

## N-Channel Trench Power MOSFET

### General Description

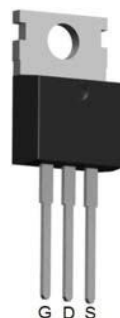
The CS60N06 is N-channel MOS Field Effect Transistor designed for high current switching applications. Rugged EAS capability and ultra low  $R_{DS(ON)}$  is suitable for PWM, load switching applications.

### Features

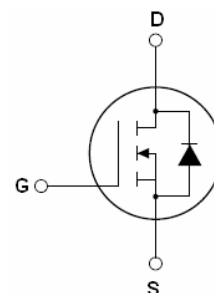
- $V_{DS}=60V$ ;  $I_D=80A@V_{GS}=10V$ ;  
 $R_{DS(ON)}<7.2m\Omega @V_{GS}=10V$
- Ultra Low On-Resistance
- High UIS and UIS 100% Test

### Application

- Hard Switched and High Frequency Circuits
- Uninterruptible Power Supply



To-220 Top View



Schematic Diagram

$$V_{DS} = 60 V$$

$$I_D = 80 A$$

$$R_{DS(ON)} = 6.2 m\Omega$$

### Package Marking and Ordering Information

| Device Marking | Device  | Device Package | Reel Size | Tape width | Quantity |
|----------------|---------|----------------|-----------|------------|----------|
| CS60N06        | CS60N06 | TO-220         | -         | -          | -        |

Table 1. Absolute Maximum Ratings (TA=25°C)

| Symbol          | Parameter   | Value      | Unit |
|-----------------|---|------------|------|
| $V_{DS}$        | Drain-Source Voltage ( $V_{GS}=0V$ )              | 60         | V    |
| $V_{GS}$        | Gate-Source Voltage ( $V_{DS}=0V$ )               | $\pm 25$   | V    |
| $I_{D(DC)}$     | Drain Current (DC) at $T_c=25^\circ C$            | 80         | A    |
| $I_{D(DC)}$     | Drain Current (DC) at $T_c=100^\circ C$           | 56         | A    |
| $I_{DM(pluse)}$ | Drain Current-Continuous@ Current-Pulsed (Note 1) | 320        | A    |
| dv/dt           | Peak Diode Recovery Voltage                       | 9.5        | V/ns |
| $P_D$           | Maximum Power Dissipation( $T_c=25^\circ C$ )     | 100        | W    |
|                 | Derating Factor                                   | 0.66       | W/°C |
| $E_{AS}$        | Single Pulse Avalanche Energy (Note 2)            | 410        | mJ   |
| $T_J, T_{STG}$  | Operating Junction and Storage Temperature Range  | -55 To 175 | °C   |

Notes 1.Repetitive Rating: Pulse width limited by maximum junction temperature

2.EAS condition: $T_J=25^\circ C, V_{DD}=33V, V_G=10V, I_D=40.5A$

**Table 2. Thermal Characteristic**

| Symbol           | Parameter                            | Value | Max | Unit |
|------------------|--------------------------------------|-------|-----|------|
| R <sub>θJC</sub> | Thermal Resistance, Junction-to-Case | ---   | 1.5 | °C/W |

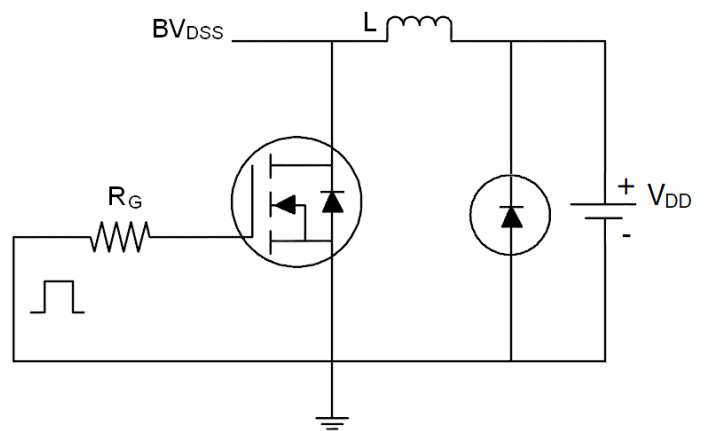
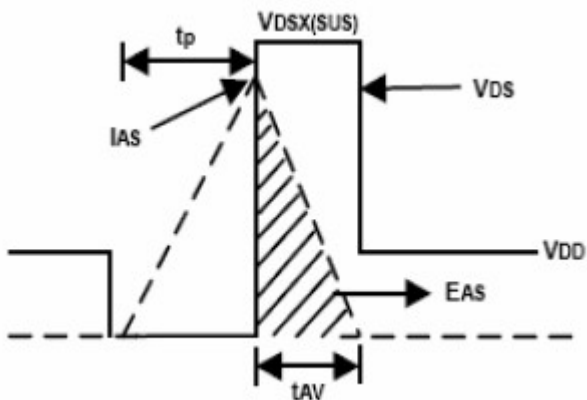
**Table 3. Electrical Characteristics (TA=25°C unless otherwise noted)**

| Symbol                                    | Parameter                                   | Conditions  | Min | Typ  | Max  | Unit |
|---|---|---|-----|------|------|------|
| <b>On/Off States</b>                      |   |   |     |      |      |      |
| BV <sub>DSS</sub>                         | Drain-Source Breakdown Voltage              | V <sub>GS</sub> =0V, I <sub>D</sub> =250μA  | 60  |      |      | V    |
| I <sub>DSS</sub>                          | Zero Gate Voltage Drain Current(Tc=25°C)    | V <sub>DS</sub> =60V, V <sub>GS</sub> =0V   |     |      | 1    | μA   |
| I <sub>DSS</sub>                          | Zero Gate Voltage Drain Current(Tc=125°C)   | V <sub>DS</sub> =60V, V <sub>GS</sub> =0V   |     |      | 10   | μA   |
| I <sub>GSS</sub>                          | Gate-Body Leakage Current                   | V <sub>GS</sub> =±25V, V <sub>DS</sub> =0V  |     |      | ±100 | nA   |
| V <sub>GS(th)</sub>                       | Gate Threshold Voltage                      | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA  | 2   |      | 4    | V    |
| R <sub>DS(ON)</sub>                       | Drain-Source On-State Resistance            | V <sub>GS</sub> =10V, I <sub>D</sub> =40A   |     | 6.2  | 7.2  | mΩ   |
| <b>Dynamic Characteristics</b>            |   |   |     |      |      |      |
| g <sub>FS</sub>                           | Forward Transconductance                    | V <sub>DS</sub> =10V, I <sub>D</sub> =15A   | 20  |      |      | S    |
| C <sub>iss</sub>                          | Input Capacitance                           | V <sub>DS</sub> =25V, V <sub>GS</sub> =0V,<br>f=1.0MHz  |     | 3290 |      | pF   |
| C <sub>oss</sub>                          | Output Capacitance                          |   |     | 335  |      | pF   |
| C <sub>rss</sub>                          | Reverse Transfer Capacitance                |   |     | 245  |      | pF   |
| Q <sub>g</sub>                            | Total Gate Charge                           | V <sub>DS</sub> =50V, I <sub>D</sub> =40A,<br>V <sub>GS</sub> =10V  |     | 90   |      | nC   |
| Q <sub>gs</sub>                           | Gate-Source Charge                          |   |     | 18   |      | nC   |
| Q <sub>gd</sub>                           | Gate-Drain Charge                           |   |     | 42   |      | nC   |
| <b>Switching Times</b>                    |   |   |     |      |      |      |
| t <sub>d(on)</sub>                        | Turn-on Delay Time                          | V <sub>DD</sub> =30V, I <sub>D</sub> =2A, R <sub>L</sub> =15Ω<br>V <sub>GS</sub> =10V, R <sub>G</sub> =2.5Ω |     | 21   |      | nS   |
| t <sub>r</sub>                            | Turn-on Rise Time                           |   |     | 31   |      | nS   |
| t <sub>d(off)</sub>                       | Turn-Off Delay Time                         |   |     | 63   |      | nS   |
| t <sub>f</sub>                            | Turn-Off Fall Time                          |   |     | 29   |      | nS   |
| <b>Source-Drain Diode Characteristics</b> |   |   |     |      |      |      |
| I <sub>SD</sub>                           | Source-Drain Current(Body Diode)            |   |     | 80   |      | A    |
| I <sub>SDM</sub>                          | Pulsed Source-Drain Current(Body Diode)     |   |     | 320  |      | A    |
| V <sub>SD</sub>                           | Forward On Voltage <sup>(Note 1)</sup>      | T <sub>J</sub> =25°C, I <sub>SD</sub> =40A, V <sub>GS</sub> =0V   |     | 0.89 | 0.99 | V    |
| t <sub>rr</sub>                           | Reverse Recovery Time <sup>(Note 1)</sup>   | T <sub>J</sub> =25°C, I <sub>F</sub> =75A<br>di/dt=100A/μs  |     | 26   |      | nS   |
| Q <sub>rr</sub>                           | Reverse Recovery Charge <sup>(Note 1)</sup> |   |     | 35   |      | nC   |
| t <sub>on</sub>                           | Forward Turn-on Time                        | Intrinsic turn-on time is negligible(turn-on is dominated by L <sub>S</sub> +L <sub>D</sub> )               |     |      |      |      |

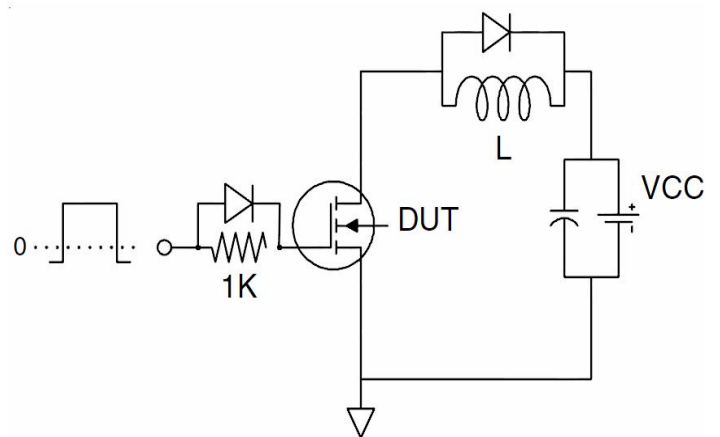
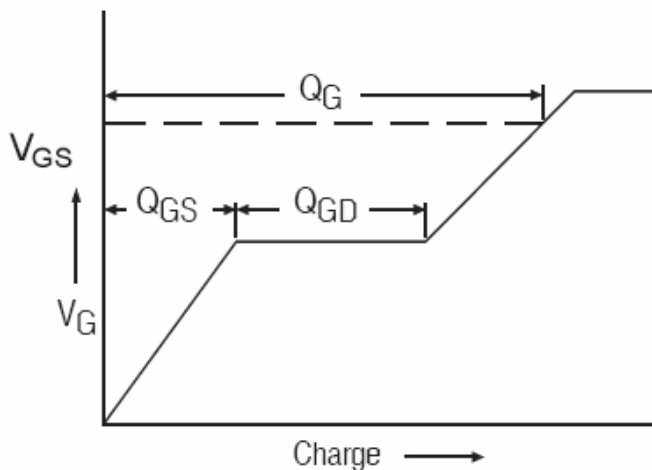
Notes 1. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 1.5%, R<sub>G</sub>=25Ω, Starting T<sub>J</sub>=25°C

### Test Circuit

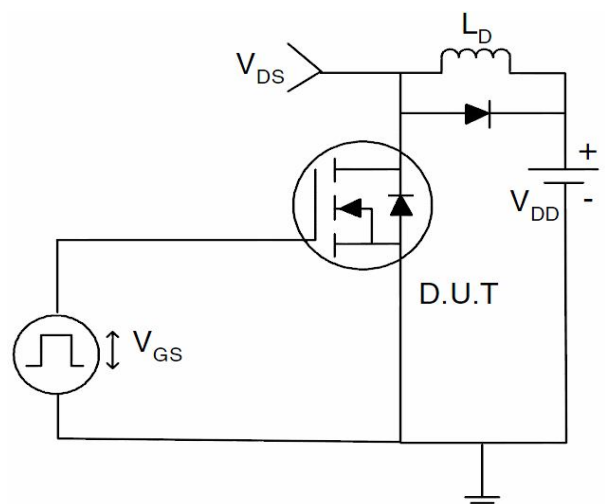
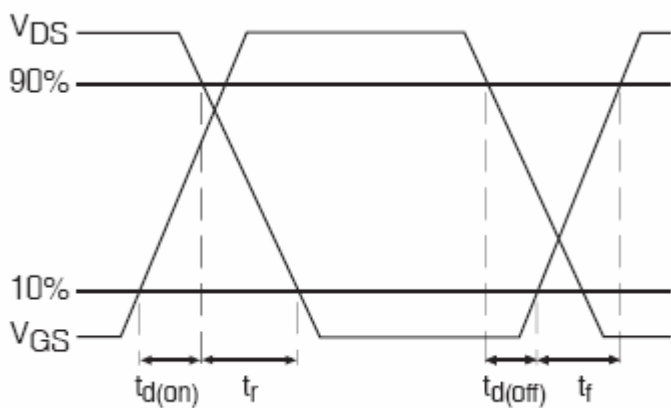
#### 1) E<sub>AS</sub> Test Circuits



#### 2) Gate Charge Test Circuit:

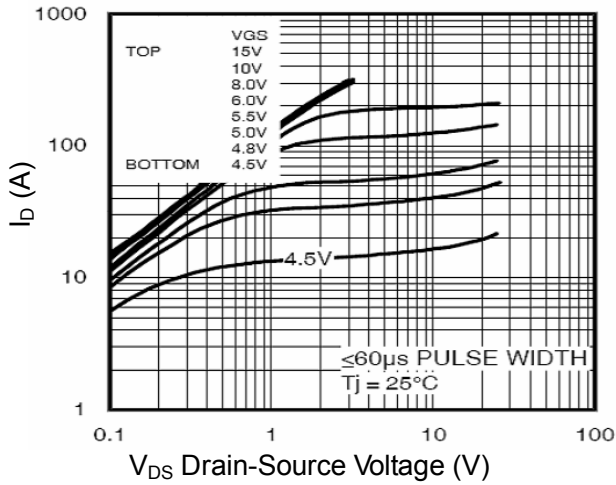


#### 3) Switch Time Test Circuit:

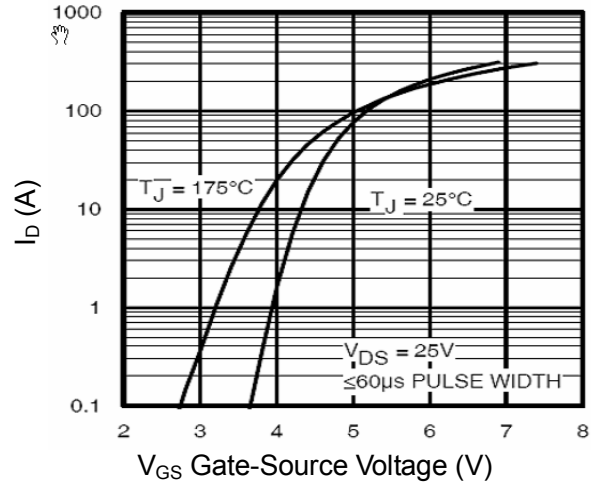


## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (Curves)

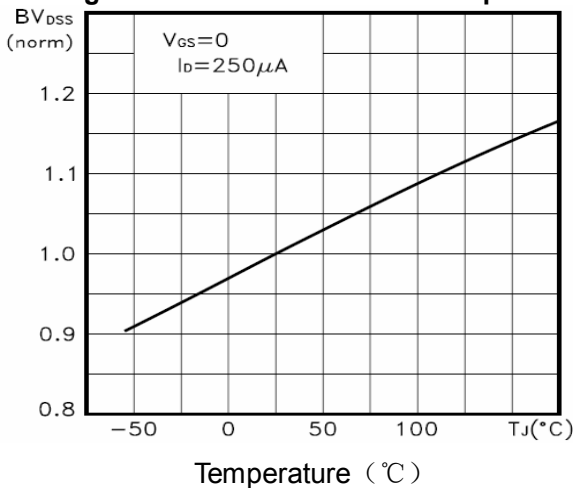
**Figure1. Output Characteristics**



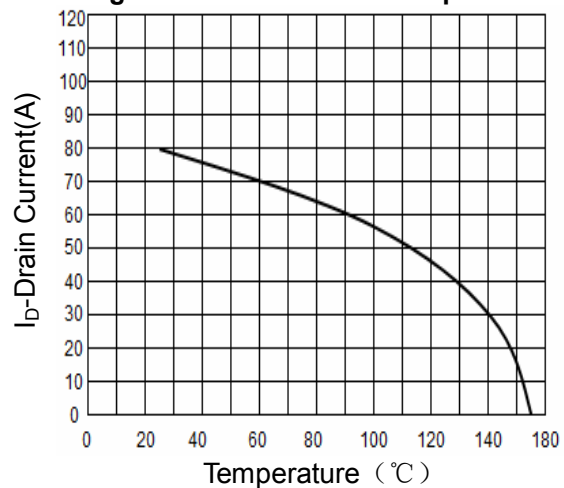
**Figure2. Transfer Characteristics**



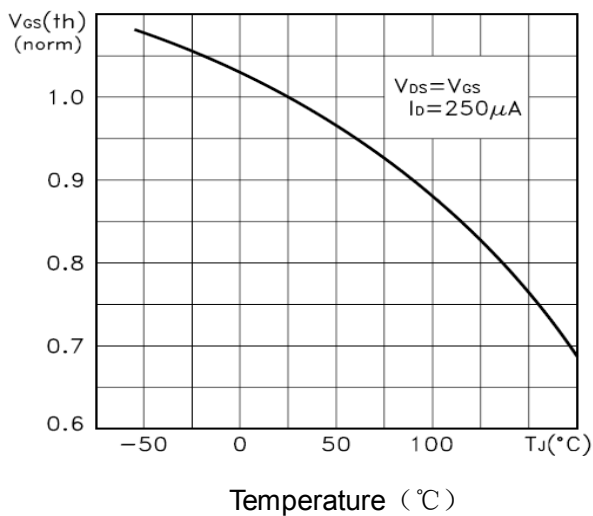
**Figure3. BVDSS vs Junction Temperature**



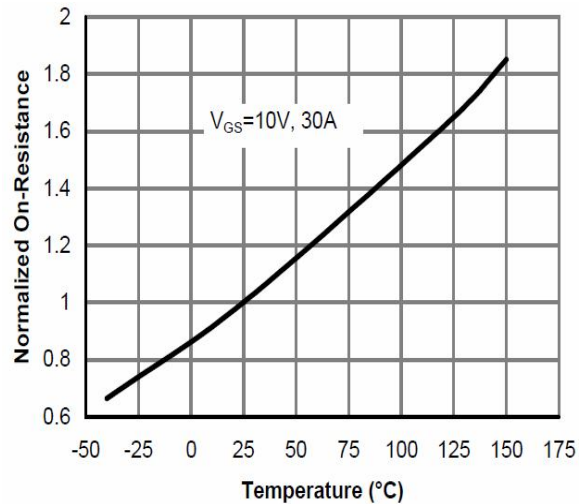
**Figure4. ID vs Junction Temperature**



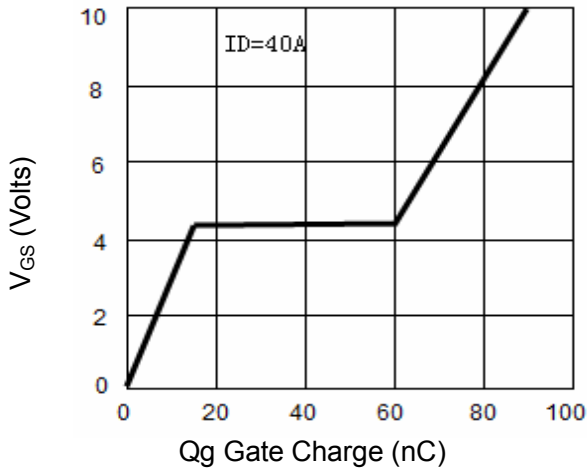
**Figure5. VGS(th) vs Junction Temperature**



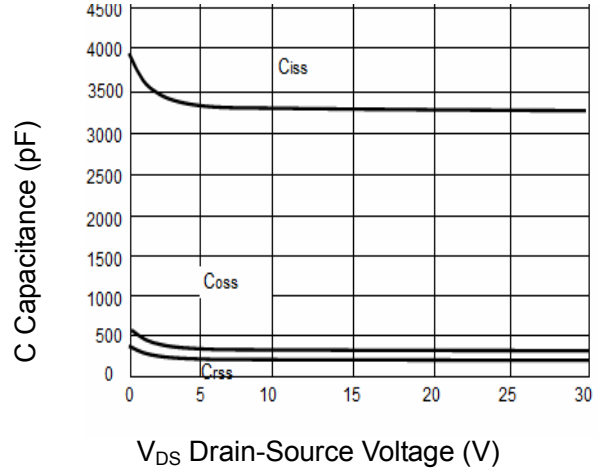
**Figure6. Rds(on) vs Junction Temperature**



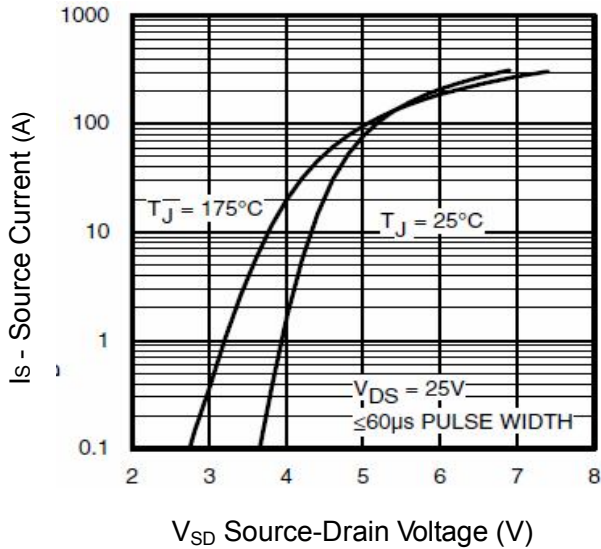
**Figure7. Gate Charge**



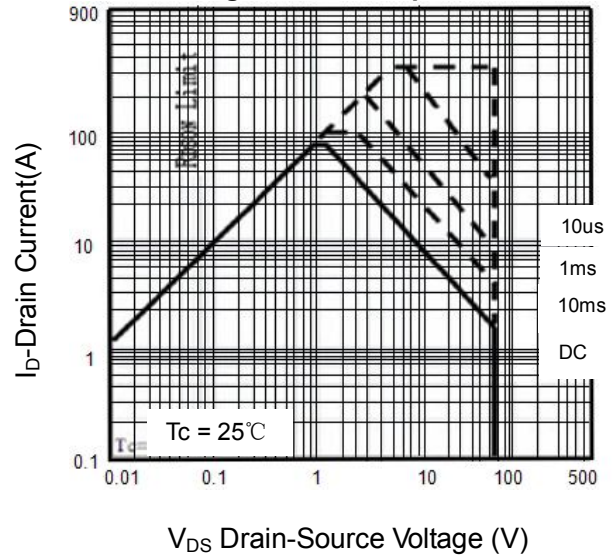
**Figure8. Capacitance vs Vds**



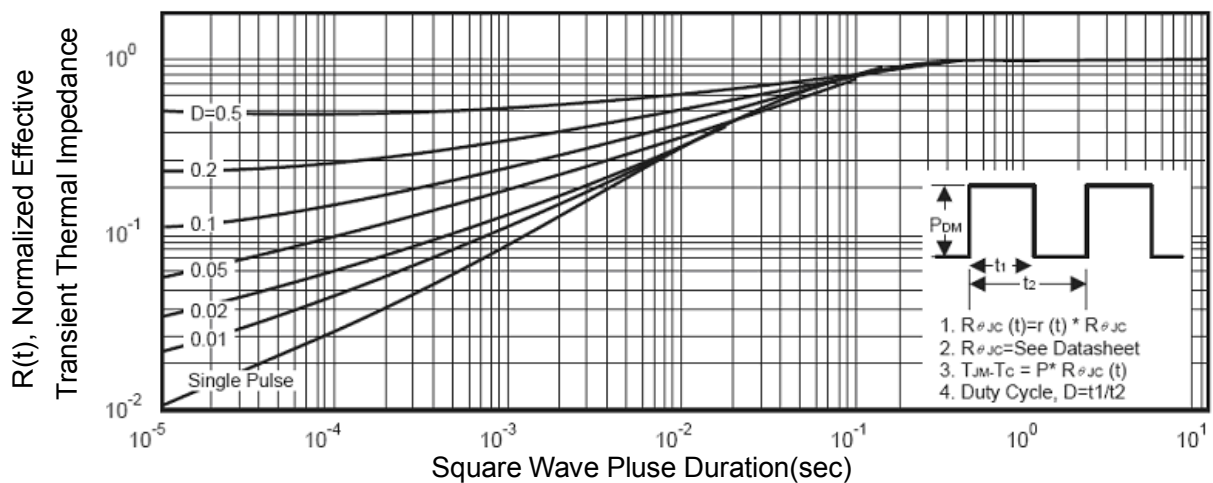
**Figure9. Source- Drain Diode Forward**



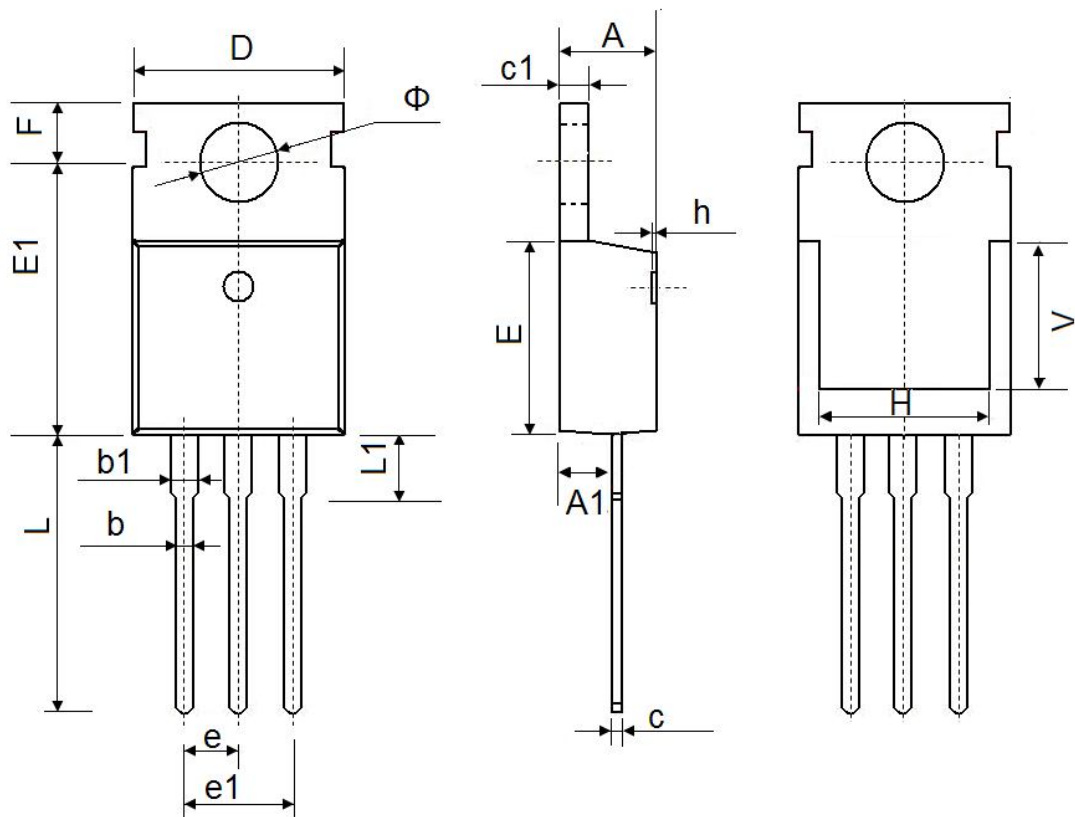
**Figure10. Safe Operation Area**



**Figure11. Normalized Maximum Transient Thermal Impedance**



## TO-220 Package Information



| Symbol | Dimensions In Millimeters |        | Dimensions In Inches |       |
|--------|---------------------------|--------|----------------------|-------|
|        | Min.                      | Max.   | Min.                 | Max.  |
| A      | 4.300                     | 4.700  | 0.169                | 0.185 |
| A1     | 2.200                     | 2.600  | 0.087                | 0.102 |
| b      | 0.700                     | 0.950  | 0.028                | 0.037 |
| b1     | 1.170                     | 1.410  | 0.046                | 0.056 |
| c      | 0.450                     | 0.650  | 0.018                | 0.026 |
| c1     | 1.200                     | 1.400  | 0.047                | 0.055 |
| D      | 9.600                     | 10.400 | 0.378                | 0.409 |
| E      | 8.8500                    | 9.750  | 0.348                | 0.384 |
| E1     | 12.650                    | 12.950 | 0.498                | 0.510 |
| e      | 2.540 TYP.                |        | 0.100TYP.            |       |
| 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      | 12.750                    | 14.300 | 0.502                | 0.563 |
| L1     | 2.850                     | 3.950  | 0.112                | 0.156 |
| V      | 7.500 REF.                |        | 0.295 REF.           |       |
| Φ      | 3.400                     | 4.000  | 0.134                | 0.157 |