

## NCE P-Channel Enhancement Mode Power MOSFET

### Description

The NCE60P45AK 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.

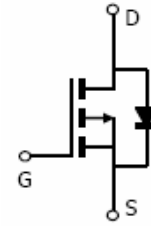
### General Features

- $V_{DS} = -60V, I_D = -45A$   
 $R_{DS(ON)} < 35m\Omega @ V_{GS} = -10V$   
 $R_{DS(ON)} < 50m\Omega @ V_{GS} = -4.5V$
- 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

### Application

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

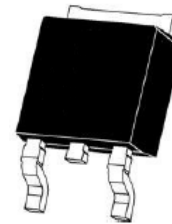
**100% UIS TESTED!**



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 |
|----------------|------------|----------------|-----------|------------|----------|
| NCE60P45AK     | NCE60P45AK | TO-252-2L      | -         | -          | -        |

### 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                          | $I_D$              | -45        | A             |
| Drain Current-Continuous( $T_C = 100^\circ C$ )   | $I_D(100^\circ C)$ | -31.8      | A             |
| Pulsed Drain Current                              | $I_{DM}$           | 180        | A             |
| Maximum Power Dissipation                         | $P_D$              | 100        | W             |
| Derating factor                                   |                    | 0.67       | W/ $^\circ C$ |
| Single pulse avalanche energy <sup>(Note 5)</sup> | $E_{AS}$           | 156        | 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> | $R_{\theta JC}$ | 1.5 | $^\circ C/W$ |
|----------------------------------------------------------|-----------------|-----|--------------|

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

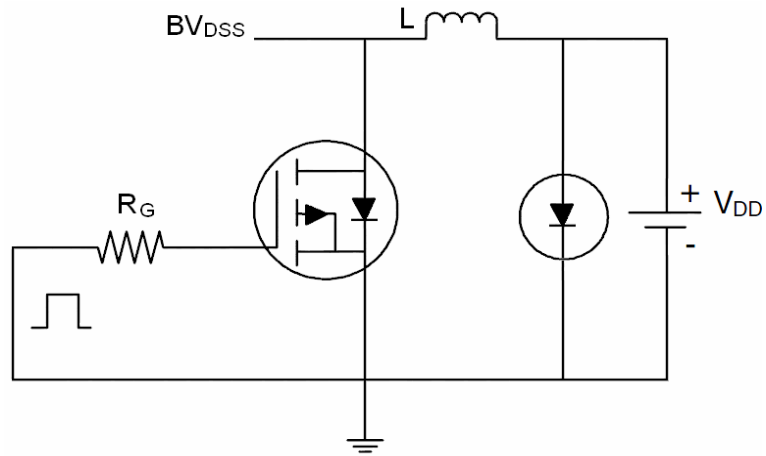
| Parameter                                     | Symbol              | Condition                                                                                  | Min  | Typ    | Max  | Unit |
|-----------------------------------------------|---------------------|--------------------------------------------------------------------------------------------|------|--------|------|------|
| Off Characteristics                           |                     |                                                                                            |      |        |      |      |
| Drain-Source Breakdown Voltage                | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =-250μA                                                 | -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                                  | -1.0 | -1.75  | -2.5 | V    |
| Drain-Source On-State Resistance              | R <sub>DS(ON)</sub> | V <sub>GS</sub> =-10V, I <sub>D</sub> =-20A                                                | -    | 30.5   | 35   | mΩ   |
|                                               |                     | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-20A                                               | -    | 37     | 50   | mΩ   |
| 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> =-30V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                    | -    | 1919.7 | -    | PF   |
| Output Capacitance                            | C <sub>oss</sub>    |                                                                                            | -    | 124.3  | -    | PF   |
| Reverse Transfer Capacitance                  | C <sub>rss</sub>    |                                                                                            | -    | 96.9   | -    | PF   |
| Switching Characteristics <sup>(Note 4)</sup> |                     |                                                                                            |      |        |      |      |
| Turn-on Delay Time                            | t <sub>d(on)</sub>  | V <sub>DD</sub> =-30V, I <sub>D</sub> =-20A<br>V <sub>GS</sub> =-10V, R <sub>GEN</sub> =3Ω | -    | 12     | -    | nS   |
| Turn-on Rise Time                             | t <sub>r</sub>      |                                                                                            | -    | 14     | -    | nS   |
| Turn-Off Delay Time                           | t <sub>d(off)</sub> |                                                                                            | -    | 38     | -    | nS   |
| Turn-Off Fall Time                            | t <sub>f</sub>      |                                                                                            | -    | 15     | -    | nS   |
| Total Gate Charge                             | Q <sub>g</sub>      | V <sub>DS</sub> =-30V, I <sub>D</sub> =-20A,<br>V <sub>GS</sub> =-10V                      | -    | 36.5   | -    | nC   |
| Gate-Source Charge                            | Q <sub>gs</sub>     |                                                                                            | -    | 6.9    | -    | nC   |
| Gate-Drain Charge                             | Q <sub>gd</sub>     |                                                                                            | -    | 8.2    | -    | 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> =-20A                                                  | -    | -      | 1.2  | V    |
| Diode Forward Current <sup>(Note 2)</sup>     | I <sub>S</sub>      |                                                                                            | -    | -      | -45  | A    |
| Reverse Recovery Time                         | t <sub>rr</sub>     | TJ = 25°C, IF = -20A                                                                       | -    | -      | 40   | nS   |
| Reverse Recovery Charge                       | Q <sub>rr</sub>     | di/dt = 100A/μs <sup>(Note3)</sup>                                                         | -    | -      | 70   | nC   |

### Notes:

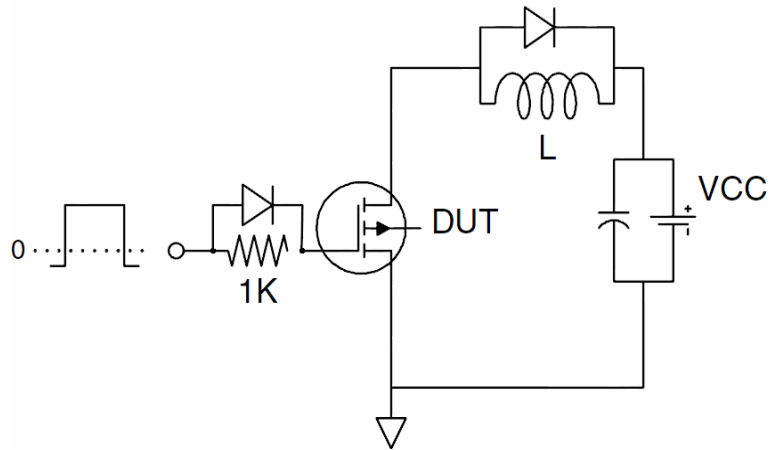
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5.  $E_{AS}$  condition:  $T_J=25^{\circ}\text{C}, V_{DS}=-30V, V_{GS}=-10V, L=0.5\text{mH}, R_g=25\Omega$

## Test Circuit

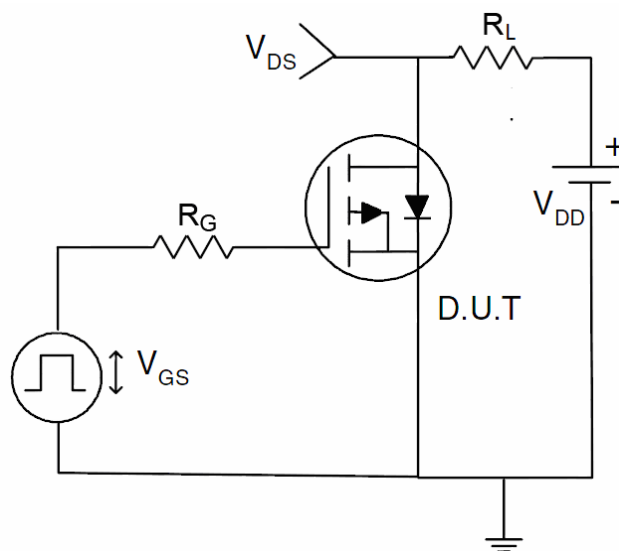
### 1) $E_{AS}$ Test Circuit



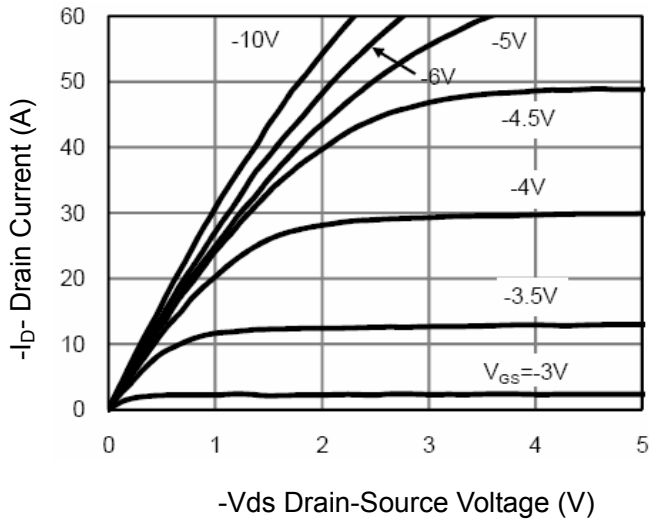
### 2) Gate Charge Test Circuit



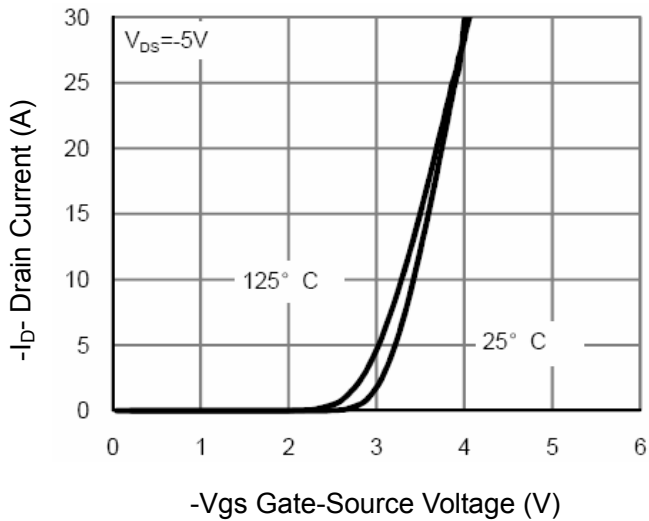
### 3) Switch Time Test Circuit



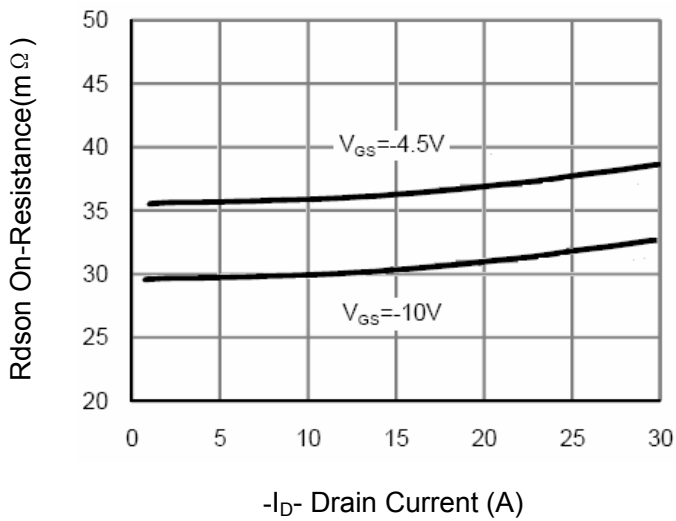
## Typical Electrical and Thermal Characteristics (Curves)



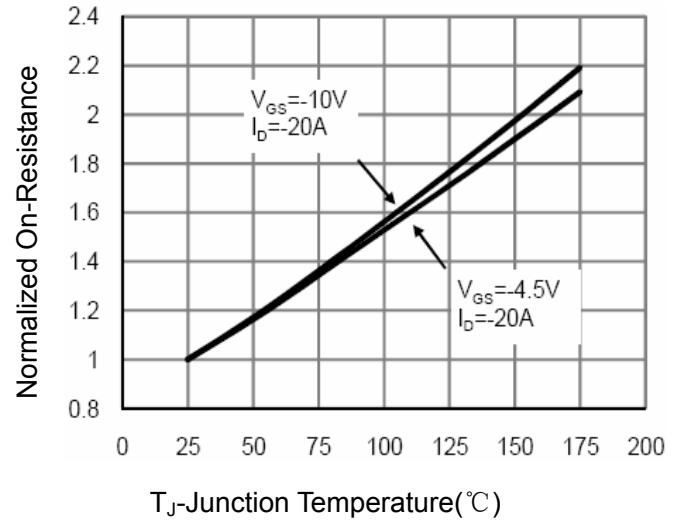
**Figure 1 Output Characteristics**



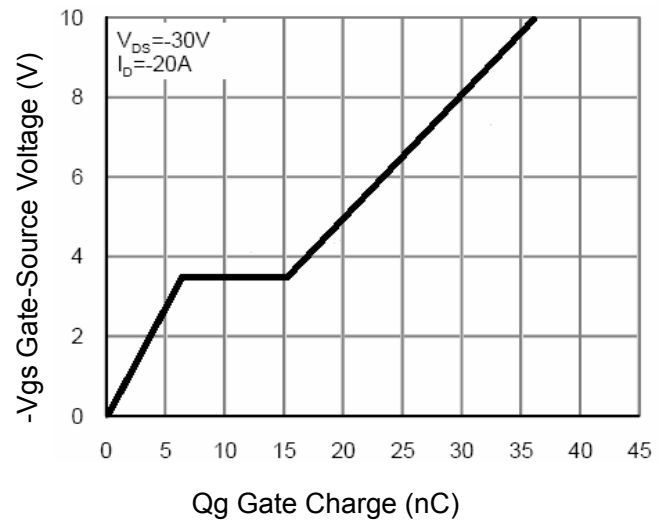
**Figure 2 Transfer Characteristics**



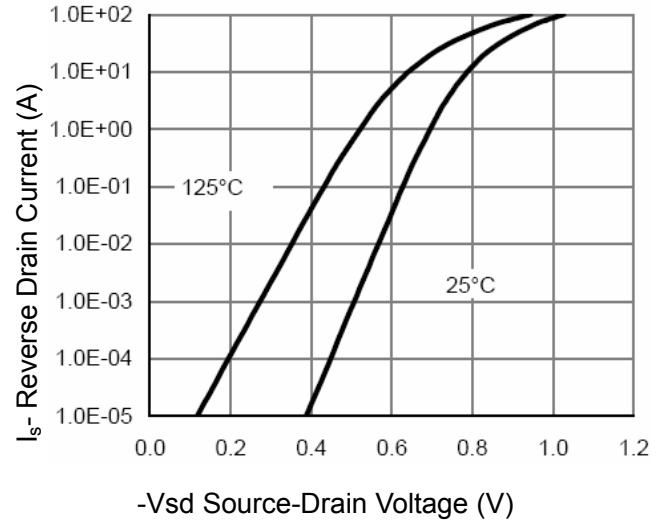
**Figure 3  $R_{DS(on)}$ - Drain Current**



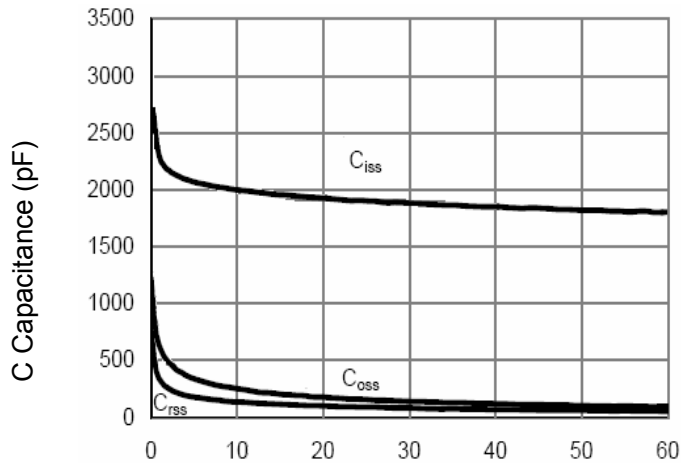
**Figure 4  $R_{DS(on)}$ -Junction Temperature**



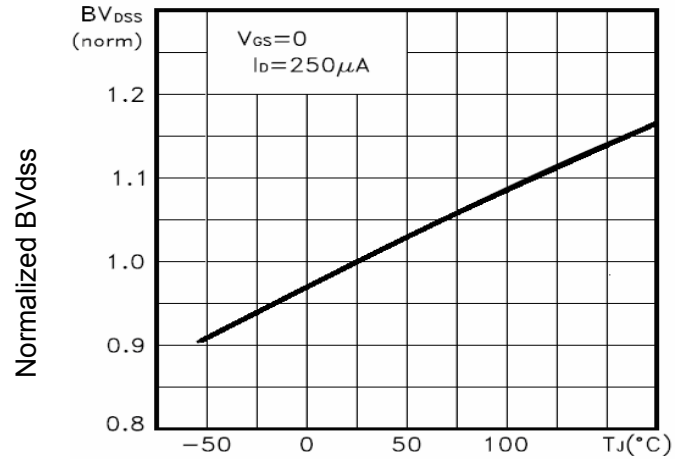
**Figure 5 Gate Charge**



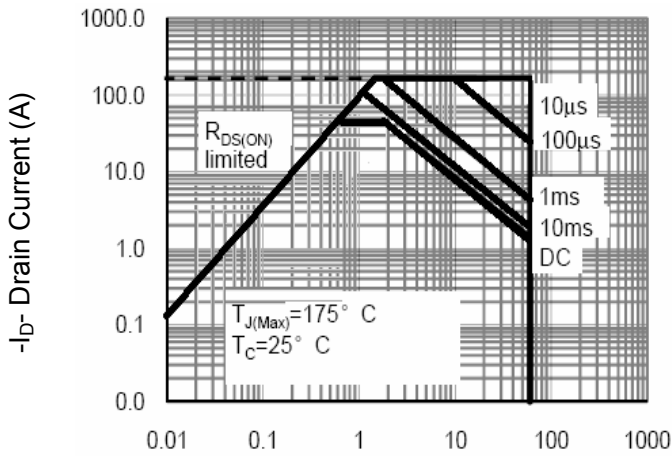
**Figure 6 Source- Drain Diode Forward**



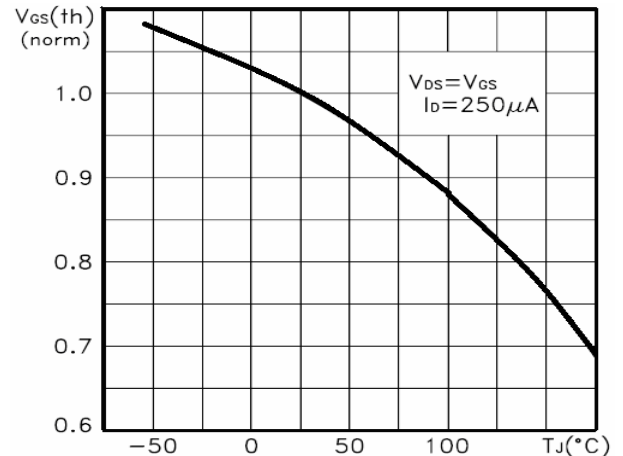
-Vds Drain-Source Voltage (V)  
**Figure 7 Capacitance vs Vds**



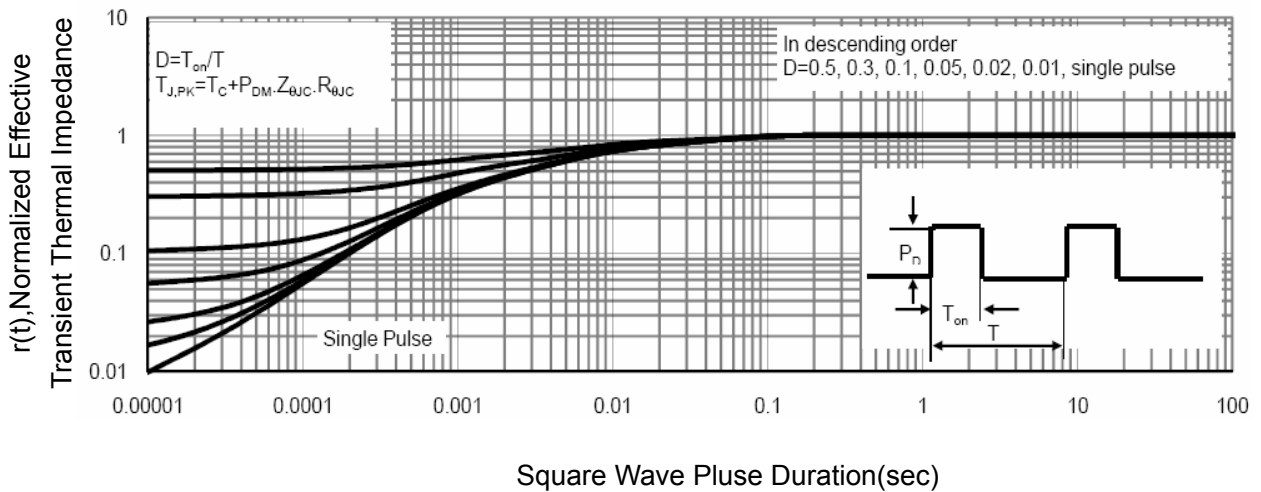
TJ-Junction Temperature (°C)  
**Figure 9 BV<sub>DSS</sub> vs Junction Temperature**



-Vds Drain-Source Voltage (V)  
**Figure 8 Safe Operation Area**

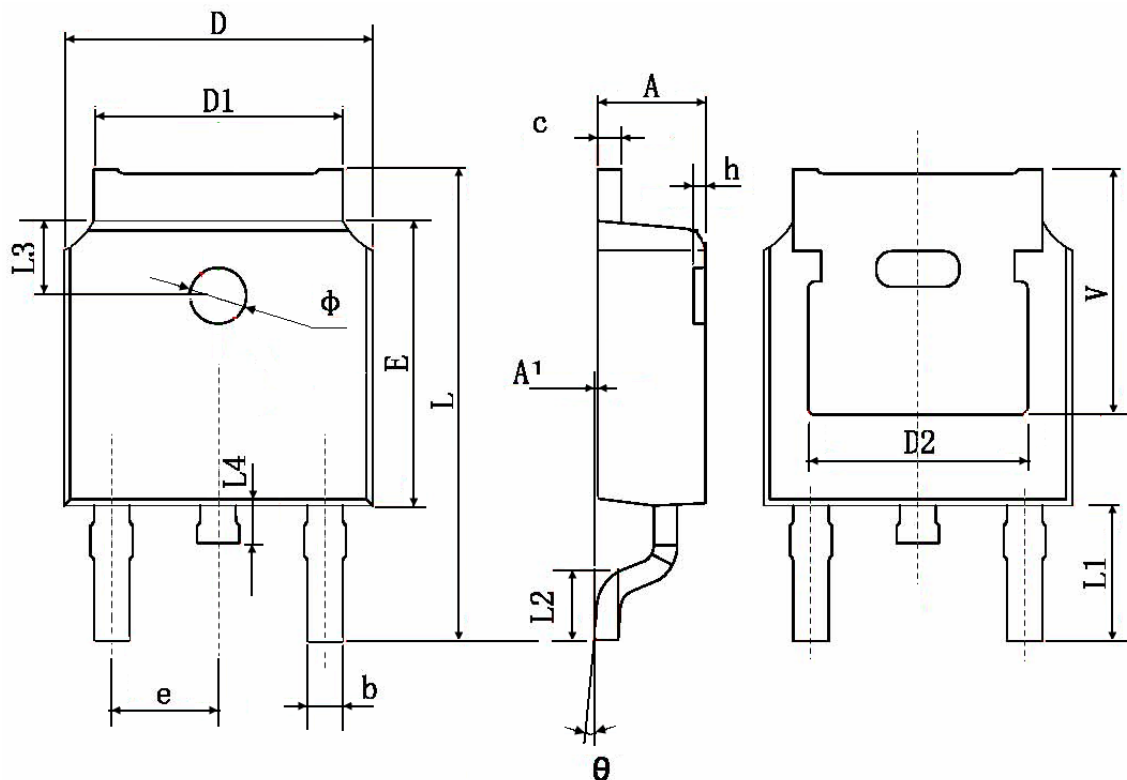


TJ-Junction Temperature(°C)  
**Figure 10 V<sub>GS(th)</sub> vs Junction Temperature**



**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.           |       |

## Attention:

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