

# N-Channel Logic Level Enhancement Mode Field Effect Transistor

## BSS138K

### Features

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

### ABSOLUTE MAXIMUM RATINGS

( $T_A = 25^\circ\text{C}$  unless otherwise noted) (Note 1)

| Symbol    | Parameter                               | Value           | Unit                 |
|-----------|-----------------------------------------|-----------------|----------------------|
| $V_{DS}$  | Drain-Source Voltage                    | 50              | V                    |
| $V_{GS}$  | Gate-Source Voltage                     | $\pm 12$        | V                    |
| $I_D$     | Drain Current – Continuous              | 0.22            | A                    |
|           | Drain Current – Pulsed                  | 0.88            |                      |
| $P_D$     | Total Device Dissipation                | 350             | mW                   |
|           | Derating above $T_A = 25^\circ\text{C}$ | 2.8             | mW/ $^\circ\text{C}$ |
| $T_J$     | Operating Junction Temperature Range    | $-55$ to $+150$ | $^\circ\text{C}$     |
| $T_{STG}$ | Storage Temperature Range               | $-55$ to $+150$ | $^\circ\text{C}$     |

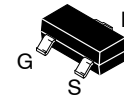
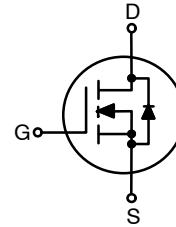
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. These ratings are limiting values above which the serviceability of any semiconductor device maybe impaired.

### THERMAL CHARACTERISTICS

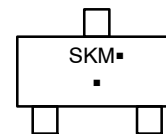
| Symbol          | Parameter                                        | Value | Unit               |
|-----------------|--------------------------------------------------|-------|--------------------|
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient (Note 2) | 350   | $^\circ\text{C/W}$ |

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



SOT-23-3  
CASE 318-08

### MARKING DIAGRAM



SK = Specific Device Code  
M = Assembly Operation Month  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

| Device  | Package               | Shipping <sup>†</sup> |
|---------|-----------------------|-----------------------|
| BSS138K | SOT-23-3<br>(Pb-Free) | 3000 /<br>Tape & Reel |

<sup>†</sup>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.

# BSS138K

## ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|--------|-----------|-----------------|-----|-----|-----|------|
|--------|-----------|-----------------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                        |                                           |                                                                   |    |      |            |                     |
|------------------------|-------------------------------------------|-------------------------------------------------------------------|----|------|------------|---------------------|
| $BV_{DSS}$             | Drain–Source Breakdown Voltage            | $V_{GS} = 0\text{ V}, I_D = 10\text{ }\mu\text{A}$                | 50 | –    | –          | V                   |
| $\frac{BV_{DSS}}{T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\text{ }\mu\text{A}$ , Referenced to $25^\circ\text{C}$ | –  | 0.11 | –          | V/ $^\circ\text{C}$ |
| $I_{DSS}$              | Zero Gate Voltage Drain Current           | $V_{DS} = 50\text{ V}, V_{GS} = 0\text{ V}$                       | –  | –    | 0.1        | $\mu\text{A}$       |
| $I_{GSS}$              | Gate–Body Leakage                         | $V_{GS} = \pm 12\text{ V}, V_{DS} = 0\text{ V}$                   | –  | –    | $\pm 1$    | $\mu\text{A}$       |
|                        |                                           | $V_{GS} = \pm 10\text{ V}, V_{DS} = 0\text{ V}$                   | –  | –    | $\pm 0.5$  |                     |
|                        |                                           | $V_{GS} = \pm 5\text{ V}, V_{DS} = 0\text{ V}$                    | –  | –    | $\pm 0.05$ |                     |

### ON CHARACTERISTICS

|                          |                                                |                                                        |     |      |     |                      |
|--------------------------|------------------------------------------------|--------------------------------------------------------|-----|------|-----|----------------------|
| $V_{GS(th)}$             | Gate Threshold Voltage                         | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$        | 0.6 | –    | 1.2 | V                    |
| $\frac{V_{GS(th)}}{T_J}$ | Gate Threshold Voltage Temperature Coefficient | $I_D = 1\text{ mA}$ , Referenced to $25^\circ\text{C}$ | –   | –1.4 | –   | mV/ $^\circ\text{C}$ |
| $R_{DS(on)}$             | Static Drain–Source On–Resistance              | $V_{GS} = 1.8\text{ V}, I_D = 50\text{ mA}$            | –   | –    | 2.5 | $\Omega$             |
|                          |                                                | $V_{GS} = 2.5\text{ V}, I_D = 50\text{ mA}$            | –   | –    | 2.0 |                      |
|                          |                                                | $V_{GS} = 5\text{ V}, I_D = 50\text{ mA}$              | –   | –    | 1.6 |                      |
| $I_{D(ON)}$              | On–State Drain Current                         | $V_{GS} = 10\text{ V}, V_{DS} = 5\text{ V}$            | 0.2 | –    | –   | A                    |
| $g_{FS}$                 | Forward Transconductance                       | $V_{DS} = 10\text{ V}, I_D = 200\text{ mA}$            | 200 | –    | –   | mS                   |

### DYNAMIC CHARACTERISTICS

|           |                              |                                                                      |   |      |   |          |
|-----------|------------------------------|----------------------------------------------------------------------|---|------|---|----------|
| $C_{iss}$ | Input Capacitance            | $V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1.0\text{ MHz}$ | – | 58   | – | pF       |
| $C_{oss}$ | Output Capacitance           |                                                                      | – | 9.75 | – |          |
| $C_{rss}$ | Reverse Transfer Capacitance |                                                                      | – | 5.2  | – |          |
| $R_G$     | Gate Resistance              | $V_{DS} = 5\text{ V}, V_{GS} = 10\text{ mV}$                         | – | 281  | – | $\Omega$ |

### SWITCHING CHARACTERISTICS

|              |                     |                                                                                                   |   |   |     |    |
|--------------|---------------------|---------------------------------------------------------------------------------------------------|---|---|-----|----|
| $t_{D(ON)}$  | Turn–On Delay Time  | $V_{DD} = 30\text{ V}, I_D = 0.29\text{ A},$<br>$V_{GS} = 10\text{ V}, R_{GEN} = 6\text{ }\Omega$ | – | – | 5   | ns |
| $t_r$        | Turn–On Rise Time   |                                                                                                   | – | – | 5   |    |
| $t_{D(OFF)}$ | Turn–Off Delay Time |                                                                                                   | – | – | 60  |    |
| $t_f$        | Turn–Off Fall Time  |                                                                                                   | – | – | 35  |    |
| $Q_g$        | Total Gate Charge   | $V_{DS} = 25\text{ V}, I_D = 0.2\text{ A},$<br>$V_{GS} = 10\text{ V}, I_G = 0.1\text{ mA}$        | – | – | 2.4 | nC |
| $Q_{gs}$     | Gate–Source Charge  |                                                                                                   | – | – | 0.5 |    |
| $Q_{gd}$     | Gate–Drain Charge   |                                                                                                   | – | – | 0.5 |    |

### DRAIN–SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS

|          |                                    |                                            |   |   |     |   |
|----------|------------------------------------|--------------------------------------------|---|---|-----|---|
| $V_{sd}$ | Drain–Source Diode Forward Voltage | $V_{GS} = 0\text{ V}, I_S = 115\text{ mA}$ | – | – | 1.2 | V |
|----------|------------------------------------|--------------------------------------------|---|---|-----|---|

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

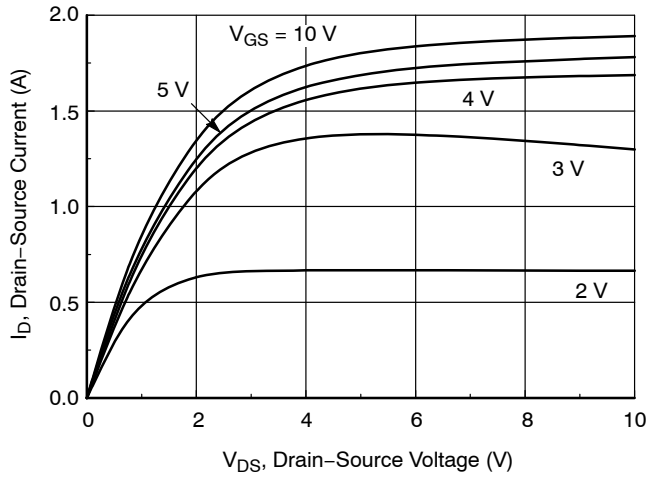


Figure 1. On-Region Characteristics

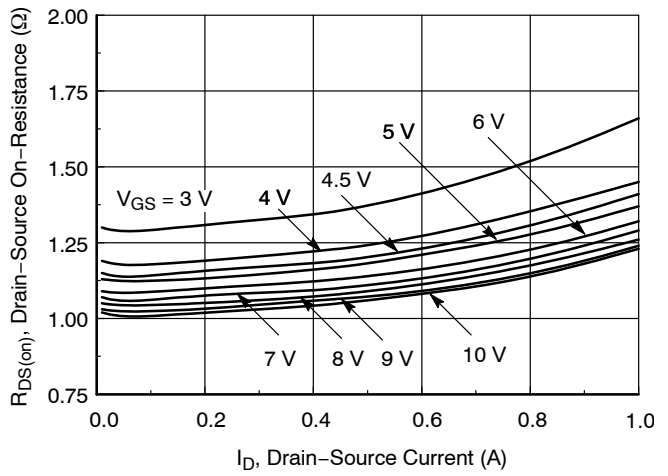


Figure 2. On-Resistance Variation with Gate Voltage and Drain Current

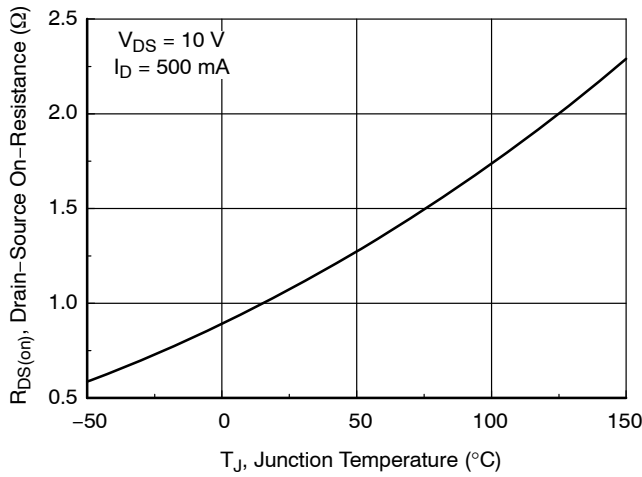


Figure 3. On-Resistance Variation with Temperature

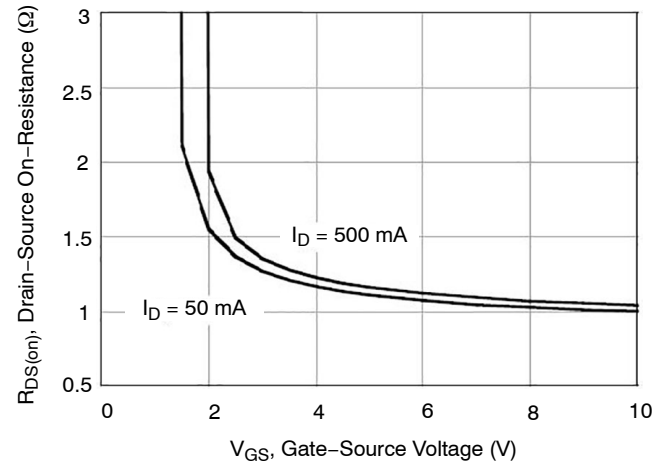


Figure 4. On-Resistance Variation with Gate-Source Voltage

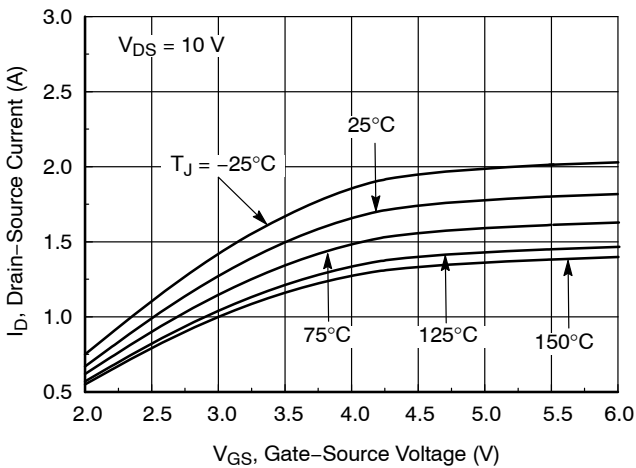


Figure 5. Transfer Characteristics

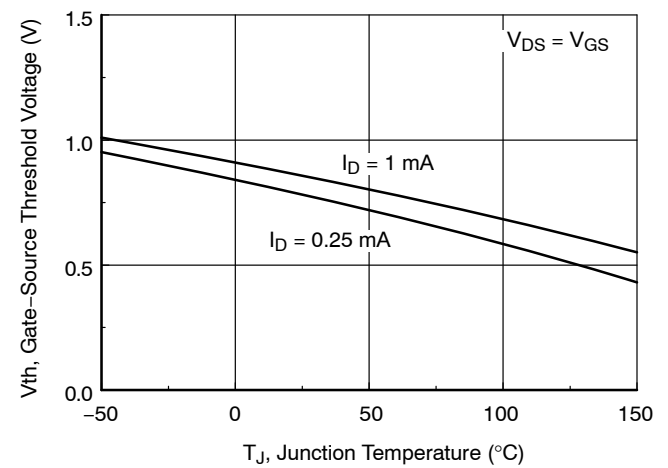
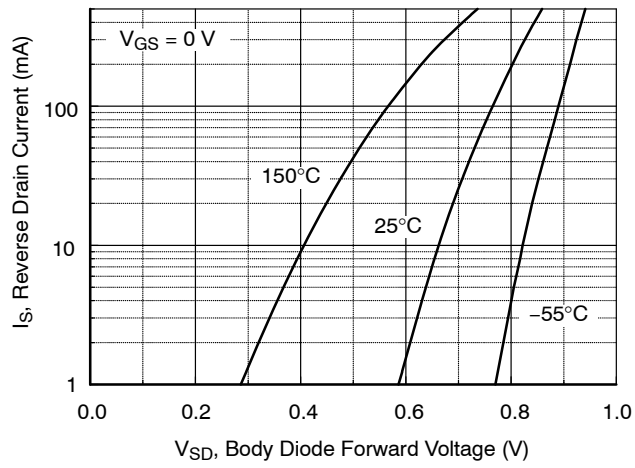


Figure 6. Gate Threshold Variation with Temperature

**TYPICAL CHARACTERISTICS** (continued)

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

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