PCFFS40120AF
Silicon Carbide Schottky Diode
1200 V, 40 A

Features
• Max Junction Temperature 175 °C
• Avalanche Rated 420 mJ
• High Surge Current Capacity
• Positive Temperature Coefficient
• Ease of Paralleling
• No Reverse Recovery / No Forward Recovery

Applications
• General Purpose
• SMPS, Solar Inverter, UPS
• Power Switching Circuits

Description
Silicon Carbide (SiC) Schottky Diodes use a completely new technology that provides superior switching performance and higher reliability compared to Silicon. No reverse recovery current, temperature dependent switching characteristics, and excellent thermal performance sets Silicon Carbide as the next generation of power semiconductor. System benefits include highest efficiency, faster operation frequency, increased power density, reduced EMI, and reduced system size and cost.

Die Information
• Wafer Diameter 6 inch
• Die Size 4,200 x 4,200 µm (include Scribe Lane)
• Die Thickness Typ. 200 µm
• Die Metallization
  · Top Ti / TiN / AlCu 4 µm
  · Back Ti/ NiV /Ag
• Recommended Wire Bond (Note 1)
  · Anode 20mil ×3

Electrical Characteristics on Wafer
(Note 2) \( T_C = 25^\circ \text{C} \) unless otherwise noted.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_R )</td>
<td>Reverse Blocking Voltage</td>
<td>( I_R = 200 \mu \text{A}, T_C = 25 , ^\circ \text{C} )</td>
<td>1200</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>( V_F )</td>
<td>Forward Voltage</td>
<td>( I_F = 40 , \text{A}, T_C = 25 , ^\circ \text{C} )</td>
<td>1.20</td>
<td>-</td>
<td>1.75</td>
<td>V</td>
</tr>
<tr>
<td>( I_R )</td>
<td>Reverse Current</td>
<td>( V_R = 1200 , \text{V}, T_C = 25 , ^\circ \text{C} )</td>
<td>-</td>
<td>-</td>
<td>200</td>
<td>µA</td>
</tr>
</tbody>
</table>

Notes:
1. Based on TO-247 package of ON Semiconductor
2. Tested 100% on wafer

For Additional Product Information and Electrical Characteristics on Package
Refer to FFSH40120A product datasheet.

www.onsemi.com
Die Layout (Dimension: \( \mu m \), except Scribe Lane)

Cross Section

Passivation Information
- Passivation Material: Polymide (PSPI)
- Passivation Type: Local Passivation
- Passivation Thickness: 90KA

The Configuration of chips (Based on 6 inch wafer)

- PSPI Passivation Line
- Scribe Lane
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Absolute Maximum Ratings $T_C = 25$ °C unless otherwise noted.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>FFSH40120A</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{RRM}$</td>
<td>Peak Repetitive Reverse Voltage</td>
<td>1200</td>
<td>V</td>
</tr>
<tr>
<td>$E_{AS}$</td>
<td>Single Pulse Avalanche Energy</td>
<td>(Note 1)</td>
<td>420 mJ</td>
</tr>
<tr>
<td>$I_F$</td>
<td>Continuous Rectified Forward Current @ $T_C &lt; 155$ °C</td>
<td>40</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Continuous Rectified Forward Current @ $T_C &lt; 135$ °C</td>
<td>61</td>
<td>A</td>
</tr>
<tr>
<td>$I_{F,Max}$</td>
<td>Non-Repetitive Peak Forward Surge Current</td>
<td>$T_C = 25$ °C, 10 $\mu$s</td>
<td>1650</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_C = 150$ °C, 10 $\mu$s</td>
<td>1550</td>
</tr>
<tr>
<td>$I_{F,SM}$</td>
<td>Non-Repetitive Forward Surge Current</td>
<td>Half-Sine Pulse, $t_p = 8.3$ ms</td>
<td>270</td>
</tr>
<tr>
<td>$I_{F,RM}$</td>
<td>Repetitive Forward Surge Current</td>
<td>Half-Sine Pulse, $t_p = 8.3$ ms</td>
<td>120</td>
</tr>
<tr>
<td>$P_{tot}$</td>
<td>Power Dissipation</td>
<td>$T_C = 25$ °C</td>
<td>682 W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_C = 150$ °C</td>
<td>114 W</td>
</tr>
<tr>
<td>$T_{J, TSTG}$</td>
<td>Operating and Storage Temperature Range</td>
<td>-55 to +175 °C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TO247 Mounting Torque, M3 Screw</td>
<td>60</td>
<td>Ncm</td>
</tr>
</tbody>
</table>

Thermal Characteristic

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{JUC}$</td>
<td>Thermal Resistance, Junction to Case, Max</td>
<td>0.22</td>
<td>°C/W</td>
</tr>
</tbody>
</table>
Package Marking and Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Top Mark</th>
<th>Package</th>
<th>Packing Method</th>
<th>Reel Size</th>
<th>Tape Width</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFSH40120A</td>
<td>FFSH40120A</td>
<td>TO-247-2L</td>
<td>Tube</td>
<td>N/A</td>
<td>N/A</td>
<td>30 units</td>
</tr>
</tbody>
</table>

Electrical Characteristics \( T_C = 25 \, ^\circ\text{C} \) unless otherwise noted.

<table>
<thead>
<tr>
<th>Symbol</th>
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<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_F )</td>
<td>Forward Voltage</td>
<td>( I_F = 40 , \text{A}, , T_C = 25 , ^\circ\text{C} )</td>
<td>-</td>
<td>1.45</td>
<td>1.75</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( I_F = 40 , \text{A}, , T_C = 125 , ^\circ\text{C} )</td>
<td>-</td>
<td>1.7</td>
<td>2.0</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( I_F = 40 , \text{A}, , T_C = 175 , ^\circ\text{C} )</td>
<td>-</td>
<td>2.0</td>
<td>2.4</td>
<td>V</td>
</tr>
<tr>
<td>( I_R )</td>
<td>Reverse Current</td>
<td>( V_R = 1200 , \text{V}, , T_C = 25 , ^\circ\text{C} )</td>
<td>-</td>
<td>-</td>
<td>200</td>
<td>( \mu\text{A} )</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( V_R = 1200 , \text{V}, , T_C = 125 , ^\circ\text{C} )</td>
<td>-</td>
<td>-</td>
<td>300</td>
<td>( \mu\text{A} )</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( V_R = 1200 , \text{V}, , T_C = 175 , ^\circ\text{C} )</td>
<td>-</td>
<td>-</td>
<td>400</td>
<td>( \mu\text{A} )</td>
</tr>
<tr>
<td>( Q_C )</td>
<td>Total Capacitive Charge</td>
<td>( V = 800 , \text{V} )</td>
<td>-</td>
<td>220</td>
<td>-</td>
<td>nC</td>
</tr>
<tr>
<td>( C )</td>
<td>Total Capacitance</td>
<td>( V_R = 1 , \text{V}, , f = 100 , \text{kHz} )</td>
<td>-</td>
<td>2250</td>
<td>-</td>
<td>pF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( V_R = 400 , \text{V}, , f = 100 , \text{kHz} )</td>
<td>-</td>
<td>204</td>
<td>-</td>
<td>pF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( V_R = 800 , \text{V}, , f = 100 , \text{kHz} )</td>
<td>-</td>
<td>169</td>
<td>-</td>
<td>pF</td>
</tr>
</tbody>
</table>

Notes:
1: \( E_{AS} \) of 420 mJ is based on starting \( T_J = 25 \, ^\circ\text{C} , \, L = 0.5 \, \text{mH}, \, I_{AS} = 41 \, \text{A}, \, V = 50 \, \text{V} \).

Typical Characteristics \( T_J = 25 \, ^\circ\text{C} \) unless otherwise noted.

Figure 1. Forward Characteristics

Figure 2. Reverse Characteristics

Figure 3. Current Derating

Figure 4. Power Derating
Typical Characteristics  $T_J = 25 \, ^\circ\text{C}$ unless otherwise noted.

Figure 5. Capacitive Charge vs. Reverse Voltage

![Capacitive Charge vs. Reverse Voltage](image)

Figure 6. Capacitive vs. Reverse Voltage

![Capacitive vs. Reverse Voltage](image)

Figure 7. Capacitance Stored Energy

![Capacitance Stored Energy](image)

Figure 8. Junction-to-Case Transient Thermal Response Curve

![Junction-to-Case Transient Thermal Response Curve](image)
Test Circuit and Waveforms

Figure 9. Unclamped Inductive Switching Test Circuit & Waveform

\[ L = 0.5 \text{mH} \]

\[ R < 0.1\Omega \]

\[ V_{DD} = 50V \]

\[ EAVL = \frac{1}{2}L \frac{I^2}{t} \left[ V_{R(EAVL)} - V_{R(0)} \right] \]

\[ Q1 = \text{IGBT (BVces > DUT V_R(EAVL))} \]

\[ \text{CURRENT SENSE} \]

\[ V_{DD} \]

\[ V_{DD} \]

\[ t_0 \quad t_1 \quad t_2 \quad t \]

\[ I_L \quad I_L \]

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Mechanical Dimensions

Figure 10. TO-247, Molded, 2LD, Jede Option AB

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