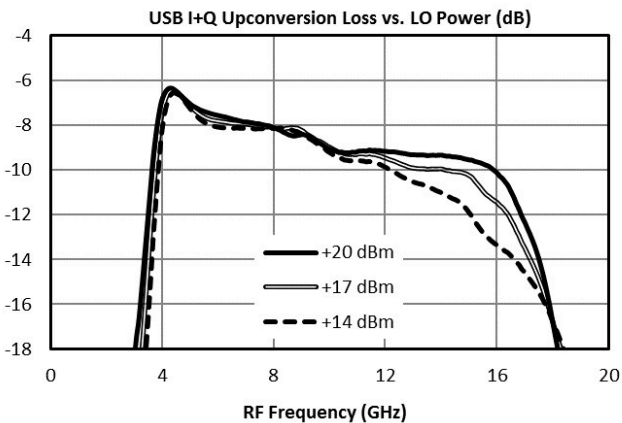
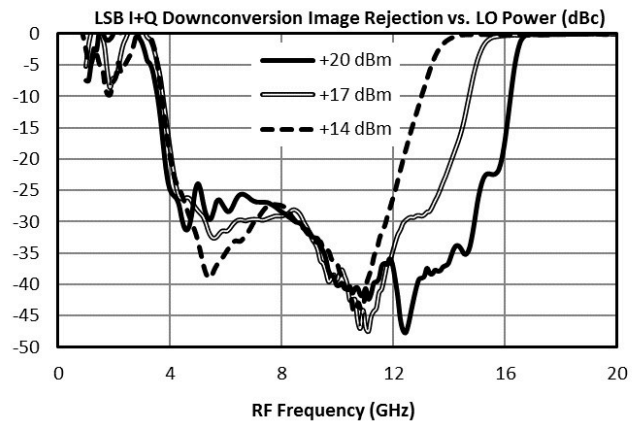
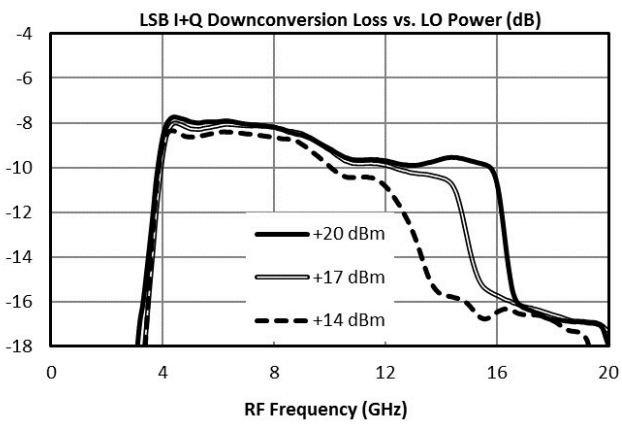
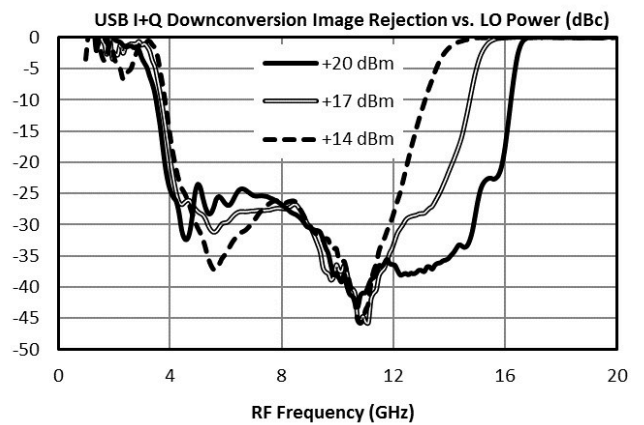
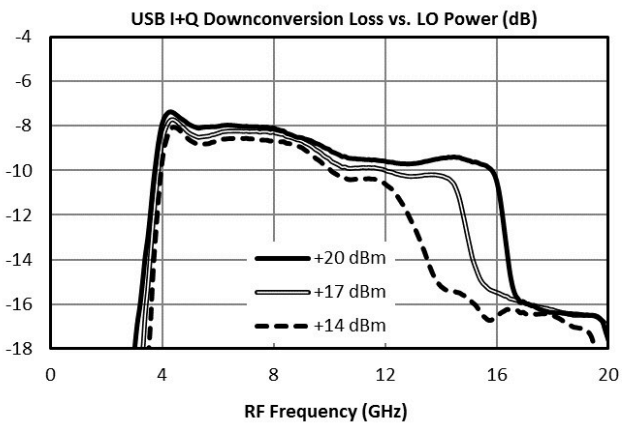
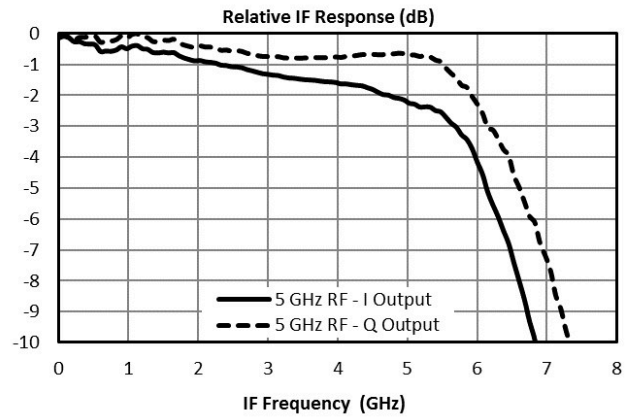
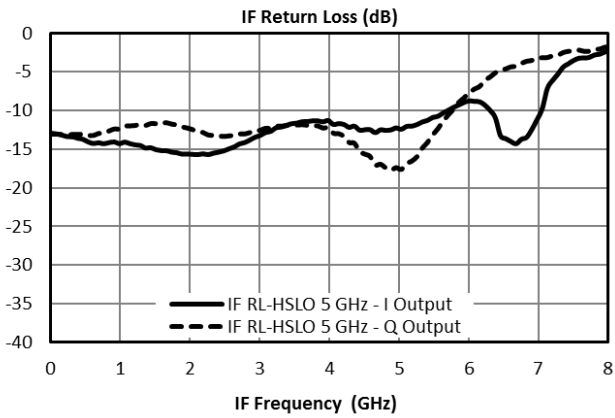
[7] Typical IIP3 is measured with I and Q ports combined with an external quadrature hybrid coupler in a down conversion.

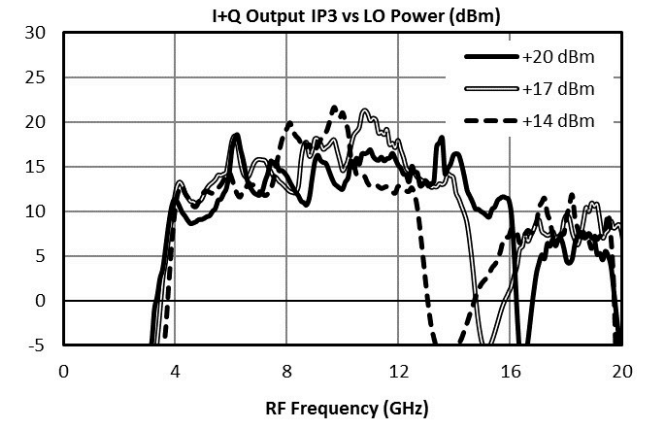
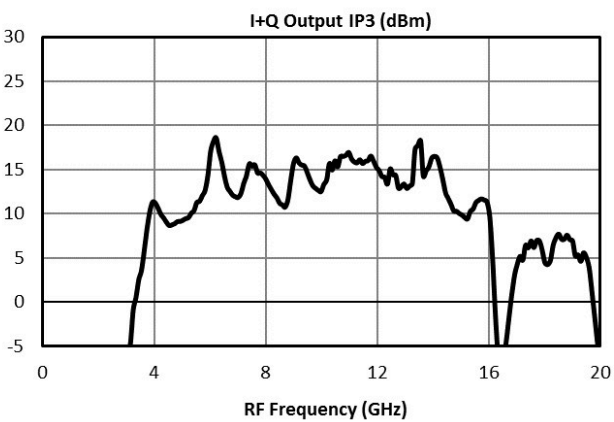
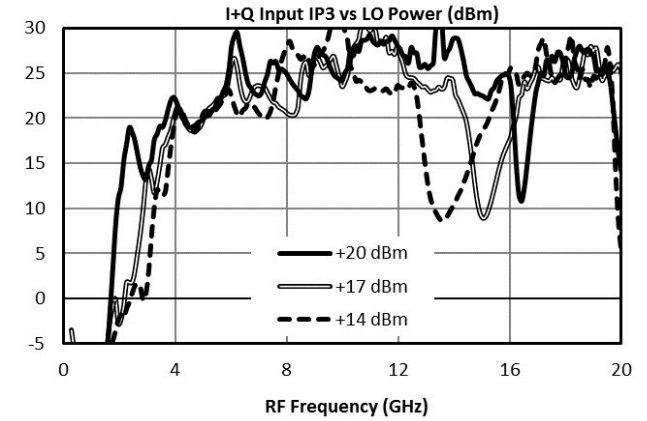
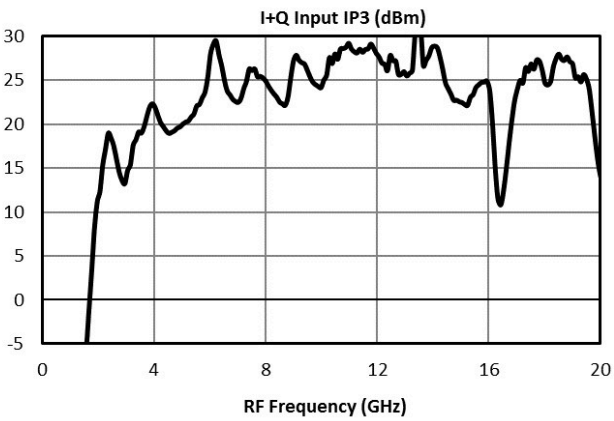
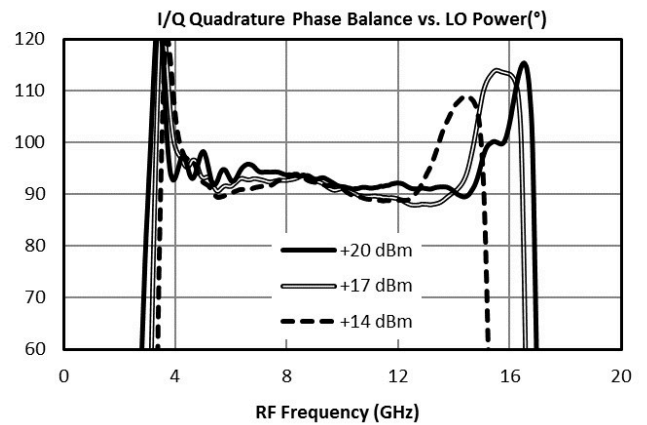
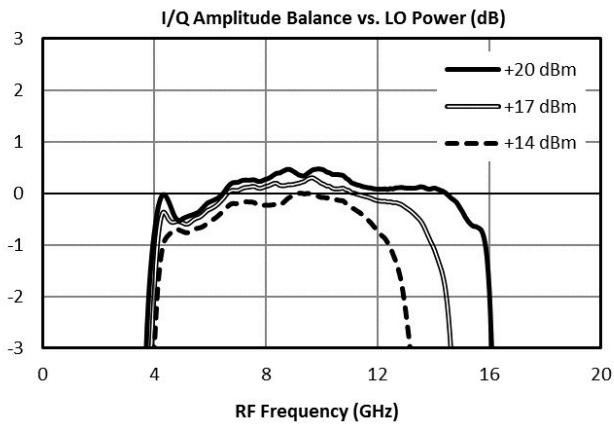
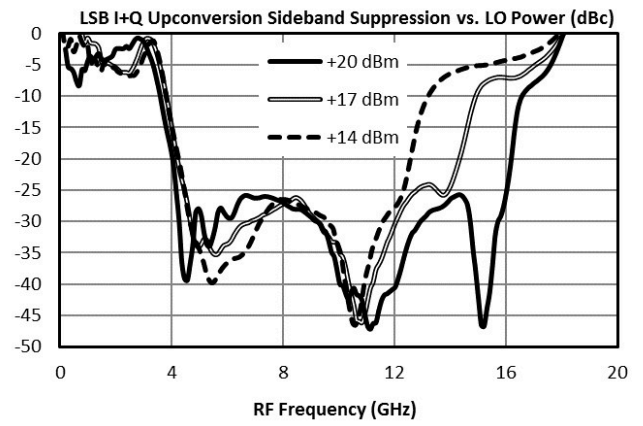
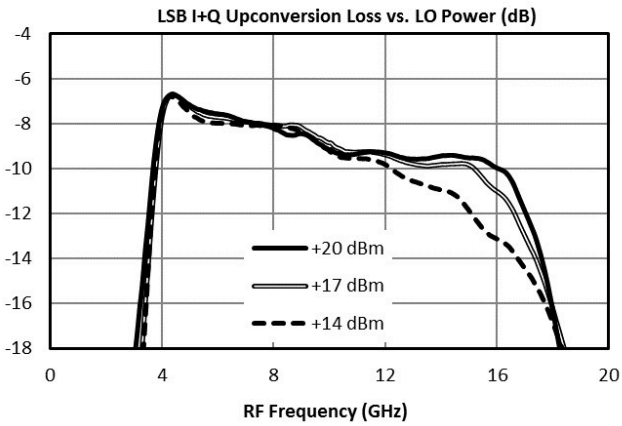
[8][9] Mixer Noise Figure typically measures within 0.5 dB of conversion loss for IF frequencies greater than 5 MHz.

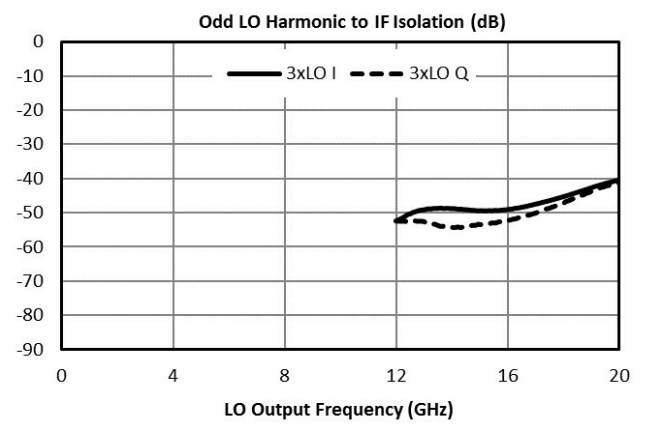
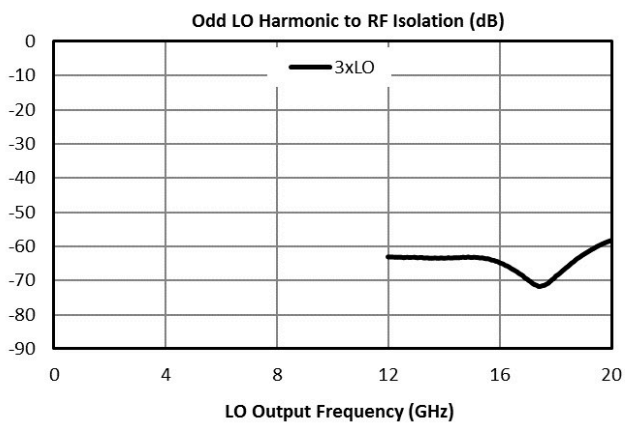
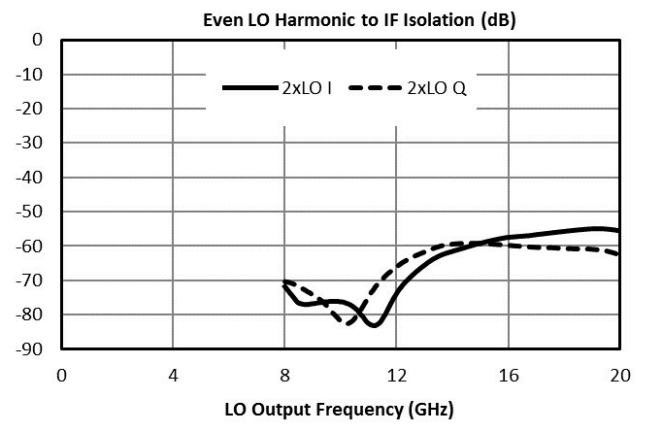
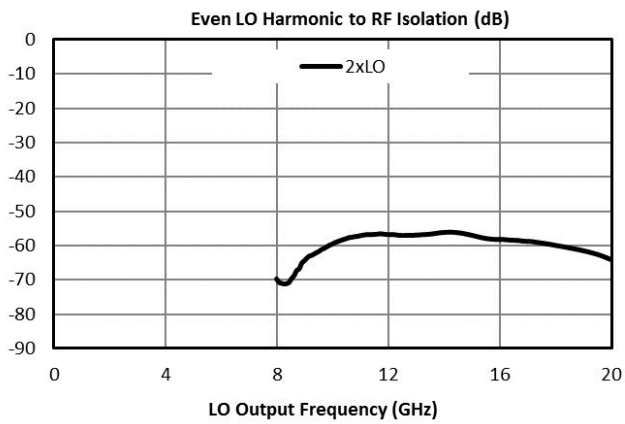
### Typical Performance Plots

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.









## Spur Table

### Typical Spurious Performance: Down-Conversion

Typical spurious data is provided by selecting RF and LO frequencies ( $\pm m \cdot \text{LO} \pm n \cdot \text{RF}$ ) 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 73 dBc for a -10 dBm input, so a -20 dBm RF input creates a spur that is (2-1) x (-10 dB) lower, or 83 dBc.

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

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
0xRF	-	41 (39)	70 (68)	49 (52)	N/A	N/A
1xRF	31 (31)	Reference	30 (35)	16 (11)	N/A	N/A
2xRF	72 (66)	53 (59)	73 (70)	64 (63)	64 (66)	63 (56)
3xRF	99 (97)	63 (72)	93 (95)	82 (85)	95 (89)	85 (82)
4xRF	N/A	N/A	120 (124)	116 (121)	124 (122)	119 (117)
5xRF	N/A	N/A	137 (143)	138 (140)	138 (141)	138 (140)

**Typical Spurious Performance: Up-Conversion**

Typical spurious data is taken by mixing an input within the IF band, with LO frequencies ( $\pm m \cdot LO \pm n \cdot IF$ ), 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  $2IF \pm 1LO$  spur is typically 73 dBc for a -10 dBm input with a sine-wave LO, so a -20 dBm IF input creates a spur that is  $(2-1) \times (-10 \text{ dB})$  lower, or 83 dBc.

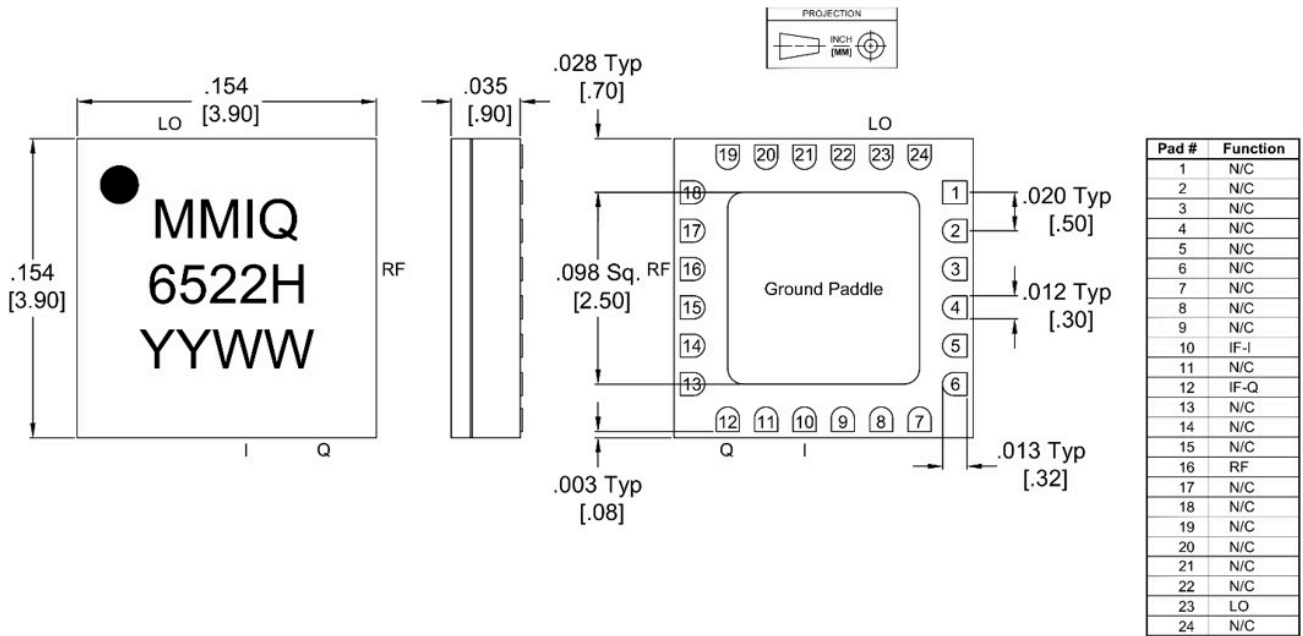
**Typical Up-conversion spurious suppression (dBc): I Port (Q Port)**

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
0xIF	-	22 (22)	59 (59)	65 (65)	N/A	N/A
1xIF	31 (31)	Reference	39 (32)	13 (13)	N/A	N/A
2xIF	82 (82)	73 (67)	58 (58)	79 (75)	N/A	N/A
3xIF	105 (106)	71 (68)	87 (76)	70 (74)	N/A	N/A
4xIF	113 (113)	117 (118)	100 (106)	126 (121)	N/A	N/A
5xIF	137 (136)	118 (119)	133 (133)	118 (124)	N/A	N/A

**Mechanical Data**

**Outline Drawing**

Download : [Outline 2D Drawing](#) | [Outline 3D Drawing](#) | [Outline 3D STP](#)

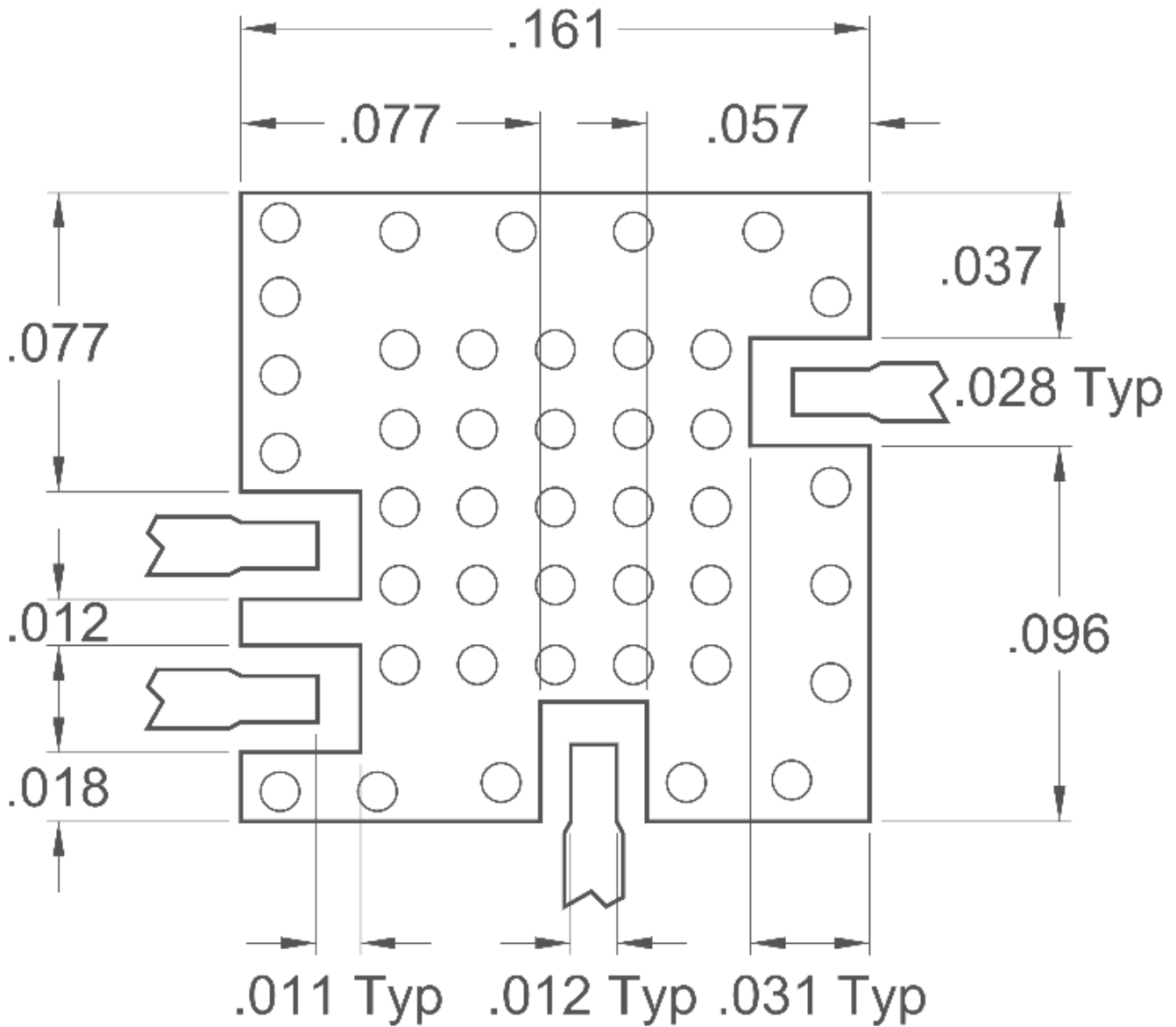


- Substrate material is ceramic.
- I/O Leads and Ground Paddle plating is (from base to finish):
 

Ni:	8.89um MAX	1.27um MIN
Pd:	0.17um MAX	0.07um MIN
Au:	0.254um MAX	0.03um MIN
- All unconnected pads should be connected to PCB RF ground.

**Footprint Image**

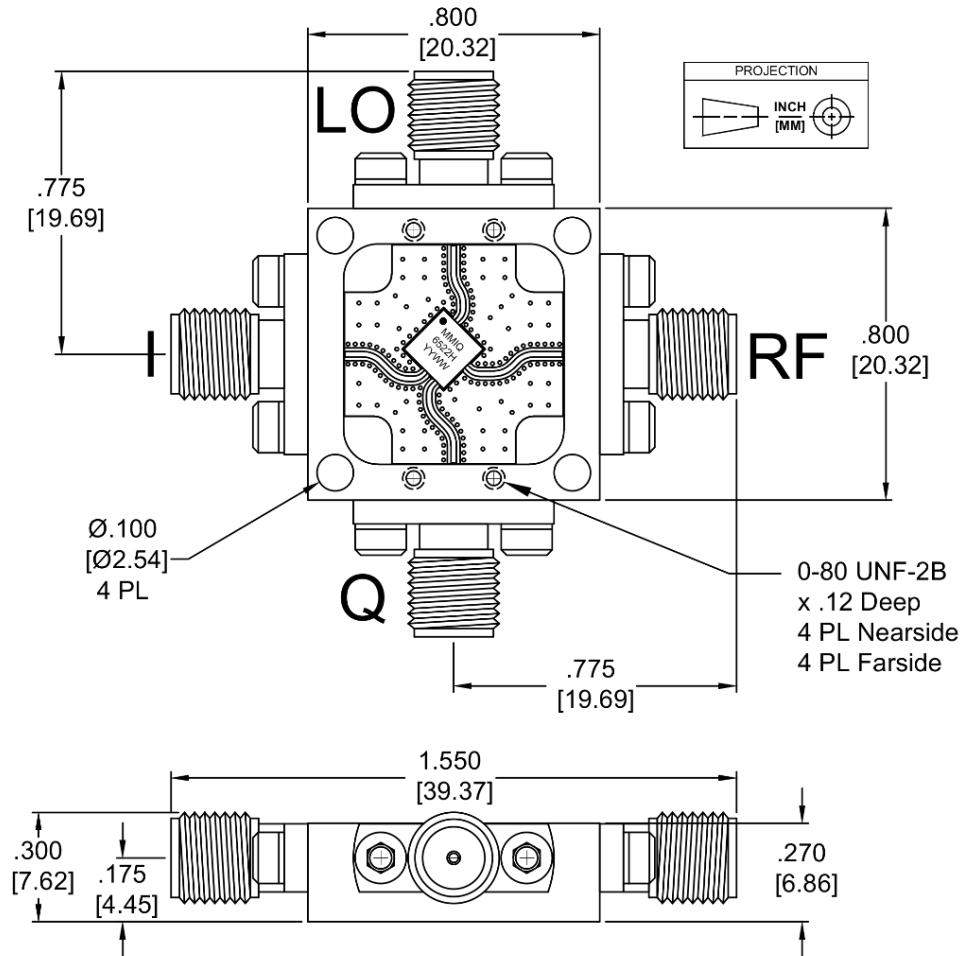
Download: [Footprint Drawing](#)



**Evaluation Board - Outline Drawing**

Port	Connector Type
LO	SMA Female
RF	SMA Female
I/Q	SMA Female

Note: Eval Connectors are not removeable.



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