

## N-Channel Super Trench II Power MOSFET

### Description

The series of devices uses **Super Trench II** 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.

### Application

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

### General Features

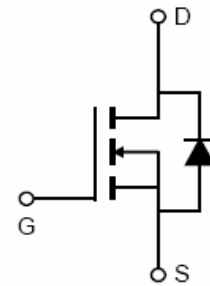
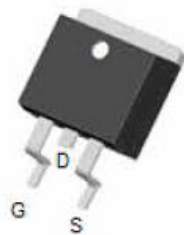
- $V_{DS} = 100V, I_D = 120A$   
 $R_{DS(on)} = 4.6m\Omega$ , typical (TO-263) @  $V_{GS} = 10V$   
 $R_{DS(on)} = 4.7m\Omega$ , typical (TO-220) @  $V_{GS} = 10V$
- Excellent gate charge x  $R_{DS(on)}$  product(FOM)
- Very low on-resistance  $R_{DS(on)}$
- 175 °C operating temperature
- Pb-free lead plating

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

TO-220



TO-263



Schematic Diagram

### Package Marking and Ordering Information

| Device Marking | Device     | Device Package | Reel Size | Tape width | Quantity |
|----------------|------------|----------------|-----------|------------|----------|
| HMS120N10      | HMS120N10  | TO-220         | -         | -          | -        |
| HMS120N10D     | HMS120N10D | TO-263         | -         | -          | -        |

### 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                          | $I_D$              | 120        | A             |
| Drain Current-Continuous( $T_C = 100^\circ C$ )   | $I_D(100^\circ C)$ | 84         | A             |
| Pulsed Drain Current                              | $I_{DM}$           | 360        | A             |
| Maximum Power Dissipation                         | $P_D$              | 200        | W             |
| Derating factor                                   |                    | 1.33       | W/ $^\circ C$ |
| Single pulse avalanche energy <sup>(Note 5)</sup> | $E_{AS}$           | 1050       | 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> | $R_{\theta JC}$ | 0.75 | $^{\circ}\text{C/W}$ |
|----------------------------------------------------------|-----------------|------|----------------------|

## 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                                               | 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                                              | -      | -    | ±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                                | 2.0    | 3.0  | 4.0  | V    |    |
| Drain-Source On-State Resistance              | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =70A                                               | TO-263 | -    | 4.6  | 6.0  | mΩ |
|                                               |                     |                                                                                         | TO-220 |      | 4.7  | 6.0  | mΩ |
| Forward Transconductance                      | g <sub>FS</sub>     | V <sub>DS</sub> =5V, I <sub>D</sub> =70A                                                |        | 90   | -    | S    |    |
| Dynamic Characteristics <sup>(Note4)</sup>    |                     |                                                                                         |        |      |      |      |    |
| Input Capacitance                             | C <sub>ISS</sub>    | V <sub>DS</sub> =40V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                  | -      | 4950 | -    | PF   |    |
| Output Capacitance                            | C <sub>OSS</sub>    |                                                                                         | -      | 850  | -    | PF   |    |
| Reverse Transfer Capacitance                  | C <sub>rss</sub>    |                                                                                         | -      | 40   | -    | PF   |    |
| Switching Characteristics <sup>(Note 4)</sup> |                     |                                                                                         |        |      |      |      |    |
| Turn-on Delay Time                            | t <sub>d(on)</sub>  | V <sub>DD</sub> =40V, I <sub>D</sub> =70A<br>V <sub>GS</sub> =10V, R <sub>G</sub> =1.6Ω | -      | 18   | -    | nS   |    |
| Turn-on Rise Time                             | t <sub>r</sub>      |                                                                                         | -      | 11   | -    | nS   |    |
| Turn-Off Delay Time                           | t <sub>d(off)</sub> |                                                                                         | -      | 38   | -    | nS   |    |
| Turn-Off Fall Time                            | t <sub>f</sub>      |                                                                                         | -      | 9    | -    | nS   |    |
| Total Gate Charge                             | Q <sub>g</sub>      | V <sub>DS</sub> =40V, I <sub>D</sub> =70A,<br>V <sub>GS</sub> =10V                      | -      | 88   | -    | nC   |    |
| Gate-Source Charge                            | Q <sub>gs</sub>     |                                                                                         | -      | 22   |      | nC   |    |
| Gate-Drain Charge                             | Q <sub>gd</sub>     |                                                                                         | -      | 25   |      | 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> =70A                                                | -      |      | 1.2  | V    |    |
| Diode Forward Current <sup>(Note 2)</sup>     | I <sub>S</sub>      |                                                                                         | -      | -    | 120  | A    |    |
| Reverse Recovery Time                         | t <sub>rr</sub>     | T <sub>J</sub> = 25°C, I <sub>F</sub> = 70A<br>di/dt = 100A/μs <sup>(Note3)</sup>       | -      | 72   | -    | nS   |    |
| Reverse Recovery Charge                       | Q <sub>rr</sub>     |                                                                                         | -      | 102  | -    | 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 :  $T_J=25^{\circ}\text{C}, V_{DD}=40V, V_G=10V, L=0.5\text{mH}, R_G=25\Omega$

Typical Electrical and Thermal Characteristics

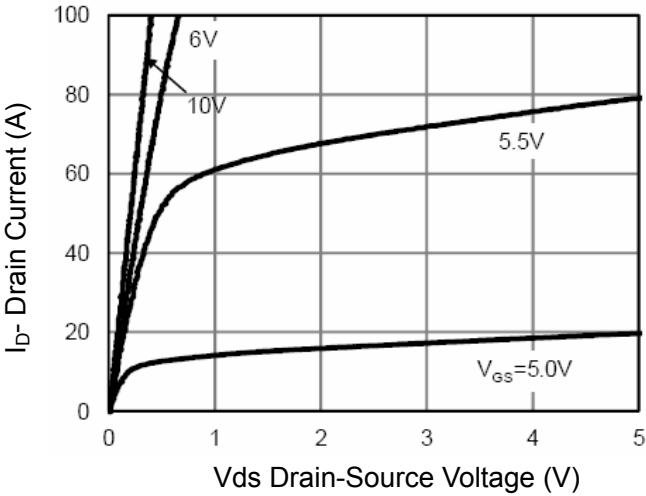


Figure 1 Output Characteristics

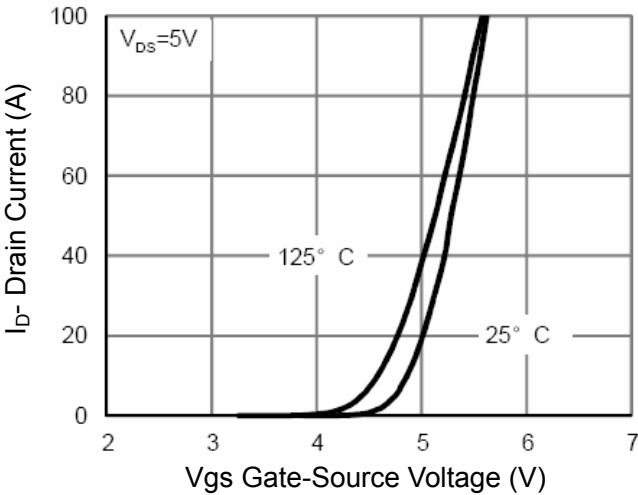


Figure 2 Transfer Characteristics

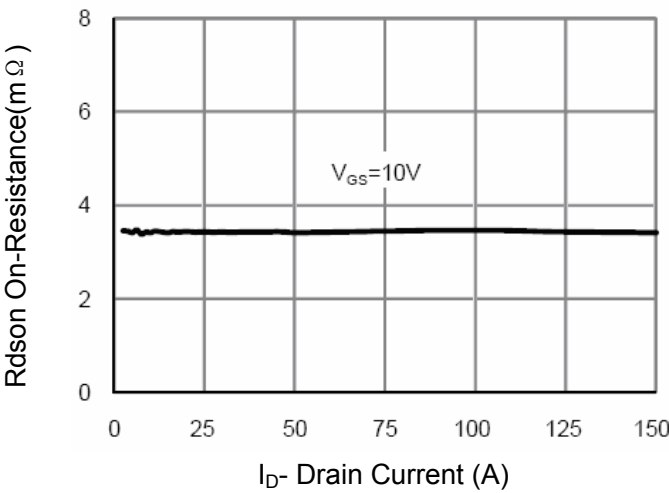


Figure 3  $R_{DS(on)}$ - Drain Current

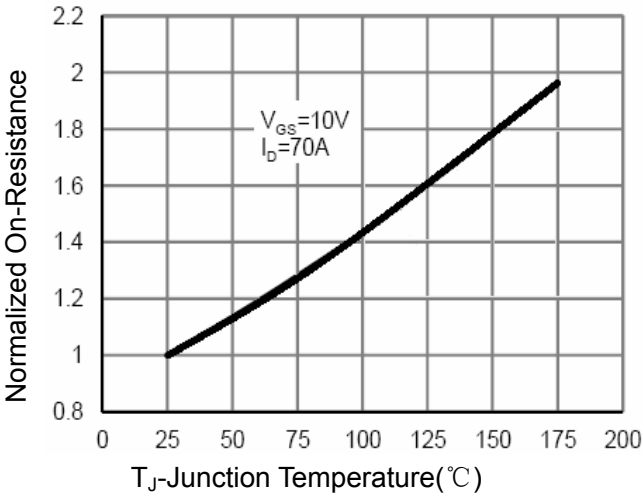


Figure 4  $R_{DS(on)}$ -Junction Temperature

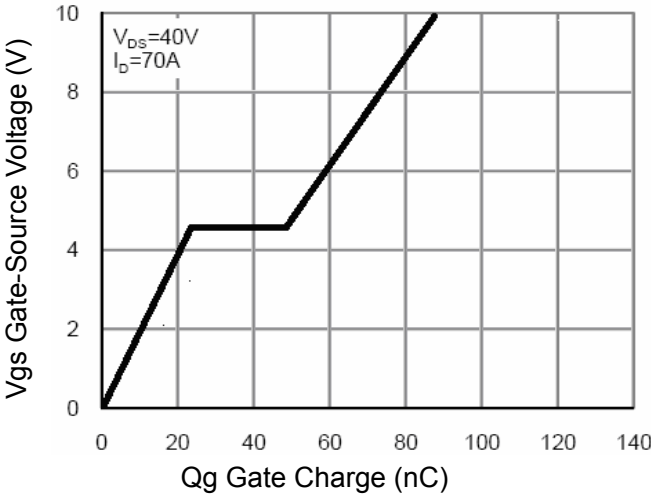


Figure 5 Gate Charge

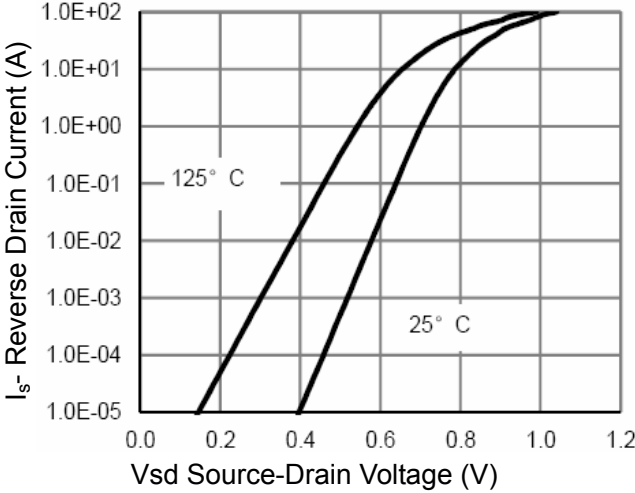


Figure 6 Source- Drain Diode Forward

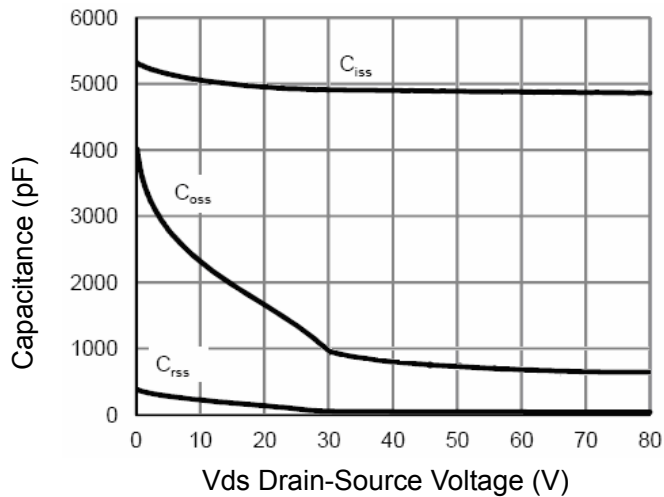


Figure 7 Capacitance vs Vds

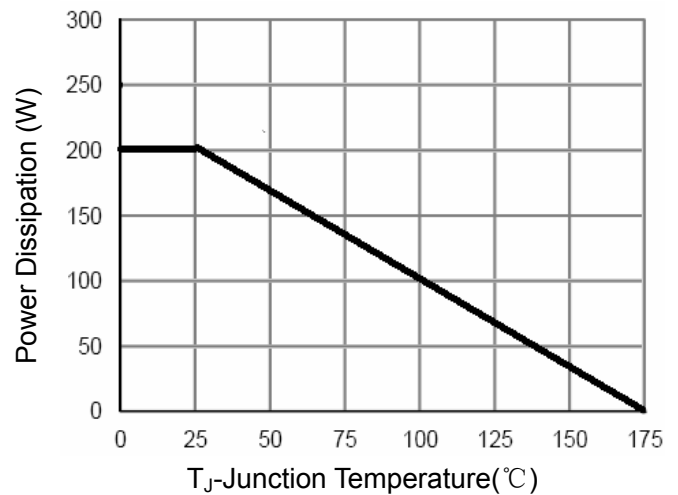


Figure 9 Power De-rating

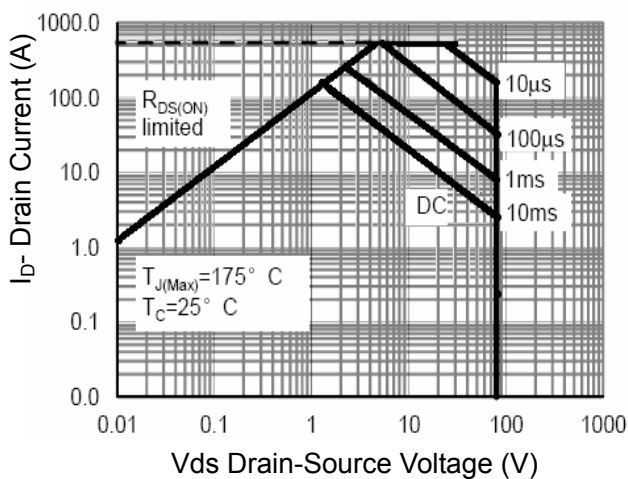


Figure 8 Safe Operation Area

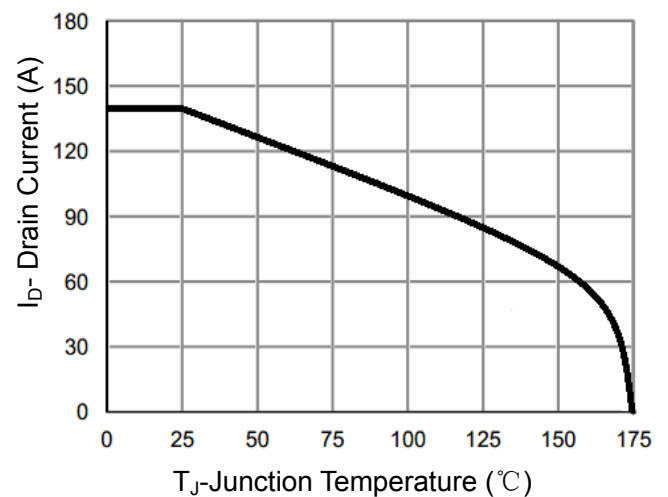


Figure 10 Current De-rating

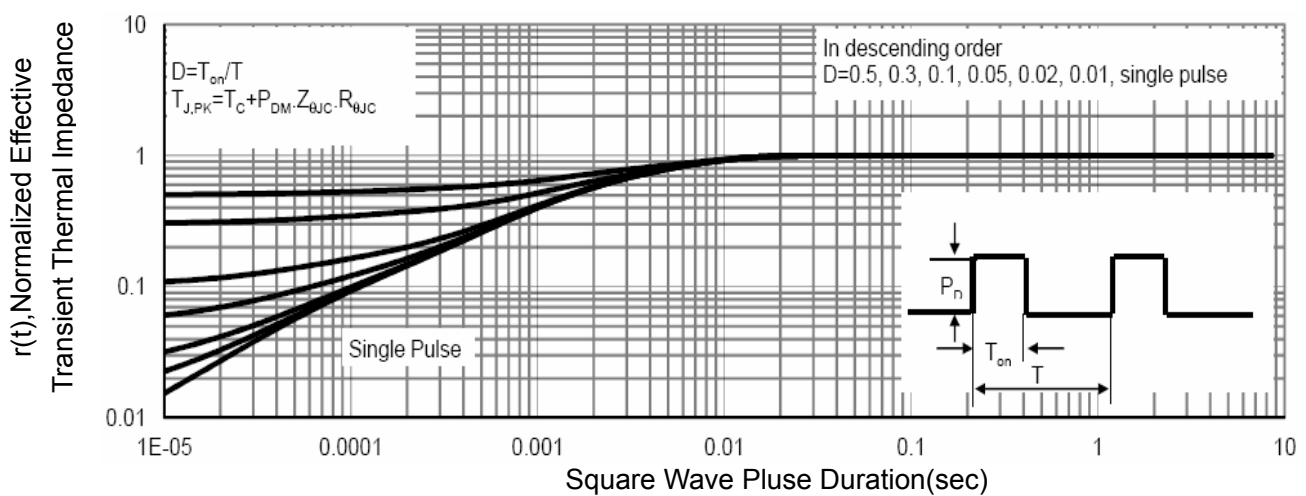
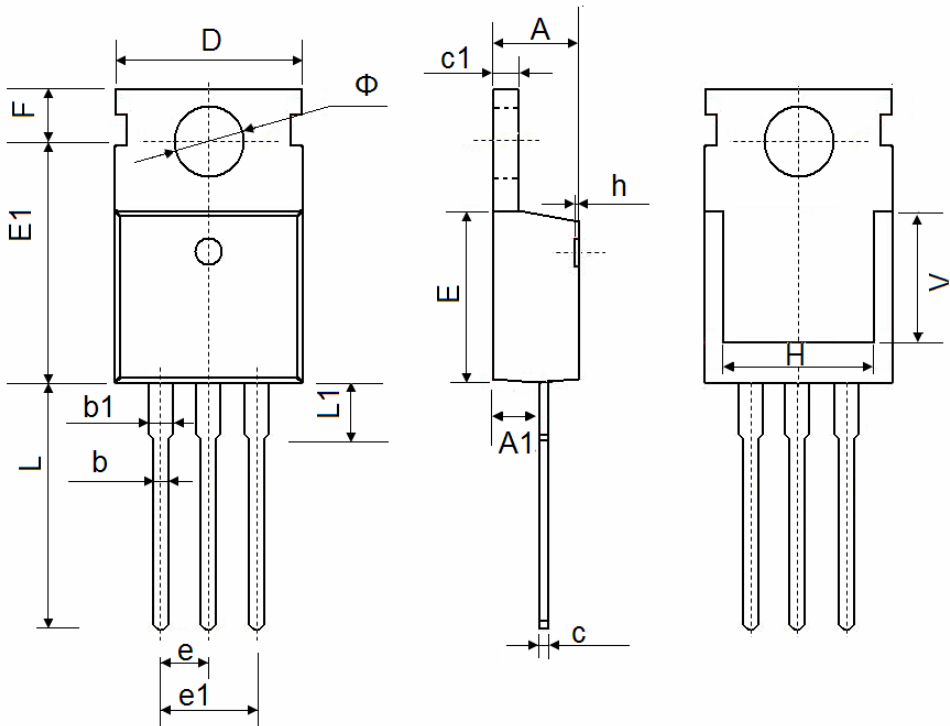


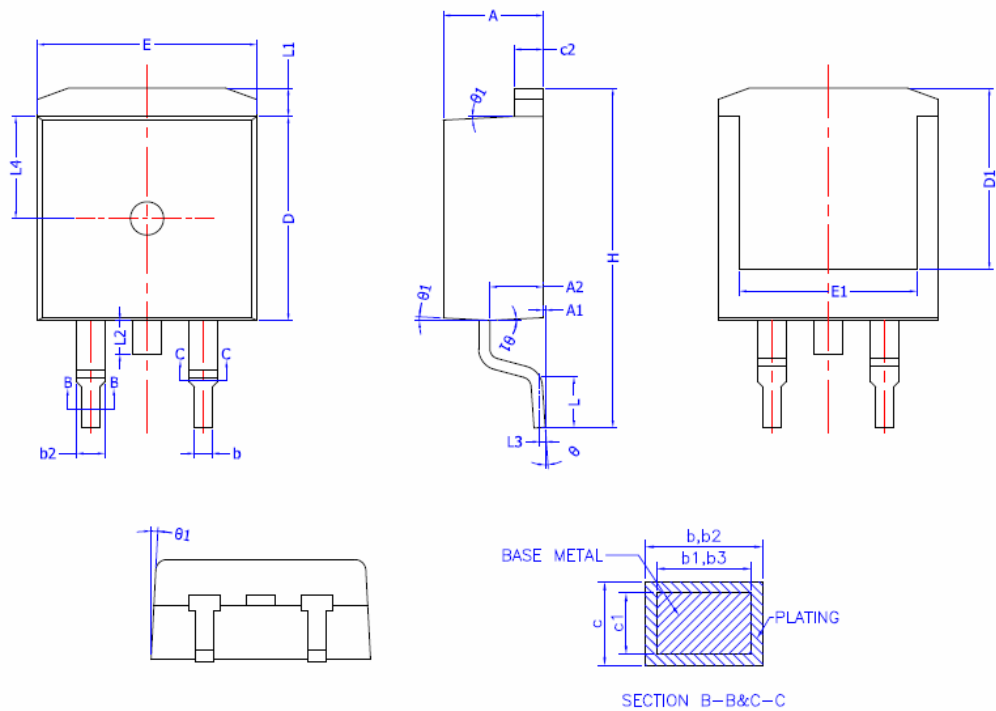
Figure 11 Normalized Maximum Transient Thermal Impedance

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      | 6.900 REF.                |        | 0.276 REF.           |       |
| Φ      | 3.400                     | 3.800  | 0.134                | 0.150 |

TO-263-2L Package Information



COMMON DIMENSIONS  
(UNITS OF MEASURE =MILLIMETER)

| SYMBOL | MIN      | NOM   | MAX   |
|--------|----------|-------|-------|
| A      | 4.40     | 4.50  | 4.60  |
| A1     | 0        | 0.10  | 0.25  |
| A2     | 2.20     | 2.40  | 2.60  |
| b      | 0.76     | —     | 0.89  |
| b1     | 0.75     | 0.80  | 0.85  |
| b2     | 1.23     | —     | 1.37  |
| b3     | 1.22     | 1.27  | 1.32  |
| c      | 0.47     | —     | 0.60  |
| c1     | 0.46     | 0.51  | 0.56  |
| c2     | 1.25     | 1.30  | 1.35  |
| D      | 9.10     | 9.20  | 9.30  |
| D1     | 8.00     | —     | —     |
| E      | 9.80     | 9.90  | 10.00 |
| E1     | 7.80     | —     | —     |
| e      | 2.54 BSC |       |       |
| H      | 14.90    | 15.30 | 15.70 |
| L      | 2.00     | 2.30  | 2.60  |
| L1     | 1.17     | 1.27  | 1.40  |
| L2     | —        | —     | 1.75  |
| L3     | 0.25BSC  |       |       |
| L4     | 4.60 REF |       |       |
| θ      | 0°       | —     | 8°    |
| θ1     | 1°       | 3°    | 5°    |