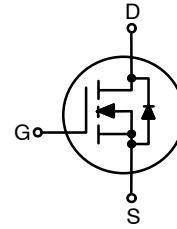


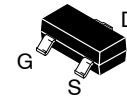
# N-Channel Logic Level Enhancement Mode Field Effect Transistor

## BSS138K



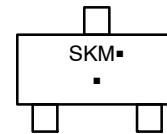
### Features

- 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



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)

### ABSOLUTE MAXIMUM RATINGS

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

Symbol	Parameter	Value	Unit
$V_{DSS}$	Drain-Source Voltage	50	V
$V_{GSS}$	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 may be impaired.

### THERMAL CHARACTERISTICS

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

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

### ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
BSS138K	SOT-23-3 (Pb-Free)	3000 / 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<sub>A</sub> = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

BV <sub>DSS</sub>	Drain–Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 10 μA	50	–	–	V
$\frac{BV_{DSS}}{T_J}$	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250 μA, Referenced to 25°C	–	0.11	–	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 50 V, V <sub>GS</sub> = 0 V	–	–	0.1	μA
I <sub>GSS</sub>	Gate–Body Leakage	V <sub>GS</sub> = ±12 V, V <sub>DS</sub> = 0 V	–	–	±1	μA
		V <sub>GS</sub> = ±10 V, V <sub>DS</sub> = 0 V	–	–	±0.5	
		V <sub>GS</sub> = ±5 V, V <sub>DS</sub> = 0 V	–	–	±0.05	

### ON CHARACTERISTICS

V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	0.6	–	1.2	V
$\frac{V_{GS(th)}}{T_J}$	Gate Threshold Voltage Temperature Coefficient	I <sub>D</sub> = 1 mA, Referenced to 25°C	–	–1.4	–	mV/°C
R <sub>DS(on)</sub>	Static Drain–Source On–Resistance	V <sub>GS</sub> = 1.8 V, I <sub>D</sub> = 50 mA	–	–	2.5	Ω
		V <sub>GS</sub> = 2.5 V, I <sub>D</sub> = 50 mA	–	–	2.0	
		V <sub>GS</sub> = 5 V, I <sub>D</sub> = 50 mA,	–	–	1.6	
I <sub>D(ON)</sub>	On–State Drain Current	V <sub>GS</sub> = 10 V, V <sub>DS</sub> = 5 V	0.2	–	–	A
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 200 mA	200	–	–	mS

### DYNAMIC CHARACTERISTICS

C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz	–	58	–	pF
C <sub>oss</sub>	Output Capacitance		–	9.75	–	
C <sub>rss</sub>	Reverse Transfer Capacitance		–	5.2	–	
R <sub>G</sub>	Gate Resistance	V <sub>DS</sub> = 5 V, V <sub>GS</sub> = 10 mV	–	281	–	Ω

### SWITCHING CHARACTERISTICS

t <sub>D(ON)</sub>	Turn–On Delay Time	V <sub>DD</sub> = 30 V, I <sub>D</sub> = 0.29 A, V <sub>GS</sub> = 10 V, R <sub>GEN</sub> = 6 Ω	–	–	5	ns
t <sub>r</sub>	Turn–On Rise Time		–	–	5	
t <sub>D(OFF)</sub>	Turn–Off Delay Time		–	–	60	
t <sub>f</sub>	Turn–Off Fall Time		–	–	35	
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> = 25 V, I <sub>D</sub> = 0.2 A, V <sub>GS</sub> = 10 V, I <sub>G</sub> = 0.1 mA	–	–	2.4	nC
Q <sub>gs</sub>	Gate–Source Charge		–	–	0.5	
Q <sub>gd</sub>	Gate–Drain Charge		–	–	0.5	

### DRAIN–SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS

V <sub>sd</sub>	Drain–Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 115 mA	–	–	1.2	V
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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

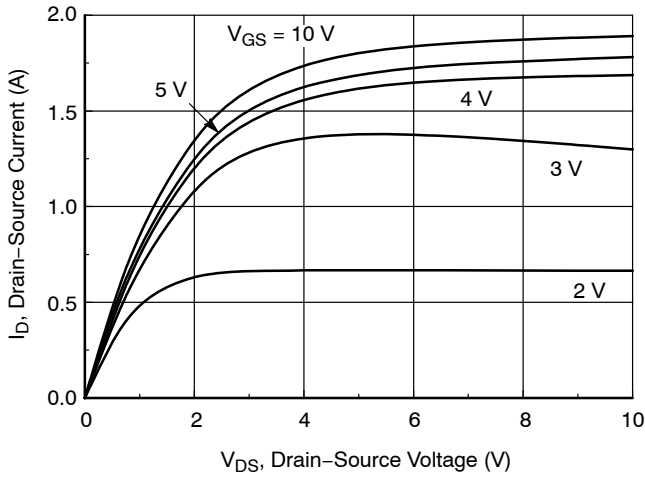


Figure 1. On-Region Characteristics

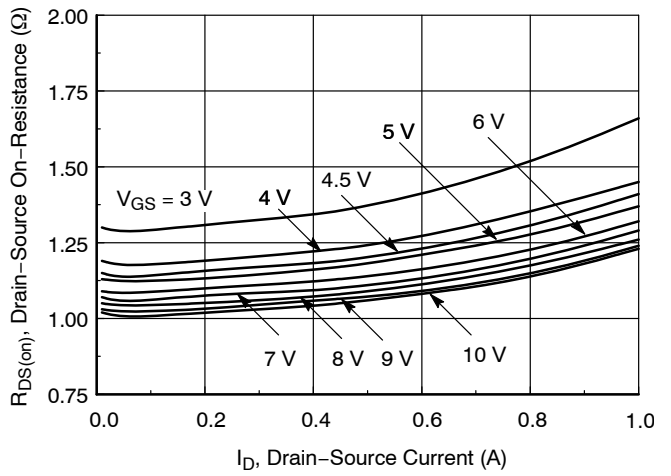


Figure 2. On-Resistance Variation with Gate Voltage and Drain Current

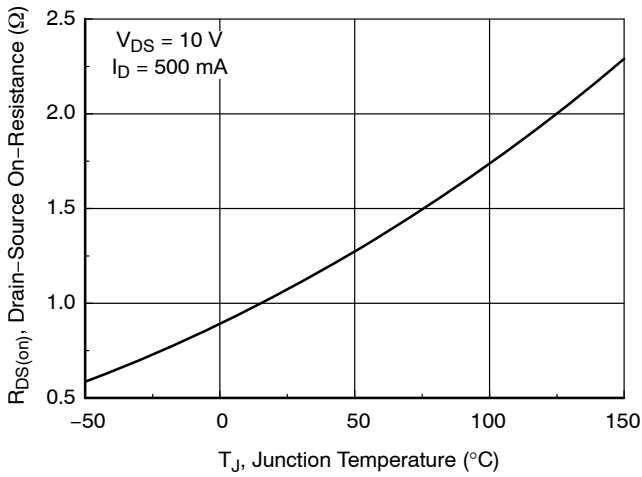


Figure 3. On-Resistance Variation with Temperature

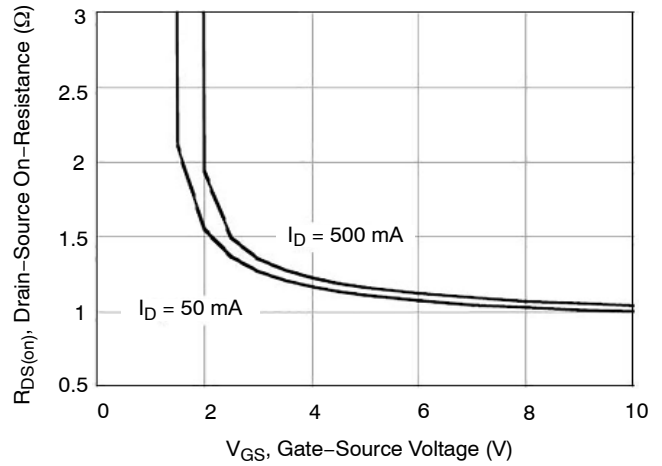


Figure 4. On-Resistance Variation with Gate-Source Voltage

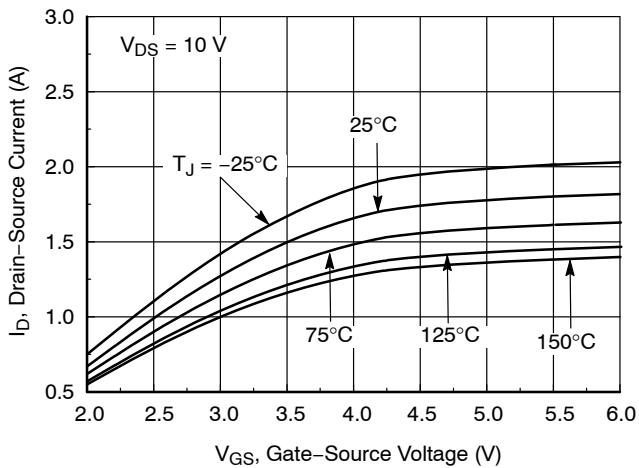


Figure 5. Transfer Characteristics

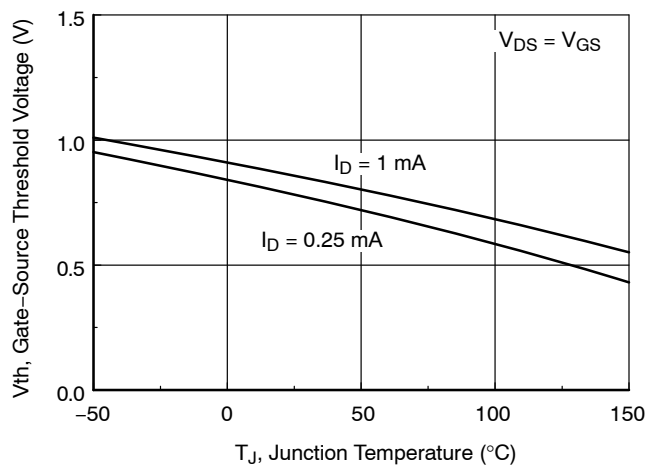


Figure 6. Gate Threshold Variation with Temperature

TYPICAL CHARACTERISTICS (continued)

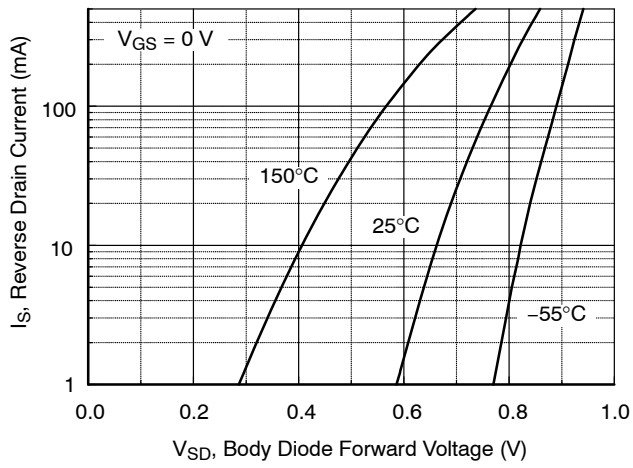
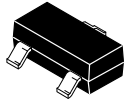


Figure 7. Reverse Drain Current Variation with Diode Forward Voltage and Temperature

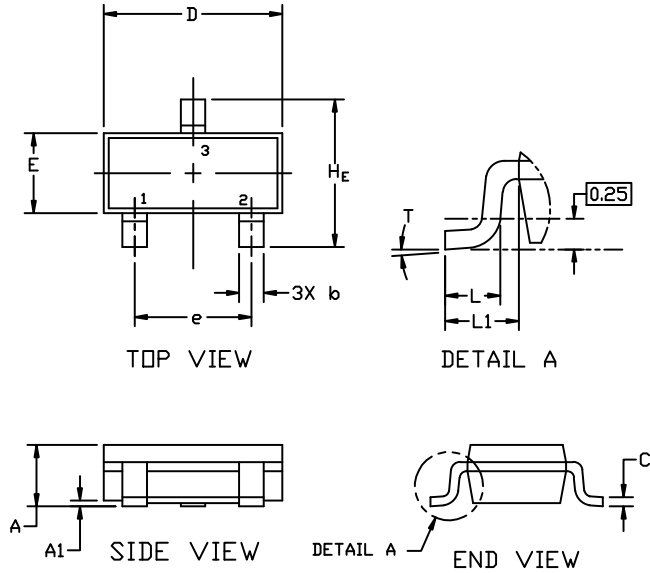
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



**SOT-23 (TO-236)**  
CASE 318  
ISSUE AT

DATE 01 MAR 2023

SCALE 4:1



**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M,1994.
2. CONTROLLING DIMENSION: MILLIMETERS
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

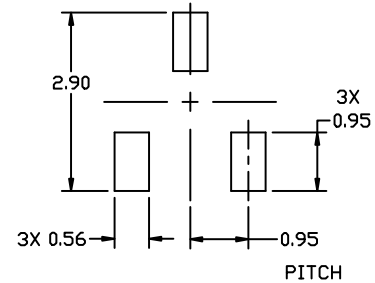
DIM	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.89	1.00	1.11	0.035	0.039	0.044
A1	0.01	0.06	0.10	0.000	0.002	0.004
b	0.37	0.44	0.50	0.015	0.017	0.020
c	0.08	0.14	0.20	0.003	0.006	0.008
D	2.80	2.90	3.04	0.110	0.114	0.120
E	1.20	1.30	1.40	0.047	0.051	0.055
e	1.78	1.90	2.04	0.070	0.075	0.080
L	0.30	0.43	0.55	0.012	0.017	0.022
L1	0.35	0.54	0.69	0.014	0.021	0.027
H <sub>E</sub>	2.10	2.40	2.64	0.083	0.094	0.104
T	0°	---	10°	0°	---	10°

**GENERIC MARKING DIAGRAM\***



- XXX = Specific Device Code
- M = Date Code
- = Pb-Free Package

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



**RECOMMENDED MOUNTING FOOTPRINT**

\* For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

**STYLES ON PAGE 2**

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**MECHANICAL CASE OUTLINE  
PACKAGE DIMENSIONS**



**SOT-23 (TO-236)  
CASE 318  
ISSUE AT**

DATE 01 MAR 2023

- |   |   |   |   |   |   |
|---|---|---|---|---|---|
| STYLE 1 THRU 5:<br>CANCELLED                            | STYLE 6:<br>PIN 1. BASE<br>2. EMITTER<br>3. COLLECTOR | STYLE 7:<br>PIN 1. EMITTER<br>2. BASE<br>3. COLLECTOR       | STYLE 8:<br>PIN 1. ANODE<br>2. NO CONNECTION<br>3. CATHODE  |   |   |
| STYLE 9:<br>PIN 1. ANODE<br>2. ANODE<br>3. CATHODE      | STYLE 10:<br>PIN 1. DRAIN<br>2. SOURCE<br>3. GATE     | STYLE 11:<br>PIN 1. ANODE<br>2. CATHODE<br>3. CATHODE-ANODE | STYLE 12:<br>PIN 1. CATHODE<br>2. CATHODE<br>3. ANODE       | STYLE 13:<br>PIN 1. SOURCE<br>2. DRAIN<br>3. GATE           | STYLE 14:<br>PIN 1. CATHODE<br>2. GATE<br>3. ANODE          |
| STYLE 15:<br>PIN 1. GATE<br>2. CATHODE<br>3. ANODE      | STYLE 16:<br>PIN 1. ANODE<br>2. CATHODE<br>3. CATHODE | STYLE 17:<br>PIN 1. NO CONNECTION<br>2. ANODE<br>3. CATHODE | STYLE 18:<br>PIN 1. NO CONNECTION<br>2. CATHODE<br>3. ANODE | STYLE 19:<br>PIN 1. CATHODE<br>2. ANODE<br>3. CATHODE-ANODE | STYLE 20:<br>PIN 1. CATHODE<br>2. ANODE<br>3. GATE          |
| STYLE 21:<br>PIN 1. GATE<br>2. SOURCE<br>3. DRAIN       | STYLE 22:<br>PIN 1. RETURN<br>2. OUTPUT<br>3. INPUT   | STYLE 23:<br>PIN 1. ANODE<br>2. ANODE<br>3. CATHODE         | STYLE 24:<br>PIN 1. GATE<br>2. DRAIN<br>3. SOURCE           | STYLE 25:<br>PIN 1. ANODE<br>2. CATHODE<br>3. GATE          | STYLE 26:<br>PIN 1. CATHODE<br>2. ANODE<br>3. NO CONNECTION |
| STYLE 27:<br>PIN 1. CATHODE<br>2. CATHODE<br>3. CATHODE | STYLE 28:<br>PIN 1. ANODE<br>2. ANODE<br>3. ANODE     |   |   |   |   |

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