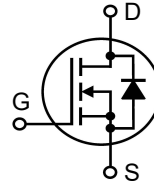


# X3-Class HiPerFET™ Power MOSFET

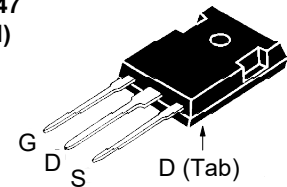
## IXFH48N60X3

N-Channel Enhancement Mode  
Avalanche Rated



$$\begin{aligned} V_{DSS} &= 600V \\ I_{D25} &= 48A \\ R_{DS(on)} &\leq 65m\Omega \end{aligned}$$

TO-247  
(IXFH)



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

| Symbol    | Test Conditions                                                                | Maximum Ratings |                  |
|-----------|--------------------------------------------------------------------------------|-----------------|------------------|
| $V_{DSS}$ | $T_J = 25^\circ\text{C to } 150^\circ\text{C}$                                 | 600             | V                |
| $V_{DGR}$ | $T_J = 25^\circ\text{C to } 150^\circ\text{C}, R_{GS} = 1M\Omega$              | 600             | V                |
| $V_{GSS}$ | Continuous                                                                     | $\pm 20$        | V                |
| $V_{GSM}$ | Transient                                                                      | $\pm 30$        | V                |
| $I_{D25}$ | $T_C = 25^\circ\text{C}$                                                       | 48              | A                |
| $I_{DM}$  | $T_C = 25^\circ\text{C}$ , Pulse Width Limited by $T_{JM}$                     | 68              | A                |
| $I_A$     | $T_C = 25^\circ\text{C}$                                                       | 10              | A                |
| $E_{AS}$  | $T_C = 25^\circ\text{C}$                                                       | 1.4             | J                |
| $dv/dt$   | $I_S \leq I_{DM}, V_{DD} \leq V_{DSS}, T_J \leq 150^\circ\text{C}$             | 50              | V/ns             |
| $P_D$     | $T_C = 25^\circ\text{C}$                                                       | 520             | W                |
| $T_J$     |                                                                                | -55 ... +150    | $^\circ\text{C}$ |
| $T_{JM}$  |                                                                                | 150             | $^\circ\text{C}$ |
| $T_{stg}$ |                                                                                | -55 ... +150    | $^\circ\text{C}$ |
| $T_L$     | Maximum Lead Temperature for Soldering<br>1.6 mm (0.062 in.) from Case for 10s | 300             | $^\circ\text{C}$ |
| $M_d$     | Mounting Torque                                                                | 1.13 / 10       | Nm/lb.in         |
| Weight    |                                                                                | 6               | 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>( $T_J = 25^\circ\text{C}$ , Unless Otherwise Specified) | Characteristic Values |      |                            |
|--------------|-----------------------------------------------------------------------------|-----------------------|------|----------------------------|
|              |                                                                             | Min.                  | Typ. | Max.                       |
| $BV_{DSS}$   | $V_{GS} = 0V, I_D = 1mA$                                                    | 600                   |      | V                          |
| $V_{GS(th)}$ | $V_{DS} = V_{GS}, I_D = 2.5mA$                                              | 3.5                   |      | 5.0 V                      |
| $I_{GSS}$    | $V_{GS} = \pm 20V, V_{DS} = 0V$                                             |                       |      | $\pm 100$ nA               |
| $I_{DSS}$    | $V_{DS} = V_{DSS}, V_{GS} = 0V$<br>$T_J = 125^\circ\text{C}$                |                       |      | 25 $\mu\text{A}$<br>1.5 mA |
| $R_{DS(on)}$ | $V_{GS} = 10V, I_D = 0.5 \cdot I_{D25}$ , Note 1                            |                       |      | 65 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                                                                                         | 16                                                   | 27   | S                         |
| $R_{Gi}$                            | Gate Input Resistance                                                                                                                              |                                                      | 3.6  | $\Omega$                  |
| $C_{iss}$                           | $V_{GS} = 0\text{V}$ , $V_{DS} = 25\text{V}$ , $f = 1\text{MHz}$                                                                                   |                                                      | 2730 | pF                        |
| $C_{oss}$                           |                                                                                                                                                    |                                                      | 4660 | pF                        |
| $C_{rss}$                           |                                                                                                                                                    |                                                      | 18   | pF                        |
| <b>Effective Output Capacitance</b> |                                                                                                                                                    |                                                      |      |                           |
| $C_{o(er)}$                         | Energy related                                                                                                                                     | $V_{GS} = 0\text{V}$<br>$V_{DS} = 0.8 \cdot V_{DSS}$ | 135  | pF                        |
| $C_{o(tr)}$                         | Time related                                                                                                                                       |                                                      | 680  | 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>$R_G = 3\Omega$ (External) |                                                      | 23   | ns                        |
| $t_r$                               |                                                                                                                                                    |                                                      | 11   | ns                        |
| $t_{d(off)}$                        |                                                                                                                                                    |                                                      | 46   | ns                        |
| $t_f$                               |                                                                                                                                                    |                                                      | 5    | ns                        |
| $Q_{g(on)}$                         | $V_{GS} = 10\text{V}$ , $V_{DS} = 0.5 \cdot V_{DSS}$ , $I_D = 0.5 \cdot I_{D25}$                                                                   |                                                      | 38   | nC                        |
| $Q_{gs}$                            |                                                                                                                                                    |                                                      | 13   | nC                        |
| $Q_{gd}$                            |                                                                                                                                                    |                                                      | 13   | nC                        |
| $R_{thJC}$                          |                                                                                                                                                    |                                                      |      | 0.24 $^{\circ}\text{C/W}$ |
| $R_{thCS}$                          |                                                                                                                                                    |                                                      | 0.21 | $^{\circ}\text{C/W}$      |

#### Source-Drain Diode

| Symbol   | Test Conditions<br>( $T_J = 25^\circ\text{C}$ , Unless Otherwise Specified)    | Characteristic Values |      |               |
|----------|--------------------------------------------------------------------------------|-----------------------|------|---------------|
|          |                                                                                | Min.                  | Typ. | Max           |
| $I_S$    | $V_{GS} = 0\text{V}$                                                           |                       |      | 48 A          |
| $I_{SM}$ | Repetitive, Pulse Width Limited by $T_{JM}$                                    |                       |      | 192 A         |
| $V_{SD}$ | $I_F = I_S$ , $V_{GS} = 0\text{V}$ , Note 1                                    |                       |      | 1.4 V         |
| $t_{rr}$ | $I_F = 24\text{A}$ , $-di/dt = 200\text{A}/\mu\text{s}$<br>$V_R = 100\text{V}$ |                       | 163  | ns            |
| $Q_{RM}$ |                                                                                |                       | 2.3  | $\mu\text{C}$ |
| $I_{RM}$ |                                                                                |                       | 28.6 | A             |

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   | 6,404,065B1 | 6,683,344   | 6,727,585   | 7,005,734B2 | 7,157,338B2 |
| by one or more of the following U.S. patents: | 4,860,072 | 5,017,508 | 5,063,307 | 5,381,025 | 6,259,123B1 | 6,534,343   | 6,710,405B2 | 6,759,692   | 7,063,975B2 |             |
|                                               | 4,881,106 | 5,034,796 | 5,187,117 | 5,486,715 | 6,306,728B1 | 6,583,505   | 6,710,463   | 6,771,478B2 | 7,071,537   |             |

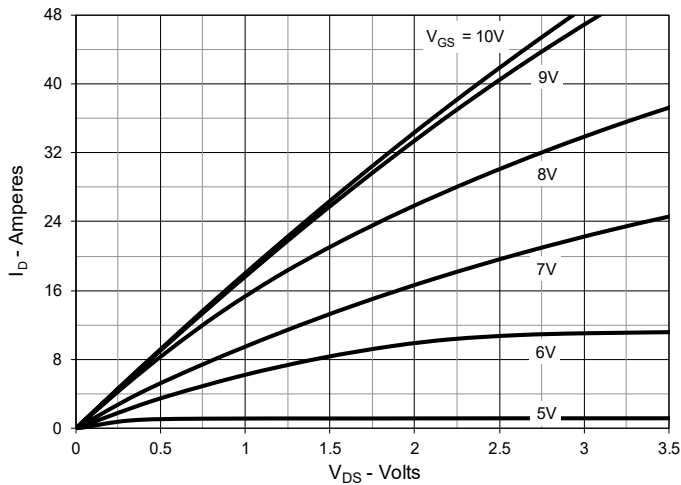
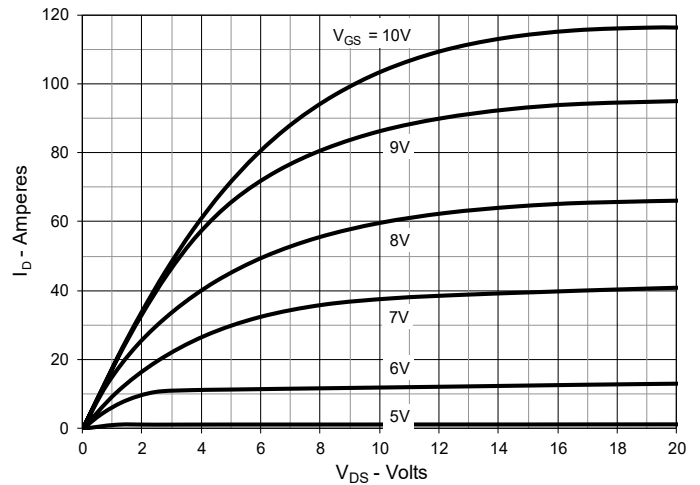
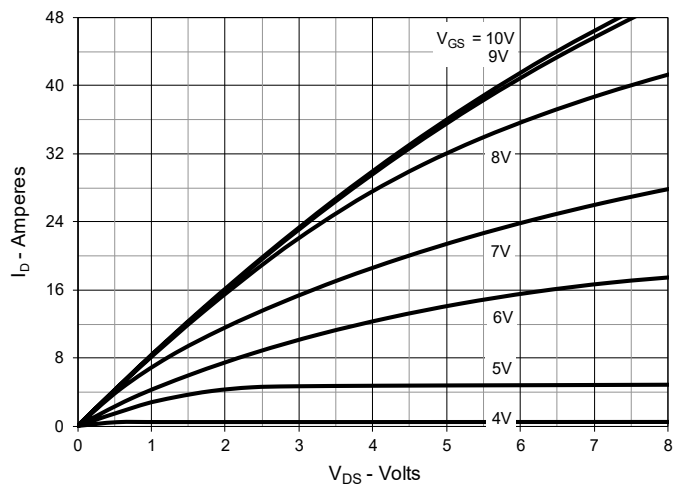
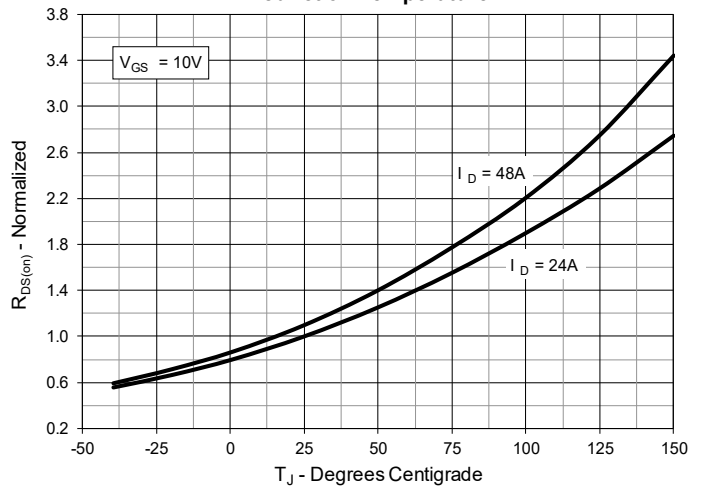
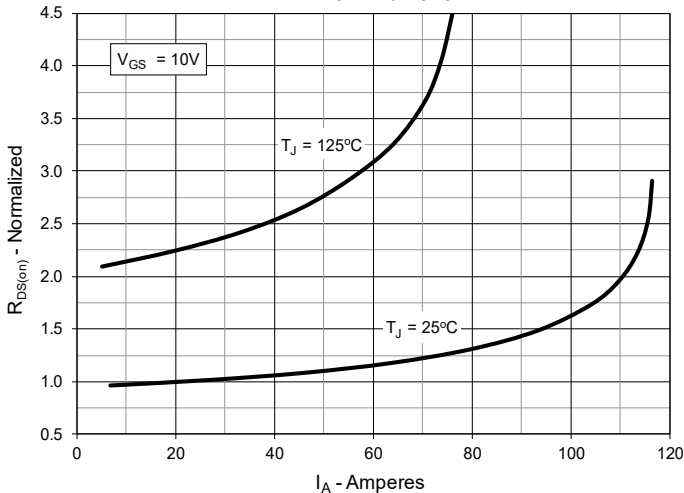
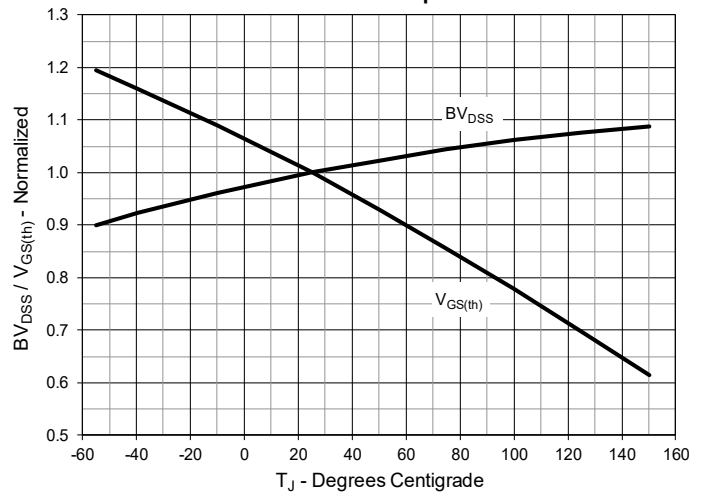
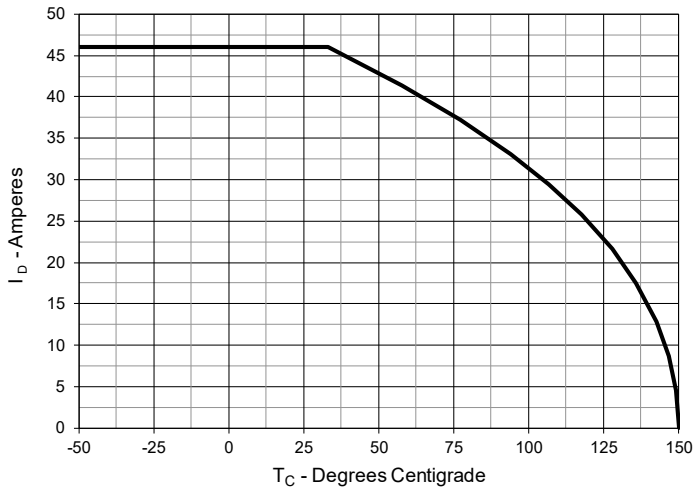
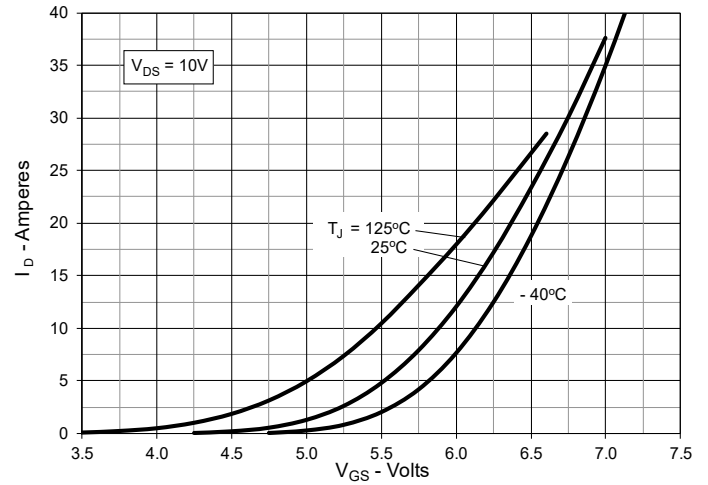
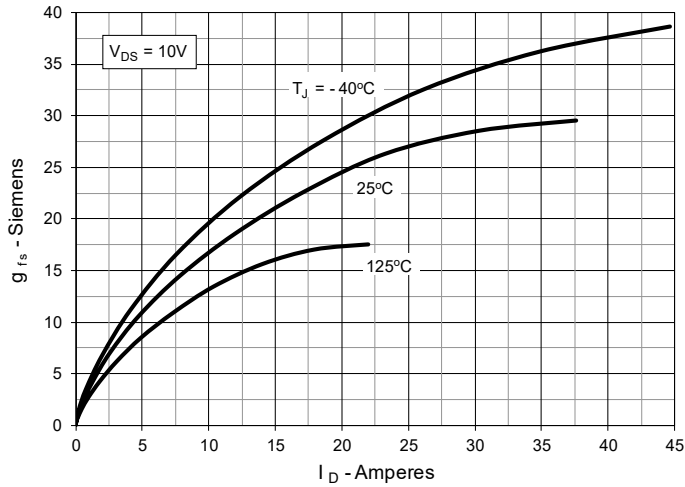
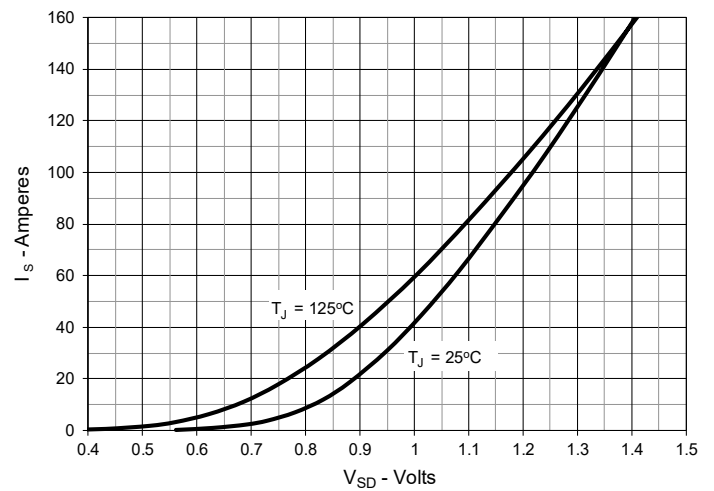
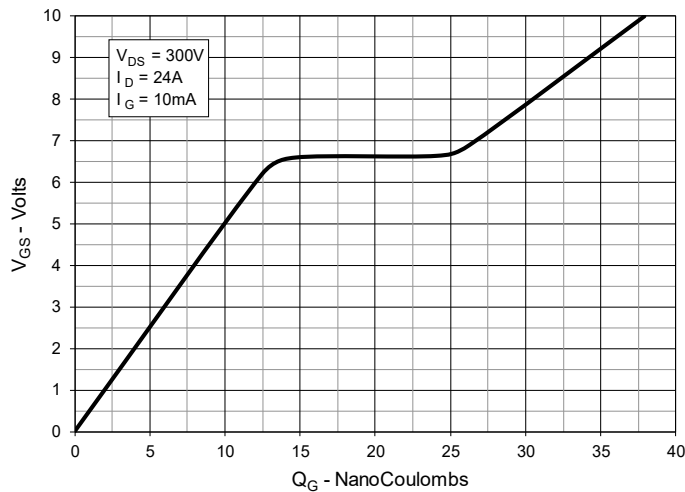
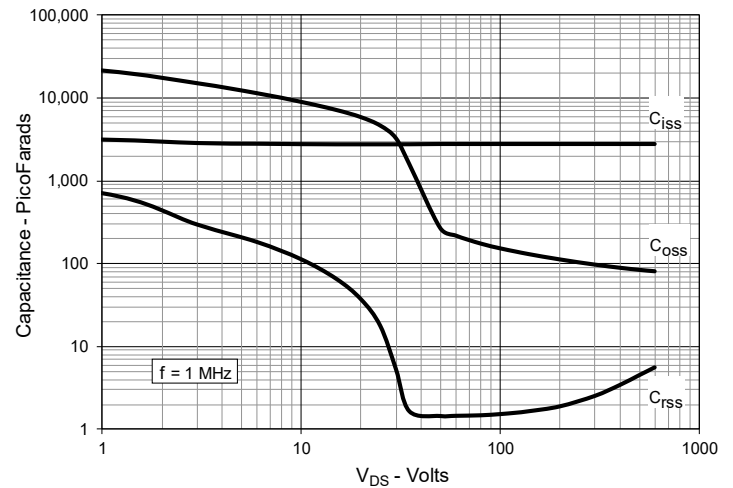
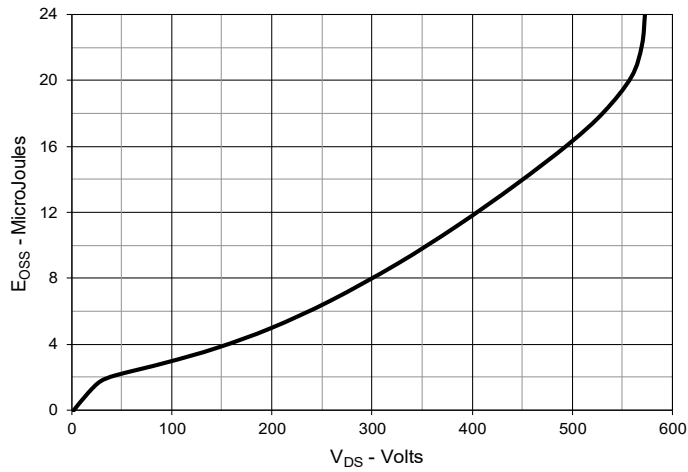
Fig. 1. Output Characteristics @  $T_J = 25^\circ\text{C}$ Fig. 2. Extended Output Characteristics @  $T_J = 25^\circ\text{C}$ Fig. 3. Output Characteristics @  $T_J = 125^\circ\text{C}$ Fig. 4.  $R_{DS(on)}$  Normalized to  $I_D = 24\text{A}$  Value vs. Junction TemperatureFig. 5.  $R_{DS(on)}$  Normalized to  $I_D = 24\text{A}$  Value vs. Drain Current

Fig. 6. Normalized Breakdown &amp; Threshold Voltages vs. Junction Temperature

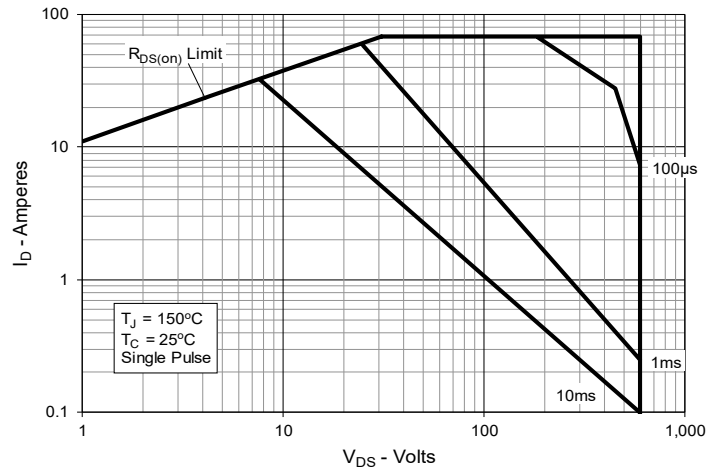


**Fig. 7. Maximum Drain Current vs. Case Temperature**

**Fig. 8. Input Admittance**

**Fig. 9. Transconductance**

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

**Fig. 11. Gate Charge**

**Fig. 12. Capacitance**


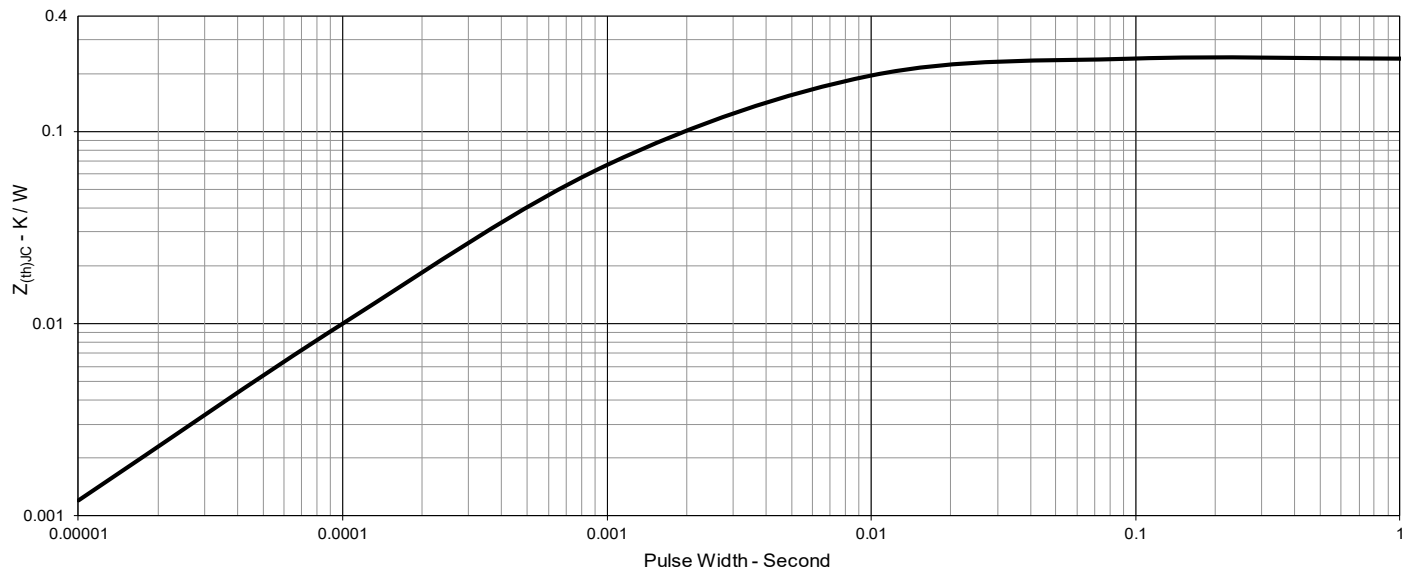
**Fig. 13. Output Capacitance Stored Energy**



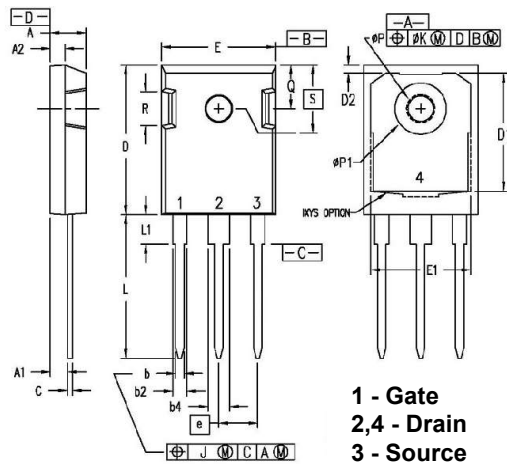
**Fig. 14. Forward-Bias Safe Operating Area**



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



## TO-247 Outline



| SYM | INCHES   |      | MILLIMETERS |       |
|-----|----------|------|-------------|-------|
|     | MIN      | MAX  | MIN         | MAX   |
| A   | .190     | .205 | 4.83        | 5.21  |
| A1  | .090     | .100 | 2.29        | 2.54  |
| A2  | .075     | .085 | 1.91        | 2.16  |
| b   | .045     | .055 | 1.14        | 1.40  |
| b2  | .075     | .087 | 1.91        | 2.20  |
| b4  | .115     | .126 | 2.92        | 3.20  |
| C   | .024     | .031 | 0.61        | 0.80  |
| D   | .819     | .840 | 20.80       | 21.34 |
| D1  | .650     | .690 | 16.51       | 17.53 |
| D2  | .035     | .050 | 0.89        | 1.27  |
| E   | .620     | .635 | 15.75       | 16.13 |
| E1  | .545     | .565 | 13.84       | 14.35 |
| e   | .215 BSC |      | 5.45 BSC    |       |
| J   | --       | .010 | --          | 0.25  |
| K   | --       | .025 | --          | 0.64  |
| L   | .780     | .810 | 19.81       | 20.57 |
| L1  | .150     | .170 | 3.81        | 4.32  |
| ØP  | .140     | .144 | 3.55        | 3.65  |
| ØP1 | .275     | .290 | 6.99        | 7.37  |
| Q   | .220     | .244 | 5.59        | 6.20  |
| R   | .170     | .190 | 4.32        | 4.83  |
| S   | .242 BSC |      | 6.15 BSC    |       |

NOTE: This drawing will meet all dimensions requirement of JEDEC outlines TO-247 AD (R-PSIP-F3)

