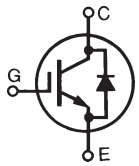
# IXYS

## GenX3™ 600V IGBT with Diode

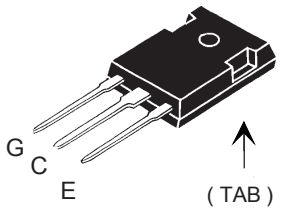
## IXGH48N60C3D1

$V_{CES}$ = 600V
$I_{C110}$ = 48A
$V_{CE(sat)}$ ≤ 2.5V
$t_{fi(typ)}$ = 38ns

**High speed PT IGBT for 40-100kHz Switching**




**TO-247**




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

| Symbol | Test Conditions | Maximum Ratings | |
|---|---|---|---|
| $V_{CES}$ | $T_J$ = 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 |
| $I_{C25}$ | $T_C$ = 25°C (Limited by Leads) | 75 | A |
| $I_{C110}$ | $T_C$ = 110°C | 48 | A |
| $I_{D110}$ | $T_C$ = 110°C | 30 | A |
| $I_{CM}$ | $T_C$ = 25°C, 1ms | 250 | A |
| $I_A$ | $T_C$ = 25°C | 30 | A |
| $E_{AS}$ | $T_C$ = 25°C | 300 | mJ |
| **SSOA** | $V_{GE}$ = 15V, $T_{VJ}$ = 125°C, $R_G$ = 3Ω | $I_{CM}$ = 100 | A |
| **(RBSOA)** | Clamped Inductive Load | @$V_{CE}$ ≤ 600 | V |
| $P_C$ | $T_C$ = 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 |
| $F_C$ | Mounting Torque | 1.13/10 | Nm/lb.in |
| **Weight** | | 6 | g |

| Symbol | Test Conditions ($T_J$ = 25°C, Unless Otherwise Specified) | Characteristic Values Min. | Typ. | Max. | |
|---|---|---|---|---|---|
| $V_{GE(th)}$ | $I_C$ = 250μA, $V_{CE}$ = $V_{GE}$ | 3.0 | | 5.5 | 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 |
| $V_{CE(sat)}$ | $I_C$ = 30A, $V_{GE}$ = 15V, Note 1 | | 2.3 | 2.5 | V |
| | $T_J$ = 125°C | | 1.8 | | V |

### Features

- Optimized for Low Switching Losses
- Square RBSOA
- Anti-Parallel Ultra Fast Diode
- Fast Switching
- Avalanche Rated
- International Standard Package

### Advantages

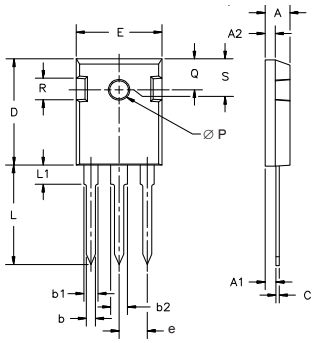
- High Power Density
- Low Gate Drive Requirement

### Applications

- High Frequency 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. | |
|---|---|---|---|---|---|
| $g_{fs}$ | $I_C$ = 30A, $V_{CE}$ = 10V, Note 1 | 20 | 30 | | S |
| $C_{ies}$ | $V_{CE}$ = 25V, $V_{GE}$ = 0V, f = 1MHz | | 1960 | | pF |
| $C_{oes}$ | | | 202 | | pF |
| $C_{res}$ | | | 66 | | pF |
| $Q_g$ | $I_C$ = 30A, $V_{GE}$ = 15V, $V_{CE}$ = 0.5 • $V_{CES}$ | | 77 | | nC |
| $Q_{ge}$ | | | 16 | | nC |
| $Q_{gc}$ | | | 32 | | nC |
| $t_{d(on)}$ | **Inductive Load, $T_J$ = 25°C** | | 19 | | ns |
| $t_{ri}$ | $I_C$ = 30A, $V_{GE}$ = 15V | | 26 | | ns |
| $E_{on}$ | $V_{CE}$ = 400V, $R_G$ = 3Ω | | 0.41 | | mJ |
| $t_{d(off)}$ | | | 60 | 100 | ns |
| $t_{fi}$ | | | 38 | | ns |
| $E_{off}$ | | | 0.23 | 0.42 | mJ |
| $t_{d(on)}$ | **Inductive Load, $T_J$ = 125°C** | | 19 | | ns |
| $t_{ri}$ | $I_C$ = 30A, $V_{GE}$ = 15V | | 26 | | ns |
| $E_{on}$ | $V_{CE}$ = 400V, $R_G$ = 3Ω | | 0.65 | | mJ |
| $t_{d(off)}$ | | | 92 | | ns |
| $t_{fi}$ | | | 95 | | ns |
| $E_{off}$ | | | 0.57 | | mJ |
| $R_{thJC}$ | | | | 0.42 | °C/W |
| $R_{thCS}$ | | | 0.21 | | °C/W |

**TO-247 AD 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 |

**Reverse Diode (FRED)**

| 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 | | | 2.7 | V |
| | | $T_J$ = 150°C | 1.6 | | V |
| $I_{RM}$ | $I_F$ = 30A, $V_{GE}$ = 0V, -$di_F$/dt = 100A/µs, | $T_J$ = 100°C | | 4 | A |
| $t_{rr}$ | $V_R$ = 100V | $T_J$ = 100°C | 100 | | ns |
| | $I_F$ = 1A, $V_{GE}$ = 0V, -$di_F$/dt = 100A/µs, $V_R$ = 30V | | 25 | | ns |
| $R_{thJC}$ | | | | 0.9 | °C/W |

Note 1: Pulse Test, t ≤ 300µs, Duty Cycle, d ≤ 2%.

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

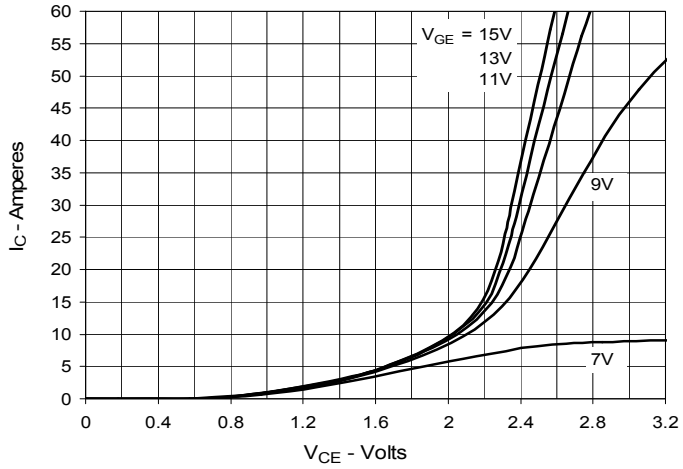



**Fig. 2. Extended Output Characteristics @ 25ºC**

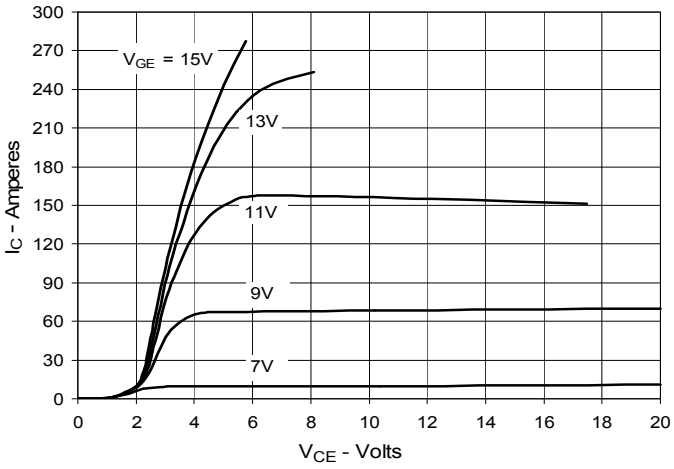



**Fig. 3. Output Characteristics @ 125ºC**

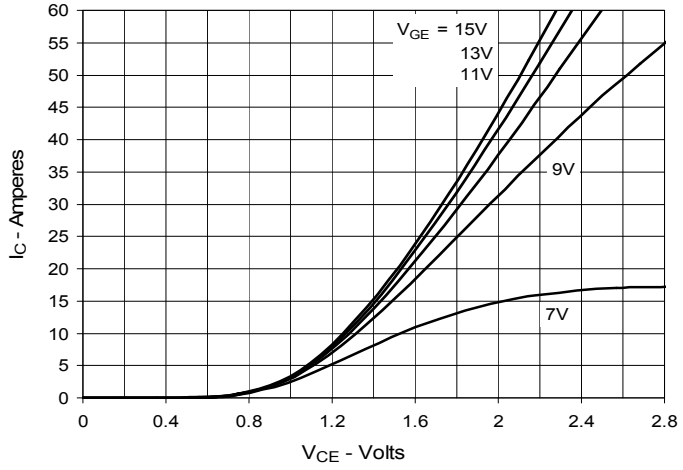



**Fig. 4. Dependence of $V_{CE(sat)}$ on Junction Temperature**

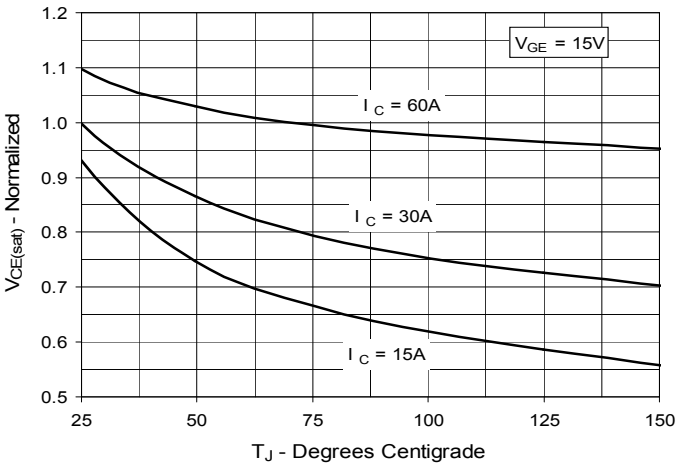



**Fig. 5. Collector-to-Emitter Voltage vs. Gate-to-Emitter Voltage**

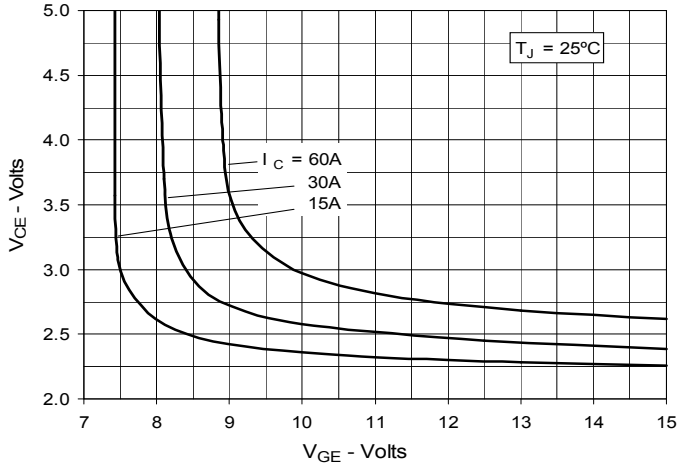



**Fig. 6. Input Admittance**

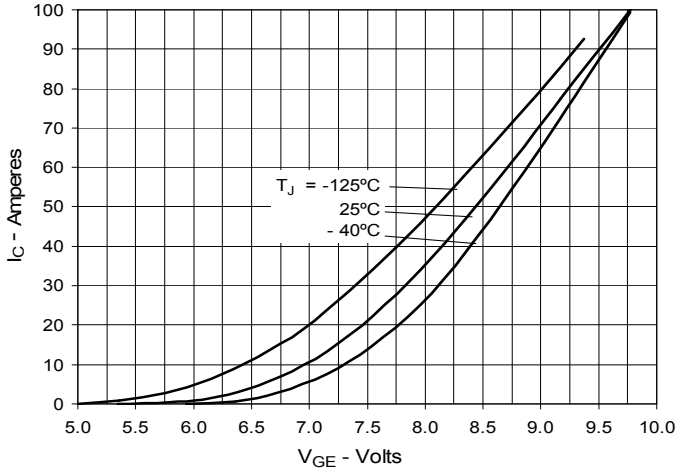


**Fig. 7. Transconductance**

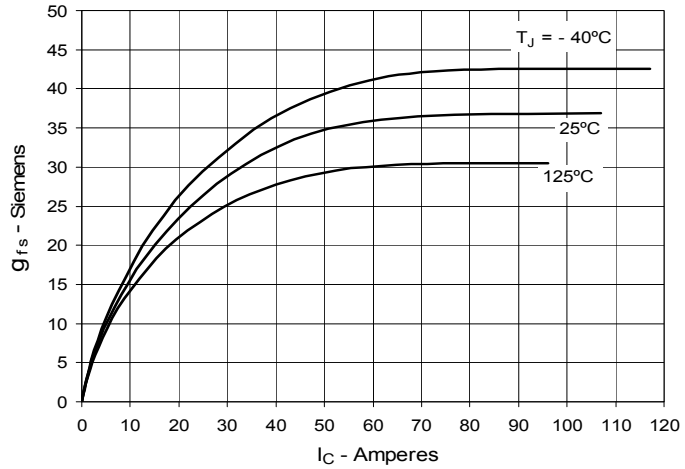



**Fig. 8. Gate Charge**

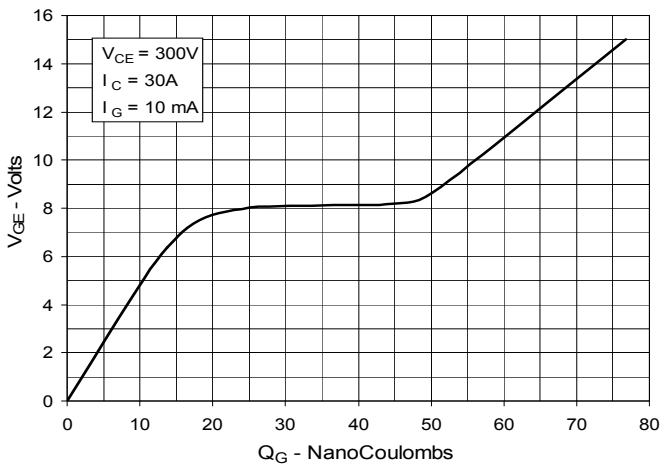



**Fig. 9. Capacitance**

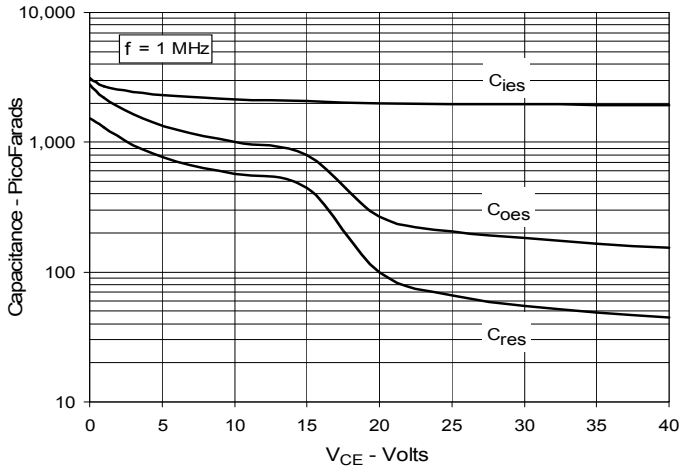



**Fig. 10. Reverse-Bias Safe Operating Area**

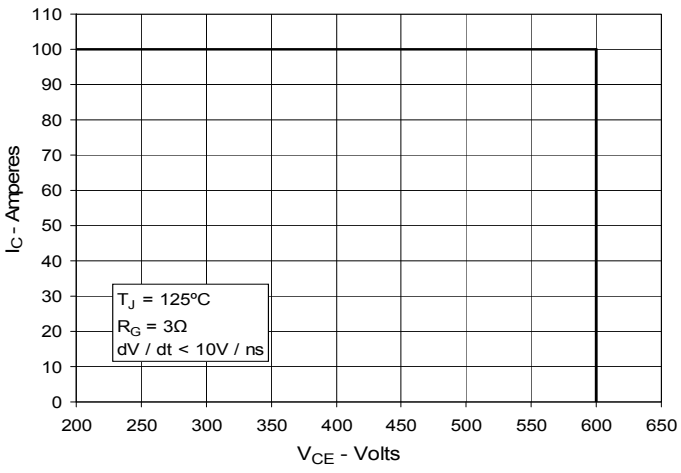



**Fig. 11. Maximum Transient Thermal Impedance**

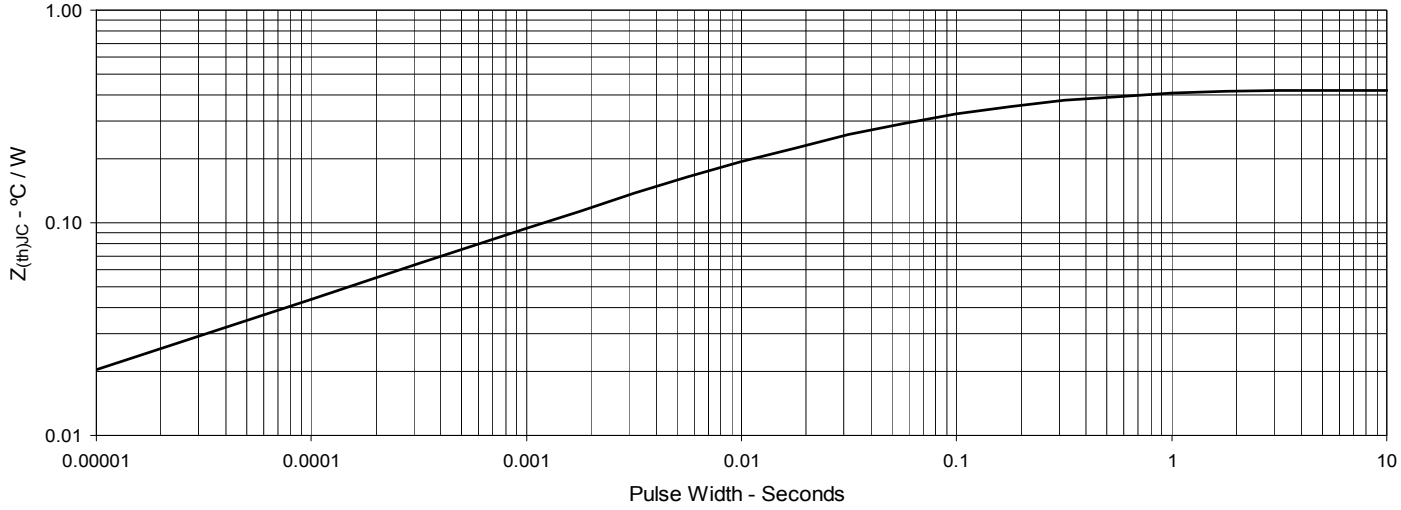


**Fig. 12. Inductive Switching Energy Loss vs. Gate Resistance**

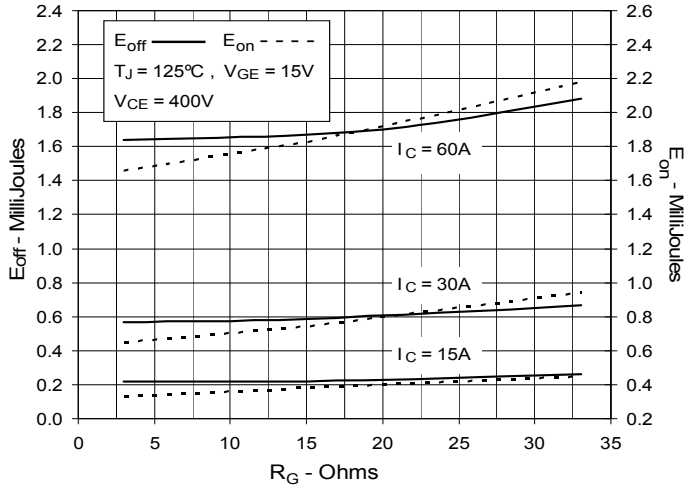



**Fig. 13. Inductive Swiching Energy Loss vs. Collector Current**

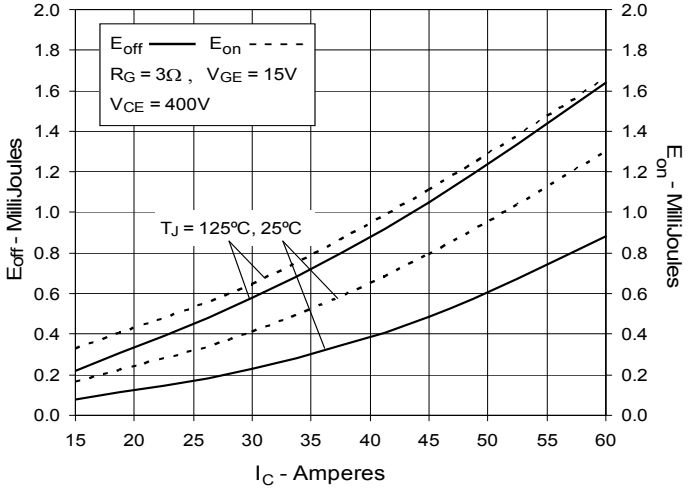



**Fig. 14. Inductive Swiching Energy Loss vs. Junction Temperature**

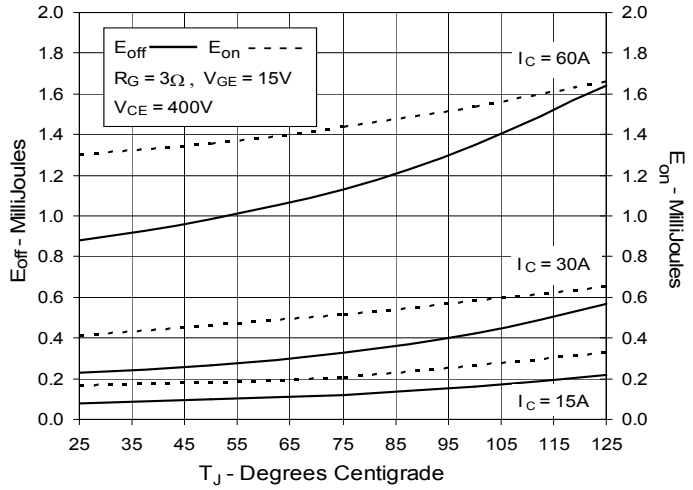



**Fig. 15. Inductive Turn-off Switching Times vs. Gate Resistance**

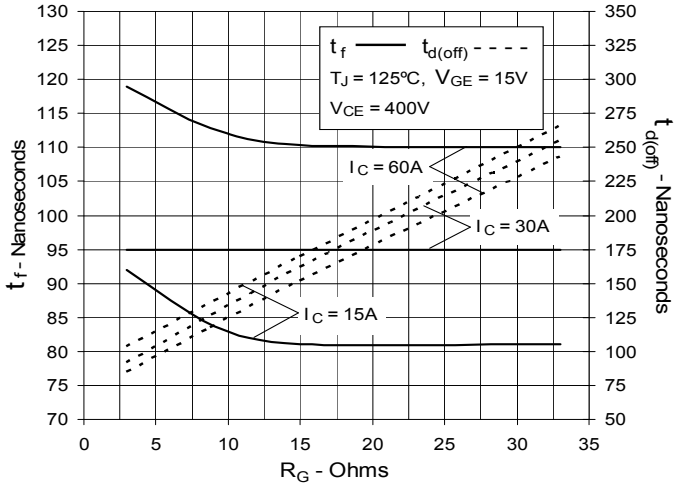



**Fig. 16. Inductive Turn-off Switching Times vs. Collector Current**

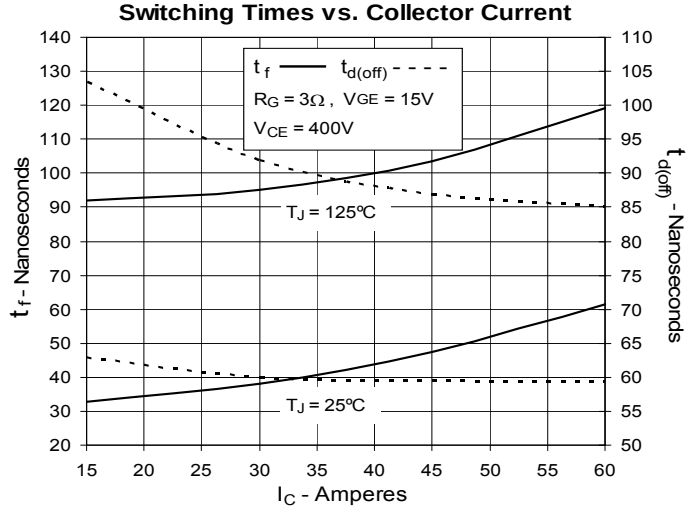



**Fig. 17. Inductive Turn-off Switching Times vs. Junction Temperature**

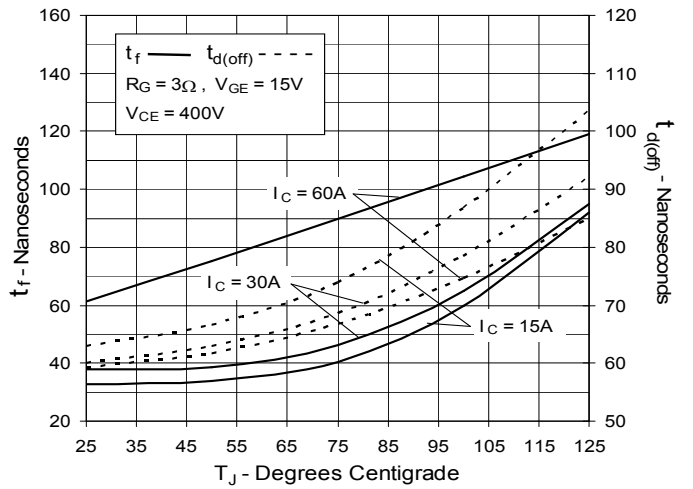


**Fig. 18. Inductive Turn-on Switching Times vs. Gate Resistance**

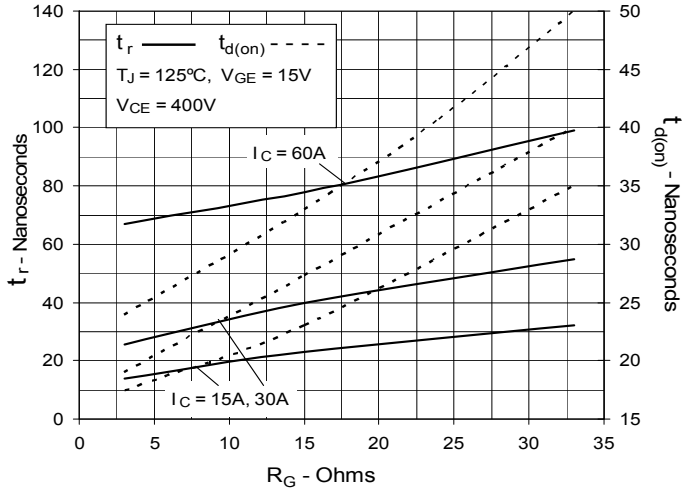



**Fig. 19. Inductive Turn-on Switching Times vs. Collector Current**

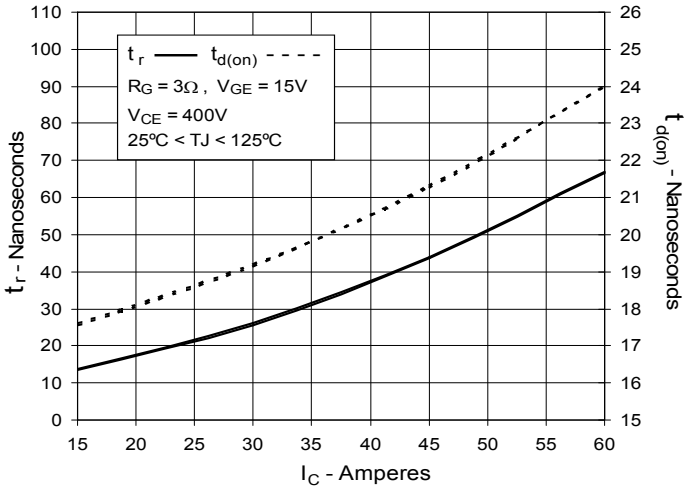
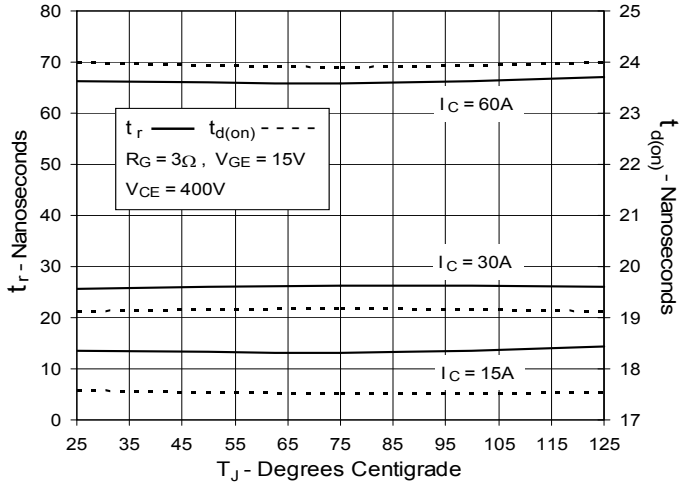



**Fig. 20. Inductive Turn-on Switching Times vs. Junction Temperature**



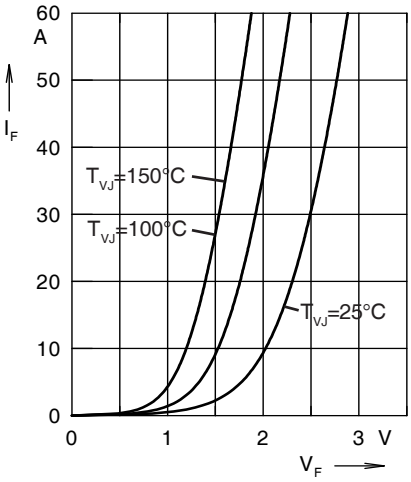



**Fig. 21. Forward current $I_F$ versus $V_F$**

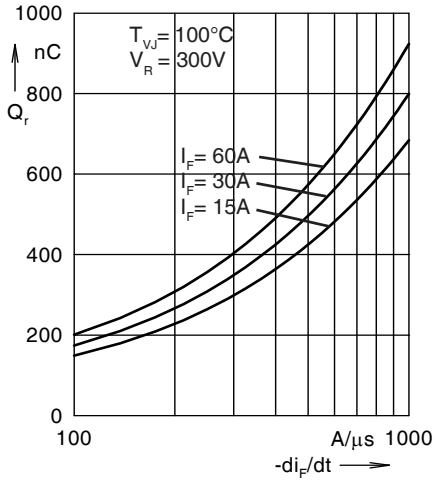



**Fig. 22. Reverse recovery charge $Q_r$ versus -$di_F$/dt**

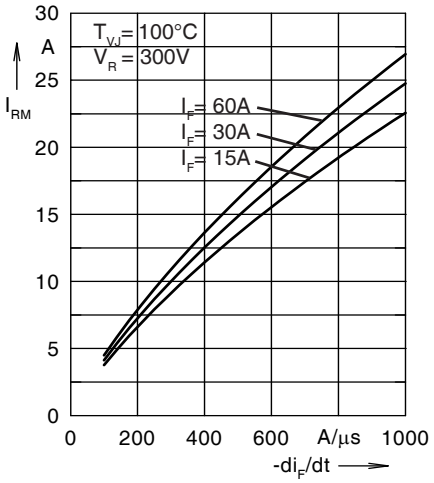



**Fig. 23. Peak reverse current $I_{RM}$ versus -$di_F$/dt**

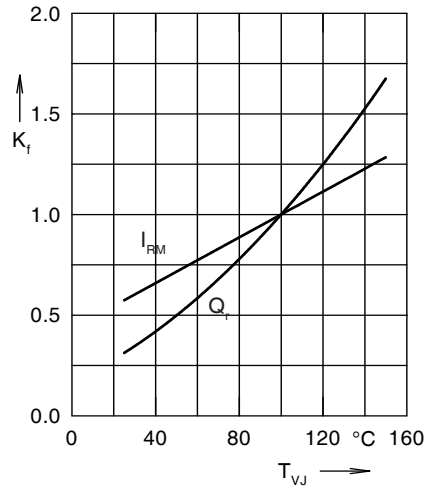



**Fig. 24. Dynamic parameters $Q_r$, $I_{RM}$ versus $T_{VJ}$**

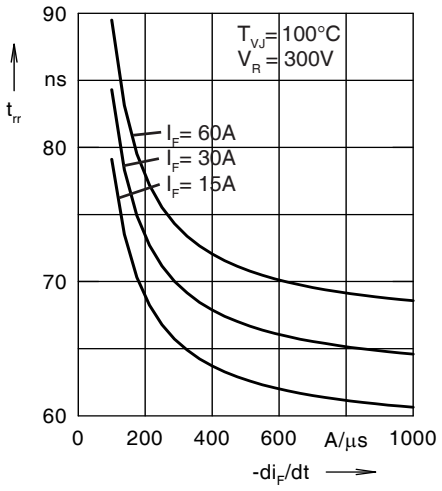



**Fig. 25. Recovery time $t_{rr}$ versus -$di_F$/dt**

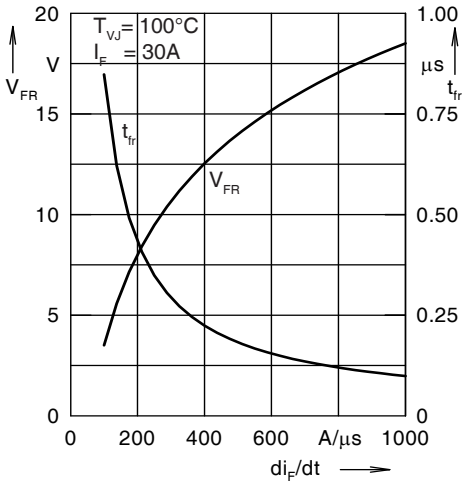



**Fig. 26. Peak forward voltage $V_{FR}$ and $t_{fr}$ versus $di_F$/dt**

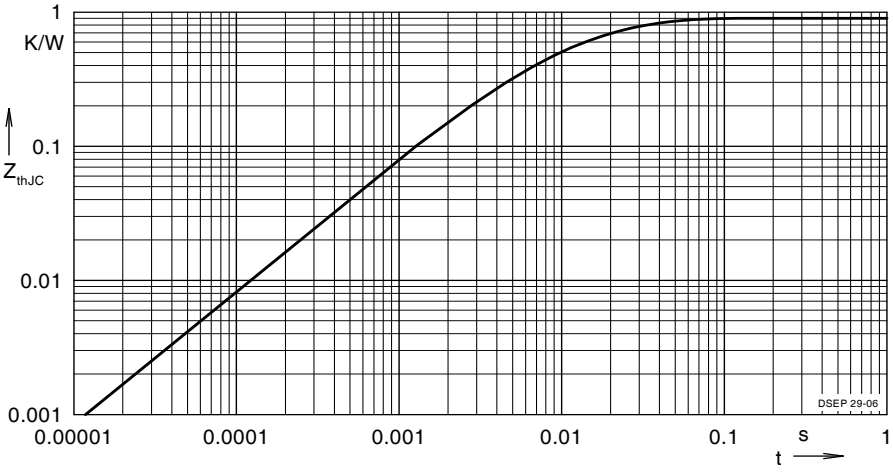



**Fig. 27. Transient thermal resistance junction to case**

Constants for $Z_{thJC}$ calculation:

| i | $R_{thi}$ (K/W) | $t_i$ (s) |
|---|---|---|
| 1 | 0.502 | 0.0052 |
| 2 | 0.193 | 0.0003 |
| 3 | 0.205 | 0.0162 |