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MM1-0320HCH-2

GaAs DOUBLE-BALANCED MIXER

DEVICE OVERVIEW

General Description

The MM1-0320H is a passive double balanced MMIC mixer. It features excellent conversion loss, superior isolations and spurious performance across a broad bandwidth, in a highly miniaturized form factor. Accurate, nonlinear simulation models are available for Microwave Office® through the Marki Microwave PDK. The MM1-0320H is available as a wire bondable chip or an SMA connectorized package. The MM1-0320H is a superior alternative to Marki Microwave carrier and packaged M1 and M3 mixers

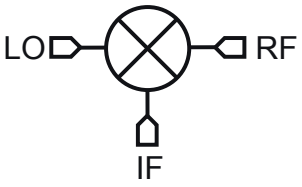
Features

- Compact Chip Style Package (0.058” x 0.046”x0.004”)
- CAD Optimized for Superior Isolation and Spurious Response
- Broadband Performance
- Excellent Unit-to-Unit Repeatability
- Fully nonlinear software models available with Marki PDK for Microwave Office®
- RoHS Compliant

Applications

N/A

Functional Block Diagram



Part Ordering Options

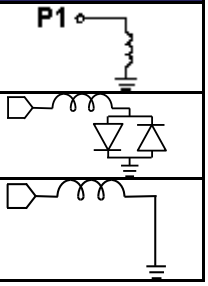
Part Number	Description	Package	Connectors	Green Status	Product Lifecycle	Export Classification
MM1-0320HS	GaAs DOUBLE-BALANCED MIXER	S	Standard	REACH RoHS	Released	EAR99
MM1-0320HCH-2	GaAs DOUBLE-BALANCED MIXER	CH	-	REACH RoHS	Released	EAR99

Table Of Contents

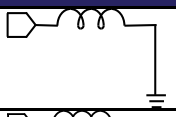
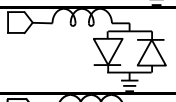
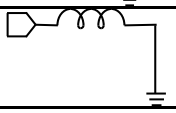
Port Configuration and Functions

Port Functions

Configuration A

Port	Function	Description	Equivalent Circuit for Package
Port 1	LO	Electrical Specifications - Specifications guaranteed from -55 to +100°C, measured in a 50Ω system	
Port 2	IF	Port 2 is DC coupled to the diodes. Blocking capacitor is optional.	
Port 3	RF	Port 3 is DC short to ground and AC matched to 50 Ohms from 3.5 to 20 GHz. Blocking capacitor is optional.	

Configuration B

Port	Function	Description	Equivalent Circuit for Package
Port 1	RF	Port 1 is DC short to ground and AC matched to 50 Ohms from 3.5 to 20 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 to ground and AC matched to 50 Ohms from 3.5 to 20 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	15	mA
Port 2 DC Current	30	mA
Port 3 DC Current	15	mA
RF Power Handling (RF+LO), 100°C	21	dBm
RF Power Handling (RF+LO), 25°C	25	dBm

Package Information

Parameter	Details	Rating
Dimensions	-	1.38 x 1.17 mm

Recommended Operating Conditions

Parameter	Min	Nominal	Max	Unit
LO Input Power	12	-	20	-

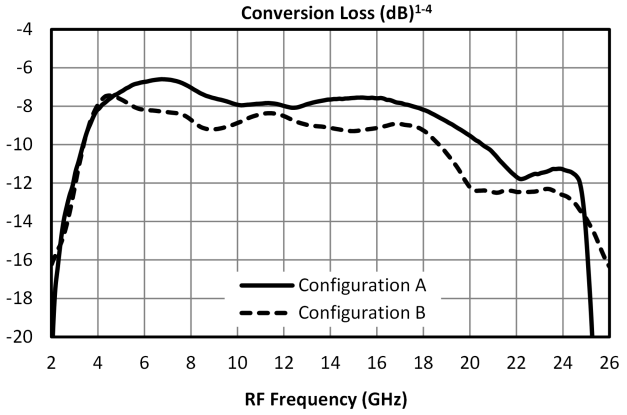
Electrical Specifications

Specifications guaranteed from -55 to +100°C, measured in a 50Ω system

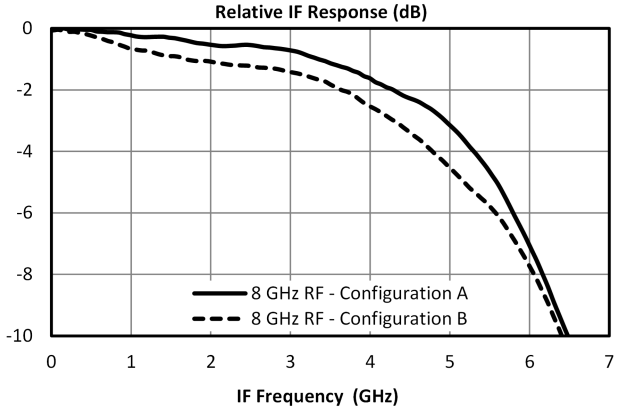
Parameter	Port Configuration	Test Conditions	Min	Typ	Max	Unit
Conversion Loss	A	LO/RF=3.5-20GHz IF=DC-4GHz	-	8	13	dB
IF Frequency Range	A	-	0	-	4	GHz
Input 1 dB Compression	A	LO/RF=3.5-20GHz IF=DEC-4GHz LO drive level=13-20dBm	-	9	-	dBm
Input IP3	A	LO/RF=3.5-20GHz IF=DC-4GHz LO drive level=13-20dBm	-	20	-	dBm
Isolation, LO to RF	A	-	-	52	-	dB
LO Frequency Range	A	-	3.5	-	20	GHz
RF Frequency Range	A	-	3.5	-	20	GHz
Conversion Loss	B	LO/RF=3.5-20GHz IF=DC-4GHz	-	9	16	dB
Input 1dB Compression	B	LO/RF=3.5-20GHz IF=DC-4GHz LO drive level=12-17dBm	-	9	-	dBm
Input IP3	B	LO/RF=3.5-20GHz IF=DC-4GHz LO drive level=12-17dBm	-	20	-	dBm

Typical Performance Plots

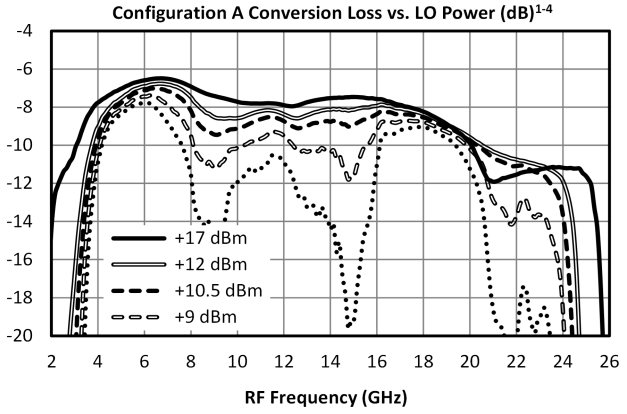
Conversion Loss (dB)[1-4]



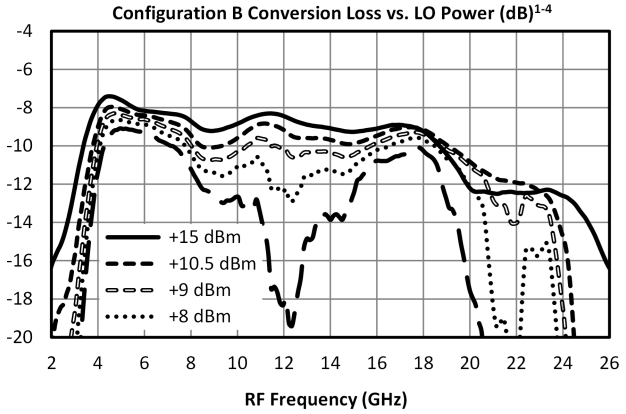
Relative IF Response (dB)



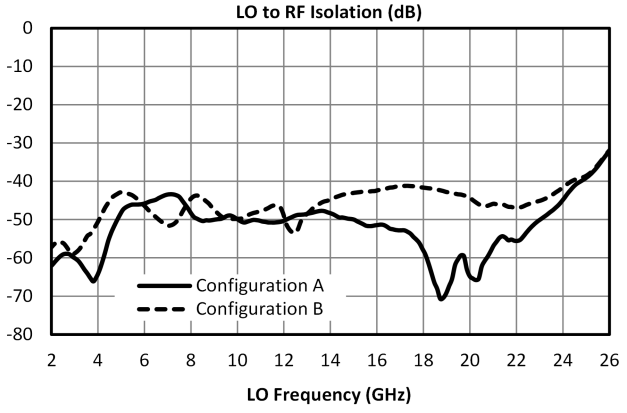
Configuration A Conversion Loss vs. LO Power (dB)[1-4]



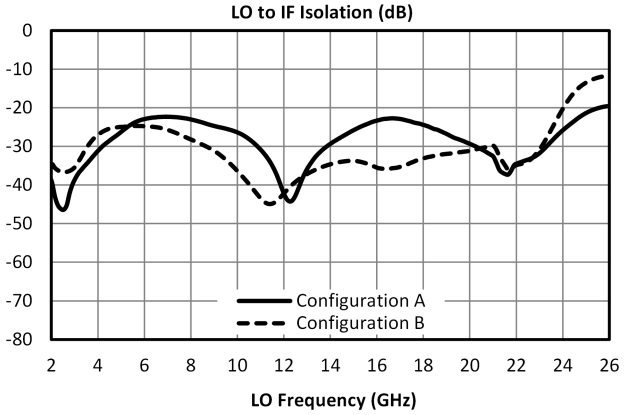
Configuration B Conversion Loss vs. LO Power (dB)[1-4]



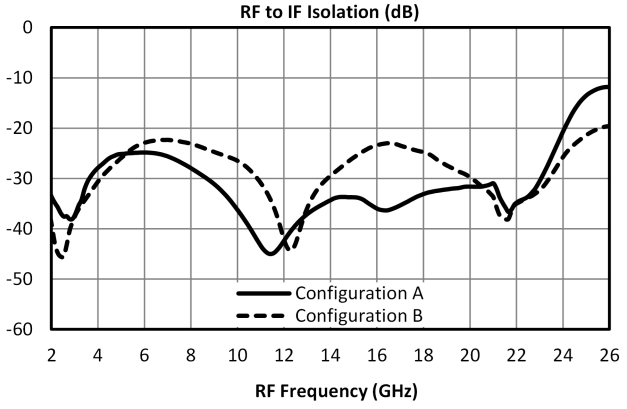
LO to RF Isolation (dB)



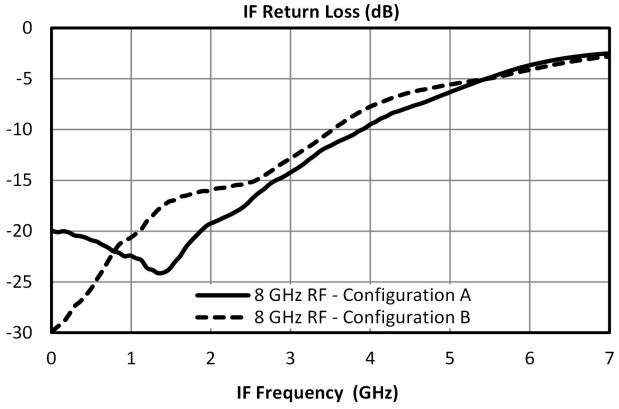
LO to IF Isolation (dB)



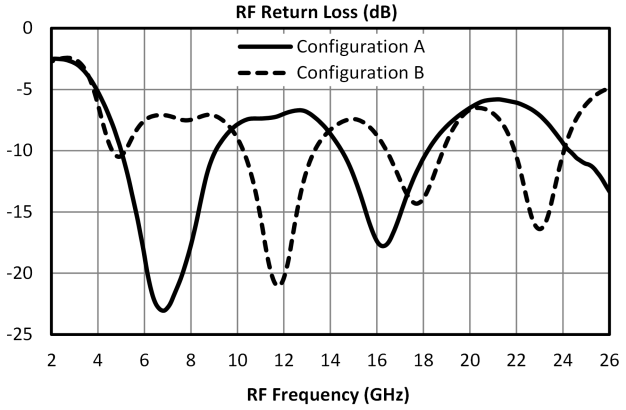
RF to IF Isolation (dB)



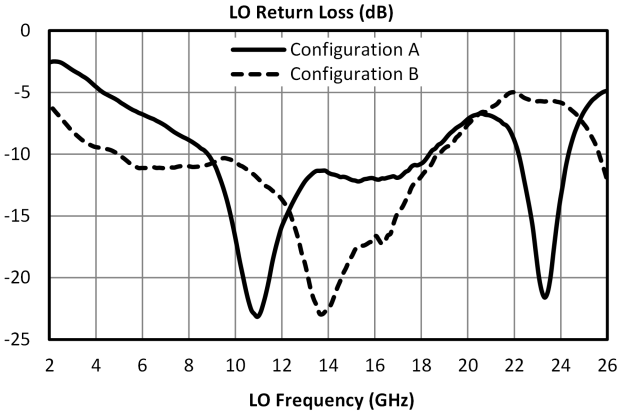
IF Return Loss (dB)



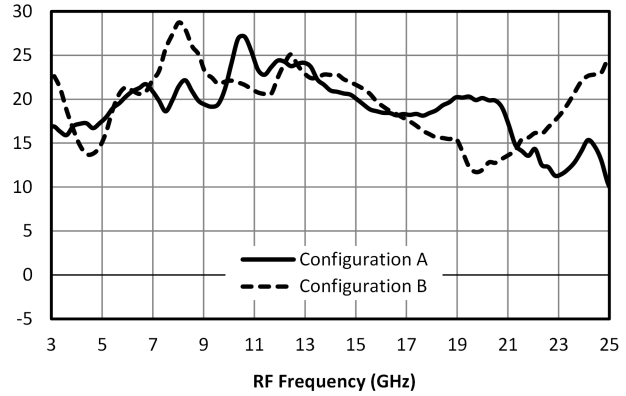
RF Return Loss (dB)



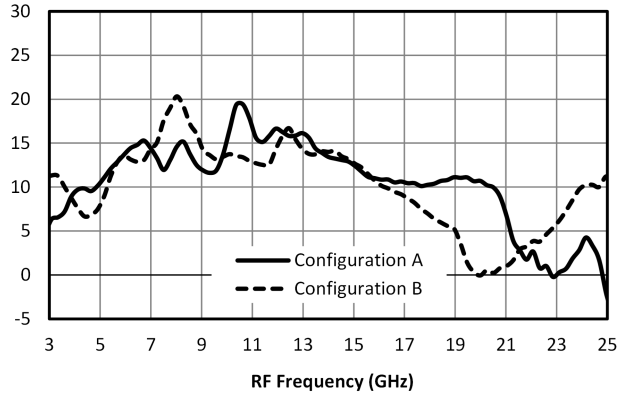
LO Return Loss (dB)



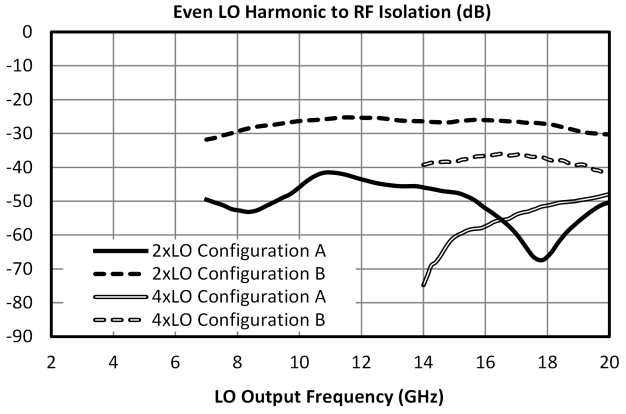
Input IP3 (dBm)



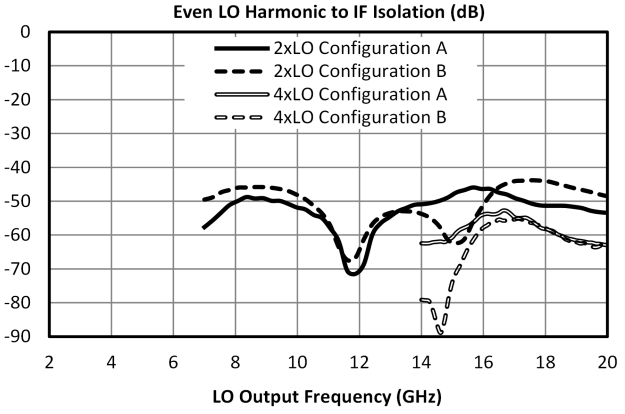
Output IP3 (dBm)



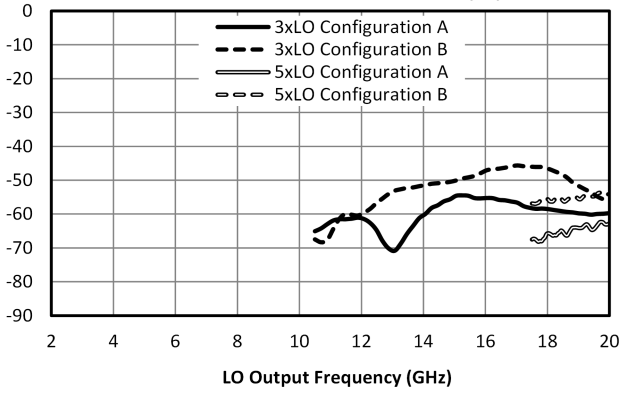
Even LO Harmonic to RF Isolation (dB)



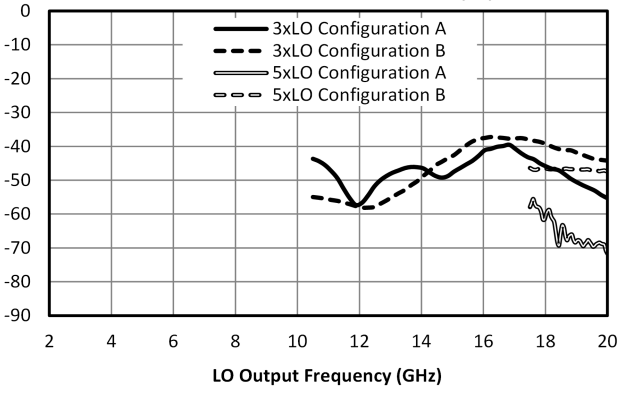
Even LO Harmonic to IF Isolation (dB)

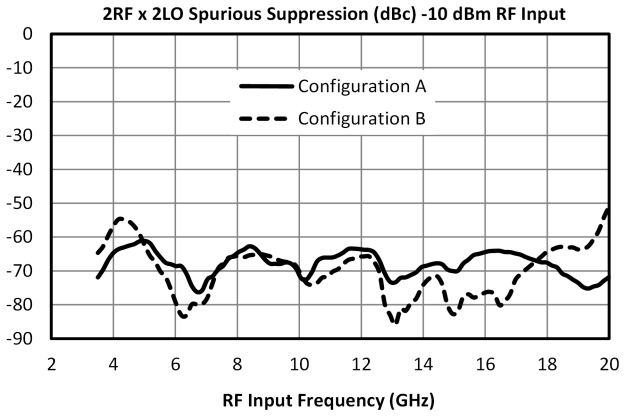


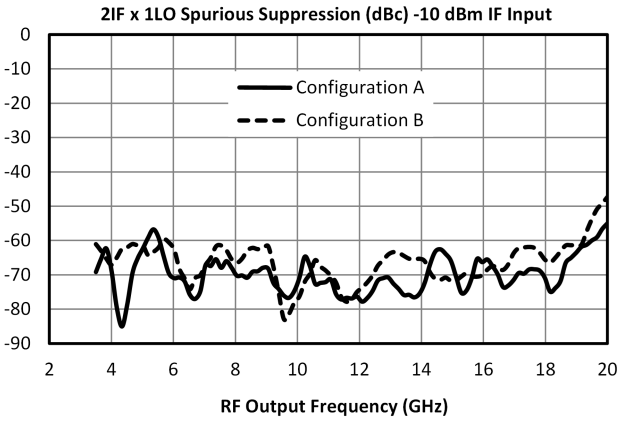
Odd LO Harmonic to RF Isolation (dB)



Odd LO Harmonic to IF Isolation (dB)



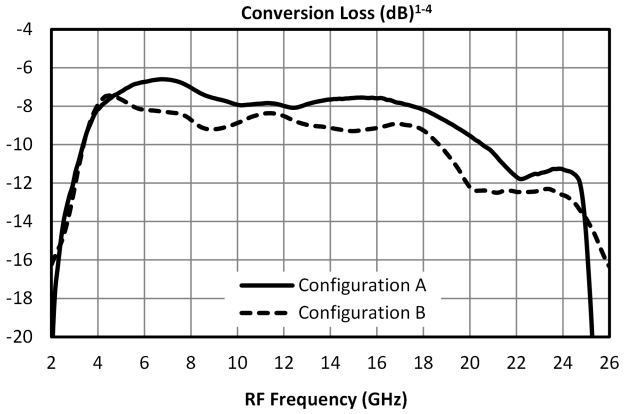




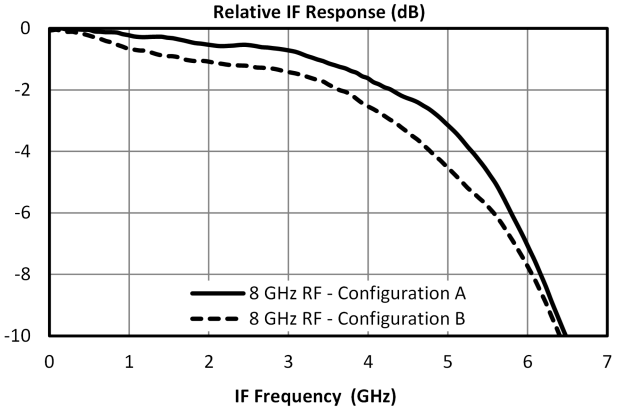
MM1-0320HS - Typical Performance Plots

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.

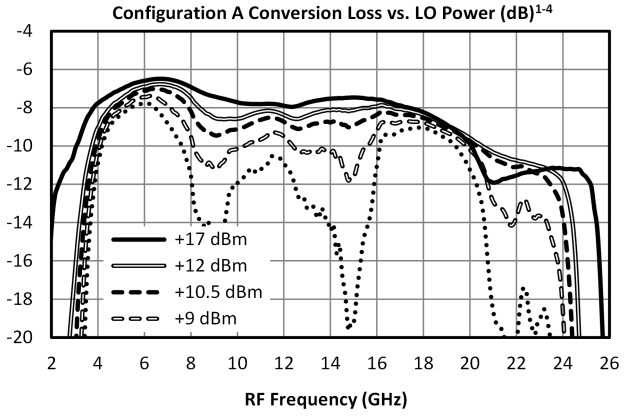
Conversion Loss (dB)[1-4]



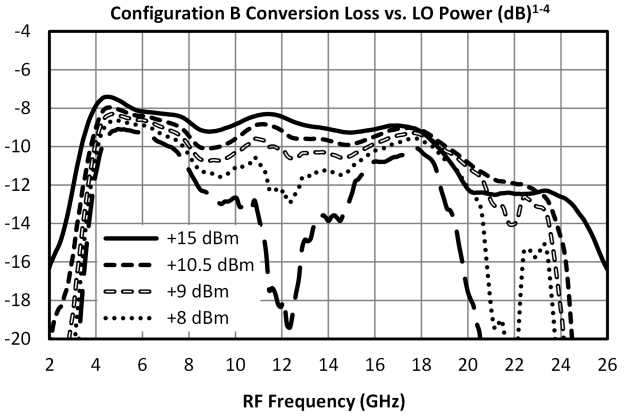
Relative IF Response (dB)



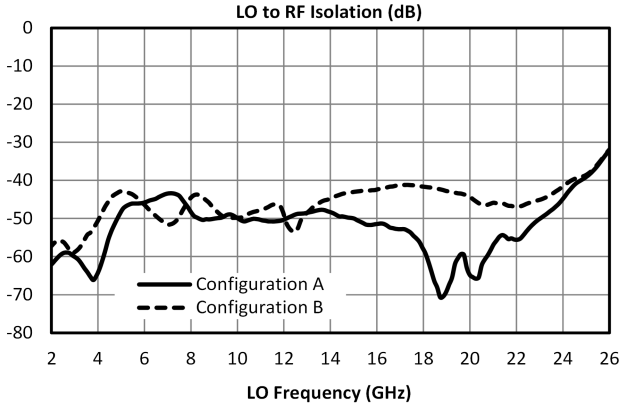
Configuration A Conversion Loss vs. LO Power (dB)[1-4]



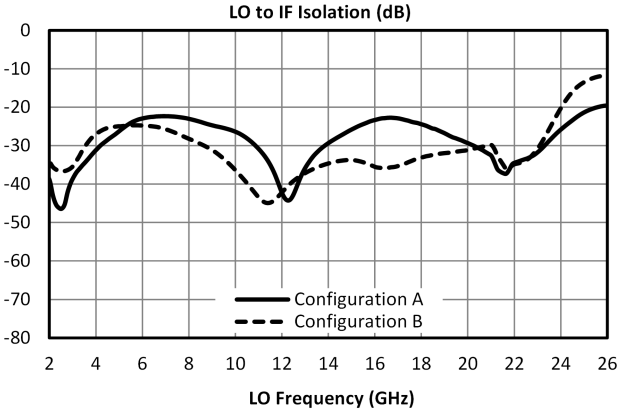
Configuration B Conversion Loss vs. LO Power (dB)[1-4]



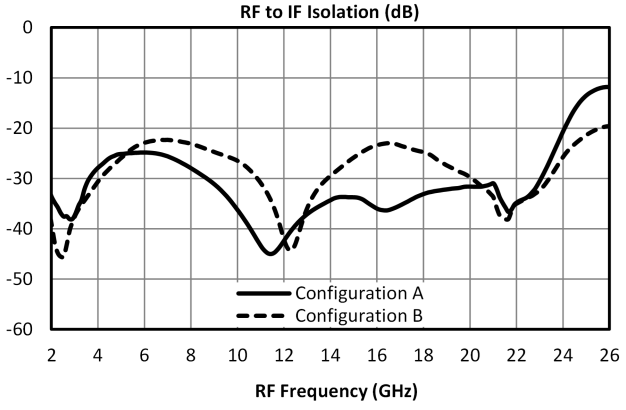
LO to RF Isolation (dB)



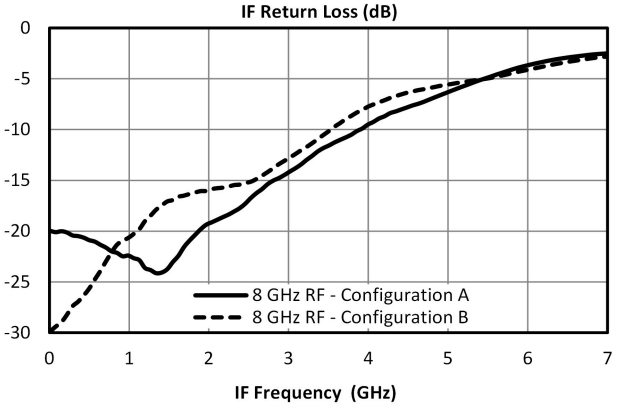
LO to IF Isolation (dB)



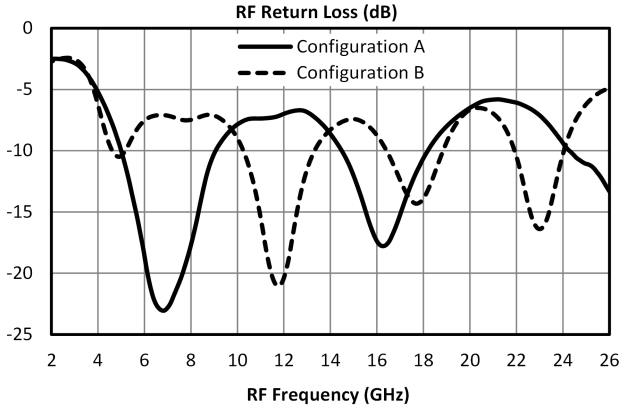
RF to IF Isolation (dB)



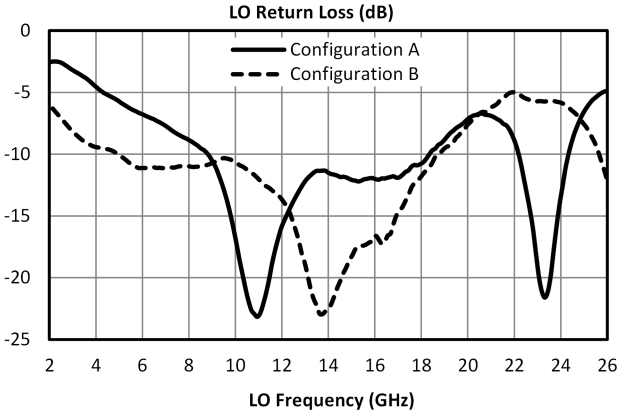
IF Return Loss (dB)



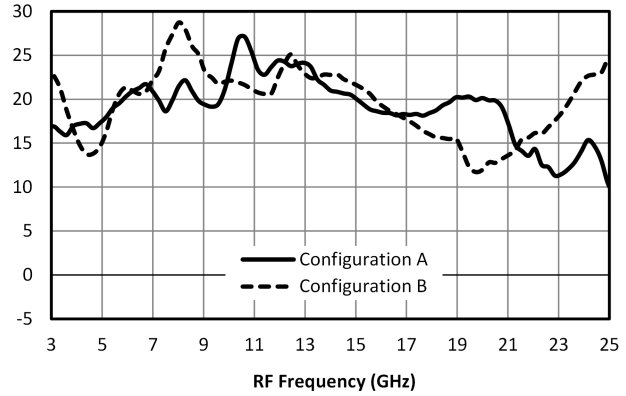
RF Return Loss (dB)



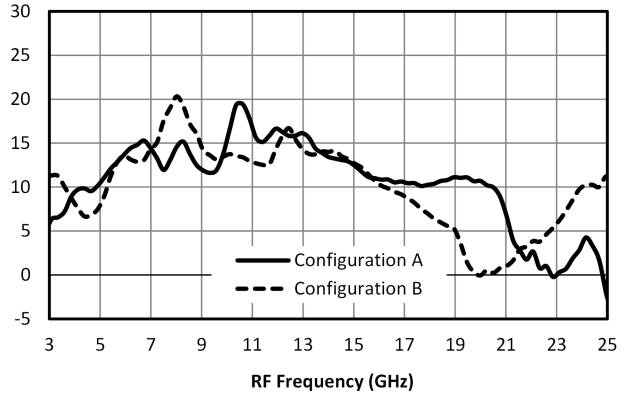
LO Return Loss (dB)



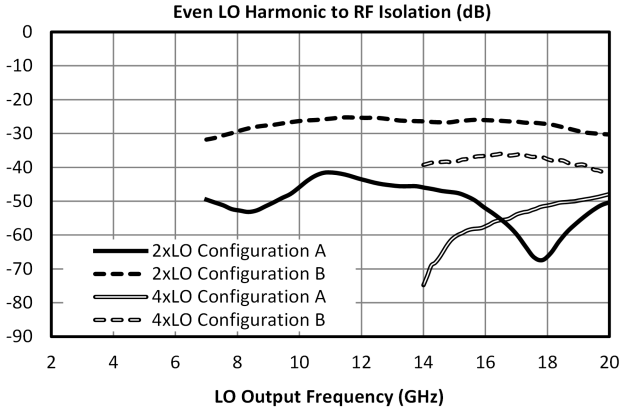
Input IP3 (dBm)



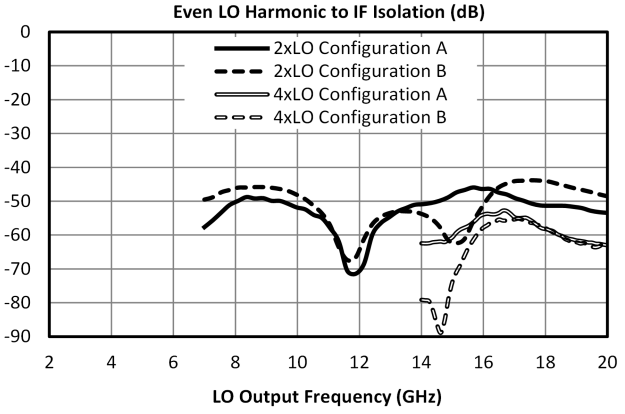
Output IP3 (dBm)



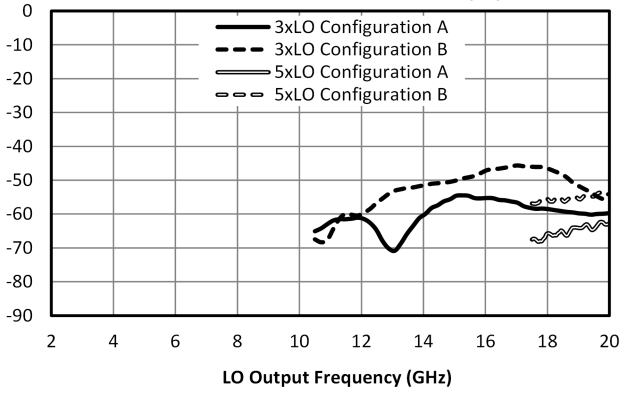
Even LO Harmonic to RF Isolation (dB)



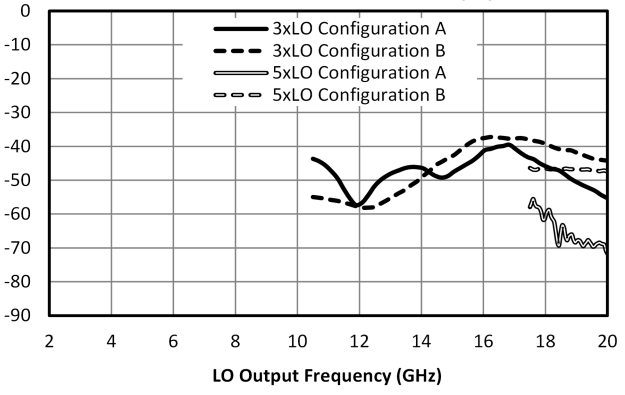
Even LO Harmonic to IF Isolation (dB)

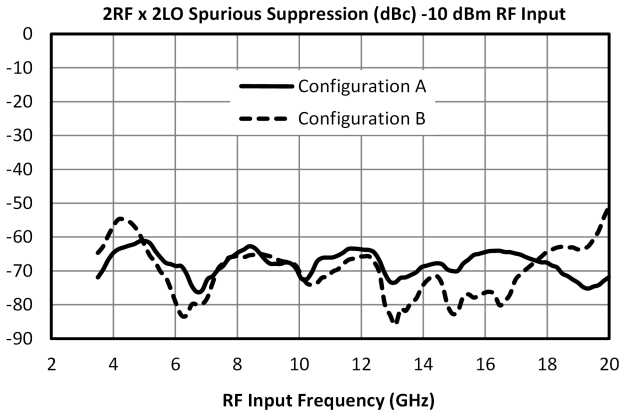


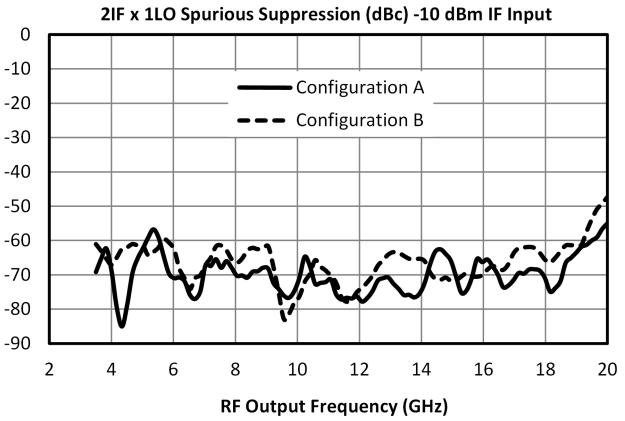
Odd LO Harmonic to RF Isolation (dB)



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 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 68 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 78 dBc.

Typical Downconversion Spurious Suppression (dBc): A Configuration (B Configuration)

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xRF	23 (18)	Reference	19 (32)	13 (12)	34 (47)	21 (24)
2xRF	71 (74)	55 (49)	68 (70)	64 (50)	69 (64)	66 (51)
3xRF	88 (89)	66 (61)	78 (87)	74 (73)	82 (89)	68 (72)
4xRF	122 (124)	104 (106)	108 (110)	112 (107)	118 (115)	114 (105)
5xRF	134 (134)	123 (115)	120 (125)	119 (119)	125 (127)	123 (121)

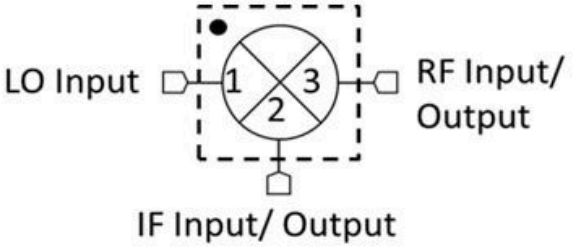
Upconversion Spurious Suppression

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.

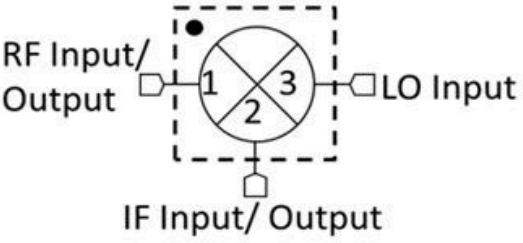
Typical Upconversion Spurious Suppression (dBc): A Configuration (B Configuration)

-10 dBm IF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xIF	21 (25)	Reference	18 (31)	12 (11)	34 (37)	24 (22)
2xIF	55 (44)	70 (66)	60 (47)	68 (65)	59 (50)	66 (64)
3xIF	72 (78)	72 (72)	71 (82)	63 (68)	71 (81)	60 (56)
4xIF	112 (110)	121 (110)	121 (95)	110 (105)	115 (90)	99 (98)
5xIF	129 (129)	119 (121)	123 (123)	119 (110)	126 (118)	110 (94)

Application Circuit



Configuration A



Configuration B

Application Circuit Description

Configuration A/B refer to the same part number (MM1-0320H) 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 and the epoxy should have high thermal conductivity. 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. MMICs with high power dissipation, particularly those with high DC power requirements, also require a thermally conductive ground plane with a thermally conductive epoxy attachment.

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 ohm 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.

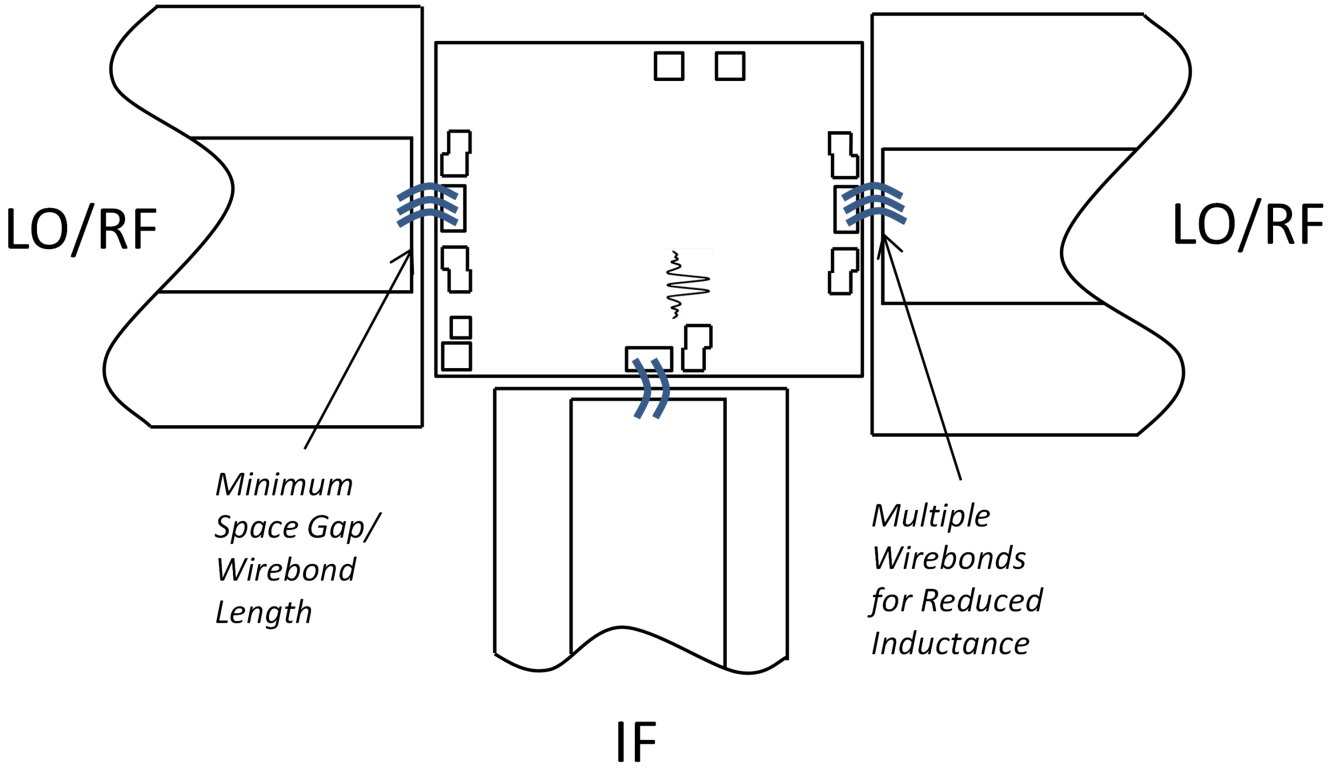
Handling Precautions

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.

Bonding Diagram



Mechanical Data

Outline Drawing

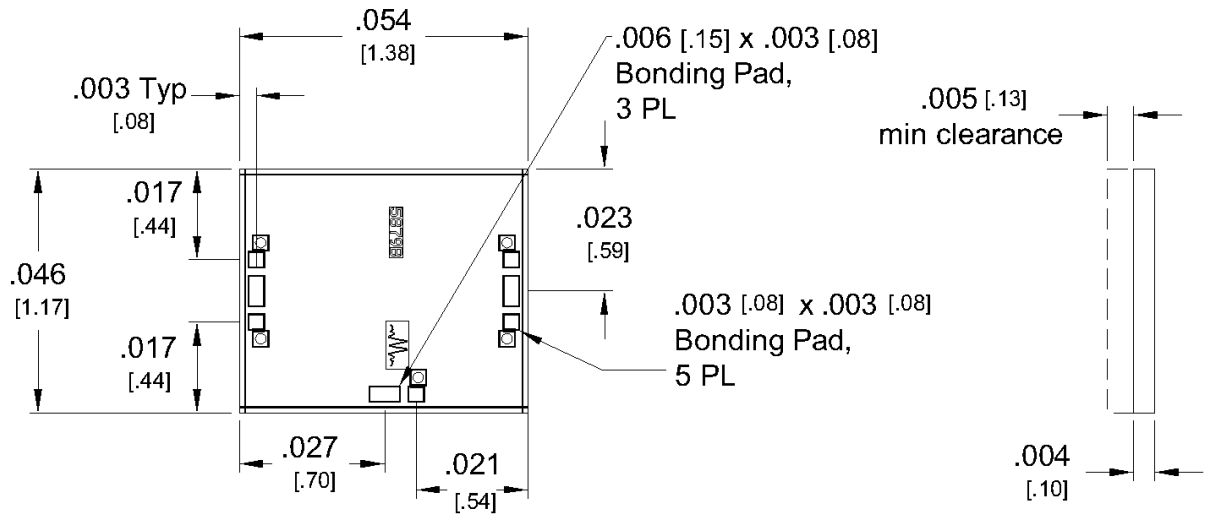
Download : Outline 2D Drawing

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.	10/16/24	AT



Notes:

1. CH substrate is .004 Thick GaAs.
2. I/O traces and ground plane finish is 2 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.

NOTES:

DRAWN BY	DATE
STR	8/14/15

MATERIAL: 210-05878-R70

FINISH:

DO NOT SCALE DRAWING

Marki microwave www.markimicrowave.com

Outline
MMIC Mixer

SIZE	CAGE CODE	DWG. NO.
A	0UC32	MM1-0320HCH-2

SCALE 40/1 SHEET 1 OF 1

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