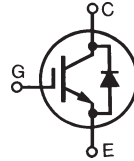


# GenX3™ 600V IGBTs w/ Diode

## IXGH30N60C3D1 IXGT30N60C3D1

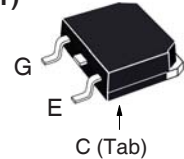
High-Speed PT IGBTs for  
40-100 kHz Switching



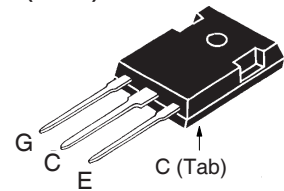
$V_{CES} = 600V$   
 $I_{C110} = 30A$   
 $V_{CE(sat)} \leq 3.0V$   
 $t_{fi(typ)} = 47ns$

| Symbol                        | Test Conditions   | Maximum Ratings                   |            |
|-------------------------------|---|-----------------------------------|------------|
| $V_{CES}$                     | $T_C = 25^\circ C$ to $150^\circ C$   | 600                               | V          |
| $V_{CGR}$                     | $T_J = 25^\circ C$ to $150^\circ C$ , $R_{GE} = 1M\Omega$                           | 600                               | V          |
| $V_{GES}$                     | Continuous  | $\pm 20$                          | V          |
| $V_{GEM}$                     | Transient   | $\pm 30$                          | V          |
| $I_{C25}$                     | $T_C = 25^\circ C$  | 60                                | A          |
| $I_{C110}$                    | $T_C = 110^\circ C$   | 30                                | A          |
| $I_{F110}$                    | $T_C = 110^\circ C$   | 30                                | A          |
| $I_{CM}$                      | $T_C = 25^\circ C$ , 1ms  | 150                               | A          |
| <b>SSOA</b><br><b>(RBSOA)</b> | $V_{GE} = 15V$ , $T_{VJ} = 125^\circ C$ , $R_G = 5\Omega$<br>Clamped Inductive Load | $I_{CM} = 60$<br>@ $\leq V_{CES}$ | A          |
| $P_C$                         | $T_C = 25^\circ C$  | 220                               | W          |
| $T_J$                         |   | -55 ... +150                      | $^\circ C$ |
| $T_{JM}$                      |   | 150                               | $^\circ C$ |
| $T_{stg}$                     |   | -55 ... +150                      | $^\circ C$ |
| $T_L$                         | 1.6mm (0.062 in.) from Case for 10s   | 300                               | $^\circ C$ |
| $T_{SOLD}$                    | Plastic Body for 10 seconds   | 260                               | $^\circ C$ |
| $M_d$                         | Mounting Torque (TO-247)  | 1.13/10                           | Nm/lb.in.  |
| <b>Weight</b>                 | TO-268  | 4                                 | g          |
|                               | TO-247  | 6                                 | g          |

TO-268 (IXGT)



TO-247 (IXGH)



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

### Features

- Optimized for Low Switching Losses
- Square RBSOA
- Anti-Parallel Ultra Fast Diode
- International Standard Packages

### 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>( $T_J = 25^\circ C$ Unless Otherwise Specified) | Characteristic Values |            |                    |
|---------------|---|-----------------------|------------|--------------------|
|               |   | Min.                  | Typ.       | Max.               |
| $V_{GE(th)}$  | $I_C = 250\mu A$ , $V_{CE} = V_{GE}$                                | 3.0                   |            | 5.5 V              |
| $I_{CES}$     | $V_{CE} = V_{CES}$ , $V_{GE} = 0V$<br>$T_J = 125^\circ C$           |                       |            | 75 $\mu A$<br>1 mA |
| $I_{GES}$     | $V_{CE} = 0V$ , $V_{GE} = \pm 20V$                                  |                       |            | $\pm 100$ nA       |
| $V_{CE(sat)}$ | $I_C = 20A$ , $V_{GE} = 15V$ , Note 1<br>$T_J = 125^\circ C$        |                       | 2.6<br>1.8 | 3.0 V<br>V         |

| Symbol       | Test Conditions<br>( $T_J = 25^\circ\text{C}$ , Unless Otherwise Specified)   | Characteristic Values |      |                    |    |
|--------------|---|-----------------------|------|--------------------|----|
|              |   | Min.                  | Typ. | Max.               |    |
| $g_{fs}$     | $I_C = 20\text{A}$ , $V_{CE} = 10\text{V}$ , Note 1   | 9                     | 30   | S                  |    |
| $C_{ies}$    | $V_{CE} = 25\text{V}$ , $V_{GE} = 0\text{V}$ , $f = 1\text{MHz}$  |                       | 915  | pF                 |    |
| $C_{oes}$    |   |                       | 78   | pF                 |    |
| $C_{res}$    |   |                       | 32   | pF                 |    |
| $Q_g$        | $I_C = 20\text{A}$ , $V_{GE} = 15\text{V}$ , $V_{CE} = 0.5 \cdot V_{CES}$   |                       | 38   | nC                 |    |
| $Q_{ge}$     |   |                       | 8    | nC                 |    |
| $Q_{gc}$     |   |                       | 17   | nC                 |    |
| $t_{d(on)}$  | <b>Inductive load, <math>T_J = 25^\circ\text{C}</math></b><br>$I_C = 20\text{A}$ , $V_{GE} = 15\text{V}$<br>$V_{CE} = 300\text{V}$ , $R_G = 5\Omega$<br>Note 2  |                       | 16   | ns                 |    |
| $t_{ri}$     |   |                       | 26   | ns                 |    |
| $E_{on}$     |   |                       | 0.27 | mJ                 |    |
| $t_{d(off)}$ |   |                       | 42   | 75                 | ns |
| $t_{fi}$     |   |                       | 47   | ns                 |    |
| $E_{off}$    |   |                       | 0.09 | 0.18               | mJ |
| $t_{d(on)}$  | <b>Inductive load, <math>T_J = 125^\circ\text{C}</math></b><br>$I_C = 20\text{A}$ , $V_{GE} = 15\text{V}$<br>$V_{CE} = 300\text{V}$ , $R_G = 5\Omega$<br>Note 2 |                       | 17   | ns                 |    |
| $t_{ri}$     |   |                       | 28   | ns                 |    |
| $E_{on}$     |   |                       | 0.44 | mJ                 |    |
| $t_{d(off)}$ |   |                       | 70   | ns                 |    |
| $t_{fi}$     |   |                       | 90   | ns                 |    |
| $E_{off}$    |   |                       | 0.33 | mJ                 |    |
| $R_{thJC}$   | TO-247  |                       | 0.56 | $^\circ\text{C/W}$ |    |
| $R_{thCS}$   |   |                       | 0.21 | $^\circ\text{C/W}$ |    |

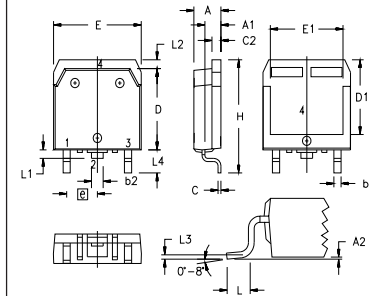
### Reverse Diode (FRED)

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

### Notes:

1. Pulse test,  $t \leq 300\mu\text{s}$ , duty cycle,  $d \leq 2\%$ .
2. Switching times & energy losses may increase for higher  $V_{CE}$  (Clamp),  $T_J$  or  $R_G$ .

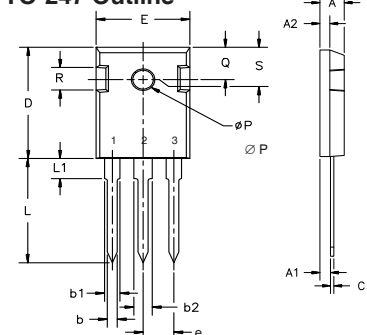
### TO-268 Outline



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

| SYM | INCHES   |      | MILLIMETERS |       |
|-----|----------|------|-------------|-------|
|     | MIN      | MAX  | MIN         | MAX   |
| A   | .193     | .201 | 4.90        | 5.10  |
| A1  | .106     | .114 | 2.70        | 2.90  |
| A2  | .001     | .010 | 0.02        | 0.25  |
| b   | .045     | .057 | 1.15        | 1.45  |
| b2  | .075     | .083 | 1.90        | 2.10  |
| C   | .016     | .026 | 0.40        | 0.65  |
| C2  | .057     | .063 | 1.45        | 1.60  |
| D   | .543     | .551 | 13.80       | 14.00 |
| D1  | .488     | .500 | 12.40       | 12.70 |
| E   | .624     | .632 | 15.85       | 16.05 |
| E1  | .524     | .535 | 13.30       | 13.60 |
| e   | .215 BSC |      | 5.45 BSC    |       |
| H   | .736     | .752 | 18.70       | 19.10 |
| L   | .094     | .106 | 2.40        | 2.70  |
| L1  | .047     | .055 | 1.20        | 1.40  |
| L2  | .039     | .045 | 1.00        | 1.15  |
| L3  | .010 BSC |      | 0.25 BSC    |       |
| L4  | .150     | .161 | 3.80        | 4.10  |

### TO-247 Outline



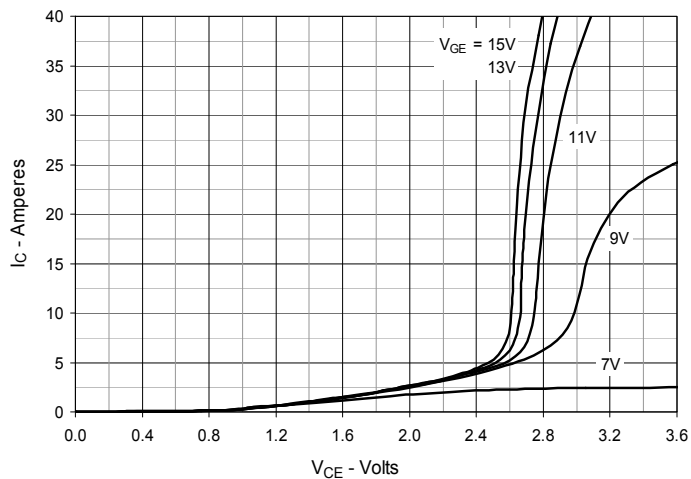
Terminals: 1 - Gate, 2 - Collector, 3 - Emitter

| 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  |
| ∅P             | 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 |       |

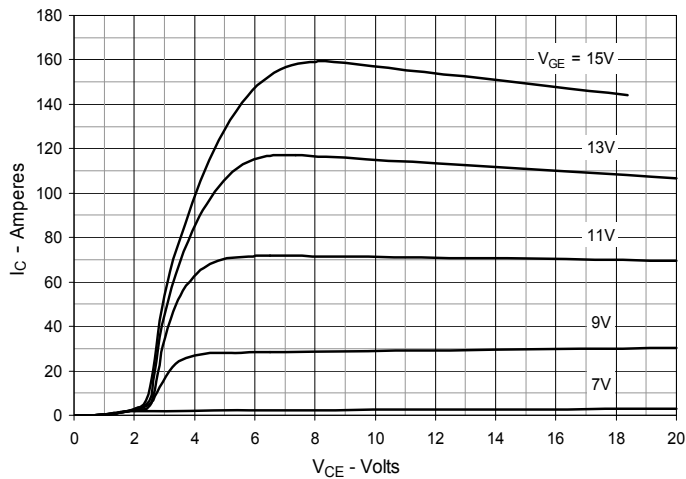
IXYS Reserves the Right to Change Limits, Test Conditions, and Dimensions.

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

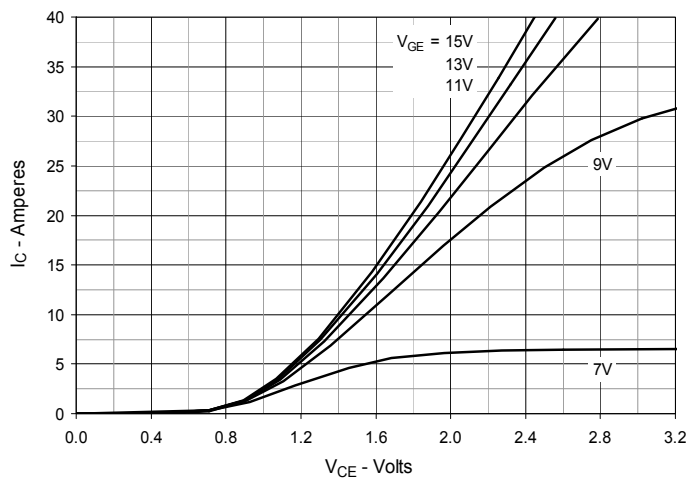
**Fig. 1. Output Characteristics @  $T_J = 25^\circ\text{C}$**



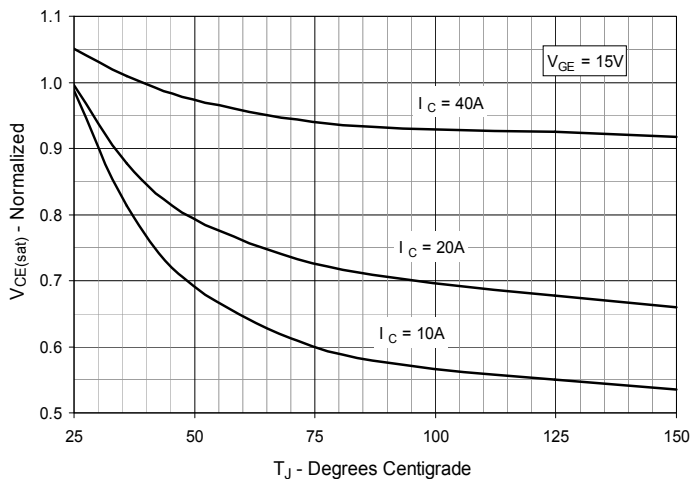
**Fig. 2. Extended Output Characteristics @  $T_J = 25^\circ\text{C}$**



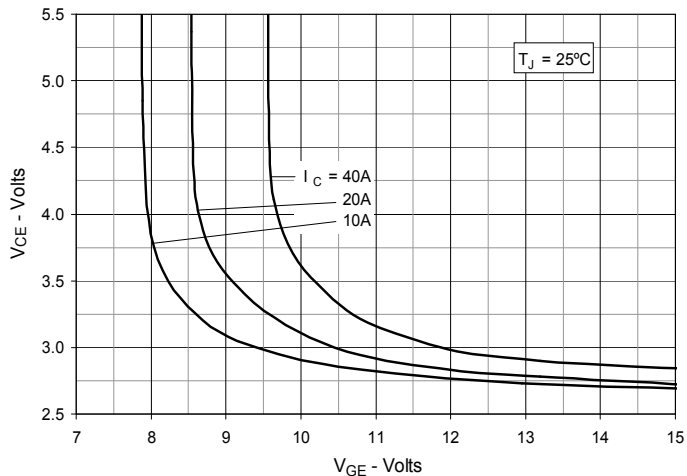
**Fig. 3. Output Characteristics @  $T_J = 125^\circ\text{C}$**



**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**

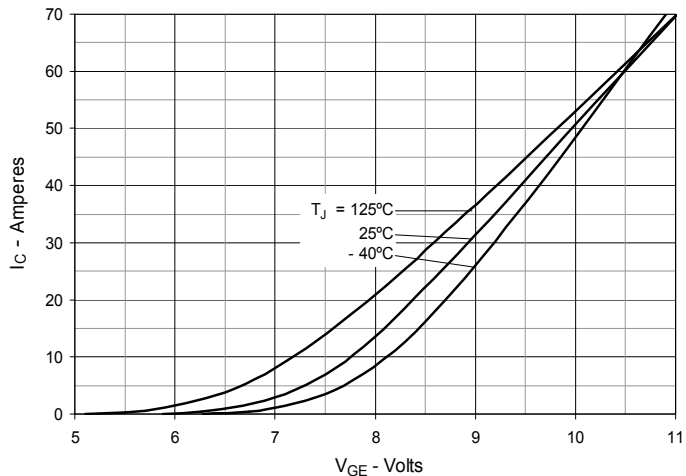


Fig. 7. Transconductance

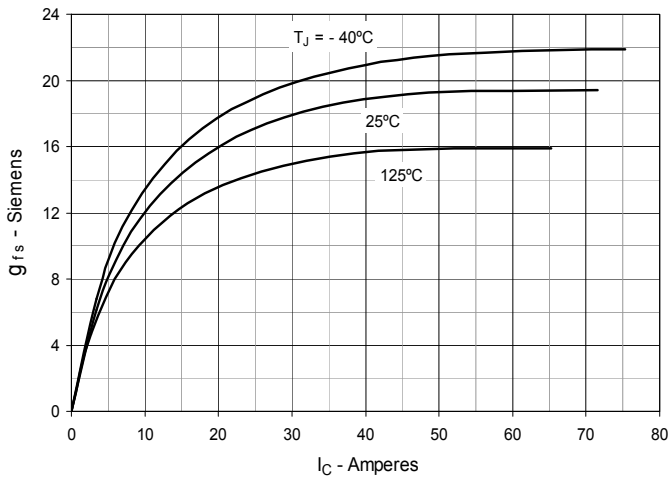


Fig. 8. Gate Charge

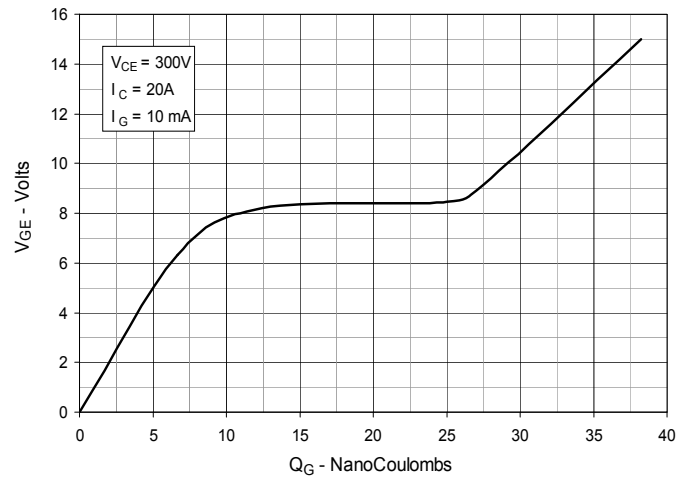


Fig. 9. Capacitance

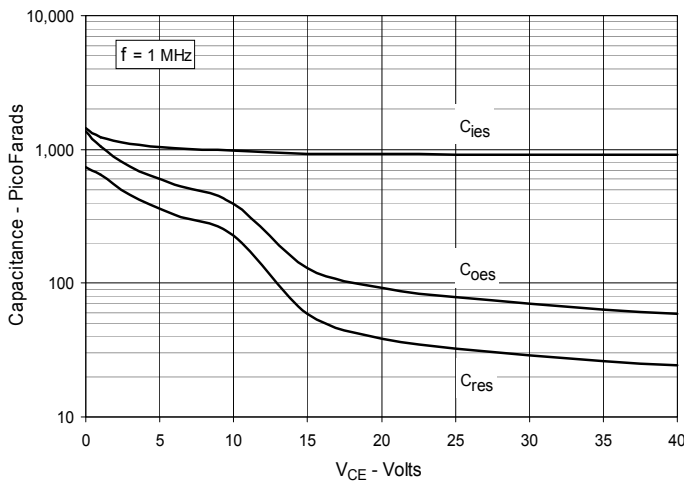


Fig. 10. Reverse-Bias Safe Operating Area

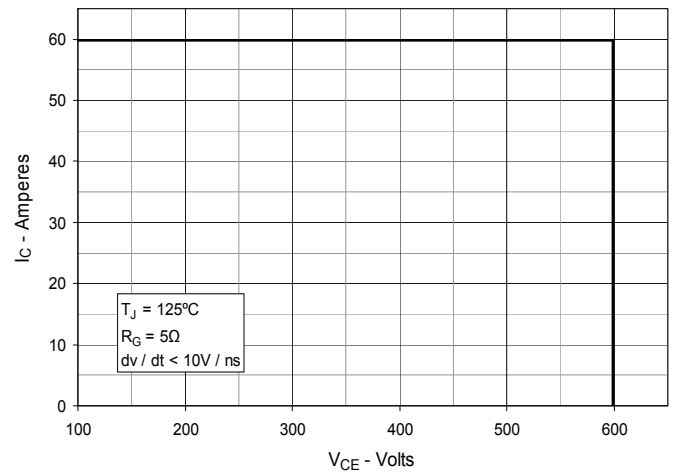
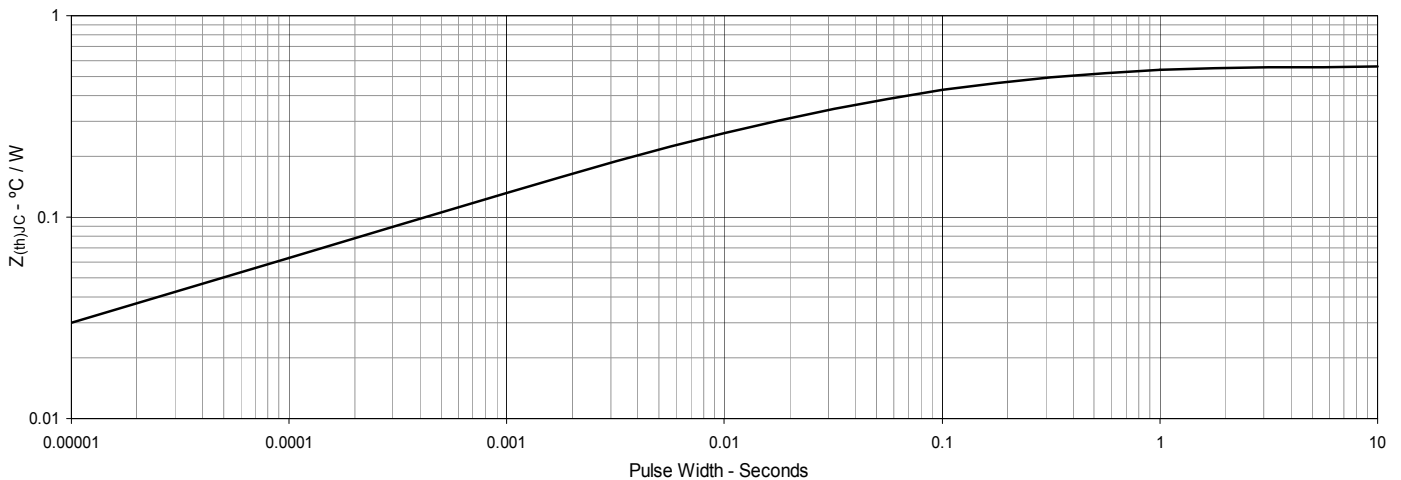
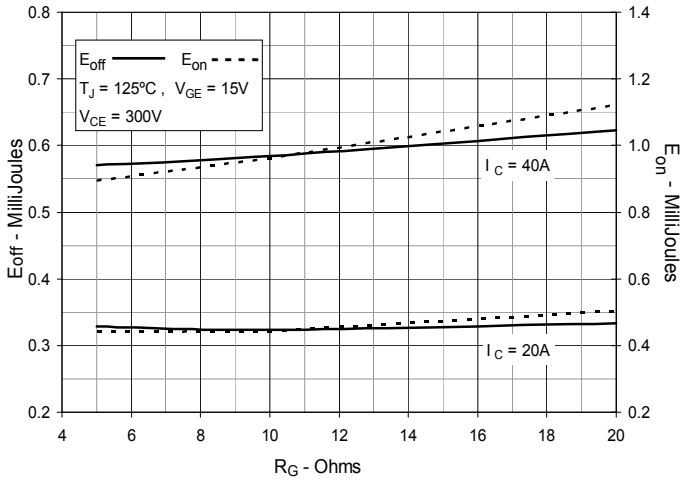


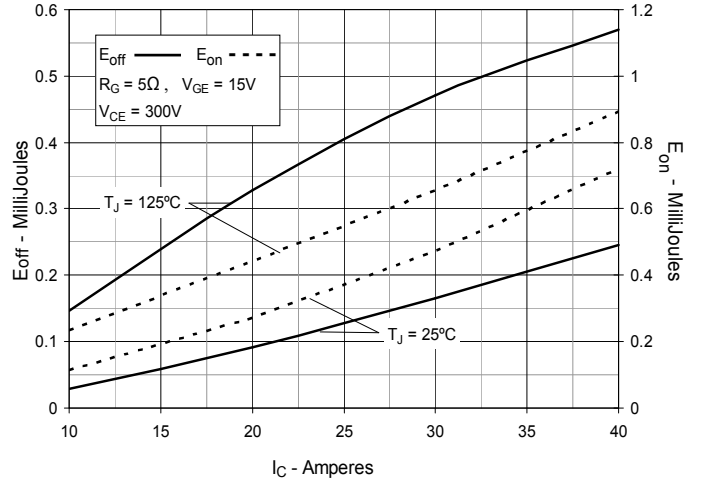
Fig. 11. Maximum Transient Thermal Impedance



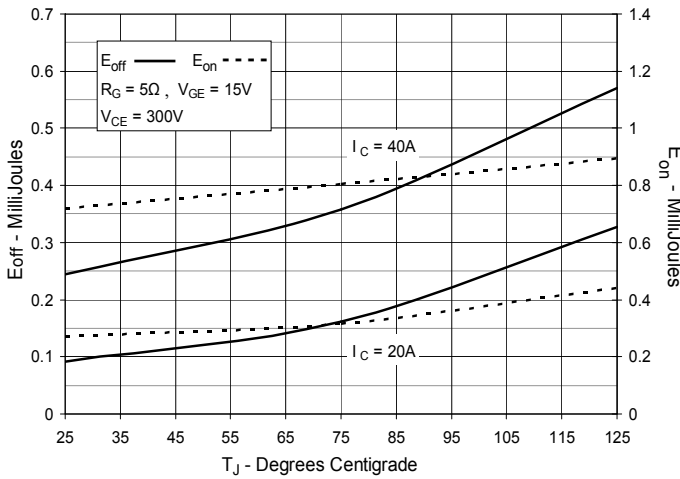
**Fig. 12. Inductive Switching Energy Loss vs. Gate Resistance**



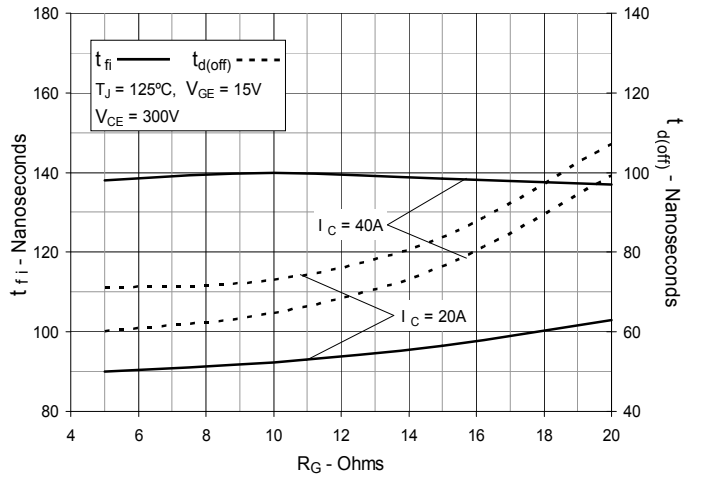
**Fig. 13. Inductive Switching Energy Loss vs. Collector Current**



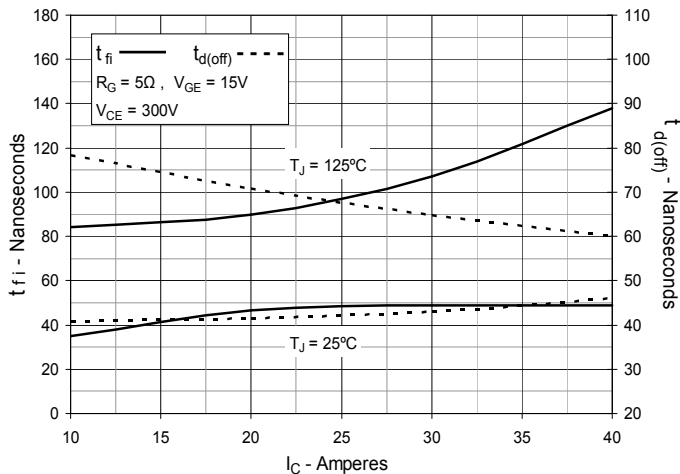
**Fig. 14. Inductive Switching Energy Loss vs. Junction Temperature**



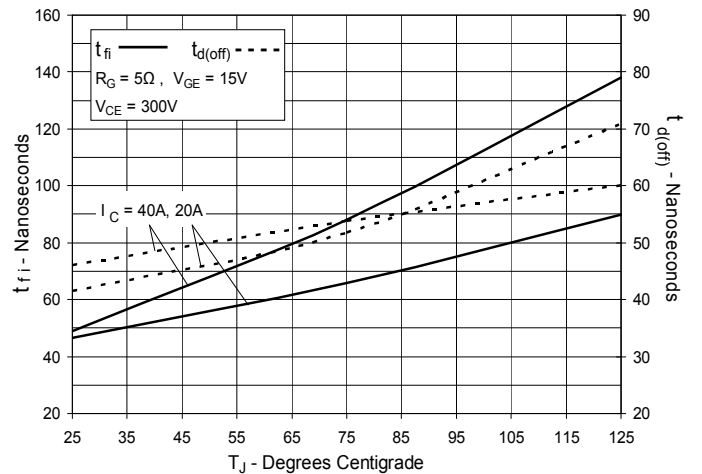
**Fig. 15. Inductive Turn-off Switching Times vs. Gate Resistance**



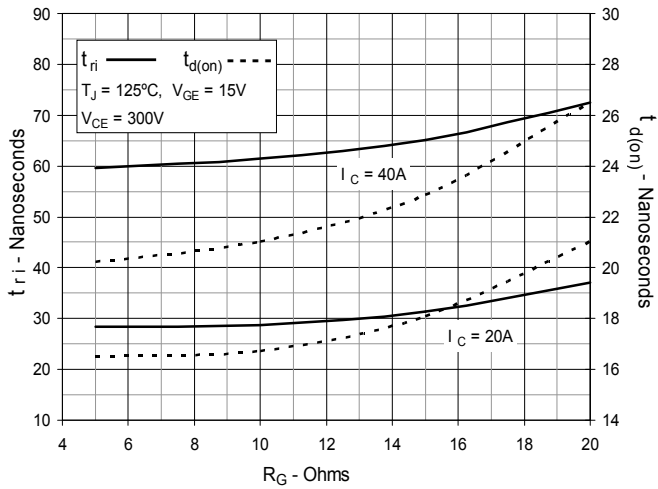
**Fig. 16. Inductive Turn-off Switching Times vs. Collector Current**



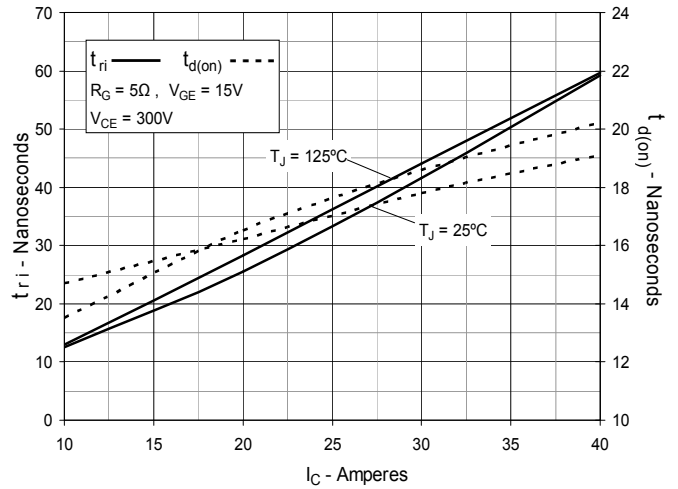
**Fig. 17. Inductive Turn-off Switching Times vs. Junction Temperature**



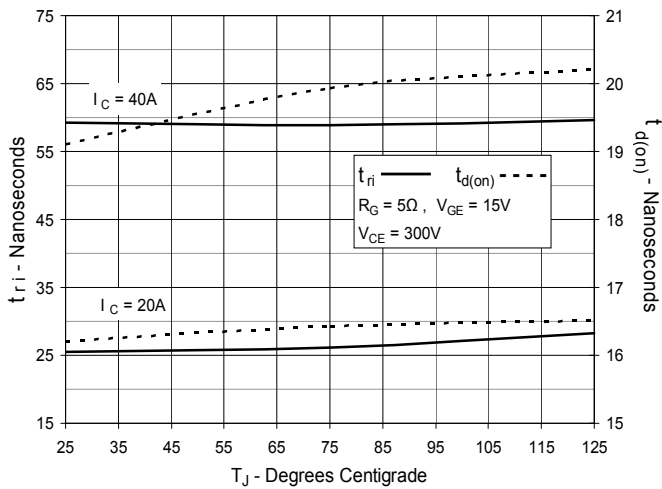
**Fig. 18. Inductive Turn-on Switching Times vs. Gate Resistance**

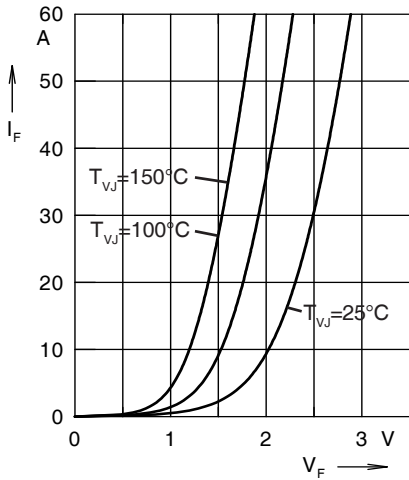


**Fig. 19. Inductive Turn-on Switching Times vs. Collector Current**

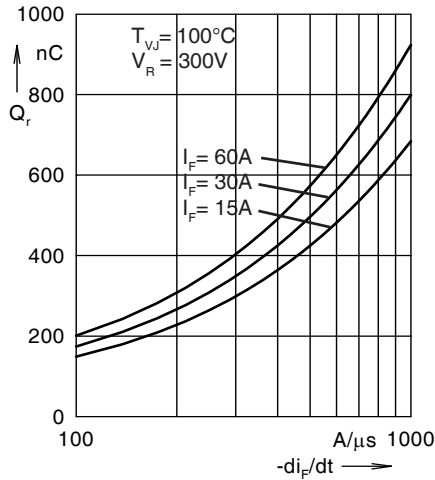


**Fig. 20. Inductive Turn-on Switching Times vs. Junction Temperature**

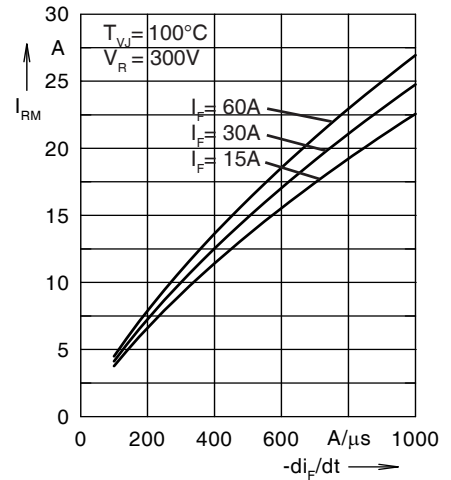




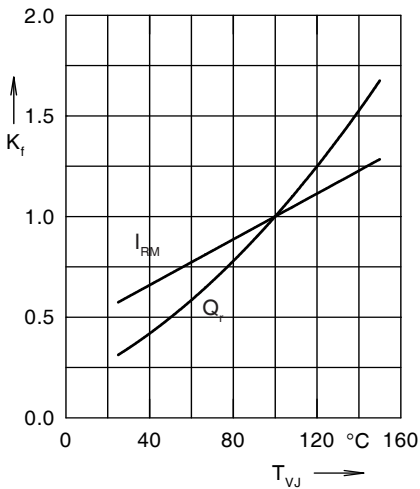
**Fig. 21. Forward current  $I_F$  versus  $V_F$**



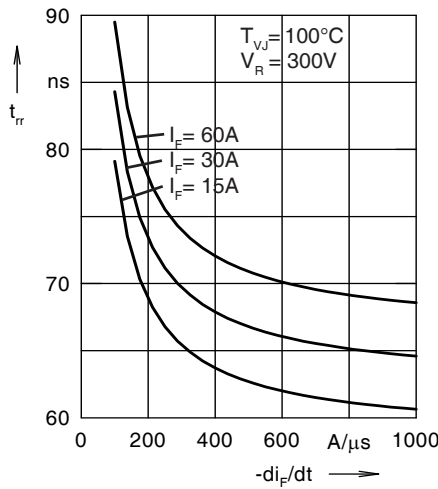
**Fig. 22. Reverse recovery charge  $Q_r$  versus  $-di_F/dt$**



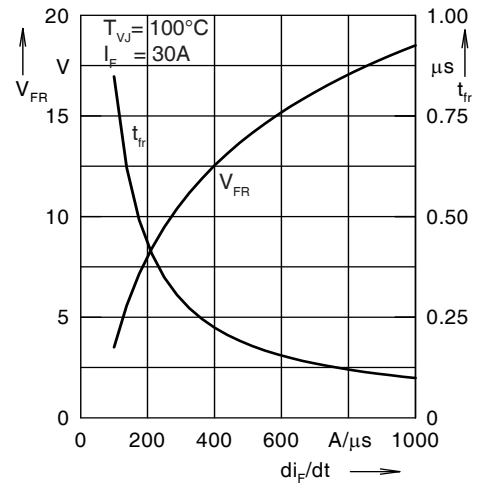
**Fig. 23. Peak reverse current  $I_{RM}$  versus  $-di_F/dt$**



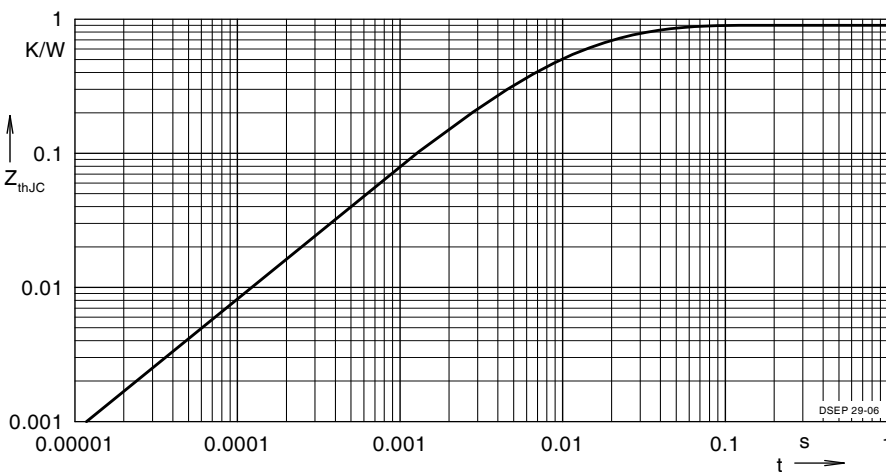
**Fig. 24. Dynamic parameters  $Q_r$ ,  $I_{RM}$  versus  $T_{VJ}$**



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



**Fig. 26. Peak forward voltage  $V_{FR}$  and  $t_{rr}$  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    |