

## FNK N-Channel Enhancement Mode Power MOSFET

### Description

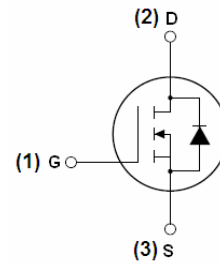
The FNK60N60D uses advanced trench technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. It can be used in a wide variety of applications.

### General Features

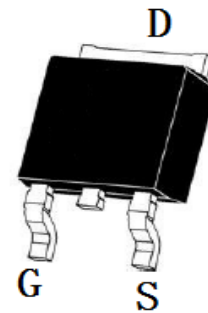
- $V_{DS} = 60V, I_D = 60A$   
 $R_{DS(ON)} < 11m\Omega @ V_{GS}=10V$  (Typ: 8.0m $\Omega$ )
- Special process technology for high ESD capability
- High density cell design for ultra low  $R_{DS(ON)}$
- Fully characterized avalanche voltage and current
- Good stability and uniformity with high  $E_{AS}$
- Excellent package for good heat dissipation

### Application

- Power switching application
- Hard switched and High frequency circuits
- Uninterruptible power supply



Schematic diagram



TO-252 top view

### Package Marking and Ordering Information

| Device Marking | Device    | Device Package | Reel Size | Tape width | Quantity |
|----------------|-----------|----------------|-----------|------------|----------|
| FNK60N60D      | FNK60N60D | TO-252         | -         | -          | -        |

### 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                       | $I_D$               | 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                      | $P_D$               | 85       | W    |

| Derating factor                                   |                                   | 0.57       | W/°C |
|---------------------------------------------------|-----------------------------------|------------|------|
| Parameter                                         | Symbol                            | Limit      | Unit |
| Single pulse avalanche energy <sup>(Note 5)</sup> | E <sub>AS</sub>                   | 50         | mJ   |
| Operating Junction and Storage Temperature Range  | T <sub>J</sub> , T <sub>STG</sub> | -55 To 175 | °C   |

## Thermal Characteristic

|                                                          |                  |   |      |
|----------------------------------------------------------|------------------|---|------|
| Thermal Resistance, Junction-to-Case <sup>(Note 2)</sup> | R <sub>θJc</sub> | 2 | °C/W |
|----------------------------------------------------------|------------------|---|------|

## Electrical Characteristics (TC=25°C unless otherwise noted)

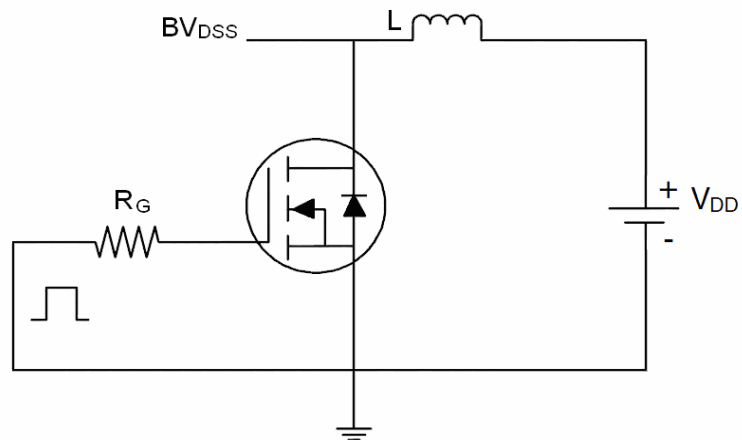
| Parameter                                     | Symbol              | Condition                                                                              | Min | Typ  | Max  | Unit |
|-----------------------------------------------|---------------------|----------------------------------------------------------------------------------------|-----|------|------|------|
| 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                               | 2   | 2.8  | 4    | V    |
| Drain-Source On-State Resistance              | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =30A                                              | -   | 8.0  | 11   | mΩ   |
| Forward Transconductance                      | g <sub>FS</sub>     | V <sub>DS</sub> =10V, I <sub>D</sub> =20A                                              | 20  | -    | -    | S    |
| Dynamic Characteristics <sup>(Note4)</sup>    |                     |                                                                                        |     |      |      |      |
| Input Capacitance                             | C <sub>iss</sub>    | V <sub>DS</sub> =25V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                 | -   | 2040 | -    | PF   |
| Output Capacitance                            | C <sub>oss</sub>    |                                                                                        | -   | 240  | -    | PF   |
| Reverse Transfer Capacitance                  | C <sub>rss</sub>    |                                                                                        | -   | 165  | -    | 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> =1Ω<br>V <sub>GS</sub> =10V, R <sub>GEN</sub> =3Ω | -   | 15   | -    | nS   |
| Turn-on Rise Time                             | t <sub>r</sub>      |                                                                                        | -   | 35   | -    | nS   |
| Turn-Off Delay Time                           | t <sub>d(off)</sub> |                                                                                        | -   | 44   | -    | nS   |
| Turn-Off Fall Time                            | t <sub>f</sub>      |                                                                                        | -   | 23   | -    | nS   |
| Total Gate Charge                             | Q <sub>g</sub>      | V <sub>DS</sub> =30V, I <sub>D</sub> =30A,<br>V <sub>GS</sub> =10V                     | -   | 45   | -    | nC   |
| Gate-Source Charge                            | Q <sub>gs</sub>     |                                                                                        | -   | 10   | -    | nC   |
| Gate-Drain Charge                             | Q <sub>gd</sub>     |                                                                                        | -   | 15   | -    | 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> =20A                                               | -   | -    | 1.2  | V    |
| Diode Forward Current <sup>(Note 2)</sup>     | I <sub>S</sub>      | -                                                                                      | -   | -    | 60   | A    |
| Reverse Recovery Time                         | t <sub>rr</sub>     | TJ = 25°C, IF =10A                                                                     | -   | 53   | -    | nS   |
| Reverse Recovery Charge                       | Q <sub>rr</sub>     | di/dt = 100A/μs <sup>(Note3)</sup>                                                     | -   | 51   | -    | nC   |

## Notes:

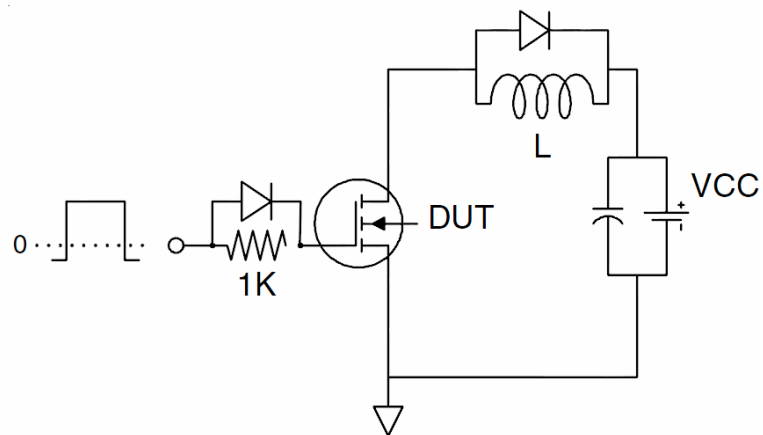
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board, t ≤ 10 sec.
3. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.
4. Guaranteed by design, not subject to production
5. E<sub>AS</sub> condition: T<sub>J</sub>=25°C, V<sub>DD</sub>=30V, V<sub>G</sub>=10V, L=0.5mH, R<sub>g</sub>=25Ω

## Test Circuit

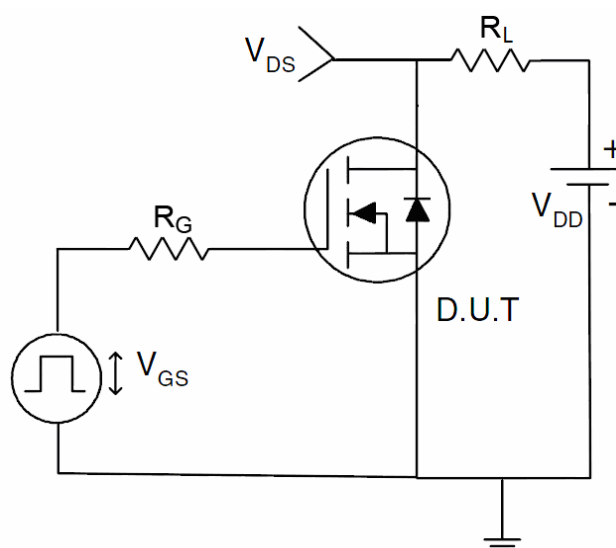
### 1) $E_{AS}$ test Circuit



### 2) Gate charge test Circuit



### 3) Switch Time Test Circuit



## Typical Electrical and Thermal Characteristics (Curves)

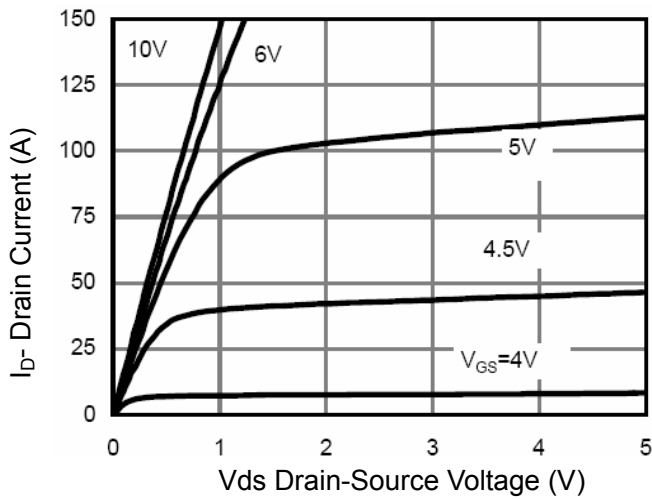


**Figure 1 Output Characteristics**

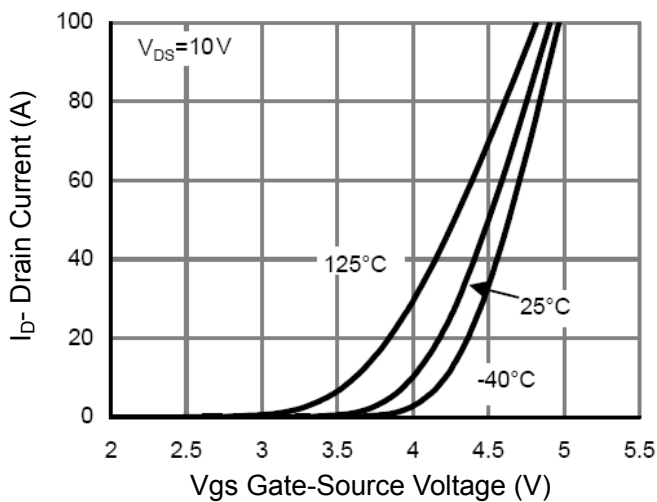


**Figure 2 Transfer Characteristics**

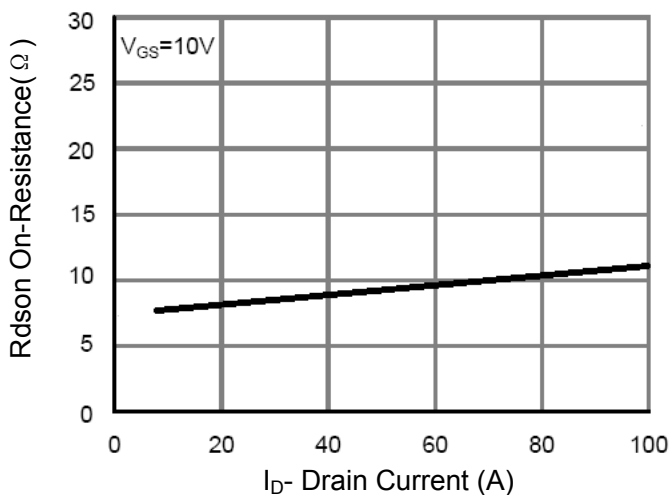


**Figure 3 Rdson- Drain Current**

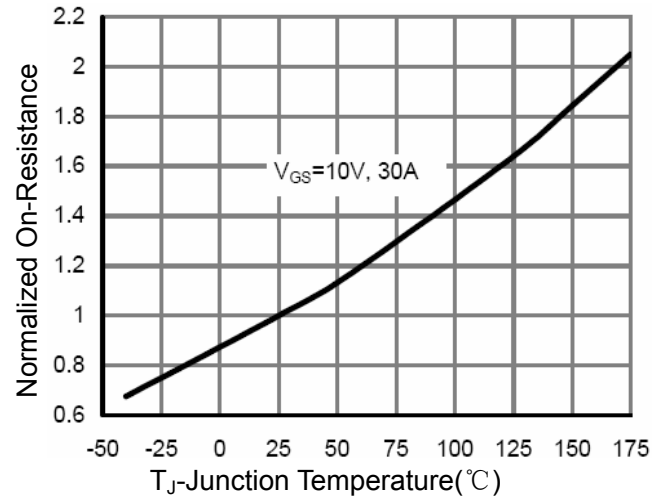


**Figure 4 Rdson-Junction Temperature**

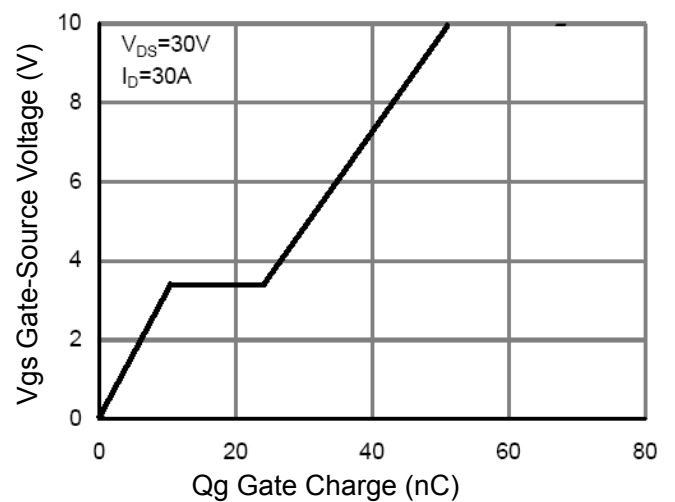


**Figure 5 Gate Charge**

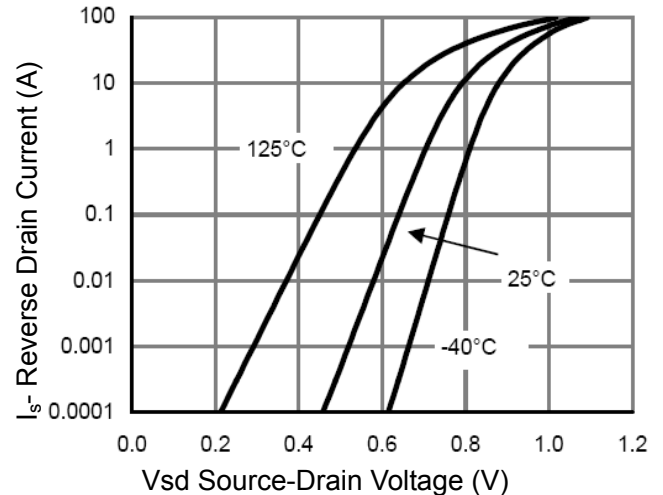


**Figure 6 Source- Drain Diode Forward**

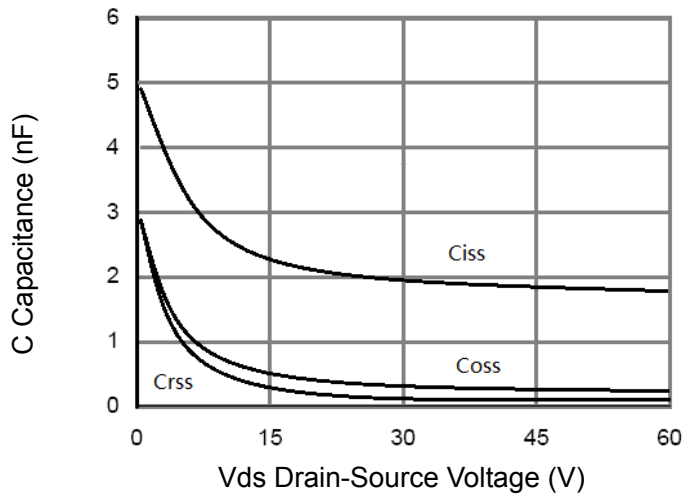


**Figure 7 Capacitance vs Vds**

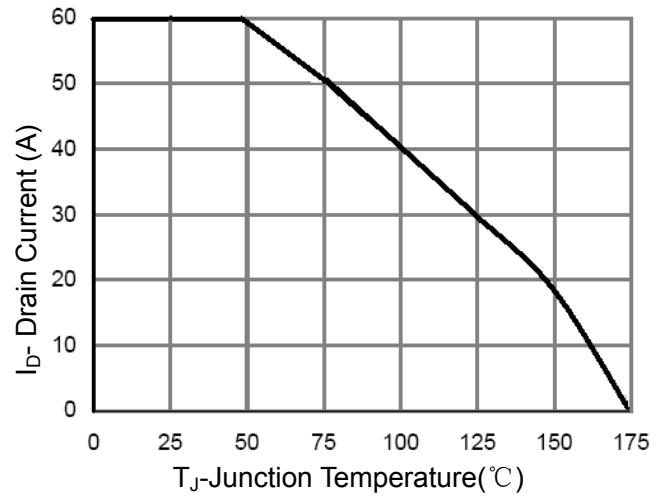


**Figure 9 I<sub>D</sub> De-rating**

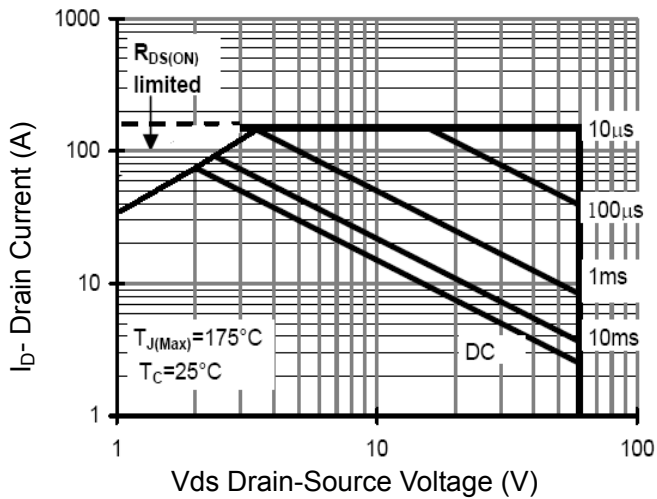


**Figure 8 Safe Operation Area**

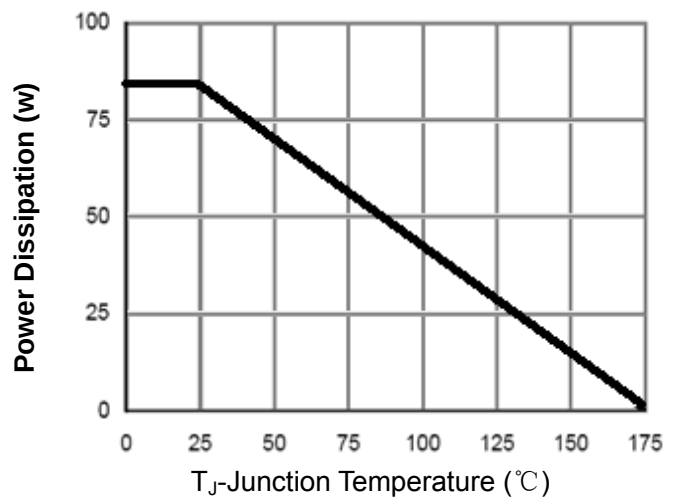


**Figure 10 Power De-rating**

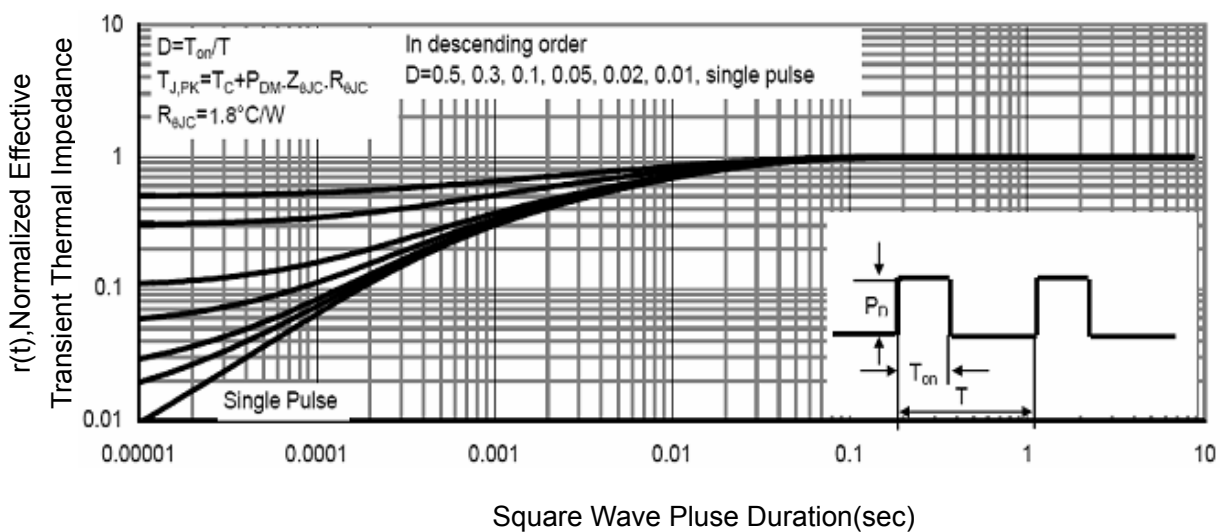
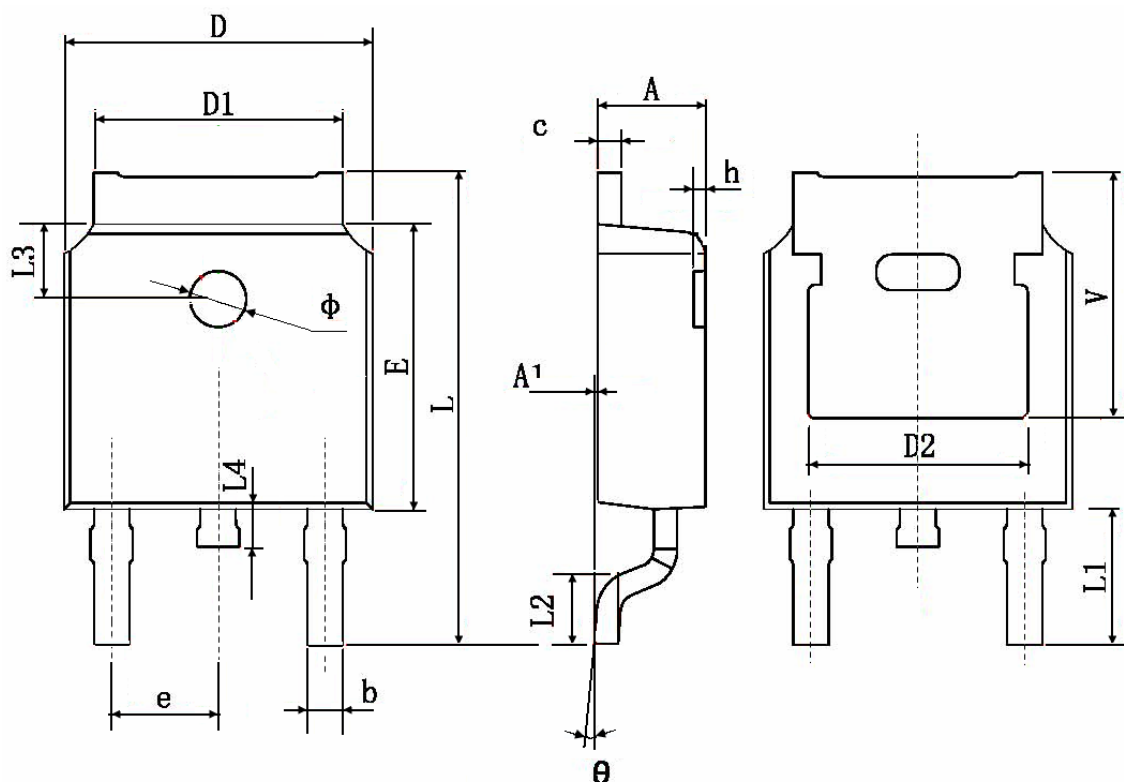


**Figure 11 Normalized Maximum Transient Thermal Impedance**

## 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 |
| Φ      | 1.100                     | 1.300  | 0.043                | 0.051 |
| θ      | 0°                        | 8°     | 0°                   | 8°    |
| h      | 0.000                     | 0.300  | 0.000                | 0.012 |
| V      | 5.350 TYP.                |        | 0.211 TYP.           |       |

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