# FL9014-VB Datasheet

## P-Channel 60-V (D-S) MOSFET

| PRODUCT SUMMARY | | | |
|---|---|---|---|
| $V_{DS}$ (V) | $R_{DS(on)}$ (Ω) | $I_D$ (A)[a] | $Q_g$ (Typ.) |
| - 60 | 0.055 at $V_{GS}$ = - 10 V | - 7.0 | 30 nC |
| | 0.065 at $V_{GS}$ = - 4.5 V | - 6.0 | |

### FEATURES

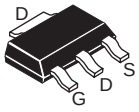
- Trench Power MOSFET
- 100 % UIS Tested

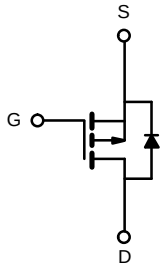
### APPLICATIONS

- Load Switch

RoHS COMPLIANT
HALOGEN FREE

SOT-223




P-Channel MOSFET

| ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25 °C, unless otherwise noted) | | | | |
|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Limit** | **Unit** |
| Drain-Source Voltage | | $V_{DS}$ | - 60 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 20 | |
| Continuous Drain Current ($T_J$ = 150 °C) | $T_C$ = 25 °C | $I_D$ | - 7.0[a] | A |
| | $T_C$ = 70 °C | | - 5.2 | |
| | $T_A$ = 25 °C | | - 4.8[b] | |
| | $T_A$ = 70 °C | | - 4.1[b] | |
| Pulsed Drain Current | | $I_{DM}$ | - 25 | |
| Avalanche Current Pulse | L = 0.1 mH | $I_{AS}$ | - 4.5 | |
| Single Pulse Avalanche Energy | | $E_{AS}$ | 10.1 | mJ |
| Continuous Source-Drain Diode Current | $T_C$ = 25 °C | $I_S$ | 6.9[a] | A |
| | $T_A$ = 25 °C | | 3.5[b] | |
| Maximum Power Dissipation | $T_C$ = 25 °C | $P_D$ | 10.4[a] | W |
| | $T_C$ = 70 °C | | 6.6[a] | |
| | $T_A$ = 25 °C | | 2.1[b] | |
| | $T_A$ = 70 °C | | 1.1[b] | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | - 55 to 150 | °C |

| THERMAL RESISTANCE RATINGS | | | | | |
|---|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Typical** | **Maximum** | **Unit** |
| Maximum Junction-to-Ambient[b] | Steady State | $R_{thJA}$ | 33 | 40 | °C/W |
| Maximum Junction-to-Case | Steady State | $R_{thJC}$ | 0.98 | 1.2 | |

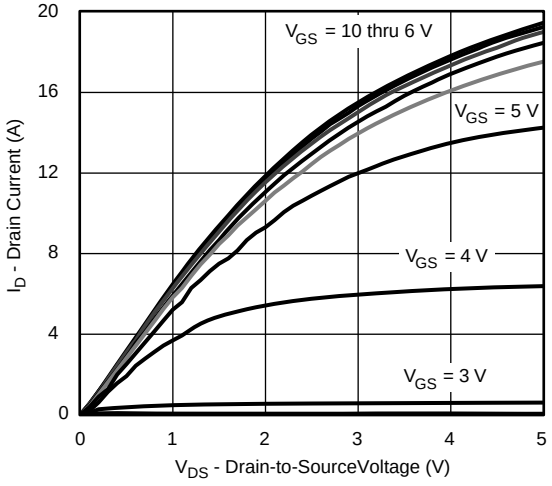
Notes:
a. Based on $T_C$ = 25 °C.
b. Surface mounted on 1" x 1" FR4 board.

| **SPECIFICATIONS** ($T_J$ = 25 °C, unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Test Conditions** | **Min.** | **Typ.** | **Max.** | **Unit** |
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{GS}$ = 0 V, $I_D$ = - 250 µA | - 60 | | | V |
| $V_{DS}$ Temperature Coefficient | $\Delta V_{DS}/T_J$ | $I_D$ = - 250 µA | | 68 | | mV/°C |
| $V_{GS(th)}$ Temperature Coefficient | $\Delta V_{GS(th)}/T_J$ | | | - 5.2 | | |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = - 250 µA | - 1.0 | | - 2.5 | V |
| Gate-Source Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | | | ± 100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = - 60 V, $V_{GS}$ = 0 V | | | - 1 | µA |
| | | $V_{DS}$ = - 60 V, $V_{GS}$ = 0 V, $T_J$ = 55 °C | | | - 10 | |
| On-State Drain Current[a] | $I_{D(on)}$ | $V_{DS}$ = - 5 V, $V_{GS}$ = - 10 V | - 25 | | | A |
| Drain-Source On-State Resistance[a] | $R_{DS(on)}$ | $V_{GS}$ = - 10 V, $I_D$ = - 3 A | | 0.055 | | Ω |
| | | $V_{GS}$ = - 4.5 V, $I_D$ = - 2 A | | 0.065 | | |
| Forward Transconductance[a] | $g_{fs}$ | $V_{DS}$ = - 15 V, $I_D$ = - 5 A | 20 | | | S |
| **Dynamic[b]** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{DS}$ = - 25 V, $V_{GS}$ = 0 V, f = 1 MHz | | 1500 | | pF |
| Output Capacitance | $C_{oss}$ | | | 200 | | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | 150 | | |
| Total Gate Charge | $Q_g$ | $V_{DS}$ = - 30 V, $V_{GS}$ = - 10 V, $I_D$ = - 5 A | | 38 | 56 | nC |
| | | $V_{DS}$ = - 30 V, $V_{GS}$ = - 4.5 V, $I_D$ = - 5 A | | 19 | 30 | |
| Gate-Source Charge | $Q_{gs}$ | | | 9 | | |
| Gate-Drain Charge | $Q_{gd}$ | | | 10 | | |
| Gate Resistance | $R_g$ | f = 1 MHz | | 5.2 | | Ω |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD}$ = - 2 V, $R_L$ = 2 Ω<br>$I_D \cong$ - 5 A, $V_{GEN}$ = - 10 V, $R_g$ = 1 Ω | | 10 | 15 | ns |
| Rise Time | $t_r$ | | | 7 | 15 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 70 | 110 | |
| Fall Time | $t_f$ | | | 40 | 60 | |
| **Drain-Source Body Diode Characteristics** | | | | | | |
| Continuous Source-Drain Diode Current | $I_S$ | $T_C$ = 25 °C | | | - 6.9 | A |
| Pulse Diode Forward Current[a] | $I_{SM}$ | | | | - 15 | |
| Body Diode Voltage | $V_{SD}$ | $I_S$ = - 3 A | | - 1 | - 1.5 | V |
| Body Diode Reverse Recovery Time | $t_{rr}$ | $I_F$ = - 5 A, di/dt = 10 A/µs, $T_J$ = 25 °C | | 45 | 68 | ns |
| Body Diode Reverse Recovery Charge | $Q_{rr}$ | | | 59 | 120 | nC |
| Reverse Recovery Fall Time | $t_a$ | | | 29 | | ns |
| Reverse Recovery Rise Time | $t_b$ | | | 16 | | |

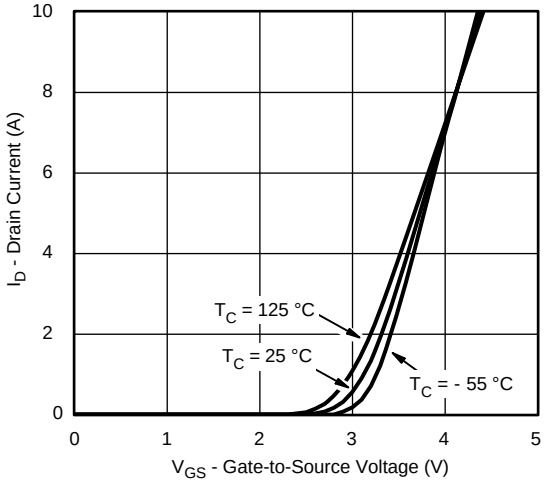
Notes:
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.

*Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

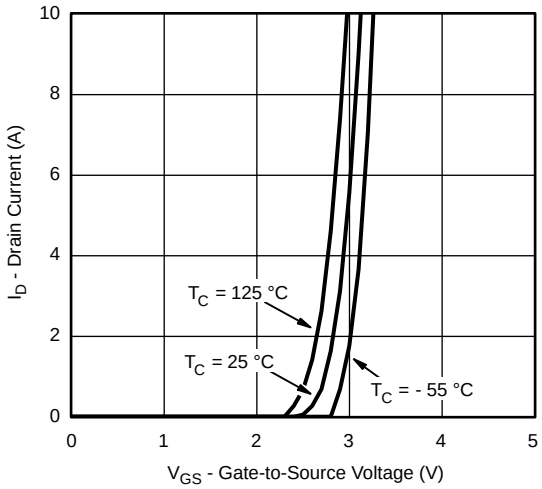
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



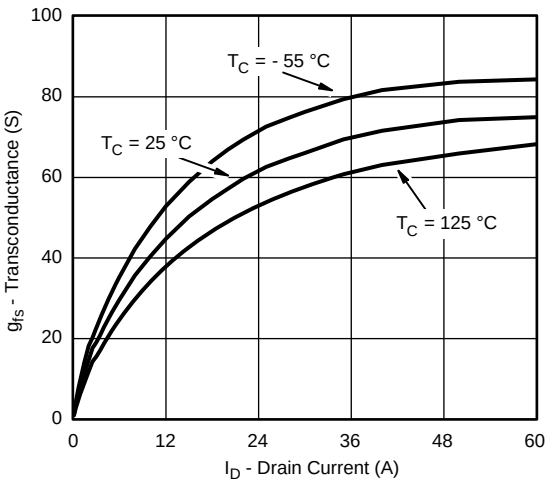

**Output Characteristics**



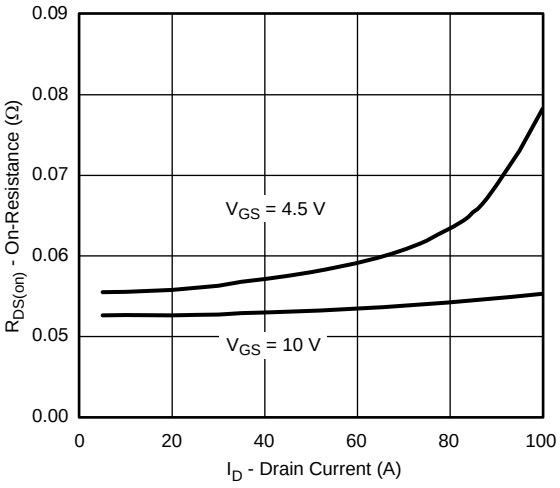

**Transfer Characteristics**



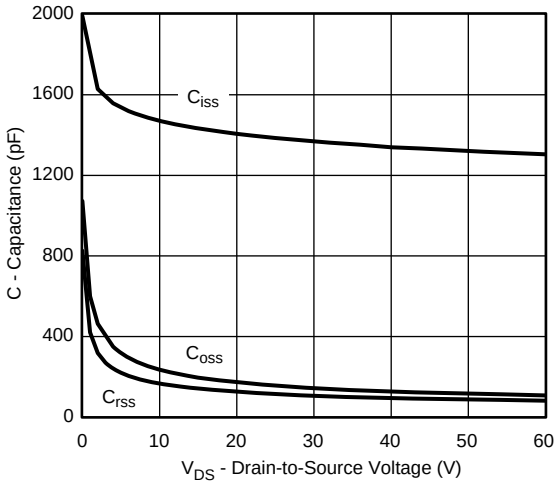

**Transfer Characteristics**




**Transconductance**

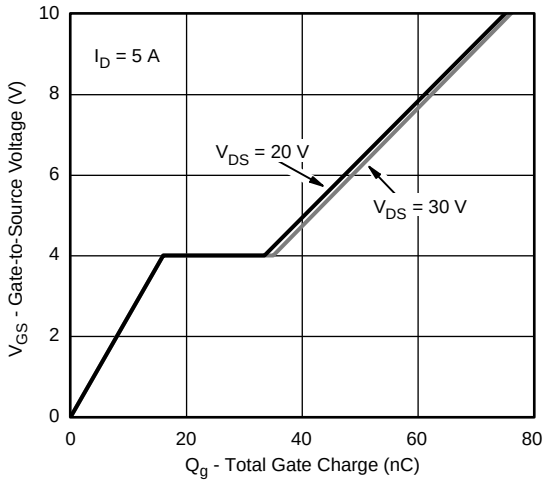



**On-Resistance vs. Drain Current**

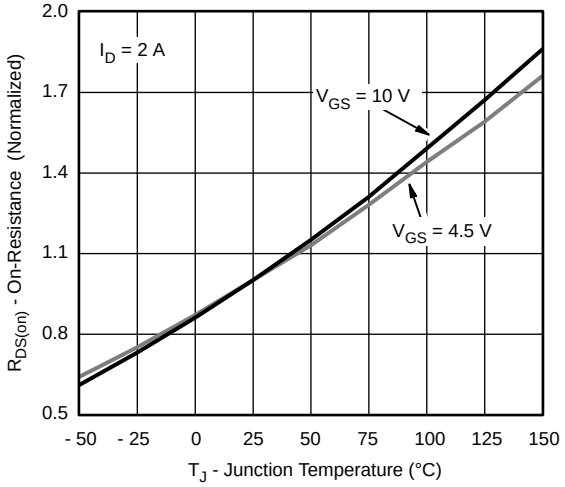



**Capacitance**

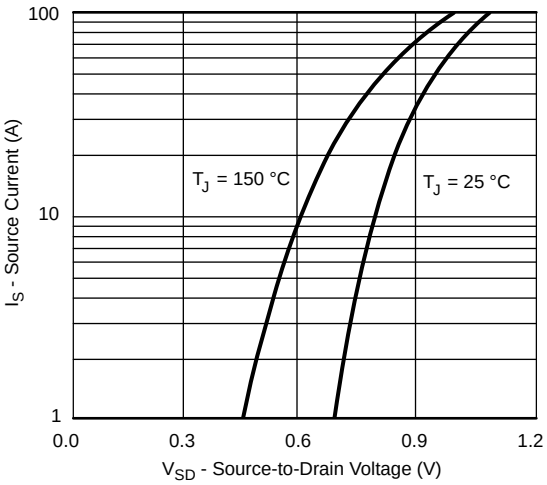
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



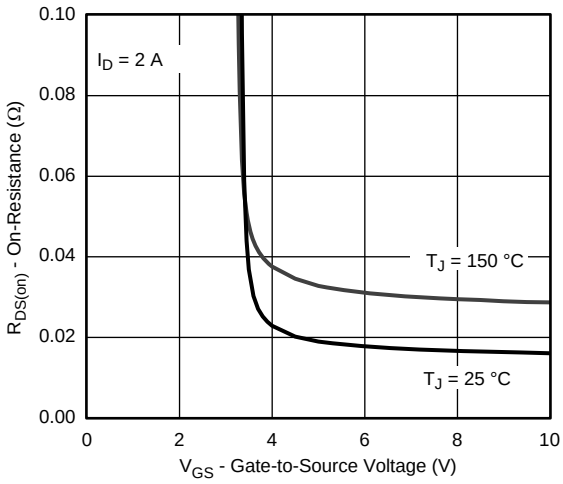

**Gate Charge**



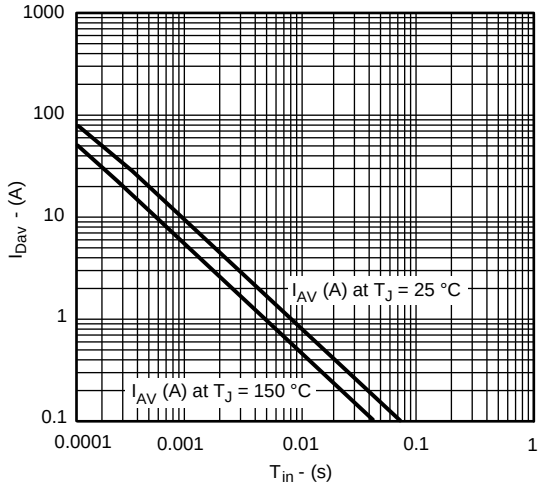

**On-Resistance vs. Gate-to-Source Voltage**



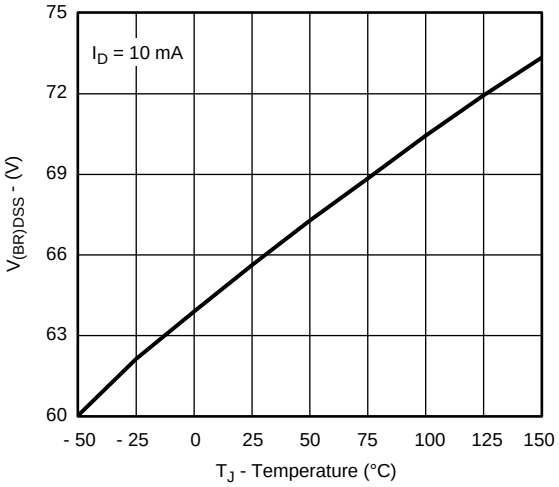

**Source-Drain Diode Forward Voltage**




**On-Resistance vs. Gate-to-Source Voltage**

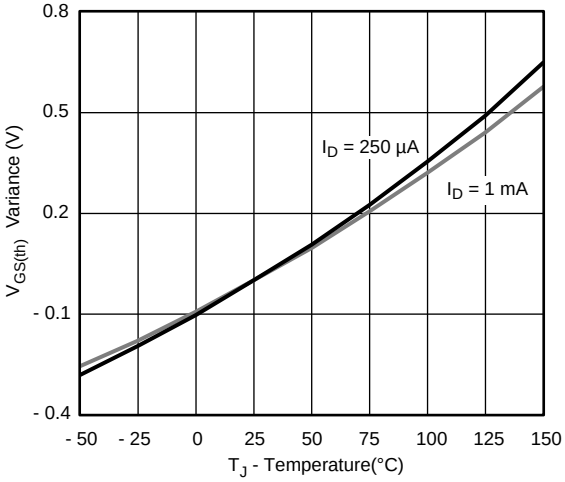



**Single Pulse Avalanche Current Capability vs. Time**

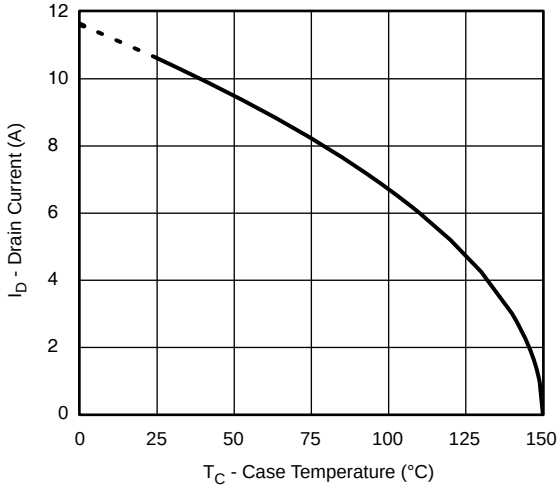



**Drain-Source Breakdown Voltage vs. Junction Temperature**

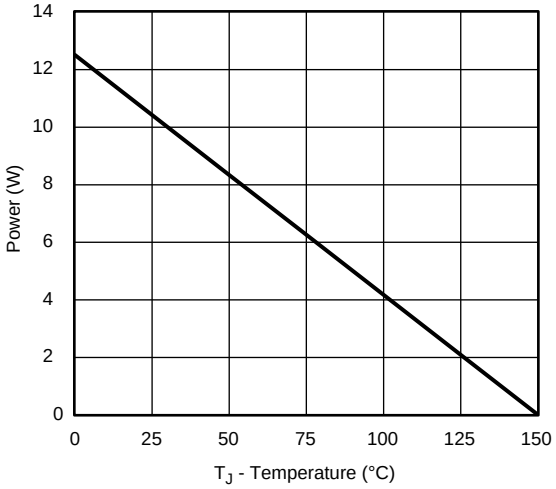
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



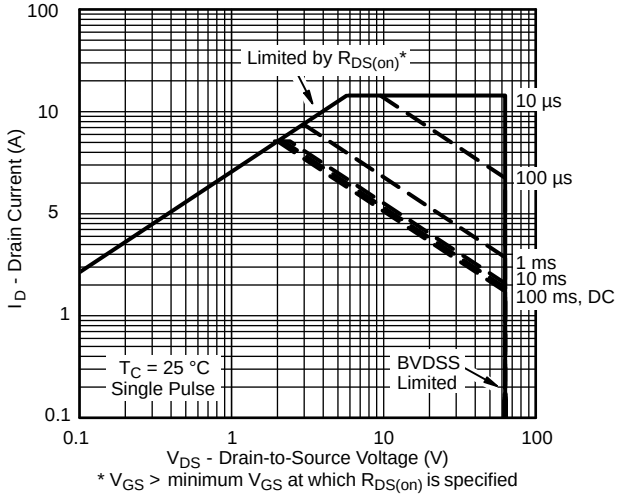

**Threshold Voltage**



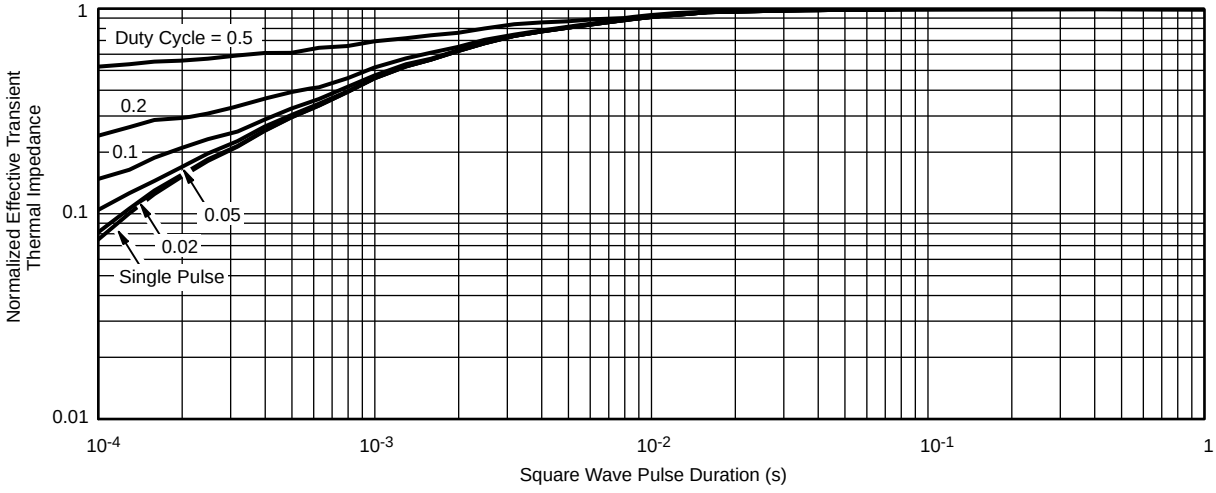

**Max. Drain Current vs. Case Temperature**




**Power Derating, Junction-to-Case**

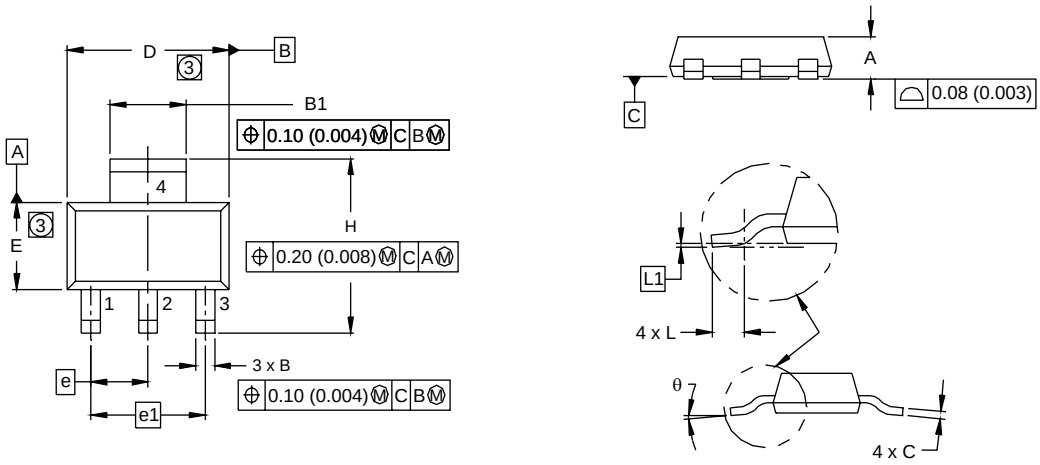



**Safe Operating Area, Junction-to-Case**




**Normalized Thermal Transient Impedance, Junction-to-Case**

## SOT-223 (HIGH VOLTAGE)




| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| **DIM.** | **MIN.** | **MAX.** | **MIN.** | **MAX.** |
| A | 1.55 | 1.80 | 0.061 | 0.071 |
| B | 0.65 | 0.85 | 0.026 | 0.033 |
| B1 | 2.95 | 3.15 | 0.116 | 0.124 |
| C | 0.25 | 0.35 | 0.010 | 0.014 |
| D | 6.30 | 6.70 | 0.248 | 0.264 |
| E | 3.30 | 3.70 | 0.130 | 0.146 |
| e | 2.30 BSC | | 0.0905 BSC | |
| e1 | 4.60 BSC | | 0.181 BSC | |
| H | 6.71 | 7.29 | 0.264 | 0.287 |
| L | 0.91 | - | 0.036 | - |
| L1 | 0.061 BSC | | 0.0024 BSC | |
| θ | - | 10' | - | 10' |
| ECN: S-82109-Rev. A, 15-Sep-08<br>DWG: 5969 | | | | |

**Notes**

1. Dimensioning and tolerancing per ASME Y14.5M-1994.
2. Dimensions are shown in millimeters (inches).
3. Dimension do not include mold flash.
4. Outline conforms to JEDEC outline TO-261AA.

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