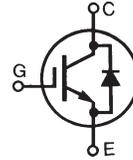


# HiPerFAST™ IGBT with Diode C2-Class High Speed IGBTs

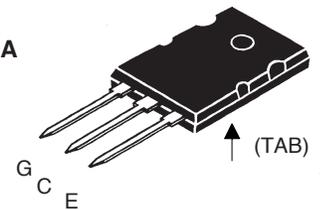
**IXGK 60N60C2D1**  
**IXGX 60N60C2D1**

$V_{CES} = 600 \text{ V}$   
 $I_{C25} = 75 \text{ A}$   
 $V_{CE(sat)} = 2.5 \text{ V}$   
 $t_{fi(typ)} = 35 \text{ ns}$

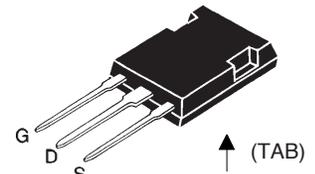


Symbol	Test Conditions	Maximum Ratings	
$V_{CES}$	$T_J = 25^\circ\text{C to } 150^\circ\text{C}$	600	V
$V_{CGR}$	$T_J = 25^\circ\text{C to } 150^\circ\text{C}; R_{GE} = 1 \text{ M}\Omega$	600	V
$V_{GES}$	Continuous	$\pm 20$	V
$V_{GEM}$	Transient	$\pm 30$	V
$I_{C25}$	$T_C = 25^\circ\text{C}$ (limited by leads)	75	A
$I_{C110}$	$T_C = 110^\circ\text{C}$	60	A
$I_{F110}$	$T_C = 110^\circ\text{C}$	48	A
$I_{CM}$	$T_C = 25^\circ\text{C}, 1 \text{ ms}$	300	A
<b>SSOA</b> <b>(RBSOA)</b>	$V_{GE} = 15 \text{ V}, T_{VJ} = 125^\circ\text{C}, R_G = 10 \Omega$ Clamped inductive load @ $V_{CE} \leq 600 \text{ V}$	$I_{CM} = 100$	A
$P_c$	$T_C = 25^\circ\text{C}$	480	W
$T_J$		-55 ... +150	$^\circ\text{C}$
$T_{JM}$		150	$^\circ\text{C}$
$T_{stg}$		-55 ... +150	$^\circ\text{C}$
$M_d$	Mounting torque, TO-264	1.13/10 Nm/lb.in.	
<b>Weight</b>	TO-264	10	g
	PLUS247	6	g
Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s		300	$^\circ\text{C}$

**TO-264 AA**  
**(IXGK)**



**PLUS247**  
**(IXGX)**



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

### Features

- Very high frequency IGBT and anti-parallel FRED in one package
- Square RBSOA
- High current handling capability
- MOS Gate turn-on for drive simplicity
- Fast Recovery Epitaxial Diode (FRED) with soft recovery and low  $I_{RM}$

### Applications

- Switch-mode and resonant-mode power supplies
- Uninterruptible power supplies (UPS)
- DC choppers
- AC motor speed control
- DC servo and robot drives

### Advantages

- Space savings (two devices in one package)
- Easy to mount with 1 screw

Symbol	Test Conditions	Characteristic Values ( $T_J = 25^\circ\text{C}$ unless otherwise specified)		
		Min.	Typ.	Max.
$V_{GE(th)}$	$I_C = 250 \mu\text{A}, V_{CE} = V_{GE}$	3.0		5.0 V
$I_{CES}$	$V_{CE} = V_{CES}$ $V_{GE} = 0 \text{ V}$	$T_J = 25^\circ\text{C}$		650 $\mu\text{A}$
		$T_J = 125^\circ\text{C}$		5 mA
$I_{GES}$	$V_{CE} = 0 \text{ V}, V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = 50 \text{ A}, V_{GE} = 15 \text{ V}$ Note 1	$T_J = 25^\circ\text{C}$	2.1	2.5 V
		$T_J = 125^\circ\text{C}$	1.8	V

Symbol	Test Conditions	Characteristic Values			
		(T <sub>J</sub> = 25°C unless otherwise specified)			
		Min.	Typ.	Max.	
<b>g<sub>fs</sub></b>	I <sub>C</sub> = 50 A; V <sub>CE</sub> = 10 V, Note 1	40	58	S	
<b>C<sub>ies</sub></b>	V <sub>CE</sub> = 25 V, V <sub>GE</sub> = 0 V, f = 1 MHz		3900	pF	
<b>C<sub>oes</sub></b>			280	pF	
<b>C<sub>res</sub></b>			97	pF	
<b>Q<sub>g</sub></b>	I <sub>C</sub> = 50 A, V <sub>GE</sub> = 15 V, V <sub>CE</sub> = 0.5 V <sub>CES</sub>		146	nC	
<b>Q<sub>ge</sub></b>			28	nC	
<b>Q<sub>gc</sub></b>			50	nC	
<b>t<sub>d(on)</sub></b>	<b>Inductive load, T<sub>J</sub> = 25°C</b> I <sub>C</sub> = 50 A, V <sub>GE</sub> = 15 V V <sub>CE</sub> = 400 V, R <sub>G</sub> = R <sub>off</sub> = 2.0 Ω		18	ns	
<b>t<sub>ri</sub></b>			25	ns	
<b>t<sub>d(off)</sub></b>			95	150	ns
<b>t<sub>fi</sub></b>			35	ns	
<b>E<sub>off</sub></b>			0.48	0.8	mJ
<b>t<sub>d(on)</sub></b>	<b>Inductive load, T<sub>J</sub> = 125°C</b> I <sub>C</sub> = 50 A, V <sub>GE</sub> = 15 V V <sub>CE</sub> = 400 V, R <sub>G</sub> = R <sub>off</sub> = 2.0 Ω		18	ns	
<b>t<sub>ri</sub></b>			25	ns	
<b>E<sub>on</sub></b>			0.9	mJ	
<b>t<sub>d(off)</sub></b>			130	ns	
<b>t<sub>fi</sub></b>			80	ns	
<b>E<sub>off</sub></b>		1.2	mJ		
<b>R<sub>thJC</sub></b>			0.26	K/W	
<b>R<sub>thCK</sub></b>		0.15		K/W	

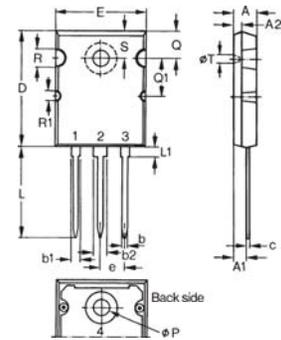
Symbol	Test Conditions	Characteristic Values		
		(T <sub>J</sub> = 25°C, unless otherwise specified)		
		min.	typ.	max.
<b>V<sub>F</sub></b>	I <sub>F</sub> = 60 A, V <sub>GE</sub> = 0 V, Note 1			2.1 V
				1.4
<b>I<sub>RM</sub></b>	I <sub>F</sub> = 60 A, V <sub>GE</sub> = 0 V, -di <sub>F</sub> /dt = 100 A/μs V <sub>R</sub> = 100 V			8.3 A
<b>t<sub>rr</sub></b>	I <sub>F</sub> = 1 A; -di/dt = 200 A/ms; V <sub>R</sub> = 30 V		35	ns
<b>R<sub>thJC</sub></b>				0.65 K/W

Note 1: Pulse test, t ≤ 300 μs, duty cycle ≤ 2 %

IXYS reserves the right to change limits, test conditions, and dimensions.

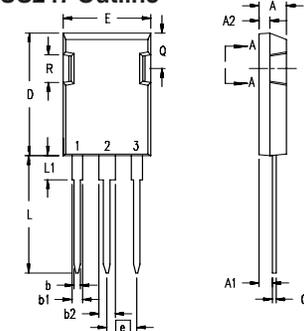
IXYS MOSFETs and IGBTs are covered by one or more of the following U.S. patents:	4,835,592	4,931,844	5,049,961	5,237,481	6,162,665	6,404,065 B1	6,683,344	6,727,585
	4,850,072	5,017,508	5,063,307	5,381,025	6,259,123 B1	6,534,343	6,710,405 B2	6,759,692
	4,881,106	5,034,796	5,187,117	5,486,715	6,306,728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

### TO-264 AA Outline



Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.82	5.13	.190	.202
A1	2.54	2.89	.100	.114
A2	2.00	2.10	.079	.083
b	1.12	1.42	.044	.056
b1	2.39	2.69	.094	.106
b2	2.90	3.09	.114	.122
c	0.53	0.83	.021	.033
D	25.91	26.16	1.020	1.030
E	19.81	19.96	.780	.786
e	5.46 BSC		.215 BSC	
J	0.00	0.25	.000	.010
K	0.00	0.25	.000	.010
L	20.32	20.83	.800	.820
L1	2.29	2.59	.090	.102
P	3.17	3.66	.125	.144
Q	6.07	6.27	.239	.247
Q1	8.38	8.69	.330	.342
R	3.81	4.32	.150	.170
R1	1.78	2.29	.070	.090
S	6.04	6.30	.238	.248
T	1.57	1.83	.062	.072

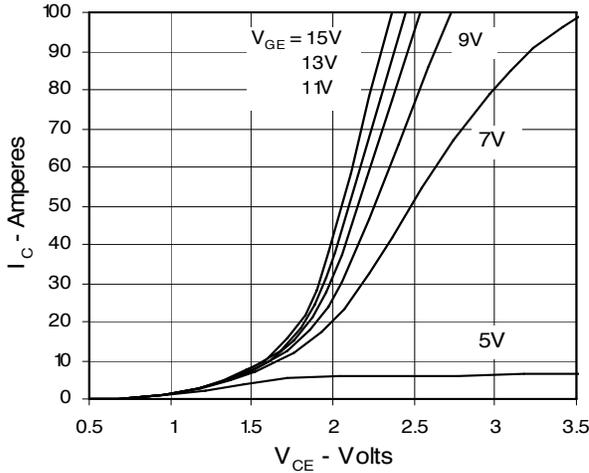
### PLUS247 Outline



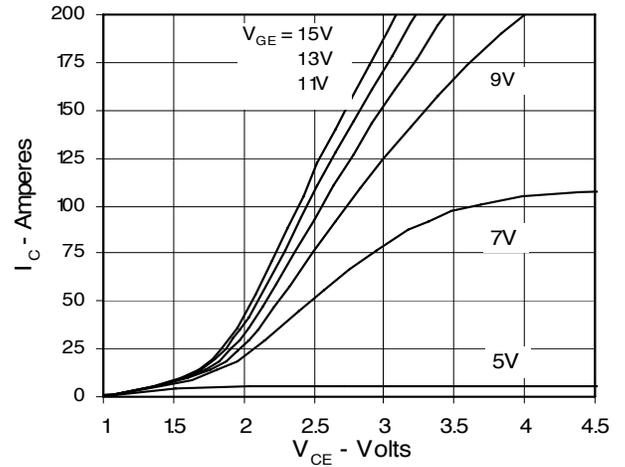
Terminals: 1 - Gate  
2 - Drain (Collector)  
3 - Source (Emitter)  
4 - Drain (Collector)

Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.83	5.21	.190	.205
A <sub>1</sub>	2.29	2.54	.090	.100
A <sub>2</sub>	1.91	2.16	.075	.085
b	1.14	1.40	.045	.055
b <sub>1</sub>	1.91	2.13	.075	.084
b <sub>2</sub>	2.92	3.12	.115	.123
C	0.61	0.80	.024	.031
D	20.80	21.34	.819	.840
E	15.75	16.13	.620	.635
e	5.45 BSC		.215 BSC	
L	19.81	20.32	.780	.800
L1	3.81	4.32	.150	.170
Q	5.59	6.20	.220	0.244
R	4.32	4.83	.170	.190

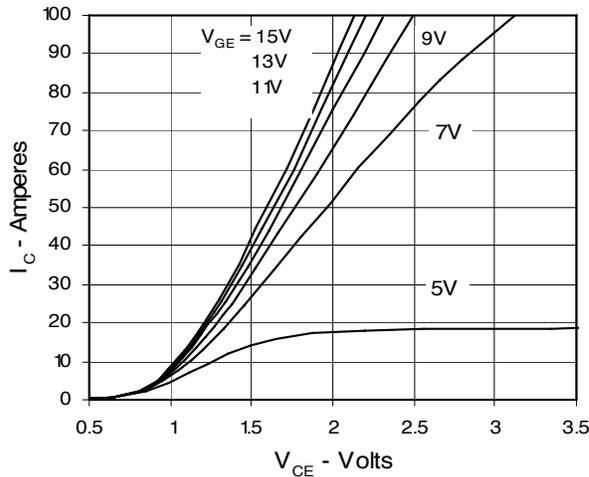
**Fig. 1. Output Characteristics**  
@ 25 Deg. C



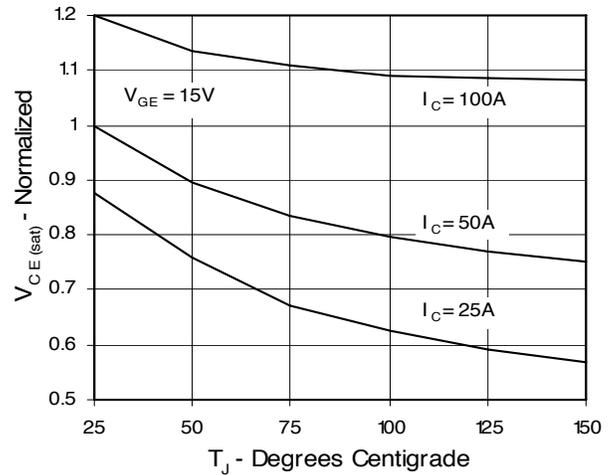
**Fig. 2. Extended Output Characteristics**  
@ 25 deg. C



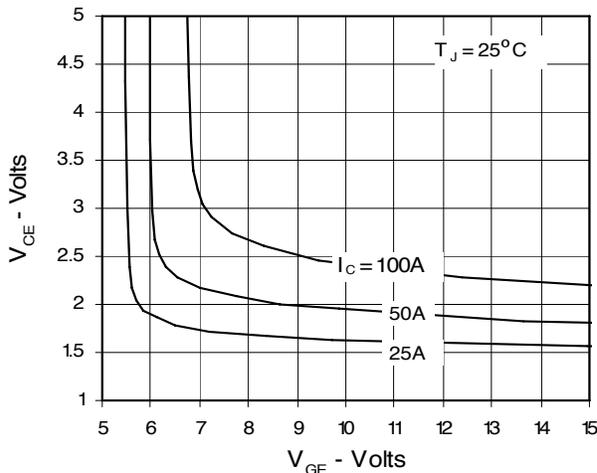
**Fig. 3. Output Characteristics**  
@ 125 Deg. C



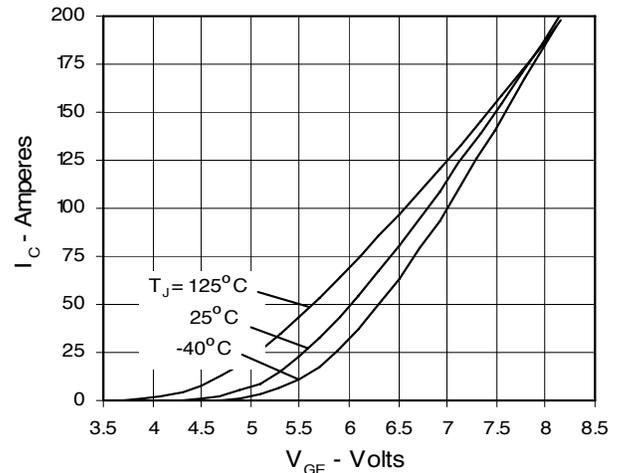
**Fig. 4. Temperature Dependence of  $V_{CE(sat)}$**



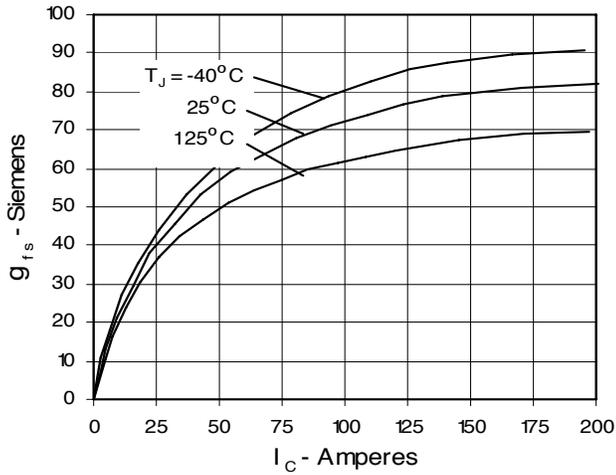
**Fig. 5. Collector-to-Emitter Voltage vs. Gate-to-Emitter voltage**



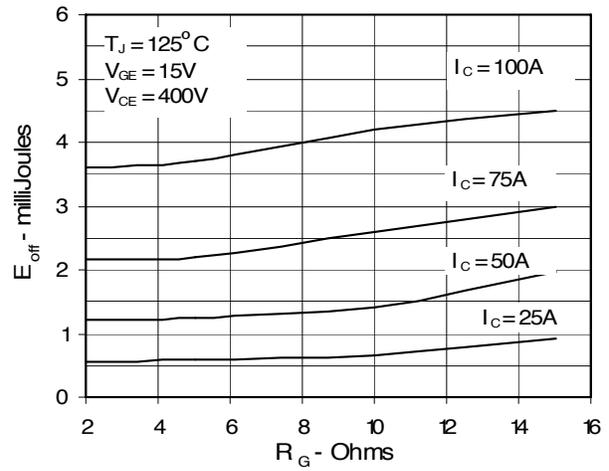
**Fig. 6. Input Admittance**



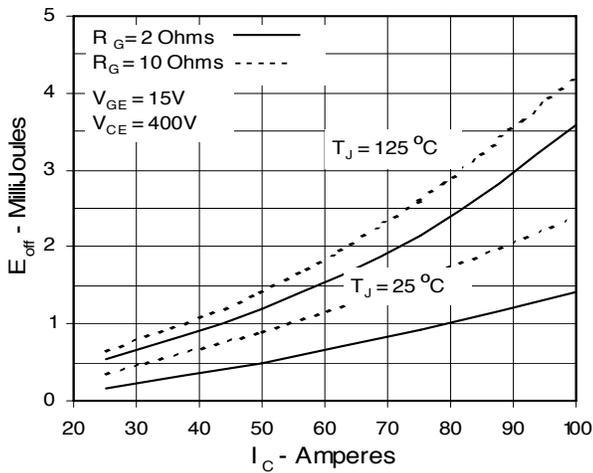
**Fig. 7. Transconductance**



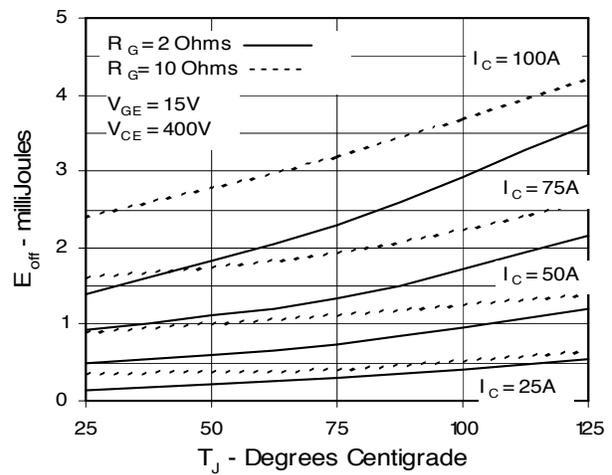
**Fig. 8. Dependence of  $E_{off}$  on  $R_G$**



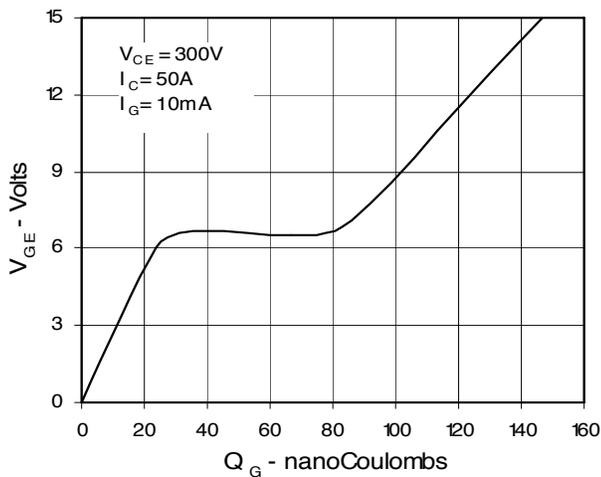
**Fig. 9. Dependence of  $E_{off}$  on  $I_C$**



**Fig. 10. Dependence of  $E_{off}$  on Temperature**



**Fig. 11. Gate Charge**



**Fig. 12. Capacitance**

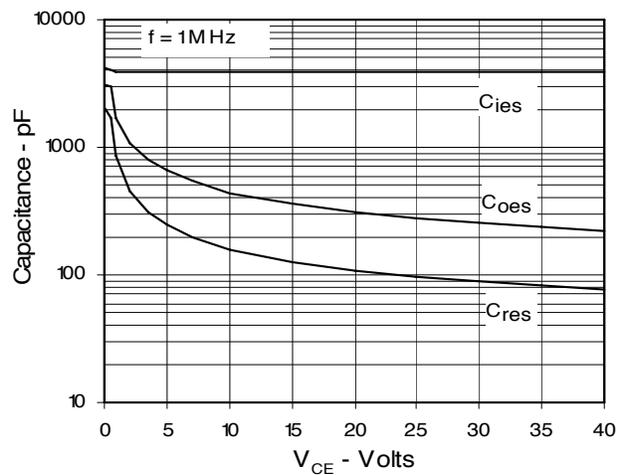
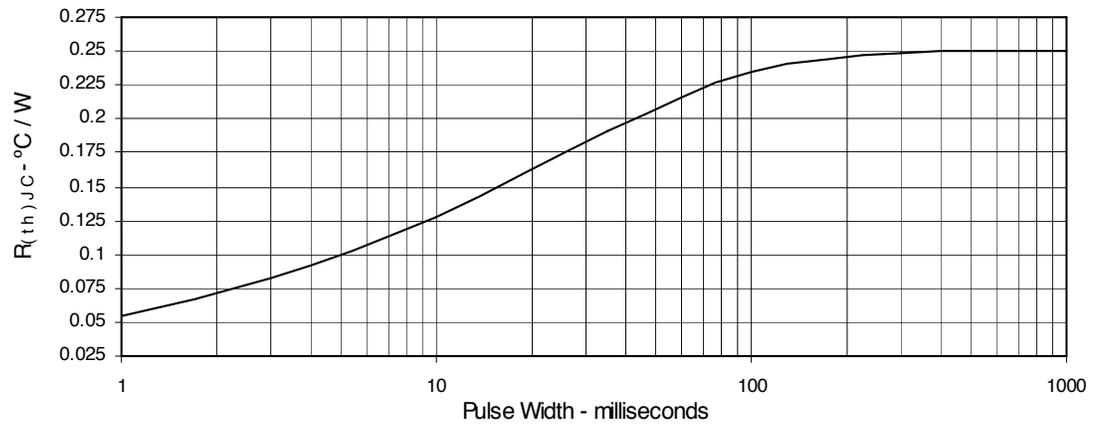


Fig. 13. Maximum Transient Thermal Resistance



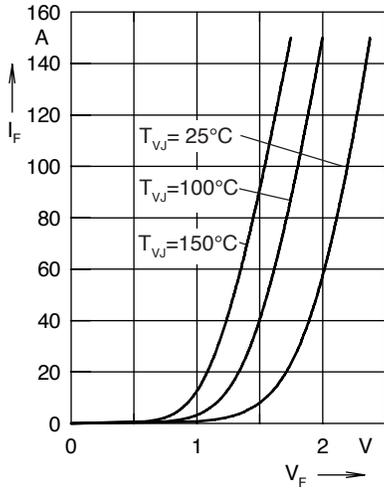


Fig. 14. Forward current  $I_F$  versus  $V_F$

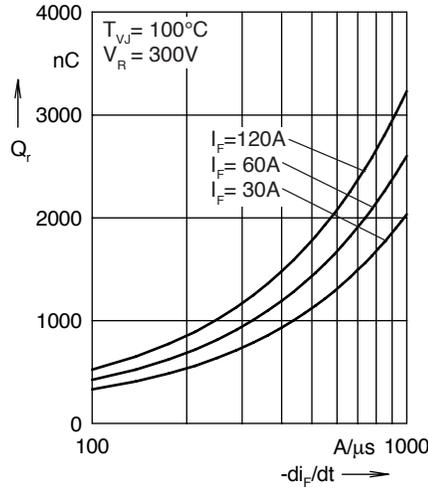


Fig. 15. Reverse recovery charge  $Q_r$  versus  $-di_F/dt$

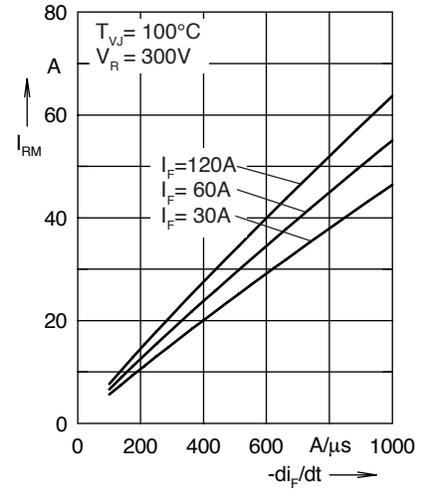


Fig. 16. Peak reverse current  $I_{RM}$  versus  $-di_F/dt$

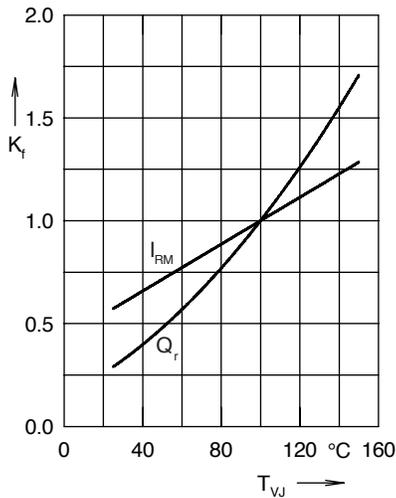


Fig. 17. Dynamic parameters  $Q_r$ ,  $I_{RM}$  versus  $T_{VJ}$

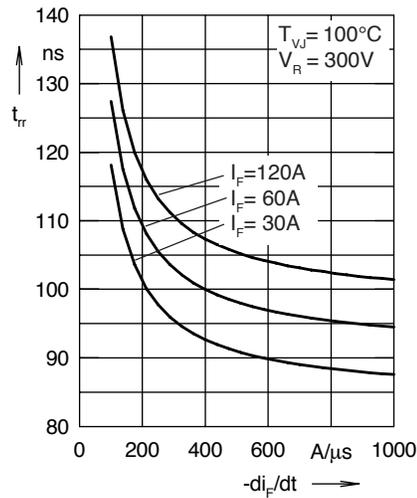


Fig. 18. Recovery time  $t_{rr}$  versus  $-di_F/dt$

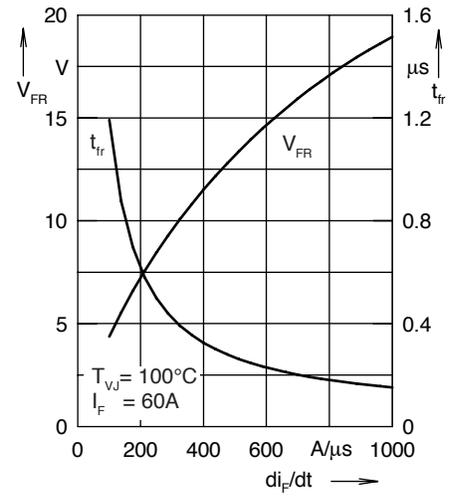


Fig. 19. Peak forward voltage  $V_{FR}$  and  $t_{fr}$  versus  $di_F/dt$

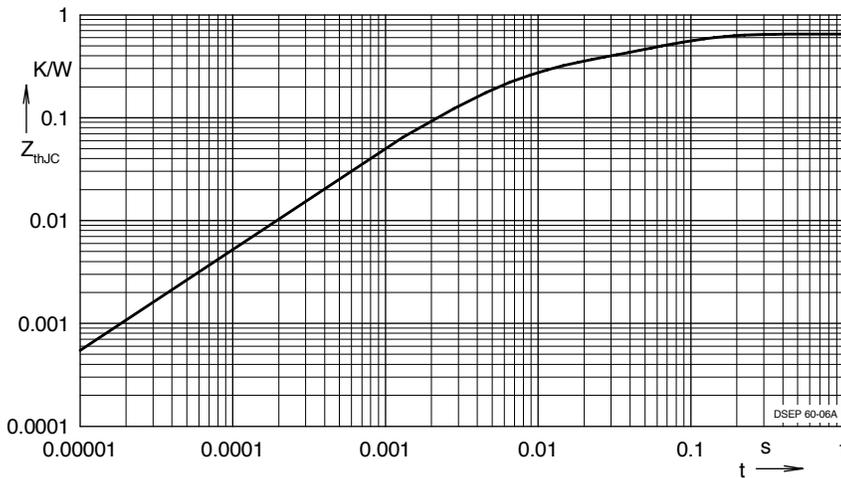


Fig. 20. Transient thermal resistance junction to case

Constants for  $Z_{thjC}$  calculation:

i	$R_{thi}$ (K/W)	$t_i$ (s)
1	0.324	0.0052
2	0.125	0.0003
3	0.201	0.0385

Note: Fig. 15 through Fig. 20 show typical values