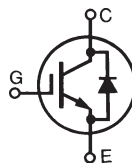


# GenX3™ 600V IGBT with Diode

## IXGH48N60C3D1

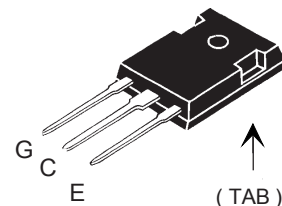
High speed PT IGBT for  
40-100kHz Switching



$$\begin{aligned} V_{CES} &= 600V \\ I_{C110} &= 48A \\ V_{CE(sat)} &\leq 2.5V \\ t_{fi(typ)} &= 38ns \end{aligned}$$

| 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 $150^\circ\text{C}$ , $R_{GE} = 1M\Omega$ | 600                 | V                |
| $V_{GES}$      | Continuous                                                            | $\pm 20$            | V                |
| $V_{GEM}$      | Transient                                                             | $\pm 30$            | V                |
| $I_{C25}$      | $T_C = 25^\circ\text{C}$ (Limited by Leads)                           | 75                  | A                |
| $I_{C110}$     | $T_C = 110^\circ\text{C}$                                             | 48                  | A                |
| $I_{D110}$     | $T_C = 110^\circ\text{C}$                                             | 30                  | A                |
| $I_{CM}$       | $T_C = 25^\circ\text{C}$ , 1ms                                        | 250                 | A                |
| $I_A$          | $T_C = 25^\circ\text{C}$                                              | 30                  | A                |
| $E_{AS}$       | $T_C = 25^\circ\text{C}$                                              | 300                 | mJ               |
| <b>SSOA</b>    | $V_{GE} = 15V$ , $T_{VJ} = 125^\circ\text{C}$ , $R_G = 3\Omega$       | $I_{CM} = 100$      | A                |
| <b>(RBSOA)</b> | Clamped Inductive Load                                                | @ $V_{CE} \leq 600$ | V                |
| $P_C$          | $T_C = 25^\circ\text{C}$                                              | 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                 | $^\circ\text{C}$ |
| $F_C$          | Mounting Torque                                                       | 1.13/10             | Nm/lb.in         |
| <b>Weight</b>  |                                                                       | 6                   | g                |

TO-247



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

### Features

- Optimized for Low Switching Losses
- Square RBSOA
- Anti-Parallel Ultra Fast Diode
- Fast Switching
- Avalanche Rated
- International Standard Package

### Advantages

- High Power Density
- Low Gate Drive Requirement

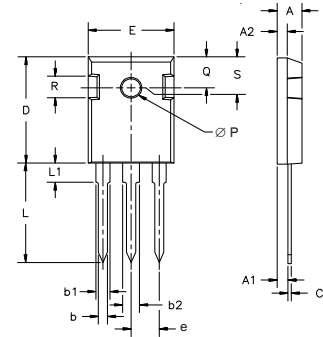
### Applications

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

| Symbol        | Test Conditions<br>( $T_J = 25^\circ\text{C}$ , Unless Otherwise Specified) | Characteristic Values |      |                              |
|---------------|-----------------------------------------------------------------------------|-----------------------|------|------------------------------|
|               |                                                                             | 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>$V_{GE} = 0V$ $T_J = 125^\circ\text{C}$               |                       |      | 300 $\mu\text{A}$<br>1.75 mA |
| $I_{GES}$     | $V_{CE} = 0V$ , $V_{GE} = \pm 20V$                                          |                       |      | $\pm 100$ nA                 |
| $V_{CE(sat)}$ | $I_C = 30A$ , $V_{GE} = 15V$ , Note 1<br>$T_J = 125^\circ\text{C}$          | 2.3<br>1.8            |      | 2.5 V<br>V                   |

| Symbol       | Test Conditions                                                                                    | Characteristic Values |      |              |
|--------------|----------------------------------------------------------------------------------------------------|-----------------------|------|--------------|
|              |                                                                                                    | Min.                  | Typ. | Max.         |
| $g_{fs}$     | $I_C = 30A, V_{CE} = 10V$ , Note 1                                                                 | 20                    | 30   | S            |
| $C_{ies}$    | $V_{CE} = 25V, V_{GE} = 0V, f = 1MHz$                                                              | 1960                  |      | pF           |
| $C_{oes}$    |                                                                                                    | 202                   |      | pF           |
| $C_{res}$    |                                                                                                    | 66                    |      | pF           |
| $Q_g$        | $I_C = 30A, V_{GE} = 15V, V_{CE} = 0.5 \cdot V_{CES}$                                              | 77                    |      | nC           |
| $Q_{ge}$     |                                                                                                    | 16                    |      | nC           |
| $Q_{gc}$     |                                                                                                    | 32                    |      | nC           |
| $t_{d(on)}$  | Inductive Load, $T_J = 25^\circ C$<br>$I_C = 30A, V_{GE} = 15V$<br>$V_{CE} = 400V, R_G = 3\Omega$  | 19                    |      | ns           |
| $t_{ri}$     |                                                                                                    | 26                    |      | ns           |
| $E_{on}$     |                                                                                                    | 0.41                  |      | mJ           |
| $t_{d(off)}$ |                                                                                                    | 60                    | 100  | ns           |
| $t_{fi}$     |                                                                                                    | 38                    |      | ns           |
| $E_{off}$    |                                                                                                    | 0.23                  | 0.42 | mJ           |
| $t_{d(on)}$  | Inductive Load, $T_J = 125^\circ C$<br>$I_C = 30A, V_{GE} = 15V$<br>$V_{CE} = 400V, R_G = 3\Omega$ | 19                    |      | ns           |
| $t_{ri}$     |                                                                                                    | 26                    |      | ns           |
| $E_{on}$     |                                                                                                    | 0.65                  |      | mJ           |
| $t_{d(off)}$ |                                                                                                    | 92                    |      | ns           |
| $t_{fi}$     |                                                                                                    | 95                    |      | ns           |
| $E_{off}$    |                                                                                                    | 0.57                  |      | mJ           |
| $R_{thJC}$   |                                                                                                    |                       | 0.42 | $^\circ C/W$ |
| $R_{thCS}$   |                                                                                                    | 0.21                  |      | $^\circ C/W$ |

TO-247 AD 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  |

## Reverse Diode (FRED)

Characteristic Values  
( $T_J = 25^\circ C$ , Unless Otherwise Specified)

| Symbol     | Test Conditions                                                       | Characteristic Values |      |                  |
|------------|-----------------------------------------------------------------------|-----------------------|------|------------------|
|            |                                                                       | Min.                  | Typ. | Max.             |
| $V_F$      | $I_F = 30A, V_{GE} = 0V$ , Note 1                                     |                       |      | 2.7 V            |
|            | $T_J = 150^\circ C$                                                   |                       | 1.6  | V                |
| $I_{RM}$   | $I_F = 30A, V_{GE} = 0V, -di_F/dt = 100A/\mu s$ , $T_J = 100^\circ C$ |                       |      | 4 A              |
| $t_{rr}$   | $V_R = 100V, T_J = 100^\circ C$                                       |                       | 100  | ns               |
|            | $I_F = 1A, V_{GE} = 0V, -di_F/dt = 100A/\mu s, V_R = 30V$             |                       | 25   | ns               |
| $R_{thJC}$ |                                                                       |                       |      | 0.9 $^\circ C/W$ |

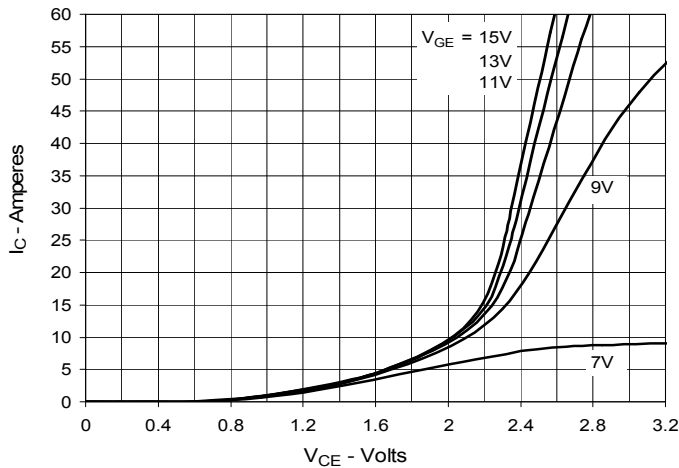
Note 1: Pulse Test,  $t \leq 300\mu s$ , Duty Cycle,  $d \leq 2\%$ .

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

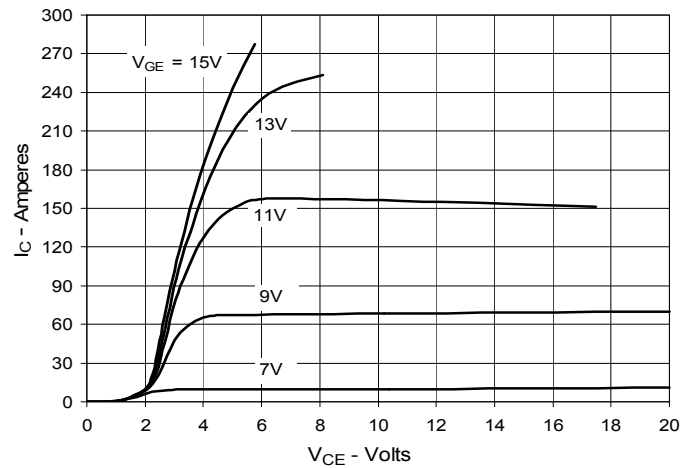
IXYS MOSFETs and IGBTs are covered by one or more of the following U.S. patents:

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

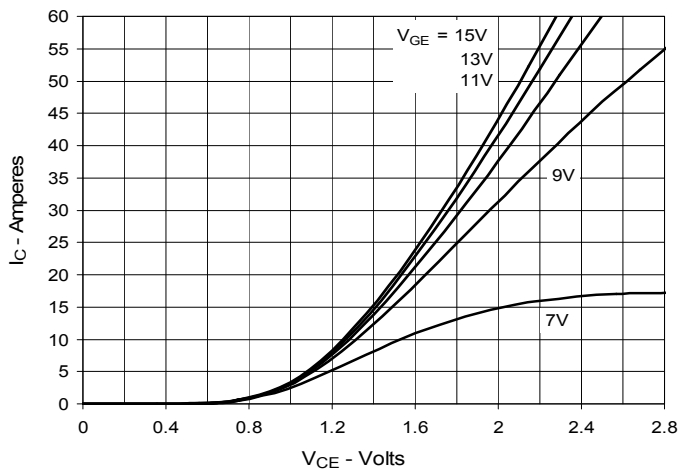
**Fig. 1. Output Characteristics  
@ 25°C**



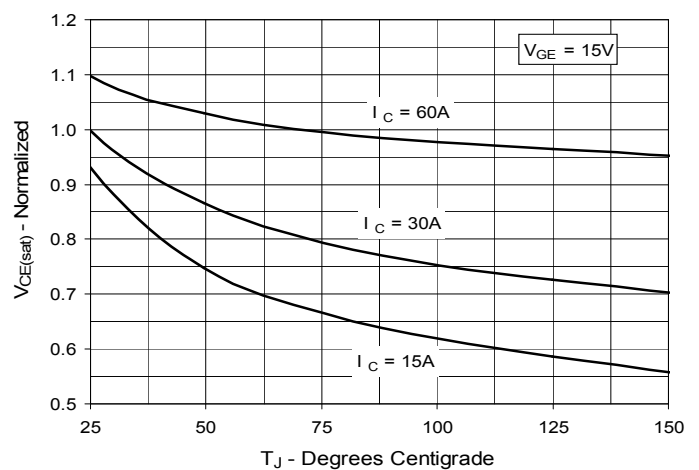
**Fig. 2. Extended Output Characteristics  
@ 25°C**



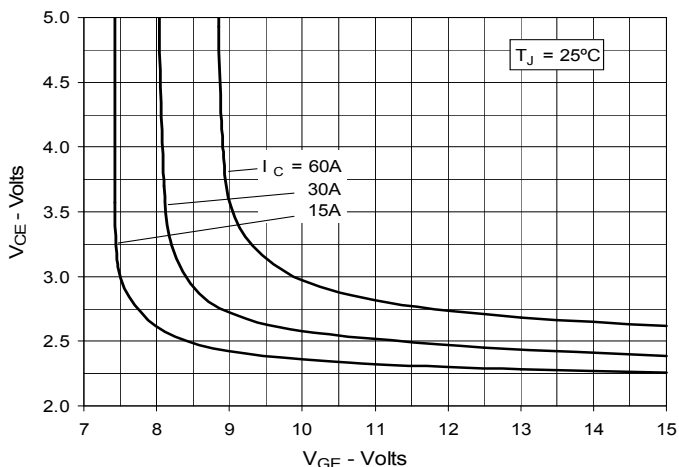
**Fig. 3. Output Characteristics  
@ 125°C**



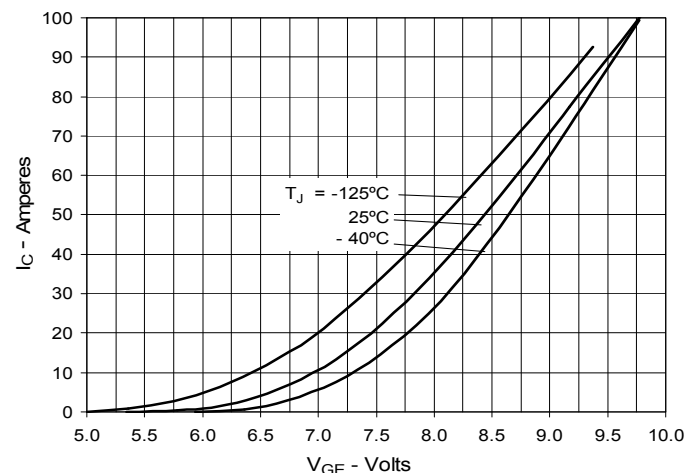
**Fig. 4. Dependence of  $V_{CE(sat)}$  on  
Junction Temperature**

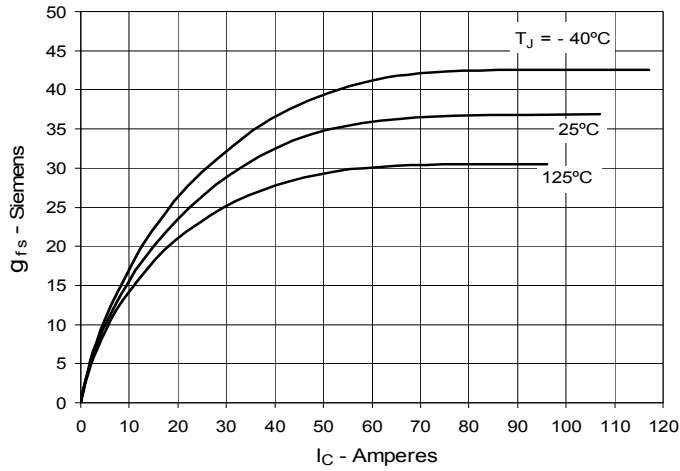
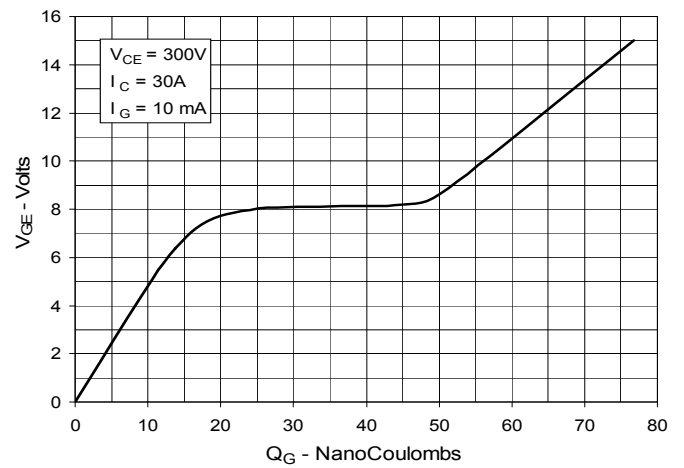
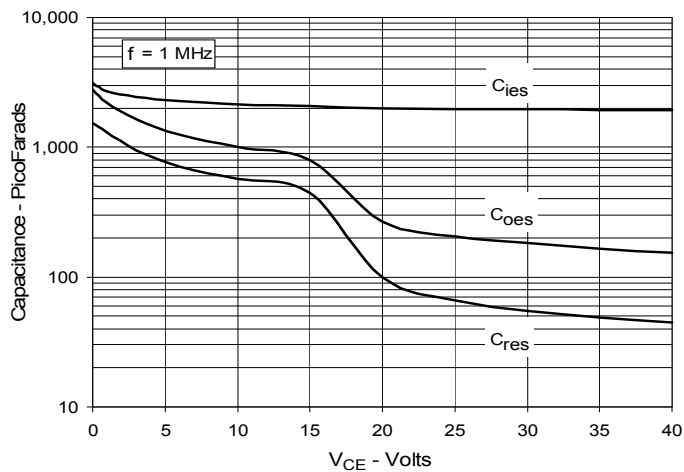
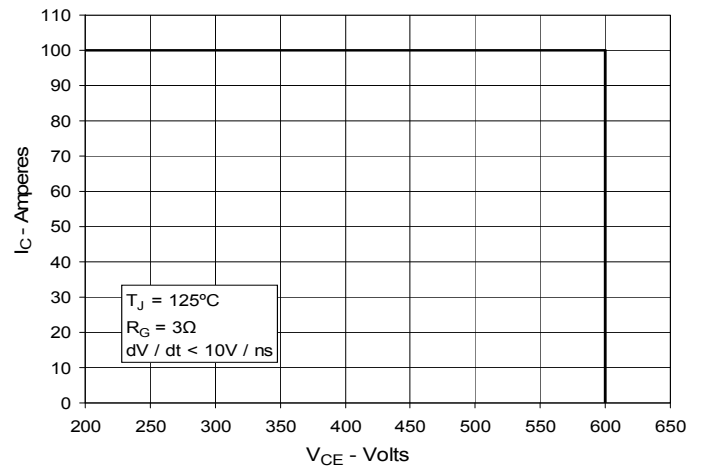
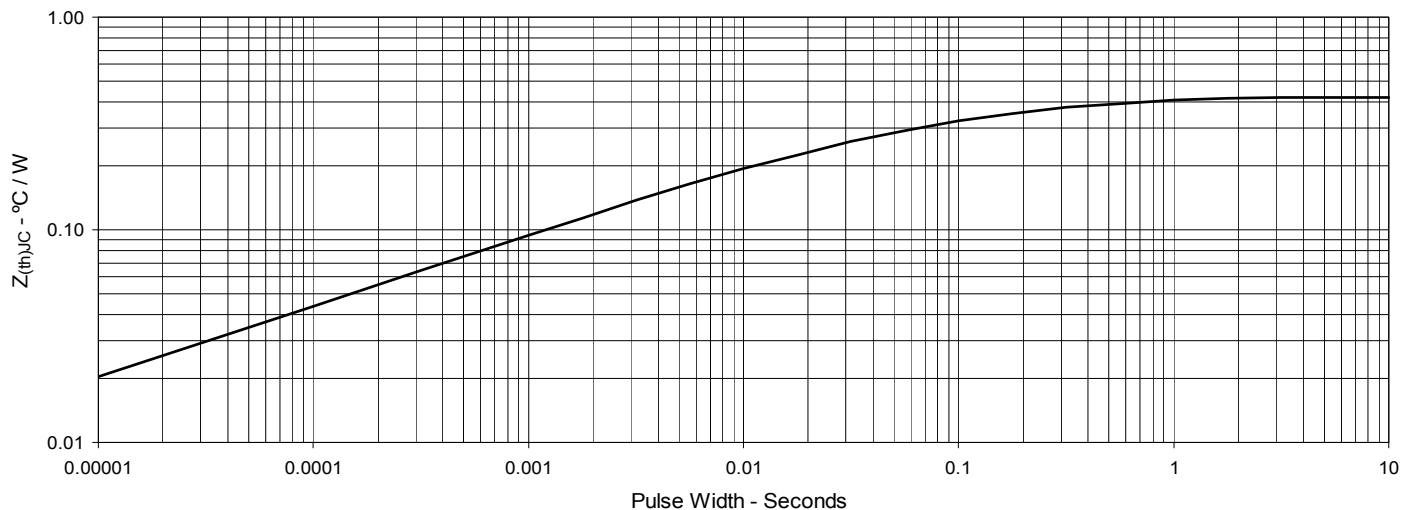


**Fig. 5. Collector-to-Emitter Voltage  
vs. Gate-to-Emitter Voltage**



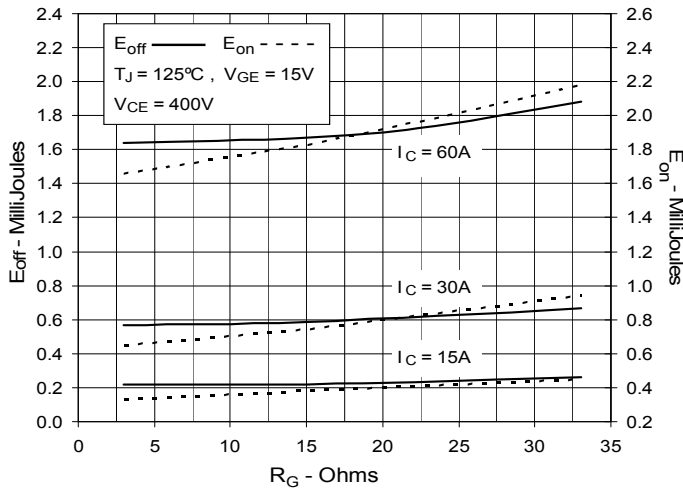
**Fig. 6. Input Admittance**



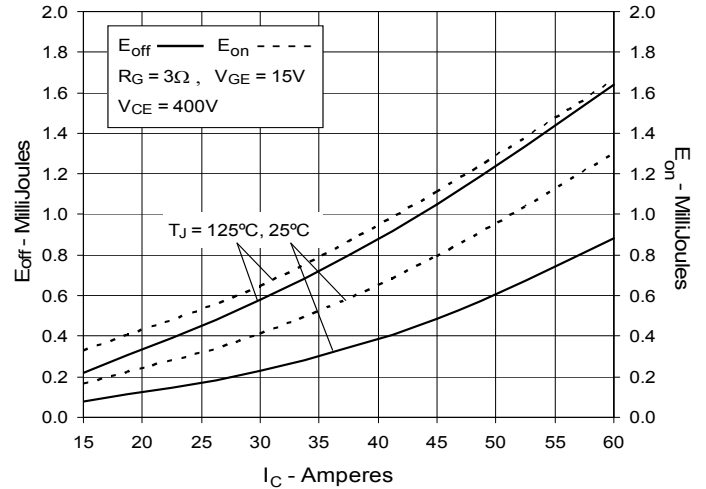
**Fig. 7. Transconductance**

**Fig. 8. Gate Charge**

**Fig. 9. Capacitance**

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

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


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

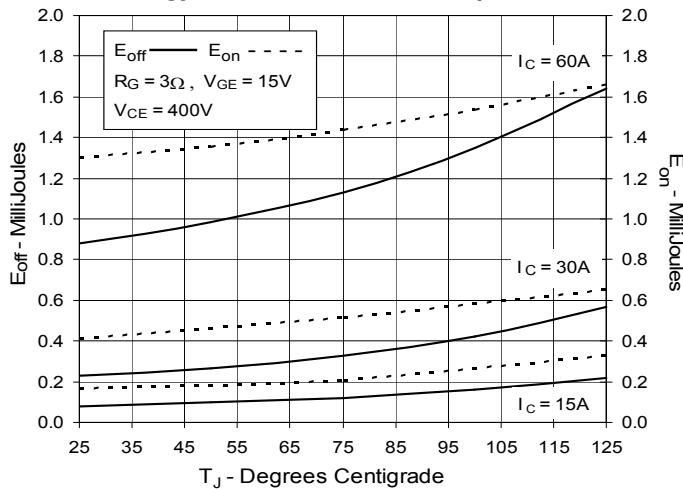
**Fig. 12. Inductive Switching  
Energy Loss vs. Gate Resistance**



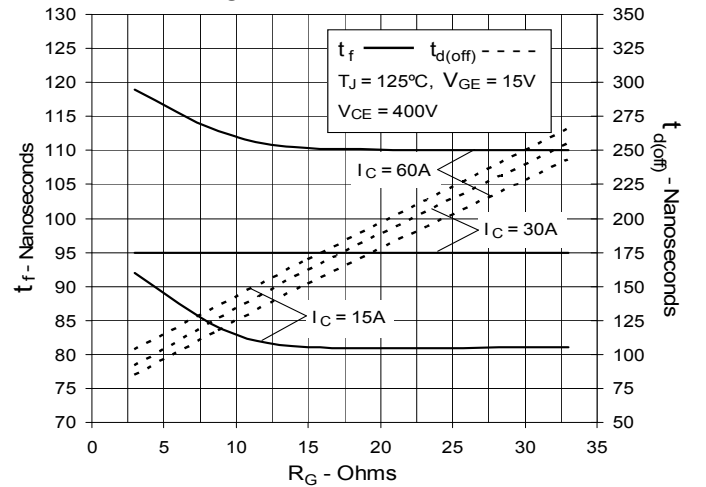
**Fig. 13. Inductive Switching  
Energy Loss vs. Collector Current**



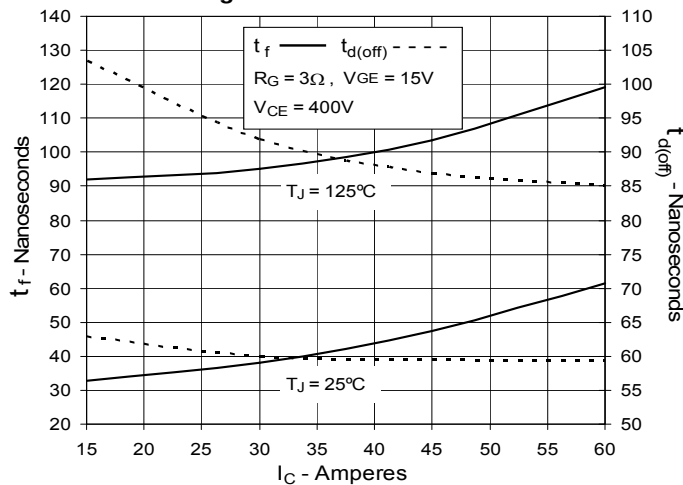
**Fig. 14. Inductive Switching  
Energy Loss vs. Junction Temperature**



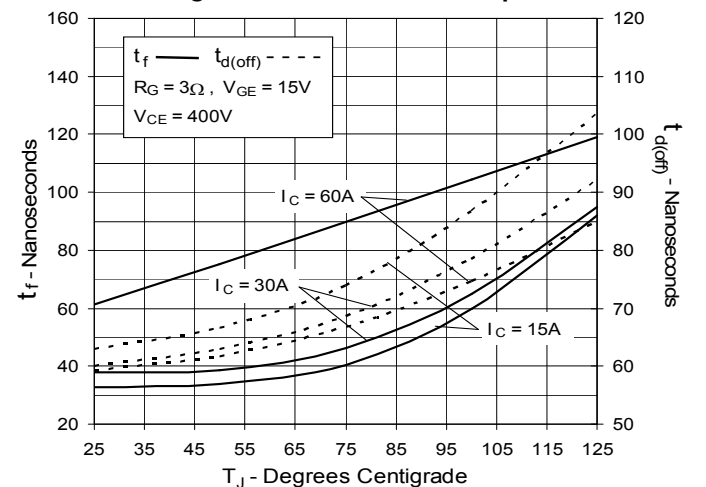
**Fig. 15. Inductive Turn-off  
Switching Times vs. Gate Resistance**



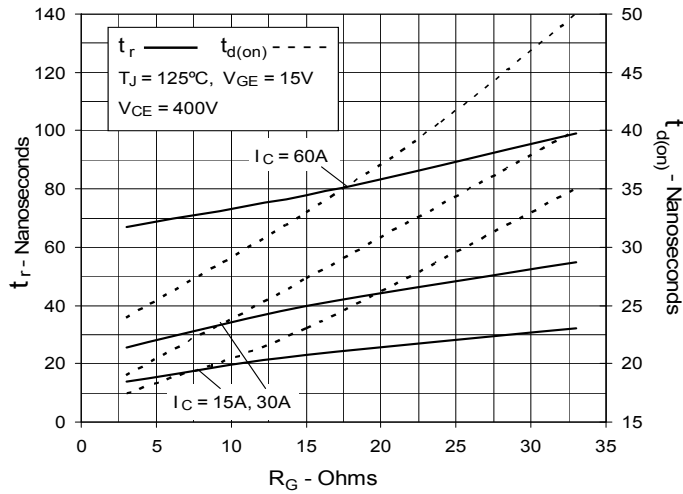
**Fig. 16. Inductive Turn-off  
Switching Times vs. Collector Current**



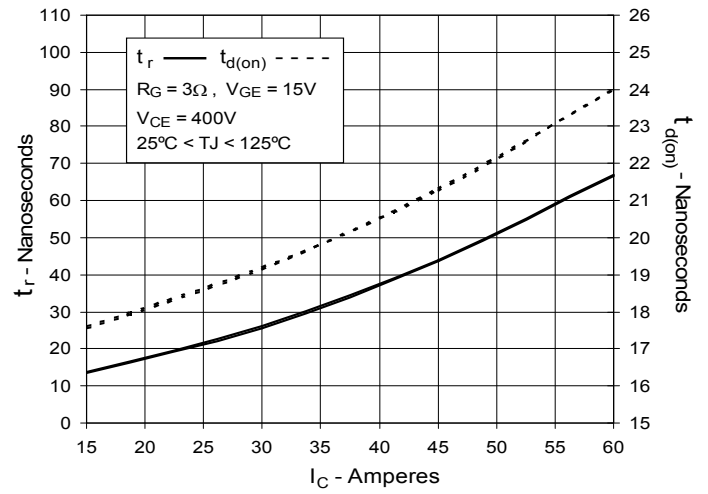
**Fig. 17. Inductive Turn-off  
Switching Times vs. Junction Temperature**



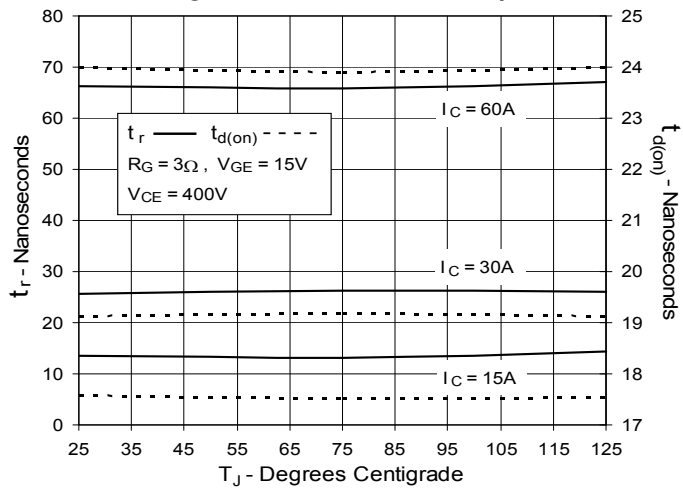
**Fig. 18. Inductive Turn-on  
Switching Times vs. Gate Resistance**



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



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



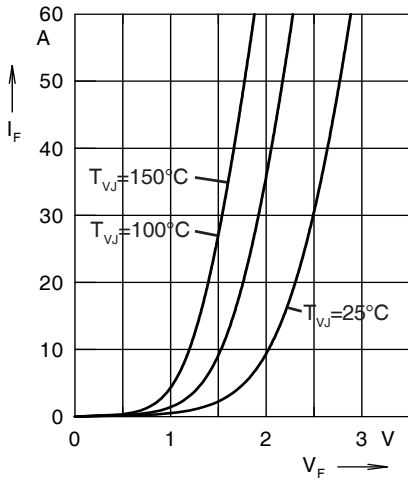


Fig. 21. Forward current  $I_F$  versus  $V_F$

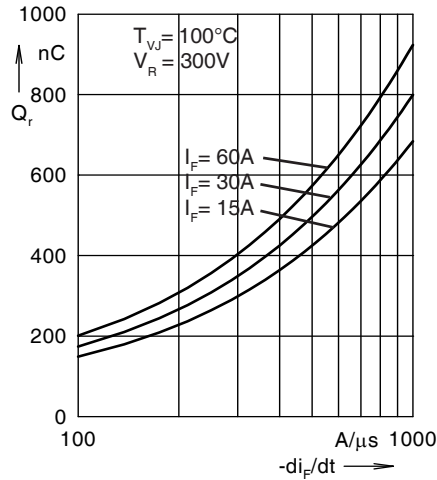


Fig. 22. Reverse recovery charge  $Q_r$  versus  $-di_F/dt$

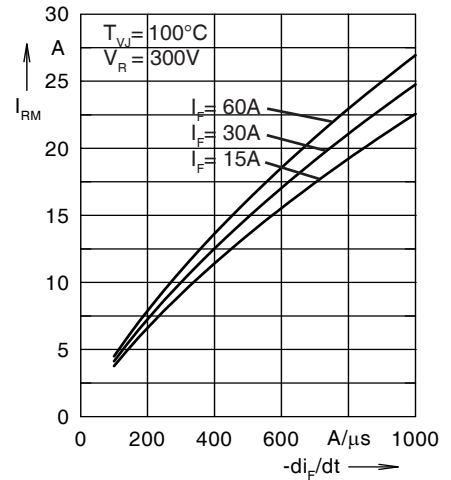


Fig. 23. Peak reverse current  $I_{RM}$  versus  $-di_F/dt$

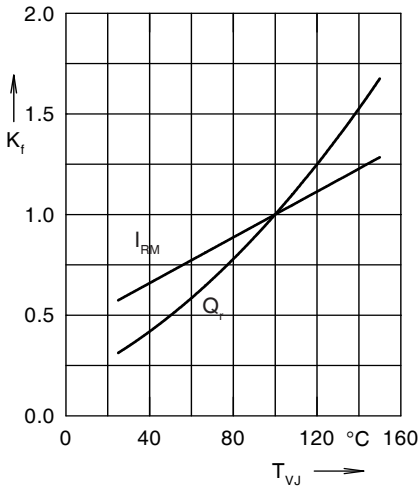


Fig. 24. Dynamic parameters  $Q_r$ ,  $I_{RM}$  versus  $T_{VJ}$

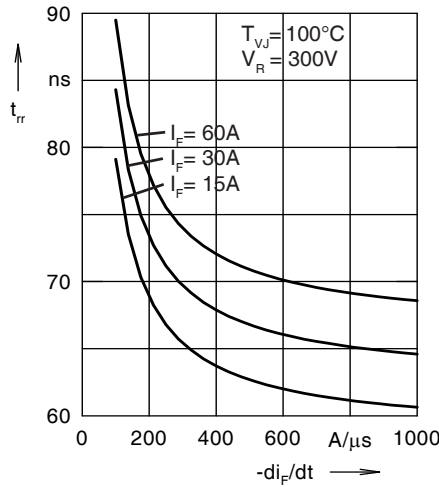


Fig. 25. Recovery time  $t_{rr}$  versus  $-di_F/dt$

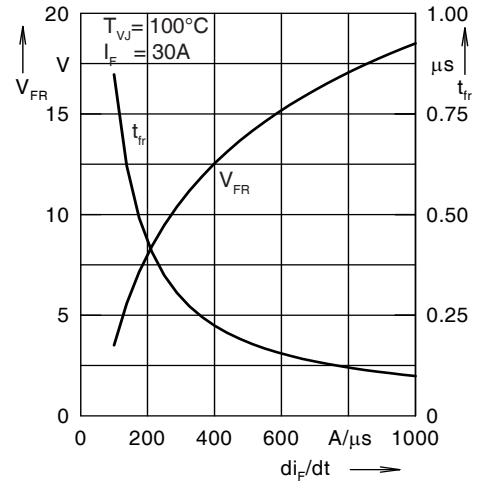


Fig. 26. Peak forward voltage  $V_{FR}$  and  $t_{fr}$  versus  $di_F/dt$

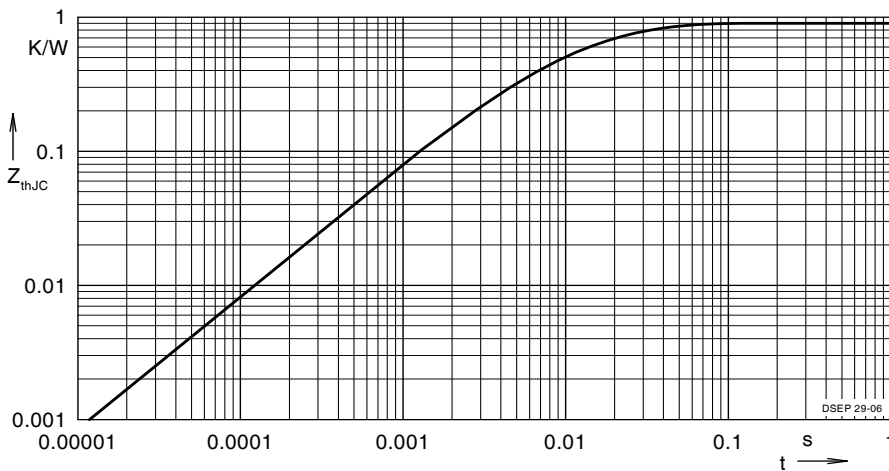


Fig. 27. Transient thermal resistance junction to case

Constants for  $Z_{thJC}$  calculation:

| i | $R_{thi}$ (K/W) | $t_i$ (s) |
|---|-----------------|-----------|
| 1 | 0.502           | 0.0052    |
| 2 | 0.193           | 0.0003    |
| 3 | 0.205           | 0.0162    |



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