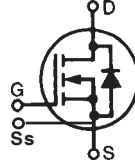


# X2-Class HiPerFET™ Power MOSFET

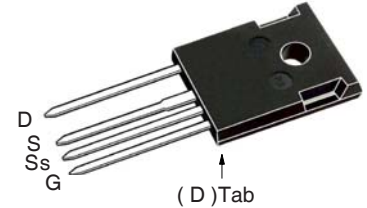
## IXFH60N65X2-4

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

N-Channel Enhancement Mode  
Avalanche Rated  
Fast Intrinsic Diode



TO-247-4L



S = Source G = Gate  
D = Drain Ss = Source Sense

| 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                                          | Characteristic Values |      |                      |
|--------------|----------------------------------------------------------|-----------------------|------|----------------------|
|              | ( $T_J = 25^\circ\text{C}$ , Unless Otherwise Specified) | 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         |
| $I_{DSS}$    | $V_{DS} = V_{DSS}$ , $V_{GS} = 0V$                       |                       |      | 25 $\mu A$<br>2.5 mA |
|              | $T_J = 125^\circ\text{C}$                                |                       |      |                      |
| $R_{DS(on)}$ | $V_{GS} = 10V$ , $I_D = 0.5 \cdot I_{D25}$ , 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             |

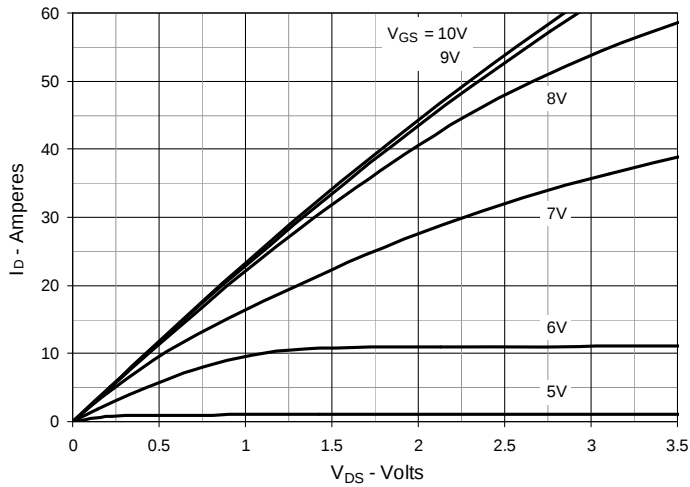
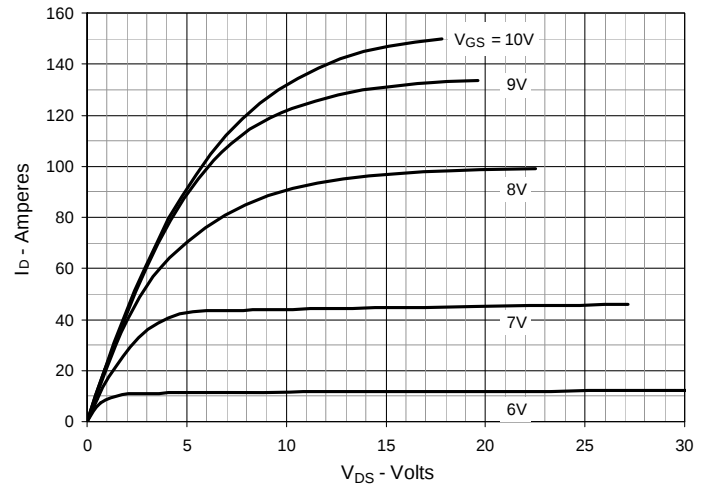
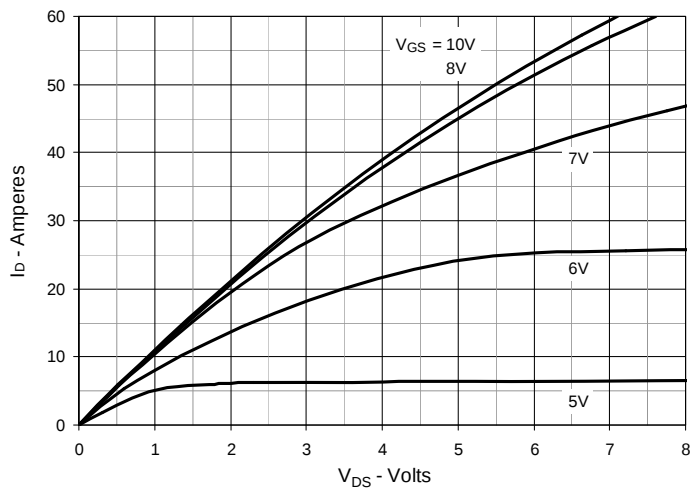
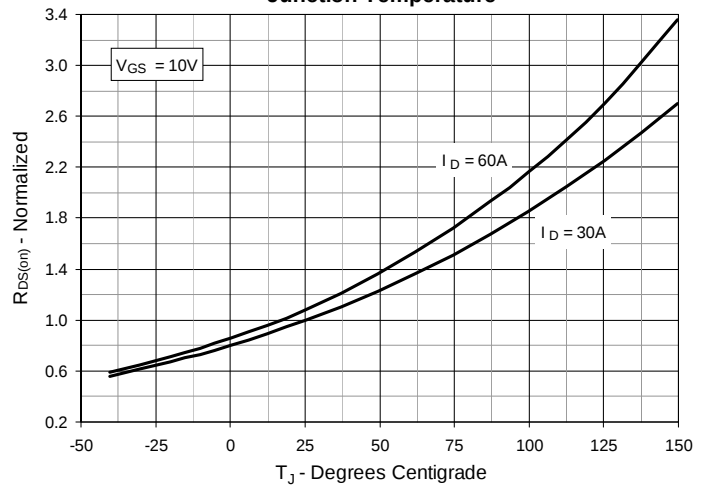
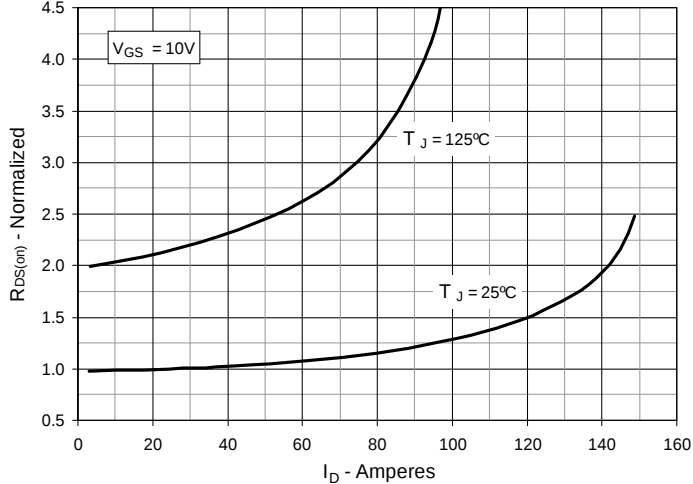
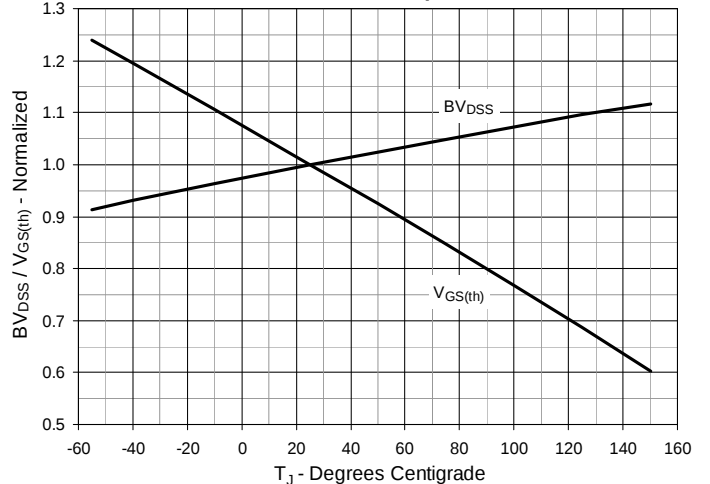
Note 1. Pulse test,  $t \leq 300\mu\text{s}$ , duty cycle,  $d \leq 2\%$ .

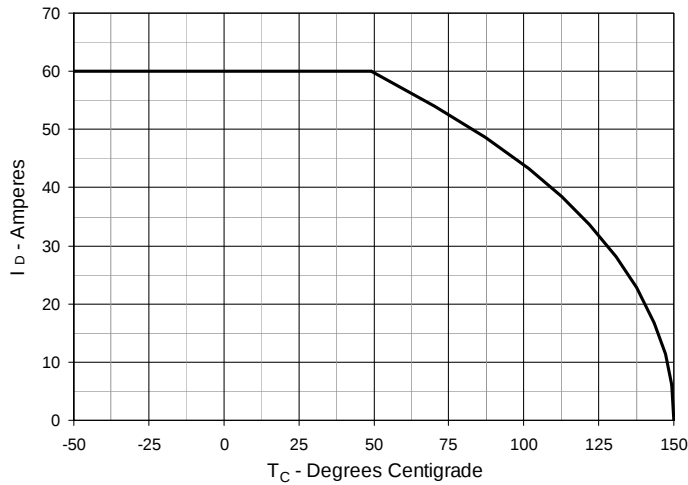
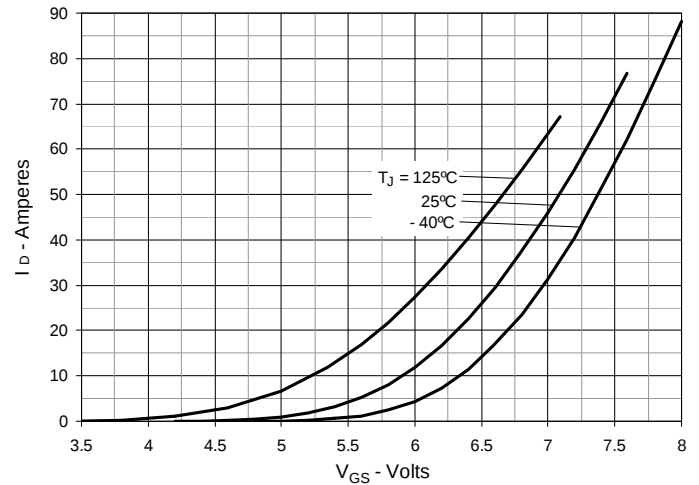
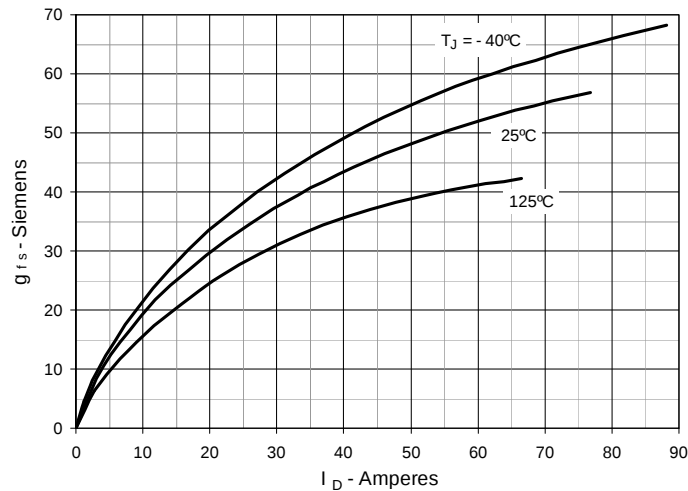
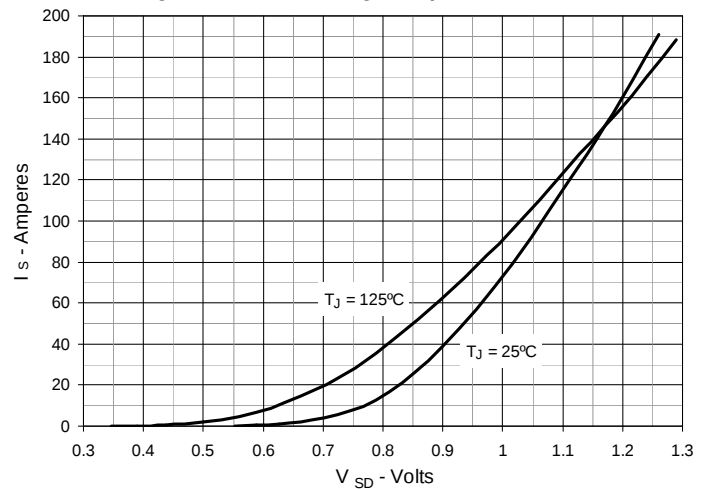
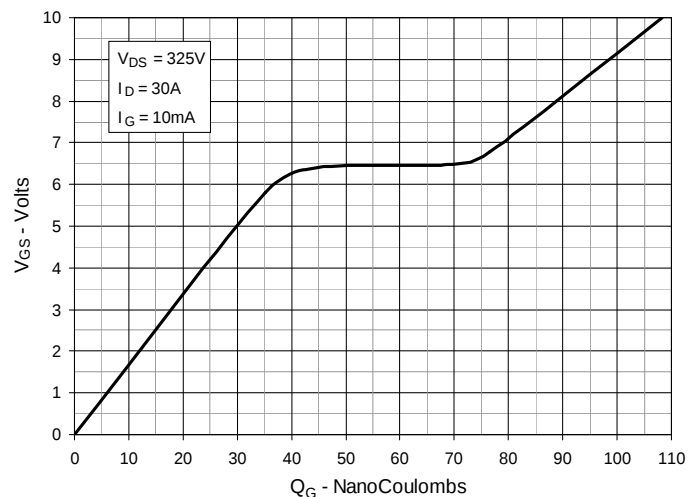
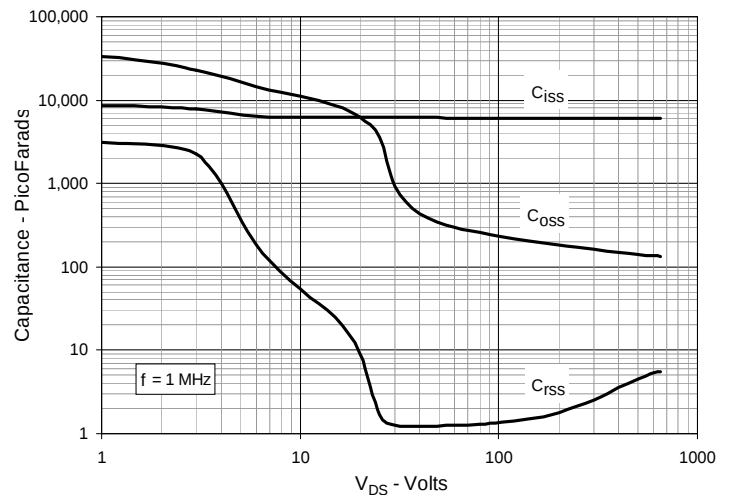
#### ADVANCE TECHNICAL INFORMATION

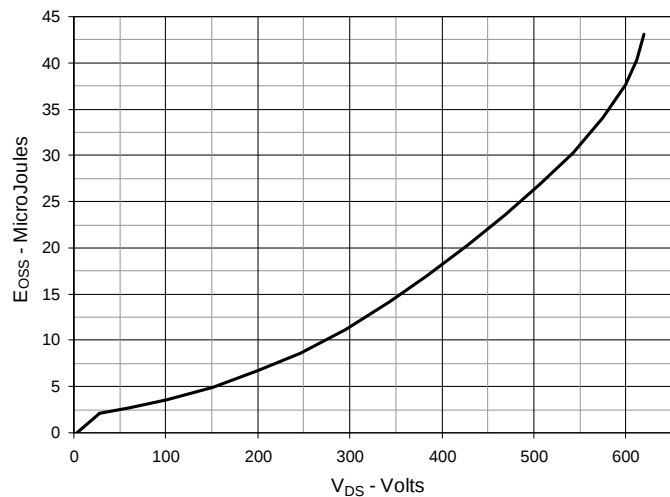
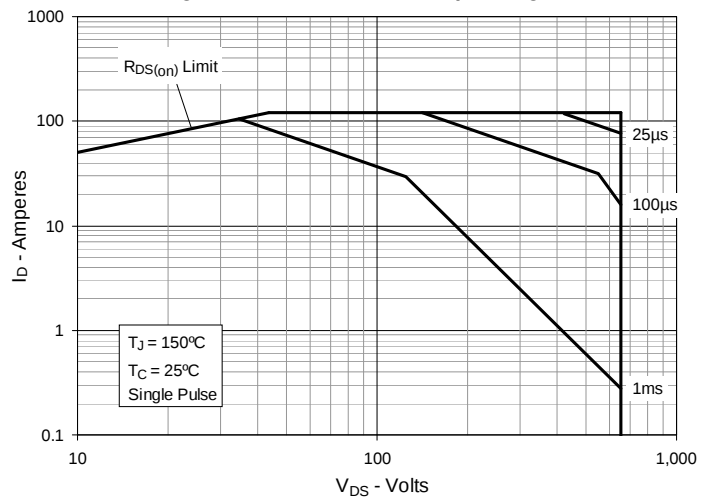
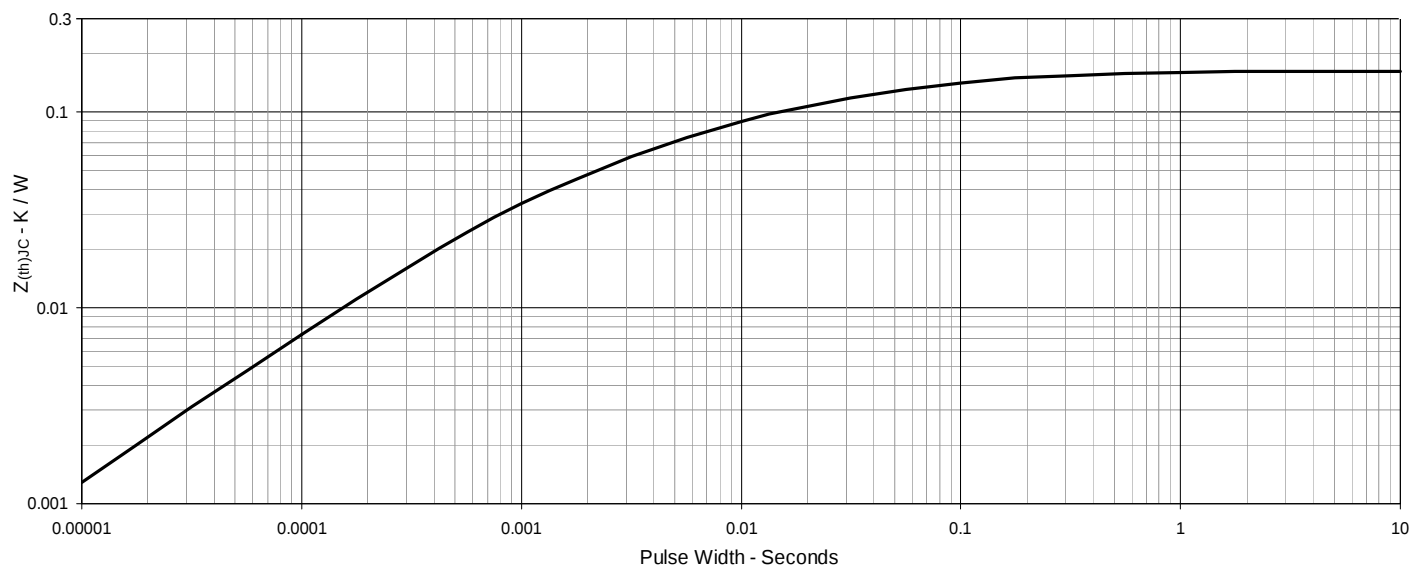
The product presented herein is under development. The Technical Specifications offered are derived from a subjective evaluation of the design, based upon prior knowledge and experience, and constitute a "considered reflection" of the anticipated result. IXYS reserves the right to change limits, test conditions, and dimensions without notice.

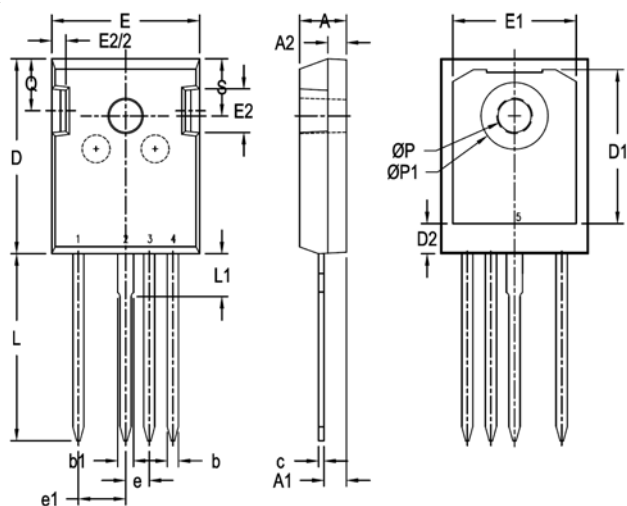
IXYS Reserves the Right to Change Limits, Test Conditions, and Dimensions.

|                                                                                  |           |           |           |           |             |             |             |             |             |             |
|----------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-------------|-------------|-------------|-------------|-------------|-------------|
| 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**


**TO-247 - 4L Outline**


**PINS:**  
**1,5 - Drain      3 - Source Sense**  
**2 - Source      4 - Gate**

| SYM | INCHES   |      | MILLIMETERS |       |
|-----|----------|------|-------------|-------|
|     | MIN      | MAX  | MIN         | MAX   |
| A   | .189     | .205 | 4.80        | 5.20  |
| A1  | .090     | .098 | 2.30        | 2.50  |
| A2  | .075     | .083 | 1.90        | 2.10  |
| b   | .043     | .055 | 1.10        | 1.40  |
| b1  | .063     | .071 | 1.60        | 1.80  |
| c   | .020     | .031 | 0.50        | 0.80  |
| D   | .819     | .839 | 20.80       | 21.30 |
| D1  | .630     | .670 | 16.00       | 17.00 |
| D2  | .118     | .138 | 3.00        | 3.50  |
| E   | .620     | .636 | 15.75       | 16.15 |
| E1  | .531     | .559 | 13.50       | 14.20 |
| E2  | .169     | .193 | 4.30        | 4.90  |
| e   | .100 BSC |      | 2.54 BSC    |       |
| e1  | .200 BSC |      | 5.08 BSC    |       |
| L   | .780     | .799 | 19.80       | 20.30 |
| L1  | .157     | .177 | 4.00        | 4.50  |
| ØP  | .140     | .144 | 3.55        | 3.65  |
| ØP1 | .280     | .287 | 7.10        | 7.30  |
| Q   | .213     | .236 | 5.40        | 6.00  |
| S   | .242 BSC |      | 6.15 BSC    |       |

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