

# X3-Class HiPerFET™ Power MOSFET

## IXFP60N25X3M

(Electrically Isolated Tab)

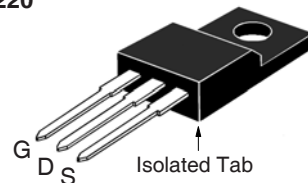
N-Channel Enhancement Mode  
Avalanche Rated



$$\begin{aligned} V_{DSS} &= 250V \\ I_{D25} &= 60A \\ R_{DS(on)} &\leq 23m\Omega \end{aligned}$$

| Symbol     | Test Conditions                                                          | Maximum Ratings |                  |
|------------|--------------------------------------------------------------------------|-----------------|------------------|
| $V_{DSS}$  | $T_J = 25^\circ\text{C}$ to $150^\circ\text{C}$                          | 250             | V                |
| $V_{DGR}$  | $T_J = 25^\circ\text{C}$ to $150^\circ\text{C}$ , $R_{GS} = 1M\Omega$    | 250             | V                |
| $V_{GSS}$  | Continuous                                                               | $\pm 20$        | V                |
| $V_{GSM}$  | Transient                                                                | $\pm 30$        | V                |
| $I_{D25}$  | $T_C = 25^\circ\text{C}$ , Limited by $T_{JM}$                           | 60              | A                |
| $I_{DM}$   | $T_C = 25^\circ\text{C}$ , Pulse Width Limited by $T_{JM}$               | 210             | A                |
| $I_A$      | $T_C = 25^\circ\text{C}$                                                 | 30              | A                |
| $E_{AS}$   | $T_C = 25^\circ\text{C}$                                                 | 700             | mJ               |
| $dv/dt$    | $I_S \leq I_{DM}$ , $V_{DD} \leq V_{DSS}$ , $T_J \leq 150^\circ\text{C}$ | 20              | V/ns             |
| $P_D$      | $T_C = 25^\circ\text{C}$                                                 | 36              | 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             | $^\circ\text{C}$ |
| $V_{ISOL}$ | 50/60 Hz, 1 Minute                                                       | 2500            | V~               |
| $M_d$      | Mounting Torque                                                          | 1.13 / 10       | Nm/lb.in         |
| Weight     |                                                                          | 2.5             | g                |

OVERMOLDED  
TO-220



G = Gate      D = Drain  
S = Source

### Features

- International Standard Package
- Plastic Overmolded Tab
- Low  $R_{DS(ON)}$  and  $Q_G$
- Avalanche Rated
- 2500V~ Electrical Isolation
- 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.                     |
| $BV_{DSS}$   | $V_{GS} = 0V$ , $I_D = 250\mu A$                                            | 250                   |      | V                        |
| $V_{GS(th)}$ | $V_{DS} = V_{GS}$ , $I_D = 1.5mA$                                           | 2.5                   |      | 4.5 V                    |
| $I_{GSS}$    | $V_{GS} = \pm 20V$ , $V_{DS} = 0V$                                          |                       |      | $\pm 100$ nA             |
| $I_{DSS}$    | $V_{DS} = V_{DSS}$ , $V_{GS} = 0V$<br>$T_J = 125^\circ\text{C}$             |                       |      | 5 $\mu A$<br>500 $\mu A$ |
| $R_{DS(on)}$ | $V_{GS} = 10V$ , $I_D = 0.5 \cdot I_{D25}$ , Note 1                         |                       | 19   | 23 m $\Omega$            |

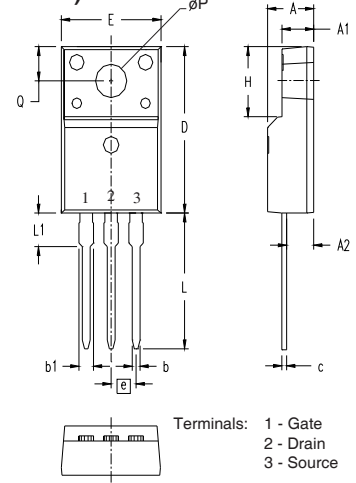
| Symbol                              | Test Conditions<br>(T <sub>J</sub> = 25°C, Unless Otherwise Specified)                                                                                                          | Characteristic Values                                            |      |          |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|------|----------|
|                                     |                                                                                                                                                                                 | 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                                                                                                         | 30                                                               | 50   | S        |
| <b>R<sub>Gi</sub></b>               | Gate Input Resistance                                                                                                                                                           |                                                                  | 1.9  | Ω        |
| <b>C<sub>iss</sub></b>              | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 25V, f = 1MHz                                                                                                                           |                                                                  | 3610 | pF       |
| <b>C<sub>oss</sub></b>              |                                                                                                                                                                                 |                                                                  | 645  | pF       |
| <b>C<sub>rss</sub></b>              |                                                                                                                                                                                 |                                                                  | 2    | 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> | 260  | pF       |
| <b>C<sub>o(tr)</sub></b>            | Time related                                                                                                                                                                    |                                                                  | 955  | 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> = 5Ω (External) |                                                                  | 18   | ns       |
| <b>t<sub>r</sub></b>                |                                                                                                                                                                                 |                                                                  | 10   | ns       |
| <b>t<sub>d(off)</sub></b>           |                                                                                                                                                                                 |                                                                  | 62   | ns       |
| <b>t<sub>f</sub></b>                |                                                                                                                                                                                 |                                                                  | 7    | 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>                                                                       |                                                                  | 50   | nC       |
| <b>Q<sub>gs</sub></b>               |                                                                                                                                                                                 |                                                                  | 15   | nC       |
| <b>Q<sub>gd</sub></b>               |                                                                                                                                                                                 |                                                                  | 17   | nC       |
| <b>R<sub>thJC</sub></b>             |                                                                                                                                                                                 | 0.50                                                             |      | 3.5 °C/W |
| <b>R<sub>thCS</sub></b>             |                                                                                                                                                                                 |                                                                  |      | °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>$V_R = 100\text{V}$ |                       | 95   | ns    |
| $Q_{RM}$ |                                                                                |                       | 380  | nC    |
| $I_{RM}$ |                                                                                |                       | 8    | A     |

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

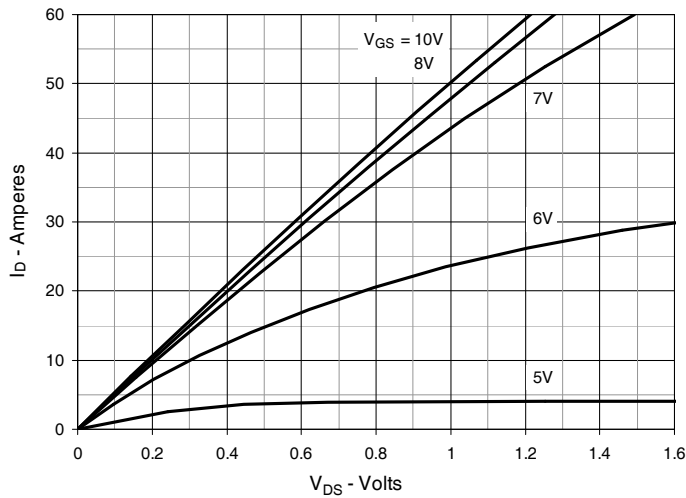
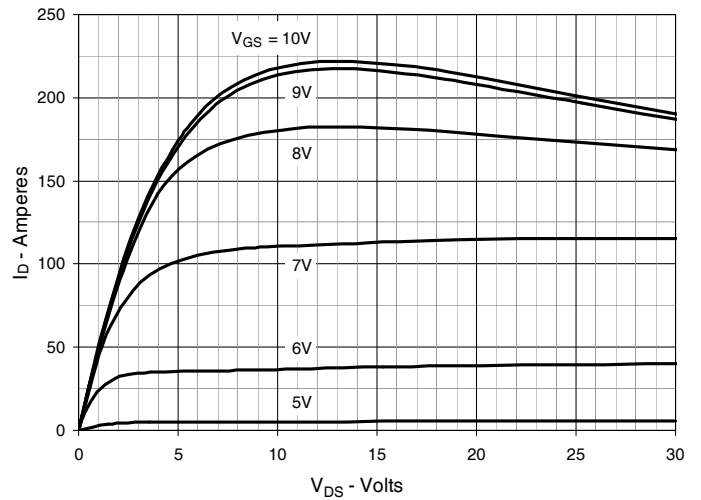
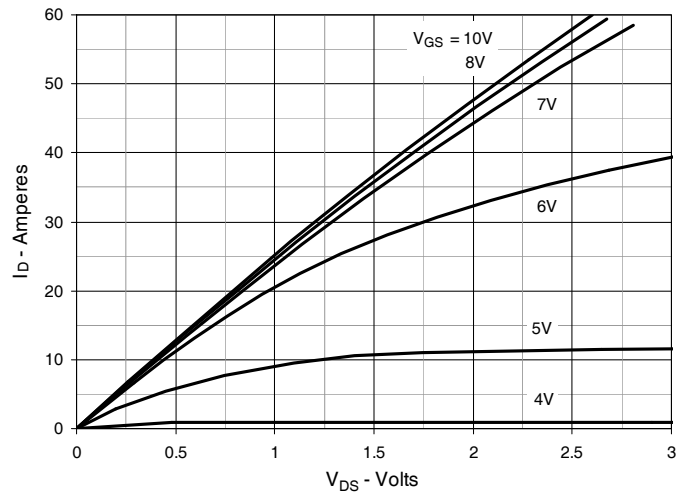
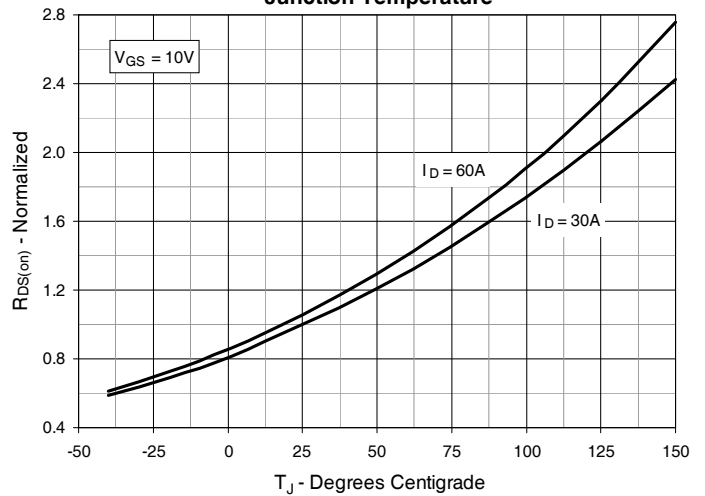
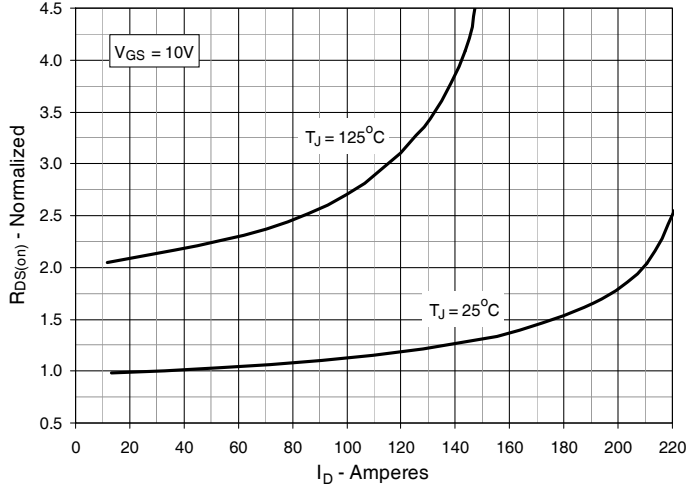
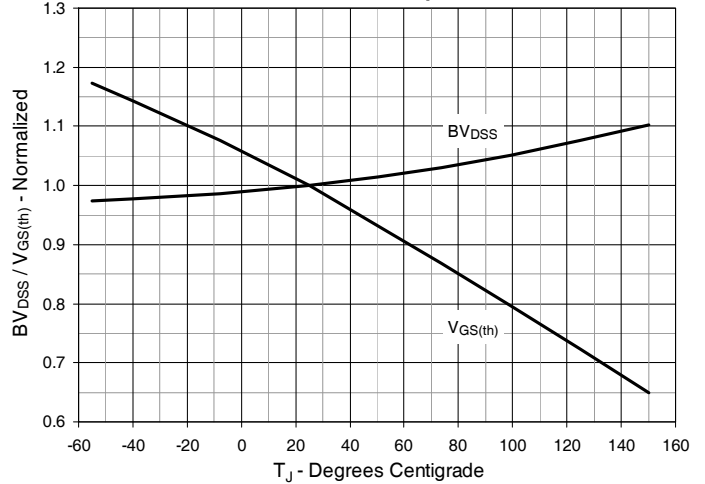
## OVERMOLDED TO-220 (IXFP...M)

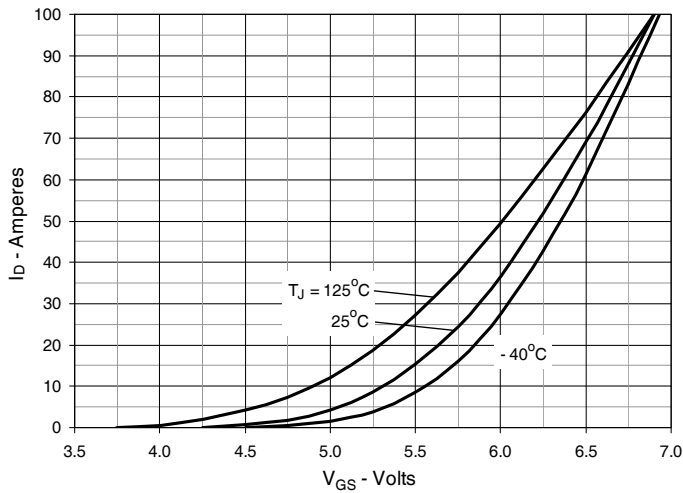
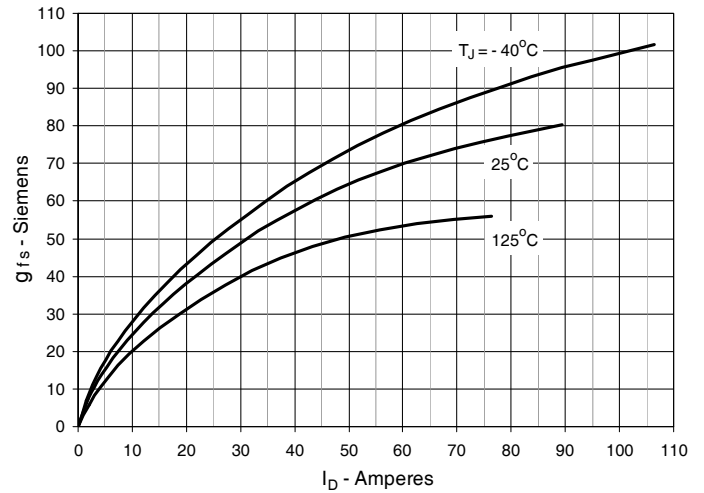
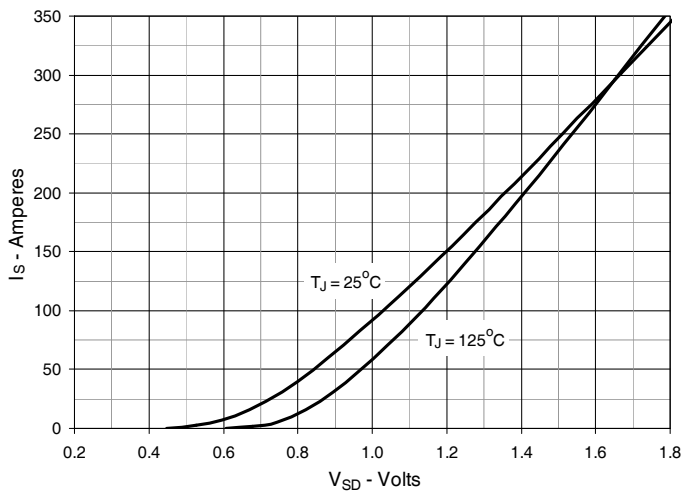
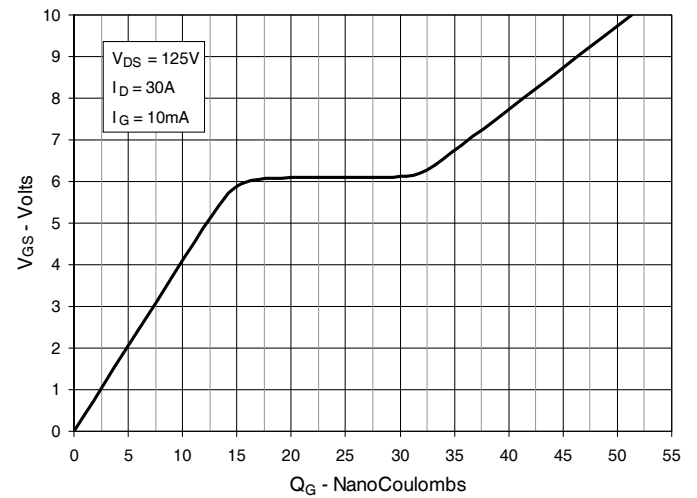
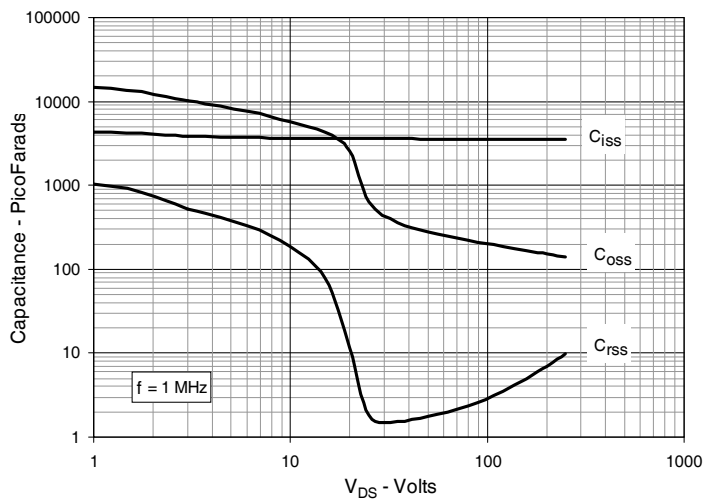
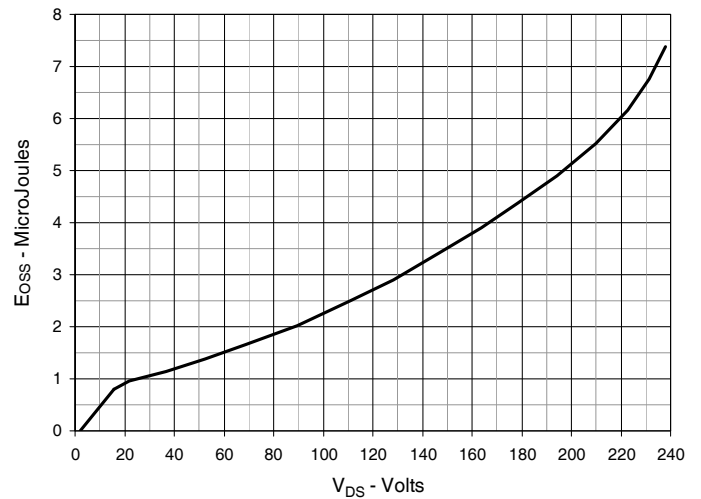


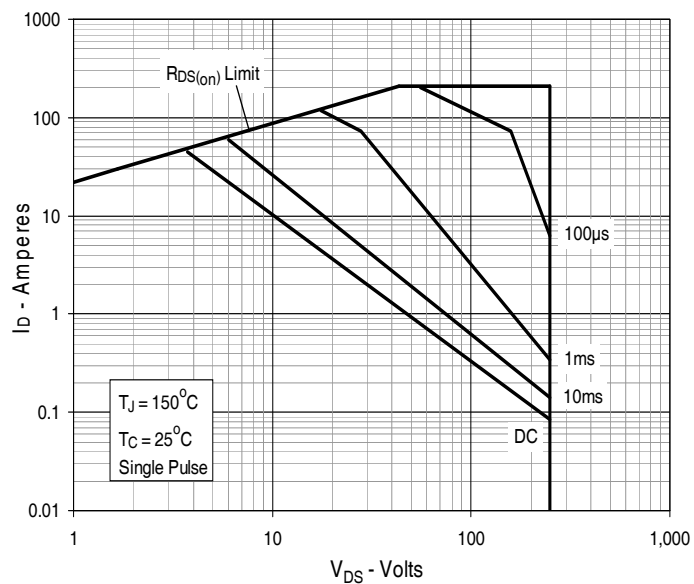
| SYM | INCHES   |      | MILLIMETERS |       |
|-----|----------|------|-------------|-------|
|     | MIN      | MAX  | MIN         | MAX   |
| A   | .177     | .193 | 4.50        | 4.90  |
| A1  | .092     | .108 | 2.34        | 2.74  |
| A2  | .101     | .117 | 2.56        | 2.96  |
| b   | .028     | .035 | 0.70        | 0.90  |
| b1  | .050     | .058 | 1.27        | 1.47  |
| c   | .018     | .024 | 0.45        | 0.60  |
| D   | .617     | .633 | 15.67       | 16.07 |
| E   | .392     | .408 | 9.96        | 10.36 |
| e   | .100 BSC |      | 2.54 BSC    |       |
| H   | .255     | .271 | 6.48        | 6.88  |
| L   | .499     | .523 | 12.68       | 13.28 |
| L1  | .119     | .135 | 3.03        | 3.43  |
| ØP  | .121     | .129 | 3.08        | 3.28  |
| Q   | .126     | .134 | 3.20        | 3.40  |

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. Input Admittance**

**Fig. 8. Transconductance**

**Fig. 9. Forward Voltage Drop of Intrinsic Diode**

**Fig. 10. Gate Charge**

**Fig. 11. Capacitance**

**Fig. 12. Output Capacitance Stored Energy**


**Fig. 13. Forward-Bias Safe Operating Area**

**Fig. 14. Maximum Transient Thermal Impedance**
