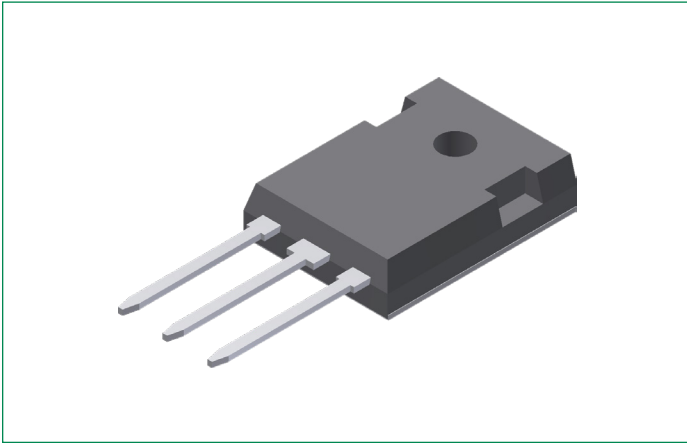


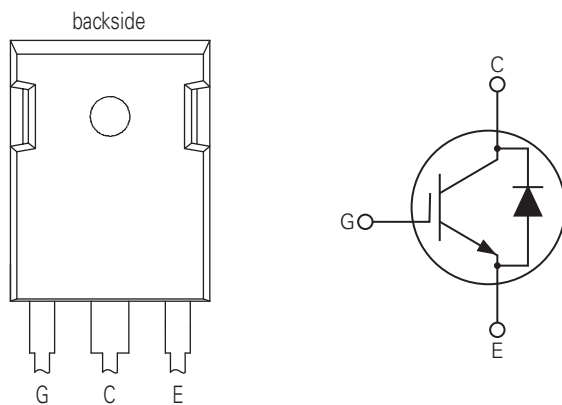
IXYH40N120C4H1

1200 V, 40 A XPT™ Gen4 IGBT with Sonic Diode

High Speed Through IGBT for 20–50 kHz Switching



Pinout Diagram (TO-247-3L)



G: Gate; **C:** Collector; **E:** Emitter; **backside:** Collector

Description:

Developed using our proprietary XPT™ thin-wafer technology and state-of-the-art Trench IGBT process, these devices feature reduced thermal resistance, low energy losses, fast switching, low tail current, and high current densities.

Features & Benefits:

- Optimized for Low Switching Loss
- Positive Thermal Coefficient of $V_{CE(sat)}$
- International Standard Package
- High Current Handling Capability
- High Power Density
- Low Gate Drive Requirement
- Anti-Parallel Sonic Diode

Applications:

- Power Inverters
- UPS
- Motor Drives
- SMPS
- PFC Circuits
- Battery Chargers
- Welding Machines

Product Summary

| Characteristic | Value | Unit |
|----------------|-------|------|
| V_{CES} | 1200 | V |
| I_{C110} | 40 | A |
| $V_{CE(sat)}$ | 2.50 | V |
| $t_{fi(typ)}$ | 80 | ns |

Maximum Ratings

| Symbol | Characteristic | Conditions | Value | Unit |
|-----------------|---|--|------------|------------------|
| V_{CES} | Collector-Emitter Voltage | $T_J = 25^\circ\text{C}$ to 175°C | 1200 | V |
| V_{GES} | Gate-Emitter Voltage | Continuous | ± 20 | V |
| V_{GEM} | Transient Gate-Emitter Voltage | Transient | ± 30 | V |
| I_{C25} | Continuous Collector Current | $T_C = 25^\circ\text{C}$ | 110 | A |
| I_{C110} | Continuous Collector Current | $T_C = 110^\circ\text{C}$ | 40 | A |
| I_{F110} | Diode Forward Current | $T_C = 110^\circ\text{C}$ | 32 | A |
| I_{CM} | Pulsed Collector Current | $T_C = 25^\circ\text{C}$, 1 ms | 230 | A |
| SSOA (RBSOA) | Switching Safe Operating Area (Reverse Biased Safe Operating Area) | $V_{GE} = 15\text{ V}$, $T_{VJ} = 150^\circ\text{C}$, $R_G = 5\ \Omega$, Clamped Inductive Load, $I_{CM} = V_{CE} \leq 0.8 \times V_{CES}$ | 80 | A |
| P_C | Collector Power Dissipation | $T_C = 25^\circ\text{C}$ | 680 | W |
| T_J | Junction Temperature | – | -55 to 175 | $^\circ\text{C}$ |
| T_{JM} | Maximum Junction Temperature | – | 175 | $^\circ\text{C}$ |
| T_{stg} | Storage Temperature | – | -55 to 175 | $^\circ\text{C}$ |
| T_L | Lead Temperature for Soldering | 1.6 mm (0.062 in.) from Case for 10 s | 300 | $^\circ\text{C}$ |
| M_d | Mounting Torque | – | 1.13 / 10 | Nm/lb.in |
| W | Weight | – | 6 | g |

Thermal Characteristics

| Symbol | Characteristic | Value | | | Unit |
|--------------|---------------------------------------|-------|------|------|---------------------------|
| | | Min. | Typ. | Max. | |
| $R_{th, JC}$ | Thermal Resistance, junction-to-case | – | – | 0.22 | $^\circ\text{C}/\text{W}$ |
| $R_{th, CS}$ | Thermal Resistance, case-to-heat sink | – | 0.21 | – | $^\circ\text{C}/\text{W}$ |

Electrical Characteristics – Static ($T_J = 25^\circ\text{C}$ unless otherwise specified)

| Symbol | Characteristic | Conditions | Value | | | Unit |
|---------------|---|--|-------|------|-----------|---------------|
| | | | Min. | Typ. | Max. | |
| BV_{CES} | Collector-Emitter Breakdown Voltage | $I_C = 250\ \mu\text{A}$, $V_{GE} = 0\text{ V}$ | 1200 | – | – | V |
| $V_{GE(th)}$ | Gate-Emitter Threshold Voltage | $I_C = 250\ \mu\text{A}$, $V_{CE} = V_{GE}$ | 4.0 | – | 6.5 | V |
| I_{GES} | Gate-Emitter Leakage Current | $V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$ | – | – | ± 100 | nA |
| I_{CES} | Zero Gate Voltage Collector Current | $V_{CE} = V_{CES}$, $V_{GE} = 0\text{ V}$ | – | – | 50 | μA |
| | | $V_{CE} = V_{CES}$, $V_{GE} = 0\text{ V}$, $T_J = 150^\circ\text{C}$ | – | – | 5 | mA |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage ¹ | $I_C = 32\text{ A}$, $V_{GE} = 15\text{ V}$ | – | 2.05 | 2.50 | V |
| | | $I_C = 32\text{ A}$, $V_{GE} = 15\text{ V}$, $T_J = 150^\circ\text{C}$ | – | 2.50 | – | V |

Note 1: Pulse test, $t \leq 300\ \mu\text{s}$, duty cycle, $d \leq 2\%$

Electrical Characteristics – Dynamic ($T_J = 25^\circ\text{C}$ unless otherwise specified)

| Symbol | Characteristic | Conditions | Value | | | Unit | |
|--------------|----------------------------------|--|---------------------------|------|------|------|----|
| | | | Min. | Typ. | Max. | | |
| g_{fs} | Transconductance ¹ | $I_C = 32\text{ A}, V_{CE} = 10\text{ V}$ | 13 | 22 | – | S | |
| C_{ies} | Input Capacitance | $V_{GE} = 0\text{ V}, V_{CE} = 25\text{ V}, f = 1\text{ MHz}$ | – | 1665 | – | pF | |
| C_{oes} | Output Capacitance | | – | 170 | – | | |
| C_{res} | Reverse Transfer Capacitance | | – | 63 | – | | |
| $Q_{g(on)}$ | Total Gate Charge | $V_{GE} = 15\text{ V}, V_{CE} = 0.5 \times V_{CES},$ $I_C = 32\text{ A}$ | – | 92 | – | nC | |
| Q_{ge} | Gate-Emitter Charge | | – | 11 | – | | |
| Q_{gc} | Gate-Collector Charge | | – | 37 | – | | |
| $t_{d(on)}$ | Turn-on Delay Time ² | Inductive Load, $V_{GE} = 15\text{ V},$ $V_{CE} = 0.8 \times V_{CES},$ $I_C = 32\text{ A},$ $R_{G(ext)} = 5\ \Omega$ | $T_J = 25^\circ\text{C}$ | – | 21 | – | ns |
| | | | $T_J = 150^\circ\text{C}$ | – | 18 | – | |
| t_{ri} | Turn-on Rise Time ² | | $T_J = 25^\circ\text{C}$ | – | 55 | – | ns |
| | | | $T_J = 150^\circ\text{C}$ | – | 45 | – | |
| E_{on} | Turn-on Energy ² | | $T_J = 25^\circ\text{C}$ | – | 5.55 | – | mJ |
| | | | $T_J = 150^\circ\text{C}$ | – | 7.80 | – | |
| $t_{d(off)}$ | Turn-off Delay Time ² | | $T_J = 25^\circ\text{C}$ | – | 140 | – | ns |
| | | | $T_J = 150^\circ\text{C}$ | – | 190 | – | |
| t_{fi} | Turn-off Fall Time ² | | $T_J = 25^\circ\text{C}$ | – | 80 | – | ns |
| | | | $T_J = 150^\circ\text{C}$ | – | 80 | – | |
| E_{off} | Turn-off Energy ² | $T_J = 25^\circ\text{C}$ | – | 1.55 | – | mJ | |
| | | $T_J = 150^\circ\text{C}$ | – | 2.65 | – | | |

Note 1: Pulse test, $t \leq 300\ \mu\text{s}$, duty cycle, $d \leq 2\%$

Note 2: Switching times and energy losses may increase for higher $V_{CE(clamp)}$, T_J , or R_G .

Reverse Sonic Diode (FRD) ($T_J = 25^\circ\text{C}$ unless otherwise specified)

| Symbol | Characteristic | Conditions | Value | | | Unit |
|--------------|--------------------------------------|---|-------|------|------|---------------------------|
| | | | Min. | Typ. | Max. | |
| V_F | Diode Forward Voltage ¹ | $I_F = 32\text{ A}, V_{GE} = 0\text{ V}$ | – | 2.30 | 2.80 | V |
| | | $I_F = 32\text{ A}, V_{GE} = 0\text{ V}, T_J = 125^\circ\text{C}$ | – | 2.80 | – | |
| I_{RM} | Reverse Recovery Current | $I_F = 32\text{ A}, V_{GE} = 0\text{ V}, T_J = 125^\circ\text{C}$ | – | 26 | – | A |
| t_{rr} | Reverse Recovery Time | $-di_F/dt = 400\text{ A}/\mu\text{s}, V_R = 600\text{ V}$ | – | 380 | – | ns |
| $R_{th, JC}$ | Thermal Resistance, junction-to-case | – | – | – | 0.35 | $^\circ\text{C}/\text{W}$ |

Note 1: Pulse test, $t \leq 300\ \mu\text{s}$, duty cycle, $d \leq 2\%$

Characteristic Curves

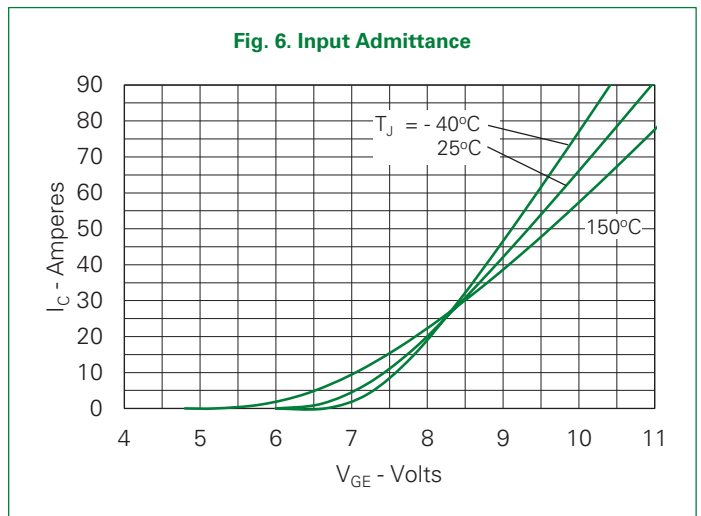
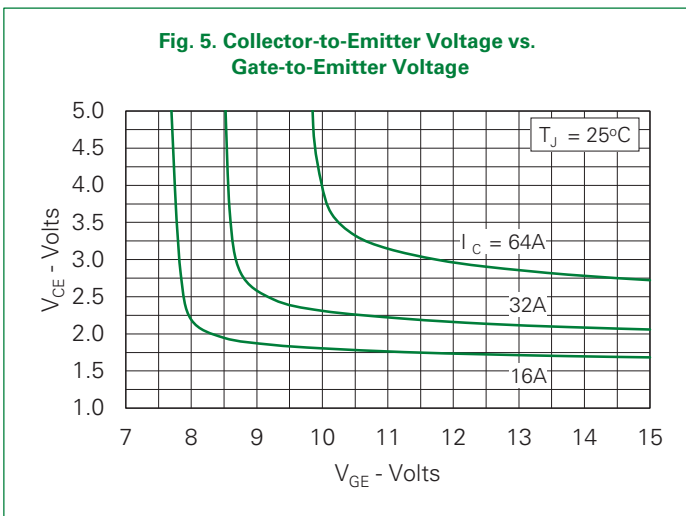
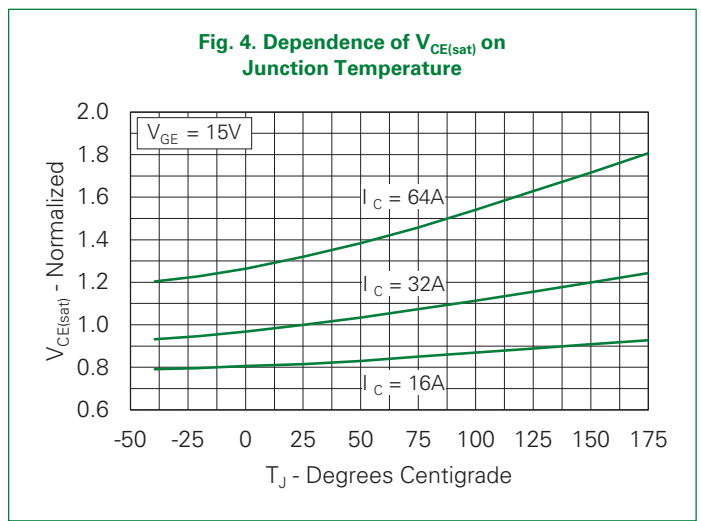
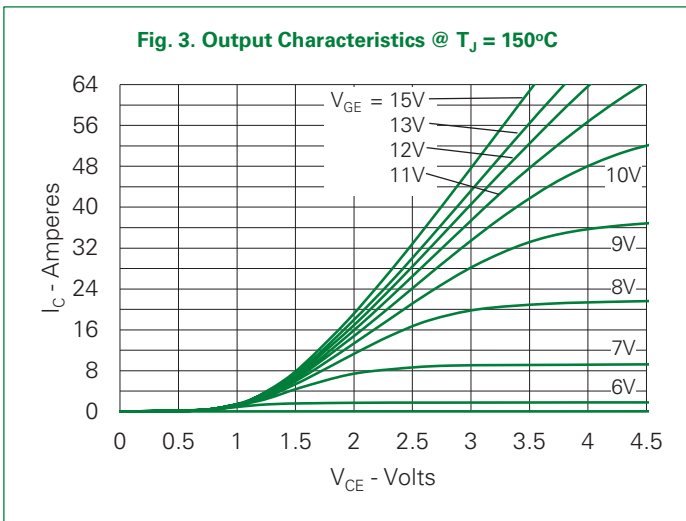
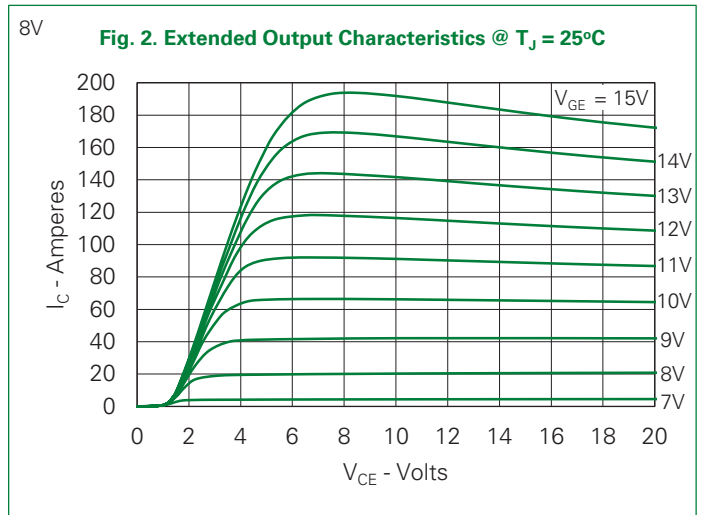
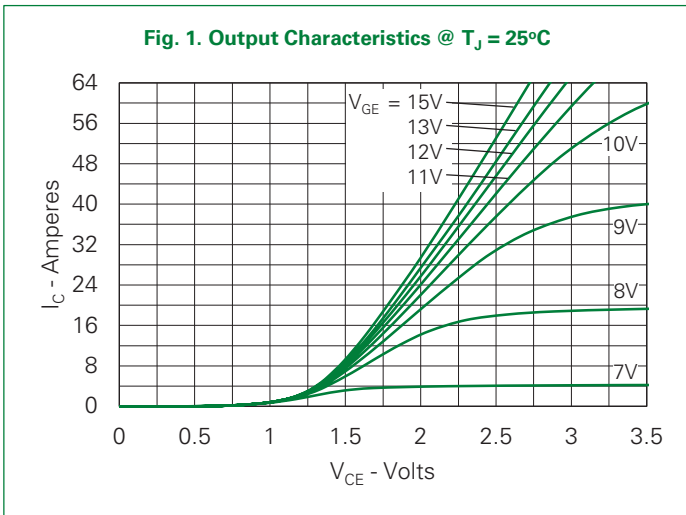


Fig. 7. Transconductance

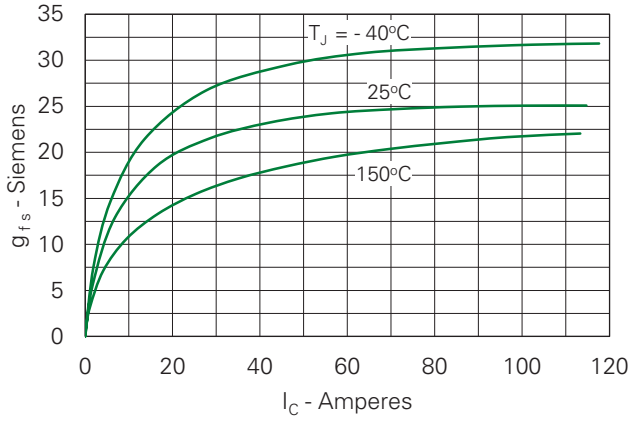


Fig. 8. Gate Charge

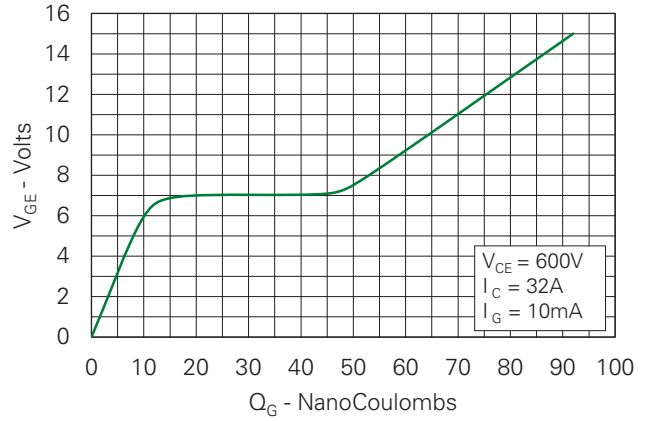


Fig. 9. Capacitance

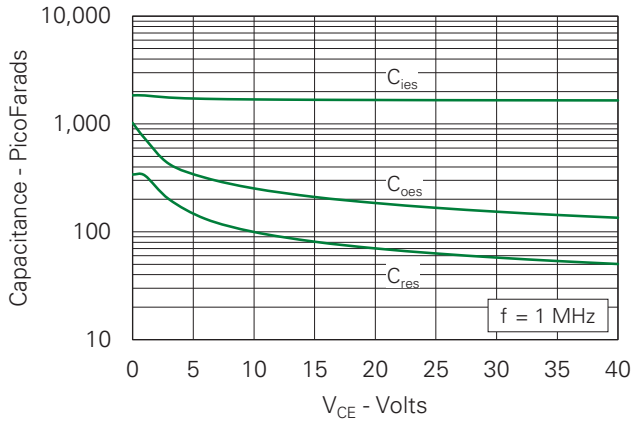


Fig. 10. Reverse-Bias Safe Operating Area

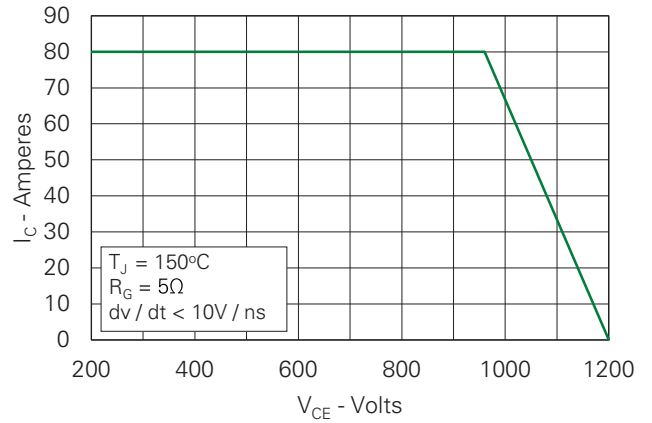


Fig. 11. Maximum Transient Thermal Impedance

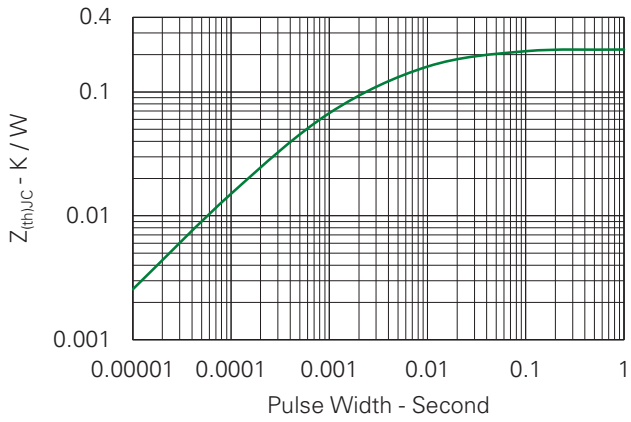


Fig. 12. Inductive Switching Energy Loss vs. Gate Resistance

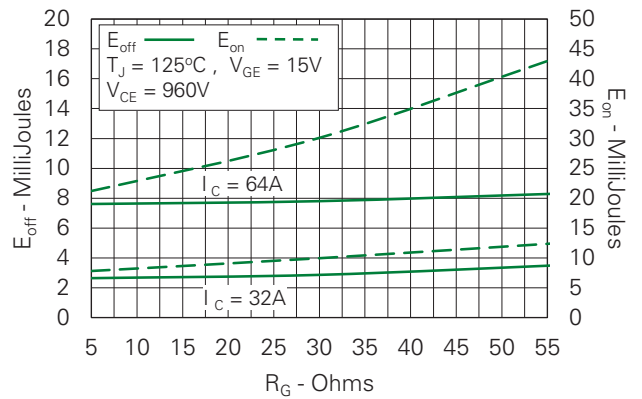


Fig. 13. Inductive Switching Energy Loss vs. Collector Current

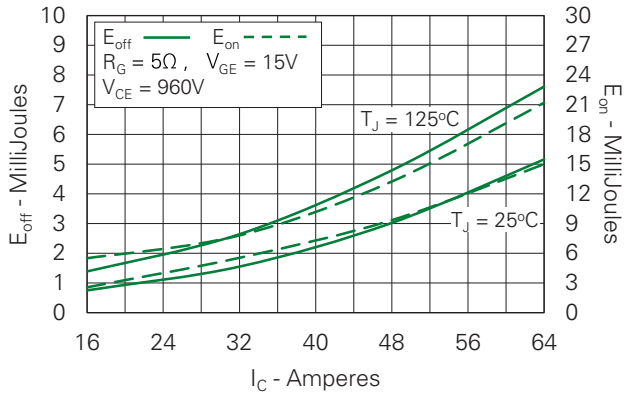


Fig. 14. Inductive Switching Energy Loss vs. Junction Temperature

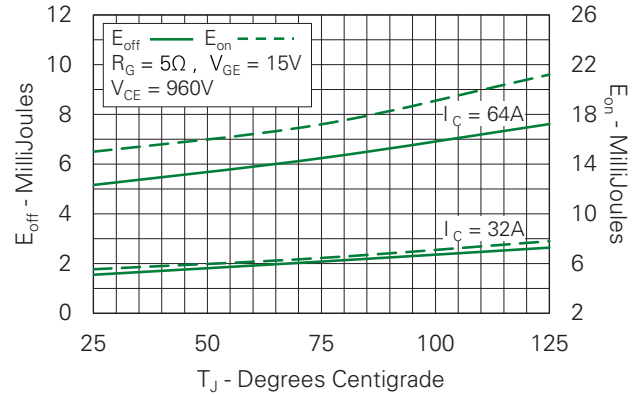


Fig. 15. Inductive Turn-off Switching Times vs. Gate Resistance

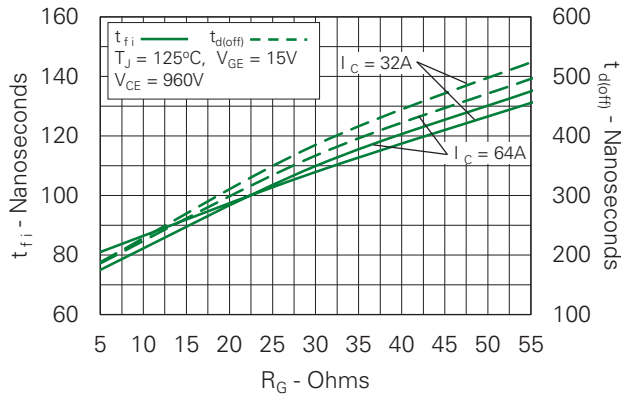


Fig. 16. Inductive Turn-off Switching Times vs. Collector Current

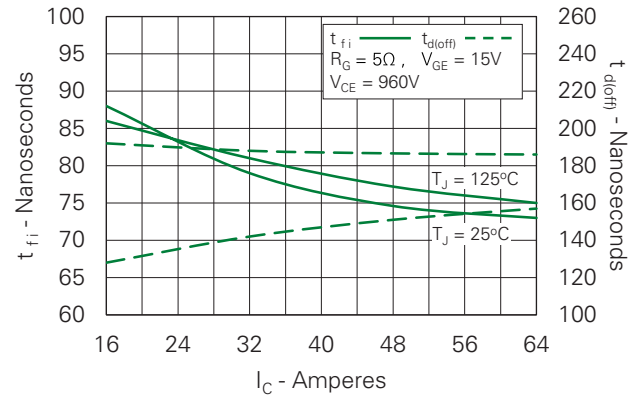


Fig. 17. Inductive Turn-off Switching Times vs. Junction Temperature

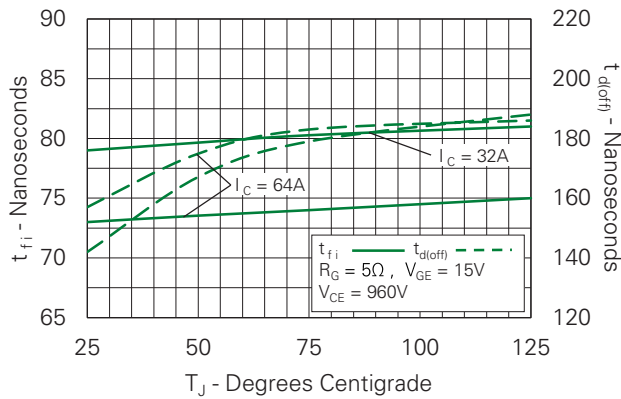


Fig. 18. Inductive Turn-on Switching Times vs. Gate Resistance

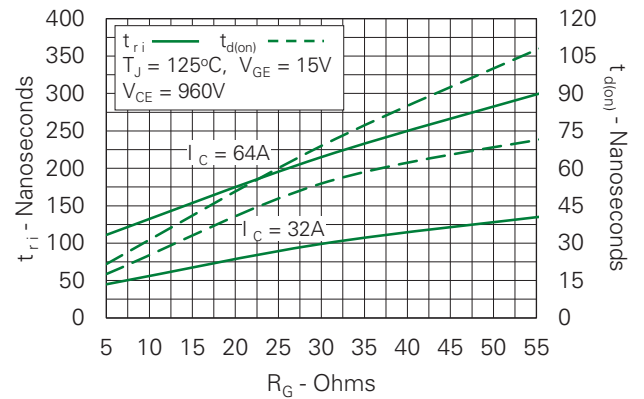


Fig. 19. Inductive Turn-on Switching Times vs. Collector Current

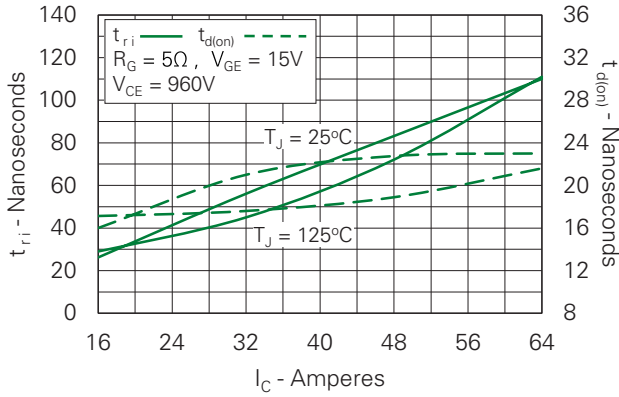


Fig. 20. Inductive Turn-on Switching Times vs. Junction Temperature

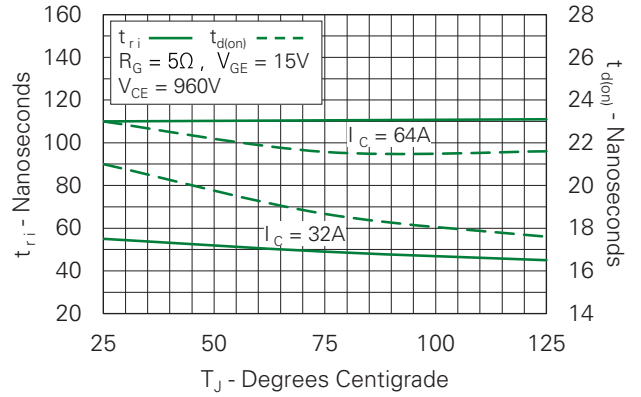
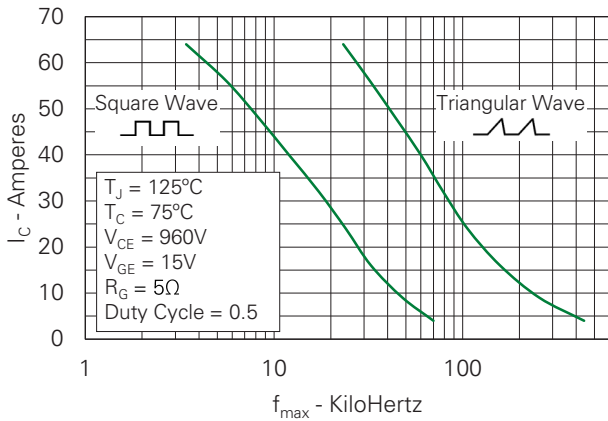
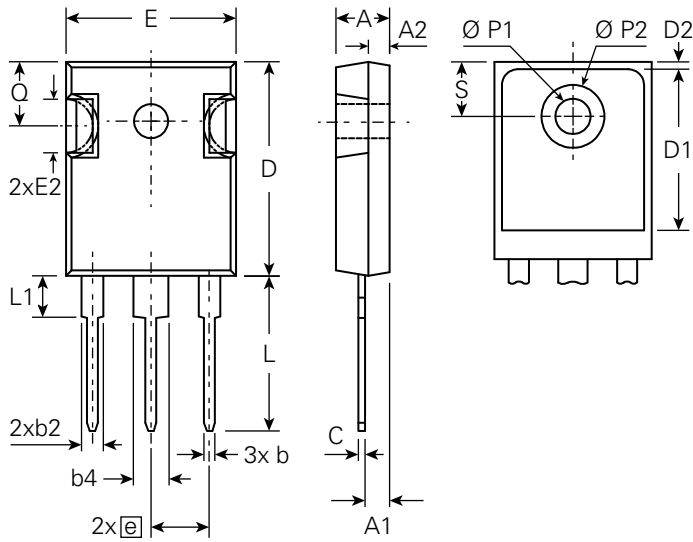


Fig. 21. Maximum Peak Load Current vs. Frequency



Part Outline Drawing (TO-247-3L)



| Symbol | Inches | | | Millimeters | | |
|--------|-----------|---------|-------|-------------|---------|-------|
| | Min. | Typical | Max. | Min. | Typical | Max |
| A | 0.185 | – | 0.209 | 4.70 | – | 5.30 |
| A1 | 0.087 | – | 0.102 | 2.21 | – | 2.59 |
| A2 | 0.059 | – | 0.098 | 1.50 | – | 2.49 |
| b | 0.039 | – | 0.055 | 0.99 | – | 1.40 |
| b2 | 0.065 | – | 0.094 | 1.65 | – | 2.39 |
| b4 | 0.102 | – | 0.135 | 2.59 | – | 3.43 |
| c | 0.015 | – | 0.035 | 0.38 | – | 0.89 |
| D | 0.819 | – | 0.844 | 20.79 | – | 21.45 |
| D1 | 0.515 | – | – | 13.07 | – | – |
| D2 | 0.020 | – | 0.053 | 0.51 | – | 1.35 |
| E | 0.609 | – | 0.639 | 15.48 | – | 16.24 |
| E1 | 0.530 | – | – | 13.45 | – | – |
| E2 | 0.170 | – | 0.216 | 4.31 | – | 5.48 |
| e | 0.215 BSC | | | 5.45 BSC | | |
| L | 0.780 | – | 0.799 | 19.80 | – | 20.30 |
| L1 | – | – | 0.177 | – | – | 4.49 |
| Ø P1 | 0.140 | – | 0.144 | 3.55 | – | 3.65 |
| Ø P2 | – | – | 0.291 | – | – | 7.39 |
| Q | 0.212 | – | 0.244 | 5.38 | – | 6.19 |
| S | 0.242 BSC | | | 6.14 BSC | | |

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