Sales: 408-778-9952 | General: 408-778-4200 | Fax: 408-778-4300
Sales & Customer Support: sales@markimicrowave.com
Tech Support: support@markimicrowave.com

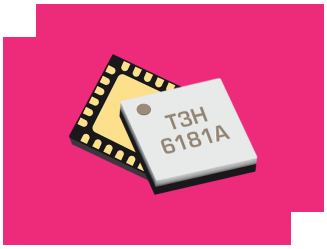
MT3H-0113LSM-2

GaAs MMIC High Dynamic Range Mixer

DEVICE OVERVIEW

General Description

The MT3H-0113LSM is a triple balanced passive diode mixer offering high dynamic range, low conversion loss, and excellent repeatability. As with all T3 mixers, this mixer offers unparalleled nonlinear performance in terms of IIP3, P1dB, and spurious performance with a flexible LO drive requirement from +7 dBm to +15 dBm. RF, LO, and IF ports are all operated single ended due to integrated baluns. The MT3H-0113LSM is available in a 4x4mm QFN, or in an SMA connectorized evaluation fixture. The MT3H-0113LSM is a superior alternative to Marki Microwave carrier and packaged T3 mixers. If >+16dBm LO power is available, the higher barrier MT3H-0113HSM is recommended.



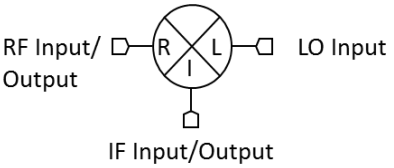
Features

- Industry-Leading Spurious, IP3, and P1dB Performance
- RoHS Compliant
- Broadband, Overlapping RF, LO and IF

Applications

N/A

Functional Block Diagram



Part Ordering Options

Part Number	Description	Package	Green Status	Product Lifecycle	Export Classification
MT3H-0113LSM-2	GaAs MMIC High Dynamic Range Mixer	QFN	REACH RoHS	Released	EAR99
EVAL-MT3H-0113L	Evaluation Board, GaAs MMIC High Dynamic Range Mixer	EVAL	REACH RoHS	Released	EAR99

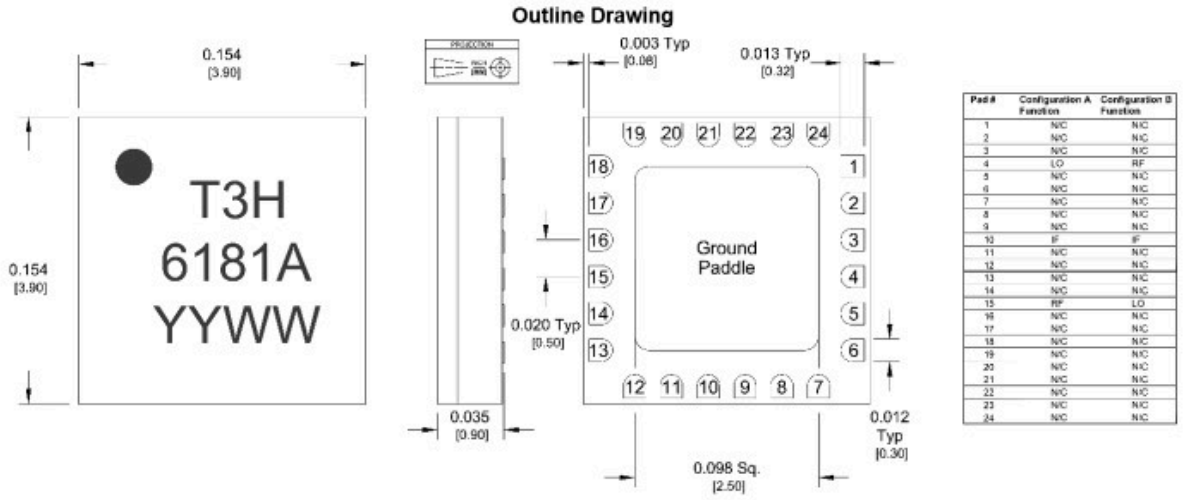
Table Of Contents

Revision History

Revision Code	Revision Date	Comment
-	2017-01-01	Initial Release
A	2019-01-01	Revised square wave LO IP3 plots. End note 5 updated to reflect new test condition.
B	2025-02-10	Updated ESD Class

Port Configuration and Functions

Port Diagram

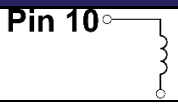
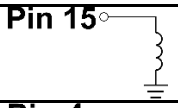
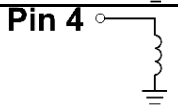


Pad #	Configuration A Function	Configuration B Function
1	N/C	N/C
2	N/C	N/C
3	N/C	N/C
4	LO	RF
5	N/C	N/C
6	N/C	N/C
7	N/C	N/C
8	N/C	N/C
9	N/C	N/C
10	IF	IF
11	N/C	N/C
12	N/C	N/C
13	N/C	N/C
14	N/C	N/C
15	RF	LO
16	N/C	N/C
17	N/C	N/C
18	N/C	N/C
19	N/C	N/C
20	N/C	N/C
21	N/C	N/C
22	N/C	N/C
23	N/C	N/C
24	N/C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

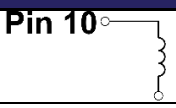
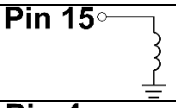
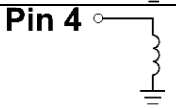
1. Substrate material is Ceramic.
2. All unconnected pads should be connected to PCB RF ground.
3. ENEPIG Plating/Finish: Ni: 8.89 micron max, 1.27 micron min. Pd: 0.17 micron max, 0.07 micron min. Au: 0.254 micron max, 0.03 micron min.

Port Functions

Configuration A

Port	Function	Description	Equivalent Circuit for Package
10	IF	Pin 10 is DC open. Blocking capacitor is optional.	
1-3, 5-9, 11-14, 16-24	Non-connect (NC)	These pins are not connected internally. Datasheet performance is tested with NC pins grounded.	-
15	RF	Pin 15 is DC short and AC matched to 50 Ω from 0.8 to 13 GHz. Blocking capacitor is optional.	
4	LO	Pin 4 is DC short and AC matched to 50 Ω from 0.8 to 13 GHz. Blocking capacitor is optional.	
Paddle	Ground	Ground pad should be connected to RF/DC ground with low electrical and thermal resistance.	-

Configuration B

Port	Function	Description	Equivalent Circuit for Package
10	IF	Pin 10 is DC open. Blocking capacitor is optional.	
1-3, 5-9, 11-14, 16-24	Non-connect (NC)	These pins are not connected internally. Datasheet performance is tested with NC pins grounded.	-
15	LO	Pin 15 is DC short and AC matched to 50 Ω from 0.8 to 13 GHz. Blocking capacitor is optional.	
4	RF	Pin 4 is DC short and AC matched to 50 Ω from 0.8 to 13 GHz. Blocking capacitor is optional.	
Paddle	Ground	Ground pad should be connected to RF/DC ground with low electrical and thermal resistance.	-

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
RF Power Handling (RF+LO)	30	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

Parameter	Min	Nominal	Max	Unit
LO Input Power	7	-	15	-

Electrical Specifications

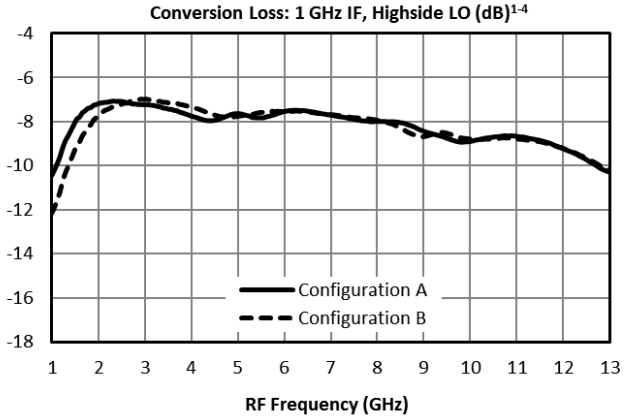
Specifications guaranteed from -55 to +100°C, measured in a 50Ω system. All bare die are 100% DC tested and 100% visually inspected. RF testing is performed on a sample basis to verify conformance to datasheet guaranteed specifications. Consult factory for more information.

Parameter	Port Configuration	Test Conditions	Min	Typ	Max	Unit
IF Frequency Range	A	-	0.8	-	8.5	GHz
Input IP3 [1]	A	LO/RF=1.5-13 GHz IF=0.8-8.5 GHz LO drive level=7-15 dBm	-	22	-	dBm
LO Frequency Range	A	-	1.5	-	13	GHz
RF Frequency Range	A	-	1.5	-	13	GHz
Input IP3 [2]	B	LO/RF=1.5-13 GHz IF=0.8-8.5 GHz LO drive level=7-15 dBm	-	22	-	dBm
Conversion Loss [3]	-	LO/RF=1.5-13 GHz IF=0.8-1 GHz LO drive level=15 dBm	-	8	11.5	dB
Conversion Loss [4]	-	LO/RF=1.5-13 GHz IF=1-8.5 GHz LO drive level=15 dBm	-	11.5	-	dB
Isolation, LO to RF	-	-	-	42	-	dB

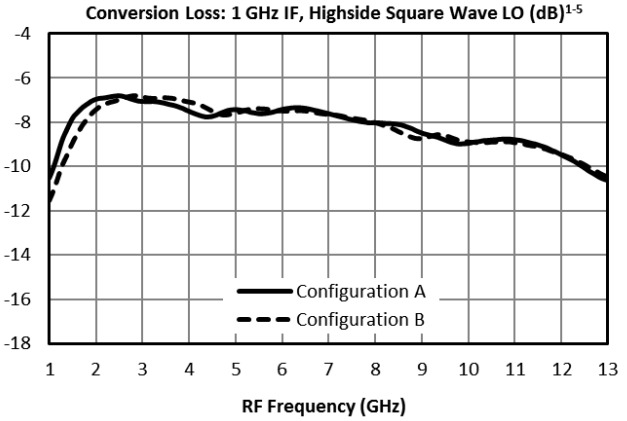
[1][2] IP3 depends on LO drive conditions, see plots for more details.
[3][4] Measured Conversion Loss measured at 1 GHz fixed IF.

Typical Performance

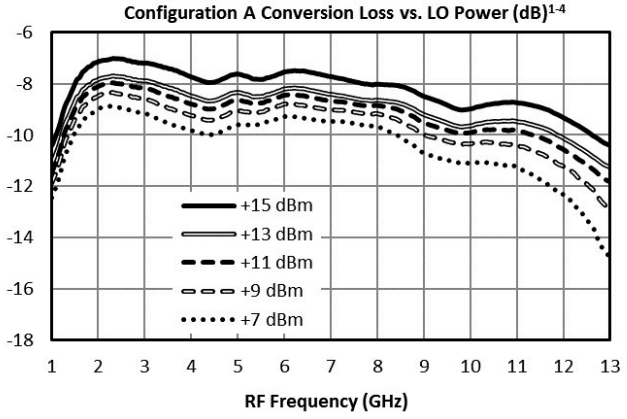
Conversion Loss: 1 GHz IF, Highside LO (dB)[1-4]



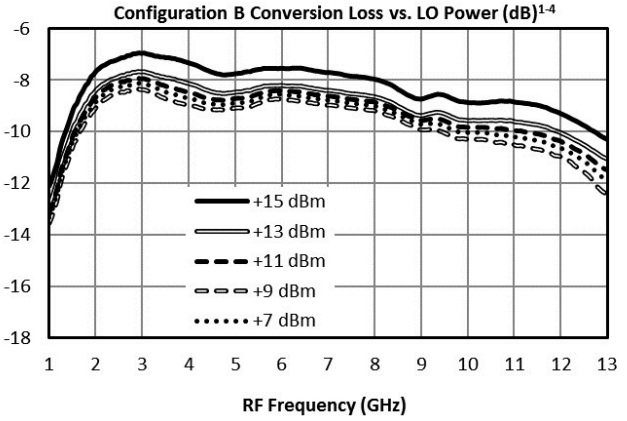
Conversion Loss: 1 GHz IF, Highside Square Wave LO (dB)[1-5]



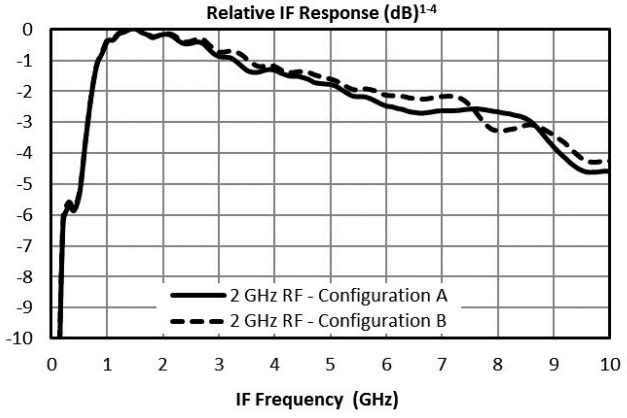
Configuration A Conversion Loss vs. LO Power (dB)[1-4]



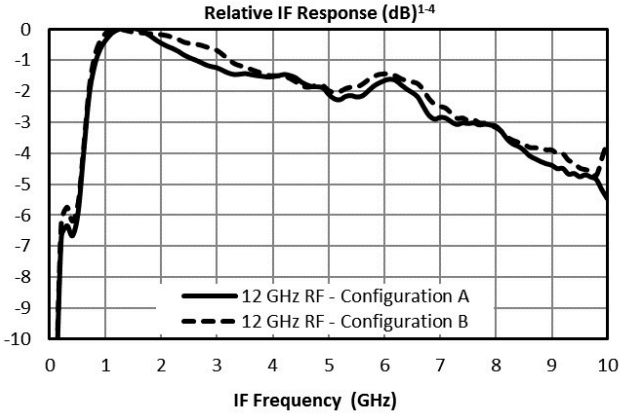
Configuration B Conversion Loss vs. LO Power (dB)[1-4]



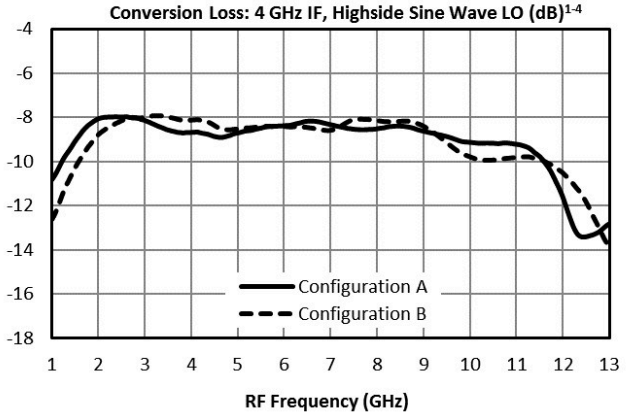
Relative IF Response (dB)[1-4]



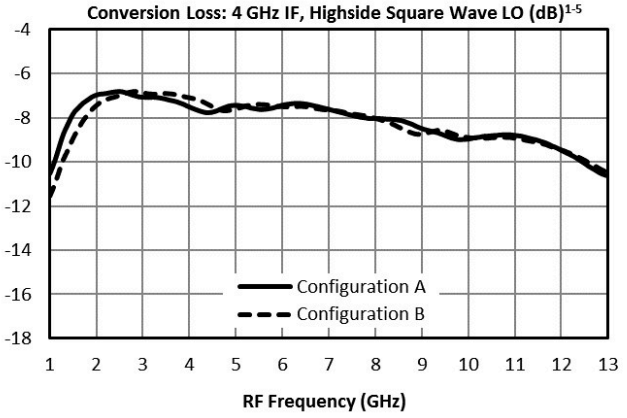
Relative IF Response (dB)[1-4]



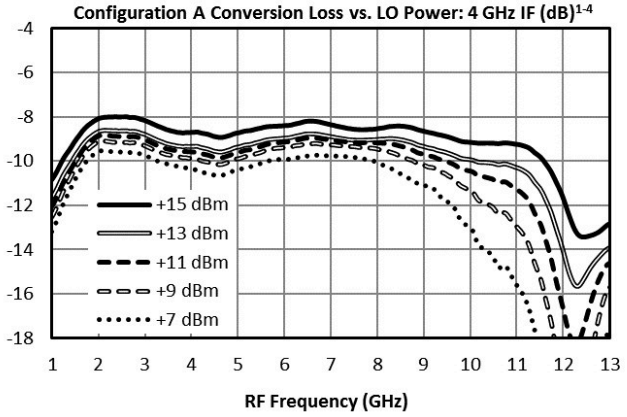
Conversion Loss: 4 GHz IF, Highside Sine Wave LO (dB)[1-4]



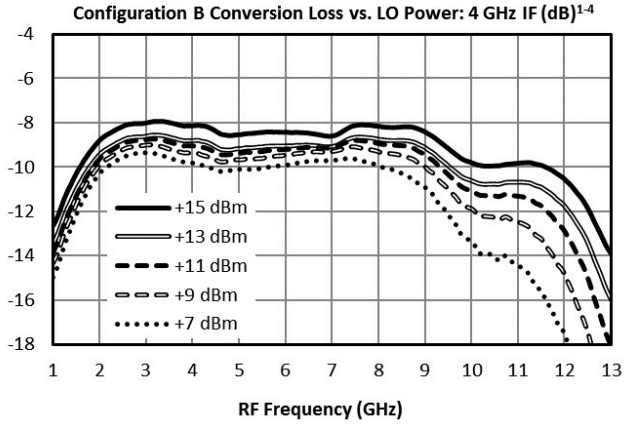
Conversion Loss: 4 GHz IF, Highside Square Wave LO (dB)[1-5]



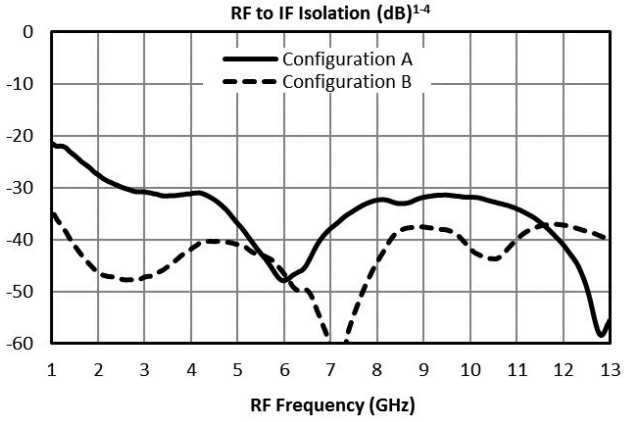
Configuration A Conversion Loss vs. LO Power: 4 GHz IF (dB)[1-4]



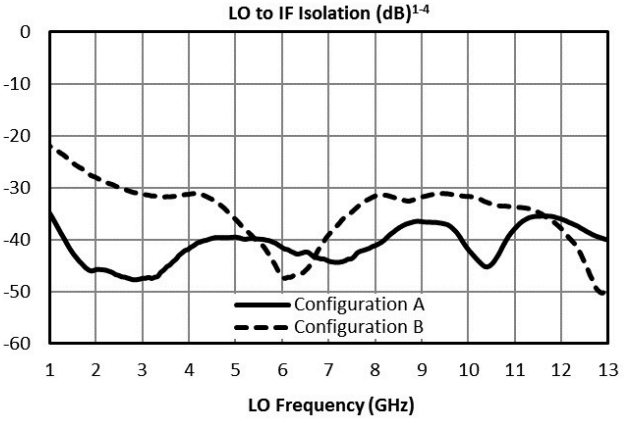
Configuration B Conversion Loss vs. LO Power: 4 GHz IF (dB)[1-4]



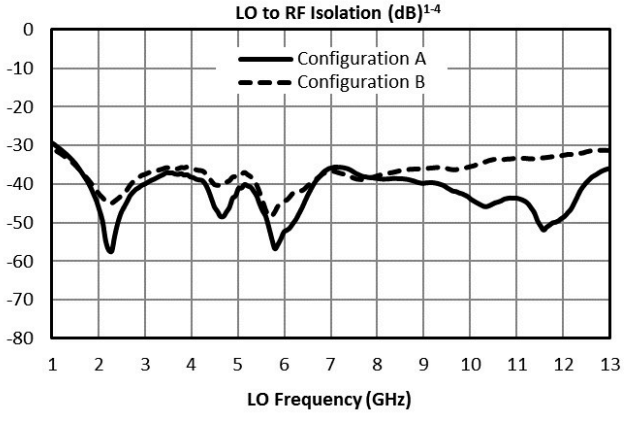
RF to IF Isolation (dB)[1-4]



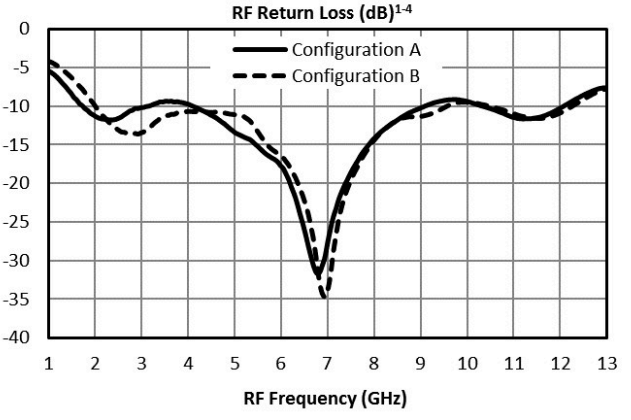
LO to IF Isolation (dB)[1-4]



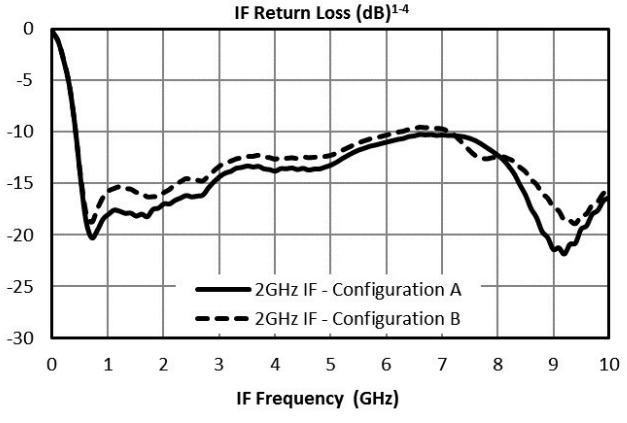
LO to RF Isolation (dB)[1-4]



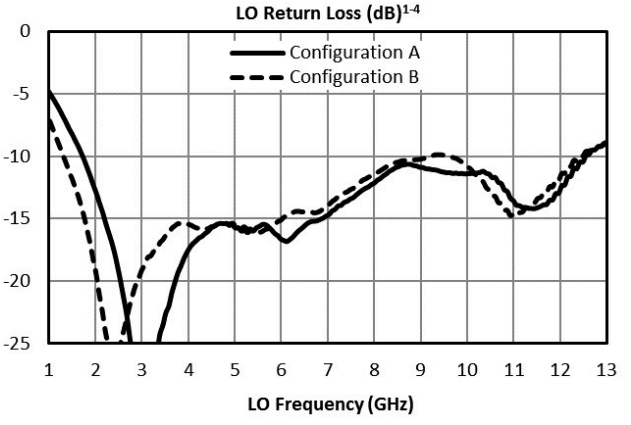
RF Return Loss (dB)[1-4]



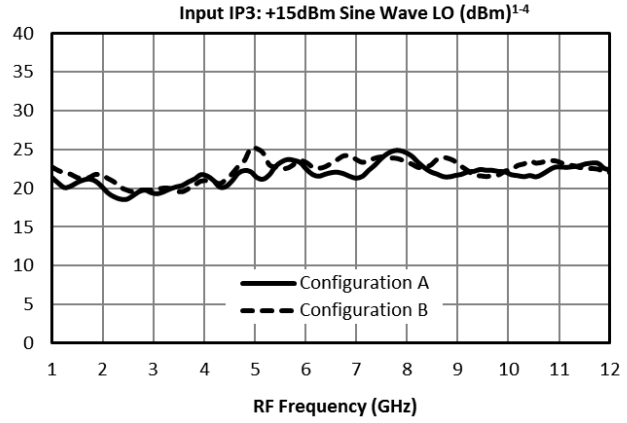
IF Return Loss (dB)[1-4]



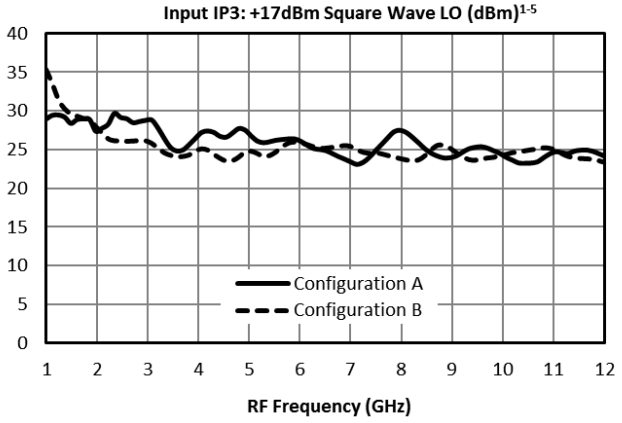
LO Return Loss (dB)[1-4]



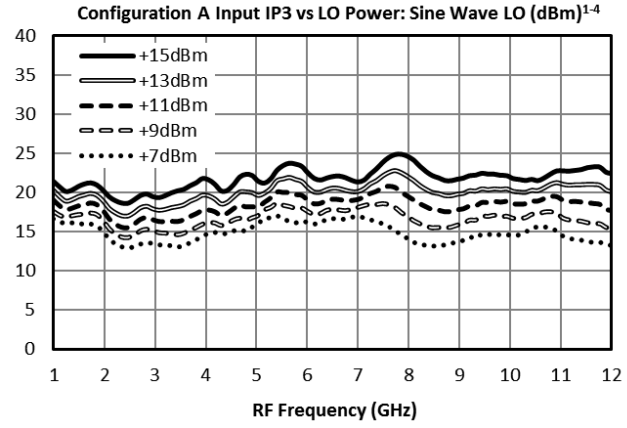
Input IP3: +15dBm Sine Wave LO (dBm)[1-4]



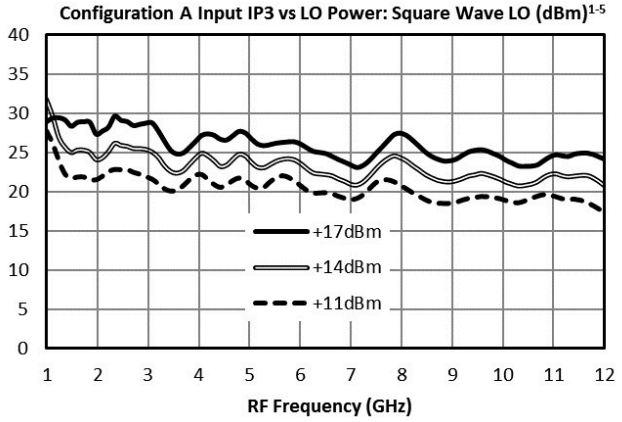
Input IP3: +17dBm Square Wave LO (dBm)[1-5]



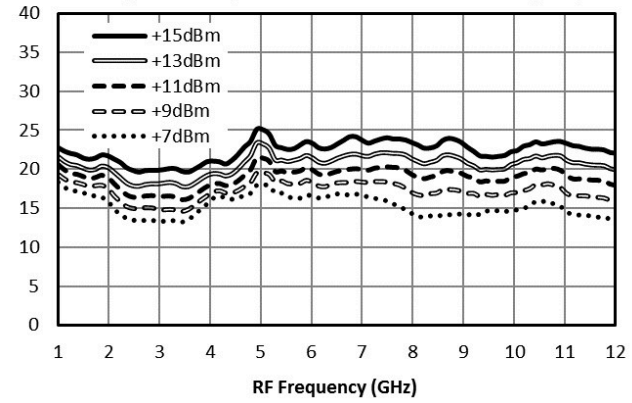
Configuration A Input IP3 vs LO Power: Sine Wave LO (dBm)[1-4]



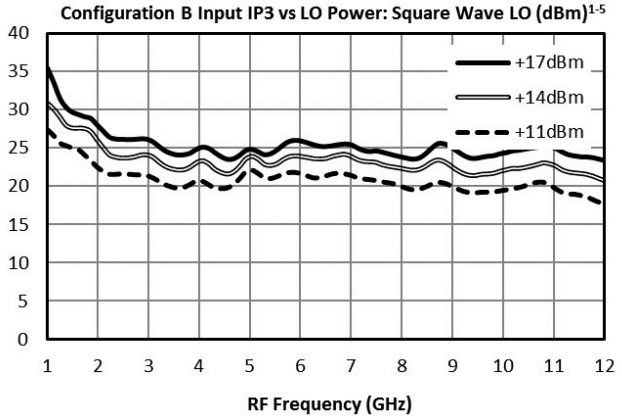
Configuration A Input IP3 vs LO Power: Square Wave LO (dBm)[1-5]



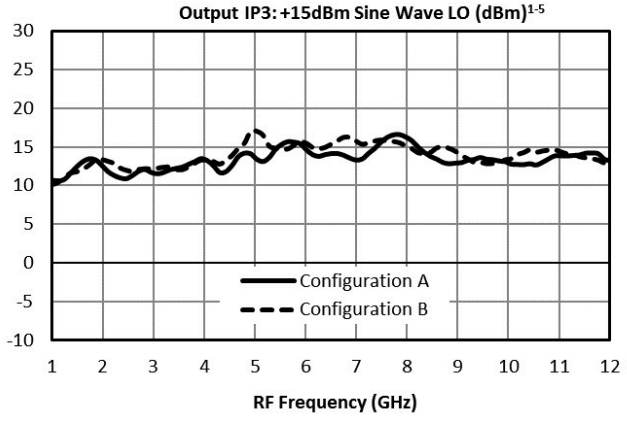
Configuration B Input IP3 vs LO Power: Sine Wave LO (dBm)[1-5]



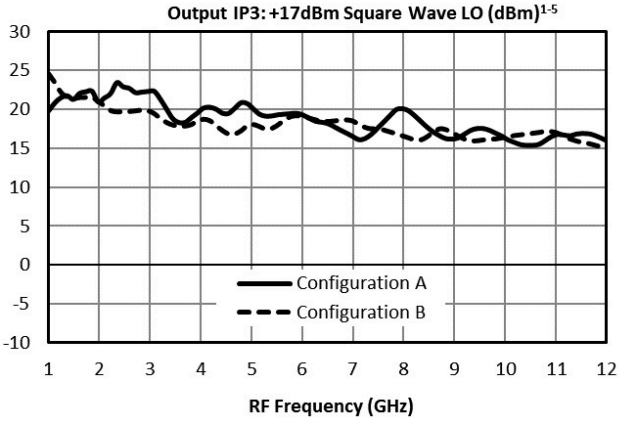
Configuration B Input IP3 vs LO Power: Square Wave LO (dBm)[1-5]



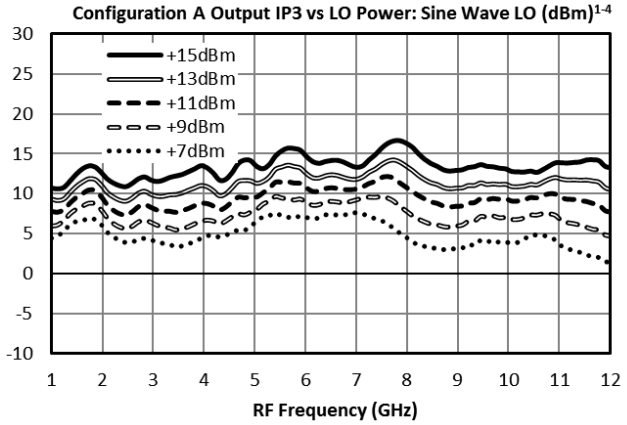
Output IP3: +15dBm Sine Wave LO (dBm)[1-5]



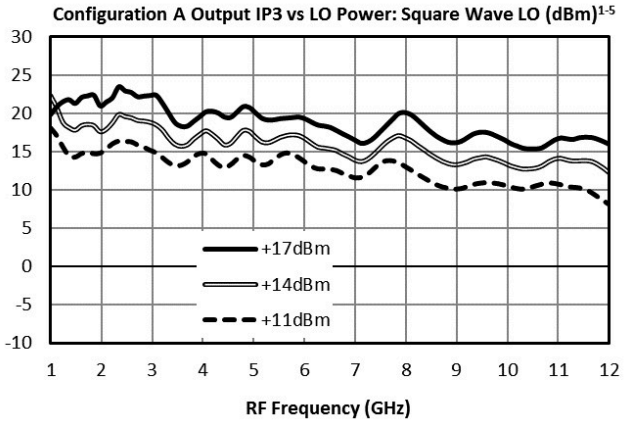
Output IP3: +17dBm Square Wave LO (dBm)[1-5]



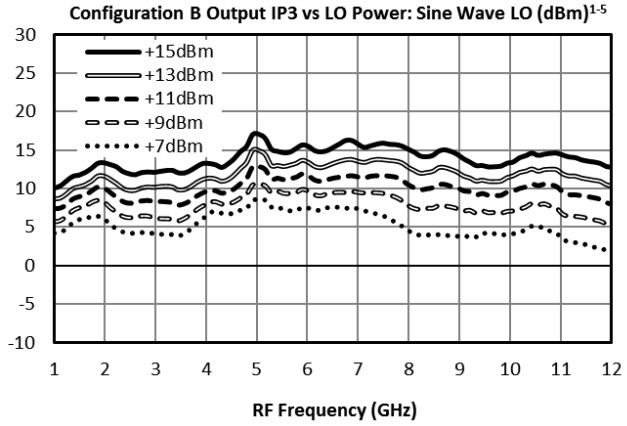
Configuration A Output IP3 vs LO Power: Sine Wave LO (dBm)[1-4]



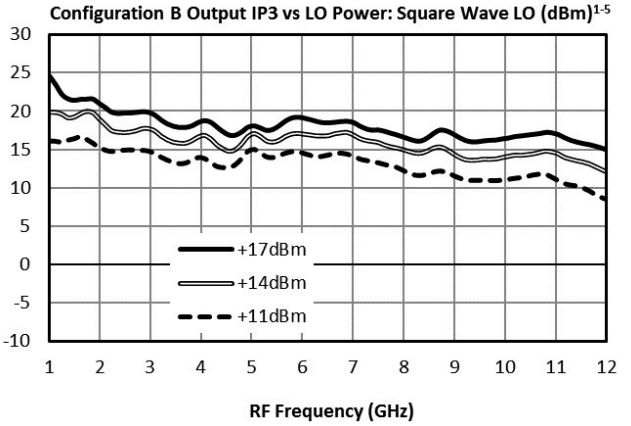
Configuration A Output IP3 vs LO Power: Square Wave LO (dBm)[1-5]



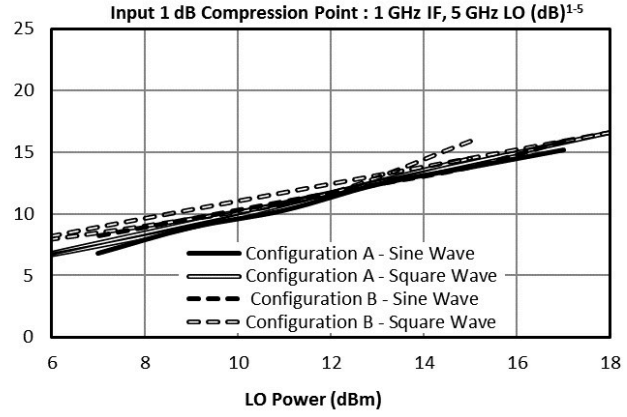
Configuration B Output IP3 vs LO Power: Sine Wave LO (dBm)[1-5]



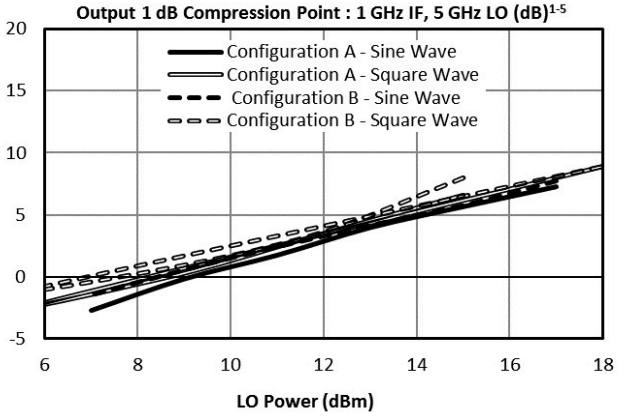
Configuration B Output IP3 vs LO Power: Square Wave LO (dBm)[1-5]



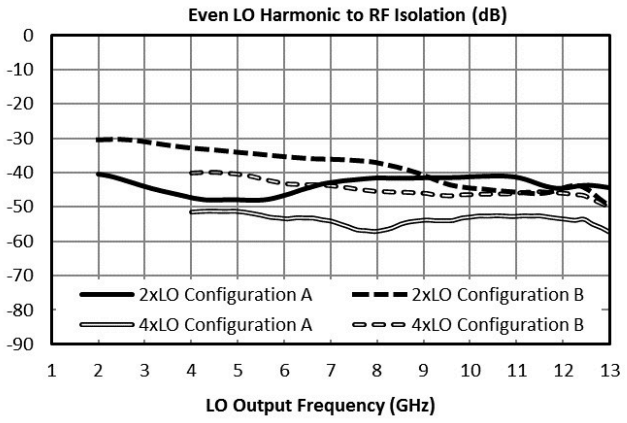
Input 1 dB Compression Point : 1 GHz IF, 5 GHz LO (dB)[1-5]



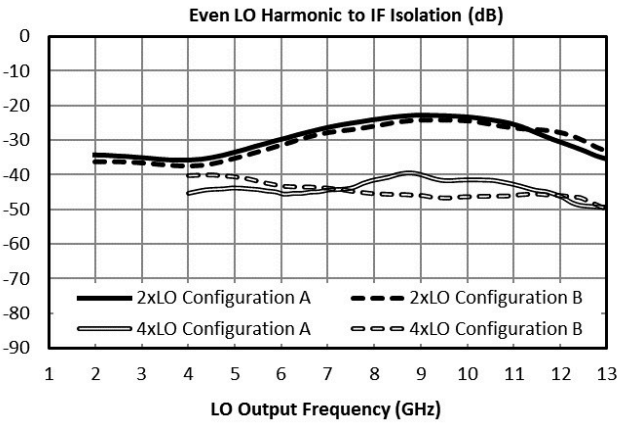
Output 1 dB Compression Point : 1 GHz IF, 5 GHz LO (dB)[1-5]



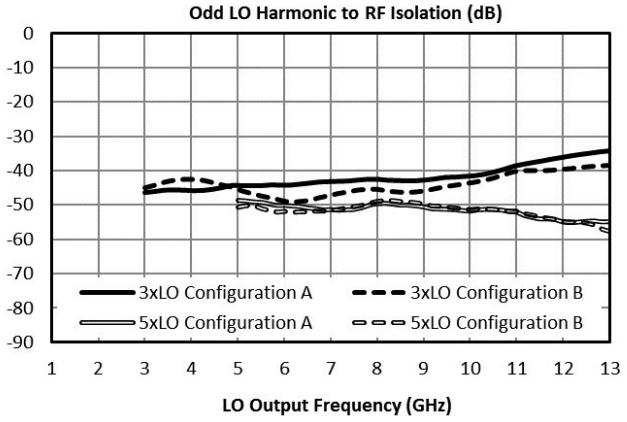
Even LO Harmonic to RF Isolation (dB)



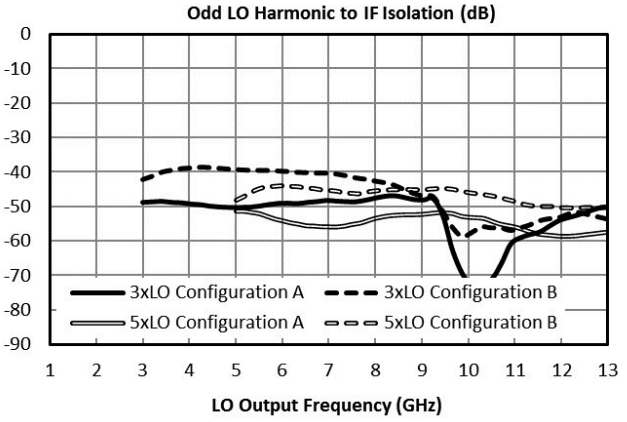
Even LO Harmonic to IF Isolation (dB)



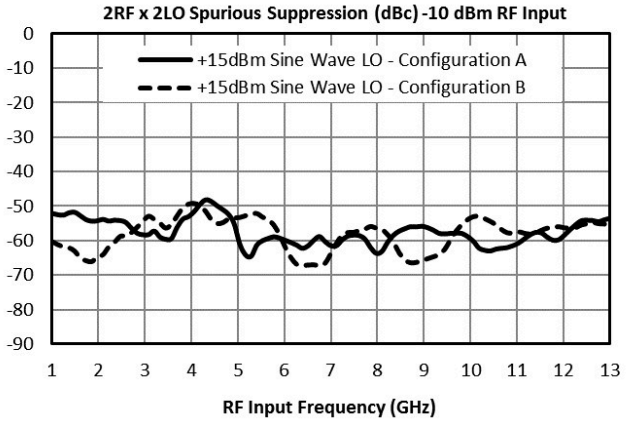
Odd LO Harmonic to RF Isolation (dB)



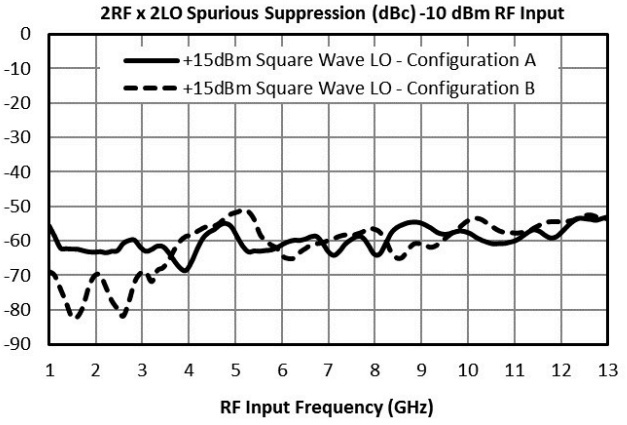
Odd LO Harmonic to IF Isolation (dB)



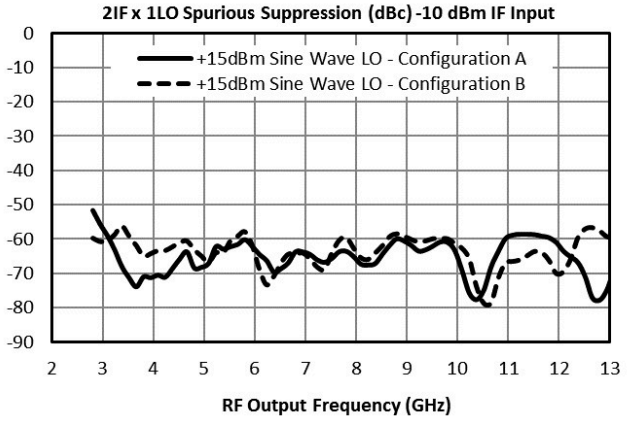
2RF x 2LO Spurious Suppression (dBc) -10 dBm RF Input



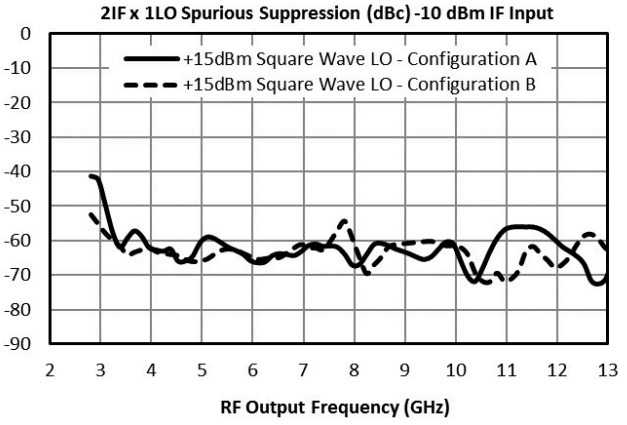
2RF x 2LO Spurious Suppression (dBc) -10 dBm RF Input



2IF x 1LO Spurious Suppression (dBc) -10 dBm IF Input



2IF x 1LO Spurious Suppression (dBc) -10 dBm IF Input



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 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 57 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 67 dBc.

Typical Downconversion Spurious Suppression (dBc): A Configuration (B Configuration), Sine Wave LO [6]

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xRF	27 (31)	Reference	33 (37)	15 (15)	31 (37)	29 (30)
2xRF	57 (54)	64 (60)	57 (58)	62 (55)	60 (62)	61 (53)
3xRF	92 (91)	72 (73)	84 (86)	65 (67)	85 (89)	118 (118)
4xRF	117 (114)	114 (115)	113 (114)	114 (112)	107 (106)	112 (109)
5xRF	146 (147)	130 (137)	133 (137)	128 (130)	134 (138)	117 (119)

Typical Downconversion Spurious Suppression (dBc): A Configuration (B Configuration), Square Wave LO [6]

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xRF	26 (32)	Reference	35 (38)	13 (12)	29 (41)	19 (18)
2xRF	57 (53)	65 (59)	60 (61)	63 (58)	61 (67)	66 (60)
3xRF	93 (98)	84 (85)	95 (98)	78 (80)	95 (101)	128 (131)
4xRF	120 (117)	123 (123)	121 (122)	123 (120)	117 (116)	123 (116)
5xRF	147 (154)	146 (153)	152 (155)	163 (149)	152 (156)	137 (141)

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 65 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 75 dBc.

Typical Upconversion Spurious Suppression (dBc): A Configuration (B Configuration), Sine Wave LO [6]

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xIF	22 (28)	Reference	31 (37)	15 (15)	31 (45)	30 (30)
2xIF	64 (56)	65 (64)	61 (52)	66 (64)	58 (51)	59 (61)
3xIF	80 (71)	91 (91)	93 (93)	81 (82)	85 (93)	77 (80)
4xIF	118 (109)	122 (121)	118 (115)	118 (117)	115 (110)	120 (115)
5xIF	135 (126)	147 (146)	151 (149)	137 (139)	144 (148)	131 (135)

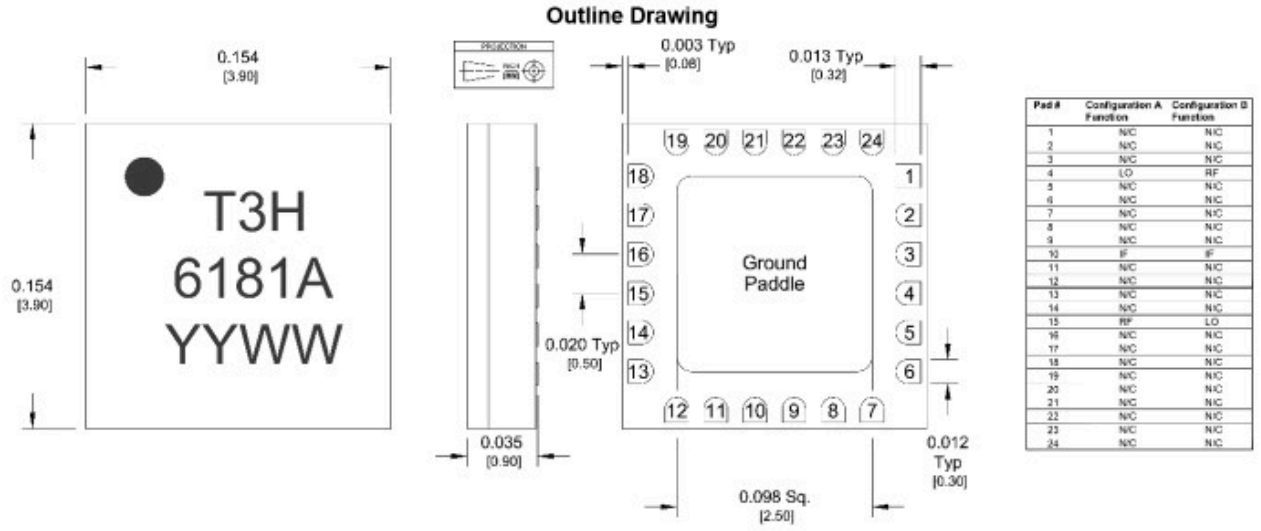
Typical Upconversion Spurious Suppression (dBc): A Configuration (B Configuration), Square Wave LO [6]

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xIF	22 (28)	Reference	35 (37)	13 (12)	29 (41)	19 (18)
2xIF	64 (56)	65 (64)	60 (54)	63 (58)	61 (67)	66 (60)
3xIF	80 (71)	89 (91)	95 (99)	78 (80)	95 (101)	128 (131)
4xIF	118 (109)	122 (121)	119 (118)	123 (120)	117 (116)	123 (116)
5xIF	135 (126)	147 (146)	155 (154)	163 (149)	152 (156)	137 (141)

Mechanical Data

Outline Drawing

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

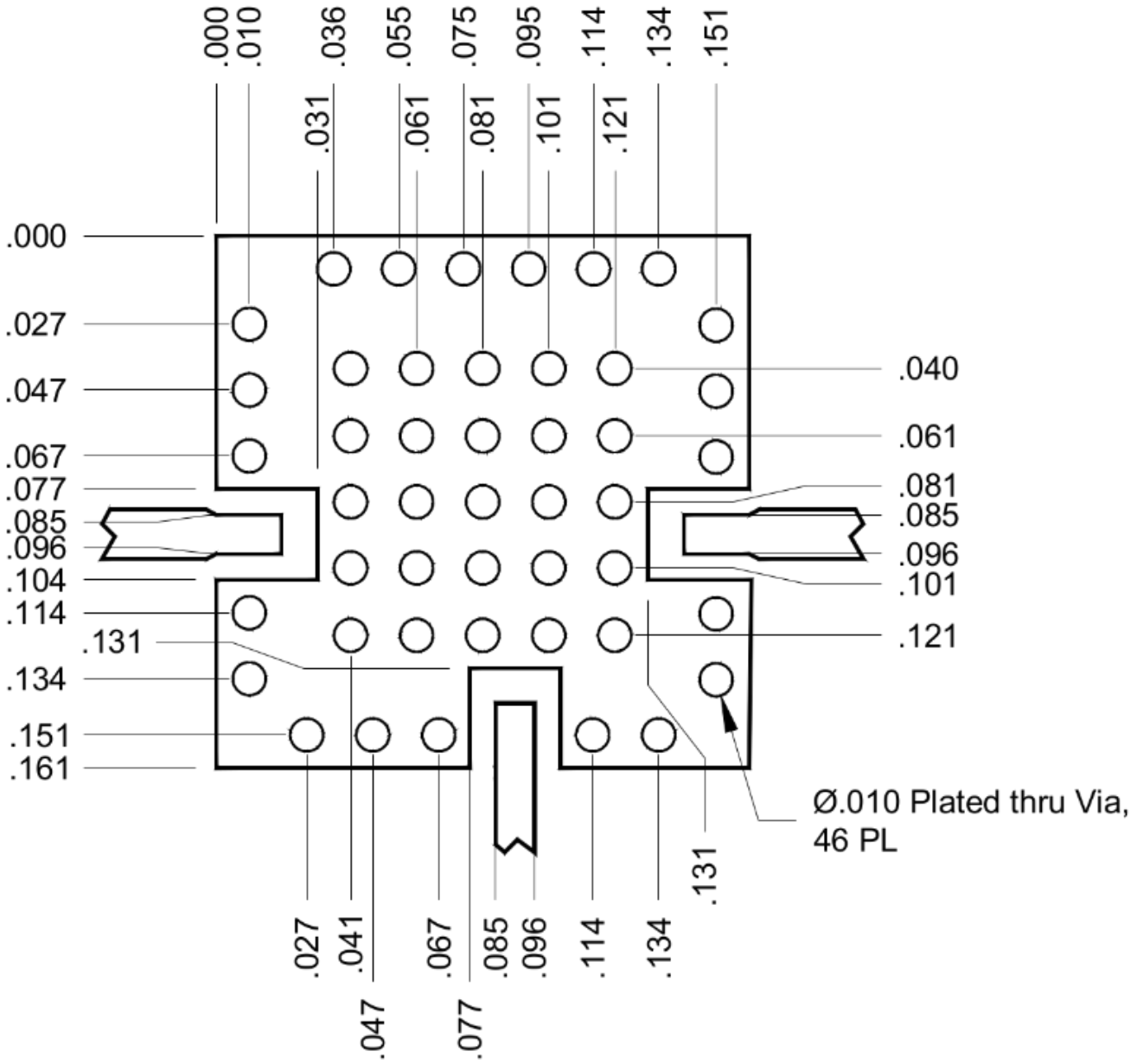


Pad #	Configuration A Function	Configuration B Function
1	N/C	N/C
2	N/C	N/C
3	N/C	N/C
4	LO	RF
5	N/C	N/C
6	N/C	N/C
7	N/C	N/C
8	N/C	N/C
9	N/C	N/C
10	IF	IF
11	N/C	N/C
12	N/C	N/C
13	N/C	N/C
14	N/C	N/C
15	RF	LO
16	N/C	N/C
17	N/C	N/C
18	N/C	N/C
19	N/C	N/C
20	N/C	N/C
21	N/C	N/C
22	N/C	N/C
23	N/C	N/C
24	N/C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

1. Substrate material is Ceramic.
2. All unconnected pads should be connected to PCB RF ground.
3. ENEPIG Plating/Finish: Ni: 8.89 micron max, 1.27 micron min. Pd: 0.17 micron max, 0.07 micron min. Au: 0.254 micron max, 0.03 micron min.

Footprint Image

Download : Footprint Drawing



Notes

1. Mixer Conversion Loss Plot IF frequency is 1 GHz unless otherwise specified.

2. Mixer Noise Figure typically measures within 0.5 dB of conversion loss for IF frequencies greater than 5 MHz.

3. Conversion Loss typically degrades less than 0.5 dB at +100°C and improves less than 0.5 dB at -55°C.

4. Unless otherwise specified, data is taken with highside, +15 dBm sine wave LO drive.

5. Square wave LO generated using 2x ADM1-0026PA with +10 dBm input into the first stage. LO Power reported in plots is of the fundamental tone only. Square wave LO power in plots is stepped down using broadband DC-40 GHz attenuators.

6. Specifications are subject to change without notice. Contact Marki Microwave for the most recent specifications and data sheets.

7. Catalog mixer circuits are continually improved. Configuration control requires custom mixer model numbers and specifications

Note: Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value. Exceeding any of the limits listed here may result in permanent damage to the device.