

### Description

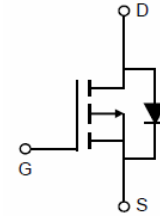
The LCE60P04R uses advanced trench technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. This device is well suited for use as a load switch or in PWM applications.

### General Features

- $V_{DS} = -60V, I_D = -4.3A$   
 $R_{DS(ON)} < 120m\Omega @ V_{GS} = -10V$   
 $R_{DS(ON)} < 170m\Omega @ V_{GS} = -4.5V$
- High density cell design for ultra low  $R_{dson}$
- Fully characterized avalanche voltage and current
- Excellent package for good heat dissipation

### Application

- Load switch
- PWM application



Schematic diagram



SOT-223 top view

### Package Marking and Ordering Information

| Device Marking | Device    | Device Package | Reel Size | Tape width | Quantity   |
|----------------|-----------|----------------|-----------|------------|------------|
| NCE60P04R      | LCE60P04R | SOT-223-3L     | Ø330mm    | 12mm       | 2500 units |

### Absolute Maximum Ratings ( $T_C = 25^\circ C$ 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                         | $I_D$          | -4.3       | A          |
| Pulsed Drain Current                             | $I_{DM}$       | -20        | A          |
| Maximum Power Dissipation                        | $P_D$          | 3.1        | 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> | $R_{\theta JA}$ | 40.3 | $^\circ C/W$ |
|-------------------------------------------------------------|-----------------|------|--------------|

### Electrical Characteristics ( $T_C = 25^\circ C$ unless otherwise noted)

| Parameter                       | Symbol     | Condition                      | Min | Typ | Max | Unit    |
|---------------------------------|------------|--------------------------------|-----|-----|-----|---------|
| <b>Off Characteristics</b>      |            |                                |     |     |     |         |
| Drain-Source Breakdown Voltage  | $BV_{DSS}$ | $V_{GS} = 0V, I_D = -250\mu A$ | -60 | -   | -   | V       |
| Zero Gate Voltage Drain Current | $I_{DSS}$  | $V_{DS} = -60V, V_{GS} = 0V$   | -   | -   | -1  | $\mu A$ |

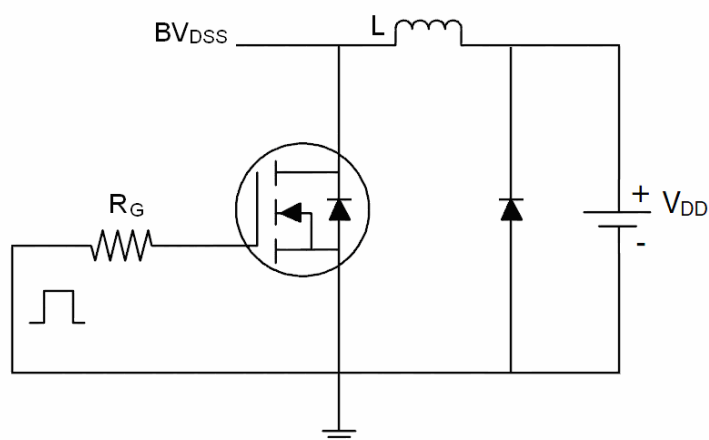
|                                    |                     |                                                                                           |      |      |      |    |
|------------------------------------|---------------------|-------------------------------------------------------------------------------------------|------|------|------|----|
| 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                                 | -1.5 | -2.2 | -3.0 | V  |
| Drain-Source On-State Resistance   | R <sub>DS(ON)</sub> | V <sub>GS</sub> =-10V, I <sub>D</sub> =-4A                                                | -    | 106  | 120  | mΩ |
|                                    |                     | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-3A                                               | -    | 135  | 170  | mΩ |
| Forward Transconductance           | g <sub>FS</sub>     | V <sub>DS</sub> =-5V, I <sub>D</sub> =-4A                                                 | -    | 10   | -    | S  |
| Dynamic Characteristics (Note4)    |                     |                                                                                           |      |      |      |    |
| Input Capacitance                  | C <sub>ISS</sub>    | V <sub>DS</sub> =-30V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                   | -    | 930  | -    | PF |
| Output Capacitance                 | C <sub>OSS</sub>    |                                                                                           | -    | 85   | -    | PF |
| Reverse Transfer Capacitance       | C <sub>RSS</sub>    |                                                                                           | -    | 35   | -    | PF |
| Switching Characteristics (Note 4) |                     |                                                                                           |      |      |      |    |
| Turn-on Delay Time                 | t <sub>d(on)</sub>  | V <sub>DD</sub> =-30V, R <sub>L</sub> =7.5Ω,<br>V <sub>GS</sub> =-10V, R <sub>G</sub> =3Ω | -    | 8    | -    | nS |
| Turn-on Rise Time                  | t <sub>r</sub>      |                                                                                           | -    | 4    | -    | nS |
| Turn-Off Delay Time                | t <sub>d(off)</sub> |                                                                                           | -    | 32   | -    | nS |
| Turn-Off Fall Time                 | t <sub>f</sub>      |                                                                                           | -    | 7    | -    | nS |
| Total Gate Charge                  | Q <sub>g</sub>      | V <sub>DS</sub> =-30, I <sub>D</sub> =-4A,<br>V <sub>GS</sub> =-10V                       | -    | 25   | -    | nC |
| Gate-Source Charge                 | Q <sub>gs</sub>     |                                                                                           | -    | 3    | -    | nC |
| Gate-Drain Charge                  | Q <sub>gd</sub>     |                                                                                           | -    | 7    | -    | nC |
| Drain-Source Diode Characteristics |                     |                                                                                           |      |      |      |    |
| Diode Forward Voltage (Note 3)     | V <sub>SD</sub>     | V <sub>GS</sub> =0V, I <sub>S</sub> =-4A                                                  | -    |      | -1.2 | V  |
| Diode Forward Current (Note 2)     | I <sub>S</sub>      |                                                                                           | -    | -    | -4.3 | A  |
| Reverse Recovery Time              | t <sub>rr</sub>     | T <sub>J</sub> = 25°C, I <sub>F</sub> =- 4A                                               | -    | 25   |      | nS |
| Reverse Recovery Charge            | Q <sub>rr</sub>     | di/dt = -100A/μs (Note3)                                                                  | -    | 31   |      | nC |

## Notes:

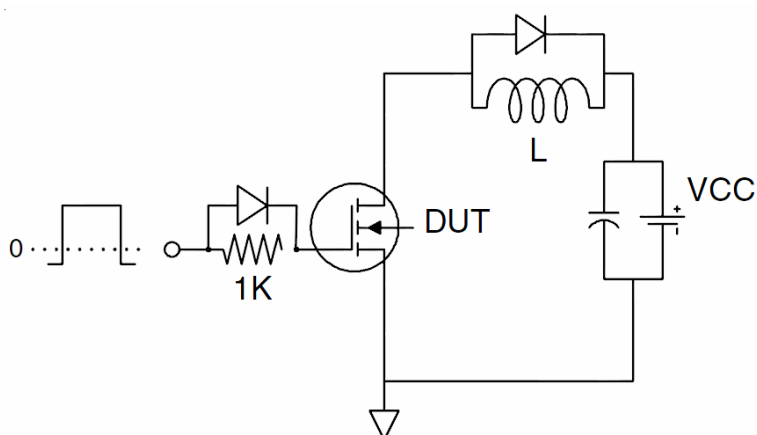
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production

## Test Circuit

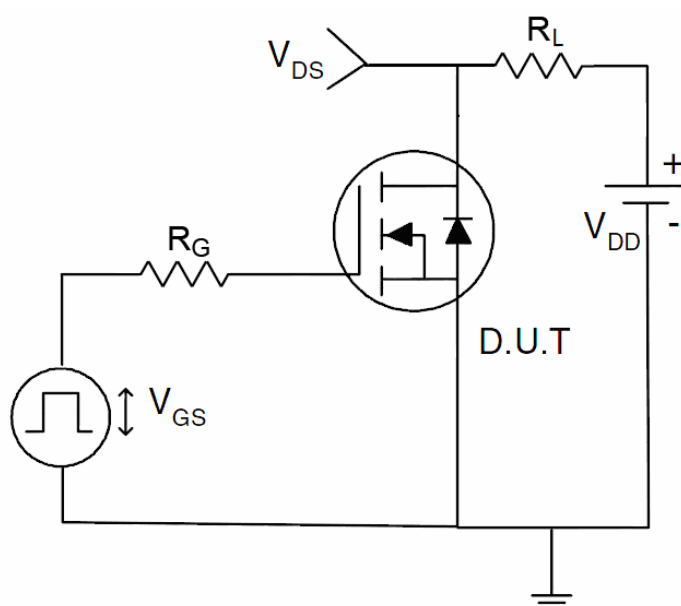
### 1) $E_{AS}$ test Circuit



### 2) Gate charge test Circuit



### 3) Switch Time Test Circuit



## Typical Electrical and Thermal Characteristics (Curves)

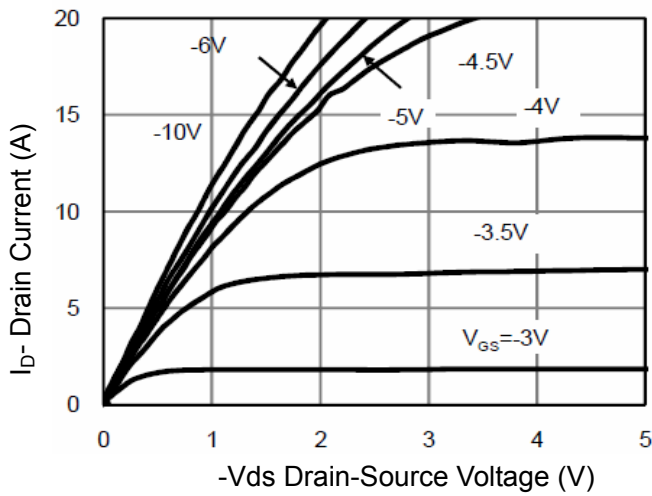


**Figure 1 Output Characteristics**

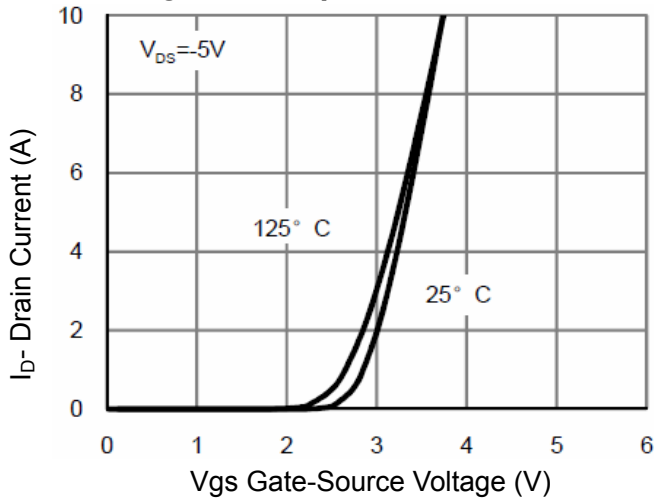


**Figure 2 Transfer Characteristics**

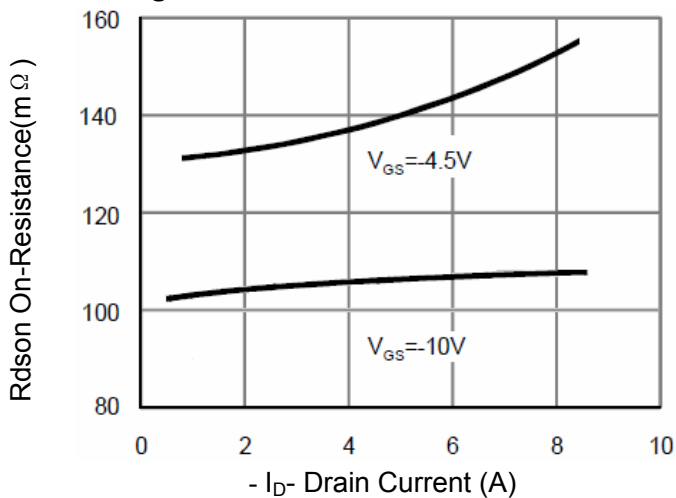


**Figure 3  $R_{DS(on)}$ - Drain Current**

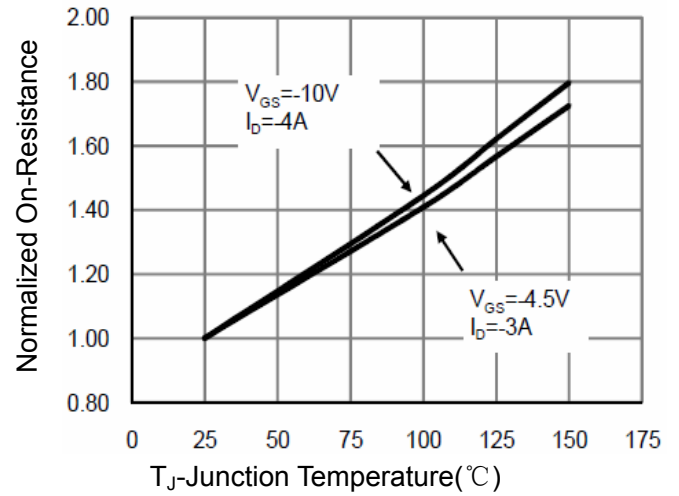


**Figure 4  $R_{DS(on)}$ -Junction Temperature**

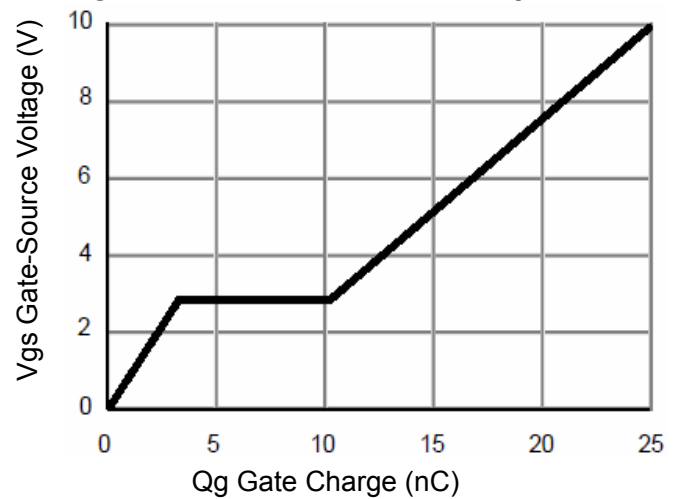


**Figure 5 Gate Charge**

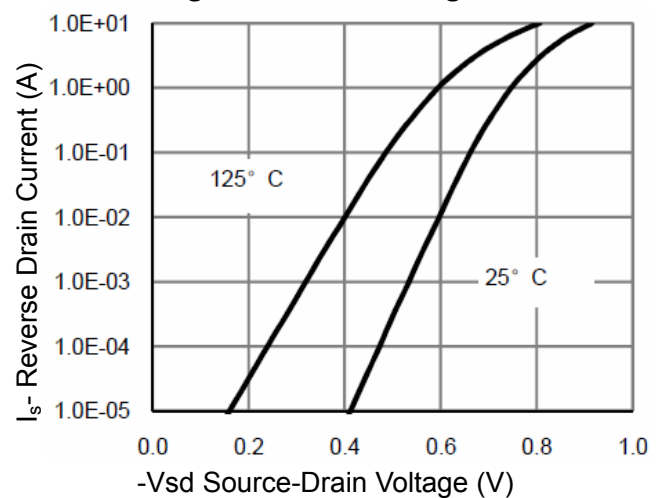


**Figure 6 Source- Drain Diode Forward**

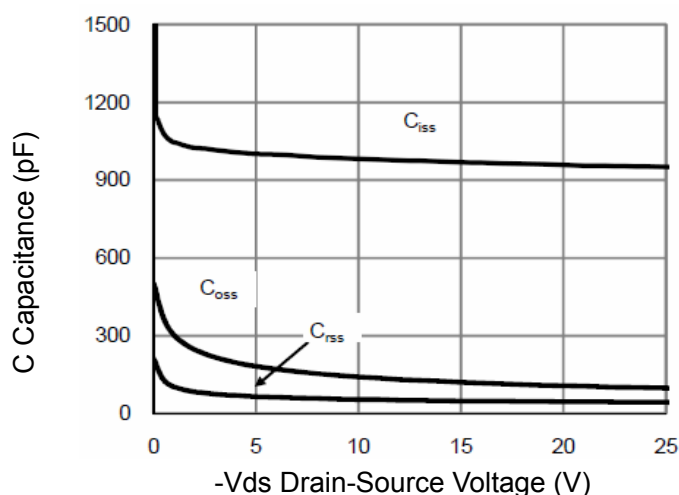


**Figure 7 Capacitance vs Vds**

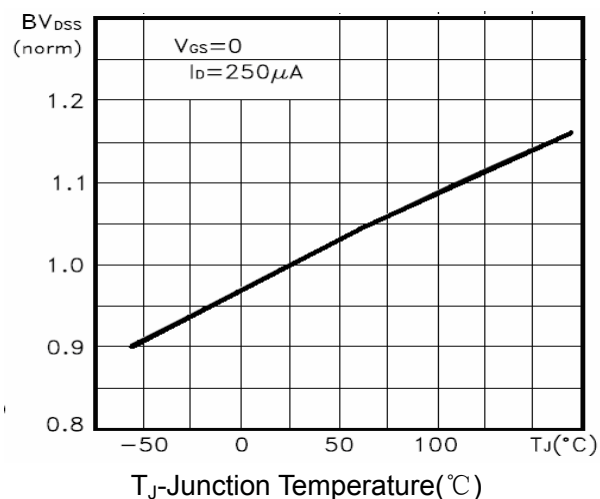


**Figure 9  $BV_{DSS}$  vs Junction Temperature**

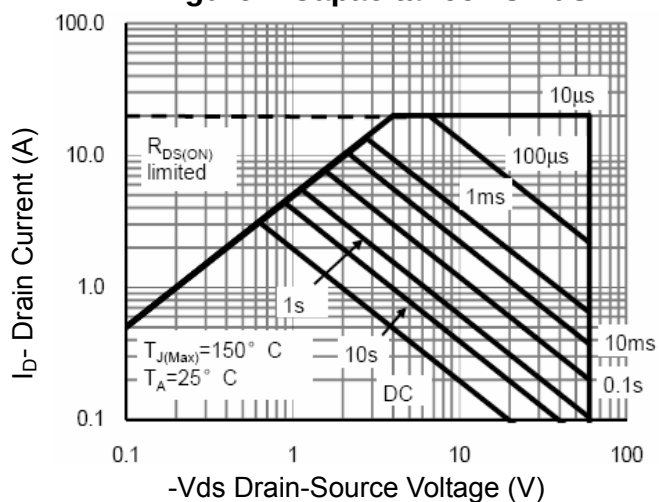


**Figure 8 Safe Operation Area**

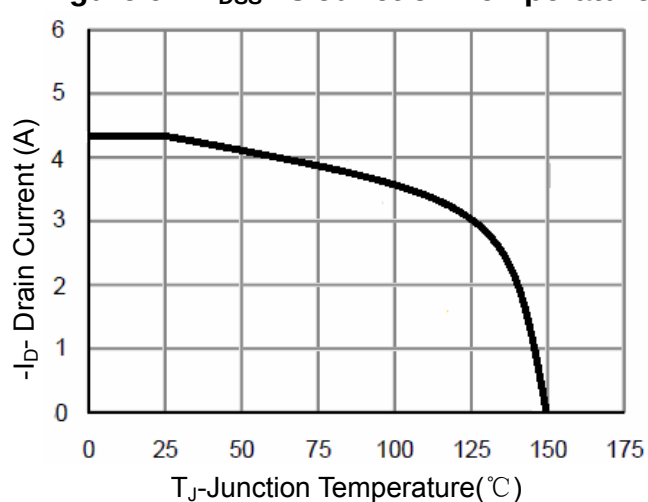


**Figure 10  $I_D$  Current De-rating**

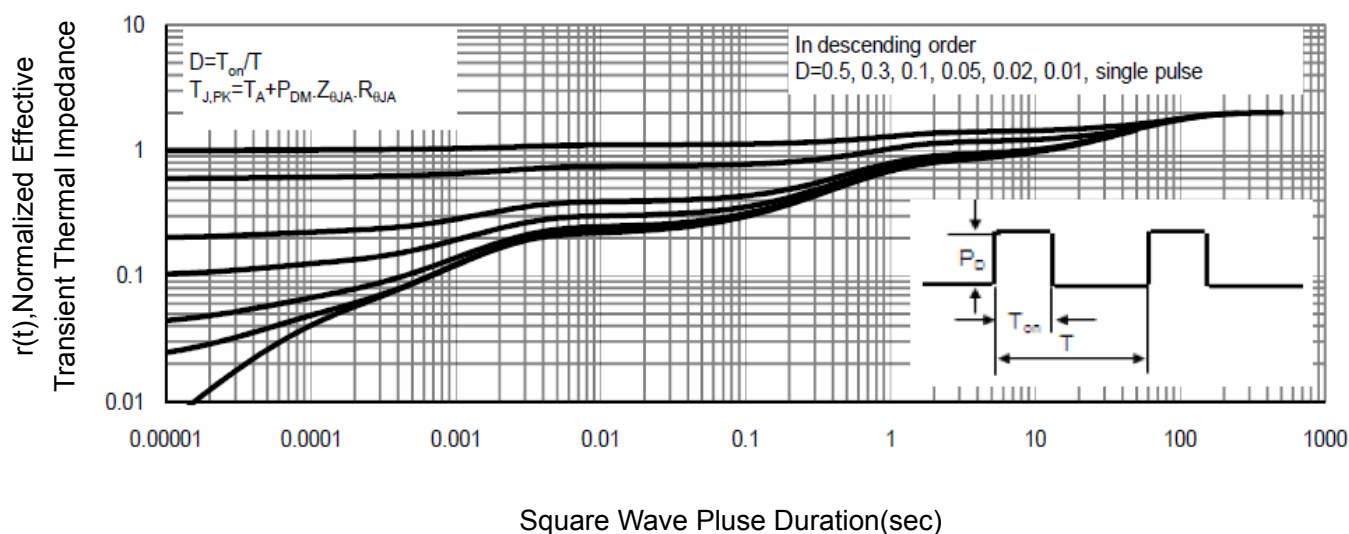
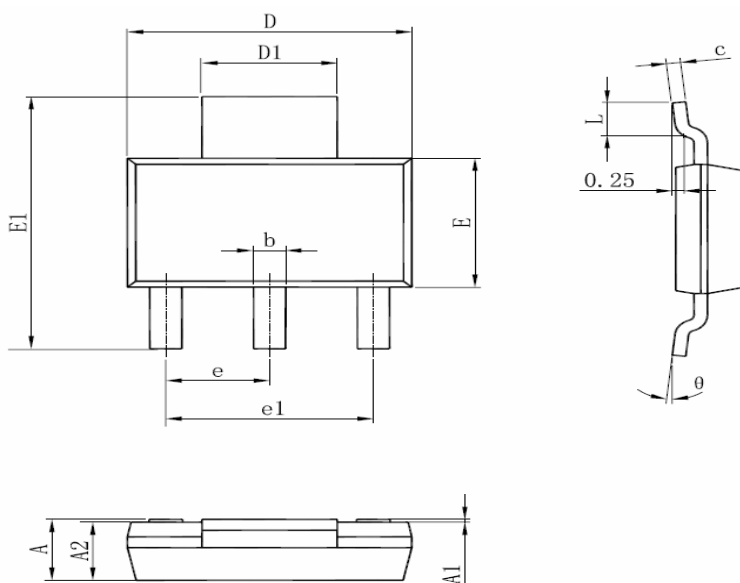


**Figure 11 Normalized Maximum Transient Thermal Impedance**

## SOT-223 Package Information



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min                       | Max   | Min                  | Max   |
| A      | 1.520                     | 1.800 | 0.060                | 0.071 |
| A1     | 0.000                     | 0.100 | 0.000                | 0.004 |
| A2     | 1.500                     | 1.700 | 0.059                | 0.067 |
| b      | 0.660                     | 0.820 | 0.026                | 0.032 |
| c      | 0.250                     | 0.350 | 0.010                | 0.014 |
| D      | 6.200                     | 6.400 | 0.244                | 0.252 |
| D1     | 2.900                     | 3.100 | 0.114                | 0.122 |
| E      | 3.300                     | 3.700 | 0.130                | 0.146 |
| E1     | 6.830                     | 7.070 | 0.269                | 0.278 |
| e      | 2.300(BSC)                |       | 0.091(BSC)           |       |
| e1     | 4.500                     | 4.700 | 0.177                | 0.185 |
| L      | 0.900                     | 1.150 | 0.035                | 0.045 |
| θ      | 0°                        | 10°   | 0°                   | 10°   |

### 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.

Shanghai Leiditech Electronic Co.,Ltd  
 Email: sale1@leiditech.com  
 Tel : +86- 021 50828806  
 Fax : +86- 021 50477059