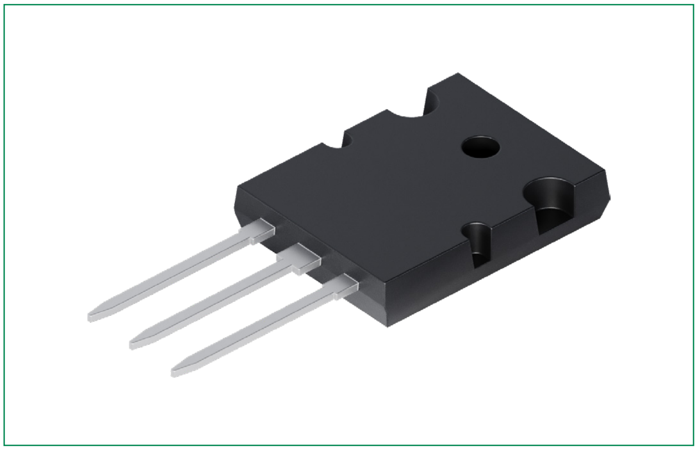
IXYK85N120C4H1

1200 V, 85 A XPT™ Gen4 IGBT with Sonic Diode

High Speed Through IGBT for 20 – 50 kHz Switching



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.

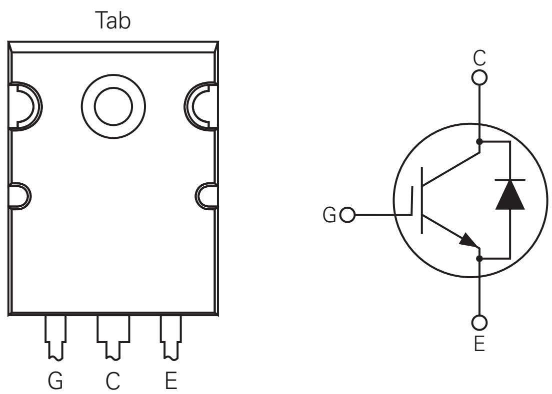
Features & Benefits:

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

Applications:

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

Pinout Diagram (TO-264)



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

Product Summary

Characteristic	Value	Unit
V_{CES}	1200	V
I_{C110}	85	A
$V_{CE(sat)}$	2.50	V
$t_{fi(typ)}$	37	ns

Revised: XZ 10/13/2023

Maximum Ratings

Symbol	Characteristic	Conditions	Value	Unit
V_{CES}	Collector-Emitter Voltage	T_{VJ} = 25 °C to 175 °C	1200	V
V_{GES}	Gate-Emitter Voltage	Continuous	±20	V
V_{GEM}	Transient Gate-Emitter Voltage	Transient, < 1 ms	±30	V
I_{C25}	Continuous Collector Current	T_C = 25 °C	220	A
I_{LRMS}	Terminal Current Limit	–	160	A
I_{C110}	Continuous Collector Current	T_C = 110 °C	85	A
I_{F110}	Diode Forward Current	T_C = 110 °C	140	A
I_{CM}	Pulsed Collector Current	T_C = 25 °C, 1 ms	420	A
SSOA (RBSOA)	Switching Safe Operating Area (Reverse Biased Safe Operating Area)	V_{GE} = 15 V, T_{VJ} = 150 °C, R_G = 5 Ω, Clamped Inductive Load, I_{CM} = $V_{CE} \leq 0.8 \times V_{CES}$	170	A
P_C	Collector Power Dissipation	T_C = 25 °C	1150	W
T_{VJ}	Virtual Junction Temperature	–	–55 to 175	°C
T_{stg}	Storage Temperature	–	–55 to 175	
T_L	Maximum Lead Temperature for Soldering	1.6 mm (0.062 in.) from Case for 10 s	300	°C
M_d	Mounting Torque	–	1.13 / 10	Nm/lb.in
W	Weight	–	10	g

Thermal Characteristics

Symbol	Characteristic	Conditions	Value			Unit
			Min.	Typ.	Max.	
$R_{th, JC}$	Thermal Resistance, junction-to-case, IGBT	–	–	–	0.13	K/W
$R_{th, CS}$	Thermal Resistance, case-to-heat sink	–	–	0.15	–	K/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	1200	–	–	V
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	I_C = 250 µA, V_{CE} = V_{GE}	4.0	–	6.5	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	–	–	25	µA
		V_{CE} = V_{CES}, V_{GE} = 0 V, T_{VJ} = 150 °C	–	–	5	mA
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage[1]	I_C = 85 A, V_{GE} = 15 V	–	2.00	2.50	V
		I_C = 85 A, V_{GE} = 15 V, T_{VJ} = 150 °C	–	2.45	–	V

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

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

Symbol	Characteristic	Conditions		Value			Unit
				Min.	Typ.	Max.	
g_{fs}	Transconductance[1]	I_C = 60 A, V_{CE} = 10 V		30	50	–	S
C_{ies}	Input Capacitance	V_{GE} = 0 V, V_{CE} = 25 V, f = 1 MHz		–	4030	–	pF
C_{oes}	Output Capacitance			–	355	–	
C_{res}	Reverse Transfer Capacitance			–	135	–	
$Q_{g(on)}$	Total Gate Charge	V_{GE} = 15 V, V_{CE} = 0.5 x $V_{CES,}$ I_C = 85 A		–	192	–	nC
Q_{ge}	Gate-Emitter Charge			–	34	–	
Q_{gc}	Gate-Collector Charge			–	72	–	
$t_{d(on)}$	Turn-on Delay Time[2]	Inductive Load, V_{GE} = 15 V, V_{CE} = 0.5 x V_{CES}, I_C = 50 A, $R_{G(ext)}$ = 5 Ω	T_{VJ} = 25 °C	–	35	–	ns
			T_{VJ} = 150 °C	–	27	–	
t_{ri}	Turn-on Rise Time[2]		T_{VJ} = 25 °C	–	60	–	ns
			T_{VJ} = 150 °C	–	45	–	
E_{on}	Turn-on Energy[2]		T_{VJ} = 25 °C	–	4.30	–	mJ
			T_{VJ} = 150 °C	–	6.15	–	
$t_{d(off)}$	Turn-off Delay Time[2]		T_{VJ} = 25 °C	–	280	–	ns
			T_{VJ} = 150 °C	–	260	–	
t_{fi}	Turn-off Fall Time[2]		T_{VJ} = 25 °C	–	37	–	ns
			T_{VJ} = 150 °C	–	110	–	
E_{off}	Turn-off Energy[2]		T_{VJ} = 25 °C	–	2.00	–	mJ
			T_{VJ} = 150 °C	–	3.30	–	

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 = 60 A, V_{GE} = 0 V	–	1.80	2.40	V
		I_F = 60 A, V_{GE} = 0 V, T_{VJ} = 150 °C	–	1.65	–	
I_{RM}	Reverse Recovery Current	I_F = 50 A, V_{GE} = 0 V, T_{VJ} = 150 °C -di_F/dt = 750 A/µs, V_R = 600 V	–	42	–	A
t_{rr}	Reverse Recovery Time		–	265	–	ns
$R_{th, JC}$	Thermal Resistance, junction-to-case	–	–	–	0.16	K/W

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

Characteristic Curves

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

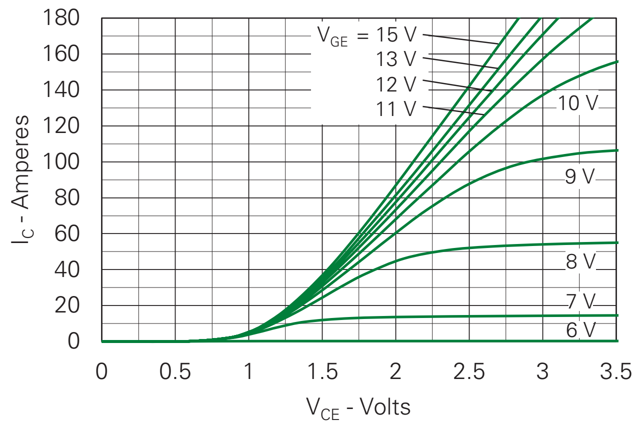


Fig. 2. Extended Output Characteristics @ T_{VJ} = 25 °C

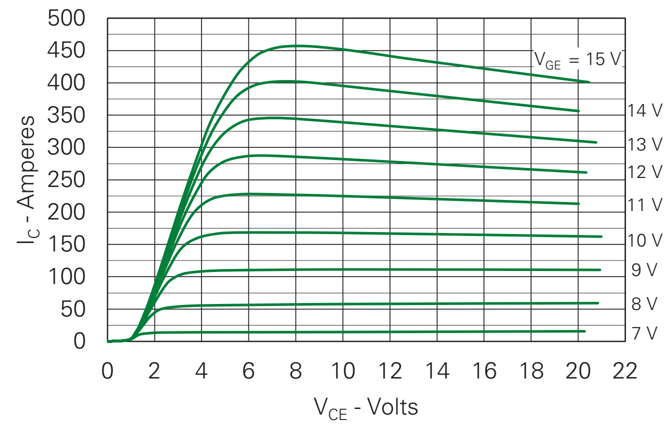


Fig. 3. Output Characteristics @ T_{VJ} = 150 °C

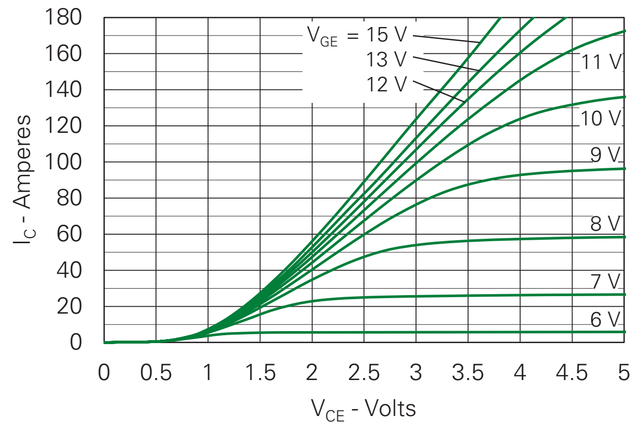


Fig. 4. Dependence of $V_{CE(sat)}$ on Junction Temperature

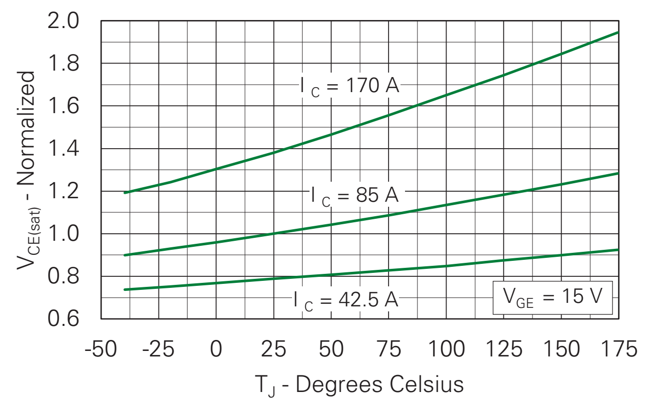


Fig. 5. Collector-to-Emitter Voltage vs. Gate-to-Emitter Voltage

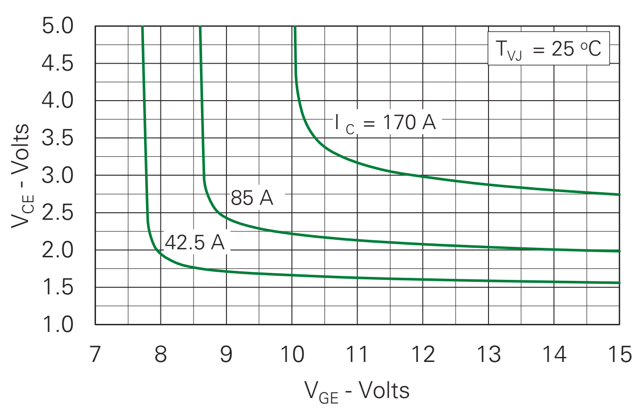


Fig. 6. Input Admittance

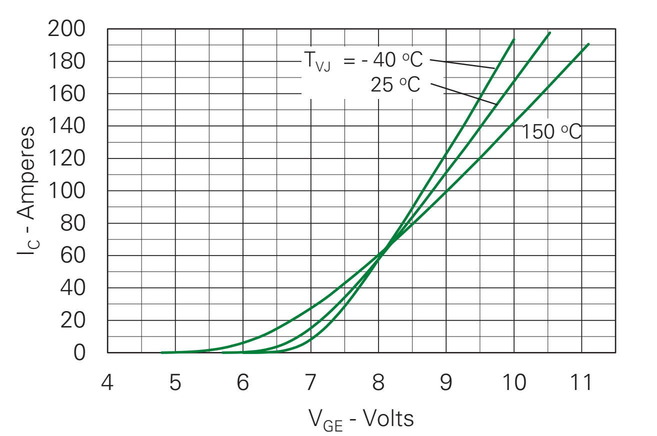


Fig. 7. Transconductance

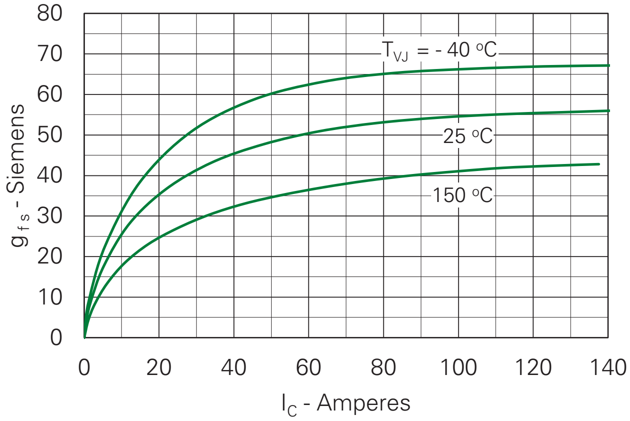


Fig. 8. Gate Charge

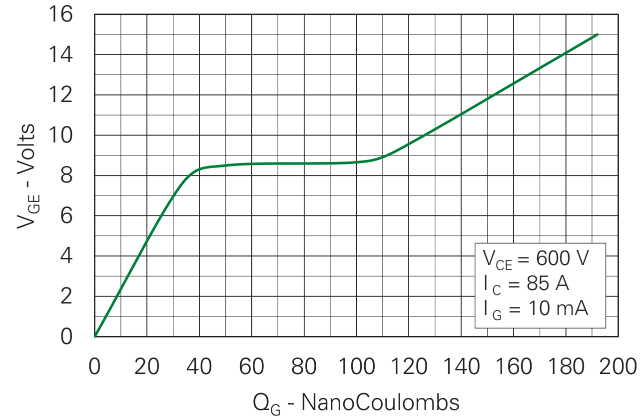


Fig. 9. Capacitance

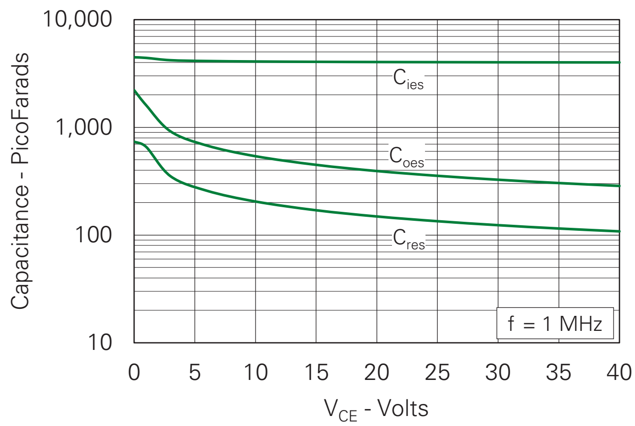


Fig. 10. Reverse-Bias Safe Operating Area

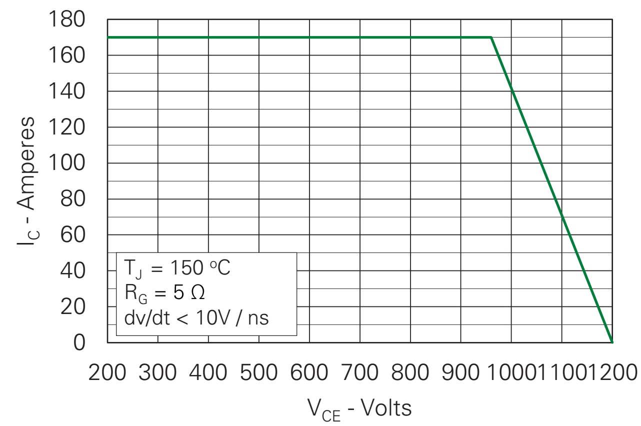


Fig. 11. Maximum Transient Thermal Impedance (IGBT)

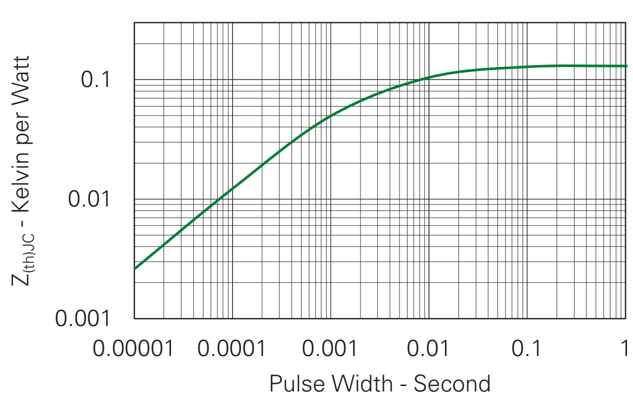


Fig. 12. Inductive Switching Energy Loss vs. Collector Current

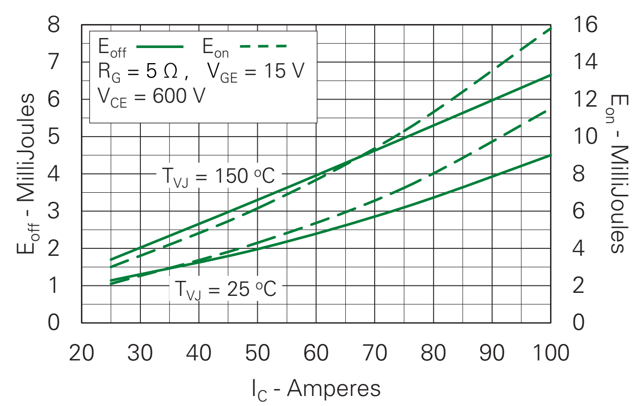


Fig. 13. Inductive Switching Energy Loss vs. Collector-Emitter Voltage

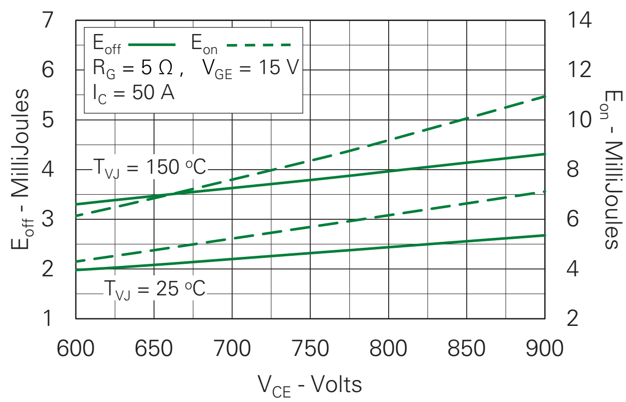


Fig. 14. Inductive Switching Energy Loss vs. Gate Resistance

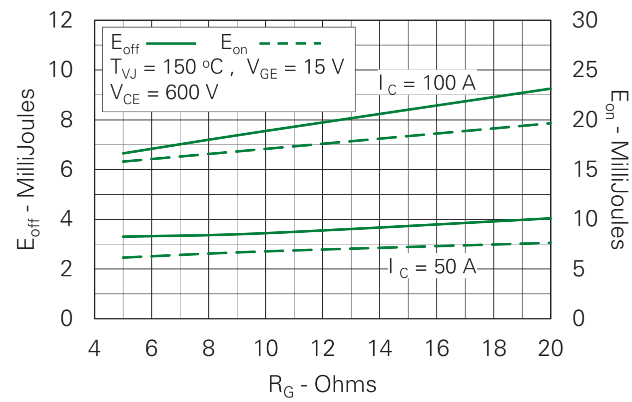


Fig. 15. Inductive Switching Energy Loss vs. Junction Temperature

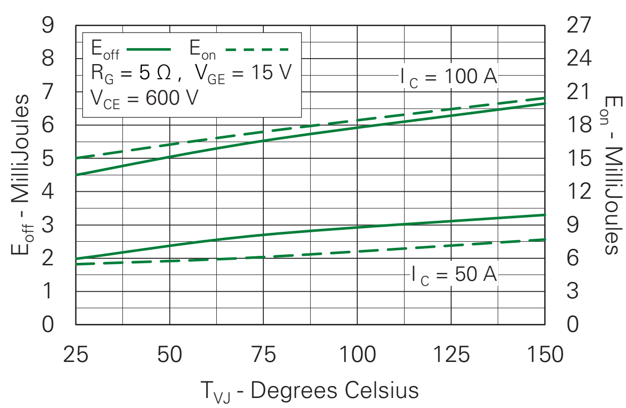


Fig. 16. Inductive Turn-off Switching Times vs. Gate Resistance

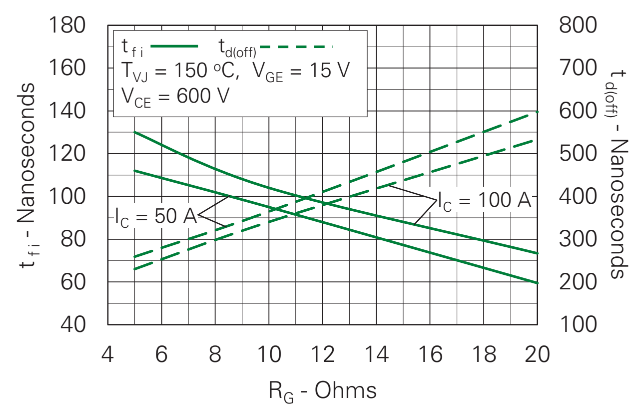


Fig. 17. Inductive Turn-off Switching Times vs. Collector Current

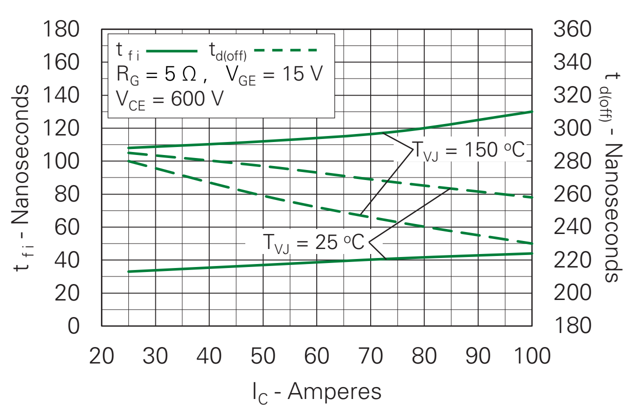
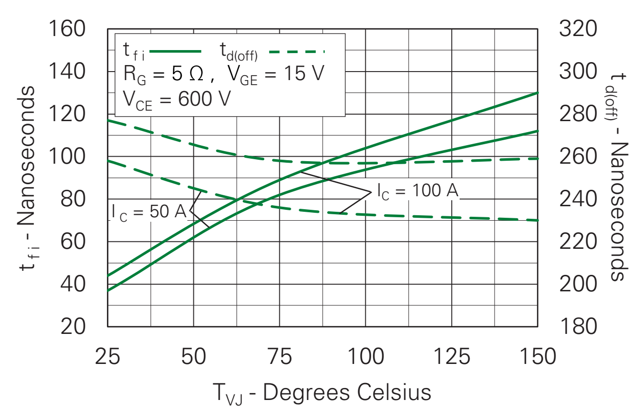


Fig. 18. Inductive Turn-off Switching Times vs. Junction Temperature



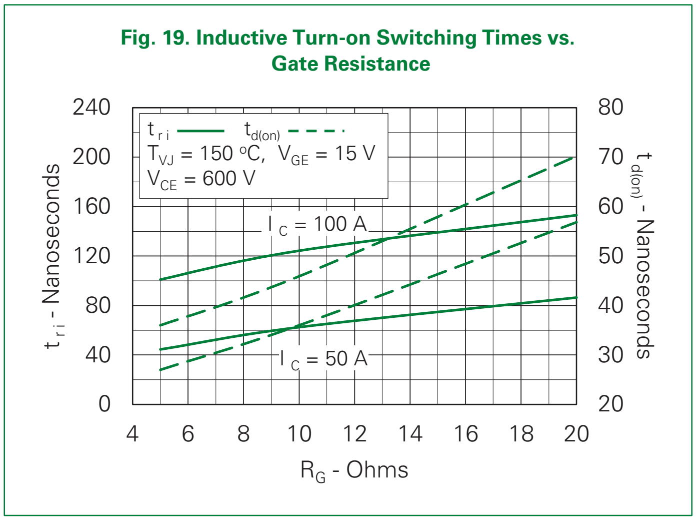


Fig. 19. Inductive Turn-on Switching Times vs. Gate Resistance
t r i
td(on)
TVJ = 150 ºC, VGE = 15 V
VCE = 600 V
I C = 100 A
I C = 50 A
t r i - Nanoseconds
t d(on) - Nanoseconds
RG - Ohms
240
200
160
120
80
40
0
80
70
60
50
40
30
20
4
6
8
10
12
14
16
18
20

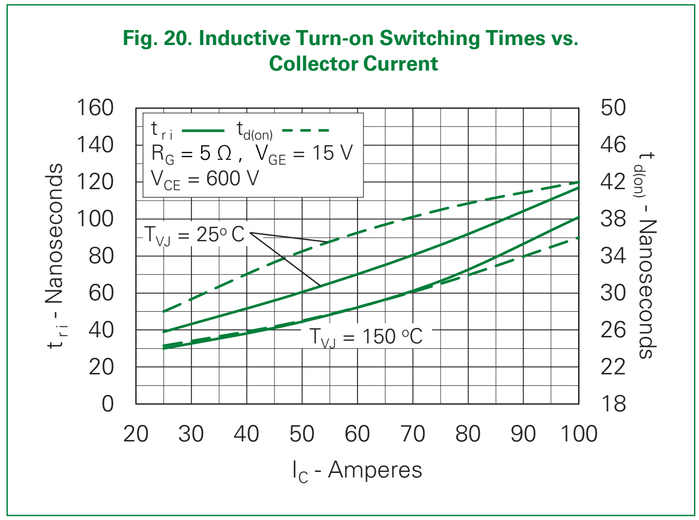


Fig. 20. Inductive Turn-on Switching Times vs. Collector Current
t r i
td(on)
RG = 5 Ω , VGE = 15 V
VCE = 600 V
TVJ = 25º C
TVJ = 150 ºC
t r i - Nanoseconds
t d(on) - Nanoseconds
IC - Amperes
160
140
120
100
80
60
40
20
0
50
46
42
38
34
30
26
22
18
20
30
40
50
60
70
80
90
100

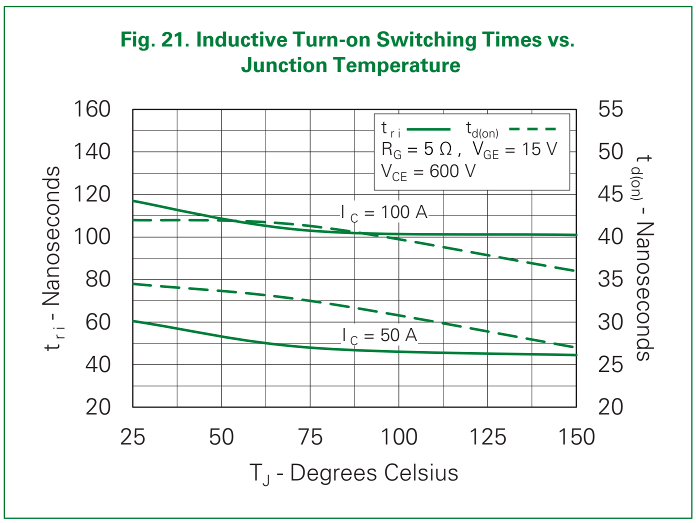


Fig. 21. Inductive Turn-on Switching Times vs. Junction Temperature
t r i
td(on)
RG = 5 Ω , VGE = 15 V
VCE = 600 V
I C = 100 A
I C = 50 A
t r i - Nanoseconds
t d(on) - Nanoseconds
TJ - Degrees Celsius
160
140
120
100
80
60
40
20
55
50
45
40
35
30
25
20
25
50
75
100
125
150

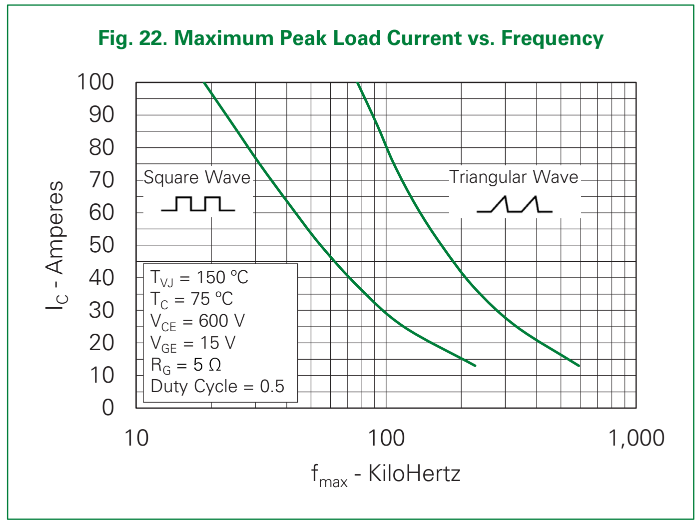


Fig. 22. Maximum Peak Load Current vs. Frequency
Square Wave
Triangular Wave
TVJ = 150 ºC
TC = 75 ºC
VCE = 600 V
VGE = 15 V
RG = 5 Ω
Duty Cycle = 0.5
IC - Amperes
fmax - KiloHertz
100
90
80
70
60
50
40
30
20
10
0
10
100
1,000

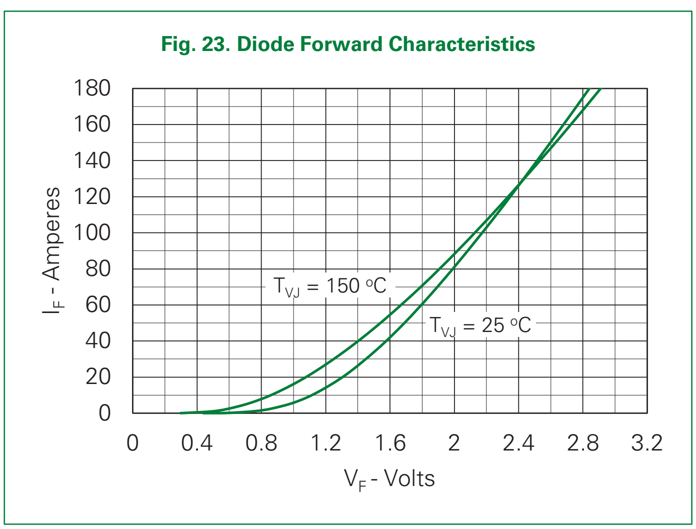


Fig. 23. Diode Forward Characteristics
TVJ = 150 ºC
TVJ = 25 ºC
IF - Amperes
VF - Volts
180
160
140
120
100
80
60
40
20
0
0
0.4
0.8
1.2
1.6
2
2.4
2.8
3.2

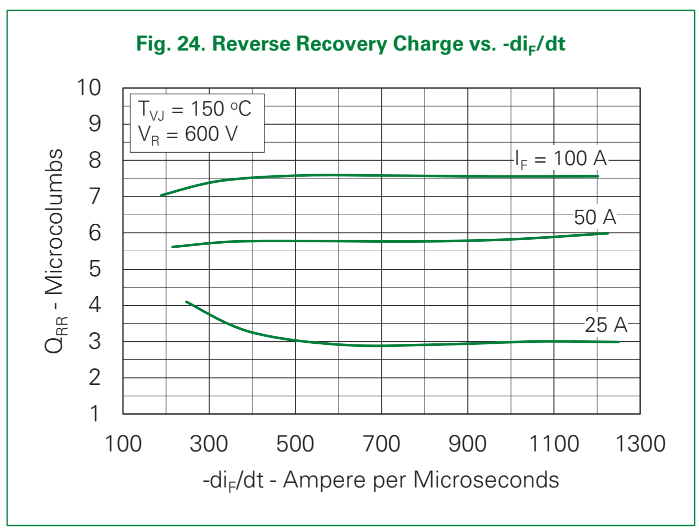


Fig. 24. Reverse Recovery Charge vs. -diF/dt
TVJ = 150 ºC
VR = 600 V
IF = 100 A
50 A
25 A
QRR - Microcolumbs
-diF/dt - Ampere per Microseconds
10
9
8
7
6
5
4
3
2
1
100
300
500
700
900
1100
1300

Fig. 25 Reverse Recovery Current vs. -di_F/dt

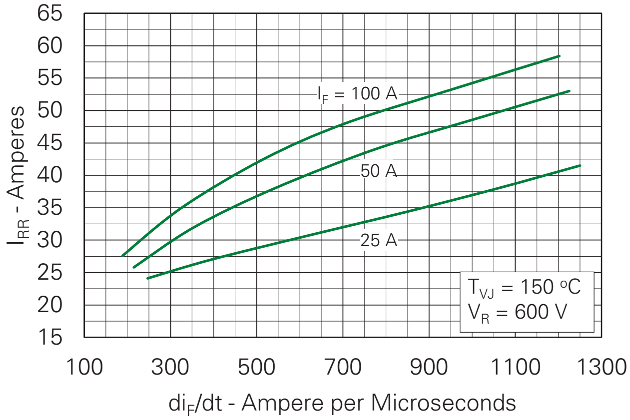


Fig. 26. Reverse Recovery Time vs. -di_F/dt

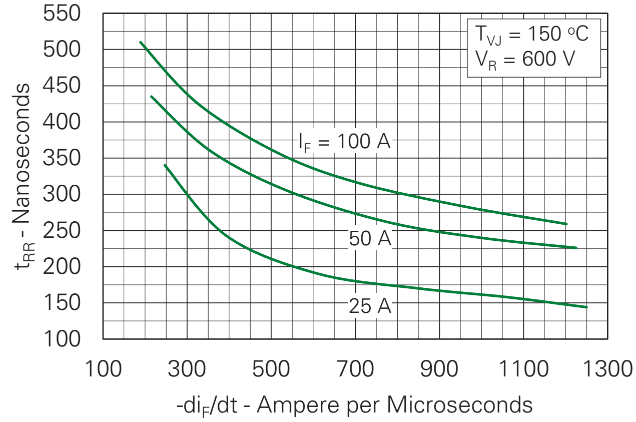


Fig. 27. Dynamic Parameters Q_{RR}, I_{RR} vs. Junction Temperature

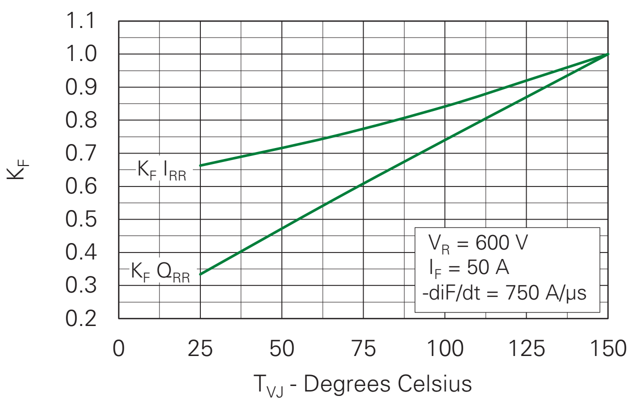
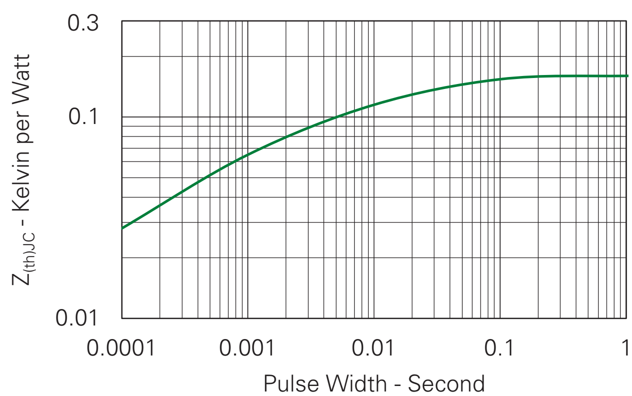
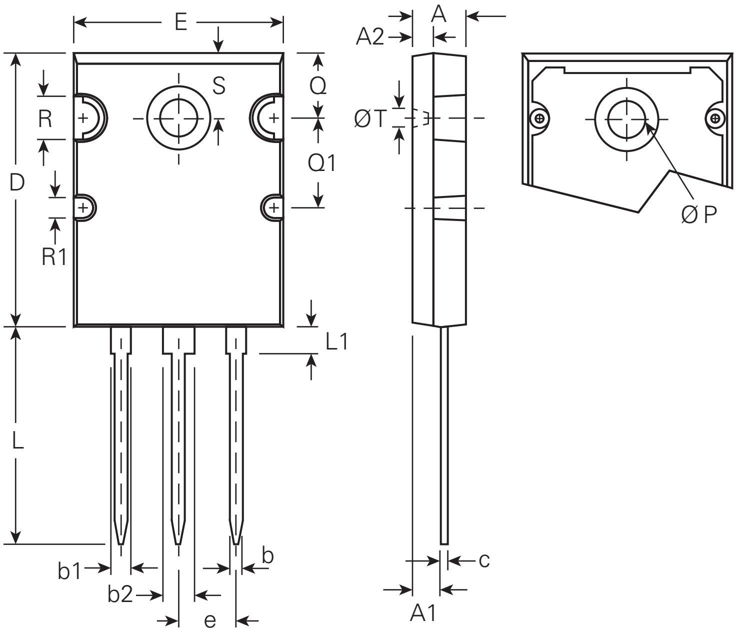


Fig. 28. Maximum Transient Thermal Impedance (Diode)



Part Outline Drawing (TO-264)



Symbol	Inches			Millimeters		
	Min.	Typical	Max.	Min.	Typical	Max
A	0.190	–	0.202	4.82	–	5.13
A1	0.100	–	0.114	2.54	–	2.89
A2	0.079	–	0.083	2.00	–	2.10
b	0.044	–	0.056	1.12	–	1.42
b2	0.114	–	0.122	2.90	–	3.09
C	0.021	–	0.033	0.53	–	0.83
D	1.020	–	1.030	25.91	–	26.16
E	0.780	–	0.786	19.81	–	19.96
e	0.215 BSC			5.45 BSC		
J	0.000	–	0.010	0.00	–	0.25
K	0.000	–	0.010	0.00	–	0.25
L	0.800	–	0.820	20.32	–	20.83
L1	0.090	–	0.102	2.29	–	2.59
Ø P	0.125	–	0.105	3.17	–	2.66
Q	0.239	–	0.247	6.07	–	6.27
Q1	0.330	–	0.342	8.38	–	8.69
R	0.150	–	0.170	3.81	–	4.32
R1	0.070	–	0.090	1.78	–	2.29
S	0.238	–	0.248	6.04	–	6.30
Ø T	0.062	–	0.072	1.57	–	1.83