

## NCE N-Channel Enhancement Mode Power MOSFET

### Description

The NCE60H15AD 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

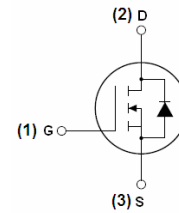
- $V_{DS} = 60V, I_D = 150A$   
 $R_{DS(ON)} < 4.0m\Omega @ V_{GS} = 10V$
- High density cell design for ultra low  $R_{dson}$
- Fully characterized avalanche voltage and current
- Good stability and uniformity with high  $E_{AS}$
- Excellent package for good heat dissipation
- Special process technology for high ESD capability

### Application

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

**100% UIS TESTED!**

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



Schematic diagram



Marking and pin assignment



TO-263-2L top view

### Package Marking and Ordering Information

| Device Marking | Device     | Device Package | Reel Size | Tape width | Quantity |
|----------------|------------|----------------|-----------|------------|----------|
| NCE60H15AD     | NCE60H15AD | TO-263-2L      | -         | -          | -        |

### 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                          | $I_D$              | 150        | A             |
| Drain Current-Continuous( $T_C = 100^\circ C$ )   | $I_D(100^\circ C)$ | 105        | A             |
| Pulsed Drain Current                              | $I_{DM}$           | 600        | A             |
| Maximum Power Dissipation                         | $P_D$              | 220        | W             |
| Derating factor                                   |                    | 1.47       | W/ $^\circ C$ |
| Single pulse avalanche energy <sup>(Note 5)</sup> | $E_{AS}$           | 900        | 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> | $R_{\theta JC}$ | 0.68 | $^{\circ}\text{C}/\text{W}$ |
|--|-----------------|------|-----------------------------|

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

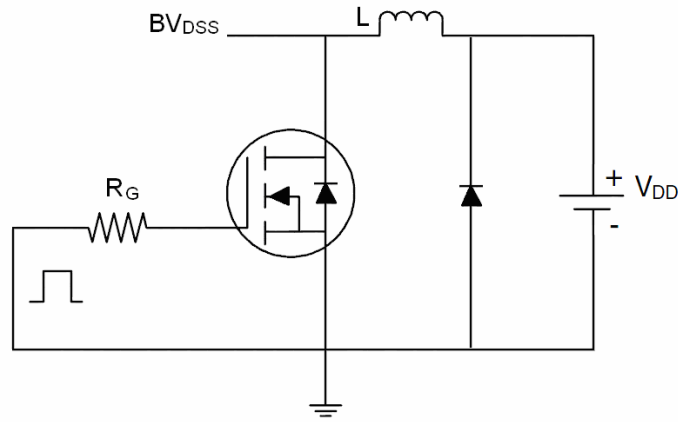
| Parameter  | Symbol       | Condition   | Min | Typ   | Max       | Unit       |
|--|--------------|---|-----|-------|-----------|------------|
| <b>Off Characteristics</b>                           |              |   |     |       |           |            |
| Drain-Source Breakdown Voltage                       | $BV_{DSS}$   | $V_{GS}=0V, I_D=250\mu A$   | 60  |       | -         | V          |
| Zero Gate Voltage Drain Current                      | $I_{DSS}$    | $V_{DS}=60V, V_{GS}=0V$   | -   | -     | 1         | $\mu A$    |
| Gate-Body Leakage Current                            | $I_{GSS}$    | $V_{GS}=\pm 20V, V_{DS}=0V$   | -   | -     | $\pm 100$ | nA         |
| <b>On Characteristics</b> <sup>(Note 3)</sup>        |              |   |     |       |           |            |
| Gate Threshold Voltage                               | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu A$   | 2   | 3     | 4         | V          |
| Drain-Source On-State Resistance                     | $R_{DS(ON)}$ | $V_{GS}=10V, I_D=75A$   | -   | 3.1   | 4.0       | m $\Omega$ |
| Forward Transconductance                             | $g_{FS}$     | $V_{DS}=50V, I_D=75A$   | 80  | -     | -         | S          |
| <b>Dynamic Characteristics</b> <sup>(Note 4)</sup>   |              |   |     |       |           |            |
| Input Capacitance                                    | $C_{iss}$    | $V_{DS}=30V, V_{GS}=0V,$<br>$F=1.0\text{MHz}$                                     | -   | 5451  | -         | PF         |
| Output Capacitance                                   | $C_{oss}$    |   | -   | 609   | -         | PF         |
| Reverse Transfer Capacitance                         | $C_{rss}$    |   | -   | 488   | -         | PF         |
| <b>Switching Characteristics</b> <sup>(Note 4)</sup> |              |   |     |       |           |            |
| Turn-on Delay Time                                   | $t_{d(on)}$  | $V_{DD}=30V, R_L=0.4\Omega$<br>$V_{GS}=10V, R_G=2.5\Omega$                        | -   | 25    | -         | nS         |
| Turn-on Rise Time                                    | $t_r$        |   | -   | 23    | -         | nS         |
| Turn-Off Delay Time                                  | $t_{d(off)}$ |   | -   | 90    | -         | nS         |
| Turn-Off Fall Time                                   | $t_f$        |   | -   | 38    | -         | nS         |
| Total Gate Charge                                    | $Q_g$        | $V_{DS}=30V, I_D=75A,$<br>$V_{GS}=10V$  | -   | 130.8 |           | nC         |
| Gate-Source Charge                                   | $Q_{gs}$     |   | -   | 22.8  |           | nC         |
| Gate-Drain Charge                                    | $Q_{gd}$     |   | -   | 56.9  |           | nC         |
| <b>Drain-Source Diode Characteristics</b>            |              |   |     |       |           |            |
| Diode Forward Voltage <sup>(Note 3)</sup>            | $V_{SD}$     | $V_{GS}=0V, I_S=75A$  | -   |       | 1.2       | V          |
| Diode Forward Current <sup>(Note 2)</sup>            | $I_S$        |   | -   | -     | 150       | A          |
| Reverse Recovery Time                                | $t_{rr}$     | $T_J = 25^{\circ}\text{C}, I_F = 75A$<br>$di/dt = 100A/\mu s$ <sup>(Note 3)</sup> | -   | -     | 60        | nS         |
| Reverse Recovery Charge                              | $Q_{rr}$     |   | -   | -     | 80        | nC         |
| Forward Turn-On Time                                 | $t_{on}$     | Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)              |     |       |           |            |

## Notes:

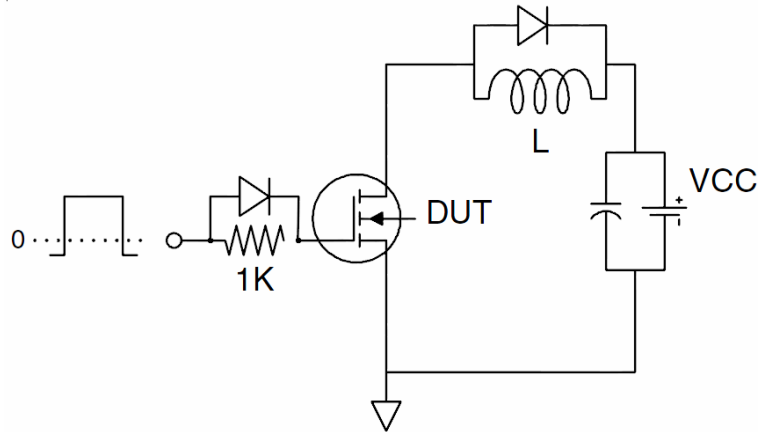
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5. EAS condition:  $T_J=25^{\circ}\text{C}, V_{DD}=30V,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

## Test circuit

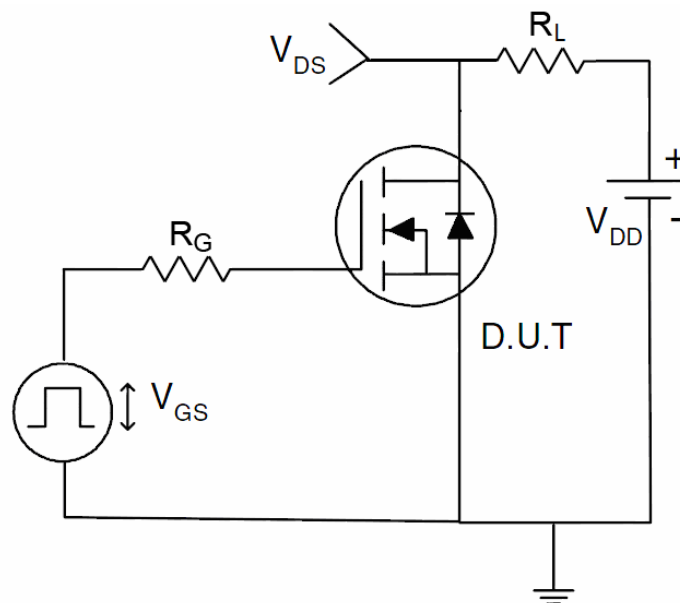
### 1) E<sub>AS</sub> test Circuits



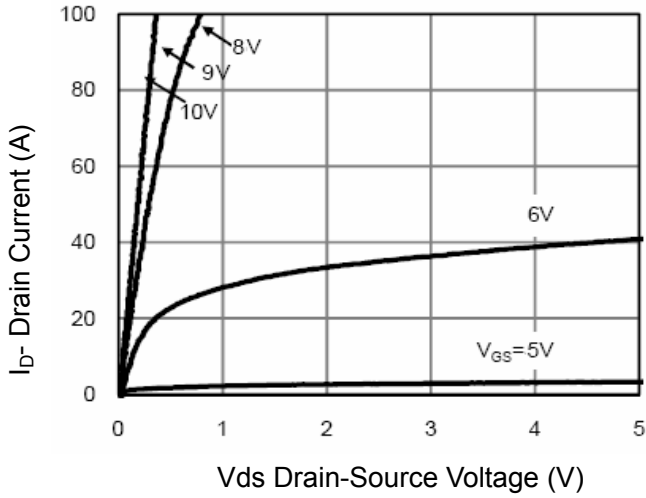
### 2) Gate charge test Circuit:



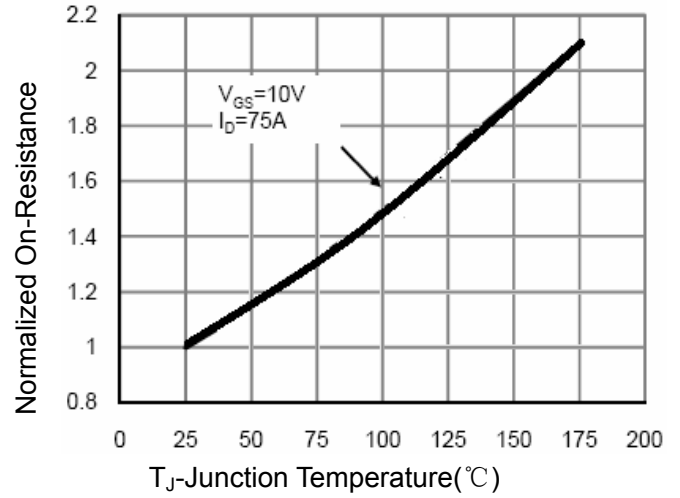
### 3) Switch Time Test Circuit:



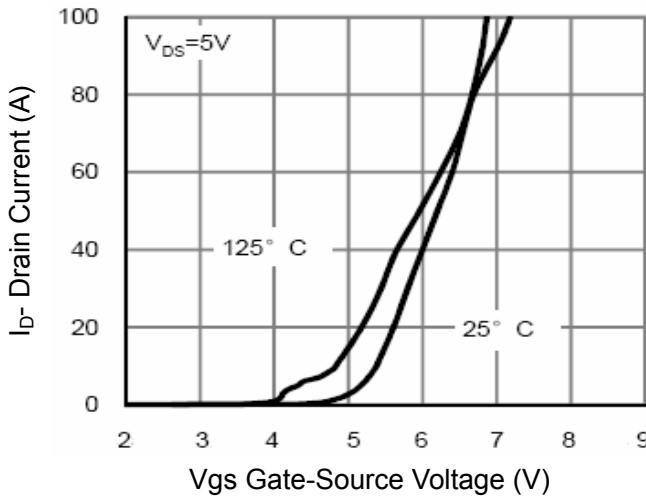
## Typical Electrical and Thermal Characteristics (Curves)



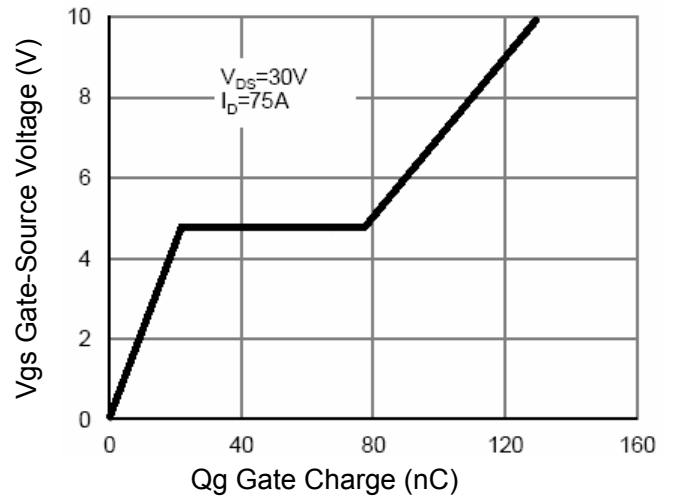
**Figure 1 Output Characteristics**



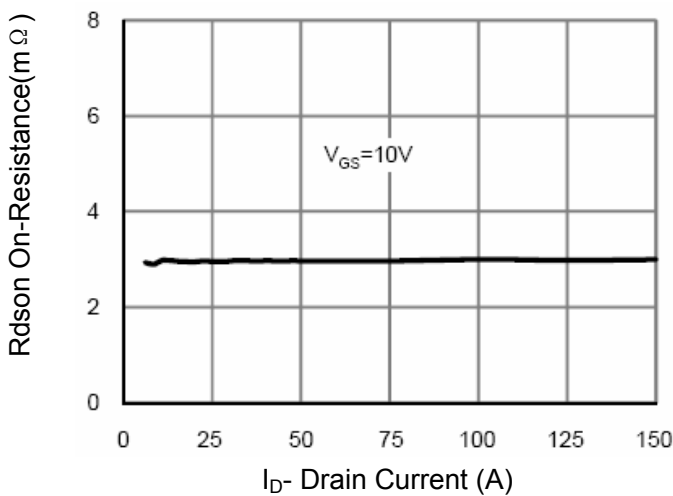
**Figure 4  $R_{dson}$ -Junction Temperature**



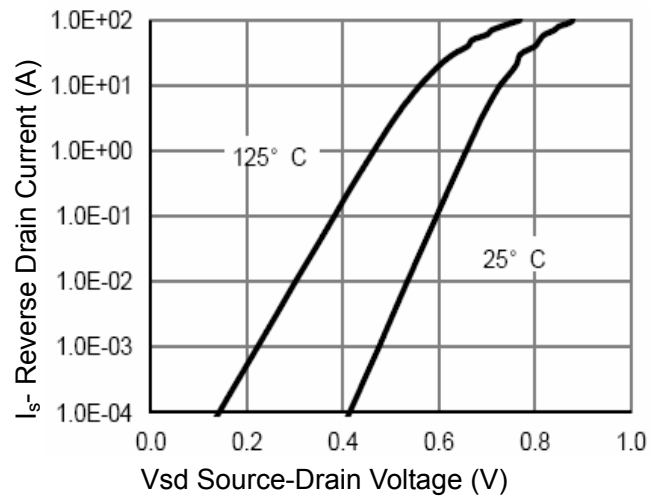
**Figure 2 Transfer Characteristics**



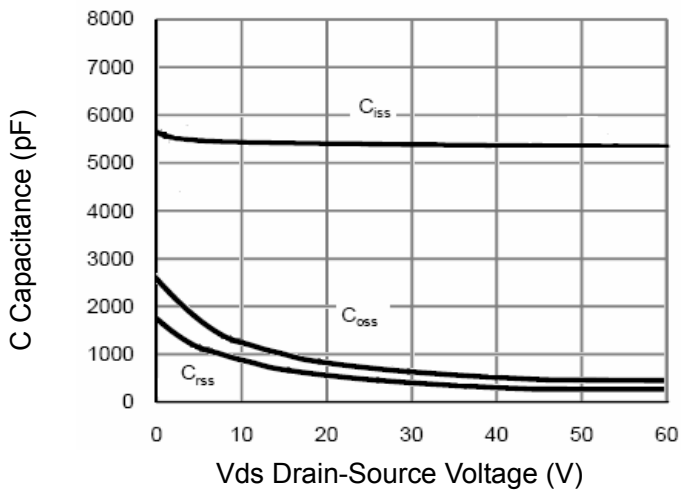
**Figure 5 Gate Charge**



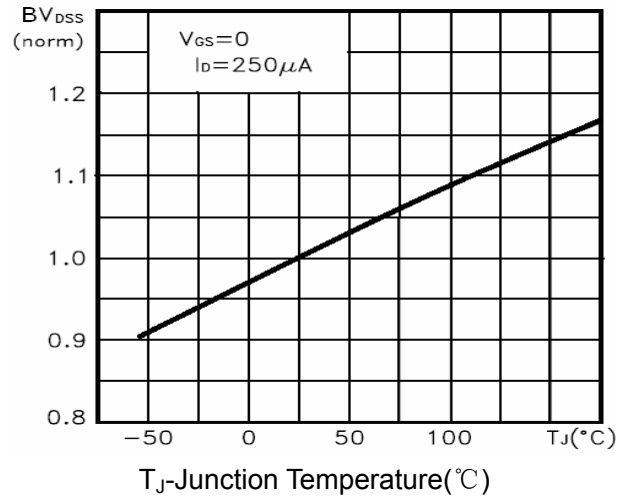
**Figure 3  $R_{dson}$ - Drain Current**



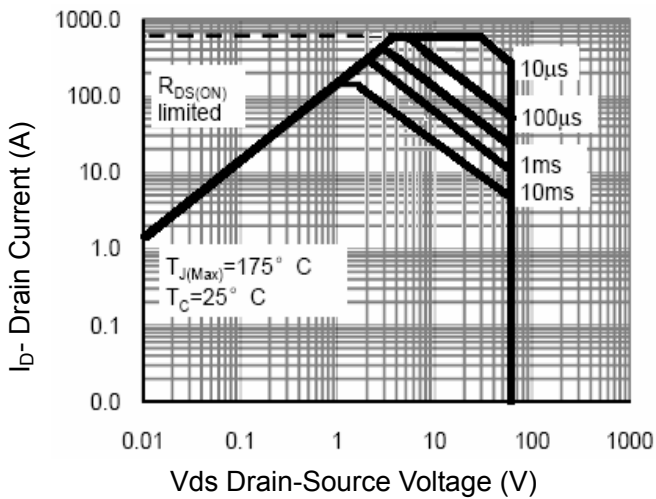
**Figure 6 Source- Drain Diode Forward**



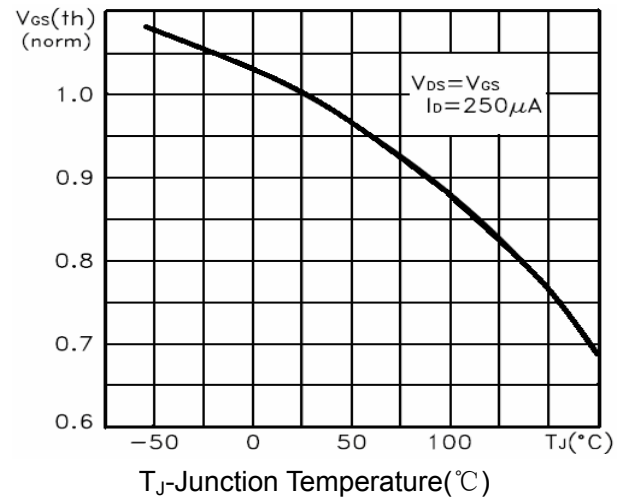
**Figure 7 Capacitance vs Vds**



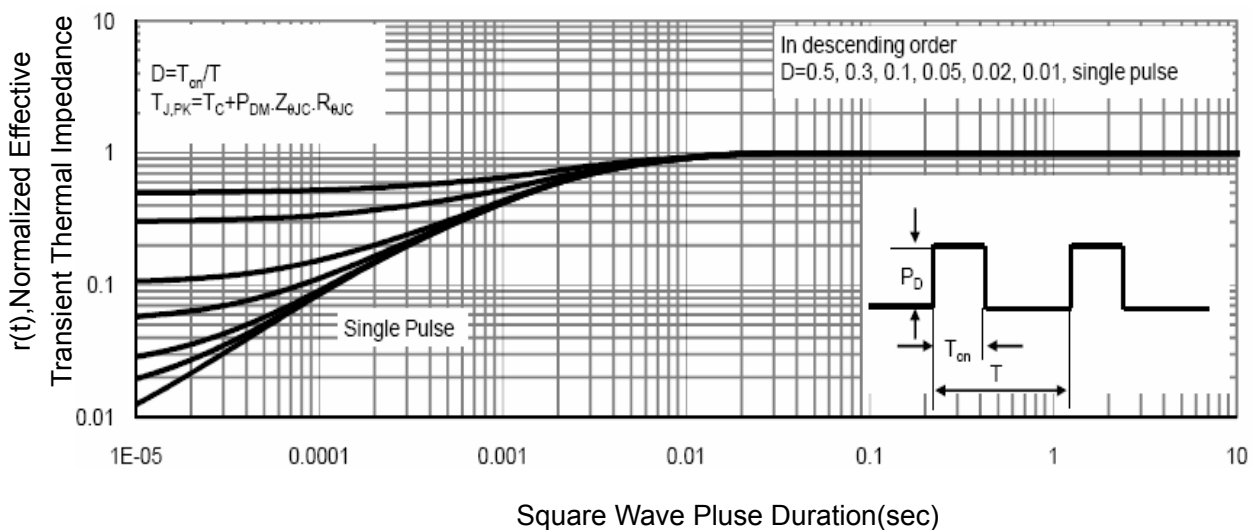
**Figure 9 BV<sub>DSS</sub> vs Junction Temperature**



**Figure 8 Safe Operation Area**

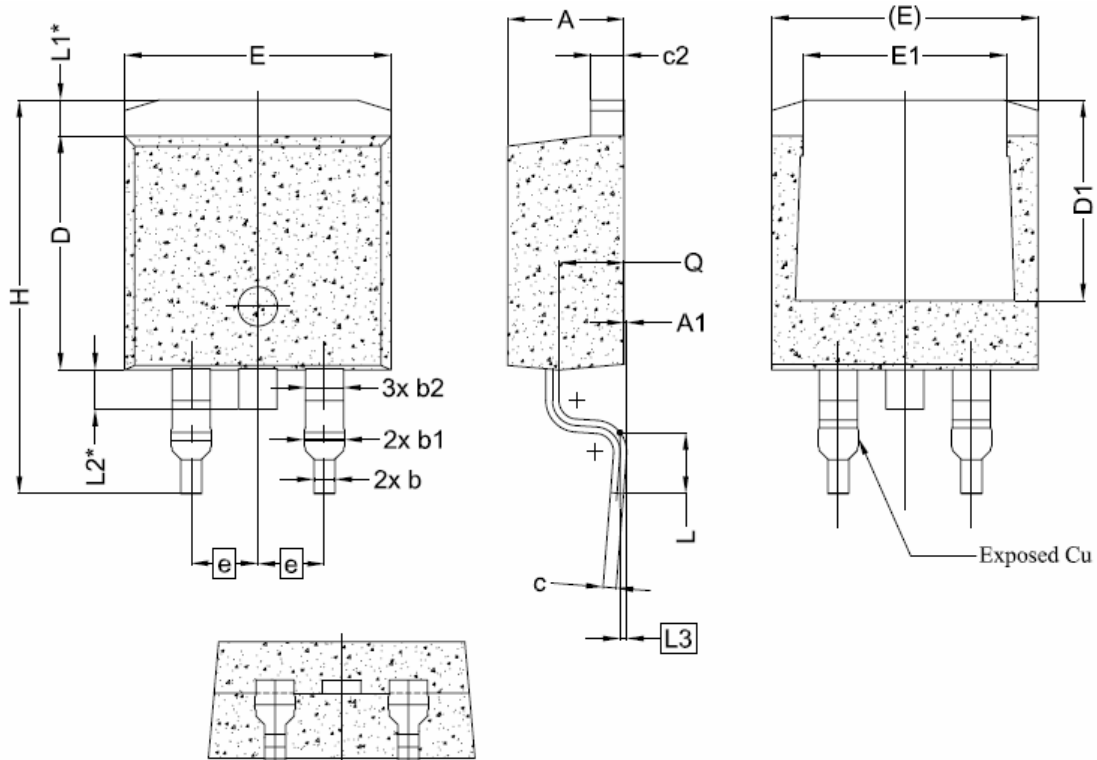


**Figure 10 V<sub>GS(th)</sub> vs Junction Temperature**



**Figure 11 Normalized Maximum Transient Thermal Impedance**

## TO-263-2L Package Information



| Symbol | Dimensions In Millimeters |       |       |
|--------|---------------------------|-------|-------|
|        | Min.                      | Nom.  | Max.  |
| A      | 4.24                      | 4.44  | 4.64  |
| A1     | 0.00                      | 0.10  | 0.25  |
| b      | 0.70                      | 0.80  | 0.90  |
| b1     | 1.20                      | 1.55  | 1.75  |
| b2     | 1.20                      | 1.45  | 1.70  |
| c      | 0.40                      | 0.50  | 0.60  |
| c2     | 1.15                      | 1.27  | 1.40  |
| D      | 8.82                      | 8.92  | 9.02  |
| D1     | 6.86                      | 7.65  | -     |
| E      | 9.96                      | 10.16 | 10.36 |
| E1     | 6.89                      | 7.77  | 7.89  |
| e      | 2.54BSC                   |       |       |
| H      | 14.61                     | 15.00 | 15.88 |
| L      | 1.78                      | 2.32  | 2.79  |
| L1     | 1.36 REF.                 |       |       |
| L2     | 1.50 REF.                 |       |       |
| L3     | 0.25 BSC                  |       |       |
| Q      | 2.30                      | 2.48  | 2.70  |

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