

## NCE N-Channel Super Trench Power MOSFET

### Description

The NCEP6090AK uses **Super Trench** technology that is uniquely optimized to provide the most efficient high frequency switching performance. Both conduction and switching power losses are minimized due to an extremely low combination of  $R_{DS(ON)}$  and  $Q_g$ . This device is ideal for high-frequency switching and synchronous rectification.

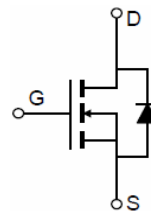
### General Features

- $V_{DS} = 60V, I_D = 90A$
- $R_{DS(ON)} < 8.0m\Omega @ V_{GS}=10V$  (Typ:7.2m $\Omega$ )
- $R_{DS(ON)} < 9.5m\Omega @ V_{GS}=4.5V$  (Typ:8.6m $\Omega$ )
- Excellent gate charge x  $R_{DS(on)}$  product
- Very low on-resistance  $R_{DS(on)}$
- Pb-free lead plating
- 100% UIS tested

### Application

- DC/DC Converter
- Ideal for high-frequency switching and synchronous rectification

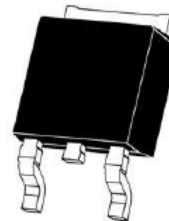
**100% UIS TESTED!**  
**100%  $\Delta V_{ds}$  TESTED!**



Schematic diagram



Marking and pin assignment



TO-252 -2L top view

### Package Marking and Ordering Information

| Device Marking | Device     | Device Package | Reel Size | Tape width | Quantity |
|----------------|------------|----------------|-----------|------------|----------|
| NCEP6090AK     | NCEP6090AK | TO-252-2L      | -         | -          | -        |

### Absolute Maximum Ratings ( $T_C=25^\circ\text{C}$ 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 (Silicon Limited)          | $I_D$                    | 90         | A                   |
| Drain Current-Continuous( $T_C=100^\circ\text{C}$ ) | $I_D(100^\circ\text{C})$ | 63.6       | A                   |
| Pulsed Drain Current                                | $I_{DM}$                 | 360        | A                   |
| Maximum Power Dissipation                           | $P_D$                    | 85         | W                   |
| Derating factor                                     |                          | 0.68       | W/ $^\circ\text{C}$ |
| Single pulse avalanche energy <sup>(Note 5)</sup>   | $E_{AS}$                 | 320        | mJ                  |
| Operating Junction and Storage Temperature Range    | $T_J, T_{STG}$           | -55 To 175 | $^\circ\text{C}$    |

### Thermal Characteristic

|                                                          |                 |      |                    |
|----------------------------------------------------------|-----------------|------|--------------------|
| Thermal Resistance, Junction-to-Case <sup>(Note 2)</sup> | $R_{\theta JC}$ | 1.76 | $^\circ\text{C/W}$ |
|----------------------------------------------------------|-----------------|------|--------------------|

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

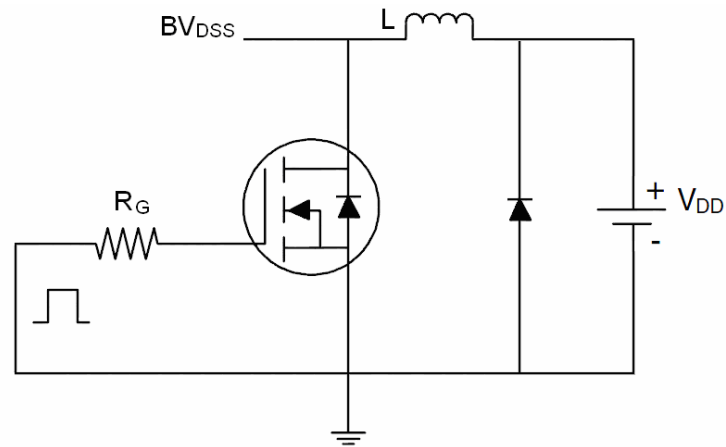
| Parameter                                     | Symbol              | Condition                                                                                    | Min | Typ  | Max  | Unit |
|-----------------------------------------------|---------------------|----------------------------------------------------------------------------------------------|-----|------|------|------|
| Off Characteristics                           |                     |                                                                                              |     |      |      |      |
| Drain-Source Breakdown Voltage                | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =250μA                                                    | 60  |      | -    | 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 <sup>(Note 3)</sup>        |                     |                                                                                              |     |      |      |      |
| Gate Threshold Voltage                        | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                                     | 1.2 | 1.7  | 2.5  | V    |
| Drain-Source On-State Resistance              | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =45A                                                    | -   | 7.2  | 8.0  | mΩ   |
|                                               |                     | V <sub>GS</sub> =4.5V, I <sub>D</sub> =45A                                                   | -   | 8.6  | 9.5  | mΩ   |
| Forward Transconductance                      | g <sub>FS</sub>     | V <sub>DS</sub> =5V, I <sub>D</sub> =45A                                                     | -   | 35   | -    | S    |
| Dynamic Characteristics <sup>(Note4)</sup>    |                     |                                                                                              |     |      |      |      |
| Input Capacitance                             | C <sub>ISS</sub>    | V <sub>DS</sub> =30V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                       | -   | 2100 | -    | PF   |
| Output Capacitance                            | C <sub>OSS</sub>    |                                                                                              | -   | 359  | -    | PF   |
| Reverse Transfer Capacitance                  | C <sub>RSS</sub>    |                                                                                              | -   | 12   | -    | PF   |
| Switching Characteristics <sup>(Note 4)</sup> |                     |                                                                                              |     |      |      |      |
| Turn-on Delay Time                            | t <sub>d(on)</sub>  | V <sub>DD</sub> =30V, I <sub>D</sub> =45A<br>V <sub>GS</sub> =10V, R <sub>G</sub> =4.7Ω      | -   | 8    | -    | nS   |
| Turn-on Rise Time                             | t <sub>r</sub>      |                                                                                              | -   | 2    | -    | nS   |
| Turn-Off Delay Time                           | t <sub>d(off)</sub> |                                                                                              | -   | 29   | -    | nS   |
| Turn-Off Fall Time                            | t <sub>f</sub>      |                                                                                              | -   | 4    | -    | nS   |
| Total Gate Charge                             | Q <sub>g</sub>      | V <sub>DS</sub> =30V, I <sub>D</sub> =45A,<br>V <sub>GS</sub> =10V                           | -   | 36.6 |      | nC   |
| Gate-Source Charge                            | Q <sub>gs</sub>     |                                                                                              | -   | 6.7  |      | nC   |
| Gate-Drain Charge                             | Q <sub>gd</sub>     |                                                                                              | -   | 5.8  |      | nC   |
| Drain-Source Diode Characteristics            |                     |                                                                                              |     |      |      |      |
| Diode Forward Voltage <sup>(Note 3)</sup>     | V <sub>SD</sub>     | V <sub>GS</sub> =0V, I <sub>S</sub> =45A                                                     | -   |      | 1.2  | V    |
| Diode Forward Current <sup>(Note 2)</sup>     | I <sub>S</sub>      |                                                                                              | -   | -    | 90   | A    |
| Reverse Recovery Time                         | t <sub>rr</sub>     | T <sub>J</sub> = 25°C, I <sub>F</sub> = I <sub>S</sub><br>di/dt = 100A/μs <sup>(Note3)</sup> | -   | 38   |      | nS   |
| Reverse Recovery Charge                       | Q <sub>rr</sub>     |                                                                                              | -   | 48   |      | nC   |

### Notes:

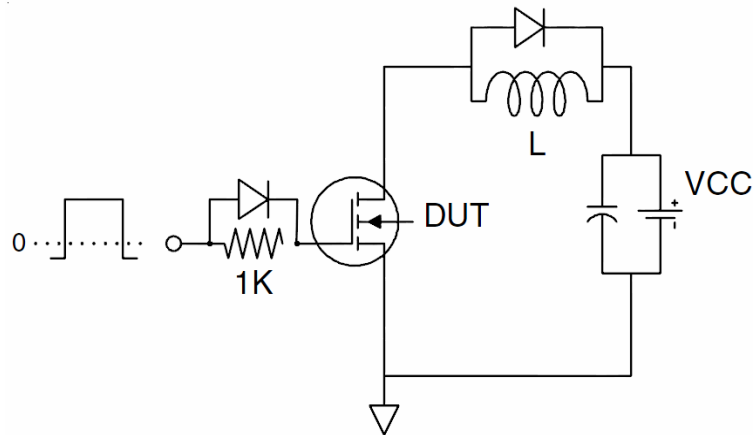
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5. EAS condition :  $T_J=25^{\circ}\text{C}, V_{DD}=30V, V_{GS}=10V, L=0.5mH, R_g=25\Omega$

## Test Circuit

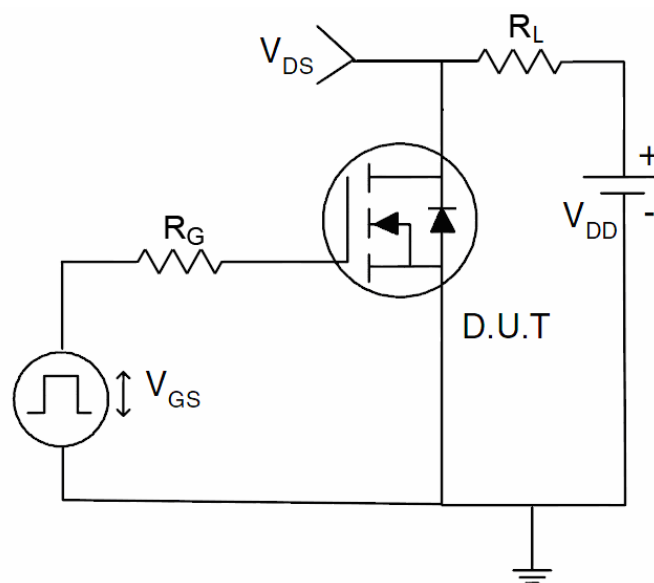
### 1) $E_{AS}$ test Circuit



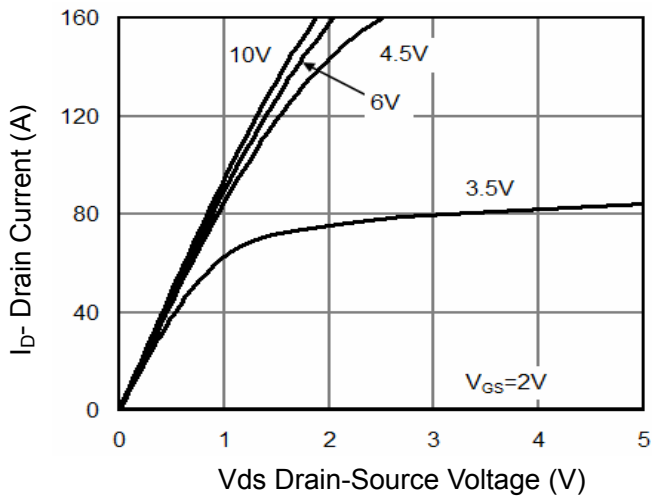
### 2) Gate charge test Circuit



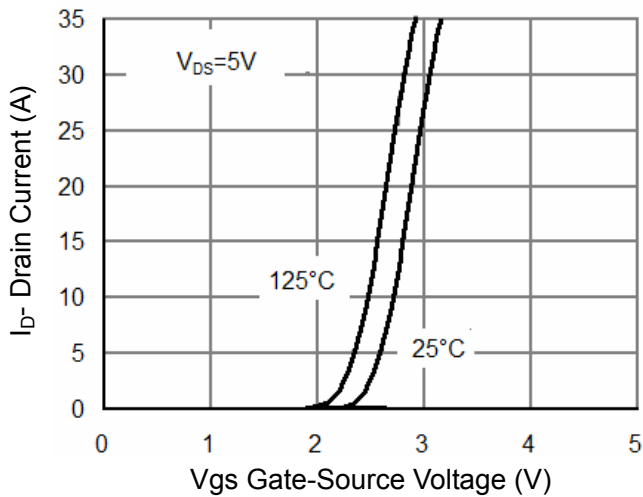
### 3) Switch Time Test Circuit



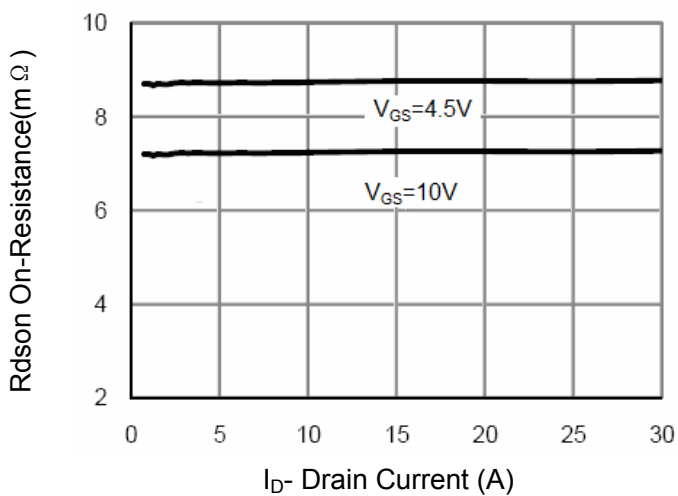
## Typical Electrical and Thermal Characteristics



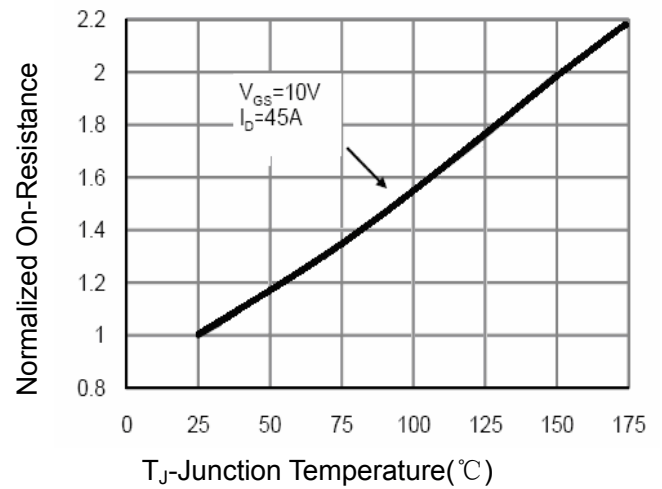
**Figure 1 Output Characteristics**



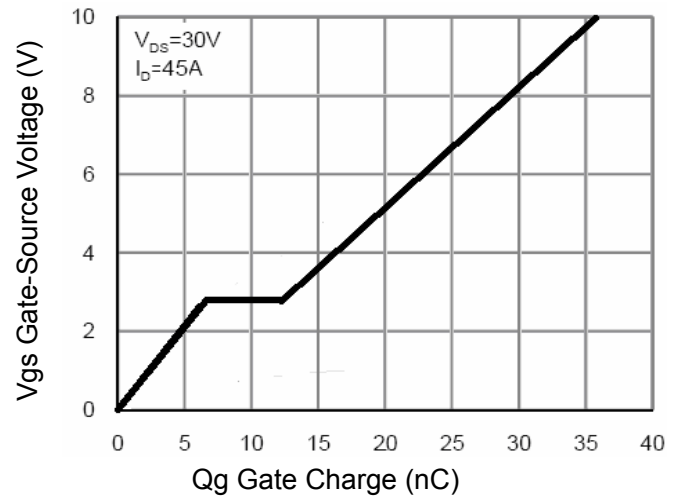
**Figure 2 Transfer Characteristics**



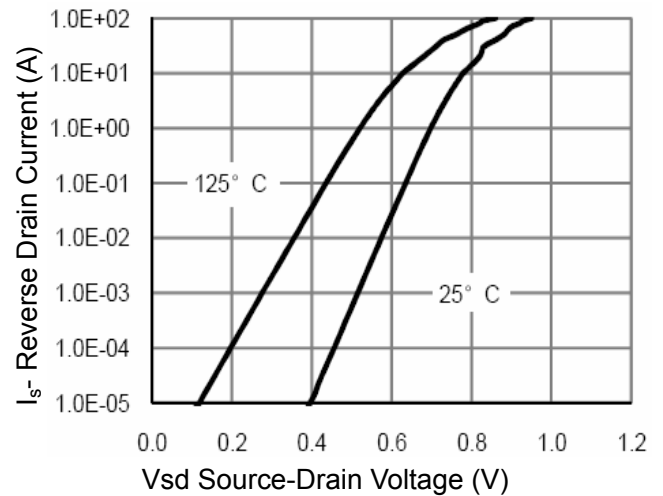
**Figure 3 Rdson- Drain Current**



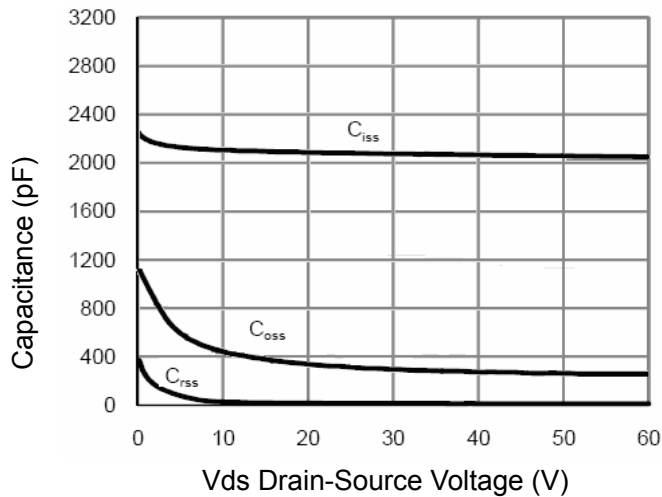
**Figure 4 Rdson-Junction Temperature**



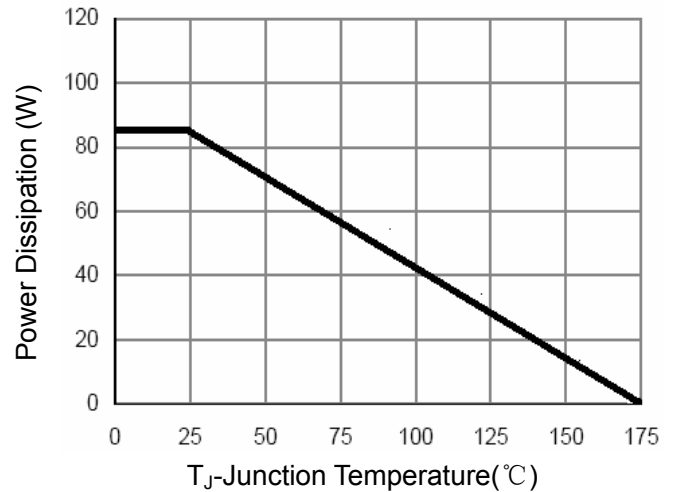
**Figure 5 Gate Charge**



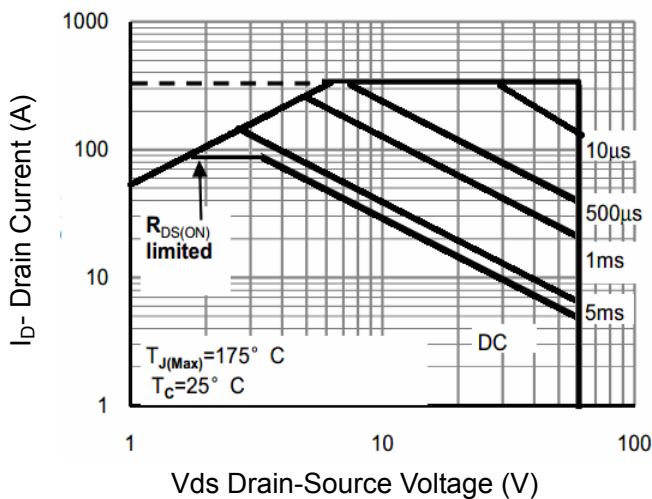
**Figure 6 Source- Drain Diode Forward**



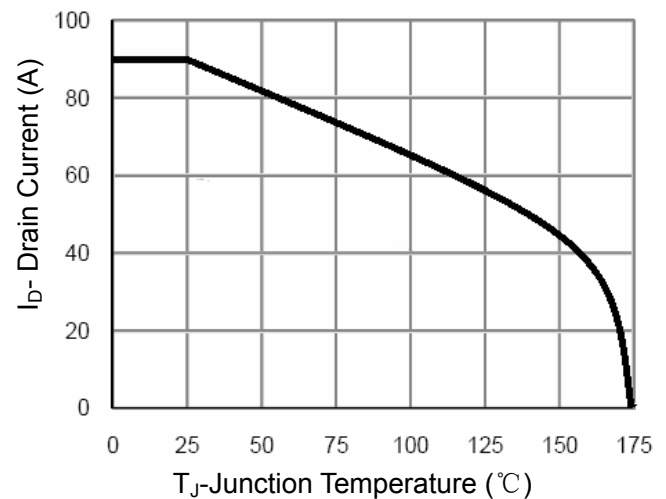
**Figure 7 Capacitance vs Vds**



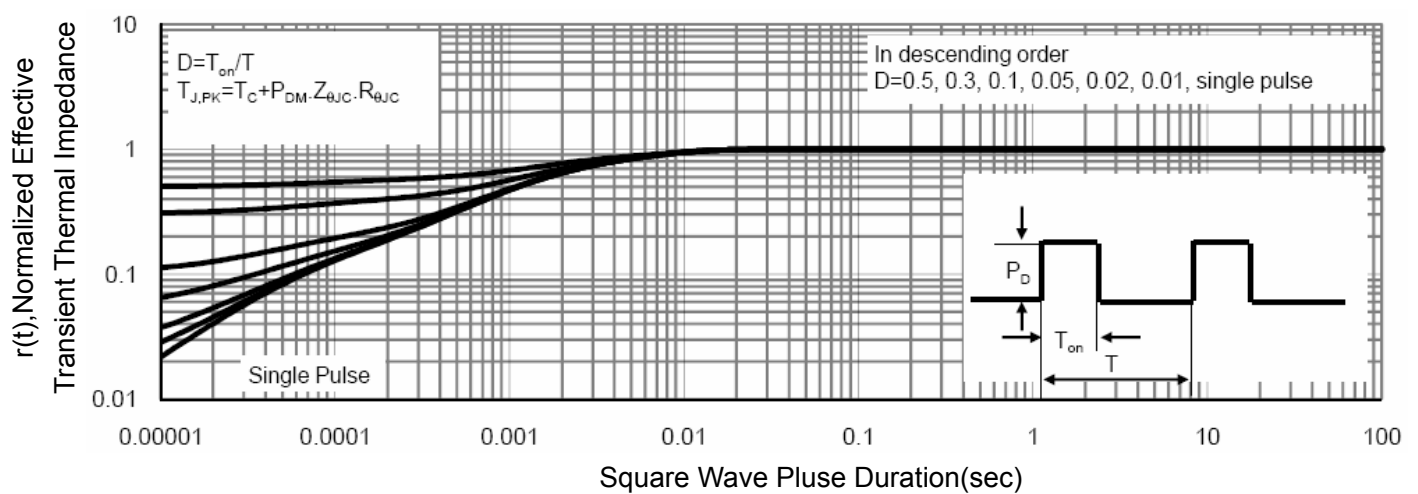
**Figure 9 Power De-rating**



**Figure 8 Safe Operation Area**

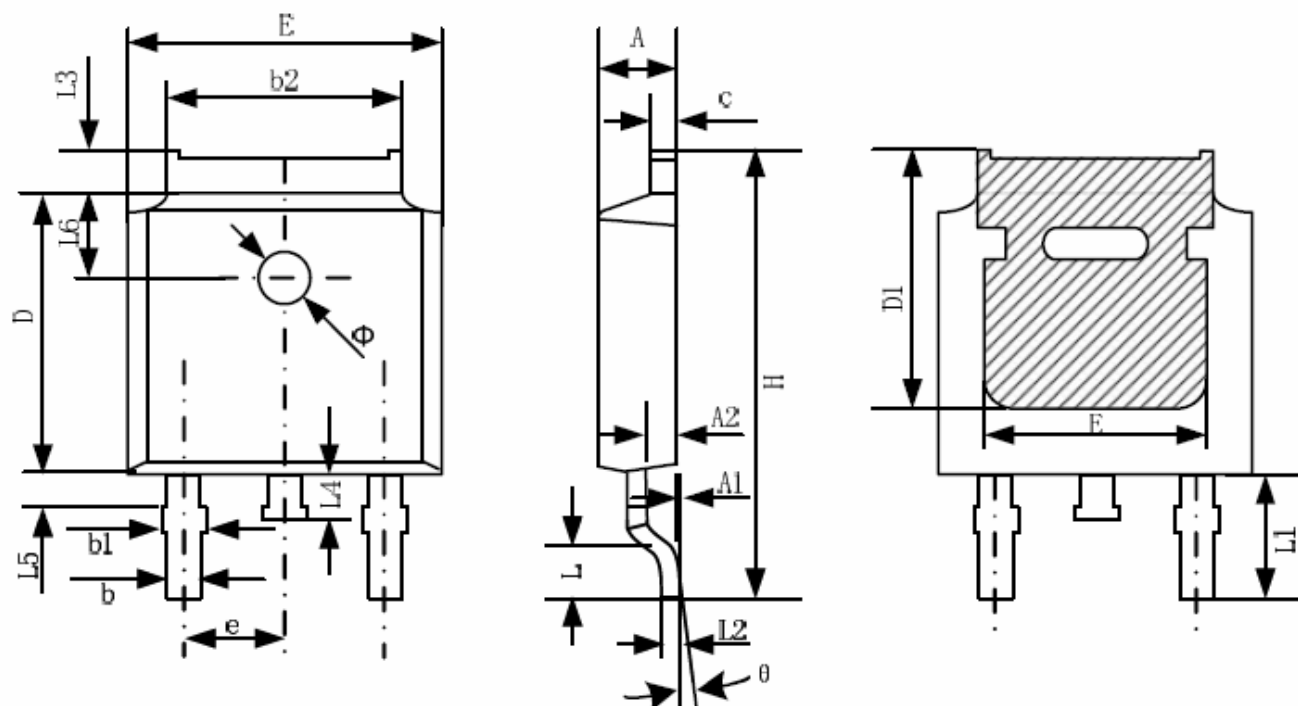


**Figure 10 Current De-rating**



**Figure 11 Normalized Maximum Transient Thermal Impedance**

## TO-252-2L Package Information



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min.                      | Max.  | Min.                 | Max.  |
| A      | 2.20                      | 2.38  | 0.087                | 0.094 |
| A1     | 0.00                      | 0.10  | 0.000                | 0.004 |
| A2     | 0.90                      | 1.10  | 0.035                | 0.043 |
| b      | 0.72                      | 0.85  | 0.028                | 0.033 |
| b1     | 0.72                      | 0.90  | 0.028                | 0.035 |
| b2     | 5.13                      | 5.46  | 0.202                | 0.215 |
| c      | 0.47                      | 0.60  | 0.019                | 0.024 |
| D      | 6.00                      | 6.20  | 0.236                | 0.244 |
| D1     | 5.25                      | --    | 0.207                | --    |
| E      | 6.50                      | 6.70  | 0.256                | 0.264 |
| E1     | 4.70                      | --    | 0.185                | --    |
| e      | 2.19                      | 2.39  | 0.086                | 0.094 |
| H      | 9.80                      | 10.40 | 0.386                | 0.409 |
| L      | 1.40                      | 1.70  | 0.055                | 0.067 |
| L1     | 2.90 REF                  |       | 0.114 REF            |       |
| L2     | 0.508 BSC                 |       | 0.020 BSC            |       |
| L3     | 0.90                      | 1.25  | 0.035                | 0.049 |
| L4     | 0.60                      | 1.00  | 0.024                | 0.039 |
| L5     | 0.15                      | 0.75  | 0.006                | 0.030 |
| L6     | 1.80 REF                  |       | 0.071 REF            |       |
| Φ      | 1.20                      | 1.40  | 0.047                | 0.055 |
| θ      | 0°                        | 8°    | 0°                   | 8°    |

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