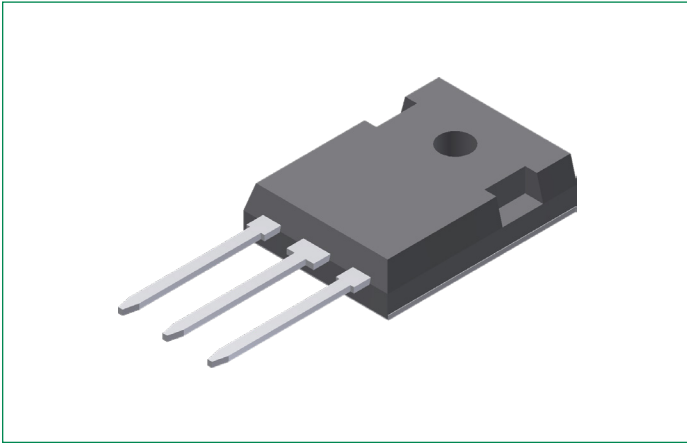


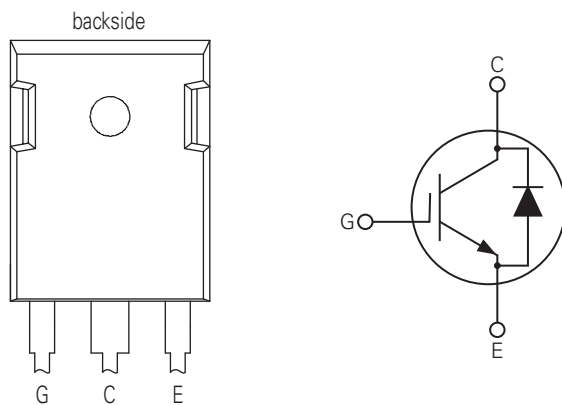
# IXYH40N120C4H1

## 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 $175^\circ\text{C}$	1200	V
$V_{GES}$	Gate-Emitter Voltage	Continuous	$\pm 20$	V
$V_{GEM}$	Transient Gate-Emitter Voltage	Transient	$\pm 30$	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	$V_{CE} = 0\text{ V}$ , $V_{GE} = \pm 20\text{ V}$	–	–	$\pm 100$	nA
$I_{CES}$	Zero Gate Voltage Collector Current	$V_{CE} = V_{CES}$ , $V_{GE} = 0\text{ V}$	–	–	50	$\mu\text{A}$
		$V_{CE} = V_{CES}$ , $V_{GE} = 0\text{ V}$ , $T_J = 150^\circ\text{C}$	–	–	5	mA
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage <sup>1</sup>	$I_C = 32\text{ A}$ , $V_{GE} = 15\text{ V}$	–	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 <sup>1</sup>	$I_C = 32\text{ A}, V_{CE} = 10\text{ V}$	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 <sup>2</sup>	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 <sup>2</sup>		$T_J = 25^\circ\text{C}$	–	55	–	ns
			$T_J = 150^\circ\text{C}$	–	45	–	
$E_{on}$	Turn-on Energy <sup>2</sup>		$T_J = 25^\circ\text{C}$	–	5.55	–	mJ
			$T_J = 150^\circ\text{C}$	–	7.80	–	
$t_{d(off)}$	Turn-off Delay Time <sup>2</sup>		$T_J = 25^\circ\text{C}$	–	140	–	ns
			$T_J = 150^\circ\text{C}$	–	190	–	
$t_{fi}$	Turn-off Fall Time <sup>2</sup>		$T_J = 25^\circ\text{C}$	–	80	–	ns
			$T_J = 150^\circ\text{C}$	–	80	–	
$E_{off}$	Turn-off Energy <sup>2</sup>	$T_J = 25^\circ\text{C}$	–	1.55	–	mJ	
		$T_J = 150^\circ\text{C}$	–	2.65	–		

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

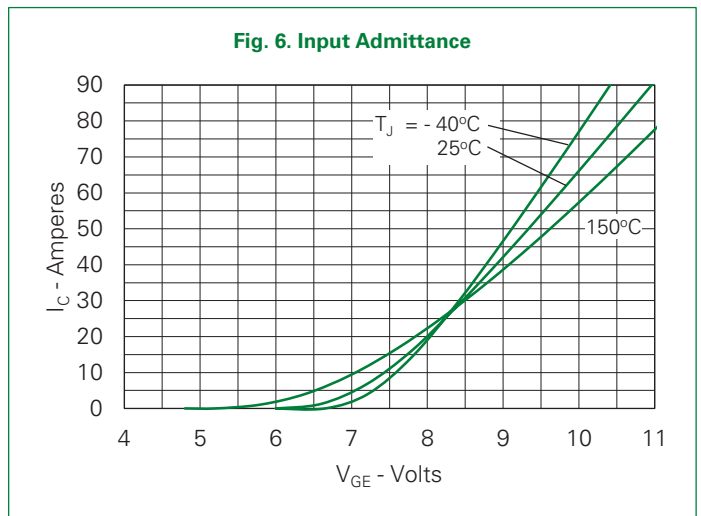
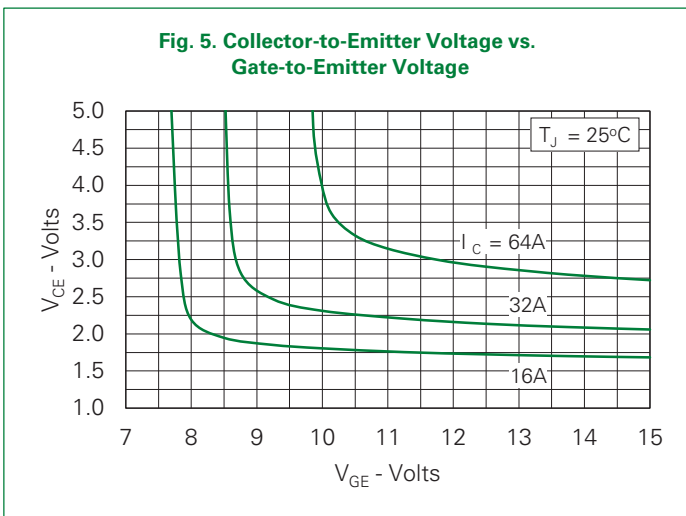
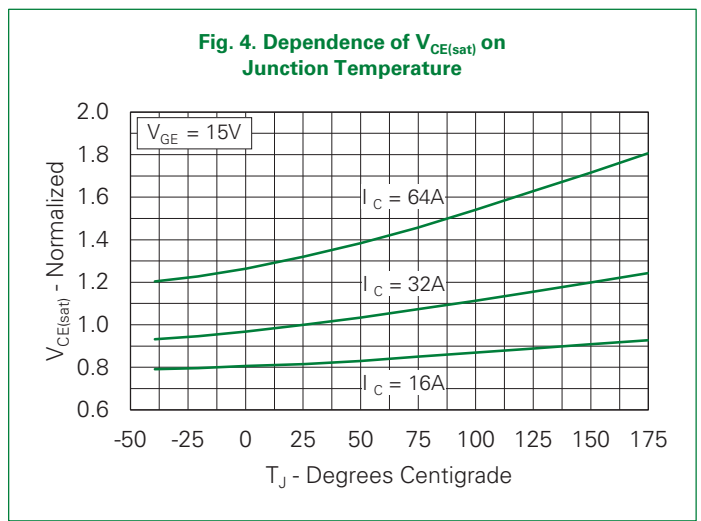
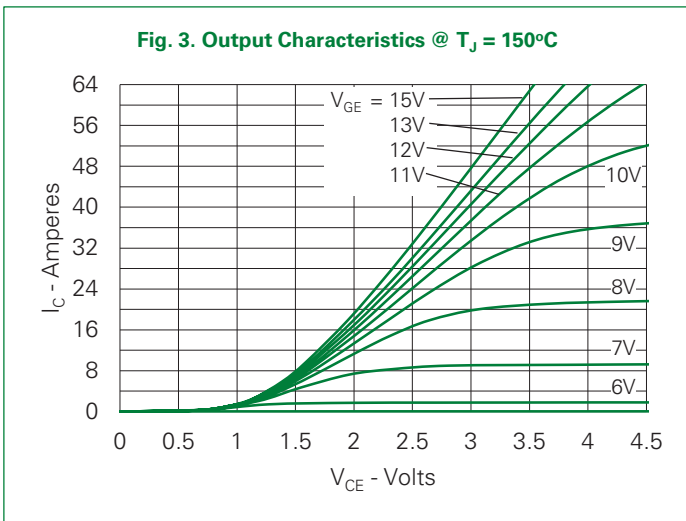
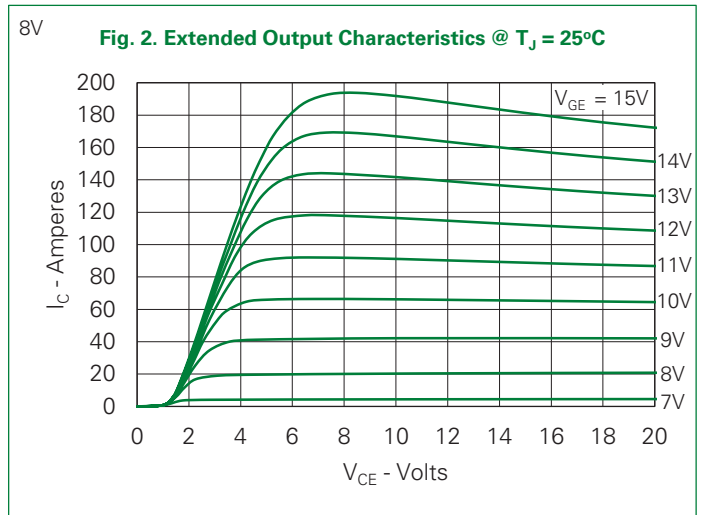
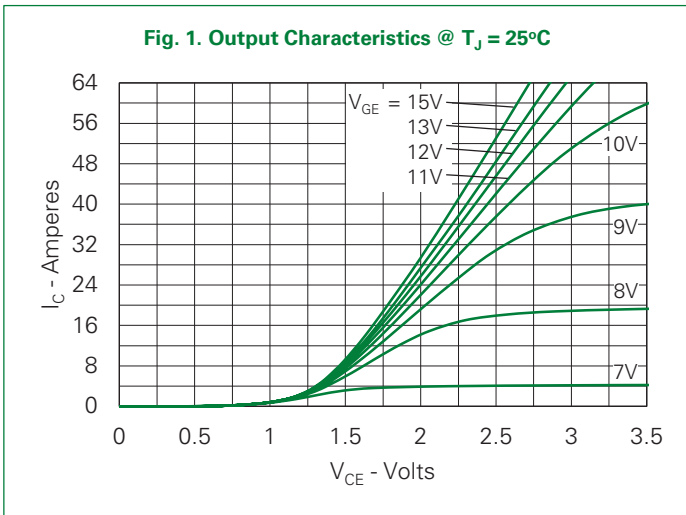
**Note 2:** Switching times and energy losses may increase for higher  $V_{CE(clamp)}$ ,  $T_J$ , or  $R_G$ .

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

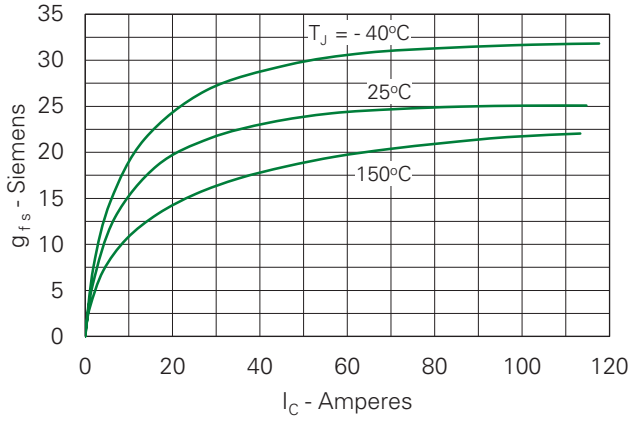
Symbol	Characteristic	Conditions	Value			Unit
			Min.	Typ.	Max.	
$V_F$	Diode Forward Voltage <sup>1</sup>	$I_F = 32\text{ A}, V_{GE} = 0\text{ V}$	–	2.30	2.80	V
		$I_F = 32\text{ A}, V_{GE} = 0\text{ V}, T_J = 125^\circ\text{C}$	–	2.80	–	
$I_{RM}$	Reverse Recovery Current	$I_F = 32\text{ A}, V_{GE} = 0\text{ V}, T_J = 125^\circ\text{C}$	–	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,  $d \leq 2\%$

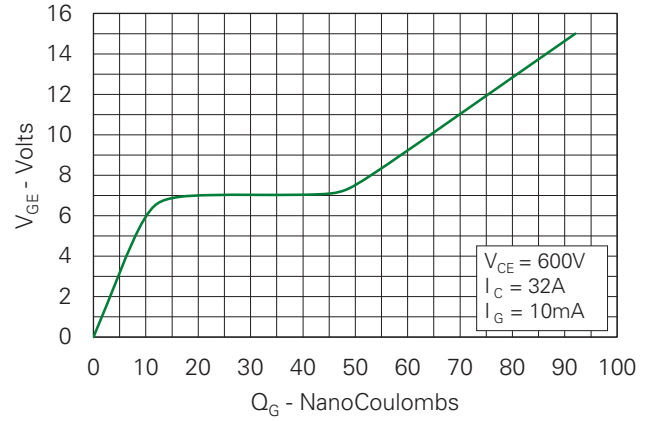
Characteristic Curves



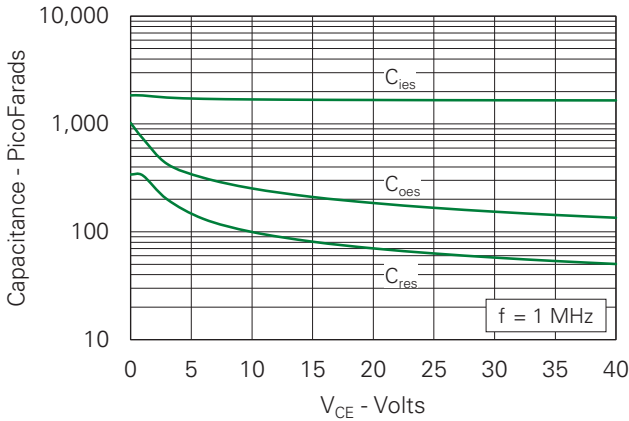
**Fig. 7. Transconductance**



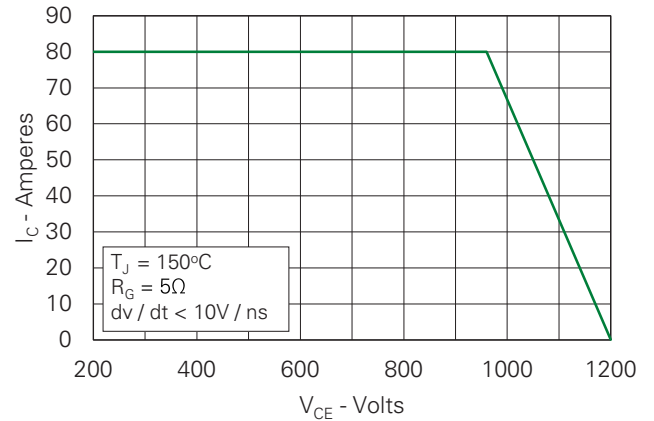
**Fig. 8. Gate Charge**



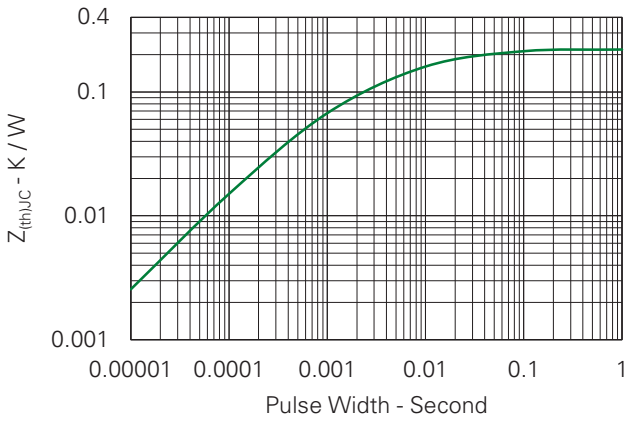
**Fig. 9. Capacitance**



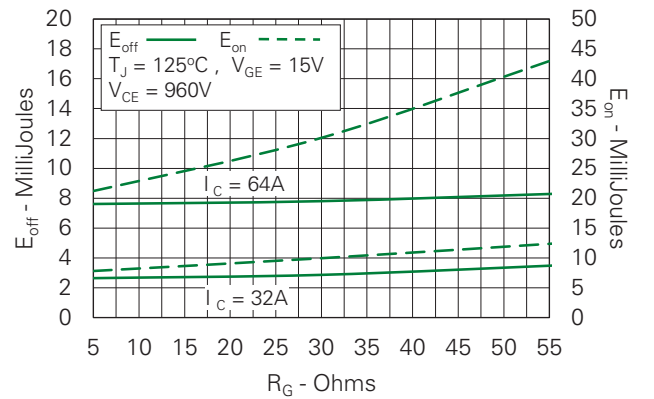
**Fig. 10. Reverse-Bias Safe Operating Area**



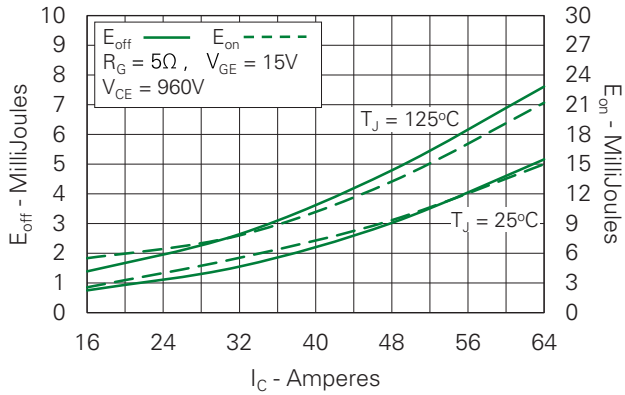
**Fig. 11. Maximum Transient Thermal Impedance**



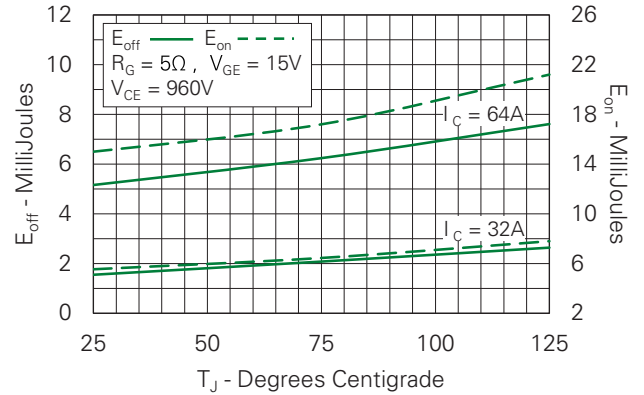
**Fig. 12. Inductive Switching Energy Loss vs. Gate Resistance**



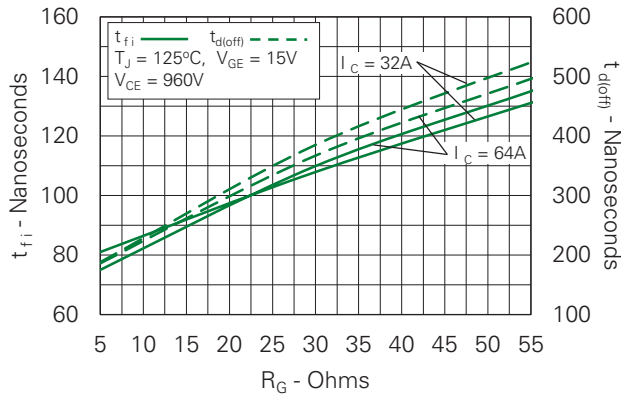
**Fig. 13. Inductive Switching Energy Loss vs. Collector Current**



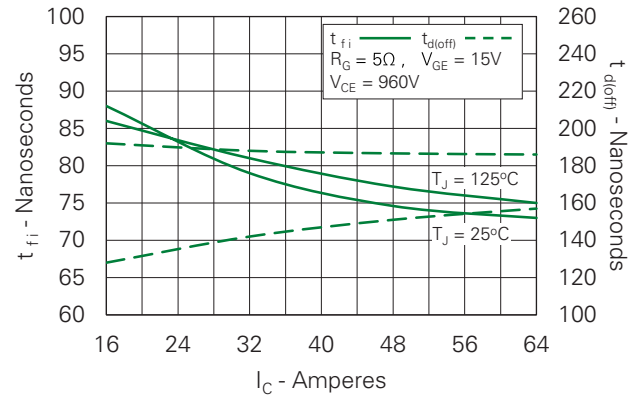
**Fig. 14. Inductive Switching Energy Loss vs. Junction Temperature**



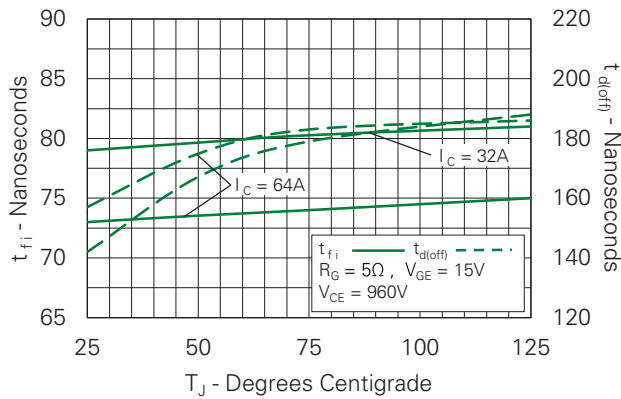
**Fig. 15. Inductive Turn-off Switching Times vs. Gate Resistance**



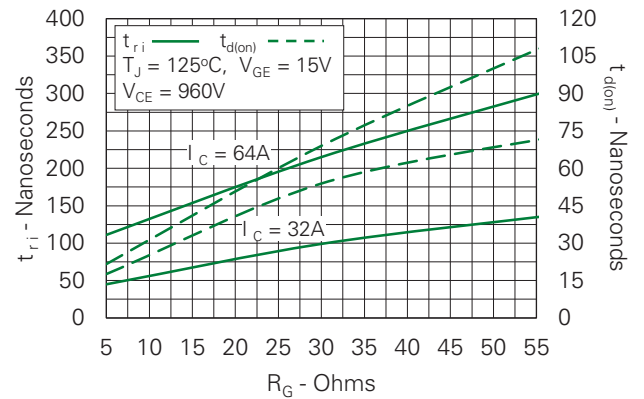
**Fig. 16. Inductive Turn-off Switching Times vs. Collector Current**



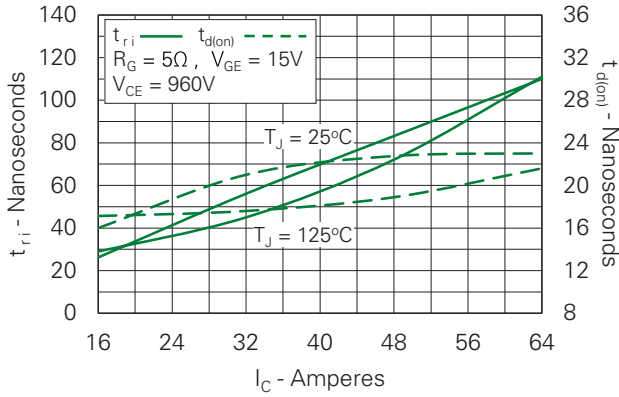
**Fig. 17. Inductive Turn-off Switching Times vs. Junction Temperature**



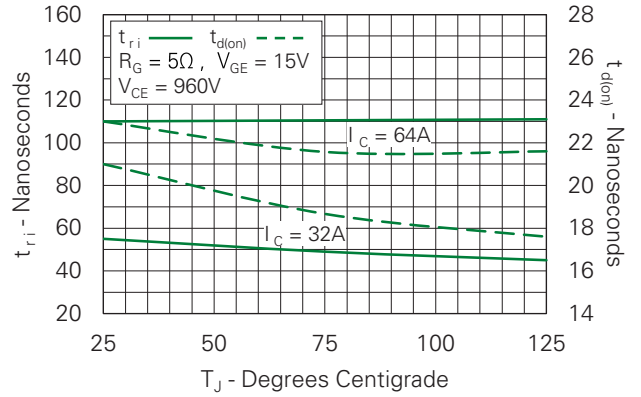
**Fig. 18. Inductive Turn-on Switching Times vs. Gate Resistance**



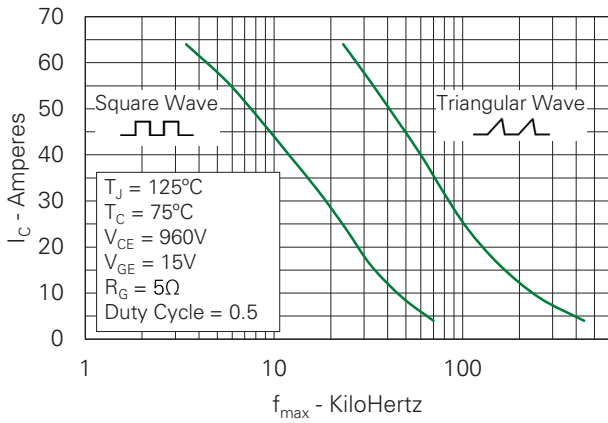
**Fig. 19. Inductive Turn-on Switching Times vs. Collector Current**



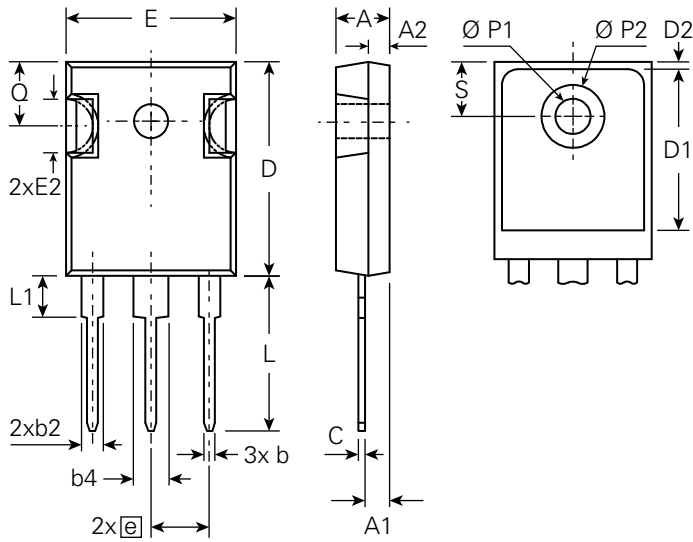
**Fig. 20. Inductive Turn-on Switching Times vs. Junction Temperature**



**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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