

# Double-Balanced Mixer

## 3 - 12 GHz



MAMX-011034

Rev. V1

### Features

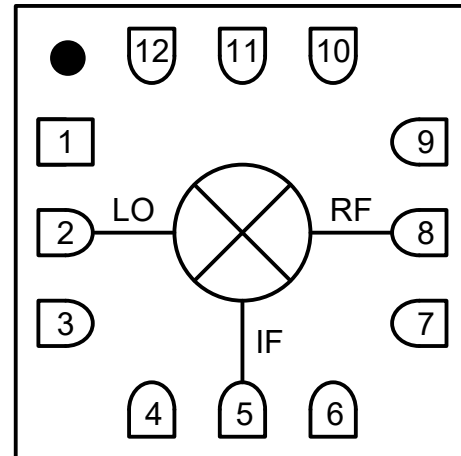
- Low conversion loss: 7.5 dB
- High linearity: 22 dBm IIP3
- Wide IF bandwidth: DC to 4 GHz
- High isolation
- 3 mm 12-lead QFN package
- Lead-free and RoHS\* compliant

### Description

MAMX-011034 is a GaAs double-balanced passive diode mixer housed in a 3 mm, 12-lead QFN package. The mixer offers low conversion loss, high linearity and a wide IF bandwidth. The double-balanced circuit configuration provides excellent port isolation while internal 50  $\Omega$  matching simplifies its application.

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

### Functional Schematic



### Ordering Information<sup>1</sup>

| Part Number        | Package          |
|--------------------|------------------|
| MAMX-011034        | Cut Tape or Tray |
| MAMX-011034-TR0100 | 100 Piece Reel   |
| MAMX-011034-TR0500 | 500 Piece Reel   |
| MAMX-011034-SB1    | Sample Board     |

1. Reference Application Note M513 for reel size information.

### Pin Configuration<sup>2</sup>

| Pin #               | Function         |
|---------------------|------------------|
| 1, 4, 9             | GND              |
| 2                   | LO               |
| 3, 6, 7, 10, 11, 12 | NC <sup>2</sup>  |
| 5                   | IF               |
| 8                   | RF               |
| 13                  | GND <sup>3</sup> |

2. MACOM recommends connecting unused package pins to ground.
3. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

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

# Double-Balanced Mixer

## 3 - 12 GHz



MAMX-011034

Rev. V1

### Pin Description

| Pin #               | Name        | Description   |
|---------------------|-------------|---|
| 1, 4, 9             | Ground      | Ground Connection pads must be connected to ground.   |
| 2                   | LO          | LO input matched and DC open, AC coupled.   |
| 5                   | IF          | DC coupled to diodes and IF matched.  |
| 8                   | RF          | RF matched and DC open, AC coupled.   |
| 3, 6, 7, 10, 11, 12 | Non connect | No internal connection.<br>Recommended these pins are connected to ground.                              |
| 13                  | Paddle      | Package ground paddle and must be connected to RF and DC ground to ensure best possible RF performance. |

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MAMX-011034

Rev. V1

### Electrical Specifications<sup>4</sup>: $F_{IF} = 100 \text{ MHz}$ , $P_{LO} = +15 \text{ dBm}$ , $T_A = 25^\circ\text{C}$ , $Z_0 = 50 \Omega$

| Parameter           | Test Conditions  | Units | Min. | Typ. | Max. |
|---------------------|--|-------|------|------|------|
| LO and RF Frequency | —  | GHz   | 3    | —    | 12   |
| IF Frequency        | —  | GHz   | 0    | —    | 4    |
| LO Power            | —  | dBm   | —    | 15   | —    |
| Conversion Loss     | $F_{IF} = 100 \text{ MHz}$ , $P_{LO} = +15 \text{ dBm}$      | dB    | —    | 7.5  | 9.5  |
| Input P1dB          | $P_{LO} = +15 \text{ dBm}$                                   | dBm   | —    | 12   | —    |
| Input IP3           | $P_{RF} = -10 \text{ dBm/tone}$ , $\Delta f = 1 \text{ MHz}$ | dBm   | —    | 22   | —    |
| Input IP2           | $P_{RF} = -10 \text{ dBm/tone}$ , $\Delta f = 1 \text{ MHz}$ | dBm   | —    | 50   | —    |
| LO-to-RF Isolation  | —  | dB    | —    | 40   | —    |
| LO-to-IF Isolation  | —  | dB    | —    | 40   | —    |
| RF-to-IF Isolation  | —  | dB    | —    | 15   | —    |

4. All specifications refer to down-conversion operation.

### Recommended Operating Conditions

| Parameter   | Minimum | Nominal | Maximum |
|-------------|---------|---------|---------|
| LO Power    | +11 dBm | +15 dBm | +17 dBm |
| RF/IF Power | —       | -10 dBm | +8 dBm  |
| Temperature | -55°C   | +25°C   | +85°C   |

### Absolute Maximum Ratings<sup>5,6</sup>

| Parameter                         | Absolute Maximum |
|-----------------------------------|------------------|
| LO Power                          | 23 dBm           |
| RF or IF Power                    | 20 dBm           |
| Junction Temperature <sup>7</sup> | +150°C           |
| Storage Temperature               | -65°C to +150°C  |

5. Exceeding any one or combination of these limits may cause permanent damage to this device.
6. MACOM does not recommend sustained operation near these survivability limits.
7. Operating at nominal conditions with  $T_J \leq +150^\circ\text{C}$  will ensure  $\text{MTTF} > 1 \times 10^6$  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 devices with the following rating: HBM Class 1B

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Rev. V1

### MxN Spurious Rejection at IF Port

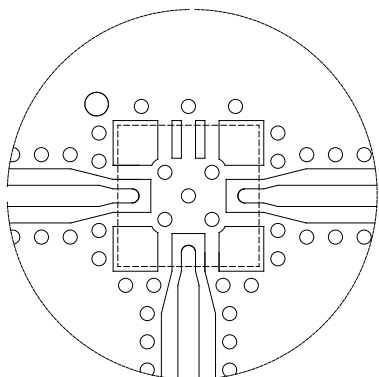
RF = 6.1 GHz @ -10 dBm

LO = 6 GHz @ +15 dBm

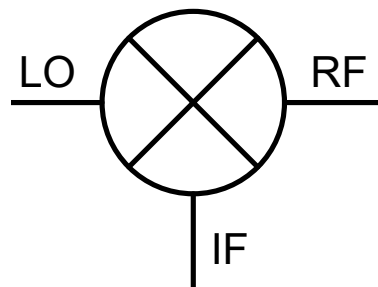
Levels shown referenced to the IF output (dBc)

| mxRF | nxLO |      |      |      |      |
|------|------|------|------|------|------|
|      | 0    | 1    | 2    | 3    | 4    |
| 0    | X    | -10  | -23  | -27  | -33  |
| 1    | -4   | 0    | -27  | -49  | -54  |
| 2    | -81  | -74  | -78  | -68  | -91  |
| 3    | -106 | -104 | -83  | -81  | -80  |
| 4    | -102 | -107 | -102 | -106 | -102 |

### PCB Layout



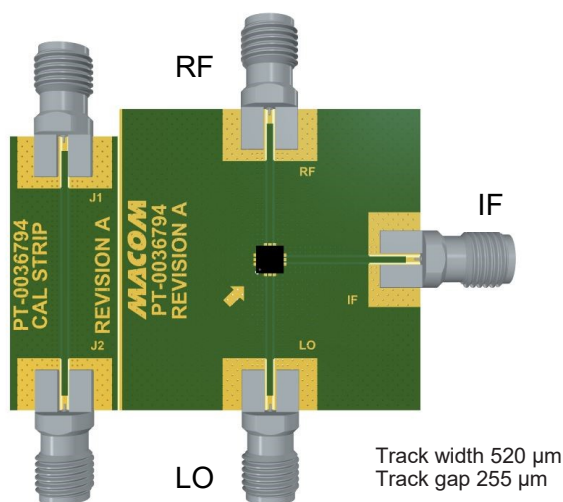
### Application Schematic



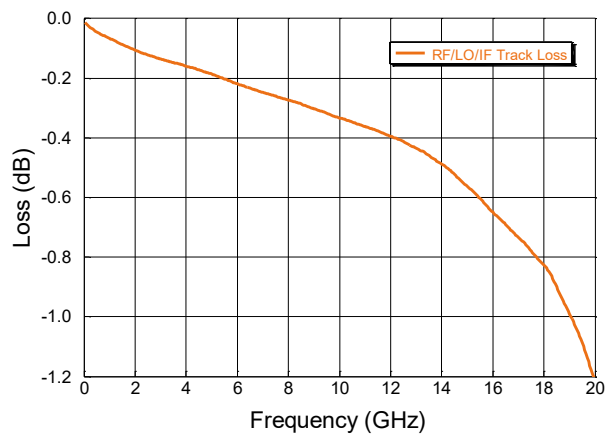
DXF/Gerber available on request based on 10 mil RO4350

No external parts required for operation of MAMX-011034.

### Evaluation Board



### Evaluation Board Losses



# Double-Balanced Mixer

## 3 - 12 GHz

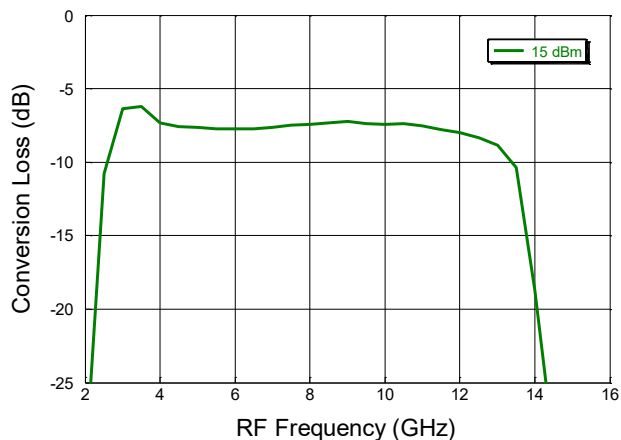


MAMX-011034

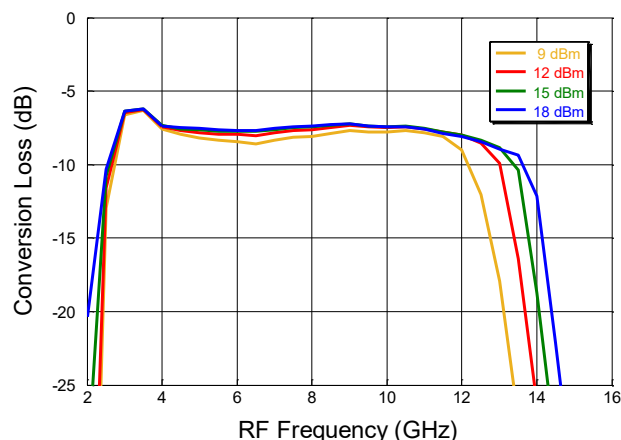
Rev. V1

Typical Performance Curves: Down Conversion Mode, RF = -10dBm, Upper Side Band (USB), Low Side LO @ 25°C. IF = 100 MHz

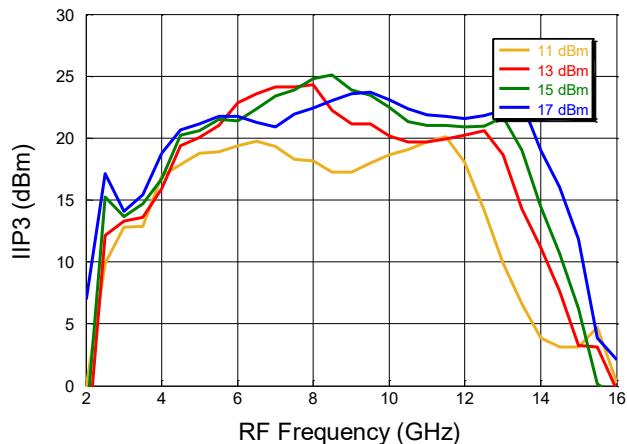
**Conversion Loss vs. Frequency**



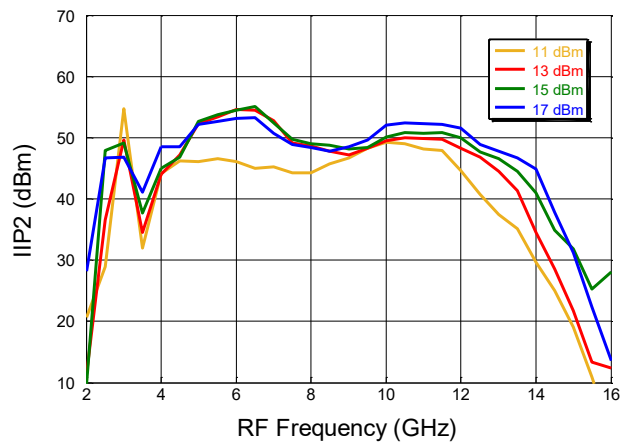
**Conversion Loss over LO Drive**



**IIP3 over LO Drive vs. RF Frequency**



**IIP2 over LO Drive vs. RF Frequency**



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## 3 - 12 GHz

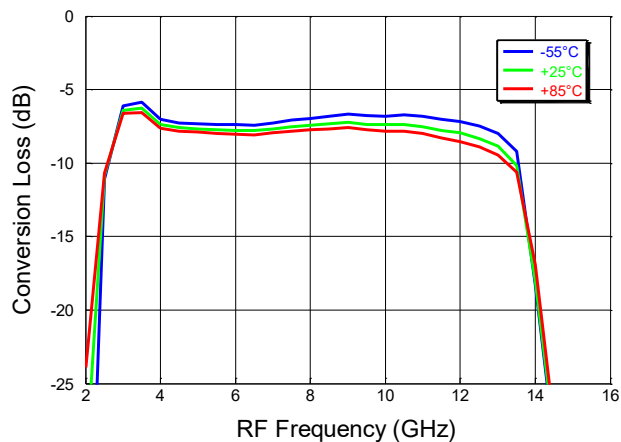


MAMX-011034

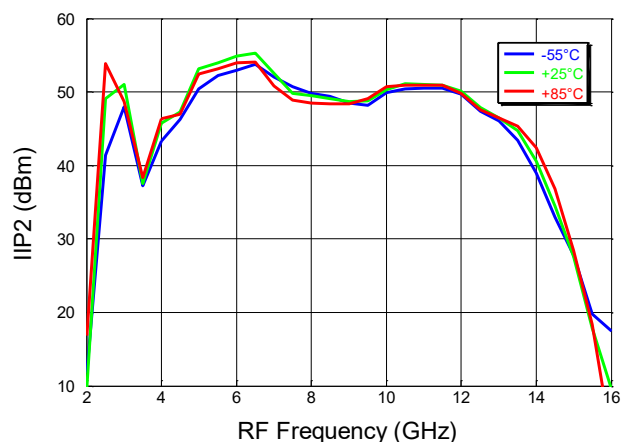
Rev. V1

**Typical Performance Curves: Down Conversion Mode, RF = -10dBm, Upper Side Band (USB), Over Temperature. IF = 100 MHz**

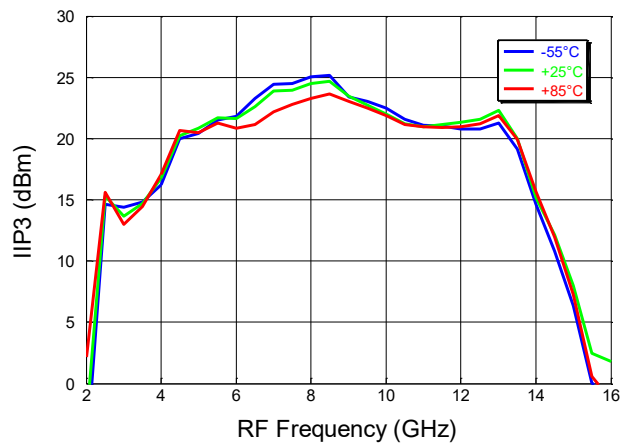
**Conversion Loss over Temperature @  $P_{Lo} = +15$  dBm**



**IIP2 over Temperature @  $P_{Lo} = +15$  dBm**



**IIP3 over Temperature @  $P_{Lo} = +15$  dBm**



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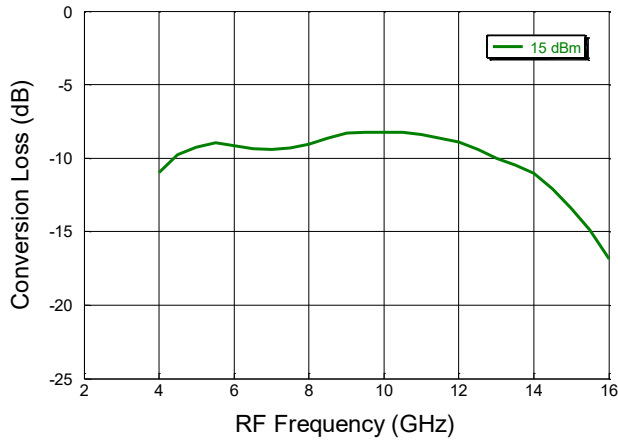


MAMX-011034

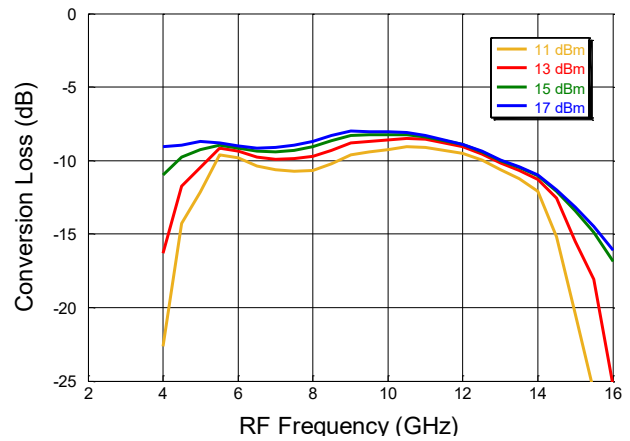
Rev. V1

Typical Performance Curves: Down Conversion Mode, RF = -10dBm, Upper Side Band (USB), Low Side LO @ 25°C. IF = 2 GHz

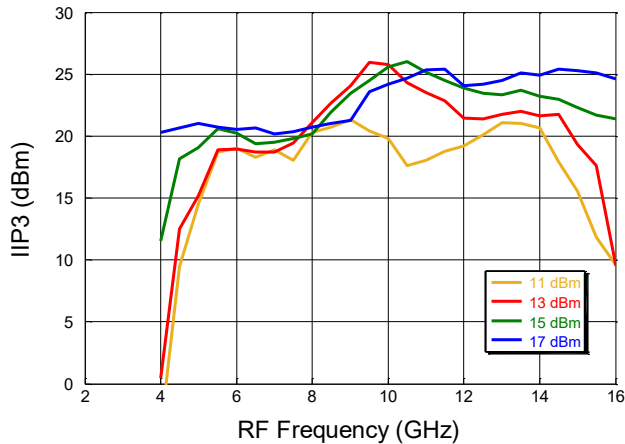
**Conversion Loss vs. Frequency**



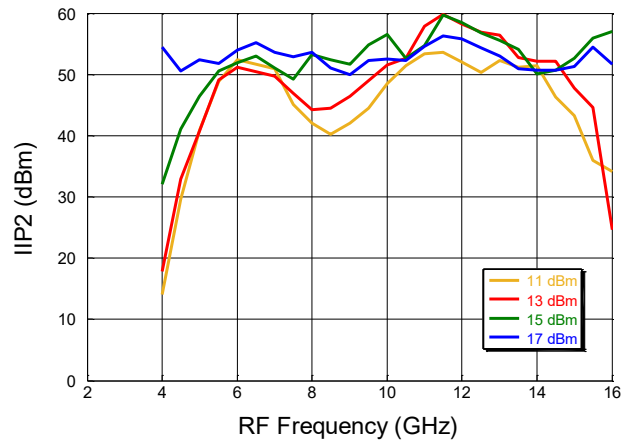
**Conversion Loss over LO Drive**



**IIP3 over LO Drive vs. RF Frequency**



**IIP2 over LO Drive vs. RF Frequency**



# Double-Balanced Mixer

## 3 - 12 GHz

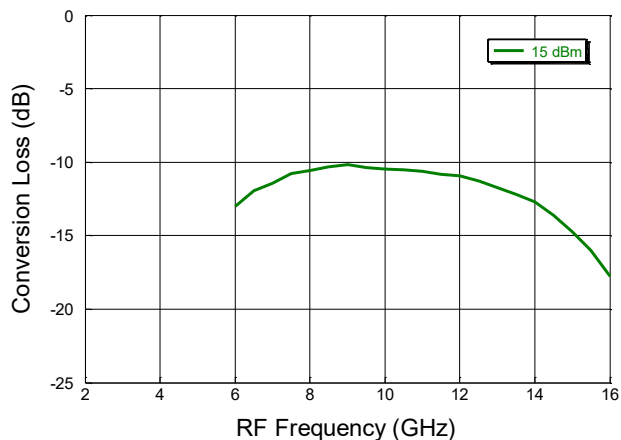


MAMX-011034

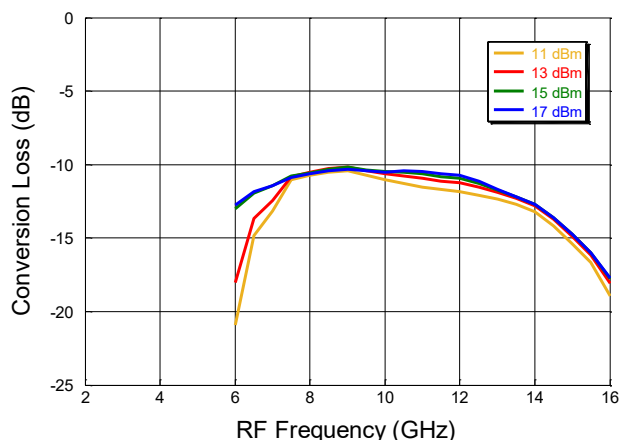
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**Typical Performance Curves: Down Conversion Mode, RF = -10dBm, Upper Side Band (USB), Low Side LO @ 25°C. IF = 4 GHz**

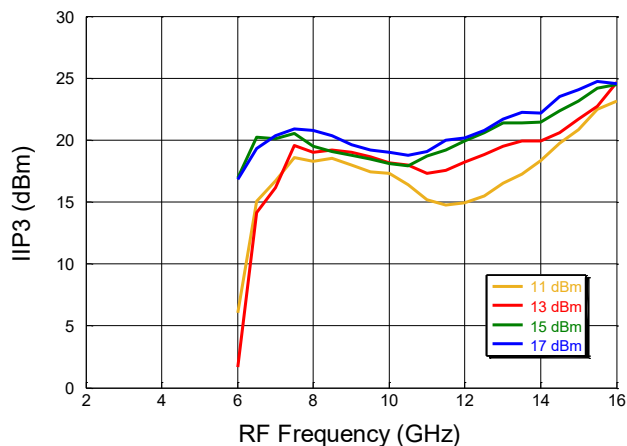
**Conversion Loss vs. Frequency**



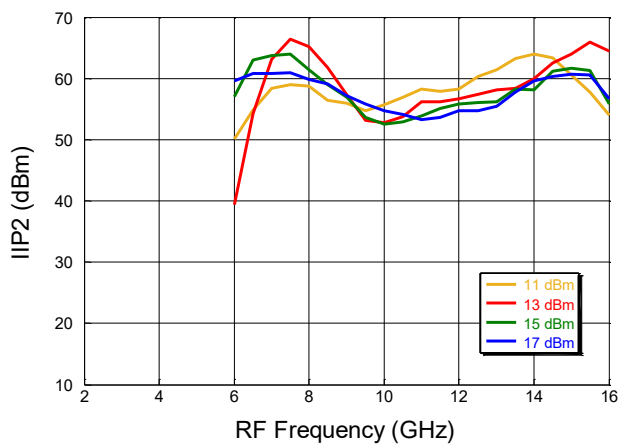
**Conversion Loss over LO Drive**



**IIP3 over LO Drive vs. RF Frequency**



**IIP2 over LO Drive vs. RF Frequency**





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## 3 - 12 GHz

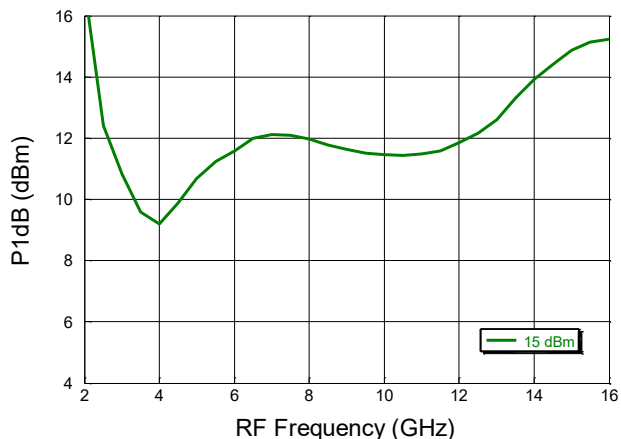


MAMX-011034

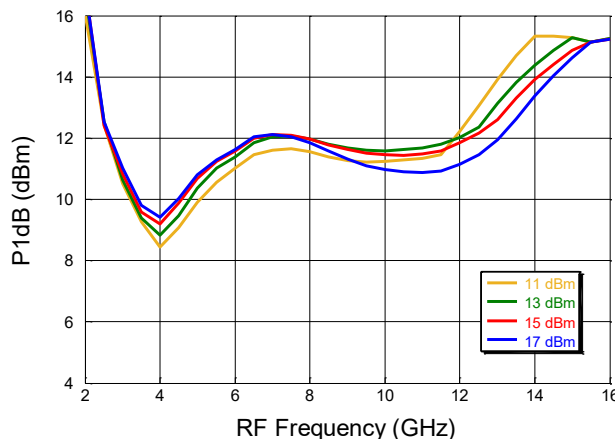
Rev. V1

**Typical Performance Curves: Down Conversion Mode, Upper Side Band (USB), Low Side LO @ 25°C.**

**P1dB vs. RF Frequency**

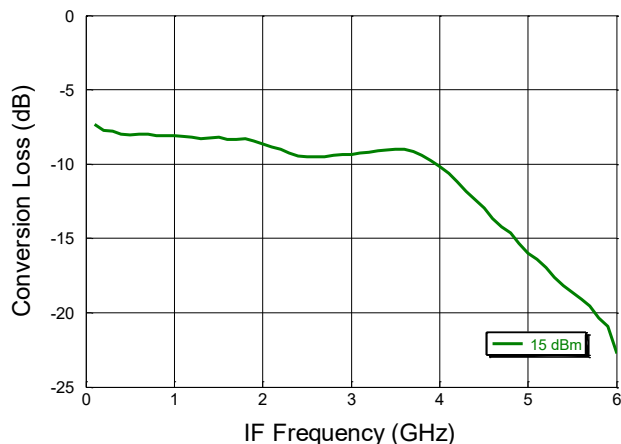


**P1dB over LO drive**



**IF Bandwidth vs. IF Frequency**

**RF -10dBm, USB, LO +15dBm @6GHz**



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## 3 - 12 GHz

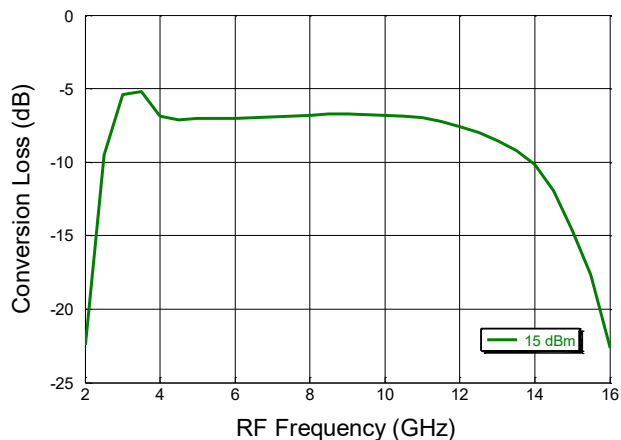


MAMX-011034

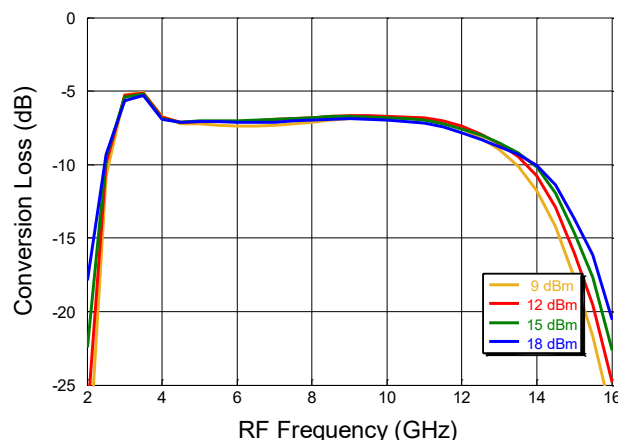
Rev. V1

Typical Performance Curves: Up Conversion Mode, Upper Side Band (USB),  
Low side LO @ 25°C. IF = 100 MHz @ -10dBm

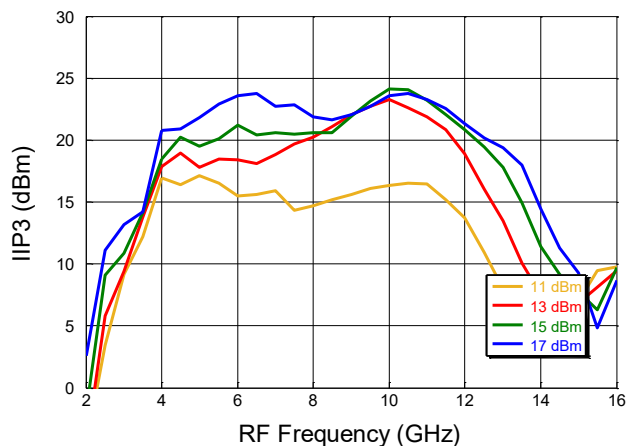
Conversion Loss vs. Frequency



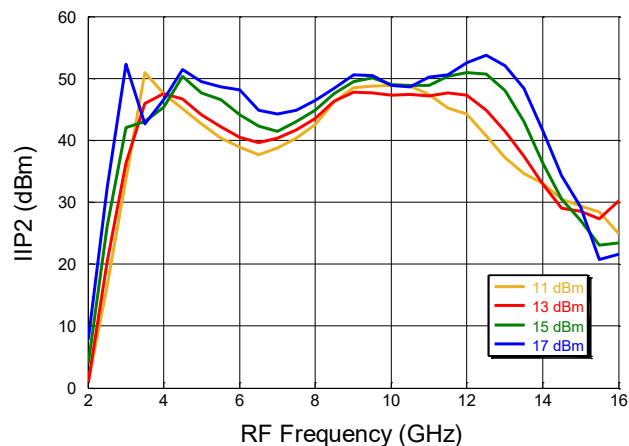
Conversion Loss over LO Drive



IIP3 over LO Drive vs. RF Frequency



IIP2 over LO Drive vs. RF Frequency



# Double-Balanced Mixer

## 3 - 12 GHz

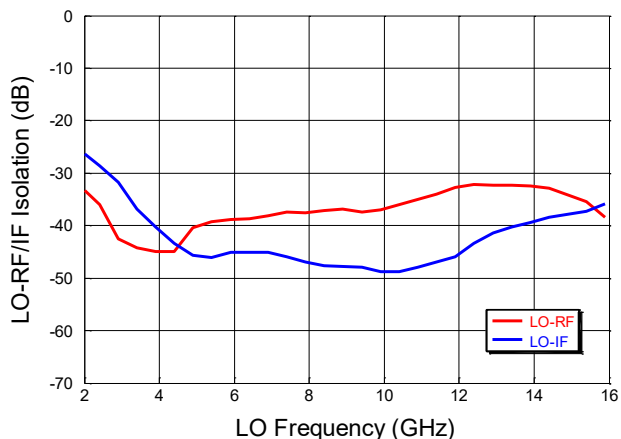


MAMX-011034

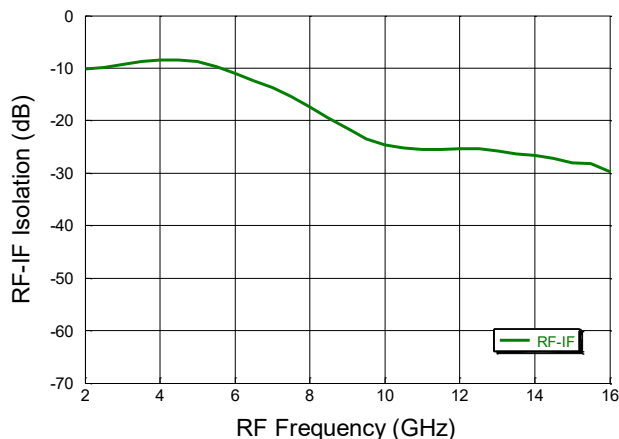
Rev. V1

Typical Performance Curves: LO +15dBm, RF -10dBm @ 25°C.

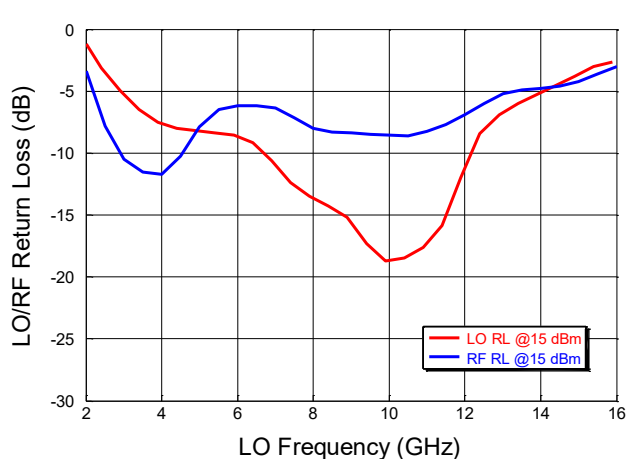
LO to RF/IF Isolation vs. LO Frequency



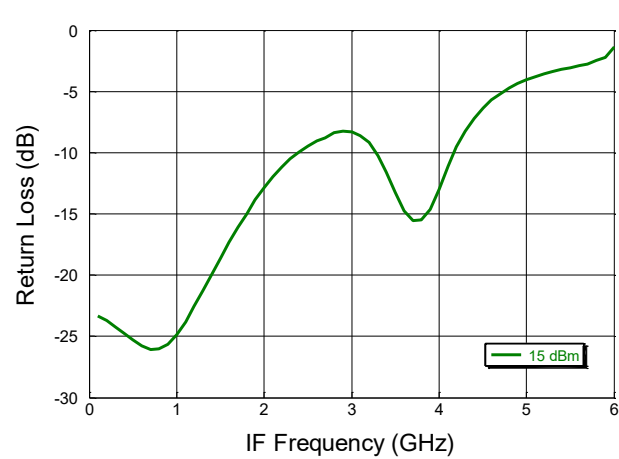
RF to IF Isolation vs. RF Frequency



LO/RF Return Loss vs. RF Frequency



IF Return Loss vs. RF Frequency



# Double-Balanced Mixer

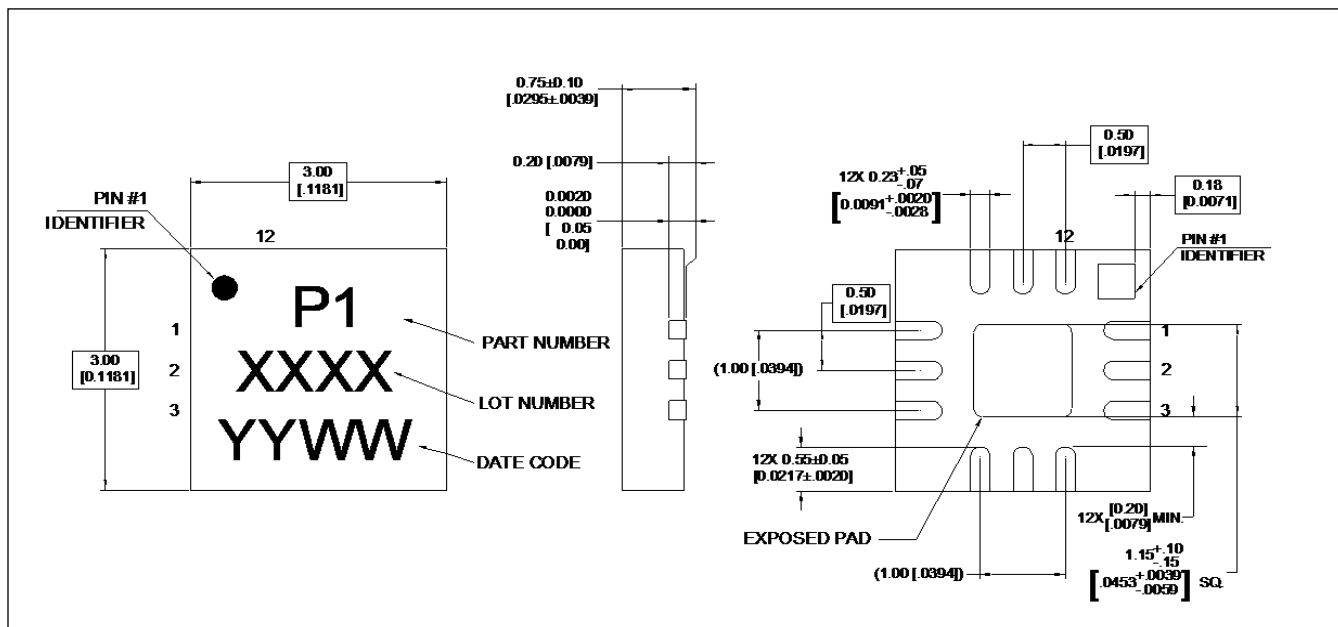
## 3 - 12 GHz



MAMX-011034

Rev. V1

### Lead-Free 3 mm 12-Lead PQFN<sup>†</sup>



<sup>†</sup> Reference Application Note S2083 for lead-free solder reflow recommendations.  
 Meets JEDEC moisture sensitivity level 1 requirements.  
 100% Matte Sn Plating

### Revision History

| Rev | Date      | Change Description |
|-----|-----------|--------------------|
| V1  | June 2024 | Production Release |

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## 3 - 12 GHz



MAMX-011034

Rev. V1

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