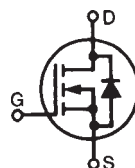


# X2-Class HiPerFET™ Power MOSFET

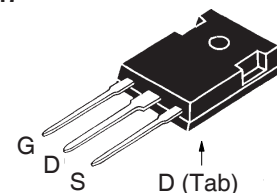
## IXFH60N65X2

$$\begin{aligned} V_{DSS} &= 650V \\ I_{D25} &= 60A \\ R_{DS(on)} &\leq 52m\Omega \end{aligned}$$

N-Channel Enhancement Mode  
Avalanche Rated  
Fast Intrinsic Diode



TO-247



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

| Symbol     | Test Conditions                                                          | Maximum Ratings |                  |
|------------|--------------------------------------------------------------------------|-----------------|------------------|
| $V_{DSS}$  | $T_J = 25^\circ\text{C}$ to $150^\circ\text{C}$                          | 650             | V                |
| $V_{DGR}$  | $T_J = 25^\circ\text{C}$ to $150^\circ\text{C}$ , $R_{GS} = 1M\Omega$    | 650             | V                |
| $V_{GSS}$  | Continuous                                                               | $\pm 30$        | V                |
| $V_{GSM}$  | Transient                                                                | $\pm 40$        | V                |
| $I_{D25}$  | $T_C = 25^\circ\text{C}$                                                 | 60              | A                |
| $I_{DM}$   | $T_C = 25^\circ\text{C}$ , Pulse Width Limited by $T_{JM}$               | 120             | A                |
| $I_A$      | $T_C = 25^\circ\text{C}$                                                 | 15              | A                |
| $E_{AS}$   | $T_C = 25^\circ\text{C}$                                                 | 2.5             | J                |
| $dv/dt$    | $I_S \leq I_{DM}$ , $V_{DD} \leq V_{DSS}$ , $T_J \leq 150^\circ\text{C}$ | 50              | V/ns             |
| $P_D$      | $T_C = 25^\circ\text{C}$                                                 | 780             | 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                                   | 300             | $^\circ\text{C}$ |
| $T_{SOLD}$ | 1.6 mm (0.062in.) from Case for 10s                                      | 260             | $^\circ\text{C}$ |
| $M_d$      | 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.                 |
| $BV_{DSS}$   | $V_{GS} = 0V$ , $I_D = 1mA$                                                 | 650                   |      | V                    |
| $V_{GS(th)}$ | $V_{DS} = V_{GS}$ , $I_D = 4mA$                                             | 3.5                   |      | 5.0 V                |
| $I_{GSS}$    | $V_{GS} = \pm 30V$ , $V_{DS} = 0V$                                          |                       |      | $\pm 100$ nA         |
| $I_{DSS}$    | $V_{DS} = V_{DSS}$ , $V_{GS} = 0V$<br>$T_J = 125^\circ\text{C}$             |                       |      | 25 $\mu A$<br>2.5 mA |
| $R_{DS(on)}$ | $V_{GS} = 10V$ , $I_D = 0.5 \cdot I_{D25}$ , Note 1                         |                       |      | 52 m $\Omega$        |

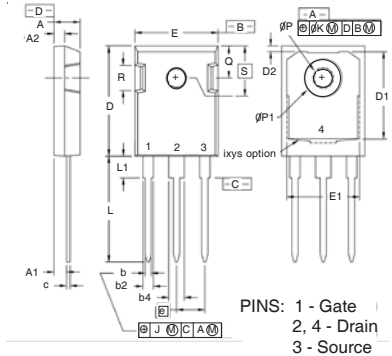
| Symbol                              | Test Conditions<br>( $T_J = 25^{\circ}\text{C}$ , Unless Otherwise Specified)                                                                      | Characteristic Values                                |      |                           |
|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|------|---------------------------|
|                                     |                                                                                                                                                    | Min.                                                 | Typ. | Max                       |
| $g_{fs}$                            | $V_{DS} = 10\text{V}$ , $I_D = 0.5 \cdot I_{D25}$ , Note 1                                                                                         | 23                                                   | 38   | S                         |
| $R_{Gi}$                            | Gate Input Resistance                                                                                                                              |                                                      | 0.8  | $\Omega$                  |
| $C_{iss}$                           | $V_{GS} = 0\text{V}$ , $V_{DS} = 25\text{V}$ , $f = 1\text{MHz}$                                                                                   |                                                      | 6300 | pF                        |
| $C_{oss}$                           |                                                                                                                                                    |                                                      | 3540 | pF                        |
| $C_{rss}$                           |                                                                                                                                                    |                                                      | 1.7  | pF                        |
| <b>Effective Output Capacitance</b> |                                                                                                                                                    |                                                      |      |                           |
| $C_{o(er)}$                         | Energy related                                                                                                                                     | $V_{GS} = 0\text{V}$<br>$V_{DS} = 0.8 \cdot V_{DSS}$ | 207  | pF                        |
| $C_{o(tr)}$                         | Time related                                                                                                                                       |                                                      | 855  | 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) |                                                      | 30   | ns                        |
| $t_r$                               |                                                                                                                                                    |                                                      | 23   | ns                        |
| $t_{d(off)}$                        |                                                                                                                                                    |                                                      | 63   | ns                        |
| $t_f$                               |                                                                                                                                                    |                                                      | 12   | ns                        |
| $Q_{g(on)}$                         | $V_{GS} = 10\text{V}$ , $V_{DS} = 0.5 \cdot V_{DSS}$ , $I_D = 0.5 \cdot I_{D25}$                                                                   |                                                      | 108  | nC                        |
| $Q_{gs}$                            |                                                                                                                                                    |                                                      | 40   | nC                        |
| $Q_{gd}$                            |                                                                                                                                                    |                                                      | 34   | nC                        |
| $R_{thJC}$                          |                                                                                                                                                    |                                                      |      | 0.16 $^{\circ}\text{C/W}$ |
| $R_{thCS}$                          |                                                                                                                                                    |                                                      | 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           |
| $I_S$    | $V_{GS} = 0\text{V}$                                                           |                       |      | 60 A          |
| $I_{SM}$ | Repetitive, pulse Width Limited by $T_{JM}$                                    |                       |      | 240 A         |
| $V_{SD}$ | $I_F = I_S$ , $V_{GS} = 0\text{V}$ , Note 1                                    |                       |      | 1.4 V         |
| $t_{rr}$ | $I_F = 30\text{A}$ , $-di/dt = 100\text{A}/\mu\text{s}$<br>$V_R = 100\text{V}$ |                       | 180  | ns            |
| $Q_{RM}$ |                                                                                |                       | 1.4  | $\mu\text{C}$ |
| $I_{RM}$ |                                                                                |                       | 16.0 | A             |

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

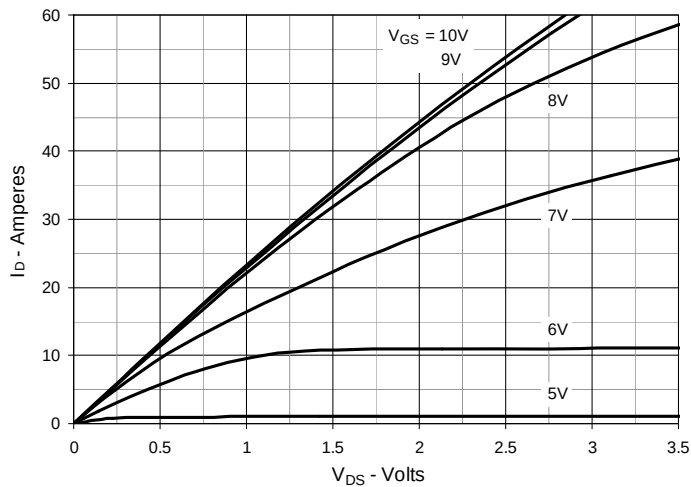
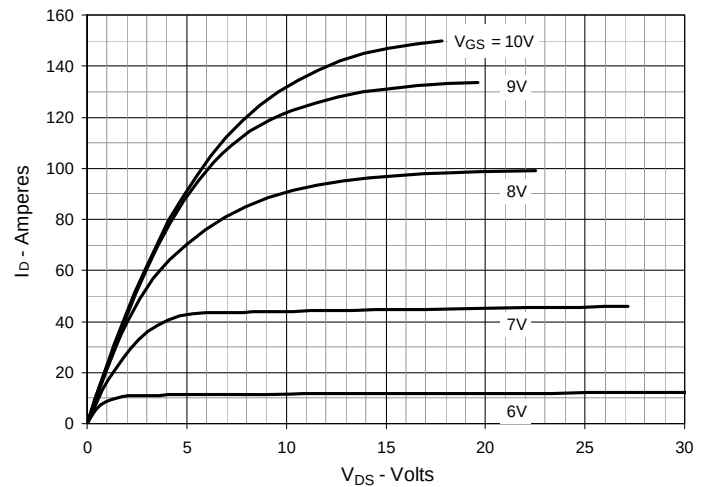
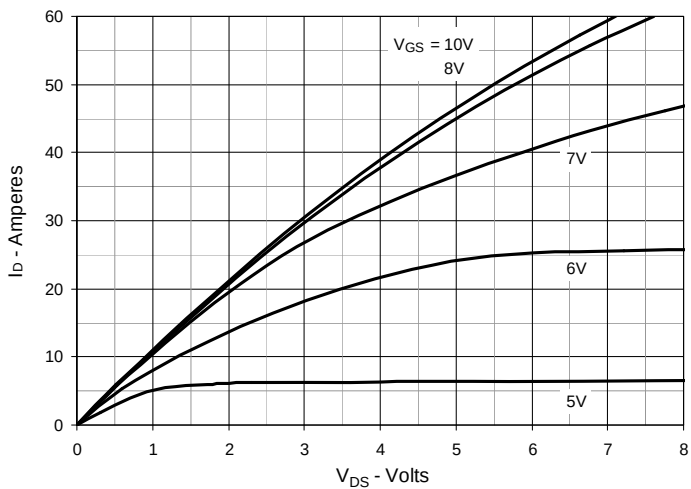
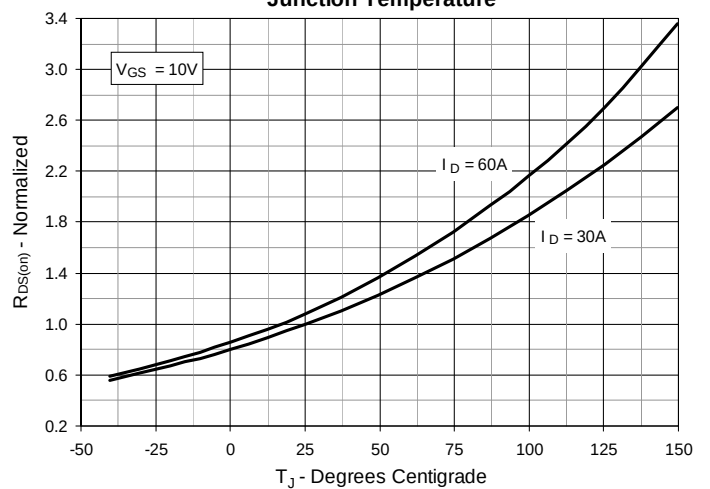
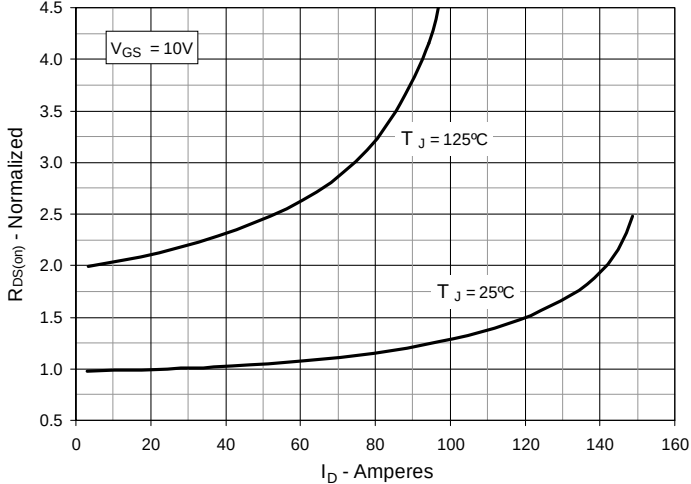
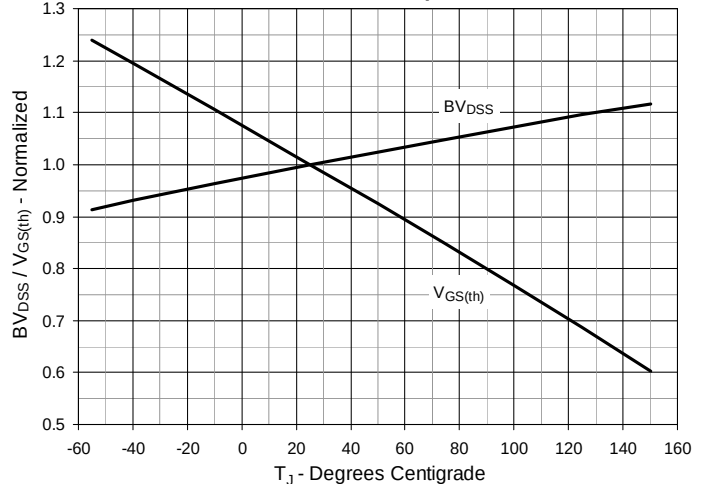
## TO-247 (IXFH) Outline

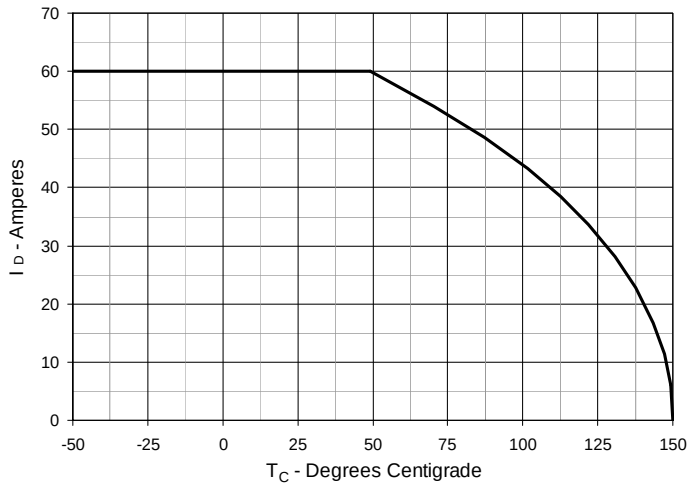
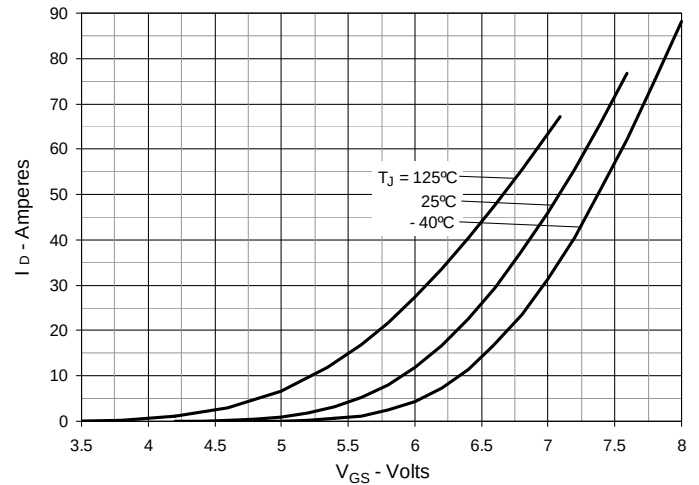
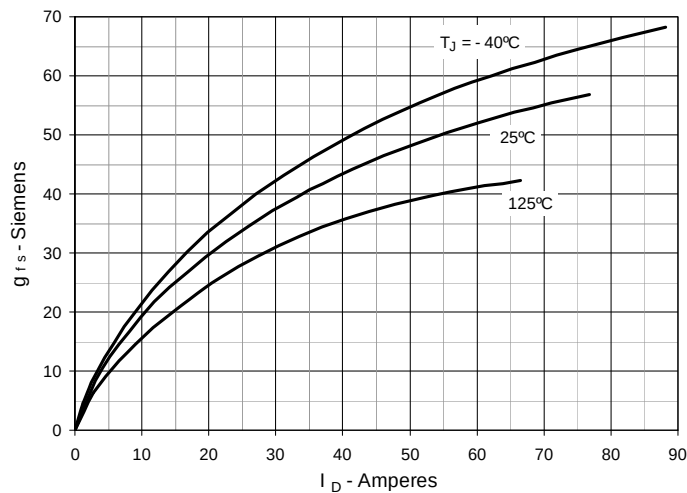
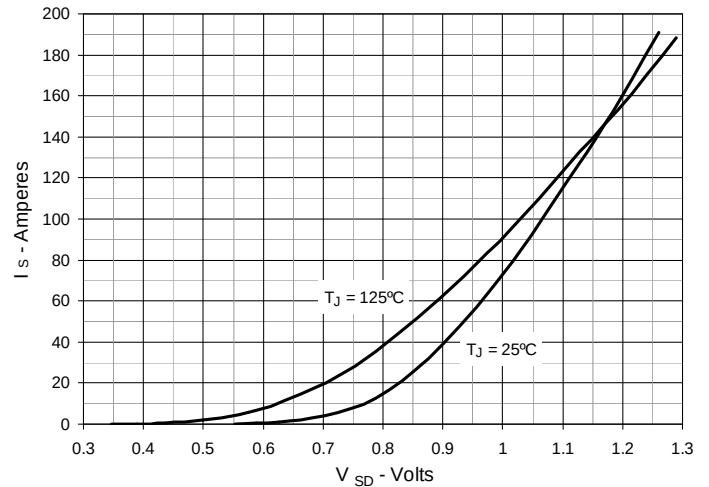
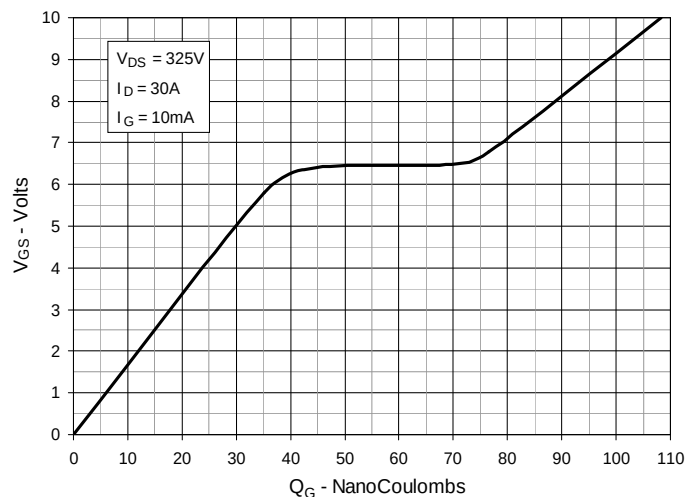
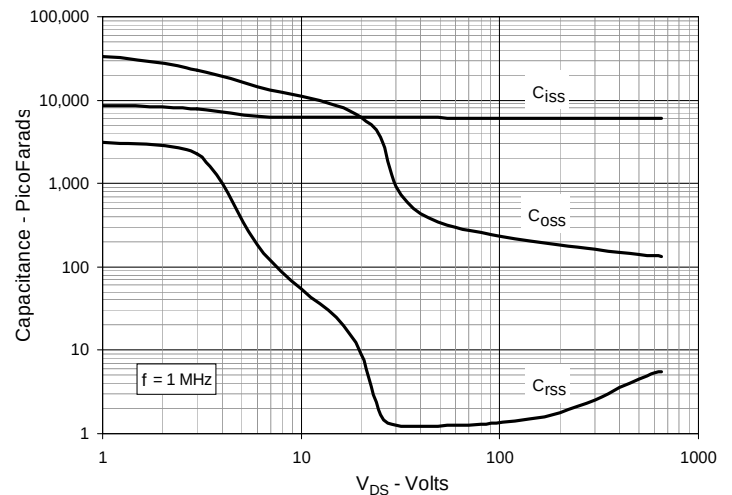


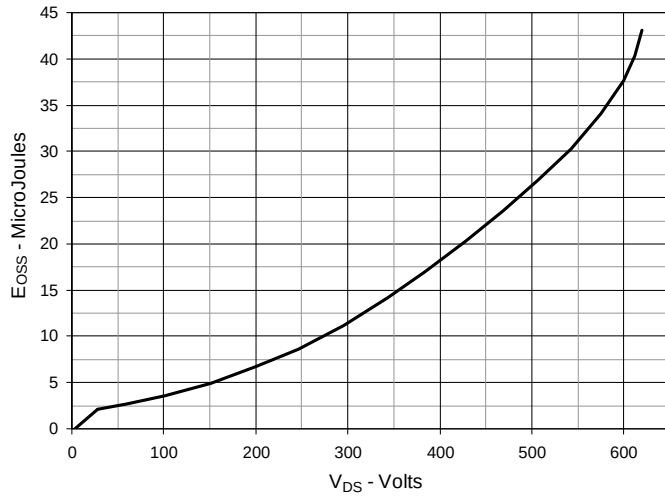
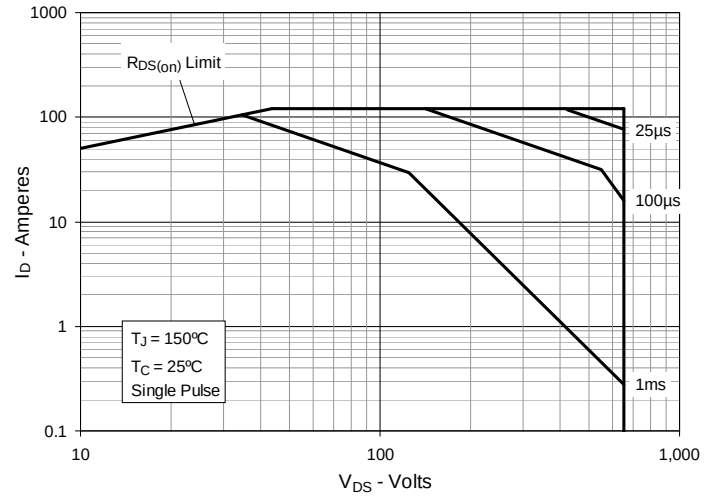
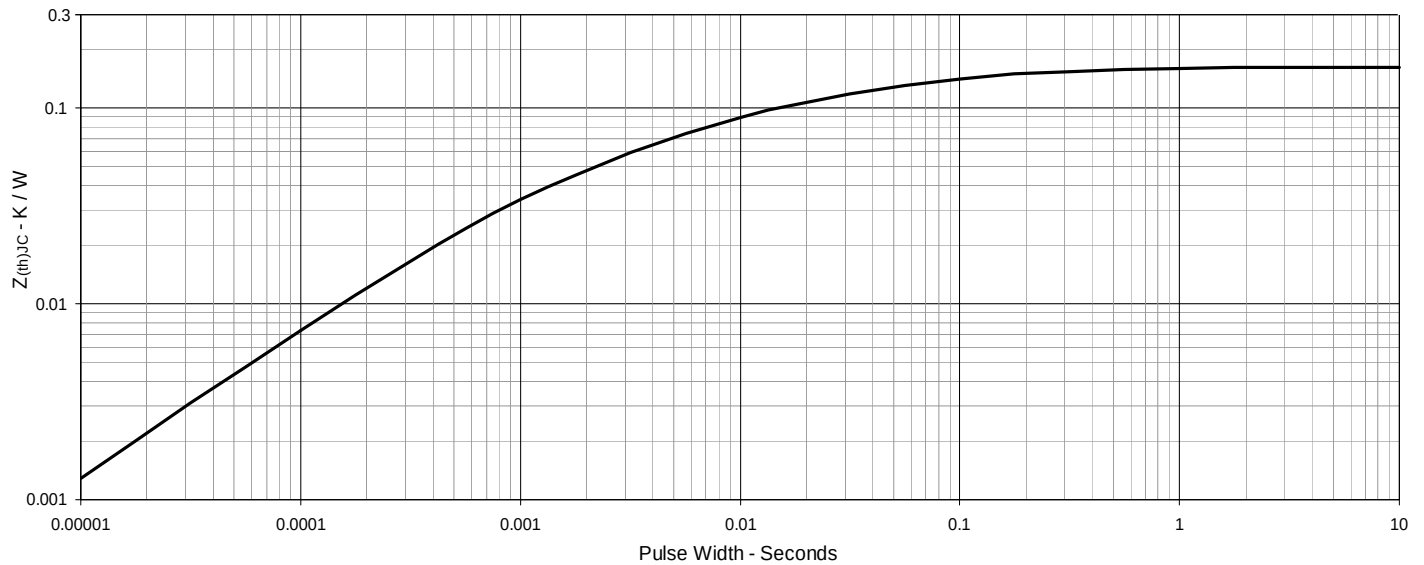
| SYM       | INCHES   |      | MILLIMETERS |       |
|-----------|----------|------|-------------|-------|
|           | MIN      | MAX  | MIN         | MAX   |
| A         | .190     | .205 | 4.83        | 5.21  |
| A1        | .090     | .100 | 2.29        | 2.54  |
| A2        | .075     | .085 | 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  |
| $\phi P$  | .140     | .144 | 3.55        | 3.65  |
| $\phi P1$ | .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    |       |

IXYS Reserves the Right to Change Limits, Test Conditions, and Dimensions.

|                                                                                  |           |           |           |           |             |             |             |             |             |             |
|----------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-------------|-------------|-------------|-------------|-------------|-------------|
| IXYS 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  $I_D = 30\text{A}$  Value vs. Junction Temperature**

**Fig. 5.  $R_{DS(on)}$  Normalized to  $I_D = 30\text{A}$  Value vs. Drain Current**

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


**Fig. 7. Maxing 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**




---

Disclaimer Notice - Information furnished is believed to be accurate and reliable. However, users should independently evaluate the suitability of and test each product selected for their own applications. Littelfuse products are not designed for, and may not be used in, all applications. Read complete Disclaimer Notice at [www.littelfuse.com/disclaimer-electronics](http://www.littelfuse.com/disclaimer-electronics).