

High-Gain IGBT w/ Diode

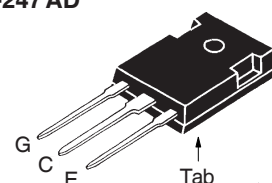
IXGH24N60C4D1

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

High-Speed PT Trench IGBT



TO-247 AD



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

Symbol	Test Conditions	Maximum Ratings	
V_{CES}	$T_J = 25^\circ C$ to $150^\circ C$	600	V
V_{CGR}	$T_J = 25^\circ C$ to $150^\circ C$, $R_{GE} = 1M\Omega$	600	V
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ C$	56	A
I_{C110}	$T_C = 110^\circ C$	24	A
I_{F110}	$T_C = 110^\circ C$	18	A
I_{CM}	$T_C = 25^\circ C$, 1ms	130	A
SSOA (RBSOA)	$V_{GE} = 15V$, $T_{VJ} = 125^\circ C$, $R_G = 10\Omega$ Clamped Inductive Load	$I_{CM} = 48$ @ $\leq V_{CES}$	A
P_C	$T_C = 25^\circ C$	190	W
T_J		-55 ... +150	$^\circ C$
T_{JM}		150	$^\circ C$
T_{stg}		-55 ... +150	$^\circ C$
T_L	Maximum Lead Temperature for Soldering	300	$^\circ C$
T_{SOLD}	1.6 mm (0.062in.) from Case for 10s	260	$^\circ C$
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

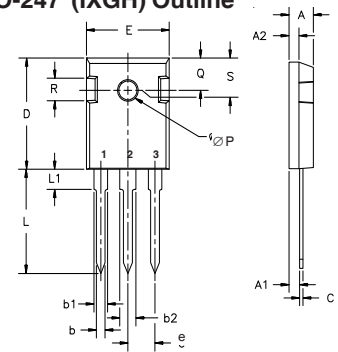
Applications

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

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

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

TO-247 (IXGH) Outline



Terminals: 1 - Gate 2 - Collector
3 - Emitter

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

Notes:

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

IXYS Reserves the Right to Change Limits, Test Conditions, and Dimensions.

IXYS MOSFETs and IGBTs are covered by one or more of the following U.S. patents:	4,835,592	4,931,844	5,049,961	5,237,481	6,162,665	6,404,065 B1	6,683,344	6,727,585	7,005,734 B2	7,157,338 B2
	4,850,072	5,017,508	5,063,307	5,381,025	6,259,123 B1	6,534,343	6,710,405 B2	6,759,692	7,063,975 B2	
	4,881,106	5,034,796	5,187,117	5,486,715	6,306,728 B1	6,583,505	6,710,463	6,771,478 B2	7,071,537	

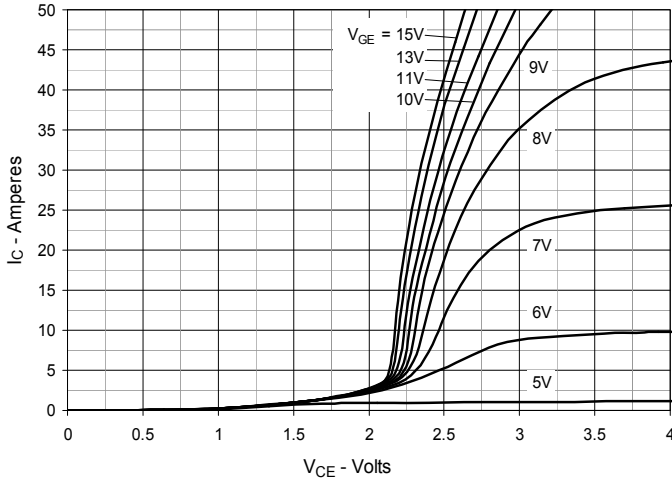
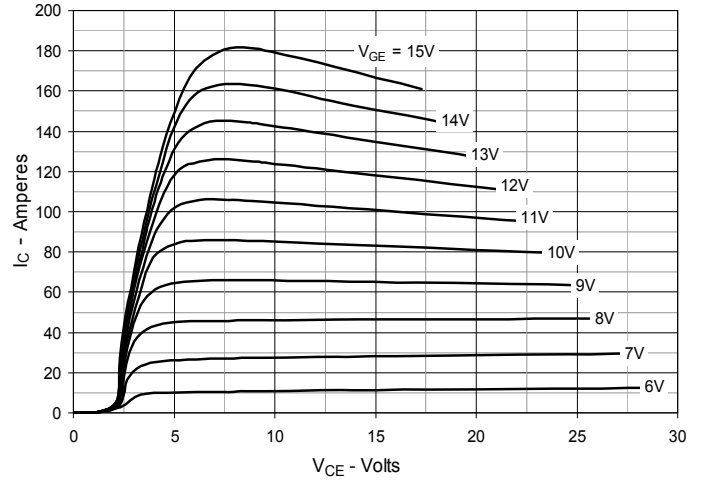
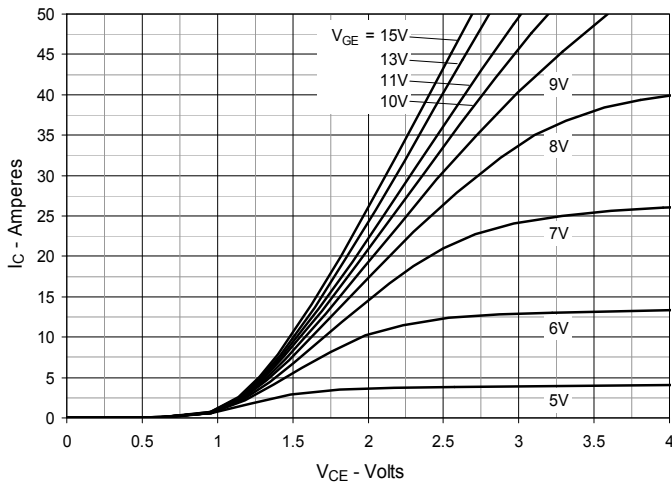
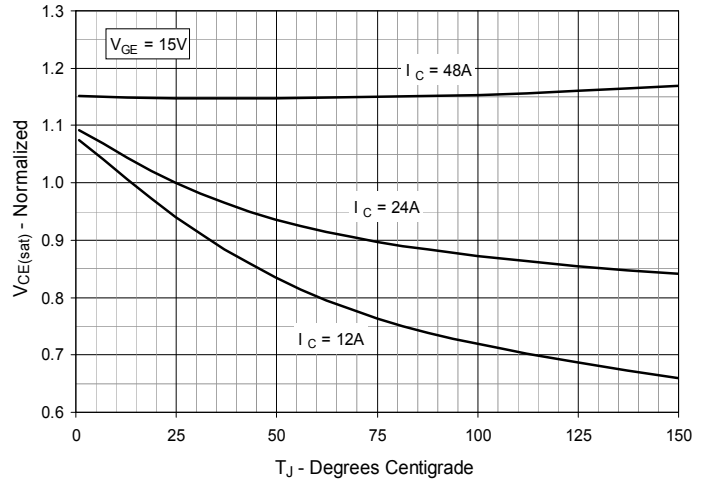
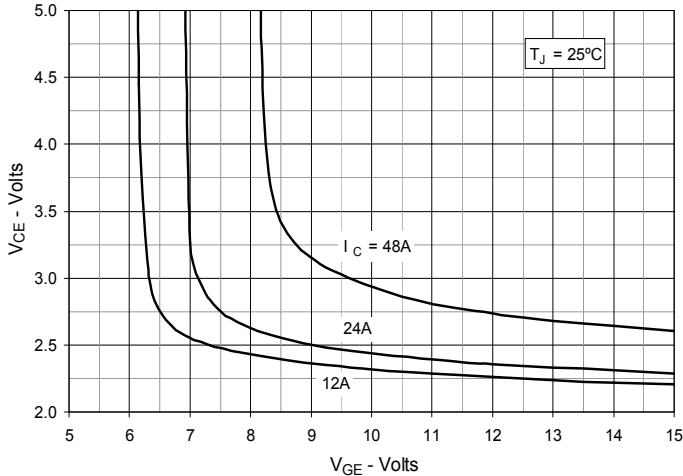
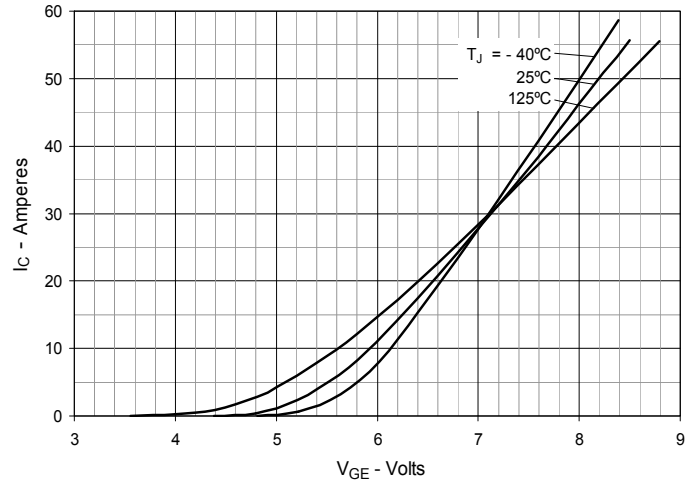
Fig. 1. Output Characteristics @ $T_J = 25^\circ\text{C}$

Fig. 2. Extended Output Characteristics @ $T_J = 25^\circ\text{C}$

Fig. 3. Output Characteristics @ $T_J = 125^\circ\text{C}$

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


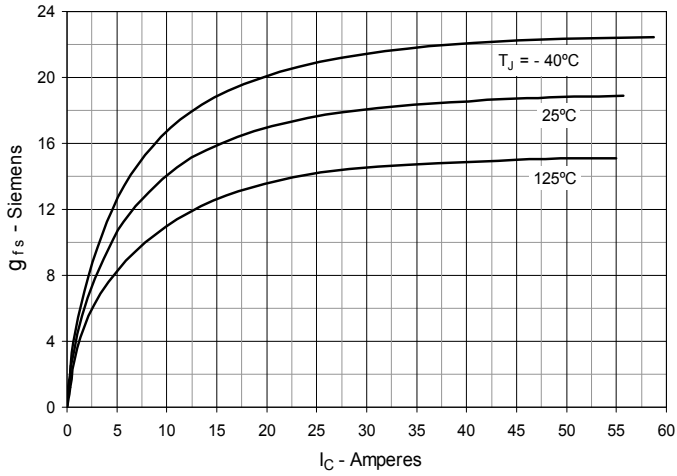
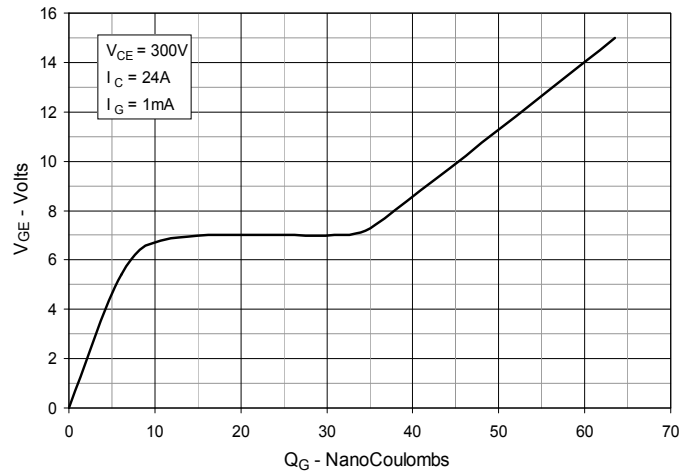
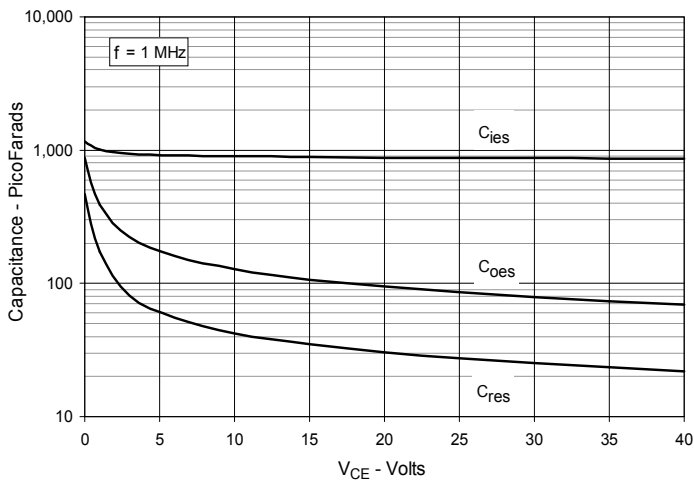
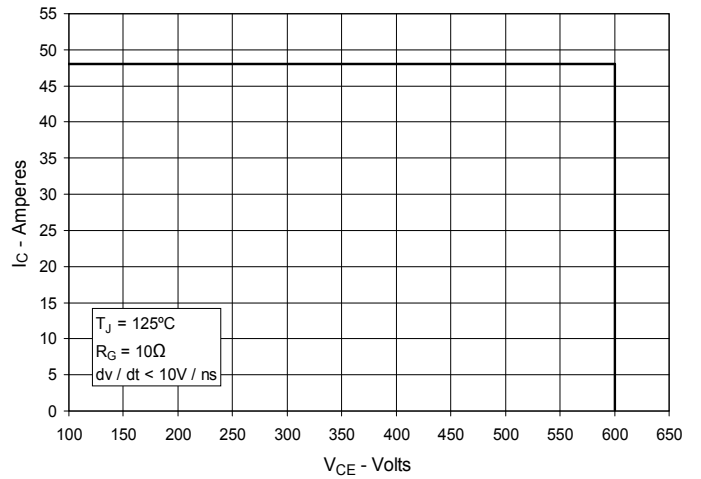
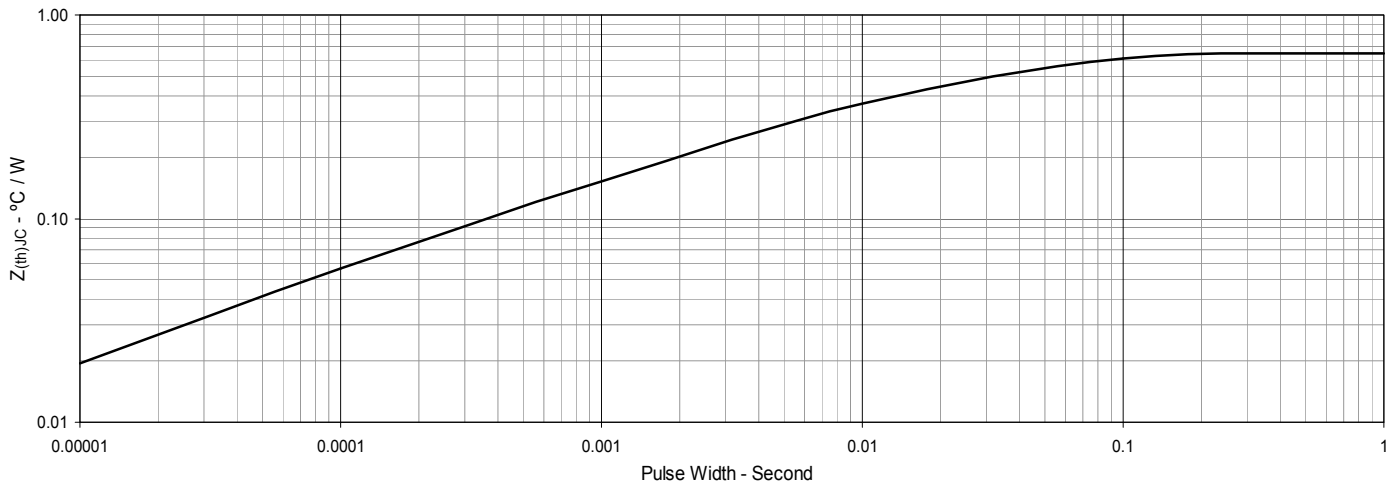
Fig. 7. Transconductance

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

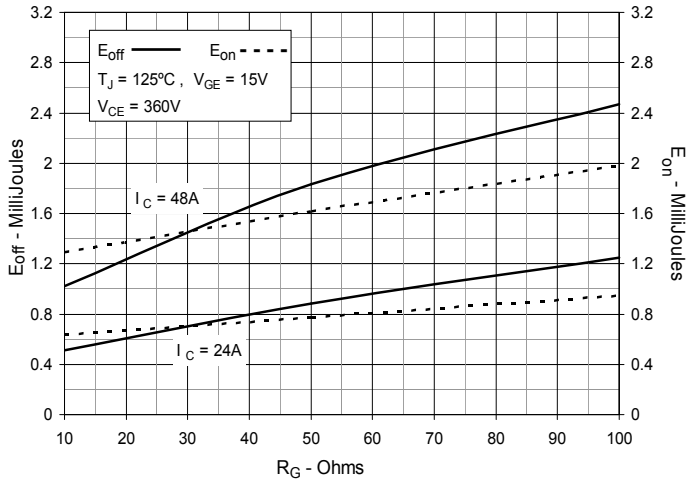


Fig. 13. Inductive Switching Energy Loss vs. Collector Current

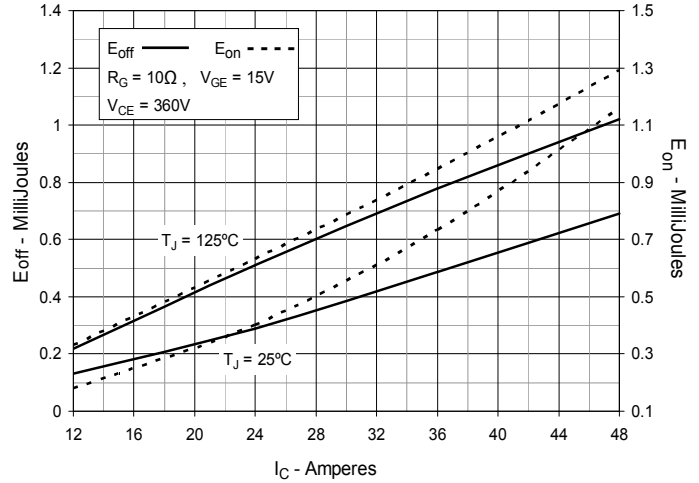


Fig. 14. Inductive Switching Energy Loss vs. Junction Temperature

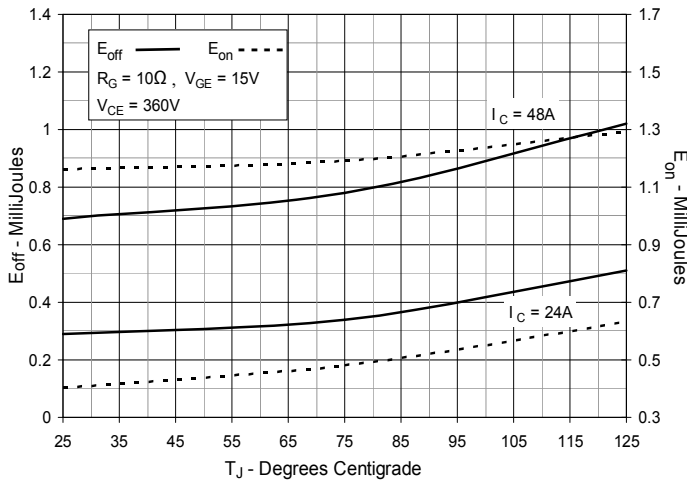


Fig. 15. Inductive Turn-off Switching Times vs. Gate Resistance

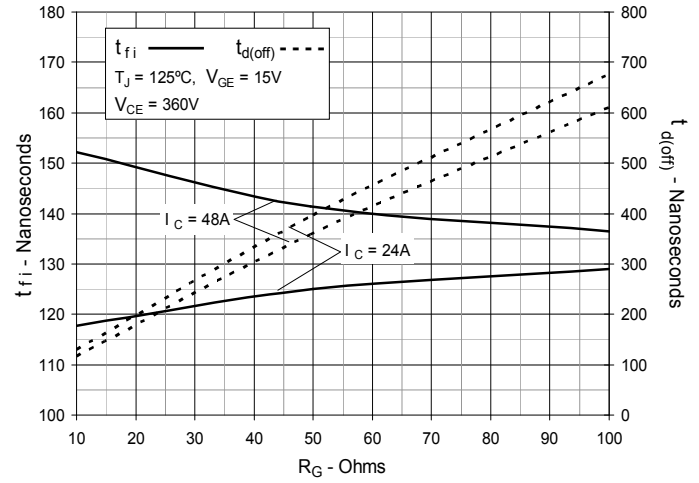


Fig. 16. Inductive Turn-off Switching Times vs. Collector Current

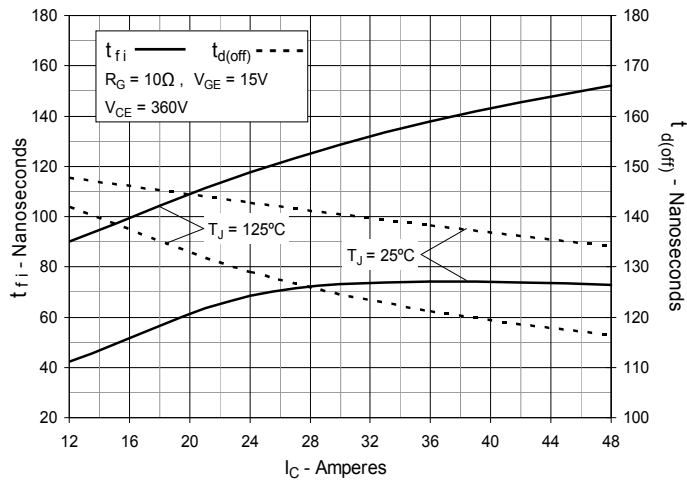


Fig. 17. Inductive Turn-off Switching Times vs. Junction Temperature

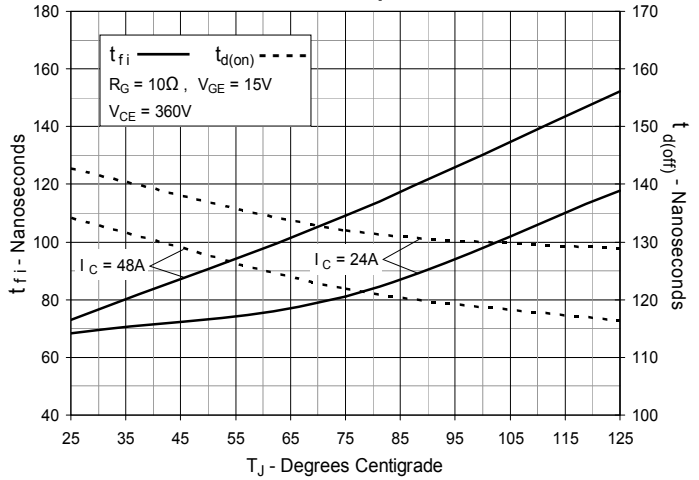
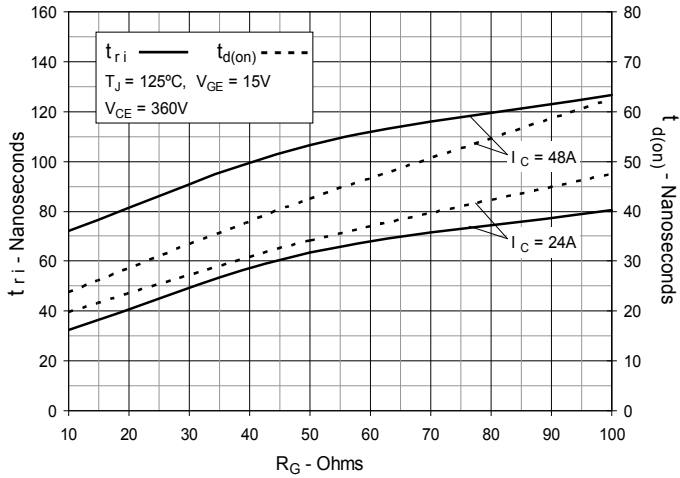
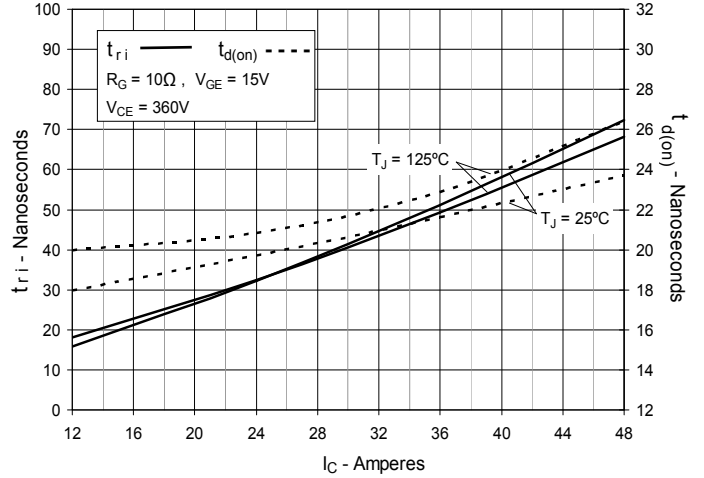
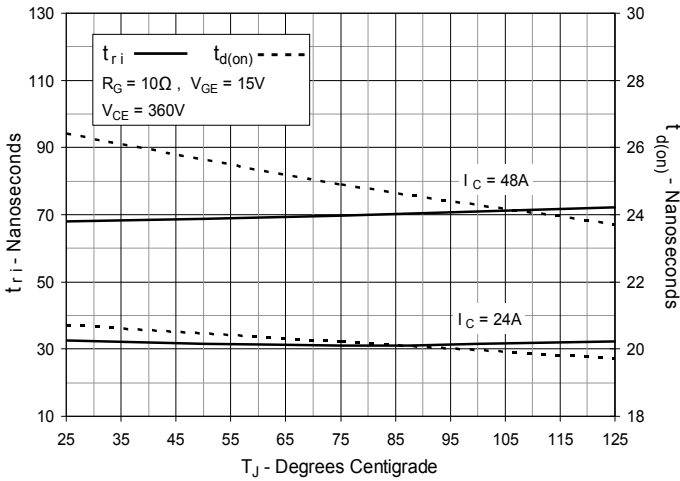


Fig. 18. Inductive Turn-on Switching Times vs. Gate Resistance

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

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


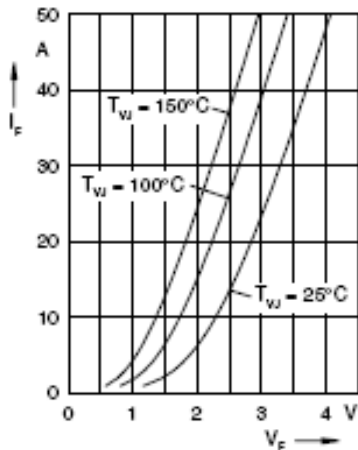


Fig. 21. Forward Current I_F vs. V_F

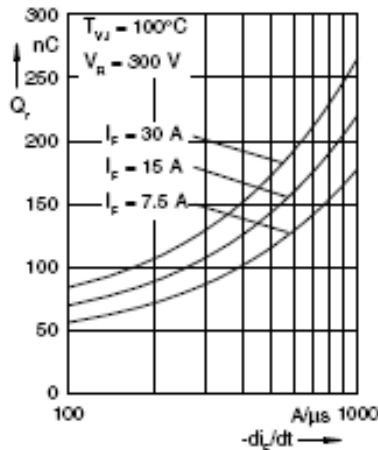


Fig. 22. Reverse Recovery Charge Q_r vs. $-di_F/dt$

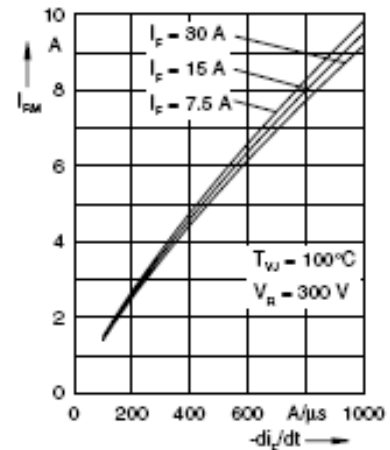


Fig. 23. Peak Reverse Current I_{RM} vs. $-di_F/dt$

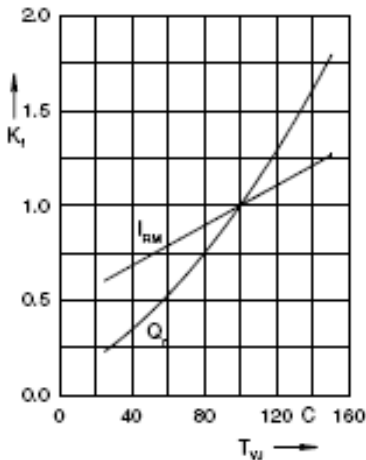


Fig. 24. Dynamic Parameters Q_r, I_{RM} vs. T_{vj}

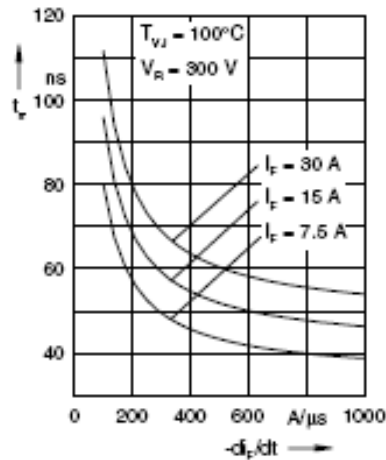


Fig. 25. Recovery Time t_r vs. $-di_F/dt$

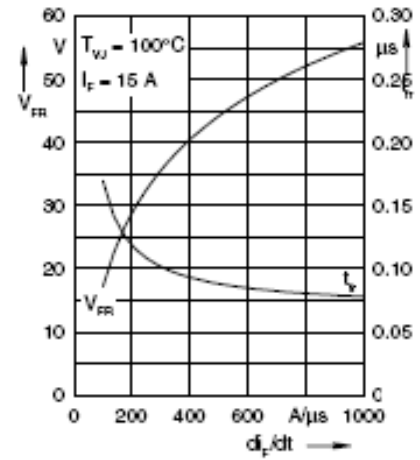


Fig. 26. Peak Forward Voltage V_{FR}, t_r vs. $-di_F/dt$

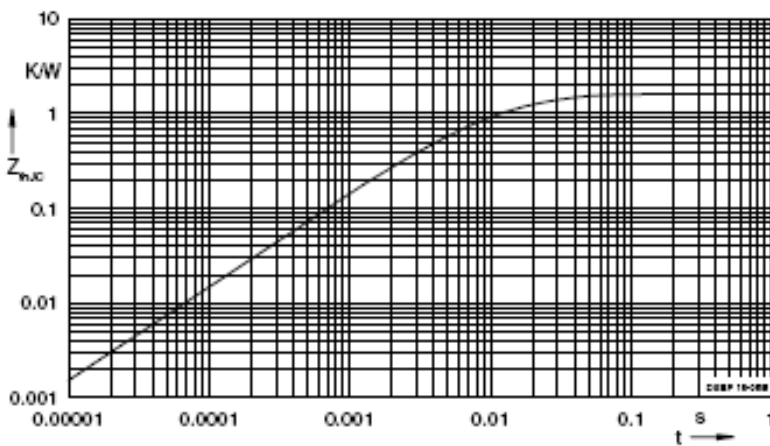


Fig. 27. Transient Thermal Resistance Junction to Case

Constants for $Z_{\theta JC}$ calculation:

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

NOTE: Fig. 18 to Fig. 22 show typical values