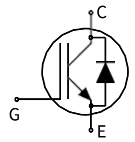
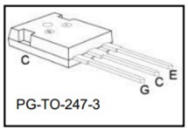
英飞凌低损耗 DuoPack： 第二代 IGBT TRENCHSTOP™

软、快速恢复的反并联发射级控制 HE 二极管





- 行业领先 TO247
- 短路耐受时间–10µs
- 设计用于：
  - 变频器
  - 不间断电源
- 适用于 1200 V 应用的第二代TRENCHSTOP™ 具有以下特点：
  - 参数分布紧密
  - 高稳健性、温度稳定性
- 由于 $V_{CE(sat)}$ 具有正温度系数，因此易于并联
- 低电磁干扰
- 低栅极电荷
- 非常软、快速恢复的反并联发射级控制 HE 二极管
- 符合 JEDEC[1]目标应用要求
- 无铅镀层；符合RoHS标准
- 完整的产品品类和 PSpice 模型： http://www.infineon.com/igbt/

Type	V_{CE}	I_C	$V_{CE(sat),Tj=25°C}$	$T_{j,max}$	Marking Code	Package
IKW40N120T2	1200V	40A	1.75V	175°C	K40T1202	PG-TO-247-3

最大额定值

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	1200	V
DC collector current (T_j=150°C) T_C = 25°C T_C = 110°C	I_C	 75[2] 40	A
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	160	
Turn off safe operating area V_{CE} ≤ 1200V, T_j ≤ 175°C	-	160	
DC Diode forward current (T_j=150°C) T_C = 25°C T_C = 110°C	I_F	 75[2] 40	
Diode pulsed current, t_p limited by T_{jmax}	I_{Fpuls}	160	
Gate-emitter voltage	V_{GE}	±20	V
Short circuit withstand time[3] V_{GE} = 15V, V_{CC} ≤ 600V, $T_{j,start}$ ≤ 175°C	t_{SC}	10	µs
Power dissipation T_C = 25°C	P_{tot}	480	W
Operating junction temperature	T_j	-40...+175	°C
Storage temperature	T_{stg}	-55...+150	
Soldering temperature, 1.6mm (0.063 in.) from case for 10s Wavesoldering only, temperature on leads only	-	260	

[1]J-STD-020 and JESD-022
[2]受键合线限制
[3]允许短路次数低于1000次；短路间隔时间大于1S。

本数据手册的原文使用英文撰写。为方便起见，英飞凌提供了译文；由于翻译过程中可能使用了自动化工具，英飞凌不保证译文的准确性。为确认准确性，请务必访问 infineon.com 参考最新的英文版本（控制文档）。

热阻抗

Parameter	Symbol	Conditions	Max. Value	Unit
特性				
IGBT thermal resistance, junction – case	R_{thJC}		0.31	K/W
Diode thermal resistance, junction – case	R_{thJCD}		0.53	
Thermal resistance, junction – ambient	R_{thJA}		40	

电气特性， 除非另有规定，否则均为 T_j=25 °C°

Parameter	Symbol	Conditions	Value min.	Value typ.	Value max.	Unit
静态特性						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	V_{GE} = 0 V, I_C=500 μ A	1200	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	V_{GE} = 15 V, I_C = 40 A				
		T_j = 25 °C	-	1.75	2.2	
		T_j =150 °C	-	2.25	-	
		T_j =175 °C	-	2.3	-	
Diode forward voltage	V_F	V_{GE} = 0 V, I_F = 40 A				
		T_j = 25 °C	-	1.75	2.2	
		T_j =150 °C	-	1.80	-	
		T_j =175 °C	-	1.80	-	
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 1.5 mA, V_{CE} = V_{GE}	5.2	5.8	6.4	
Zero gate voltage collector current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V				mA
		T_j = 25 °C	-	-	0.4	
		T_j = 150 °C	-	-	4.0	
		T_j =175 °C	-	-	20	
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V	-	-	200	nA
Transconductance	g_{fs}	V_{CE} = 20 V, I_C = 40 A	-	21	-	S

动态特性

Input capacitance	C_{iss}	V_{CE} = 25 V,	-	2360	-	pF
Output capacitance	C_{oss}	V_{GE} = 0 V,	-	230	-	
Reverse transfer capacitance	C_{rss}	f = 1 MHz	-	125	-	
Gate charge	Q_{Gate}	V_{CC} = 960 V, I_C = 40 A V_{GE} = 15 V	-	192	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	13	-	nH
Short circuit collector current[1]	$I_{C(SC)}$	V_{GE} = 15 V, $t_{SC} \le$ 10 µs V_{CC} = 600 V, $T_{j,start}$ = 25 °C $T_{j,start}$ = 175 °C	-	 220 156	-	A

开关特性，电感负载，T_j = 25 °C

Parameter	Symbol	Conditions	Value min.	Value typ.	Value max.	Unit
IGBT特性						
Turn-on delay time	$t_{d(on)}$	T_j = 25 °C, V_{CC} = 600 V, I_C = 40 A, V_{GE} = 0 / 15 V, R_G = 12 Ω, L_σ[2] = 80 n H, C_σ[2] = 67 pF Energy losses include "tail" and diode reverse recovery.	-	33	-	ns
Rise time	t_r		-	28	-	
Turn-off delay time	$t_{d(off)}$		-	314	-	
Fall time	t_f		-	94	-	
Turn-on energy	E_{on}		-	3.2	-	mJ
Turn-off energy	E_{off}		-	2.05	-	
Total switching energy	E_{ts}		-	5.25	-	
反并联二极管特性						
Diode reverse recovery time	t_{rr}	T_j = 25 °C, V_R = 600 V, I_F = 40 A, di_F/dt = 950 A/ µs	-	285	-	ns
Diode reverse recovery charge	Q_{rr}		-	3.3		µC
Diode peak reverse recovery current	I_{rrm}		-	23		A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	350	-	A/µs

[1] 允许短路次数低于1000次；短路间隔时间大于1S。

[2] 图E中动态测试电路产生的漏电感L_σ和杂散电容C_σ。

开关特性，电感负载， T_j = 175 °C

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT特性						
Turn-on delay time	$t_{d(on)}$	T_j = 175 °C V_{CC} = 600 V, I_C = 40 A, V_{GE} = 0 / 15 V, R_G = 12 Ω , L_σ[1] = 180 n H, C_σ[1] = 67 pF Energy losses include “tail” and diode reverse recovery.	-	32	-	ns
Rise time	t_r		-	28	-	
Turn-off delay time	$t_{d(off)}$		-	405	-	
Fall time	t_f		-	195	-	
Turn-on energy	E_{on}		-	4.5	-	mJ
Turn-off energy	E_{off}		-	3.8	-	
Total switching energy	E_{ts}		-	8.3	-	
反并联二极管特性						
Diode reverse recovery time	t_{rr}	T_j=175 °C V_R = 600 V, I_F = 40 A, di_F/dt = 950 A/ µs	-	480	-	ns
Diode reverse recovery charge	Q_{rr}		-	6.6	-	µC
Diode peak reverse recovery current	I_{rrm}		-	31	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	200		A/µs

[1] 图 E中的动态测试电路引起的漏电感L_σ和杂散电容C_σ。

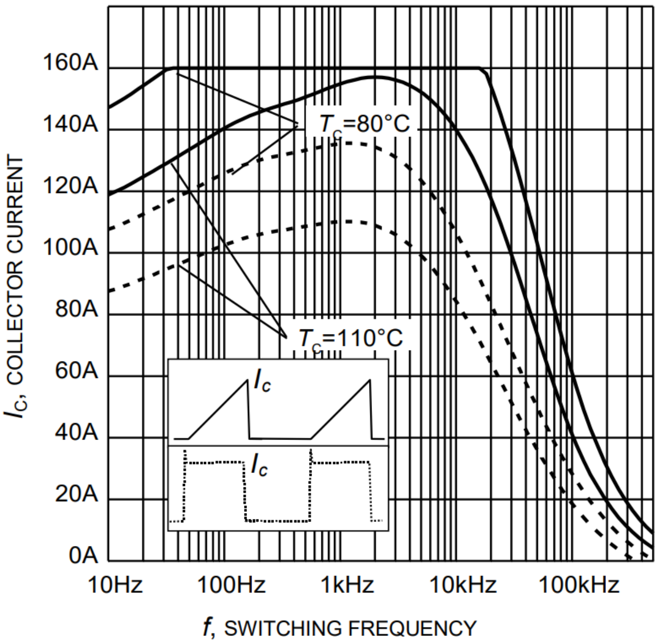


Figure 1. Collector current as a function of switching frequency
($T_j \leq 175°C$, $D = 0.5$, $V_{CE} = 600V$, $V_{GE} = 0/+15V$, $R_G = 12\Omega$)

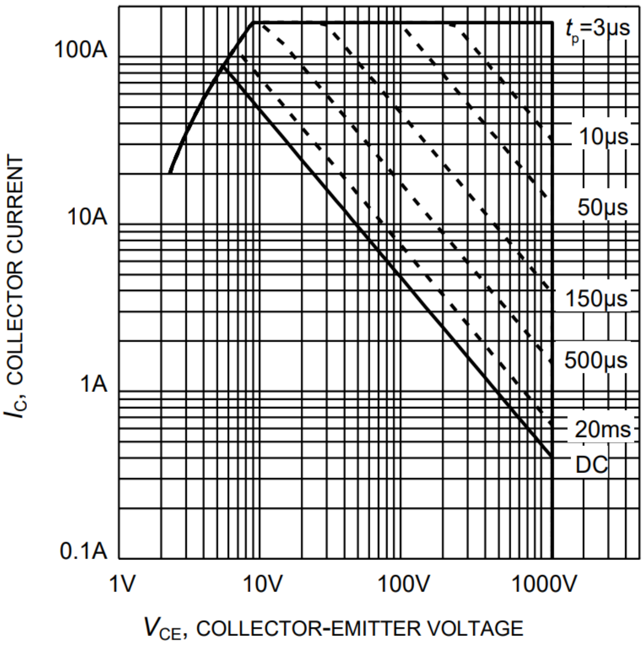


Figure 2. Safe operating area
($D = 0$, $T_C = 25°C$, $T_j \leq 175°C$; V_{GE}=15V)

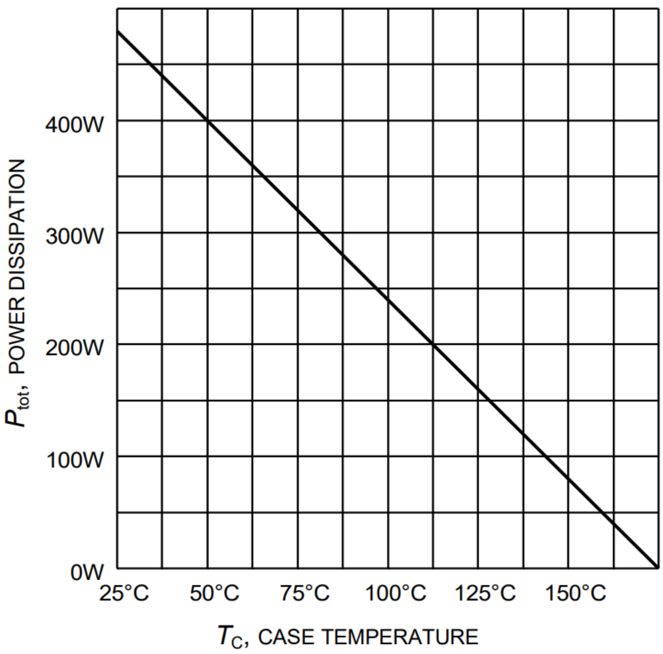


Figure 3. Maximum power dissipation as a function of case temperature
($T_j \leq 175°C$)

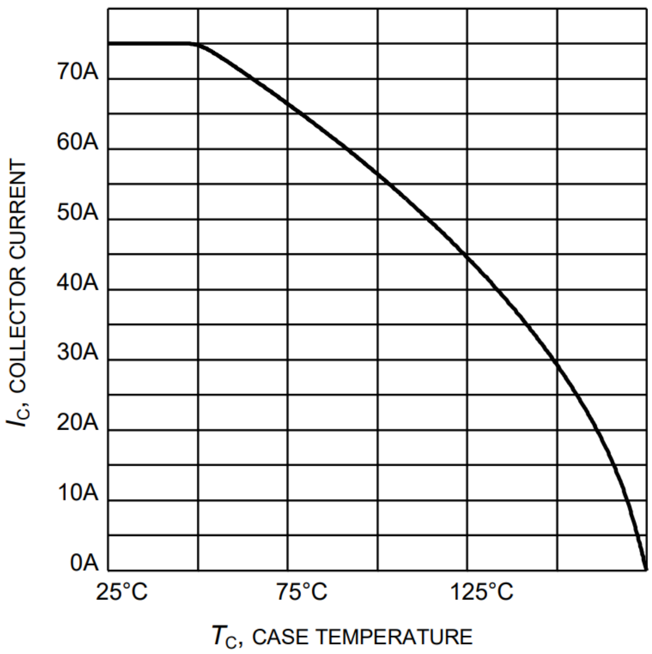


Figure 4. Maximum collector current as a function of case temperature
($V_{GE} \geq 15V$, $T_j \leq 175°C$)

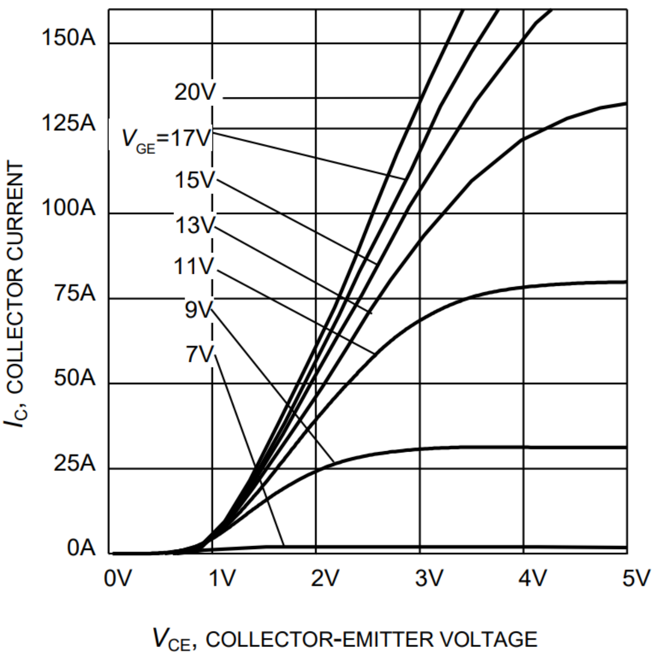


Figure 5. Typical output characteristic
(T_j = 25°C)

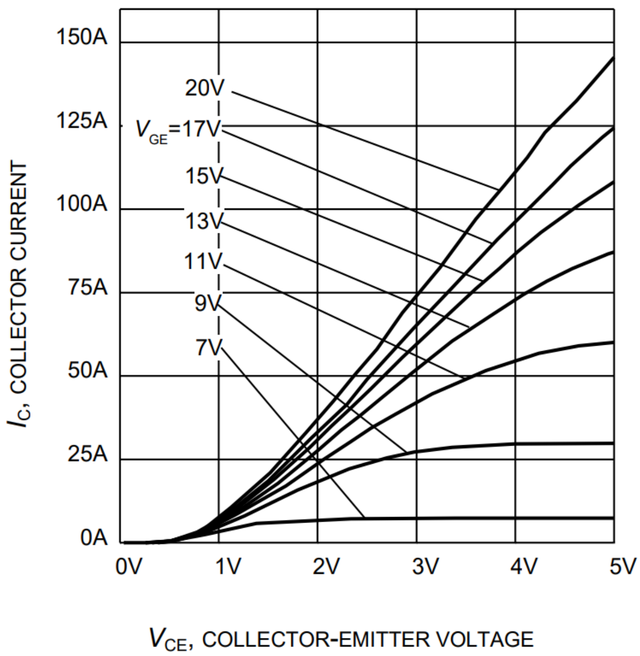


Figure 6. Typical output characteristic
(T_j = 175°C)

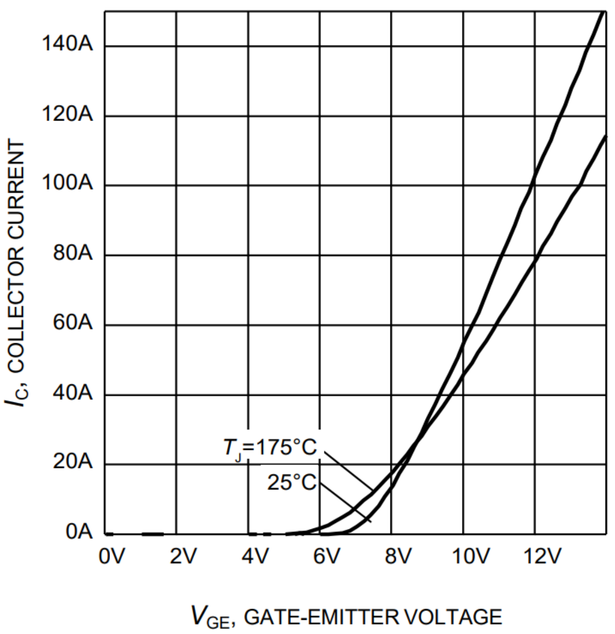


Figure 7. Typical transfer characteristic
(V_{CE}=20V)

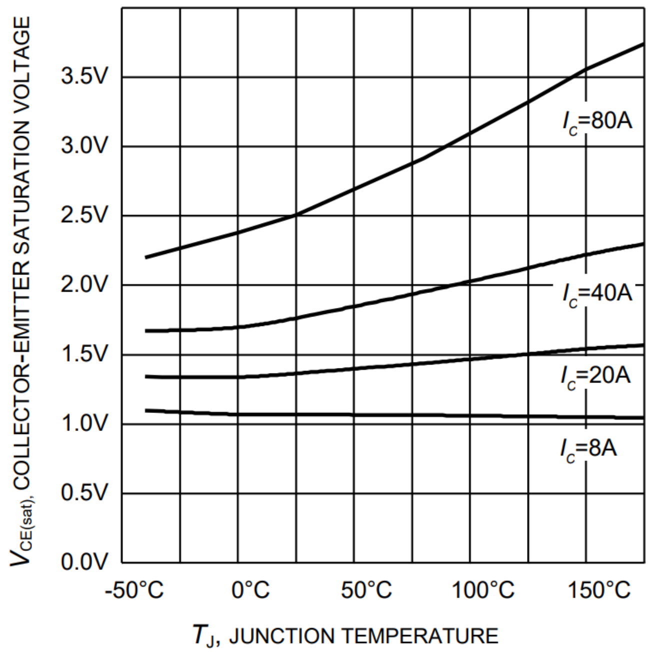


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
(V_{GE} = 15V)

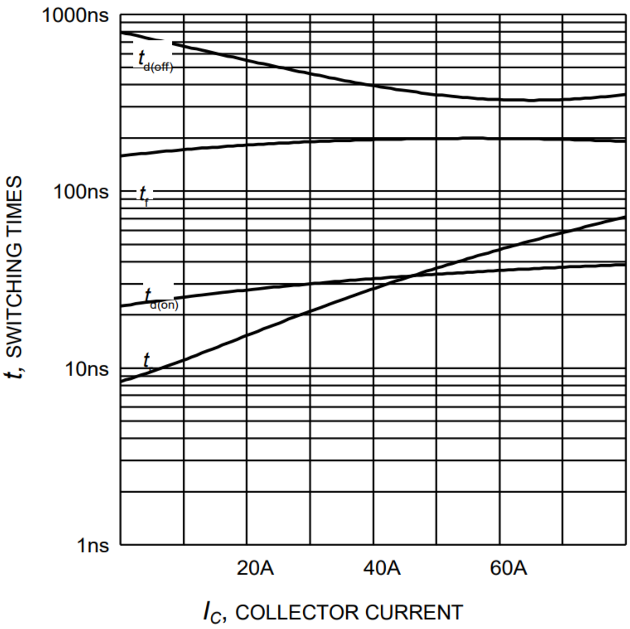


Figure 9. Typical switching times as a function of collector current
(inductive load, T_J=175°C, V_{CE}=600V, V_{GE}=0/15V, R_G=12Ω, Dynamic test circuit in Figure E)

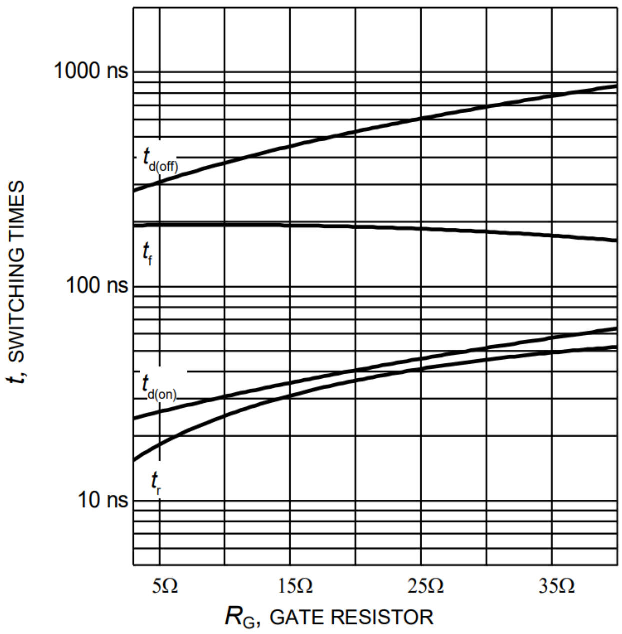


Figure 10. Typical switching times as a function of gate resistor
(inductive load, T_J=175°C, V_{CE}=600V, V_{GE}=0/15V, I_C=40A, Dynamic test circuit in Figure E)

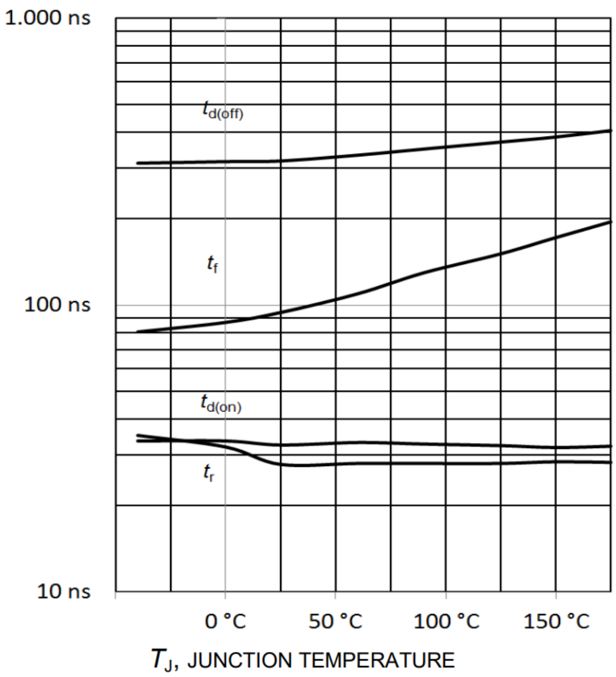


Figure 11. Typical switching times as a function of junction temperature
(inductive load, V_{CE}=600V, V_{GE}=0/15V, I_C=40A, R_G=12Ω, Dynamic test circuit in Figure E)

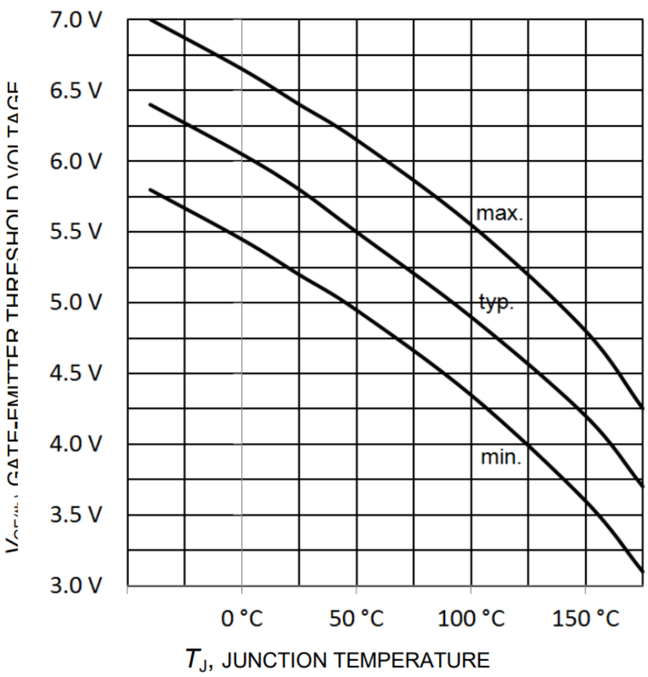


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
(I_C = 1.5mA)

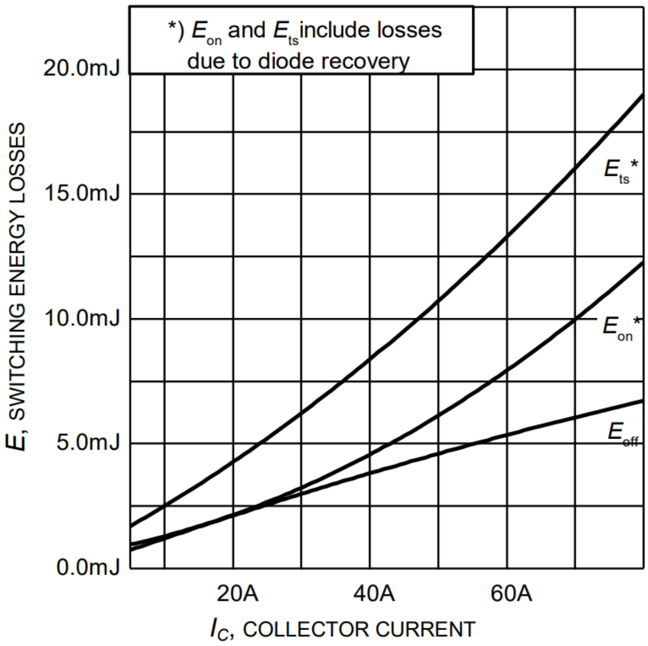


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, T_J=175°C, V_{CE}=600V, V_{GE}=0/15V, R_G=12Ω, Dynamic test circuit in Figure E)

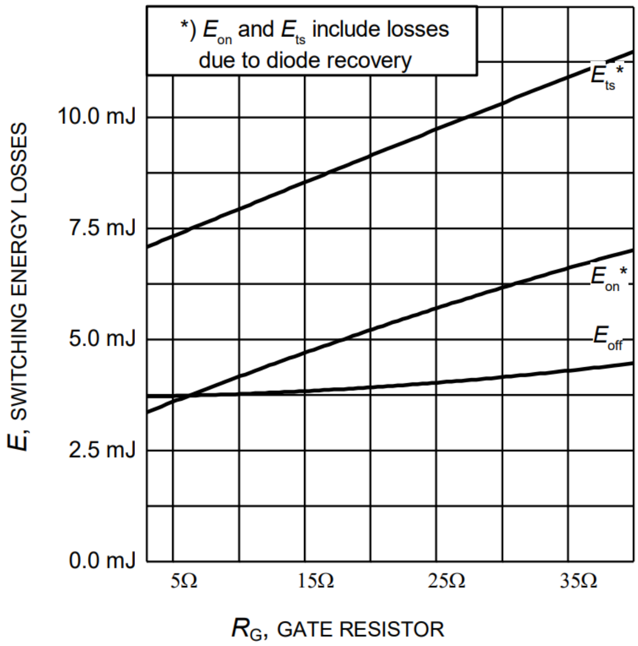


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, T_J=175°C, V_{CE}=600V, V_{GE}=0/15V, I_C=40A, Dynamic test circuit in Figure E)

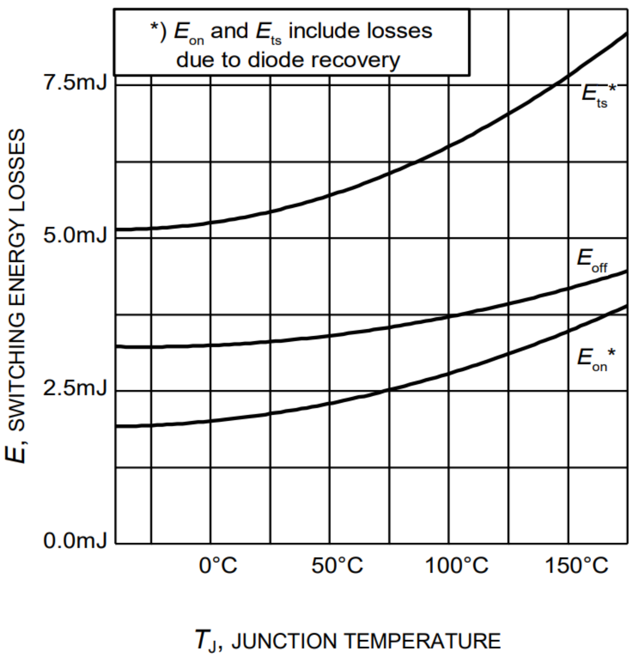


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, V_{CE}=600V, V_{GE}=0/15V, I_C=40A, R_G=12Ω, Dynamic test circuit in Figure E)

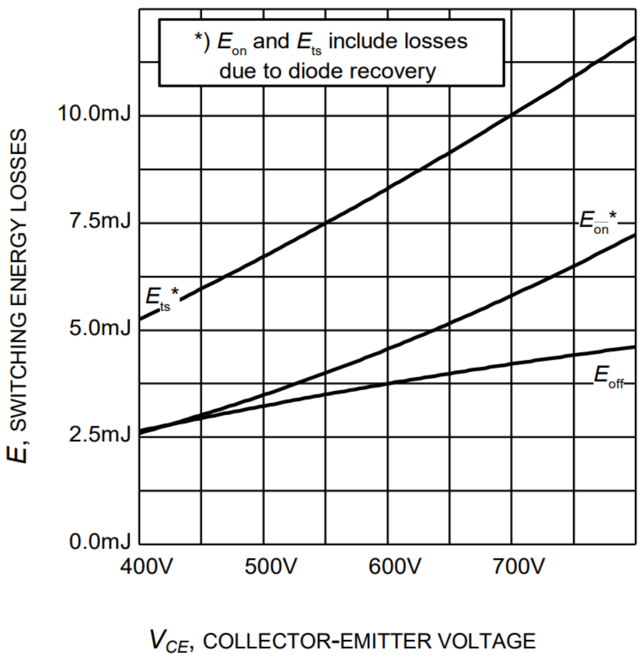


Figure 16. Typical switching energy losses as a function of collector emitter voltage
(inductive load, T_J=175°C, V_{GE}=0/15V, I_C=40A, R_G=12Ω, Dynamic test circuit in Figure E)

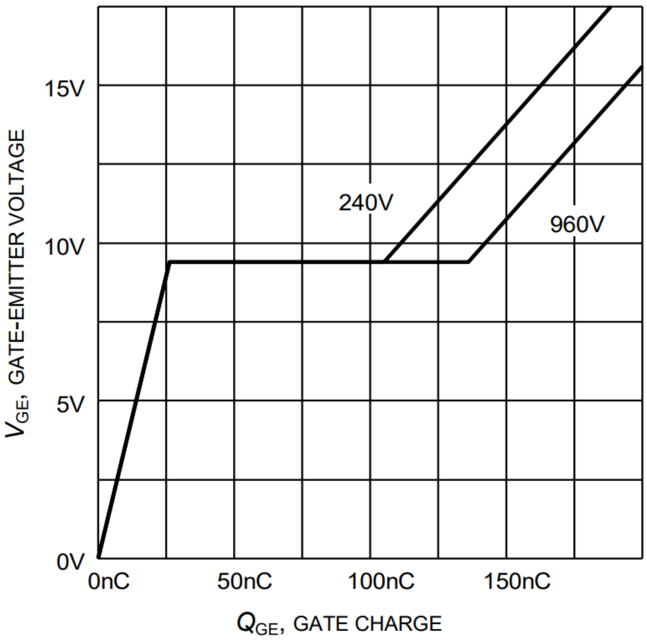


Figure 17. Typical gate charge
(I_C=40 A)

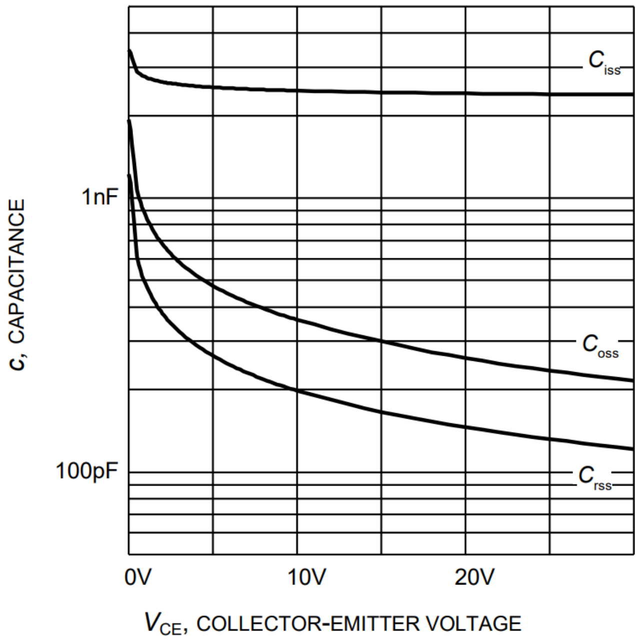


Figure 18. Typical capacitance as a function of collector-emitter voltage
(V_{GE}=0V, f = 1 MHz)

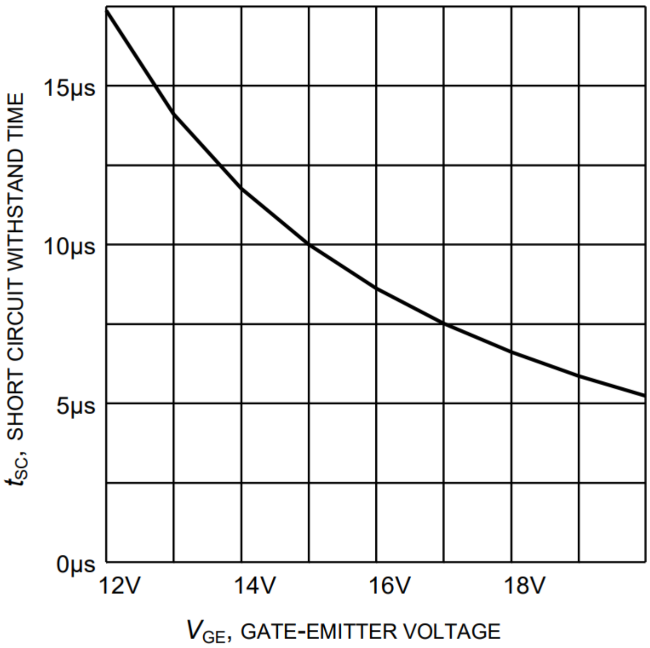


Figure 19. Short circuit withstand time as a function of gate-emitter voltage
(V_{CE}=600V, start at $T_J \leq$ 175°C)

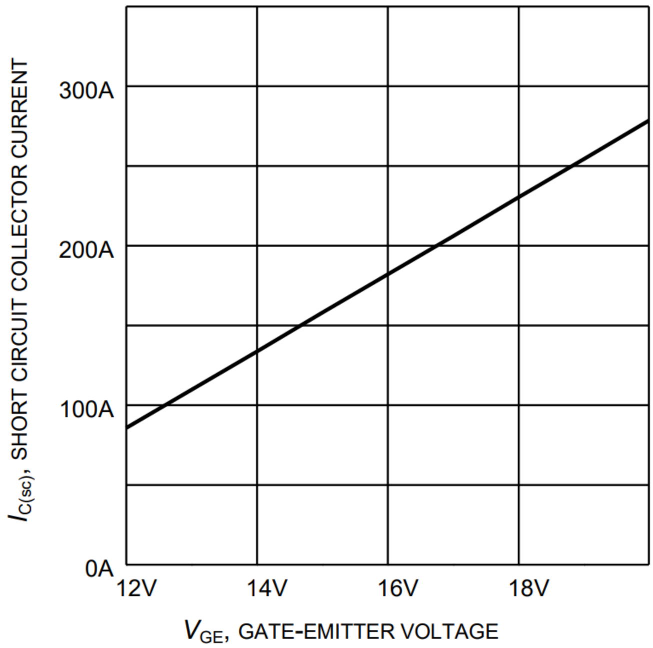


Figure 20. Typical short circuit collector current as a function of gate-emitter voltage
($V_{CE} \leq$ 600V, $T_{j,start}$ = 175°C)

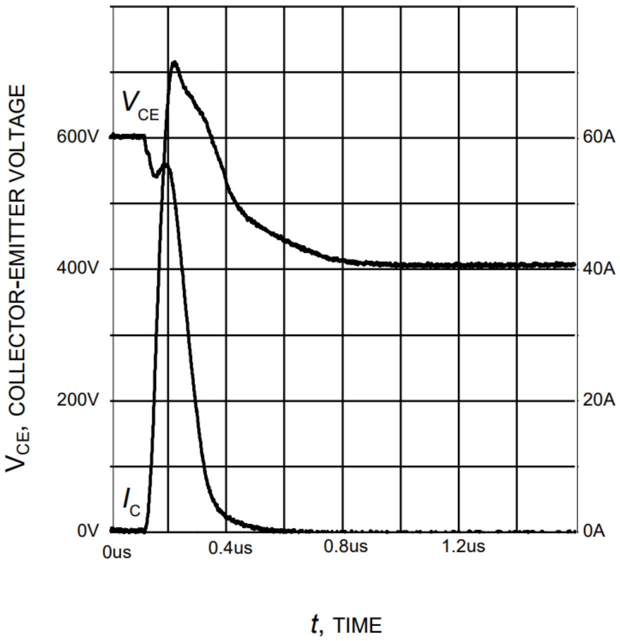


Figure 21. Typical turn on behavior
(V_{GE}=0/15V, R_G=12Ω, T_j = 175°C, Dynamic test circuit in Figure E)

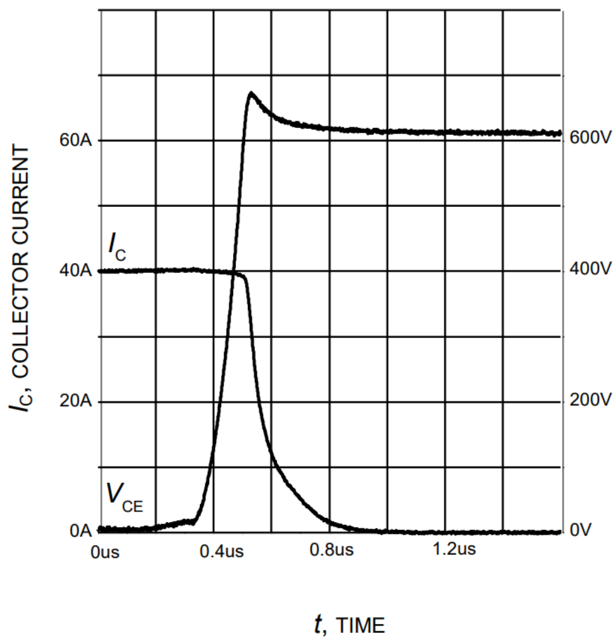


Figure 22. Typical turn off behavior
(V_{GE}=15/0V, R_G=12Ω, T_j = 175°C, Dynamic test circuit in Figure E)

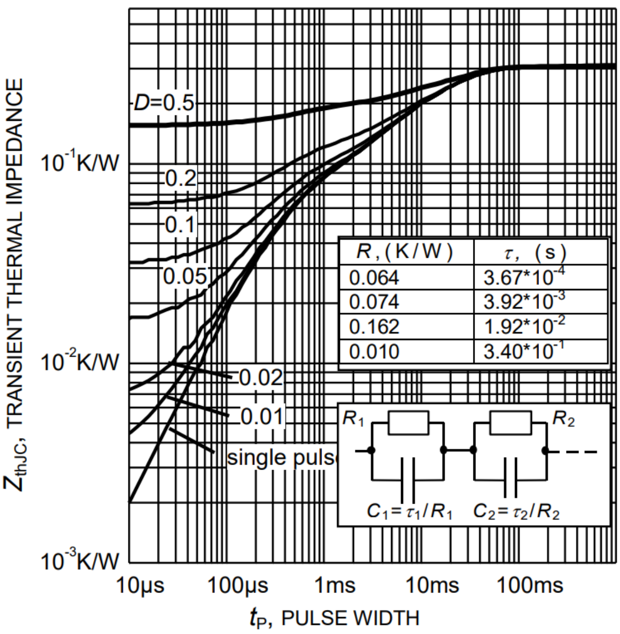


Figure 23. IGBT transient thermal impedance
($D = t_p / T$)

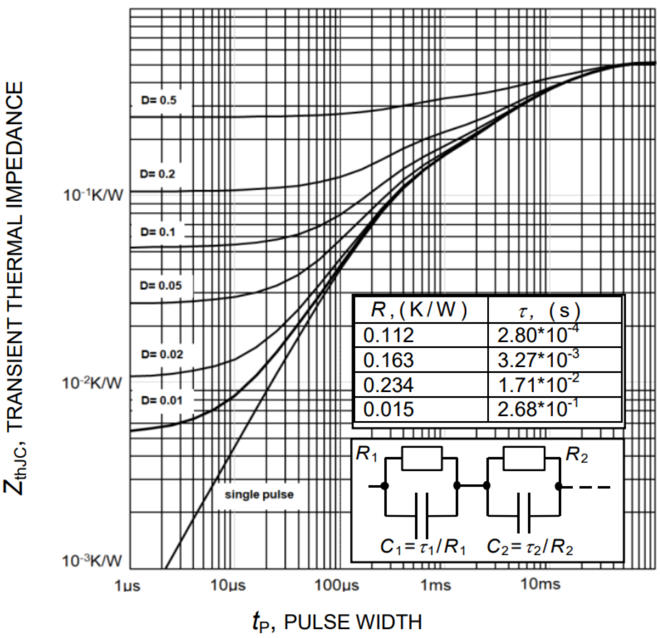


Figure 24. Diode transient thermal impedance as a function of pulse width
($D=t_P/T$)

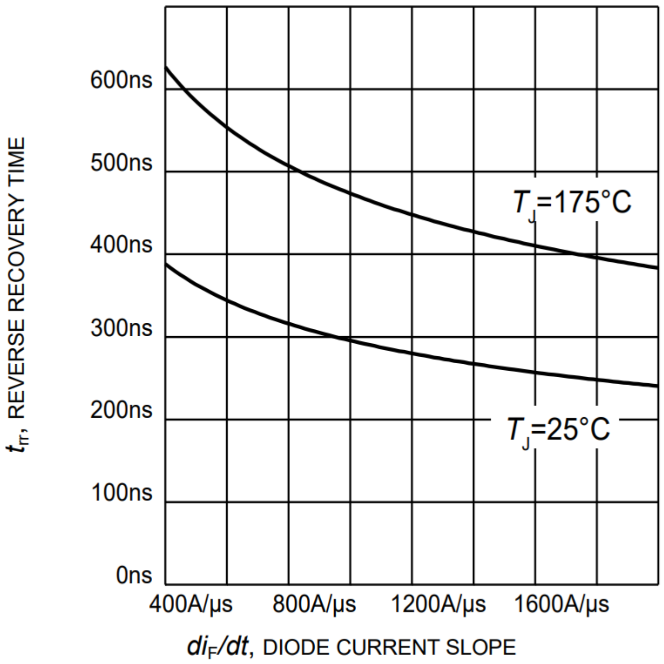


Figure 23. Typical reverse recovery time as a function of diode current slope
(V_R=600V, I_F=40A,
Dynamic test circuit in Figure E)

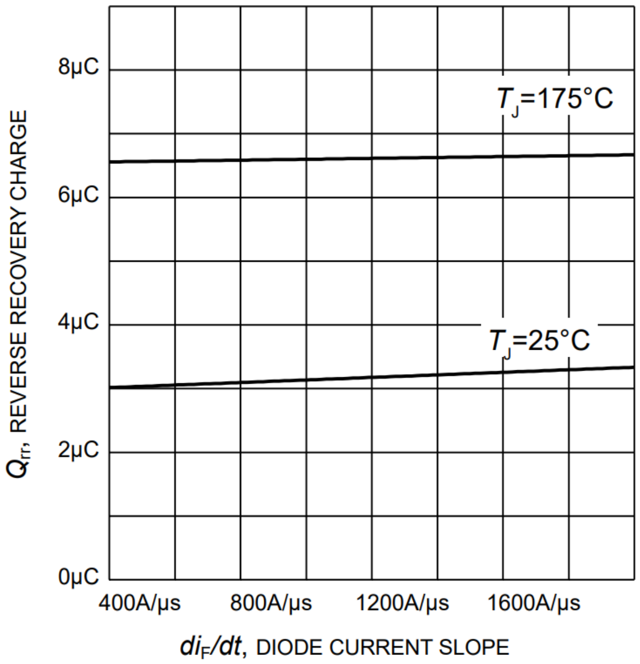


Figure 24. Typical reverse recovery charge as a function of diode current slope
(V_R=600V, I_F=40A,
Dynamic test circuit in Figure E)

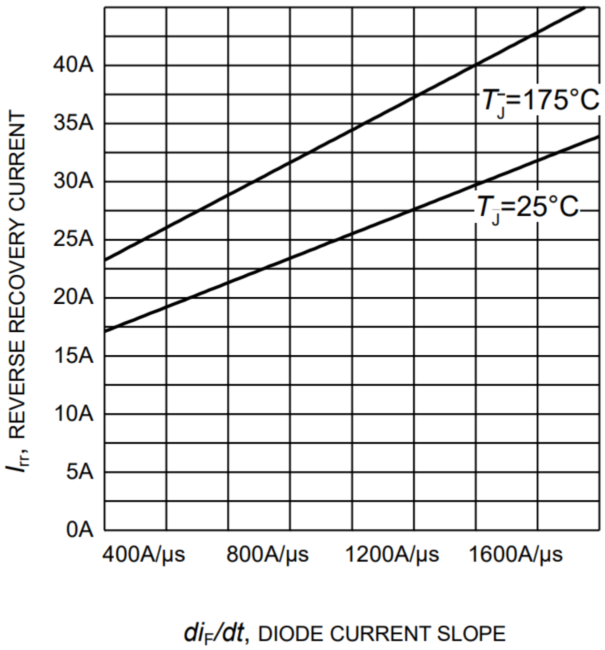


Figure 25. Typical reverse recovery current as a function of diode current slope
(V_R=600V, I_F=40A,
Dynamic test circuit in Figure E)

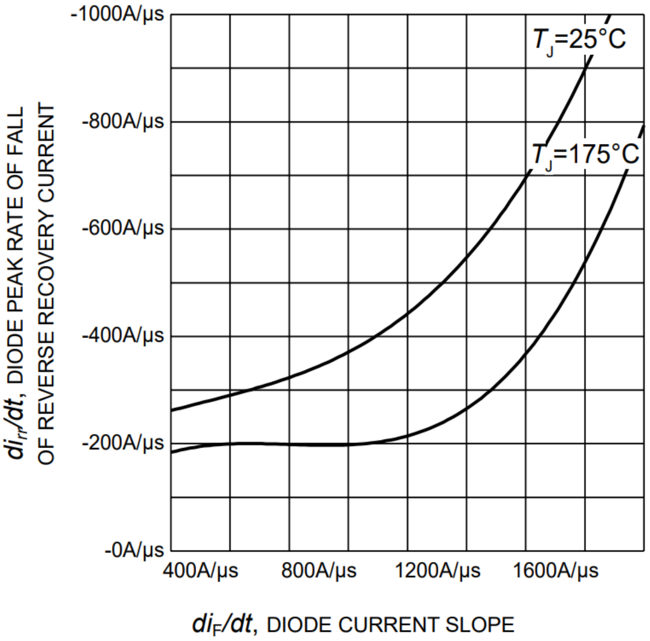


Figure 26. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope
(V_R=600V, I_F=40A,
Dynamic test circuit in Figure E)

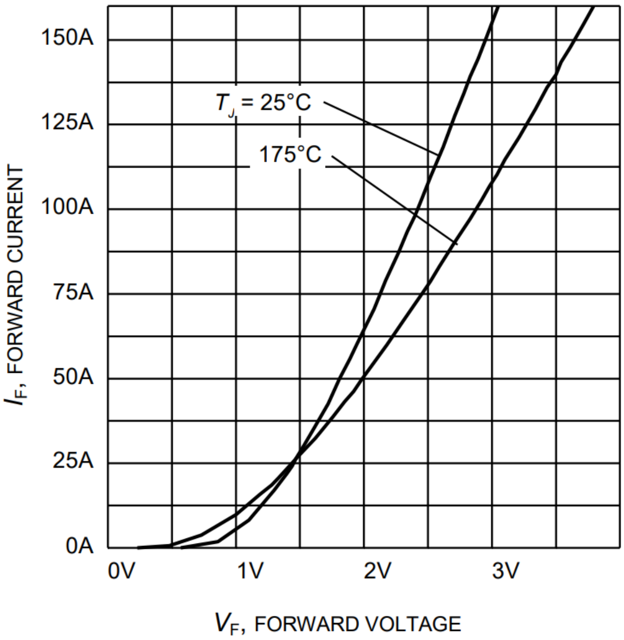


Figure 27. Typical diode forward current as a function of forward voltage

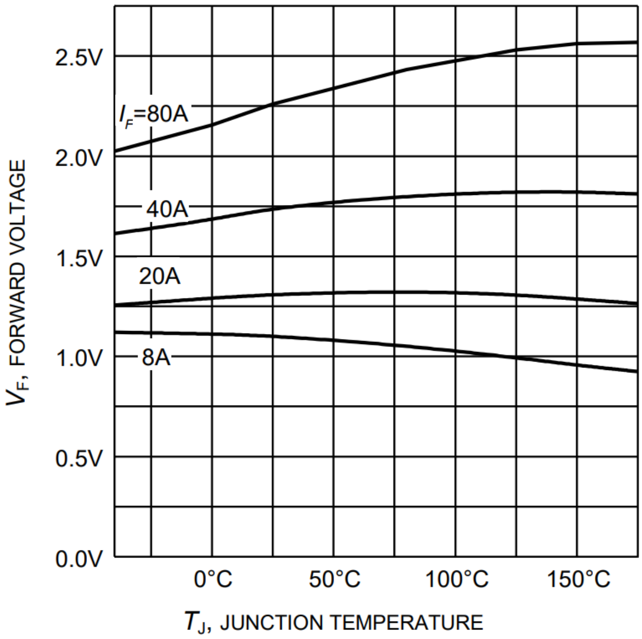
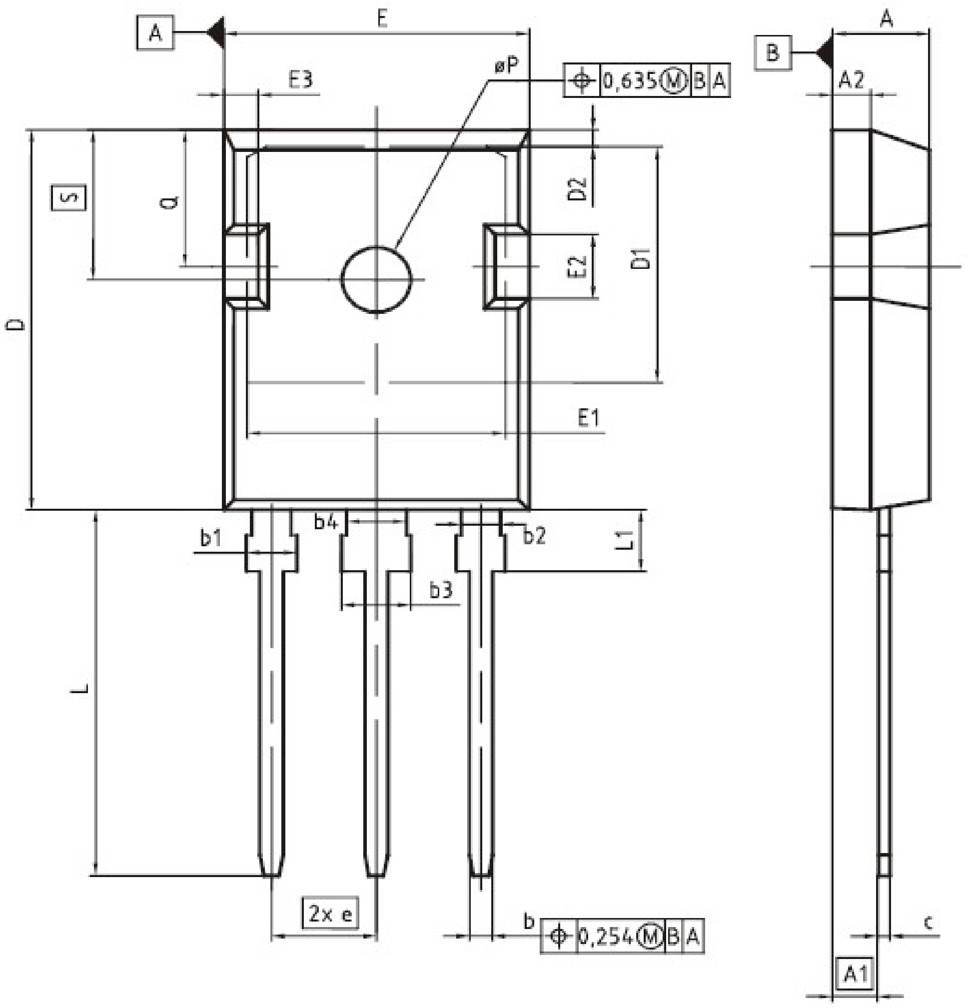


Figure 28. Typical diode forward voltage as a function of junction temperature

PG-TO247-3



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	0.190	0.205
A1	2.27	2.54	0.089	0.100
A2	1.85	2.16	0.073	0.085
b	1.07	1.33	0.042	0.052
b1	1.90	2.41	0.075	0.095
b2	1.90	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c	0.55	0.68	0.022	0.027
D	20.80	21.10	0.819	0.831
D1	16.25	17.65	0.640	0.695
D2	0.95	1.35	0.037	0.053
E	15.70	16.13	0.618	0.635
E1	13.10	14.15	0.516	0.557
E2	3.68	5.10	0.145	0.201
E3	1.00	2.60	0.039	0.102
e	5.44 (BSC)		0.214 (BSC)	
N	3		3	
L	19.80	20.32	0.780	0.800
L1	4.10	4.47	0.161	0.176
øP	3.50	3.70	0.138	0.146
Q	5.49	6.00	0.216	0.236
S	6.04	6.30	0.238	0.248

DOCUMENT NO.
Z8B00003327

SCALE
0 5 7.5mm

EUROPEAN PROJECTION

ISSUE DATE
09-07-2010

REVISION
05

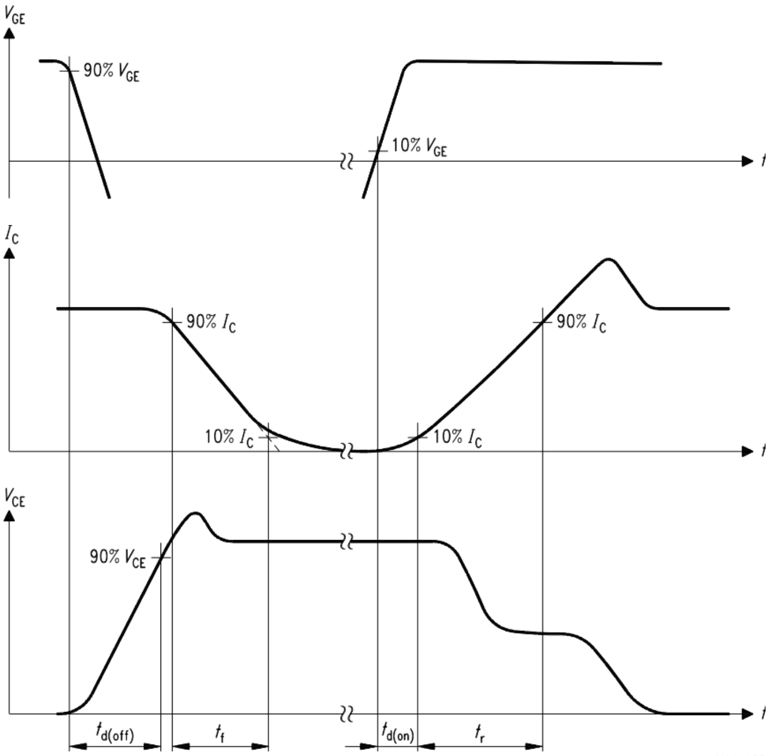


Figure A. Definition of switching times

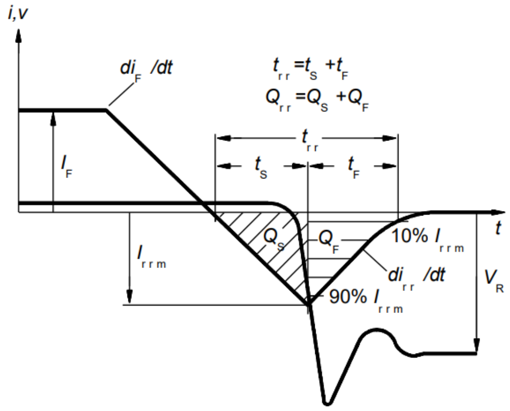


Figure C. Definition of diodes switching characteristics

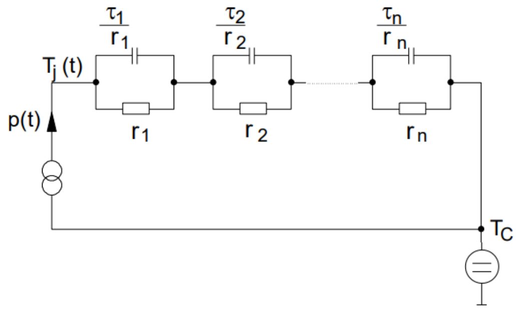


Figure D. Thermal equivalent circuit

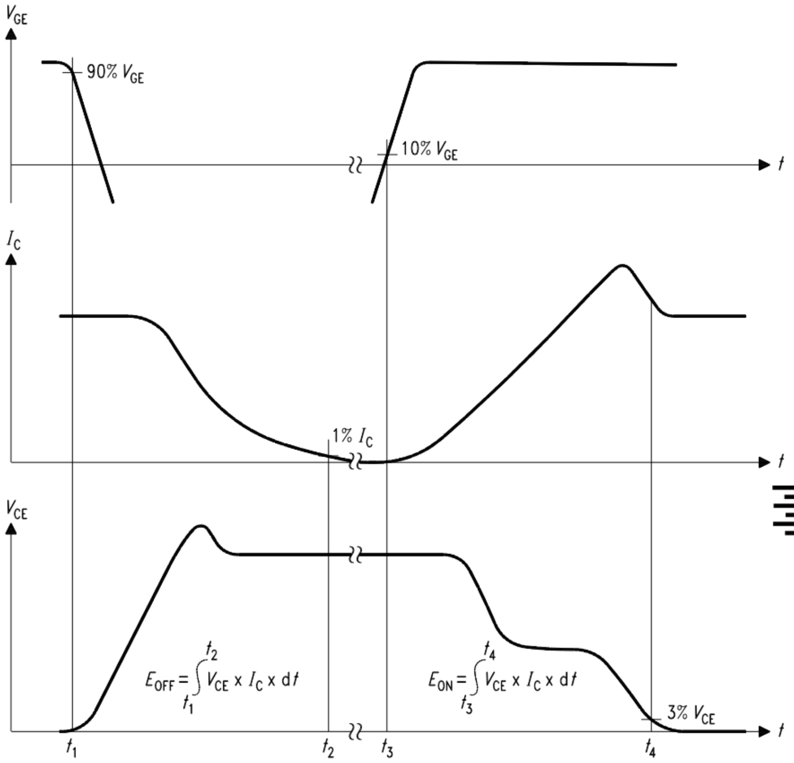


Figure B. Definition of switching losses

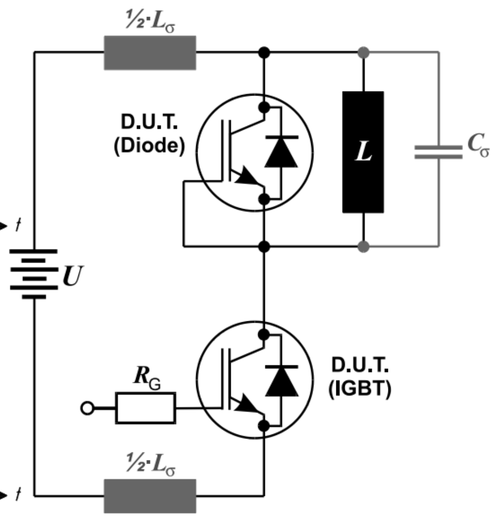


Figure E. Dynamic test circuit

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