

# HiPerFAST™ IGBT

# ISOPLUS247™

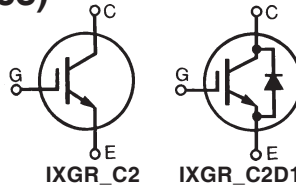
## C2-Class High Speed IGBTs

(Electrically Isolated Back Surface)

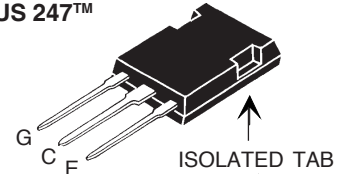
**IXGR 40N60C2**  
**IXGR 40N60C2D1**

$V_{CES} = 600 \text{ V}$   
 $I_{C25} = 56 \text{ A}$   
 $V_{CE(SAT)} = 2.7 \text{ V}$   
 $t_{fi(typ)} = 32 \text{ ns}$

**Preliminary Data Sheet**



**ISOPLUS 247™ (IXGR)**



G = Gate      C = Collector  
E = Emitter

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
$I_{C25}$	$T_C = 25^\circ\text{C}$	56	A
$I_{C110}$	$T_C = 110^\circ\text{C}$	26	A
$I_{D110}$	$T_C = 110^\circ\text{C}$ (40N60C2D1)	27	A
$I_{CM}$	$T_C = 25^\circ\text{C}, 1 \text{ ms}$	200	A
<b>SSOA (RBSOA)</b>	$V_{GE} = 15 \text{ V}, T_{VJ} = 125^\circ\text{C}, R_G = 10 \Omega$ Clamped inductive load @ $V_{CE} \leq 600 \text{ V}$	$I_{CM} = 80$	A
$P_C$	$T_C = 25^\circ\text{C}$	170	W
$T_J$		-55 ... +150	$^\circ\text{C}$
$T_{JM}$		150	$^\circ\text{C}$
$T_{stg}$		-55 ... +150	$^\circ\text{C}$
Maximum Lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s		300	$^\circ\text{C}$
$V_{ISOL}$	50/60 Hz, RMS, $t = 1 \text{ minute}, I_{ISOL} < 1 \text{ mA}$	2500	V~
$F_C$	Mounting force	20..120/4.5..25	N/lb.
<b>Weight</b>		4	g

**Features**

- DCB Isolated mounting tab
- Meets TO-247AD package Outline
- High current handling capability
- Latest generation HDMOS™ process
- MOS Gate turn-on - drive simplicity

**Applications**

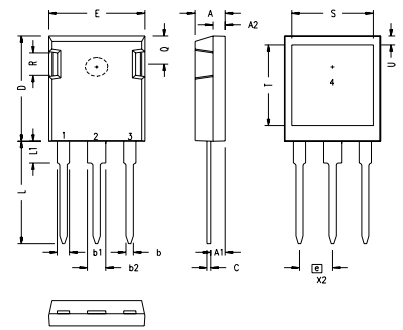
- Uninterruptible power supplies (UPS)
- Switched-mode and resonant-mode power supplies
- AC motor speed control
- DC servo and robot drives
- DC choppers

**Advantages**

- Easy assembly
- High power density
- Very fast switching speeds for high frequency applications

Symbol	Test Conditions	Characteristic Values ( $T_J = 25^\circ\text{C}$ unless otherwise specified)		
		min.	typ.	max.
$BV_{CES}$	$I_C = 250 \mu\text{A}, V_{GE} = 0 \text{ V}$	600		V
$V_{GE(th)}$	$I_C = 250 \mu\text{A}, V_{CE} = V_{GE}$	3.0		V
$I_{CES}$	$V_{CE} = V_{CES}, V_{GE} = 0 \text{ V}$			40N60C2: 50 $\mu\text{A}$ 40N60C2/D1: 100 $\mu\text{A}$
$I_{GES}$	$V_{CE} = 0 \text{ V}, V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = 30 \text{ A}, V_{GE} = 15 \text{ V}$		$T_J = 25^\circ\text{C}: 2.2$ $T_J = 125^\circ\text{C}: 2.0$	2.7 V 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> = 30 A; V <sub>CE</sub> = 10 V, Pulse test, t ≤ 300 μs, duty cycle ≤ 2 %	20	36	S
<b>C<sub>ies</sub></b>	V <sub>CE</sub> = 25 V, V <sub>GE</sub> = 0 V, f = 1 MHz	40N60C2 40N60C2D1	2500	pF
<b>C<sub>oes</sub></b>			180	pF
<b>C<sub>res</sub></b>			220	pF
<b>Q<sub>g</sub></b>	I <sub>C</sub> = 30 A, V <sub>GE</sub> = 15 V, V <sub>CE</sub> = 0.5 V <sub>CES</sub>	95	nC	
<b>Q<sub>ge</sub></b>		14	nC	
<b>Q<sub>gc</sub></b>		36	nC	
<b>t<sub>d(on)</sub></b>	<b>Inductive load, T<sub>J</sub> = 25°C</b> I <sub>C</sub> = 30 A, V <sub>GE</sub> = 15 V V <sub>CE</sub> = 400 V, R <sub>G</sub> = R <sub>off</sub> = 3 Ω	18	ns	
<b>t<sub>ri</sub></b>		20	ns	
<b>t<sub>d(off)</sub></b>		90	140 ns	
<b>t<sub>fi</sub></b>		32	ns	
<b>E<sub>off</sub></b>		0.20	0.37 mJ	
<b>t<sub>d(on)</sub></b>	<b>Inductive load, T<sub>J</sub> = 125°C</b> I <sub>C</sub> = 30 A, V <sub>GE</sub> = 15 V V <sub>CE</sub> = 400 V, R <sub>G</sub> = R <sub>off</sub> = 3 Ω	18	ns	
<b>t<sub>ri</sub></b>		20	ns	
<b>E<sub>on</sub></b>		40N60C2 40N60C2D1	0.3	mJ
<b>t<sub>d(off)</sub></b>		130	ns	
<b>t<sub>fi</sub></b>		80	240 ns	
<b>E<sub>off</sub></b>	0.50	mJ		
<b>R<sub>thJ-DCB</sub></b>	(Note 1)	0.26	K/W	
<b>R<sub>thJC</sub></b>	(Note 2)		0.74 K/W	
<b>R<sub>thCS</sub></b>		0.15	K/W	

**ISOPLUS 247 Outline**


SYM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.190	.205	4.83	5.21
A1	.090	.100	2.29	2.54
A2	.075	.085	1.91	2.16
b	.045	.055	1.14	1.40
b1	.075	.084	1.91	2.13
b2	.115	.123	2.92	3.12
C	.024	.031	0.61	0.80
D	.819	.840	20.80	21.34
E	.620	.635	15.75	16.13
e	.215 BSC		5.45 BSC	
L	.780	.800	19.81	20.32
L1	.150	.170	3.81	4.32
Q	.220	.244	5.59	6.20
R	.170	.190	4.32	4.83
S	.520	.540	13.21	13.72
T	.620	.640	15.75	16.26
U	.065	.080	1.65	2.03

- 1 - GATE
- 2 - DRAIN (COLLECTOR)
- 3 - SOURCE (EMITTER)
- 4 - NO CONNECTION

NOTE: This drawing will meet all dimensions requirement of JEDEC outline TO-247AD except screw hole.

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> = 30 A, V <sub>GE</sub> = 0 V, Pulse test t ≤ 300 μs, duty cycle d ≤ 2 %	T <sub>J</sub> = 150°C T <sub>J</sub> = 25°C		1.6 V 2.5 V
<b>I<sub>RM</sub></b>	I <sub>F</sub> = 30 A, V <sub>GE</sub> = 0 V, -di <sub>F</sub> /dt = 100 A/μs, T <sub>J</sub> = 100°C V <sub>R</sub> = 100 V		100	4 A
<b>t<sub>rr</sub></b>				ns
<b>t<sub>rr</sub></b>		I <sub>F</sub> = 1 A; -di/dt = 100 A/μs; V <sub>R</sub> = 30 V		25
<b>R<sub>thJC</sub></b>				1.5 K/W
<b>R<sub>thCS</sub></b>		0.15		K/W

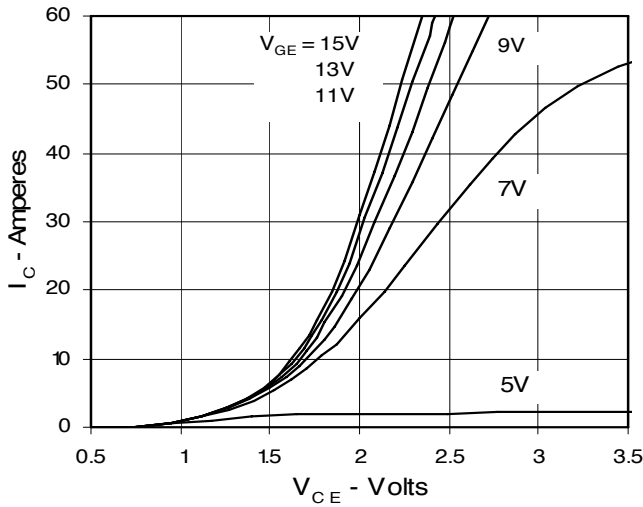
**Notes:**

- R<sub>thJ-DCB</sub> is the thermal resistance junction-to-internal side of DCB substrate
- R<sub>thJC</sub> is the thermal resistance junction-to-external side of DCB substrate

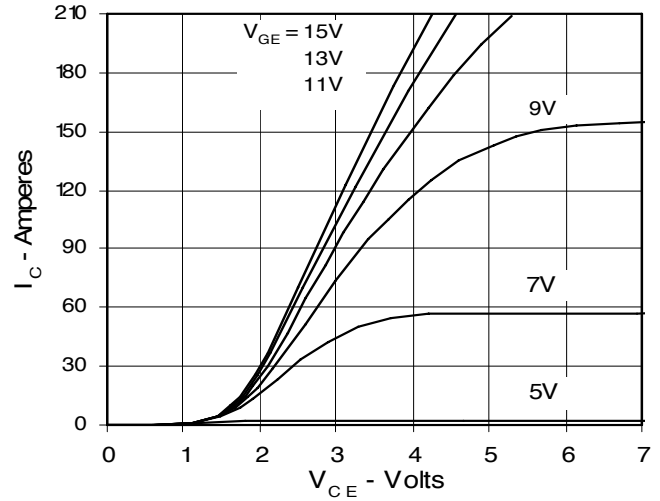
IXYS reserves the right to change limits, test conditions, and dimensions.

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

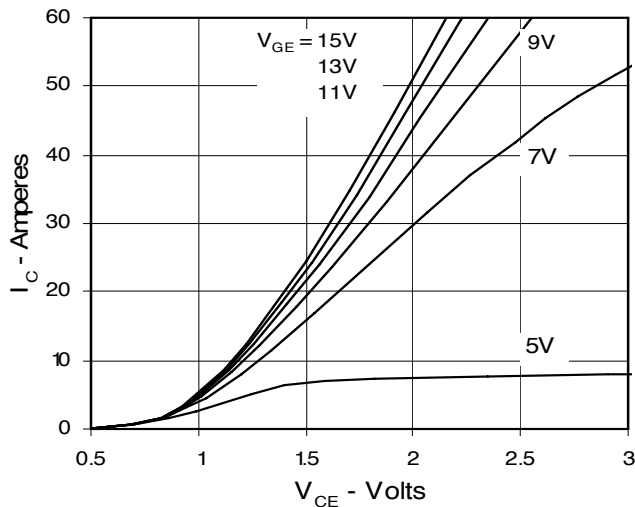
**Fig. 1. Output Characteristics**  
@ 25 Deg. C



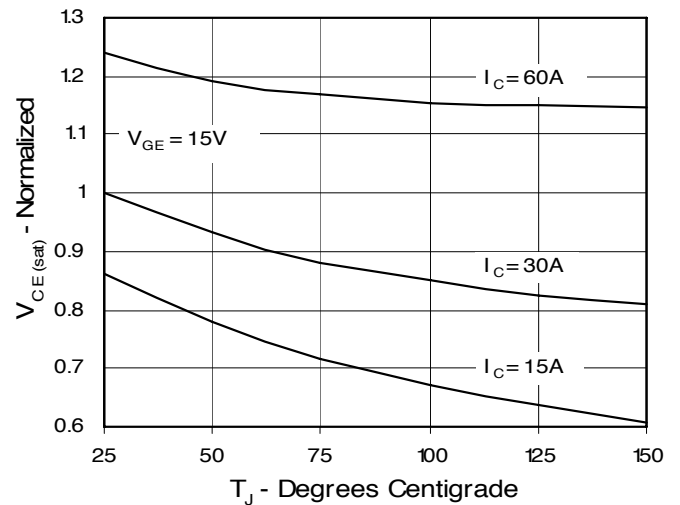
**Fig. 2. Extended Output Characteristics**  
@ 25 deg. C



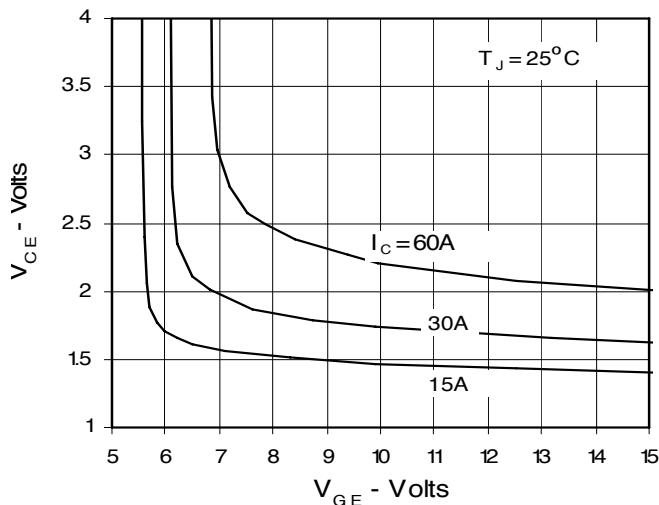
**Fig. 3. Output Characteristics**  
@ 125 Deg. C



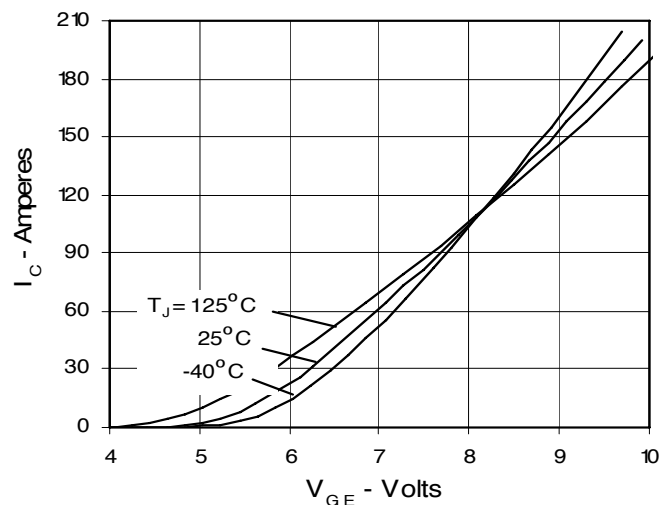
**Fig. 4. Temperature Dependence of  $V_{CE(sat)}$**



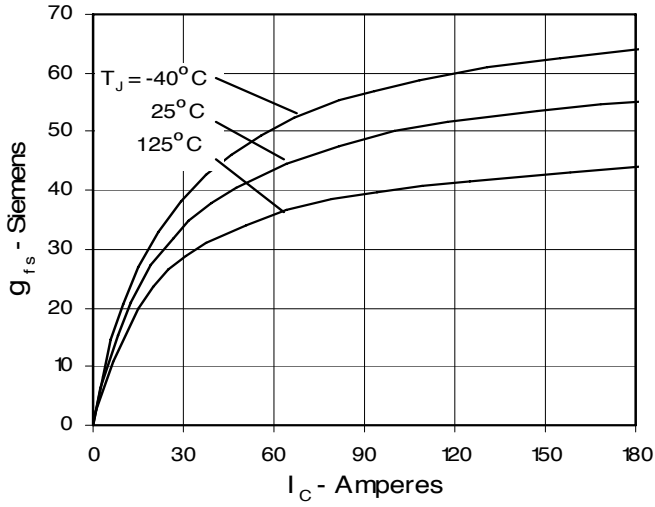
**Fig. 5. Collector-to-Emitter Voltage vs. Gate-to-Emiiter voltage**



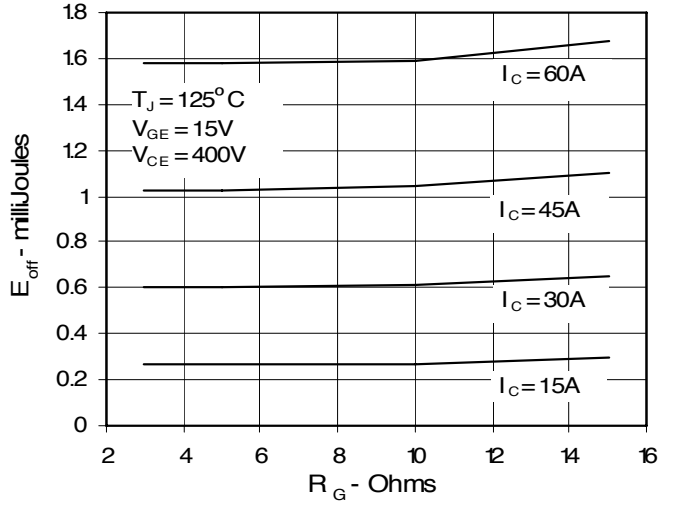
**Fig. 6. Input Admittance**



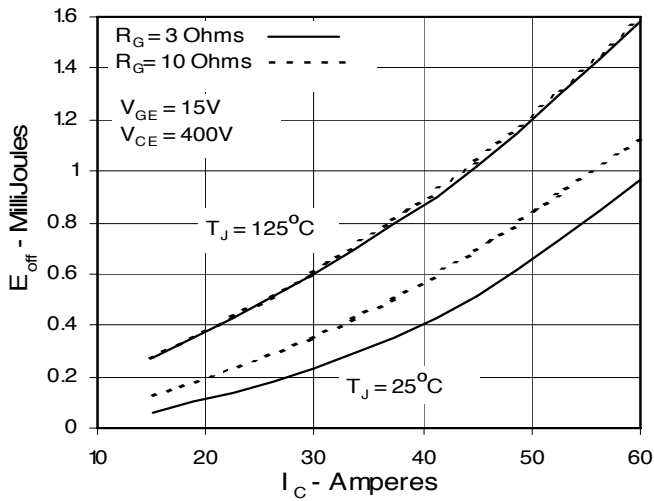
**Fig. 7. Transconductance**



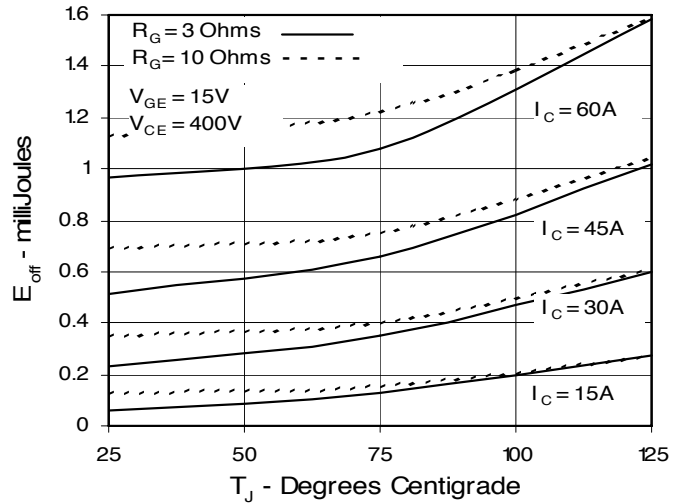
**Fig. 8. Dependence of  $E_{off}$  on  $R_G$**



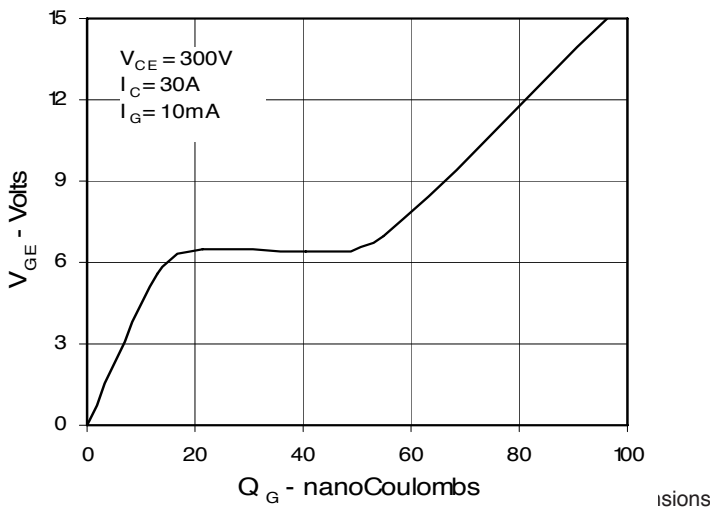
**Fig. 9. Dependence of  $E_{off}$  on  $I_C$**



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



**Fig. 11. Gate Charge**



**Fig. 12. Capacitance**

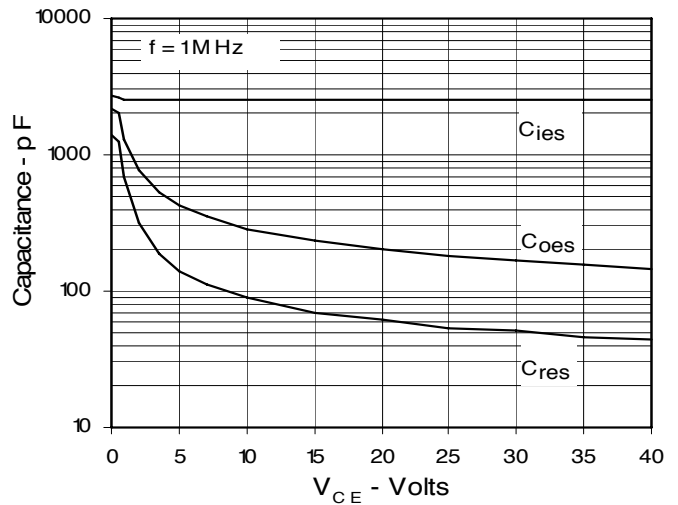
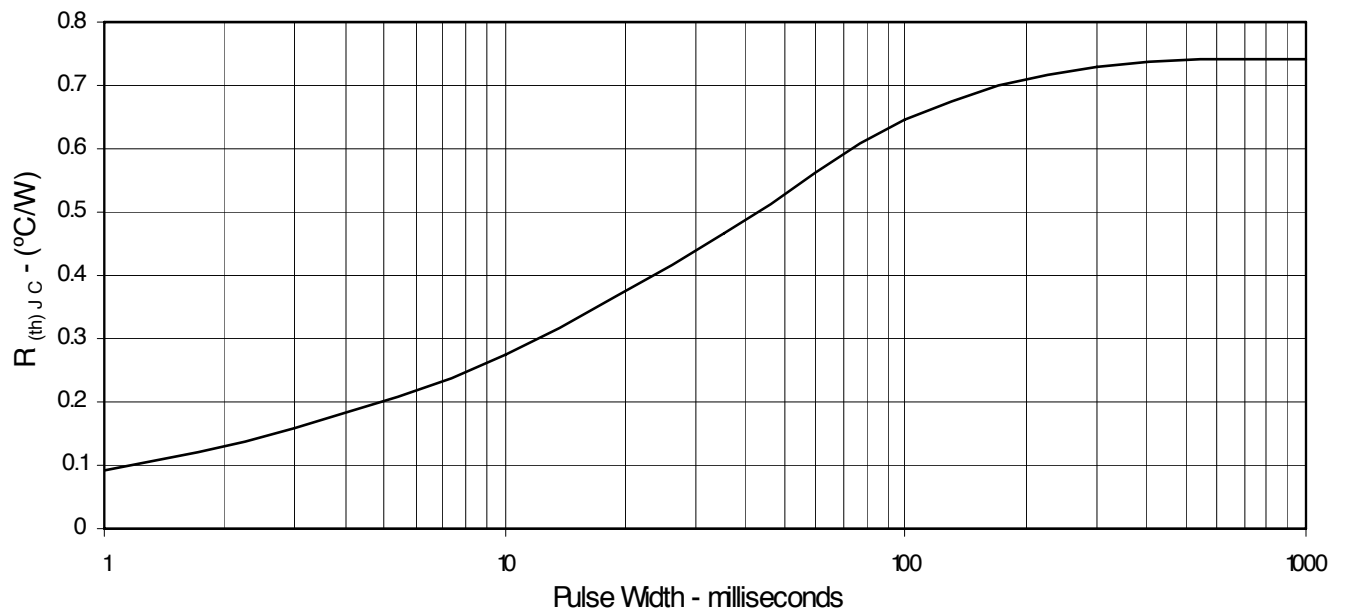


Fig. 13. Maximum Transient Thermal Resistance



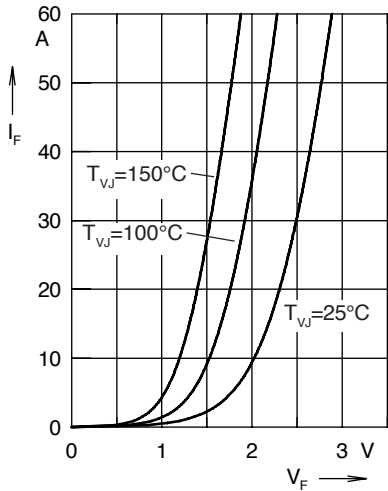


Fig. 14. Forward current  $I_F$  versus  $V_F$

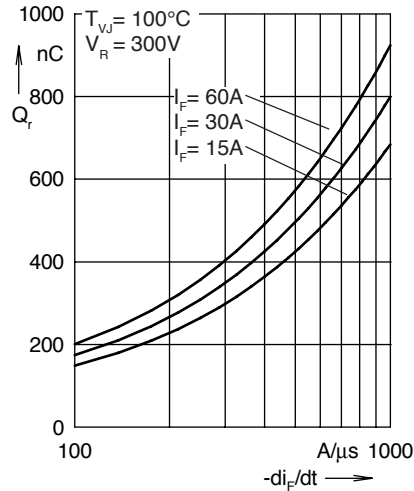


Fig. 15. Reverse recovery charge  $Q_r$  versus  $-di_F/dt$

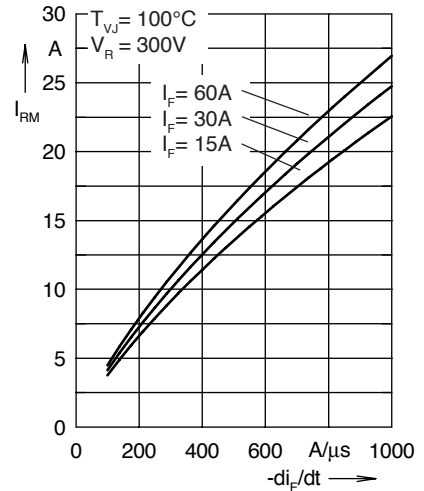


Fig. 16. Peak reverse current  $I_{RM}$  versus  $-di_F/dt$

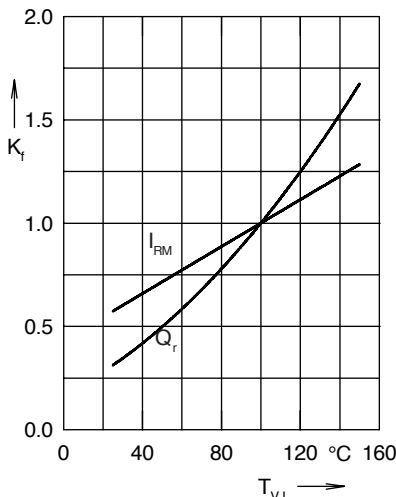


Fig. 17. Dynamic parameters  $Q_r$ ,  $I_{RM}$  versus  $T_{VJ}$

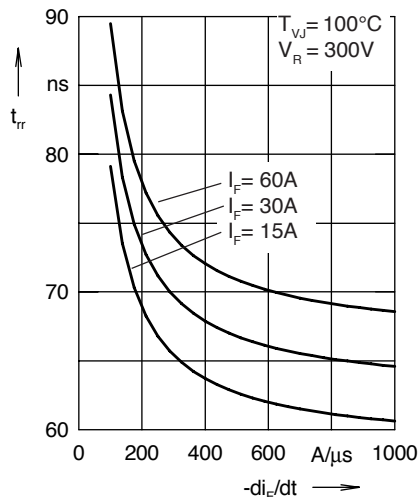


Fig. 18. Recovery time  $t_{rr}$  versus  $-di_F/dt$

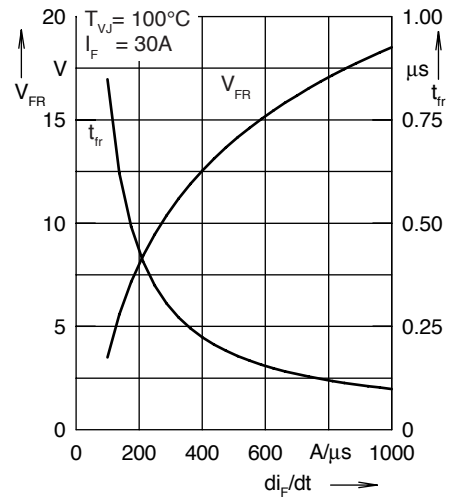


Fig. 19. Peak forward voltage  $V_{FR}$  and  $t_{rr}$  versus  $di_F/dt$

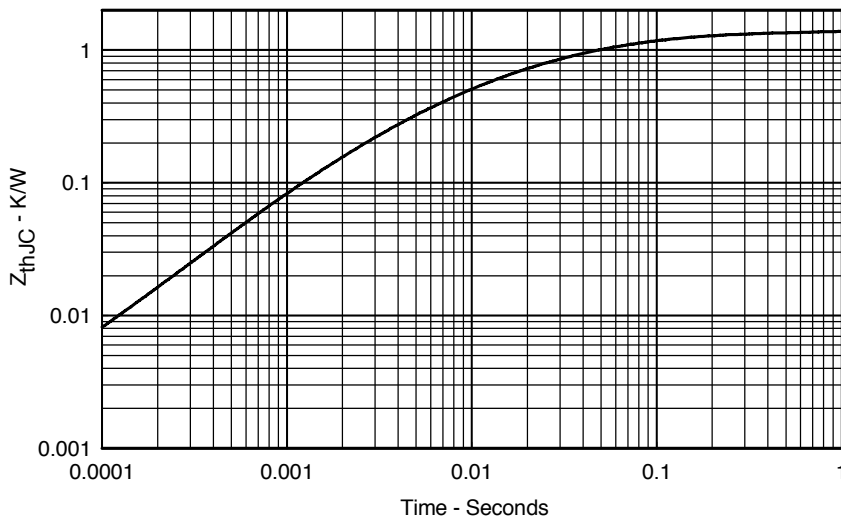


Fig. 20. Transient thermal resistance junction to case