

## N-Channel Super Trench Power MOSFET

### Description

The HMS65N15KA 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

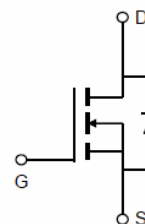
- $V_{DS} = 150V, I_D = 65A$   
 $R_{DS(ON)} = 15.5m\Omega$  (Typ) @  $V_{GS} = 10V$   
 $R_{DS(ON)} = 17.5m\Omega$  (Typ) @  $V_{GS} = 4.5V$
- Excellent gate charge x  $R_{DS(on)}$  product(FOM)
- Very low on-resistance  $R_{DS(on)}$
- 175 °C operating temperature
- Pb-free lead plating
- 100% UIS tested

### Application

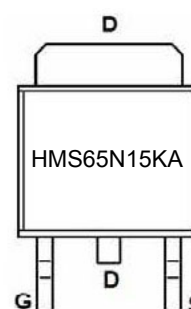
- DC/DC Converter
- Ideal for high-frequency switching and synchronous rectification

**100% UIS TESTED!**

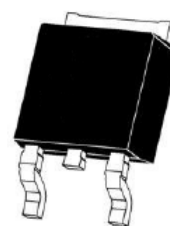
**100%  $\Delta V_{ds}$  TESTED!**



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 |
|----------------|------------|----------------|-----------|------------|----------|
| HMS65N15KA     | HMS65N15KA | TO-252-2L      | -         | -          | -        |

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

| Parameter                                             | Symbol                   | Limit      | Unit                |
|-------------------------------------------------------|--------------------------|------------|---------------------|
| Drain-Source Voltage                                  | $V_{DS}$                 | 150        | V                   |
| Gate-Source Voltage                                   | $V_{GS}$                 | $\pm 20$   | V                   |
| Drain Current-Continuous                              | $I_D$                    | 65         | A                   |
| Drain Current-Continuous( $T_C = 100^\circ\text{C}$ ) | $I_D(100^\circ\text{C})$ | 45.5       | A                   |
| Pulsed Drain Current                                  | $I_{DM}$                 | 195        | A                   |
| Maximum Power Dissipation                             | $P_D$                    | 300        | W                   |
| Derating factor                                       |                          | 2          | W/ $^\circ\text{C}$ |
| Single pulse avalanche energy <sup>(Note 5)</sup>     | $E_{AS}$                 | 1296       | 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> | $R_{\theta JC}$ | 0.5 | $^{\circ}\text{C/W}$ |
|----------------------------------------------------------|-----------------|-----|----------------------|

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

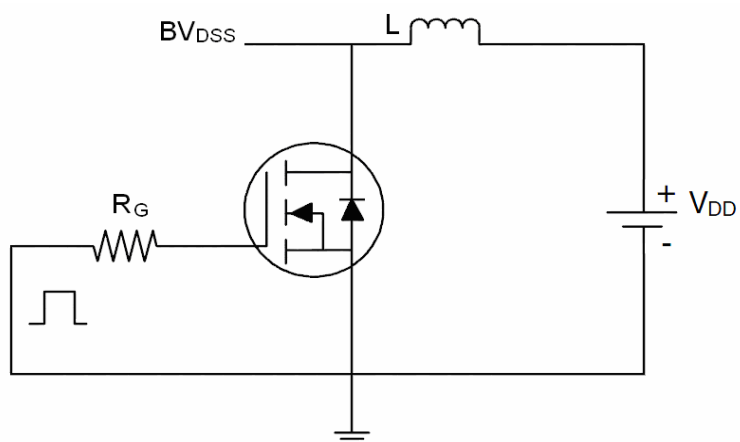
| Parameter                                     | Symbol              | Condition                                                                               | Min | Typ   | Max  | Unit |
|-----------------------------------------------|---------------------|-----------------------------------------------------------------------------------------|-----|-------|------|------|
| Off Characteristics                           |                     |                                                                                         |     |       |      |      |
| Drain-Source Breakdown Voltage                | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =250μA                                               | 150 | -     | -    | V    |
| Zero Gate Voltage Drain Current               | I <sub>DSS</sub>    | V <sub>DS</sub> =150V, 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                                | 1.5 | 1.9   | 2.5  | V    |
| Drain-Source On-State Resistance              | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =55A                                               | -   | 15.5  | 19   | mΩ   |
|                                               |                     | V <sub>GS</sub> =4.5V, I <sub>D</sub> =55A                                              | -   | 17.5  | 23   | mΩ   |
| Forward Transconductance                      | g <sub>FS</sub>     | V <sub>DS</sub> =10V, I <sub>D</sub> =55A                                               | 70  | -     | -    | S    |
| Dynamic Characteristics <sup>(Note4)</sup>    |                     |                                                                                         |     |       |      |      |
| Input Capacitance                             | C <sub>iss</sub>    | V <sub>DS</sub> =75V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                  | -   | 10000 | -    | PF   |
| Output Capacitance                            | C <sub>oss</sub>    |                                                                                         | -   | 2046  | -    | PF   |
| Reverse Transfer Capacitance                  | C <sub>rss</sub>    |                                                                                         | -   | 55    | -    | PF   |
| Switching Characteristics <sup>(Note 4)</sup> |                     |                                                                                         |     |       |      |      |
| Turn-on Delay Time                            | t <sub>d(on)</sub>  | V <sub>DD</sub> =75V, I <sub>D</sub> =55A<br>V <sub>GS</sub> =10V, R <sub>G</sub> =4.7Ω | -   | 30    | -    | nS   |
| Turn-on Rise Time                             | t <sub>r</sub>      |                                                                                         | -   | 52    | -    | nS   |
| Turn-Off Delay Time                           | t <sub>d(off)</sub> |                                                                                         | -   | 69    | -    | nS   |
| Turn-Off Fall Time                            | t <sub>f</sub>      |                                                                                         | -   | 21    | -    | nS   |
| Total Gate Charge                             | Q <sub>g</sub>      | V <sub>DS</sub> =75V, I <sub>D</sub> =55A,<br>V <sub>GS</sub> =10V                      | -   | 150   |      | nC   |
| Gate-Source Charge                            | Q <sub>gs</sub>     |                                                                                         | -   | 50    |      | nC   |
| Gate-Drain Charge                             | Q <sub>gd</sub>     |                                                                                         | -   | 26    |      | nC   |
| Drain-Source Diode Characteristics            |                     |                                                                                         |     |       |      |      |
| Diode Forward Voltage <sup>(Note 3)</sup>     | V <sub>SD</sub>     | V <sub>GS</sub> =0V, I <sub>F</sub> = I <sub>S</sub>                                    | -   |       | 1.2  | V    |
| Diode Forward Current <sup>(Note 2)</sup>     | I <sub>S</sub>      |                                                                                         | -   | -     | 65   | A    |
| Reverse Recovery Time                         | t <sub>rr</sub>     | T <sub>J</sub> = 25°C, I <sub>F</sub> = I <sub>S</sub>                                  | -   | 140   |      | nS   |
| Reverse Recovery Charge                       | Q <sub>rr</sub>     | di/dt = 100A/μs <sup>(Note3)</sup>                                                      | -   | 498   |      | nC   |

## Notes:

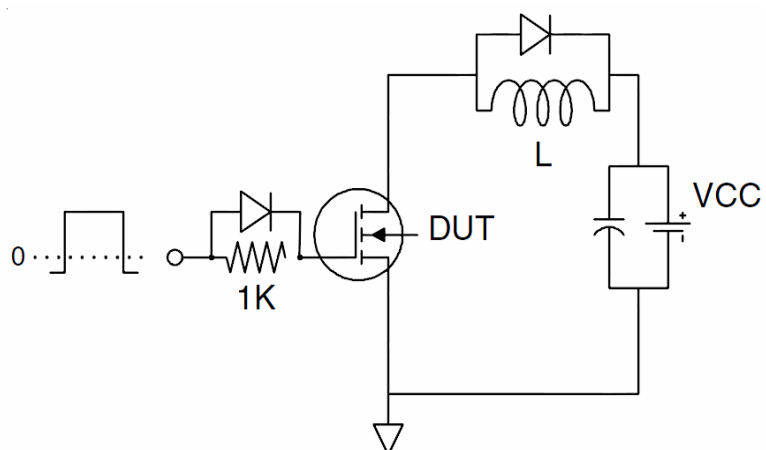
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5. EAS condition :  $T_J=25^{\circ}\text{C}, V_{DD}=50V,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

## Test Circuit

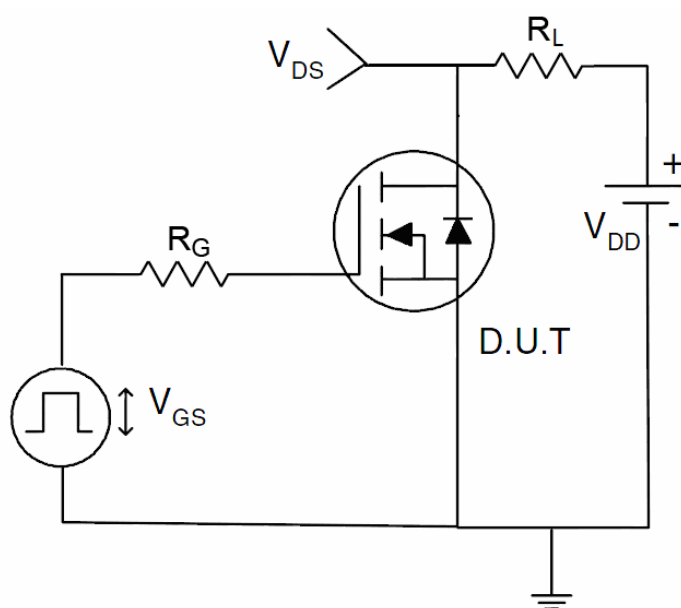
### 1) $E_{AS}$ test Circuit



### 2) Gate charge test Circuit



### 3) Switch Time Test Circuit



Typical Electrical and Thermal Characteristics

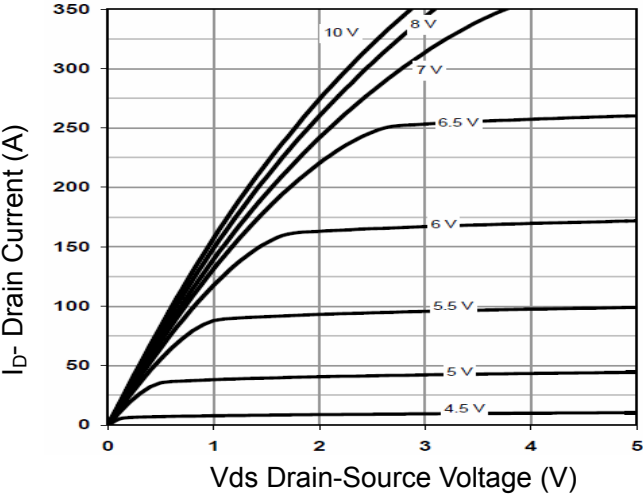


Figure 1 Output Characteristics

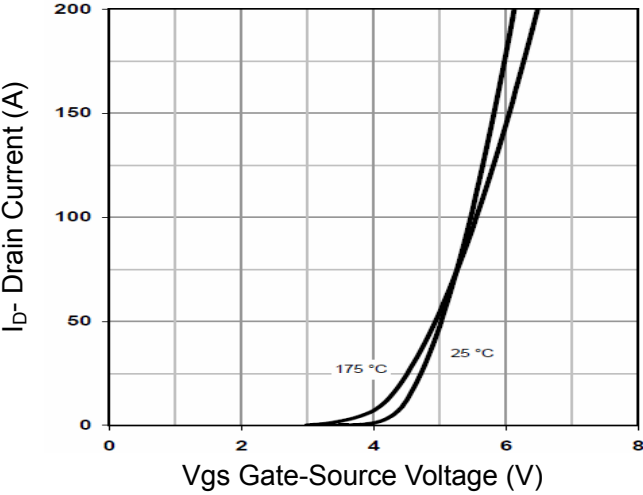


Figure 2 Transfer Characteristics

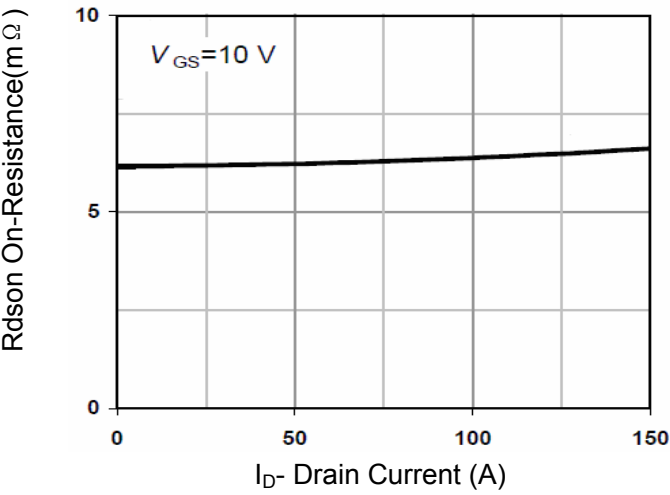


Figure 3  $R_{DS(on)}$ - Drain Current

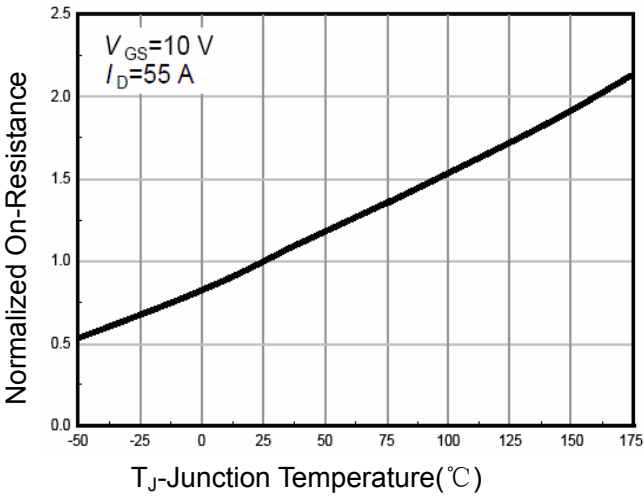


Figure 4  $R_{DS(on)}$ -Junction Temperature

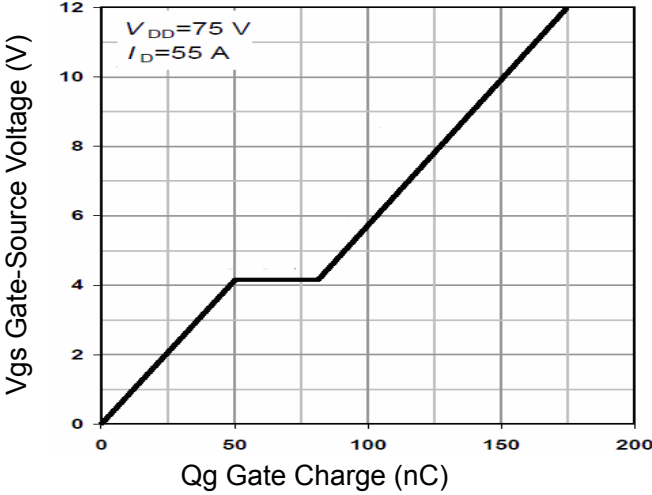


Figure 5 Gate Charge

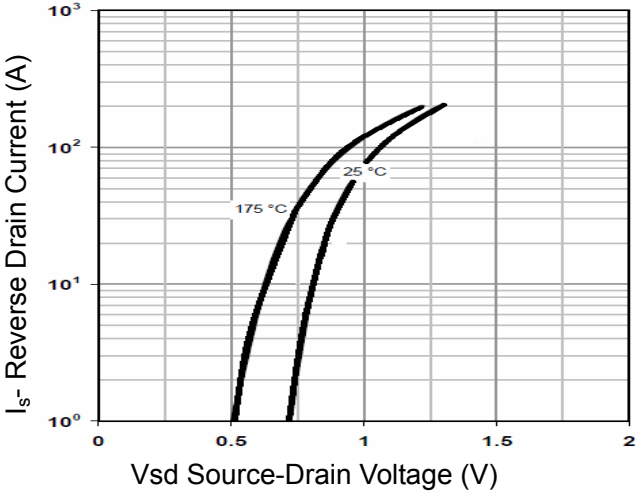


Figure 6 Source- Drain Diode Forward

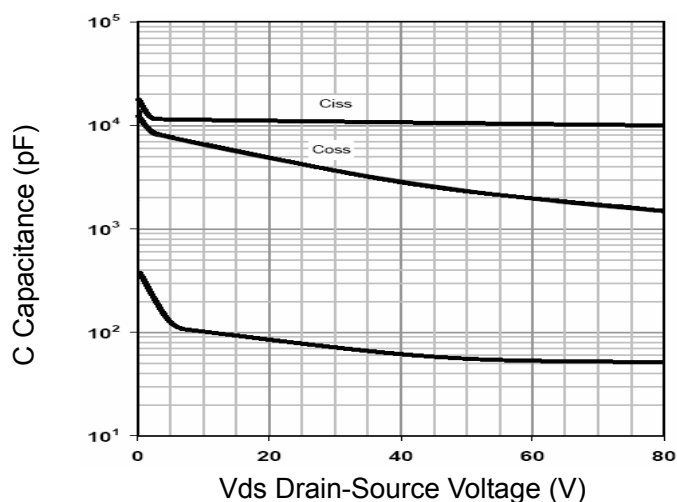


Figure 7 Capacitance vs Vds

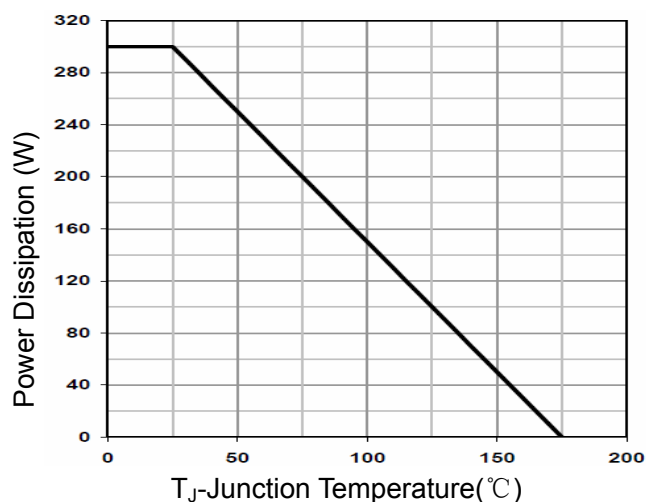


Figure 9 Power De-rating

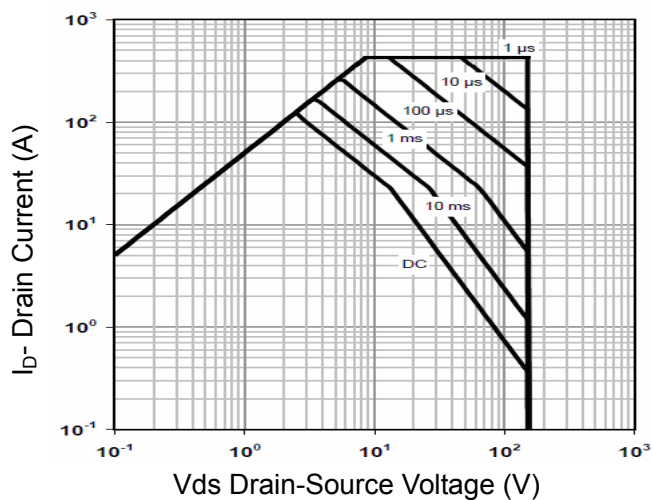


Figure 8 Safe Operation Area

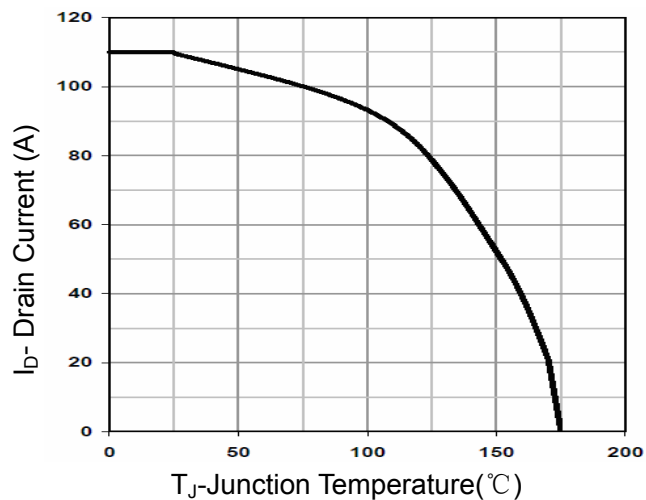


Figure 10 Current De-rating

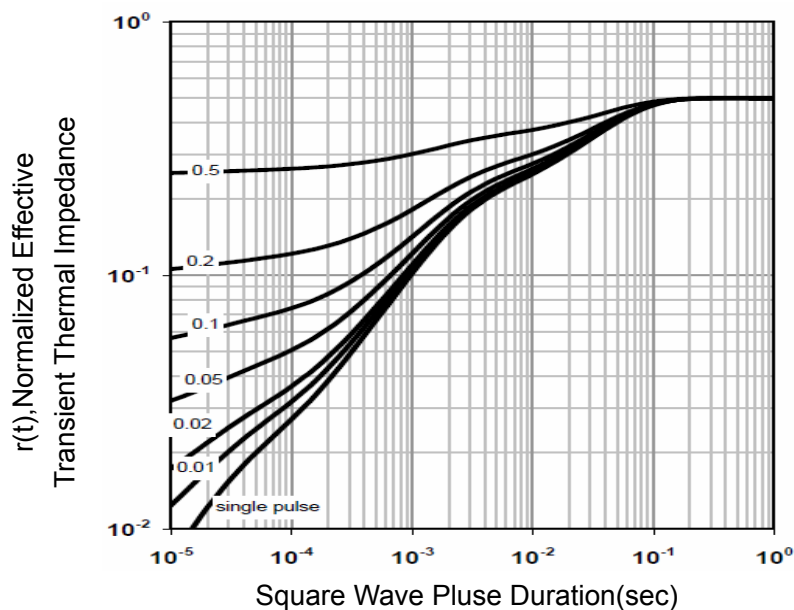
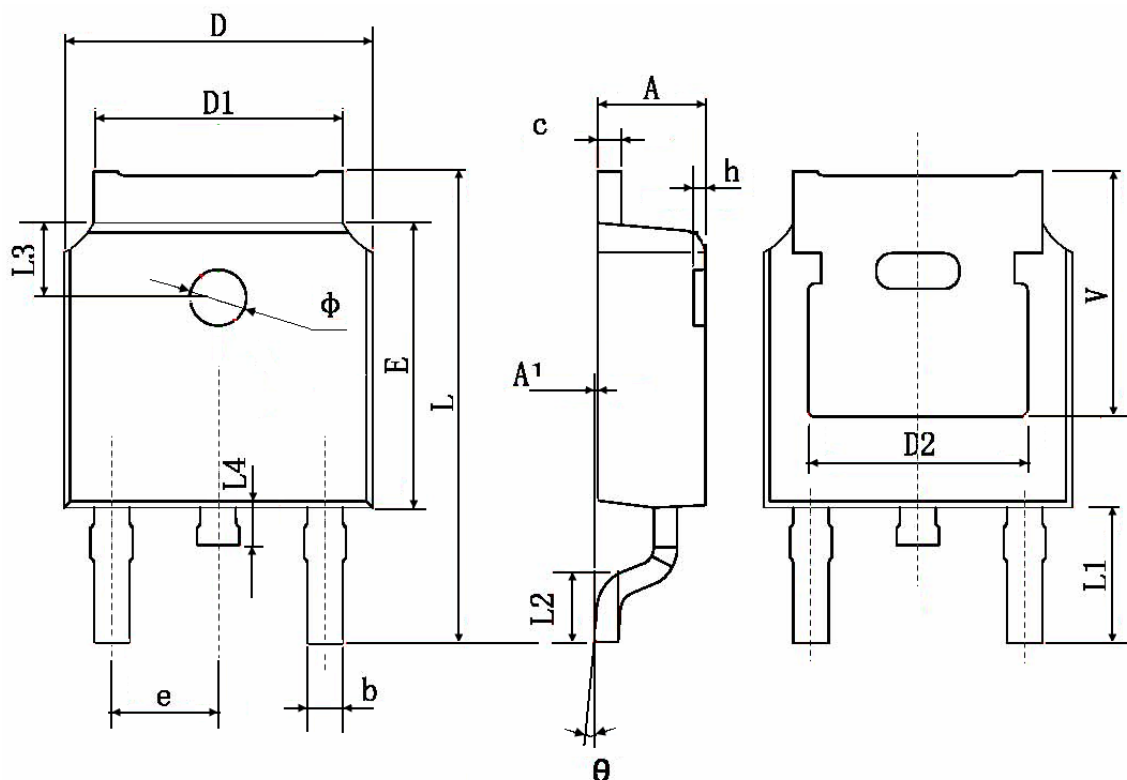


Figure 11 Normalized Maximum Transient Thermal Impedance

TO-252 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.           |       |

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