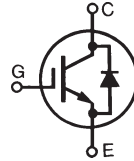


**XPT™ 650V IGBT
GenX4™ w/Diode**
IXXH40N65C4D1

 Extreme Light Punch Through
IGBT for 5-20 kHz Switching


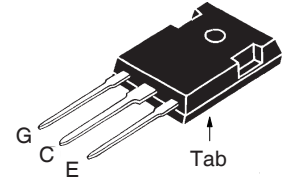
$$V_{CES} = 650V$$

$$I_{C110} = 40A$$

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

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

| 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 | ± 20 | V |
| V_{GEM} | Transient | ± 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 |
| SSOA (RBSOA) | $V_{GE} = 15V$, $T_{VJ} = 150^\circ C$, $R_G = 5\Omega$ Clamped Inductive Load | $I_{CM} = 80$ @ $V_{CE} \leq V_{CES}$ | A |
| t_{sc} (SCSOA) | $V_{GE} = 15V$, $V_{CE} = 360V$, $T_J = 150^\circ C$ $R_G = 82\Omega$, Non Repetitive | 10 | μs |
| 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 |
| Weight | | 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 ($T_J = 25^\circ C$, 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} | $V_{CE} = V_{CES}$, $V_{GE} = 0V$ $T_J = 150^\circ C$ | | | 25 μA 1.5 mA |
| I_{GES} | $V_{CE} = 0V$, $V_{GE} = \pm 20V$ | | | ± 100 nA |
| $V_{CE(sat)}$ | $I_C = 40A$, $V_{GE} = 15V$, Note 1 $T_J = 150^\circ C$ | | 1.90 2.24 | V V |

| Symbol | Test Conditions ($T_J = 25^\circ\text{C}$ 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 |
| $t_{d(on)}$ | Inductive load, $T_J = 25^\circ\text{C}$ $I_C = 40\text{A}, V_{GE} = 15\text{V}$ $V_{CE} = 400\text{V}, R_G = 5\Omega$ 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 |
| $t_{d(on)}$ | Inductive load, $T_J = 150^\circ\text{C}$ $I_C = 40\text{A}, V_{GE} = 15\text{V}$ $V_{CE} = 400\text{V}, R_G = 5\Omega$ 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 ($T_J = 25^\circ\text{C}$ Unless Otherwise Specified) | Characteristic Values | | |
|------------|--|-----------------------|------|-------------------------|
| | | Min. | Typ. | Max. |
| V_F | $I_F = 30\text{A}, V_{GE} = 0\text{V}$, Note 1 $T_J = 150^\circ\text{C}$ | | 1.3 | 2.6 V |
| I_{RM} | $I_F = 30\text{A}, V_{GE} = 0\text{V}, T_J = 150^\circ\text{C}$ $-di_F/dt = 500\text{A}/\mu\text{s}, V_R = 400\text{V}$ | | 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 .

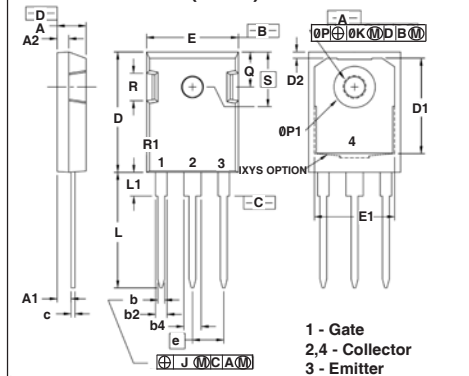
ADVANCE TECHNICAL INFORMATION

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 | |

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 | |

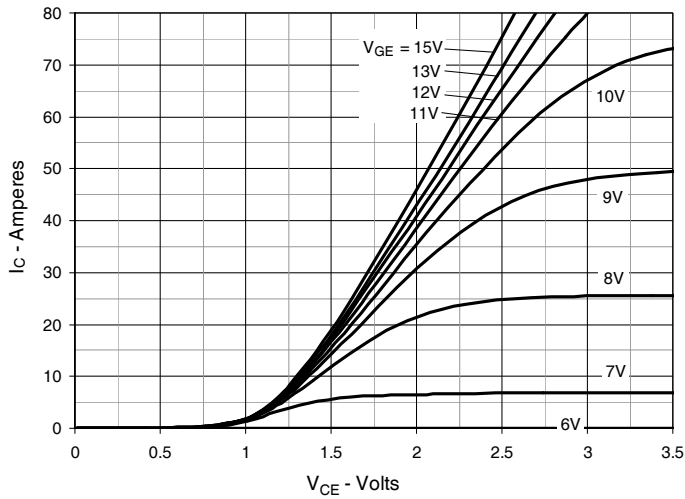
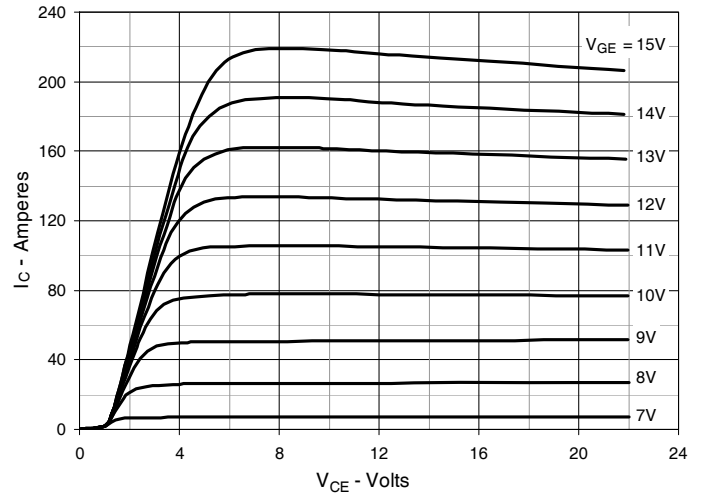
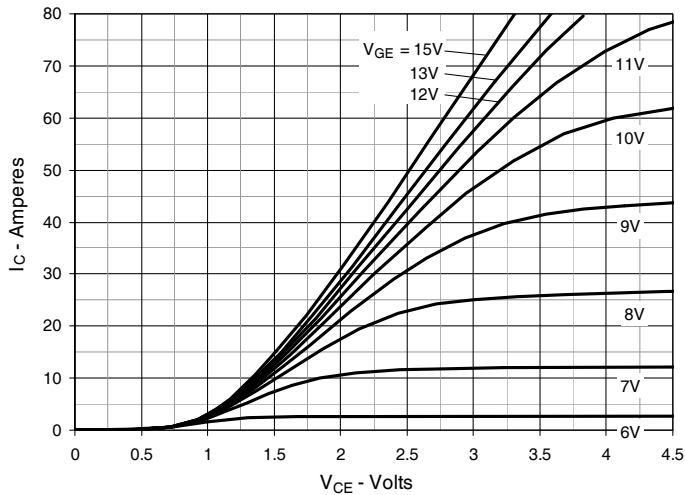
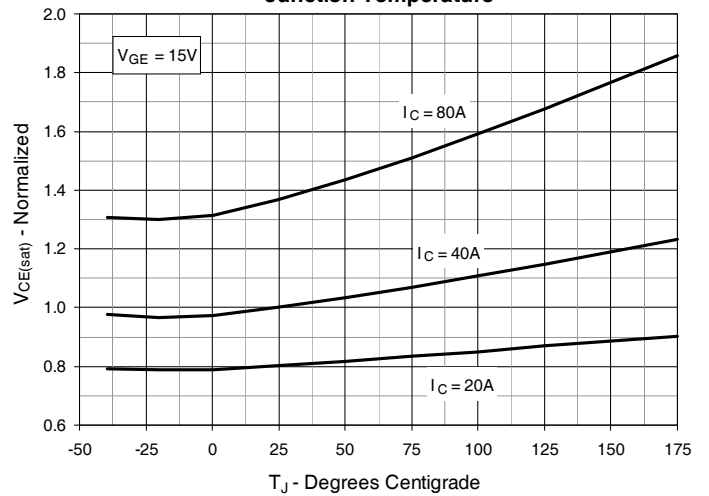
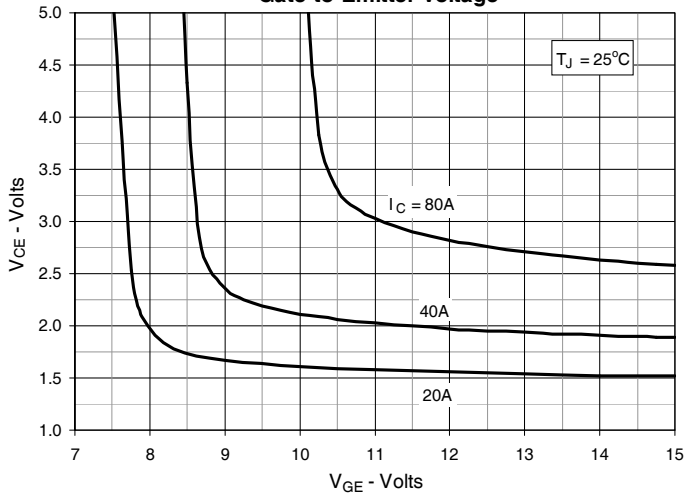
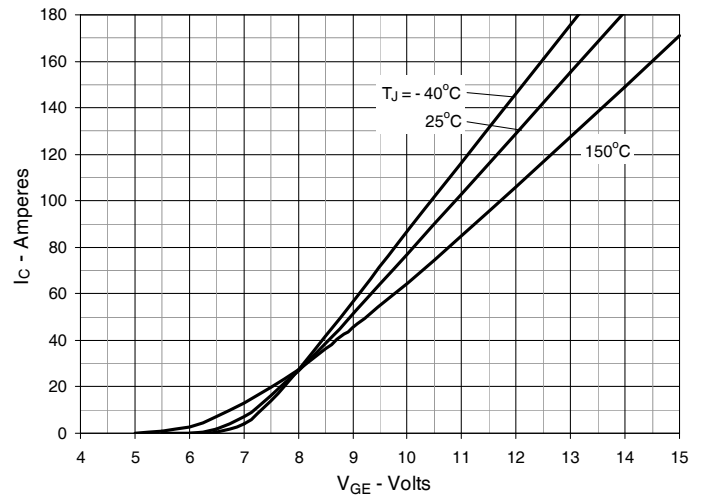
Fig. 1. Output Characteristics @ $T_J = 25^\circ\text{C}$

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


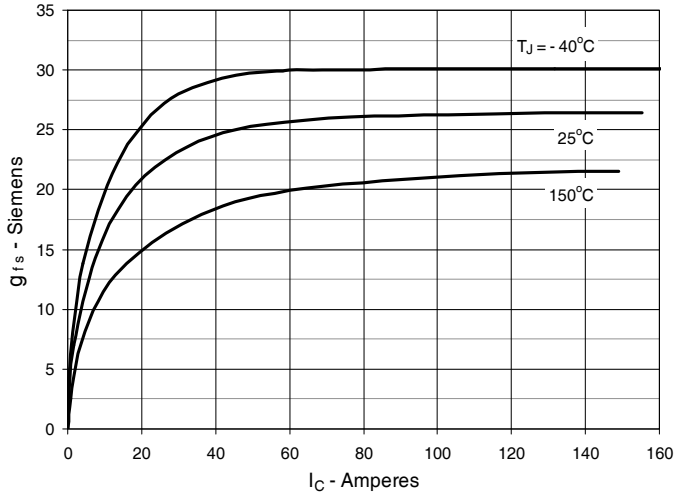
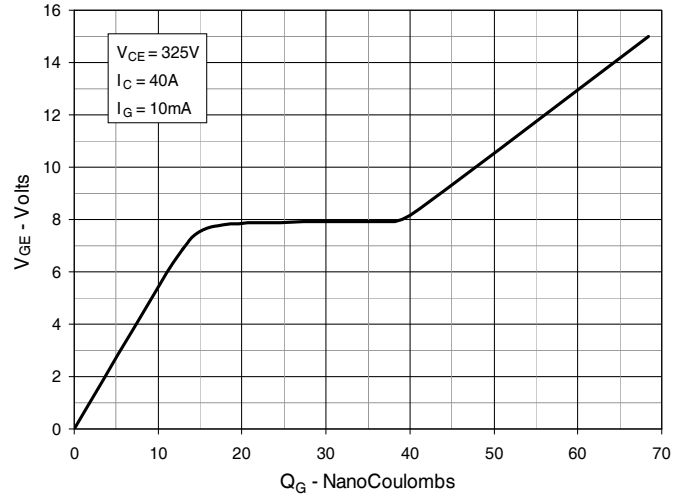
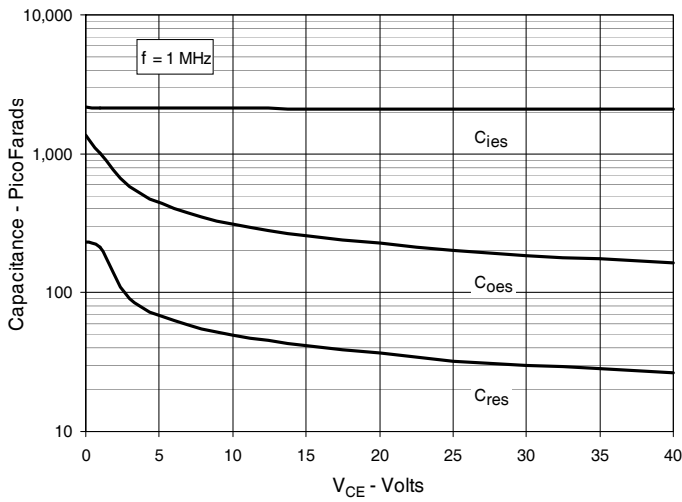
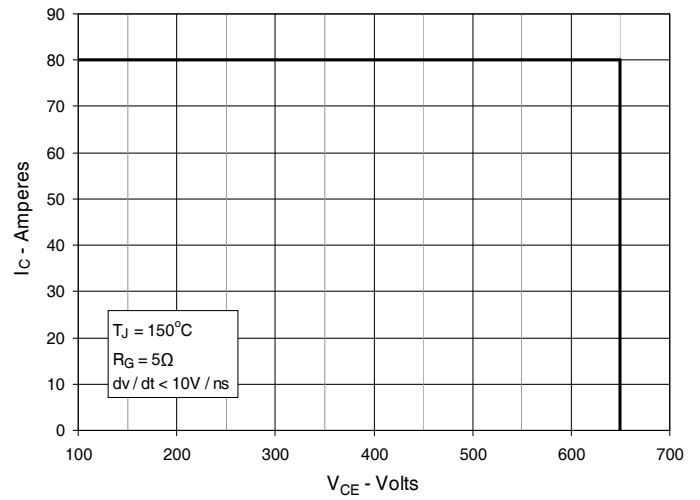
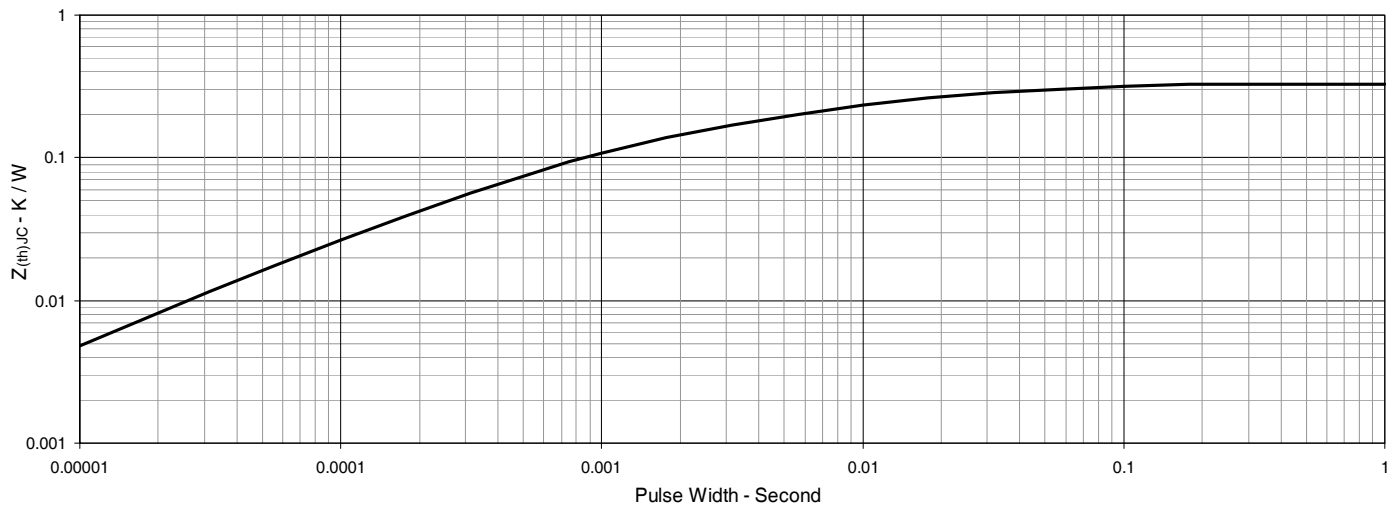
Fig. 7. Transconductance

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

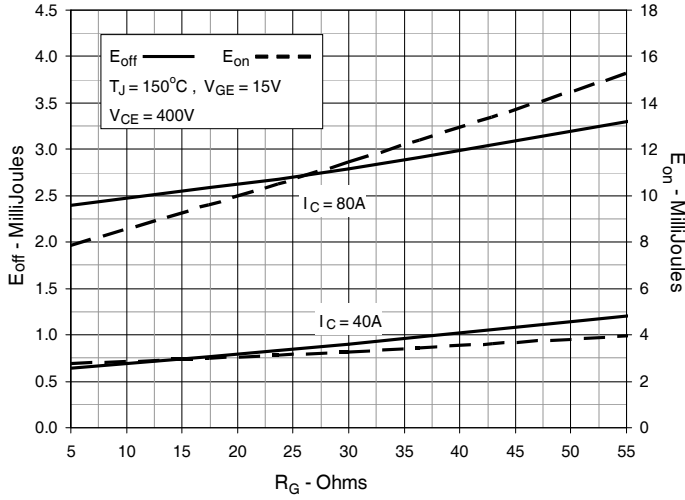


Fig. 13. Inductive Switching Energy Loss vs. Collector Current

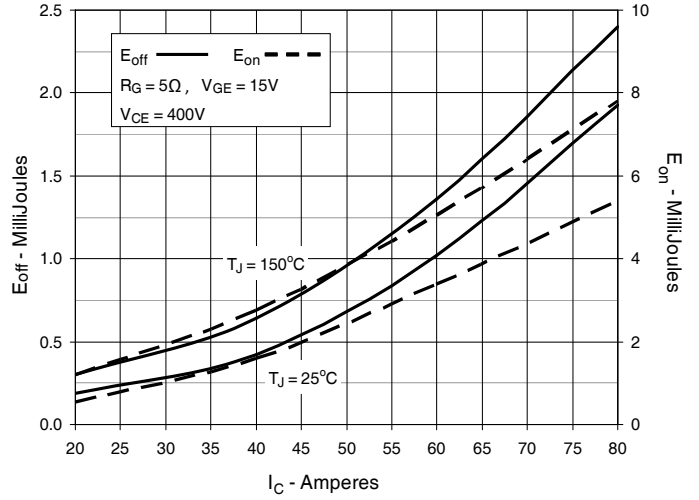


Fig. 14. Inductive Switching Energy Loss vs. Junction Temperature

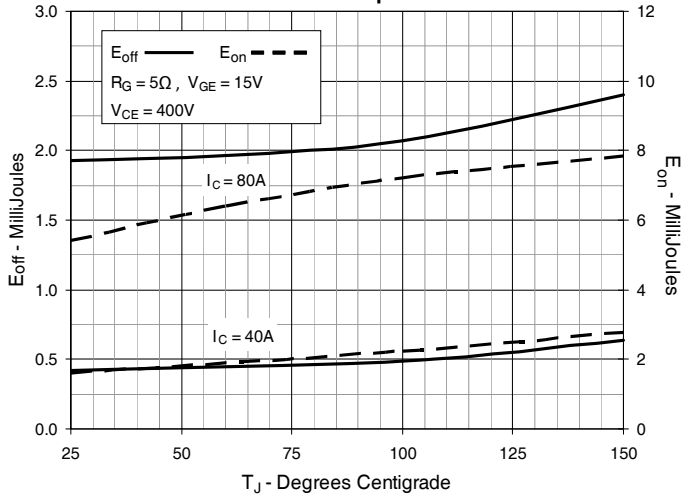


Fig. 15. Inductive Turn-off Switching Times vs. Gate Resistance

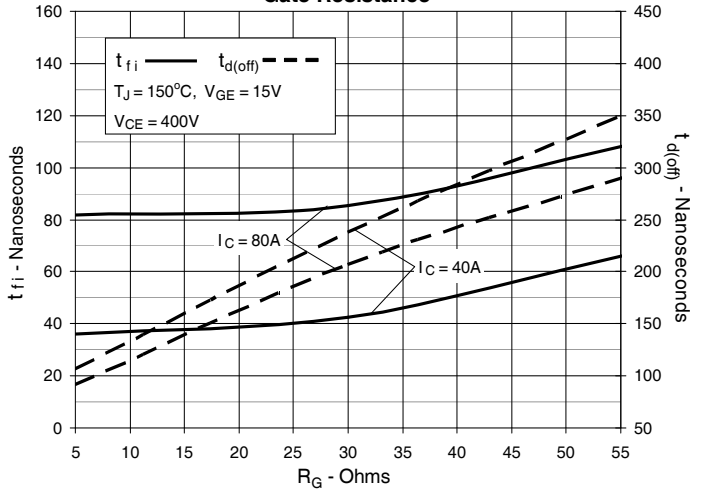


Fig. 16. Inductive Turn-off Switching Times vs. Collector Current

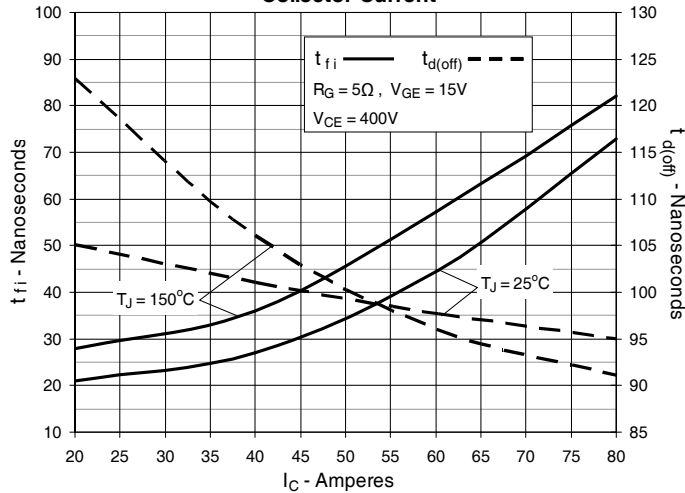


Fig. 17. Inductive Turn-off Switching Times vs. Junction Temperature

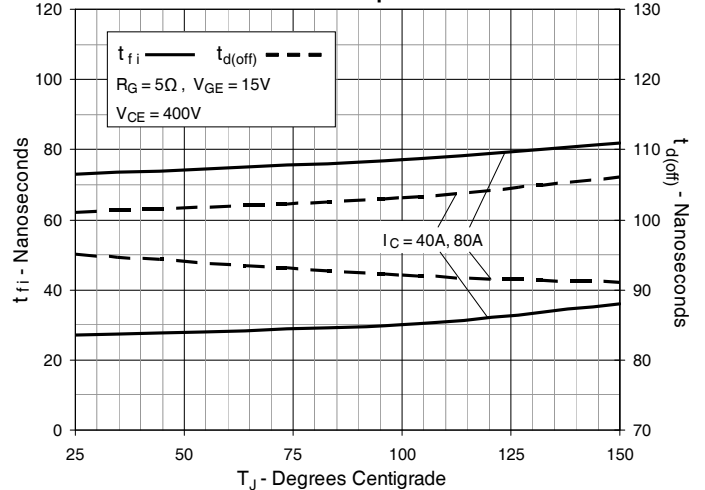


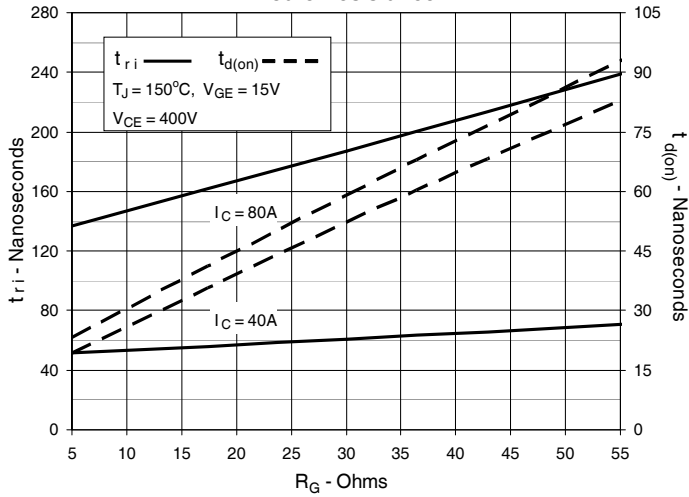
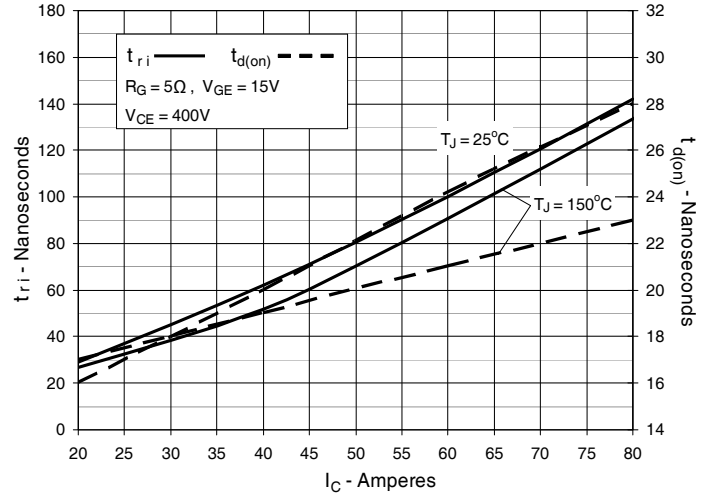
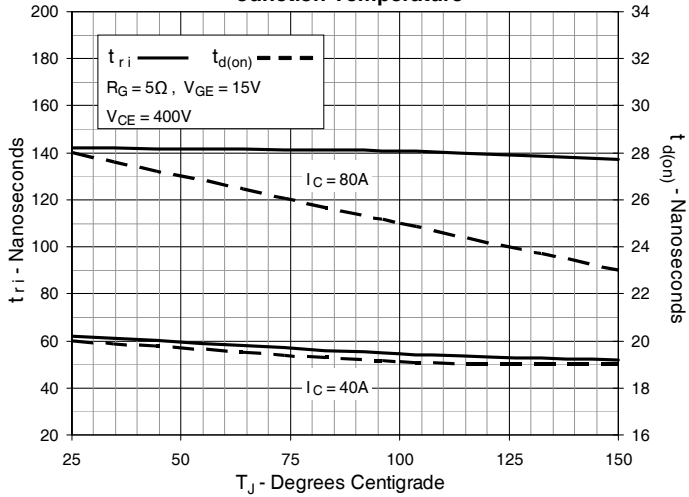
Fig. 18. Inductive Turn-on Switching Times vs. Gate Resistance

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

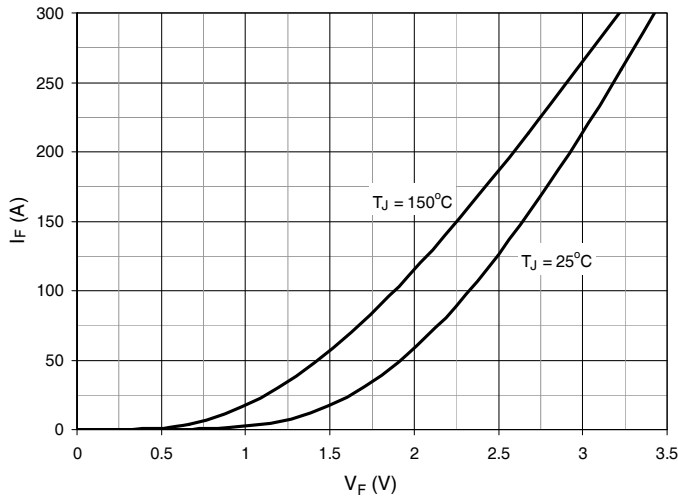


Fig. 22. Reverse Recovery Charge vs. $-di_F/dt$

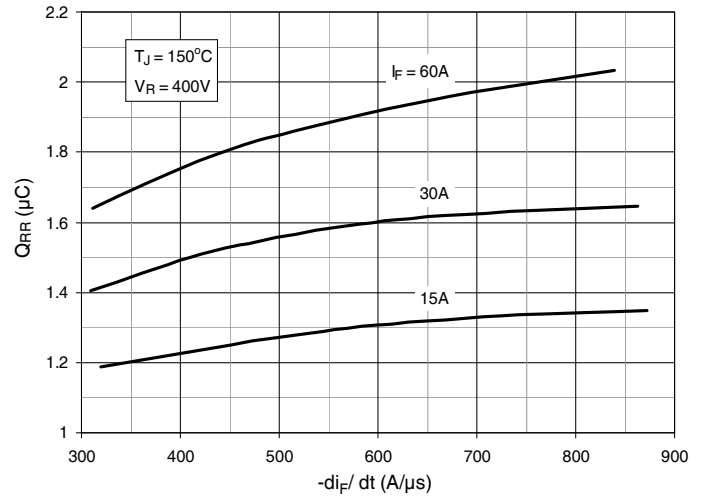


Fig. 23. Reverse Recovery Current vs. $-di_F/dt$

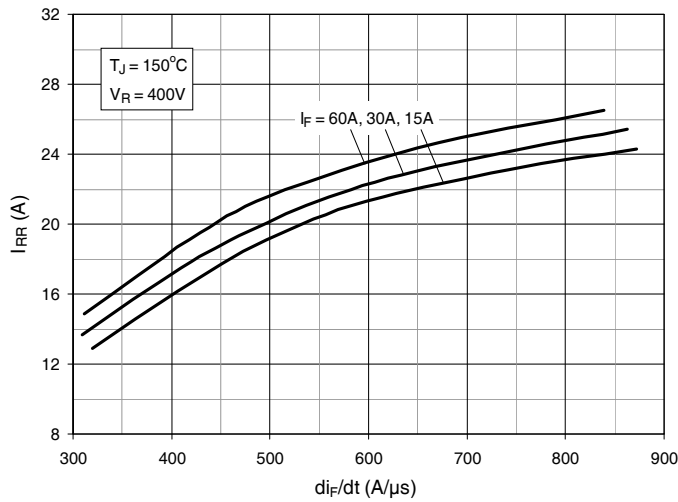


Fig. 24. Reverse Recovery Time vs. $-di_F/dt$

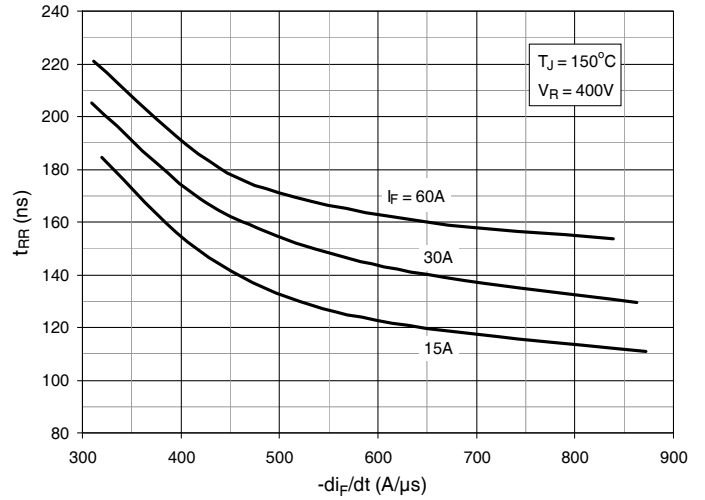


Fig. 25. Dynamic Parameters Q_{RR} , I_{RR} vs. Junction Temperature

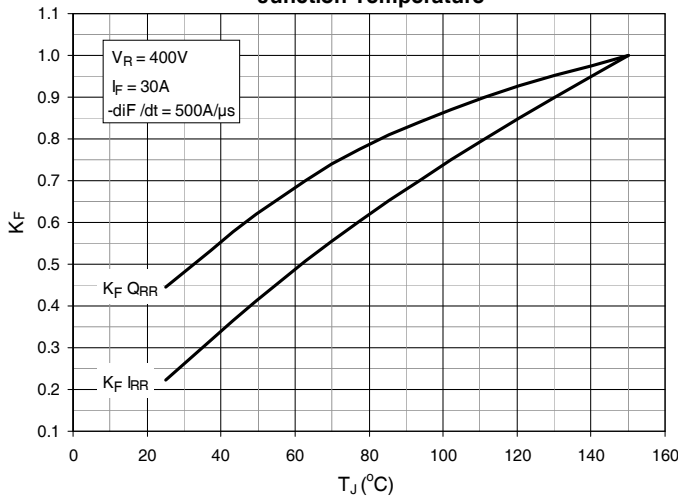
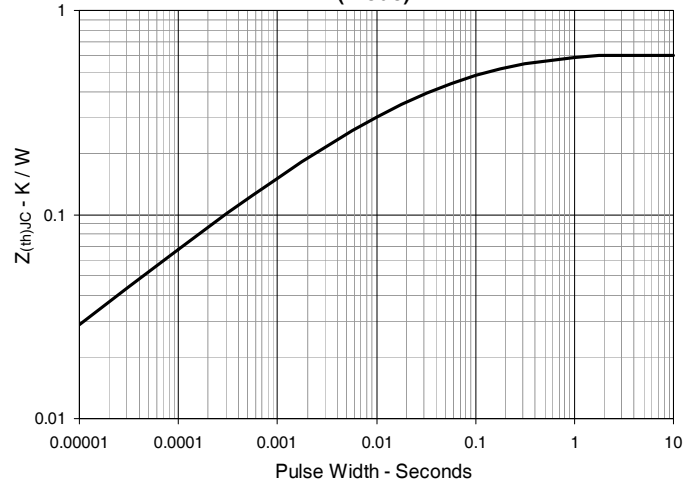


Fig. 26. Maximum Transient Thermal Impedance (Diode)





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