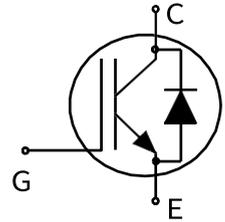


## 第五代高速开关系列

采用 TRENCHSTOP™ 5 技术的高速快开关IGBT，  
与 RAPID 1 快速软恢复反并联二极管共封装

### 特征和优点：

- 高速 F5 技术提供：
- 硬开关和谐振拓扑中的行业领先效率
  - 650 V 击穿电压
  - 低栅极电荷  $Q_G$
  - IGBT 与 RAPID 1 快速软恢复反并联二极管共封装
  - 最高结温 175°C
  - 经过动态压力测试
  - 符合 AEC-Q101 标准
  - 绿色封装（符合 RoHS 要求）
  - 完整的产品范围和 PSpice 模型：  
<http://www.infineon.com/igbt/>



### 应用：

- 车载充电器
- 车载充电器
- 直流/直流转换器
- 功率因数校正

### 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	$V_{CE}$	$I_C$	$V_{CEsat}, T_{vj}=25^\circ C$	$T_{vjmax}$	Marking	Package
AIKB50N65DF5	650V	50A	1.6V	175°C	AK50EDF5	PG-T0263-3

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](http://www.infineon.com) 参考最新的英文版本（控制文档）。

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## 第五代高速开关系列

## 最大额定值

Parameter	Symbol	Value	Unit
Collector-emitter voltage, $T_{vj} \geq 25^{\circ}\text{C}$	$V_{CE}$	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 56.0	A
Pulsed collector current, $t_p$ limited by $T_{vjmax}$ <sup>1)</sup>	$I_{Cpuls}$	150.0	A
Turn off safe operating area $V_{CE} \leq 650\text{V}$ , $T_{vj} \leq 175^{\circ}\text{C}$ , $t_p = 1\mu\text{s}$ <sup>1)</sup>	-	150.0	A
Diode forward current, limited by $T_{vjmax}$ $T_c = 25^{\circ}\text{C}$ value limited by bondwire $T_c$ = 100°C	$I_F$	42.0 26.0	A
Diode pulsed current, $t_p$ limited by $T_{vjmax}$ <sup>1)</sup>	$I_{Fpuls}$	150.0	A
Gate-emitter voltage Transient Gate-emitter voltage ( $t_p \leq 10\mu\text{s}$ , $D < 0.010$ )	$V_{GE}$	$\pm 20$ $\pm 30$	V
Power dissipation $T_c = 25^{\circ}\text{C}$ Power dissipation $T_c = 100^{\circ}\text{C}$	$P_{tot}$	305.0 152.5	W
Operating junction temperature	$T_{vj}$	-40...+175	$^{\circ}\text{C}$
Storage temperature	$T_{stg}$	-55...+150	$^{\circ}\text{C}$
Soldering temperature, reflow soldering (MSL1 according to JEDEC J-STA-020)		260	$^{\circ}\text{C}$

## 热阻抗

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	

 $R_{th}$  特性

IGBT thermal resistance, junction - case	$R_{th(j-c)}$		-	-	0.50	K/W
Diode thermal resistance, junction - case	$R_{th(j-c)}$		-	-	1.60	K/W
Thermal resistance, min. footprint junction - ambient	$R_{th(j-a)}$		-	-	65	K/W
Thermal resistance, 6cm <sup>2</sup> Cu on PCB junction - ambient	$R_{th(j-a)}$		-	-	40	K/W

<sup>1)</sup>由设计标定，不受限于生产测试。

## 第五代高速开关系列

除非另有规定，电气特性均为  $T_{vj} = 25^\circ\text{C}$ 

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b>静态特性</b>						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE} = 0V, I_C = 0.20mA$	650	-	-	V
Collector-emitter saturation voltage	$V_{CEsat}$	$V_{GE} = 15.0V, I_C = 50.0A$ $T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$ $T_{vj} = 175^\circ\text{C}$	-	1.60 1.80 1.90	2.10 - -	V
Diode forward voltage	$V_F$	$V_{GE} = 0V, I_F = 27.0A$ $T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$ $T_{vj} = 175^\circ\text{C}$	-	1.45 1.40 1.40	1.80 - -	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	$I_{CES}$	$V_{CE} = 650V, V_{GE} = 0V$ $T_{vj} = 25^\circ\text{C}$ $T_{vj} = 175^\circ\text{C}$	-	- 1000	40 -	$\mu\text{A}$
Gate-emitter leakage current	$I_{GES}$	$V_{CE} = 0V, V_{GE} = 20V$	-	-	100	nA
Transconductance	$g_{fs}$	$V_{CE} = 20V, I_C = 50.0A$	-	50.0	-	S

电气特性， $T_{vj} = 25^\circ\text{C}$ ，除非另有说明

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b>动态特性</b>						
Input capacitance	$C_{ies}$	$V_{CE} = 25V, V_{GE} = 0V, f = 1MHz$	-	3000	-	pF
Output capacitance	$C_{oes}$		-	65	-	
Reverse transfer capacitance	$C_{res}$		-	11	-	
Gate charge	$Q_G$	$V_{CC} = 520V, I_C = 50.0A,$ $V_{GE} = 15V$	-	115.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	$L_E$		-	7.0	-	nH

## 开关特性、感性负载

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
<b>IGBT 特性，<math>T_{vj} = 25^\circ\text{C}</math></b>						
Turn-on delay time	$t_{d(on)}$	$T_{vj} = 25^\circ\text{C},$ $V_{CC} = 400V, I_C = 25.0A,$ $V_{GE} = 0.0/15.0V,$ $R_{G(on)} = 12.0\Omega, R_{G(off)} = 12.0\Omega,$ $L\sigma = 30nH, C\sigma = 30pF$ $L\sigma, C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	23	-	ns
Rise time	$t_r$		-	16	-	ns
Turn-off delay time	$t_{d(off)}$		-	166	-	ns
Fall time	$t_f$		-	13	-	ns
Turn-on energy	$E_{on}$		-	0.55	-	mJ
Turn-off energy	$E_{off}$		-	0.11	-	mJ
Total switching energy	$E_{ts}$		-	0.66	-	mJ

## 第五代高速开关系列

Turn-on delay time	$t_{d(on)}$	$T_{vj} = 25^{\circ}\text{C}$ , $V_{CC} = 400\text{V}$ , $I_C = 6.0\text{A}$ , $V_{GE} = 0.0/15.0\text{V}$ , $R_{G(on)} = 12.0\Omega$ , $R_{G(off)} = 12.0\Omega$ , $L\sigma = 30\text{nH}$ , $C\sigma = 30\text{pF}$ $L\sigma$ , $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	20	-	ns
Rise time	$t_r$		-	5	-	ns
Turn-off delay time	$t_{d(off)}$		-	172	-	ns
Fall time	$t_f$		-	28	-	ns
Turn-on energy	$E_{on}$		-	0.13	-	mJ
Turn-off energy	$E_{off}$		-	0.04	-	mJ
Total switching energy	$E_{ts}$		-	0.17	-	mJ

二极管特性,  $T_{vj} = 25^{\circ}\text{C}$ 

Diode reverse recovery time	$t_{rr}$	$T_{vj} = 25^{\circ}\text{C}$ , $V_R = 400\text{V}$ , $I_F = 25.0\text{A}$ , $di_f/dt = 1225\text{A}/\mu\text{s}$	-	79	-	ns
Diode reverse recovery charge	$Q_{rr}$		-	0.65	-	$\mu\text{C}$
Diode peak reverse recovery current	$I_{rrm}$		-	14.9	-	A
Diode peak rate of fall of reverse recovery current during $t_b$	$di_{rr}/dt$		-	-235	-	A/ $\mu\text{s}$
Diode reverse recovery time	$t_{rr}$	$T_{vj} = 25^{\circ}\text{C}$ , $V_R = 400\text{V}$ , $I_F = 6.0\text{A}$ , $di_f/dt = 1335\text{A}/\mu\text{s}$	-	36	-	ns
Diode reverse recovery charge	$Q_{rr}$		-	0.32	-	$\mu\text{C}$
Diode peak reverse recovery current	$I_{rrm}$		-	14.3	-	A
Diode peak rate of fall of reverse recovery current during $t_b$	$di_{rr}/dt$		-	-805	-	A/ $\mu\text{s}$

## 开关特性、感性负载

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	

IGBT 特性,  $T_{vj} = 150^{\circ}\text{C}$ 

Turn-on delay time	$t_{d(on)}$	$T_{vj} = 150^{\circ}\text{C}$ , $V_{CC} = 400\text{V}$ , $I_C = 25.0\text{A}$ , $V_{GE} = 0.0/15.0\text{V}$ , $R_{G(on)} = 12.0\Omega$ , $R_{G(off)} = 12.0\Omega$ , $L\sigma = 30\text{nH}$ , $C\sigma = 30\text{pF}$ $L\sigma$ , $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	22	-	ns
Rise time	$t_r$		-	17	-	ns
Turn-off delay time	$t_{d(off)}$		-	179	-	ns
Fall time	$t_f$		-	9	-	ns
Turn-on energy	$E_{on}$		-	0.74	-	mJ
Turn-off energy	$E_{off}$		-	0.15	-	mJ
Total switching energy	$E_{ts}$		-	0.89	-	mJ
Turn-on delay time	$t_{d(on)}$	$T_{vj} = 150^{\circ}\text{C}$ , $V_{CC} = 400\text{V}$ , $I_C = 6.0\text{A}$ , $V_{GE} = 0.0/15.0\text{V}$ , $R_{G(on)} = 12.0\Omega$ , $R_{G(off)} = 12.0\Omega$ , $L\sigma = 30\text{nH}$ , $C\sigma = 30\text{pF}$ $L\sigma$ , $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	19	-	ns
Rise time	$t_r$		-	6	-	ns
Turn-off delay time	$t_{d(off)}$		-	205	-	ns
Fall time	$t_f$		-	19	-	ns
Turn-on energy	$E_{on}$		-	0.21	-	mJ
Turn-off energy	$E_{off}$		-	0.06	-	mJ
Total switching energy	$E_{ts}$		-	0.27	-	mJ

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 第五代高速开关系列

 二极管特性,  $T_{vj} = 150^{\circ}\text{C}$ 

Diode reverse recovery time	$t_{rr}$	$T_{vj} = 150^{\circ}\text{C}, V_R = 400\text{V}, I_F = 25.0\text{A}, di_F/dt = 1190\text{A}/\mu\text{s}$	-	117	-	ns
Diode reverse recovery charge	$Q_{rr}$		-	1.35	-	$\mu\text{C}$
Diode peak reverse recovery current	$I_{rrm}$		-	20.9	-	A
Diode peak rate of fall of reverse recovery current during $t_b$	$di_{rr}/dt$		-	-224	-	$\text{A}/\mu\text{s}$
Diode reverse recovery time	$t_{rr}$	$T_{vj} = 150^{\circ}\text{C}, V_R = 400\text{V}, I_F = 6.0\text{A}, di_F/dt = 1268\text{A}/\mu\text{s}$	-	63	-	ns
Diode reverse recovery charge	$Q_{rr}$		-	0.70	-	$\mu\text{C}$
Diode peak reverse recovery current	$I_{rrm}$		-	20.3	-	A
Diode peak rate of fall of reverse recovery current during $t_b$	$di_{rr}/dt$		-	-514	-	$\text{A}/\mu\text{s}$

第五代高速开关系列

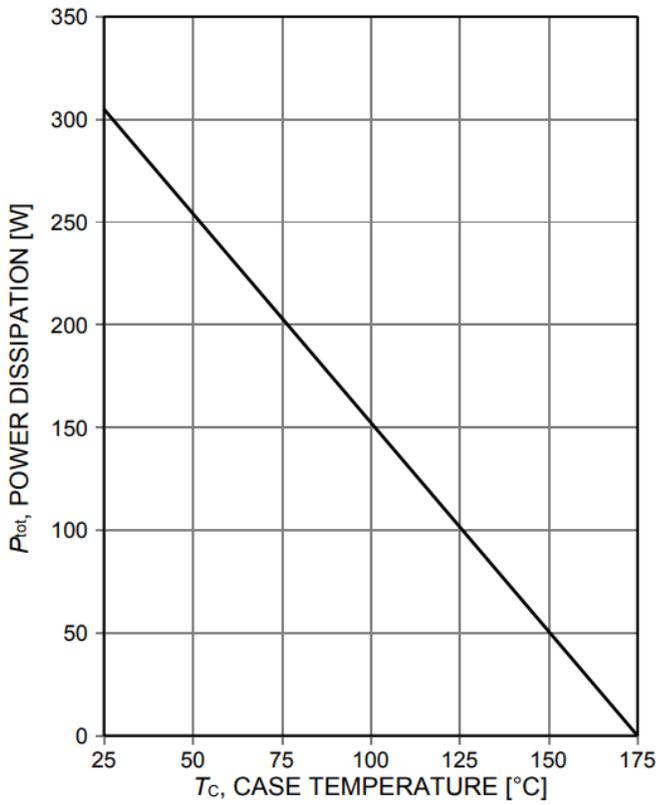


Figure 1. Power dissipation as a function of case temperature ( $T_{vj} \leq 175^\circ\text{C}$ )

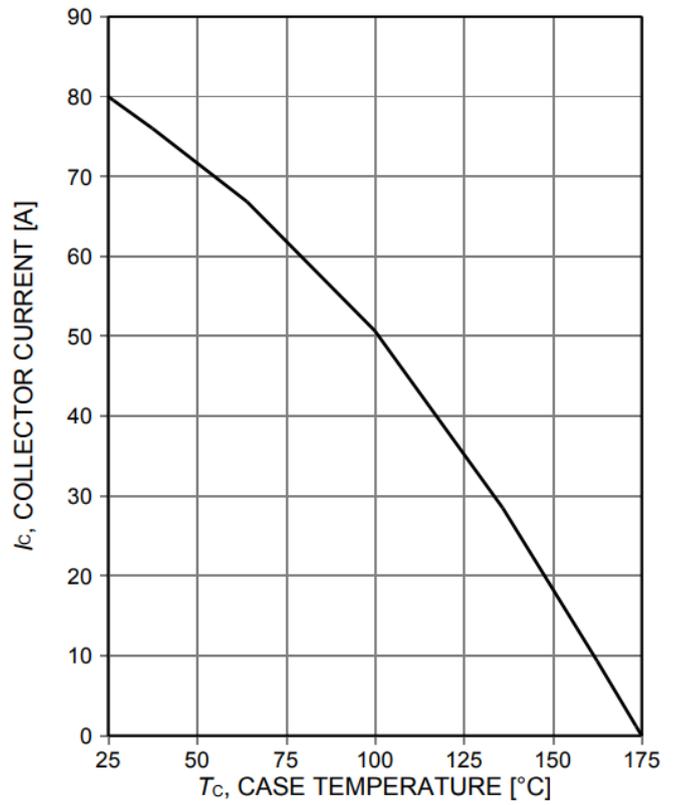


Figure 2. Collector current as a function of case temperature ( $V_{GE} \geq 15\text{V}$ ,  $T_{vj} \leq 175^\circ\text{C}$ )

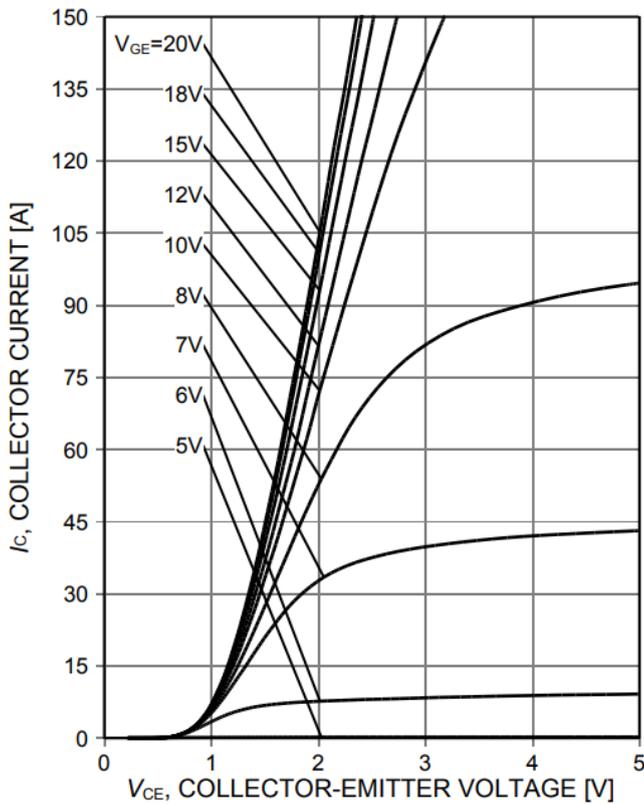


Figure 3. Typical output characteristic ( $T_{vj} = 25^\circ\text{C}$ )

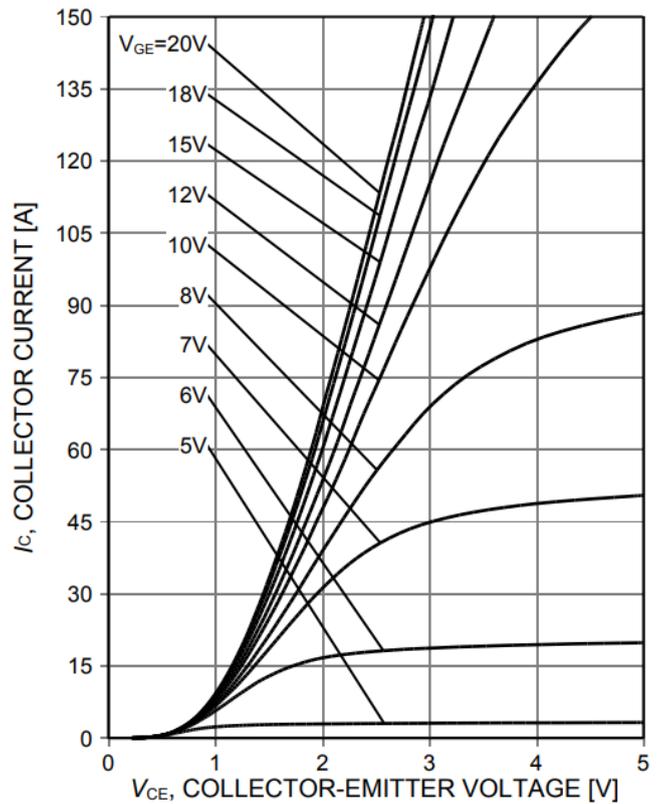


Figure 4. Typical output characteristic ( $T_{vj} = 150^\circ\text{C}$ )

第五代高速开关系列

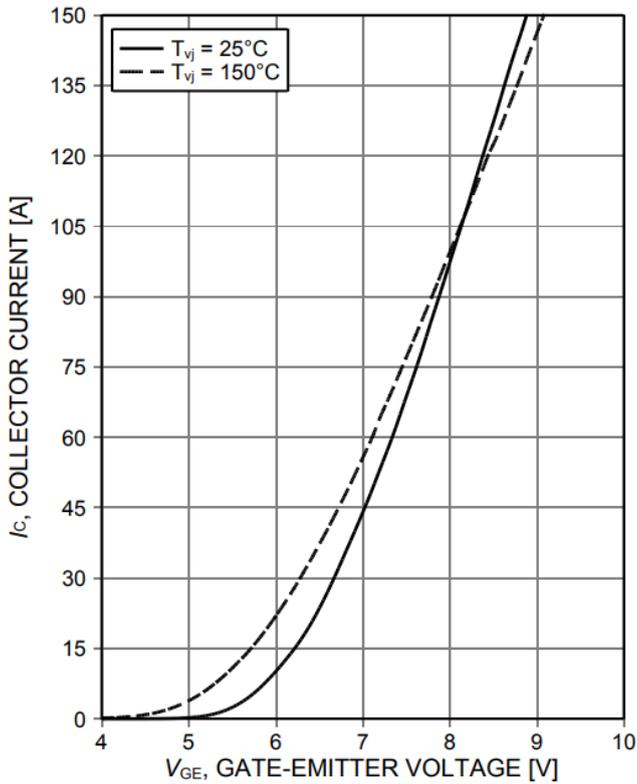


Figure 5. Typical transfer characteristic ( $V_{CE}=20V$ )

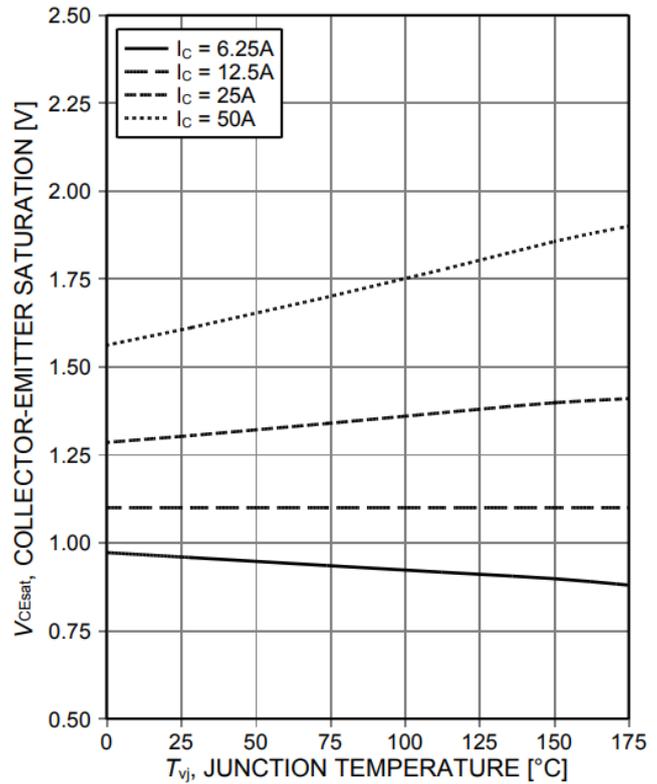


Figure 6. Typical collector-emitter saturation voltage as a function of junction temperature ( $V_{GE}=15V$ )

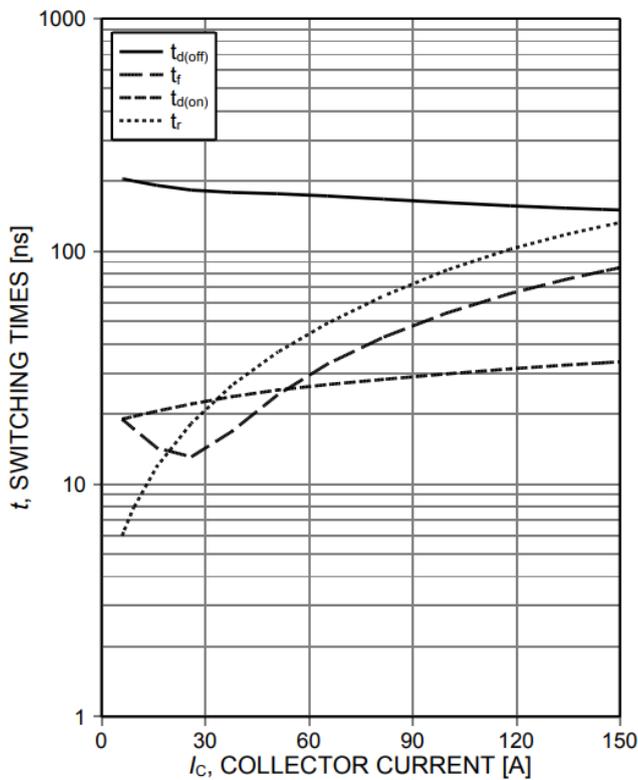


Figure 7. Typical switching times as a function of collector current (inductive load,  $T_{vj}=150^{\circ}C$ ,  $V_{CE}=400V$ ,  $V_{GE}=15/0V$ ,  $r_G=12\Omega$ , Dynamic test circuit in Figure E)

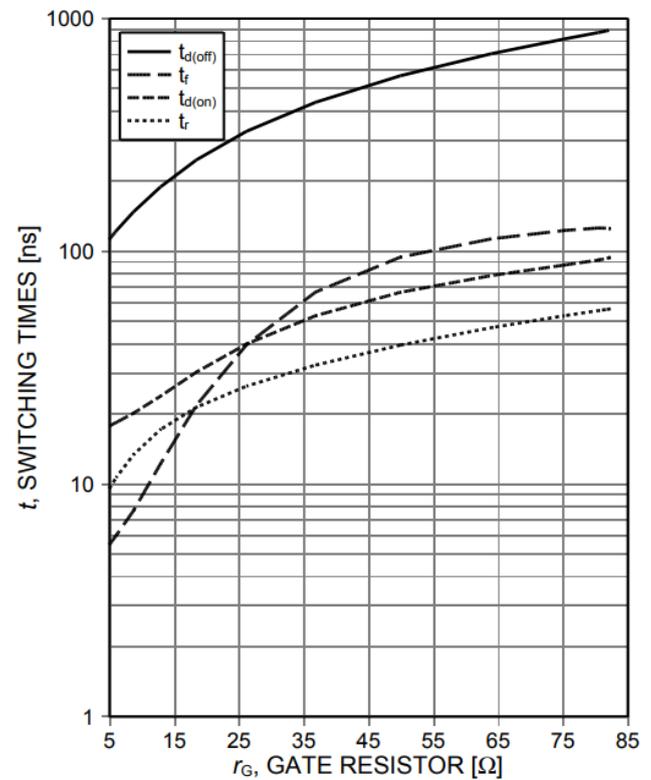


Figure 8. Typical switching times as a function of gate resistor (inductive load,  $T_{vj}=150^{\circ}C$ ,  $V_{CE}=400V$ ,  $V_{GE}=15/0V$ ,  $I_C=25A$ , Dynamic test circuit in Figure E)

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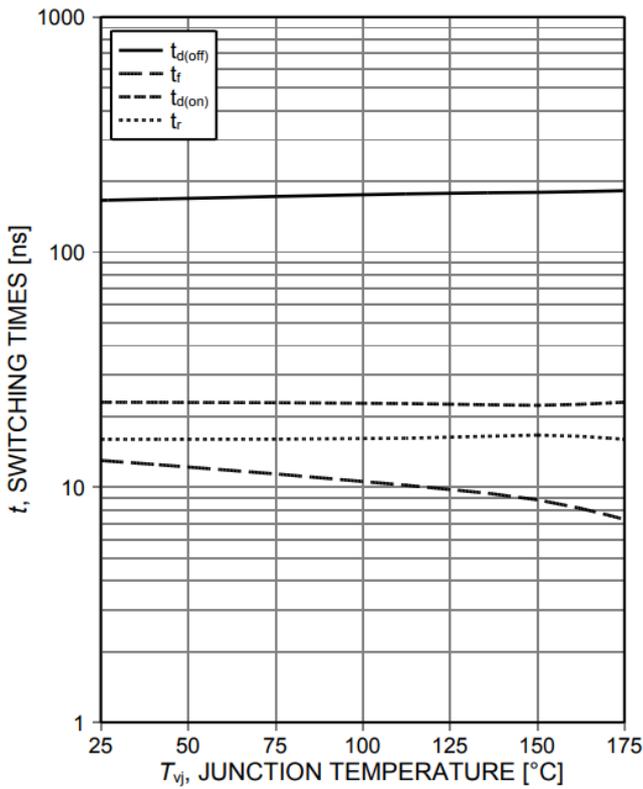


Figure 9. **Typical switching times as a function of junction temperature**  
 (inductive load,  $V_{CE}=400V$ ,  $V_{GE}=15/0V$ ,  $I_C=25A$ ,  $r_G=12\Omega$ , Dynamic test circuit in Figure E)

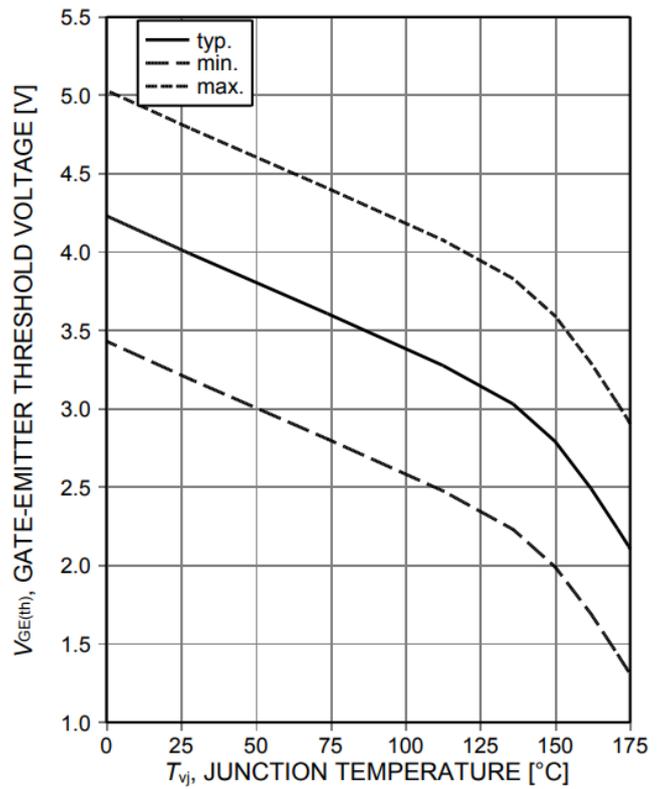


Figure 10. **Gate-emitter threshold voltage as a function of junction temperature**  
 ( $I_C=0.5mA$ )

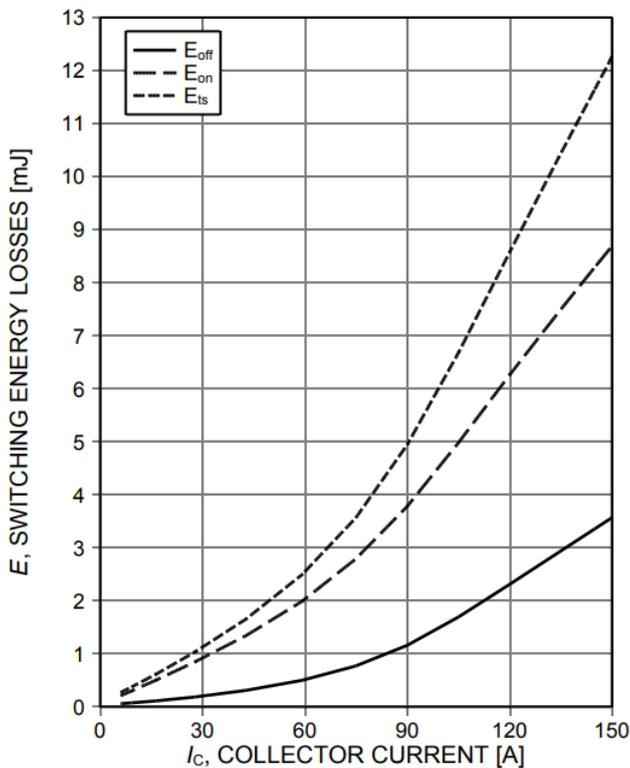


Figure 11. **Typical switching energy losses as a function of collector current**  
 (inductive load,  $T_{vj}=150^\circ C$ ,  $V_{CE}=400V$ ,  $V_{GE}=15/0V$ ,  $r_G=12\Omega$ , Dynamic test circuit in Figure E)

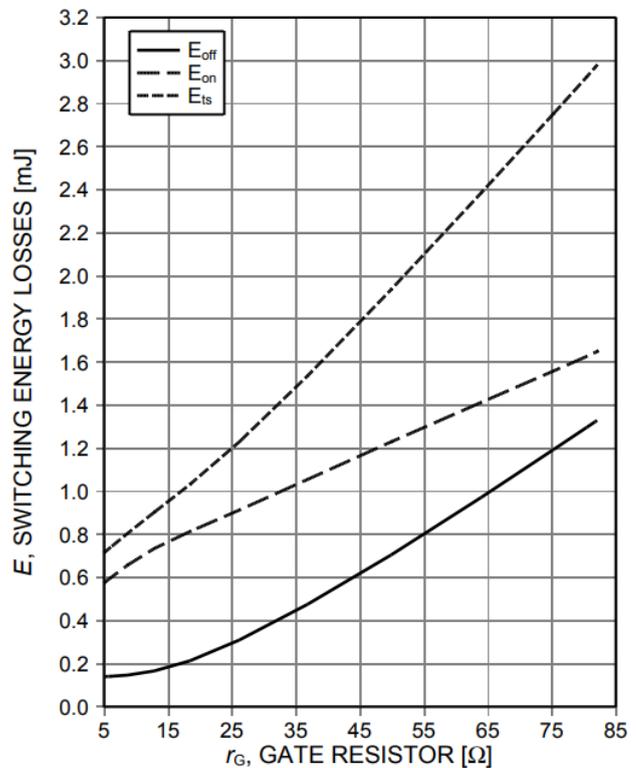


Figure 12. **Typical switching energy losses as a function of gate resistor**  
 (inductive load,  $T_{vj}=150^\circ C$ ,  $V_{CE}=400V$ ,  $V_{GE}=15/0V$ ,  $I_C=25A$ , Dynamic test circuit in Figure E)

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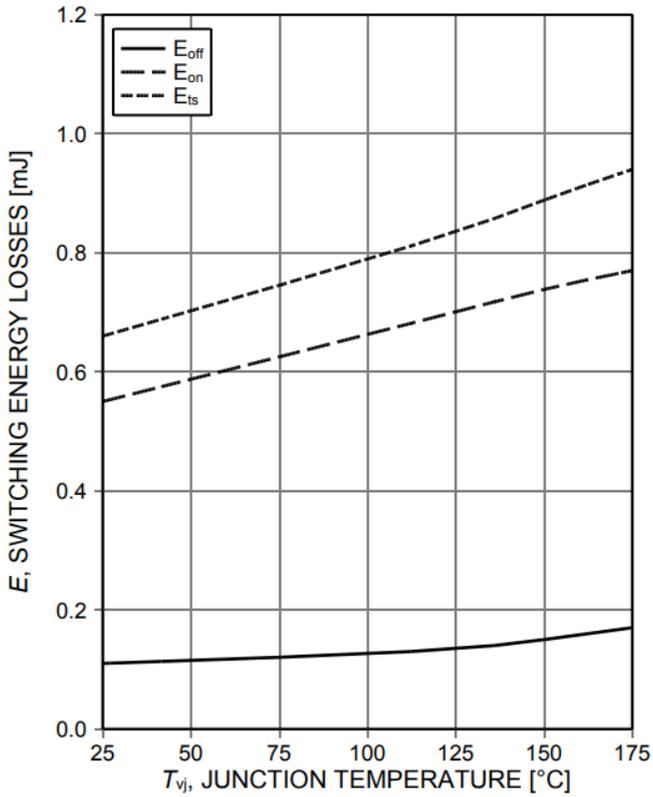


Figure 13. Typical switching energy losses as a function of junction temperature (inductive load,  $V_{CE}=400V$ ,  $V_{GE}=15/0V$ ,  $I_C=25A$ ,  $r_G=12\Omega$ , Dynamic test circuit in Figure E)

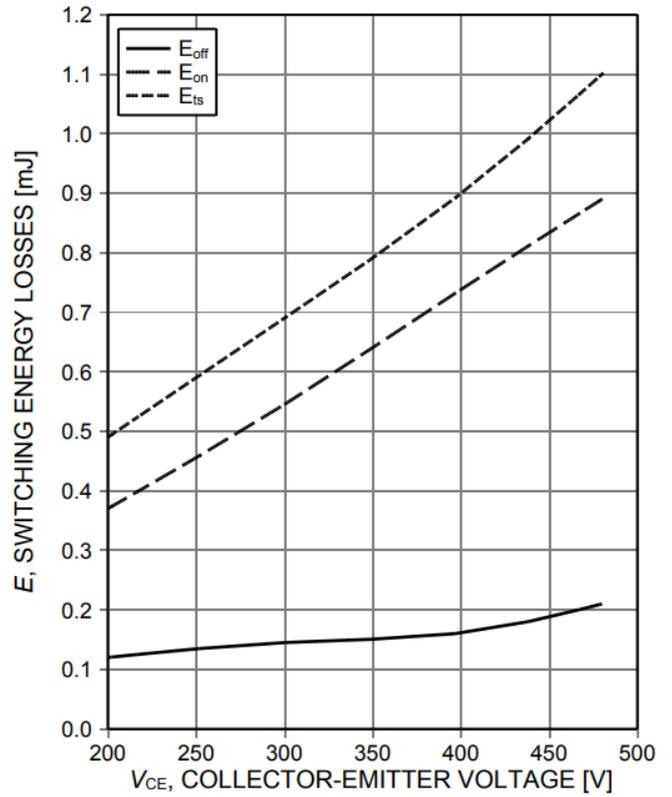


Figure 14. Typical switching energy losses as a function of collector emitter voltage (inductive load,  $T_{vj}=150^\circ C$ ,  $V_{GE}=15/0V$ ,  $I_C=25A$ ,  $r_G=12\Omega$ , Dynamic test circuit in Figure E)

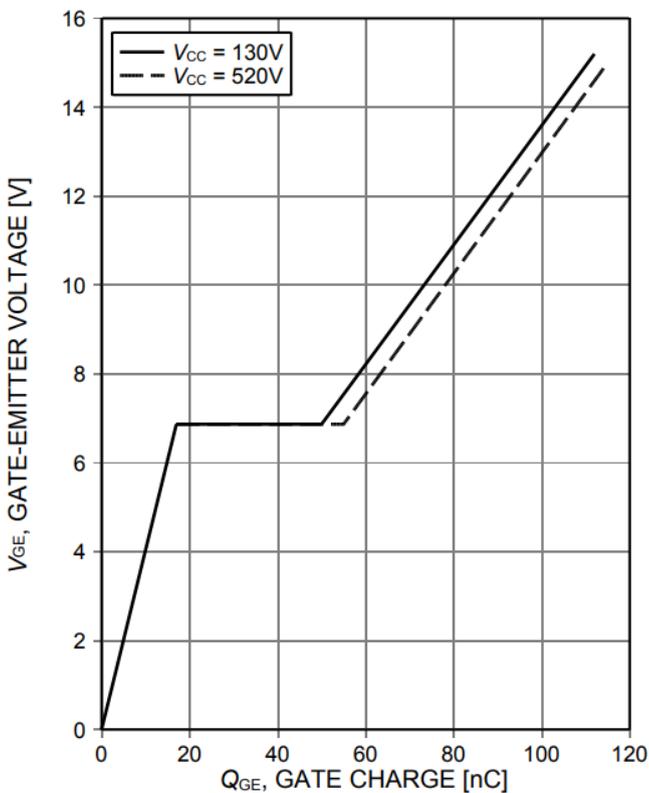


Figure 15. Typical gate charge ( $I_C=50A$ )

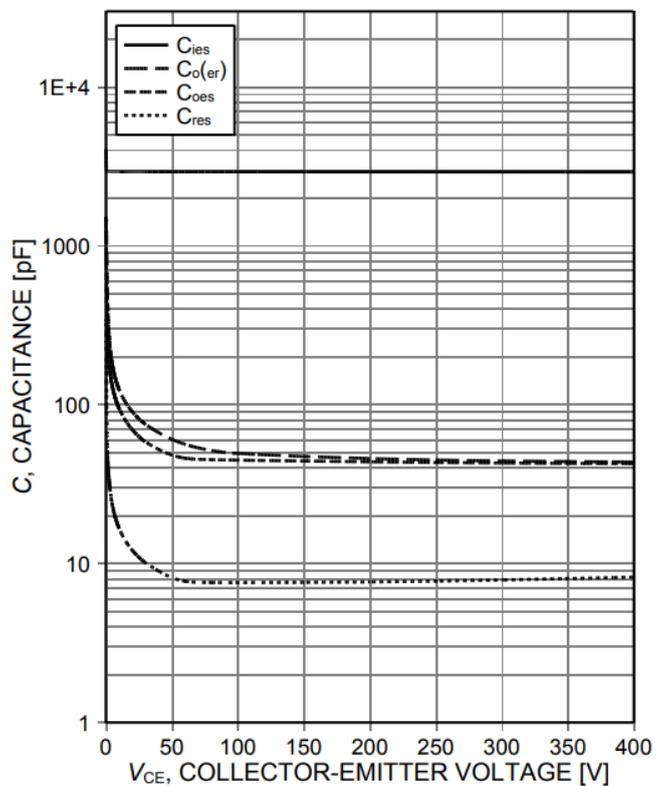


Figure 16. Typical capacitance as a function of collector-emitter voltage ( $V_{GE}=0V$ ,  $f=1MHz$ )

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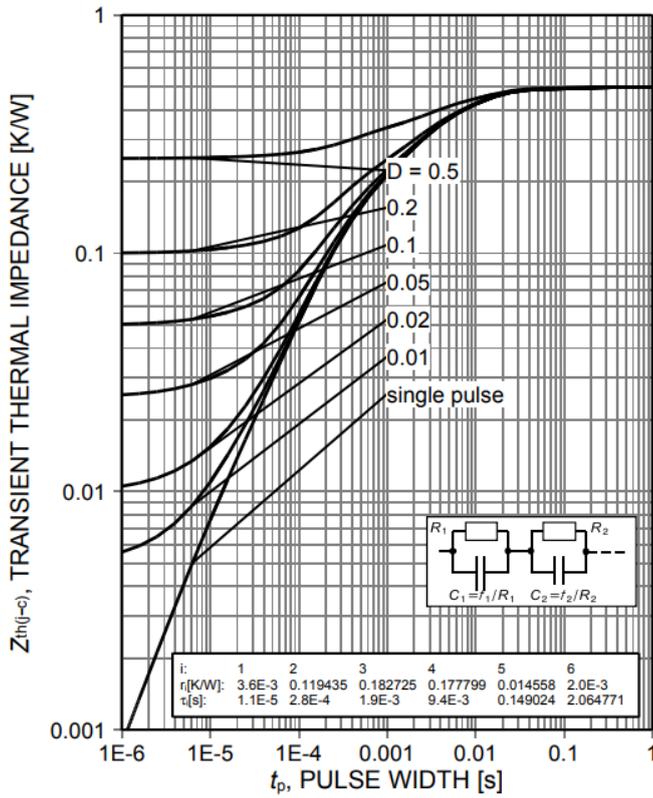


Figure 17. IGBT transient thermal impedance ( $D=t_p/T$ )

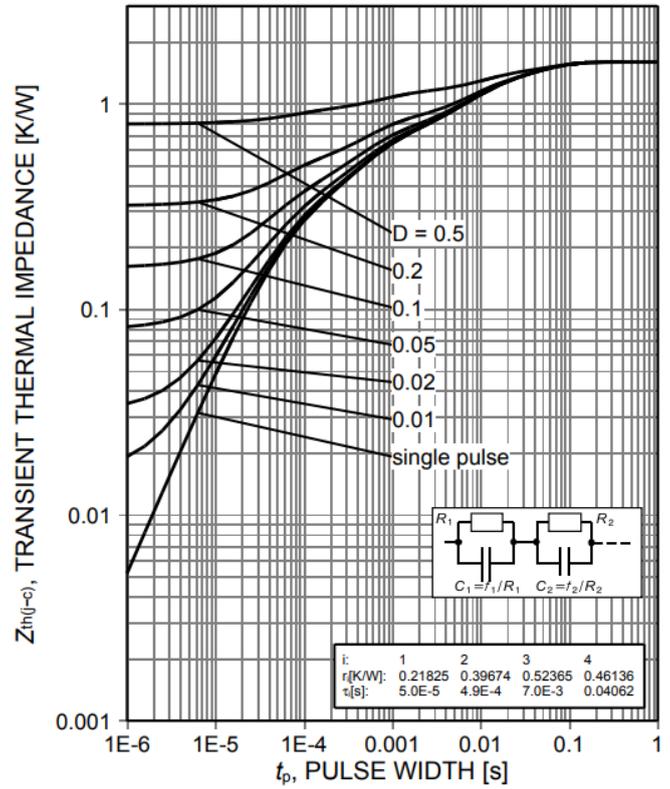


Figure 18. Diode transient thermal impedance as a function of pulse width ( $D=t_p/T$ )

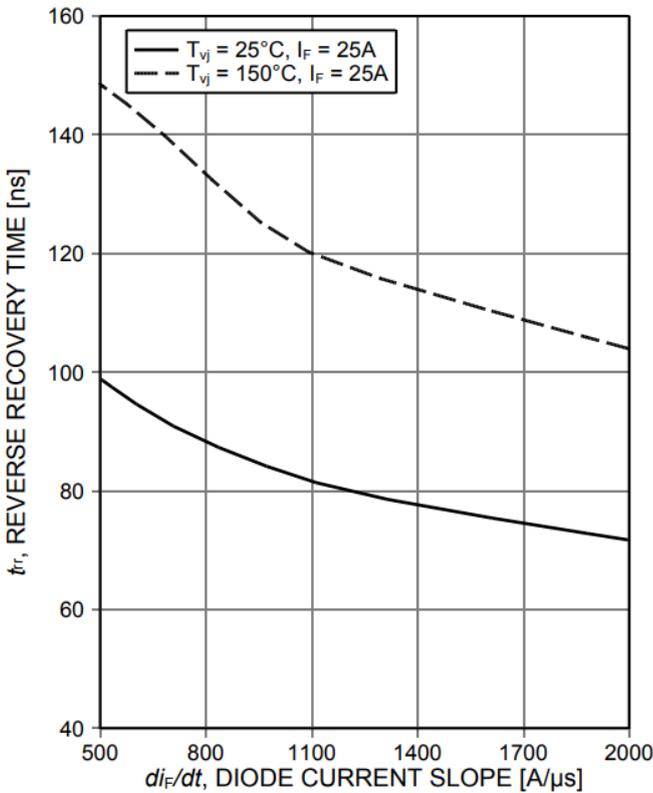


Figure 19. Typical reverse recovery time as a function of diode current slope ( $V_R=400V$ )

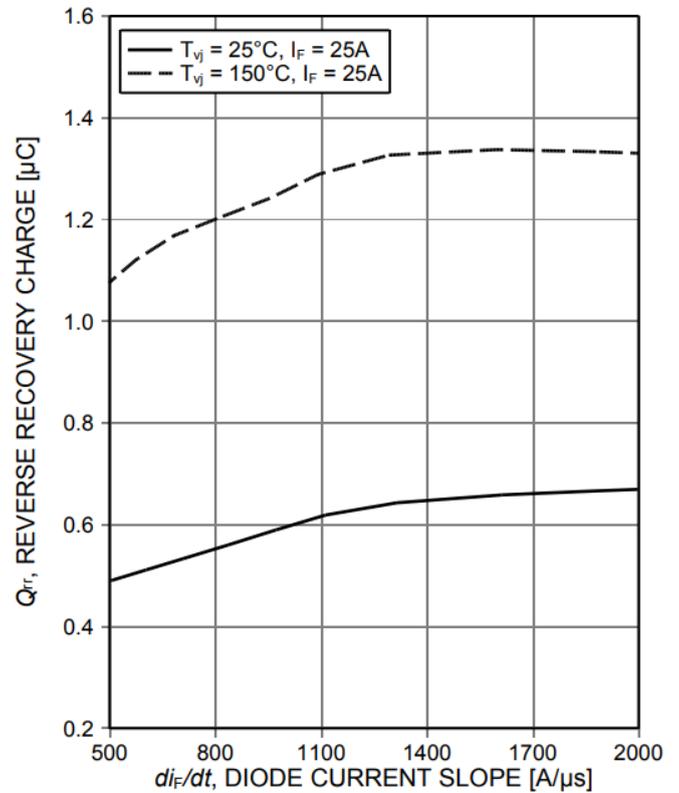


Figure 20. Typical reverse recovery charge as a function of diode current slope ( $V_R=400V$ )

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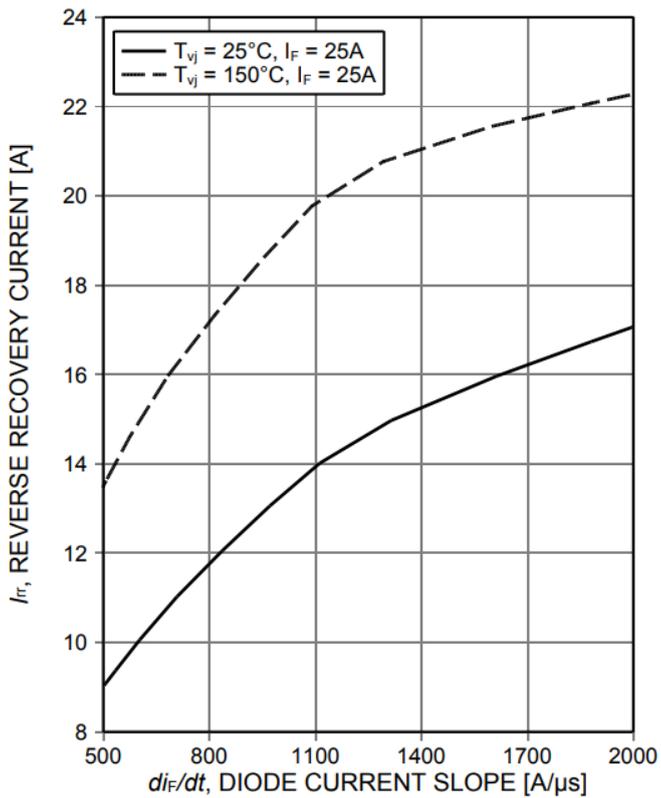


Figure 21. Typical reverse recovery current as a function of diode current slope ( $V_R=400V$ )

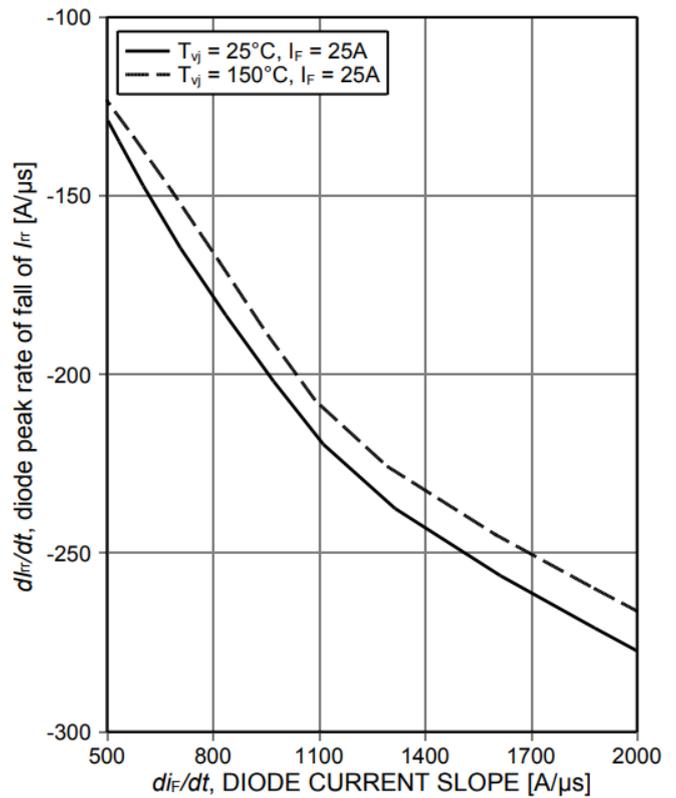


Figure 22. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope ( $V_R=400V$ )

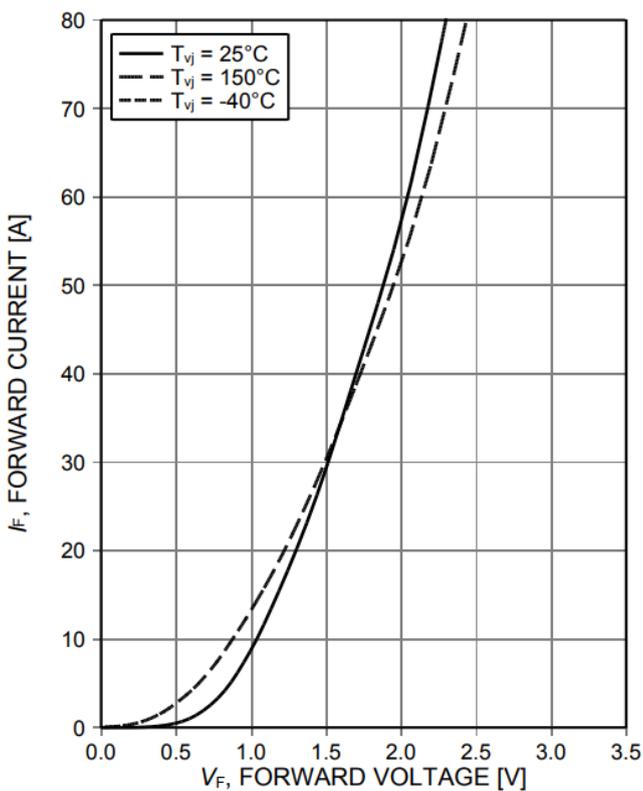


Figure 23. Typical diode forward current as a function of forward voltage

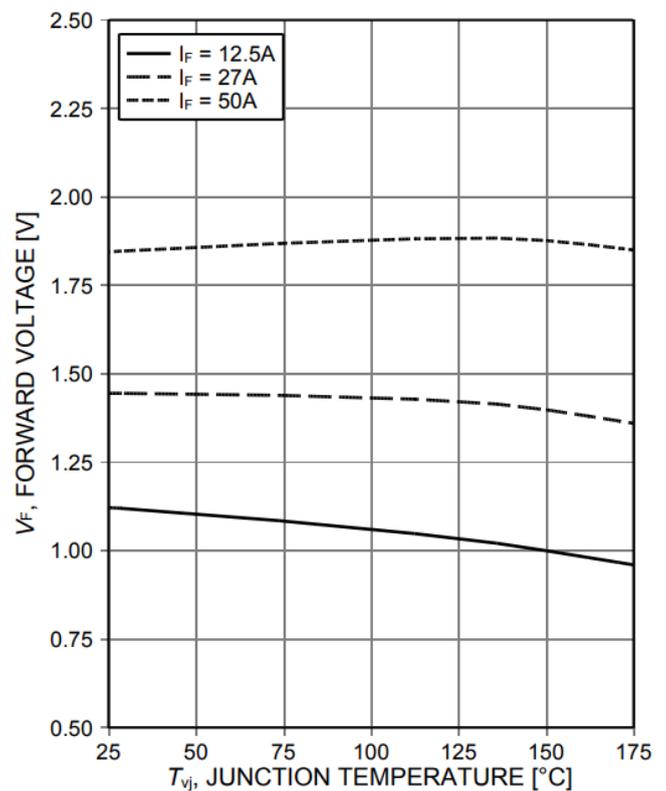
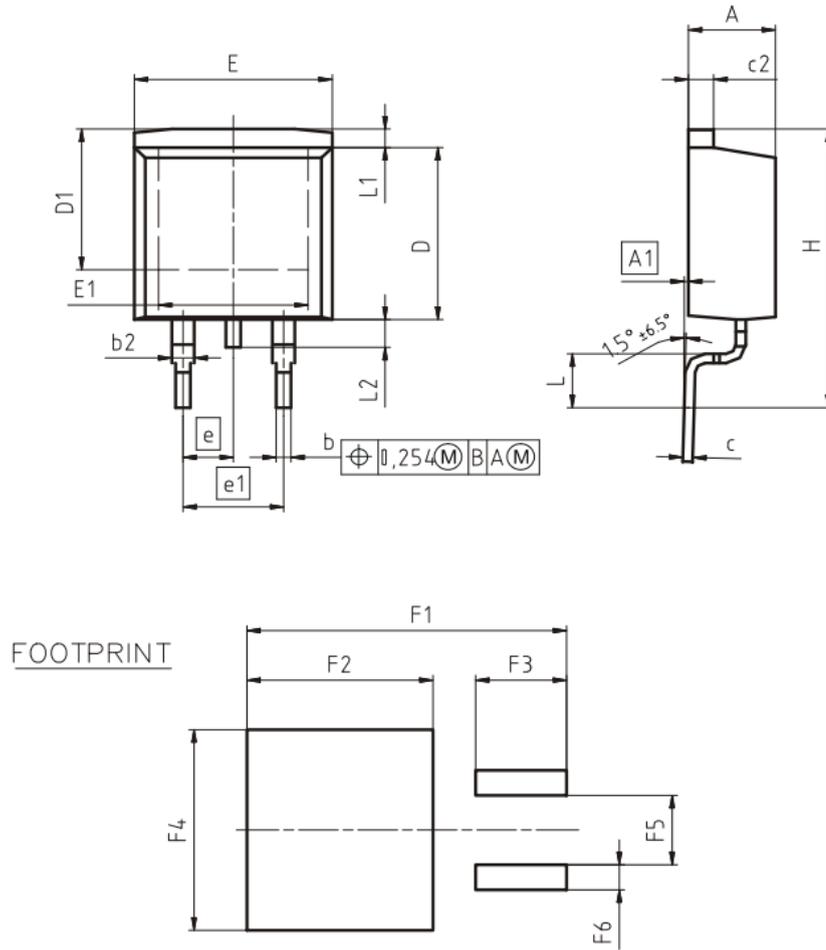


Figure 24. Typical diode forward voltage as a function of junction temperature

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封装图 PG-T0263-3



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.30	4.57	0.169	0.180
A1	0.00	0.25	0.000	0.010
b	0.65	0.85	0.026	0.033
b2	0.95	1.15	0.037	0.045
c	0.33	0.65	0.013	0.026
c2	1.17	1.40	0.046	0.055
D	8.51	9.45	0.335	0.372
D1	7.10	7.90	0.280	0.311
E	9.80	10.31	0.386	0.406
E1	6.50	8.60	0.256	0.339
e	2.54		0.100	
e1	5.08		0.200	
N	2		2	
H	14.61	15.88	0.575	0.625
L	2.29	3.00	0.090	0.118
L1	0.70	1.60	0.028	0.063
L2	1.00	1.78	0.039	0.070
F1	16.05	16.25	0.632	0.640
F2	9.30	9.50	0.366	0.374
F3	4.50	4.70	0.177	0.185
F4	10.70	10.90	0.421	0.429
F5	3.65	3.85	0.144	0.152
F6	1.25	1.45	0.049	0.057

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7.5mm

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第五代高速开关系列

测试条件

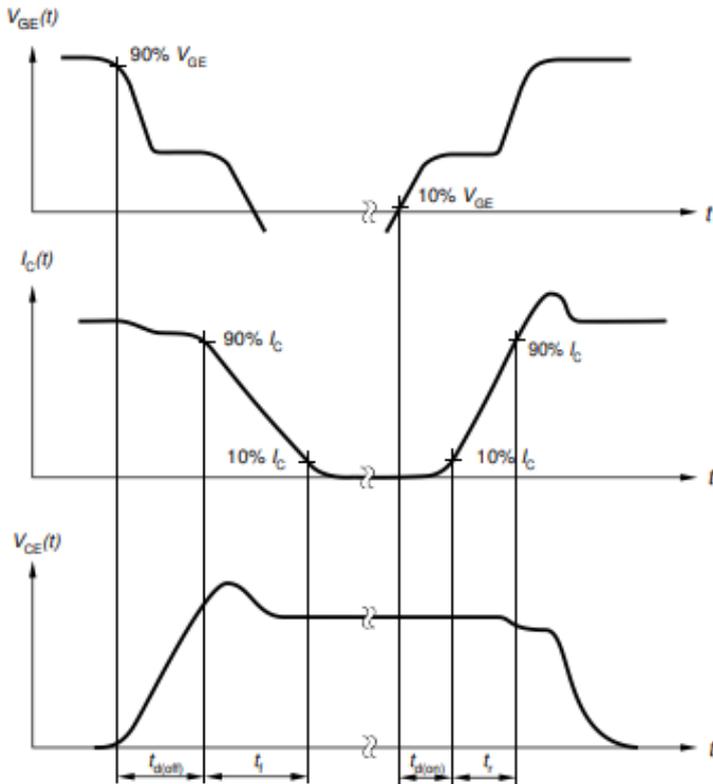


Figure A. Definition of switching times

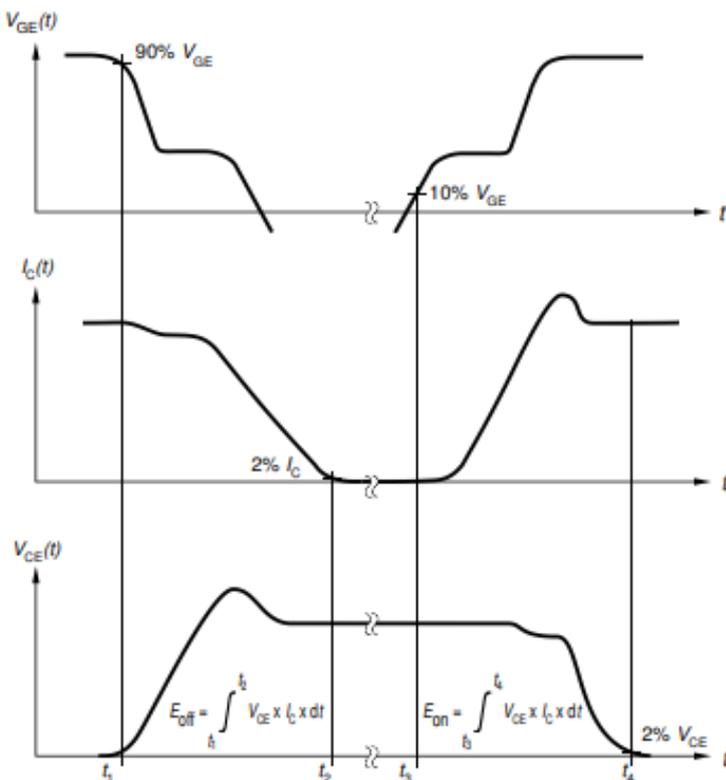


Figure B. Definition of switching losses

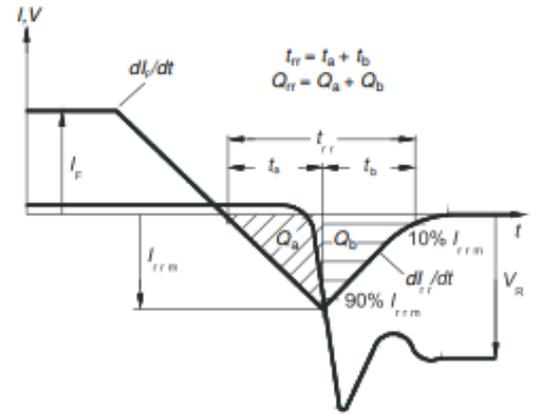


Figure C. Definition of diode switching characteristics

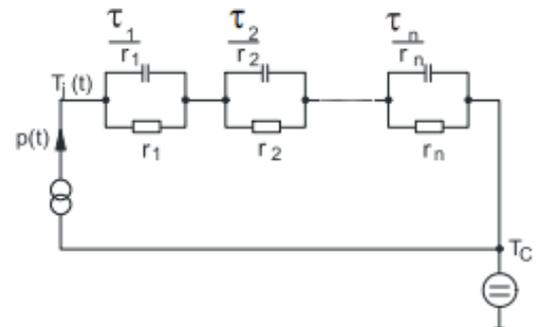


Figure D. Thermal equivalent circuit

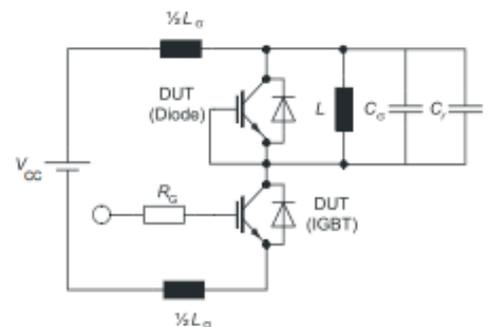


Figure E. **Dynamic test circuit**  
Parasitic inductance  $L_G$ ,  
parasitic capacitor  $C_G$ ,  
relief capacitor  $C_r$   
(only for ZVT switching)

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第五代高速开关系列

修订记录

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AIKB50N65DF5

**Revision: 2019-10-17, Rev. 2.1**

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历史修订版本

Revision	Date	Subjects (major changes since last revision)
2.1	2019-10-17	Final Datasheet



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