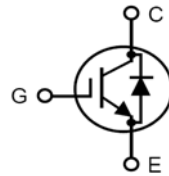


**XPT™ 650V IGBT  
GenX3™ w/Diode**
**IXYP10N65C3D1**

 Extreme Light Punch Through  
IGBT for 20-60kHz Switching


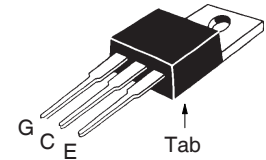
$$V_{CES} = 650V$$

$$I_{C110} = 10A$$

$$V_{CE(sat)} \leq 2.50V$$

$$t_{fi(typ)} = 23ns$$

TO-220


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

Symbol	Test Conditions	Maximum Ratings	
$V_{CES}$	$T_J = 25^\circ C$ to $175^\circ C$	650	V
$V_{CGR}$	$T_J = 25^\circ C$ to $175^\circ C$ , $R_{GE} = 1M\Omega$	650	V
$V_{GES}$	Continuous	$\pm 20$	V
$V_{GEM}$	Transient	$\pm 30$	V
$I_{C25}$	$T_C = 25^\circ C$	30	A
$I_{C110}$	$T_C = 110^\circ C$	10	A
$I_{F110}$	$T_C = 110^\circ C$	9	A
$I_{CM}$	$T_C = 25^\circ C$ , 1ms	54	A
$I_A$	$T_C = 25^\circ C$	5	A
$E_{AS}$	$T_C = 25^\circ C$	50	mJ
<b>SSOA</b>	$V_{GE} = 15V$ , $T_{VJ} = 150^\circ C$ , $R_G = 50\Omega$	$I_{CM} = 20$	A
<b>(RBSOA)</b>	Clamped Inductive Load	$V_{CE} \leq V_{CES}$	
$t_{sc}$	$V_{GE} = 15V$ , $V_{CE} = 360V$ , $T_J = 150^\circ C$	8	$\mu s$
<b>(SCSOA)</b>	$R_G = 150\Omega$ , Non Repetitive		
$P_C$	$T_C = 25^\circ C$	160	W
$T_J$		-55 ... +175	$^\circ C$
$T_{JM}$		175	$^\circ C$
$T_{stg}$		-55 ... +175	$^\circ C$
$T_L$	Maximum Lead Temperature for Soldering	300	$^\circ C$
$T_{SOLD}$	1.6 mm (0.062in.) from Case for 10s	260	$^\circ C$
$M_d$	Mounting Torque	1.13/10	Nm/lb.in.
<b>Weight</b>		2.5	g

**Features**

- Optimized for 20-60kHz Switching
- Square RBSOA
- Avalanche Rated
- Anti-Parallel Fast Diode
- Short Circuit Capability
- International Standard Package

**Advantages**

- High Power Density
- Extremely Rugged
- Low Gate Drive Requirement

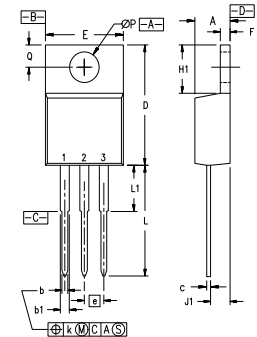
**Applications**

- Power Inverters
- UPS
- Motor Drives
- SMPS
- PFC Circuits
- Battery Chargers
- Welding Machines
- Lamp Ballasts
- High Frequency Power Inverters

Symbol	Test Conditions ( $T_J = 25^\circ C$ , Unless Otherwise Specified)	Characteristic Values		
		Min.	Typ.	Max.
$BV_{CES}$	$I_C = 250\mu A$ , $V_{GE} = 0V$	650		V
$V_{GE(th)}$	$I_C = 250\mu A$ , $V_{CE} = V_{GE}$	3.5		6.0 V
$I_{CES}$	$V_{CE} = V_{CES}$ , $V_{GE} = 0V$ $T_J = 150^\circ C$			10 $\mu A$ 200 $\mu A$
$I_{GES}$	$V_{CE} = 0V$ , $V_{GE} = \pm 20V$			$\pm 100$ nA
$V_{CE(sat)}$	$I_C = 10A$ , $V_{GE} = 15V$ , Note 1 $T_J = 150^\circ C$		2.27 2.54	2.50 V V

Symbol	Test Conditions ( $T_J = 25^\circ\text{C}$ Unless Otherwise Specified)	Characteristic Values		
		Min.	Typ.	Max.
$g_{fs}$	$I_C = 10\text{A}, V_{CE} = 10\text{V}$ , Note 1	3.8	6.2	S
$C_{ies}$	$V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$		423	pF
$C_{oes}$			42	pF
$C_{res}$			10	pF
$Q_{g(on)}$	$I_C = 10\text{A}, V_{GE} = 15\text{V}, V_{CE} = 0.5 \cdot V_{CES}$		18	nC
$Q_{ge}$			4	nC
$Q_{gc}$			8	nC
$t_{d(on)}$	<b>Inductive load, <math>T_J = 25^\circ\text{C}</math></b> $I_C = 10\text{A}, V_{GE} = 15\text{V}$ $V_{CE} = 400\text{V}, R_G = 50\Omega$ Note 2		20	ns
$t_{ri}$			26	ns
$E_{on}$			0.24	mJ
$t_{d(off)}$			77	ns
$t_{fi}$			23	ns
$E_{off}$			0.11	0.17 mJ
$t_{d(on)}$	<b>Inductive load, <math>T_J = 150^\circ\text{C}</math></b> $I_C = 10\text{A}, V_{GE} = 15\text{V}$ $V_{CE} = 400\text{V}, R_G = 50\Omega$ Note 2		17	ns
$t_{ri}$			27	ns
$E_{on}$			0.44	mJ
$t_{d(off)}$			90	ns
$t_{fi}$			38	ns
$E_{off}$			0.15	mJ
$R_{thJC}$			0.94	$^\circ\text{C/W}$
$R_{thCS}$		0.50		$^\circ\text{C/W}$

### TO-220 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
$\varnothing P$	.139	.161	3.53	4.08
Q	.100	.125	2.54	3.18

### 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 $T_J = 150^\circ\text{C}$		1.5	2.5 V
$I_{RM}$	$I_F = 10\text{A}, V_{GE} = 0\text{V},$ $-di_F/dt = 200\text{A}/\mu\text{s}, V_R = 400\text{V}, T_J = 150^\circ\text{C}$		6.3	A
$t_{rr}$			170	ns
$R_{thJC}$				2.30 $^\circ\text{C/W}$

#### Notes:

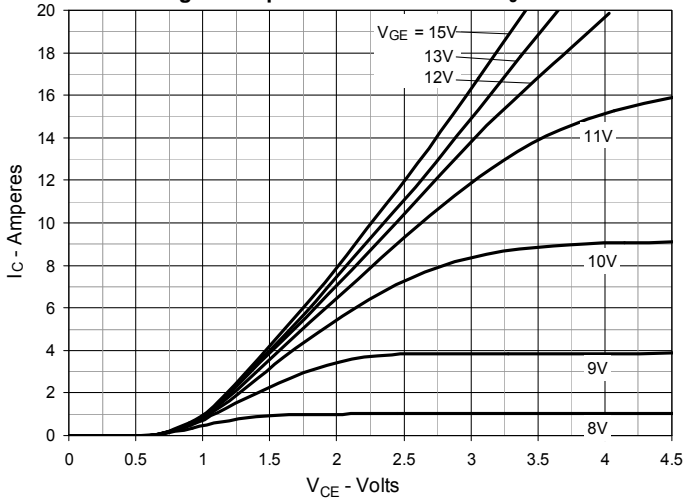
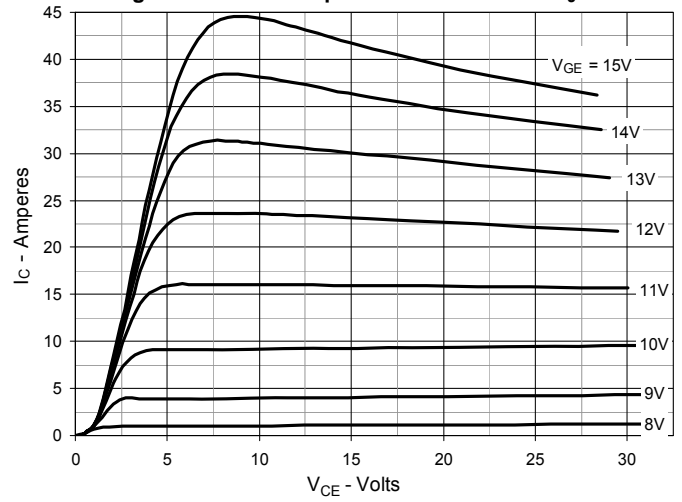
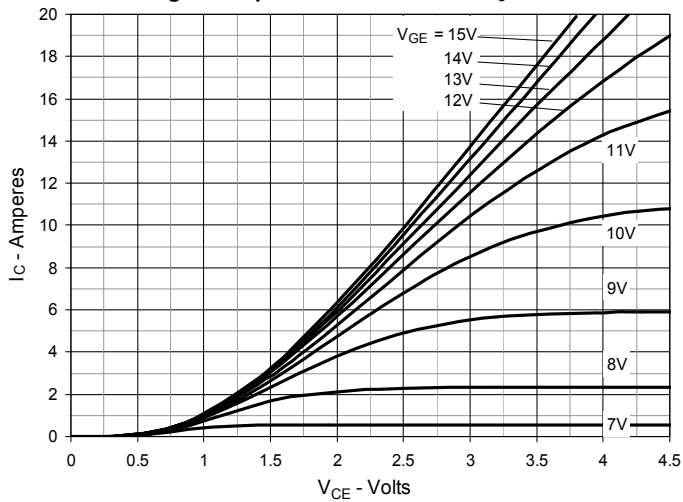
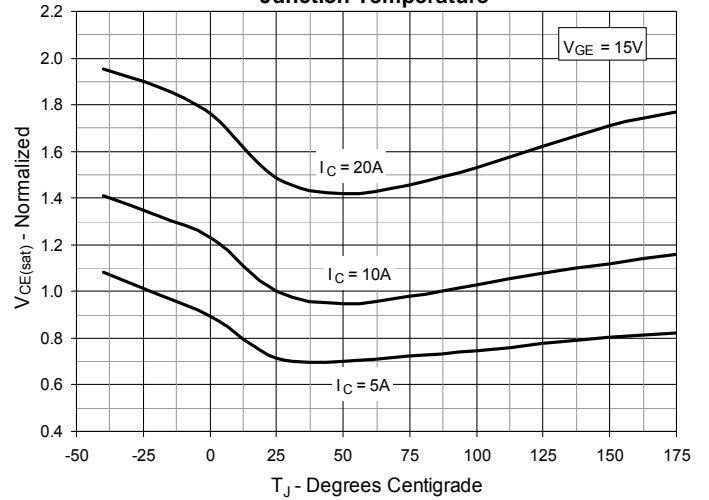
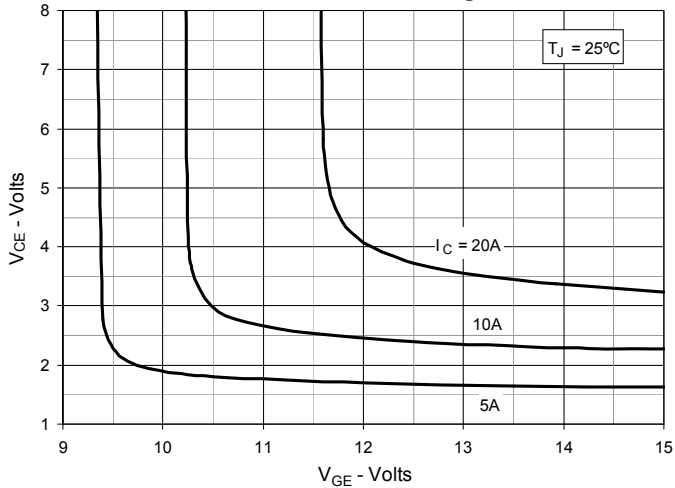
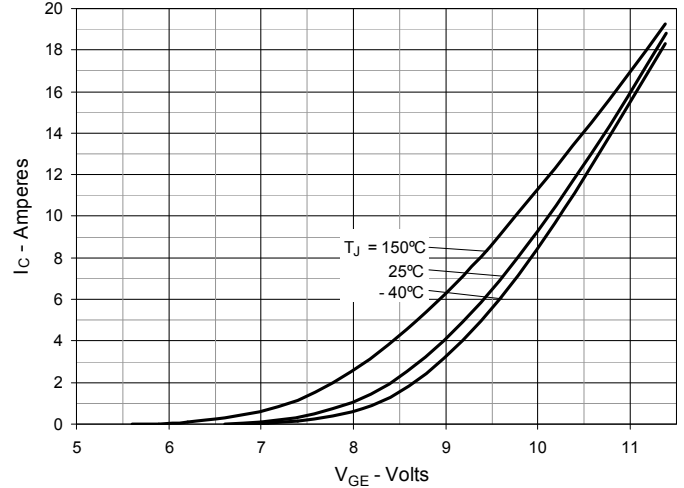
1. Pulse test,  $t \leq 300\mu\text{s}$ , duty cycle,  $d \leq 2\%$ .
2. Switching times & energy losses may increase for higher  $V_{CE}(\text{clamp})$ ,  $T_J$  or  $R_G$ .

### PRELIMINARY TECHNICAL INFORMATION

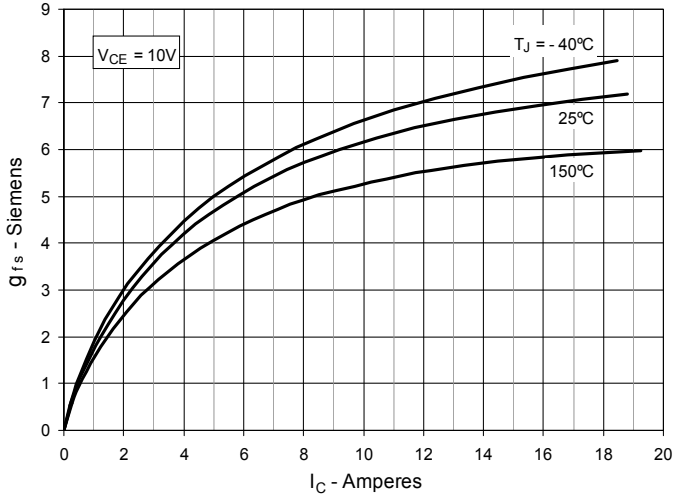
The product presented herein is under development. The Technical Specifications offered are derived from a subjective evaluation of the design, based upon prior knowledge and experience, and constitute a "considered reflection" of the anticipated result. IXYS reserves the right to change limits, test conditions, and dimensions without notice.

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

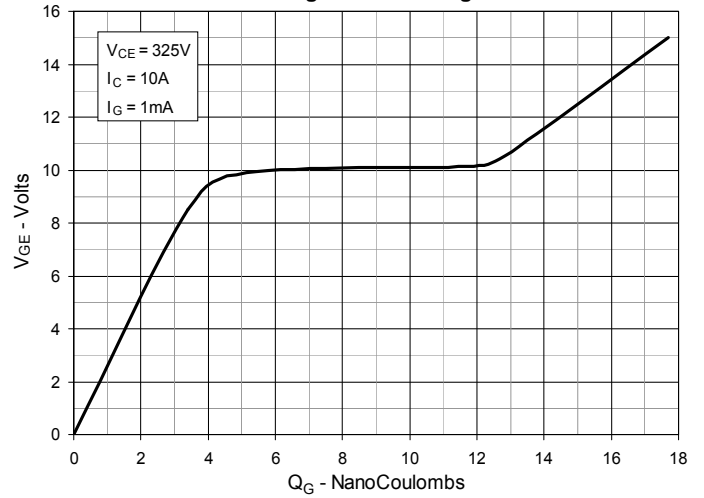
IXYS MOSFETs and IGBTs are covered by one or more of the following U.S. patents:	4,835,592	4,931,844	5,049,961	5,237,481	6,162,665	6,404,065 B1	6,683,344	6,727,585	7,005,734 B2	7,157,338B2
	4,860,072	5,017,508	5,063,307	5,381,025	6,259,123 B1	6,534,343	6,710,405 B2	6,759,692	7,063,975 B2	
	4,881,106	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 @  $T_J = 25^\circ\text{C}$** 

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

**Fig. 3. Output Characteristics @  $T_J = 150^\circ\text{C}$** 

**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**


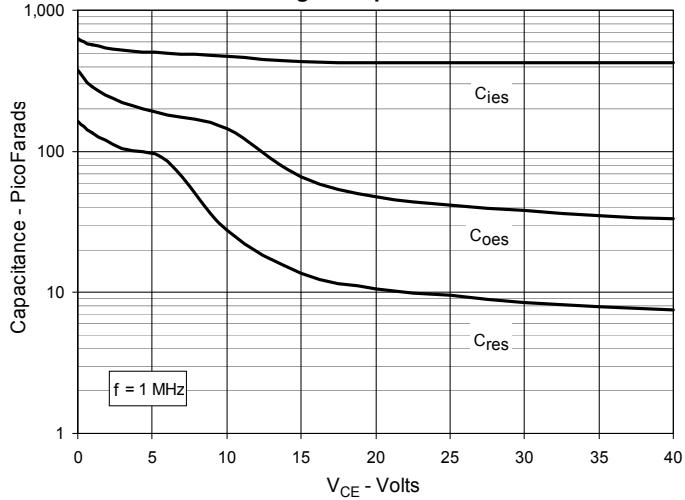
**Fig. 7. Transconductance**



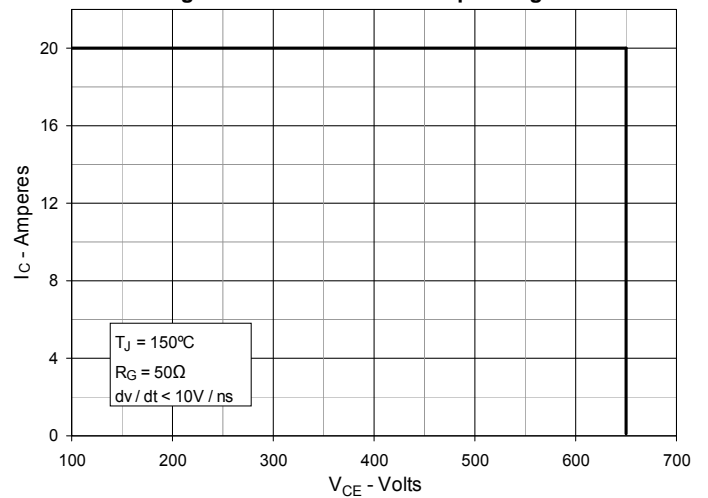
**Fig. 8. Gate Charge**



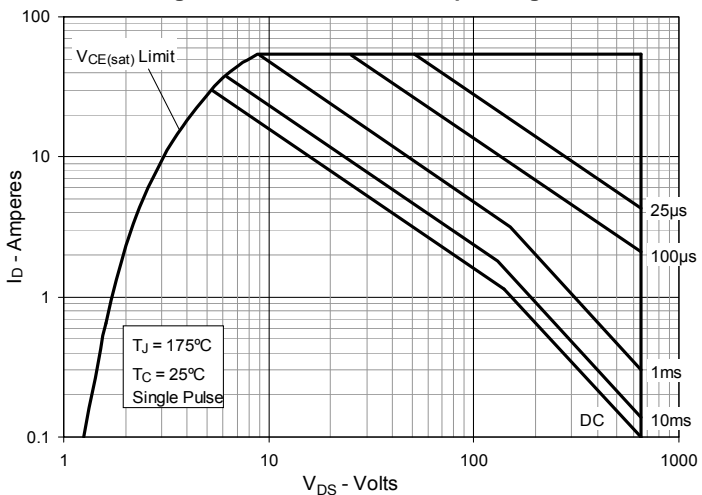
**Fig. 9. Capacitance**



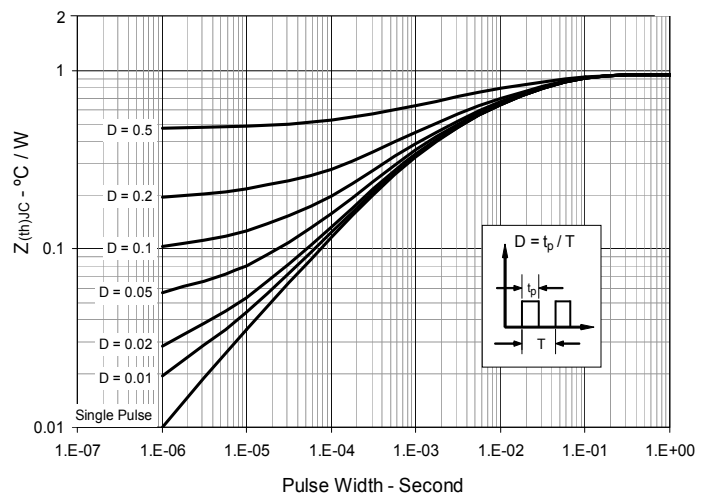
**Fig. 10. Reverse-Bias Safe Operating Area**

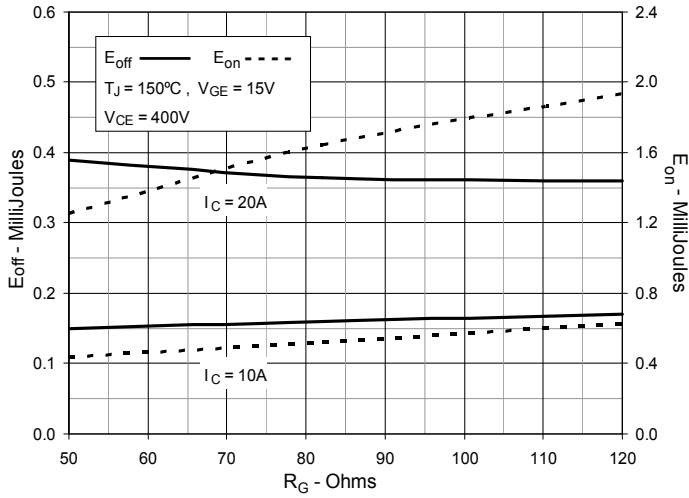
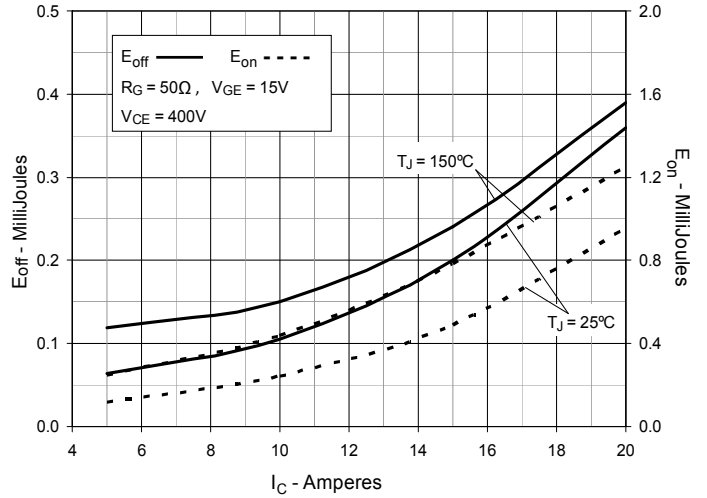
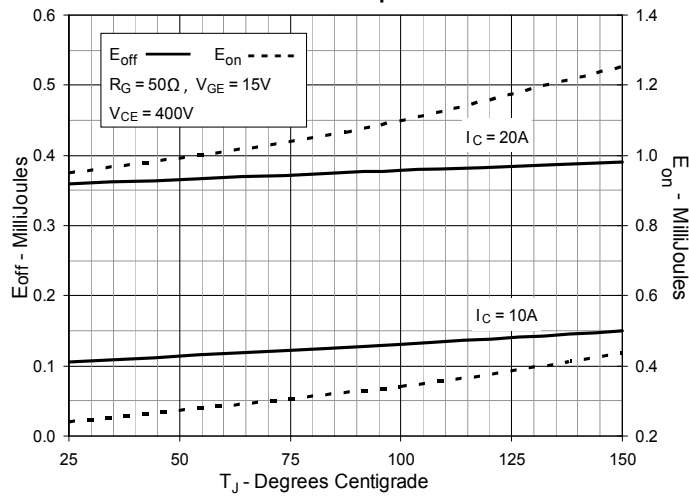
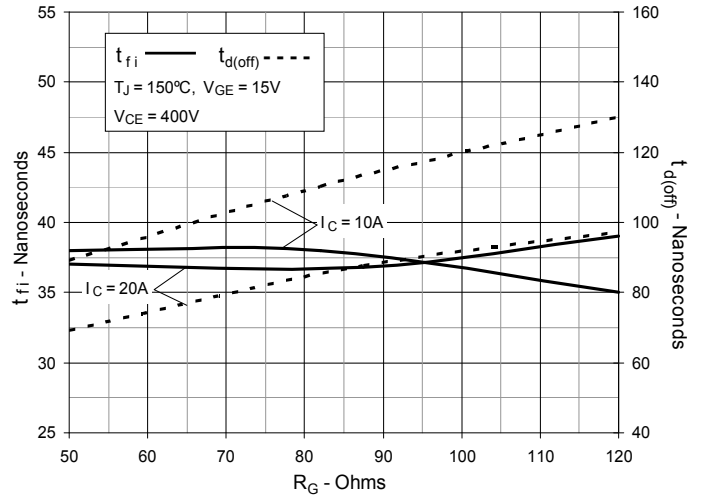
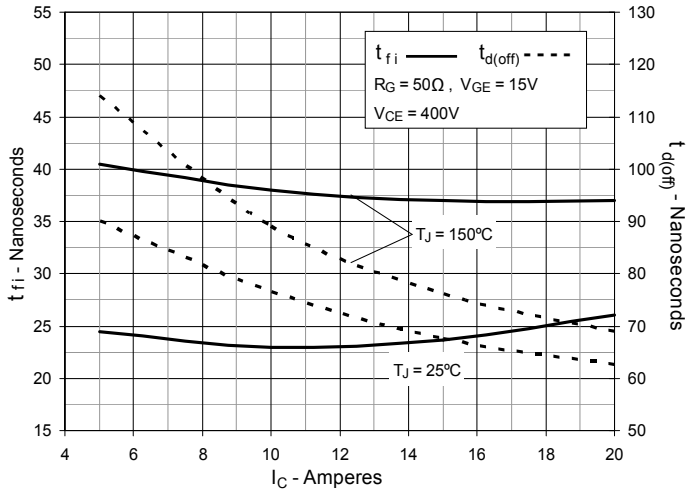
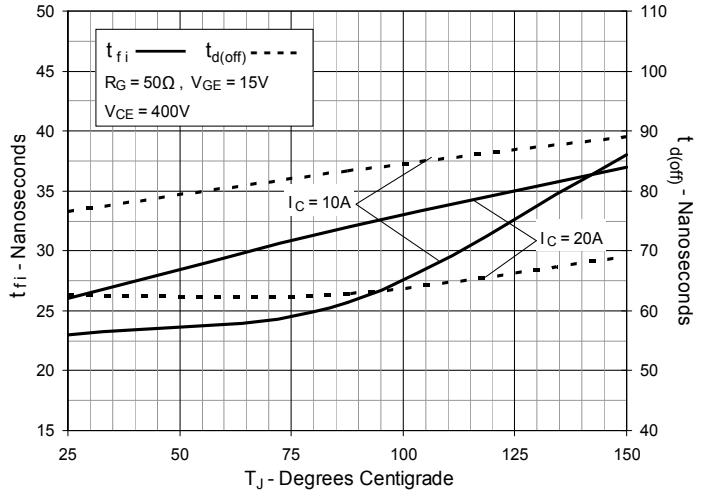


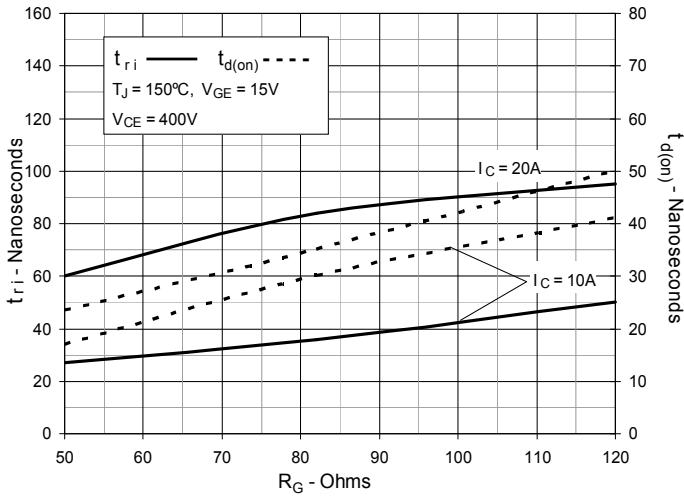
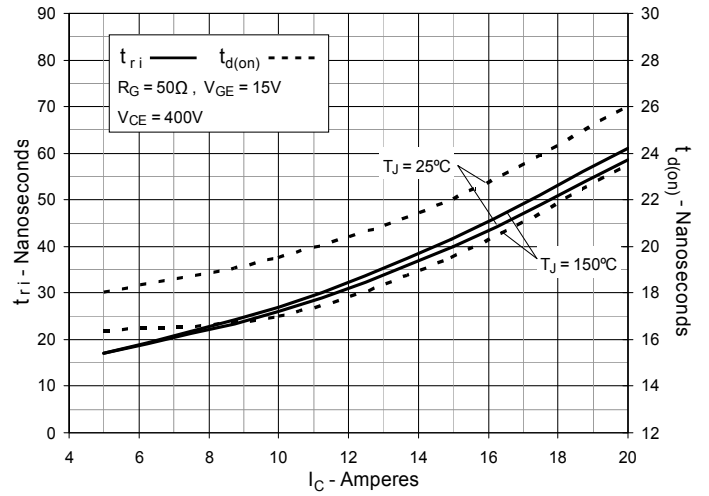
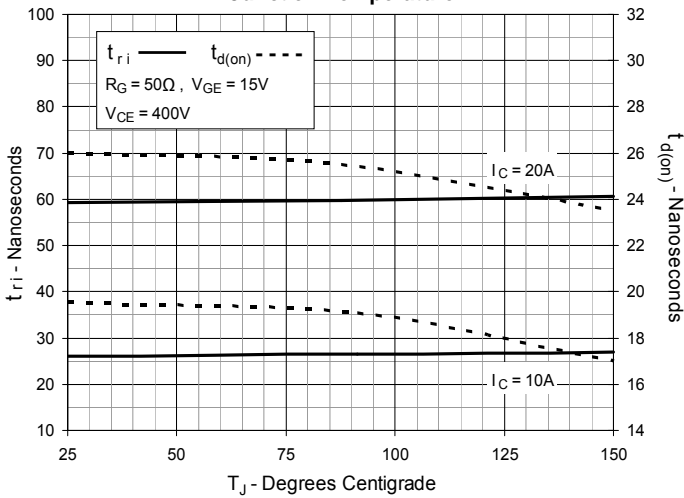
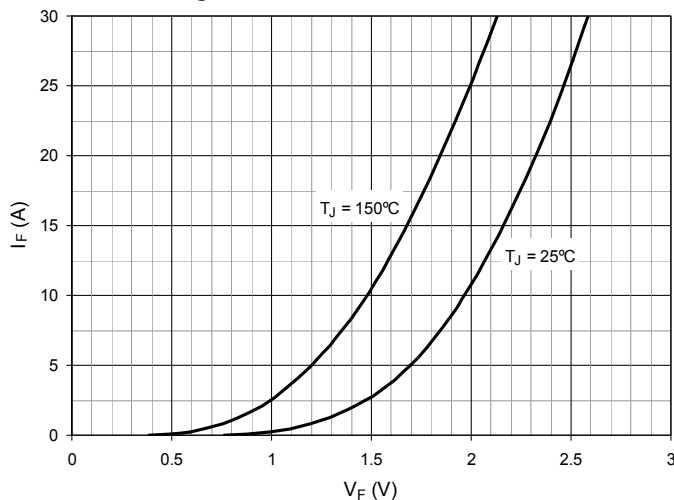
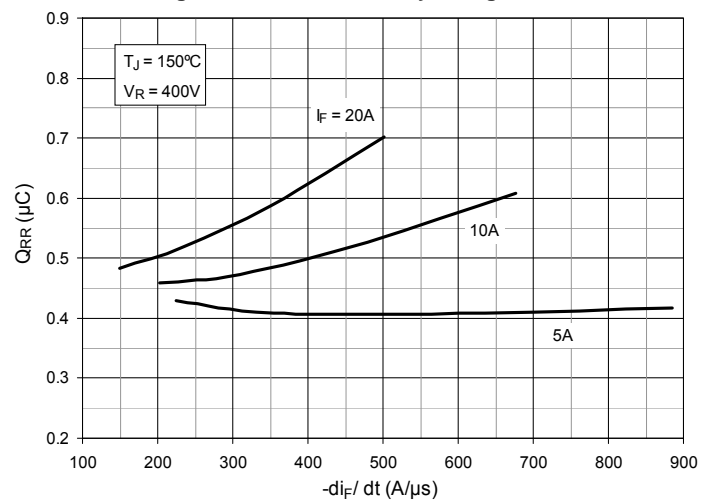
**Fig. 11. Forward-Bias Safe Operating Area**



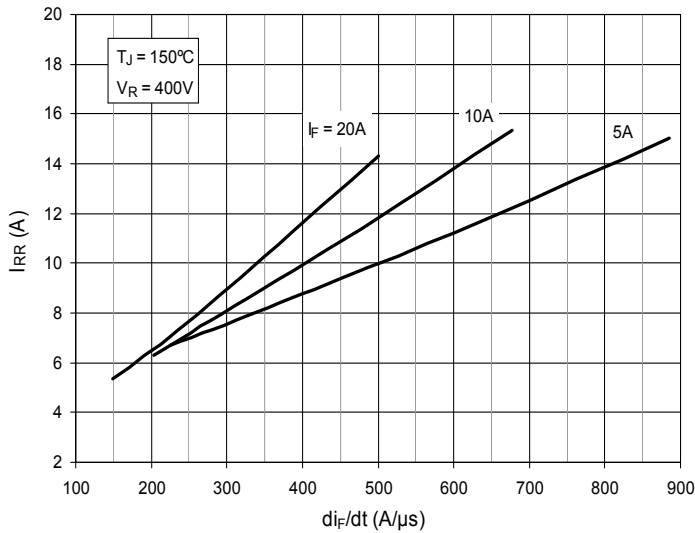
**Fig. 12. Maximum Transient Thermal Impedance (IGBT)**



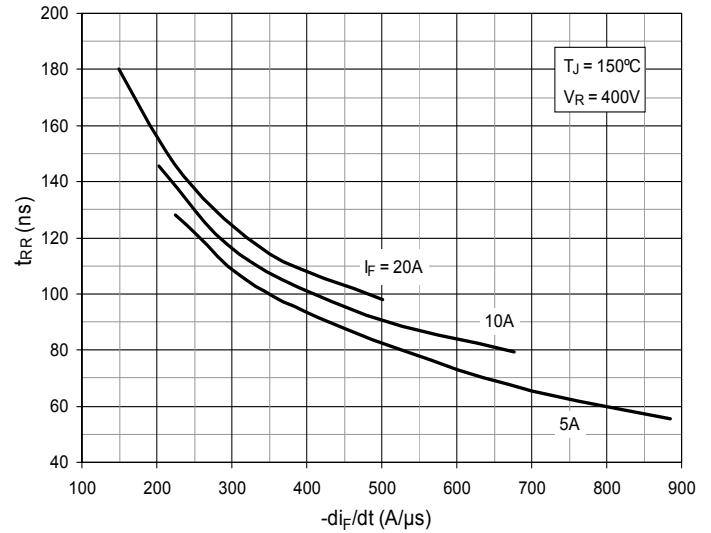
**Fig. 13. Inductive Switching Energy Loss vs. Gate Resistance**

**Fig. 14. Inductive Switching Energy Loss vs. Collector Current**

**Fig. 15. Inductive Switching Energy Loss vs. Junction Temperature**

**Fig. 16. Inductive Turn-off Switching Times vs. Gate Resistance**

**Fig. 17. Inductive Turn-off Switching Times vs. Collector Current**

**Fig. 18. Inductive Turn-off Switching Times vs. Junction Temperature**


**Fig. 19. Inductive Turn-on Switching Times vs. Gate Resistance**

**Fig. 20. Inductive Turn-on Switching Times vs. Collector Current**

**Fig. 21. Inductive Turn-on Switching Times vs. Junction Temperature**

**Fig. 22. Diode Forward Characteristics**

**Fig. 23. Reverse Recovery Charge vs. -di\_F/dt**


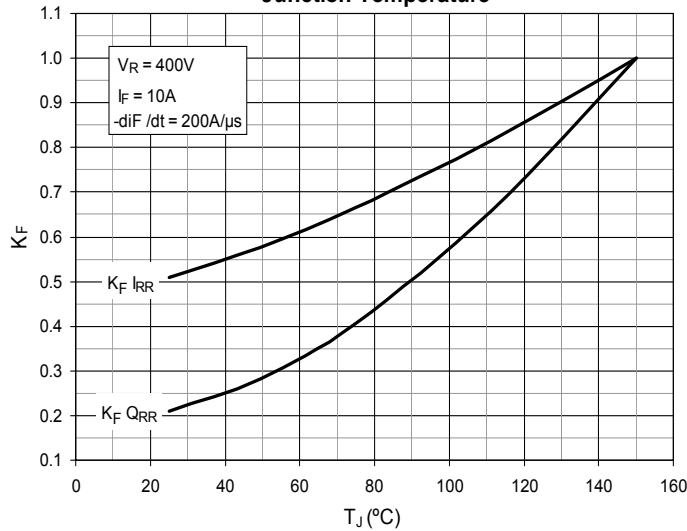
**Fig. 24. Reverse Recovery Current vs.  $-di_F/dt$**



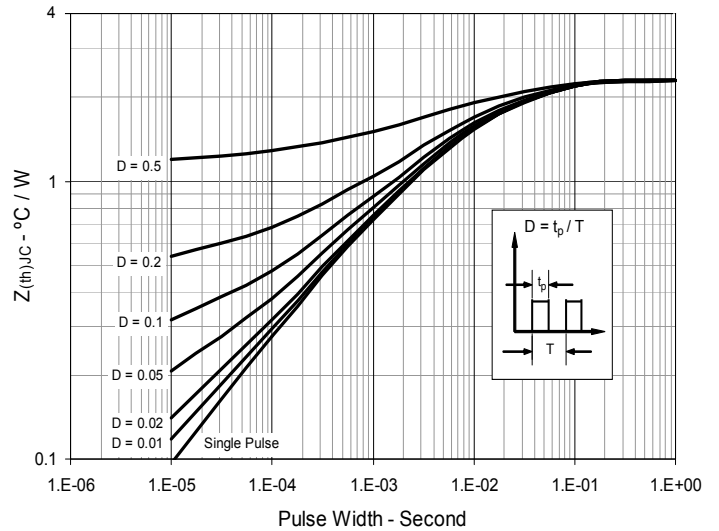
**Fig. 25. Reverse Recovery Time vs.  $-di_F/dt$**



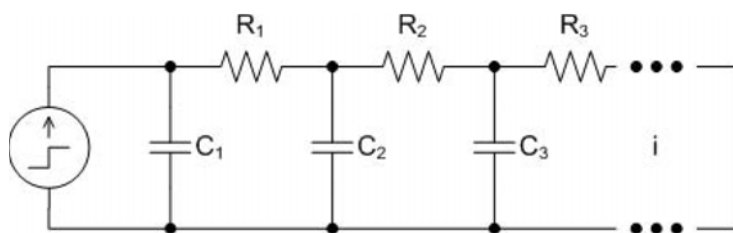
**Fig. 26. Dynamic Parameters  $Q_{RR}$ ,  $I_{RR}$  vs. Junction Temperature**



**Fig. 27. Maximum Transient Thermal Impedance (Diode)**



**Fig. 28. Cauer Thermal Network**



**IGBT**

i	Ri (°C/W)	Ci (J/°C)
1	0.314390	0.00097276
2	0.289260	0.00981820
3	0.090928	0.07681600

**DIODE**

i	Ri (°C/W)	Ci (J/°C)
1	0.862020	0.00082372
2	0.650090	0.00427340
3	0.192070	0.05408700



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