

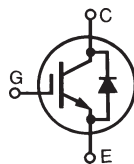
# XPT™ 600V IGBT

## GenX3™ w/Diode

MMIX1X200N60B3H1

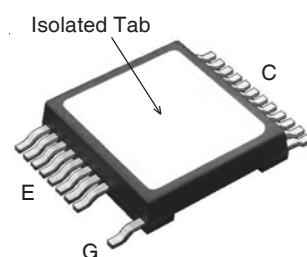
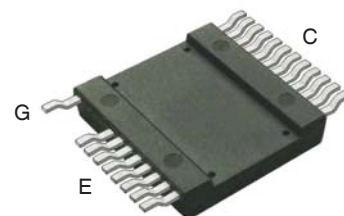
(Electrically Isolated Tab)

Extreme Light Punch Through  
IGBT for 10-30kHz Switching



$$\begin{aligned} V_{CES} &= 600V \\ I_{C110} &= 72A \\ V_{CE(sat)} &\leq 1.7V \\ t_{fi(typ)} &= 110ns \end{aligned}$$

| 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                |
| $I_{C25}$                     | $T_C = 25^\circ\text{C}$ (Chip Capability)                                                  | 175                                       | A                |
| $I_{C110}$                    | $T_C = 110^\circ\text{C}$                                                                   | 72                                        | A                |
| $I_{F110}$                    | $T_C = 110^\circ\text{C}$                                                                   | 28                                        | A                |
| $I_{CM}$                      | $T_C = 25^\circ\text{C}, 1\text{ms}$                                                        | 1000                                      | A                |
| $I_A$                         | $T_C = 25^\circ\text{C}$                                                                    | 100                                       | A                |
| $E_{AS}$                      | $T_C = 25^\circ\text{C}$                                                                    | 1                                         | J                |
| <b>SSOA</b><br><b>(RBSOA)</b> | $V_{GE} = 15V, T_{VJ} = 150^\circ\text{C}, R_G = 1\Omega$<br>Clamped Inductive Load         | $I_{CM} = 400$<br>@ $V_{CE} \leq V_{CES}$ | A                |
| $t_{sc}$<br><b>(SCSOA)</b>    | $V_{GE} = 15V, V_{CE} = 360V, T_J = 150^\circ\text{C}$<br>$R_G = 10\Omega$ , Non Repetitive | 10                                        | $\mu\text{s}$    |
| $P_C$                         | $T_C = 25^\circ\text{C}$                                                                    | 520                                       | W                |
| $T_J$                         |                                                                                             | -55 ... +150                              | $^\circ\text{C}$ |
| $T_{JM}$                      |                                                                                             | 150                                       | $^\circ\text{C}$ |
| $T_{stg}$                     |                                                                                             | -55 ... +150                              | $^\circ\text{C}$ |
| $T_L$                         | Maximum Lead Temperature for Soldering                                                      | 300                                       | $^\circ\text{C}$ |
| $T_{SOLD}$                    | 1.6 mm (0.062 in.) from Case for 10                                                         | 260                                       | $^\circ\text{C}$ |
| $V_{ISOL}$                    | 50/60Hz, 1 minute                                                                           | 2500                                      | V~               |
| $F_C$                         | Mounting Force                                                                              | 50..200/11..45                            | N/lb.            |
| <b>Weight</b>                 |                                                                                             | 8                                         | g                |



G = Gate  
C = Collector

E = Emitter

### Features

- Silicon Chip on Direct-Copper Bond (DCB) Substrate
- Isolated Mounting Surface
- 2500V~ Electrical Isolation
- Optimized for Low Conduction and Switching Losses
- Avalanche Rated
- Short Circuit Capability
- Very High Current Capability
- Square RBSOA

### 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>( $T_J = 25^\circ\text{C}$ , Unless Otherwise Specified) | Characteristic Values |      |                          |
|---------------|-----------------------------------------------------------------------------|-----------------------|------|--------------------------|
|               |                                                                             | Min.                  | Typ. | Max.                     |
| $BV_{CES}$    | $I_C = 250\mu\text{A}, V_{GE} = 0V$                                         | 600                   |      | V                        |
| $V_{GE(th)}$  | $I_C = 250\mu\text{A}, V_{CE} = V_{GE}$                                     | 3.5                   |      | 6.0 V                    |
| $I_{CES}$     | $V_{CE} = V_{CES}, V_{GE} = 0V$<br>Note 2, $T_J = 150^\circ\text{C}$        |                       |      | 50 $\mu\text{A}$<br>3 mA |
| $I_{GES}$     | $V_{CE} = 0V, V_{GE} = \pm 20V$                                             |                       |      | $\pm 200$ nA             |
| $V_{CE(sat)}$ | $I_C = 100A, V_{GE} = 15V$ , Note 1<br>$T_J = 150^\circ\text{C}$            | 1.40<br>1.58          |      | V<br>V                   |

| Symbol Test Conditions<br>( $T_J = 25^\circ\text{C}$ Unless Otherwise Specified) |                                                                                                                                                            | Characteristic Values |      |                         |
|----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------|-------------------------|
|                                                                                  |                                                                                                                                                            | Min.                  | Typ. | Max.                    |
| $g_{fs}$                                                                         | $I_C = 60\text{A}, V_{CE} = 10\text{V}, \text{Note 1}$                                                                                                     | 27                    | 45   | S                       |
| $C_{ies}$                                                                        | $V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$                                                                                                 |                       | 9970 | pF                      |
| $C_{oes}$                                                                        |                                                                                                                                                            |                       | 570  | pF                      |
| $C_{res}$                                                                        |                                                                                                                                                            |                       | 183  | pF                      |
| $Q_{g(on)}$                                                                      | $I_C = 200\text{A}, V_{GE} = 15\text{V}, V_{CE} = 0.5 \cdot V_{CES}$                                                                                       |                       | 315  | nC                      |
| $Q_{ge}$                                                                         |                                                                                                                                                            |                       | 98   | nC                      |
| $Q_{gc}$                                                                         |                                                                                                                                                            |                       | 130  | nC                      |
| $t_{d(on)}$                                                                      | <b>Inductive load, <math>T_J = 25^\circ\text{C}</math></b><br>$I_C = 100\text{A}, V_{GE} = 15\text{V}$<br>$V_{CE} = 360\text{V}, R_G = 1\Omega$<br>Note 3  |                       | 48   | ns                      |
| $t_{ri}$                                                                         |                                                                                                                                                            |                       | 100  | ns                      |
| $E_{on}$                                                                         |                                                                                                                                                            |                       | 2.85 | mJ                      |
| $t_{d(off)}$                                                                     |                                                                                                                                                            |                       | 160  | ns                      |
| $t_{fi}$                                                                         |                                                                                                                                                            |                       | 110  | ns                      |
| $E_{off}$                                                                        |                                                                                                                                                            |                       | 2.90 | 4.40 mJ                 |
| $t_{d(on)}$                                                                      | <b>Inductive load, <math>T_J = 150^\circ\text{C}</math></b><br>$I_C = 100\text{A}, V_{GE} = 15\text{V}$<br>$V_{CE} = 360\text{V}, R_G = 1\Omega$<br>Note 3 |                       | 46   | ns                      |
| $t_{ri}$                                                                         |                                                                                                                                                            |                       | 94   | ns                      |
| $E_{on}$                                                                         |                                                                                                                                                            |                       | 4.40 | mJ                      |
| $t_{d(off)}$                                                                     |                                                                                                                                                            |                       | 180  | ns                      |
| $t_{fi}$                                                                         |                                                                                                                                                            |                       | 215  | ns                      |
| $E_{off}$                                                                        |                                                                                                                                                            |                       | 3.45 | mJ                      |
| $R_{thJC}$                                                                       |                                                                                                                                                            |                       |      | 0.24 $^\circ\text{C/W}$ |
| $R_{thCS}$                                                                       |                                                                                                                                                            |                       | 0.05 | $^\circ\text{C/W}$      |

## Reverse Diode (FRED)

| Symbol Test Conditions<br>( $T_J = 25^\circ\text{C}$ Unless Otherwise Specified) |                                                                                                      | Characteristic Values |      |                         |
|----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|-----------------------|------|-------------------------|
|                                                                                  |                                                                                                      | Min.                  | Typ. | Max.                    |
| $V_F$                                                                            | $I_F = 100\text{A}, V_{GE} = 0\text{V}, \text{Note 1}$                                               |                       |      | 2.5 V                   |
|                                                                                  | $T_J = 150^\circ\text{C}$                                                                            |                       | 2.3  | V                       |
| $I_{RM}$                                                                         | $I_F = 100\text{A}, V_{GE} = 0\text{V},$<br>$-di_F/dt = 1500\text{A}/\mu\text{s}, V_R = 300\text{V}$ |                       | 95   | A                       |
| $t_{rr}$                                                                         |                                                                                                      |                       | 100  | ns                      |
| $R_{thJC}$                                                                       |                                                                                                      |                       |      | 0.83 $^\circ\text{C/W}$ |

## Notes:

1. Pulse test,  $t \leq 300\mu\text{s}$ , duty cycle,  $d \leq 2\%$ .
2. Part must be heatsunk for high-temp  $I_{CES}$  measurement.
3. Switching times & energy losses may increase for higher  $V_{CE}(\text{Clamp})$ ,  $T_J$  or  $R_G$ .

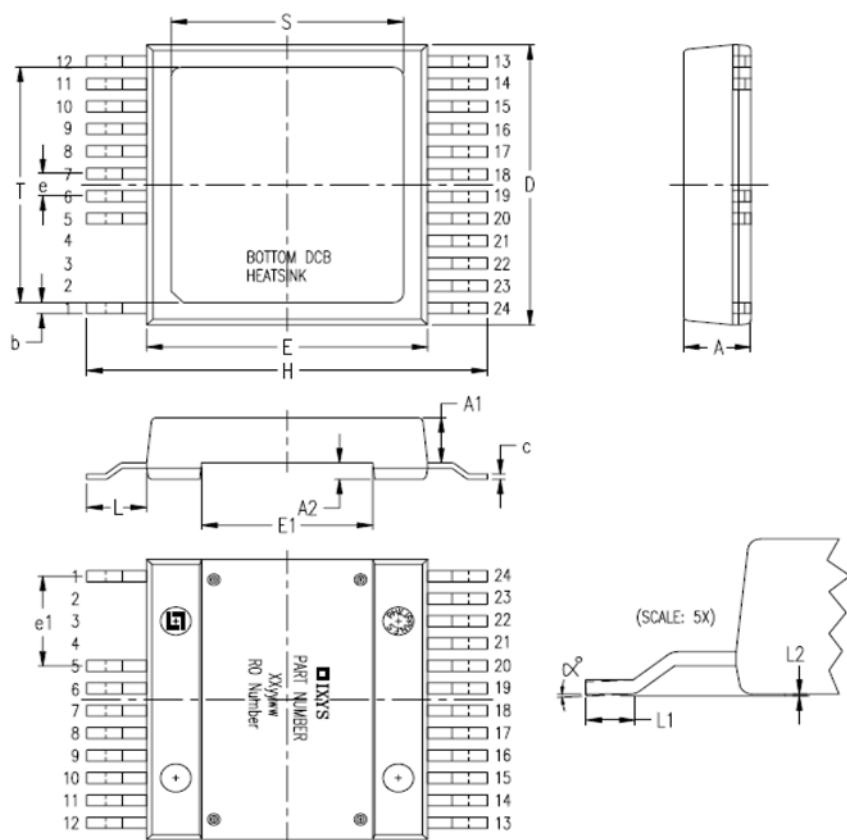
**PRELIMINARY TECHNICAL INFORMATION**

The product presented herein is under development. The Technical Specifications offered are derived from a subjective evaluation of the design, based upon prior knowledge and experience, and constitute a "considered reflection" of the anticipated result. IXYS reserves the right to change limits, test conditions, and dimensions without notice.

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

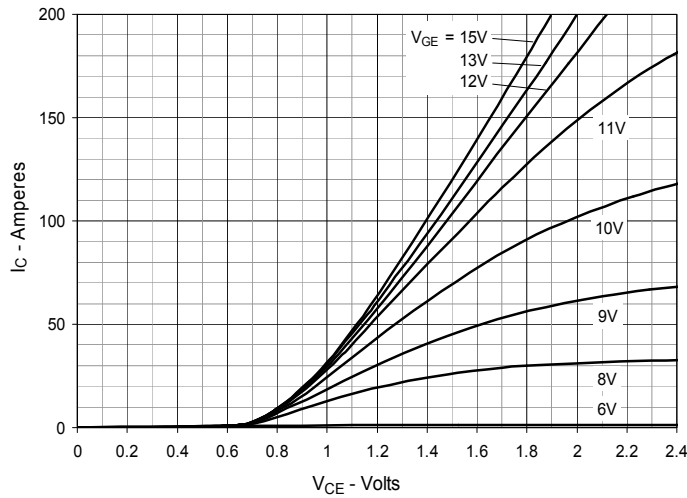
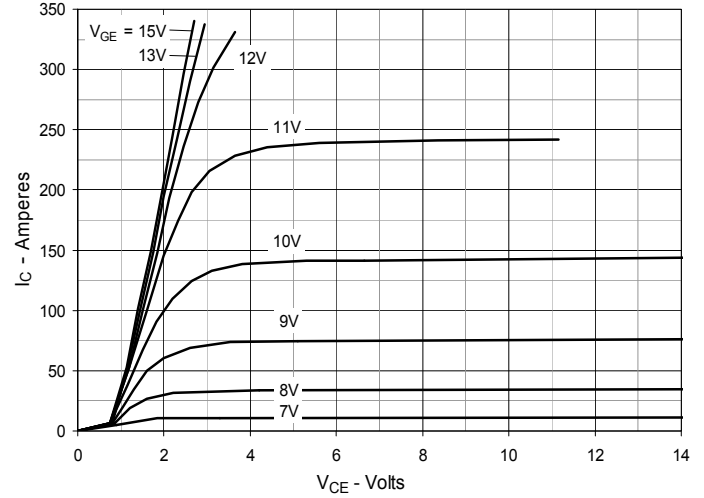
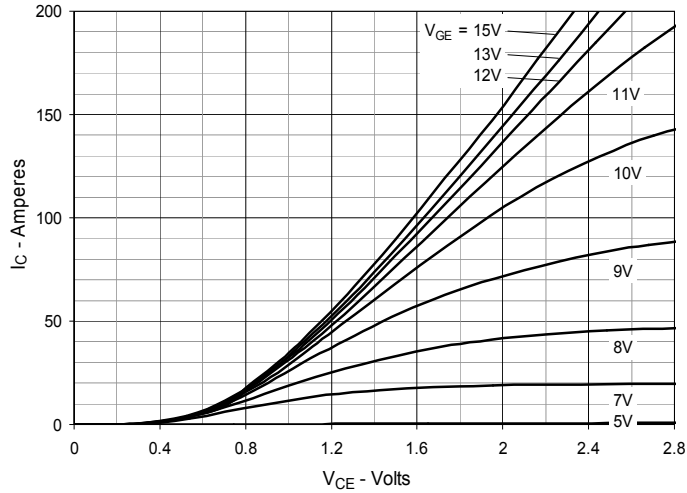
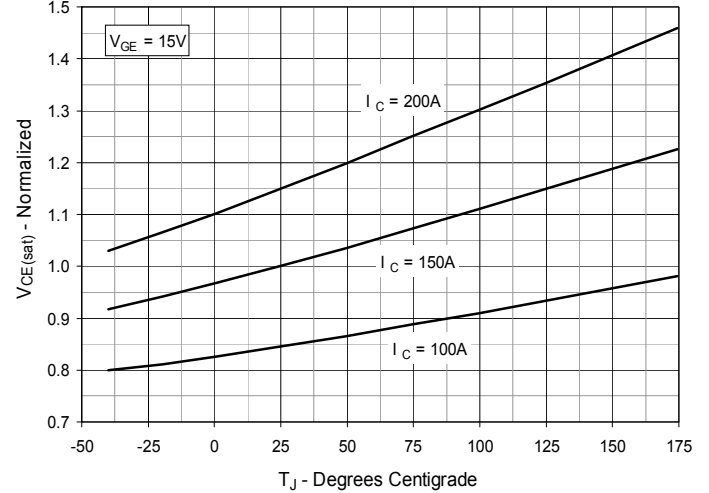
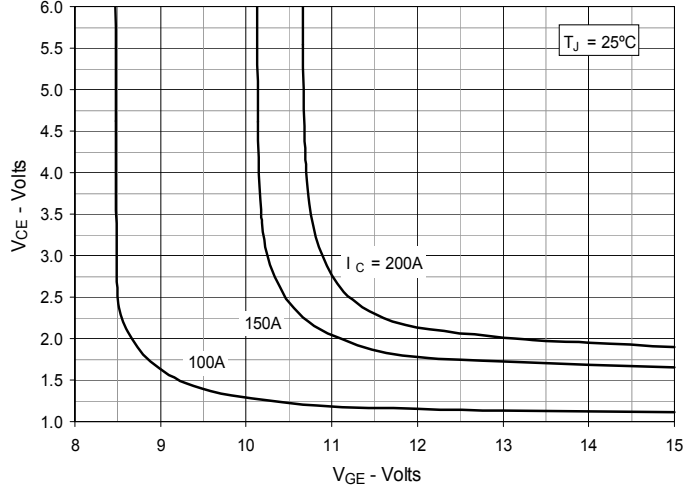
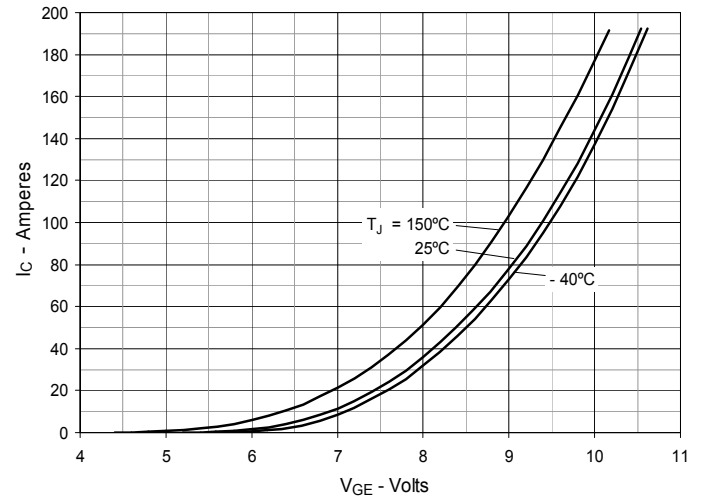
IXYS MOSFETs and IGBTs are covered by one or more of the following U.S. patents:

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

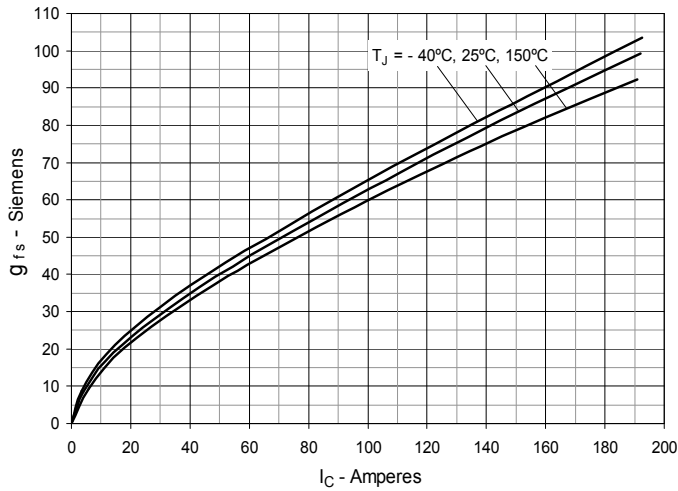


| SYM | INCHES   |       | MILLIMETERS |       |
|-----|----------|-------|-------------|-------|
|     | MIN      | MAX   | MIN         | MAX   |
| A   | .209     | .224  | 5.30        | 5.70  |
| A1  | .154     | .161  | 3.90        | 4.10  |
| A2  | .055     | .063  | 1.40        | 1.60  |
| b   | .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°    |

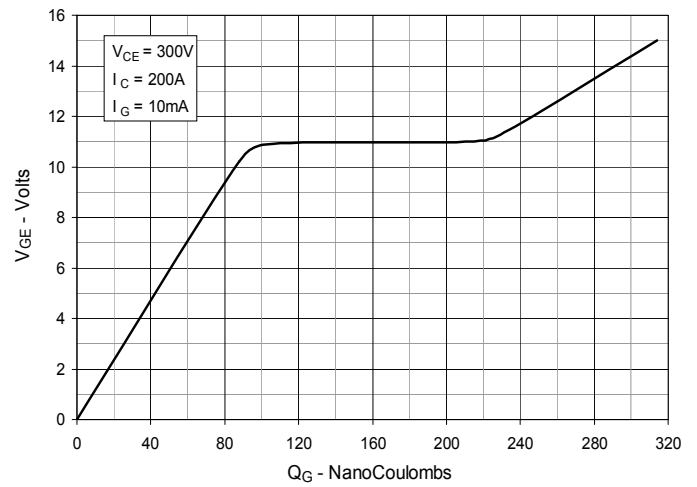
PIN: 1 = Gate  
 5-12 = Emitter  
 13-24 = Collector

**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**


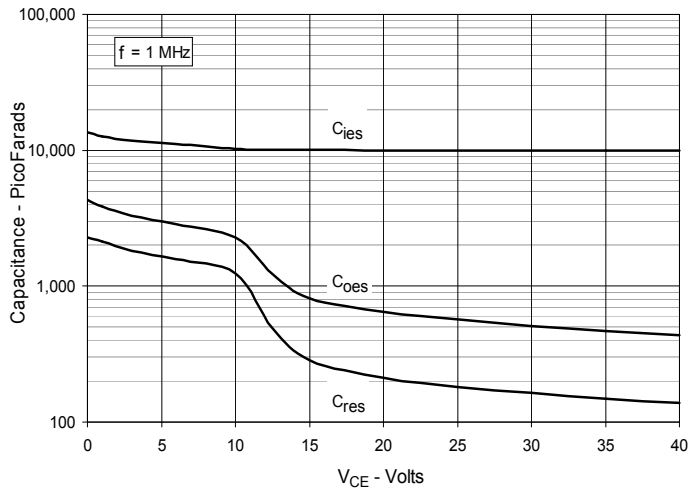
**Fig. 7. Transconductance**



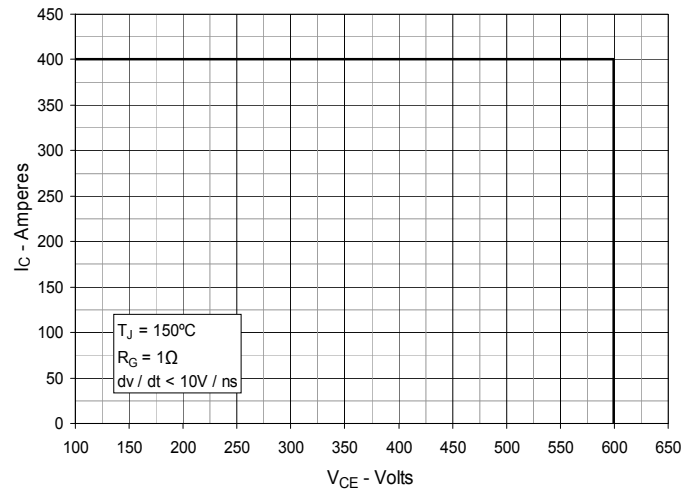
**Fig. 8. Gate Charge**



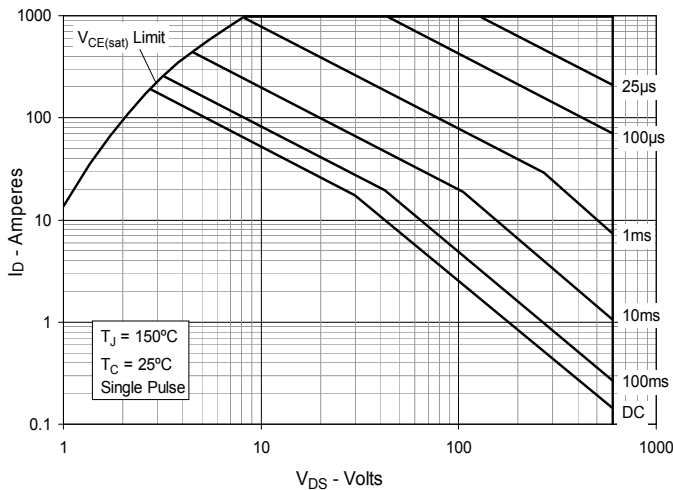
**Fig. 9. Capacitance**



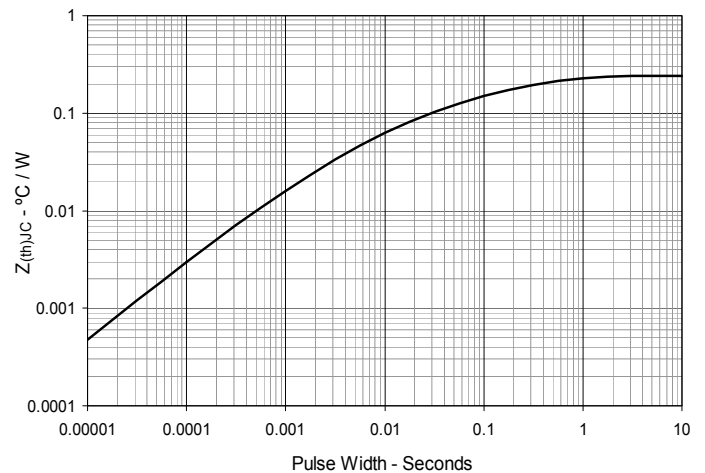
**Fig. 10. Reverse-Bias Safe Operating Area**



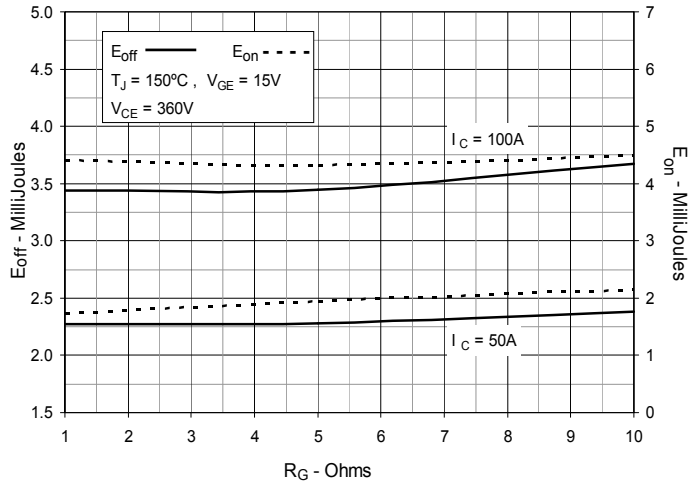
**Fig. 11. Forward-Bias Safe Operating Area**



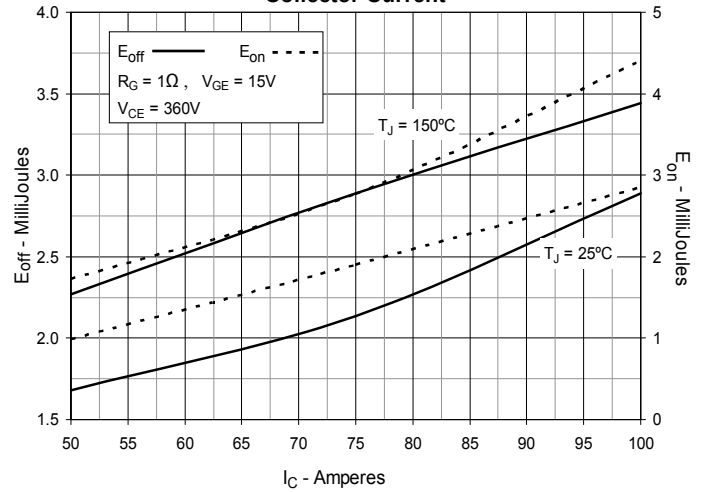
**Fig. 12. Maximum Transient Thermal Impedance**



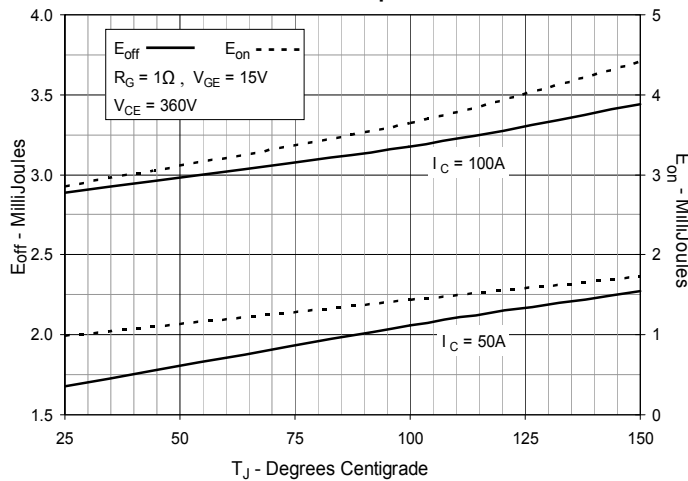
**Fig. 13. Inductive Switching Energy Loss vs. Gate Resistance**



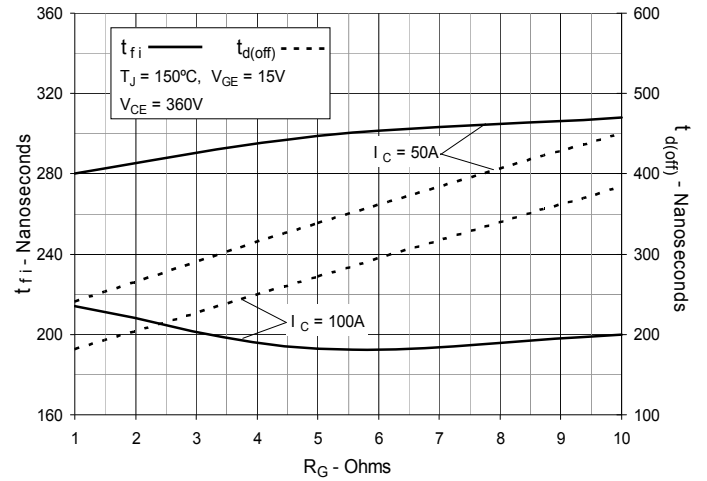
**Fig. 14. Inductive Switching Energy Loss vs. Collector Current**



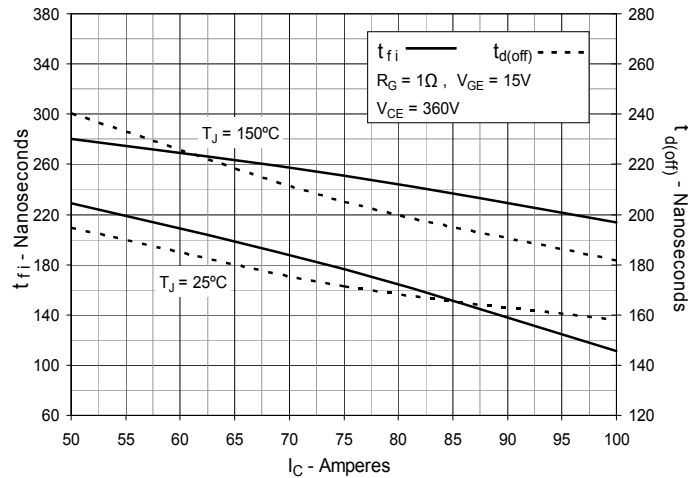
**Fig. 15. Inductive Switching Energy Loss vs. Junction Temperature**



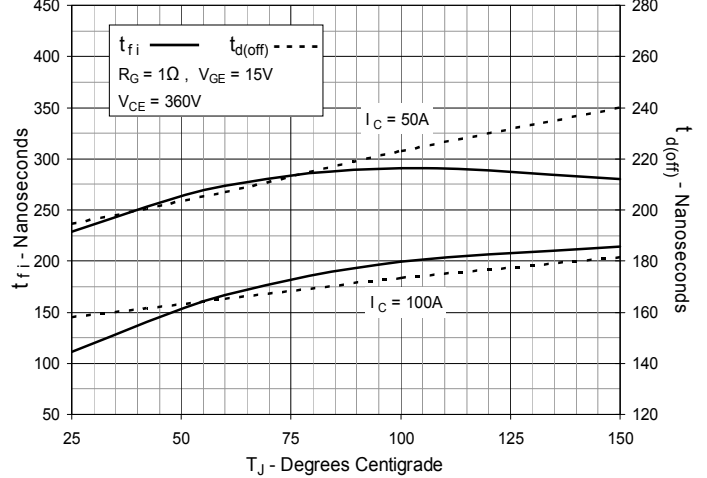
**Fig. 16. Inductive Turn-off Switching Times vs. Gate Resistance**



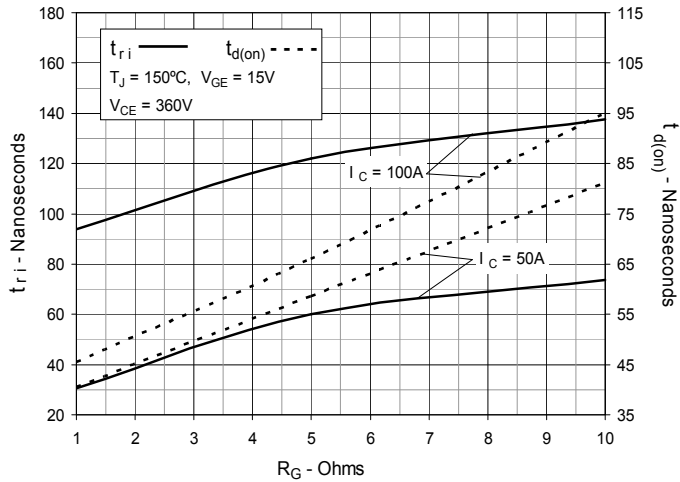
**Fig. 17. Inductive Turn-off Switching Times vs. Collector Current**



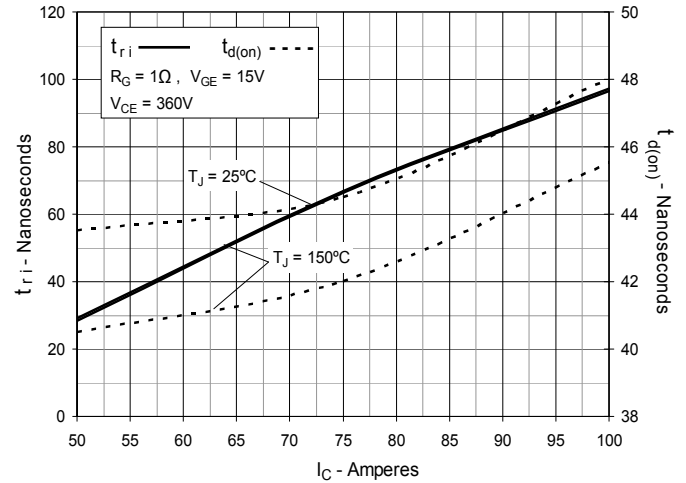
**Fig. 18. Inductive Turn-off Switching Times vs. Junction Temperature**



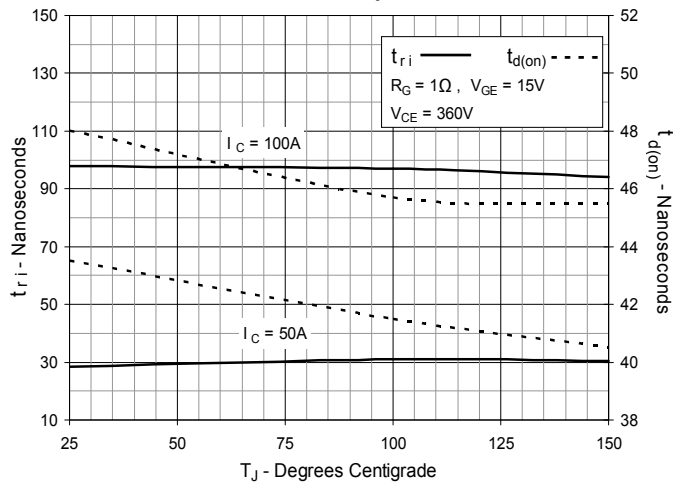
**Fig. 19. Inductive Turn-on Switching Times vs. Gate Resistance**



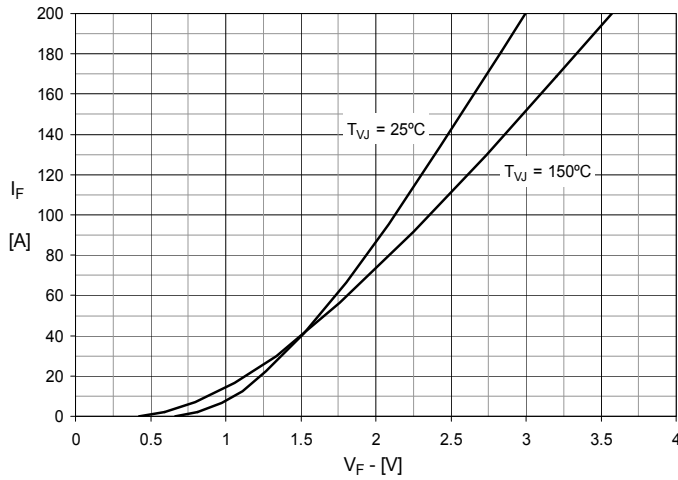
**Fig. 20. Inductive Turn-on Switching Times vs. Collector Current**



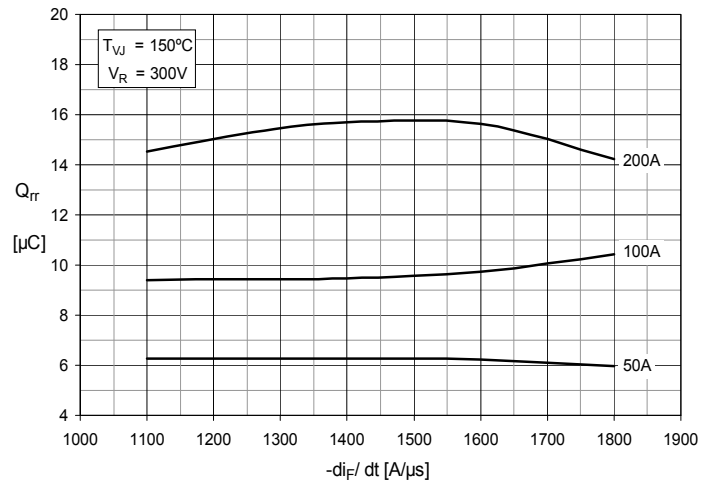
**Fig. 21. Inductive Turn-on Switching Times vs. Junction Temperature**



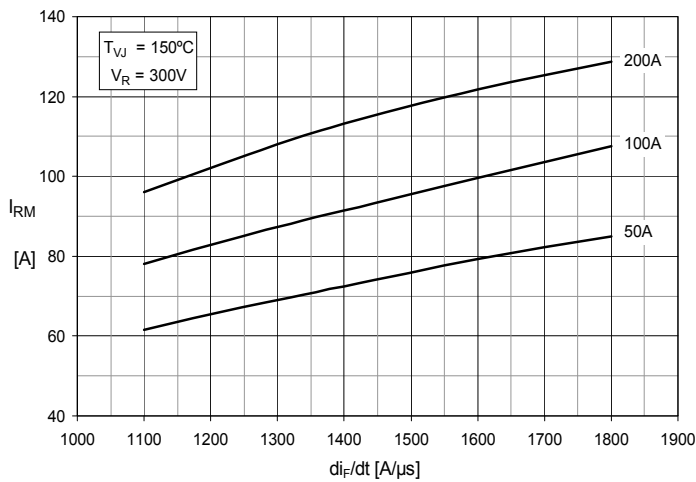
**Fig. 22. Typ. Forward characteristics**



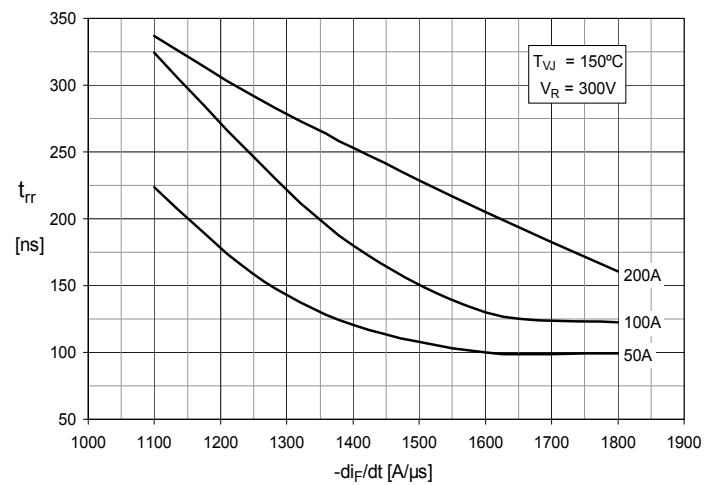
**Fig. 23. Typ. Reverse Recovery Charge  $Q_{rr}$  vs.  $-di_F/dt$**



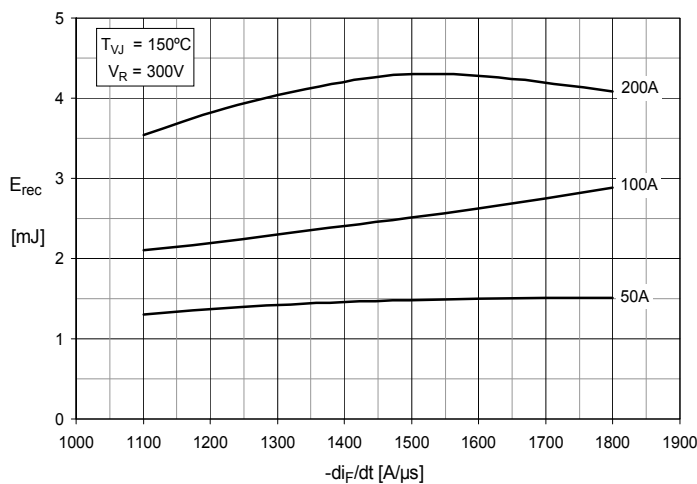
**Fig. 24. Typ. Peak Reverse Current  $I_{RM}$  vs.  $-di_F/dt$**



**Fig. 25. Typ. Recovery Time  $t_{rr}$  vs.  $-di_F/dt$**



**Fig. 26. Typ. Recovery Energy  $E_{rec}$  vs.  $-di_F/dt$**





---

Disclaimer Notice - Information furnished is believed to be accurate and reliable. However, users should independently evaluate the suitability of and test each product selected for their own applications. Littelfuse products are not designed for, and may not be used in, all applications. Read complete Disclaimer Notice at [www.littelfuse.com/disclaimer-electronics](http://www.littelfuse.com/disclaimer-electronics).