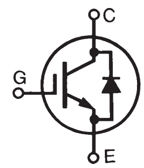
IXYS

High-Gain IGBT w/ Diode

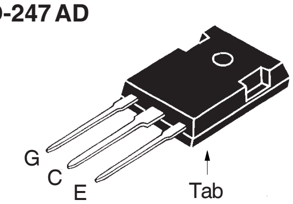
IXGH24N60C4D1

V_{CES} = 600V
I_{C110} = 24A
$V_{CE(sat)}$ ≤ 2.70V
$t_{fi(typ)}$ = 68ns

High-Speed PT Trench IGBT



TO-247 AD



G = Gate   C = Collector
E = Emitter   Tab = Collector

Symbol	Test Conditions	Maximum Ratings	
V_{CES}	T_J = 25°C to 150°C	600	V
V_{CGR}	T_J = 25°C to 150°C, R_{GE} = 1MΩ	600	V
V_{GES}	Continuous	±20	V
V_{GEM}	Transient	±30	V
I_{C25}	T_C = 25°C	56	A
I_{C110}	T_C = 110°C	24	A
I_{F110}	T_C = 110°C	18	A
I_{CM}	T_C = 25°C, 1ms	130	A
SSOA (RBSOA)	V_{GE} = 15V, T_{VJ} = 125°C, R_G = 10Ω Clamped Inductive Load	I_{CM} = 48 @ ≤ V_{CES}	A
P_C	T_C = 25°C	190	W
T_J		-55 ... +150	°C
T_{JM}		150	°C
T_{stg}		-55 ... +150	°C
T_L	Maximum Lead Temperature for Soldering	300	°C
T_{SOLD}	1.6 mm (0.062in.) from Case for 10s	260	°C
M_d	Mounting Torque	1.13/10	Nm/lb.in.
Weight		6	g

Features

- Optimized for Low Switching Losses
- Square RBSOA
- Anti-Parallel Ultra Fast Diode
- International Standard Package

Advantages

- High Power Density
- Low Gate Drive Requirement

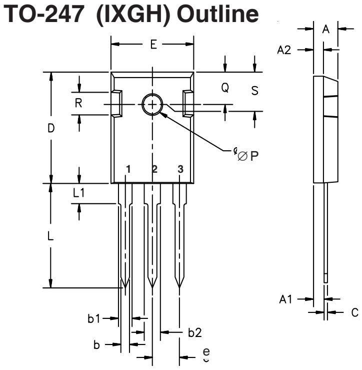
Applications

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

Symbol	Test Conditions (T_J = 25°C, Unless Otherwise Specified)	Characteristic Values Min.	Typ.	Max.	
$V_{GE(th)}$	I_C = 250µA, V_{CE} = V_{GE}	4.0		6.5	V
I_{CES}	V_{CE} = V_{CES}, V_{GE} = 0V			10	µA
	T_J = 125°C			1.5	mA
I_{GES}	V_{CE} = 0V, V_{GE} = ±20V			±100	nA
$V_{CE(sat)}$	I_C = I_{C110}, V_{GE} = 15V, Note 1		2.28	2.70	V
	T_J = 125°C		1.95		V

Symbol	Test Conditions ($T_J = 25°C$ Unless Otherwise Specified)	Characteristic Values Min.	Typ.	Max.	
g_{fs}	$I_C = I_{C110}$, $V_{CE} = 10V$, Note 1	10	17		S
C_{ies}	$V_{CE} = 25V$, $V_{GE} = 0V$, f = 1MHz		875		pF
C_{oes}			86		pF
C_{res}			28		pF
Q_g	$I_C = I_{C110}$, $V_{GE} = 15V$, $V_{CE} = 0.5 \bullet V_{CES}$		64		nC
Q_{ge}			7		nC
Q_{gc}			28		nC
$t_{d(on)}$	**Inductive Load, $T_J = 25°C$**		21		ns
t_{ri}	$I_C = I_{C110}$, $V_{GE} = 15V$		33		ns
E_{on}	$V_{CE} = 360V$, $R_G = 10\Omega$		0.40		mJ
$t_{d(off)}$	Note 2		143		ns
t_{fi}			68		ns
E_{off}			0.30	0.55	mJ
$t_{d(on)}$	**Inductive Load, $T_J = 125°C$**		20		ns
t_{ri}	$I_C = I_{C110}$, $V_{GE} = 15V$		32		ns
E_{on}	$V_{CE} = 360V$, $R_G = 10\Omega$		0.63		mJ
$t_{d(off)}$	Note 2		130		ns
t_{fi}			118		ns
E_{off}			0.50		mJ
R_{thJC}				0.65	°C/W
R_{thCS}			0.21		°C/W

TO-247 (IXGH) Outline



Terminals: 1 - Gate 2 - Collector 3 - Emitter

Dim.	Millimeter Min.	Max.	Inches Min.	Max.
A	4.7	5.3	.185	.209
A_1	2.2	2.54	.087	.102
A_2	2.2	2.6	.059	.098
b	1.0	1.4	.040	.055
b_1	1.65	2.13	.065	.084
b_2	2.87	3.12	.113	.123
C	.4	.8	.016	.031
D	20.80	21.46	.819	.845
E	15.75	16.26	.610	.640
e	5.20	5.72	0.205	0.225
L	19.81	20.32	.780	.800
L1		4.50		.177
∅P	3.55	3.65	.140	.144
Q	5.89	6.40	0.232	0.252
R	4.32	5.49	.170	.216
S	6.15	BSC	242	BSC

Reverse Diode (FRED)

Symbol	Test Conditions ($T_J = 25°C$ Unless Otherwise Specified)		Characteristic Values Min.	Typ.	Max.	
V_F	$I_F = 15A$, $V_{GE} = 0V$, Note 1				2.7	V
		$T_J = 150°C$		1.6		V
I_{RM}	$I_F = 15A$, $V_{GE} = 0V$, $-di_F/dt = 100A/\mu s$,	$T_J = 100°C$			2.6	A
t_{rr}	$V_R = 100V$	$T_J = 100°C$		100		ns
	$I_F = 1A$, $V_{GE} = 0V$, $-di_F/dt = 100A/\mu s$, $V_R = 30V$			25		ns
R_{thJC}					1.6	°C/W

Notes:

1. Pulse test, $t \leq 300\mu s$, duty cycle, $d \leq 2\%$.
2. Switching times & energy losses may increase for higher V_{CE}(clamp), T_J or R_G.

Fig. 1. Output Characteristics @ T_J = 25ºC

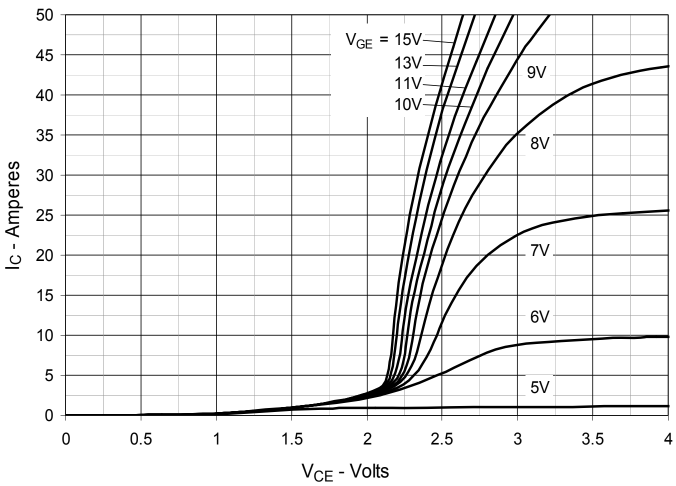


Fig. 2. Extended Output Characteristics @ T_J = 25ºC

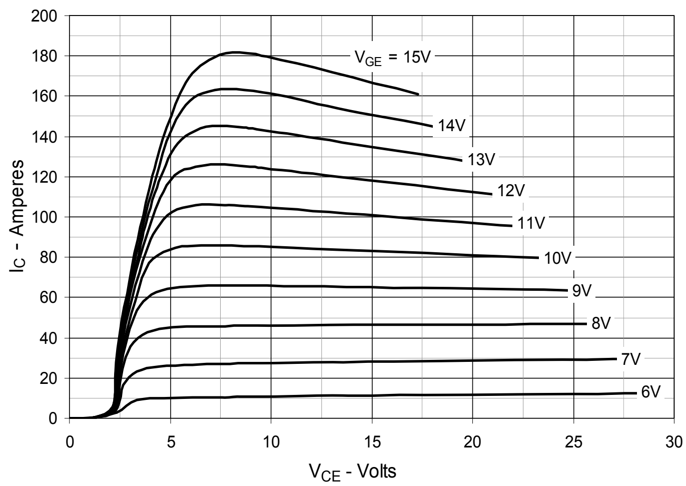


Fig. 3. Output Characteristics @ T_J = 125ºC

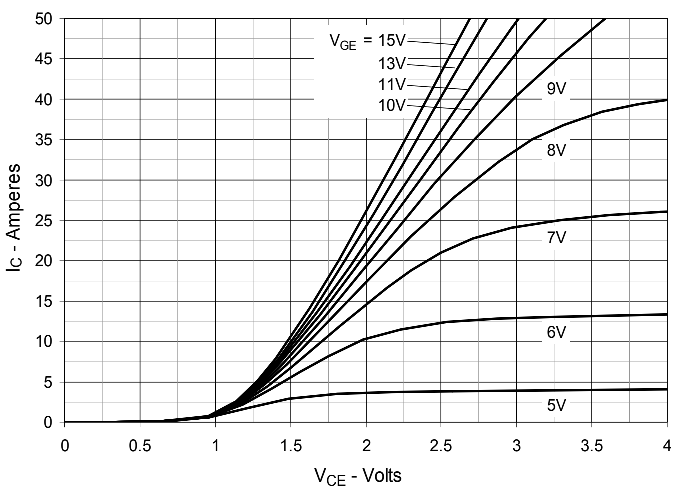


Fig. 4. Dependence of $V_{CE(sat)}$ on Junction Temperature

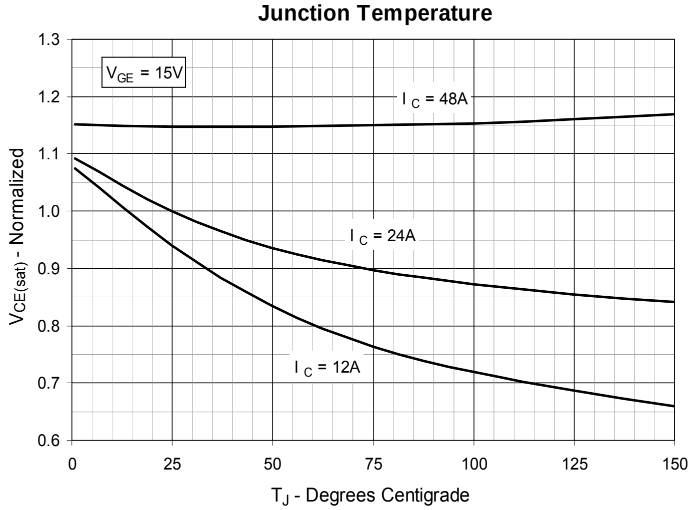


Fig. 5. Collector-to-Emitter Voltage vs. Gate-to-Emitter Voltage

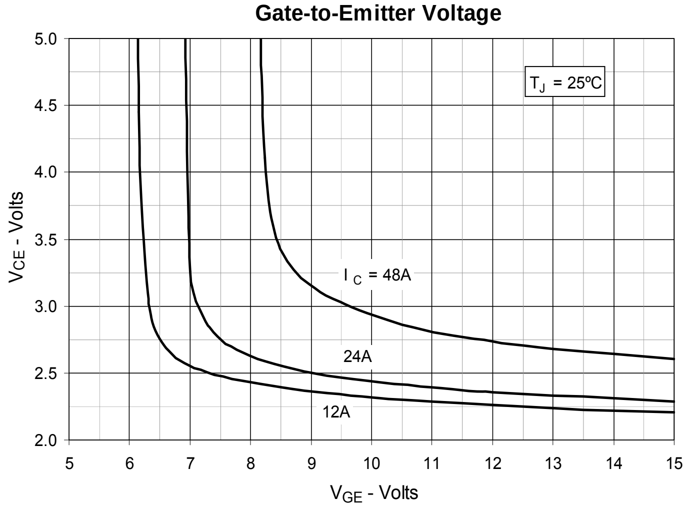


Fig. 6. Input Admittance

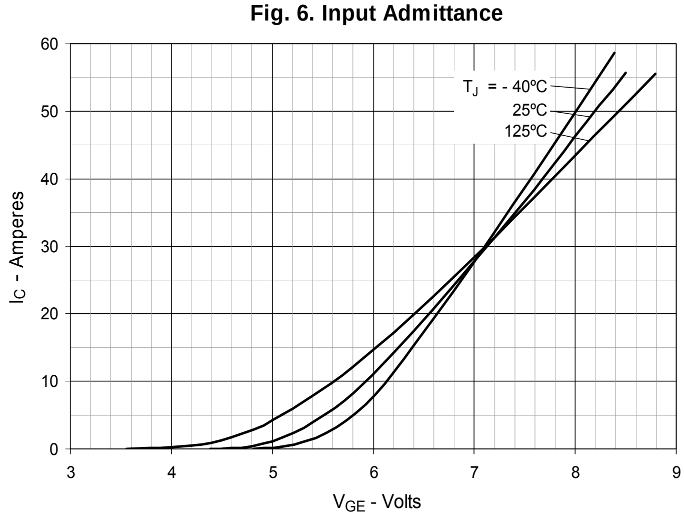


Fig. 7. Transconductance

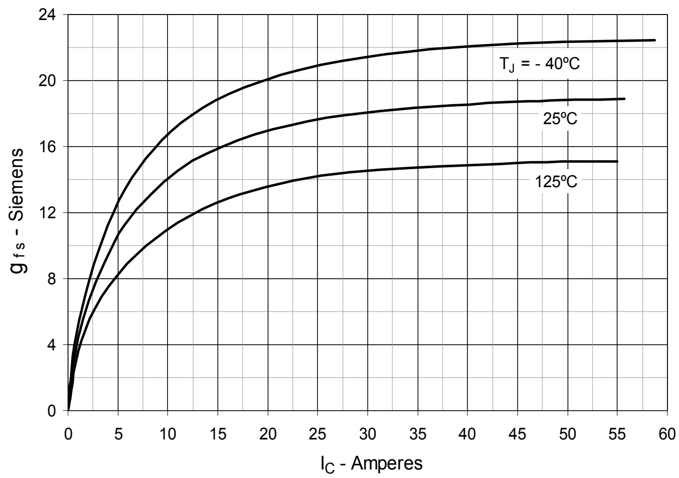


Fig. 8. Gate Charge

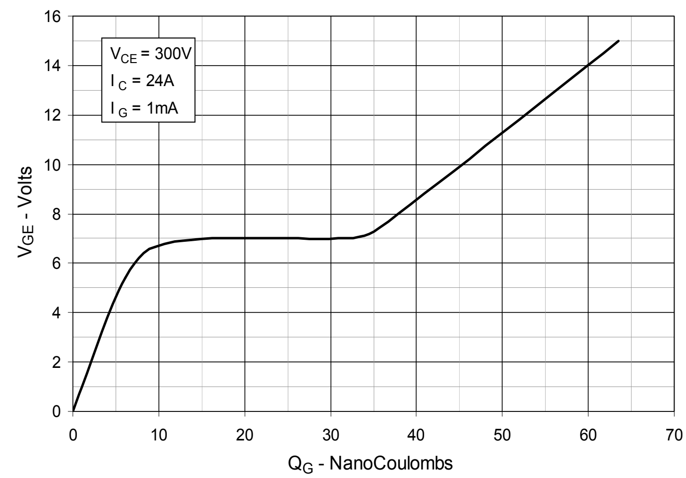


Fig. 9. Capacitance

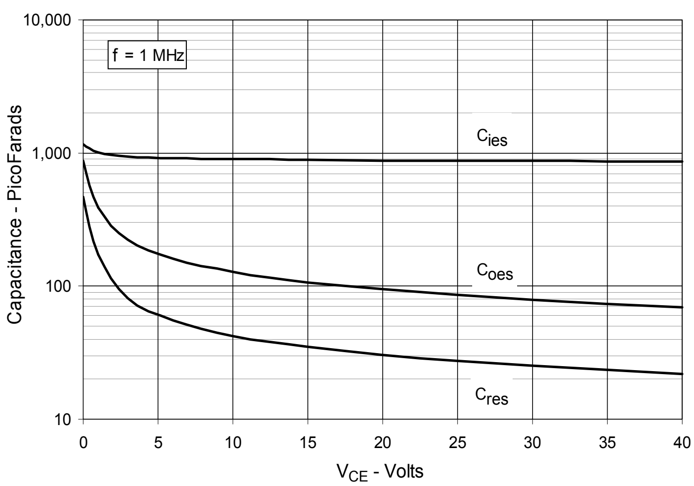


Fig. 10. Reverse-Bias Safe Operating Area

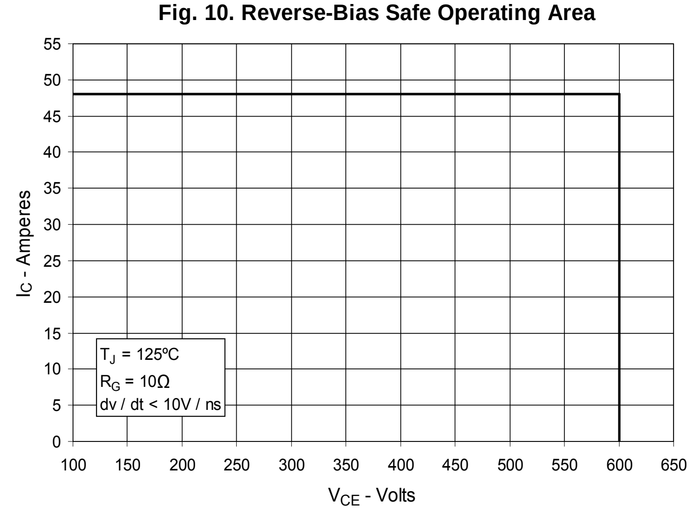


Fig. 11. Maximum Transient Thermal Impedance

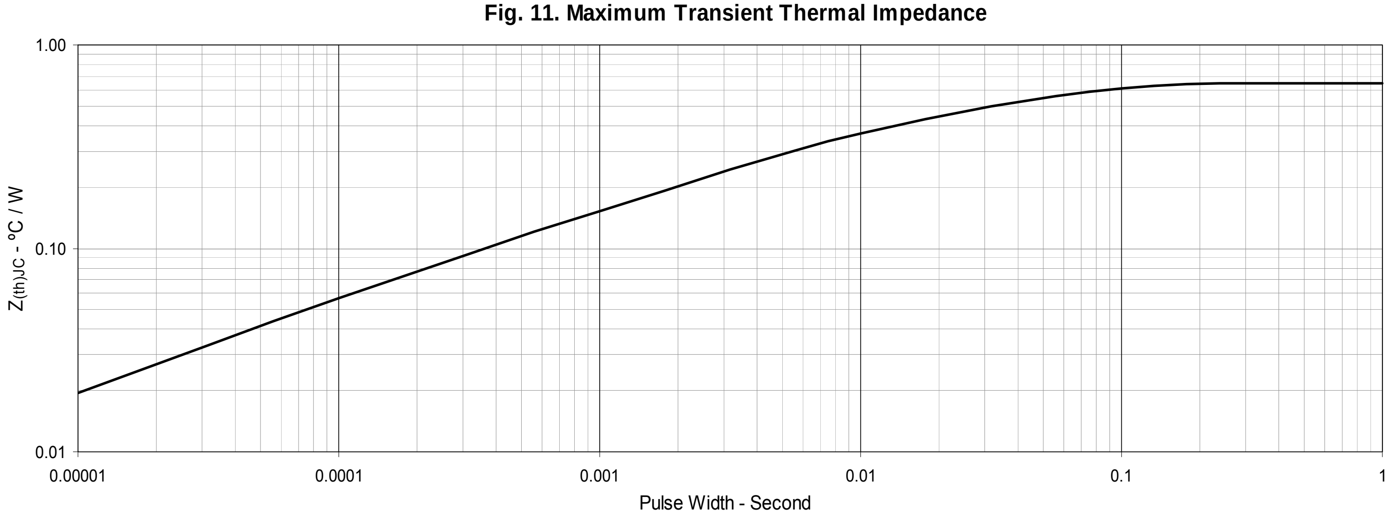


Fig. 12. Inductive Switching Energy Loss vs. Gate Resistance

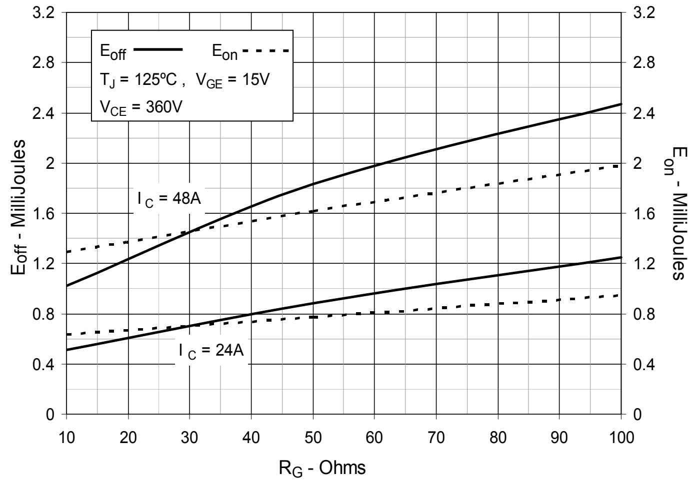


Fig. 13. Inductive Switching Energy Loss vs. Collector Current

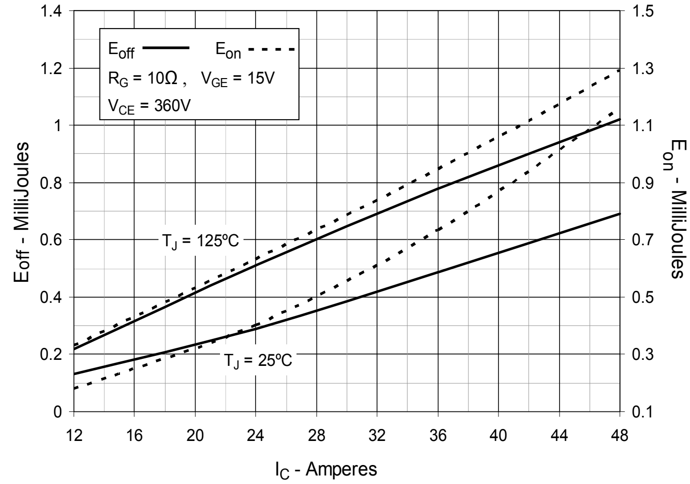


Fig. 14. Inductive Switching Energy Loss vs. Junction Temperature

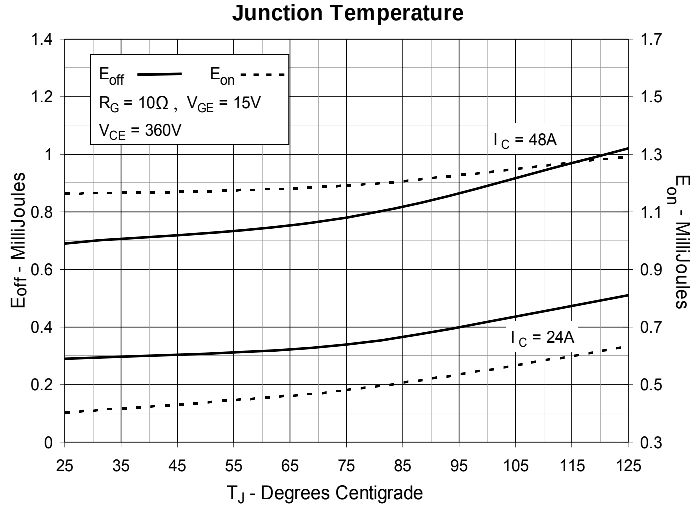


Fig. 15. Inductive Turn-off Switching Times vs. Gate Resistance

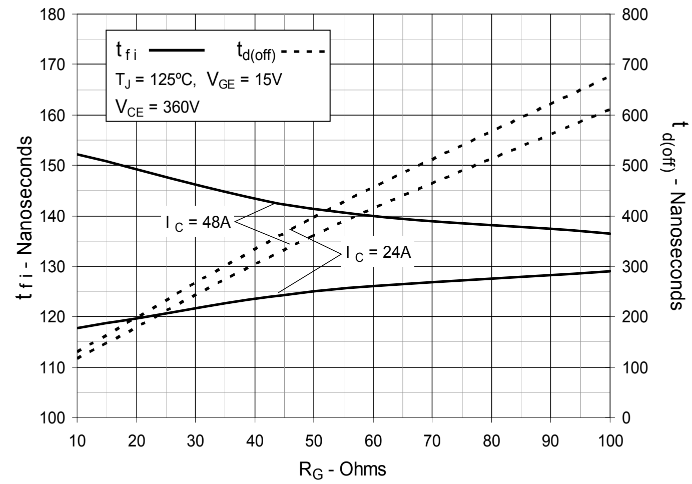


Fig. 16. Inductive Turn-off Switching Times vs. Collector Current

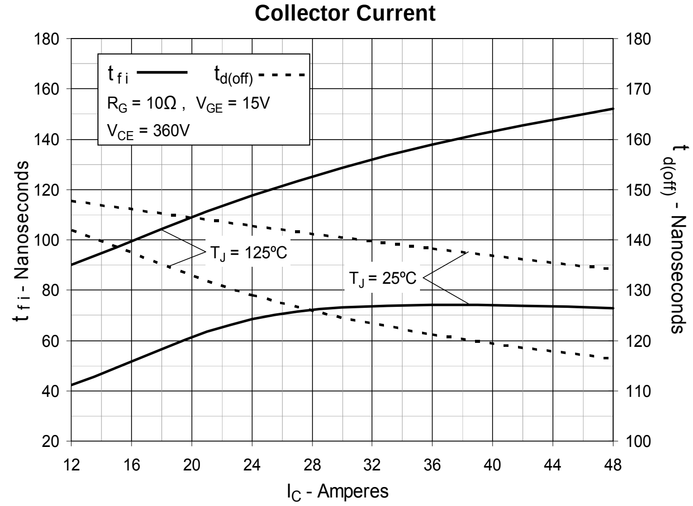


Fig. 17. Inductive Turn-off Switching Times vs. Junction Temperature

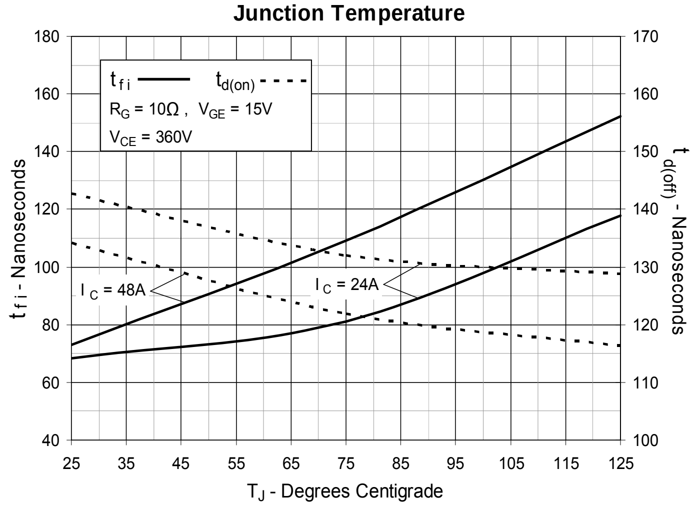


Fig. 18. Inductive Turn-on Switching Times vs. Gate Resistance

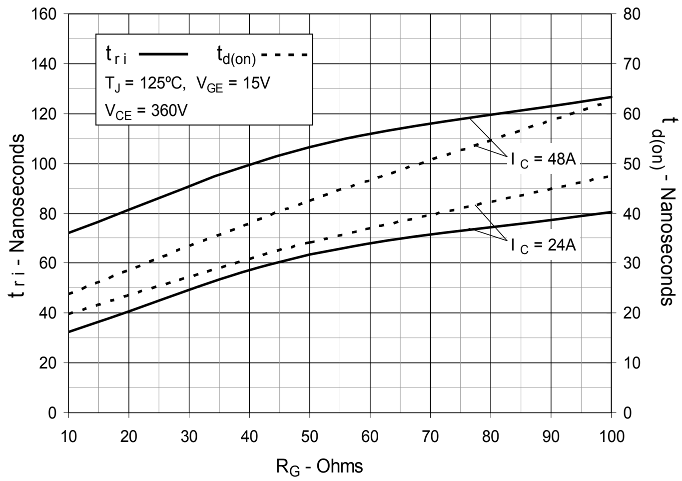


Fig. 19. Inductive Turn-on Switching Times vs. Collector Current

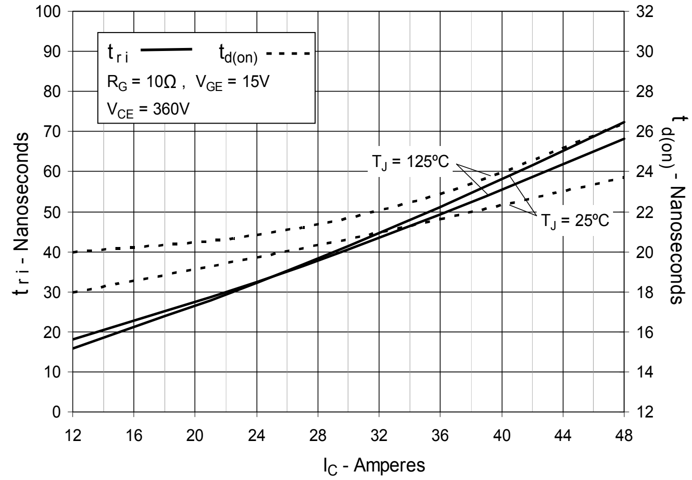
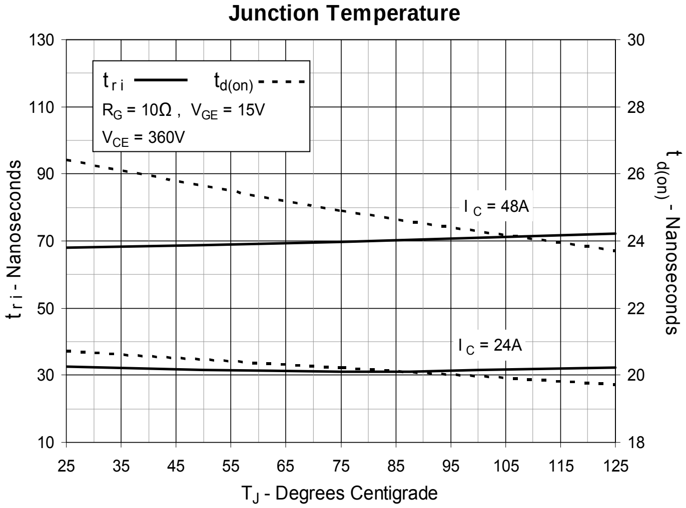


Fig. 20. Inductive Turn-on Switching Times vs. Junction Temperature



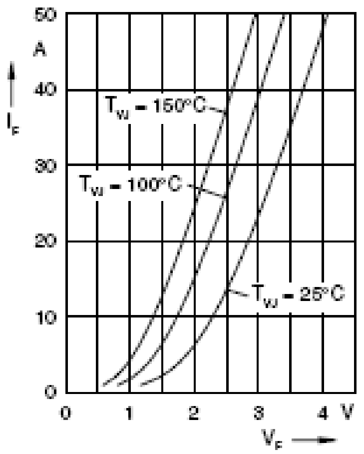


Fig. 21. Forward Current I_F vs. V_F

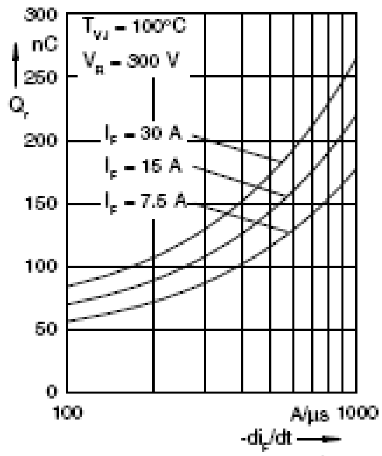


Fig. 22. Reverse Recovery Change Q_r vs. $-di_F/dt$

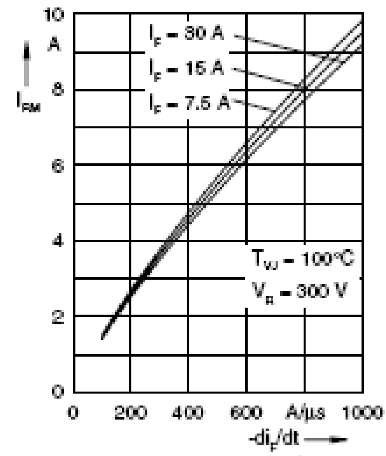


Fig. 23. Peak Reverse Current I_{RM} vs. $-di_F/dt$

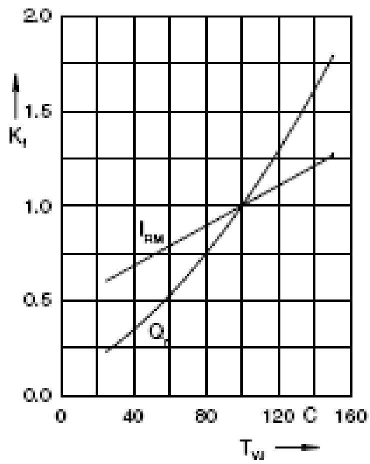


Fig. 24. Dynamic Parameters Q_r, I_{RM} vs. T_{VJ}

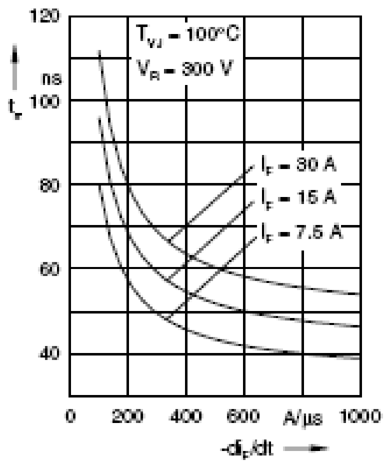


Fig. 25. Recovery Time t_r vs. $-di_F/dt$

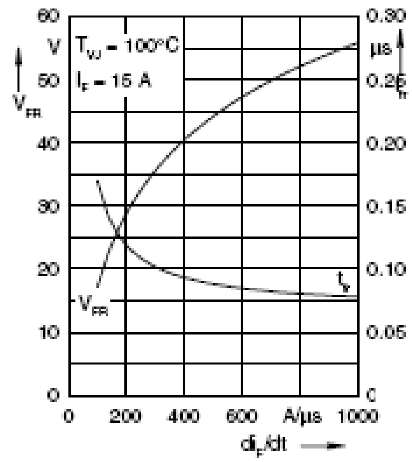


Fig. 26. Peak Forward Voltage V_{FR}, t_r vs. $-di_F/dt$

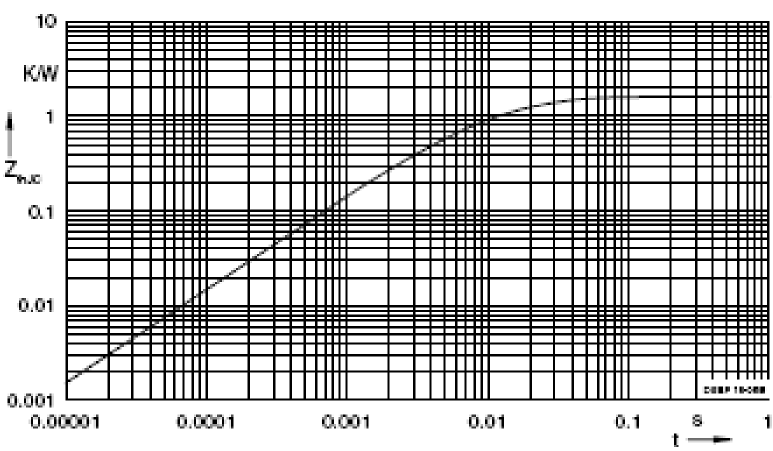


Fig. 27. Transient Thermal Resistance Junction to Case

Constants for Z_{thJC} calculation:

i	R_{thi} (K/W)	t_i (s)
1	0.908	0.0052
2	0.35	0.0003
3	0.342	0.017

NOTE: Fig. 19 to Fig. 22 show typical values