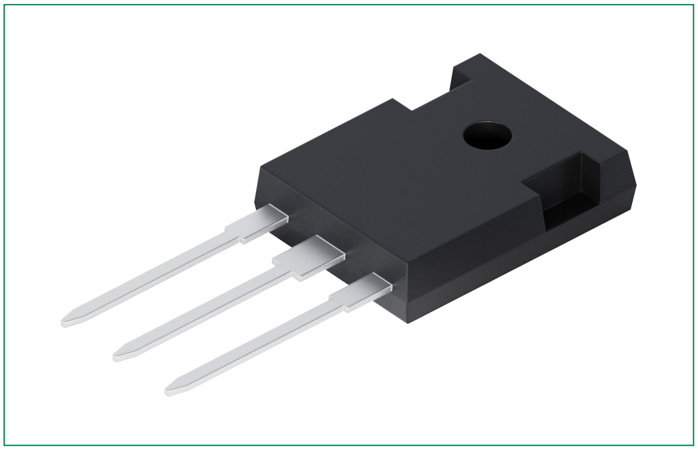
IXYH40N65C3H1

XPT™ 650 V IGBT GenX3™ w/ Sonic Diode

Extreme Light Punch Through IGBT for 20–60 kHz Switching



Features

- Optimized for 20–60kHz Switching
- Square RBSOA
- Anti-Parallel Sonic Diode
- Avalanche Rated
- Short Circuit Capability
- International Standard Package

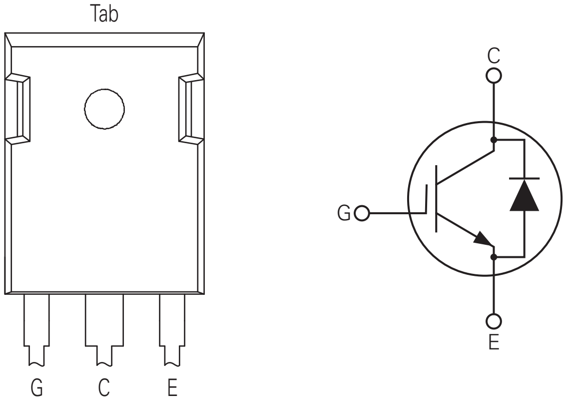
Benefits

- High Power Density
- Extremely Rugged
- Low Gate Drive Requirement

Applications

- Power Inverters
- UPS
- Motor Drives
- SMPS
- PFC Circuits
- Battery Chargers
- Welding Machines
- Lamp Ballasts
- High Frequency Power Inverters

Pinout Diagram (IXYH)



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

Product Summary

Characteristic	Value	Unit
V_{CES}	650	V
I_{C110}	40	A
$V_{CE(sat)}$	≤ 2.35	V
$t_{fi(typ)}$	52	ns

Maximum Ratings

Symbol	Characteristic	Conditions	Value	Unit
V_{CES}	Collector-emitter voltage	T_{vj} = 25 °C to 175 °C	650	V
V_{CGR}	Collector gate voltage	T_{vj} = 25 °C to 175 °C, R_{GE} = 1 mΩ	650	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 °C	80	A
I_{C110}	Continuous collector current	T_C = 110 °C	40	A
I_{F110}	Forward current	T_C = 110 °C	40	A
I_{CM}	Pulsed collector current	T_C = 25°C, 1 ms	180	A
I_A	Avalanche current	T_C = 25 °C	20	A
E_{AS}	Non-repetitive single pulse avalanche energy	T_C = 25 °C	300	mJ
SSOA (RBSOA)	Switching safe operating area (Reverse biased safe operating area)	V_{GE} = 15 V, T_{vj} = 150 °C, R_G = 10 Ω, $V_{CE} \leq V_{CES}$, Clamped inductive load	80	A
t_{sc} (SCSOA)	Short circuit duration (Short circuit safe operating area)	V_{GE} = 15 V, V_{CE} = 360 V, T_{vj} = 150 °C, R_G = 82 Ω, Non repetitive	5	µs
P_C	Collector power dissipation	T_C = 25 °C	300	W
T_{vj}	Virtual junction temperature range	–	–55 ... +175	°C
$T_{vj(max)}$	Maximum virtual junction temperature	–	175	°C
T_{stg}	Storage temperature range	–	–55 ... +175	°C
T_L	Maximum lead temperature for soldering	–	300	°C
T_{sold}	Soldering temperature	1.6 mm (0.062 in.) from Case for 10 s	260	
M_d	Mounting torque	–	1.13 / 10	Nm/lb.in
W	Weight	–	6	g

Thermal Characteristics

Symbol	Characteristic	Value			Unit
		Min.	Typ.	Max.	
$R_{th(j-c)}$	Thermal resistance, junction-to-case	–	–	0.50	°C/W
$R_{th(c-s)}$	Thermal resistance, case-to-heatsink	–	0.21	–	°C/W

Electrical Characteristics – Static (T_{VJ} = 25 °C unless otherwise specified)

Symbol	Characteristic	Conditions	Value			Unit
			Min.	Typ.	Max.	
BV_{CES}	Collector-emitter breakdown voltage	I_C = 250 µA, V_{GE} = 0 V	650	–	–	V
$V_{GE(th)}$	Gate-emitter threshold voltage	I_C = 250 µA, V_{CE} = V_{GE}	3.5	–	6.0	V
I_{GES}	Gate-emitter leakage current	V_{CE} = 0 V, V_{GE} = ±20 V	–	–	±100	nA
I_{CES}	Zero gate voltage collector current	V_{CE} = V_{CES}, V_{GE} = 0 V	–	–	50	µA
		V_{CE} = V_{CES}, V_{GE} = 0 V, T_{vj} = 150 °C	–	–	3	mA
$V_{CE(sat)}$	Collector-emitter saturation voltage[1]	I_C = 40 A, V_{GE} = 15 V	–	2.00	2.35	V
		I_C = 40 A, V_{GE} = 15 V, T_{vj} = 150 °C	–	2.40	–	V

Revised: XZ 05/19/2025 (0.4)

Electrical Characteristics – Dynamic (T_{VJ} = 25 °C unless otherwise specified)

Symbol	Characteristic	Conditions		Value			Unit
				Min.	Typ.	Max.	
g_{fs}	Transconductance[1]	I_C = 40 A, V_{CE} = 10 V		16	27	–	S
C_{ies}	Input capacitance	V_{GE} = 0 V, V_{CE} = 25 V, f = 1 MHz		–	1980	–	pF
C_{oes}	Output capacitance			–	215	–	
C_{res}	Reverse transfer capacitance			–	40	–	
$Q_{g(on)}$	Total gate charge	V_{GE} = 15 V, V_{CE} = 0.5 × $V_{CES,}$ I_C = 40 A		–	70	–	nC
Q_{ge}	Gate-emitter charge			–	14	–	
Q_{gc}	Gate-collector charge			–	34	–	
$t_{d(on)}$	Turn-on delay time[2]	Inductive Load, V_{GE} = 15 V, V_{CE} = 400 V, I_C = 30 A, $R_{G(ext)}$ = 10 Ω	T_{vj} = 25 °C	–	26	–	ns
			T_{vj} = 150 °C	–	25	–	
t_{ri}	Turn-on rise time[2]		T_{vj} = 25 °C	–	40	–	ns
			T_{vj} = 150 °C	–	40	–	
E_{on}	Turn-on energy[2]		T_{vj} = 25 °C	–	0.86	–	mJ
			T_{vj} = 150 °C	–	1.33	–	
$t_{d(off)}$	Turn-off delay time[2]		T_{vj} = 25 °C	–	106	–	ns
			T_{vj} = 150 °C	–	126	–	
t_{fi}	Turn-off fall time[2]		T_{vj} = 25 °C	–	52	–	ns
			T_{vj} = 150 °C	–	80	–	
E_{off}	Turn-off energy[2]		T_{vj} = 25 °C	–	0.40	0.75	mJ
			T_{vj} = 150 °C	–	0.46	–	

Note 1 Pulse test, t ≤ 300 µs, duty cycle, d ≤ 2%
Note 2 Switching times and energy losses may increase for higher $V_{CE(clamp)}$, T_{vj}, or R_G.

Reverse Sonic Diode (FRD) (T_{vj} = 25 °C unless otherwise specified)

Symbol	Characteristic	Conditions	Value			Unit
			Min.	Typ.	Max.	
V_F	Diode Forward voltage[1]	I_F = 30 A, V_{GE} = 0 V	–	–	2.5	V
		I_F = 30 A, V_{GE} = 0 V, T_{vj} = 150 °C	–	2.15	–	
I_{RM}	Reverse recovery current	I_F = 30 A, V_{GE} = 0 V, T_{vj} = 150 °C $-di_F/dt$ = 900 A/µs, V_R = 300 V	–	32	–	A
t_{rr}	Reverse recovery time		–	78	–	ns
$R_{th(j-c)}$	Thermal resistance, junction-to-case	–	–	–	0.60	°C/W

Note 1 Pulse test, t ≤ 300 µs, duty cycle, d ≤ 2%

Characteristic Curves

Fig. 1. Output Characteristics @ T_{vj} = 25 °C

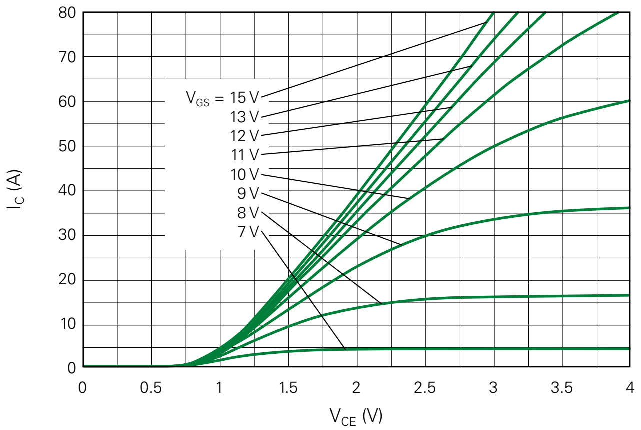


Fig. 2. Extended Output Characteristics @ T_{vj} = 25 °C

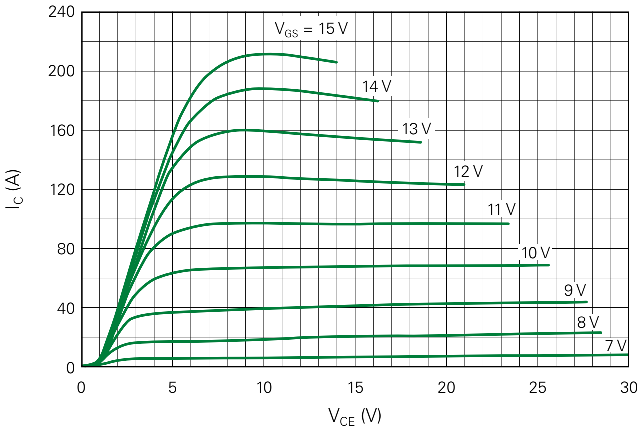


Fig. 3. Extended Output Characteristics @ T_{vj} = 150 °C

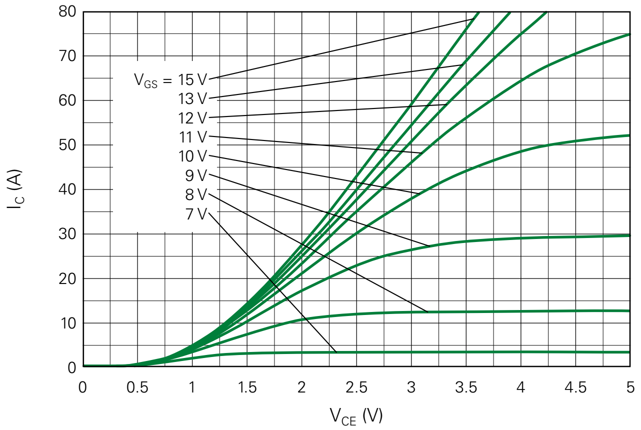


Fig. 4. Dependence of $V_{CE(sat)}$ on Junction Temperature

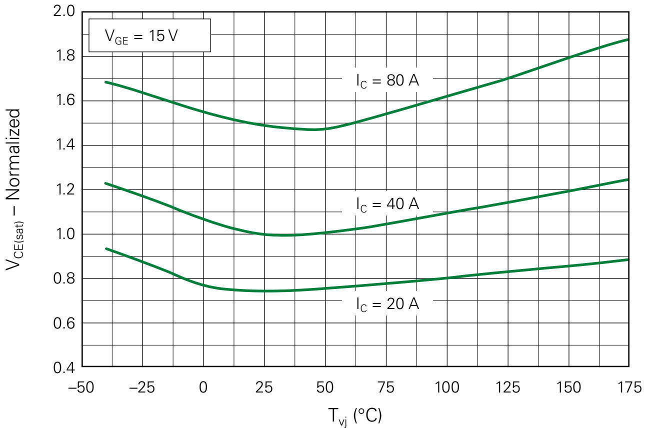


Fig. 5. Collector-to-Emitter Voltage vs. Gate-to-Emitter Voltage

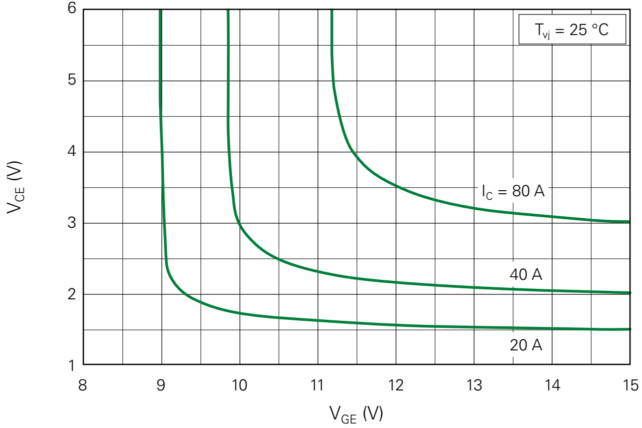


Fig. 6. Input Admittance

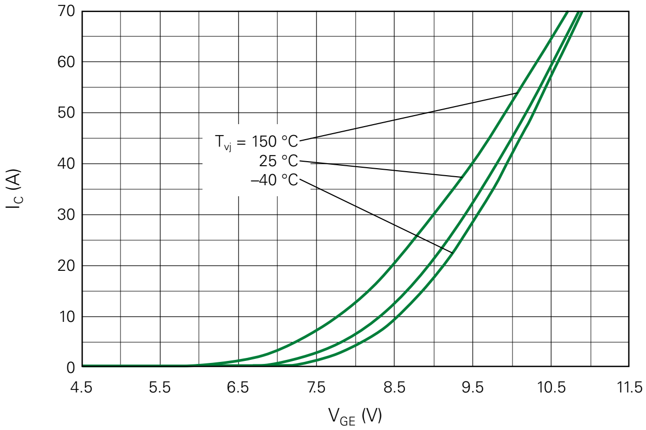


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Fig. 7. Transconductance

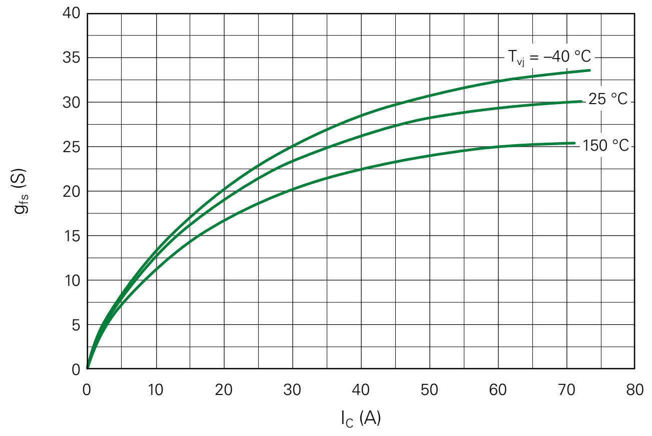


Fig. 8. Gate Charge

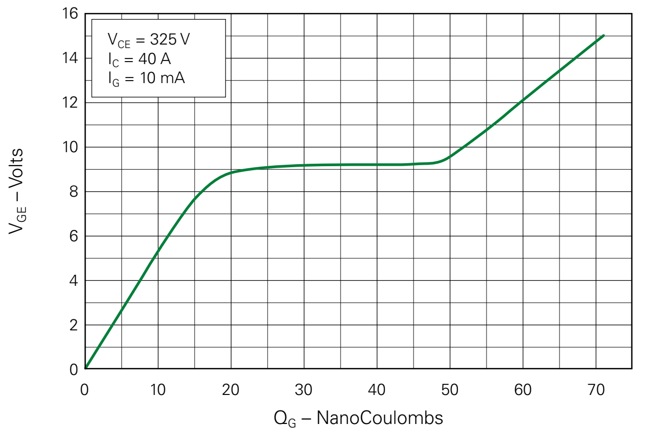


Fig. 9. Capacitance

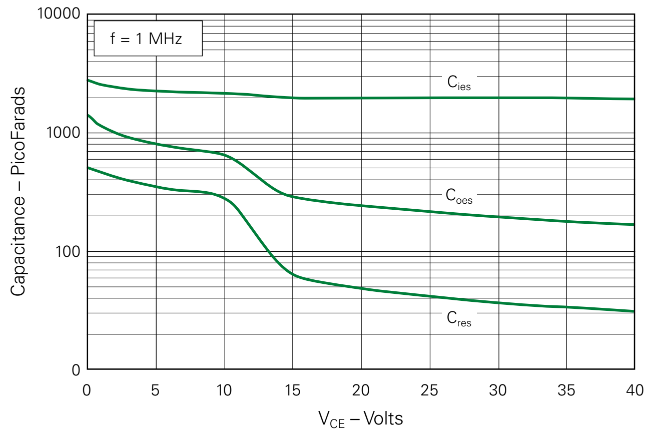


Fig. 10. Reverse-Bias Safe Operating Area

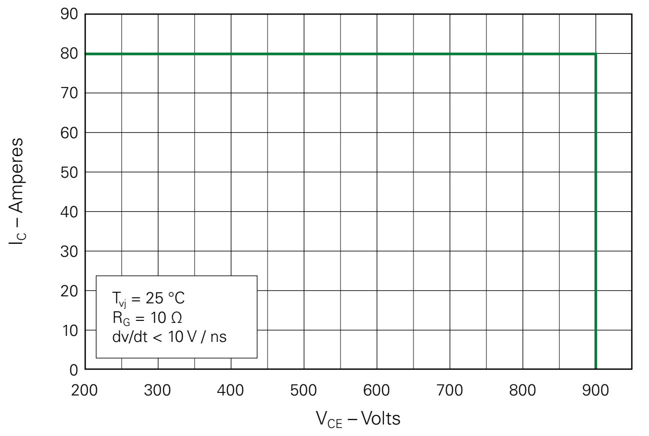


Fig. 11. Forward-Bias Safe Operating Area

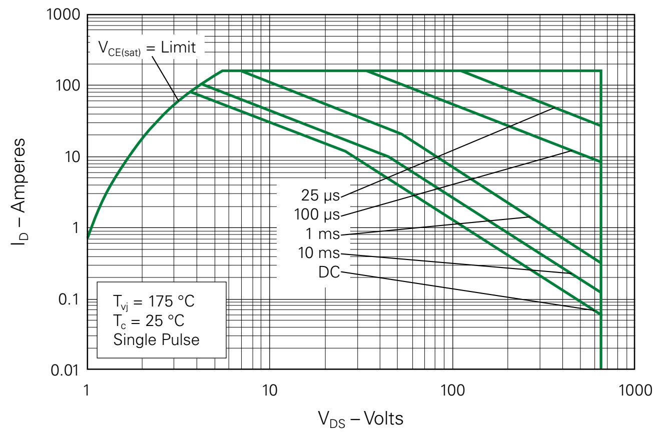


Fig. 12. Maximum Transient Thermal Impedance (IGBT)

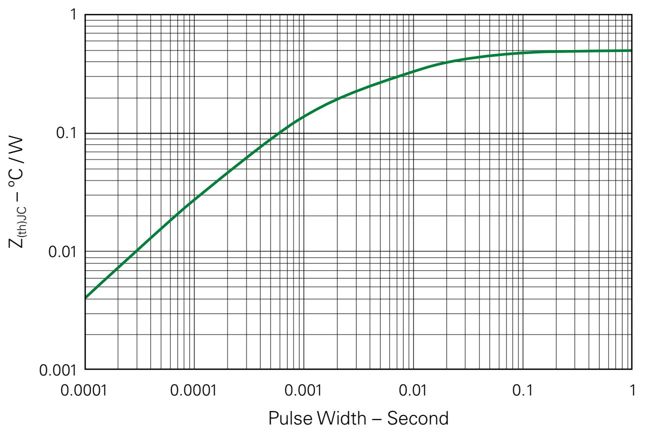


Fig. 13. Inductive Switching Energy Loss vs. Gate Resistance

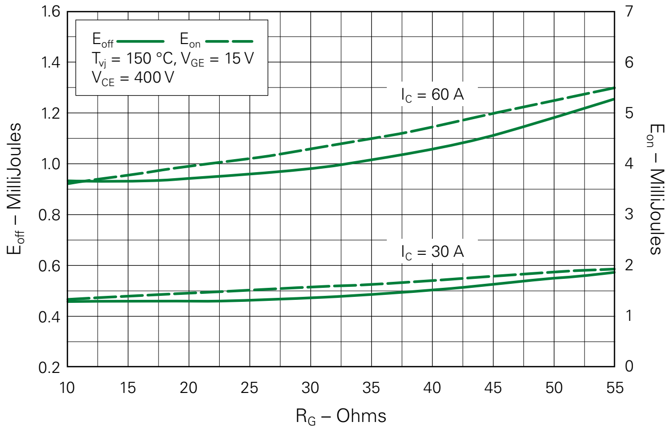


Fig. 14. Inductive Switching Energy Loss vs. Collector Current

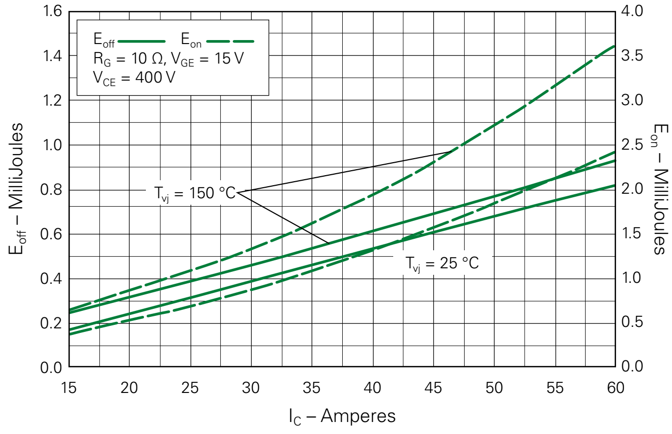


Fig. 15. Inductive Switching Energy Loss vs. Junction Temperature

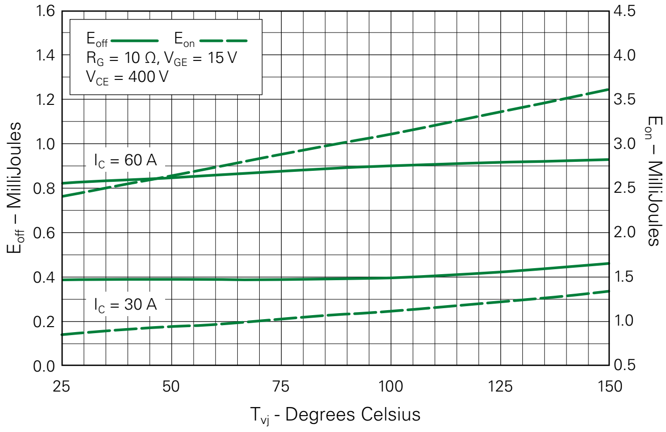


Fig. 16. Inductive Turn-off Switching Times vs. Gate Resistance

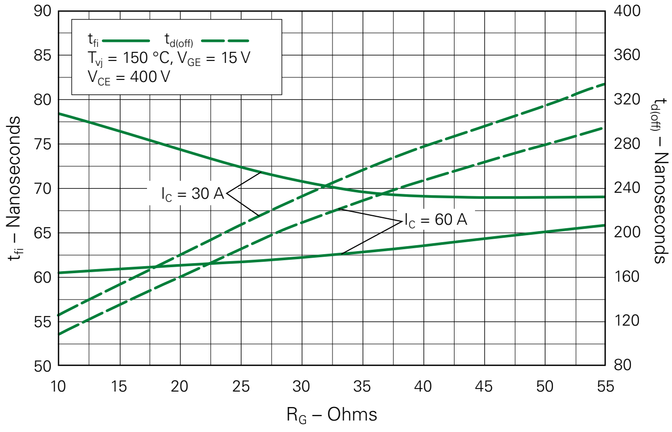


Fig. 17. Inductive Turn-off Switching Times vs. Collector Current

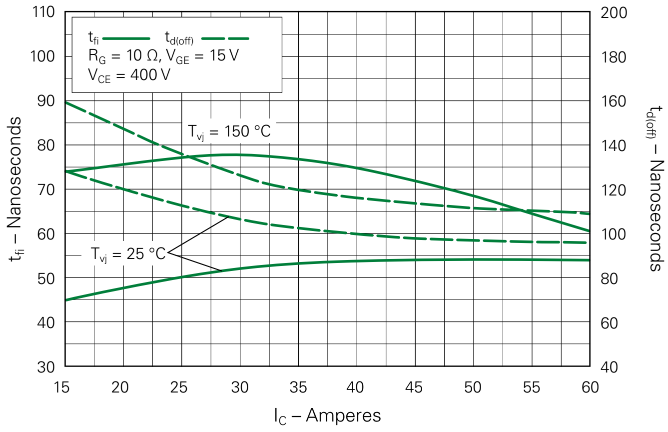


Fig. 18. Inductive Turn-off Switching Times vs. Junction Temperature

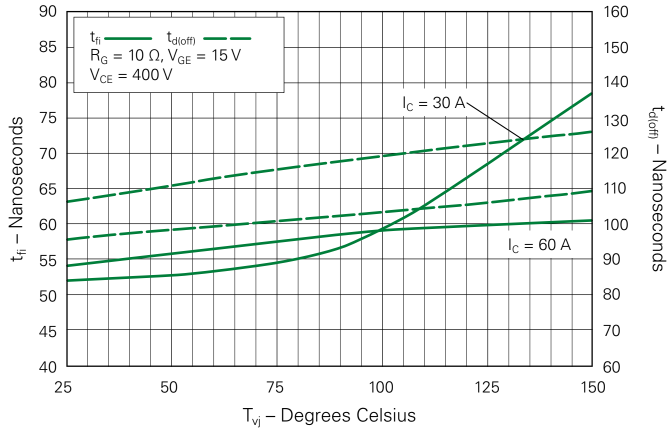


Fig. 19. Inductive Turn-on Switching Times vs. Gate Resistance

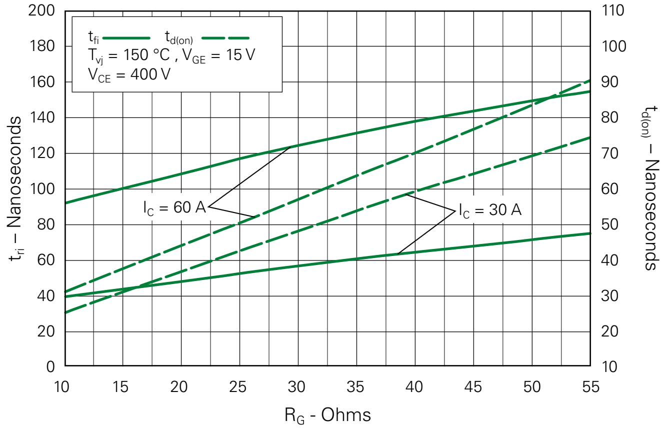


Fig. 20. Inductive Turn-on Switching Times vs. Collector Current

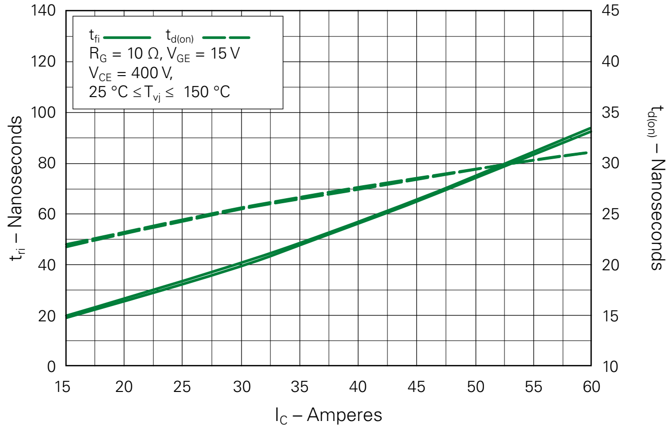


Fig. 21. Inductive Turn-on Switching Times vs. Junction Temperature

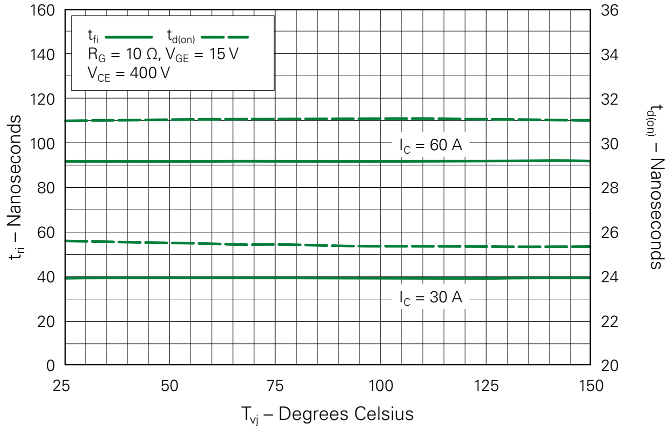


Fig. 22. Maximum Transient Thermal Impedance (Diode)

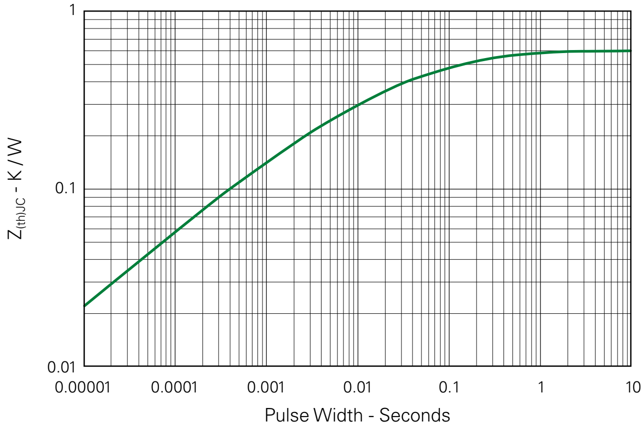


Fig. 23. Forward Current vs. Forward Voltage

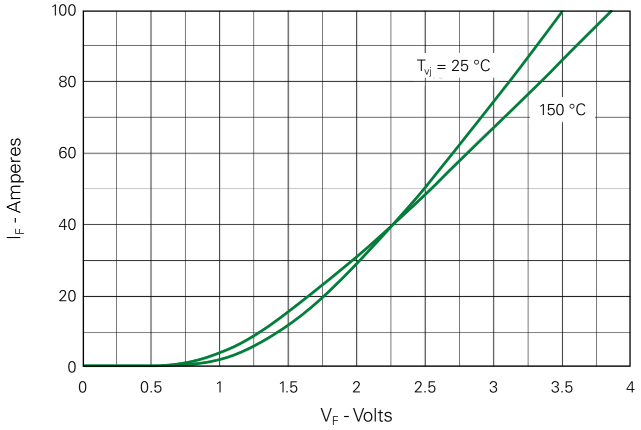


Fig. 24. Reverse Recovery Charge Q_{RR} vs. $-di_F/dt$

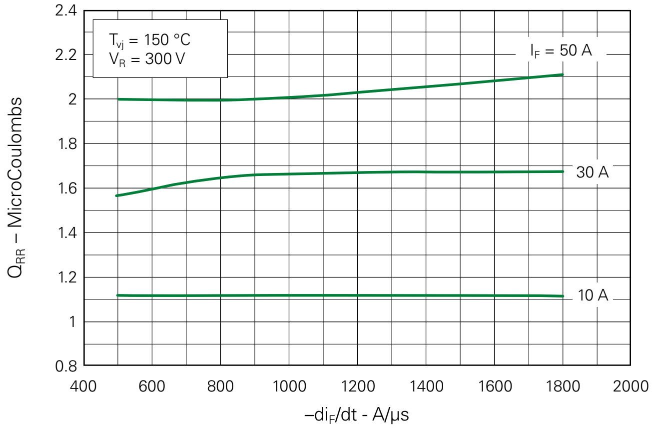


Fig. 25. Peak Reverse Current I_{RM} vs. $-di_F/dt$

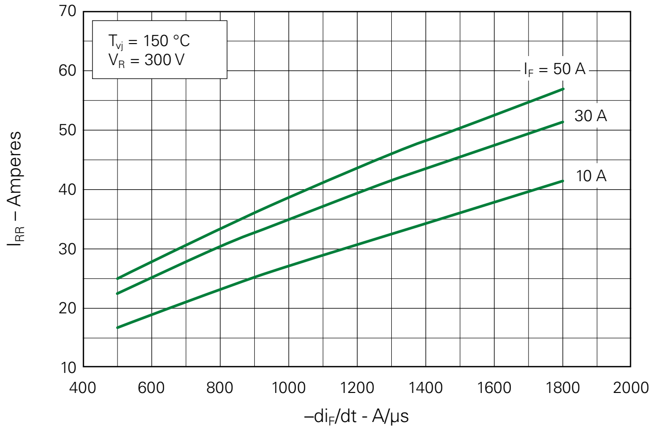


Fig. 26. Recover Time t_{RR} vs. $-di_F/dt$

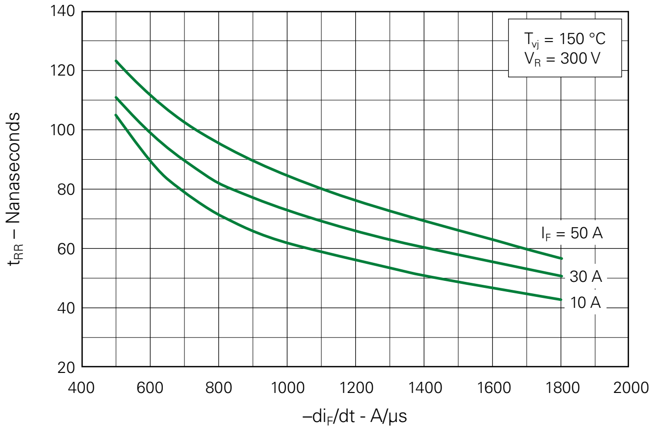


Fig. 27. Recovery Energy E_{REC} vs. $-di_F/dt$

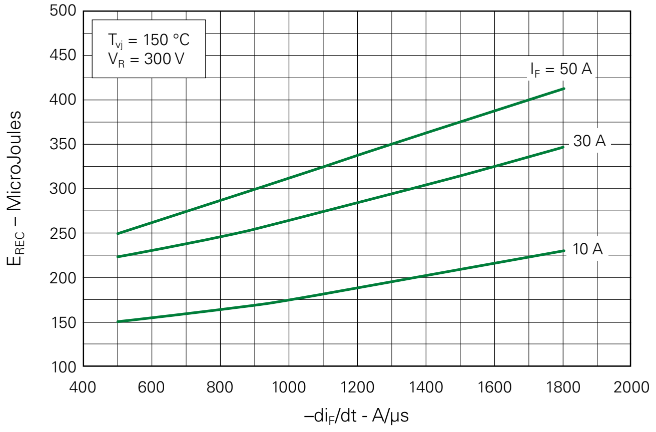
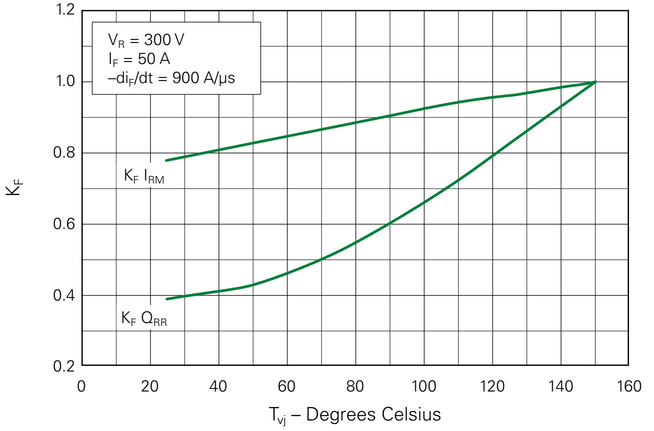
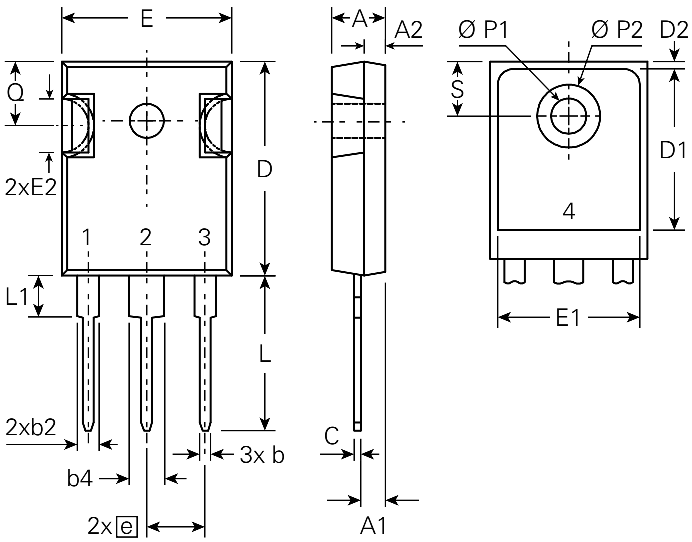


Fig. 28. Dynamic Parameters Q_{RR}, I_{RM} vs. Virtual Junction Temperature T_{vj}



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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