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Sales & Customer Support: sales@markimicrowave.com
Tech Support: support@markimicrowave.com

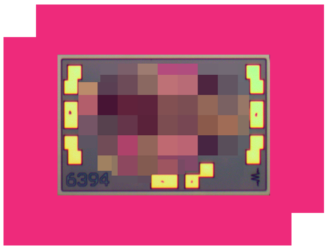
MM1-1044LCH-2

Low Power GaAs MMIC Double Balanced Mixer

DEVICE OVERVIEW

General Description

The MM1-1044L is a low power GaAs MMIC double balanced mixer that is designed for and operates at the K and Ka band 5G frequencies. MM1-1044L is a low power Ka band mixer that works well as both an up and down converter. This mixer offers low conversion loss and high LO to RF isolations over a broadband Ku to Ka band. The sister MM1-1044H is recommended for high linearity applications. The MM1-1044L is available as both wire bondable die and as connectorized modules.



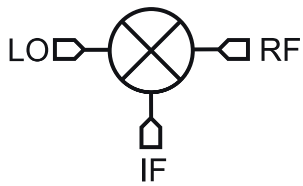
Features

- Low +7 dBm minimum input drive
- Low cost Ka band mixer
- Small 0.77mm x 1.17mm form factor
- 5G band coverage

Applications

- Mobile test and measurement equipment
- 5G
- Power efficient modules

Functional Block Diagram



Part Ordering Options

Part Number	Description	Package	Connectors	Green Status	Product Lifecycle	Export Classification
MM1-1044LS-KKS	Low Power GaAs MMIC Double Balanced Mixer	S	Standard	REACH RoHS	Released	EAR99
MM1-1044LS	Low Power GaAs MMIC Double Balanced Mixer	S	Standard	REACH RoHS	Released	EAR99
MM1-1044LCH-2	Low Power GaAs MMIC Double Balanced Mixer	CH	-	REACH RoHS	Released	EAR99

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Table Of Contents

Revision History

Revision Code	Revision Date	Comment
-	2018-02-01	Datasheet Initial Release
A	2020-02-01	Correction to Spur Chart
B	2020-03-01	Power Handling Update

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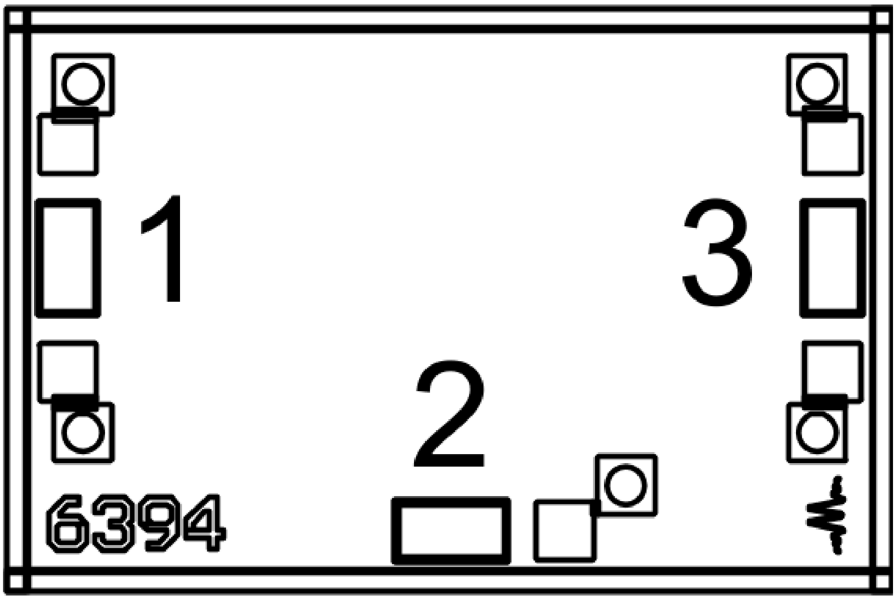
Port Configuration and Functions

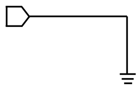
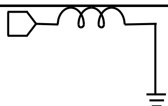
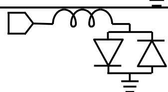
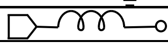
Port Diagram

A top-down view of the MM1-1044L's CH package outline drawing is shown below. The MM1-1044L has the input and output ports given in Port Functions. The MM1-1044L can be used in either an up or down conversion. For configuration A, input the LO into port 1, use port 3 for the RF, and port 2 for the IF. For configuration B, input the LO into port 3, use port 1 for the RF, and port 2 for the IF.



Port Functions

Configuration A

Port	Function	Description	Equivalent Circuit for Package
GND	Ground	CH package ground path is provided through the substrate and ground bond pads.	
Port 1	LO	Port 1 is DC short for the CH and S packages.	
Port 2	IF	Port 2 is diode connected for the CH and S package.	
Port 3	RF	Port 3 is DC open for the CH and S packages.	

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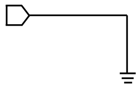
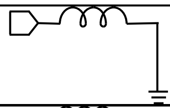
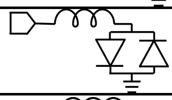
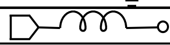
Configuration B

Port	Function	Description	Equivalent Circuit for Package
GND	Ground	CH package ground path is provided through the substrate and ground bond pads.	
Port 1	RF	Port 1 is DC short for the CH and S packages.	
Port 2	IF	Port 2 is diode connected for the CH and S package.	
Port 3	LO	Port 3 is DC open for the CH and S packages.	

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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
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
Dimensions	-	1.17 x 0.77mm

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
Ambient Temperature	-55	25	100	°C
LO Input Power	7	-	15	dBm

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

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Electrical Specifications

The electrical specifications apply at TA=+25°C in a 50Ω system. Typical data shown is for the connectorized S package mixer used in the forward direction with a +9 dBm sine wave input. Min and Max limits apply only to our connectorized units and are guaranteed at TA=+25°C. All bare die are 100% DC tested and visually inspected. RF testing of our die is performed on a sample basis to verify conformance to datasheet guaranteed specifications.

Parameter	Port Configuration	Test Conditions	Min	Typ	Max	Unit
Conversion Loss [1]	A	RF/LO = 9 - 44 GHz I = 4 - 14 GHz	-	9.5	-	dB
Conversion Loss [2]	A	RF/LO = 9 - 44 GHz I = DC - 4 GHz	-	7.6	13.5	dB
Input 1 dB Gain Compression Point (P1dB)	A	-	-	5	-	dBm
Input IP3	A	RF/LO = 9 - 44 GHz I = DC - 0.2 GHz	-	12.5	-	dBm
Conversion Loss [3]	B	RF/LO = 9 - 44 GHz I = 4 - 14 GHz	-	10	-	dB
Conversion Loss [4]	B	RF/LO = 9 - 44 GHz I = DC - 4 GHz	-	8.6	14.5	dB
Input 1 dB Gain Compression Point (P1dB)	B	-	-	6	-	dBm
Input IP3	B	RF/LO = 9 - 44 GHz I = DC - 0.2 GHz	-	13.7	-	dBm
IF Frequency Range	-	-	0	-	14	GHz
Isolation, LO to IF	-	IF/LO = 9 - 44 GHz	-	49	-	dB
Isolation, LO to RF	-	RF/LO = 9 - 44 GHz	-	47	-	dB
Isolation, RF to IF	-	RF/IF = 9 - 44 GHz	-	39	-	dB
LO Frequency Range	-	-	10	-	44	GHz
Noise Figure [5]	-	RF/LO = 9 - 44 GHz I = DC - 0.2 GHz	-	7.6	-	dB
RF Frequency Range	-	-	10	-	44	GHz

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

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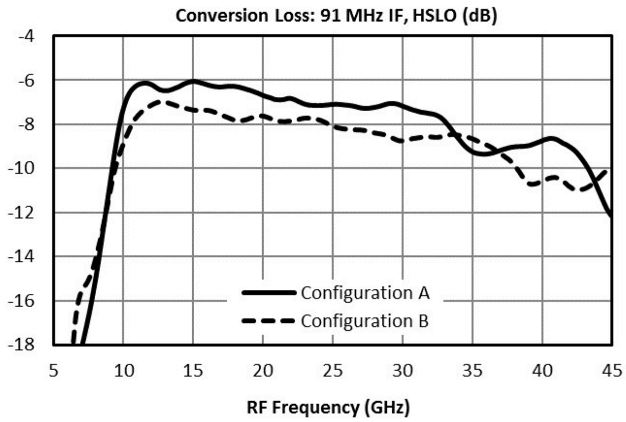
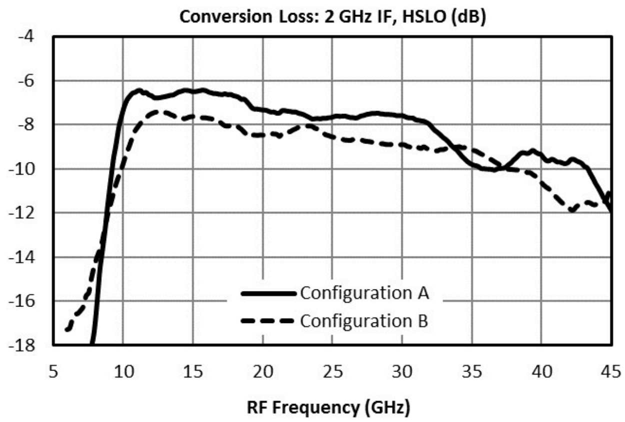
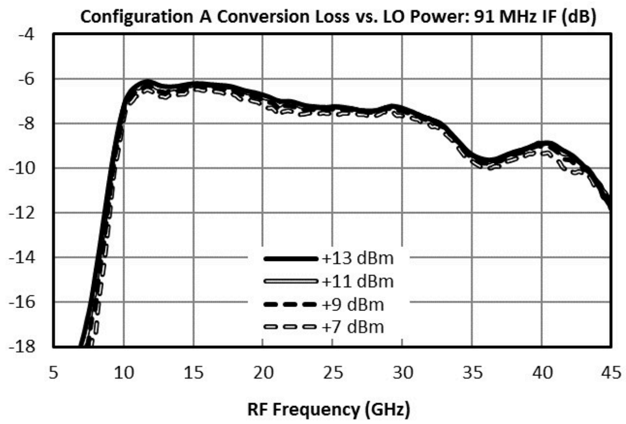
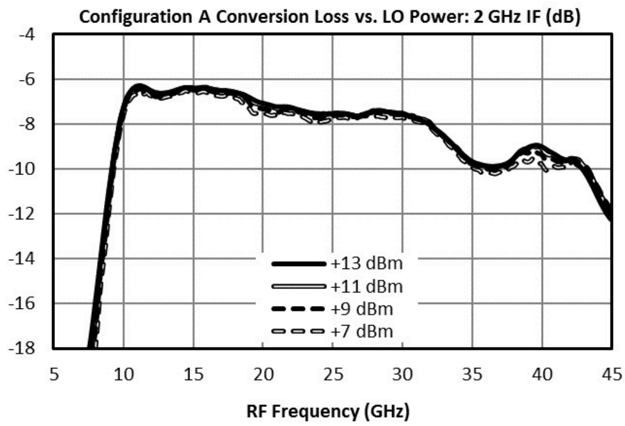
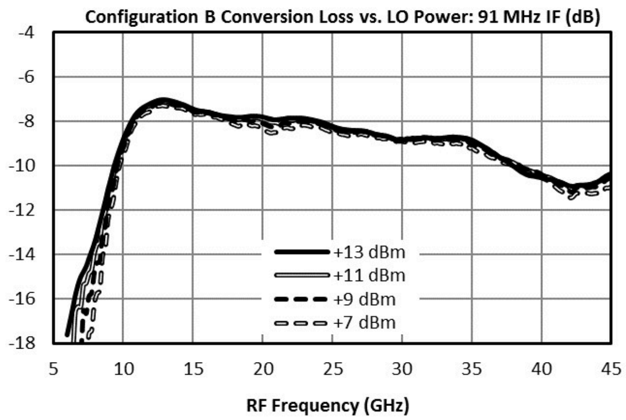
Typical Performance Plots

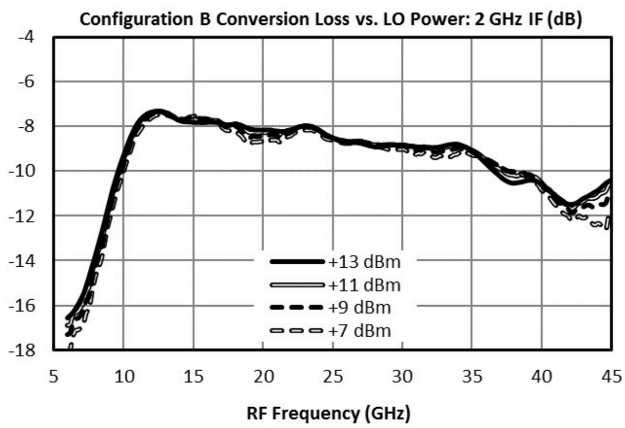


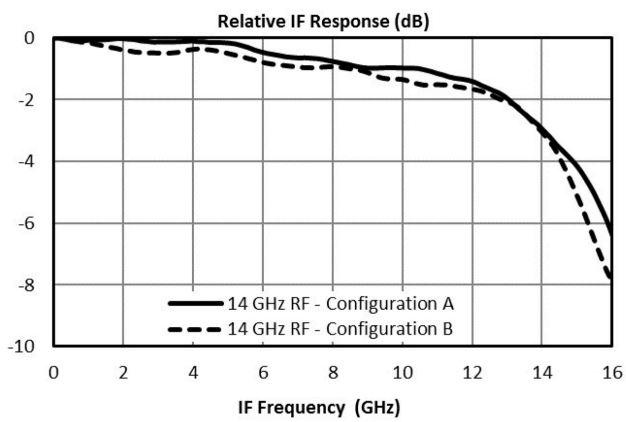


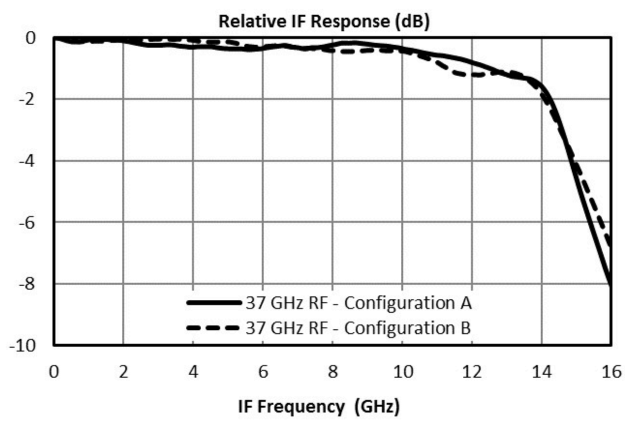












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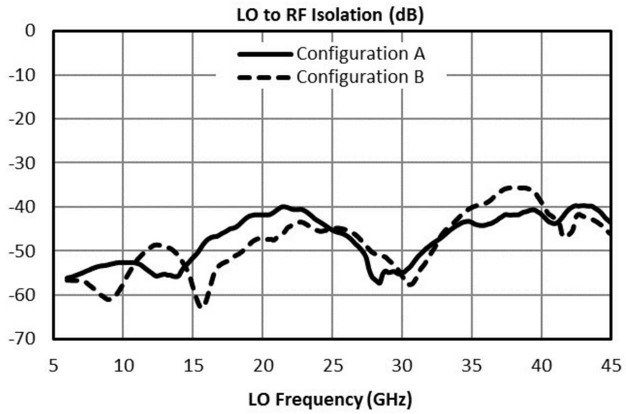
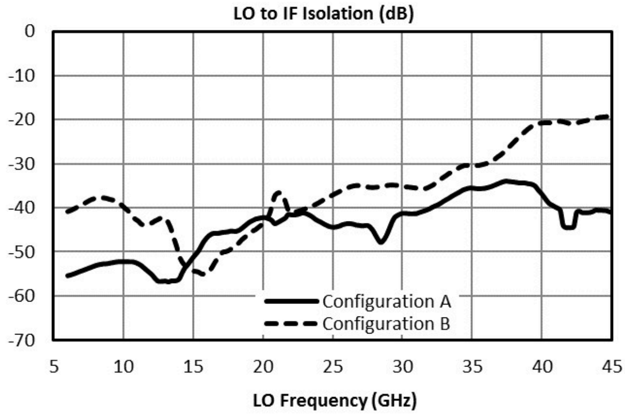
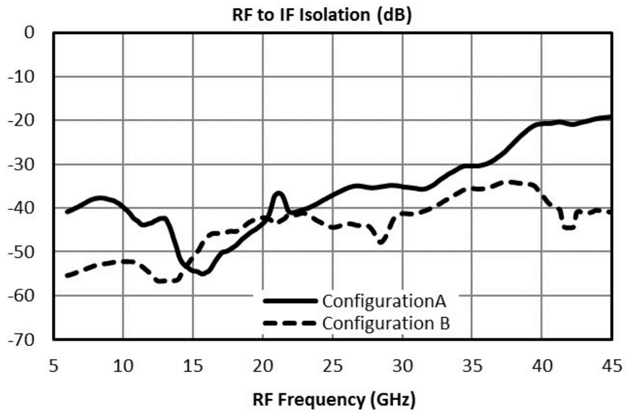
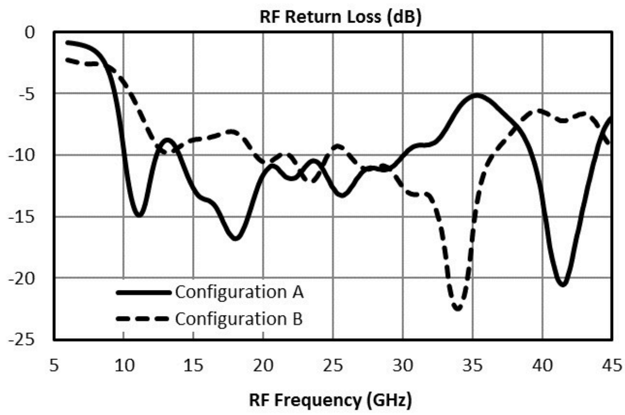
MM1-1044LCH-2

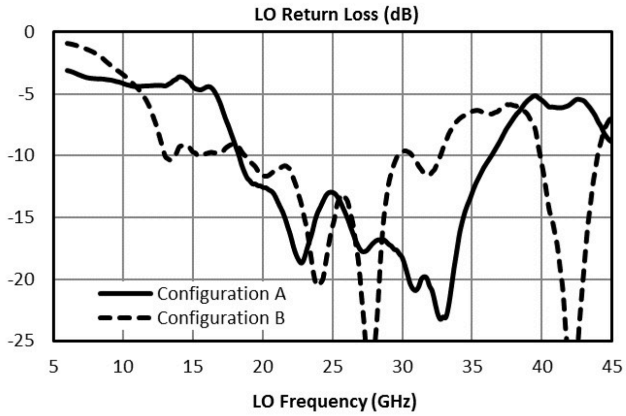
Low Power GaAs MMIC Double Balanced Mixer

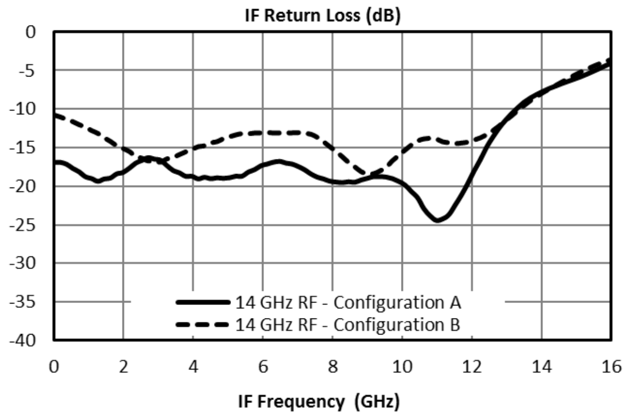


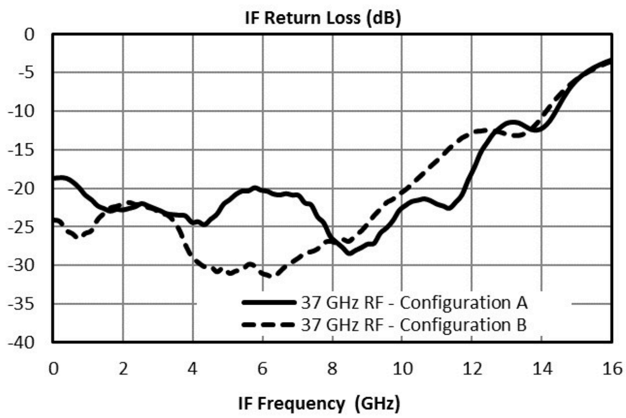












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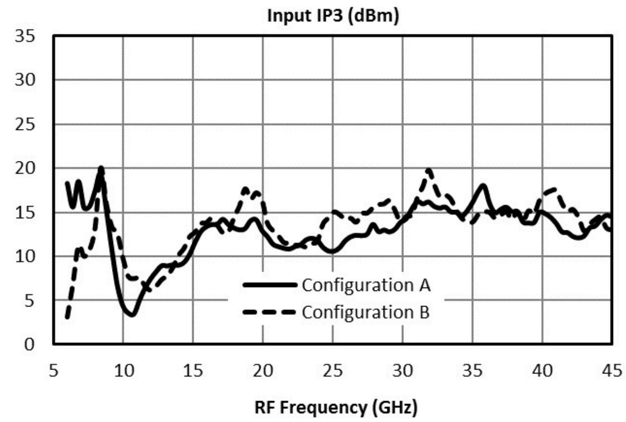
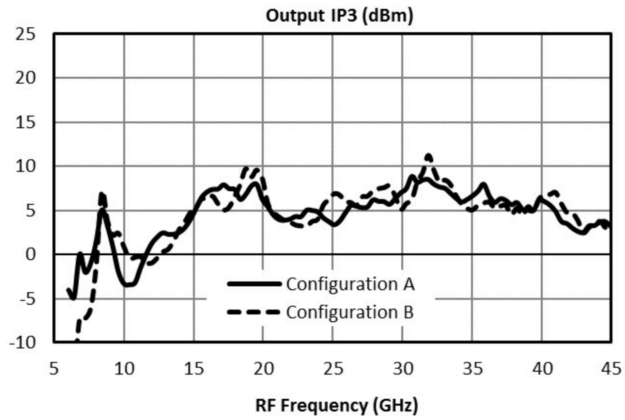
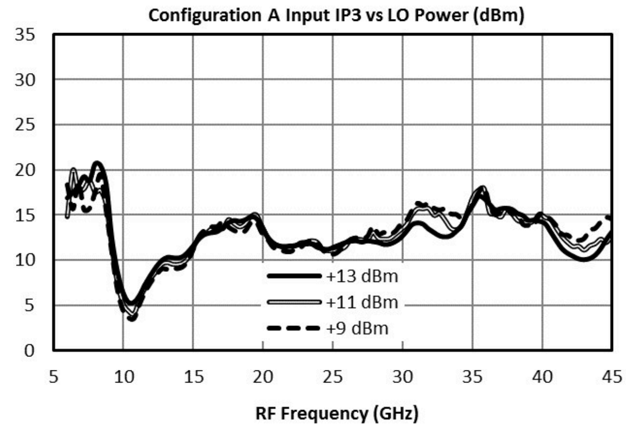
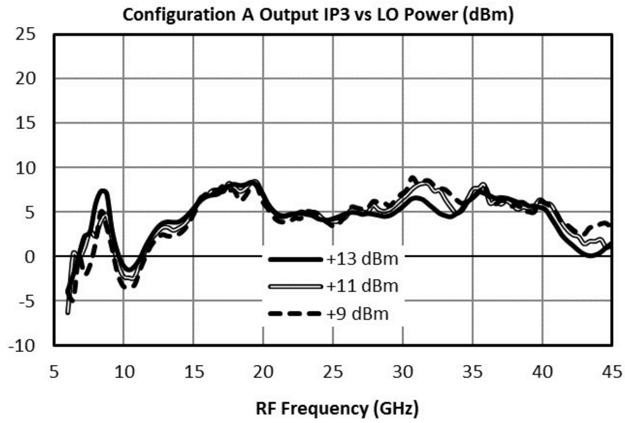
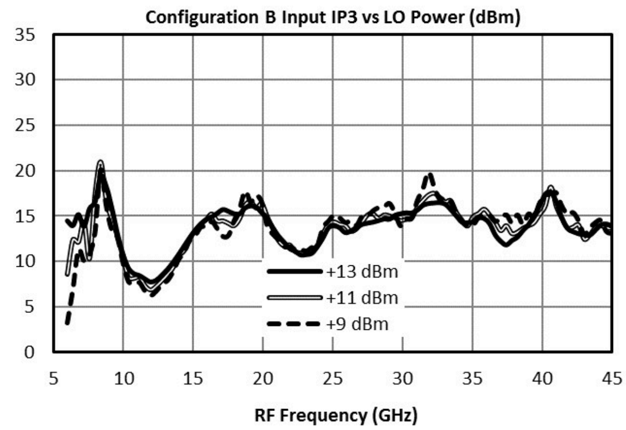
Typical Performance Plots: IP3

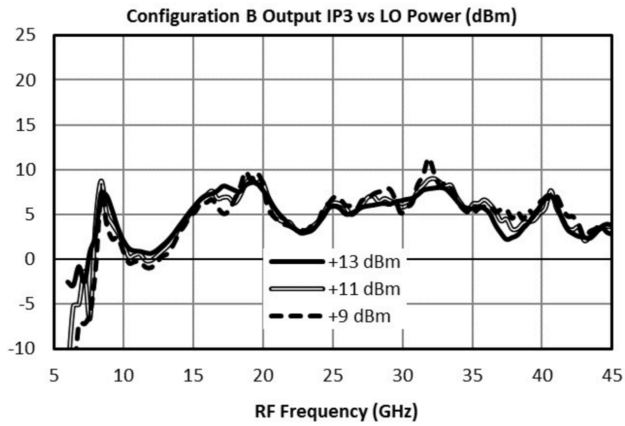












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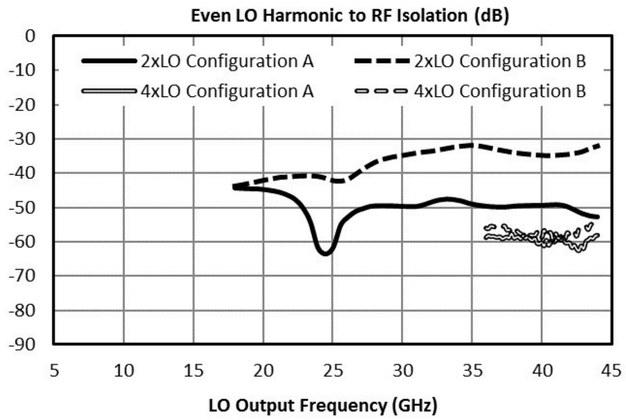
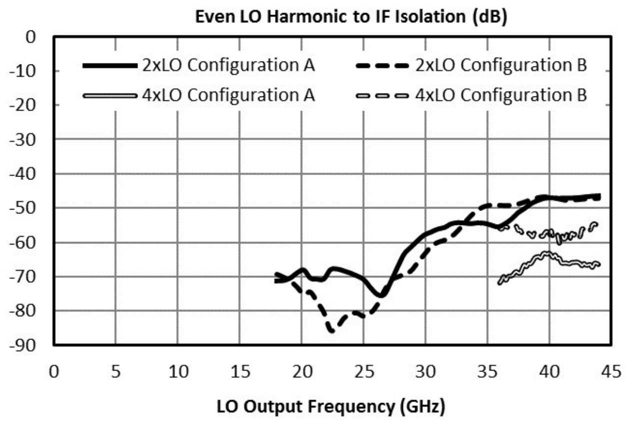
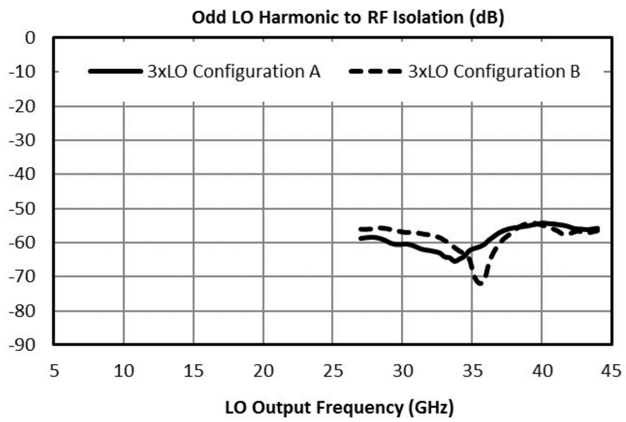
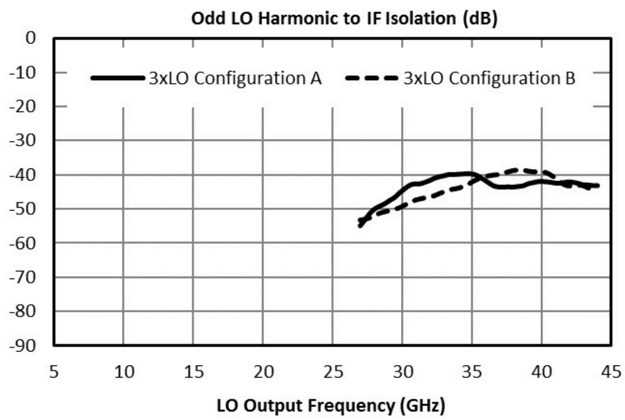
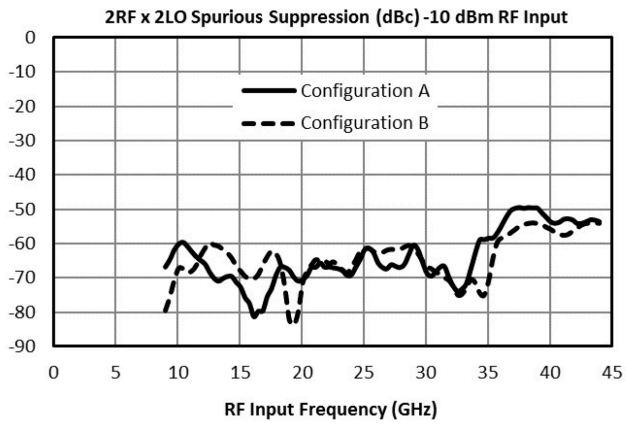
Typical Performance Plots: LO Harmonic Isolation

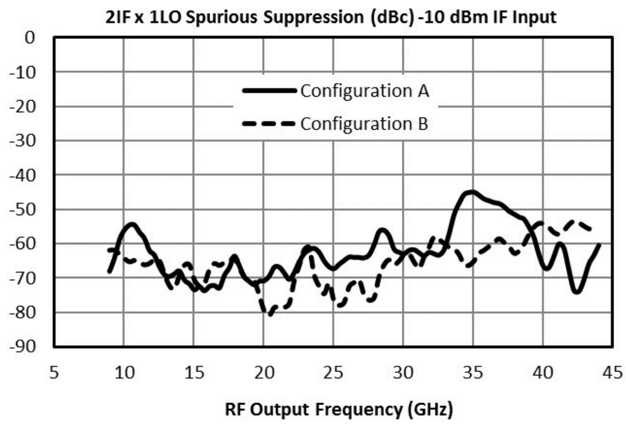












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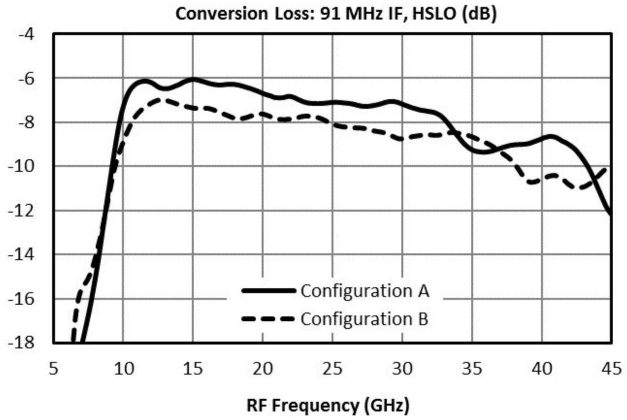
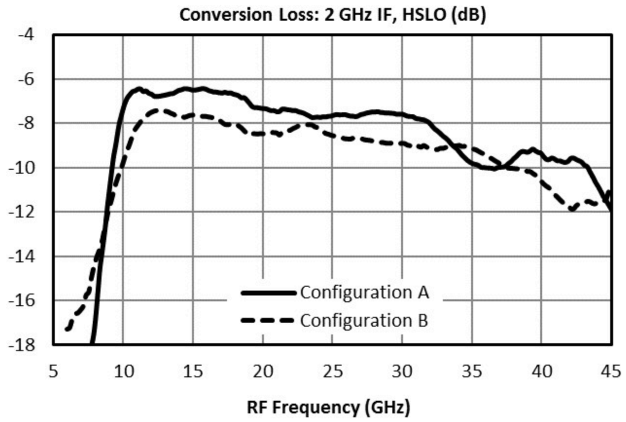
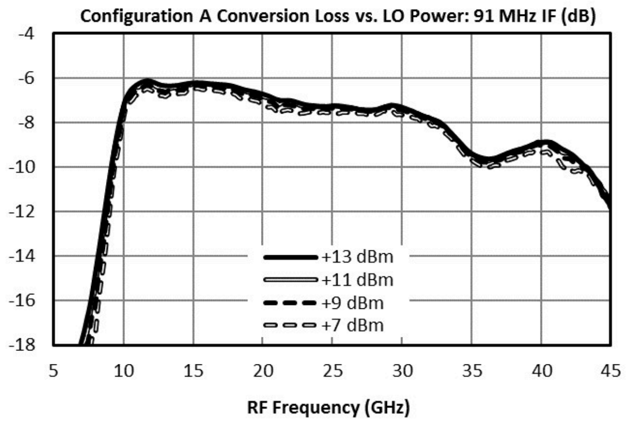
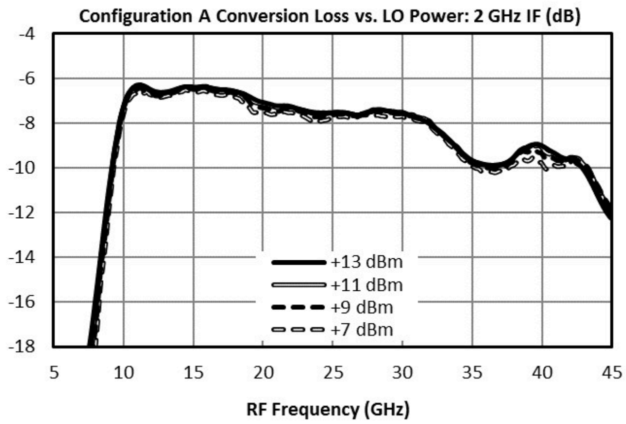
MM1-1044LS-KKS - Typical Performance Plots

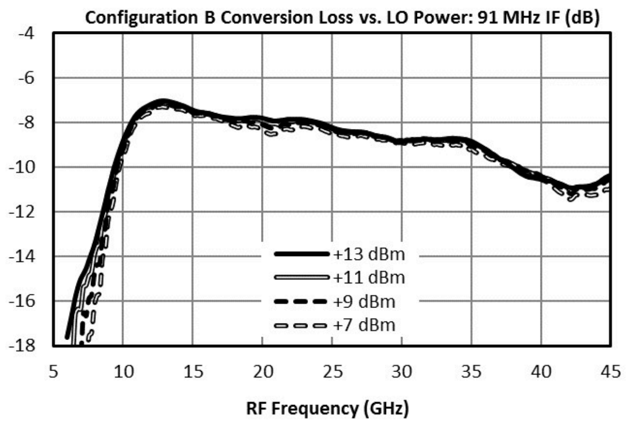
Performance plots for the connectorized module are shown for measurements where directly probed measurements of the die are unavailable. Note that the following measurements include losses from connectors and microstrip traces.

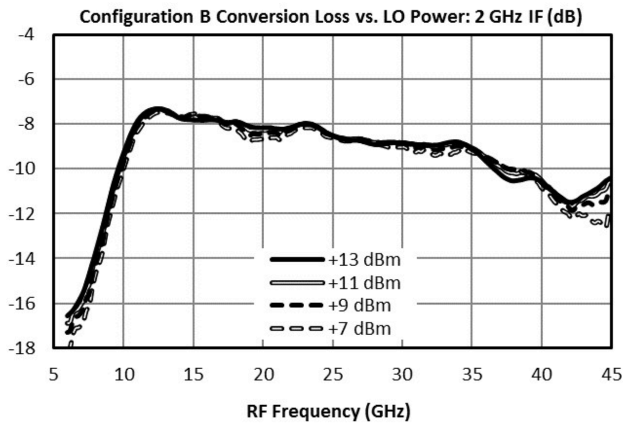


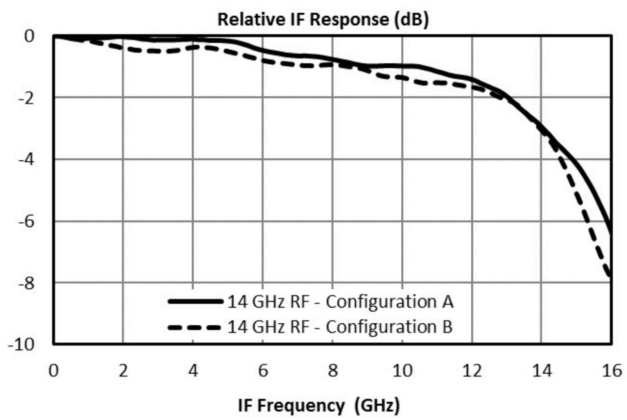


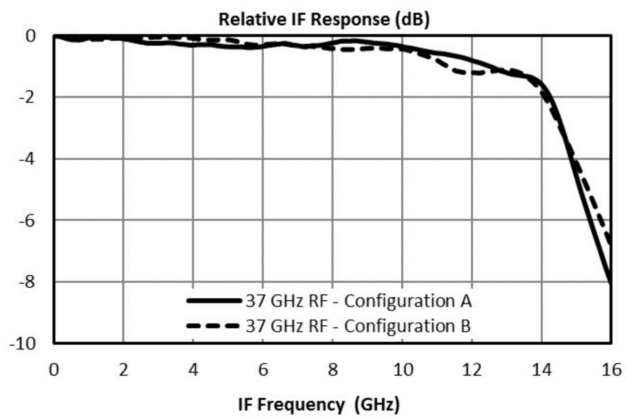












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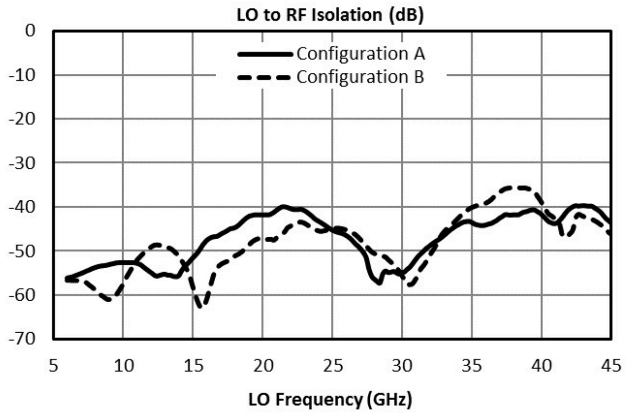

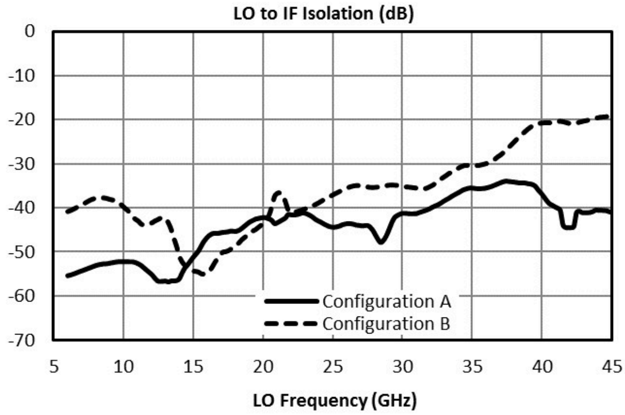

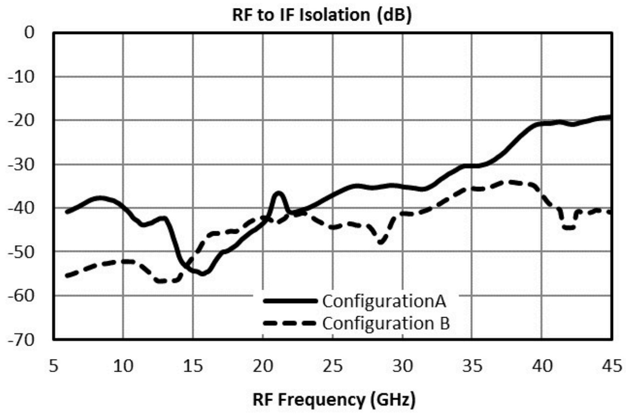

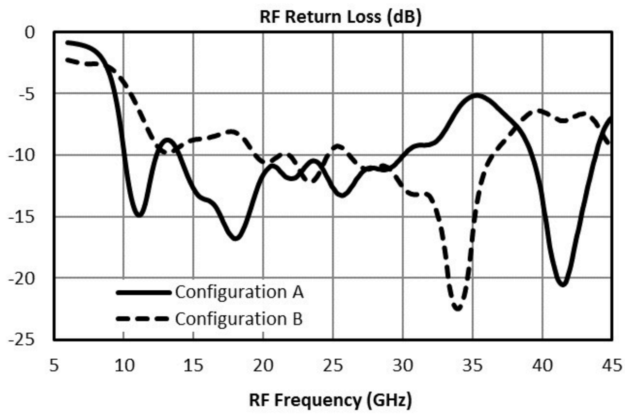

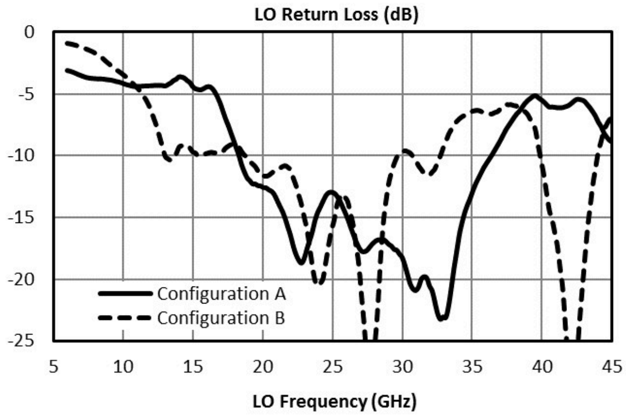

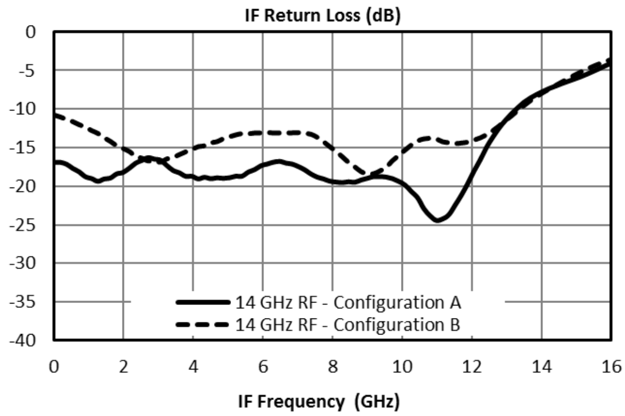

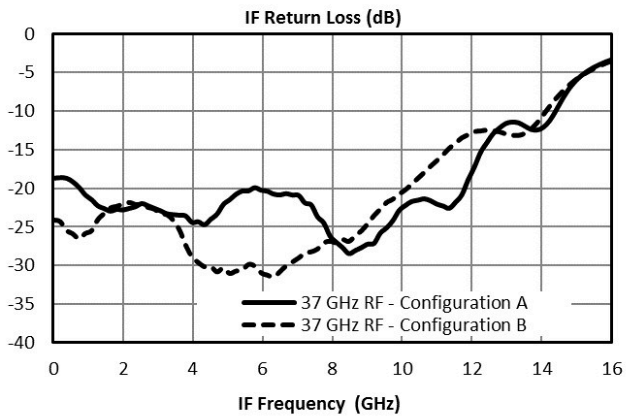

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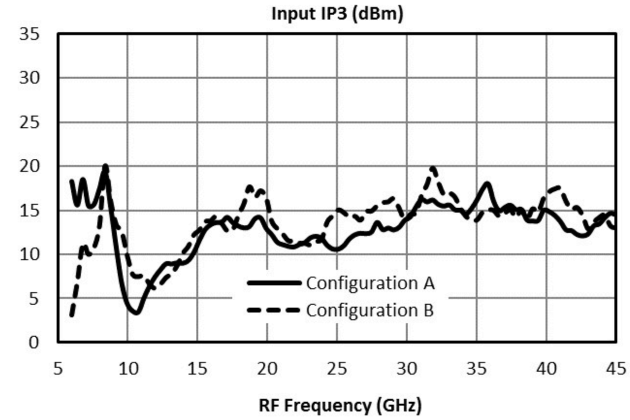
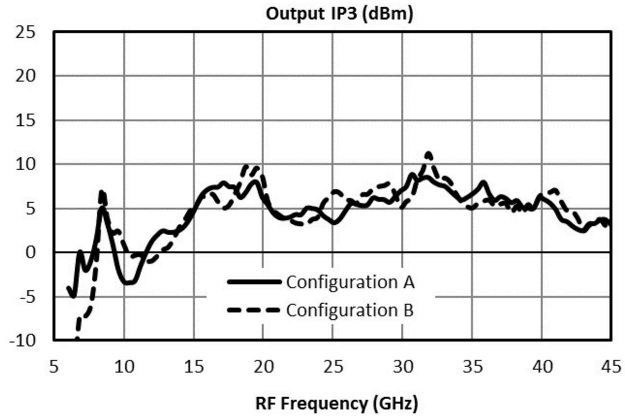
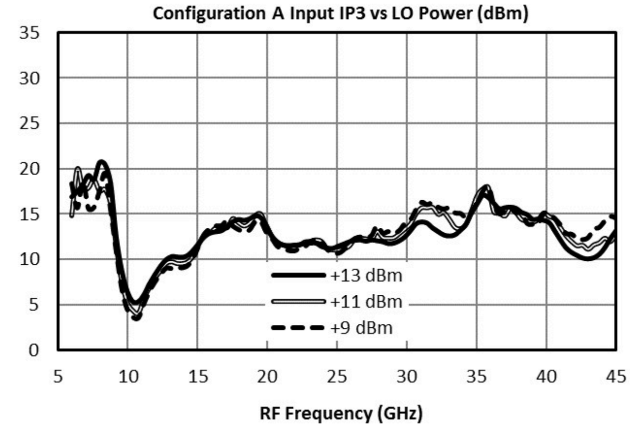
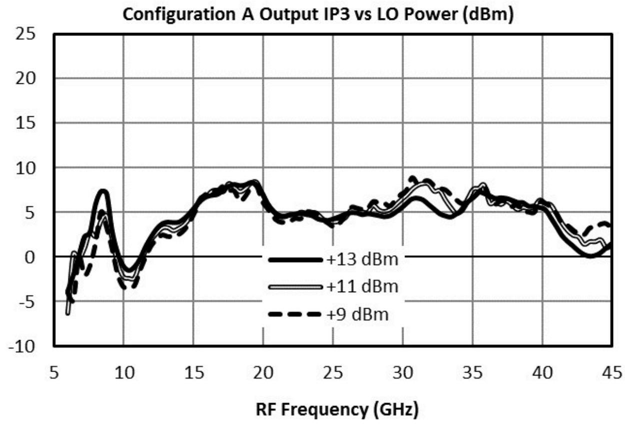
MM1-1044LS-KKS - Typical Performance Plots: IP3

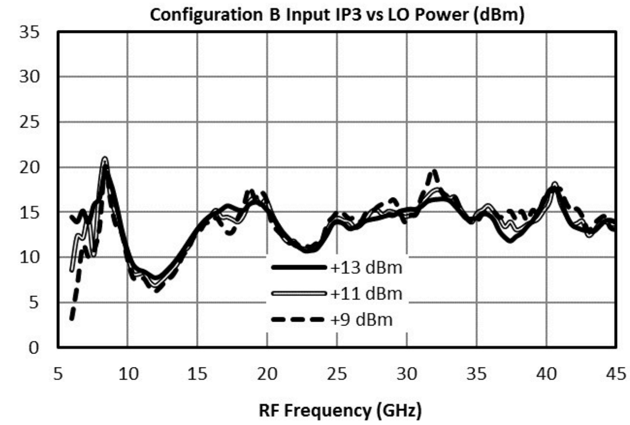
Performance plots for the connectorized module are shown for measurements where directly probed measurements of the die are unavailable. Note that the following measurements include losses from connectors and microstrip traces.

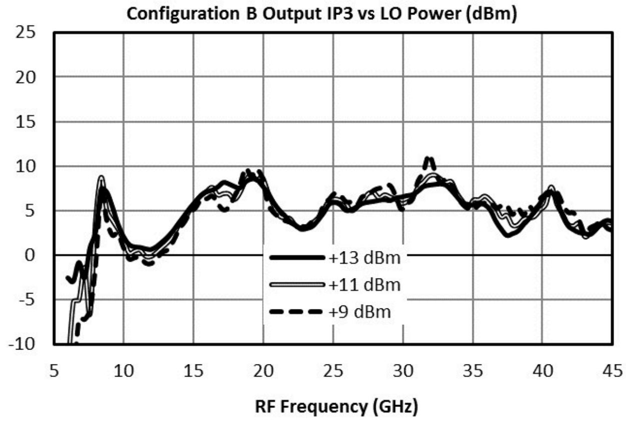












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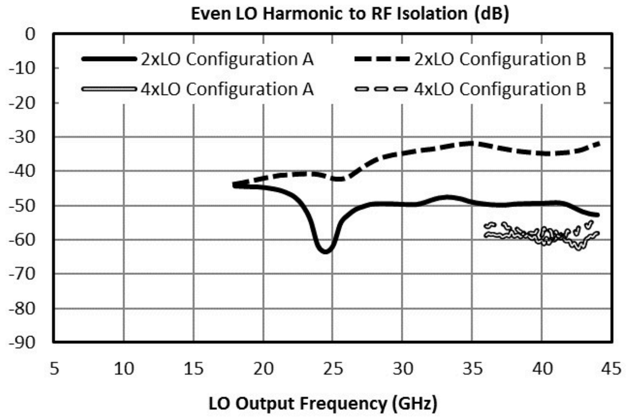
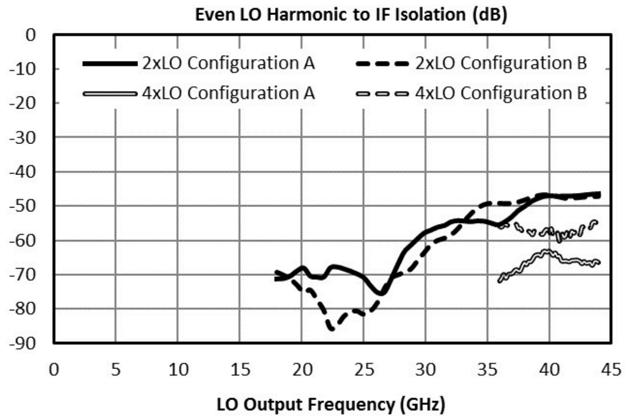
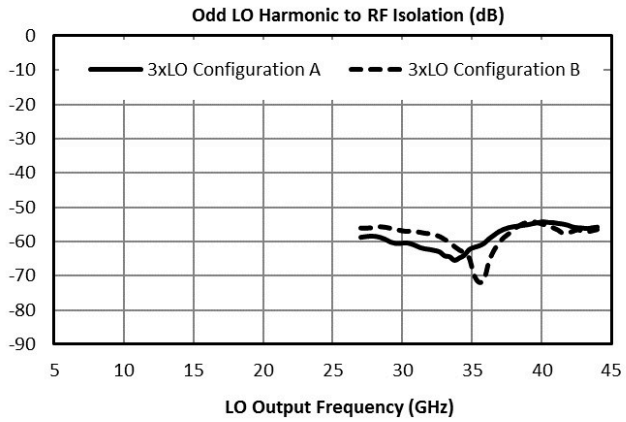
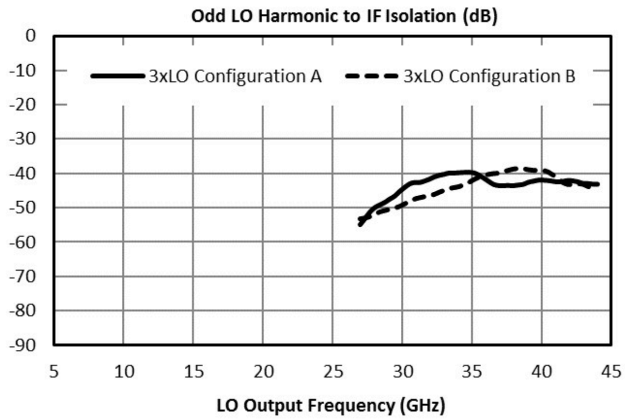
MM1-1044LS-KKS - Typical Performance Plots: LO Harmonic Isolation

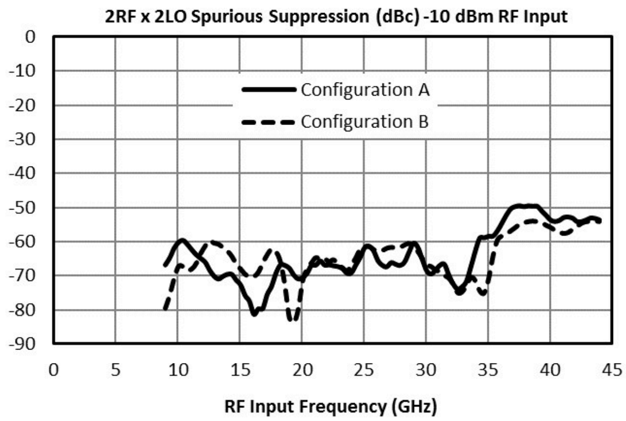
Performance plots for the connectorized module are shown for measurements where directly probed measurements of the die are unavailable. Note that the following measurements include losses from connectors and microstrip traces.

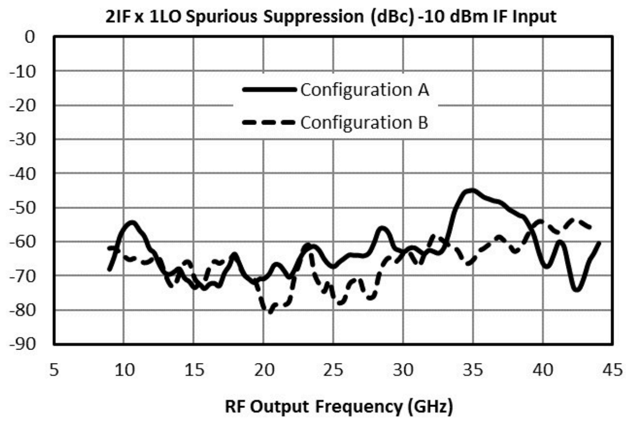












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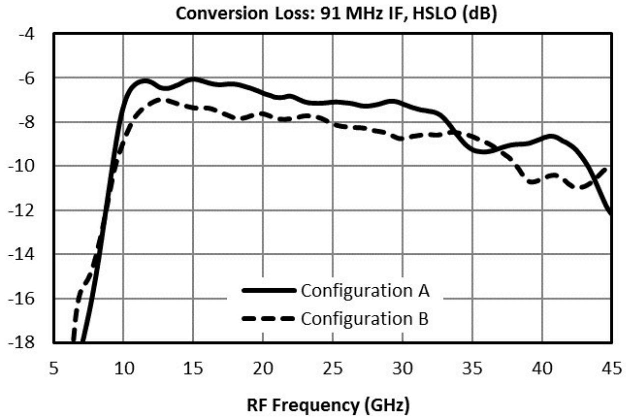
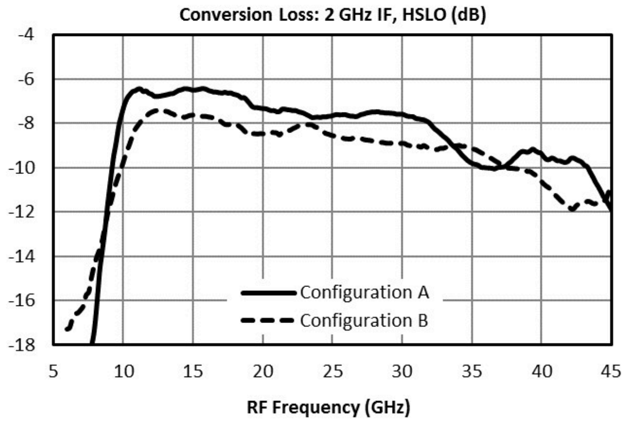
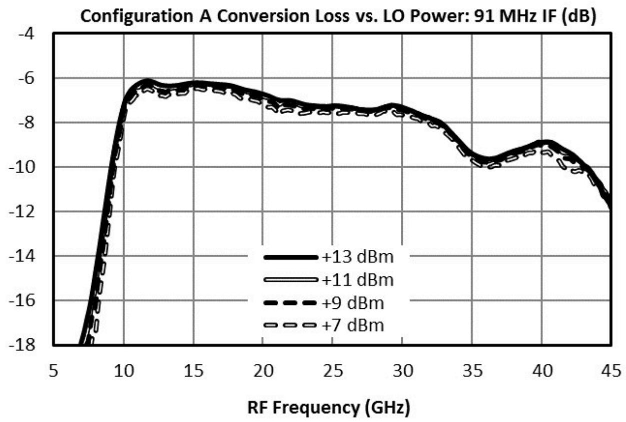
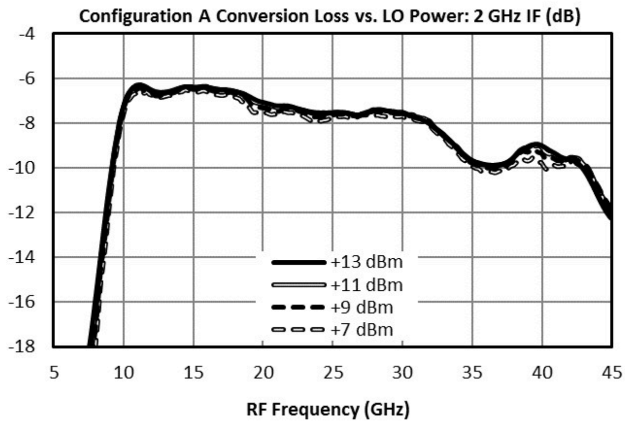
MM1-1044LS - Typical Performance Plots

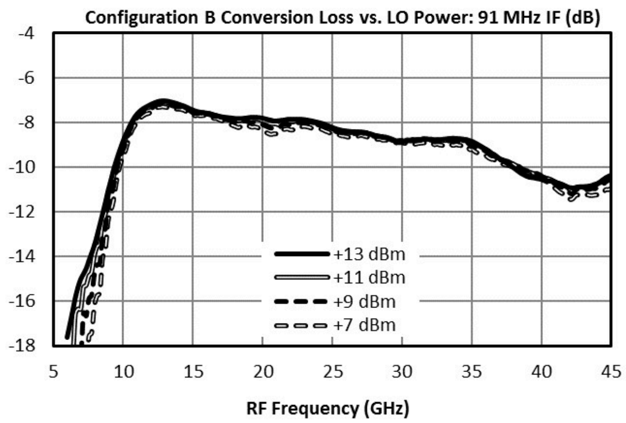
Performance plots for the connectorized module are shown for measurements where directly probed measurements of the die are unavailable. Note that the following measurements include losses from connectors and microstrip traces.

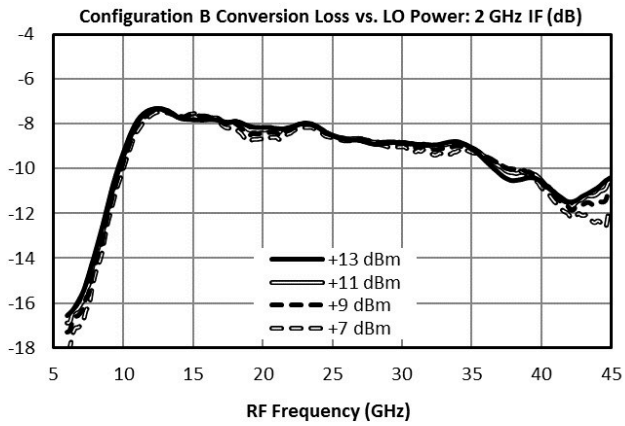


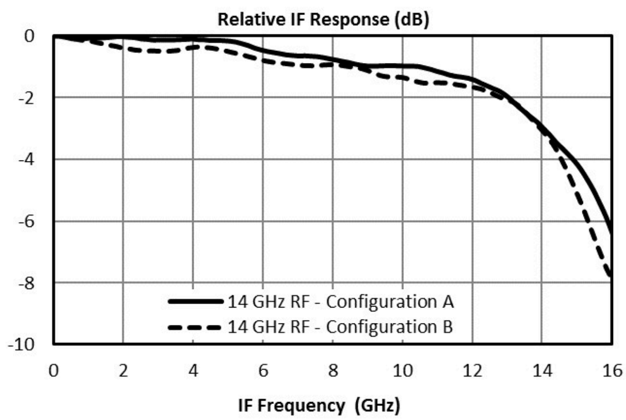


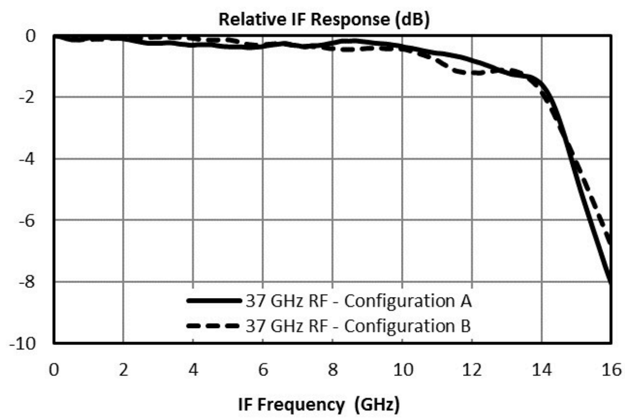












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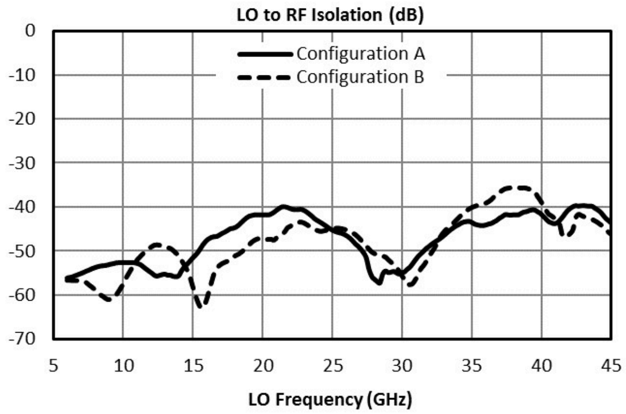

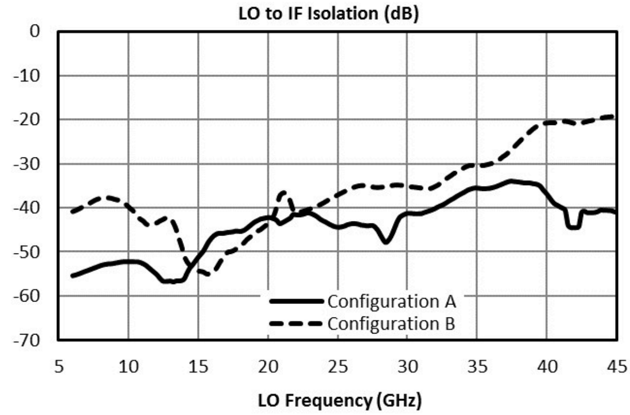

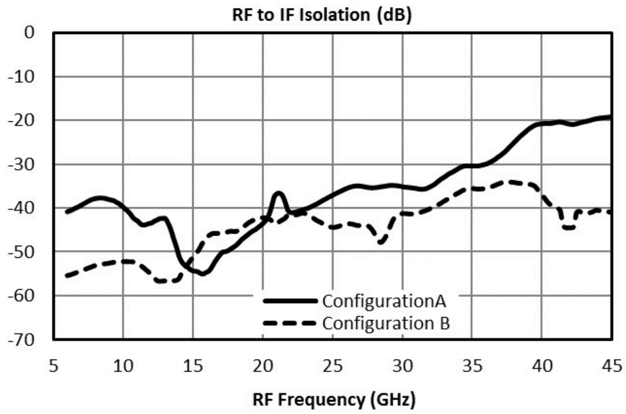

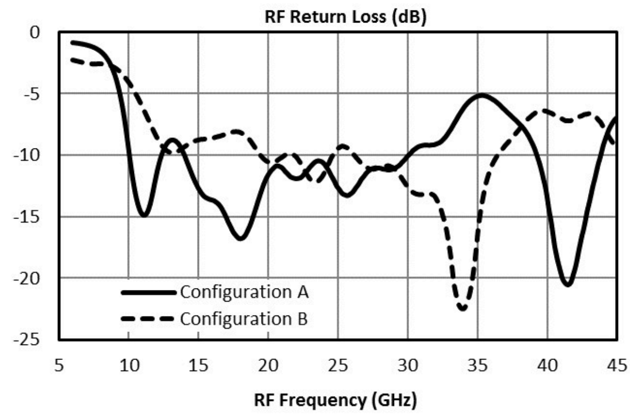

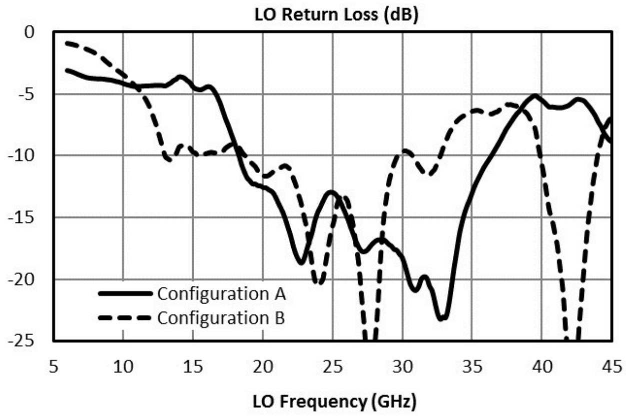

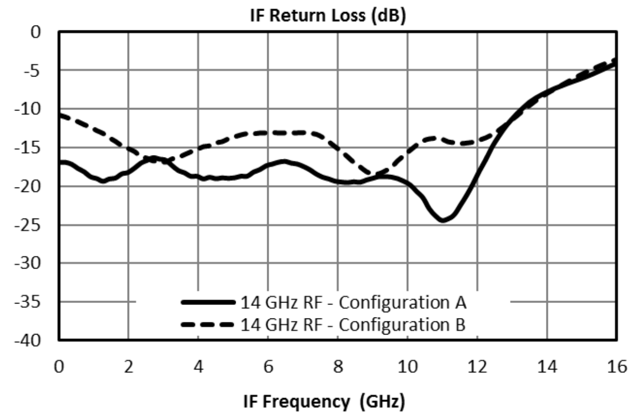

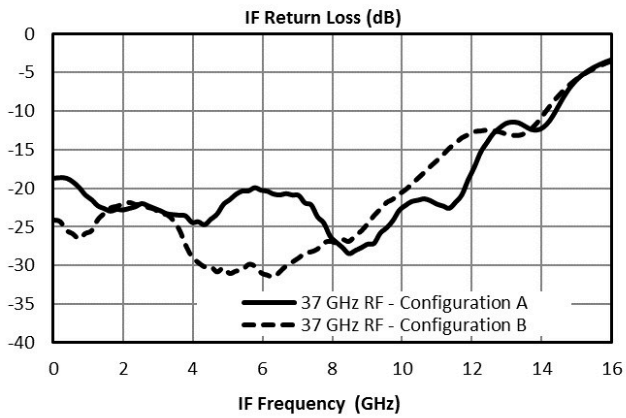

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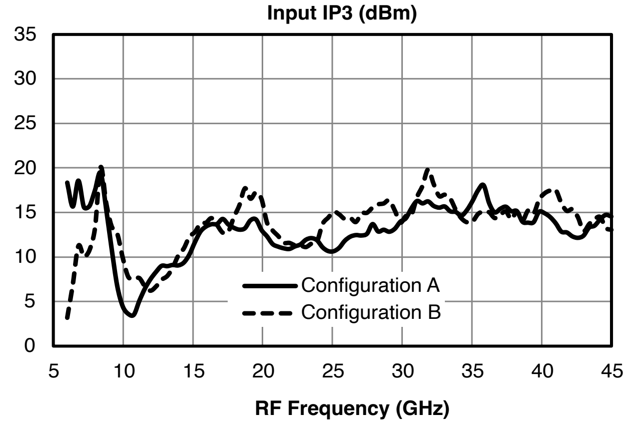
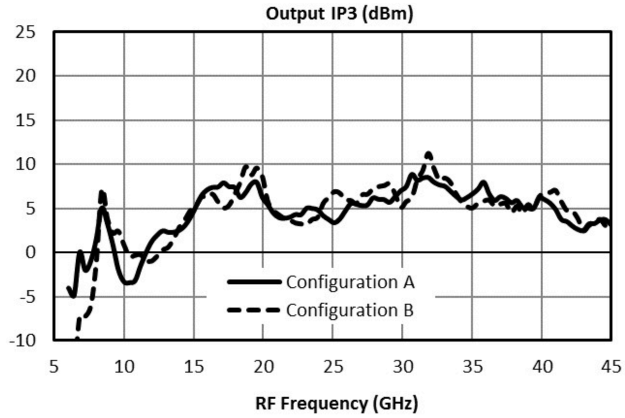
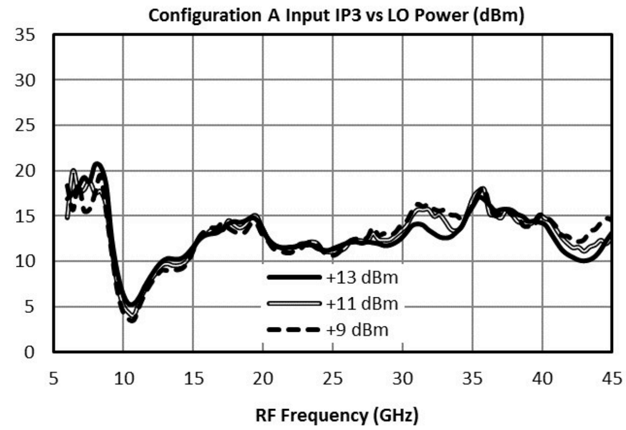
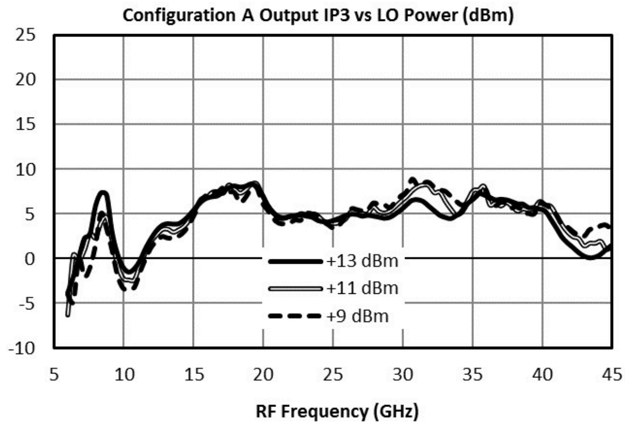
MM1-1044LS - Typical Performance Plots: IP3

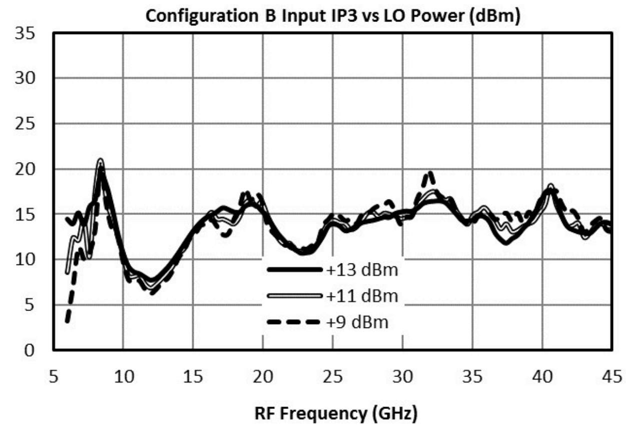
Performance plots for the connectorized module are shown for measurements where directly probed measurements of the die are unavailable. Note that the following measurements include losses from connectors and microstrip traces.

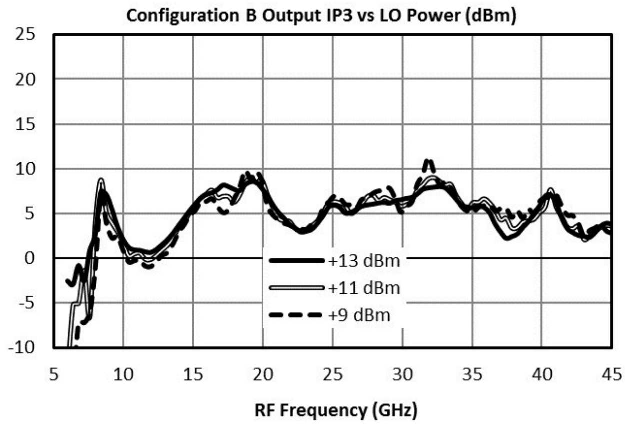












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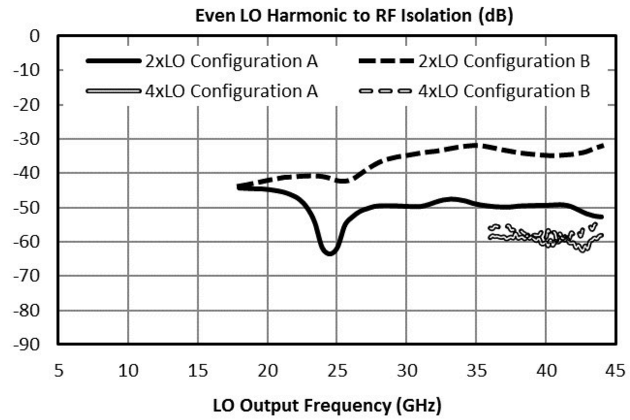
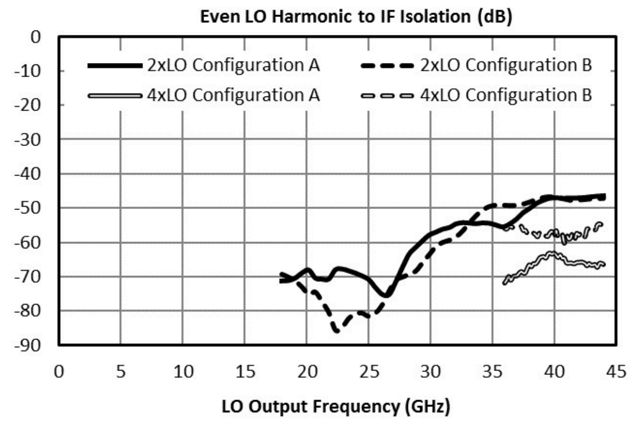
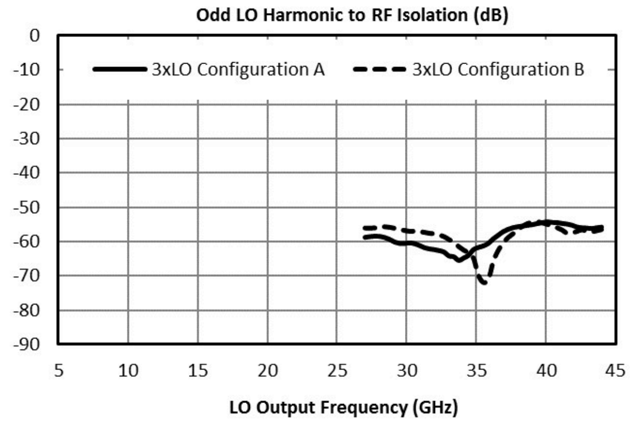
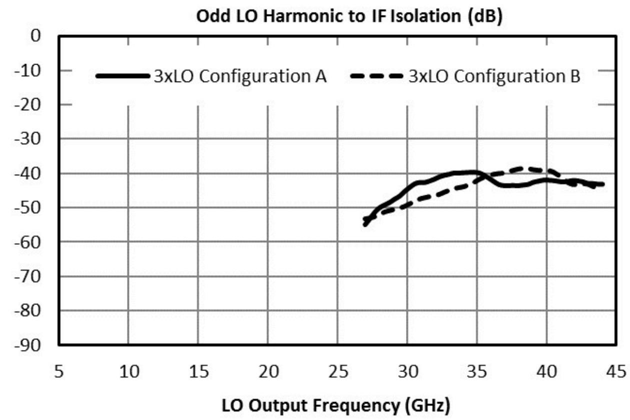
MM1-1044LS - Typical Performance Plots: LO Harmonic Isolation

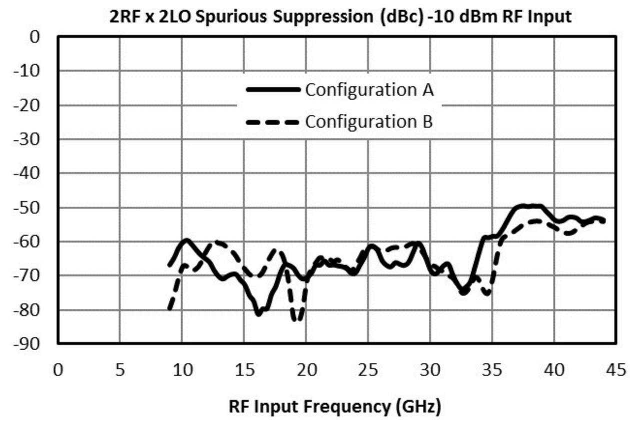
Performance plots for the connectorized module are shown for measurements where directly probed measurements of the die are unavailable. Note that the following measurements include losses from connectors and microstrip traces.

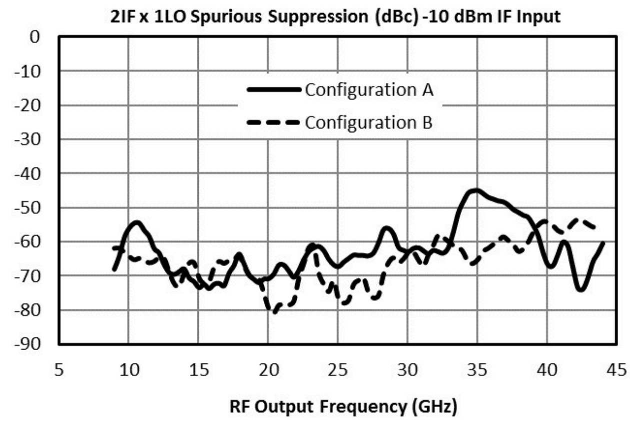












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Spur Table

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 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 2RF x 2LO spur is 64 dBc for a -10 dBm input, so a -20 dBm RF input creates a spur that is (2-1) x (-10 dB) lower, or 74 dBc. Data is shown for the frequency plan in 3.6 Typical Performance.

Typical Down-conversion spurious suppression (dBc): Config A (B)

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xRF	24 (21)	Reference	26 (40)	14 (14)	46 (40)	38 (32)
2xRF	74 (68)	52 (46)	64 (64)	61 (48)	68 (68)	59 (53)
3xRF	84 (83)	46 (49)	68 (82)	56 (58)	66 (79)	55 (56)
4xRF	107 (104)	92 (84)	93 (98)	93 (85)	100 (101)	97 (86)
5xRF	N/A	107 (103)	88 (105)	90 (94)	100 (114)	93 (96)

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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 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 62 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 72 dBc. Data is shown for the frequency plan in 3.6 Typical Performance.

Typical Up-conversion spurious suppression (dBc): Config A (B)

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xIF	24 (21)	Reference	28 (40)	15 (14)	46 (45)	20 (21)
2xIF	65 (58)	62 (66)	62 (46)	64 (69)	57 (49)	66 (75)
3xIF	73 (83)	53 (55)	61 (73)	50 (51)	62 (66)	58 (55)
4xIF	93 (90)	94 (99)	94 (84)	101 (99)	86 (86)	101 (103)
5xIF	116 (124)	87 (91)	99 (110)	84 (84)	101 (103)	81 (84)

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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.

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Handling Precautions

General Handling

Chips should be handled with care using tweezers or a vacuum collet. Users should take precautions to protect chips from direct human contact that can deposit contaminants, like perspiration and skin oils on any of the chip's surfaces.

Static Sensitivity

GaAs MMIC devices are sensitive to ESD 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.

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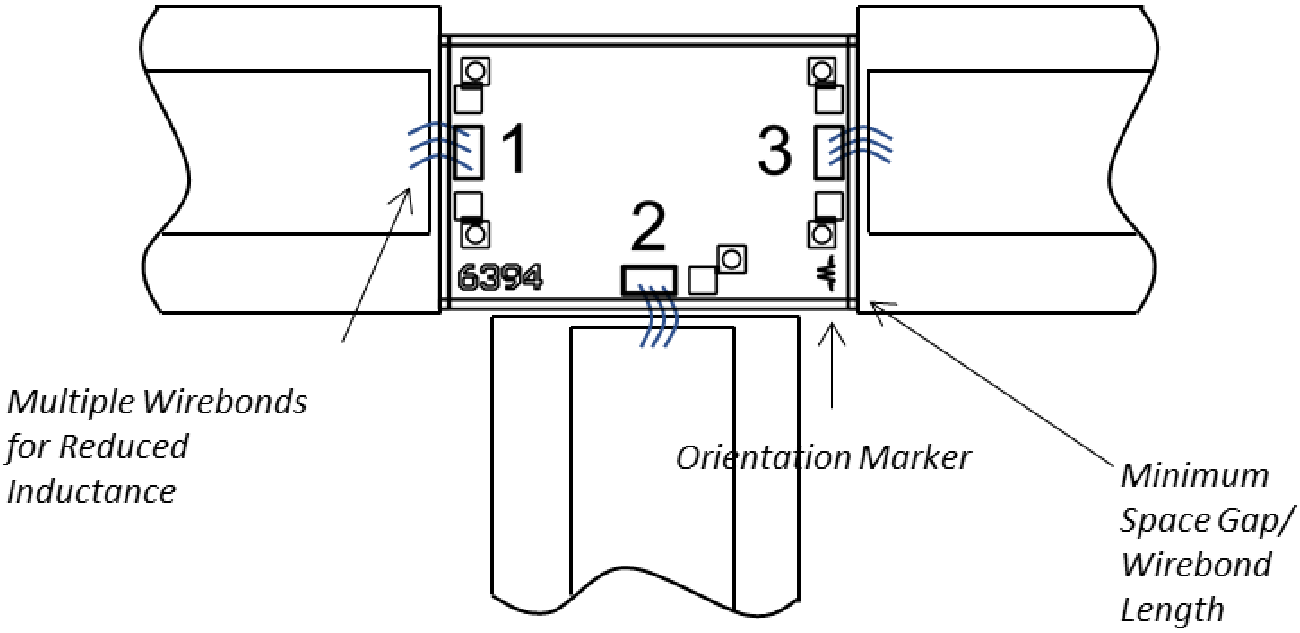
Bonding Diagram



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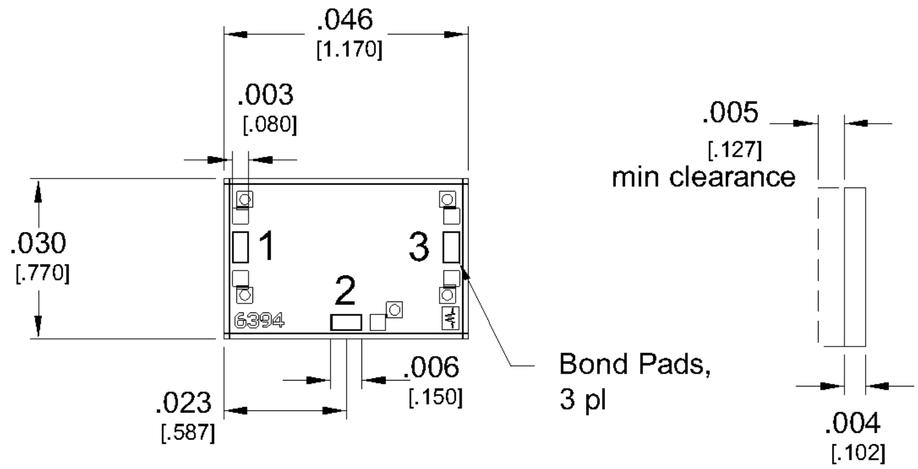
Mechanical Data

Outline Drawing

Download : Outline 2D Drawing

PROJECTION	REVISIONS			
INCH [MM]	REV.	DESCRIPTION	DATE	APPROVALS
	B	ECN 24096 remove gel-pak info.	10/17/24	AT

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



Notes:

1. CH substrate is .004 in Thick GaAs.
2. I/O trace is 4.2 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.

MATERIAL: 210-06394-R25	NOTES:	Marki microwave www.markimicrowave.com
FINISH:	DRAWN BY: JL / DATE: 01/25/2018	Outline MMIC Mixer
DO NOT SCALE DRAWING		SIZE: A / CAGE CODE: 0UC32 / DWG. NO. MM1-1044LCH-2
		SCALE 40/1 / SHEET 1 OF 1

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