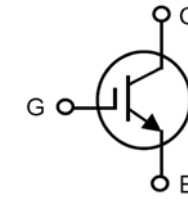


# XPT™ 650V IGBT

## GenX3™

# IXYP10N65C3

Extreme Light Punch Through  
IGBT for 20-60kHz Switching

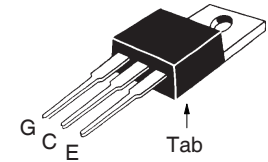


$$\begin{aligned} V_{CES} &= 650V \\ I_{C110} &= 10A \\ V_{CE(sat)} &\leq 2.50V \\ t_{fi(typ)} &= 23ns \end{aligned}$$

| Symbol                        | Test Conditions                                                                                    | Maximum Ratings                          |                  |
|-------------------------------|----------------------------------------------------------------------------------------------------|------------------------------------------|------------------|
| $V_{CES}$                     | $T_J = 25^\circ\text{C to } 175^\circ\text{C}$                                                     | 650                                      | V                |
| $V_{CGR}$                     | $T_J = 25^\circ\text{C to } 175^\circ\text{C}, R_{GE} = 1M\Omega$                                  | 650                                      | V                |
| $V_{GES}$                     | Continuous                                                                                         | $\pm 20$                                 | V                |
| $V_{GEM}$                     | Transient                                                                                          | $\pm 30$                                 | V                |
| $I_{C25}$                     | $T_C = 25^\circ\text{C}$                                                                           | 30                                       | A                |
| $I_{C110}$                    | $T_C = 110^\circ\text{C}$                                                                          | 10                                       | A                |
| $I_{CM}$                      | $T_C = 25^\circ\text{C}, 1\text{ms}$                                                               | 54                                       | A                |
| $I_A$                         | $T_C = 25^\circ\text{C}$                                                                           | 5                                        | A                |
| $E_{AS}$                      | $T_C = 25^\circ\text{C}$                                                                           | 50                                       | mJ               |
| <b>SSOA</b><br><b>(RBSOA)</b> | $V_{GE} = 15V, T_{VJ} = 150^\circ\text{C}, R_G = 50\Omega$<br>Clamped Inductive Load               | $I_{CM} = 20$<br>$@ V_{CE} \leq V_{CES}$ | A                |
| $t_{sc}$<br><b>(SCSOA)</b>    | $V_{GE} = 15V, V_{CE} = 360V, T_J = 150^\circ\text{C}$<br>$R_G = 150\Omega, \text{Non Repetitive}$ | 8                                        | $\mu\text{s}$    |
| $P_C$                         | $T_C = 25^\circ\text{C}$                                                                           | 160                                      | W                |
| $T_J$                         |                                                                                                    | -55 ... +175                             | $^\circ\text{C}$ |
| $T_{JM}$                      |                                                                                                    | 175                                      | $^\circ\text{C}$ |
| $T_{stg}$                     |                                                                                                    | -55 ... +175                             | $^\circ\text{C}$ |
| $T_L$                         | 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.        |
| <b>Weight</b>                 |                                                                                                    | 3                                        | g                |

| Symbol        | Test Conditions<br>( $T_J = 25^\circ\text{C}$ , Unless Otherwise Specified) | Characteristic Values |              |                                       |
|---------------|-----------------------------------------------------------------------------|-----------------------|--------------|---------------------------------------|
|               |                                                                             | Min.                  | Typ.         | Max.                                  |
| $BV_{CES}$    | $I_C = 250\mu\text{A}, V_{GE} = 0V$                                         | 650                   |              | V                                     |
| $V_{GE(th)}$  | $I_C = 250\mu\text{A}, V_{CE} = V_{GE}$                                     | 3.5                   |              | 6.0 V                                 |
| $I_{CES}$     | $V_{CE} = V_{CES}, V_{GE} = 0V$<br>$T_J = 150^\circ\text{C}$                |                       |              | 10 $\mu\text{A}$<br>100 $\mu\text{A}$ |
| $I_{GES}$     | $V_{CE} = 0V, V_{GE} = \pm 20V$                                             |                       |              | $\pm 100$ nA                          |
| $V_{CE(sat)}$ | $I_C = 10A, V_{GE} = 15V, \text{Note 1}$<br>$T_J = 150^\circ\text{C}$       |                       | 2.27<br>2.54 | 2.50 V<br>V                           |

## TO-220



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

## Features

- Optimized for 20-60kHz Switching
- Square RBSOA
- Avalanche Rated
- 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
- High Frequency Power Inverters

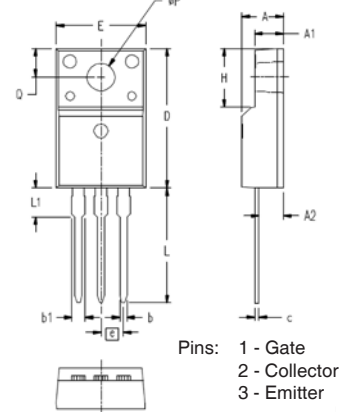
## Symbol Test Conditions

( $T_J = 25^\circ\text{C}$  Unless Otherwise Specified)

## Characteristic Values

|              |                                                                                                                                                            | Min. | Typ. | Max.                    |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|-------------------------|
| $g_{fs}$     | $I_C = 10\text{A}, V_{CE} = 10\text{V}$ , Note 1                                                                                                           | 3.8  | 6.2  | S                       |
| $C_{ies}$    | $V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$                                                                                                 |      | 423  | pF                      |
| $C_{oes}$    |                                                                                                                                                            |      | 27   | pF                      |
| $C_{res}$    |                                                                                                                                                            |      | 10   | pF                      |
| $Q_{g(on)}$  | $I_C = 10\text{A}, V_{GE} = 15\text{V}, V_{CE} = 0.5 \cdot V_{CES}$                                                                                        |      | 18   | nC                      |
| $Q_{ge}$     |                                                                                                                                                            |      | 4    | nC                      |
| $Q_{gc}$     |                                                                                                                                                            |      | 8    | nC                      |
| $t_{d(on)}$  | <b>Inductive load, <math>T_J = 25^\circ\text{C}</math></b><br>$I_C = 10\text{A}, V_{GE} = 15\text{V}$<br>$V_{CE} = 400\text{V}, R_G = 50\Omega$<br>Note 2  |      | 20   | ns                      |
| $t_{ri}$     |                                                                                                                                                            |      | 26   | ns                      |
| $E_{on}$     |                                                                                                                                                            |      | 0.24 | mJ                      |
| $t_{d(off)}$ |                                                                                                                                                            |      | 77   | ns                      |
| $t_{fi}$     |                                                                                                                                                            |      | 23   | ns                      |
| $E_{off}$    |                                                                                                                                                            |      | 0.11 | mJ                      |
| $t_{d(on)}$  | <b>Inductive load, <math>T_J = 150^\circ\text{C}</math></b><br>$I_C = 10\text{A}, V_{GE} = 15\text{V}$<br>$V_{CE} = 400\text{V}, R_G = 50\Omega$<br>Note 2 |      | 17   | ns                      |
| $t_{ri}$     |                                                                                                                                                            |      | 27   | ns                      |
| $E_{on}$     |                                                                                                                                                            |      | 0.44 | mJ                      |
| $t_{d(off)}$ |                                                                                                                                                            |      | 90   | ns                      |
| $t_{fi}$     |                                                                                                                                                            |      | 38   | ns                      |
| $E_{off}$    |                                                                                                                                                            |      | 0.15 | mJ                      |
| $R_{thJC}$   |                                                                                                                                                            |      |      | 0.94 $^\circ\text{C/W}$ |
| $R_{thCS}$   |                                                                                                                                                            |      | 0.50 | $^\circ\text{C/W}$      |

## TO-220 (IXYP) Outline



| Dim. | Millimeters |       | Inches    |       |
|------|-------------|-------|-----------|-------|
|      | min         | max   | min       | max   |
| A    | 4.50        | 4.90  | 0.177     | 0.193 |
| A1   | 2.34        | 2.74  | 0.092     | 0.108 |
| A2   | 2.56        | 2.96  | 0.101     | 0.117 |
| b    | 0.70        | 0.90  | 0.028     | 0.035 |
| b1   | 1.27        | 1.47  | 0.050     | 0.058 |
| c    | 0.45        | 0.60  | 0.018     | 0.024 |
| D    | 15.67       | 16.07 | 0.617     | 0.633 |
| E    | 9.96        | 10.36 | 0.392     | 0.408 |
| e    | 2.54 BSC    |       | 0.100 BSC |       |
| H    | 6.48        | 6.88  | 0.255     | 0.271 |
| L    | 12.68       | 13.28 | 0.499     | 0.523 |
| L1   | 3.03        | 3.43  | 0.119     | 0.135 |
| Ø P  | 3.08        | 3.28  | 0.121     | 0.129 |
| Q    | 3.20        | 3.40  | 0.126     | 0.134 |

## Notes:

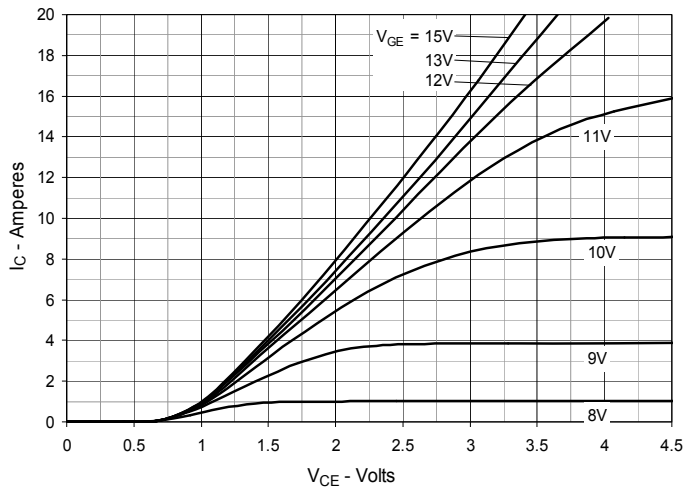
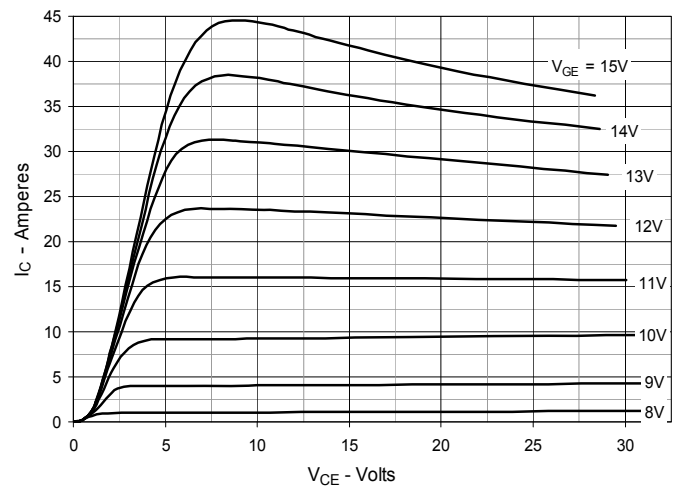
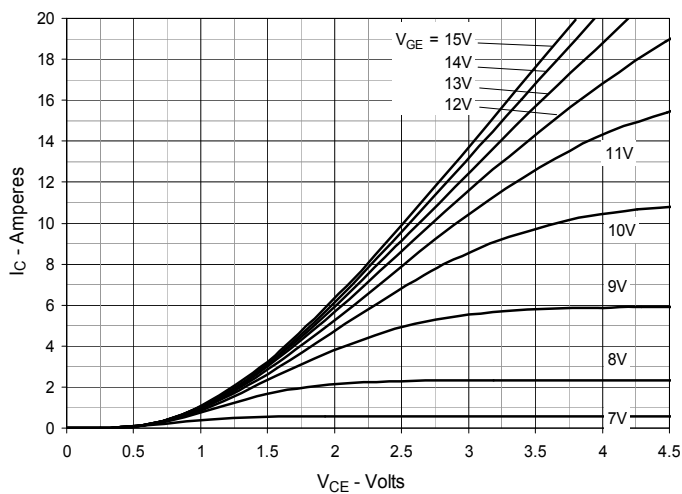
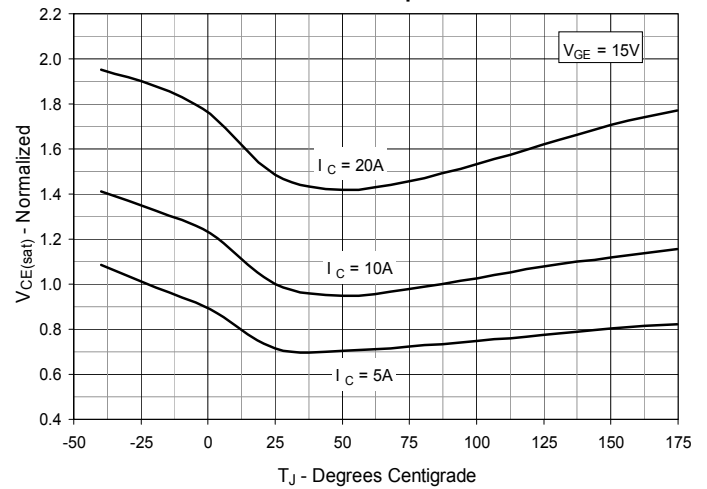
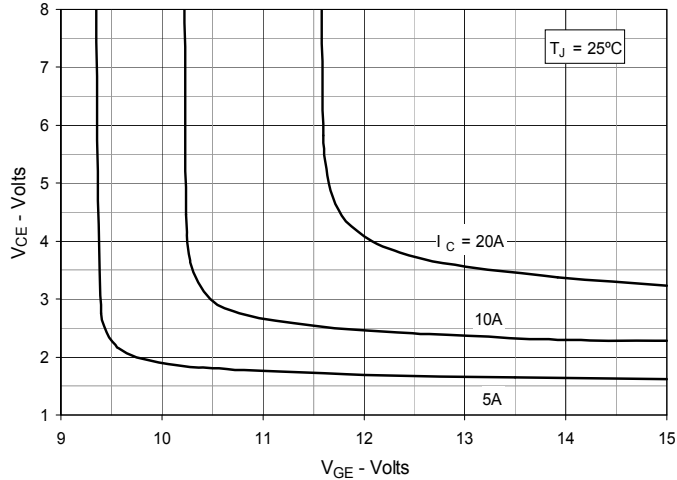
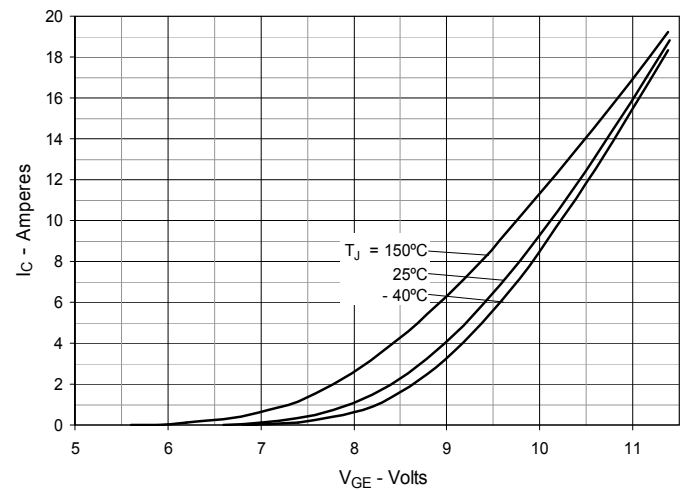
1. Pulse test,  $t \leq 300\mu\text{s}$ , duty cycle,  $d \leq 2\%$ .
2. Switching times & energy losses may increase for higher  $V_{CE}(\text{clamp})$ ,  $T_J$  or  $R_G$ .

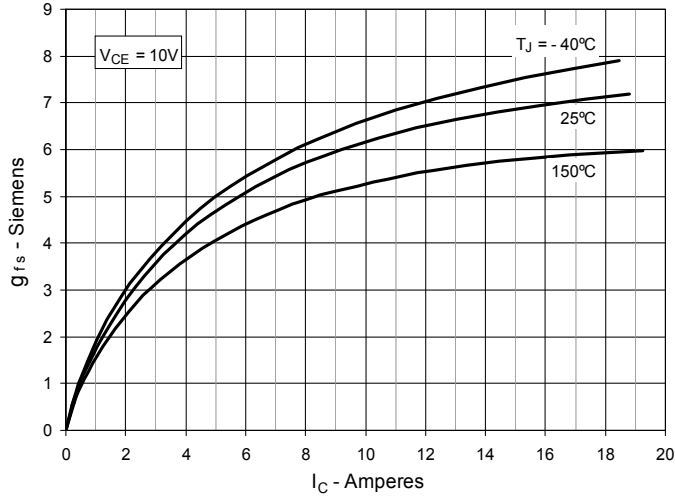
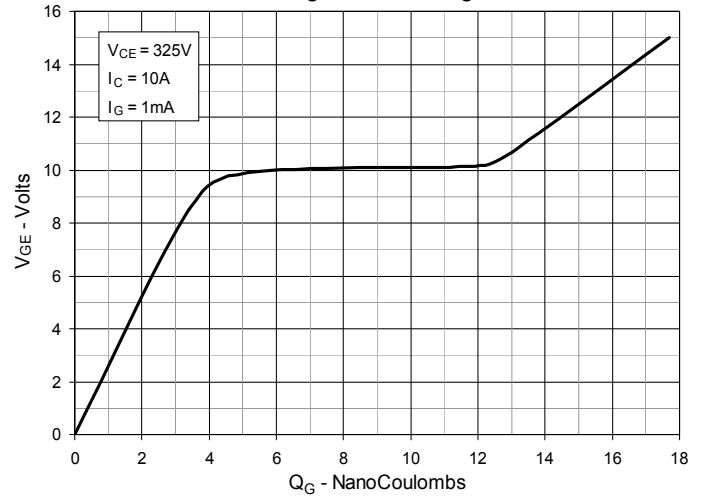
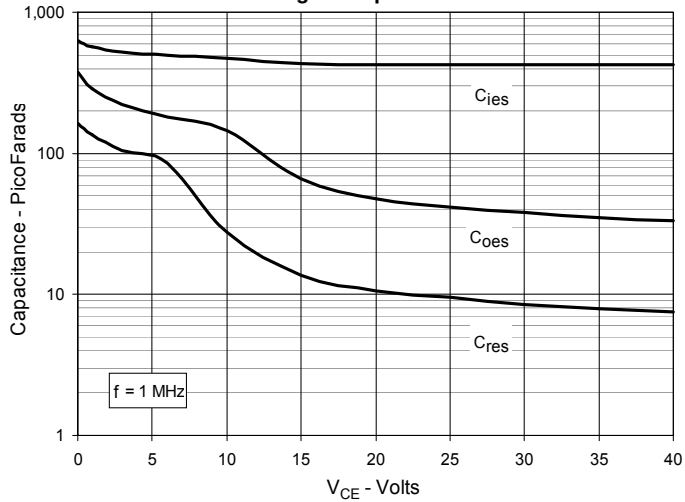
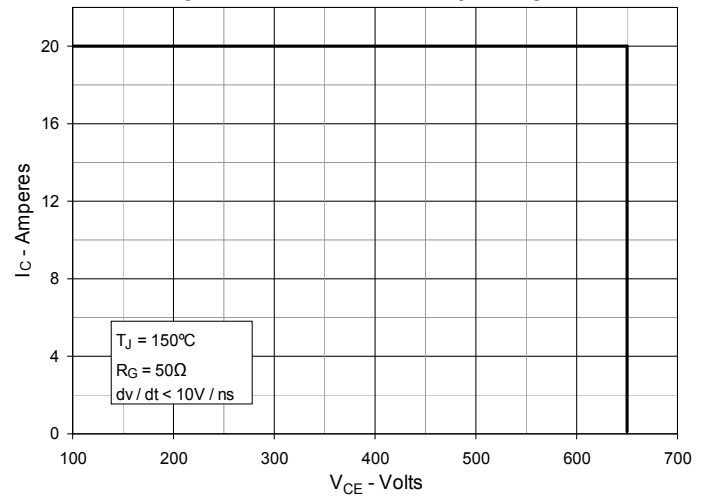
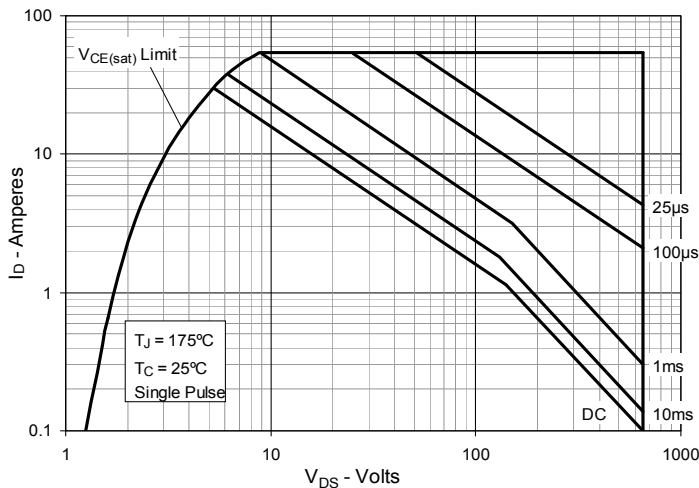
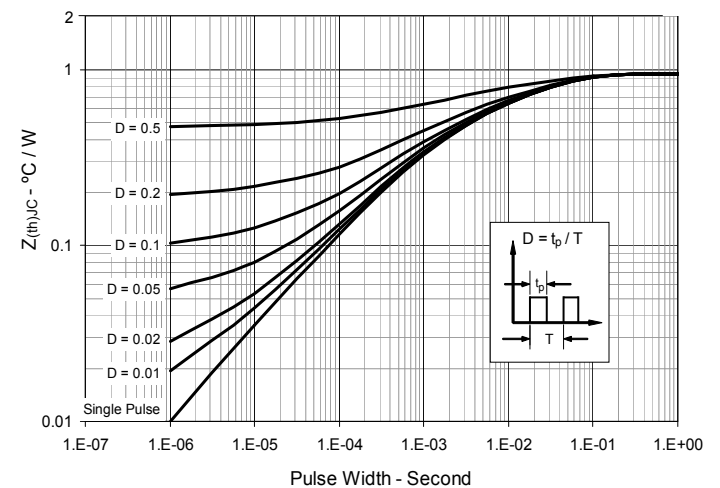
## PRELIMINARY TECHNICAL INFORMATION

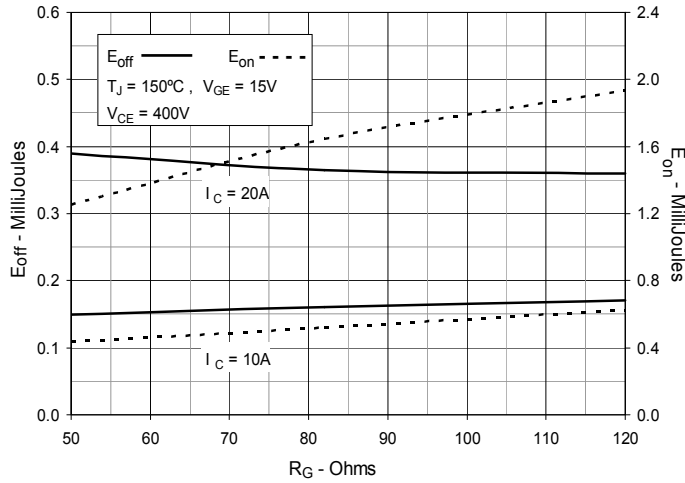
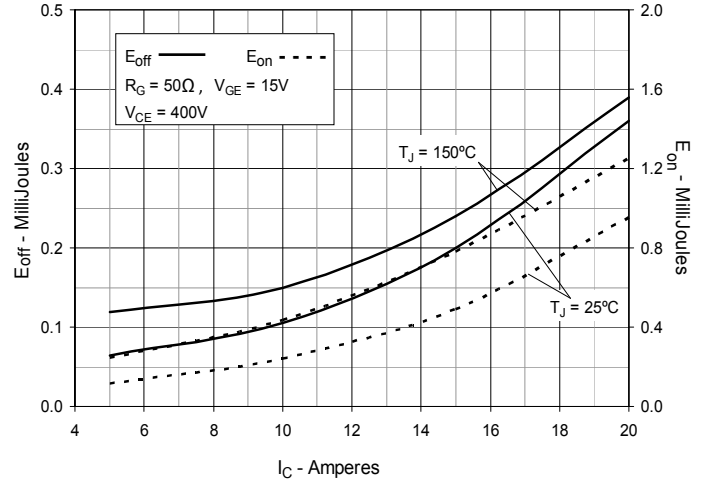
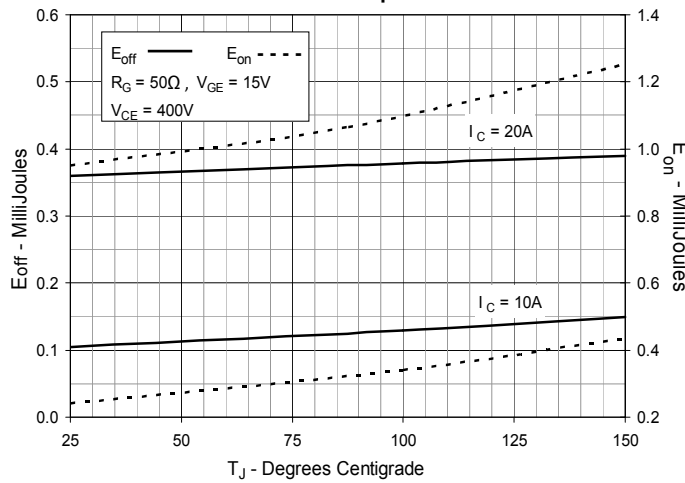
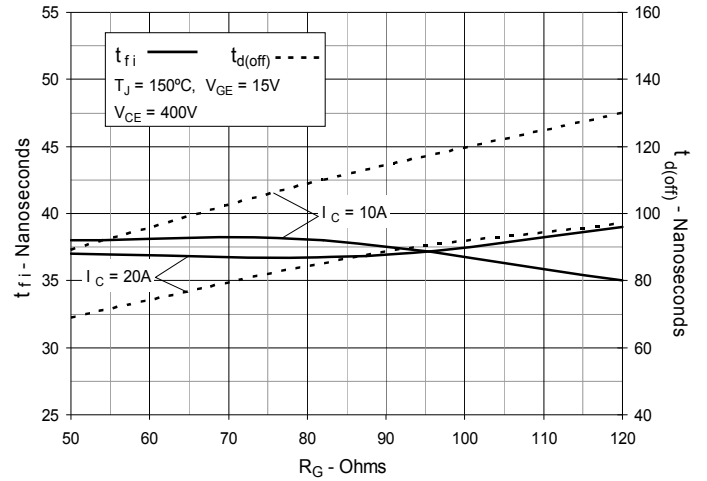
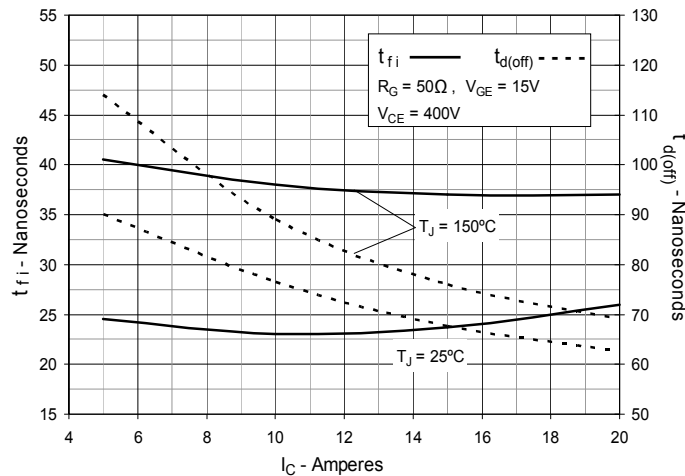
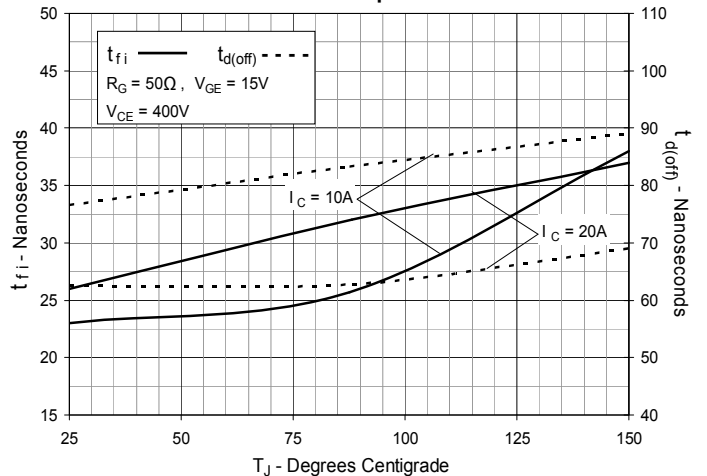
The product presented herein is under development. The Technical Specifications offered are derived from a subjective evaluation of the design, based upon prior knowledge and experience, and constitute a "considered reflection" of the anticipated result. IXYS reserves the right to change limits, test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

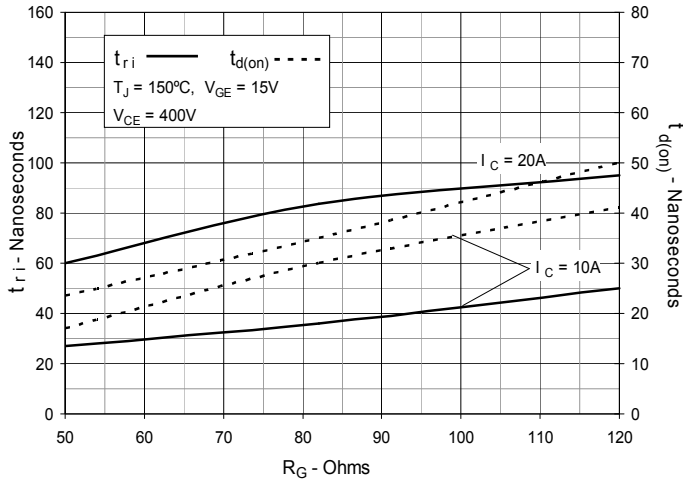
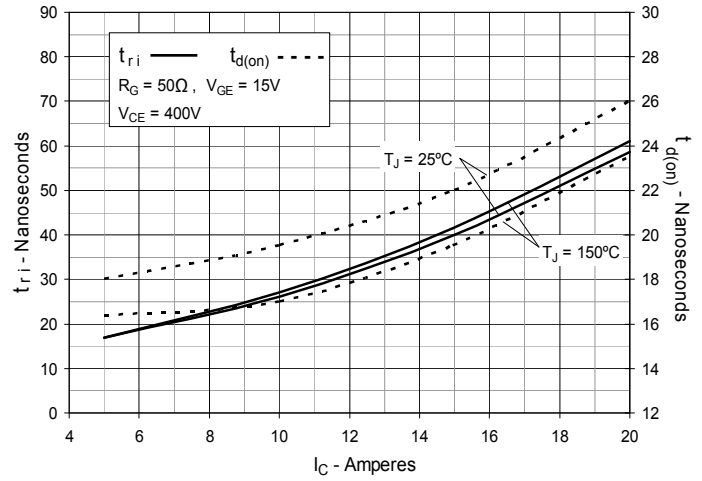
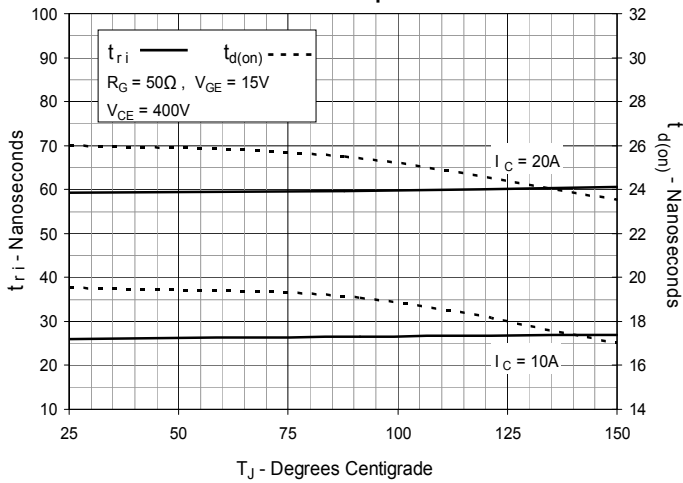
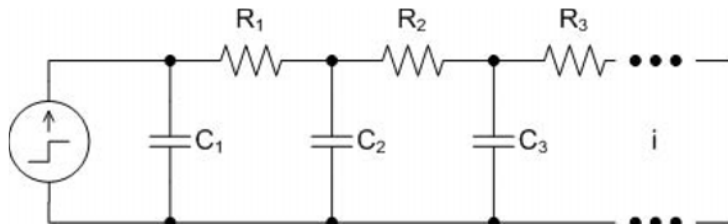
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|                                                                                  |           |           |           |           |              |              |              |              |              |             |
|----------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|--------------|--------------|--------------|--------------|--------------|-------------|
| 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. Forward-Bias Safe Operating Area**

**Fig. 12. Maximum Transient Thermal Impedance (IGBT)**


**Fig. 13. Inductive Switching Energy Loss vs. Gate Resistance**

**Fig. 14. Inductive Switching Energy Loss vs. Collector Current**

**Fig. 15. Inductive Switching Energy Loss vs. Junction Temperature**

**Fig. 16. Inductive Turn-off Switching Times vs. Gate Resistance**

**Fig. 17. Inductive Turn-off Switching Times vs. Collector Current**

**Fig. 18. Inductive Turn-off Switching Times vs. Junction Temperature**


**Fig. 19. Inductive Turn-on Switching Times vs. Gate Resistance**

**Fig. 20. Inductive Turn-on Switching Times vs. Collector Current**

**Fig. 21. Inductive Turn-on Switching Times vs. Junction Temperature**

**Fig. 22. Cauer Thermal Network**


| i | Ri (°C/W) | Ci (J/°C)  |
|---|-----------|------------|
| 1 | 0.314390  | 0.00097276 |
| 2 | 0.289260  | 0.00981820 |
| 3 | 0.090928  | 0.07681600 |