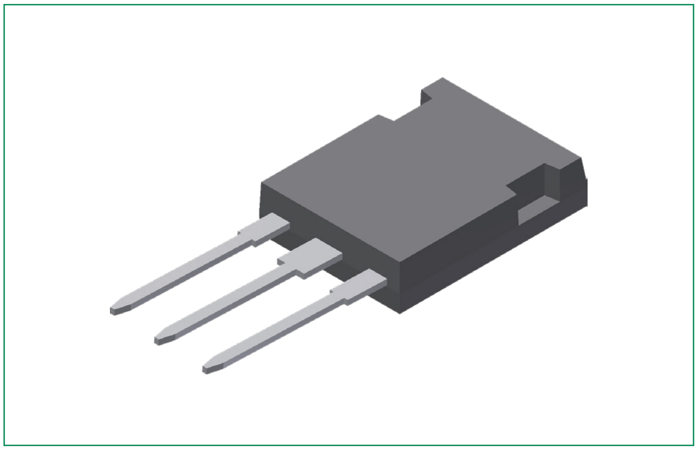
# IXYX180N65A5

## 650 V, 180 A, Gen5 XPT™ IGBT

Extreme Light Punch Through IGBT for up to 5 kHz Switching



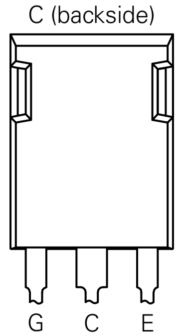
## Description:

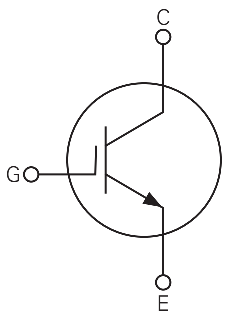
Developed using our proprietary XPT™ thin-wafer technology and state-of-the-art Trench IGBT process, these devices feature reduced thermal resistance, low conduction losses, and low gate driver requirements.

## Features & Benefits:

- Optimized for Low Conduction Losses
- High Surge Current Capability
- Square RBSOA
- International Standard Package
- Low Gate Charge $Q_G$
- Low Gate Drive Requirement

## Pinout Diagram PLUS-247 (IXYX)




**G:** Gate; **C:** Collector; **E:** Emitter; **backside:** Collector

## Applications:

- Power Inverters
- UPS
- PFC Circuits
- Battery Chargers
- Welding Machines
- Lamp Ballasts
- Inrush Current Protection Circuits

## Product Summary

| Characteristic | Value | Unit |
|---|---|---|
| $V_{CES}$ | 650 | V |
| $I_{C110}$ | 180 | A |
| $V_{CE(sat)}$ | ≤ 1.35 | V |
| $t_{fi(typ)}$ | 110 | ns |

## Maximum Ratings

| Symbol | Characteristic | Conditions | Value | Unit |
|---|---|---|---|---|
| $V_{CES}$ | Collector-Emitter Voltage | $T_J$ = 25 °C to 175 °C | 650 | V |
| $V_{CGR}$ | Collector-Gate Voltage | $T_J$ = 25 °C to 175 °C, $R_{GE}$ = 1 MΩ | 650 | V |
| $V_{GES}$ | Gate-Emitter Voltage | Continuous | ±20 | V |
| $V_{GEM}$ | Transient Gate-Emitter Voltage | Transient | ±30 | V |
| $I_{C25}$ | Continuous Collector Current | $T_C$ = 25 °C (Chip Capability) | 400 | A |
| $I_{LRM}$ | Terminal Current Limit | – | 160 | A |
| $I_{C110}$ | Continuous Collector Current | $T_C$ = 110 °C | 180 | A |
| $I_{CM}$ | Peak Collector Current | $T_C$ = 25 °C, 1 ms | 1030 | A |
| SSOA (RBSOA) | Switching Safe Operating Area (Reverse Biased Safe Operating Area) | $V_{GE}$ = 15 V, $T_{VJ}$ = 125 °C, $R_G$ = 2 Ω, Clamped Inductive Load, $I_{CM} = V_{CE} \leq V_{CES}$ | 360 | A |
| $P_C$ | Collector Power Dissipation | $T_C$ = 25 °C | 1150 | W |
| $T_J$ | Junction Temperature | – | –55 to 175 | °C |
| $T_{JM}$ | Maximum Junction Temperature | – | 175 | °C |
| $T_{stg}$ | Storage Temperature | – | –55 to 175 | °C |
| $T_L$ | Maximum Lead Temperature for Soldering | 1.6 mm (0.062 in.) from Case for 10 s | 300 | °C |
| $F_C$ | Mounting Force | – | 20..120 /4.5..27 | N/lb |
| W | Weight | – | 10 | g |

## Thermal Characteristics

| Symbol | Characteristic | Value | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| $R_{th,\ JC}$ | Thermal Resistance, Junction-to-Case | – | – | 0.13 | °C/W |
| $R_{th,\ CS}$ | Thermal Resistance, Case-to-Sink | – | 0.21 | – | °C/W |

## Electrical Characteristics – Static ($T_J$ = 25 °C unless otherwise specified)

| Symbol | Characteristic | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $BV_{CES}$ | Collector-Emitter Breakdown Voltage | $I_C$ = 250 µA, $V_{GE}$ = 0 V | 650 | – | – | V |
| $V_{GE(th)}$ | Gate-Emitter Threshold Voltage | $I_C$ = 250 µA, $V_{CE} = V_{GE}$ | 3.7 | – | 5.8 | V |
| $I_{GES}$ | Gate-Emitter Leakage Current | $V_{CE}$ = 0 V, $V_{GE}$ = ±20 V | – | – | ±200 | nA |
| $I_{CES}$ | Zero Gate Voltage Collector Current | $V_{CE} = V_{CES}$, $V_{GE}$ = 0 V | – | – | 25 | µA |
| | | $V_{CE} = V_{CES}$, $V_{GE}$ = 0 V, $T_J$ = 150 °C | – | – | 1.5 | mA |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage[1] | $I_C$ = 100 A, $V_{GE}$ = 15 V | – | 1.20 | 1.35 | V |
| | | $I_C$ = 100 A, $V_{GE}$ = 15 V, $T_J$ = 150 °C | – | 1.25 | – | V |

**Note 1:** Pulse test, t ≤ 300 µs, duty cycle, d ≤ 2%

## Electrical Characteristics – Dynamic ($T_J$ = 25 °C unless otherwise specified)

| Symbol | Characteristic | Conditions | | Value Min. | Value Typ. | Value Max. | Unit |
|---|---|---|---|---|---|---|---|
| $g_{fs}$ | Transconductance[1] | $I_C$ = 60 A, $V_{CE}$ = 10 V | | 63 | 105 | – | S |
| $R_{Gi}$ | Gate Input Resistance | – | | – | 1.1 | – | Ω |
| $C_{ies}$ | Input Capacitance | $V_{GE}$ = 0 V, $V_{CE}$ = 25 V, f = 1 MHz | | – | 870 | – | pF |
| $C_{oes}$ | Output Capacitance | | | – | 440 | – | |
| $C_{res}$ | Reverse Transfer Capacitance | | | – | 250 | – | |
| $Q_{g(on)}$ | Total Gate Charge | $V_{GE}$ = 15 V, $V_{CE}$ = 0.5 x $V_{CES,}$ $I_C$ = 180 A | | – | 654 | – | nC |
| $Q_{ge}$ | Gate-Emitter Charge | | | – | 63 | – | |
| $Q_{gc}$ | Gate-Collector Charge | | | – | 345 | – | |
| $t_{d(on)}$ | Turn-on Delay Time[2] | Inductive Load, $V_{GE}$ = 15 V, $V_{CE}$ = 300 V, $I_C$ = 100 A, $R_{G(ext)}$ = 2 Ω | $T_J$ = 25 °C | – | 70 | – | ns |
| | | | $T_J$ = 150 °C | – | 50 | – | |
| $t_{ri}$ | Turn-on Rise Time[2] | | $T_J$ = 25 °C | – | 64 | – | ns |
| | | | $T_J$ = 150 °C | – | 70 | – | |
| $E_{on}$ | Turn-on Energy[2] | | $T_J$ = 25 °C | – | 0.42 | – | mJ |
| | | | $T_J$ = 150 °C | – | 1.06 | – | |
| $t_{d(off)}$ | Turn-off Delay Time[2] | | $T_J$ = 25 °C | – | 500 | – | ns |
| | | | $T_J$ = 150 °C | – | 415 | – | |
| $t_{fi}$ | Turn-off Fall Time[2] | | $T_J$ = 25 °C | – | 110 | – | ns |
| | | | $T_J$ = 150 °C | – | 245 | – | |
| $E_{off}$ | Turn-off Energy[2] | | $T_J$ = 25 °C | – | 4.10 | – | mJ |
| | | | $T_J$ = 150 °C | – | 5.80 | – | |

**Note 1:** Pulse test, t ≤ 300 μs, duty cycle, d ≤ 2%
**Note 2:** Switching times and energy losses may increase for higher $V_{CE(clamp)}$, $T_J$, or $R_G$.

## Characteristic Curves

**Fig. 1. Output Characteristics @ $T_J$ = 25 °C**

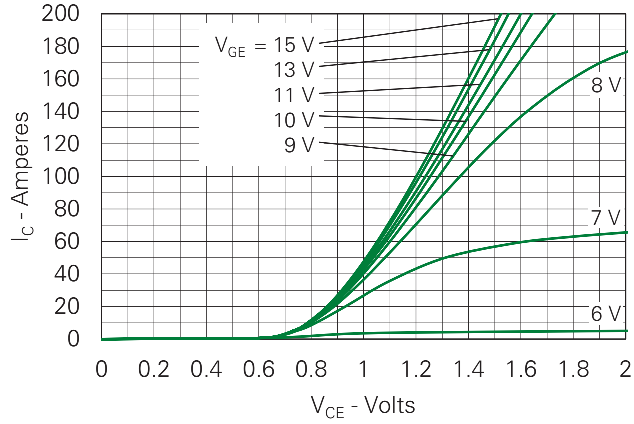



**Fig. 2. Extended Output Characteristics @ $T_J$ = 25 °C**

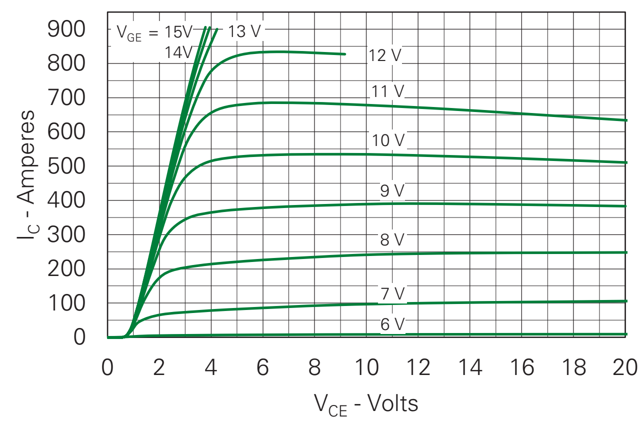



**Fig. 3. Output Characteristics @ $T_J$ = 150 °C**

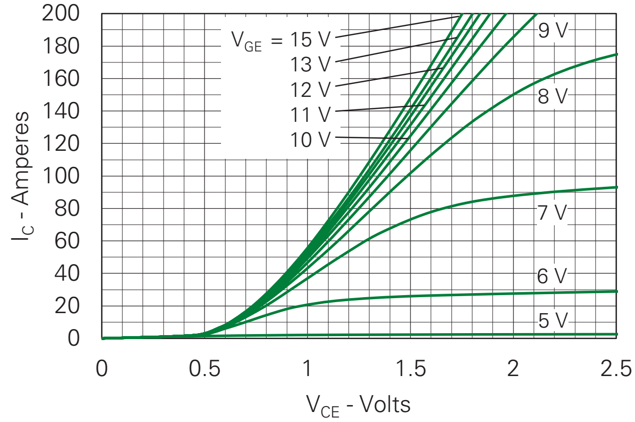



**Fig. 4. Dependence of $V_{CE(sat)}$ on Junction Temperature**

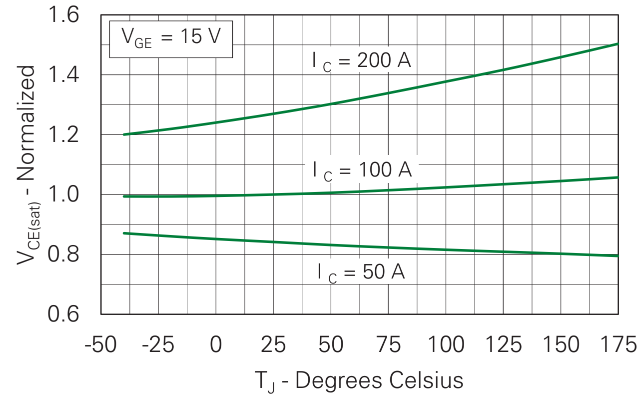



**Fig. 5. Collector-to-Emitter Voltage vs. Gate-to-Emitter Voltage**

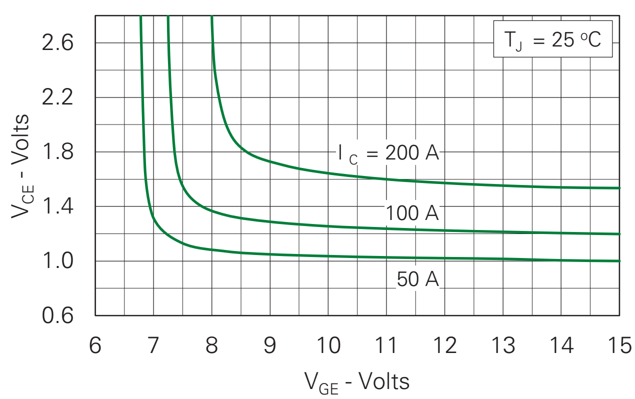



**Fig. 6. Input Admittance**

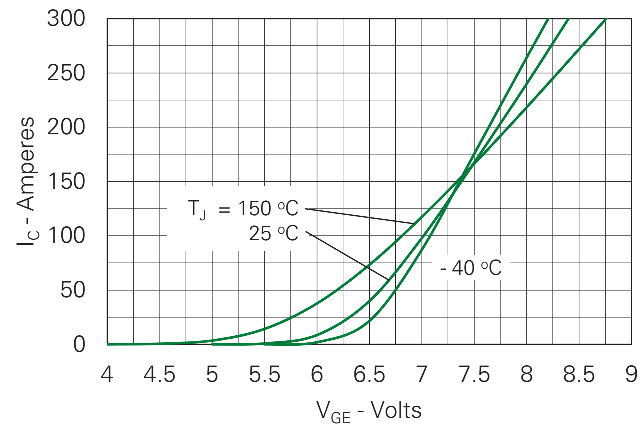


**Fig. 7. Transconductance**

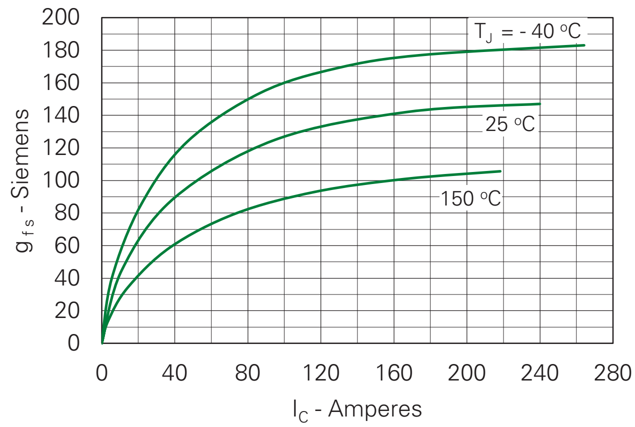



**Fig. 8. Gate Charge**

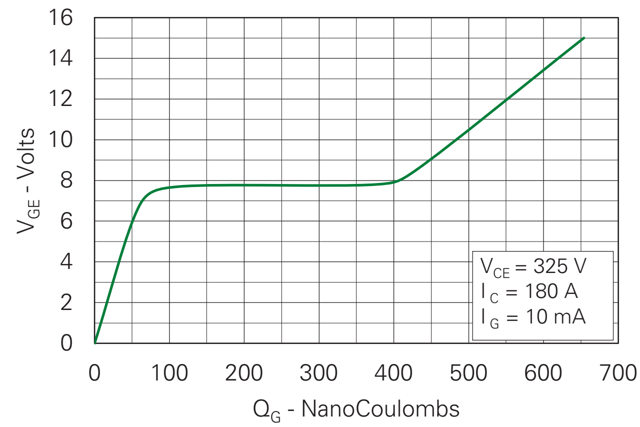



**Fig. 9. Capacitance**

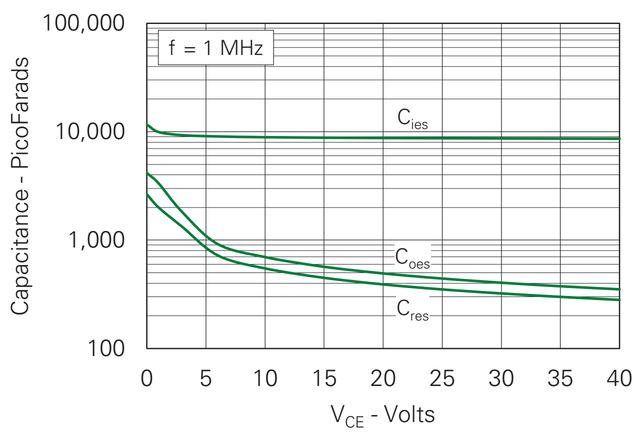



**Fig. 10. Reverse-Bias Safe Operating Area**

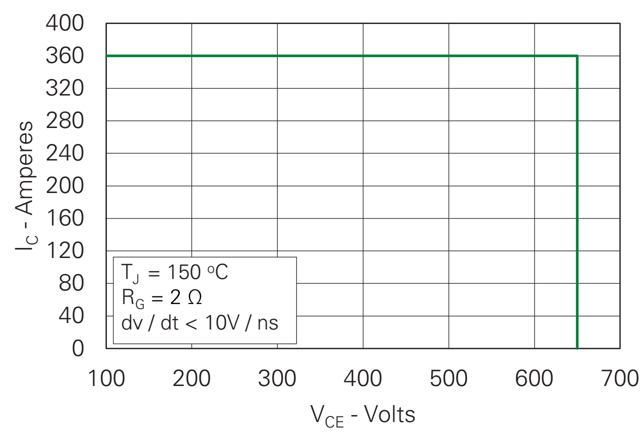



**Fig. 11. Maximum Transient Thermal Impedance**

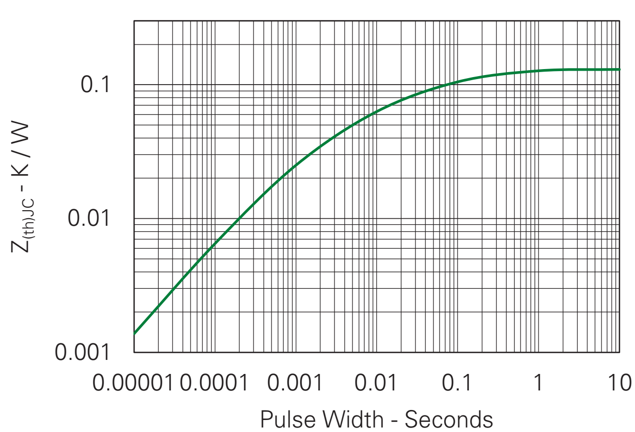



**Fig. 12. Inductive Switching Energy Loss vs. Gate Resistance**

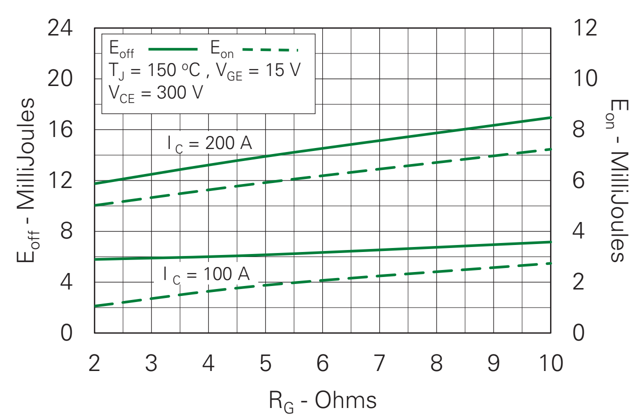


**Fig. 13. Inductive Switching Energy Loss vs. Collector Current**

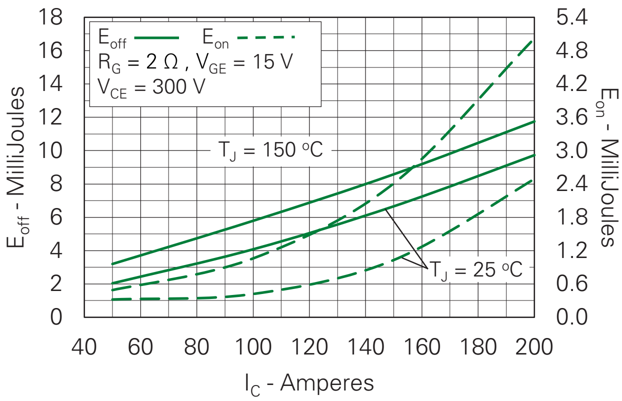



**Fig. 14. Inductive Switching Energy Loss vs. Junction Temperature**

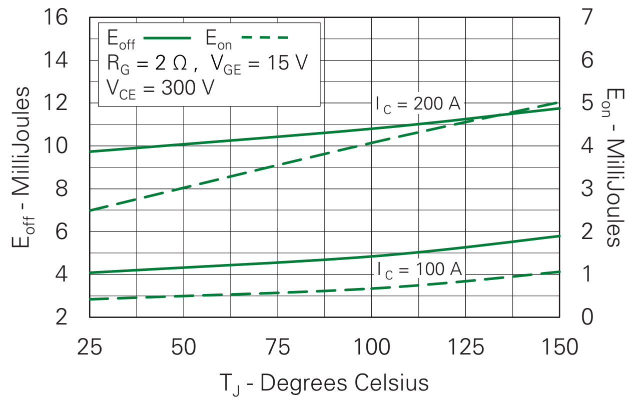



**Fig. 15. Inductive Turn-off Switching Times vs. Gate Resistance**

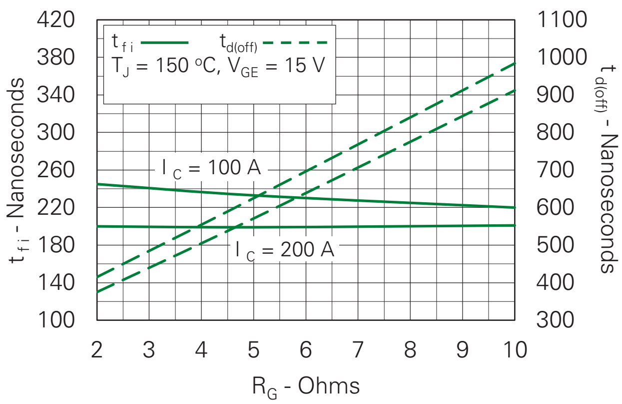



**Fig. 16. Inductive Turn-off Switching Times vs. Collector Current**

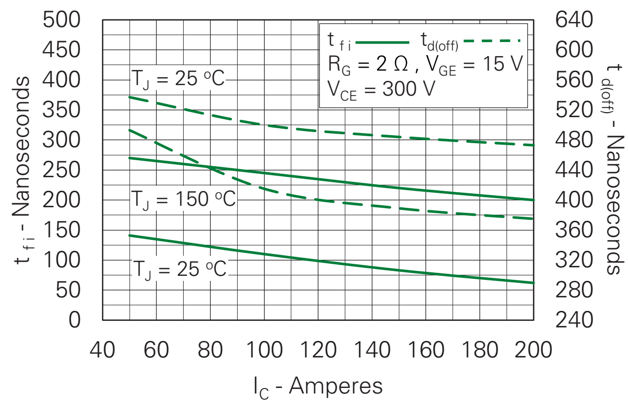



**Fig. 17. Inductive Turn-off Switching Times vs. Junction Temperature**

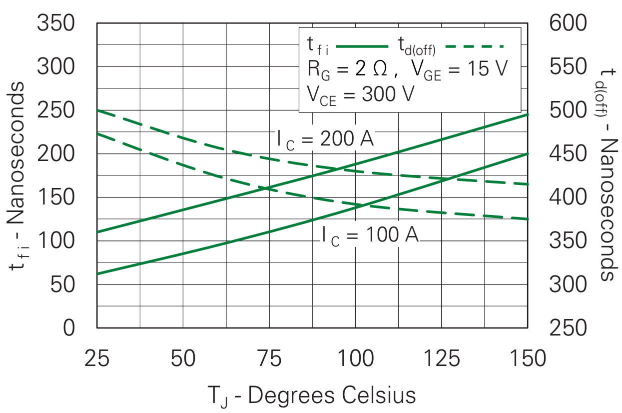



**Fig. 18. Inductive Turn-on Switching Times vs. Gate Resistance**

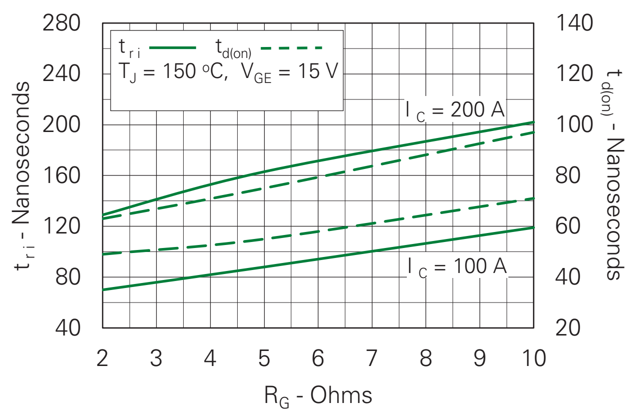


**Fig. 19. Inductive Turn-on Switching Times vs. Collector Current**

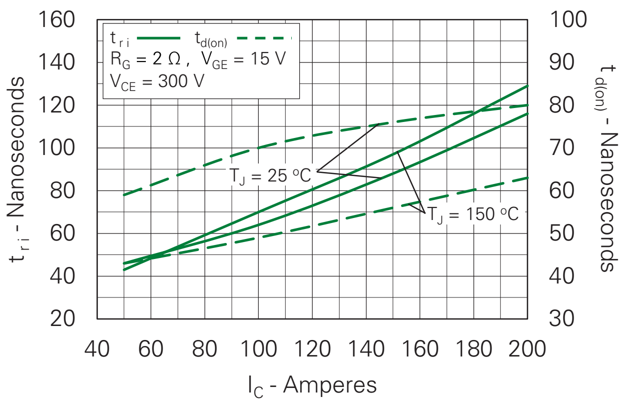



**Fig. 20. Inductive Turn-on Switching Times vs. Junction Temperature**

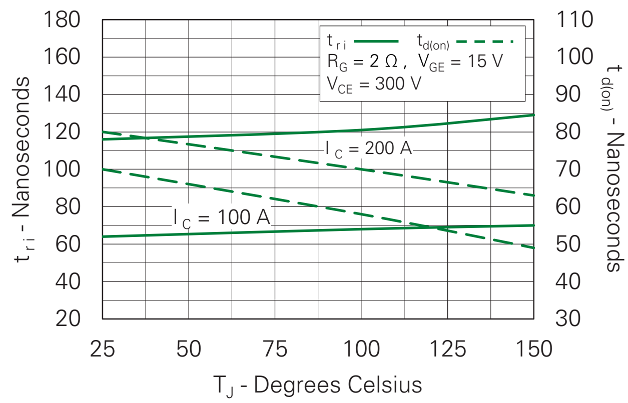
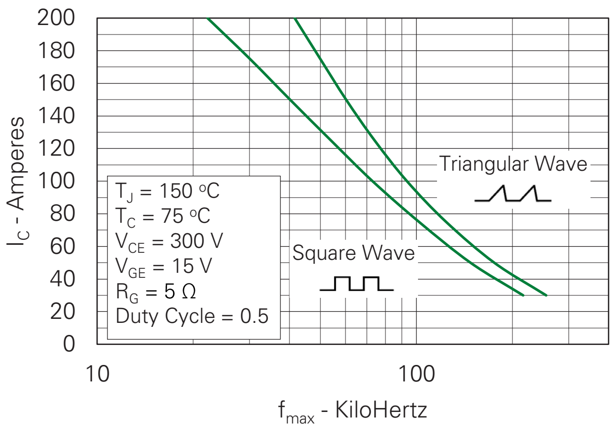
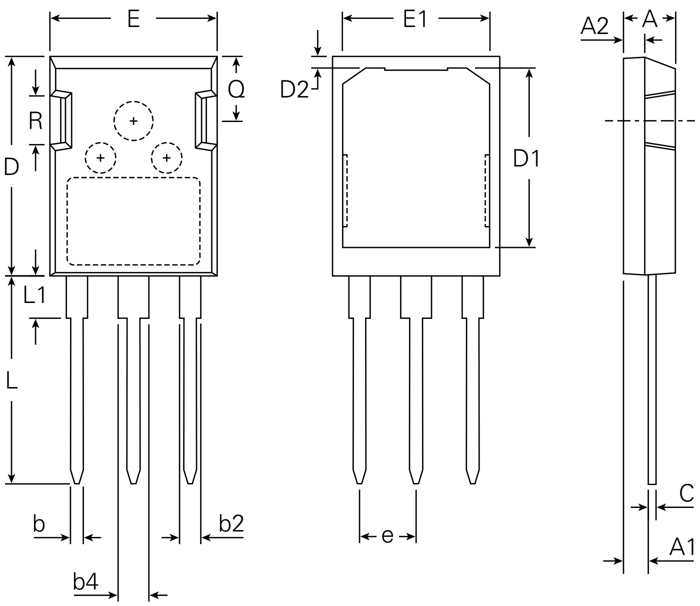



**Fig. 21. Maximum Peak Load Current vs. Frequency**



## Part Outline Drawing PLUS-247 (IXYX)




| Symbol | Inches | | | Millimeters | | |
|---|---|---|---|---|---|---|
| | **Min.** | **Typical** | **Max.** | **Min.** | **Typical** | **Max** |
| A | 0.190 | – | 0.205 | 4.83 | – | 5.21 |
| A1 | 0.090 | – | 0.100 | 2.29 | – | 2.54 |
| A2 | 0.075 | – | 0.085 | 1.91 | – | 2.16 |
| b | 0.045 | – | 0.055 | 1.14 | – | 1.40 |
| b2 | 0.075 | – | 0.087 | 1.91 | – | 2.20 |
| b4 | 0.115 | – | 0.126 | 2.92 | – | 3.20 |
| C | 0.024 | – | 0.031 | 0.61 | – | 0.80 |
| D | 0.819 | – | 0.840 | 20.80 | – | 21.34 |
| D1 | 0.650 | – | 0.690 | 16.51 | – | 17.53 |
| D2 | 0.035 | – | 0.050 | 0.89 | – | 1.27 |
| E | 0.620 | – | 0.635 | 15.75 | – | 16.13 |
| E1 | 0.520 | – | 0.560 | 13.08 | – | 14.22 |
| e | 0.215 BSC | | | 5.45 BSC | | |
| L | 0.780 | – | 0.810 | 19.81 | – | 20.57 |
| L1 | 0.150 | – | 0.170 | 3.81 | – | 4.32 |
| Q | 0.220 | – | 0.244 | 5.59 | – | 6.20 |
| R | 0.170 | – | 0.190 | 4.32 | – | 4.83 |

## REVISION HISTORY

| | | |
|---|---|---|
| 08/15/2023 | XZ | ■ New datasheet. Create first draft. |