

## N-Channel Enhancement Mode Power MOSFET

### Description

The HM50N20 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

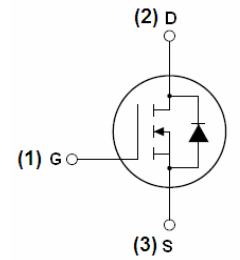
- $V_{DS} = 200V, I_D = 50A$   
 $R_{DS(ON)} < 40m\Omega @ V_{GS} = 10V$  (Typ: 30mΩ)
- High density cell design for ultra low  $R_{DS(on)}$
- Fully characterized avalanche voltage and current
- Good stability and uniformity with high  $E_{AS}$
- Excellent package for good heat dissipation
- Special process technology for high ESD capability

### Application

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

**100% UIS TESTED!**

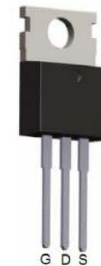
**100%  $\Delta V_{ds}$  TESTED!**



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 |
|----------------|---------|----------------|-----------|------------|----------|
| HM50N20        | HM50N20 | 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                          | $I_D$               | 50         | A          |
| Drain Current-Continuous ( $T_C = 100^\circ C$ )  | $I_D (100^\circ C)$ | 35         | A          |
| Pulsed Drain Current                              | $I_{DM}$            | 200        | A          |
| Maximum Power Dissipation                         | $P_D$               | 270        | W          |
| Single pulse avalanche energy <sup>(Note 5)</sup> | $E_{AS}$            | 500        | 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> | $R_{\theta JC}$ | 0.6 | $^\circ C/W$ |
|----------------------------------------------------------|-----------------|-----|--------------|

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

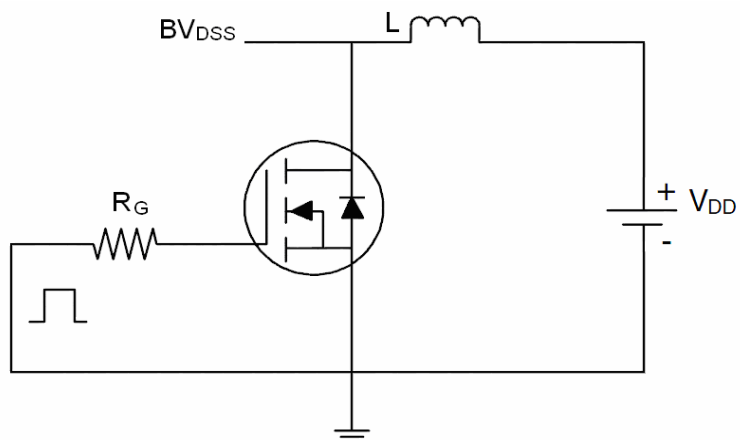
| Parameter                                     | Symbol              | Condition                                                                                  | Min | Typ  | Max  | Unit |
|-----------------------------------------------|---------------------|--------------------------------------------------------------------------------------------|-----|------|------|------|
| Off Characteristics                           |                     |                                                                                            |     |      |      |      |
| Drain-Source Breakdown Voltage                | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =250μA                                                  | 200 | 220  | -    | V    |
| Zero Gate Voltage Drain Current               | I <sub>DSS</sub>    | V <sub>DS</sub> =200V, 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                                   | 2   | 3    | 4    | V    |
| Drain-Source On-State Resistance              | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =28A                                                  | -   | 30   | 40   | mΩ   |
| Forward Transconductance                      | g <sub>FS</sub>     | V <sub>DS</sub> =10V, I <sub>D</sub> =20A                                                  | 25  | -    | -    | S    |
| Dynamic Characteristics <sup>(Note4)</sup>    |                     |                                                                                            |     |      |      |      |
| Input Capacitance                             | C <sub>iss</sub>    | V <sub>DS</sub> =25V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                     |     | 5460 |      | PF   |
| Output Capacitance                            | C <sub>oss</sub>    |                                                                                            |     | 603  |      | PF   |
| Reverse Transfer Capacitance                  | C <sub>rss</sub>    |                                                                                            |     | 161  |      | PF   |
| Switching Characteristics <sup>(Note 4)</sup> |                     |                                                                                            |     |      |      |      |
| Turn-on Delay Time                            | t <sub>d(on)</sub>  | V <sub>DD</sub> =100V, I <sub>D</sub> =28A<br>V <sub>GS</sub> =10V, R <sub>GEN</sub> =2.5Ω | -   | 17   | -    | nS   |
| Turn-on Rise Time                             | t <sub>r</sub>      |                                                                                            | -   | 60   | -    | nS   |
| Turn-Off Delay Time                           | t <sub>d(off)</sub> |                                                                                            | -   | 55   | -    | nS   |
| Turn-Off Fall Time                            | t <sub>f</sub>      |                                                                                            | -   | 48   | -    | nS   |
| Total Gate Charge                             | Q <sub>g</sub>      | V <sub>DS</sub> =100V, I <sub>D</sub> =28A,<br>V <sub>GS</sub> =10V                        |     | 150  |      | nC   |
| Gate-Source Charge                            | Q <sub>gs</sub>     |                                                                                            |     | 25   |      | nC   |
| Gate-Drain Charge                             | Q <sub>gd</sub>     |                                                                                            |     | 50   |      | 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>      | -                                                                                          | -   | -    | 50   | A    |
| Reverse Recovery Time                         | t <sub>rr</sub>     | T <sub>J</sub> = 25°C, I <sub>F</sub> =28A<br>di/dt = 100A/μs <sup>(Note3)</sup>           | -   | 100  | -    | nS   |
| Reverse Recovery Charge                       | Q <sub>rr</sub>     |                                                                                            | -   | 320  | -    | nC   |
| Forward Turn-On Time                          | t <sub>on</sub>     | Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)                       |     |      |      |      |

**Notes:**

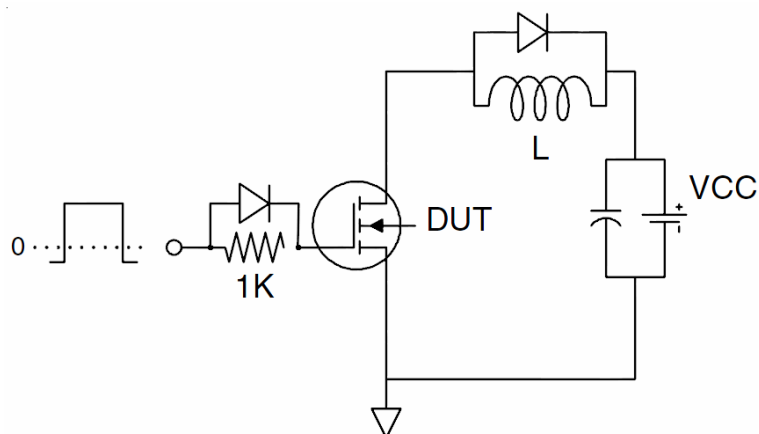
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5. EAS condition:  $T_J=25^{\circ}\text{C}, V_{DD}=50V,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

## Test Circuit

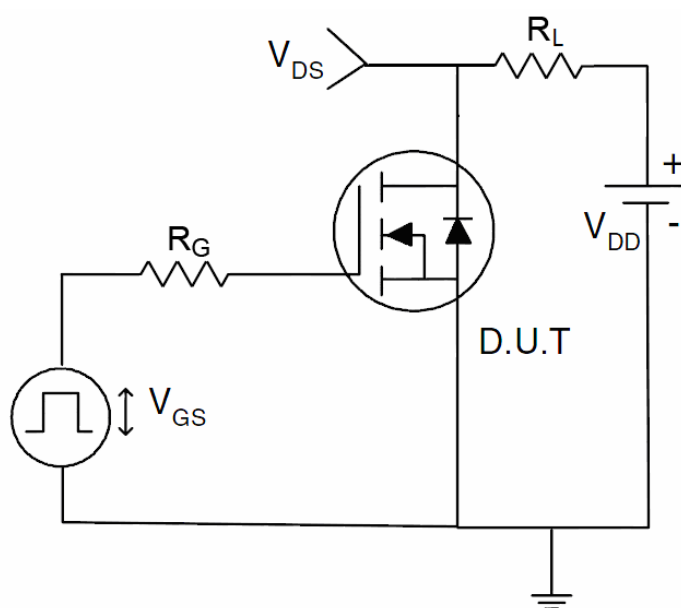
### 1) $E_{AS}$ test Circuits



### 2) Gate charge test Circuit:



### 3) Switch Time Test Circuit:



## Typical Electrical and Thermal Characteristics (Curves)

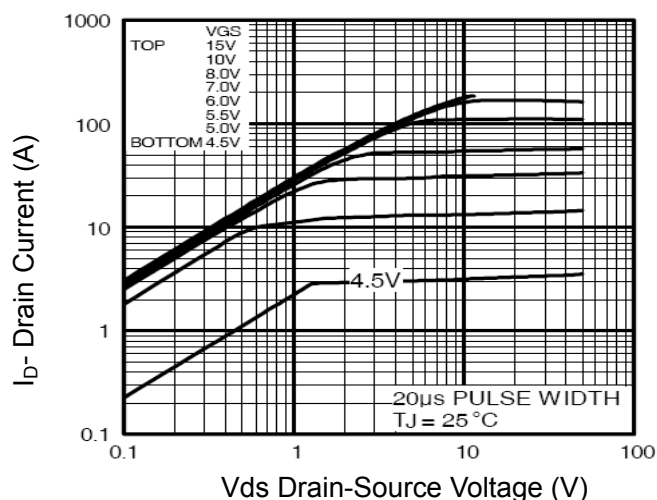


Figure 1 Output Characteristics

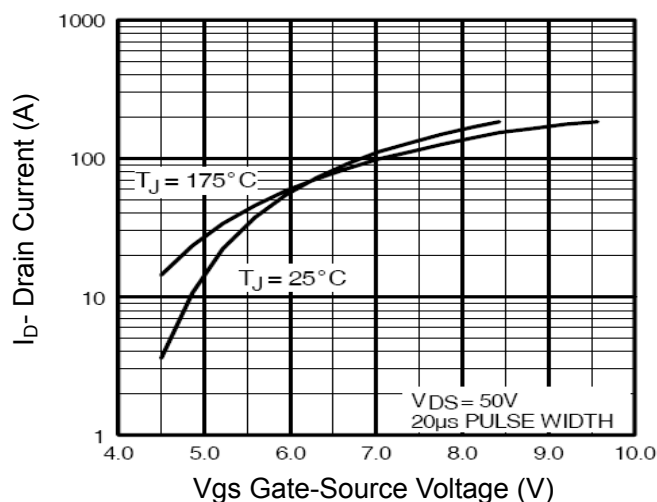


Figure 2 Transfer Characteristics

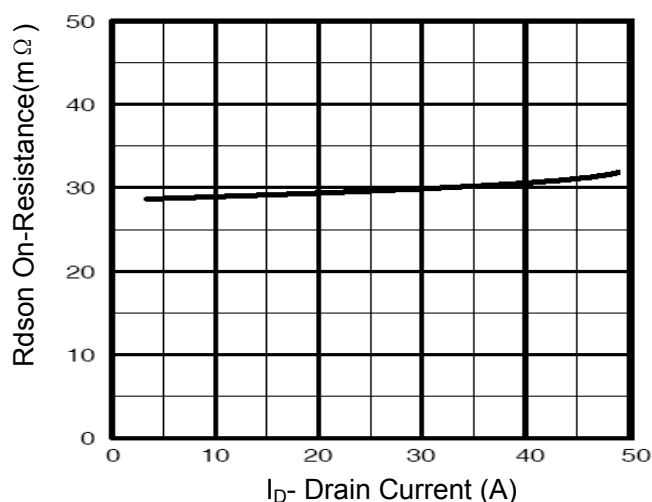


Figure 3  $R_{DS(on)}$ - Drain Current

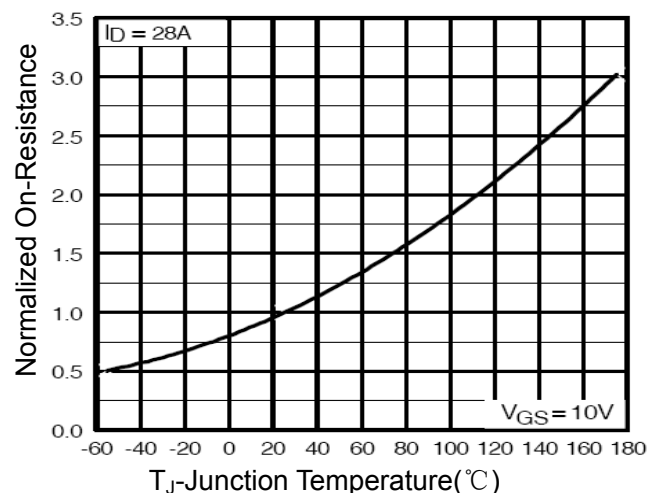


Figure 4  $R_{DS(on)}$ -Junction Temperature

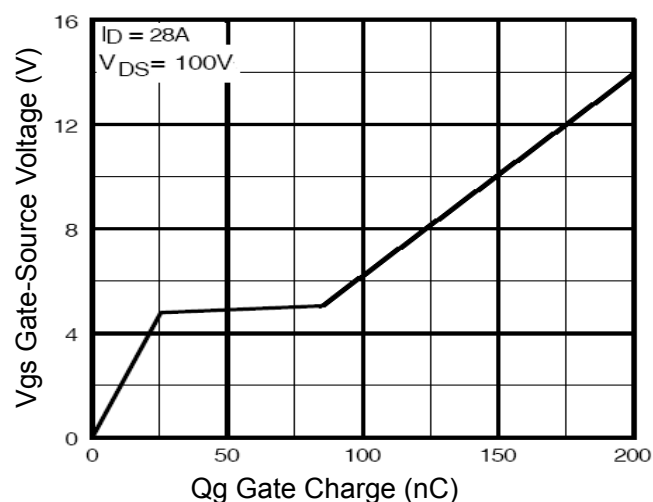


Figure 5 Gate Charge

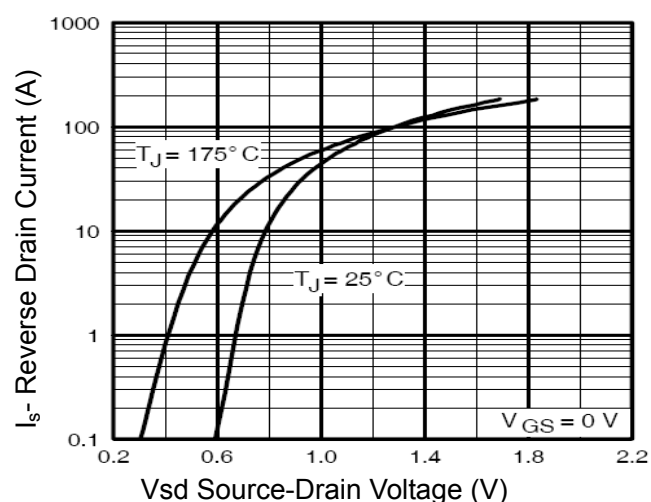


Figure 6 Source- Drain Diode Forward

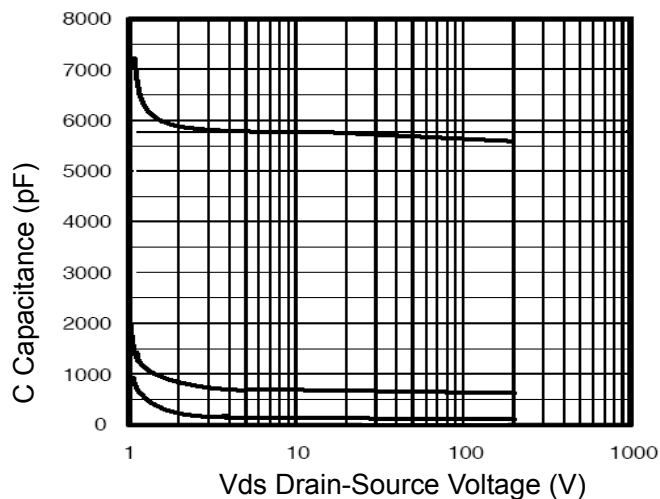


Figure 7 Capacitance vs Vds

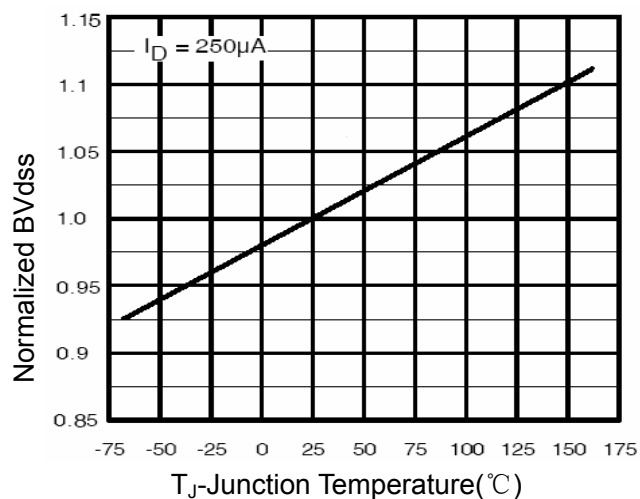


Figure 9  $BV_{DSS}$  vs Junction Temperature

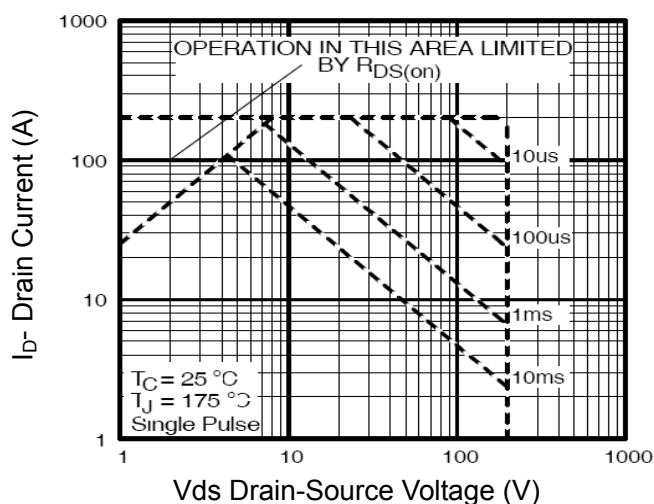


Figure 8 Safe Operation Area

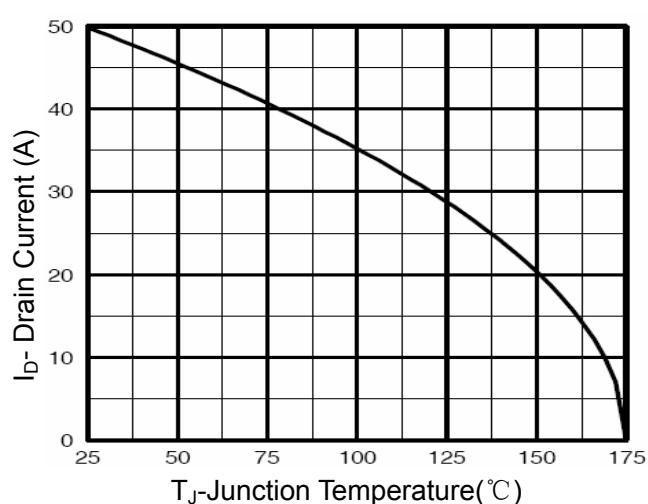


Figure 10  $I_D$  Current De-rating

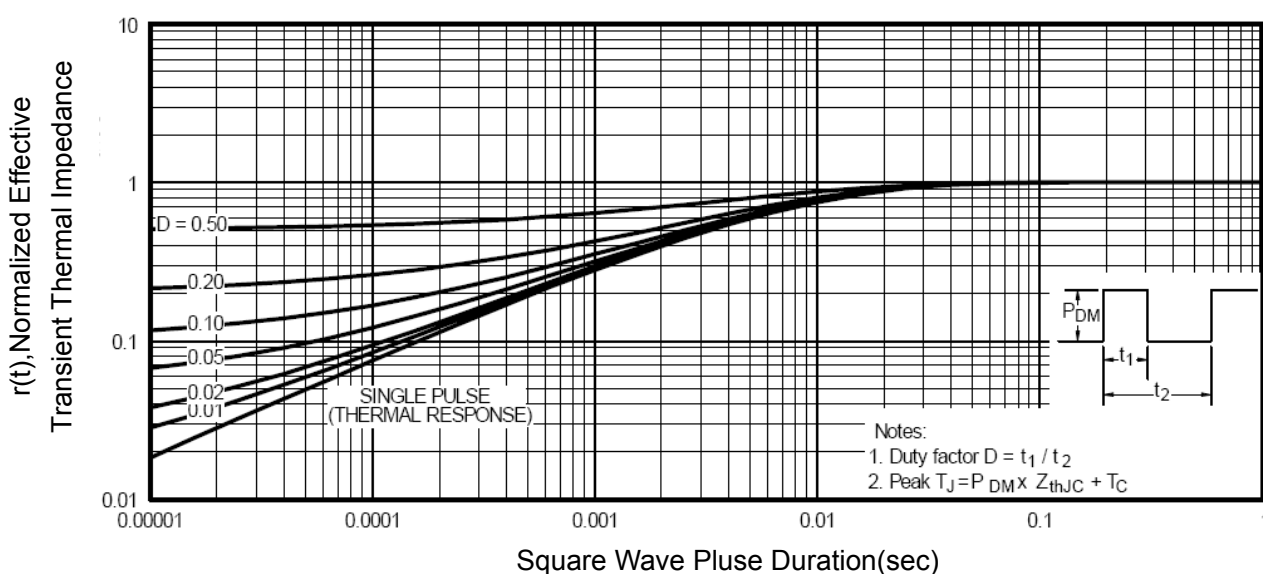
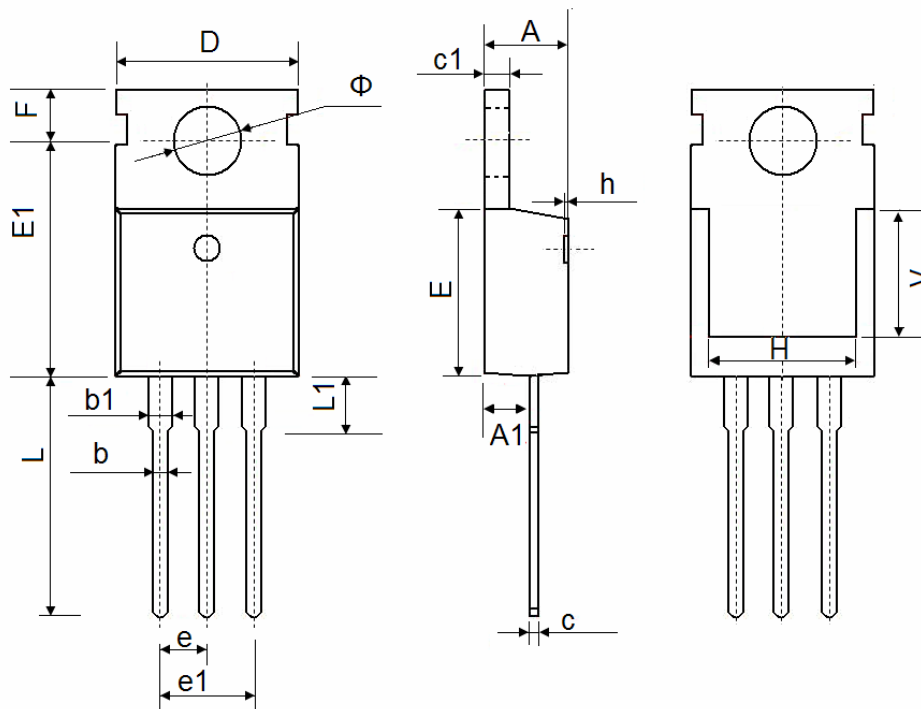


Figure 11 Normalized Maximum Transient Thermal Impedance

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 |