IXYS

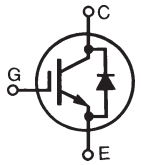
Preliminary Technical Information

# GenX3™ 600V IGBT with Diode

# IXGH48N60B3D1

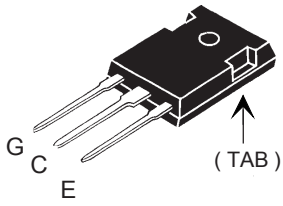
$V_{CES}$ = 600V
$I_{C110}$ = 48A
$V_{CE(sat)}$ ≤ 1.8V

Medium speed low Vsat PT
IGBTs 5-40 kHz switching




| Symbol | Test Conditions | Maximum Ratings | |
|---|---|---|---|
| $V_{CES}$ | $T_C$ = 25°C to 150°C | 600 | V |
| $V_{CGR}$ | $T_J$ = 25°C to 150°C, $R_{GE}$ = 1MΩ | 600 | V |
| $V_{GES}$ | Continuous | ± 20 | V |
| $V_{GEM}$ | Transient | ± 30 | V |
| $I_{C110}$ | $T_C$ = 110°C | 48 | A |
| $I_{D110}$ | $T_C$ = 110°C | 30 | A |
| $I_{CM}$ | $T_C$ = 25°C, 1ms | 280 | A |
| **SSOA (RBSOA)** | $V_{GE}$ = 15V, $T_{VJ}$ = 125°C, $R_G$ = 5Ω<br>Clamped inductive load @ ≤ 600V | $I_{CM}$ = 120 | A |
| $P_C$ | $T_C$ = 25°C | 300 | W |
| $T_J$ | | -55 ... +150 | °C |
| $T_{JM}$ | | 150 | °C |
| $T_{stg}$ | | -55 ... +150 | °C |
| $T_L$ | 1.6mm (0.062 in.) from case for 10s | 300 | °C |
| $T_{SOLD}$ | Plastic body for 10 seconds | 260 | °C |
| $M_d$ | Mounting torque | 1.13/10 | Nm/lb.in. |
| **Weight** | | 6 | g |

**TO-247(IXGH)**




G = Gate C = Collector
E = Emitter TAB = Collector

**Features**

- Optimized for low conduction and switching losses
- Square RBSOA
- Anti-parallel ultra fast diode
- International standard package

**Advantages**

- High power density
- Low gate drive requirement

**Applications**

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

| Symbol | Test Conditions ($T_J$ = 25°C unless otherwise specified) | Characteristic Values Min. | Typ. | Max. | |
|---|---|---|---|---|---|
| $BV_{CES}$ | $I_C$ = 250μA, $V_{GE}$ = 0V | 600 | | | V |
| $V_{GE(th)}$ | $I_C$ = 250μA, $V_{CE}$ = $V_{GE}$ | 3.0 | | 5.0 | V |
| $I_{CES}$ | $V_{CE}$ = $V_{CES}$ | | | 300 | μA |
| | $V_{GE}$ = 0V $T_J$ = 125°C | | | 1.75 | mA |
| $I_{GES}$ | $V_{CE}$ = 0V, $V_{GE}$ = ± 20V | | | ±100 | nA |
| $V_{CE(sat)}$ | $I_C$ = 32A, $V_{GE}$ = 15V, Note 1 | | | 1.8 | V |

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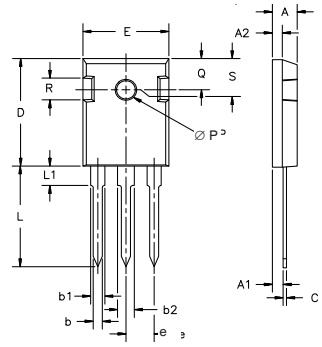
| Symbol | Test Conditions ($T_J$ = 25°C unless otherwise specified) | Characteristic Values Min. | Typ. | Max. | |
|---|---|---|---|---|---|
| $g_{fs}$ | $I_C$ = 30A, $V_{CE}$ = 10V, Note 1 | 28 | 46 | | S |
| $C_{ies}$ | $V_{CE}$ = 25V, $V_{GE}$ = 0V, f = 1MHz | | 3980 | | pF |
| $C_{oes}$ | | | 190 | | pF |
| $C_{res}$ | | | 45 | | pF |
| $Q_g$ | $I_C$ = 40A, $V_{GE}$ = 15V, $V_{CE}$ = 0.5 • $V_{CES}$ | | 115 | | nC |
| $Q_{ge}$ | | | 21 | | nC |
| $Q_{gc}$ | | | 40 | | nC |
| $t_{d(on)}$ | **Inductive Load, $T_J$ = 25°C** | | 22 | | ns |
| $t_{ri}$ | | | 25 | | ns |
| $E_{on}$ | $I_C$ = 30A, $V_{GE}$ = 15V | | 0.84 | | mJ |
| $t_{d(off)}$ | $V_{CE}$ = 480V, $R_G$ = 5Ω | | 130 | 200 | ns |
| $t_{fi}$ | | | 116 | 200 | ns |
| $E_{off}$ | | | 0.66 | 1.20 | mJ |
| $t_{d(on)}$ | **Inductive Load, $T_J$ = 125°C** | | 19 | | ns |
| $t_{ri}$ | | | 25 | | ns |
| $E_{on}$ | $I_C$ = 30A, $V_{GE}$ = 15V | | 1.71 | | mJ |
| $t_{d(off)}$ | $V_{CE}$ = 480V, $R_G$ = 5Ω | | 190 | | ns |
| $t_{fi}$ | | | 157 | | ns |
| $E_{off}$ | | | 1.30 | | mJ |
| $R_{thJC}$ | | | | 0.42 | °C/W |
| $R_{thCS}$ | | | 0.21 | | °C/W |

**TO-247 (IXGH) Outline**




| Dim. | Millimeter Min. | Max. | Inches Min. | Max. |
|---|---|---|---|---|
| A | 4.7 | 5.3 | .185 | .209 |
| $A_1$ | 2.2 | 2.54 | .087 | .102 |
| $A_2$ | 2.2 | 2.6 | .059 | .098 |
| b | 1.0 | 1.4 | .040 | .055 |
| $b_1$ | 1.65 | 2.13 | .065 | .084 |
| $b_2$ | 2.87 | 3.12 | .113 | .123 |
| C | .4 | .8 | .016 | .031 |
| D | 20.80 | 21.46 | .819 | .845 |
| E | 15.75 | 16.26 | .610 | .640 |
| e | 5.20 | 5.72 | 0.205 | 0.225 |
| L | 19.81 | 20.32 | .780 | .800 |
| L1 | | 4.50 | | .177 |
| ∅P | 3.55 | 3.65 | .140 | .144 |
| Q | 5.89 | 6.40 | 0.232 | 0.252 |
| R | 4.32 | 5.49 | .170 | .216 |
| S | 6.15 | BSC | 242 | BSC |

**Reverse Diode (FRED) (D1 Version ONLY)**

| Symbol | Test Conditions ($T_J$ = 25°C, unless otherwise specified) | Characteristic Values Min. | Typ. | Max. | |
|---|---|---|---|---|---|
| $V_F$ | $I_F$ = 30A, $V_{GE}$ = 0V, Note 1 | | | 2.8 | V |
| | $T_J$ = 150°C | | 1.6 | | V |
| $I_{RM}$ | $I_F$= 30A, $V_{GE}$ = 0V, $V_R$= 100V<br>$-di_F/dt$ =100A/µs | | 4 | | A |
| $t_{rr}$ | $I_F$ = 1A; -di/dt = 100A/µs, $V_R$ = 30V $T_J$ = 100°C | | 100 | | ns |
| $R_{thJC}$ | | | | 1.5 | °C/W |
| $R_{thCS}$ | | | 1.5 | | °C/W |

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

**PRELIMINARY TECHNICAL INFORMATION**

The product presented herein is under development. The Technical Specifications offered are derived from data gathered during objective characterizations of preliminary engineering lots; but also may yet contain some information supplied during a pre-production design evaluation. 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 4,850,072 4,881,106 4,931,844 5,017,508 5,034,796 5,049,961 5,063,307 5,187,117 5,237,481 5,381,025 5,486,715 6,162,665 6,259,123 B1 6,306,728 B1 6,404,065 B1 6,534,343 6,583,505 6,683,344 6,710,405 B2 6,710,463 6,727,585 6,759,692 6,771,478 B2 7,005,734 B2 7,063,975 B2 7,071,537 7,157,338B2

**Fig. 1. Output Characteristics @ 25ºC**

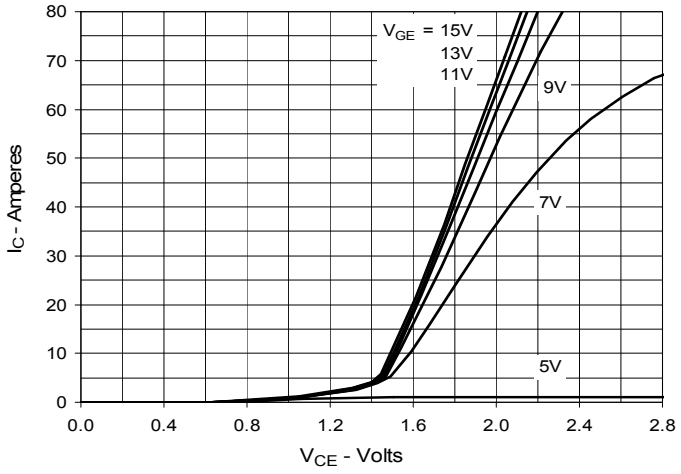


**Fig. 2. Extended Output Characteristics @ 25ºC**

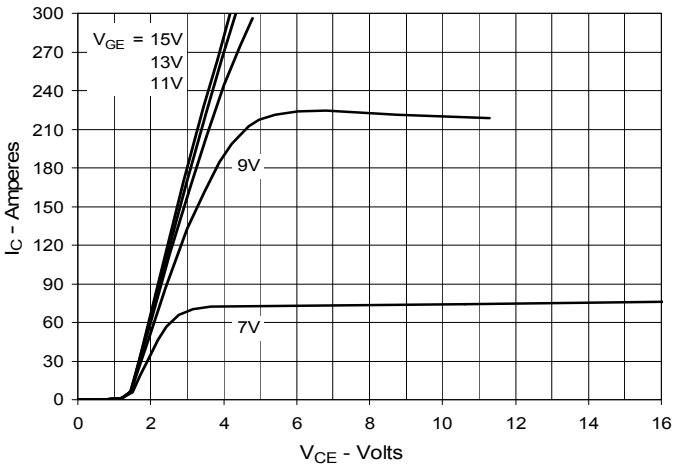


**Fig. 3. Output Characteristics @ 125ºC**

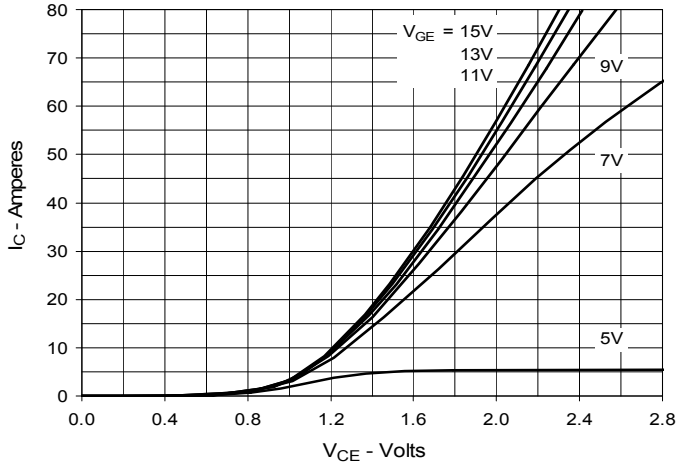


**Fig. 4. Dependence of $V_{CE(sat)}$ on Junction Temperature**

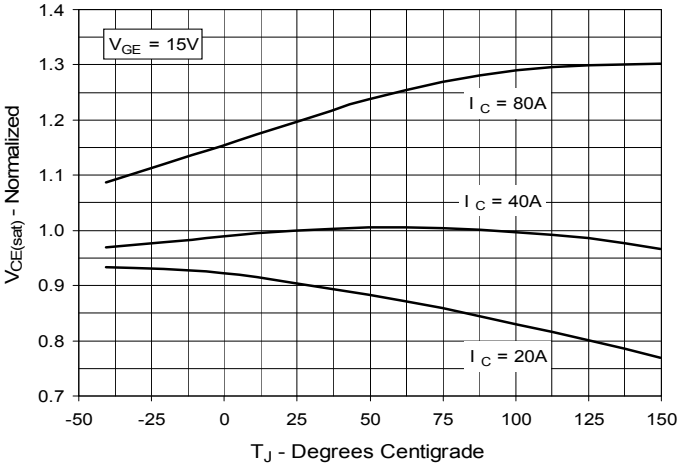


**Fig. 5. Collector-to-Emitter Voltage vs. Gate-to-Emitter Voltage**

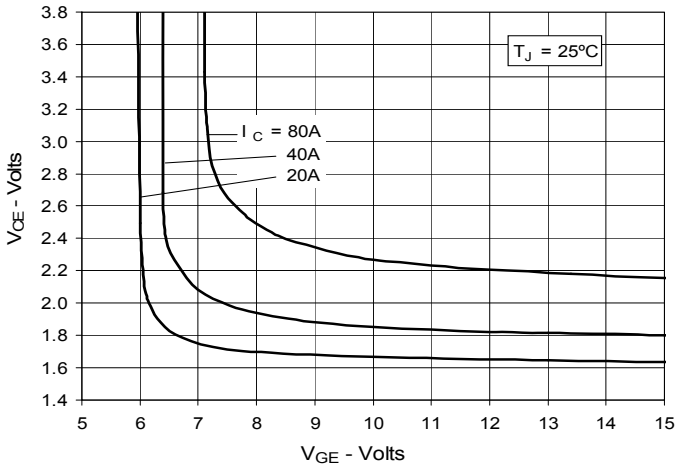


**Fig. 6. Input Admittance**

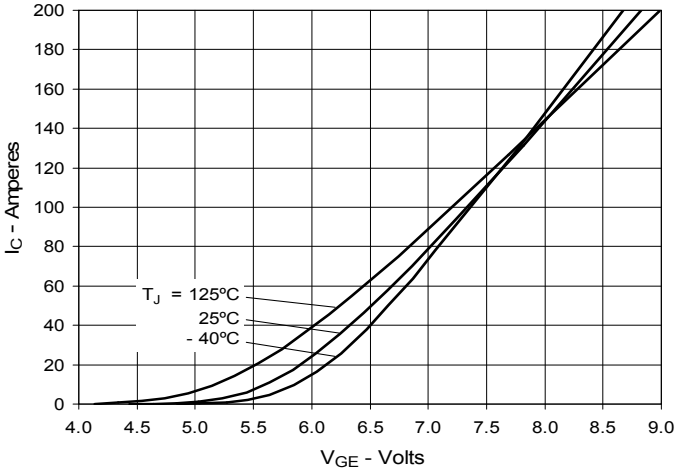


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**Fig. 7. Transconductance**

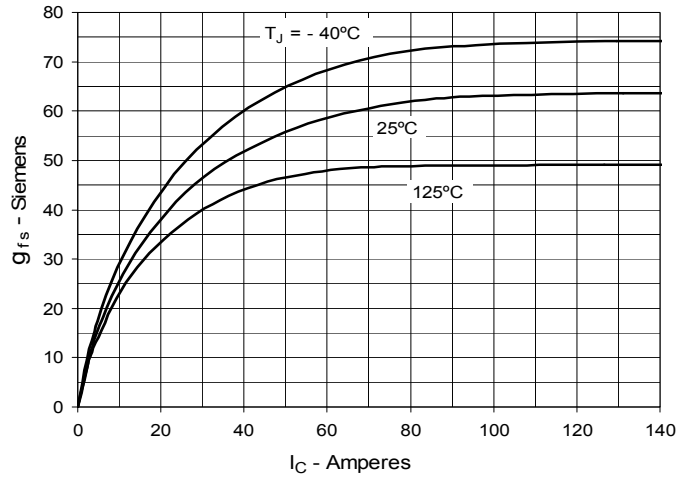



**Fig. 8. Gate Charge**

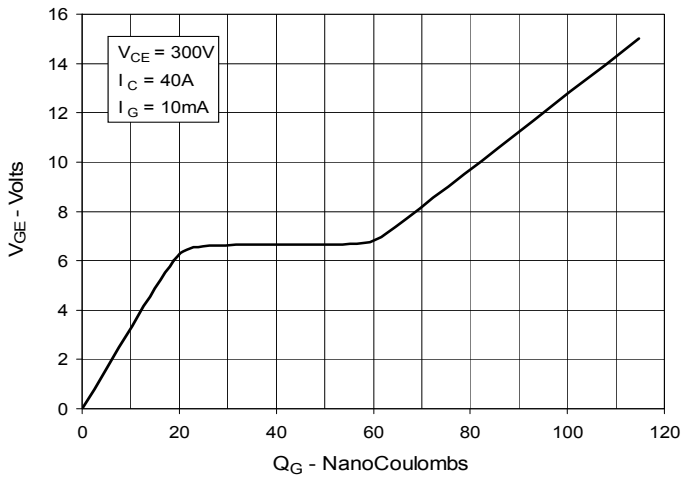



**Fig. 9. Capacitance**

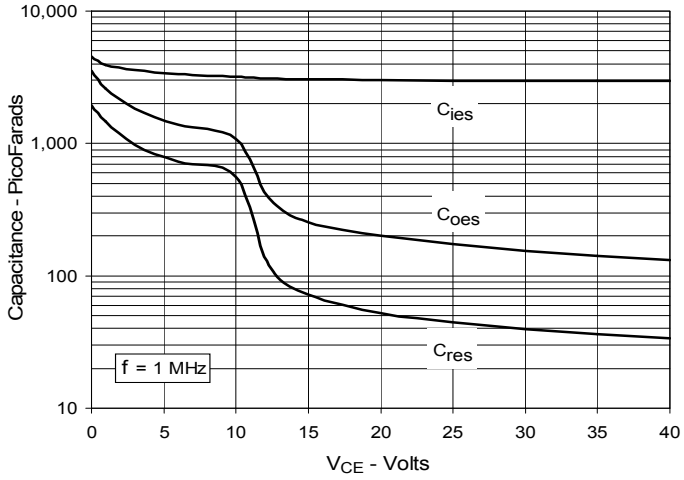



**Fig. 10. Reverse-Bias Safe Operating Area**

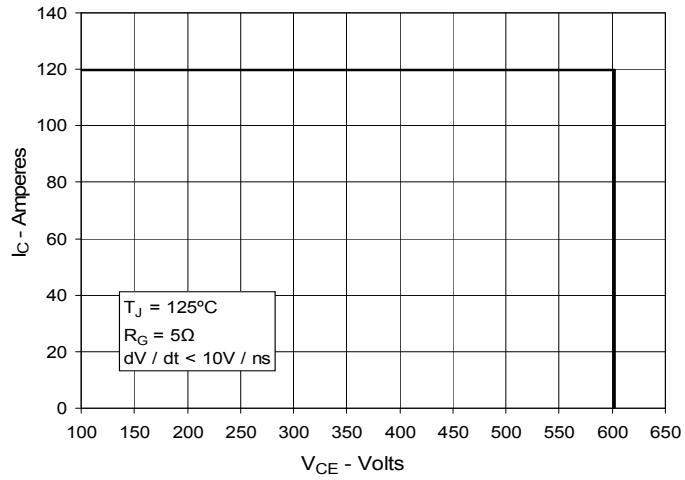
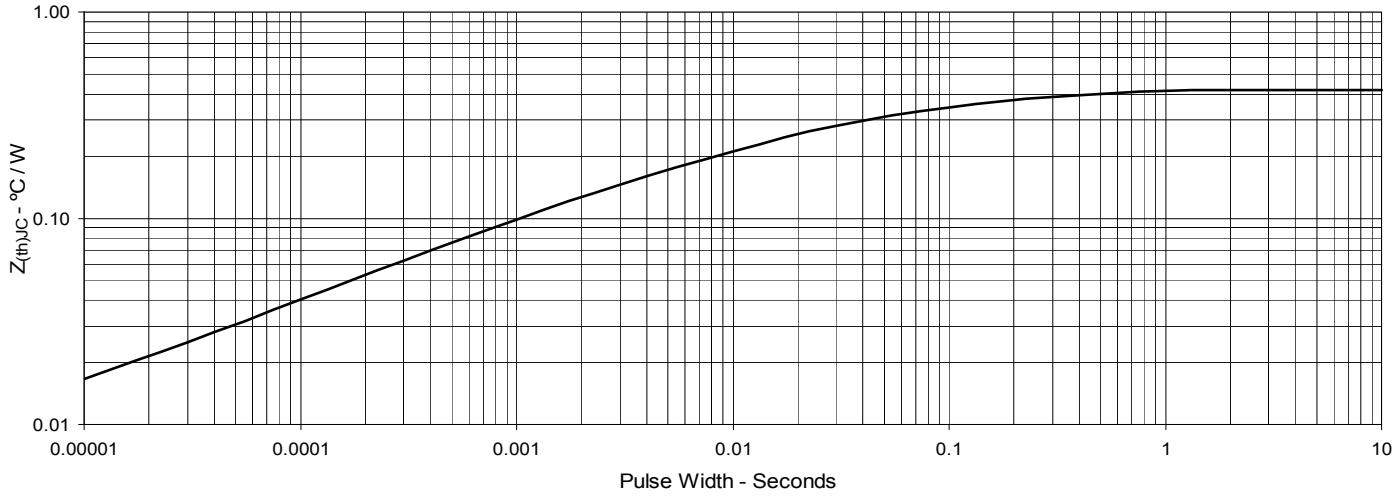



**Fig. 11. Maximum Transient Thermal Impedance**




IXYS reserves the right to change limits, test conditions and dimensions.

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

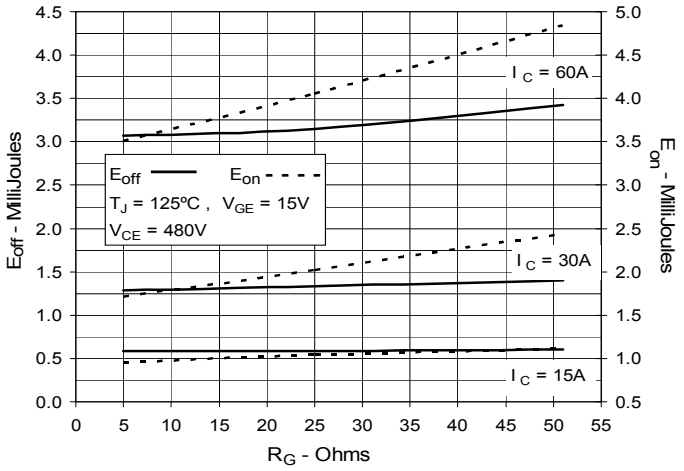



**Fig. 13. Inductive Switching Energy Loss vs. Collector Current**

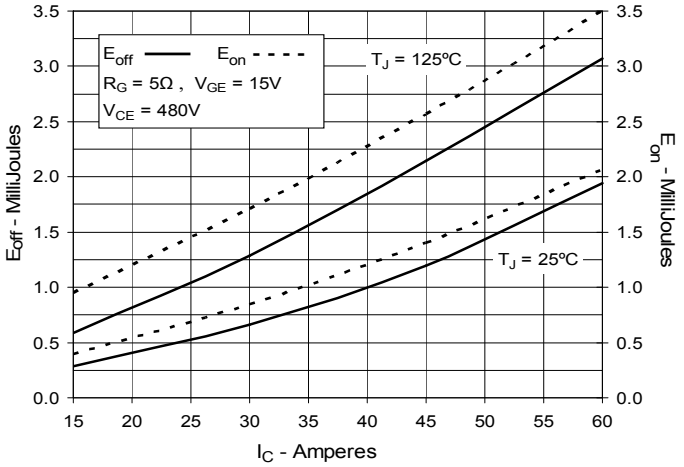



**Fig. 14. Inductive Switching Energy Loss vs. Junction Temperature**

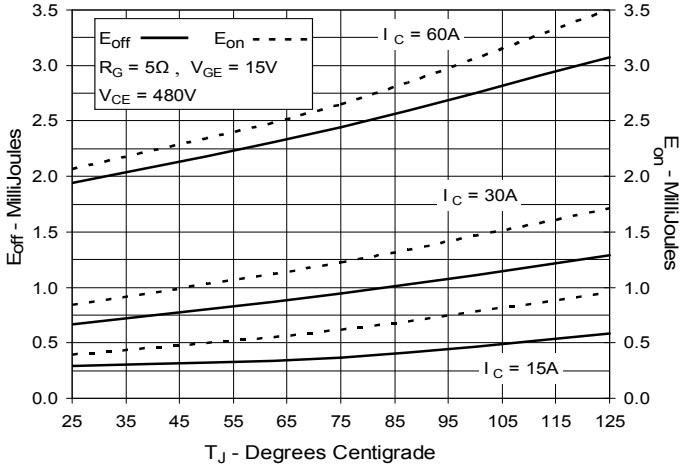



**Fig. 15. Inductive Turn-off Switching Times vs. Junction Temperature**

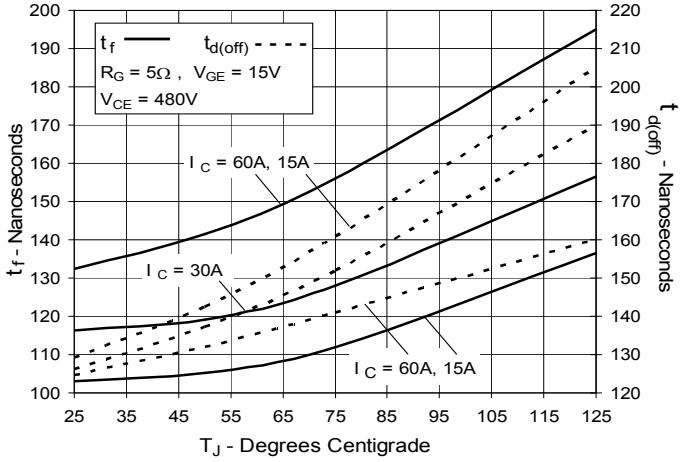



**Fig. 16. Inductive Turn-off Switching Times vs. Collector Current**

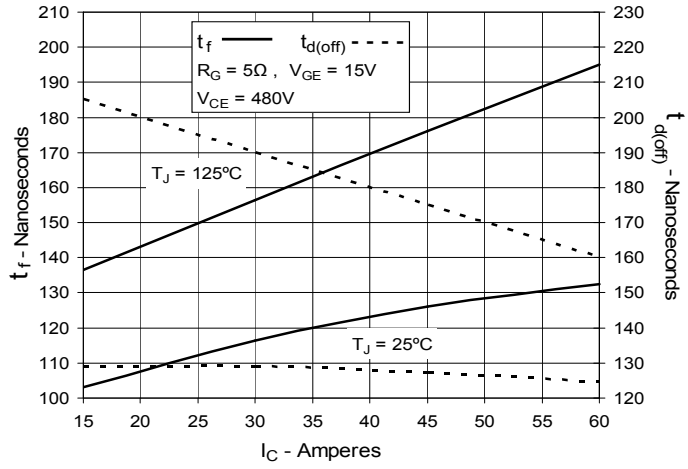



**Fig. 17. Inductive Turn-off Switching Times vs. Gate Resistance**

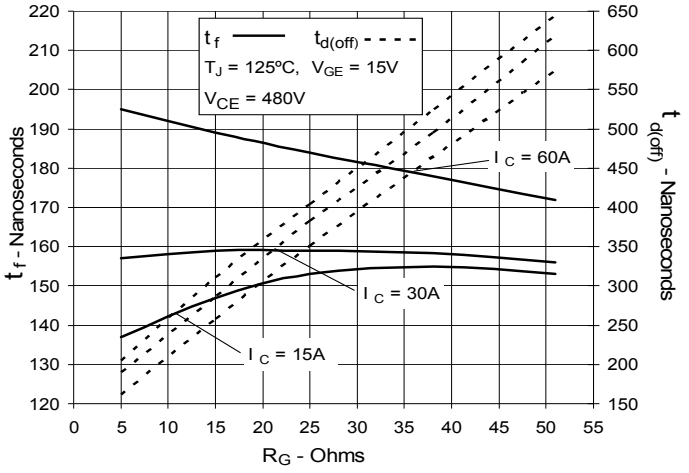



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**Fig. 18. Inductive Turn-on Switching Times vs. Gate Resistance**

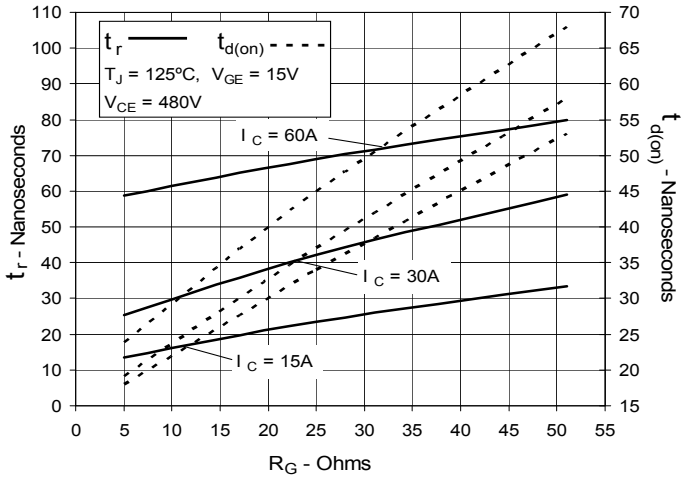



**Fig. 19. Inductive Turn-on Switching Times vs. Collector Current**

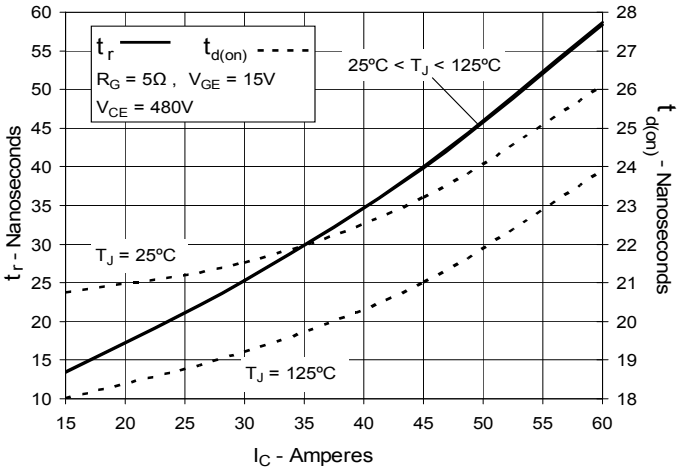
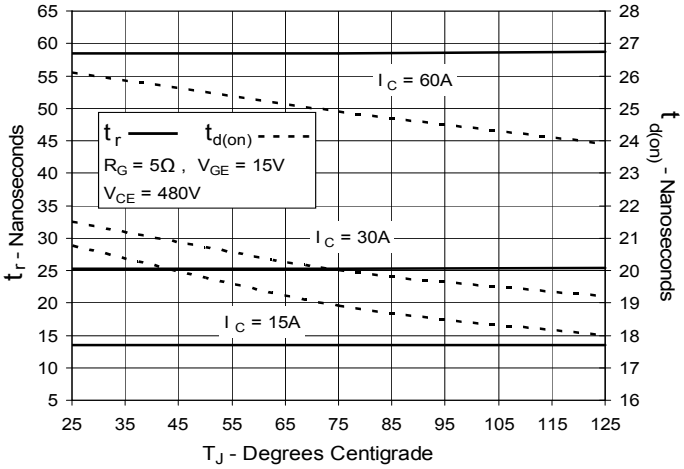



**Fig. 20. Inductive Turn-on Switching Times vs. Junction Temperature**

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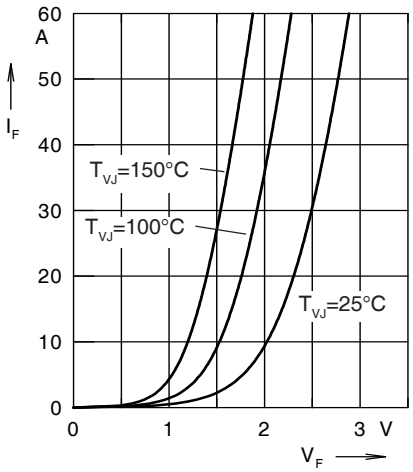


Fig. 21. Forward current $I_F$ versus $V_F$

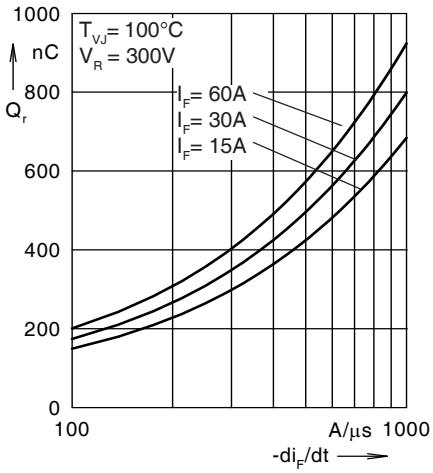


Fig. 22. Reverse recovery charge $Q_r$ versus $-di_F/dt$

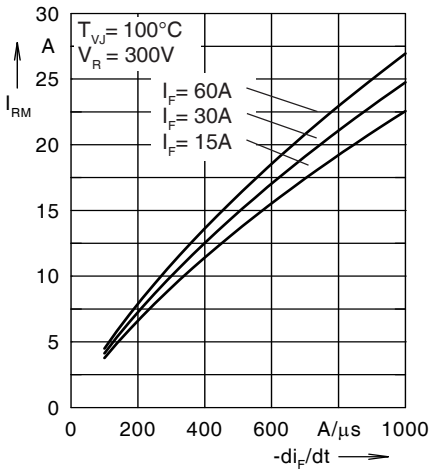


Fig. 23. Peak reverse current $I_{RM}$ versus $-di_F/dt$

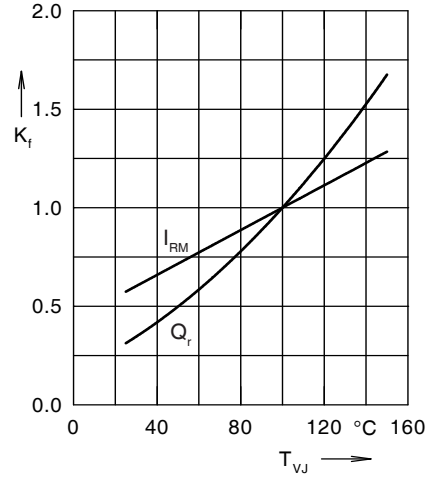


Fig. 24. Dynamic parameters $Q_r$, $I_{RM}$ versus $T_{VJ}$

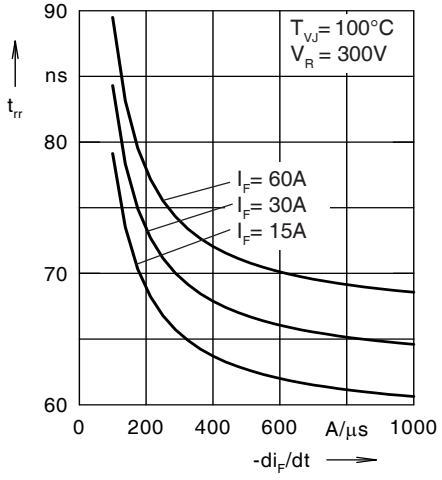


Fig. 25. Recovery time $t_{rr}$ versus $-di_F/dt$

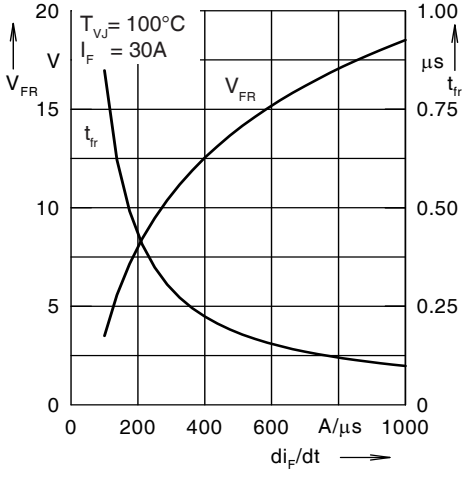


Fig. 26. Peak forward voltage $V_{FR}$ and $t_{fr}$ versus $di_F/dt$

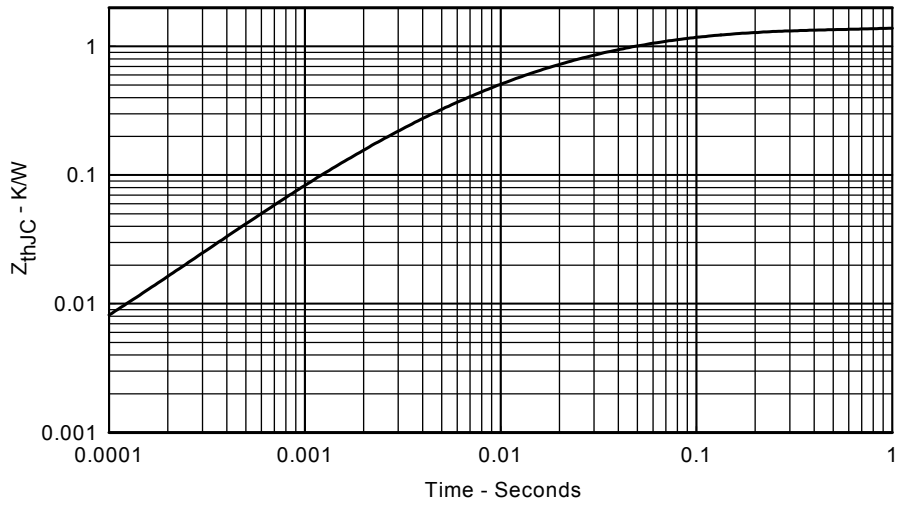


Fig. 27. Transient thermal resistance junction to case

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