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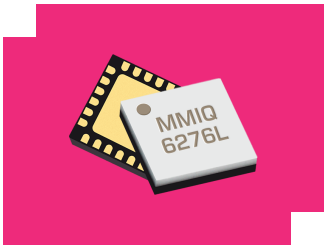
MMIQ-0520LSM-2

Low LO Drive Surface Mount MMIC IQ Mixer

DEVICE OVERVIEW

General Description

The MMIQ-0520LSM is a low LO drive, passive GaAs MMIC IQ mixer that operates down to an unrivaled +5 dBm LO drive level. This is an ultra-broadband mixer spanning 5 to 20GHz 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.



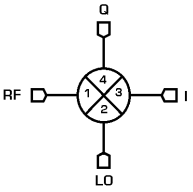
Features

N/A

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	Green Status	Product Lifecycle	Export Classification
MMIQ-0520LSM-2	Low LO Drive Surface Mount MMIC IQ Mixer	QFN	REACH RoHS	Released	EAR99
EVAL-MMIQ-0520L	Evaluation Board, Low LO Drive MMIC 5 - 20 GHz IQ Mixer	EVAL	REACH RoHS	Released	EAR99

Table Of Contents

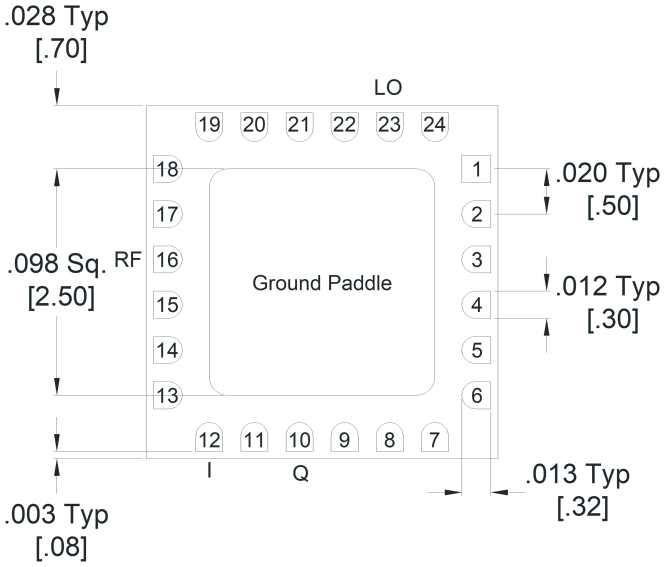
Revision History

Revision Code	Revision Date	Comment
-	2018-03-01	Datasheet Initial Release
A	2019-07-01	Changed minimum LO drive to +5dBm
B	2019-08-01	Changed I/Q Max Current Handling
C	2019-10-01	Updated Max Power Handling Spec
D	2019-11-01	Updated Outline Drawings
E	2025-07-10	Updated I/Q Port Drawings / Diagram / Table

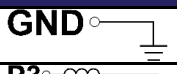
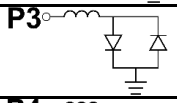
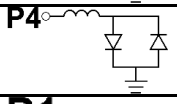
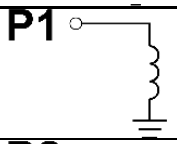
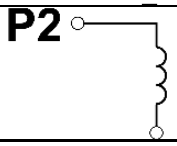
Port Configuration and Functions

Port Diagram

A bottom-up view of the MMIQ-0520L'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	DC Equivalent Circuit
GND	Ground	SM package ground path is provided through the ground paddle.	
Pin 10	Q Input / Output	Port 3 is diode coupled and AC matched to 50Ω over the specified Q port frequency range.	
Pin 12	I Input / Output	Port 4 is diode coupled and AC matched to 50Ω over the specified I port frequency range.	
Pin 16	RF Input / Output	Port 1 is DC short and AC matched to 50Ω over the specified RF frequency range.	
Pin 23	LO Input	Port 2 is DC open and AC matched to 50Ω over the specified LO frequency range.	

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
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
Ambient Temperature	-55	25	100	°C
RF/IF Input Power	-	-	2	dBm
LO Input Power	5	9	13	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

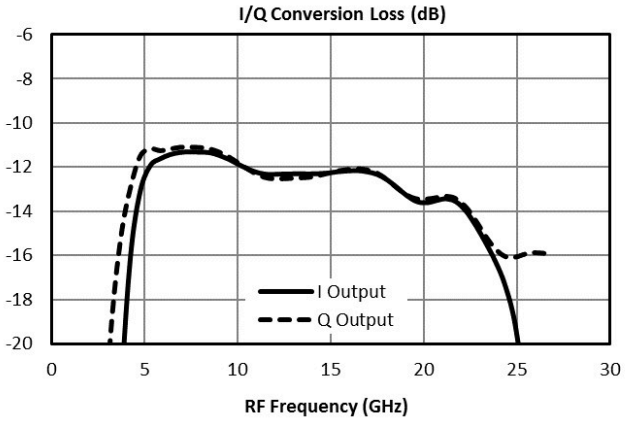
The electrical specifications apply at TA=+25°C in a 50Ω system. Typical data shown is for a down conversion application with a +9dBm sine wave LO input. Min and Max limits apply only to our connectorized units and are guaranteed at TA=+25°C. All bare die are 100% DC tested and visually inspected.

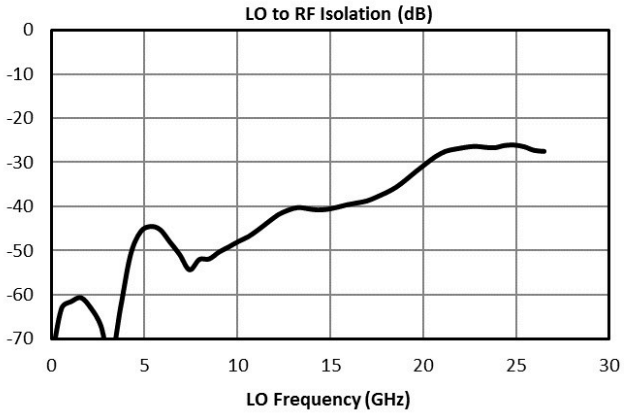
Parameter	Test Conditions	Minimum Frequency (GHz)	Maximum Frequency (GHz)	Min	Typ	Max	Unit
Amplitude Balance [1]	-	-	-	-	0.5	-	dB
Conversion Loss [2]	RF/LO = 5 - 20 GHz I = 0.2 - 6 GHz	5	20	-	14	-	dB
Conversion Loss [3]	RF/LO = 5 - 20 GHz I = DC - 0.2 GHz	5	20	-	12	15	dB
Conversion Loss [4]	RF/LO = 5 - 20 GHz Q = 0.2 - 6 GHz	5	20	-	14	-	dB
Conversion Loss [5]	RF/LO = 5 - 20 GHz Q = DC - 0.2 GHz	5	20	-	12	15	dB
IF Frequency Range	-	-	-	0	-	6	GHz
Image Rejection [6]	RF/LO = 5 - 20 GHz I+Q = DC – 0.2 GHz	5	20	-	35	-	dBc
Input 1 dB Gain Compression Point, I	-	-	-	-	2.6	-	dBm
Input 1 dB Gain Compression Point, Q	-	-	-	-	3.3	-	dBm
Input IP3 [7]	RF/LO = 5 - 20 GHz I = DC – 0.2 GHz	5	20	-	13	-	dBm
LO Frequency Range	-	-	-	5	-	20	GHz
LO-IF Isolation	IF/LO = 5 - 20 GHz	5	20	-	49	-	dB
LO-RF Isolation	RF/LO = 5 - 20 GHz	5	20	-	46	-	dB
Noise Figure [8]	RF/LO = 5 - 20 GHz I = DC – 0.2 GHz	5	20	-	12	-	dB
Noise Figure [9]	RF/LO = 5 - 20 GHz Q = DC – 0.2 GHz	5	20	-	12	-	dB
Phase Balance	-	-	-	-	3	-	°
Q (Port 4) Frequency Range	-	-	-	0	-	6	GHz
RF Frequency Range	-	-	-	5	-	20	GHz
RF-IF Isolation	RF/IF = 5 - 20 GHz	5	20	-	37	-	dB

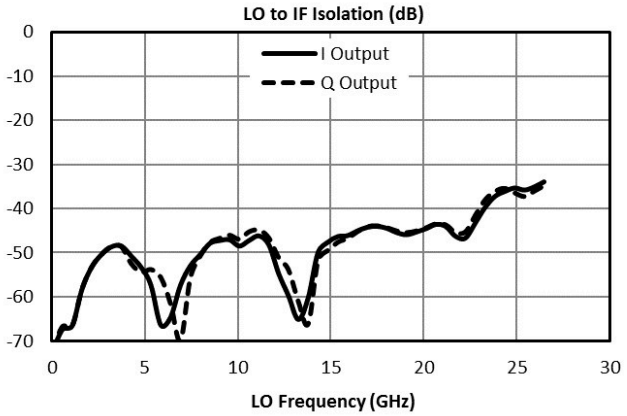
[1] Amplitude and phase balance measured in a down conversion.
[2][3][4][5] Measured as an I/Q down converter (i.e., I and Q powers are not combined)
[6] Image Rejection and Single sideband performance plots are defined by the upper sideband (USB) or lower sideband (LSB) with respect to the LO signal. 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.

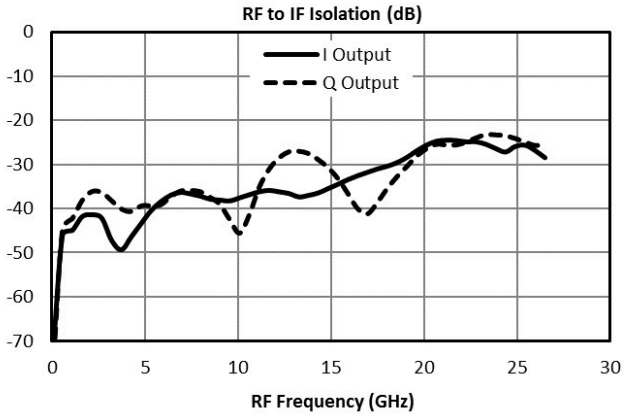
Typical Performance Plots

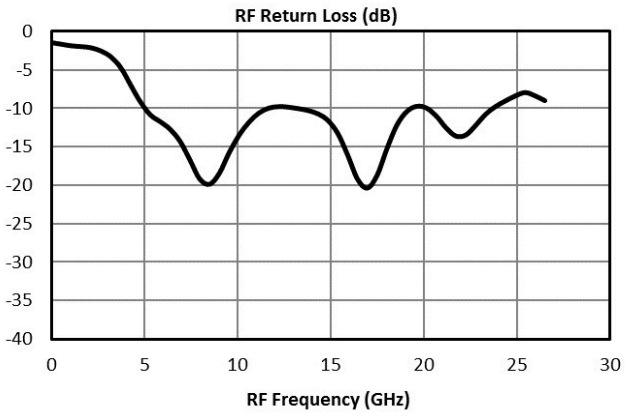
I output means that the IF output signal is measured at the I port of the mixer and the Q port is loaded. Q output means the IF output signal is measured at the Q port of the mixer while the I port is loaded.

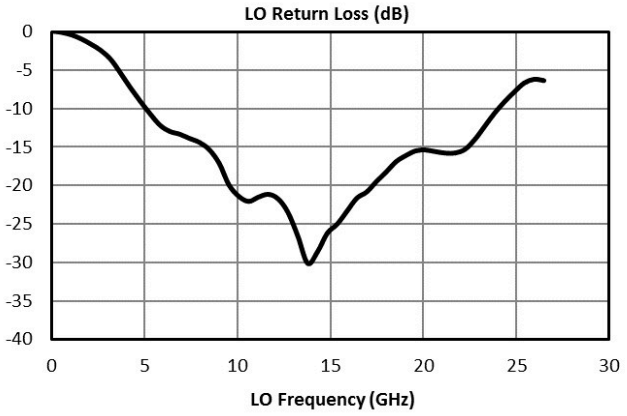








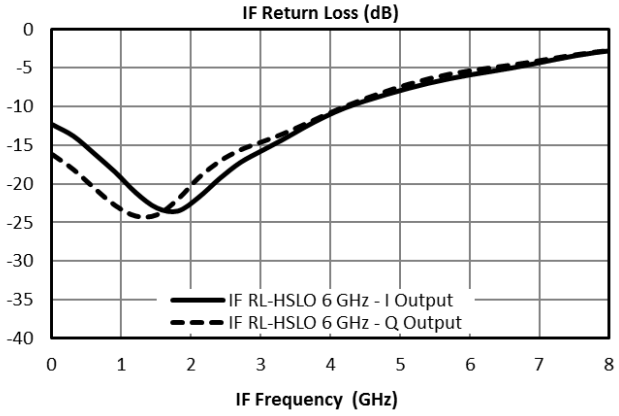




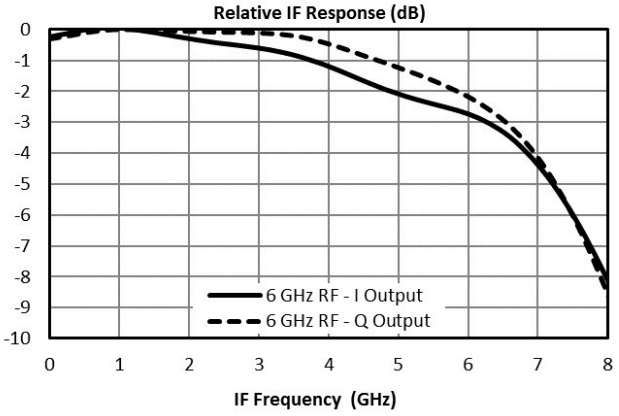
MMIQ-0520LSM-2

Low LO Drive Surface Mount MMIC IQ Mixer

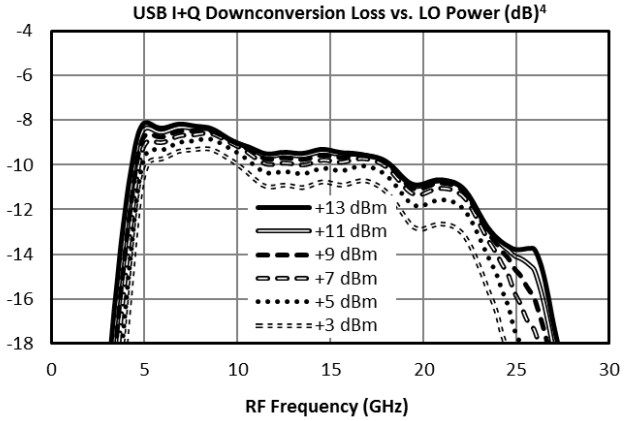
IF Return Loss (dB)



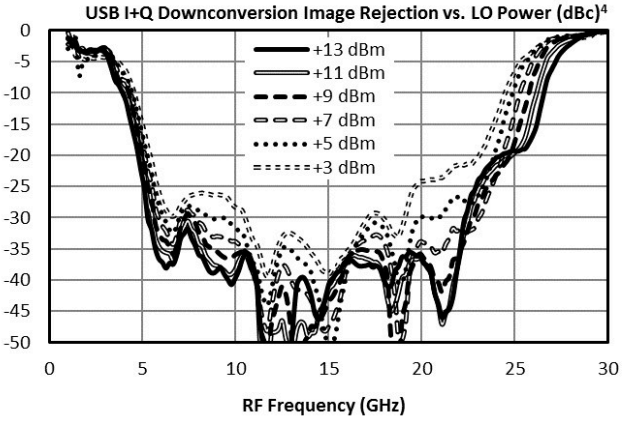
Relative IF Response (dB)



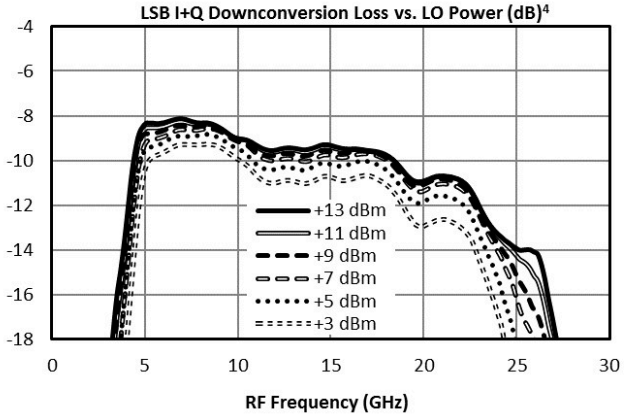
USB I+Q Downconversion Loss vs. LO Power (dB)[4]



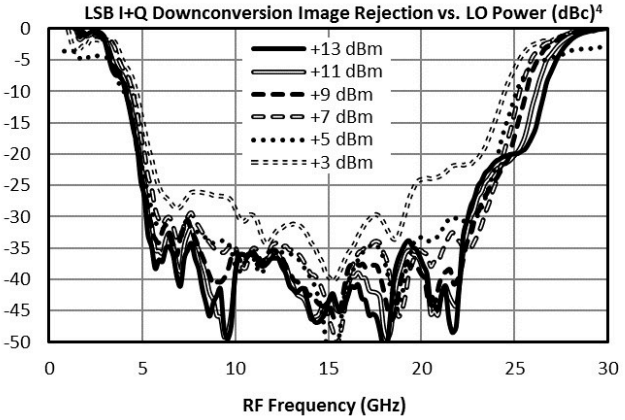
USB I+Q Downconversion Image Rejection vs. LO Power (dBc)[4]



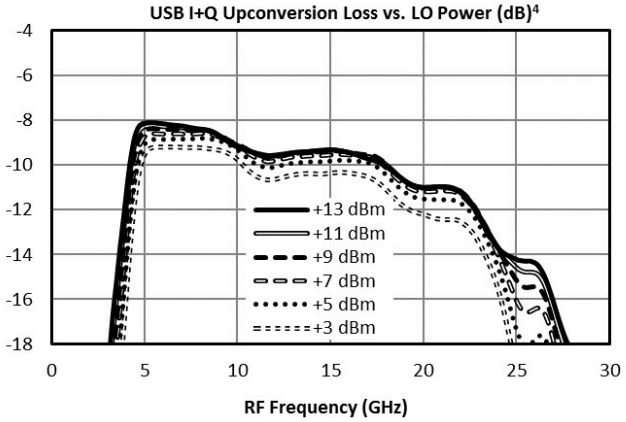
LSB I+Q Downconversion Loss vs. LO Power (dB)[4]



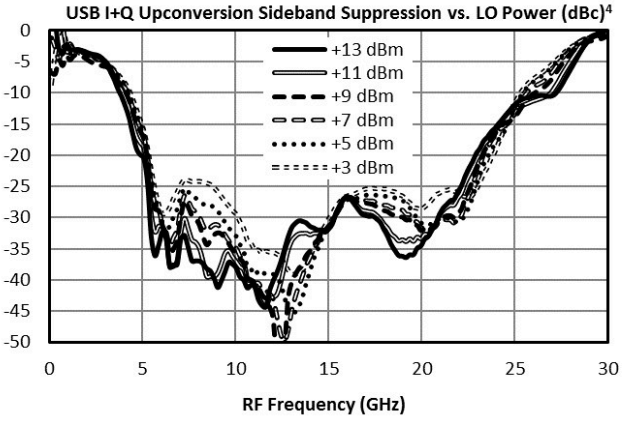
LSB I+Q Downconversion Image Rejection vs. LO Power (dBc)[4]



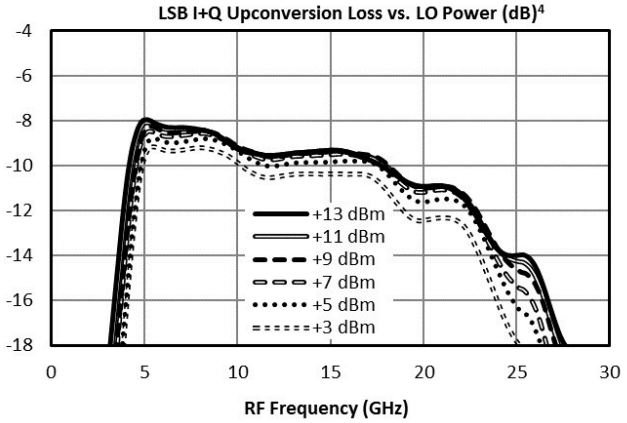
USB I+Q Upconversion Loss vs. LO Power (dB)[4]



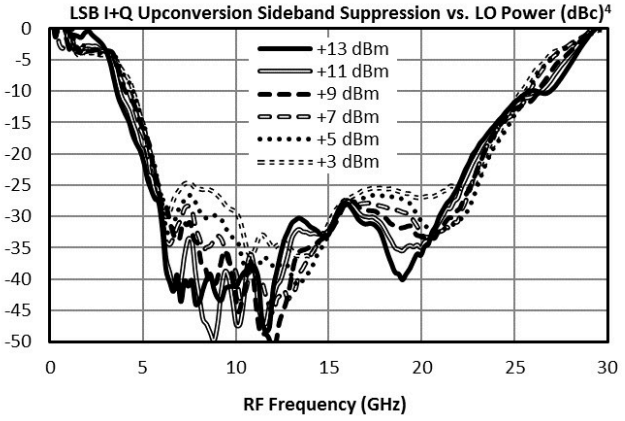
USB I+Q Upconversion Sideband Suppression vs. LO Power (dBc)[4]



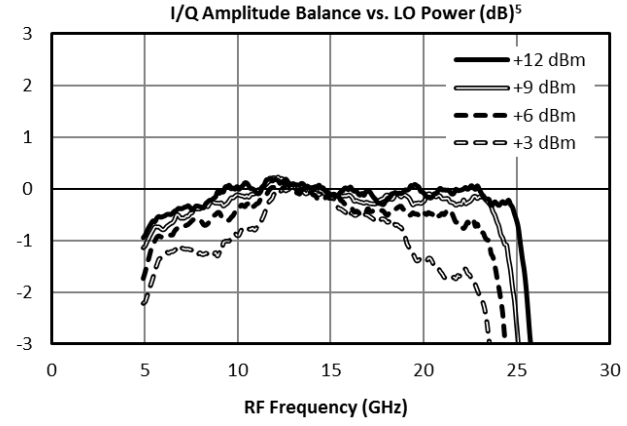
LSB I+Q Upconversion Loss vs. LO Power (dB)[4]



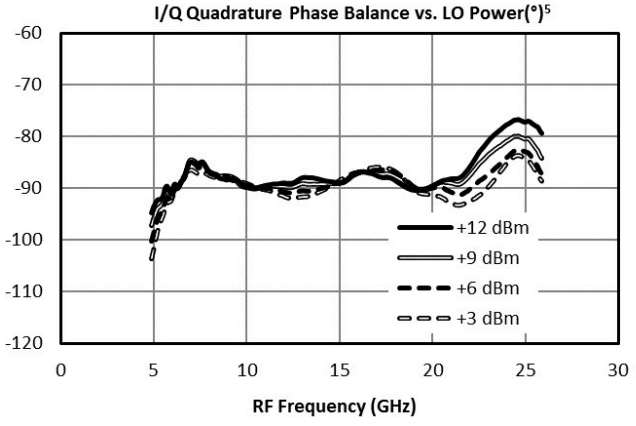
LSB I+Q Upconversion Sideband Suppression vs. LO Power (dBc)[4]



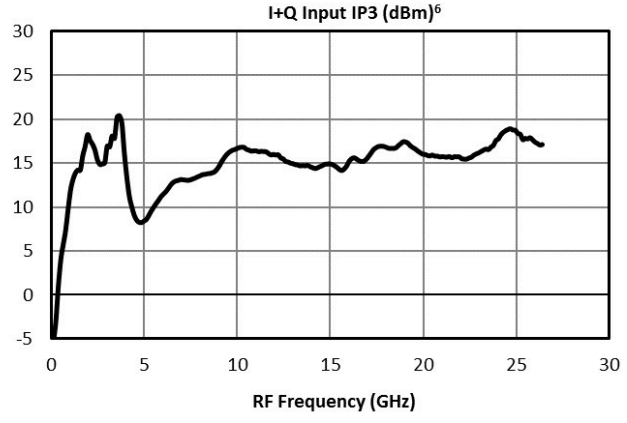
I/Q Amplitude Balance vs. LO Power (dB)[5]



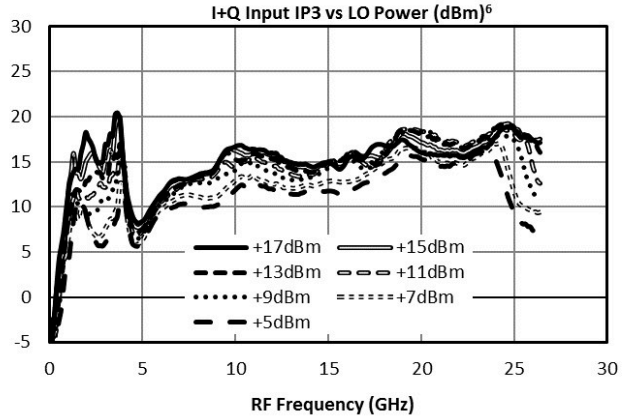
I/Q Quadrature Phase Balance vs. LO Power(°)[5]



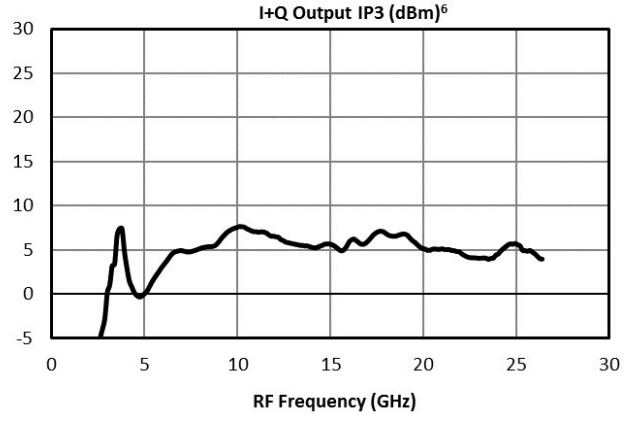
I+Q Input IP3 (dBm)[6]



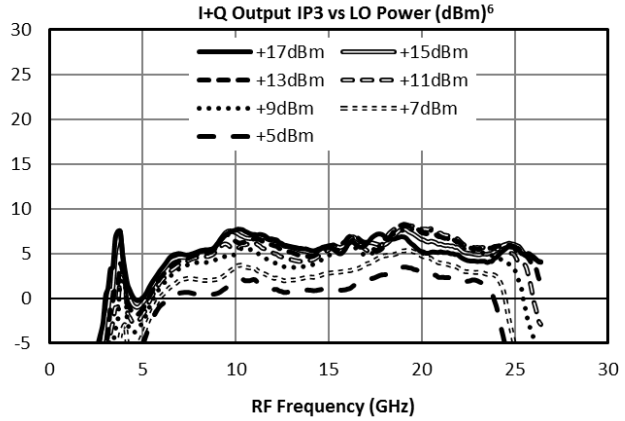
I+Q Input IP3 vs LO Power (dBm)[6]

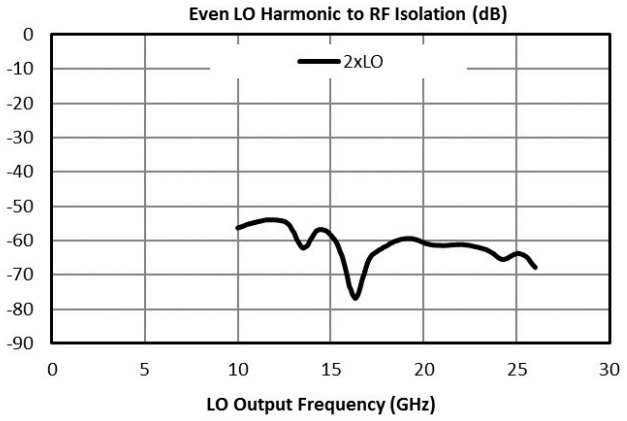


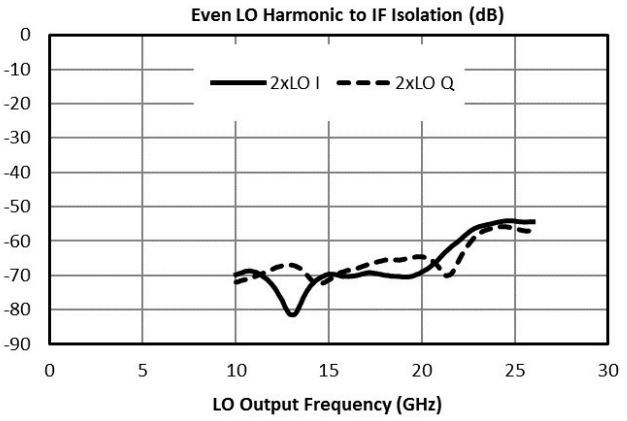
I+Q Output IP3 (dBm)[6]

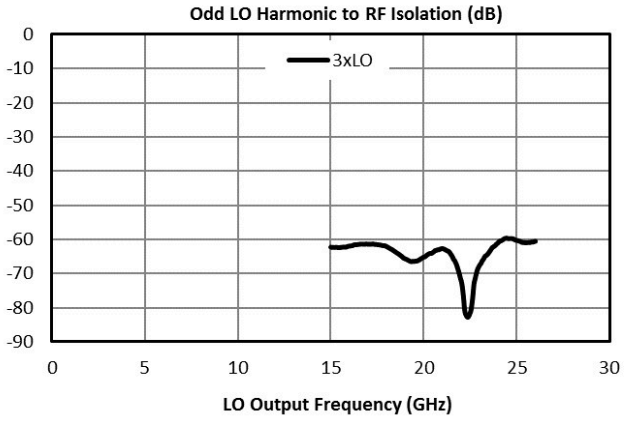


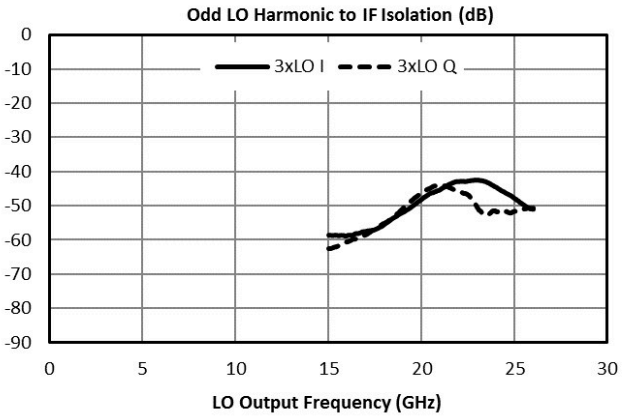
I+Q Output IP3 vs LO Power (dBm)[6]











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 67 dBc for a -10 dBm input, so a -20 dBm RF input creates a spur that is (2-1) x (-10 dB) lower, or 77 dBc. Data is shown for the frequency plan inTypical Performance.

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

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
0xRF	-	51 (50)	67 (66)	50 (52)	N/A	N/A
1xRF	25 (25)	Reference	42 (34)	26 (15)	60 (49)	N/A
2xRF	71 (71)	51 (51)	67 (66)	57 (56)	68 (67)	61 (56)
3xRF	72 (71)	50 (50)	61 (66)	59 (60)	67 (69)	58 (59)
4xRF	N/A	59 (75)	65 (72)	84 (87)	88 (90)	86 (87)
5xRF	N/A	N/A	69 (76)	78 (86)	93 (93)	90 (92)

Measured as I/Q mixer (not IR/SSB mixer). SSB/IR mixers experience additional spurious suppressions.

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 65 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 75 dBc. Data is shown for the frequency plan inTypical Performance.

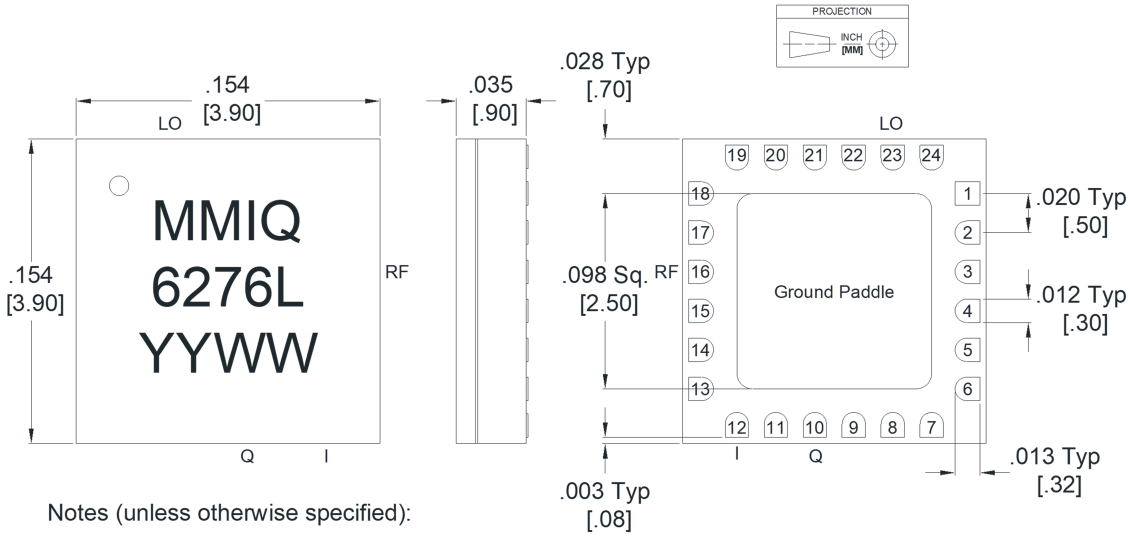
Typical Up-conversion spurious suppression (dBc): I Port (Q Port)

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
0xIF	-	43 (47)	61 (61)	64 (64)	N/A	N/A
1xIF	24 (24)	Reference	37 (33)	14 (11)	53 (43)	N/A
2xIF	62 (62)	65 (67)	53 (58)	65 (65)	54 (57)	60 (63)
3xIF	70 (71)	52 (53)	68 (66)	43 (45)	64 (65)	53 (49)
4xIF	88 (76)	91 (75)	78 (66)	88 (73)	75 (70)	85 (75)
5xIF	94 (74)	83 (63)	95 (74)	72 (54)	92 (66)	80 (55)

Mechanical Data

Outline Drawing

Download : Outline 2D Drawing | Outline 3D Drawing | Outline 3D STP



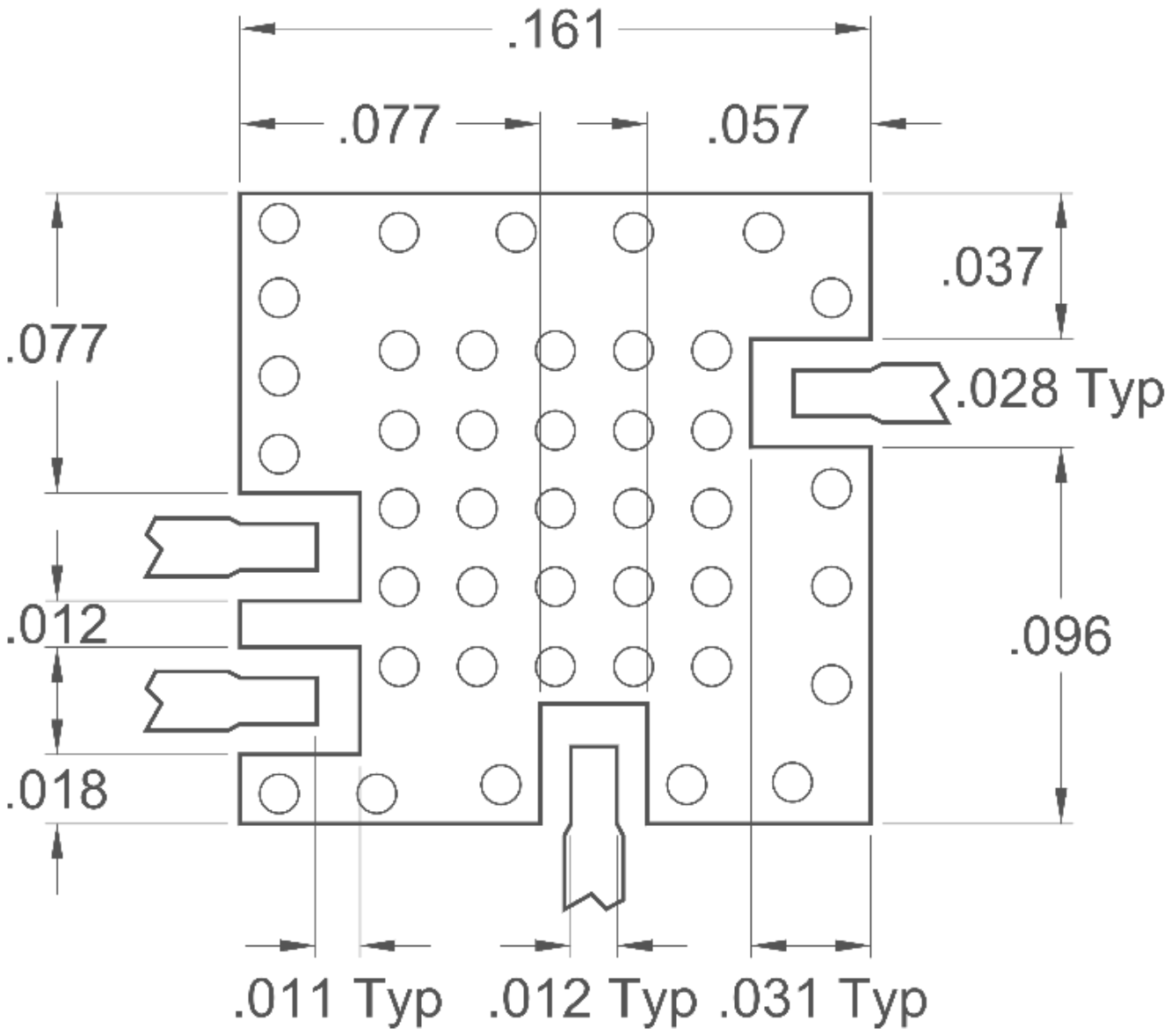
Pad #	Function
1	N/C
2	N/C
3	N/C
4	N/C
5	N/C
6	N/C
7	N/C
8	N/C
9	N/C
10	IF-Q
11	N/C
12	IF-I
13	N/C
14	N/C
15	N/C
16	RF
17	N/C
18	N/C
19	N/C
20	N/C
21	N/C
22	N/C
23	LO
24	N/C

Notes (unless otherwise specified):

1. Substrate material is Ceramic.
2. I/O Leads and Die Paddle are:
   0.03-0.254 microns Gold, over
   0.07-0.17 microns Palladium, over
   1.27 to 8.89 microns Nickel.
3. All unconnected pins should be connected to PCB RF ground.

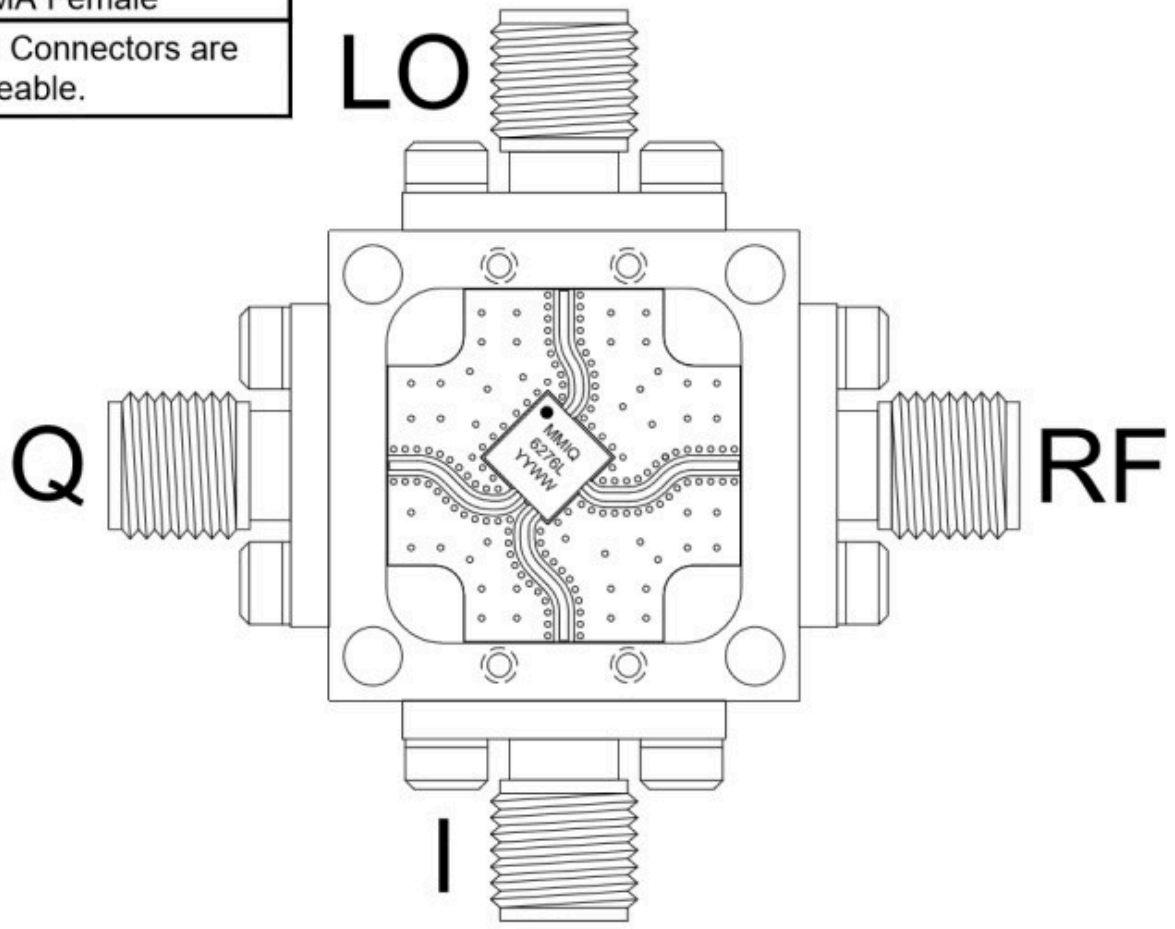
Footprint Image

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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