SiC Power Module
BSM300D12P2E001

- **Application**
  - Motor drive
  - Inverter, Converter
  - Photovoltaics, wind power generation.
  - Induction heating equipment.

- **Features**
  1) Low surge, low switching loss.
  2) High-speed switching possible.
  3) Reduced temperature dependence.

- **Construction**
  This product is a half bridge module consisting of SiC-DMOSFET and SiC-SBD from ROHM.

- **Dimensions & Pin layout** (Unit: mm)
### Absolute maximum ratings \((T_j = 25^\circ\text{C})\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Limit</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain-source voltage</td>
<td>(V_{\text{DSS}})</td>
<td>G-S short</td>
<td>1200</td>
<td>V</td>
</tr>
<tr>
<td>Gate-source voltage(+)</td>
<td>(V_{\text{GSS}})</td>
<td>D-S short</td>
<td>22</td>
<td>A</td>
</tr>
<tr>
<td>Gate-source voltage(−)</td>
<td></td>
<td></td>
<td>−6</td>
<td></td>
</tr>
<tr>
<td>G - S Voltage ((t_{\text{surge}} &lt; 300\text{ns}))</td>
<td>(V_{\text{GSS, surge}})</td>
<td>D-S short</td>
<td>−10 to 26</td>
<td></td>
</tr>
<tr>
<td>Drain current (^1)</td>
<td>(I_{\text{D}})</td>
<td>DC ((T_c=60^\circ\text{C}))</td>
<td>300</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>(I_{\text{DRM}})</td>
<td>Pulse ((T_c=60^\circ\text{C})) (1\text{ms}) (^2)</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Source current (^1)</td>
<td>(I_{\text{S}})</td>
<td>DC ((T_c=60^\circ\text{C}))</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(I_{\text{SRM}})</td>
<td>Pulse ((T_c=60^\circ\text{C})) (1\text{ms}) (^2)</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Total power dissipation (^3)</td>
<td>(P_{\text{tot}})</td>
<td>(T_c=25^\circ\text{C})</td>
<td>1875</td>
<td>W</td>
</tr>
<tr>
<td>Max Junction Temperature</td>
<td>(T_{\text{jop}})</td>
<td></td>
<td>175</td>
<td></td>
</tr>
<tr>
<td>Operating junction temperature</td>
<td></td>
<td></td>
<td>−40 to 150</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>(T_{\text{stg}})</td>
<td></td>
<td>−40 to 125</td>
<td></td>
</tr>
<tr>
<td>Isolation voltage</td>
<td>(V_{\text{isol}})</td>
<td>Terminals to baseplate, (f=60\text{Hz AC 1min.})</td>
<td>2500</td>
<td>Vrms</td>
</tr>
<tr>
<td>Mounting torque</td>
<td></td>
<td>Main Terminals : M6 screw</td>
<td>4.5</td>
<td>N · m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mounting to heat shink : M5 screw</td>
<td>3.5</td>
<td></td>
</tr>
</tbody>
</table>

\(^1\) Case temperature \((T_c)\) is defined on the surface of base plate just under the chips.

\(^2\) Repetition rate should be kept within the range where temperature rise if die should not exceed \(T_{\text{jmax}}\).

\(^3\) \(T_j\) is less than 175°C

Example of acceptable \(V_{\text{GS}}\) waveform

![Example of acceptable VGS waveform](image-url)
### Electrical Characteristics \((T_j=25°C)\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static drain-source on-state voltage</td>
<td>(V_{DS(on)})</td>
<td>(I_D=300A, V_{GS}=18V)</td>
<td>(T_j=25°C)</td>
<td>-</td>
<td>2.2</td>
<td>2.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(T_j=125°C)</td>
<td>-</td>
<td>3.0</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(T_j=150°C)</td>
<td>-</td>
<td>3.4</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>Drain cutoff current</td>
<td>(I_{DS})</td>
<td>(V_{DS}=1200V, V_{GS}=0V)</td>
<td>-</td>
<td>-</td>
<td>3.2</td>
<td>mA</td>
</tr>
<tr>
<td>Source-drain voltage</td>
<td>(V_{SD})</td>
<td>(V_{GS}=0V, I_S=300A)</td>
<td>(T_j=25°C)</td>
<td>-</td>
<td>1.6</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(T_j=125°C)</td>
<td>-</td>
<td>2.2</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(T_j=150°C)</td>
<td>-</td>
<td>2.4</td>
<td>3.2</td>
<td></td>
</tr>
<tr>
<td>Gate-source threshold voltage</td>
<td>(V_{GS(th)})</td>
<td>(V_{DS}=10V, I_{D}=68mA)</td>
<td>1.6</td>
<td>2.7</td>
<td>4.0</td>
<td>V</td>
</tr>
<tr>
<td>Gate-source leakage current</td>
<td>(I_{GSS})</td>
<td>(V_{GS}=22V, V_{DS}=0V)</td>
<td>-</td>
<td>-</td>
<td>0.5</td>
<td>μA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(V_{GS}=-6V, V_{DS}=0V)</td>
<td>-0.5</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Switching characteristics</td>
<td></td>
<td>(t_d(on)) (V_{GS(on)}=18V, V_{GS(off)}=0V)</td>
<td>-</td>
<td>80</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(V_{DS}=600V)</td>
<td>-</td>
<td>70</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(t_r) (I_D=300A)</td>
<td>-</td>
<td>50</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(t_{d(off)}) (R_C=0.2\Omega)</td>
<td>-</td>
<td>250</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(t_f) inductive load</td>
<td>-</td>
<td>65</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Input capacitance</td>
<td>(C_{iss})</td>
<td>(V_{DS}=10V, V_{GS}=0V, 100kHz)</td>
<td>-</td>
<td>32</td>
<td>-</td>
<td>nF</td>
</tr>
<tr>
<td>Gate Resistance</td>
<td>(R_{Gh})</td>
<td>(T_j=25°C)</td>
<td>-</td>
<td>1.6</td>
<td>-</td>
<td>Ω</td>
</tr>
<tr>
<td>NTC Rated Resistance</td>
<td>(R_{25})</td>
<td></td>
<td>-</td>
<td>5.0</td>
<td>-</td>
<td>kΩ</td>
</tr>
<tr>
<td>NTC B Value</td>
<td>B50/25</td>
<td></td>
<td>3370</td>
<td>K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stray Inductance</td>
<td>(L_s)</td>
<td></td>
<td>13</td>
<td>-</td>
<td>-</td>
<td>nH</td>
</tr>
<tr>
<td>Creepage Distance</td>
<td>-</td>
<td>Terminal to heat sink</td>
<td>14.5</td>
<td>-</td>
<td>-</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>Terminal to terminal</td>
<td>15.0</td>
<td>-</td>
<td>-</td>
<td>mm</td>
</tr>
<tr>
<td>Clearance Distance</td>
<td>-</td>
<td>Terminal to heat sink</td>
<td>12.0</td>
<td>-</td>
<td>-</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>Terminal to terminal</td>
<td>9.0</td>
<td>-</td>
<td>-</td>
<td>mm</td>
</tr>
<tr>
<td>Junction-to-case thermal resistance</td>
<td>(R_{th}(j-c))</td>
<td>DMOS (1/2 module) (^*4)</td>
<td>-</td>
<td>-</td>
<td>0.08</td>
<td>K/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SBD (1/2 module) (^*4)</td>
<td>-</td>
<td>-</td>
<td>0.11</td>
<td></td>
</tr>
<tr>
<td>Case-to-heat sink Thermal resistance</td>
<td>(R_{th}(c-f))</td>
<td>Case to heat sink, per 1 module, Thermal grease applied (^*5)</td>
<td>-</td>
<td>0.035</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

\(^*4\) Measurement of \(T_c\) is to be done at the point just under the chip.

\(^*5\) Typical value is measured by using thermally conductive grease of \(\lambda=0.9W/(m \cdot K)\).

\(^*6\) If the Product is used beyond absolute maximum ratings defined in the Specifications, as its internal structure may be damaged, please replace such Product with a new one.
Electrical characteristic curves (Typical)

Fig.1 Typical Output Characteristics [ $T_j=25^\circ\text{C}$ ]

Fig.2 Drain-Source Voltage vs. Drain Current

Fig.3 Drain-Source Voltage vs. Gate-Source Voltage [ $T_j=25^\circ\text{C}$ ]

Fig.4 Static Drain - Source On-State Resistance vs. Junction Temperature
Electrical characteristic curves (Typical)

Fig.5 Forward characteristic of Diode

Source Current : $I_s$ [A]  
Source-Drain Voltage : $V_{SD}$ [V]  
$V_{GS}=0V$  
$V_{GS}=18V$  
$T_j=25ºC$  
$T_j=125ºC$  
$T_j=150ºC$

Fig.6 Forward characteristic of Diode

Source Current : $I_s$ [A]  
Source-Drain Voltage : $V_{SD}$ [V]  
$V_{GS}=0V$  
$V_{GS}=18V$  
$T_j=25ºC$  
$T_j=125ºC$  
$T_j=150ºC$

Fig.7 Drain Current vs. Gate-Source Voltage

Drain Current : $I_d$ [A]  
Gate-Source Voltage : $V_{GS}$ [V]  
$V_{DS}=20V$  
$T_j=25ºC$  
$T_j=125ºC$  
$T_j=150ºC$

Fig.8 Drain Current vs. Gate-Source Voltage

Drain Current : $I_d$ [A]  
Gate-Source Voltage : $V_{GS}$ [V]  
$V_{DS}=20V$  
$T_j=25ºC$  
$T_j=125ºC$  
$T_j=150ºC$
Electrical characteristic curves (Typical)

Fig. 9 Switching Characteristics [T_j=25°C]

Fig. 10 Switching Characteristics [T_j=150°C]

Fig. 11 Switching Loss vs. Drain Current [T_j=25°C]

Fig. 12 Switching Loss vs. Drain Current [T_j=150°C]
Electrical characteristic curves (Typical)

Fig. 13 Recovery Characteristics vs. Drain Current \( T_j = 25^\circ C \)

![Recovery Characteristics vs. Drain Current \( T_j = 25^\circ C \)](image)

Fig. 14 Recovery Characteristics vs. Drain Current \( T_j = 150^\circ C \)

![Recovery Characteristics vs. Drain Current \( T_j = 150^\circ C \)](image)

Fig. 15 Switching Characteristics vs. Gate Resistance \( T_j = 25^\circ C \)

![Switching Characteristics vs. Gate Resistance \( T_j = 25^\circ C \)](image)

Fig. 16 Switching Characteristics vs. Gate Resistance \( T_j = 150^\circ C \)

![Switching Characteristics vs. Gate Resistance \( T_j = 150^\circ C \)](image)
Electrical characteristic curves (Typical)

- **Fig. 17** Switching Loss vs. Gate Resistance
  
  ![Graph](image1.png)

  - **[Tj=25°C]**
  - Switching Loss [mJ]
  - Gate Resistance: \( R_G \) [Ω]
  - Conditions: \( V_{DS}=600V \), \( I_D=300A \), \( V_{GS(on)}=18V \), \( V_{GS(off)}=0V \)
  - Load: Inductive

- **Fig. 18** Switching Loss vs. Gate Resistance
  
  ![Graph](image2.png)

  - **[Tj=150°C]**
  - Switching Loss [mJ]
  - Gate Resistance: \( R_G \) [Ω]
  - Conditions: \( V_{DS}=600V \), \( I_D=300A \), \( V_{GS(on)}=18V \), \( V_{GS(off)}=0V \)
  - Load: Inductive

- **Fig. 19** Typical Capacitance vs. Drain-Source Voltage
  
  ![Graph](image3.png)

  - Capasitance: \( C \) [F]
  - Conditions: \( Tj=25°C \), \( V_{DS}=0V \)

- **Fig. 20** Gate Charge Characteristics
  
  ![Graph](image4.png)

  - Gate-Source Voltage: \( V_{GS} \) [V]
  - Total Gate charge: \( Q_g \) [nC]
  - Conditions: \( I_D=300A \), \( Tj=25°C \)
● **Electrical characteristic curves (Typical)**

![Normalized Transient Thermal Impedance](image)

- **Fig.21 Normalized Transient Thermal Impedance**
- Normalized Transient Thermal Impedance: $Z_{th}$
- Single Pulse
  - $T_c=25^\circ C$
- Per unit base
  - DMOS part: $0.08K/W$
  - SBD part: $0.11K/W$

**Time [s]**

**Normalized Transient Thermal Impedance vs. Time**

- 0.001
- 0.01
- 0.1
- 1
- 10

- 0.01
- 0.1
- 1

- 1
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