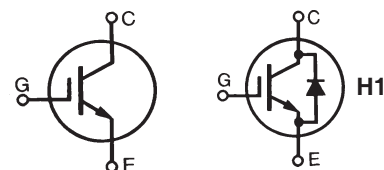


## High Voltage IGBT w/ Sonic Diode

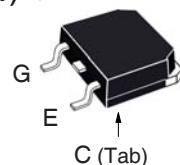
**IXGT16N170A**  
**IXGH16N170A**  
**IXGT16N170AH1**  
**IXGH16N170AH1**

$V_{CES} = 1700V$   
 $I_{C90} = 11A$   
 $V_{CE(sat)} \leq 5.0V$   
 $t_{fi(typ)} = 35ns$

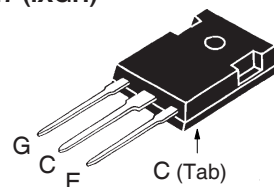


| Symbol                        | Test Conditions                                                                               | Maximum Ratings                      |             |
|-------------------------------|-----------------------------------------------------------------------------------------------|--------------------------------------|-------------|
| $V_{CES}$                     | $T_J = 25^{\circ}C$ to $150^{\circ}C$                                                         | 1700                                 | V           |
| $V_{CGR}$                     | $T_J = 25^{\circ}C$ to $150^{\circ}C$ , $R_{GE} = 1M\Omega$                                   | 1700                                 | V           |
| $V_{GES}$                     | Continuous                                                                                    | $\pm 20$                             | V           |
| $V_{GEM}$                     | Transient                                                                                     | $\pm 30$                             | V           |
| $I_{C25}$                     | $T_C = 25^{\circ}C$                                                                           | 16                                   | A           |
| $I_{C90}$                     | $T_C = 90^{\circ}C$                                                                           | 11                                   | A           |
| $I_{F90}$                     | $T_C = 90^{\circ}C$                                                                           | 17                                   | A           |
| $I_{CM}$                      | $T_C = 25^{\circ}C$ , 1ms                                                                     | 40                                   | A           |
| <b>SSOA</b><br><b>(RBSOA)</b> | $V_{GE} = 15V$ , $T_{VJ} = 125^{\circ}C$ , $R_G = 10\Omega$<br>Clamped Inductive Load         | $I_{CM} = 40$<br>$0.8 \cdot V_{CES}$ | A           |
| $t_{sc}$<br><b>(SCSOA)</b>    | $V_{GE} = 15V$ , $V_{CE} = 1200V$ , $T_J = 125^{\circ}C$<br>$R_G = 22\Omega$ , Non Repetitive | 10                                   | $\mu s$     |
| $P_C$                         | $T_C = 25^{\circ}C$                                                                           | 190                                  | W           |
| $T_J$                         |                                                                                               | -55 ... +150                         | $^{\circ}C$ |
| $T_{JM}$                      |                                                                                               | 150                                  | $^{\circ}C$ |
| $T_{stg}$                     |                                                                                               | -55 ... +150                         | $^{\circ}C$ |
| $T_L$                         | Maximum Lead Temperature for Soldering                                                        | 300                                  | $^{\circ}C$ |
| $T_{SOLD}$                    | Plastic Body for 10s                                                                          | 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

- High Blocking Voltage
- International Standard Packages
- Low Conduction Losses
- Anti-Parallel Sonic Diode
- High Blocking Voltage
- High Current Handling Capability

### Advantages

- Low Gate Drive Requirement
- High Power Density

### Applications

- Switch-Mode and Resonant-Mode Power Supplies
- Uninterruptible Power Supplies (UPS)
- AC Choppers
- Capacitor Discharge Circuits
- AC Motor Drives
- DC Servo & Robot Drives

| Symbol        | Test Conditions<br>( $T_J = 25^{\circ}C$ , Unless Otherwise Specified)   | Characteristic Values |      |              |
|---------------|--------------------------------------------------------------------------|-----------------------|------|--------------|
|               |                                                                          | Min.                  | Typ. | Max.         |
| $BV_{CES}$    | $I_C = 250\mu A$ , $V_{GE} = 0V$                                         | 1700                  |      | V            |
| $V_{GE(th)}$  | $I_C = 250\mu A$ , $V_{CE} = V_{GE}$                                     | 3.0                   |      | 5.0 V        |
| $I_{CES}$     | $V_{CE} = 0.8 \cdot V_{CES}$ , $V_{GE} = 0V$<br><br>$T_J = 125^{\circ}C$ | 16N170A               |      | 50 $\mu A$   |
|               |                                                                          | 16N170AH1             |      | 100 $\mu A$  |
|               |                                                                          | 16N170A               |      | 750 $\mu A$  |
|               |                                                                          | 16N170AH1             |      | 1.5 mA       |
| $I_{GES}$     | $V_{CE} = 0V$ , $V_{GE} = \pm 20V$                                       |                       |      | $\pm 100$ nA |
| $V_{CE(sat)}$ | $I_C = 11A$ , $V_{GE} = 15V$ , Note 1<br>$T_J = 125^{\circ}C$            | 4.0                   | 5.0  | V            |
|               |                                                                          | 4.5                   |      | V            |

| Symbol       | Test Conditions                                                                                                            | Characteristic Values |      |                  |
|--------------|----------------------------------------------------------------------------------------------------------------------------|-----------------------|------|------------------|
|              |                                                                                                                            | Min.                  | Typ. | Max.             |
| $g_{fs}$     | $I_C = 16A, V_{CE} = 10V$ , Note 1                                                                                         | 6.0                   | 12.5 | S                |
| $C_{ies}$    | $V_{CE} = 25V, V_{GE} = 0V, f = 1MHz$                                                                                      | 16N170A<br>16N170AH1  | 1500 | pF               |
| $C_{oes}$    |                                                                                                                            |                       | 99   | pF               |
| $C_{res}$    |                                                                                                                            |                       | 110  | pF               |
| $C_{res}$    |                                                                                                                            |                       | 33   | pF               |
| $Q_{g(on)}$  | $I_C = 11A, V_{GE} = 15V, V_{CE} = 0.5 \cdot V_{CES}$                                                                      |                       | 70   | nC               |
| $Q_{ge}$     |                                                                                                                            |                       | 9    | nC               |
| $Q_{gc}$     |                                                                                                                            |                       | 32   | nC               |
| $t_{d(on)}$  | Inductive load, $T_J = 25^\circ C$<br>$I_C = 16A, V_{GE} = 15V$<br>$V_{CE} = 0.5 \cdot V_{CES}, R_G = 10\Omega$<br>Note 2  |                       | 12   | ns               |
| $t_{ri}$     |                                                                                                                            |                       | 22   | ns               |
| $E_{on}$     |                                                                                                                            |                       | 2.35 | mJ               |
| $t_{d(off)}$ |                                                                                                                            |                       | 200  | ns               |
| $t_{fi}$     |                                                                                                                            |                       | 35   | ns               |
| $E_{off}$    |                                                                                                                            |                       | 0.38 | mJ               |
| $t_{d(on)}$  | Inductive load, $T_J = 125^\circ C$<br>$I_C = 16A, V_{GE} = 15V$<br>$V_{CE} = 0.5 \cdot V_{CES}, R_G = 10\Omega$<br>Note 2 |                       | 13   | ns               |
| $t_{ri}$     |                                                                                                                            |                       | 22   | ns               |
| $E_{on}$     |                                                                                                                            |                       | 2.80 | mJ               |
| $t_{d(off)}$ |                                                                                                                            |                       | 210  | ns               |
| $t_{fi}$     |                                                                                                                            |                       | 88   | ns               |
| $E_{off}$    |                                                                                                                            |                       | 0.67 | mJ               |
| $R_{thJC}$   |                                                                                                                            |                       | 0.21 | $0.65^\circ C/W$ |
| $R_{thCS}$   |                                                                                                                            |                       |      | $^\circ C/W$     |

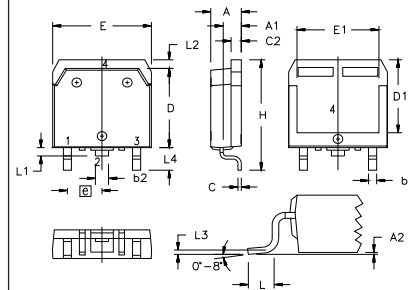
### Reverse Sonic Diode (FRD)

| Symbol     | Test Conditions                                                  | Characteristic Values |      |                  |
|------------|------------------------------------------------------------------|-----------------------|------|------------------|
|            |                                                                  | Min.                  | Typ. | Max.             |
| $V_F$      | $I_F = 20A, V_{GE} = 0V$ , Note 1                                | $T_J = 125^\circ C$   | 2.8  | 3.4 V            |
| $t_{rr}$   | $I_F = 10A, V_{GE} = 0V,$<br>$-di_F/dt = 250A/\mu s, V_R = 900V$ | $T_J = 125^\circ C$   | 300  | ns               |
| $I_{RM}$   |                                                                  | $T_J = 125^\circ C$   | 550  | ns               |
| $I_{RM}$   |                                                                  | $T_J = 125^\circ C$   | 13   | A                |
| $R_{thJC}$ |                                                                  |                       |      | 15 A             |
| $R_{thJC}$ |                                                                  |                       |      | 1.5 $^\circ C/W$ |

### Notes:

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

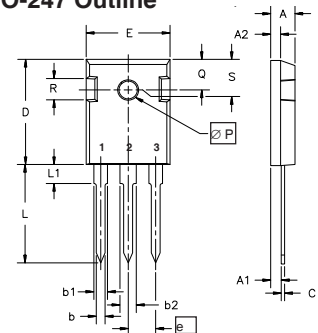
### TO-268 Outline



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



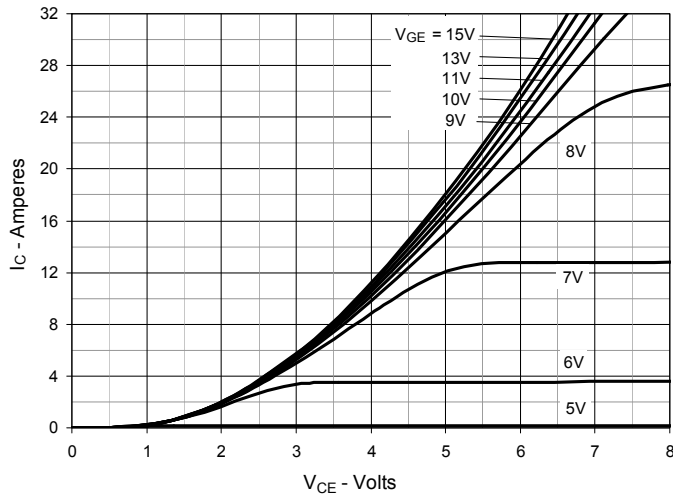
Terminals: 1 - Gate 2 - Collector  
3 - Emitter

| Dim. | Millimeter |       | Inches |       |
|------|------------|-------|--------|-------|
|      | Min.       | Max.  | Min.   | Max.  |
| A    | 4.7        | 5.3   | .185   | .209  |
| A1   | 2.2        | 2.54  | .087   | .102  |
| A2   | 2.2        | 2.6   | .059   | .098  |
| b    | 1.0        | 1.4   | .040   | .055  |
| b1   | 1.65       | 2.13  | .065   | .084  |
| b2   | 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   |

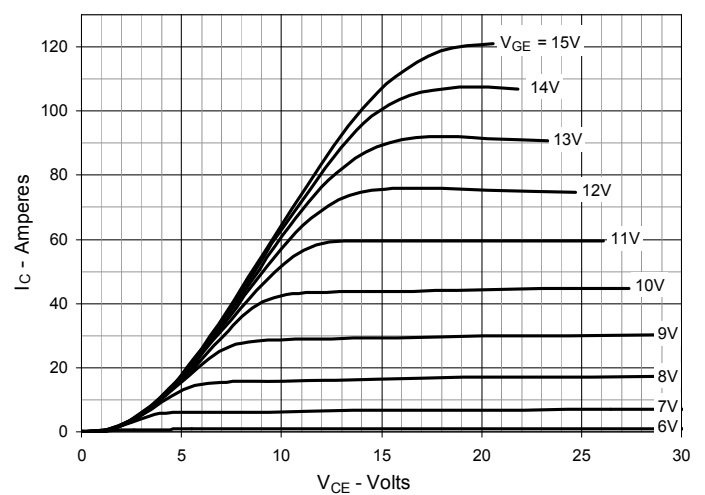
IXYS Reserves the Right to Change Limits, Test Conditions, and Dimensions.

|                                                                                  |           |           |           |           |              |              |              |              |              |             |
|----------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|--------------|--------------|--------------|--------------|--------------|-------------|
| 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 |
|                                                                                  | 4,860,072 | 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    |             |

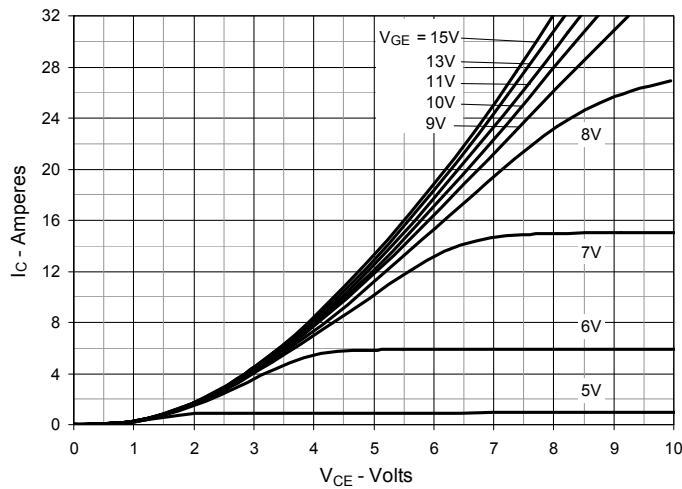
**Fig. 1. Output Characteristics @  $T_J = 25^\circ\text{C}$**



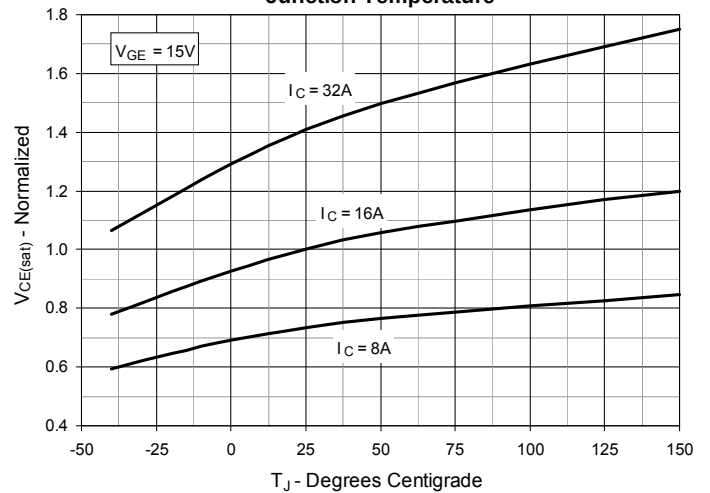
**Fig. 2. Extended Output Characteristics @  $T_J = 25^\circ\text{C}$**



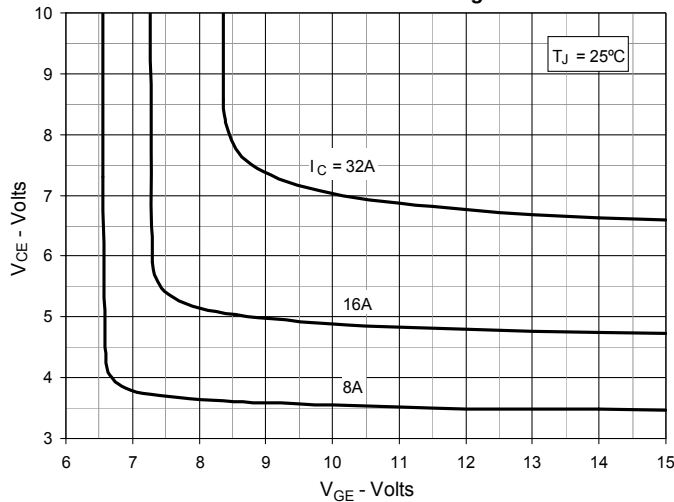
**Fig. 3. Output Characteristics @  $T_J = 125^\circ\text{C}$**



**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**

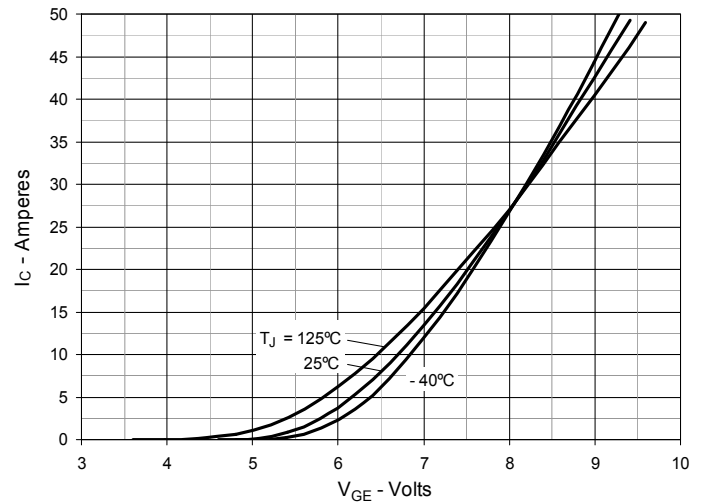


Fig. 7. Transconductance

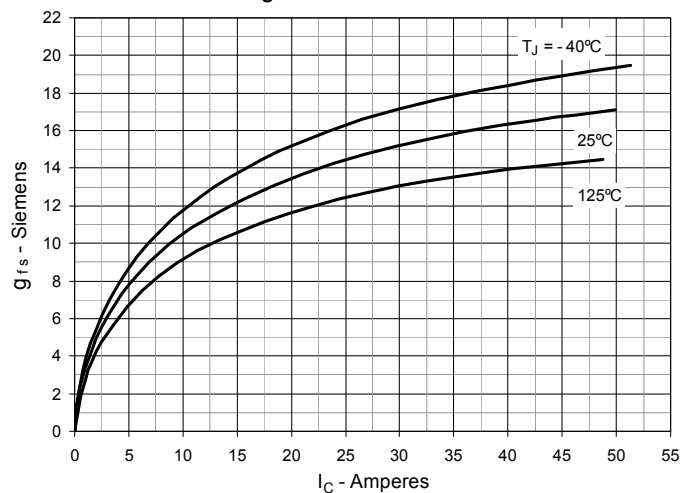


Fig. 8. Gate Charge

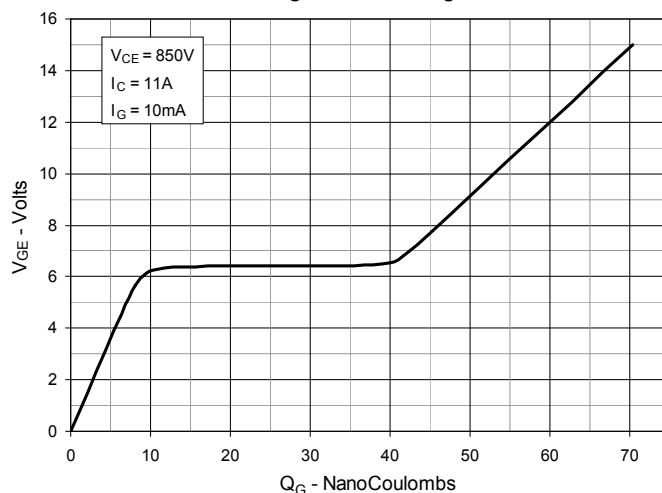


Fig. 9. Capacitance

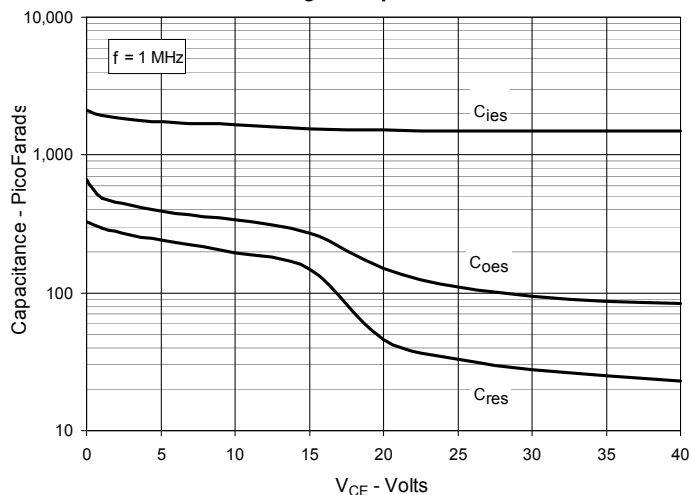


Fig. 10. Reverse-Bias Safe Operating Area

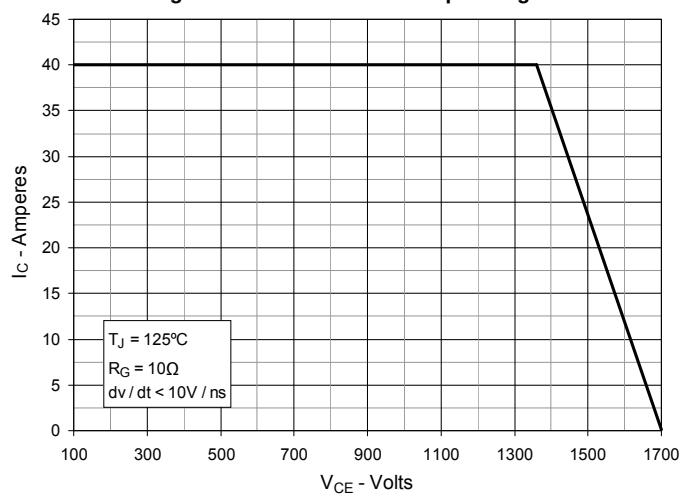
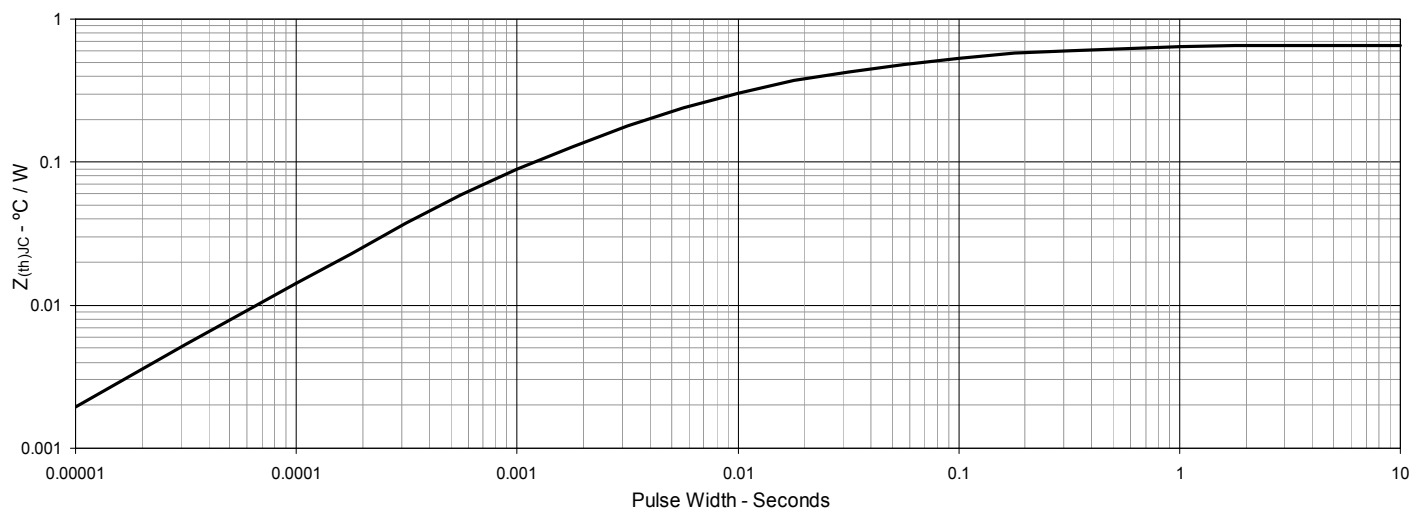
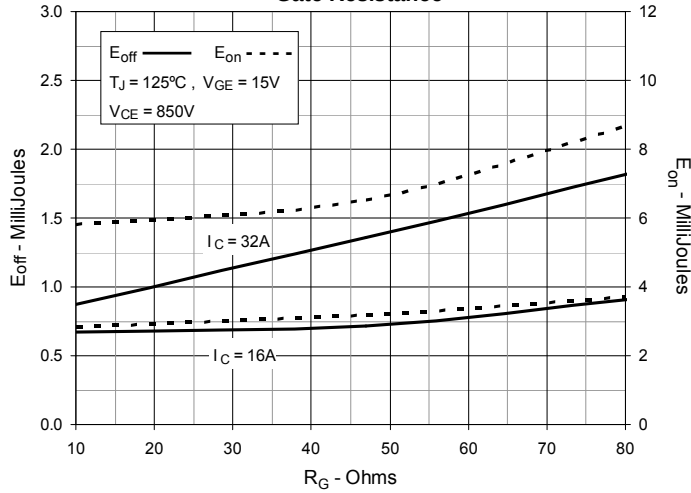


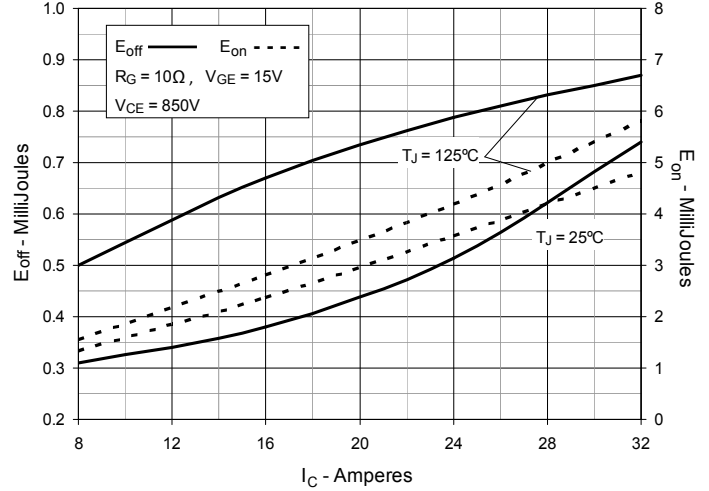
Fig. 11. Maximum Transient Thermal Impedance (IGBT)



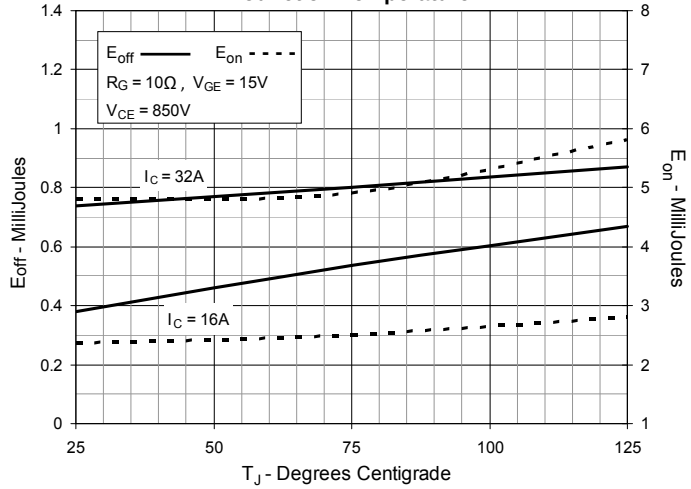
**Fig. 12. Inductive Switching Energy Loss vs. Gate Resistance**



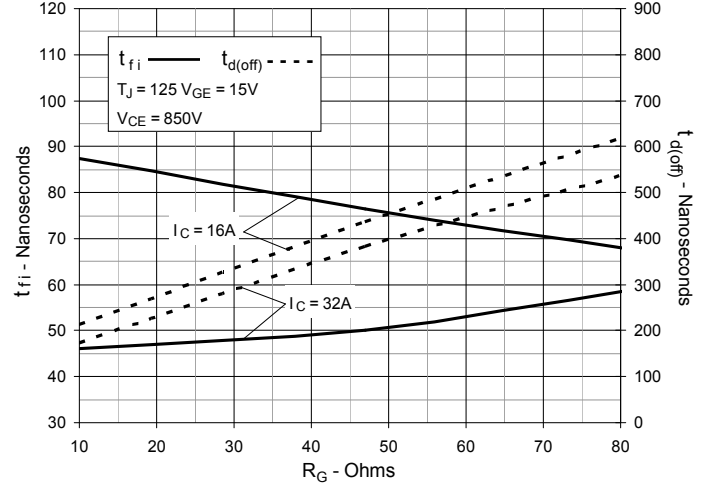
**Fig. 13. Inductive Switching Energy Loss vs. Collector Current**



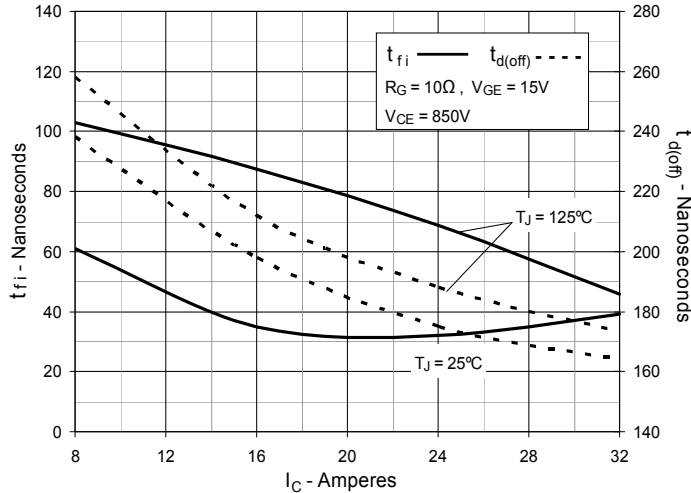
**Fig. 14. Inductive Switching Energy Loss vs. Junction Temperature**



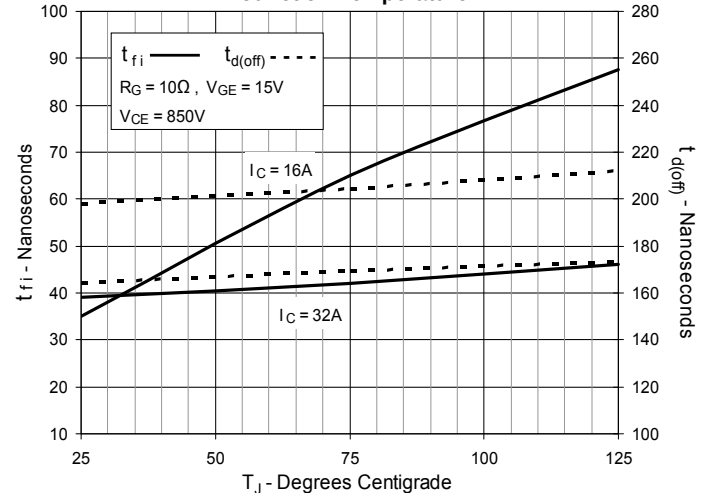
**Fig. 15. Inductive Turn-off Switching Times vs. Gate Resistance**



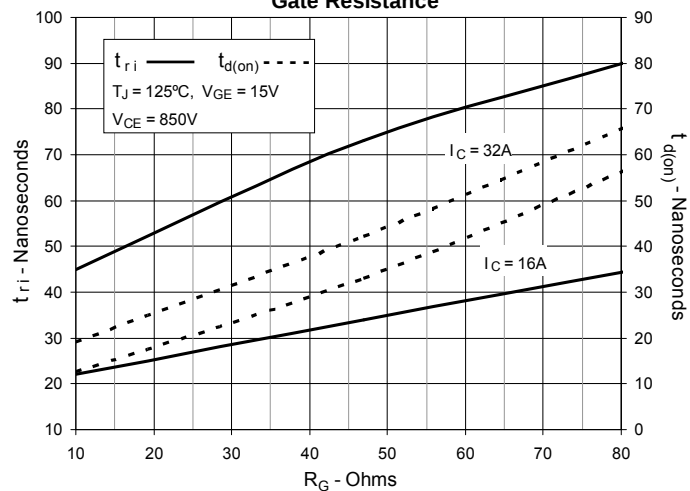
**Fig. 16. Inductive Turn-off Switching Times vs. Collector Current**



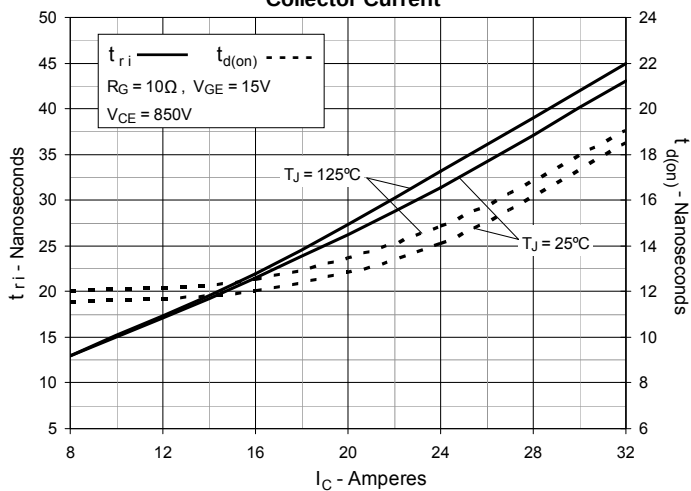
**Fig. 17. Inductive Turn-off Switching Times vs. Junction Temperature**



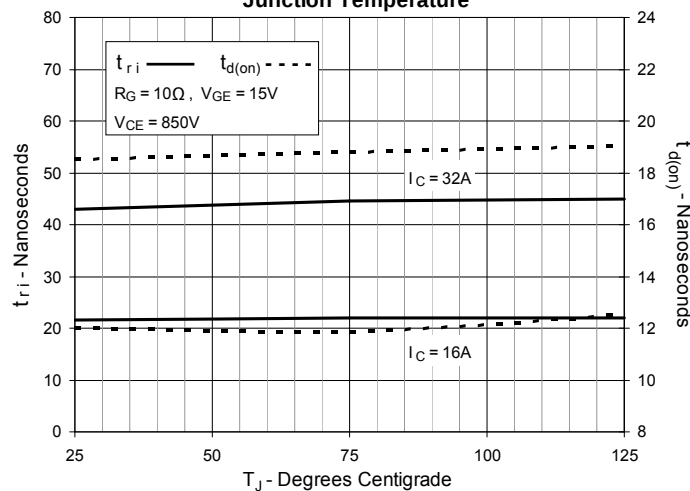
**Fig. 18. Inductive Turn-on Switching Times vs. Gate Resistance**



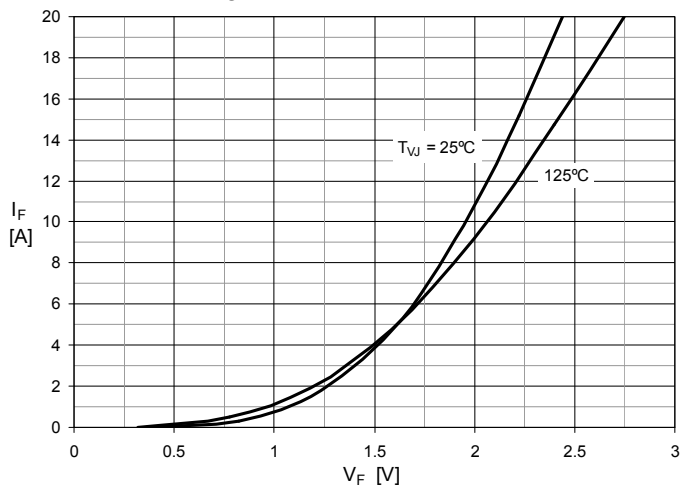
**Fig. 19. Inductive Turn-on Switching Times vs. Collector Current**



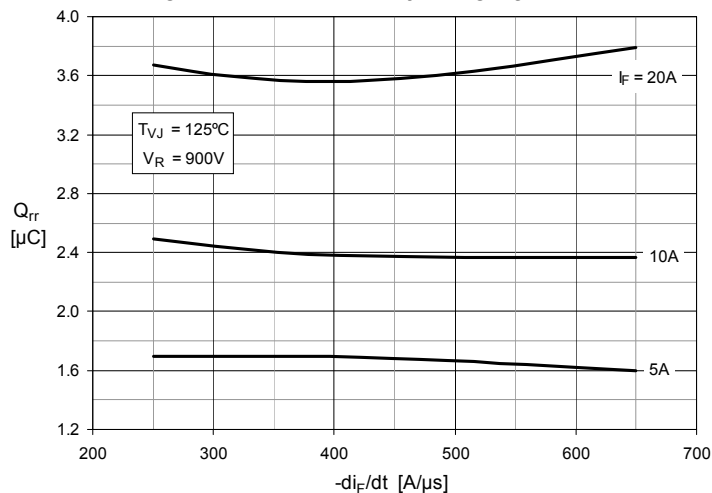
**Fig. 20. Inductive Turn-on Switching Times vs. Junction Temperature**



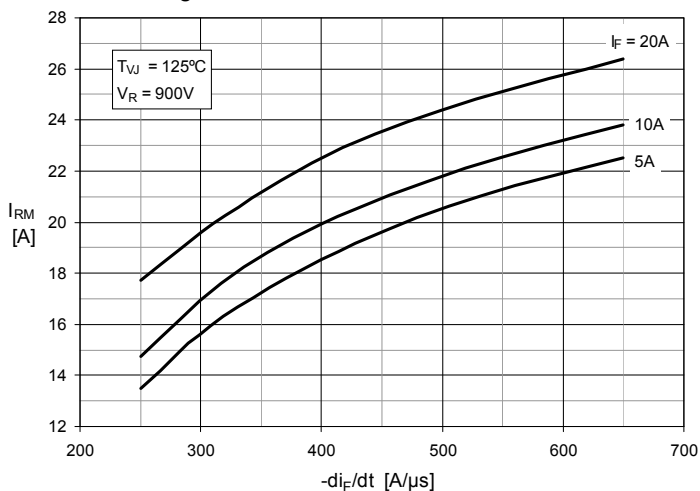
**Fig. 21. Forward Current  $I_F$  vs  $V_F$**



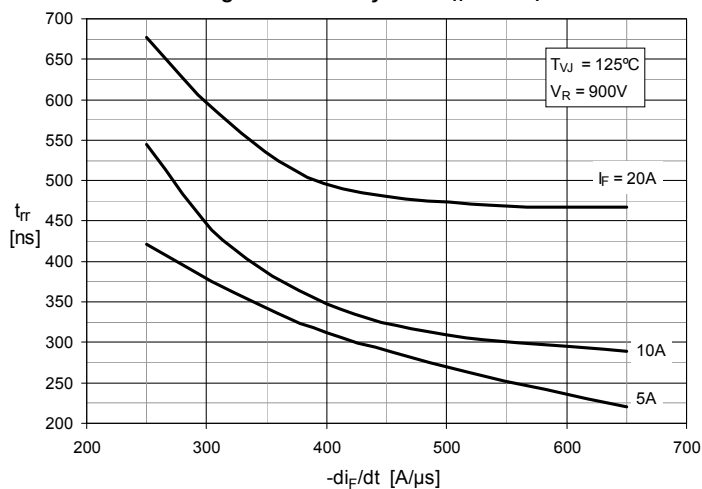
**Fig. 22. Reverse Recovery Charge  $Q_{rr}$  vs.  $-di_F/dt$**



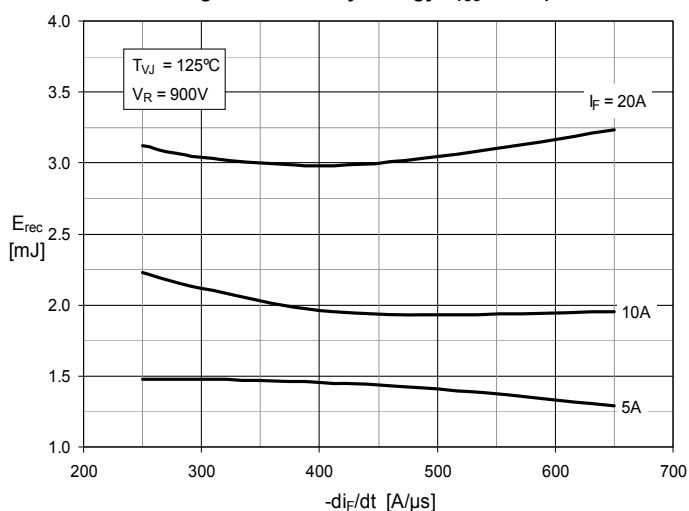
**Fig. 23. Peak Reverse Current  $I_{RM}$  vs.  $-di_F/dt$**



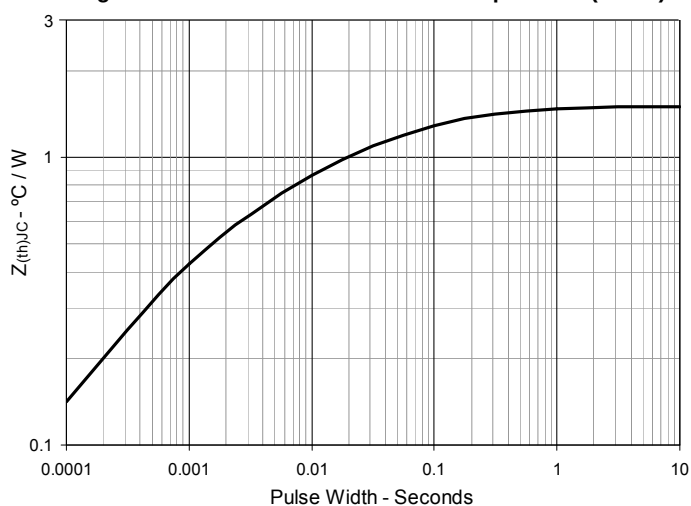
**Fig. 24. Recovery Time  $t_{rr}$  vs.  $-di_F/dt$**



**Fig. 25. Recovery Energy  $E_{rec}$  vs  $-di_F/dt$**



**Fig. 26. Maximum Transient Thermal Impedance (Diode)**





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