

## N-Channel Super Trench Power MOSFET

### Description

The HMS60N06D 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.

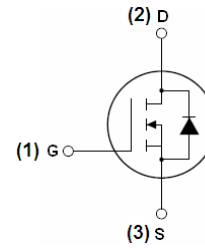
### General Features

- $V_{DS} = 60V, I_D = 60A$   
 $R_{DS(ON)} = 4.4m\Omega$  (typical) @  $V_{GS} = 10V$   
 $R_{DS(ON)} = 6.4m\Omega$  (typical) @  $V_{GS} = 4.5V$
- Excellent gate charge x  $R_{DS(on)}$  product(FOM)
- Very low on-resistance  $R_{DS(on)}$
- 150 °C operating temperature
- Pb-free lead plating
- 100% UIS tested

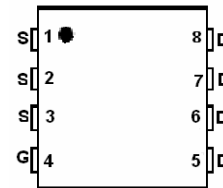
### Application

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

**100% UIS TESTED!**



Schematic diagram



Marking and pin assignment

### Package Marking and Ordering Information

| Device Marking | Device    | Device Package | Reel Size | Tape width | Quantity   |
|----------------|-----------|----------------|-----------|------------|------------|
| HMS60N06D      | HMS60N06D | DFN5X6-8L      | Ø330mm    | 12mm       | 2500 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                          | $I_D$              | 60         | A          |
| Drain Current-Continuous( $T_C = 100^\circ C$ )   | $I_D(100^\circ C)$ | 42         | A          |
| Pulsed Drain Current                              | $I_{DM}$           | 240        | A          |
| Maximum Power Dissipation                         | $P_D$              | 75         | W          |
| Single pulse avalanche energy <sup>(Note 5)</sup> | $E_{AS}$           | 320        | mJ         |
| 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> | $R_{\theta JA}$ | 36 | $^\circ C/W$ |
|-------------------------------------------------------------|-----------------|----|--------------|

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

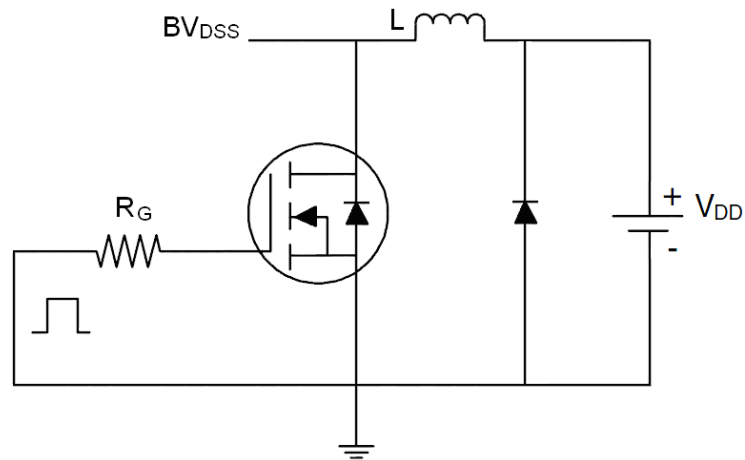
| Parameter                                     | Symbol              | Condition                                                                              | Min | Typ  | Max  | Unit |
|-----------------------------------------------|---------------------|----------------------------------------------------------------------------------------|-----|------|------|------|
| Off Characteristics                           |                     |                                                                                        |     |      |      |      |
| Drain-Source Breakdown Voltage                | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =250μA                                              | 60  | -    | -    | 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 | 1.65 | 2.3  | V    |
| Drain-Source On-State Resistance              | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =60A                                              | -   | 4.4  | 5.2  | mΩ   |
|                                               |                     | V <sub>GS</sub> =4.5V, I <sub>D</sub> =18A                                             | -   | 6.4  | 7.8  | mΩ   |
| Forward Transconductance                      | g <sub>FS</sub>     | V <sub>DS</sub> =5V, I <sub>D</sub> =60A                                               | 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                                 | -   | 4000 | -    | PF   |
| Output Capacitance                            | C <sub>oss</sub>    |                                                                                        | -   | 680  | -    | PF   |
| Reverse Transfer Capacitance                  | C <sub>rss</sub>    |                                                                                        | -   | 23   | -    | PF   |
| Switching Characteristics <sup>(Note 4)</sup> |                     |                                                                                        |     |      |      |      |
| Turn-on Delay Time                            | t <sub>d(on)</sub>  | V <sub>DD</sub> =30V, R <sub>L</sub> =1.7Ω<br>V <sub>GS</sub> =10V, R <sub>G</sub> =3Ω | -   | 11   | -    | nS   |
| Turn-on Rise Time                             | t <sub>r</sub>      |                                                                                        | -   | 5    | -    | nS   |
| Turn-Off Delay Time                           | t <sub>d(off)</sub> |                                                                                        | -   | 56   | -    | nS   |
| Turn-Off Fall Time                            | t <sub>f</sub>      |                                                                                        | -   | 12   | -    | nS   |
| Total Gate Charge                             | Q <sub>g</sub>      | V <sub>DS</sub> =30V, I <sub>D</sub> =60A,<br>V <sub>GS</sub> =10V                     | -   | 67   | -    | nC   |
| Gate-Source Charge                            | Q <sub>gs</sub>     |                                                                                        | -   | 12   | -    | nC   |
| Gate-Drain Charge                             | Q <sub>gd</sub>     |                                                                                        | -   | 8.5  | -    | 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> =60A                                               | -   | -    | 1.2  | V    |
| Diode Forward Current <sup>(Note 2)</sup>     | I <sub>S</sub>      |                                                                                        | -   | -    | 60   | A    |
| Reverse Recovery Time                         | t <sub>rr</sub>     | T <sub>J</sub> = 25°C, I <sub>F</sub> = I <sub>S</sub>                                 | -   | 48   | -    | nS   |
| Reverse Recovery Charge                       | Q <sub>rr</sub>     | di/dt = 100A/μs <sup>(Note3)</sup>                                                     | -   | 60   | -    | nC   |

**Notes:**

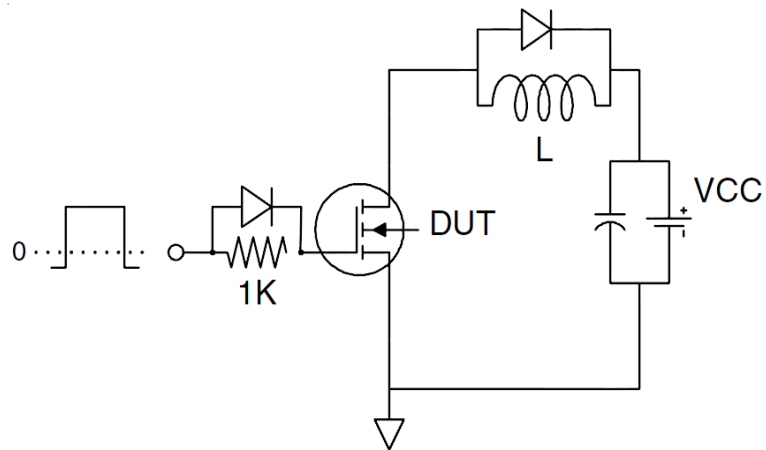
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5. EAS condition :  $T_J=25^{\circ}\text{C}, V_{DD}=50V, V_G=10V, L=0.5mH, R_g=25\Omega$

## Test Circuit

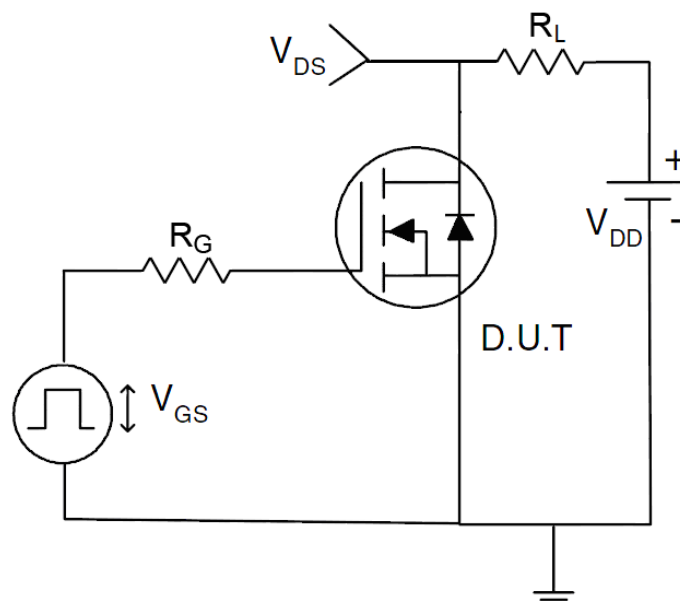
### 1) E<sub>AS</sub> test Circuit



### 2) Gate charge test Circuit



### 3) Switch Time Test Circuit



Typical Electrical and Thermal Characteristics

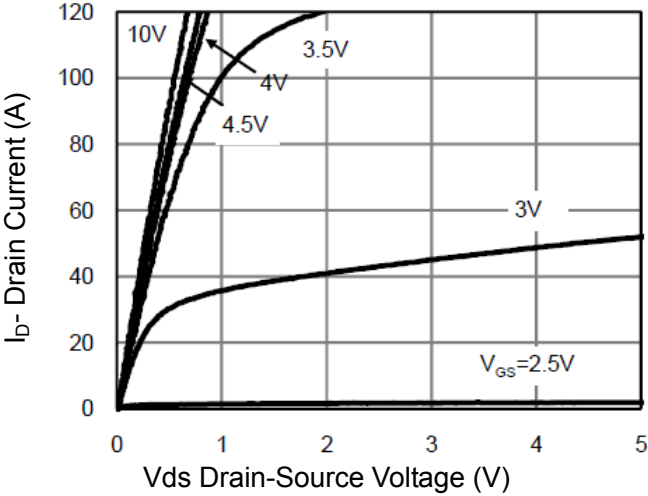


Figure 1 Output Characteristics

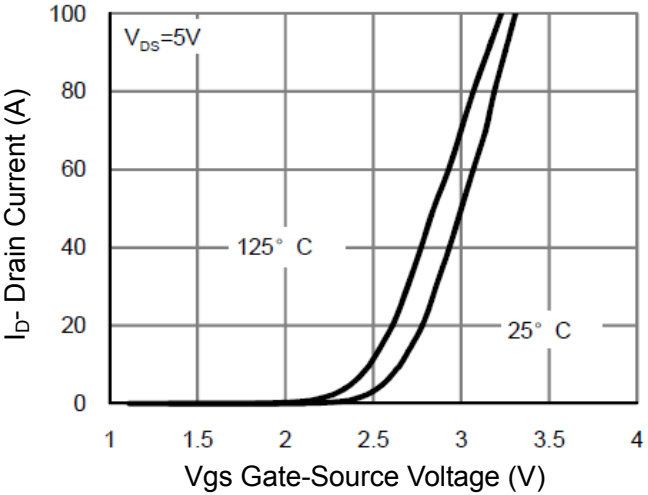


Figure 2 Transfer Characteristics

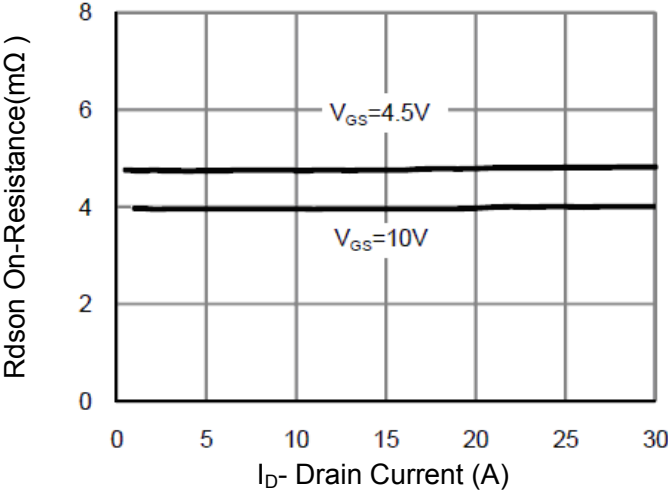


Figure 3  $R_{DS(on)}$ - Drain Current

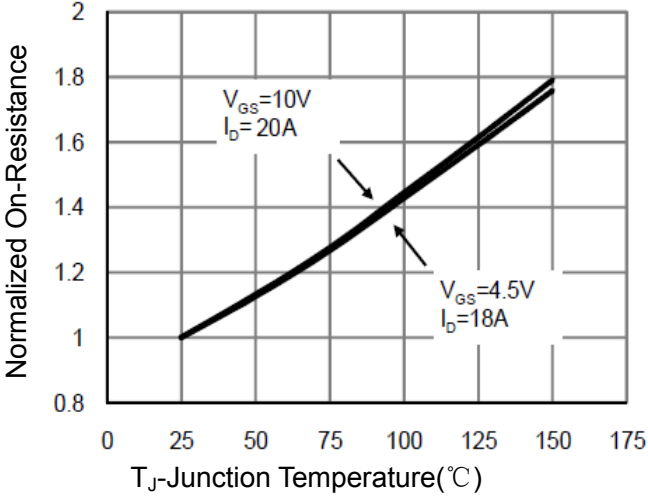


Figure 4  $R_{DS(on)}$ -Junction Temperature

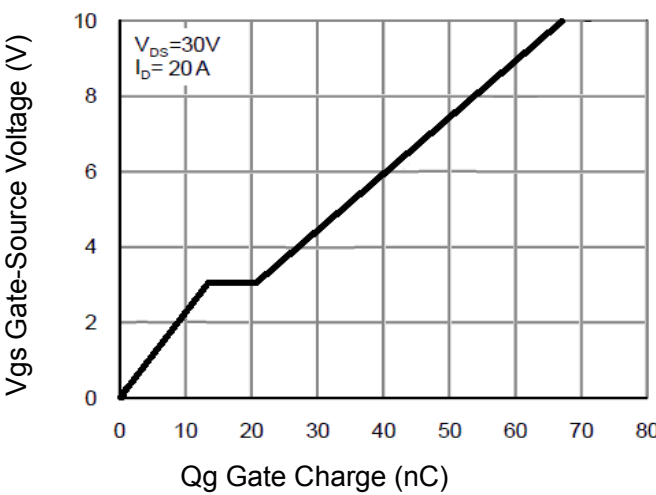


Figure 5 Gate Charge

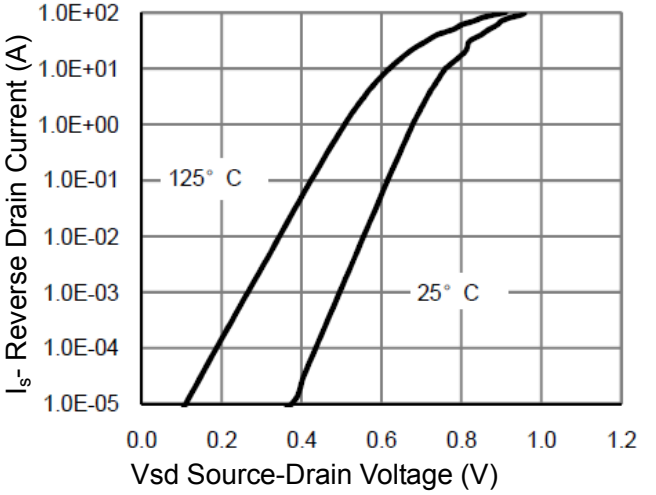


Figure 6 Source- Drain Diode Forward

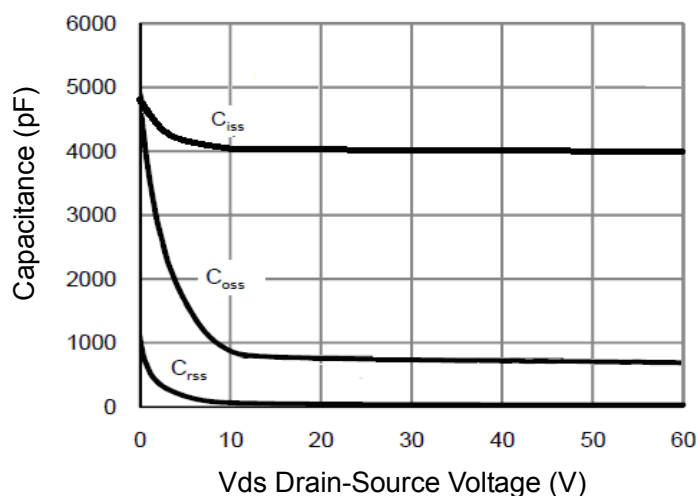


Figure 7 Capacitance vs Vds

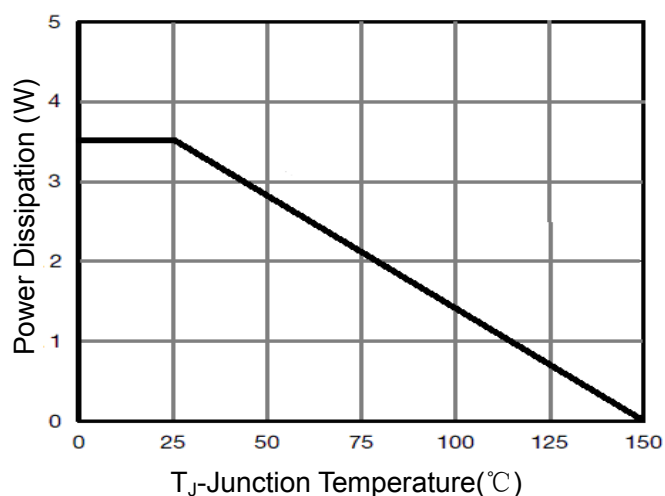


Figure 9 Power De-rating

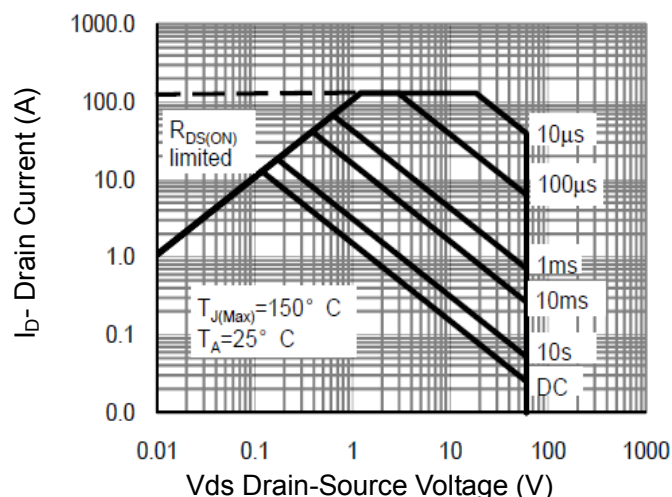


Figure 8 Safe Operation Area

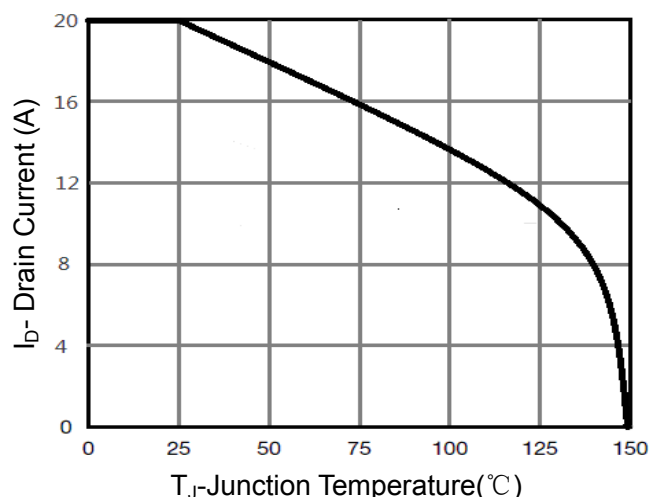


Figure 10 Current De-rating

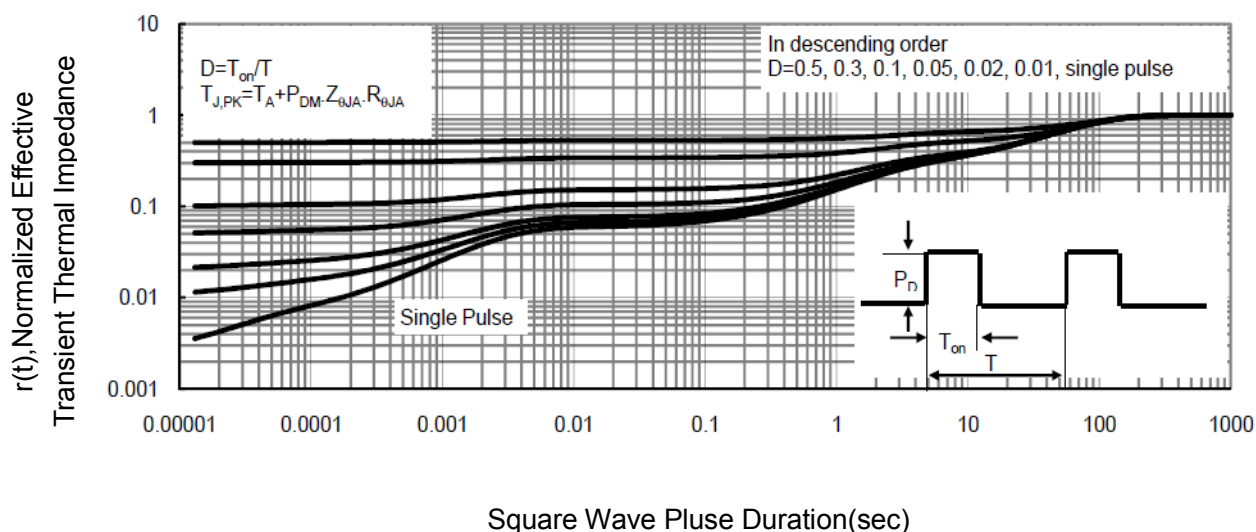
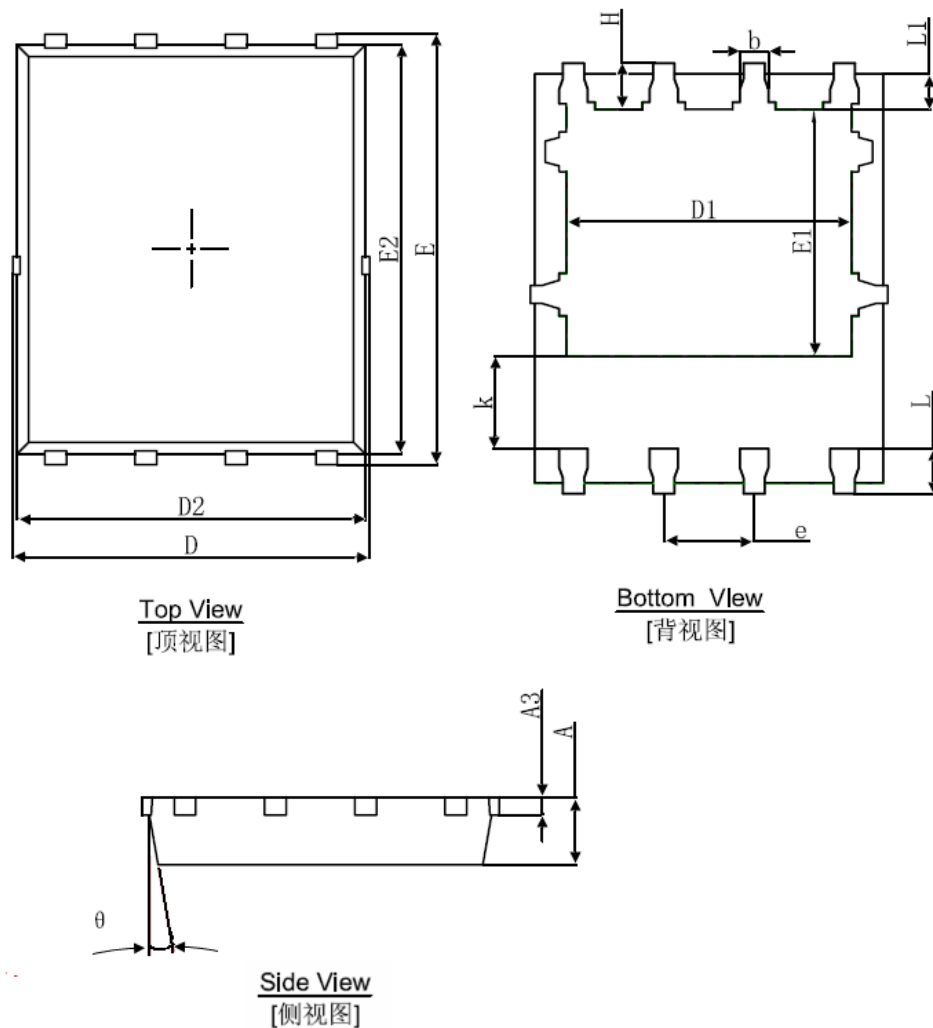


Figure 11 Normalized Maximum Transient Thermal Impedance

## DFN5X6-8L Package Information



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min.                      | Max.  | Min.                 | Max.  |
| A      | 0.900                     | 1.000 | 0.035                | 0.039 |
| A3     | 0.254REF.                 |       | 0.010REF.            |       |
| D      | 4.944                     | 5.096 | 0.195                | 0.201 |
| E      | 5.974                     | 6.126 | 0.235                | 0.241 |
| D1     | 3.910                     | 4.110 | 0.154                | 0.162 |
| E1     | 3.375                     | 3.575 | 0.133                | 0.141 |
| D2     | 4.824                     | 4.976 | 0.190                | 0.196 |
| E2     | 5.674                     | 5.826 | 0.223                | 0.229 |
| k      | 1.190                     | 1.390 | 0.047                | 0.055 |
| b      | 0.350                     | 0.450 | 0.014                | 0.018 |
| e      | 1.270TYP.                 |       | 0.050TYP.            |       |
| L      | 0.559                     | 0.711 | 0.022                | 0.028 |
| L1     | 0.424                     | 0.576 | 0.017                | 0.023 |
| H      | 0.574                     | 0.726 | 0.023                | 0.029 |
| θ      | 8°                        | 12°   | 8°                   | 12°   |