

## NCE N-Channel Super Trench Power MOSFET

### Description

The NCEP02T10 uses **Super Trench** technology that is uniquely optimized to provide the most efficient high frequency switching performance. Both conduction and switching power losses are minimized due to an extremely low combination of  $R_{DS(ON)}$  and  $Q_g$ . This device is ideal for high-frequency switching and synchronous rectification.

### General Features

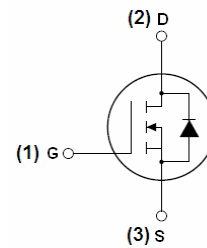
- $V_{DS} = 200V, I_D = 100A$   
 $R_{DS(ON)} < 11m\Omega @ V_{GS} = 10V$
- Excellent gate charge x  $R_{DS(on)}$  product
- Very low on-resistance  $R_{DS(on)}$
- 175 °C operating temperature
- Pb-free lead plating
- 100% UIS tested

### Application

- DC/DC Converter
- Ideal for high-frequency switching and synchronous rectification

**100% UIS TESTED!**

**100%  $\Delta V_d$ s TESTED!**



Schematic diagram



Marking and pin assignment



TO-220-3L top view

### Package Marking and Ordering Information

| Device Marking | Device    | Device Package | Reel Size | Tape width | Quantity |
|----------------|-----------|----------------|-----------|------------|----------|
| NCEP02T10      | NCEP02T10 | TO-220-3L      | -         | -          | -        |

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

| Parameter  | Symbol             | Limit      | Unit          |
|--|--------------------|------------|---------------|
| Drain-Source Voltage                             | $V_{DS}$           | 200        | V             |
| Gate-Source Voltage                              | $V_{GS}$           | $\pm 20$   | V             |
| Drain Current-Continuous                         | $I_D$              | 100        | A             |
| Drain Current-Continuous( $T_C = 100^\circ C$ )  | $I_D(100^\circ C)$ | 70.7       | A             |
| Pulsed Drain Current                             | $I_{DM}$           | 400        | A             |
| Maximum Power Dissipation                        | $P_D$              | 300        | W             |
| Derating factor                                  |                    | 2          | W/ $^\circ C$ |
| Single pulse avalanche energy (Note 5)           | $E_{AS}$           | 1216       | 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> | $R_{\theta JC}$ | 0.5 | $^{\circ}C/W$ |
|--|-----------------|-----|---------------|

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

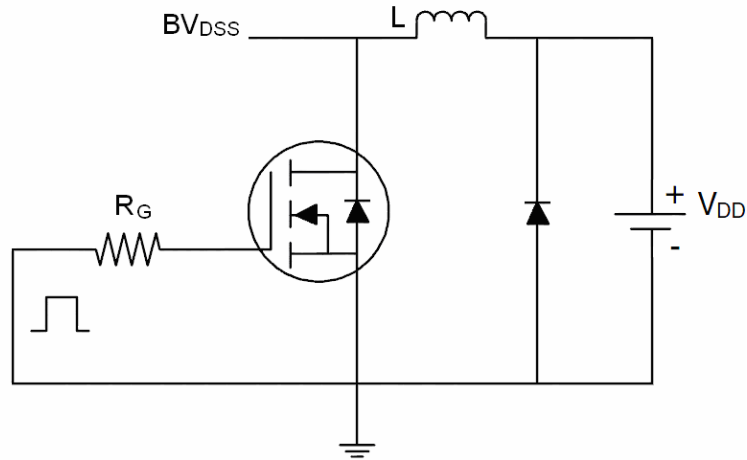
| Parameter  | Symbol       | Condition   | Min | Typ   | Max       | Unit       |
|--|--------------|---|-----|-------|-----------|------------|
| <b>Off Characteristics</b>                           |              |   |     |       |           |            |
| Drain-Source Breakdown Voltage                       | $BV_{DSS}$   | $V_{GS}=0V, I_D=250\mu A$   | 200 | 230   | -         | V          |
| Zero Gate Voltage Drain Current                      | $I_{DSS}$    | $V_{DS}=200V, V_{GS}=0V$  | -   | -     | 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                               | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu A$   | 2.5 |       | 4.5       | V          |
| Drain-Source On-State Resistance                     | $R_{DS(ON)}$ | $V_{GS}=10V, I_D=50A$   | -   | 10    | 11        | m $\Omega$ |
| Forward Transconductance                             | $g_{FS}$     | $V_{DS}=10V, I_D=50A$   | 70  | -     | -         | S          |
| <b>Dynamic Characteristics</b> <sup>(Note 4)</sup>   |              |   |     |       |           |            |
| Input Capacitance                                    | $C_{iss}$    | $V_{DS}=100V, V_{GS}=0V,$<br>$F=1.0MHz$                                   | -   | 4200  | -         | PF         |
| Output Capacitance                                   | $C_{oss}$    |   | -   | 333.1 | -         | PF         |
| Reverse Transfer Capacitance                         | $C_{rss}$    |   | -   | 8.8   | -         | PF         |
| <b>Switching Characteristics</b> <sup>(Note 4)</sup> |              |   |     |       |           |            |
| Turn-on Delay Time                                   | $t_{d(on)}$  | $V_{DD}=100V, I_D=50A$<br>$V_{GS}=10V, R_G=4.7\Omega$                     | -   | 18    | -         | nS         |
| Turn-on Rise Time                                    | $t_r$        |   | -   | 26    | -         | nS         |
| Turn-Off Delay Time                                  | $t_{d(off)}$ |   | -   | 41    | -         | nS         |
| Turn-Off Fall Time                                   | $t_f$        |   | -   | 11    | -         | nS         |
| Total Gate Charge                                    | $Q_g$        | $V_{DS}=100V, I_D=50A,$<br>$V_{GS}=10V$                                   | -   | 63.2  |           | nC         |
| Gate-Source Charge                                   | $Q_{gs}$     |   | -   | 24    |           | nC         |
| Gate-Drain Charge                                    | $Q_{gd}$     |   | -   | 16.4  |           | nC         |
| <b>Drain-Source Diode Characteristics</b>            |              |   |     |       |           |            |
| Diode Forward Voltage <sup>(Note 3)</sup>            | $V_{SD}$     | $V_{GS}=0V, I_S=100A$   | -   |       | 1.2       | V          |
| Diode Forward Current <sup>(Note 2)</sup>            | $I_S$        |   | -   | -     | 100       | A          |
| Reverse Recovery Time                                | $t_{rr}$     | $T_J = 25^{\circ}C, I_F = 50$<br>$di/dt = 100A/\mu S$ <sup>(Note 3)</sup> | -   | 140   |           | nS         |
| Reverse Recovery Charge                              | $Q_{rr}$     |   | -   | 600   |           | nC         |

**Notes:**

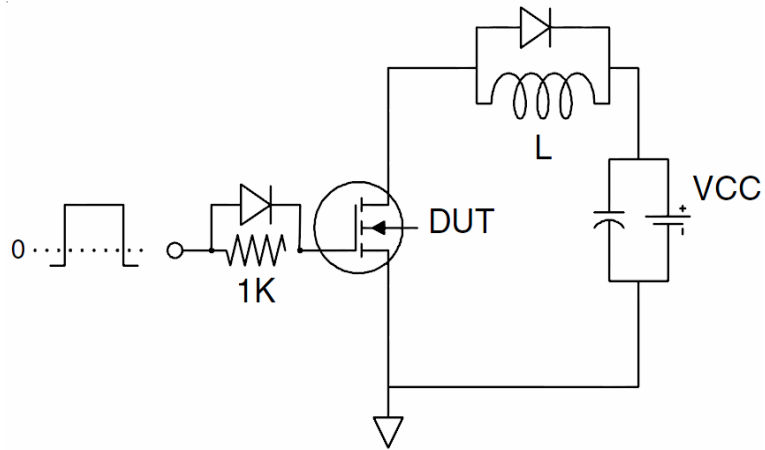
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5. EAS condition :  $T_J=25^{\circ}C, V_{DD}=50V, V_G=10V, L=0.5mH, R_g=25\Omega$

**Test Circuit**

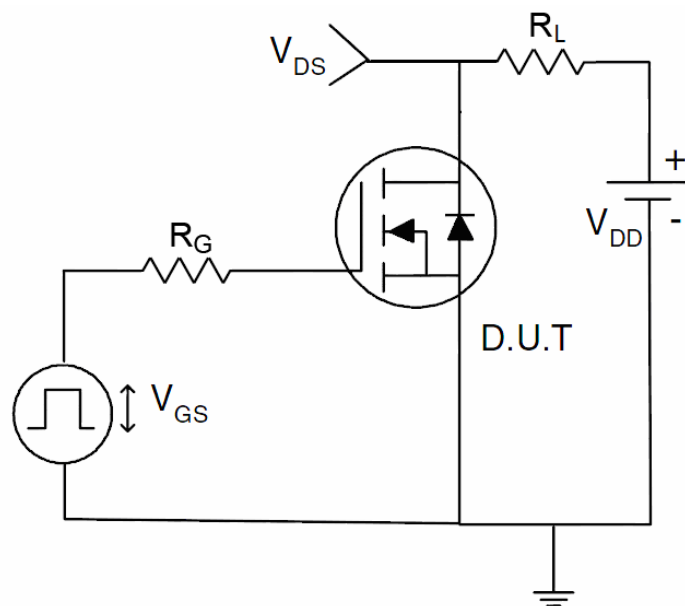
**1) E<sub>AS</sub> test Circuit**



**2) Gate charge test Circuit**



**3) Switch Time Test Circuit**



Typical Electrical and Thermal Characteristics

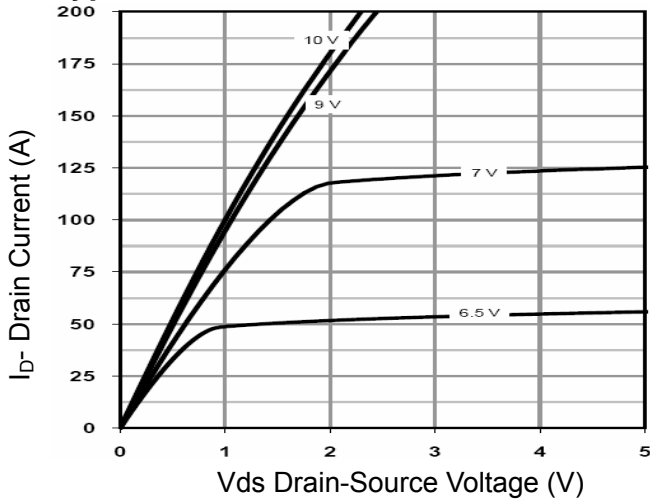


Figure 1 Output Characteristics

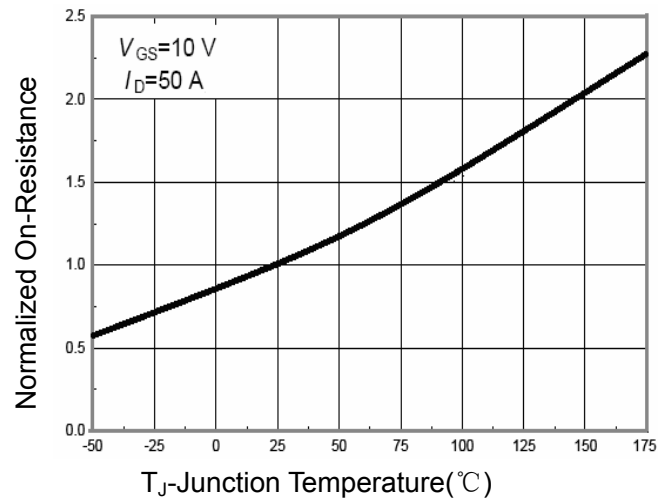


Figure 4 Rds(on)-Junction Temperature

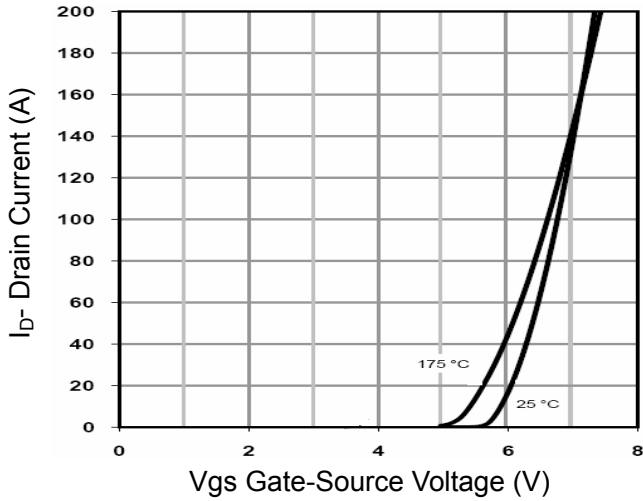


Figure 2 Transfer Characteristics

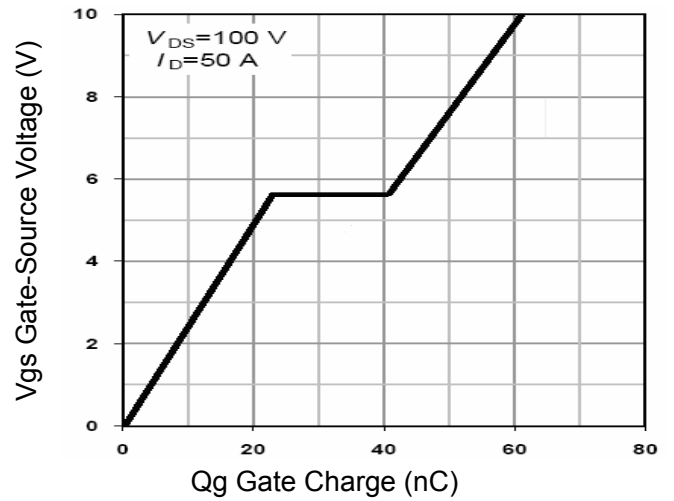


Figure 5 Gate Charge

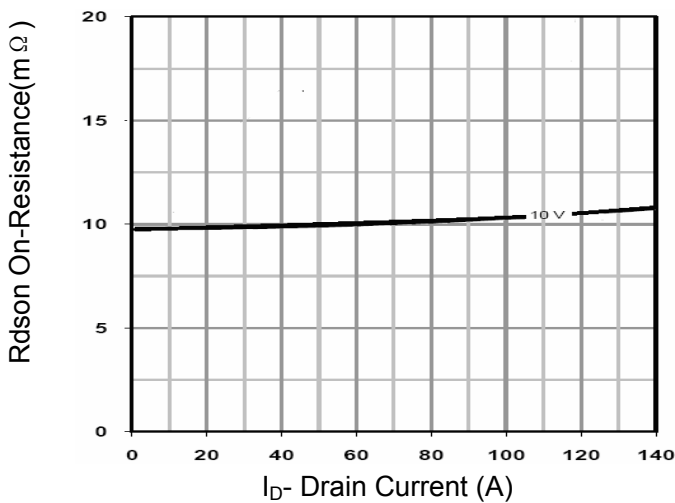


Figure 3 Rds(on)- Drain Current

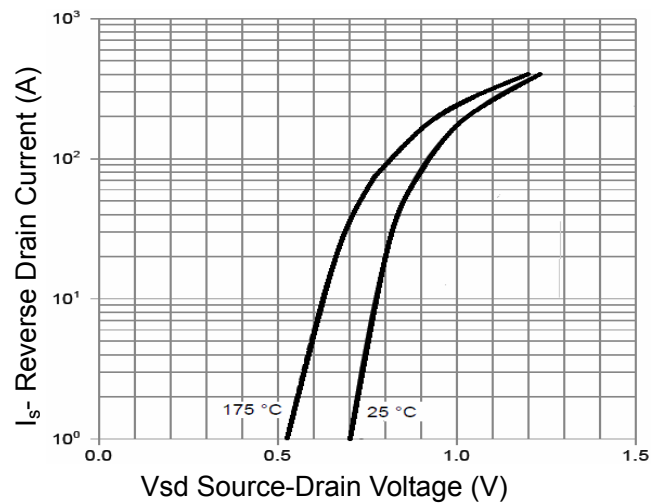


Figure 6 Source- Drain Diode Forward

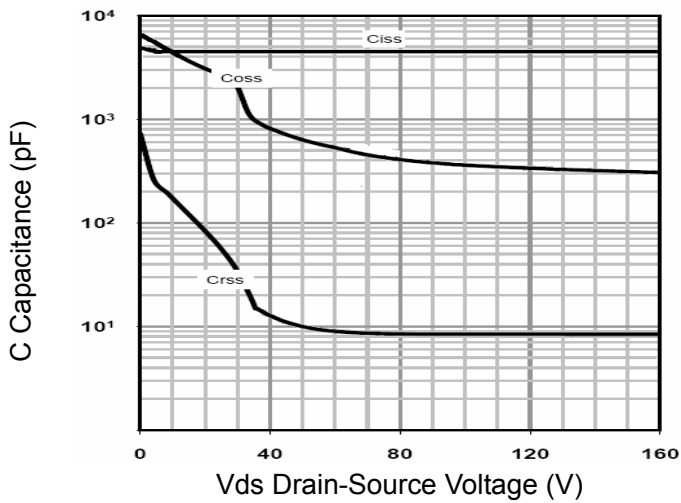


Figure 7 Capacitance vs Vds

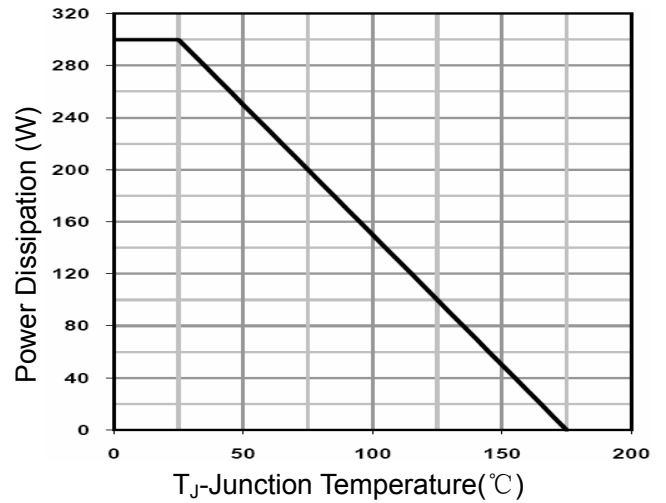


Figure 9 Power De-rating

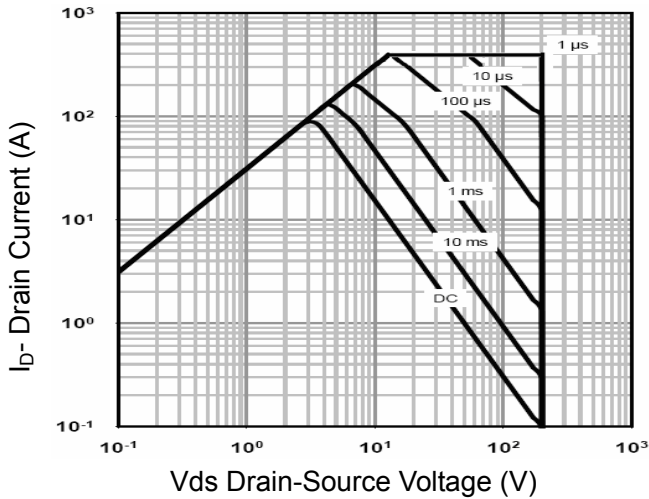


Figure 8 Safe Operation Area

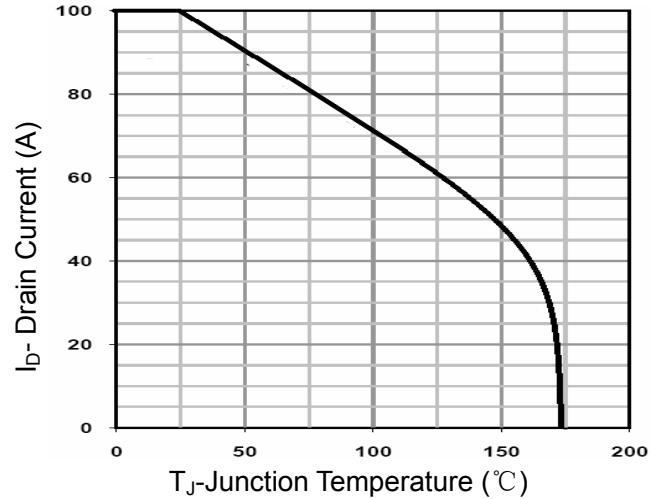


Figure 10 Current De-rating

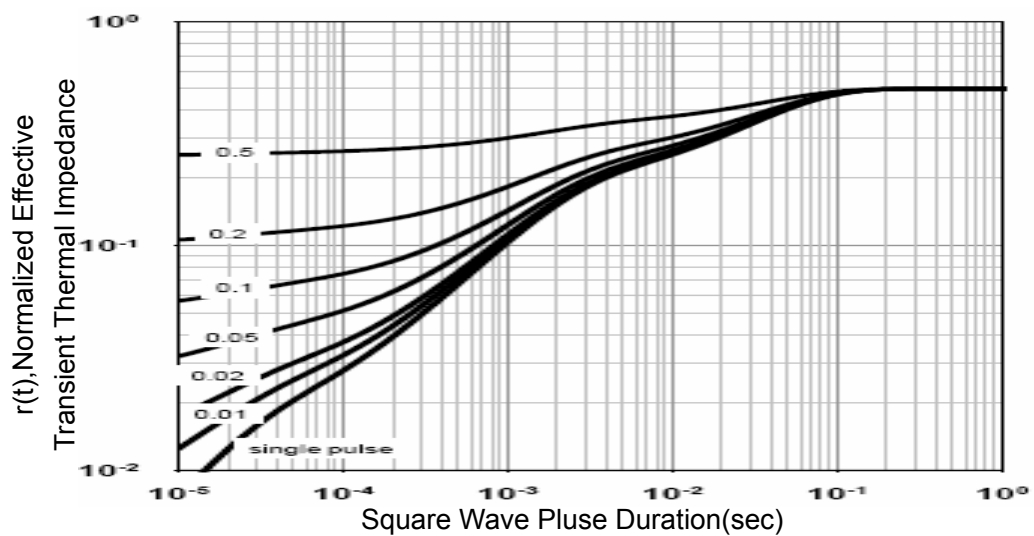
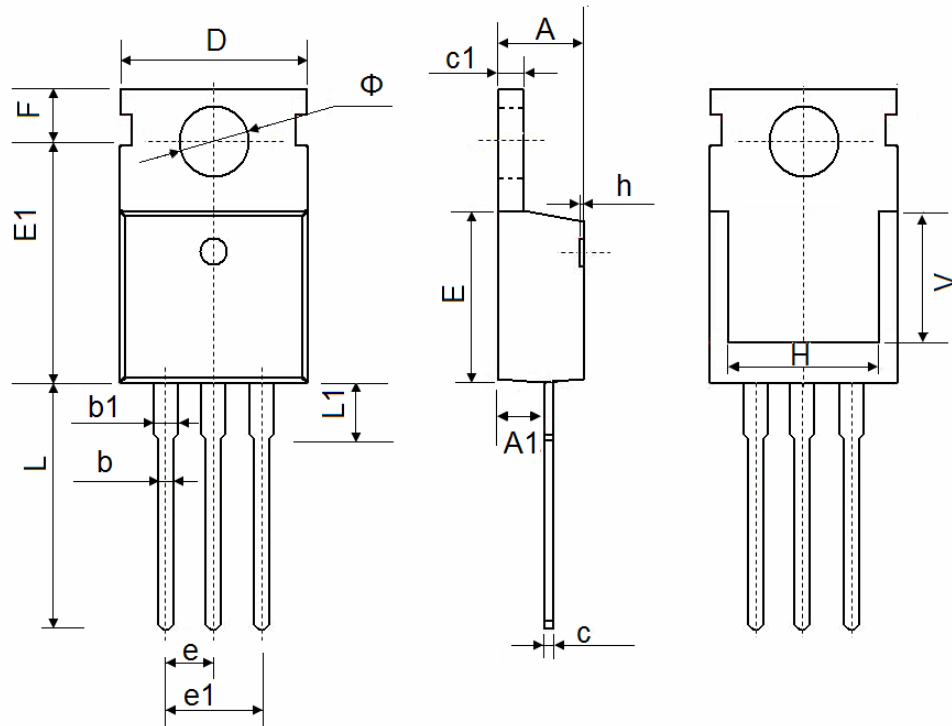


Figure 11 Normalized Maximum Transient Thermal Impedance

**TO-220-3L Package Information**


| Symbol | Dimensions In Millimeters |        | Dimensions In Inches |       |
|--------|---------------------------|--------|----------------------|-------|
|        | Min.                      | Max.   | Min.                 | Max.  |
| A      | 4.400                     | 4.600  | 0.173                | 0.181 |
| A1     | 2.250                     | 2.550  | 0.089                | 0.100 |
| b      | 0.710                     | 0.910  | 0.028                | 0.036 |
| b1     | 1.170                     | 1.370  | 0.046                | 0.054 |
| c      | 0.330                     | 0.650  | 0.013                | 0.026 |
| c1     | 1.200                     | 1.400  | 0.047                | 0.055 |
| D      | 9.910                     | 10.250 | 0.390                | 0.404 |
| E      | 8.9500                    | 9.750  | 0.352                | 0.384 |
| E1     | 12.650                    | 12.950 | 0.498                | 0.510 |
| e      | 2.540 TYP.                |        | 0.100 TYP.           |       |
| e1     | 4.980                     | 5.180  | 0.196                | 0.204 |
| F      | 2.650                     | 2.950  | 0.104                | 0.116 |
| H      | 7.900                     | 8.100  | 0.311                | 0.319 |
| h      | 0.000                     | 0.300  | 0.000                | 0.012 |
| L      | 12.900                    | 13.400 | 0.508                | 0.528 |
| L1     | 2.850                     | 3.250  | 0.112                | 0.128 |
| V      | 7.500 REF.                |        | 0.295 REF.           |       |
| Φ      | 3.400                     | 3.800  | 0.134                | 0.150 |

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