MAMX-011044

Image Reject Mixer
2.5 to 9 GHz

Features
- Passive Mixer - No Bias Required
- Usable as Image Reject Down Converter or as Single Sideband (SSB) Up Converter
- Low Conversion Loss: 7.5 dB typical
- High Linearity: 22 dBm IIP3 typical
- High Image Rejection: 22 dBc typical
- Wide IF Bandwidth: DC to 3.5 GHz
- High Isolation
- Package Size: 4 mm 24-Lead QFN
- RoHS* Compliant

Description
MAMX-011044 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.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAMX-011044</td>
<td>Bulk</td>
</tr>
<tr>
<td>MAMX-011044-TR0100</td>
<td>100 Piece Reel</td>
</tr>
<tr>
<td>MAMX-011044-TR0500</td>
<td>500 Piece Reel</td>
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<tr>
<td>MAMX-011044-SB1</td>
<td>Sample Board</td>
</tr>
</tbody>
</table>

1. Reference Application Note M513 for reel size information.
2. All sample boards include 5 loose parts.

Functional Schematic

Pin Configuration

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Function</th>
<th>Pin #</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 3</td>
<td>Ground</td>
<td>12 - 14</td>
<td>Ground</td>
</tr>
<tr>
<td>4</td>
<td>RF</td>
<td>15</td>
<td>LO</td>
</tr>
<tr>
<td>5</td>
<td>Ground</td>
<td>16</td>
<td>Ground</td>
</tr>
<tr>
<td>6</td>
<td>No Connection³</td>
<td>17</td>
<td>No Connection³</td>
</tr>
<tr>
<td>7, 8</td>
<td>Ground</td>
<td>18 - 20</td>
<td>Ground</td>
</tr>
<tr>
<td>9</td>
<td>IF1</td>
<td>21</td>
<td>No Connection³</td>
</tr>
<tr>
<td>10</td>
<td>No Connection³</td>
<td>22 - 24</td>
<td>Ground</td>
</tr>
<tr>
<td>11</td>
<td>IF2</td>
<td>25</td>
<td>Paddle⁴</td>
</tr>
</tbody>
</table>

3. MACOM recommends connecting unused package pins to ground.
4. 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.
### Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>LO Power</td>
<td>23 dBm</td>
</tr>
<tr>
<td>RF or IF Power</td>
<td>20 dBm</td>
</tr>
<tr>
<td>Junction Temperature</td>
<td>+150°C</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-55°C to +85°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-65°C to +150°C</td>
</tr>
</tbody>
</table>

5. All specifications refer to down-conversion operation with upper sideband selected, unless otherwise noted.

### 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.

#### Assembly Information

- Do not subject the device to excessive force, especially at elevated temperatures > 60°C.
- No-clean flux is required for assembly. Post SMT washing is not recommended.

### Electrical Specifications

**Parameter** | **Test Conditions** | **Units** | **Min.** | **Typ.** | **Max.**
---|---|---|---|---|---
LO and RF Frequency | — | GHz | 2.5 | — | 9
IF Frequency | — | GHz | 0 | — | 3.5
LO Power | — | dBm | — | 18 | —
Conversion Loss | — | dB | — | 12.0 | 10.0
Input P1dB | — | dBm | — | 11.0 | 8.5
Input IP3 | — | dBm | — | 7.0 | 6.0
LO-to-RF Isolation | — | dB | — | 45 | —
LO-to-IF Isolation | — | dB | — | 45 | —
RF-to-IF Isolation | — | dB | — | 15 | —
Image Rejection | — | dBc | — | 17 | 17.5
Amplitude Imbalance | — | dB | — | ±1 | —
Phase Imbalance | — | ° | — | ±10 | —
RF Return Loss | — | dB | — | 6 | —
IF Return Loss | — | dB | — | 13 | —

5. All specifications refer to down-conversion operation with upper sideband selected, unless otherwise noted.

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 $> 1 \times 10^6$ hours. Thermal resistance, $\Theta_{JC}$ is 85°C/W.

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Image Reject Mixer
2.5 to 9 GHz

Typical Performance Curves: 90° Hybrid @ 500 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**
Image Reject Mixer
2.5 to 9 GHz

Typical Performance Curves: 90° Hybrid @ 500 MHz IF

**Up Conversion Gain Over LO Drive**

**Up Conversion Image Rejection Over LO Drive**

**Down Conversion IIP3 Over LO Drive**

**Down Conversion IIP2 (USB) Over LO Drive**

**Down Conversion IIP3 (USB) Over Temperature**

**Down Conversion P1dB (USB) Over LO Drive**
Typical Performance Curves

**IF Return Loss**

-25  -20  -15  -10  -5  0
0  2  4  6  8  10
IF Return Loss (dB)
RF Frequency (GHz)

**RF Return Loss**

-25  -20  -15  -10  -5  0
0  2  4  6  8  10
RF Return Loss (dB)
RF Frequency (GHz)

**IF Bandwidth**

-30  -25  -20  -15  -10  -5  0
0  2  4  6  8  10
IF BW (dB)
RF Frequency (GHz)

**Isolation**

-60  -50  -40  -30  -20  -10  0
0  2  4  6  8  10
Isolation (dB)
RF Frequency (GHz)

**Amplitude Imbalance**

-2  -1  0  1  2
0  2  4  6  8  10
Amplitude Imbalance (dB)
RF Frequency (GHz)

**Phase Imbalance**

-20  -10  0  10  20
0  2  4  6  8  10
Phase Imbalance (degree)
RF Frequency (GHz)
MAMX-011044

Image Reject Mixer
2.5 to 9 GHz

Rev. V1

MxN Spurious Rejection @ IF port

RF 5.5 GHz @ -10 dBm, LO 5 GHz @ +18 dBm
(All values in dBc below the IF output power level)

<table>
<thead>
<tr>
<th>mxRF</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>X</td>
<td>12</td>
<td>22</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>0</td>
<td>26</td>
<td>80</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>X</td>
<td>100</td>
<td>77</td>
<td>80</td>
<td>97</td>
</tr>
<tr>
<td>3</td>
<td>88</td>
<td>X</td>
<td>90</td>
<td>80</td>
<td>96</td>
</tr>
<tr>
<td>4</td>
<td>X</td>
<td>102</td>
<td>X</td>
<td>105</td>
<td>102</td>
</tr>
</tbody>
</table>

LO Harmonics

LO +18 dBm
(Values in dBc below input LO level measured at RF)

<table>
<thead>
<tr>
<th>LO GHz</th>
<th>nxLO spur @ RF port</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5</td>
<td>48  52  53  69</td>
</tr>
<tr>
<td>4.5</td>
<td>47  50  56  68</td>
</tr>
<tr>
<td>5.5</td>
<td>46  40  46  70</td>
</tr>
<tr>
<td>6.5</td>
<td>46  48  45  73</td>
</tr>
<tr>
<td>7.5</td>
<td>47  54  55  51</td>
</tr>
<tr>
<td>8.5</td>
<td>46  49  82  60</td>
</tr>
</tbody>
</table>

PCB Layout

- Material: Rogers 4350B
- Dielectric thickness 0.254 mm
- Finished copper thickness 17 microns (0.5 oz) plated to 44 microns +/- 10 microns
- Finish both sides: ENIG, 0.05-0.15 μm gold over 3-6 μm nickel
- DXF available on request

Application Schematic

External Hybrid

- Down conversion and Up conversion data captured with external hybrid 90° coupler part number: ATM PNR H912.
- 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 to IF1 mixer port.
Lead-Free 4 mm 24-Lead AQFN†

† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 3 requirements.
Plating is NiPdAu