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: 8.0 dB typical
- Operates at low LO level of +10 dBm
- LO Power Operating Range: 10-18 dBm
- Nominal LO drive of +14 dBm
- 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 +14 dBm. However, the MAMX-011040 exhibits excellent Conversion Loss and Image Rejection performance at 10 dBm. The overall LO operating range is +10 dBm to +18 dBm. 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.

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Electrical Specifications:\footnote{5} \(F_{IF} = 100\) MHz, \(P_{\text{LO}} = +14\) 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</td>
<td>—</td>
<td>dB</td>
<td>8</td>
<td>9</td>
<td>11.5</td>
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<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>±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>—</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\footnote{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\footnote{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.

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 Gain over LO drive graph](image)

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

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

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

![IIP3 over LO drive graph](image)

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

![IIP2 over LO drive graph](image)

**Amplitude Imbalance over LO drive**

![Amplitude Imbalance over LO drive graph](image)

**Phase Imbalance over LO drive**

![Phase Imbalance over LO drive graph](image)
Image Reject Mixer
8 to 26 GHz

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

![Conversion Gain over temperature](image1)

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

![Image Rejection over temperature](image2)

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

![IIP3 over temperature](image3)

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

![IIP2 over temperature](image4)
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
Image Reject Mixer
8 to 26 GHz
Rev. V1

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

<table>
<thead>
<tr>
<th>Down Conversion Gain over LO drive</th>
<th>Down Conversion Image Rejection over LO drive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data captured with 90deg hybrid at 2GHz IF</td>
<td></td>
</tr>
</tbody>
</table>

![Conversion Gain Graph](image1)

![Image Rejection Graph](image2)

<table>
<thead>
<tr>
<th>IIP3 over LO drive</th>
<th>IIP2 over LO drive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data captured with 90deg hybrid at 2GHz IF</td>
<td></td>
</tr>
</tbody>
</table>

![IIP3 Graph](image3)

![IIP2 Graph](image4)
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

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DC-0021879
MAMX-011040

Image Reject Mixer
8 to 26 GHz

Rev. V1

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>nxLO</th>
<th>mxRF</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<tbody>
<tr>
<td>0</td>
<td>x</td>
<td>11</td>
<td>14</td>
<td>28</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>22</td>
<td>0</td>
<td>52</td>
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<td>46</td>
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<tr>
<td>2</td>
<td>82</td>
<td>68</td>
<td>61</td>
<td>58.6</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>74.9</td>
<td>X</td>
<td>90</td>
<td>79</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>x</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>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>
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<tr>
<td>12</td>
<td>37.9</td>
<td>56.6</td>
<td>81.2</td>
<td>38.2</td>
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<tr>
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<td>30.4</td>
<td>52.1</td>
<td>47.8</td>
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</tr>
<tr>
<td>16</td>
<td>42.8</td>
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<td>47.8</td>
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<tr>
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<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

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