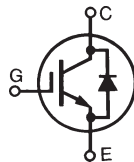


## GenX3™ 600V IGBT with Diode

## IXGR48N60C3D1

(Electrically Isolated Back Surface)

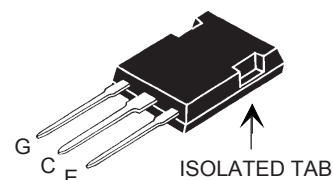
High Speed PT IGBTs for  
40-100kHz Switching



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

| Symbol                        | Test Conditions                                                                                  | Maximum Ratings                       |                  |
|-------------------------------|--------------------------------------------------------------------------------------------------|---------------------------------------|------------------|
| $V_{CES}$                     | $T_J = 25^\circ\text{C}$ to $150^\circ\text{C}$                                                  | 600                                   | V                |
| $V_{CGR}$                     | $T_J = 25^\circ\text{C}$ to $150^\circ\text{C}$ , $R_{GE} = 1\text{M}\Omega$                     | 600                                   | V                |
| $V_{GES}$                     | Continuous                                                                                       | $\pm 20$                              | V                |
| $V_{GEM}$                     | Transient                                                                                        | $\pm 30$                              | V                |
| $I_{C25}$                     | $T_C = 25^\circ\text{C}$                                                                         | 56                                    | A                |
| $I_{C110}$                    | $T_C = 110^\circ\text{C}$                                                                        | 26                                    | A                |
| $I_{D110}$                    | $T_C = 110^\circ\text{C}$                                                                        | 27                                    | A                |
| $I_{CM}$                      | $T_C = 25^\circ\text{C}$ , 1ms                                                                   | 230                                   | A                |
| $I_A$                         | $T_C = 25^\circ\text{C}$                                                                         | 30                                    | A                |
| $E_{AS}$                      | $T_C = 25^\circ\text{C}$                                                                         | 300                                   | mJ               |
| <b>SSOA</b><br><b>(RBSOA)</b> | $V_{GE} = 15\text{V}$ , $T_{VJ} = 125^\circ\text{C}$ , $R_G = 3\Omega$<br>Clamped Inductive Load | $I_{CM} = 100$<br>@ $V_{CE} \leq 600$ | A<br>V           |
| $P_C$                         | $T_C = 25^\circ\text{C}$                                                                         | 125                                   | W                |
| $T_J$                         |                                                                                                  | -55 ... +150                          | $^\circ\text{C}$ |
| $T_{JM}$                      |                                                                                                  | 150                                   | $^\circ\text{C}$ |
| $T_{stg}$                     |                                                                                                  | -55 ... +150                          | $^\circ\text{C}$ |
| $T_L$                         | 1.6mm (0.062 in.) from Case for 10s                                                              | 300                                   | $^\circ\text{C}$ |
| $T_{SOLD}$                    | Plastic Body for 10 Seconds                                                                      | 260                                   | $^\circ\text{C}$ |
| $V_{ISOL}$                    | 50/60 Hz RMS, $t = 1\text{min}$                                                                  | 2500                                  | V~               |
| $F_C$                         | Mounting Force                                                                                   | 20..120 / 4.5..27                     | N/lb.            |
| <b>Weight</b>                 |                                                                                                  | 5                                     | g                |

### ISOPLUS 247™



G = Gate      C = Collector  
E = 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

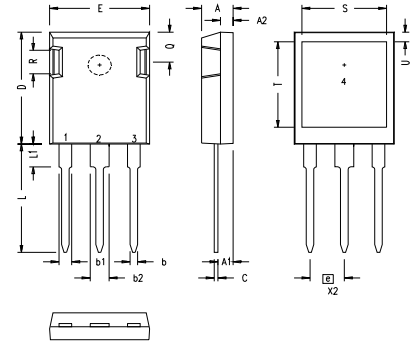
### Applications

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

| Symbol        | Test Conditions                                                                  | Characteristic Values<br>( $T_J = 25^\circ\text{C}$ , Unless Otherwise Specified) |            |                              |
|---------------|----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------|------------------------------|
|               |                                                                                  | Min.                                                                              | Typ.       | Max.                         |
| $V_{GE(th)}$  | $I_C = 250\mu\text{A}$ , $V_{CE} = V_{GE}$                                       | 3.0                                                                               |            | 5.5 V                        |
| $I_{CES}$     | $V_{CE} = V_{CES}$<br>$V_{GE} = 0\text{V}$ $T_J = 125^\circ\text{C}$             |                                                                                   |            | 300 $\mu\text{A}$<br>1.75 mA |
| $I_{GES}$     | $V_{CE} = 0\text{V}$ , $V_{GE} = \pm 20\text{V}$                                 |                                                                                   |            | $\pm 100$ nA                 |
| $V_{CE(sat)}$ | $I_C = 30\text{A}$ , $V_{GE} = 15\text{V}$ , Note 1<br>$T_J = 125^\circ\text{C}$ |                                                                                   | 2.3<br>1.8 | 2.7 V<br>V                   |

| 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.

## Reverse Diode (FRED)

| 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 |

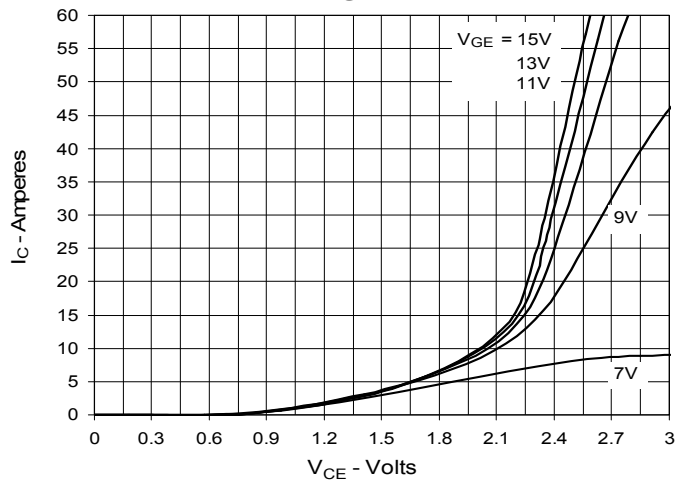
Note 1: Pulse test, t ≤ 300μs, Duty cycle, d ≤ 2 %.

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

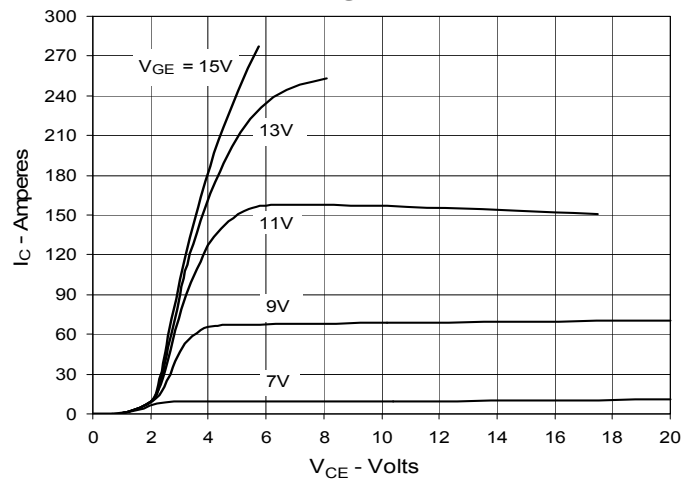
IXYS MOSFETs and IGBTs are covered by one or more of the following U.S. patents:

|           |           |           |           |              |              |              |              |              |              |
|-----------|-----------|-----------|-----------|--------------|--------------|--------------|--------------|--------------|--------------|
| 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    |              |

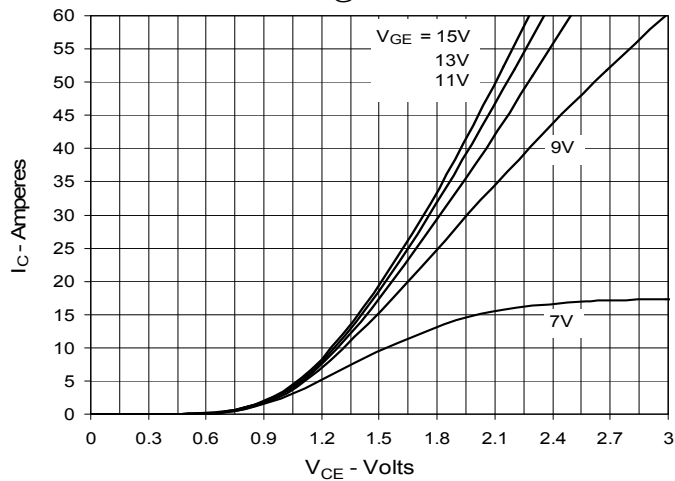
**Fig. 1. Output Characteristics**  
@ 25°C



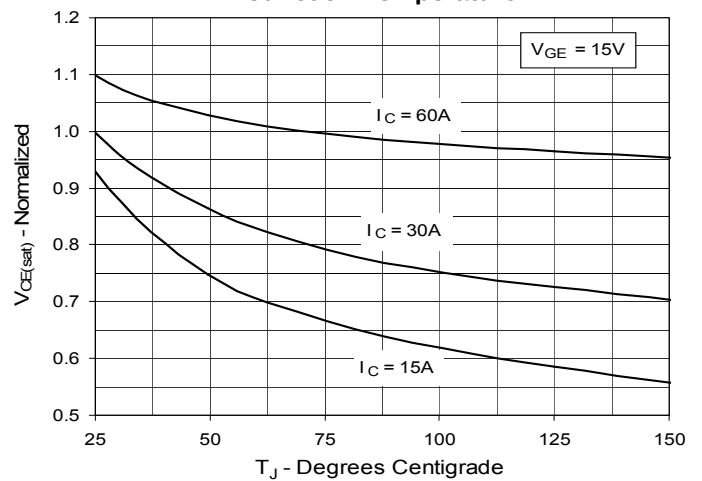
**Fig. 2. Extended Output Characteristics**  
@ 25°C



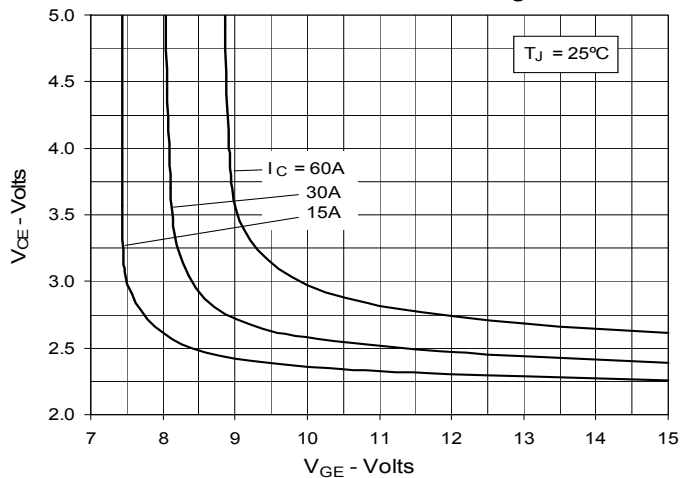
**Fig. 3. Output Characteristics**  
@ 125°C



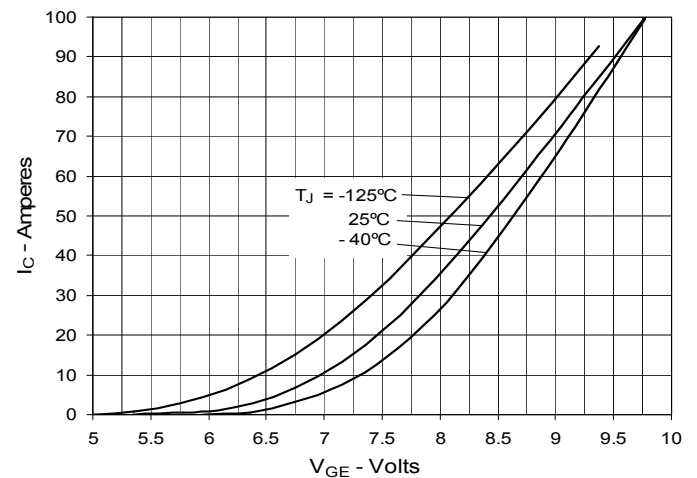
**Fig. 4. Dependence of  $V_{CE(sat)}$  on Junction Temperature**

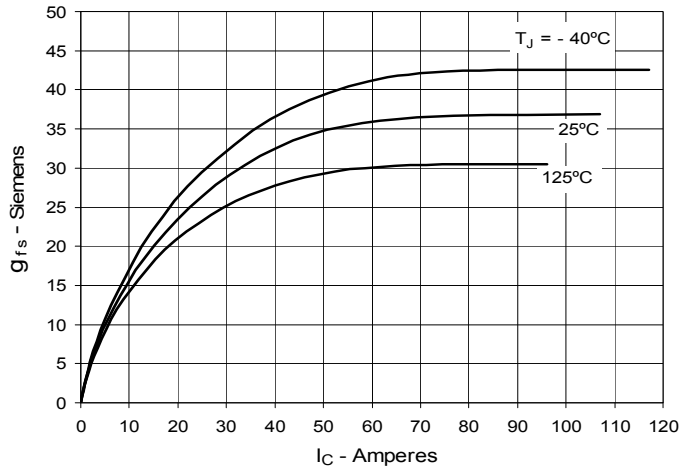
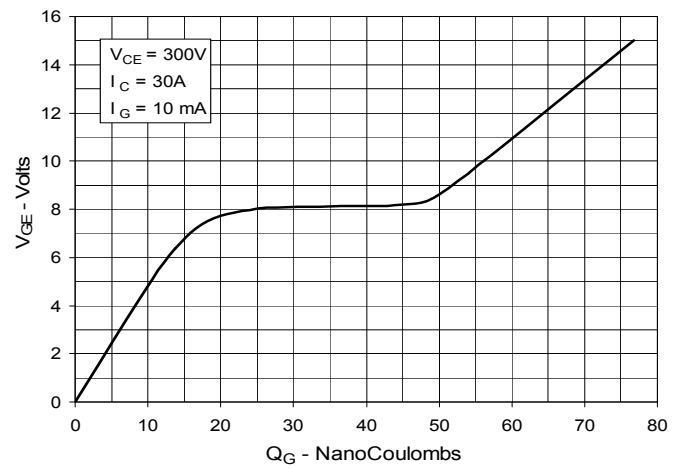
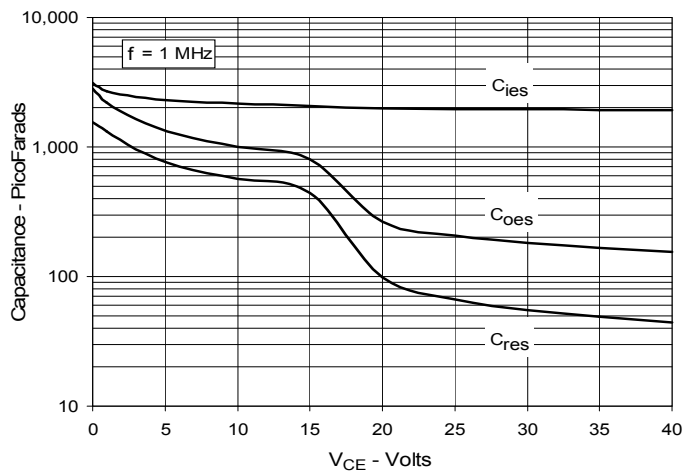
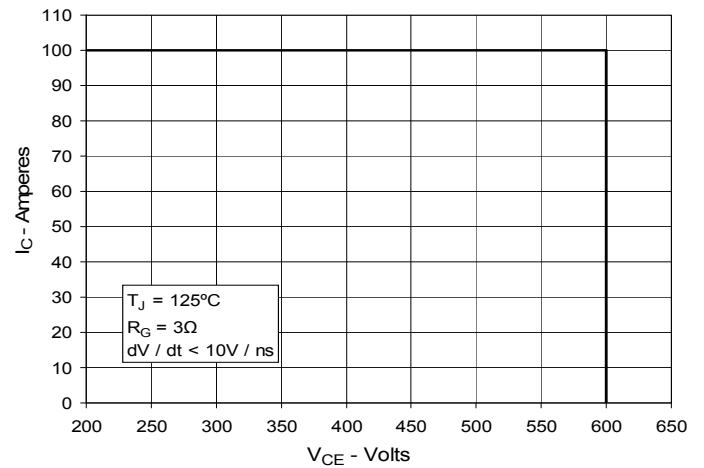
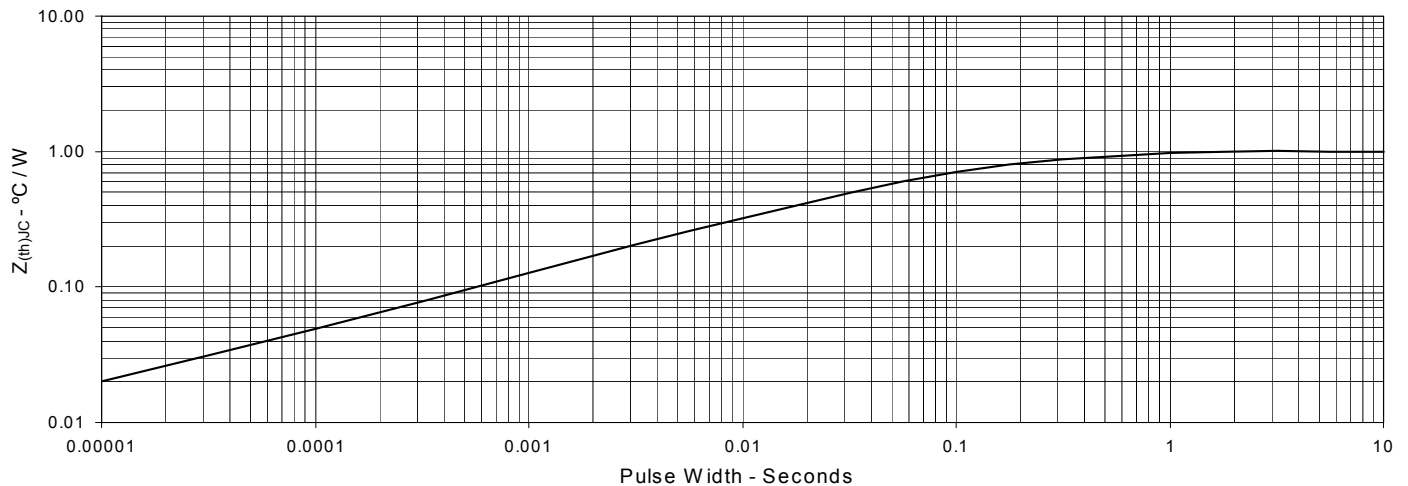


**Fig. 5. Collector-to-Emitter Voltage vs. Gate-to-Emitter Voltage**

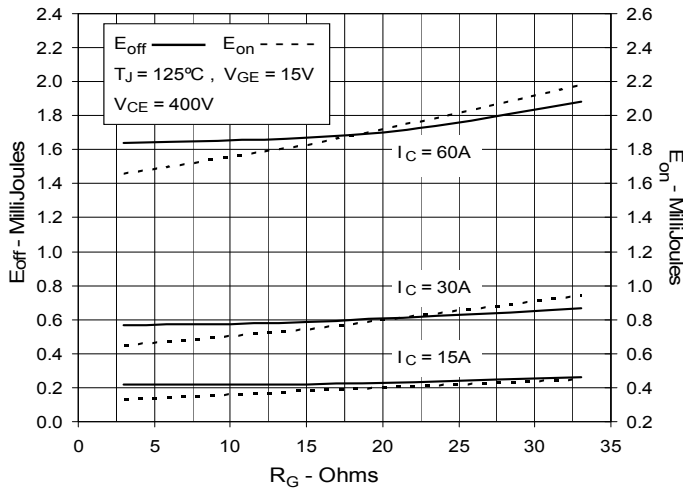


**Fig. 6. Input Admittance**

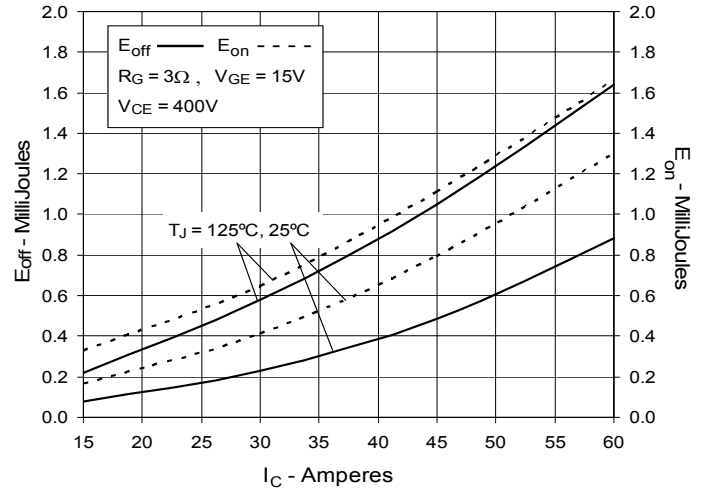


**Fig. 7. Transconductance**

**Fig. 8. Gate Charge**

**Fig. 9. Capacitance**

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

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


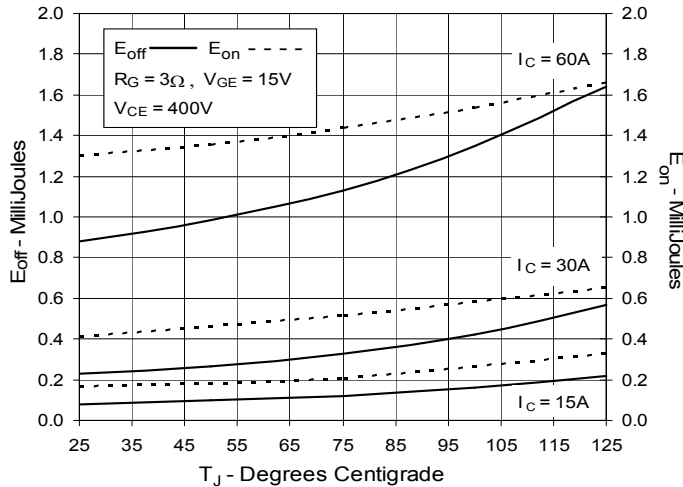
**Fig. 12. Inductive Switching  
Energy Loss vs. Gate Resistance**



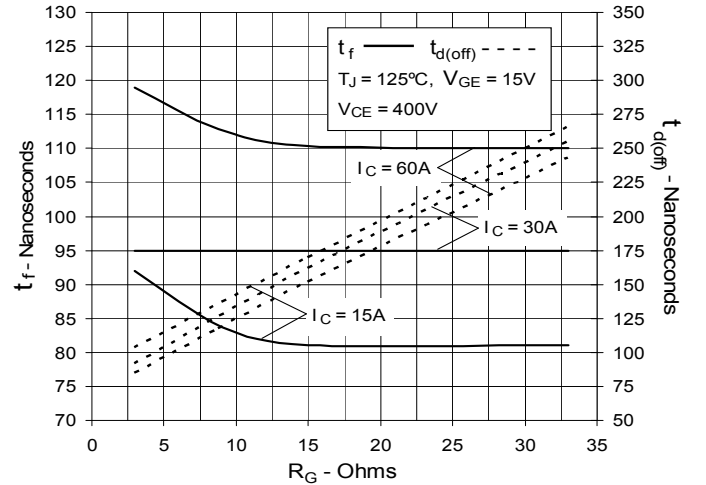
**Fig. 13. Inductive Switching  
Energy Loss vs. Collector Current**



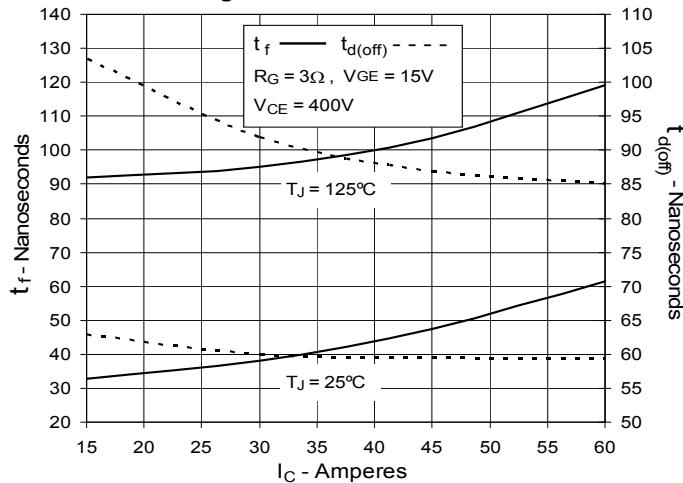
**Fig. 14. Inductive Switching  
Energy Loss vs. Junction Temperature**



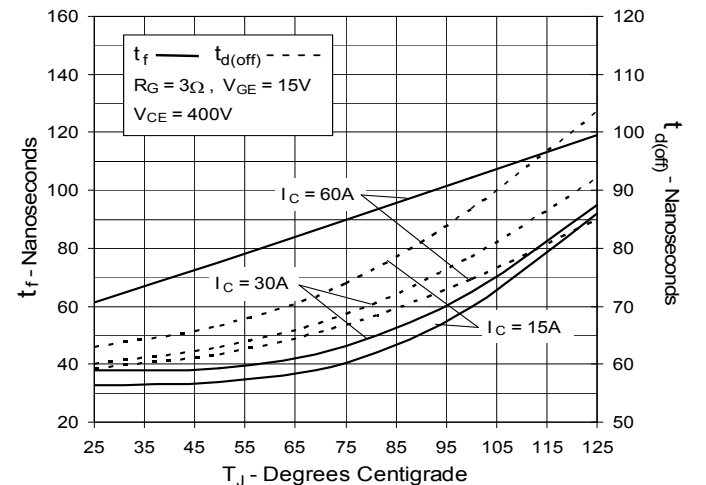
**Fig. 15. Inductive Turn-off  
Switching Times vs. Gate Resistance**



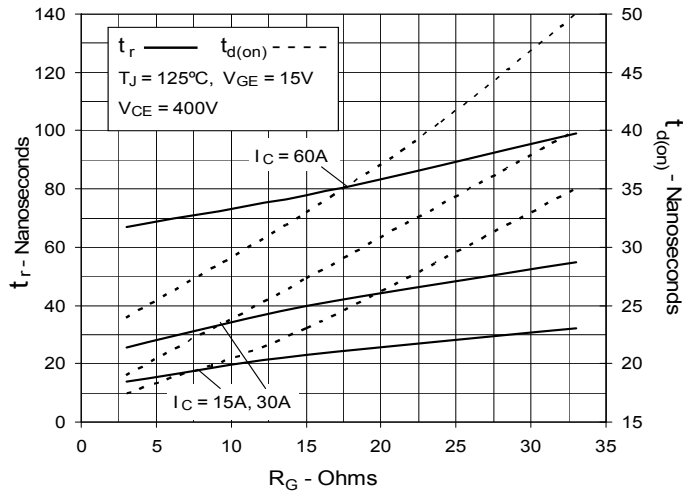
**Fig. 16. Inductive Turn-off  
Switching Times vs. Collector Current**



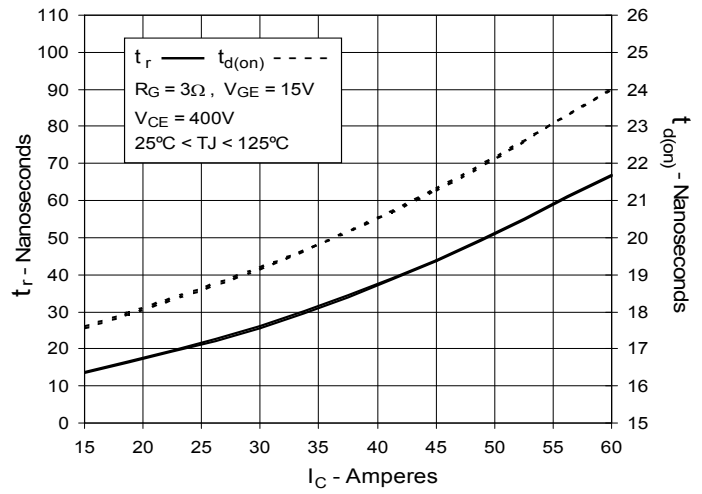
**Fig. 17. Inductive Turn-off  
Switching Times vs. Junction Temperature**



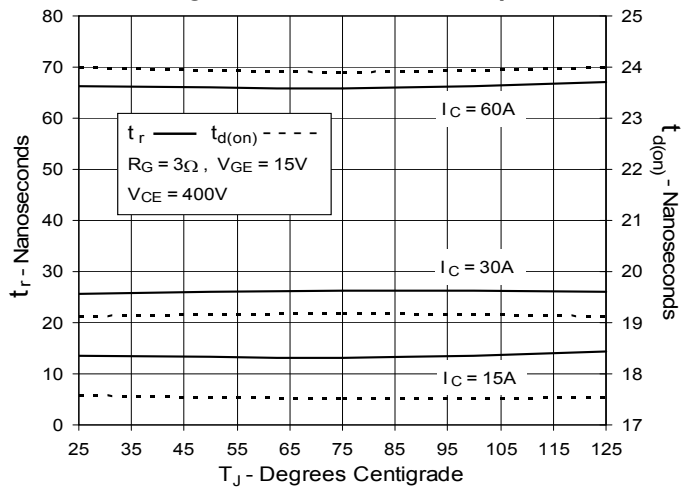
**Fig. 18. Inductive Turn-on  
Switching Times vs. Gate Resistance**



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



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



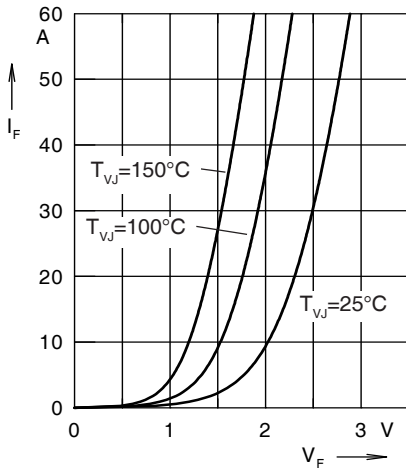


Fig. 21. Forward current  $I_F$  versus  $V_F$

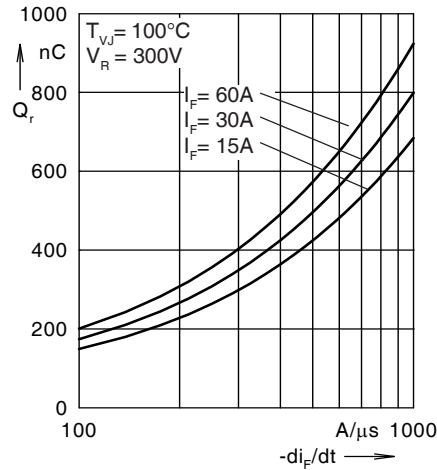


Fig. 22. Reverse recovery charge  $Q_r$  versus  $-di_F/dt$

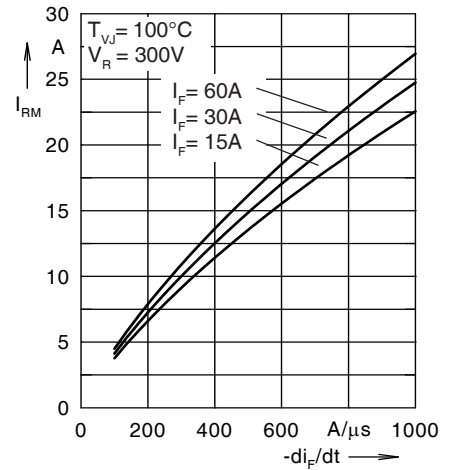


Fig. 23. Peak reverse current  $I_{RM}$  versus  $-di_F/dt$

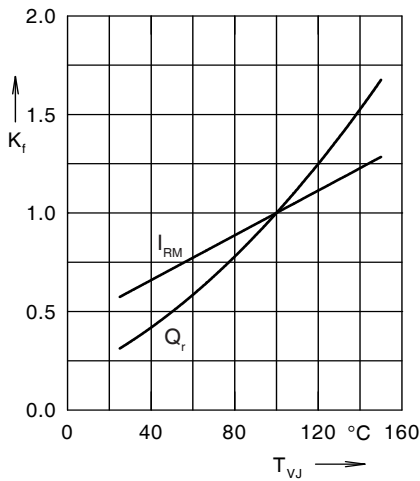


Fig. 24. Dynamic parameters  $Q_r$ ,  $I_{RM}$  versus  $T_{VJ}$

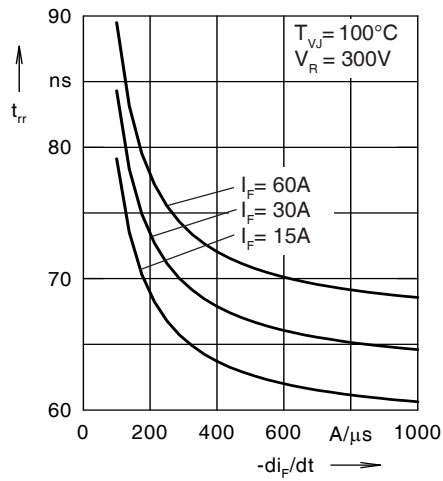


Fig. 25. Recovery time  $t_{rr}$  versus  $-di_F/dt$

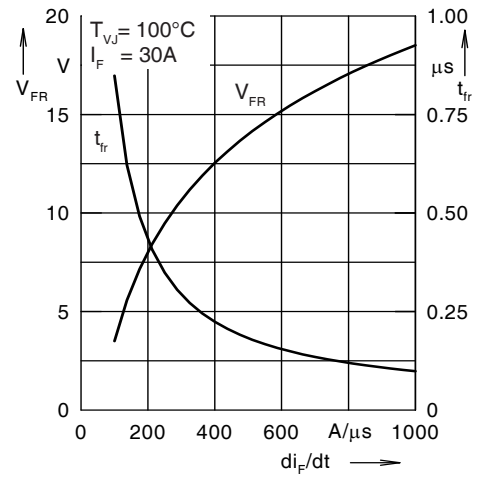


Fig. 26. Peak forward voltage  $V_{FR}$  and  $t_{fr}$  versus  $di_F/dt$

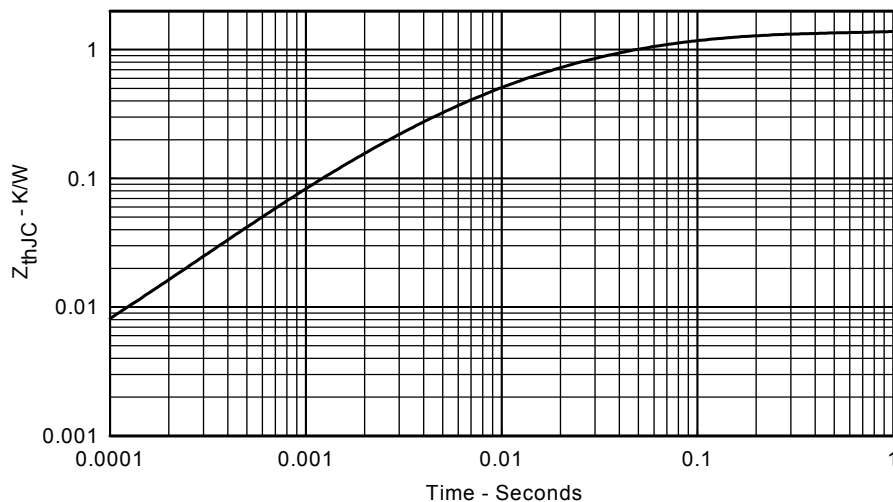


Fig. 27. Transient thermal resistance junction to case



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