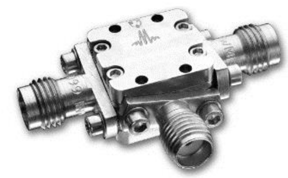
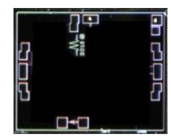
GaAs MMIC High Dynamic Range Mixer **MT3H-0113L**

The MT3H-0113L is a triple balanced passive diode mixer offering high dynamic range, low conversion loss, and excellent repeatability. As with all T3 mixers, this mixer offers unparalleled nonlinear performance in terms of IIP3, P_{1dB}, and spurious performance with a flexible LO drive requirement from +7 dBm to +15 dBm. RF, LO, and IF ports are all operated single ended due to integrated baluns. The MT3H-0113L is available as a wire bondable chip or an SMA connectorized package. The MT3H-0113L is a superior alternative to Marki Microwave carrier and packaged T3 mixers. If >+16dBm LO power is available, the higher barrier MT3H-0113H is recommended.





Features

- Broadband, Overlapping RF, LO and IF
- RoHS Compliant
- Square-Wave LO delivers Industry-Leading Spurious, IP3, and P_{1dB} Performance
- Application Note: T3 Mixer Primer
- Recommended Surface Mount Amplifier: ADM-0026-5929SM, ADM-0012-5931SM
- Recommended Amplifier Modules: ADM1-0026PA

Electrical Specifications - Specifications guaranteed from -55 to +100°C, measured in a 50Ω system. Specifications are shown for Configurations A (B). See page 2 for port locations. All bare die are 100% DC tested and 100% visually inspected. RF testing is performed on a sample basis to verify conformance to datasheet guaranteed specifications. Consult factory for more information.

Parameter	LO (GHz)	RF (GHz)	IF (GHz)	Min	Typ	Max	LO drive level (dBm)
Conversion Loss (dB) [1]	1.5-13	1.5-13	0.8-1		8	11	+15
			1-8.5		11.5		
Isolation (dB) LO-RF LO-IF RF-IF			0.8-8.5		See Plots		Config. A: +7 to +15 Config. B: +7 to +15
Input 1 dB Compression (dBm)					See Plots See Plots		
Input Two-Tone Third Order Intercept Point (dBm) [2]					+20 +22		

[1] Measured Conversion Loss measured at 1 GHz fixed IF

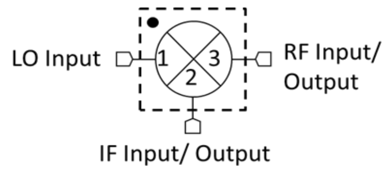
[2] IP3 depends on LO drive conditions, see plots for more details

Part Number Options

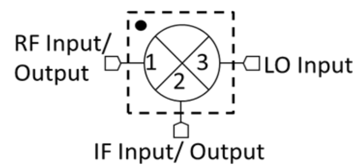
Please specify diode level and package style by adding to model number.				
Package Styles		**Examples**		
Connectorized[1, 3]	S	MT3H-0113LCH-2, MT3H-0113LS		
Chip[2, 3] (RoHS)	CH-2	MT3H-0113 (Model)	L (Diode Option)	CH-2 (Package)

[1] Connectorized package consists of chip package wire bonded to a substrate, equivalent to an evaluation board.
[2] Chip package connects to external circuit through wire bondable gold pads.
[3] Note: For port locations and I/O designations, refer to the drawings on page 2 of this document.

215 Vineyard Court, Morgan Hill, CA 95037 | Ph: 408.778.4200 | Fax 408.778.4300 | info@markimicrowave.com



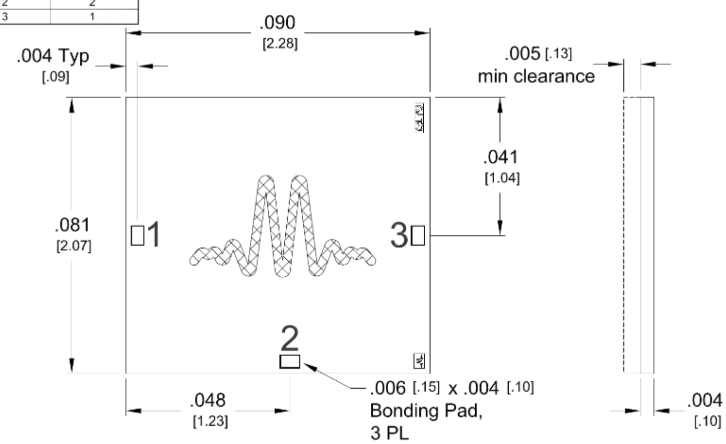
Configuration A



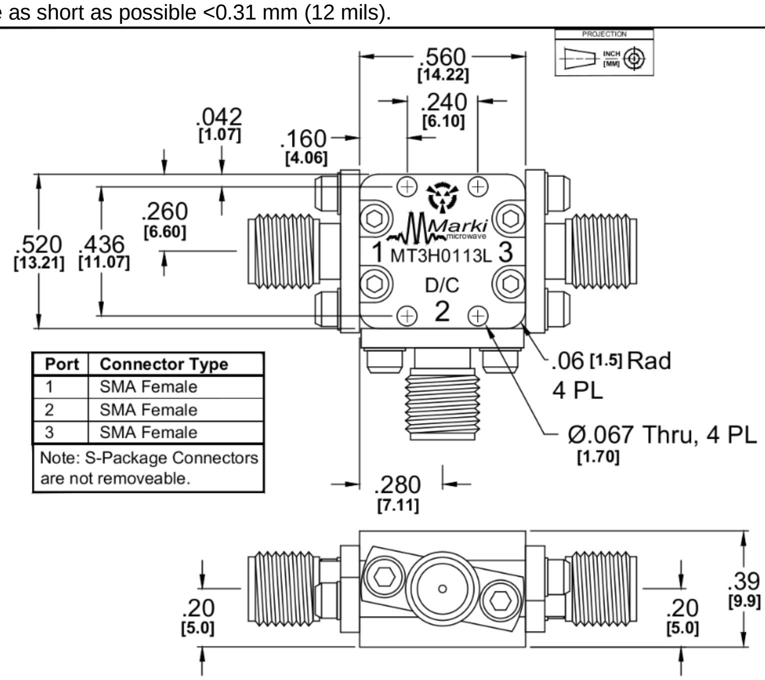
Configuration B

1. Configuration A/B refer to the same part number (MT3H-0113L) 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. For more information, see here.

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



1. CH Substrate material is .004 thick GaAs.
2. I/O traces finish is 2.6 microns Au. Ground finish is 5 microns Au.
3. 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).



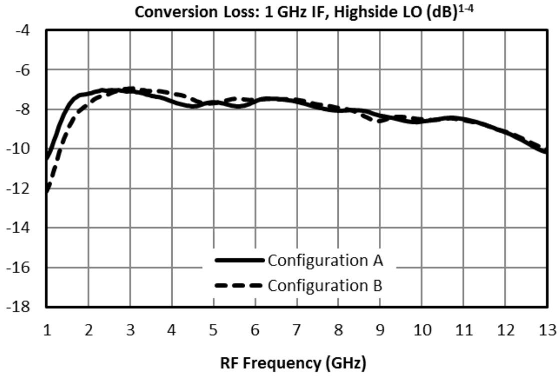
Port	Connector Type
1	SMA Female
2	SMA Female
3	SMA Female

Note: S-Package Connectors are not removeable.

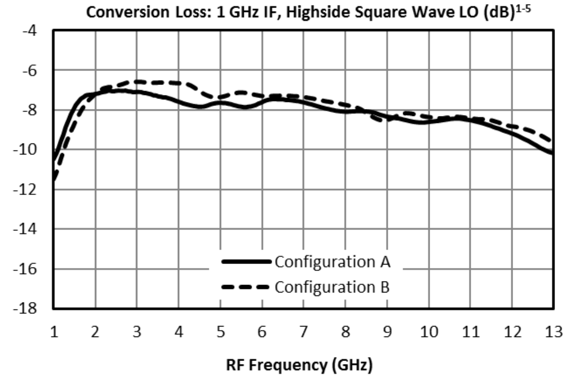
215 Vineyard Court, Morgan Hill, CA 95037 | Ph: 408.778.4200 | Fax 408.778.4300 | info@markimicrowave.com

Typical Performance

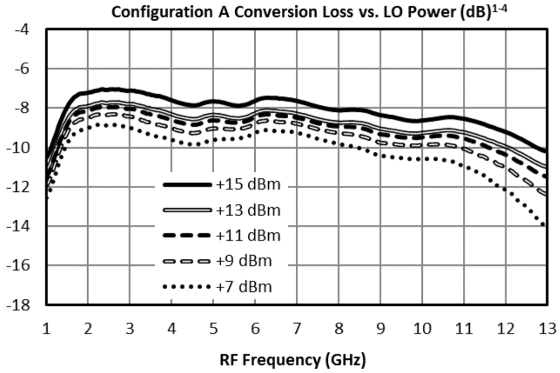
Conversion Loss: 1 GHz IF, Highside LO (dB)[1-4]



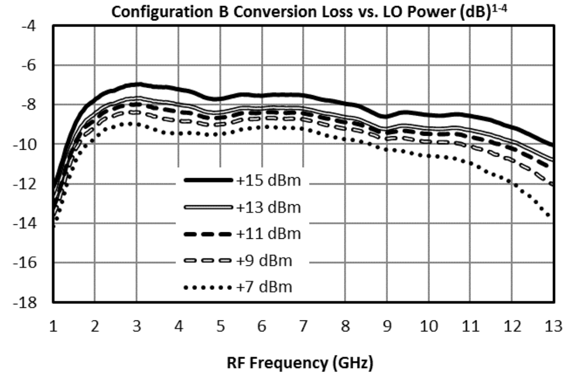
Conversion Loss: 1 GHz IF, Highside Square Wave LO (dB)[1-5]



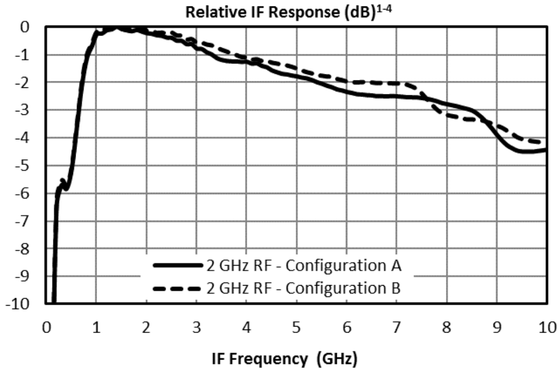
Configuration A Conversion Loss vs. LO Power (dB)[1-4]



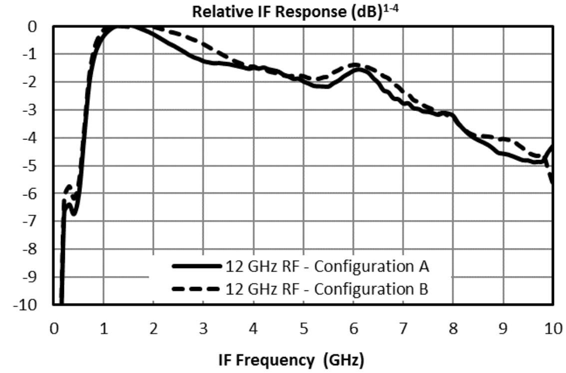
Configuration B Conversion Loss vs. LO Power (dB)[1-4]



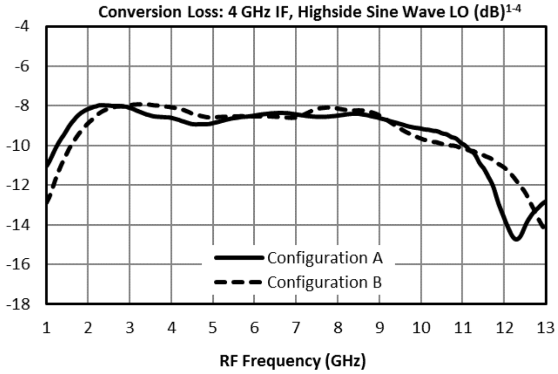
Relative IF Response (dB)[1-4]



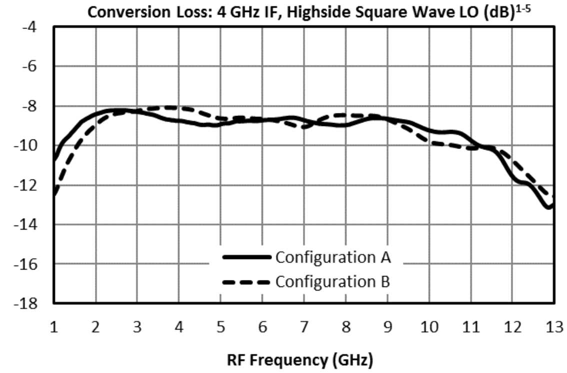
Relative IF Response (dB)[1-4]



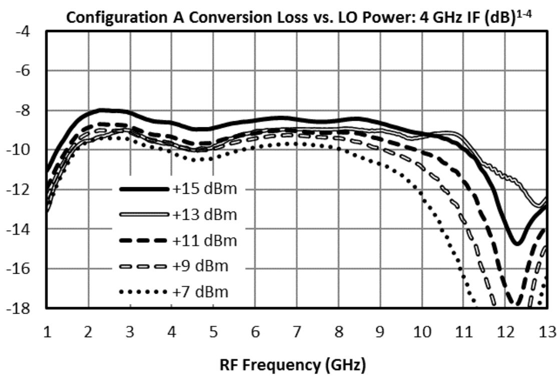
Conversion Loss: 4 GHz IF, Highside Sine Wave LO (dB)[1-4]

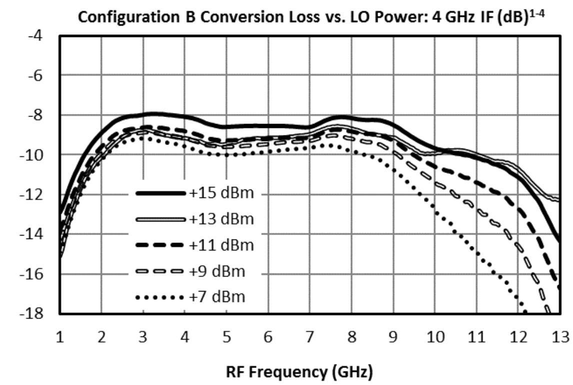


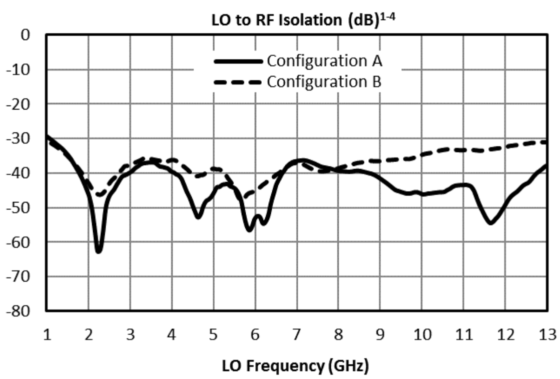
Conversion Loss: 4 GHz IF, Highside Square Wave LO (dB)[1-5]

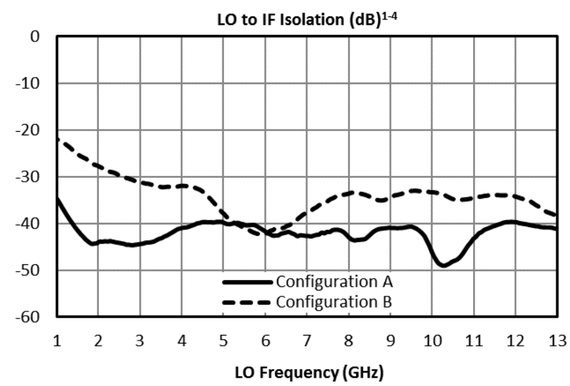


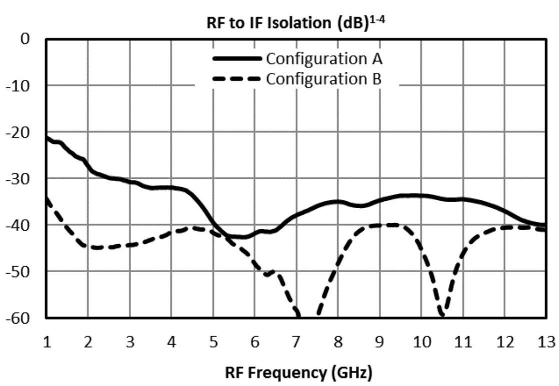
Typical Performance

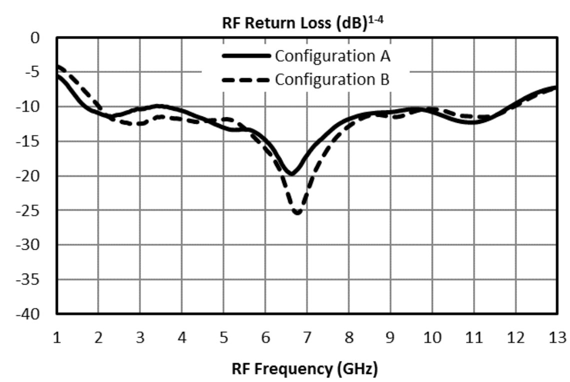


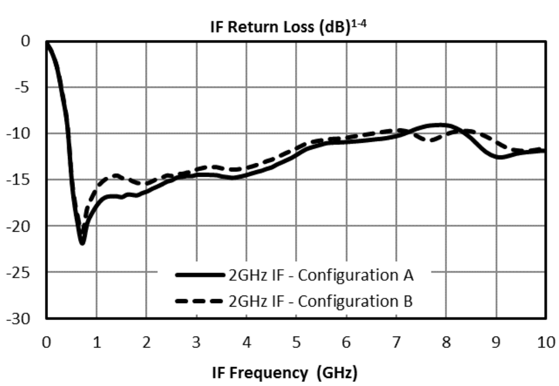


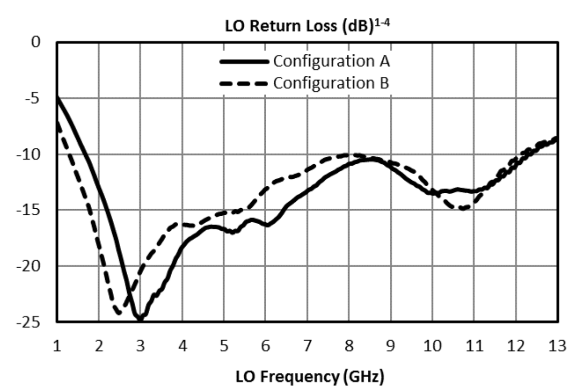




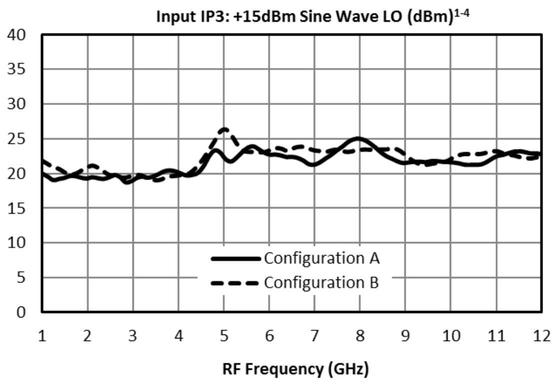


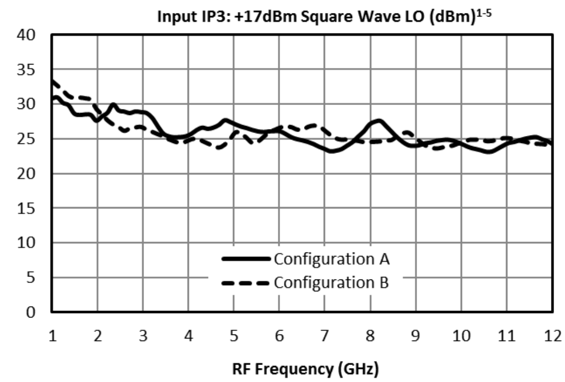


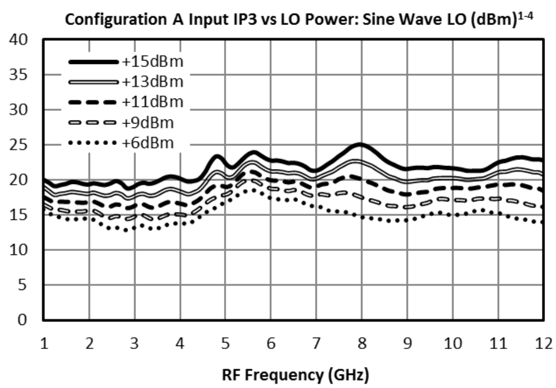


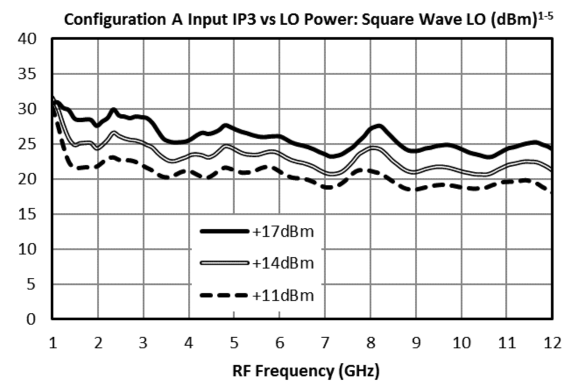


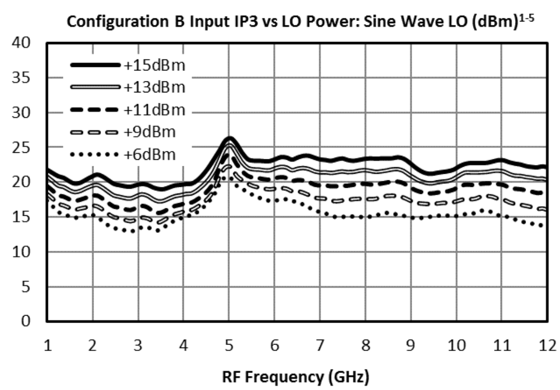
Typical Performance

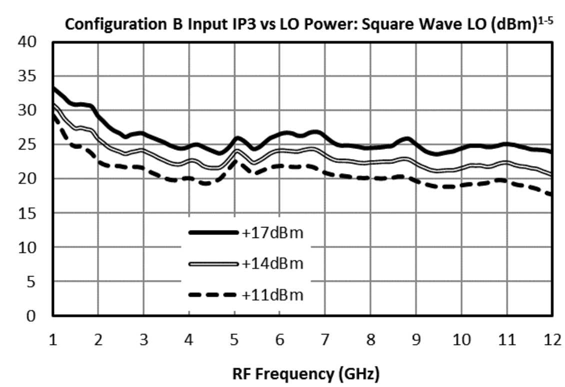


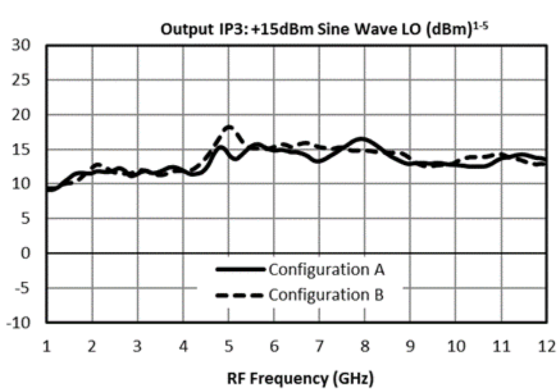


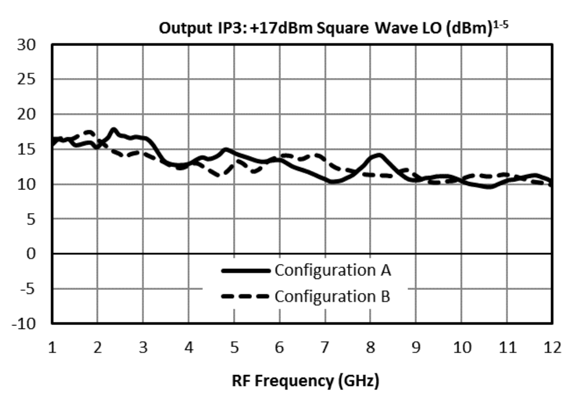




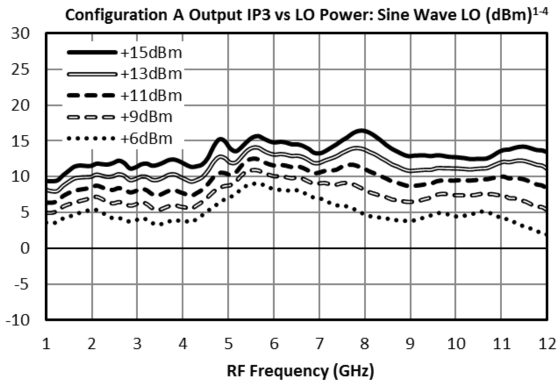


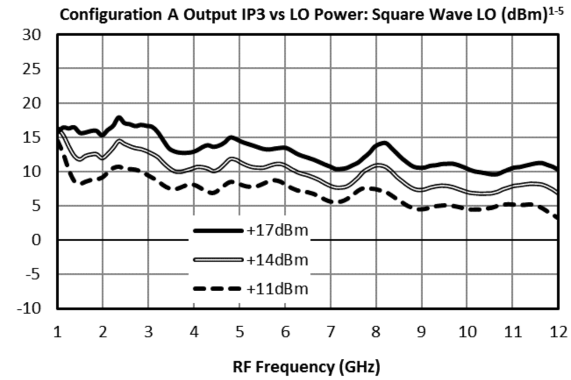


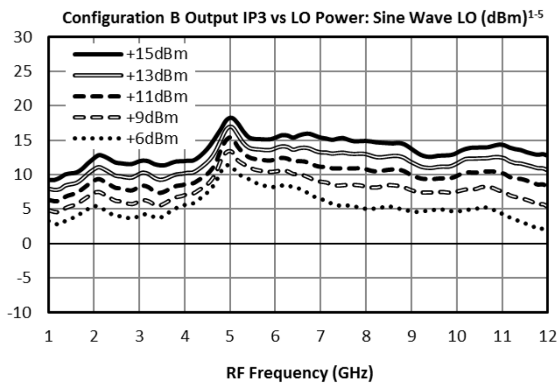


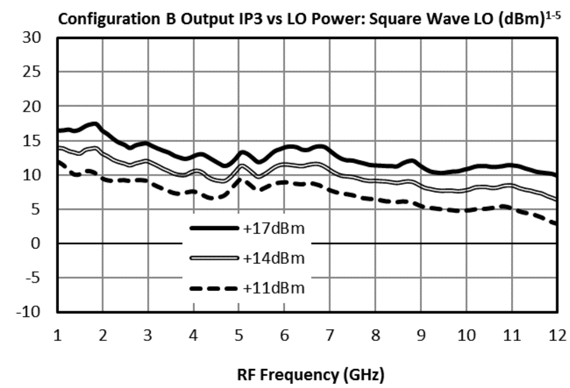


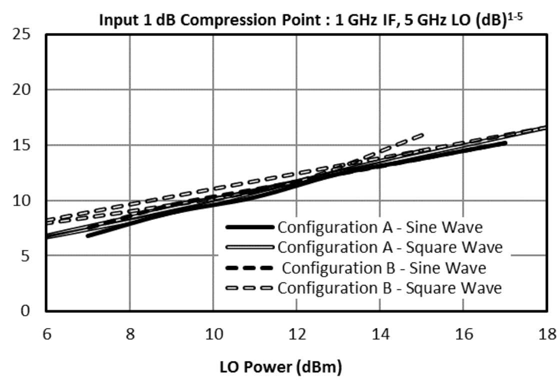
Typical Performance

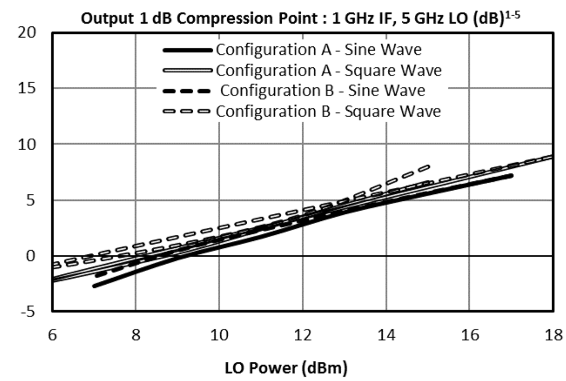






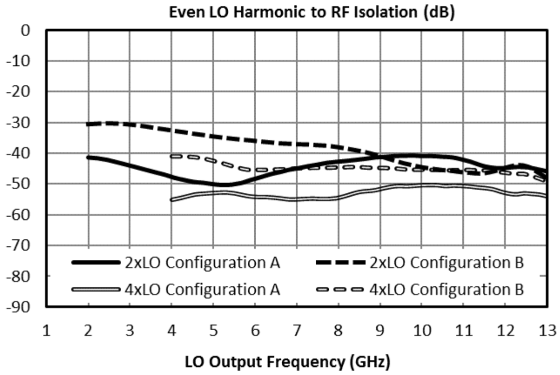




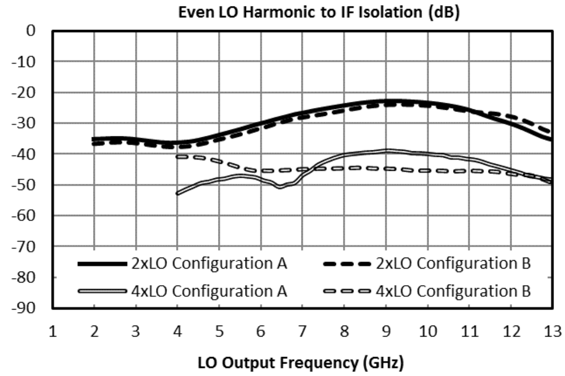


Typical Performance

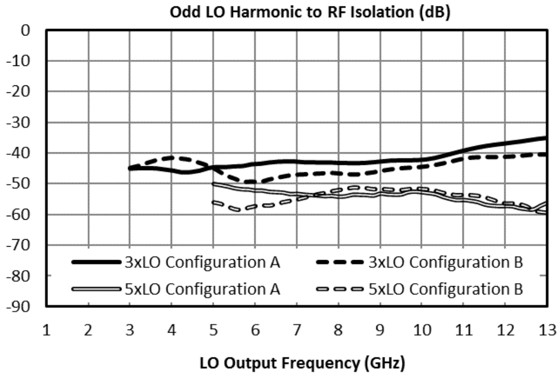
Even LO Harmonic to RF Isolation (dB)



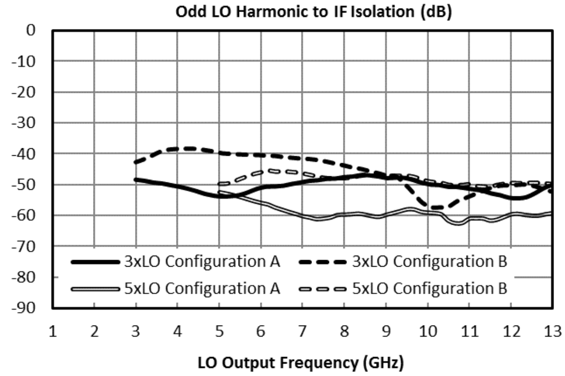
Even LO Harmonic to IF Isolation (dB)



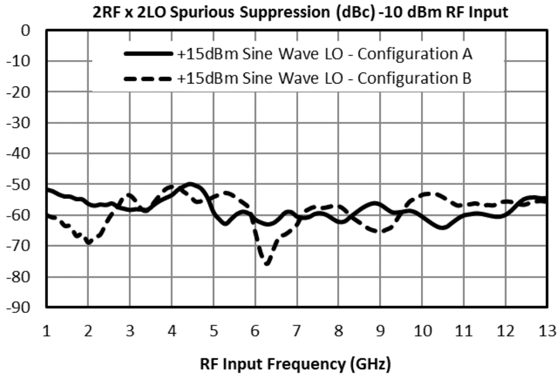
Odd LO Harmonic to RF Isolation (dB)



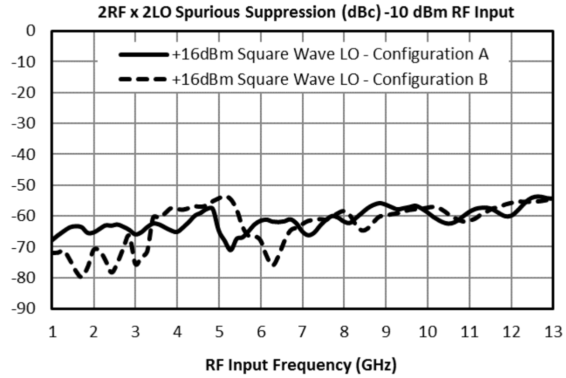
Odd LO Harmonic to IF Isolation (dB)



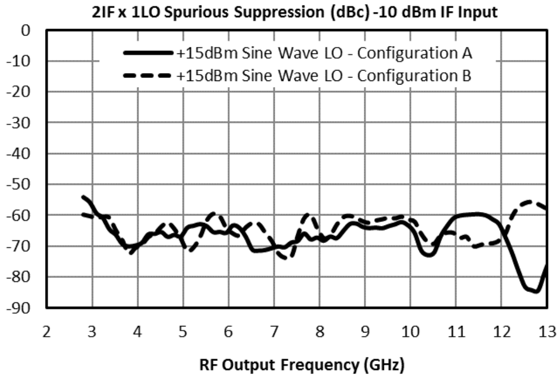
2RF x 2LO Spurious Suppression (dBc) -10 dBm RF Input



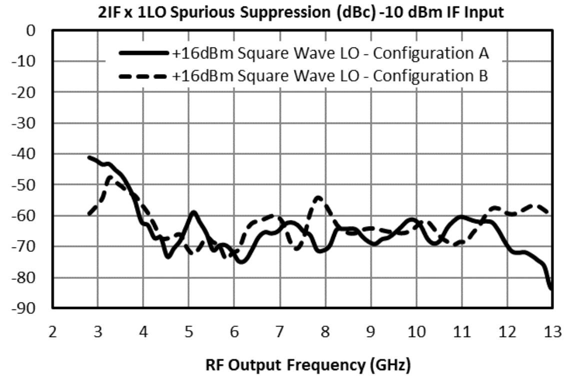
2RF x 2LO Spurious Suppression (dBc) -10 dBm RF Input



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



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



Downconversion Spurious Suppression

Spurious data is taken by selecting RF and LO frequencies (±mLO±nRF) within the RF/LO bands, to create a spurious output within the IF band. The mixer is swept across the full spurious band and the mean is calculated. The numbers shown in the table below are for a -10 dBm RF input. Spurious suppression is scaled for different RF power levels by (n-1), where "n" is the RF spur order. For example, the 2RFx2LO spur is 57 dBc for the A configuration for a -10 dBm input, so a -20 dBm RF input creates a spur that is (2-1) x (-10 dB) dB lower, or 67 dBc.

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

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xRF	27 (33)	Reference	32 (40)	15 (15)	31 (40)	30 (33)
2xRF	59 (56)	65 (60)	57 (57)	62 (55)	59 (62)	62 (53)
3xRF	96 (91)	72 (73)	85 (86)	65 (67)	84 (89)	122 (122)
4xRF	119 (114)	138 (138)	114 (116)	115 (112)	109 (108)	113 (110)
5xRF	143 (126)	130 (136)	134 (139)	129 (132)	136 (139)	119 (120)

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

-10 dBm RF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xRF	26 (29)	Reference	25 (25)	13 (11)	22 (24)	21 (19)
2xRF	61 (62)	65 (59)	60 (60)	64 (60)	61 (65)	67 (62)
3xRF	94 (100)	75 (78)	87 (92)	71 (73)	85 (90)	125 (122)
4xRF	124 (130)	116 (119)	117 (120)	119 (115)	115 (116)	116 (115)
5xRF	144 (151)	134 (141)	138 (138)	135 (137)	139 (142)	128 (132)

215 Vineyard Court, Morgan Hill, CA 95037 | Ph: 408.778.4200 | Fax 408.778.4300 | info@markimicrowave.com

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 62 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 72 dBc.

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

-10 dBm IF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xIF	23 (31)	Reference	31 (37)	15 (14)	30 (47)	31 (30)
2xIF	66 (58)	62 (62)	63 (52)	67 (64)	60 (54)	60 (62)
3xIF	90 (80)	80 (80)	84 (83)	72 (72)	74 (83)	67 (70)
4xIF	114 (110)	116 (116)	112 (110)	112 (111)	109 (105)	114 (112)
5xIF	140 (126)	132 (130)	137 (135)	122 (123)	129 (132)	115 (119)

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

-10 dBm IF Input	0xLO	1xLO	2xLO	3xLO	4xLO	5xLO
1xIF	23 (31)	Reference	28 (25)	13 (11)	22 (24)	21 (19)
2xIF	66 (58)	63 (70)	63 (58)	64 (60)	61 (65)	67 (62)
3xIF	90 (80)	81 (82)	85 (90)	71 (73)	85 (90)	125 (122)
4xIF	114 (110)	116 (116)	118 (116)	119 (115)	115 (116)	116 (115)
5xIF	140 (126)	132 (130)	142 (144)	135 (137)	139 (142)	128 (132)

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.

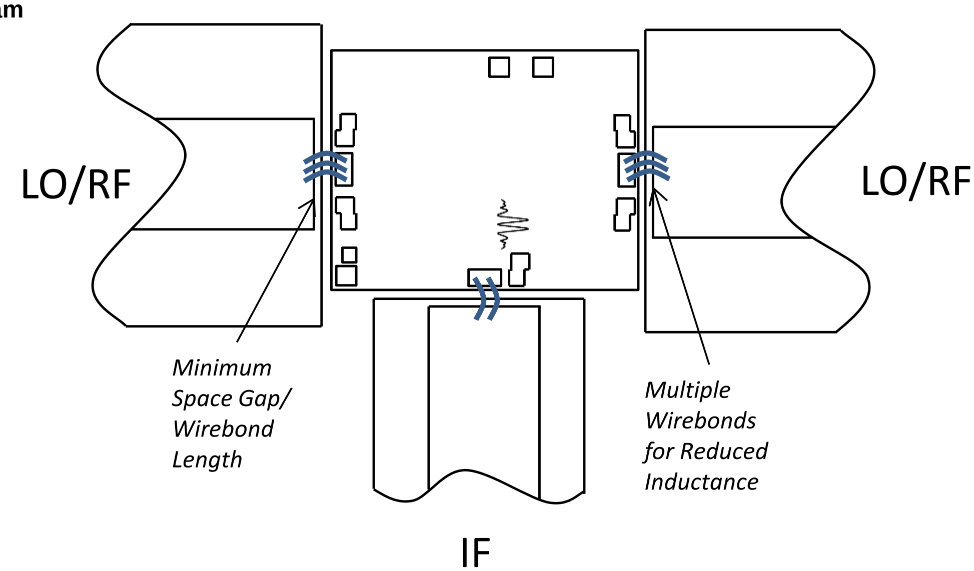
Handling Precautions

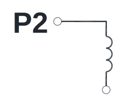
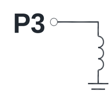
General Handling: Chips should be handled with a vacuum collet when possible, or with sharp tweezers using well trained personnel. The surface of the chip is fragile and should not be contacted if possible.

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.

Bonding Diagram



Port	Description	DC Interface Schematic
Port 1	Port 1 is DC short and AC matched to 50 Ω from 0.8 to 13 GHz. Blocking capacitor is optional.	
Port 2	Port 2 is DC open. Blocking capacitor is optional.	
Port 3	Port 3 is DC short and AC matched to 50 Ω from 0.8 to 13 GHz. Blocking capacitor is optional.	

Absolute Maximum Ratings	
Parameter	**Maximum Rating**
Port 1 DC Current	N/A
Port 2 DC Current	N/A
Port 3 DC Current	N/A
RF Power Handling (RF+LO)	+30 dBm (L -Version)
Operating Temperature	-55ºC to +100ºC
Storage Temperature	-65ºC to +125ºC

DATA SHEET NOTES: 1
1. Mixer Conversion Loss Plot IF frequency is 1 GHz unless otherwise specified.
2. Mixer Noise Figure typically measures within 0.5 dB of conversion loss for IF frequencies greater than 5 MHz.
3. Conversion Loss typically degrades less than 0.5 dB at +100°C and improves less than 0.5 dB at -55°C.
4. Unless otherwise specified, data is taken with highside, +15 dBm sine wave LO drive.
5. Square wave LO generated using 2x ADM1-0026PA with +10 dBm input into the first stage. LO Power reported in plots is of the fundamental tone only. Square wave LO power in plots is stepped down using broadband DC-40 GHz attenuators.
6. Specifications are subject to change without notice. Contact Marki Microwave for the most recent specifications and data sheets.
7. Catalog mixer circuits are continually improved. Configuration control requires custom mixer model numbers and specifications
.

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

Revision History

Revision Code	Revision Date	Comment
-	2017	Initial Release
A	January 2019	Revised square wave LO IP3 plots. End note 5 updated to reflect new test condition.

215 Vineyard Court, Morgan Hill, CA 95037 | Ph: 408.778.4200 | Fax 408.778.4300 | info@markimicrowave.com