MAOC-113100

Broadband Voltage Controlled Oscillator
12.5 - 13.7 GHz

Features

- Phase Noise: -81/-109dBc/Hz @ 10/100kHz
- Wide Tuning Range
- Low Current Consumption: 90 mA
- Excellent Temperature Stability
- Proven Microphonic Performance
- +5 V Bias
- Lead-Free 5 mm 32-Lead Package
- Halogen-Free “Green” Mold Compound
- RoHS* Compliant and 260°C Reflow Compatible

Description

The MAOC-113100 is a 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-113100 primary applications are Point-to-Point Radio, Point-to-Multipoint Radio, Communications Systems, and Low Phase Noise applications.

The 5 mm package has a lead-free finish that is RoHS compliant and compatible with a 260°C reflow temperature. The package 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-113100-TR0500</td>
<td>500 Part Reel</td>
</tr>
<tr>
<td>MAOC-113100-TR1000</td>
<td>1000 Part Reel</td>
</tr>
<tr>
<td>MAOC-113100-001SMB</td>
<td>Sample Board</td>
</tr>
</tbody>
</table>

1. Reference Application Note M513 for reel size information.

Pin Configuration²

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 11</td>
<td>N/C</td>
</tr>
<tr>
<td>12</td>
<td>RF/2</td>
</tr>
<tr>
<td>13 - 18</td>
<td>N/C</td>
</tr>
<tr>
<td>19</td>
<td>RF</td>
</tr>
<tr>
<td>20</td>
<td>N/C</td>
</tr>
<tr>
<td>21</td>
<td>V_CC</td>
</tr>
<tr>
<td>22 - 28</td>
<td>N/C</td>
</tr>
<tr>
<td>29</td>
<td>V_TUNE</td>
</tr>
<tr>
<td>30 - 32</td>
<td>N/C</td>
</tr>
<tr>
<td>33³</td>
<td>GND</td>
</tr>
</tbody>
</table>

2. MACOM recommends connecting unused package pins to ground.
3. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

Broadband Voltage Controlled Oscillator
12.5 - 13.7 GHz

**Electrical Specifications:** \(T_A = +25^\circ\text{C}, V_{CC} = 5.0 \text{ V}^4, Z_0 = 50 \Omega\)

<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, 12.5 - 13.7 GHz</td>
<td>dBM</td>
<td>3</td>
<td>8</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>RF/2 Port, 6.25 - 6.85 GHz</td>
<td></td>
<td>-1</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>SSB Phase Noise</td>
<td>RF Port, 10 kHz Offset, 12.5 - 13.7 GHz</td>
<td>dBC/Hz</td>
<td>—</td>
<td>-81</td>
<td>-109</td>
</tr>
<tr>
<td></td>
<td>RF Port, 100 kHz Offset, 12.5 - 13.7 GHz</td>
<td></td>
<td></td>
<td>-109</td>
<td>-104</td>
</tr>
<tr>
<td>Harmonics/Subharmonics</td>
<td>RF Port, (\frac{1}{2} F_0)</td>
<td>dBC</td>
<td>—</td>
<td>-30</td>
<td>—</td>
</tr>
<tr>
<td>(V_{CC} = V_{TUNE} = 5 \text{ V})</td>
<td>RF Port, 2 (F_0)</td>
<td></td>
<td></td>
<td>-37</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>9</td>
<td>—</td>
</tr>
<tr>
<td>Pulling (Sensitivity to Supply Voltage)</td>
<td>RF Port, (V_{TUNE} = 5 \text{ V})</td>
<td>MHz/V</td>
<td>—</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Pushing (Sensitivity to Supply Voltage)</td>
<td>RF Port, (V_{TUNE} = 5 \text{ V})</td>
<td>MHz/V</td>
<td>—</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Frequency Drift Rate (Sensitivity to Temperature)</td>
<td>RF Port, 12.5 - 13.7 GHz</td>
<td>MHz/(^\circ\text{C})</td>
<td>—</td>
<td>1.5</td>
<td>0.75</td>
</tr>
<tr>
<td></td>
<td>RF/2 Port, 6.25 - 6.85 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>RF Port, 12.5 - 13.7 GHz</td>
<td>dB</td>
<td>—</td>
<td>8.0</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>RF/2 Port, 6.25 - 6.85 GHz</td>
<td></td>
<td></td>
<td>4.0</td>
<td>—</td>
</tr>
<tr>
<td>Tuning Sensitivity @ RF Port</td>
<td>(V_{TUNE} = 5 \text{ V})</td>
<td>GHz/V</td>
<td>—</td>
<td>0.25</td>
<td>—</td>
</tr>
<tr>
<td>Supply Current</td>
<td>(I_{CC})</td>
<td>mA</td>
<td>—</td>
<td>90</td>
<td>130</td>
</tr>
<tr>
<td>Tune Voltage</td>
<td>(V_{TUNE})</td>
<td>V</td>
<td>1.5</td>
<td>—</td>
<td>12.5</td>
</tr>
<tr>
<td>Tuning Current Leakage</td>
<td>(V_{TUNE} = 13 \text{ V})</td>
<td>(\mu\text{A})</td>
<td>—</td>
<td>5</td>
<td>—</td>
</tr>
</tbody>
</table>

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

**Absolute Maximum Ratings** \(^5,6,7\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</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>-55°C to +150°C</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>Junction Temperature (^8)</td>
<td>+150°C</td>
</tr>
</tbody>
</table>

5. Exceeding any one or combination of these limits may cause permanent damage to this device.
6. MACOM does not recommend sustained operation near these survivability limits.
7. Operating at nominal conditions with \(T_J \leq +150^\circ\text{C}\) will ensure MTBF > 1 x 10\(^6\) hours.
8. Junction Temperature \((T_J) = T_C + \Theta_{JC} \times (V \times I)\)
   Typical thermal resistance \((\Theta_{JC}) = 42^\circ\text{C/W}\).
   a) For \(T_C = 25^\circ\text{C}, T_J = 44^\circ\text{C} @ 5 \text{ V}, 90 \text{ mA}\)
   b) For \(T_C = 85^\circ\text{C}, T_J = 104^\circ\text{C} @ 5 \text{ V}, 91 \text{ mA}\)

**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 1B devices.

**Static Sensitive Devices Handling Procedures Requires**

**ESD Rating:** Class 1B

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

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

![Graph showing frequency sensitivity vs. tuning voltage for RF port]

**Frequency Sensitivity vs. Tuning Voltage - RF/2 Port**

![Graph showing frequency sensitivity vs. tuning voltage for RF/2 port]

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

![Graph showing single side band phase noise vs. tuning voltage for RF port]

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

![Graph showing single side band phase noise vs. frequency offset for 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, C4</td>
<td>0.1 µF</td>
<td>0402</td>
</tr>
<tr>
<td>C5</td>
<td>10 µF Tantalum</td>
<td>1206</td>
</tr>
</tbody>
</table>

Lead-Free 5 mm 32-Lead PQFN†

† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 3 requirements.
Plating is ENEPIG over copper.
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