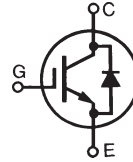


# XPT™ 650V IGBT GenX3™ w/ Diode

## IXYH75N65C3D1

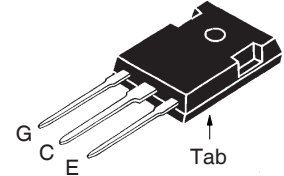
Extreme Light Punch through  
IGBT for 20-60kHz Switching



$$\begin{aligned} V_{CES} &= 650V \\ I_{C110} &= 75A \\ V_{CE(sat)} &\leq 2.3V \\ t_{fi(typ)} &= 60ns \end{aligned}$$

| Symbol                        | Test Conditions                                                                             | Maximum Ratings                         |                  |
|-------------------------------|---------------------------------------------------------------------------------------------|-----------------------------------------|------------------|
| $V_{CES}$                     | $T_J = 25^\circ\text{C to } 175^\circ\text{C}$                                              | 650                                     | V                |
| $V_{CGR}$                     | $T_J = 25^\circ\text{C to } 175^\circ\text{C}, R_{GE} = 1M\Omega$                           | 650                                     | V                |
| $V_{GES}$                     | Continuous                                                                                  | $\pm 20$                                | V                |
| $V_{GEM}$                     | Transient                                                                                   | $\pm 30$                                | V                |
| $I_{C25}$                     | $T_C = 25^\circ\text{C}$ (Chip Capability)                                                  | 175                                     | A                |
| $I_{LRMS}$                    | Terminal Current Limit                                                                      | 160                                     | A                |
| $I_{C110}$                    | $T_C = 110^\circ\text{C}$                                                                   | 75                                      | A                |
| $I_{F110}$                    | $T_C = 110^\circ\text{C}$                                                                   | 66                                      | A                |
| $I_{CM}$                      | $T_C = 25^\circ\text{C}, 1\text{ms}$                                                        | 360                                     | A                |
| $I_A$                         | $T_C = 25^\circ\text{C}$                                                                    | 30                                      | A                |
| $E_{AS}$                      | $T_C = 25^\circ\text{C}$                                                                    | 300                                     | mJ               |
| <b>SSOA</b><br><b>(RBSOA)</b> | $V_{GE} = 15V, T_{VJ} = 150^\circ\text{C}, R_G = 3\Omega$<br>Clamped Inductive Load         | $I_{CM} = 150$<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>$R_G = 82\Omega$ , Non Repetitive | 8                                       | $\mu\text{s}$    |
| $P_C$                         | $T_C = 25^\circ\text{C}$                                                                    | 750                                     | W                |
| $T_J$                         |                                                                                             | -55 ... +175                            | $^\circ\text{C}$ |
| $T_{JM}$                      |                                                                                             | 175                                     | $^\circ\text{C}$ |
| $T_{stg}$                     |                                                                                             | -55 ... +175                            | $^\circ\text{C}$ |
| $T_L$                         | Maximum Lead Temperature for Soldering                                                      | 300                                     | $^\circ\text{C}$ |
| $T_{SOLD}$                    | 1.6 mm (0.062in.) from Case for 10s                                                         | 260                                     | $^\circ\text{C}$ |
| $M_d$                         | Mounting Torque                                                                             | 1.13/10                                 | Nm/lb.in         |
| <b>Weight</b>                 |                                                                                             | 6                                       | g                |

### TO-247 AD



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

### Features

- International Standard Package
- Optimized for 20-60kHz Switching
- Square RBSOA
- Avalanche Rated
- Short Circuit Capability
- High Current Handling Capability
- Anti-Parallel Fast Diode

### 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.                     |
| $BV_{CES}$    | $I_C = 250\mu\text{A}, V_{GE} = 0V$                                         | 650                   |            | 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>$T_J = 150^\circ\text{C}$                |                       |            | 25 $\mu\text{A}$<br>3 mA |
| $I_{GES}$     | $V_{CE} = 0V, V_{GE} = \pm 20V$                                             |                       |            | $\pm 100$ nA             |
| $V_{CE(sat)}$ | $I_C = 60A, V_{GE} = 15V$ , Note 1<br>$T_J = 150^\circ\text{C}$             |                       | 1.8<br>2.2 | 2.3 V<br>V               |

## Symbol Test Conditions

( $T_J = 25^\circ\text{C}$  Unless Otherwise Specified)

## Characteristic Values

Min. Typ. Max.

|              |                                                                                                                                                           |      |      |                         |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|-------------------------|
| $g_{fs}$     | $I_C = 60\text{A}, V_{CE} = 10\text{V}$ , Note 1                                                                                                          | 25   | 44   | S                       |
| $C_{ies}$    | $V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$                                                                                                |      | 3410 | pF                      |
| $C_{oes}$    |                                                                                                                                                           |      | 330  | pF                      |
| $C_{res}$    |                                                                                                                                                           |      | 73   | pF                      |
| $Q_{g(on)}$  | $I_C = 60\text{A}, V_{GE} = 15\text{V}, V_{CE} = 0.5 \cdot V_{CES}$                                                                                       |      | 122  | nC                      |
| $Q_{ge}$     |                                                                                                                                                           |      | 22   | nC                      |
| $Q_{gc}$     |                                                                                                                                                           |      | 60   | nC                      |
| $t_{d(on)}$  | <b>Inductive load, <math>T_J = 25^\circ\text{C}</math></b><br>$I_C = 60\text{A}, V_{GE} = 15\text{V}$<br>$V_{CE} = 400\text{V}, R_G = 3\Omega$<br>Note 2  |      | 26   | ns                      |
| $t_{ri}$     |                                                                                                                                                           |      | 65   | ns                      |
| $E_{on}$     |                                                                                                                                                           |      | 2.00 | mJ                      |
| $t_{d(off)}$ |                                                                                                                                                           |      | 93   | ns                      |
| $t_{fi}$     |                                                                                                                                                           |      | 60   | ns                      |
| $E_{off}$    |                                                                                                                                                           |      | 0.95 | mJ                      |
| $t_{d(on)}$  | <b>Inductive load, <math>T_J = 150^\circ\text{C}</math></b><br>$I_C = 60\text{A}, V_{GE} = 15\text{V}$<br>$V_{CE} = 400\text{V}, R_G = 3\Omega$<br>Note 2 |      | 26   | ns                      |
| $t_{ri}$     |                                                                                                                                                           |      | 64   | ns                      |
| $E_{on}$     |                                                                                                                                                           |      | 3.40 | mJ                      |
| $t_{d(off)}$ |                                                                                                                                                           |      | 115  | ns                      |
| $t_{fi}$     |                                                                                                                                                           |      | 64   | ns                      |
| $E_{off}$    |                                                                                                                                                           |      | 1.30 | mJ                      |
| $R_{thJC}$   |                                                                                                                                                           |      |      | 0.20 $^\circ\text{C/W}$ |
| $R_{thCS}$   |                                                                                                                                                           | 0.21 |      | $^\circ\text{C/W}$      |

## Reverse Diode (FRED)

## Symbol Test Conditions

( $T_J = 25^\circ\text{C}$  Unless Otherwise Specified)

## Characteristic Values

Min. Typ. Max.

|            |                                                                            |                                                        |           |                         |
|------------|----------------------------------------------------------------------------|--------------------------------------------------------|-----------|-------------------------|
| $V_F$      | $I_F = 50\text{A}, V_{GE} = 0\text{V}$ , Note 1                            | $T_J = 150^\circ\text{C}$                              | 1.45      | 2.50 V                  |
| $I_{rr}$   | $I_F = 50\text{A}, V_{GE} = 0\text{V}, -di_F/dt = 700\text{A}/\mu\text{s}$ |                                                        |           | V                       |
| $t_{rr}$   | $V_R = 400\text{V}$                                                        | $T_J = 150^\circ\text{C}$<br>$T_J = 150^\circ\text{C}$ | 30<br>135 | A<br>ns                 |
| $R_{thJC}$ |                                                                            |                                                        |           | 0.45 $^\circ\text{C/W}$ |

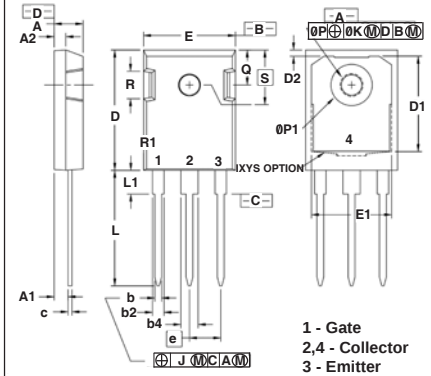
## Notes:

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  $R_G$ .

## 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.

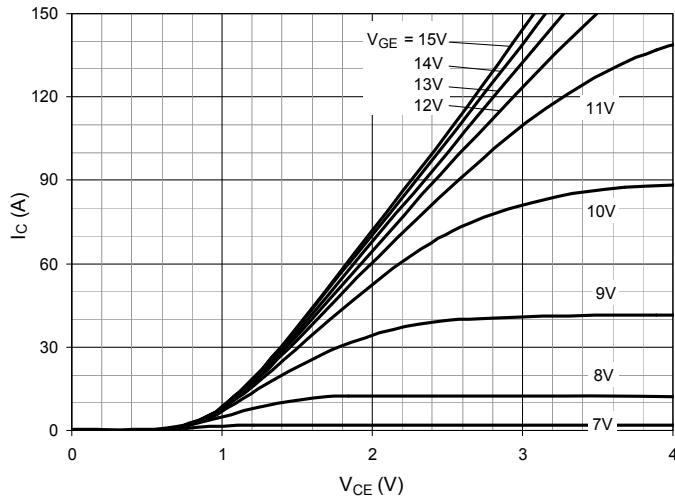
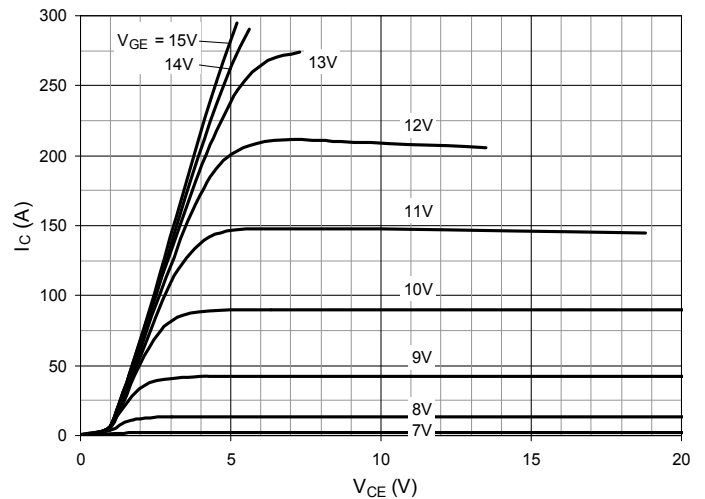
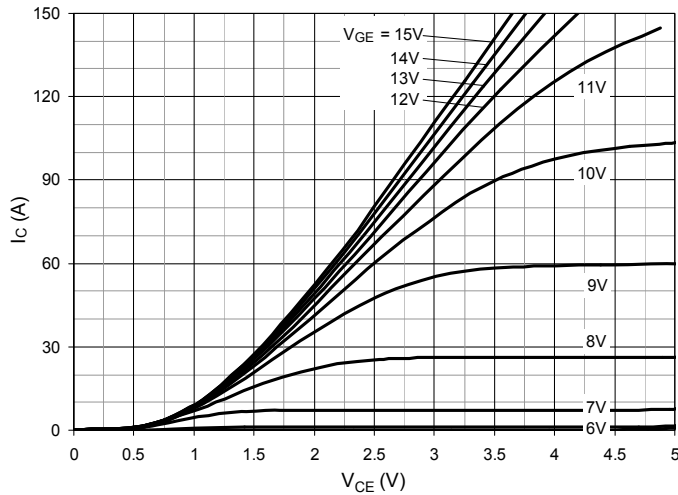
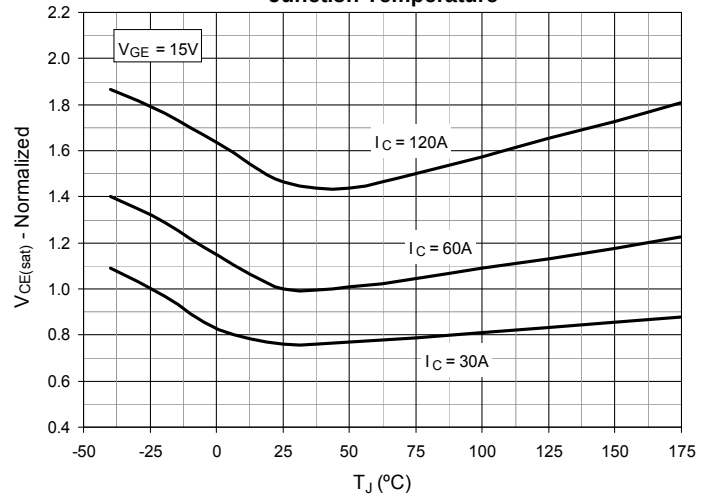
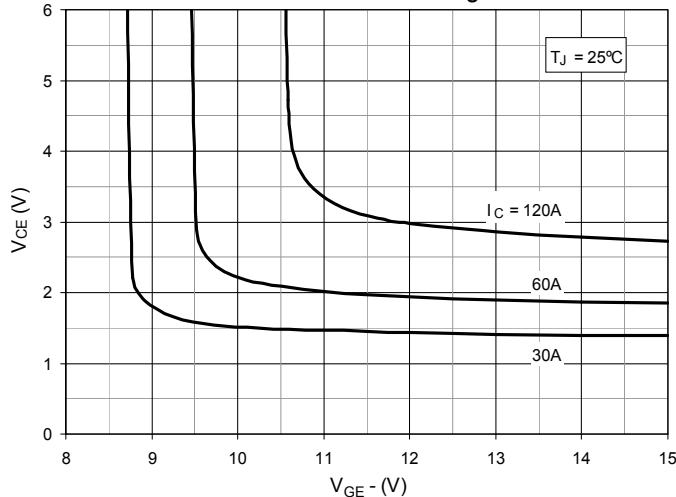
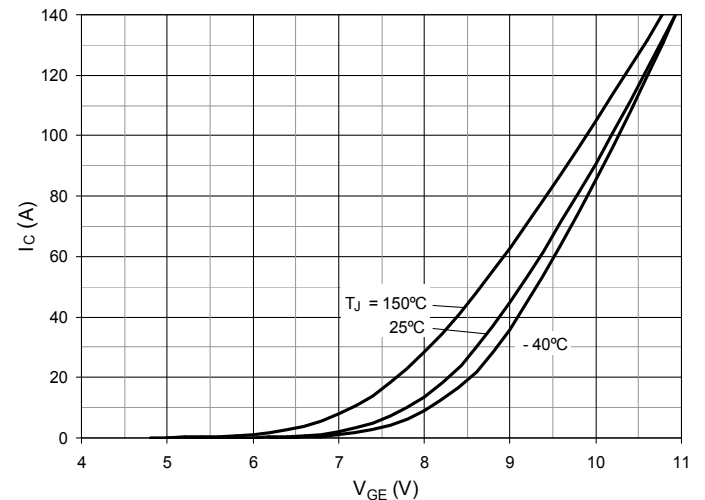
## TO-247 (IXYH) Outline



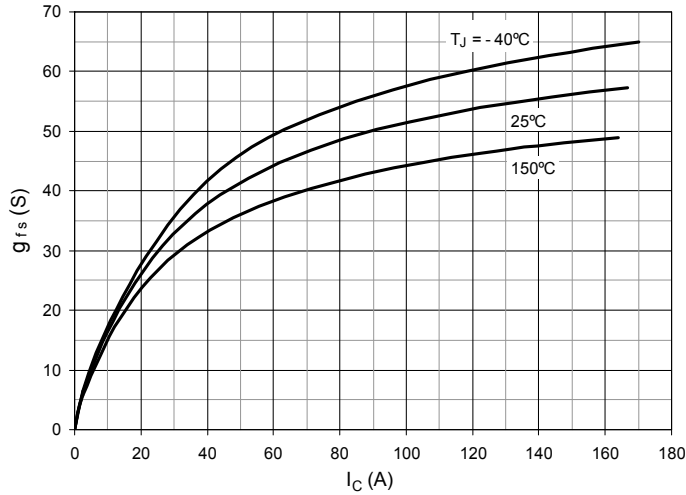
| Dim. | Millimeter |       | Inches    |       |
|------|------------|-------|-----------|-------|
|      | min        | max   | min       | max   |
| A    | 4.70       | 5.30  | 0.185     | 0.209 |
| A1   | 2.21       | 2.59  | 0.087     | 0.102 |
| A2   | 1.50       | 2.49  | 0.059     | 0.098 |
| b    | 0.99       | 1.40  | 0.039     | 0.055 |
| b2   | 1.65       | 2.39  | 0.065     | 0.094 |
| b4   | 2.59       | 3.43  | 0.102     | 0.135 |
| c    | 0.38       | 0.89  | 0.015     | 0.035 |
| D    | 20.79      | 21.45 | 0.819     | 0.845 |
| D1   | 13.07      | -     | 0.515     | -     |
| D2   | 0.51       | 1.35  | 0.020     | 0.053 |
| E    | 15.48      | 16.24 | 0.610     | 0.640 |
| E1   | 13.45      | -     | 0.53      | -     |
| E2   | 4.31       | 5.48  | 0.170     | 0.216 |
| e    | 5.45 BSC   |       | 0.215 BSC |       |
| L    | 19.80      | 20.30 | 0.078     | 0.800 |
| L1   | -          | 4.49  | -         | 0.177 |
| Ø P  | 3.55       | 3.65  | 0.140     | 0.144 |
| Ø P1 | -          | 7.39  | -         | 0.290 |
| Q    | 5.38       | 6.19  | 0.212     | 0.244 |
| S    | 6.14 BSC   |       | 0.242 BSC |       |

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

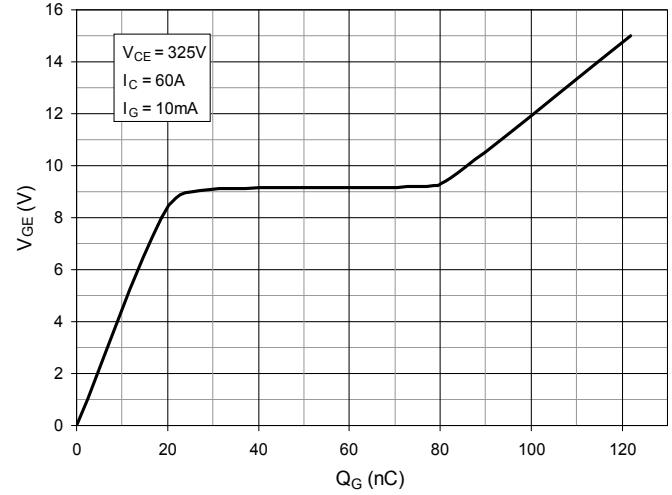
|                                                                                  |           |           |           |           |              |              |              |              |              |             |
|----------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|--------------|--------------|--------------|--------------|--------------|-------------|
| 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 @  $T_J = 150^\circ\text{C}$** 

**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**


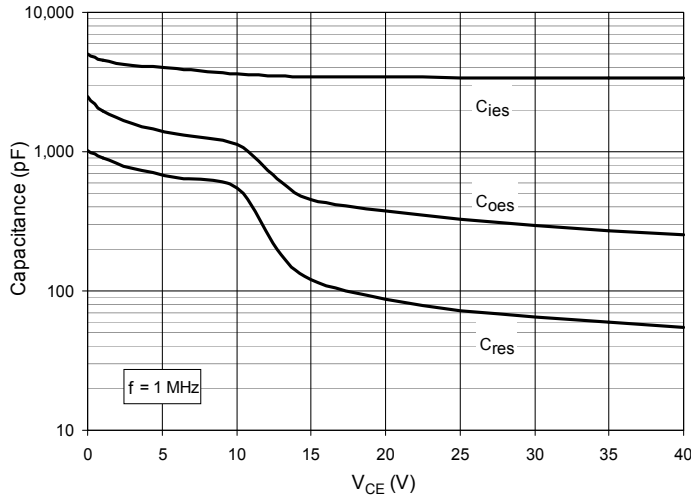
**Fig. 7. Transconductance**



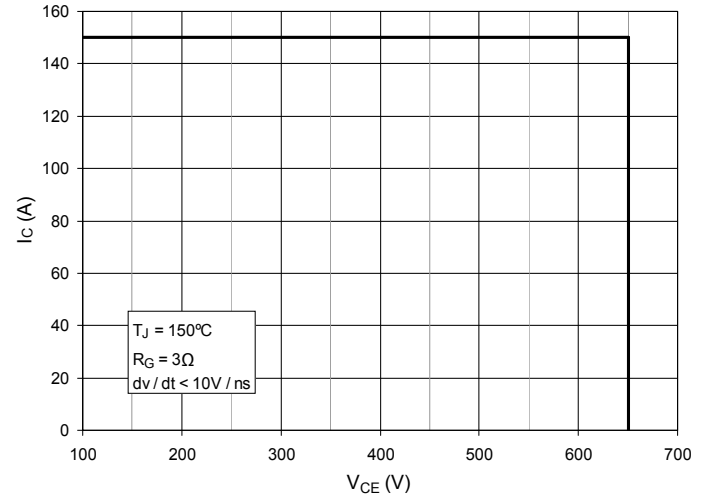
**Fig. 8. Gate Charge**



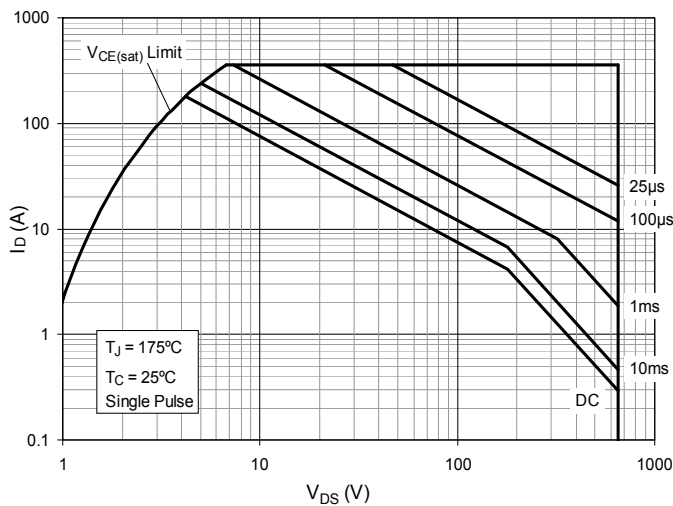
**Fig. 9. Capacitance**



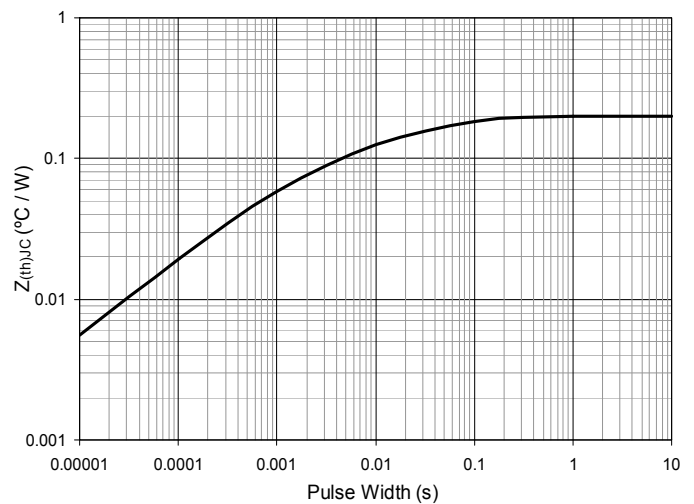
**Fig. 10. Reverse-Bias Safe Operating Area**

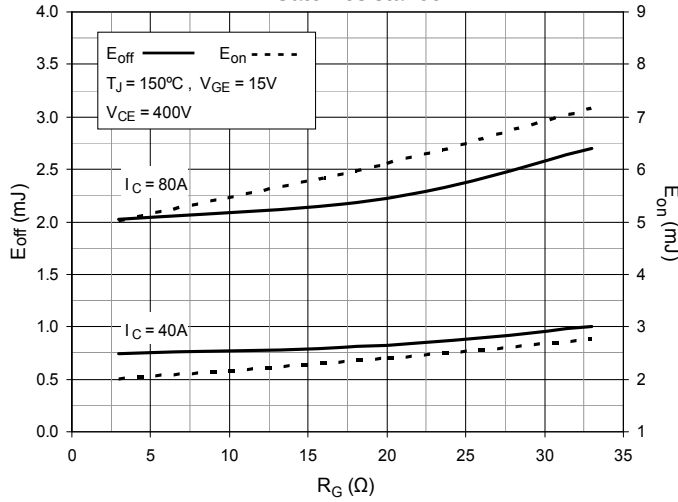
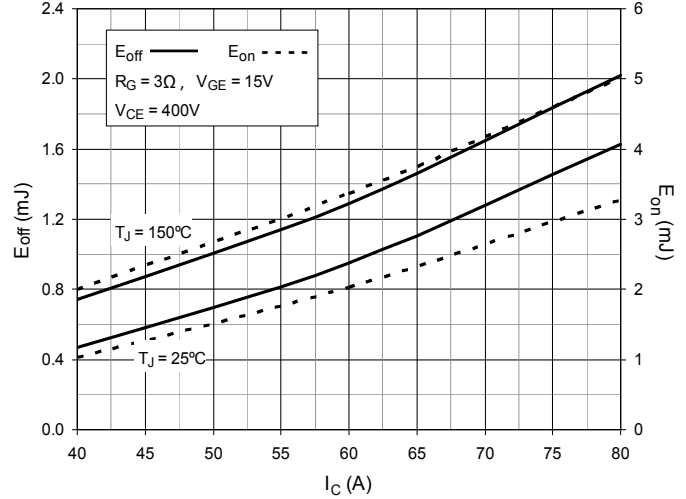
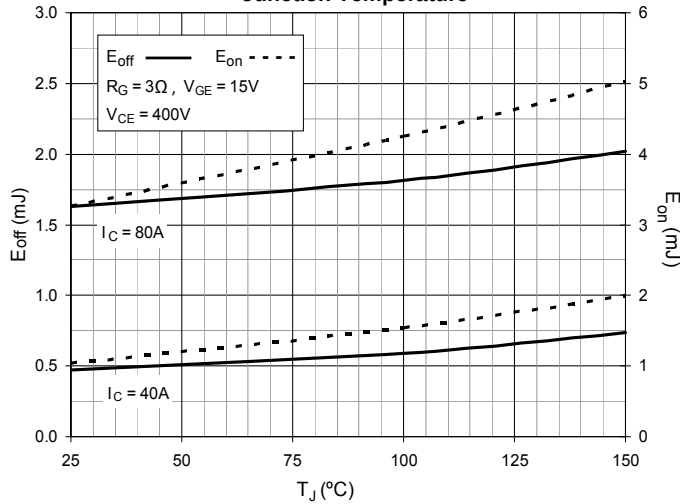
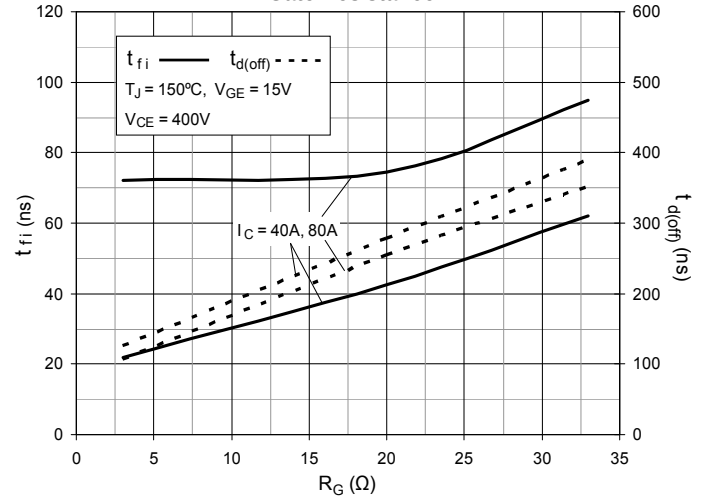
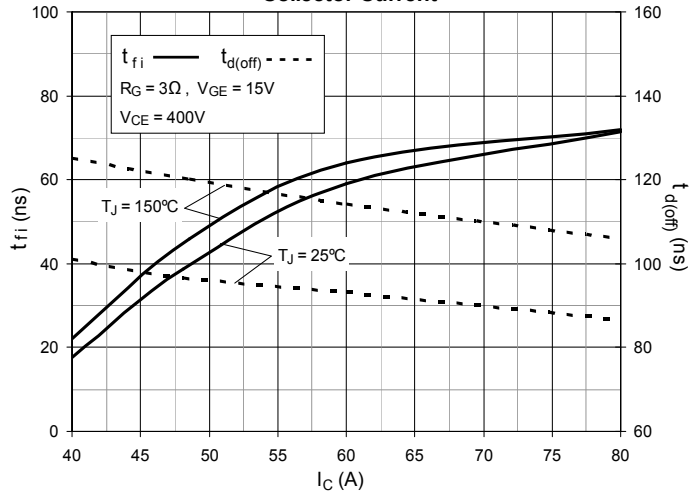
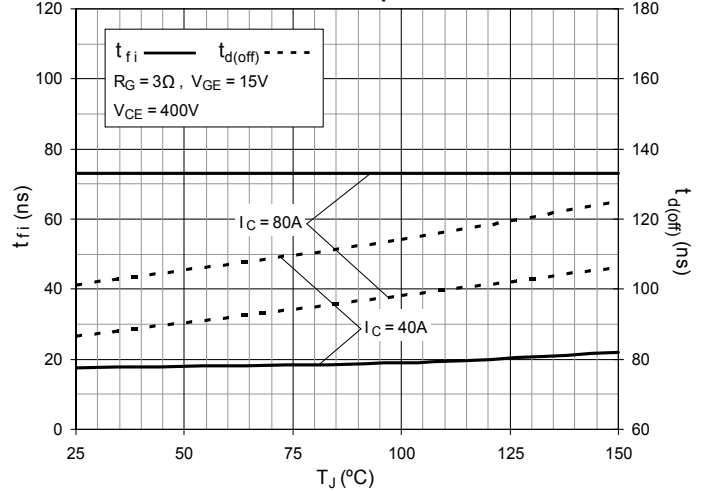


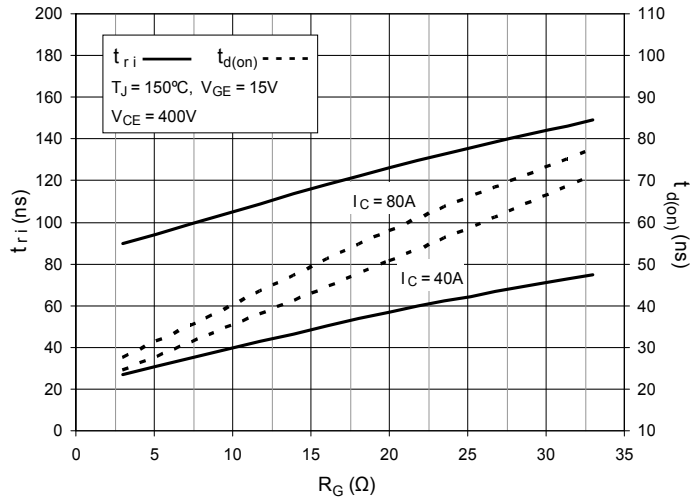
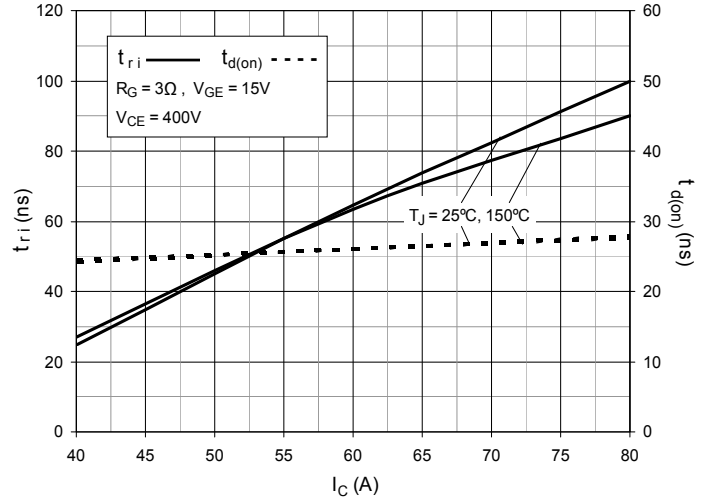
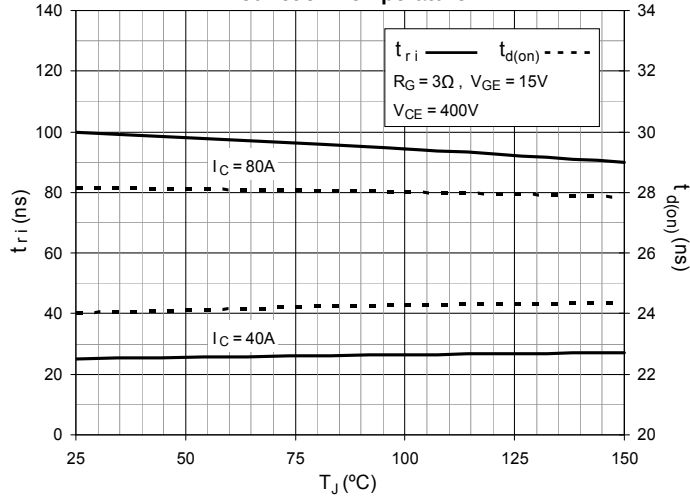
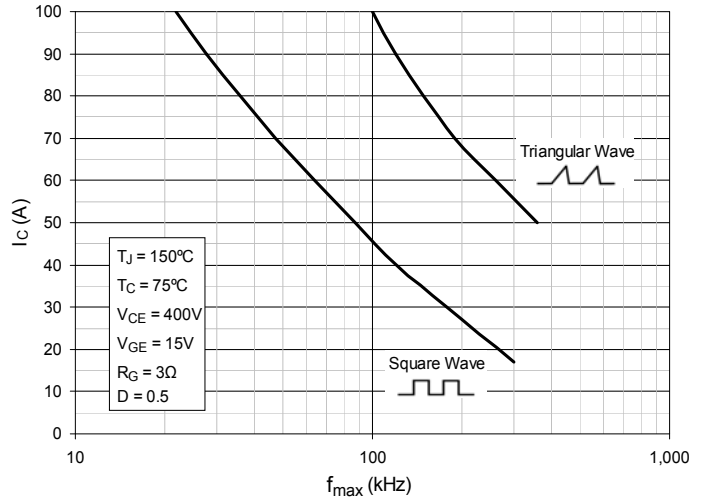
**Fig. 11. Forward-Bias Safe Operating Area**

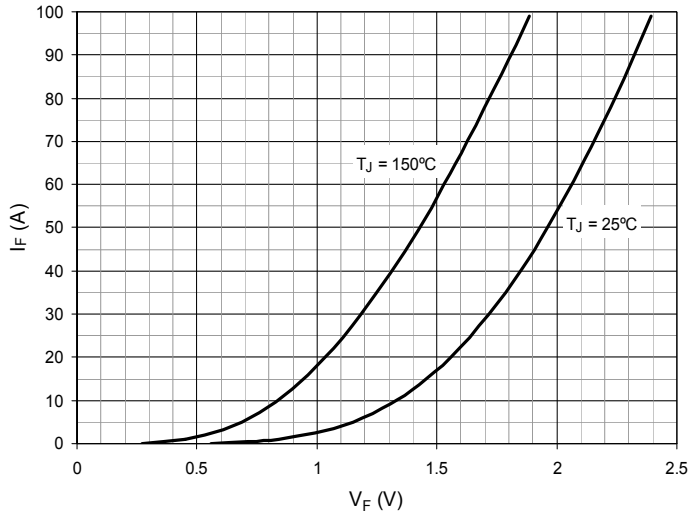
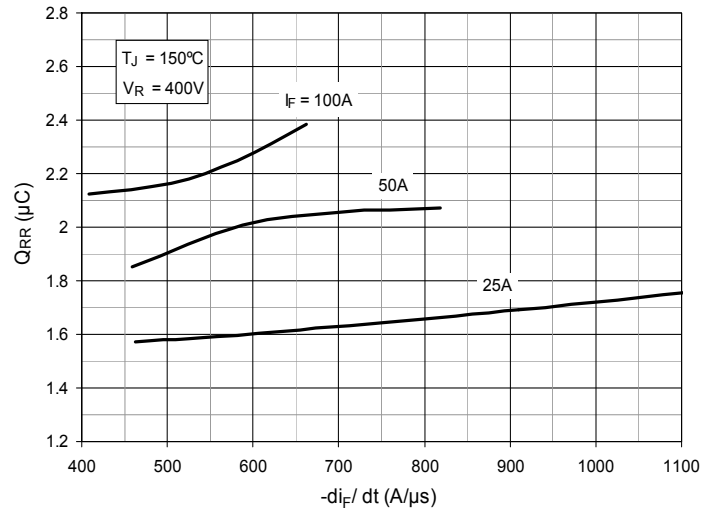
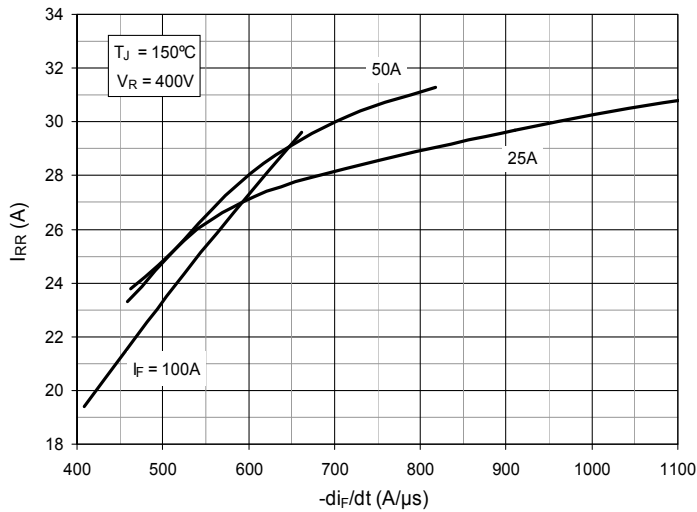
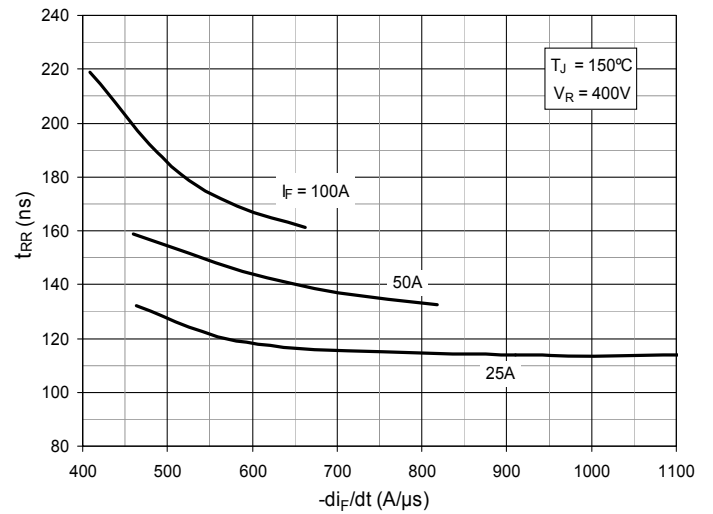
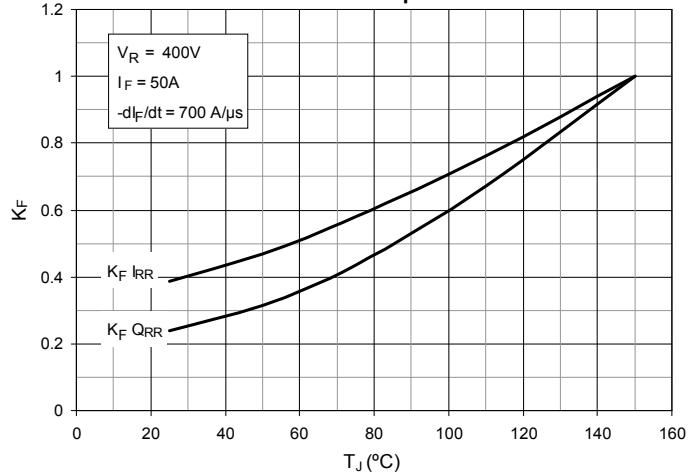
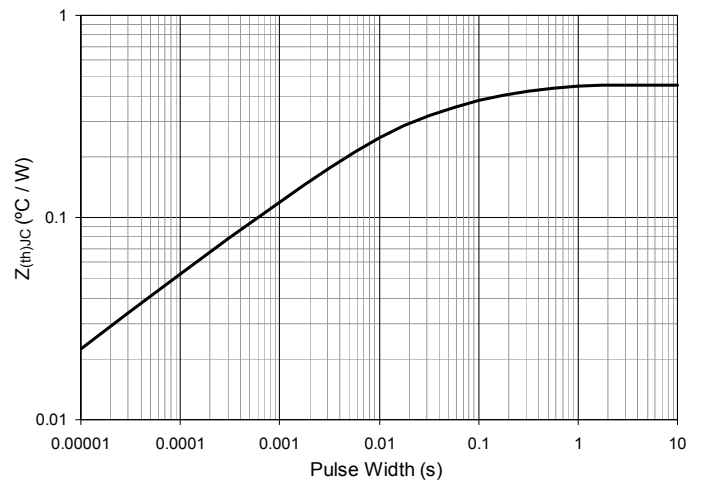


**Fig. 12. Maximum Transient Thermal Impedance (IGBT)**



**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. Maximum Peak Load Current vs. Frequency**


**Fig. 23. Diode Forward Characteristics**

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

**Fig. 25. Reverse Recovery Current vs.  $-di_F/dt$** 

**Fig. 26. Reverse Recovery Time vs.  $-di_F/dt$** 

**Fig. 27. Dynamic Parameters  $Q_{RR}$ ,  $I_{RR}$  vs. Junction Temperature**

**Fig. 28. Maximum Transient Thermal Impedance (Diode)**


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