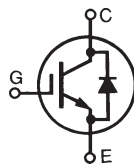


### GenX3™ 600V IGBT with Diode

### IXGH48N60B3D1

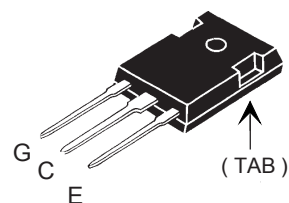
Medium speed low V<sub>sat</sub> PT  
IGBTs 5-40 kHz switching



$$\begin{aligned} V_{CES} &= 600V \\ I_{C110} &= 48A \\ V_{CE(sat)} &\leq 1.8V \end{aligned}$$

| Symbol                        | Test Conditions                                                                                         | Maximum Ratings |                  |
|-------------------------------|---------------------------------------------------------------------------------------------------------|-----------------|------------------|
| $V_{CES}$                     | $T_C = 25^\circ\text{C}$ to $150^\circ\text{C}$                                                         | 600             | V                |
| $V_{CGR}$                     | $T_J = 25^\circ\text{C}$ to $150^\circ\text{C}$ , $R_{GE} = 1M\Omega$                                   | 600             | V                |
| $V_{GES}$                     | Continuous                                                                                              | $\pm 20$        | V                |
| $V_{GEM}$                     | Transient                                                                                               | $\pm 30$        | V                |
| $I_{C110}$                    | $T_C = 110^\circ\text{C}$                                                                               | 48              | A                |
| $I_{D110}$                    | $T_C = 110^\circ\text{C}$                                                                               | 30              | A                |
| $I_{CM}$                      | $T_C = 25^\circ\text{C}$ , 1ms                                                                          | 280             | A                |
| <b>SSOA</b><br><b>(RBSOA)</b> | $V_{GE} = 15V$ , $T_{VJ} = 125^\circ\text{C}$ , $R_G = 5\Omega$<br>Clamped inductive load @ $\leq 600V$ | $I_{CM} = 120$  | A                |
| $P_C$                         | $T_C = 25^\circ\text{C}$                                                                                | 300             | 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             | $^\circ\text{C}$ |
| $M_d$                         | Mounting torque                                                                                         | 1.13/10         | Nm/lb.in.        |
| <b>Weight</b>                 |                                                                                                         | 6               | g                |

#### TO-247(IXGH)



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

#### Features

- Optimized for low conduction and switching losses
- Square RBSOA
- Anti-parallel ultra fast diode
- International standard package

#### Advantages

- High power density
- Low gate drive requirement

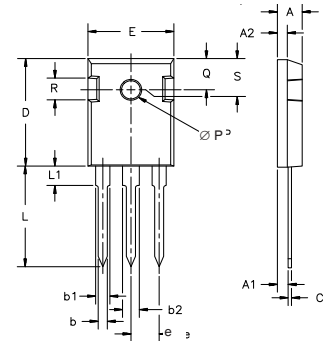
#### Applications

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

| Symbol        | Test Conditions<br>( $T_J = 25^\circ\text{C}$ unless otherwise specified) | Characteristic Values |      |                              |
|---------------|---------------------------------------------------------------------------|-----------------------|------|------------------------------|
|               |                                                                           | Min.                  | Typ. | Max.                         |
| $BV_{CES}$    | $I_C = 250\mu\text{A}$ , $V_{GE} = 0V$                                    | 600                   |      | V                            |
| $V_{GE(th)}$  | $I_C = 250\mu\text{A}$ , $V_{CE} = V_{GE}$                                | 3.0                   |      | 5.0 V                        |
| $I_{CES}$     | $V_{CE} = V_{CES}$<br>$V_{GE} = 0V$ $T_J = 125^\circ\text{C}$             |                       |      | 300 $\mu\text{A}$<br>1.75 mA |
| $I_{GES}$     | $V_{CE} = 0V$ , $V_{GE} = \pm 20V$                                        |                       |      | $\pm 100$ nA                 |
| $V_{CE(sat)}$ | $I_C = 32A$ , $V_{GE} = 15V$ , Note 1                                     |                       |      | 1.8 V                        |

| Symbol       | Test Conditions                                       | Characteristic Values          |      |              |
|--------------|-------------------------------------------------------|--------------------------------|------|--------------|
|              |                                                       | Min.                           | Typ. | Max.         |
| $g_{fs}$     | $I_C = 30A, V_{CE} = 10V$ , Note 1                    | 28                             | 46   | S            |
| $C_{ies}$    | $V_{CE} = 25V, V_{GE} = 0V, f = 1MHz$                 |                                | 3980 | pF           |
| $C_{oes}$    |                                                       |                                | 190  | pF           |
| $C_{res}$    |                                                       |                                | 45   | pF           |
| $Q_g$        | $I_C = 40A, V_{GE} = 15V, V_{CE} = 0.5 \cdot V_{CES}$ |                                | 115  | nC           |
| $Q_{ge}$     |                                                       |                                | 21   | nC           |
| $Q_{gc}$     |                                                       |                                | 40   | nC           |
| $t_{d(on)}$  | Inductive Load, $T_J = 25^\circ C$                    |                                | 22   | ns           |
| $t_{ri}$     |                                                       |                                | 25   | ns           |
| $E_{on}$     |                                                       | $I_C = 30A, V_{GE} = 15V$      | 0.84 | mJ           |
| $t_{d(off)}$ |                                                       | $V_{CE} = 480V, R_G = 5\Omega$ | 130  | 200 ns       |
| $t_{fi}$     |                                                       |                                | 116  | 200 ns       |
| $E_{off}$    |                                                       |                                | 0.66 | 1.20 mJ      |
| $t_{d(on)}$  | Inductive Load, $T_J = 125^\circ C$                   |                                | 19   | ns           |
| $t_{ri}$     |                                                       |                                | 25   | ns           |
| $E_{on}$     |                                                       | $I_C = 30A, V_{GE} = 15V$      | 1.71 | mJ           |
| $t_{d(off)}$ |                                                       | $V_{CE} = 480V, R_G = 5\Omega$ | 190  | ns           |
| $t_{fi}$     |                                                       |                                | 157  | ns           |
| $E_{off}$    |                                                       |                                | 1.30 | mJ           |
| $R_{thJC}$   |                                                       |                                | 0.42 | $^\circ C/W$ |
| $R_{thCS}$   |                                                       |                                | 0.21 | $^\circ C/W$ |

TO-247 (IXGH) Outline



| Dim.           | Millimeter |       | Inches |       |
|----------------|------------|-------|--------|-------|
|                | Min.       | Max.  | Min.   | Max.  |
| A              | 4.7        | 5.3   | .185   | .209  |
| A <sub>1</sub> | 2.2        | 2.54  | .087   | .102  |
| A <sub>2</sub> | 2.2        | 2.6   | .059   | .098  |
| b              | 1.0        | 1.4   | .040   | .055  |
| b <sub>1</sub> | 1.65       | 2.13  | .065   | .084  |
| b <sub>2</sub> | 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   |

## Reverse Diode (FRED) (D1 Version ONLY)

| Symbol     | Test Conditions                                                 | Characteristic Values |      |              |
|------------|-----------------------------------------------------------------|-----------------------|------|--------------|
|            |                                                                 | Min.                  | Typ. | Max.         |
| $V_F$      | $I_F = 30A, V_{GE} = 0V$ , Note 1                               |                       |      | 2.8 V        |
|            | $T_J = 150^\circ C$                                             |                       | 1.6  | V            |
| $I_{RM}$   | $I_F = 30A, V_{GE} = 0V, V_R = 100V$<br>$-di_F/dt = 100A/\mu s$ |                       | 4    | A            |
| $t_{rr}$   | $I_F = 1A; -di/dt = 100A/\mu s, V_R = 30V, T_J = 100^\circ C$   |                       | 100  | ns           |
| $R_{thJC}$ |                                                                 |                       | 1.5  | $^\circ C/W$ |
| $R_{thCS}$ |                                                                 |                       | 1.5  | $^\circ C/W$ |

Note 1: Pulse test,  $t \leq 300\mu s$ ; duty cycle,  $d \leq 2\%$ .

## PRELIMINARY TECHNICAL INFORMATION

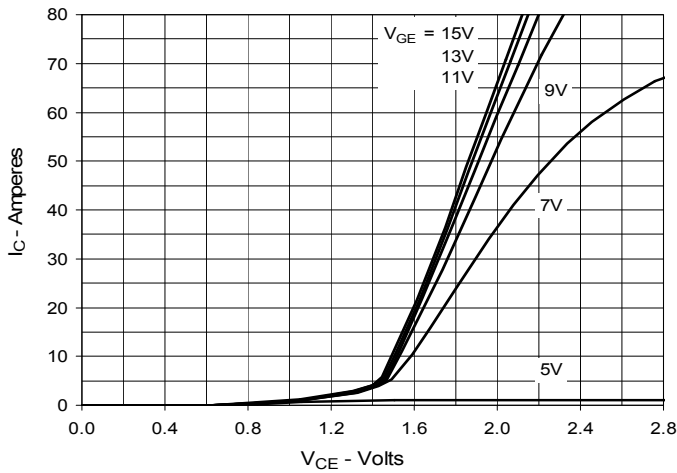
The product presented herein is under development. The Technical Specifications offered are derived from data gathered during objective characterizations of preliminary engineering lots; but also may yet contain some information supplied during a pre-production design evaluation. IXYS reserves the right to change limits, test conditions, and dimensions without notice.

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

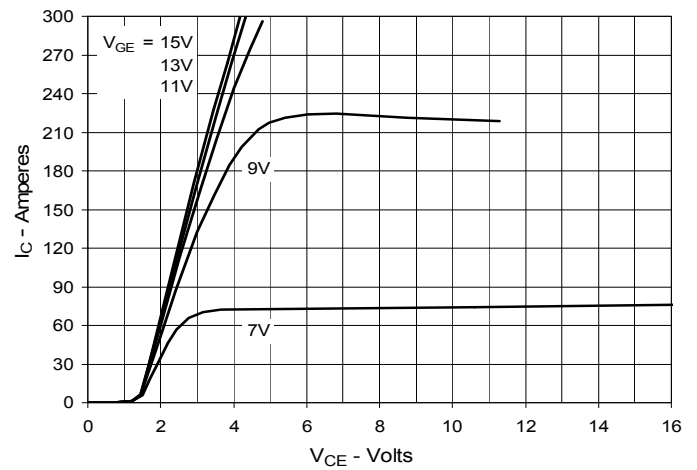
IXYS MOSFETs and IGBTs are covered by one or more of the following U.S. patents:

|           |           |           |           |              |              |              |              |              |             |
|-----------|-----------|-----------|-----------|--------------|--------------|--------------|--------------|--------------|-------------|
| 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 | 7,157,338B2 |
| 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    |             |

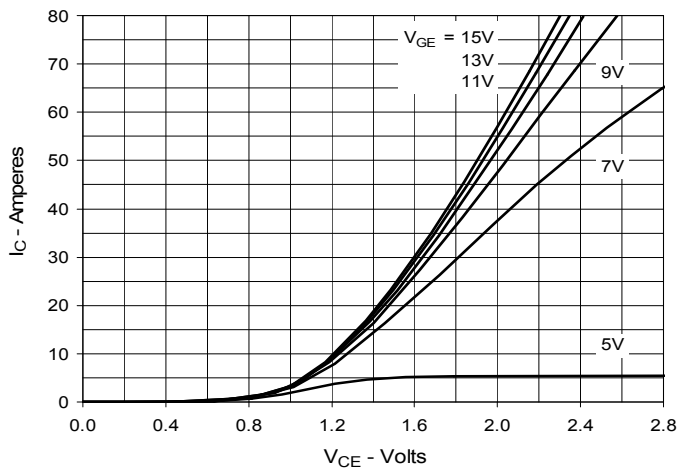
**Fig. 1. Output Characteristics  
@ 25°C**



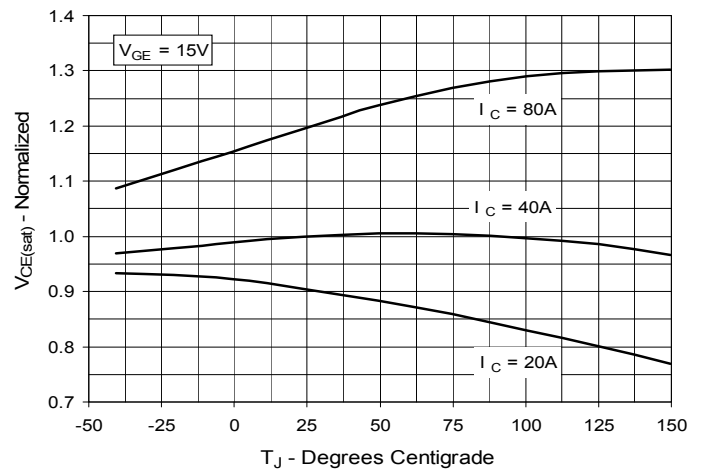
**Fig. 2. Extended Output Characteristics  
@ 25°C**



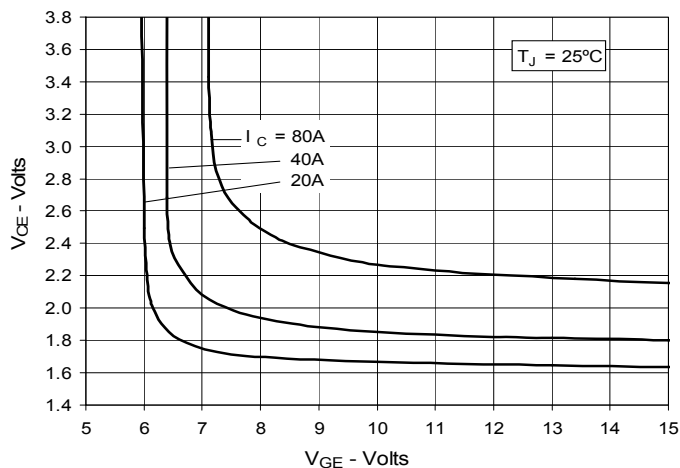
**Fig. 3. Output Characteristics  
@ 125°C**



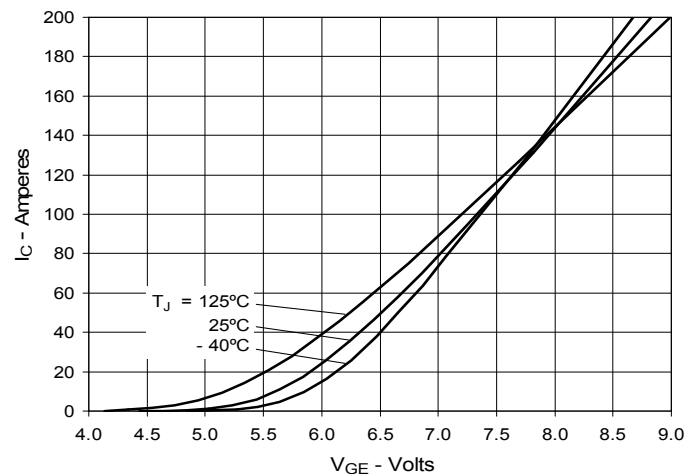
**Fig. 4. Dependence of  $V_{CE(sat)}$  on  
Junction Temperature**

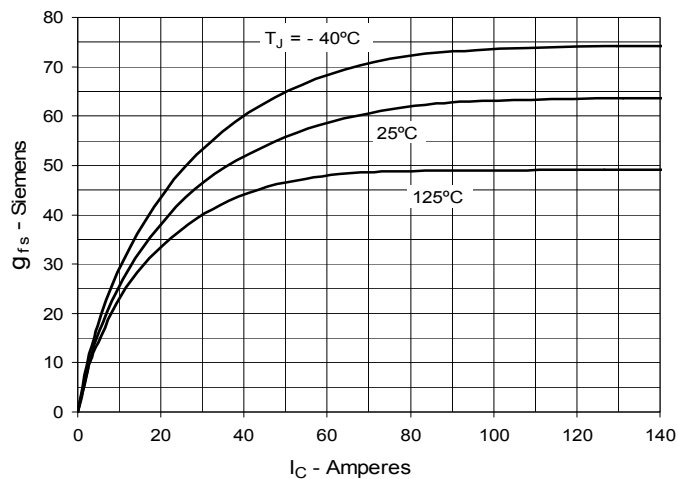
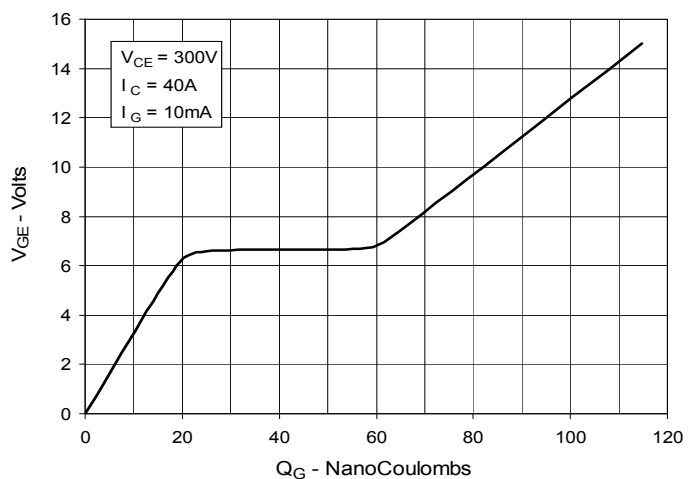
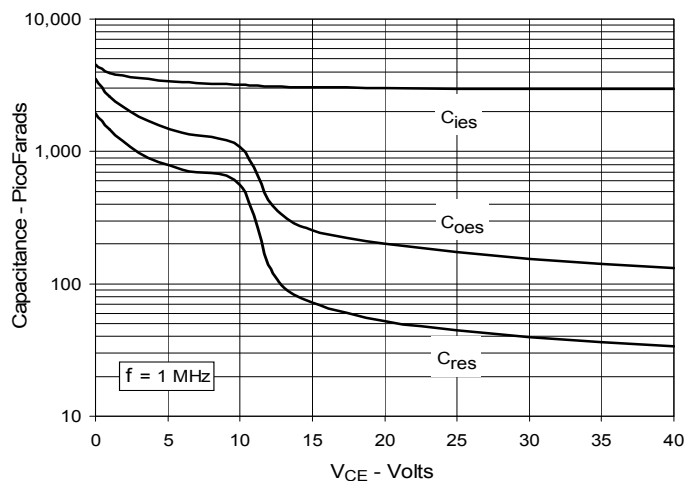
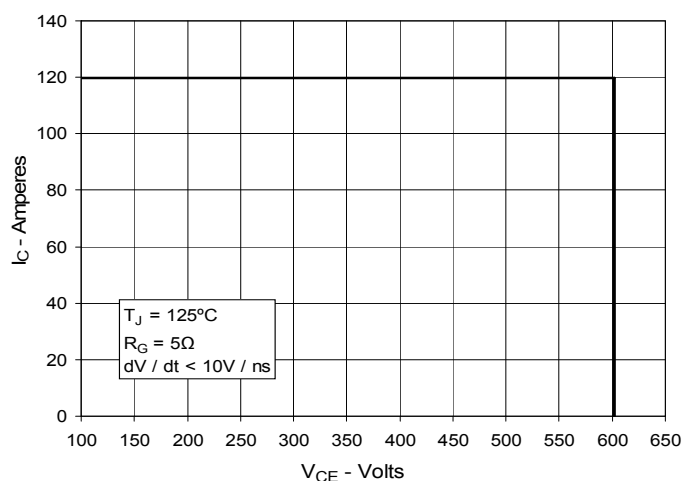
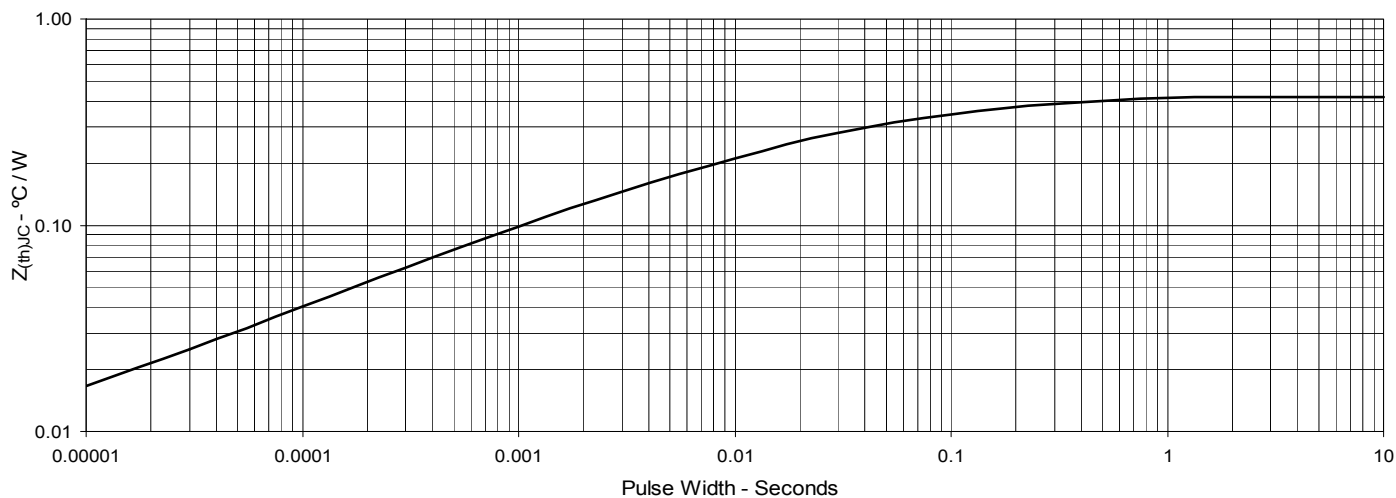


**Fig. 5. Collector-to-Emitter Voltage  
vs. Gate-to-Emitter Voltage**

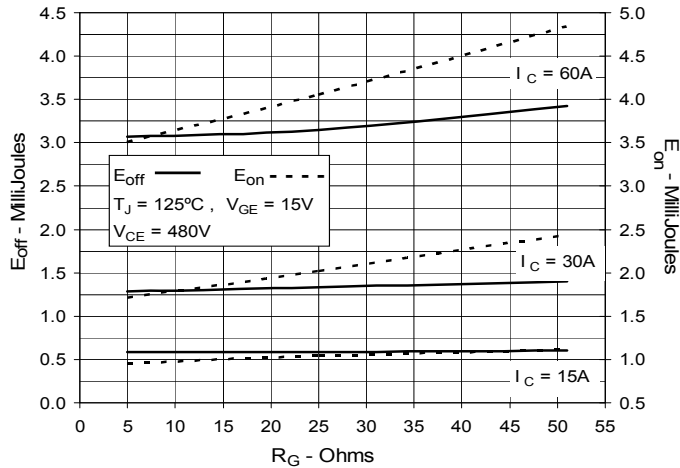


**Fig. 6. Input Admittance**

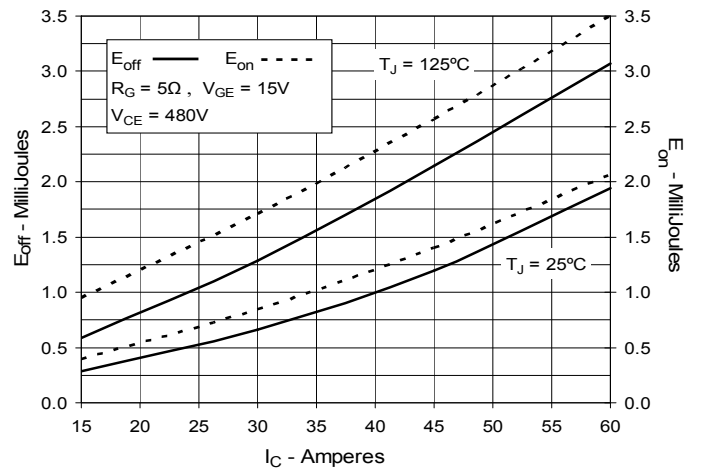


**Fig. 7. Transconductance**

**Fig. 8. Gate Charge**

**Fig. 9. Capacitance**

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

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


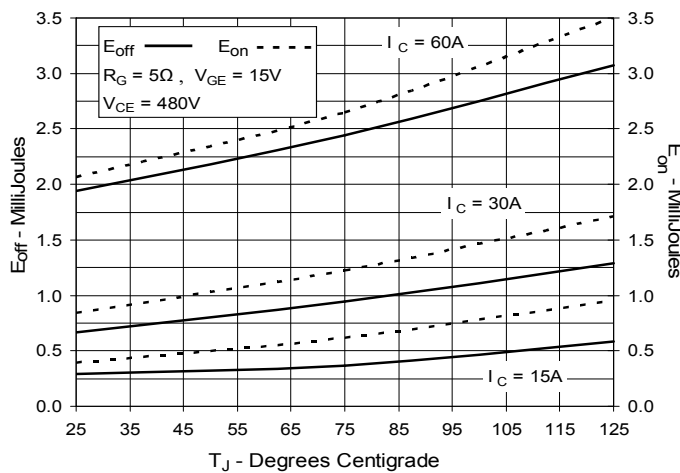
**Fig. 12. Inductive Switching  
Energy Loss vs. Gate Resistance**



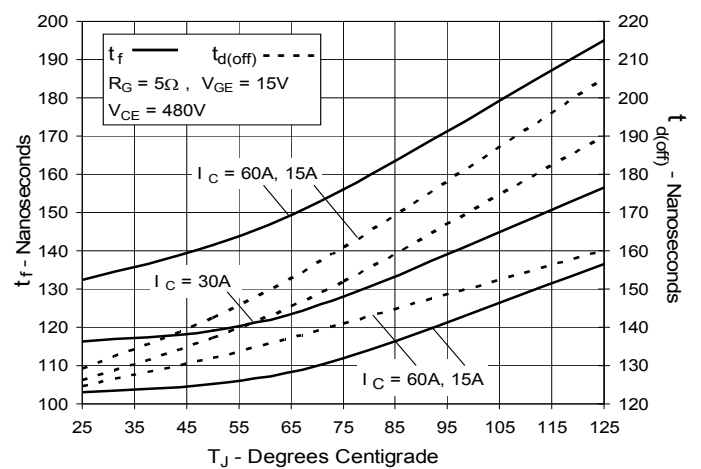
**Fig. 13. Inductive Switching  
Energy Loss vs. Collector Current**



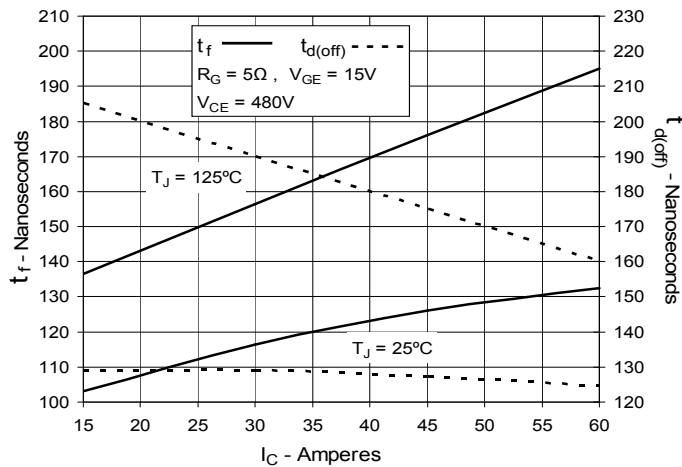
**Fig. 14. Inductive Switching  
Energy Loss vs. Junction Temperature**



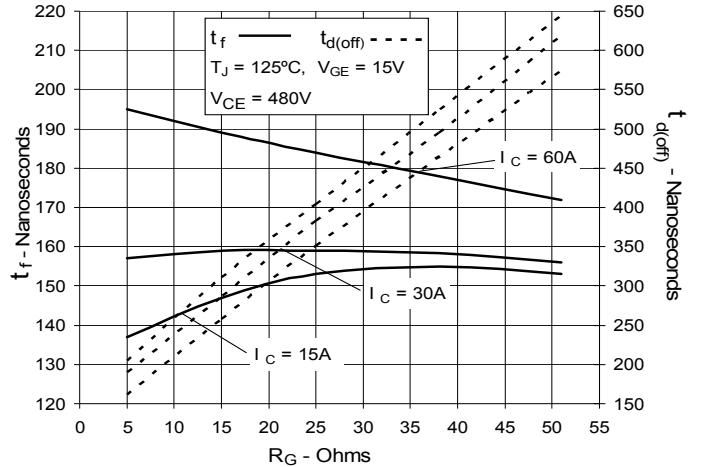
**Fig. 15. Inductive Turn-off  
Switching Times vs. Junction Temperature**



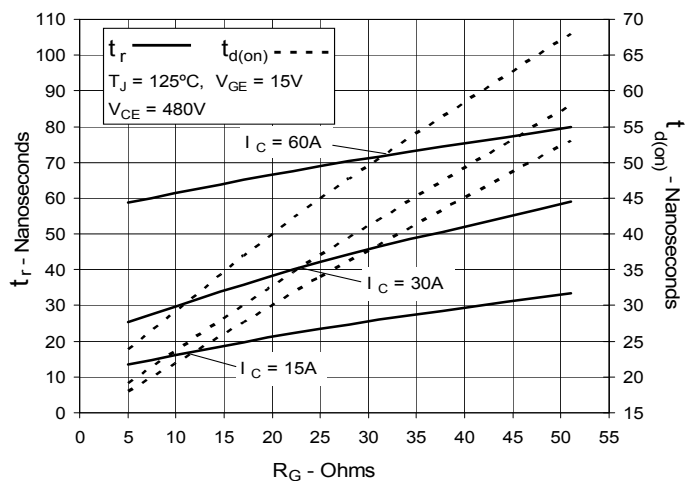
**Fig. 16. Inductive Turn-off  
Switching Times vs. Collector Current**



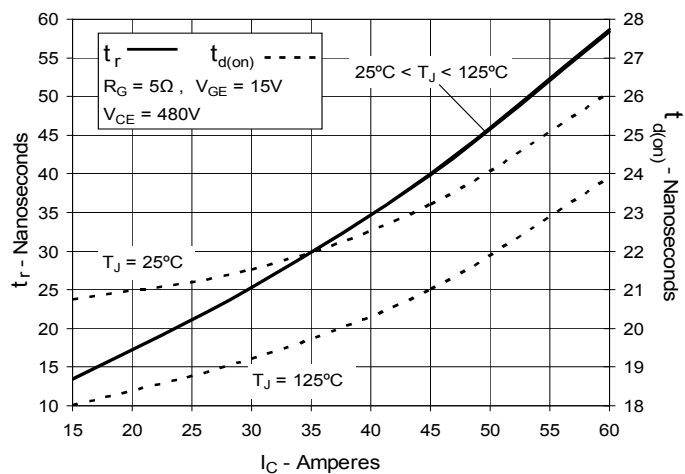
**Fig. 17. Inductive Turn-off  
Switching Times vs. Gate Resistance**



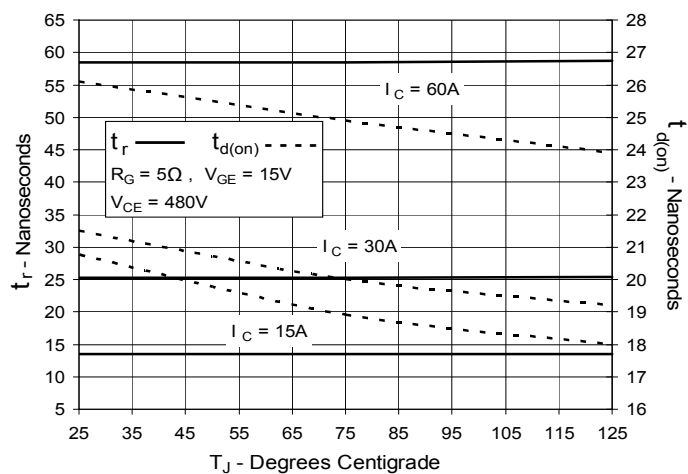
**Fig. 18. Inductive Turn-on  
Switching Times vs. Gate Resistance**



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



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



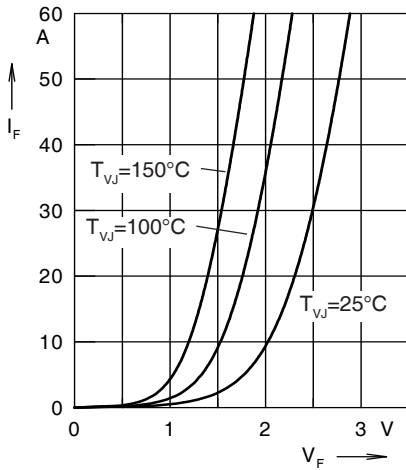


Fig. 21. Forward current  $I_F$  versus  $V_F$

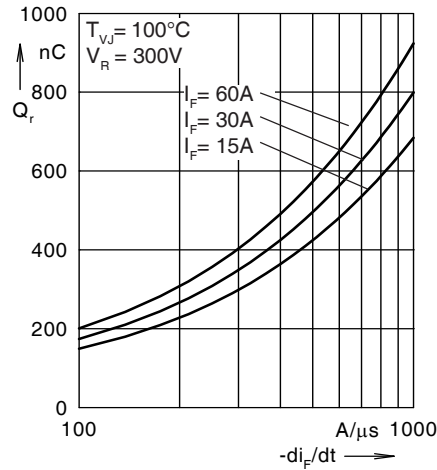


Fig. 22. Reverse recovery charge  $Q_r$  versus  $-di_F/dt$

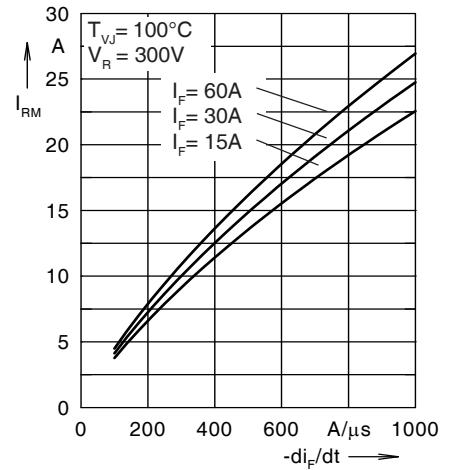


Fig. 23. Peak reverse current  $I_{RM}$  versus  $-di_F/dt$

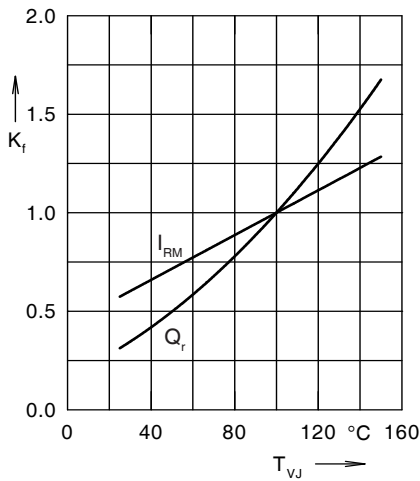


Fig. 24. Dynamic parameters  $Q_r$ ,  $I_{RM}$  versus  $T_{VJ}$

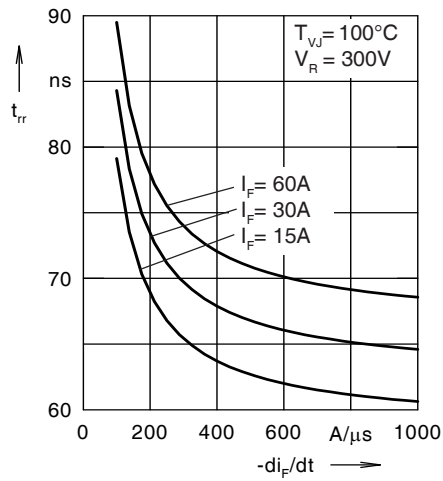


Fig. 25. Recovery time  $t_{rr}$  versus  $-di_F/dt$

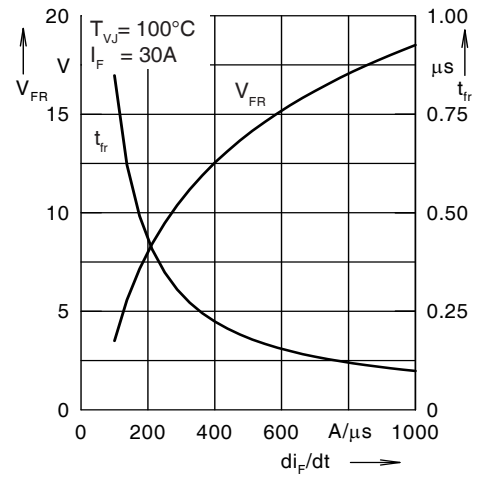


Fig. 26. Peak forward voltage  $V_{FR}$  and  $t_{fr}$  versus  $di_F/dt$

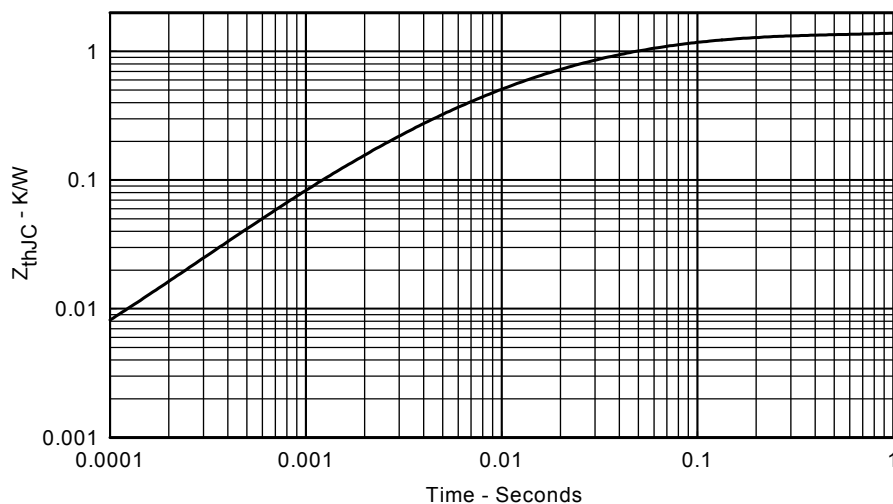


Fig. 27. Transient thermal resistance junction to case



---

Disclaimer Notice - Information furnished is believed to be accurate and reliable. However, users should independently evaluate the suitability of and test each product selected for their own applications. Littelfuse products are not designed for, and may not be used in, all applications. Read complete Disclaimer Notice at [www.littelfuse.com/disclaimer-electronics](http://www.littelfuse.com/disclaimer-electronics).