

## NCE N-Channel Super Trench Power MOSFET

### Description

The NCEP60T15G 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.

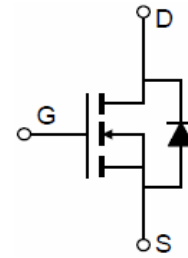
### General Features

- $V_{DS} = 60V, I_D = 150A$   
 $R_{DS(ON)} < 3.1m\Omega @ V_{GS}=10V$  (Typ:2.8m $\Omega$ )
- Excellent gate charge x  $R_{DS(on)}$  product
- Very low on-resistance  $R_{DS(on)}$
- 150 °C operating temperature
- Pb-free lead plating
- 100% UIS tested

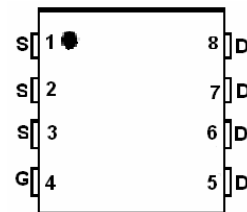
### Application

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

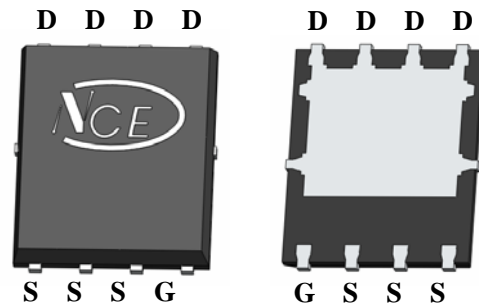
**100% UIS TESTED!**  
**100%  $\Delta V_{ds}$  TESTED!**



Schematic diagram



Marking and pin assignment



Top View

Bottom View

### Package Marking and Ordering Information

| Device Marking | Device     | Device Package | Reel Size | Tape width | Quantity |
|----------------|------------|----------------|-----------|------------|----------|
| NCEP60T15G     | NCEP60T15G | DFN5X6-8L      | -         | -          | -        |

### 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 (Silicon Limited)        | $I_D$              | 150        | A             |
| Drain Current-Continuous( $T_C=100^\circ C$ )     | $I_D(100^\circ C)$ | 105        | A             |
| Pulsed Drain Current                              | $I_{DM}$           | 600        | A             |
| Maximum Power Dissipation                         | $P_D$              | 200        | W             |
| Derating factor                                   |                    | 1.6        | W/ $^\circ C$ |
| Single pulse avalanche energy <sup>(Note 5)</sup> | $E_{AS}$           | 819        | mJ            |
| Operating Junction and Storage Temperature Range  | $T_J, T_{STG}$     | -55 To 150 | $^\circ C$    |

## Thermal Characteristic

|  |                 |       |               |
|--|-----------------|-------|---------------|
| Thermal Resistance, Junction-to-Case <sup>(Note 2)</sup> | $R_{\theta JC}$ | 0.625 | $^{\circ}C/W$ |
|--|-----------------|-------|---------------|

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

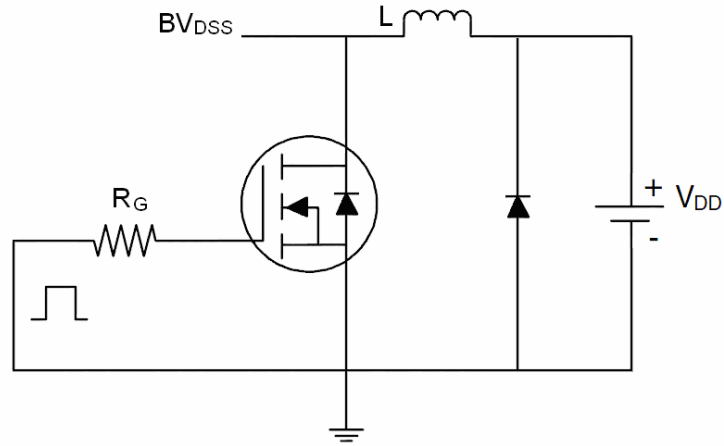
| Parameter  | Symbol       | Condition  | Min | Typ  | Max       | Unit       |
|--|--------------|--|-----|------|-----------|------------|
| <b>Off Characteristics</b>                           |              |  |     |      |           |            |
| Drain-Source Breakdown Voltage                       | $BV_{DSS}$   | $V_{GS}=0V, I_D=250\mu A$  | 60  |      | -         | V          |
| Zero Gate Voltage Drain Current                      | $I_{DSS}$    | $V_{DS}=60V, V_{GS}=0V$  | -   | -    | 1         | $\mu A$    |
| Gate-Body Leakage Current                            | $I_{GSS}$    | $V_{GS}=\pm 20V, V_{DS}=0V$  | -   | -    | $\pm 100$ | nA         |
| <b>On Characteristics</b> <sup>(Note 3)</sup>        |              |  |     |      |           |            |
| Gate Threshold Voltage                               | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu A$  | 2.0 | 2.8  | 4.0       | V          |
| Drain-Source On-State Resistance                     | $R_{DS(ON)}$ | $V_{GS}=10V, I_D=20A$  | -   | 2.8  | 3.1       | m $\Omega$ |
| Forward Transconductance                             | $g_{FS}$     | $V_{DS}=5V, I_D=20A$   | 50  | -    | -         | S          |
| <b>Dynamic Characteristics</b> <sup>(Note 4)</sup>   |              |  |     |      |           |            |
| Input Capacitance                                    | $C_{iss}$    | $V_{DS}=30V, V_{GS}=0V,$<br>$F=1.0MHz$                                     | -   | 4500 | -         | PF         |
| Output Capacitance                                   | $C_{oss}$    |  | -   | 965  | -         | PF         |
| Reverse Transfer Capacitance                         | $C_{rss}$    |  | -   | 24   | -         | PF         |
| <b>Switching Characteristics</b> <sup>(Note 4)</sup> |              |  |     |      |           |            |
| Turn-on Delay Time                                   | $t_{d(on)}$  | $V_{DD}=30V, I_D=20A$<br>$V_{GS}=10V, R_G=4.7\Omega$                       | -   | 6    | -         | nS         |
| Turn-on Rise Time                                    | $t_r$        |  | -   | 11   | -         | nS         |
| Turn-Off Delay Time                                  | $t_{d(off)}$ |  | -   | 23   | -         | nS         |
| Turn-Off Fall Time                                   | $t_f$        |  | -   | 3    | -         | nS         |
| Total Gate Charge                                    | $Q_g$        | $V_{DS}=30V, I_D=20A,$<br>$V_{GS}=10V$                                     | -   | 70   | -         | nC         |
| Gate-Source Charge                                   | $Q_{gs}$     |  | -   | 18.6 | -         | nC         |
| Gate-Drain Charge                                    | $Q_{gd}$     |  | -   | 15.3 | -         | nC         |
| <b>Drain-Source Diode Characteristics</b>            |              |  |     |      |           |            |
| Diode Forward Voltage <sup>(Note 3)</sup>            | $V_{SD}$     | $V_{GS}=0V, I_S=150A$  | -   |      | 1.2       | V          |
| Diode Forward Current <sup>(Note 2)</sup>            | $I_S$        |  | -   | -    | 150       | A          |
| Reverse Recovery Time                                | $t_{rr}$     | $T_J = 25^{\circ}C, I_F = I_S$<br>$di/dt = 100A/\mu S$ <sup>(Note 3)</sup> | -   | 50   |           | nS         |
| Reverse Recovery Charge                              | $Q_{rr}$     |  | -   | 66   |           | nC         |

## Notes:

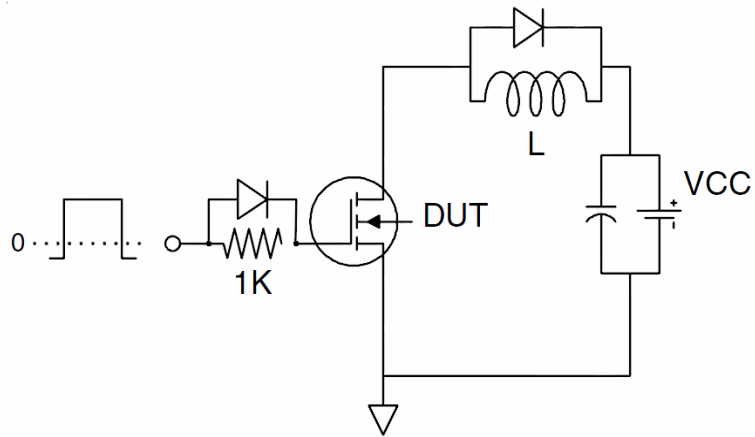
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5. EAS condition :  $T_J=25^{\circ}C, V_{DD}=30V, V_G=10V,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

## Test Circuit

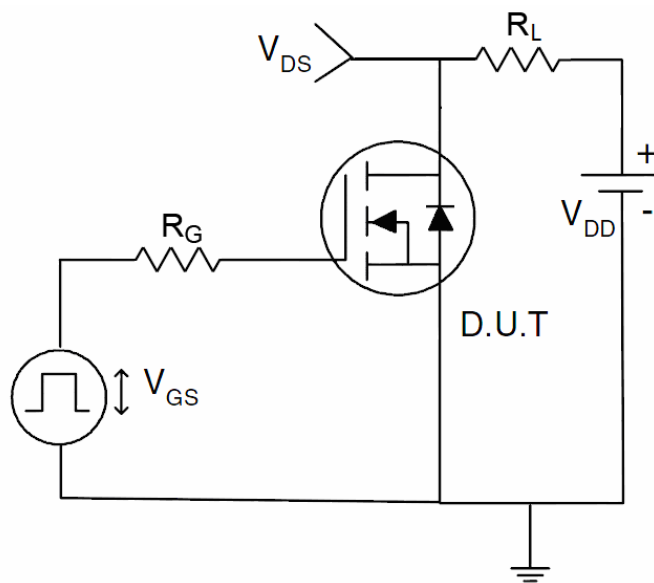
### 1) $E_{AS}$ test Circuit



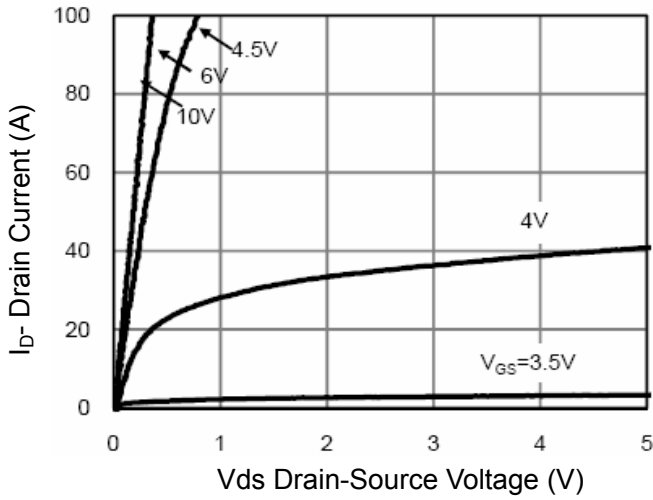
### 2) Gate charge test Circuit



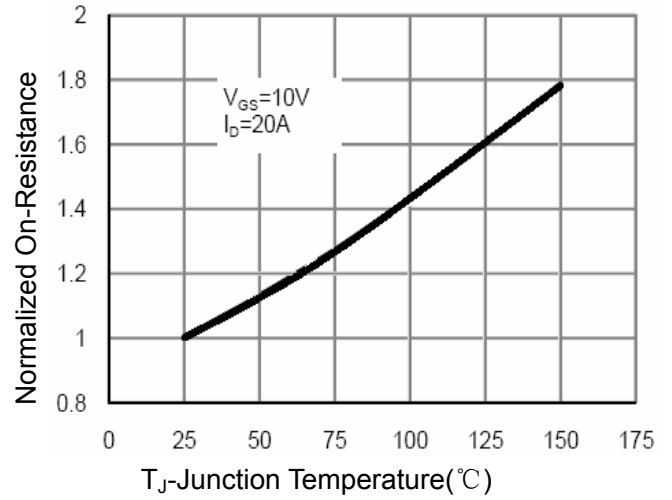
### 3) Switch Time Test Circuit



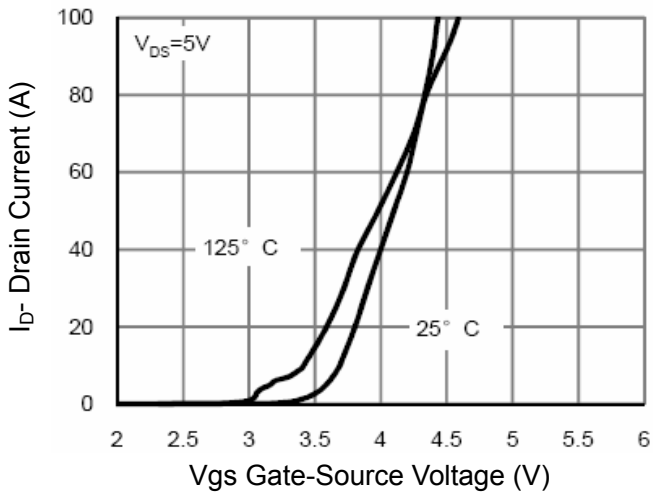
**Typical Electrical and Thermal Characteristics**



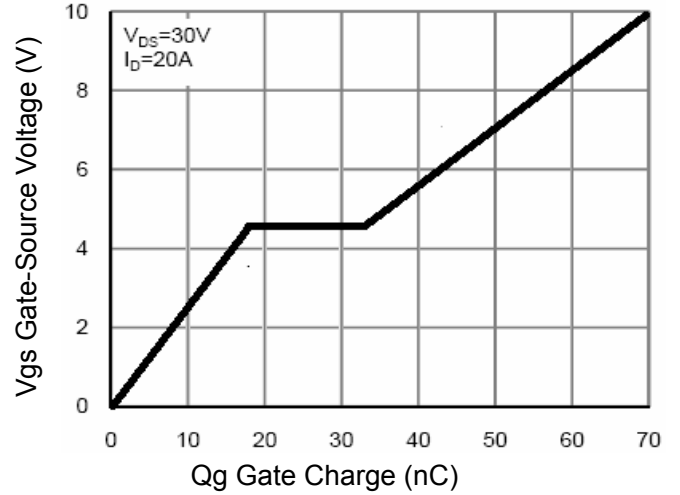
**Figure 1 Output Characteristics**



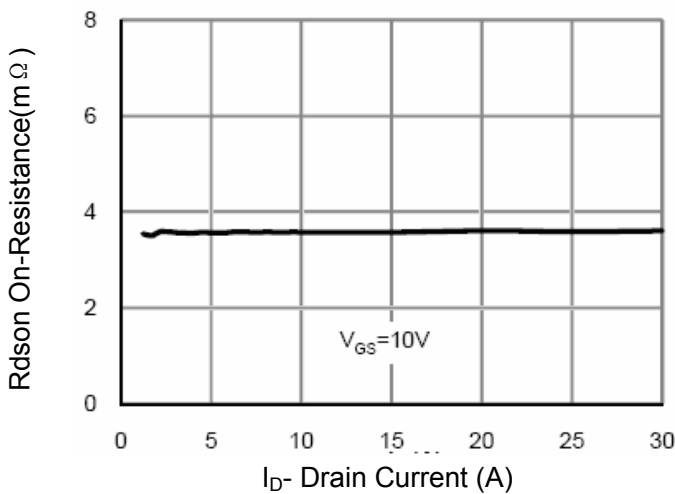
**Figure 4 Rdson-Junction Temperature**



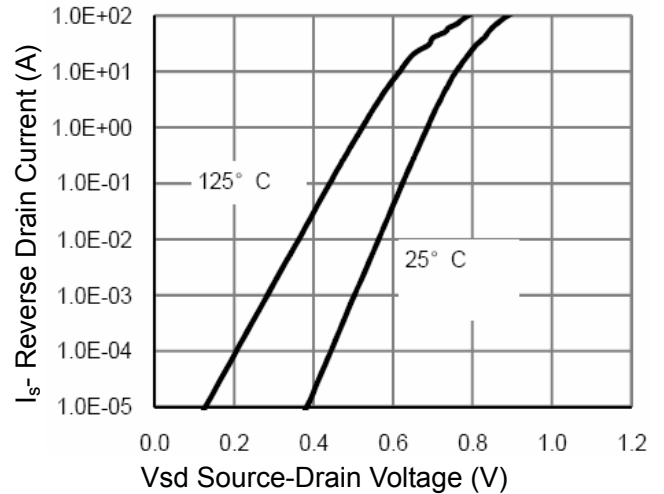
**Figure 2 Transfer Characteristics**



**Figure 5 Gate Charge**



**Figure 3 Rdson- Drain Current**



**Figure 6 Source- Drain Diode Forward**

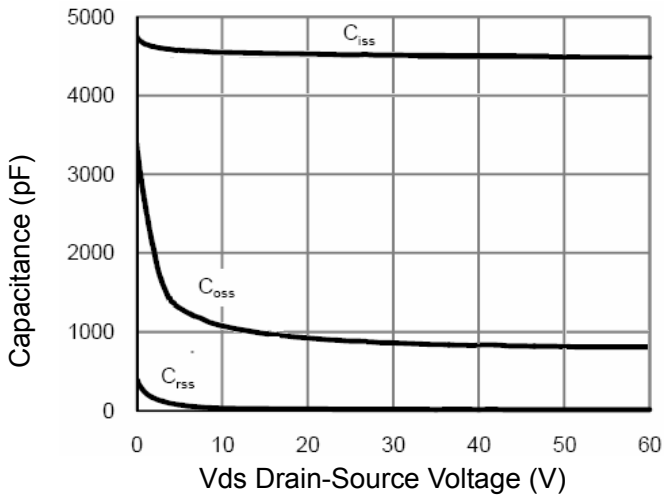


Figure 7 Capacitance vs Vds

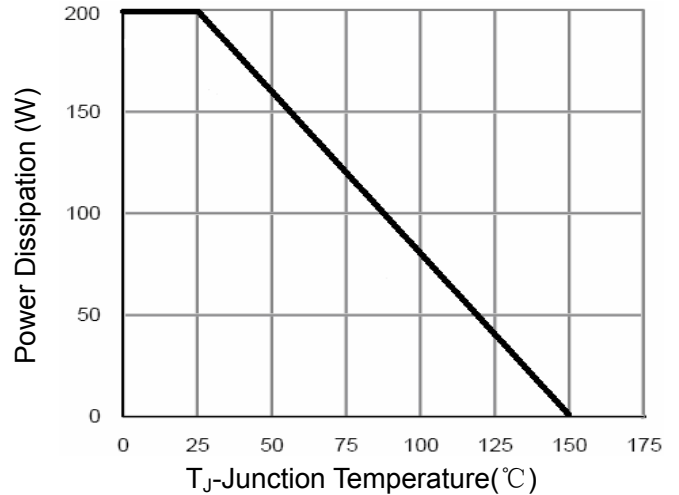


Figure 9 Power De-rating

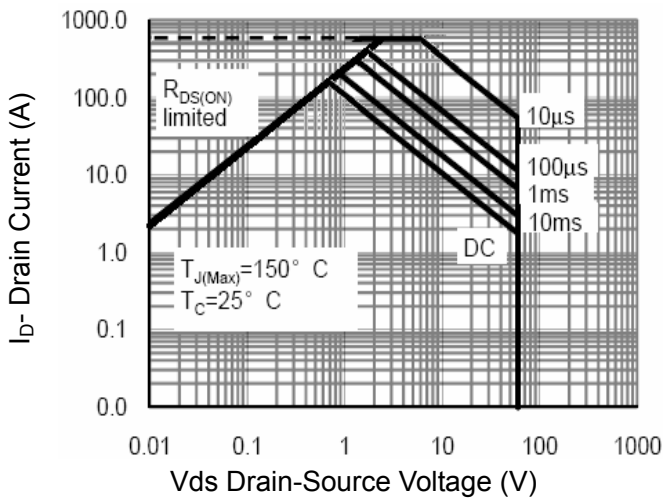


Figure 8 Safe Operation Area

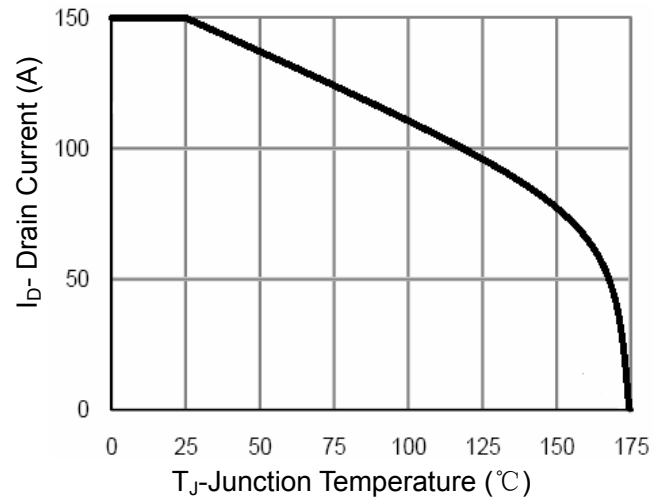


Figure 10 Current De-rating

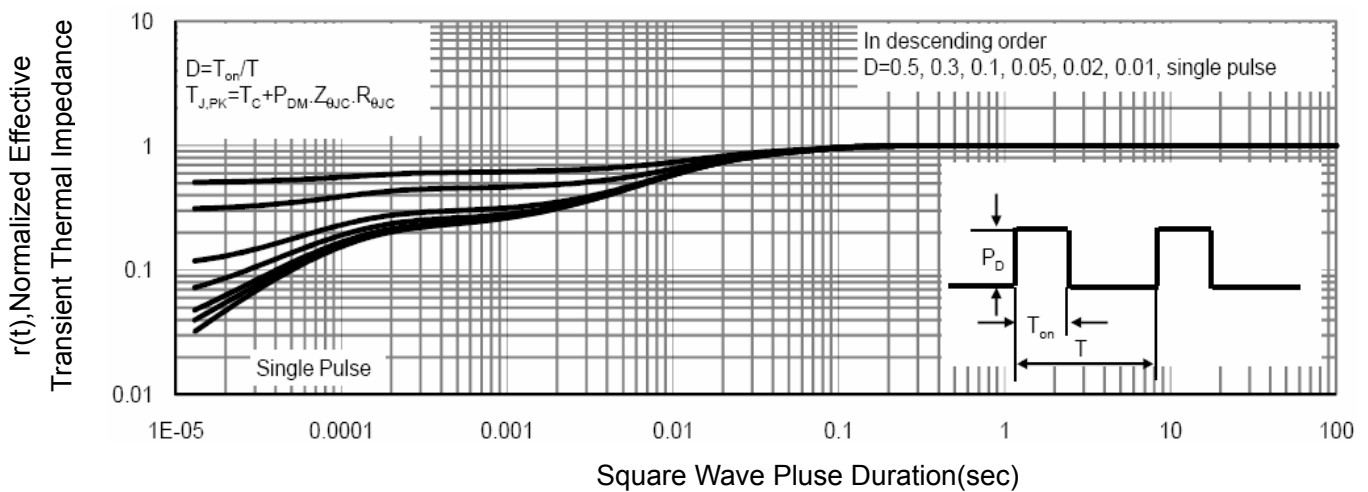
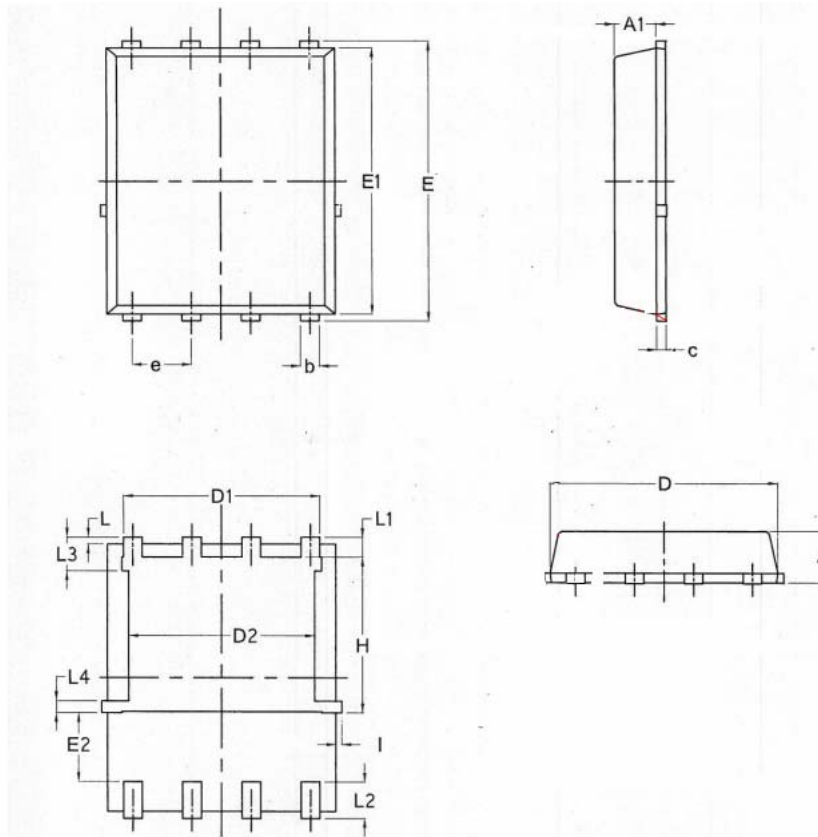


Figure 11 Normalized Maximum Transient Thermal Impedance

## DFN5X6-8L Package Information



| Symbol | Dimensions In Millimeters |       |       | Dimensions In Inches |        |        |
|--------|---------------------------|-------|-------|----------------------|--------|--------|
|        | Min.                      | Nom.  | Max.  | Min.                 | Nom.   | Max.   |
| A      | 0.90                      | 1.10  | 1.17  | 0.0354               | 0.0433 | 0.0461 |
| A1     | 0.824                     | 0.897 | 0.97  | 0.0324               | 0.0353 | 0.0382 |
| b      | 0.33                      | 0.41  | 0.50  | 0.0130               | 0.0161 | 0.0197 |
| C      | 0.150                     | 0.20  | 0.250 | 0.0059               | 0.0079 | 0.0098 |
| D      | 4.80                      | 4.90  | 5.00  | 0.1890               | 0.1929 | 0.1969 |
| D1     | 3.91                      | 4.22  | 4.36  | 0.1539               | 0.1661 | 0.1717 |
| D2     | 3.85                      | 4.00  | 4.15  | 0.1516               | 0.1575 | 0.1634 |
| E      | 5.90                      | 6.05  | 6.15  | 0.2323               | 0.2382 | 0.2421 |
| E1     | 5.65                      | 5.76  | 5.85  | 0.2224               | 0.2268 | 0.2303 |
| E2     | 1.10                      | /     | /     | 0.0433               | /      | /      |
| e      | 1.27 BSC                  |       |       | 0.050 BSC            |        |        |
| L      | 0.05                      | 0.15  | 0.25  | 0.0020               | 0.0059 | 0.0098 |
| L1     | 0.38                      | 0.425 | 0.50  | 0.0150               | 0.0167 | 0.0197 |
| L2     | 0.51                      | 0.785 | 0.86  | 0.0201               | 0.0309 | 0.0339 |
| L3     | 0.55                      | 0.70  | 0.85  | 0.0217               | 0.0276 | 0.0335 |
| L4     | 0.10                      | 0.25  | 0.40  | 0.0039               | 0.0098 | 0.0157 |
| H      | 3.25                      | 3.35  | 3.58  | 0.1280               | 0.1319 | 0.1409 |
| I      | 0                         | /     | 0.18  | 0                    | /      | 0.0071 |

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