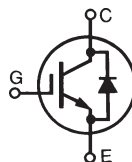


## XPT™ 600V IGBT GenX3™ w/ Diode

(Electrically Isolated Tab)

Extreme Light Punch Through  
IGBT for 10-30kHz Switching

## MMIX1X100N60B3H1

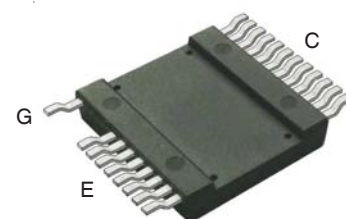


$$V_{CES} = 600V$$

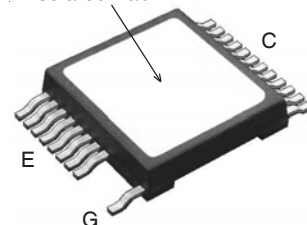
$$I_{C110} = 68A$$

$$V_{CE(sat)} \leq 1.80V$$

| Symbol                        | Test Conditions                                                                              | Maximum Ratings                         |             |
|-------------------------------|----------------------------------------------------------------------------------------------|-----------------------------------------|-------------|
| $V_{CES}$                     | $T_J = 25^{\circ}C$ 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           |
| $I_{C25}$                     | $T_C = 25^{\circ}C$ (Chip Capability)                                                        | 145                                     | A           |
| $I_{C110}$                    | $T_C = 110^{\circ}C$                                                                         | 68                                      | A           |
| $I_{F90}$                     | $T_C = 90^{\circ}C$                                                                          | 54                                      | A           |
| $I_{CM}$                      | $T_C = 25^{\circ}C$ , 1ms                                                                    | 440                                     | A           |
| $I_A$                         | $T_C = 25^{\circ}C$                                                                          | 50                                      | A           |
| $E_{AS}$                      | $T_C = 25^{\circ}C$                                                                          | 600                                     | mJ          |
| <b>SSOA</b><br><b>(RBSOA)</b> | $V_{GE} = 15V$ , $T_{VJ} = 150^{\circ}C$ , $R_G = 2\Omega$<br>Clamped Inductive Load         | $I_{CM} = 200$<br>$V_{CE} \leq V_{CES}$ | A           |
| $t_{sc}$<br><b>(SCSOA)</b>    | $V_{GE} = 15V$ , $V_{CE} = 360V$ , $T_J = 150^{\circ}C$<br>$R_G = 10\Omega$ , Non Repetitive | 10                                      | $\mu s$     |
| $P_C$                         | $T_C = 25^{\circ}C$                                                                          | 400                                     | 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                                     | $^{\circ}C$ |
| $T_{SOLD}$                    | 1.6 mm (0.062 in.) from Case for 10s                                                         | 260                                     | $^{\circ}C$ |
| $V_{ISOL}$                    | 50/60Hz, 1 minute                                                                            | 2500                                    | V~          |
| $F_C$                         | Mounting Force                                                                               | 50..200/11..45                          | N/lb.       |
| <b>Weight</b>                 |                                                                                              | 8                                       | g           |



Isolated Tab



G = Gate  
C = Collector

E = Emitter

### Features

- Silicon Chip on Direct-Copper Bond (DCB) Substrate
- Isolated Mounting Surface
- 2500V~ Electrical Isolation
- Optimized for 10-30kHz Switching
- Square RBSOA
- FBSOA
- Avalanche Rated
- Short Circuit Capability
- Anti-Parallel Ultra Fast Diode
- High Current Handling Capability

### 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>( $T_J = 25^{\circ}C$ , Unless Otherwise Specified) | Characteristic Values |              |                    |
|---------------|------------------------------------------------------------------------|-----------------------|--------------|--------------------|
|               |                                                                        | Min.                  | Typ.         | Max.               |
| $BV_{CES}$    | $I_C = 250\mu A$ , $V_{GE} = 0V$                                       | 600                   |              | V                  |
| $V_{GE(th)}$  | $I_C = 250\mu A$ , $V_{CE} = V_{GE}$                                   | 3.0                   |              | 5.5 V              |
| $I_{CES}$     | $V_{CE} = V_{CES}$ , $V_{GE} = 0V$<br>$T_J = 125^{\circ}C$             |                       |              | 50 $\mu A$<br>4 mA |
| $I_{GES}$     | $V_{CE} = 0V$ , $V_{GE} = \pm 20V$                                     |                       |              | $\pm 100$ nA       |
| $V_{CE(sat)}$ | $I_C = 70A$ , $V_{GE} = 15V$ , Note 1<br>$T_J = 150^{\circ}C$          |                       | 1.50<br>1.77 | 1.80 V<br>V        |

**Symbol Test Conditions**(T<sub>J</sub> = 25°C Unless Otherwise Specified)**Characteristic Values****Min.      Typ.      Max.**

|                           |                                                                                                                                                      |    |      |           |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|----|------|-----------|
| <b>g<sub>fs</sub></b>     | I <sub>C</sub> = 60A, V <sub>CE</sub> = 10V, Note 1                                                                                                  | 22 | 40   | S         |
| <b>C<sub>ies</sub></b>    | V <sub>CE</sub> = 25V, V <sub>GE</sub> = 0V, f = 1MHz                                                                                                |    | 4860 | pF        |
| <b>C<sub>oes</sub></b>    |                                                                                                                                                      |    | 475  | pF        |
| <b>C<sub>res</sub></b>    |                                                                                                                                                      |    | 83   | pF        |
| <b>Q<sub>g(on)</sub></b>  | I <sub>C</sub> = 70A, V <sub>GE</sub> = 15V, V <sub>CE</sub> = 0.5 • V <sub>CES</sub>                                                                |    | 143  | nC        |
| <b>Q<sub>ge</sub></b>     |                                                                                                                                                      |    | 37   | nC        |
| <b>Q<sub>gc</sub></b>     |                                                                                                                                                      |    | 60   | nC        |
| <b>t<sub>d(on)</sub></b>  | <b>Inductive load, T<sub>J</sub> = 25°C</b><br>I <sub>C</sub> = 70A, V <sub>GE</sub> = 15V<br>V <sub>CE</sub> = 360V, R <sub>G</sub> = 2Ω<br>Note 2  |    | 30   | ns        |
| <b>t<sub>ri</sub></b>     |                                                                                                                                                      |    | 70   | ns        |
| <b>E<sub>on</sub></b>     |                                                                                                                                                      |    | 1.9  | mJ        |
| <b>t<sub>d(off)</sub></b> |                                                                                                                                                      |    | 120  | ns        |
| <b>t<sub>fi</sub></b>     |                                                                                                                                                      |    | 150  | ns        |
| <b>E<sub>off</sub></b>    |                                                                                                                                                      |    | 2.0  | 2.8 mJ    |
| <b>t<sub>d(on)</sub></b>  | <b>Inductive load, T<sub>J</sub> = 150°C</b><br>I <sub>C</sub> = 70A, V <sub>GE</sub> = 15V<br>V <sub>CE</sub> = 360V, R <sub>G</sub> = 2Ω<br>Note 2 |    | 32   | ns        |
| <b>t<sub>ri</sub></b>     |                                                                                                                                                      |    | 60   | ns        |
| <b>E<sub>on</sub></b>     |                                                                                                                                                      |    | 2.3  | mJ        |
| <b>t<sub>d(off)</sub></b> |                                                                                                                                                      |    | 150  | ns        |
| <b>t<sub>fi</sub></b>     |                                                                                                                                                      |    | 200  | ns        |
| <b>E<sub>off</sub></b>    |                                                                                                                                                      |    | 2.8  | mJ        |
| <b>R<sub>thJC</sub></b>   |                                                                                                                                                      |    |      | 0.31 °C/W |
| <b>R<sub>thCS</sub></b>   |                                                                                                                                                      |    | 0.05 | °C/W      |

**Reverse Diode (FRED)****Symbol Test Conditions**(T<sub>J</sub> = 25°C Unless Otherwise Specified)**Characteristic Values****Min.      Typ.      Max.**

|                         |                                                                                                      |                        |     |           |    |
|-------------------------|------------------------------------------------------------------------------------------------------|------------------------|-----|-----------|----|
| <b>V<sub>F</sub></b>    | I <sub>F</sub> = 60A, V <sub>GE</sub> = 0V, Note 1                                                   | T <sub>J</sub> = 150°C | 1.6 | 2.5       | V  |
|                         |                                                                                                      |                        | 1.4 | 1.8       | V  |
| <b>I<sub>RM</sub></b>   | I <sub>F</sub> = 60A, V <sub>GE</sub> = 0V,<br>-di <sub>F</sub> /dt = 200A/μs, V <sub>R</sub> = 300V | T <sub>J</sub> = 100°C | 8.3 |           | A  |
| <b>t<sub>rr</sub></b>   |                                                                                                      |                        | 140 |           | ns |
| <b>R<sub>thJC</sub></b> |                                                                                                      |                        |     | 0.62 °C/W |    |

**Notes:**

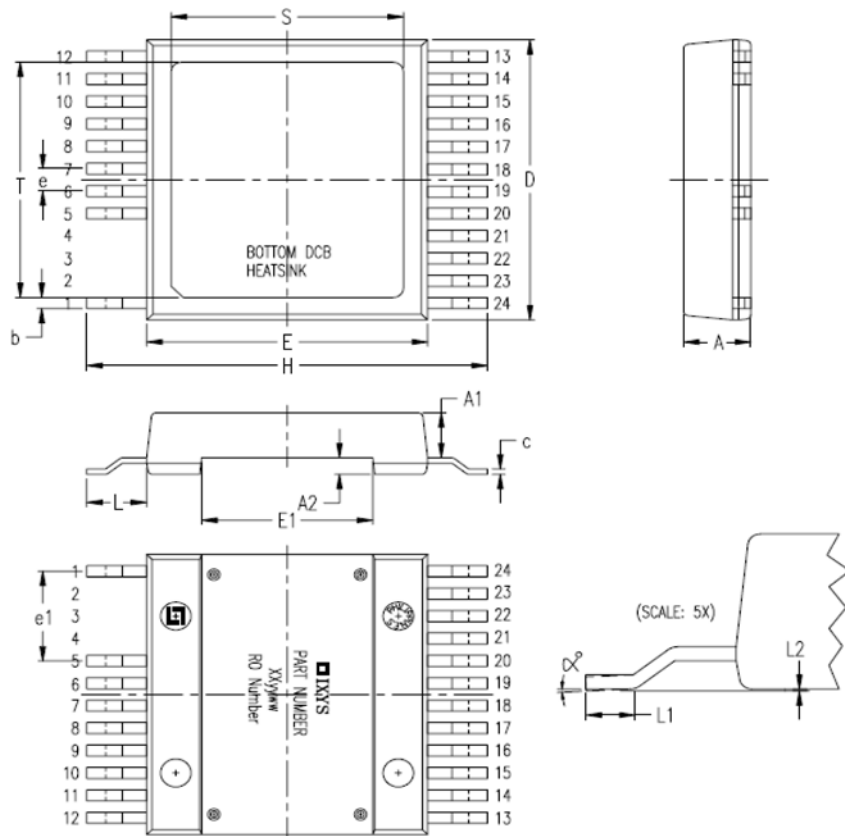
1. Pulse test, t ≤ 300μs, duty cycle, d ≤ 2%.
2. Switching times & energy losses may increase for higher V<sub>CE</sub>(clamp), T<sub>J</sub> or R<sub>G</sub>.

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    |             |

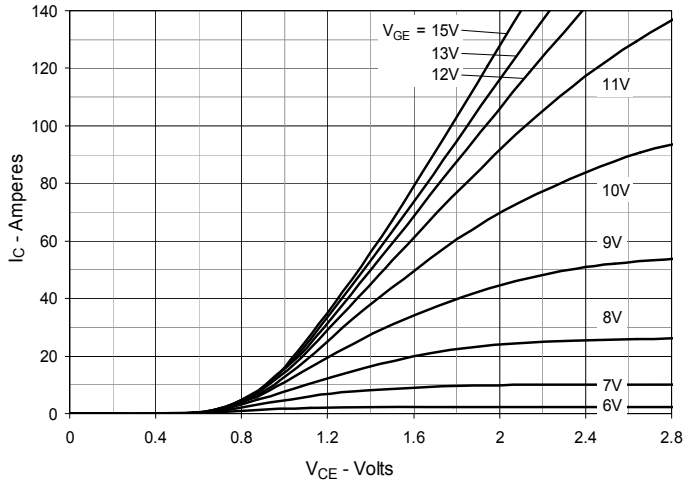
## Package Outline



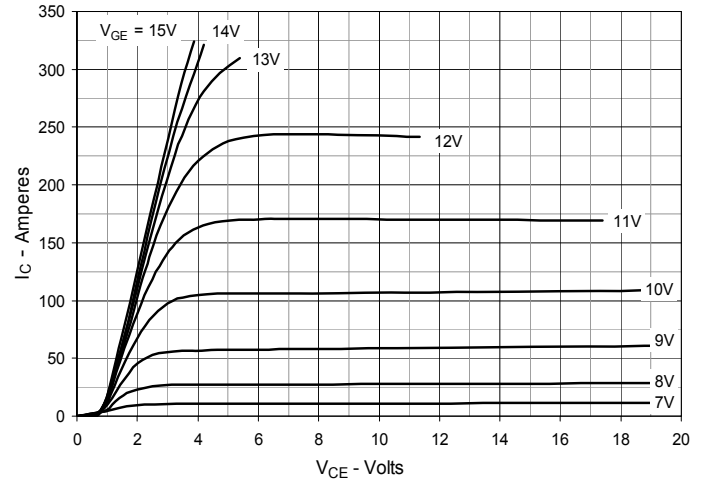
| SYM | INCHES   |       | MILLIMETERS |       |
|-----|----------|-------|-------------|-------|
|     | MIN      | MAX   | MIN         | MAX   |
| A   | .209     | .224  | 5.30        | 5.70  |
| A1  | .154     | .161  | 3.90        | 4.10  |
| A2  | .055     | .063  | 1.40        | 1.60  |
| b   | .035     | .045  | 0.90        | 1.15  |
| c   | .018     | .026  | 0.45        | 0.65  |
| D   | .976     | .994  | 24.80       | 25.25 |
| E   | .898     | .915  | 22.80       | 23.25 |
| E1  | .543     | .559  | 13.80       | 14.20 |
| e   | .079 BSC |       | 2.00 BSC    |       |
| e1  | .315 BSC |       | 8.00 BSC    |       |
| H   | 1.272    | 1.311 | 32.30       | 33.30 |
| L   | .181     | .209  | 4.60        | 5.30  |
| L1  | .051     | .067  | 1.30        | 1.70  |
| L2  | .000     | .006  | 0.00        | 0.15  |
| S   | .736     | .760  | 18.70       | 19.30 |
| T   | .815     | .839  | 20.70       | 21.30 |
| α   | 0        | 4°    | 0           | 4°    |

PIN: 1 = Gate  
5-12 = Emitter  
13-24 = Collector

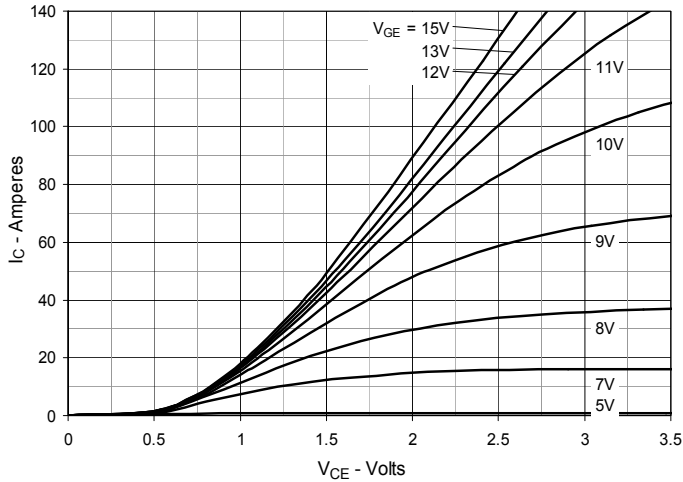
**Fig. 1. Output Characteristics @  $T_J = 25^\circ\text{C}$**



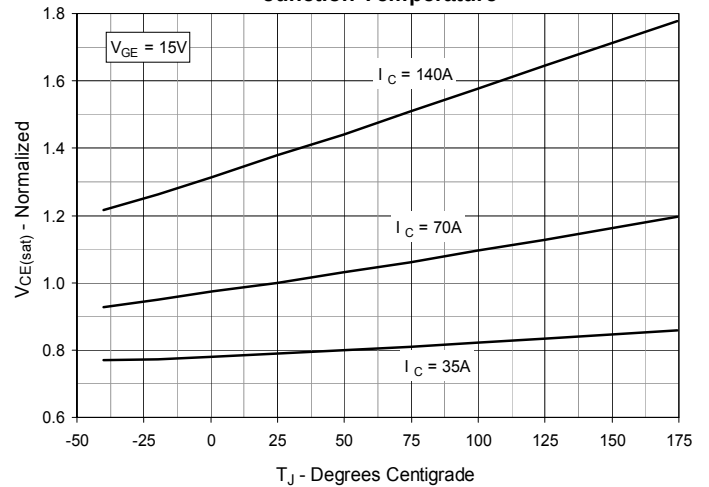
**Fig. 2. Extended Output Characteristics @  $T_J = 25^\circ\text{C}$**



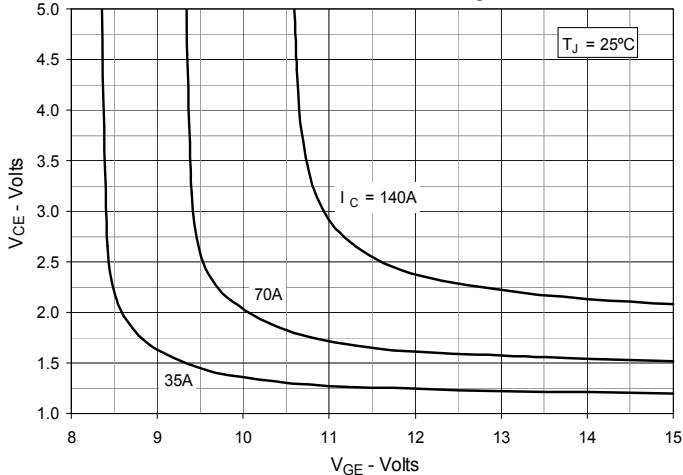
**Fig. 3. Output Characteristics @  $T_J = 150^\circ\text{C}$**



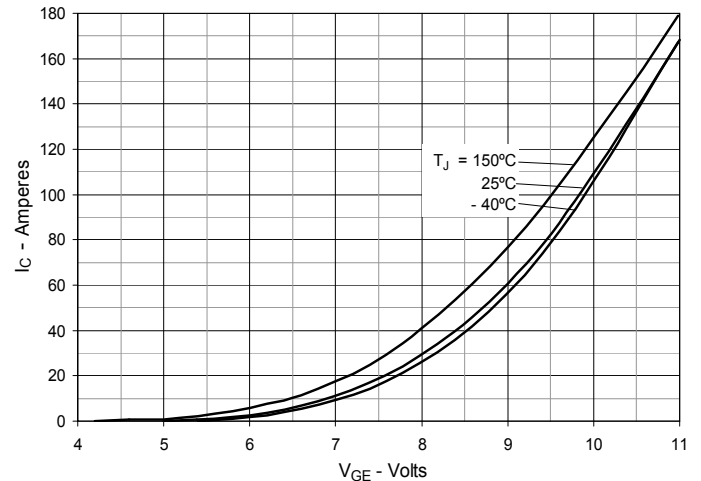
**Fig. 4. Dependence of  $V_{CE(sat)}$  on Junction Temperature**



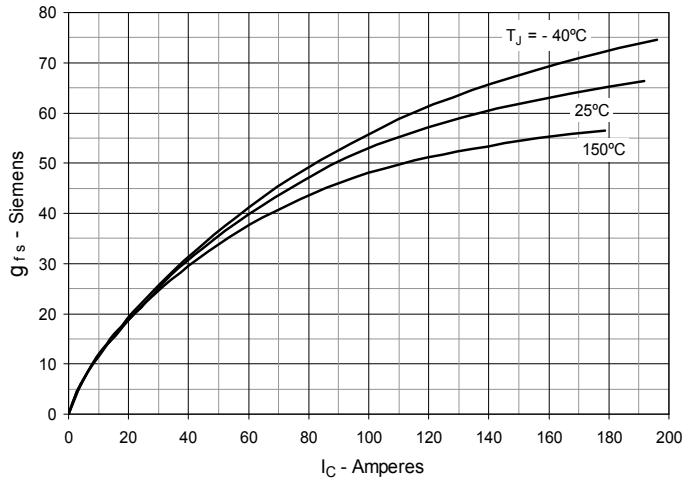
**Fig. 5. Collector-to-Emitter Voltage vs. Gate-to-Emitter Voltage**



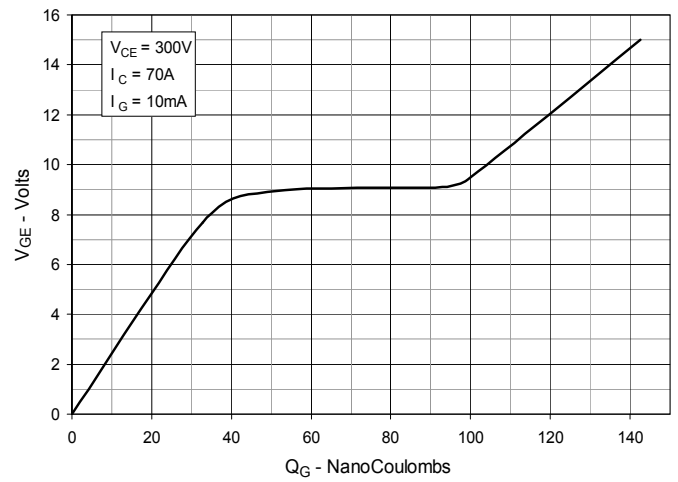
**Fig. 6. Input Admittance**



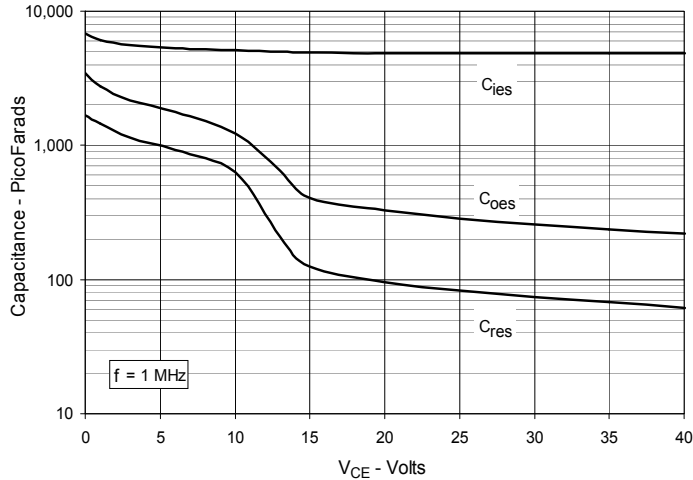
**Fig. 7. Transconductance**



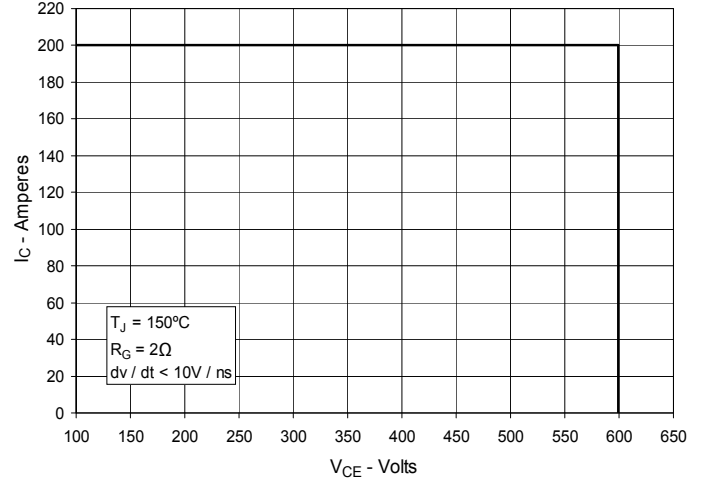
**Fig. 8. Gate Charge**



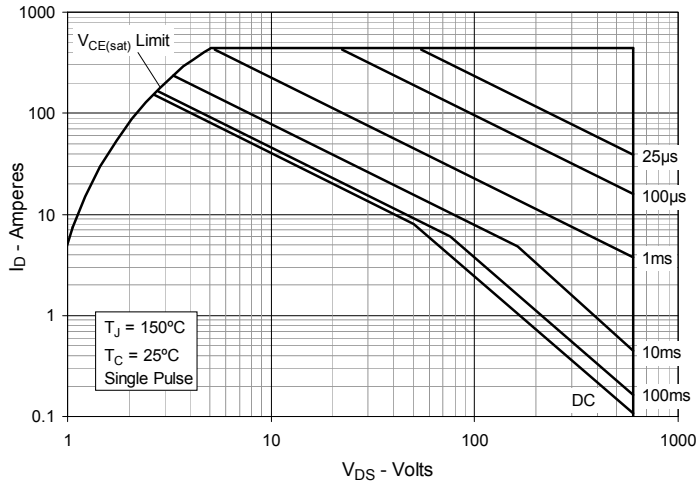
**Fig. 9. Capacitance**



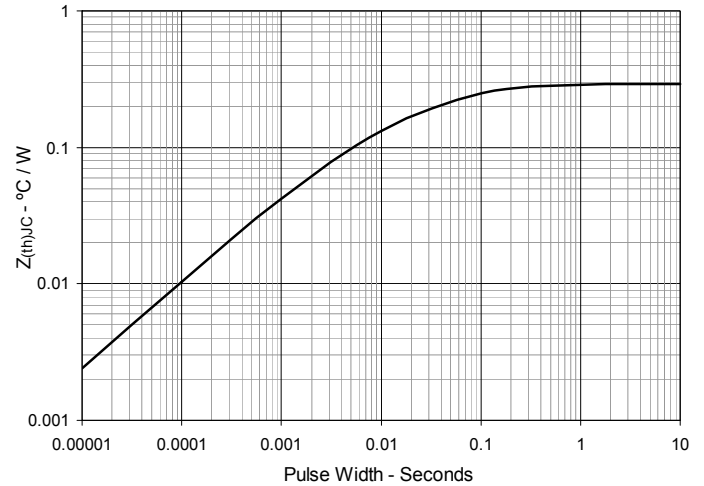
**Fig. 10. Reverse-Bias Safe Operating Area**



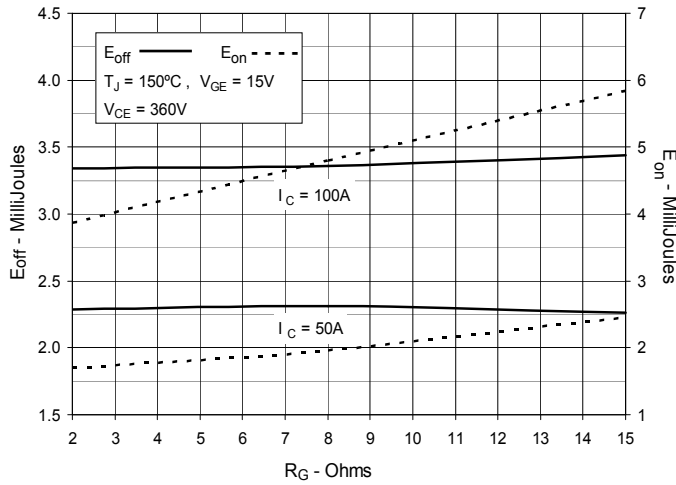
**Fig. 11. Forward-Bias Safe Operating Area**



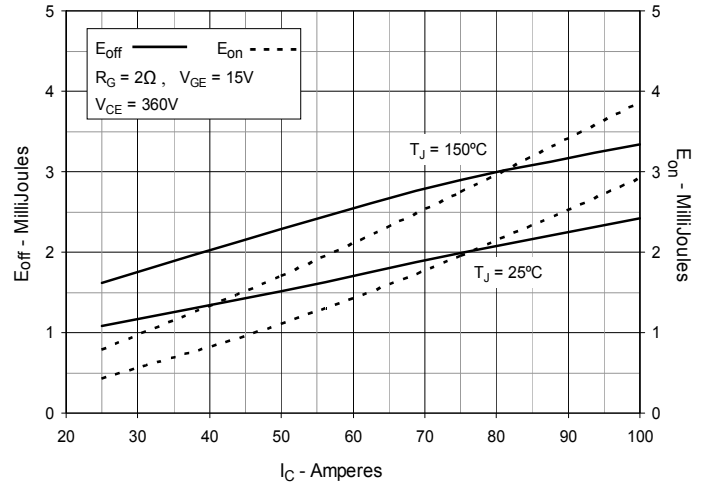
**Fig. 12. Maximum Transient Thermal Impedance**



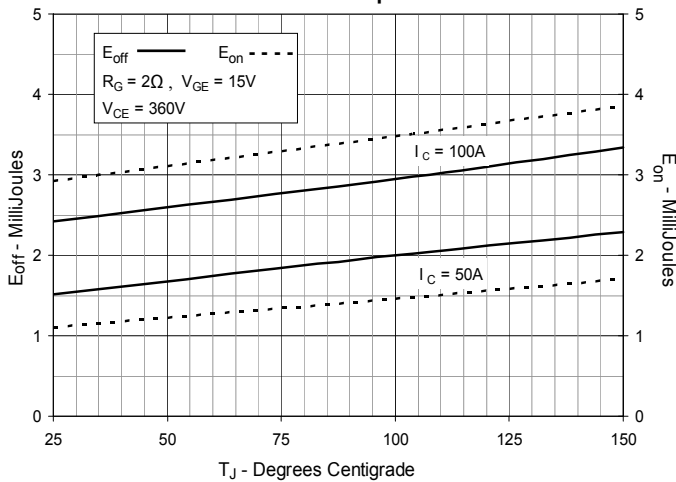
**Fig. 13. Inductive Switching Energy Loss vs. Gate Resistance**



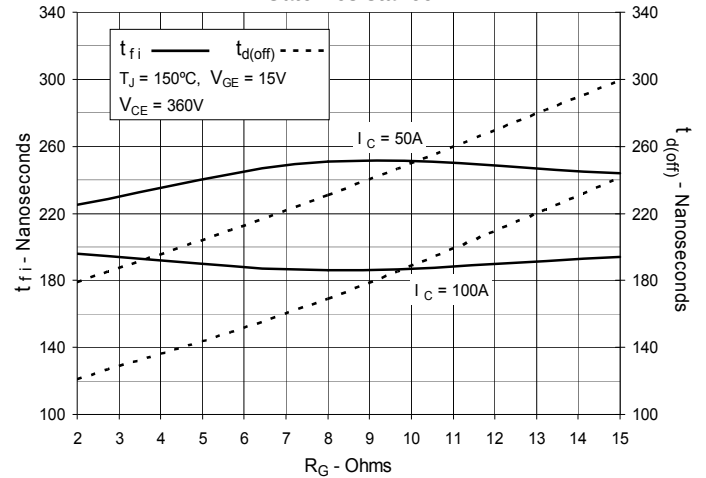
**Fig. 14. Inductive Switching Energy Loss vs. Collector Current**



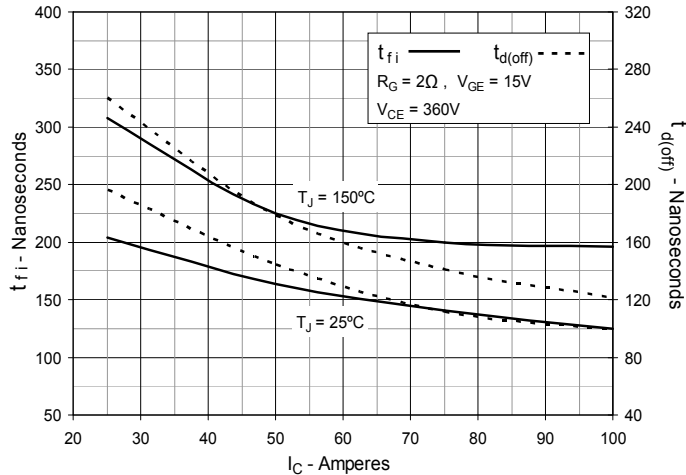
**Fig. 15. Inductive Switching Energy Loss vs. Junction Temperature**



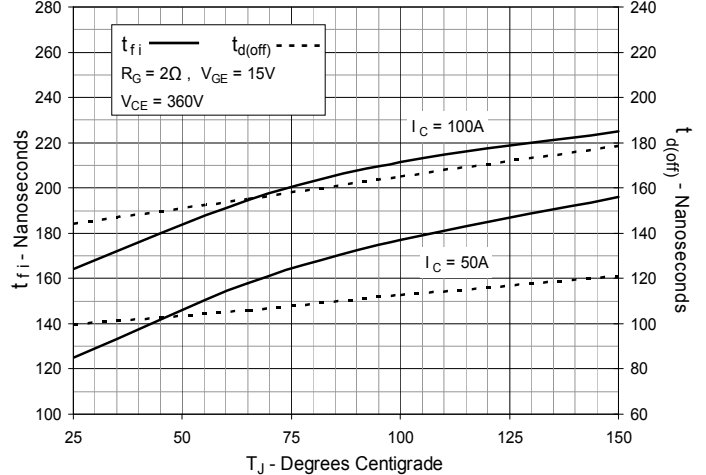
**Fig. 16. Inductive Turn-off Switching Times vs. Gate Resistance**



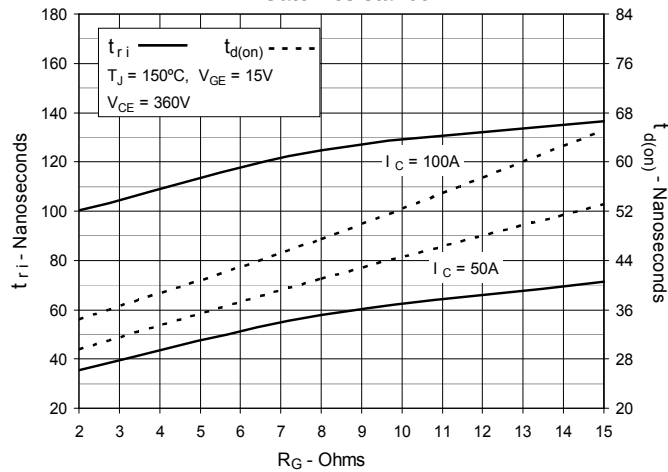
**Fig. 17. Inductive Turn-off Switching Times vs. Collector Current**



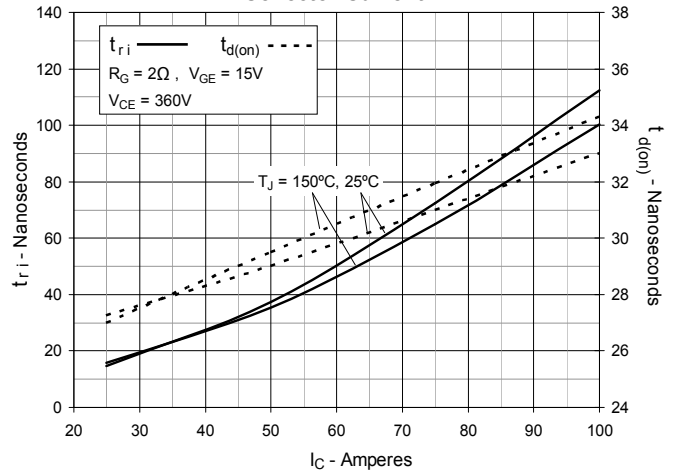
**Fig. 18. Inductive Turn-off Switching Times vs. Junction Temperature**



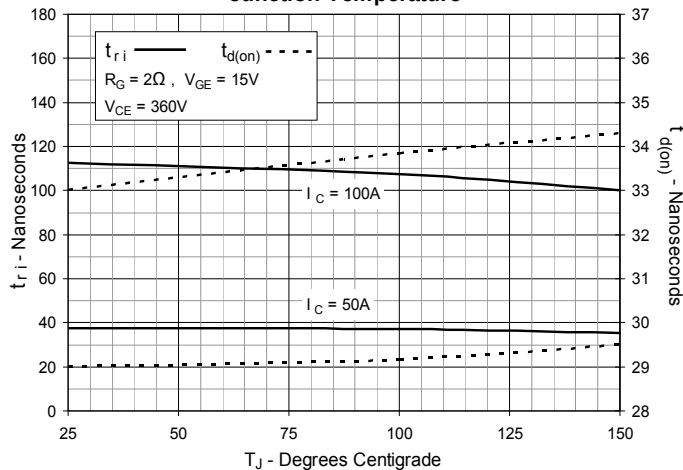
**Fig. 19. Inductive Turn-on Switching Times vs. Gate Resistance**

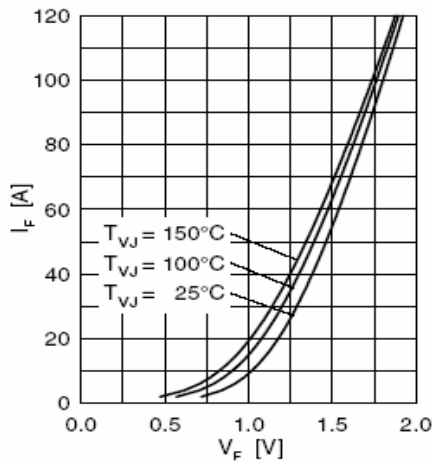
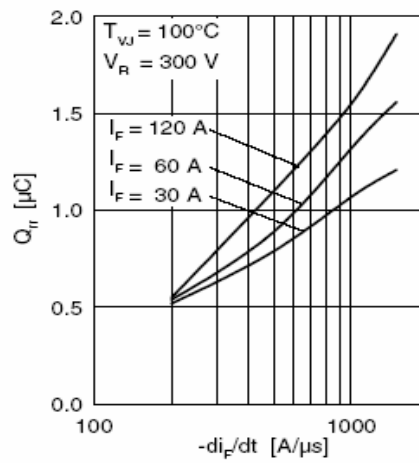
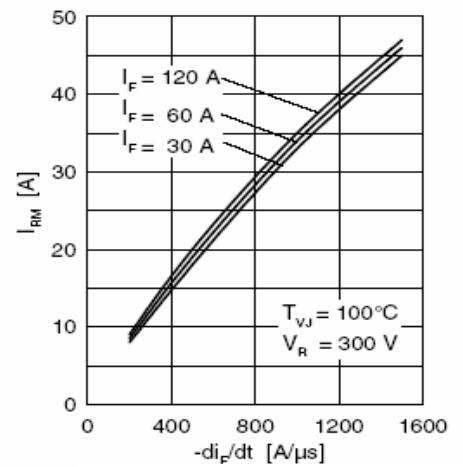
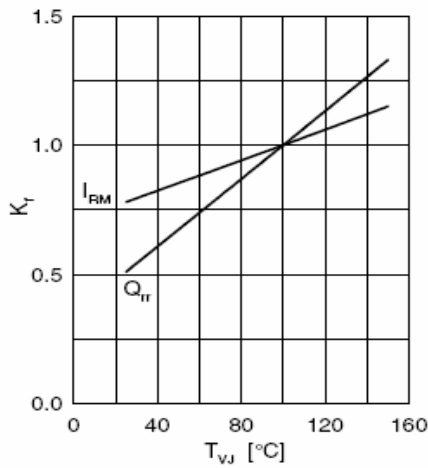
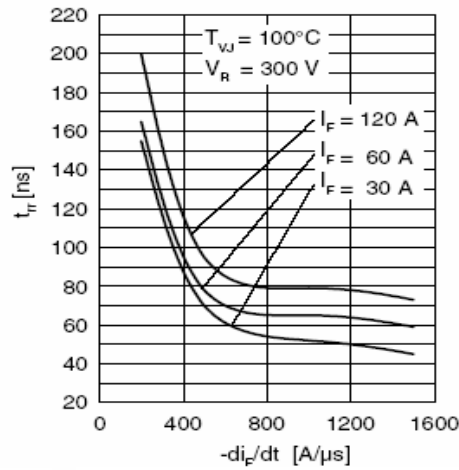
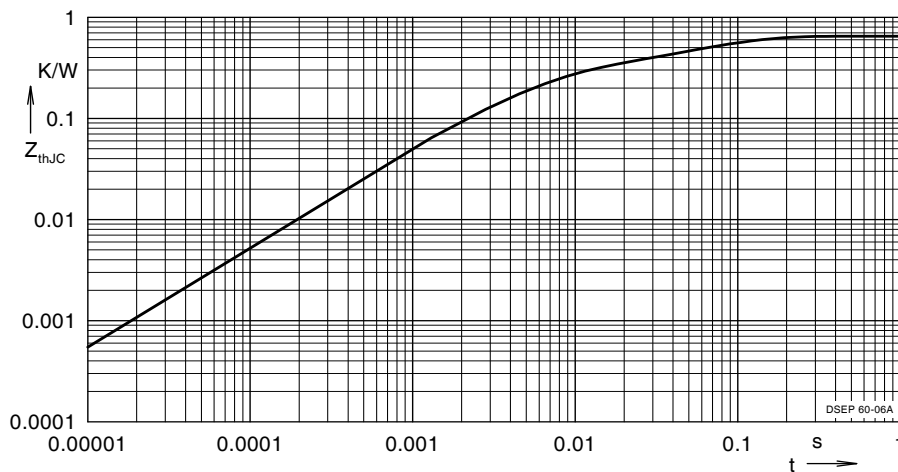


**Fig. 20. Inductive Turn-on Switching Times vs. Collector Current**



**Fig. 21. Inductive Turn-on Switching Times vs. Junction Temperature**




**Fig. 22 Forward Current  $I_F$  vs.  $V_F$** 

**Fig. 23 Typ. Reverse Recovery Charge  $Q_{rr}$** 

**Fig. 24 Typ. Peak Reverse Current  $I_{RM}$** 

**Fig. 25 Typ. Dynamic Parameters  $Q_{rr}$ ,  $I_{RM}$** 

**Fig. 26 Typ Recovery Time  $t_{rr}$** 

**Fig. 27. Maximum Transient Thermal Impedance**



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