

IGBT

采用 TRENCHSTOP™ 5 技术的低 $V_{CE(sat)}$ IGBT 与 RAPID 1 快速软反并联二极管共同封装

IKW30N65EL5

英飞凌 650V DuoPack IGBT 和二极管

低 $V_{CE(sat)}$ 系列第五代

数据手册

工业功率控制

英飞凌低 $V_{CE(sat)}$ 系列第五代

采用 TRENCHSTOP™ 5 技术的低 $V_{CE(sat)}$ IGBT 与 RAPID 1 快速软反并联二极管共同封装

特征和优点:

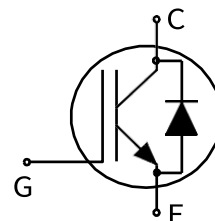
低 $V_{CE(sat)}$ L5 技术产品

- 极低的集电极-发射极饱和电压 V_{CEsat}
- 传导损耗和开关损耗之间的最佳平衡
- 650 V 击穿电压
- 低栅极电荷 Q_G
- 最高结温 175°C
- 符合 JEDEC 目标应用要求
- 无铅电镀
- 符合 RoHS 标准
- 完整的产品品类和 PSpice 模型:

<http://www.infineon.com/igbt/>

应用:

- UPS (不间断电源)
- 太阳能光伏逆变器
- 焊接机



关键性能和封装参数

Type	V_{CE}	I_C	$V_{CEsat}, T_{vj}=25^{\circ}\text{C}$	T_{vjmax}	Marking	Package
IKW30N65EL5	650V	30A	1.05V	175°C	K30EEL5	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）。

低 $V_{CE(sat)}$ 系列第五代

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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, $T_{vj} \geq 25^{\circ}\text{C}$	V_{CE}	650	V
DC collector current, limited by T_{vjmax} T_c = 25°C value limited by bondwire $T_c = 100^{\circ}\text{C}$	I_C	85.0 62.0	A
Pulsed collector current, t_p limited by T_{vjmax} ¹⁾	I_{Cpuls}	120.0	A
Turn off safe operating area $V_{CE} \leq 650\text{V}$, $T_{vj} \leq 175^{\circ}\text{C}$, $t_p = 1\mu\text{s}$ ¹⁾	-	120.0	A
Diode forward current, limited by T_{vjmax} $T_c = 25^{\circ}\text{C}$ value limited by bondwire $T_c = 100^{\circ}\text{C}$	I_F	50.0 41.0	A
Diode pulsed current, t_p limited by T_{vjmax} ¹⁾	I_{FPuls}	120.0	A
Gate-emitter voltage Transient Gate-emitter voltage ($t_p \leq 10\mu\text{s}$, $D < 0.010$)	V_{GE}	± 20 ± 30	V
Power dissipation $T_c = 25^{\circ}\text{C}$ Power dissipation $T_c = 100^{\circ}\text{C}$	P_{tot}	227.0 114.0	W
Operating junction temperature	T_{vj}	$-40 \dots +175$	$^{\circ}\text{C}$
Storage temperature	T_{stg}	$-55 \dots +150$	$^{\circ}\text{C}$
Soldering temperature, ²⁾ wave soldering 1.6mm (0.063in.) from case for 10s		260	$^{\circ}\text{C}$
Mounting torque, M3 screw Maximum of mounting processes: 3	M	0.6	Nm

热阻抗

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	

 R_{th} 特性

IGBT thermal resistance, junction - case	$R_{th(j-c)}$		-	-	0.66	K/W
Diode thermal resistance, junction - case	$R_{th(j-c)}$		-	-	0.95	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		-	-	40	K/W

¹⁾由设计标定，不受限于生产测试。

²⁾封装不推荐用于表面贴装应用

低 $V_{CE(sat)}$ 系列第五代电气特性，测于 $T_{vj} = 25^{\circ}\text{C}$ 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}	$V_{GE} = 15.0V, I_C = 30.0A$ $T_{vj} = 25^{\circ}C$ T_{vj} $= 100^{\circ}C$ $T_{vj} =$ $150^{\circ}C$	- - -	1.05 1.05 1.04	1.35 - -	V
Diode forward voltage	V_F	$V_{GE} = 0V, I_F = 30.0A$ $T_{vj} = 25^{\circ}C$ T_{vj} $= 100^{\circ}C$ $T_{vj} =$ $150^{\circ}C$	- - -	1.35 1.32 1.28	1.70 - -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C = 0.40mA, V_{CE} = 20V$	4.2	5.0	5.8	V
Zero gate voltage collector current	I_{CES}	$V_{CE} = 650V, V_{GE} = 0V$ $T_{vj} = 25^{\circ}C$ T_{vj} $= 150^{\circ}C$ $T_{vj} =$ $175^{\circ}C$	- - -	- 400 2000	40 - -	μA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0V, V_{GE} = 20V$	-	-	100	nA
Transconductance	g_{fs}	$V_{CE} = 20V, I_C = 30.0A$	-	65.0	-	S

电气特性，测于 $T_{vj} = 25^{\circ}\text{C}$ 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}	$V_{CE} = 25V, V_{GE} = 0V$ $f = 1000kHz$	-	4600	-	pF
Output capacitance	C_{oes}		-	64	-	
Reverse transfer capacitance	C_{res}		-	18	-	
Gate charge	Q_G	$V_{CC} = 520V, I_C = 30.0A,$ $V_{GE} = 15V$	-	168.0	-	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 $T_{vj} = 25^{\circ}\text{C}$ 的条件下						
Turn-on delay time	$t_{d(\text{on})}$	$T_{vj} = 25^{\circ}\text{C},$ $V_{CC} = 400\text{V}, I_c = 30.0\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(\text{on})} = 10.0\Omega, R_{G(\text{off})} = 10.0\Omega,$ $L\sigma = 60\text{nH}, C\sigma = 30\text{pF}$ $L\sigma, C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	33	-	ns
Rise time	t_r		-	11	-	ns
Turn-off delay time	$t_{d(\text{off})}$		-	308	-	ns
Fall time	t_f		-	51	-	ns
Turn-on energy	E_{on}		-	0.47	-	mJ
Turn-off energy	E_{off}		-	1.35	-	mJ
Total switching energy	E_{ts}		-	1.82	-	mJ

低 $V_{CE(sat)}$ 系列第五代二极管特性, $T_{vj} = 25^{\circ}\text{C}$

Diode reverse recovery time	t_{rr}	$T_{vj} = 25^{\circ}\text{C},$ $V_R = 400\text{V}, I_F = 30.0\text{A},$ $di_F/dt = 1500\text{A}/\mu\text{s}$	-	87	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.91	-	μC
Diode peak reverse recovery current	I_{rrm}		-	21.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-1250	-	$\text{A}/\mu\text{s}$

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	$t_{d(on)}$	$T_{vj} = 150^{\circ}\text{C},$ $V_{CC} = 400\text{V}, I_C = 30.0\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(on)} = 10.0\Omega, R_{G(off)} = 10.0\Omega,$ $L\sigma = 60\text{nH}, C\sigma = 30\text{pF}$ $L\sigma, C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	31	-	ns
Rise time	t_r		-	13	-	ns
Turn-off delay time	$t_{d(off)}$		-	370	-	ns
Fall time	t_f		-	150	-	ns
Turn-on energy	E_{on}		-	0.68	-	mJ
Turn-off energy	E_{off}		-	2.18	-	mJ
Total switching energy	E_{ts}		-	2.86	-	mJ

二极管特性, $T_{vj} = 150^{\circ}\text{C}$

Diode reverse recovery time	t_{rr}	$T_{vj} = 150^{\circ}\text{C}, V_R = 400\text{V}, I_F = 30.0\text{A},$ $di_F/dt = 1500\text{A}/\mu\text{s}$	-	100	-	ns
Diode reverse recovery charge	Q_{rr}		-	1.91	-	μC
Diode peak reverse recovery current	I_{rrm}		-	28.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-1075	-	$\text{A}/\mu\text{s}$

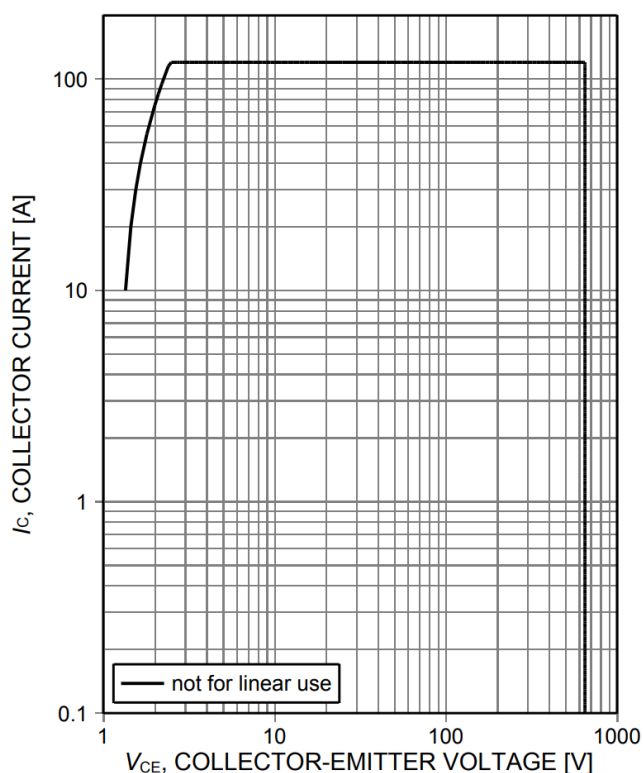
低 $V_{CE(sat)}$ 系列第五代

Figure 1. **Forward bias safe operating area**
($D=0$, $T_C=25^\circ\text{C}$, $T_{vj}\leq 175^\circ\text{C}$, $V_{GE}=15\text{V}$, $t_p=1\mu\text{s}$,
 I_{Cmax} defined by design - not subject to production test)

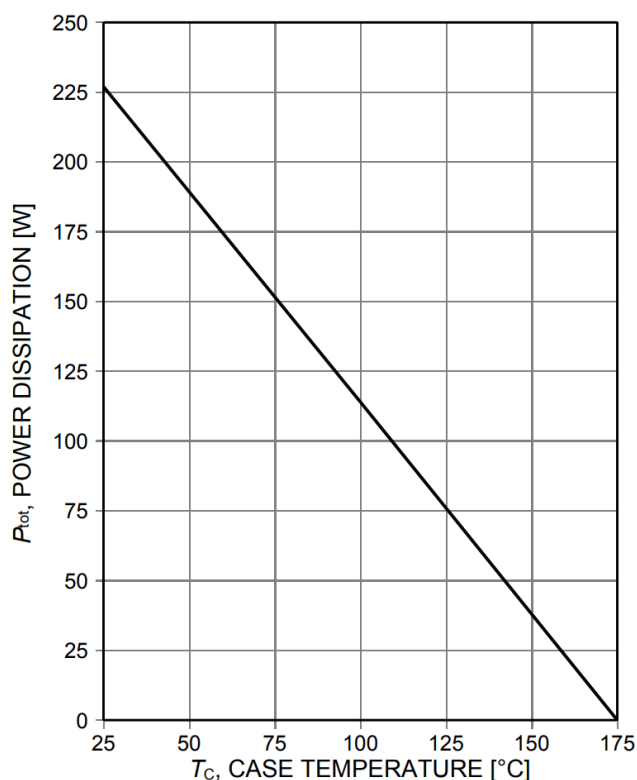


Figure 2. **Power dissipation as a function of case temperature**
($T_{vj}\leq 175^\circ\text{C}$)

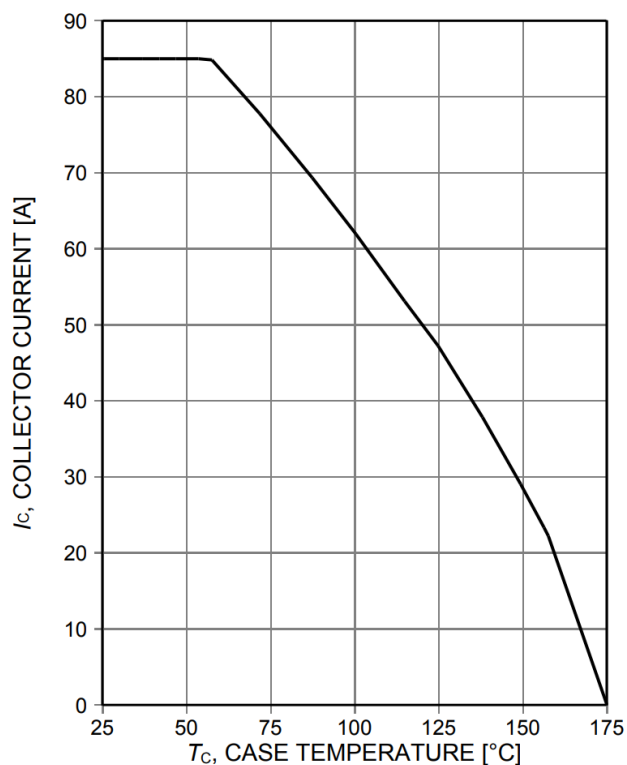


Figure 3. **Collector current as a function of case temperature**
($V_{GE}\geq 15\text{V}$, $T_{vj}\leq 175^\circ\text{C}$)

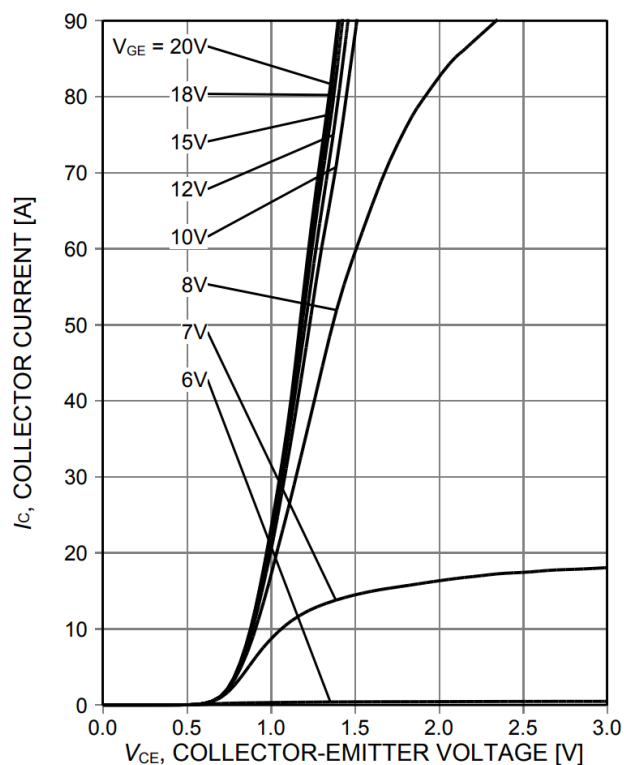
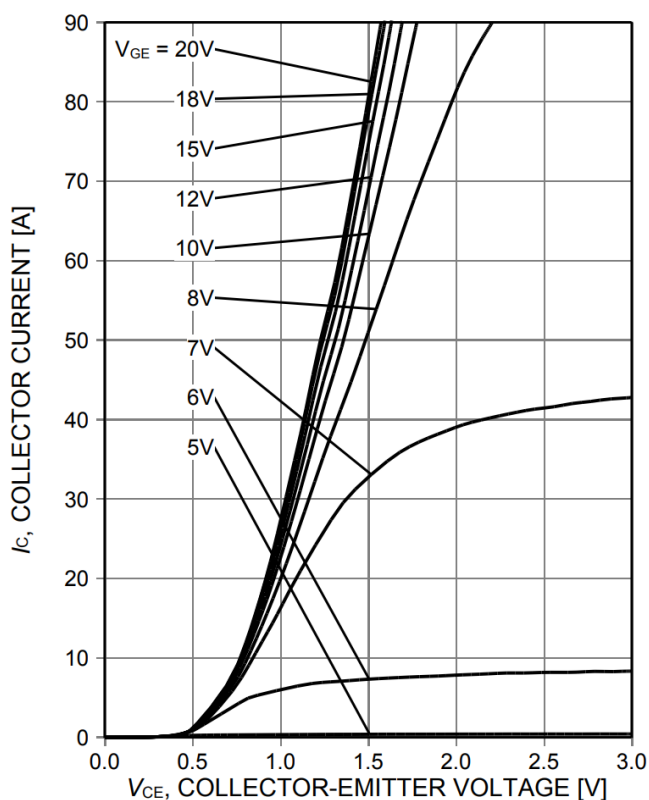
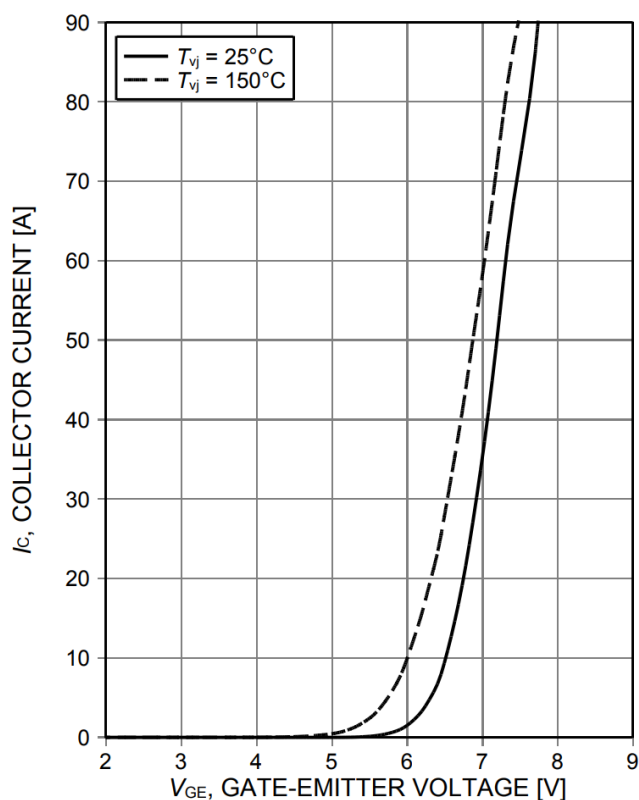
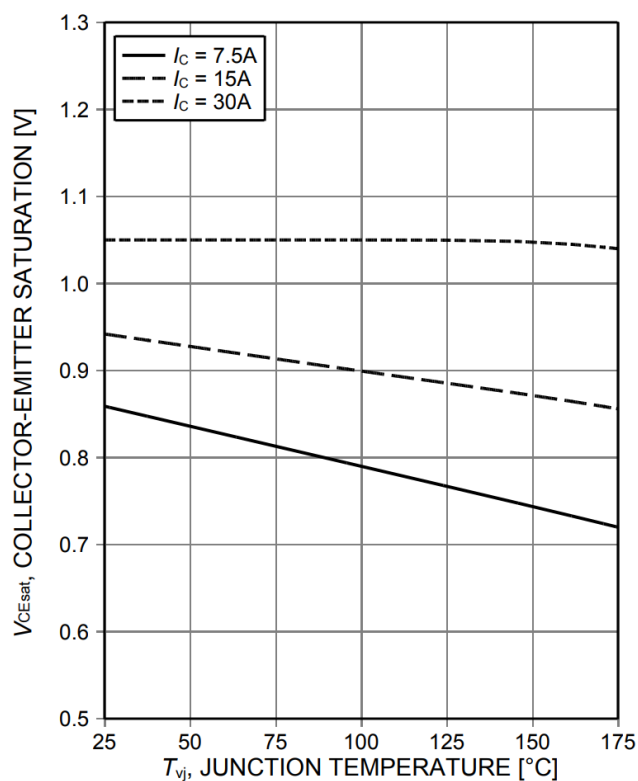
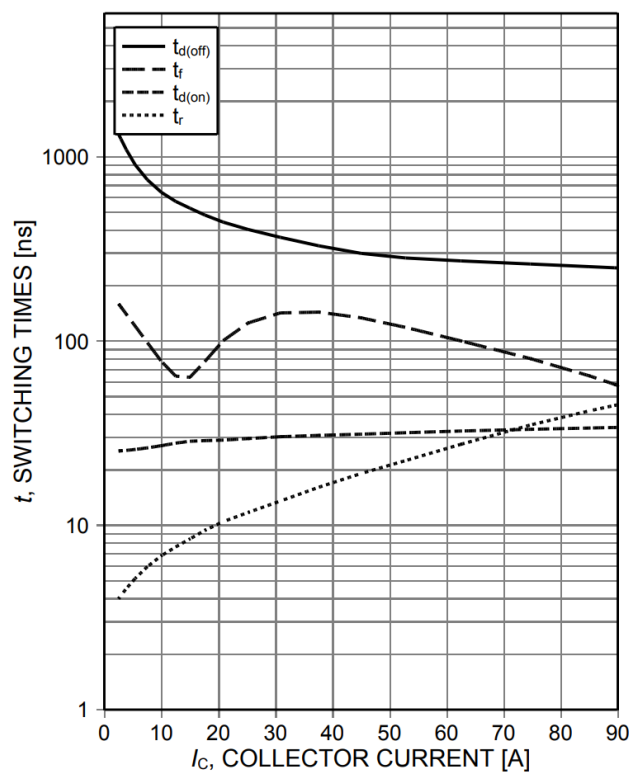


Figure 4. **Typical output characteristic**
($T_{vj}=25^\circ\text{C}$)

低 $V_{CE(sat)}$ 系列第五代Figure 5. **Typical output characteristic**
($T_{vj}=175^{\circ}\text{C}$)Figure 6. **Typical transfer characteristic**
($V_{CE}=20\text{V}$)Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{GE}=15\text{V}$)Figure 8. **Typical switching times as a function of collector current**
(inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $R_{G(on)}=10\Omega$, $R_{G(off)}=10\Omega$, dynamic test circuit in Figure E)

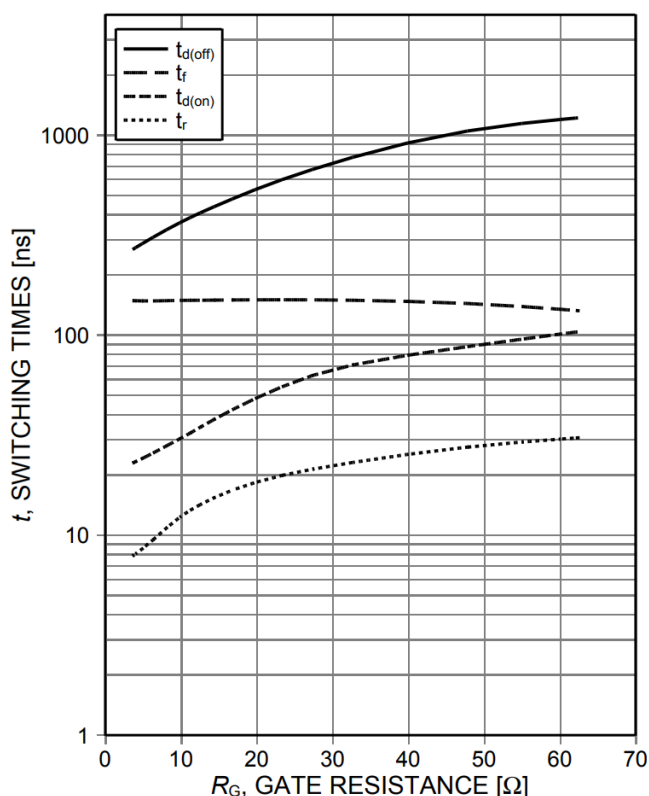
低 $V_{CE(sat)}$ 系列第五代

Figure 9. **Typical switching times as a function of gate resistance**
(inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=30\text{A}$, dynamic test circuit in Figure E)

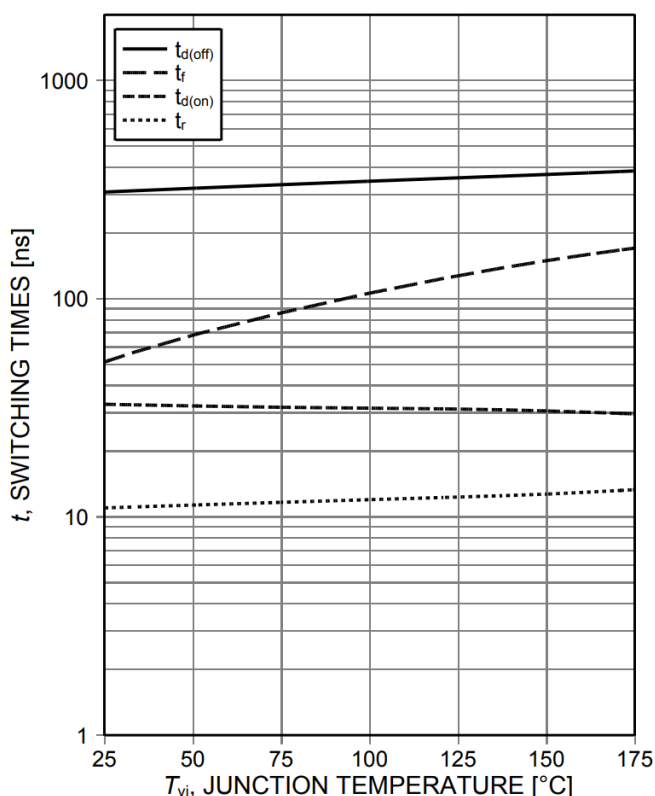


Figure 10. **Typical switching times as a function of junction temperature**
(inductive load, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=30\text{A}$, $R_{G(on)}=10\Omega$, $R_{G(off)}=10\Omega$, dynamic test circuit in Figure E)

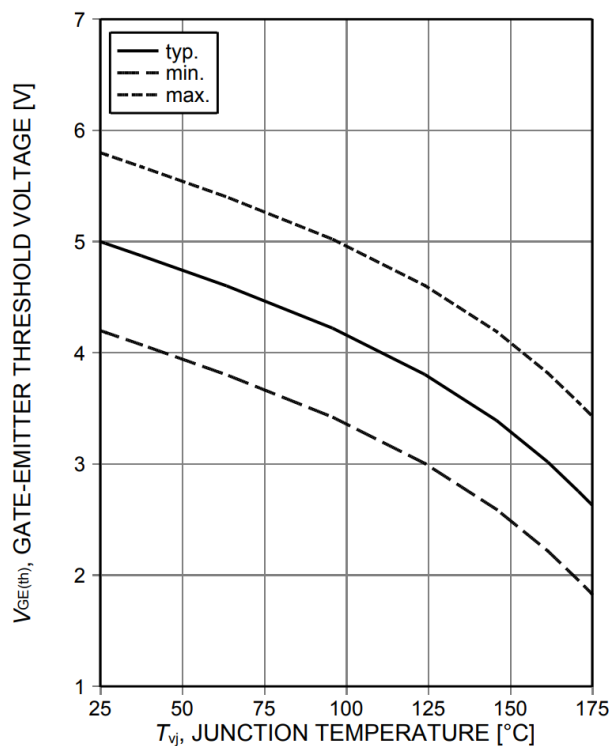


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**
($I_C=0.4\text{mA}$)

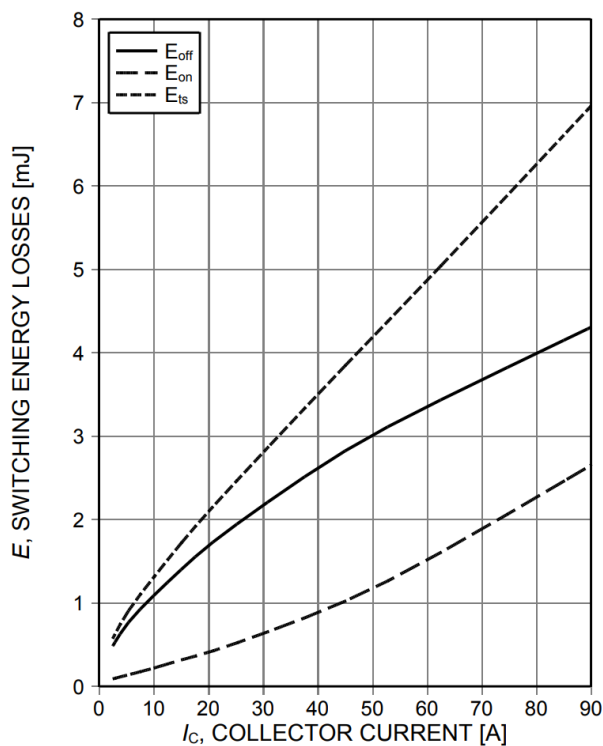


Figure 12. **Typical switching energy losses as a function of collector current**
(inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $R_{G(on)}=10\Omega$, $R_{G(off)}=10\Omega$, dynamic test circuit in Figure E)

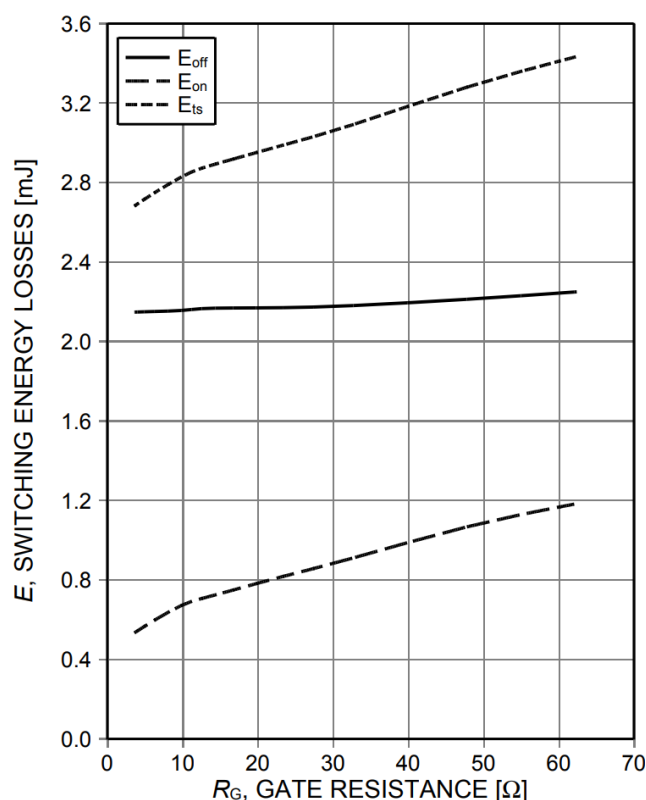
低 $V_{CE(sat)}$ 系列第五代

Figure 13. **Typical switching energy losses as a function of gate resistance**
(inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=30\text{A}$, dynamic test circuit in Figure E)

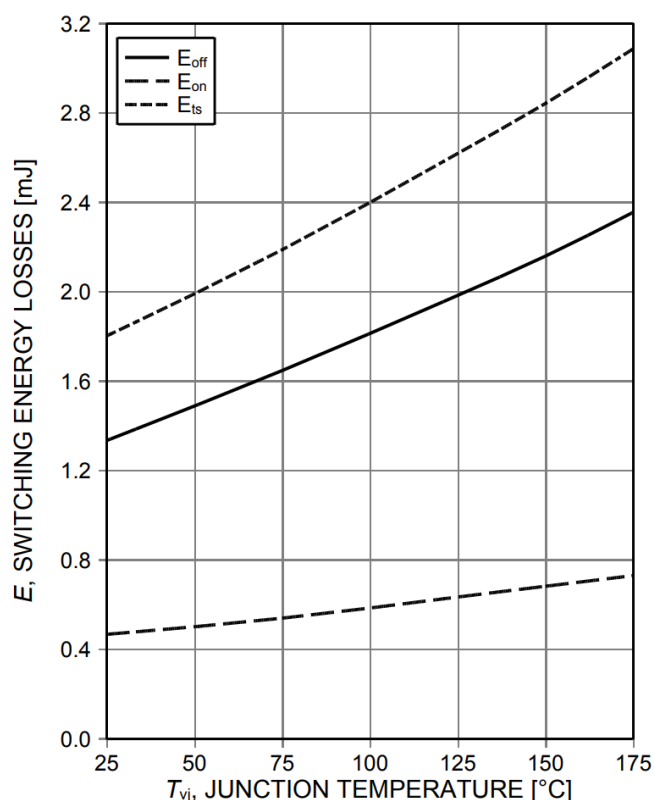


Figure 14. **Typical switching energy losses as a function of junction temperature**
(inductive load, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=30\text{A}$, $R_{G(on)}=10\Omega$, $R_{G(off)}=10\Omega$, dynamic test circuit in Figure E)

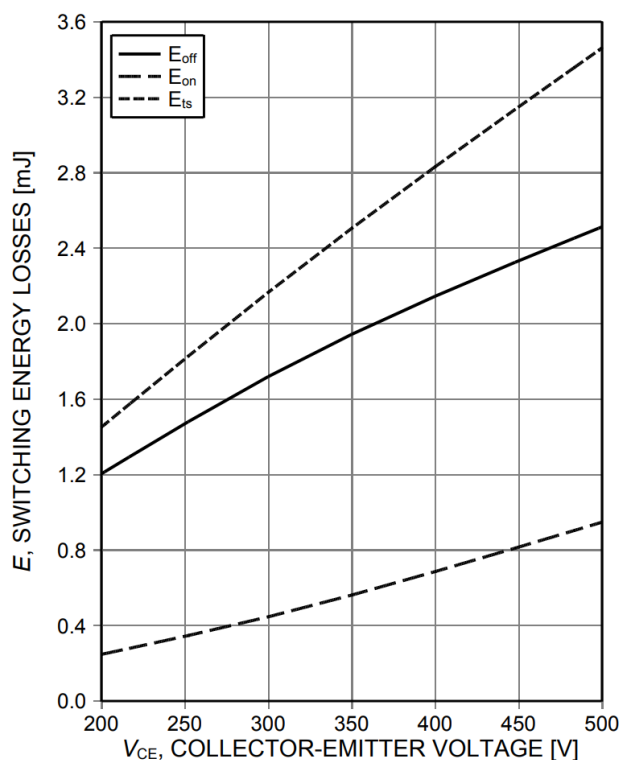


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**
(inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{GE}=0/15\text{V}$, $I_C=30\text{A}$, $R_{G(on)}=10\Omega$, $R_{G(off)}=10\Omega$, dynamic test circuit in Figure E)

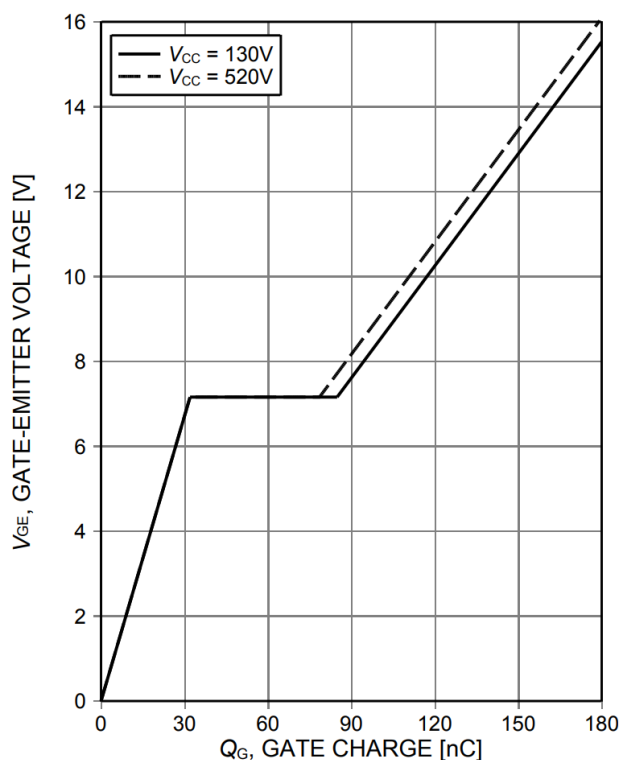


Figure 16. **Typical gate charge**
($I_C=30\text{A}$)

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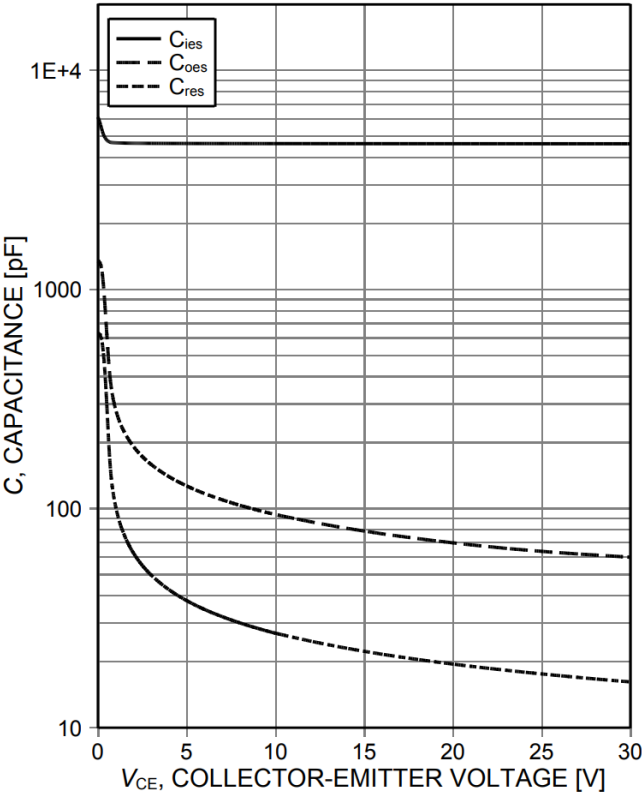


Figure 17. Typical capacitance as a function of collector-emitter voltage ($V_{GE}=0V$, $f=1MHz$)

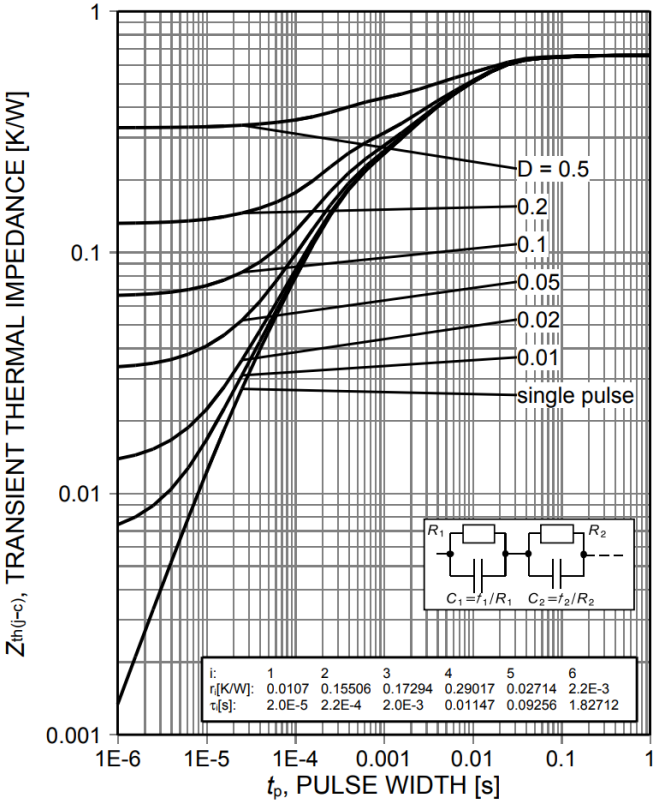


Figure 18. IGBT transient thermal impedance ($D=t_p/T$)

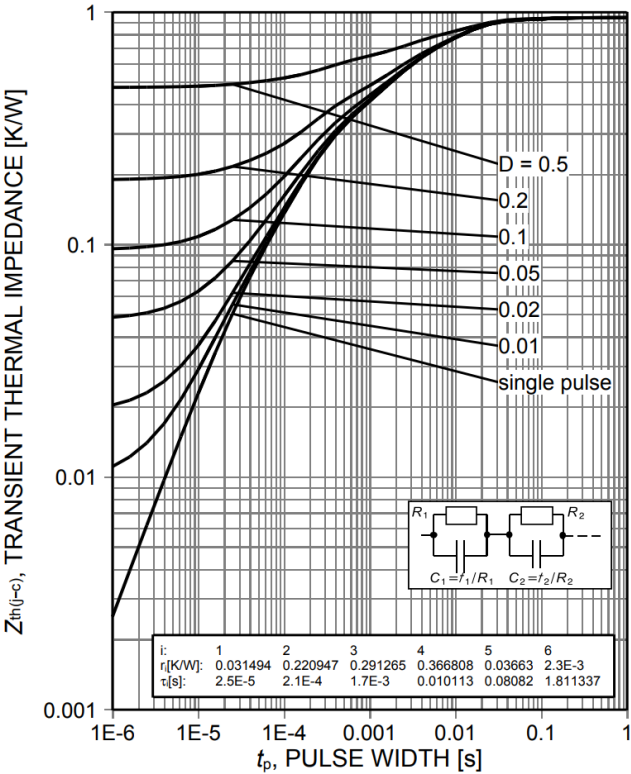


Figure 19. Diode transient thermal impedance as a function of pulse width ($D=t_p/T$)

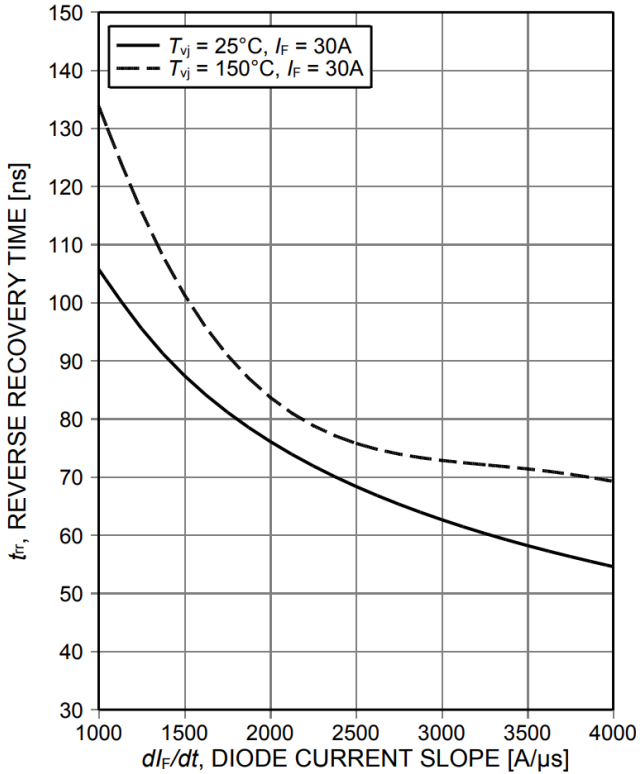


Figure 20. Typical reverse recovery time as a function of diode current slope ($V_R=400V$)

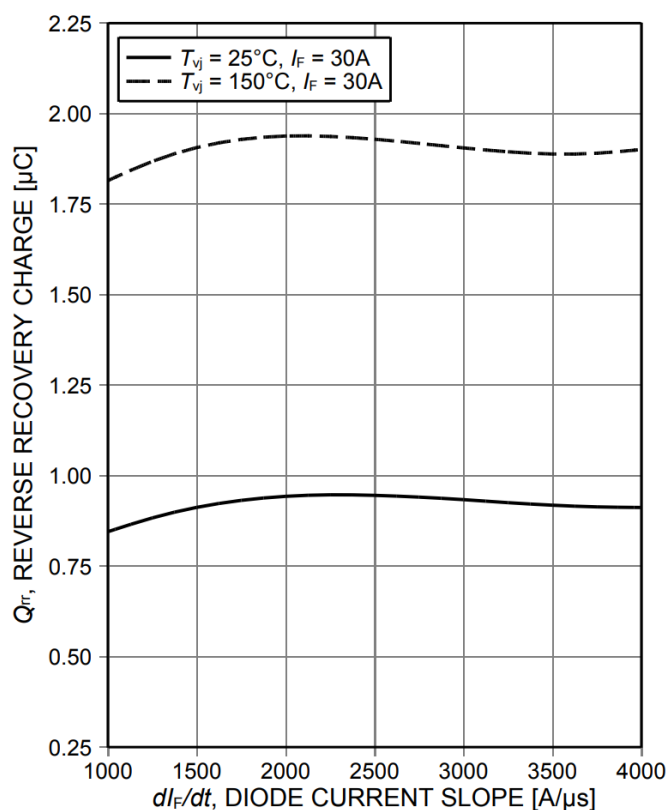
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Figure 21. Typical reverse recovery charge as a function of diode current slope ($V_R=400V$)

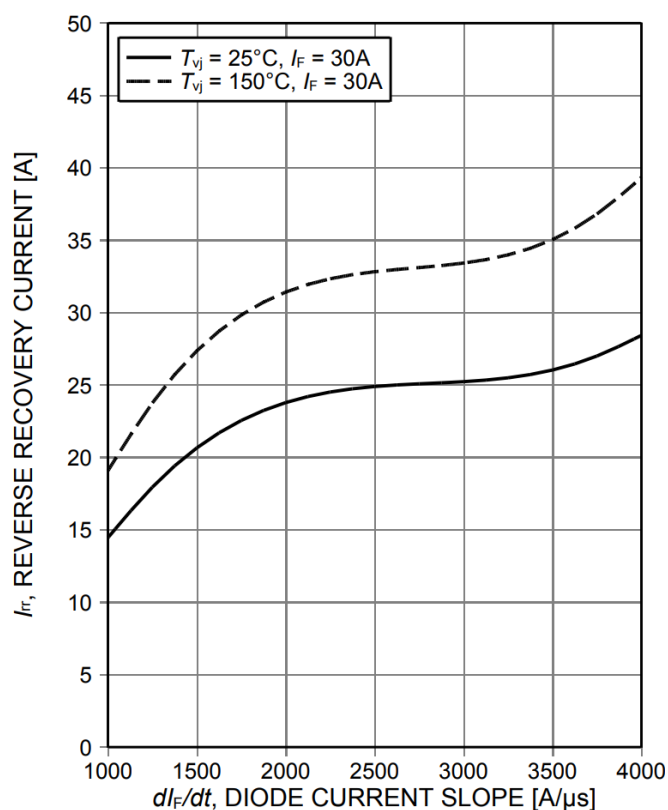


Figure 22. Typical reverse recovery current as a function of diode current slope ($V_R=400V$)

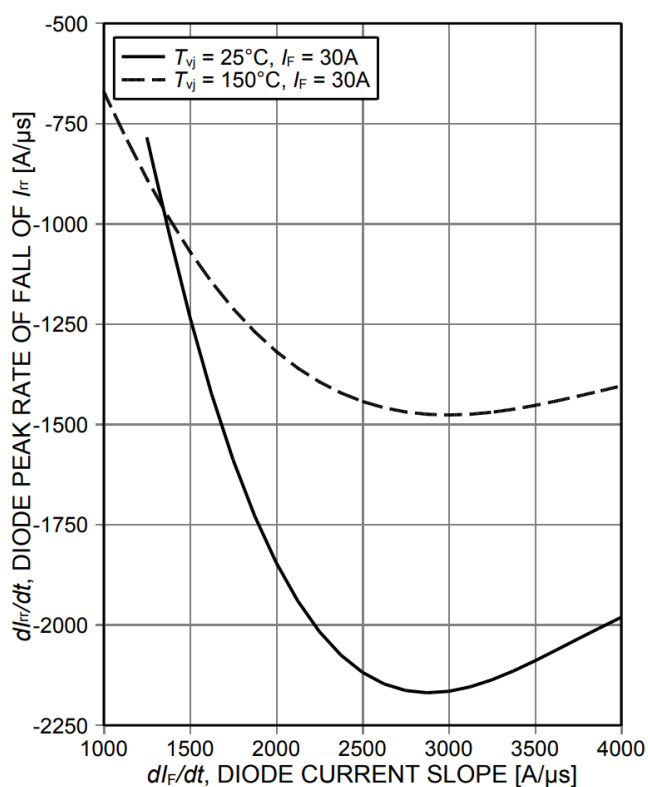


Figure 23. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope ($V_R=400V$)

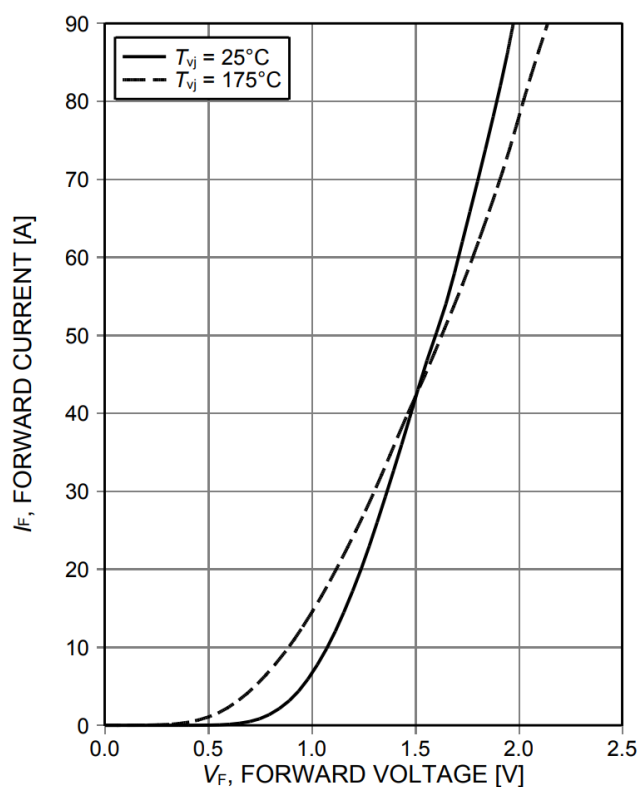


Figure 24. Typical diode forward current as a function of forward voltage

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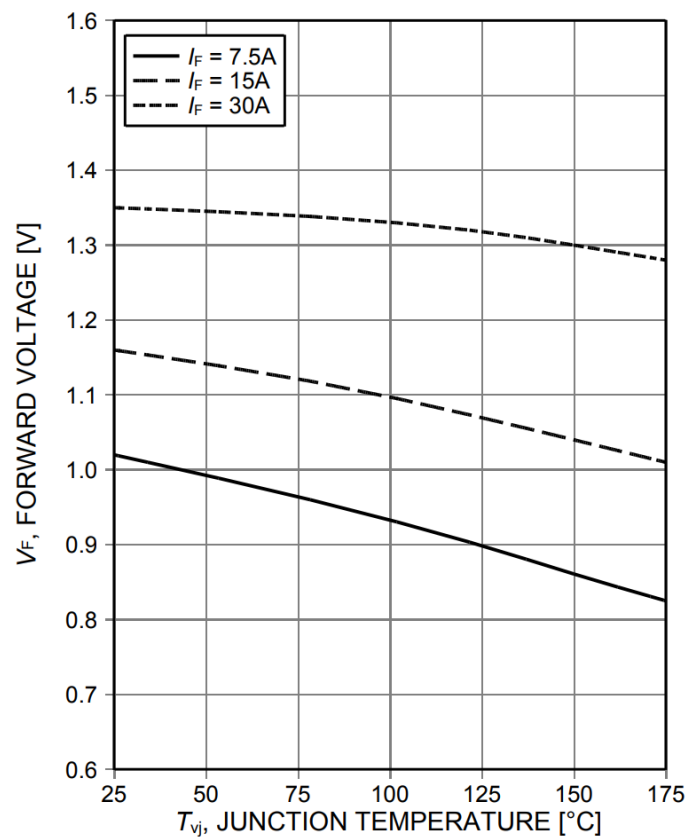
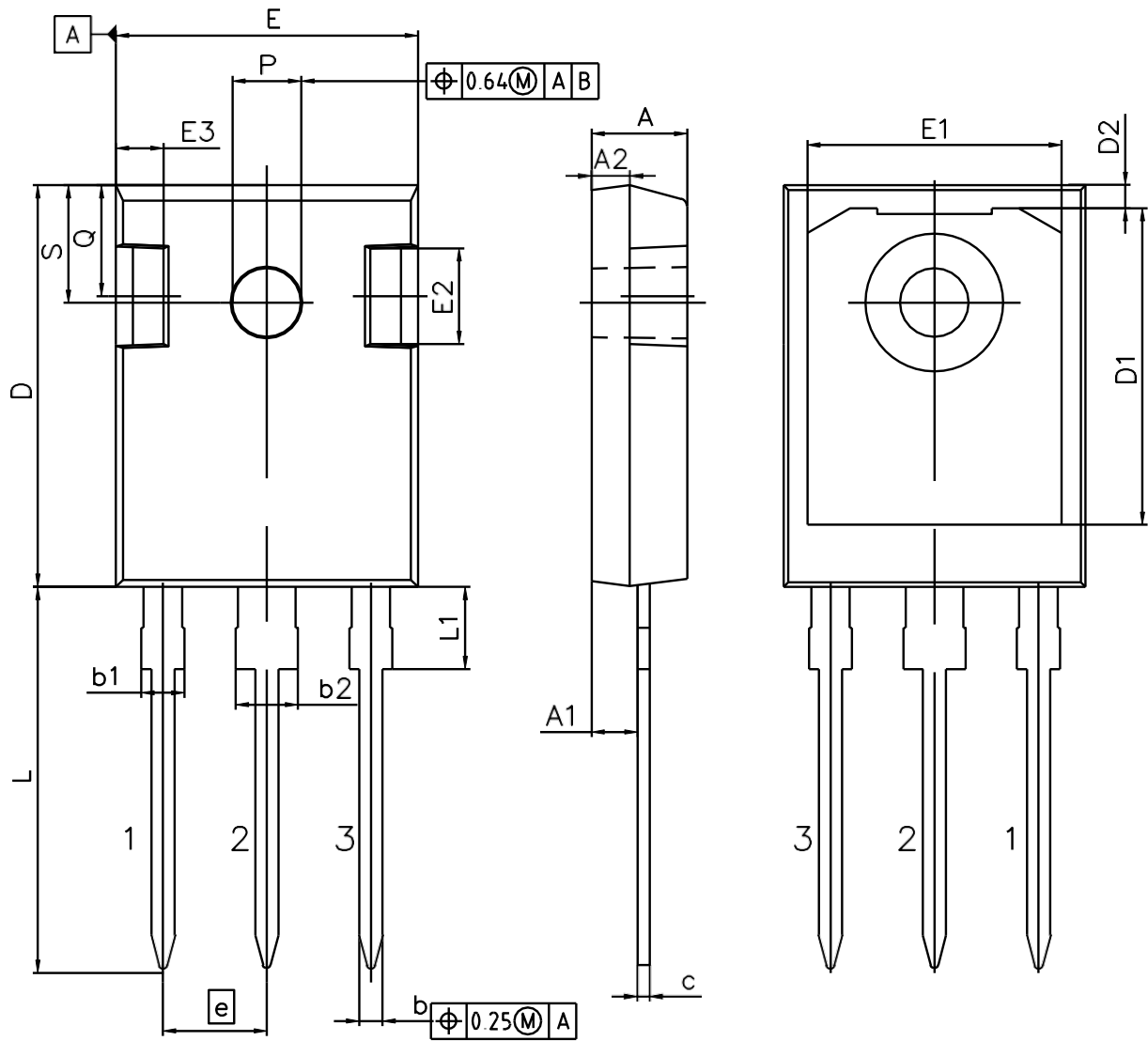


Figure 25. Typical diode forward voltage as a function of junction temperature

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封装图 PG-T0247-3



DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.70	5.30
A1	2.20	2.60
A2	1.50	2.50
b	1.00	1.40
b1	1.60	2.41
b2	2.57	3.43
c	0.38	0.89
D	20.70	21.50
D1	13.08	17.65
D2	0.51	1.35
E	15.50	16.30
E1	12.38	14.15
E2	3.40	5.10
E3	1.00	2.60
e	5.44	
L	19.80	20.40
L1	3.85	4.50
P	3.50	3.70
Q	5.35	6.25
S	6.04	6.30

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REVISION
06

SCALE 3:1
0 1 2 3 4 5mm

EUROPEAN PROJECTION

ISSUE DATE
25.07.2018

低 $V_{CE(sat)}$ 系列第五代

测试条件

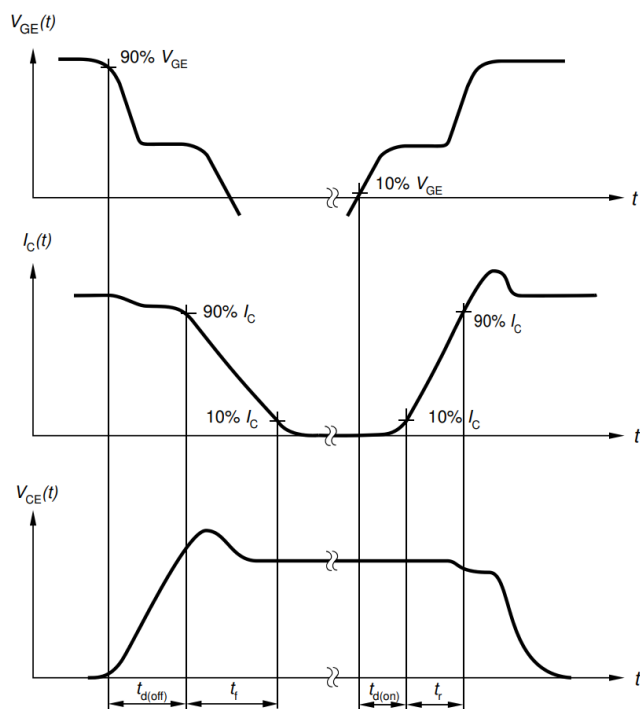


Figure A. Definition of switching times

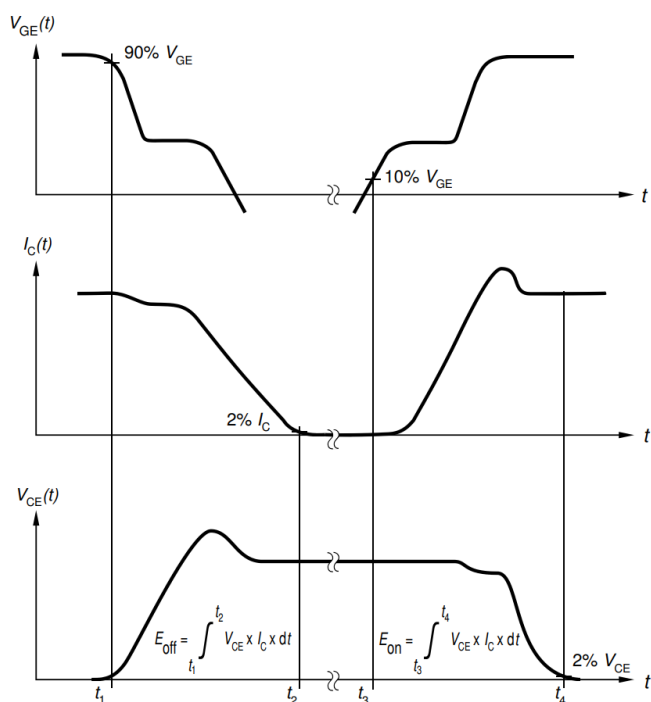


Figure B. Definition of switching losses

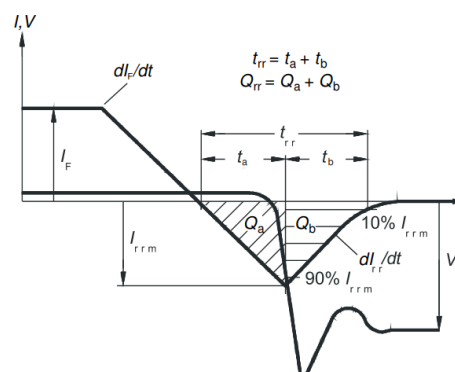


Figure C. Definition of diode switching characteristics

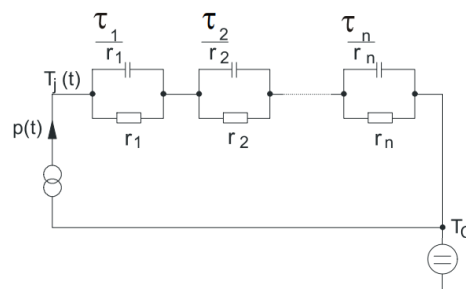


Figure D. Thermal equivalent circuit

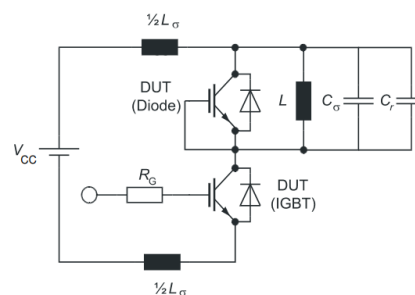


Figure E. Dynamic test circuit
Parasitic inductance L_{σ} ,
parasitic capacitor C_{σ} ,
relief capacitor C_r ,
(only for ZVT switching)

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修订记录

IKW30N65EL5

Revision: 2020-10-07, Rev. 2.2

历史修订版本

Revision	Date	Subjects (major changes since last revision)
2.1	2014-12-10	Final data sheet
2.2	2020-10-07	VGE(th): test condition update



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