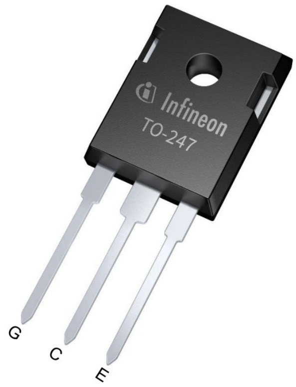
采用 TRENCHSTOP™ 5 技术的高速开关5 IGBT

与全额定RAPID 1 快速软恢复反并联二极管共封装



特性

- V_{CE} = 650 V
- I_C = 50 A
- 硬开关和谐振拓扑中的行业领先效率
- 即插即用，替代上一代 IGBT
- 650 V 击穿电压
- 低栅极电荷Q_G
- IGBT 与全额定RAPID 1 快速软恢复反并联二极管共封装
- 最高结温 T_{vjmax} = 175°C
- 符合 JEDEC 目标应用要求
- 无铅镀层；符合RoHS标准
- 完整的产品范围和 PSpice 模型： http://www.infineon.com/igbt/

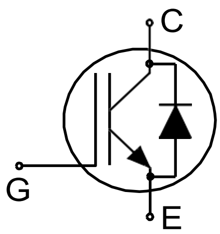
Lead-free
Green
Halogen-free
RoHS

潜在应用

- UPS（不间断电源）
- 太阳能逆变器
- 焊接转换器
- 中高开关频率变频器

描述

封装引脚定义：
- 引脚G - 栅极
- 引脚 C & 背面 - 集电极
- 引脚 E - 发射极



Type	Package	Marking
IKW50N65EH5	PG-TO247-3	K50EEH5

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

1 封装

表1 特征值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Internal emitter inductance measured 5 mm (0.197 in.) from case	L_E			13		nH
Storage temperature	T_{stg}		-55		150	°C
Soldering temperature	T_{sold}	wave soldering 1.6 mm (0.063 in.) from case for 10 s			260	°C
Mounting torque	M	M3 screw Maximum of mounting process: 3			0.6	Nm
Thermal resistance, junction-ambient	$R_{th(j-a)}$				40	K/W
IGBT thermal resistance, junction-case	$R_{th(j-c)}$				0.55	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$				0.63	K/W

2 绝缘栅双极晶体管

表2 最大额定值

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CE}	$T_{vj} \geq 25$ °C		650	V
DC collector current, limited by T_{vjmax}	I_C	limited by bondwire	$T_c = 25$ °C	80	A
			$T_c = 100$ °C	50	
Pulsed collector current, t_p limited by T_{vjmax} 1)	I_{Cpulse}			200	A
Turn-off safe operating area1)		$V_{CE} \leq 650$ V, $t_p = 1$ µs, $T_{vj} \leq 175$ °C		200	A
Gate-emitter voltage	V_{GE}			±20	V
Transient gate-emitter voltage	V_{GE}	$t_p \leq 10$ µs, $D < 0.01$		±30	V
Power dissipation	P_{tot}		$T_c = 25$ °C	275	W
			$T_c = 100$ °C	138	

1) 由设计标定，不受制于生产测试。

表3　　　　特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter breakdown voltage	V_{BRCES}	I_C = 0.2 mA, V_{GE} = 0 V		650			V
Collector-emitter saturation voltage	V_{CEsat}	I_C = 50 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.65	2.1	V
			T_{vj} = 125 °C		1.85		
			T_{vj} = 175 °C		1.95		
Gate-emitter threshold voltage	V_{GEth}	I_C = 0.5 mA, V_{CE} = V_{GE}		3.2	4	4.8	V
Zero gate-voltage collector current	I_{CES}	V_{CE} = 650 V, V_{GE} = 0 V	T_{vj} = 25 °C		1	50	µA
			T_{vj} = 175 °C		2000		
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V				100	nA
Transconductance	g_{fs}	I_C = 50 A, V_{CE} = 20 V			62		S
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1000 kHz			3000		pF
Output capacitance	C_{oes}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1000 kHz			90		pF
Reverse transfer capacitance	C_{res}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1000 kHz			12		pF
Gate charge	Q_G	I_C = 50 A, V_{GE} = 15 V, V_{CC} = 520 V			120		nC
Turn-on delay time	$t_{d(on)}$	V_{CC} = 400 V, V_{GE} = 15 V, R_{Gon} = 12 Ω, R_{Goff} = 12 Ω	T_{vj} = 25 °C, I_C = 50 A		25		ns
			T_{vj} = 25 °C, I_C = 25 A		24		
			T_{vj} = 150 °C, I_C = 50 A		24		
			T_{vj} = 150 °C, I_C = 25 A		23		
Rise time (inductive load)	t_r	V_{CC} = 400 V, V_{GE} = 15 V, R_{Gon} = 12 Ω, R_{Goff} = 12 Ω	T_{vj} = 25 °C, I_C = 50 A		29		ns
			T_{vj} = 25 °C, I_C = 25 A		12		
			T_{vj} = 150 °C, I_C = 50 A		30		
			T_{vj} = 150 °C, I_C = 25 A		14		

（表格续下页……）

表 3 （续） 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-off delay time	$t_{d(off)}$	V_{CC} = 400 V, V_{GE} = 15 V, R_{Gon} = 12 Ω, R_{Goff} = 12 Ω	T_{vj} = 25 °C, I_C = 50 A		172		ns
			T_{vj} = 25 °C, I_C = 25 A		173		
			T_{vj} = 150 °C, I_C = 50 A		190		
			T_{vj} = 150 °C, I_C = 25 A		203		
Fall time (inductive load)	t_f	V_{CC} = 400 V, V_{GE} = 15 V, R_{Gon} = 12 Ω, R_{Goff} = 12 Ω	T_{vj} = 25 °C, I_C = 50 A		35		ns
			T_{vj} = 25 °C, I_C = 25 A		15		
			T_{vj} = 150 °C, I_C = 50 A		30		
			T_{vj} = 150 °C, I_C = 25 A		20		
Turn-on energy	E_{on}	V_{CC} = 400 V, V_{GE} = 15 V, R_{Gon} = 12 Ω, R_{Goff} = 12 Ω	T_{vj} = 25 °C, I_C = 50 A		1.5		mJ
			T_{vj} = 25 °C, I_C = 25 A		0.57		
			T_{vj} = 150 °C, I_C = 50 A		2		
			T_{vj} = 150 °C, I_C = 25 A		0.95		
Turn-off energy	E_{off}	V_{CC} = 400 V, V_{GE} = 15 V, R_{Gon} = 12 Ω, R_{Goff} = 12 Ω	T_{vj} = 25 °C, I_C = 50 A		0.5		mJ
			T_{vj} = 25 °C, I_C = 25 A		0.16		
			T_{vj} = 150 °C, I_C = 50 A		0.6		
			T_{vj} = 150 °C, I_C = 25 A		0.25		

（表格续下页......）

表 3 （续） 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Total switching energy	E_{ts}	V_{CC} = 400 V, V_{GE} = 15 V, R_{Gon} = 12 Ω, R_{Goff} = 12 Ω	T_{vj} = 25 °C, I_C = 50 A		2		mJ
			T_{vj} = 25 °C, I_C = 25 A		0.73		
			T_{vj} = 150 °C, I_C = 50 A		2.6		
			T_{vj} = 150 °C, I_C = 25 A		1.2		
Operating junction temperature	T_{vj}			-40		175	°C

3 二极管

表4 最大额定值

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}	T_{vj} ≥ 25 °C		650	V
Diode forward current, limited by T_{vjmax}	I_F	limited by bondwire	T_c = 25 °C	80	A
			T_c = 100 °C	50	
Diode pulsed current, t_p limited by T_{vjmax} [1)]	I_{Fpulse}			200	A

1) 由设计定义。未经过生产测试。

表5 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	I_F = 50 A	T_{vj} = 25 °C		1.35	1.7	V
			T_{vj} = 125 °C		1.33		
			T_{vj} = 175 °C		1.3		

（表格续下页......）

表 5 （续） 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode reverse recovery time	t_{rr}	V_R = 400 V	T_{vj} = 25 °C, I_F = 50 A, $-di_F/dt$ = 1000 A/µs		81		ns
			T_{vj} = 25 °C, I_F = 25 A, $-di_F/dt$ = 1000 A/µs		56		
			T_{vj} = 150 °C, I_F = 50 A, $-di_F/dt$ = 1000 A/µs		108		
			T_{vj} = 150 °C, I_F = 25 A, $-di_F/dt$ = 1000 A/µs		98		
Diode reverse recovery charge	Q_{rr}	V_R = 400 V	T_{vj} = 25 °C, I_F = 50 A, $-di_F/dt$ = 1000 A/µs		1.1		µC
			T_{vj} = 25 °C, I_F = 25 A, $-di_F/dt$ = 1000 A/µs		0.7		
			T_{vj} = 150 °C, I_F = 50 A, $-di_F/dt$ = 1000 A/µs		2.6		
			T_{vj} = 150 °C, I_F = 25 A, $-di_F/dt$ = 1000 A/µs		1.8		
Diode peak reverse recovery current	I_{rrm}	V_R = 400 V	T_{vj} = 25 °C, I_F = 50 A, $-di_F/dt$ = 1000 A/µs		17		A
			T_{vj} = 25 °C, I_F = 25 A, $-di_F/dt$ = 1000 A/µs		19.7		
			T_{vj} = 150 °C, I_F = 50 A, $-di_F/dt$ = 1000 A/µs		36		
			T_{vj} = 150 °C, I_F = 25 A, $-di_F/dt$ = 1000 A/µs		28.8		

（表格续下页......）

表 5 （续） 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode peak rate of fall of reverse recovery current	di_{rr}/dt	$V_R = 400$ V	$T_{vj} = 25$ °C, $I_F = 50$ A, $-di_F/dt = 1000$ A/µs		1000		A/µs
			$T_{vj} = 25$ °C, $I_F = 25$ A, $-di_F/dt = 1000$ A/µs		1500		
			$T_{vj} = 150$ °C, $I_F = 50$ A, $-di_F/dt = 1000$ A/µs		2000		
			$T_{vj} = 150$ °C, $I_F = 25$ A, $-di_F/dt = 1000$ A/µs		1500		
Operating junction temperature	T_{vj}			-40		175	°C

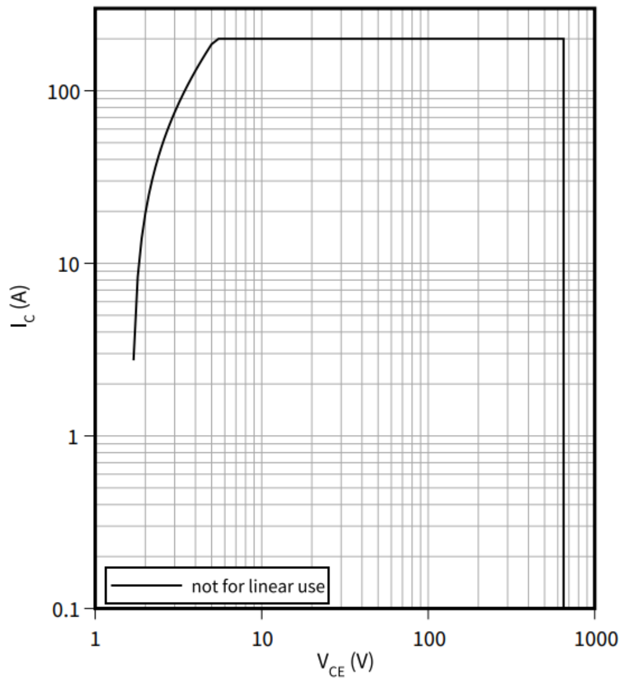
注意：为了获得最佳的使用寿命和可靠性，英飞凌建议运行条件不超过本数据手册中所述最大额定值的80%。

除非另有规定，*电气特性均为$T_{vj} = 25$°C。*

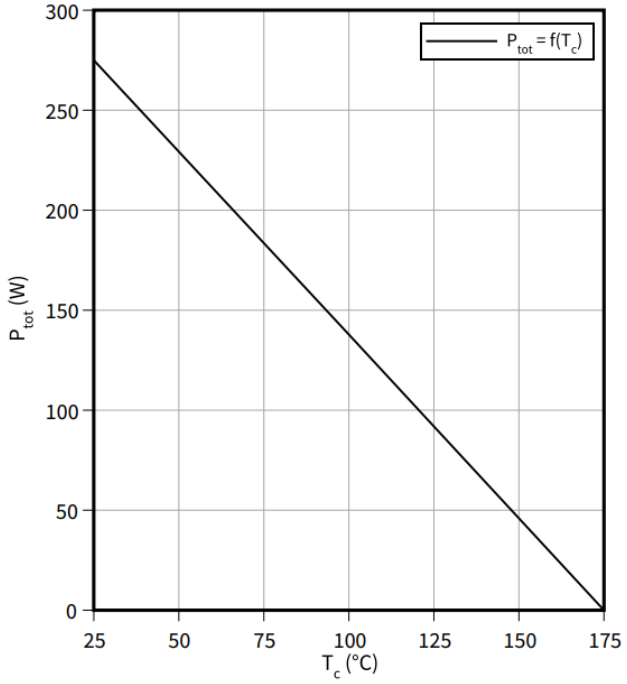
动态测试电路，寄生电感$L_\sigma = 30$ nH，寄生电容$C_\sigma = 25$ pF，来自图E。能量损失包括“尾部”和二极管反向恢复。

4 特性图

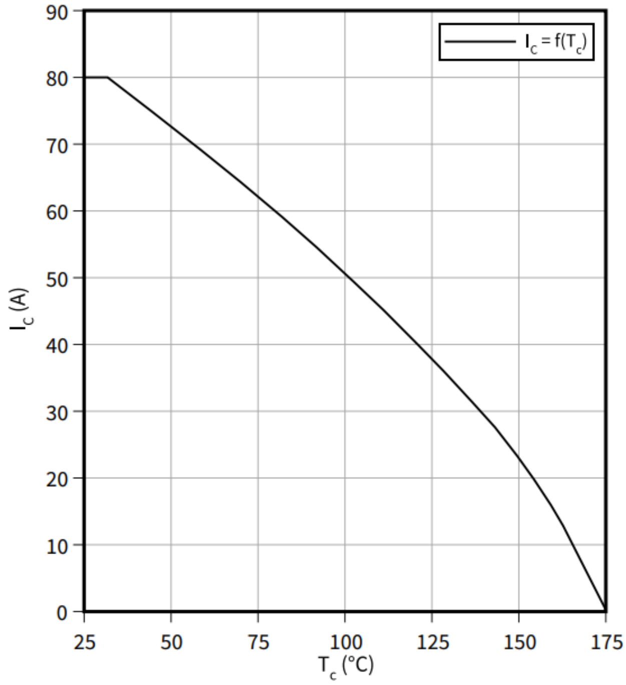
Forward bias safe operating area
$I_C = f(V_{CE})$
$D = 0$, $T_{vj} \leq 175$ °C, $V_{GE} = 15$ V, $t_p = 1$ µs, $T_c = 25$ °C



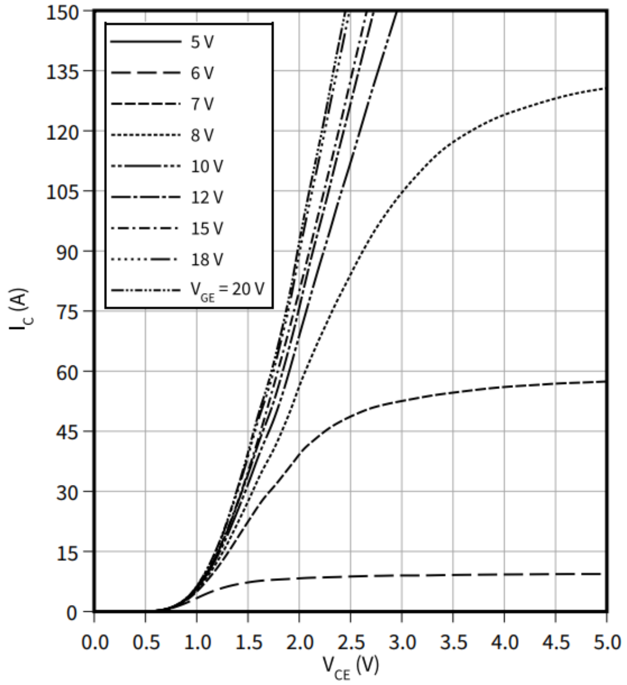
Power dissipation as a function of case temperature
$P_{tot} = f(T_c)$
$T_{vj} \leq 175$ °C



Collector current as a function of case temperature
$I_C = f(T_c)$
$T_{vj} \leq 175$ °C, $V_{GE} \geq 15$ V



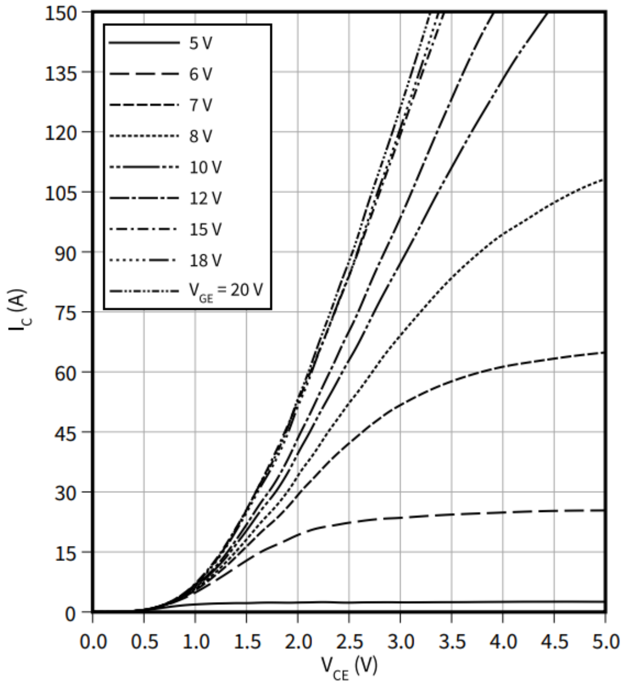
Typical output characteristic
$I_C = f(V_{CE})$
$T_{vj} = 25$ °C



Typical output characteristic

$I_C = f(V_{CE})$

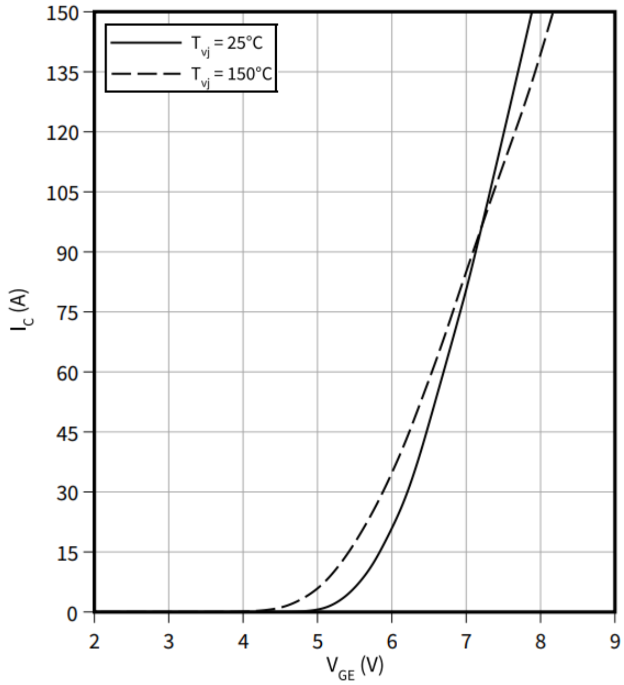
$T_{vj} = 150\ °C$



Typical transfer characteristic

$I_C = f(V_{GE})$

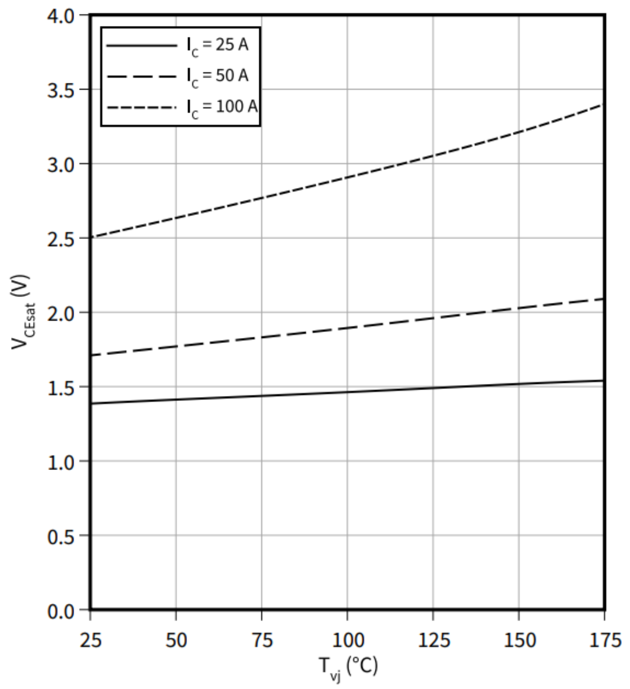
$V_{CE} = 20\ V$



Typical collector-emitter saturation voltage as a function of junction temperature

$V_{CEsat} = f(T_{vj})$

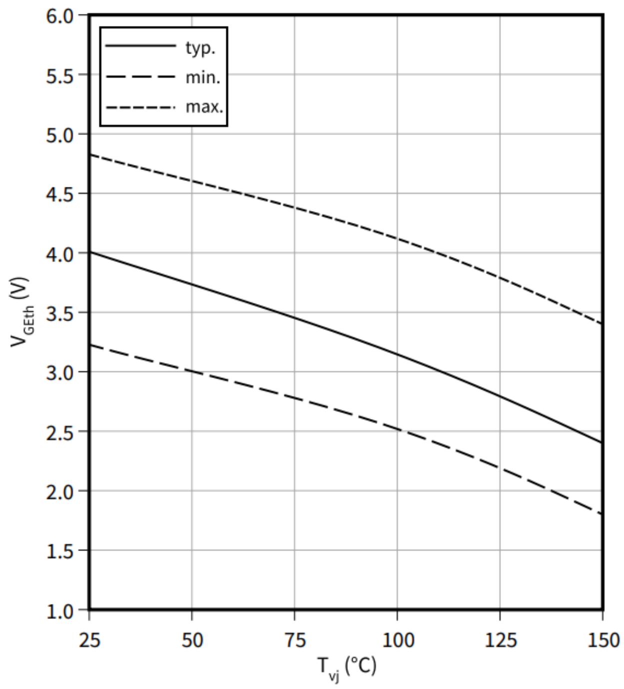
$V_{GE} = 15\ V$



Gate-emitter threshold voltage as a function of junction temperature

$V_{GEth} = f(T_{vj})$

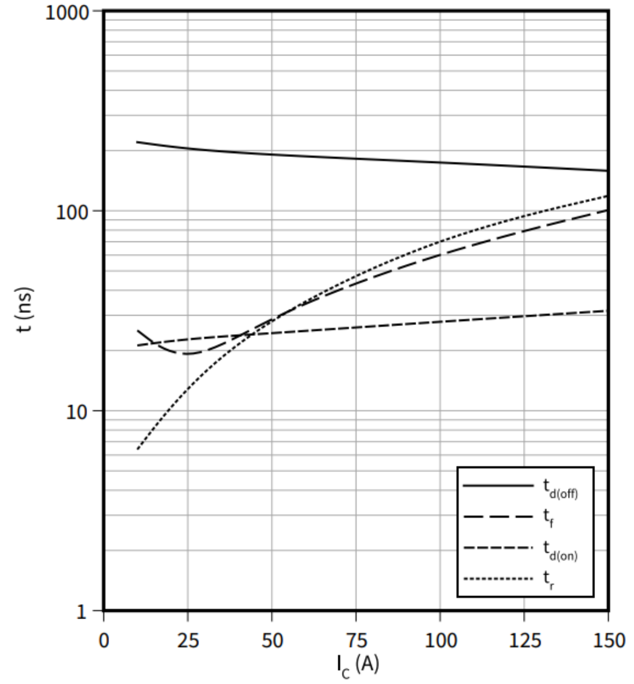
$I_C = 0.5\ mA$



Typical switching times as a function of collector current

$t = f(I_C)$

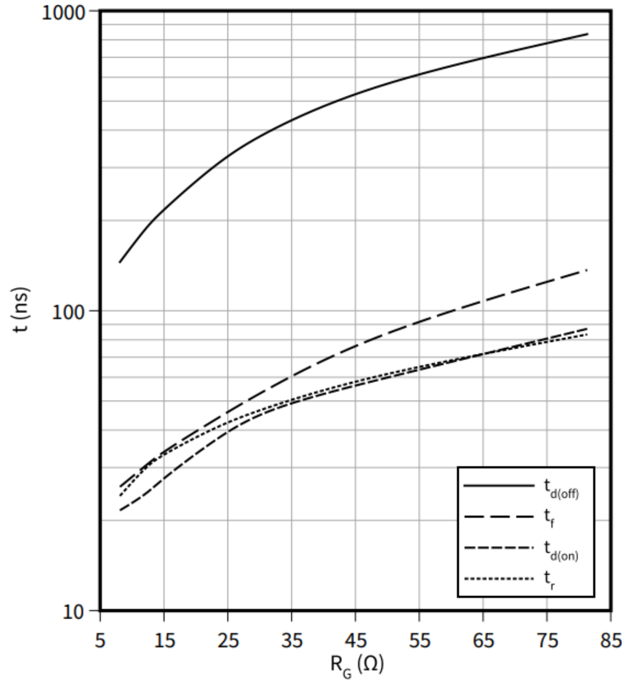
$V_{CC} = 400$ V, $T_{vj} = 150$ °C, $V_{GE} = 0/15$ V, $R_G = 12\ \Omega$



Typical switching times as a function of gate resistor

$t = f(R_G)$

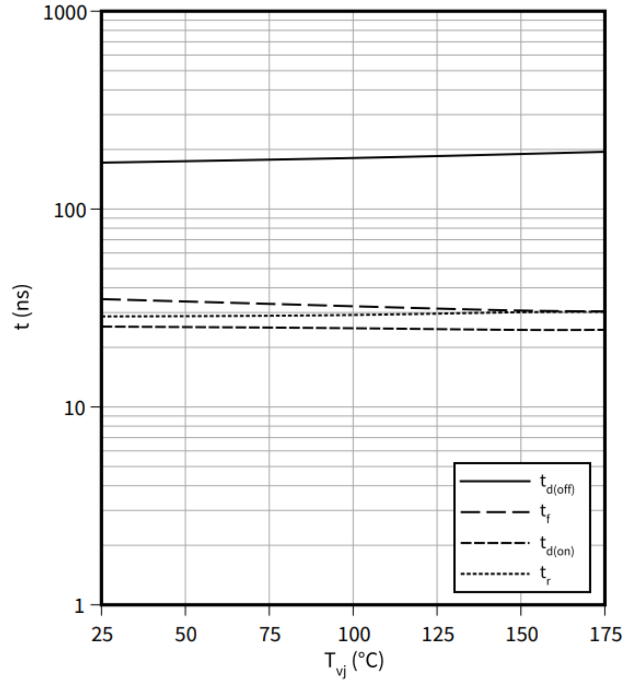
$I_C = 50$ A, $V_{CC} = 400$ V, $T_{vj} = 150$ °C, $V_{GE} = 0/15$ V



Typical switching times as a function of junction temperature

$t = f(T_{vj})$

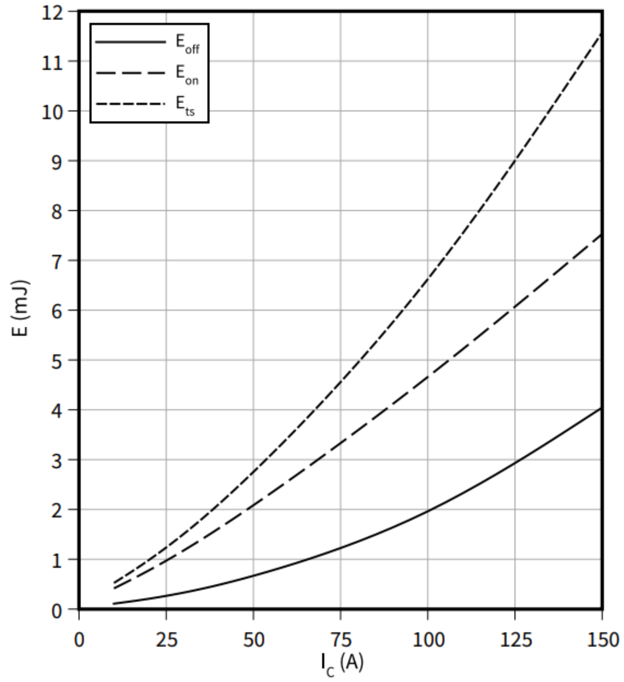
$I_C = 50$ A, $V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_G = 12\ \Omega$



Typical switching energy losses as a function of collector current

$E = f(I_C)$

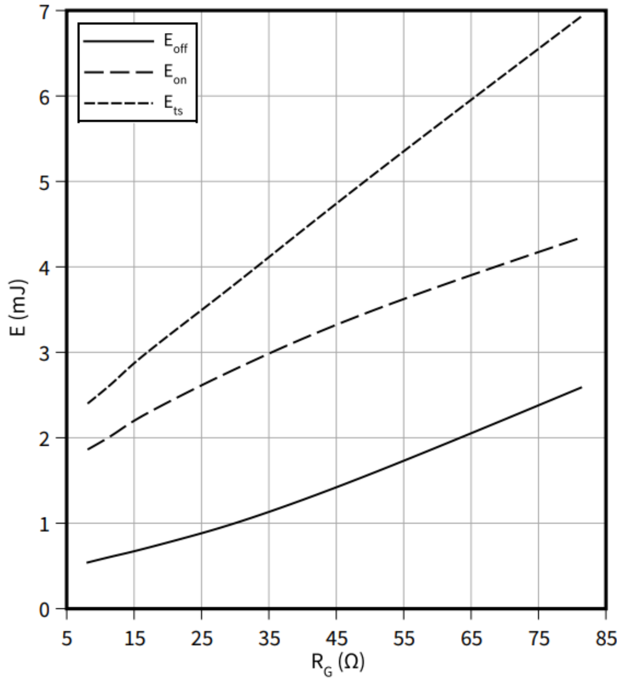
$V_{CC} = 400$ V, $T_{vj} = 150$ °C, $V_{GE} = 0/15$ V, $R_G = 12\ \Omega$



Typical switching energy losses as a function of gate resistor

$E = f(R_G)$

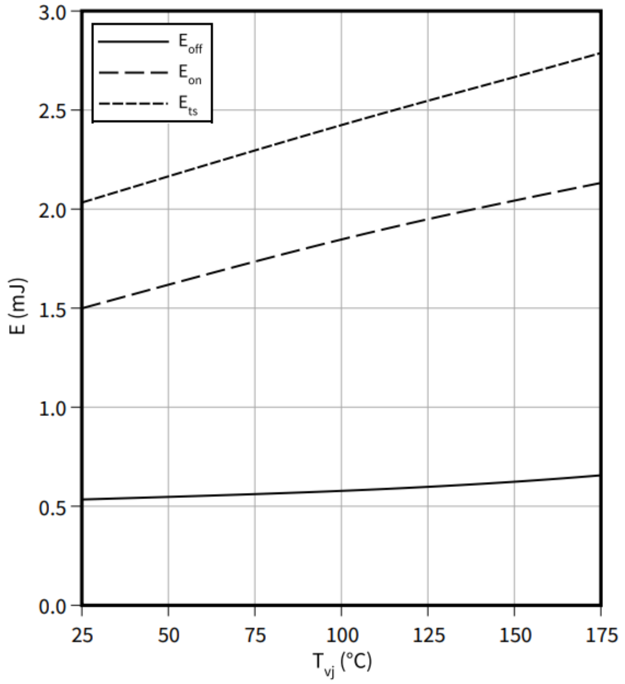
$I_C = 50$ A, $V_{CC} = 400$ V, $T_{vj} = 150$ °C, $V_{GE} = 0/15$ V



Typical switching energy losses as a function of junction temperature

$E = f(T_{vj})$

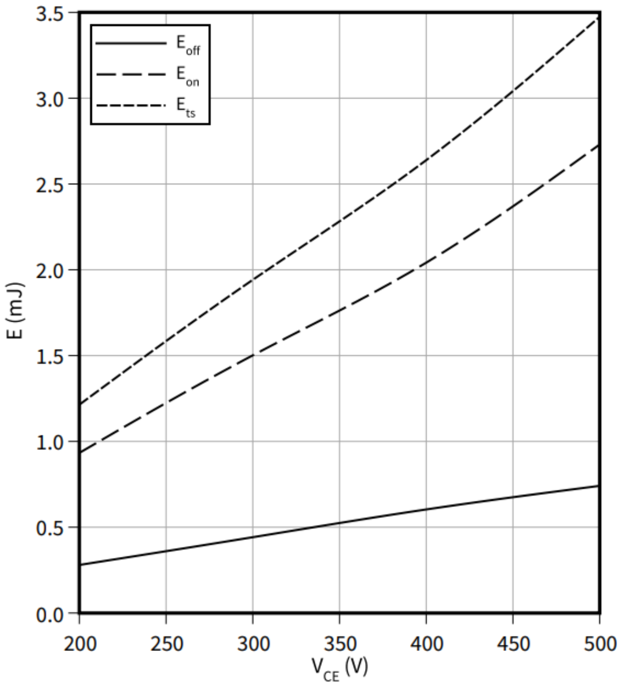
$I_C = 50$ A, $V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_G = 12$ Ω



Typical switching energy losses as a function of collector emitter voltage

$E = f(V_{CE})$

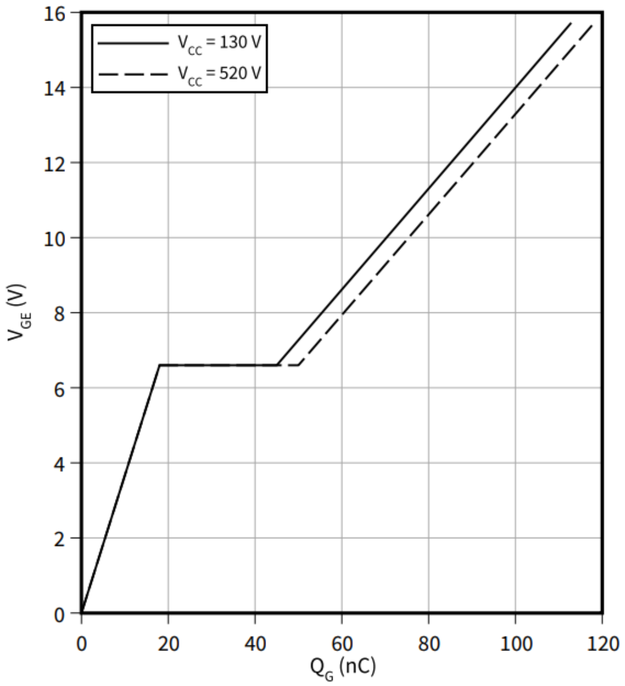
$I_C = 50$ A, $T_{vj} = 150$ °C, $V_{GE} = 0/15$ V, $R_G = 12$ Ω



Typical gate charge

$V_{GE} = f(Q_G)$

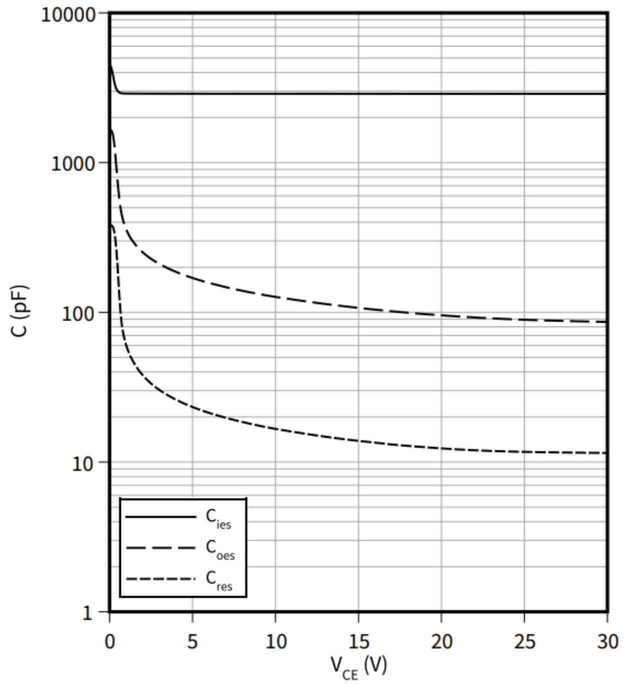
$I_C = 50$ A



Typical capacitance as a function of collector-emitter voltage

$C = f(V_{CE})$

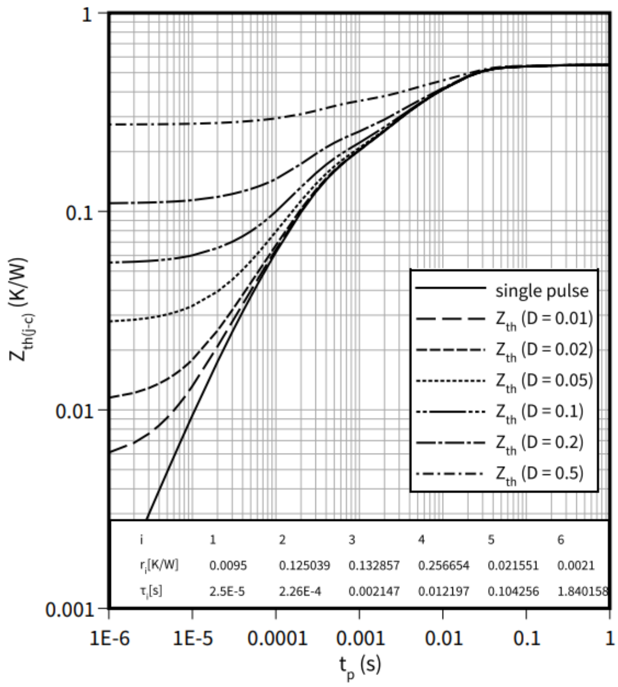
$f = 1000\ \text{kHz}, V_{GE} = 0\ \text{V}$



IGBT transient thermal impedance as a function of pulse width

$Z_{th(j\text{-}c)} = f(t_p)$

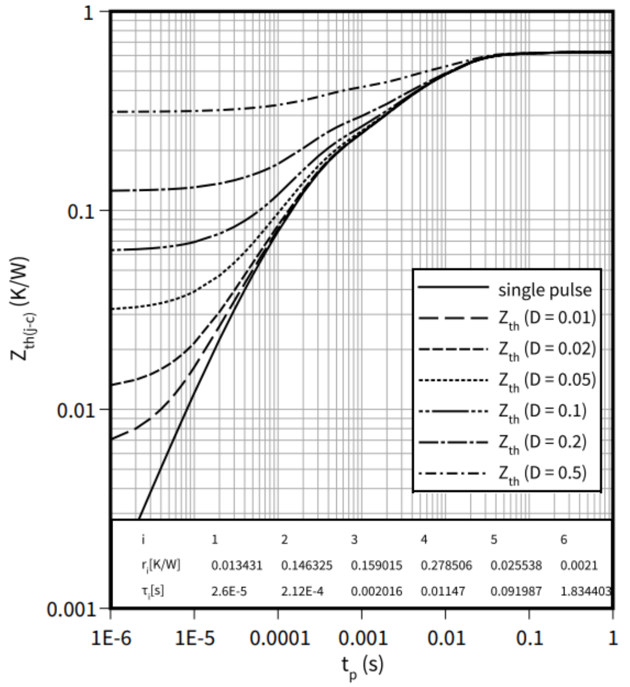
$D = t_p/T$



Diode transient thermal impedance as a function of pulse width

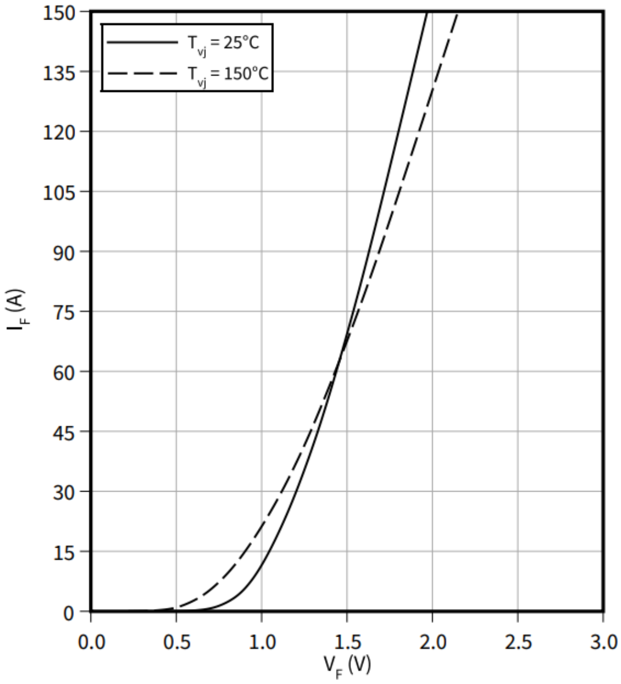
$Z_{th(j\text{-}c)} = f(t_p)$

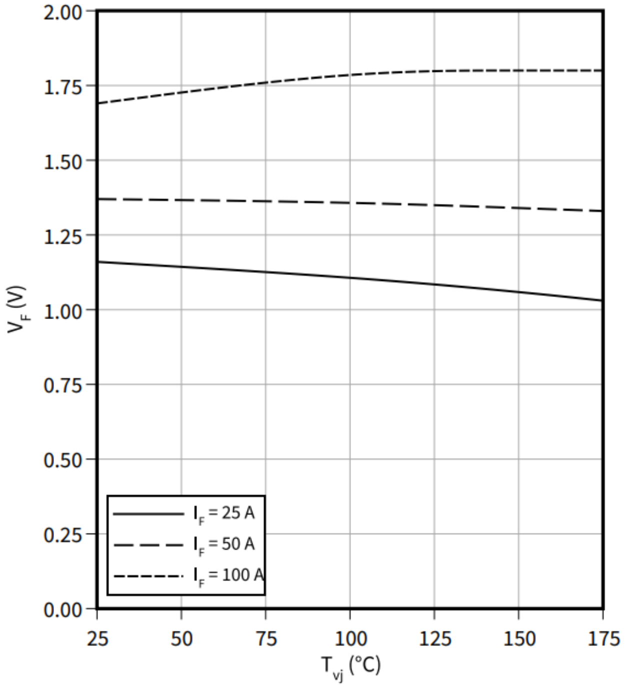
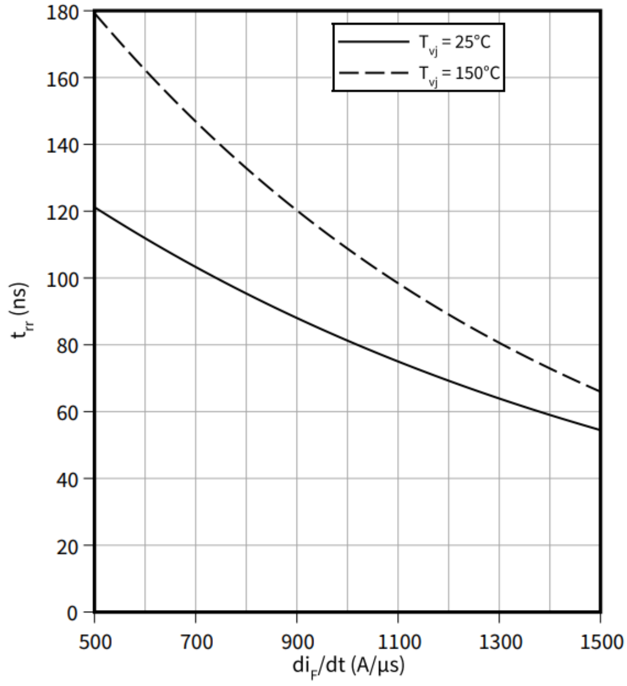
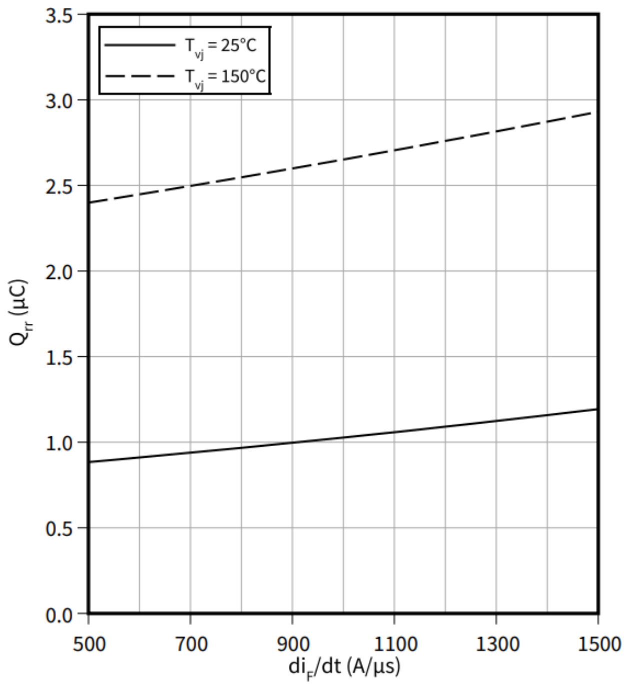
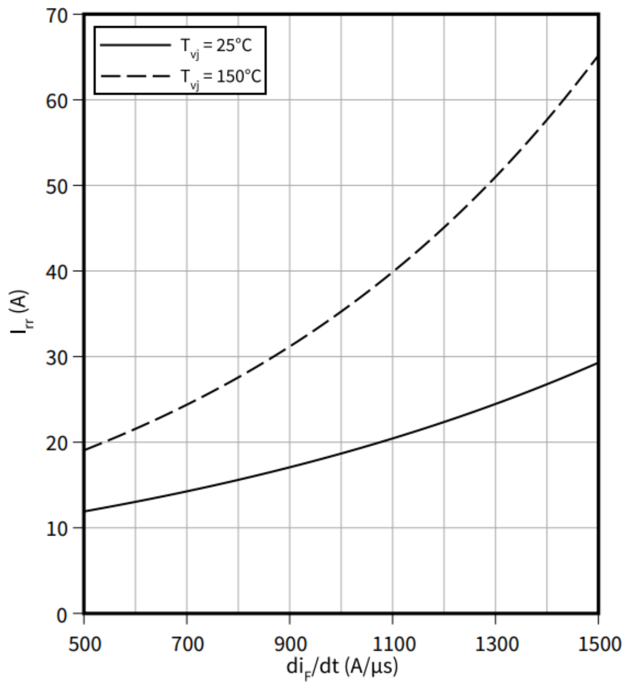
$D = t_p/T$



Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$

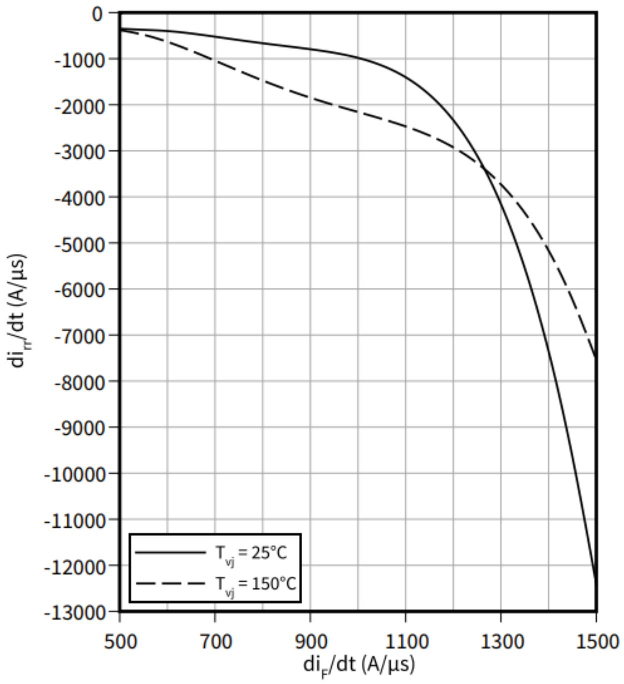


Typical diode forward voltage as a function of junction temperature $V_F = f(T_{vj})$	**Typical reverse recovery time as a function of diode current slope** $t_{rr} = f(di_F/dt)$ $V_R = 400$ V, $I_F = 50$ A
	
Typical reverse recovery charge as a function of diode current slope $Q_{rr} = f(di_F/dt)$ $V_R = 400$ V, $I_F = 50$ A	**Typical reverse recovery current as a function of diode current slope** $I_{rr} = f(di_F/dt)$ $V_R = 400$ V, $I_F = 50$ A
	

Typical diode peak rate of fall of reverse recovery current as a function of diode current slope

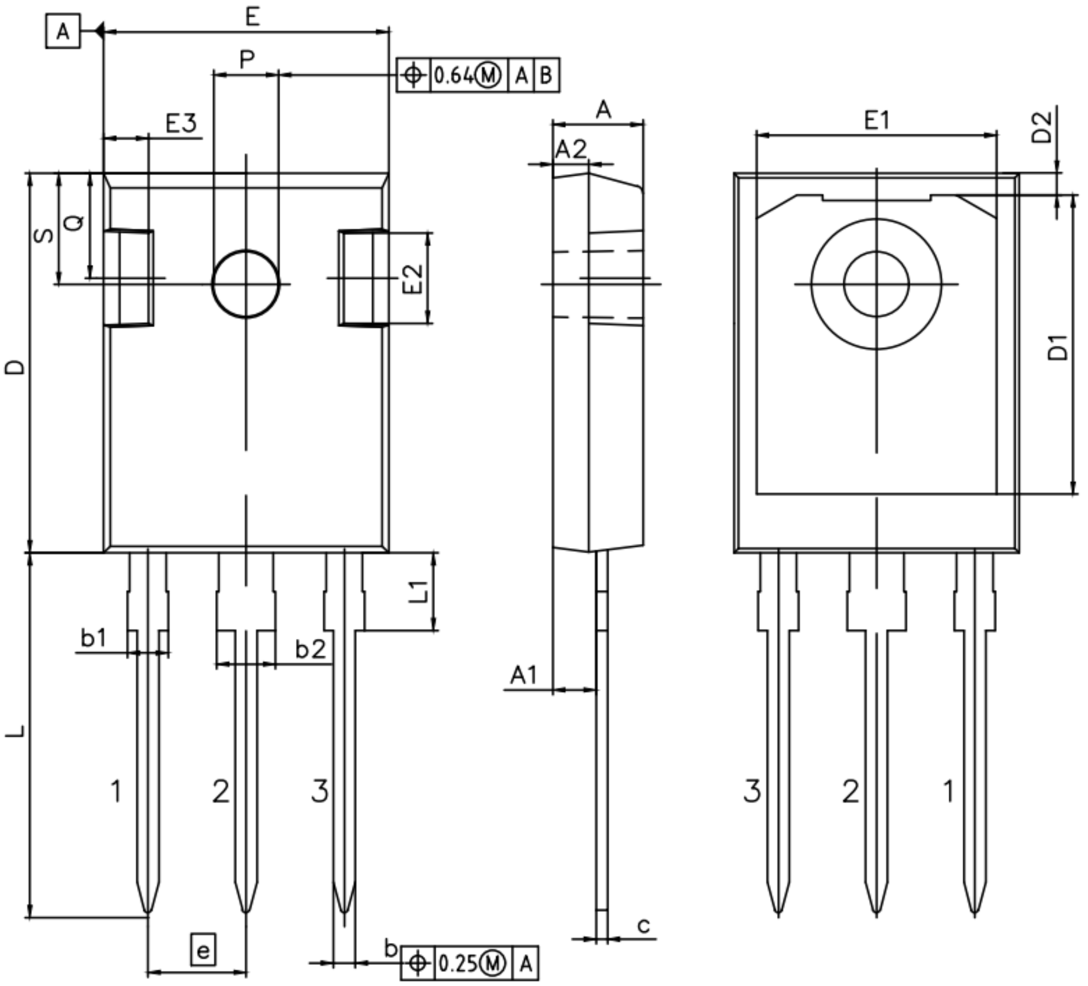
$di_{rr}/dt = f(di_F/dt)$

$V_R = 400$ V, $I_F = 50$ A



5 封装外形

Package Drawing PG-TO247-3



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

DOCUMENT NO.	Z8B00003327
REVISION	06
SCALE 3:1	0 1 2 3 4 5mm
EUROPEAN PROJECTION	
ISSUE DATE	25.07.2018

图 1

6 测试条件

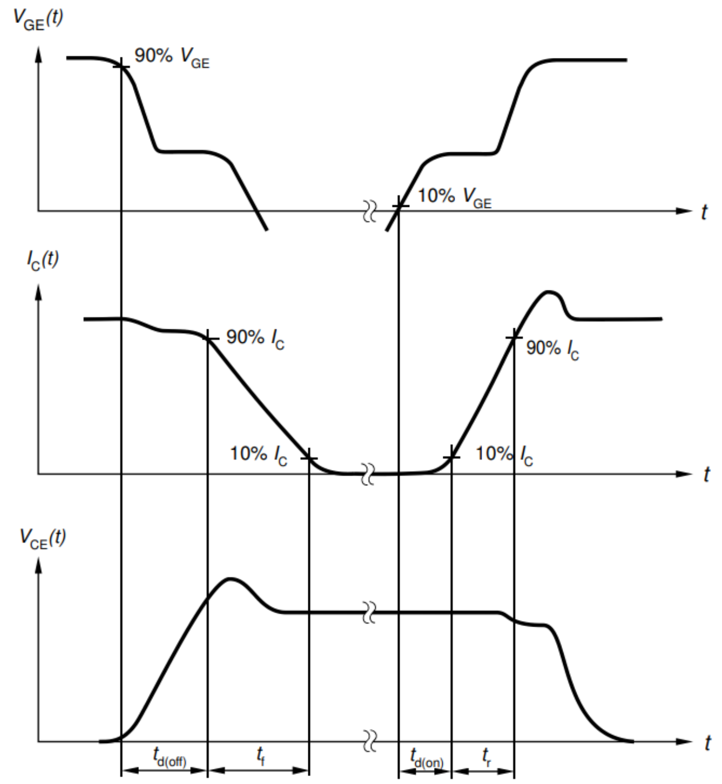


Figure A. **Definition of switching times**

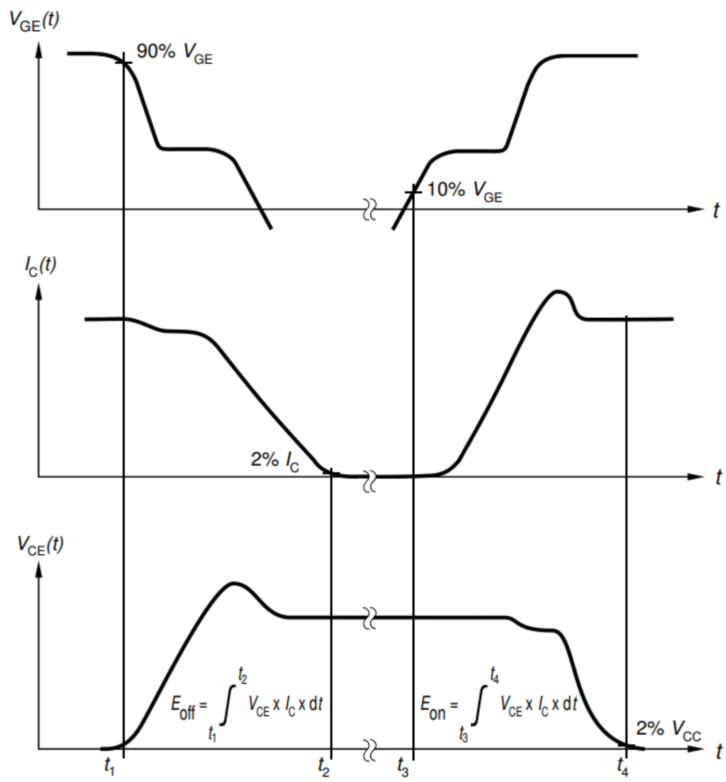


Figure B. **Definition of switching losses**

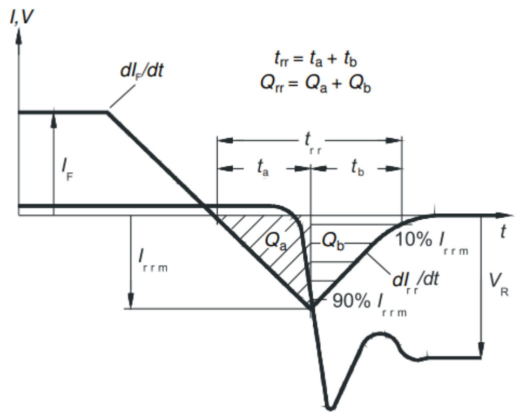


Figure C. **Definition of diode switching characteristics**

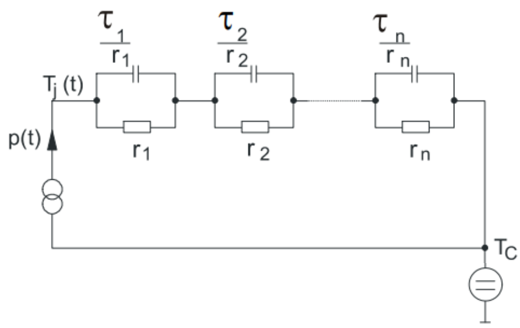


Figure D. **Thermal equivalent circuit**

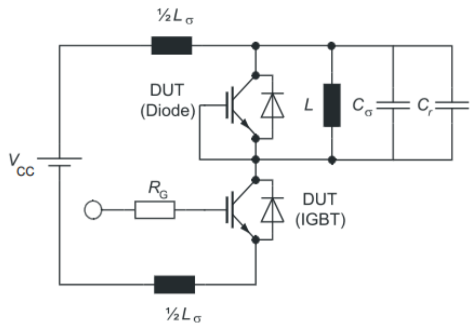


Figure E. **Dynamic test circuit**
Parasitic inductance L_{σ},
parasitic capacitor C_{σ},
relief capacitor C_r,
(only for ZVT switching)

图 2

t

修订记录

Document revision	Date of release	Description of changes
V2.1	2015-05-20	Final data sheet
V2.2	2017-07-27	Correction Fig.1
n/a	2020-11-30	Datasheet migrated to a new system with a new layout and new revision number schema: target or preliminary datasheet = 0.xy; final datasheet = 1.xy
1.10	2022-11-09	Correction of diagram: “Typical switching energy losses as a function of collector emitter voltage”

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。

Trademarks
All referenced product or service names and trademarks are the property of their respective owners.

版本 **2025-09-16**

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

Do you have a question about this document?

Email:

erratum@infineon.com