

## NCE P-Channel Enhancement Mode Power MOSFET

### Description

The NCE01P13K 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. It is ESD protested.

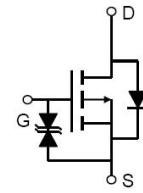
### General Features

- $V_{DS} = -100V, I_D = -13A$   
 $R_{DS(ON)} < 200m\Omega @ V_{GS} = -10V$  (Typ:170m $\Omega$ )
- Super high dense cell design
- Advanced trench process technology
- Reliable and rugged
- High density cell design for ultra low on-resistance

### Application

- Power switch
- DC/DC converters

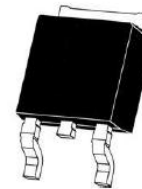
**100% UIS TESTED!**  
**100%  $\Delta V_{ds}$  TESTED!**



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   |
|----------------|-----------|----------------|-----------|------------|------------|
| NCE01P13K      | NCE01P13K | TO-252-2L      | Ø330mm    | 16mm       | 2500 units |

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

| Parameter  | Symbol             | Limit      | Unit          |
|--|--------------------|------------|---------------|
| Drain-Source Voltage                             | $V_{DS}$           | -100       | V             |
| Gate-Source Voltage                              | $V_{GS}$           | $\pm 20$   | V             |
| Drain Current-Continuous                         | $I_D$              | -13        | A             |
| Drain Current-Continuous( $T_c=100^\circ C$ )    | $I_D(100^\circ C)$ | -9.2       | A             |
| Pulsed Drain Current                             | $I_{DM}$           | -52        | A             |
| Maximum Power Dissipation                        | $P_D$              | 40         | W             |
| Derating factor                                  |                    | 0.27       | W/ $^\circ C$ |
| Single pulse avalanche energy (Note 5)           | $E_{AS}$           | 80         | mJ            |
| Operating Junction and Storage Temperature Range | $T_J, T_{STG}$     | -55 To 175 | $^\circ C$    |

### Thermal Characteristic

|   |                 |      |              |
|---|-----------------|------|--------------|
| Thermal Resistance, Junction-to-Case (Note 2) | $R_{\theta Jc}$ | 3.75 | $^\circ C/W$ |
|---|-----------------|------|--------------|

## Electrical Characteristics (T<sub>c</sub>=25°C unless otherwise noted)

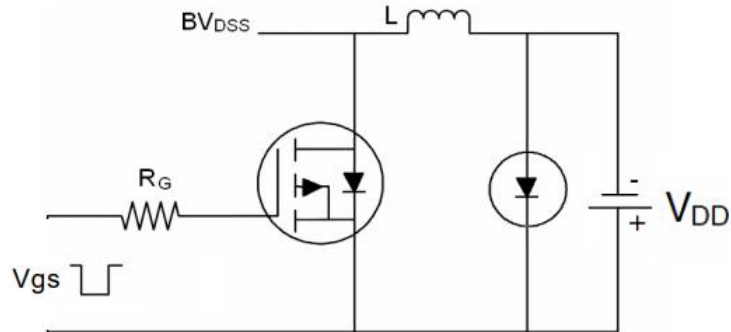
| Parameter                                 | Symbol              | Condition  | Min  | Typ  | Max  | Unit |
|---|---------------------|--|------|------|------|------|
| <b>Off Characteristics</b>                |                     |  |      |      |      |      |
| Drain-Source Breakdown Voltage            | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V, I <sub>D</sub> =-250μA  | -100 | -    | -    | V    |
| Zero Gate Voltage Drain Current           | I <sub>DSS</sub>    | V <sub>DS</sub> =-100V, 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   | -    | -    | ±10  | μA   |
| <b>On Characteristics</b> (Note 3)        |                     |  |      |      |      |      |
| Gate Threshold Voltage                    | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =-250μA                                    | -1   | -1.9 | -3   | V    |
| Drain-Source On-State Resistance          | R <sub>DS(ON)</sub> | V <sub>GS</sub> =-10V, I <sub>D</sub> =-10A  | -    | 170  | 200  | mΩ   |
| Forward Transconductance                  | g <sub>FS</sub>     | V <sub>DS</sub> =-20V, I <sub>D</sub> =-10A  | -    | 19   | -    | S    |
| <b>Dynamic Characteristics</b> (Note4)    |                     |  |      |      |      |      |
| Input Capacitance                         | C <sub>iss</sub>    | V <sub>DS</sub> =-50V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                      | -    | 1491 | -    | PF   |
| Output Capacitance                        | C <sub>oss</sub>    |  | -    | 47.5 | -    | PF   |
| Reverse Transfer Capacitance              | C <sub>rss</sub>    |  | -    | 41.8 | -    | PF   |
| <b>Switching Characteristics</b> (Note 4) |                     |  |      |      |      |      |
| Turn-on Delay Time                        | t <sub>d(on)</sub>  | V <sub>DD</sub> =-50V, I <sub>D</sub> =-10A<br>V <sub>GS</sub> =-10V, R <sub>GEN</sub> =9.1Ω | -    | 12   | -    | nS   |
| Turn-on Rise Time                         | t <sub>r</sub>      |  | -    | 52   | -    | nS   |
| Turn-Off Delay Time                       | t <sub>d(off)</sub> |  | -    | 28   | -    | nS   |
| Turn-Off Fall Time                        | t <sub>f</sub>      |  | -    | 38   | -    | nS   |
| Total Gate Charge                         | Q <sub>g</sub>      | V <sub>DS</sub> =-50V, I <sub>D</sub> =-10A,<br>V <sub>GS</sub> =-10V                        | -    | 32.5 | -    | nC   |
| Gate-Source Charge                        | Q <sub>gs</sub>     |  | -    | 5.2  | -    | nC   |
| Gate-Drain Charge                         | Q <sub>gd</sub>     |  | -    | 6.5  | -    | nC   |
| <b>Drain-Source Diode Characteristics</b> |                     |  |      |      |      |      |
| Diode Forward Voltage (Note 3)            | V <sub>SD</sub>     | V <sub>GS</sub> =0V, I <sub>S</sub> =-10A  | -    | -    | -1.2 | V    |
| Diode Forward Current (Note 2)            | I <sub>S</sub>      | -  | -    | -    | -13  | A    |
| Reverse Recovery Time                     | t <sub>rr</sub>     | T <sub>J</sub> = 25°C, I <sub>F</sub> =-10A<br>di/dt = 100A/μs (Note3)                       | -    | 35   | -    | nS   |
| Reverse Recovery Charge                   | Q <sub>rr</sub>     |  | -    | 46   | -    | nC   |
| Forward Turn-On Time                      | t <sub>on</sub>     | Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)                         |      |      |      |      |

### Notes:

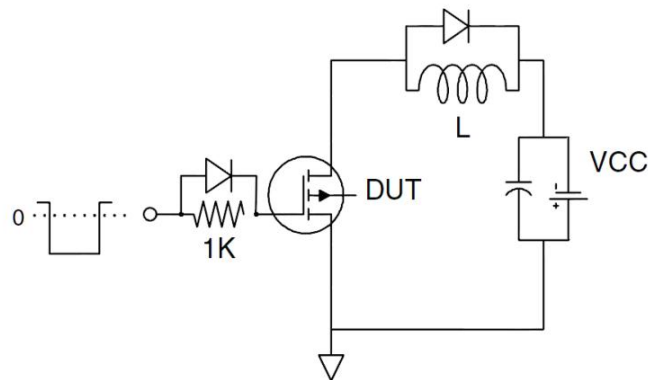
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board, t ≤ 10 sec.
3. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.
4. Guaranteed by design, not subject to production
5. E<sub>AS</sub> condition: T<sub>J</sub>=25°C, V<sub>DD</sub>=-50V, V<sub>G</sub>=-10V, L=0.5mH, R<sub>g</sub>=25Ω

## Test Circuit

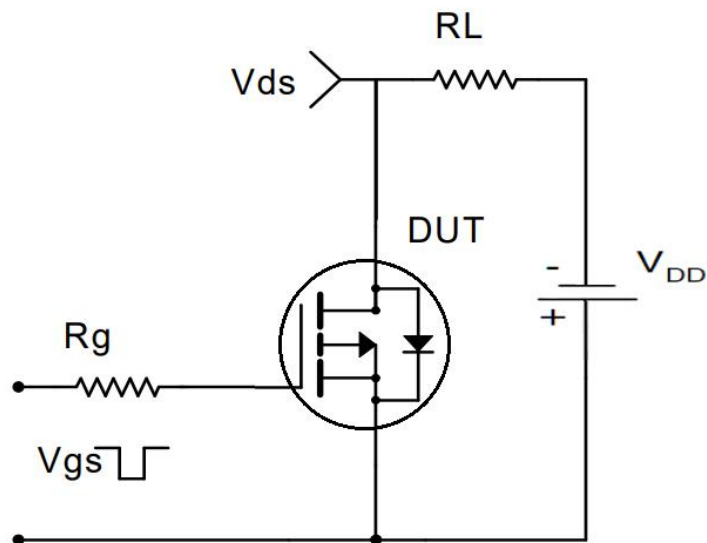
### 1) EAS test Circuit



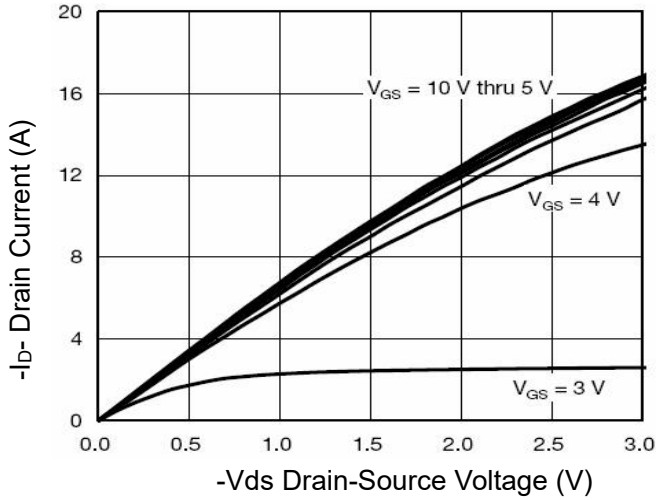
### 2) Gate charge test Circuit



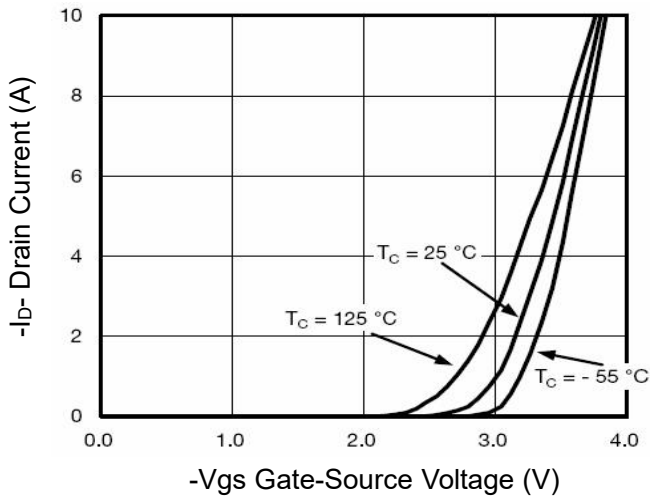
### 3) Switch Time Test Circuit



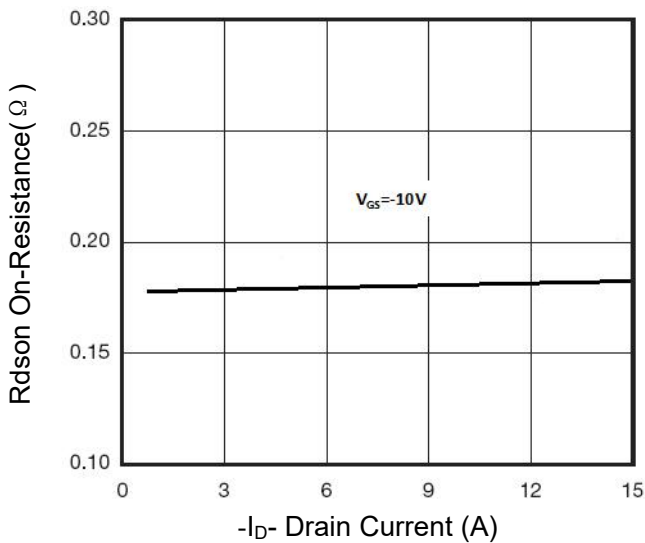
## Typical Electrical and Thermal Characteristics (Curves)



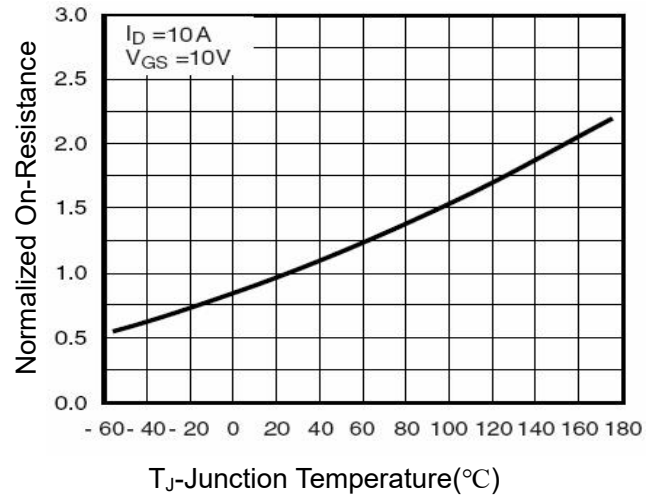
**Figure 1 Output Characteristics**



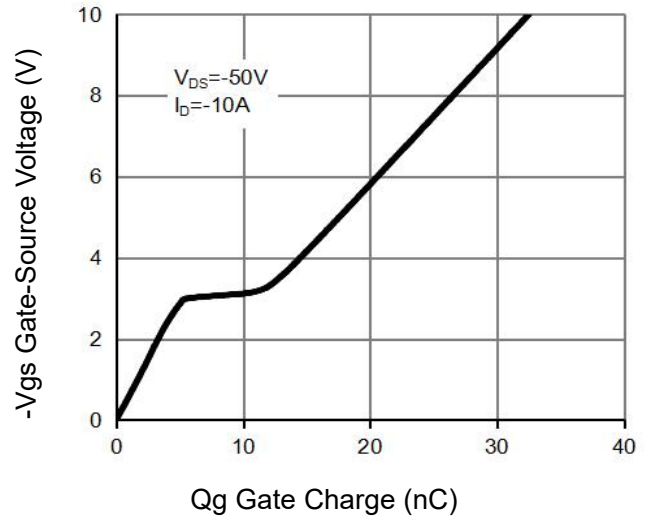
**Figure 2 Transfer Characteristics**



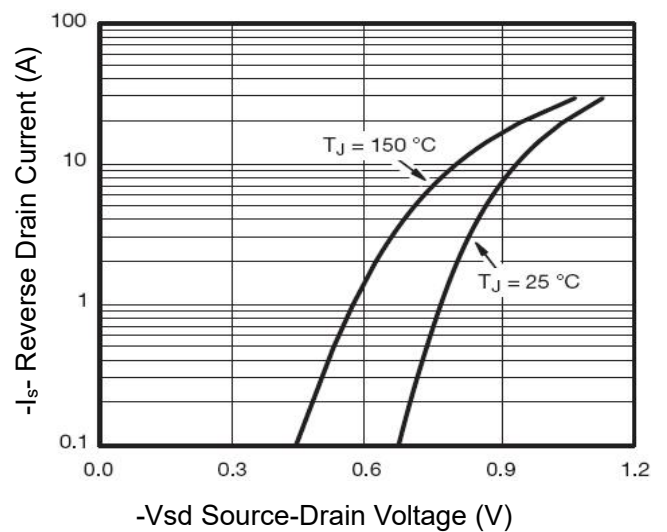
**Figure 3 Rdson- Drain Current**



**Figure 4 Rdson-Junction Temperature**



**Figure 5 Gate Charge**



**Figure 6 Source- Drain Diode Forward**

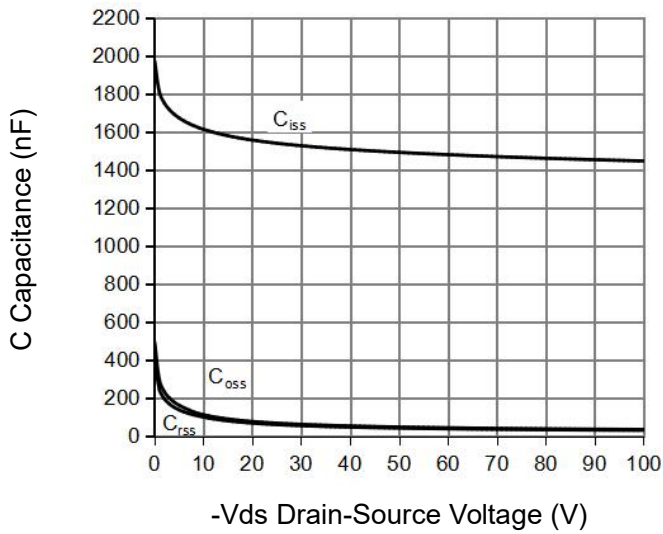


Figure 7 Capacitance vs Vds

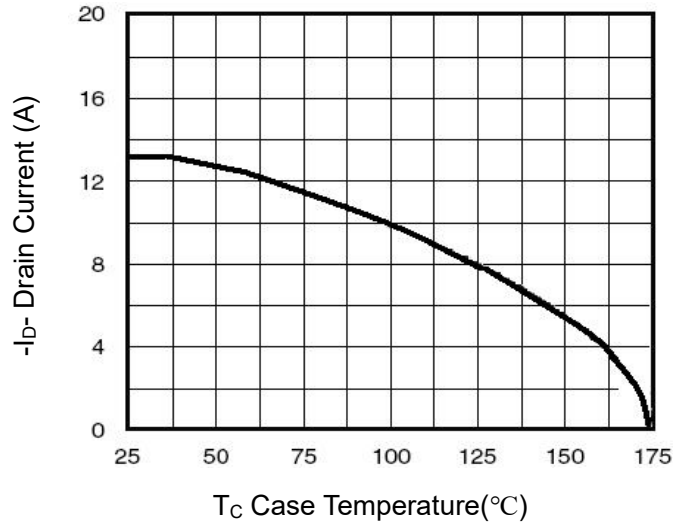


Figure 9 Drain Current vs Case Temperature

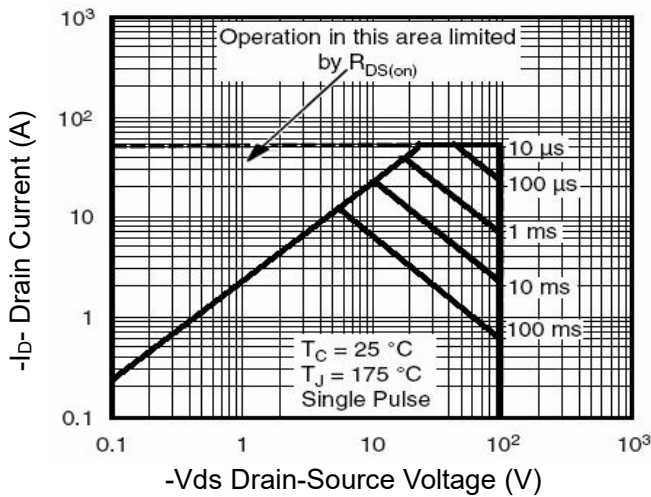


Figure 8 Safe Operation Area

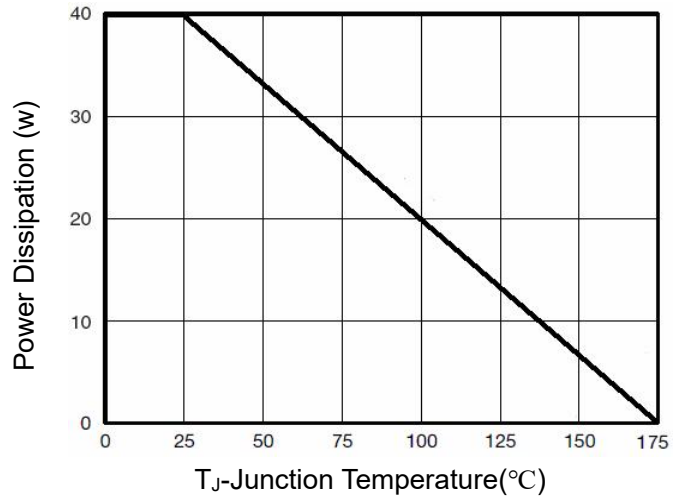


Figure 10 Power De-rating

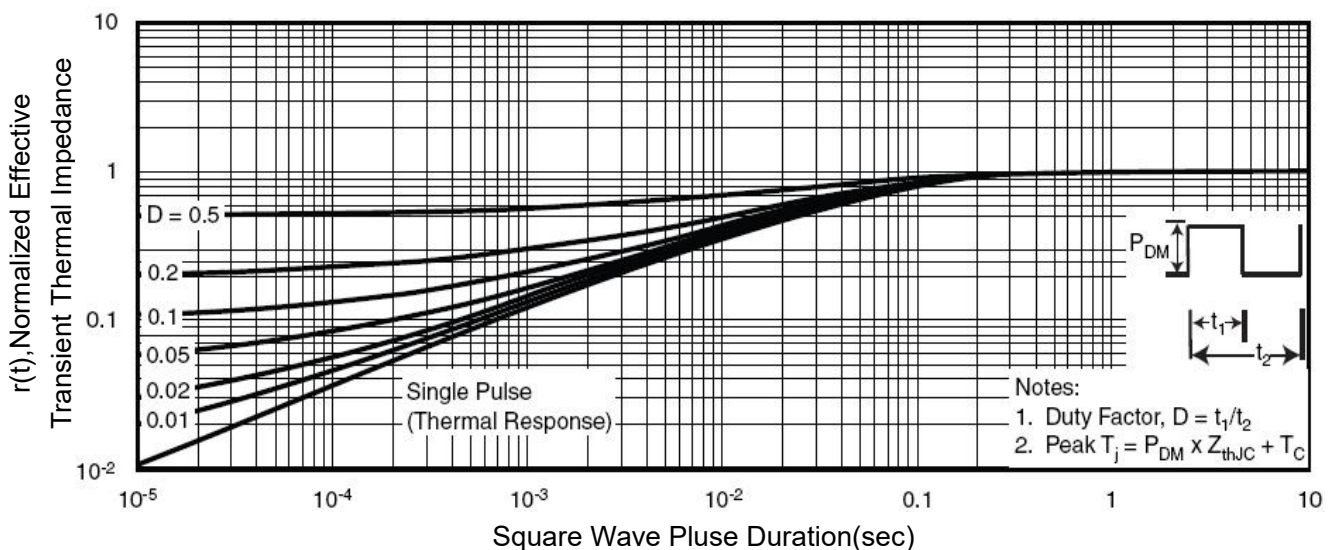
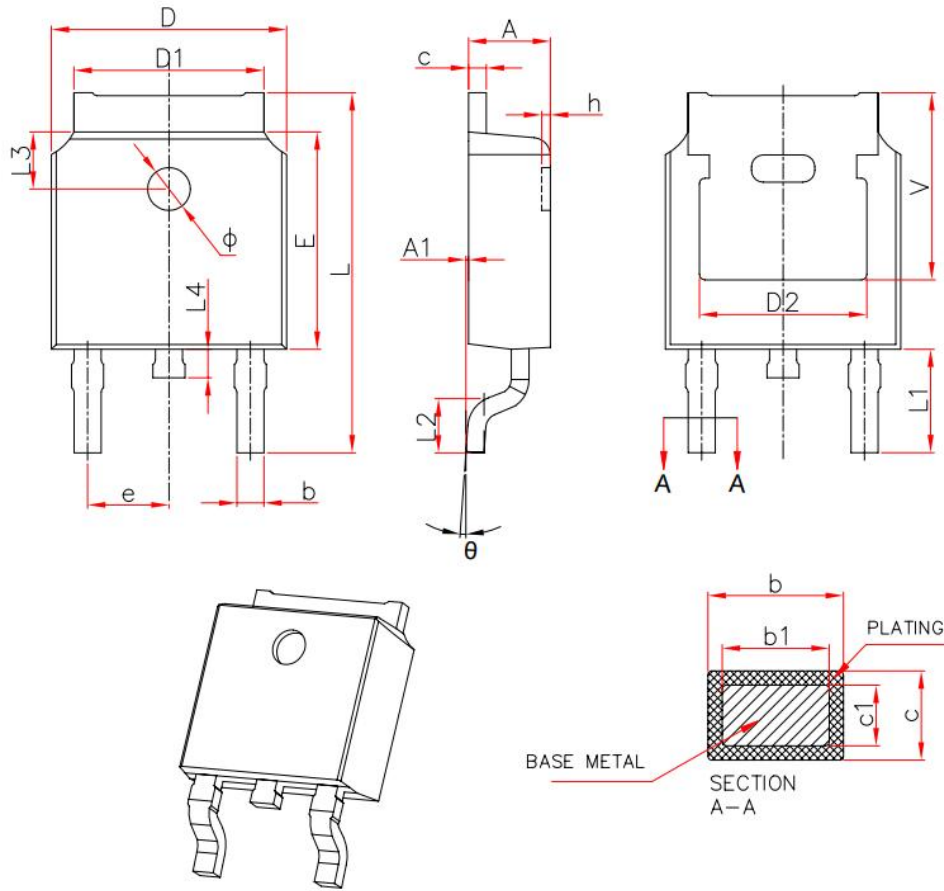


Figure 11 Normalized Maximum Transient Thermal Impedance

## TO-252-2L Package Information



| Symbol   | Millimeters |       |
|----------|-------------|-------|
|          | Min.        | Max.  |
| A        | 2.20        | 2.40  |
| A1       | 0.00        | 0.13  |
| b        | 0.66        | 0.86  |
| b1       | 0.73        | 0.79  |
| c        | 0.46        | 0.58  |
| c1       | 0.50        | 0.52  |
| D        | 6.50        | 6.70  |
| D1       | 5.10        | 5.46  |
| D2       | 4.83 REF.   |       |
| E        | 6.00        | 6.20  |
| e        | 2.19        | 2.39  |
| L        | 9.80        | 10.40 |
| L1       | 2.90 REF.   |       |
| L2       | 1.40        | 1.70  |
| L3       | 1.60 REF.   |       |
| L4       | 0.60        | 1.00  |
| $\Phi$   | 1.10        | 1.30  |
| $\theta$ | 0°          | 8°    |
| h        | 0.00        | 0.30  |
| V        | 5.35 REF.   |       |

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