

## N-Channel Super Trench Power MOSFET

### Description

The HMS90N10KA 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

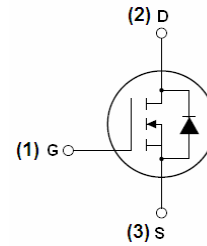
- $V_{DS} = 100V, I_D = 90A$   
 $R_{DS(on)} = 6.4m\Omega(Typ) @ V_{GS} = 10V$   
 $R_{DS(on)} = 9.3m\Omega(Typ) @ V_{GS} = 4.5V$
- Excellent gate charge x  $R_{DS(on)}$  product(FOM)
- Very low on-resistance  $R_{DS(on)}$
- 175 °C operating temperature
- Pb-free lead plating
- 100% UIS tested

### Application

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

**100% UIS TESTED!**

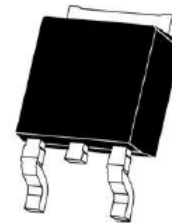
**100%  $\Delta V_{ds}$  TESTED!**



Schematic diagram



Marking and pin assignment



TO-252-2L top view

### Package Marking and Ordering Information

| Device Marking | Device     | Device Package | Reel Size | Tape width | Quantity |
|----------------|------------|----------------|-----------|------------|----------|
| HMS90N10KA     | HMS90N10KA | TO-252-2L      | -         | -          | -        |

### Absolute Maximum Ratings ( $T_C = 25^\circ C$ unless otherwise noted)

| Parameter                                         | Symbol             | Limit      | Unit          |
|---------------------------------------------------|--------------------|------------|---------------|
| Drain-Source Voltage                              | $V_{DS}$           | 100        | V             |
| Gate-Source Voltage                               | $V_{GS}$           | $\pm 20$   | V             |
| Drain Current-Continuous                          | $I_D$              | 90         | A             |
| Drain Current-Continuous( $T_C = 100^\circ C$ )   | $I_D(100^\circ C)$ | 63         | A             |
| Pulsed Drain Current                              | $I_{DM}$           | 270        | A             |
| Maximum Power Dissipation                         | $P_D$              | 125        | W             |
| Derating factor                                   |                    | 0.83       | W/ $^\circ C$ |
| 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 | $^\circ C$    |

## Thermal Characteristic

|                                                          |                 |     |                      |
|----------------------------------------------------------|-----------------|-----|----------------------|
| Thermal Resistance, Junction-to-Case <sup>(Note 2)</sup> | $R_{\theta JC}$ | 1.2 | $^{\circ}\text{C/W}$ |
|----------------------------------------------------------|-----------------|-----|----------------------|

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

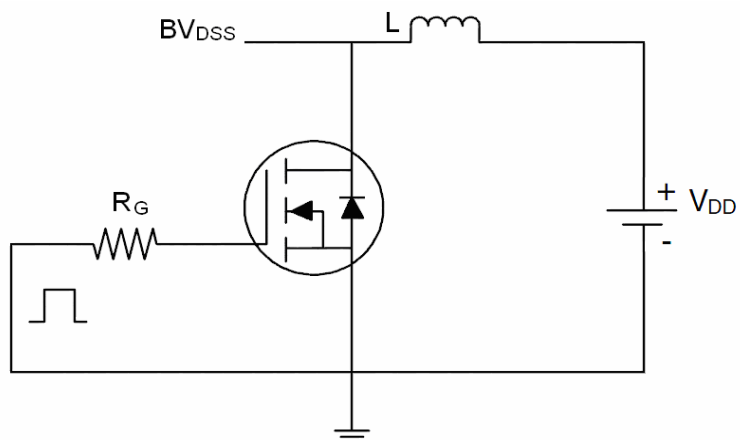
| Parameter                          | Symbol              | Condition                                                                               | Min | Typ  | Max  | Unit |
|------------------------------------|---------------------|-----------------------------------------------------------------------------------------|-----|------|------|------|
| Off Characteristics                |                     |                                                                                         |     |      |      |      |
| Drain-Source Breakdown Voltage     | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =250μA                                               | 100 |      | -    | V    |
| Zero Gate Voltage Drain Current    | I <sub>DSS</sub>    | V <sub>DS</sub> =100V, 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                                | 1.2 | 2.0  | 2.5  | V    |
| Drain-Source On-State Resistance   | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =39A                                               | -   | 6.4  | 7.7  | mΩ   |
|                                    |                     | V <sub>GS</sub> =4.5V, I <sub>D</sub> =39A                                              | -   | 9.3  | 11.6 | mΩ   |
| Forward Transconductance           | g <sub>FS</sub>     | V <sub>DS</sub> =10V, I <sub>D</sub> =39A                                               | 40  | -    | -    | S    |
| Dynamic Characteristics (Note4)    |                     |                                                                                         |     |      |      |      |
| Input Capacitance                  | C <sub>iss</sub>    | V <sub>DS</sub> =50V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                  | -   | 4200 | 5480 | PF   |
| Output Capacitance                 | C <sub>oss</sub>    |                                                                                         | -   | 354  | 425  | PF   |
| Reverse Transfer Capacitance       | C <sub>rss</sub>    |                                                                                         | -   | 23   | 30   | PF   |
| Switching Characteristics (Note 4) |                     |                                                                                         |     |      |      |      |
| Turn-on Delay Time                 | t <sub>d(on)</sub>  | V <sub>DD</sub> =50V, I <sub>D</sub> =39A<br>V <sub>GS</sub> =10V, R <sub>G</sub> =4.7Ω | -   | 15   | -    | nS   |
| Turn-on Rise Time                  | t <sub>r</sub>      |                                                                                         | -   | 10   | -    | nS   |
| Turn-Off Delay Time                | t <sub>d(off)</sub> |                                                                                         | -   | 41   | -    | nS   |
| Turn-Off Fall Time                 | t <sub>f</sub>      |                                                                                         | -   | 6    | -    | nS   |
| Total Gate Charge                  | Q <sub>g</sub>      | V <sub>DS</sub> =50V, I <sub>p</sub> =39A,<br>V <sub>GS</sub> =10V                      | -   | 65   |      | nC   |
| Gate-Source Charge                 | Q <sub>gs</sub>     |                                                                                         | -   | 15.3 |      | nC   |
| Gate-Drain Charge                  | Q <sub>gd</sub>     |                                                                                         | -   | 9    |      | nC   |
| Drain-Source Diode Characteristics |                     |                                                                                         |     |      |      |      |
| Diode Forward Voltage (Note 3)     | V <sub>SD</sub>     | V <sub>GS</sub> =0V, I <sub>S</sub> =90A                                                | -   |      | 1.2  | V    |
| Diode Forward Current (Note 2)     | 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 (Note3)       | -   | 101  |      | nS   |
| Reverse Recovery Charge            | Q <sub>rr</sub>     |                                                                                         | -   | 193  |      | nC   |

## Notes:

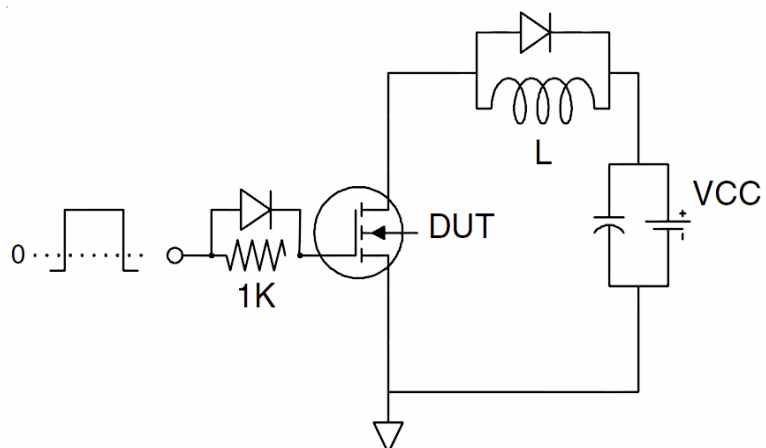
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5. EAS condition :  $T_J=25^{\circ}\text{C}, V_{DD}=50V,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

## Test Circuit

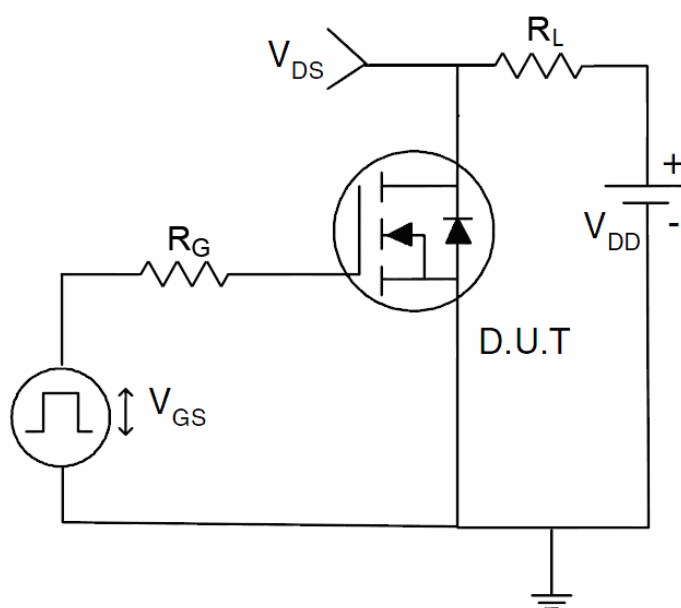
### 1) $E_{AS}$ test Circuit



### 2) Gate charge test Circuit



### 3) Switch Time Test Circuit



## Typical Electrical and Thermal Characteristics

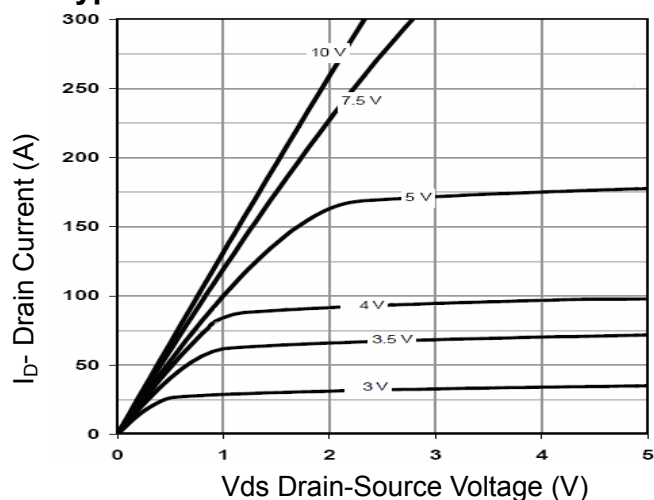


Figure 1 Output Characteristics

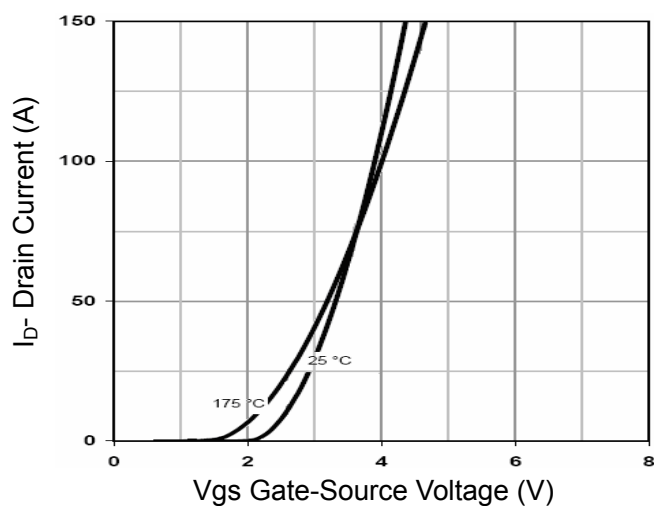


Figure 2 Transfer Characteristics

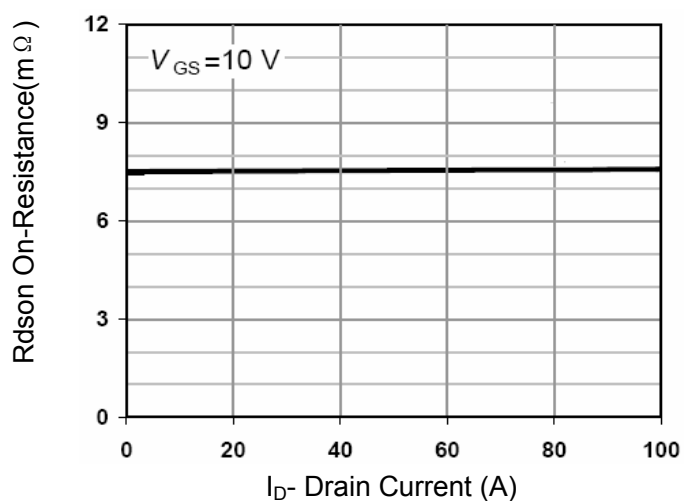


Figure 3  $R_{DS(on)}$ - Drain Current

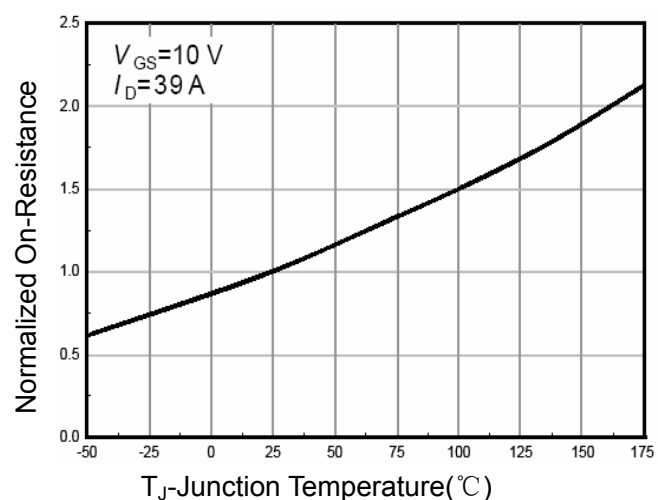


Figure 4  $R_{DS(on)}$ -Junction Temperature

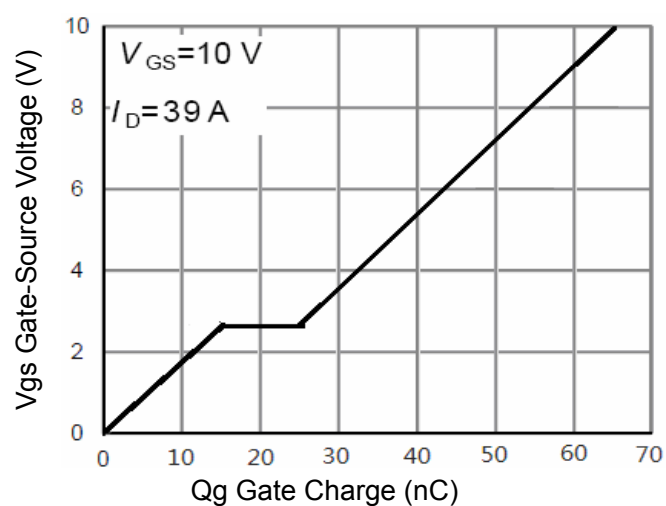


Figure 5 Gate Charge

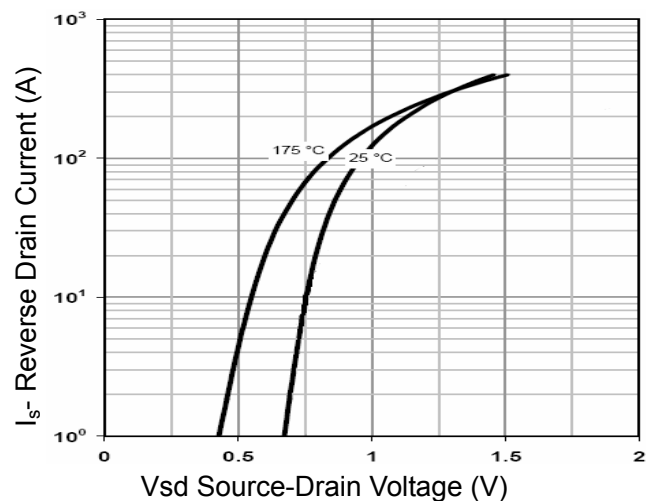


Figure 6 Source- Drain Diode Forward

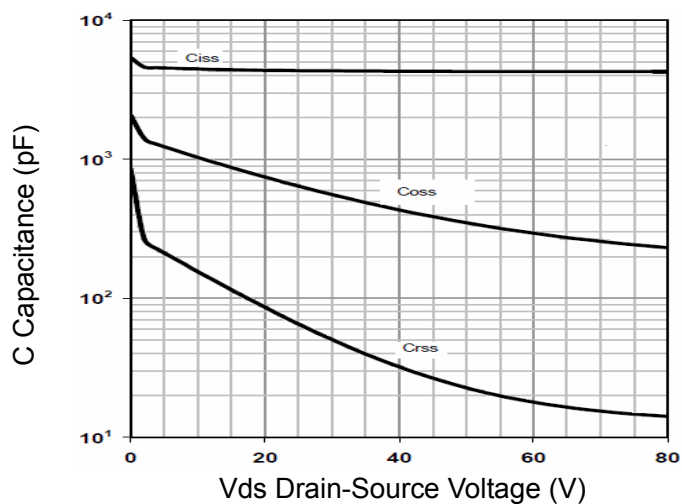


Figure 7 Capacitance vs  $V_{ds}$

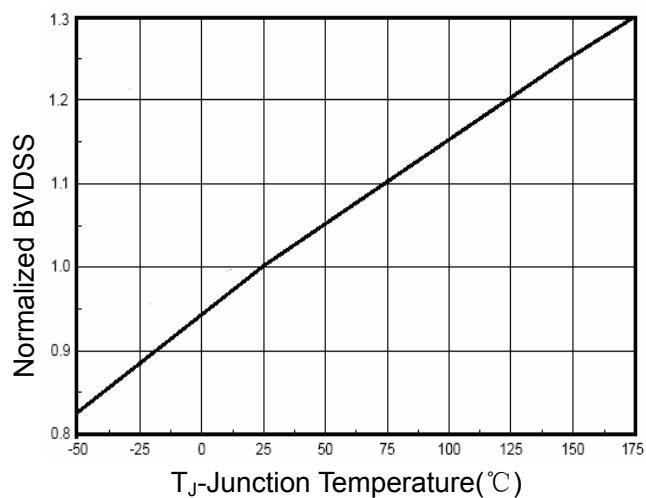


Figure 9  $BV_{DSS}$  vs Junction Temperature

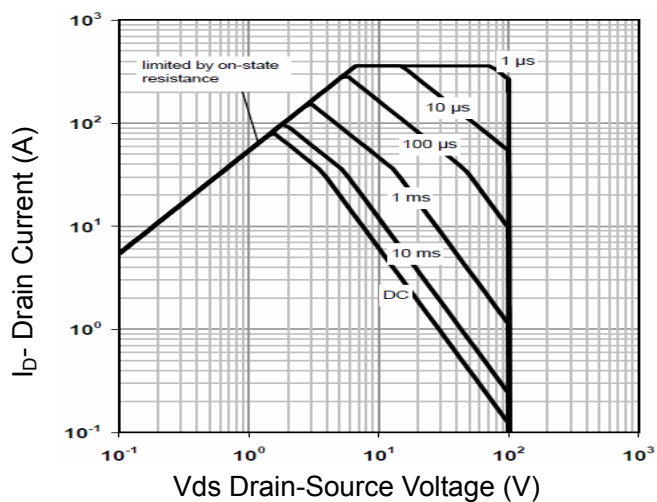


Figure 8 Safe Operation Area

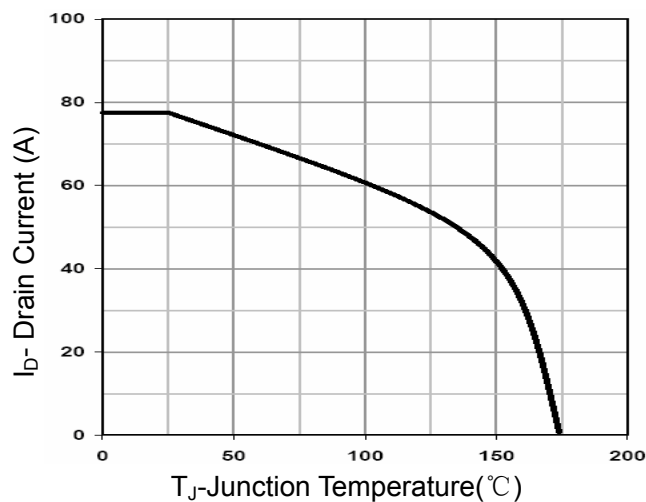


Figure 10 Current De-rating

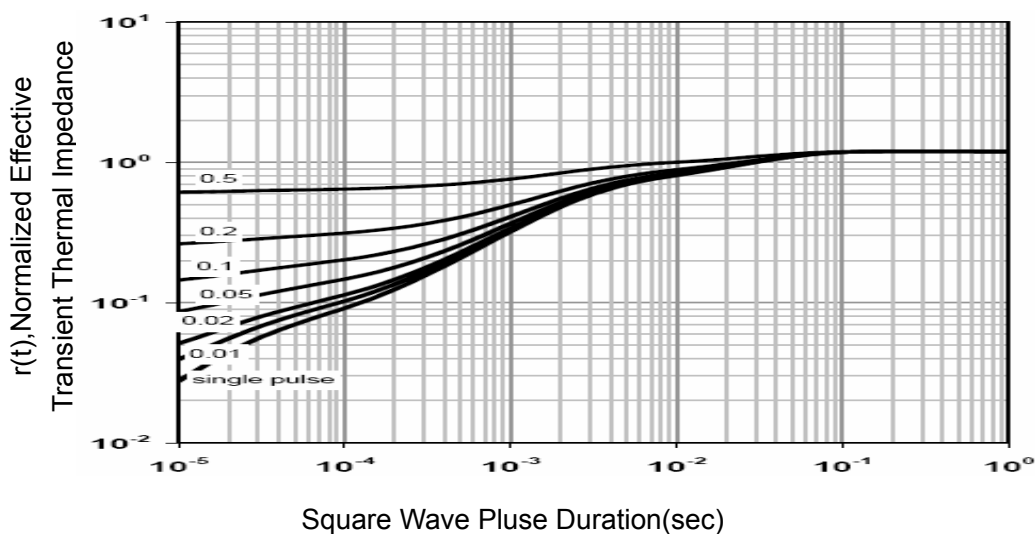
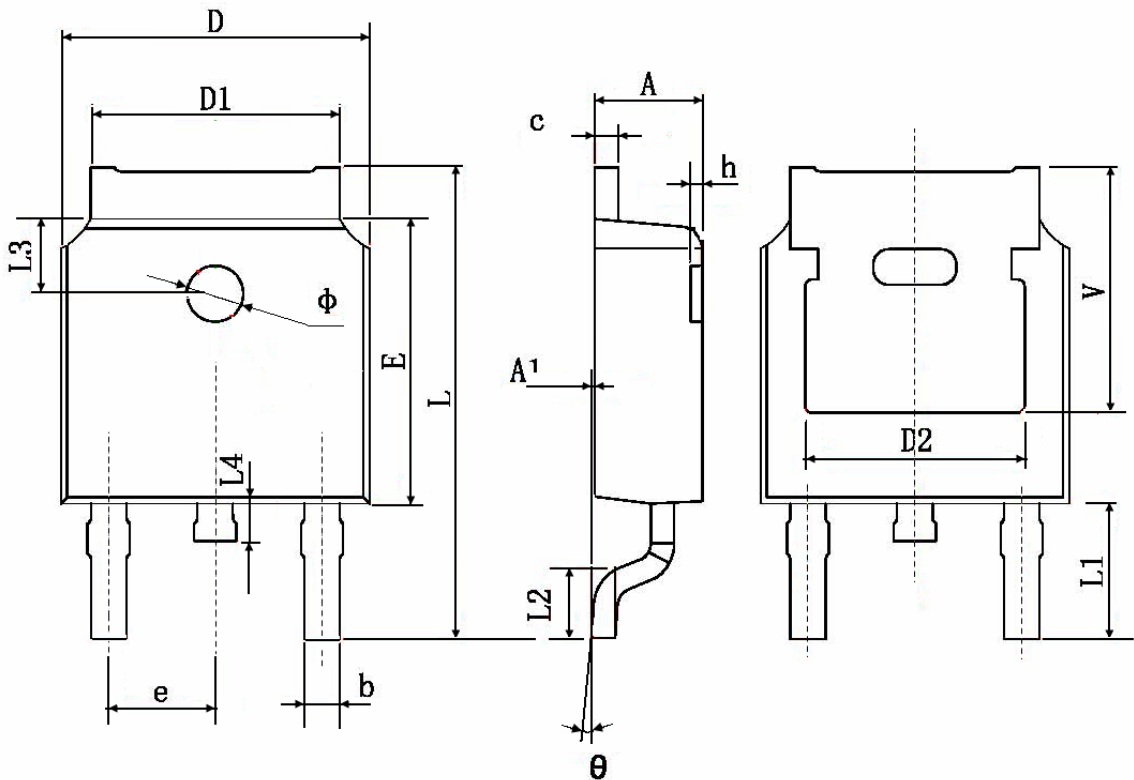


Figure 11 Normalized Maximum Transient Thermal Impedance

TO-252 Package Information



| Symbol   | Dimensions In Millimeters |        | Dimensions In Inches |       |
|----------|---------------------------|--------|----------------------|-------|
|          | Min.                      | Max.   | Min.                 | Max.  |
| A        | 2.200                     | 2.400  | 0.087                | 0.094 |
| A1       | 0.000                     | 0.127  | 0.000                | 0.005 |
| b        | 0.660                     | 0.860  | 0.026                | 0.034 |
| c        | 0.460                     | 0.580  | 0.018                | 0.023 |
| D        | 6.500                     | 6.700  | 0.256                | 0.264 |
| D1       | 5.100                     | 5.460  | 0.201                | 0.215 |
| D2       | 4.830 TYP.                |        | 0.190 TYP.           |       |
| E        | 6.000                     | 6.200  | 0.236                | 0.244 |
| e        | 2.186                     | 2.386  | 0.086                | 0.094 |
| L        | 9.800                     | 10.400 | 0.386                | 0.409 |
| L1       | 2.900 TYP.                |        | 0.114 TYP.           |       |
| L2       | 1.400                     | 1.700  | 0.055                | 0.067 |
| L3       | 1.600 TYP.                |        | 0.063 TYP.           |       |
| L4       | 0.600                     | 1.000  | 0.024                | 0.039 |
| $\Phi$   | 1.100                     | 1.300  | 0.043                | 0.051 |
| $\theta$ | 0°                        | 8°     | 0°                   | 8°    |
| h        | 0.000                     | 0.300  | 0.000                | 0.012 |
| V        | 5.350 TYP.                |        | 0.211 TYP.           |       |