

## Voltage Controlled Oscillator

### 11.0 – 11.8 GHz

Rev. V4

#### 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.

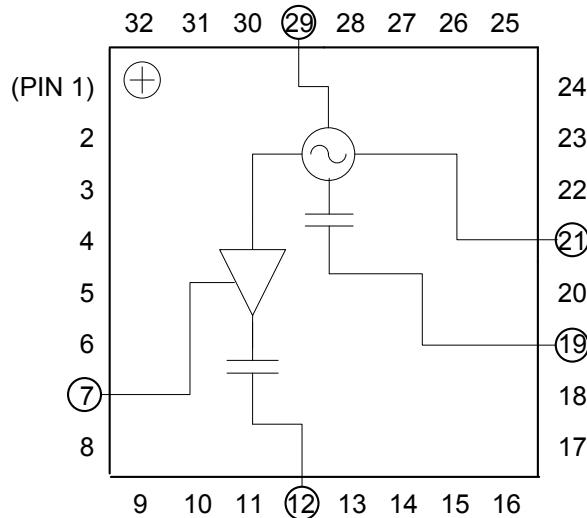
The 5 mm PQFN package has a lead-free finish that is RoHS compliant and compatible with a 260°C reflow temperature. The package also features low lead inductance and an excellent thermal path.

#### Ordering Information<sup>1</sup>

Part Number	Package
MAOC-009872-TR0500	500 piece reel
MAOC-009872-TR1000	1000 piece reel
MAOC-009872-001SMB	Sample Board

1. Reference Application Note M513 for reel size information.

#### Block Diagram



#### Pin Designations<sup>2</sup>

Pin	Function	Pin	Function
1	N/C	17	N/C
2	N/C	18	N/C
3	N/C	19	RF
4	N/C	20	N/C
5	N/C	21	V <sub>CC</sub>
6	N/C	22	N/C
7	V <sub>BUFFER</sub>	23	N/C
8	N/C	24	N/C
9	N/C	25	N/C
10	N/C	26	N/C
11	N/C	27	N/C
12	RF/2	28	N/C
13	N/C	29	V <sub>TUNE</sub>
14	N/C	30	N/C
15	N/C	31	N/C
16	N/C	32	N/C

2. The exposed pad centered on the package bottom must be connected to RF and DC ground. Connecting all N/C pins to RF/DC Ground in the layout is also recommended.

\* Restrictions on Hazardous Substances, European Union Directive 2002/95/EC.

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#### Electrical Specifications: $T_A = +25^\circ\text{C}$ , $V_{CC} = V_{BUFFER} = 5 \text{ V}^3$ , $Z_0 = 50 \Omega$

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Output Power	RF Port, 11.0 - 11.8 GHz RF/2 Port, 5.5 - 5.9 GHz	dBm	5 2	7 5	—
SSB Phase Noise	RF Port, 10 kHz Offset RF Port, 100 kHz Offset	dBc/Hz	—	-83 -112	—
Harmonics/Subharmonics $V_{CC}=V_{BUFFER}=V_{TUNE}=5\text{V}$	RF Port, $\frac{1}{2}F_o$ RF/2 Port, $2F_o$	dBc	—	-20 -9	—
Pulling (Sensitivity to Match) $V_{CC}=V_{BUFFER}=V_{TUNE}=5\text{V}$	RF Port, VSWR = 1.95:1 to 2.25:1	MHz pk-pk	—	11.0	—
Pushing (Sensitivity to Supply Voltage)	RF Port, $V_{TUNE} = 5 \text{ V}$ RF/2 Port, $V_{TUNE} = 5 \text{ V}$	MHz/V	—	5 2.5	—
Frequency Drift Rate (Sensitivity to Temperature)	RF Port, 11.0 - 11.8 GHz RF/2 Port, 5.5 - 5.9 GHz	MHz/ $^\circ\text{C}$	—	0.8 0.5	—
Output Return Loss	RF Port, 11.0 - 11.8 GHz RF/2 Port, 5.5 - 5.9 GHz	dB	—	3 5	—
Tuning Sensitivity @ RF Port	$V_{TUNE}=5 \text{ V}$	GHz/V	—	0.19	—
Supply Current	$I_{TOTAL} (I_{CC} + I_{BUFFER})$ $I_{CC}$ $I_{BUFFER}$	mA	— — —	165 145 20	195 165 30
Tune Voltage	$V_{TUNE}$	V	2	—	13
Tuning Current Leakage	$V_{TUNE}=13 \text{ V}$	$\mu\text{A}$	—	5	10

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

#### Absolute Maximum Ratings<sup>4,5</sup>

Parameter	Absolute Maximum
Supply Voltage ( $V_{CC}$ & $V_{BUFFER}$ )	+5.5 Vdc
$V_{TUNE}$	0 to +15 Vdc
Storage Temperature	-55°C to +150°C
Operating Temperature <sup>6</sup>	-40°C to +85°C
Case Temperature ( $T_C$ ) (measured @ exposed pad)	+100°C
Junction Temperature <sup>7</sup>	+135°C

- Exceeding any one or combination of these limits may cause permanent damage to this device.
- MACOM does not recommend sustained operation near these survivability limits.
- Operating at nominal conditions with  $T_J \leq 135^\circ\text{C}$  will ensure  $MTTF > 1 \times 10^6$  hours.
- Junction Temperature ( $T_J$ ) =  $T_C + \Theta_{JC} * (V * I)$   
Typical thermal resistance ( $\Theta_{JC}$ ) = 35° C/W.
  - For  $T_C = 25^\circ\text{C}$ ,  $T_J = 53.9^\circ\text{C}$  @ 5 V, 165 mA
  - For  $T_C = 85^\circ\text{C}$ ,  $T_J = 114.8^\circ\text{C}$  @ 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

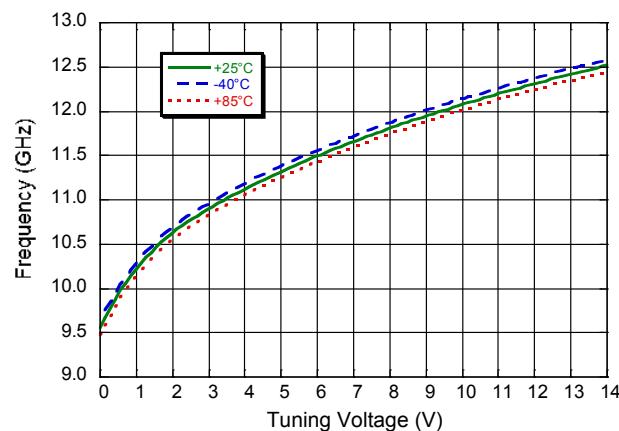
## Voltage Controlled Oscillator

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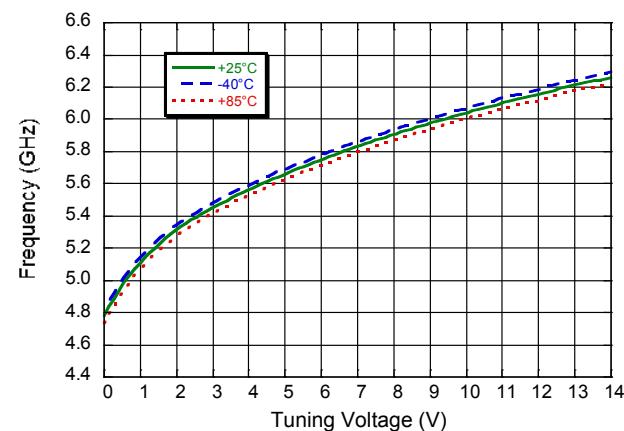
Rev. V4

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

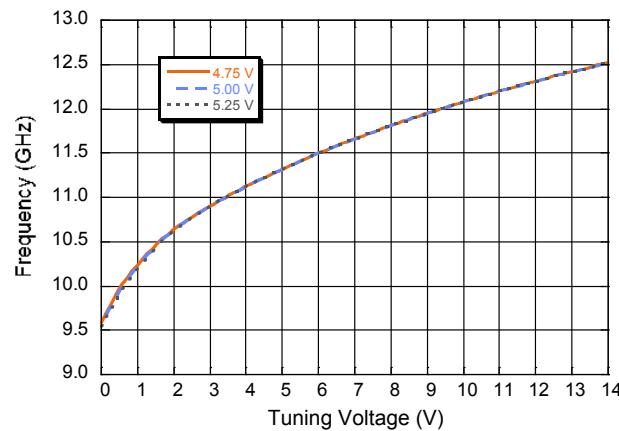
**Output Frequency vs. Tuning Voltage - RF Port**



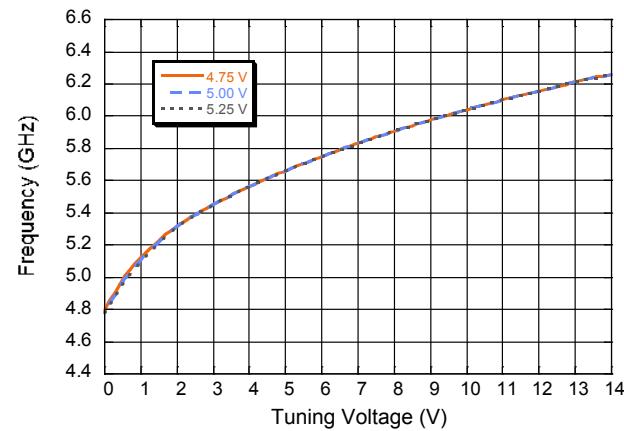
**Output Frequency vs. Tuning Voltage - RF/2 Port**



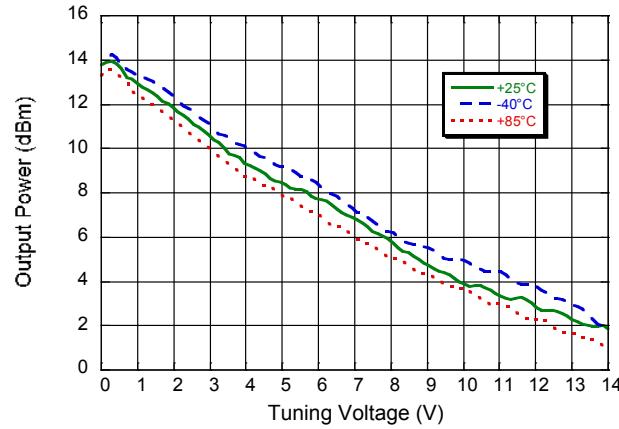
**Output Frequency vs. Tuning / Supply Voltage - RF Port**



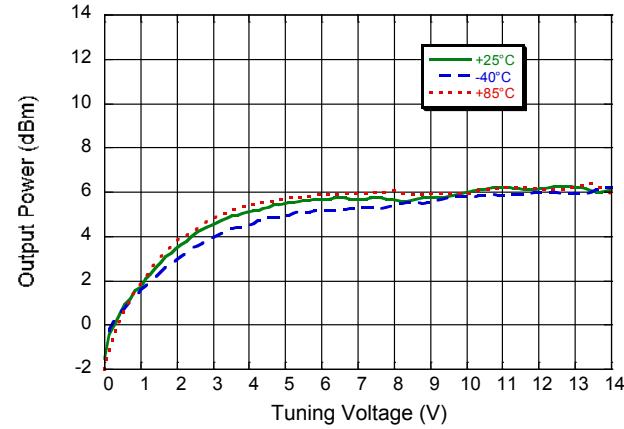
**Output Frequency vs. Tuning / Supply Voltage - RF2 Port**



**Output Power vs. Tuning Voltage - RF Port**



**Output Power vs. Tuning Voltage - RF2 Port**



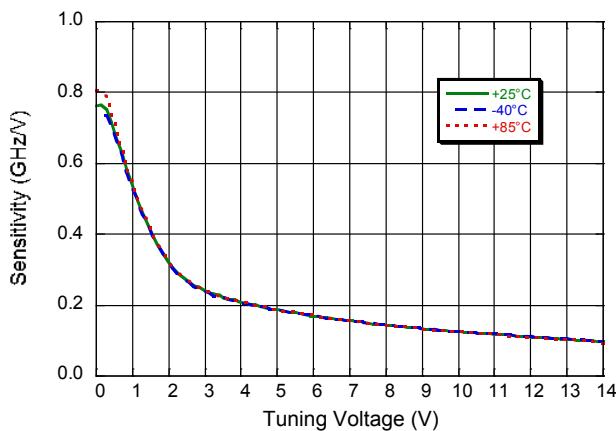
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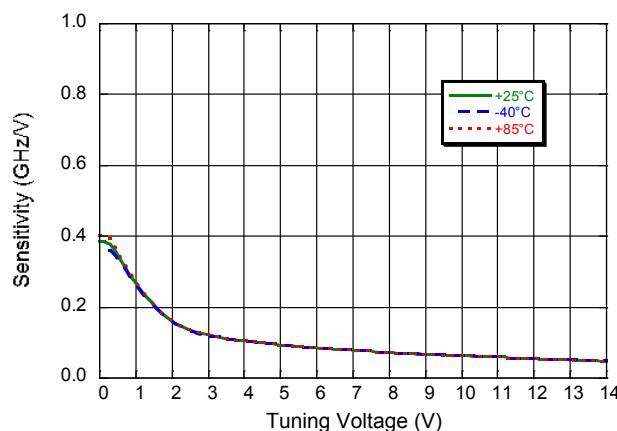
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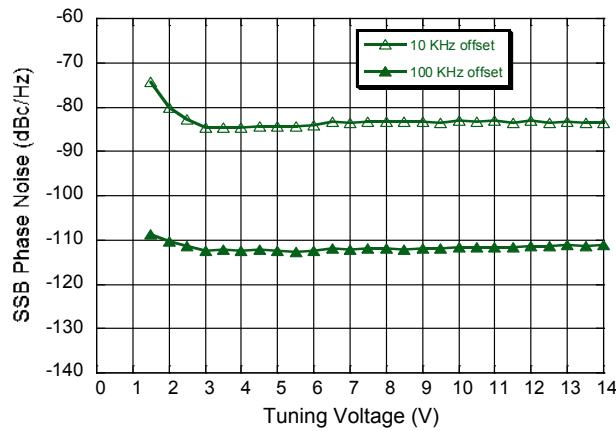
**Frequency Sensitivity vs. Tuning Voltage - RF Port**



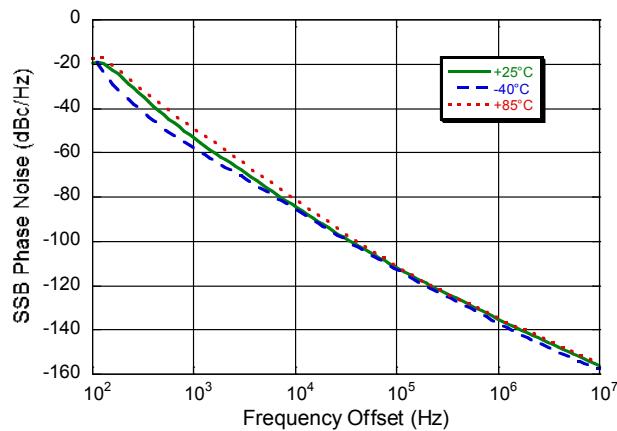
**Frequency Sensitivity vs. Tuning Voltage - RF2 Port**



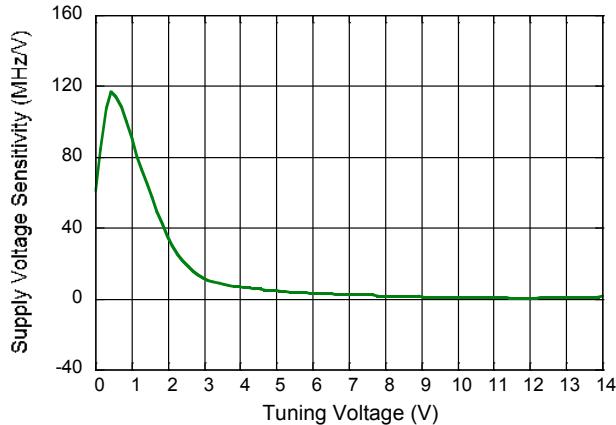
**Single Side Band Phase Noise vs. Tuning Voltage - RF Port**



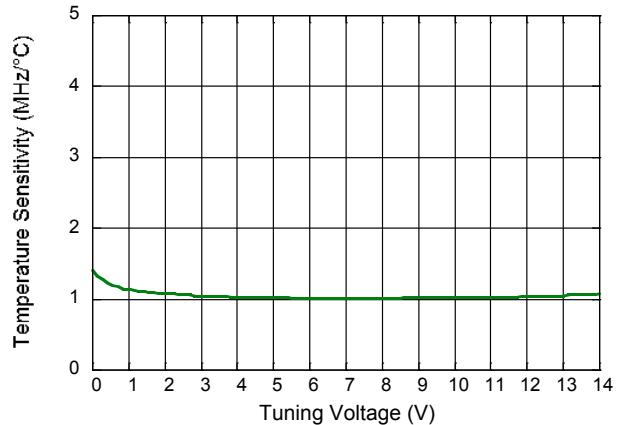
**Single Side Band Phase Noise vs. Frequency Offset - RF Port ( $V_{TUNE} = 5V$ )**



**Pushing - RF Port**



**Temperature Drift - RF Port**

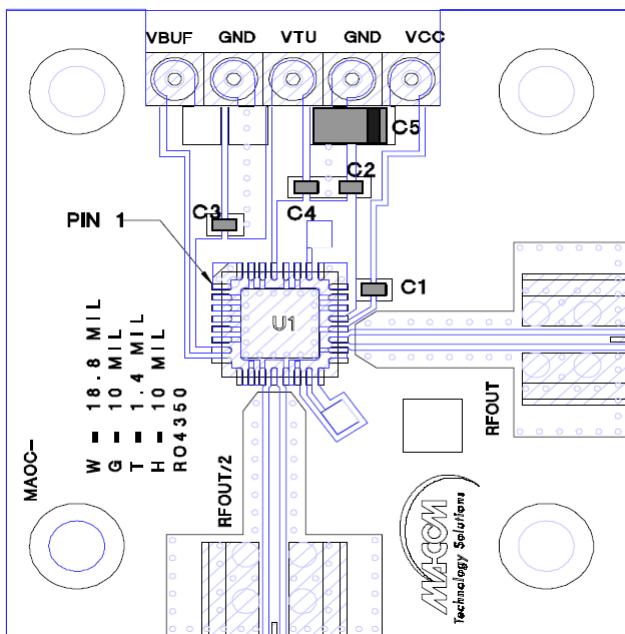


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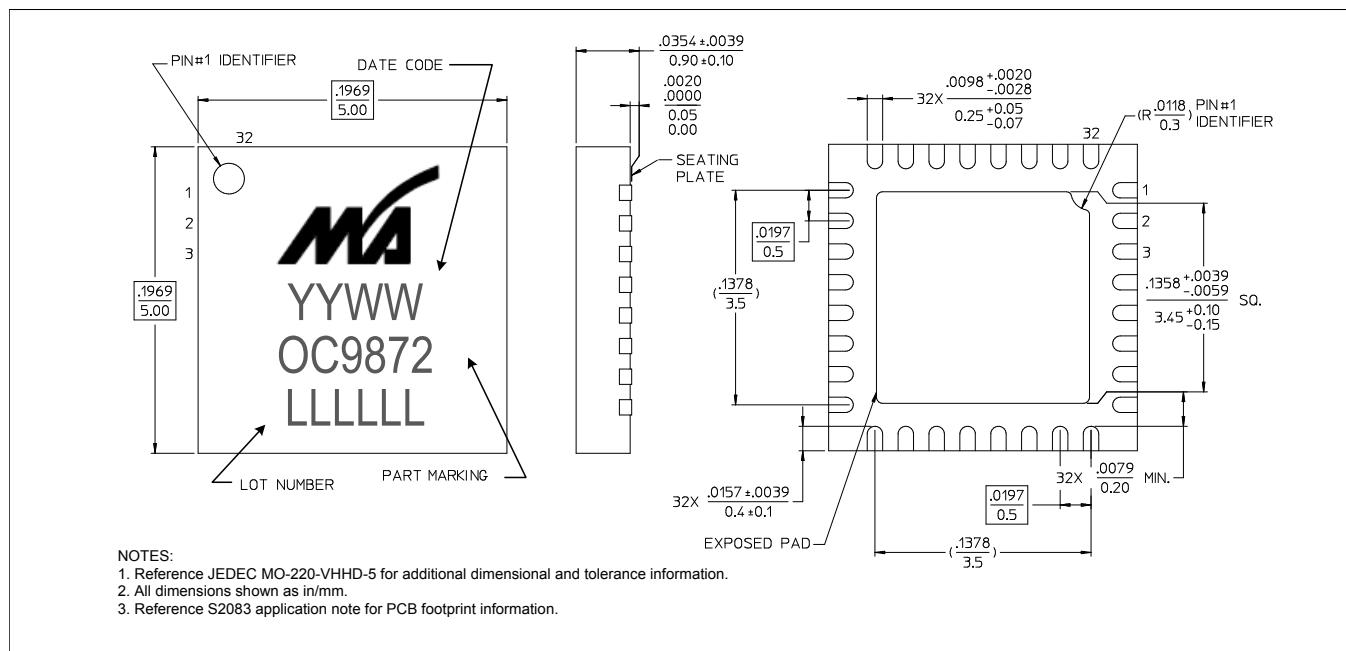
### Sample Board



### Parts List

Component	Value	Case Size
C1	100 pF	0402
C2, C3, C4	0.1 $\mu$ F	0402
C5	10 $\mu$ F Tantalum	1206

### Lead-Free 5 mm 32-Lead PQFN<sup>†</sup>



<sup>†</sup>Reference Application Note S2083 for lead-free solder reflow recommendations.

Meets JEDEC moisture sensitivity level 3 requirements.

Plating is 100% matte tin over copper.

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