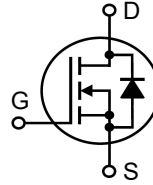


# X3-Class HiPerFET™ Power MOSFET

## IXFK400N15X3 IXFX400N15X3

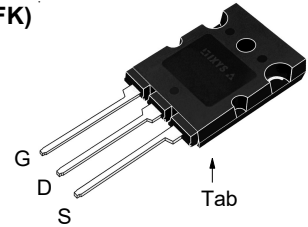
N-Channel Enhancement Mode  
Avalanche Rated



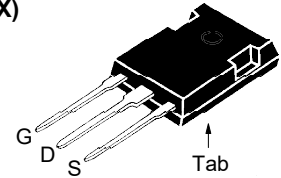
$$\begin{aligned} V_{DSS} &= 150V \\ I_{D25} &= 400A \\ R_{DS(on)} &\leq 3m\Omega \end{aligned}$$

| Symbol       | Test Conditions                                                                | Maximum Ratings   |                  |
|--------------|--------------------------------------------------------------------------------|-------------------|------------------|
| $V_{DSS}$    | $T_J = 25^\circ\text{C}$ to $150^\circ\text{C}$                                | 150               | V                |
| $V_{DGR}$    | $T_J = 25^\circ\text{C}$ to $150^\circ\text{C}$ , $R_{GS} = 1M\Omega$          | 150               | V                |
| $V_{GSS}$    | Continuous                                                                     | $\pm 20$          | V                |
| $V_{GSM}$    | Transient                                                                      | $\pm 30$          | V                |
| $I_{D25}$    | $T_C = 25^\circ\text{C}$ (Chip Capability)                                     | 400               | A                |
| $I_{L(RMS)}$ | External Lead Current Limit                                                    | 160               | A                |
| $I_{DM}$     | $T_C = 25^\circ\text{C}$ , Pulse Width Limited by $T_{JM}$                     | 900               | A                |
| $I_A$        | $T_C = 25^\circ\text{C}$                                                       | 200               | A                |
| $E_{AS}$     | $T_C = 25^\circ\text{C}$                                                       | 3.5               | J                |
| $dv/dt$      | $I_S \leq I_{DM}$ , $V_{DD} \leq V_{DSS}$ , $T_J \leq 150^\circ\text{C}$       | 50                | V/ns             |
| $P_D$        | $T_C = 25^\circ\text{C}$                                                       | 1250              | 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 (TO-264K)                                                      | 1.13/10           | Nm/lb.in         |
| $F_C$        | Mounting Force (PLUS247)                                                       | 20..120 / 4.5..27 | N/lb             |
| Weight       | TO-264K                                                                        | 10                | g                |
|              | PLUS247                                                                        | 6                 | g                |

TO-264K  
(IXFK)



PLUS247  
(IXFX)



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

### Features

- International Standard Packages
- 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.                       |
| $BV_{DSS}$   | $V_{GS} = 0V$ , $I_D = 3mA$                                                 | 150                   |      | V                          |
| $V_{GS(th)}$ | $V_{DS} = V_{GS}$ , $I_D = 8mA$                                             | 2.5                   |      | 4.5 V                      |
| $I_{GSS}$    | $V_{GS} = \pm 20V$ , $V_{DS} = 0V$                                          |                       |      | $\pm 200$ 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                         |                       |      | 3 m $\Omega$               |

| Symbol                              | Test Conditions<br>(T <sub>J</sub> = 25°C, Unless Otherwise Specified)                                                                                                          | Characteristic Values                                            |      |           |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|------|-----------|
|                                     |                                                                                                                                                                                 | Min.                                                             | Typ. | Max       |
| <b>g<sub>fs</sub></b>               | V <sub>DS</sub> = 10V, I <sub>D</sub> = 60A, Note 1                                                                                                                             | 85                                                               | 145  | S         |
| <b>R<sub>Gi</sub></b>               | Gate Input Resistance                                                                                                                                                           |                                                                  | 2.15 | Ω         |
| <b>C<sub>iss</sub></b>              | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 25V, f = 1MHz                                                                                                                           |                                                                  | 23.7 | nF        |
| <b>C<sub>oss</sub></b>              |                                                                                                                                                                                 |                                                                  | 3730 | PF        |
| <b>C<sub>rss</sub></b>              |                                                                                                                                                                                 |                                                                  | 140  | pF        |
| <b>Effective Output Capacitance</b> |                                                                                                                                                                                 |                                                                  |      |           |
| <b>C<sub>o(er)</sub></b>            | Energy related                                                                                                                                                                  | V <sub>GS</sub> = 0V<br>V <sub>DS</sub> = 0.8 • V <sub>DSS</sub> | 2200 | pF        |
| <b>C<sub>o(tr)</sub></b>            | Time related                                                                                                                                                                    |                                                                  | 5330 | pF        |
| <b>t<sub>d(on)</sub></b>            | <b>Resistive Switching Times</b><br>V <sub>GS</sub> = 10V, V <sub>DS</sub> = 0.5 • V <sub>DSS</sub> , I <sub>D</sub> = 0.5 • I <sub>D25</sub><br>R <sub>G</sub> = 1Ω (External) |                                                                  | 36   | ns        |
| <b>t<sub>r</sub></b>                |                                                                                                                                                                                 |                                                                  | 30   | ns        |
| <b>t<sub>d(off)</sub></b>           |                                                                                                                                                                                 |                                                                  | 210  | ns        |
| <b>t<sub>f</sub></b>                |                                                                                                                                                                                 |                                                                  | 19   | ns        |
| <b>Q<sub>g(on)</sub></b>            | V <sub>GS</sub> = 10V, V <sub>DS</sub> = 0.5 • V <sub>DSS</sub> , I <sub>D</sub> = 0.5 • I <sub>D25</sub>                                                                       |                                                                  | 365  | nC        |
| <b>Q<sub>gs</sub></b>               |                                                                                                                                                                                 |                                                                  | 103  | nC        |
| <b>Q<sub>gd</sub></b>               |                                                                                                                                                                                 |                                                                  | 87   | nC        |
| <b>R<sub>thJC</sub></b>             |                                                                                                                                                                                 |                                                                  |      | 0.10 °C/W |
| <b>R<sub>thCS</sub></b>             |                                                                                                                                                                                 |                                                                  | 0.15 | °C/W      |

#### Source-Drain Diode

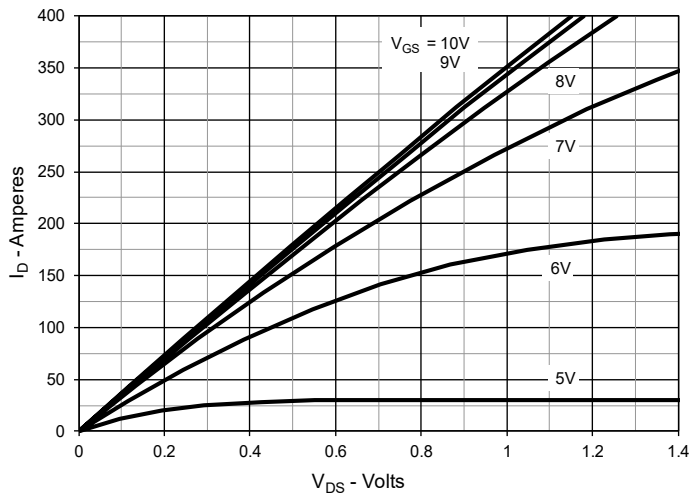
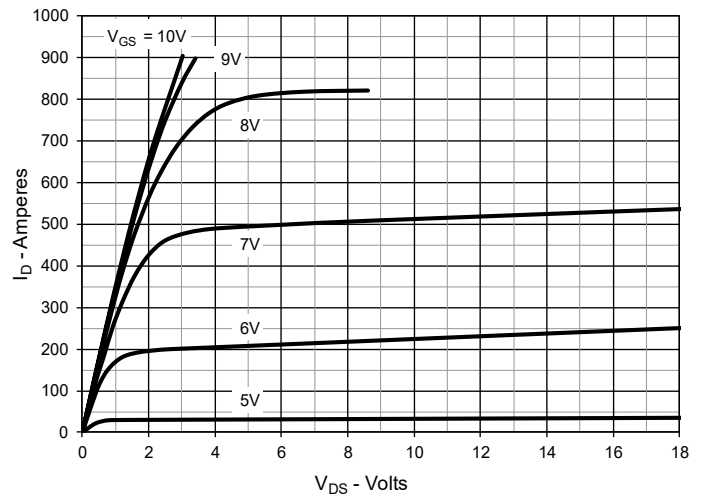
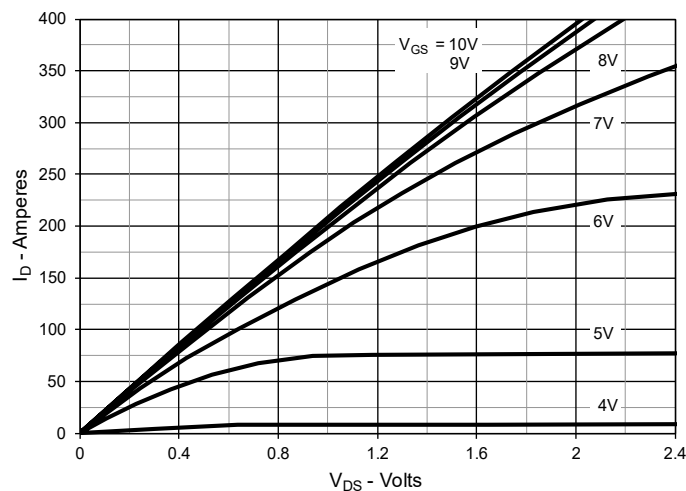
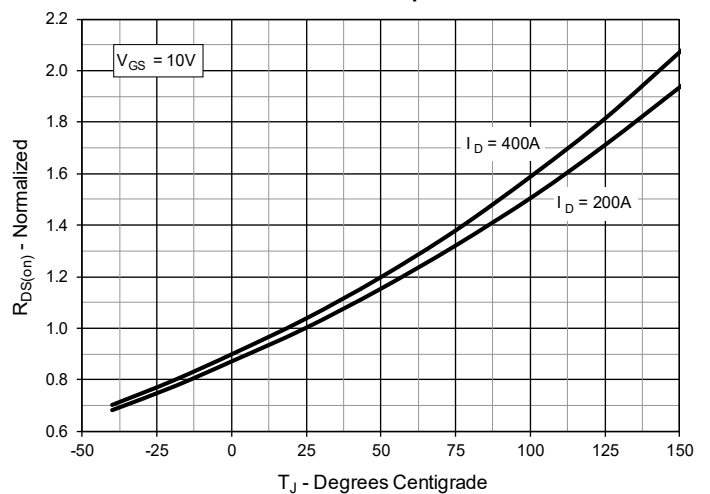
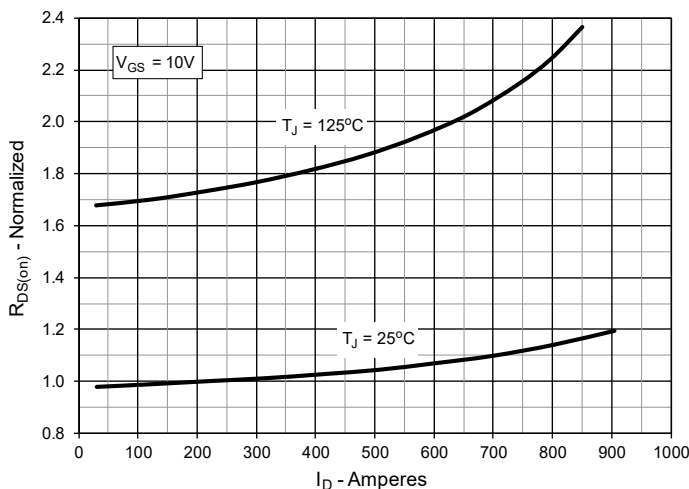
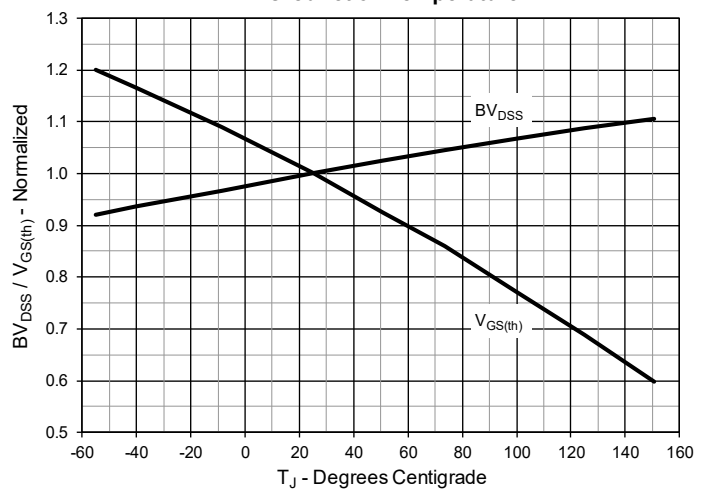
| Symbol   | Test Conditions<br>( $T_J = 25^\circ\text{C}$ , Unless Otherwise Specified)     | Characteristic Values |      |        |
|----------|---------------------------------------------------------------------------------|-----------------------|------|--------|
|          |                                                                                 | Min.                  | Typ. | Max    |
| $I_S$    | $V_{GS} = 0\text{V}$                                                            |                       |      | 400 A  |
| $I_{SM}$ | Repetitive, Pulse Width Limited by $T_{JM}$                                     |                       |      | 1600 A |
| $V_{SD}$ | $I_F = 100\text{A}$ , $V_{GS} = 0\text{V}$ , Note 1                             |                       |      | 1.4 V  |
| $t_{rr}$ | $I_F = 150\text{A}$ , $-di/dt = 100\text{A}/\mu\text{s}$<br>$V_R = 100\text{V}$ |                       | 132  | ns     |
| $Q_{RM}$ |                                                                                 |                       | 580  | nC     |
| $I_{RM}$ |                                                                                 |                       | 8.8  | A      |

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

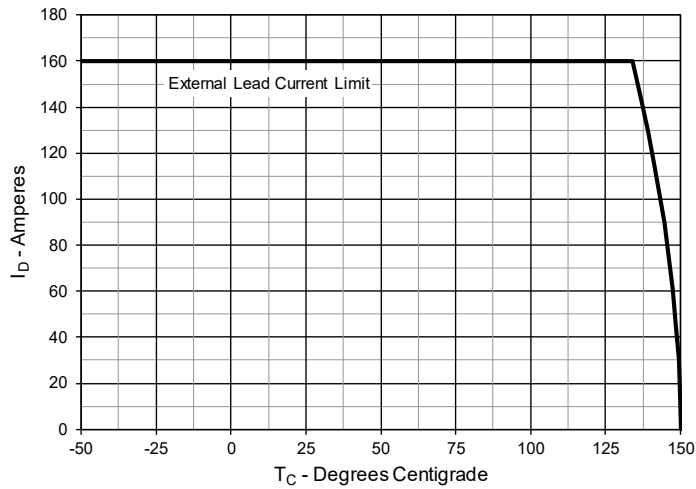
Littelfuse reserves the right to change limits, test conditions, and dimensions.

LF MOSFETs and IGBTs are covered by one or more of the following U.S. patents:

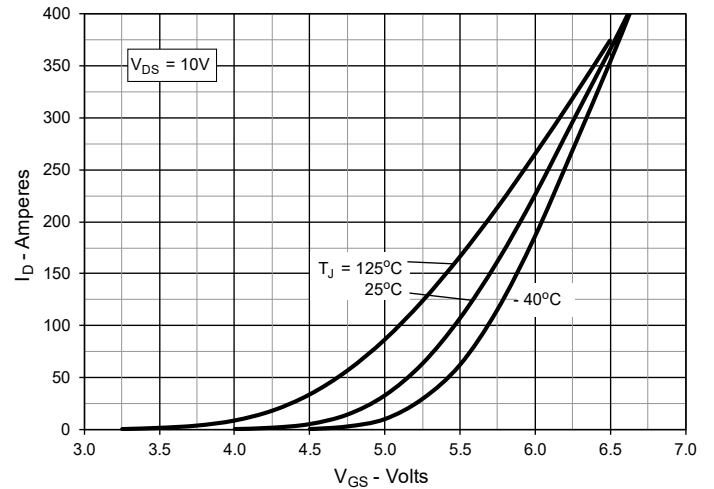
|           |           |           |           |             |             |             |             |             |             |
|-----------|-----------|-----------|-----------|-------------|-------------|-------------|-------------|-------------|-------------|
| 4,835,592 | 4,931,844 | 5,049,961 | 5,237,481 | 6,162,665   | 6,404,065B1 | 6,683,344   | 6,727,585   | 7,005,734B2 | 7,157,338B2 |
| 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  $I_D = 200\text{A}$  Value vs. Junction Temperature**

**Fig. 5.  $R_{DS(on)}$  Normalized to  $I_D = 200\text{A}$  Value vs. Drain Current**

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


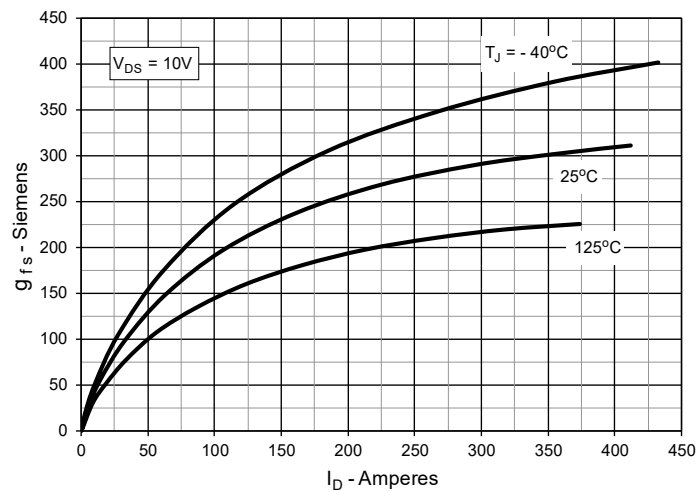
**Fig. 7. Maximum Drain Current vs. Case Temperature**



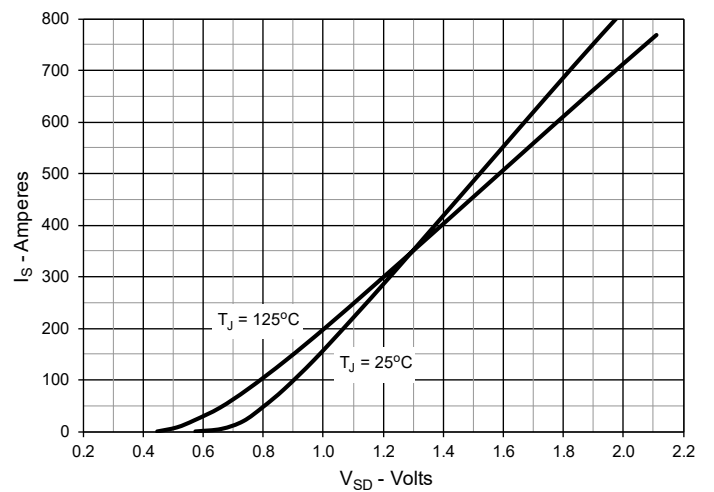
**Fig. 8. Input Admittance**



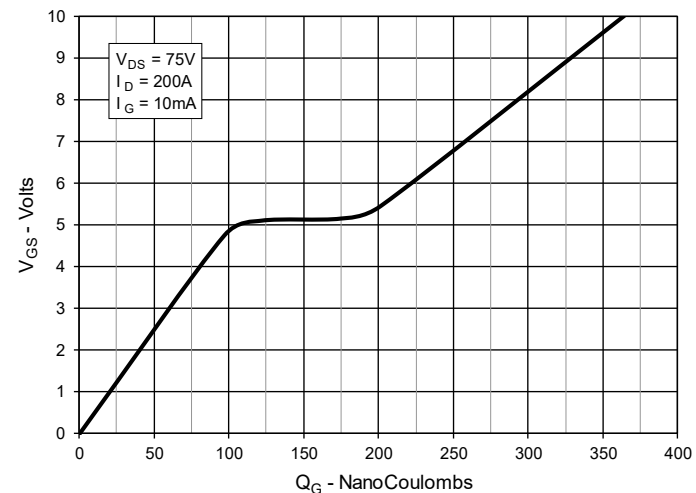
**Fig. 9. Transconductance**



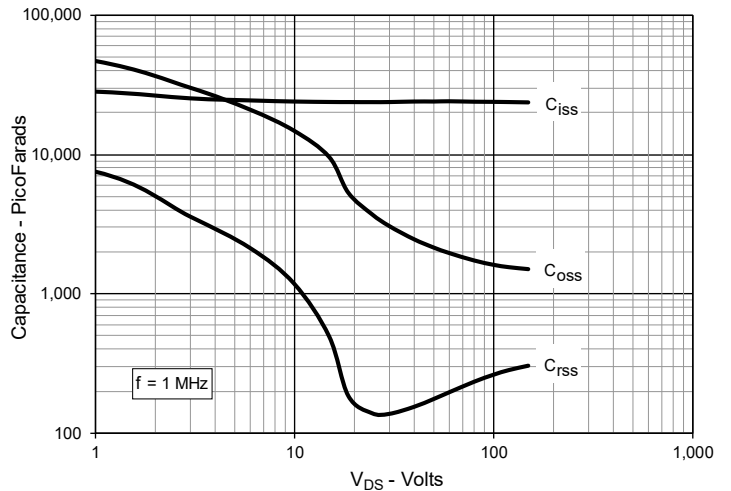
**Fig. 10. Forward Voltage Drop of Intrinsic Diode**



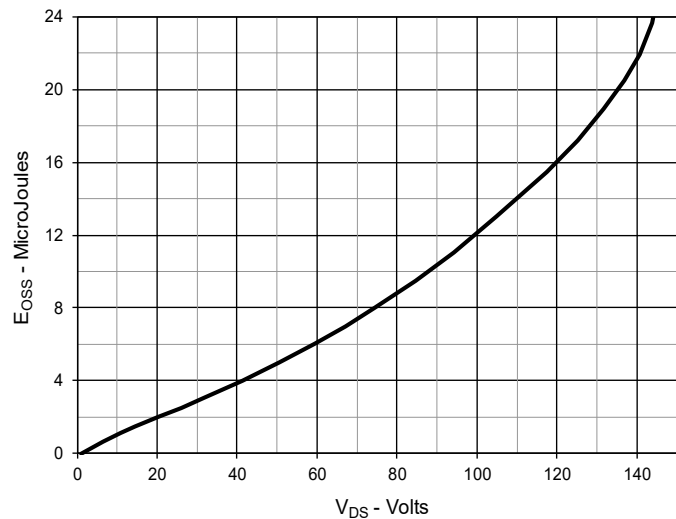
**Fig. 11. Gate Charge**



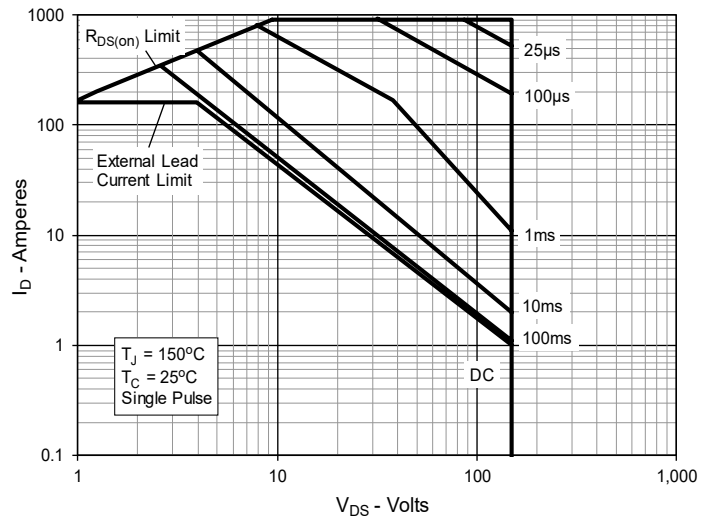
**Fig. 12. Capacitance**



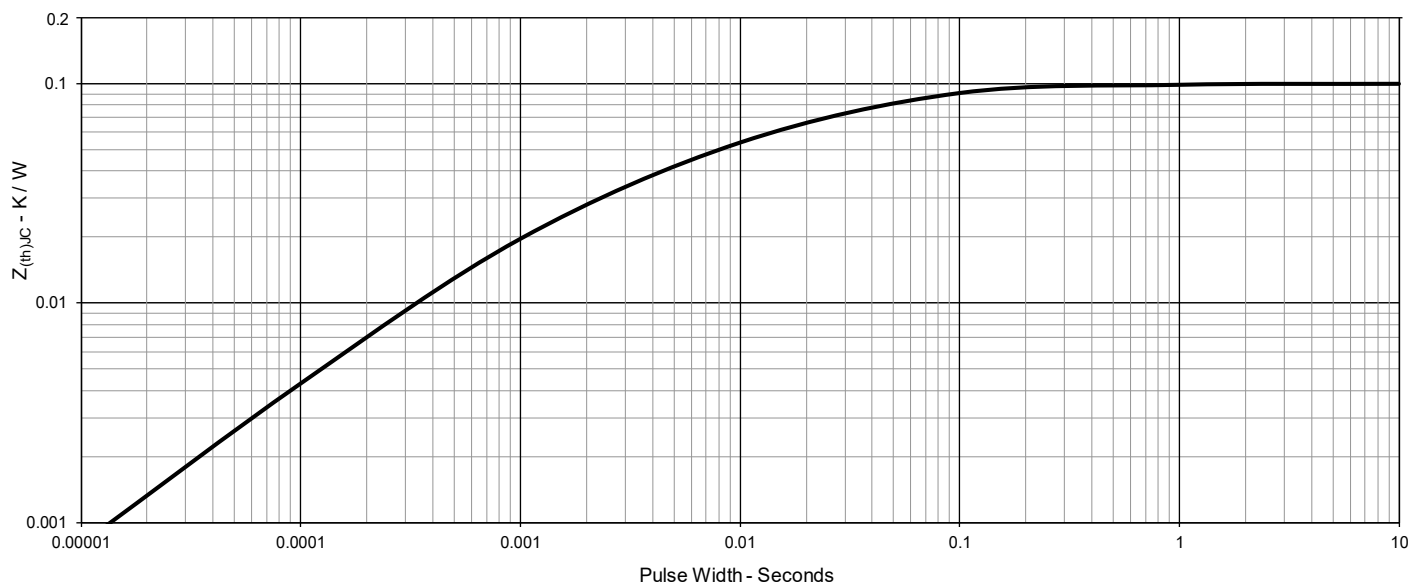
**Fig. 13. Output Capacitance Stored Energy**



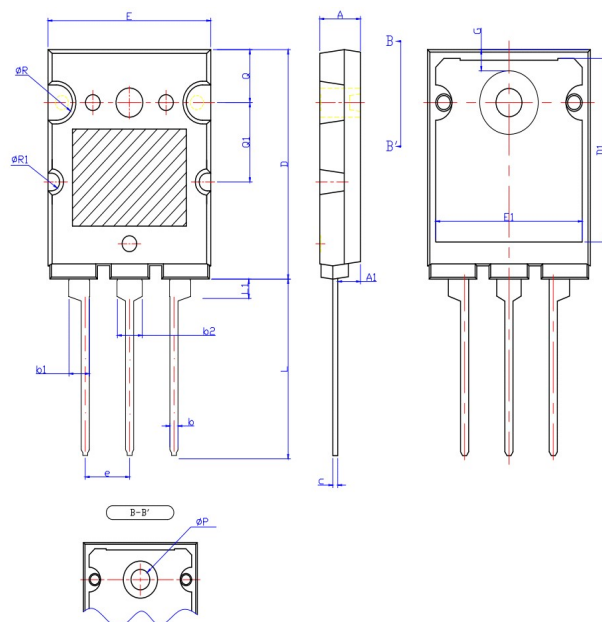
**Fig. 14. Forward-Bias Safe Operating Area**



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



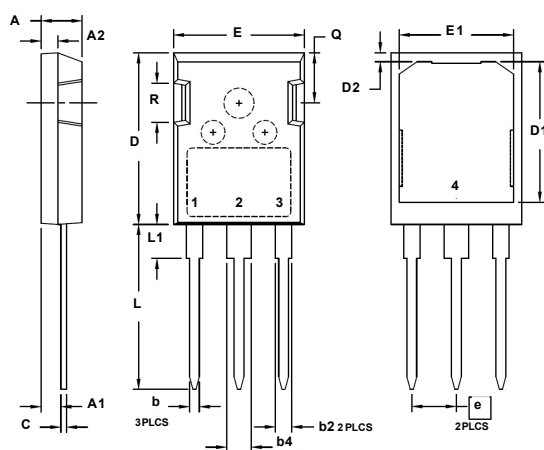
### TO-264K Outline



1 - Gate  
 2,4 - Drain  
 3 - Source

| SYM | INCHES |       | MILLIMETERS |       |
|-----|--------|-------|-------------|-------|
|     | MIN    | MAX   | MIN         | MAX   |
| A   | 0.189  | 0.205 | 4.80        | 5.20  |
| A1  | 0.098  | 0.122 | 2.50        | 3.10  |
| b   | 0.035  | 0.049 | 0.90        | 1.25  |
| b1  | 0.091  | 0.106 | 2.30        | 2.70  |
| b2  | 0.110  | 0.126 | 2.80        | 3.20  |
| c   | 0.020  | 0.033 | 0.50        | 0.85  |
| D   | 1.016  | 1.031 | 25.80       | 26.20 |
| E   | 0.780  | 0.795 | 19.80       | 20.20 |
| e   | 0.203  | 0.226 | 5.15        | 5.75  |
| L   | 0.768  | 0.807 | 19.50       | 20.50 |
| L1  | 0.094  | 0.102 | 2.40        | 2.60  |
| ØP  | 0.118  | 0.134 | 3.00        | 3.40  |
| Q   | 0.228  | 0.244 | 5.80        | 6.20  |
| Q1  | 0.346  | 0.362 | 8.80        | 9.20  |
| E1  | 0.701  | 0.717 | 17.80       | 18.20 |
| D1  | 0.811  | 0.827 | 20.60       | 21.00 |
| G   | 0.087  | 0.102 | 2.20        | 2.60  |
| ØR  | 0.079  |       | 2.00        |       |
| ØR1 | 0.039  |       | 1.00        |       |

### PLUS247™ Outline



1 - Gate  
 2,4 - Drain  
 3 - Source

| 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  | .520     | .560 | 13.08       | 14.22 |
| e   | .215 BSC |      | 5.45 BSC    |       |
| L   | .780     | .810 | 19.81       | 20.57 |
| L1  | .150     | .170 | 3.81        | 4.32  |
| Q   | .220     | .244 | 5.59        | 6.20  |
| R   | .170     | .190 | 4.32        | 4.83  |

