Silicon Carbide (SiC) MOSFET – EliteSiC, 160 mohm, 1200 V, M1, D2PAK-7L

NTBG160N120SC1

Features
- Typ. R_DS(on) = 160 mΩ
- Ultra Low Gate Charge (typ. Q_G(tot) = 33.8 nC)
- Low Effective Output Capacitance (typ. C_oss = 50.7 pF)
- 100% Avalanche Tested
- T_J = 175°C
- This Device is Halide Free and RoHS Compliant with exemption 7a, Pb-Free 2LI (on second level interconnection)

Typical Applications
- UPS
- DC-DC Converter
- Boost Inverter

MAXIMUM RATINGS (T_J = 25°C unless otherwise noted)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain-to-Source Voltage</td>
<td>V_DSS</td>
<td>1200</td>
<td>V</td>
</tr>
<tr>
<td>Gate-to-Source Voltage</td>
<td>V_GS</td>
<td>-15/+25</td>
<td>V</td>
</tr>
<tr>
<td>Continuous Drain Current (Note 1)</td>
<td>I_D</td>
<td>19.5</td>
<td>A</td>
</tr>
<tr>
<td>Power Dissipation (Note 1)</td>
<td>P_D</td>
<td>136</td>
<td>W</td>
</tr>
<tr>
<td>Continuous Drain Current (Note 1)</td>
<td>I_D</td>
<td>13.7</td>
<td>A</td>
</tr>
<tr>
<td>Power Dissipation (Note 1)</td>
<td>P_D</td>
<td>68</td>
<td>W</td>
</tr>
<tr>
<td>Pulsed Drain Current (Note 2)</td>
<td>I_DM</td>
<td>78</td>
<td>A</td>
</tr>
<tr>
<td>Operating Junction and Storage Temperature Range</td>
<td>T_J, T_stg</td>
<td>-55 to +175</td>
<td>°C</td>
</tr>
<tr>
<td>Source Current (Body Diode)</td>
<td>I_S</td>
<td>13.6</td>
<td>A</td>
</tr>
<tr>
<td>Single Pulse Drain-to-Source Avalanche Energy (I_L = 15.5 A, L = 1 mH) (Note 3)</td>
<td>E_AAS</td>
<td>120</td>
<td>mJ</td>
</tr>
<tr>
<td>Maximum Lead Temperature for Soldering, 1/8&quot; from Case for 10 Seconds</td>
<td>T_L</td>
<td>300</td>
<td>°C</td>
</tr>
</tbody>
</table>

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.
2. Repetitive rating, limited by max junction temperature.
3. E_AAS of 120 mJ is based on starting T_J = 25°C; L = 1 mH, I_AAS = 15.5 A, V_DD = 120 V, V_GS = 18 V.

MARKING DIAGRAM

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>Device</th>
<th>Package</th>
<th>Shipping†</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTBG160N120SC1</td>
<td>D2PAK–7L</td>
<td>800 / Tape &amp; Reel</td>
</tr>
</tbody>
</table>

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.
Table 1. THERMAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Resistance Junction–to–Case (Note 1)</td>
<td>R_{JC}</td>
<td>1.1</td>
<td>°C/W</td>
</tr>
<tr>
<td>Thermal Resistance Junction–to–Ambient (Note 1)</td>
<td>R_{JA}</td>
<td>40</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

Table 2. ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise stated)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test Condition</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF CHARACTERISTICS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drain–to–Source Breakdown Voltage</td>
<td>V_{(BR)DSS}</td>
<td>V_{GS} = 0 V, I_{D} = 1 mA</td>
<td>1200</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Drain–to–Source Breakdown Voltage Temperature Coefficient</td>
<td>V_{(BR)DSS}/T_J</td>
<td>I_{D} = 1 mA, refer to 25°C</td>
<td>0.7</td>
<td></td>
<td></td>
<td>V/°C</td>
</tr>
<tr>
<td>Zero Gate Voltage Drain Current</td>
<td>I_{DSS}</td>
<td>V_{GS} = 0 V, V_{DS} = 1200 V</td>
<td>T_J = 25°C</td>
<td>100</td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>Gate–to–Source Leakage Current</td>
<td>I_{GSS}</td>
<td>V_{GS} = +25/-15 V, V_{DS} = 0 V</td>
<td></td>
<td>±1</td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>ON CHARACTERISTICS (Note 2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate Threshold Voltage</td>
<td>V_{GS(TH)}</td>
<td>V_{GS} = V_{DS}, I_{D} = 2.5 mA</td>
<td>1.8</td>
<td>3</td>
<td>4.3</td>
<td>V</td>
</tr>
<tr>
<td>Recommended Gate Voltage</td>
<td>V_{Gop}</td>
<td></td>
<td>-5</td>
<td>+20</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Drain–to–Source On Resistance</td>
<td>R_{DS(on)}</td>
<td>V_{GS} = 20 V, I_{D} = 12 A, T_J = 25°C</td>
<td>160</td>
<td>224</td>
<td></td>
<td>mΩ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{GS} = 20 V, I_{D} = 12 A, T_J = 175°C</td>
<td>239</td>
<td>365</td>
<td></td>
<td>mΩ</td>
</tr>
<tr>
<td>Forward Transconductance</td>
<td>g_{FS}</td>
<td>V_{DS} = 10 V, I_{D} = 12 A</td>
<td>5.5</td>
<td></td>
<td></td>
<td>S</td>
</tr>
<tr>
<td>CHARGES, CAPACITANCES &amp; GATE RESISTANCE</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Capacitance</td>
<td>C_{ISS}</td>
<td>V_{GS} = 0 V, f = 1 MHz, V_{DS} = 800 V</td>
<td>678</td>
<td></td>
<td></td>
<td>pF</td>
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<tr>
<td>Output Capacitance</td>
<td>C_{DSS}</td>
<td></td>
<td>50.7</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Reverse Transfer Capacitance</td>
<td>C_{RSS}</td>
<td></td>
<td>5.87</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Total Gate Charge</td>
<td>Q_{G(TOT)}</td>
<td>V_{GS} = -5/20 V, V_{DS} = 600 V, I_{D} = 16 A</td>
<td>33.8</td>
<td></td>
<td></td>
<td>nC</td>
</tr>
<tr>
<td>Threshold Gate Charge</td>
<td>Q_{G(TH)}</td>
<td></td>
<td>6.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate–to–Source Charge</td>
<td>Q_{GS}</td>
<td></td>
<td>11.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate–to–Drain Charge</td>
<td>Q_{GD}</td>
<td></td>
<td>9.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate–Resistance</td>
<td>R_{G}</td>
<td>f = 1 MHz</td>
<td>1.39</td>
<td></td>
<td></td>
<td>Ω</td>
</tr>
<tr>
<td>SWITCHING CHARACTERISTICS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn–On Delay Time</td>
<td>t_{d(ON)}</td>
<td>V_{GS} = -5/20 V, V_{DS} = 800 V, I_{D} = 16 A, R_{G} = 6 Ω, Inductive Load</td>
<td>11</td>
<td>20</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Rise Time</td>
<td>t_r</td>
<td></td>
<td>11</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn–Off Delay Time</td>
<td>t_{d(OFF)}</td>
<td></td>
<td>15</td>
<td>27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall Time</td>
<td>t_f</td>
<td></td>
<td>7.4</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn–On Switching Loss</td>
<td>E_{ON}</td>
<td></td>
<td>120</td>
<td></td>
<td></td>
<td>μJ</td>
</tr>
<tr>
<td>Turn–Off Switching Loss</td>
<td>E_{OFF}</td>
<td></td>
<td>28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Switching Loss</td>
<td>E_{TOT}</td>
<td></td>
<td>148</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DRAIN–SOURCE DIODE CHARACTERISTICS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous Drain–Source Diode Forward Current</td>
<td>I_{SD}</td>
<td>V_{GS} = -5 V, T_J = 25°C</td>
<td>13.6</td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Pulsed Drain–Source Diode Forward Current (Note 2)</td>
<td>I_{SDM}</td>
<td>V_{GS} = -5 V, T_J = 25°C</td>
<td>78</td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Forward Diode Voltage</td>
<td>V_{SD}</td>
<td>V_{GS} = -5 V, I_{SD} = 6 A, T_J = 25°C</td>
<td>3.9</td>
<td></td>
<td></td>
<td>V</td>
</tr>
</tbody>
</table>
Table 2. ELECTRICAL CHARACTERISTICS (\(T_J = 25^\circ C\) unless otherwise stated) (continued)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test Condition</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reverse Recovery Time</td>
<td>(I_{RR})</td>
<td>(V_{GS} = -5/20) V, (I_{SD} = 16) A, (\frac{dI_S}{dt} = 1000) A/(\mu)s</td>
<td>15</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Reverse Recovery Charge</td>
<td>(Q_{RR})</td>
<td></td>
<td>47</td>
<td></td>
<td></td>
<td>nC</td>
</tr>
<tr>
<td>Reverse Recovery Energy</td>
<td>(E_{REC})</td>
<td></td>
<td>3.9</td>
<td></td>
<td></td>
<td>(\mu)J</td>
</tr>
<tr>
<td>Peak Reverse Recovery Current</td>
<td>(I_{RRM})</td>
<td></td>
<td>6.6</td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Charge Time</td>
<td>(T_a)</td>
<td></td>
<td>7.0</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Discharge Time</td>
<td>(T_b)</td>
<td></td>
<td>7.4</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
</tbody>
</table>

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.
TYPICAL CHARACTERISTICS

Figure 1. On-Region Characteristics

Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

Figure 3. On-Resistance Variation with Temperature

Figure 4. On-Resistance vs. Gate-to-Source Voltage

Figure 5. Transfer Characteristics

Figure 6. Diode Forward Voltage vs. Current
TYPICAL CHARACTERISTICS (continued)

Figure 7. Gate-to-Source Voltage vs. Total Charge

Figure 8. Capacitance vs. Drain-to-Source Voltage

Figure 9. Unclamped Inductive Switching Capability

Figure 10. Maximum Continuous Drain Current vs. Case Temperature

Figure 11. Safe Operating Area

Figure 12. Single Pulse Maximum Power Dissipation
Figure 13. Junction-to-Ambient Transient Thermal Response Curve

Notes:
- \( Z_{JC}(t) = r(t) \times R_{JC} \)
- \( R_{JC} = 0.1^\circ\text{C/W} \)
- Peak \( T_J = P_{DM} \times Z_{JC}(t) + T_C \)
- Duty Cycle, \( D = t_1/t_2 \)
**MECHANICAL CASE OUTLINE**

**PACKAGE DIMENSIONS**

---

**D²PAK7 (TO–263–7L HV)**

**CASE 418BJ**

**ISSUE B**

**DATE 16 AUG 2019**

---

**NOTES:**

A. PACKAGE CONFORMS TO JEDEC TO-263 VARIATION CB EXCEPT WHERE NOTED.
B. ALL DIMENSIONS ARE IN MILLIMETERS.
C. OUT OF JEDEC STANDARD VALUE.
E. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.

---

**LAND PATTERN RECOMMENDATION**

---

**GENERIC MARKING DIAGRAM**

```
XXXXXXXXX
AYWWG
```

**XXX = Specific Device Code**

**A = Assembly Location**

**Y = Year**

**WW = Work Week**

**G = Pb-Free Package**

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "G", may or may not be present. Some products may not follow the Generic Marking.*

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**DOCUMENT NUMBER:** 98AON84234G

**DESCRIPTION:** D²PAK7 (TO–263–7L HV)

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