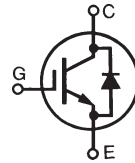


# High Voltage IGBTs w/Diode

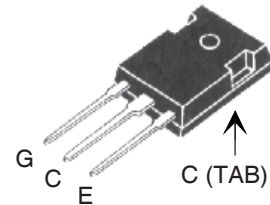
# IXGH40N120B2D1 IXGT40N120B2D1



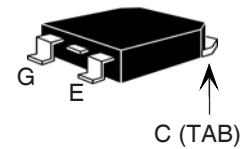
$V_{CES} = 1200V$   
 $I_{C110} = 40A$   
 $V_{CE(sat)} \leq 3.5V$   
 $t_{fi(typ)} = 140ns$

| Symbol                        | Test Conditions   | Maximum Ratings                       |            |
|-------------------------------|---|---------------------------------------|------------|
| $V_{CES}$                     | $T_C = 25^\circ C$ to $150^\circ C$   | 1200                                  | V          |
| $V_{CGR}$                     | $T_J = 25^\circ C$ to $150^\circ C$ , $R_{GE} = 1M\Omega$                           | 1200                                  | V          |
| $V_{GES}$                     | Continuous  | $\pm 20$                              | V          |
| $V_{GEM}$                     | Transient   | $\pm 30$                              | V          |
| $I_{C25}$                     | $T_C = 25^\circ C$ (Limited by Lead)  | 75                                    | A          |
| $I_{C110}$                    | $T_C = 110^\circ C$   | 40                                    | A          |
| $I_{F110}$                    | $T_C = 110^\circ C$   | 25                                    | A          |
| $I_{CM}$                      | $T_C = 25^\circ C$ , 1ms  | 200                                   | A          |
| <b>SSOA</b><br><b>(RBSOA)</b> | $V_{GE} = 15V$ , $T_{VJ} = 125^\circ C$ , $R_G = 2\Omega$<br>Clamped Inductive Load | $I_{CM} = 80$<br>@ $0.8 \leq V_{CES}$ | A<br>V     |
| $P_C$                         | $T_C = 25^\circ C$  | 380                                   | 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-247  | 6                                     | g          |
|                               | TO-268  | 4                                     | g          |

## TO-247 (IXGH)



## TO-268 (IXGT)



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

## Features

- International Standard Packages
- IGBT and Anti-Parallel FRED for Resonant Power Supplies
  - Induction Heating
  - Rice Cookers
- Square RBSOA
- Fast Recovery Exipitaxial Diode (FRED)
  - Soft Recovery with Low  $I_{RM}$

## Advantages

- High Power Density
- Low Gate Drive Requirement

| 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                   |      | 5.0 V               |
| $I_{CES}$     | $V_{CE} = V_{CES}$ , $V_{GE} = 0V$                                  |                       |      | 100 $\mu A$<br>3 mA |
|               |   |                       |      | $T_J = 125^\circ C$ |
| $I_{GES}$     | $V_{CE} = 0V$ , $V_{GE} = \pm 20V$                                  |                       |      | $\pm 100$ nA        |
| $V_{CE(sat)}$ | $I_C = 40A$ , $V_{GE} = 15V$ , Note 1                               |                       | 2.9  | 3.5 V               |

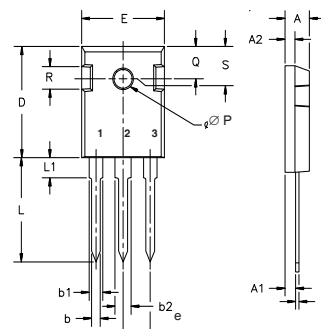
| Symbol       | Test Conditions  | Characteristic Values |      |              |
|--------------|--|-----------------------|------|--------------|
|              |  | Min.                  | Typ. | Max.         |
| $g_{fs}$     | $I_C = 40A, V_{CE} = 10V, \text{Note 1}$   | 23                    | 37   | S            |
| $C_{ies}$    | $V_{CE} = 25V, V_{GE} = 0V, f = 1MHz$  |                       | 3360 | pF           |
| $C_{oes}$    |  |                       | 190  | pF           |
| $C_{res}$    |  |                       | 63   | pF           |
| $Q_g$        | $I_C = 40A, V_{GE} = 15V, V_{CE} = 0.5 \cdot V_{CES}$  |                       | 138  | nC           |
| $Q_{ge}$     |  |                       | 20   | nC           |
| $Q_{gc}$     |  |                       | 48   | nC           |
| $t_{d(on)}$  | <b>Inductive load, <math>T_J = 25^\circ C</math></b><br>$I_C = 40A, V_{GE} = 15V$<br>$V_{CE} = 960V, R_G = 2\Omega$<br>Note 2  |                       | 21   | ns           |
| $t_{ri}$     |  |                       | 55   | ns           |
| $E_{on}$     |  |                       | 4.5  | mJ           |
| $t_{d(off)}$ |  |                       | 290  | ns           |
| $t_{fi}$     |  |                       | 140  | 270          |
| $E_{off}$    |  | 3.0                   | 6.0  | mJ           |
| $t_{d(on)}$  | <b>Inductive load, <math>T_J = 125^\circ C</math></b><br>$I_C = 40A, V_{GE} = 15V$<br>$V_{CE} = 960V, R_G = 2\Omega$<br>Note 2 |                       | 21   | ns           |
| $t_{ri}$     |  |                       | 58   | ns           |
| $E_{on}$     |  |                       | 6.5  | mJ           |
| $t_{d(off)}$ |  |                       | 350  | ns           |
| $t_{fi}$     |  |                       | 420  | ns           |
| $E_{off}$    |  | 8.3                   | mJ   |              |
| $R_{thJC}$   |  |                       | 0.33 | $^\circ C/W$ |
| $R_{thCS}$   |  | 0.21                  |      | $^\circ C/W$ |

### Reverse Diode (FRED)

| Symbol     | Test Conditions  | Characteristic Values |      |                  |
|------------|--|-----------------------|------|------------------|
|            |  | Min.                  | Typ. | Max.             |
| $V_F$      | $I_F = 30A, V_{GE} = 0V$                                       |                       |      | 2.8 V            |
|            |  | $T_J = 150^\circ C$   | 1.6  | V                |
| $I_{RM}$   | $I_F = 30A, -di/dt = 100A/\mu s,$<br>$V_R = 300V, V_{GE} = 0V$ | $T_J = 100^\circ C$   |      | 4 A              |
| $t_{rr}$   |  | $T_J = 100^\circ C$   | 100  | ns               |
| $R_{thJC}$ |  |                       |      | 0.9 $^\circ C/W$ |

Note 1: Pulse Test,  $t \leq 300\mu s$ , Duty Cycle,  $d \leq 2\%$ .  
 2. Switching Times may Increase for  $V_{CE} (\text{Clamp}) > 0.8 \cdot V_{CES}$ , Higher  $T_J$  or Increased  $R_G$ .

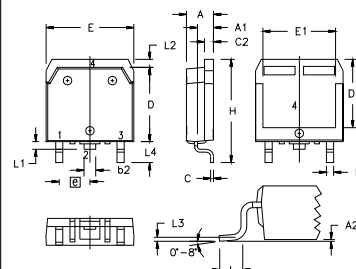
### TO-247 (IXGH) Outline



Terminals: 1 - Gate  
2 - Drain  
3 - Source  
Tab - Drain

| 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  |
| L <sub>1</sub> |            | 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   |

### TO-268 (IXGT) Outline



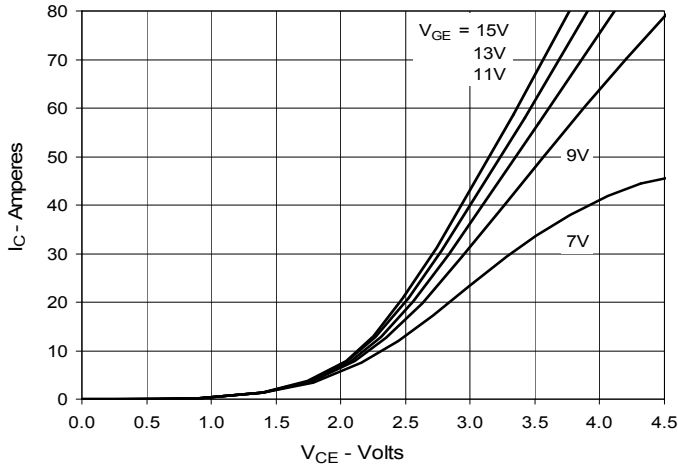
| SYM            | INCHES   |      | MILLIMETERS |       |
|----------------|----------|------|-------------|-------|
|                | MIN      | MAX  | MIN         | MAX   |
| A              | .193     | .201 | 4.90        | 5.10  |
| A <sub>1</sub> | .106     | .114 | 2.70        | 2.90  |
| A <sub>2</sub> | .001     | .010 | 0.02        | 0.25  |
| b              | .045     | .057 | 1.15        | 1.45  |
| b <sub>2</sub> | .075     | .083 | 1.90        | 2.10  |
| C              | .016     | .026 | 0.40        | 0.65  |
| C <sub>2</sub> | .057     | .063 | 1.45        | 1.60  |
| D              | .543     | .551 | 13.80       | 14.00 |
| D <sub>1</sub> | .488     | .500 | 12.40       | 12.70 |
| E              | .624     | .632 | 15.85       | 16.05 |
| E <sub>1</sub> | .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  |
| L <sub>1</sub> | .047     | .055 | 1.20        | 1.40  |
| L <sub>2</sub> | .039     | .045 | 1.00        | 1.15  |
| L <sub>3</sub> | .010 BSC |      | 0.25 BSC    |       |
| L <sub>4</sub> | .150     | .161 | 3.80        | 4.10  |

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

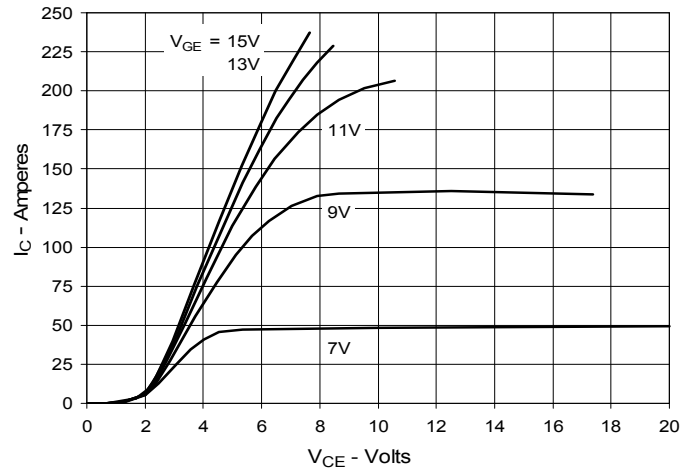
IXYS MOSFETs and IGBTs are covered by one or more of the following U.S. patents:

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

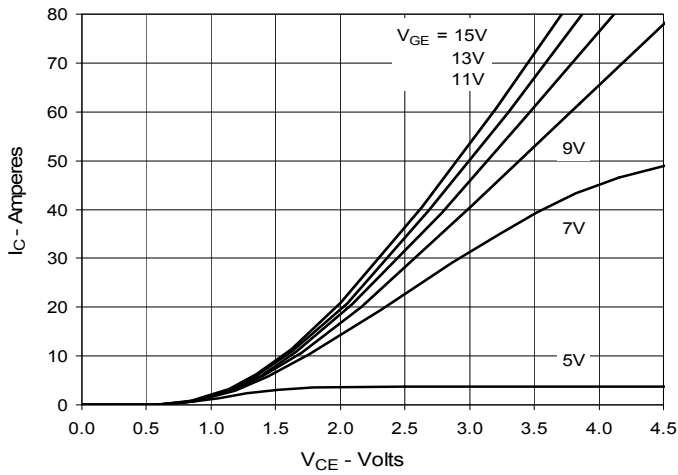
**Fig. 1. Output Characteristics @ 25°C**



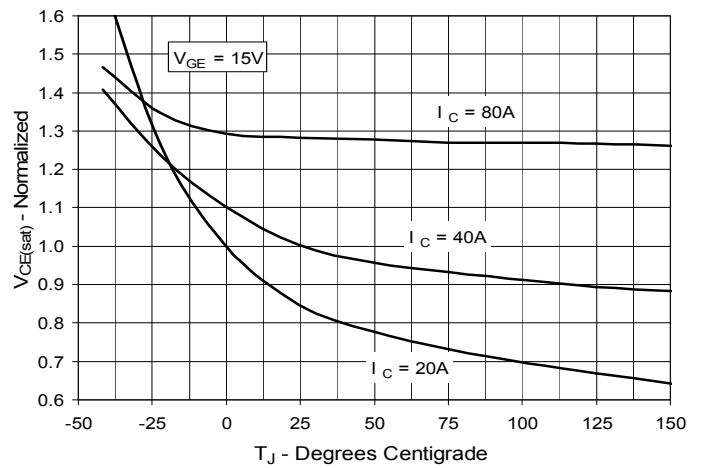
**Fig. 2. Extended Output Characteristics @ 25°C**



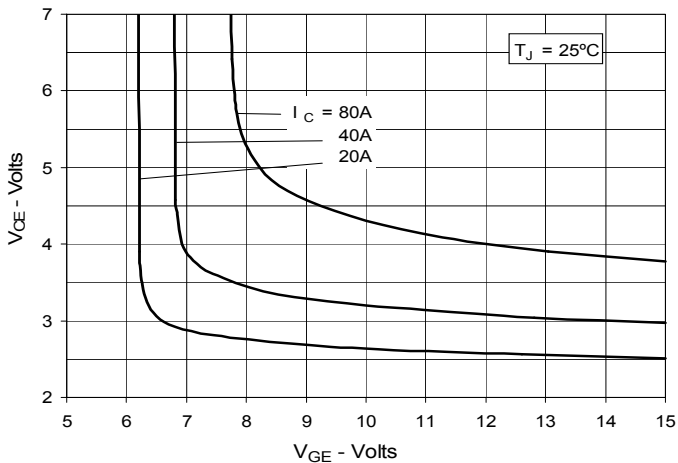
**Fig. 3. Output Characteristics @ 125°C**



**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**

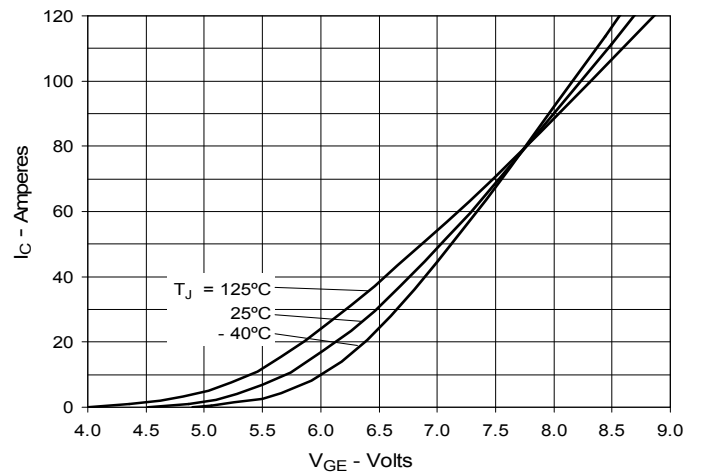


Fig. 7. Transconductance

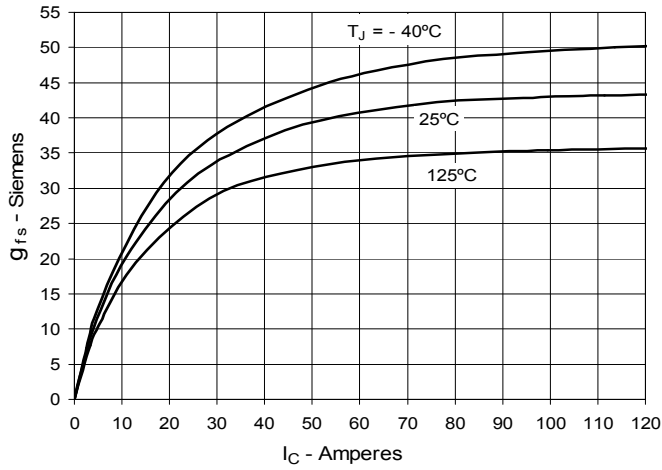


Fig. 8. Gate Charge

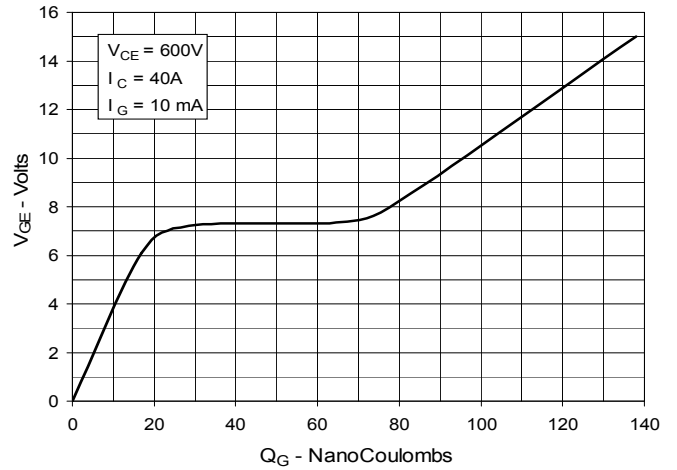


Fig. 9. Capacitance

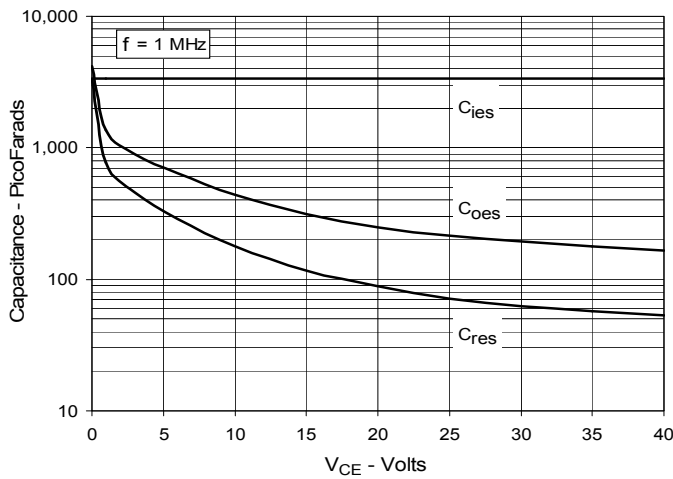


Fig. 10. Reverse-Bias Safe Operating Area

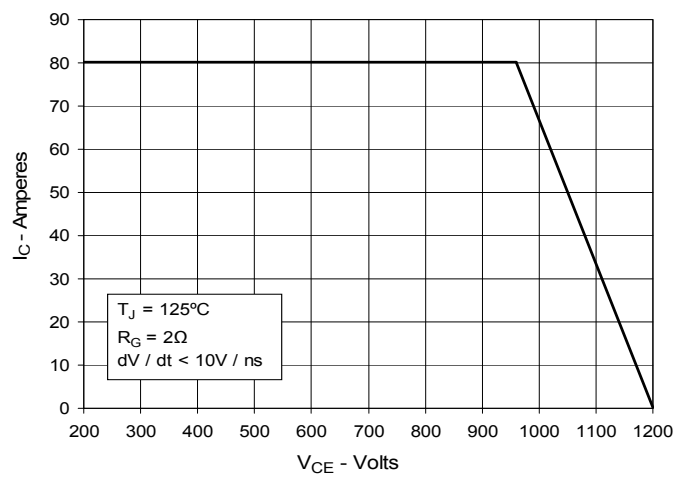
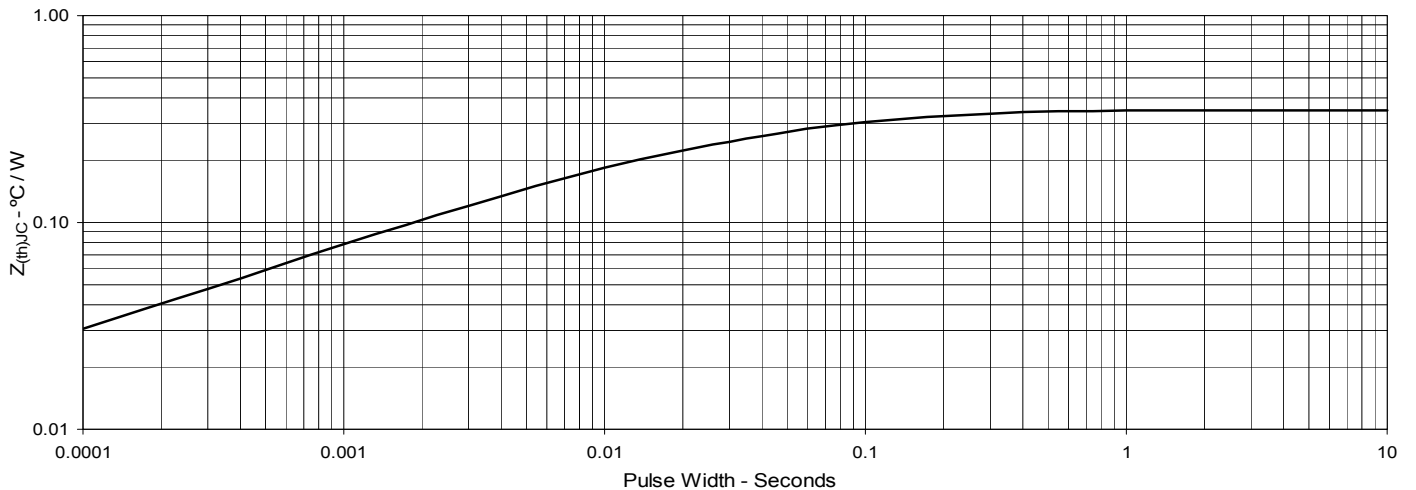
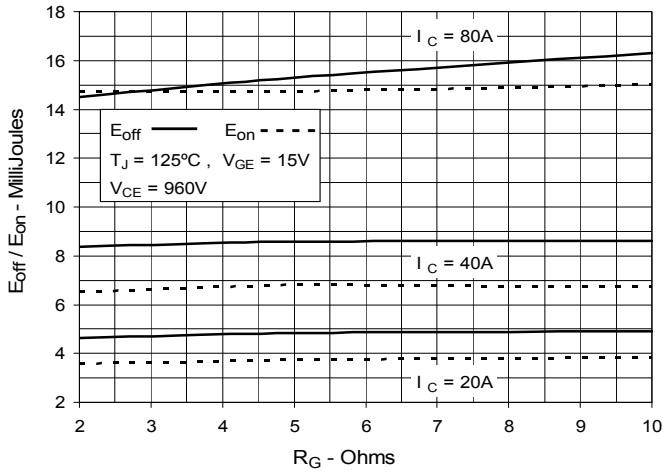


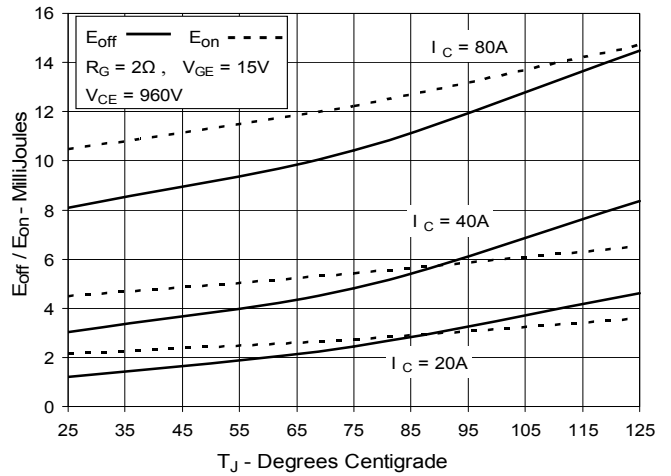
Fig. 11. Maximum Transient Thermal Impedance



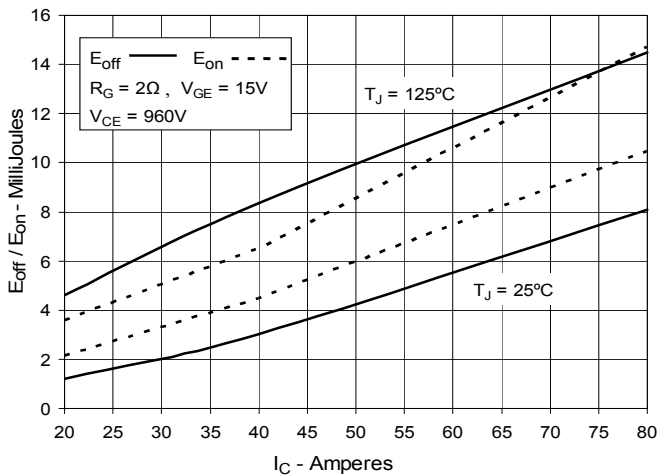
**Fig. 12. Inductive Switching Energy Loss vs. Gate Resistance**



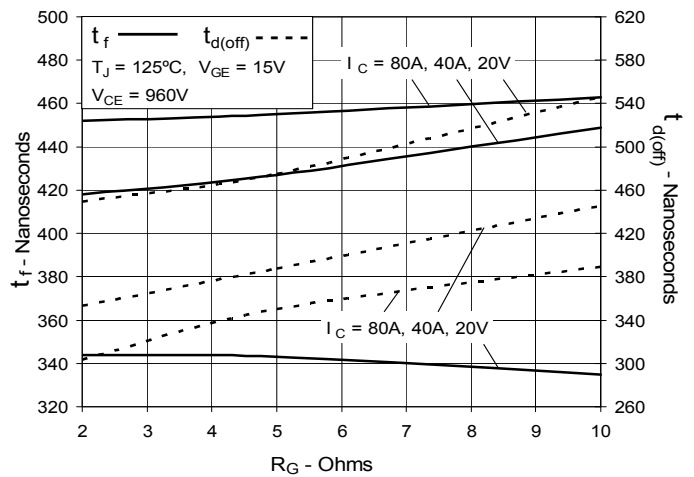
**Fig. 13. Inductive Switching Energy Loss vs. Junction Temperature**



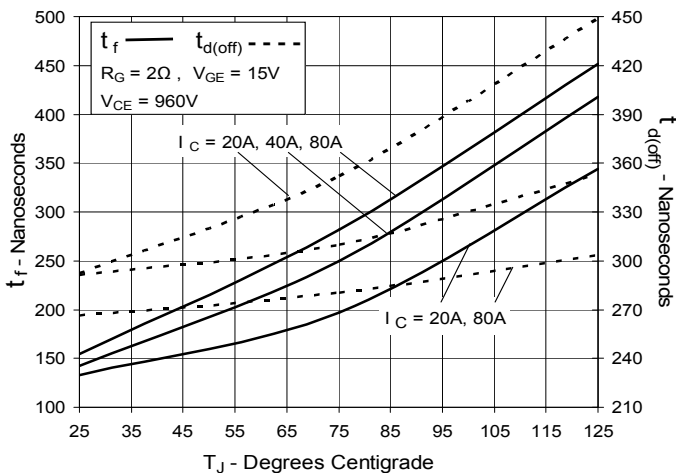
**Fig. 14. Inductive Switching Energy Loss vs. Collector Current**



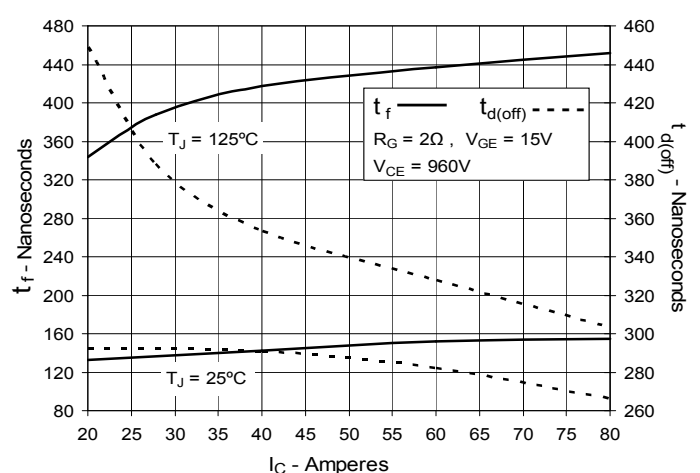
**Fig. 15. Inductive Turn-off Switching Times vs. Gate Resistance**



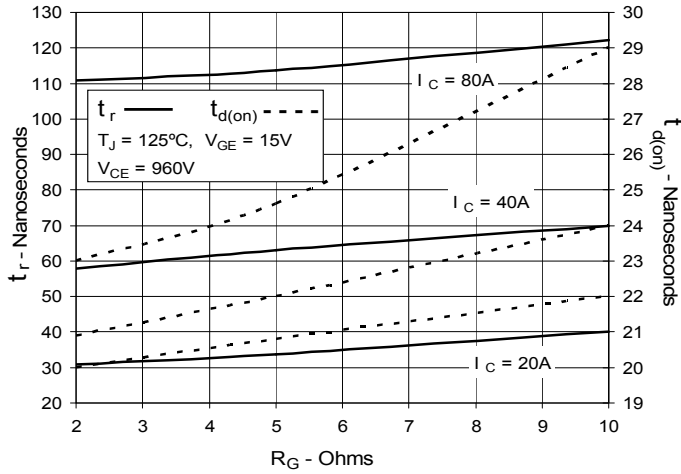
**Fig. 16. Inductive Turn-off Switching Times vs. Junction Temperature**



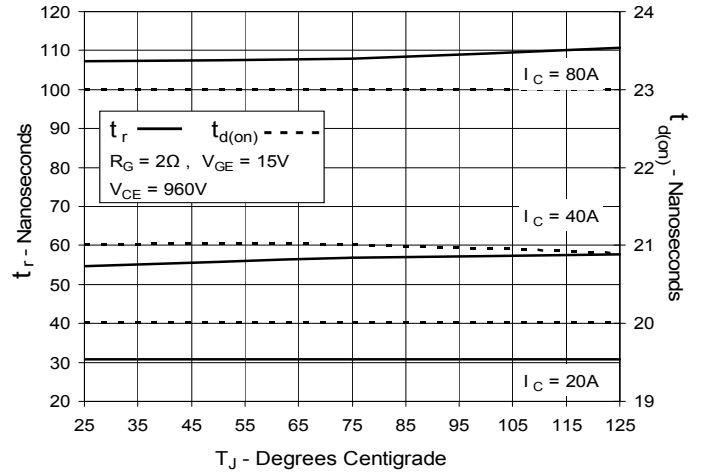
**Fig. 17. Inductive Turn-off Switching Times vs. Collector Current**



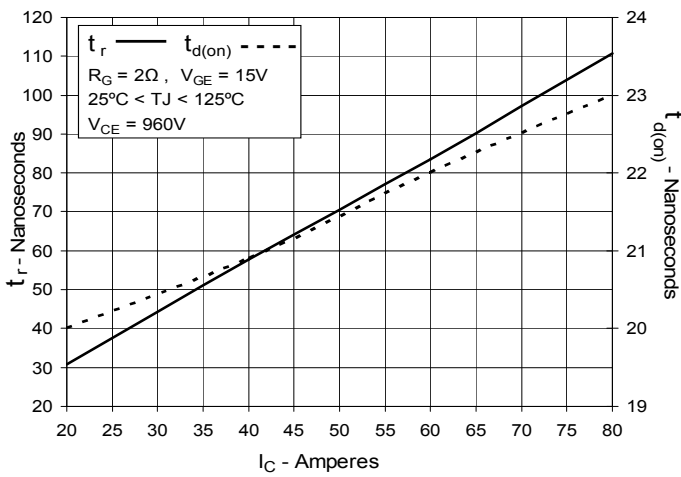
**Fig. 18. Inductive Turn-on Switching Times vs. Gate Resistance**



**Fig. 19. Inductive Turn-on Switching Times vs. Junction Temperature**



**Fig. 20. Inductive Turn-on Switching Times vs. Collector Current**



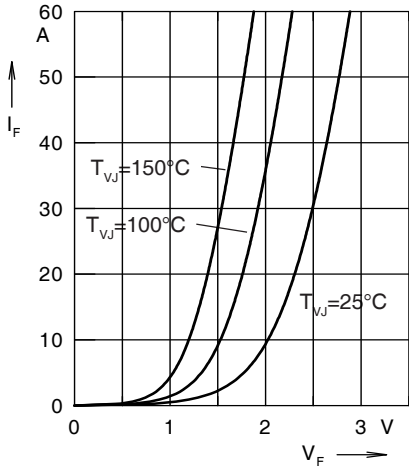


Fig. 21. Forward current  $I_F$  versus  $V_F$

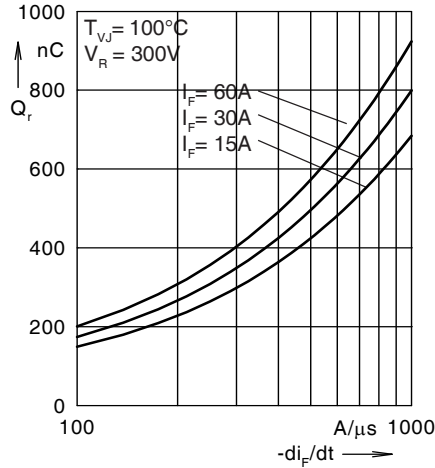


Fig. 22. Reverse recovery charge  $Q_r$  versus  $-di_F/dt$

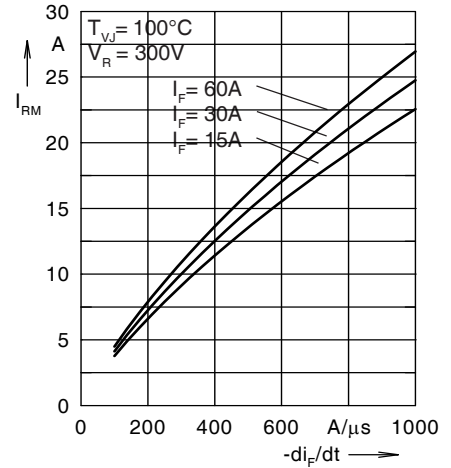


Fig. 23. Peak reverse current  $I_{RM}$  versus  $-di_F/dt$



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

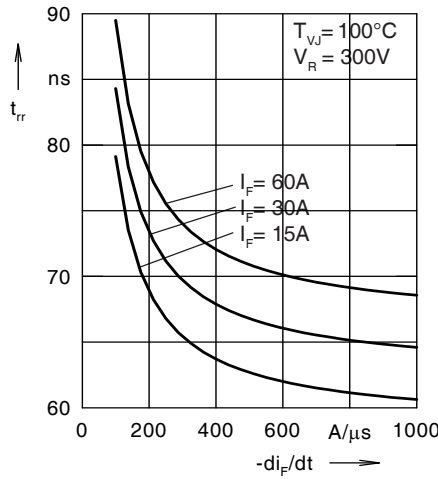


Fig. 25. Recovery time  $t_{rr}$  versus  $-di_F/dt$

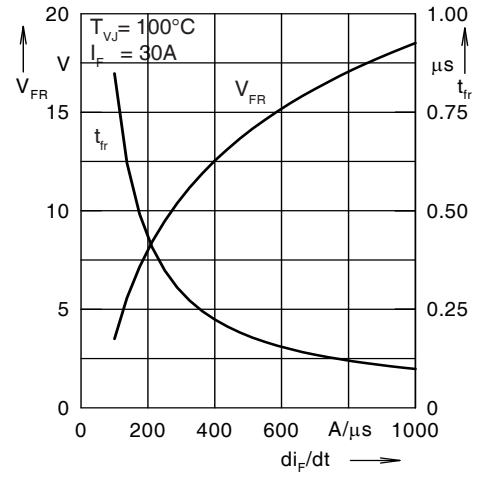


Fig. 26. Peak forward voltage  $V_{FR}$  and  $t_{fr}$  versus  $di_F/dt$

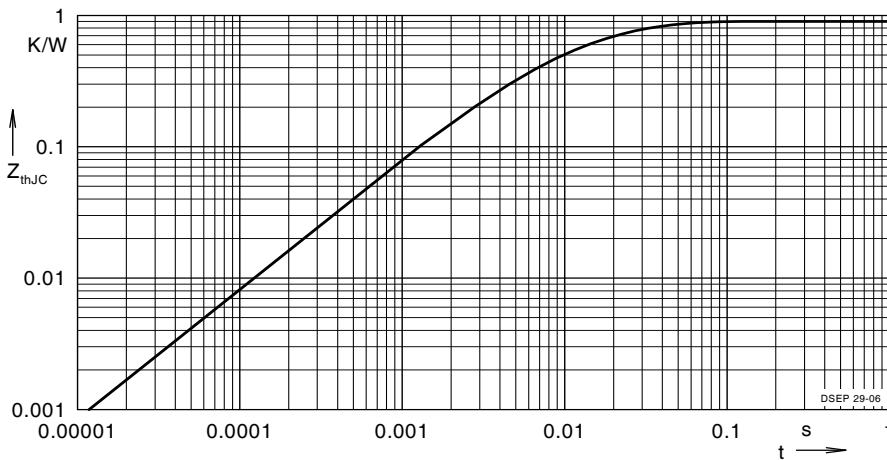


Fig. 27. Transient thermal resistance junction to case

### Constants for $Z_{thJC}$ calculation

| i | $R_{th}$ (°C/W) | $t_i$ (s) |
|---|-----------------|-----------|
| 1 | 0.465           | 0.0052    |
| 2 | 0.179           | 0.0003    |
| 3 | 0.256           | 0.0397    |



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