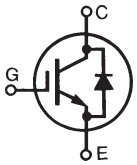
# IXYS

## GenX3™ 1400V IGBTs w/ Diode

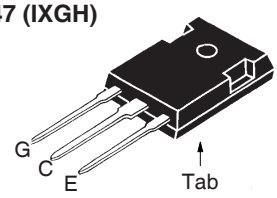
## IXGH28N140B3H1
## IXGX28N140B3H1
## IXGK28N140B3H1

$V_{CES}$ = 1400V
$I_{C110}$ = 28A
$V_{CE(sat)} \leq$ 3.60V

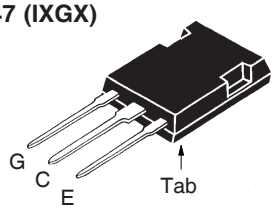
Avalanche Rated



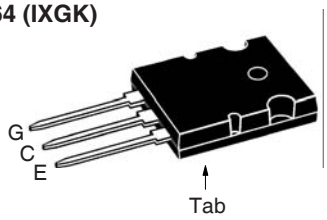

**TO-247 (IXGH)**




**PLUS247 (IXGX)**




**TO-264 (IXGK)**




G = Gate E = Emitter
C = Collector Tab = Collector

| Symbol | Test Conditions | Maximum Ratings | |
|---|---|---|---|
| $V_{CES}$ | $T_J$ = 25°C to 150°C | 1400 | V |
| $V_{CGR}$ | $T_J$ = 25°C to 150°C, $R_{GE}$ = 1MΩ | 1400 | V |
| $V_{GES}$ | Continuous | ±20 | V |
| $V_{GEM}$ | Transient | ±30 | V |
| $I_{C25}$ | $T_C$ = 25°C | 60 | A |
| $I_{C110}$ | $T_C$ = 110°C | 28 | A |
| $I_{F110}$ | $T_C$ = 110°C | 15 | A |
| $I_{CM}$ | $T_C$ = 25°C, 1ms | 150 | A |
| $I_A$ | $T_C$ = 25°C | 28 | A |
| $E_{AS}$ | $T_C$ = 25°C | 360 | mJ |
| SSOA (RBSOA) | $V_{GE}$ = 15V, $T_{VJ}$ = 125°C, $R_G$ = 5Ω<br>Clamped Inductive Load | $I_{CM}$ = 120<br>@ $V_{CES} < V_{CE}$ | A |
| $P_C$ | $T_C$ = 25°C | 300 | W |
| $T_J$ | | -55 ... +150 | °C |
| $T_{JM}$ | | 150 | °C |
| $T_{stg}$ | | -55 ... +150 | °C |
| $T_L$ | 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 (IXGH & IXGK) | 1.13/10 | Nm/lb.in. |
| $F_C$ | Mounting Force (IXGX) | 20..120/4.5..27 | N/lb. |
| Weight | TO-247 & PLUS247 | 6 | g |
| | TO-264 | 10 | 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 | | 5.0 | V |
| $I_{CES}$ | $V_{CE}$ = $V_{CES}$, $V_{GE}$ = 0V | | | 50 | μA |
| | Note 2, $T_J$ = 125°C | | | 1 | mA |
| $I_{GES}$ | $V_{CE}$ = 0V, $V_{GE}$ = ±20V | | | ±100 | nA |
| $V_{CE(sat)}$ | $I_C$ = $I_{C110}$, $V_{GE}$ = 15V, Note 1 | | 3.00 | 3.60 | V |
| | $T_J$ = 125°C | | 3.05 | | |

### Features

- Optimized for Low Conduction and Switching Losses
- Square RBSOA
- Avalanche Rated
- Anti-Parallel Ultra Fast Diode
- High Current Handling Capability

### Advantages

- High Power Density
- Low Gate Drive Requirement

### Applications

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

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| Symbol | Test Conditions ($T_J$ = 25°C, Unless Otherwise Specified) | Characteristic Values Min. | Typ. | Max. | |
|---|---|---|---|---|---|
| $g_{fs}$ | $I_C = I_{C110}$, $V_{CE}$ = 10V, Note 1 | 12 | 19 | | S |
| $C_{ies}$ | $V_{CE}$ = 25V, $V_{GE}$ = 0V, f = 1 MHz | | 1830 | | pF |
| $C_{oes}$ | | | 163 | | pF |
| $C_{res}$ | | | 46 | | pF |
| $Q_{g(on)}$ | $I_C = I_{C110}$, $V_{GE}$ = 15V, $V_{CE} = 0.5 \bullet V_{CES}$ | | 88 | | nC |
| $Q_{ge}$ | | | 12 | | nC |
| $Q_{gc}$ | | | 38 | | nC |
| $t_{d(on)}$ | **Inductive load, $T_J$ = 25°C** | | 16 | | ns |
| $t_{ri}$ | $I_C = I_{C110}$, $V_{GE}$ = 15V | | 36 | | ns |
| $E_{on}$ | $V_{CE}$ = 960V, $R_G$ = 5Ω | | 3.6 | | mJ |
| $t_{d(off)}$ | Note 3 | | 190 | 400 | ns |
| $t_{fi}$ | | | 360 | | ns |
| $E_{off}$ | | | 3.9 | 6.5 | J |
| $t_{d(on)}$ | **Inductive load, $T_J$ = 125°C** | | 16 | | ns |
| $t_{ri}$ | $I_C = I_{C110}$, $V_{GE}$ = 15V | | 50 | | ns |
| $E_{on}$ | $V_{CE}$ = 960V, $R_G$ = 5Ω | | 7.3 | | mJ |
| $t_{d(off)}$ | Note 3 | | 215 | | ns |
| $t_{fi}$ | | | 700 | | ns |
| $E_{off}$ | | | 6.5 | | mJ |
| $R_{thJC}$ | | | | 0.42 | °C/W |
| $R_{thCs}$ | | | 0.21 | | °C/W |
| | | | 0.15 | | °C/W |

**Reverse Diode (FRED)**

| Symbol | Test Conditions ($T_J$ = 25°C, Unless Otherwise Specified) | Characteristic Values Min. | Typ. | Max. | |
|---|---|---|---|---|---|
| $V_F$ | $I_F$ = 20A, $V_{GE}$ = 0V, Note 1 | | | 3.0 | V |
| | $T_J$ = 150°C | | 2.65 | | V |
| $t_{rr}$ | $I_F$ = 20A, $V_{GE}$ = 0V, $-di_F/dt$ = -200A/μs, | | 350 | | ns |
| $I_{RM}$ | $V_R$ = 1200V, $T_J$ = 125°C | | 18.5 | | A |
| $R_{thJC}$ | | | | 0.90 | °C/W |

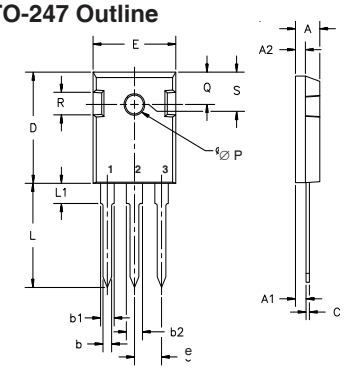
Notes:

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

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 4,850,072 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

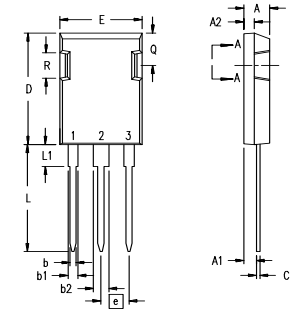
## TO-247 Outline




Terminals: 1 - Gate 2 - Collector
3 - Emitted

| Dim. | Millimeter | | Inches | |
|---|---|---|---|---|
| | Min. | Max. | 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 |
| ØP | 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 | |

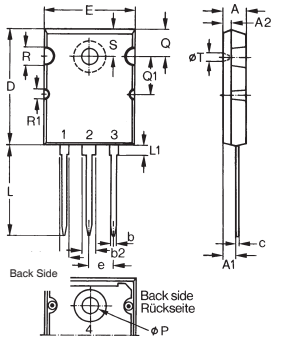
## PLUS247 Outline




Terminals: 1 - Gate
2 - Collector
3 - Emitter

| Dim. | Millimeter | | Inches | |
|---|---|---|---|---|
| | Min. | Max. | Min. | Max. |
| A | 4.83 | 5.21 | .190 | .205 |
| $A_1$ | 2.29 | 2.54 | .090 | .100 |
| $A_2$ | 1.91 | 2.16 | .075 | .085 |
| b | 1.14 | 1.40 | .045 | .055 |
| $b_1$ | 1.91 | 2.13 | .075 | .084 |
| $b_2$ | 2.92 | 3.12 | .115 | .123 |
| C | 0.61 | 0.80 | .024 | .031 |
| D | 20.80 | 21.34 | .819 | .840 |
| E | 15.75 | 16.13 | .620 | .635 |
| e | 5.45 BSC | | .215 BSC | |
| L | 19.81 | 20.32 | .780 | .800 |
| L1 | 3.81 | 4.32 | .150 | .170 |
| Q | 5.59 | 6.20 | .220 | 0.244 |
| R | 4.32 | 4.83 | .170 | .190 |

## TO-264 AA Outline




Terminals: 1 = Gate
2,4 = Collector
3 = Emitter

| Dim. | Millimeter | | Inches | |
|---|---|---|---|---|
| | Min. | Max. | Min. | Max. |
| A | 4.82 | 5.13 | .190 | .202 |
| A1 | 2.54 | 2.89 | .100 | .114 |
| A2 | 2.00 | 2.10 | .079 | .083 |
| b | 1.12 | 1.42 | .044 | .056 |
| b1 | 2.39 | 2.69 | .094 | .106 |
| b2 | 2.90 | 3.09 | .114 | .122 |
| c | 0.53 | 0.83 | .021 | .033 |
| D | 25.91 | 26.16 | 1.020 | 1.030 |
| E | 19.81 | 19.96 | .780 | .786 |
| e | 5.46 BSC | | .215 BSC | |
| J | 0.00 | 0.25 | .000 | .010 |
| K | 0.00 | 0.25 | .000 | .010 |
| L | 20.32 | 20.83 | .800 | .820 |
| L1 | 2.29 | 2.59 | .090 | .102 |
| P | 3.17 | 3.66 | .125 | .144 |
| Q | 6.07 | 6.27 | .239 | .247 |
| Q1 | 8.38 | 8.69 | .330 | .342 |
| R | 3.81 | 4.32 | .150 | .170 |
| R1 | 1.78 | 2.29 | .070 | .090 |
| S | 6.04 | 6.30 | .238 | .248 |
| T | 1.57 | 1.83 | .062 | .072 |

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**Fig. 1. Output Characteristics @ $T_J$ = 25ºC**

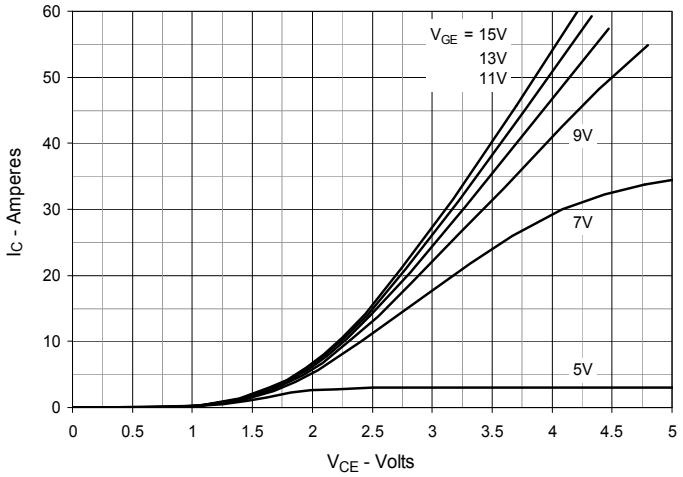


**Fig. 2. Extended Output Characteristics @ $T_J$ = 25ºC**

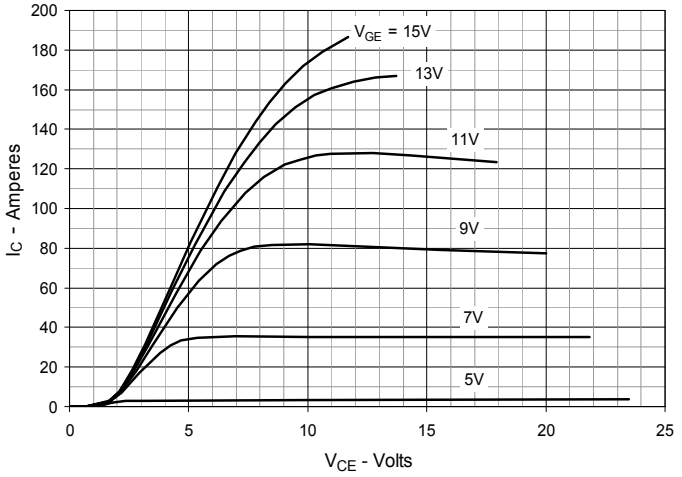


**Fig. 3. Output Characteristics @ $T_J$ = 125ºC**

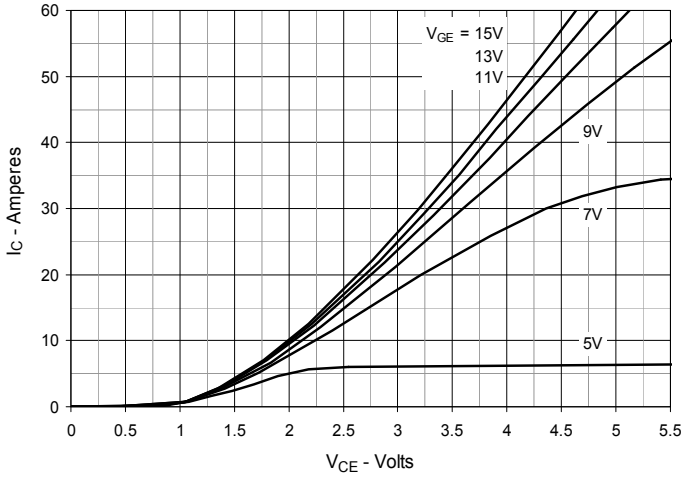


**Fig. 4. Dependence of $V_{CE(sat)}$ on Junction Temperature**

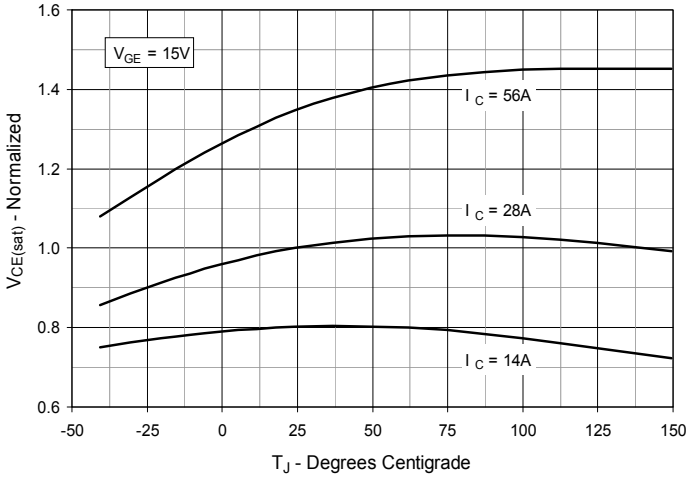


**Fig. 5. Collector-to-Emitter Voltage vs. Gate-to-Emitter Voltage**

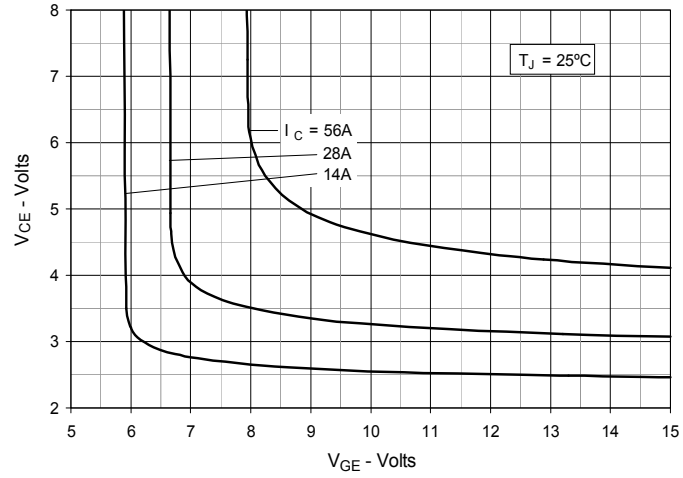


**Fig. 6. Input Admittance**

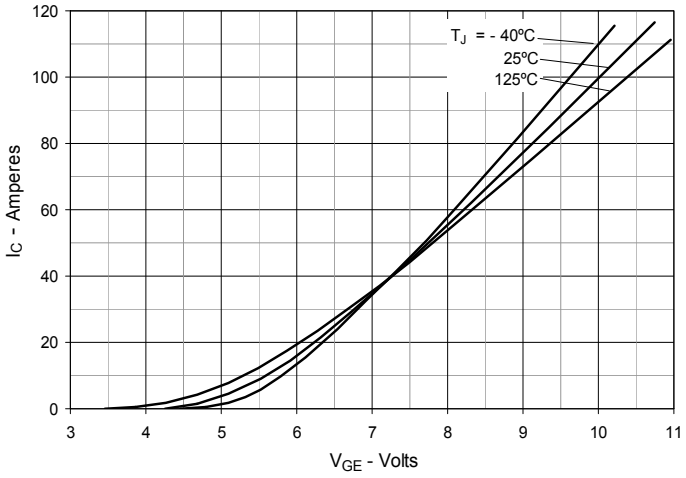


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**Fig. 7. Transconductance**

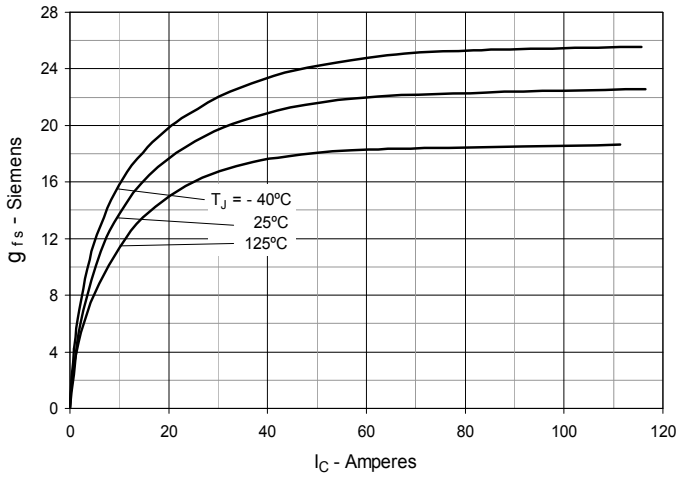


**Fig. 8. Gate Charge**

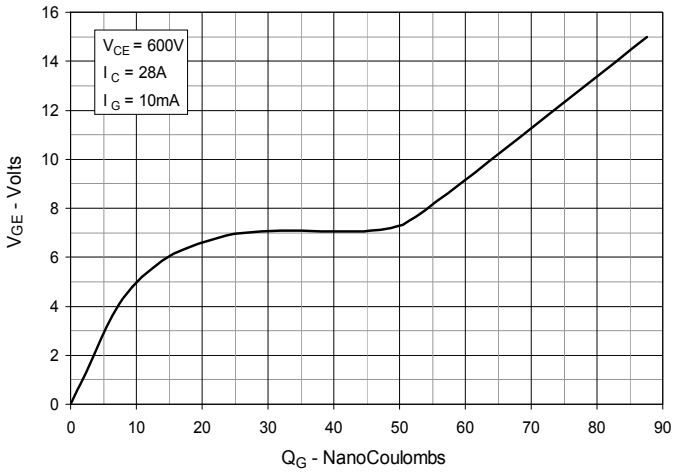


**Fig. 9. Capacitance**

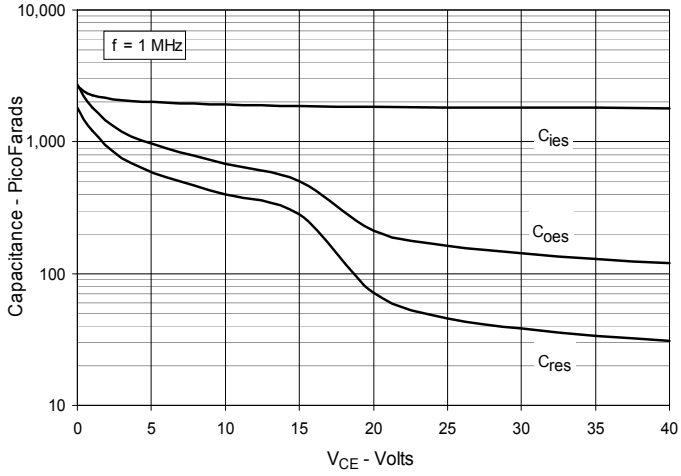


**Fig. 10. Reverse-Bias Safe Operating Area**

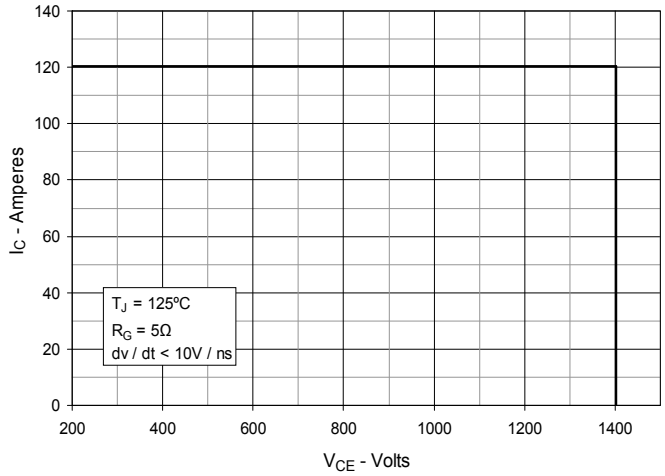


**Fig. 11. Maximum Transient Thermal Impedance**

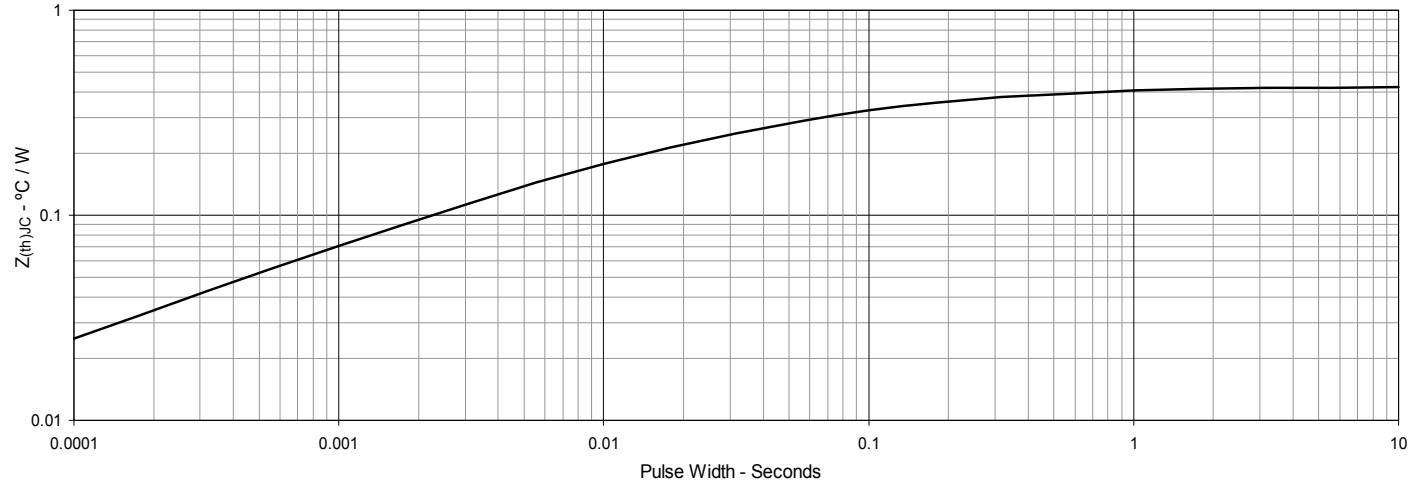


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**Fig. 12. Inductive Switching Energy Loss vs. Gate Resistance**

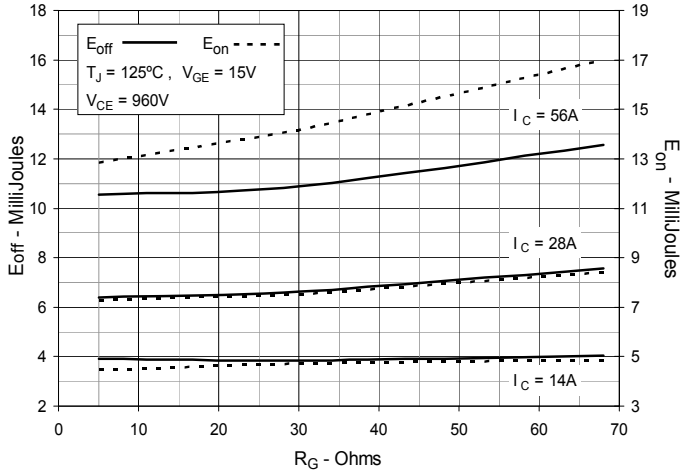


**Fig. 13. Inductive Swiching Energy Loss vs. Collector Current**

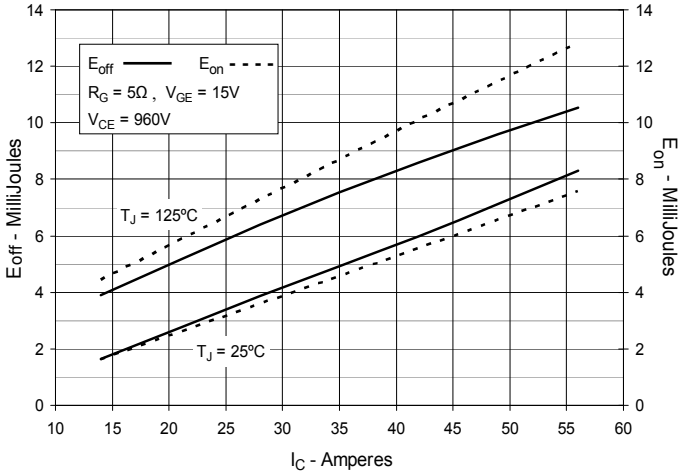


**Fig. 14. Inductive Swiching Energy Loss vs. Junction Temperature**

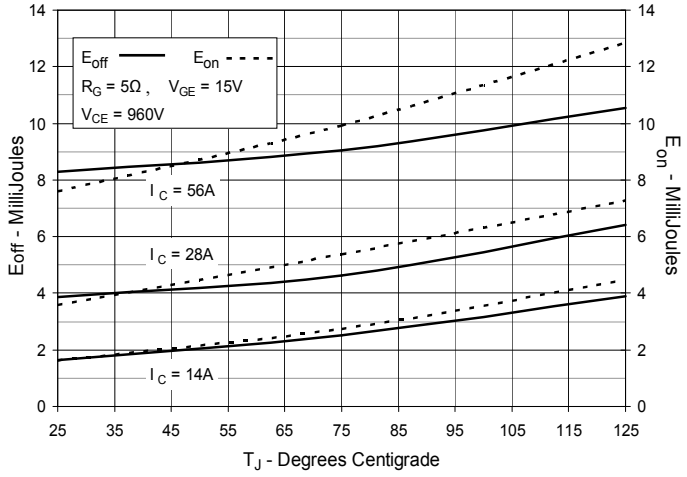


**Fig. 15. Inductive Turn-off Switching Times vs. Gate Resistance**

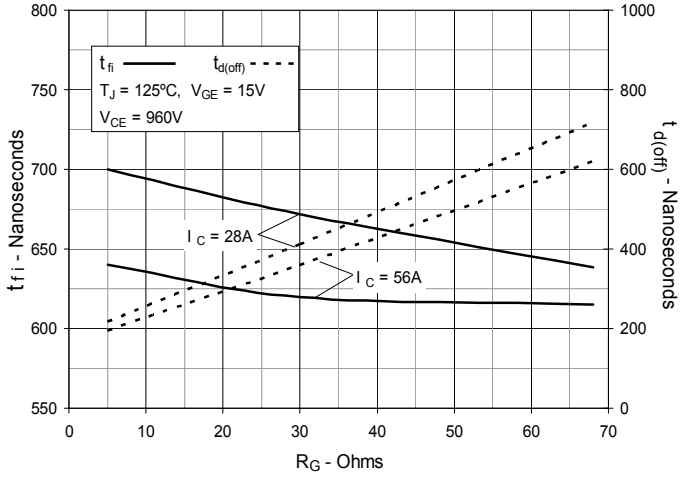


**Fig. 16. Inductive Turn-off Switching Times vs. Collector Current**

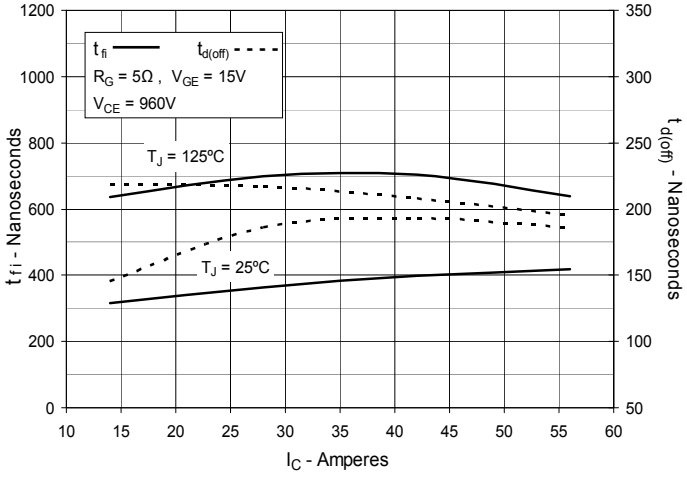


**Fig. 17. Inductive Turn-off Switching Times vs. Junction Temperature**

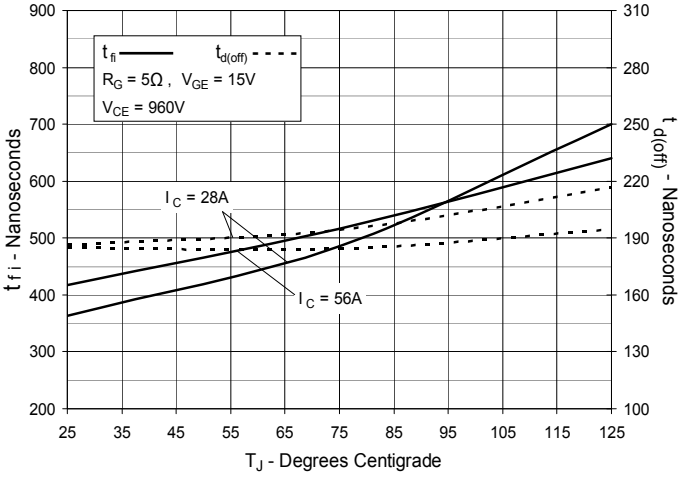


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**Fig. 18. Inductive Turn-on Switching Times vs. Gate Resistance**

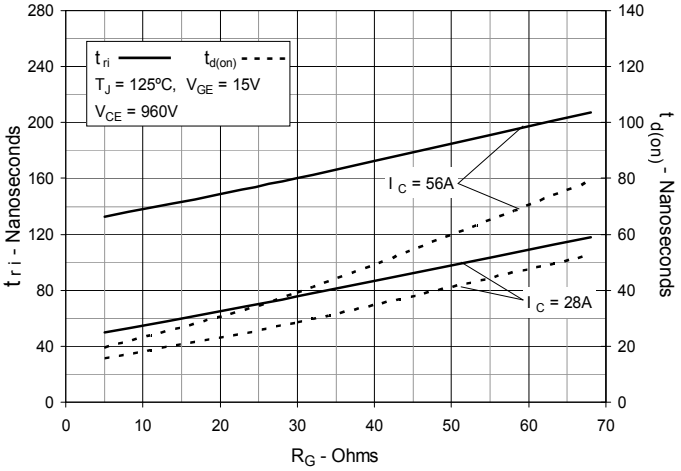



**Fig. 19. Inductive Turn-on Switching Times vs. Collector Current**

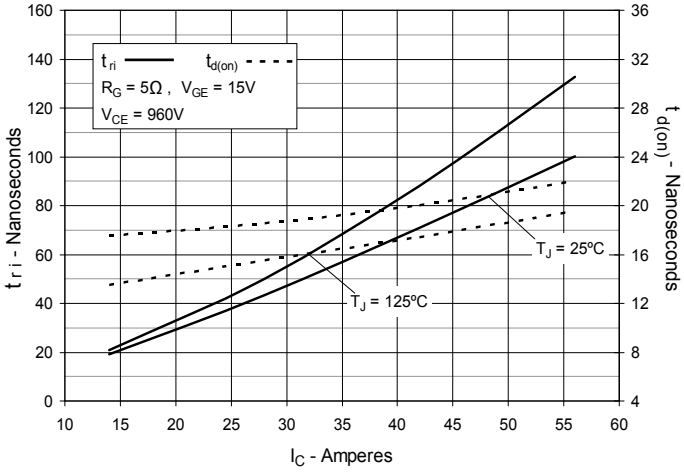
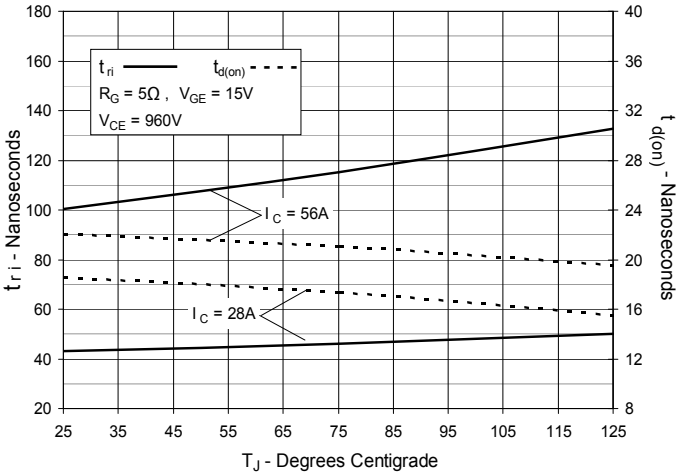



**Fig. 20. Inductive Turn-on Switching Times vs. Junction Temperature**

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