

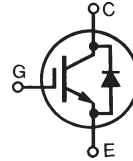
**XPT™ 650V IGBT  
GenX4™ w/Diode**
**IXXH40N65C4D1**

$$V_{CES} = 650V$$

$$I_{C110} = 40A$$

$$V_{CE(sat)} \leq 2.3V$$

$$t_{fi(typ)} = 27ns$$

 Extreme Light Punch Through  
IGBT for 5-20 kHz Switching


| Symbol         | Test Conditions   | Maximum Ratings         |            |
|----------------|---|-------------------------|------------|
| $V_{CES}$      | $T_J = 25^\circ C$ to $175^\circ C$                       | 650                     | V          |
| $V_{CGR}$      | $T_J = 25^\circ C$ to $175^\circ C$ , $R_{GE} = 1M\Omega$ | 650                     | V          |
| $V_{GES}$      | Continuous  | $\pm 20$                | V          |
| $V_{GEM}$      | Transient   | $\pm 30$                | V          |
| $I_{C25}$      | $T_C = 25^\circ C$  | 110                     | A          |
| $I_{C110}$     | $T_C = 110^\circ C$                                       | 40                      | A          |
| $I_{F110}$     | $T_C = 110^\circ C$                                       | 55                      | A          |
| $I_{CM}$       | $T_C = 25^\circ C$ , 1ms                                  | 215                     | A          |
| <b>SSOA</b>    | $V_{GE} = 15V$ , $T_{VJ} = 150^\circ C$ , $R_G = 5\Omega$ | $I_{CM} = 80$           | A          |
| <b>(RBSOA)</b> | Clamped Inductive Load                                    | @ $V_{CE} \leq V_{CES}$ |            |
| $t_{sc}$       | $V_{GE} = 15V$ , $V_{CE} = 360V$ , $T_J = 150^\circ C$    | 10                      | $\mu s$    |
| <b>(SCSOA)</b> | $R_G = 82\Omega$ , Non Repetitive                         |                         |            |
| $P_C$          | $T_C = 25^\circ C$  | 455                     | W          |
| $T_J$          |   | -55 ... +175            | $^\circ C$ |
| $T_{JM}$       |   | 175                     | $^\circ C$ |
| $T_{stg}$      |   | -55 ... +175            | $^\circ C$ |
| $T_L$          | Maximum Lead Temperature for Soldering                    | 300                     | $^\circ C$ |
| $T_{SOLD}$     | 1.6 mm (0.062in.) from Case for 10s                       | 260                     | $^\circ C$ |
| $M_d$          | Mounting Torque   | 1.13/10                 | Nm/lb.in   |
| <b>Weight</b>  |   | 6                       | g          |

**TO-247**


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

**Features**

- Optimized for 5-20kHz Switching
- Square RBSOA
- Anti-Parallel Diode
- Avalanche Rated
- Short Circuit Capability
- International Standard Package

**Advantages**

- High Power Density
- Extremely Rugged
- 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.                 |
| $BV_{CES}$    | $I_C = 250\mu A$ , $V_{GE} = 0V$                                      | 650                   |              | V                    |
| $V_{GE(th)}$  | $I_C = 250\mu A$ , $V_{CE} = V_{GE}$                                  | 4.0                   |              | 6.5 V                |
| $I_{CES}$     | $V_{CE} = V_{CES}$ , $V_{GE} = 0V$<br>$T_J = 150^\circ C$             |                       |              | 25 $\mu A$<br>1.5 mA |
| $I_{GES}$     | $V_{CE} = 0V$ , $V_{GE} = \pm 20V$                                    |                       |              | $\pm 100$ nA         |
| $V_{CE(sat)}$ | $I_C = 40A$ , $V_{GE} = 15V$ , Note 1<br>$T_J = 150^\circ C$          |                       | 1.90<br>2.24 | V<br>V               |

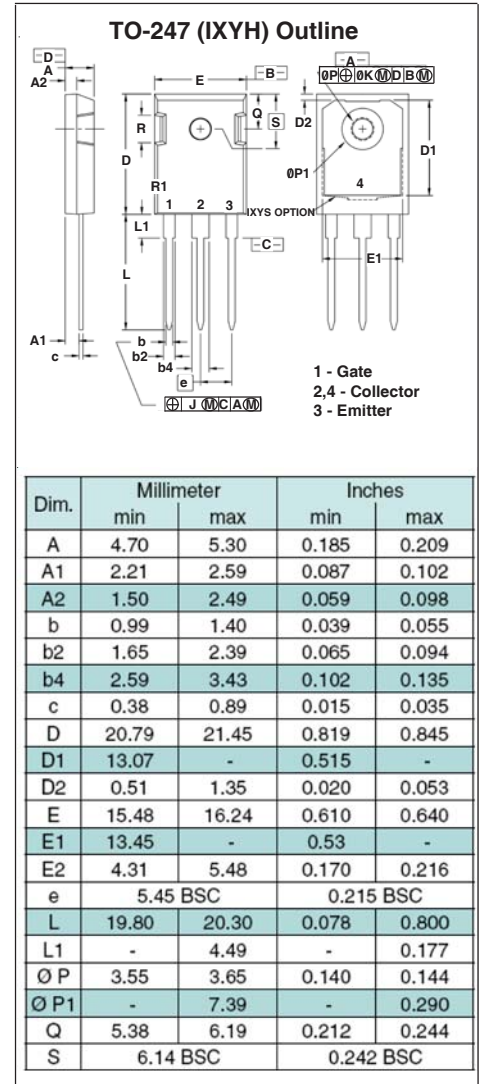
| Symbol       | Test Conditions<br>( $T_J = 25^\circ\text{C}$ Unless Otherwise Specified)   | Characteristic Values |      |                    |
|--------------|---|-----------------------|------|--------------------|
|              |   | Min.                  | Typ. | Max.               |
| $g_{fs}$     | $I_C = 40\text{A}, V_{CE} = 10\text{V}$ , Note 1  | 14                    | 24   | S                  |
| $C_{ies}$    | $V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$  |                       | 2100 | pF                 |
| $C_{oes}$    |   |                       | 200  | pF                 |
| $C_{res}$    |   |                       | 32   | pF                 |
| $Q_{g(on)}$  | $I_C = 40\text{A}, V_{GE} = 15\text{V}, V_{CE} = 0.5 \cdot V_{CES}$   |                       | 68   | nC                 |
| $Q_{ge}$     |   |                       | 14   | nC                 |
| $Q_{gc}$     |   |                       | 26   | nC                 |
| $t_{d(on)}$  | <b>Inductive load, <math>T_J = 25^\circ\text{C}</math></b><br>$I_C = 40\text{A}, V_{GE} = 15\text{V}$<br>$V_{CE} = 400\text{V}, R_G = 5\Omega$<br>Note 2  |                       | 20   | ns                 |
| $t_{ri}$     |   |                       | 62   | ns                 |
| $E_{on}$     |   |                       | 1.60 | mJ                 |
| $t_{d(off)}$ |   |                       | 100  | ns                 |
| $t_{fi}$     |   |                       | 27   | ns                 |
| $E_{off}$    |   |                       | 0.42 | mJ                 |
| $t_{d(on)}$  | <b>Inductive load, <math>T_J = 150^\circ\text{C}</math></b><br>$I_C = 40\text{A}, V_{GE} = 15\text{V}$<br>$V_{CE} = 400\text{V}, R_G = 5\Omega$<br>Note 2 |                       | 19   | ns                 |
| $t_{ri}$     |   |                       | 52   | ns                 |
| $E_{on}$     |   |                       | 2.75 | mJ                 |
| $t_{d(off)}$ |   |                       | 106  | ns                 |
| $t_{fi}$     |   |                       | 36   | ns                 |
| $E_{off}$    |   |                       | 0.64 | mJ                 |
| $R_{thJC}$   |   |                       | 0.33 | $^\circ\text{C/W}$ |
| $R_{thCS}$   |   | 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<br>$T_J = 150^\circ\text{C}$   |                       | 1.3  | 2.6 V                   |
| $I_{RM}$   | $I_F = 30\text{A}, V_{GE} = 0\text{V}, T_J = 150^\circ\text{C}$<br>$-di_F/dt = 500\text{A}/\mu\text{s}, V_R = 400\text{V}$ |                       | 20   | A                       |
| $t_{rr}$   |  |                       | 155  | ns                      |
| $R_{thJC}$ |  |                       |      | 0.60 $^\circ\text{C/W}$ |

### Notes:

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

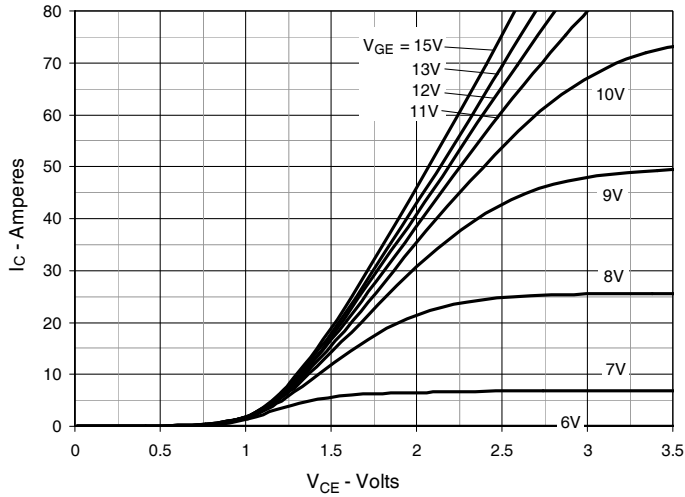
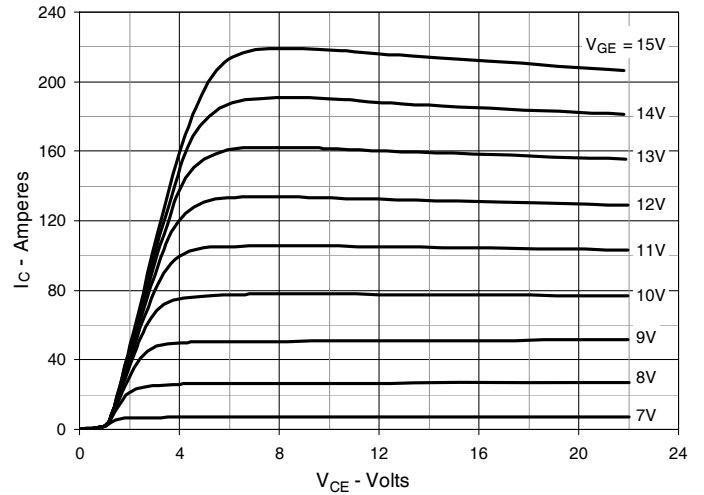
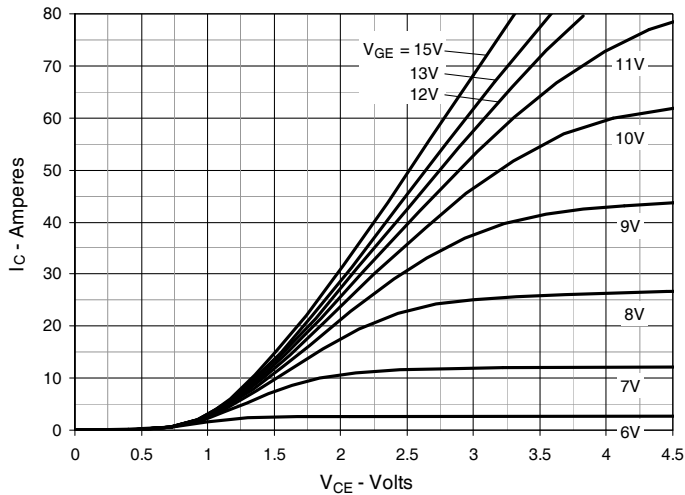
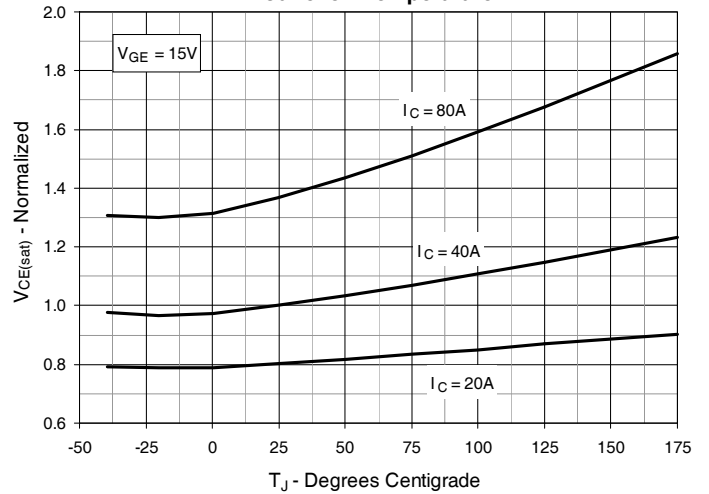
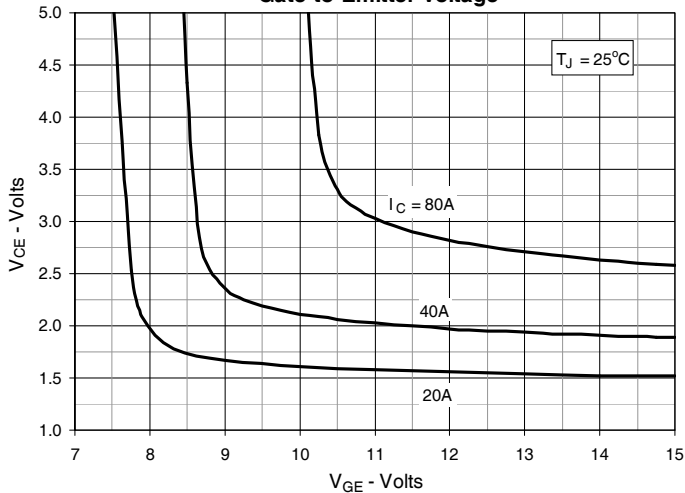
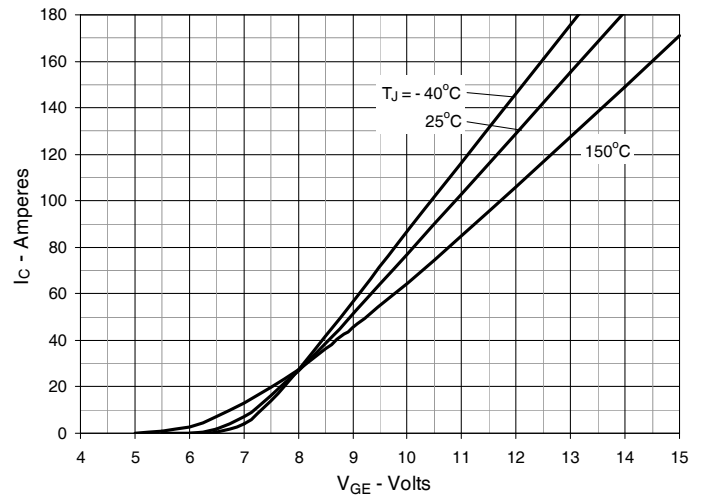


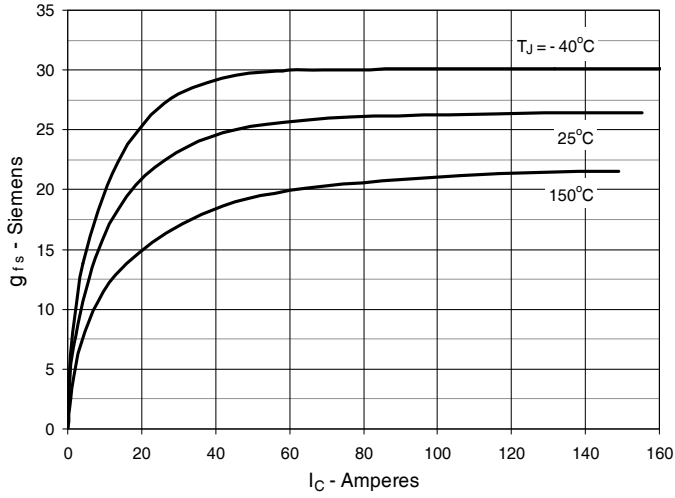
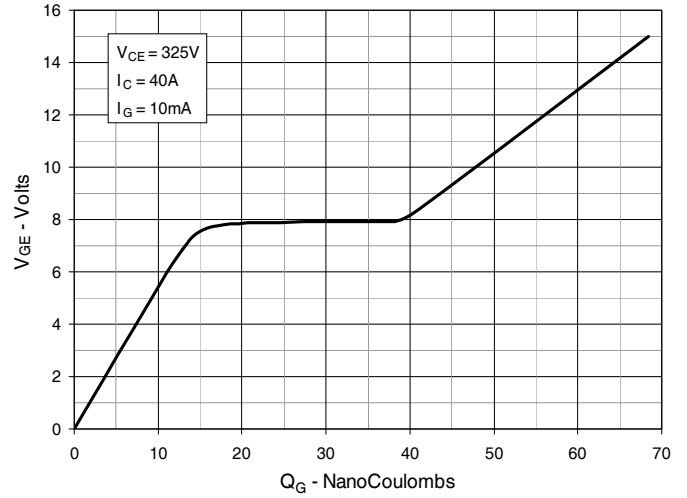
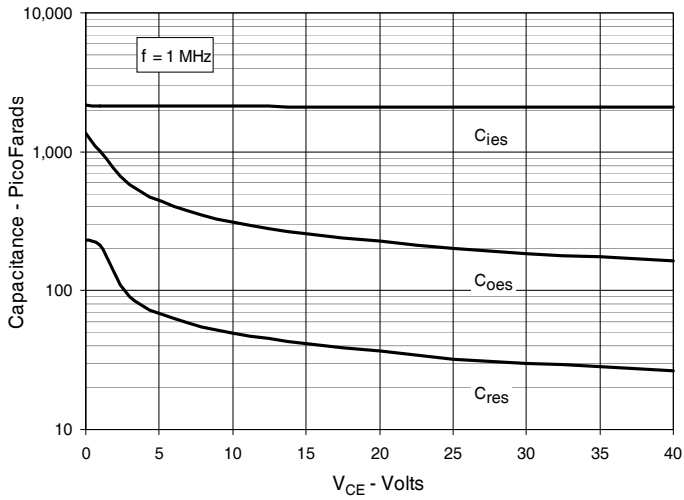
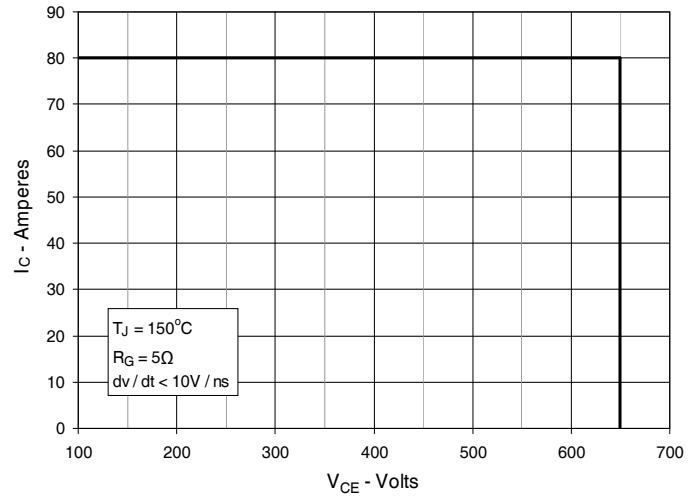
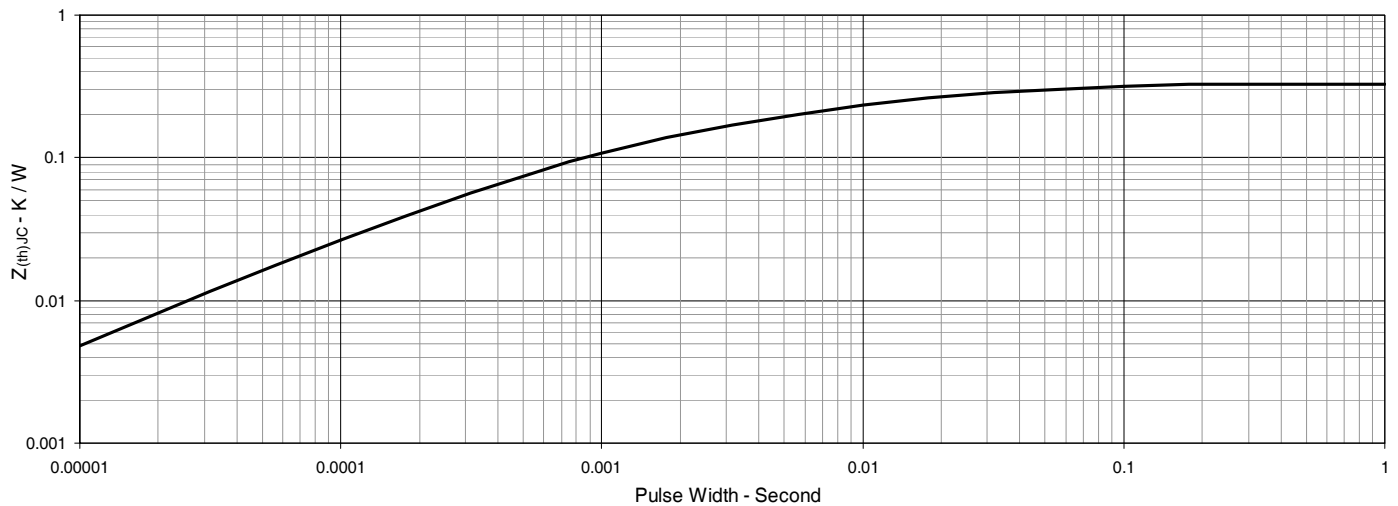
### ADVANCE TECHNICAL INFORMATION

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.

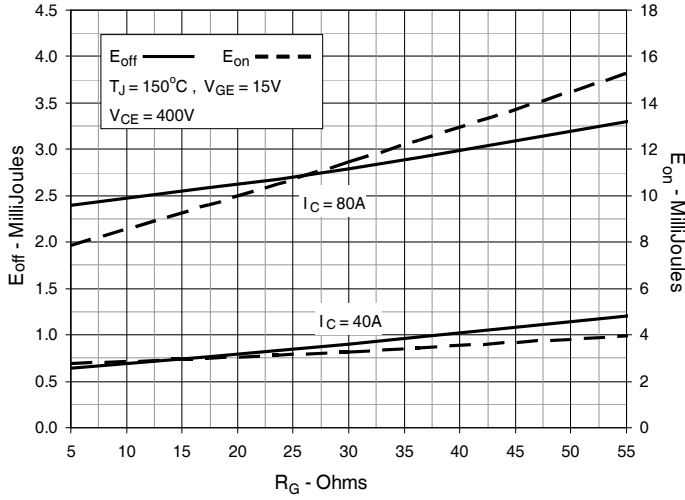
### IXYS Reserves the Right to Change Limits, Test Conditions, and Dimensions.

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

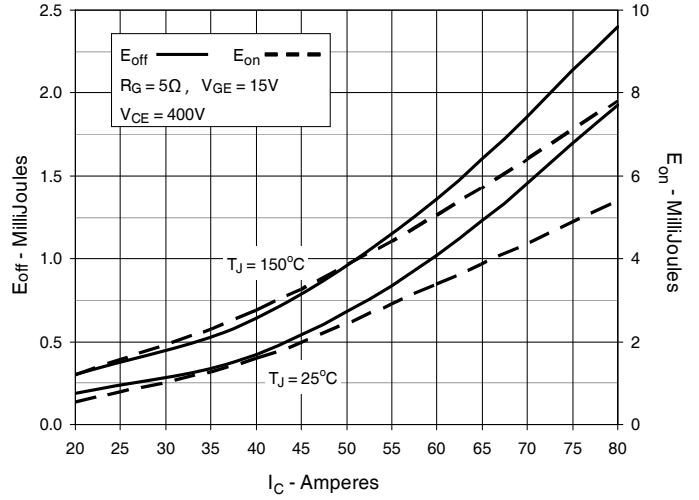
**Fig. 1. Output Characteristics @  $T_J = 25^\circ\text{C}$** 

**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. Maximum Transient Thermal Impedance (IGBT)**


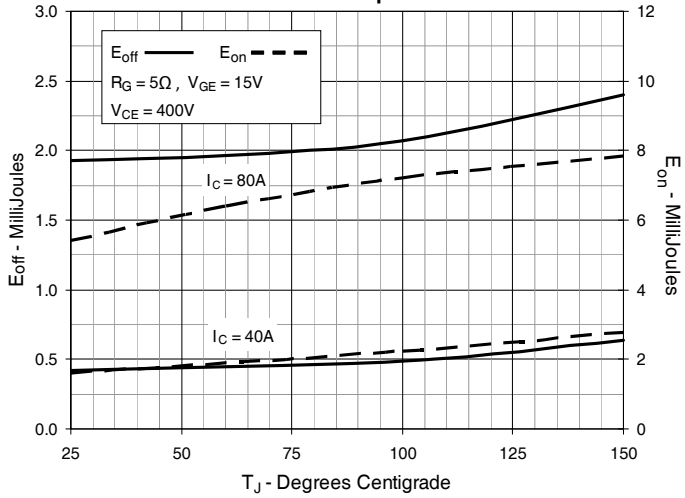
**Fig. 12. Inductive Switching Energy Loss vs. Gate Resistance**



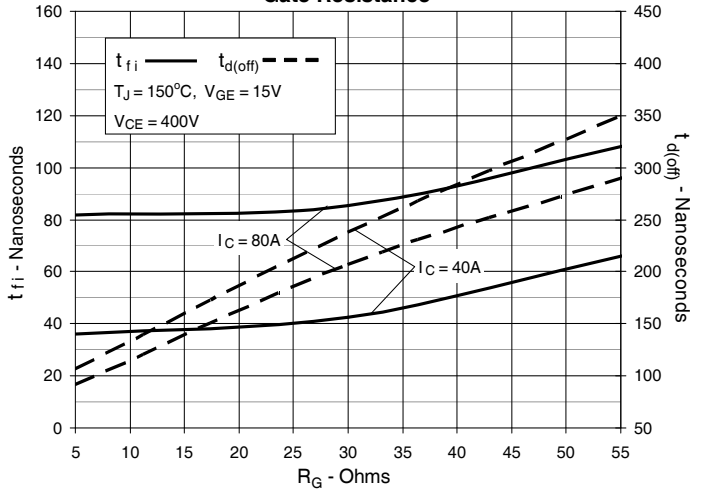
**Fig. 13. Inductive Switching Energy Loss vs. Collector Current**



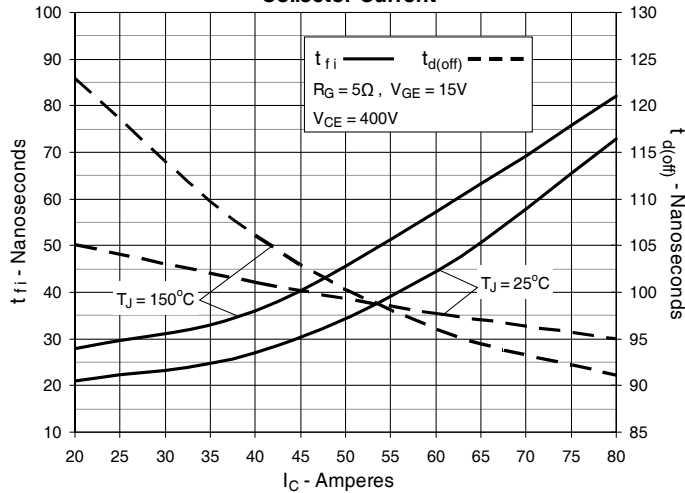
**Fig. 14. Inductive Switching Energy Loss vs. Junction Temperature**



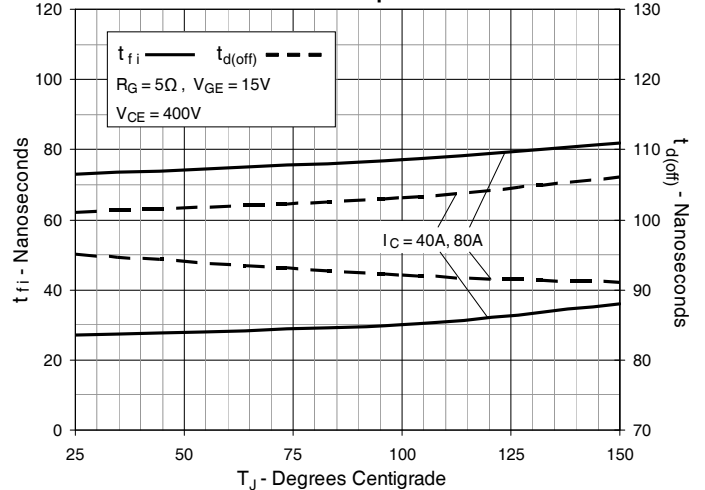
**Fig. 15. Inductive Turn-off Switching Times vs. Gate Resistance**

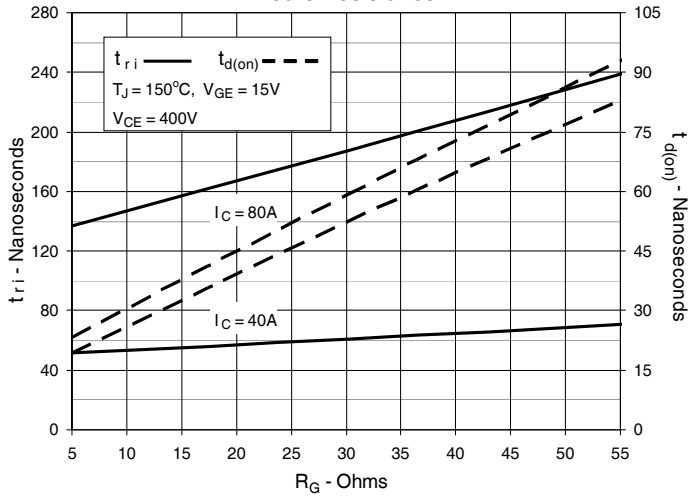
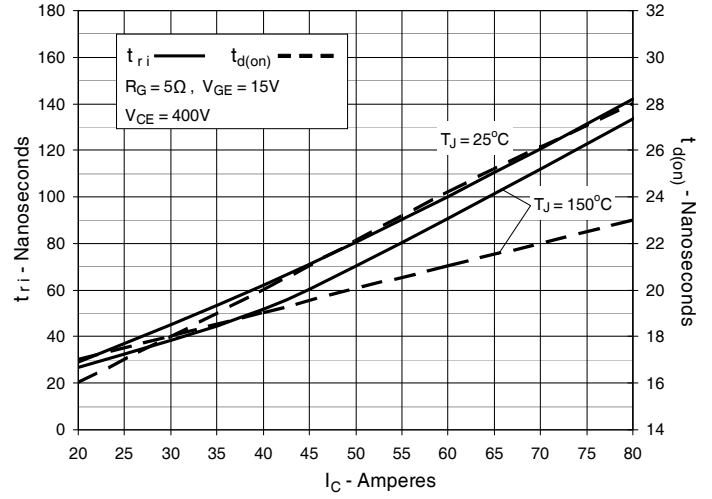
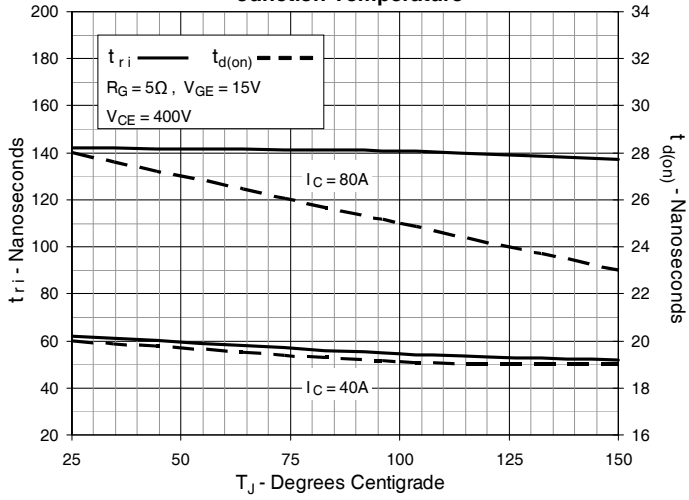


**Fig. 16. Inductive Turn-off Switching Times vs. Collector Current**

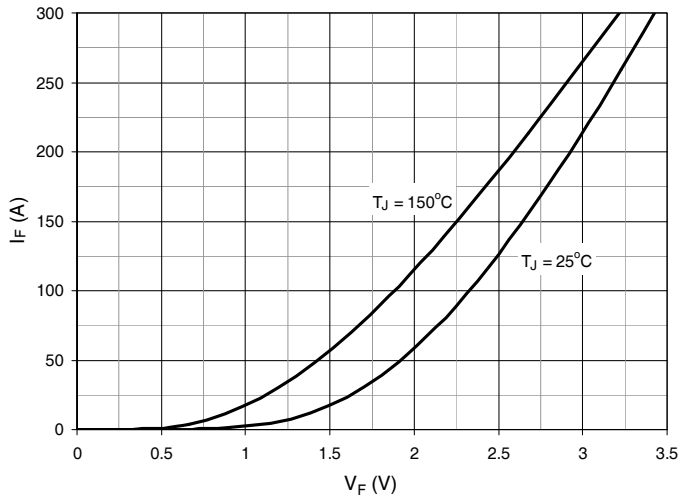


**Fig. 17. Inductive Turn-off Switching Times vs. Junction Temperature**

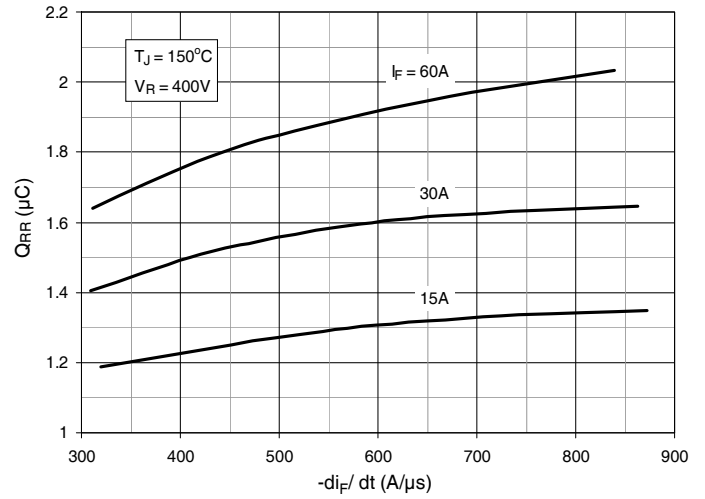


**Fig. 18. Inductive Turn-on Switching Times vs. Gate Resistance**

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

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


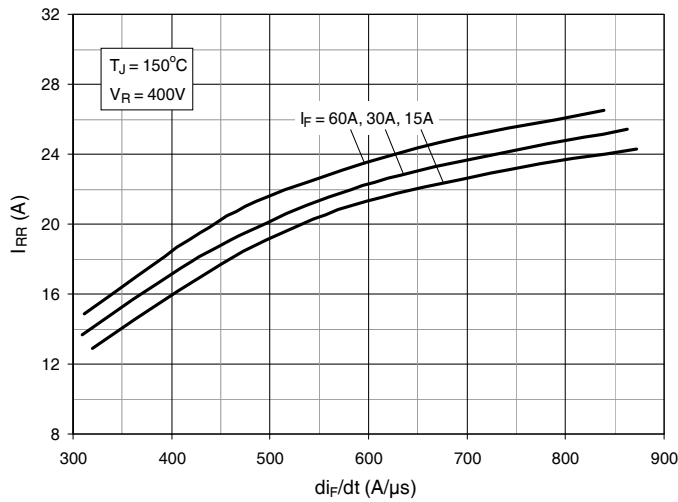
**Fig. 21. Diode Forward Characteristics**



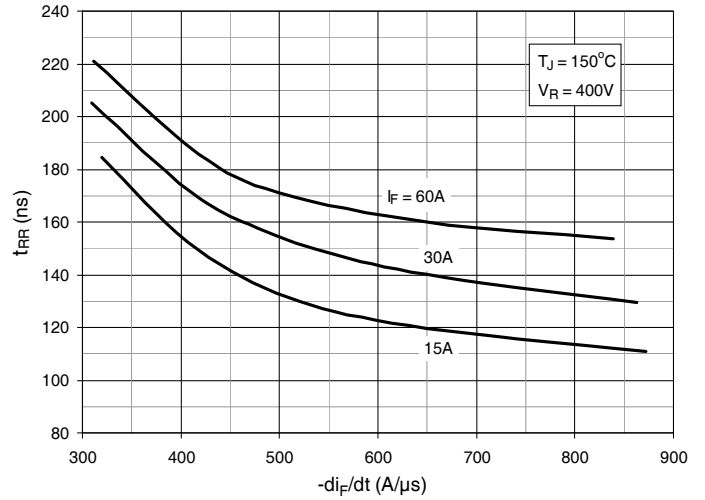
**Fig. 22. Reverse Recovery Charge vs.  $-di_F/dt$**



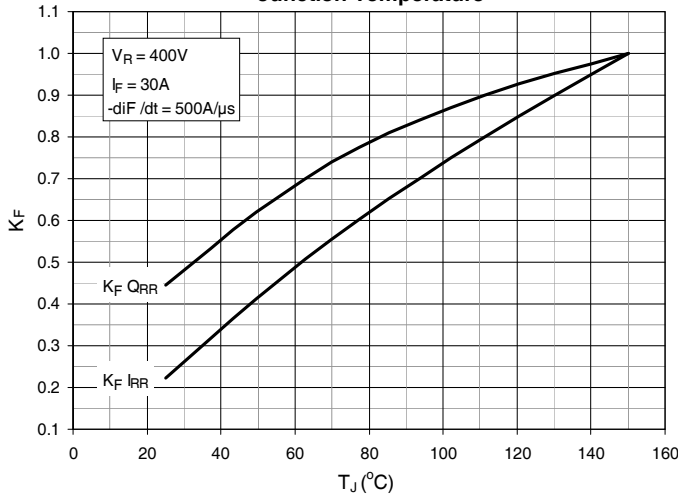
**Fig. 23. Reverse Recovery Current vs.  $-di_F/dt$**



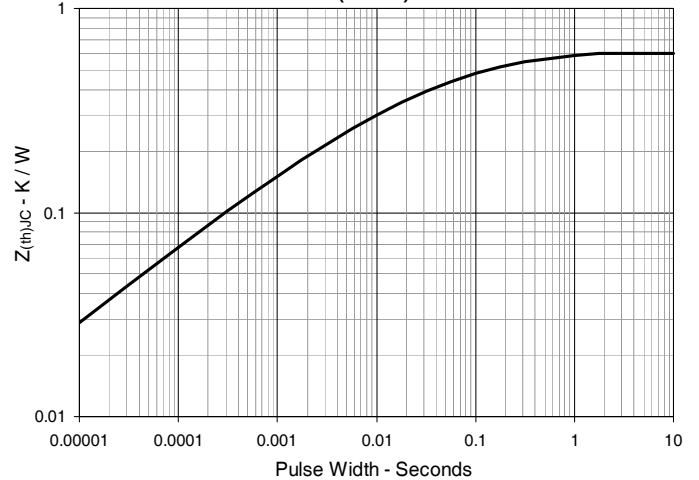
**Fig. 24. Reverse Recovery Time vs.  $-di_F/dt$**



**Fig. 25. Dynamic Parameters  $Q_{RR}$ ,  $I_{RR}$  vs. Junction Temperature**



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





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