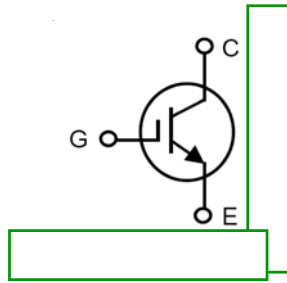


# XPT™ 650V IGBT GenX4™

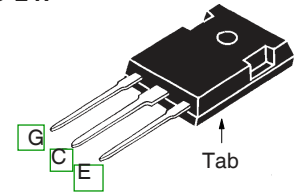
# IXXH60N65B4

Extreme Light Punch Through  
IGBT for 5-30 kHz Switching



$V_{CES} = 650V$   
 $I_{C110} = 60A$   
 $V_{CE(sat)} \leq 2.2V$   
 $t_{fi(typ)} = 43ns$

TO-247



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

| 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)  | 145                                       | A          |
| $I_{C110}$                    | $T_C = 110^\circ C$   | 60  | A          |
| $I_{CM}$                      | $T_C = 25^\circ C$ , 1ms  | 265                                       | A          |
| <b>SSOA</b><br><b>(RBSOA)</b> | $V_{GE} = 15V$ , $T_{VJ} = 150^\circ C$ , $R_G = 5\Omega$<br>Clamped Inductive Load         | $I_{CM} = 120$<br>@ $V_{CE} \leq V_{CES}$ | A          |
| $t_{sc}$<br><b>(SCSOA)</b>    | $V_{GE} = 15V$ , $V_{CE} = 360V$ , $T_J = 150^\circ C$<br>$R_G = 82\Omega$ , Non Repetitive | 10  | $\mu s$    |
| $P_C$                         | $T_C = 25^\circ C$  | 536                                       | 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          |

## Features

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

## Advantages

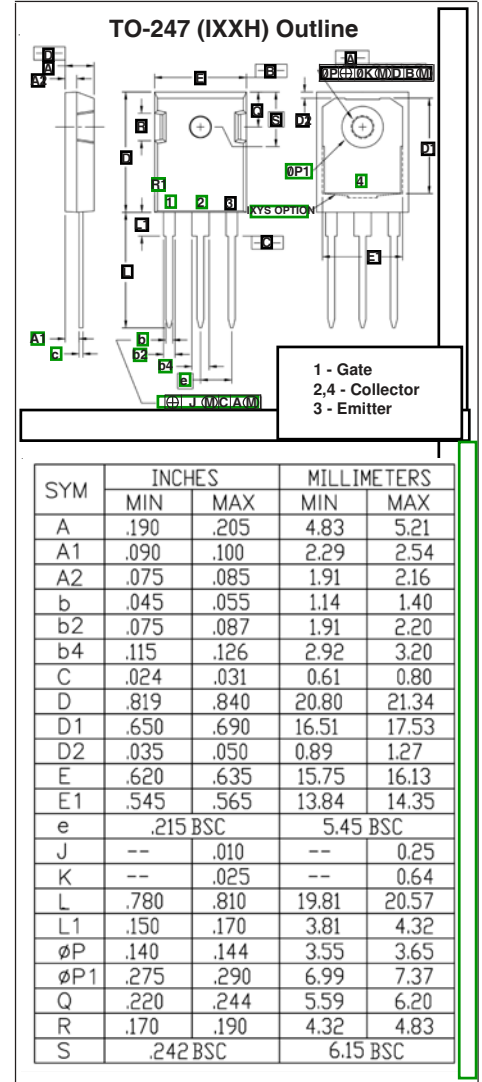
- High Power Density
- Extremely Rugged
- Low Gate Drive Requirement

## 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>$T_J = 150^\circ C$             |                       |            | 5 $\mu A$<br>250 $\mu A$ |
| $I_{GES}$     | $V_{CE} = 0V$ , $V_{GE} = \pm 20V$                                    |                       |            | $\pm 100$ nA             |
| $V_{CE(sat)}$ | $I_C = 60A$ , $V_{GE} = 15V$ , Note 1<br>$T_J = 150^\circ C$          |                       | 1.8<br>2.1 | 2.2 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  | 17                    | 28   | S                       |
| $C_{ies}$  | $V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$  |                       | 2590 | pF                      |
| $C_{oes}$  |   |                       | 133  | pF                      |
| $C_{res}$  |   |                       | 40   | pF                      |
| $Q_{g(on)}$  | $I_C = 60\text{A}, V_{GE} = 15\text{V}, V_{CE} = 0.5 \cdot V_{CES}$   |                       | 86   | nC                      |
| $Q_{ge}$   |   |                       | 22   | nC                      |
| $Q_{gc}$   |   |                       | 35   | nC                      |
| $t_{d(on)}$  | <b>Inductive load, <math>T_J = 25^\circ\text{C}</math></b><br>$I_C = 60\text{A}, V_{GE} = 15\text{V}$<br>$V_{CE} = 400\text{V}, R_G = 5\Omega$<br>Note 2  |                       | 19   | ns                      |
| $t_{ri}$   |   |                       | 80   | ns                      |
| $E_{on}$   |   |                       | 3.2  | mJ                      |
| $t_{d(off)}$   |   |                       | 107  | ns                      |
| $t_{fi}$   |   |                       | 43   | ns                      |
| $E_{off}$  |   |                       | 1.1  | mJ                      |
| $t_{d(on)}$  | <b>Inductive load, <math>T_J = 150^\circ\text{C}</math></b><br>$I_C = 60\text{A}, V_{GE} = 15\text{V}$<br>$V_{CE} = 400\text{V}, R_G = 5\Omega$<br>Note 2 |                       | 20   | ns                      |
| $t_{ri}$   |   |                       | 74   | ns                      |
| $E_{on}$   |   |                       | 4.2  | mJ                      |
| $t_{d(off)}$   |   |                       | 120  | ns                      |
| $t_{fi}$   |   |                       | 88   | ns                      |
| $E_{off}$  |   |                       | 1.8  | mJ                      |
| $R_{thJC}$   |   |                       |      | 0.28 $^\circ\text{C/W}$ |
| $R_{thCS}$   |   | 0.21                  |      | $^\circ\text{C/W}$      |

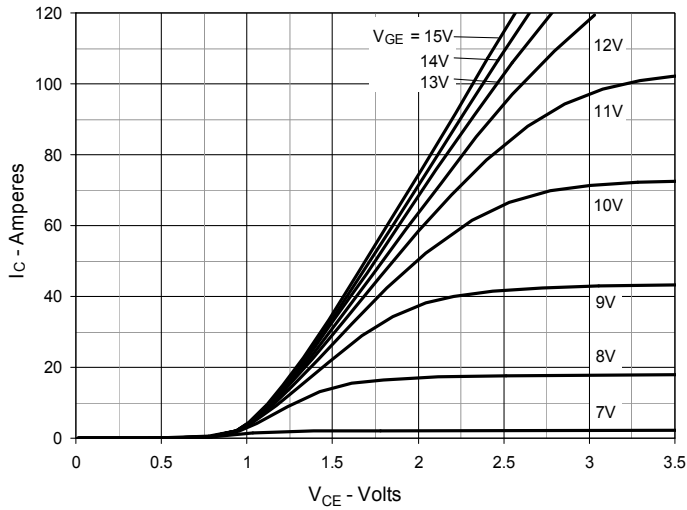
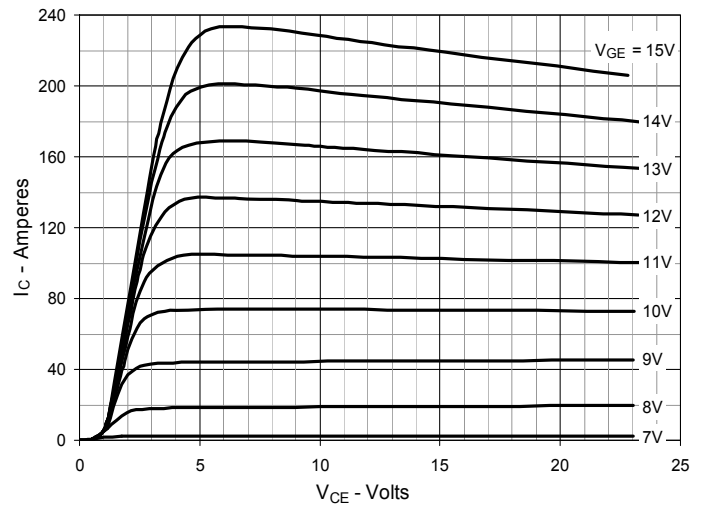
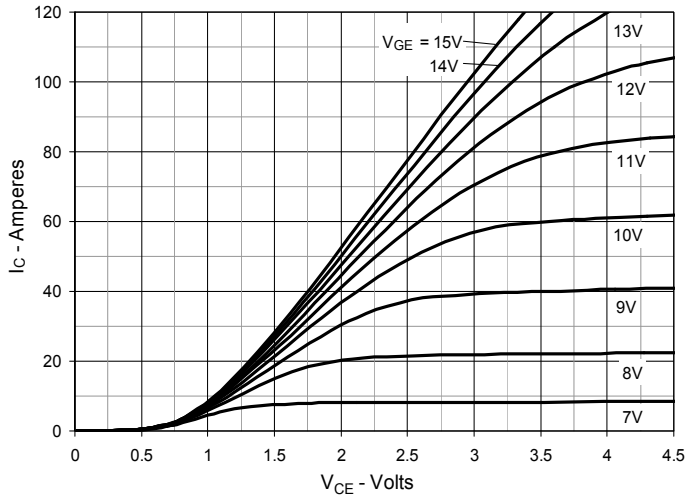
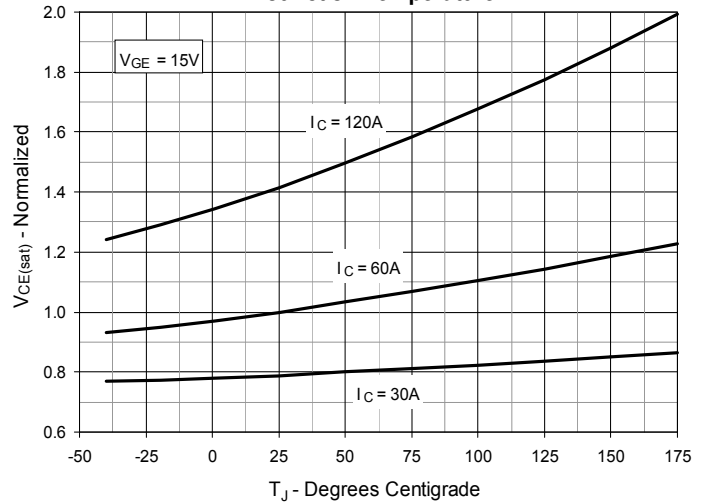
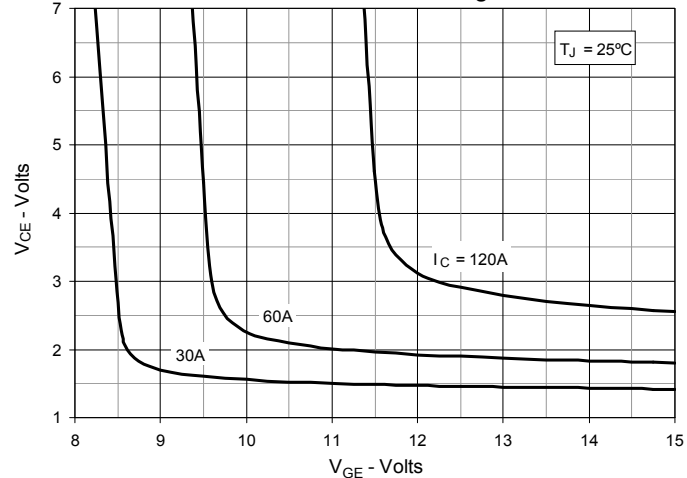
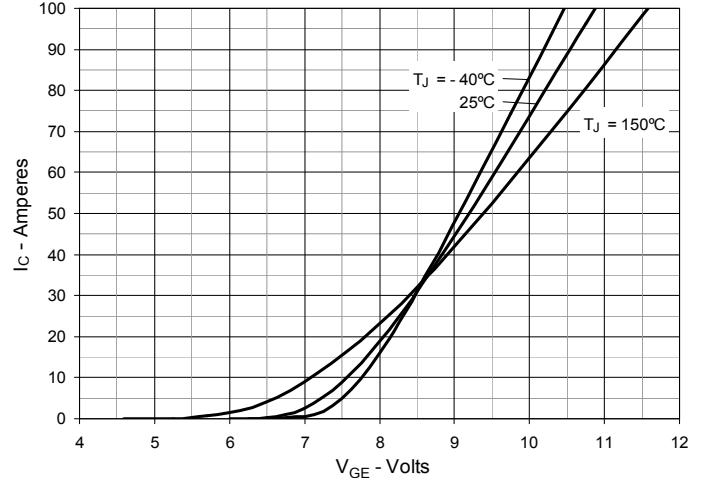


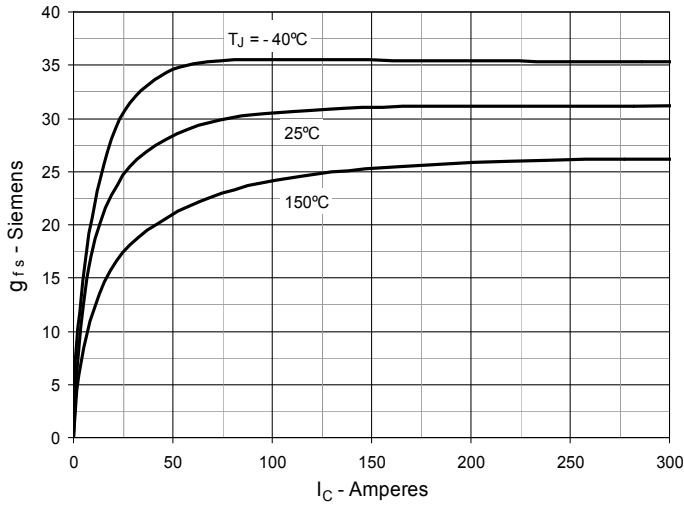
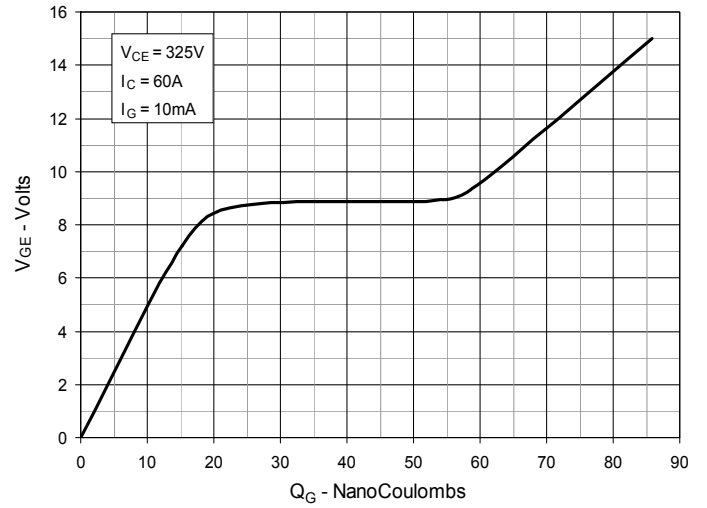
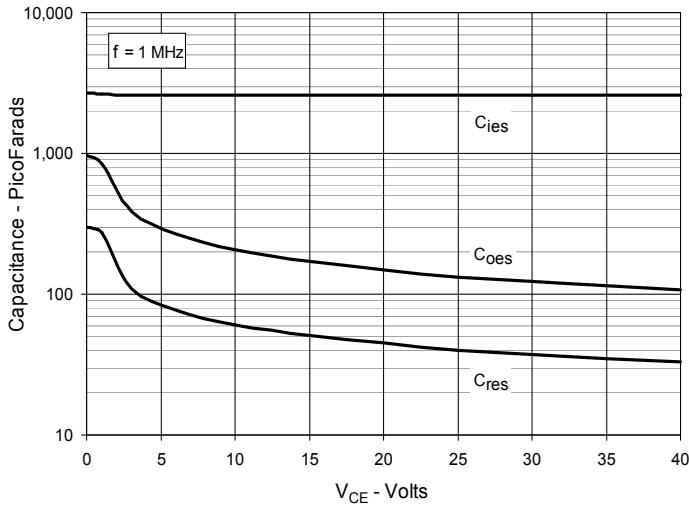
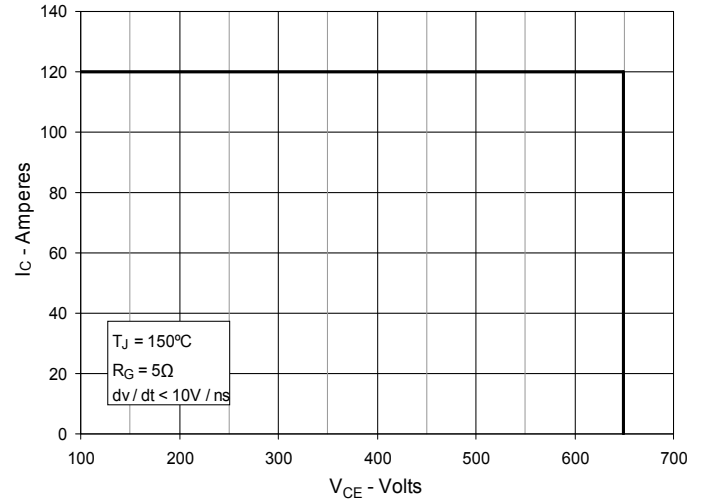
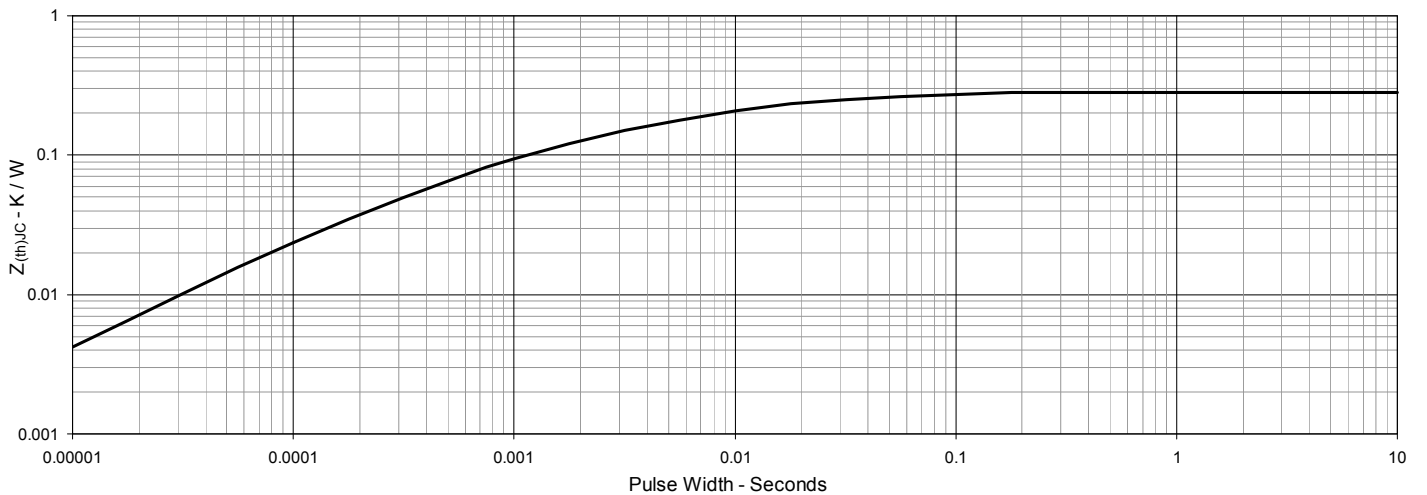
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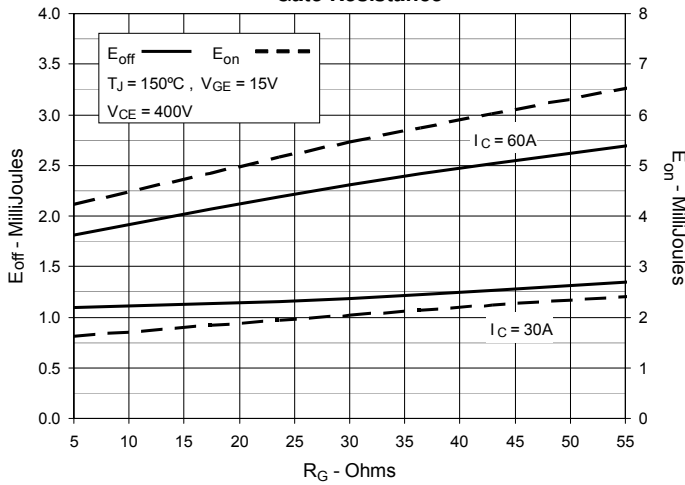
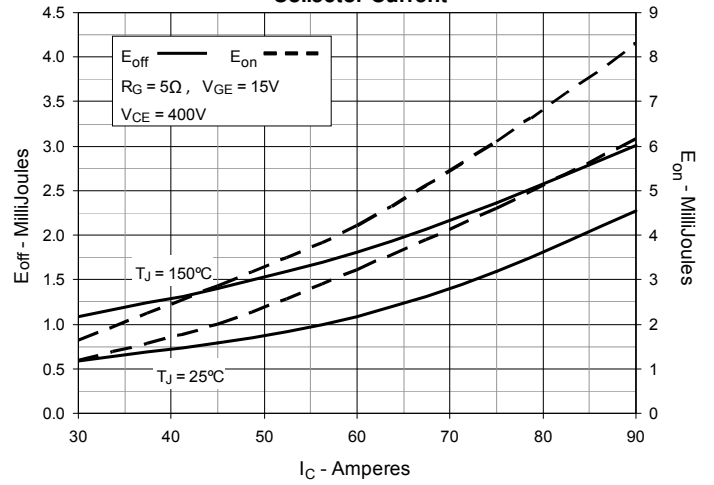
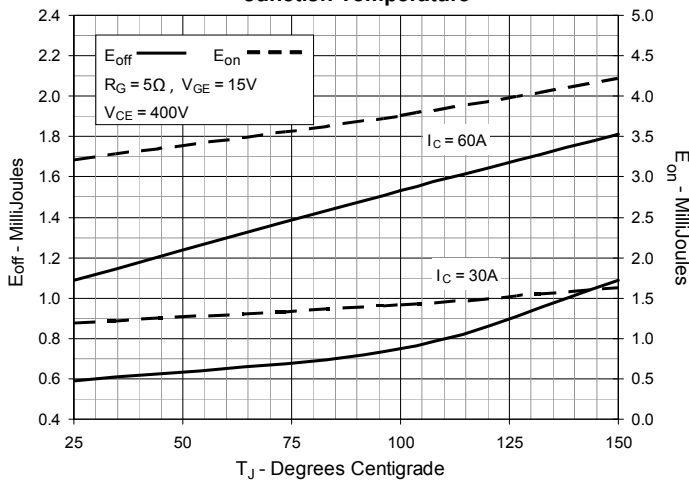
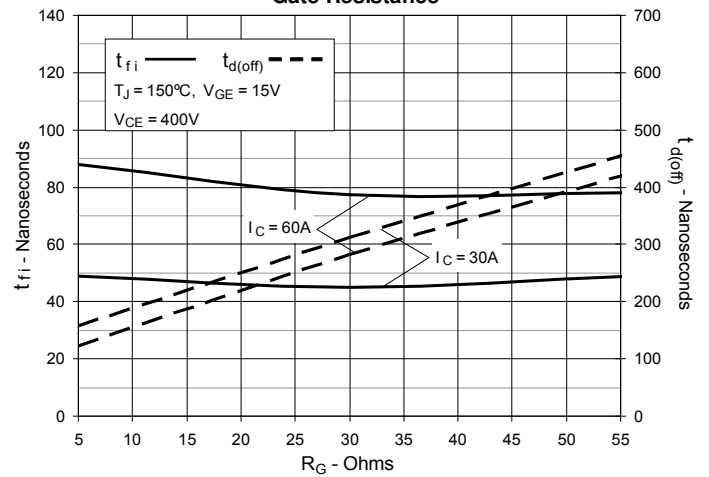
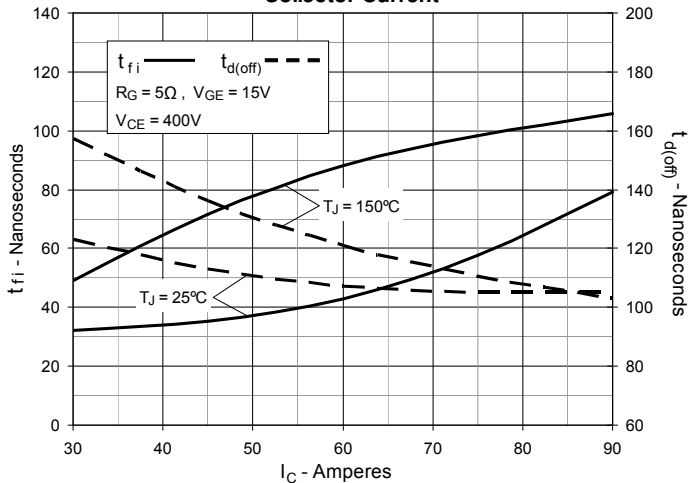
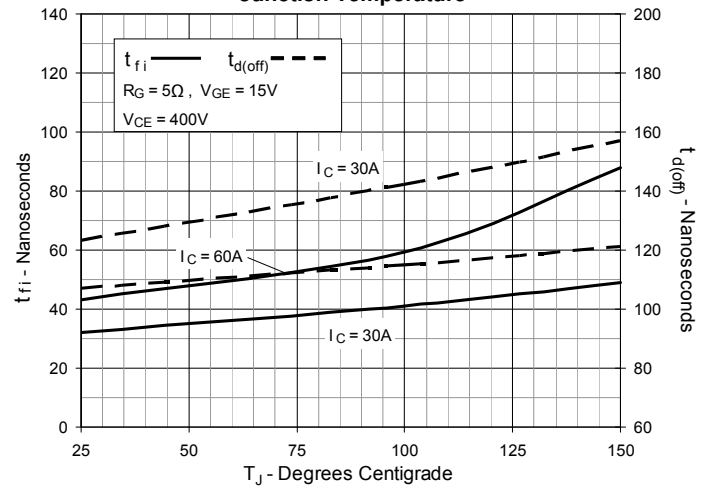
1. Pulse test,  $t \leq 300\mu\text{s}$ , duty cycle,  $d \leq 2\%$ .
2. Switching times & energy losses may increase for higher  $V_{CE}(\text{clamp})$ ,  $T_J$  or  $R_G$ .

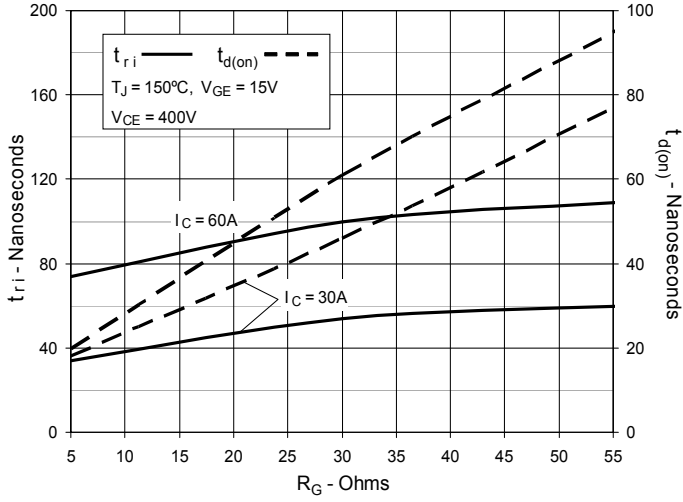
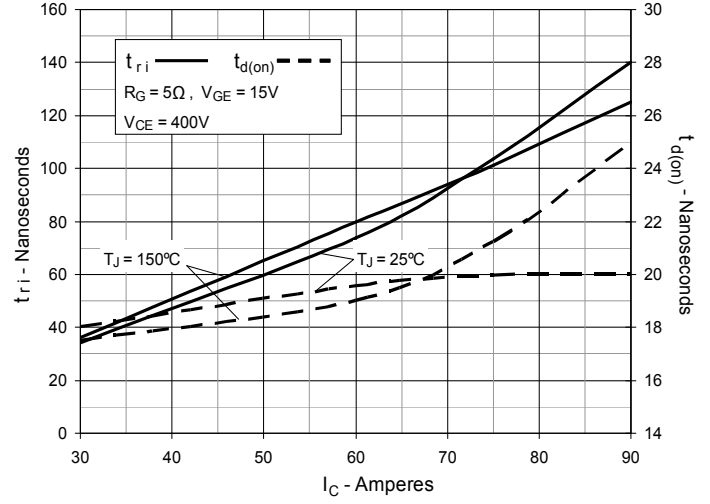
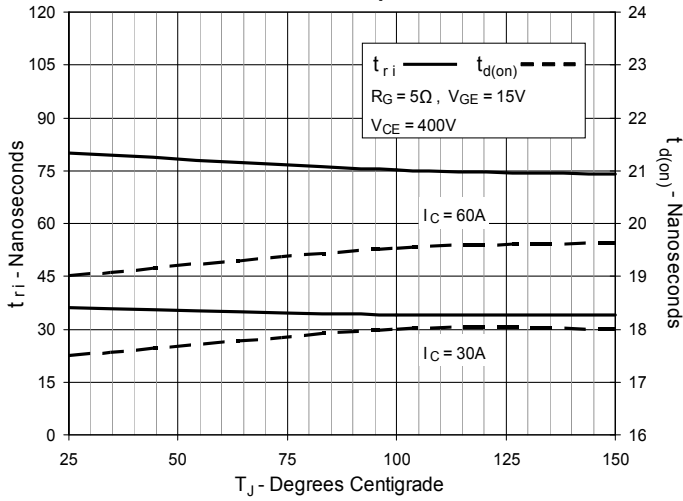
IXYS Reserves the Right to Change Limits, Test Conditions, and Dimensions.

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




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