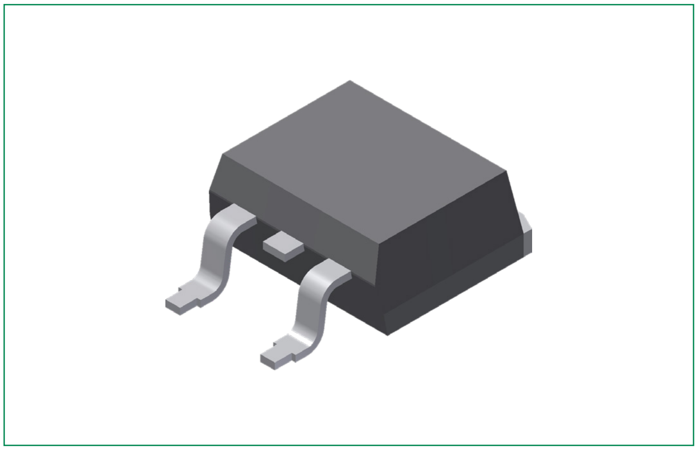
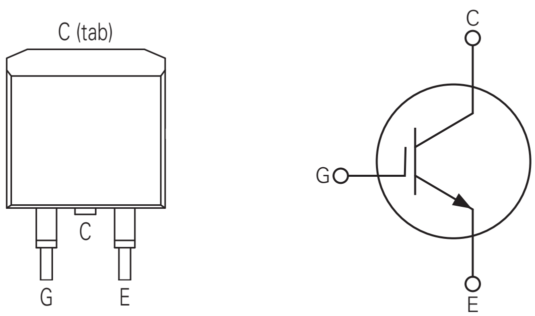
IXYA50N65C5

650 V, 50 A XPT™ Gen5 IGBT

Extreme Light Punch Through IGBT for 20–60 kHz Switching



Pinout Diagram (TO-263AB)



G: Gate; **C:** Collector; **E:** Emitter; **tab:** 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 20–60kHz Switching
- High Surge Current Capability
- Square RBSOA
- International Standard Package
- High Power Density
- Extremely Rugged
- Low Gate Drive Requirement

Applications:

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

Product Summary

Characteristic	Value	Unit
V_{CES}	650	V
I_{C110}	50	A
$V_{CE(sat)}$	2.0	V
$t_{fi(typ)}$	28	ns

Maximum Ratings

Symbol	Characteristic	Conditions	Value	Unit
V_{CES}	Collector-Emitter Voltage	T_J = 25°C to 175°C	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	110	A
I_{C110}	Continuous Collector Current	T_C = 110°C	50	A
I_{CM}	Pulsed Collector Current	T_C = 25°C, 1 ms	240	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} @ $V_{CE} \le V_{CES}$	100	A
P_C	Collector Power Dissipation	T_C = 25°C	650	W
T_J	Junction Temperature	–	-55 to 175	°C
T_{JM}	Maximum Junction Temperature	–	175	°C
T_{stg}	Storage Temperature	–	-55 to 175	°C
T_{SOLD}	Soldering Temperature	Plastic Body for 10 s	260	°C
W	Weight	–	2.5	g

Thermal Characteristics

Symbol	Characteristic	Value			Unit
		Min.	Typ.	Max.	
$R_{th,\ JC}$	Thermal Resistance, junction-to-case	–	–	0.38	°C/W
$R_{th,\ CS}$	Thermal Resistance, case-to-heat sink	–	0.21	–	°C/W

Electrical Characteristics – Static (T_J = 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, $V_{CE} = V_{GE}$	3.7	–	5.8	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	–	–	5	µA
		$V_{CE} = V_{CES}$, V_{GE} = 0 V, T_J = 150°C	–	–	750	µA
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage[1]	I_C = 36 A, V_{GE} = 15 V	–	1.67	2.00	V
		I_C = 36 A, V_{GE} = 15 V, T_J = 150°C	–	1.93	–	V

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

Electrical Characteristics – Dynamic (T_J = 25°C unless otherwise specified)

Symbol	Characteristic	Conditions		Value			Unit
				Min.	Typ.	Max.	
g_{fs}	Transconductance[1]	I_C = 36 A, V_{CE} = 10 V		20	34	–	S
C_{ies}	Input Capacitance	V_{GE} = 0 V, V_{CE} = 25 V, f = 1MHz		–	2060	–	pF
C_{oes}	Output Capacitance			–	100	–	
C_{res}	Reverse Transfer Capacitance			–	70	–	
$Q_{g(on)}$	Total Gate Charge	V_{GE} = 15 V, V_{CE} = 0.5 x $V_{CES,}$ I_C = 50 A		–	117	–	nC
Q_{ge}	Gate-Emitter Charge			–	16	–	
Q_{gc}	Gate-Collector Charge			–	55	–	
$t_{d(on)}$	Turn-on Delay Time[2]	Inductive Load, V_{GE} = 15 V, V_{CE} = 300 V, I_C = 25 A, $R_{G(ext)}$ = 5 Ω	T_J = 25°C	–	25	–	ns
			T_J = 150°C	–	19	–	
t_{ri}	Turn-on Rise Time[2]		T_J = 25°C	–	37	–	ns
			T_J = 150°C	–	27	–	
E_{on}	Turn-on Energy[2]		T_J = 25°C	–	0.36	–	mJ
			T_J = 150°C	–	0.66	–	
$t_{d(off)}$	Turn-off Delay Time[2]		T_J = 25°C	–	170	–	ns
			T_J = 150°C	–	146	–	
t_{fi}	Turn-off Fall Time[2]		T_J = 25°C	–	28	–	ns
			T_J = 150°C	–	26	–	
E_{off}	Turn-off Energy[2]		T_J = 25°C	–	0.26	–	mJ
			T_J = 150°C	–	0.30	–	

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_J, or R_G.

Characteristic Curves

Fig. 1. Output Characteristics @ $T_J = 25^oC$

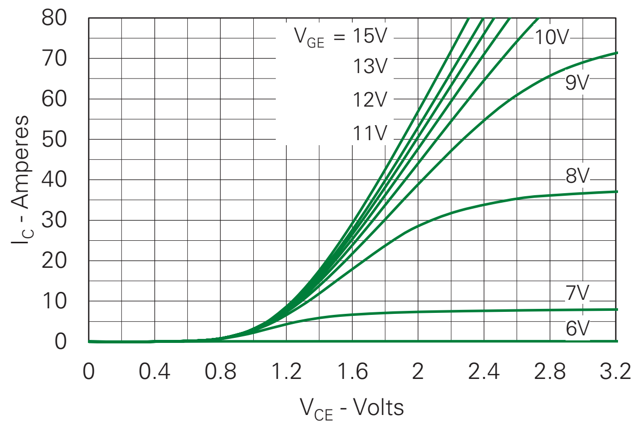


Fig. 2. Extended Output Characteristics @ $T_J = 25^oC$

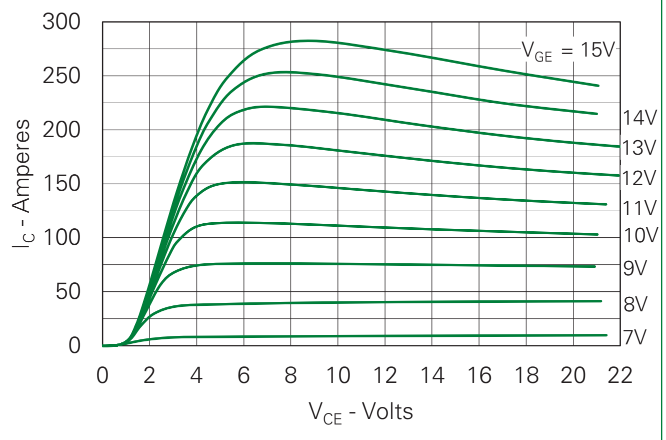


Fig. 3. Output Characteristics @ $T_J = 150^oC$

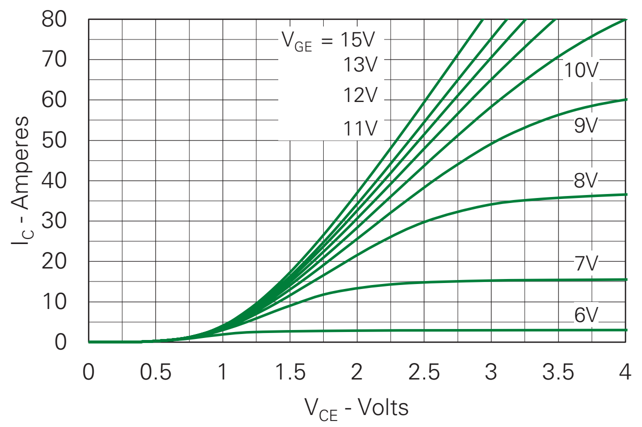


Fig. 4. Dependence of $V_{CE(sat)}$ on Junction Temperature

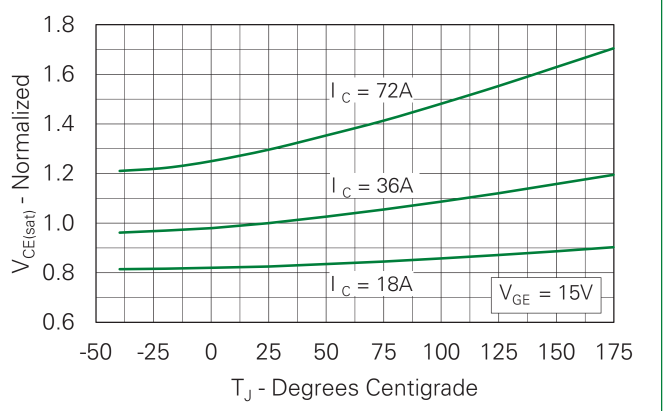


Fig. 5. Collector-to-Emitter Voltage vs. Gate-to-Emitter Voltage

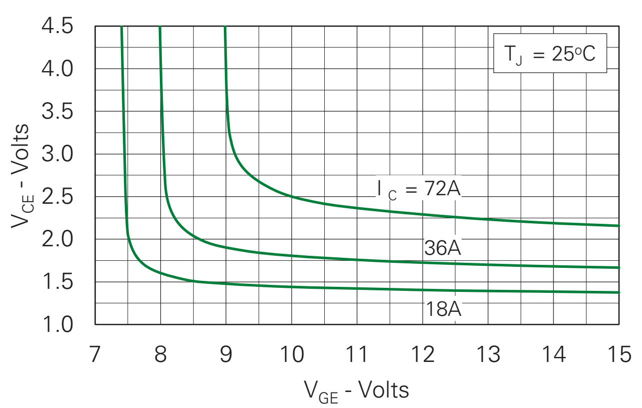
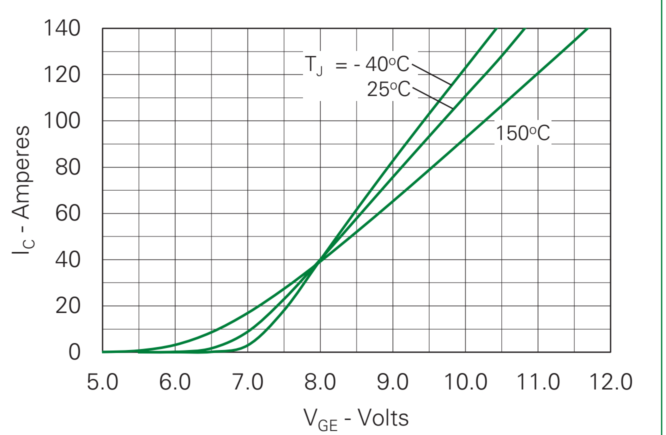


Fig. 6. Input Admittance



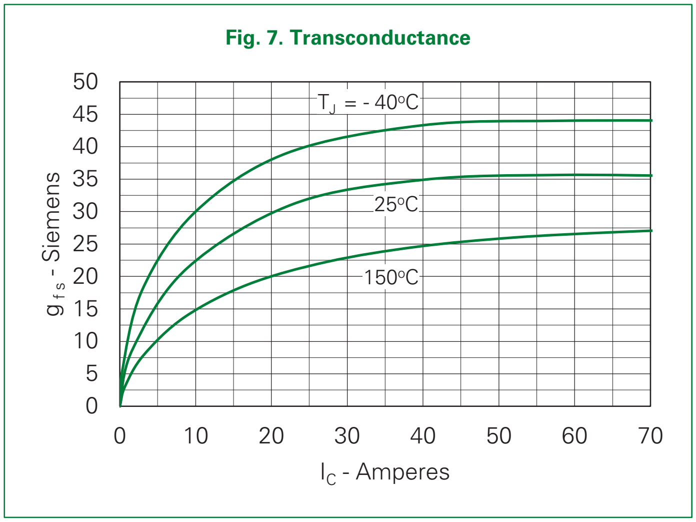


Fig. 7. Transconductance
T_J = - 40ºC
25ºC
150ºC
g_fs - Siemens
I_C - Amperes
0
5
10
15
20
25
30
35
40
45
50
0
10
20
30
40
50
60
70

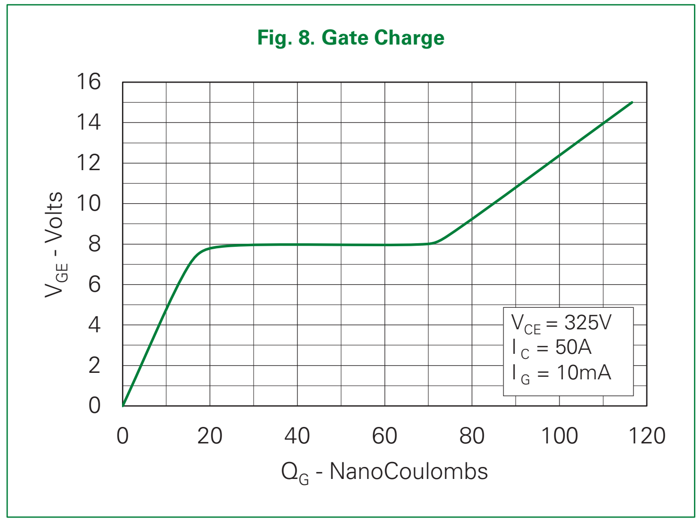


Fig. 8. Gate Charge
V_CE = 325V
I_C = 50A
I_G = 10mA
V_GE - Volts
Q_G - NanoCoulombs
0
2
4
6
8
10
12
14
16
0
20
40
60
80
100
120

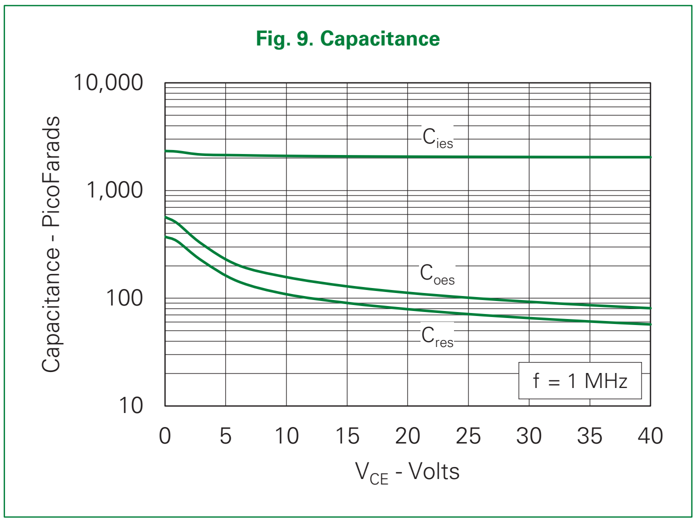


Fig. 9. Capacitance
C_ies
C_oes
C_res
f = 1 MHz
Capacitance - PicoFarads
V_CE - Volts
10
100
1,000
10,000
0
5
10
15
20
25
30
35
40

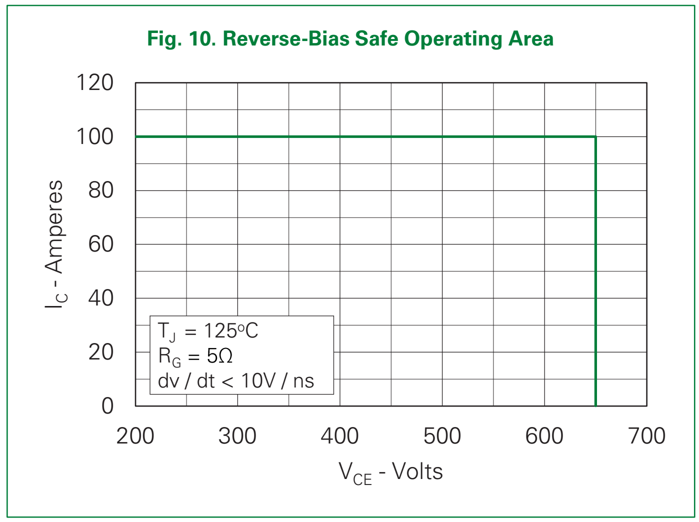


Fig. 10. Reverse-Bias Safe Operating Area
T_J = 125ºC
R_G = 5Ω
dv / dt < 10V / ns
I_C - Amperes
V_CE - Volts
0
20
40
60
80
100
120
200
300
400
500
600
700

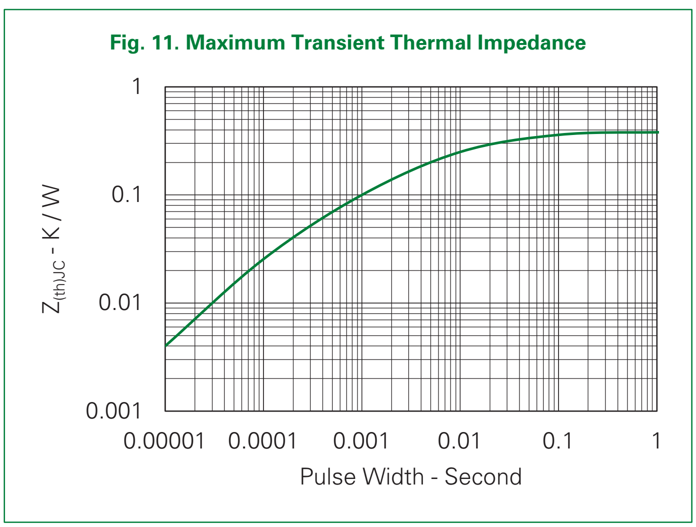


Fig. 11. Maximum Transient Thermal Impedance
Z_(th)JC - K / W
Pulse Width - Second
0.001
0.01
0.1
1
0.00001
0.0001
0.001
0.01
0.1
1

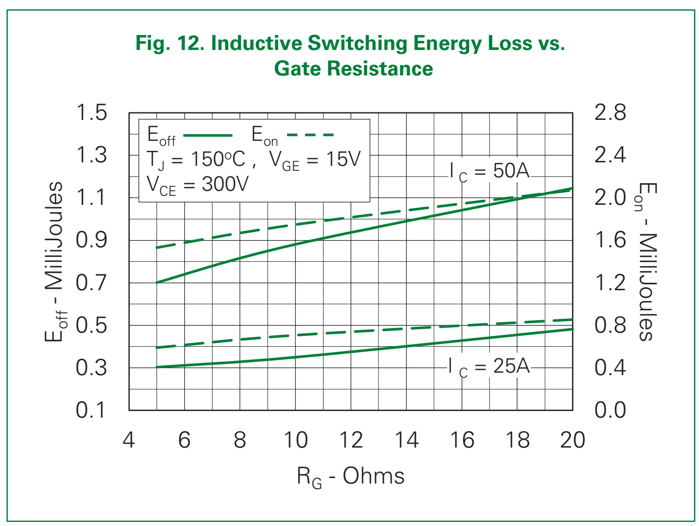


Fig. 12. Inductive Switching Energy Loss vs. Gate Resistance
E_off
E_on
T_J = 150ºC , V_GE = 15V
V_CE = 300V
I_C = 50A
I_C = 25A
E_off - MilliJoules
E_on - MilliJoules
R_G - Ohms
0.1
0.3
0.5
0.7
0.9
1.1
1.3
1.5
0.0
0.4
0.8
1.2
1.6
2.0
2.4
2.8
4
6
8
10
12
14
16
18
20

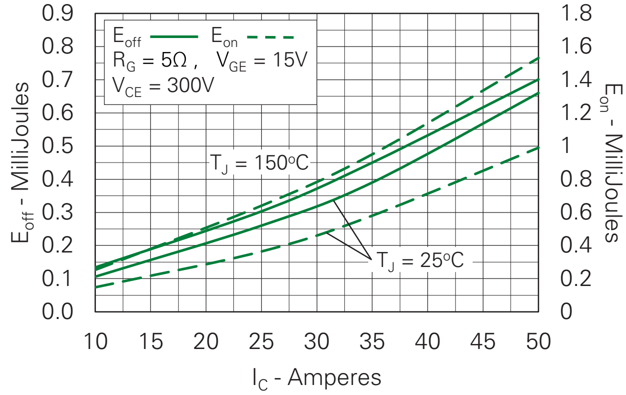


Fig. 13. Inductive Switching Energy Loss vs. Collector Current
Eoff Eon
RG = 5Ω , VGE = 15V
VCE = 300V
TJ = 150ºC
TJ = 25ºC
Eoff - MilliJoules
Eon - MilliJoules
IC - Amperes

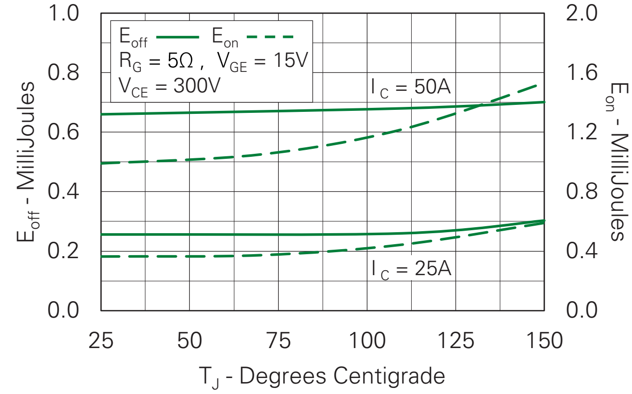


Fig. 14. Inductive Switching Energy Loss vs. Junction Temperature
Eoff Eon
RG = 5Ω , VGE = 15V
VCE = 300V
I C = 50A
I C = 25A
Eoff - MilliJoules
Eon - MilliJoules
TJ - Degrees Centigrade

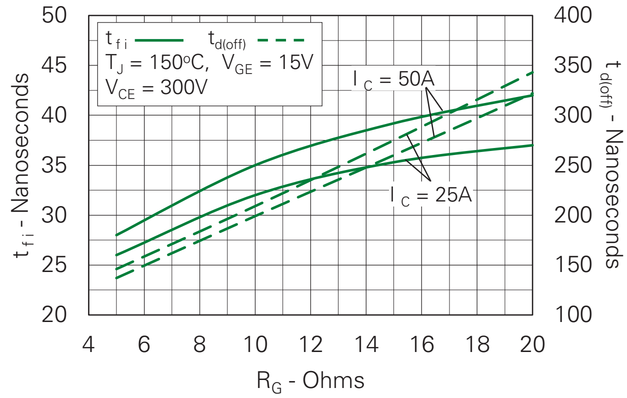


Fig. 15. Inductive Turn-off Switching Times vs. Gate Resistance
t f i td(off)
TJ = 150ºC, VGE = 15V
VCE = 300V
I C = 50A
I C = 25A
t f i - Nanoseconds
t d(off) - Nanoseconds
RG - Ohms

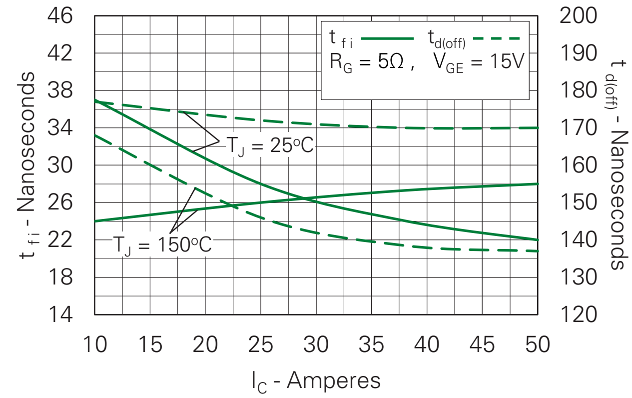


Fig. 16. Inductive Turn-off Switching Times vs. Collector Current
t f i td(off)
RG = 5Ω , VGE = 15V
TJ = 25ºC
TJ = 150ºC
t f i - Nanoseconds
t d(off) - Nanoseconds
IC - Amperes

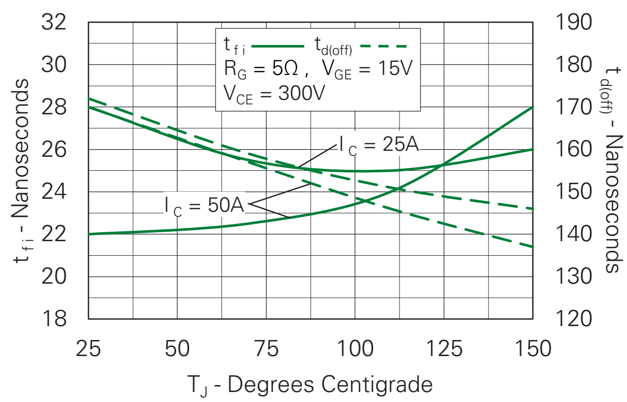


Fig. 17. Inductive Turn-off Switching Times vs. Junction Temperature
t f i td(off)
RG = 5Ω , VGE = 15V
VCE = 300V
I C = 25A
I C = 50A
t f i - Nanoseconds
t d(off) - Nanoseconds
TJ - Degrees Centigrade

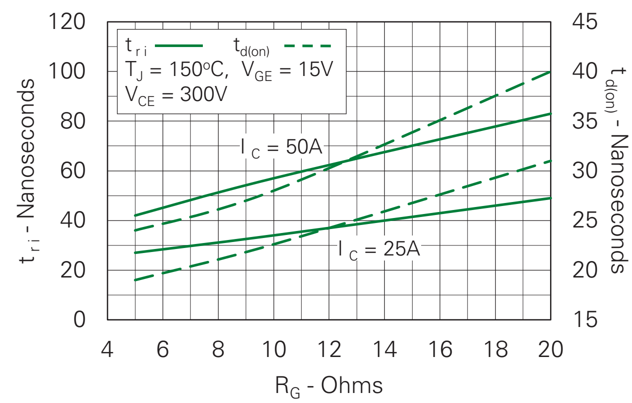


Fig. 18. Inductive Turn-on Switching Times vs. Gate Resistance
t r i td(on)
TJ = 150ºC, VGE = 15V
VCE = 300V
I C = 50A
I C = 25A
t r i - Nanoseconds
t d(on) - Nanoseconds
RG - Ohms

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

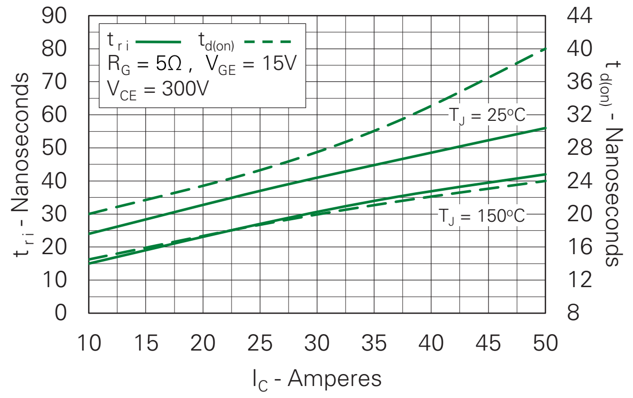


Fig. 20. Inductive Turn-on Switching Times vs. Junction Temperature

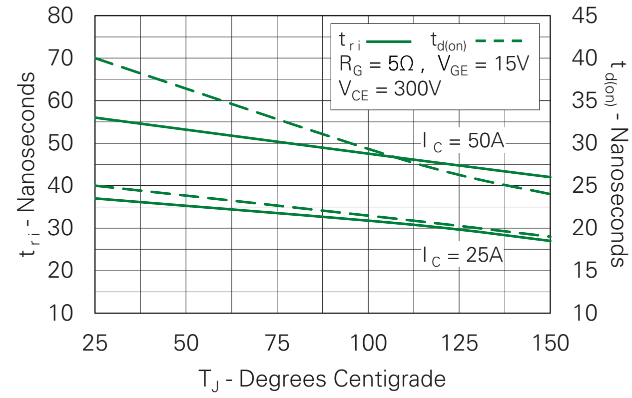
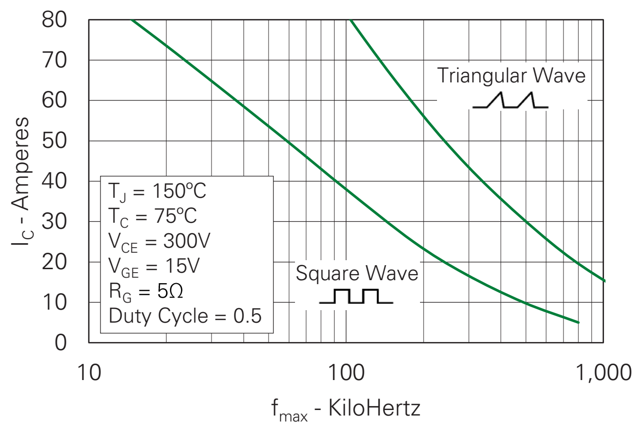
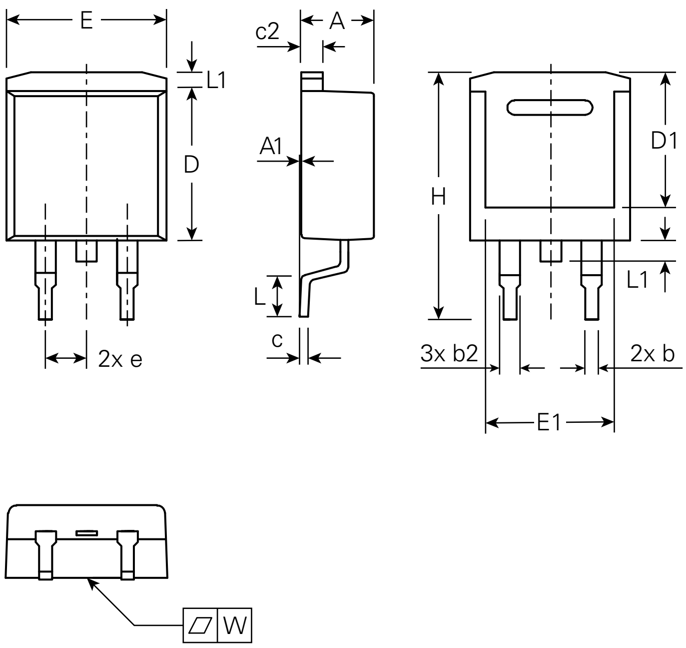


Fig. 21. Maximum Peak Load Current vs. Frequency



Part Outline Drawing (TO-263AB)



Symbol	Inches			Millimeters		
	Min.	Typical	Max.	Min.	Typical	Max
A	0.160	–	0.190	4.06	–	4.83
A1	–	0.004	–	–	0.10	–
b	0.020	–	0.039	0.51	–	0.99
b2	0.045	–	0.055	1.14	–	1.40
c	0.016	–	0.029	0.40	–	0.74
c2	0.045	–	0.055	1.14	–	1.40
D	0.330	–	0.370	8.38	–	9.40
D1	0.315	–	0.350	8.00	–	8.89
E	0.380	–	0.410	9.65	–	10.41
E1	0.245	–	0.320	6.22	–	8.13
e	0.100 BSC			2.54 BSC		
H	0.575	–	0.625	14.61	–	15.88
L	0.070	–	0.110	1.78	–	2.79
L1	0.040	–	0.066	1.02	–	1.68
W	–	0.0008	0.002	–	0.02	0.04