

## NCE N-Channel Enhancement Mode Power MOSFET

### Description

The NCE4558K 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

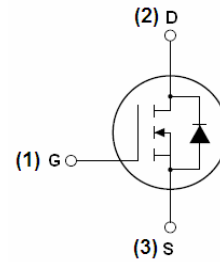
- $V_{DS} = 45V, I_D = 58A$   
 $R_{DS(ON)} < 12m\Omega @ V_{GS} = 10V$   
 $R_{DS(ON)} < 18m\Omega @ V_{GS} = 4.5V$
- High density cell design for ultra low  $R_{DS(ON)}$
- Fully characterized avalanche voltage and current
- Good stability and uniformity with high  $E_{AS}$
- Excellent package for good heat dissipation
- Special process technology for high ESD capability

### Application

- Load switching
- Hard switched and high frequency circuits
- Uninterruptible power supply

**100% UIS TESTED!**

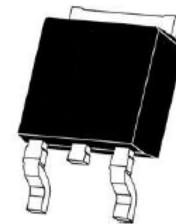
**100%  $\Delta V_{DS}$  TESTED!**



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 |
|----------------|----------|----------------|-----------|------------|----------|
| NCE4558K       | NCE4558K | TO-252-2L      | -         | -          | -        |

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

| Parameter                                         | Symbol              | Limit      | Unit          |
|---------------------------------------------------|---------------------|------------|---------------|
| Drain-Source Voltage                              | $V_{DS}$            | 45         | V             |
| Gate-Source Voltage                               | $V_{GS}$            | $\pm 20$   | V             |
| Drain Current-Continuous                          | $I_D$               | 58         | A             |
| Drain Current-Continuous( $T_C = 100^\circ C$ )   | $I_D (100^\circ C)$ | 41         | A             |
| Pulsed Drain Current                              | $I_{DM}$            | 200        | A             |
| Maximum Power Dissipation                         | $P_D$               | 65         | W             |
| Derating factor                                   |                     | 0.43       | W/ $^\circ C$ |
| Single pulse avalanche energy <sup>(Note 5)</sup> | $E_{AS}$            | 240        | 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> | $R_{\theta JC}$ | 2.3 | $^{\circ}\text{C/W}$ |
|----------------------------------------------------------|-----------------|-----|----------------------|

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

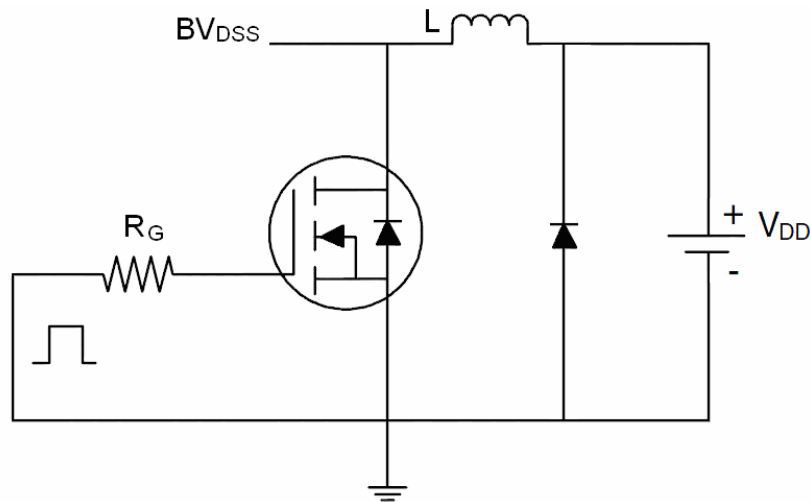
| Parameter                                     | Symbol              | Condition                                                                             | Min | Typ  | Max  | Unit |
|-----------------------------------------------|---------------------|---------------------------------------------------------------------------------------|-----|------|------|------|
| Off Characteristics                           |                     |                                                                                       |     |      |      |      |
| Drain-Source Breakdown Voltage                | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =250μA                                             | 45  | -    | -    | V    |
| Zero Gate Voltage Drain Current               | I <sub>DSS</sub>    | V <sub>DS</sub> =45V, 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 | 1.9  | 2.5  | V    |
| Drain-Source On-State Resistance              | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =20A                                             | -   | 8.0  | 10   | mΩ   |
|                                               |                     | V <sub>GS</sub> =4.5V, I <sub>D</sub> =15A                                            |     | 11.6 | 18   |      |
| Forward Transconductance                      | g <sub>FS</sub>     | V <sub>DS</sub> =5V, I <sub>D</sub> =20A                                              | 20  | -    | -    | S    |
| Dynamic Characteristics <sup>(Note4)</sup>    |                     |                                                                                       |     |      |      |      |
| Input Capacitance                             | C <sub>Iss</sub>    | V <sub>DS</sub> =20V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                | -   | 1800 | -    | PF   |
| Output Capacitance                            | C <sub>OSS</sub>    |                                                                                       | -   | 182  | -    | PF   |
| Reverse Transfer Capacitance                  | C <sub>rSS</sub>    |                                                                                       | -   | 138  | -    | PF   |
| Switching Characteristics <sup>(Note 4)</sup> |                     |                                                                                       |     |      |      |      |
| Turn-on Delay Time                            | t <sub>d(on)</sub>  | V <sub>DD</sub> =20V,, R <sub>L</sub> =1Ω<br>V <sub>GS</sub> =10V, R <sub>G</sub> =3Ω | -   | 6.4  | -    | nS   |
| Turn-on Rise Time                             | t <sub>r</sub>      |                                                                                       | -   | 17.2 | -    | nS   |
| Turn-Off Delay Time                           | t <sub>d(off)</sub> |                                                                                       | -   | 29.6 | -    | nS   |
| Turn-Off Fall Time                            | t <sub>f</sub>      |                                                                                       | -   | 16.8 | -    | nS   |
| Total Gate Charge                             | Q <sub>g</sub>      | V <sub>DS</sub> =20V, I <sub>D</sub> =20A,<br>V <sub>GS</sub> =10V                    | -   | 36.8 |      | nC   |
| Gate-Source Charge                            | Q <sub>gs</sub>     |                                                                                       | -   | 4.8  |      | nC   |
| Gate-Drain Charge                             | Q <sub>gd</sub>     |                                                                                       | -   | 11.2 |      | 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> =10A                                              | -   |      | 1.2  | V    |
| Diode Forward Current <sup>(Note 2)</sup>     | I <sub>S</sub>      |                                                                                       | -   | -    | 58   | A    |
| Reverse Recovery Time                         | t <sub>rr</sub>     | T <sub>J</sub> = 25°C, I <sub>F</sub> = 20A<br>di/dt = 100A/μs <sup>(Note3)</sup>     | -   | 29   | -    | nS   |
| Reverse Recovery Charge                       | Q <sub>rr</sub>     |                                                                                       | -   | 26   | -    | nC   |

### Notes:

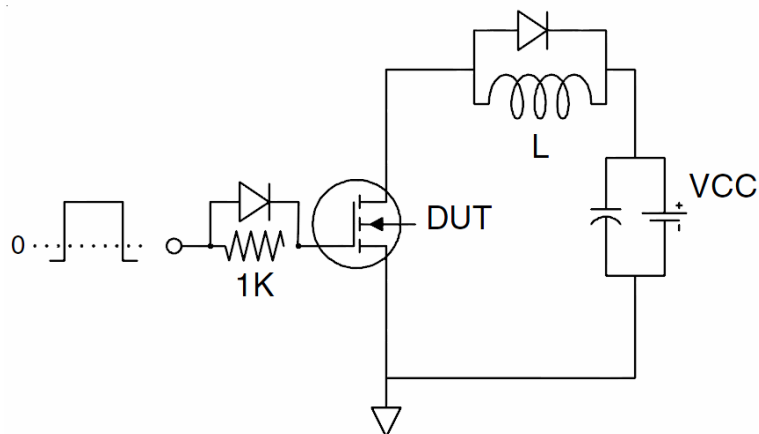
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5.  $E_{AS}$  condition :  $T_J=25^{\circ}\text{C}, V_{DD}=20V, V_G=10V, L=0.5mH, R_g=25\Omega$ ,

## Test circuit

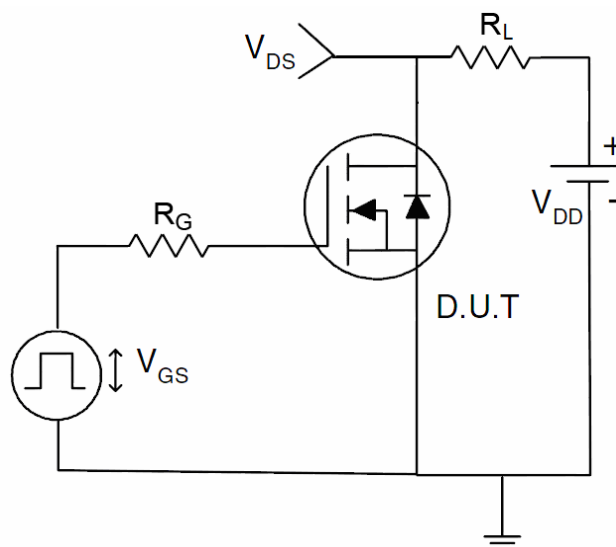
### 1) $E_{AS}$ Test Circuit



### 2) Gate Charge Test Circuit



### 3) Switch Time Test Circuit



## Typical Electrical and Thermal Characteristics (Curves)

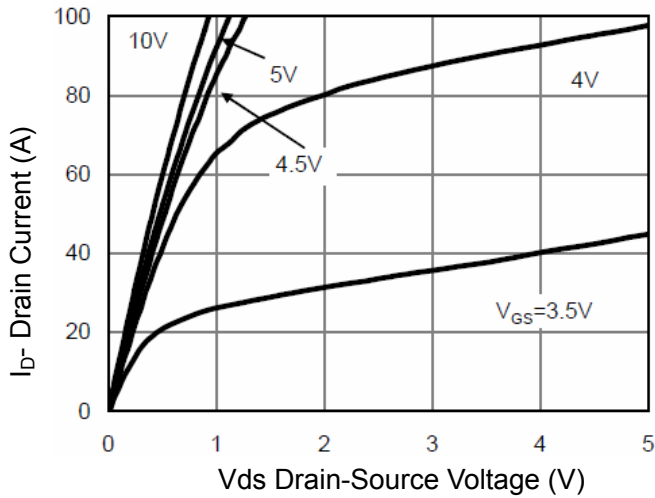


Figure 1 Output Characteristics

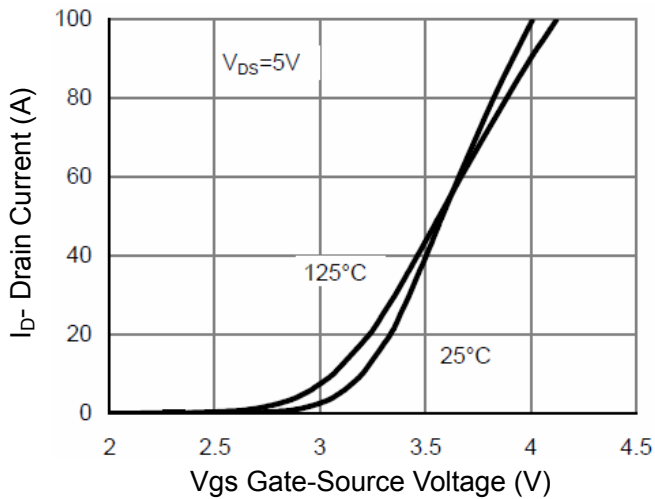


Figure 2 Transfer Characteristics

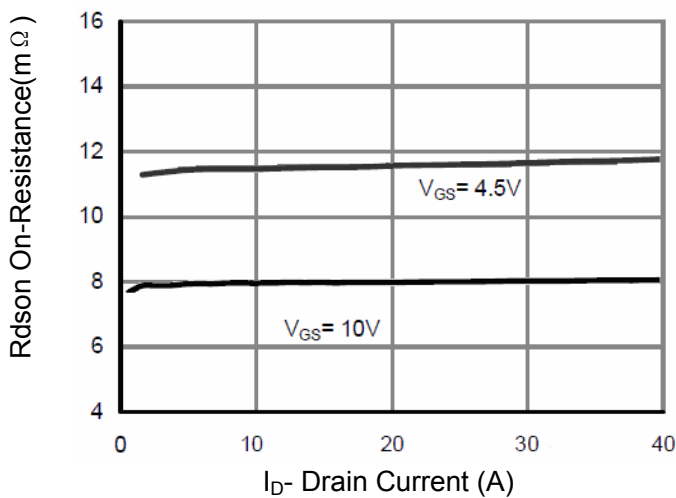


Figure 3  $R_{DS(on)}$ - Drain Current

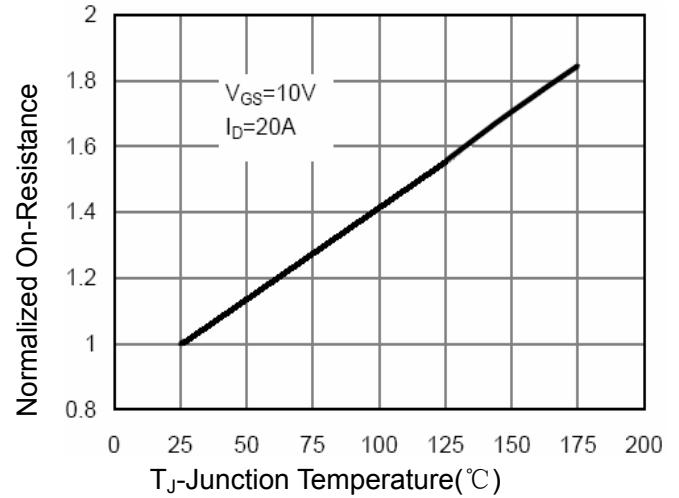


Figure 4  $R_{DS(on)}$ -Junction Temperature

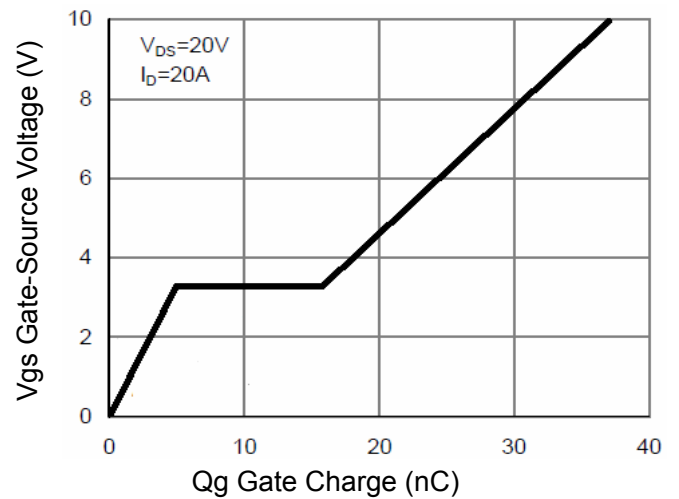


Figure 5 Gate Charge

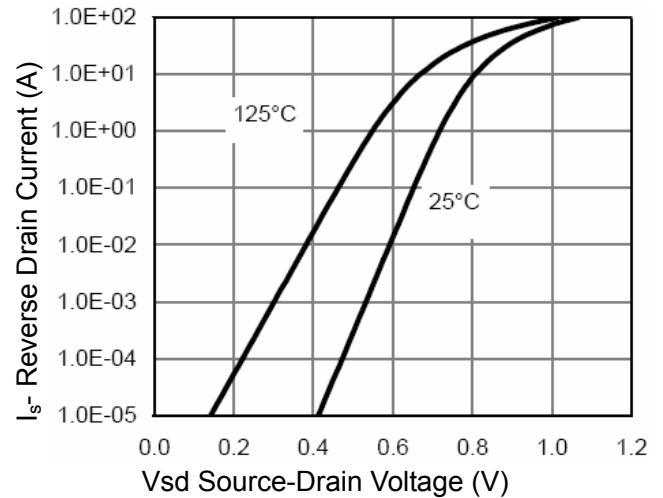


Figure 6 Source- Drain Diode Forward

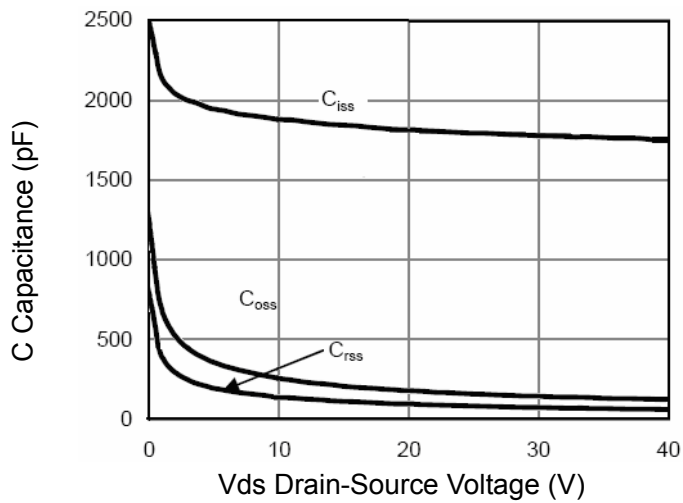


Figure 7 Capacitance vs Vds

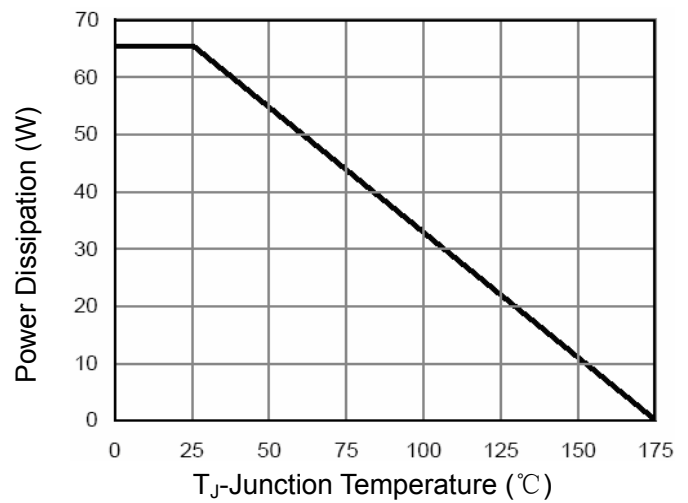


Figure 9 Power De-rating

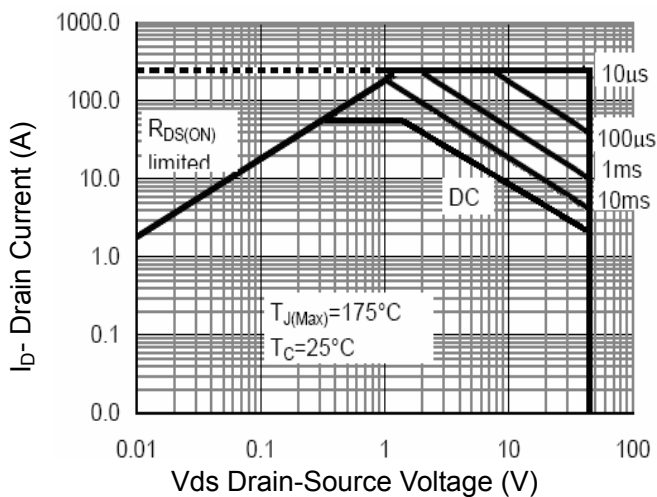


Figure 8 Safe Operation Area

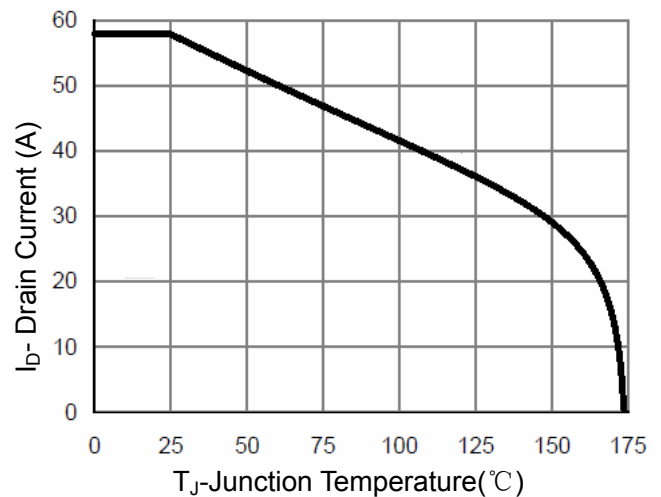


Figure 10 Current De-rating

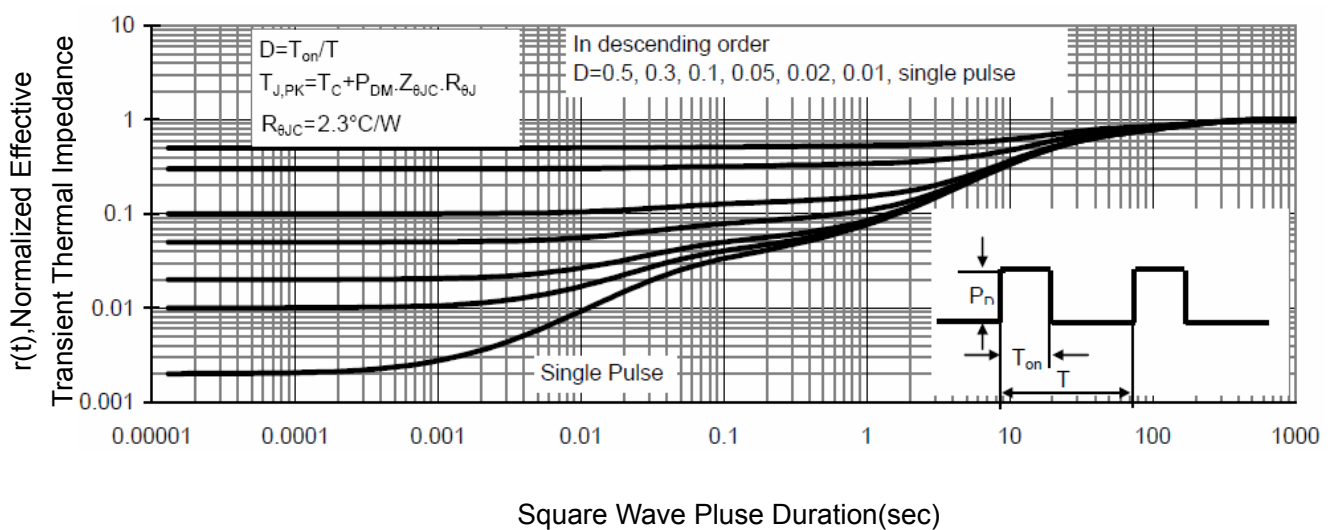
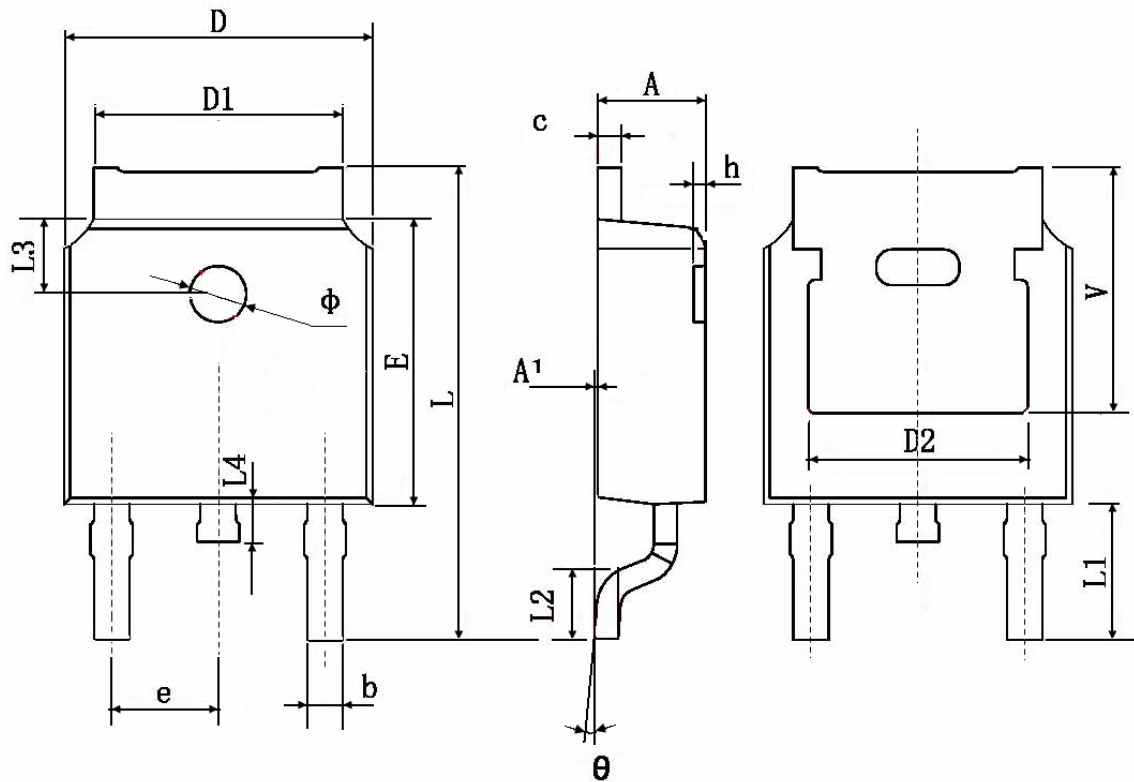


Figure 11 Normalized Maximum Transient Thermal Impedance

## 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 |
| 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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