IGBT

英飞凌TRENCHSTOP™5 高速软开关 IGBT，带全额定 RAPID 1 二极管

IKW50N65ES5

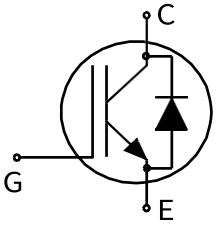
650V TRENCHSTOP™5 高速软开关 duopak

数据手册

工业功率控制

TRENCHSTOP™ 5 高速软开关 IGBT

与全额定 RAPID 1 快速软恢复反并联二极管共封装



特征和优点：

高速 S5 技术提供：
- 高速平滑开关器件适用于硬开关和软开关应用
- 极低V_{CEsat}，标称额定电流时为 1.35V
- 即插即用，替代上一代 IGBT
- 650 V 击穿电压
- 低栅极电荷 Q_G
- IGBT 与全电流 RAPID 1 快速反并联二极管共同封装
- 最高结温 175°C
- 符合 JEDEC 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/

应用：

- 谐振转换器
- UPS（不间断电源）
- 焊机
- 中高开关频率转换器

封装引脚定义：

- 引脚 1 - 栅极
- 引脚 2 & 背面 - 集电极
- 引脚 3 - 发射极

关键性能和封装参数

Type	V_{CE}	I_C	V_{CEsat}, T_{vj}=25°C	T_{vjmax}	Marking	Package
IKW50N65ES5	650V	50A	1.35V	175°C	K50EES5	PG-TO247-3

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）。

目录

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}	650	V
DC collector current, limited by T_{vjmax} $T_C = 25°C$ value limited by bondwire $T_C = 100°C$	I_C	80.0 60.5	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	200.0	A
Turn off safe operating area $V_{CE} \leq 650V$, $T_{vj} \leq 175°C$, $t_p = 1\mu s$	-	200.0	A
Diode forward current, limited by T_{vjmax} $T_C = 25°C$ value limited by bondwire $T_C = 100°C$	I_F	80.0 60.5	A
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpuls}	200.0	A
Gate-emitter voltage Transient Gate-emitter voltage ($t_p \leq 10\mu s$, $D < 0.010$)	V_{GE}	±20 ±30	V
Power dissipation $T_C = 25°C$ Power dissipation $T_C = 100°C$	P_{tot}	274.0 137.0	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

热阻抗

Parameter	Symbol	Conditions	Max. Value	Unit
特性				
IGBT thermal resistance, junction - case	$R_{th(j-c)}$		0.55	K/W
Diode thermal resistance, junction - case	$R_{th(j-c)}$		0.63	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		40	K/W

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.	
静态特性						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	V_{GE} = 0V, I_C = 0.20mA	650	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	V_{GE} = 15.0V, I_C = 50.0A T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	 - - -	 1.35 1.50 1.60	 1.70 - -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 50.0A T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	 - - -	 1.45 1.42 1.39	 1.70 - -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 0.50mA, V_{CE} = V_{GE}	3.2	4.0	4.8	V
Zero gate voltage collector current	I_{CES}	V_{CE} = 650V, V_{GE} = 0V T_{vj} = 25°C T_{vj} = 175°C	 - -	 - 2000	 50 -	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = 20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE} = 20V, I_C = 50.0A	-	62.0	-	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.	
动态特性						
Input capacitance	C_{ies}	V_{CE} = 25V, V_{GE} = 0V, f = 1MHz	-	3100	-	pF
Output capacitance	C_{oes}		-	88	-	
Reverse transfer capacitance	C_{res}		-	12	-	
Gate charge	Q_G	V_{CC} = 520V, I_C = 50.0A, V_{GE} = 15V	-	120.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	13.0	-	nH

开关特性、感性负载

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT 特性，测于T_{vj} = 25°C的条件下						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 25°C, V_{CC} = 400V, I_C = 50.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 8.2Ω, $R_{G(off)}$ = 8.2Ω, Lσ = 30nH, Cσ = 30pF Lσ, Cσ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	20	-	ns
Rise time	t_r		-	27	-	ns
Turn-off delay time	$t_{d(off)}$		-	127	-	ns
Fall time	t_f		-	34	-	ns
Turn-on energy	E_{on}		-	1.23	-	mJ
Turn-off energy	E_{off}		-	0.55	-	mJ
Total switching energy	E_{ts}		-	1.78	-	mJ

Turn-on delay time	$t_{d(on)}$	T_{vj} = 25°C, V_{CC} = 400V, I_C = 25.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 8.2Ω, $R_{G(off)}$ = 8.2Ω, Lσ = 30nH, Cσ = 30pF Lσ, Cσ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	18	-	ns
Rise time	t_r		-	9	-	ns
Turn-off delay time	$t_{d(off)}$		-	141	-	ns
Fall time	t_f		-	22	-	ns
Turn-on energy	E_{on}		-	0.50	-	mJ
Turn-off energy	E_{off}		-	0.25	-	mJ
Total switching energy	E_{ts}		-	0.75	-	mJ

二极管特性， T_{vj} = 25°C

Diode reverse recovery time	t_{rr}	T_{vj} = 25°C, V_R = 400V, I_F = 50.0A, di_F/dt = 1150A/µs	-	70	-	ns
Diode reverse recovery charge	Q_{rr}		-	1.25	-	µC
Diode peak reverse recovery current	I_{rrm}		-	25.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-2120	-	A/µs

Diode reverse recovery time	t_{rr}	T_{vj} = 25°C, V_R = 400V, I_F = 25.0A, di_F/dt = 1370A/µs	-	58	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.86	-	µC
Diode peak reverse recovery current	I_{rrm}		-	22.5	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-2125	-	A/µs

开关特性、感性负载

Parameter	**Symbol**	**Conditions**	**Value**			**Unit**
			min.	**typ.**	**max.**	
IGBT 特性， T_{vj} = 150°C						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 150°C, V_{CC} = 400V, I_C = 50.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 8.2Ω, $R_{G(off)}$ = 8.2Ω, Lσ = 30nH, Cσ = 30pF Lσ, Cσ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	19	-	ns
Rise time	t_r		-	26	-	ns
Turn-off delay time	$t_{d(off)}$		-	151	-	ns
Fall time	t_f		-	47	-	ns
Turn-on energy	E_{on}		-	1.63	-	mJ
Turn-off energy	E_{off}		-	0.85	-	mJ
Total switching energy	E_{ts}		-	2.48	-	mJ

Turn-on delay time	$t_{d(on)}$	T_{vj} = 150°C, V_{CC} = 400V, I_C = 25.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 8.2Ω, $R_{G(off)}$ = 8.2Ω, Lσ = 30nH, Cσ = 30pF Lσ, Cσ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	18	-	ns
Rise time	t_r		-	10	-	ns
Turn-off delay time	$t_{d(off)}$		-	180	-	ns
Fall time	t_f		-	46	-	ns
Turn-on energy	E_{on}		-	0.79	-	mJ
Turn-off energy	E_{off}		-	0.45	-	mJ
Total switching energy	E_{ts}		-	1.24	-	mJ

二极管特性， T_{vj} = 150°C

Diode reverse recovery time	t_{rr}	T_{vj} = 150°C, V_R = 400V, I_F = 50.0A, di_F/dt = 1150A/µs	-	115	-	ns
Diode reverse recovery charge	Q_{rr}		-	2.80	-	µC
Diode peak reverse recovery current	I_{rrm}		-	38.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-1550	-	A/µs

Diode reverse recovery time	t_{rr}	T_{vj} = 150°C, V_R = 400V, I_F = 25.0A, di_F/dt = 1370A/µs	-	92	-	ns
Diode reverse recovery charge	Q_{rr}		-	2.10	-	µC
Diode peak reverse recovery current	I_{rrm}		-	35.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-2010	-	A/µs

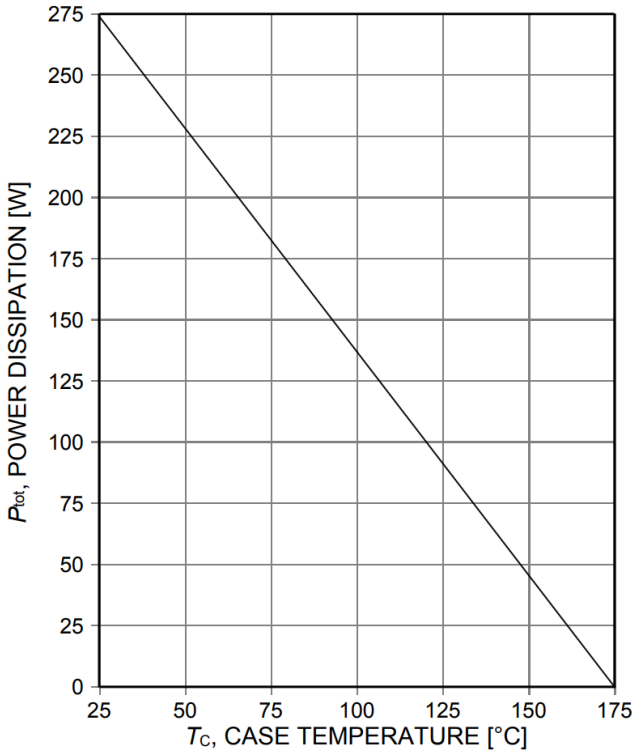


Figure 1. **Power dissipation as a function of case temperature**
(T_{vj}≤175°C)

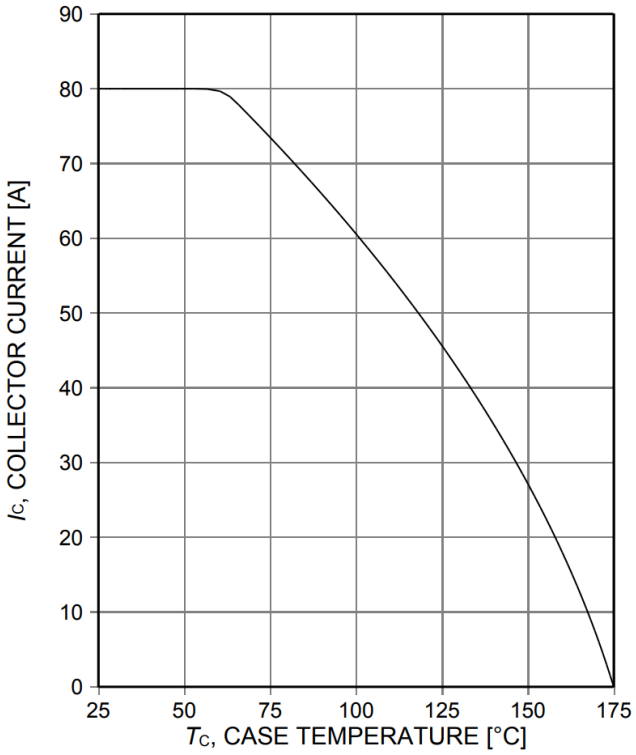


Figure 2. **Collector current as a function of case temperature**
(V_{GE}≥15V, T_{vj}≤175°C)

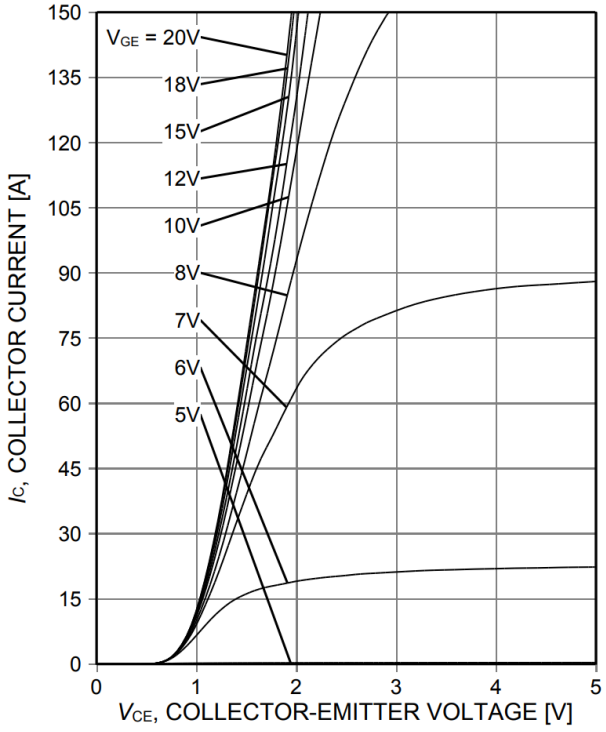


Figure 3. **Typical output characteristic**
(T_{vj}=25°C)

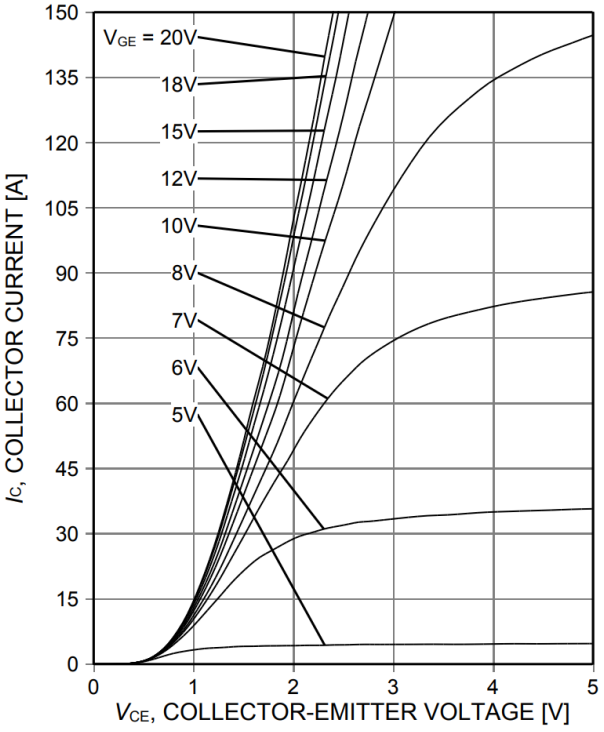


Figure 4. **Typical output characteristic**
(T_{vj}=175°C)

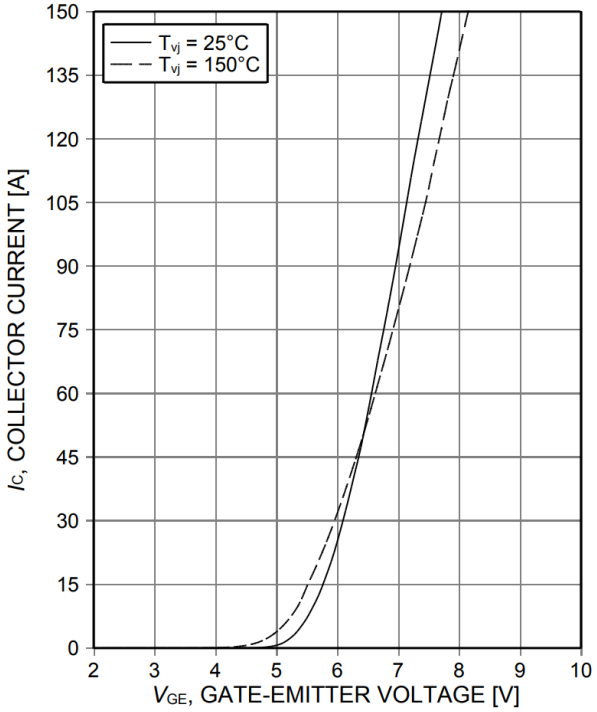


Figure 5. **Typical transfer characteristic**
(V_{CE}=20V)

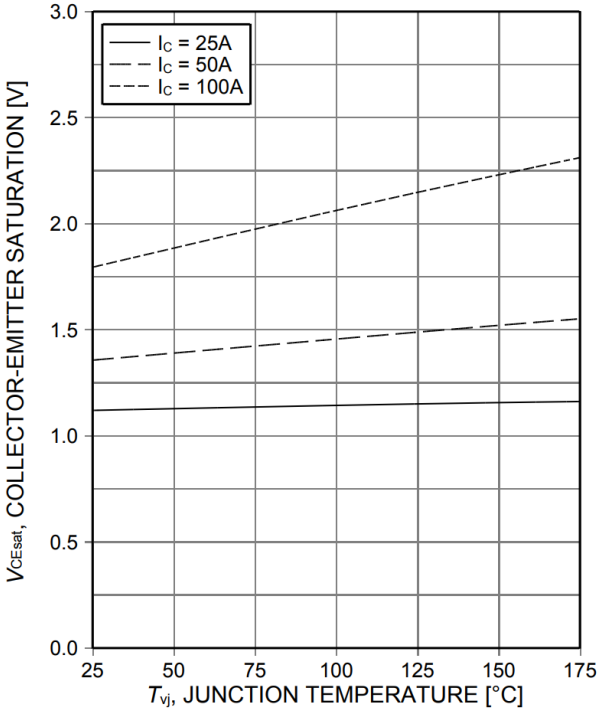


Figure 6. **Typical collector-emitter saturation voltage as a function of junction temperature**
(V_{GE}=15V)

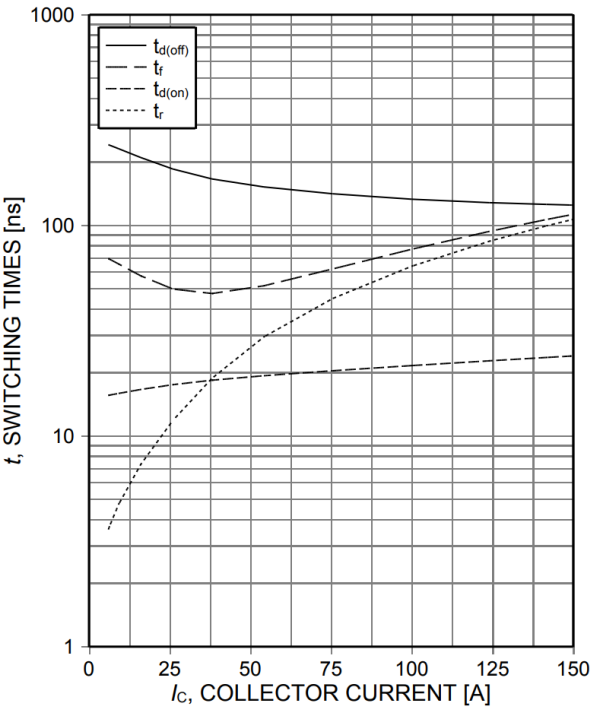


Figure 7. **Typical switching times as a function of collector current**
(inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=0/15V, R_{Gon}=8.2Ω, R_{Goff}=8.2Ω, dynamic test circuit in Figure E)

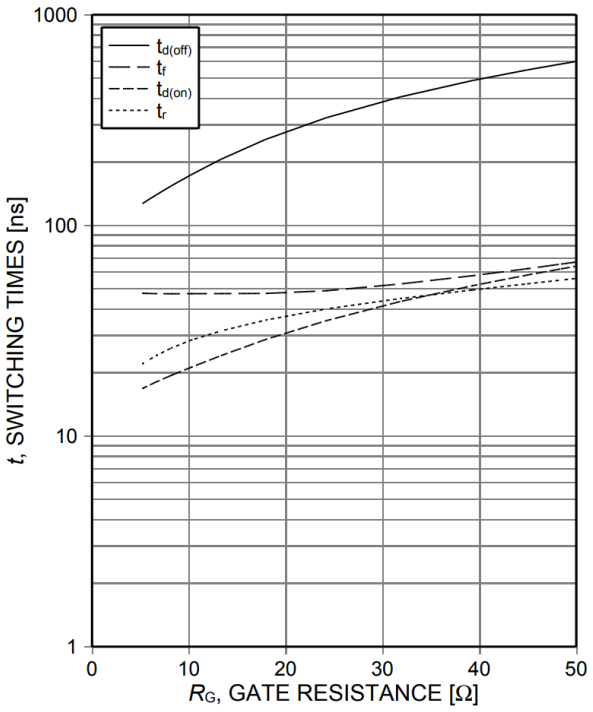


Figure 8. **Typical switching times as a function of gate resistance**
(inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=0/15V, I_C=50A, dynamic test circuit in Figure E)

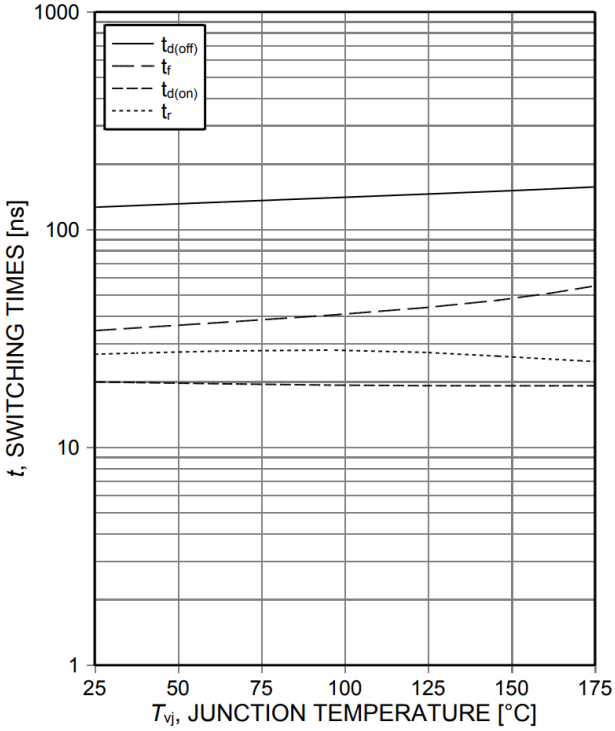


Figure 9. **Typical switching times as a function of junction temperature**
(inductive load, V_{CE}=400V, V_{GE}=0/15V, I_C=50A, R_{Gon}=8.2Ω, R_{Goff}=8.2Ω, dynamic test circuit in Figure E)

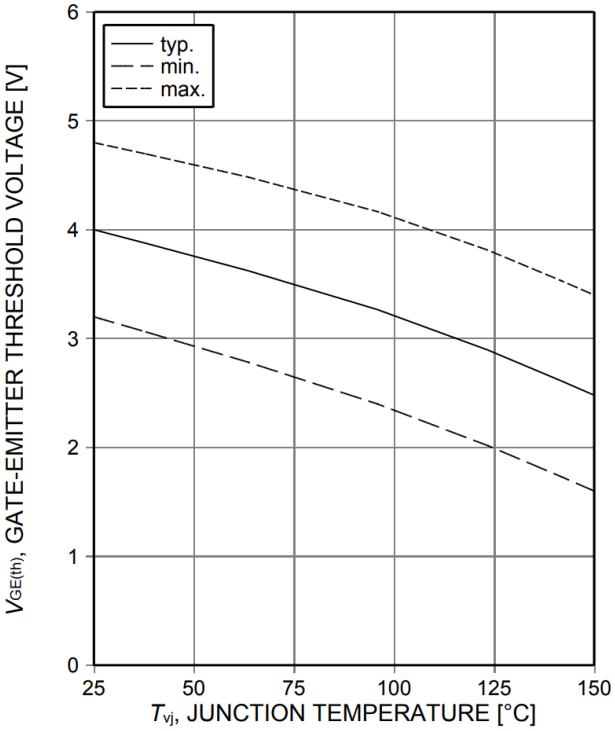


Figure 10. **Gate-emitter threshold voltage as a function of junction temperature**
(I_C=0.5mA)

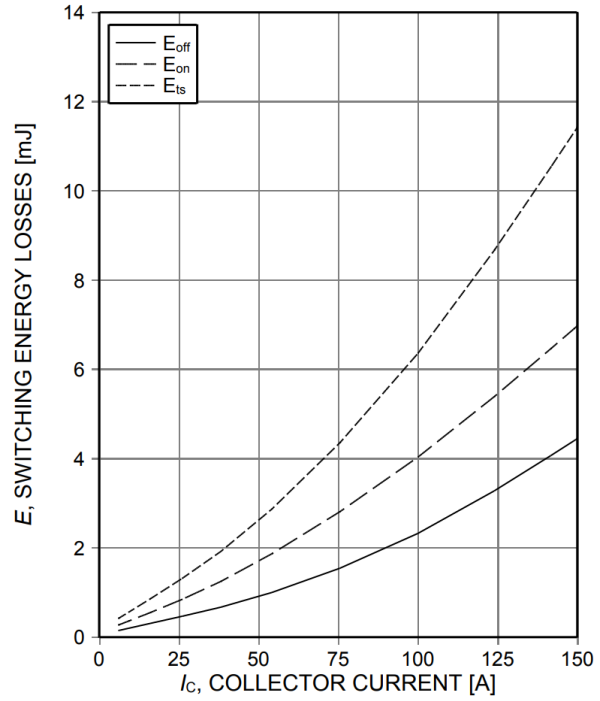


Figure 11. **Typical switching energy losses as a function of collector current**
(inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=0/15V, R_{Gon}=8.2Ω, R_{Goff}=8.2Ω, dynamic test circuit in Figure E)

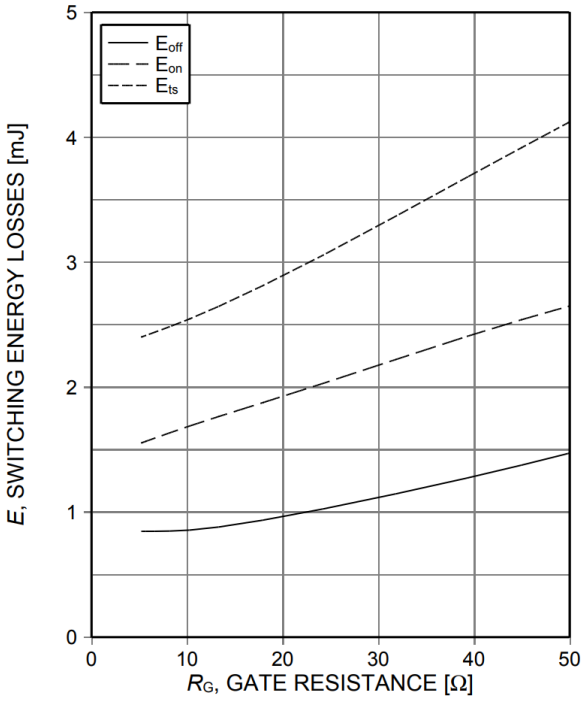


Figure 12. **Typical switching energy losses as a function of gate resistance**
(inductive load, T_{vj}=150°C, V_{CE}=400V, V_{GE}=0/15V, I_C=50A, dynamic test circuit in Figure E)

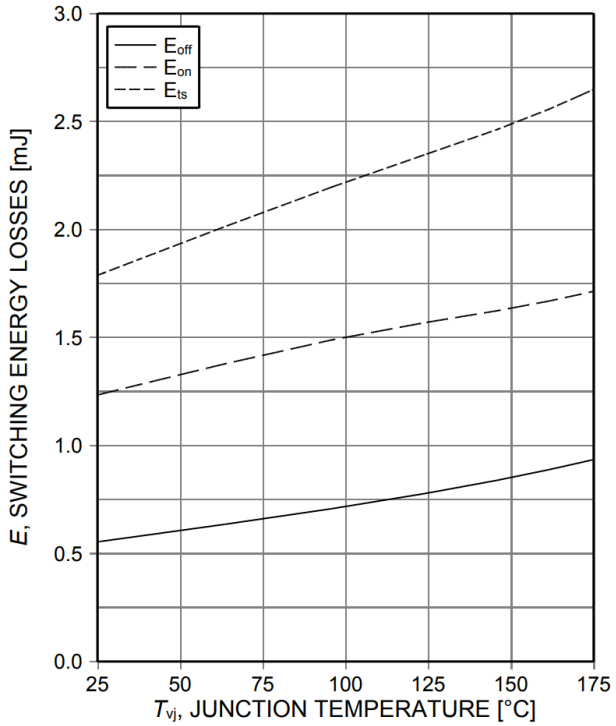


Figure 13. **Typical switching energy losses as a function of junction temperature**
(inductive load, V_{CE}=400V, V_{GE}=0/15V, I_C=50A, R_{Gon}=8.2Ω, R_{Goff}=8.2Ω, dynamic test circuit in Figure E)

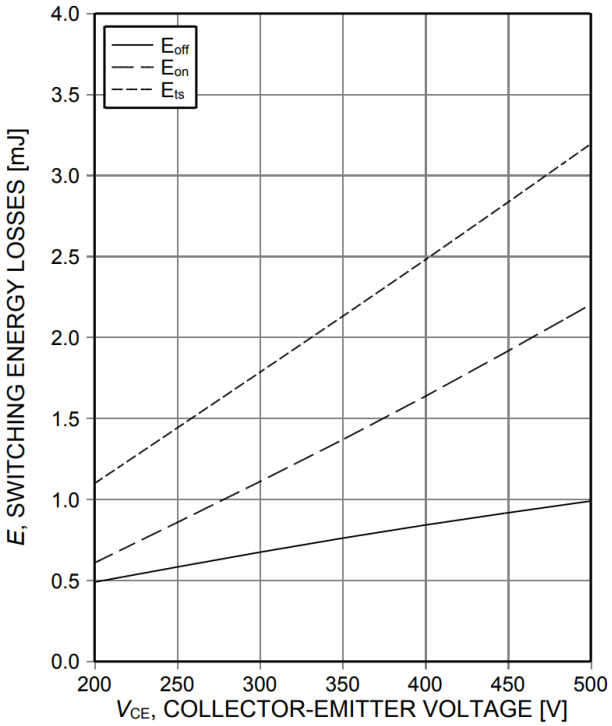


Figure 14. **Typical switching energy losses as a function of collector emitter voltage**
(inductive load, T_{vj}=150°C, V_{GE}=0/15V, I_C=50A, R_{Gon}=8.2Ω, R_{Goff}=8.2Ω, dynamic test circuit in Figure E)

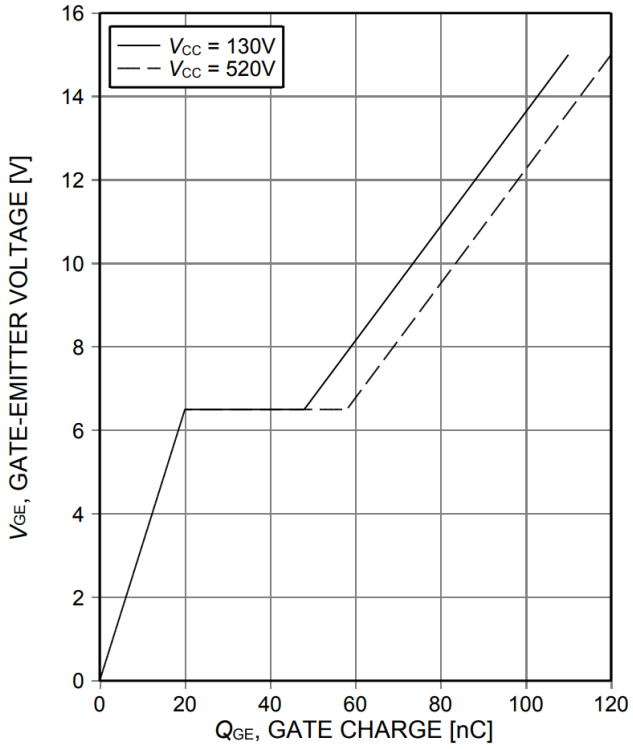


Figure 15. **Typical gate charge**
(I_C=50A)

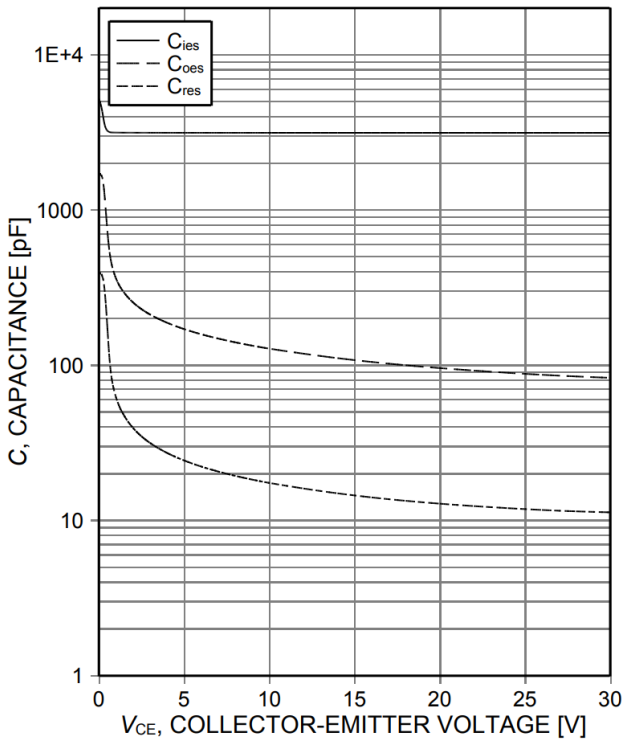


Figure 16. **Typical capacitance as a function of collector-emitter voltage**
(V_{GE}=0V, f=1MHz)

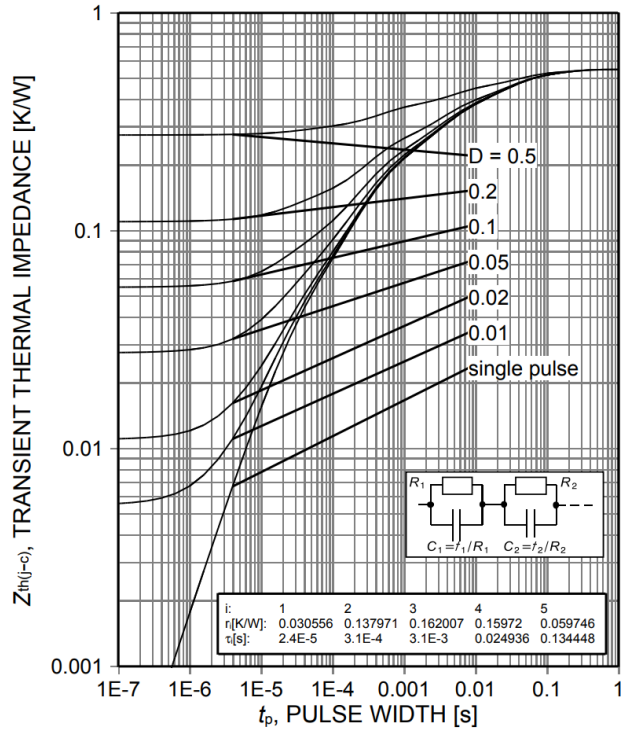


Figure 17. **IGBT transient thermal impedance**
($D=t_p/T$)

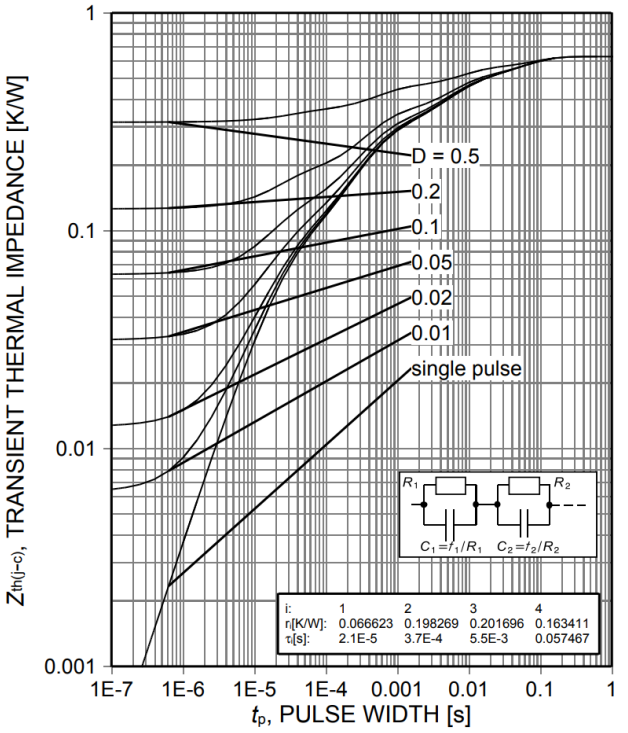


Figure 18. **Diode transient thermal impedance as a function of pulse width**
($D=t_p/T$)

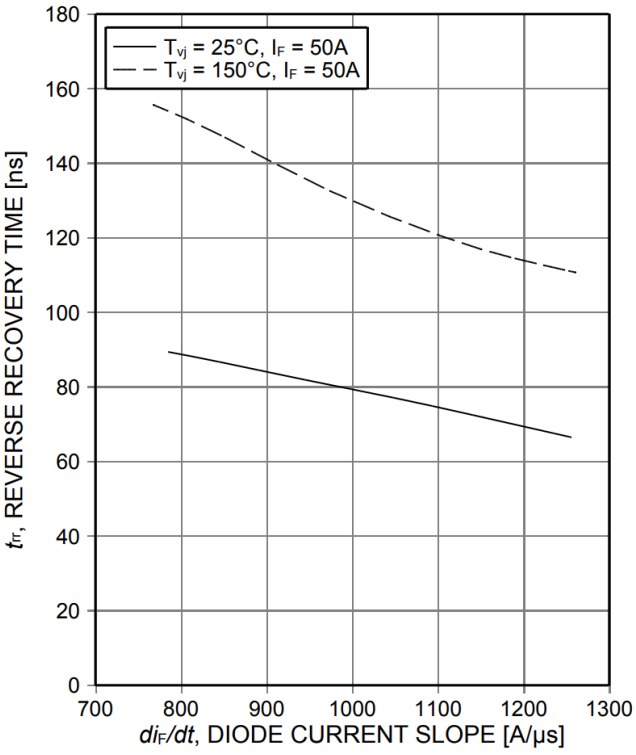


Figure 19. **Typical reverse recovery time as a function of diode current slope**
(V_R=400V)

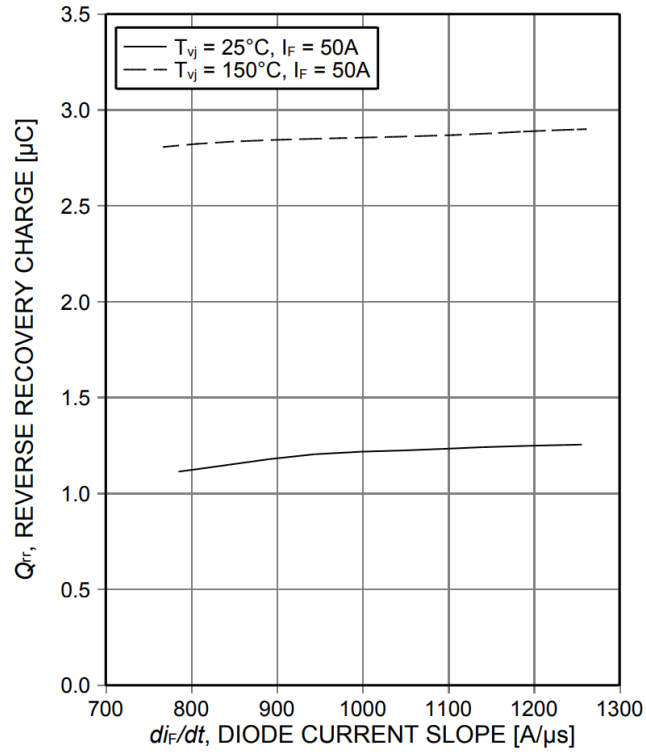


Figure 20. **Typical reverse recovery charge as a function of diode current slope**
(V_R=400V)

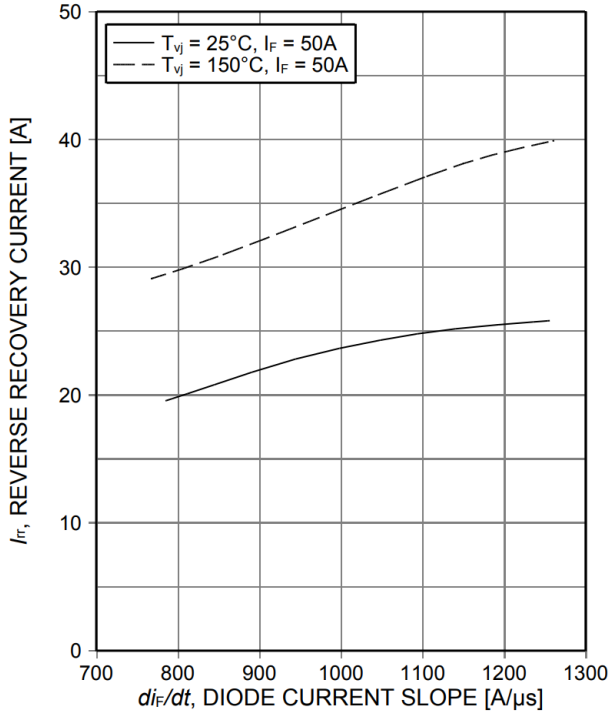


Figure 21. **Typical reverse recovery current as a function of diode current slope**
(V_R=400V)

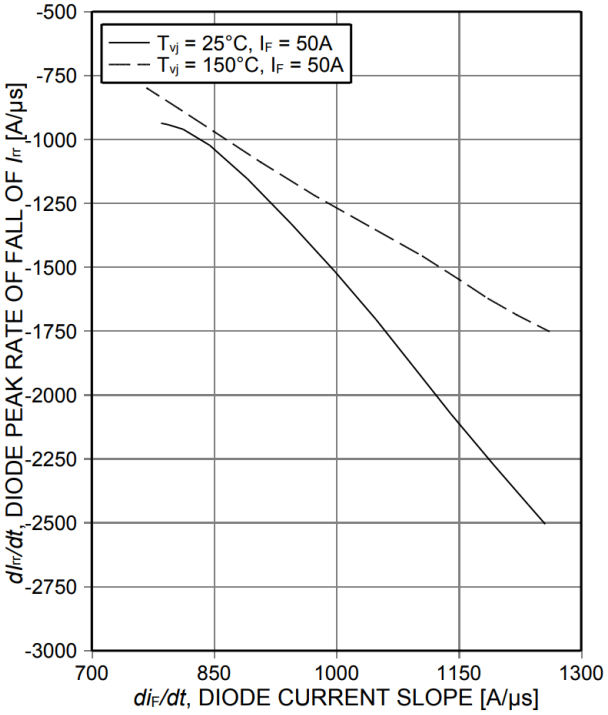


Figure 22. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**
(V_R=400V)

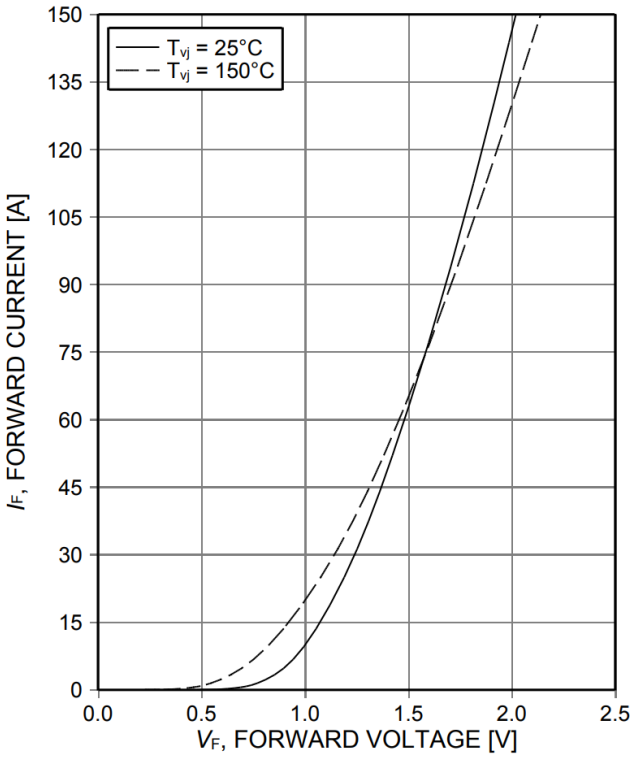


Figure 23. **Typical diode forward current as a function of forward voltage**

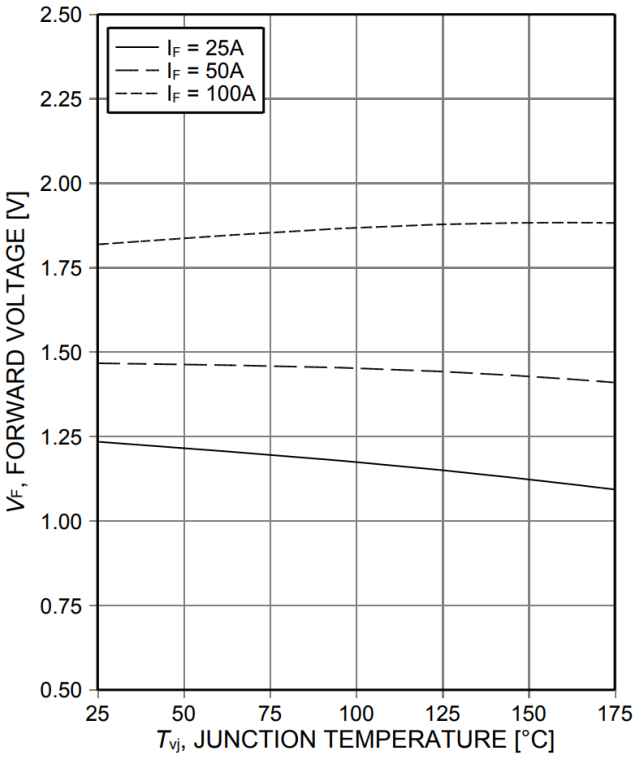
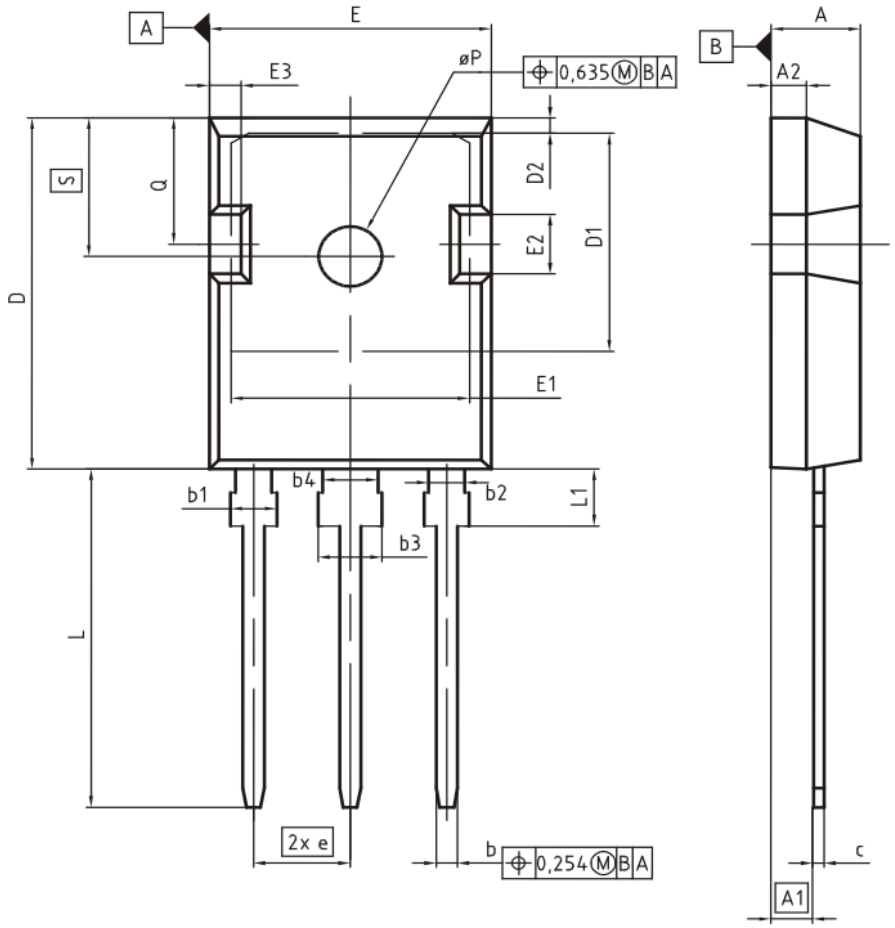


Figure 24. **Typical diode forward voltage as a function of junction temperature**

封装图 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

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Z8B00003327

SCALE
0 5 5 7.5mm

EUROPEAN PROJECTION

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05

测试条件

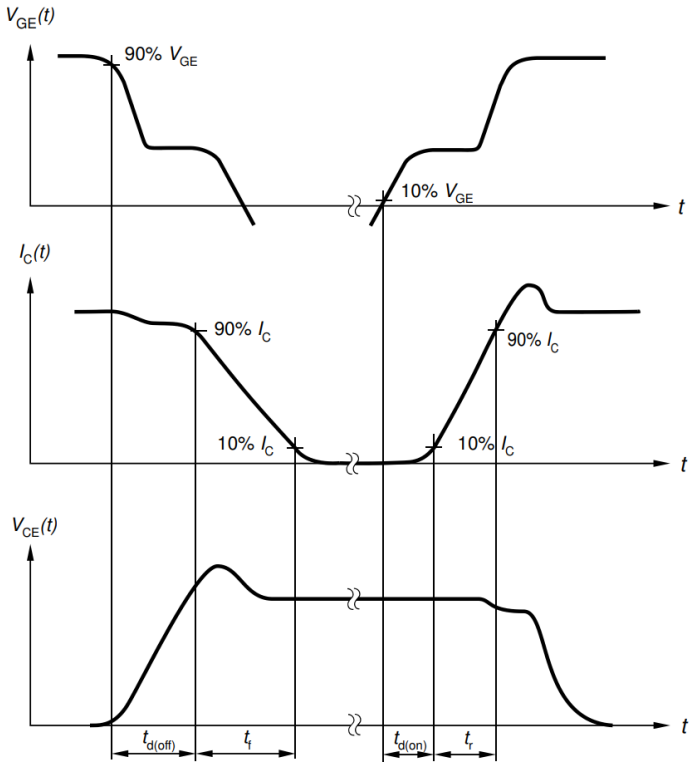

Figure A. **Definition of switching times**

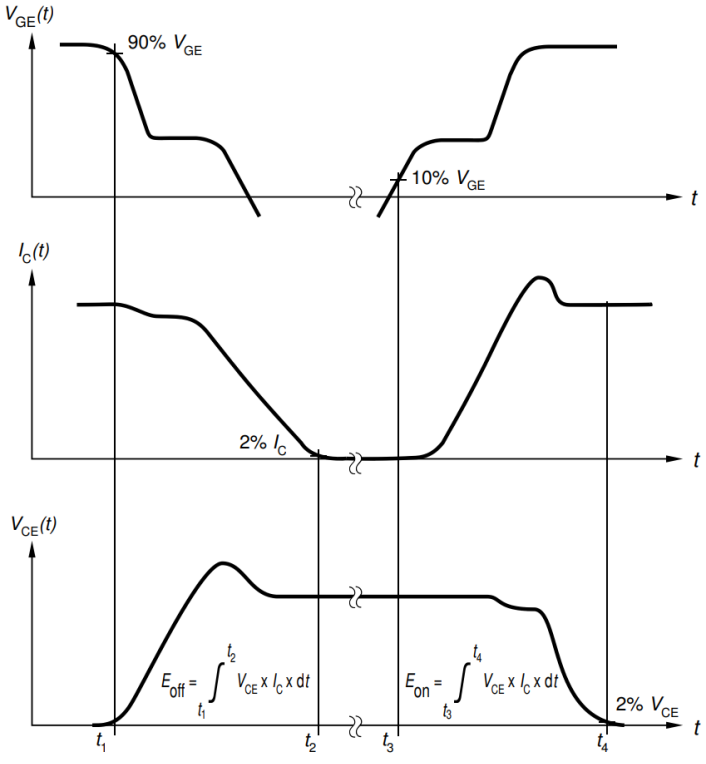

Figure B. **Definition of switching losses**

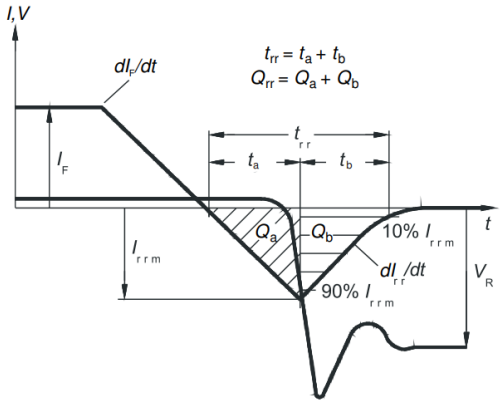

Figure C. **Definition of diode switching characteristics**

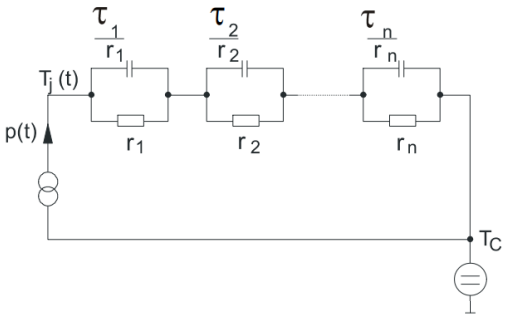

Figure D. **Thermal equivalent circuit**

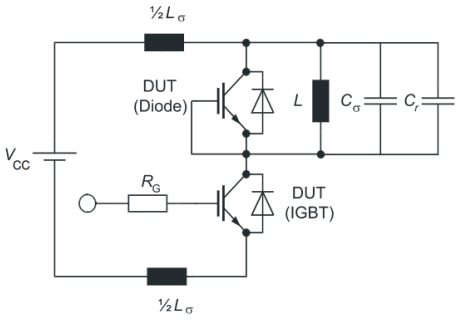

Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

修订记录

IKW50N65ES5

Revision: 2015-11-18, Rev. 2.3

历史修订版本

Revision	Date	Subjects (major changes since last revision)
1.1	2015-08-12	Preliminary data sheet
2.1	2015-09-22	Final data sheet
2.2	2015-10-16	Minor change Ic(VCE) Fig. 3 and Fig. 4
2.3	2015-11-18	Max rating IFpuls corrected

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