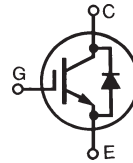


**XPT™ 650V IGBT  
GenX4™ w/ Diode**
**IXXH80N65B4D1**

 Extreme Light Punch Through  
IGBT for 5-30 kHz Switching


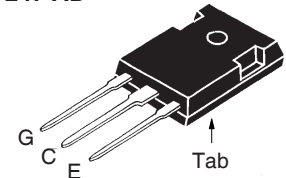
$$V_{CES} = 650V$$

$$I_{C110} = 80A$$

$$V_{CE(sat)} \leq 2.1V$$

$$t_{fi(typ)} = 53ns$$

| Symbol         | Test Conditions   | Maximum Ratings         |            |
|----------------|---|-------------------------|------------|
| $V_{CES}$      | $T_J = 25^\circ C$ to $175^\circ C$                       | 650                     | V          |
| $V_{CGR}$      | $T_J = 25^\circ C$ to $175^\circ C$ , $R_{GE} = 1M\Omega$ | 650                     | V          |
| $V_{GES}$      | Continuous  | $\pm 20$                | V          |
| $V_{GEM}$      | Transient   | $\pm 30$                | V          |
| $I_{C25}$      | $T_C = 25^\circ C$ (Chip Capability)                      | 180                     | A          |
| $I_{C110}$     | $T_C = 110^\circ C$                                       | 80                      | A          |
| $I_{F110}$     | $T_C = 110^\circ C$                                       | 65                      | A          |
| $I_{CM}$       | $T_C = 25^\circ C$ , 1ms                                  | 430                     | A          |
| <b>SSOA</b>    | $V_{GE} = 15V$ , $T_{VJ} = 150^\circ C$ , $R_G = 3\Omega$ | $I_{CM} = 160$          | A          |
| <b>(RBSOA)</b> | Clamped Inductive Load                                    | @ $V_{CE} \leq V_{CES}$ |            |
| $t_{sc}$       | $V_{GE} = 15V$ , $V_{CE} = 360V$ , $T_J = 150^\circ C$    | 10                      | $\mu s$    |
| <b>(SCSOA)</b> | $R_G = 82\Omega$ , Non Repetitive                         |                         |            |
| $P_C$          | $T_C = 25^\circ C$  | 625                     | W          |
| $T_J$          |   | -55 ... +175            | $^\circ C$ |
| $T_{JM}$       |   | 175                     | $^\circ C$ |
| $T_{stg}$      |   | -55 ... +175            | $^\circ C$ |
| $T_L$          | Maximum Lead Temperature for Soldering                    | 300                     | $^\circ C$ |
| $T_{SOLD}$     | 1.6 mm (0.062in.) from Case for 10s                       | 260                     | $^\circ C$ |
| $M_d$          | Mounting Torque   | 1.13/10                 | Nm/lb.in.  |
| <b>Weight</b>  |   | 6                       | g          |

**TO-247 AD**


G = Gate      C = Collector  
E = Emitter    Tab = Collector

**Features**

- Optimized for 5-30kHz Switching
- Square RBSOA
- Anti-Parallel Diode
- Short Circuit Capability
- International Standard Package

**Advantages**

- High Power Density
- Extremely Rugged
- Low Gate Drive Requirement

**Applications**

- Power Inverters
- UPS
- Motor Drives
- SMPS
- PFC Circuits
- Battery Chargers
- Welding Machines
- Lamp Ballasts

| Symbol        | Test Conditions<br>( $T_J = 25^\circ C$ , Unless Otherwise Specified) | Characteristic Values |              |                    |
|---------------|---|-----------------------|--------------|--------------------|
|               |   | Min.                  | Typ.         | Max.               |
| $BV_{CES}$    | $I_C = 250\mu A$ , $V_{GE} = 0V$                                      | 650                   |              | V                  |
| $V_{GE(th)}$  | $I_C = 250\mu A$ , $V_{CE} = V_{GE}$                                  | 4.0                   |              | 6.5 V              |
| $I_{CES}$     | $V_{CE} = V_{CES}$ , $V_{GE} = 0V$<br>$T_J = 150^\circ C$             |                       |              | 25 $\mu A$<br>2 mA |
| $I_{GES}$     | $V_{CE} = 0V$ , $V_{GE} = \pm 20V$                                    |                       |              | $\pm 100$ nA       |
| $V_{CE(sat)}$ | $I_C = 80A$ , $V_{GE} = 15V$ , Note 1<br>$T_J = 150^\circ C$          |                       | 1.65<br>2.00 | 2.10 V<br>V        |

| Symbol Test Conditions<br>( $T_J = 25^\circ\text{C}$ Unless Otherwise Specified) |   | Characteristic Values |      |                           |
|--|---|-----------------------|------|---------------------------|
|  |   | Min.                  | Typ. | Max.                      |
| $g_{fs}$   | $I_C = 60\text{A}, V_{CE} = 10\text{V}$ , Note 1  | 25                    | 42   | S                         |
| $C_{ies}$  | $V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$  |                       | 3860 | pF                        |
| $C_{oes}$  |   |                       | 395  | pF                        |
| $C_{res}$  |   |                       | 58   | pF                        |
| $Q_{g(on)}$  | $I_C = 80\text{A}, V_{GE} = 15\text{V}, V_{CE} = 0.5 \cdot V_{CES}$   |                       | 120  | nC                        |
| $Q_{ge}$   |   |                       | 32   | nC                        |
| $Q_{gc}$   |   |                       | 46   | nC                        |
| $t_{d(on)}$  | <b>Inductive load, <math>T_J = 25^\circ\text{C}</math></b><br>$I_C = 80\text{A}, V_{GE} = 15\text{V}$<br>$V_{CE} = 400\text{V}, R_G = 3\Omega$<br>Note 2  |                       | 26   | ns                        |
| $t_{ri}$   |   |                       | 100  | ns                        |
| $E_{on}$   |   |                       | 3.36 | mJ                        |
| $t_{d(off)}$   |   |                       | 112  | ns                        |
| $t_{fi}$   |   |                       | 53   | ns                        |
| $E_{off}$  |   |                       | 1.83 | mJ                        |
| $t_{d(on)}$  | <b>Inductive load, <math>T_J = 150^\circ\text{C}</math></b><br>$I_C = 80\text{A}, V_{GE} = 15\text{V}$<br>$V_{CE} = 400\text{V}, R_G = 3\Omega$<br>Note 2 |                       | 23   | ns                        |
| $t_{ri}$   |   |                       | 102  | ns                        |
| $E_{on}$   |   |                       | 5.50 | mJ                        |
| $t_{d(off)}$   |   |                       | 128  | ns                        |
| $t_{fi}$   |   |                       | 94   | ns                        |
| $E_{off}$  |   |                       | 2.70 | mJ                        |
| $R_{thJC}$   |   |                       | 0.24 | $^\circ\text{C}/\text{W}$ |
| $R_{thCS}$   |   | 0.21                  |      | $^\circ\text{C}/\text{W}$ |

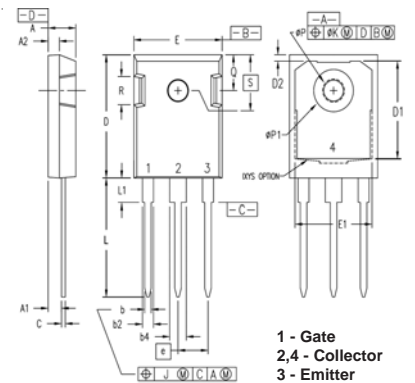
### Reverse Sonic Diode (FRD)

| Symbol Test Conditions<br>( $T_J = 25^\circ\text{C}$ Unless Otherwise Specified) |  | Characteristic Values     |      |                                |
|--|--|---------------------------|------|--------------------------------|
|  |  | Min.                      | Typ. | Max.                           |
| $V_F$  | $I_F = 50\text{A}, V_{GE} = 0\text{V}$ , Note 1  |                           |      | 2.5 V                          |
|  |  | $T_J = 150^\circ\text{C}$ | 1.35 | V                              |
| $I_{RM}$   | $I_F = 50\text{A}, V_{GE} = 0\text{V}, -di_F/dt = 500\text{A}/\mu\text{s},$<br>$V_R = 400\text{V}$ |                           | 26   | A                              |
| $t_{rr}$   |  |                           | 140  | ns                             |
| $R_{thJC}$   |  |                           |      | 0.47 $^\circ\text{C}/\text{W}$ |

### Notes:

1. Pulse test,  $t \leq 300\mu\text{s}$ , duty cycle,  $d \leq 2\%$ .
2. Switching times & energy losses may increase for higher  $V_{CE}$  (clamp),  $T_J$  or  $R_G$ .

### TO-247 (IXXH) Outline



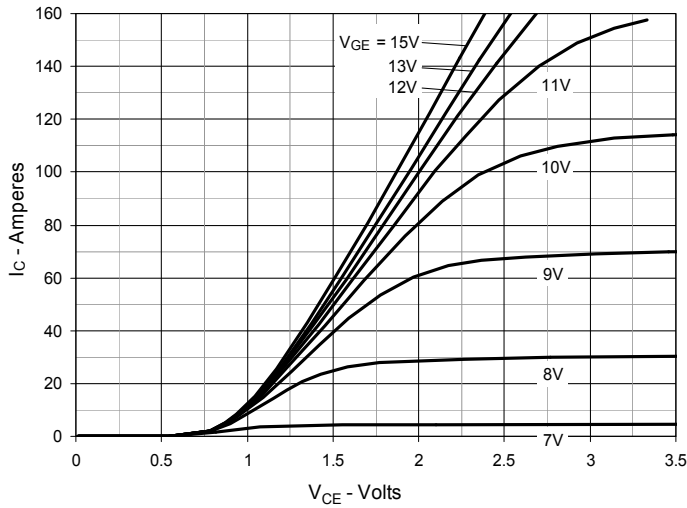
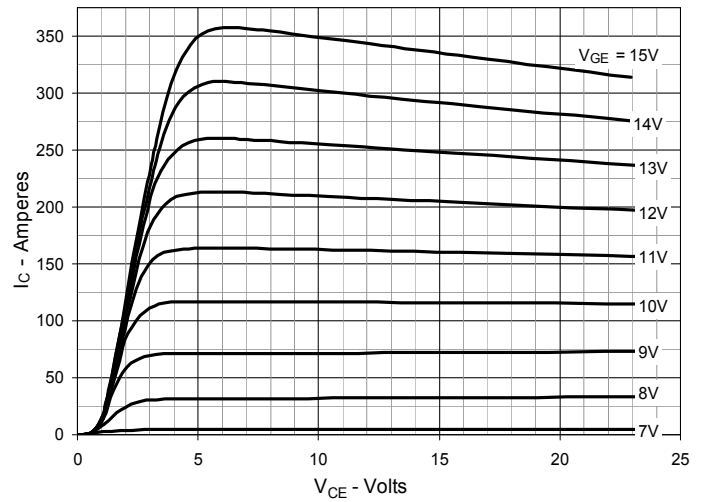
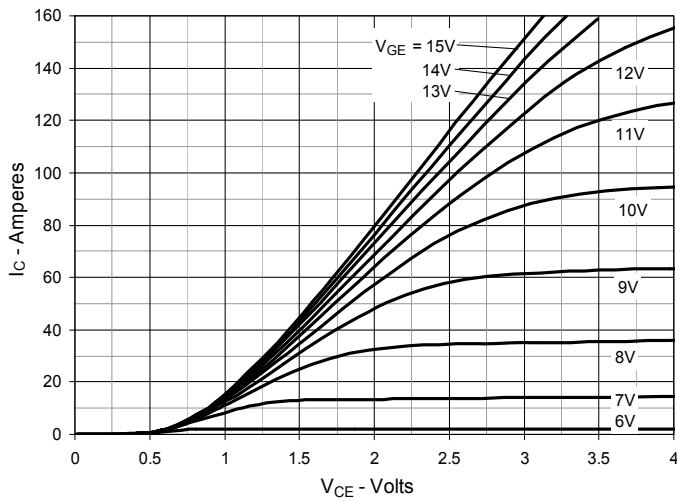
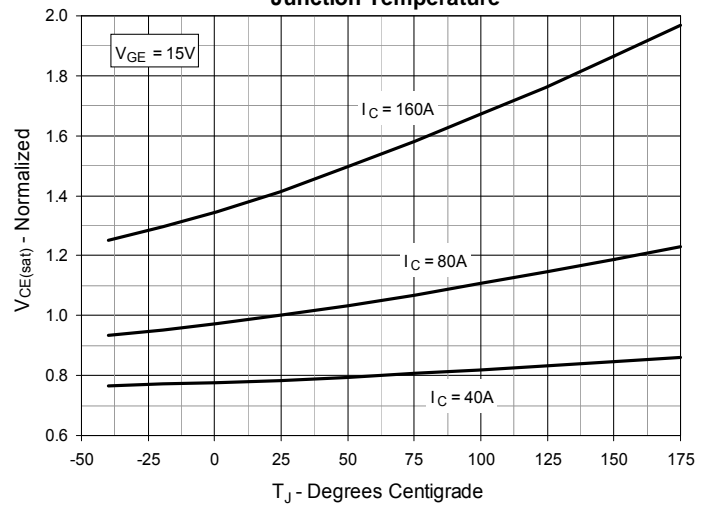
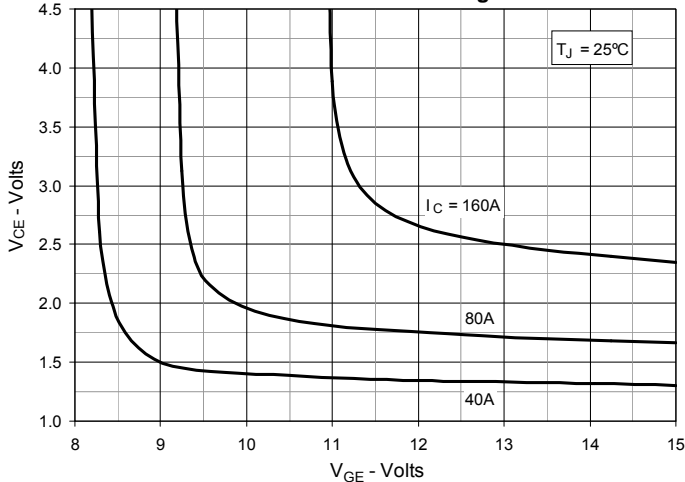
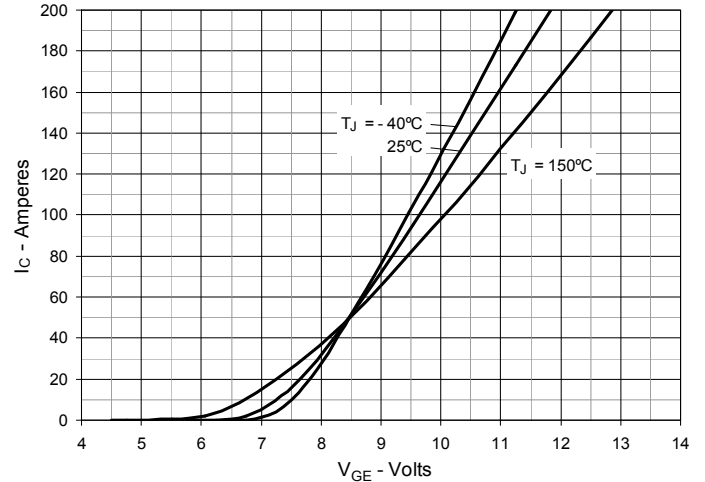
| SYM      | INCHES   |      | MILLIMETERS |       |
|----------|----------|------|-------------|-------|
|          | MIN      | MAX  | MIN         | MAX   |
| A        | .190     | .205 | 4.83        | 5.21  |
| A1       | .090     | .100 | 2.29        | 2.54  |
| A2       | .075     | .085 | 1.91        | 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  |
| Q        | .220     | .244 | 5.59        | 6.20  |
| R        | .170     | .190 | 4.32        | 4.83  |
| S        | .242 BSC |      | 6.15 BSC    |       |

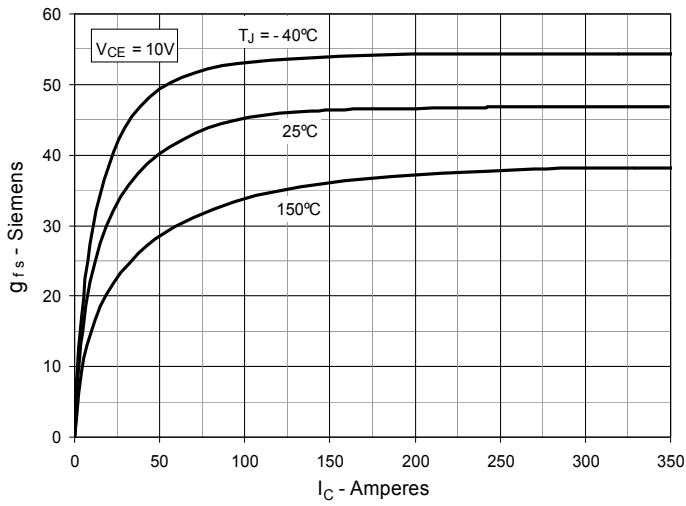
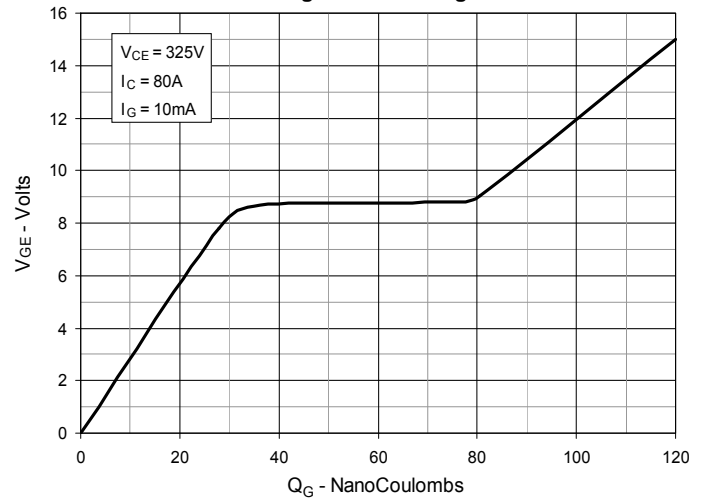
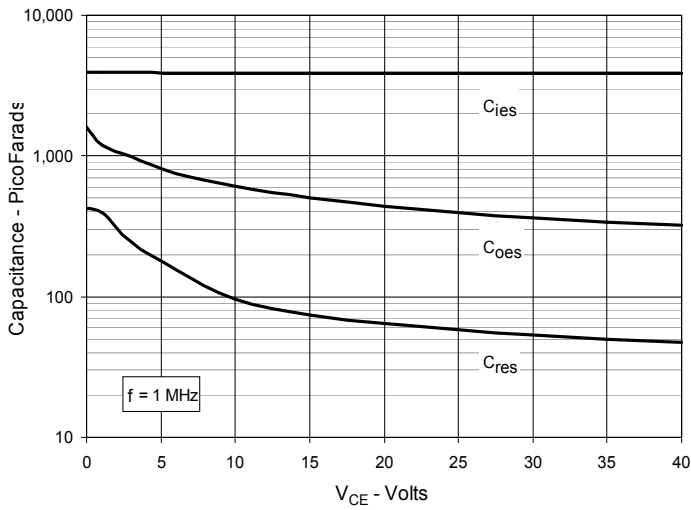
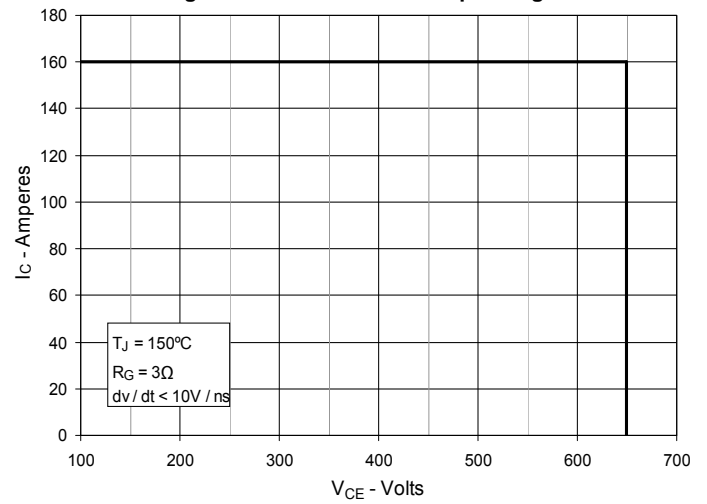
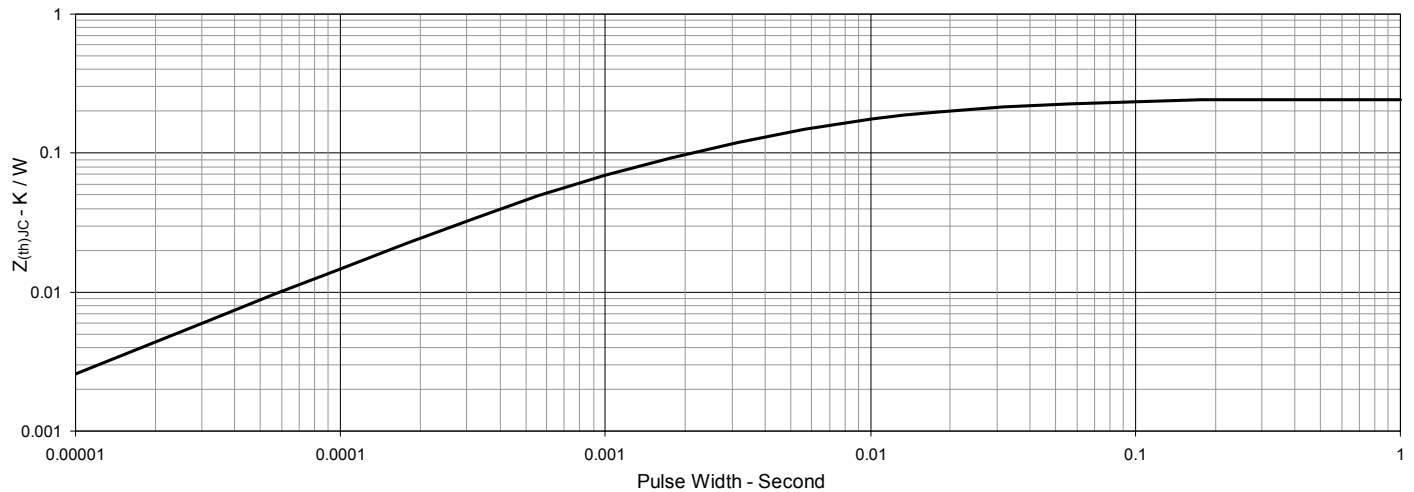
### ADVANCE TECHNICAL INFORMATION

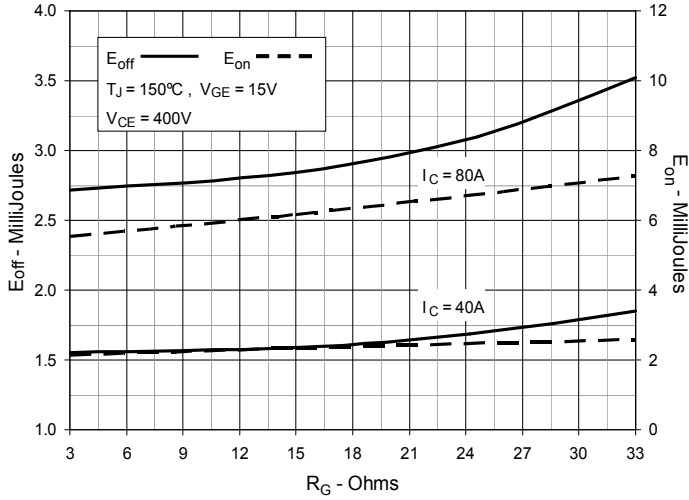
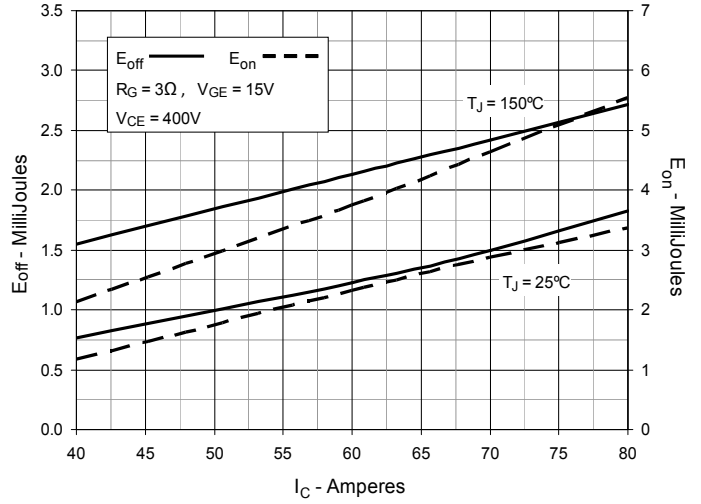
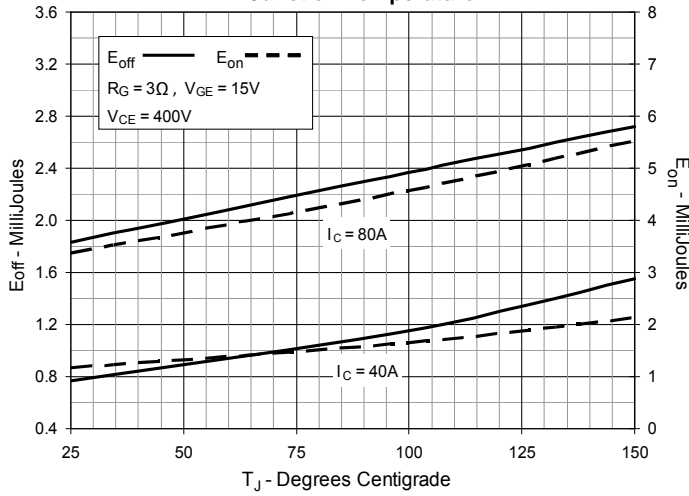
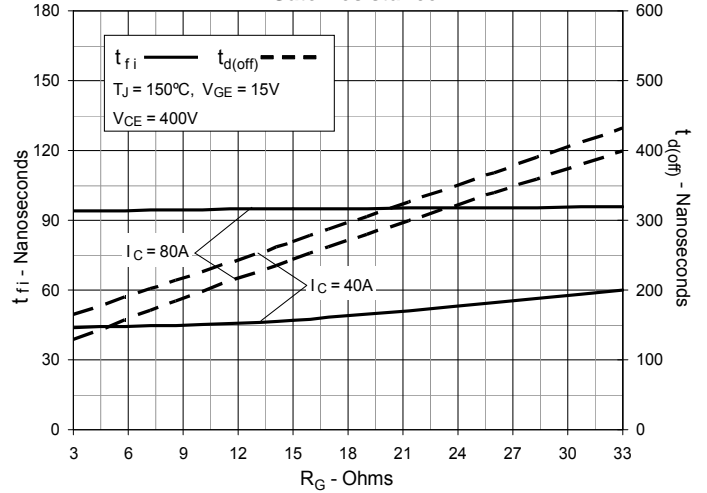
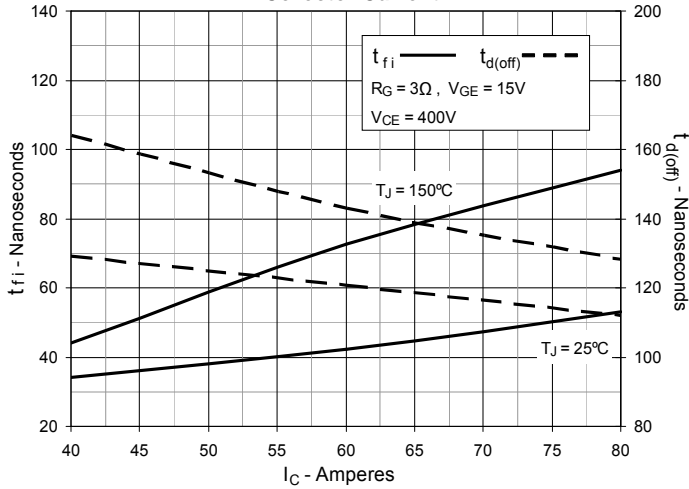
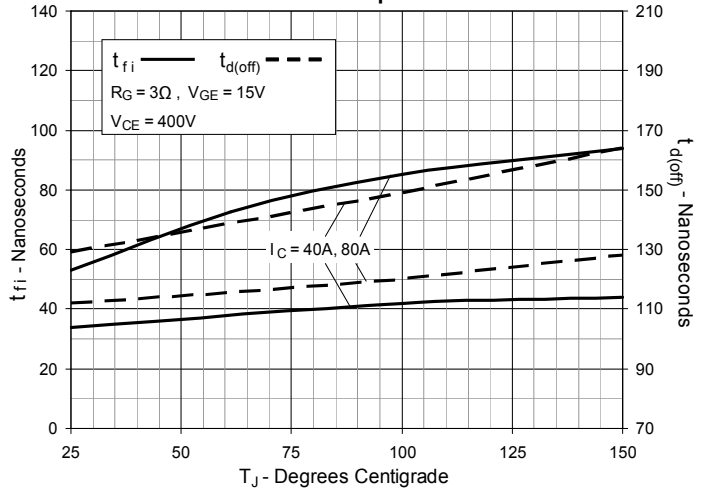
The product presented herein is under development. The Technical Specifications offered are derived from a subjective evaluation of the design, based upon prior knowledge and experience, and constitute a "considered reflection" of the anticipated result. IXYS reserves the right to change limits, test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

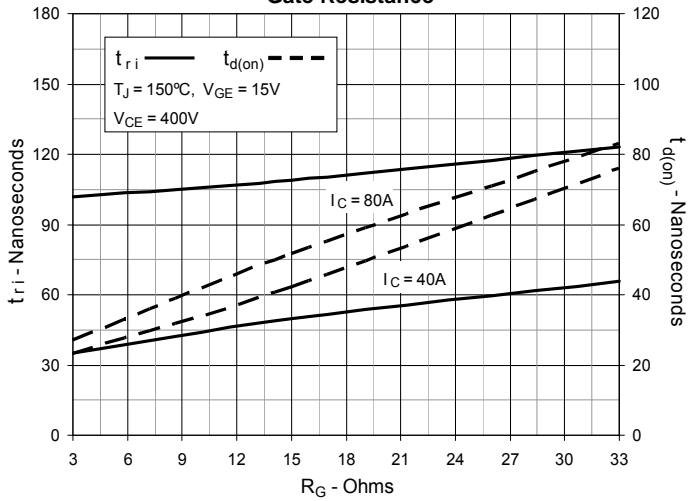
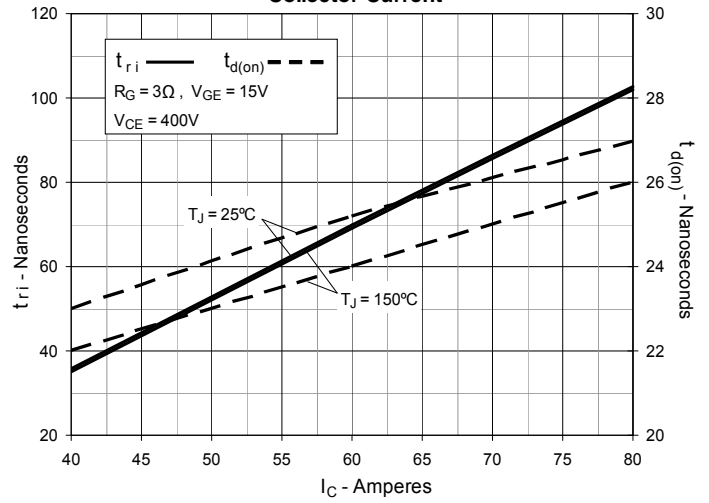
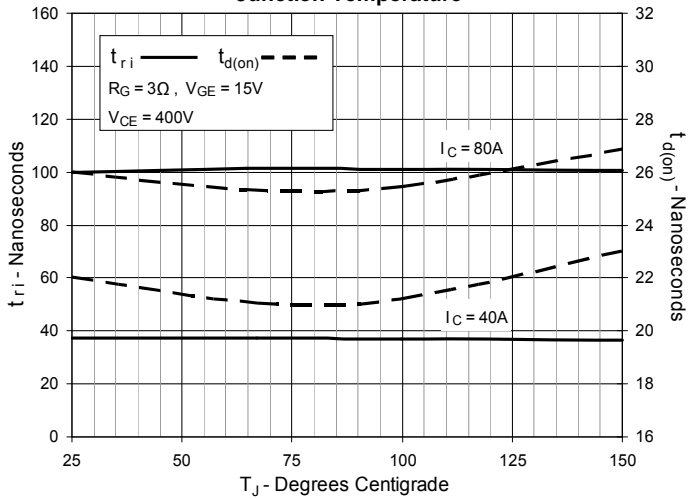
### IXYS Reserves the Right to Change Limits, Test Conditions, and Dimensions.

|  |           |           |           |           |              |              |              |              |              |             |
|--|-----------|-----------|-----------|-----------|--------------|--------------|--------------|--------------|--------------|-------------|
| 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    | 6,404,065 B1 | 6,683,344    | 6,727,585    | 7,005,734 B2 | 7,157,338B2 |
|  | 4,860,072 | 5,017,508 | 5,063,307 | 5,381,025 | 6,259,123 B1 | 6,534,343    | 6,710,405 B2 | 6,759,692    | 7,063,975 B2 |             |
|  | 4,881,106 | 5,034,796 | 5,187,117 | 5,486,715 | 6,306,728 B1 | 6,583,505    | 6,710,463    | 6,771,478 B2 | 7,071,537    |             |

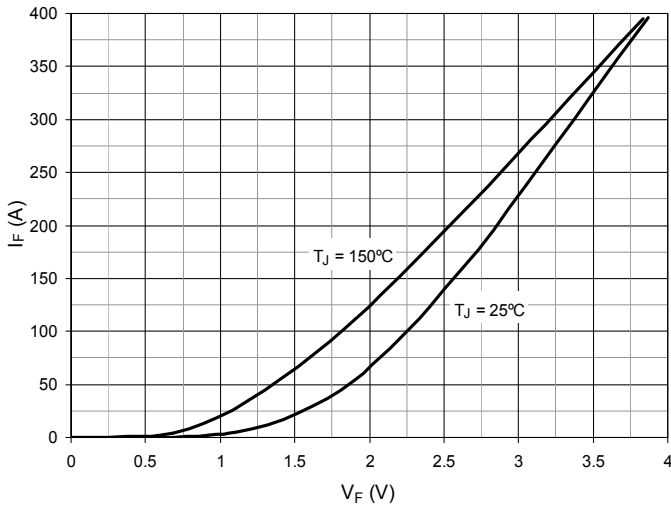
**Fig. 1. Output Characteristics @  $T_J = 25^\circ\text{C}$** 

**Fig. 2. Extended Output Characteristics @  $T_J = 25^\circ\text{C}$** 

**Fig. 3. Output Characteristics @  $T_J = 150^\circ\text{C}$** 

**Fig. 4. Dependence of  $V_{CE(sat)}$  on Junction Temperature**

**Fig. 5. Collector-to-Emitter Voltage vs. Gate-to-Emitter Voltage**

**Fig. 6. Input Admittance**


**Fig. 7. Transconductance**

**Fig. 8. Gate Charge**

**Fig. 9. Capacitance**

**Fig. 10. Reverse-Bias Safe Operating Area**

**Fig. 11. Maximum Transient Thermal Impedance**


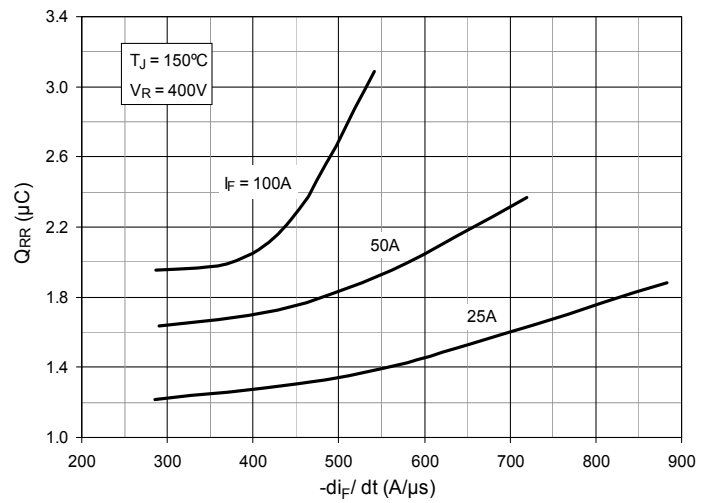
**Fig. 12. Inductive Switching Energy Loss vs. Gate Resistance**

**Fig. 13. Inductive Switching Energy Loss vs. Collector Current**

**Fig. 14. Inductive Switching Energy Loss vs. Junction Temperature**

**Fig. 15. Inductive Turn-off Switching Times vs. Gate Resistance**

**Fig. 16. Inductive Turn-off Switching Times vs. Collector Current**

**Fig. 17. Inductive Turn-off Switching Times vs. Junction Temperature**


**Fig. 18. Inductive Turn-on Switching Times vs. Gate Resistance**

**Fig. 19. Inductive Turn-on Switching Times vs. Collector Current**

**Fig. 20. Inductive Turn-on Switching Times vs. Junction Temperature**


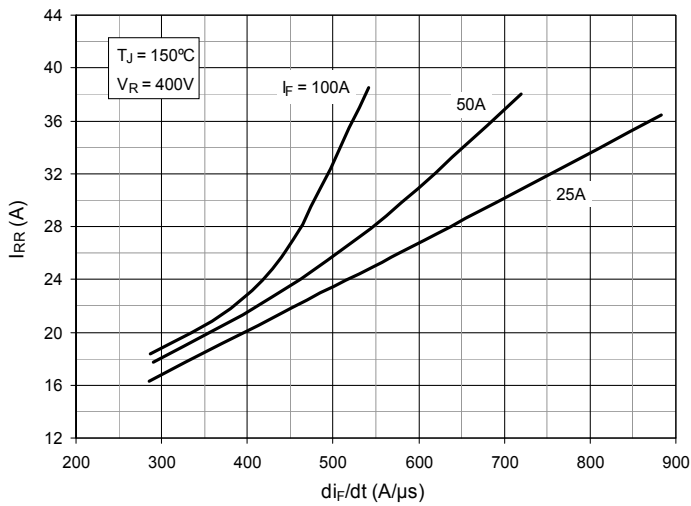
**Fig. 21. Diode Forward Characteristics**



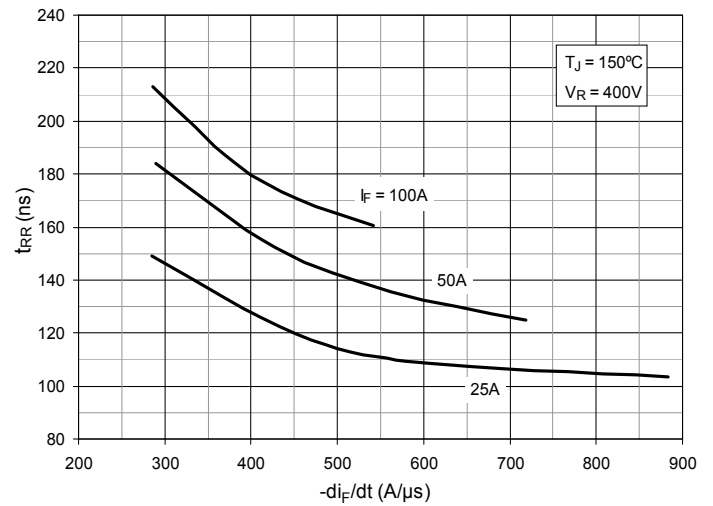
**Fig. 22. Reverse Recovery Charge vs.  $-di_F/dt$**



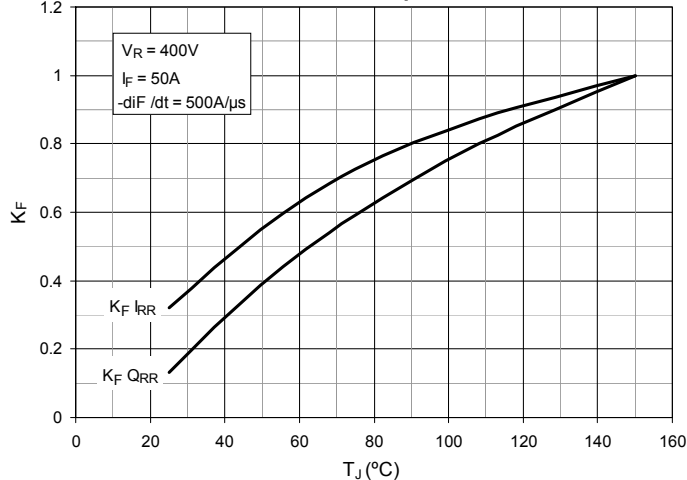
**Fig. 23 Reverse Recovery Current vs.  $-di_F/dt$**



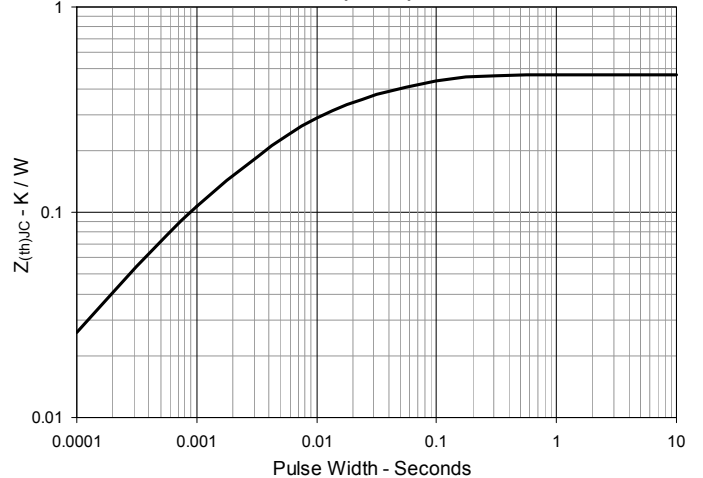
**Fig. 24. Reverse Recovery Time vs.  $-di_F/dt$**



**Fig. 25. Dynamic Parameters  $Q_{RR}$ ,  $I_{RR}$  vs. Junction Temperature**



**Fig. 26. Maximum Transient Thermal Impedance (Diode)**





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