MAMX-011040

Image Reject Mixer
8 to 26 GHz

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.

Pin Configuration

<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</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.

Ordering Information

<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.

Image Reject Mixer
8 to 26 GHz

Electrical Specifications:

<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</td>
<td>8 - 12 GHz</td>
<td>dB</td>
<td>8</td>
<td>9</td>
<td>9.5</td>
</tr>
<tr>
<td></td>
<td>12 - 26 GHz</td>
<td></td>
<td></td>
<td></td>
<td>11.5</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>—</td>
<td>17</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>—</td>
<td>12</td>
<td>—</td>
</tr>
</tbody>
</table>

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

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>-40°C to +85°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-65°C to +150°C</td>
</tr>
</tbody>
</table>

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.

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.
MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.
Visit www.macom.com for additional data sheets and product information.

For further information and support please visit:
https://www.macom.com/support

DC-0021879
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

**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 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

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

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

- **Amplitude Imbalance over LO drive**

- **Phase Imbalance over LO drive**

MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice. Visit [www.macom.com](http://www.macom.com) for additional data sheets and product information.
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

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

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

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

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

![Graph showing Down Conversion Gain over LO drive](image)

**Down Conversion Image Rejection over LO drive**

Data captured with 90deg hybrid at 2GHz IF

![Graph showing Down Conversion Image Rejection over LO drive](image)

**IIP3 over LO drive**

Data captured with 90deg hybrid at 2GHz IF

![Graph showing IIP3 over LO drive](image)

**IIP2 over LO drive**

Data captured with 90deg hybrid at 2GHz IF

![Graph showing IIP2 over LO drive](image)
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

![Graph of conversion gain over RF frequency](image)

**Down Conversion Image Rejection over LO drive**

- Data captured with 90deg hybrid at 2GHz IF

![Graph of image rejection over RF frequency](image)

**IIP3 over LO drive**

- Data captured with 90deg hybrid at 2GHz IF

![Graph of IIP3 over RF frequency](image)

**IIP2 over LO drive**

- Data captured with 90deg hybrid at 2GHz IF

![Graph of IIP2 over RF frequency](image)
Typical Performance Curves

**Isolations**

![Isolations Graph](image)

**IF Bandwidth**

![IF Bandwidth Graph](image)

**RF Return Loss**

![RF Return Loss Graph](image)

**P1dB vs LO power**

![P1dB vs LO power Graph](image)

**IF Return Loss**

![IF Return Loss Graph](image)
MxN Spurious Rejection at IF port

RF 15.9GHz at -10dBm, LO 16.0GHz at +14dBm

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>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

LO +14dBm

Values in dBC below input LO level measured at RF

<table>
<thead>
<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>
</tr>
<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
MACOM Technology Solutions Inc. All rights reserved.

Information in this document is provided in connection with MACOM Technology Solutions Inc ("MACOM") products. These materials are provided by MACOM as a service to its customers and may be used for informational purposes only. Except as provided in MACOM's Terms and Conditions of Sale for such products or in any separate agreement related to this document, MACOM assumes no liability whatsoever. MACOM assumes no responsibility for errors or omissions in these materials. MACOM may make changes to specifications and product descriptions at any time, without notice. MACOM makes no commitment to update the information and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to its specifications and product descriptions. No license, express or implied, by estoppels or otherwise, to any intellectual property rights is granted by this document.

THESE MATERIALS ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, RELATING TO SALE AND/OR USE OF MACOM PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, CONSEQUENTIAL OR INCIDENTAL DAMAGES, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT. MACOM FURTHER DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. MACOM SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS, WHICH MAY RESULT FROM THE USE OF THESE MATERIALS.

MACOM products are not intended for use in medical, lifesaving or life sustaining applications. MACOM customers using or selling MACOM products for use in such applications do so at their own risk and agree to fully indemnify MACOM for any damages resulting from such improper use or sale.

MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice. Visit www.macom.com for additional data sheets and product information.