

英飞凌低损耗 Duopack： 采用 Trench 和 Fieldstop 技术的 IGBT 7

特性

- $V_{CE} = 650\text{ V}$
- $I_C = 50\text{ A}$
- 非常低的 $V_{CE,sat}$
- 低关断损耗
- 低拖尾电流
- EMI 降低
- 非常柔软、快速恢复的反并联二极管
- 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
- 完整的产品范围和 PSpice 模型：<http://www.infineon.com/igbt7/>

潜在应用

- 伺服驱动器
- 通用驱动器（GPD）
- 工业级不间断电源（UPS）
- 工业开关电源
- 光伏优化器
- 光伏组串逆变器

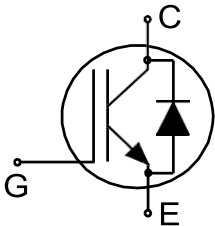
产品验证

- 符合JEDEC47/20/22相关测试的工业应用要求

描述

封装引脚定义：

- 引脚 C & 背面 - 集电极
- 引脚 E - 发射极
- 引脚 G - 栅极



Type	Package	Marking
IKW50N65ET7	PG-TO247-3	K50EET7

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）。



目录

	描述.....	1
	特性.....	1
	潜在应用	1
	产品验证	1
	目录.....	2
1	封装.....	3
2	IGBT	3
3	二极管	6
4	特性图.....	9
5	封装外形	16
6	测试条件	17
	修订记录	18
	免责声明	19

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		nH
Storage temperature	T_{stg}		-55		150	°C
Soldering temperature	T_{sld}	wave soldering 1.6 mm (0.063 in.) from case for 10 s			260	°C
Mounting torque	M	M3 screw, Maximum of mounting processes: 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	$R_{th(j-c)}$				0.8	K/W

2 IGBT

表 2 最大额定值

Parameter	Symbol	Note or test condition		Values	Unit
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
			$T_c = 100\text{ °C}$	59.7	
Pulsed collector current, t_p limited by T_{vjmax} ¹⁾	I_{Cpulse}			150	A
Turn-off safe operating area ²⁾		$V_{CE} \leq 650\text{ V}$, $t_p = 1\text{ }\mu\text{s}$, $T_{vj} \leq 175\text{ °C}$		150	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
Short-circuit withstand time	t_{SC}	$V_{GE} = 15\text{ V}$, Allowed number of short circuits < 1000, Time between short circuits $\geq 1.0\text{ s}$	$V_{CC} \leq 330\text{ V}$, $T_{vj} = 100\text{ °C}$	5	μs
			$V_{CC} \leq 400\text{ V}$, $T_{vj} = 150\text{ °C}$	3	
Power dissipation	P_{tot}		$T_c = 25\text{ °C}$	273	W
			$T_c = 100\text{ °C}$	136	

1) 由设计标定，不受限于生产测试。

2) 对每个器件进行钳位电感负载电流测试， $I_C = 150\text{ A}$ ， $V_{CC} = 400\text{ V}$ ， $T_c = 25\text{ °C}$ ， $V_{GE} = 20\text{ V}$ ， $L = 80\text{ }\mu\text{H}$ ， $R_G = 10\text{ }\Omega$

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	1.65	V
			$T_{vj} = 125\text{ °C}$		1.5		
			$T_{vj} = 175\text{ °C}$		1.6		
Gate-emitter threshold voltage	V_{GETh}	$I_C = 0.5\text{ mA}$, $V_{CE} = V_{GE}$		4.3	5	5.7	V
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 650\text{ V}$, $V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$			40	μA
			$T_{vj} = 175\text{ °C}$		1000		
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\text{ V}$, $V_{GE} = 20\text{ V}$				100	nA
Transconductance	g_{fs}	$I_C = 50\text{ A}$, $V_{CE} = 20\text{ V}$			26		S
Short-circuit collector current	I_{SC}	$V_{CC} \leq 400\text{ V}$, $V_{GE} = 15\text{ V}$, $t_{SC} \leq 3\text{ }\mu\text{s}$, Allowed number of short circuits < 1000, Time between short circuits $\geq 1.0\text{ s}$, $T_{vj} = 150\text{ °C}$			255		A
Input capacitance	C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1000\text{ kHz}$			3050		pF
Output capacitance	C_{oes}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1000\text{ kHz}$			92		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1000\text{ kHz}$			31		pF
Gate charge	Q_G	$I_C = 50\text{ A}$, $V_{GE} = 15\text{ V}$, $V_{CC} = 520\text{ V}$			290		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 400\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{G(on)} = 9\text{ }\Omega$, $R_{G(off)} = 9\text{ }\Omega$, $L_\sigma = 32\text{ nH}$, $C_\sigma = 30\text{ pF}$	$T_{vj} = 25\text{ °C}$, $I_C = 50\text{ A}$		26		ns
			$T_{vj} = 25\text{ °C}$, $I_C = 25\text{ A}$		24		
			$T_{vj} = 175\text{ °C}$, $I_C = 50\text{ A}$		30		
			$T_{vj} = 175\text{ °C}$, $I_C = 25\text{ A}$		27		
Rise time (inductive load)	t_r	$V_{CC} = 400\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{G(on)} = 9\text{ }\Omega$, $R_{G(off)} = 9\text{ }\Omega$, $L_\sigma = 32\text{ nH}$, $C_\sigma = 30\text{ pF}$	$T_{vj} = 25\text{ °C}$, $I_C = 50\text{ A}$		20		ns
			$T_{vj} = 25\text{ °C}$, $I_C = 25\text{ A}$		11		
			$T_{vj} = 175\text{ °C}$, $I_C = 50\text{ A}$		23		
			$T_{vj} = 175\text{ °C}$, $I_C = 25\text{ A}$		14		

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表 3 (续) 特征值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 9 \Omega$, $R_{G(off)} = 9 \Omega$, $L_{\sigma} = 32 \text{ nH}$, $C_{\sigma} = 30 \text{ pF}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 50 \text{ A}$	350		ns
			$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 25 \text{ A}$	370		
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 50 \text{ A}$	410		
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 25 \text{ A}$	450		
Fall time (inductive load)	t_f	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 9 \Omega$, $R_{G(off)} = 9 \Omega$, $L_{\sigma} = 32 \text{ nH}$, $C_{\sigma} = 30 \text{ pF}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 50 \text{ A}$	14		ns
			$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 25 \text{ A}$	12		
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 50 \text{ A}$	30		
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 25 \text{ A}$	40		
Turn-on energy	E_{on}	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 9 \Omega$, $R_{G(off)} = 9 \Omega$, $L_{\sigma} = 32 \text{ nH}$, $C_{\sigma} = 30 \text{ pF}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 50 \text{ A}$	1.2		mJ
			$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 25 \text{ A}$	0.51		
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 50 \text{ A}$	1.91		
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 25 \text{ A}$	0.88		
Turn-off energy	E_{off}	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 9 \Omega$, $R_{G(off)} = 9 \Omega$, $L_{\sigma} = 32 \text{ nH}$, $C_{\sigma} = 30 \text{ pF}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 50 \text{ A}$	0.85		mJ
			$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 25 \text{ A}$	0.38		
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 50 \text{ A}$	1.4		
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 25 \text{ A}$	0.69		

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表 3 (续) 特征值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Total switching energy	E_{ts}	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 9 \text{ } \Omega$, $R_{G(off)} = 9 \text{ } \Omega$, $L_{\sigma} = 32 \text{ nH}$, $C_{\sigma} = 30 \text{ pF}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 50 \text{ A}$	2.05		mJ
			$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 25 \text{ A}$	0.89		
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 50 \text{ A}$	3.31		
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 25 \text{ A}$	1.57		
Operating junction temperature	T_{vj}		-40		175	$^{\circ}\text{C}$

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}	$T_{vj} \geq 25 \text{ }^{\circ}\text{C}$		650	V
Diode forward current, limited by T_{vjmax}	I_F	limited by bondwire	$T_c = 25 \text{ }^{\circ}\text{C}$	80	A
			$T_c = 100 \text{ }^{\circ}\text{C}$	50	
Diode pulsed current, t_p limited by T_{vjmax} ¹⁾	I_{Fpulse}			150	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	$I_F = 50 \text{ A}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$	1.65	2	V
			$T_{vj} = 125 \text{ }^{\circ}\text{C}$	1.6		
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$	1.55		

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表 5 (续) 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode reverse recovery time	t_{rr}	$V_R = 400\text{ V}$	$T_{vj} = 25\text{ °C}$, $I_F = 50\text{ A}$, $-di_F/dt = 1720\text{ A/}\mu\text{s}$		93		ns
			$T_{vj} = 25\text{ °C}$, $I_F = 25\text{ A}$, $-di_F/dt = 2340\text{ A/}\mu\text{s}$		62		
			$T_{vj} = 175\text{ °C}$, $I_F = 50\text{ A}$, $-di_F/dt = 1680\text{ A/}\mu\text{s}$		140		
			$T_{vj} = 175\text{ °C}$, $I_F = 25\text{ A}$, $-di_F/dt = 2000\text{ A/}\mu\text{s}$		105		
Diode reverse recovery charge	Q_{rr}	$V_R = 400\text{ V}$	$T_{vj} = 25\text{ °C}$, $I_F = 50\text{ A}$, $-di_F/dt = 1720\text{ A/}\mu\text{s}$		1.05		μC
			$T_{vj} = 25\text{ °C}$, $I_F = 25\text{ A}$, $-di_F/dt = 2340\text{ A/}\mu\text{s}$		0.74		
			$T_{vj} = 175\text{ °C}$, $I_F = 50\text{ A}$, $-di_F/dt = 1680\text{ A/}\mu\text{s}$		2.7		
			$T_{vj} = 175\text{ °C}$, $I_F = 25\text{ A}$, $-di_F/dt = 2000\text{ A/}\mu\text{s}$		1.95		
Diode peak reverse recovery current	I_{rrm}	$V_R = 400\text{ V}$	$T_{vj} = 25\text{ °C}$, $I_F = 50\text{ A}$, $-di_F/dt = 1720\text{ A/}\mu\text{s}$		21		A
			$T_{vj} = 25\text{ °C}$, $I_F = 25\text{ A}$, $-di_F/dt = 2340\text{ A/}\mu\text{s}$		25		
			$T_{vj} = 175\text{ °C}$, $I_F = 50\text{ A}$, $-di_F/dt = 1680\text{ A/}\mu\text{s}$		33		
			$T_{vj} = 175\text{ °C}$, $I_F = 25\text{ A}$, $-di_F/dt = 2000\text{ A/}\mu\text{s}$		34		

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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	$V_R = 400\text{ V}$	$T_{vj} = 25\text{ °C},$ $I_F = 50\text{ A},$ $-di_F/dt = 1720\text{ A}/\mu\text{s}$		260		$\text{A}/\mu\text{s}$
			$T_{vj} = 25\text{ °C},$ $I_F = 25\text{ A},$ $-di_F/dt = 2340\text{ A}/\mu\text{s}$		490		
			$T_{vj} = 175\text{ °C},$ $I_F = 50\text{ A},$ $-di_F/dt = 1680\text{ A}/\mu\text{s}$		290		
			$T_{vj} = 175\text{ °C},$ $I_F = 25\text{ A},$ $-di_F/dt = 2000\text{ A}/\mu\text{s}$		415		
Operating junction temperature	T_{vj}			-40		175	$^{\circ}\text{C}$

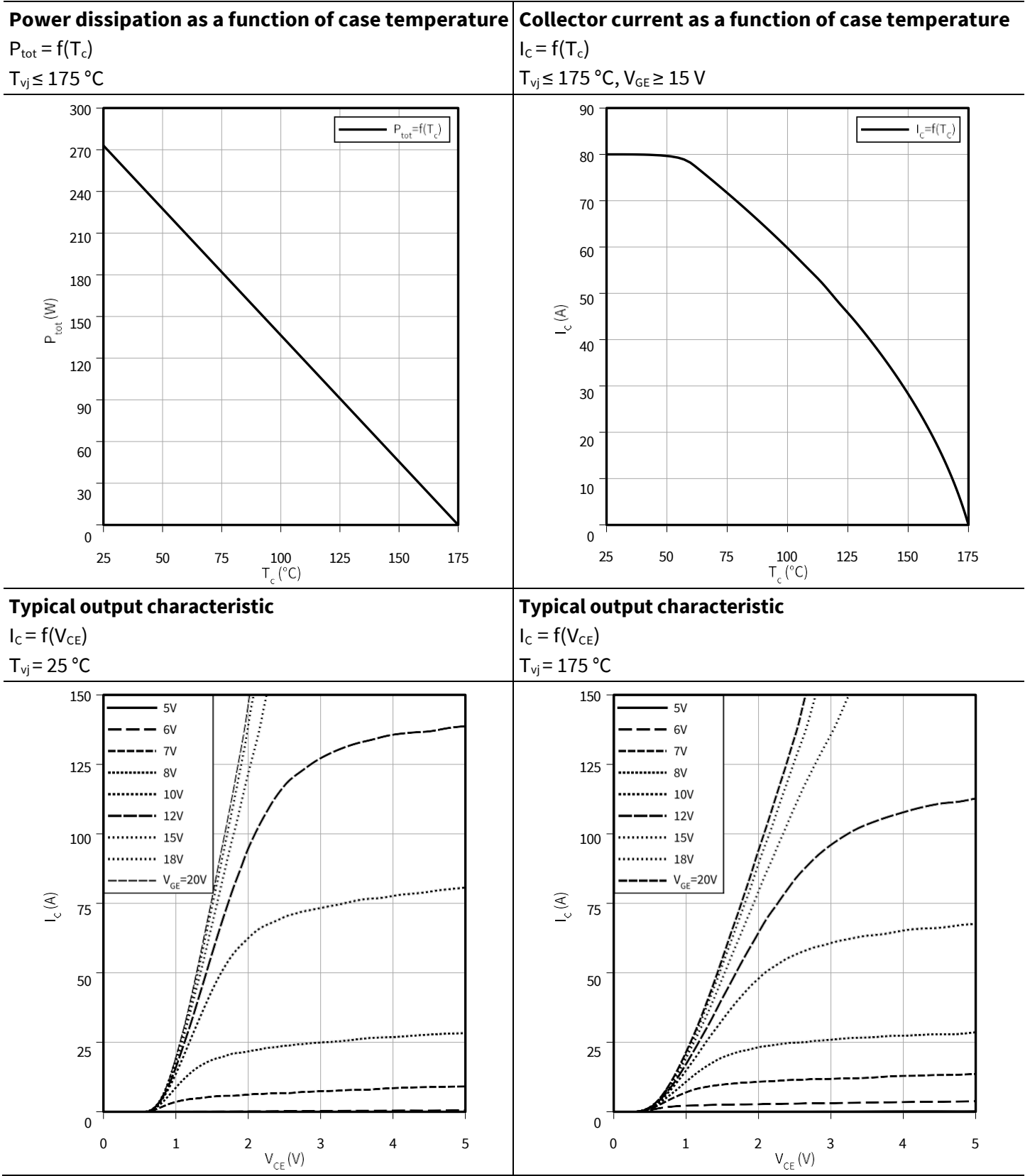
注意：为了获得最佳的使用寿命和可靠性，英飞凌建议工作条件不超过本数据手册中所述最大额定值的80%。

电气特性， $T_{vj} = 25^{\circ}\text{C}$ ，除非另有说明。

动态测试电路， L_{σ} 、 C_{σ} 来自图E。能量损失包括“拖尾”和二极管反向恢复。

4 特征图

4 特性图

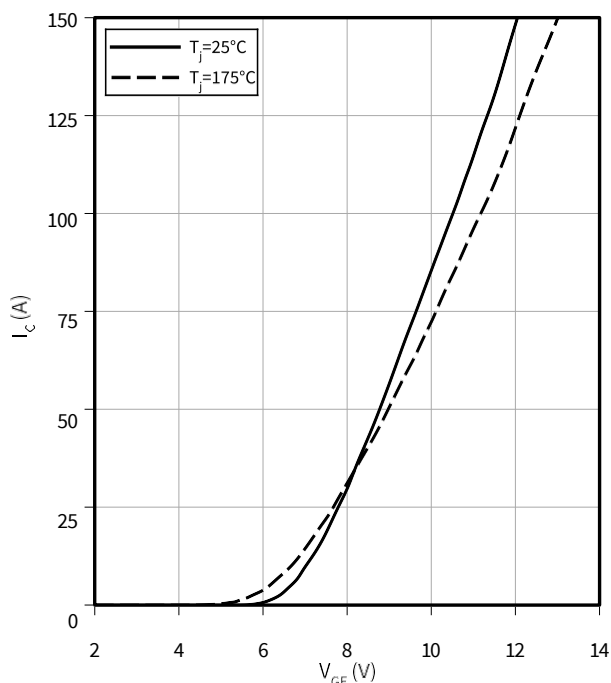


4 特征图

Typical transfer characteristic

$$I_C = f(V_{GE})$$

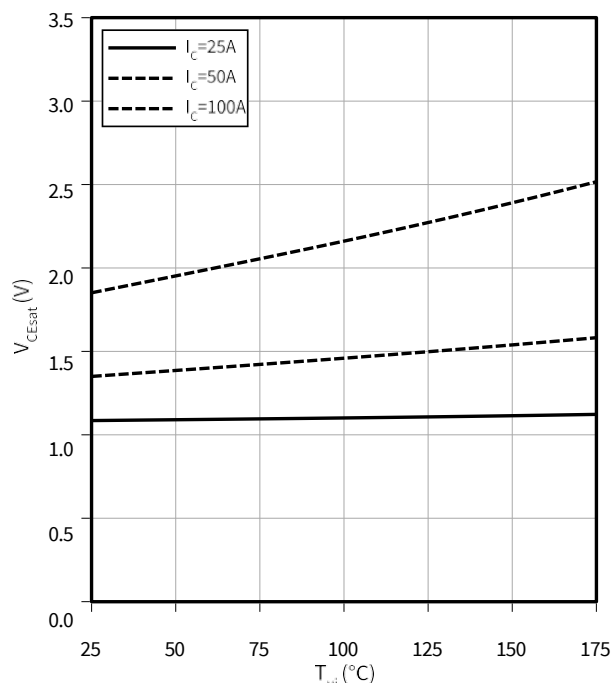
$$V_{CE} = 20 \text{ V}$$



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

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

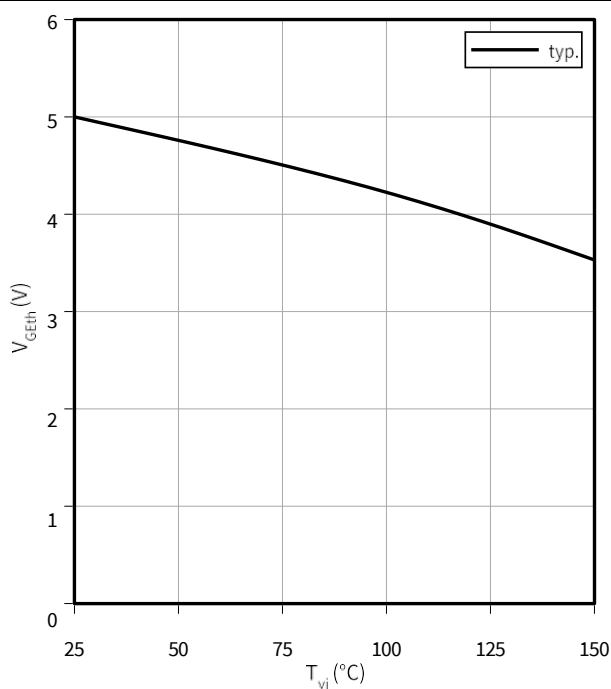
$$V_{GE} = 15 \text{ V}$$



Gate-emitter threshold voltage as a function of junction temperature

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

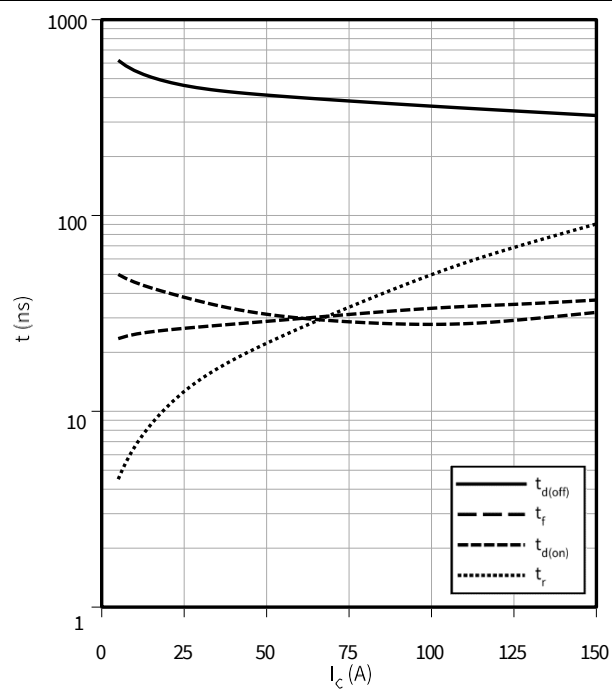
$$I_C = 0.5 \text{ mA}$$



Typical switching times as a function of collector current

$$t = f(I_C)$$

$$V_{CC} = 400 \text{ V}, T_{vj} = 175^\circ\text{C}, V_{GE} = 0/15 \text{ V}, R_G = 9 \Omega$$

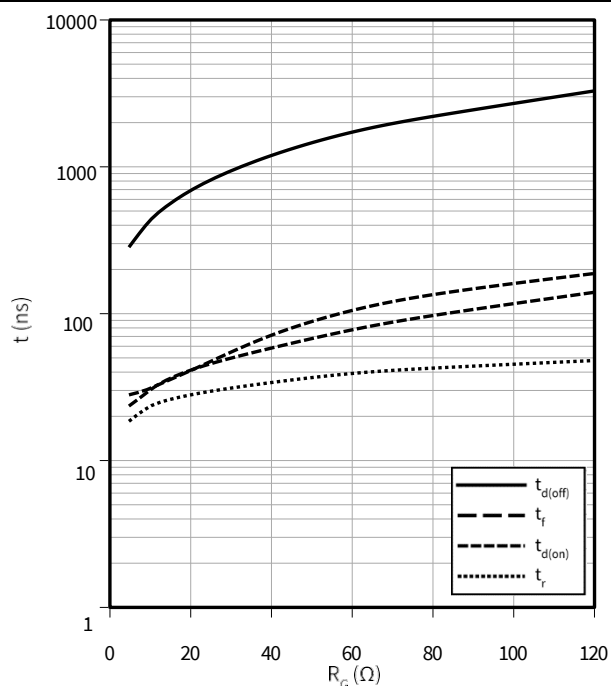


4 特征图

Typical switching times as a function of gate resistor

$$t = f(R_G)$$

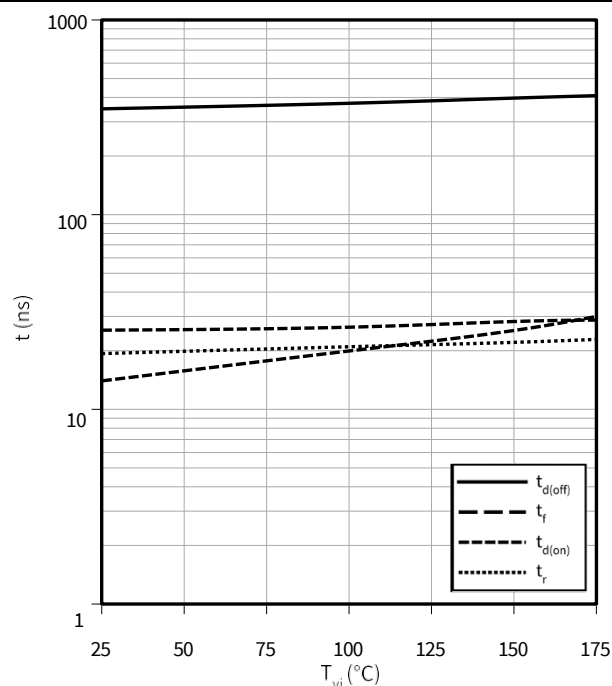
$I_C = 50 \text{ A}$, $V_{CC} = 400 \text{ V}$, $T_{vj} = 175 \text{ }^\circ\text{C}$, $V_{GE} = 0/15 \text{ V}$



Typical switching times as a function of junction temperature

$$t = f(T_{vj})$$

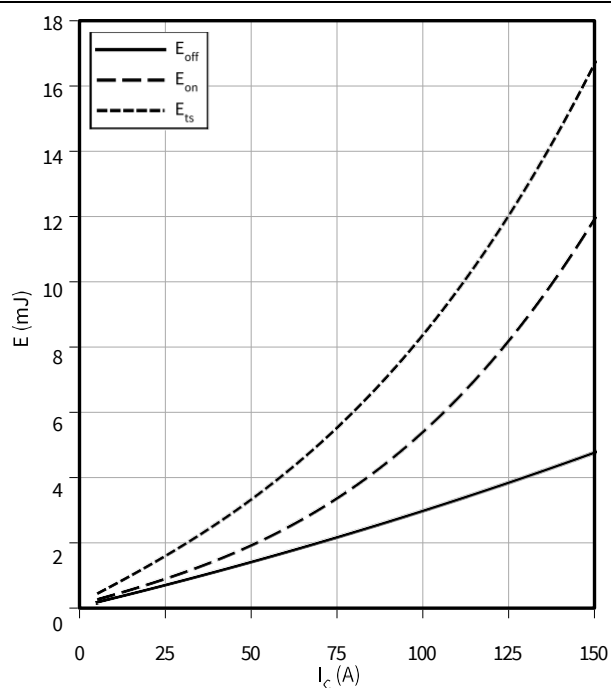
$I_C = 50 \text{ A}$, $V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 9 \text{ } \Omega$



Typical switching energy losses as a function of collector current

$$E = f(I_C)$$

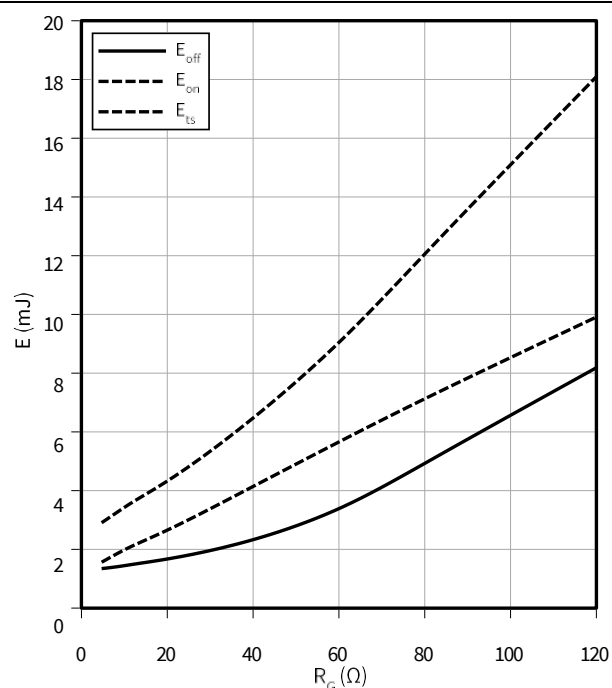
$V_{CC} = 400 \text{ V}$, $T_{vj} = 175 \text{ }^\circ\text{C}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 9 \text{ } \Omega$



Typical switching energy losses as a function of gate resistor

$$E = f(R_G)$$

$I_C = 50 \text{ A}$, $V_{CC} = 400 \text{ V}$, $T_{vj} = 175 \text{ }^\circ\text{C}$, $V_{GE} = 0/15 \text{ V}$

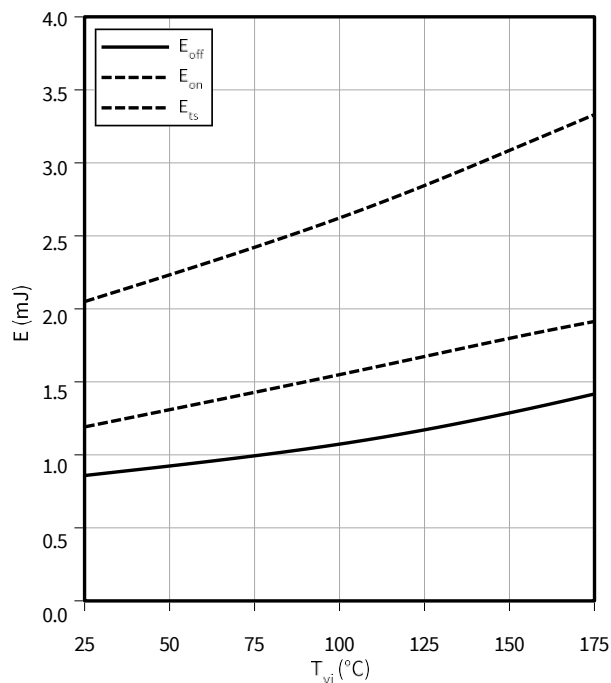


4 特征图

Typical switching energy losses as a function of junction temperature

$$E = f(T_{vj})$$

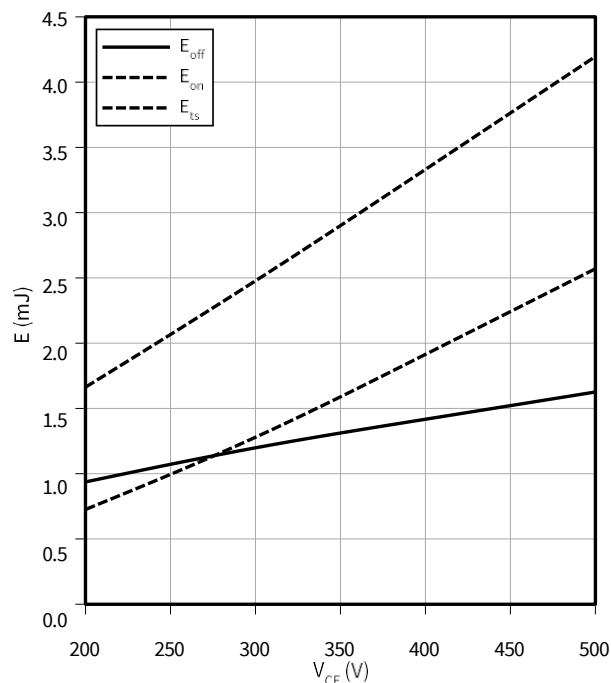
$I_C = 50\text{ A}$, $V_{CC} = 400\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_G = 9\ \Omega$



Typical switching energy losses as a function of collector emitter voltage

$$E = f(V_{CE})$$

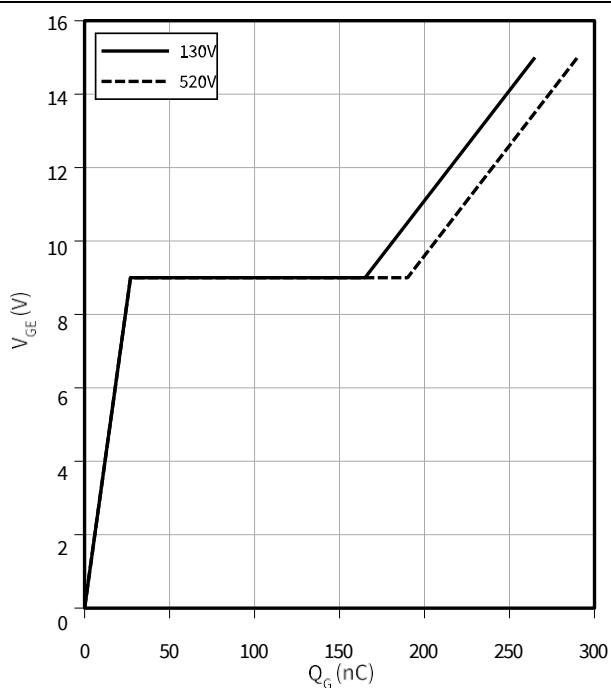
$I_C = 50\text{ A}$, $T_{vj} = 175\text{ °C}$, $V_{GE} = 0/15\text{ V}$, $R_G = 9\ \Omega$



Typical gate charge

$$V_{GE} = f(Q_G)$$

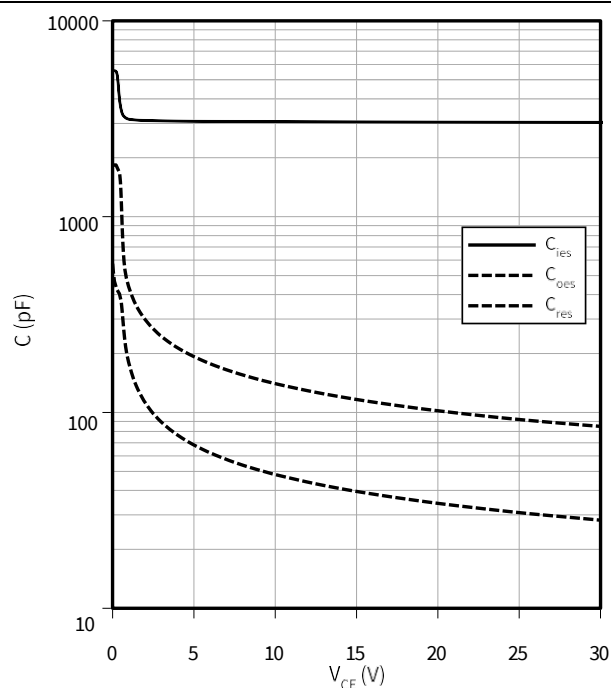
$I_C = 50\text{ A}$



Typical capacitance as a function of collector-emitter voltage

$$C = f(V_{CE})$$

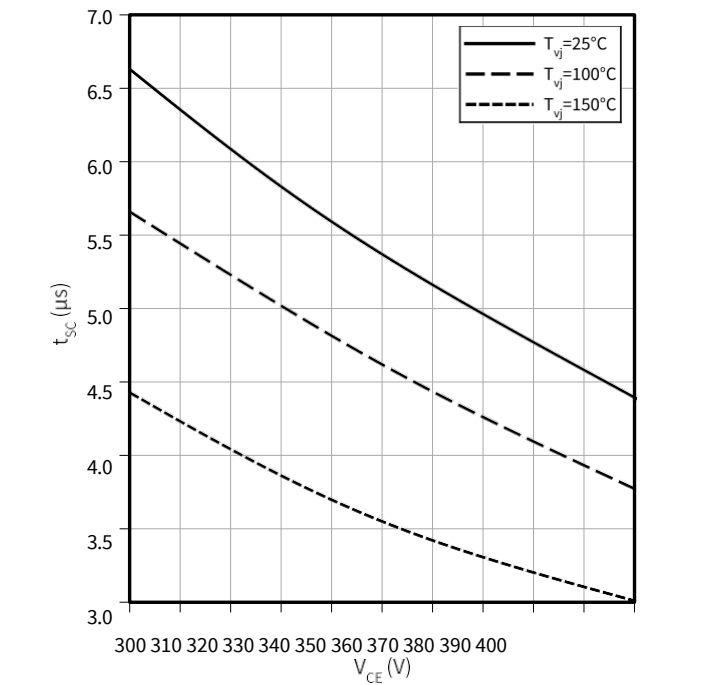
$f = 1000\text{ kHz}$, $V_{GE} = 0\text{ V}$



4 特征图

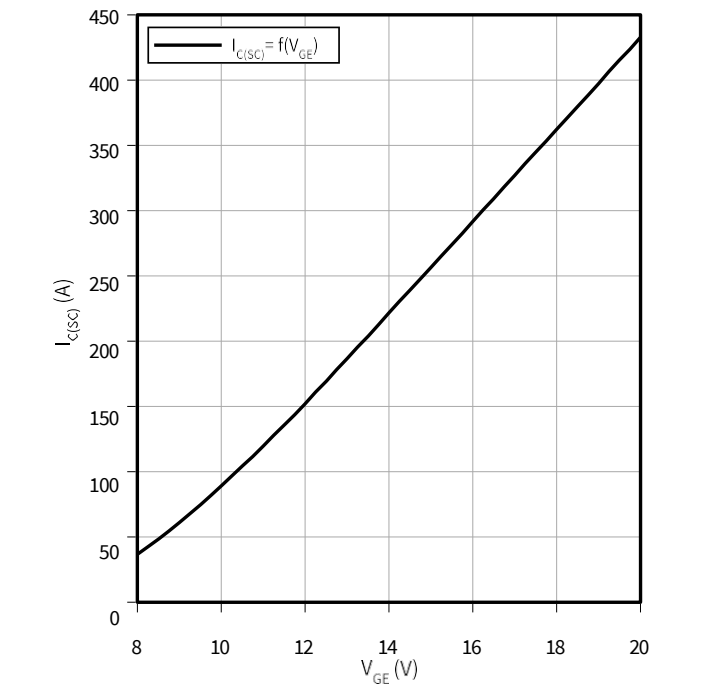
Typical short circuit safe operating range as a function of collector-emitter voltage

$t_{SC} = f(V_{CE})$



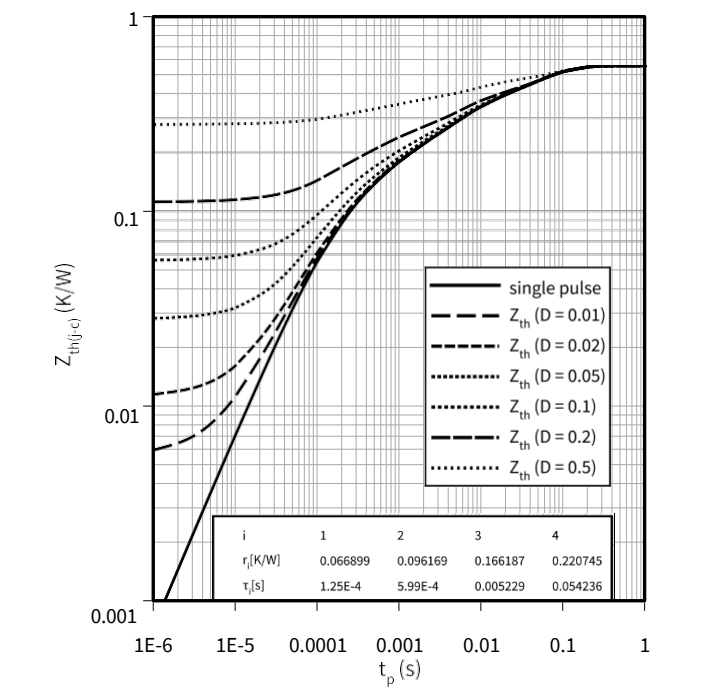
Typical short circuit collector current as a function of gate-emitter voltage

$I_{C(SC)} = f(V_{GE})$
 $V_{CE} \leq 400\text{ V}, T_{vj} = 150\text{ °C}$



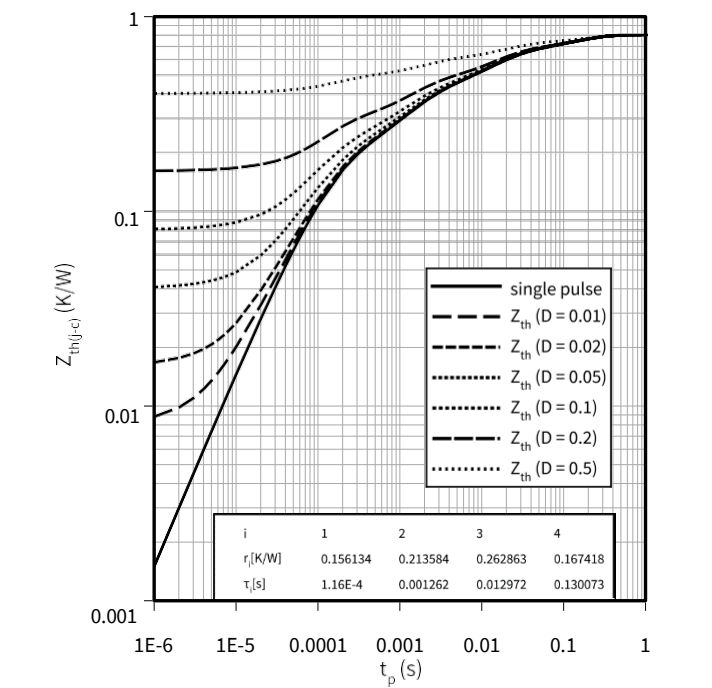
IGBT transient thermal impedance as a function of pulse width

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



Diode transient thermal impedance as a function of pulse width

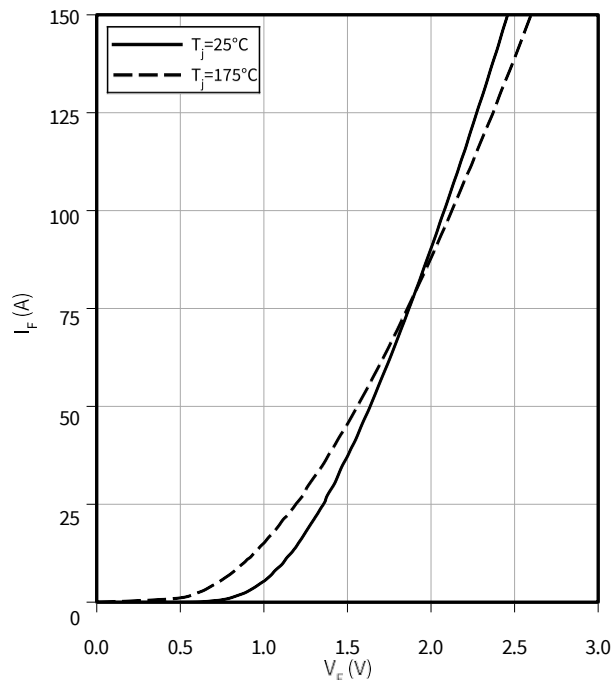
$Z_{th(j-c)} = f(t_p)$
 $D = t_p/T$



4 特征图

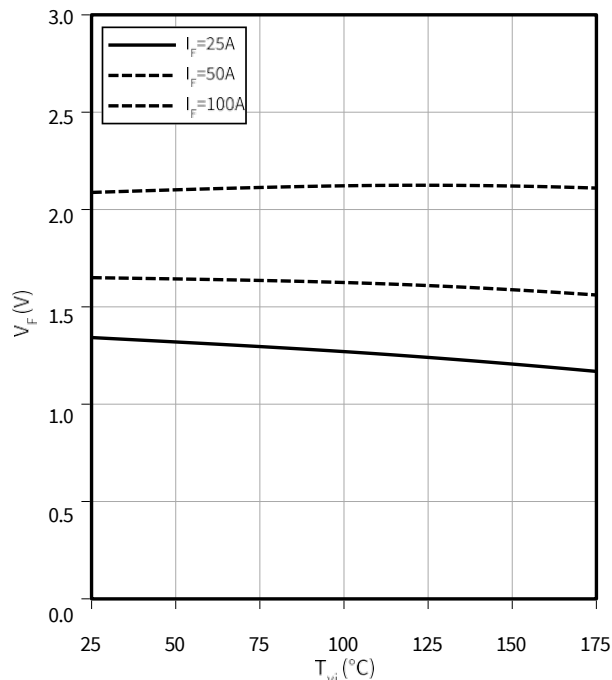
Typical diode forward current as a function of forward voltage

$$I_F = f(V_F)$$



Typical diode forward voltage as a function of junction temperature

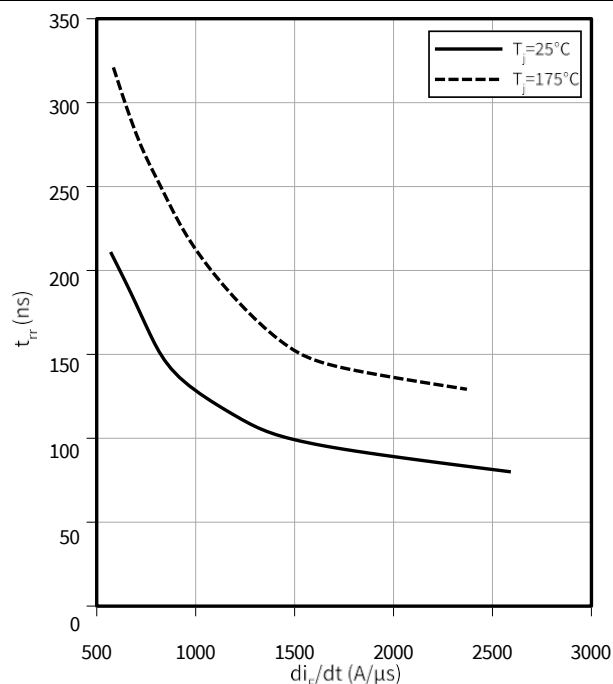
$$V_F = f(T_{vj})$$



Typical reverse recovery time as a function of diode current slope

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

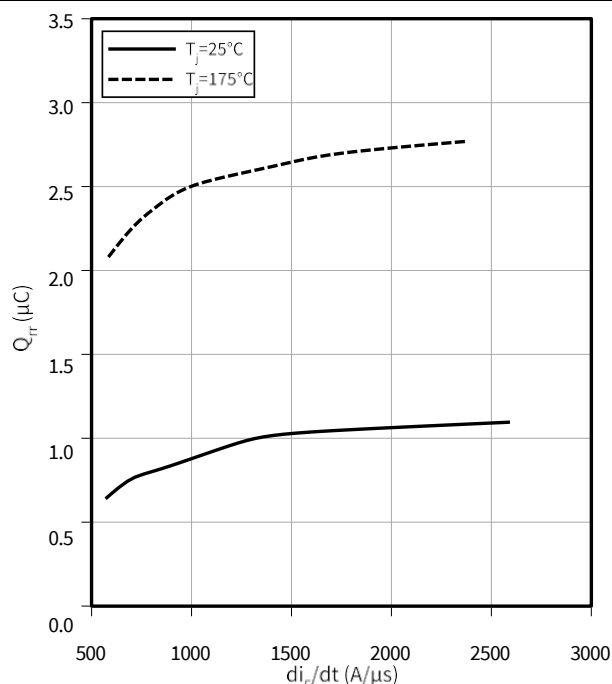
$$V_R = 400\text{ V}, I_F = 50\text{ A}$$



Typical reverse recovery charge as a function of diode current slope

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

$$V_R = 400\text{ V}, I_F = 50\text{ A}$$

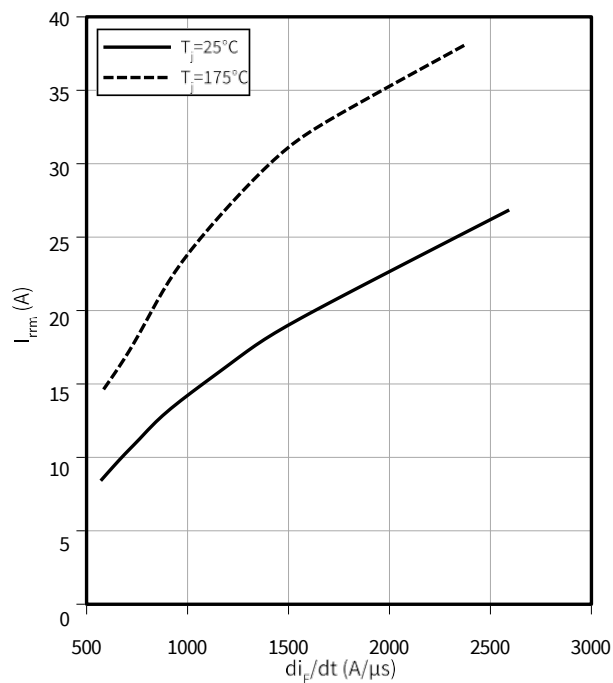


4 特征图

Typical reverse recovery current as a function of diode current slope

$$I_{rrm} = f(di_F/dt)$$

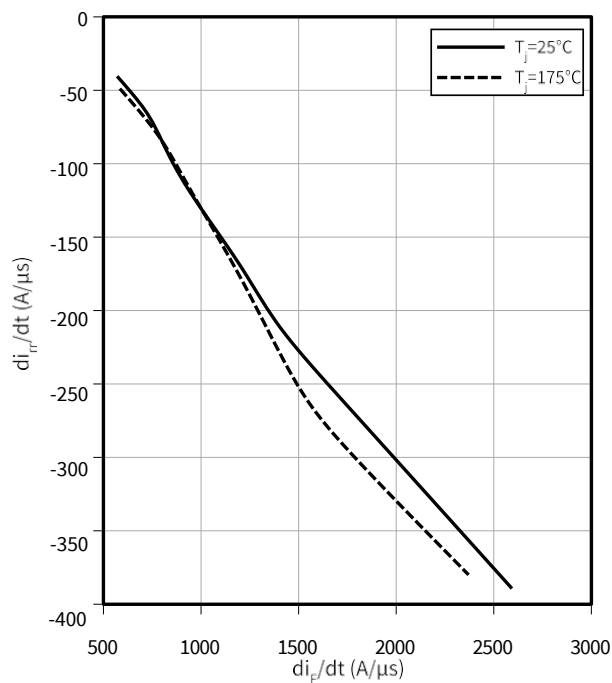
$V_R = 400 \text{ V}$, $I_F = 50 \text{ A}$



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

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

$V_R = 400 \text{ V}$, $I_F = 50 \text{ A}$



5 封装外形

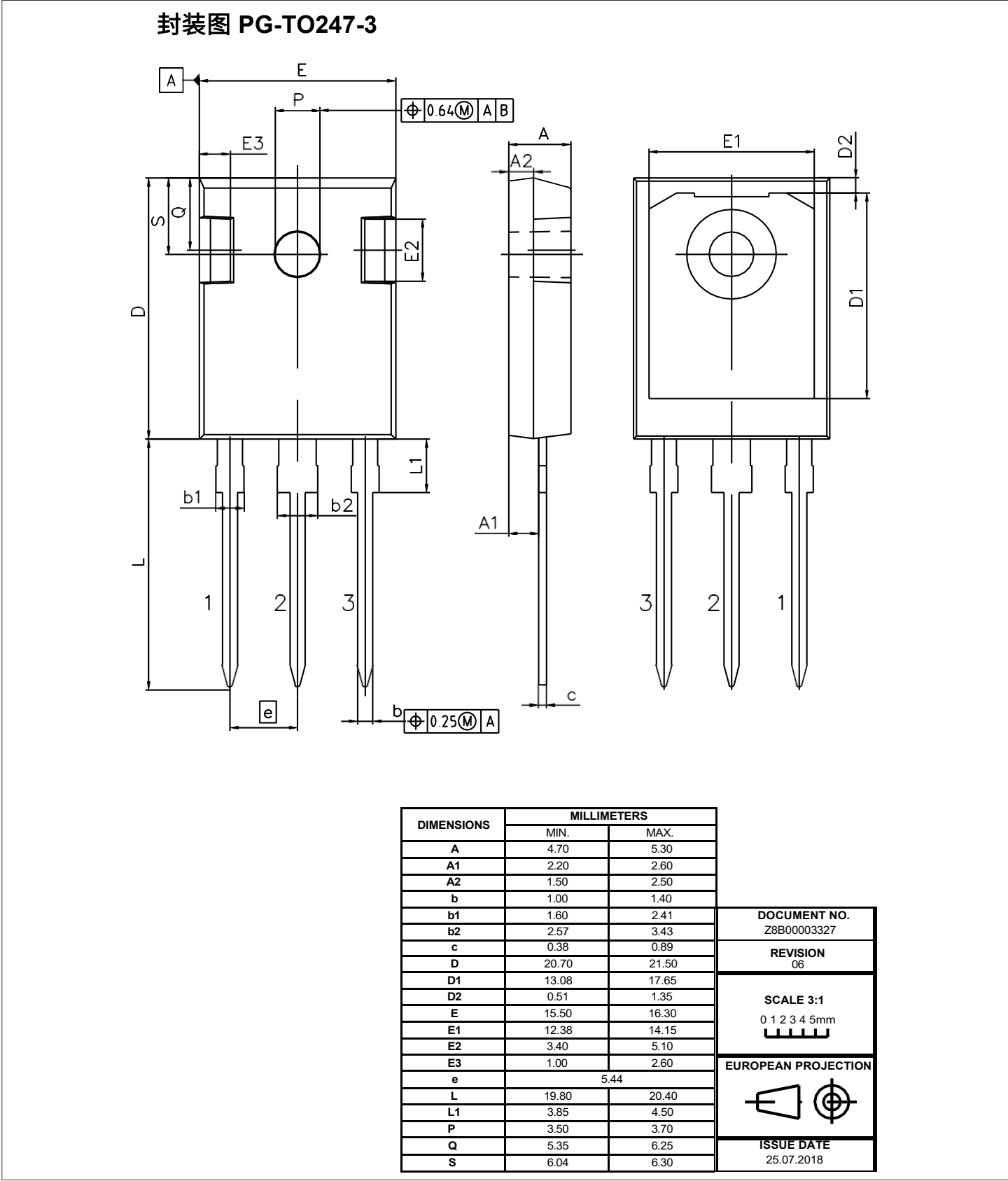


图 1

6 测试条件

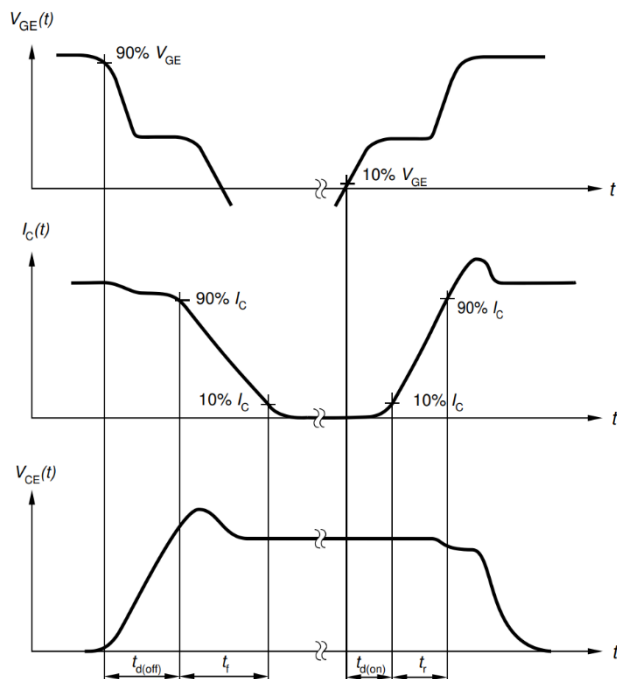


Figure A. Definition of switching times

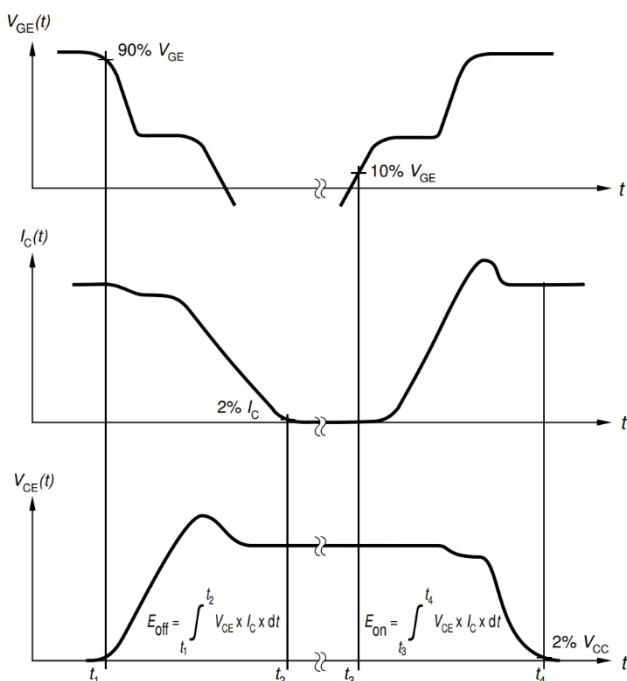


Figure B. Definition of switching losses

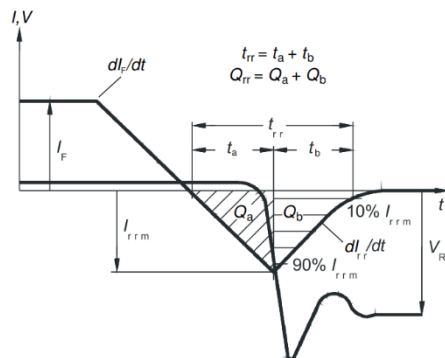


Figure C. Definition of diode switching characteristics

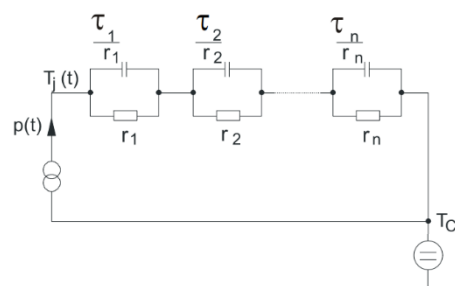


Figure D. Thermal equivalent circuit

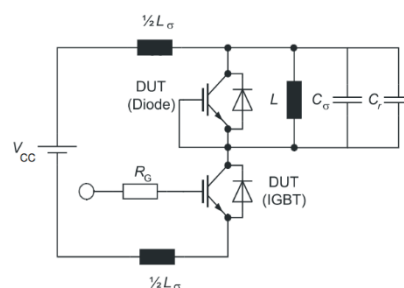


Figure E. **Dynamic test circuit**
Parasitic inductance L_{σ} ,
parasitic capacitor C_{σ} ,
relief capacitor C_r ,
(only for ZVT switching)

修订记录

Document revision	Date of release	Description of changes
V0.1	2019-10-25	Target Data Sheet
V1.1	2020-04-20	Preliminary data sheet
V2.1	2020-05-12	Final data sheet
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
1.00	2021-06-29	Change of potential applications and new diagram added (t_{sc} as function of V_{CE})
1.10	2023-01-26	Feature list corrections Editorial changes



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版本 2025-09-16

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