

英飞凌CoolSiC™ 混合单管 - TRENCHSTOP™ 5 S5 IGBT

与全额定值第六代 CoolSiC™ 二极管共同封装

特性

- $V_{CE} = 650\text{ V}$
- $I_C = 50\text{ A}$
- TRENCHSTOP™ 5 与 CoolSiC™ 技术以及开尔文发射器引脚相结合，实现超低开关损耗
- 导通损耗非常低
- 硬开关拓扑中的基准效率
- 即插即用，替代纯硅器件
- 优化的四引脚封装引脚布局简化了 PCB 设计
- 开尔文发射器和栅极引脚的间隙增大，提高了波峰焊质量
- 最高结温 $T_{vjmax} = 175^\circ\text{C}$
- 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/>

潜在应用

- 工业开关电源
- 工业级不间断电源 (UPS)
- 光伏组串逆变器
- 储能
- 充电器

产品验证

- 根据 JEDEC20/22 相关测试的测试条件，符合上述应用要求

描述

封装引脚定义：

- 引脚 C & 背面 - 集电极
- 引脚 E - 发射极
- 引脚 K - 开尔文发射极
- 引脚 G - 栅极



Lead-free



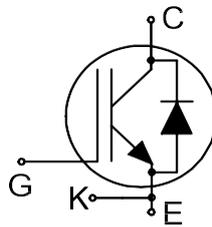
Green



Halogen-free



RoHS



Type	Package	Marking
IKZA50N65SS5	PG-TO247-4-3	K50ESS5

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）。

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1封装

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			13.0		nH
Storage temperature	T_{stg}		-55		150	°C
Soldering temperature		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

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表2 最大额定值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Collector-emitter voltage	V_{CE}	$T_{vj} \geq 25\text{ °C}$		650		V
DC collector current, limited by T_{vjmax}	I_C	limited by bondwire	$T_c = 25\text{ °C}$	80		A
			$T_c = 100\text{ °C}$	60.5		
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			200		A
Turn-off safe operating area		$V_{CE} \leq 650\text{ V}$, $t_p = 1\text{ }\mu\text{s}$, $T_{vj} \leq 175\text{ °C}$		200		A
Gate-emitter voltage	V_{GE}			± 20		V
Transient gate-emitter voltage	V_{GE}	$t_p \leq 10\text{ }\mu\text{s}$, $D < 0.01$		± 30		V
Power dissipation	P_{tot}		$T_c = 25\text{ °C}$	274		W
			$T_c = 100\text{ °C}$	137		

表3 特征值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 50\text{ A}$, $V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$	1.35	1.7	V
			$T_{vj} = 125\text{ °C}$	1.55		
			$T_{vj} = 175\text{ °C}$	1.65		
Gate-emitter threshold voltage	V_{GEth}	$I_C = 0.5\text{ mA}$, $V_{CE} = V_{GE}$	3.2	4	4.8	V

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表 3 (续) 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 650 \text{ V}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$			1300	μA
			$T_{vj} = 175 \text{ }^\circ\text{C}$		2000		
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 480 \text{ V}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$			40	μA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0 \text{ V}, V_{GE} = 20 \text{ V}$				100	nA
Transconductance	g_{fs}	$I_C = 50 \text{ A}, V_{CE} = 20 \text{ V}$			62		S
Input capacitance	C_{ies}	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 250 \text{ kHz}$			2660		pF
Output capacitance	C_{oes}	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 250 \text{ kHz}$			530		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 250 \text{ kHz}$			10		pF
Gate charge	Q_G	$I_C = 50 \text{ A}, V_{GE} = 15 \text{ V}, V_{CC} = 520 \text{ V}$			110		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{Gon} = 9 \text{ } \Omega, R_{Goff} = 9 \text{ } \Omega, L_\sigma = 30 \text{ nH}, C_\sigma = 30 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 50 \text{ A}$		19		ns
			$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 25 \text{ A}$		18		
			$T_{vj} = 150 \text{ }^\circ\text{C}, I_C = 50 \text{ A}$		19		
			$T_{vj} = 150 \text{ }^\circ\text{C}, I_C = 25 \text{ A}$		18		
Rise time (inductive load)	t_r	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{Gon} = 9 \text{ } \Omega, R_{Goff} = 9 \text{ } \Omega, L_\sigma = 30 \text{ nH}, C_\sigma = 30 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 50 \text{ A}$		9		ns
			$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 25 \text{ A}$		5		
			$T_{vj} = 150 \text{ }^\circ\text{C}, I_C = 50 \text{ A}$		10		
			$T_{vj} = 150 \text{ }^\circ\text{C}, I_C = 25 \text{ A}$		6		
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 400 \text{ V}, V_{GE} = 0/15 \text{ V}, R_{Gon} = 9 \text{ } \Omega, R_{Goff} = 9 \text{ } \Omega, L_\sigma = 30 \text{ nH}, C_\sigma = 30 \text{ pF}$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 50 \text{ A}$		140		ns
			$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 25 \text{ A}$		150		
			$T_{vj} = 150 \text{ }^\circ\text{C}, I_C = 50 \text{ A}$		165		
			$T_{vj} = 150 \text{ }^\circ\text{C}, I_C = 25 \text{ A}$		191		

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表 3 (续) 特征值

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Fall time (inductive load)	t_f	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V},$ $R_{Gon} = 9\ \Omega, R_{Goff} = 9\ \Omega, L_{\sigma}$ $= 30\text{ nH}, C_{\sigma} = 30\text{ pF}$	$T_{vj} = 25\text{ }^{\circ}\text{C},$ $I_C = 50\text{ A}$		19		ns
			$T_{vj} = 25\text{ }^{\circ}\text{C},$ $I_C = 25\text{ A}$		24		
			$T_{vj} = 150\text{ }^{\circ}\text{C},$ $I_C = 50\text{ A}$		19		
			$T_{vj} = 150\text{ }^{\circ}\text{C},$ $I_C = 25\text{ A}$		24		
Turn-on energy	E_{on}	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V},$ $R_{Gon} = 9\ \Omega, R_{Goff} = 9\ \Omega, L_{\sigma}$ $= 30\text{ nH}, C_{\sigma} = 30\text{ pF}$	$T_{vj} = 25\text{ }^{\circ}\text{C},$ $I_C = 50\text{ A}$		0.23		mJ
			$T_{vj} = 25\text{ }^{\circ}\text{C},$ $I_C = 25\text{ A}$		0.11		
			$T_{vj} = 150\text{ }^{\circ}\text{C},$ $I_C = 50\text{ A}$		0.29		
			$T_{vj} = 150\text{ }^{\circ}\text{C},$ $I_C = 25\text{ A}$		0.14		
Turn-off energy	E_{off}	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V},$ $R_{Gon} = 9\ \Omega, R_{Goff} = 9\ \Omega, L_{\sigma}$ $= 30\text{ nH}, C_{\sigma} = 30\text{ pF}$	$T_{vj} = 25\text{ }^{\circ}\text{C},$ $I_C = 50\text{ A}$		0.52		mJ
			$T_{vj} = 25\text{ }^{\circ}\text{C},$ $I_C = 25\text{ A}$		0.28		
			$T_{vj} = 150\text{ }^{\circ}\text{C},$ $I_C = 50\text{ A}$		0.88		
			$T_{vj} = 150\text{ }^{\circ}\text{C},$ $I_C = 25\text{ A}$		0.48		
Total switching energy	E_{ts}	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V},$ $R_{Gon} = 9\ \Omega, R_{Goff} = 9\ \Omega, L_{\sigma}$ $= 30\text{ nH}, C_{\sigma} = 30\text{ pF}$	$T_{vj} = 25\text{ }^{\circ}\text{C},$ $I_C = 50\text{ A}$		0.75		mJ
			$T_{vj} = 25\text{ }^{\circ}\text{C},$ $I_C = 25\text{ A}$		0.39		
			$T_{vj} = 150\text{ }^{\circ}\text{C},$ $I_C = 50\text{ A}$		1.17		
			$T_{vj} = 150\text{ }^{\circ}\text{C},$ $I_C = 25\text{ A}$		0.62		
IGBT thermal resistance, junction-case	$R_{th(j-c)}$				0.55	K/W	
Operating junction temperature	T_{vj}		-40		175	$^{\circ}\text{C}$	

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表4 最大额定值

Parameter	Symbol	Note or test condition	Values	Unit	
Repetitive peak reverse voltage	V_{RRM}	$T_{vj} \geq 25\text{ °C}$	650	V	
Diode forward current, limited by T_{vjmax}	I_F		$T_c = 25\text{ °C}$	57.5	A
			$T_c = 100\text{ °C}$	38.5	
Diode pulsed current, t_p limited by T_{vjmax} ¹⁾	I_{Fpulse}		150	A	

1) 脉冲电流水平取决于二极管芯片的 T_{vj} ，另见图“最大脉冲电流与结温的关系”

表5 特征值

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Diode forward voltage	V_F	$I_F = 40\text{ A}$		$T_{vj} = 25\text{ °C}$	1.35	1.5	V
				$T_{vj} = 125\text{ °C}$	1.55		
				$T_{vj} = 175\text{ °C}$	1.65		
Diode thermal resistance, junction-case	$R_{th(j-c)}$				1	K/W	
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 $T_{vj} = 25\text{ °C}$ 。

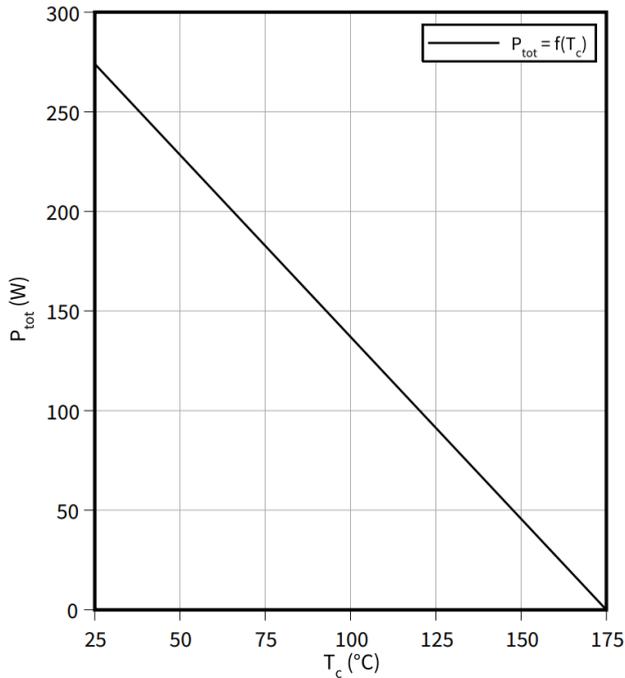
动态测试电路，寄生电感 L_σ ，寄生电容 C_σ ，来自图E。能量损失包括“拖尾”和二极管反向恢复。

4 特性图

4 特性图

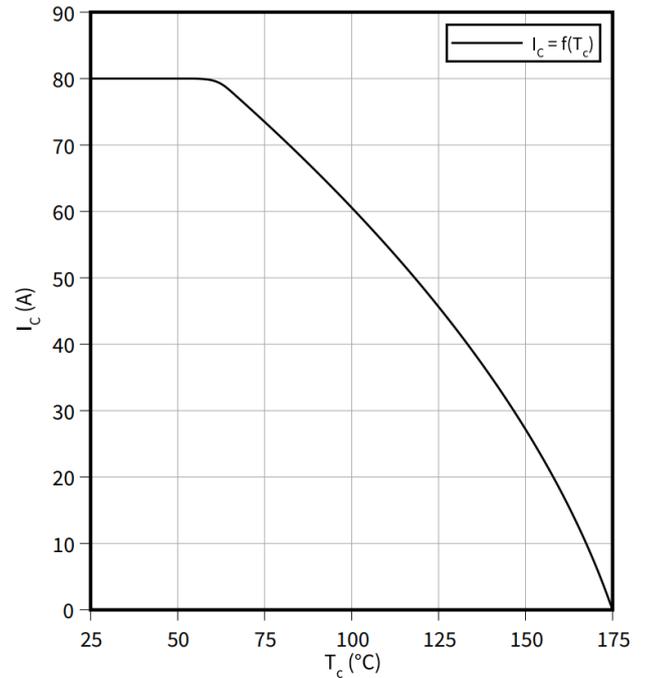
Power dissipation as a function of case temperature

$P_{tot} = f(T_c)$
 $T_{vj} \leq 175\text{ °C}$



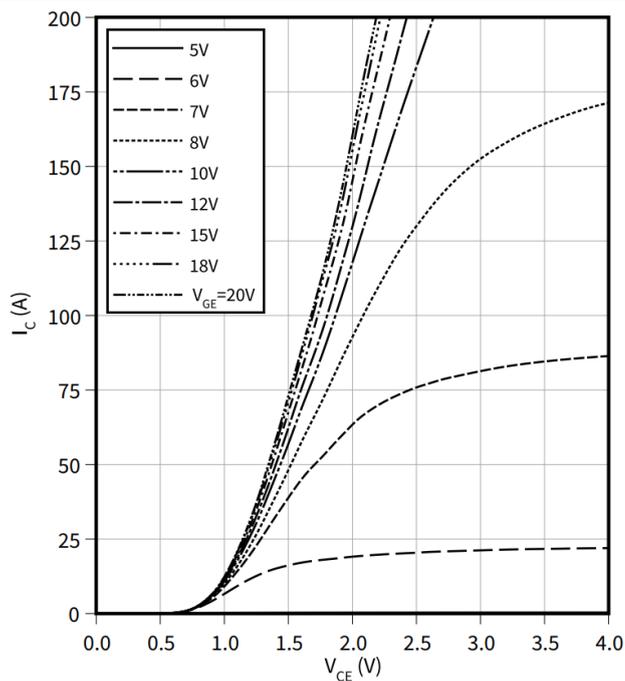
Collector current as a function of case temperature

$I_c = f(T_c)$
 $T_{vj} \leq 175\text{ °C}, V_{GE} \geq 15\text{ V}$



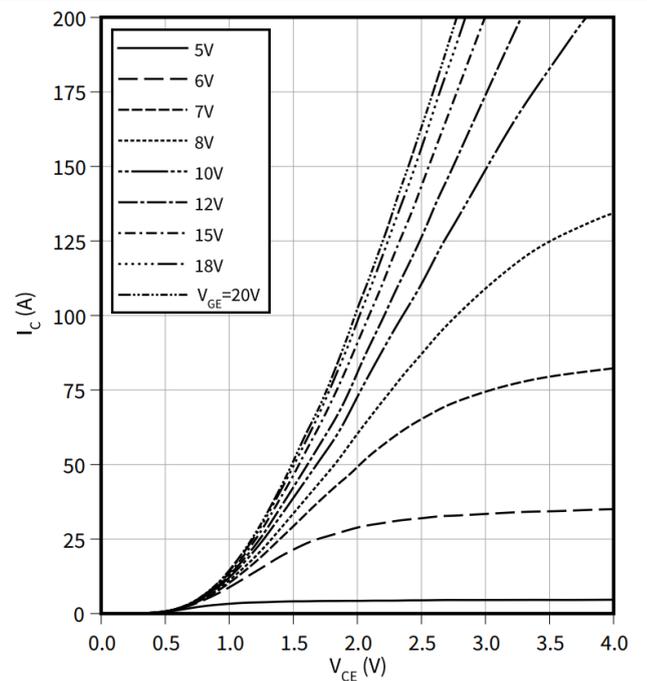
Typical output characteristic

$I_c = f(V_{CE})$
 $T_{vj} = 25\text{ °C}$



Typical output characteristic

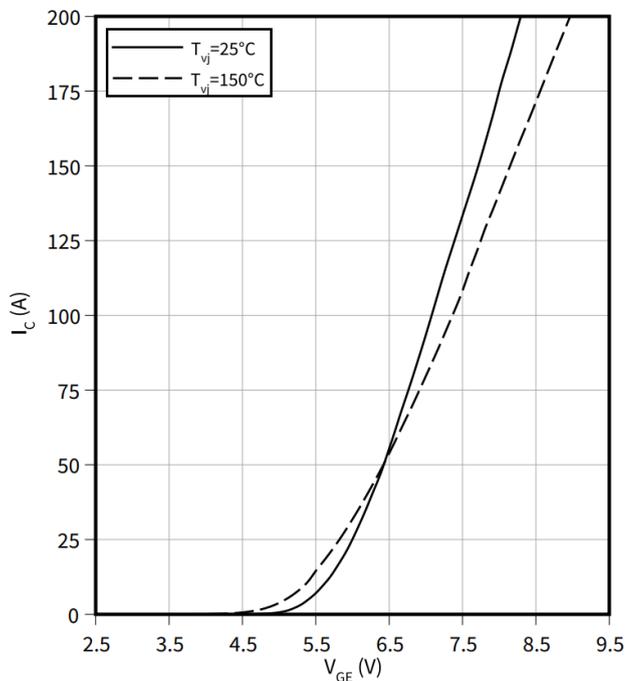
$I_c = f(V_{CE})$
 $T_{vj} = 150\text{ °C}$



4 特性图

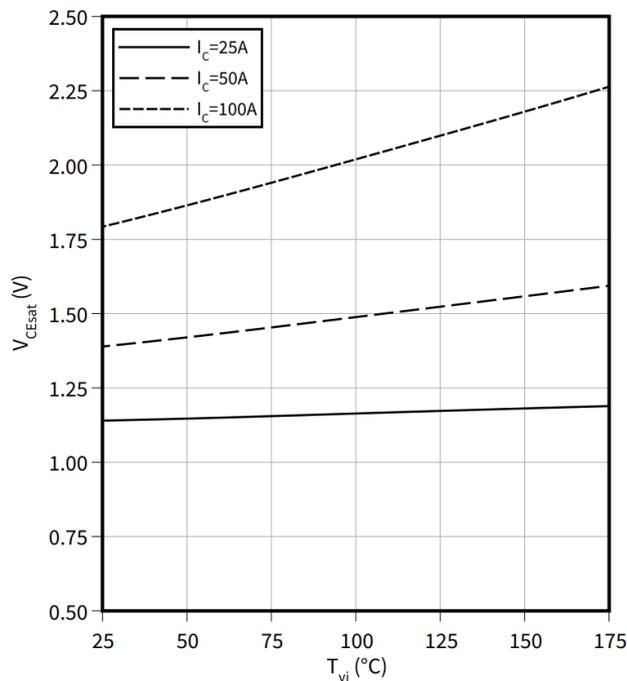
Typical transfer characteristic

$I_C = f(V_{GE})$
 $V_{CE} = 20\text{ V}$



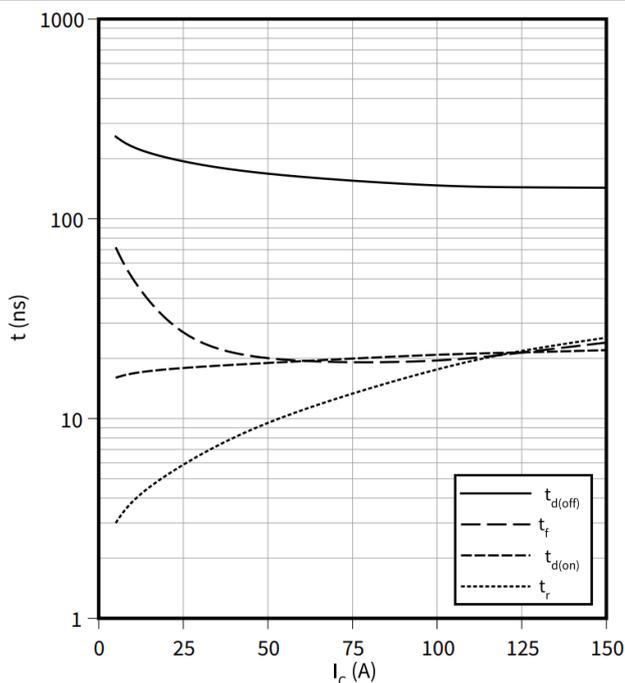
Typical collector-emitter saturation voltage as a function of junction temperature

$V_{CEsat} = f(T_{vj})$
 $V_{GE} = 15\text{ V}$



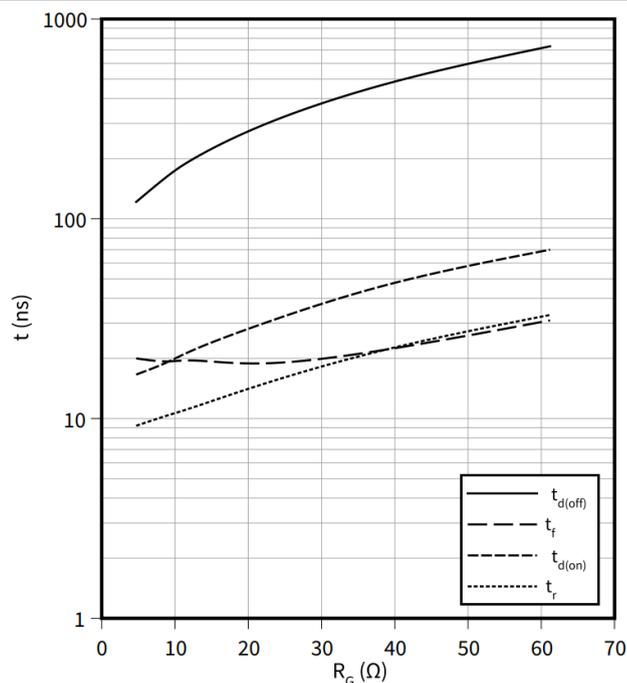
Typical switching times as a function of collector current

$t = f(I_C)$
 $V_{CC} = 400\text{ V}, T_{vj} = 150^\circ\text{ C}, V_{GE} = 0/15\text{ V}, R_G = 9\ \Omega$



Typical switching times as a function of gate resistor

$t = f(R_G)$
 $I_C = 50\text{ A}, V_{CC} = 400\text{ V}, T_{vj} = 150^\circ\text{ C}, V_{GE} = 0/15\text{ V}$

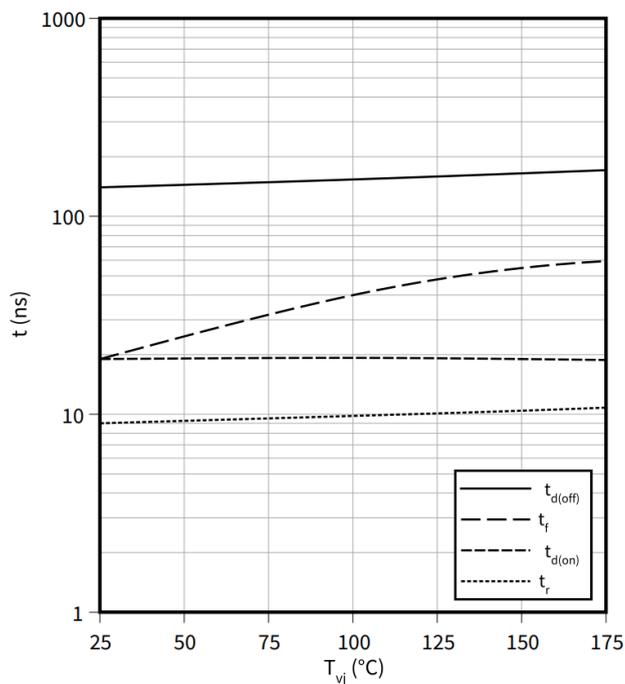


4 特性图

Typical switching times as a function of junction temperature

$t = f(T_{vj})$

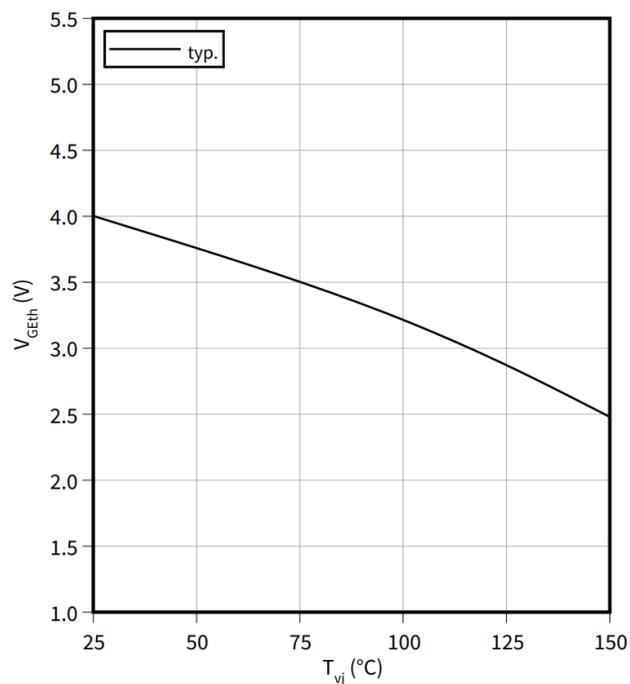
$I_C = 50 \text{ A}$, $V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 9 \Omega$



Gate-emitter threshold voltage as a function of junction temperature

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

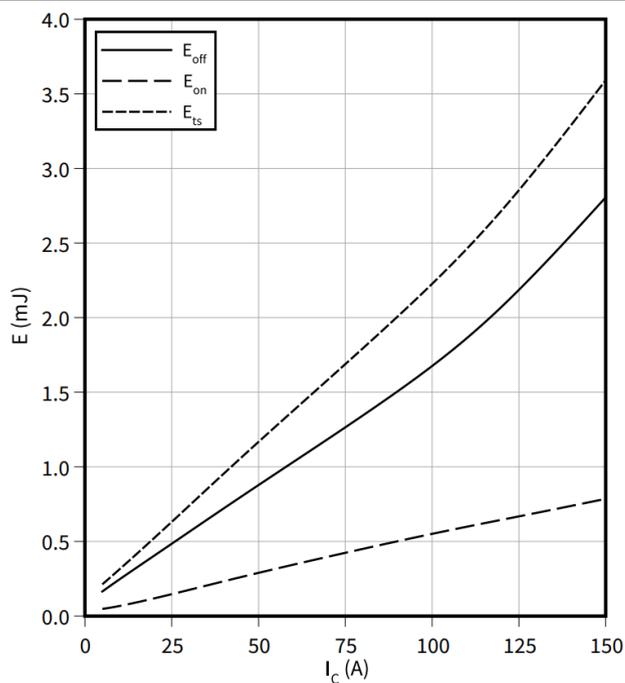
$I_C = 0.5 \text{ mA}$



Typical switching energy losses as a function of collector current

$E = f(I_C)$

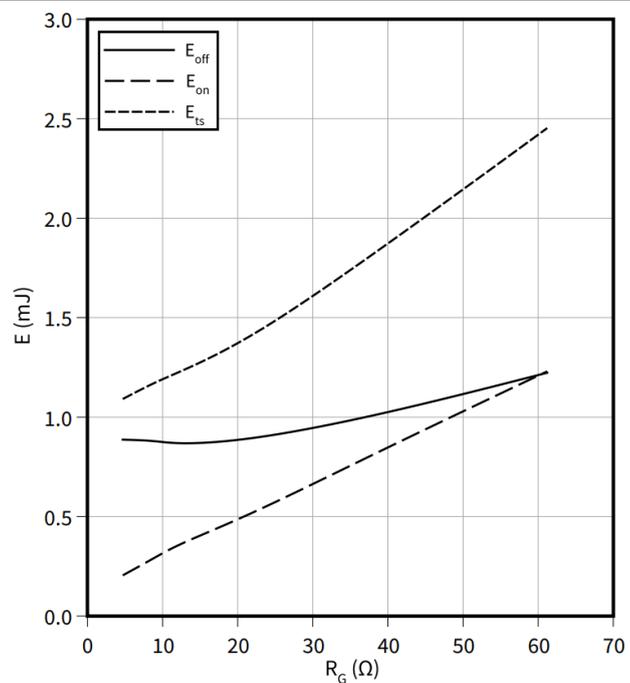
$V_{CC} = 400 \text{ V}$, $T_{vj} = 150 \text{ °C}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 9 \Omega$



Typical switching energy losses as a function of gate resistor

$E = f(R_G)$

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

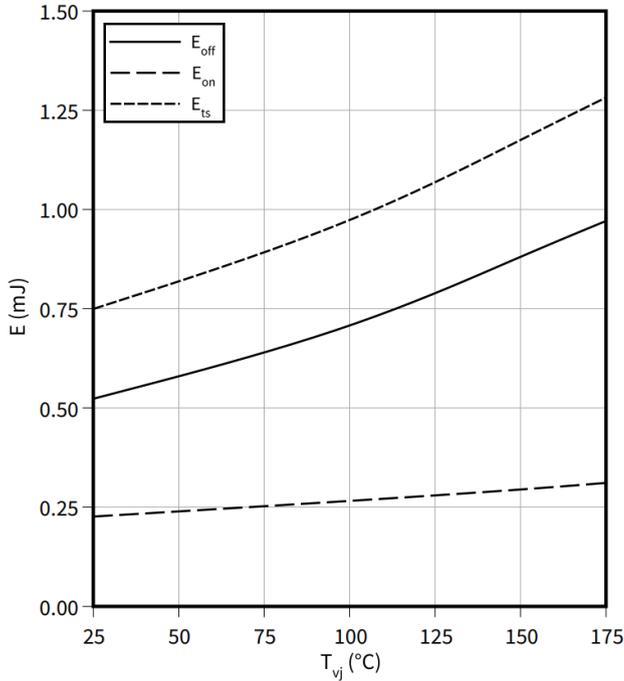


4 特性图

Typical switching energy losses as a function of junction temperature

$E = f(T_{vj})$

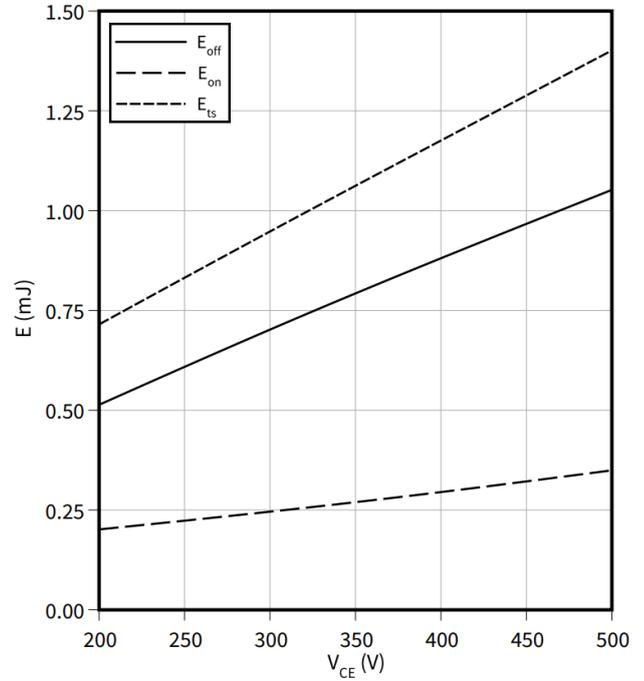
$I_C = 50\text{ A}, V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_G = 9\ \Omega$



Typical switching energy losses as a function of collector emitter voltage

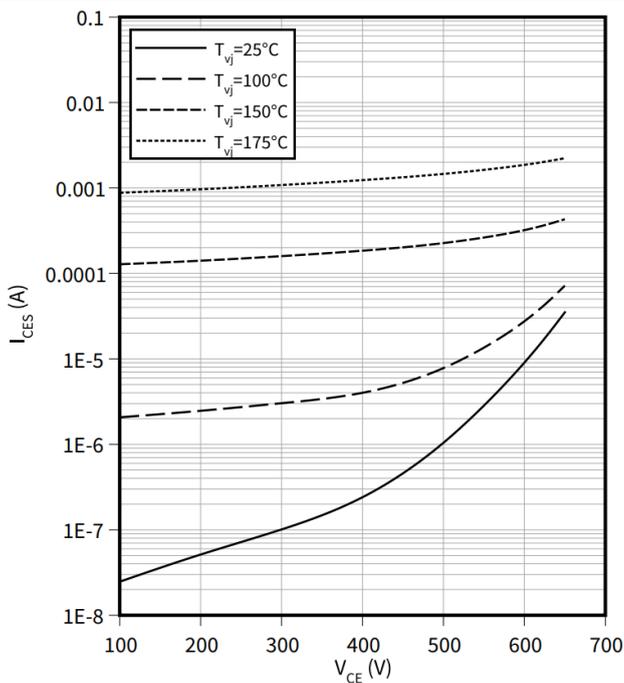
$E = f(V_{CE})$

$I_C = 50\text{ A}, V_{GE} = 0/15\text{ V}, T_{vj} = 150\text{ °C}, R_G = 9\ \Omega$



Typ. reverse current vs. reverse voltage as a function of T_{vj}

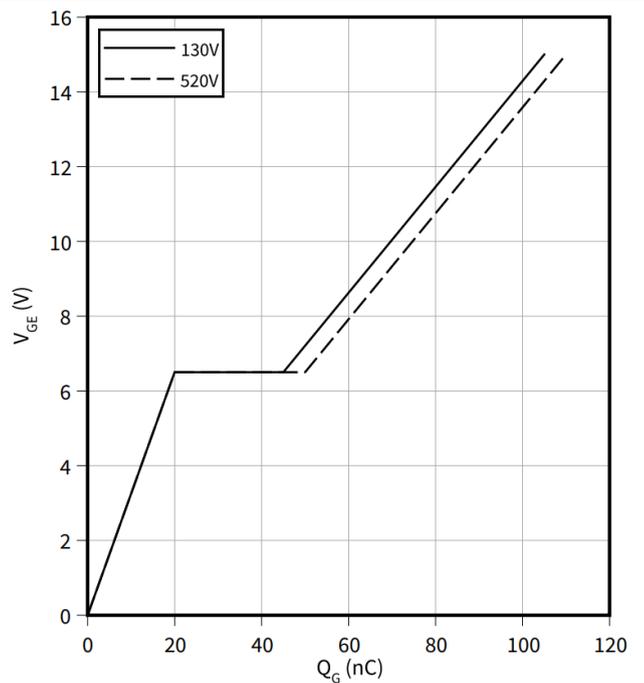
$I_{CES} = f(V_{CE})$



Typical gate charge

$V_{GE} = f(Q_G)$

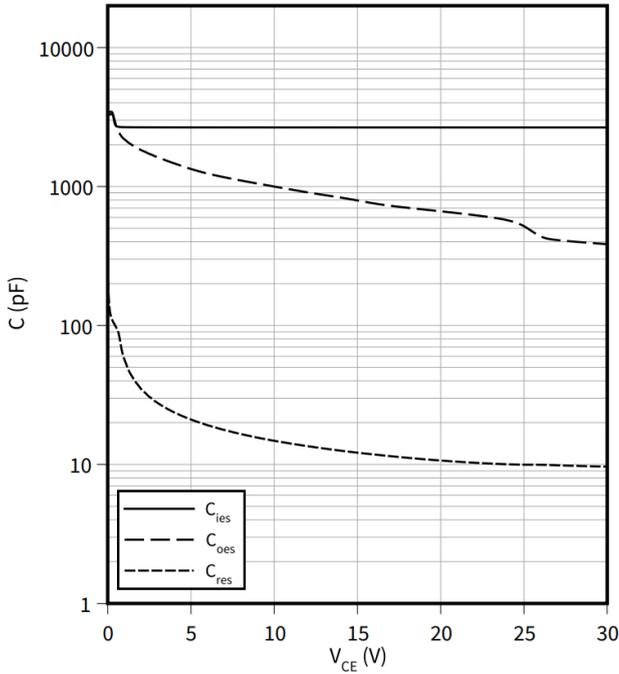
$I_C = 50\text{ A}$



4 特性图

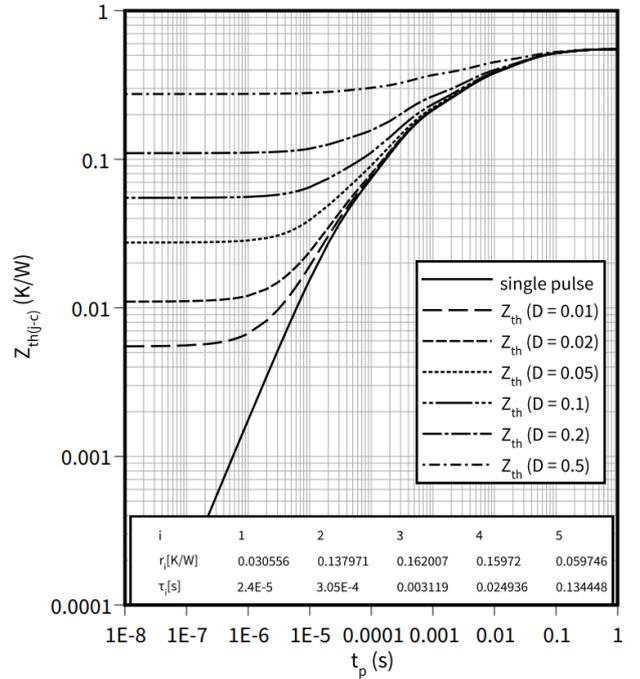
Typical capacitance as a function of collector-emitter voltage

$C = f(V_{CE})$
 $f = 250 \text{ kHz}, V_{GE} = 0 \text{ V}$



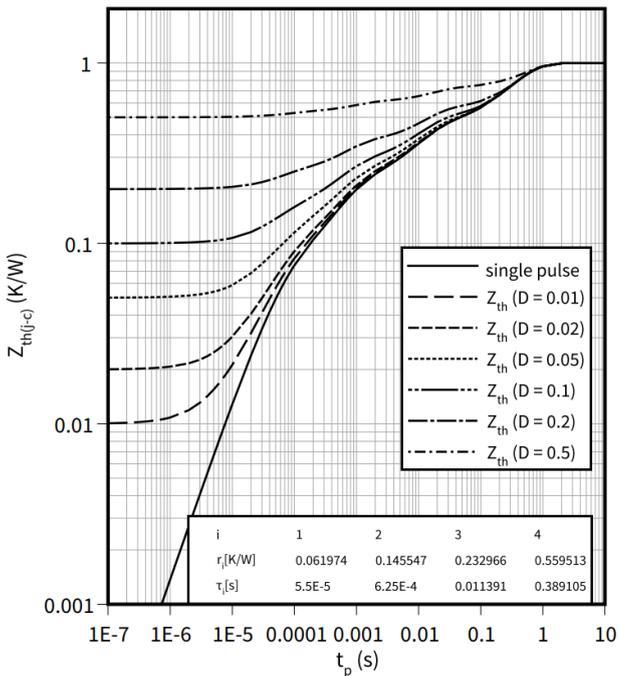
IGBT transient thermal impedance as a function of pulse width

$Z_{th(j-c)} = f(t_p)$
 $D = t_p/T$



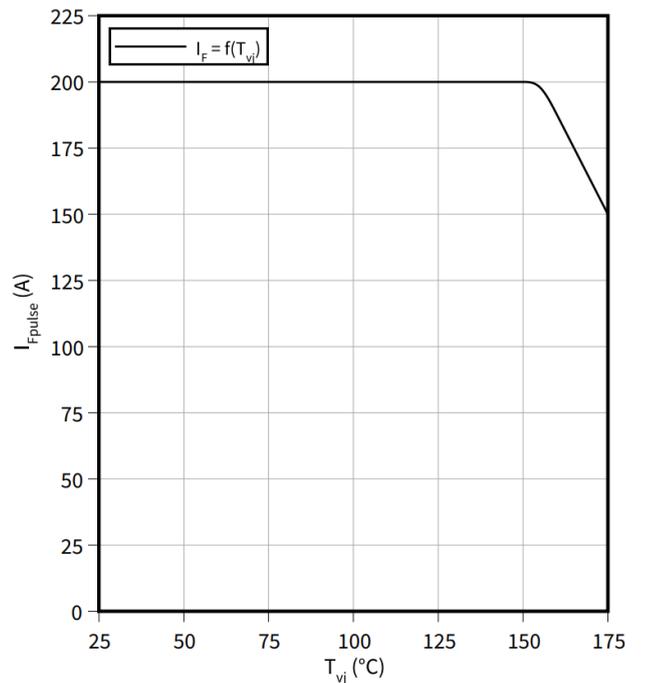
Diode transient thermal impedance as a function of pulse width

$Z_{th(j-c)} = f(t_p)$
 $D = t_p/T$



Maximum pulse current as a function of junction temperature

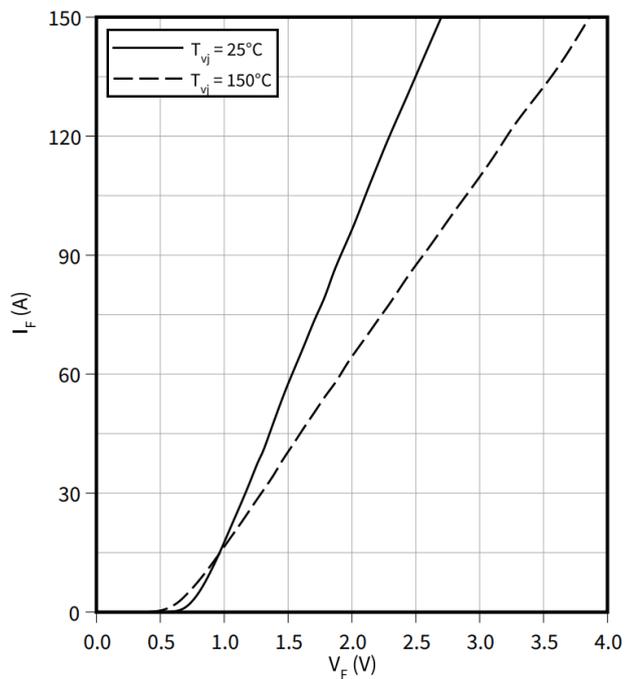
$I_{Fpulse} = f(T_{vj})$



4 特性图

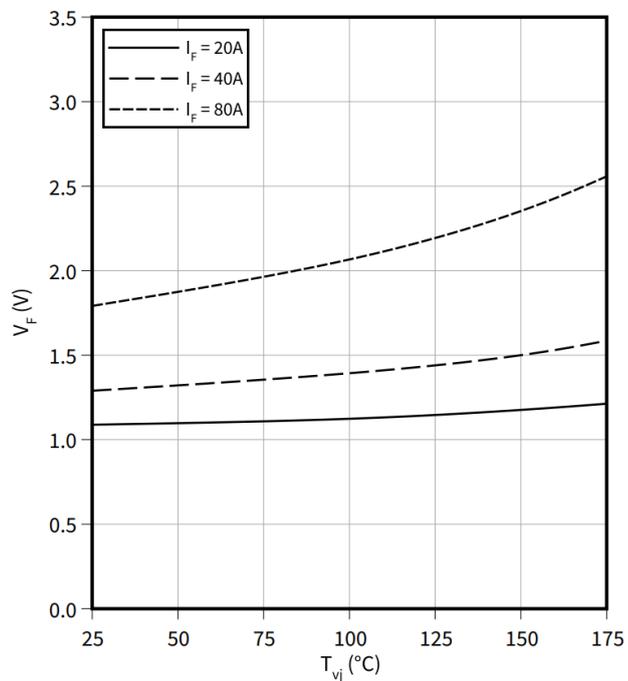
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



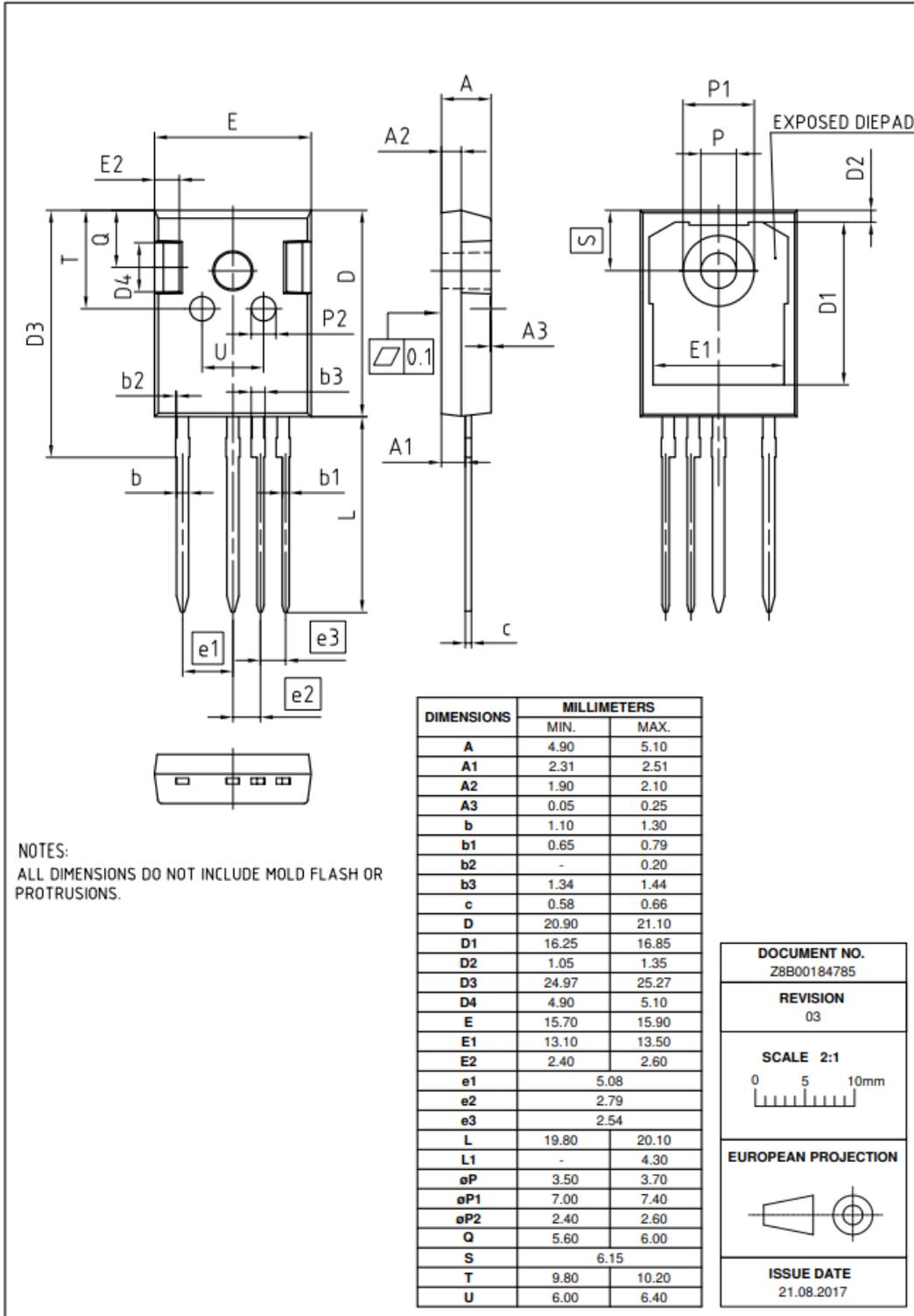
Typical diode forward voltage as a function of junction temperature

$V_F = f(T_{vj})$



5 封装外形

PG-TO247-4-3



6 测试条件

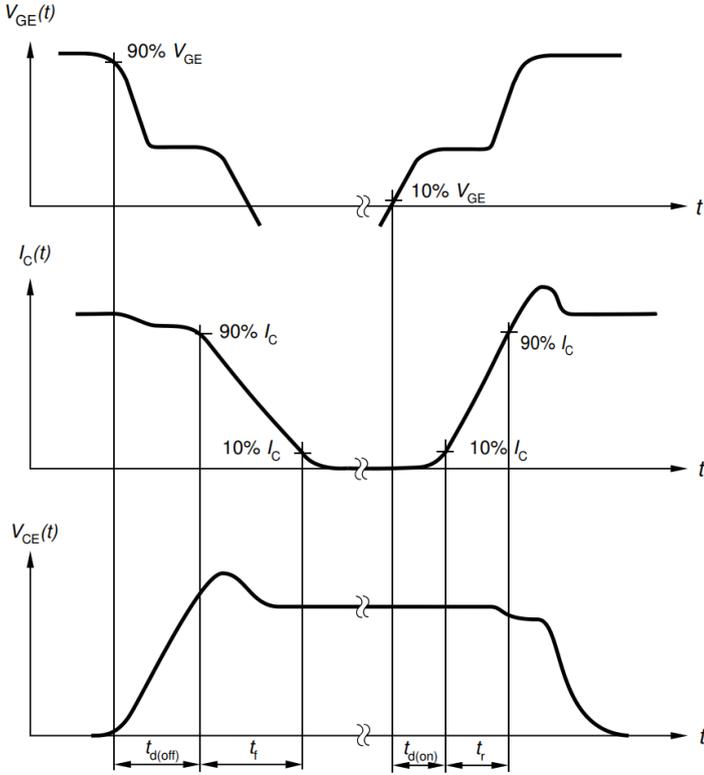


Figure A. Definition of switching times

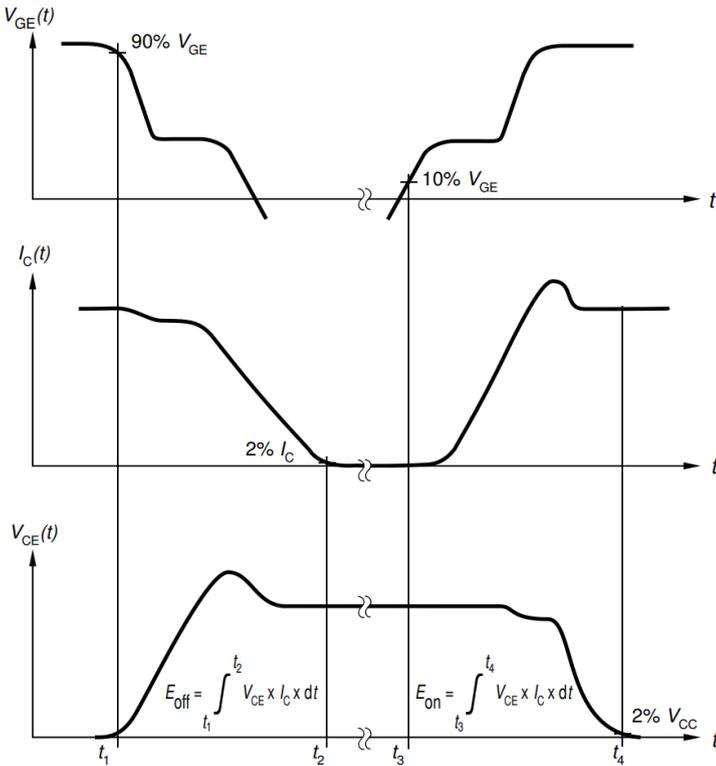


Figure B. Definition of switching losses

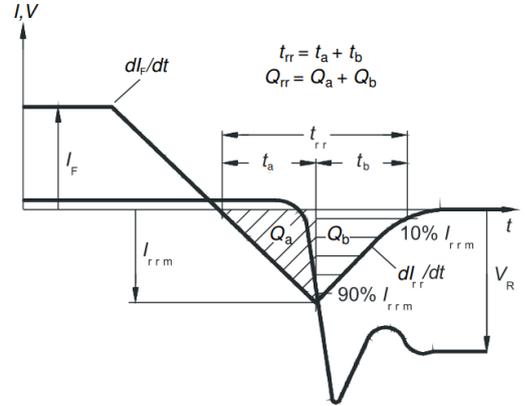


Figure C. Definition of diode switching characteristics

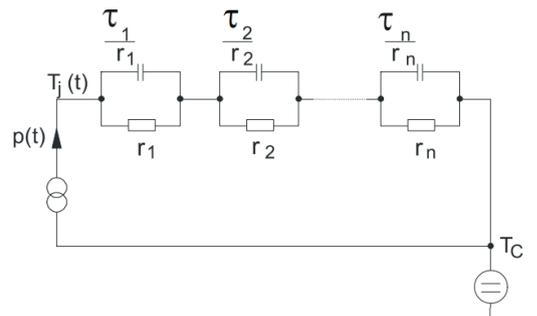


Figure D. Thermal equivalent circuit

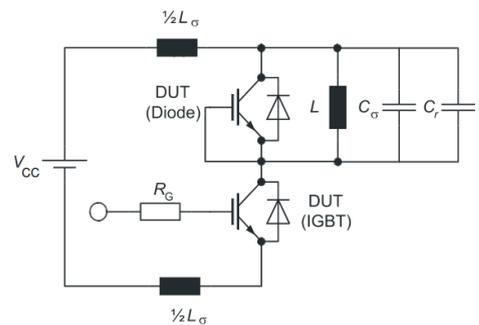


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ ,
parasitic capacitor C_σ ,
relief capacitor C_r ,
(only for ZVT switching)

修订记录

Document revision	Date of release	Description of changes
V1.1	2020-03-20	Preliminary data sheet
V2.1	2020-07-27	Final Data Sheet
V2.2	2020-07-29	Additional specification of internal emitter inductance
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	2022-09-22	Rename of product family name from “Hybrid CoolSiC™ IGBT” to “CoolSiC™ hybrid discrete”



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版本 2025-10-30

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