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

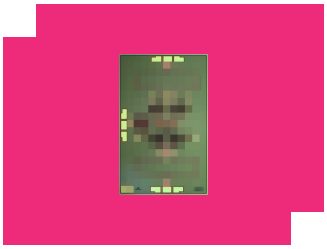
MM2-0530HCH-2

GaAs MMIC Triple Balanced Mixer

DEVICE OVERVIEW

General Description

The MM2-0530H is a passive MMIC triple balanced mixer. It features a broadband IF port that spans from 2 to 20 GHz, and has excellent spurious suppression. GaAs MMIC technology improves upon the previous generation of hand assembled, hybrid M2 triple balanced mixers with improved isolations, unit-to-unit repeatability and reliability. The MM2-0530H is available as a wire bondable chip or connectorized SMA package.



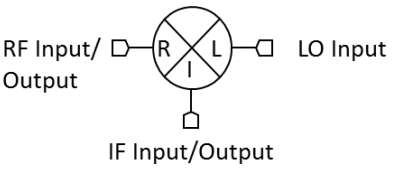
Features

- Broadband IF Port
- Typical Input 1 dB Compression of +15 dBm
- High Input IP3 of +21 dBm
- Excellent LO to IF Isolation
- Unit-to-Unit Repeatability
- RoHS Compliant

Applications

N/A

Functional Block Diagram



Part Ordering Options

Part Number	Description	Package	Connectors	Green Status	Product Lifecycle	Export Classification
MM2-0530HS	GaAs MMIC Triple Balanced Mixer	S	Standard	REACH RoHS	Released	EAR99
MM2-0530HCH-2	GaAs MMIC Triple Balanced Mixer	CH	-	REACH RoHS	Released	EAR99

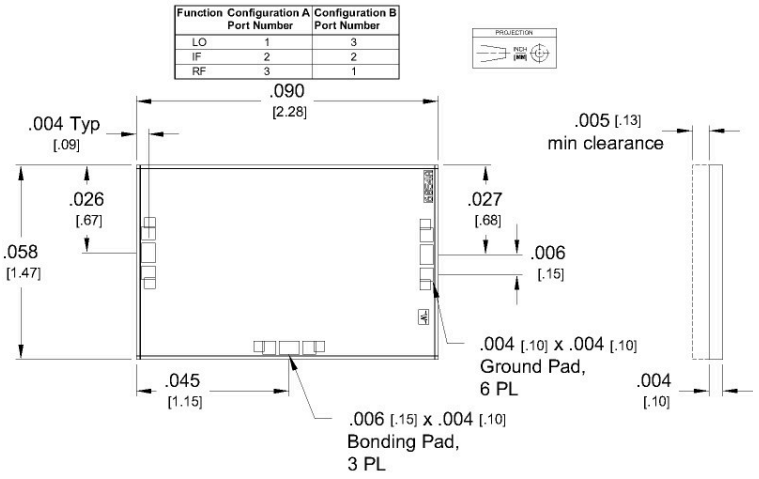
Table Of Contents

Revision History

Revision Code	Revision Date	Comment
-	2016-01-01	Initial Release
A	2018-11-01	Correction to Port Designation Description
B	2019-08-01	Added ground pad dimensions on die

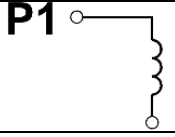
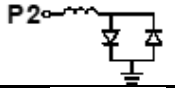
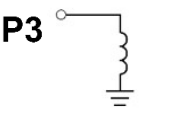
Port Configuration and Functions

Port Diagram

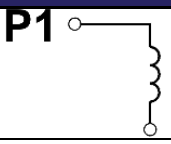
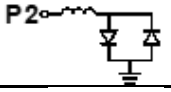
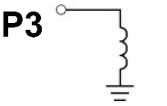


Port Functions

Configuration A

Port	Function	Description	Equivalent Circuit for Package
Port 1	LO	Port 1 is DC short and AC matched to 50 Ω from 5 to 30 GHz. Blocking capacitor is optional.	
Port 2	IF	Port 2 is DC coupled to the diodes. Blocking capacitor is optional.	
Port 3	RF	Port 3 is DC short and AC matched to 50 Ω from 5 to 30 GHz. Blocking capacitor is optional.	

Configuration B

Port	Function	Description	Equivalent Circuit for Package
Port 1	RF	Port 1 is DC short and AC matched to 50 Ω from 5 to 30 GHz. Blocking capacitor is optional.	
Port 2	IF	Port 2 is DC coupled to the diodes. Blocking capacitor is optional.	
Port 3	LO	Port 3 is DC short and AC matched to 50 Ω from 5 to 30 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 1 DC Current	21	mA
Port 2 DC Current	15	mA
Port 3 DC Current	24	mA
RF Power Handling (RF+LO), 100°C	20	dBm
RF Power Handling (RF+LO), 25°C	28	dBm

Package Information

Parameter	Details	Rating
Dimensions	-	2.28 x 1.47 mm

Recommended Operating Conditions

Parameter	Min	Nominal	Max	Unit
LO Input Power	14	-	20	-

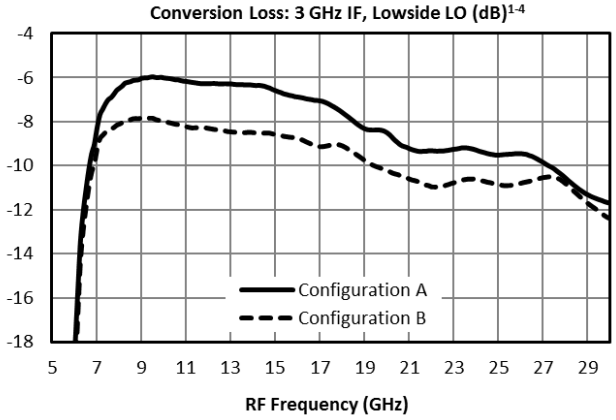
Electrical Specifications

Parameter	Port Configuration	Test Conditions	Min	Typ	Max	Unit
Conversion Loss [1]	A	LO/RF=5-30 GHz IF=2-20GHz LO Drive Level= 20	-	8	-	dB
Input 1 dB Compression	A	LO/RF=5-30 GHz IF=2-20GHz LO Drive Level= 15-20	-	15	-	dBm
Input IP3 [2]	A	LO/RF=5-30 GHz IF=2-20GHz LO Drive Level= 15-20	-	21	-	dBm
Isolation, LO to RF	A	-	-	40	-	dB
Input 1 dB Compression	B	LO/RF=5-30 GHz IF=2-20GHz LO Drive Level= 14-20	-	20	-	dBm
Conversion Loss [3]	-	LO/RF=5-30 GHz IF=2-20GHz LO Drive Level= 20	-	9	-	dB
IF Frequency Range	-	-	2	-	20	GHz
Input IP3	-	LO/RF=5-30 GHz IF=2-20GHz LO Drive Level= 14-20	-	28	-	dBm
LO Frequency Range	-	-	5	-	30	GHz
RF Frequency Range	-	-	5	-	30	GHz

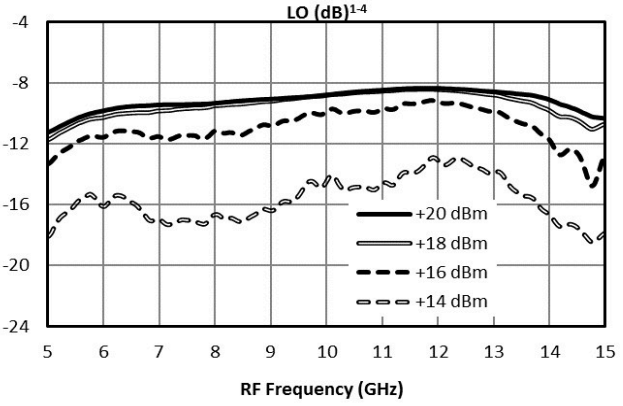
[1][3] Measured Conversion Loss measured at 3 GHz fixed IF
[2] IP3 depends on LO drive conditions, see plots for more details

Typical Performance

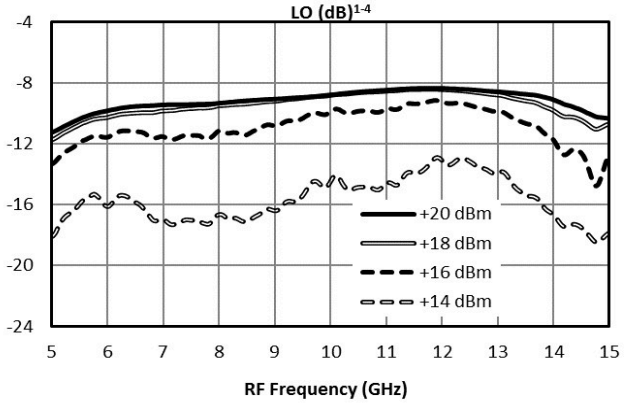
Conversion Loss: 3 GHz IF, Lowside LO (dB)[1-4]



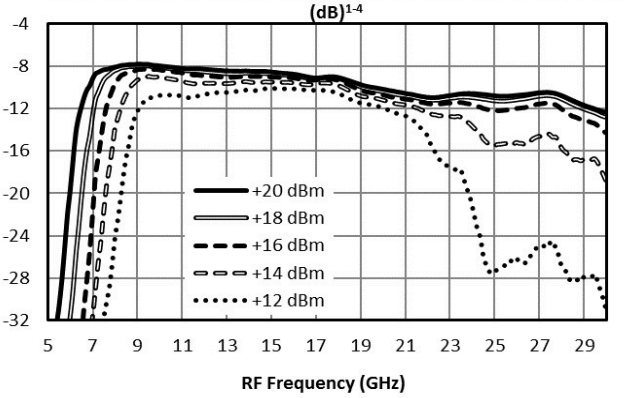
Configuration A Conversion Loss vs. LO Power: 15 GHz IF, Highside LO (dB)[1-4]



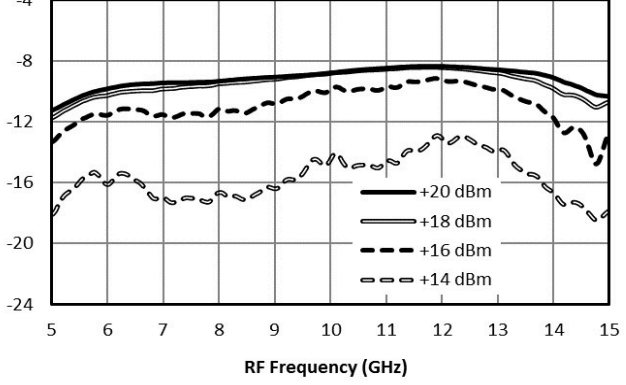
Configuration A Conversion Loss vs. LO Power: 15 GHz IF, Highside LO (dB)[1-4]



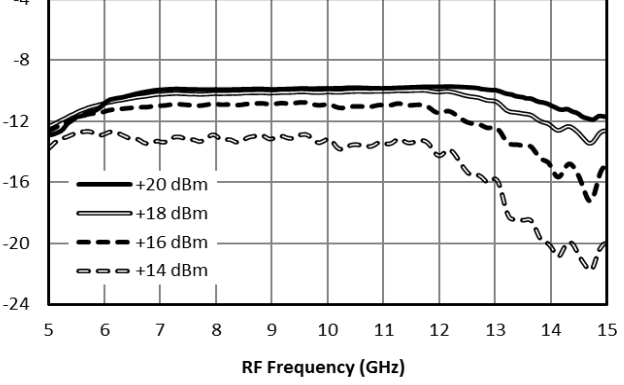
Configuration B Conversion Loss vs. LO Power: 3 GHz IF, Lowside LO (dB)[1-4]



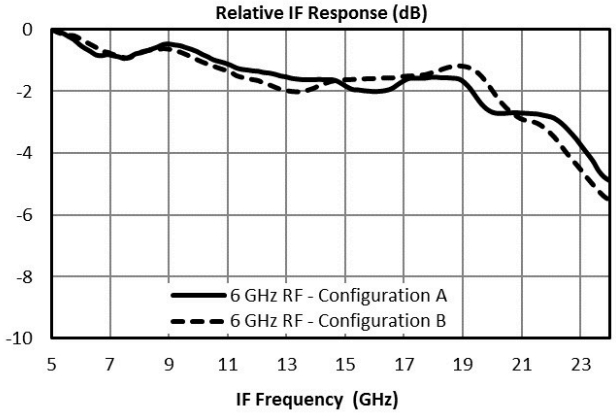
Configuration A Conversion Loss vs. LO Power: 15 GHz IF, Highside LO (dB)[1-4]



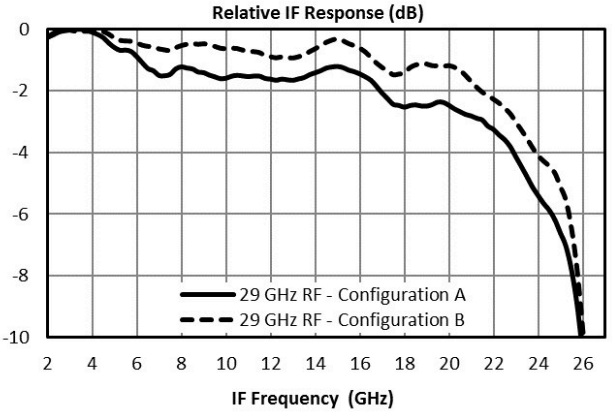
Configuration B Conversion Loss vs. LO Power: 15 GHz IF, Highside LO (dB)[1-4]



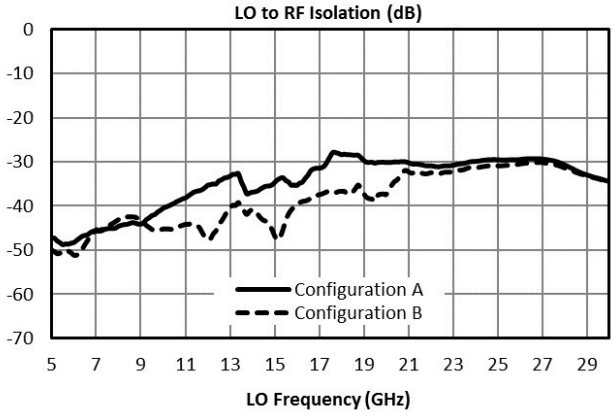
Relative IF Response (dB)



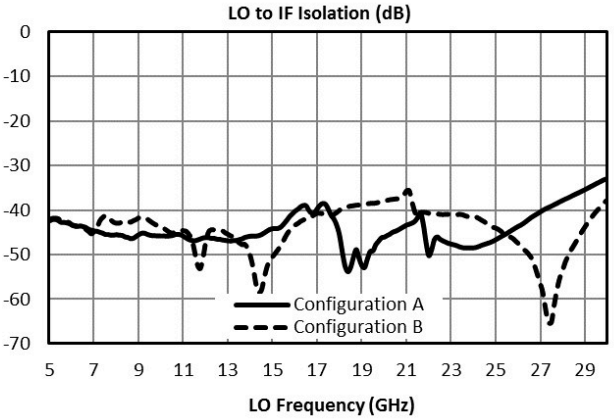
Relative IF Response (dB)



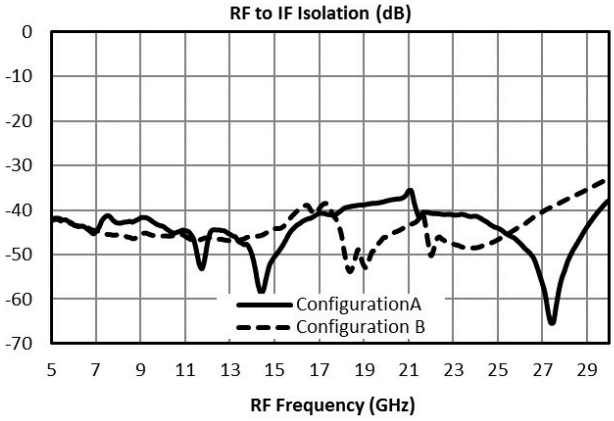
LO to RF Isolation (dB)



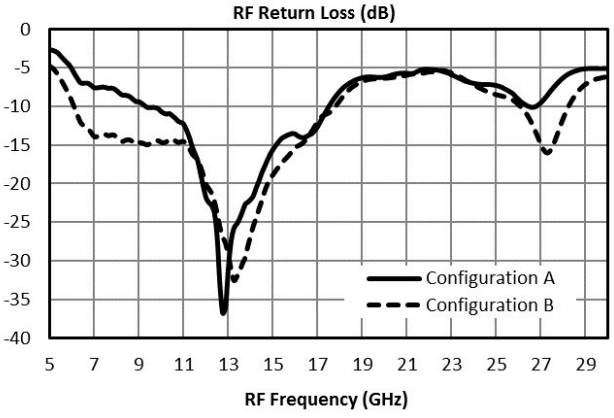
LO to IF Isolation (dB)



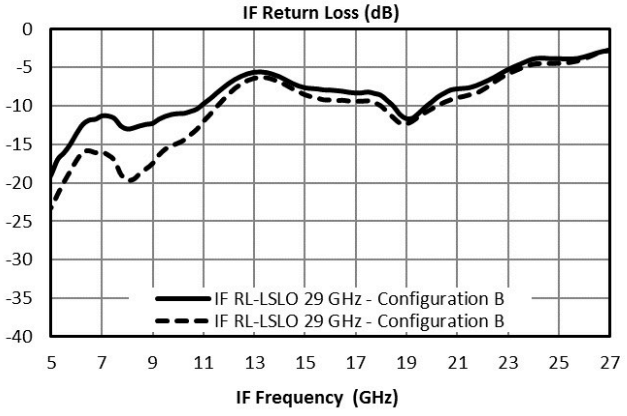
RF to IF Isolation (dB)



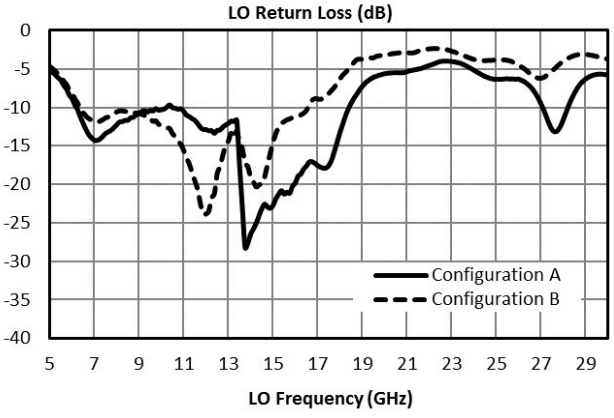
RF Return Loss (dB)



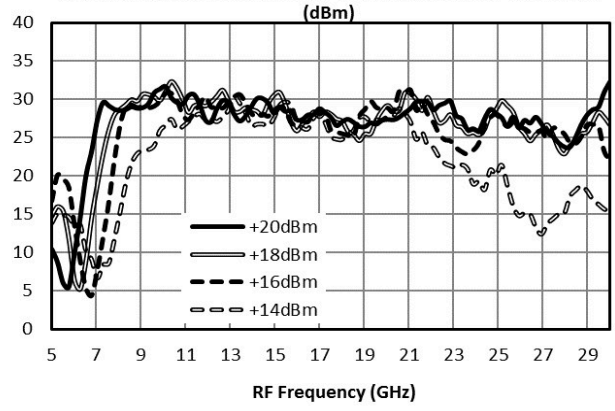
IF Return Loss (dB)



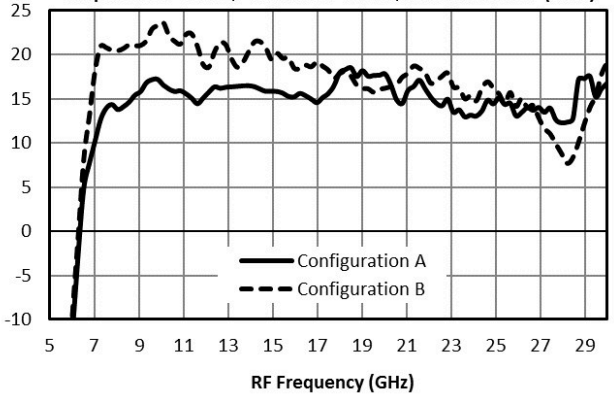
LO Return Loss (dB)



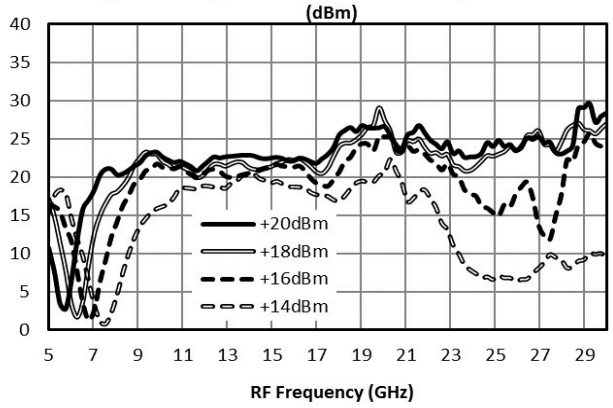
Configuration B Input IP3 vs LO Power: 3 GHz IF, Sine Wave LSLO (dBm)



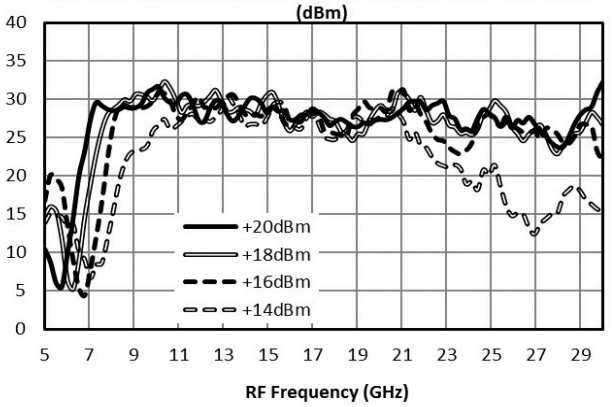
Output IP3: 3 GHz IF, +20dBm LO Power, Sine Wave LSLO (dBm)



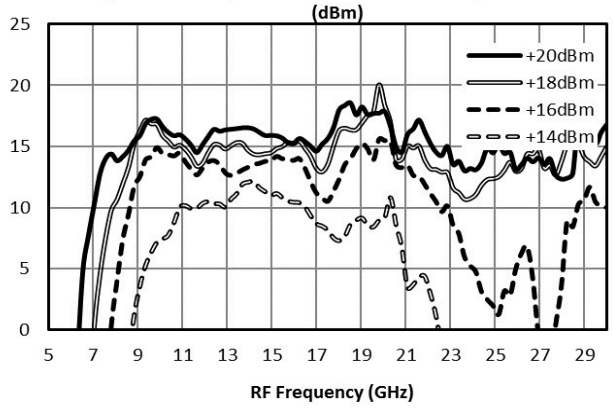
Configuration A Input IP3 vs LO Power: 3 GHz IF, Sine Wave LSLO (dBm)



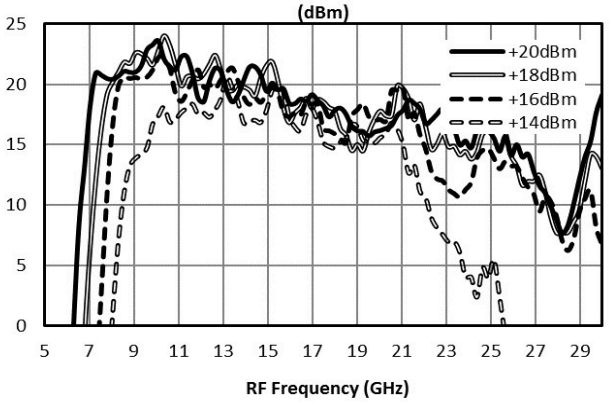
Configuration B Input IP3 vs LO Power: 3 GHz IF, Sine Wave LSLO (dBm)



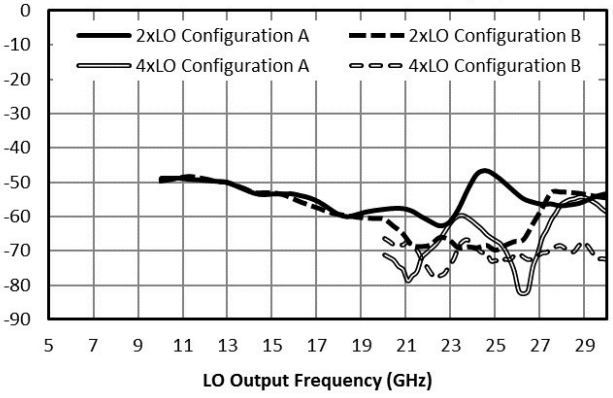
Configuration A Output IP3 vs LO Power: 3 GHz IF, Sine Wave LSLO (dBm)



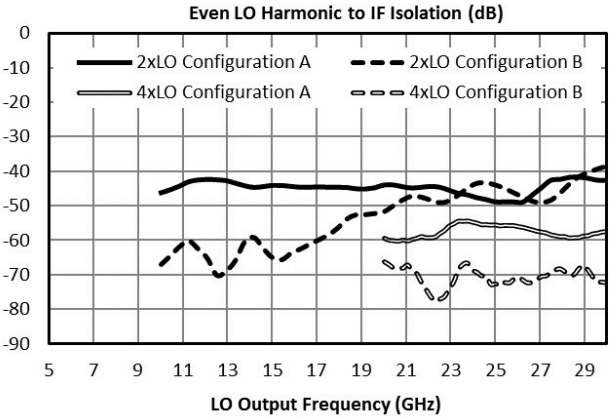
Configuration B Output IP3 vs LO Power: 3 GHz IF, Sine Wave LSLO (dBm)



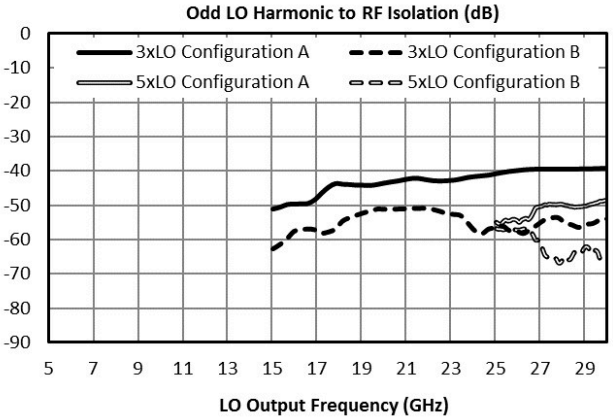
Even LO Harmonic to RF Isolation (dB)



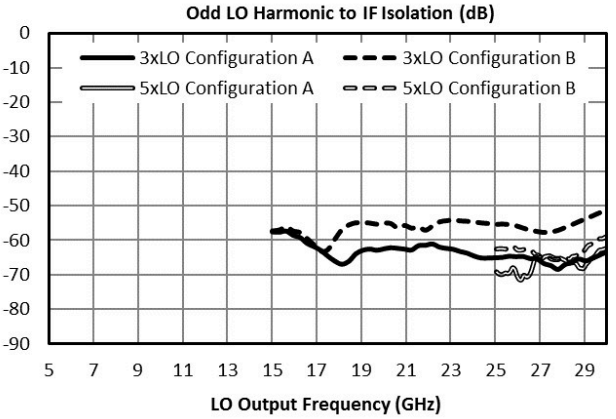
Even LO Harmonic to IF Isolation (dB)

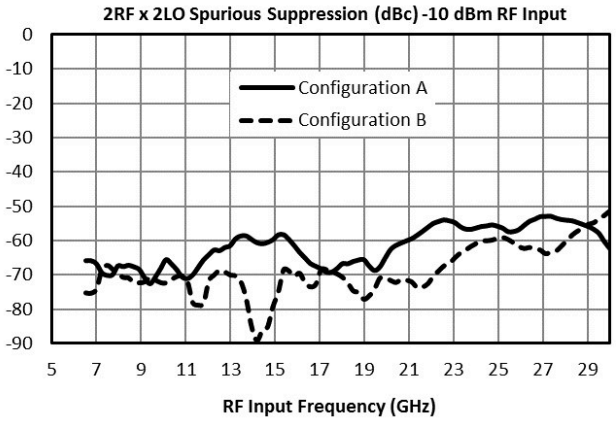


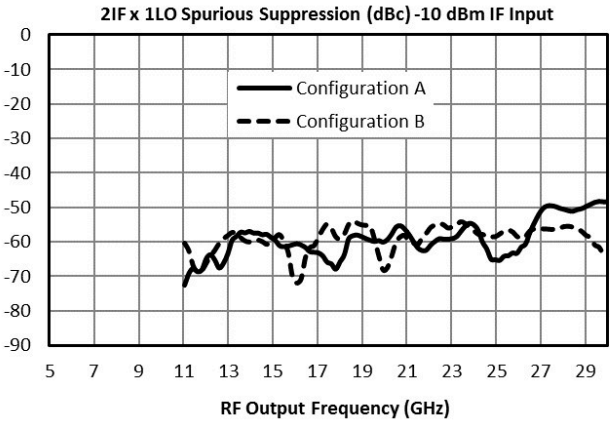
Odd LO Harmonic to RF Isolation (dB)



Odd LO Harmonic to IF Isolation (dB)



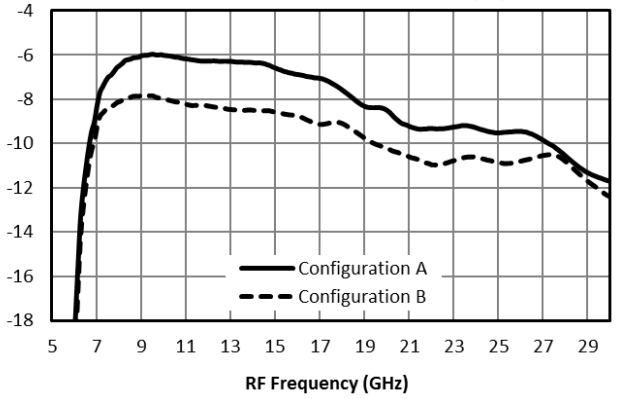




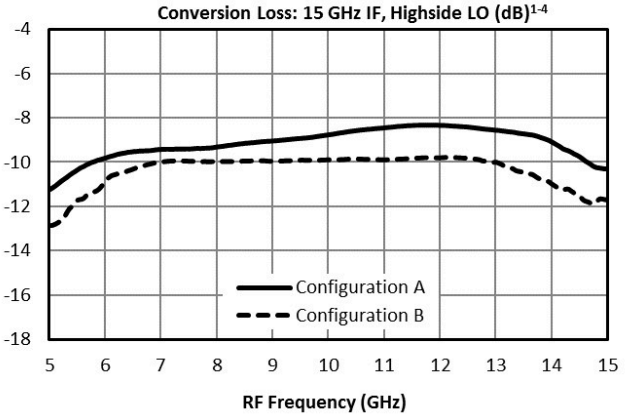
MM2-0530HS - Typical Performance

Performance plots for the connectorized module are shown for measurements where directly probed measurements of the die are unavailable. Note that the following measurements include losses from connectors and microstrip traces.

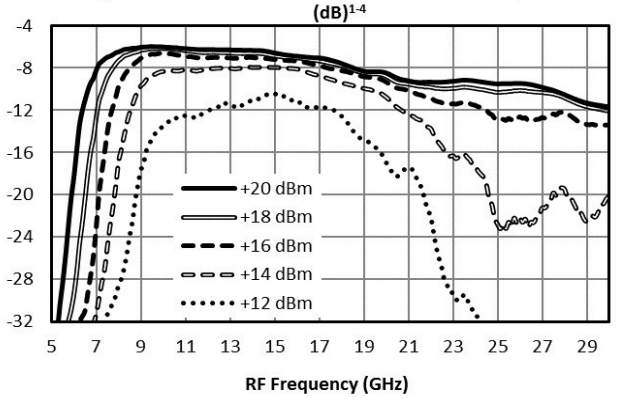
Conversion Loss: 3 GHz IF, Lowside LO (dB)[1-4]



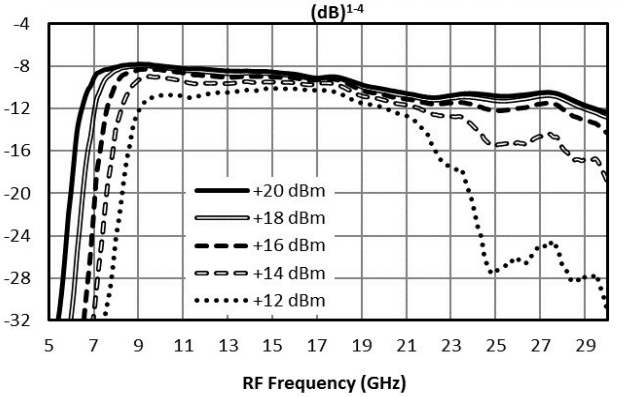
Conversion Loss: 15 GHz IF, Highside LO (dB)[1-4]



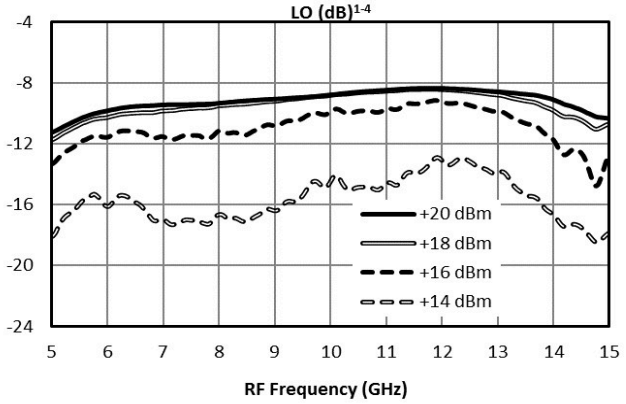
Configuration A Conversion Loss vs. LO Power: 3 GHz IF, Lowside LO (dB)[1-4]



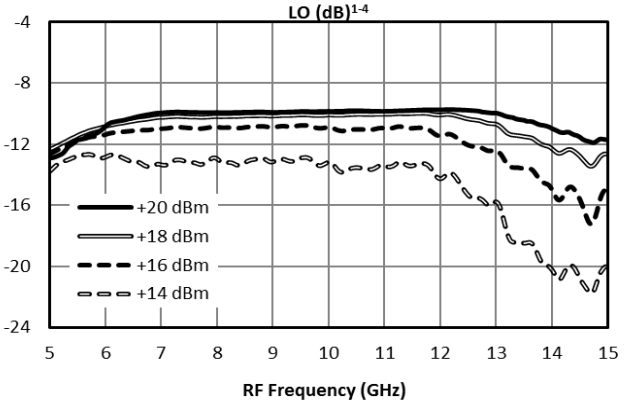
Configuration B Conversion Loss vs. LO Power: 3 GHz IF, Lowside LO (dB)[1-4]



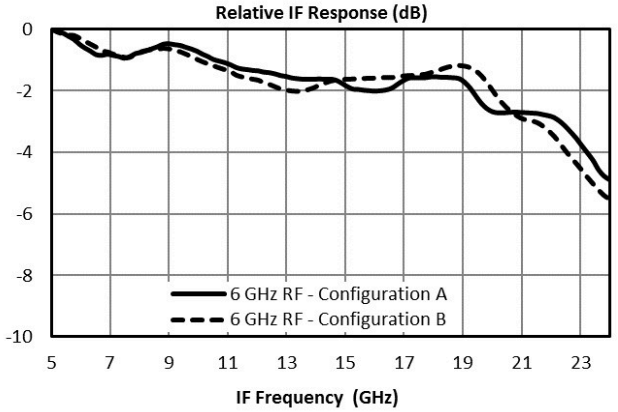
Configuration A Conversion Loss vs. LO Power: 15 GHz IF, Highside LO (dB)[1-4]



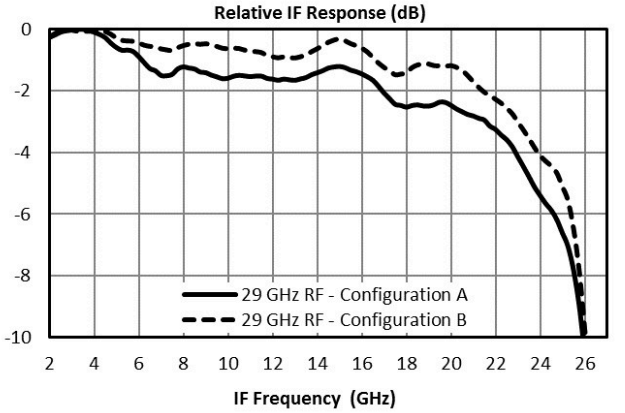
Configuration B Conversion Loss vs. LO Power: 15 GHz IF, Highside LO (dB)[1-4]

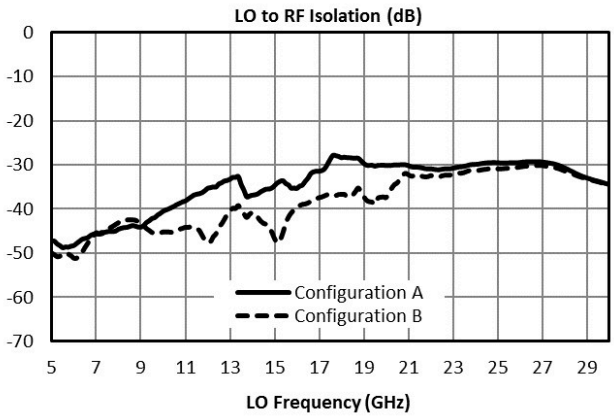


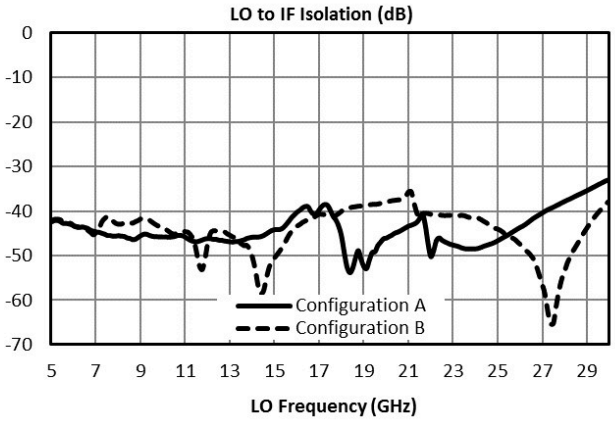
Relative IF Response (dB)

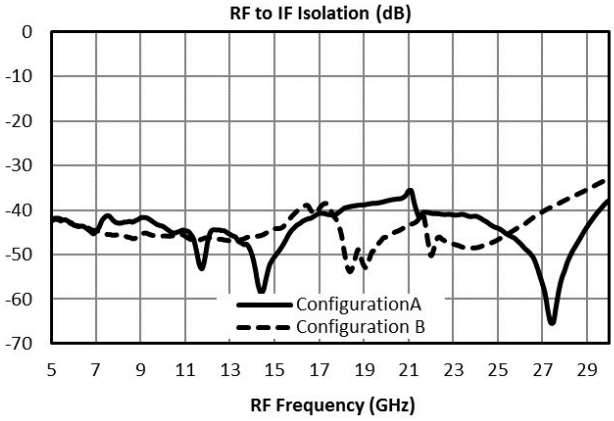


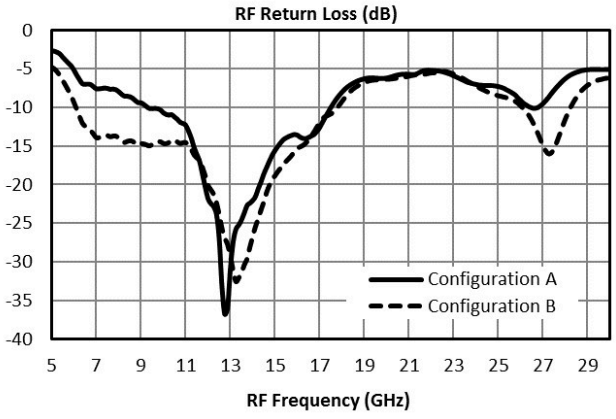
Relative IF Response (dB)

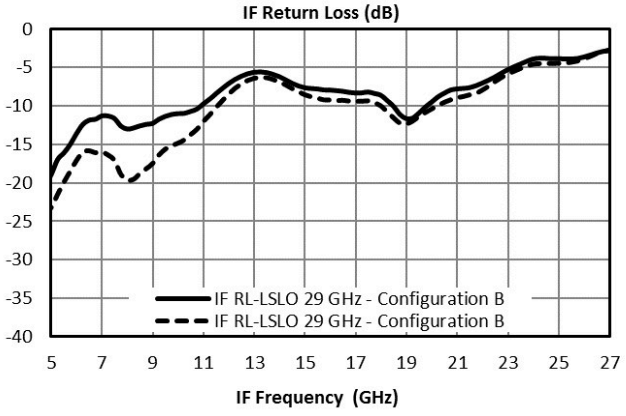


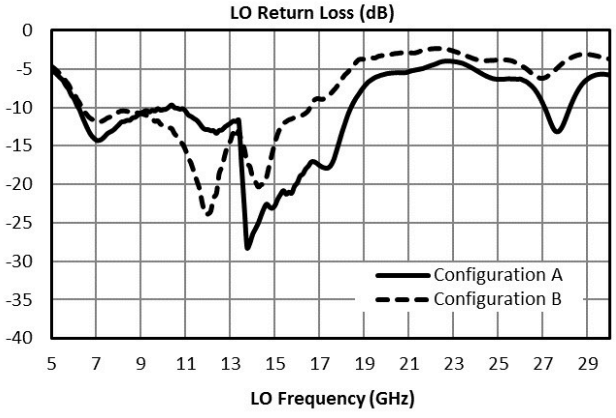


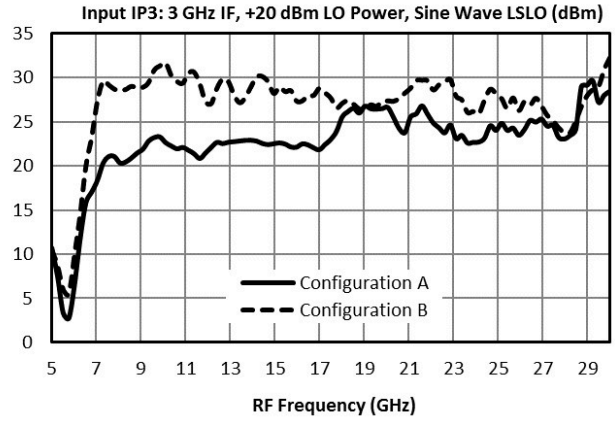


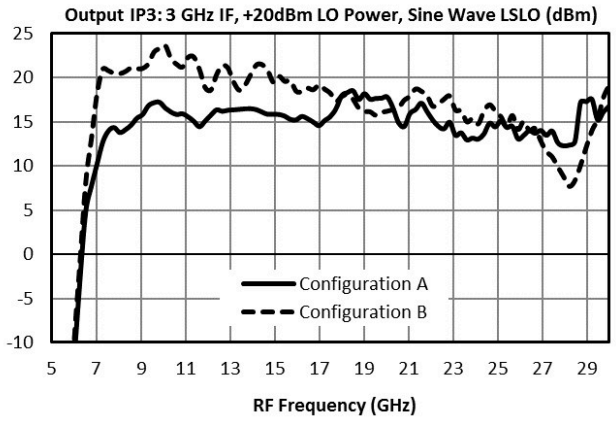




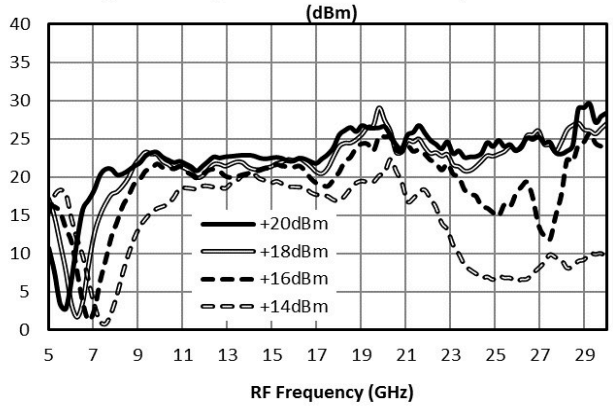




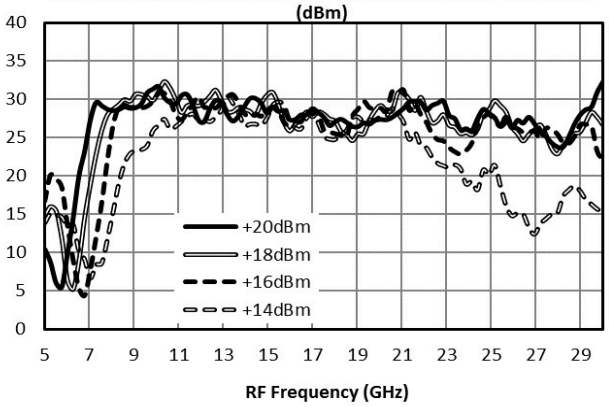




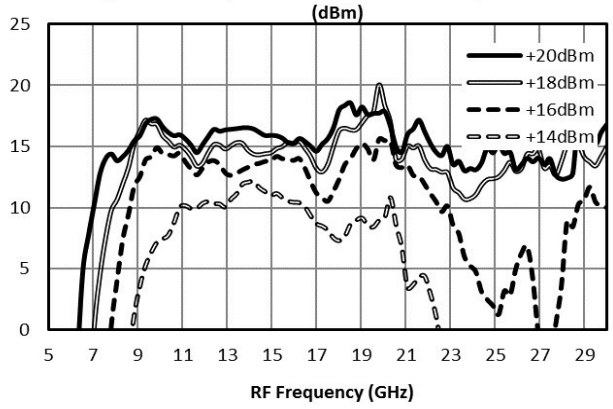
Configuration A Input IP3 vs LO Power: 3 GHz IF, Sine Wave LSLO (dBm)



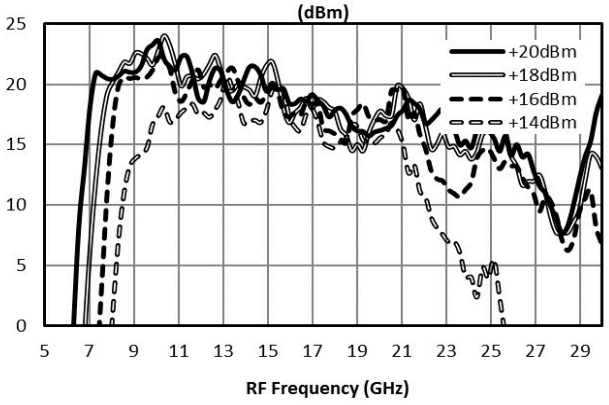
Configuration B Input IP3 vs LO Power: 3 GHz IF, Sine Wave LSLO (dBm)



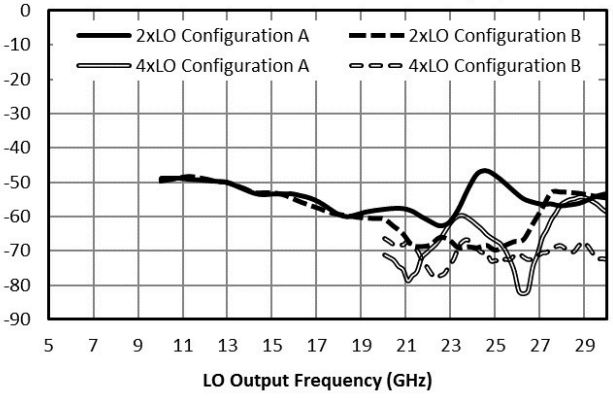
Configuration A Output IP3 vs LO Power: 3 GHz IF, Sine Wave LSLO (dBm)



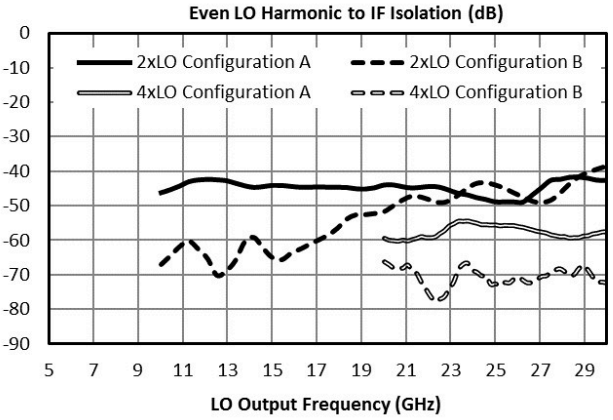
Configuration B Output IP3 vs LO Power: 3 GHz IF, Sine Wave LSLO (dBm)



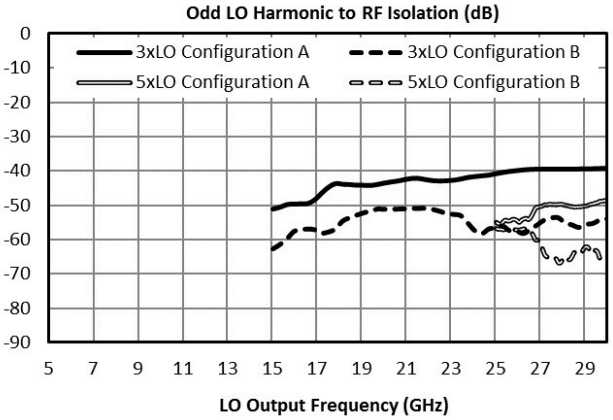
Even LO Harmonic to RF Isolation (dB)



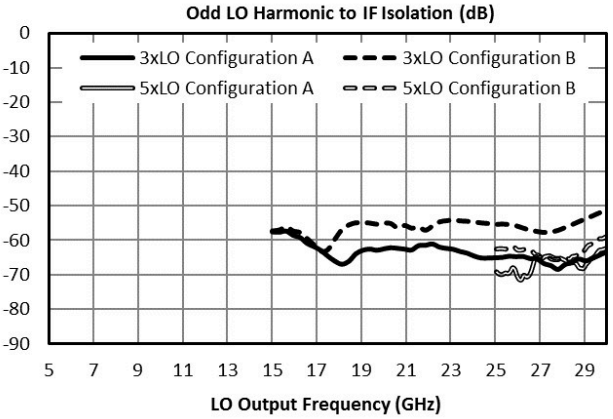
Even LO Harmonic to IF Isolation (dB)

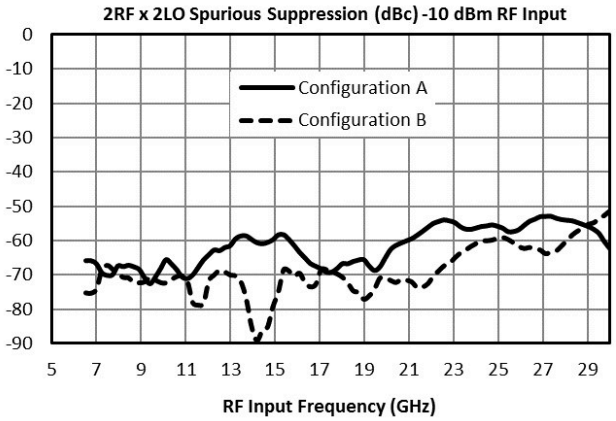


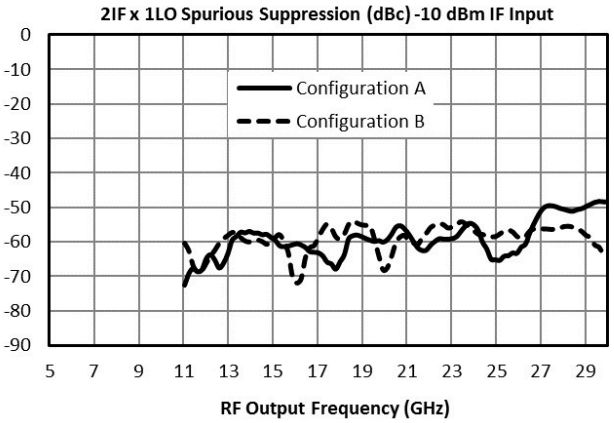
Odd LO Harmonic to RF Isolation (dB)



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 5 to 30 GHz RF/LO bands, which create a 3 GHz IF spurious output. 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 66 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 76 dBc.

Typical Downconversion Spurious Suppression (dBc): A Configuration (B Configuration), Sine Wave LO [5]

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xRF	36 (33)	Reference	35 (43)	18 (27)	35 (42)	25 (35)
2xRF	70 (65)	66 (72)	62 (69)	66 (70)	68 (79)	75 (70)
3xRF	103 (105)	76 (111)	94 (122)	79 (105)	96 (123)	78 (106)
4xRF	N/A[6]	89 (162)	121 (155)	121 (156)	123 (155)	121 (156)
5xRF	N/A[6]	143 (181)	148 (181)	137 (180)	148 (182)	145 (180)

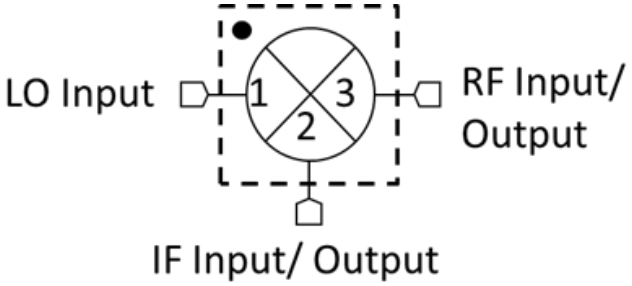
Upconversion Spurious Suppression

Spurious data is taken by mixing a 3 GHz IF with LO frequencies (+mLO+nIF), which creates an RF within the 5 to 30 GHz RF 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 63 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 73 dBc.

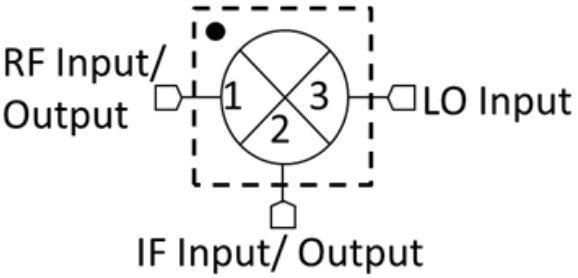
Typical Upconversion Spurious Suppression (dBc): A Configuration (B Configuration), Sine Wave LO [5]

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xIF	36 (39)	Reference	39 (42)	14 (13)	38 (39)	23 (28)
2xIF	83 (72)	59 (59)	65 (64)	68 (68)	75 (74)	67 (75)
3xIF	107 (108)	81 (82)	95 (98)	72 (86)	91 (103)	72 (85)
4xIF	131 (124)	119 (123)	123 (123)	130 (126)	127 (131)	121 (130)
5xIF	146 (164)	131 (140)	147 (151)	138 (147)	143 (152)	128 (153)

Application Circuit



Configuration A



Configuration B

Application Circuit Description

Configuration A/B refer to the same part number (MM2-0530H) used in one of two different ways for optimal spurious performance. For the lowest conversion loss, use the mixer in Configuration A (port 1 as the LO input, port 3 as the RF input or output). If you need to use a lower LO drive, use the mixer in Configuration B (port 1 as the RF input or output, port 3 as the LO input). For optimal spurious suppression, experimentation or simulation is required to choose between Configuration A and B.

Die Mounting Recommendations

Mounting and Bonding Recommendations

Marki MMICs should be attached directly to a ground plane with conductive epoxy. The ground plane electrical impedance should be as low as practically possible. This will prevent resonances and permit the best possible electrical performance. Datasheet performance is only guaranteed in an environment with a low electrical impedance ground.

Mounting- To epoxy the chip, apply a minimum amount of conductive epoxy to the mounting surface so that a thin epoxy fillet is observed around the perimeter of the chip. Cure epoxy according to manufacturer instructions.

Wire Bonding - Ball or wedge bond with 0.025 mm (1 mil) diameter pure gold wire. Thermosonic wirebonding with a nominal stage temperature of 150 °C and a ball bonding force of 40 to 50 grams or wedge bonding force of 18 to 22 grams is recommended. Use the minimum level of ultrasonic energy to achieve reliable wirebonds. Wirebonds should be started on the chip and terminated on the package or substrate. All bonds should be as short as possible <0.31 mm (12 mils).

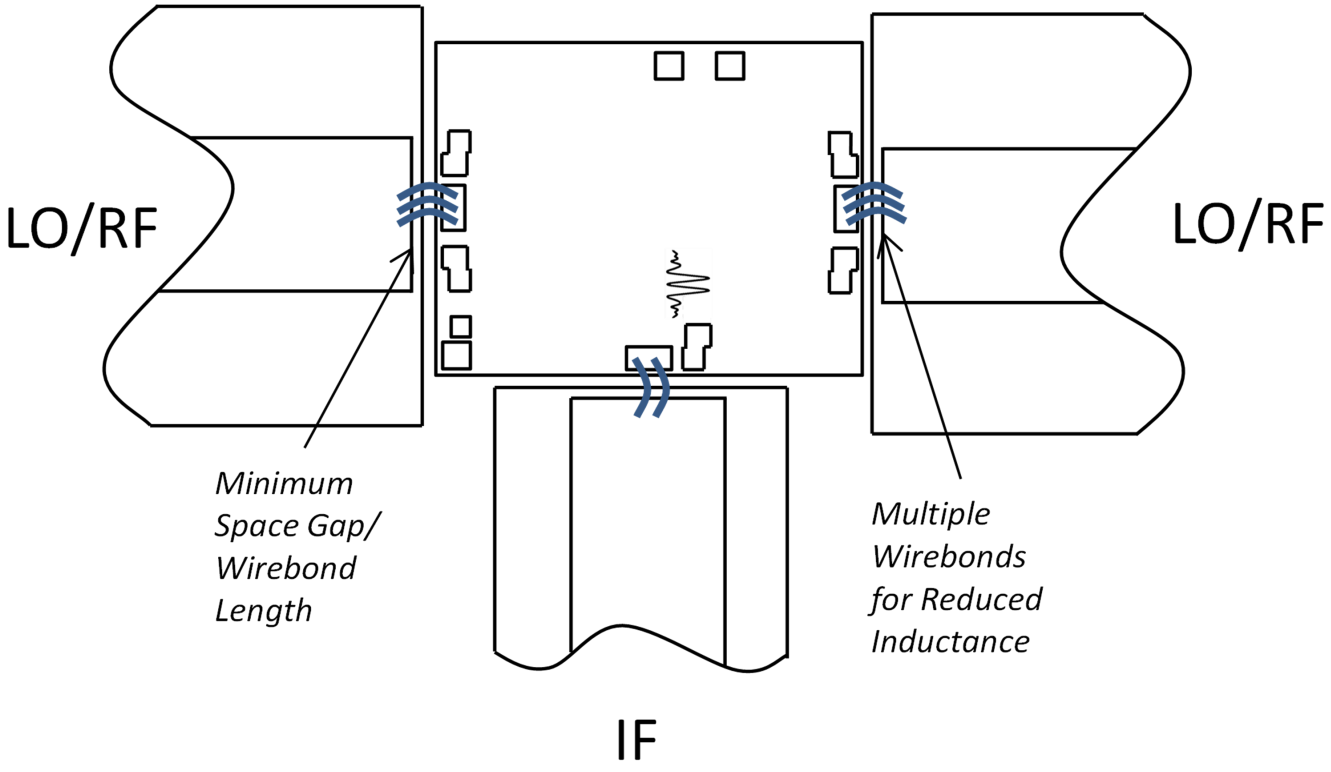
Circuit Considerations – 50 Ω transmission lines should be used for all high frequency connections in and out of the chip. Wirebonds should be kept as short as possible, with multiple wirebonds recommended for higher frequency connections to reduce parasitic inductance. In circumstances where the chip more than .001” thinner than the substrate, a heat spreading spacer tab is optional to further reduce bondwire length and parasitic inductance.

Handling Precautions

General Handling: Chips should be handled with a vacuum collet when possible, or with sharp tweezers using well trained personnel. The surface of the chip is fragile and should not be contacted if possible.

Static Sensitivity: GaAs MMIC devices are subject to static discharge, and should be handled, assembled, tested, and transported only in static protected environments.

Cleaning and Storage: Do not attempt to clean the chip with a liquid cleaning system or expose the bare chips to liquid. Once the ESD sensitive bags the chips are stored in are opened, chips should be stored in a dry nitrogen atmosphere.



Mechanical Data

Outline Drawing

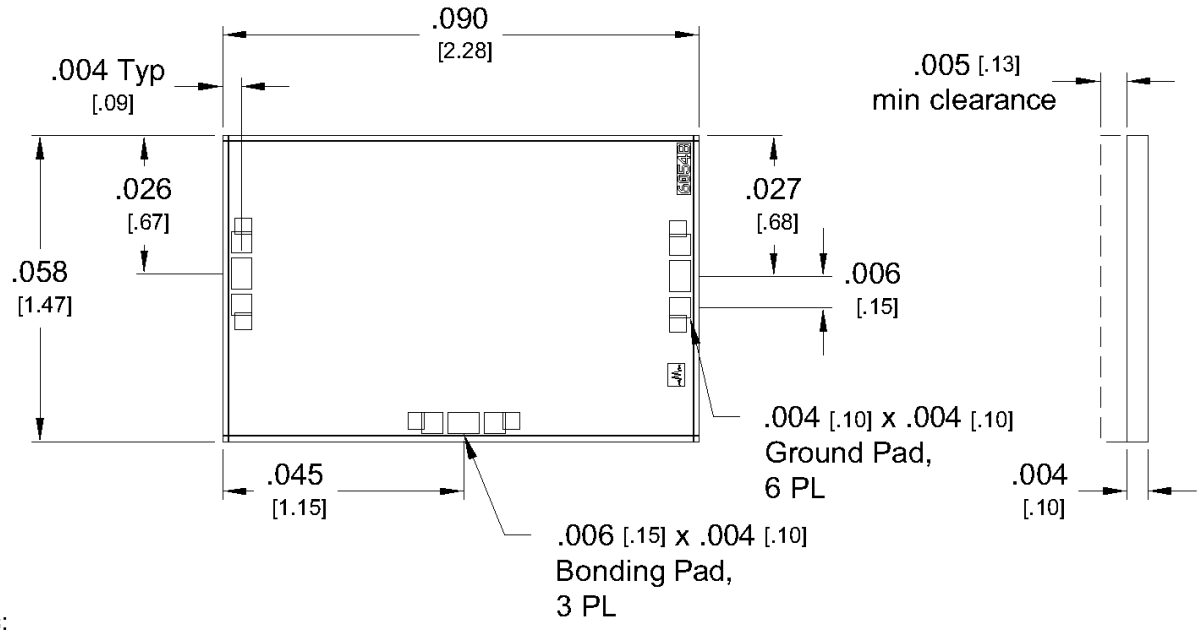
Download : Outline 2D Drawing

Function	Configuration A Port Number	Configuration B Port Number
LO	1	3
IF	2	2
RF	3	1

PROJECTION INCH [MM]

REVISIONS

REV.	DESCRIPTION	DATE	APPROVALS
D	ECN 24096 remove gel-pak info.	10/18/24	AT



Notes:

1. CH substrate is .004 Thick GaAs.
2. I/O trace is 4 microns and ground plane is 5 microns Au.
3. Tolerance for X, Y dimensions is ± 0.002 in.
   Tolerance for Z dimension is ± 0.0005 in.
   Tolerance for pad location is ± 0.0001 in.

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MATERIAL: 210-04054 (R70)

FINISH:

DO NOT SCALE DRAWING

NOTES:

DRAWN BY	DATE
STR	8/17/16

Marki microwave www.markimicrowave.com

Outline
MMIC Mixer

SIZE	CAGE CODE	DWG. NO.
A	0UC32	MM2-0530HCH-2

SCALE 40/1 SHEET 1 OF 1

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