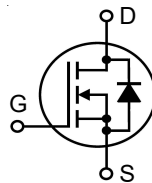


# X4-Class Power MOSFET™

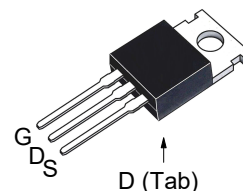
## IXTP86N20X4

$V_{DSS} = 200V$   
 $I_{D25} = 86A$   
 $R_{DS(on)} \leq 13m\Omega$

N-Channel Enhancement Mode  
Avalanche Rated



TO-220  
(IXTP)



G = Gate      D = Drain  
S = Source    Tab = Drain

| Symbol    | Test Conditions                                                                | Maximum Ratings |            |
|-----------|--------------------------------------------------------------------------------|-----------------|------------|
| $V_{DSS}$ | $T_J = 25^\circ C$ to $175^\circ C$                                            | 200             | V          |
| $V_{DGR}$ | $T_J = 25^\circ C$ to $175^\circ C$ , $R_{GS} = 1M\Omega$                      | 200             | V          |
| $V_{GS}$  | Continuous                                                                     | $\pm 20$        | V          |
| $V_{GSM}$ | Transient                                                                      | $\pm 30$        | V          |
| $I_{D25}$ | $T_C = 25^\circ C$                                                             | 86              | A          |
| $I_{DM}$  | $T_C = 25^\circ C$ , Pulse Width Limited by $T_{JM}$                           | 160             | A          |
| $I_A$     | $T_C = 25^\circ C$                                                             | 43              | A          |
| $E_{AS}$  | $T_C = 25^\circ C$                                                             | 500             | mJ         |
| $dv/dt$   | $I_S \leq I_{DM}$ , $V_{DD} \leq V_{DSS}$ , $T_J \leq 150^\circ C$             | 50              | V/ns       |
| $P_D$     | $T_C = 25^\circ C$                                                             | 300             | W          |
| $T_J$     |                                                                                | -55 ... +175    | $^\circ C$ |
| $T_{JM}$  |                                                                                | 175             | $^\circ C$ |
| $T_{stg}$ |                                                                                | -55 ... +175    | $^\circ C$ |
| $T_L$     | Maximum Lead Temperature for Soldering<br>1.6 mm (0.062 in.) from Case for 10s | 300             | $^\circ C$ |
| $M_d$     | Mounting Torque                                                                | 1.13 / 10       | Nm/lb.in   |
| Weight    |                                                                                | 3               | g          |

### Features

- International Standard Package
- Low  $R_{DS(ON)}$  and  $Q_G$
- Avalanche Rated
- Low Package Inductance

### Advantages

- High Power Density
- Easy to Mount
- Space Savings

### Applications

- Switch-Mode and Resonant-Mode Power Supplies
- DC-DC Converters
- PFC Circuits
- AC and DC Motor Drives
- Robotics and Servo Controls

| Symbol       | Test Conditions<br>( $T_J = 25^\circ C$ , Unless Otherwise Specified) | Characteristic Values |      |                          |
|--------------|-----------------------------------------------------------------------|-----------------------|------|--------------------------|
|              |                                                                       | Min.                  | Typ. | Max.                     |
| $BV_{DSS}$   | $V_{GS} = 0V$ , $I_D = 250\mu A$                                      | 200                   |      | V                        |
| $V_{GS(th)}$ | $V_{DS} = V_{GS}$ , $I_D = 250\mu A$                                  | 2.5                   |      | 4.5 V                    |
| $I_{GSS}$    | $V_{GS} = \pm 20V$ , $V_{DS} = 0V$                                    |                       |      | $\pm 100$ nA             |
| $I_{DSS}$    | $V_{DS} = V_{DSS}$ , $V_{GS} = 0V$<br>$T_J = 150^\circ C$             |                       |      | 5 $\mu A$<br>300 $\mu A$ |
| $R_{DS(on)}$ | $V_{GS} = 10V$ , $I_D = 0.5 \cdot I_{D25}$ , Note 1                   |                       | 11   | 13 m $\Omega$            |

| Symbol       | Test Conditions<br>( $T_J = 25^\circ\text{C}$ , Unless Otherwise Specified)                                                                         | Characteristic Values |      |                    |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------|--------------------|
|              |                                                                                                                                                     | Min.                  | Typ. | Max.               |
| $g_{fs}$     | $V_{DS} = 10\text{V}$ , $I_D = 0.5 \cdot I_{D25}$ , Note 1                                                                                          | 50                    | 82   | S                  |
| $R_{Gi}$     | Gate Input Resistance                                                                                                                               |                       | 4.75 | $\Omega$           |
| $C_{iss}$    | $V_{GS} = 0\text{V}$ , $V_{DS} = 25\text{V}$ , $f = 1\text{MHz}$                                                                                    |                       | 2250 | pF                 |
| $C_{oss}$    |                                                                                                                                                     |                       | 660  | pF                 |
| $C_{rss}$    |                                                                                                                                                     |                       | 185  | pF                 |
| $t_{d(on)}$  | <b>Resistive Switching Times</b><br>$V_{GS} = 10\text{V}$ , $V_{DS} = 0.5 \cdot V_{DSS}$ , $I_D = 0.5 \cdot I_{D25}$<br>$R_G = 10\Omega$ (External) |                       | 27   | ns                 |
| $t_r$        |                                                                                                                                                     |                       | 38   | ns                 |
| $t_{d(off)}$ |                                                                                                                                                     |                       | 76   | ns                 |
| $t_f$        |                                                                                                                                                     |                       | 35   | ns                 |
| $Q_{g(on)}$  | $V_{GS} = 10\text{V}$ , $V_{DS} = 0.5 \cdot V_{DSS}$ , $I_D = 0.5 \cdot I_{D25}$                                                                    |                       | 70   | nC                 |
| $Q_{gs}$     |                                                                                                                                                     |                       | 20   | nC                 |
| $Q_{gd}$     |                                                                                                                                                     |                       | 38   | nC                 |
| $R_{thJC}$   |                                                                                                                                                     |                       | 0.50 | $^\circ\text{C/W}$ |
| $R_{thJC}$   |                                                                                                                                                     |                       | 0.50 | $^\circ\text{C/W}$ |

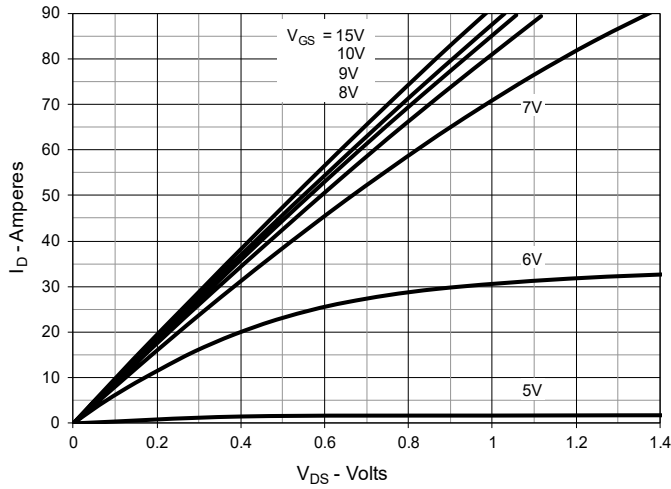
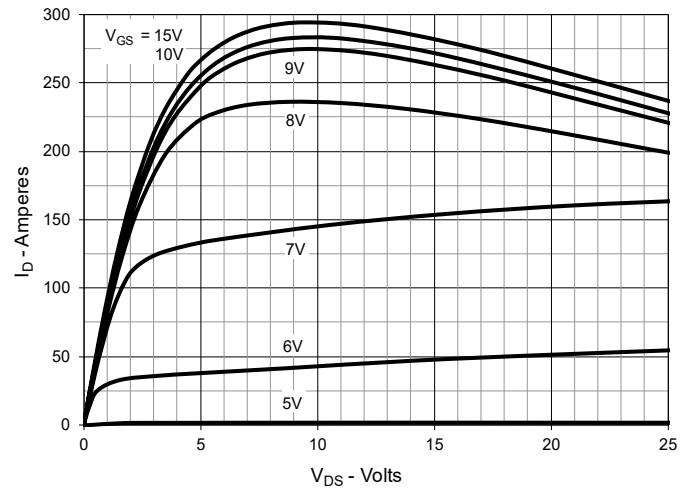
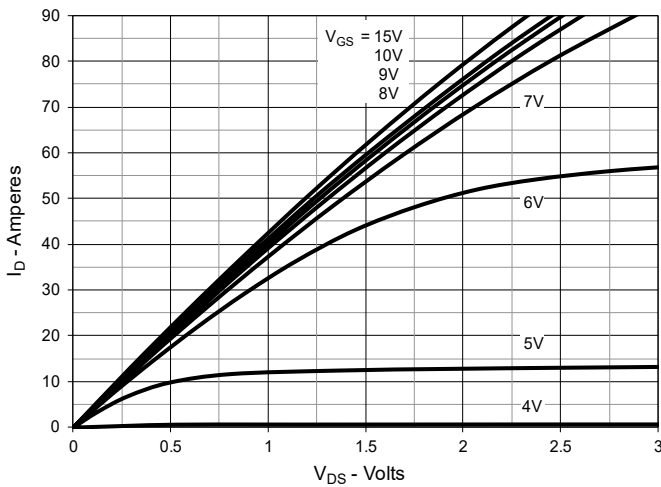
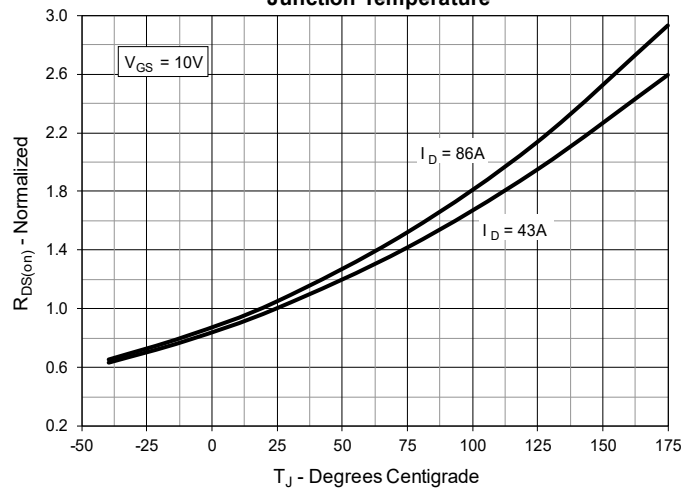
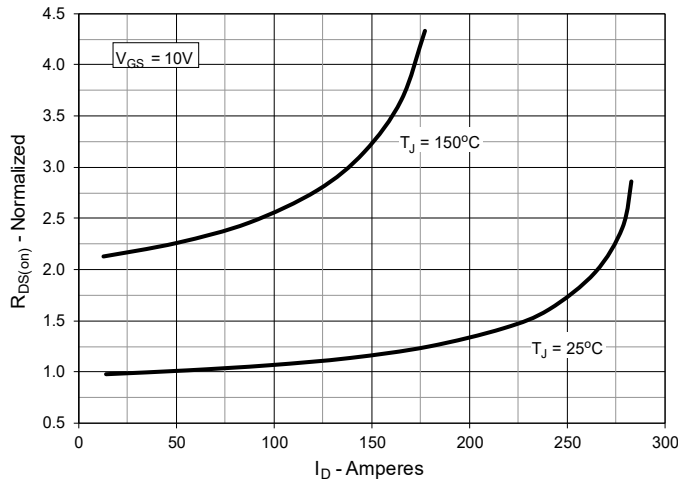
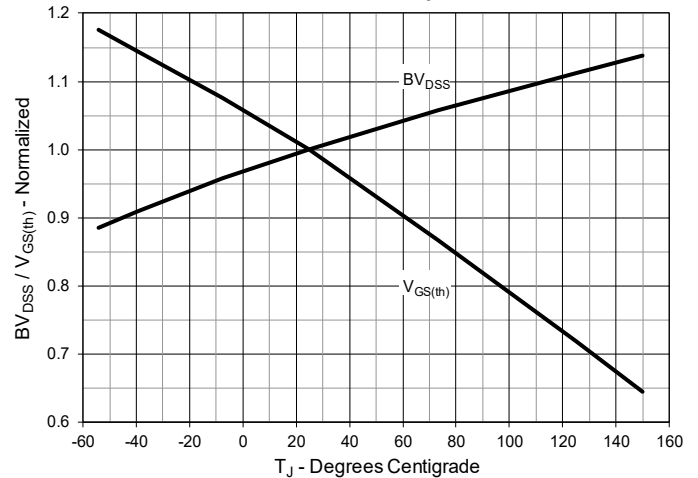
#### Source-Drain Diode

| Symbol   | Test Conditions<br>( $T_J = 25^\circ\text{C}$ , Unless Otherwise Specified)      | Characteristic Values |      |               |
|----------|----------------------------------------------------------------------------------|-----------------------|------|---------------|
|          |                                                                                  | Min.                  | Typ. | Max.          |
| $I_S$    | $V_{GS} = 0\text{V}$                                                             |                       |      | 86 A          |
| $I_{SM}$ | Repetitive, Pulse Width Limited by $T_{JM}$                                      |                       |      | 344 A         |
| $V_{SD}$ | $I_F = I_S$ , $V_{GS} = 0\text{V}$ , Note 1                                      |                       |      | 1.4 V         |
| $t_{rr}$ | $I_F = 43\text{A}$ , $-di/dt = 200\text{A}/\mu\text{s}$ ,<br>$V_R = 100\text{V}$ |                       | 96   | ns            |
| $I_{RM}$ |                                                                                  |                       | 16.7 | A             |
| $Q_{RM}$ |                                                                                  |                       | 0.8  | $\mu\text{C}$ |

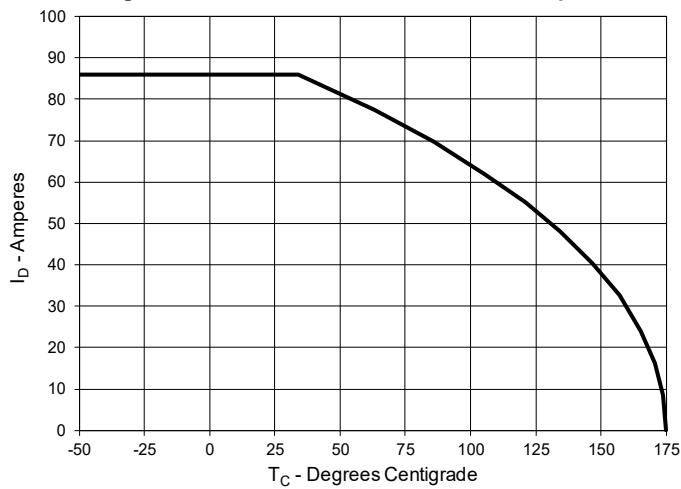
Note 1: Pulse test,  $t \leq 300\mu\text{s}$ , duty cycle,  $d \leq 2\%$

Littelfuse reserves the right to change limits, test conditions and dimensions.

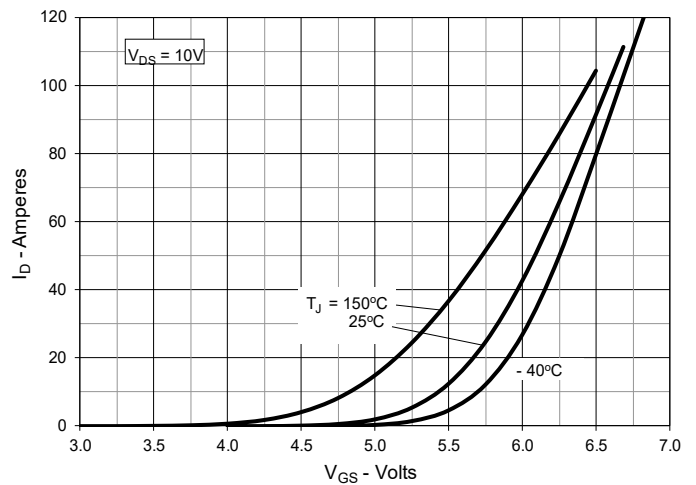
|                                               |           |           |           |           |              |              |              |              |              |              |
|-----------------------------------------------|-----------|-----------|-----------|-----------|--------------|--------------|--------------|--------------|--------------|--------------|
| IXYS MOSFETs and IGBTs are covered            | 4,835,592 | 4,931,844 | 5,049,961 | 5,237,481 | 6,162,665    | 6,404,065 B1 | 6,683,344    | 6,727,585    | 7,005,734 B2 | 7,157,338 B2 |
| by one or more of the following U.S. patents: | 4,860,072 | 5,017,508 | 5,063,307 | 5,381,025 | 6,259,123 B1 | 6,534,343    | 6,710,405 B2 | 6,759,692    | 7,063,975 B2 |              |
|                                               | 4,881,106 | 5,034,796 | 5,187,117 | 5,486,715 | 6,306,728 B1 | 6,583,505    | 6,710,463    | 6,771,478 B2 | 7,071,537    |              |

**Fig. 1. Output Characteristics @  $T_J = 25^\circ\text{C}$** 

**Fig. 2. Extended Output Characteristics @  $T_J = 25^\circ\text{C}$** 

**Fig. 3. Output Characteristics @  $T_J = 150^\circ\text{C}$** 

**Fig. 4.  $R_{DS(on)}$  Normalized to  $I_D = 43\text{A}$  Value vs. Junction Temperature**

**Fig. 5.  $R_{DS(on)}$  Normalized to  $I_D = 43\text{A}$  Value vs. Drain Current**

**Fig. 6. Normalized Breakdown & Threshold Voltages vs. Junction Temperature**


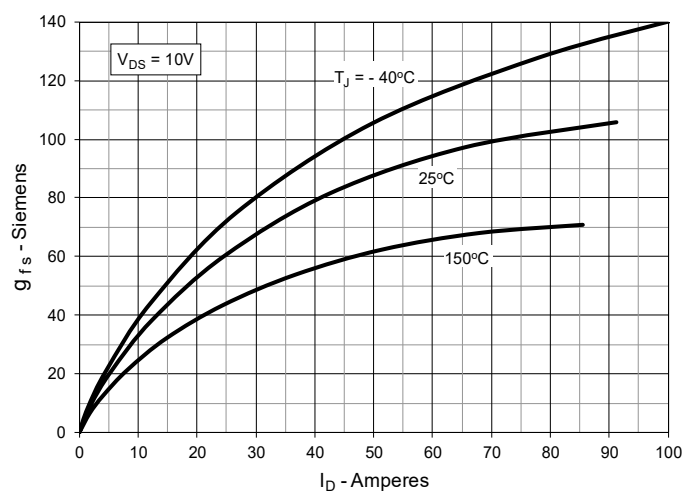
**Fig. 7. Maximum Drain Current vs. Case Temperature**



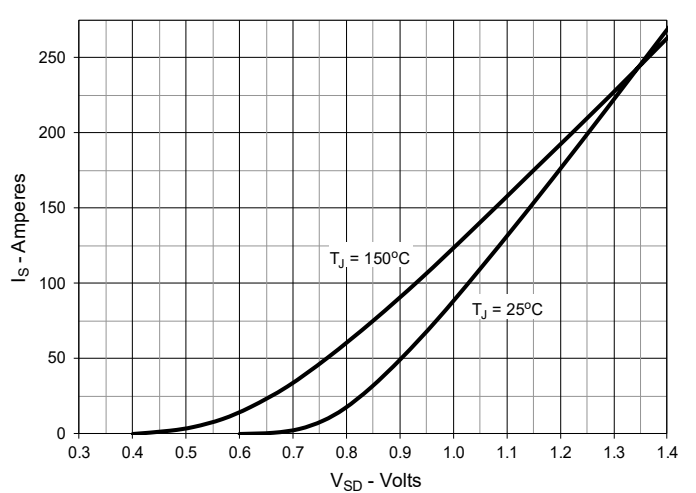
**Fig. 8. Input Admittance**



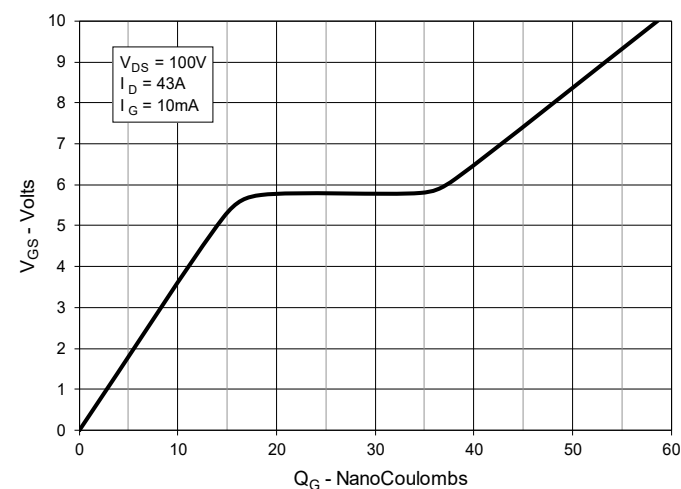
**Fig. 9. Transconductance**



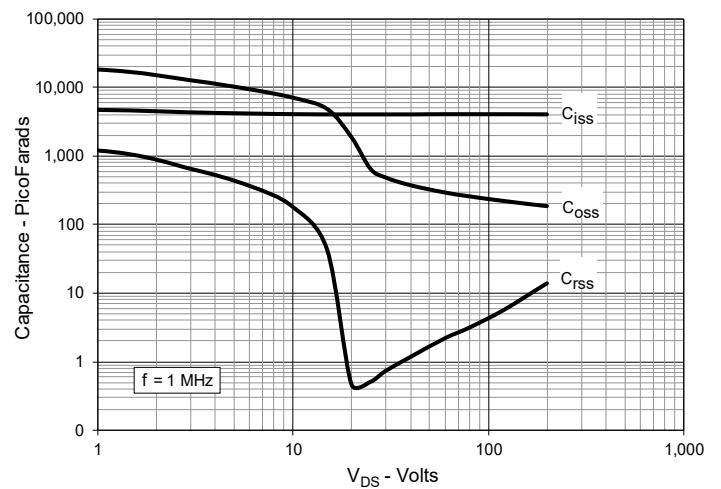
**Fig. 10. Forward Voltage Drop of Intrinsic Diode**

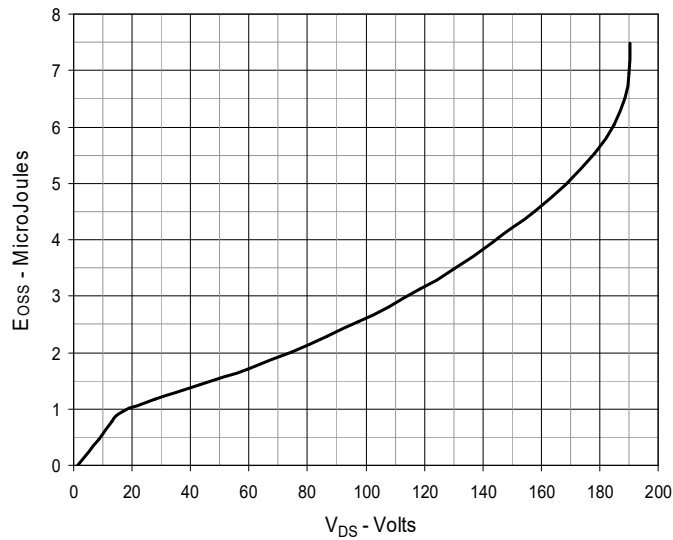
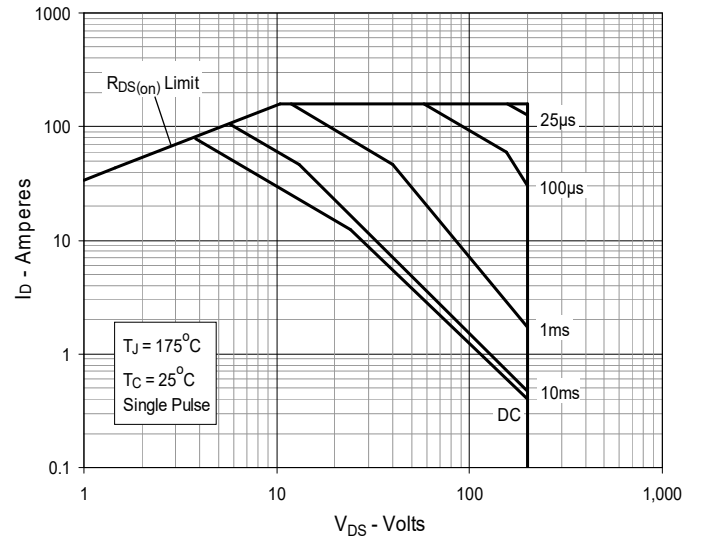
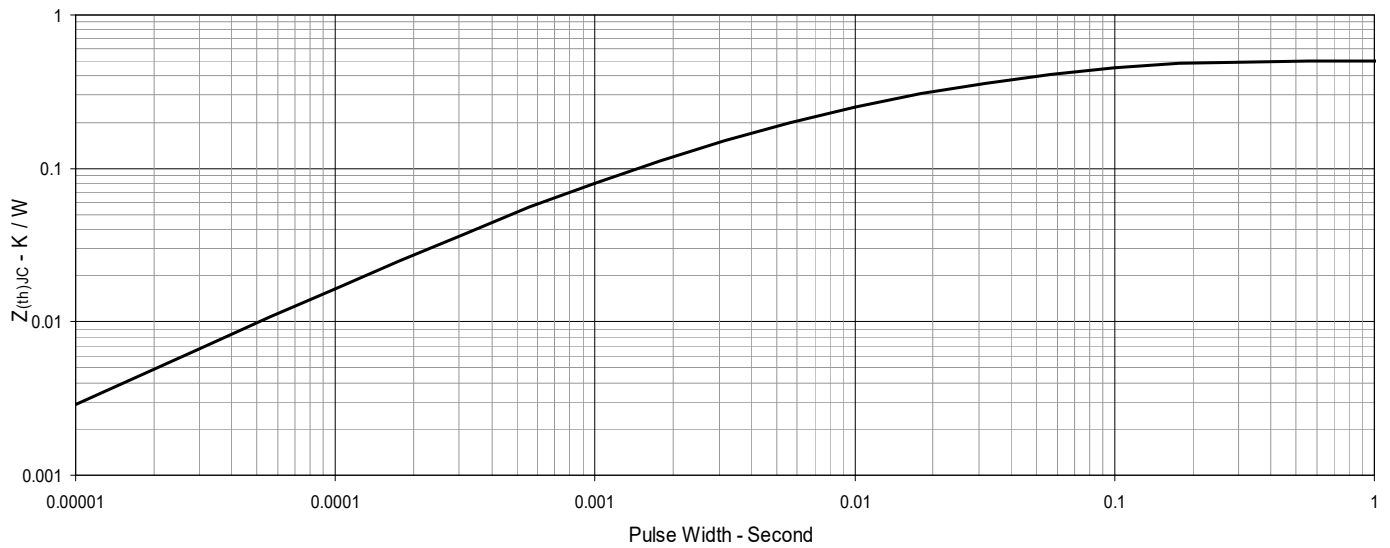


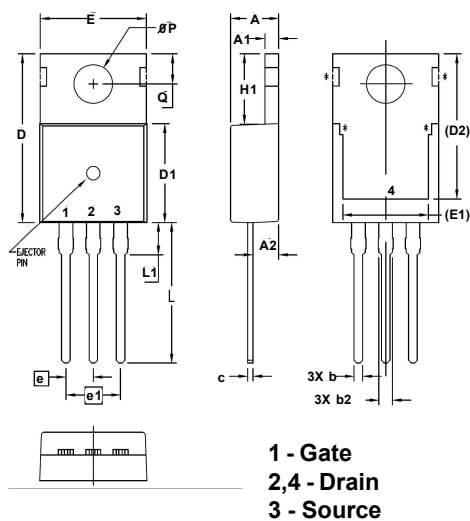
**Fig. 11. Gate Charge**



**Fig. 12. Capacitance**



**Fig. 13. Output Capacitance Stored Energy**

**Fig. 14. Forward-Bias Safe Operating Area**

**Fig. 15. Maximum Transient Thermal Impedance**


**TO-220 Outline**


| SYM  | INCHES   |      | MILLIMETERS |       |
|------|----------|------|-------------|-------|
|      | MIN      | MAX  | MIN         | MAX   |
| A    | .169     | .185 | 4.30        | 4.70  |
| A1   | .047     | .055 | 1.20        | 1.40  |
| A2   | .079     | .106 | 2.00        | 2.70  |
| b    | .024     | .039 | 0.60        | 1.00  |
| b2   | .045     | .057 | 1.15        | 1.45  |
| c    | .014     | .026 | 0.35        | 0.65  |
| D    | .587     | .626 | 14.90       | 15.90 |
| D1   | .335     | .370 | 8.50        | 9.40  |
| (D2) | .500     | .531 | 12.70       | 13.50 |
| E    | .382     | .406 | 9.70        | 10.30 |
| (E1) | .283     | .323 | 7.20        | 8.20  |
| e    | .100 BSC |      | 2.54 BSC    |       |
| e1   | .200 BSC |      | 5.08 BSC    |       |
| H1   | .244     | .268 | 6.20        | 6.80  |
| L    | .492     | .547 | 12.50       | 13.90 |
| L1   | .110     | .154 | 2.80        | 3.90  |
| ØP   | .134     | .150 | 3.40        | 3.80  |
| Q    | .106     | .126 | 2.70        | 3.20  |