

**60V(D-S) N-Channel Enhancement Mode Power MOS FET**

**General Features**

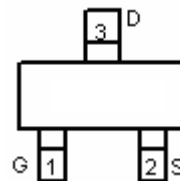
- $V_{DS} = 60V, I_D = 3A$   
 $R_{DS(ON)} < 105m\Omega @ V_{GS} = 10V$   
 $R_{DS(ON)} < 125m\Omega @ V_{GS} = 4.5V$
- High power and current handling capability
- Lead free product is acquired
- Surface mount package



**Lead Free**

**Application**

- Battery switch
- DC/DC converter

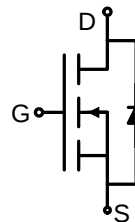


**Marking and Pin Assignment**

**PIN Configuration**



**SOT-23 top view**



**Schematic Diagram**

**Package Marking and Ordering Information**

| Device Marking | Device  | Device Package | Reel Size | Tape width | Quantity   |
|----------------|---------|----------------|-----------|------------|------------|
|                | MSN0603 | SOT-23         | Ø180mm    | 8 mm       | 3000 units |

**Absolute Maximum Ratings ( $T_A = 25^\circ C$  unless otherwise noted)**

| Parameter                                        | Symbol         | Limit      | Unit       |
|--------------------------------------------------|----------------|------------|------------|
| Drain-Source Voltage                             | $V_{DS}$       | 60         | V          |
| Gate-Source Voltage                              | $V_{GS}$       | $\pm 20$   | V          |
| Drain Current-Continuous                         | $I_D$          | 3          | A          |
| Drain Current-Pulsed <sup>(Note 1)</sup>         | $I_{DM}$       | 10         | A          |
| Maximum Power Dissipation                        | $P_D$          | 1.7        | W          |
| Operating Junction and Storage Temperature Range | $T_J, T_{STG}$ | -55 To 150 | $^\circ C$ |

**Thermal Characteristic**

|                                                             |                 |      |              |
|-------------------------------------------------------------|-----------------|------|--------------|
| Thermal Resistance, Junction-to-Ambient <sup>(Note 2)</sup> | $R_{\theta JA}$ | 73.5 | $^\circ C/W$ |
|-------------------------------------------------------------|-----------------|------|--------------|

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

| Parameter                          | Symbol              | Condition                                                                                | Min | Typ  | Max  | Unit |
|------------------------------------|---------------------|------------------------------------------------------------------------------------------|-----|------|------|------|
| Off Characteristics                |                     |                                                                                          |     |      |      |      |
| Drain-Source Breakdown Voltage     | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =250μA                                                | 60  | 65   | -    | V    |
| Zero Gate Voltage Drain Current    | I <sub>DSS</sub>    | V <sub>DS</sub> =60V, V <sub>GS</sub> =0V                                                | -   | -    | 1    | μA   |
| Gate-Body Leakage Current          | I <sub>GSS</sub>    | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V                                               | -   | -    | ±100 | nA   |
| On Characteristics (Note 3)        |                     |                                                                                          |     |      |      |      |
| Gate Threshold Voltage             | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                                 | 0.8 | 1.1  | 1.4  | V    |
| Drain-Source On-State Resistance   | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =3A                                                 | -   | 78   | 105  | mΩ   |
|                                    |                     | V <sub>GS</sub> =4.5V, I <sub>D</sub> =3A                                                | -   | 95   | 125  | mΩ   |
| Forward Transconductance           | g <sub>FS</sub>     | V <sub>DS</sub> =15V, I <sub>D</sub> =2A                                                 | 3   | -    | -    | S    |
| Dynamic Characteristics (Note4)    |                     |                                                                                          |     |      |      |      |
| Input Capacitance                  | C <sub>ISS</sub>    | V <sub>DS</sub> =30V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                   | -   | 247  | -    | PF   |
| Output Capacitance                 | C <sub>OSS</sub>    |                                                                                          | -   | 34   | -    | PF   |
| Reverse Transfer Capacitance       | C <sub>RSS</sub>    |                                                                                          | -   | 19.5 | -    | PF   |
| Switching Characteristics (Note 4) |                     |                                                                                          |     |      |      |      |
| Turn-on Delay Time                 | t <sub>d(on)</sub>  | V <sub>DD</sub> =30V, I <sub>D</sub> =1.5A<br>V <sub>GS</sub> =10V, R <sub>GEN</sub> =1Ω | -   | 6    | -    | nS   |
| Turn-on Rise Time                  | t <sub>r</sub>      |                                                                                          | -   | 15   | -    | nS   |
| Turn-Off Delay Time                | t <sub>d(off)</sub> |                                                                                          | -   | 15   | -    | nS   |
| Turn-Off Fall Time                 | t <sub>f</sub>      |                                                                                          | -   | 10   | -    | nS   |
| Total Gate Charge                  | Q <sub>g</sub>      | V <sub>DS</sub> =30V, I <sub>D</sub> =3A,<br>V <sub>GS</sub> =4.5V                       | -   | 6    | -    | nC   |
| Gate-Source Charge                 | Q <sub>gs</sub>     |                                                                                          | -   | 1    | -    | nC   |
| Gate-Drain Charge                  | Q <sub>gd</sub>     |                                                                                          | -   | 1.3  | -    | nC   |
| Drain-Source Diode Characteristics |                     |                                                                                          |     |      |      |      |
| Diode Forward Voltage (Note 3)     | V <sub>SD</sub>     | V <sub>GS</sub> =0V, I <sub>S</sub> =3A                                                  | -   | -    | 1.2  | V    |
| Diode Forward Current (Note 2)     | I <sub>S</sub>      |                                                                                          | -   | -    | 3    | A    |

Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production

## Typical Electrical and Thermal Characteristics

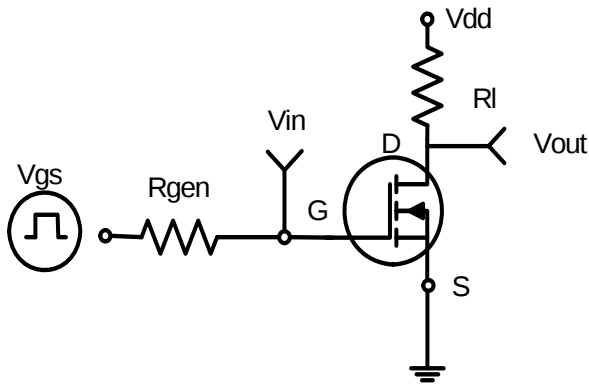


Figure 1: Switching Test Circuit

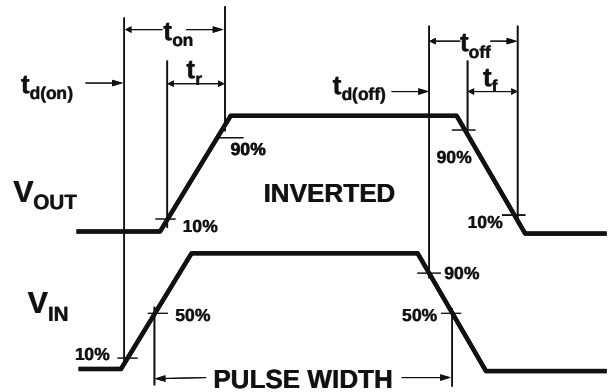


Figure 2: Switching Waveforms

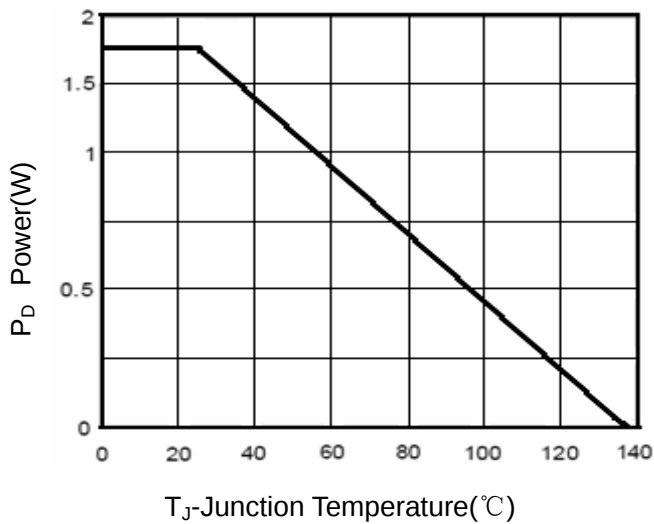


Figure 3 Power Dissipation

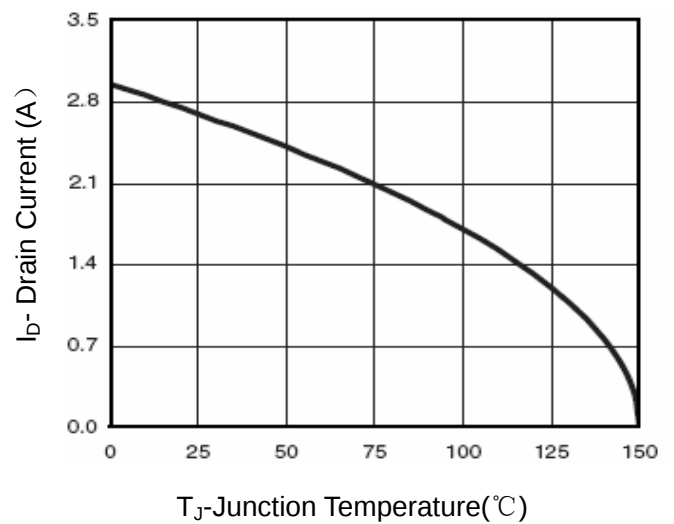


Figure 4 Drain Current

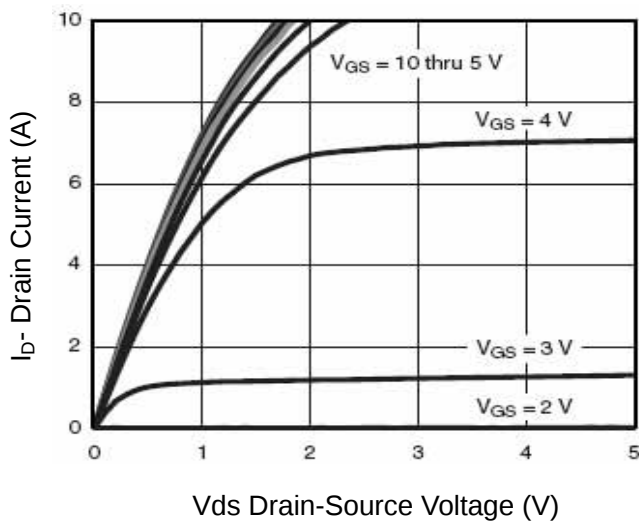


Figure 5 Output Characteristics

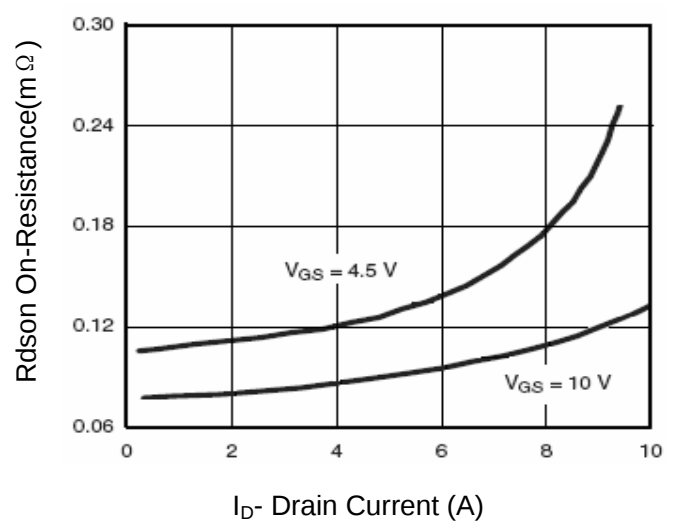


Figure 6 Drain-Source On-Resistance

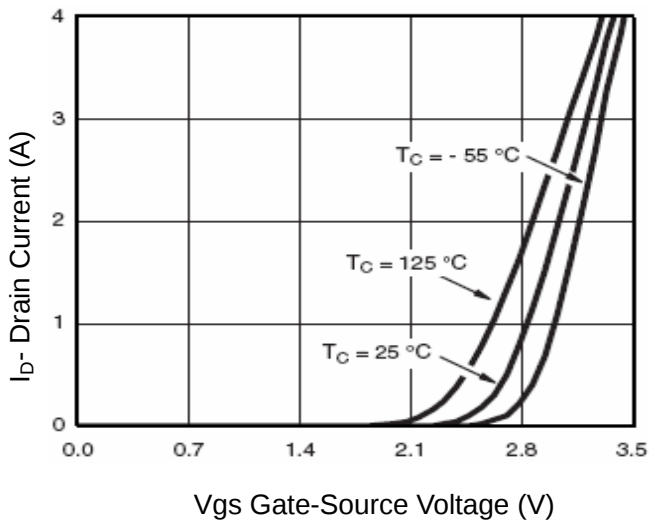


Figure 7 Transfer Characteristics

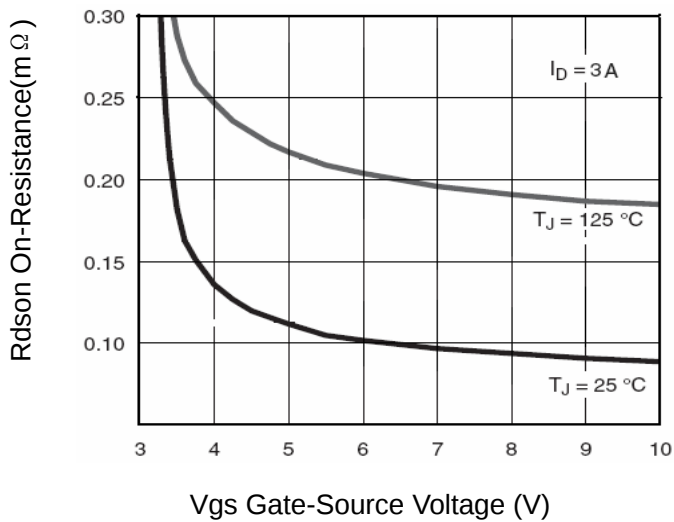


Figure 9  $R_{DS(on)}$  vs  $V_{GS}$

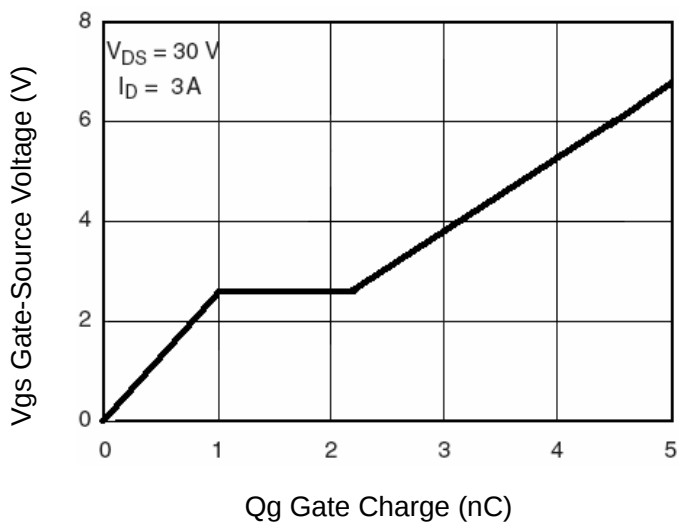


Figure 11 Gate Charge

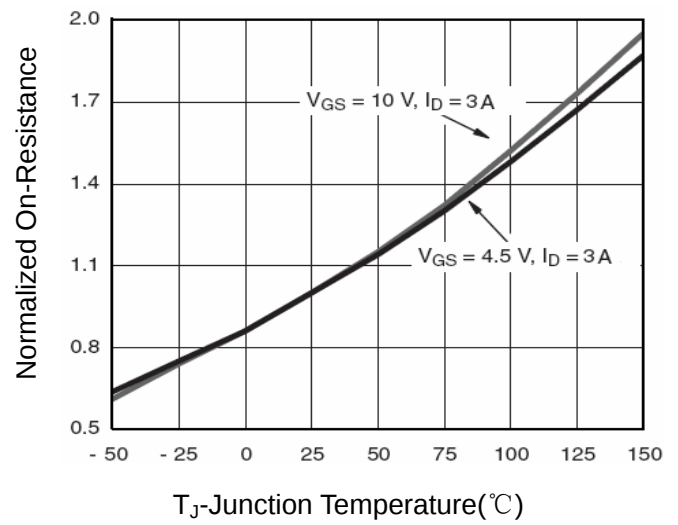


Figure 8 Drain-Source On-Resistance

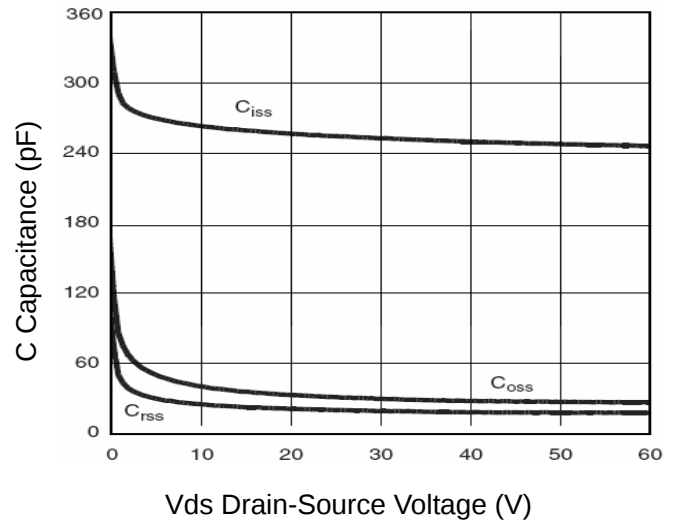


Figure 10 Capacitance vs  $V_{DS}$

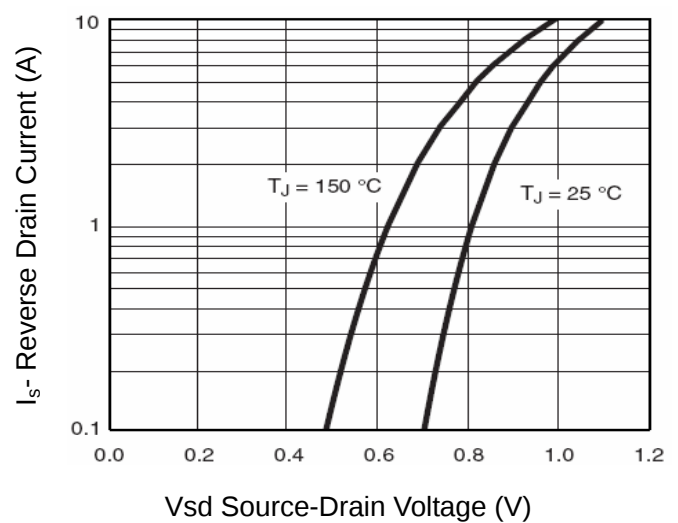
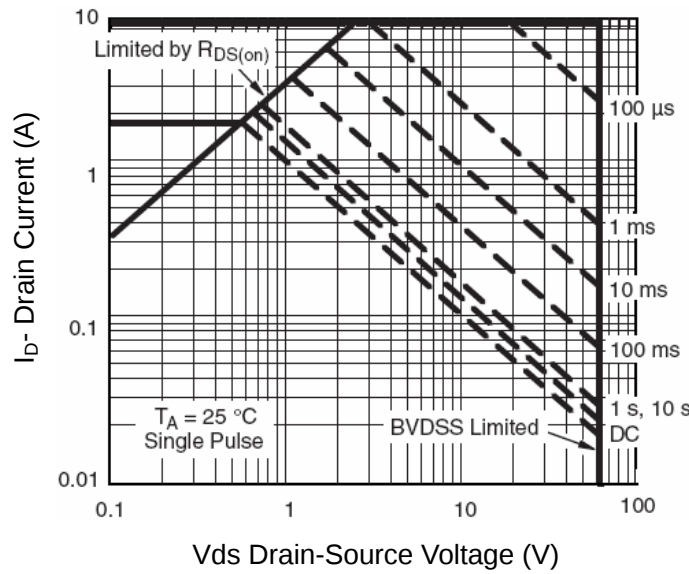
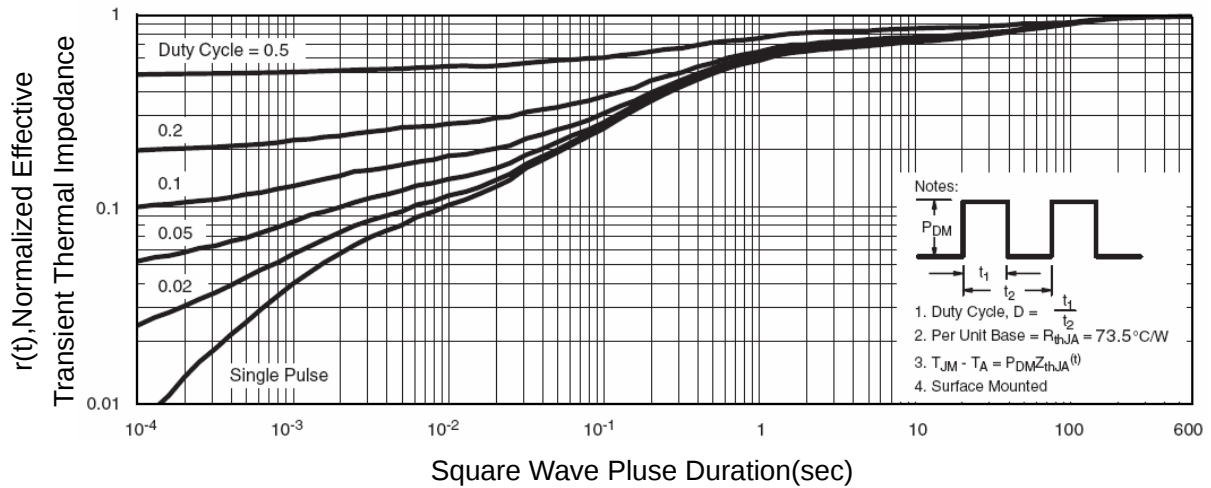


Figure 12 Source- Drain Diode Forward

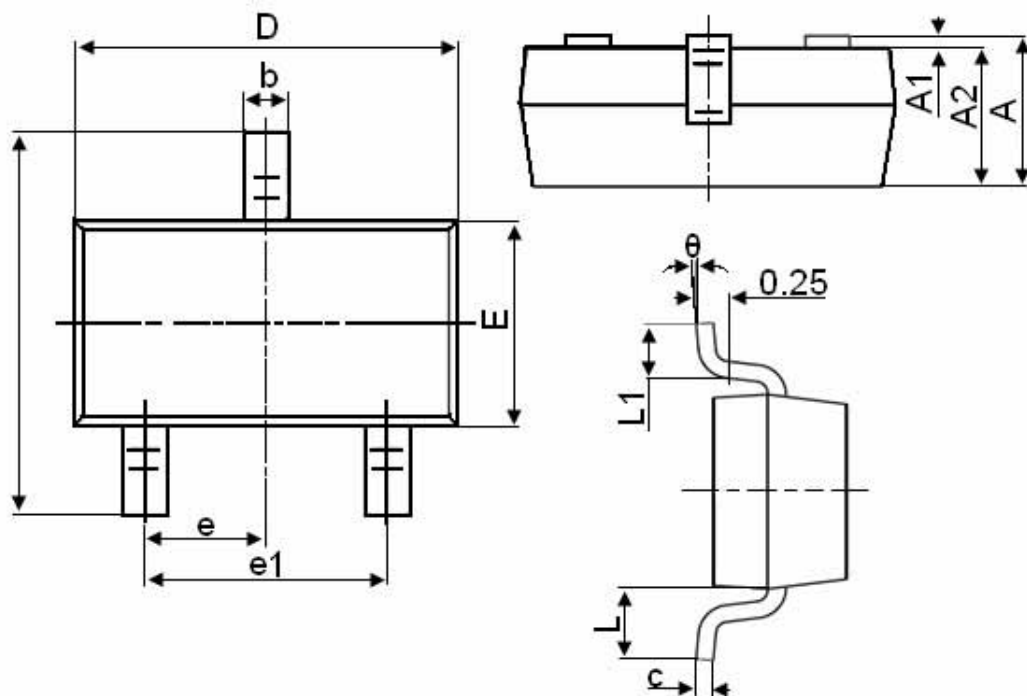


**Figure 13 Safe Operation Area**



**Figure 14 Normalized Maximum Transient Thermal Impedance**

# SOT-23 Package Information



| Symbol | Dimensions in Millimeters |       |
|--------|---------------------------|-------|
|        | MIN.                      | MAX.  |
| A      | 0.900                     | 1.150 |
| A1     | 0.000                     | 0.100 |
| A2     | 0.900                     | 1.050 |
| b      | 0.300                     | 0.500 |
| c      | 0.080                     | 0.150 |
| D      | 2.800                     | 3.000 |
| E      | 1.200                     | 1.400 |
| E1     | 2.250                     | 2.550 |
| e      | 0.950TYP                  |       |
| e1     | 1.800                     | 2.000 |
| L      | 0.550REF                  |       |
| L1     | 0.300                     | 0.500 |
| θ      | 0°                        | 8°    |

## Notes

1. All dimensions are in millimeters.
2. Tolerance  $\pm 0.10\text{mm}$  (4 mil) unless otherwise specified
3. Package body sizes exclude mold flash and gate burrs. Mold flash at the non-lead sides should be less than 5 mils.
4. Dimension L is measured in gauge plane.
5. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.