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Tech Support: support@markimicrowave.com

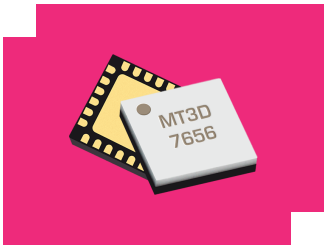
MT3D-0325HCSM-2

GaAs MMIC T3 Mixer with Differential IF

DEVICE OVERVIEW

General Description

MT3D-0325HCSM is a GaAs MMIC triple balanced mixer with high dynamic range and low conversion loss. This mixer belongs to the T3 family which offers high IP3, P1dB, and broad operating bandwidths for applications in the S through K bands. The MT3D-0325HCSM has on-chip baluns for the LO and RF ports, while offering differential ports on the IF for flexible operation with an external balun or differential interface. The MT3D-0325HCSM is available in a 4x4 mm¬ QFN package.



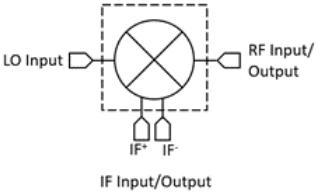
Features

- Low Conversion Loss
- Differential IF Ports
- High IP3
- Broad, Overlapping RF/LO & IF

Applications

- Test and Measurement Equipment
- SATCOM
- Radar
- Electronic Warfare

Functional Block Diagram



Part Ordering Options

Part Number	Description	Package	Green Status	Product Lifecycle	Export Classification
MT3D-0325HCSM-2	GaAs MMIC T3 Mixer with Differential IF	QFN	REACH RoHS	Released	EAR99
EVB-MT3D-0325HC	Evaluation Board, Passive GaAs MMIC 3 - 25 GHz T3 Mixer.	EVB	REACH RoHS	Released	EAR99

Table Of Contents

- **Device Overview**
  - General Description
  - Features
  - Applications
  - Functional Block Diagram
- **Port Configuration and Functions**
  - Port Diagram
  - Port Functions
- **Revision History**
- **Specifications**
  - Absolute Maximum Ratings
  - Package Information
  - Recommended Operating Conditions
  - Sequencing Requirements
  - Electrical Specifications
  - Typical Performance Plots
  - Typical Performance Plots: IP3, Sine Wave LO
  - Typical Performance Plots: IP3, Square Wave LO
  - Typical Performance Plots: Harmonic Isolations
  - Spur Tables
- **Operation**
  - Application Information
  - Application Circuit
  - Application Circuit Description
- **Mechanical Data**
  - Outline Drawing
- **Footprint Image**
- **Evaluation Board**
  - Evaluation Board Outline Drawing

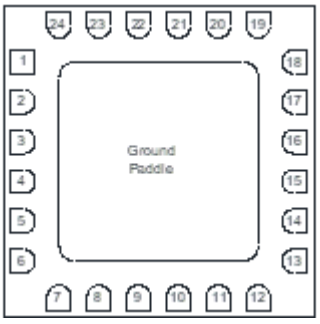
Revision History

Revision Code	Revision Date	Comment
-	2022-12-01	Datasheet Initial Release

Port Configuration and Functions

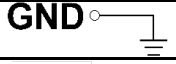
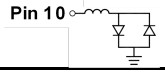
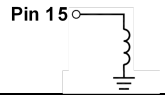
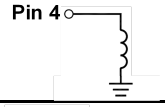
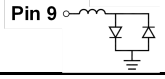
Port Diagram

A top-down x-ray view of the MT3D-0325HCSM's CSM package outline drawing is shown below. The MT3D-0325HCSM has the input and output ports given in Port Functions. The MT3D-0325HCSM can be used in either an up or down conversion application. Configuration A/B refer to the same part number used in one of two different ways for optimal spurious performance. For configuration A, input the LO into pin 4, use pin 15 for the RF. For configuration B, input the LO into pin 15, use pin 4 for the RF. Refer to Configuration A/B section for explanation of Configuration A and B operation.

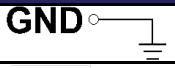
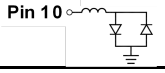
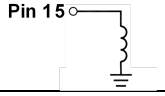
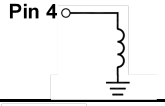
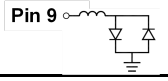


Port Functions

Configuration A

Port	Function	Description	DC Equivalent Circuit
GND	Ground	CSM package ground path is provided through the ground paddle.	
Pin 10	IFP	Pin 10 is DC coupled to the diodes.	
Pin 15	RF	Pin 15 is DC short for the CSM package.	
Pin 4	LO	Pin 4 is DC short for the CSM package.	
Pin 9	IFN	Pin 9 is DC coupled to the diodes.	

Configuration B

Port	Function	Description	DC Equivalent Circuit
GND	Ground	CSM package ground path is provided through the ground paddle.	
Pin 10	IFP	Pin 10 is DC coupled to the diodes.	
Pin 15	LO	Pin 15 is DC short for the CSM package.	
Pin 4	RF	Pin 4 is DC short for the CSM package.	
Pin 9	IFN	Pin 9 is DC coupled to the diodes.	

Specifications

Absolute Maximum Ratings

The Absolute Maximum Ratings indicate limits beyond which damage may occur to the device. All limits are unique and should not be met in parallel. 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	-40	°C
Minimum Storage Temperature	-40	°C
Pin 10 DC Current	30	mA
Pin 9 DC Current	30	mA
Power Handling, at any Port	27	dBm

Package Information

Parameter	Details	Rating
ESD	250 to < 500 Volts	HBM Class 1A
Weight	Package name: QFN	0.04g
Dimensions	-	4 x 4 mm
Moisture Sensitivity Level	-	MSL 1

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	-40	25	100	°C
LO Input Power	17	20	23	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.

Electrical Specifications

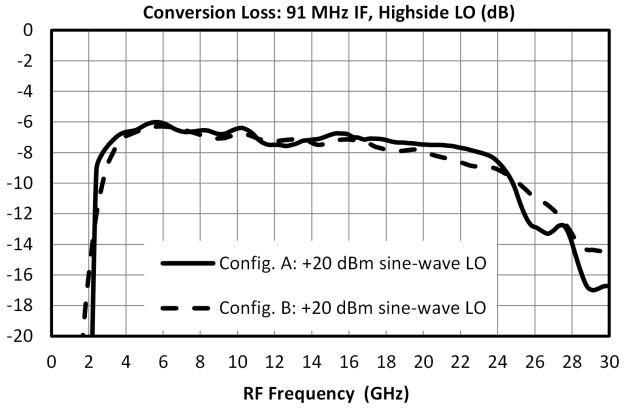
The electrical specifications apply at TA=+25°C in a 50Ω system. Typical data shown is for the connectorized EVAL package mixer† used with a +20 dBm sine wave LO. Typical IP3 data shown for a +20 dBm square wave LO. Specifications shown for configuration A (B). Min and Max limits apply only to our connectorized units and are guaranteed at TA=+25°C.

Parameter	Port Configuration	Test Conditions	Min	Typ	Max	Unit
Conversion Loss [1]	A	RF/LO=3-25GHz I=91MHz	-	7.8	13	dB
Input 1 dB Gain Compression Point (P1dB)	A	-	-	17	-	dBm
Input IP3 [2]	A	RF/LO=3-25GHz I=91MHz	-	25	-	dBm
Isolation, LO to IF	A	RF/LO=3-25GHz	-	43	-	dB
Isolation, LO to RF	A	RF/LO=3-25GHz	-	33	-	dB
Isolation, RF to IF	A	RF/LO=3-25GHz	-	43	-	dB
Noise Figure [3]	A	RF/LO=3-25GHz I=91MHz	-	8	-	dB
Conversion Loss [4]	B	RF/LO=3-25GHz I=91MHz	-	8	12.5	dB
Input 1 dB Gain Compression Point (P1dB)	B	-	-	17	-	dBm
Input IP3 [5]	B	RF/LO=3-25GHz I=91MHz	-	29	-	dBm
Isolation, LO to IF	B	RF/LO=3-25GHz	-	45	-	dB
Isolation, LO to RF	B	RF/LO=3-25GHz	-	34	-	dB
Isolation, RF to IF	B	RF/LO=3-25GHz	-	44	-	dB
Noise Figure [6]	B	RF/LO=3-25GHz I=91MHz	-	8.5	-	dB
IF Frequency Range [7]	-	-	0	-	6	GHz
IF (Pin 10) Frequency Range [8]	-	-	0	-	6	GHz
LO Frequency Range	-	-	3	-	25	GHz
RF Frequency Range	-	-	3	-	25	GHz

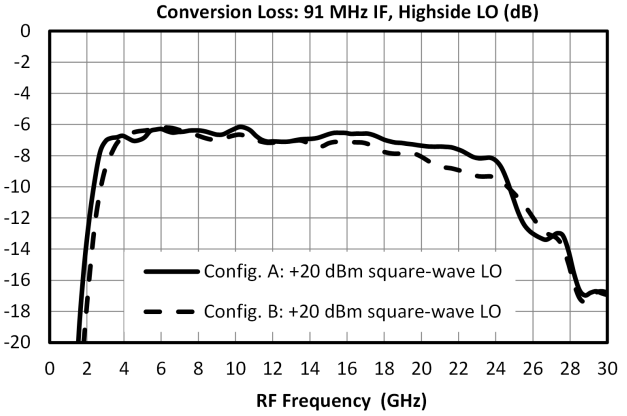
[1][4] Measured as a down converter to a fixed 91 MHz IF. Unless otherwise stated, frequency conversion done using a highside LO.
[2][5] IP3 depends on LO drive condition. Reported table value is measured with a square wave LO generated from the ADM1-0026PA with a +5 dBm input. LO Power reported in plots is of the fundamental tone only. Square wave LO power in plots is stepped down using broadband DC-40 GHz attenuators.
[3][6] Mixer Noise Figure typically measures within 0.5 dB of conversion loss for IF frequencies greater than 5 MHz.
[7][8] IF range max value is determined by off-chip balun. Contact support@markimicrowave.com for details.

Typical Performance Plots

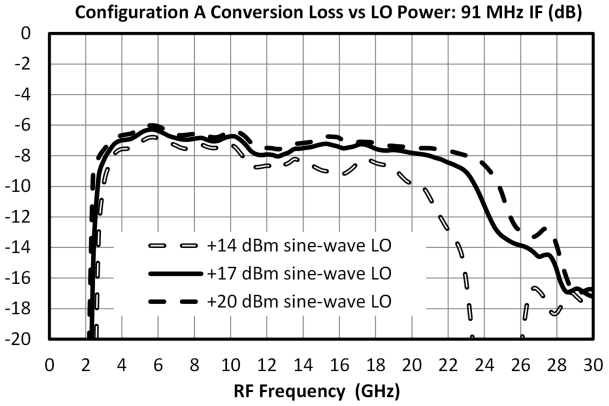
Conversion Loss: 91 MHz IF, Highside LO (dB)



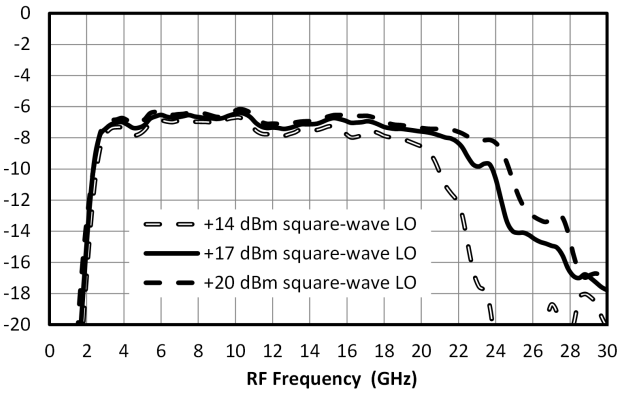
Conversion Loss: 91 MHz IF, Highside LO (dB)



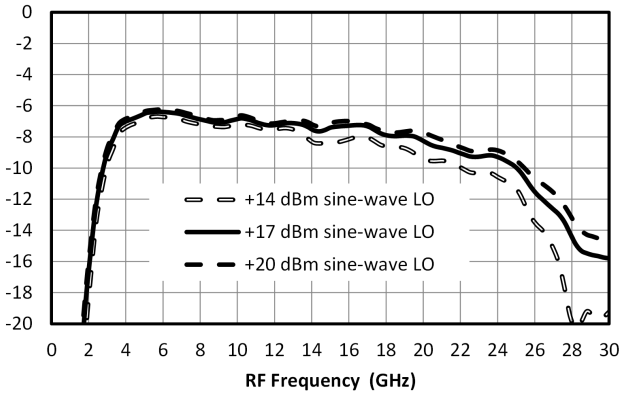
Configuration A Conversion Loss vs LO Power: 91 MHz IF (dB)



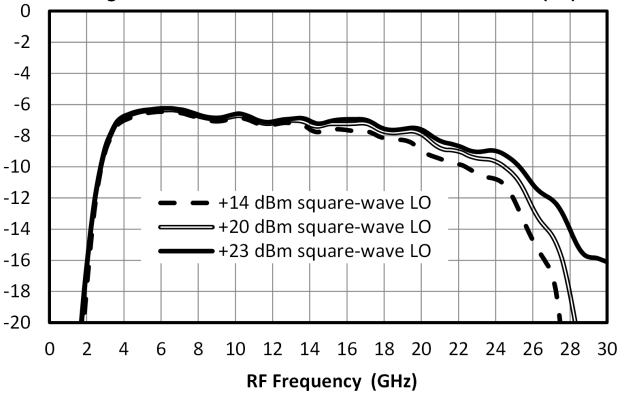
Configuration A Conversion Loss vs LO Power: 91 MHz IF (dB)



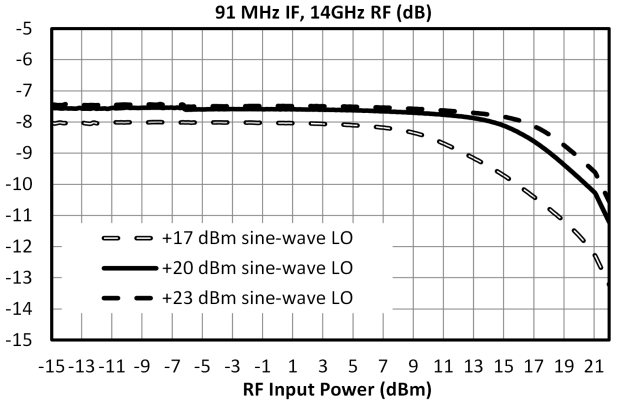
Configuration B Conversion Loss vs LO Power: 91 MHz IF (dB)



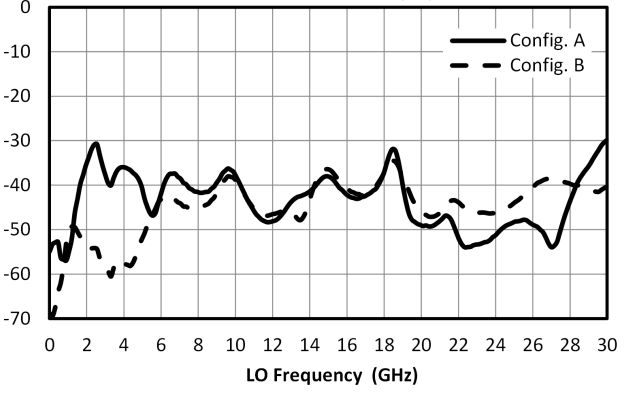
Configuration B Conversion Loss vs LO Power:91 MHz IF (dB)



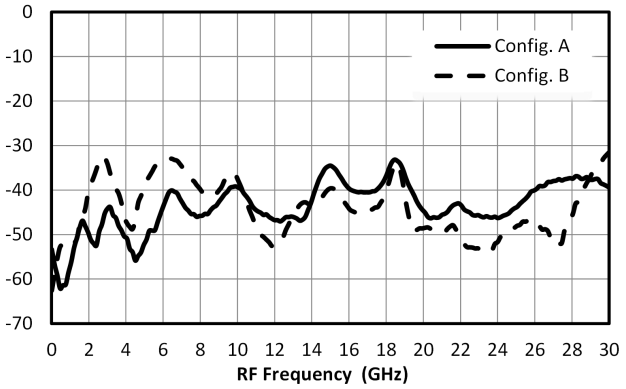
Conversion Loss vs RF Input Power w/ Various LO Drive: 91 MHz IF, 14GHz RF (dB)



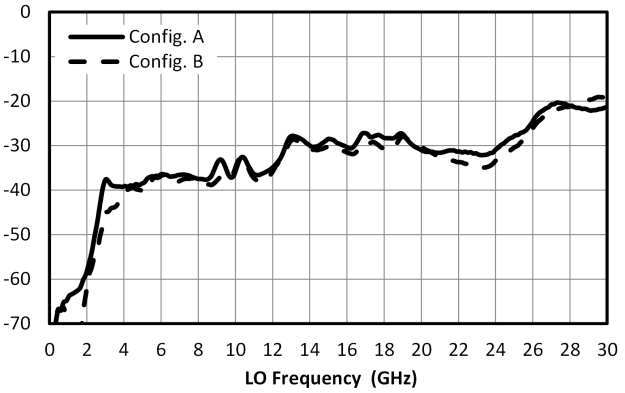
LO to IF Isolation (dB)



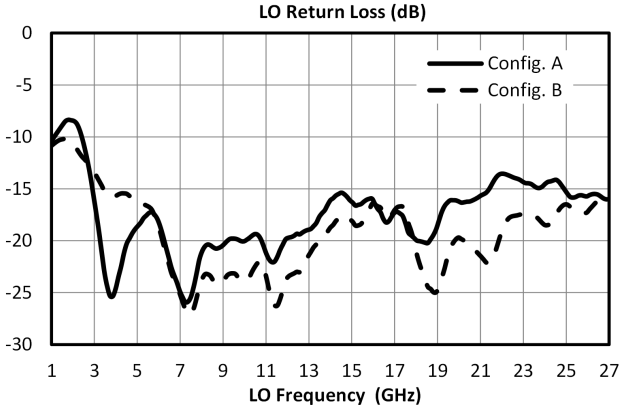
RF to IF Isolation (dB)



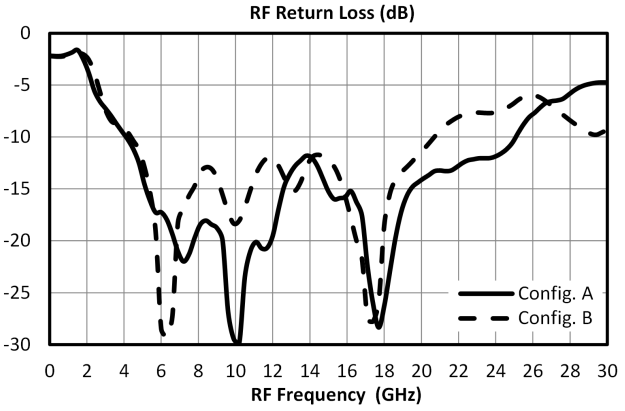
LO to RF Isolation (dB)



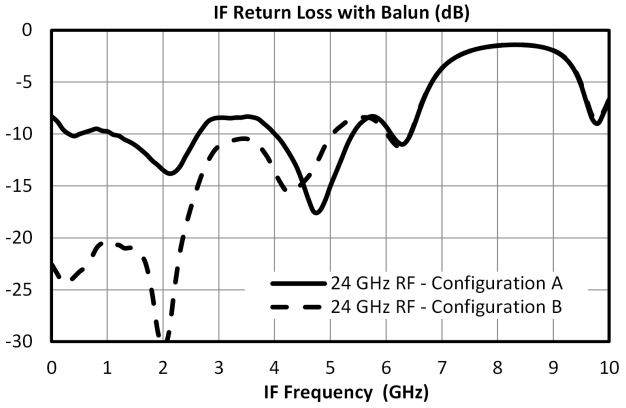
LO Return Loss (dB)



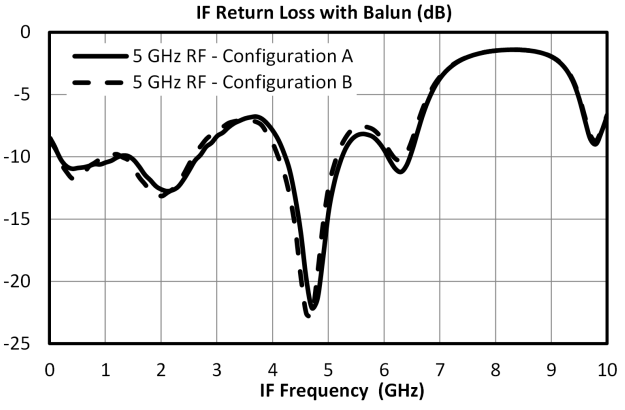
RF Return Loss (dB)



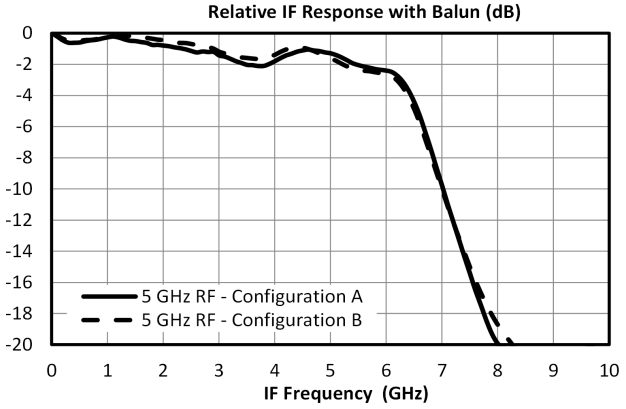
IF Return Loss with Balun (dB)



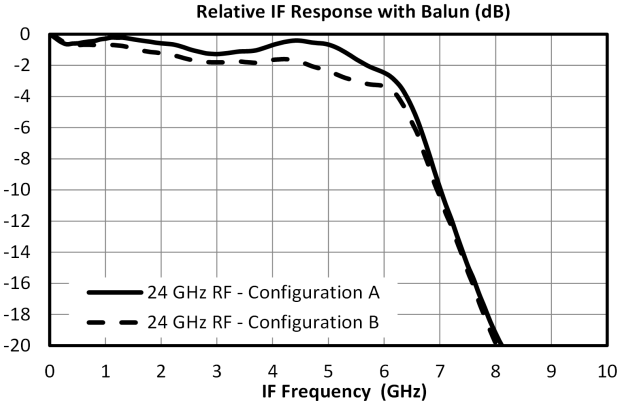
IF Return Loss with Balun (dB)



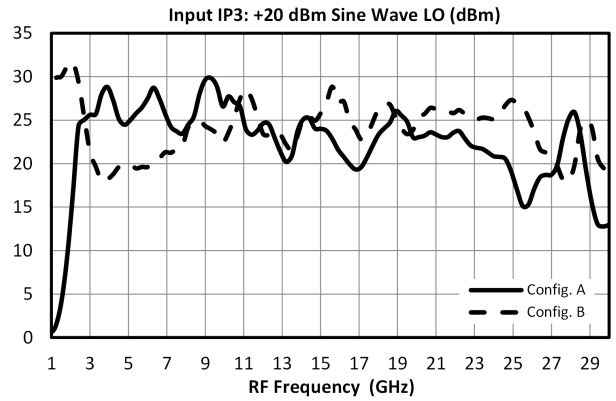
Relative IF Response with Balun (dB)

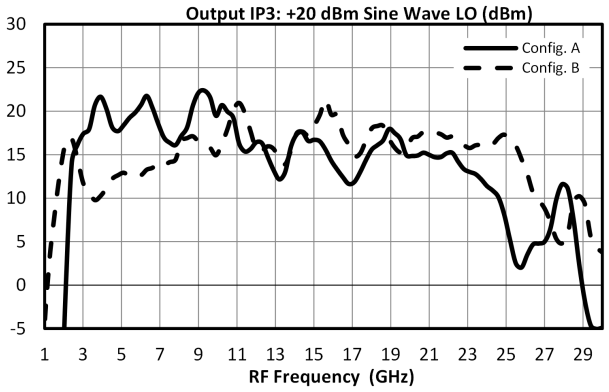


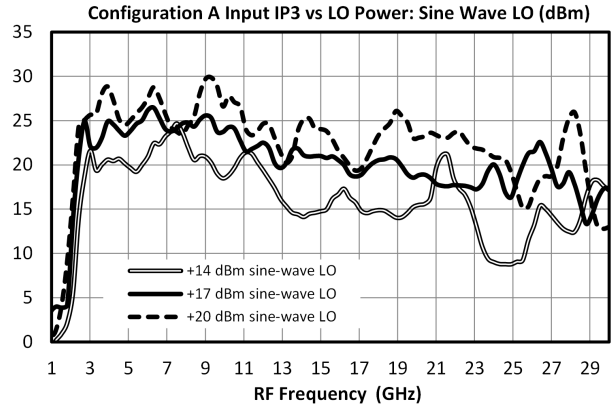
Relative IF Response with Balun (dB)

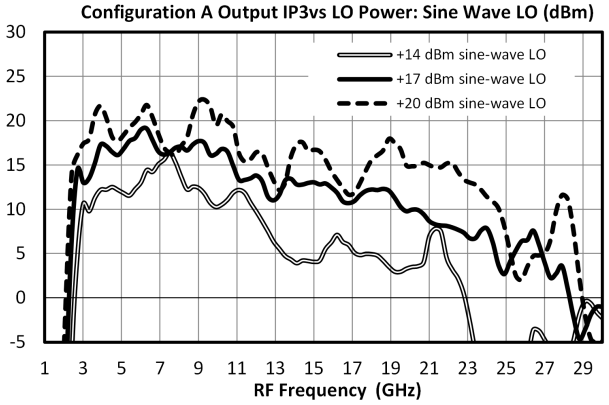


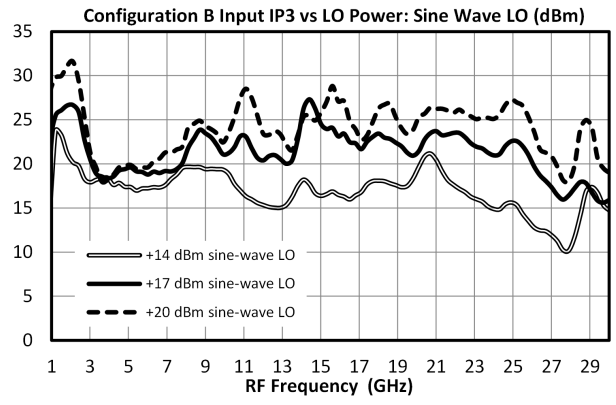
Typical Performance Plots: IP3, Sine Wave LO

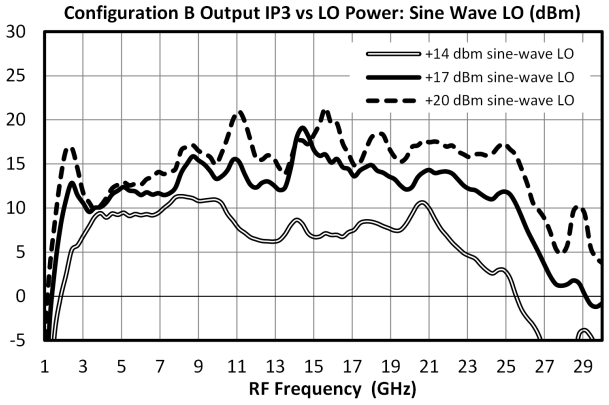






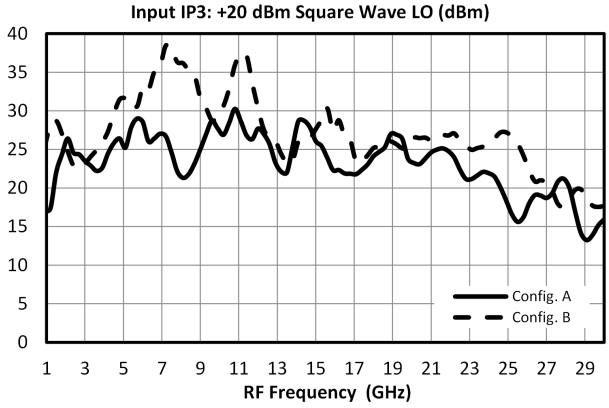




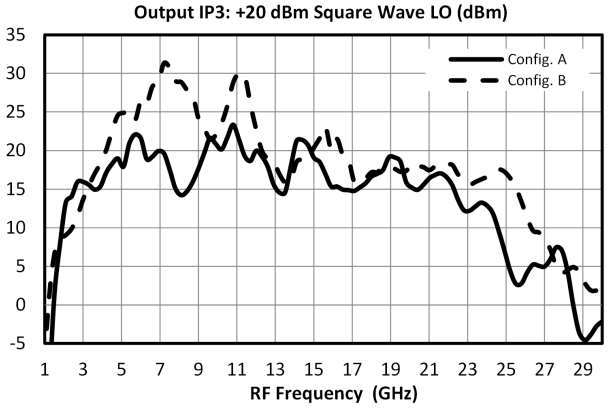


Typical Performance Plots: IP3, Square Wave LO

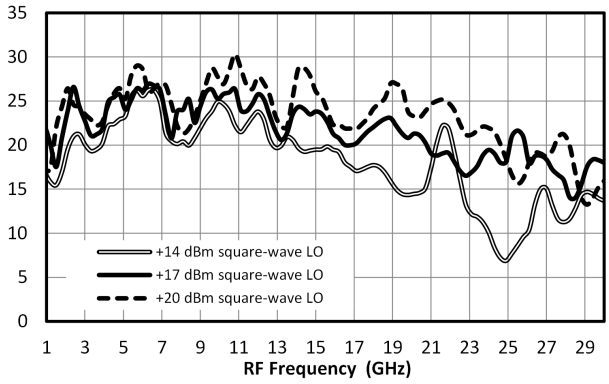
Input IP3: +20 dBm Square Wave LO (dBm)



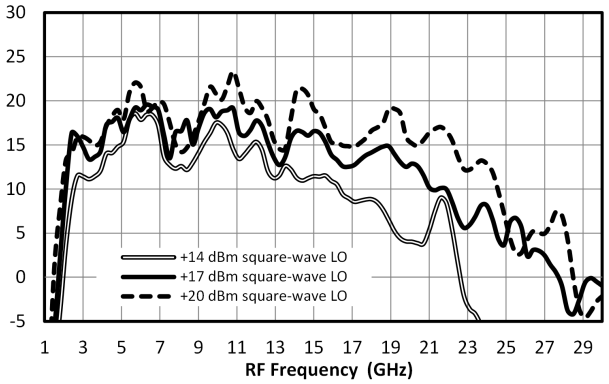
Output IP3: +20 dBm Square Wave LO (dBm)



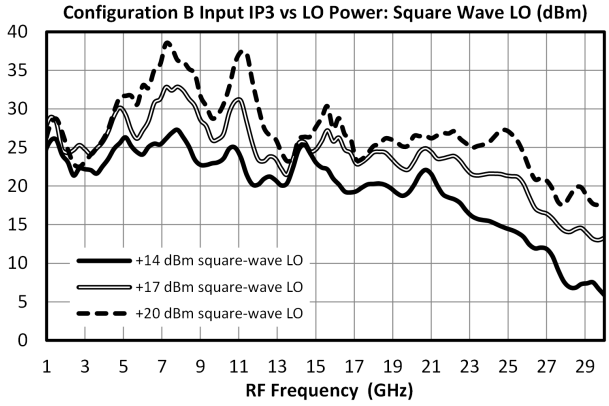
Configuration A Input IP3 vs LO Power: Square Wave LO (dBm)



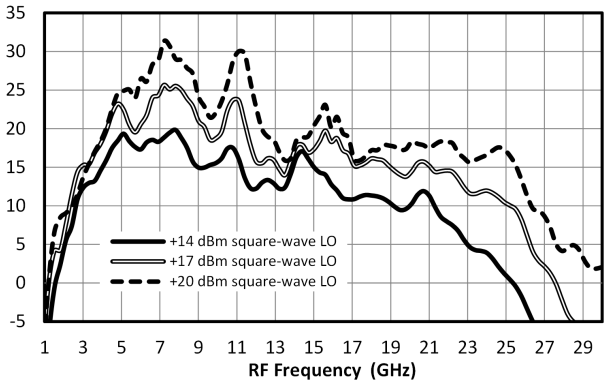
Configuration A Output IP3 vs LO Power: Square Wave LO (dBm)



Configuration B Input IP3 vs LO Power: Square Wave LO (dBm)

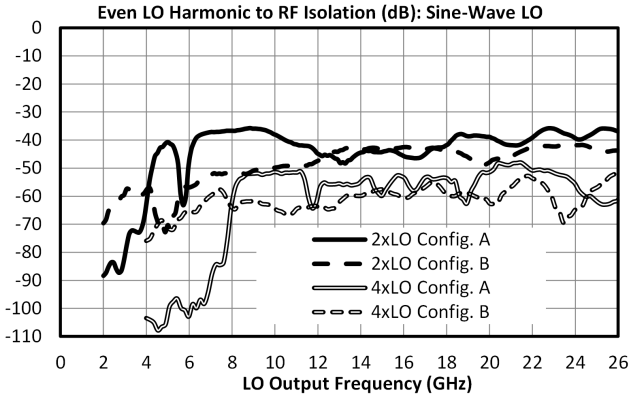


Configuration B Output IP3 vs LO Power: Square Wave LO (dBm)

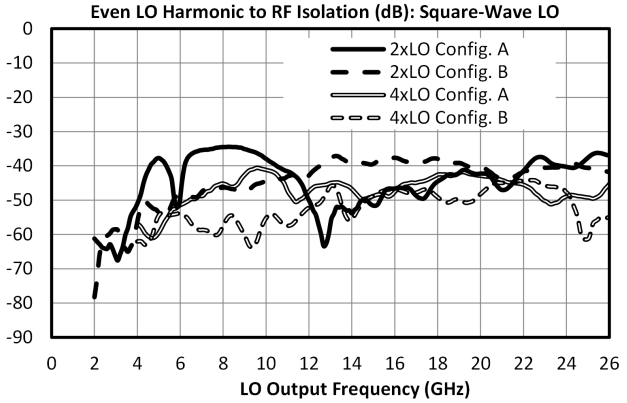


Typical Performance Plots: Harmonic Isolations

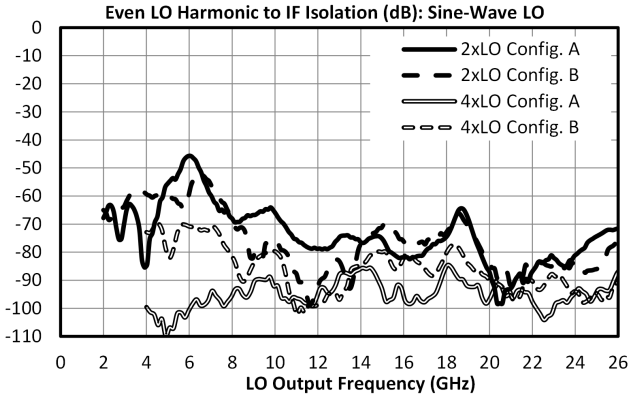
Even LO Harmonic to RF Isolation (dB): Sine-Wave LO



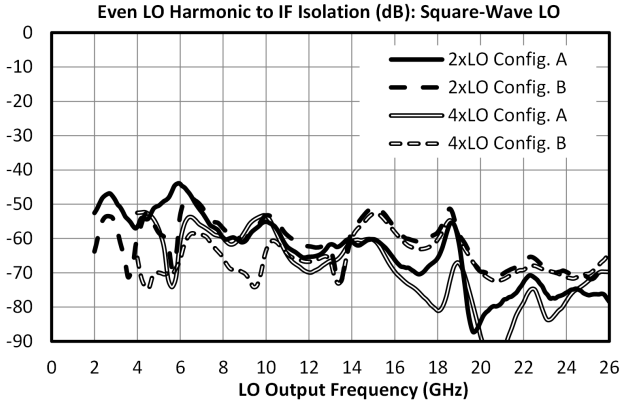
Even LO Harmonic to RF Isolation (dB): Square-Wave LO



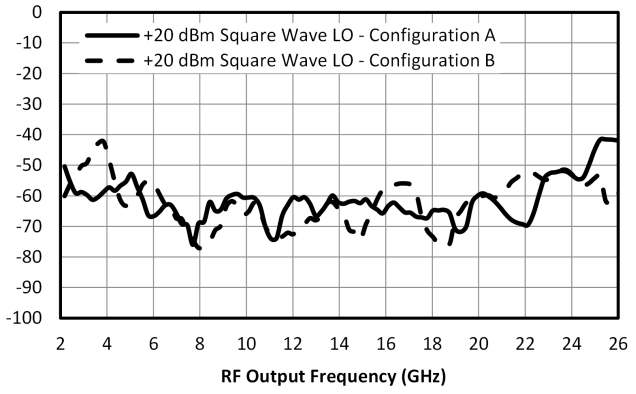
Even LO Harmonic to IF Isolation (dB): Sine-Wave LO



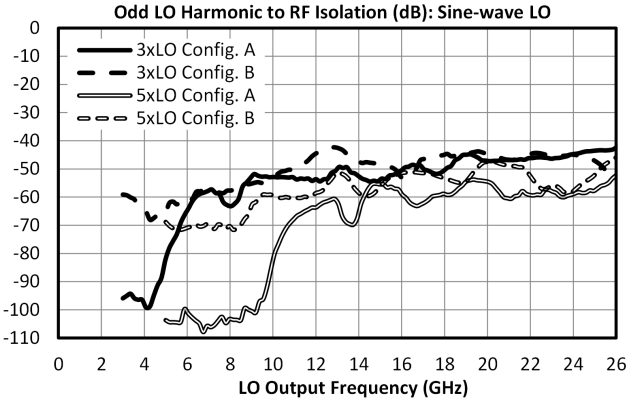
Even LO Harmonic to IF Isolation (dB): Square-Wave LO



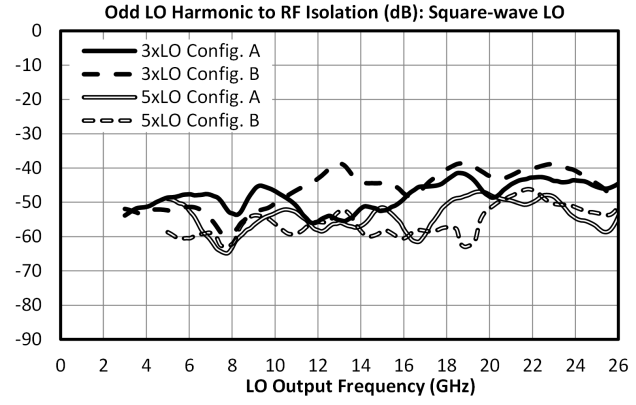
2IF x 1LO Spurious Suppression, -10 dBm IF Input (dBc)



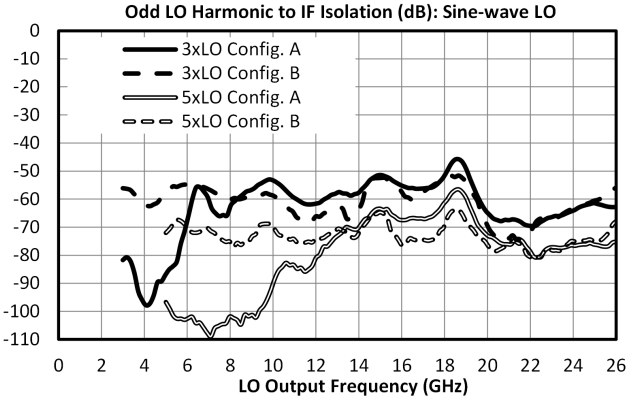
Odd LO Harmonic to RF Isolation (dB): Sine-wave LO

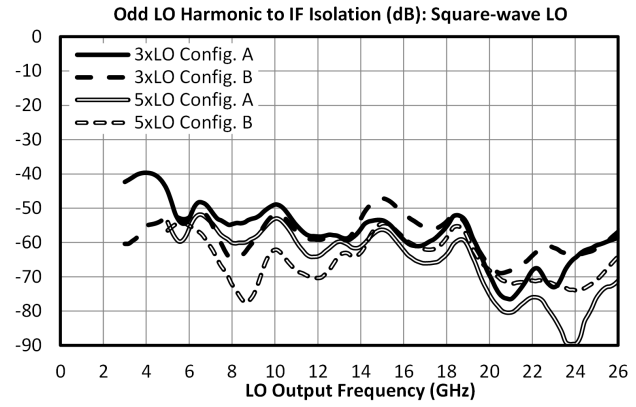


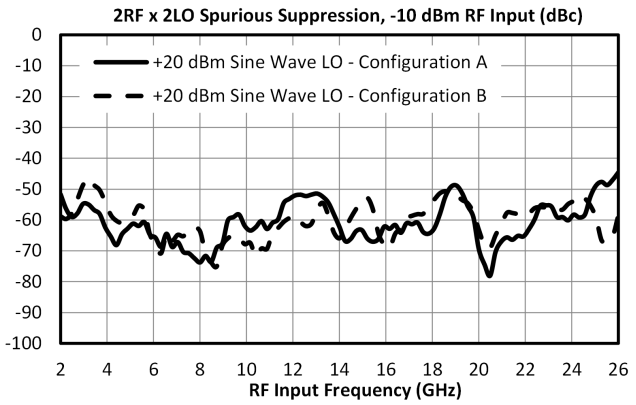
Odd LO Harmonic to RF Isolation (dB): Square-wave LO

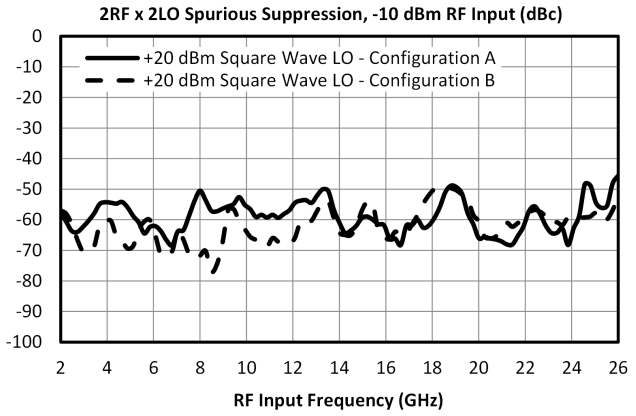


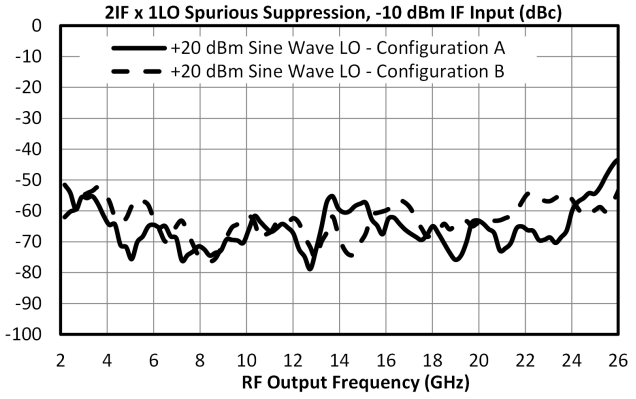
Odd LO Harmonic to IF Isolation (dB): Sine-wave LO











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 63 dBcfor a -10 dBm input, so a -20 dBm RF input creates a spur that is (2-1) x (-10 dB) lower, or 73 dBc. Data is shown for the frequency plan inTypical Performance section. mLOx0RF plots can be found in Harmonic Isolations section.

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

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xRF	35 (35)	Reference	36 (28)	20 (15)	43 (33)	17 (28)
2xRF	87 (84)	58 (61)	63 (63)	63 (60)	61 (64)	64 (64)
3xRF	111 (110)	72 (78)	84 (75)	76 (76)	86 (79)	75 (72)
4xRF	127 (125)	96 (106)	104 (105)	103 (109)	104 (107)	105 (105)
5xRF	137 (135)	116 (126)	123 (124)	118 (121)	123 (123)	121 (121)

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

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xRF	35 (34)	Reference	16 (13)	19 (16)	17 (16)	19 (32)
2xRF	85 (85)	54 (64)	63 (62)	61 (58)	59 (60)	61 (59)
3xRF	106 (110)	74 (82)	79 (81)	73 (81)	82 (81)	77 (76)
4xRF	124 (125)	99 (109)	102 (110)	104 (110)	104 (109)	104 (106)
5xRF	133 (135)	118 (122)	120 (125)	120 (126)	123 (125)	120 (125)

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 65 dBcfor 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 75 dBc. Data is shown for the frequency plan inTypical Performance section.

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

-10 dBm IF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xIF	28 (29)	Reference	37 (30)	20 (15)	42 (36)	17 (28)
2xIF	60 (70)	65 (66)	63 (59)	68 (67)	61 (58)	61 (64)
3xIF	92 (89)	82 (80)	87 (84)	78 (74)	86 (86)	71 (73)
4xIF	115 (121)	115 (113)	109 (108)	113 (111)	103 (107)	104 (105)
5xIF	129 (131)	130 (127)	130 (131)	124 (124)	125 (126)	118 (120)

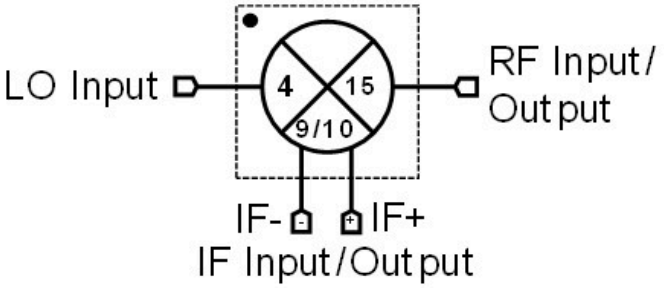
Typical Up-conversion spurious suppression square wave (dBc): Config A (B)

-10 dBm IF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xIF	35 (22)	Reference	16 (12)	18 (15)	19 (16)	18 (29)
2xIF	60 (70)	64 (62)	61 (63)	60 (64)	59 (63)	59 (59)
3xIF	98 (100)	82 (81)	80 (84)	77 (79)	78 (74)	76 (76)
4xIF	117 (121)	112 (108)	103 (108)	104 (107)	104 (102)	101 (100)
5xIF	129 (131)	128 (127)	124 (124)	121 (124)	125 (118)	120 (114)

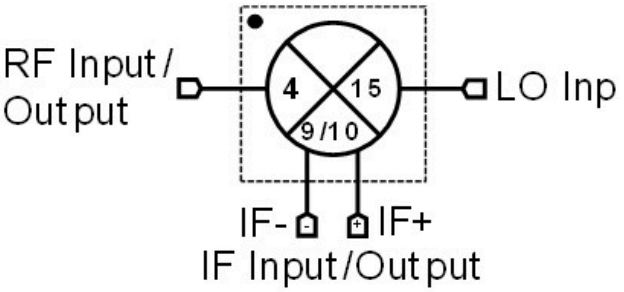
Application Information

Configuration A/B

Configuration A and Configuration B refer to the same part number used in one of two different ways to optimize spurious performance while balancing other parameters such as conversion loss, LO drive, and isolation. Experimentation or simulation is required to determine which configuration results in optimal spurious suppression for a given application.

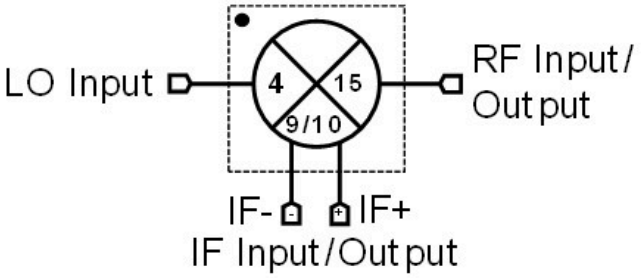


Configuration A

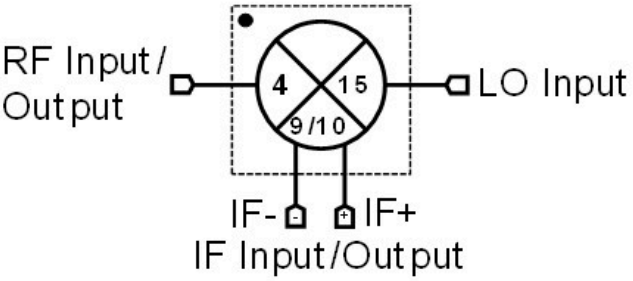


Configuration B

Application Circuit



Configuration A



Configuration B

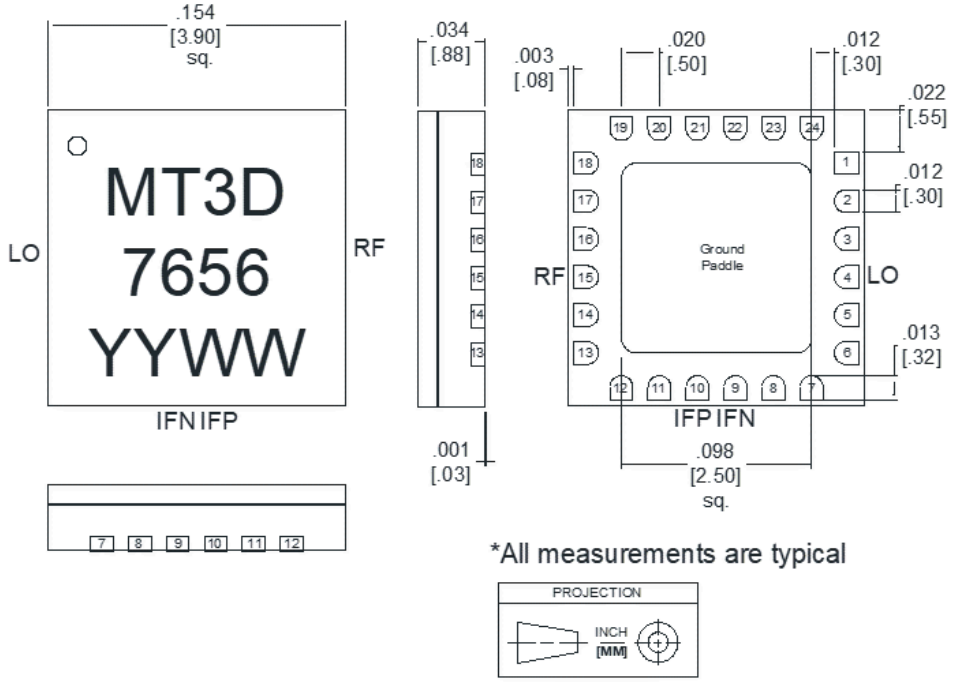
Application Circuit Description

A top-down view of the MT3D-0325HCSM's CSM package outline drawing is shown in Configuration A.

Mechanical Data

Outline Drawing

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



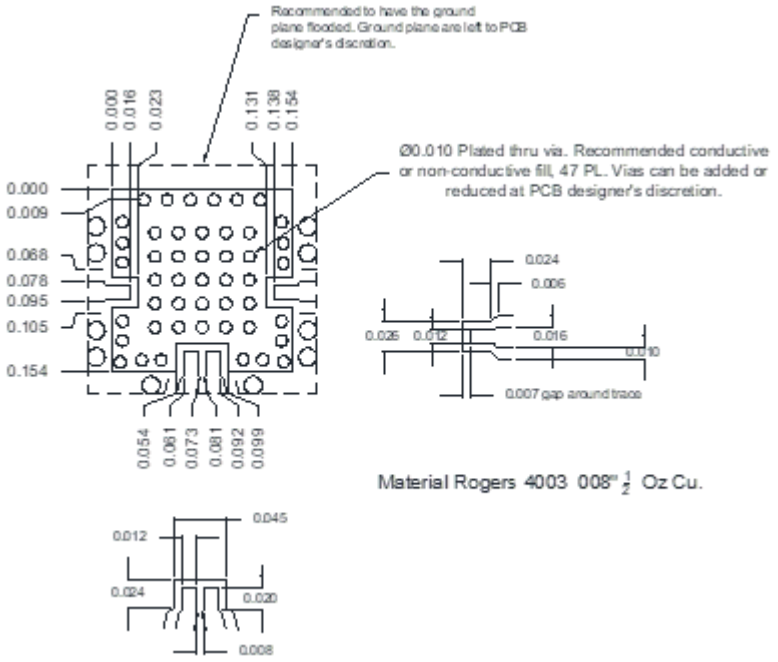
Pin #	Config A	Config B
1	N/C	N/C
2	N/C	N/C
3	N/C	N/C
4	LO	RF
5	N/C	N/C
6	N/C	N/C
7	N/C	N/C
8	N/C	N/C
9	IFN	IFN
10	IFP	IFP
11	N/C	N/C
12	N/C	N/C
13	N/C	N/C
14	N/C	N/C
15	RF	LO
16	N/C	N/C
17	N/C	N/C
18	N/C	N/C
19	N/C	N/C
20	N/C	N/C
21	N/C	N/C
22	N/C	N/C
23	N/C	N/C
24	N/C	N/C

1. Substrate material is ceramic.
2. All unconnected pads should be connected to PCB RF ground.
3. I/O Leads and Ground Paddle plating is (from base to finish):

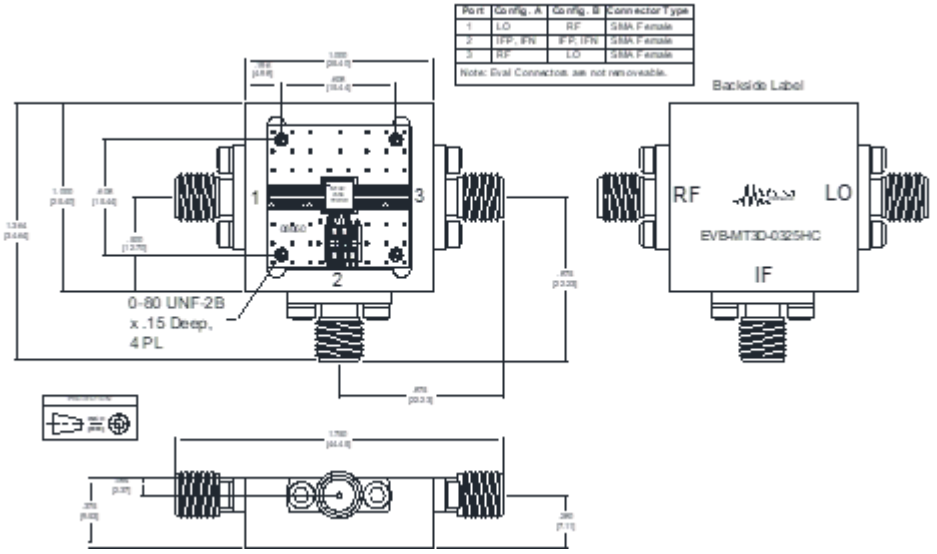
Ni:	8.89um MAX	1.27um MIN
Pd:	0.17um MAX	0.07um MIN
Au	0.254um MAX	0.03um MIN

Footprint Image

Download : Footprint Drawing



Evaluation Board - Outline Drawing



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