

## N-Channel Enhancement Mode Power MOSFET

### Description

The HM20N06KA 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

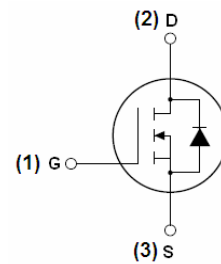
- $V_{DS} = 60V, I_D = 20A$   
 $R_{DS(ON)} < 35m\Omega @ V_{GS} = 10V$   
 $R_{DS(ON)} < 40m\Omega @ V_{GS} = 4.5V$
- High density cell design for ultra low  $R_{DS(ON)}$
- Fully characterized avalanche voltage and current
- Good stability and uniformity with high  $E_{AS}$
- Excellent package for good 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!**

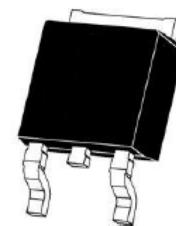
**100%  $\Delta V_{DS}$  TESTED!**



Schematic diagram



Marking and pin assignment



TO-252-2L top view

### Package Marking and Ordering Information

| Device Marking | Device    | Device Package | Reel Size | Tape width | Quantity |
|----------------|-----------|----------------|-----------|------------|----------|
| HM20N06KA      | HM20N06KA | TO-252-2L      |           |            |          |

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

| Parameter                                         | Symbol              | Limit      | Unit          |
|---------------------------------------------------|---------------------|------------|---------------|
| Drain-Source Voltage                              | $V_{DS}$            | 60         | V             |
| Gate-Source Voltage                               | $V_{GS}$            | $\pm 20$   | V             |
| Drain Current-Continuous                          | $I_D$               | 20         | A             |
| Drain Current-Continuous ( $T_C = 100^\circ C$ )  | $I_D (100^\circ C)$ | 14         | A             |
| Pulsed Drain Current                              | $I_{DM}$            | 60         | A             |
| Maximum Power Dissipation                         | $P_D$               | 45         | W             |
| Derating factor                                   |                     | 0.3        | W/ $^\circ C$ |
| Single pulse avalanche energy <sup>(Note 5)</sup> | $E_{AS}$            | 72         | 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> | $R_{\theta JC}$ | 3.3 | °C/W |
|----------------------------------------------------------|-----------------|-----|------|

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

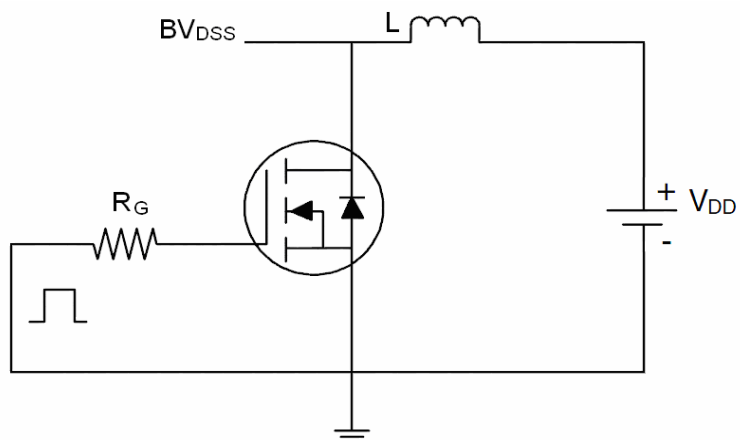
| Parameter                                     | Symbol              | Condition                                                                                                  | Min | Typ  | Max  | Unit |
|-----------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------|-----|------|------|------|
| Off Characteristics                           |                     |                                                                                                            |     |      |      |      |
| Drain-Source Breakdown Voltage                | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =250μA                                                                  | 60  | -    | -    | V    |
| Zero Gate Voltage Drain Current               | I <sub>DSS</sub>    | V <sub>DS</sub> =60V, 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                                                   | 1.2 | 1.6  | 2.5  | V    |
| Drain-Source On-State Resistance              | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =20A                                                                  | -   | 24   | 35   | mΩ   |
|                                               |                     | V <sub>GS</sub> =4.5V, I <sub>D</sub> =20A                                                                 |     | 30   | 40   |      |
| Forward Transconductance                      | g <sub>FS</sub>     | V <sub>DS</sub> =5V, I <sub>D</sub> =5A                                                                    | 11  | -    | -    | S    |
| Dynamic Characteristics <sup>(Note4)</sup>    |                     |                                                                                                            |     |      |      |      |
| Input Capacitance                             | C <sub>iss</sub>    | V <sub>DS</sub> =30V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                                     | -   | 500  | -    | PF   |
| Output Capacitance                            | C <sub>oss</sub>    |                                                                                                            | -   | 60   | -    | PF   |
| Reverse Transfer Capacitance                  | C <sub>rss</sub>    |                                                                                                            | -   | 25   | -    | PF   |
| Switching Characteristics <sup>(Note 4)</sup> |                     |                                                                                                            |     |      |      |      |
| Turn-on Delay Time                            | t <sub>d(on)</sub>  | V <sub>DD</sub> =30V, I <sub>D</sub> =2A, R <sub>L</sub> =6.7Ω<br>V <sub>GS</sub> =10V, R <sub>G</sub> =3Ω | -   | 5    | -    | nS   |
| Turn-on Rise Time                             | t <sub>r</sub>      |                                                                                                            | -   | 2.6  | -    | nS   |
| Turn-Off Delay Time                           | t <sub>d(off)</sub> |                                                                                                            | -   | 16.1 | -    | nS   |
| Turn-Off Fall Time                            | t <sub>f</sub>      |                                                                                                            | -   | 2.3  | -    | nS   |
| Total Gate Charge                             | Q <sub>g</sub>      | V <sub>DS</sub> =30V, I <sub>D</sub> =4.5A,<br>V <sub>GS</sub> =10V                                        | -   | 25   |      | nC   |
| Gate-Source Charge                            | Q <sub>gs</sub>     |                                                                                                            | -   | 4.5  |      | nC   |
| Gate-Drain Charge                             | Q <sub>gd</sub>     |                                                                                                            | -   | 6.5  |      | 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>      |                                                                                                            | -   | -    | 20   | A    |
| Reverse Recovery Time                         | t <sub>rr</sub>     | T <sub>J</sub> = 25°C, I <sub>F</sub> =20A<br>di/dt = 100A/μs <sup>(Note3)</sup>                           | -   | 29   | -    | nS   |
| Reverse Recovery Charge                       | Q <sub>rr</sub>     |                                                                                                            | -   | 49   | -    | nC   |
| Forward Turn-On Time                          | t <sub>on</sub>     | Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)                                       |     |      |      |      |

## Notes:

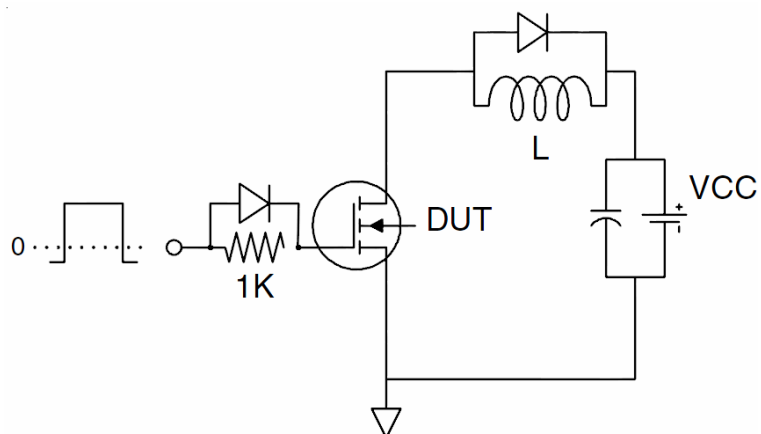
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5. EAS condition:  $T_J=25^{\circ}\text{C}$ ,  $V_{DD}=30V$ ,  $V_G=10V$ ,  $L=0.5mH$ ,  $R_G=25\Omega$

## Test Circuit

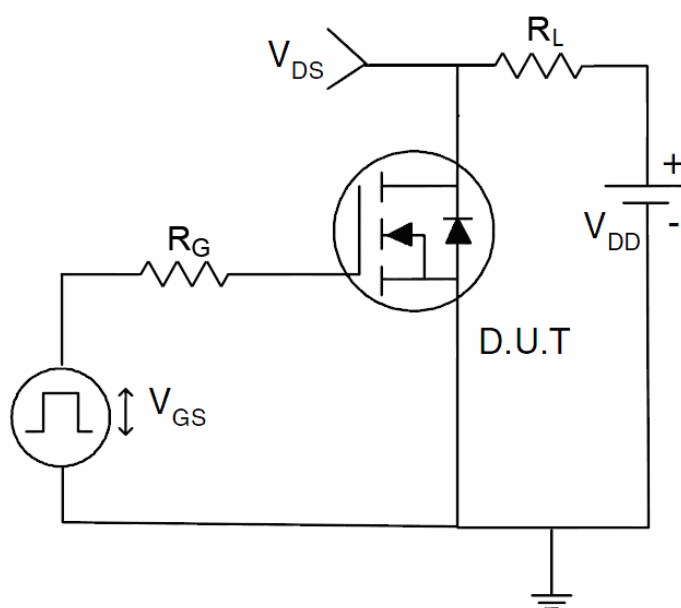
### 1) $E_{AS}$ test Circuit



### 2) Gate charge test Circuit



### 3) Switch Time Test Circuit



# Typical Electrical and Thermal Characteristics (Curves)

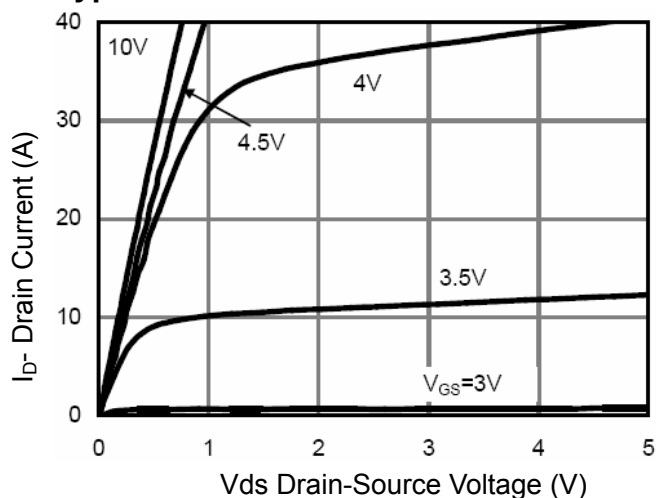


Figure 1 Output Characteristics

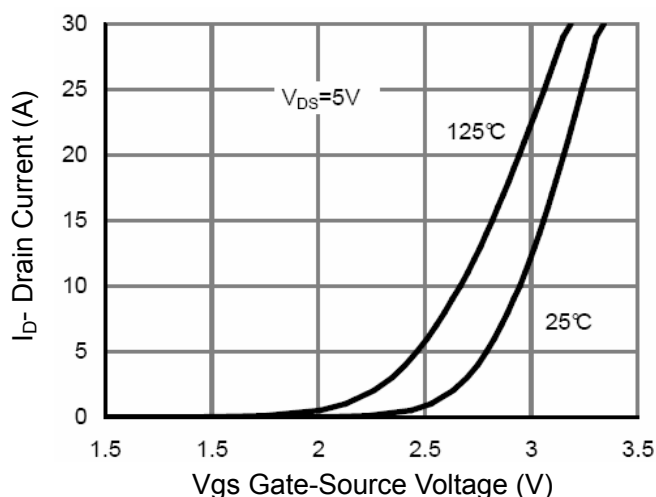


Figure 2 Transfer Characteristics

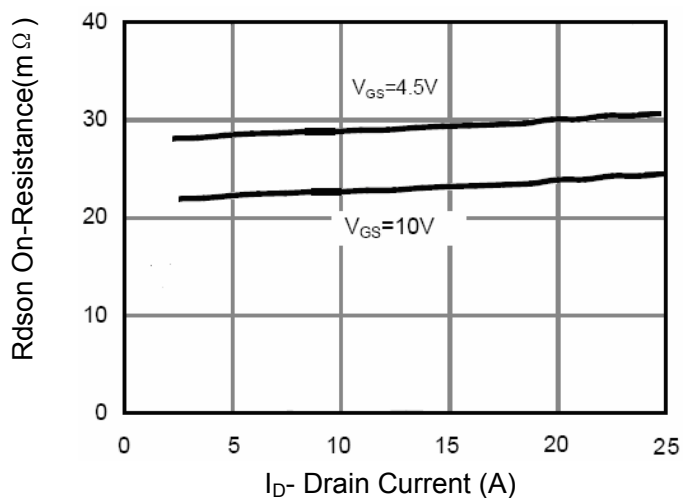


Figure 3 Rdson- Drain Current

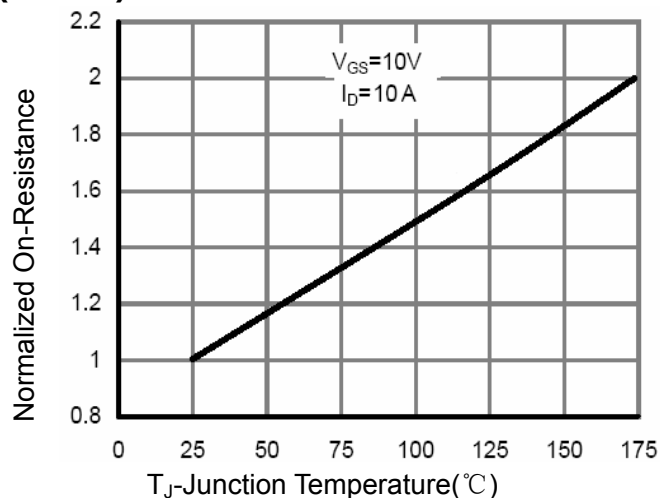


Figure 4 Rdson-Junction Temperature

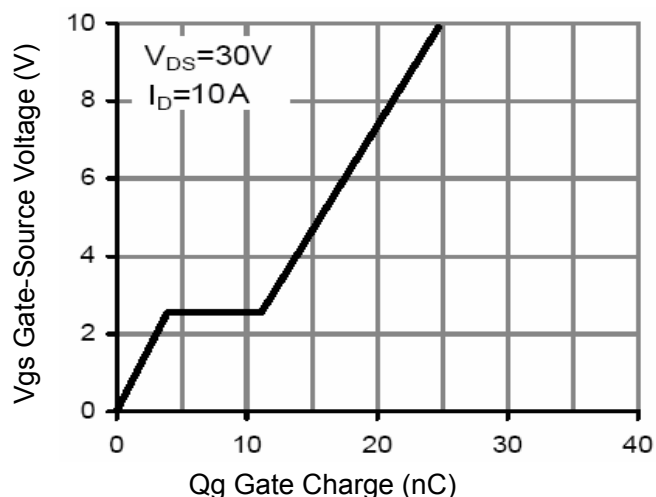


Figure 5 Gate Charge

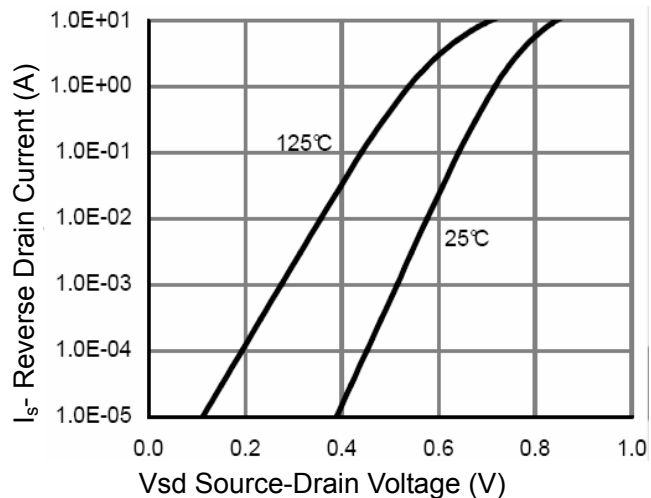


Figure 6 Source- Drain Diode Forward

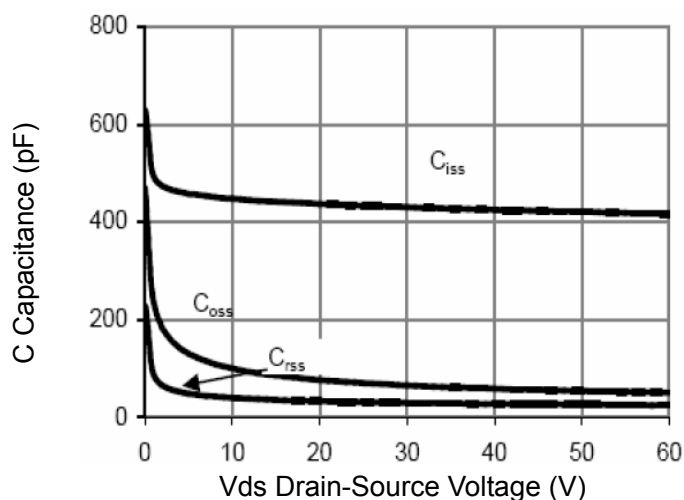


Figure 7 Capacitance vs Vds

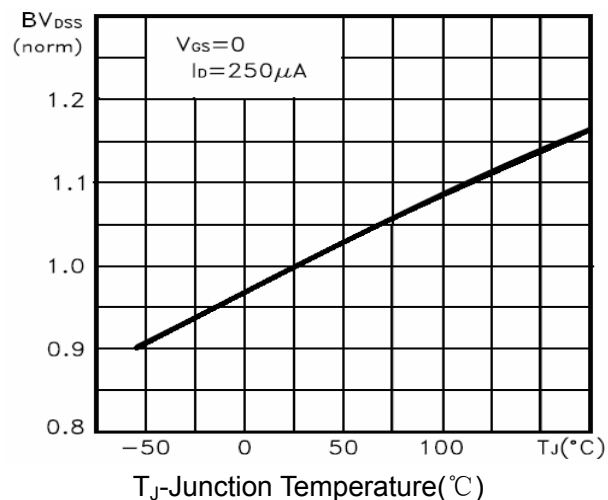


Figure 9  $BV_{DSS}$  vs Junction Temperature

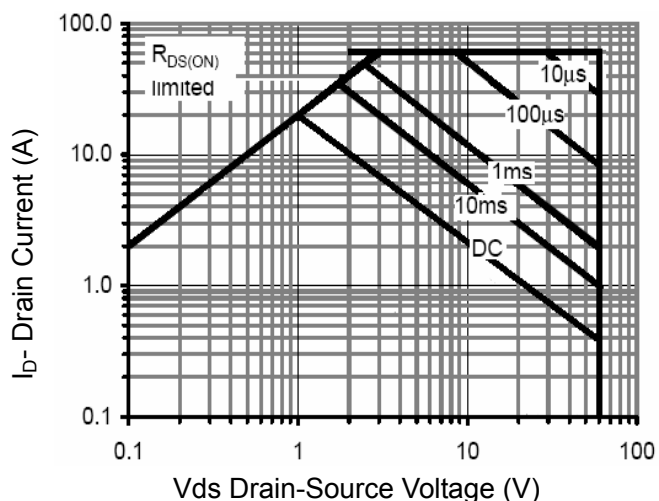


Figure 8 Safe Operation Area

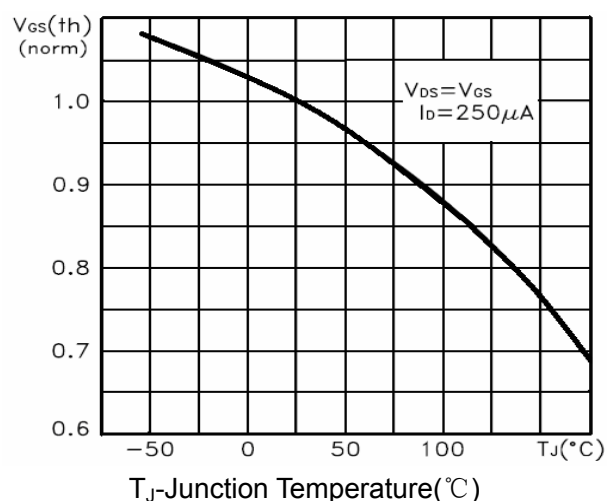


Figure 10  $V_{GS(th)}$  vs Junction Temperature

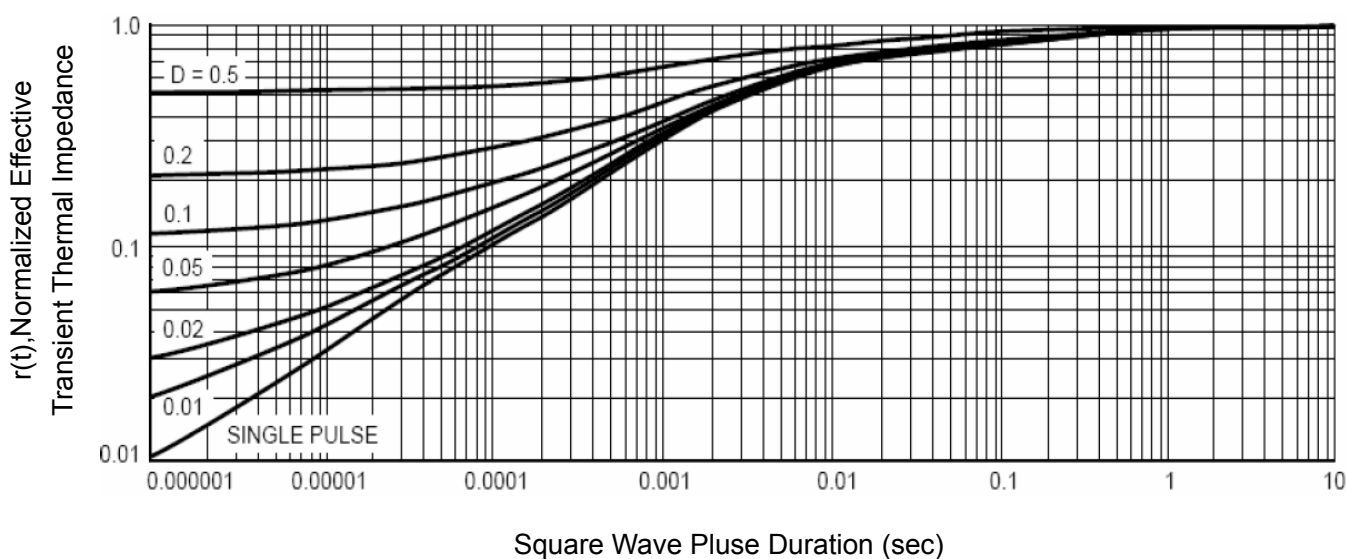
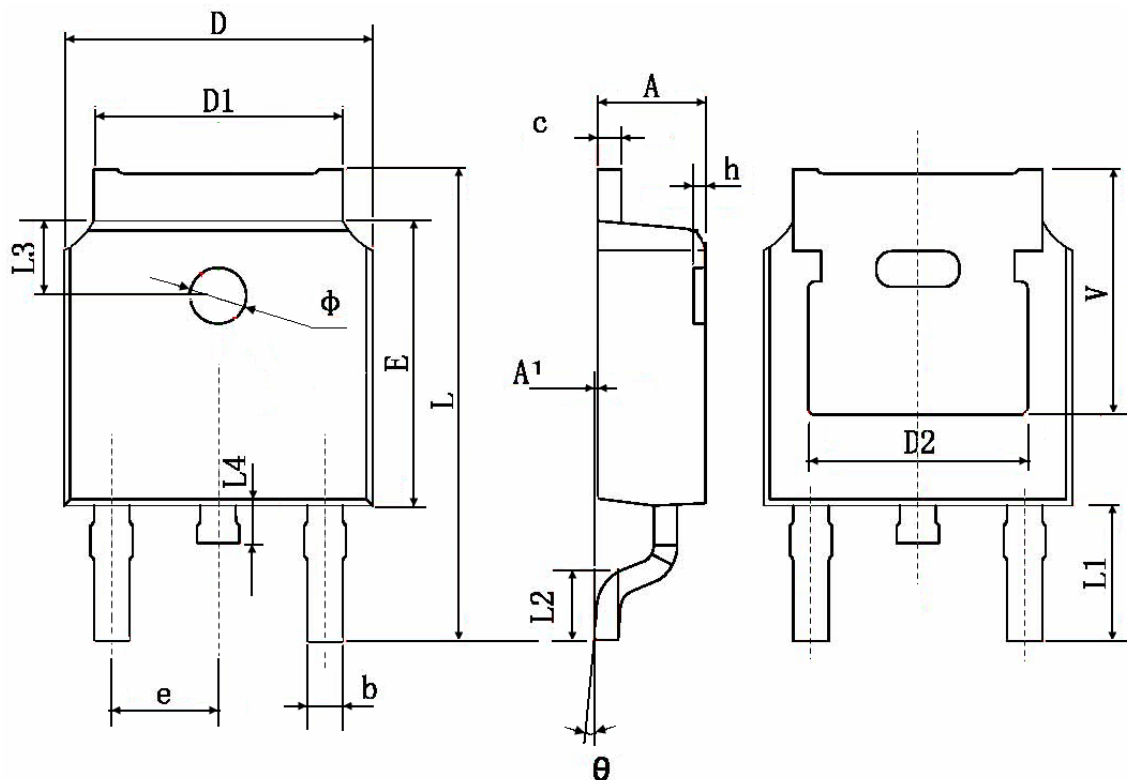


Figure 11 Normalized Maximum Transient Thermal Impedance

TO-252 Package Information



| Symbol   | Dimensions In Millimeters |        | Dimensions In Inches |       |
|----------|---------------------------|--------|----------------------|-------|
|          | Min.                      | Max.   | Min.                 | Max.  |
| A        | 2.200                     | 2.400  | 0.087                | 0.094 |
| A1       | 0.000                     | 0.127  | 0.000                | 0.005 |
| b        | 0.660                     | 0.860  | 0.026                | 0.034 |
| c        | 0.460                     | 0.580  | 0.018                | 0.023 |
| D        | 6.500                     | 6.700  | 0.256                | 0.264 |
| D1       | 5.100                     | 5.460  | 0.201                | 0.215 |
| D2       | 4.830 TYP.                |        | 0.190 TYP.           |       |
| E        | 6.000                     | 6.200  | 0.236                | 0.244 |
| e        | 2.186                     | 2.386  | 0.086                | 0.094 |
| L        | 9.800                     | 10.400 | 0.386                | 0.409 |
| L1       | 2.900 TYP.                |        | 0.114 TYP.           |       |
| L2       | 1.400                     | 1.700  | 0.055                | 0.067 |
| L3       | 1.600 TYP.                |        | 0.063 TYP.           |       |
| L4       | 0.600                     | 1.000  | 0.024                | 0.039 |
| $\Phi$   | 1.100                     | 1.300  | 0.043                | 0.051 |
| $\theta$ | 0°                        | 8°     | 0°                   | 8°    |
| h        | 0.000                     | 0.300  | 0.000                | 0.012 |
| V        | 5.350 TYP.                |        | 0.211 TYP.           |       |