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Sales & Customer Support: sales@markimicrowave.com
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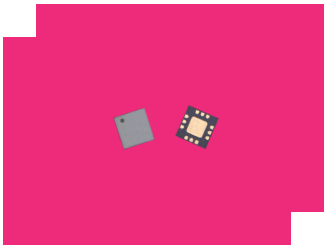
MM1-0424SSM-2

GaAs Double-Balanced Mixer

DEVICE OVERVIEW

General Description

The MM1-0424S is a high linearity passive double balanced MMIC mixer. The S diode offers superior 1 dB compression, two tone intermodulation performance, and spurious suppression, compared to other GaAs MMIC mixers. It features excellent conversion loss, superior isolations and spurious performance across a broad bandwidth, in a miniature form factor. The MM1-0424SSM is available in a lead-free, RoHS compliant QFN surface mount package and is compatible with standard leaded and lead-free PCB reflow soldering processes. The MM1-0424SSM is a superior alternative to Marki Microwave surface mount M1 and M3 mixers.



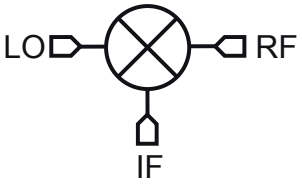
Features

- +14 dBm Typical Input 1 dB Compression
- +25 dBm Typical Input IP3
- Compact 3mm QFN SMT Style Package
- Excellent Unit-to-Unit Repeatability
- RoHS Compliant

Applications

N/A

Functional Block Diagram



Part Ordering Options

Part Number	Description	Package	Packing Size	Green Status	Product Lifecycle	Export Classification
MM1-0424SSM-2	GaAs Double-Balanced Mixer	QFN	-	REACH RoHS	Released	EAR99
EVAL-MM1-0424S	Evaluation Board, GaAs DOUBLE-BALANCED MIXER	EVAL	-	REACH RoHS	Released	EAR99
MM1-0424S-2-TR	Tape and Reel, GaAs Double-Balanced Mixer	QFN	7"	REACH RoHS	Released	EAR99

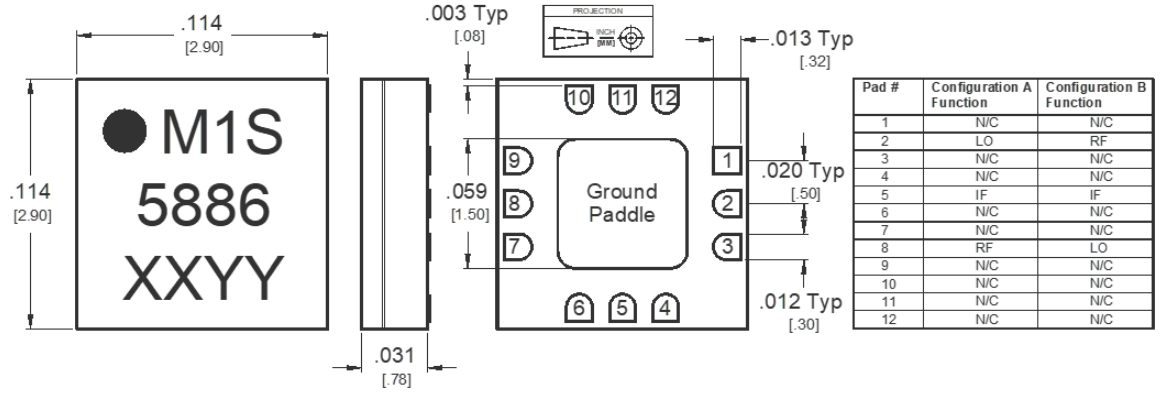
Table Of Contents

Revision History

Revision Code	Revision Date	Comment
-	2016-08-01	Initial Release
A	2019-04-01	Updated plating to ENEPIG
B	2025-08-22	ESD Class added

Port Configuration and Functions

Port Diagram



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

Outline Drawing – 3mm QFN package

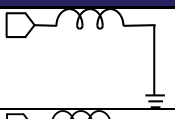
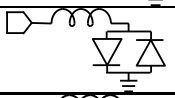
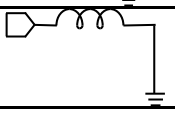
Substrate material is Ceramic.
I/O Leads and Ground Paddle plating is (from base to finish):

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

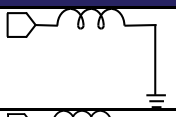
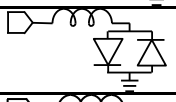
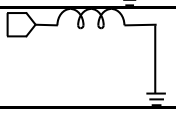
All unconnected pads should be connected to PCB RF ground.

Port Functions

Configuration A

Port	Function	Description	Equivalent Circuit for Package
Port 2	LO	Port 2 is DC short to ground and AC matched to 50 Ohms from 4.5 to 24 GHz. Blocking capacitor is optional.	
Port 5	IF	Port 5 is DC coupled to the diodes. Blocking capacitor is optional.	
Port 8	RF	Port 8 is DC short to ground and AC matched to 50 Ohms from 4.5 to 24 GHz. Blocking capacitor is optional.	

Configuration B

Port	Function	Description	Equivalent Circuit for Package
Port 2	RF	Port 2 is DC short to ground and AC matched to 50 Ohms from 4.5 to 24 GHz. Blocking capacitor is optional.	
Port 5	IF	Port 5 is DC coupled to the diodes. Blocking capacitor is optional.	
Port 8	LO	Port 8 is DC short to ground and AC matched to 50 Ohms from 4.5 to 24 GHz. Blocking capacitor is optional.	

Specifications

Absolute Maximum Ratings

Parameter	Maximum Rating	Unit
Maximum Operating Temperature	100	°C
Maximum Storage Temperature	125	°C
Minimum Operating Temperature	-55	°C
Minimum Storage Temperature	-65	°C
Port 2 DC Current	15	mA
Port 5 DC Current	30	mA
Port 8 DC Current	15	mA
RF Power Handling (RF+LO), 100°C	24	dBm
RF Power Handling (RF+LO), 25°C	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

Parameter	Min	Nominal	Max	Unit
LO Input Power	17	-	23	-

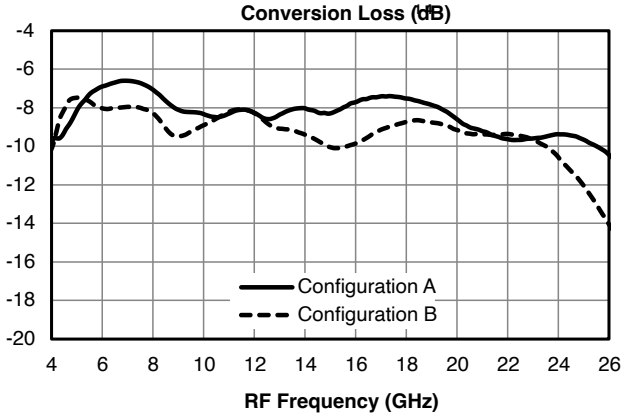
Electrical Specifications

Specifications guaranteed from -55 to +100°C, measured in a 50Ω system. Specifications are shown for Configurations A & B.

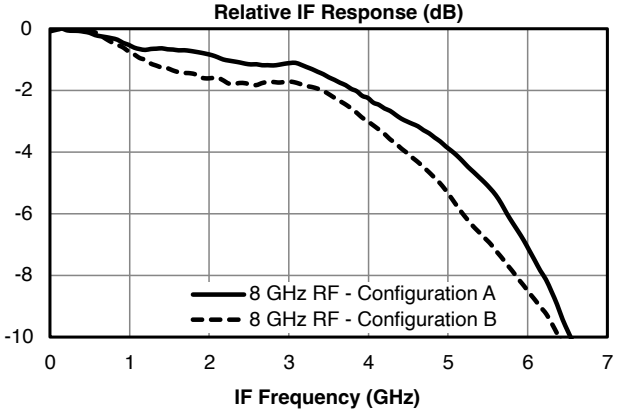
Parameter	Port Configuration	Test Conditions	Min	Typ	Max	Unit
Conversion Loss	A	LO/RF=4.5-24 GHz IF=DC-4 GHz	-	8	13	dB
IF Frequency Range	A	-	0	-	4	GHz
Input 1 dB Compression	A	LO/RF=4.5-24 GHz IF=DC-4 GHz LO Drive Level= 18-23	-	14	-	dBm
Input IP3	A	A: LO/RF=4.5-24 GHz IF=DC-4 GHz LO Drive Level= 18-23	-	25	-	dBm
LO Frequency Range	A	-	4.5	-	24	GHz
RF Frequency Range	A	-	4.5	-	24	GHz
Conversion Loss	B	LO/RF=4.5-24 GHz IF=DC-4 GHz	-	9	16	dB
Input 1 dB Compression	B	B: LO/RF=4.5-24 GHz IF=DC-4 GHz LO Drive Level= 17-23	-	14	-	dBm
Input IP3	B	B: LO/RF=4.5-24 GHz IF=DC-4 GHz LO Drive Level= 17-23	-	23	-	dBm
Isolation, LO to RF	-	-	-	48	-	dB

Typical Performance

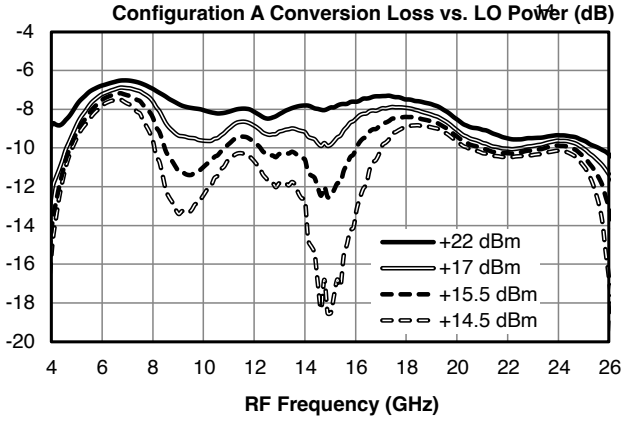
Conversion Loss (dB)



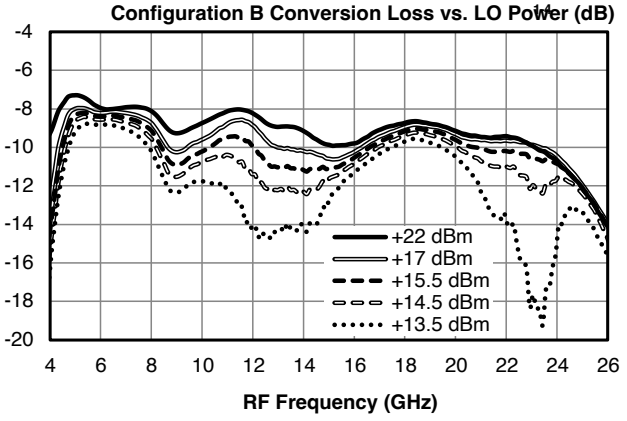
Relative IF Response (dB)



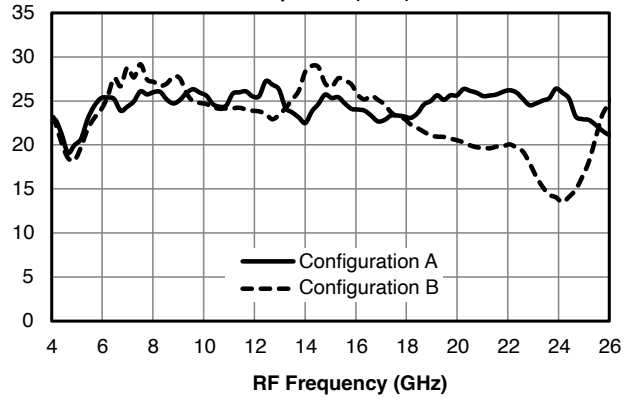
Configuration A Conversion Loss vs. LO Power (dB)



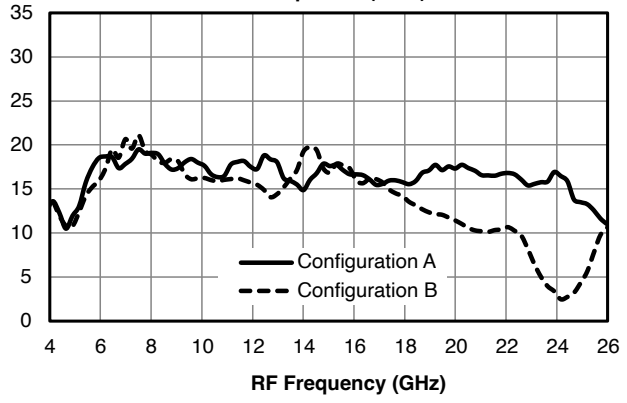
Configuration B Conversion Loss vs. LO Power (dB)



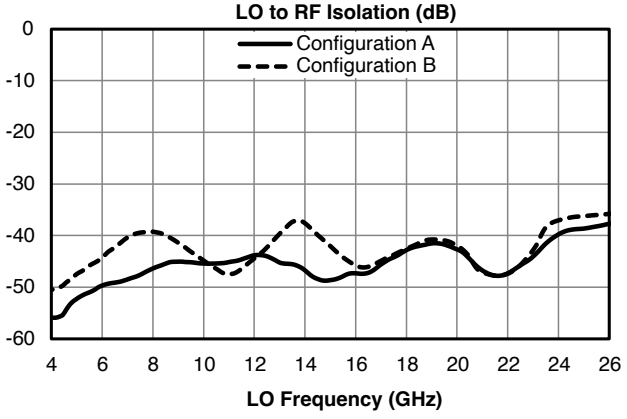
Input IP3 (dBm)



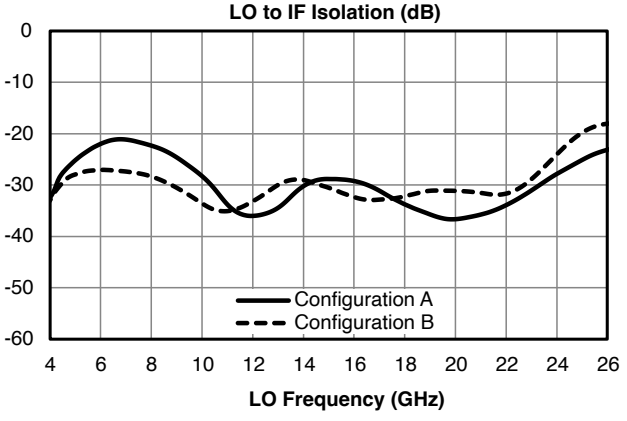
Output IP3 (dBm)



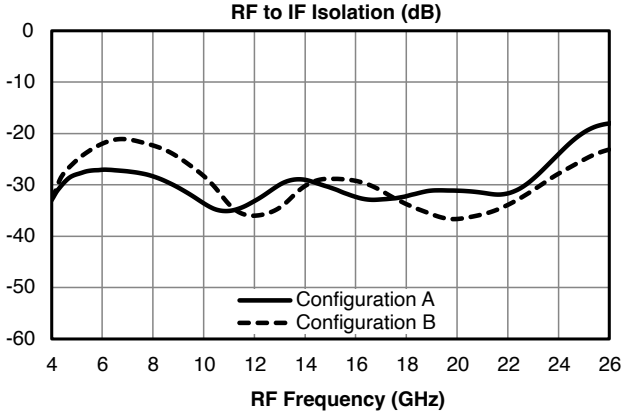
LO to RF Isolation (dB)



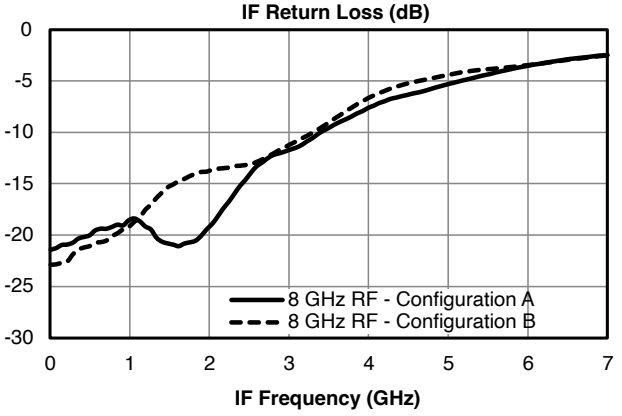
LO to IF Isolation (dB)



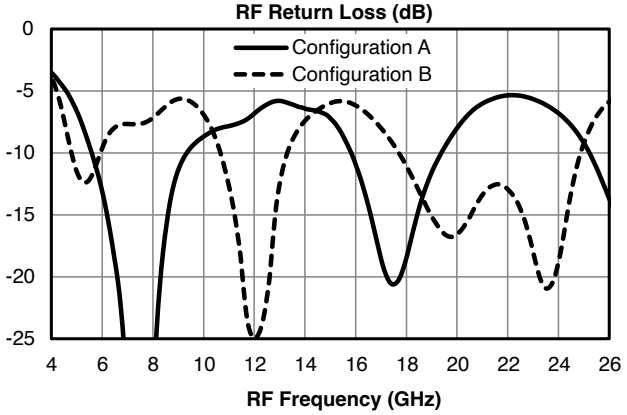
RF to IF Isolation (dB)



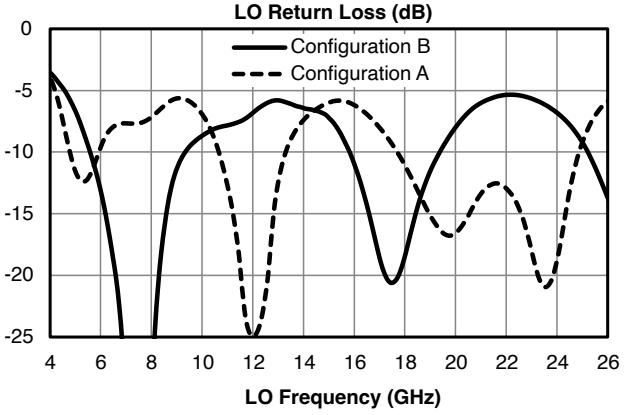
IF Return Loss (dB)



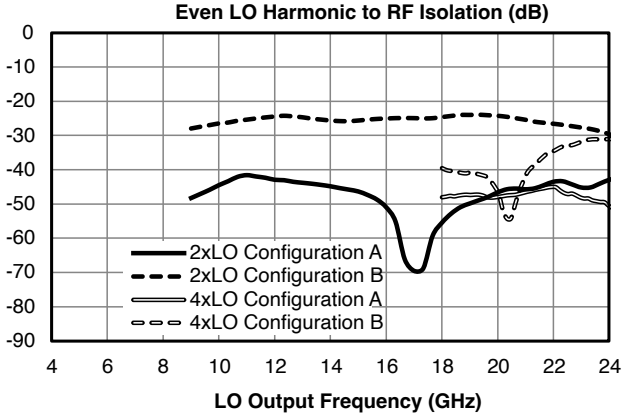
RF Return Loss (dB)



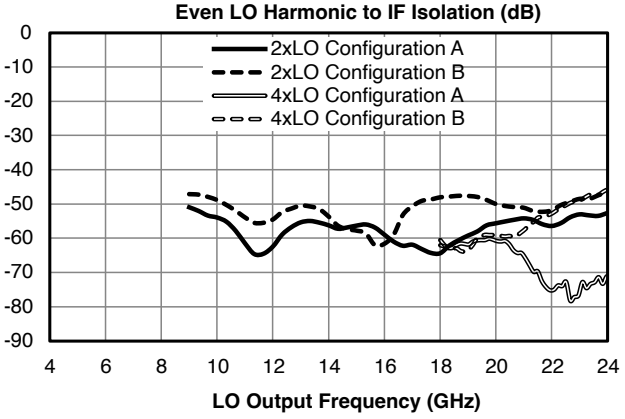
LO Return Loss (dB)



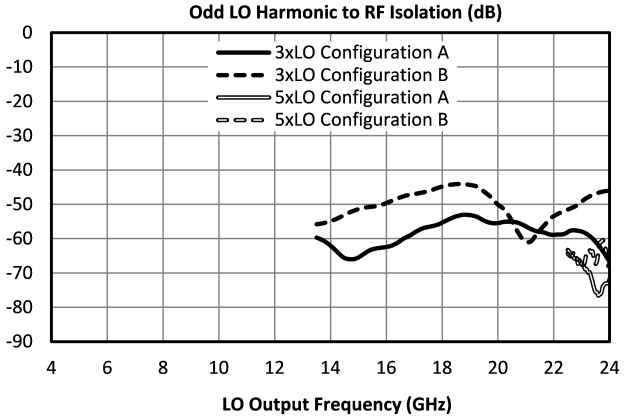
Even LO Harmonic to RF Isolation (dB)



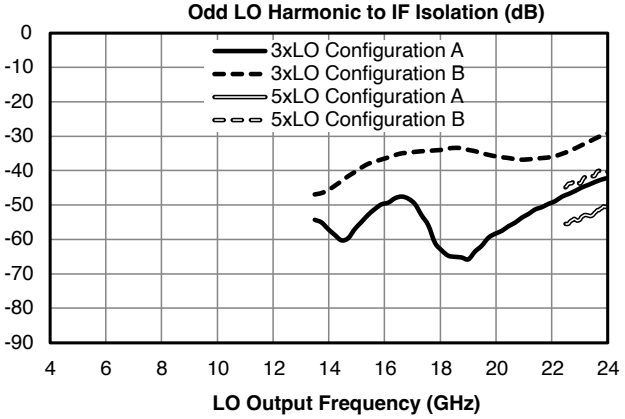
Even LO Harmonic to IF Isolation (dB)

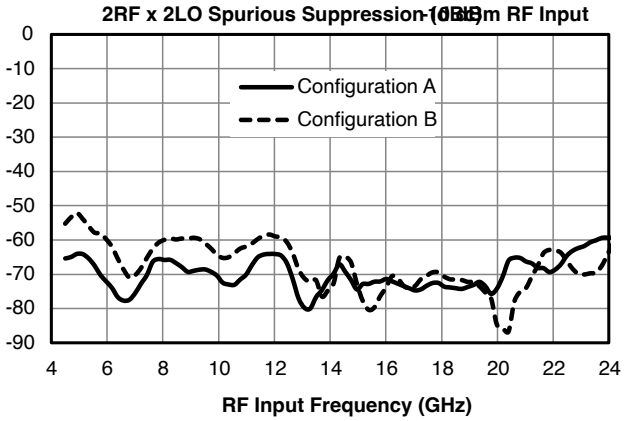


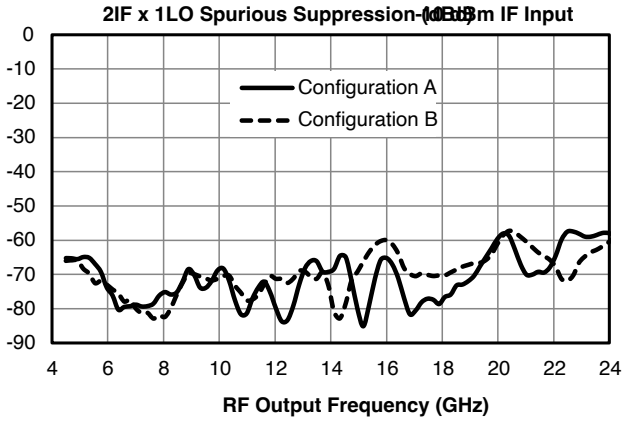
Odd LO Harmonic to RF Isolation (dB)



Odd LO Harmonic to IF Isolation (dB)







Spur Table

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 output 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 70 dBc for the A configuration for a -10 dBm input, so a -20 dBm RF input creates a spur that is (2-1) x (-10 dB) dB lower, or 80 dBc.

Typical Downconversion Spurious Suppression (dBc): A Configuration (B Configuration) [4]

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xRF	22 (20)	Reference	18 (31)	13 (13)	30 (38)	19 (28)
2xRF	66 (67)	62 (56)	70 (67)	68 (53)	72 (70)	72 (55)
3xRF	89 (95)	76 (72)	88 (94)	84 (82)	88 (91)	81 (85)
4xRF	122 (121)	120 (110)	119 (118)	120 (117)	121 (121)	118 (117)
5xRF	130 (128)	134 (123)	134 (132)	131 (130)	131 (131)	131 (127)

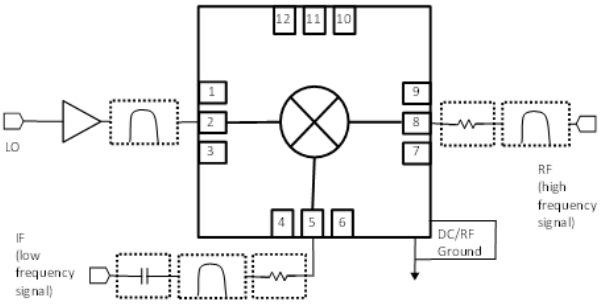
Upconversion Spurious Suppression

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 70 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 80 dBc.

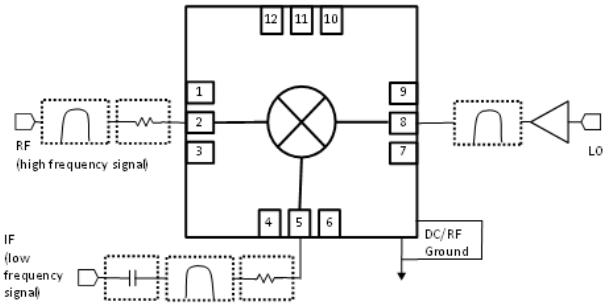
Typical Upconversion Spurious Suppression (dBc): A Configuration (B Configuration) [4]

-10 dBm IF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xIF	22 (20)	Reference	21 (34)	13 (12)	29 (37)	25 (30)
2xIF	60 (49)	**71 (70)**	61 (53)	70 (71)	59 (50)	68 (64)
3xIF	84 (88)	76 (79)	84 (93)	74 (74)	80 (88)	64 (74)
4xIF	131 (119)	118 (117)	115 (106)	117 (118)	105 (95)	111 (104)
5xIF	145 (144)	131 (127)	128 (132)	123 (123)	125 (131)	105 (117)

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.

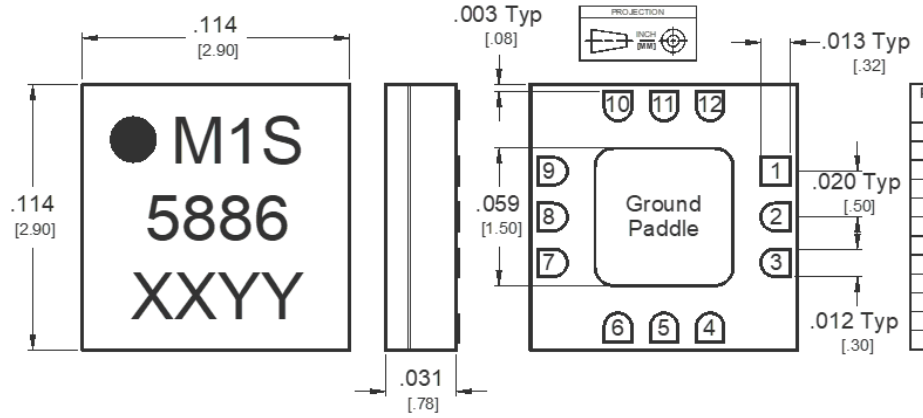
RF Ground – The ground paddle of the QFN should be connected to a low noise RF ground with very low electrical resistance for high frequency operation.

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 2D Drawing | Outline 3D Drawing | Outline 3D STP



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

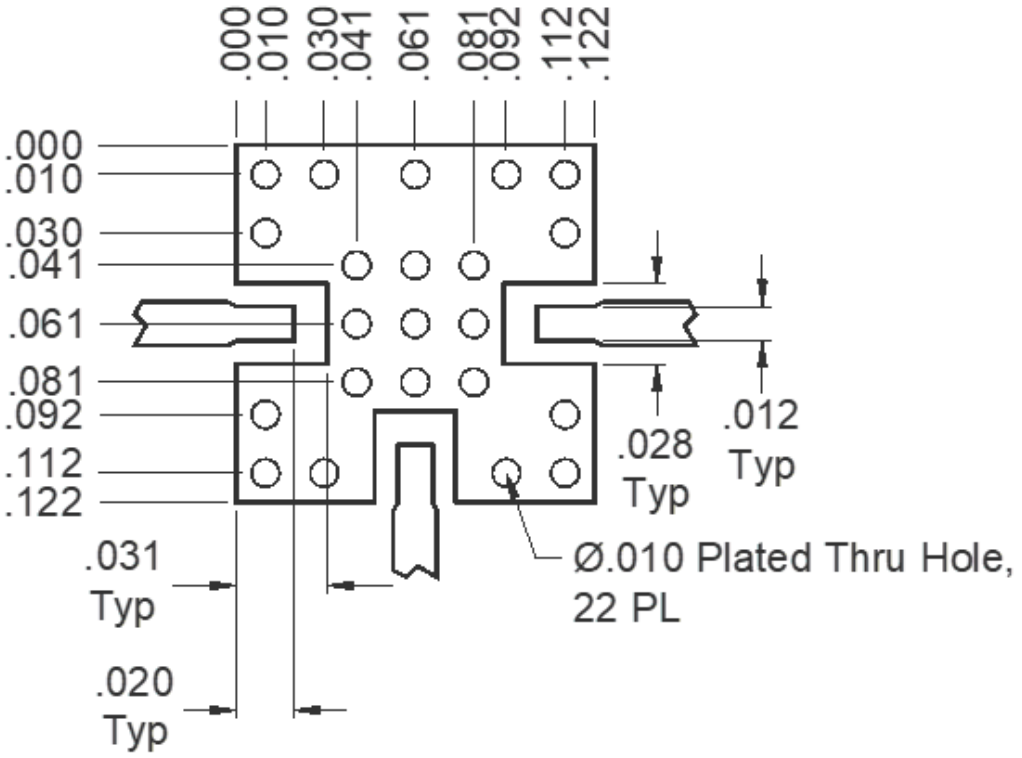
Outline Drawing – 3mm QFN package

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



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