Features

- Passive Mixer—No Bias required
- Usable as IR Downconverter or as Single Sideband (SSB) Upconverter
- Wideband 8-26 GHz RF/LO range
- Low Conversion Loss: 8.0dB typical
- Operates at low LO level of +10dBm
- LO Power Operating Range: 10-18 dBm
- Nominal LO drive of +14dBm
- High Linearity: 17 dBm IIP3 typical
- High Image Rejection: 22 dBc typical
- Wide IF Bandwidth: DC to 4.0 GHz
- High Isolation
- Package Size: 4x4 mm QFN
- RoHS* Compliant

Description

MAMX-011040 is an image-reject passive diode mixer MMIC. The mixer offers low conversion loss, high linearity, high image rejection over wideband 8-26 GHz range, and wide IF bandwidth up to 4GHz. The nominal LO drive is + 14dBm. However, the MAMX-011040 exhibits excellent Conversion Loss and Image Rejection performance at 10dBm. The overall LO operating range is +10dBm to +18dBm. The image-reject circuit configuration provides excellent port isolation while internal 50-ohm matching simplifies its application.

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

Ordering Information\(^1,2\)

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAMX-011040</td>
<td>Bulk</td>
</tr>
<tr>
<td>MAMX-011040-TR0100</td>
<td>100 Piece Reel</td>
</tr>
<tr>
<td>MAMX-011040-TR0500</td>
<td>500 Piece Reel</td>
</tr>
<tr>
<td>MAMX-011040-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

![Functional Schematic](image)

Pin Configuration\(^3\)

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 3</td>
<td>Ground</td>
</tr>
<tr>
<td>4</td>
<td>IF1</td>
</tr>
<tr>
<td>5</td>
<td>Ground</td>
</tr>
<tr>
<td>6</td>
<td>IF2</td>
</tr>
<tr>
<td>7 - 9</td>
<td>Ground</td>
</tr>
<tr>
<td>10</td>
<td>RF</td>
</tr>
<tr>
<td>11 - 16</td>
<td>Ground</td>
</tr>
<tr>
<td>17</td>
<td>LO</td>
</tr>
<tr>
<td>18 - 24</td>
<td>Ground</td>
</tr>
<tr>
<td>25</td>
<td>Paddle(^4)</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.

Image Reject Mixer
8 to 26 GHz

Electrical Specifications:\(^5\): \(F_{IF} = 100\) MHz, \(P_{LO} = +14\) dBm, \(T_A = +25^\circ\)C, \(Z_0 = 50\) \(\Omega\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Units</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LO and RF Frequency</td>
<td>—</td>
<td>GHz</td>
<td>8</td>
<td>—</td>
<td>26</td>
</tr>
<tr>
<td>IF Frequency</td>
<td>—</td>
<td>GHz</td>
<td>0</td>
<td>—</td>
<td>4</td>
</tr>
<tr>
<td>LO Power</td>
<td>—</td>
<td>dBm</td>
<td>—</td>
<td>14</td>
<td>—</td>
</tr>
<tr>
<td>Conversion Loss 8 - 12 GHz</td>
<td>—</td>
<td>dB</td>
<td>8</td>
<td>9</td>
<td>9.5</td>
</tr>
<tr>
<td>Conversion Loss 12 - 26 GHz</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>11.5</td>
<td>—</td>
</tr>
<tr>
<td>Input P1dB</td>
<td>—</td>
<td>dBm</td>
<td>9</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Input IP3</td>
<td>(P_{RF} = -10) dBm/tone, (\Delta f = 1) MHz</td>
<td>dBm</td>
<td>17</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Input IP2</td>
<td>—</td>
<td>dBm</td>
<td>40</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>LO-to-RF Isolation</td>
<td>—</td>
<td>dB</td>
<td>35</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>LO-to-IF Isolation</td>
<td>—</td>
<td>dB</td>
<td>35</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>RF-to-IF Isolation</td>
<td>—</td>
<td>dB</td>
<td>15</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Image Rejection</td>
<td>—</td>
<td>dBC</td>
<td>17</td>
<td>22</td>
<td>—</td>
</tr>
<tr>
<td>Amplitude Imbalance</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>±2.0</td>
<td>—</td>
</tr>
<tr>
<td>Phase Imbalance</td>
<td>—</td>
<td>°</td>
<td>—</td>
<td>±10.0</td>
<td>—</td>
</tr>
<tr>
<td>RF Return Loss</td>
<td>—</td>
<td>dB</td>
<td>6</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>IF Return Loss</td>
<td>—</td>
<td>dB</td>
<td>12</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

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

Absolute Maximum Ratings\(^4,5\)

<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(^6)</td>
<td>+150°C</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-65°C to +150°C</td>
</tr>
</tbody>
</table>

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 \(T_J \leq +150^\circ\)C will ensure MTTF > 1 \times 10^6 hours. Thermal resistance, \(\Theta_{JC}\), is 85°C/W.

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 1A 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.
Typical Performance Curves Lower Side Band (LSB) High Side LO at 100 MHz IF

**Down Conversion Gain over LO drive**
*Data captured with 90deg hybrid at 100MHz IF*

![Conversion Gain Graph](image)

**Down Conversion Image Rejection over LO drive**
*Data captured with 90deg hybrid at 100MHz IF*

![Image Rejection Graph](image)

**IIP3 over LO drive**
*Data captured with 90deg hybrid at 100MHz IF*

![IIP3 Graph](image)

**IIP2 over LO drive**
*Data captured with 90deg hybrid at 100MHz IF*

![IIP2 Graph](image)

**Amplitude Imbalance over LO drive**

![Amplitude Imbalance Graph](image)

**Phase Imbalance over LO drive**

![Phase Imbalance Graph](image)
Typical Performance Curves Lower Side Band (LSB) High Side LO at 100 MHz IF

**Down Conversion Gain over temperature**
Data captured with 90deg hybrid at 100MHz IF

![Conversion Gain Graph](image1)

**Down Conversion Image Rejection over temperature**
Data captured with 90deg hybrid at 100MHz IF

![Image Rejection Graph](image2)

**IIP3 over temperature**
Data captured with 90deg hybrid at 100MHz IF

![IIP3 Graph](image3)

**IIP2 over temperature**
Data captured with 90deg hybrid at 100MHz IF

![IIP2 Graph](image4)
Typical Performance Curves Upper Side Band (USB) Low Side LO at 100 MHz IF

**Down Conversion Gain over LO drive**
Data captured with 90deg hybrid at 100MHz IF

![Conversion Gain vs RF Frequency](image1)

**IIP3 over LO drive**
Data captured with 90deg hybrid at 100MHz IF

![IIP3 vs RF Frequency](image2)

**Down Conversion Image Rejection over LO drive**
Data captured with 90deg hybrid at 100MHz IF

![Image Rejection vs RF Frequency](image3)

**IIP2 over LO drive**
Data captured with 90deg hybrid at 100MHz IF

![IIP2 vs RF Frequency](image4)

**Amplitude Imbalance over LO drive**

![Amplitude Imbalance vs RF Frequency](image5)

**Phase Imbalance over LO drive**

![Phase Imbalance vs RF Frequency](image6)
Image Reject Mixer
8 to 26 GHz

Typical Performance Curves Upper Side Band (USB) Low Side LO at 100 MHz IF

**Down Conversion Gain over temperature**
*Data captured with 90deg hybrid at 100MHz IF*

**Down Conversion Image Rejection over temperature**
*Data captured with 90deg hybrid at 100MHz IF*

**IIP3 over temperature**
*Data captured with 90deg hybrid at 100MHz IF*

**IIP2 over temperature**
*Data captured with 90deg hybrid at 100MHz IF*
Typical Performance Curves Lower Side Band (LSB) High Side LO at 100 MHz IF

*Up Conversion Gain over LO drive*
*Data captured with 90deg hybrid at 100MHz IF*

![Conversion Gain](conversion_gain_lsb.png)

*Up Conversion Image Rejection over LO drive*
*Data captured with 90deg hybrid at 100MHz IF*

![Image Rejection](image_rejection_lsb.png)

Typical Performance Curves Upper Side Band (USB) Low Side LO

*Up Conversion Gain over LO drive*
*Data captured with 90deg hybrid at 100MHz IF*

![Conversion Gain](conversion_gain_usb.png)

*Up Conversion Image Rejection over LO drive*
*Data captured with 90deg hybrid at 100MHz IF*

![Image Rejection](image_rejection_usb.png)
Image Reject Mixer
8 to 26 GHz

Typical Performance Curves Lower Side Band (LSB) High Side LO at 2GHz IF

**Down Conversion Gain over LO drive**
Data captured with 90deg hybrid at 2GHz IF

**Down Conversion Image Rejection over LO drive**
Data captured with 90deg hybrid at 2GHz IF

**IIP3 over LO drive**
Data captured with 90deg hybrid at 2GHz IF

**IIP3 over LO drive**
Data captured with 90deg hybrid at 2GHz IF
Typical Performance Curves Lower Side Band (USB) Low Side LO at 2GHz IF

**Down Conversion Gain over LO drive**
*Data captured with 90deg hybrid at 2GHz IF*

![Conversion Gain vs RF Frequency](image)

**Down Conversion Image Rejection over LO drive**
*Data captured with 90deg hybrid at 2GHz IF*

![Image Rejection vs RF Frequency](image)

**IIP3 over LO drive**
*Data captured with 90deg hybrid at 2GHz IF*

![IIP3 vs RF Frequency](image)

**IIP2 over LO drive**
*Data captured with 90deg hybrid at 2GHz IF*

![IIP2 vs RF Frequency](image)
Typical Performance Curves

**Isolations**

![Isolations Graph]

**IF Bandwidth**

![IF Bandwidth Graph]

**RF Return Loss**

![RF Return Loss Graph]

**P1dB vs LO power**

![P1dB vs LO power Graph]

**IF Return Loss**

![IF Return Loss Graph]
Image Reject Mixer
8 to 26 GHz

MxN Spurious Rejection at IF port

<table>
<thead>
<tr>
<th>mxF</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>x</td>
<td>11</td>
<td>14</td>
<td>28</td>
<td>X</td>
</tr>
<tr>
<td>1</td>
<td>22</td>
<td>0</td>
<td>52</td>
<td>64.1</td>
<td>46</td>
</tr>
<tr>
<td>2</td>
<td>82</td>
<td>68</td>
<td>61</td>
<td>58.6</td>
<td>73</td>
</tr>
<tr>
<td>3</td>
<td>74.9</td>
<td>x</td>
<td>90</td>
<td>79</td>
<td>78</td>
</tr>
<tr>
<td>4</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>100.2</td>
<td>89.3</td>
</tr>
</tbody>
</table>

LO Harmonics

<table>
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<tr>
<th>LO GHz</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>37.9</td>
<td>46.1</td>
<td>60.8</td>
<td>50.2</td>
</tr>
<tr>
<td>8</td>
<td>46.6</td>
<td>53.9</td>
<td>51.9</td>
<td>59.1</td>
</tr>
<tr>
<td>10</td>
<td>42.3</td>
<td>56.6</td>
<td>51.2</td>
<td>51.4</td>
</tr>
<tr>
<td>12</td>
<td>37.9</td>
<td>56.6</td>
<td>81.2</td>
<td>38.2</td>
</tr>
<tr>
<td>14</td>
<td>30.4</td>
<td>52.1</td>
<td>47.8</td>
<td>N/A</td>
</tr>
<tr>
<td>16</td>
<td>42.8</td>
<td>52.1</td>
<td>47.8</td>
<td>N/A</td>
</tr>
<tr>
<td>18</td>
<td>42.6</td>
<td>83.3</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>20</td>
<td>55.4</td>
<td>52.6</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>22</td>
<td>39.9</td>
<td>54.4</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>24</td>
<td>52.7</td>
<td>53.6</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>26</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Sample Board

- 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: 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 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
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