

# XPT™ 600V IGBT GenX3™ w/ Diode

## IXXH50N60B3D1

Extreme Light Punch Through  
IGBT for 5-30kHz Switching



$$V_{CES} = 600V$$

$$I_{C110} = 50A$$

$$V_{CE(sat)} \leq 1.80V$$

$$t_{fi(typ)} = 135ns$$

Symbol	Test Conditions	Maximum Ratings	
$V_{CES}$	$T_J = 25^\circ C$ to $175^\circ C$	600	V
$V_{CGR}$	$T_J = 25^\circ C$ to $175^\circ C$ , $R_{GE} = 1M\Omega$	600	V
$V_{GES}$	Continuous	$\pm 20$	V
$V_{GEM}$	Transient	$\pm 30$	V
$I_{C25}$	$T_C = 25^\circ C$ (Chip Capability)	120	A
$I_{C110}$	$T_C = 110^\circ C$	50	A
$I_{F110}$	$T_C = 110^\circ C$	30	A
$I_{CM}$	$T_C = 25^\circ C$ , 1ms	200	A
$I_A$	$T_C = 25^\circ C$	25	A
$E_{AS}$	$T_C = 25^\circ C$	200	mJ
<b>SSOA</b> <b>(RBSOA)</b>	$V_{GE} = 15V$ , $T_{VJ} = 150^\circ C$ , $R_G = 5\Omega$ Clamped Inductive Load	$I_{CM} = 100$ @ $V_{CE} \leq V_{CES}$	A
$t_{sc}$ <b>(SCSOA)</b>	$V_{GE} = 15V$ , $V_{CE} = 360V$ , $T_J = 150^\circ C$ $R_G = 22\Omega$ , Non Repetitive	10	$\mu s$
$P_C$	$T_C = 25^\circ C$	600	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>		6	g

### TO-247



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

### Features

- Optimized for 5-30kHz Switching
- Square RBSOA
- Anti-Parallel Ultra Fast Diode
- Avalanche Capability
- Short Circuit Capability
- International Standard Package

### Advantages

- High Power Density
- 175°C Rated
- Extremely Rugged
- Low Gate Drive Requirement

### Applications

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

Symbol	Test Conditions ( $T_J = 25^\circ C$ , Unless Otherwise Specified)	Characteristic Values		
		Min.	Typ.	Max.
$BV_{CES}$	$I_C = 250\mu A$ , $V_{GE} = 0V$	600		V
$V_{GE(th)}$	$I_C = 250\mu A$ , $V_{CE} = V_{GE}$	3.5		6.0 V
$I_{CES}$	$V_{CE} = V_{CES}$ , $V_{GE} = 0V$ $T_J = 150^\circ C$			25 $\mu A$ 3 mA
$I_{GES}$	$V_{CE} = 0V$ , $V_{GE} = \pm 20V$			$\pm 100$ nA
$V_{CE(sat)}$	$I_C = 36A$ , $V_{GE} = 15V$ , Note 1 $T_J = 150^\circ C$	1.55	1.80	V
		1.80		V

Symbol Test Conditions ( $T_J = 25^\circ\text{C}$ Unless Otherwise Specified)		Characteristic Values		
		Min.	Typ.	Max.
$g_{fs}$	$I_C = 36\text{A}, V_{CE} = 10\text{V}$ , Note 1	12	19	S
$C_{ies}$	$V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$		2230	pF
$C_{oes}$			195	pF
$C_{res}$			44	pF
$Q_{g(on)}$	$I_C = 36\text{A}, V_{GE} = 15\text{V}, V_{CE} = 0.5 \cdot V_{CES}$		70	nC
$Q_{ge}$			16	nC
$Q_{gc}$			29	nC
$t_{d(on)}$	<b>Inductive load, <math>T_J = 25^\circ\text{C}</math></b> $I_C = 36\text{A}, V_{GE} = 15\text{V}$ $V_{CE} = 360\text{V}, R_G = 5\Omega$ Note 2		27	ns
$t_{ri}$			40	ns
$E_{on}$			0.67	mJ
$t_{d(off)}$			100	150 ns
$t_{fi}$			135	ns
$E_{off}$			0.74	1.20 mJ
$t_{d(on)}$	<b>Inductive load, <math>T_J = 150^\circ\text{C}</math></b> $I_C = 36\text{A}, V_{GE} = 15\text{V}$ $V_{CE} = 360\text{V}, R_G = 5\Omega$ Note 2		30	ns
$t_{ri}$			45	ns
$E_{on}$			1.40	mJ
$t_{d(off)}$			130	ns
$t_{fi}$			190	ns
$E_{off}$			1.20	mJ
$R_{thJC}$			0.25	$^\circ\text{C}/\text{W}$
$R_{thCS}$		0.21		$^\circ\text{C}/\text{W}$

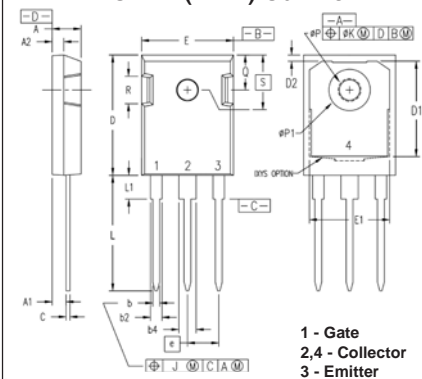
### Reverse Diode (FRED)

Symbol Test Conditions ( $T_J = 25^\circ\text{C}$ Unless Otherwise Specified)		Characteristic Values		
		Min.	Typ.	Max.
$V_F$	$I_F = 30\text{A}, V_{GE} = 0\text{V}$ , Note 1 $T_J = 150^\circ\text{C}$		1.6	2.7 V
$I_{RM}$	$I_F = 30\text{A}, V_{GE} = 0\text{V}, -di_F/dt = 100\text{A}/\mu\text{s}, T_J = 100^\circ\text{C}$			4 A
$t_{rr}$	$V_R = 100\text{V}, T_J = 100^\circ\text{C}$ $I_F = 1\text{A}, V_{GE} = 0\text{V}, -di_F/dt = 100\text{A}/\mu\text{s}, V_R = 30\text{V}$		100	ns
			25	ns
$R_{thJC}$				0.9 $^\circ\text{C}/\text{W}$

### Notes:

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

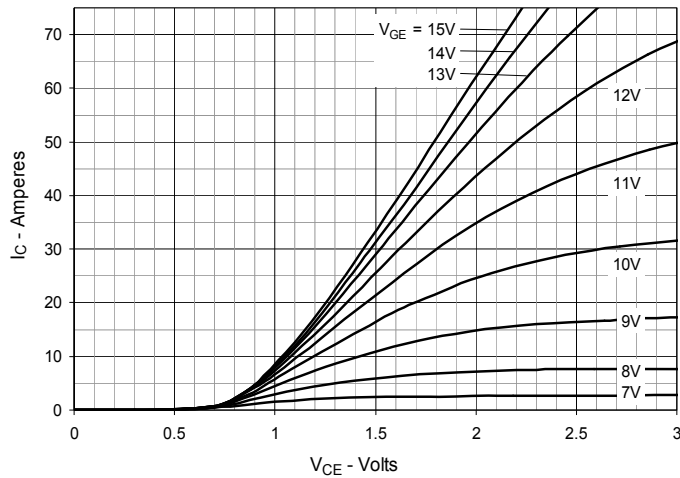
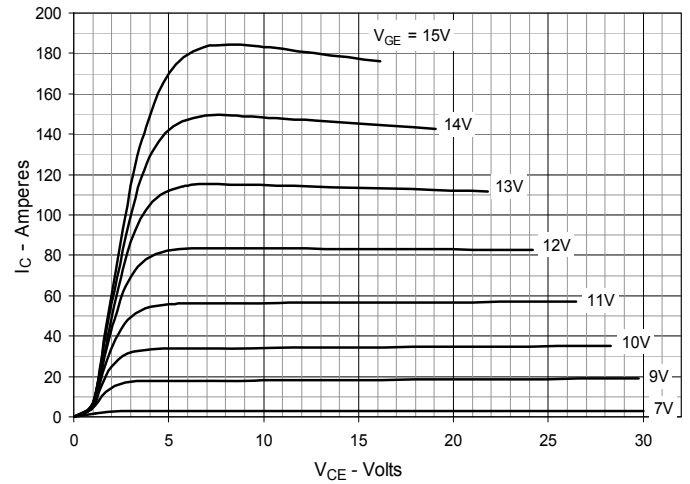
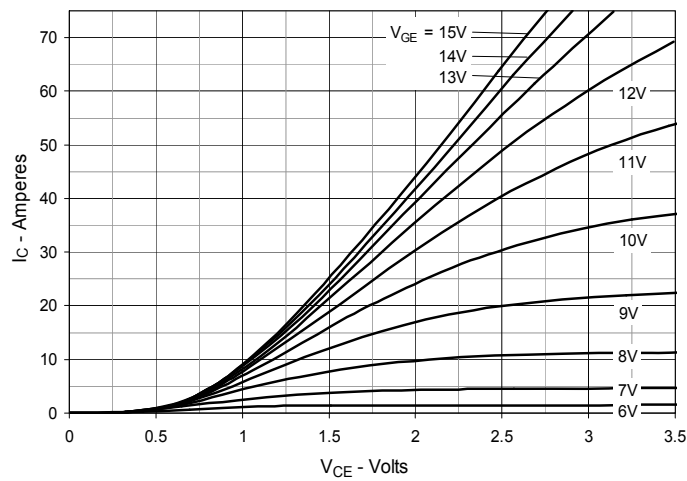
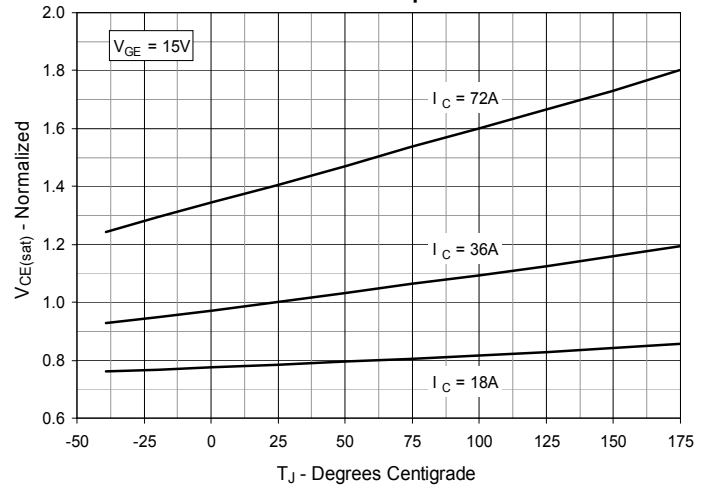
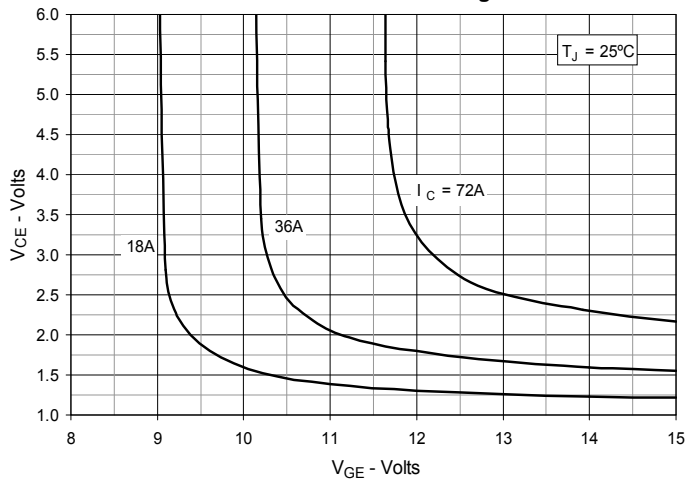
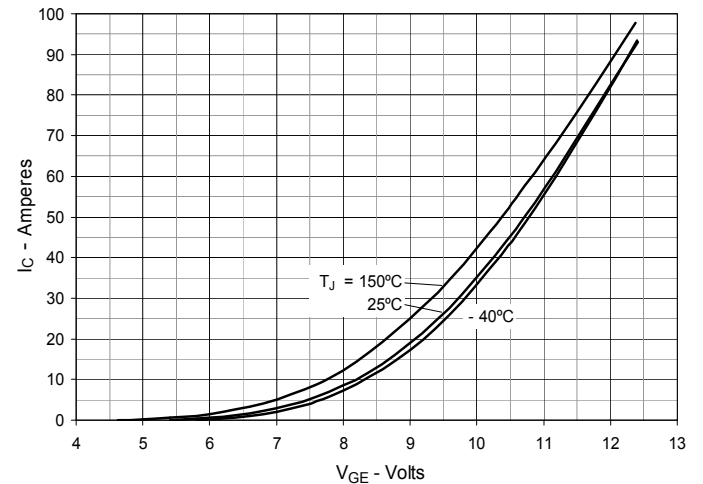
### TO-247 (IXXH) Outline

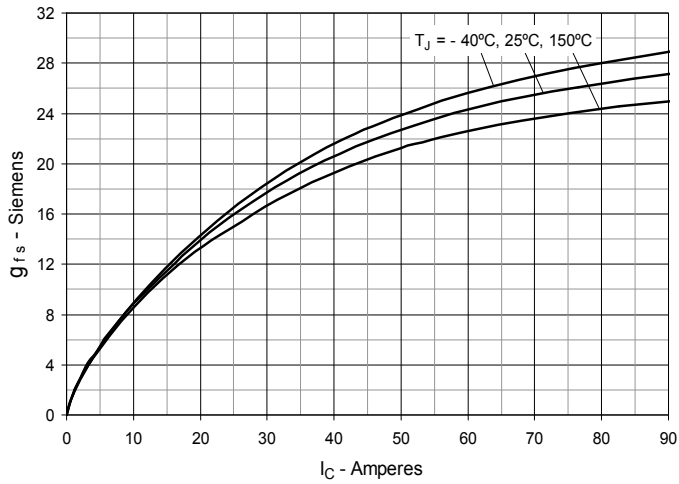
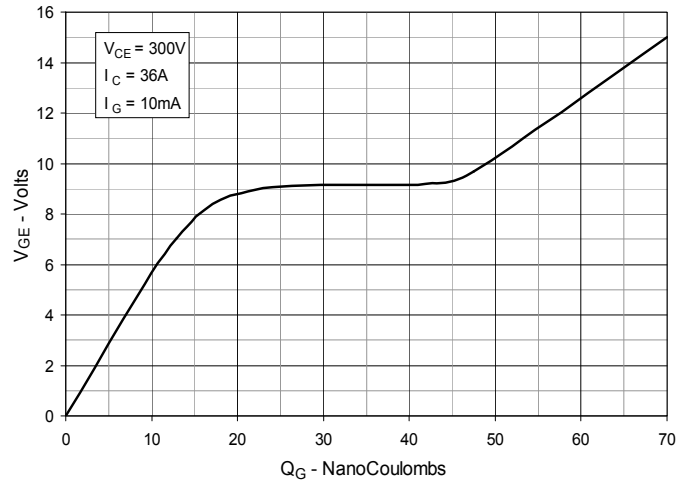
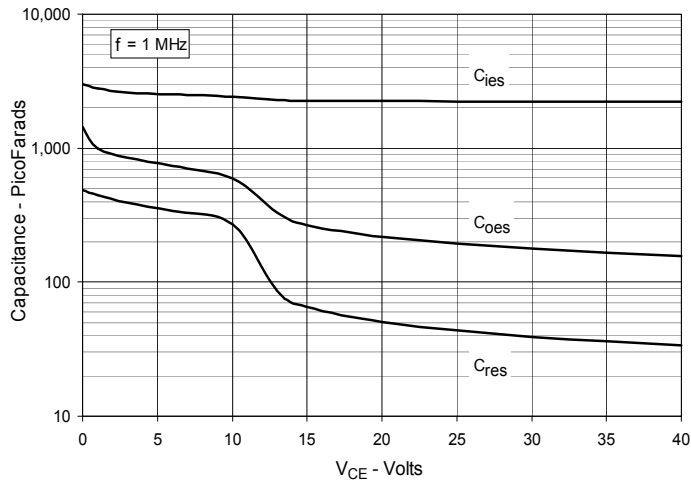
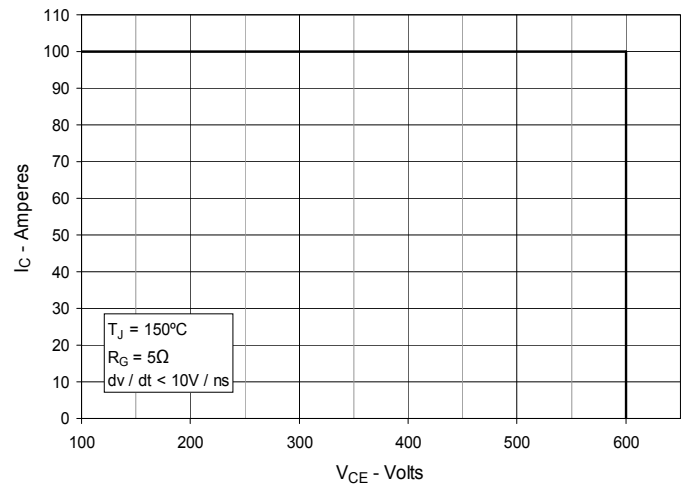
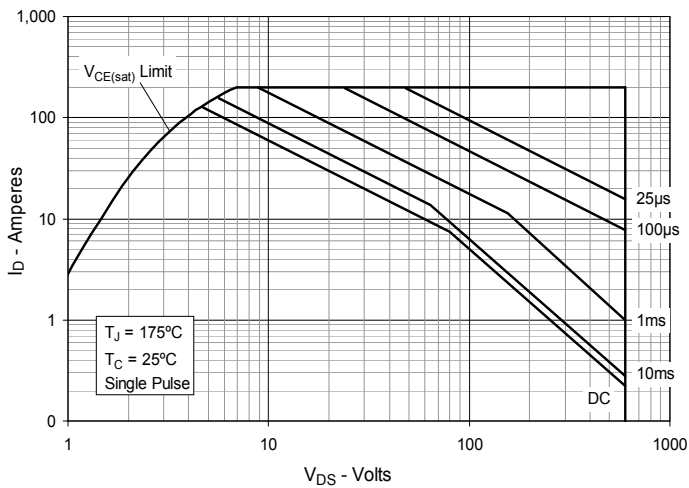
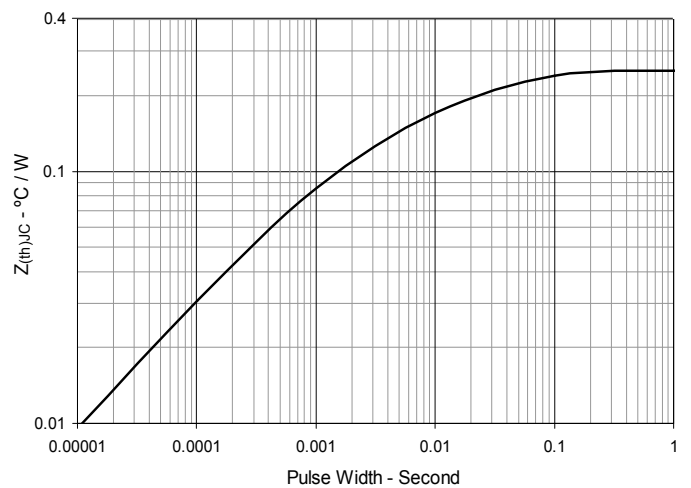


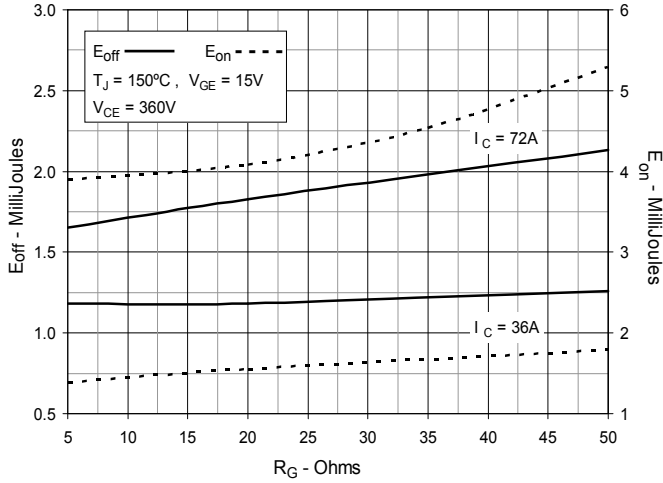
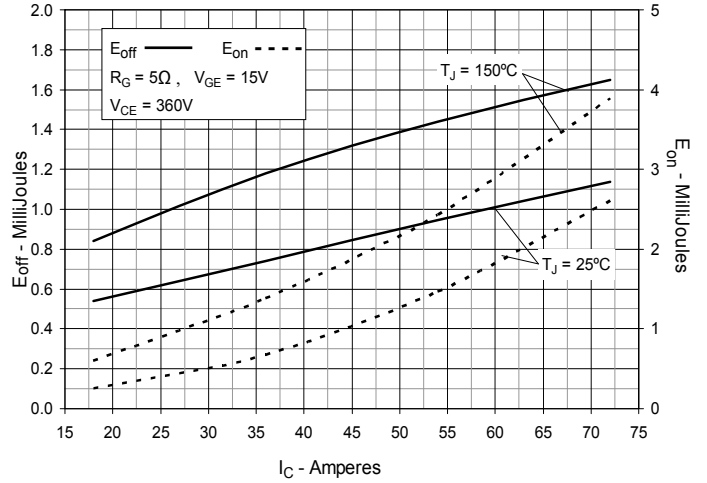
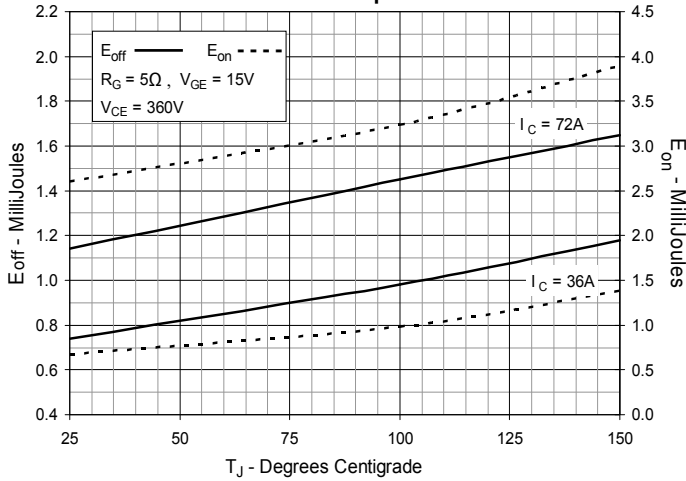
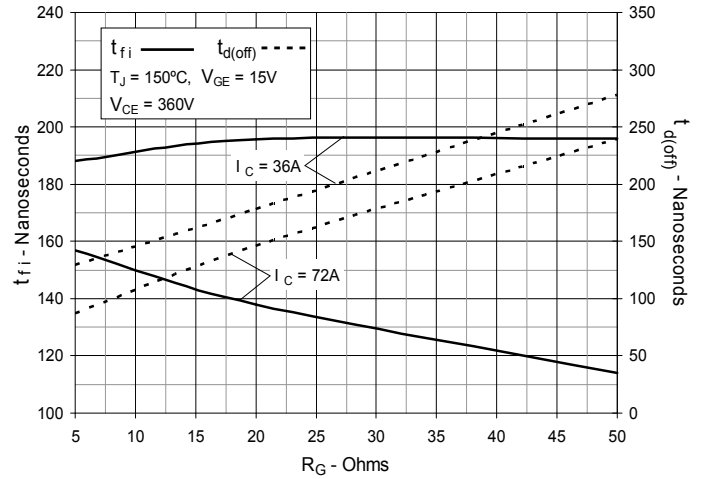
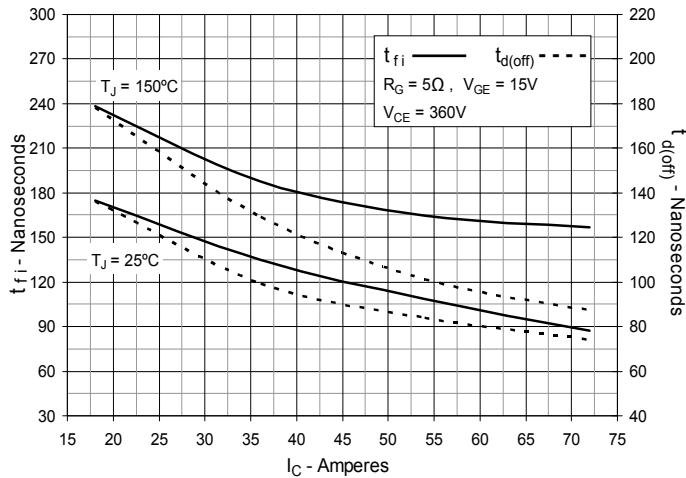
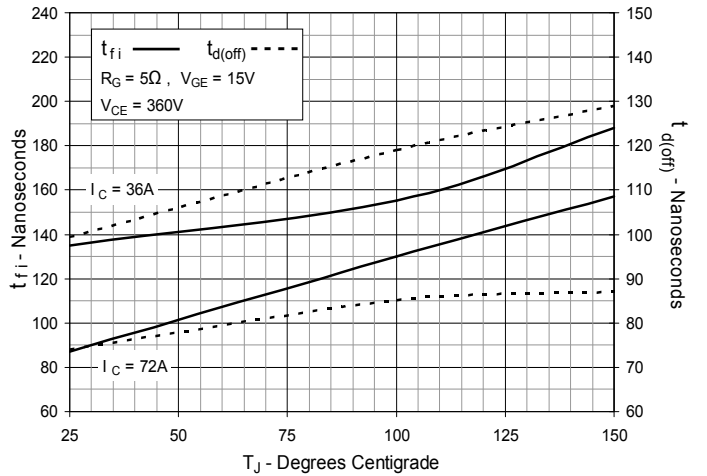
Dim.	Millimeter		Inches	
	min	max	min	max
A	4.70	5.30	0.185	0.209
A1	2.21	2.59	0.087	0.102
A2	1.50	2.49	0.059	0.098
b	0.99	1.40	0.039	0.055
b2	1.65	2.39	0.065	0.094
b4	2.59	3.43	0.102	0.135
c	0.38	0.89	0.015	0.035
D	20.79	21.45	0.819	0.845
D1	13.07	-	0.515	-
D2	0.51	1.35	0.020	0.053
E	15.48	16.24	0.610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

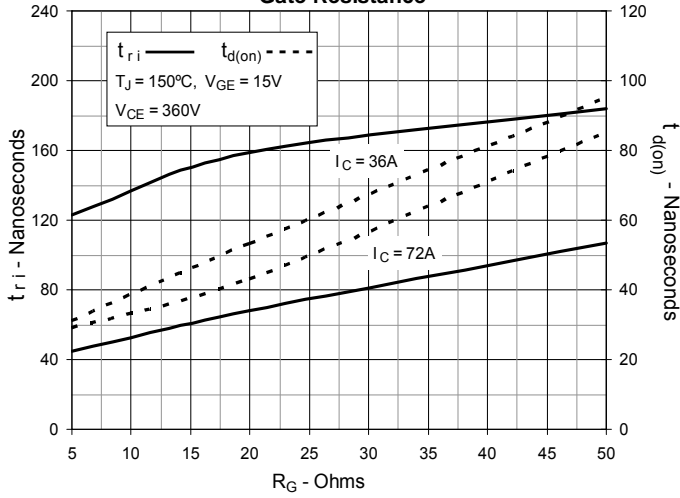
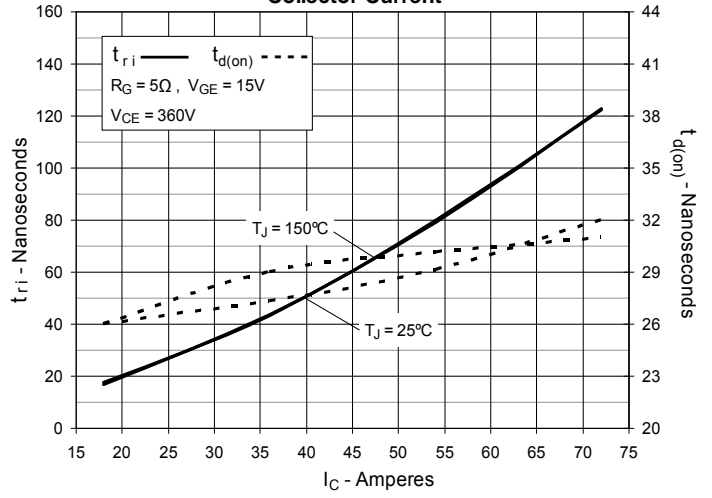
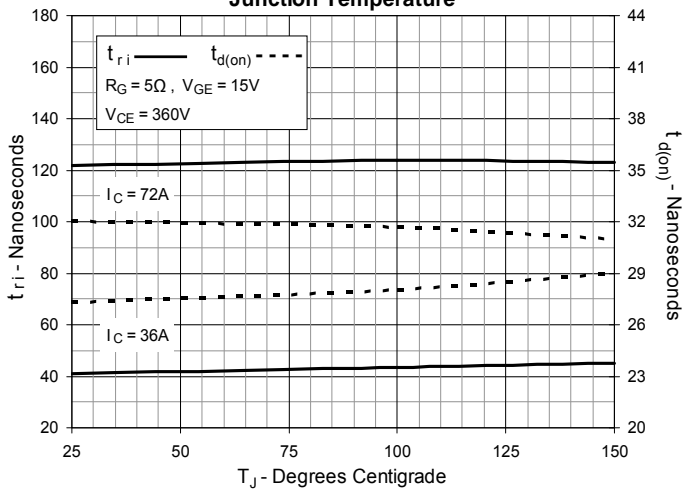
IXYS Reserves the Right to Change Limits, Test Conditions, and Dimensions.

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**


**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**


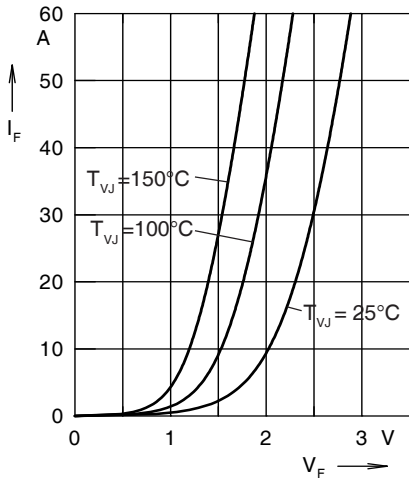
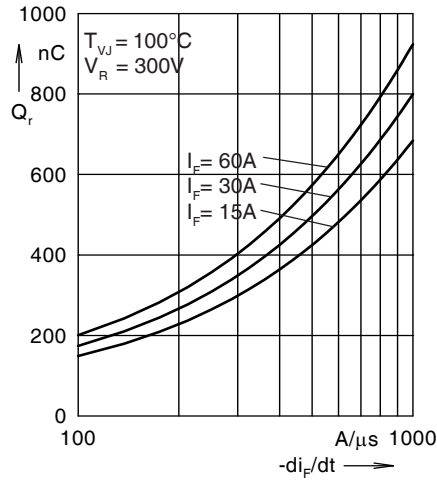
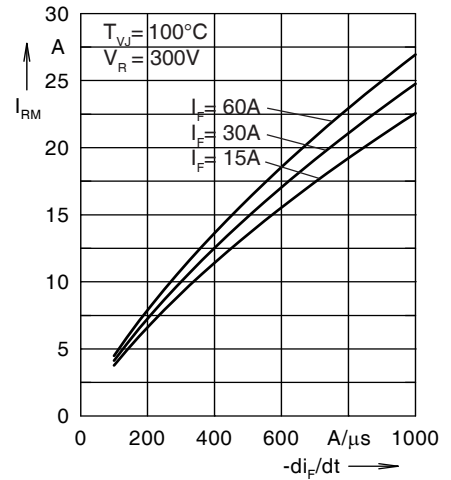
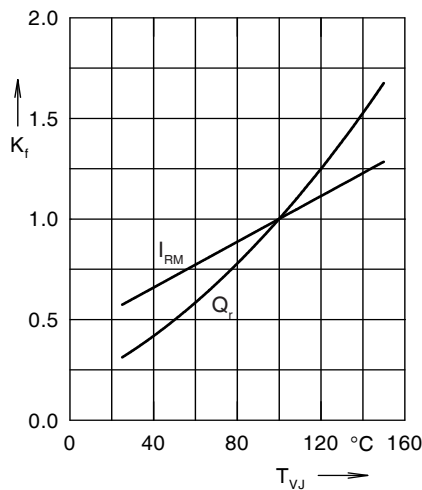
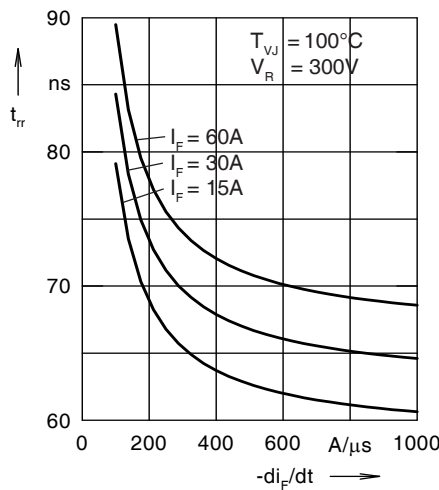
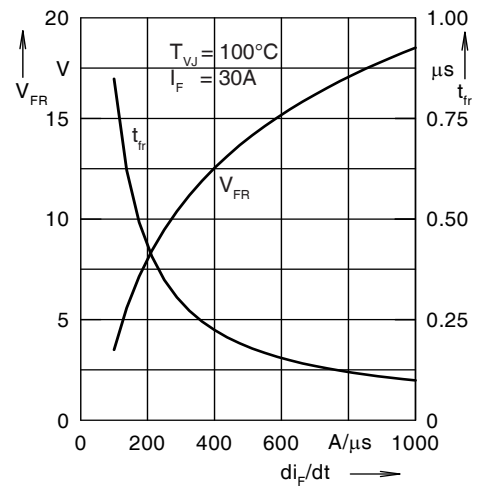
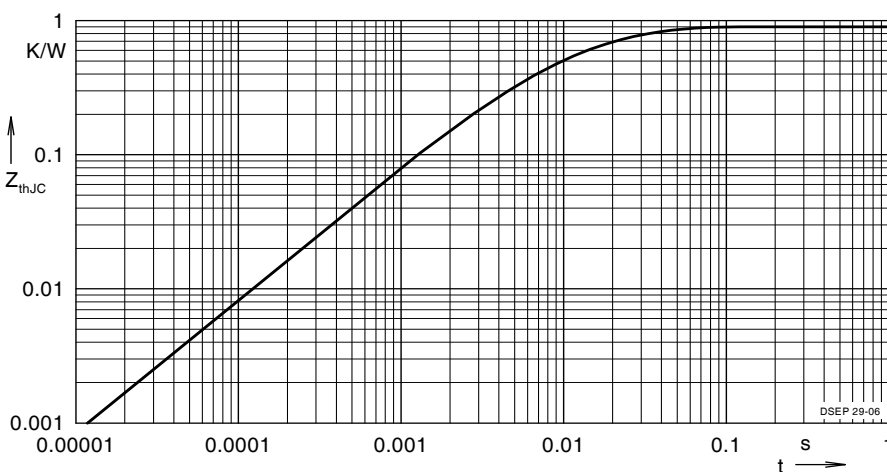

 Fig. 22. Forward Current  $I_F$  Versus  $V_F$ 

 Fig. 23. Reverse Recovery Charge  $Q_r$  Versus  $-di_F/dt$ 

 Fig. 24. Peak Reverse Current  $I_{RM}$  Versus  $-di_F/dt$ 

 Fig. 25. Dynamic Parameters  $Q_r$ ,  $I_{RM}$  Versus  $T_{VJ}$ 

 Fig. 26. Recovery Time  $t_{rr}$  Versus  $-di_F/dt$ 

 Fig. 27. Peak Forward Voltage  $V_{FR}$  and  $t_{fr}$  Versus  $di_F/dt$ 


Fig. 28. 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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