# Image-Reject Mixer
# 15 - 45 GHz

**MAMX-011043-DIE**
**Rev. V1**

## Features

- Low Conversion Loss: 9 dB
- High Linearity: 18 dBm IIP3
- High Image Rejection: 20 dBc
- Wide IF Bandwidth: DC to 10 GHz
- High Isolation
- Die Size: 1.40 × 1.90 × 0.10 mm
- RoHS* Compliant

## Applications

- Test & Measurement, Microwave Radio, and Radar

## Description

MAMX-011043-DIE is an image-reject passive diode mixer MMIC. The mixer offers low conversion loss, high linearity, high image rejection and a wide IF bandwidth. The image-reject circuit configuration provides excellent port isolation while internal 50 Ω matching simplifies its application.

This mixer is well suited for applications such as test and measurement, microwave radio and radar.

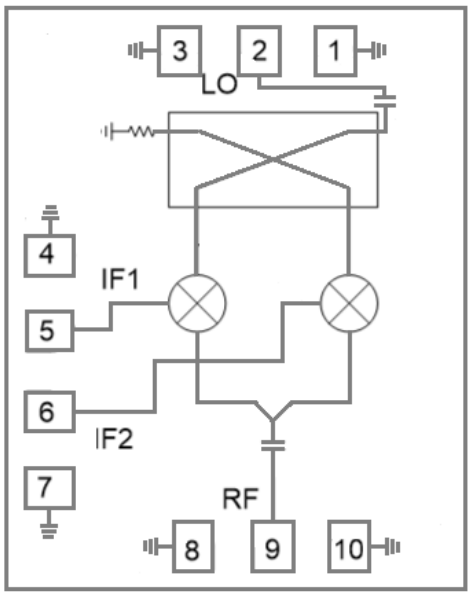
MAMX-011043-DIE is also available in a 4 mm QFN package. Refer to datasheet MAMX-011043.

## Ordering Information

| Part Number | Package |
|---|---|
| MAMX-011043-DIE | Vacuum Release Gel Pack[1] |
| MAMX-011043-SB2 | Sample Board |

1. Die quantity varies.

## Functional Schematic




## Bond-pad Configuration

| Pin # | Function |
|---|---|
| 2 | LO |
| 1, 3, 4, 7, 8, 10 | Ground[2] |
| 5 | IF1 |
| 6 | IF2 |
| 9 | RF |
| 11 | Ground[3] |

2. These pads are internally connected to ground, and they can be left unconnected.
3. The backside of the die must be connected to RF, DC and thermal ground.

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.



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## Electrical Specifications[4,5]: $F_{IF}$ = 100 MHz, $P_{LO}$ = +16 dBm, $T_A$ = 25°C, $Z_0$ = 50 Ω

| Parameter | Test Conditions | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|
| LO and RF Frequency | — | GHz | 15 | — | 45 |
| IF Frequency | — | GHz | 0 | — | 10 |
| LO Power | — | dBm | — | 16 | — |
| Conversion Loss | 15 - 45 GHz | dB | — | 9 | 10.5 |
| Input P1dB | — | dBm | — | 8 | — |
| Input IP3 | $P_{RF}$ = -10 dBm/tone, Δf = 1 MHz | dBm | — | 18 | — |
| Input IP2 (Half IF) | $P_{RF}$ = -10 dBm/tone, Δf = 1 MHz | dBm | — | 40 | — |
| LO-to-RF Isolation | — | dB | — | 40 | — |
| LO-to-IF Isolation | — | dB | — | 40 | — |
| RF-to-IF Isolation | — | dB | — | 30 | — |
| Image Rejection | 15 - 42 GHz<br>42 - 45 GHz | dBc | 15<br>14 | 20 | — |
| Amplitude Imbalance | — | dBc | — | ±1 | — |
| Phase Imbalance | — | ° | — | ±10 | — |
| RF Return Loss | RF = 36 GHz | dB | — | 7 | — |
| IF Return Loss | IF = 2 GHz | dB | — | 10 | — |

4. All specifications refer to down-conversion operation, unless otherwise noted.
5. Characterization measurements were taken using RF probes, with I/O port configuration shown in Assembly Guideline Diagram on page 7.

## Absolute Maximum Ratings[6,7]

| Parameter | Absolute Maximum |
|---|---|
| LO Power | 23 dBm |
| RF or IF Power | 20 dBm |
| Junction Temperature[8] | +150°C |
| Operating Temperature | -55°C to +85°C |
| Storage Temperature | -65°C to +150°C |

6. Exceeding any one or combination of these limits may cause permanent damage to this device.
7. MACOM does not recommend sustained operation near these survivability limits.
8. Operating at nominal conditions with $T_J \leq$ +150°C will ensure MTTF > 1 x $10^6$ hours.

## Handling Procedures

Please observe the following precautions to avoid damage:

## Static Sensitivity

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1B devices.

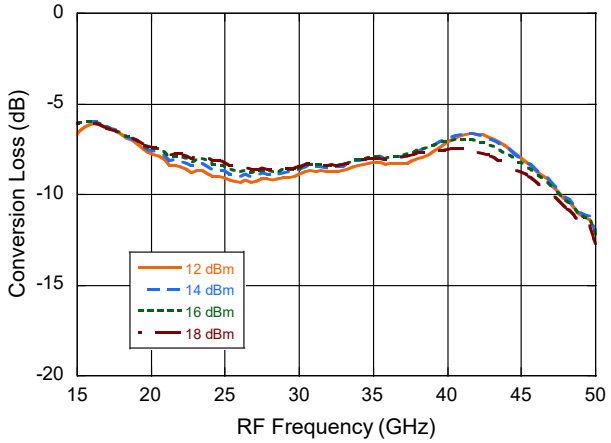


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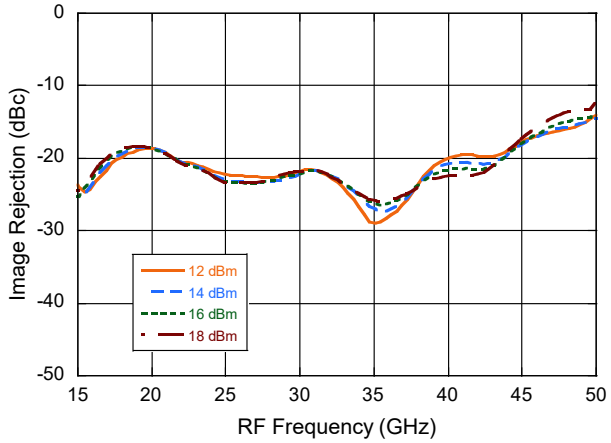
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## Typical Performance Curves: 90° Hybrid @ 100 MHz IF

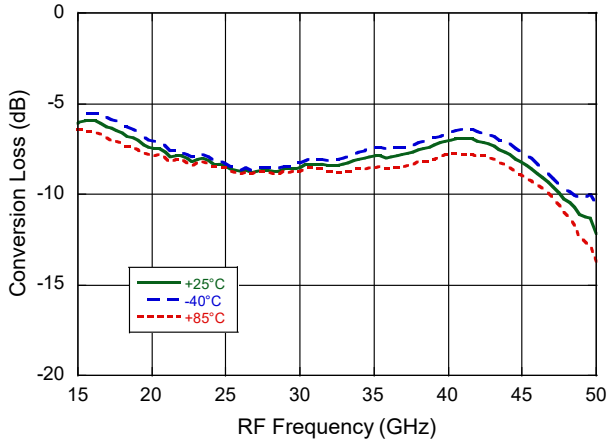
***Down Conversion Gain (Upper Side Band) over LO Drive***



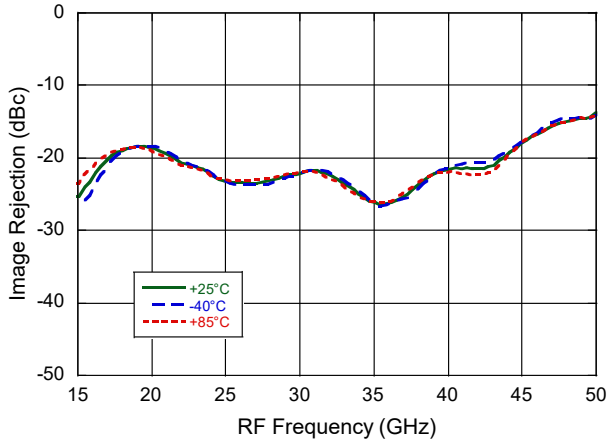

***Down Conversion Image Rejection (Upper Side Band) over LO Drive***



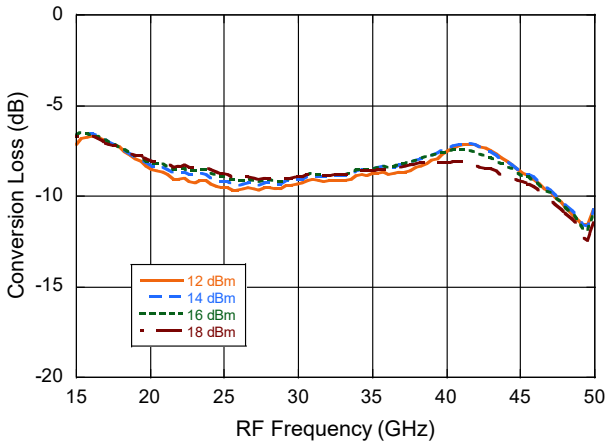

***Down Conversion Gain (Upper Side Band) over Temperature***



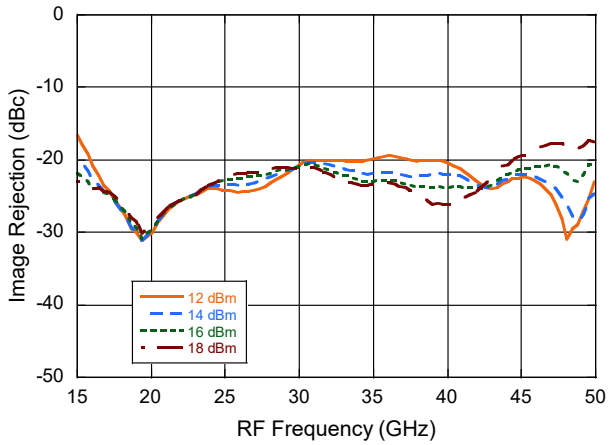

***Down Conversion Image Rejection (Upper Side Band) over Temperature***




***Down Conversion Gain (Lower Side Band) over LO Drive***




***Down Conversion Image Rejection (Lower Side Band) over LO Drive***



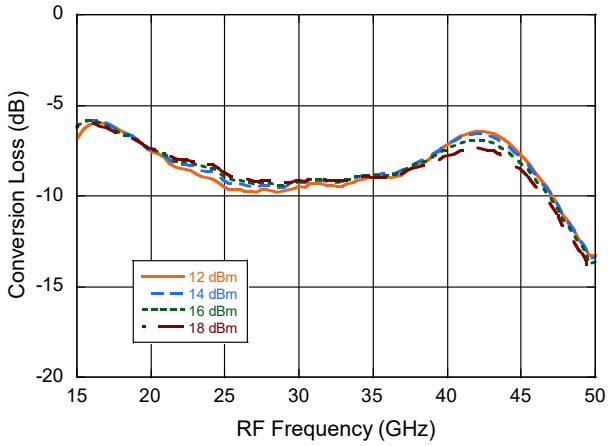



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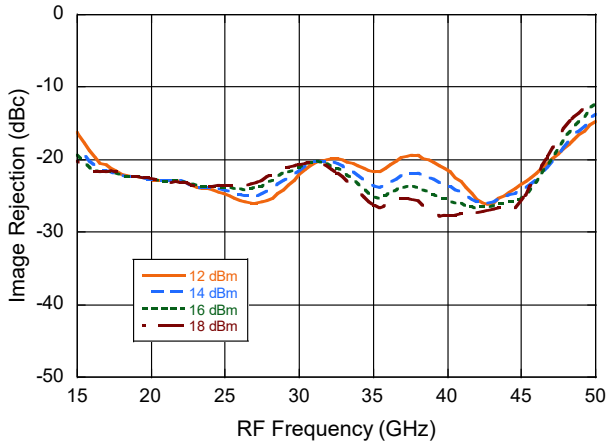
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## Typical Performance Curves: 90° Hybrid @ 100 MHz IF

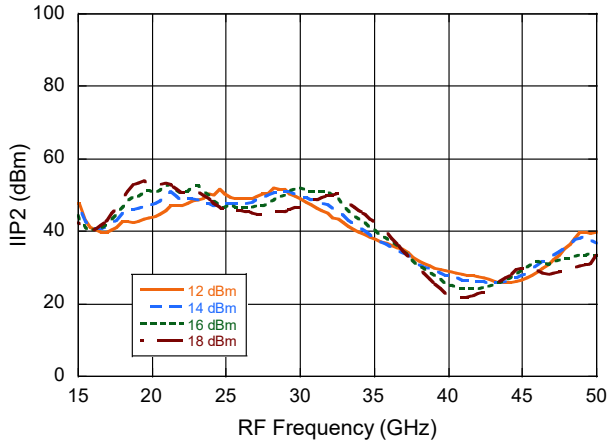
### *Up Conversion Gain (USB) over LO Drive*



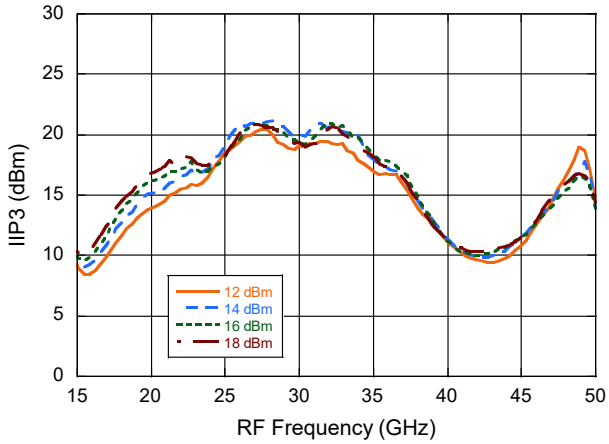

### *Up Conversion SSB (USB) over LO Drive*



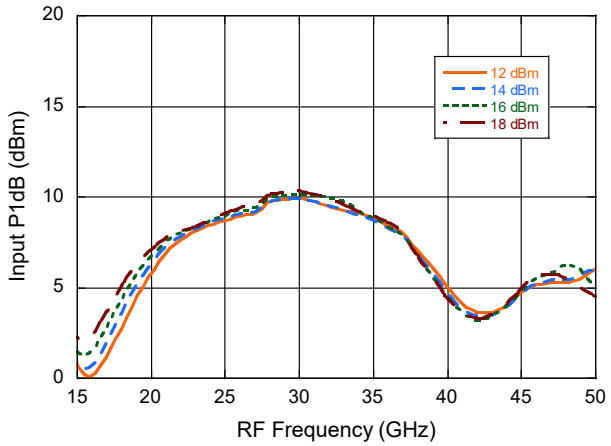

### *Down Conversion IIP2 (USB) over LO Drive*



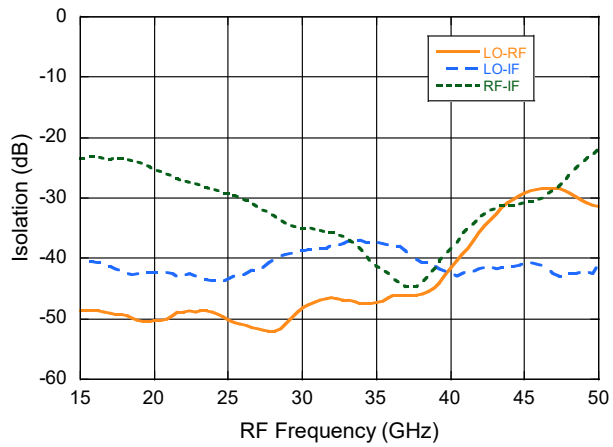

### *Down Conversion IIP3 (USB) over LO Drive*




### *Down Conversion P1dB (USB) Over LO Drive*




### *Down Conversion Isolation*



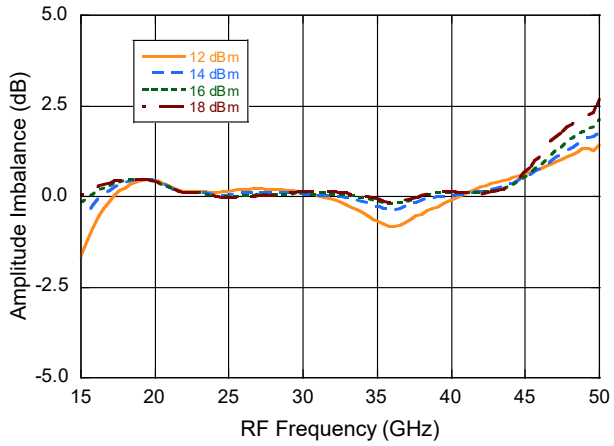



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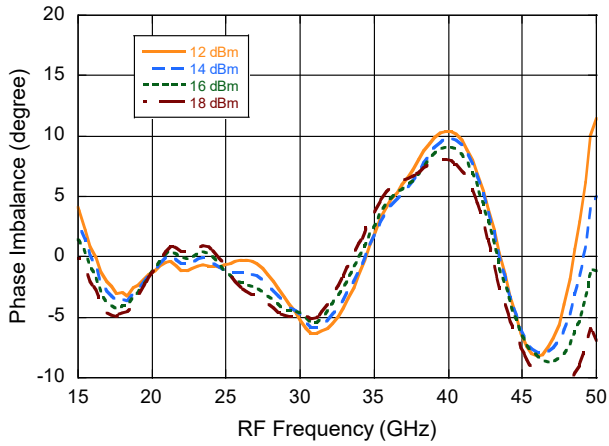
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## Typical Performance Curves:

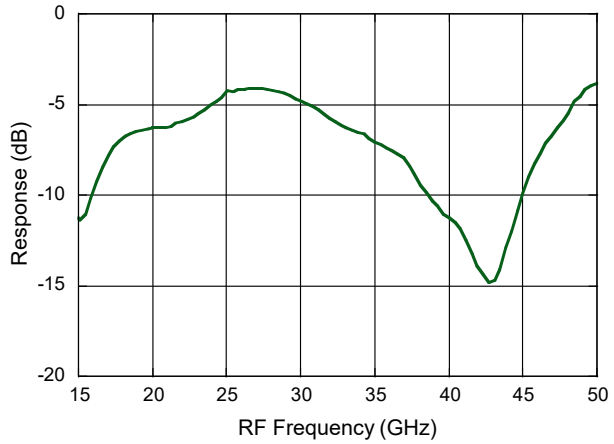
### *Amplitude Imbalance*



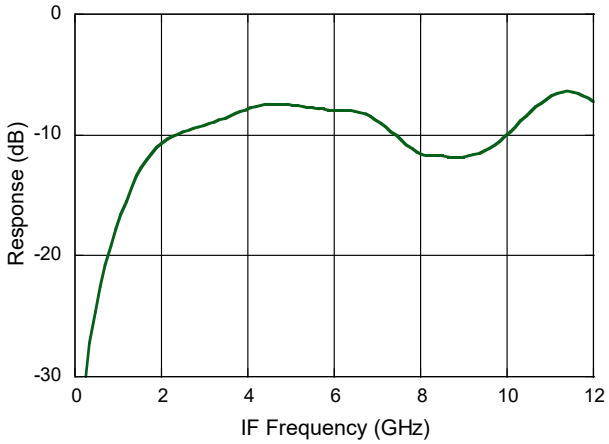

### *Phase Imbalance*



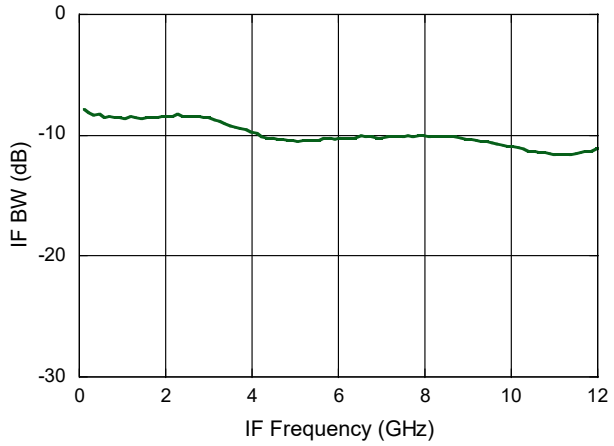

### *RF Return Loss*




### *IF Return Loss*




### *IF Bandwidth*






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## MxN Spurious Rejection @ IF Port

RF = 15.1 GHz @ -10 dBm
LO = 15 GHz @ +16 dBm
*All values in dBc below, the IF output power level*

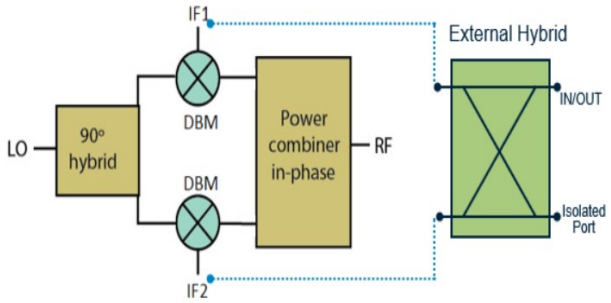
| | NxLO | | | | |
|---|---|---|---|---|---|
| **MxRF** | **0** | **1** | **2** | **3** | **4** |
| **0** | X | 14 | 53 | 56 | X |
| **1** | 17 | 0 | 36 | 57 | 57 |
| **2** | 81 | 62 | 49 | 59 | 97 |
| **3** | 87 | 97 | 57 | 53 | 61 |
| **4** | X | X | X | 95 | 80 |

## LO Harmonics

LO = +16 dBm
*All values in dBc below,*
*input LO level measured at RF*

| n LO spur at RF port | | | | |
|---|---|---|---|---|
| **LO GHz** | **1** | **2** | **3** | **4** |
| **14** | 62 | 59 | 51 | N/A |
| **16** | 54 | 61 | 58 | N/A |
| **18** | 49 | 50 | N/A | N/A |
| **20** | 48 | 48 | N/A | N/A |
| **22** | 49 | 44 | N/A | N/A |
| **24** | 48 | 45 | N/A | N/A |
| **26** | 47 | N/A | N/A | N/A |
| **30** | 44 | N/A | N/A | N/A |
| **45** | 40 | N/A | N/A | N/A |

## Hybrid Configuration




## External Hybrid

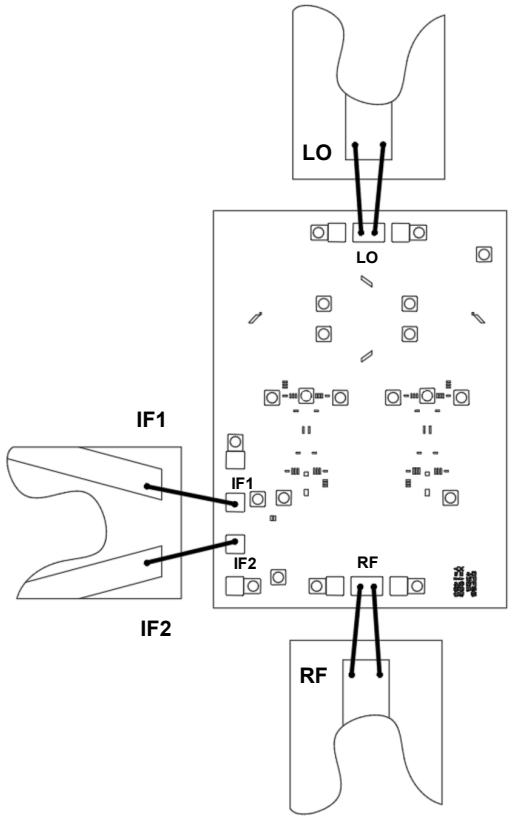
- Down conversion and Up conversion data captured with external hybrid 90° coupler part number: Innovative IPP-2345.
- RF Upper Side Band (USB) mode connect hybrid 0° port to IF1 mixer port, 90° hybrid port to IF2 mixer port.
- RF Lower Side Band (LSB) mode connect hybrid 0° port to IF2 mixer port, 90° hybrid port



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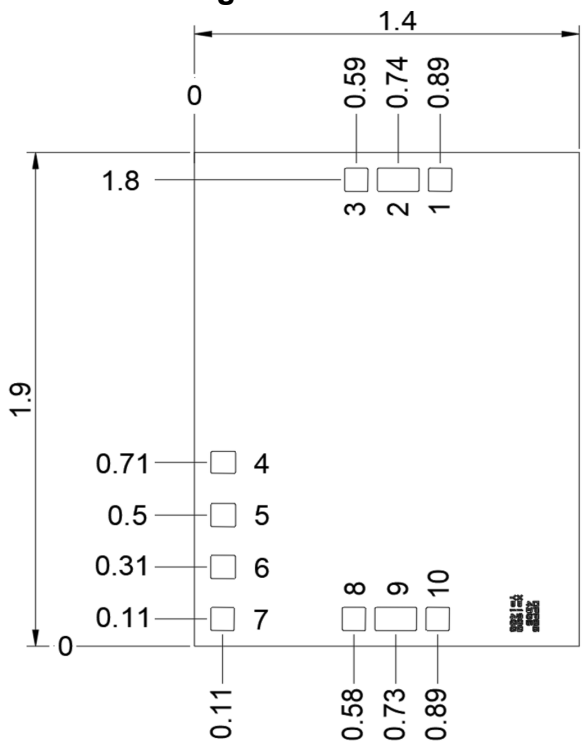
## Assembly Guideline




Attach bare die to PCB or carrier using conductive epoxy. Bond die signal pads to PCB 50 Ω traces using 1 mil gold wire. Double bond wire is recommended on RF and LO pads for optimal performance. There is no need to bond the die ground pads.

Caution: Exposed airbridges are incorporated in the circuit layout on the top surface of this die. These airbridges are sensitive in structure and due care should be taken when handling the die.

## Outline Drawing




## Bondpad Table [9,10]

| Pad # | Pad Name | Size-X | Size-Y |
|---|---|---|---|
| 1 | GND1 | 90 µm | 90 µm |
| 2 | LO | 150 µm | 90 µm |
| 3 | GND2 | 90 µm | 90 µm |
| 4 | GND3 | 90 µm | 90 µm |
| 5 | IF1 | 90 µm | 90 µm |
| 6 | IF2 | 90 µm | 90 µm |
| 7 | GND4 | 90 µm | 90 µm |
| 8 | GND5 | 90 µm | 90 µm |
| 9 | RF | 150 µm | 90 µm |
| 10 | GND6 | 90 µm | 90 µm |

9. Units are in microns with a tolerance of ±5 µm, except for die exterior dimensions which are street-center-to-street-center – nominal kerf, ±20 µm tolerance.
10. Die thickness is 100 ±10 µm.



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