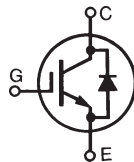


## IXGR48N60C3D1

**(Electrically Isolated Back Surface)**

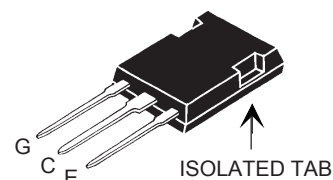
## High Speed PT IGBTs for 40-100kHz Switching


$$\begin{aligned} V_{CES} &= 600V \\ I_{C25} &= 56A \\ V_{CE(sat)} &\leq 2.7V \\ t_{fi(typ)} &= 38ns \end{aligned}$$

| Symbol            | Test Conditions                                                     | Maximum Ratings         |       |
|-------------------|---------------------------------------------------------------------|-------------------------|-------|
| V <sub>CES</sub>  | T <sub>J</sub> = 25°C to 150°C                                      | 600                     | V     |
| V <sub>CGR</sub>  | T <sub>J</sub> = 25°C to 150°C, R <sub>GE</sub> = 1MΩ               | 600                     | V     |
| V <sub>GES</sub>  | Continuous                                                          | ±20                     | V     |
| V <sub>GEM</sub>  | Transient                                                           | ±30                     | V     |
| I <sub>C25</sub>  | T <sub>C</sub> = 25°C                                               | 56                      | A     |
| I <sub>C110</sub> | T <sub>C</sub> = 110°C                                              | 26                      | A     |
| I <sub>D110</sub> | T <sub>C</sub> = 110°C                                              | 27                      | A     |
| I <sub>CM</sub>   | T <sub>C</sub> = 25°C, 1ms                                          | 230                     | A     |
| I <sub>A</sub>    | T <sub>C</sub> = 25°C                                               | 30                      | A     |
| E <sub>AS</sub>   | T <sub>C</sub> = 25°C                                               | 300                     | mJ    |
| SSOA              | V <sub>GE</sub> = 15V, T <sub>VJ</sub> = 125°C, R <sub>G</sub> = 3Ω | I <sub>CM</sub> = 100   | A     |
| (RBSOA)           | Clamped Inductive Load                                              | @ V <sub>CE</sub> ≤ 600 | V     |
| P <sub>C</sub>    | T <sub>C</sub> = 25°C                                               | 125                     | W     |
| T <sub>J</sub>    |                                                                     | -55 ... +150            | °C    |
| T <sub>JM</sub>   |                                                                     | 150                     | °C    |
| T <sub>stg</sub>  |                                                                     | -55 ... +150            | °C    |
| T <sub>L</sub>    | 1.6mm (0.062 in.) from Case for 10s                                 | 300                     | °C    |
| T <sub>SOLD</sub> | Plastic Body for 10 Seconds                                         | 260                     | °C    |
| V <sub>ISOL</sub> | 50/60 Hz RMS, t = 1min                                              | 2500                    | V~    |
| F <sub>C</sub>    | Mounting Force                                                      | 20..120 / 4.5..27       | N/lb. |
| Weight            |                                                                     | 5                       | g     |

| Symbol               | Test Conditions                                                                      | Characteristic Values<br>(T <sub>j</sub> = 25°C, Unless Otherwise Specified) |            |                   |
|----------------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------|------------|-------------------|
|                      |                                                                                      | Min.                                                                         | Typ.       | Max.              |
| V <sub>GE(th)</sub>  | I <sub>C</sub> = 250μA, V <sub>CE</sub> = V <sub>GE</sub>                            | 3.0                                                                          |            | 5.5 V             |
| I <sub>CES</sub>     | V <sub>CE</sub> = V <sub>CES</sub><br>V <sub>GE</sub> = 0V<br>T <sub>j</sub> = 125°C |                                                                              |            | 300 μA<br>1.75 mA |
| I <sub>GES</sub>     | V <sub>CE</sub> = 0V, V <sub>GE</sub> = ±20V                                         |                                                                              |            | ±100 nA           |
| V <sub>CE(sat)</sub> | I <sub>C</sub> = 30A, V <sub>GE</sub> = 15V, Note 1<br>T <sub>j</sub> = 125°C        |                                                                              | 2.3<br>1.8 | 2.7 V<br>V        |

**ISOPLUS 247™**



G = Gate      C = Collector  
F = Emitter

## Features

- Silicon Chip on Direct-Copper Bond (DCB) Substrate
  - UL Recognized Package
  - Isolated Mounting Surface
  - 2500V Electrical Isolation
- Avalanche Rated
- Square RBSOA
- Anti-Parallel Ultra Fast Diode
- Fast Switching
- International Standard Package

### Advantages

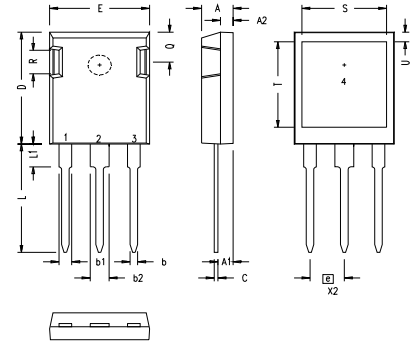
- High Power Density
- Low Gate Drive Requirement

## Applications

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

| Symbol                    | Test Conditions                                                                                                                      | Characteristic Values<br>(T <sub>J</sub> = 25°C, Unless Otherwise Specified) |      |      |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|------|------|
|                           |                                                                                                                                      | Min.                                                                         | Typ. | Max. |
| <b>g<sub>fs</sub></b>     | I <sub>C</sub> = 30A V <sub>CE</sub> = 10V, Note 1                                                                                   | 20                                                                           | 30   | S    |
| <b>C<sub>ies</sub></b>    | V <sub>CE</sub> = 25V, V <sub>GE</sub> = 0V, f = 1MHz                                                                                |                                                                              | 1960 | pF   |
| <b>C<sub>oes</sub></b>    |                                                                                                                                      |                                                                              | 220  | pF   |
| <b>C<sub>res</sub></b>    |                                                                                                                                      |                                                                              | 66   | pF   |
| <b>Q<sub>g</sub></b>      | I <sub>C</sub> = 30A, V <sub>GE</sub> = 15V, V <sub>CE</sub> = 0.5 • V <sub>CES</sub>                                                |                                                                              | 77   | nC   |
| <b>Q<sub>ge</sub></b>     |                                                                                                                                      |                                                                              | 16   | nC   |
| <b>Q<sub>gc</sub></b>     |                                                                                                                                      |                                                                              | 32   | nC   |
| <b>t<sub>d(on)</sub></b>  | Inductive Load, T <sub>J</sub> = 25°C<br>I <sub>C</sub> = 30A, V <sub>GE</sub> = 15V<br>V <sub>CE</sub> = 400V, R <sub>G</sub> = 3Ω  |                                                                              | 19   | ns   |
| <b>t<sub>ri</sub></b>     |                                                                                                                                      |                                                                              | 26   | ns   |
| <b>E<sub>on</sub></b>     |                                                                                                                                      |                                                                              | 0.41 | mJ   |
| <b>t<sub>d(off)</sub></b> |                                                                                                                                      |                                                                              | 60   | ns   |
| <b>t<sub>fi</sub></b>     |                                                                                                                                      |                                                                              | 38   | ns   |
| <b>E<sub>off</sub></b>    |                                                                                                                                      |                                                                              | 0.23 | mJ   |
| <b>t<sub>d(on)</sub></b>  | Inductive Load, T <sub>J</sub> = 125°C<br>I <sub>C</sub> = 30A, V <sub>GE</sub> = 15V<br>V <sub>CE</sub> = 400V, R <sub>G</sub> = 3Ω |                                                                              | 19   | ns   |
| <b>t<sub>ri</sub></b>     |                                                                                                                                      |                                                                              | 26   | ns   |
| <b>E<sub>on</sub></b>     |                                                                                                                                      |                                                                              | 0.65 | mJ   |
| <b>t<sub>d(off)</sub></b> |                                                                                                                                      |                                                                              | 92   | ns   |
| <b>t<sub>fi</sub></b>     |                                                                                                                                      |                                                                              | 95   | ns   |
| <b>E<sub>off</sub></b>    |                                                                                                                                      |                                                                              | 0.57 | mJ   |
| <b>R<sub>thJC</sub></b>   |                                                                                                                                      |                                                                              | 1.0  | °C/W |
| <b>R<sub>thCS</sub></b>   |                                                                                                                                      | 0.15                                                                         |      | °C/W |

## ISOPLUS247 (IXGR) Outline



| SYM | INCHES   |      | MILLIMETERS |       |
|-----|----------|------|-------------|-------|
|     | MIN      | MAX  | MIN         | MAX   |
| A   | .190     | .205 | 4.83        | 5.21  |
| A1  | .090     | .100 | 2.29        | 2.54  |
| A2  | .075     | .085 | 1.91        | 2.16  |
| b   | .045     | .055 | 1.14        | 1.40  |
| b1  | .075     | .084 | 1.91        | 2.13  |
| b2  | .115     | .123 | 2.92        | 3.12  |
| C   | .024     | .031 | 0.61        | 0.80  |
| D   | .819     | .840 | 20.80       | 21.34 |
| E   | .620     | .635 | 15.75       | 16.13 |
| e   | .215 BSC |      | 5.45 BSC    |       |
| L   | .780     | .800 | 19.81       | 20.32 |
| L1  | .150     | .170 | 3.81        | 4.32  |
| Q   | .220     | .244 | 5.59        | 6.20  |
| R   | .170     | .190 | 4.32        | 4.83  |
| S   | .520     | .540 | 13.21       | 13.72 |
| T   | .620     | .640 | 15.75       | 16.26 |
| U   | .065     | .080 | 1.65        | 2.03  |

- 1 - GATE  
2 - DRAIN (COLLECTOR)  
3 - SOURCE (EMITTER)  
4 - NO CONNECTION

NOTE: This drawing will meet all dimensions requirement of JEDEC outline TO-247AD except screw hole.

| Symbol                  | Test Conditions                                                             | Characteristic Values<br>(T <sub>J</sub> = 25°C, Unless Otherwise Specified) |      |          |
|-------------------------|-----------------------------------------------------------------------------|------------------------------------------------------------------------------|------|----------|
|                         |                                                                             | Min.                                                                         | Typ. | Max.     |
| <b>V<sub>F</sub></b>    | I <sub>F</sub> = 30A, V <sub>GE</sub> = 0V, Note 1                          | T <sub>J</sub> = 25°C                                                        |      | 2.7 V    |
| <b>I<sub>RM</sub></b>   | I <sub>F</sub> = 30A, V <sub>GE</sub> = 0V, -di <sub>F</sub> /dt = 100A/μs, | T <sub>J</sub> = 100°C                                                       |      | 4 A      |
| <b>t<sub>rr</sub></b>   | V <sub>R</sub> = 100V                                                       | T <sub>J</sub> = 100°C                                                       | 100  | ns       |
|                         | I <sub>F</sub> = 1A, -di <sub>F</sub> /dt = 100A/μs; V <sub>R</sub> = 30V   |                                                                              | 25   | ns       |
| <b>R<sub>thJC</sub></b> |                                                                             |                                                                              |      | 1.5 °C/W |

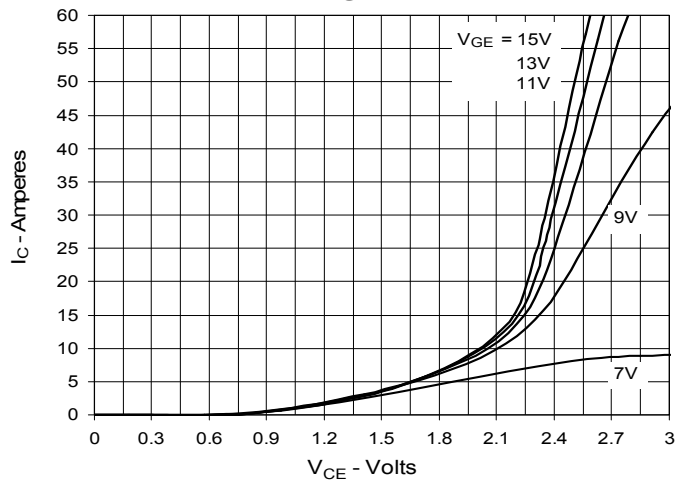
Note 1: Pulse test, t ≤ 300μs, Duty cycle, d ≤ 2 %.

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

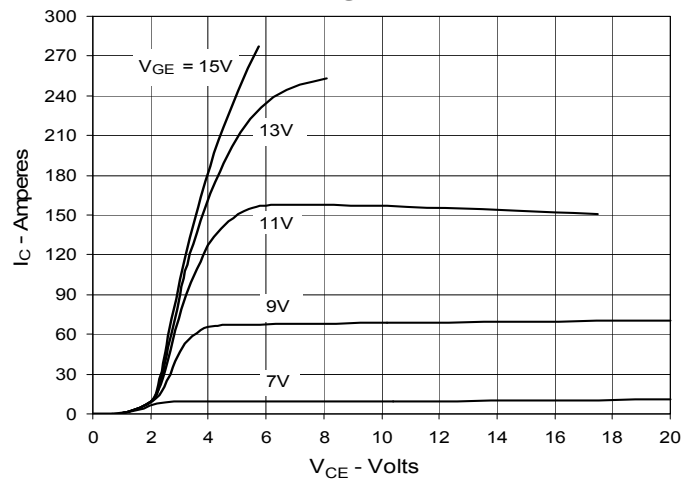
IXYS MOSFETs and IGBTs are covered by one or more of the following U.S. patents:

|           |           |           |           |              |              |              |              |              |              |
|-----------|-----------|-----------|-----------|--------------|--------------|--------------|--------------|--------------|--------------|
| 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    | 7,005,734 B2 | 7,157,338 B2 |
| 4,850,072 | 5,017,508 | 5,063,307 | 5,381,025 | 6,259,123 B1 | 6,534,343    | 6,710,405 B2 | 6,759,692    | 7,063,975 B2 |              |
| 4,881,106 | 5,034,796 | 5,187,117 | 5,486,715 | 6,306,728 B1 | 6,583,505    | 6,710,463    | 6,771,478 B2 | 7,071,537    |              |

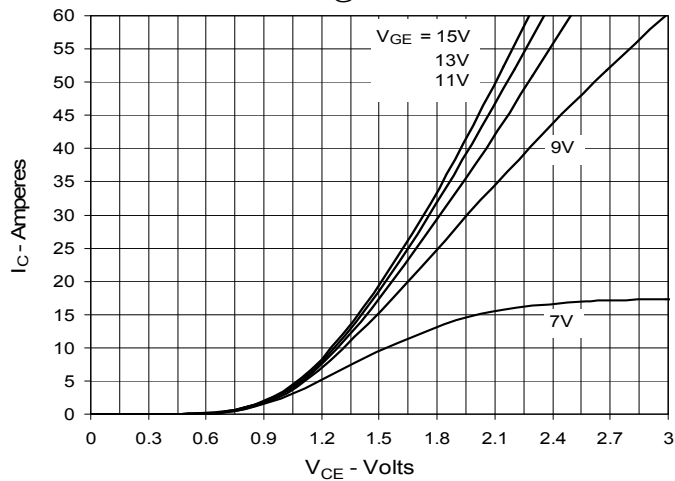
**Fig. 1. Output Characteristics**  
@ 25°C



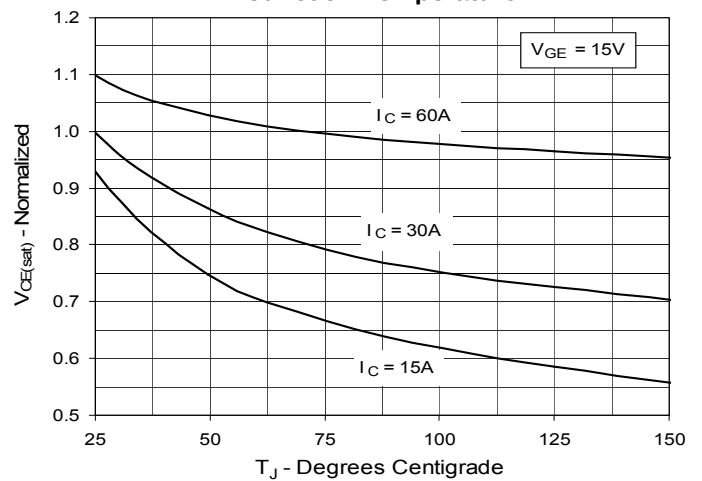
**Fig. 2. Extended Output Characteristics**  
@ 25°C



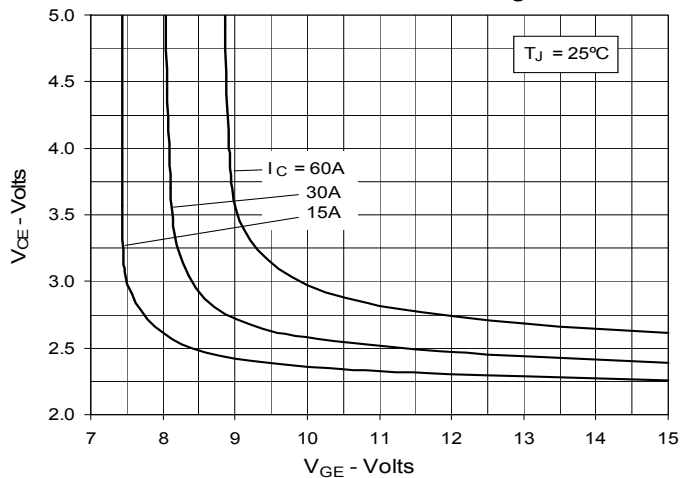
**Fig. 3. Output Characteristics**  
@ 125°C



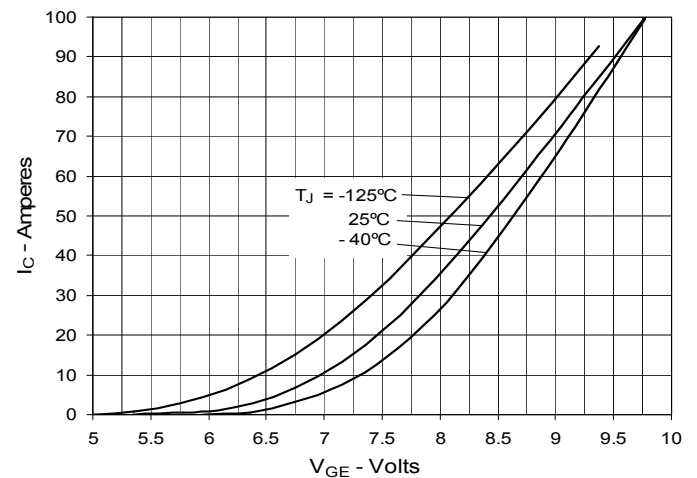
**Fig. 4. Dependence of  $V_{CE(sat)}$  on Junction Temperature**

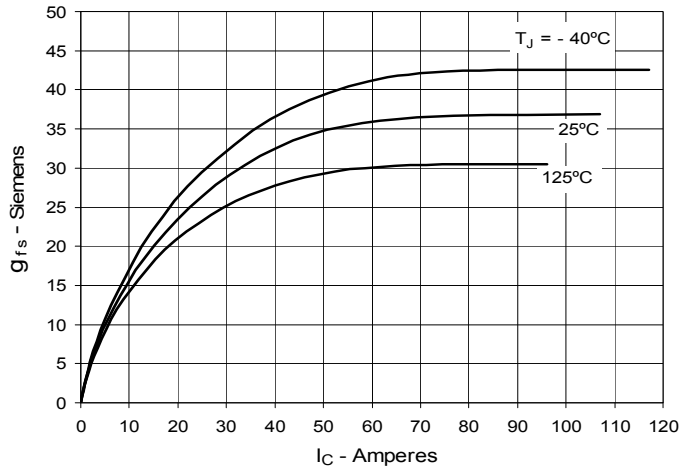
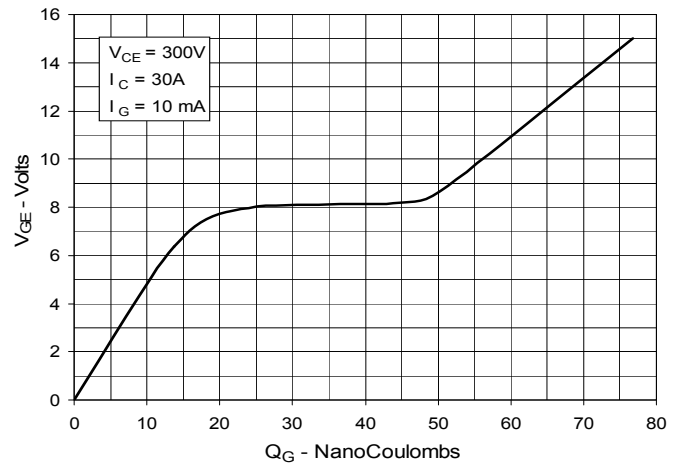
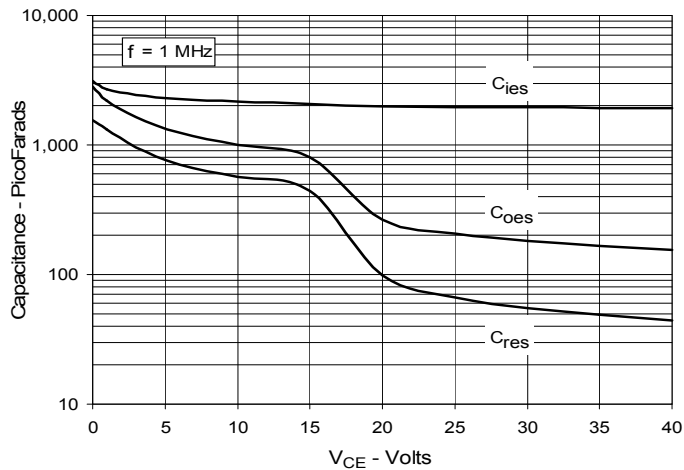
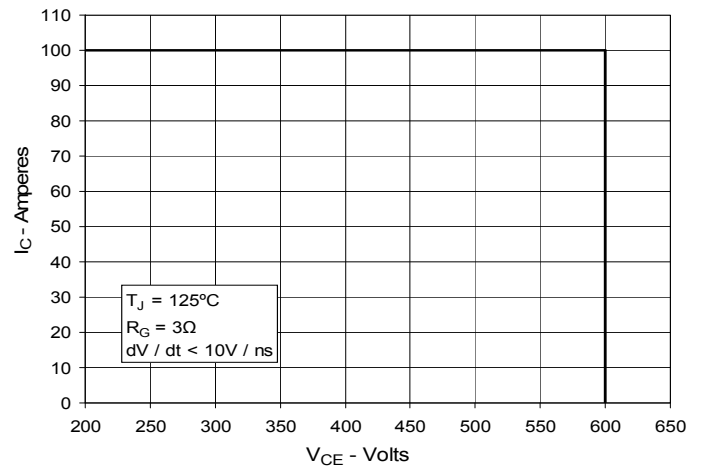
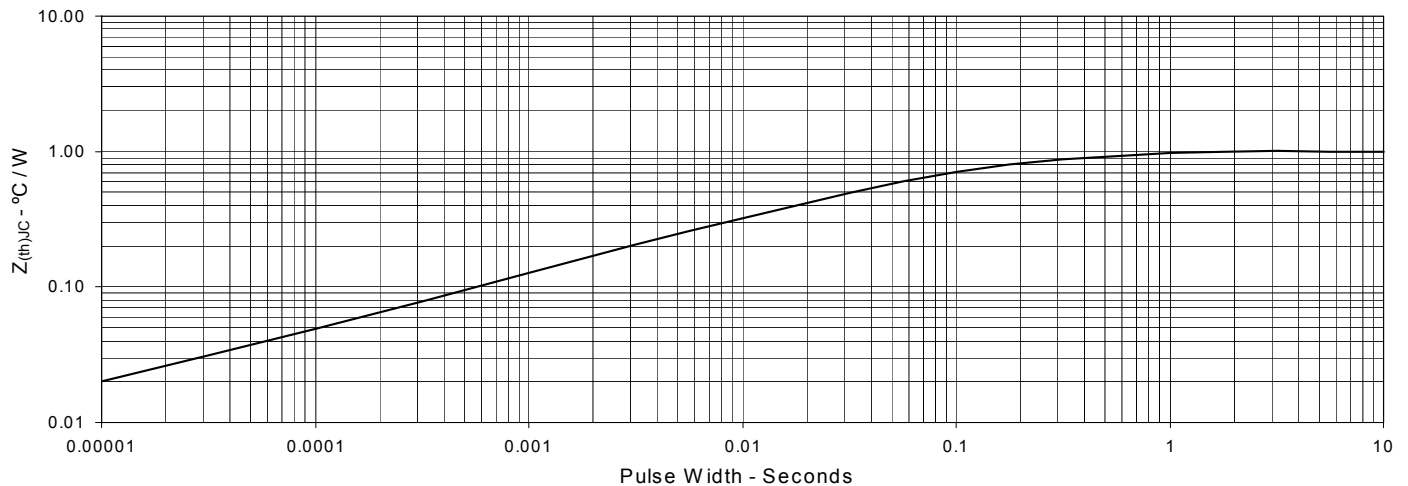


**Fig. 5. Collector-to-Emitter Voltage vs. Gate-to-Emitter Voltage**

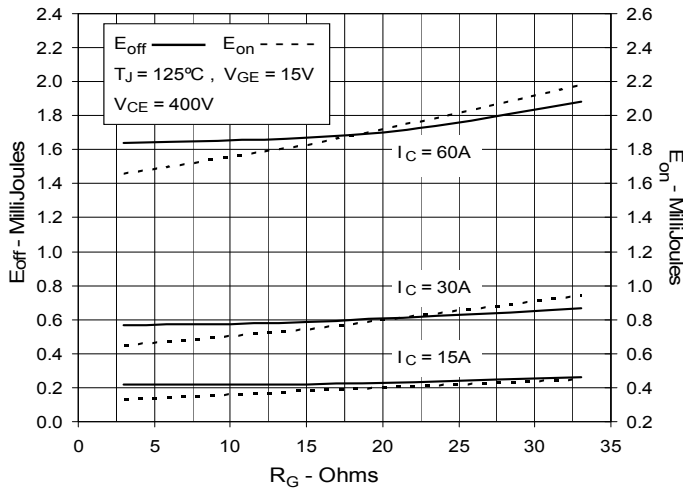


**Fig. 6. Input Admittance**

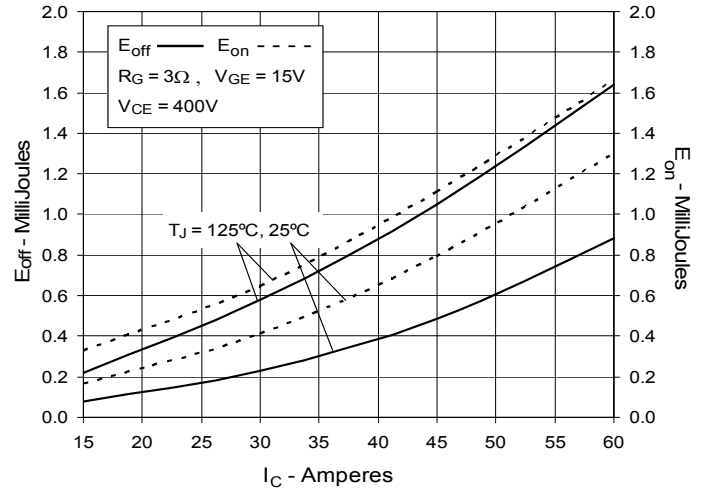


**Fig. 7. Transconductance**

**Fig. 8. Gate Charge**

**Fig. 9. Capacitance**

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

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


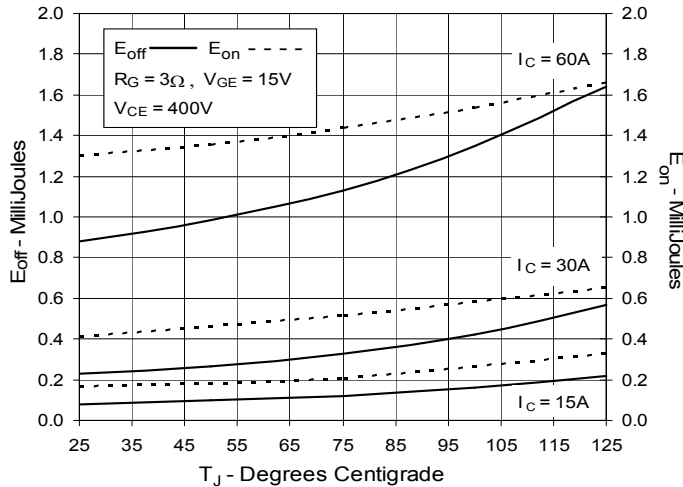
**Fig. 12. Inductive Switching  
Energy Loss vs. Gate Resistance**



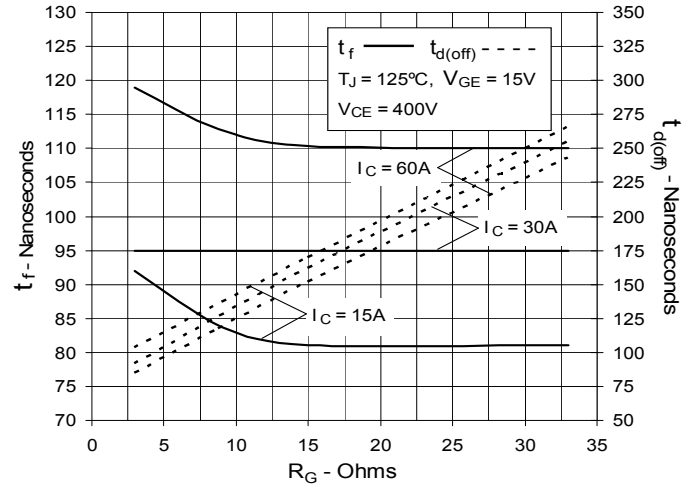
**Fig. 13. Inductive Switching  
Energy Loss vs. Collector Current**



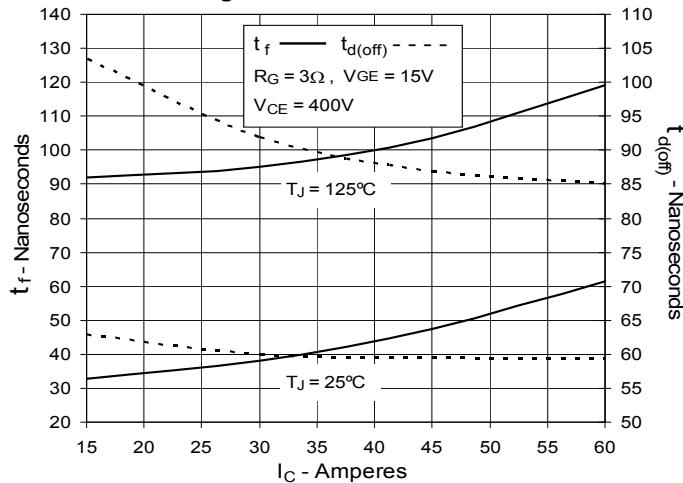
**Fig. 14. Inductive Switching  
Energy Loss vs. Junction Temperature**



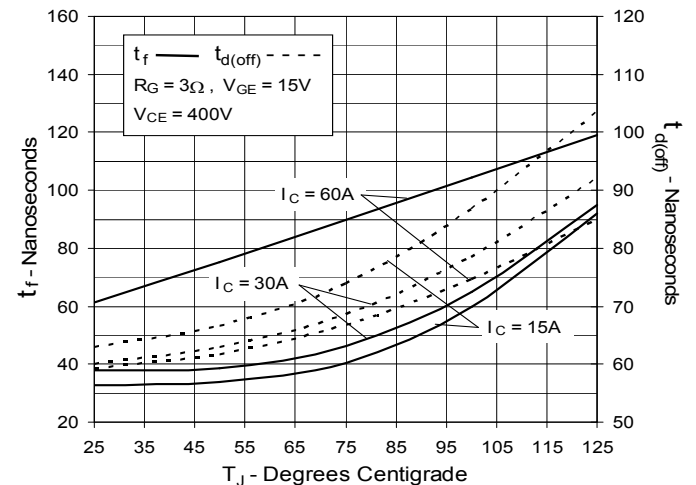
**Fig. 15. Inductive Turn-off  
Switching Times vs. Gate Resistance**



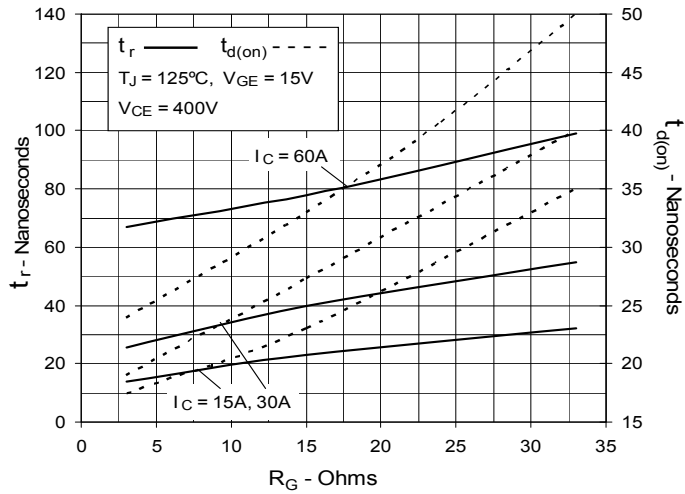
**Fig. 16. Inductive Turn-off  
Switching Times vs. Collector Current**



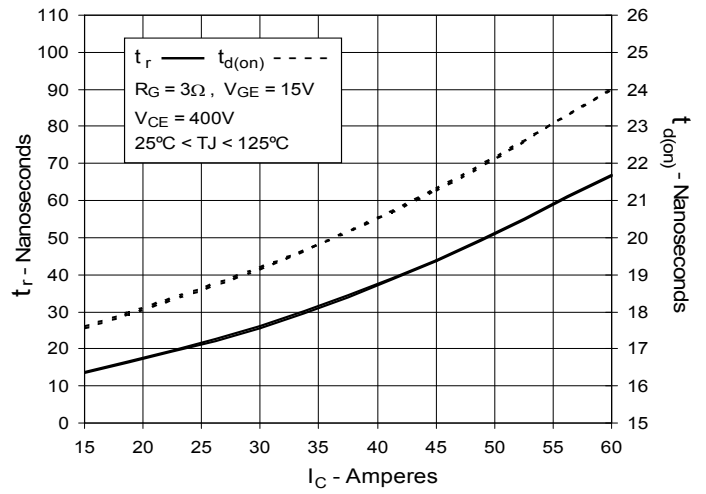
**Fig. 17. Inductive Turn-off  
Switching Times vs. Junction Temperature**



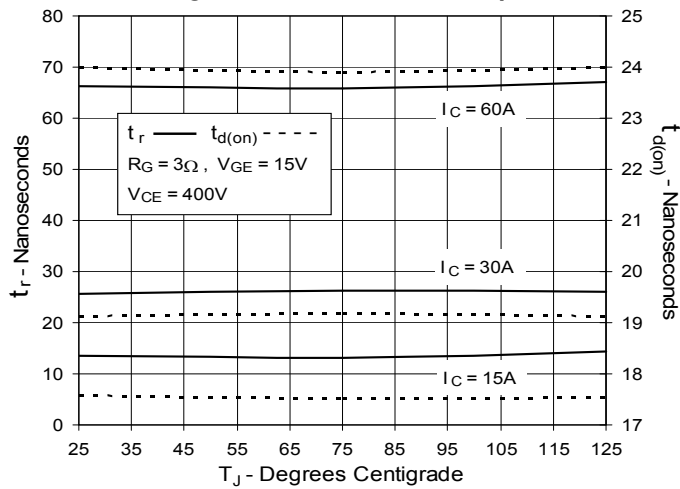
**Fig. 18. Inductive Turn-on  
Switching Times vs. Gate Resistance**



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



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



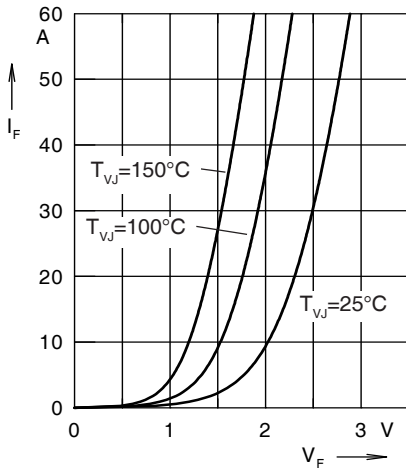


Fig. 21. Forward current  $I_F$  versus  $V_F$

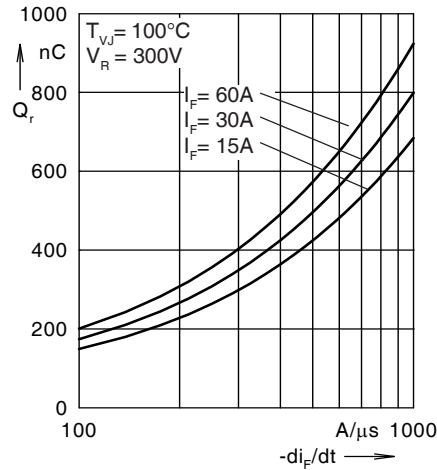


Fig. 22. Reverse recovery charge  $Q_r$  versus  $-di_F/dt$

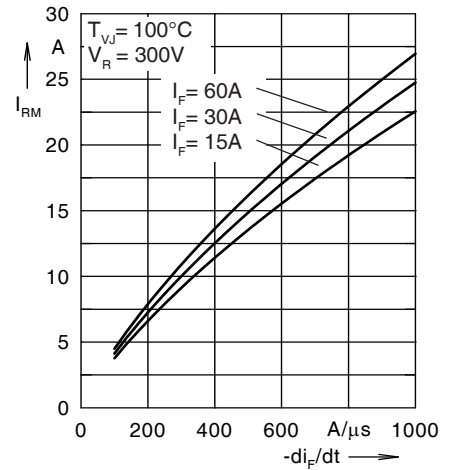


Fig. 23. Peak reverse current  $I_{RM}$  versus  $-di_F/dt$

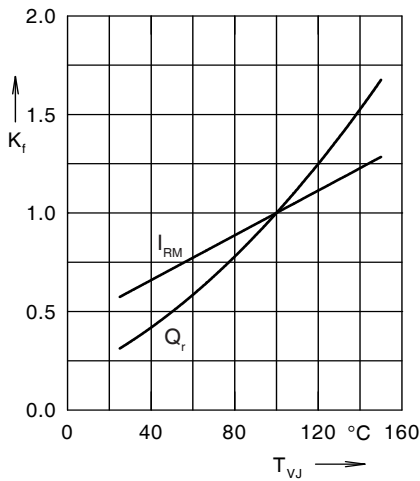


Fig. 24. Dynamic parameters  $Q_r$ ,  $I_{RM}$  versus  $T_{VJ}$

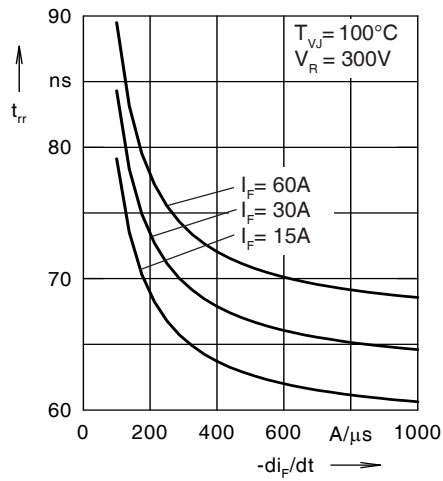


Fig. 25. Recovery time  $t_{rr}$  versus  $-di_F/dt$

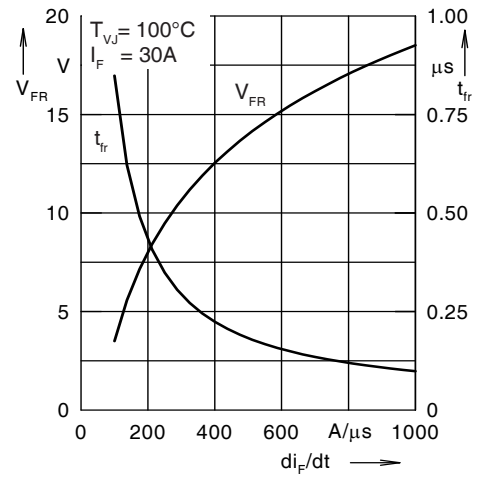


Fig. 26. Peak forward voltage  $V_{FR}$  and  $t_{fr}$  versus  $di_F/dt$

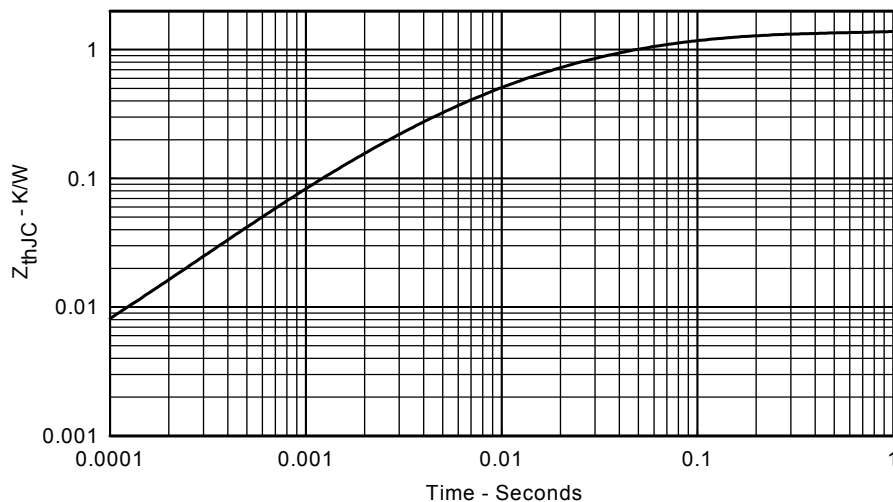


Fig. 27. Transient thermal resistance junction to case