



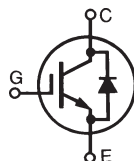
**THE DATASHEET OF  
IXGH24N60C4D1**



# High-Gain IGBT w/ Diode

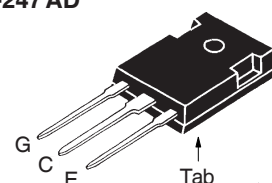
## IXGH24N60C4D1

### High-Speed PT Trench IGBT



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

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	$\pm 20$	V
$V_{GEM}$	Transient	$\pm 30$	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
<b>SSOA</b> <b>(RBSOA)</b>	$V_{GE} = 15V$ , $T_{VJ} = 125^\circ C$ , $R_G = 10\Omega$ 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.
<b>Weight</b>		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

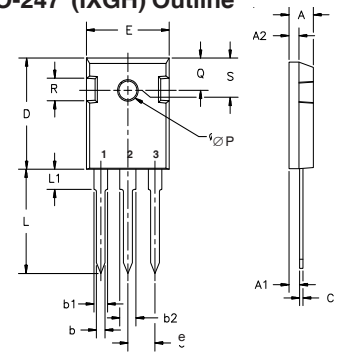
### Applications

- 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 $\mu A$ 1.5 mA
$I_{GES}$	$V_{CE} = 0V$ , $V_{GE} = \pm 20V$			$\pm 100$ 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
$t_{d(on)}$	<b>Inductive Load, <math>T_J = 25^\circ\text{C}</math></b> $I_C = I_{C110}, V_{GE} = 15\text{V}$ $V_{CE} = 360\text{V}, R_G = 10\Omega$ 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
$t_{d(on)}$	<b>Inductive Load, <math>T_J = 125^\circ\text{C}</math></b> $I_C = I_{C110}, V_{GE} = 15\text{V}$ $V_{CE} = 360\text{V}, R_G = 10\Omega$ 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 <sub>1</sub>	2.2	2.54	.087	.102
A <sub>2</sub>	2.2	2.6	.059	.098
b	1.0	1.4	.040	.055
b <sub>1</sub>	1.65	2.13	.065	.084
b <sub>2</sub>	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
ØP	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)

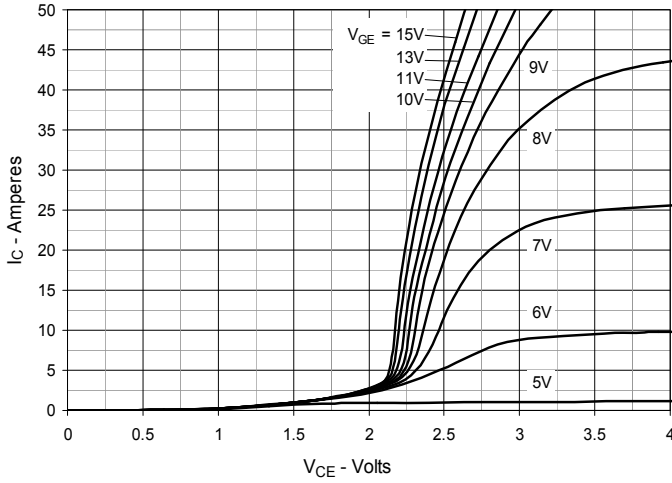
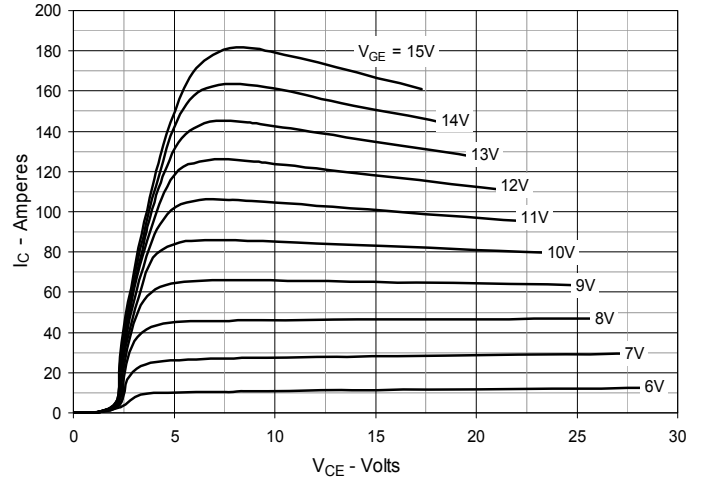
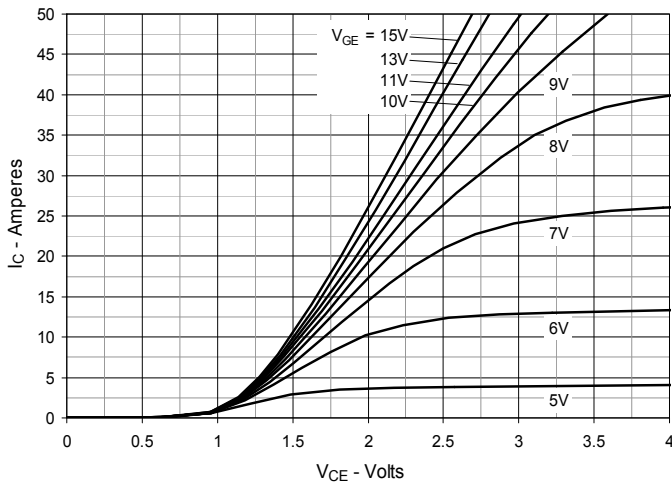
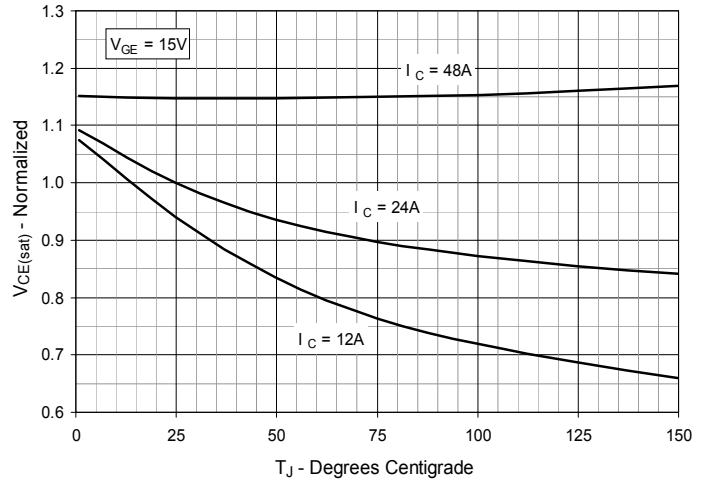
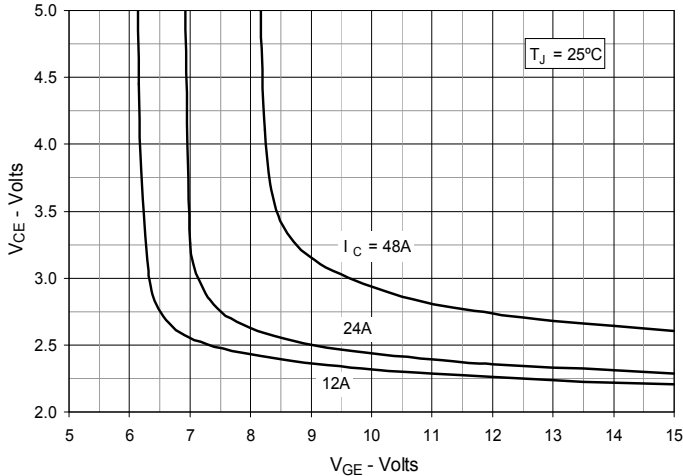
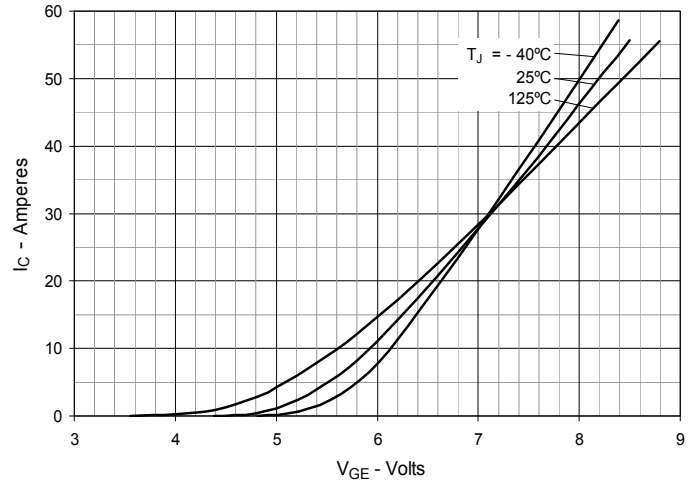
Symbol	Test Conditions ( $T_J = 25^\circ\text{C}$ Unless Otherwise Specified)	Characteristic Values		
		Min.	Typ.	Max.
$V_F$	$I_F = 15\text{A}, V_{GE} = 0\text{V}$ , Note 1 $T_J = 150^\circ\text{C}$		1.6	2.7 V V
$I_{RM}$	$I_F = 15\text{A}, V_{GE} = 0\text{V}, -di_F/dt = 100\text{A}/\mu\text{s}, T_J =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

### Notes:

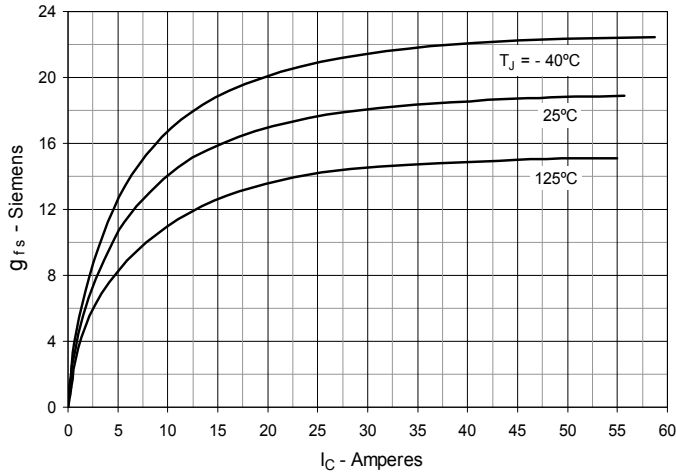
1. Pulse test,  $t \leq 300\mu\text{s}$ , duty cycle,  $d \leq 2\%$ .
2. Switching times & energy losses may increase for higher  $V_{CE}(\text{clamp})$ ,  $T_J$  or  $R_G$ .

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

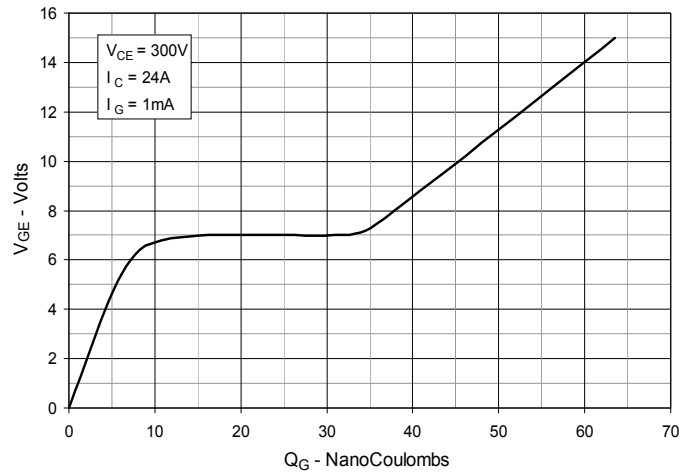
IXYS MOSFETs and IGBTs are covered by one or more of the following U.S. patents:	4,835,592	4,931,844	5,049,961	5,237,481	6,162,665	6,404,065 B1	6,683,344	6,727,585	7,005,734 B2	7,157,338 B2
	4,850,072	5,017,508	5,063,307	5,381,025	6,259,123 B1	6,534,343	6,710,405 B2	6,759,692	7,063,975 B2	
	4,881,106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


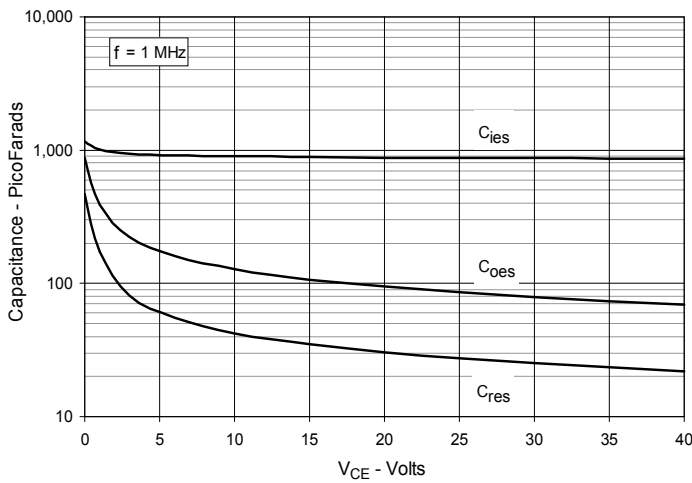
**Fig. 7. Transconductance**



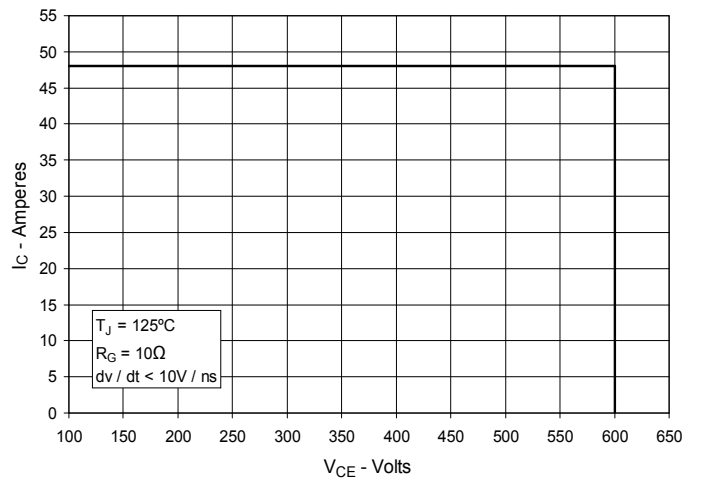
**Fig. 8. Gate Charge**



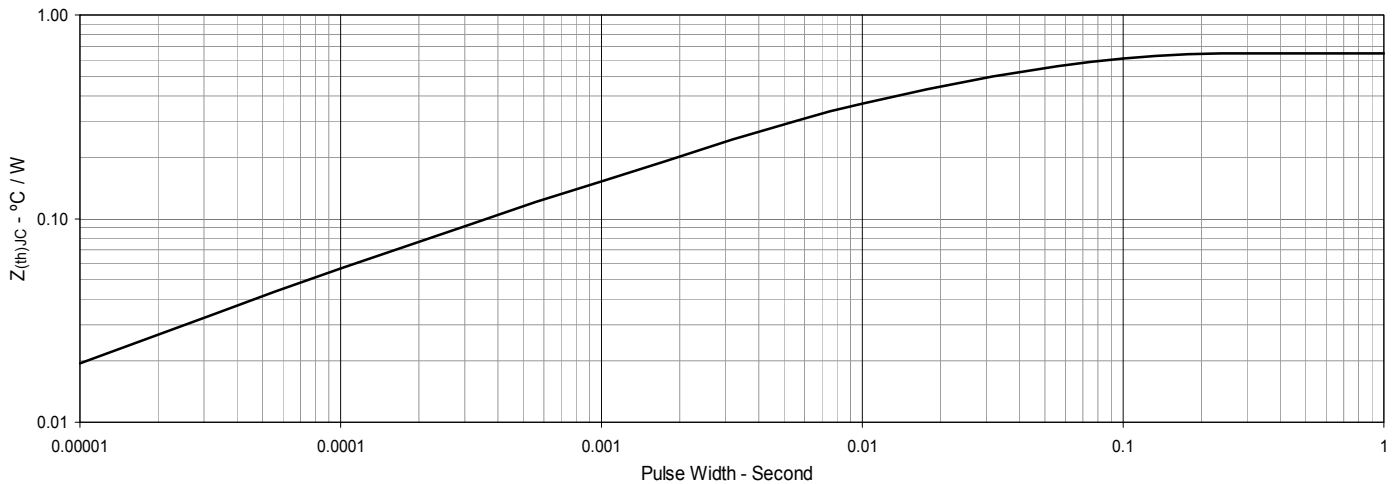
**Fig. 9. Capacitance**



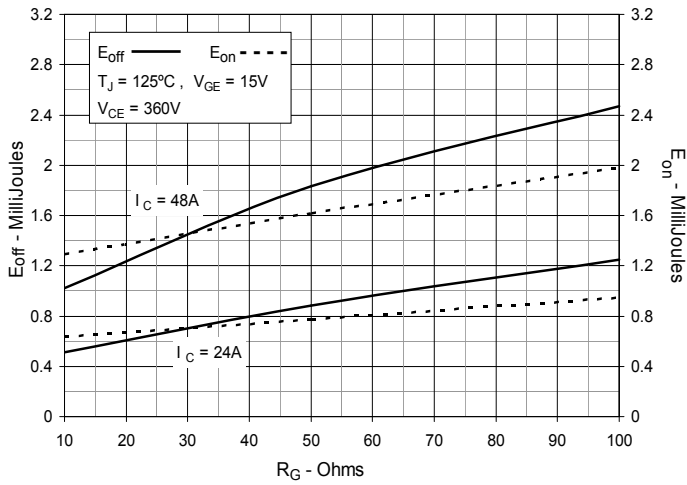
**Fig. 10. Reverse-Bias Safe Operating Area**



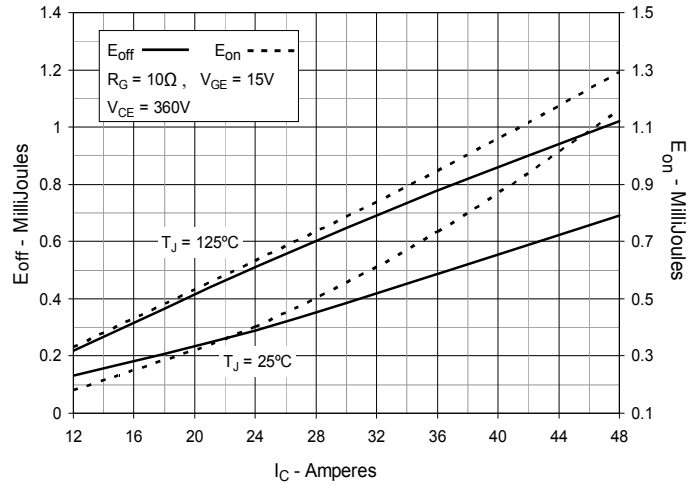
**Fig. 11. Maximum Transient Thermal Impedance**



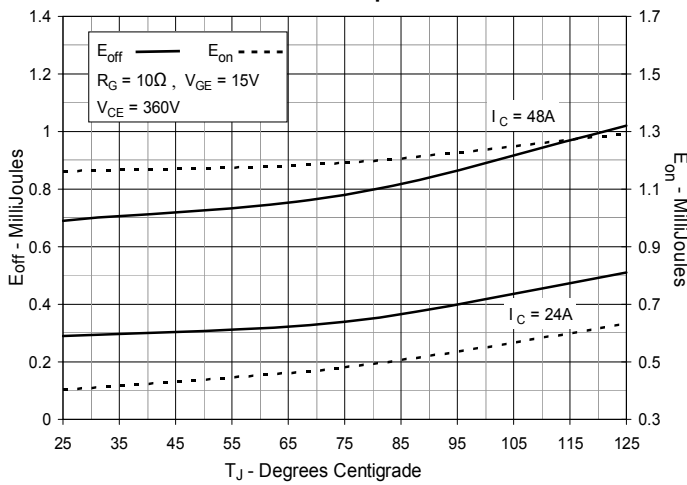
**Fig. 12. Inductive Switching Energy Loss vs. Gate Resistance**



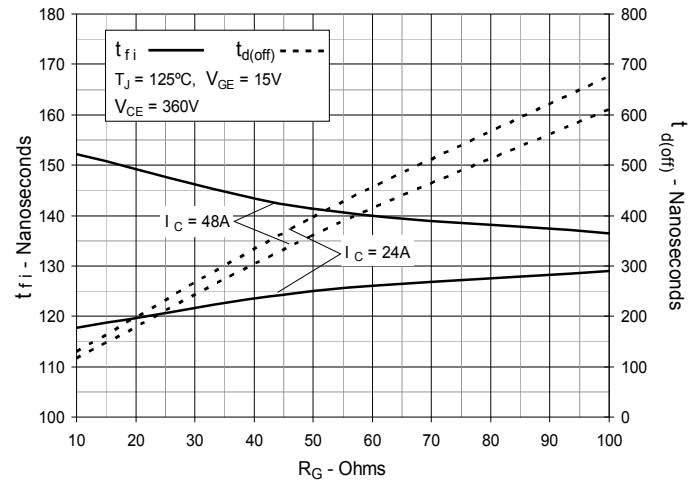
**Fig. 13. Inductive Switching Energy Loss vs. Collector Current**



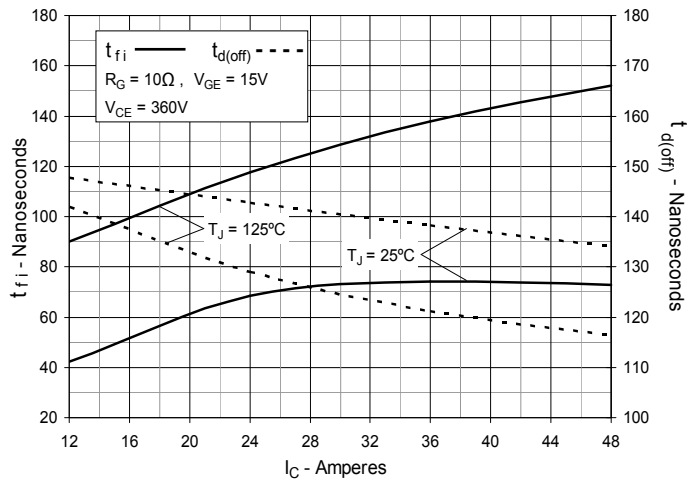
**Fig. 14. Inductive Switching Energy Loss vs. Junction Temperature**



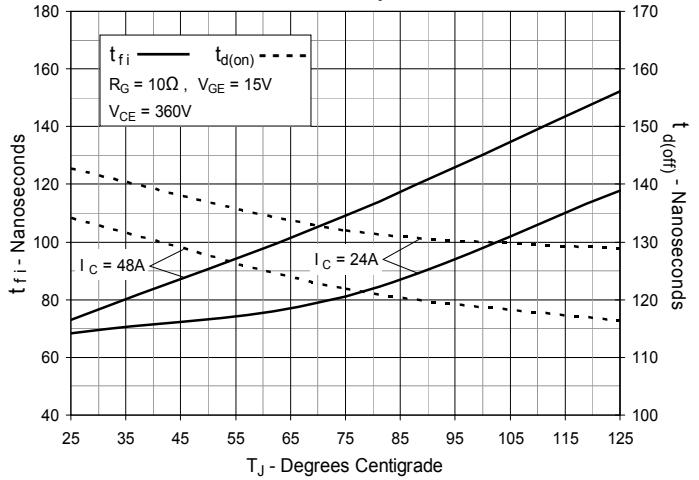
**Fig. 15. Inductive Turn-off Switching Times vs. Gate Resistance**

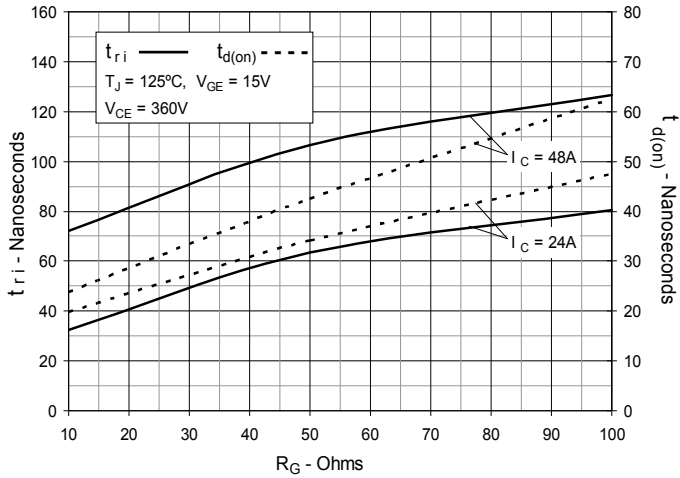
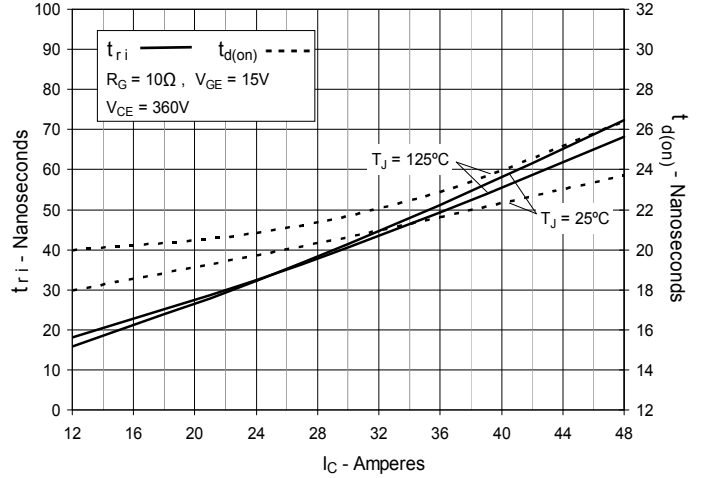
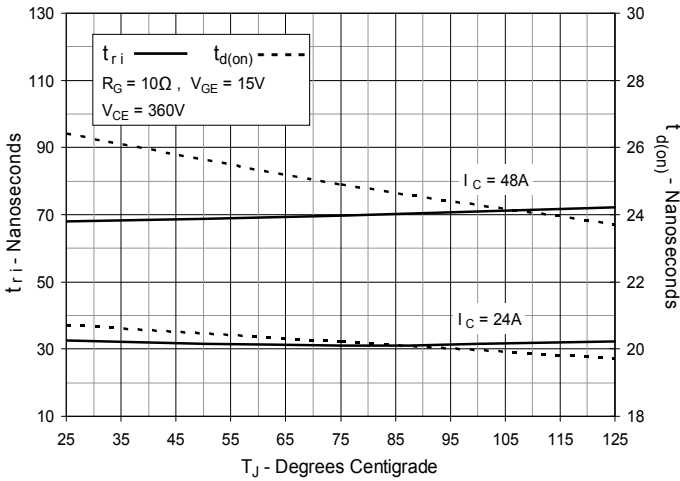


**Fig. 16. Inductive Turn-off Switching Times vs. Collector Current**



**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**


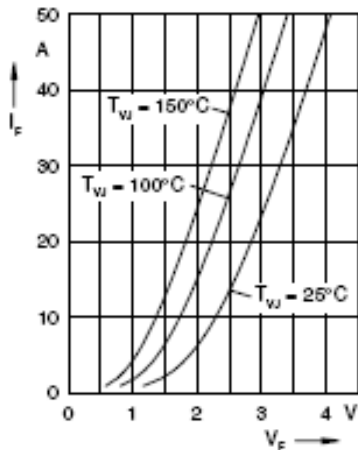


Fig. 21. Forward Current  $I_F$  vs.  $V_F$

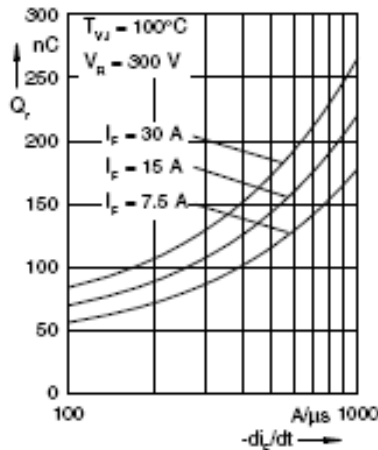


Fig. 22. Reverse Recovery Charge  $Q_r$  vs.  $-di_F/dt$

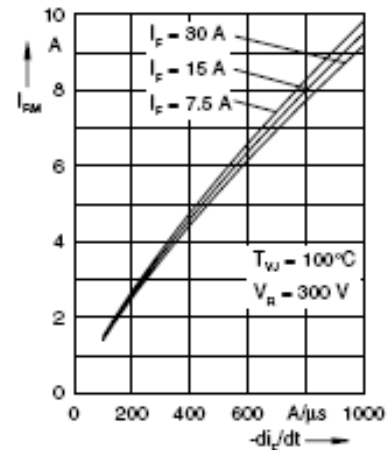


Fig. 23. Peak Reverse Current  $I_{RM}$  vs.  $-di_F/dt$

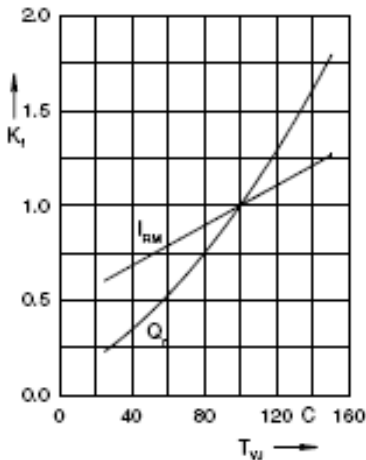


Fig. 24. Dynamic Parameters  $K_r, I_{RM}$  vs.  $T_{vj}$

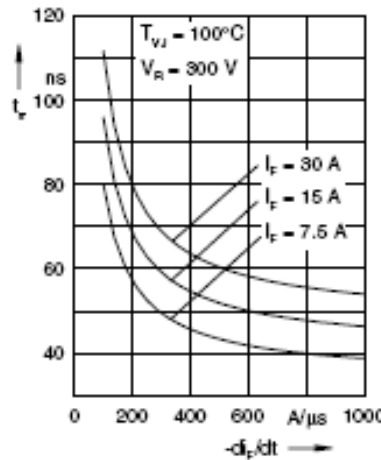


Fig. 25. Recovery Time  $t_r$  vs.  $-di_F/dt$

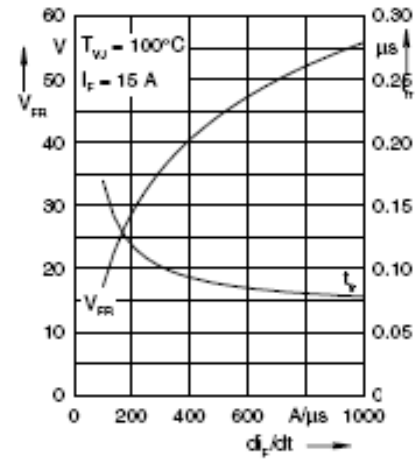


Fig. 26. Peak Forward Voltage  $V_{FR}, t_r$  vs.  $di_F/dt$

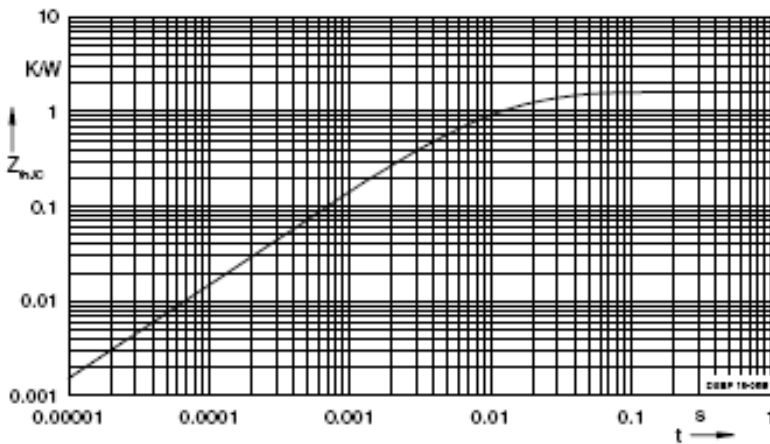


Fig. 27. Transient Thermal Resistance Junction to Case

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

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