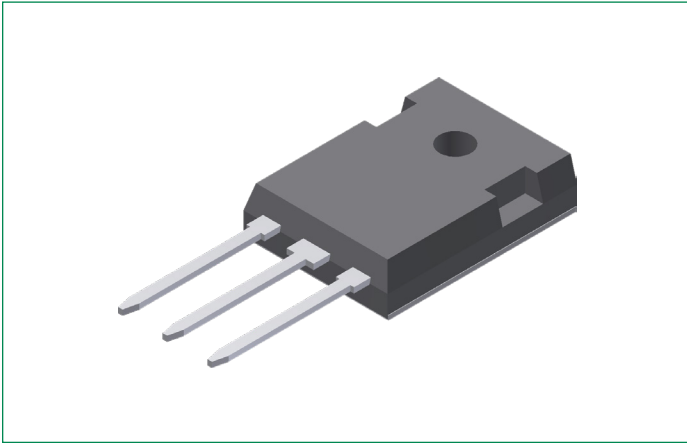


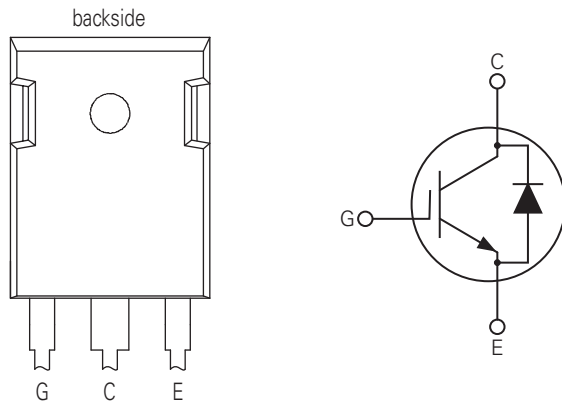
IXYH40N120C4H1

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)

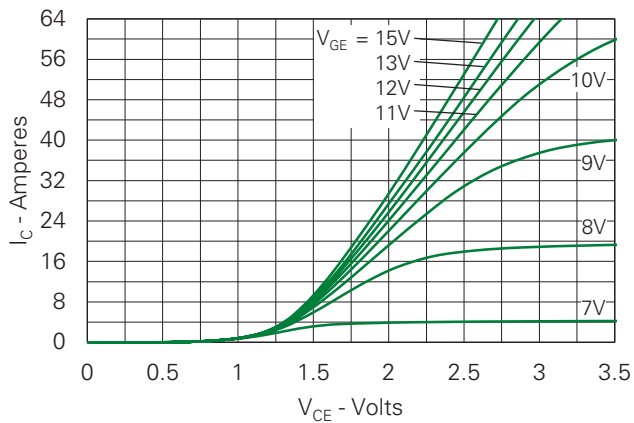
Symbol	Characteristic	Conditions		Value			Unit	
				Min.	Typ.	Max.		
g_{fs}	Transconductance ¹	$I_C = 32\text{ A}, V_{CE} = 10\text{ V}$		13	22	–	S	
C_{ies}	Input Capacitance	$V_{GE} = 0\text{ V}, V_{CE} = 25\text{ V}, f = 1\text{ MHz}$		–	1665	–	pF	
C_{oes}	Output Capacitance			–	170	–		
C_{res}	Reverse 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, $V_{GE} = 15\text{ V},$ $V_{CE} = 0.8 \times V_{CES},$ $I_C = 32\text{ A},$ $R_{G(ext)} = 5\text{ }\Omega$	$T_J = 25^\circ\text{C}$	–	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	$I_F = 32\text{ A}, V_{GE} = 0\text{ V}, T_J = 125^\circ\text{C}$ $-di_F/dt = 400\text{ A}/\mu\text{s}, V_R = 600\text{ V}$	–	26	–	A
t_{rr}	Reverse Recovery Time		–	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. 1. Output Characteristics @ $T_J = 25^\circ\text{C}$ 

8V

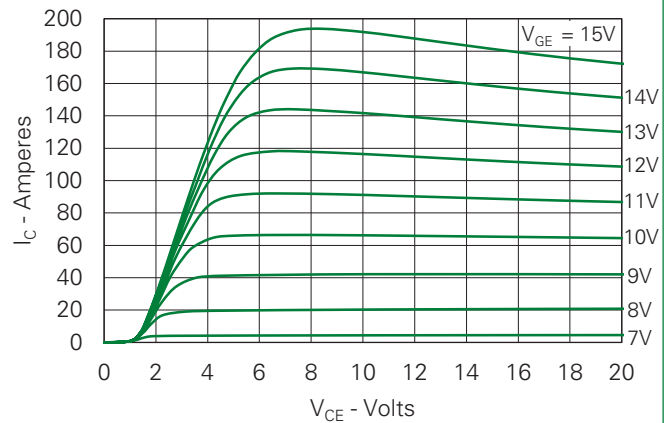
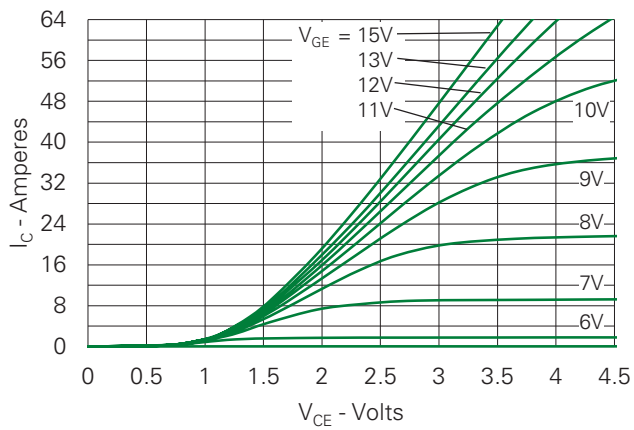
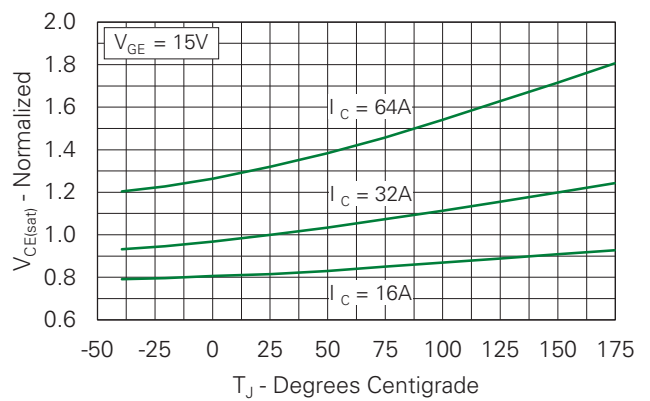
Fig. 2. Extended Output Characteristics @ $T_J = 25^\circ\text{C}$ Fig. 3. Output Characteristics @ $T_J = 150^\circ\text{C}$ Fig. 4. Dependence of $V_{CE(sat)}$ on Junction Temperature

Fig. 5. Collector-to-Emitter Voltage vs. Gate-to-Emitter Voltage

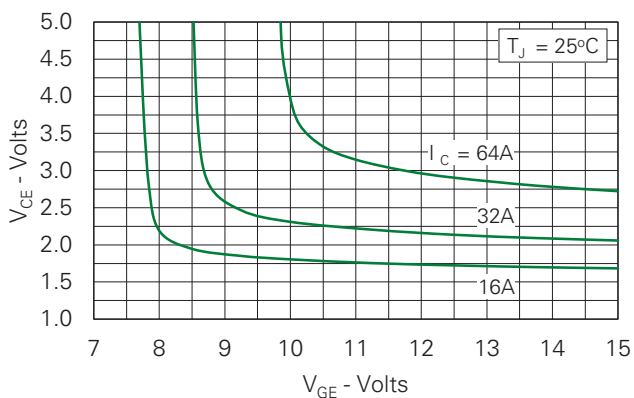


Fig. 6. Input Admittance

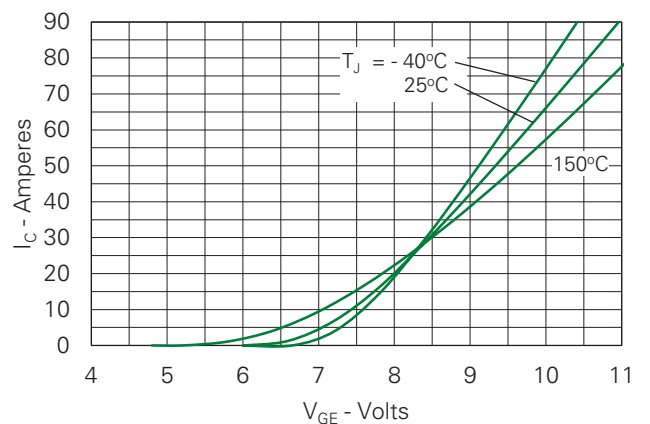


Fig. 7. Transconductance

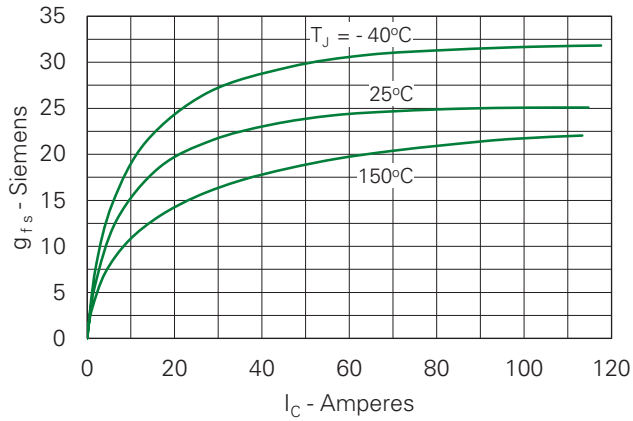


Fig. 8. Gate Charge

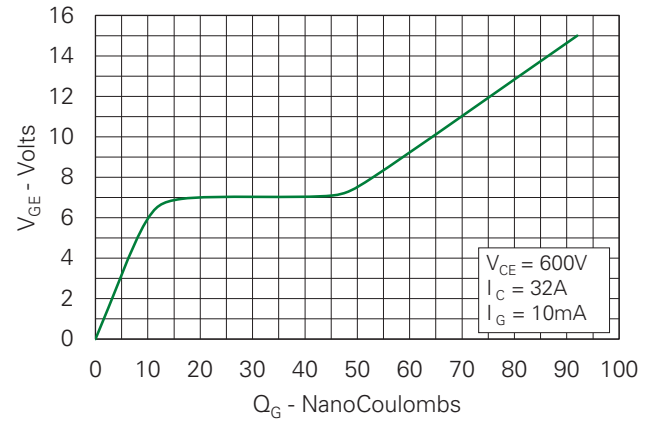


Fig. 9. Capacitance

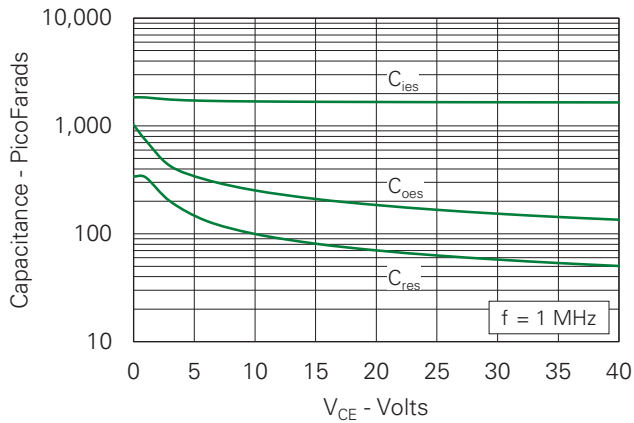


Fig. 10. Reverse-Bias Safe Operating Area

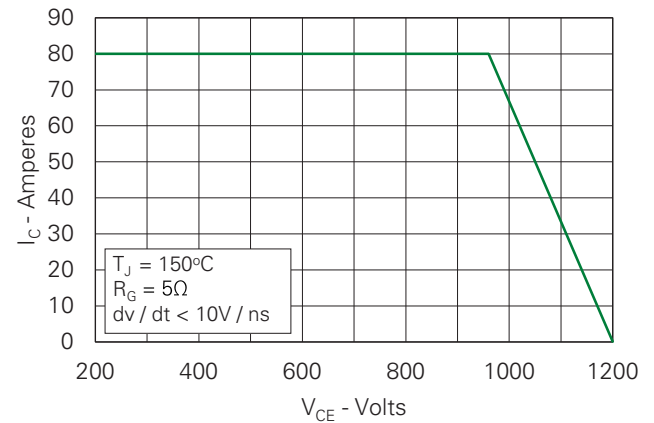


Fig. 11. Maximum Transient Thermal Impedance

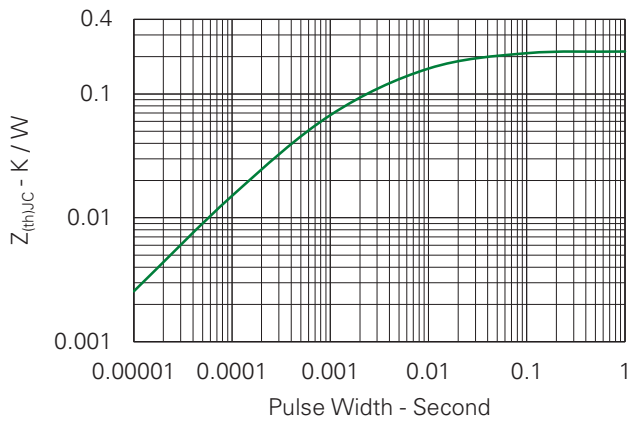


Fig. 12. Inductive Switching Energy Loss vs. Gate Resistance

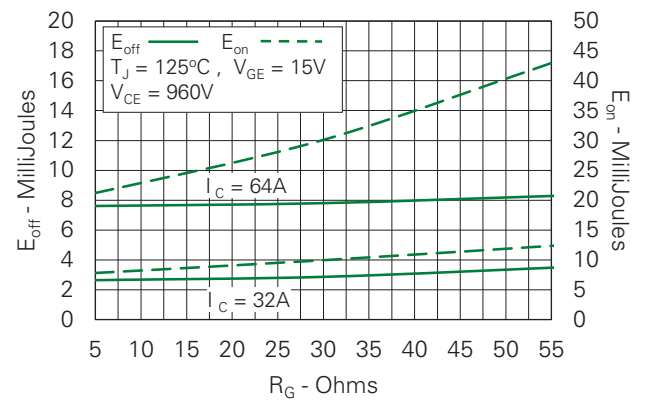


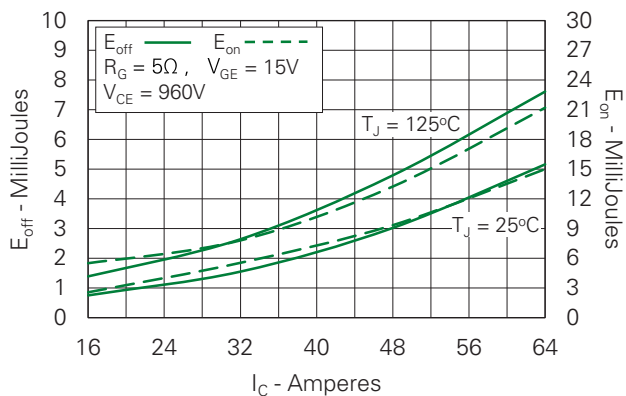
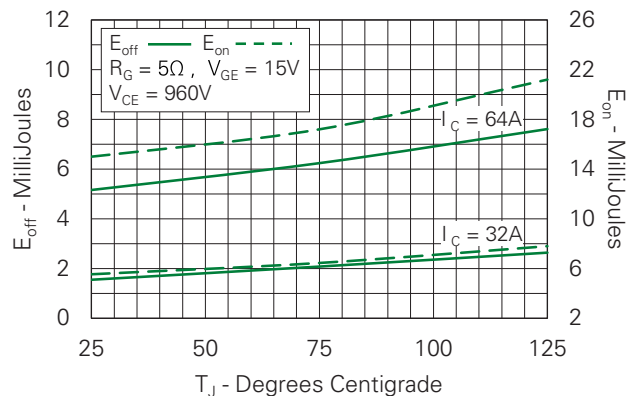
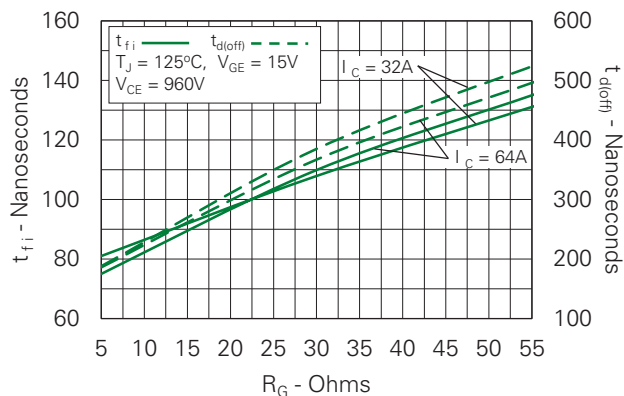
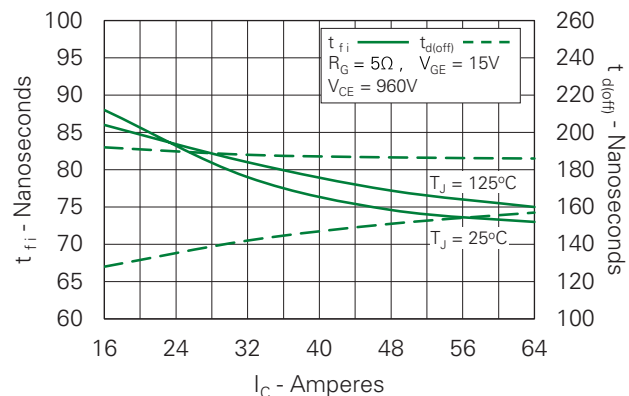
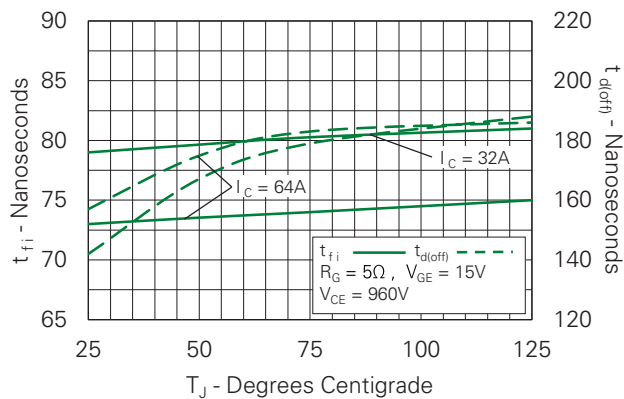
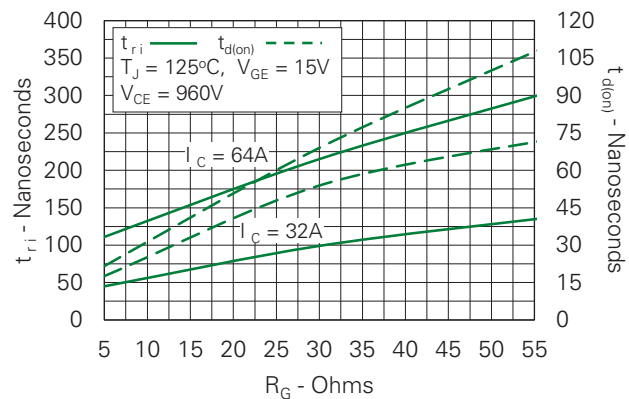
Fig. 13. Inductive Switching Energy Loss vs. Collector Current**Fig. 14. Inductive Switching Energy Loss vs. Junction Temperature****Fig. 15. Inductive Turn-off Switching Times vs. Gate Resistance****Fig. 16. Inductive Turn-off Switching Times vs. Collector Current****Fig. 17. Inductive Turn-off Switching Times vs. Junction Temperature****Fig. 18. Inductive Turn-on Switching Times vs. Gate Resistance**

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

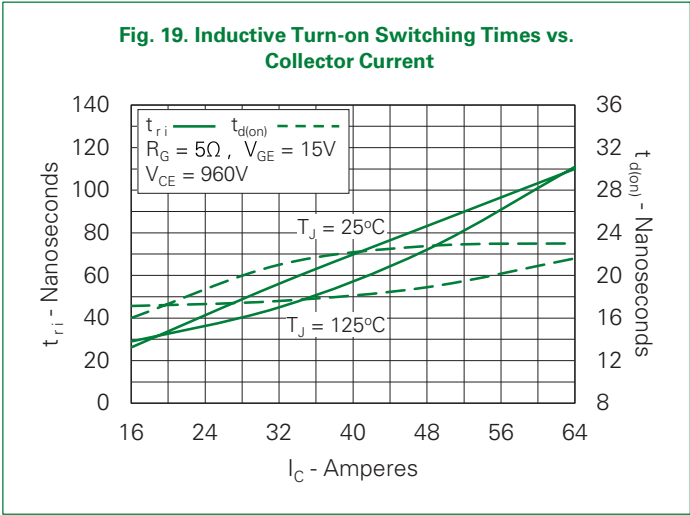


Fig. 20. Inductive Turn-on Switching Times vs. Junction Temperature

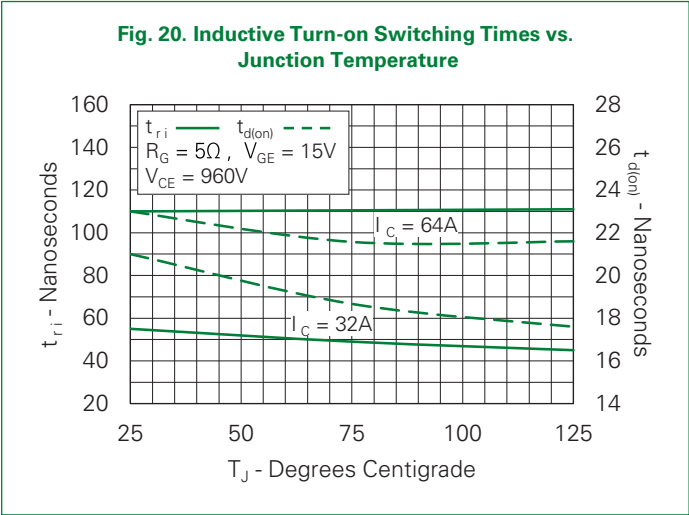
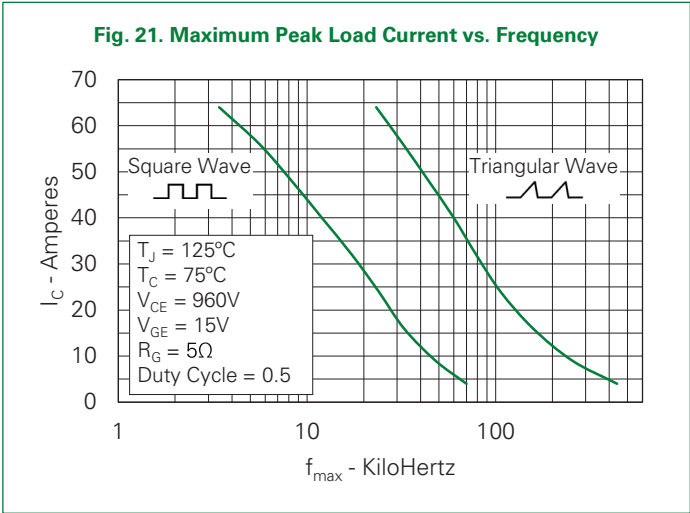
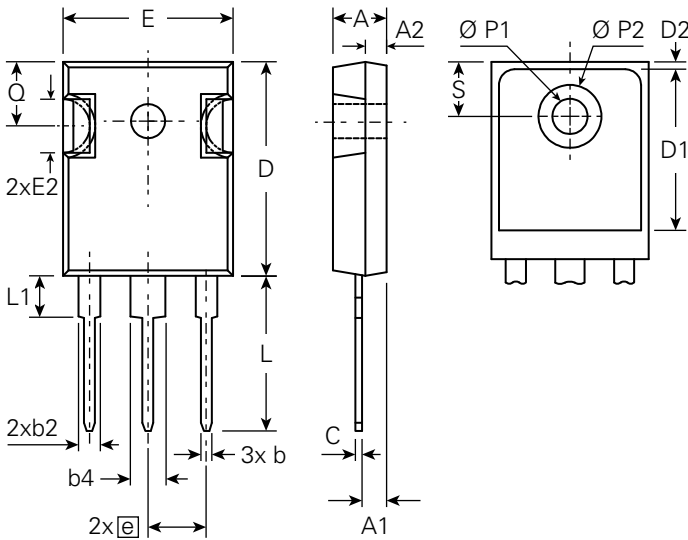


Fig. 21. Maximum Peak Load Current vs. Frequency



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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