Voltage Controlled Oscillator
11.0 – 11.82 GHz

Features
- Low Phase Noise
- Wide Tuning Range
- Divide-by-Two Output
- Integrated Buffer Amplifier
- Excellent Temperature Stability
- +5V Bias Supply
- Lead-Free 5 mm 32-Lead PQFN Package
- Halogen-Free "Green" Mold Compound
- RoHS* Compliant and 260°C Reflow Compatible

Description
The MAOC-009872 is an InGaP HBT-based voltage controlled oscillator for frequency generation. No external matching components are required. This VCO is easily integrated into a phase lock loop using the divide-by-two output. The extremely low phase noise makes this part ideal for many radio applications including high capacity digital radios.

The MAOC-009872 primary applications are Point-to-Point Radio, Point-to-Multipoint Radio, Communications Systems, and Low Phase Noise applications.

The 5 mm PQFN package has a lead-free finish that is RoHS compliant and compatible with a 260°C reflow temperature. The package also features low lead inductance and an excellent thermal path.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAOC-009872-TR0500</td>
<td>500 piece reel</td>
</tr>
<tr>
<td>MAOC-009872-TR1000</td>
<td>1000 piece reel</td>
</tr>
<tr>
<td>MAOC-009872-001SMB</td>
<td>Sample Board</td>
</tr>
</tbody>
</table>

1. Reference Application Note M513 for reel size information.


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Electrical Specifications: $T_A = +25°C$, $V_{CC} = V_{BUFFER} = 5 V$, $Z_0 = 50 \Omega$

<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>Output Power</td>
<td>RF Port, 11.0 - 11.82 GHz RF/2 Port, 5.5 - 5.91 GHz</td>
<td>dBm</td>
<td>5</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>SSB Phase Noise</td>
<td>RF Port, 10 kHz Offset RF Port, 100 kHz Offset</td>
<td>dBC/Hz</td>
<td>—</td>
<td>-83</td>
<td>—</td>
</tr>
<tr>
<td>Harmonics/Subharmonics $V_{CC}=V_{BUFFER}=V_{TUNE}=5V$</td>
<td>RF Port, $1/2 F_0$ RF/2 Port, 2$F_0$</td>
<td>dBC</td>
<td>—</td>
<td>-20</td>
<td>—</td>
</tr>
<tr>
<td>Pulling (Sensitivity to Match)</td>
<td>RF Port, VSWR = 1.95:1 to 2.25:1</td>
<td>MHz pk-pk</td>
<td>—</td>
<td>11.0</td>
<td>—</td>
</tr>
<tr>
<td>Pushing (Sensitivity to Supply Voltage)</td>
<td>RF Port, $V_{TUNE} = 5 V$ RF/2 Port, $V_{TUNE} = 5 V$</td>
<td>MHz/V</td>
<td>5</td>
<td>2.5</td>
<td>—</td>
</tr>
<tr>
<td>Frequency Drift Rate (Sensitivity to Temperature)</td>
<td>RF Port, 11.0 - 11.82 GHz RF/2 Port, 5.5 - 5.91 GHz</td>
<td>MHz/ºC</td>
<td>0.8</td>
<td>0.5</td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>RF Port, 11.0 - 11.82 GHz RF/2 Port, 5.5 - 5.91 GHz</td>
<td>dB</td>
<td>—</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Tuning Sensitivity @ RF Port</td>
<td>$V_{TUNE}=5 V$</td>
<td>GHz/V</td>
<td>—</td>
<td>0.19</td>
<td>—</td>
</tr>
<tr>
<td>Supply Current</td>
<td>$I_{TOTAL} = (I_{CC} + I_{BUFFER})$</td>
<td>mA</td>
<td>—</td>
<td>165</td>
<td>195</td>
</tr>
<tr>
<td>Tune Voltage</td>
<td>$V_{TUNE}$</td>
<td>V</td>
<td>2</td>
<td>—</td>
<td>13</td>
</tr>
<tr>
<td>Tuning Current Leakage</td>
<td>$V_{TUNE}=13 V$</td>
<td>µA</td>
<td>—</td>
<td>5</td>
<td>10</td>
</tr>
</tbody>
</table>

3. VCO can operate over the 4.75 V to 5.25 V supply voltage range.

**Absolute Maximum Ratings**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage ($V_{CC} &amp; V_{BUFFER}$)</td>
<td>+5.5 Vdc</td>
</tr>
<tr>
<td>$V_{TUNE}$</td>
<td>0 to +15 Vdc</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-55ºC to +150ºC</td>
</tr>
<tr>
<td>Operating Temperature$^b$</td>
<td>-40ºC to +85ºC</td>
</tr>
<tr>
<td>Case Temperature (T$_C$) (measured @ exposed pad)</td>
<td>+100ºC</td>
</tr>
<tr>
<td>Junction Temperature$^c$</td>
<td>+135ºC</td>
</tr>
</tbody>
</table>

4. Exceeding any one or combination of these limits may cause permanent damage to this device.
5. MACOM does not recommend sustained operation near these survivability limits.
6. Operating at nominal conditions with $T_J \leq 135ºC$ will ensure MTTF > 1 x 10^6 hours.
7. Junction Temperature ($T_J$) = $T_C + \Theta_jc * (V * I)$
   Typical thermal resistance ($\Theta_jc$) = 35º C/W.
   a) For $T_C = 25ºC$, $T_J = 53.9ºC @ 5 V$, 165 mA
   b) For $T_C = 85ºC$, $T_J = 114.8ºC @ 5 V$, 170 mA

**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 Class 1B devices.

**ESD Rating: 1B**

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Typical Performance Curves: \( V_{\text{CC}} = V_{\text{BUFFER}} = 5V, T_A = +25^\circ C \) (unless otherwise indicated)
Typical Performance Curves: $V_{CC} = V_{BUFFER} = 5\text{V}$, $T_A = +25^\circ\text{C}$ (unless otherwise indicated)

**Frequency Sensitivity vs. Tuning Voltage - RF Port**

![Graph of Frequency Sensitivity vs. Tuning Voltage - RF Port]

**Frequency Sensitivity vs. Tuning Voltage - RF2 Port**

![Graph of Frequency Sensitivity vs. Tuning Voltage - RF2 Port]

**Single Side Band Phase Noise vs. Tuning Voltage - RF Port**

![Graph of Single Side Band Phase Noise vs. Tuning Voltage - RF Port]

**Single Side Band Phase Noise vs. Frequency Offset - RF Port ($V_{TUNE} = 5\text{V}$)**

![Graph of Single Side Band Phase Noise vs. Frequency Offset - RF Port]

**Pushing - RF Port**

![Graph of Pushing - RF Port]

**Temperature Drift - RF Port**

![Graph of Temperature Drift - RF Port]
Sample Board

Parts List

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
<th>Case Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>100 pF</td>
<td>0402</td>
</tr>
<tr>
<td>C2, C3, C4</td>
<td>0.1 µF</td>
<td>0402</td>
</tr>
<tr>
<td>C5</td>
<td>10 µF Tantalum</td>
<td>1206</td>
</tr>
<tr>
<td>C6</td>
<td>0 Ω</td>
<td>0402</td>
</tr>
</tbody>
</table>

Lead-Free 5 mm 32-Lead PQFN†

NOTES:
1. Reference JEDEC MO-220-VHHD-5 for additional dimensional and tolerance information.
2. All dimensions shown as in/mm.

†Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.
Plating is 100% matte tin over copper.
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