GaAs Flip Chip
Schottky Barrier Diodes

Features

- Low Series Resistance
- Low Capacitance
- High Cutoff Frequency
- Silicon Nitride Passivation
- Polyimide Scratch Protection
- Designed for Easy Circuit Insertion

Description and Applications

The MA4E1317 single, MA4E1318 anti-parallel pair, MA4E1319-1 reverse tee, MA4E1319-2 series tee and MA4E2160 unconnected anti-parallel pair are gallium arsenide flip chip Schottky barrier diodes.

These devices are fabricated on OMCVD epitaxial wafers using a process designed for high device uniformity and extremely low parasitics. The diodes are fully passivated with silicon nitride and have an additional layer of polyimide for scratch protection. The protective coatings prevent damage to the junction during automated or manual handling. The flip chip configuration is suitable for pick and place insertion. The high cutoff frequency of these diodes allows use through millimeter wave frequencies.

Typical applications include single and double balanced mixers in PCN transceivers and radios, police radar detectors, and automotive radar detectors. The devices can be used through 80 GHz.

The MA4E1318 anti-parallel pair is designed for use in sub harmonically pumped mixers. Close matching of the diode characteristics results in high LO suppression at the RF input.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
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<tbody>
<tr>
<td>MA4E1317</td>
<td>100 piece Gel Pack</td>
</tr>
<tr>
<td>MADS-001317-1278HP</td>
<td>3000 piece Pocket Tape on Reel</td>
</tr>
<tr>
<td>MA4E1318</td>
<td>100 piece Gel Pack</td>
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<tr>
<td>MADS-001318-1197HP</td>
<td>3000 piece Pocket Tape on Reel</td>
</tr>
<tr>
<td>MA4E1319-1</td>
<td>100 piece Gel Pack</td>
</tr>
<tr>
<td>MA4E1319-2</td>
<td>100 piece Gel Pack</td>
</tr>
<tr>
<td>MA4E2160</td>
<td>100 piece Gel Pack</td>
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</tbody>
</table>
## MA4Exxxx Series

**GaAs Flip Chip**  
**Schottky Barrier Diodes**

### Electrical Specifications @ +25°C

<table>
<thead>
<tr>
<th>Parameters and Test Conditions</th>
<th>Symbol</th>
<th>Units</th>
<th>MA4E1317</th>
<th>MA4E1318</th>
<th>MA4E1319-1 or -2</th>
<th>MA4E2160</th>
</tr>
</thead>
<tbody>
<tr>
<td>Junction Capacitance at 0 V at 1 MHz</td>
<td>Cj</td>
<td>pF</td>
<td>-</td>
<td>.020</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total Capacitance at 0 V at 1 MHz (^1)</td>
<td>Ct</td>
<td>pF</td>
<td>.030</td>
<td>.045</td>
<td>.060</td>
<td>.030</td>
</tr>
<tr>
<td>Junction Capacitance Difference</td>
<td>DCj</td>
<td>pF</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Series Resistance at +10 mA (^2)</td>
<td>Rs</td>
<td>Ohms</td>
<td>-</td>
<td>4</td>
<td>7</td>
<td>-</td>
</tr>
<tr>
<td>Forward Voltage at +1 mA</td>
<td>Vf1</td>
<td>Volts</td>
<td>.60</td>
<td>.70</td>
<td>.80</td>
<td>.60</td>
</tr>
<tr>
<td>Forward Voltage Difference at +1 mA</td>
<td>Dvf</td>
<td>Volts</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Reverse Breakdown Voltage at -10 µA</td>
<td>Vbr</td>
<td>Volts</td>
<td>4.5</td>
<td>7</td>
<td>-</td>
<td>4.5</td>
</tr>
<tr>
<td>SSB Noise Figure</td>
<td>NF</td>
<td>dB</td>
<td>-</td>
<td>6.5(^4)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

1. Total capacitance is equivalent to the sum of junction capacitance \( C_j \) and parasitic capacitance \( C_p \).
2. Series resistance is determined by measuring the dynamic resistance and subtracting the junction resistance of 2.6 ohms.
3. Capacitance for the MA4E1318, MA4E2160, MA4E1319-1 or -2 is per Schottky diode.
4. Measured at a LO frequency of 9.375 GHz, with an IF frequency of 300 MHz, LO drive level is +6 dBm for a single Schottky junction. The IF noise figure contribution (1.5 dB) is included.
Absolute Maximum Ratings\textsuperscript{5,6}

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Temperature</td>
<td>-65°C to +125°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-65°C to +150°C</td>
</tr>
<tr>
<td>Incident LO Power</td>
<td>+20 dBm</td>
</tr>
<tr>
<td>Incident RF Power</td>
<td>+20 dBm</td>
</tr>
<tr>
<td>Mounting Temperature</td>
<td>+235°C for 10 seconds</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.

Mounting Techniques

These chips were designed to be inserted onto hard or soft substrates with the junction side down. They can be mounted with conductive epoxy or with a low temperature solder preform. The die can also be assembled with the junction side up, and wire or ribbon bonds made to the pads.

Solder Die Attach:
Solder which does not scavenge gold, such as Indalloy # 2, is recommended. Sn-Pb based solders are not recommended due to solder embrittlement. Do not expose die to a temperature greater than 235°C, or greater than 200°C for longer than 10 seconds. No more than three seconds of scrubbing should be required for attachment.

Epoxy Die Attach:
Assembly can be preheated to 125 - 150°C. Use a minimum amount of epoxy. Cure epoxy as per manufacturer's schedule. For extended cure times, temperatures should be kept below 200°C.

Handling Procedures

The following precautions should be observed to avoid damaging these chips:

Cleanliness:
The chips should be handled in a clean environment. Do not attempt to clean die after installation.

Static Sensitivity:
Schottky barrier diodes are ESD sensitive and can be damaged by static electricity. Proper ESD techniques should be used when handling these Class 0 devices.

General Handling:
The protective polymer coating on the active areas of these die provides scratch protection, particularly for the metal air bridge which contacts the anode. Die can be handled with tweezers or vacuum pickups and are suitable for use with automatic pick-and-place equipment.
Flip Chip Outline Drawings

**MA4E1317**
Case Style 1278

<table>
<thead>
<tr>
<th>DIM</th>
<th>INCHES</th>
<th>MILLIMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.013</td>
<td>0.330</td>
</tr>
<tr>
<td></td>
<td>0.014</td>
<td>0.335</td>
</tr>
<tr>
<td>B</td>
<td>0.026</td>
<td>0.660</td>
</tr>
<tr>
<td></td>
<td>0.027</td>
<td>0.685</td>
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<tr>
<td>C</td>
<td>0.008</td>
<td>0.203</td>
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<tr>
<td></td>
<td>0.009</td>
<td>0.228</td>
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<tr>
<td>D</td>
<td>0.007</td>
<td>0.177</td>
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<tr>
<td></td>
<td>0.008</td>
<td>0.203</td>
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<tr>
<td>E</td>
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<td>0.406</td>
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<tr>
<td></td>
<td>0.017</td>
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<td>0.101</td>
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<tr>
<td></td>
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<td>0.152</td>
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<td>G</td>
<td>0.006</td>
<td>0.172</td>
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<tr>
<td></td>
<td>0.007</td>
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<tr>
<td>H</td>
<td>0.0075</td>
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<td></td>
<td>0.0085</td>
<td>0.216</td>
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**MA4E1318**
Case Style 1197

<table>
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<tr>
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<td>0.027</td>
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<td>B</td>
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<td>C</td>
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<td>D</td>
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<td>.50</td>
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<td>.190</td>
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<tr>
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<td>.10</td>
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<tr>
<td></td>
<td>0.006</td>
<td>.15</td>
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</tbody>
</table>
MA4Exxxx Series

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Rev. V11

Flip Chip Outline Drawings

Ma4E1319-1
Case Style 1199

Ma4E1319-2
Case Style 1200

Alignment Indicator (3 Plcs)
### Flip Chip Outline Drawings

**MA4E2160**  
**Case Style 1262**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Inches</th>
<th>Millimeters</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
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<td>3.31</td>
</tr>
<tr>
<td>B</td>
<td>0.15</td>
<td>3.81</td>
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<tr>
<td>C</td>
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<td>6.35</td>
</tr>
<tr>
<td>D</td>
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<td>6.35</td>
</tr>
<tr>
<td>E</td>
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<td>6.35</td>
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<tr>
<td>F</td>
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<td>6.35</td>
</tr>
<tr>
<td>G</td>
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<td>6.35</td>
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</table>

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