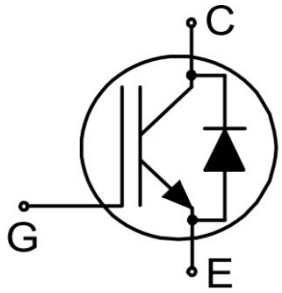
英飞凌 IKFW50N60DH3E

TRENCHSTOP™ 高级绝缘技术

英飞凌高速开关系列第三代 IGBT，与 Rapid 1 快速软反并联二极管集成于完全隔离的封装中



全隔离封装 TO-247

特性：

英飞凌 TRENCHSTOP™ 技术提供：
- 在 T_{vj} = 175°C 时，短路耐受时间为 5µs
- $V_{CE(sat)}$ 正温度系数
- 低电磁干扰
- 极软快速恢复的反并联二极管
- 最高结温 175°C
- 2500 V_{RMS} 电气隔离，50/60 Hz，t = 1 min
- 100%经过测试的隔离安装面
- 无铅引脚镀层；符合 RoHS 标准
- 完整的产品品类和 PSpice 模型：
http://www.infineon.com/igbt/

潜在应用：

- 空调 PFC
- 通用驱动器（GPD）
- 伺服驱动器

产品验证

符合JEDEC47/20/22相关测试的工业应用要求

关键性能和封装参数

Type	V_{CE}	I_C	V_{CEsat}, T_{vj}=25°C	T_{vjmax}	Marking	Package
IKFW50N60DH3E	600V	40A	2.2V	175°C	K50DDH3E	PG-TO247-3-AI

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）。

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TRENCHSTOP™ 5 高级绝缘技术

最大额定值

注意：为了获得最佳的使用寿命和可靠性，英飞凌建议运行条件不超过本数据手册中所述最大额定值的 80%。

Parameter	Symbol	Value	Unit
Collector-emitter voltage, $T_{vj} \geq 25°C$	V_{CE}	600	V
DC collector current, limited by T_{vjmax} $T_h = 25°C$ value limited by bondwire $T_h = 65°C$ $T_h = 65°C$	I_C	40.0 37.0 60.0[1]	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	120.0	A
Turn off safe operating area $V_{CE} \leq 600V$, $T_{vj} \leq 175°C$, $t_p = 1\mu s$	-	120.0	A
Diode forward current, limited by T_{vjmax} $T_h = 25°C$ value limited by bondwire $T_h = 65°C$	I_F	40.0 29.0	A
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpuls}	120.0	A
Gate-emitter voltage Transient Gate-emitter voltage ($t_p \leq 10\mu s$, $D < 0.010$)	V_{GE}	±20 ±30	V
Short circuit withstand time $V_{GE} = 15.0V$, $V_{CC} \leq 400V$ Allowed number of short circuits < 1000 Time between short circuits: ≥ 1.0s $T_{vj} = 150°C$	t_{SC}	5	µs
Power dissipation $T_h = 25°C$ Power dissipation $T_h = 65°C$	P_{tot}	130.0 95.0	W
Operating junction temperature	T_{vj}	-40...+175	°C
Storage temperature	T_{stg}	-55...+150	°C
Soldering temperature, wave soldering 1.6mm (0.063in.) from case for 10s		260	°C
Mounting torque, M3 screw Maximum of mounting processes: 3	M	0.6	Nm
Isolation voltage RMS, $f = 50/60Hz$, $t = 1min$[2]	V_{isol}	2500	V

热阻

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
R_{th} Characteristics						
IGBT thermal resistance,[3] junction - heatsink	$R_{th(j-h)}$		-	0.98	1.15	K/W
Diode thermal resistance,[3] junction - heatsink	$R_{th(j-h)}$		-	1.96	2.16	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		-	-	65	K/W

[1] TO-247-3 在 $T_h = 65°C$ 时的等效额定电流，采用参考绝缘材料：152µm、0.9 W/mK、标准聚酰亚胺基增强载体绝缘体
[2] 有关在应用中正确处理和组装高级绝缘器件的信息，请参阅封装图中的注释。
[3] 作用于本体的力 F = 500N，$T_a = 25°C$

电气特性，测于 T_{vj}= 25°C 的条件下，除非另有规定

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Static Characteristic						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	V_{GE} = 0V, I_C = 0.50mA	600	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	V_{GE} = 15.0V, I_C = 40.0A T_{vj} = 25°C T_{vj} = 175°C	- -	2.20 2.80	2.70 -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 20.0A T_{vj} = 25°C T_{vj} = 175°C	- -	1.50 1.45	1.90 -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 0.43mA, V_{CE} = V_{GE}	4.1	5.1	5.7	V
Zero gate voltage collector current	I_{CES}	V_{CE} = 600V, V_{GE} = 0V T_{vj} = 25°C T_{vj} = 175°C	- -	- 440	40 -	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = 20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE} = 20V, I_C = 40.0A	-	15.0	-	S

电气特性，测于 T_{vj} = 25°C的条件下，除非另有规定

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Dynamic Characteristic						
Input capacitance	C_{ies}	V_{CE} = 25V, V_{GE} = 0V, f = 1MHz	-	1704	-	pF
Output capacitance	C_{oes}		-	73	-	
Reverse transfer capacitance	C_{res}		-	48	-	
Gate charge	Q_G	V_{CC} = 480V, I_C = 40.0A, V_{GE} = 15V	-	160.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	13.0	-	nH
Short circuit collector current Max. 1000 short circuits Time between short circuits: ≥ 1.0s	$I_{C(SC)}$	V_{GE} = 15.0V, V_{CC} ≤ 400V, t_{SC} ≤ 5µs T_{vj} = 150°C	-	166	-	A

开关特性、感性负载

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at T_{vj} = 25°C						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 25°C, V_{CC} = 400V, I_C = 40.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 8.0Ω, $R_{G(off)}$ = 8.0Ω, L_σ = 75nH, C_σ = 30pF L_σ, C_σ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	21	-	ns
Rise time	t_r		-	39	-	ns
Turn-off delay time	$t_{d(off)}$		-	174	-	ns
Fall time	t_f		-	18	-	ns
Turn-on energy	E_{on}		-	1.28	-	mJ
Turn-off energy	E_{off}		-	0.56	-	mJ
Total switching energy	E_{ts}		-	1.84	-	mJ

Diode reverse recovery time	t_{rr}	T_{vj} = 25°C, V_R = 400V, I_F = 20.0A, di_F/dt = 1000A/µs	-	64	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.51	-	µC
Diode peak reverse recovery current	I_{rrm}		-	11.7	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-840	-	A/µs

开关特性、感性负载

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at T_{vj} = 175°C						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 175°C, V_{CC} = 400V, I_C = 40.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 8.0Ω, $R_{G(off)}$ = 8.0Ω, $L\sigma$ = 75nH, $C\sigma$ = 30pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	21	-	ns
Rise time	t_r		-	37	-	ns
Turn-off delay time	$t_{d(off)}$		-	200	-	ns
Fall time	t_f		-	20	-	ns
Turn-on energy	E_{on}		-	1.75	-	mJ
Turn-off energy	E_{off}		-	0.73	-	mJ
Total switching energy	E_{ts}		-	2.48	-	mJ
Diode reverse recovery time	t_{rr}	T_{vj} = 175°C, V_R = 400V, I_F = 20.0A, di_F/dt = 1000A/µs	-	103	-	ns
Diode reverse recovery charge	Q_{rr}		-	1.24	-	µC
Diode peak reverse recovery current	I_{rrm}		-	17.2	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-502	-	A/µs

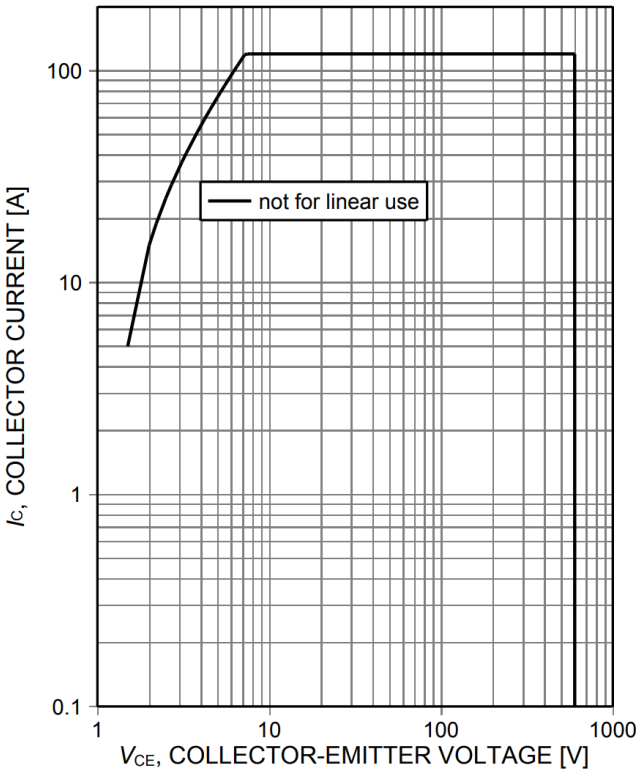


Figure 1. **Forward bias safe operating area**
(D=0, T_h=25°C, T_j≤175°C, V_{GE}=15V, t_p≤1µs)

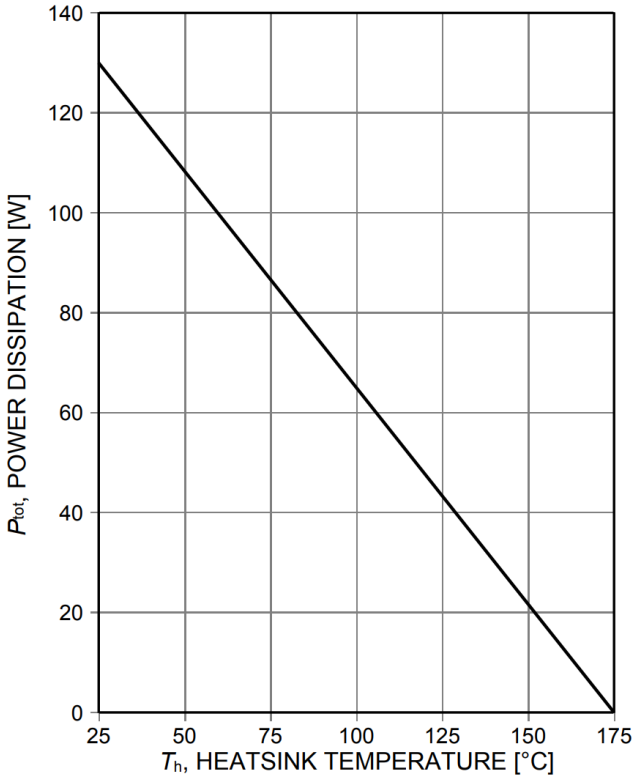


Figure 2. **Power dissipation as a function of heatsink temperature**
(T_j≤175°C)

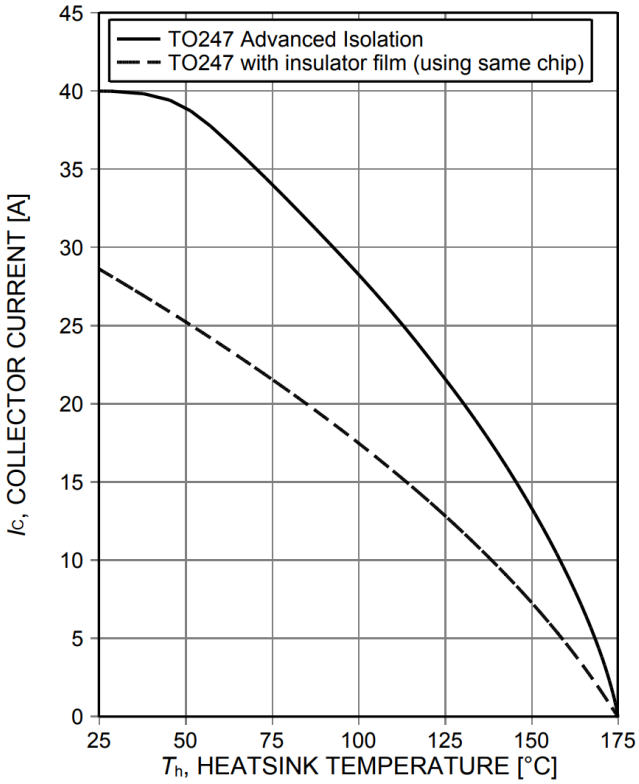


Figure 3. **Collector current as a function of heatsink temperature**
(V_{GE}≥15V, T_j≤175°C, insulator film: 152µm, 0.9W/mK)

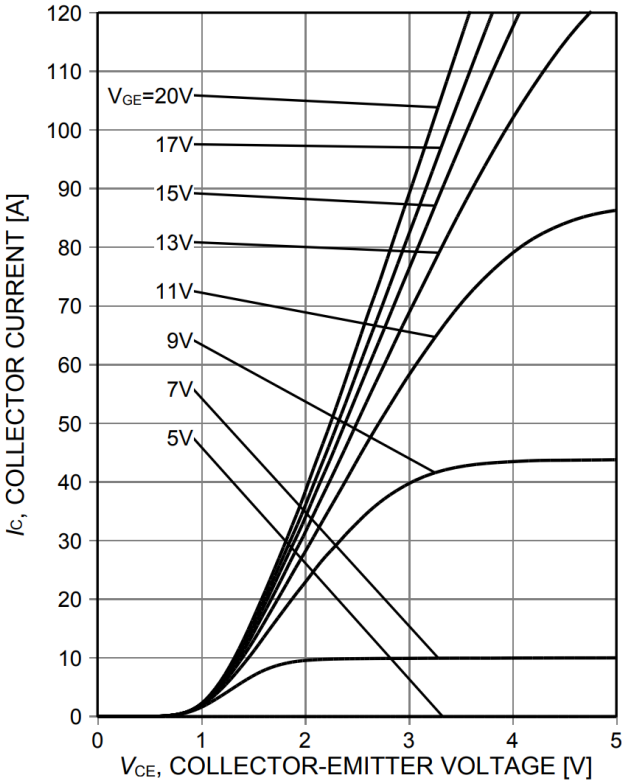


Figure 4. **Typical output characteristic**
(T_j=25°C)

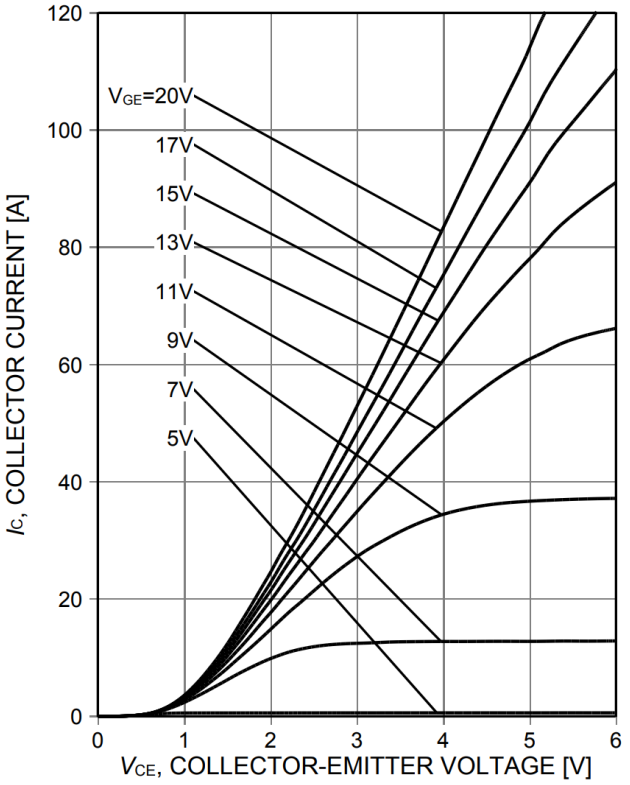


Figure 5. **Typical output characteristic**
(T_j=175°C)

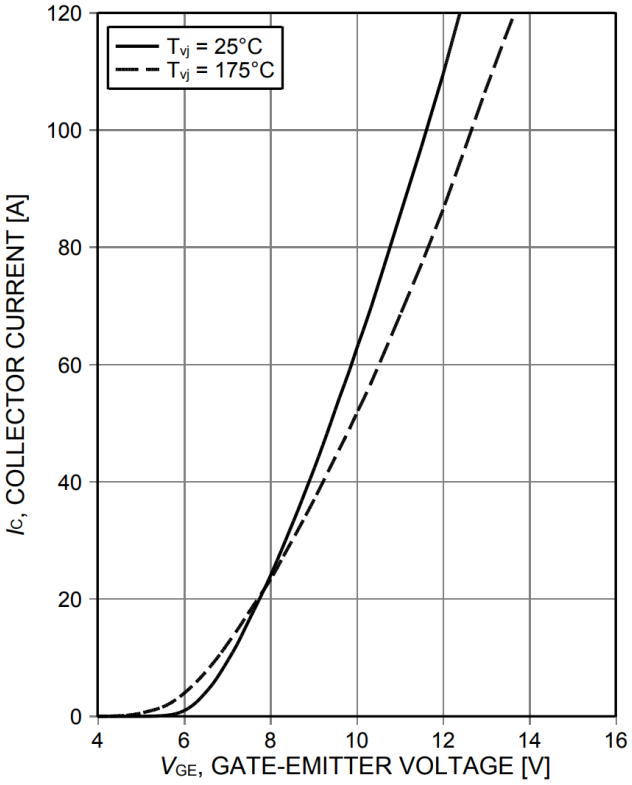


Figure 6. **Typical transfer characteristic**
(V_{CE}=20V)

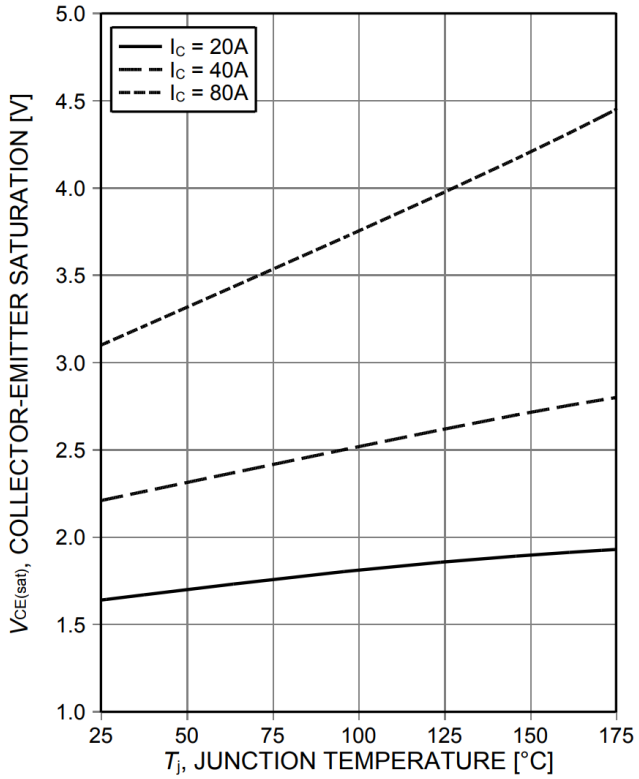


Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**
(V_{GE}=15V)

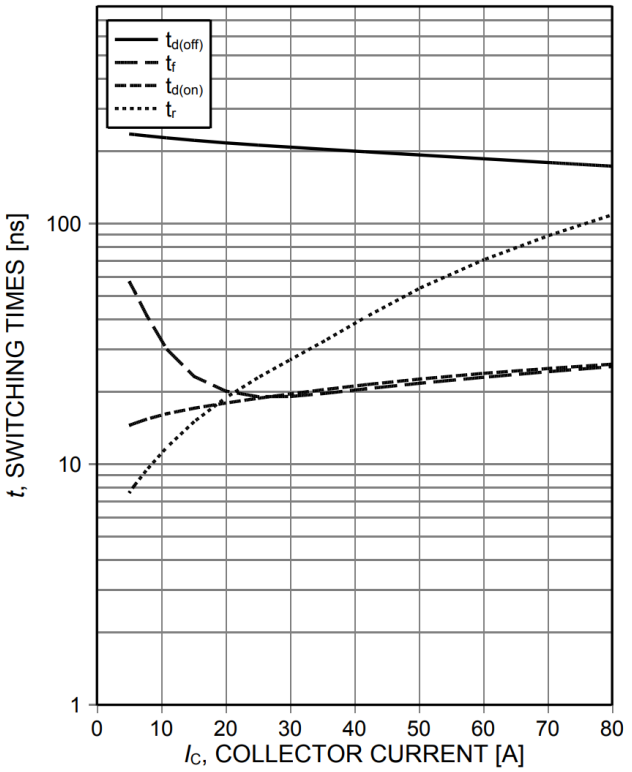


Figure 8. **Typical switching times as a function of collector current**
(ind. load, T_j=175°C, V_{CE}=400V, V_{GE}=0/15V, R_G=8Ω, test circuit in Fig. E)

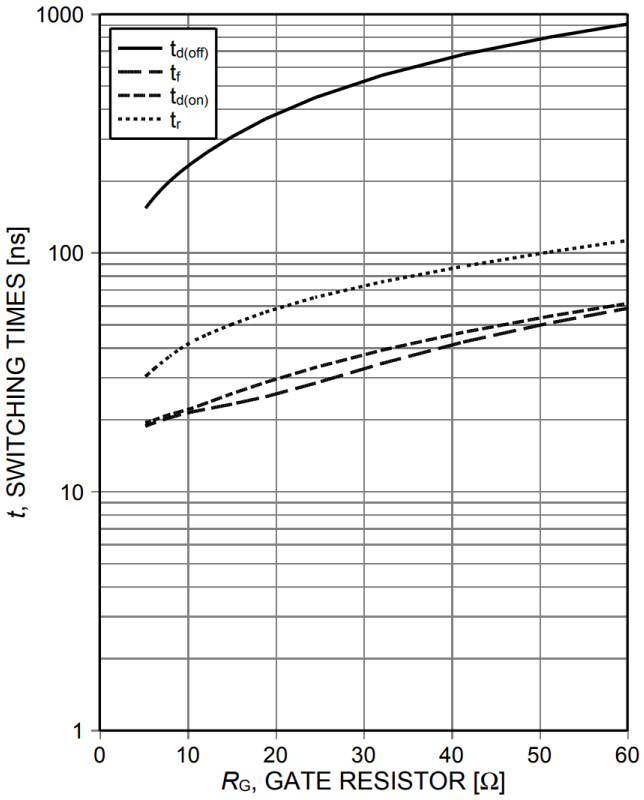


Figure 9. **Typical switching times as a function of gate resistor**
(ind. load, T_j=175°C, V_{CE}=400V, V_{GE}=0/15V, I_C=40A, test circuit in Fig. E)

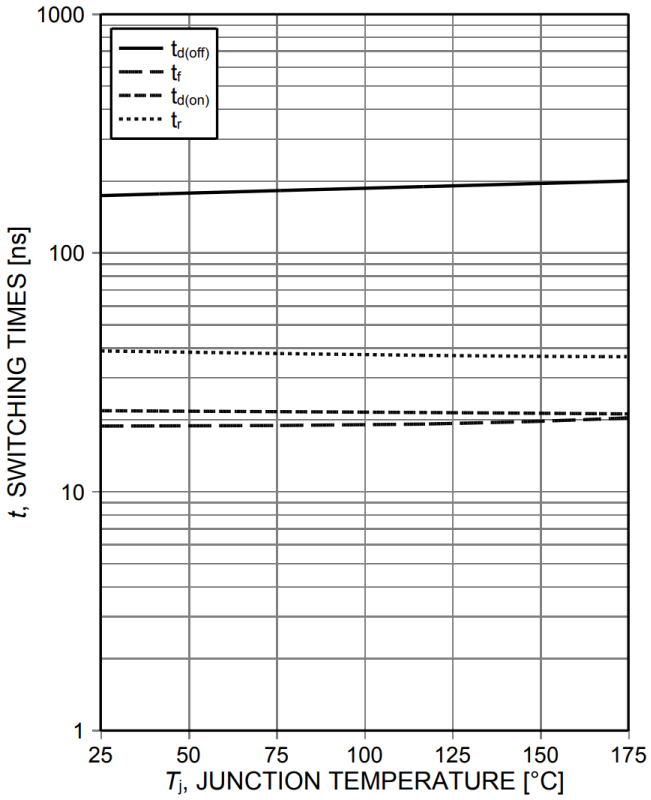


Figure 10. **Typical switching times as a function of junction temperature**
(ind. load, V_{CE}=400V, V_{GE}=0/15V, I_C=40A, r_G=8Ω, test circuit in Fig. E)

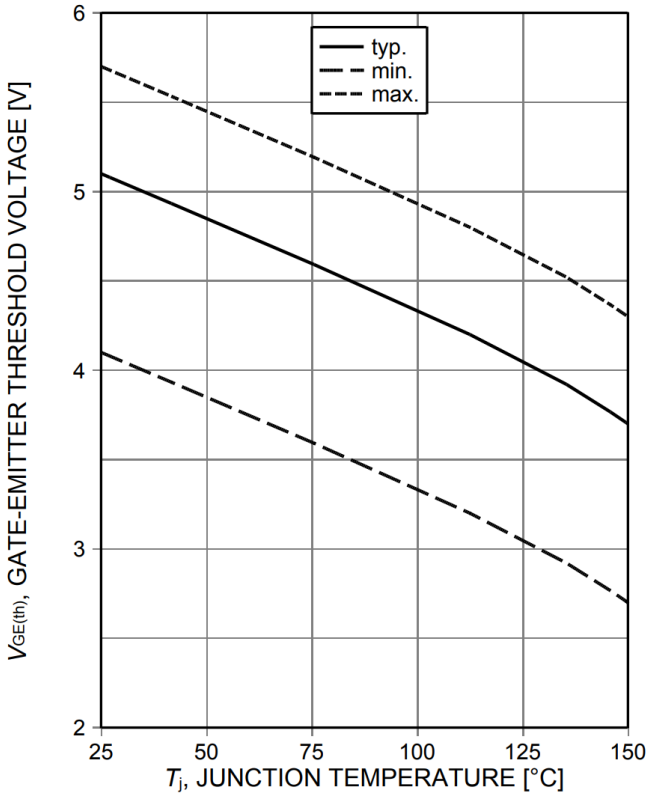


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**
(I_C=0.43mA)

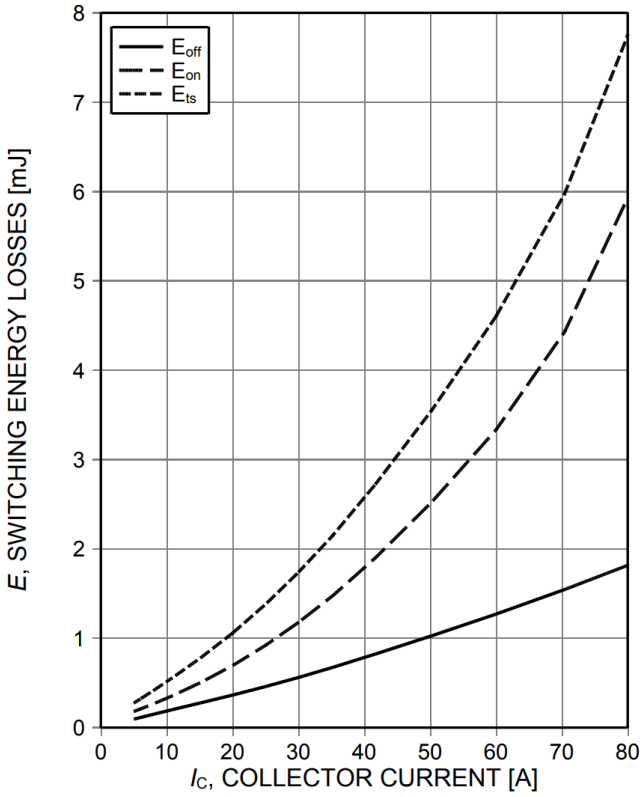


Figure 12. **Typical switching energy losses as a function of collector current**
(ind. load, T_j=175°C, V_{CE}=400V, V_{GE}=0/15V, R_G=8Ω, test circuit in Fig. E)

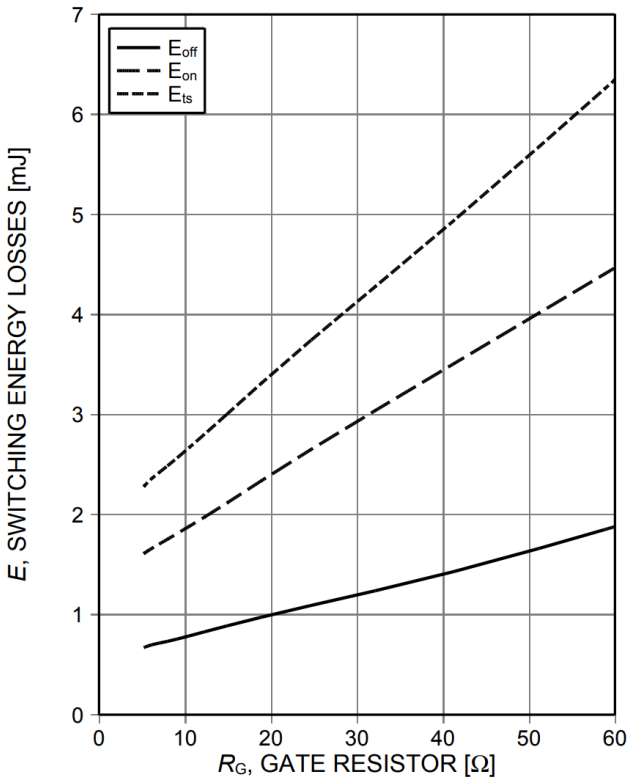


Figure 13. **Typical switching energy losses as a function of gate resistor**
(ind. load, T_j=175°C, V_{CE}=400V, V_{GE}=0/15V, I_C=40A, test circuit in Fig. E)

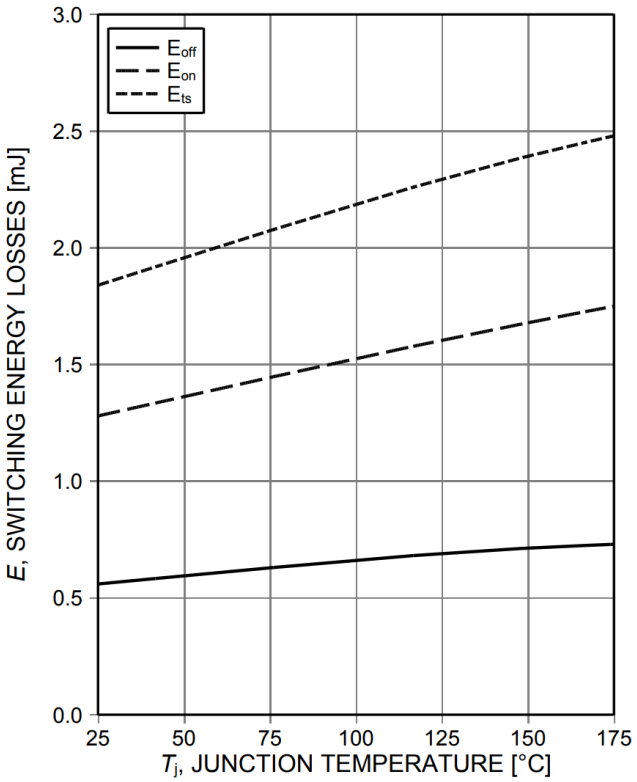


Figure 14. **Typical switching energy losses as a function of junction temperature**
(ind load, V_{CE}=400V, V_{GE}=0/15V, I_C=40A, R_G=8Ω, test circuit in Fig. E)

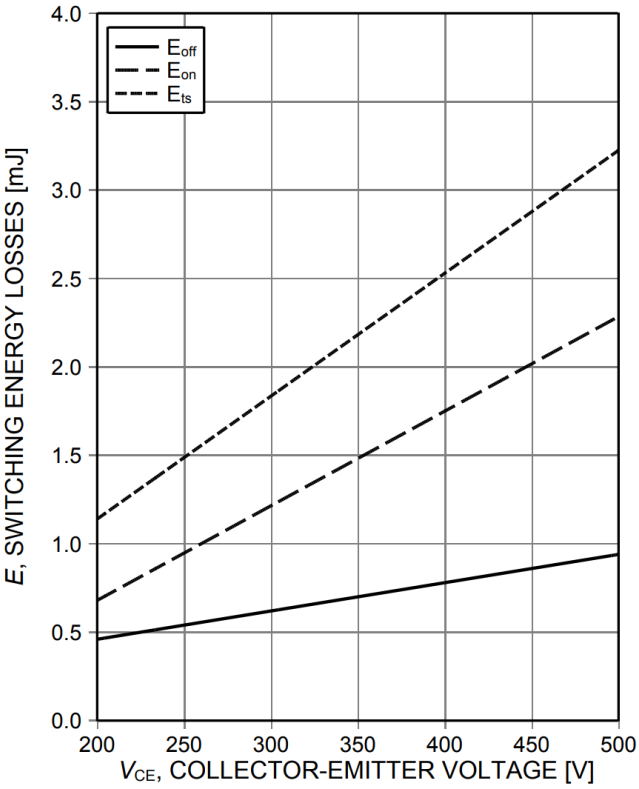


Figure 15. **Typical switching energy losses as a function of collector emitter voltage** (ind. load, T_j=175°C, V_{GE}=0/15V, I_C=40A, R_G=8Ω, test circuit in Fig. E)

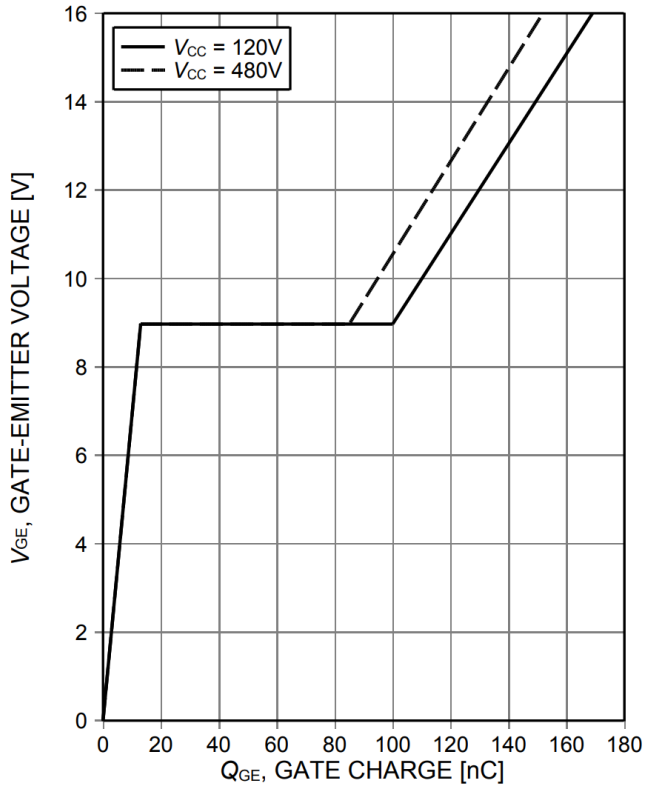


Figure 16. **Typical gate charge**
(I_C=40A)

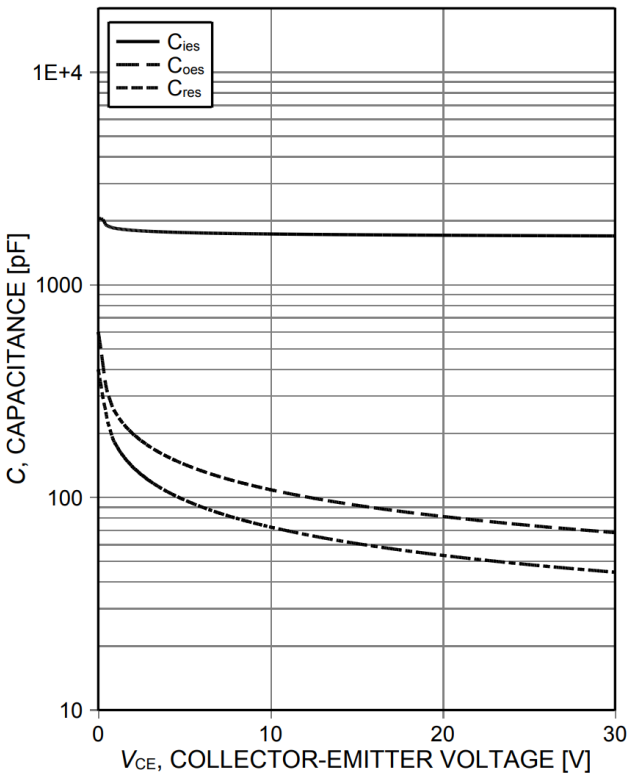


Figure 17. **Typical capacitance as a function of collector-emitter voltage** (V_{GE}=0V, f=1MHz)

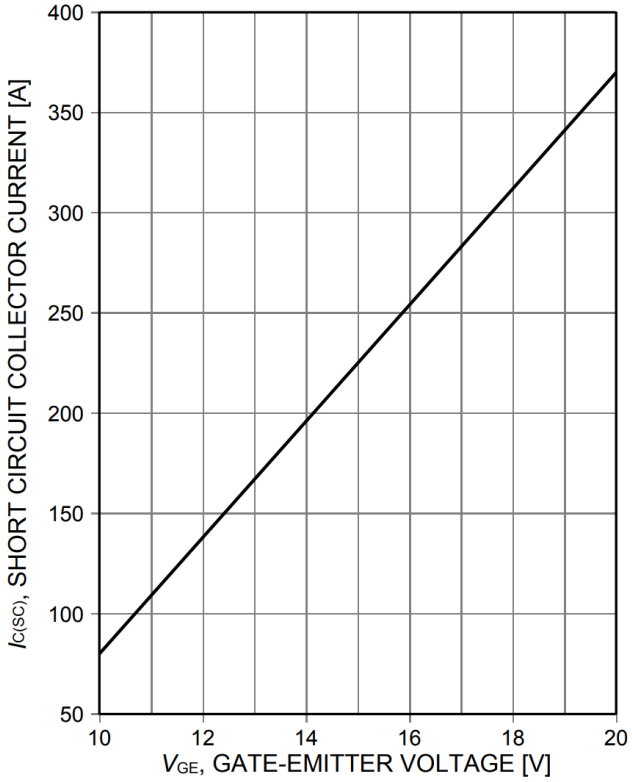


Figure 18. **Typical short circuit collector current as a function of gate-emitter voltage** (V_{CE}≤400V, start at T_j=25°C)

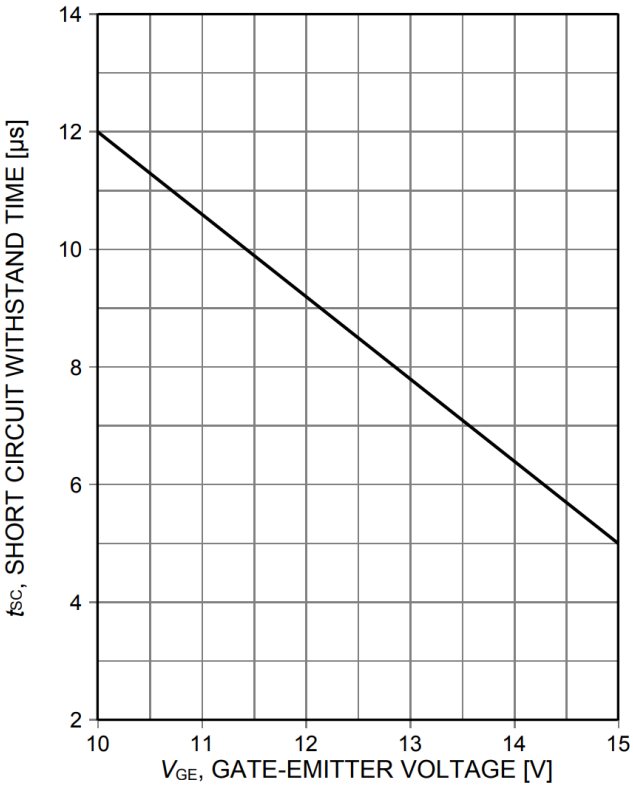


Figure 19. **Short circuit withstand time as a function of gate-emitter voltage** (V_{CE}≤400V, start at T_j≤150°C)

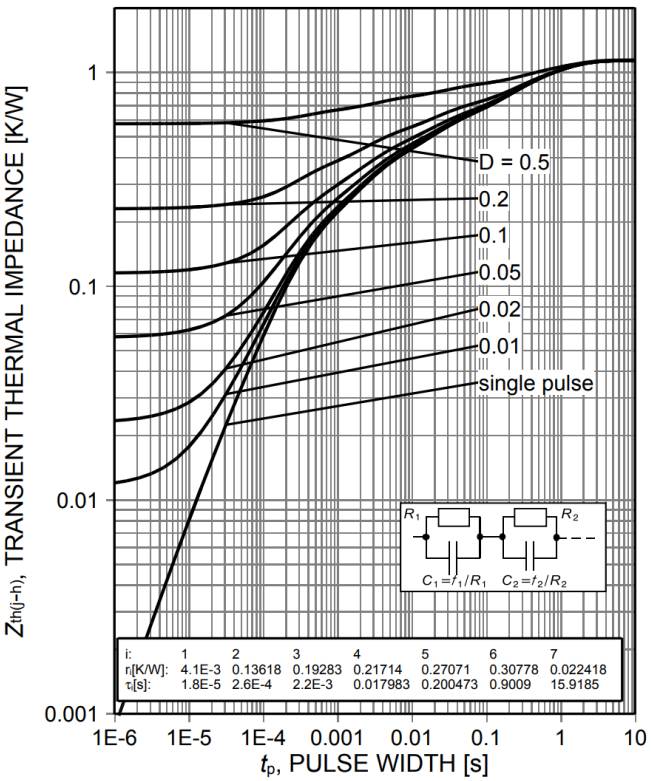


Figure 20. **IGBT transient thermal impedance as a function of pulse width** ($D=t_p/T$)

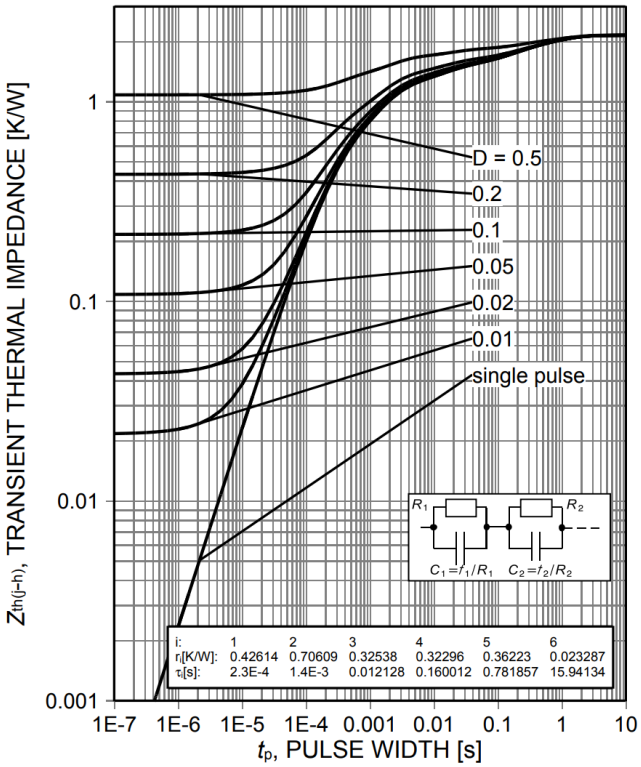


Figure 21. **Diode transient thermal impedance as a function of pulse width** ($D=t_p/T$)

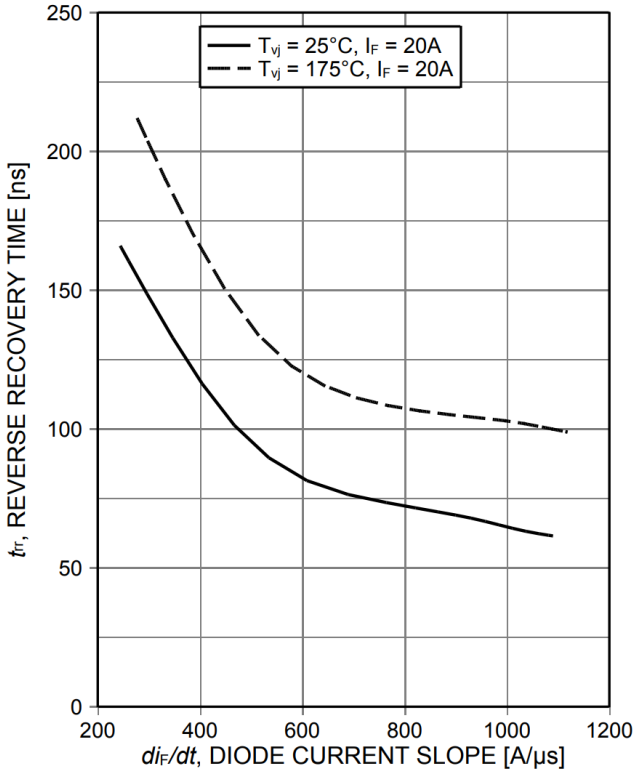


Figure 22. **Typical reverse recovery time as a function of diode current slope** (V_R=400V)

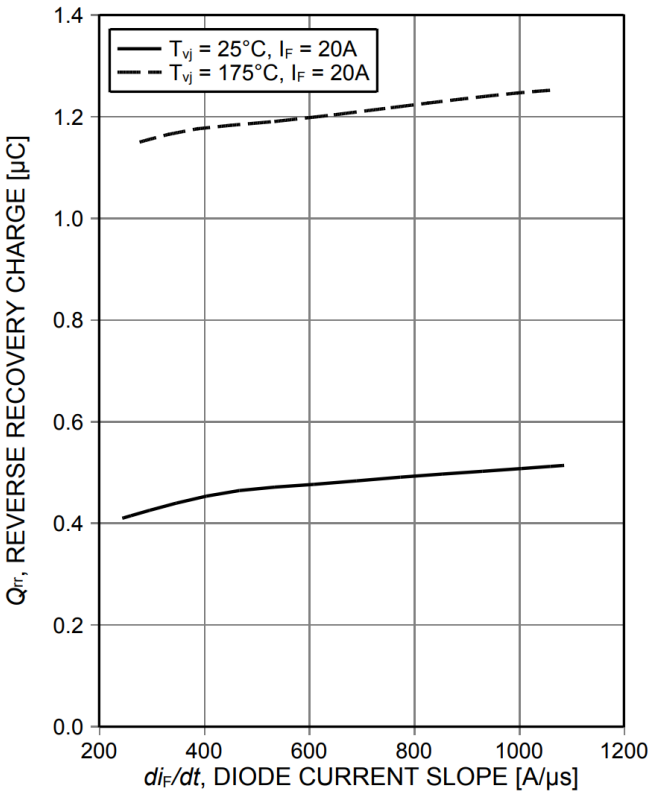


Figure 23. **Typical reverse recovery charge as a function of diode current slope** (V_R=400V)

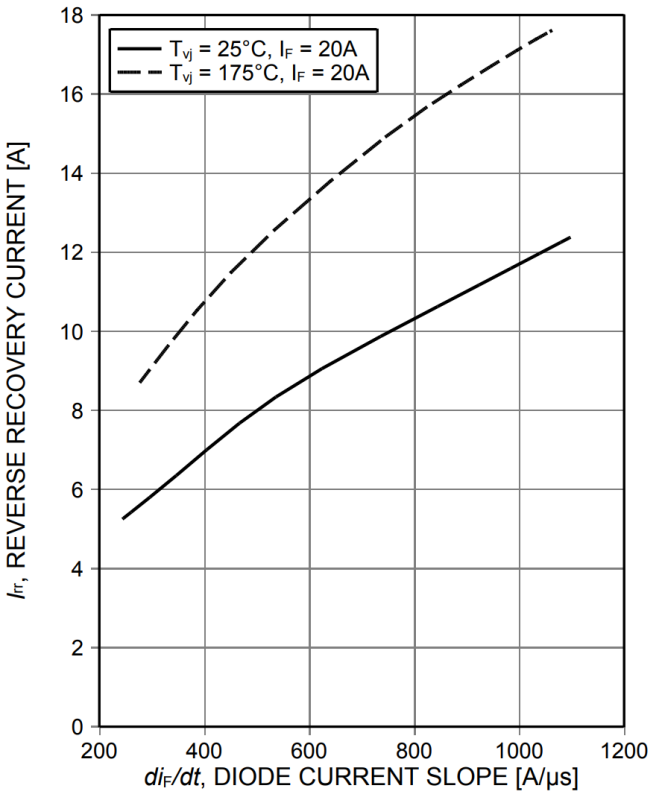


Figure 24. **Typical reverse recovery current as a function of diode current slope** (V_R=400V)

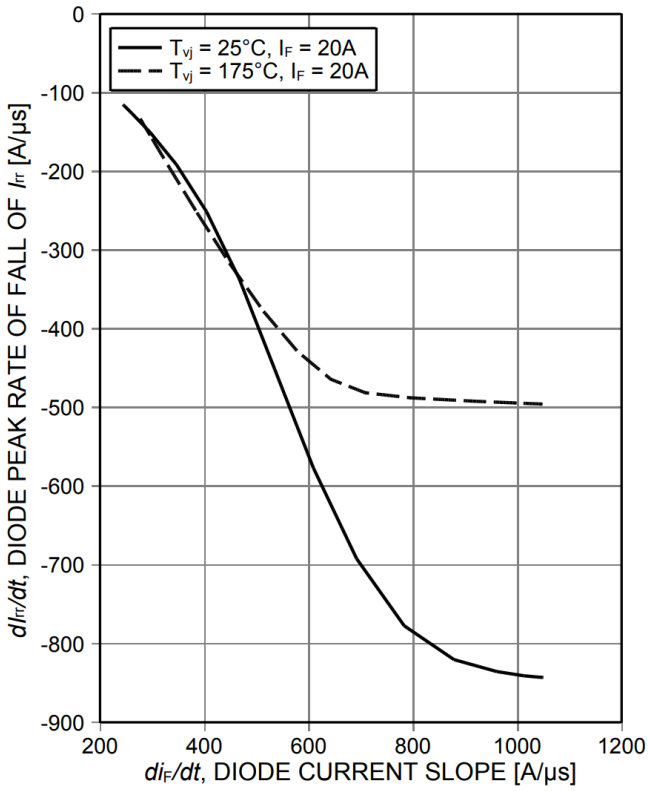


Figure 25. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**
(V_R=400V)

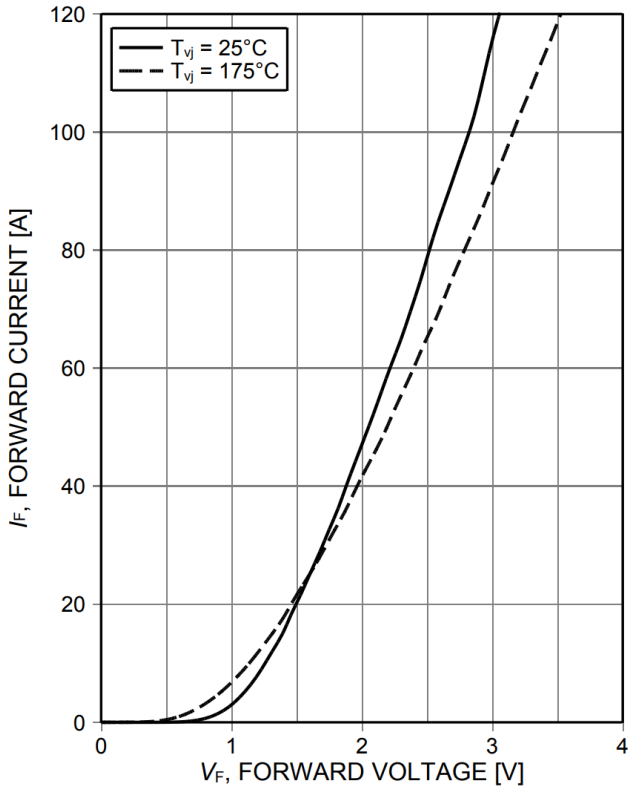


Figure 26. **Typical diode forward current as a function of forward voltage**

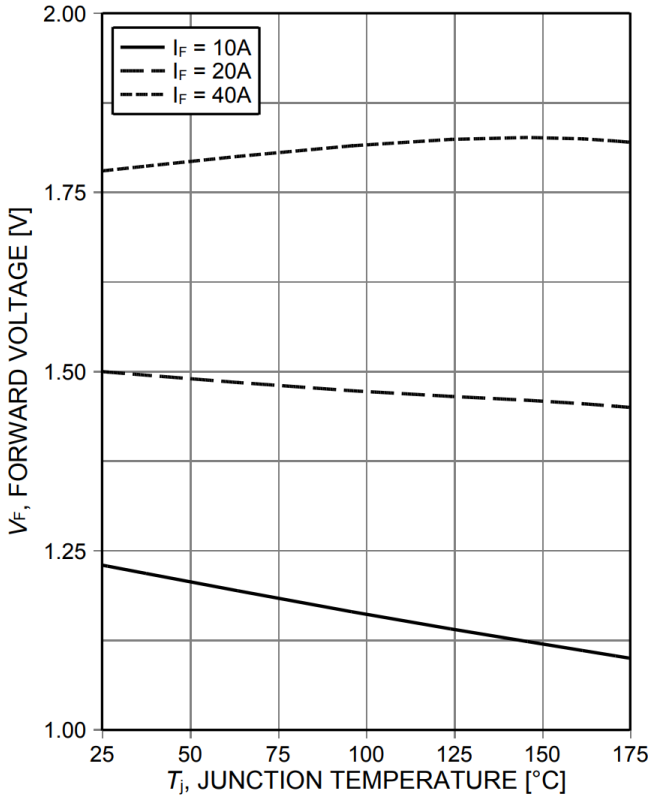
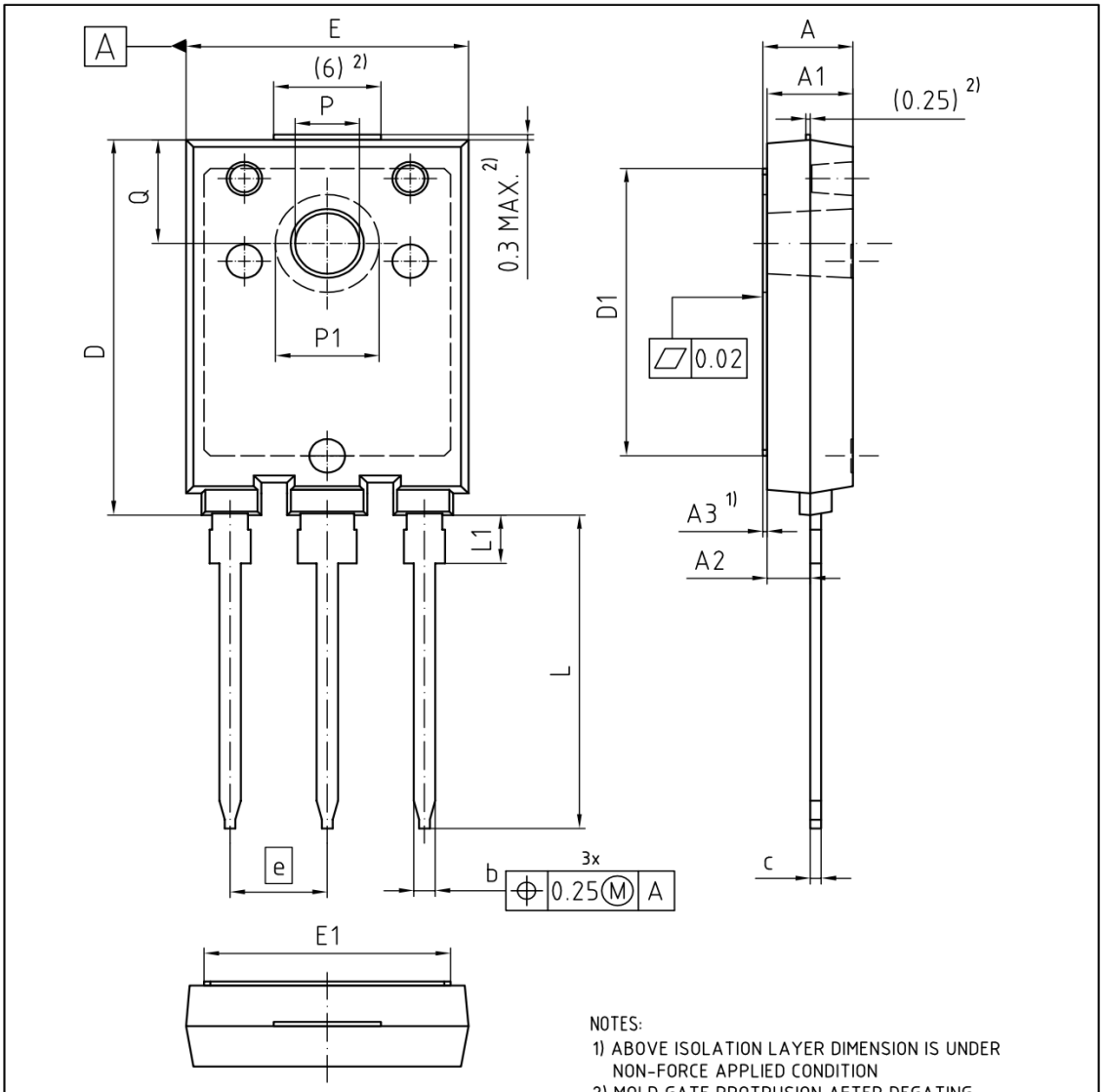


Figure 27. **Typical diode forward voltage as a function of junction temperature**

PG-TO247-3-AI (PG-HSIP247-3)



NOTES:
1) ABOVE ISOLATION LAYER DIMENSION IS UNDER NON-FORCE APPLIED CONDITION
2) MOLD GATE PROTRUSION AFTER DEGATING
ALL METAL SURFACES TIN PLATED EXCEPT AREA OF CUT

DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	-	5.18
A1	4.70	4.90
A2	2.23	2.59
A3	0.20	0.28
b	1.10	1.30
c	0.50	0.70
D	22.20	22.40
D1	16.96	17.16
E	15.70	15.90
E1	13.68	13.88
e	5.44	
L	18.31	18.91
L1	2.76	2.96
øP	3.50	3.70
øP1	5.70	5.90
Q	5.96	6.36

DOCUMENT NO. Z8B00186434
REVISION 02
SCALE 3:1 0 1 2 3 4 5 6 7 8mm
EUROPEAN PROJECTION
ISSUE DATE 05.06.2018

注： 为确保在应用中正确处理和组装该高级绝缘装置，绝缘层不得因尖锐工具的刺穿或超过国际标准（IEC 60068-2-6 和 IEC 60068-2-27）规定水平的机械冲击/震动而导致绝缘层受损。该先进绝缘装置仅适用于安装在合适的散热器上，该散热器的推荐平整度应小于每 100 mm 20 µm，粗糙度应小于 10 µm。

测试条件

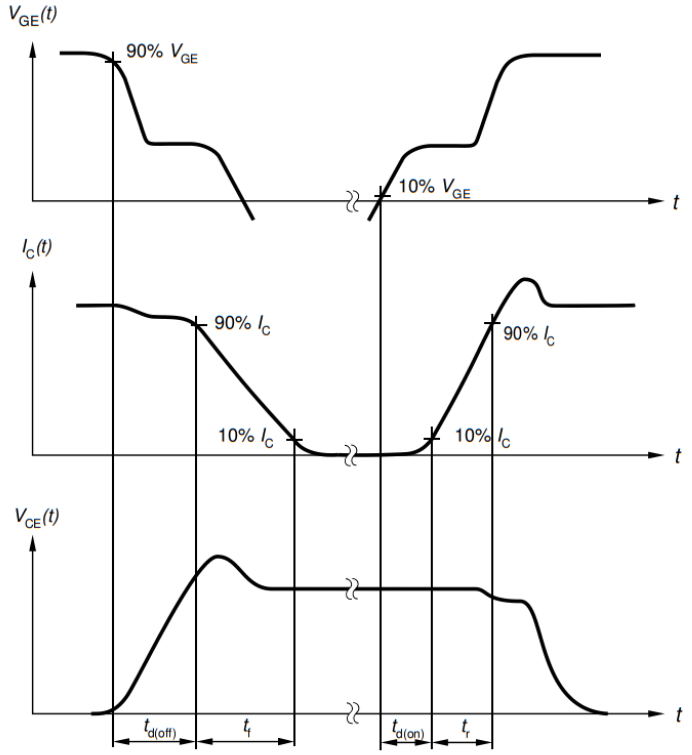


Figure A. **Definition of switching times**

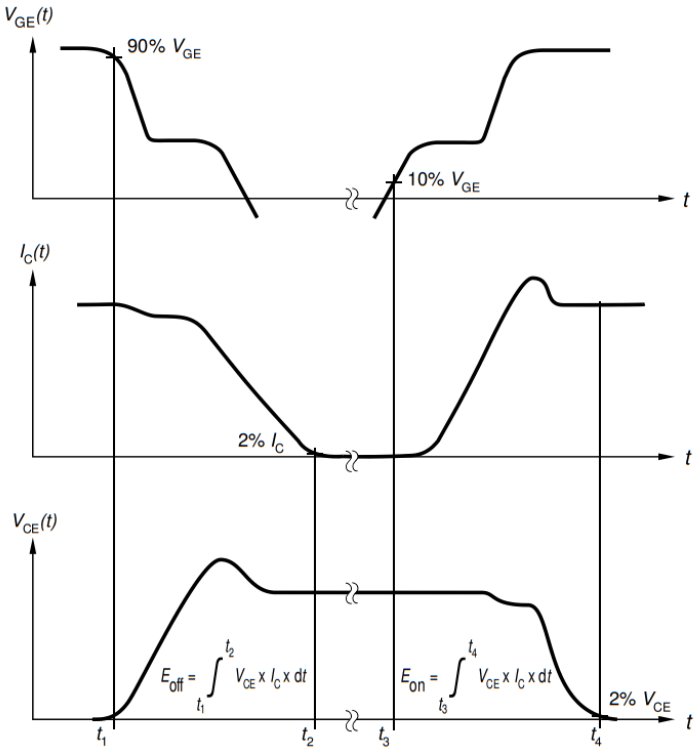


Figure B. **Definition of switching losses**

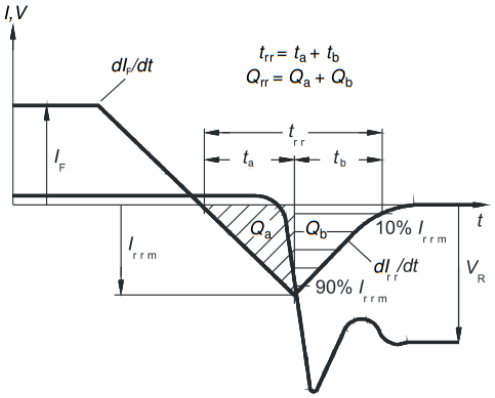


Figure C. **Definition of diode switching characteristics**

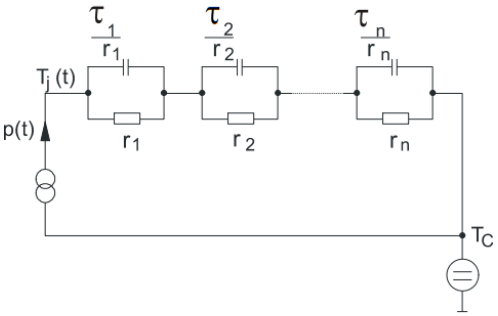


Figure D. **Thermal equivalent circuit**

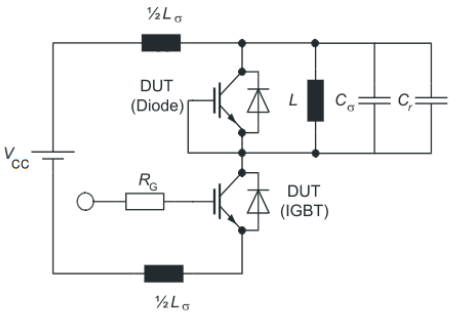


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

修订记录

IKFW50N60DH3E

Revision: 2017-09-21, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2017-09-21	Final data sheet

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