

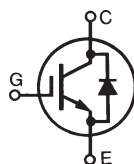
# HiPerFAST™ IGBTs

## C2-Class High Speed

### w/ Diode

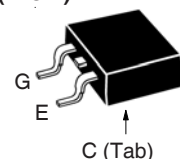
**IXGA16N60C2D1**  
**IXGP16N60C2D1**  
**IXGH16N60C2D1**

**V<sub>CES</sub> = 600V**  
**I<sub>C110</sub> = 16A**  
**V<sub>CE(sat)</sub> ≤ 3.0V**  
**t<sub>fi(typ)</sub> = 33ns**

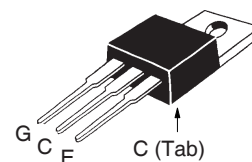


Symbol	Test Conditions	Maximum Ratings	
V <sub>CES</sub>	T <sub>J</sub> = 25°C to 150°C	600	V
V <sub>CGR</sub>	T <sub>J</sub> = 25°C to 150°C, R <sub>GE</sub> = 1MΩ	600	V
V <sub>GES</sub>	Continuous	±20	V
V <sub>GEM</sub>	Transient	±30	V
I <sub>C25</sub>	T <sub>C</sub> = 25°C	40	A
I <sub>C110</sub>	T <sub>C</sub> = 110°C	16	A
I <sub>F110</sub>	T <sub>C</sub> = 110°C	11	A
I <sub>CM</sub>	T <sub>C</sub> = 25°C, 1ms	100	A
<b>SSOA</b> <b>(RBSOA)</b>	V <sub>GE</sub> = 15V, T <sub>J</sub> = 125°C, R <sub>G</sub> = 22Ω Clamped Inductive load	I <sub>CM</sub> = 32 V <sub>CE</sub> ≤ V <sub>CES</sub>	A
P <sub>C</sub>	T <sub>C</sub> = 25°C	150	W
T <sub>J</sub>		-55 ... +150	°C
T <sub>JM</sub>		150	°C
T <sub>stg</sub>		-55 ... +150	°C
M <sub>d</sub>	Mounting Torque (TO-220 & TO-247)	1.13/10	Nm/lb.in.
F <sub>C</sub>	Mounting Force (TO-263)	10..65 / 2.2..14.6	N/lb.
T <sub>L</sub>	Maximum Lead Temperature for Soldering	300	°C
T <sub>SOLD</sub>	1.6mm (0.062 in.) from Case for 10s	260	°C
<b>Weight</b>	TO-263	2.5	g
	TO-220	3.0	g
	TO-247	6.0	g

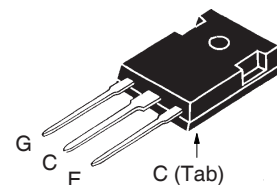
TO-263 AA (IXGA)



TO-220AB (IXGP)



TO-247 (IXGH)



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

### Features

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

### 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 <sub>J</sub> = 25°C, Unless Otherwise Specified)	Characteristic Values		
		Min.	Typ.	Max.
V <sub>GE(th)</sub>	I <sub>C</sub> = 250μA, V <sub>CE</sub> = V <sub>GE</sub>	3.0		5.5 V
I <sub>CES</sub>	V <sub>CE</sub> = V <sub>CES</sub> , V <sub>GE</sub> = 0V T <sub>J</sub> = 125°C			25 μA 1 mA
I <sub>GES</sub>	V <sub>CE</sub> = 0V, V <sub>GE</sub> = ±20V			±100 nA
V <sub>CE(sat)</sub>	I <sub>C</sub> = 12A, V <sub>GE</sub> = 15V, Note1 T <sub>J</sub> = 125°C		1.8	3.0 V V

Symbol	Test Conditions ( $T_J = 25^\circ\text{C}$ , Unless Otherwise Specified)	Characteristic Values		
		Min.	Typ.	Max.
$g_{fs}$	$I_C = 12\text{A}, V_{CE} = 10\text{V}$ , Note 1	8		S
$C_{ies}$ $C_{oes}$ $C_{res}$	} $V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$		657	pF
			72	pF
			22	pF
$Q_{g(on)}$ $Q_{ge}$ $Q_{gc}$	} $I_C = 12\text{A}, V_{GE} = 15\text{V}, V_{CE} = 0.5 \cdot V_{CES}$		25	nC
			5	nC
			13	nC
$t_{d(on)}$ $t_{ri}$ $E_{on}$ $t_{d(off)}$ $t_{fi}$ $E_{off}$	} <b>Inductive load, <math>T_J = 25^\circ\text{C}</math></b> $I_C = 12\text{A}, V_{GE} = 15\text{V}$ $V_{CE} = 400\text{V}, R_G = 22\Omega$ Note 2		16	ns
			17	ns
			0.16	mJ
			75	ns
			33	ns
			0.09	0.16 mJ
$t_{d(on)}$ $t_{ri}$ $E_{on}$ $t_{d(off)}$ $t_{fi}$ $E_{off}$	} <b>Inductive load, <math>T_J = 125^\circ\text{C}</math></b> $I_C = 12\text{A}, V_{GE} = 15\text{V}$ $V_{CE} = 400\text{V}, R_G = 22\Omega$ Note 2		16	ns
			18	ns
			0.27	mJ
			115	ns
			100	ns
			0.27	mJ
$R_{thJC}$				0.83 $^\circ\text{C/W}$
$R_{thCK}$	TO-220	0.50		$^\circ\text{C/W}$
	TO-247	0.21		$^\circ\text{C/W}$

**Reverse Diode (FRED)**

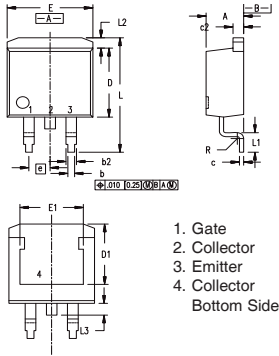
Symbol	Test Conditions ( $T_J = 25^\circ\text{C}$ , Unless Otherwise Specified)	Characteristic Values		
		Min.	Typ.	Max.
$V_F$	$I_F = 10\text{A}, V_{GE} = 0\text{V}$ , Note 1 $T_J = 125^\circ\text{C}$		1.7	3.0 V V
$I_{RM}$ $t_{rr}$ $t_{rr}$	} $I_F = 12\text{A}, V_{GE} = 0\text{V}$ , $-di_F/dt = 100\text{A}/\mu\text{s}, V_R = 100\text{V}, T_J = 125^\circ\text{C}$		2.5	A
			110	ns
	$I_F = 1\text{A}, V_{GE} = 0\text{V}, -di_F/dt = 100\text{A}/\mu\text{s}, V_R = 30\text{V}$		30	ns
$R_{thJC}$				2.5 $^\circ\text{C/W}$

**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.

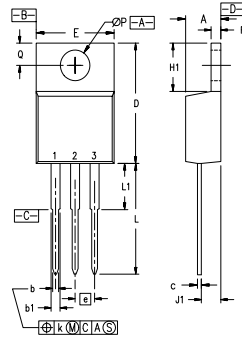
### TO-263 (IXGA) Outline



- 1. Gate
  - 2. Collector
  - 3. Emitter
  - 4. Collector
- Bottom Side

Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.06	4.83	.160	.190
b	0.51	0.99	.020	.039
b2	1.14	1.40	.045	.055
c	0.40	0.74	.016	.029
c2	1.14	1.40	.045	.055
D	8.64	9.65	.340	.380
D1	8.00	8.89	.280	.320
E	9.65	10.41	.380	.405
E1	6.22	8.13	.270	.320
e	2.54	BSC	.100	BSC
L	14.61	15.88	.575	.625
L1	2.29	2.79	.090	.110
L2	1.02	1.40	.040	.055
L3	1.27	1.78	.050	.070
L4	0	0.13	0	.005

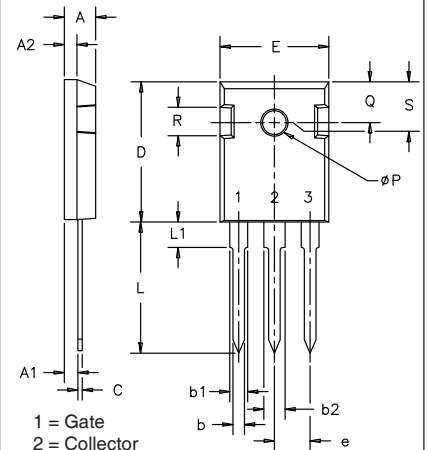
### TO-220 (IXGP) Outline



- Pins: 1 - Gate      2 - Collector  
3 - Emitter

SYM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.170	.190	4.32	4.83
b	.025	.040	0.64	1.02
b1	.045	.065	1.15	1.65
c	.014	.022	0.35	0.56
D	.580	.630	14.73	16.00
E	.390	.420	9.91	10.66
e	.100 BSC		2.54 BSC	
F	.045	.055	1.14	1.40
H1	.230	.270	5.85	6.85
J1	.090	.110	2.29	2.79
k	0	.015	0	0.38
L	.500	.550	12.70	13.97
L1	.110	.230	2.79	5.84
ØP	.139	.161	3.53	4.08
Q	.100	.125	2.54	3.18

### TO-247 (IXGH) AD Outline



- 1 = Gate  
2 = Collector  
3 = Emitter

SYM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.185	.209	4.7	5.3
A1	.087	.102	2.2	2.54
A2	.059	.098	2.2	2.6
b	.040	.055	1.0	1.4
b1	.065	.084	1.65	2.13
b2	.113	.123	2.87	3.12
C	.016	.031	.4	.8
D	.819	.845	20.80	21.46
E	.610	.640	15.75	16.26
e	.215 BSC		5.45 BSC	
L	.780	.800	19.81	20.32
L1		.177		4.50
ØP	.140	.144	3.55	3.65
Q	.212	.244	5.4	6.2
R	.170	.216	4.32	5.49
S	.242 BSC		6.15 BSC	

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

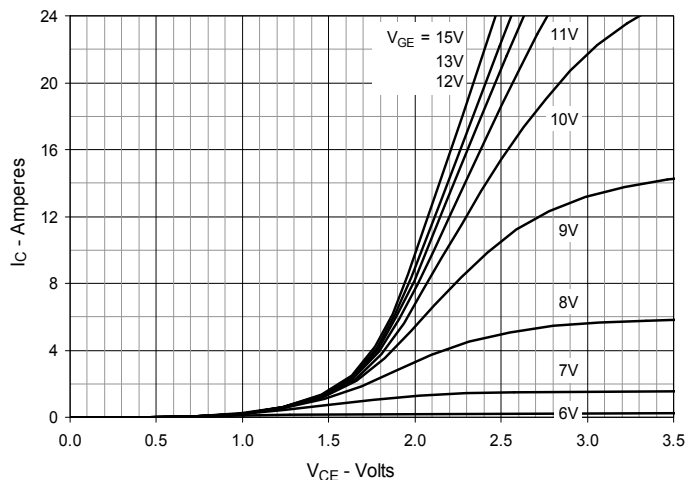


Fig. 2. Extended Output Characteristics @  $T_J = 25^\circ\text{C}$

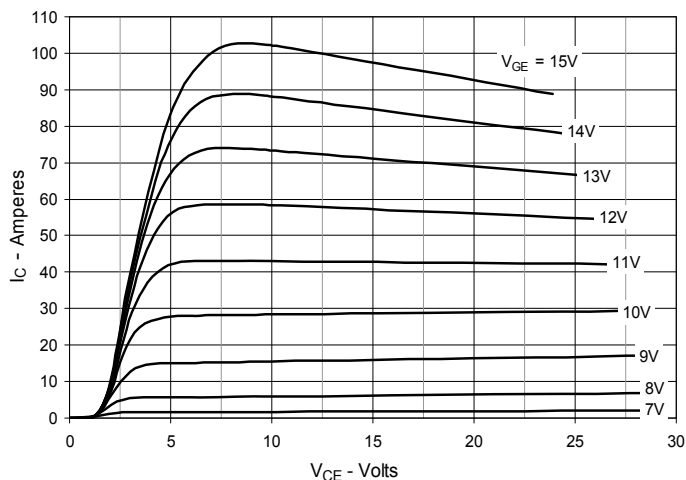


Fig. 3. Output Characteristics @  $T_J = 125^\circ\text{C}$

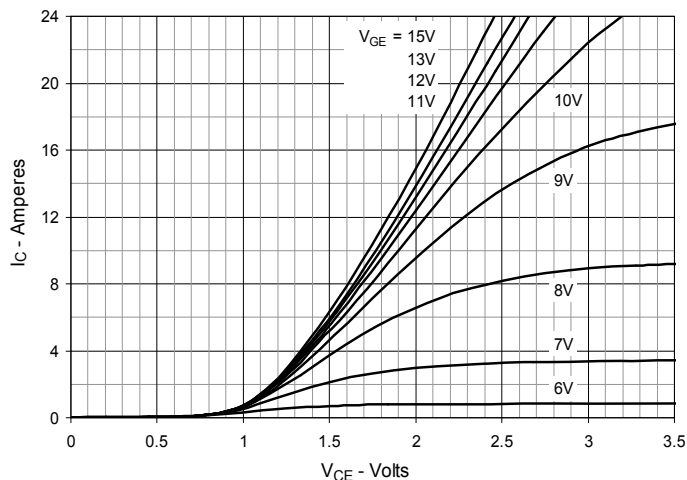


Fig. 4. Dependence of  $V_{CE(sat)}$  on Junction Temperature

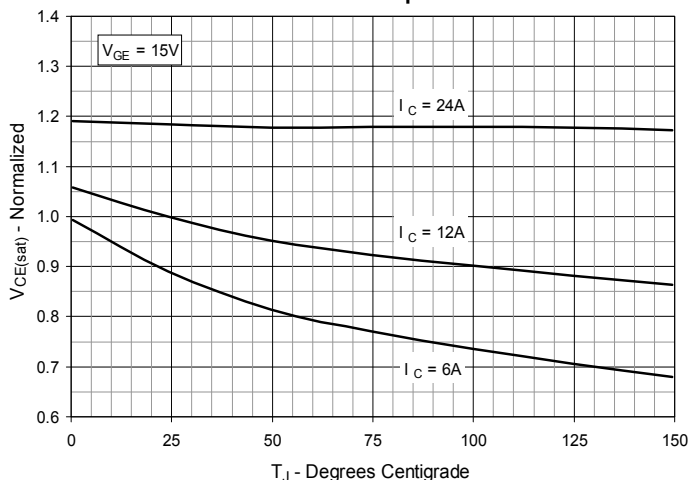


Fig. 5. Collector-to-Emitter Voltage vs. Gate-to-Emitter Voltage

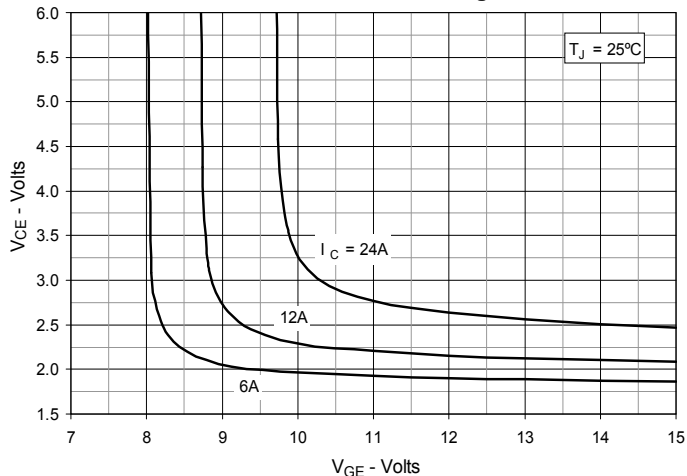
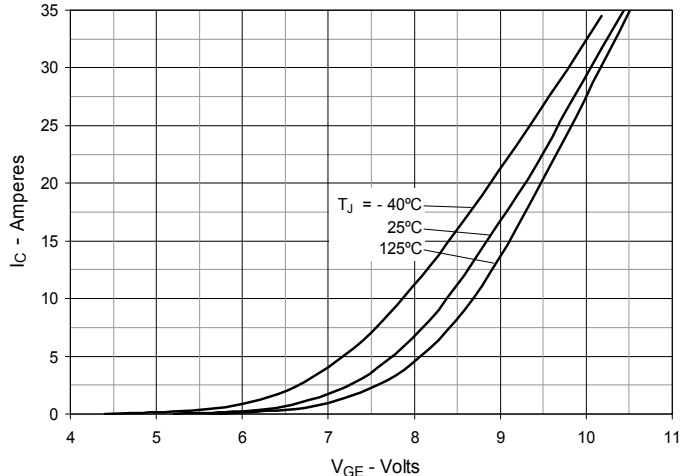
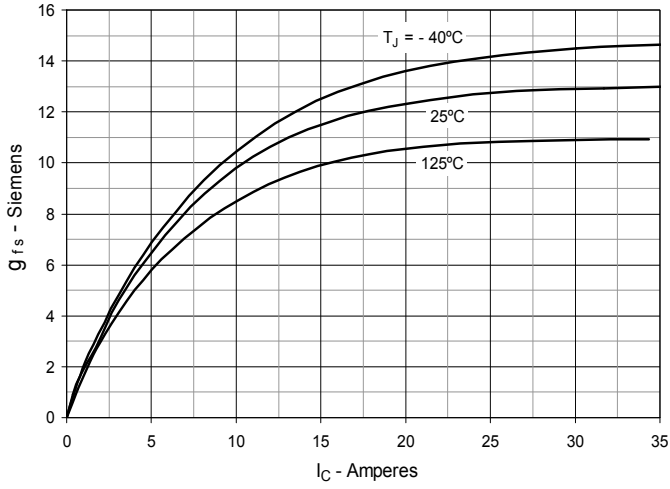


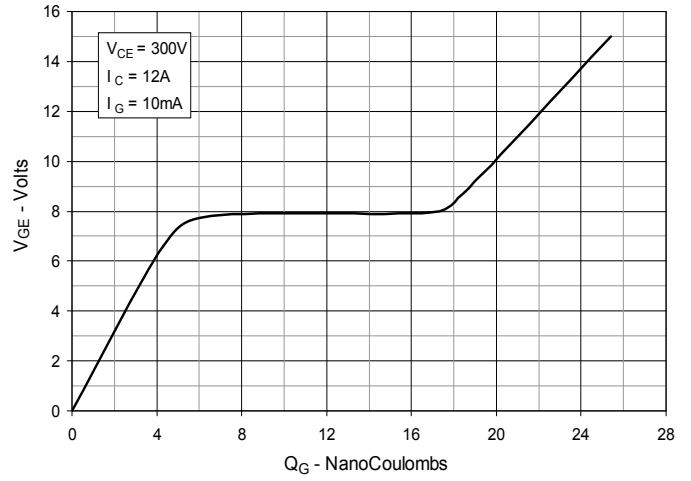
Fig. 6. Input Admittance



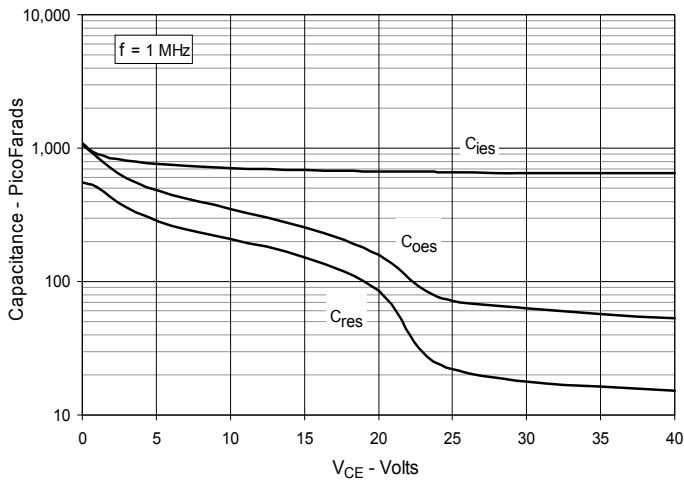
**Fig. 7. Transconductance**



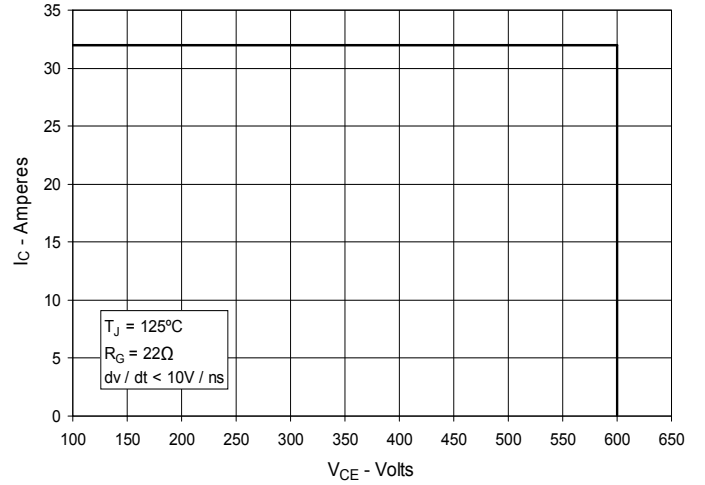
**Fig. 8. Gate Charge**



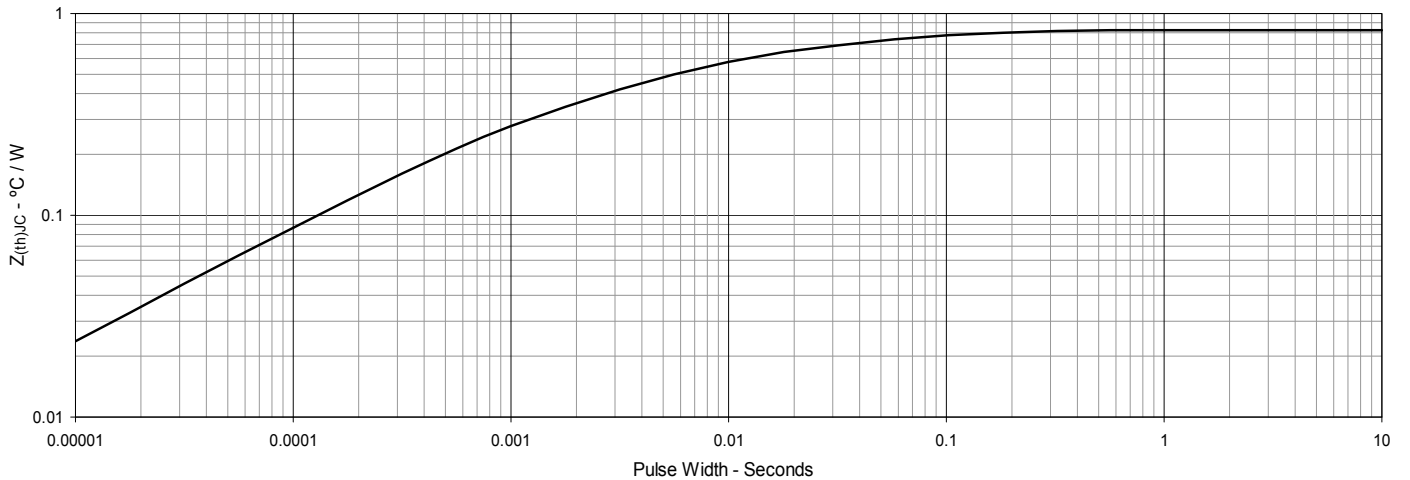
**Fig. 9. Capacitance**



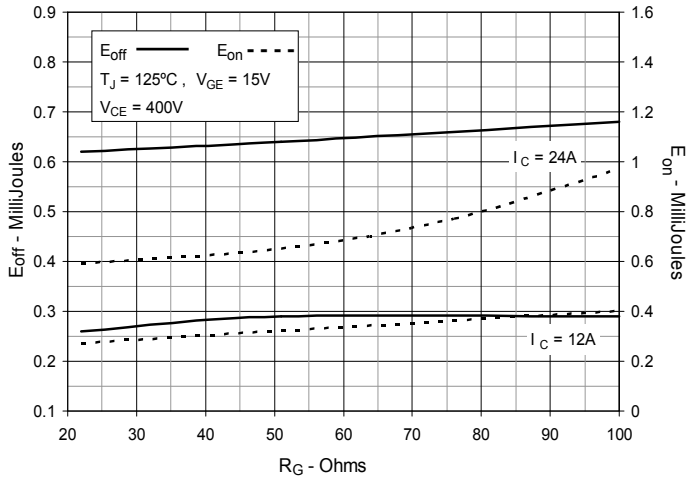
**Fig. 10. Reverse-Bias Safe Operating Area**



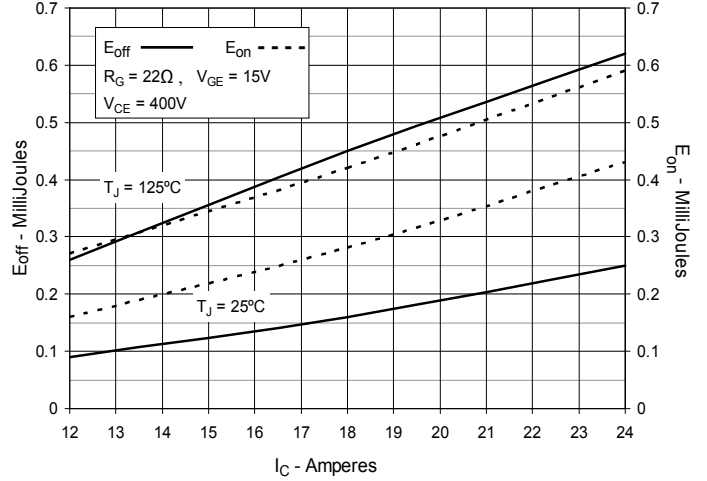
**Fig. 11. Maximum Transient Thermal Impedance**



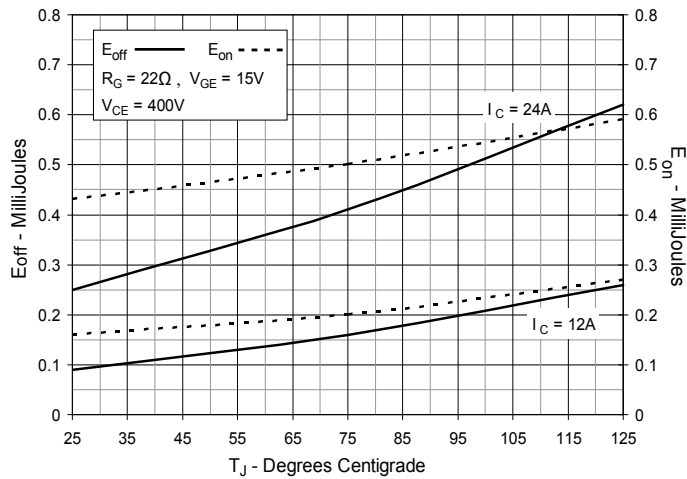
**Fig. 12. Inductive Switching Energy Loss vs. Gate Resistance**



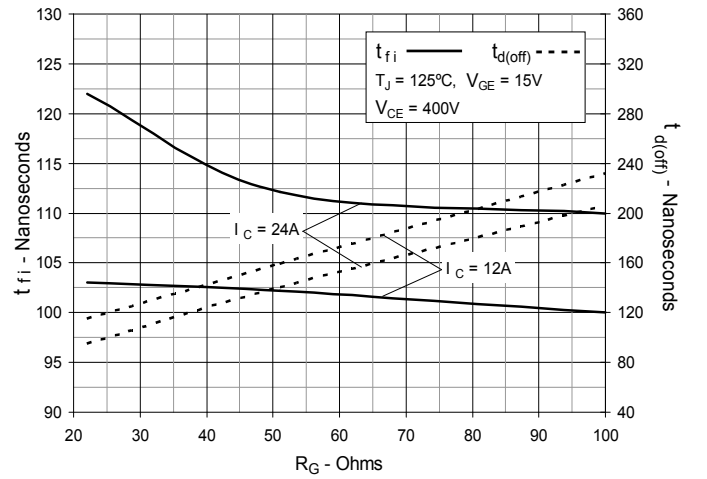
**Fig. 13. Inductive Switching Energy Loss vs. Collector Current**



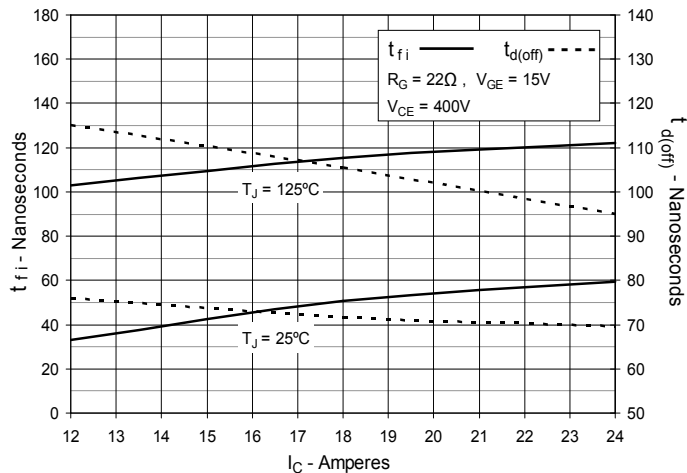
**Fig. 14. Inductive Switching Energy Loss vs. Junction Temperature**



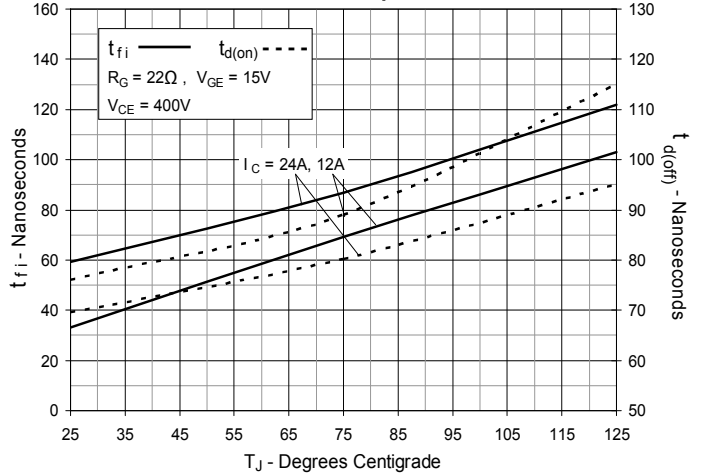
**Fig. 15. Inductive Turn-off Switching Times vs. Gate Resistance**



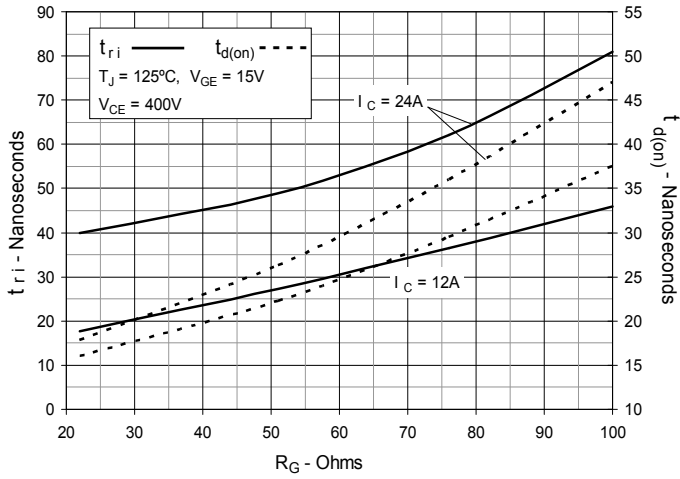
**Fig. 16. Inductive Turn-off Switching Times vs. Collector Current**



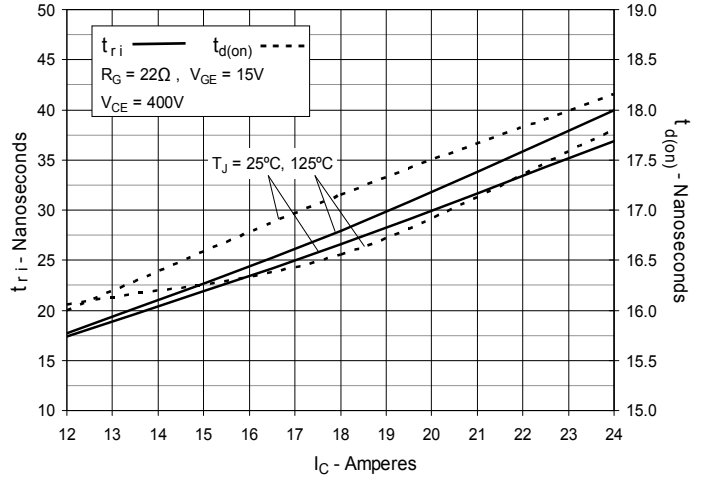
**Fig. 17. Inductive Turn-off Switching Times vs. Junction Temperature**



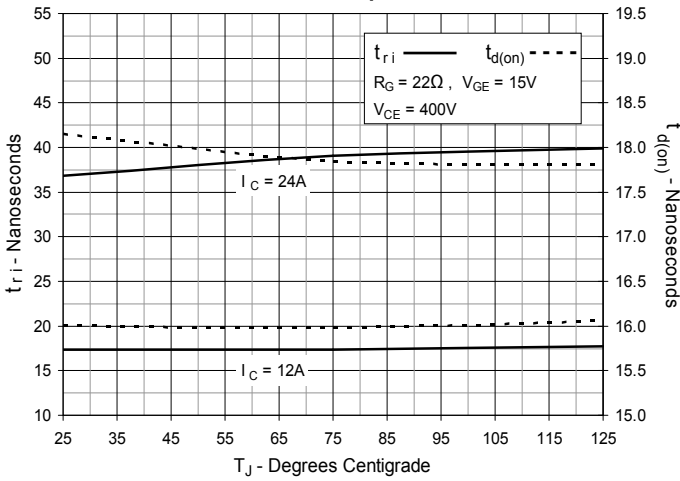
**Fig. 18. Inductive Turn-on Switching Times vs. Gate Resistance**



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



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





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