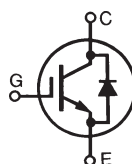


XPT™ 650V IGBT GenX3™ w/ Diode

IXYH40N65B3D1 IXYQ40N65B3D1

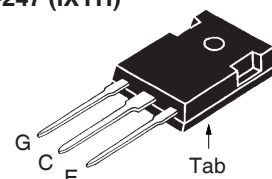
Extreme Light Punch Through
IGBT for 5-30kHz Switching



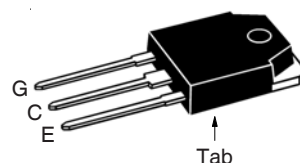
$$\begin{aligned} V_{CES} &= 650V \\ I_{C110} &= 40A \\ V_{CE(sat)} &\leq 2.0V \\ t_{fi(typ)} &= 73ns \end{aligned}$$

Symbol	Test Conditions	Maximum Ratings	
V_{CES}	$T_J = 25^\circ\text{C}$ to 175°C	650	V
V_{CGR}	$T_J = 25^\circ\text{C}$ to 175°C , $R_{GE} = 1M\Omega$	650	V
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$	86	A
I_{C110}	$T_C = 110^\circ\text{C}$	40	A
I_{F110}	$T_C = 110^\circ\text{C}$	50	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1ms	195	A
I_A	$T_C = 25^\circ\text{C}$	20	A
E_{AS}	$T_C = 25^\circ\text{C}$	300	mJ
SSOA (RBSOA)	$V_{GE} = 15V$, $T_{VJ} = 150^\circ\text{C}$, $R_G = 10\Omega$ Clamped Inductive Load	$I_{CM} = 80$ @ $V_{CE} \leq V_{CES}$	A
t_{sc} (SCSOA)	$V_{GE} = 15V$, $V_{CE} = 360V$, $T_J = 150^\circ\text{C}$ $R_G = 82\Omega$, Non Repetitive	5	μs
P_C	$T_C = 25^\circ\text{C}$	300	W
T_J		-55 ... +175	$^\circ\text{C}$
T_{JM}		175	$^\circ\text{C}$
T_{stg}		-55 ... +175	$^\circ\text{C}$
T_L	Maximum Lead Temperature for Soldering	300	$^\circ\text{C}$
T_{SOLD}	1.6 mm (0.062in.) from Case for 10s	260	$^\circ\text{C}$
M_d	Mounting Torque	1.13/10	Nm/lb.in
Weight	TO-247	6.0	g
	TO-3P	5.5	g

TO-247 (IXYH)



TO-3P (IXYQ)



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

Features

- Optimized for Low 5-30kHz Switching
- Square RBSOA
- Anti-Parallel Fast Diode
- Avalanche Rated
- Short Circuit Capability

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

Symbol	Test Conditions ($T_J = 25^\circ\text{C}$, Unless Otherwise Specified)	Characteristic Values		
		Min.	Typ.	Max.
BV_{CES}	$I_C = 250\mu\text{A}$, $V_{GE} = 0V$	650		V
$V_{GE(th)}$	$I_C = 250\mu\text{A}$, $V_{CE} = V_{GE}$	3.5		6.0 V
I_{CES}	$V_{CE} = V_{CES}$, $V_{GE} = 0V$ $T_J = 150^\circ\text{C}$			10 μA 1.5 mA
I_{GES}	$V_{CE} = 0V$, $V_{GE} = \pm 20V$			± 100 nA
$V_{CE(sat)}$	$I_C = 40A$, $V_{GE} = 15V$, Note 1 $T_J = 150^\circ\text{C}$		1.7 2.0	2.0 V V

Symbol Test Conditions
 $(T_J = 25^\circ\text{C Unless Otherwise Specified})$
Characteristic Values

		Min.	Typ.	Max.
g_{fs}	$I_C = 40\text{A}, V_{CE} = 10\text{V}, \text{Note 1}$	16	27	S
C_{ies}	$V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$		1880	pF
C_{oes}			210	pF
C_{res}			43	pF
$Q_{g(on)}$	$I_C = 40\text{A}, V_{GE} = 15\text{V}, V_{CE} = 0.5 \cdot V_{CES}$		68	nC
Q_{ge}			10	nC
Q_{gc}			33	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$ $I_C = 30\text{A}, V_{GE} = 15\text{V}$ $V_{CE} = 400\text{V}, R_G = 10\Omega$ Note 2		20	ns
t_{ri}			37	ns
E_{on}			0.80	mJ
$t_{d(off)}$			140	ns
t_{fi}			73	ns
E_{off}			0.70	mJ
$t_{d(on)}$	Inductive load, $T_J = 150^\circ\text{C}$ $I_C = 30\text{A}, V_{GE} = 15\text{V}$ $V_{CE} = 400\text{V}, R_G = 10\Omega$ Note 2		20	ns
t_{ri}			37	ns
E_{on}			1.60	mJ
$t_{d(off)}$			176	ns
t_{fi}			174	ns
E_{off}			1.15	mJ
R_{thJC}			0.25	$^\circ\text{C/W}$
R_{thCS}				$^\circ\text{C/W}$

Reverse Diode (FRED)
Symbol Test Conditions
 $(T_J = 25^\circ\text{C Unless Otherwise Specified})$
Characteristic Values

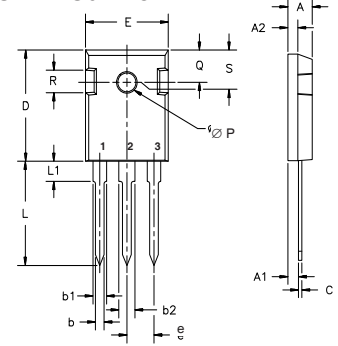
		Min.	Typ.	Max.
V_F	$I_F = 30\text{A}, V_{GE} = 0\text{V}, \text{Note 1}$			2.5 V
I_{rr}	$I_F = 30\text{A}, V_{GE} = 0\text{V},$ $-di_F/dt = 500\text{A}/\mu\text{s}, V_R = 400\text{V}$	$T_J = 150^\circ\text{C}$	1.2	V
t_{rr}		$T_J = 150^\circ\text{C}$	24	A
		$T_J = 150^\circ\text{C}$	125	ns
R_{thJC}				0.60 $^\circ\text{C/W}$

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 .

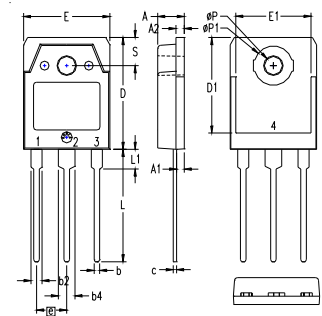
ADVANCE TECHNICAL INFORMATION

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.

TO-247 Outline


Terminals: 1 - Gate 2 - Collector
3 - Emitted

Dim.	Millimeter Min.	Max.	Inches Min.	Max.
A	4.7	5.3	.185	.209
A ₁	2.2	2.54	.087	.102
A ₂	2.2	2.6	.059	.098
b	1.0	1.4	.040	.055
b ₁	1.65	2.13	.065	.084
b ₂	2.87	3.12	.113	.123
C	.4	.8	.016	.031
D	20.80	21.46	.819	.845
E	15.75	16.26	.610	.640
e	5.20	5.72	0.205	0.225
L	19.81	20.32	.780	.800
L ₁		4.50		.177
ØP	3.55	3.65	.140	.144
Q	5.89	6.40	0.232	0.252
R	4.32	5.49	.170	.216
S	6.15	BSC	242	BSC

TO-3P Outline


1 = Gate 2,4 = Collector
3 = Emitter

SYM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.185	.193	4.70	4.90
A ₁	.051	.059	1.30	1.50
A ₂	.057	.065	1.45	1.65
b	.035	.045	0.90	1.15
b ₂	.075	.087	1.90	2.20
b ₄	.114	.126	2.90	3.20
c	.022	.031	0.55	0.80
D	.780	.799	19.80	20.30
D ₁	.665	.677	16.90	17.20
E	.610	.622	15.50	15.80
E ₁	.531	.539	13.50	13.70
e		.215 BSC		5.45 BSC
L	.779	.795	19.80	20.20
L ₁	.134	.142	3.40	3.60
ØP	.126	.134	3.20	3.40
ØP ₁	.272	.280	6.90	7.10
S	.193	.201	4.90	5.10

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	

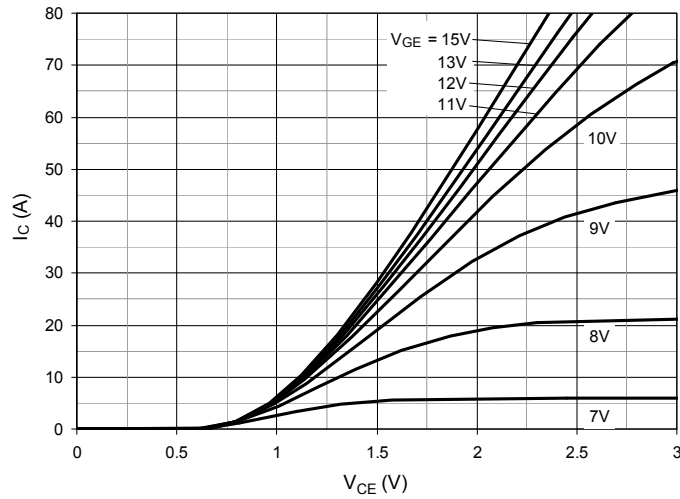
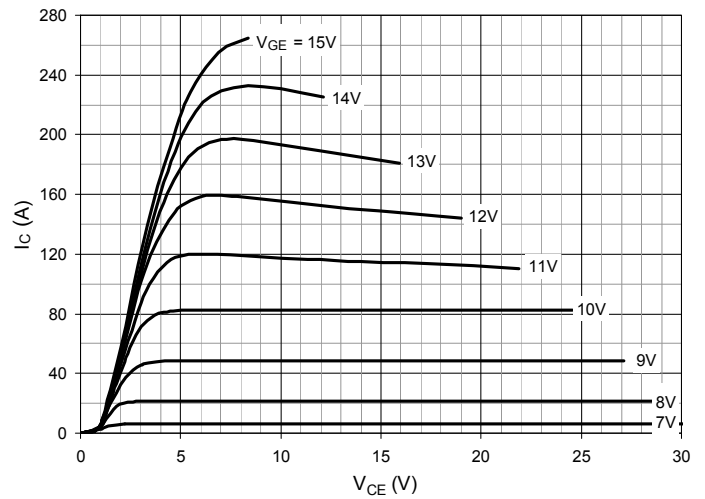
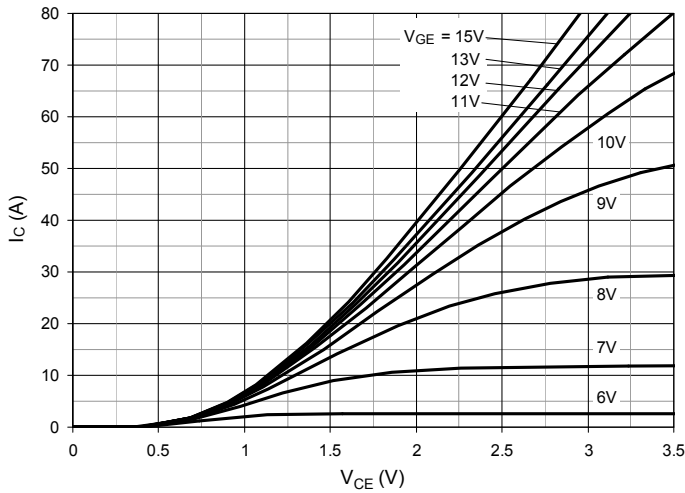
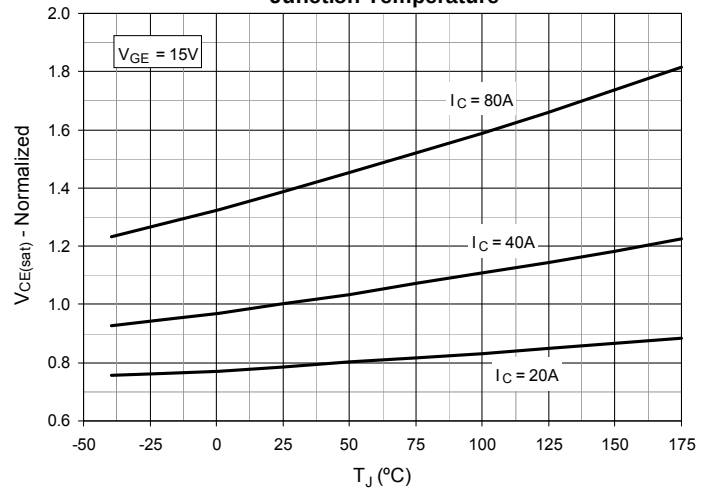
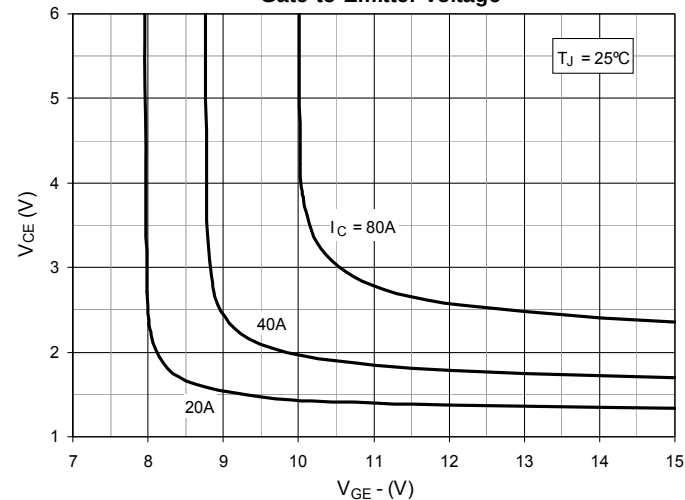
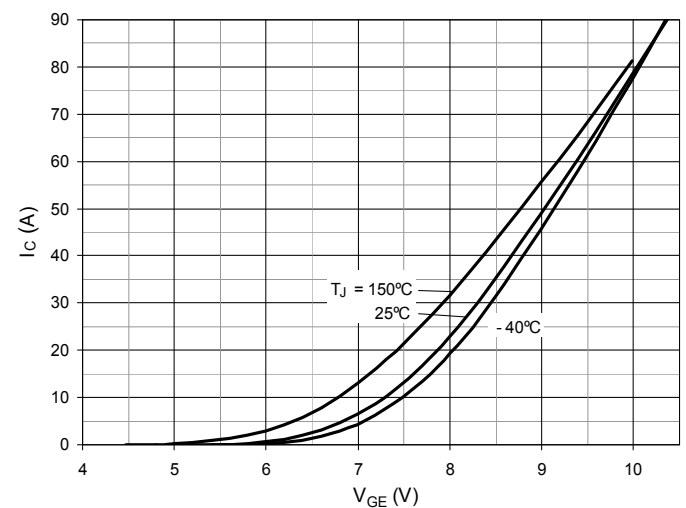
Fig. 1. Output Characteristics @ $T_J = 25^\circ\text{C}$

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

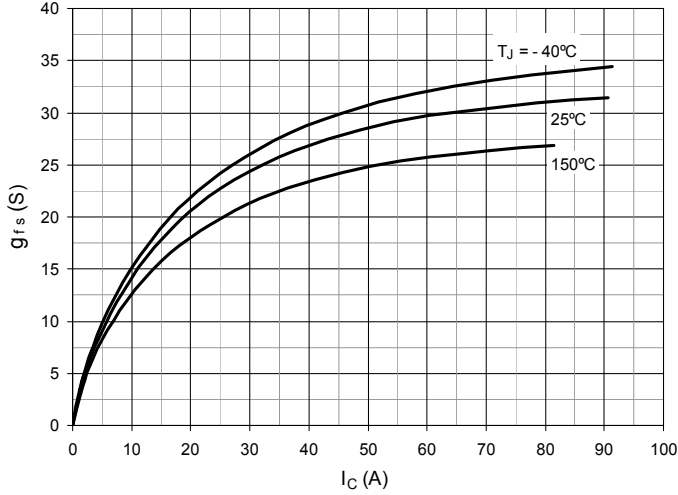


Fig. 8. Gate Charge

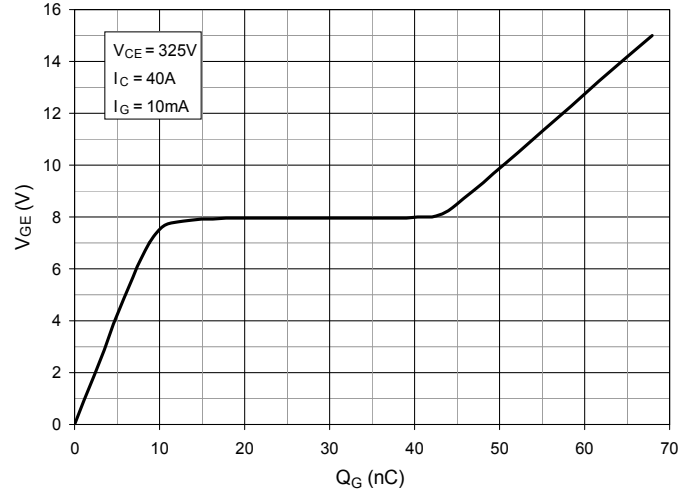


Fig. 9. Capacitance

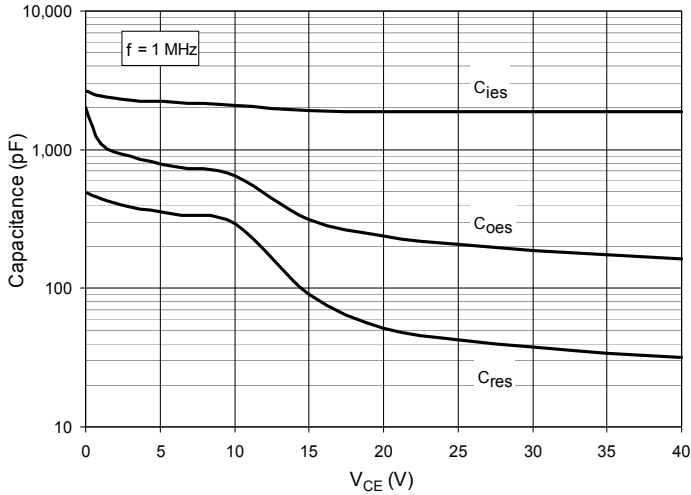


Fig. 10. Reverse-Bias Safe Operating Area

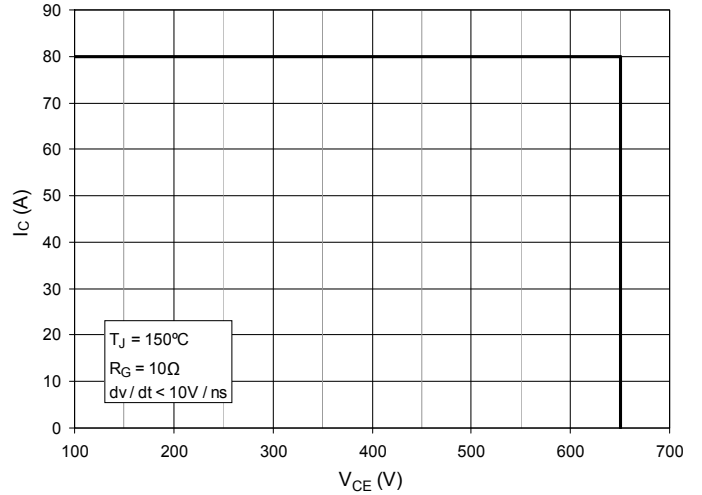


Fig. 11. Forward-Bias Safe Operating Area

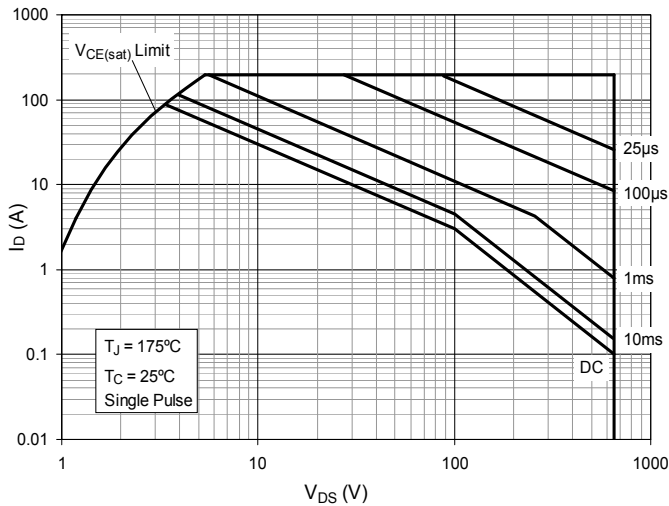


Fig. 12. Maximum Transient Thermal Impedance (IGBT)

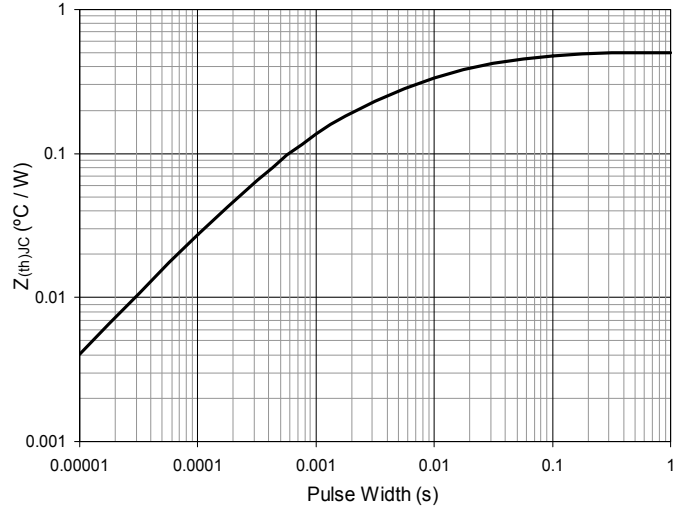


Fig. 13. Inductive Switching Energy Loss vs. Gate Resistance

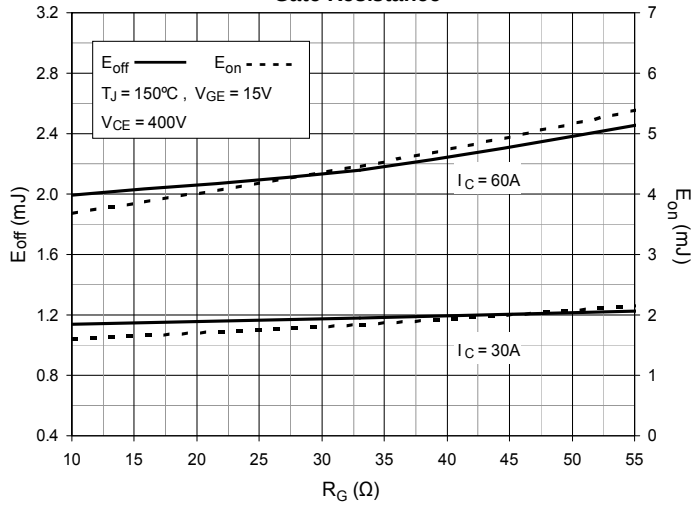


Fig. 14. Inductive Switching Energy Loss vs. Collector Current

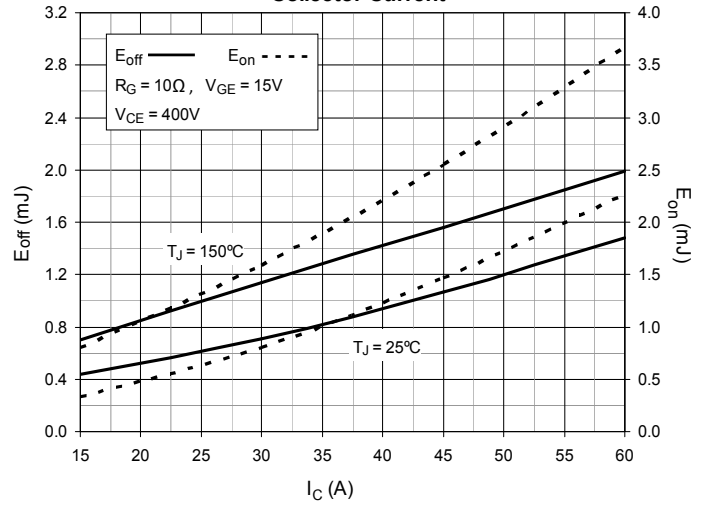


Fig. 15. Inductive Switching Energy Loss vs. Junction Temperature

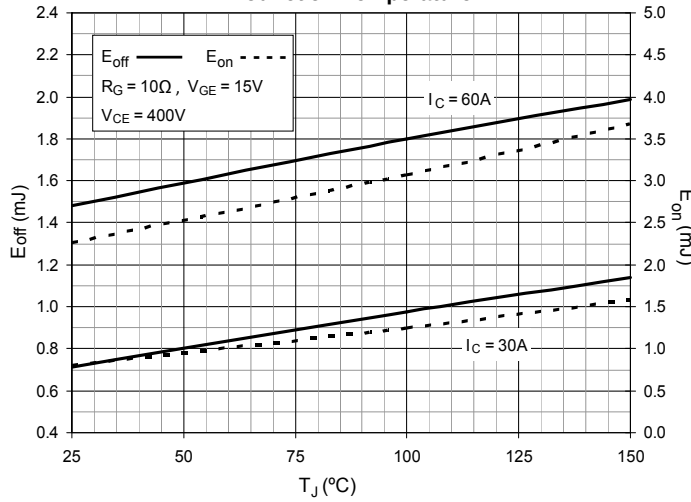


Fig. 16. Inductive Turn-off Switching Times vs. Gate Resistance

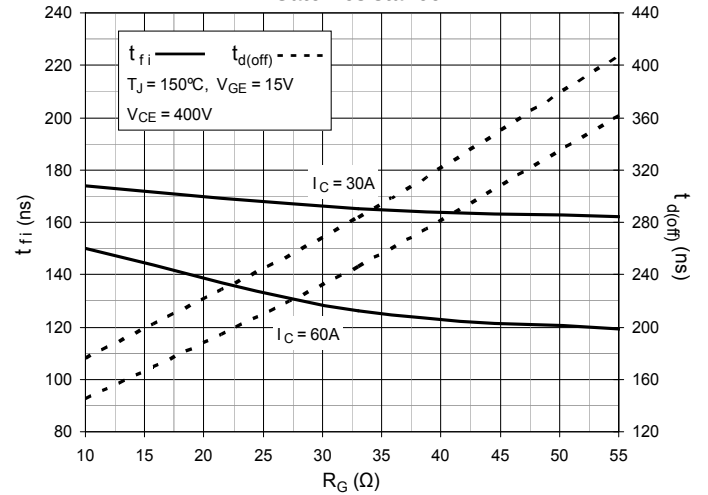


Fig. 17. Inductive Turn-off Switching Times vs. Collector Current

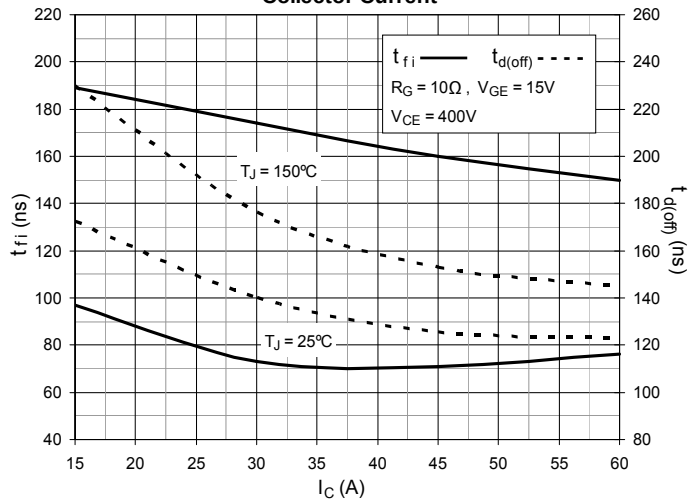


Fig. 18. Inductive Turn-off Switching Times vs. Junction Temperature

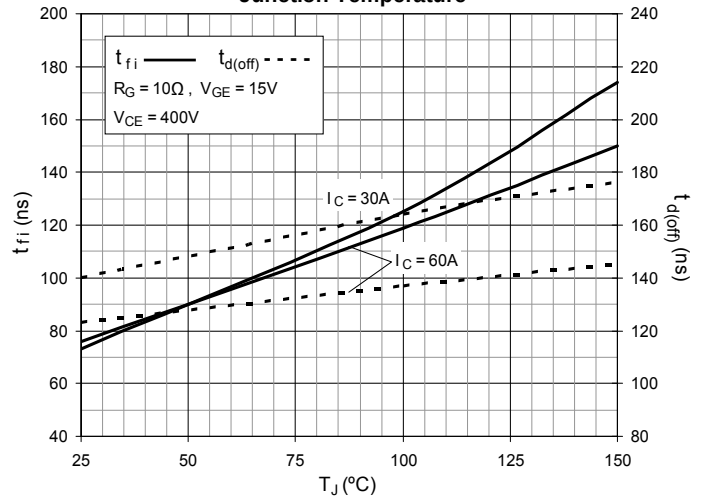


Fig. 19. Inductive Turn-on Switching Times vs. Gate Resistance

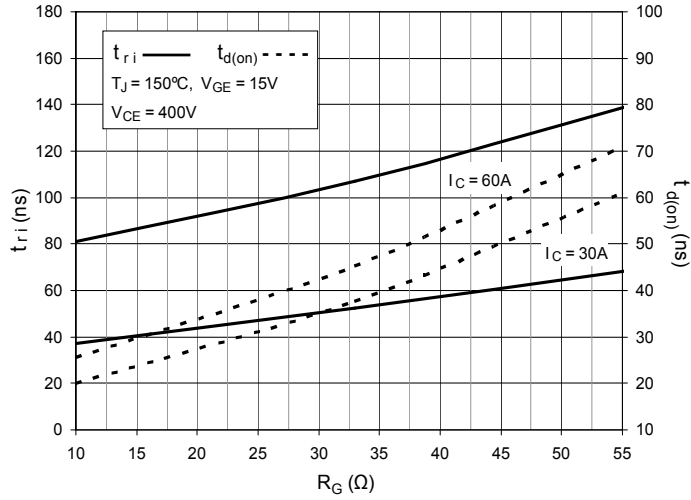


Fig. 20. Inductive Turn-on Switching Times vs. Collector Current

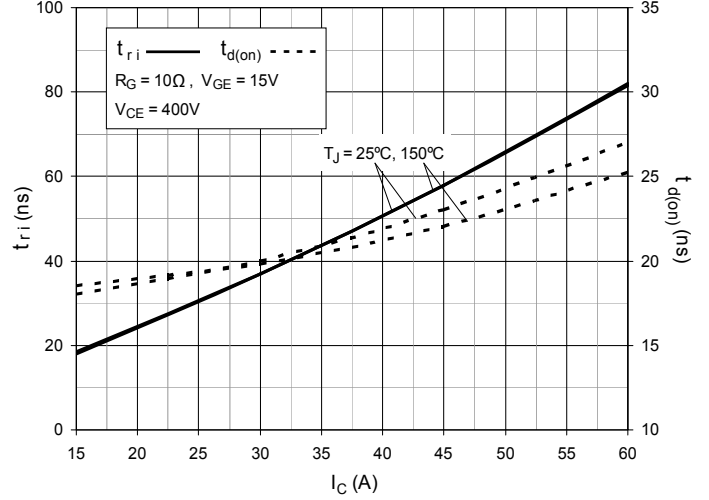


Fig. 21. Inductive Turn-on Switching Times vs. Junction Temperature

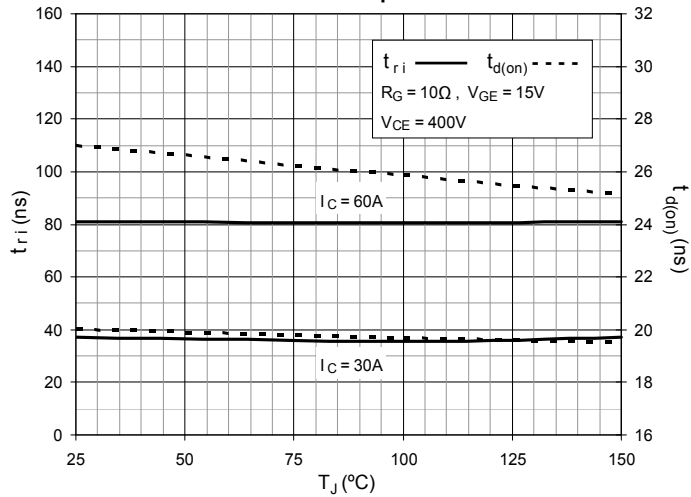


Fig. 22. Diode Forward Characteristics

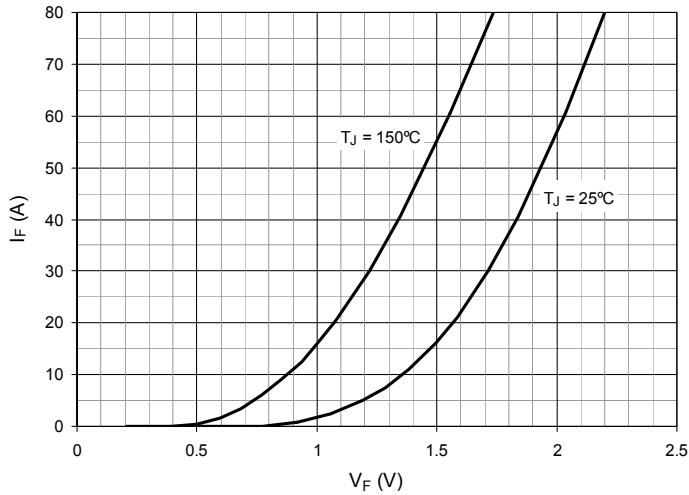


Fig. 23. Reverse Recovery Charge vs. $-di_F/dt$

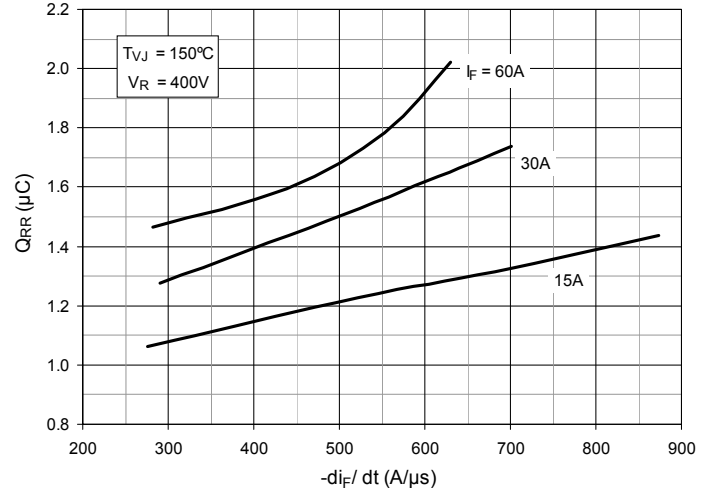


Fig. 24. Reverse Recovery Current vs. $-di_F/dt$

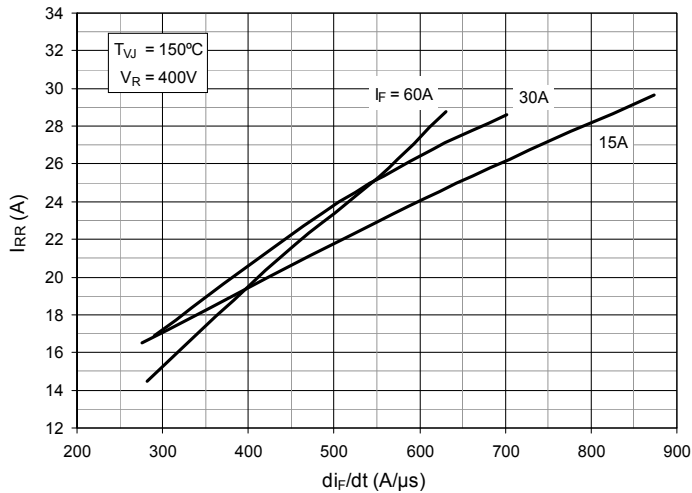


Fig. 25. Reverse Recovery Time vs. $-di_F/dt$

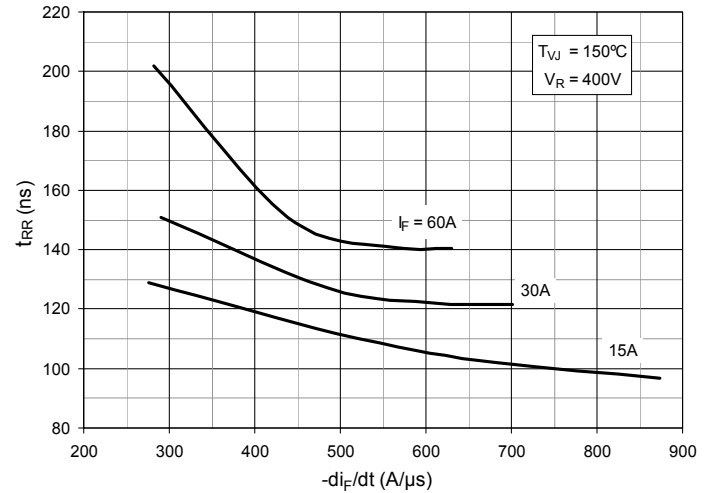


Fig. 26. Dynamic Parameters Q_{RR} , I_{RR} vs. Junction Temperature

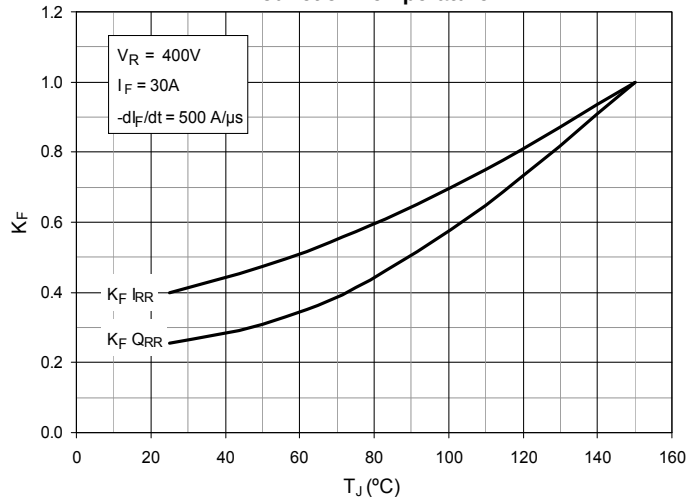


Fig. 27. Maximum Transient Thermal Impedance (Diode)

