Transceiver
21 - 27 GHz

Features
- Conversion Gain:
  \( T_X = 3 \text{ dB} \)
  \( R_X = 11 \text{ dB} \)
- Receive:
  \( \text{Noise Figure} = 3 \text{ dB} \)
  \( \text{IIP3} = +5 \text{ dBm} \)
- Transmit:
  \( \text{IM3} = -40 \text{ dBc} @ 0 \text{ dBm} \)
- LO: 8 - 10 GHz & 0 dBm Drive
- Wide IF Bandwidth = 0.1 - 6.0 GHz
- Single 5 Volt DC Bias, 180 mA
- Lead-Free 4 mm 24-lead PQFN Package
- Halogen-Free “Green” Mold Compound
- RoHS* Compliant and 260°C Reflow Compatible

Description
The MAMF-011024 is a 21 - 27 GHz transceiver IC. It integrates an LNA, PA, \( T_X/R_X \) switch, bi-directional mixer, filtering, and LO frequency x2 multiplier with amplification. This device is assembled in a lead-free 4 mm 24 lead PQFN surface mount plastic package.

This transceiver operates either in receive or in transmit TDD (Time Division Duplex) mode. Receive and transmit circuitry can be turned off during transmit and receive, respectively. The \( T_X/R_X \) switch can be operated independently of the power up timing. It is powered from a single positive 5 V bias.

The MAMF-011024 is ideally suited for unlicensed 24 GHz ISM band applications.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAMF-011024 -TR0500</td>
<td>500 piece reel</td>
</tr>
<tr>
<td>MAMF-011024 -SMB</td>
<td>Sample Test Board</td>
</tr>
</tbody>
</table>

1. Reference Application Note M513 for reel size information.
2. All sample boards include 3 loose parts.

**Electrical Specifications:** $T_A = 25^\circ C$, RF = 24 GHz, IF = 5.6 GHz, LO = 9.2 GHz, 0 dBm, $Z_0 = 50 \ \Omega$, VDT = VDR = VDLO = 5 V, Control / Bias Adjust Voltages$^5 = 0 / 5$ V

<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: Drive Power</td>
<td>—</td>
<td>dBm</td>
<td>—</td>
<td>0</td>
<td>—</td>
</tr>
<tr>
<td>LO: Return Loss</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>12</td>
<td>—</td>
</tr>
<tr>
<td>$R_{X}$: Down Conversion Gain</td>
<td>—</td>
<td>dB</td>
<td>9</td>
<td>11</td>
<td>—</td>
</tr>
<tr>
<td>$R_{X}$: Noise Figure</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>3</td>
<td>—</td>
</tr>
<tr>
<td>$R_{X}$: Return Loss</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>11</td>
<td>—</td>
</tr>
<tr>
<td>$R_{X}$: Input IP3</td>
<td>—</td>
<td>dBm</td>
<td>—</td>
<td>+5</td>
<td>—</td>
</tr>
<tr>
<td>$R_{X}$: LO Isolation</td>
<td>LO to IF port, LO Frequency, 2xLO Frequency, 3xLO Frequency</td>
<td>dB</td>
<td>22</td>
<td>33</td>
<td>55</td>
</tr>
<tr>
<td>$T_X$: Up Conversion Gain</td>
<td>—</td>
<td>dB</td>
<td>1</td>
<td>3</td>
<td>—</td>
</tr>
<tr>
<td>$T_X$: Output Noise</td>
<td>—</td>
<td>dBm/Hz</td>
<td>—</td>
<td>-85</td>
<td>—</td>
</tr>
<tr>
<td>$T_X$: Return Loss</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>15</td>
<td>—</td>
</tr>
<tr>
<td>$T_X$: Output IM3</td>
<td>+5 dBm $P_{OUT}$</td>
<td>dBC</td>
<td>—</td>
<td>-40</td>
<td>—</td>
</tr>
<tr>
<td>$T_X$: LO Isolation</td>
<td>LO to $T_X$ port, LO Frequency, 2xLO Frequency, 3xLO Frequency</td>
<td>dB</td>
<td>48</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>IF: Return Loss</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>7</td>
<td>—</td>
</tr>
<tr>
<td>Isolation</td>
<td>$T_X$ Mode, $R_X$ to IF, $R_X$ Mode, $T_X$ to IF</td>
<td>dB</td>
<td>69</td>
<td>58</td>
<td>—</td>
</tr>
<tr>
<td>Current (sum of all DC currents)</td>
<td>$T_X$ Mode, $R_X$ Mode, Standby Mode</td>
<td>mA</td>
<td>110</td>
<td>150</td>
<td>170</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>120</td>
<td>160</td>
<td>180</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>—</td>
<td>&lt;1</td>
<td>—</td>
</tr>
</tbody>
</table>

5. See Truth Table.
Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Power (R_x)</td>
<td>+15 dBm</td>
</tr>
<tr>
<td>Input Power (LO, IF)</td>
<td>+10 dBm</td>
</tr>
<tr>
<td>Voltage</td>
<td>6 V</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>

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.

Handling Procedures
Please observe the following precautions to avoid damage:

Static Sensitivity
Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

Truth Table

<table>
<thead>
<tr>
<th>Mode / Pin</th>
<th>VBLO (V)</th>
<th>VBT (V)</th>
<th>VBR (V)</th>
<th>VCT (V)</th>
<th>VCR (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R_x</td>
<td>+5</td>
<td>0</td>
<td>+5</td>
<td>0</td>
<td>+5</td>
</tr>
<tr>
<td>T_x</td>
<td>+5</td>
<td>+5</td>
<td>0</td>
<td>+5</td>
<td>0</td>
</tr>
<tr>
<td>Standby</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
The MAMF-011024 is designed to be easy to use yet high performance. The ultra small size and simple bias allow easy placement on any system board. It requires no matching or external tuning elements; all RF ports are matched to 50 Ω.

The MAMF-011024 requires only a single +5 V power supply to operate. All VDx and VBx lines can be tied to the +5 V (with appropriate bypass capacitors) for simple operation. See the Truth Table for Tₓ/Rₓ/Standby modes of operation.

### Parts List

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1 - C6</td>
<td>0.22 µF</td>
<td>0201</td>
</tr>
</tbody>
</table>

### Application Schematic
RX (Receive) Typical Performance for Down-Conversion

Gain

![Gain Graph](image)

Input IP3

![Input IP3 Graph](image)

Noise Figure

![Noise Figure Graph](image)

Input IP3 vs. IF Frequency, LO = 0 dBm

![Input IP3 vs IF Graph](image)

Isolation LO to IF

![Isolation LO to IF Graph](image)

Conversion Gain vs. IF Frequency

![Conversion Gain vs IF Graph](image)
**TX (Transmit) Typical Performance for Up-Conversion**

**Gain**

- Frequency vs. Temperature

**Output IM3 @ 5 dBm**

- Frequency vs. Temperature

**Output Noise**

- Frequency vs. Temperature

**Output IM3 @ LO Input Power**

- Frequency vs. LO Power

**Isolation LO to TX**

- Frequency vs. LO Power

**Conversion Gain vs. IF Frequency**

- Frequency vs. IF Frequency

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Typical Performance

**R\text{X}/T\text{X} Input Return Loss**

- **LO Return Loss vs. LO Frequency**
  - Frequency (GHz) range: 7 to 11
  - Return Loss in dB range: -20 to 0 dB

- **IF Return Loss vs. IF Frequency**
  - Frequency (GHz) range: 0 to 10
  - Return Loss in dB range: -20 to 0 dB

- **TX Output Spectrum**
  - Spurious Response (dBm) range: -50 to 0 dBm
  - Frequency (GHz) range: LO - IF to LO x4

- **RX Conversion Gain vs. LO Drive**
  - Frequency (GHz) range: -6 to 6
  - Conversion Gain in dB range: 0 to 20 dB

- **TX Conversion Gain vs. LO Drive**
  - Frequency (GHz) range: -6 to 6
  - Conversion Gain in dB range: 0 to 20 dB

For further information and support please visit: https://www.macom.com/support
Lead-Free 4 mm 24-Lead PQFN†

† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.
Plating is NiPdAuAg.

NOTES:
1. Reference JEDEC MO-220, V01, V000-6 for additional dimensional and tolerance information.
2. Reference S2083 application note for PCB footprint information.
3. All dimensions shown as inches [mm].