MAFC-004403

Frequency Doubler
16 - 24 GHz Output

**Features**
- 16 - 24 GHz Output Frequency Range
- 20 dBm Output Power
- High 1xF\(_{\text{IN}}\) and 3xF\(_{\text{IN}}\) Suppression
- High Dynamic Range
- Lead-Free 4 mm, 16-Lead QFN Package
- RoHS* Compliant and 260°C Reflow Compatible

**Description**
The MAFC-004403 is an active frequency doubler with an output frequency range of 16 - 24 GHz. The input power level ranges from 0 to 6 dBm, delivering a typical output power of 20 dBm. The device has excellent input and output return losses, and high 1xF\(_{\text{IN}}\) and 3xF\(_{\text{IN}}\) isolations.

The MAFC-004403 is ideally suited for use in LO chains in Point-to-Point radios for cellular backhaul applications. The 4mm QFN package is RoHS compliant and compatible with reflow temperatures to 260°C.

**Ordering Information**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAFC-004403-TR0500</td>
<td>500 piece reel</td>
</tr>
<tr>
<td>MAFC-004403-TR1000</td>
<td>1000 piece reel</td>
</tr>
<tr>
<td>MAFC-004403-TR3000</td>
<td>3000 piece reel</td>
</tr>
<tr>
<td>MAFC-004403-001SMB</td>
<td>Sample Test Board</td>
</tr>
</tbody>
</table>


For further information and support please visit: [https://www.macom.com/support](https://www.macom.com/support)
**Frequency Doubler**

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**Electrical Specifications:** $V_D = +5$ V, $V_G = -0.7$ V, $P_{IN} = 0$ dBm, $T_A = +25^\circ$C

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency (Input)</td>
<td>GHz</td>
<td>8</td>
<td>—</td>
<td>12</td>
</tr>
<tr>
<td>Frequency (Output)</td>
<td>GHz</td>
<td>16</td>
<td>—</td>
<td>24</td>
</tr>
<tr>
<td>Output Power ($P_{OUT}$)</td>
<td>dBm</td>
<td>+18</td>
<td>+20</td>
<td>—</td>
</tr>
<tr>
<td>1xF$_{IN}$ Leakage</td>
<td>dBC</td>
<td>—</td>
<td>30</td>
<td>—</td>
</tr>
<tr>
<td>3xF$_{IN}$ Leakage</td>
<td>dBC</td>
<td>—</td>
<td>20</td>
<td>—</td>
</tr>
<tr>
<td>4xF$_{IN}$ Leakage</td>
<td>dBC</td>
<td>—</td>
<td>20</td>
<td>—</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>dB</td>
<td>—</td>
<td>12</td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>dB</td>
<td>—</td>
<td>12</td>
<td>—</td>
</tr>
<tr>
<td>Supply Current ($I_D$)</td>
<td>mA</td>
<td>95</td>
<td>140</td>
<td>170</td>
</tr>
</tbody>
</table>

**Absolute Maximum Ratings**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Power</td>
<td>+8 dBm</td>
</tr>
<tr>
<td>Drain Voltage</td>
<td>+7 V</td>
</tr>
<tr>
<td>Gate Voltage</td>
<td>-1.5 V to 0 V</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-55°C to +150°C</td>
</tr>
<tr>
<td>Case Temperature</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>Junction Temperature$^6$</td>
<td>+160 ºC</td>
</tr>
</tbody>
</table>

**Handling Procedures**

The following precautions should be observed 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 1A devices.

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3. Exceeding any one or combination of these limits may cause permanent damage to this device.
4. MACOM does not recommend sustained operation near these survivability limits.
5. Operating at nominal conditions with $T_J \leq 160^\circ$C will ensure $MTTF > 1 \times 10^6$ hours.
6. Junction Temperature ($T_J$) = $T_C + \Theta_{jc} \times ((V \times I) - (P_{OUT} - P_{IN}))$
   
   Typical thermal resistance ($\Theta_{jc}$) = 93°C/W.
   
   a) For $T_C = 25^\circ$C,
   
   $T_J = 81^\circ$C @ 5 V, 130 mA, $P_{IN} = +5$ dBm, $P_{OUT} = 17$ dBm
   
   b) For $T_C = 85^\circ$C,
   
   $T_J = 141^\circ$C @ 5 V, 130 mA, $P_{IN} = +5$ dBm, $P_{OUT} = 17$ dBm

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Typical Performance Curves: \( V_D = +5 \text{ V}, \; V_G = -0.7 \text{ V}, \; Z_0 = 50 \Omega \)

### Output Power @ 2xF\(_{\text{IN}}\) vs. Temp., \( P_{\text{IN}} = 0, 3, 6 \text{ dBm} \)

![Graph showing output power vs. input frequency for different temperatures and input powers.]

### Output Power @ 3xF\(_{\text{IN}}\) vs. Temp., \( P_{\text{IN}} = 0, 3, 6 \text{ dBm} \)

![Graph showing output power vs. input frequency for different temperatures and input powers.]

### Output Power @ 1xF\(_{\text{IN}}\), 2xF\(_{\text{IN}}\) & 3xF\(_{\text{IN}}\), \( P_{\text{IN}} = 0 \text{ dBm} \)

![Graph showing output power vs. input frequency for different temperatures and input powers.]

### Supply Current

![Graph showing supply current vs. input power frequency for different frequencies.]

### Return Loss

![Graph showing return loss vs. frequency for different frequencies.]

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Lead-Free 4 mm 16-Lead PQFN†

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