

## High Speed IGBT

**IXSA 20N60B2D1**  
**IXSP 20N60B2D1**

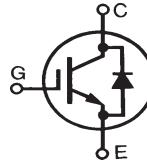
Short Circuit SOA Capability

$$V_{CES} = 600 \text{ V}$$

$$I_{C25} = 35 \text{ A}$$

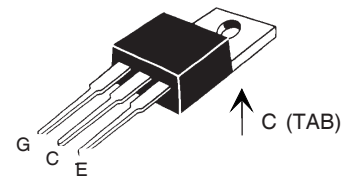
$$V_{CE(sat)} = 2.5 \text{ V}$$

### Preliminary Data Sheet

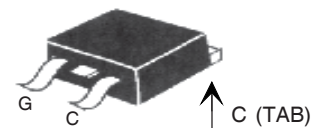


Symbol	Test Conditions	Maximum Ratings	
$V_{CES}$	$T_J = 25^\circ\text{C}$ to $150^\circ\text{C}$	600	V
$V_{CGR}$	$T_J = 25^\circ\text{C}$ to $150^\circ\text{C}$ ; $R_{GE} = 1 \text{ M}\Omega$	600	V
$V_{GES}$	Continuous	$\pm 20$	V
$V_{GEM}$	Transient	$\pm 30$	V
$I_{C25}$	$T_C = 25^\circ\text{C}$	35	A
$I_{C110}$	$T_C = 110^\circ\text{C}$	20	A
$I_{F(110)}$		11	A
$I_{CM}$	$T_C = 25^\circ\text{C}$ , 1 ms	60	A
<b>SSOA (RBSOA)</b>	$V_{GE} = 15 \text{ V}$ , $T_J = 125^\circ\text{C}$ , $R_G = 82 \Omega$ Clamped inductive load	$I_{CM} = 32$ @ $0.8 V_{CES}$	A
<b><math>t_{SC}</math> (SCSOA)</b>	$V_{GE} = 15 \text{ V}$ , $V_{CE} = 360 \text{ V}$ , $T_J = 125^\circ\text{C}$ $R_G = 82 \Omega$ , non repetitive	10	$\mu\text{s}$
$P_C$	$T_C = 25^\circ\text{C}$	190	W
$T_J$		-55 ... +150	$^\circ\text{C}$
$T_{JM}$		150	$^\circ\text{C}$
$T_{stg}$		-55 ... +150	$^\circ\text{C}$
<b>Weight</b>		2	g
Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s		300	$^\circ\text{C}$
Maximum tab temperature for soldering for 10s		260	$^\circ\text{C}$

### TO-220 (IXSP)



### TO-220 (IXSA)



G = Gate      C = Collector  
E = Emitter    TAB = Collector

### Features

- International standard packages
- Guaranteed Short Circuit SOA capability
- Low  $V_{CE(sat)}$ 
  - for low on-state conduction losses
- High current handling capability
- MOS Gate turn-on
  - drive simplicity
- Fast fall time for switching speeds up to 20 kHz

### Applications

- AC motor speed control
- Uninterruptible power supplies (UPS)
- Welding

### Advantages

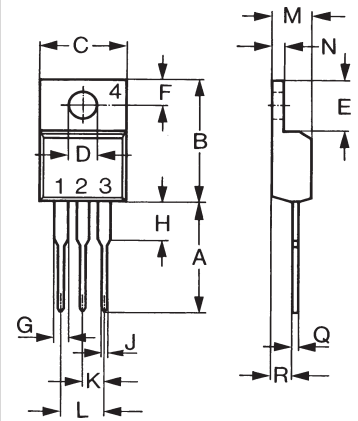
- High power density

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
$V_{GE(th)}$	$I_C = 750 \mu\text{A}$ , $V_{CE} = V_{GE}$	3.5		6.5 V
$I_{CES}$	$V_{CE} = V_{CES}$ $V_{GE} = 0 \text{ V}$			85 $\mu\text{A}$ 0.6 mA
$I_{GES}$	$V_{CE} = 0 \text{ V}$ , $V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = 16 \text{ A}$ , $V_{GE} = 15 \text{ V}$			2.5 V

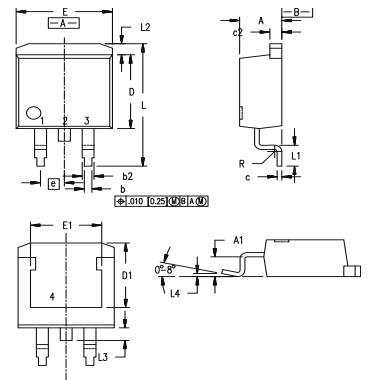
Symbol	Test Conditions	Characteristic Values ( $T_J = 25^\circ\text{C}$ , unless otherwise specified)		
		min.	typ.	max.
$g_{fs}$	$I_C = 16\text{A}; V_{CE} = 10\text{V}$ , Note 1	3.5	7.0	S
$C_{ies}$	$V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$ $f = 1\text{MHz}$ 20N60B2D1		800	pF
$C_{oes}$			76	pF
$C_{res}$			90	pF
$Q_g$			28	pF
$Q_{ge}$	$I_C = 16\text{A}, V_{GE} = 15\text{V}, V_{CE} = 0.5 V_{CES}$		33	nC
$Q_{gc}$			12	nC
$t_{d(on)}$	<b>Inductive load, <math>T_J = 25^\circ\text{C}</math></b>		30	ns
$t_{ri}$	$I_C = 16\text{A}, V_{GE} = 15\text{V}$ $V_{CE} = 0.8 V_{CES}, R_G = 10\ \Omega$		30	ns
$t_{d(off)}$	Switching times may increase for $V_{CE}$ (Clamp) $> 0.8 \cdot V_{CES}$ , higher $T_J$ or increased $R_G$		116	ns
$t_{fi}$			126	ns
$E_{off}$			380	600 $\mu\text{J}$
$t_{d(on)}$	<b>Inductive load, <math>T_J = 125^\circ\text{C}</math></b>		30	ns
$t_{ri}$			30	ns
$E_{on}$	$I_C = 16\text{A}, V_{GE} = 15\text{V}$ $V_{CE} = 0.8 V_{CES}, R_G = 10\ \Omega$ 20N60B2 20N60B2D1		0.12	mJ
$t_{d(off)}$	Switching times may increase for $V_{CE}$ (Clamp) $> 0.8 \cdot V_{CES}$ , higher $T_J$ or increased $R_G$		0.42	mJ
$t_{fi}$			180	ns
$t_{fi}$			210	ns
$E_{off}$			970	$\mu\text{J}$
$R_{thJC}$				0.66 K/W
$R_{thCS}$			0.3	K/W

Symbol	Test Conditions	Characteristic Values ( $T_J = 25^\circ\text{C}$ , unless otherwise specified)		
		min.	typ.	max.
$V_F$	$I_F = 10\text{A}, V_{GE} = 0\text{V}$ $T_J = 150^\circ\text{C}$			1.66 V 2.66 V
$I_{RM}$	$I_F = 12\text{A}, V_{GE} = 0\text{V}, -di_F/dt = 100\text{A}/\mu\text{s}$ $T_J = 100^\circ\text{C}$		1.5	A
$t_{rr}$	$V_R = 100\text{V}$ $T_J = 100^\circ\text{C}$		90	ns
$t_{rr}$	$I_F = 1\text{A}; -di/dt = 100\text{A}/\mu\text{s}; V_R = 30\text{V}$		30	ns
$R_{thJC}$				2.5 K/W

Note 1: Pulse test,  $t \leq 300\ \mu\text{s}$ , duty cycle  $d \leq 2\%$

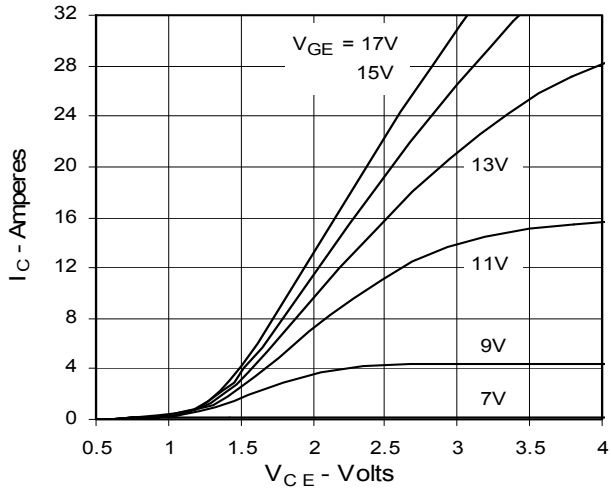
**TO-220 AB (IXSP) Outline**


Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	12.70	13.97	0.500	0.550
B	14.73	16.00	0.580	0.630
C	9.91	10.66	0.390	0.420
D	3.54	4.08	0.139	0.161
E	5.85	6.85	0.230	0.270
F	2.54	3.18	0.100	0.125
G	1.15	1.65	0.045	0.065
H	2.79	5.84	0.110	0.230
J	0.64	1.01	0.025	0.040
K	2.54	BSC	0.100	BSC
M	4.32	4.82	0.170	0.190
N	1.14	1.39	0.045	0.055
Q	0.35	0.56	0.014	0.022
R	2.29	2.79	0.090	0.110

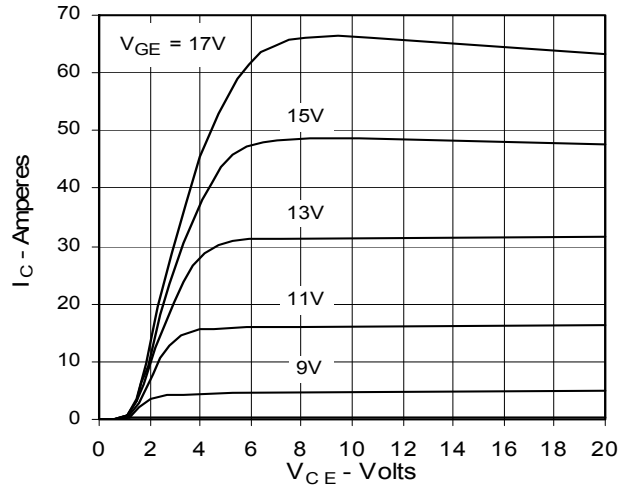
**TO-263 (IXSA) Outline**


Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.06	4.83	.160	.190
A1	2.03	2.79	.080	.110
b	0.51	0.99	.020	.039
b2	1.14	1.40	.045	.055
c	0.46	0.74	.018	.029
c2	1.14	1.40	.045	.055
D	8.64	9.65	.340	.380
D1	7.11	8.13	.280	.320
E	9.65	10.29	.380	.405
E1	6.86	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	0.38	0	.015
R	0.46	0.74	.018	.029

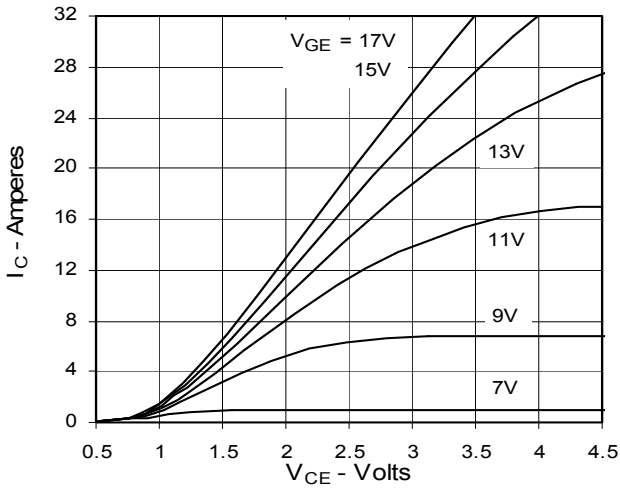
**Fig. 1. Output Characteristics @ 25 °C**



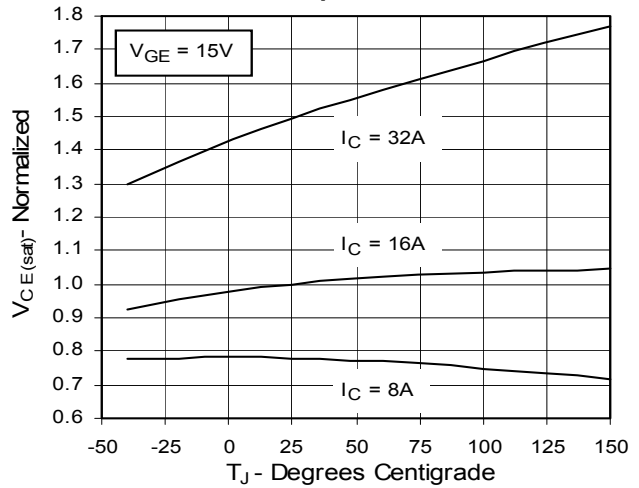
**Fig. 2. Extended Output Characteristics @ 25 °C**



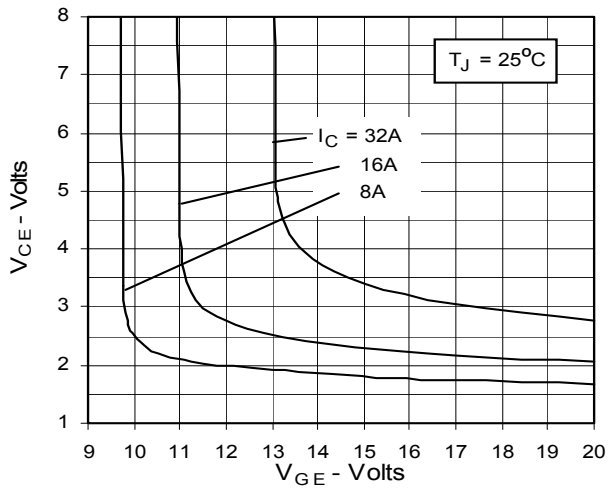
**Fig. 3. Output Characteristics @ 125 °C**



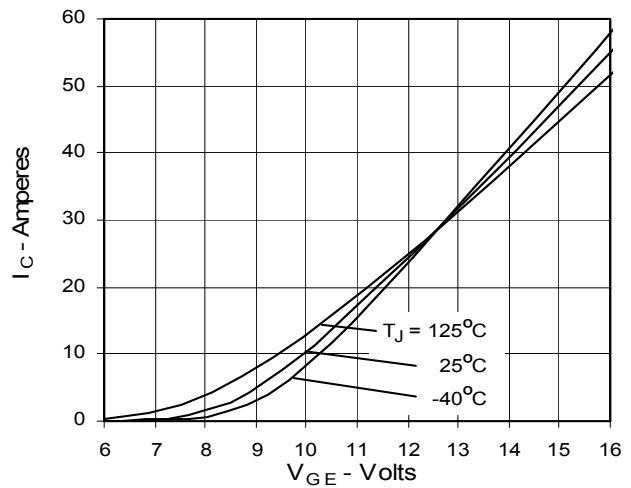
**Fig. 4. Dependence of  $V_{CE(sat)}$  on Temperature**



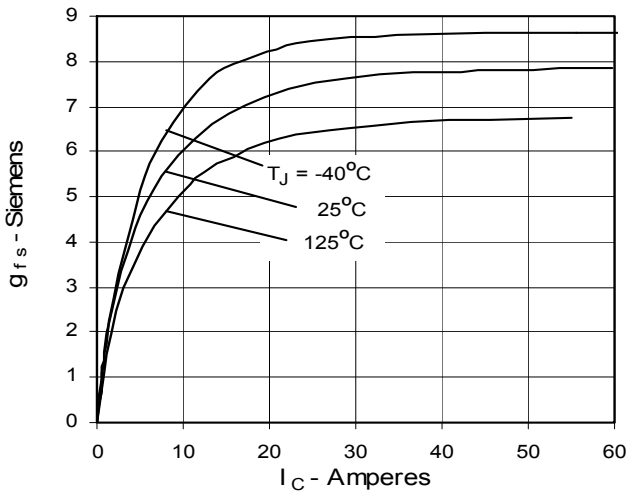
**Fig. 5. Collector-to-Emitter Voltage vs. Gate-to-Emitter voltage**



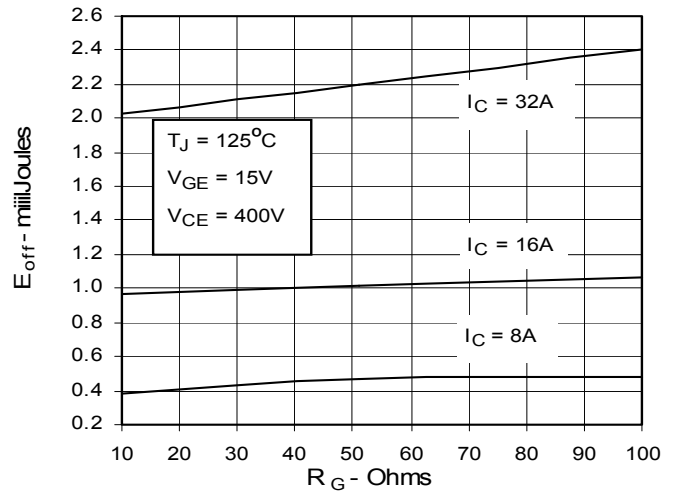
**Fig. 6. Input Admittance**



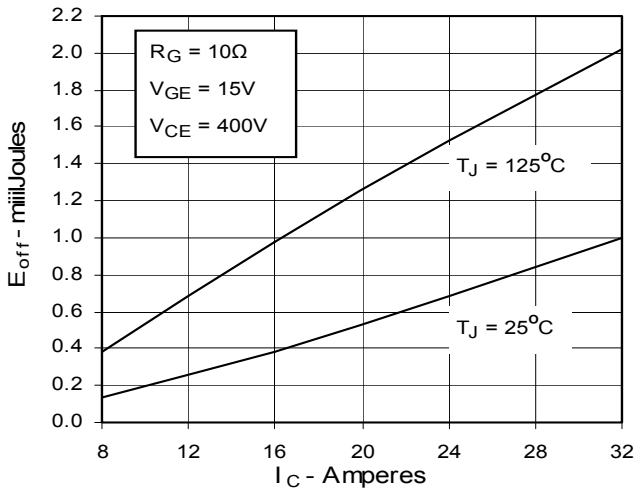
**Fig. 7. Transconductance**



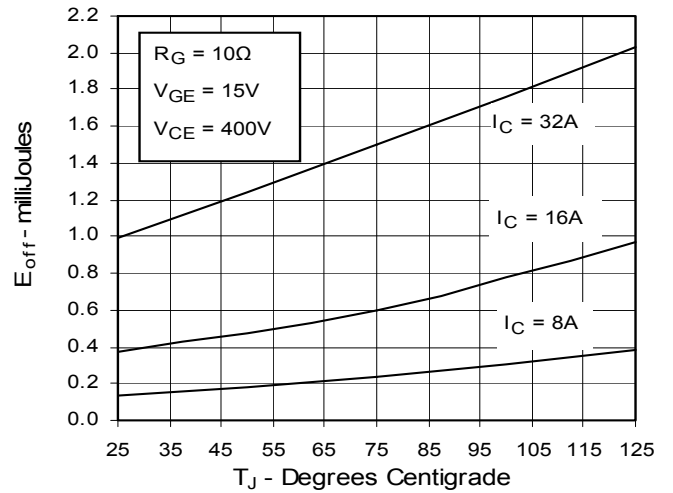
**Fig. 8. Dependence of Turn-off Energy Loss on  $R_G$**



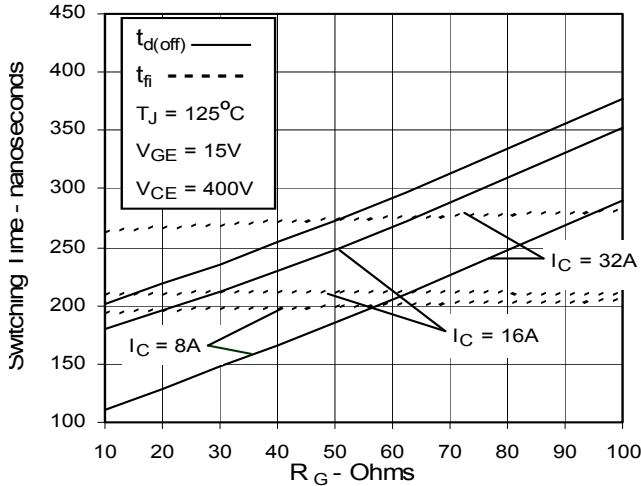
**Fig. 9. Dependence of Turn-Off Energy Loss on  $I_C$**



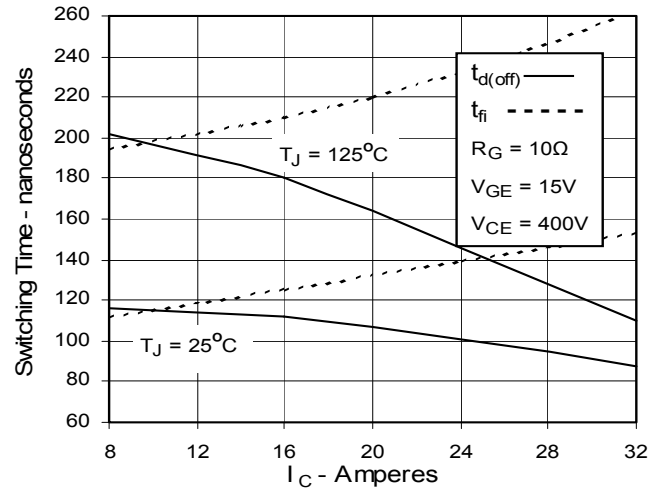
**Fig. 10. Dependence of Turn-off Energy Loss on Temperature**



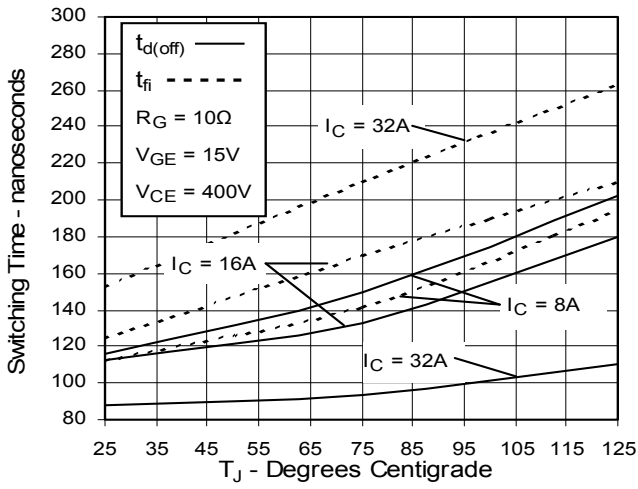
**Fig. 11. Dependence of Turn-off Switching Time on  $R_G$**



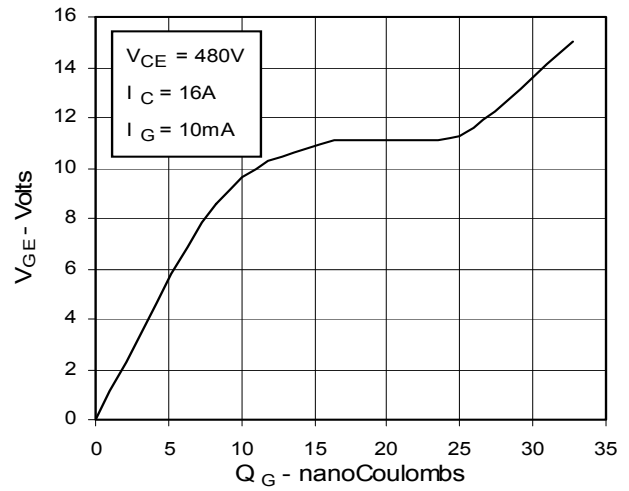
**Fig. 12. Dependence of Turn-off Switching Time on  $I_C$**



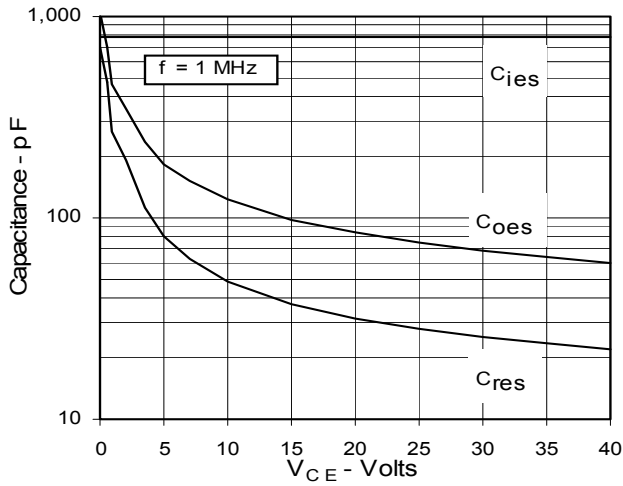
**Fig. 13. Dependence of Turn-off Switching Time on Temperature**



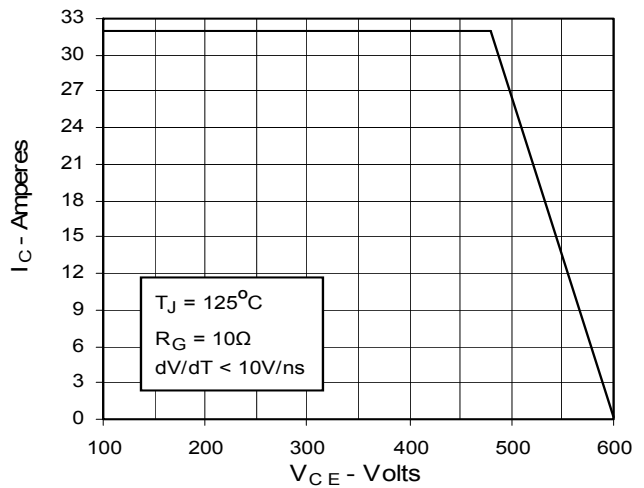
**Fig. 14. Gate Charge**



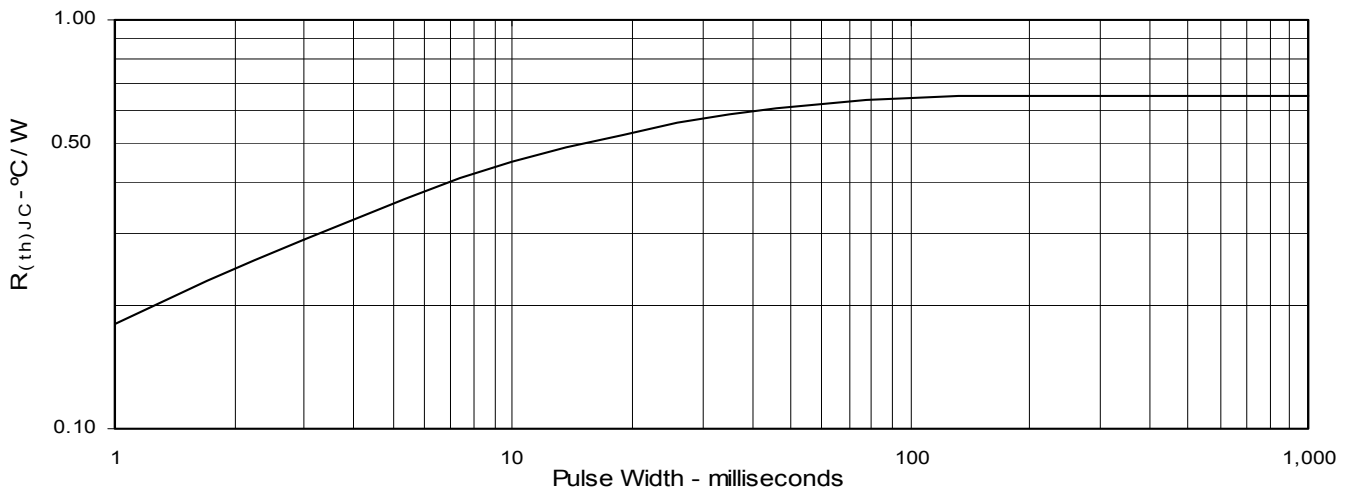
**Fig. 15. Capacitance**



**Fig. 16. Reverse-Bias Safe Operating Area**



**Fig. 17. Maximum Transient Thermal Resistance**



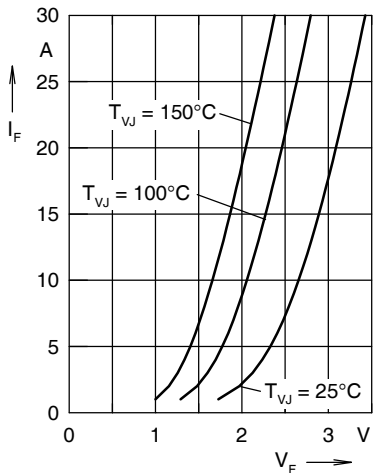


Fig. 18. Forward current  $I_F$  versus  $V_F$

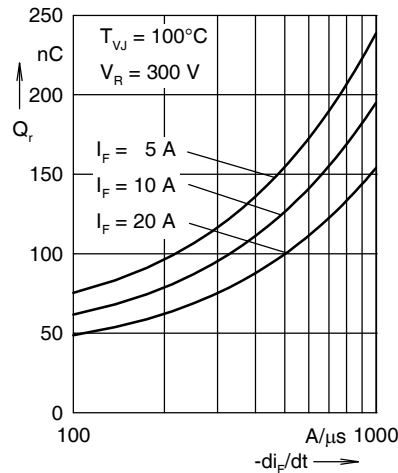


Fig. 19. Reverse recovery charge  $Q_r$

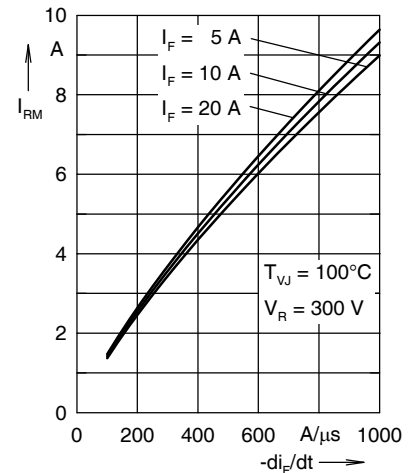


Fig. 20. Peak reverse current  $I_{RM}$

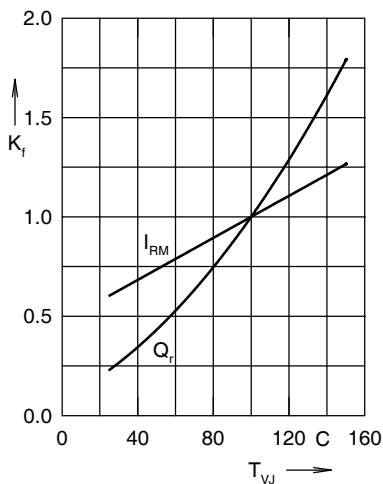


Fig. 21. Dynamic parameters  $Q_r$ ,  $I_{RM}$

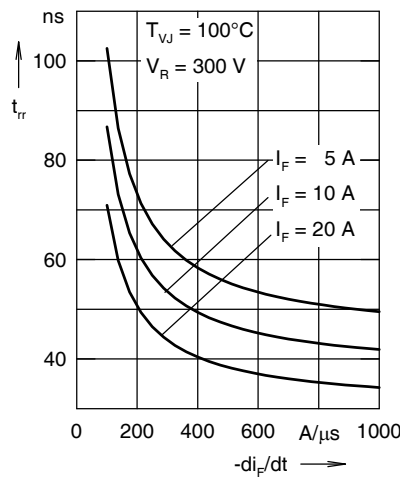


Fig. 22. Recovery time  $t_{tr}$  versus  $-di_F/dt$

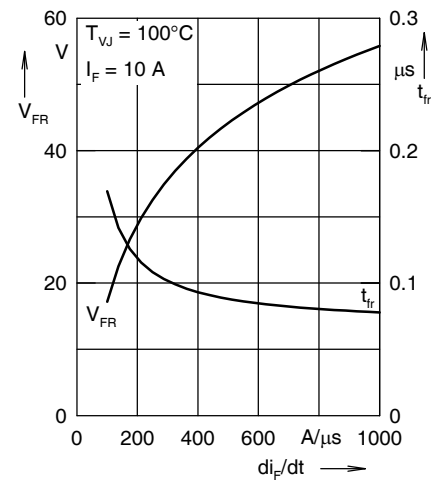


Fig. 23. Peak forward voltage  $V_{FR}$  and  $t_{tr}$

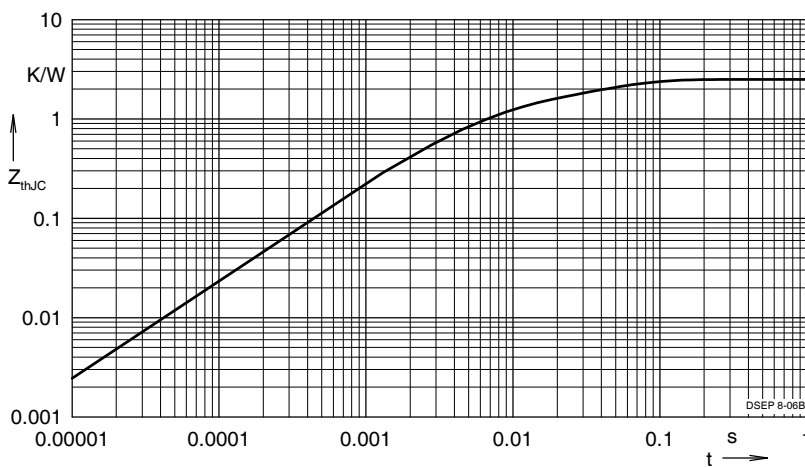


Fig. 24. Transient thermal resistance junction-to-case

Constants for  $Z_{thJC}$  calculation:

i	$R_{thi}$ (K/W)	$t_i$ (s)
1	1.449	0.0052
2	0.5578	0.0003

NOTE: Fig. 18 to Fig. 23 shows typical values

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	4,881,106	5,017,508	5,049,961	5,187,117	5,381,025	6,162,665	6,306,728 B1	6,534,343	6,683,344
4,850,072	4,931,844	5,034,796	5,063,307	5,237,481	5,486,715	6,259,123 B1	6,404,065 B1	6,583,505	6,710,405 B2