C3M0350120J
Silicon Carbide Power MOSFET
C3M™ MOSFET Technology
N-Channel Enhancement Mode

Features

- 3rd generation SiC MOSFET technology
- Low impedance package with driver source pin
- 7mm of creepage distance between drain and source
- High blocking voltage with low on-resistance
- High-speed switching with low capacitances
- Fast intrinsic diode with low reverse recovery ($Q_{rr}$)
- Halogen free, RoHS compliant

Benefits

- Reduce switching losses and minimize gate ringing
- Higher system efficiency
- Reduce cooling requirements
- Increase power density
- Increase system switching frequency

Applications

- Renewable energy
- High voltage DC/DC converters
- Switch Mode Power Supplies
- UPS

Maximum Ratings ($T_C = 25{^\circ}C$ unless otherwise specified)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
<th>Test Conditions</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{DS(max)}$</td>
<td>Drain - Source Voltage</td>
<td>1200</td>
<td>V</td>
<td>$V_{GS} = 0 \text{ V}, I_D = 100 \mu\text{A}$</td>
<td></td>
</tr>
<tr>
<td>$V_{GS(max)}$</td>
<td>Gate - Source Voltage (dynamic)</td>
<td>-8/+19</td>
<td>V</td>
<td>AC ($f &gt; 1$ Hz)</td>
<td>Note: 1</td>
</tr>
<tr>
<td>$V_{GS(op)}$</td>
<td>Gate - Source Voltage (static)</td>
<td>-4/+15</td>
<td>V</td>
<td>Static</td>
<td>Note: 2</td>
</tr>
<tr>
<td>$I_D$</td>
<td>Continuous Drain Current</td>
<td>7.2</td>
<td>A</td>
<td>$V_{GS} = 15 \text{ V}, T_C = 25{^\circ}C$</td>
<td>Fig. 19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td></td>
<td>$V_{GS} = 15 \text{ V}, T_C = 100{^\circ}C$</td>
<td></td>
</tr>
<tr>
<td>$I_{D(pulse)}$</td>
<td>Pulsed Drain Current</td>
<td>20</td>
<td>A</td>
<td>Pulse width $t_p$ limited by $T_{j,max}$</td>
<td>Fig. 22</td>
</tr>
<tr>
<td>$P_D$</td>
<td>Power Dissipation</td>
<td>40.8</td>
<td>W</td>
<td>$T_C = 25{^\circ}C, T_J = 150{^\circ}C$</td>
<td>Fig. 20</td>
</tr>
<tr>
<td>$T_J, T_{stg}$</td>
<td>Operating Junction and Storage Temperature</td>
<td>-55 to +150</td>
<td>°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T_L$</td>
<td>Solder Temperature</td>
<td>260</td>
<td>°C</td>
<td>1.6mm (0.063&quot;) from case for 10s</td>
<td></td>
</tr>
</tbody>
</table>

Note (1): When using MOSFET Body Diode $V_{GS(max)} = -4V/+19V$
Note (2): MOSFET can also safely operate at 0/+15 V
## Electrical Characteristics (T<sub>C</sub> = 25°C unless otherwise specified)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Test Conditions</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>V&lt;sub&gt;B(RDSS)&lt;/sub&gt;</td>
<td>Drain-Source Breakdown Voltage</td>
<td>1200</td>
<td></td>
<td></td>
<td>V</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = 0 V, I&lt;sub&gt;B&lt;/sub&gt; = 100 μA</td>
<td></td>
</tr>
<tr>
<td>V&lt;sub&gt;GS(th)&lt;/sub&gt;</td>
<td>Gate Threshold Voltage</td>
<td>1.8</td>
<td>2.5</td>
<td>3.6</td>
<td>V</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = V&lt;sub&gt;GS(th)&lt;/sub&gt;, I&lt;sub&gt;B&lt;/sub&gt; = 1 mA</td>
<td></td>
</tr>
<tr>
<td>I&lt;sub&gt;DS&lt;/sub&gt;</td>
<td>Zero Gate Voltage Drain Current</td>
<td>1</td>
<td>50</td>
<td></td>
<td>μA</td>
<td>V&lt;sub&gt;DS&lt;/sub&gt; = 1200 V, V&lt;sub&gt;GS&lt;/sub&gt; = 0 V</td>
<td></td>
</tr>
<tr>
<td>I&lt;sub&gt;GS&lt;/sub&gt;</td>
<td>Gate-Source Leakage Current</td>
<td>10</td>
<td>250</td>
<td></td>
<td>nA</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = 15 V, V&lt;sub&gt;DS&lt;/sub&gt; = 0 V</td>
<td></td>
</tr>
<tr>
<td>R&lt;sub&gt;(on)&lt;/sub&gt;</td>
<td>Drain-Source On-State Resistance</td>
<td>350</td>
<td>455</td>
<td></td>
<td>mΩ</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = 15 V, I&lt;sub&gt;D&lt;/sub&gt; = 3.6 A, T&lt;sub&gt;J&lt;/sub&gt; = 150°C</td>
<td>Fig. 4, 5, 6</td>
</tr>
<tr>
<td>g&lt;sub&gt;s&lt;/sub&gt;</td>
<td>Transconductance</td>
<td>2.9</td>
<td>2.6</td>
<td></td>
<td>S</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = 20 V, I&lt;sub&gt;D&lt;/sub&gt; = 3.6 A, T&lt;sub&gt;J&lt;/sub&gt; = 150°C</td>
<td>Fig. 7</td>
</tr>
<tr>
<td>C&lt;sub&gt;iss&lt;/sub&gt;</td>
<td>Input Capacitance</td>
<td></td>
<td></td>
<td>345</td>
<td>pF</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = 0 V, V&lt;sub&gt;DS&lt;/sub&gt; = 1000 V, f = 1 MHz, V&lt;sub&gt;AC&lt;/sub&gt; = 25 mV</td>
<td>Fig. 17, 18</td>
</tr>
<tr>
<td>C&lt;sub&gt;oss&lt;/sub&gt;</td>
<td>Output Capacitance</td>
<td>20</td>
<td></td>
<td></td>
<td>pF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C&lt;sub&gt;rss&lt;/sub&gt;</td>
<td>Reverse Transfer Capacitance</td>
<td>3.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E&lt;sub&gt;oss&lt;/sub&gt;</td>
<td>Stored Energy</td>
<td>10.6</td>
<td></td>
<td></td>
<td>μJ</td>
<td>V&lt;sub&gt;DS&lt;/sub&gt; = 800 V, V&lt;sub&gt;GS&lt;/sub&gt; = -4 V/15 V, I&lt;sub&gt;C&lt;/sub&gt; = 3.6 A, R&lt;sub&gt;(on)&lt;/sub&gt; = 2.5 Ω, L = 716 μH</td>
<td>Fig. 16</td>
</tr>
<tr>
<td>E&lt;sub&gt;ON&lt;/sub&gt;</td>
<td>Turn-On Switching Energy (Body Diode FWD)</td>
<td>46</td>
<td></td>
<td></td>
<td>μJ</td>
<td>V&lt;sub&gt;DS&lt;/sub&gt; = 800 V, V&lt;sub&gt;GS&lt;/sub&gt; = -4 V/15 V, I&lt;sub&gt;C&lt;/sub&gt; = 3.6 A, R&lt;sub&gt;(on)&lt;/sub&gt; = 2.5 Ω, L = 716 μH</td>
<td>Fig. 26, 29</td>
</tr>
<tr>
<td>t&lt;sub&gt;on&lt;/sub&gt;</td>
<td>Turn-On Delay Time</td>
<td>6</td>
<td></td>
<td></td>
<td>ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t&lt;sub&gt;r&lt;/sub&gt;</td>
<td>Rise Time</td>
<td>7</td>
<td></td>
<td></td>
<td>ns</td>
<td>V&lt;sub&gt;DS&lt;/sub&gt; = 800 V, V&lt;sub&gt;GS&lt;/sub&gt; = -4 V/15 V, I&lt;sub&gt;C&lt;/sub&gt; = 3.6 A, R&lt;sub&gt;(on)&lt;/sub&gt; = 0 Ω, Timing relative to V&lt;sub&gt;DS&lt;/sub&gt; Inductive load</td>
<td>Fig. 27, 28, 29</td>
</tr>
<tr>
<td>t&lt;sub&gt;off&lt;/sub&gt;</td>
<td>Turn-Off Delay Time</td>
<td>9</td>
<td></td>
<td></td>
<td>ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t&lt;sub&gt;f&lt;/sub&gt;</td>
<td>Fall Time</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R&lt;sub&gt;(on)&lt;/sub&gt;</td>
<td>Internal Gate Resistance</td>
<td>7</td>
<td></td>
<td></td>
<td>Ω</td>
<td></td>
<td></td>
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<tr>
<td>Q&lt;sub&gt;gs&lt;/sub&gt;</td>
<td>Gate to Source Charge</td>
<td>5.1</td>
<td></td>
<td></td>
<td>nC</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = 800 V, V&lt;sub&gt;DS&lt;/sub&gt; = -4 V/15 V, I&lt;sub&gt;B&lt;/sub&gt; = 3.6 A, Per IEC60747-8-4 pg 21</td>
<td>Fig. 12</td>
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<tr>
<td>Q&lt;sub&gt;gd&lt;/sub&gt;</td>
<td>Gate to Drain Charge</td>
<td>4.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q&lt;sub&gt;gs&lt;/sub&gt;</td>
<td>Total Gate Charge</td>
<td>13</td>
<td></td>
<td></td>
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## Reverse Diode Characteristics (T<sub>C</sub> = 25°C unless otherwise specified)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Test Conditions</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>V&lt;sub&gt;D&lt;/sub&gt;</td>
<td>Diode Forward Voltage</td>
<td>4.5</td>
<td></td>
<td>V</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = -4 V, I&lt;sub&gt;D&lt;/sub&gt; = 1.8 A</td>
<td>Fig. 8, 9, 10</td>
</tr>
<tr>
<td>I&lt;sub&gt;S&lt;/sub&gt;</td>
<td>Continuous Diode Forward Current</td>
<td>4.0</td>
<td></td>
<td>V</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = -4 V, I&lt;sub&gt;D&lt;/sub&gt; = 1.8 A, T&lt;sub&gt;J&lt;/sub&gt; = 150 °C</td>
<td></td>
</tr>
<tr>
<td>I&lt;sub&gt;spulse&lt;/sub&gt;</td>
<td>Diode pulse Current</td>
<td>7.3</td>
<td></td>
<td>A</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = -4 V</td>
<td>Note 1</td>
</tr>
<tr>
<td>t&lt;sub&gt;pulse&lt;/sub&gt;</td>
<td>Pulse Recovery time</td>
<td>20</td>
<td></td>
<td>A</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = -4 V, pulse width t&lt;sub&gt;p&lt;/sub&gt; limited by T&lt;sub&gt;max&lt;/sub&gt;</td>
<td>Note 1</td>
</tr>
<tr>
<td>Q&lt;sub&gt;r&lt;/sub&gt;</td>
<td>Reverse Recovery time</td>
<td>5</td>
<td></td>
<td>ns</td>
<td></td>
<td>Note 1, Fig. 29</td>
</tr>
<tr>
<td>Q&lt;sub&gt;rr&lt;/sub&gt;</td>
<td>Reverse Recovery Charge</td>
<td>23</td>
<td></td>
<td>nC</td>
<td>V&lt;sub&gt;GS&lt;/sub&gt; = -4 V, I&lt;sub&gt;D&lt;/sub&gt; = 3.6 A, V&lt;sub&gt;R&lt;/sub&gt; = 800 V, dI/dt = 3550 A/μs, T&lt;sub&gt;J&lt;/sub&gt; = 25 °C</td>
<td></td>
</tr>
<tr>
<td>I&lt;sub&gt;lim&lt;/sub&gt;</td>
<td>Peak Reverse Recovery Current</td>
<td>8</td>
<td></td>
<td>A</td>
<td></td>
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## Thermal Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Typ.</th>
<th>Unit</th>
<th>Test Conditions</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&lt;sub&gt;θJC&lt;/sub&gt;</td>
<td>Thermal Resistance from Junction to Case</td>
<td>2.9</td>
<td>°C/W</td>
<td></td>
<td>Fig. 21</td>
</tr>
</tbody>
</table>
Typical Performance

Figure 1. Output Characteristics $T_j = -55 \degree C$

Figure 2. Output Characteristics $T_j = 25 \degree C$

Figure 3. Output Characteristics $T_j = 150 \degree C$

Figure 4. Normalized On-Resistance vs. Temperature

Figure 5. On-Resistance vs. Drain Current For Various Temperatures

Figure 6. On-Resistance vs. Temperature For Various Gate Voltage
Typical Performance

Figure 7. Transfer Characteristic for Various Junction Temperatures

Conditions:
- $T_J = 25\, ^\circ C$
- $T_J = 25\, ^\circ C$
- $V_{DS} = 20\, V$
- $I_{DS} = 5\, A$
- $I_{GS} = 50\, mA$
- $V_{DS} = 800\, V$
- $T_J = 25\, ^\circ C$

Figure 8. Body Diode Characteristic at -55 °C

Conditions:
- $T_J = -55\, ^\circ C$
- $t_p < 200\, \mu s$
- $V_{GS} = -4\, V$
- $V_{GS} = 0\, V$
- $V_{GS} = -2\, V$

Figure 9. Body Diode Characteristic at 25 °C

Conditions:
- $T_J = -55\, ^\circ C$
- $t_p < 200\, \mu s$
- $V_{GS} = -4\, V$
- $V_{GS} = 0\, V$
- $V_{GS} = -2\, V$

Figure 10. Body Diode Characteristic at 150 °C

Conditions:
- $T_J = 150\, ^\circ C$
- $t_p < 200\, \mu s$
- $V_{GS} = -4\, V$
- $V_{GS} = 0\, V$
- $V_{GS} = -2\, V$

Figure 11. Threshold Voltage vs. Temperature

Conditions:
- $V_{DS} = V_{GS}$
- $I_{DS} = 1\, mA$

Figure 12. Gate Charge Characteristics

Conditions:
- $I_{DS} = 5\, A$
- $I_{GS} = 25\, mA$
- $V_{DS} = 800\, V$
- $T_J = 25\, ^\circ C$
Typical Performance

**Figure 13.** 3rd Quadrant Characteristic at -55 °C

**Figure 14.** 3rd Quadrant Characteristic at 25 °C

**Figure 15.** 3rd Quadrant Characteristic at 150 °C

**Figure 16.** Output Capacitor Stored Energy

**Figure 17.** Capacitances vs. Drain-Source Voltage (0 - 200V)

**Figure 18.** Capacitances vs. Drain-Source Voltage (0 - 1000V)
Typical Performance

Figure 19. Continuous Drain Current Derating vs. Case Temperature

Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

Figure 21. Transient Thermal Impedance (Junction - Case)

Figure 22. Safe Operating Area

Figure 23. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 600V$)

Figure 24. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 800V$)
Typical Performance

Figure 25. Clamped Inductive Switching Energy vs. $R_{G(\text{ext})}$

Conditions:
$T_J = 25 \, ^\circ\text{C}$
$V_{DS} = 800 \, \text{V}$
$I_{DS} = 3.6 \, \text{A}$
$V_{GS} = -4V/+15 \, \text{V}$
$L = 716 \, \mu\text{H}$

$E_{\text{on}}$

$E_{\text{off}}$

Figure 26. Clamped Inductive Switching Energy vs. Temperature

Figure 27. Switching Times vs. $R_{G(\text{ext})}$

Conditions:
$T_J = 25 \, ^\circ\text{C}$
$V_{DS} = 800 \, \text{V}$
$I_{DS} = 3.6 \, \text{A}$
$V_{GS} = -4V/+15 \, \text{V}$
$L = 716 \, \mu\text{H}$

$FWD = \text{C3M0350120J}$

$E_{\text{on}}$

$E_{\text{off}}$

Figure 28. Switching Times Definition
Figure 29. Clamped Inductive Switching Waveform Test Circuit

Note (3): Turn-off and Turn-on switching energy and timing values measured using SiC MOSFET Body Diode as shown above.
Package Dimensions

Package 7L D2PAK

NOTES:
1. ALL DIMENSION ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.
Notes

- **RoHS Compliance**
  The levels of RoHS restricted materials in this product are below the maximum concentration values (also referred to as the threshold limits) permitted for such substances, or are used in an exempted application, in accordance with EU Directive 2011/65/EC (RoHS2), as implemented January 2, 2013. RoHS Declarations for this product can be obtained from your Cree representative or from the Product Documentation sections of www.cree.com.

- **REACCh Compliance**
  REACCh substances of high concern (SVHCs) information is available for this product. Since the European Chemical Agency (ECHA) has published notice of their intent to frequently revise the SVHC listing for the foreseeable future, please contact a Cree representative to insure you get the most up-to-date REACCh SVHC Declaration. REACCh banned substance information (REACCh Article 67) is also available upon request.

- This product has not been designed or tested for use in, and is not intended for use in, applications implanted into the human body nor in applications in which failure of the product could lead to death, personal injury or property damage, including but not limited to equipment used in the operation of nuclear facilities, life-support machines, cardiac defibrillators or similar emergency medical equipment, aircraft navigation or communication or control systems, air traffic control systems.

Related Links

- **SPICE Models:** [http://wolfspeed.com/power/tools-and-support](http://wolfspeed.com/power/tools-and-support)
- **SiC MOSFET Isolated Gate Driver reference design:** [http://wolfspeed.com/power/tools-and-support](http://wolfspeed.com/power/tools-and-support)
- **SiC MOSFET Evaluation Board:** [http://wolfspeed.com/power/tools-and-support](http://wolfspeed.com/power/tools-and-support)