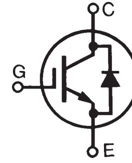
**IXYS** Advance Technical Information

# HiPerFAST™ IGBT with Fast Diode

## B2-Class High Speed IGBTs with Ultrafast Diode

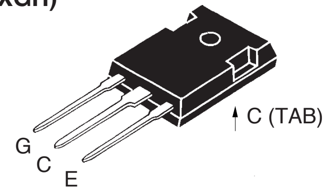
**IXGH 32N90B2D1**
**IXGT 32N90B2D1**

$V_{CES}$ = 900 V
$I_{C25}$ = 64 A
$V_{CE(sat)}$ = 2.7 V
$t_{fi\,typ}$ = 150 ns

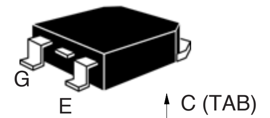



| Symbol | Test Conditions | Maximum Ratings | |
|---|---|---|---|
| $V_{CES}$ | $T_J$ = 25°C to 150°C | 900 | V |
| $V_{CGR}$ | $T_J$ = 25°C to 150°C; $R_{GE}$ = 1 MW | 900 | V |
| $V_{GES}$ | Continuous | ±20 | V |
| $V_{GEM}$ | Transient | ±30 | V |
| $I_{C25}$ | $T_C$ = 25°C | 64 | A |
| $I_{C110}$ | $T_C$ = 110°C | 32 | A |
| $I_{CM}$ | $T_C$ = 25°C, 1 ms | 200 | A |
| **SSOA (RBSOA)** | $V_{GE}$= 15 V, $T_{VJ}$ = 125°C, $R_G$ = 10 Ω<br>Clamped inductive load: $V_{CL}$ < 600V | $I_{CM}$ = 64 | A |
| $P_C$ | $T_C$ = 25°C | 300 | W |
| $T_J$ | | -55 ... +150 | °C |
| $T_{JM}$ | | 150 | °C |
| $T_{stg}$ | | -55 ... +150 | °C |
| Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s | | 300 | °C |
| $M_d$ | Mounting torque (TO-247) | 1.13/10 | Nm/lb.in. |
| **Weight** | TO-247 | 6 | g |
| | TO-268 | 4 | g |

**TO-247 (IXGH)**




**TO-268 (IXGT)**




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

| Symbol | Test Conditions | | Characteristic Values ($T_J$ = 25°C unless otherwise specified) min. | typ. | max. | |
|---|---|---|---|---|---|---|
| $V_{GE(th)}$ | $I_C$ = 250 mA, $V_{CE}$ = $V_{GE}$ | | 3.0 | | 5.0 | V |
| $I_{CES}$ | $V_{CE}$ = $V_{CES}$ | | | | 300 | µA |
| | $V_{GE}$ = 0 V | $T_J$ = 150°C | | | 1.5 | mA |
| $I_{GES}$ | $V_{CE}$ = 0 V, $V_{GE}$ = ± 20 V | | | | ± 100 | nA |
| $V_{CE(sat)}$ | $I_C$ = $I_{C110}$, $V_{GE}$ = 15 V | | | 2.2 | 2.7 | V |
| | | $T_J$ = 125°C | | 2.1 | | V |

**Features**

- High frequency IGBT
- High current handling capability
- MOS Gate turn-on
  - drive simplicity

**Applications**

- PFC circuits
- Uninterruptible power supplies (UPS)
- Switched-mode and resonant-mode power supplies
- AC motor speed control
- DC servo and robot drives
- DC choppers

**Advantages**

- High power density
- Very fast switching speeds for high frequency applications

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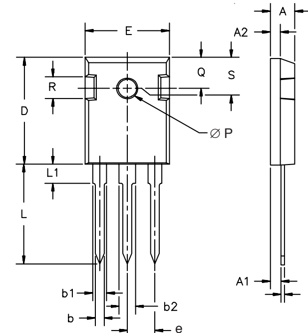
| Symbol | Test Conditions (Characteristic Values, $T_J = 25°C$ unless otherwise specified) | Min. | Typ. | Max. | |
|---|---|---|---|---|---|
| $g_{fs}$ | $I_C = I_{C110}$, $V_{CE} = 10$ V<br>Pulse test, t < 300 µs, duty cycle < 2 % | 18 | 28 | | S |
| $C_{ies}$ | $V_{CE} = 25$ V, $V_{GE} = 0$ V, f = 1 MHz | | 1790 | | pF |
| $C_{oes}$ | | | 146 | | pF |
| $C_{res}$ | | | 49 | | pF |
| $Q_g$ | $I_C = I_{C110}$, $V_{GE} = 15$ V, $V_{CE} = 0.5\ V_{CES}$ | | 89 | | nC |
| $Q_{ge}$ | | | 15 | | nC |
| $Q_{gc}$ | | | 34 | | nC |
| $t_{d(on)}$ | **Inductive load, $T_J = 25°C$**<br>$I_C = I_{C110}$, $V_{GE} = 15$ V<br>$V_{CE} = 720$ V, $R_G = R_{off} = 5\ \Omega$ | | 20 | | ns |
| $t_{ri}$ | | | 22 | | ns |
| $t_{d(off)}$ | | | 260 | 400 | ns |
| $t_{fi}$ | | | 150 | | ns |
| $E_{off}$ | | | 2.2 | 4.5 | mJ |
| $t_{d(on)}$ | **Inductive load, $T_J = 125°C$**<br>$I_C = I_{C110}$ A, $V_{GE} = 15$ V<br>$V_{CE} = 720$ V, $R_G = R_{off} = 5\ \Omega$ | | 20 | | ns |
| $t_{ri}$ | | | 22 | | ns |
| $E_{on}$ | | | 3.8 | | mJ |
| $t_{d(off)}$ | | | 360 | | ns |
| $t_{fi}$ | | | 330 | | ns |
| $E_{off}$ | | | 5.75 | | mJ |
| $R_{thJC}$ | | | | 0.42 | K/W |
| $R_{thCS}$ | (TO-247) | | 0.25 | | K/W |

## Ultrafast Diode

| Symbol | Conditions | Maximum Ratings | |
|---|---|---|---|
| $I_{F110}$ | $T_C = 110°C$ | 27 | A |

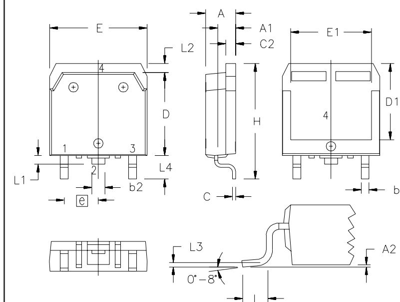
| Symbol | Conditions (Characteristic Values, $T_J = 25°C$ unless otherwise specified) | Min. | Typ. | Max. | |
|---|---|---|---|---|---|
| $V_F$ | $I_F = 30$ A; | | | 2.75 | V |
| | $T_{VJ} = 125°C$ | | 1.9 | | V |
| $I_{RM}$ | $I_F = 50$ A; $di_F/dt = -100$ A/µs; $T_{VJ} = 100°C$ | | 5.5 | 11.4 | A |
| $t_{rr}$ | $V_R = 100$ V; $V_{GE} = 0$ V | | 190 | | ns |
| $R_{thJC}$ | | | | 0.9 | K/W |
| $R_{thCS}$ | | | 0.25 | | K/W |

### TO-247 AD Outline




| Dim. | Millimeter Min. | Millimeter Max. | Inches Min. | Inches 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 | |

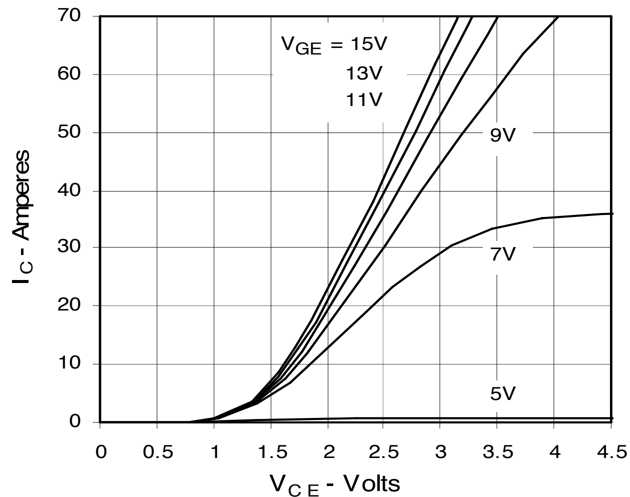
### TO-268 Outline

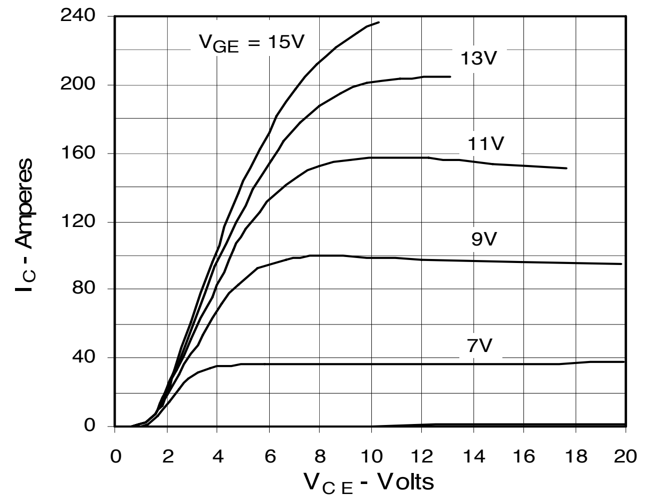


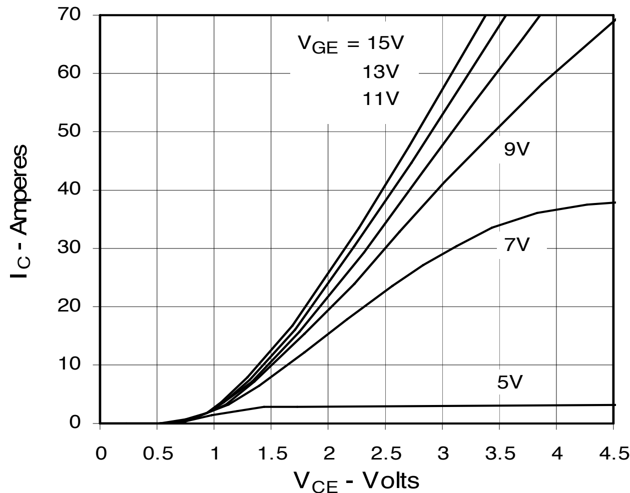

| SYM | INCHES MIN | INCHES MAX | MILLIMETERS MIN | MILLIMETERS MAX |
|---|---|---|---|---|
| A | .193 | .201 | 4.90 | 5.10 |
| A1 | .106 | .114 | 2.70 | 2.90 |
| A2 | .001 | .010 | 0.02 | 0.25 |
| b | .045 | .057 | 1.15 | 1.45 |
| b2 | .075 | .083 | 1.90 | 2.10 |
| C | .016 | .026 | 0.40 | 0.65 |
| 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 |

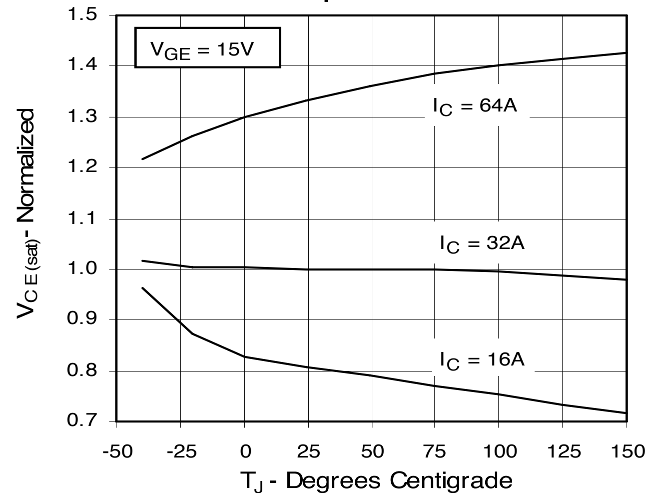
IXYS reserves the right to change limits, test conditions, and dimensions.

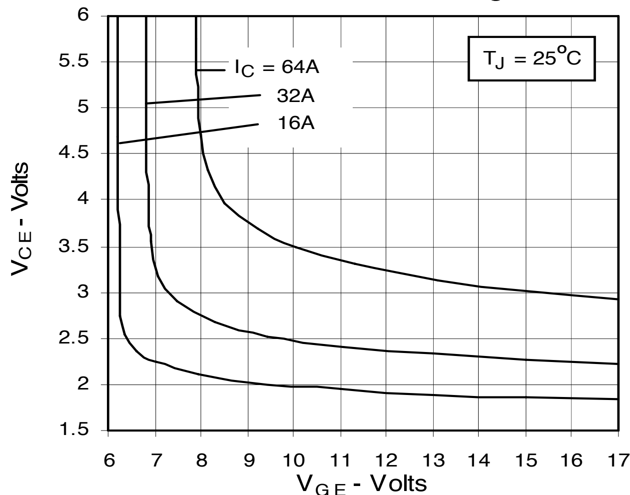
IXYS MOSFETs and IGBTs are covered by one or more of the following U.S. patents: 4,835,592 4,931,844 5,049,961 5,237,481 6,162,665 6,404,065 B1 6,683,344 6,727,585 4,850,072 5,017,508 5,063,307 5,381,025 6,259,123 B1 6,534,343 6,710,405B2 6,759,692 4,881,106 5,034,796 5,187,117 5,486,715 6,306,728 B1 6,583,505 6,710,463 6771478 B2

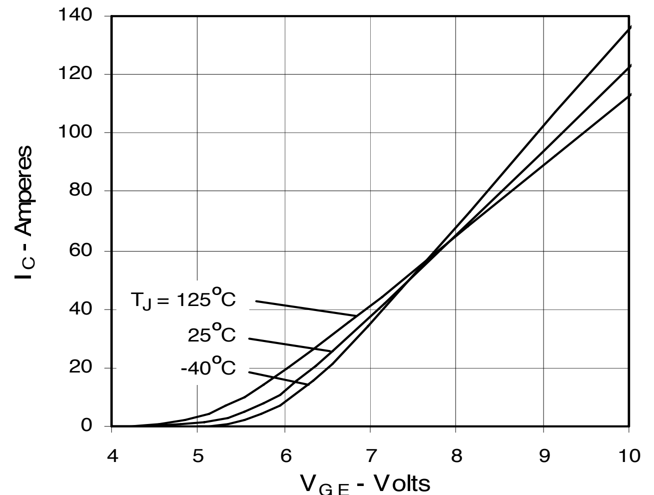
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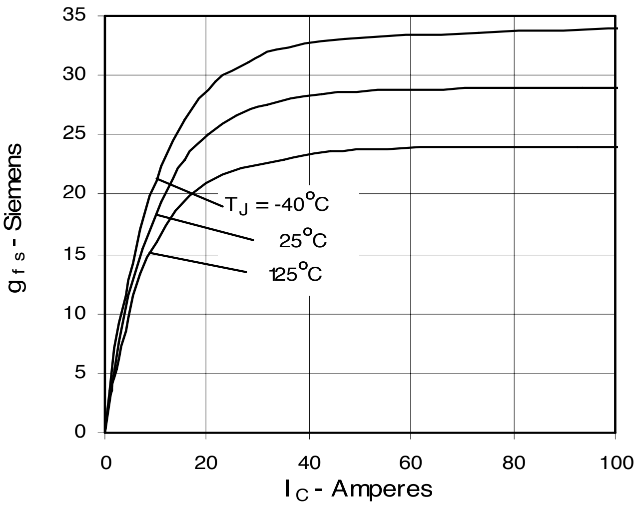


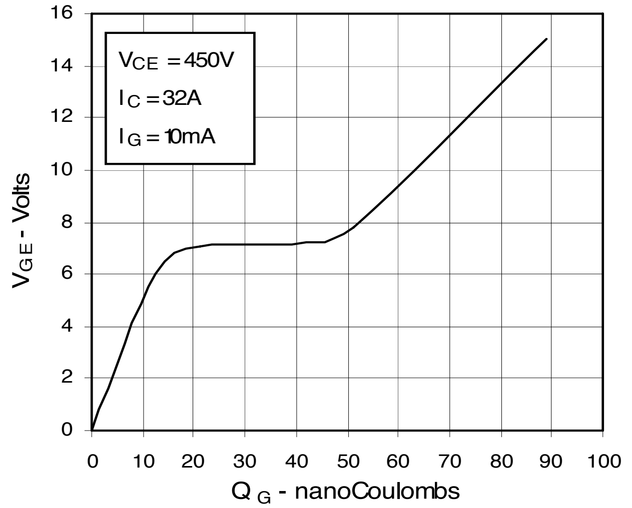


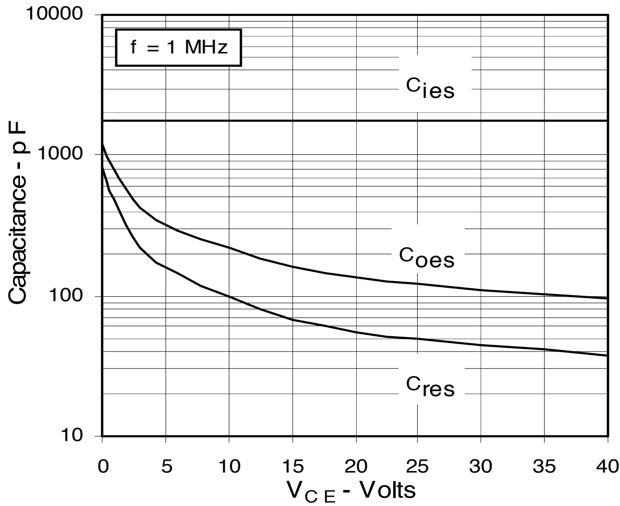


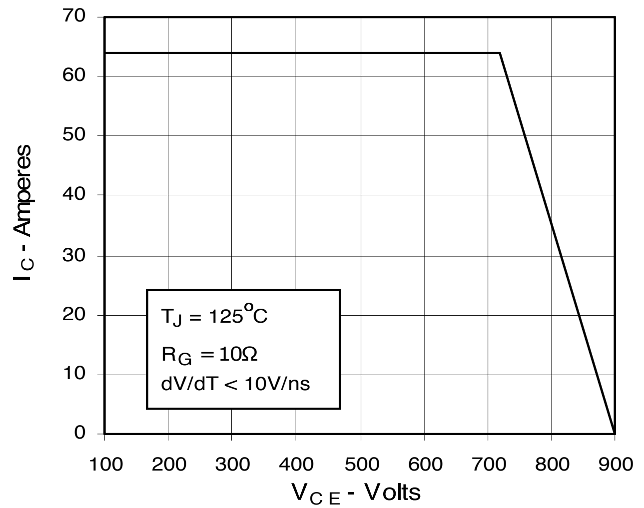

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Fig. 12. Dependence of Turn-off Energy Loss on Gate Resistance

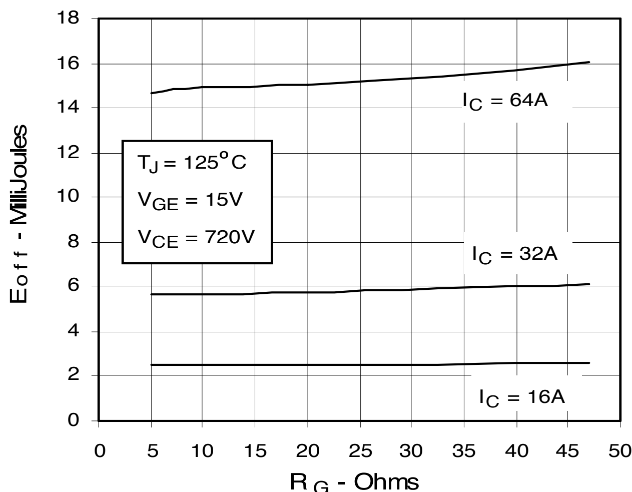


Fig. 13. Dependence of Turn-on Energy Loss on Gate Resistance

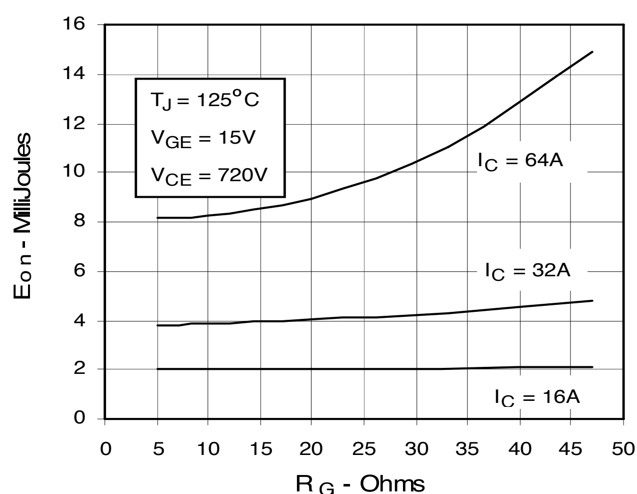


Fig. 14. Dependence of Turn-off Energy Loss on Collector Current

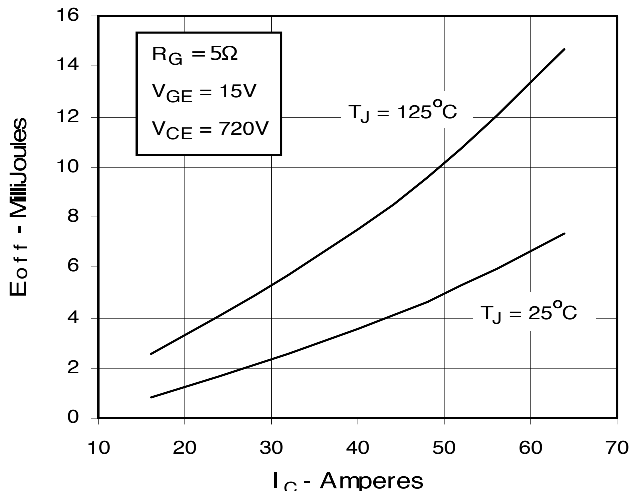


Fig. 15. Dependence of Turn-on Energy Loss on Collector Current

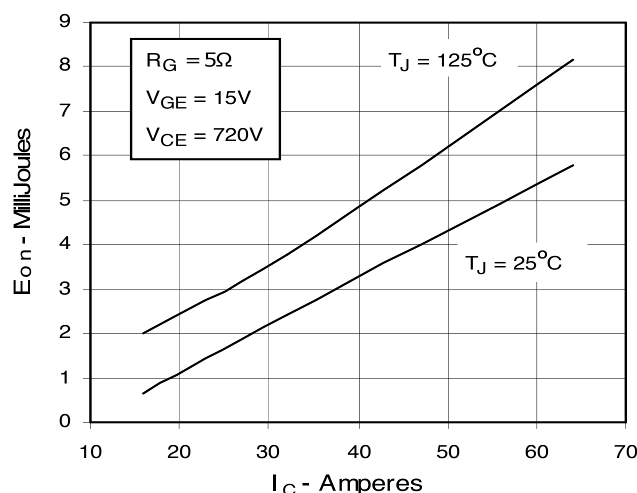


Fig. 16. Dependence of Turn-off Energy Loss on Temperature

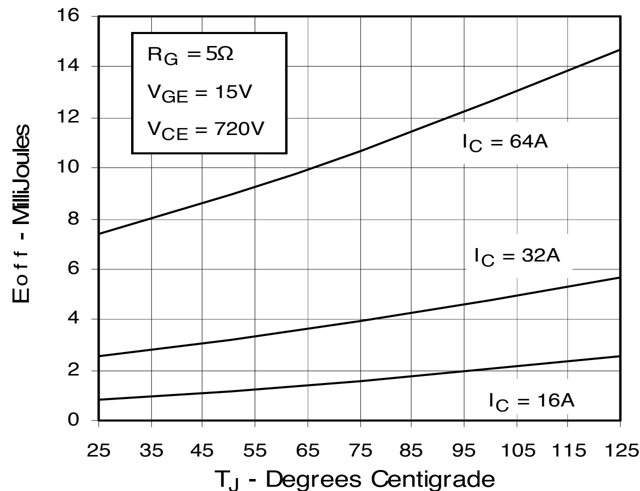


Fig. 17. Dependence of Turn-on Energy Loss on Temperature

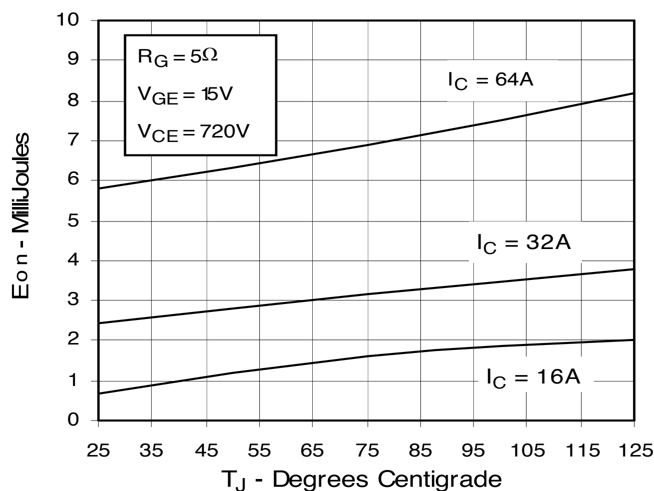


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**Fig. 18. Dependence of Turn-off Switching Time on Gate Resistance**

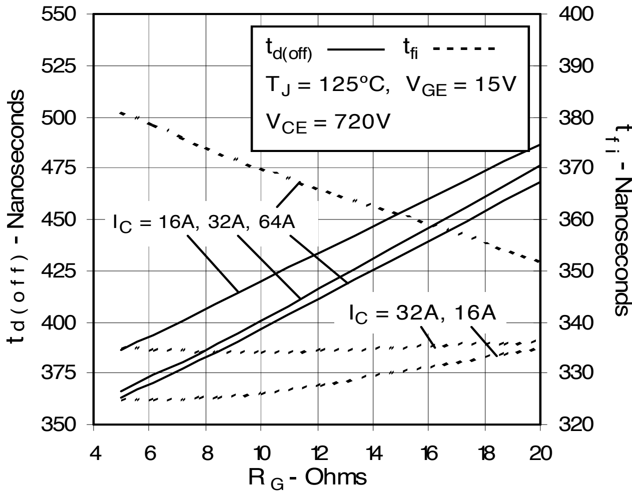



**Fig. 19. Dependence of Turn-on Switching Time on Gate Resistance**

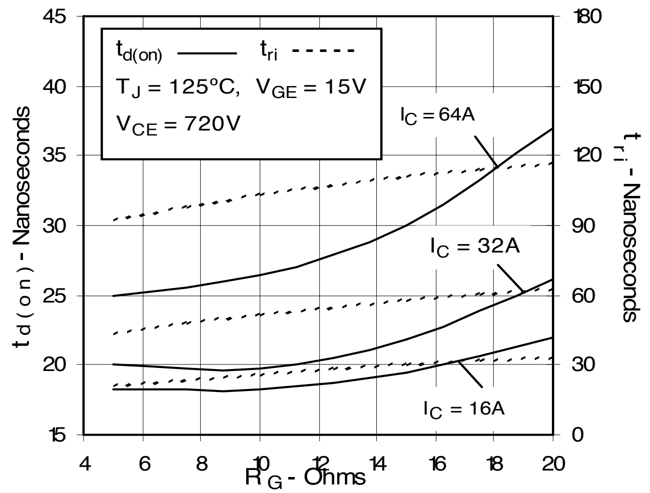



**Fig. 20. Dependence of Turn-off Switching Time on Collector Current**

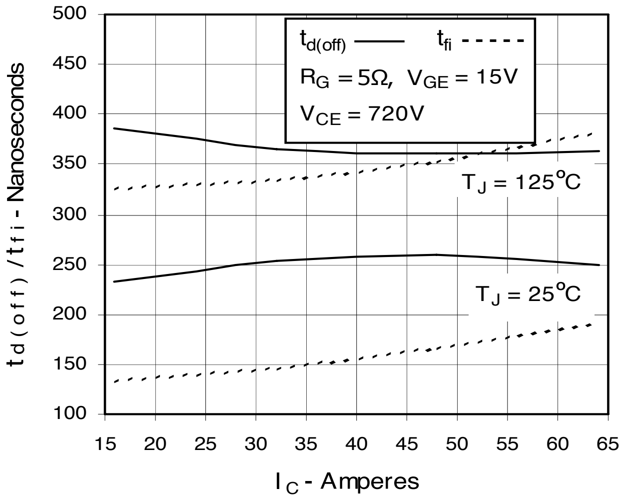



**Fig. 21. Dependence of Turn-on Switching Time on Collector Current**

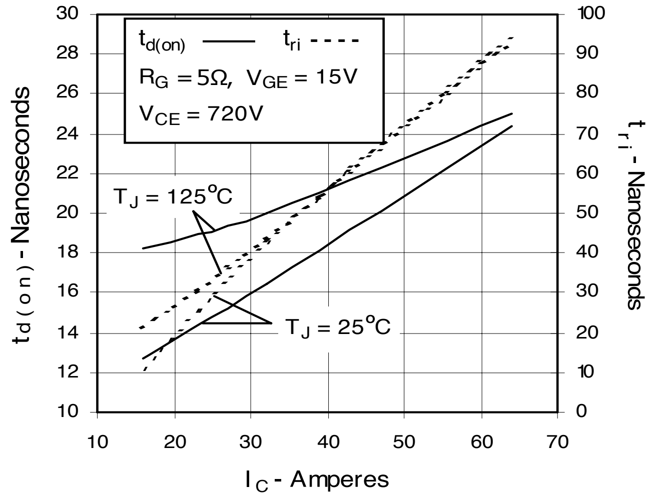



**Fig. 22. Dependence of Turn-off Switching Time on Temperature**

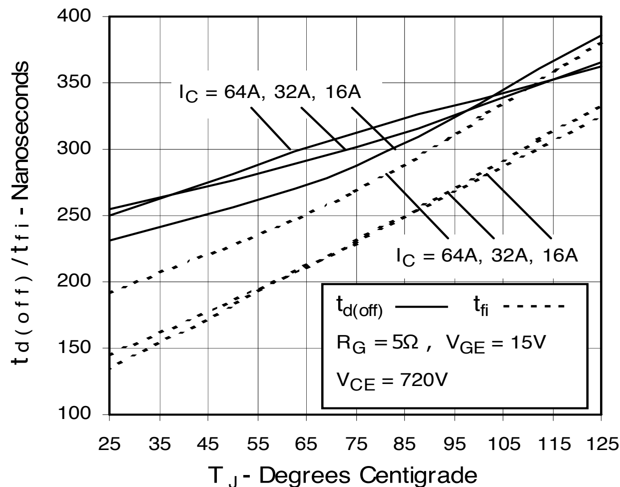
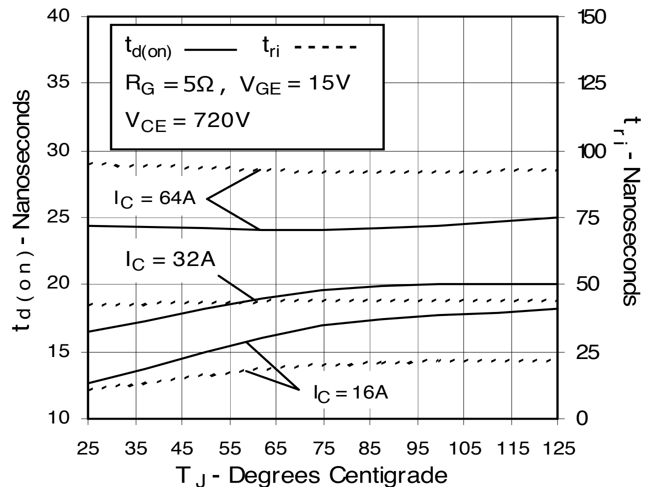



**Fig. 23. Dependence of Turn-on Switching Time on Temperature**

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## Ultrafast Diode Charateristic Curves

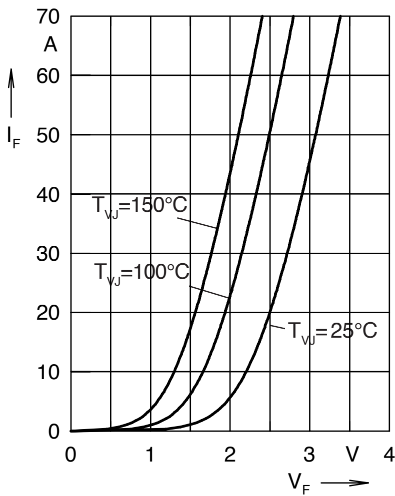


Fig. 24. Forward current $I_F$ versus $V_F$

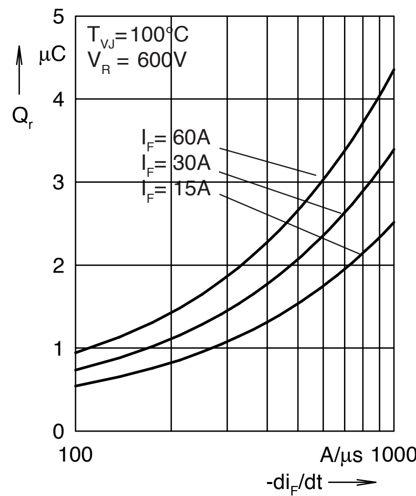


Fig. 25. Reverse recovery charge $Q_r$ versus $-di_F/dt$

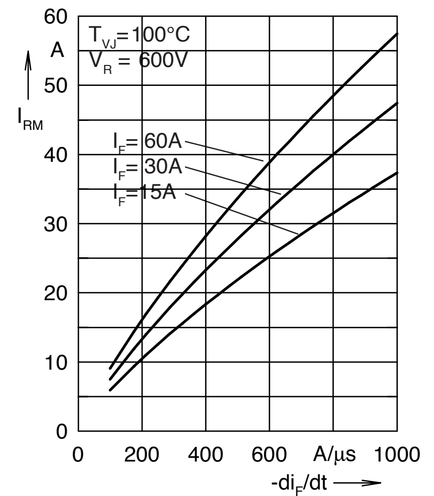


Fig. 26. Peak reverse current $I_{RM}$ versus $-di_F/dt$

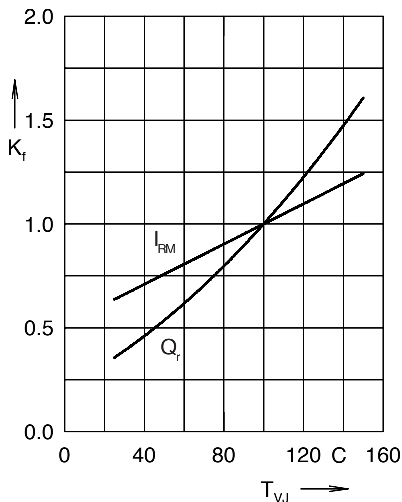


Fig. 27. Dynamic parameters $Q_r$, $I_{RM}$ versus $T_{VJ}$

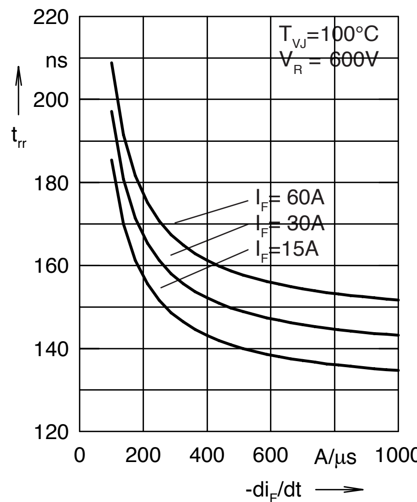


Fig. 28. Recovery time $t_{rr}$ versus $-di_F/dt$

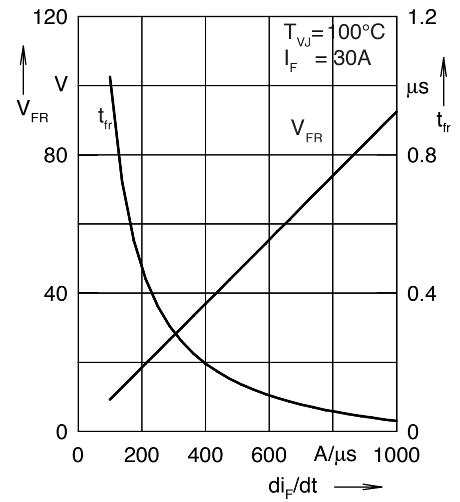


Fig. 29. Peak forward voltage $V_{FR}$ and $t_{fr}$ versus $di_F/dt$

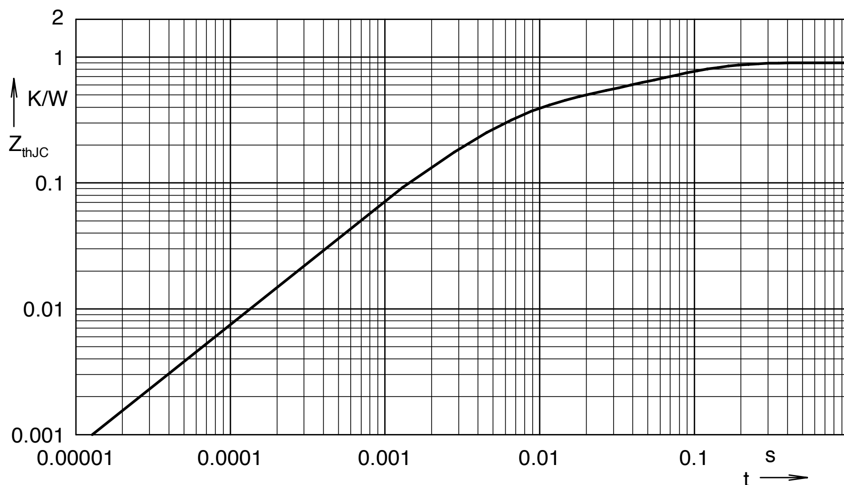


Fig. 30. Transient thermal resistance junction to case

Constants for $Z_{thJC}$ calculation:

| i | $R_{thi}$ (K/W) | $t_i$ (s) |
|---|---|---|
| 1 | 0.465 | 0.0052 |
| 2 | 0.179 | 0.0003 |
| 3 | 0.256 | 0.0397 |

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