

英飞凌IGBT

采用节省空间封装的集成二极管 IGBT

IKD03N60RF

TRENCHSTOP™ RC 系列，适用于最高 30 kHz 的硬开关应用

数据手册

TRENCHSTOP™ RC-Drives Fast 系列

采用节省空间封装的集成二极管 IGBT

特性：

适用于 600V 应用的反向导通(RC)TRENCHSTOP™ 技术，提供：

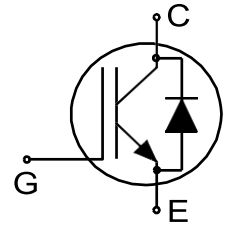
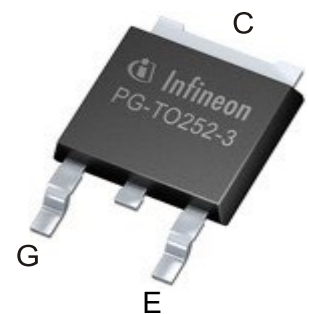
- 针对低开关损耗优化的 E_{on} 、 E_{off} 和 Q_{rr}
- 工作频率范围为 4 至 30 kHz
- 平滑的开关性能，从而实现低电磁干扰 (EMI) 水平
- 参数分布紧密
- 最高结温 175°C
- 5 μ s 的短路耐受能力
- 行业领先的电流与封装尺寸性能
- 符合 JEDEC 目标应用要求
- 无铅镀层；符合 RoHS 要求（焊接温度 260°C，MSL1）

完整的产品品类和 PSpice 模型：<http://www.infineon.com/igbt/>

应用：

家用和工业用驱动器：

- 压缩机
- 水泵
- 风扇



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
IKD03N60RF	600V	2.5A	2.2V	175°C	K03R60F	PG-T0252-3

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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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} $T_c = 25^{\circ}\text{C}$ value limited by bondwire $T_c = 100^{\circ}\text{C}$	I_C	6.5 6.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	7.5	A
Turn off safe operating area $V_{CE} \leq 600\text{V}$, $T_{vj} \leq 175^{\circ}\text{C}$, $t_p = 1\mu\text{s}$	-	7.5	A
Diode forward current, limited by T_{vjmax} $T_c = 25^{\circ}\text{C}$ $T_c = 100^{\circ}\text{C}$	I_F	6.3 3.9	A
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpuls}	7.5	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 $T_c = 25^{\circ}\text{C}$	P_{tot}	53.6	W
Operating junction temperature	T_{vj}	$-40 \dots +175$	$^{\circ}\text{C}$
Storage temperature	T_{stg}	$-55 \dots +150$	$^{\circ}\text{C}$
Soldering temperature, reflow soldering (MSL1 according to JEDEC J-STA-020)		260	$^{\circ}\text{C}$

热阻

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
R _{th} 特性						
IGBT thermal resistance, ¹⁾ junction - case	R _{th(j-c)}		-	-	2.80	K/W
Diode thermal resistance, ²⁾ junction - case	R _{th(j-c)}		-	-	6.80	K/W
Thermal resistance, min. footprint junction - ambient	R _{th(j-a)}		-	-	75	K/W
Thermal resistance, 6cm ² Cu on PCB junction - ambient	R _{th(j-a)}		-	-	50	K/W

¹⁾ R_{th}/Z_{th} 基于单次冷却脉冲。请注意，使用热电偶无法正确测量 IGBT 的 R_{th} 。

²⁾ R_{th}/Z_{th} 基于单次冷却脉冲。请注意，使用热电偶无法正确测量二极管的 R_{th} 。

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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	$V_{(BR)CES}$	$V_{GE} = 0V, I_C = 0.20mA$	600	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	$V_{GE} = 15.0V, I_C = 2.5A$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 175^{\circ}C$	- -	2.20 2.30	2.50 -	V
Diode forward voltage	V_F	$V_{GE} = 0V, I_F = 2.5A$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 175^{\circ}C$	- -	2.10 2.00	2.40 -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C = 0.05mA, V_{CE} = V_{GE}$	4.3	5.0	5.7	V
Zero gate voltage collector current ¹⁾	I_{CES}	$V_{CE} = 600V, V_{GE} = 0V$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 175^{\circ}C$	- -	- -	40 1000	μA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0V, V_{GE} = 20V$	-	-	100	nA
Transconductance	g_{fs}	$V_{CE} = 20V, I_C = 2.5A$	-	1.3	-	S
Integrated gate resistor	r_G			none		Ω

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	-	200	-	pF
Output capacitance	C _{oes}		-	13	-	
Reverse transfer capacitance	C _{res}		-	7	-	
Gate charge	Q _G	V _{CC} = 480V, I _C = 2.5A, V _{GE} = 15V	-	17.1	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L _E		-	7.0	-	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} = 25°C	-	23	-	A

开关特性、感性负载

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Turn-on delay time	$t_{d(on)}$	$T_{vj} = 25^{\circ}\text{C},$ $V_{CC} = 400\text{V}, I_C = 2.5\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(on)} = 68.0\Omega, R_{G(off)} = 68.0\Omega,$ $L_{\sigma} = 60\text{nH}, C_{\sigma} = 40\text{pF}$ L_{σ}, C_{σ} from Fig. E	-	10	-	ns
Rise time	t_r		-	8	-	ns
Turn-off delay time	$t_{d(off)}$		-	128	-	ns
Fall time	t_f		-	93	-	ns
Turn-on energy	E_{on}		-	0.05	-	mJ
Turn-off energy	E_{off}		-	0.04	-	mJ
Total switching energy	E_{ts}		-	0.09	-	mJ

¹⁾ 无需经过生产测试 - 经过设计/特性验证

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二极管特性, $T_{vj} = 25^{\circ}\text{C}$

Diode reverse recovery time	t_{rr}	$T_{vj} = 25^{\circ}\text{C},$ $V_R = 400\text{V},$ $I_F = 2.5\text{A},$ $di_F/dt = 470\text{A}/\mu\text{s}$	-	31	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.06	-	μC
Diode peak reverse recovery current	I_{rrm}		-	3.8	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-196	-	A/ μs

开关特性、感性负载

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	

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

Turn-on delay time	$t_{d(on)}$	$T_{vj} = 175^{\circ}\text{C},$ $V_{CC} = 400\text{V}, I_C = 2.5\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(on)} = 68.0\Omega, R_{G(off)} = 68.0\Omega,$ $L\sigma = 60\text{nH}, C\sigma = 40\text{pF}$ $L\sigma, C\sigma$ from Fig. E	-	9	-	ns
Rise time	t_r		-	9	-	ns
Turn-off delay time	$t_{d(off)}$		-	142	-	ns
Fall time	t_f		-	123	-	ns
Turn-on energy	E_{on}		-	0.08	-	mJ
Turn-off energy	E_{off}		-	0.06	-	mJ
Total switching energy	E_{ts}		-	0.14	-	mJ

二极管特性, 测于 $T_{vj} = 175^{\circ}\text{C}$ 的条件下

Diode reverse recovery time	t_{rr}	$T_{vj} = 175^{\circ}\text{C},$ $V_R = 400\text{V},$ $I_F = 2.5\text{A},$ $di_F/dt = 470\text{A}/\mu\text{s}$	-	66	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.19	-	μC
Diode peak reverse recovery current	I_{rrm}		-	6.2	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-125	-	A/ μs

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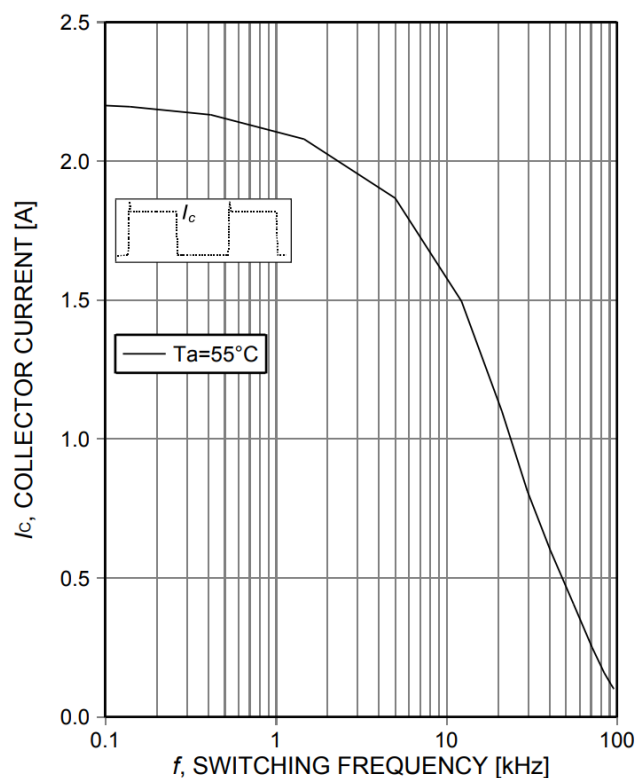


Figure 1. **Collector current as a function of switching frequency**
 ($T_{vj} \leq 175^\circ\text{C}$, $T_a = 55^\circ\text{C}$, $D = 0.5$, $V_{CE} = 400\text{V}$,
 $V_{GE} = 0/15\text{V}$, $R_G = 68\Omega$, PCB mounting, 6cm² Cu, P_{tot} = 2.4W)

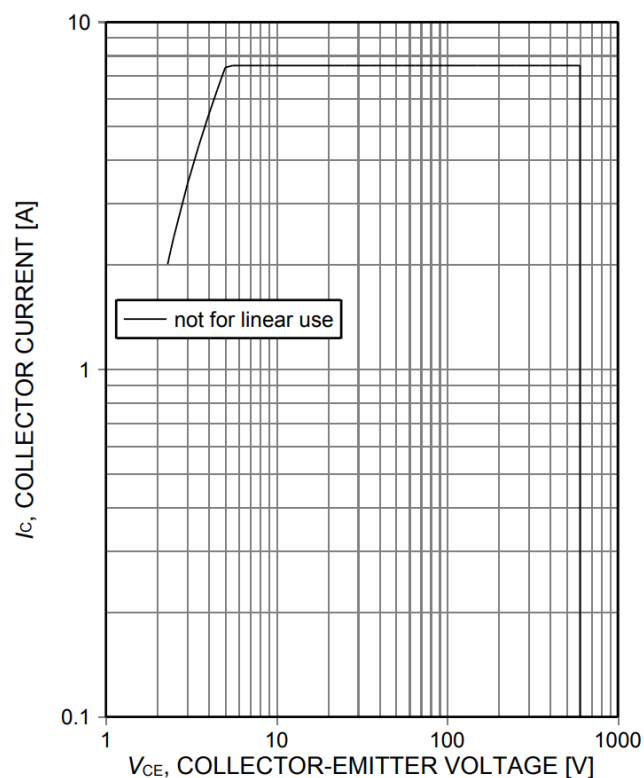


Figure 2. **Forward bias safe operating area**
 ($D = 0$, $T_C = 25^\circ\text{C}$, $T_{vj} \leq 175^\circ\text{C}$; $V_{GE} = 15\text{V}$)

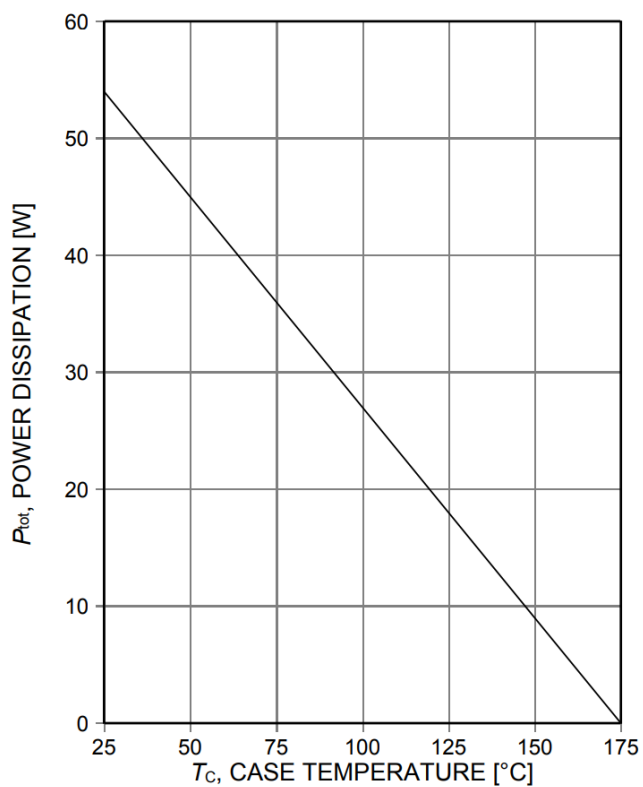


Figure 3. **Power dissipation as a function of case temperature**
 ($T_{vj} \leq 175^\circ\text{C}$)

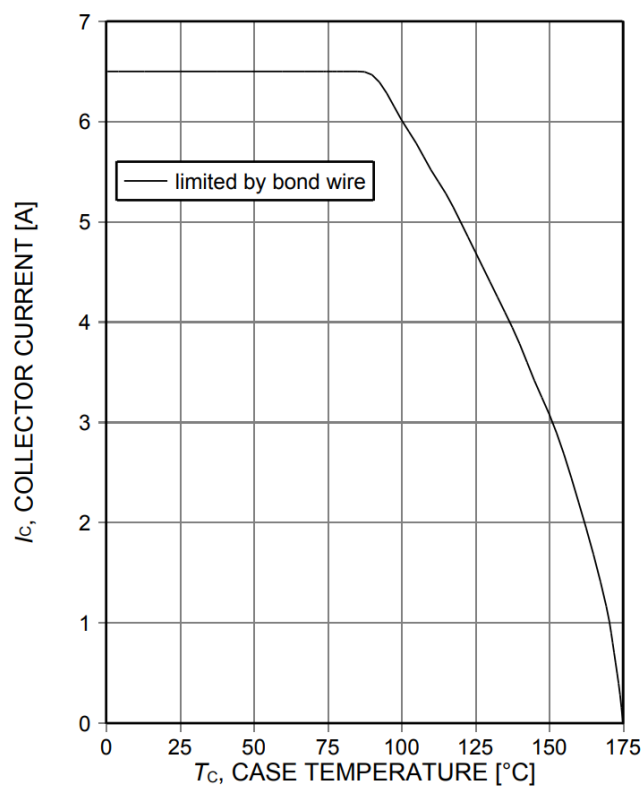


Figure 4. **Collector current as a function of case temperature**
 ($V_{GE} \geq 15\text{V}$, $T_{vj} \leq 175^\circ\text{C}$)

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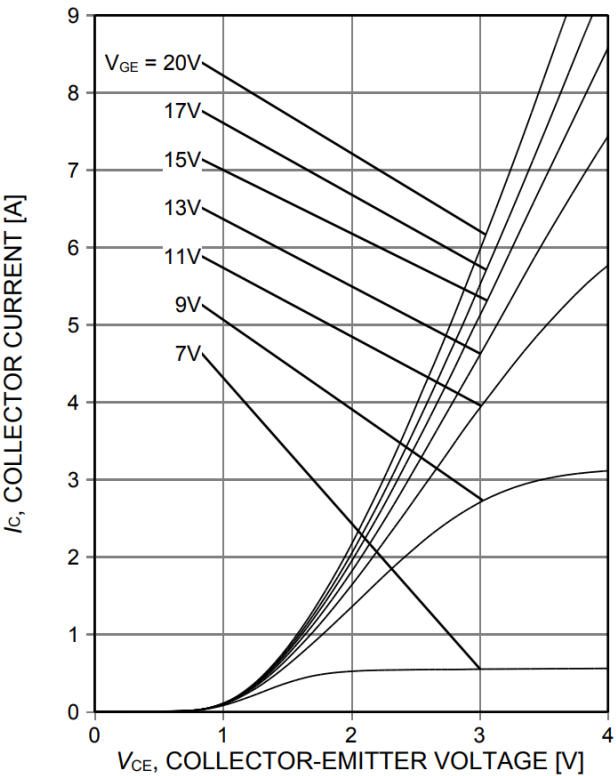


Figure 5. **Typical output characteristic**
($T_{vj}=25^{\circ}\text{C}$)

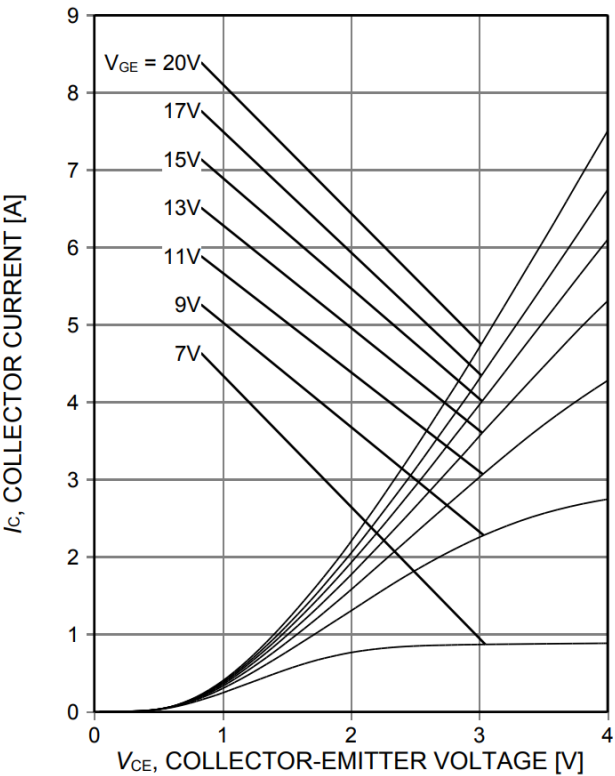


Figure 6. **Typical output characteristic**
($T_{vj}=175^{\circ}\text{C}$)

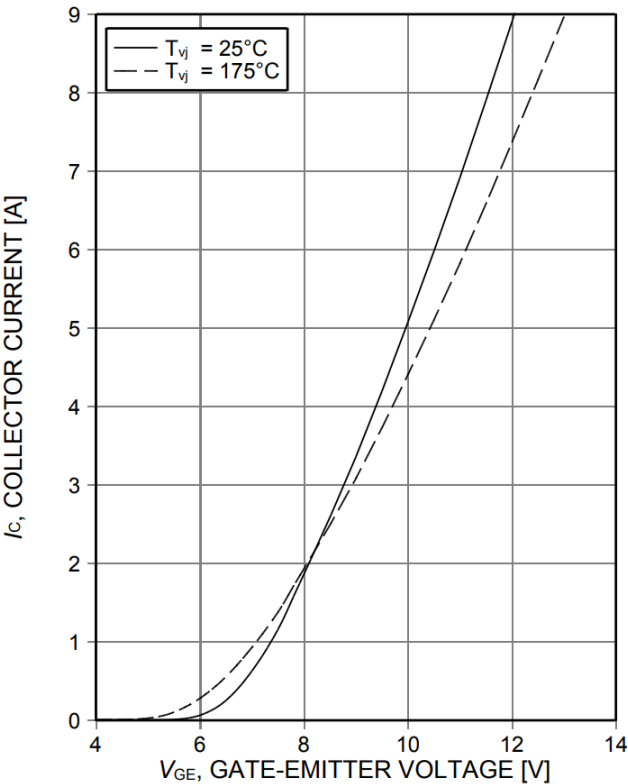


Figure 7. **Typical transfer characteristic**
($V_{CE}=10\text{V}$)

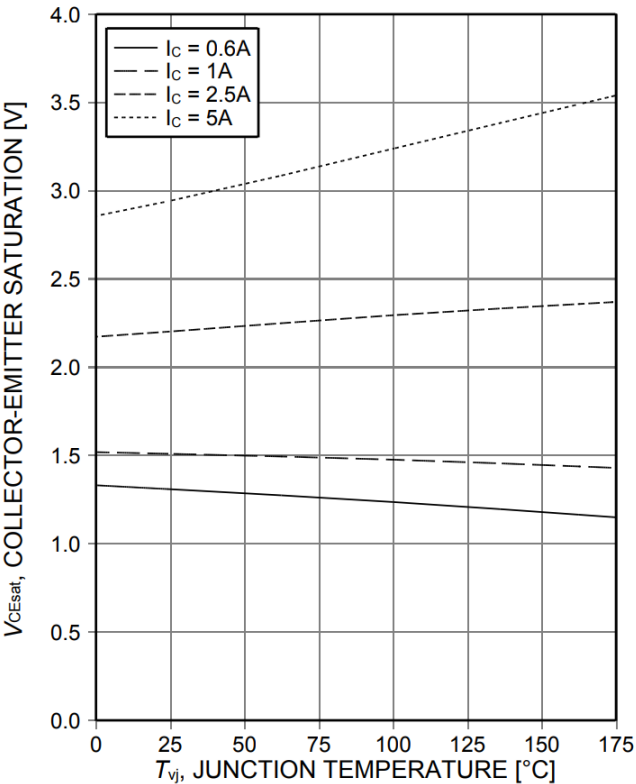


Figure 8. **Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{GE}=15\text{V}$)

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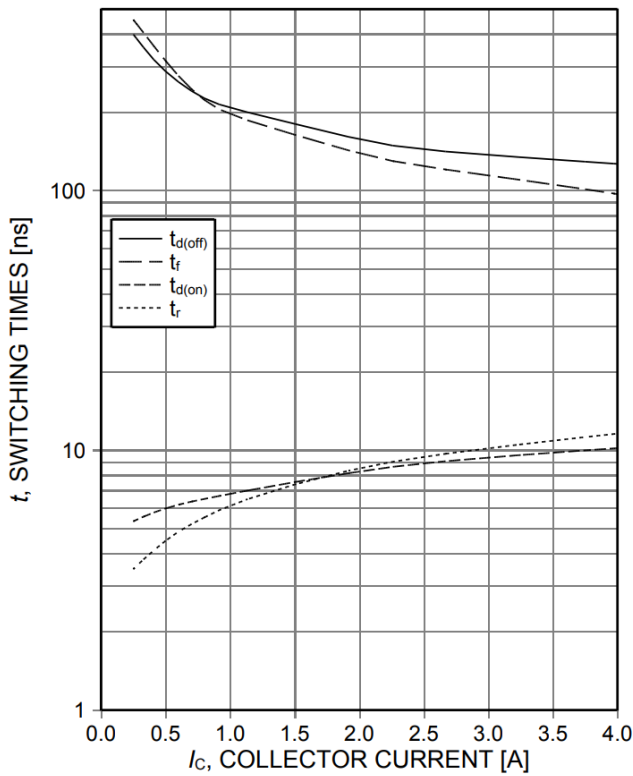


Figure 9. **Typical switching times as a function of collector current**
(inductive load, $T_{vj}=175^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $R_{Gon}=68\Omega$, $R_{Goff}=68\Omega$, dynamic test circuit in Figure E)

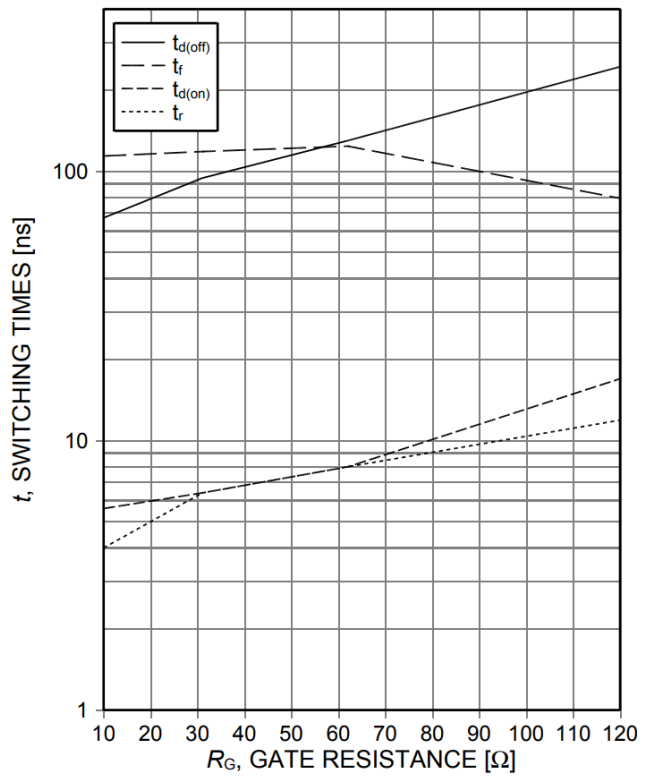


Figure 10. **Typical switching times as a function of gate resistance**
(inductive load, $T_{vj}=175^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=2,5\text{A}$, dynamic test circuit in Figure E)

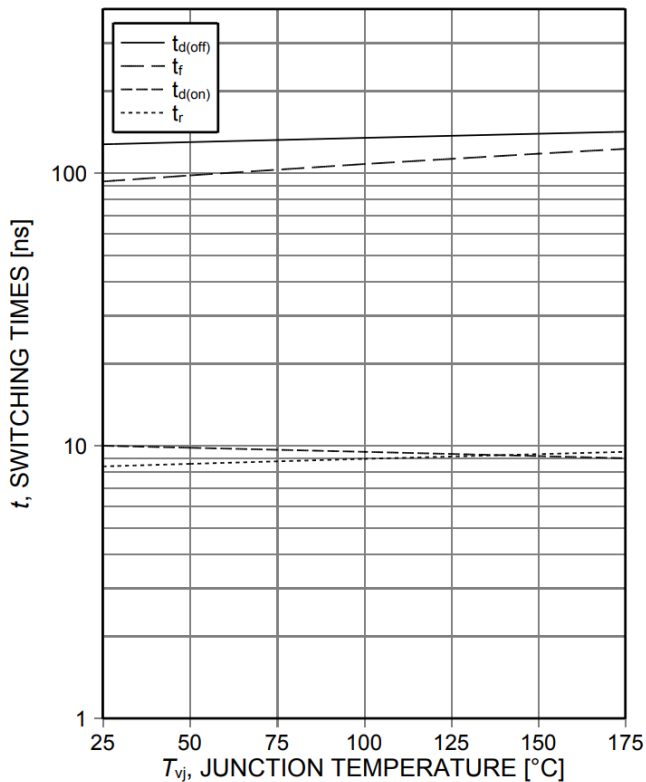


Figure 11. **Typical switching times as a function of junction temperature**
(inductive load, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=2,5\text{A}$, $R_{Gon}=68\Omega$, $R_{Goff}=68\Omega$, dynamic test circuit in Figure E)

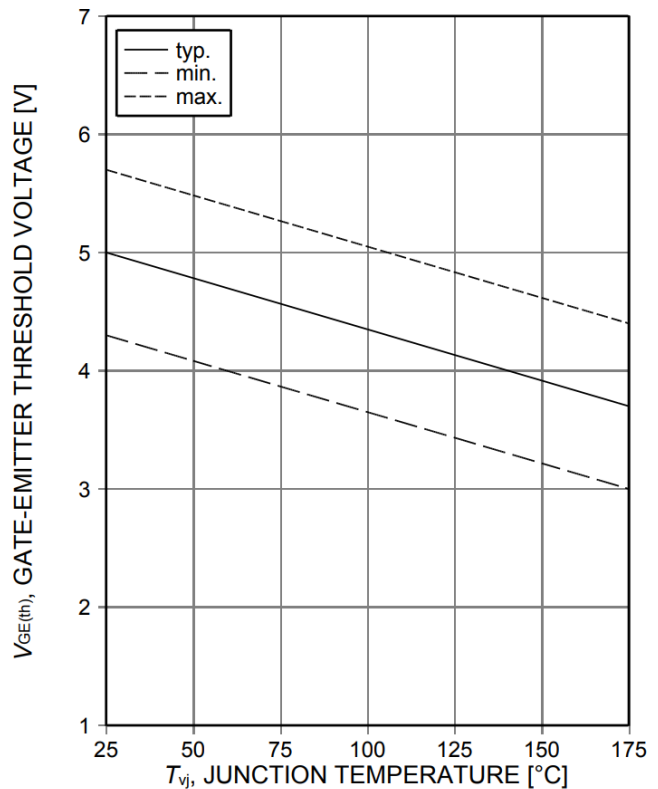


Figure 12. **Gate-emitter threshold voltage as a function of junction temperature**
($I_C=0,05\text{mA}$)

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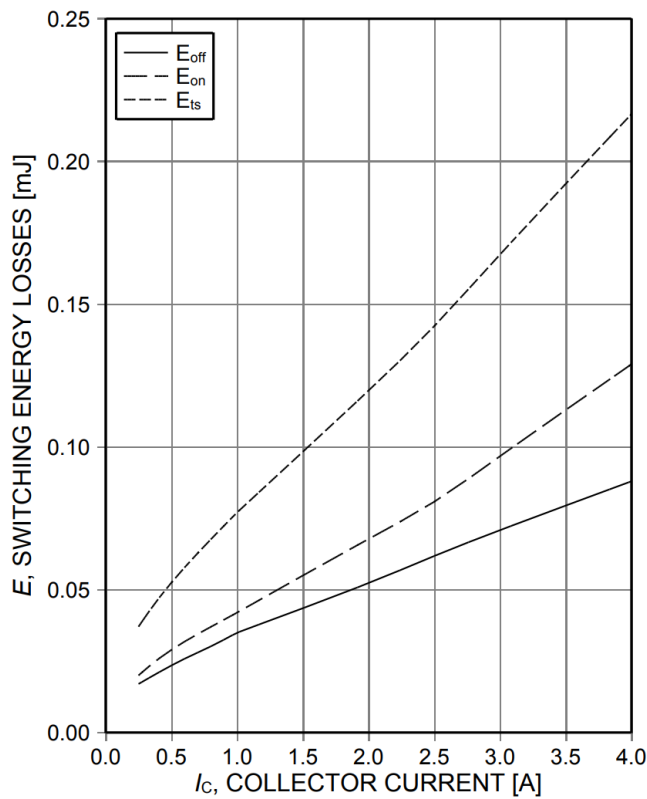


Figure 13. **Typical switching energy losses as a function of collector current**
(inductive load, $T_{vj}=175^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $R_{Gon}=68\Omega$, $R_{Goff}=68\Omega$, dynamic test circuit in Figure E)

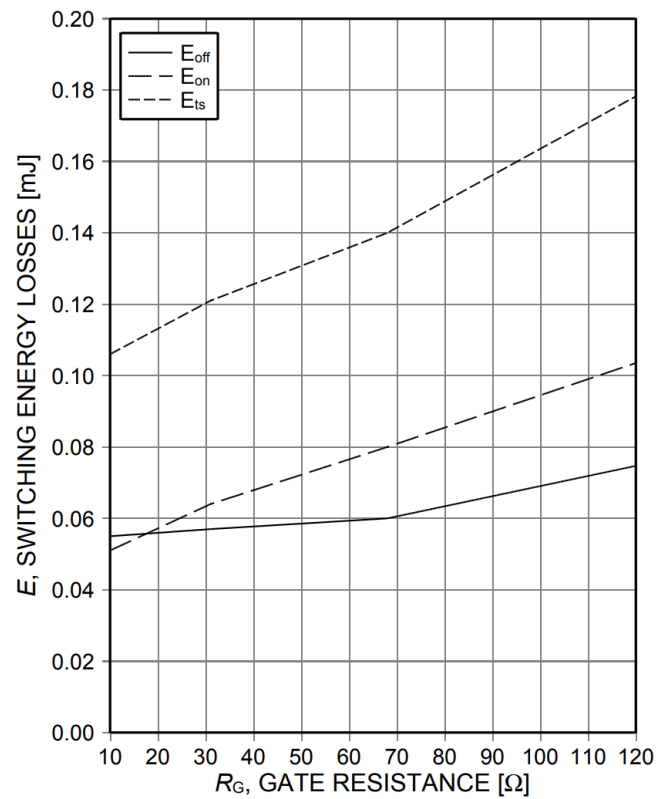


Figure 14. **Typical switching energy losses as a function of gate resistance**
(inductive load, $T_{vj}=175^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=2.5\text{A}$, dynamic test circuit in Figure E)

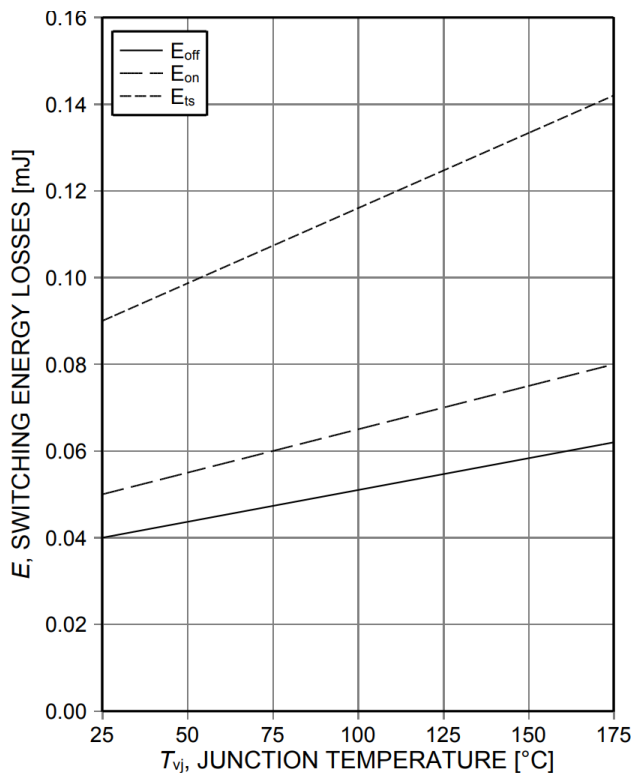


Figure 15. **Typical switching energy losses as a function of junction temperature**
(inductive load, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=2.5\text{A}$, $R_{Gon}=68\Omega$, $R_{Goff}=68\Omega$, dynamic test circuit in Figure E)

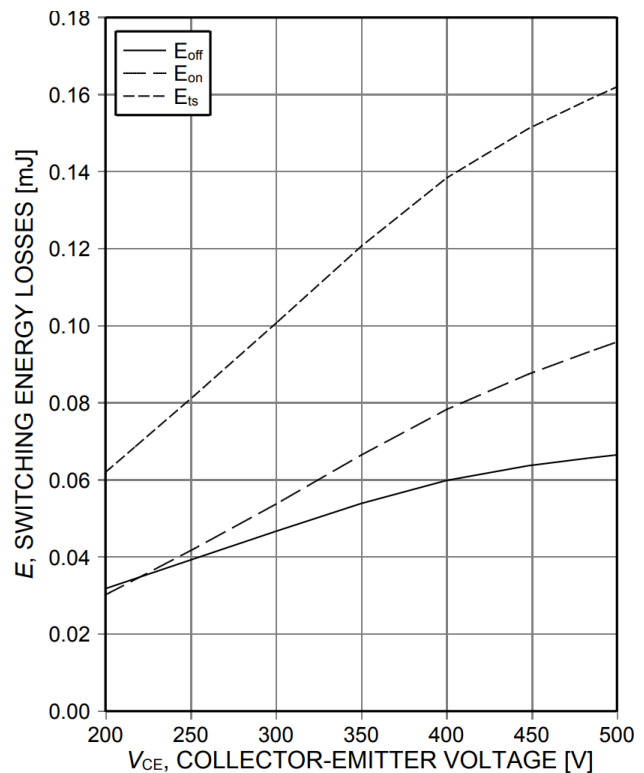


Figure 16. **Typical switching energy losses as a function of collector emitter voltage**
(inductive load, $T_{vj}=175^{\circ}\text{C}$, $V_{GE}=0/15\text{V}$, $I_C=2.5\text{A}$, $R_{Gon}=68\Omega$, $R_{Goff}=68\Omega$, dynamic test circuit in Figure E)

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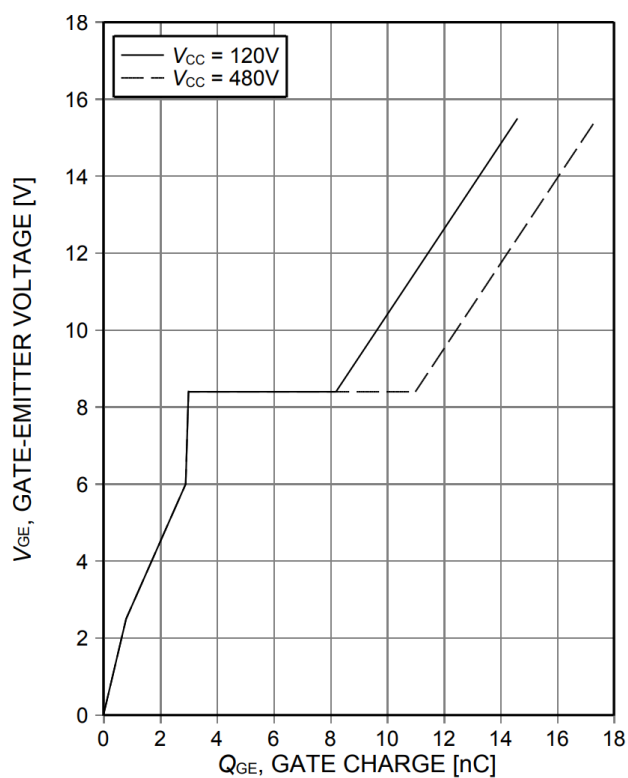


Figure 17. **Typical gate charge**
($I_C=2,5A$)

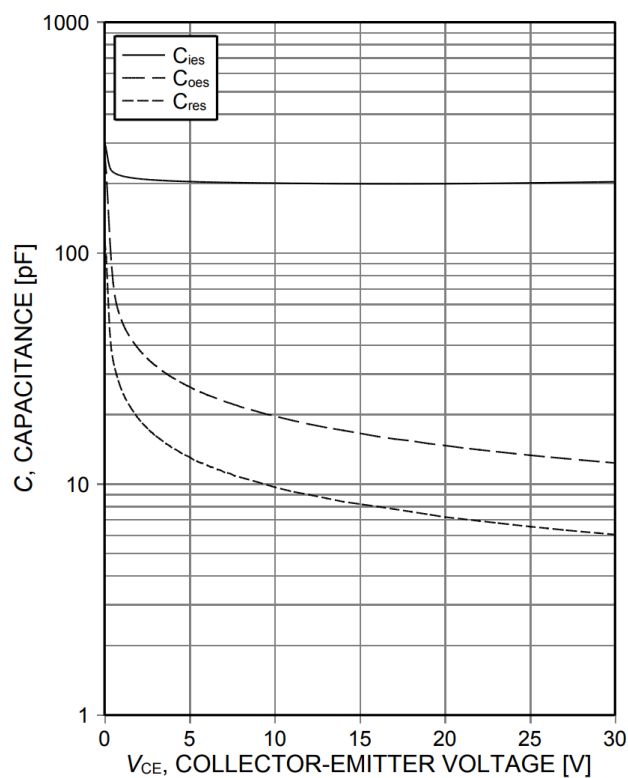


Figure 18. **Typical capacitance as a function of collector-emitter voltage**
($V_{GE}=0V$, $f=1MHz$)

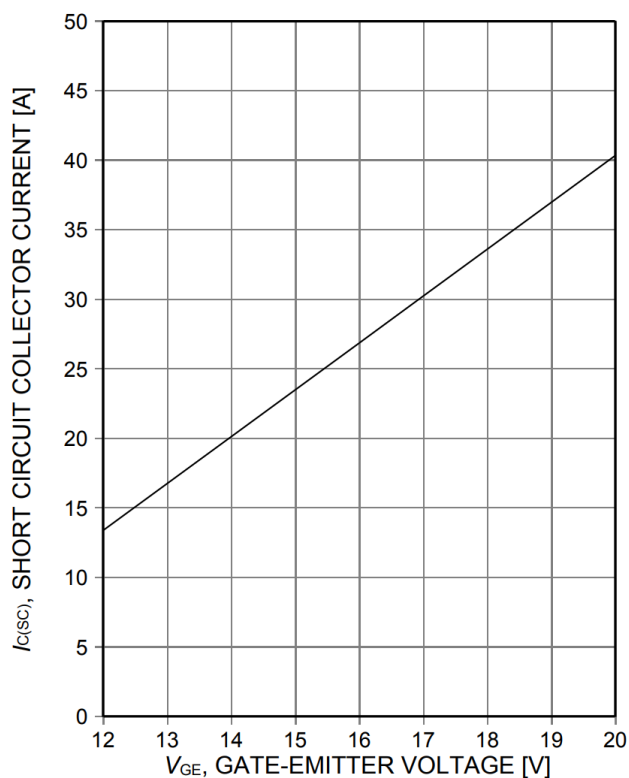


Figure 19. **Typical short circuit collector current as a function of gate-emitter voltage**
($V_{CE} \leq 400V$, start at $T_{vj}=25^\circ C$)

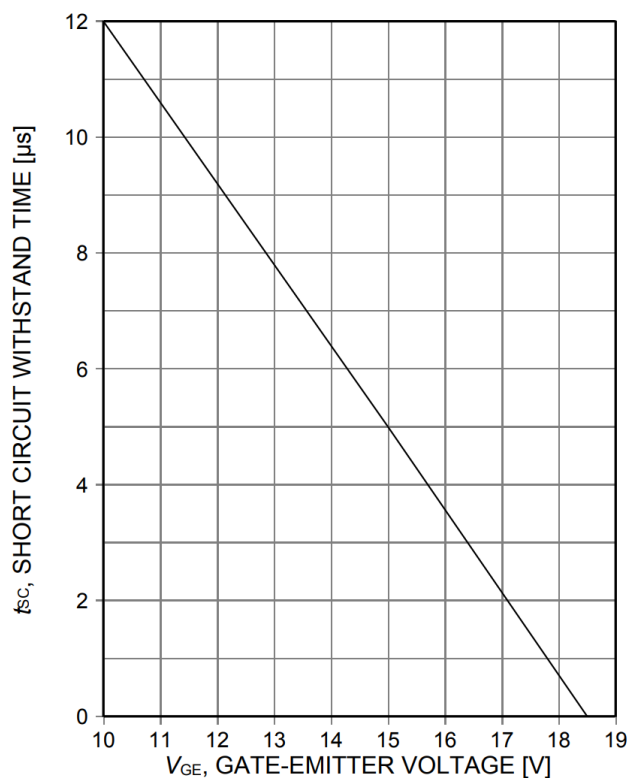


Figure 20. **Short circuit withstand time as a function of gate-emitter voltage**
($V_{CE} \leq 400V$, start at $T_{vj}=150^\circ C$)

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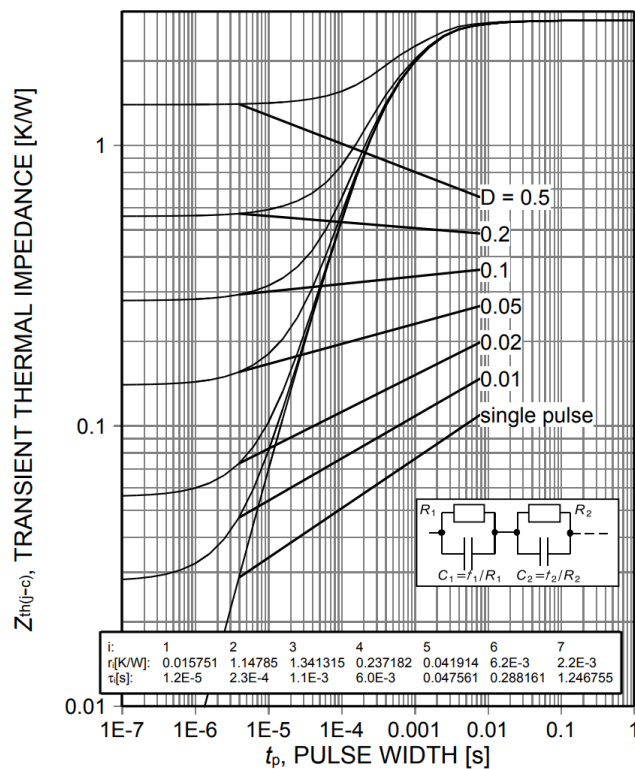


Figure 21. IGBT transient thermal impedance as a function of pulse width ¹⁾ (see page 4)
($D=t_p/T$)

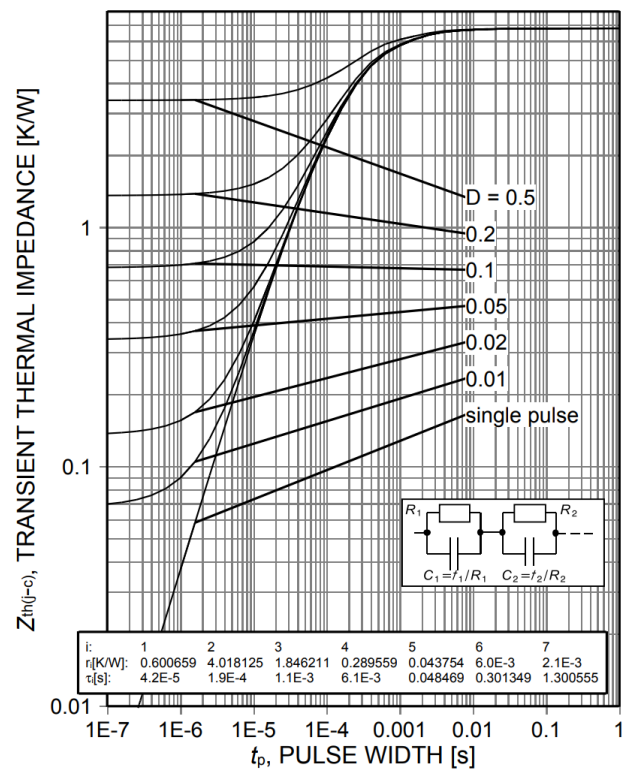


Figure 22. Diode transient thermal impedance as a function of pulse width ²⁾ (see page 4)
($D=t_p/T$)

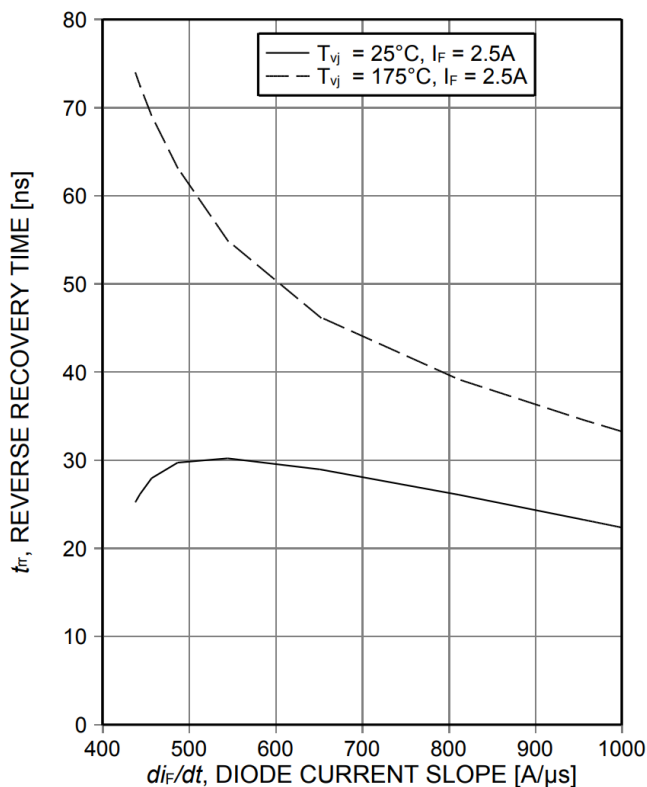


Figure 23. Typical reverse recovery time as a function of diode current slope
($V_R=400V$)

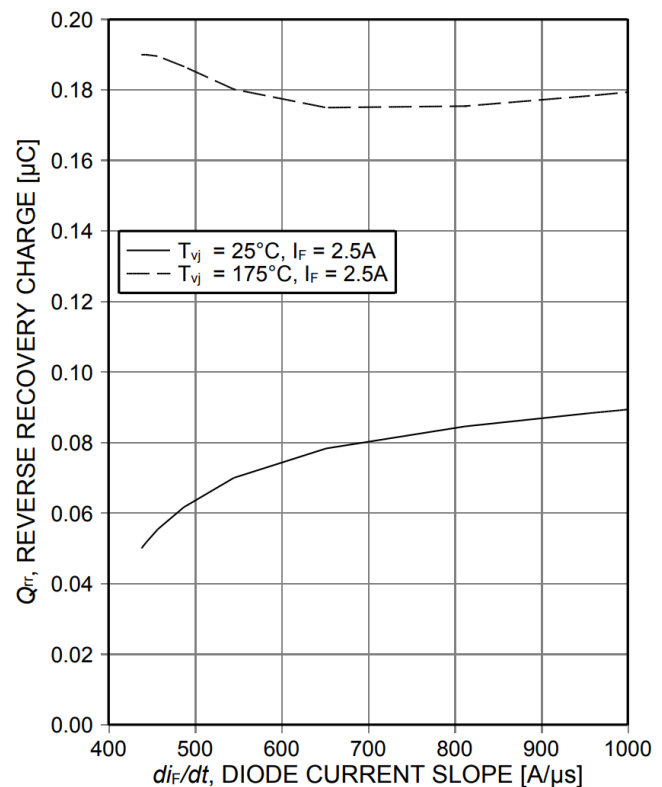


Figure 24. Typical reverse recovery charge as a function of diode current slope
($V_R=400V$)

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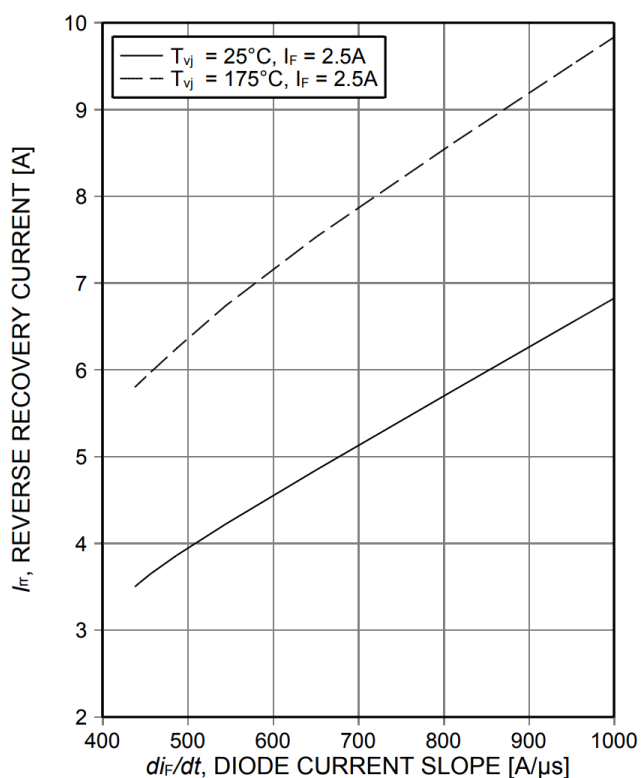


Figure 25. Typical reverse recovery current as a function of diode current slope ($V_R=400V$)

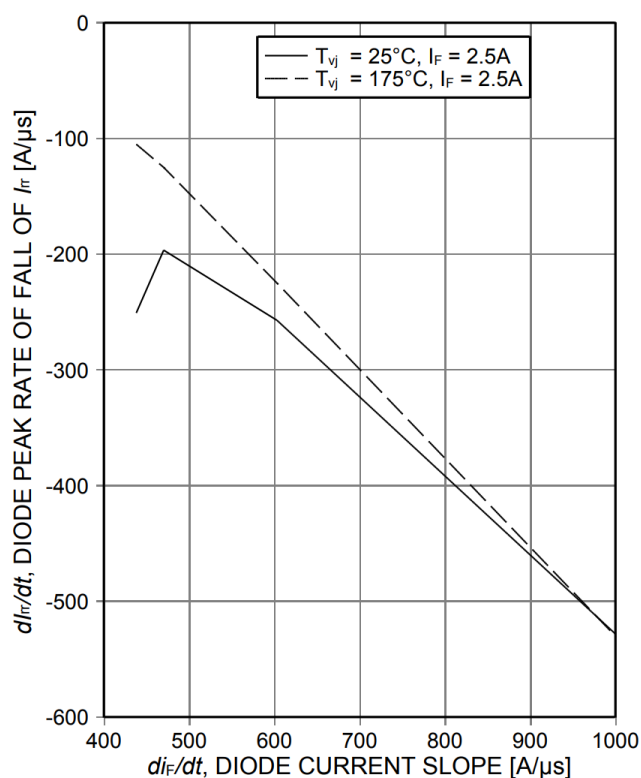


Figure 26. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope ($V_R=400V$)

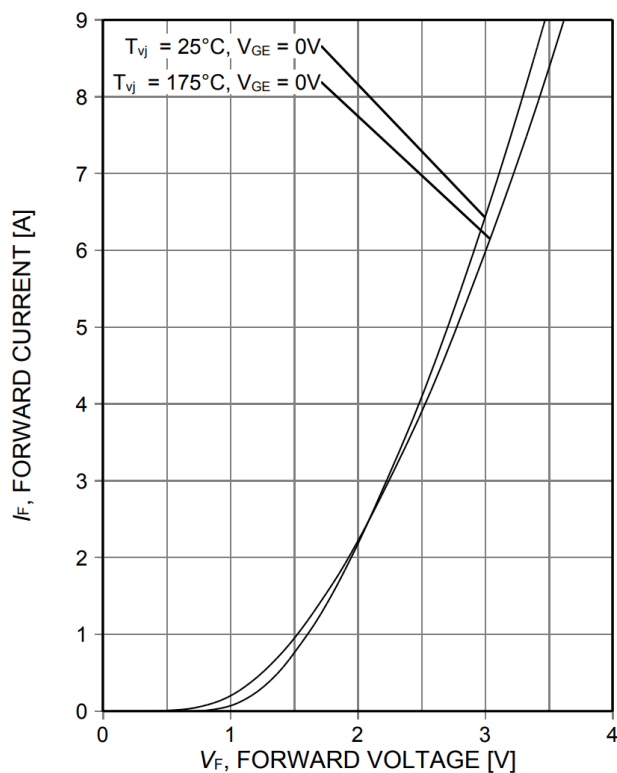


Figure 27. Typical diode forward current as a function of forward voltage

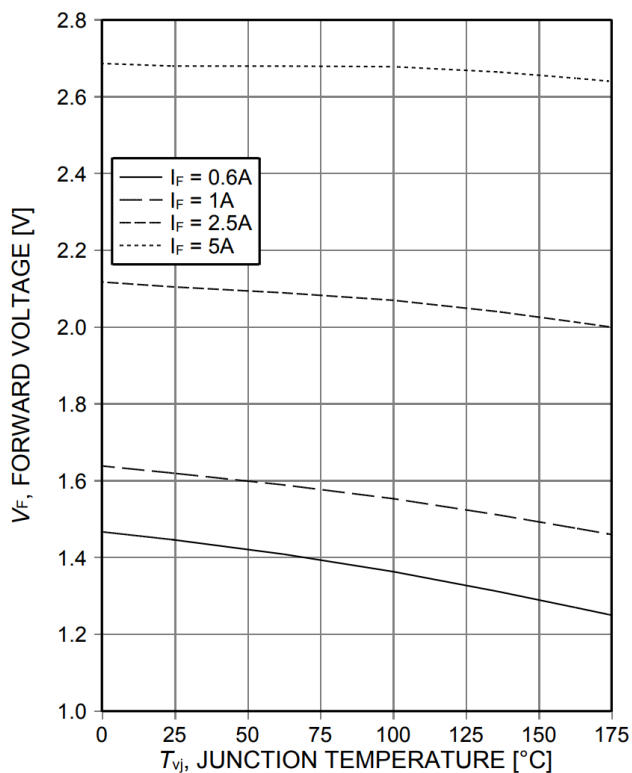
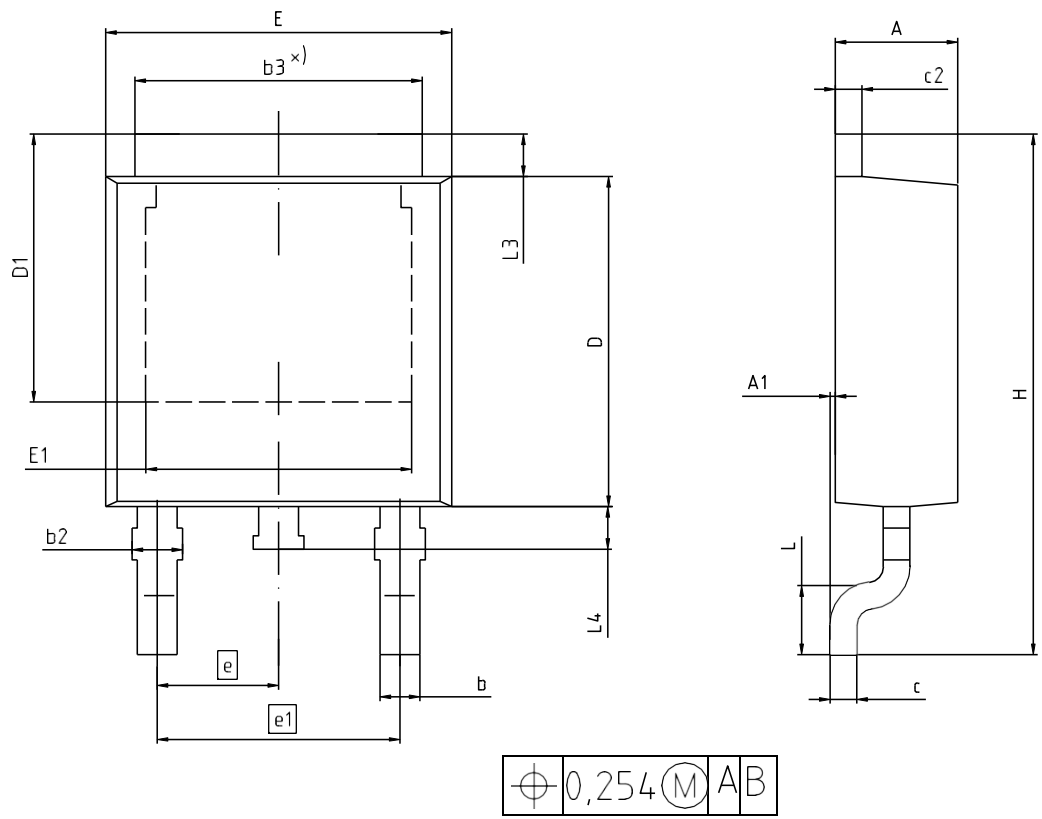


Figure 28. Typical diode forward voltage as a function of junction temperature

封装图 PG-T0252-3



NOTES:
1. ALL DIMENSIONS REFER TO JEDEC
STANDARD TO-252 DO NOT INCLUDE MOLD
FLASH OR PROTRUSIONS.

DIM	MILLIMETERS	
	MIN	MAX
A	2.16	2.41
A1	0.00	0.15
b	0.64	0.89
b2	0.65	1.15
b3	4.95	5.50
c	0.46	0.61
c2	0.40	0.98
D	5.97	6.22
D1	5.02	5.84
E	6.35	6.73
E1	4.32	5.21
e	2.29 (BSC)	
e1	4.57 (BSC)	
N	3	
H	9.40	10.48
L	1.18	1.78
L3	0.89	1.27
L4	0.51	1.02

DOCUMENT NO. Z8B00003328
SCALE 0 2.5 5mm
EUROPEAN PROJECTION
ISSUE DATE 05-02-2016
REVISION 06

TRENCHSTOP™ RC-Drives Fast 系列

测试条件

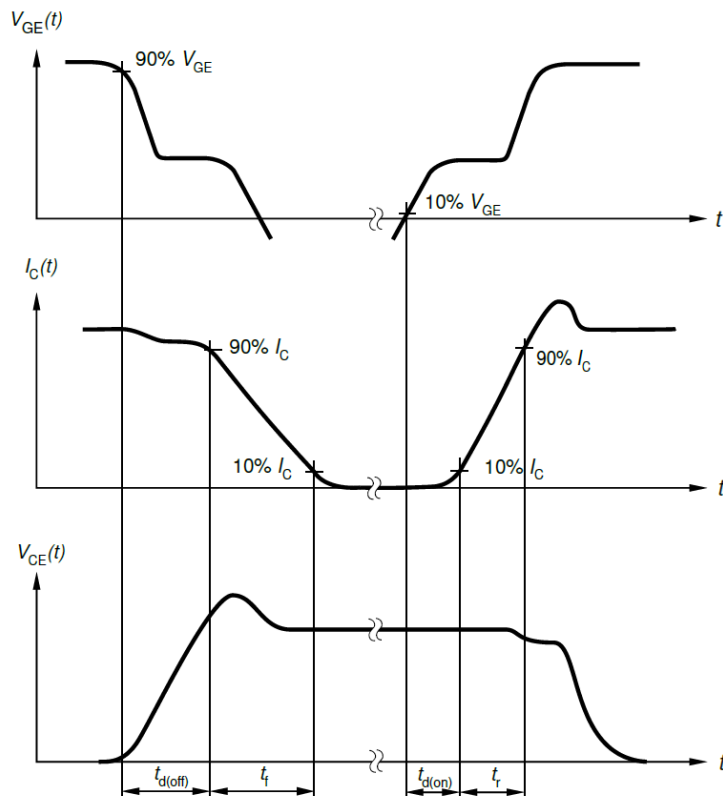


Figure A. Definition of switching times

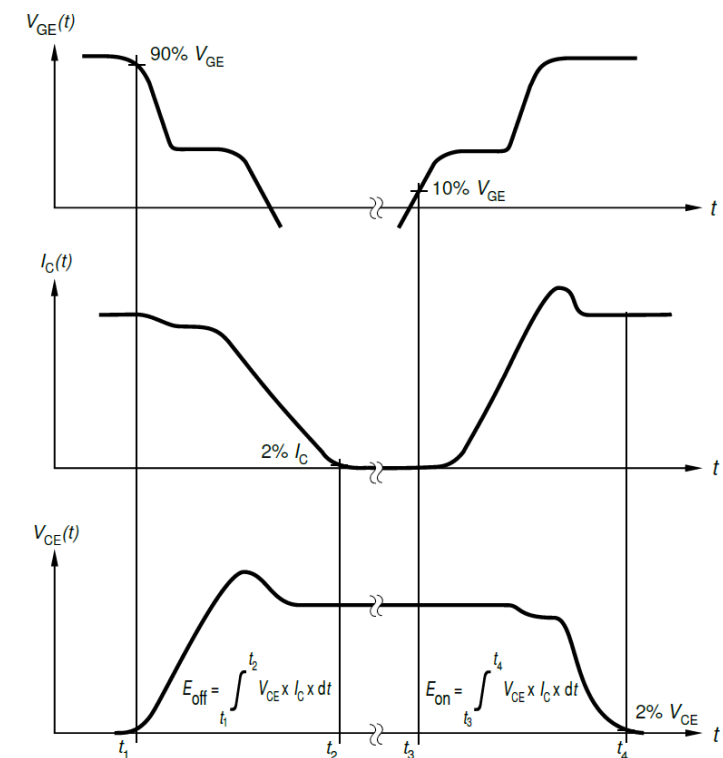


Figure B. Definition of switching losses

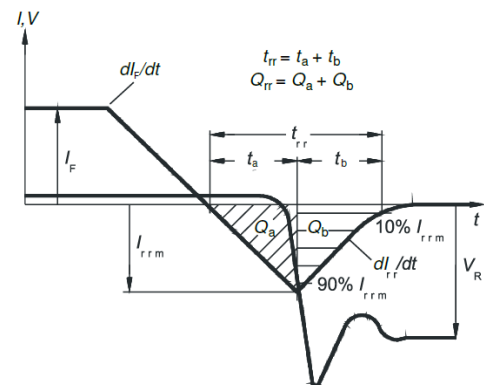


Figure C. Definition of diode switching characteristics

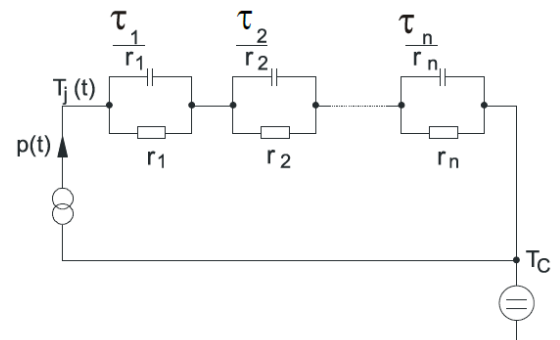


Figure D. Thermal equivalent circuit

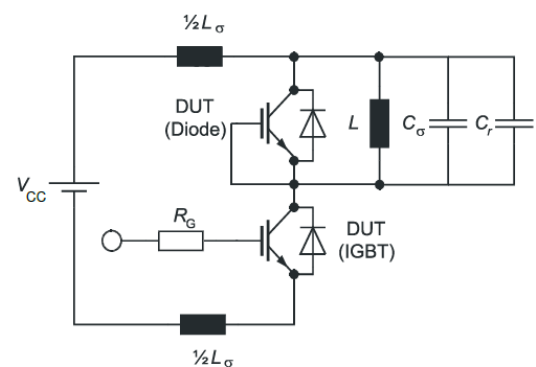


Figure E. **Dynamic test circuit**
 Parasitic inductance L_σ ,
 parasitic capacitor C_σ ,
 relief capacitor C_r ,
 (only for ZVT switching)

TRENCHSTOP™ RC-Drives Fast 系列

修订记录

IKD03N60RF

Revision: 2016-05-10, Rev. 2.6

修订历史

Revision	Date	Subjects (major changes since last revision)
1.1	2011-06-07	Preliminary Data sheet
2.2	2012-02-23	Final data sheet
2.3	2013-12-10	New value ICES max limit at 175°C
2.4	2014-02-26	Without PB free logo
2.5	2014-03-12	Storage temperature -55...+150°C
2.6	2016-05-10	New maximum values $I_c(T_c)$, $I_F(T_c)$ and Figure 4

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