

IGBT

英飞凌TRENCHSTOP™性能技术与 RAPID 1 快速反并联二极管共同封装

IKW40N60DTP

英飞凌600V DuoPack IGBT 和二极管

TRENCHSTOP™高性能系列

数据手册

英飞凌600V DuoPack IGBT 和二极管

TRENCHSTOP™高性能系列

特性:

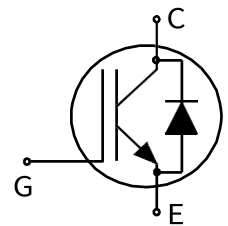
TRENCHSTOP™技术产品

- 极低 V_{CEsat}
- 低关断损耗
- 低拖尾电流
- 低电磁干扰
- 非常柔软、快速恢复的反并联二极管
- 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:

- 驱动器
- 太阳能逆变器
- UPS (不间断电源)
- 中等开关频率转换器



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
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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）。



IKW40N60DTP

TRENCHSTOP™性能系列

IKW40N60DTP	600V	40A	1.6V	175°C	K40DDTP	PG-TO247-3
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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}	600	V
DC collector current, limited by T_{vjmax} $T_C = 25^{\circ}\text{C}$ $T_C = 100^{\circ}\text{C}$	I_C	67.0 48.0	A
Pulsed collector current, t_p limited by T_{vjmax} ¹⁾	I_{Cpuls}	120.0	A
Turn off safe operating area $V_{CE} \leq 600\text{V}$, $T_{vj} \leq 175^{\circ}\text{C}$, $t_p = 1\mu\text{s}$ ¹⁾	-	120.0	A
Diode forward current, limited by T_{vjmax} $T_C = 25^{\circ}\text{C}$ $T_C = 100^{\circ}\text{C}$	I_F	58.0 35.0	A
Diode pulsed current, t_p limited by T_{vjmax} ¹⁾	I_{Fpuls}	120.0	A
Gate-emitter voltage	V_{GE}	± 20	V
Short circuit withstand time $V_{GE} = 15.0\text{V}$, $V_{CC} \leq 400\text{V}$ Allowed number of short circuits < 1000 Time between short circuits: $\geq 1.0\text{s}$ $T_{vj} = 150^{\circ}\text{C}$	t_{SC}	5	μs
Power dissipation $T_C = 25^{\circ}\text{C}$ Power dissipation $T_C = 100^{\circ}\text{C}$	P_{tot}	246.0 123.0	W
Operating junction temperature	T_{vj}	$-40 \dots +175$	$^{\circ}\text{C}$
Storage temperature	T_{stg}	$-55 \dots +150$	$^{\circ}\text{C}$
Soldering temperature, 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	$R_{th(j-c)}$		-	0.41	0.61	K/W
Diode thermal resistance, junction - case	$R_{th(j-c)}$		-	0.83	1.29	K/W

¹⁾由设计标定，不受限于生产测试。

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	$V_{(\text{BR})\text{CES}}$	$V_{\text{GE}} = 0\text{V}, I_{\text{C}} = 2.00\text{mA}$	600	-	-	V
Collector-emitter saturation voltage	V_{CESat}	$V_{\text{GE}} = 15.0\text{V}, I_{\text{C}} = 40.0\text{A}$ $T_{\text{vj}} = 25^{\circ}\text{C}$ $T_{\text{vj}} = 175^{\circ}\text{C}$	- -	1.60 1.94	1.80 -	V
Diode forward voltage	V_{F}	$V_{\text{GE}} = 0\text{V}, I_{\text{F}} = 20.0\text{A}$ $T_{\text{vj}} = 25^{\circ}\text{C}$ $T_{\text{vj}} = 175^{\circ}\text{C}$	- -	1.45 1.39	1.70 -	V
Gate-emitter threshold voltage	$V_{\text{GE(th)}}$	$I_{\text{C}} = 0.64\text{mA}, V_{\text{CE}} = V_{\text{GE}}$	4.1	5.1	5.7	V
Zero gate voltage collector current	I_{CES}	$V_{\text{CE}} = 600\text{V}, V_{\text{GE}} = 0\text{V}$ $T_{\text{vj}} = 25^{\circ}\text{C}$ $T_{\text{vj}} = 175^{\circ}\text{C}$	- -	- -	40 -	μA
Gate-emitter leakage current	I_{GES}	$V_{\text{CE}} = 0\text{V}, V_{\text{GE}} = 20\text{V}$	-	-	100	nA
Transconductance	g_{fs}	$V_{\text{CE}} = 20\text{V}, I_{\text{C}} = 40.0\text{A}$	-	40.0	-	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}	$V_{CE} = 25V, V_{GE} = 0V, f = 1MHz$	-	1400	-	pF
Output capacitance	C_{oes}		-	76	-	
Reverse transfer capacitance	C_{res}		-	48	-	
Gate charge	Q_G	$V_{CC} = 480V, I_C = 40.0A,$ $V_{GE} = 15V$	-	177.0	-	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: $\geq 1.0s$	$I_{C(SC)}$	$V_{GE} = 15.0V, V_{CC} \leq 400V,$ $t_{SC} \leq 5\mu s$ $T_{vj} = 150^{\circ}C$	-	183	-	A

开关特性、感性负载

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Turn-on delay time	$t_{d(on)}$	$T_{vj} = 25^{\circ}\text{C},$ $V_{CC} = 400\text{V}, I_C = 40.0\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(on)} = 10.1\Omega, R_{G(off)} = 10.1\Omega,$ $L\sigma = 32\text{nH}, C\sigma = 60\text{pF}$ $L\sigma, C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery.	-	18	-	ns
Rise time	t_r		-	30	-	ns
Turn-off delay time	$t_{d(off)}$		-	222	-	ns
Fall time	t_f		-	18	-	ns
Turn-on energy	E_{on}		-	1.06	-	mJ
Turn-off energy	E_{off}		-	0.61	-	mJ
Total switching energy	E_{ts}		-	1.67	-	mJ

IGBT 特性，测于 $T_{vj} = 25^{\circ}\text{C}$ 的条件下

Diode reverse recovery time	t_{rr}	$T_{vj} = 25^{\circ}\text{C},$ $V_R = 400\text{V}, I_F = 20.0\text{A},$ $di_F/dt = 1175\text{A}/\mu\text{s}$	-	87	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.56	-	μC
Diode peak reverse recovery current	I_{rrm}		-	11.5	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	144	-	A/ μs

开关特性、感性负载

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	

IGBT 特性，测于 $T_{vj} = 175^{\circ}\text{C}$ 的条件

Turn-on delay time	$t_{d(on)}$	$T_{vj} = 175^{\circ}\text{C},$ $V_{CC} = 400\text{V}, I_C = 40.0\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(on)} = 10.1\Omega, R_{G(off)} = 10.1\Omega,$ $L\sigma = 32\text{nH}, C\sigma = 60\text{pF}$ $L\sigma, C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	19	-	ns
Rise time	t_r		-	30	-	ns
Turn-off delay time	$t_{d(off)}$		-	273	-	ns
Fall time	t_f		-	47	-	ns
Turn-on energy	E_{on}		-	1.63	-	mJ
Turn-off energy	E_{off}		-	1.05	-	mJ
Total switching energy	E_{ts}		-	2.68	-	mJ

Diode reverse recovery time	t_{rr}	$T_{vj} = 175^{\circ}\text{C}, V_R = 400\text{V}, I_F = 20.0\text{A},$ $di_F/dt = 1175\text{A}/\mu\text{s}$	-	144	-	ns
Diode reverse recovery charge	Q_{rr}		-	1.52	-	μC
Diode peak reverse recovery current	I_{rrm}		-	18.3	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	142	-	A/ μs

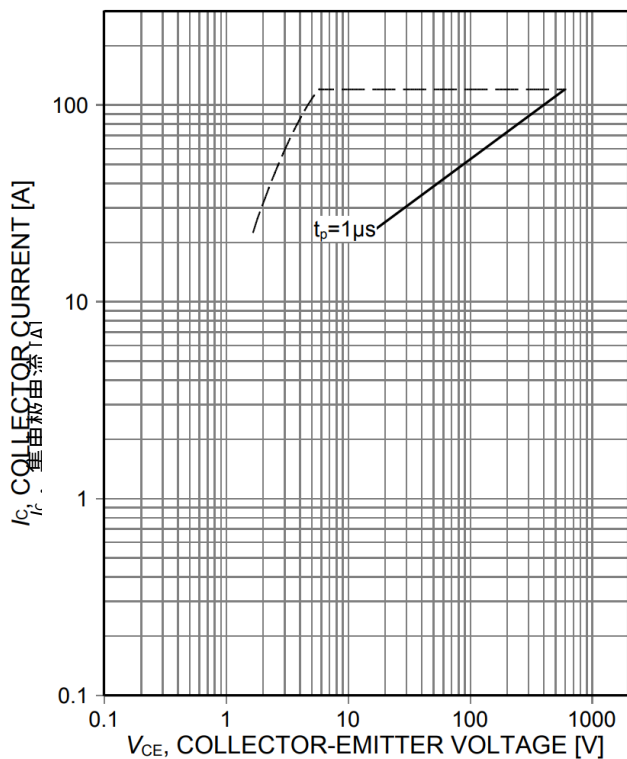


Figure 1. **Forward bias safe operating area**
($D=0$, $T_C=25^\circ\text{C}$, $T_J\leq 175^\circ\text{C}$; $V_{GE}=15\text{V}$)

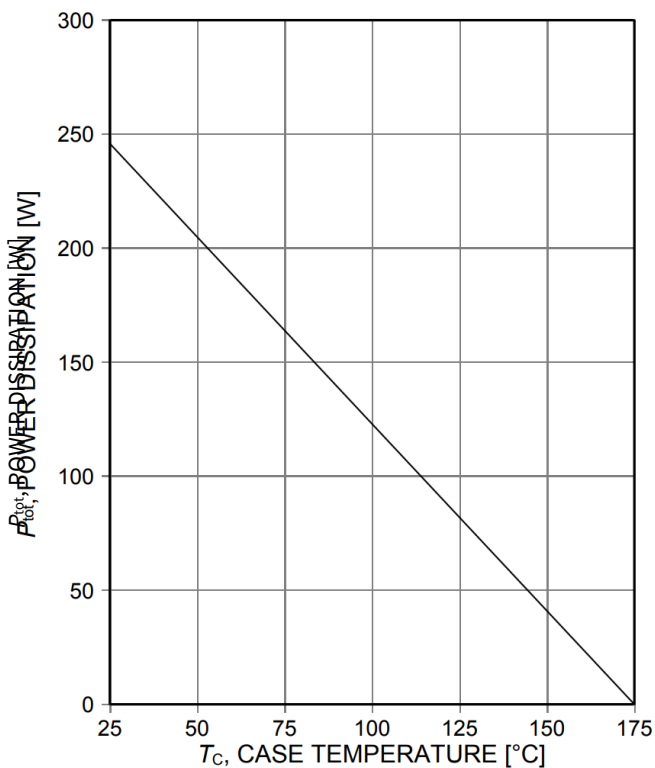


Figure 2. **Power dissipation as a function of case temperature**
($T_J\leq 175^\circ\text{C}$)

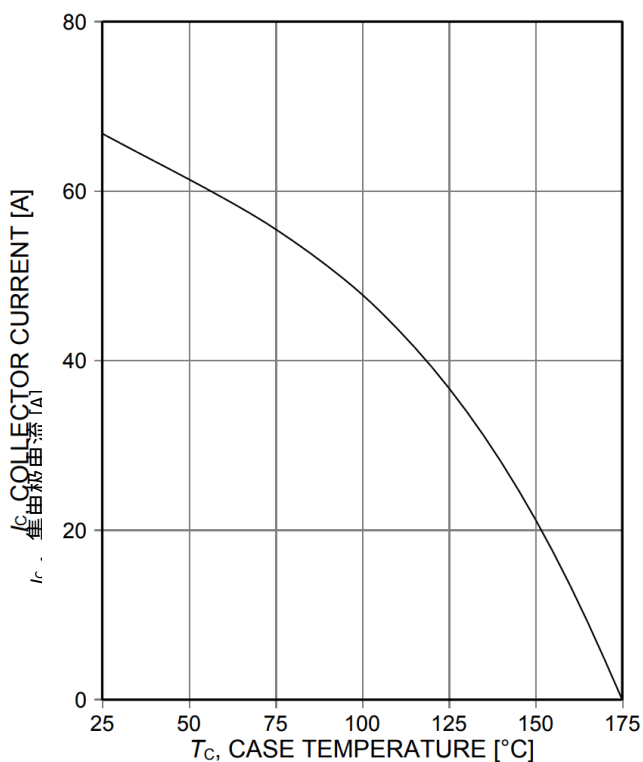


Figure 3. **Collector current as a function of case temperature**
($V_{GE}\geq 15\text{V}$, $T_J\leq 175^\circ\text{C}$)

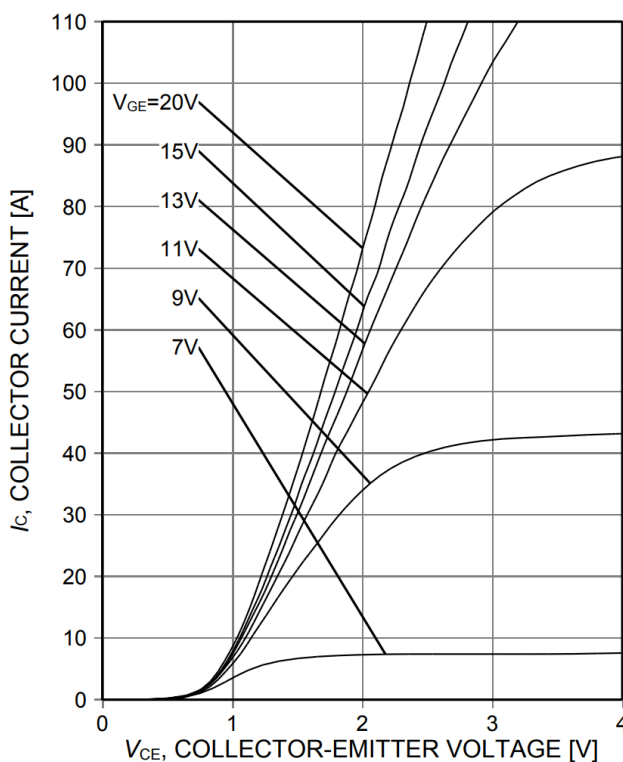


Figure 4. **Typical output characteristic**
($T_J=25^\circ\text{C}$)

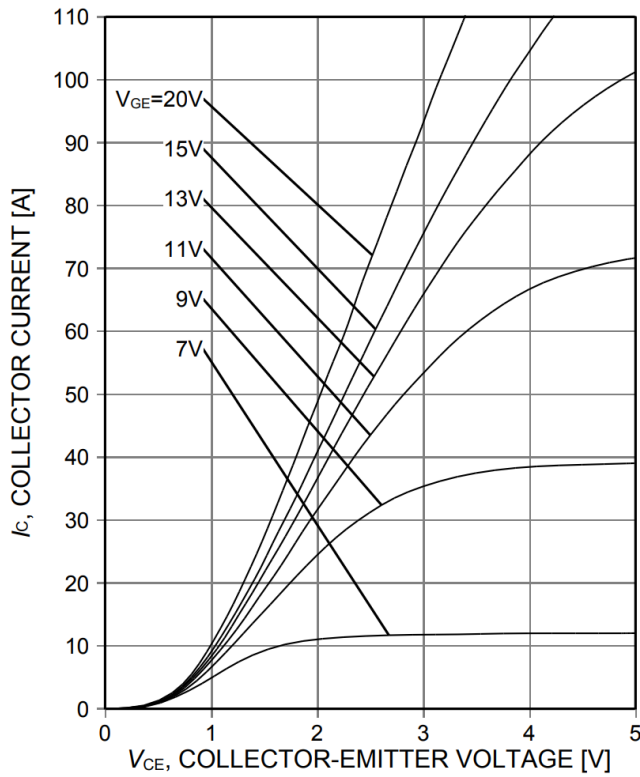


Figure 5. **Typical output characteristic**
($T_j=175^\circ\text{C}$)

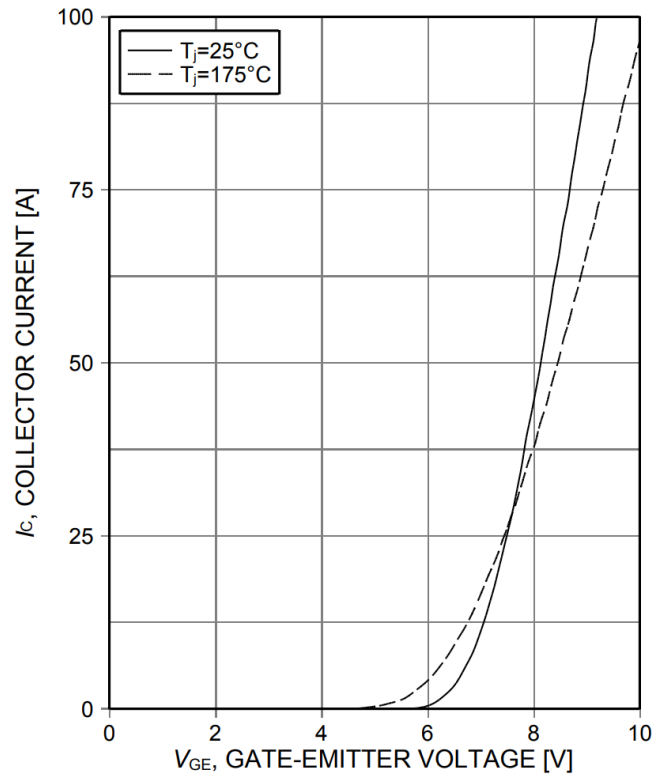


Figure 6. **Typical transfer characteristic**
($V_{CE}=20\text{V}$)

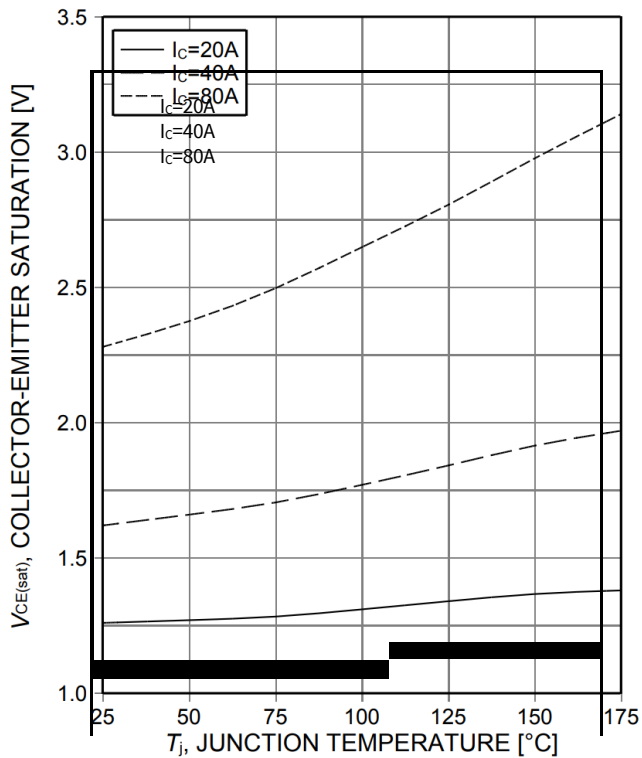


Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{GE}=15\text{V}$)

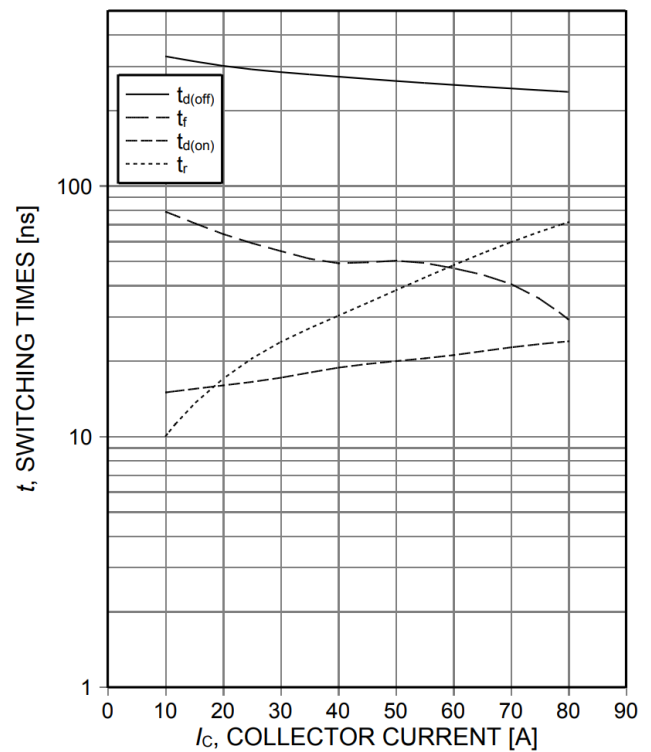


Figure 8. **Typical switching times as a function of collector current**
(ind. load, $T_j=175^\circ\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $r_G=10, 1\Omega$, test circuit in Fig. E)

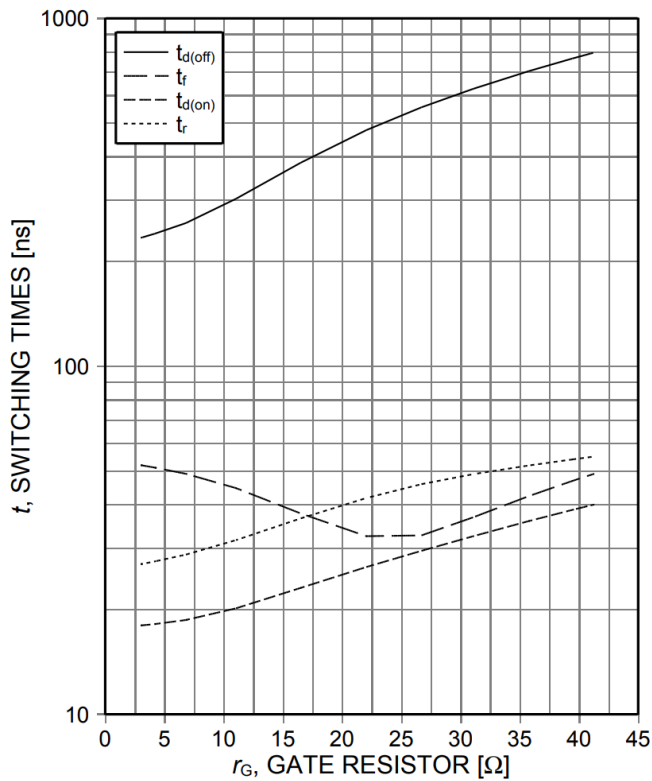


Figure 9. **Typical switching times as a function of gate resistor**
(ind. load, $T_j=175^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=40\text{A}$, test circuit in Fig. E)

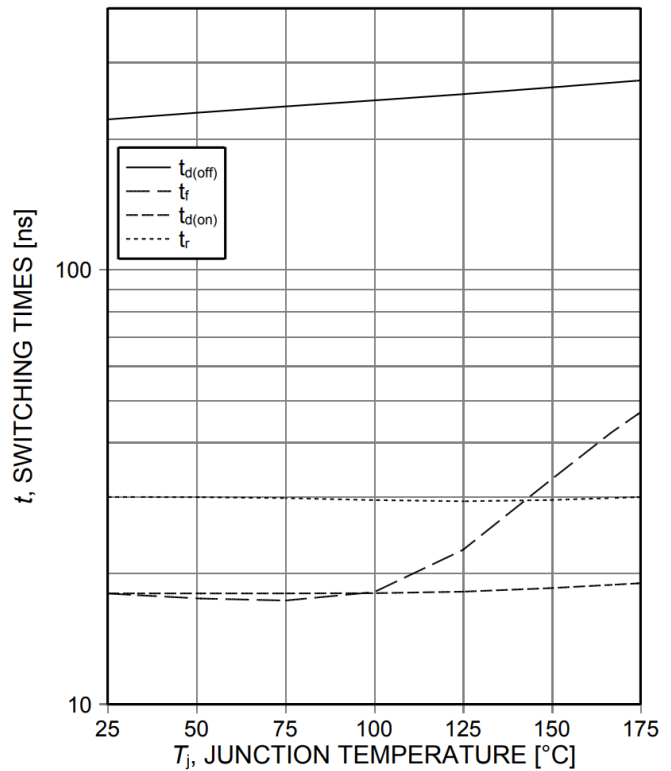


Figure 10. **Typical switching times as a function of junction temperature**
(ind. load, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=40\text{A}$, $r_G=10,1\Omega$, test circuit in Fig. E)

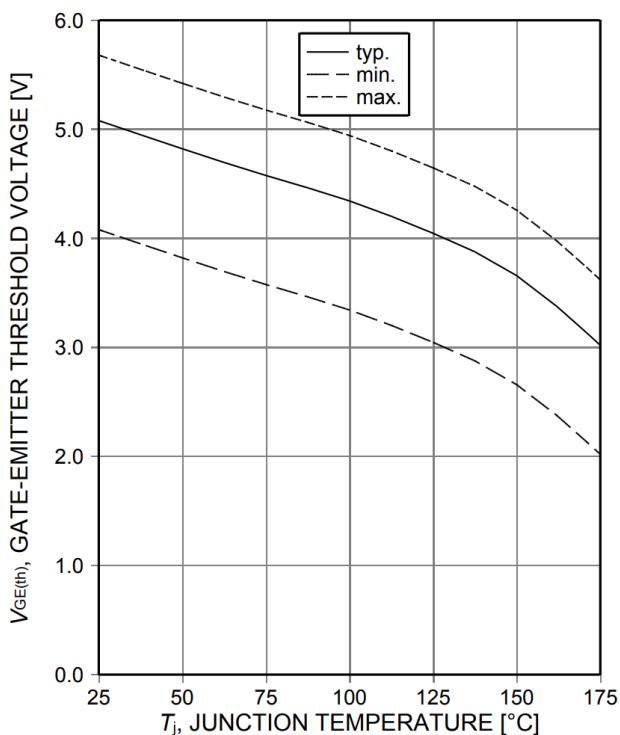


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**
($I_C=0,64\text{mA}$)

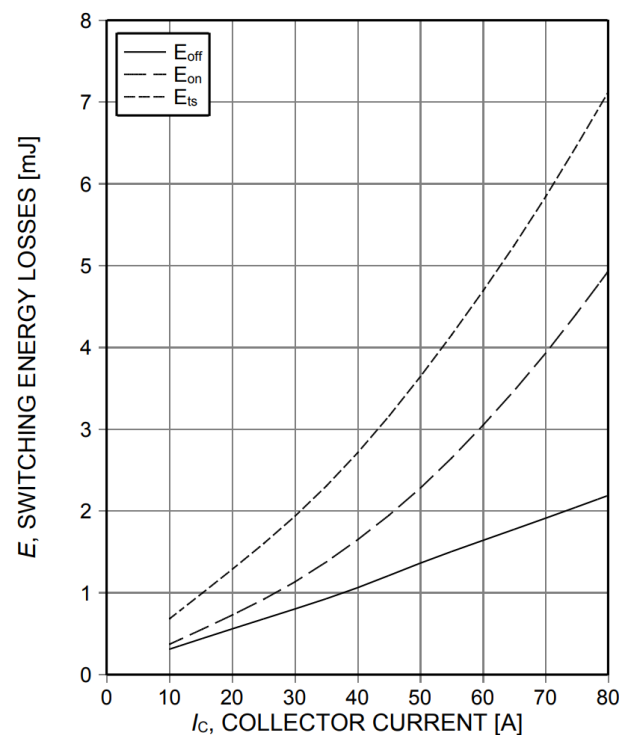


Figure 12. **Typical switching energy losses as a function of collector current**
(ind. load, $T_j=175^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $r_G=10,1\Omega$, test circuit in Fig. E)

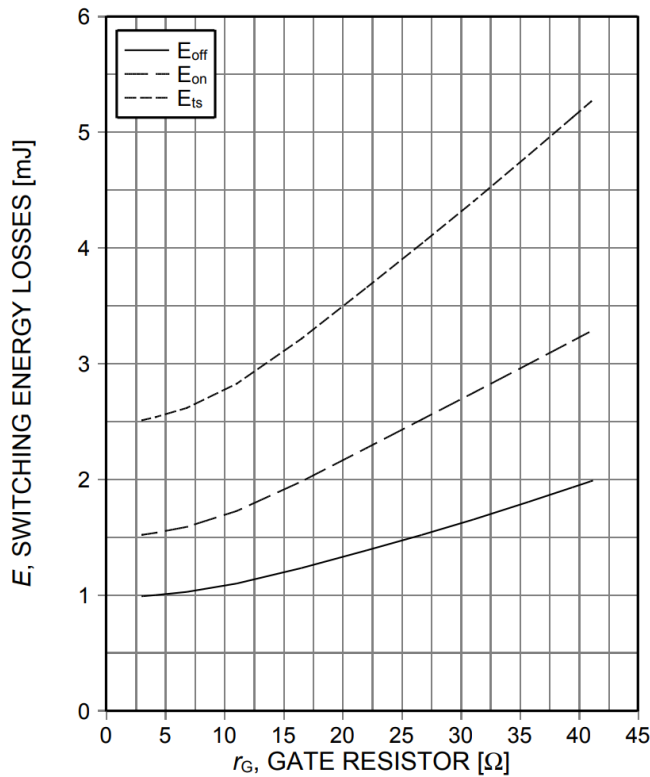


Figure 13. **Typical switching energy losses as a function of gate resistor**
(ind. load, $T_j=175^\circ\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=40\text{A}$, test circuit in Fig. E)

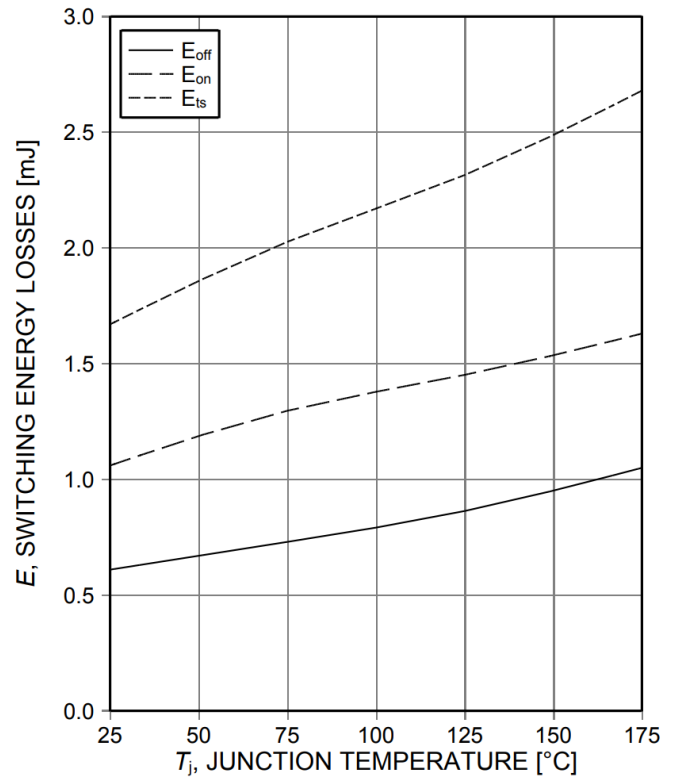


Figure 14. **Typical switching energy losses as a function of junction temperature**
(ind load, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=40\text{A}$, $r_G=10, 1\Omega$, test circuit in Fig. E)

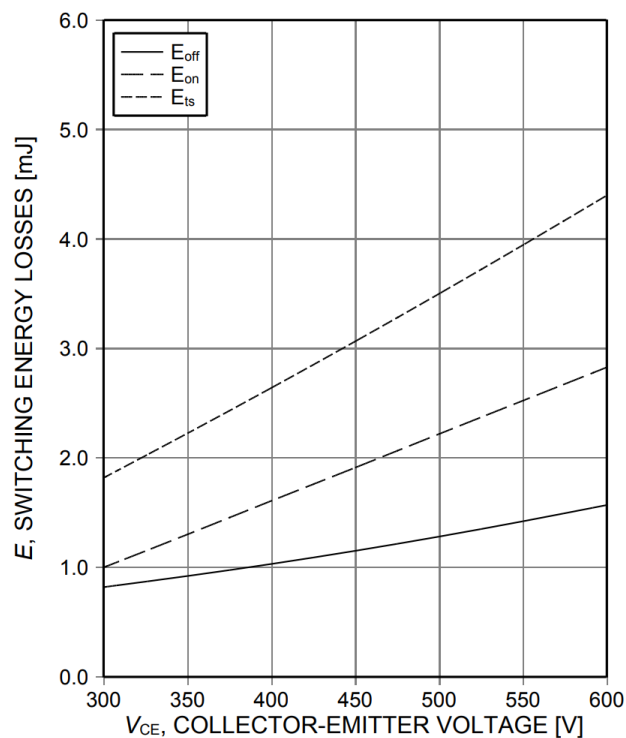


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**
(ind. load, $T_j=175^\circ\text{C}$, $V_{GE}=15/0\text{V}$, $I_C=40\text{A}$, $r_G=10, 1\Omega$, test circuit in Fig. E)

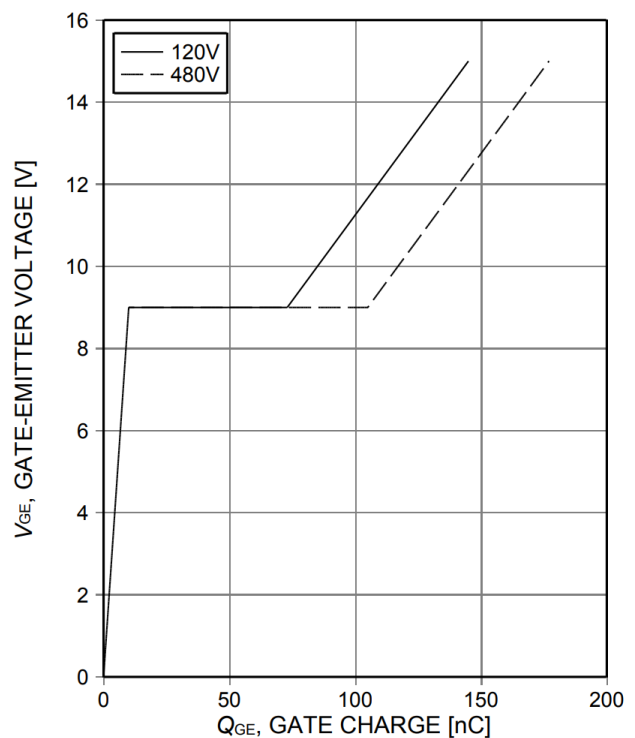


Figure 16. **Typical gate charge**
($I_C=40\text{A}$)

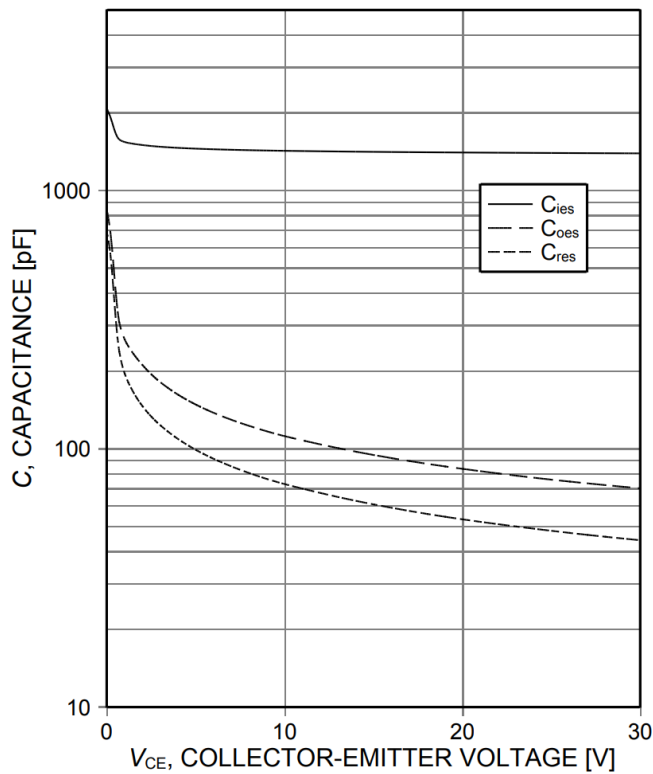


Figure 17. **Typical capacitance as a function of collector-emitter voltage**
($V_{GE}=0V$, $f=1MHz$)

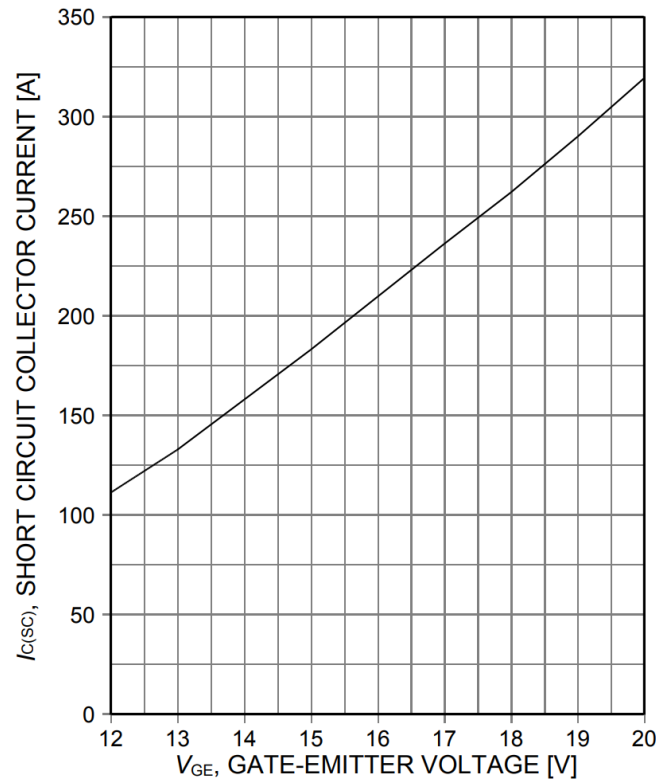


Figure 18. **Typical short circuit collector current as a function of gate-emitter voltage**
($V_{CE}\leq 400V$, start at $T_J=25^\circ C$)

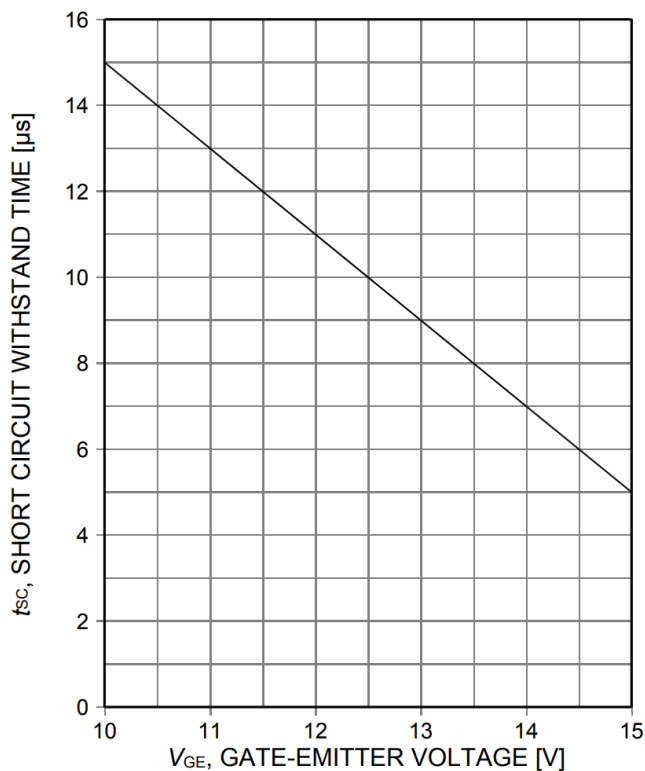


Figure 19. **Short circuit withstand time as a function of gate-emitter voltage**
($V_{CE}\leq 400V$, start at $T_J\leq 150^\circ C$)

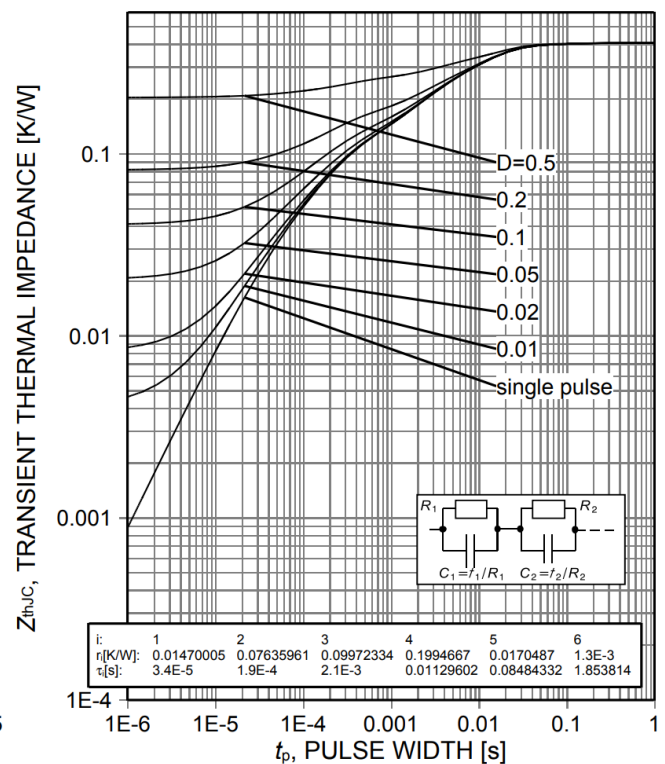


Figure 20. **Typical IGBT transient thermal impedance**
($D=t_p/T$)

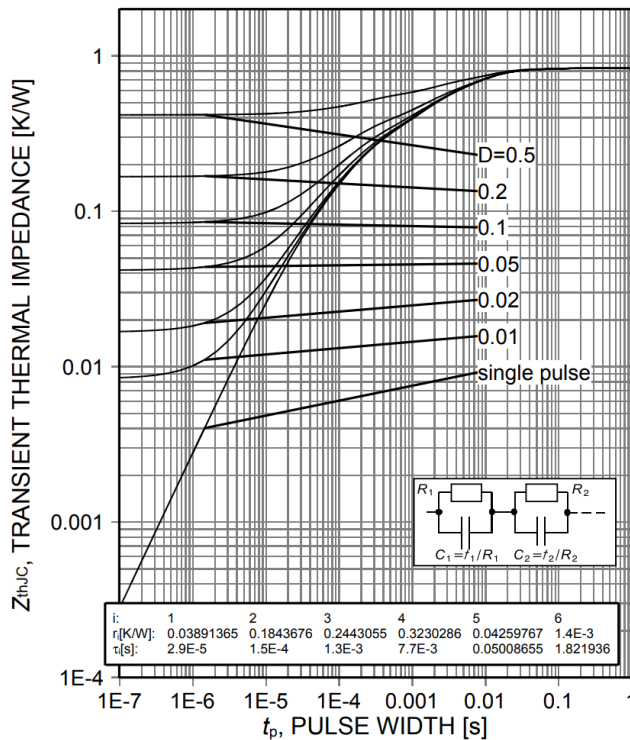


Figure 21. Typical diode transient thermal impedance as a function of pulse width ($D=t_p/T$)

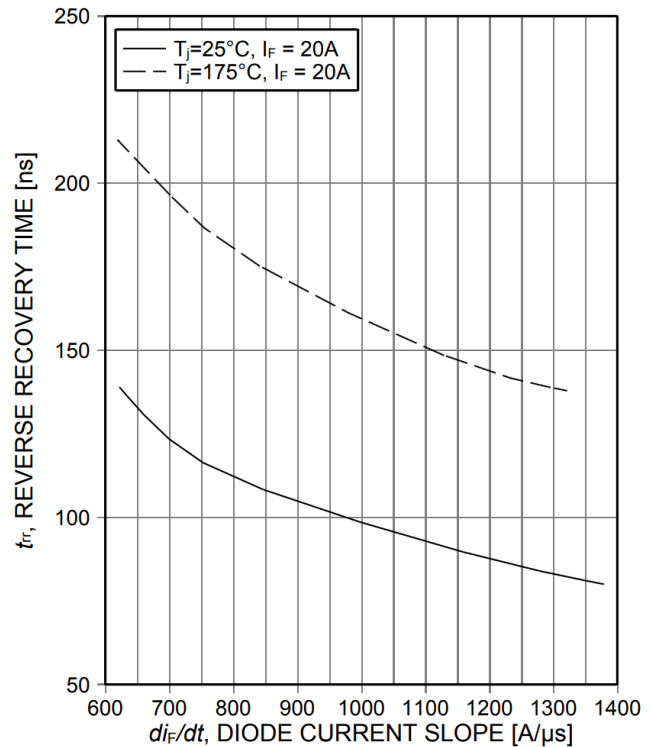


Figure 22. Typical reverse recovery time as a function of diode current slope ($V_R=400V$)

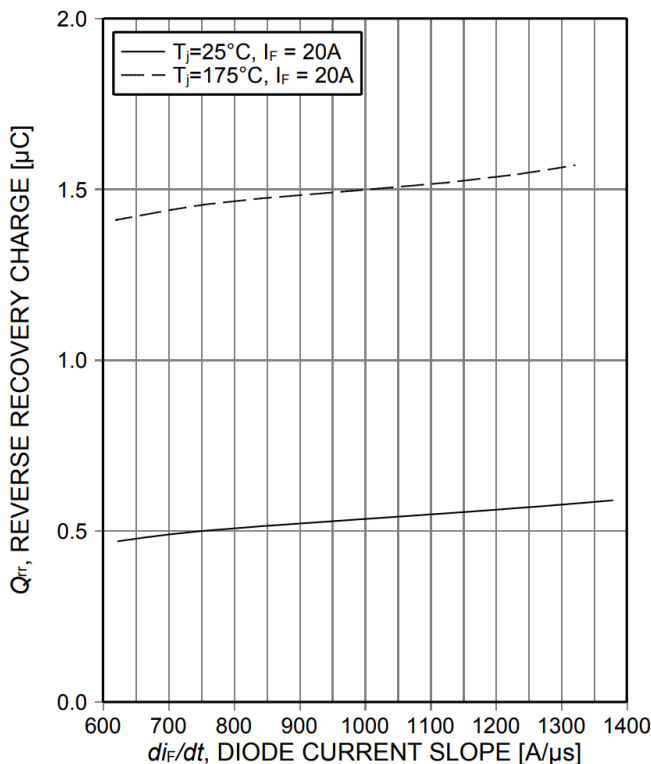


Figure 23. Typical reverse recovery charge as a function of diode current slope ($V_R=400V$)

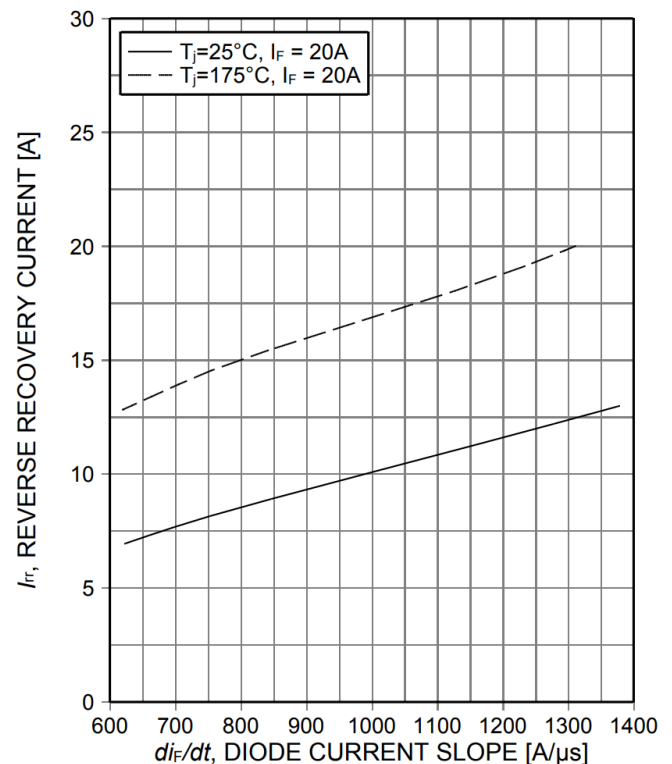


Figure 24. Typical reverse recovery current as a function of diode current slope ($V_R=400V$)

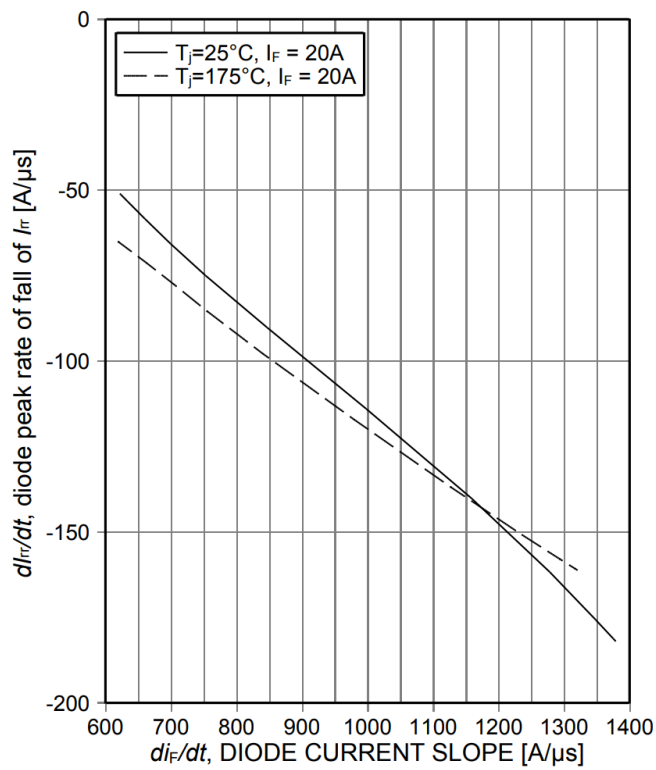


Figure 25. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope ($V_R=400V$)

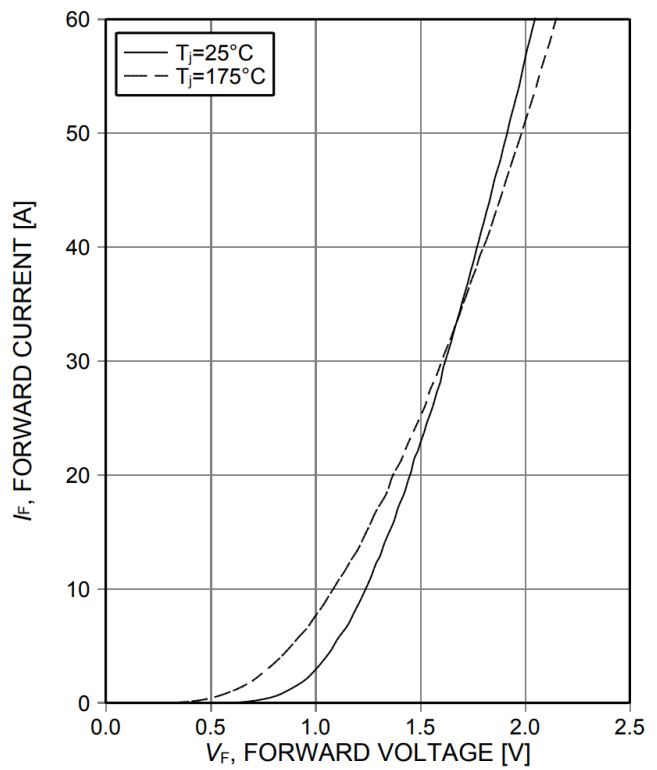


Figure 26. Typical diode forward current as a function of forward voltage

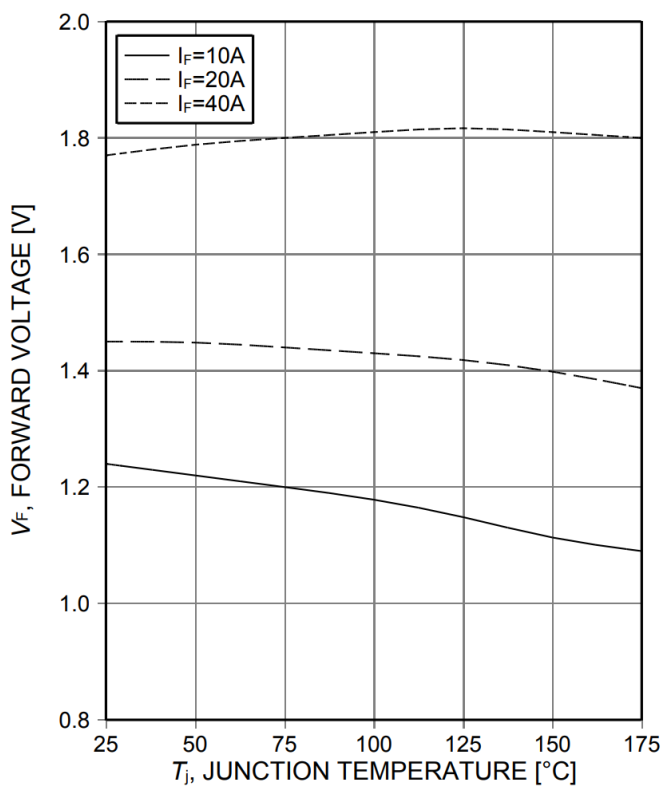
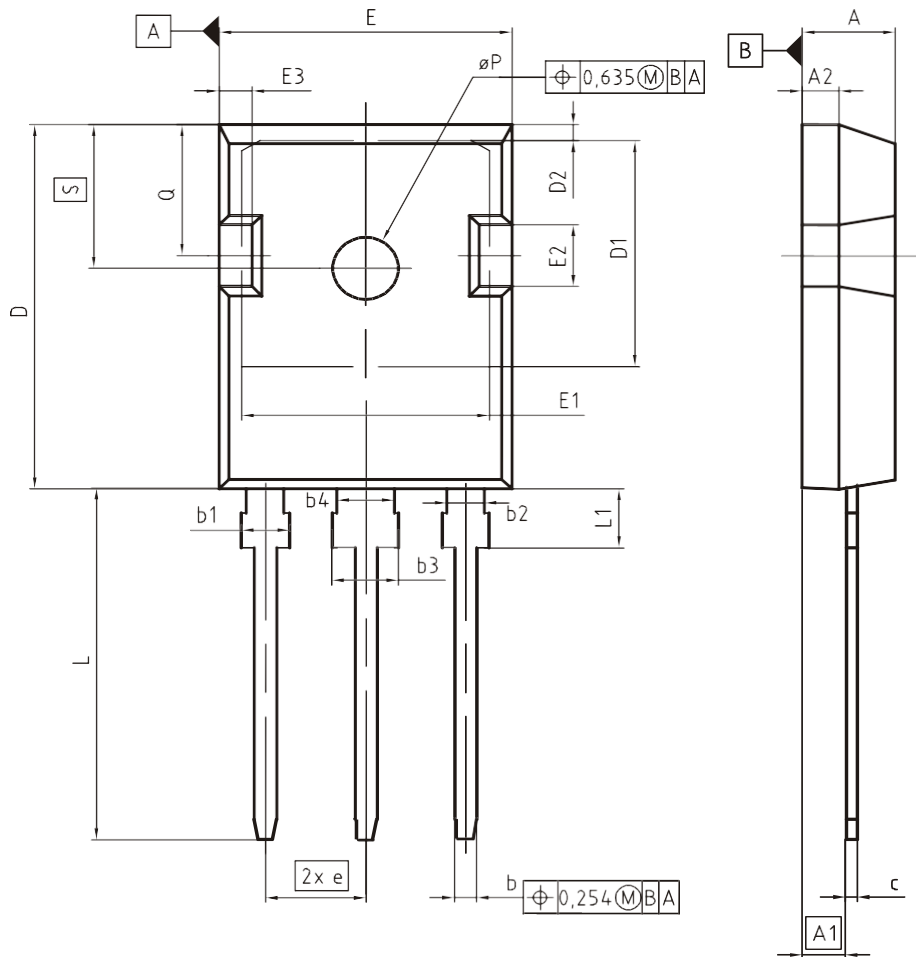
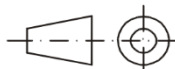


Figure 27. Typical diode forward voltage as a function of junction temperature

封装图 PG-T0247-3



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 5 7.5mm
EUROPEAN PROJECTION	
	
ISSUE DATE 09-07-2010	
REVISION 05	

测试条件

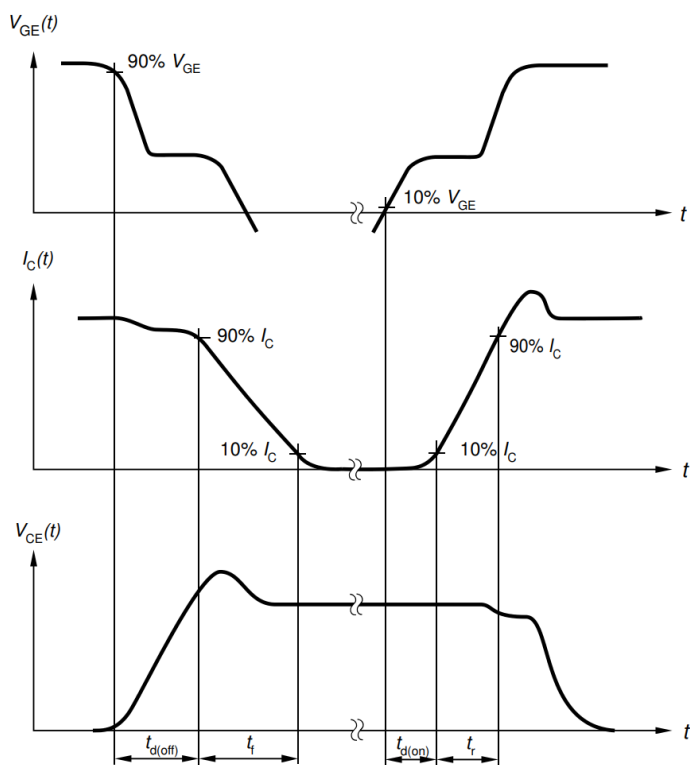


Figure A. Definition of switching times

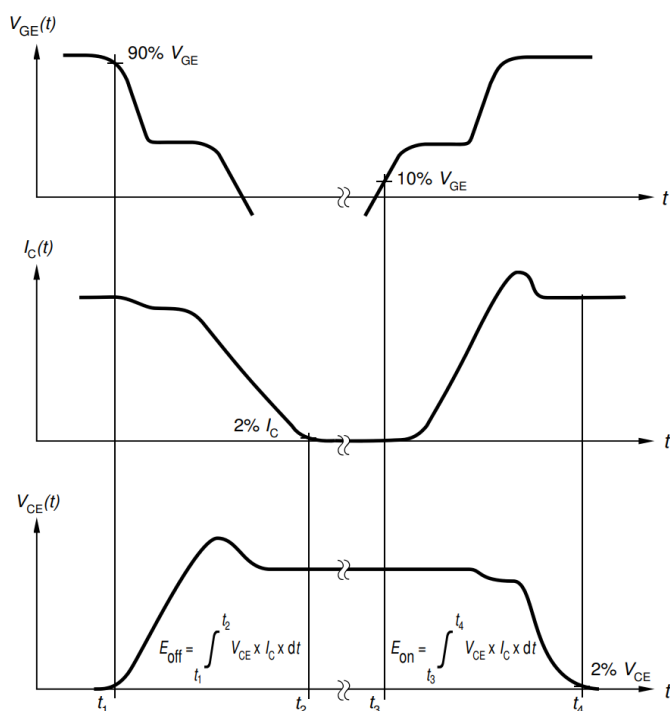


Figure B. Definition of switching losses

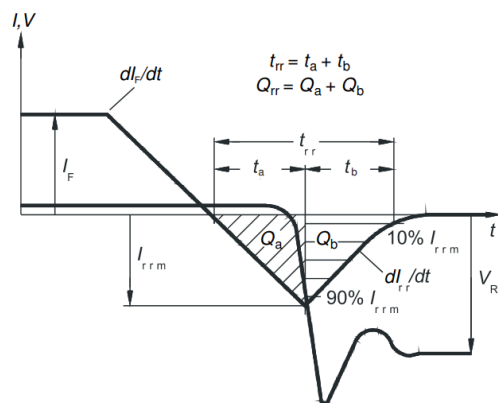


Figure C. Definition of diode switching characteristics

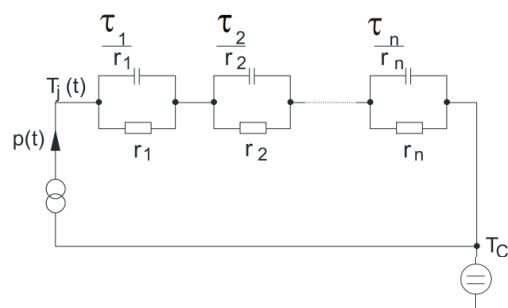


Figure D. Thermal equivalent circuit

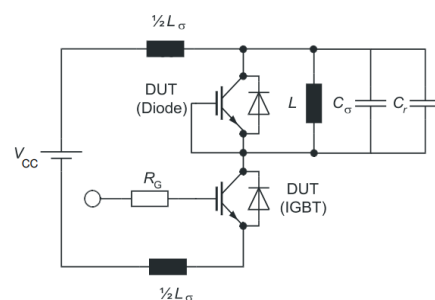


Figure E. **Dynamic test circuit**
Parasitic inductance L_{σ} ,
parasitic capacitor C_{σ} ,
relief capacitor C_r ,
(only for ZVT switching)

修订记录

IKW40N60DTP

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历史修订版本

Revision	Date	Subjects (major changes since last revision)
2.1	-	Release final datasheet

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