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.

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

<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>—</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>12 - 26 GHz</td>
<td>—</td>
<td></td>
<td></td>
<td>9.5</td>
<td>11.5</td>
</tr>
<tr>
<td>Input P1dB</td>
<td>—</td>
<td>dBm</td>
<td>—</td>
<td>9</td>
<td>—</td>
</tr>
<tr>
<td>Input IP3 (P_{RF} = -10, \text{dBm/tone}, \Delta f = 1, \text{MHz})</td>
<td>dBm</td>
<td>—</td>
<td>17</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Input IP2</td>
<td>—</td>
<td>dBm</td>
<td>—</td>
<td>40</td>
<td>—</td>
</tr>
<tr>
<td>LO-to-RF Isolation</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>35</td>
<td>—</td>
</tr>
<tr>
<td>LO-to-IF Isolation</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>35</td>
<td>—</td>
</tr>
<tr>
<td>RF-to-IF Isolation</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>15</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>(\pm 2)</td>
<td>—</td>
</tr>
<tr>
<td>Phase Imbalance</td>
<td>—</td>
<td>°</td>
<td>—</td>
<td>(\pm 10)</td>
<td>—</td>
</tr>
<tr>
<td>RF Return Loss</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>6</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\(^4,5\)

<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 \(T_J \leq +150^\circ\, \text{C}\) will ensure MTTF > 1 x 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

**Down Conversion Image Rejection 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**
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

- **Down Conversion Image Rejection 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**
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

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

Down Conversion Image Rejection 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 Graph](image1)

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

![Image Rejection Graph](image2)

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 Graph](image3)

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

![Image Rejection Graph](image4)
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

**IIP2 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

**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

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

**Isolations**

**IF Bandwidth**

**RF Return Loss**

**P1dB vs LO power**

**IF Return Loss**
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>n LO spur at RF port</th>
<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>
<td></td>
</tr>
<tr>
<td>8</td>
<td>46.6</td>
<td>53.9</td>
<td>51.9</td>
<td>59.1</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>42.3</td>
<td>56.6</td>
<td>51.2</td>
<td>51.4</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>37.9</td>
<td>56.6</td>
<td>81.2</td>
<td>38.2</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>30.4</td>
<td>52.1</td>
<td>47.8</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>42.8</td>
<td>52.1</td>
<td>47.8</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>42.6</td>
<td>83.3</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>55.4</td>
<td>52.6</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>39.9</td>
<td>54.4</td>
<td>N/A</td>
<td>N/A</td>
<td></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>
<td></td>
</tr>
<tr>
<td>26</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td></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

LO Harmonics

*LO +14dBm*

Values in dBc below input LO level measured at RF

<table>
<thead>
<tr>
<th>n LO spur at RF port</th>
<th>LO GHz</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>

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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