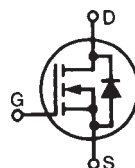


# X2-Class HiPerFET™ Power MOSFET

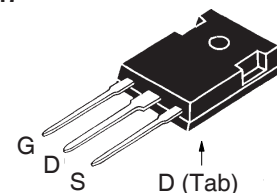
## IXFH60N65X2

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

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 $\mu\text{A}$<br>2.5 mA |
| $R_{DS(on)}$ | $V_{GS} = 10V$ , $I_D = 0.5 \cdot I_{D25}$ , Note 1                         |                       |      | 52 m $\Omega$              |

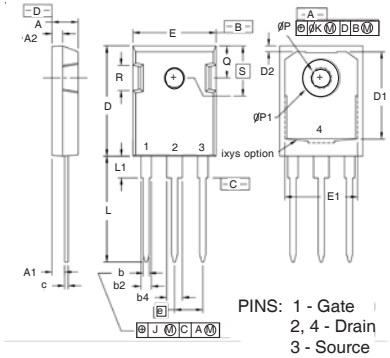
| Symbol                              | Test Conditions<br>(T <sub>J</sub> = 25°C, Unless Otherwise Specified)                                                                                                          | Characteristic Values                                            |      |           |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|------|-----------|
|                                     |                                                                                                                                                                                 | Min.                                                             | Typ. | Max       |
| <b>g<sub>fs</sub></b>               | V <sub>DS</sub> = 10V, I <sub>D</sub> = 0.5 • I <sub>D25</sub> , Note 1                                                                                                         | 23                                                               | 38   | S         |
| <b>R<sub>Gi</sub></b>               | Gate Input Resistance                                                                                                                                                           |                                                                  | 0.8  | Ω         |
| <b>C<sub>iss</sub></b>              | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 25V, f = 1MHz                                                                                                                           |                                                                  | 6300 | pF        |
| <b>C<sub>oss</sub></b>              |                                                                                                                                                                                 |                                                                  | 3540 | pF        |
| <b>C<sub>rss</sub></b>              |                                                                                                                                                                                 |                                                                  | 1.7  | 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> | 207  | pF        |
| <b>C<sub>o(tr)</sub></b>            | Time related                                                                                                                                                                    |                                                                  | 855  | 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> = 3Ω (External) |                                                                  | 30   | ns        |
| <b>t<sub>r</sub></b>                |                                                                                                                                                                                 |                                                                  | 23   | ns        |
| <b>t<sub>d(off)</sub></b>           |                                                                                                                                                                                 |                                                                  | 63   | ns        |
| <b>t<sub>f</sub></b>                |                                                                                                                                                                                 |                                                                  | 12   | 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>                                                                       |                                                                  | 108  | nC        |
| <b>Q<sub>gs</sub></b>               |                                                                                                                                                                                 |                                                                  | 40   | nC        |
| <b>Q<sub>gd</sub></b>               |                                                                                                                                                                                 |                                                                  | 34   | nC        |
| <b>R<sub>thJC</sub></b>             |                                                                                                                                                                                 |                                                                  |      | 0.16 °C/W |
| <b>R<sub>thCS</sub></b>             |                                                                                                                                                                                 |                                                                  | 0.21 | °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,  $d \leq 2\%$ .

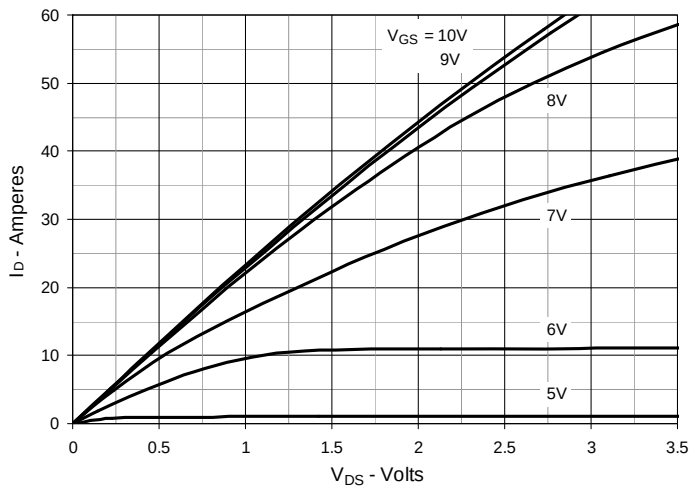
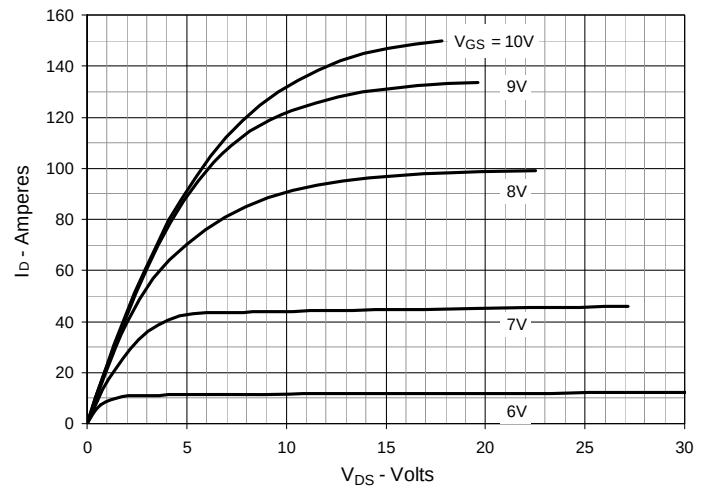
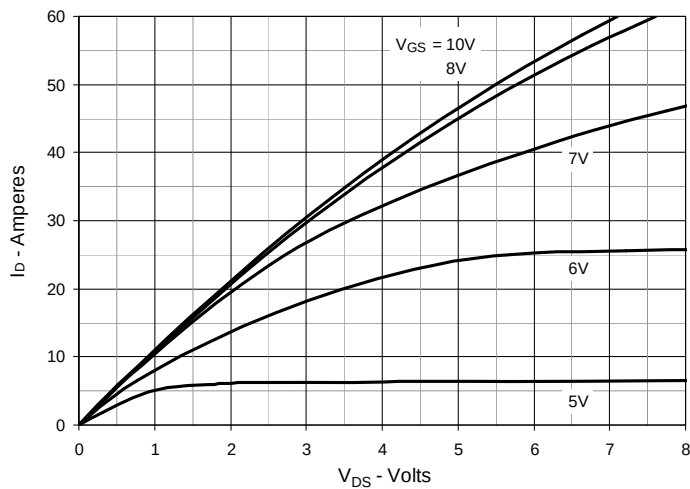
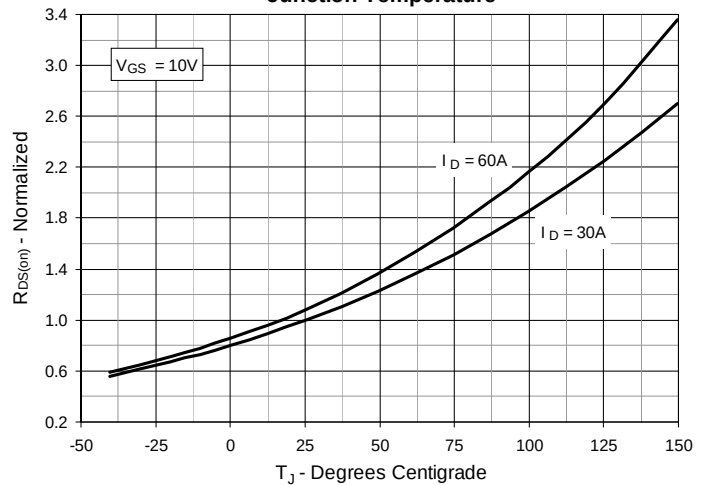
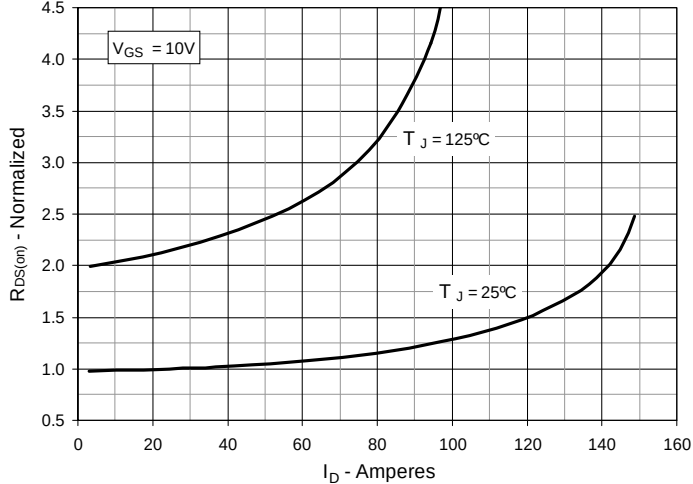
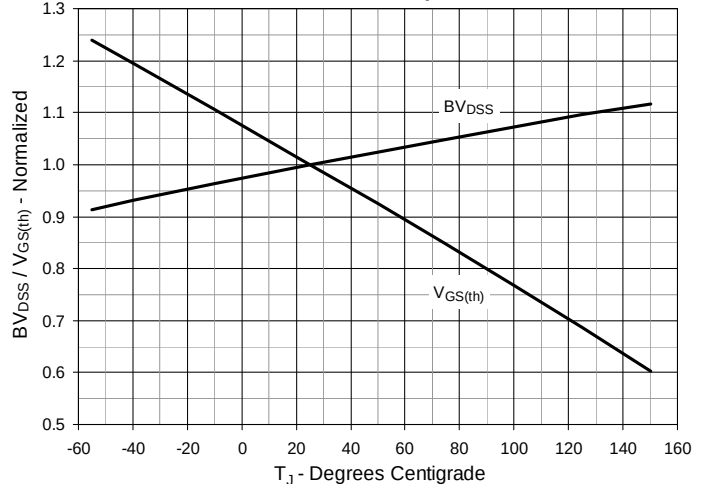
## TO-247 (IXFH) Outline

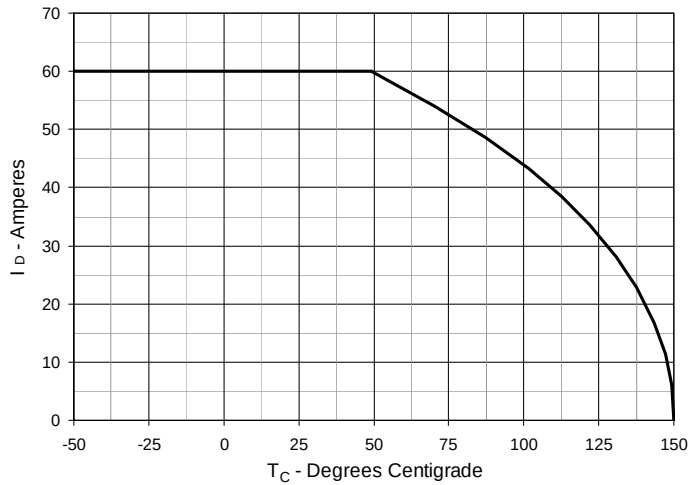
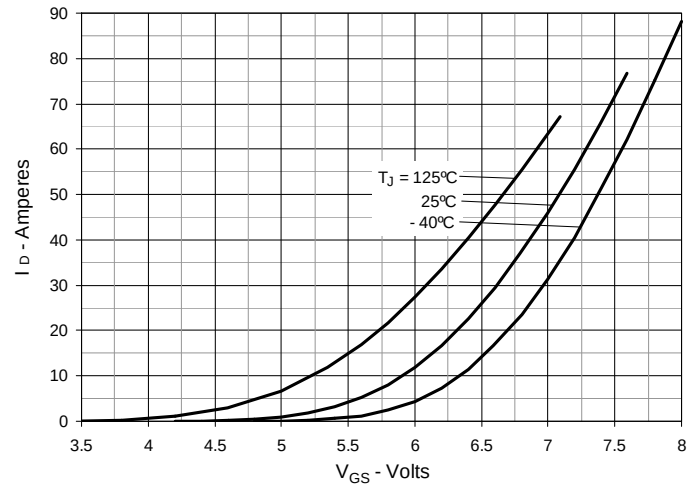
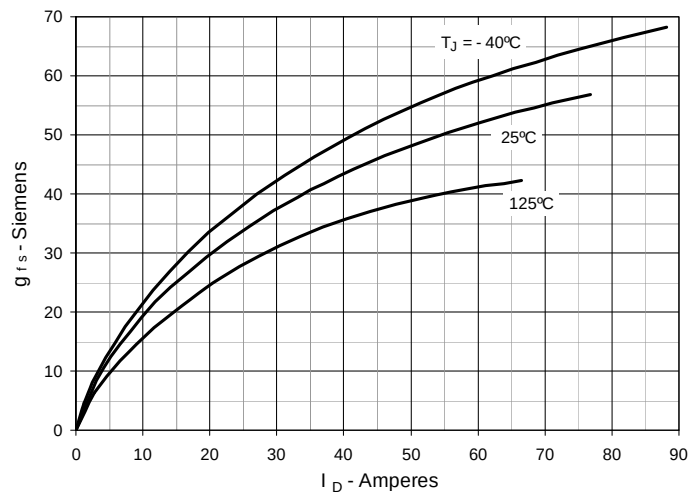
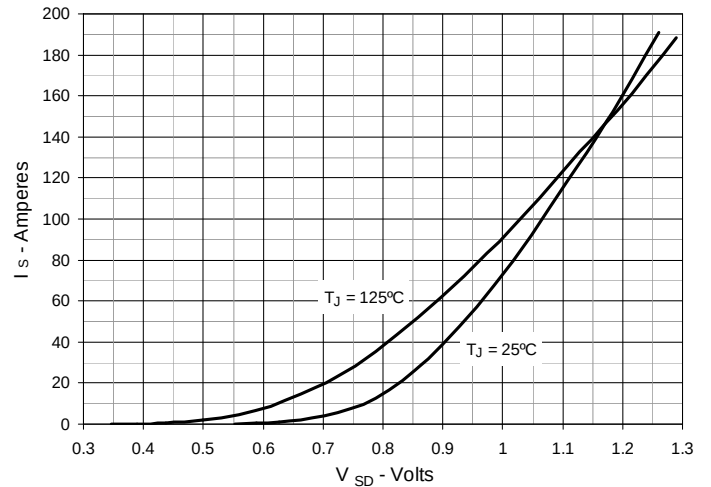
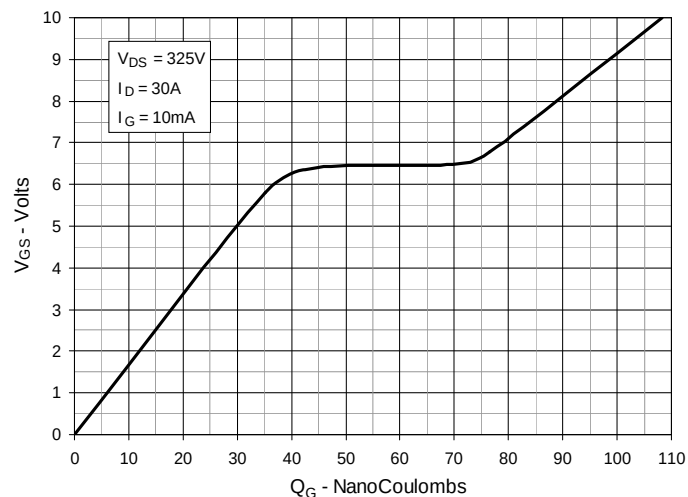
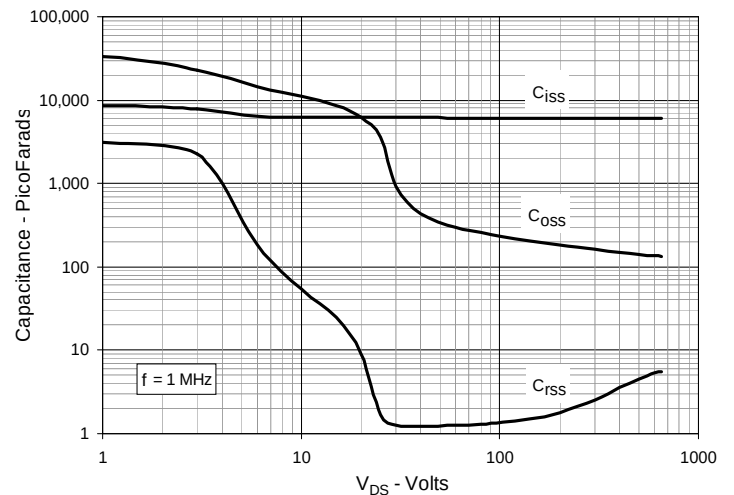


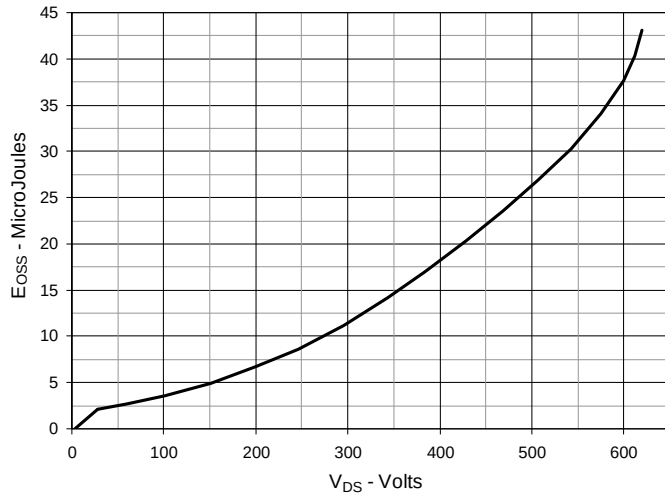
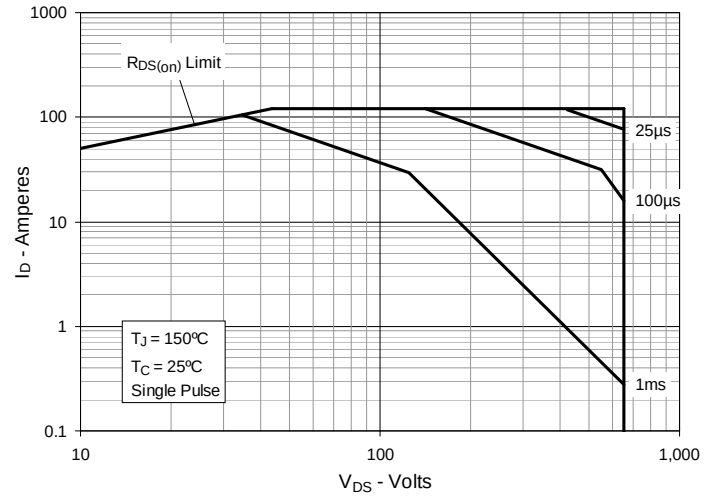
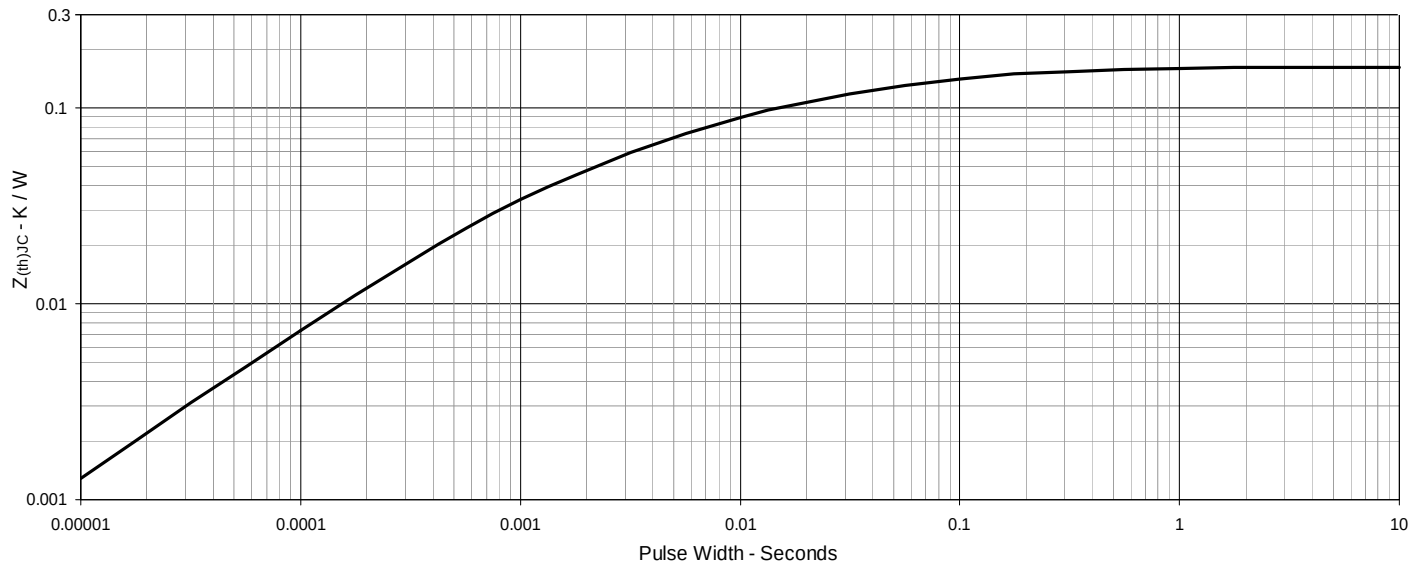
| SYM       | INCHES   |      | MILLIMETERS |       |
|-----------|----------|------|-------------|-------|
|           | MIN      | MAX  | MIN         | MAX   |
| A         | .190     | .205 | 4.83        | 5.21  |
| A1        | .090     | .100 | 2.29        | 2.54  |
| A2        | .075     | .085 | 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**




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