

## LCE N-Channel Enhancement Mode Power MOSFET

### Description

The LCE6990 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

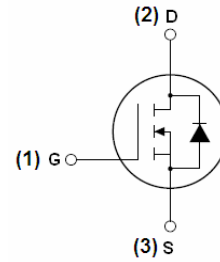
- $V_{DS} = 69V, I_D = 90A$   
 $R_{DS(ON)} < 7.2m\Omega @ V_{GS} = 10V$  (Typ: 6.2m $\Omega$ )
- High density cell design for ultra low  $R_{dson}$
- Fully characterized avalanche voltage and current
- Good stability and uniformity with high  $E_{AS}$
- Excellent package for good heat dissipation
- Special process technology for high ESD capability

### Application

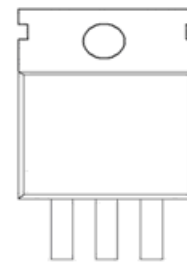
- Power switching application
- Hard switched and high frequency circuits
- Uninterruptible power supply

**100% UIS TESTED!**

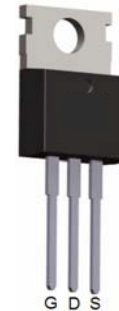
**100%  $\Delta V_{ds}$  TESTED!**



Schematic diagram



Marking and pin assignment



TO-220-3L top view

### Package Marking and Ordering Information

| Device Marking | Device  | Device Package | Reel Size | Tape width | Quantity |
|----------------|---------|----------------|-----------|------------|----------|
| NCE6990        | LCE6990 | TO-220         | -         | -          | -        |

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

| Parameter   | Symbol               | Limit      | Unit          |
|---|----------------------|------------|---------------|
| Drain-Source Voltage                              | $V_{DS}$             | 69         | V             |
| Gate-Source Voltage                               | $V_{GS}$             | $\pm 20$   | V             |
| Drain Current-Continuous                          | $I_D$                | 90         | A             |
| Drain Current-Continuous( $T_C = 100^\circ C$ )   | $I_{D(100^\circ C)}$ | 62         | A             |
| Pulsed Drain Current                              | $I_{DM}$             | 310        | A             |
| Maximum Power Dissipation                         | $P_D$                | 160        | W             |
| Derating factor                                   |                      | 1.1        | W/ $^\circ C$ |
| Single pulse avalanche energy <sup>(Note 5)</sup> | $E_{AS}$             | 450        | 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> | $R_{\theta JC}$ | 0.9 | $^{\circ}C/W$ |
|--|-----------------|-----|---------------|

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

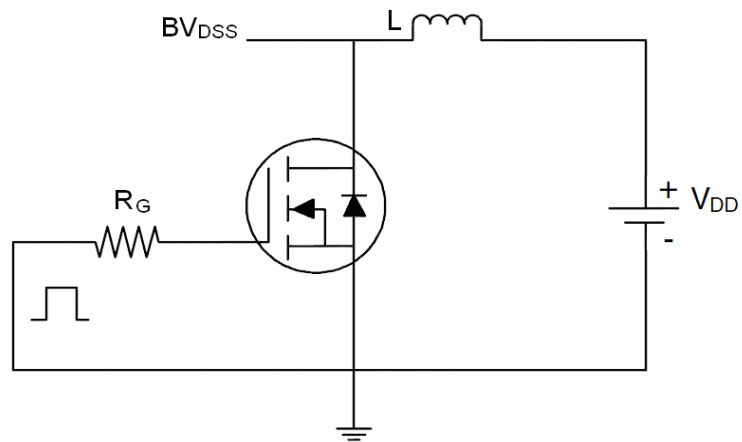
| Parameter  | Symbol       | Condition  | Min | Typ  | Max       | Unit       |
|--|--------------|--|-----|------|-----------|------------|
| <b>Off Characteristics</b>                           |              |  |     |      |           |            |
| Drain-Source Breakdown Voltage                       | $B_{VDSS}$   | $V_{GS}=0V, I_D=250\mu A$  | 69  | 73   | -         | V          |
| Zero Gate Voltage Drain Current                      | $I_{DSS}$    | $V_{DS}=69V, V_{GS}=0V$  | -   | -    | 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   | 2.9  | 4         | V          |
| Drain-Source On-State Resistance                     | $R_{DS(on)}$ | $V_{GS}=10V, I_D=30A$  | -   | 6.2  | 7.2       | m $\Omega$ |
| Forward Transconductance                             | $g_{FS}$     | $V_{DS}=10V, I_D=100A$   | 25  | -    | -         | S          |
| <b>Dynamic Characteristics</b> <sup>(Note 4)</sup>   |              |  |     |      |           |            |
| Input Capacitance                                    | $C_{iss}$    | $V_{DS}=25V, V_{GS}=0V,$<br>$F=1.0MHz$                                     | -   | 3400 | -         | PF         |
| Output Capacitance                                   | $C_{oss}$    |  | -   | 310  | -         | PF         |
| Reverse Transfer Capacitance                         | $C_{riss}$   |  | -   | 221  | -         | PF         |
| <b>Switching Characteristics</b> <sup>(Note 4)</sup> |              |  |     |      |           |            |
| Turn-on Delay Time                                   | $t_{d(on)}$  | $V_{DD}=30V, I_D=2A, R_L=15\Omega$<br>$V_{GS}=10V, R_G=2.5\Omega$          | -   | 15   | -         | nS         |
| Turn-on Rise Time                                    | $t_r$        |  | -   | 11   | -         | nS         |
| Turn-Off Delay Time                                  | $t_{d(off)}$ |  | -   | 52   | -         | nS         |
| Turn-Off Fall Time                                   | $t_f$        |  | -   | 13   | -         | nS         |
| Total Gate Charge                                    | $Q_g$        | $V_{DS}=30V, I_D=30A,$<br>$V_{GS}=10V$                                     | -   | 94   | -         | nC         |
| Gate-Source Charge                                   | $Q_{gs}$     |  | -   | 16   | -         | nC         |
| Gate-Drain Charge                                    | $Q_{gd}$     |  | -   | 24   | -         | nC         |
| <b>Drain-Source Diode Characteristics</b>            |              |  |     |      |           |            |
| Diode Forward Voltage <sup>(Note 3)</sup>            | $V_{SD}$     | $V_{GS}=0V, I_S=90A$   | -   | -    | 1.2       | V          |
| Diode Forward Current <sup>(Note 2)</sup>            | $I_S$        |  | -   | -    | 90        | A          |
| Reverse Recovery Time                                | $t_{rr}$     | $T_J = 25^{\circ}C, I_F = 90A$<br>$di/dt = 100A/\mu s$ <sup>(Note 3)</sup> | -   | 33   |           | nS         |
| Reverse Recovery Charge                              | $Q_{rr}$     |  | -   | 54   |           | nC         |
| Forward Turn-On Time                                 | $t_{on}$     | Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)       |     |      |           |            |

**Notes:**

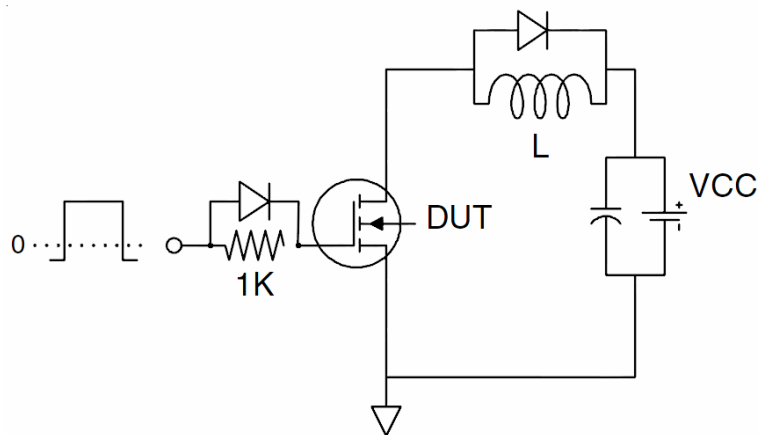
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5. EAS condition:  $T_J=25^{\circ}C, V_{DD}=35V, V_G=10V, L=0.5mH, R_g=25\Omega$

**Test Circuit**

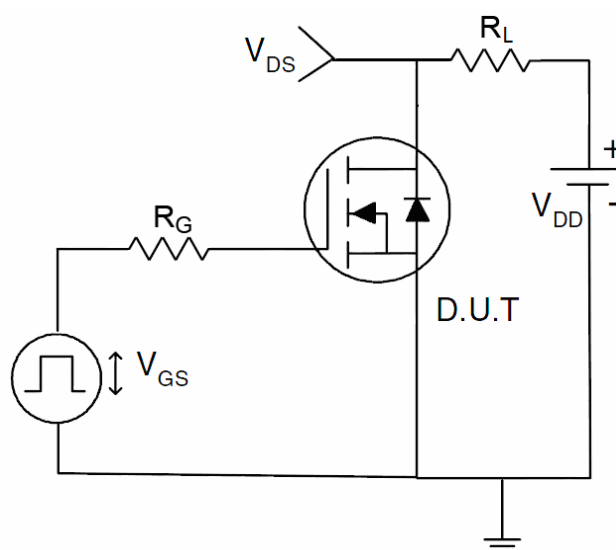
**1) EAS test Circuit**



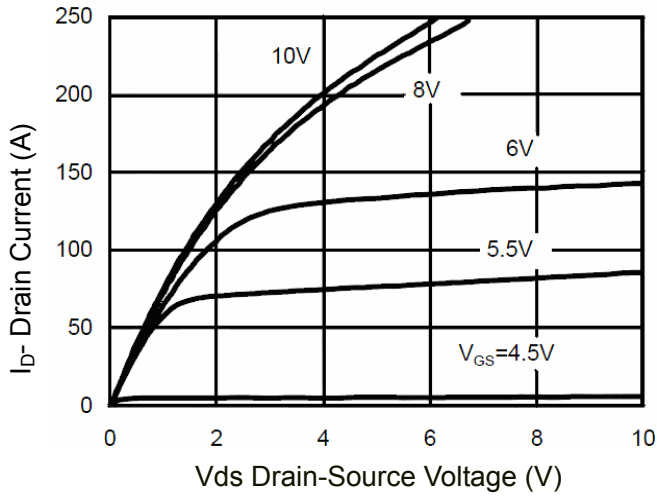
**2) Gate charge test Circuit**



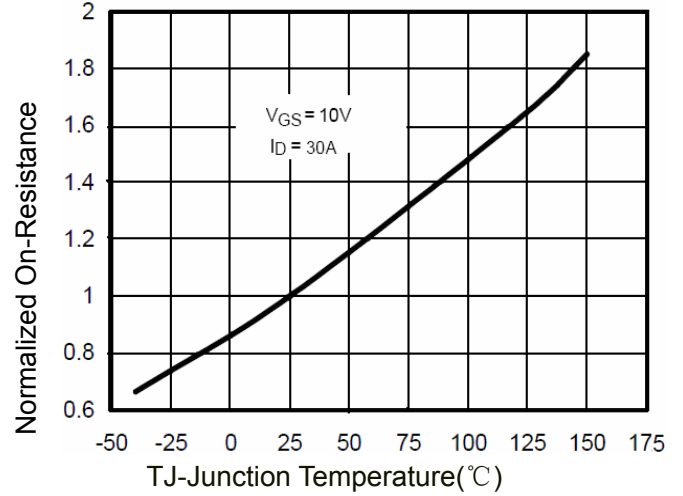
**3) Switch Time Test Circuit**



**Typical Electrical and Thermal Characteristics (Curves)**



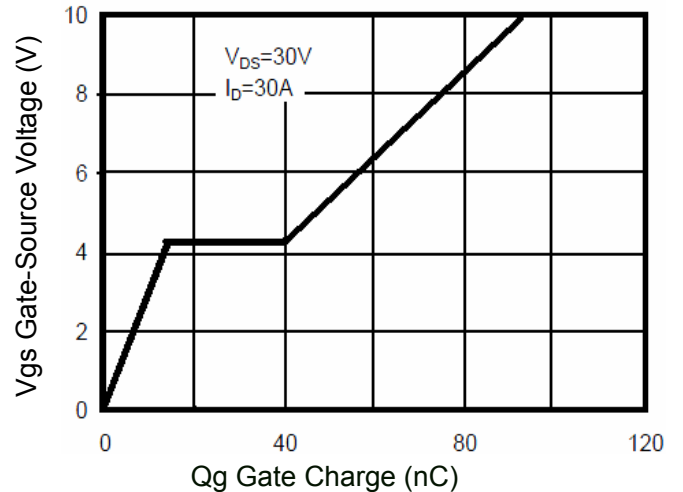
**Figure 1 Output Characteristics**



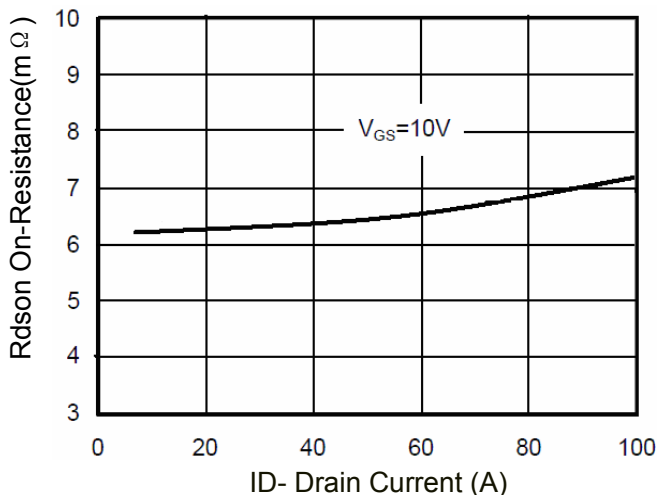
**Figure 4 Rdson-Junction Temperature**



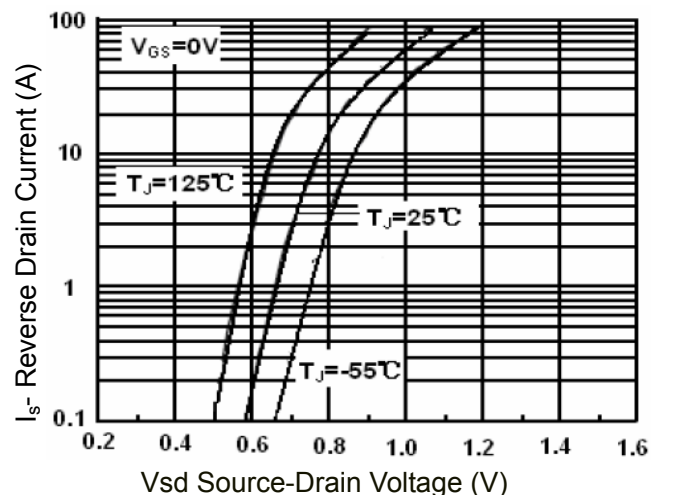
**Figure 2 Transfer Characteristics**



**Figure 5 Gate Charge**



**Figure 3 Rdson- Drain Current**



**Figure 6 Source- Drain Diode Forward**

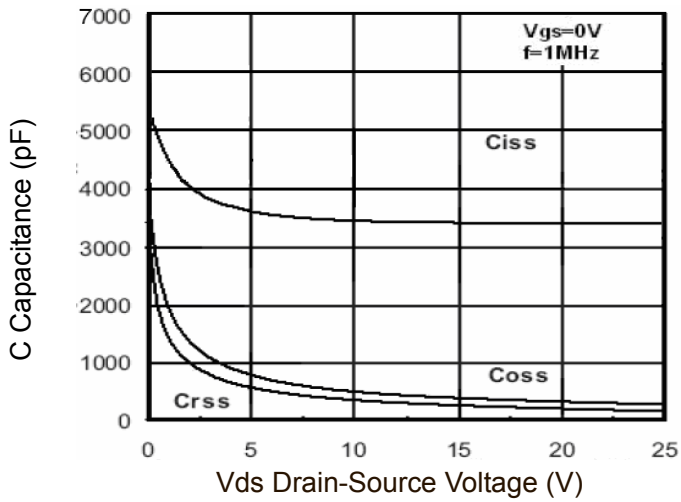


Figure 7 Capacitance vs Vds

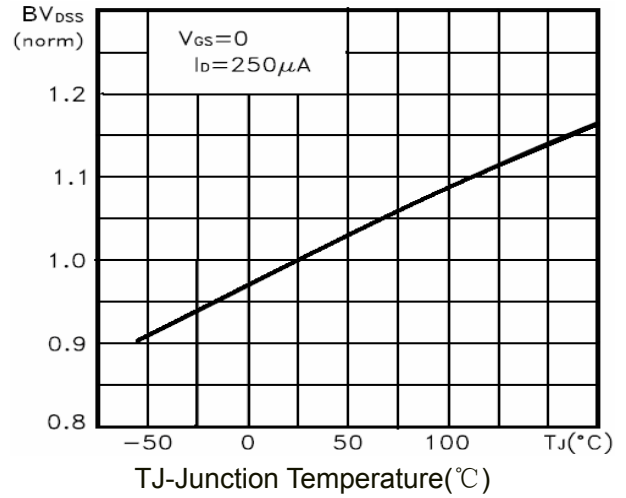


Figure 9  $BV_{DSS}$  vs Junction Temperature

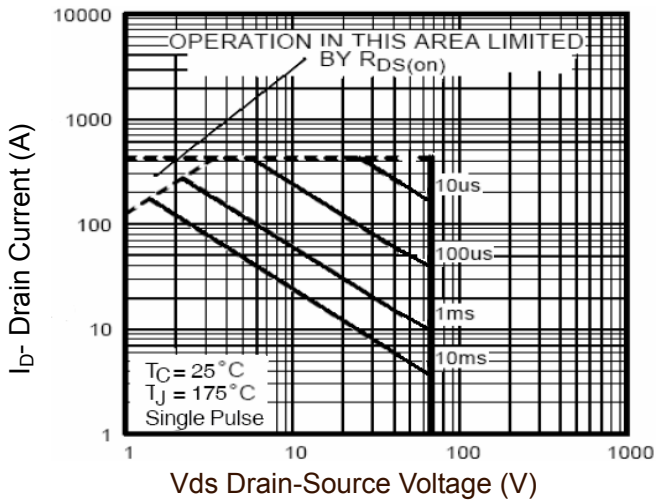


Figure 8 Safe Operation Area

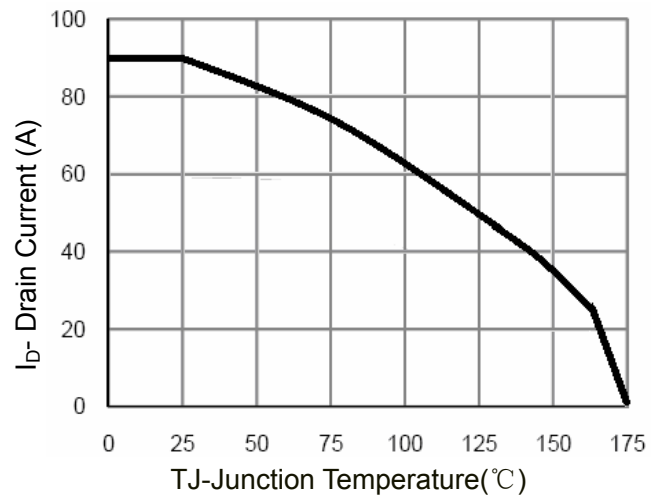


Figure 10 Current vs Junction Temperature

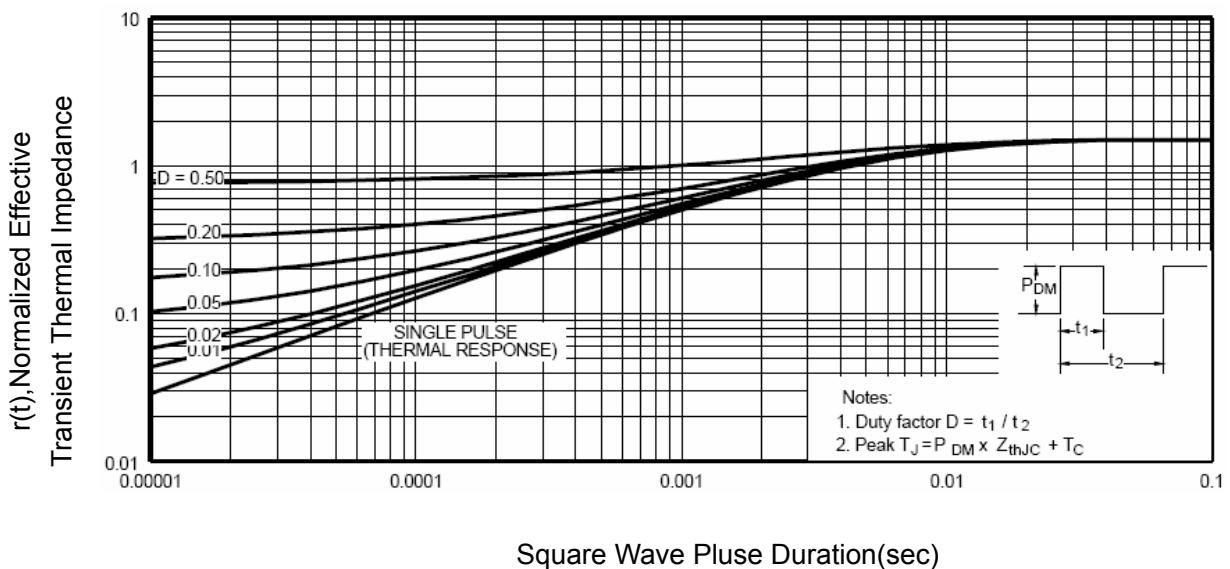
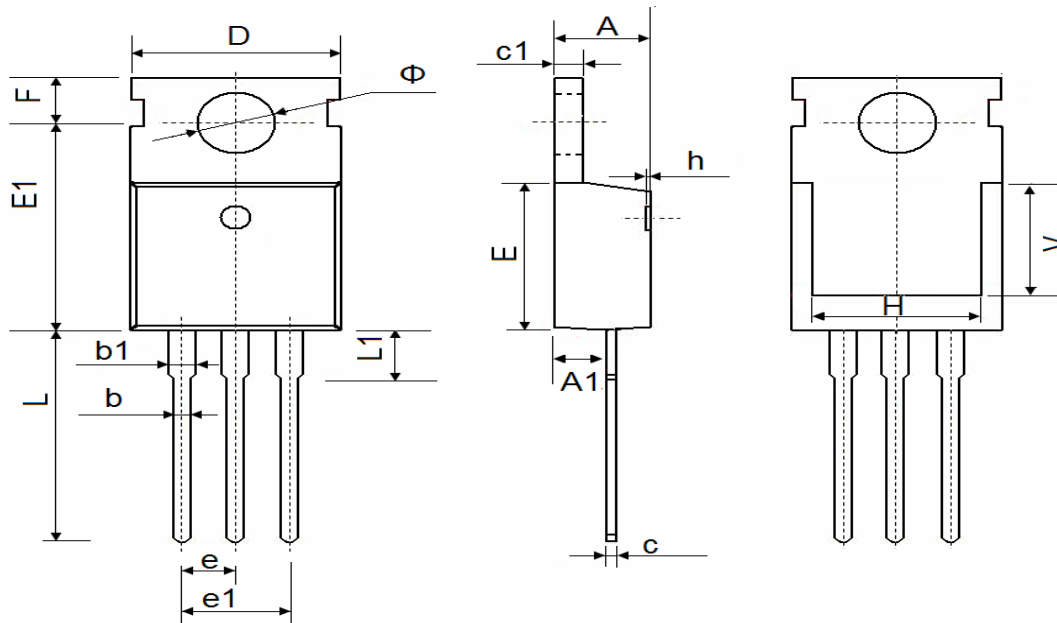


Figure 11 Normalized Maximum Transient Thermal Impedance

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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