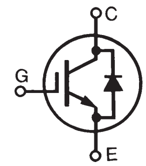
# IXYS

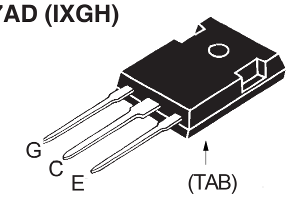
## High Voltage IGBT w/ Diode

## IXGH28N120BD1
## IXGT28N120BD1

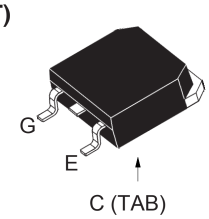
$V_{CES}$ = 1200V
$I_{C25}$ = 50A
$V_{CE(sat)} \leq$ 3.5V
$t_{fi(typ)}$ = 170ns




**TO-247AD (IXGH)**




**TO-268 (IXGT)**




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

| Symbol | Test Conditions | Maximum Ratings | |
|---|---|---|---|
| $V_{CES}$ | $T_J$ = 25°C to 150°C | 1200 | V |
| $V_{CGR}$ | $T_J$ = 25°C to 150°C, $R_{GE}$ = 1MΩ | 1200 | V |
| $V_{GES}$ | Continuous | ±20 | V |
| $V_{GEM}$ | Transient | ±30 | V |
| $I_{C25}$ | $T_C$ = 25°C ( Chip Capability ) | 50 | A |
| $I_{C100}$ | $T_C$ = 100°C | 28 | A |
| $I_{F90}$ | $T_C$ = 90°C | 10 | A |
| $I_{CM}$ | $T_C$ = 25°C, 1ms | 150 | A |
| SSOA | $V_{GE}$= 15V, $T_J$ = 125°C, $R_G$ = 5Ω | $I_{CM}$ = 120 | A |
| (RBSOA) | Clamped Inductive Load | 0.8 • $V_{CES}$ | |
| $P_C$ | $T_C$ = 25°C | 250 | W |
| $T_J$ | | -55 ... +150 | °C |
| $T_{JM}$ | | 150 | °C |
| $T_{stg}$ | | -55 ... +150 | °C |
| $T_L$ | Maximum Lead Temperature for Soldering | 300 | °C |
| $T_{SOLD}$ | 1.6 mm (0.062 in.) from Case for 10 | 260 | °C |
| $M_d$ | Mounting Torque (TO-247) | 1.13/10 | Nm/lb.in. |
| Weight | TO-247 | 6 | g |
| | TO-286 | 4 | g |

| Symbol | Test Conditions ($T_J$ = 25°C, Unless Otherwise Specified) | Characteristic Values Min. | Typ. | Max. | |
|---|---|---|---|---|---|
| $V_{GE(th)}$ | $I_C$ = 250μA, $V_{CE}$ = $V_{GE}$ | 2.5 | | 5.0 | V |
| $I_{CES}$ | $V_{CE}$ = $V_{CES}$, $V_{GE}$= 0V | | | 50 | μA |
| | $T_J$ = 125°C, Note1 | | | 250 | μA |
| $I_{GES}$ | $V_{CE}$ = 0V, $V_{GE}$ = ±20V | | | ±100 | nA |
| $V_{CE(sat)}$ | $I_C$ = 28A, $V_{GE}$ = 15V, Note 2 | | 2.9 | 3.5 | V |
| | $T_J$ = 125°C | | 2.8 | | V |

### Features

- International Standard Packages JEDEC TO-247AD & TO-268
- IGBT and Anti-Parallel FRED for Resonant Power Supplies
  - Induction Heating
  - Rice Cookers
- MOS Gate Turn-On
- Fast Recovery Expitaxial Diode (FRED)
  - Soft Recovery with Low $I_{RM}$

### Advantages

- Saves Space (Two Devices in One Package)
- Easy to Mount with 1 Screw (Isolated Mounting Screw Hole)
- Reduces Assembly Time and Cost

### Applications

- Switch-Mode and Resonant-Mode Power Supplies
- Uninterruptible Power Supplies (UPS)
- DC Choppers
- AC Motor Speed Drives
- DC Servo and Robot Drives

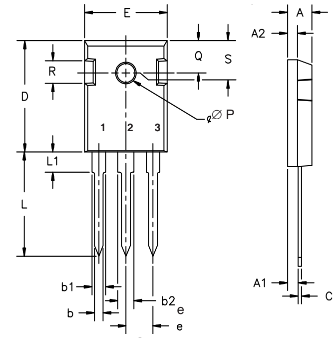
| Symbol (T$_J$ = 25°C, Unless Otherwise Specified) | Test Conditions | Characteristic Values Min. | Typ. | Max. | |
|---|---|---|---|---|---|
| $g_{fs}$ | $I_C$ = 28A, $V_{CE}$ = 10V, Note 2 | 15 | 23 | | S |
| $C_{ies}$ | $V_{CE}$ = 25V, $V_{GE}$ = 0V, f = 1MHz | | 1700 | | pF |
| $C_{oes}$ | | | 130 | | pF |
| $C_{res}$ | | | 45 | | pF |
| $Q_g$ | $I_C$ = 28A, $V_{GE}$ = 15V, $V_{CE}$ = 0.5 • $V_{CES}$ | | 92 | | nC |
| $Q_{ge}$ | | | 13 | | nC |
| $Q_{gc}$ | | | 35 | | nC |
| $t_{d(on)}$ | **Inductive load, T$_J$ = 25°C** | | 30 | | ns |
| $t_{ri}$ | $I_C$ = 28A, $V_{GE}$ = 15V | | 20 | | ns |
| $t_{d(off)}$ | $V_{CE}$ = 0.8 • $V_{CES}$, $R_G$ = 5Ω | | 210 | 280 | ns |
| $t_{fi}$ | Note 3 | | 170 | 320 | ns |
| $E_{off}$ | | | 2.2 | 5.0 | mJ |
| $t_{d(on)}$ | **Inductive load, T$_J$ = 125°C** | | 35 | | ns |
| $t_{ri}$ | $I_C$ = 28A, $V_{GE}$ = 15V | | 28 | | ns |
| $E_{on}$ | $V_{CE}$ = 0.8 • $V_{CES}$, $R_G$ = 5Ω | | 1.4 | | mJ |
| $t_{d(off)}$ | Note 3 | | 250 | | ns |
| $t_{fi}$ | | | 340 | | ns |
| $E_{off}$ | | | 4.6 | | mJ |
| $R_{thJC}$ | | | | 0.50 | °C/W |
| $R_{thCK}$ | (TO-247) | | 0.21 | | °C/W |

**Reverse Diode (FRED)**

| Symbol (T$_J$ = 25°C, Unless Otherwise Specified) | Test Conditions | Characteristic Values Min. | Typ. | Max. | |
|---|---|---|---|---|---|
| $V_F$ | $I_F$ = 10A, $V_{GE}$ = 0V, Note 2 | | | 3.2 | V |
| | T$_J$ = 100°C | | 2.3 | | V |
| $I_{RM}$ | $I_F$ = 10A, $V_{GE}$ = 0V, | | 14 | | A |
| $t_{rr}$ | -di$_F$/dt = 400A/μs, $V_R$ = 600V | | 120 | | ns |
| $t_{rr}$ | $I_F$ = 1A, $V_{GE}$ = 0V, -di$_F$/dt = 100A/μs, $V_R$ = 30V | | 40 | | ns |
| $R_{thJC}$ | | | | 2.5 | °C/W |

Notes:
1. Part must be heatsunk for high-temp $I_{CES}$ measurement.
2. Pulse test, t ≤ 300μs, duty cycle, d ≤ 2%.
3. Switching times & energy loses may increase for higher $V_{CE}$(Clamp), $T_J$ or $R_G$.

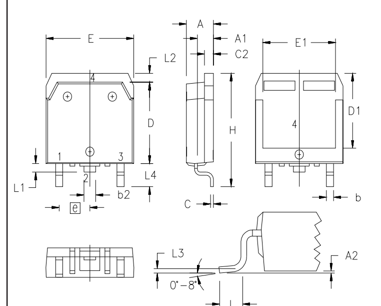
**TO-247 (IXGH) Outline**




Terminals: 1 - Gate 2 - Drain
3 - Source Tab - Drain

| 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 | |

**TO-268 (IXGT) Outline**




| SYM | INCHES MIN | MAX | MILLIMETERS MIN | MAX |
|---|---|---|---|---|
| A | .193 | .201 | 4.90 | 5.10 |
| A1 | .106 | .114 | 2.70 | 2.90 |
| A2 | .001 | .010 | 0.02 | 0.25 |
| b | .045 | .057 | 1.15 | 1.45 |
| b2 | .075 | .083 | 1.90 | 2.10 |
| C | .016 | .026 | 0.40 | 0.65 |
| C2 | .057 | .063 | 1.45 | 1.60 |
| D | .543 | .551 | 13.80 | 14.00 |
| D1 | .488 | .500 | 12.40 | 12.70 |
| E | .624 | .632 | 15.85 | 16.05 |
| E1 | .524 | .535 | 13.30 | 13.60 |
| e | .215 BSC | | 5.45 BSC | |
| H | .736 | .752 | 18.70 | 19.10 |
| L | .094 | .106 | 2.40 | 2.70 |
| L1 | .047 | .055 | 1.20 | 1.40 |
| L2 | .039 | .045 | 1.00 | 1.15 |
| L3 | .010 BSC | | 0.25 BSC | |
| L4 | .150 | .161 | 3.80 | 4.10 |

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

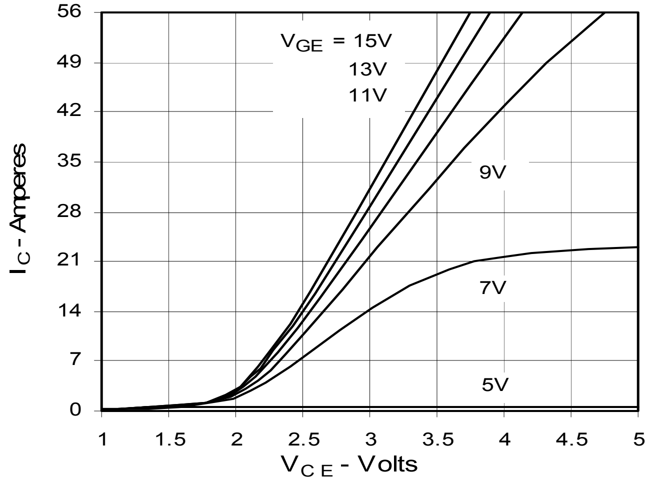



**Fig. 2. Extended Output Characteristics @ 25 ºC**

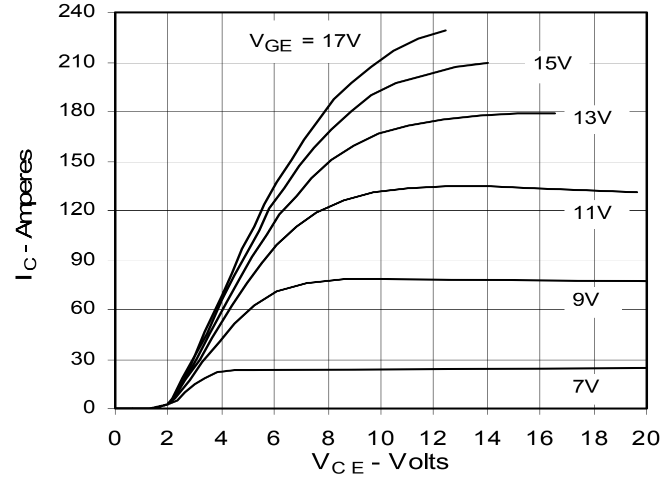



**Fig. 3. Output Characteristics @ 125 ºC**

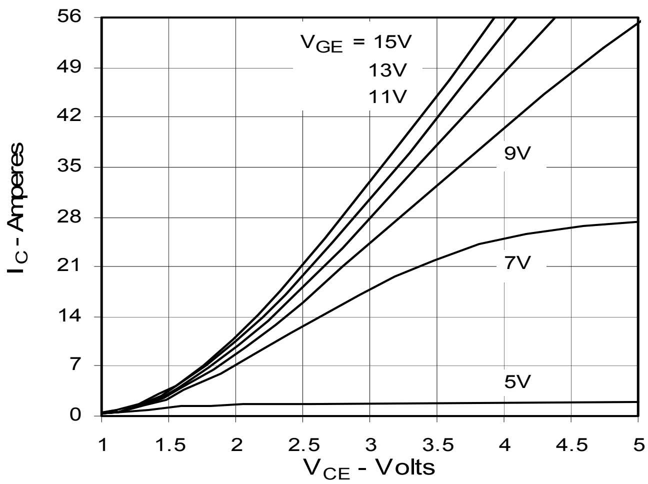



**Fig. 4. Dependence of $V_{CE(sat)}$ on Temperature**

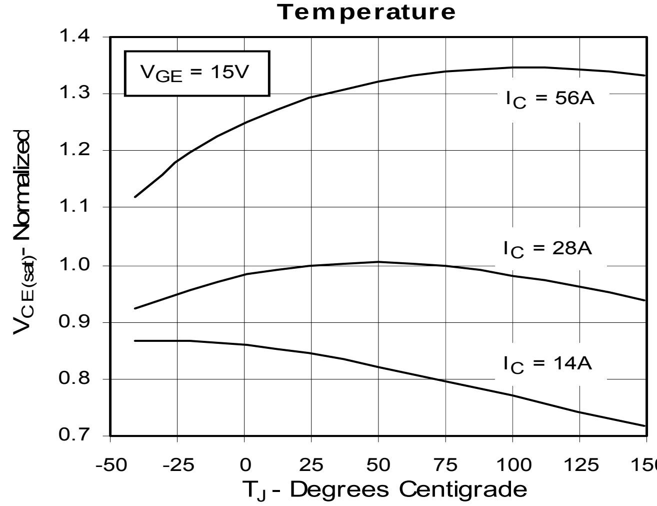



**Fig. 5. Collector-to-Emitter Voltage vs. Gate-to-Emitter voltage**

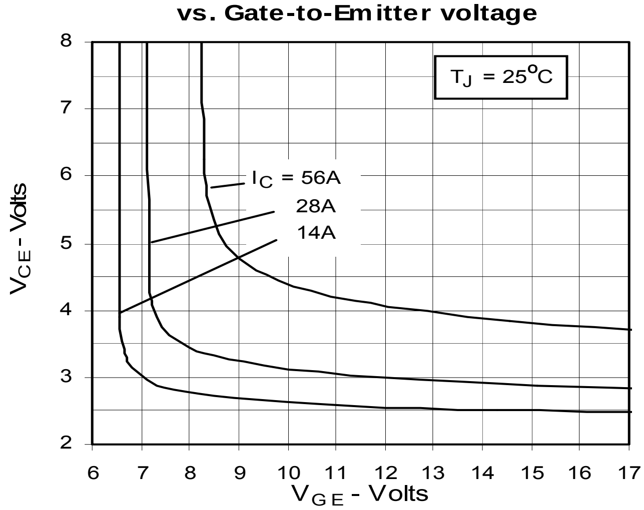



**Fig. 6. Input Admittance**

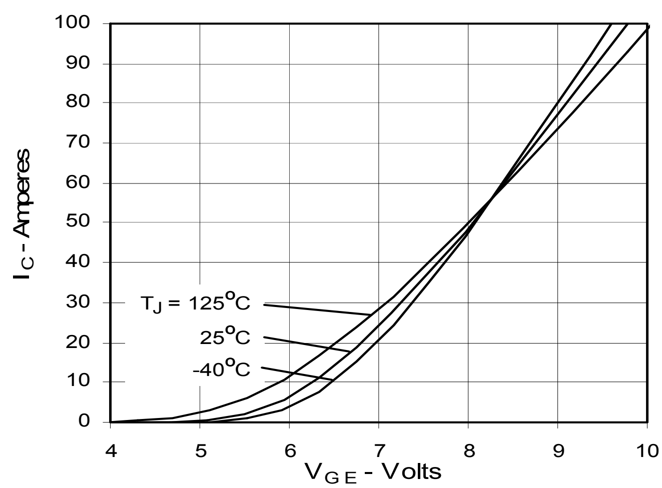


**Fig. 7. Transconductance**

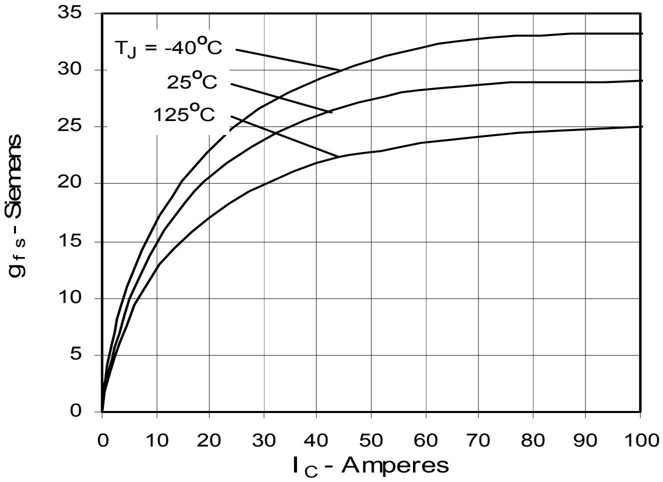



**Fig. 8. Dependence of Turn-off Energy Loss on $R_G$**

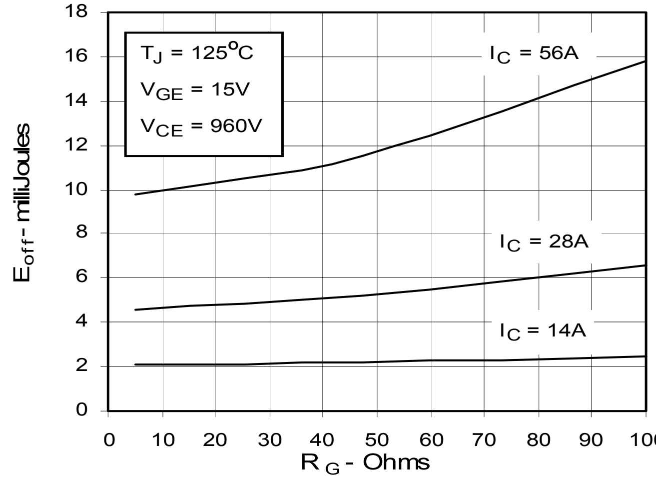



**Fig. 9. Dependence of Turn-Off Energy Loss on $I_C$**

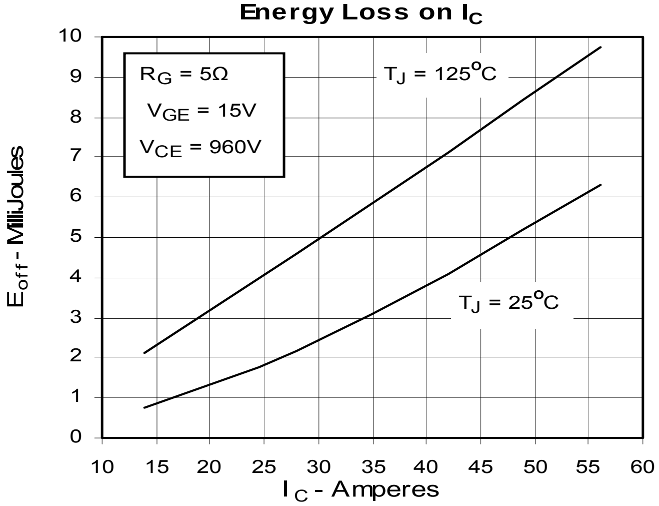



**Fig. 10. Dependence of Turn-off Energy Loss on Temperature**

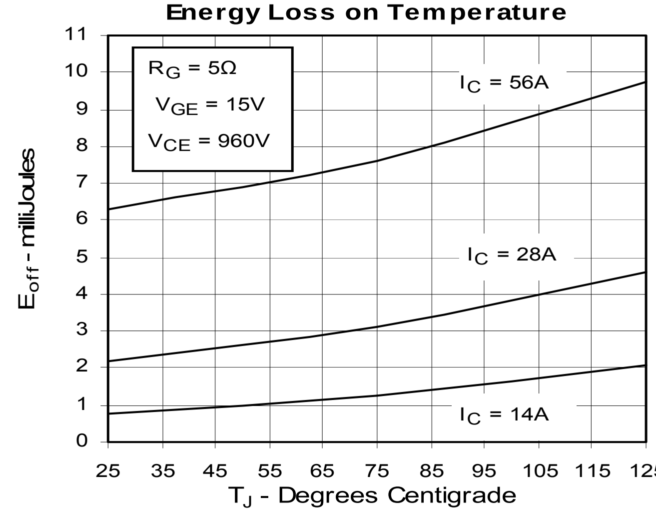



**Fig. 11. Dependence of Turn-off Switching Time on $R_G$**

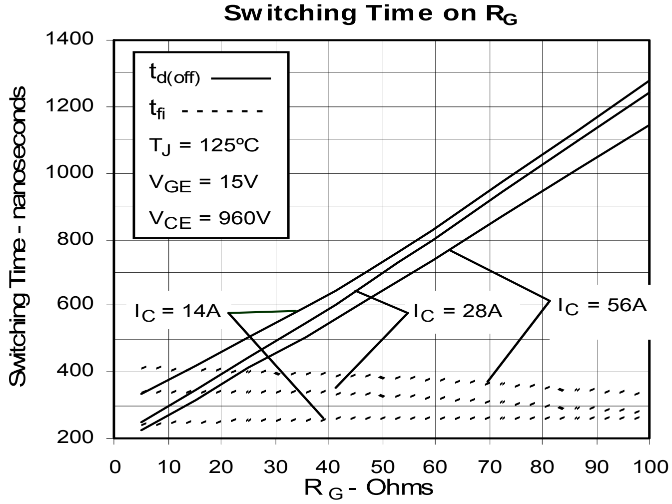



**Fig. 12. Dependence of Turn-off Switching Time on $I_C$**

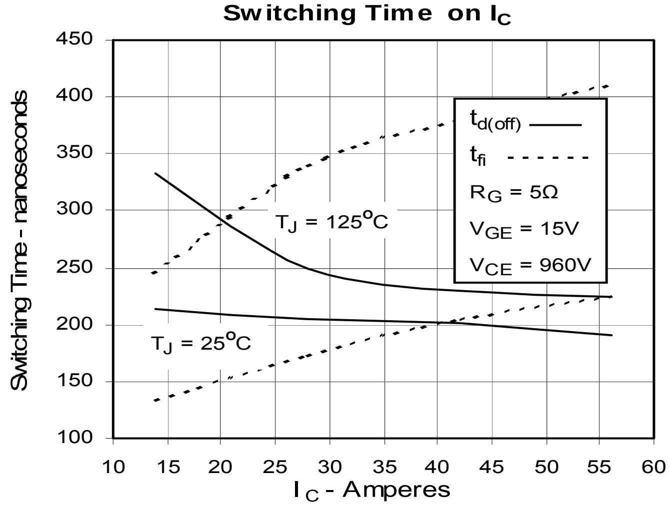


**Fig. 13. Dependence of Turn-off Switching Time on Temperature**

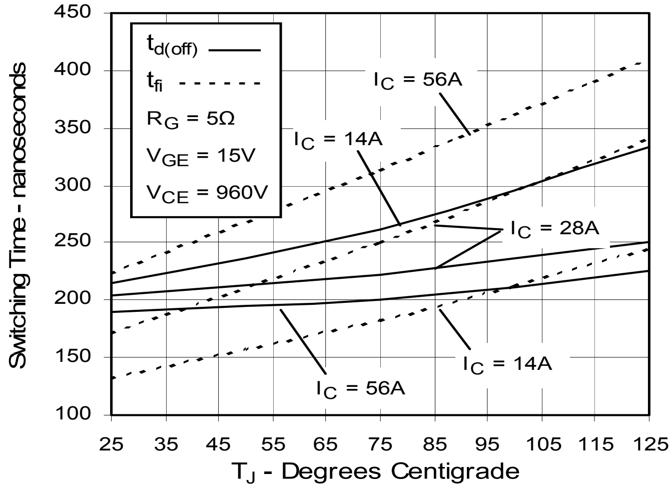



**Fig. 14. Gate Charge**

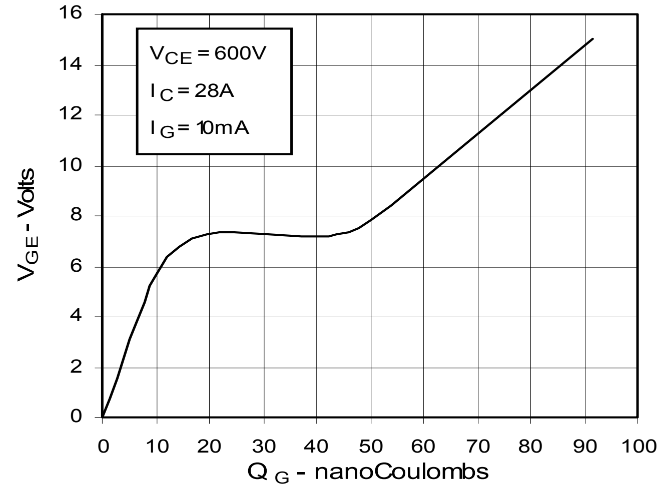



**Fig. 15. Capacitance**

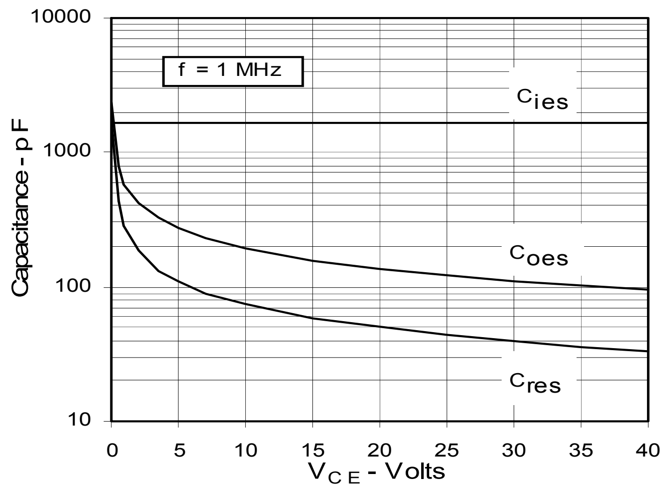



**Fig. 16. Reverse-Bias Safe Operating Area**

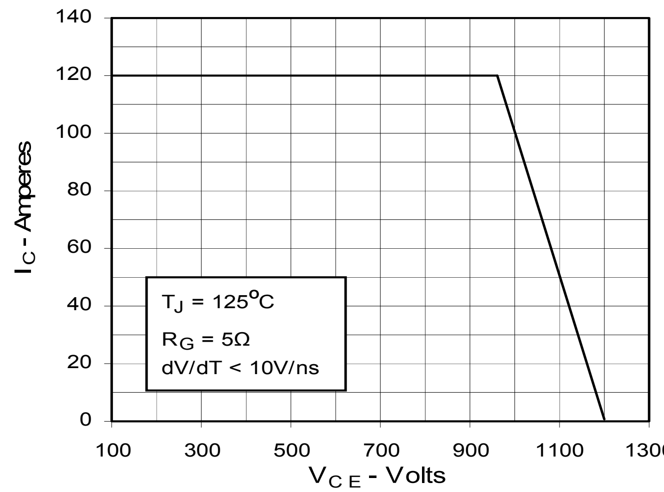
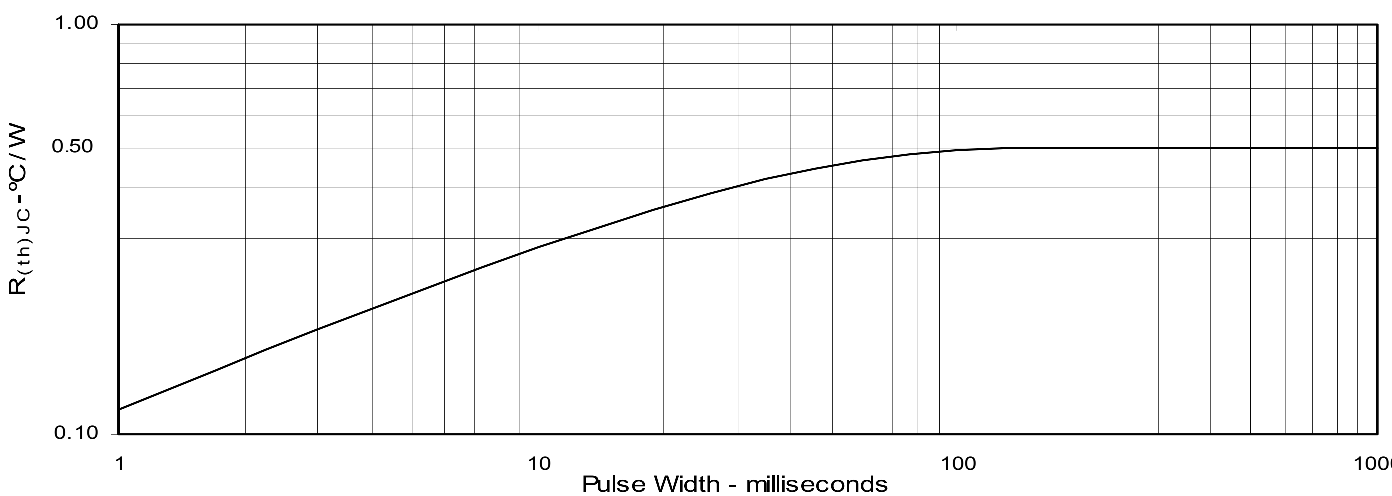



**Fig. 17. Maximum Transient Thermal Resistance**



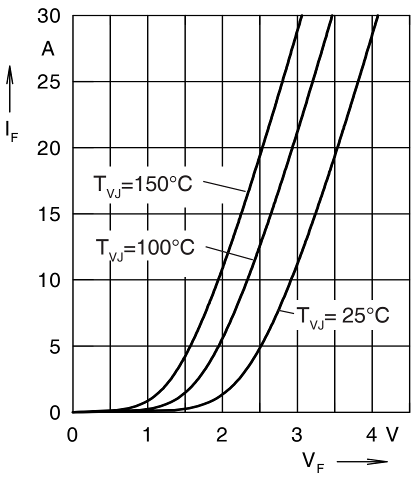



Fig. 18. Forward current $I_F$ versus $V_F$

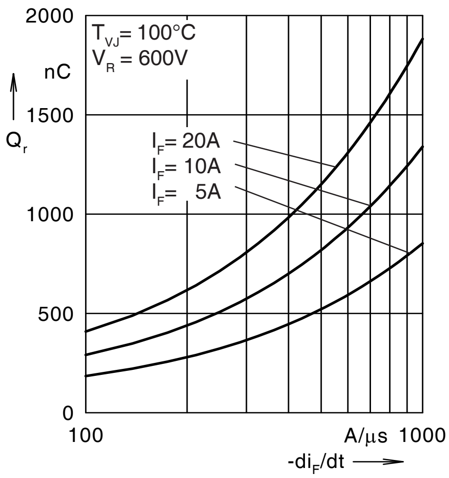



Fig. 19. Reverse recovery charge $Q_r$ versus $-di_F/dt$

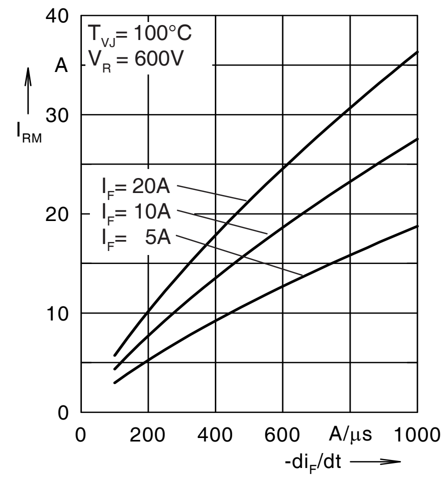



Fig. 20. Peak reverse current $I_{RM}$ versus $-di_F/dt$

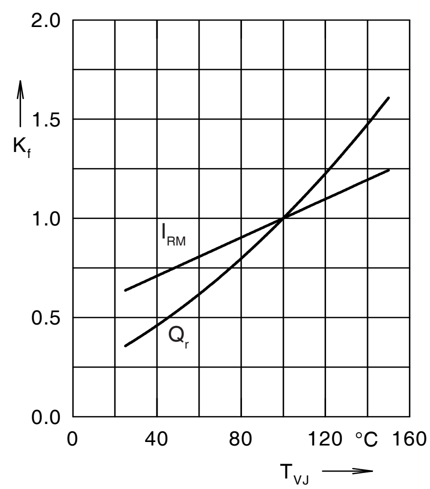



Fig. 21. Dynamic parameters $Q_r$, $I_{RM}$ versus $T_{VJ}$

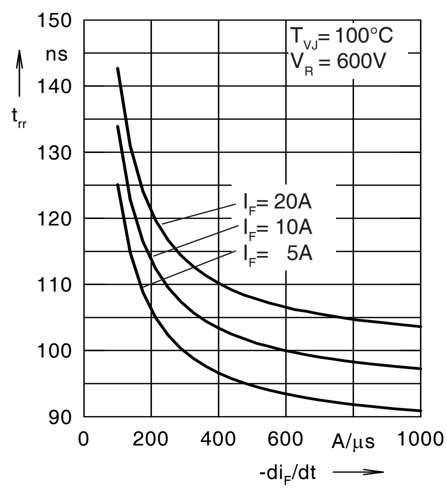



Fig. 22. Recovery time $t_{rr}$ versus $-di_F/dt$

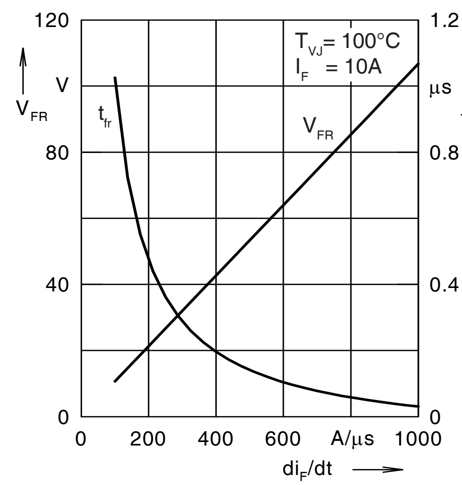



Fig. 23. Peak forward voltage $V_{FR}$ and $t_{fr}$ versus $di_F/dt$

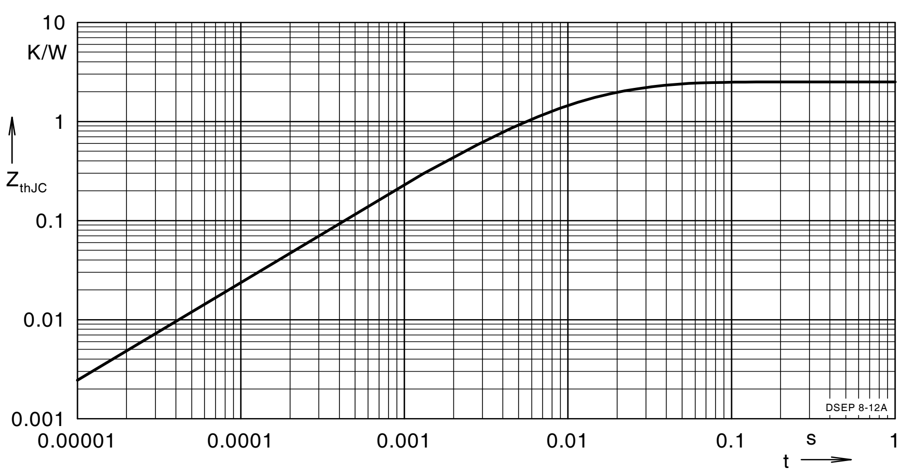



Fig. 24. Transient thermal resistance junction to case

Constants for $Z_{thJC}$ calculation:

| i | $R_{thi}$ (K/W) | $t_i$ (s) |
|---|---|---|
| 1 | 1.449 | 0.0052 |
| 2 | 0.558 | 0.0003 |
| 3 | 0.493 | 0.017 |