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October 2014

# BSS138L

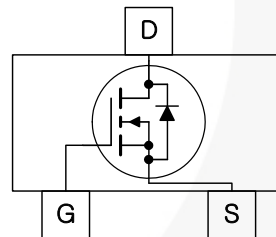
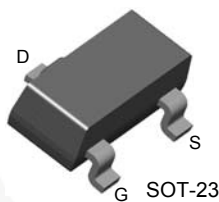
## N-Channel Logic Level Enhancement Mode Field Effect Transistor

### Features

- High Density Cell Design for Low  $R_{DS(ON)}$
- Rugged and Reliable
- Compact Industry Standard SOT-23 Surface Mount Package
- Very Low Capacitance
- Fast Switching Speed

### Description

This N-channel enhancement mode field effect transistor is produced using high cell density, trench MOSFET technology. This product minimizes on-state resistance while providing rugged, reliable, and fast switching performance. This product is particularly suited for low-voltage, low-current applications such as small servo motor control, power MOSFET gate drivers, logic level translator, high speed line drivers, power management/power supply and switching applications.



### Ordering Information

Part Number	Marking	Package	Packing Method
BSS138L	SL	SOT-23 3L	Tape and Reel

BSS138L — N-Channel Logic Level Enhancement Mode Field Effect Transistor

## 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  $T_A = 25^\circ\text{C}$  unless otherwise noted.

Symbol	Parameter	Value	Unit
$V_{DSS}$	Drain-Source Voltage	50	V
$V_{GSS}$	Gate-Source Voltage	$\pm 20$	V
$I_D$	Maximum Drain Current	Continuous	0.20
		Pulsed	0.80
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +150	$^\circ\text{C}$
$T_L$	Maximum Lead Temperature for Soldering Purposes, 1/16 inch from Case for 10 Seconds	300	$^\circ\text{C}$

## Thermal Characteristics

Values are at  $T_A = 25^\circ\text{C}$  unless otherwise noted.

Symbol	Parameter	Value	Unit
$P_D$	Maximum Power Dissipation <sup>(1)</sup>	0.35	W
	Derate Above $25^\circ\text{C}$	2.8	$\text{mW}/^\circ\text{C}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient <sup>(1)</sup>	380	$^\circ\text{C}/\text{W}$

### Note:

- $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



a)  $380^\circ\text{C}/\text{W}$  when mounted on a minimum pad.

Scale 1: 1 on letter size paper

## ESD Rating<sup>(2)</sup>

Symbol	Parameter	Value	Unit
HBM	Human Body Model per ANSI/ESDA/JEDEC JS-001-2012	50	V
CDM	Charged Device Model per JEDEC C101C	>2000	

### Note:

- ESD values are in typical, no over-voltage rating is implied, ESD CDM zap voltage is 2000 V maximum.

## Electrical Characteristics

Values are at  $T_A = 25^\circ\text{C}$  unless otherwise noted.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
<b>Off Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	50.0	65.4		V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$		58		$\text{mV}/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 50\text{ V}, V_{GS} = 0\text{ V}$		0.263	500	nA
		$V_{DS} = 50\text{ V}, V_{GS} = 0\text{ V}, T_J = 125^\circ\text{C}$		0.109	5	$\mu\text{A}$
		$V_{DS} = 30\text{ V}, V_{GS} = 0\text{ V}$		0.062	100	nA
$I_{GSSF}$	Gate-Body Leakage, Forward	$V_{GS} = 20\text{ V}, V_{DS} = 0\text{ V}$		0.058	100	nA
$I_{GSSR}$	Gate-Body Leakage, Reverse	$V_{GS} = -20\text{ V}, V_{DS} = 0\text{ V}$		-0.06	-100	
<b>On Characteristics<sup>(3)</sup></b>						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 1\text{ mA}$	0.80	1.25	1.50	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = 1\text{ mA}$ , Referenced to $25^\circ\text{C}$		-2.42		$\text{mV}/^\circ\text{C}$
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 5\text{ V}, I_D = 0.20\text{ A}$		2.78	3.50	$\Omega$
		$V_{GS} = 2.75\text{ V}, I_D = 0.20\text{ A}$		3.78	10	
$I_{D(on)}$	On-State Drain Current	$V_{GS} = 10\text{ V}, V_{DS} = 5\text{ V}$	0.20	0.67		A
$g_{FS}$	Forward Transconductance	$V_{DS} = 10\text{ V}, I_D = 0.22\text{ A}$	0.12	0.35		S
<b>Dynamic Characteristics</b>						
$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$		12.2	50	pF
$C_{oss}$	Output Capacitance			3.04	25	pF
$C_{riss}$	Reverse Transfer Capacitance			1.43	5	pF
$R_G$	Gate Resistance	$V_{GS} = 15\text{ V}, V_{GS} = 1.0\text{ MHz}$		26.6		$\Omega$
<b>Switching Characteristics<sup>(3)</sup></b>						
$t_{d(on)}$	Turn-On Delay	$V_{DD} = 30\text{ V}, I_D = 0.29\text{ A}, V_{GS} = 10\text{ V}$		2.2	5	ns
$t_r$	Turn-On Rise Time			1.8	18	ns
$t_{d(off)}$	Turn-Off Delay			5.3	36	ns
$t_f$	Turn-Off Fall Time			5.1	14	ns
$Q_g$	Total Gate Charge	$V_{DS} = 25\text{ V}, I_D = 0.22\text{ A}, V_{GS} = 10\text{ V}, I_G = 0.1\text{ mA}$		0.549	2.4	nC
$Q_{gs}$	Gate-Source Charge			0.075		nC
$Q_{gd}$	Gate-Drain Charge			0.117		nC
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
$I_S$	Maximum Continuous Drain-Source Diode Forward Current				0.22	A
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 115\text{ mA}$		0.93	1.4	V

### Note:

3. Pulse test: pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2.0\%$ .

## Typical Performance Characteristics

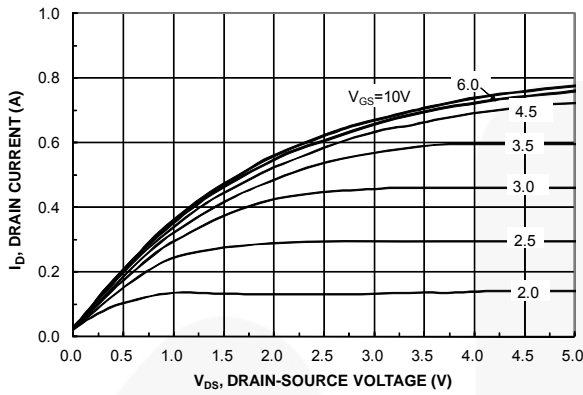


Figure 1. On-Region Characteristics

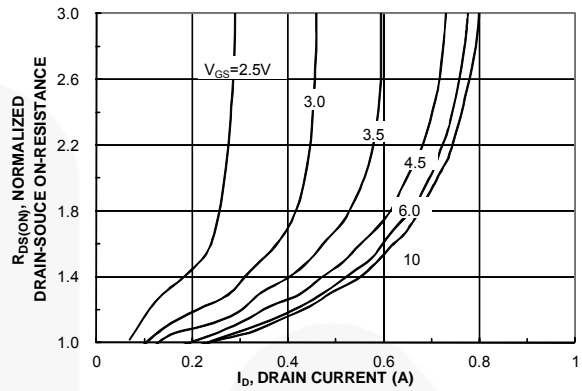


Figure 2. On-Resistance Variation with Gate Voltage and Drain Current

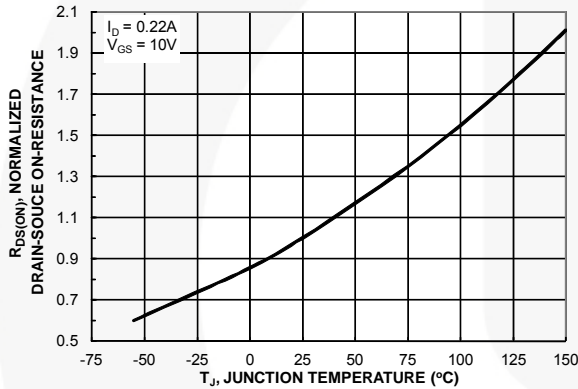


Figure 3. On-Resistance Variation with Temperature

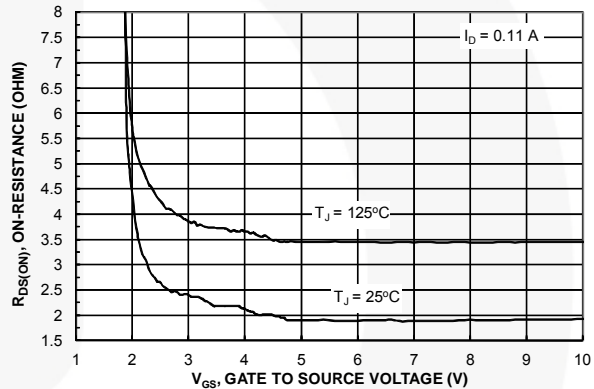


Figure 4. On-Resistance Variation with Gate-to-Source Voltage

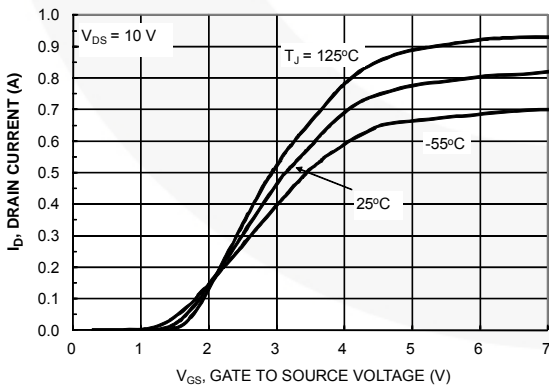


Figure 5. Transfer Characteristics

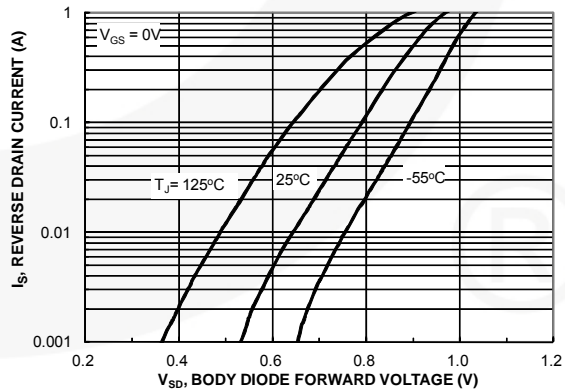


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature

Typical Performance Characteristics (Continued)

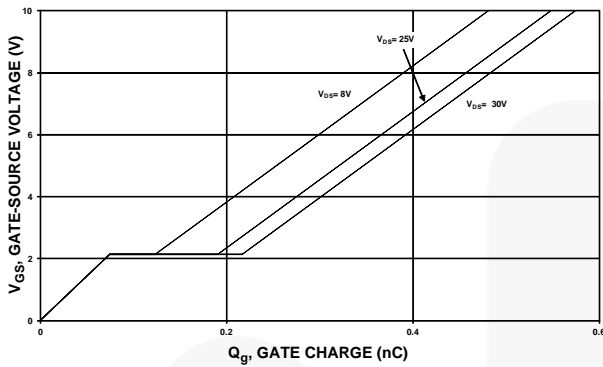


Figure 7. Gate Charge Characteristics

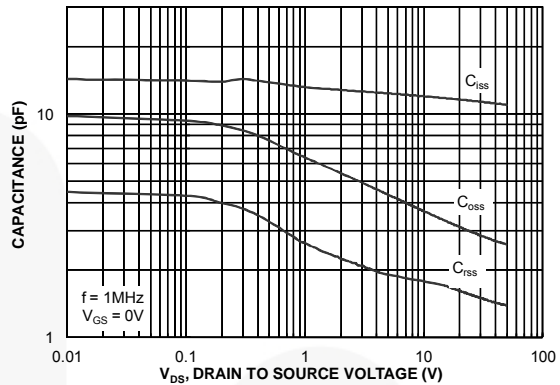


Figure 8. Capacitance Characteristics

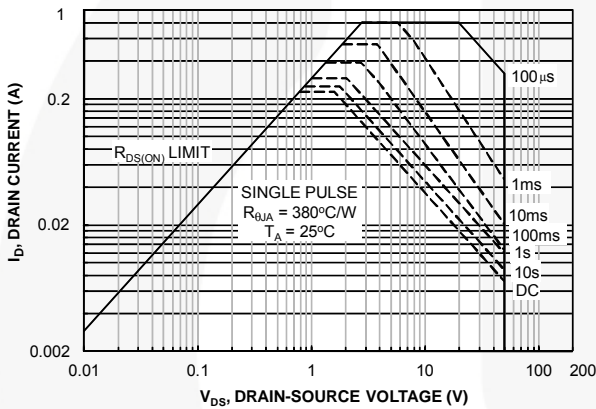


Figure 9. Maximum Safe Operating Area

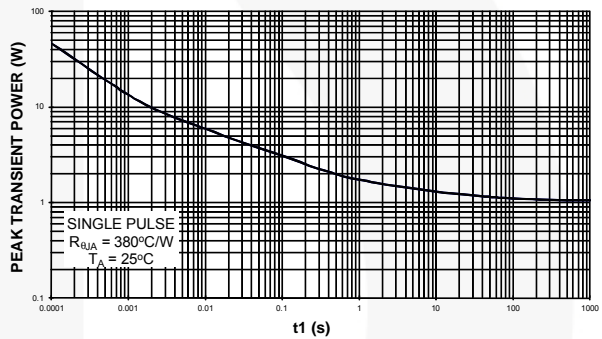


Figure 10. Single Pulse Maximum Power Dissipation

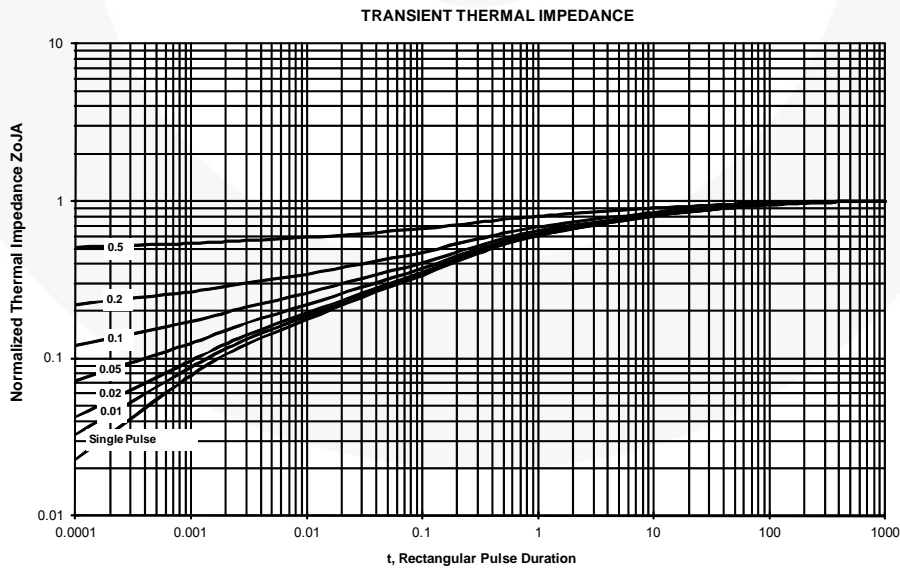
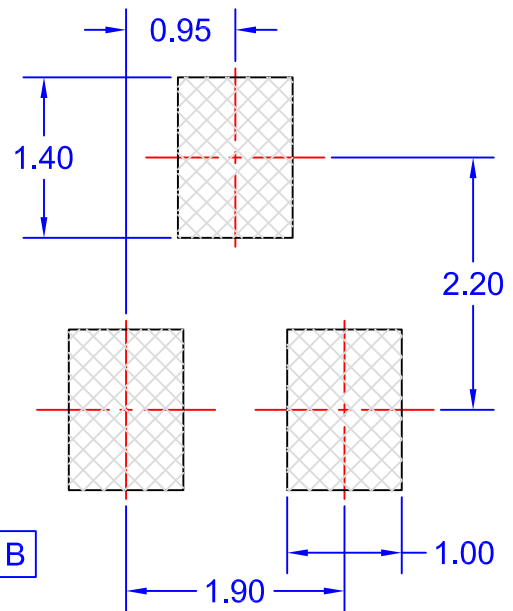
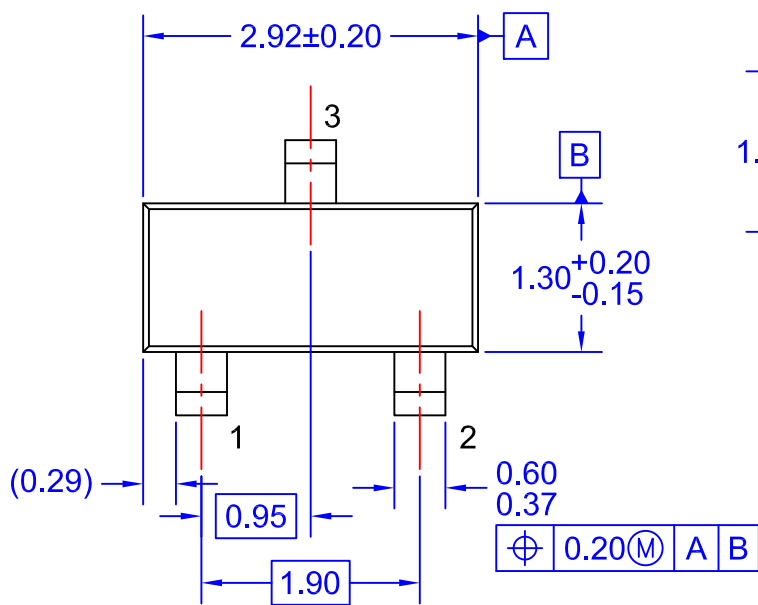
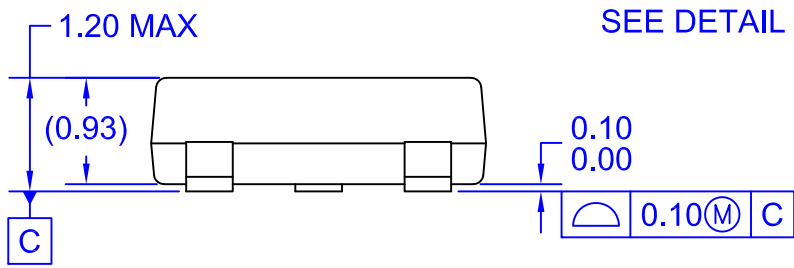


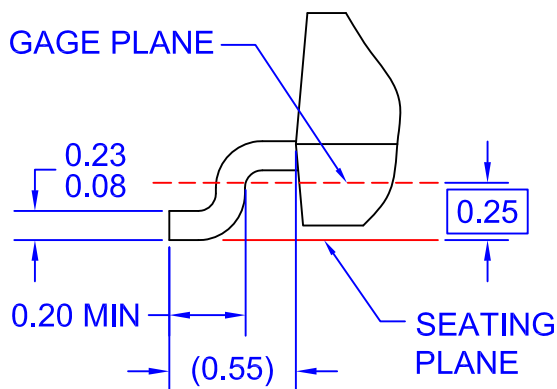
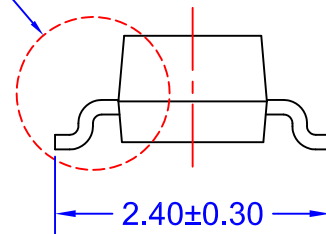
Figure 11. Transient Thermal Response Curve.



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