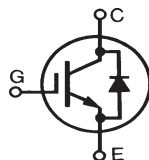


GenX3™ 600V IGBT w/ Diode

IXGH56N60B3D1

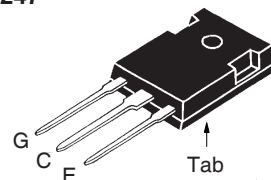
Medium-Speed-Low-Vsat PT
IGBT 5-40kHz Switching



$$\begin{aligned} V_{CES} &= 600V \\ I_{C110} &= 56A \\ V_{CE(sat)} &\leq 1.80V \end{aligned}$$

Symbol	Test Conditions	Maximum Ratings	
V_{CES}	$T_J = 25^\circ\text{C}$ to 150°C	600	V
V_{CGR}	$T_J = 25^\circ\text{C}$ to 150°C , $R_{GE} = 1M\Omega$	600	V
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C110}	$T_C = 110^\circ\text{C}$	56	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1ms	350	A
SSOA (RBSOA)	$V_{GE} = 15V$, $T_{VJ} = 125^\circ\text{C}$, $R_G = 5\Omega$ Clamped Inductive Load	$I_{CM} = 150$ @ $V_{CE} \leq V_{CES}$	A
P_C	$T_C = 25^\circ\text{C}$	330	W
T_J		-55 ... +150	$^\circ\text{C}$
T_{JM}		150	$^\circ\text{C}$
T_{stg}		-55 ... +150	$^\circ\text{C}$
T_L	Maximum Lead Temperature for Soldering	300	$^\circ\text{C}$
T_{SOLD}	1.6 mm (0.062in.) from Case for 10s	260	$^\circ\text{C}$
M_d	Mounting Torque	1.13/10	Nm/lb.in.
Weight		6	g

TO-247



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

Features

- Optimized for Low Conduction and 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 ($T_J = 25^\circ\text{C}$, Unless Otherwise Specified)	Characteristic Values		
		Min.	Typ.	Max.
$V_{GE(th)}$	$I_C = 250\mu\text{A}$, $V_{CE} = V_{GE}$	3.0		5.0 V
I_{CES}	$V_{CE} = V_{CES}$, $V_{GE} = 0V$ $T_J = 125^\circ\text{C}$			300 μA 2 mA
I_{GES}	$V_{CE} = 0V$, $V_{GE} = \pm 20V$			± 100 nA
$V_{CE(sat)}$	$I_C = 44A$, $V_{GE} = 15V$, Note 1 $T_J = 125^\circ\text{C}$	1.49 1.47		1.80 V V

Symbol Test Conditions

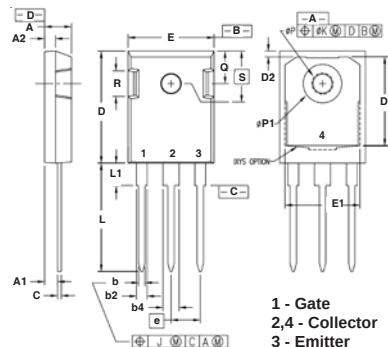
($T_J = 25^\circ\text{C}$ Unless Otherwise Specified)

Characteristic Values

Min. Typ. Max.

g_{fs}	$I_C = 44\text{A}, V_{CE} = 10\text{V}, \text{Note 1}$	36	60	S
C_{ies}	$V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$		3950	pF
C_{oes}			220	pF
C_{res}			56	pF
$Q_{g(on)}$	$I_C = 40\text{A}, V_{GE} = 15\text{V}, V_{CE} = 0.5 \cdot V_{CES}$		138	nC
Q_{ge}			25	nC
Q_{gc}			47	nC
$t_{d(on)}$	Inductive Load, $T_J = 25^\circ\text{C}$ $I_C = 44\text{A}, V_{GE} = 15\text{V}$ $V_{CE} = 480\text{V}, R_G = 5\Omega$ Note 2		26	ns
t_{ri}			41	ns
E_{on}			1.30	mJ
$t_{d(off)}$			155	ns
t_{fi}			95	ns
E_{off}			1.05	mJ
$t_{d(on)}$	Inductive Load, $T_J = 125^\circ\text{C}$ $I_C = 44\text{A}, V_{GE} = 15\text{V}$ $V_{CE} = 480\text{V}, R_G = 5\Omega$ Note 2		26	ns
t_{ri}			37	ns
E_{on}			2.34	mJ
$t_{d(off)}$			220	ns
t_{fi}			165	ns
E_{off}			2.20	mJ
R_{thJC}			0.375	$^\circ\text{C/W}$
R_{thCS}		0.21		$^\circ\text{C/W}$

TO-247 (IXGH) Outline



Dim.	Millimeter		Inches	
	min	max	min	max
A	4.70	5.30	0.185	0.209
A1	2.21	2.59	0.087	0.102
A2	1.50	2.49	0.059	0.098
b	0.99	1.40	0.039	0.055
b2	1.65	2.39	0.065	0.094
b4	2.59	3.43	0.102	0.135
c	0.38	0.89	0.015	0.035
D	20.79	21.45	0.819	0.845
D1	13.07	-	0.515	-
D2	0.51	1.35	0.020	0.053
E	15.48	16.24	0.610	0.640
E1	13.45	-	0.53	-
E2	4.31	5.48	0.170	0.216
e	5.45 BSC		0.215 BSC	
L	19.80	20.30	0.078	0.800
L1	-	4.49	-	0.177
P	3.55	3.65	0.140	0.144
P1	-	7.39	-	0.290
Q	5.38	6.19	0.212	0.244
S	6.14 BSC		0.242 BSC	

Reverse Diode (FRED)

Symbol Test Conditions

($T_J = 25^\circ\text{C}$ Unless Otherwise Specified)

Characteristic Values

Min. Typ. Max.

V_F	$I_F = 30\text{A}, V_{GE} = 0\text{V}, \text{Note 1}$	$T_J = 150^\circ\text{C}$	2.7	V
			1.6	V
I_{RM}	$I_F = 30\text{A}, V_{GE} = 0\text{V}, -di_F/dt = 100\text{A}/\mu\text{s}, T_J = 100^\circ\text{C}$	$T_J = 100^\circ\text{C}$	4	A
t_{rr}	$V_R = 100\text{V}$		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}			0.9	$^\circ\text{C/W}$

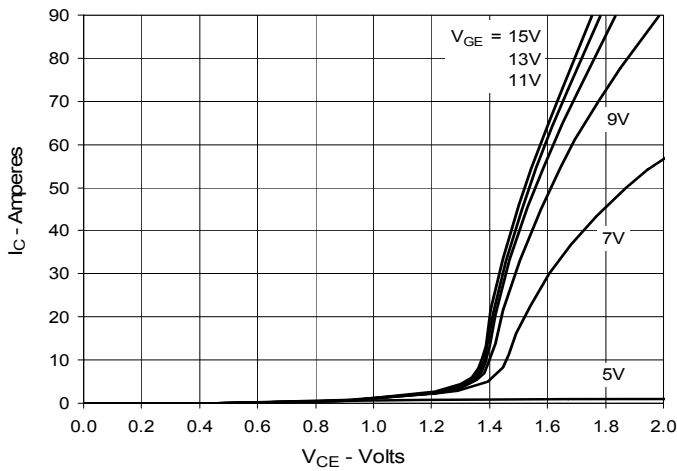
Notes:

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

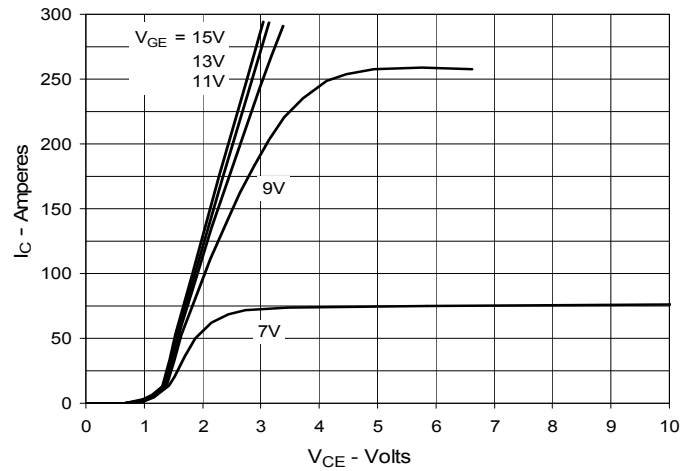
IXYS Reserves the Right to Change Limits, Test Conditions and Dimensions.

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	7,157,338B2
	4,860,072	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	

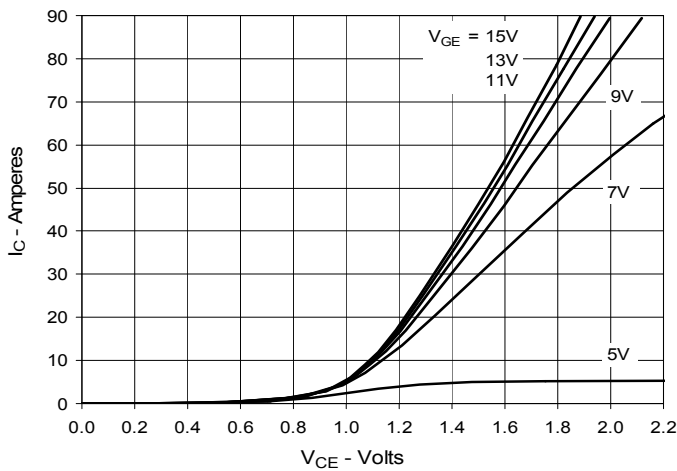
**Fig. 1. Output Characteristics
@ 25°C**



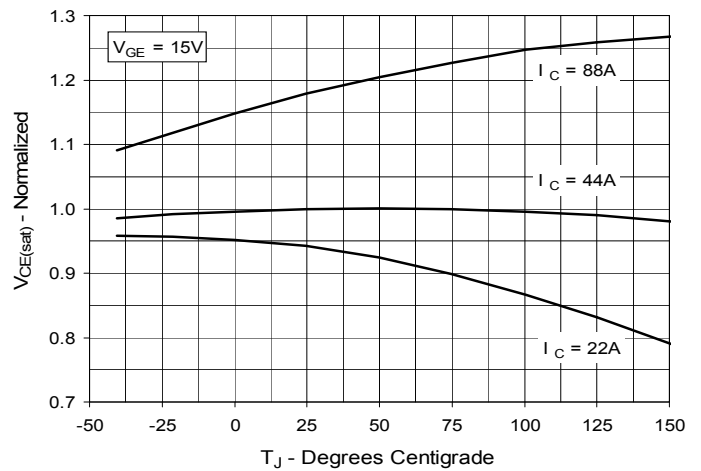
**Fig. 2. Extended Output Characteristics
@ 25°C**



**Fig. 3. Output Characteristics
@ 125°C**



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



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

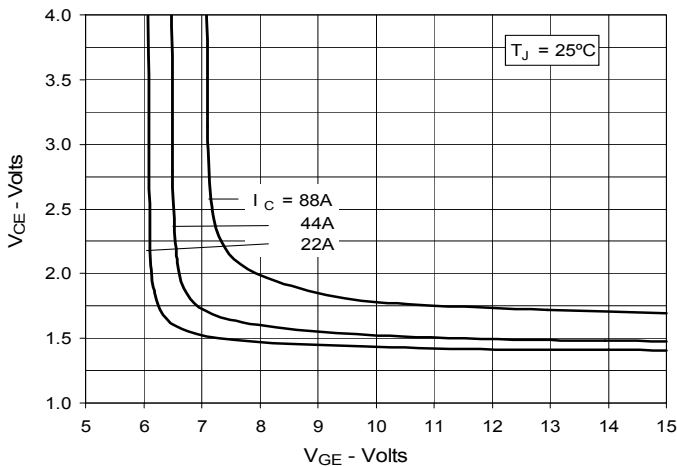


Fig. 6. Input Admittance

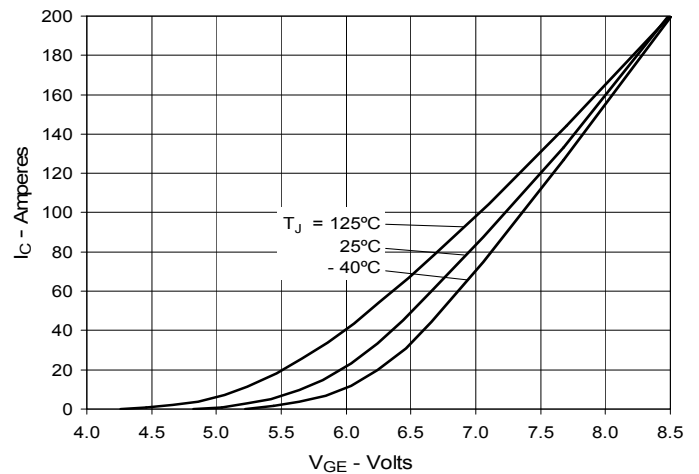


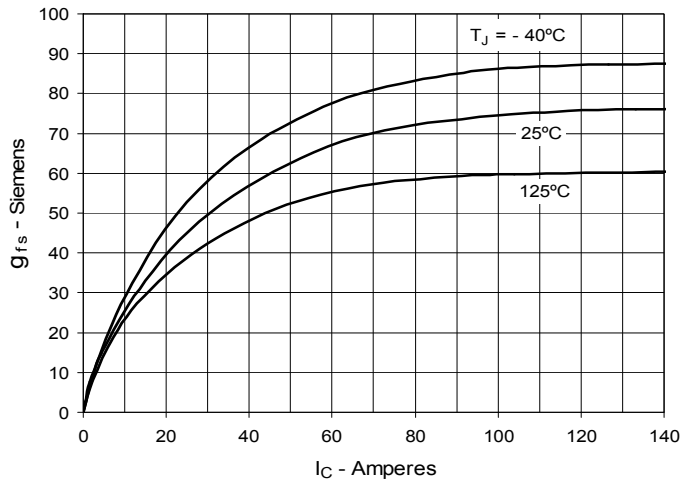
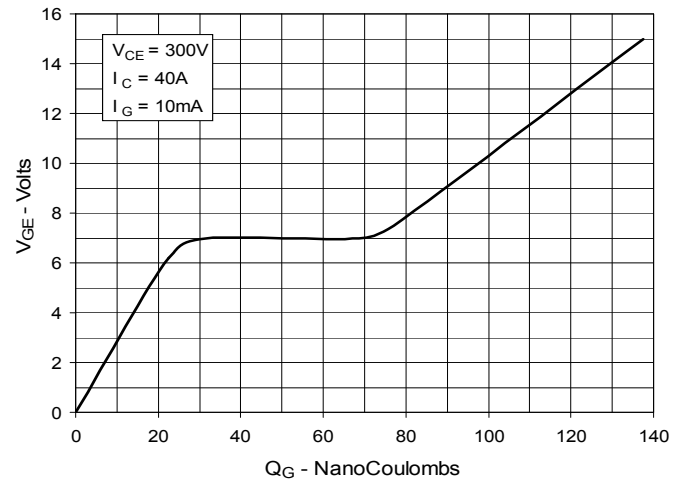
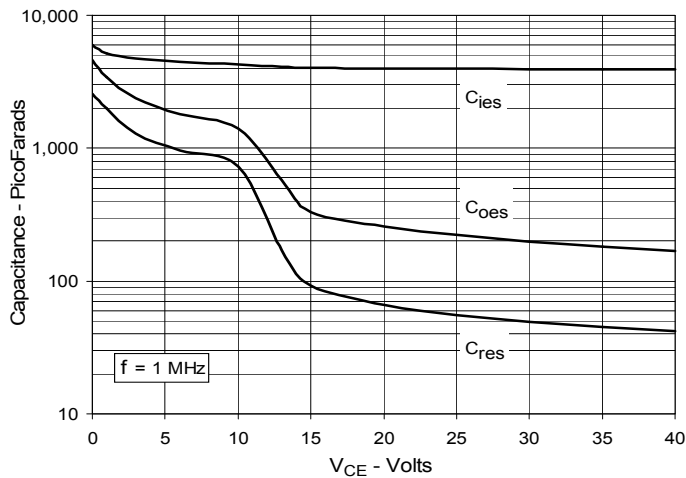
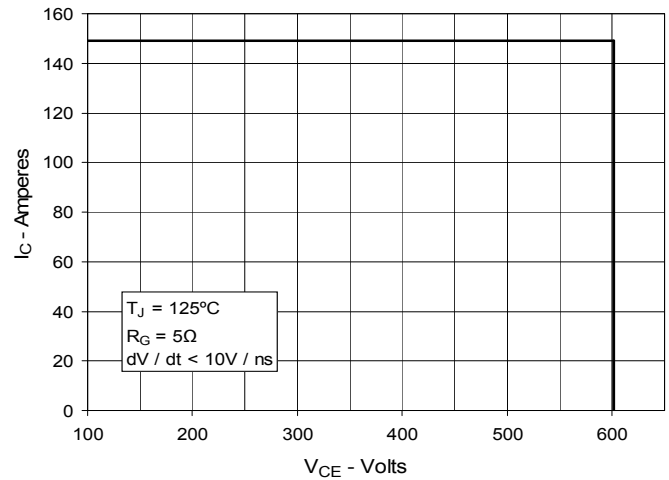
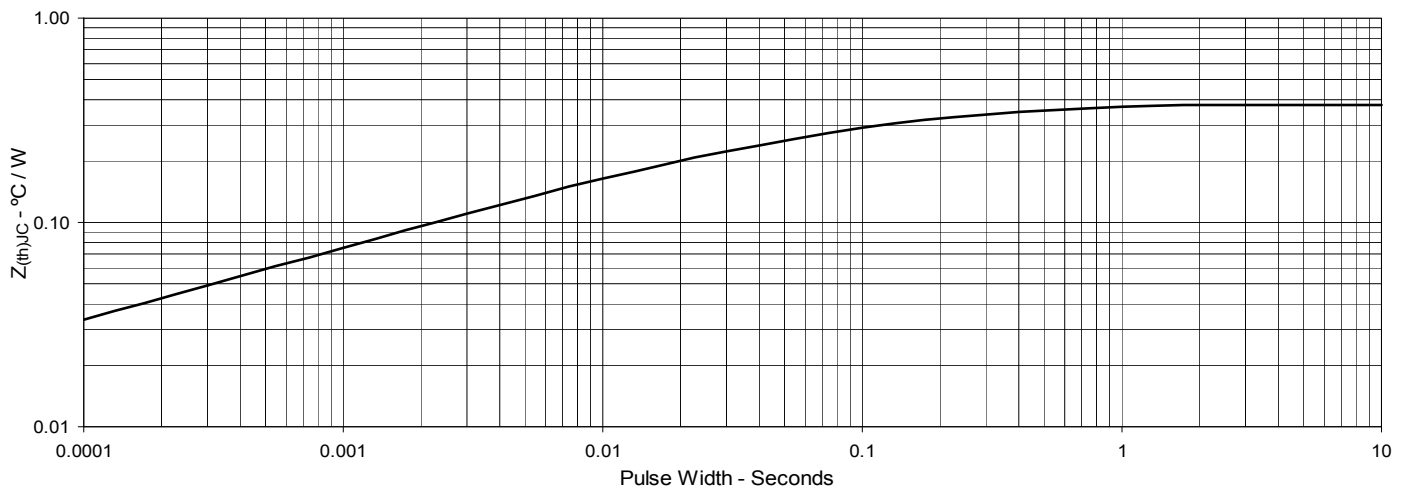
Fig. 7. Transconductance

Fig. 8. Gate Charge

Fig. 9. Capacitance

Fig. 10. Reverse-Bias Safe Operating Area

Fig. 11. Maximum Transient Thermal Impedance


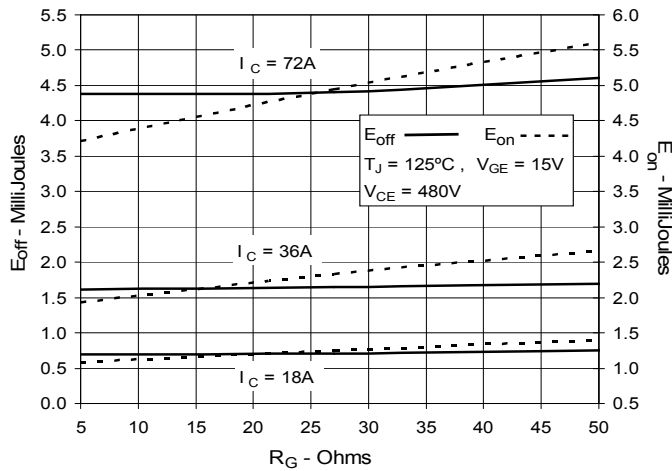
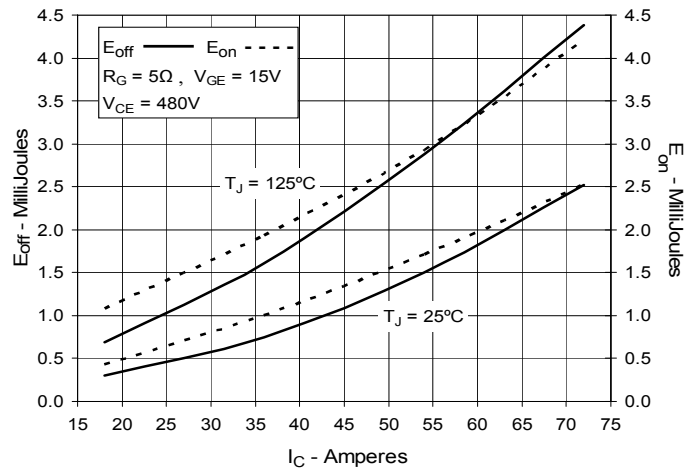
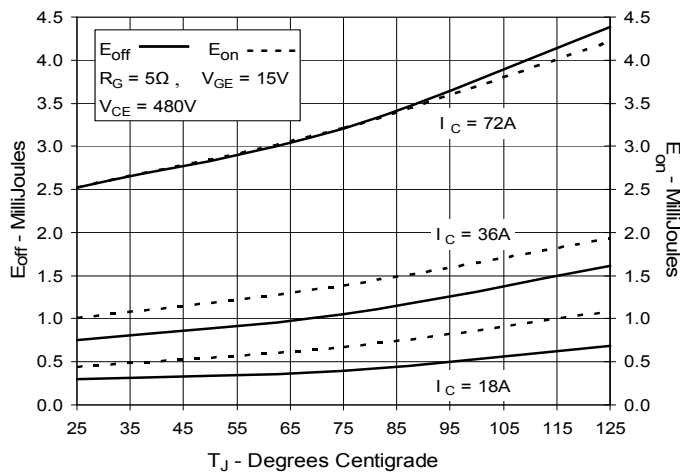
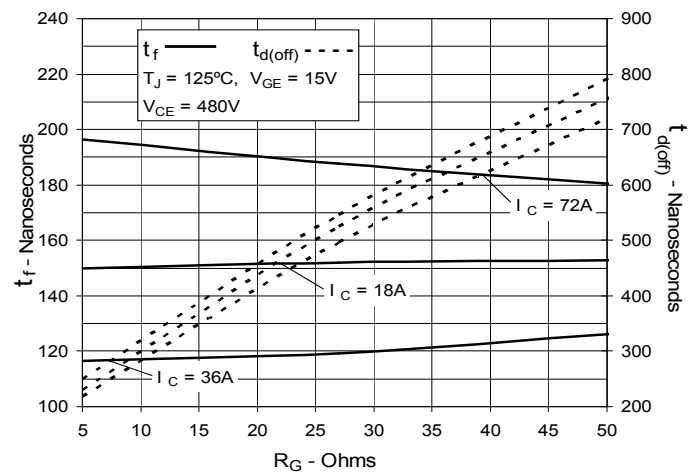
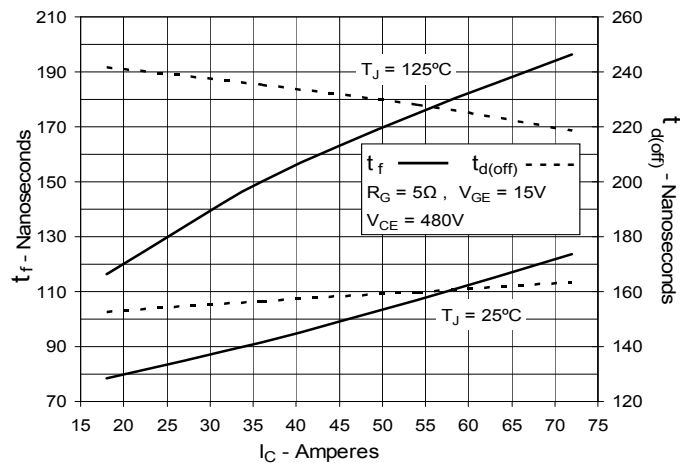
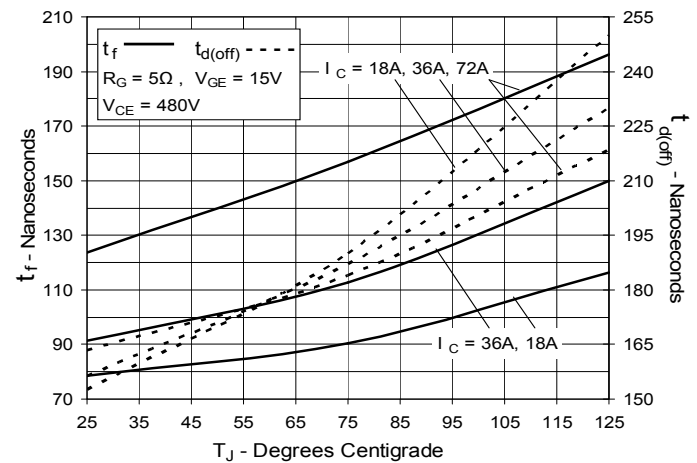
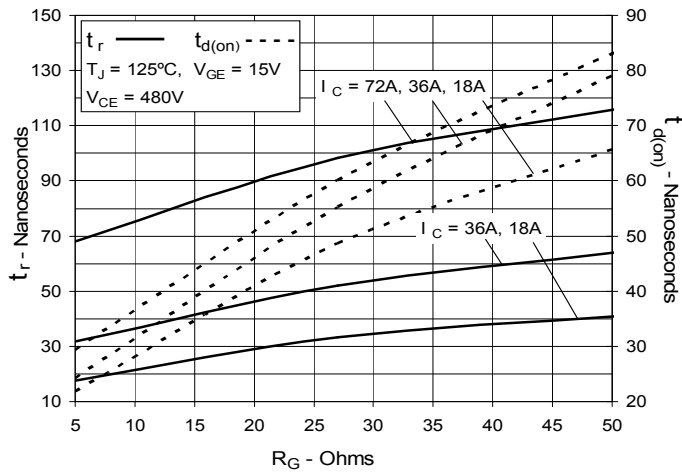
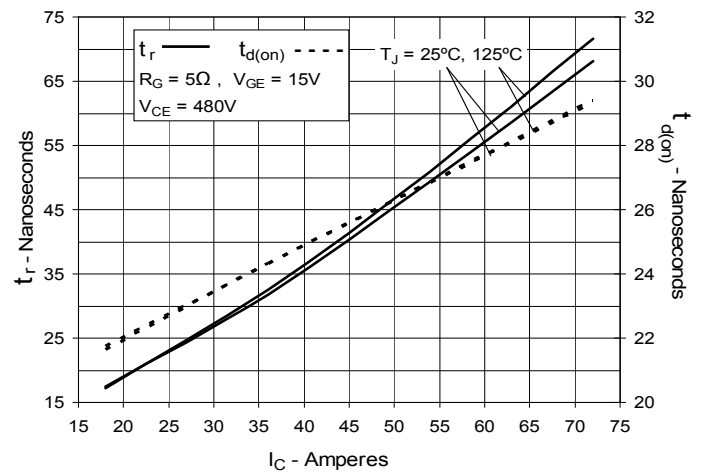
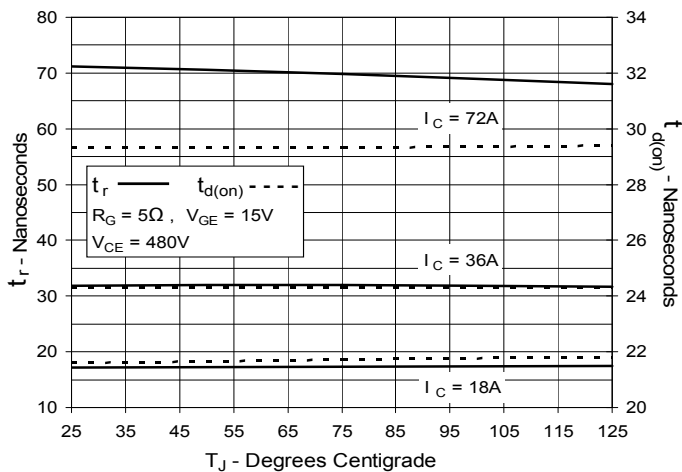
Fig. 12. Inductive Switching Energy Loss vs. Gate Resistance

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


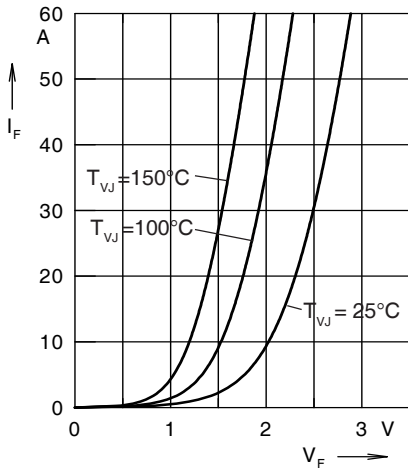


Fig. 21. Forward Current I_F Versus V_F

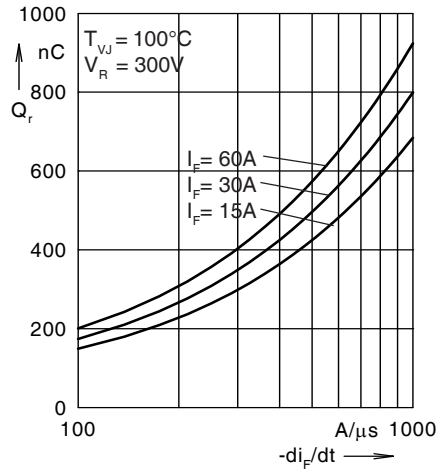


Fig. 22. Reverse Recovery Charge Q_r Versus $-di_F/dt$

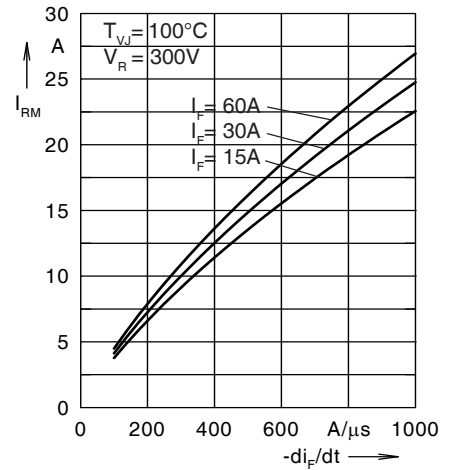


Fig. 23. Peak Reverse Current I_{RM} Versus $-di_F/dt$

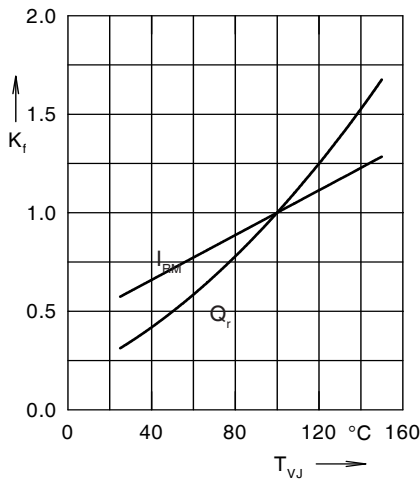


Fig. 24. Dynamic Parameters Q_r , I_{RM} Versus T_{VJ}

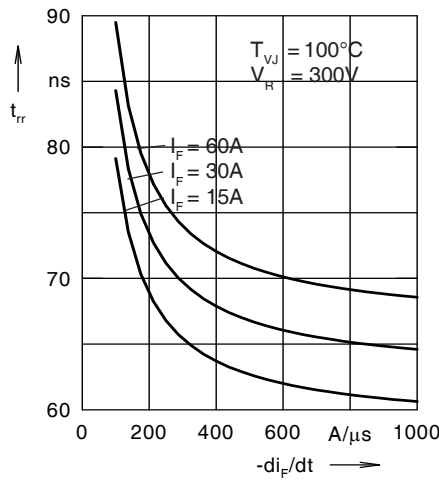


Fig. 25. Recovery Time t_{rr} Versus $-di_F/dt$

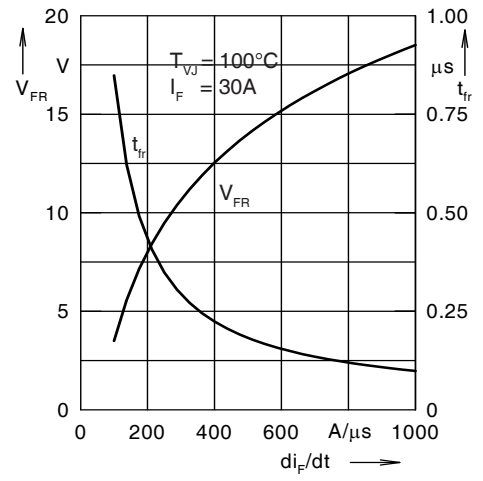


Fig. 26. Peak Forward Voltage V_{FR} and t_{rr} Versus di_F/dt

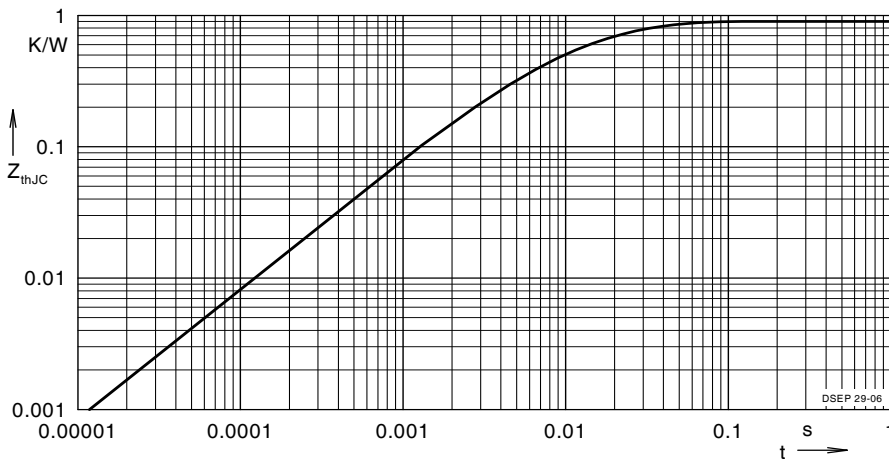


Fig. 27. Transient Thermal Resistance Junction to Case

Constants for Z_{thJC} calculation:

i	R_{thi} (K/W)	t_i (s)
1	0.502	0.0052
2	0.193	0.0003
3	0.205	0.0162



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