IGBT

高速 DuoPack：采用 Trench 和 Fieldstop 技术的 IGBT，搭配软、快速恢复反并联二极管

IKW40N60H3

600V DuoPack IGBT 和二极管
第三代高速开关系列

数据手册

功率控制

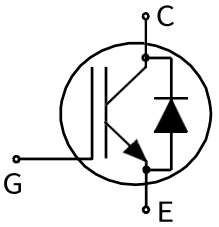
高速 DuoPack：采用 Trench 和 Fieldstop 技术的 IGBT，搭配软、快速恢复反并联二极管

特性：

TRENCHSTOP™技术产品

- 极低 V_{CEsat}
- 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：

- UPS（不间断电源）
- 焊机
- 高开关频率转换器

Green

Halogen-Free

RoHS

关键性能和封装参数

Type	V_{CE}	I_C	V_{CEsat}, T_{vj}=25°C	T_{vjmax}	Marking	Package
IKW40N60H3	600V	40A	1.95V	175°C	K40H603	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

描述 2

目录 3

最大额定值 4

热阻抗 4

电气特性 5

电气特性图 7

封装图 14

测试条件 15

修订记录 16

免责声明 16

最大额定值

Parameter	Symbol	Value	Unit
Collector-emitter voltage, $T_{vj} \geq 25°C$	V_{CE}	600	V
DC collector current, limited by T_{vjmax} T_C = 25°C T_C = 100°C	I_C	80.0 40.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	160.0	A
Turn off safe operating area $V_{CE} \leq 600V$, $T_{vj} \leq 175°C$, t_p = 1µs	-	160.0	A
Diode forward current, limited by T_{vjmax} T_C = 25°C T_C = 100°C	I_F	40.0 20.0	A
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpuls}	160.0	A
Gate-emitter voltage	V_{GE}	±20	V
Short circuit withstand time V_{GE} = 15.0V, $V_{CC} \leq 400V$ Allowed number of short circuits < 1000 Time between short circuits: ≥ 1.0s T_{vj} = 150°C	t_{SC}	5	µs
Power dissipation T_C = 25°C Power dissipation T_C = 100°C	P_{tot}	306.0 153.0	W
Operating junction temperature	T_{vj}	-40...+175	°C
Storage temperature	T_{stg}	-55...+150	°C
Soldering temperature, wave soldering 1.6 mm (0.063 in.) 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	$R_{th(j-c)}$		0.49	K/W
Diode thermal resistance, junction - case	$R_{th(j-c)}$		1.50	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 = 2.00mA	600	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	V_{GE} = 15.0V, I_C = 40.0A T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	 - - -	 1.95 2.30 2.50	 2.40 - -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 20.0A T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 175°C	 - - -	 1.65 1.67 1.65	 2.05 - -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 0.58mA, V_{CE} = V_{GE}	4.1	5.1	5.7	V
Zero gate voltage collector current	I_{CES}	V_{CE} = 600V, V_{GE} = 0V T_{vj} = 25°C T_{vj} = 175°C	 - -	 - -	 40.0 3000.0	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = 20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE} = 20V, I_C = 40.0A	-	24.0	-	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	-	2190	-	pF
Output capacitance	C_{oes}		-	112	-	
Reverse transfer capacitance	C_{res}		-	64	-	
Gate charge	Q_G	V_{CC} = 480V, I_C = 40.0A, V_{GE} = 15V	-	223.0	-	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: ≥ 1.0s	$I_{C(SC)}$	V_{GE} = 15.0V, V_{CC} ≤ 400V, t_{SC} ≤ 5µs T_{vj} = 150°C	-	 235	-	A

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 = 40.0A, V_{GE} = 0.0/15.0V, r_G = 7.9Ω, $L\sigma$ = 90nH, $C\sigma$ = 60pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	19	-	ns
Rise time	t_r		-	33	-	ns
Turn-off delay time	$t_{d(off)}$		-	197	-	ns
Fall time	t_f		-	21	-	ns
Turn-on energy	E_{on}		-	1.10	-	mJ
Turn-off energy	E_{off}		-	0.58	-	mJ
Total switching energy	E_{ts}		-	1.68	-	mJ
Diode reverse recovery time	t_{rr}	T_{vj} = 25°C, V_R = 400V, I_F = 20.0A, di_F/dt = 1000A/µs	-	124	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.81	-	µC
Diode peak reverse recovery current	I_{rrm}		-	13.6	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-332	-	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°C的条件						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 175°C, V_{CC} = 400V, I_C = 40.0A, V_{GE} = 0.0/15.0V, r_G = 7.9Ω, $L\sigma$ = 90nH, $C\sigma$ = 60pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	19	-	ns
Rise time	t_r		-	29	-	ns
Turn-off delay time	$t_{d(off)}$		-	227	-	ns
Fall time	t_f		-	22	-	ns
Turn-on energy	E_{on}		-	1.33	-	mJ
Turn-off energy	E_{off}		-	0.79	-	mJ
Total switching energy	E_{ts}		-	2.12	-	mJ
Diode reverse recovery time	t_{rr}	T_{vj} = 175°C, V_R = 400V, I_F = 20.0A, di_F/dt = 1000A/µs	-	190	-	ns
Diode reverse recovery charge	Q_{rr}		-	1.70	-	µC
Diode peak reverse recovery current	I_{rrm}		-	18.5	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-290	-	A/µs

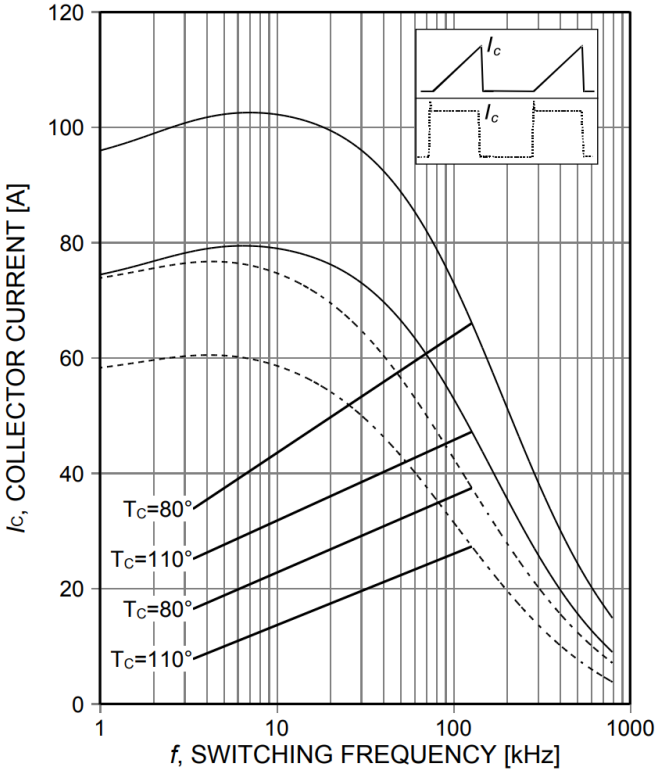


Figure 1. **Collector current as a function of switching frequency**
(T_j≤175°C, D=0.5, V_{CE}=400V, V_{GE}=15/0V, r_G=7,9Ω)

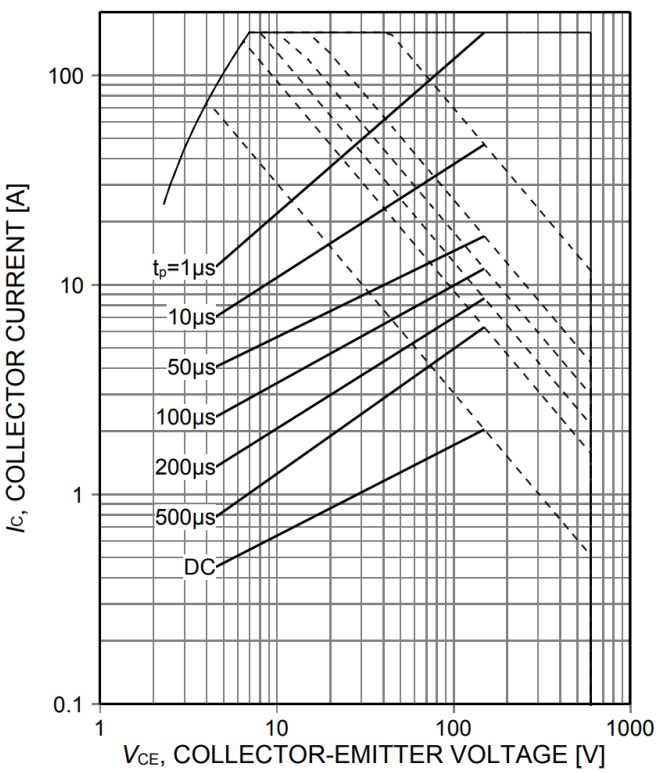


Figure 2. **Forward bias safe operating area**
(D=0, T_C=25°C, T_j≤175°C; V_{GE}=15V)

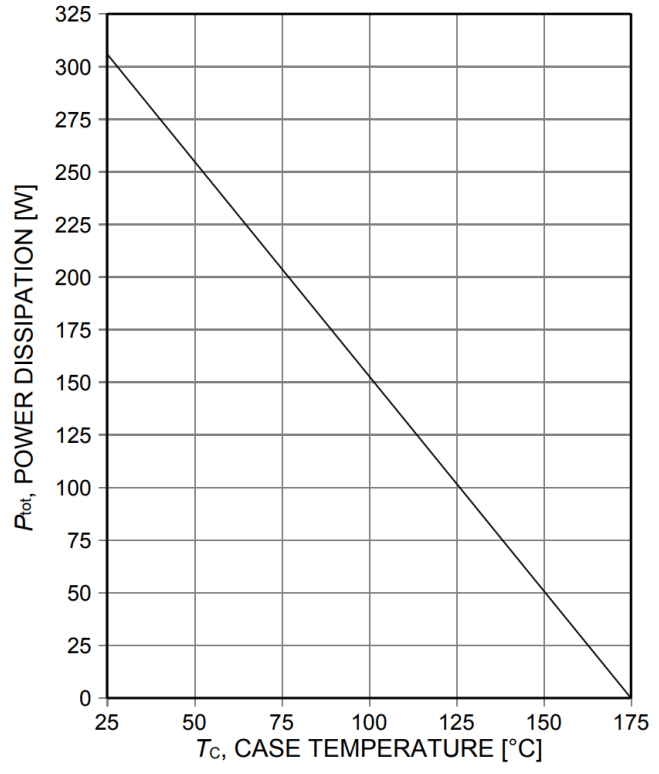


Figure 3. **Power dissipation as a function of case temperature**
(T_j≤175°C)

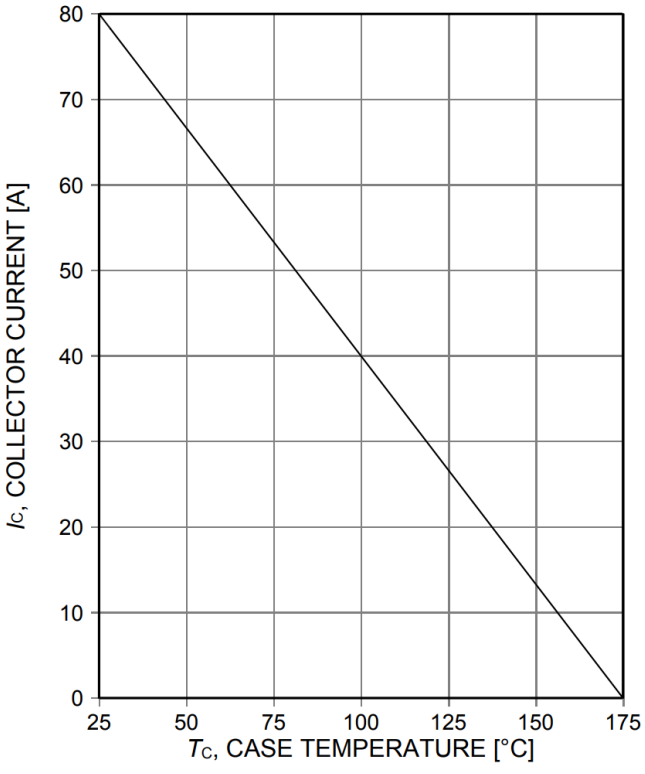


Figure 4. **Collector current as a function of case temperature**
(V_{GE}≥15V, T_j≤175°C)

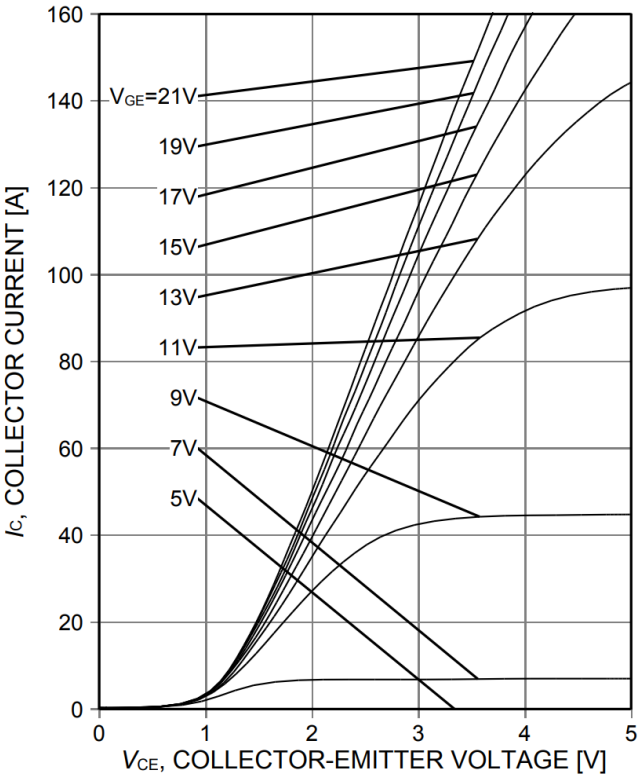


Figure 5. **Typical output characteristic**
(T_j=25°C)

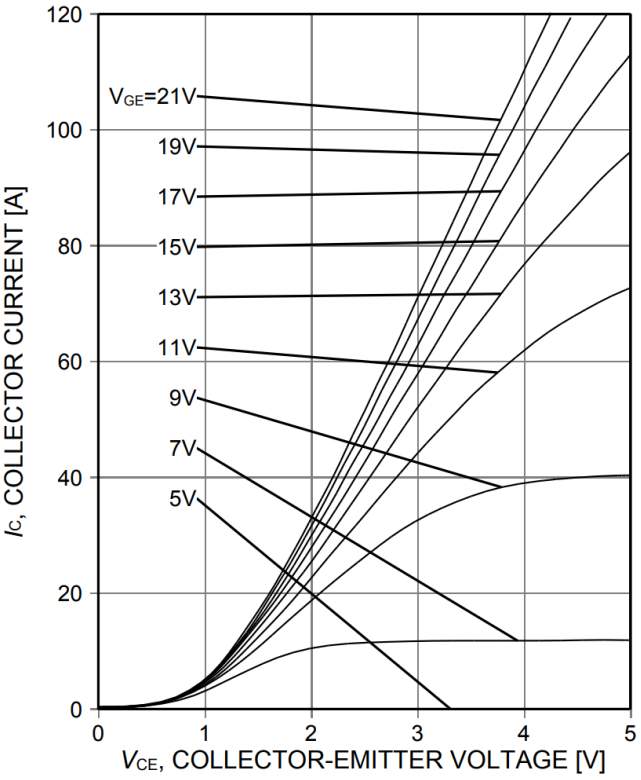


Figure 6. **Typical output characteristic**
(T_j=175°C)

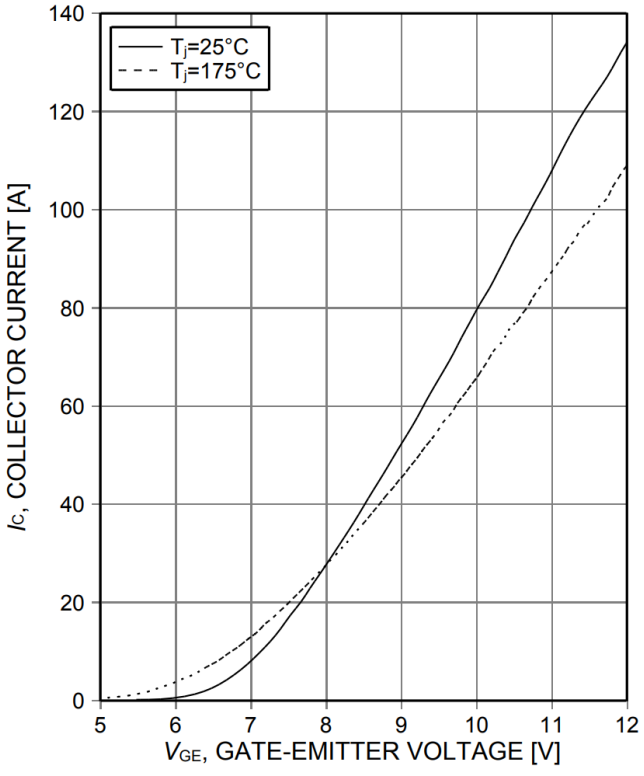


Figure 7. **Typical transfer characteristic**
(V_{CE}=20V)

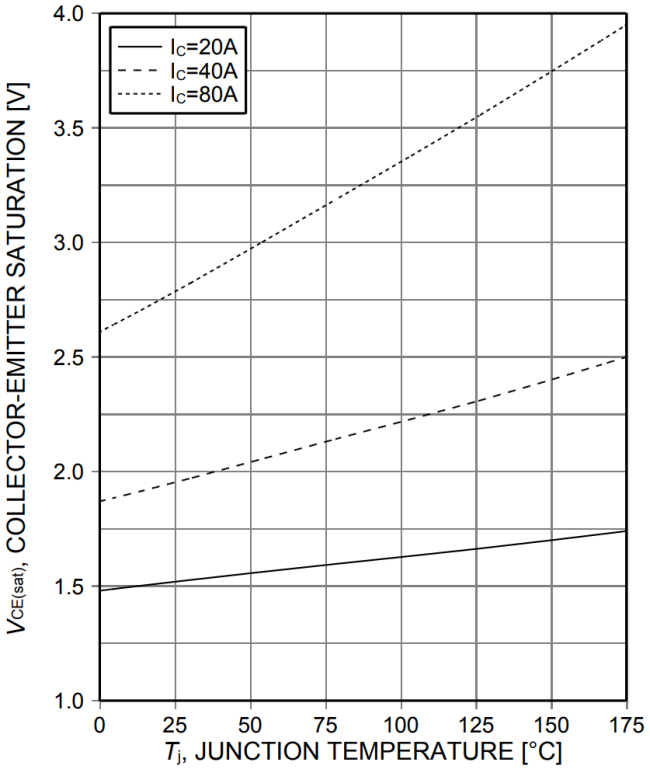


Figure 8. **Typical collector-emitter saturation voltage as a function of junction temperature**
(V_{GE}=15V)

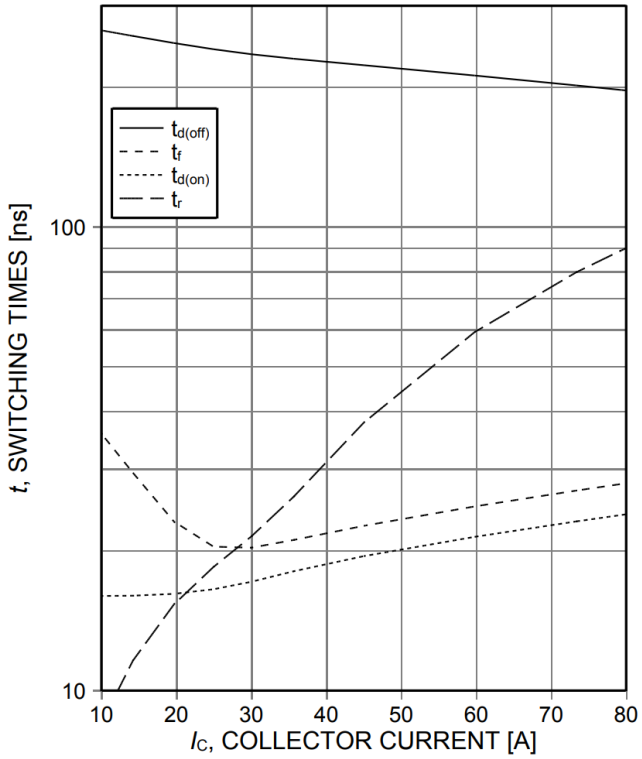


Figure 9. **Typical switching times as a function of collector current**
(ind. load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, r_G=7,9Ω, test circuit in Fig. E)

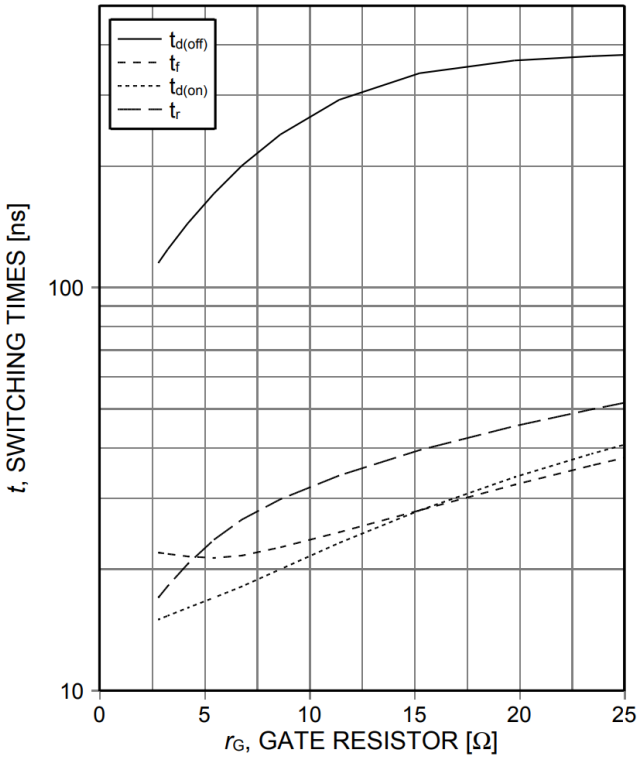


Figure 10. **Typical switching times as a function of gate resistor**
(ind. load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, I_C=40A, test circuit in Fig. E)

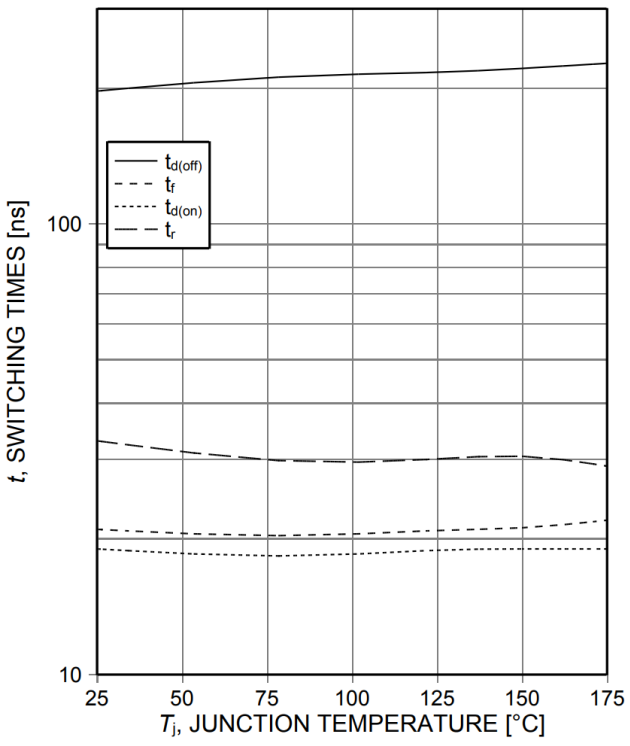


Figure 11. **Typical switching times as a function of junction temperature**
(ind. load, V_{CE}=400V, V_{GE}=15/0V, I_C=40A, r_G=7,9Ω, test circuit in Fig. E)

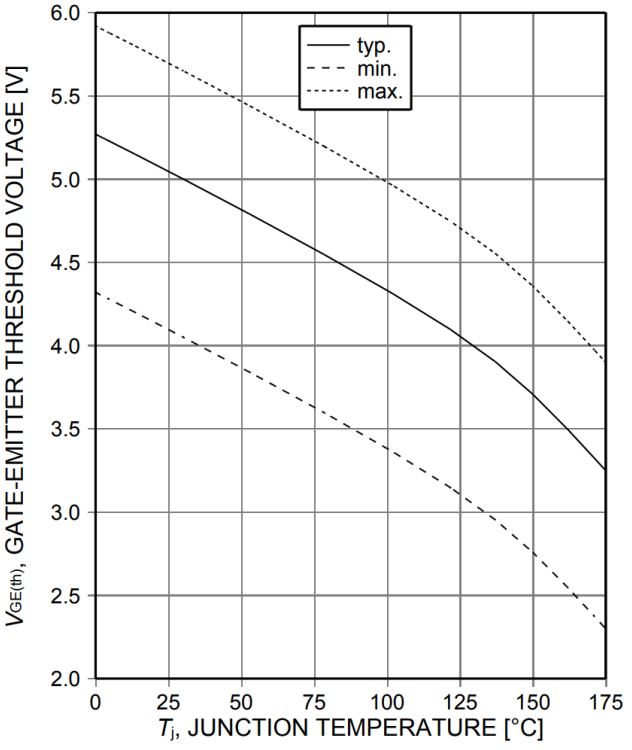


Figure 12. **Gate-emitter threshold voltage as a function of junction temperature**
(I_C=0.58mA)

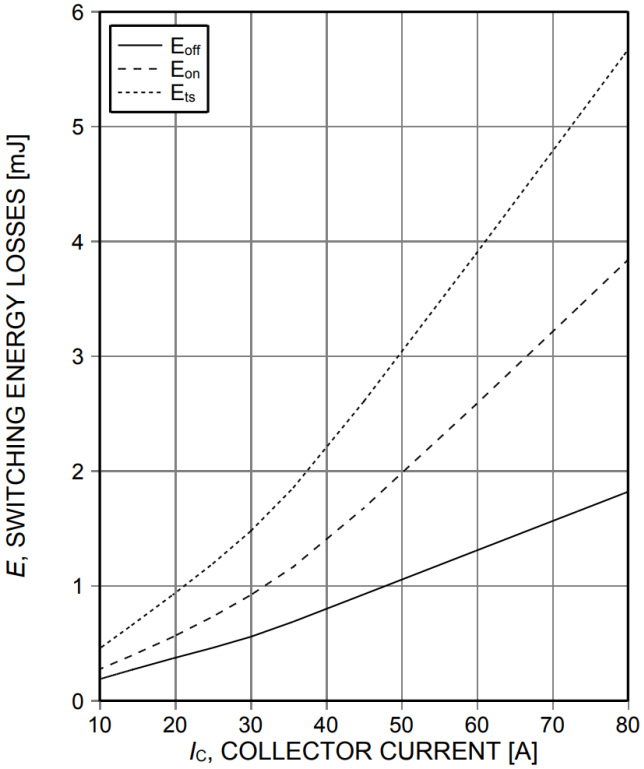


Figure 13. **Typical switching energy losses as a function of collector current**
(ind. load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, r_G=7,9Ω, test circuit in Fig. E)

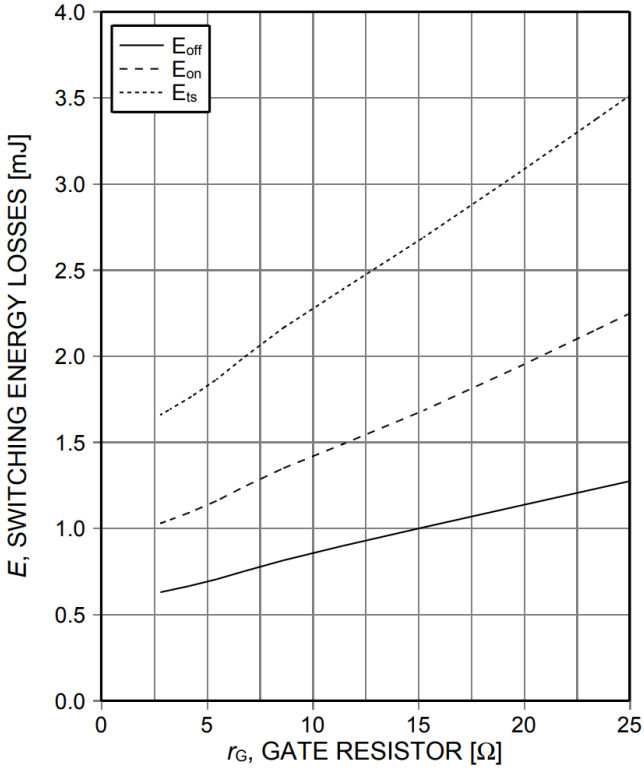


Figure 14. **Typical switching energy losses as a function of gate resistor**
(ind. load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, I_C=40A, test circuit in Fig. E)

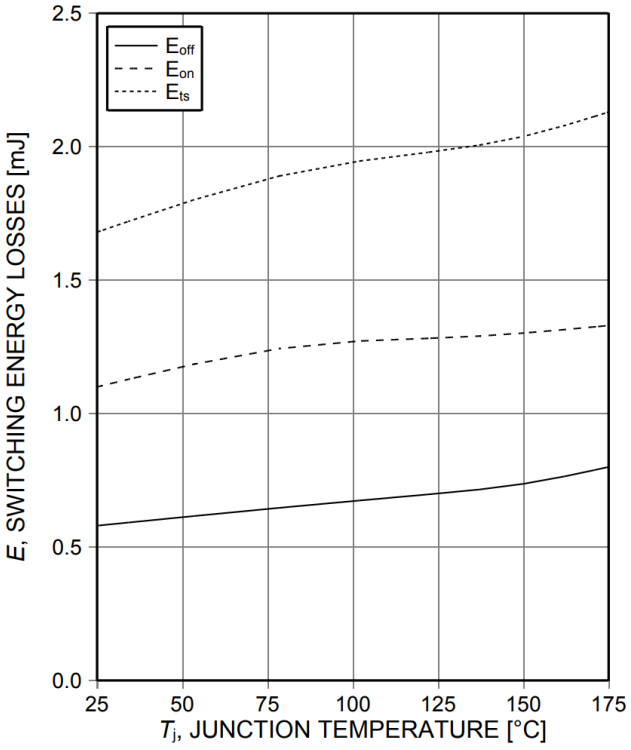


Figure 15. **Typical switching energy losses as a function of junction temperature**
(ind load, V_{CE}=400V, V_{GE}=15/0V, I_C=40A, r_G=7,9Ω, test circuit in Fig. E)

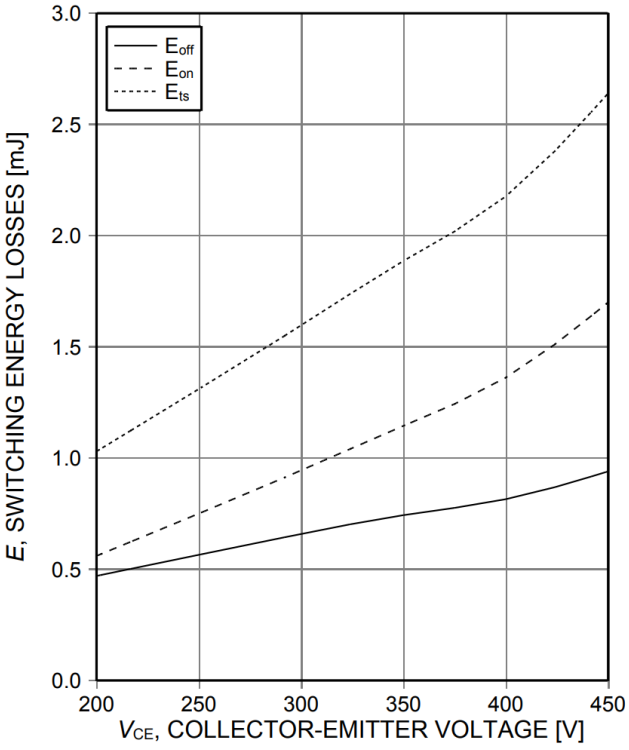


Figure 16. **Typical switching energy losses as a function of collector emitter voltage**
(ind. load, T_j=175°C, V_{GE}=15/0V, I_C=40A, r_G=7,9Ω, test circuit in Fig. E)

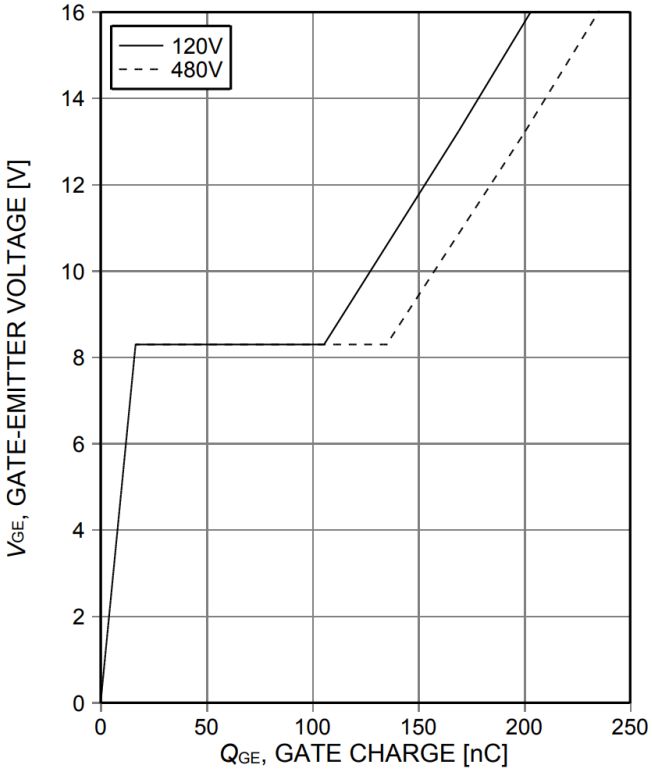


Figure 17. **Typical gate charge**
(I_C=40A)

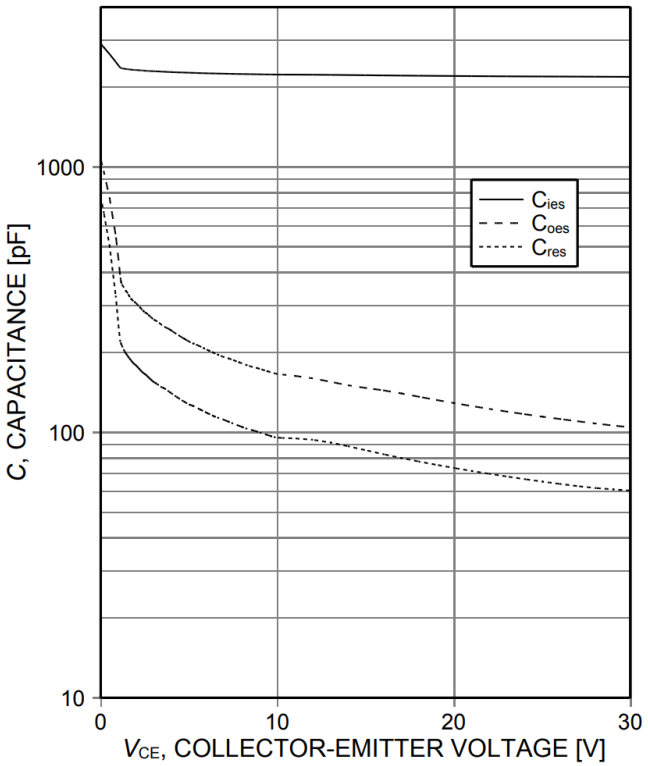


Figure 18. **Typical capacitance as a function of collector-emitter voltage**
(V_{GE}=0V, f=1MHz)

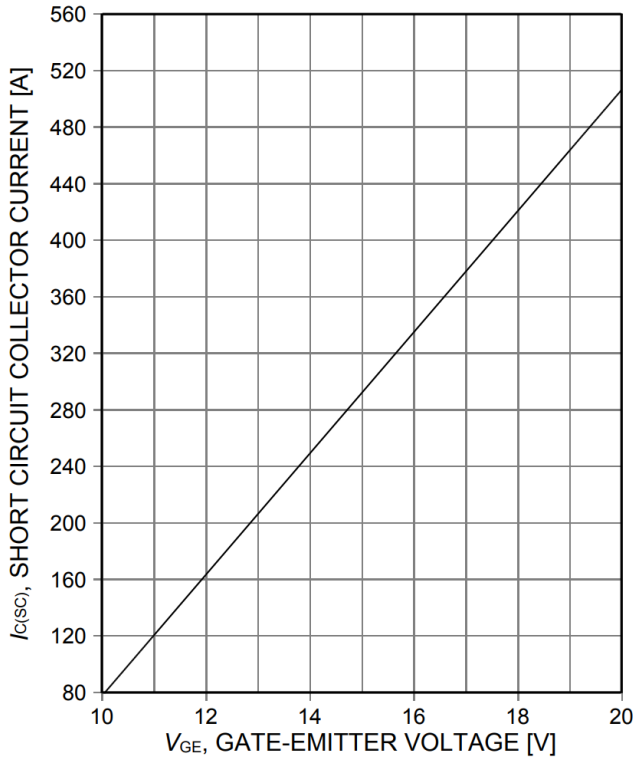


Figure 19. **Typical short circuit collector current as a function of gate-emitter voltage**
(V_{CE}≤400V, start atT_j=25°C)

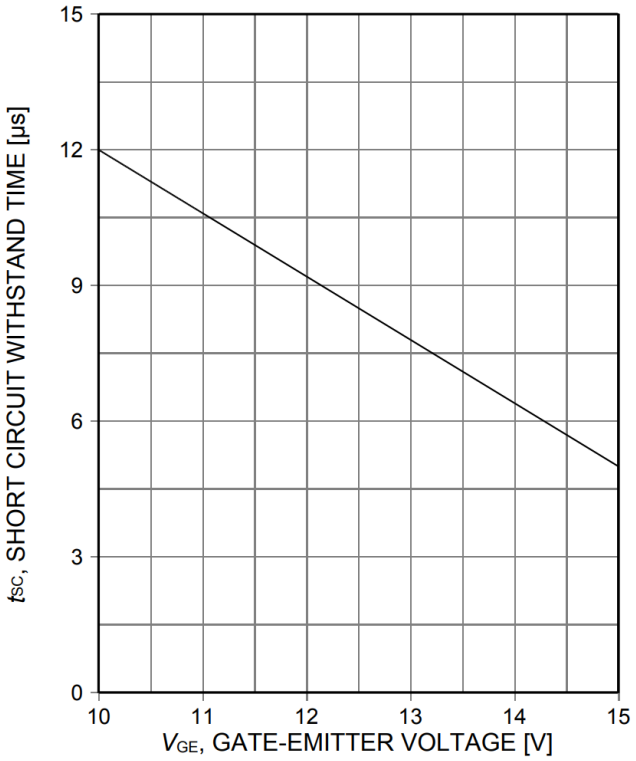


Figure 20. **Short circuit withstand time as a function of gate-emitter voltage**
(V_{CE}≤400V, start at T_j≤150°C)

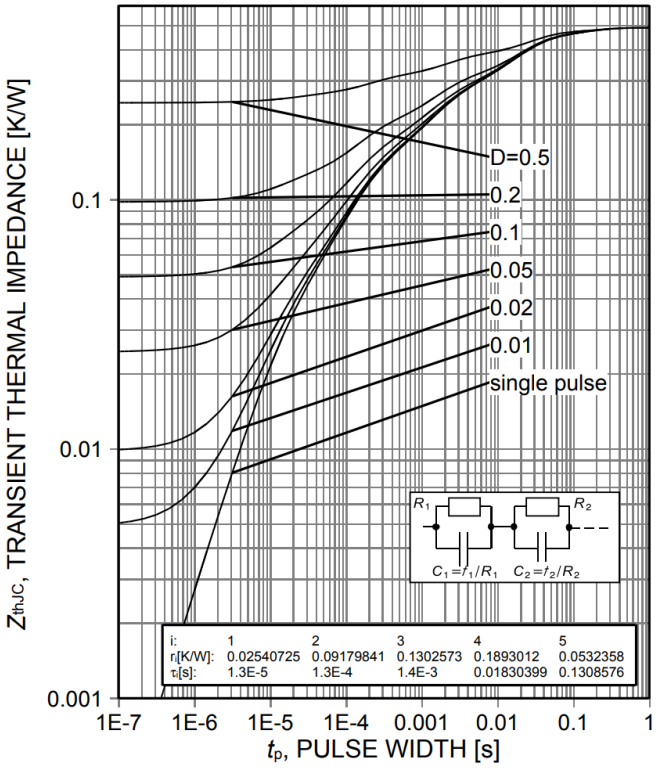


Figure 21. **IGBT transient thermal impedance** ($D=t_p/T$)

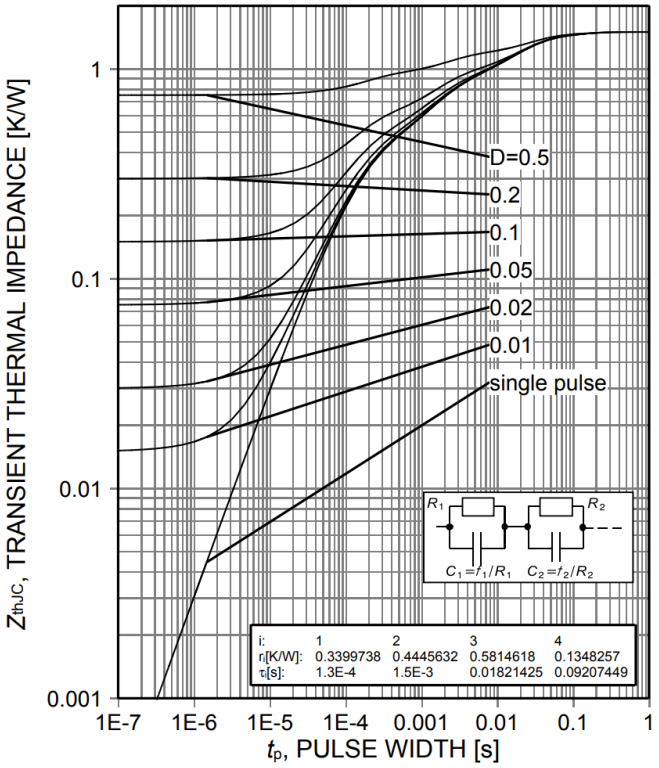


Figure 22. **Diode transient thermal impedance as a function of pulse width** ($D=t_p/T$)

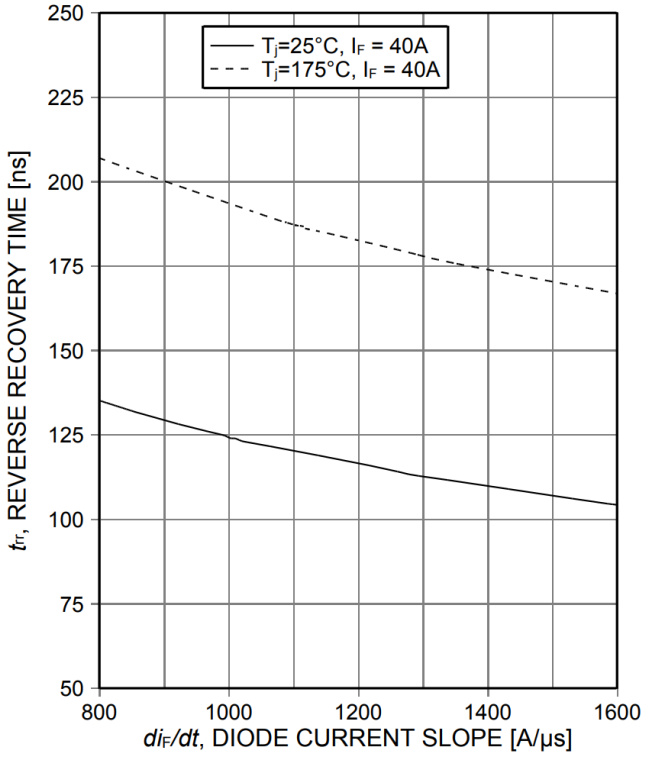


Figure 23. **Typical reverse recovery time as a function of diode current slope** (V_R=400V)

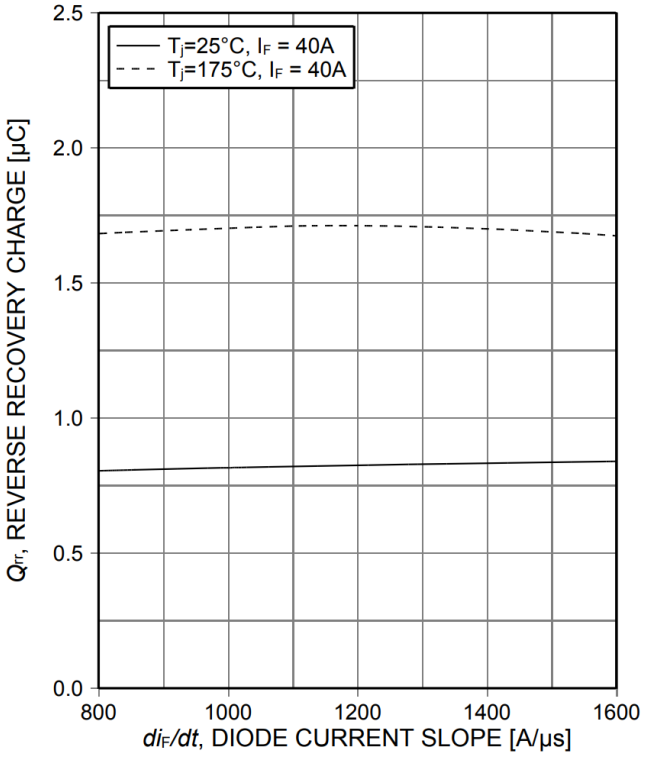


Figure 24. **Typical reverse recovery charge as a function of diode current slope** (V_R=400V)

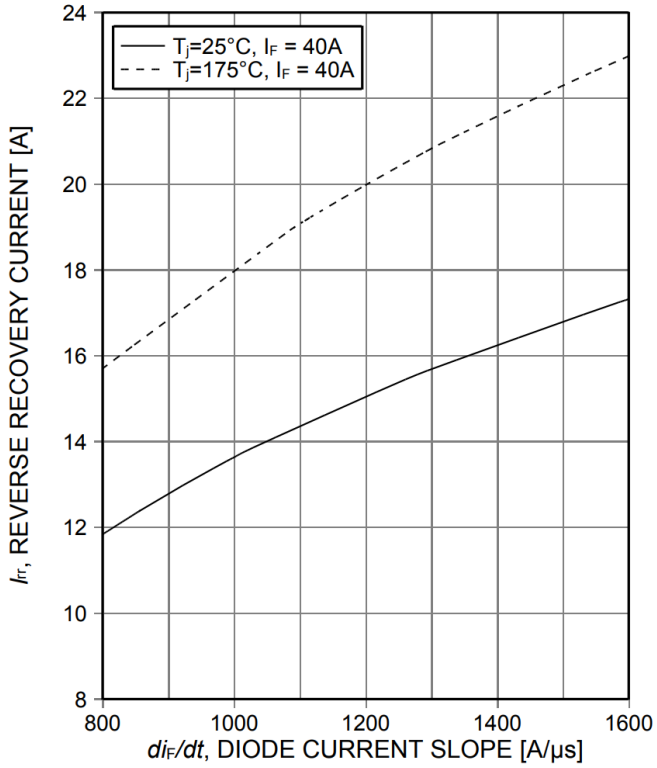


Figure 25. **Typical reverse recovery current as a function of diode current slope**
(V_R=400V)

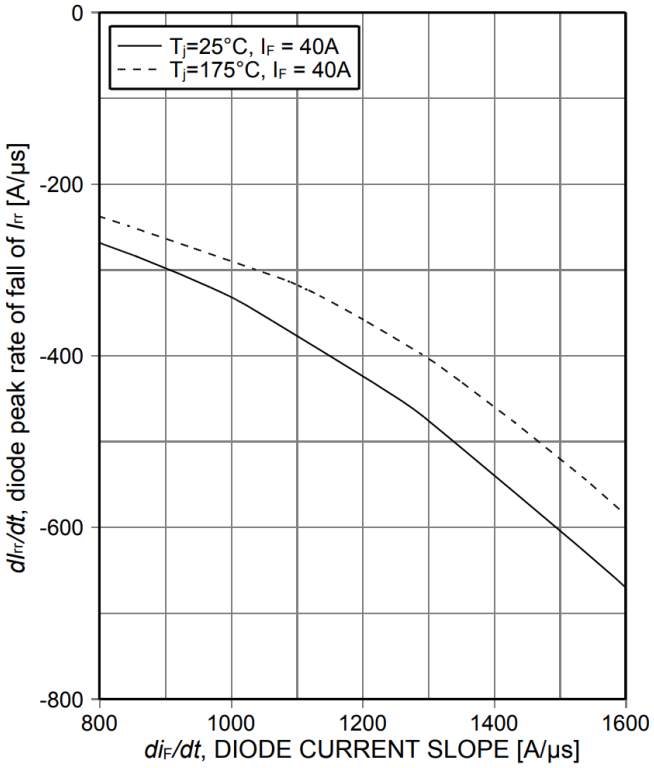


Figure 26. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**
(V_R=400V)

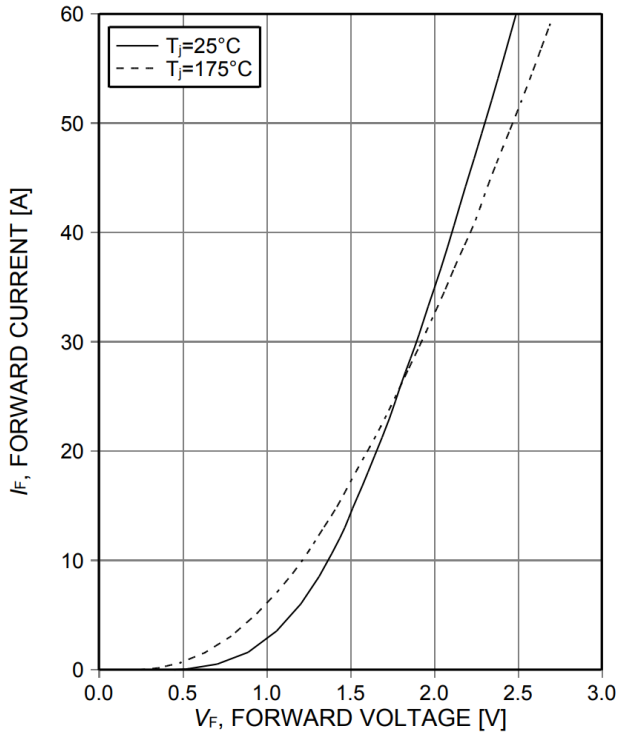


Figure 27. **Typical diode forward current as a function of forward voltage**

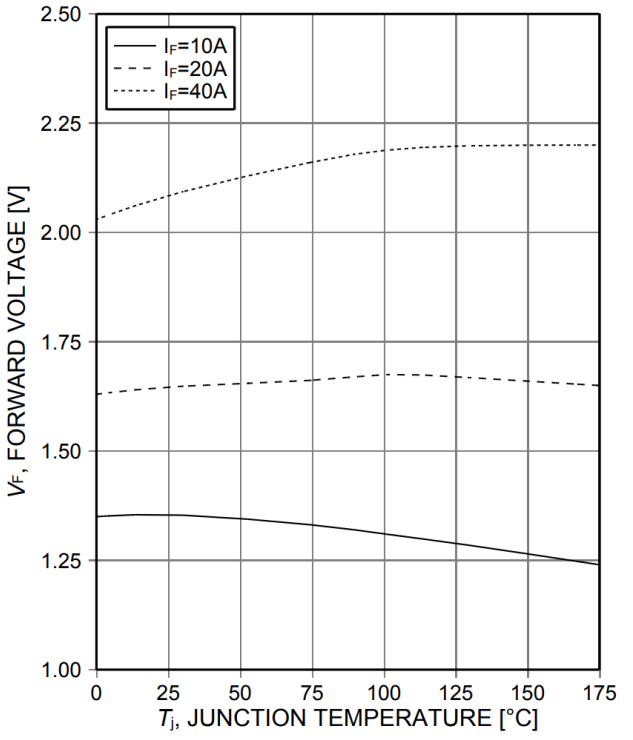
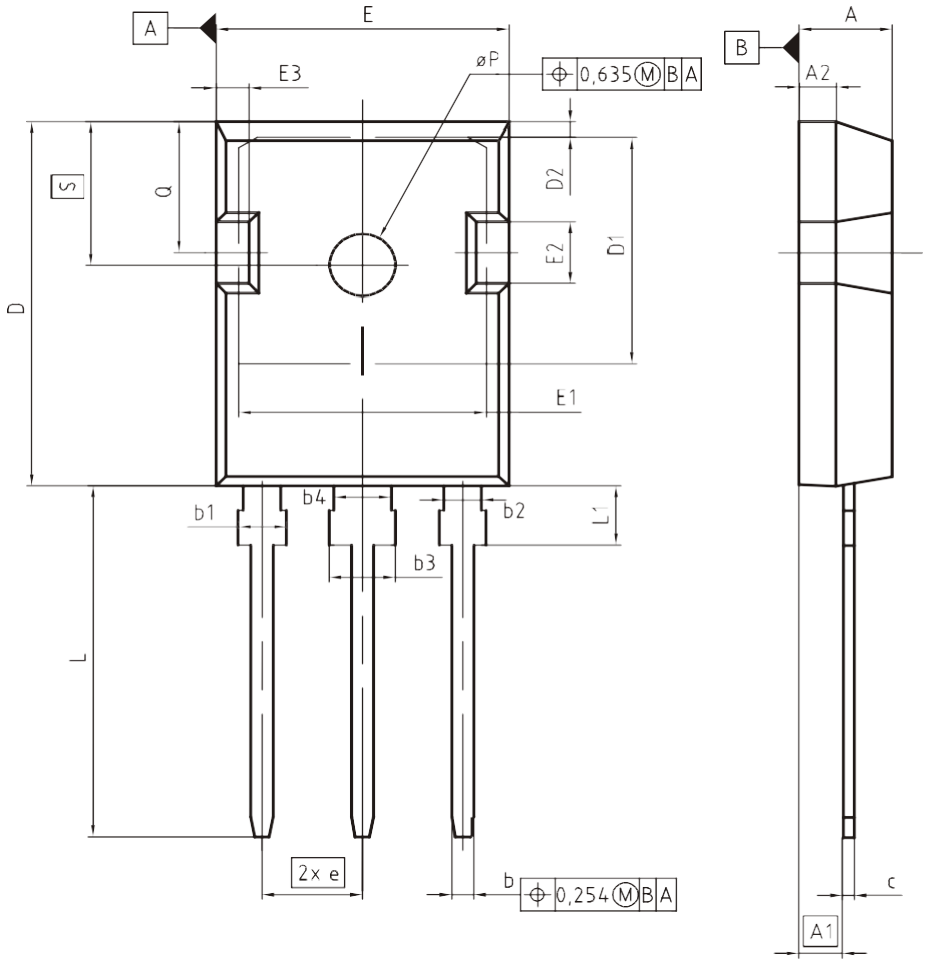


Figure 28. **Typical diode forward voltage as a function of junction temperature**

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

DOCUMENT NO.	Z8B00003327
SCALE	0 5 5 7.5mm
EUROPEAN PROJECTION	
ISSUE DATE	09-07-2010
REVISION	05

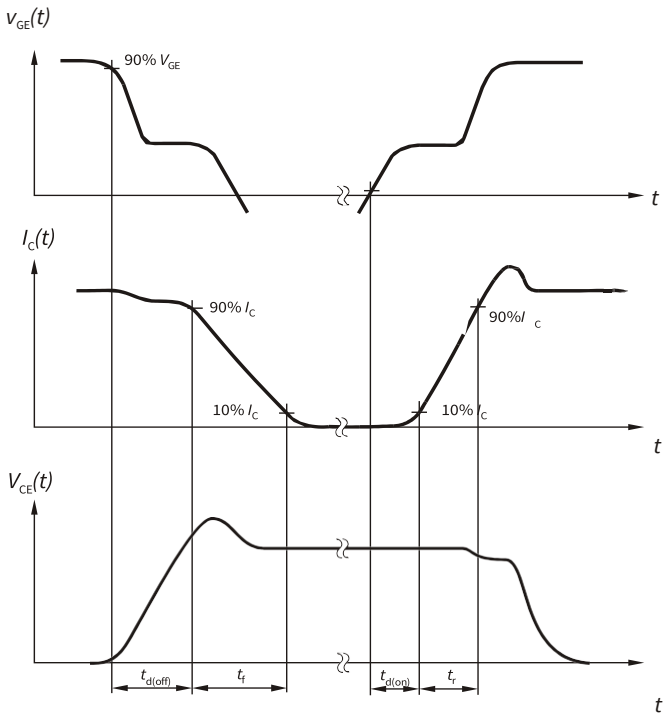


Figure A. Definition of switching times

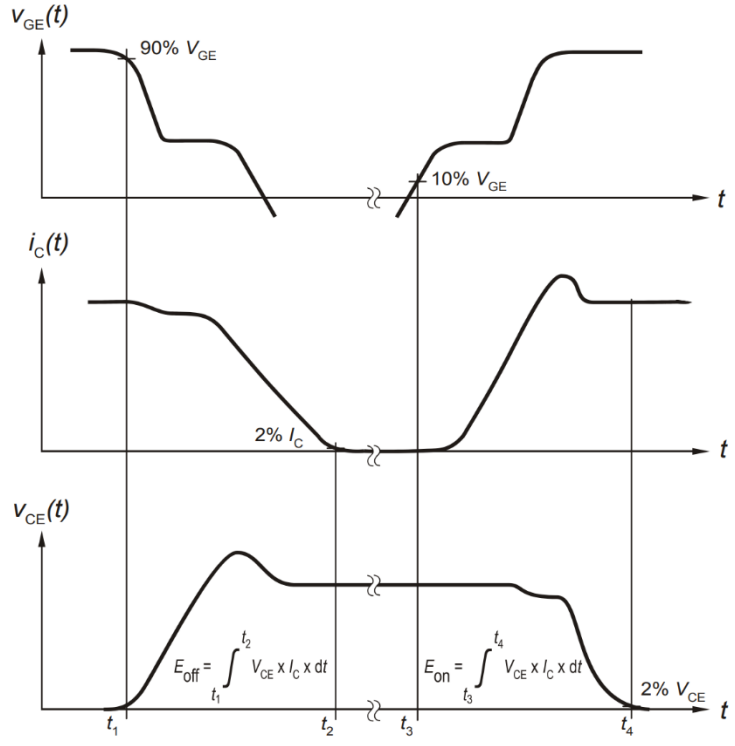


Figure B. Definition of switching losses

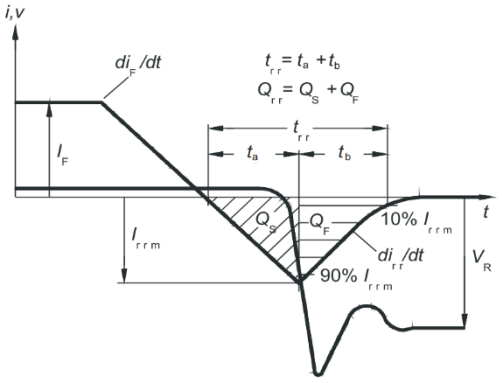


Figure C. Definition of diodes switching characteristics

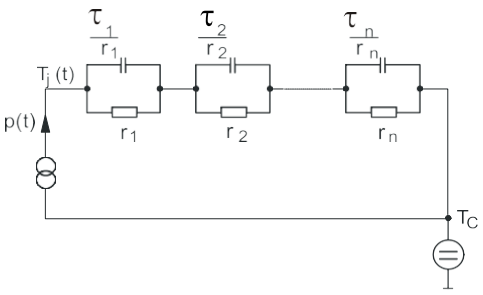


Figure D. Thermal equivalent circuit

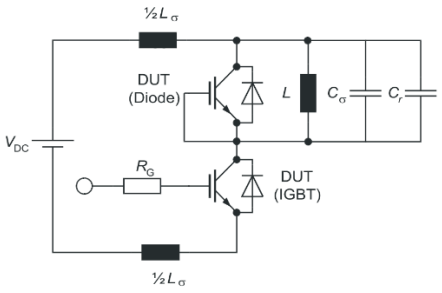


Figure E. Dynamic test circuit
Parasitic inductance L_σ,
Parasitic capacitor C_σ,
Relief capacitor C_r
(only for ZVT switching)

修订记录

IKW40N60H3

Revision: 2014-03-12, Rev. 2.4

历史修订版本

Revision	Date	Subjects (major changes since last revision)
2.1	2010-06-14	Release of final datasheet
2.2	2010-10-14	Updated IGBT switching conditions
2.3	2013-12-10	New value ICES max limit at 175°C
2.4	2014-03-12	Max ratings Vce, Tvj ≥ 25°C

We Listen to Your Comments
Any information within this document that you feel is wrong, unclear or missing at all? Your feedback will help us to continuously improve the quality of this document.
Please send your proposal (including a reference to this document) to: erratum@infineon.com

Published by
Infineon Technologies AG 81726
Munich, Germany
81726 München, Germany

Legal Disclaimer
The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation, warranties of non-infringement of intellectual property rights of any third party.

Information
For further information on technology, delivery terms and conditions and prices, please contact the nearest Infineon Technologies Office (www.infineon.com).

Warnings
Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.
The Infineon Technologies component described in this Data Sheet may be used in life-support devices or systems and/or automotive, aviation and aerospace applications or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support, automotive, aviation and aerospace device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

免责声明

请注意，本文件的原文使用英文撰写，为方便客户浏览英飞凌提供了中文译文。该中文译文仅供参考，并不可作为任何论点之依据。
由于翻译过程中可能使用了自动化程序，以及语言翻译和转换过程中的差异，最后的中文译文与最新的英文版本原文含义可能存在不尽相同之处。
因此，我们同时提供该中文译文版本的最新英文原文供您阅读，请参见 http://www.infineon.com
英文原文和中文译文版本之间若存有任何歧异，以最新的英文版本为准，并且仅认可英文版本为正式文件。
您如果使用本文件，即表示您同意并理解上述说明。英飞凌不对因翻译过程中可能存在的任何不完整或不准确信息而产生的任何直接或间接损失或损害负责。英飞凌不承担中文译文版本的完整性和准确性责任。如果您不同意上述说明，请不要使用本文件。

版本 **2025-10-30**

Infineon Technologies AG 出版，
德国 **Neubiberg 85579**

Do you have a question about this document?

Email:

erratum@infineon.com

重要通知

Infineon Technologies AG 及其关联公司（以下简称 "英飞凌"）销售或提供和交付的产品（可能也包括样品，且可能由硬件或软件或两者组成）（以下简称 "产品"），应遵守客户与英飞凌签订的框架供应合同或其他书面协议的条款和条件，如无上述合同或其他书面协议，则应遵守适用的英飞凌销售条件。只有在英飞凌明确书面同意的情况下，客户的一般条款和条件或对适用的英飞凌销售条件的偏离才对英飞凌具有约束力。

为避免疑义，英飞凌不承担不侵犯第三方权利的所有保证和默示保证，例如对特定用途/目的的适用性或适销性的保证。

英飞凌对与样品、应用或客户对任何产品的具体使用有关的任何信息或本文档中给出的任何示例或典型值概不负责。

本文件中包含的数据仅供具有技术资格和技能的客户代表使用。客户有责任评估产品对预期应用和客户特定用途的适用性，并在预期应用和客户特定用途中验证本文件中包含的所有相关技术数据。客户有责任正确设计、编程和测试预期应用的功能性和安全性，并遵守与其使用相关的法律要求。

除非英飞凌另行明确批准，否则产品不得用于任何因产品故障或使用产品的任何后果可合理预期会导致人身伤害的应用。但是，上述规定并不妨碍客户在英飞凌明确设计和销售的使用领域中使用任何产品，但是客户对应用负有全部责任。

英飞凌明确保留根据适用法律，如《德国版权法》（UrhG）第 44b 条，将其内容用于商业资料和数据探勘（TDM）的权利。

如果产品包含安全功能：
由于任何计算设备都不可能绝对安全，尽管产品采取了安全措施，但英飞凌不保证产品不会被入侵、数据不会被盗或遗失，或不会发生其他漏洞（以下简称"安全漏洞"），英飞凌对任何安全漏洞不承担任何责任。

如果本文档包含或引用软件：
根据美国、德国和世界其他国家的知识产权法律和条约，该软件归英飞凌所有。英飞凌保留所有权利。因此，您只能按照软件附带的软件授权协议的规定使用本软件。

如果没有适用的软件授权协议，英飞凌特此授予您个人的、非排他性的、不可转让的软件知识产权授权（无权转授权）：(a) 对于以源代码形式提供的软件，仅在贵组织内部修改和复制该软件用于英飞凌硬件产品；及 (b) 对于以二进制代码(binary code)形式对外向终端用户分发该软件，仅得用于英飞凌硬件产品。禁止对本软件进行任何其他使用、复制、修改、翻译或编译。有关产品、技术、交货条款和条件以及价格的详细信息，请联系离您最近的英飞凌办公室或访问 **https://www.infineon.com**。