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Tech Support: support@markimicrowave.com

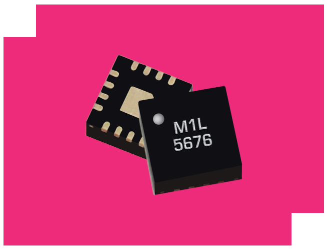
MM1-2567LSM-2

GaAs MMIC Double Balanced Mixer

DEVICE OVERVIEW

General Description

The MM1-2567LSM is a GaAs MMIC double balanced mixer that is optimized for high frequency applications. MM1-2567LSM is a Ka to V band mixer that works well as both an up and down converter. This mixer offers low conversion loss and high isolation at low LO powers. The MM1-2567LSM is available in a 3x3 mm QFN package. Evaluation boards are available.



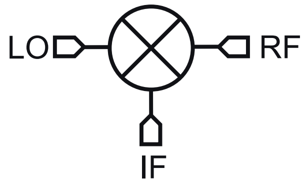
Features

- High Frequency Operation
- High LO to RF isolation
- RoHS Compliant
- Extremely Low LO Drive

Applications

- 5G Test Receivers
- Electronic Warfare Scanner

Functional Block Diagram



Part Ordering Options

Part Number	Description	Package	Green Status	Product Lifecycle	Export Classification
MM1-2567LSM-2	GaAs MMIC Double Balanced Mixer	QFN	REACH RoHS	Released	EAR99
EVAL-MM1-2567L	Evaluation Board, GaAs MMIC 25 - 67 GHz Double-balanced Mixer	EVAL	REACH RoHS	Released	EAR99

Table Of Contents

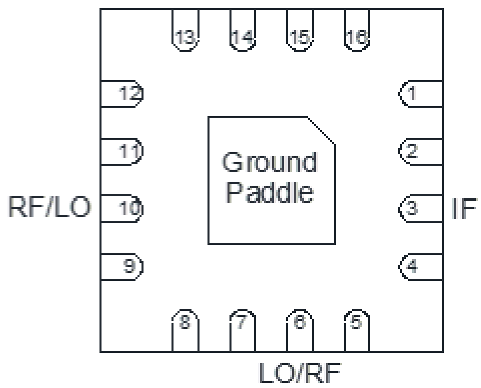
Revision History

Revision Code	Revision Date	Comment
-	2019-11-01	Datasheet Release
A	2020-10-01	EVAL package outline drawing and board material added

Port Configuration and Functions

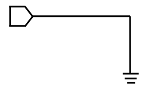
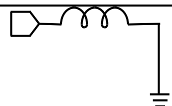
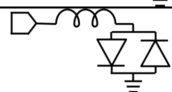
Port Diagram

A bottom-up view of the MM1-2567LSM-2's SM package outline drawing is shown below. The MM1-2567LSM-2 has the input and output ports given in Port Functions. The MM1-2567LSM-2 can be used in either an up or down conversion. For configuration A, input the LO into pin 6, use pin 10 for the RF, and pin 3 for the IF. For configuration B, input the LO into pin 10, use pin 6 for the RF, and pin 3 for the IF.

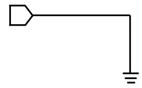
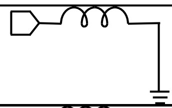
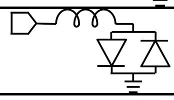


Port Functions

Configuration A

Port	Function	Description	Equivalent Circuit for Package
GND	Ground	SM package ground path is provided through the ground paddle.	
Pin 10	RF	Pin 10 is DC short and AC matched to 50 Ohms from 25 to 67 GHz. Blocking capacitor is optional.	
Pin 3	IF	Pin 3 is DC coupled to the diodes. Blocking capacitor is optional	
Pin 6	LO	Pin 6 is DC open and AC matched to 50 Ohms from 25 to 67 GHz. Blocking capacitor is optional.	

Configuration B

Port	Function	Description	Equivalent Circuit for Package
GND	Ground	SM package ground path is provided through the ground paddle.	
Pin 10	LO	Pin 10 is DC short and AC matched to 50 Ohms from 25 to 67 GHz. Blocking capacitor is optional.	
Pin 3	IF	Pin 3 is DC coupled to the diodes. Blocking capacitor is optional.	
Pin 6	RF	Pin 6 is DC open and AC matched to 50 Ohms from 25 to 67 GHz. Blocking capacitor is optional.	

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
Power Handling, at any Port	28	dBm

Package Information

Parameter	Details	Rating
ESD	250 to < 500 Volts	HBM Class 1A
Dimensions	-	3 x 3 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	10	13	16	dBm
Ambient Temperature	-	25	-	°C

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

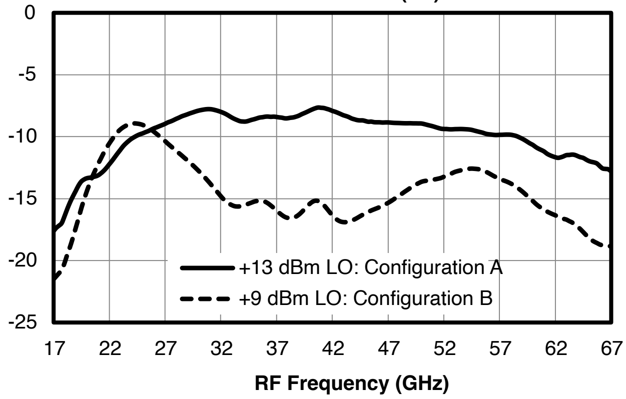
The electrical specifications apply at TA=+25°C in a 50Ω system. Typical data shown is for a down conversion application with a +13dBm sine wave LO input unless otherwise specified.

Parameter	Port Configuration	Test Conditions	Min	Typ	Max	Unit
Conversion Loss [1]	A	RF/LO = 25 - 67 GHz IF = 0.2 - 30 GHz	-	11	-	dB
Conversion Loss [2]	A	RF/LO = 25 - 67 GHz IF = DC - 0.2 GHz	-	9.5	17	dB
Input 1 dB Gain Compression Point (P1dB)	A	-	-	1	-	dBm
Input IP3	A	RF/LO = 25 - 67 GHz IF = DC - 0.2 GHz	-	9	-	dBm
Noise Figure [3]	A	RF/LO = 25 - 67 GHz IF = DC - 0.2 GHz	-	9.5	-	dB
Output IP3	A	RF/LO = 25 - 67 GHz IF = DC - 0.2 GHz	-	-1	-	dBm
Conversion Loss [4]	B	RF/LO = 25 - 67 GHz IF = 0.2 - 30 GHz	-	17	-	dB
Conversion Loss [5]	B	RF/LO = 25 - 67 GHz IF = DC - 0.2 GHz	-	15	22	dB
Input 1 dB Gain Compression Point (P1dB)	B	-	-	5	-	dBm
Input IP3	B	RF/LO = 25 - 67 GHz IF = DC - 0.2 GHz	-	18	-	dBm
Noise Figure [6]	B	RF/LO = 25 - 67 GHz IF = DC - 0.2 GHz	-	15	-	dB
Output IP3	B	RF/LO = 25 - 67 GHz IF = DC - 0.2 GHz	-	3	-	dBm
IF Frequency Range	-	-	0	-	30	GHz
Isolation, LO to IF	-	IF/LO = 25 - 67 GHz	-	28	-	dB
Isolation, LO to RF	-	RF/LO = 25 - 67 GHz	-	40	-	dB
Isolation, RF to IF	-	RF/IF = 25 - 67 GHz	-	25	-	dB
LO Frequency Range	-	-	25	-	67	GHz
RF Frequency Range	-	-	25	-	67	GHz

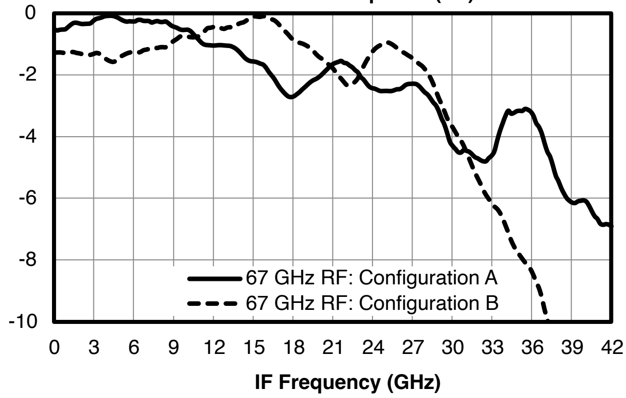
[1] Measured as a down converter to a fixed 91MHz IF.
[2] Measured as a down converter to a fixed 91MHz IF.
[3][6] Mixer Noise Figure typically measures within 0.5 dB of conversion loss for IF frequencies greater than 5 MHz.
[4][5] Measured as a down converter to a fixed 91MHz IF.

Typical Performance Plots

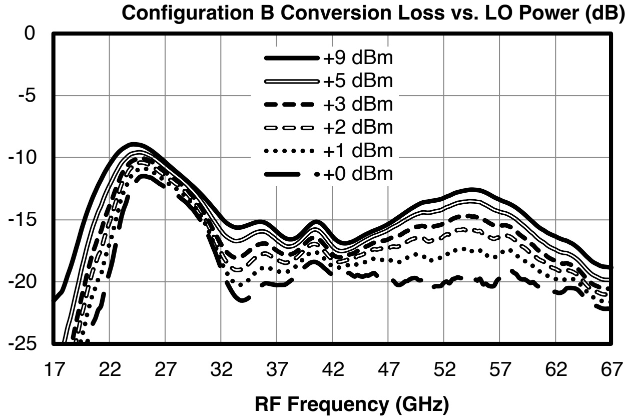
Conversion Loss (dB)



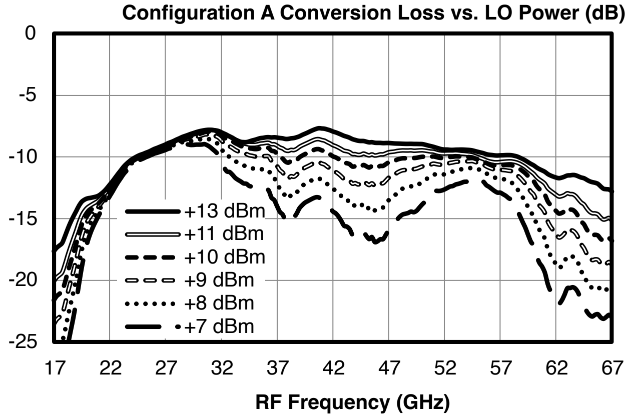
Relative IF Response (dB)



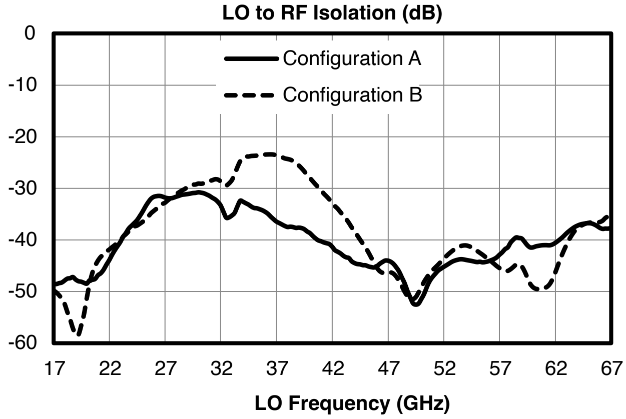
Configuration B Conversion Loss vs. LO Power (dB)



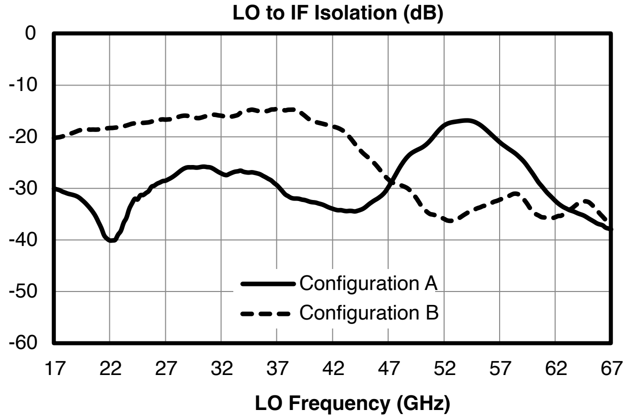
Configuration A Conversion Loss vs. LO Power (dB)



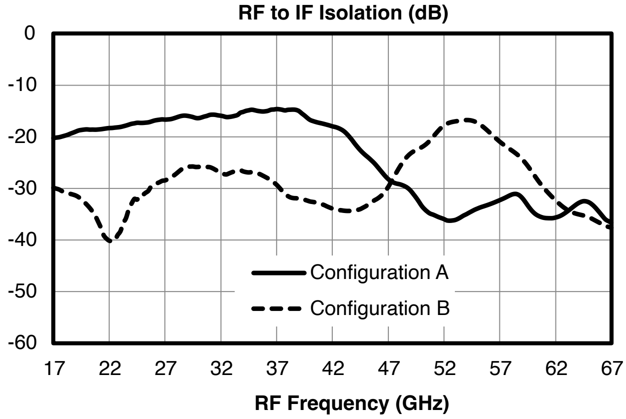
LO to RF Isolation (dB)



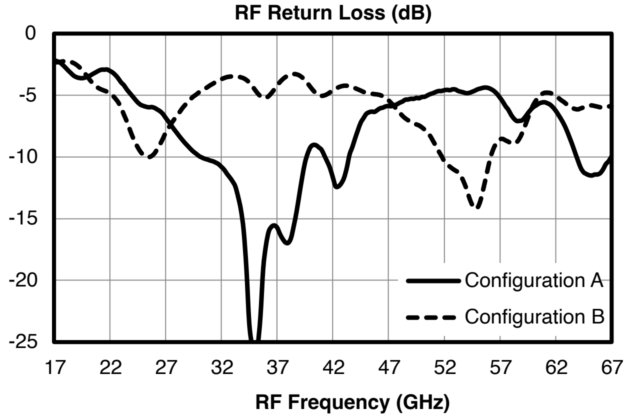
LO to IF Isolation (dB)

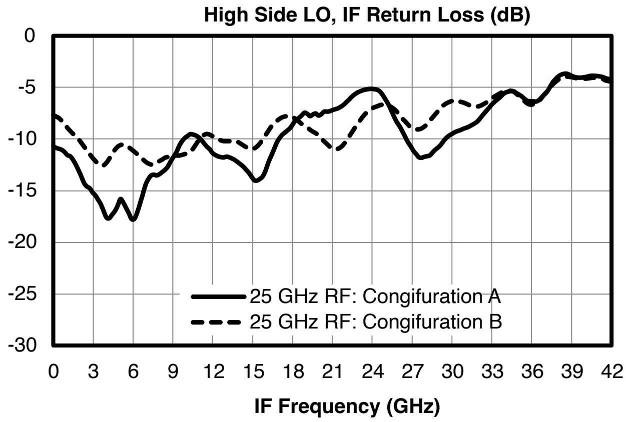


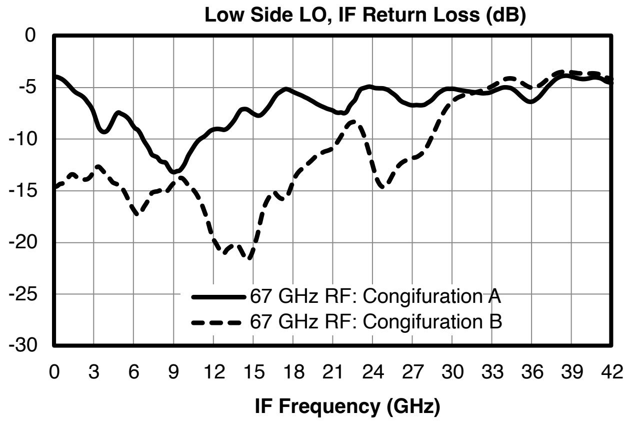
RF to IF Isolation (dB)

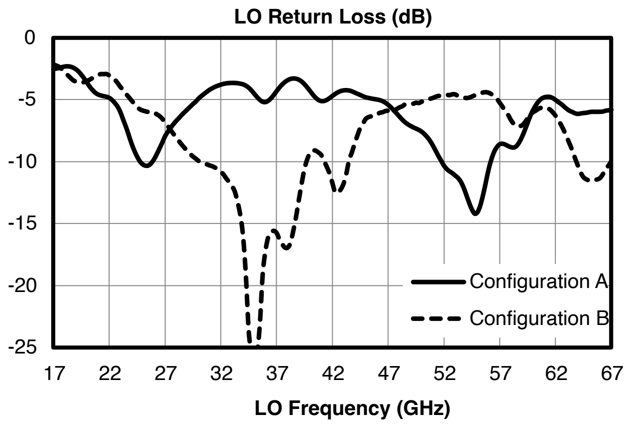


RF Return Loss (dB)

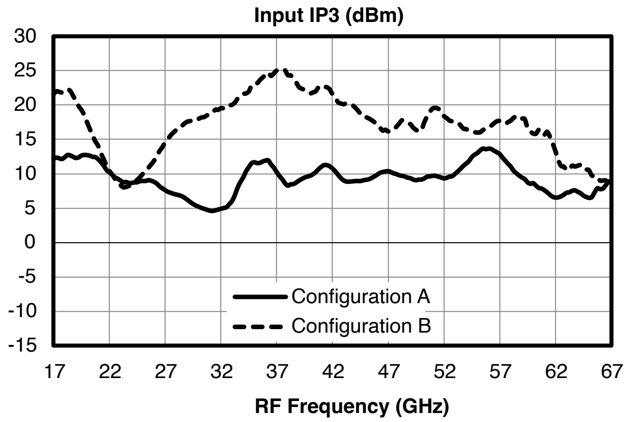


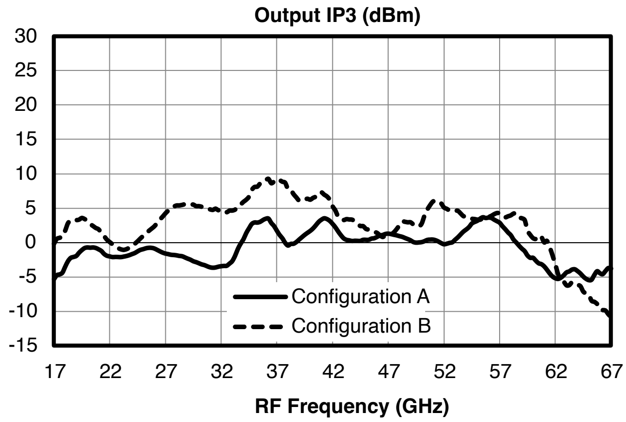

High Side LO, IF Return Loss (dB)
0
-5
-10
-15
-20
-25
-30
0 3 6 9 12 15 18 21 24 27 30 33 36 39 42
IF Frequency (GHz)
25 GHz RF: Congifuration A
25 GHz RF: Congifuration B

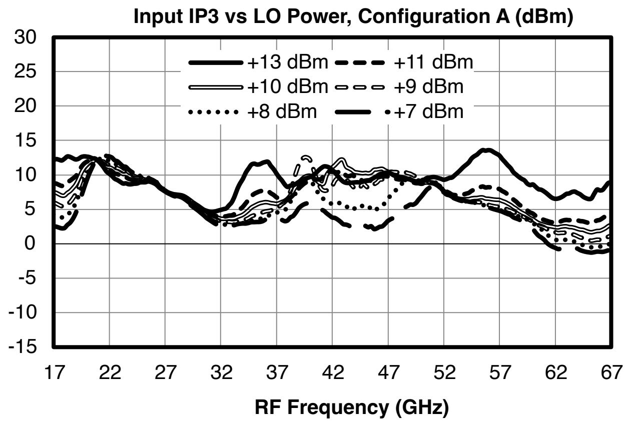

Low Side LO, IF Return Loss (dB)
0
-5
-10
-15
-20
-25
-30
0 3 6 9 12 15 18 21 24 27 30 33 36 39 42
IF Frequency (GHz)
67 GHz RF: Congifuration A
67 GHz RF: Congifuration B

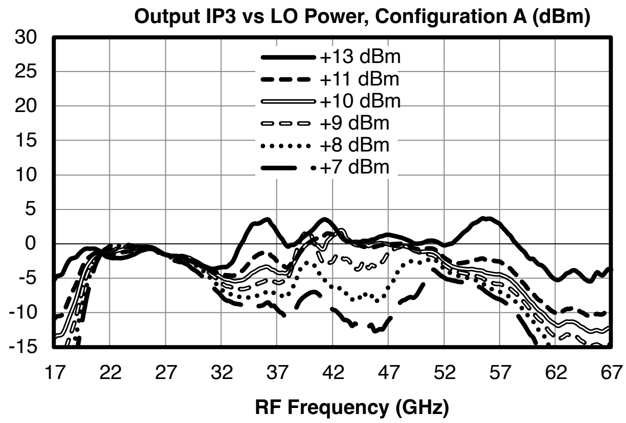

LO Return Loss (dB)
0
-5
-10
-15
-20
-25
17 22 27 32 37 42 47 52 57 62 67
LO Frequency (GHz)
Configuration A
Configuration B

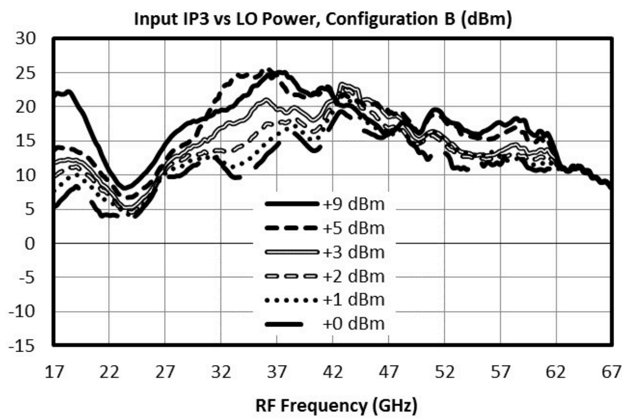
Typical Performance Plots: IP3

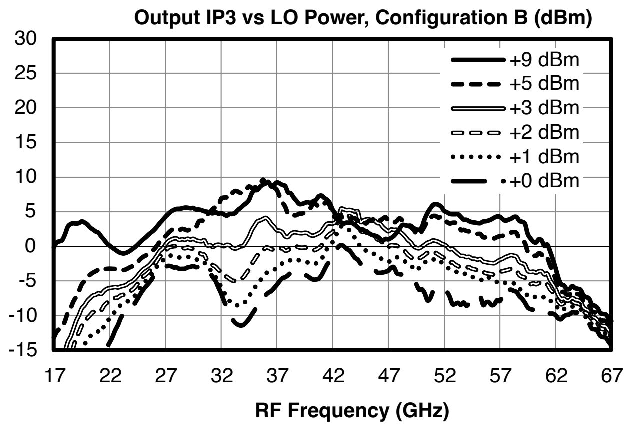




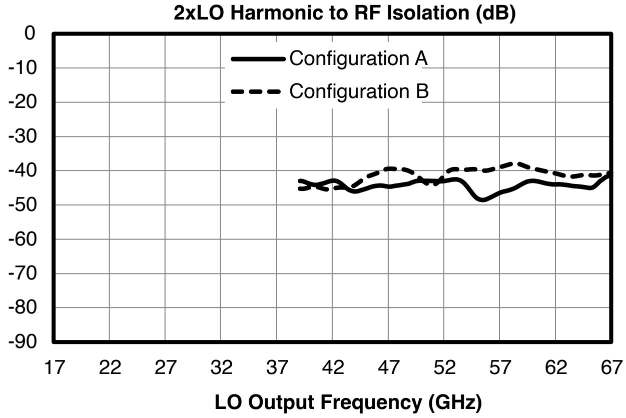


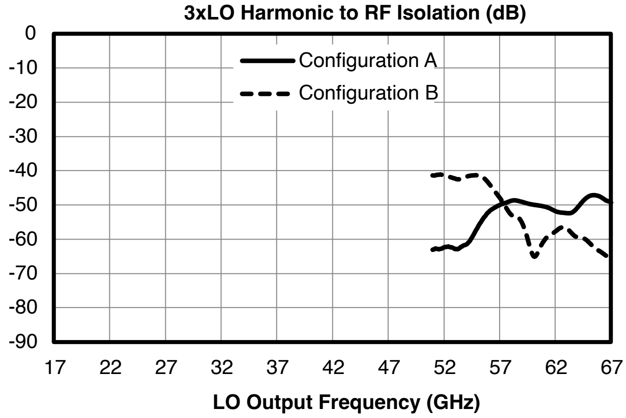


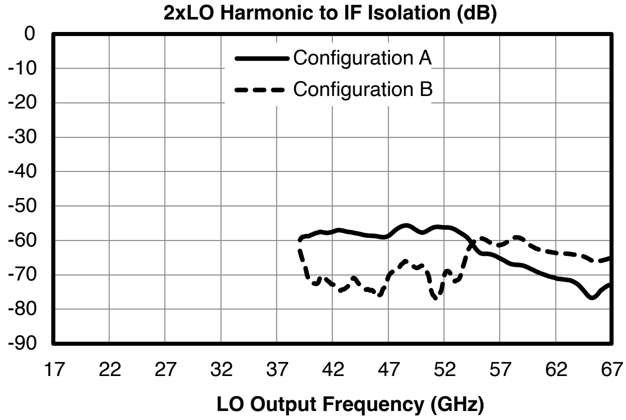


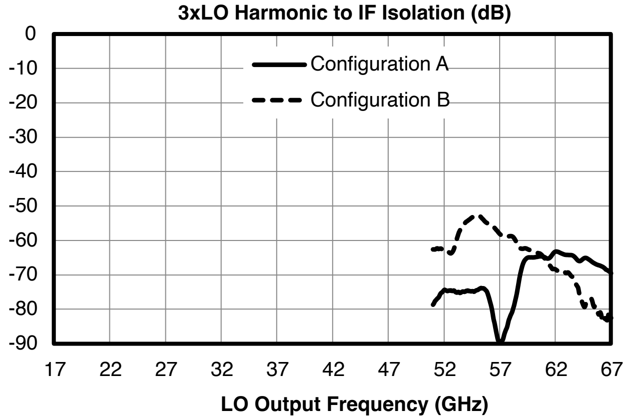


Typical Performance Plots: LO Harmonic Isolation





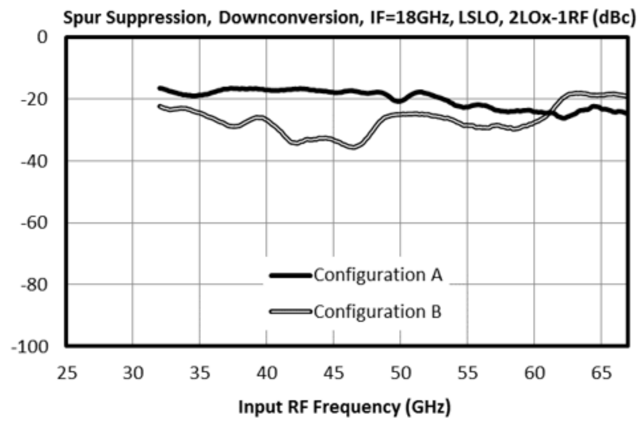


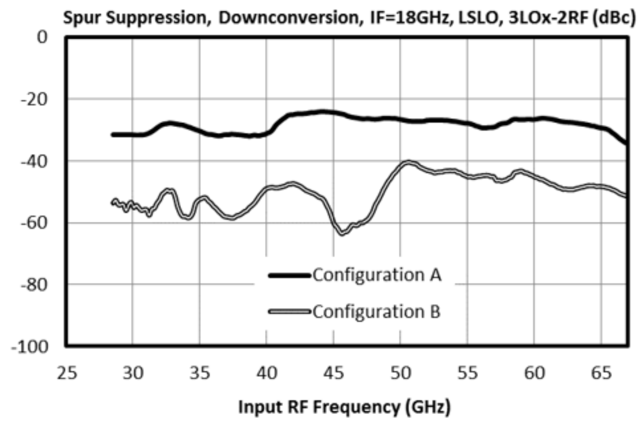


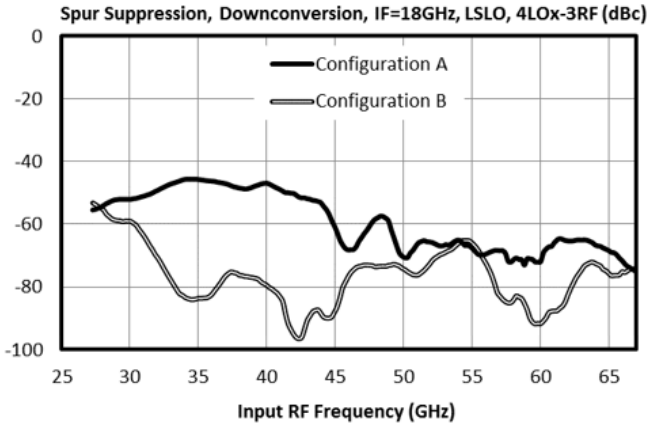
Spur Table

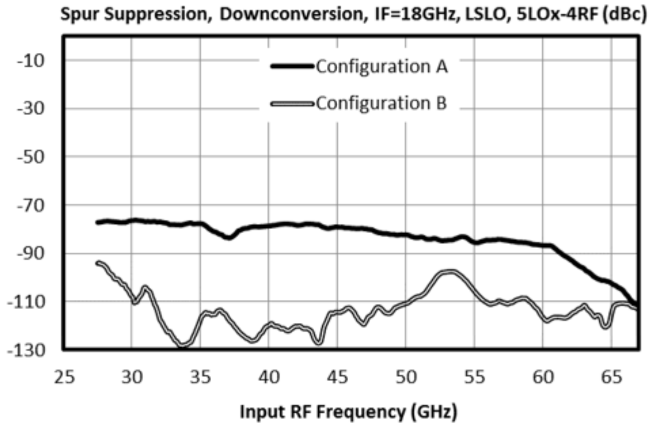
Typical Spurious Performance: Down-Conversion

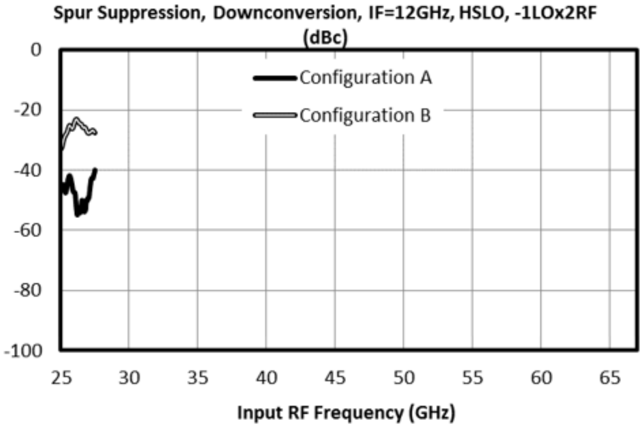
Typical spurious data is provided by selecting RF and LO frequencies (± m*LO ± n*RF) within the RF/LO bands, to create a spurious output within the IF band. The mixer is swept across the full spurious band. The numbers shown in the graphs below are for a -10 dBm RF input. Spurious suppression is scaled for different RF power levels by (n-1), where "n" is the RF spur order. For example, the 2LO x 2RF spur is 40 dBc for a -10 dBm input, so a -20 dBm RF input creates a spur that is (2-1) x (-10 dB) lower, or 50 dBc. Data is shown for the frequency plan in Typical Performance.

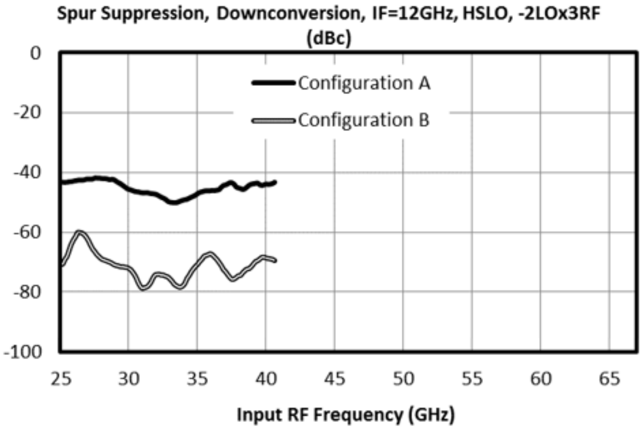


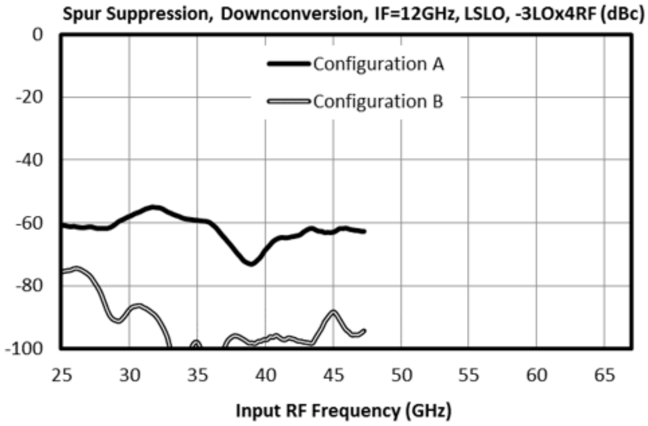


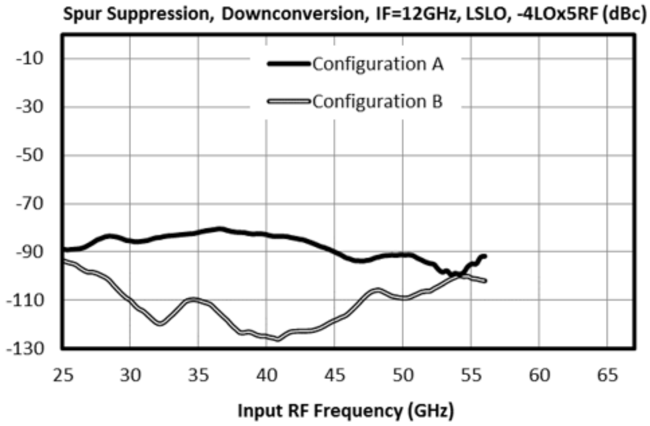

Spur Suppression, Downconversion, IF=18GHz, LSLO, 4LOx-3RF (dBc)
Configuration A
Configuration B
0
-20
-40
-60
-80
-100
25
30
35
40
45
50
55
60
65
Input RF Frequency (GHz)

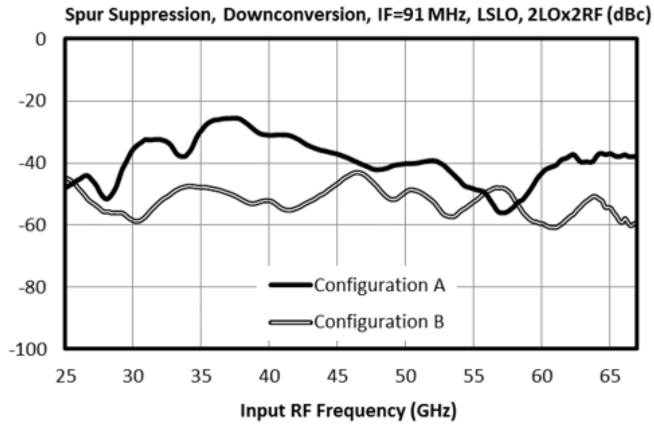

Spur Suppression, Downconversion, IF=18GHz, LSLO, 5LOx-4RF (dBc)
Configuration A
Configuration B
-10
-30
-50
-70
-90
-110
-130
25
30
35
40
45
50
55
60
65
Input RF Frequency (GHz)

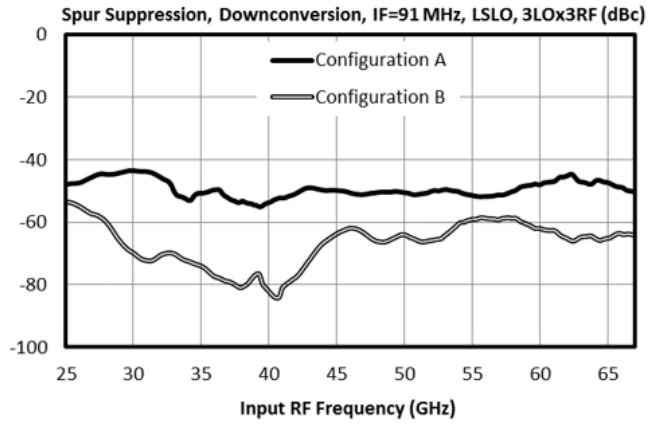

Spur Suppression, Downconversion, IF=12GHz, HSLO, -1LOx2RF (dBc)
Configuration A
Configuration B
0
-20
-40
-60
-80
-100
25 30 35 40 45 50 55 60 65
Input RF Frequency (GHz)

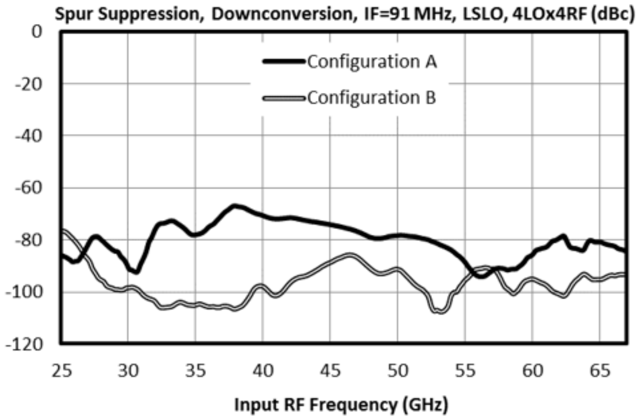

Spur Suppression, Downconversion, IF=12GHz, HSLO, -2LOx3RF (dBc)
Configuration A
Configuration B
0
-20
-40
-60
-80
-100
25 30 35 40 45 50 55 60 65
Input RF Frequency (GHz)


Spur Suppression, Downconversion, IF=12GHz, LSLO, -3LOx4RF (dBc)
Configuration A
Configuration B
0
-20
-40
-60
-80
-100
25 30 35 40 45 50 55 60 65
Input RF Frequency (GHz)


Spur Suppression, Downconversion, IF=12GHz, LSLO, -4LOx5RF (dBc)
Configuration A
Configuration B
-10
-30
-50
-70
-90
-110
-130
25 30 35 40 45 50 55 60 65
Input RF Frequency (GHz)

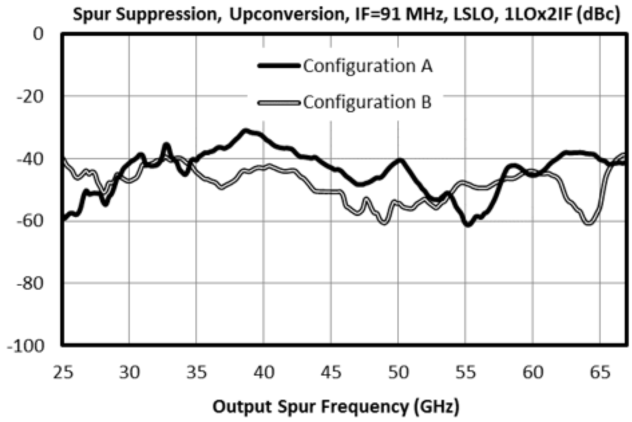

Spur Suppression, Downconversion, IF=91 MHz, LSLO, 2LOx2RF (dBc)
0
-20
-40
-60
-80
-100
25
30
35
40
45
50
55
60
65
Configuration A
Configuration B
Input RF Frequency (GHz)

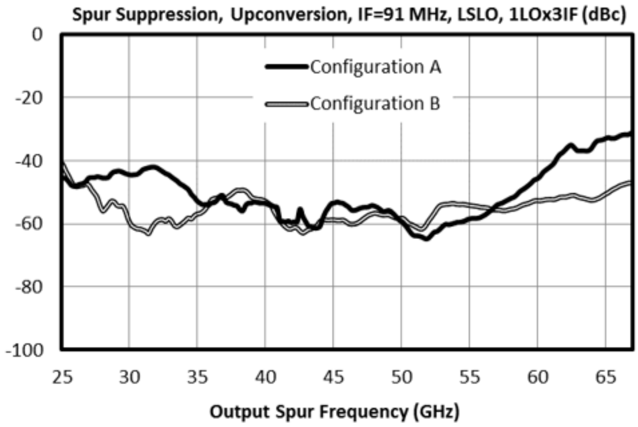

Spur Suppression, Downconversion, IF=91 MHz, LSLO, 3LOx3RF (dBc)
0
-20
-40
-60
-80
-100
25
30
35
40
45
50
55
60
65
Configuration A
Configuration B
Input RF Frequency (GHz)

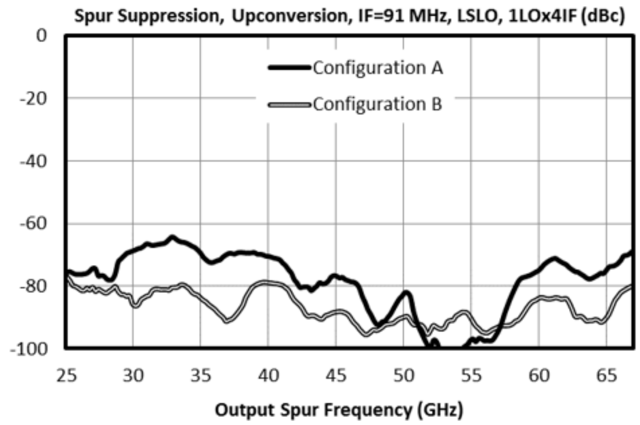

Spur Suppression, Downconversion, IF=91 MHz, LSLO, 4LOx4RF (dBc)
Configuration A
Configuration B
0
-20
-40
-60
-80
-100
-120
25
30
35
40
45
50
55
60
65
Input RF Frequency (GHz)

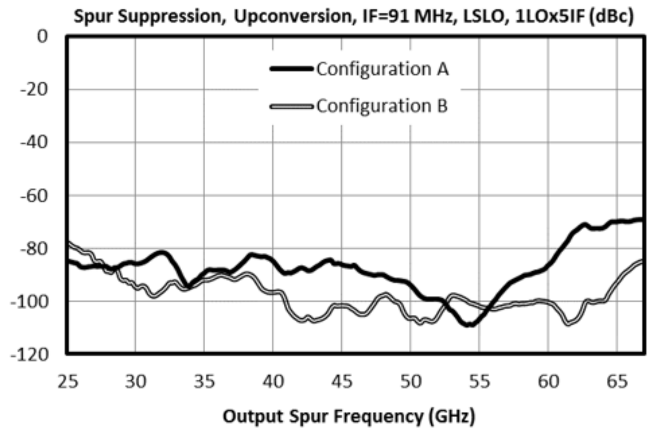
Typical Spurious Performance: Up-Conversion

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. The numbers shown in the graphs 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 2LOx1IF spur is typically 57 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 67 dBc. Data is shown for the frequency plan in Typical Performance.

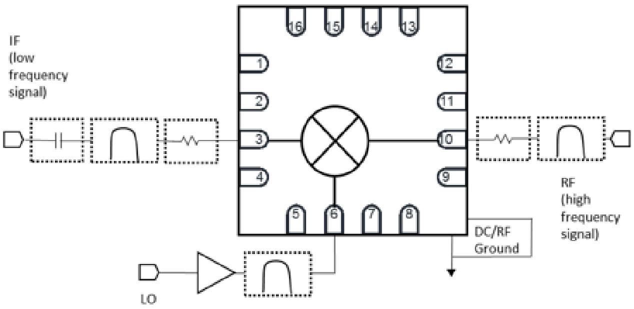




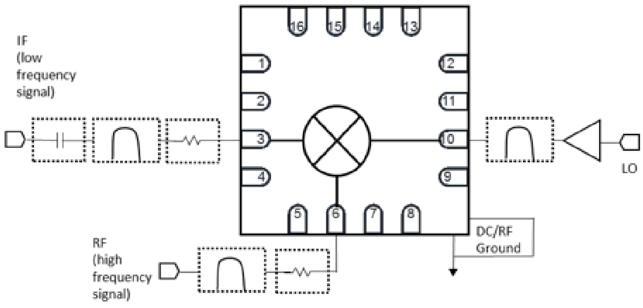

Spur Suppression, Upconversion, IF=91 MHz, LSLO, 1LOx4IF (dBc)
Configuration A
Configuration B
0
-20
-40
-60
-80
-100
25
30
35
40
45
50
55
60
65
Output Spur Frequency (GHz)


Spur Suppression, Upconversion, IF=91 MHz, LSLO, 1LOx5IF (dBc)
Configuration A
Configuration B
0
-20
-40
-60
-80
-100
-120
25
30
35
40
45
50
55
60
65
Output Spur Frequency (GHz)

Application Circuit



Configuration A



Configuration B

Application Circuit Description

IF Port – Used as input on an upconversion, output on downconversion, or LO port in a band shifting application. Signals should be connected by 50 ohm microstrip or coplanar traces to well matched broadband 50 ohm sources and loads. Blocking capacitor is recommended if DC voltage is present on the line.

RF Port – Used as input on a downconversion, output on upconversion, or output in a band shifting application. Signals should be connected by 50 ohm microstrip or coplanar traces to well matched broadband 50 ohm sources and loads.

Filtering and Matching- Filtering is generally desired for spurious and image removal on the output port of the mixer. Reflective filters can cause out of band signals to reflect back into the mixer and cause conversion loss ripple, erroneous spurs, and other undesired behaviors. To eliminate these problems it is recommend that the filters be placed as close to the output port as possible. If undesired behavior is still observed, a diplexer with one port terminated or a 1-3 dB attenuator may reduce this problem.

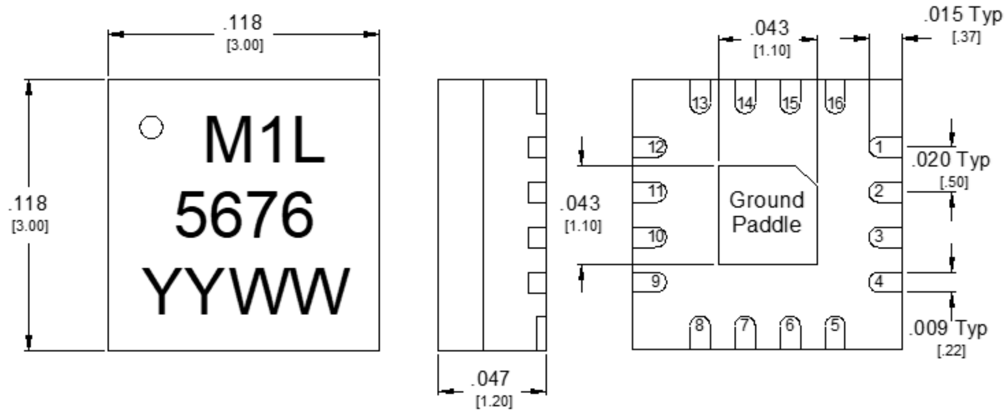
RF Ground – The ground paddle of the QFN should be connected to a low noise RF ground with very low electrical resistance for high frequency operation.

LO Port – The noise floor of the LO input signal should be less than the value of the noise floor plus isolation of the mixer, or a filter is recommended to prevent reduction in dynamic range. An LO amplifier is required if the LO power is below the recommended drive level. It is important to use an amplifier with a broadband 50 ohm match such that it does not reflect spurious signals back into the mixer or other system circuitry.

Mechanical Data

Outline Drawing

Download : Outline 3D Drawing | Outline 3D STP

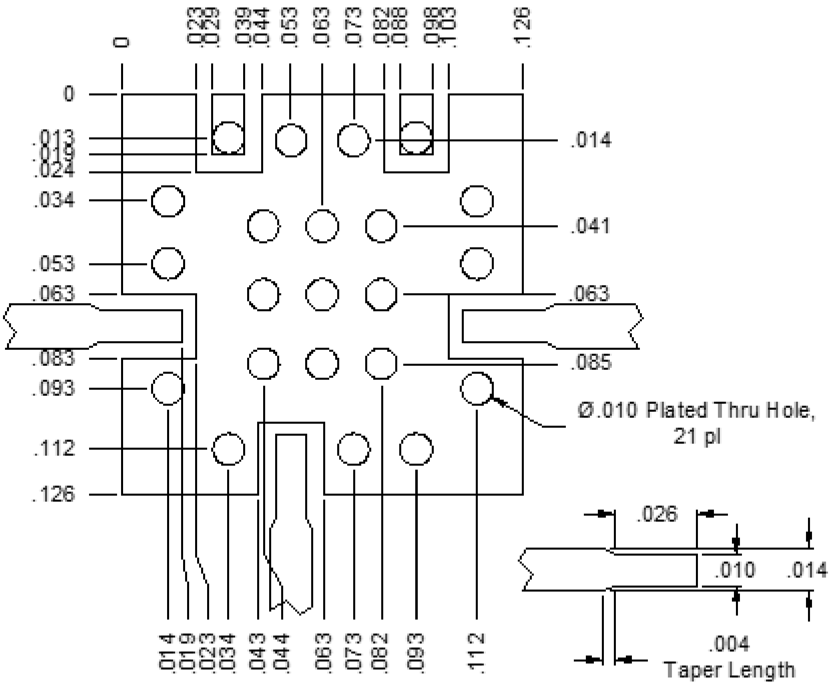


Pad #	Configuration A Function	Configuration B Function
1	N/C	N/C
2	N/C	N/C
3	IF	IF
4	N/C	N/C
5	N/C	N/C
6	LO	RF
7	N/C	N/C
8	N/C	N/C
9	N/C	N/C
10	RF	LO
11	N/C	N/C
12	N/C	N/C
13	N/C	N/C
14	N/C	N/C
15	N/C	N/C
16	N/C	N/C

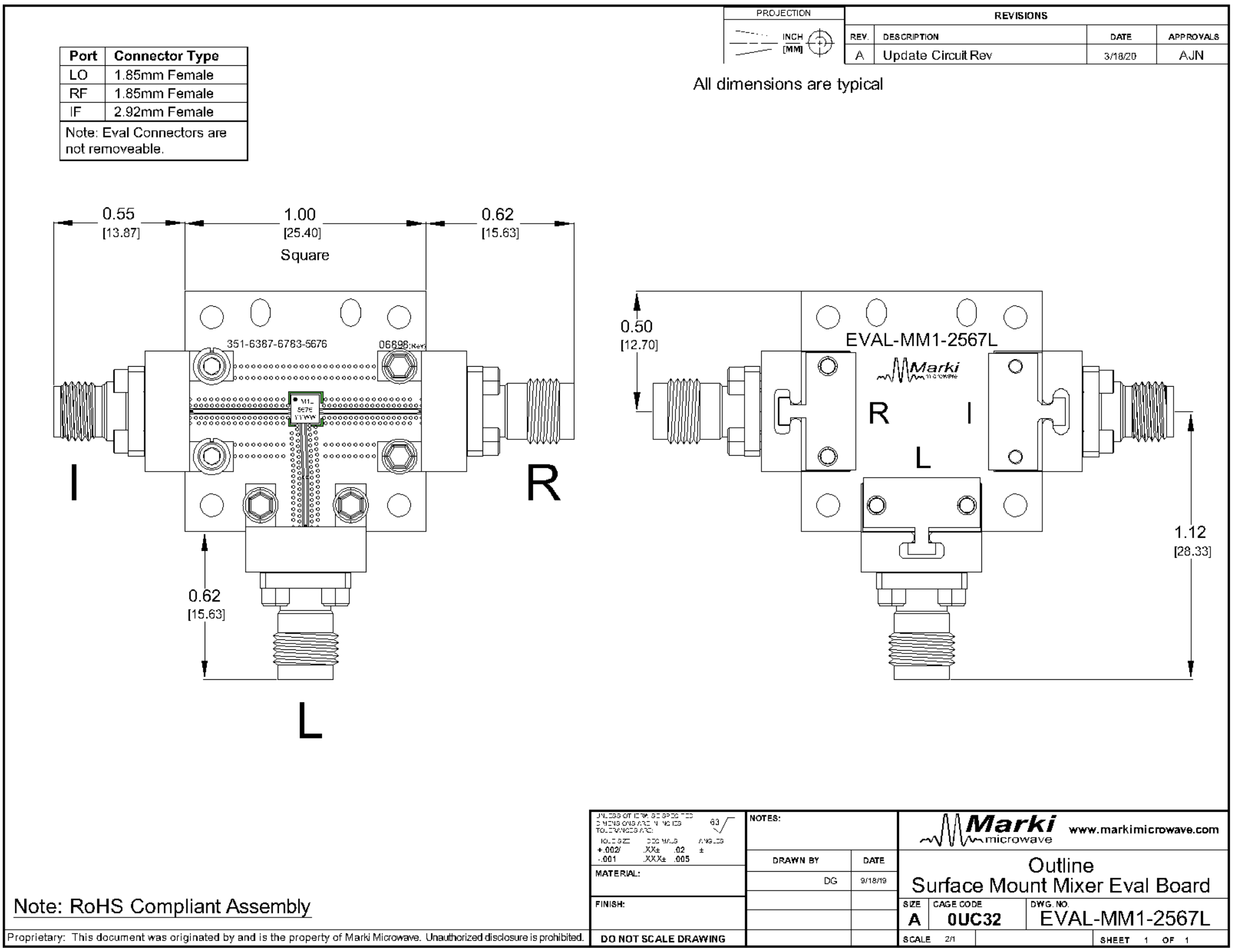
1. Substrate material is LCP.
2. I/O Leads and Ground Paddle plating is ENEPIG, 0.05 µm max Au.
3. All unconnected pads should be connected to PCB RF ground.

Footprint Image

Download : Footprint Drawing



Evaluation Board - Outline Drawing



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