BSS138K
N-Channel Logic Level Enhancement Mode Field Effect Transistor

Features
• Low On-Resistance
• Low Gate Threshold Voltage
• Low Input Capacitance
• Fast Switching Speed
• Low Input/Output Leakage
• Ultra-Small Surface Mount Package
• Pb Free / RoHS Compliant
• Green Compound
• ESD HBM = 2000 V as per JEDEC A114A; ESD CDM = 2000 V as per JEDEC C101C

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. Values are at $T_A = 25°C$ unless otherwise noted.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{DSS}$</td>
<td>Drain-Source Voltage</td>
<td>50</td>
<td>V</td>
</tr>
<tr>
<td>$V_{GSS}$</td>
<td>Gate-Source Voltage</td>
<td>±12</td>
<td>V</td>
</tr>
<tr>
<td>$I_D$</td>
<td>Drain Current</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Continuous</td>
<td>0.22</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Pulsed</td>
<td>0.88</td>
<td></td>
</tr>
<tr>
<td>$T_J$</td>
<td>Operating Junction Temperature Range</td>
<td>-55 to +150</td>
<td>°C</td>
</tr>
<tr>
<td>$T_{STG}$</td>
<td>Storage Temperature Range</td>
<td>-55 to +150</td>
<td>°C</td>
</tr>
</tbody>
</table>

Note:
1. These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

Thermal Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_D$</td>
<td>Total Device Dissipation</td>
<td>350</td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td>Derating above $T_A = 25°C$</td>
<td>2.8</td>
<td>mW/°C</td>
</tr>
<tr>
<td>$R_{JUA}$</td>
<td>Thermal Resistance, Junction to Ambient</td>
<td>350</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

Note:
2. Device mounted on FR-4 PCB, 1 inch x 0.85 inch x 0.062 inch. Minimum land pad size.

Package Marking and Ordering Information

<table>
<thead>
<tr>
<th>Device Marking</th>
<th>Device</th>
<th>Reel Size</th>
<th>Tape Width</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>SK</td>
<td>BSS138K</td>
<td>7”</td>
<td>8 mm</td>
<td>3000 units</td>
</tr>
</tbody>
</table>
## Electrical Characteristics

Values are at $T_A = 25^\circ C$ unless otherwise noted

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Condition</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BVDSS</td>
<td>Drain-Source Breakdown Voltage</td>
<td>$V_{GS} = 0 , V, , I_D = 10 , \mu A$</td>
<td>50</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$V_{TH}$</td>
<td>Breakdown Voltage Temperature Coefficient</td>
<td>$I_D = 250 , \mu A$, Referenced to $25^\circ C$</td>
<td>0.11</td>
<td></td>
<td></td>
<td>V/$^\circ C$</td>
</tr>
<tr>
<td>$I_D$</td>
<td>Zero Gate Voltage Drain Current</td>
<td>$V_{DS} = 50 , V, , V_{GS} = 0 , V$</td>
<td>0.1</td>
<td></td>
<td></td>
<td>$\mu A$</td>
</tr>
<tr>
<td>$I_{GS}$</td>
<td>Gate-Body Leakage</td>
<td>$V_{GS} = \pm 12 , V, , V_{DS} = 0 , V$</td>
<td>$\pm 1$</td>
<td></td>
<td></td>
<td>$\mu A$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{GS} = \pm 10 , V, , V_{DS} = 0 , V$</td>
<td>$\pm 0.5$</td>
<td></td>
<td></td>
<td>$\mu A$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{GS} = \pm 5 , V, , V_{DS} = 0 , V$</td>
<td>$\pm 0.05$</td>
<td></td>
<td></td>
<td>$\mu A$</td>
</tr>
</tbody>
</table>

### Off Characteristics

### On Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Condition</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{TH}$</td>
<td>Gate Threshold Voltage</td>
<td>$V_{DS} = V_{GS}, , I_D = 250 , \mu A$</td>
<td>0.6</td>
<td></td>
<td>1.2</td>
<td>V</td>
</tr>
<tr>
<td>$V_{TH}$</td>
<td>Gate Threshold Voltage Temperature Coefficient</td>
<td>$I_D = 1 , mA$, Referenced to $25^\circ C$</td>
<td>-1.4</td>
<td></td>
<td></td>
<td>mV/$^\circ C$</td>
</tr>
<tr>
<td>$R_{DS(on)}$</td>
<td>Static Drain-Source On-Resistance</td>
<td>$V_{GS} = 1.8 , V, , I_D = 50 , mA$</td>
<td>2.5</td>
<td></td>
<td></td>
<td>$\Omega$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{GS} = 2.5 , V, , I_D = 50 , mA$</td>
<td>2.0</td>
<td></td>
<td></td>
<td>$\Omega$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{GS} = 5 , V, , I_D = 50 , mA$</td>
<td>1.6</td>
<td></td>
<td></td>
<td>$\Omega$</td>
</tr>
<tr>
<td>$I_{D(on)}$</td>
<td>On-State Drain Current</td>
<td>$V_{GS} = 10 , V, , V_{DS} = 5 , V$</td>
<td>0.2</td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>$g_{FS}$</td>
<td>Forward Transconductance</td>
<td>$V_{DS} = 10 , V, , I_D = 200 , mA$</td>
<td>200</td>
<td></td>
<td></td>
<td>mS</td>
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</table>

### Dynamic Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Condition</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_{ss}$</td>
<td>Input Capacitance</td>
<td>$V_{DS} = 25 , V, , V_{GS} = 0 , V, , f = 1.0 , MHz$</td>
<td>58</td>
<td></td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>$C_{oss}$</td>
<td>Output Capacitance</td>
<td>$V_{DS} = 25 , V, , V_{GS} = 10 , V, , f = 1.0 , MHz$</td>
<td>9.75</td>
<td></td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>$C_{rss}$</td>
<td>Reverse Transfer Capacitance</td>
<td>$V_{DS} = 5 , V, , V_{GS} = 10 , mA$</td>
<td>5.2</td>
<td></td>
<td></td>
<td>$\Omega$</td>
</tr>
<tr>
<td>$R_{G}$</td>
<td>Gate Resistance</td>
<td>$V_{DS} = 5 , V, , V_{GS} = 10 , mA$</td>
<td>281</td>
<td></td>
<td></td>
<td>$\Omega$</td>
</tr>
</tbody>
</table>

### Switching Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Condition</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$t_{D(on)}$</td>
<td>Turn-On Delay Time</td>
<td>$V_{DD} = 30 , V, , I_D = 0.29 , A, , V_{GS} = 10 , V, , R_{GEN} = 6 , \Omega$</td>
<td>5</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>$t_{r}$</td>
<td>Turn-On Rise Time</td>
<td>$V_{DD} = 30 , V, , I_D = 0.29 , A, , V_{GS} = 10 , V, , R_{GEN} = 6 , \Omega$</td>
<td>5</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>$t_{D(off)}$</td>
<td>Turn-Off Delay Time</td>
<td>$V_{DS} = 25 , V, , I_D = 0.2 , A, , V_{GS} = 10 , V, , I_{D} = 0.1 , mA$</td>
<td>60</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>$t_{f}$</td>
<td>Turn-Off Fall Time</td>
<td>$V_{DS} = 25 , V, , I_D = 0.2 , A, , V_{GS} = 10 , V, , I_{D} = 0.1 , mA$</td>
<td>35</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>$Q_{G}$</td>
<td>Total Gate Charge</td>
<td>$V_{DS} = 25 , V, , I_D = 0.2 , A, , V_{GS} = 10 , V, , I_{D} = 0.1 , mA$</td>
<td>2.4</td>
<td></td>
<td></td>
<td>nC</td>
</tr>
<tr>
<td>$Q_{GS}$</td>
<td>Gate-Source Charge</td>
<td>$V_{DS} = 25 , V, , I_D = 0.2 , A, , V_{GS} = 10 , V, , I_{D} = 0.1 , mA$</td>
<td>0.5</td>
<td></td>
<td></td>
<td>nC</td>
</tr>
<tr>
<td>$Q_{gd}$</td>
<td>Gate-Drain Charge</td>
<td>$V_{DS} = 25 , V, , I_D = 0.2 , A, , V_{GS} = 10 , V, , I_{D} = 0.1 , mA$</td>
<td>0.5</td>
<td></td>
<td></td>
<td>nC</td>
</tr>
</tbody>
</table>

### Drain-Source Diode Characteristics and Maximum Ratings

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Condition</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{sd}$</td>
<td>Drain-Source Diode Forward Voltage</td>
<td>$V_{GS} = 0 , V, , I_S = 115 , mA$</td>
<td>1.2</td>
<td></td>
<td></td>
<td>V</td>
</tr>
</tbody>
</table>
Typical Performance Characteristics

Figure 1. On-Region Characteristics

Figure 2. On-Resistance Variation with Gate Voltage and Drain Current

Figure 3. On-Resistance Variation with Temperature

Figure 4. On-Resistance Variation with Gate-Source Voltage

Figure 5. Transfer Characteristics

Figure 6. Gate Threshold Variation with Temperature
Typical Performance Characteristics (Continue)

Figure 7. Reverse Drain Current Variation with Diode Forward Voltage and Temperature
Physical Dimensions

Figure 8. 3LEAD, SOT23, JEDEC TO-236, LOW PROFILE (ACTIVE)

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PRODUCT STATUS DEFINITIONS

Definition of Terms

<table>
<thead>
<tr>
<th>Datasheet Identification</th>
<th>Product Status</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advance Information</td>
<td>Formative / In Design</td>
<td>Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.</td>
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<td>Preliminary</td>
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</tr>
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</tbody>
</table>

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