

最终数据手册

英飞凌IKZA50N65EH7高速、低饱和电压 650 V TRENCHSTOP™ IGBT7 技术与快速软恢复发射极控制 7 二极管共同封装

特性

- $V_{CE} = 650\text{ V}$
- $I_C = 50\text{ A}$
- 低开关损耗
- 极低的集电极-发射极饱和电压 V_{CEsat}
- 非常柔软、快速恢复的反并联二极管
- 平滑切换
- 防潮性
- 针对硬开关、两电平和三电平拓扑进行了优化
- 完整的产品品类和 PSpice 模型：<http://www.infineon.com/igbt/>



潜在应用

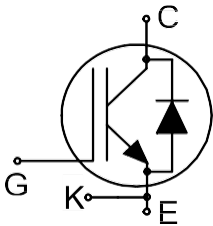
- 工业级不间断电源（UPS）
- 电动汽车充电桩
- 组串式逆变器
- 焊接

- Lead-free
- Green
- Halogen-free
- RoHS

产品验证

- 符合JEDEC47/20/22相关测试的工业应用要求

描述



Type	Package	Marking
IKZA50N65EH7	PG-TO247-4-STD-NT3.7	K50EEH7



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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		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 processes: 3			0.6	Nm
Thermal resistance, junction-ambient	$R_{th(j-a)}$				40	K/W
IGBT thermal resistance, junction-case	$R_{th(j-c)}$			0.46	0.6	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$			0.61	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
			$T_c = 100\text{ °C}$	76	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			200	A
Turn-off safe operating area		$V_{CE} \leq 650\text{ V}$, $t_p \leq 1\text{ }\mu\text{s}$, $T_{vj} \leq 175\text{ °C}$		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}		$T_c = 25\text{ °C}$	250	W
			$T_c = 100\text{ °C}$	124	

表 3 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 50\text{ A}$, $V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$		1.4	1.65	V
			$T_{vj} = 175\text{ °C}$		1.6		
Gate-emitter threshold voltage	V_{GEth}	$I_C = 0.44\text{ mA}$, $V_{CE} = V_{GE}$		2.9	3.85	4.8	V
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 650\text{ V}$, $V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$			15	μA
			$T_{vj} = 175\text{ °C}$		1500		
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\text{ V}$, $V_{GE} = 20\text{ V}$				100	nA
Transconductance	g_{fs}	$I_C = 50\text{ A}$, $V_{CE} = 20\text{ V}$			79		S
Input capacitance	C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 100\text{ kHz}$			2591		pF
Output capacitance	C_{oes}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 100\text{ kHz}$			87.1		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 100\text{ kHz}$			11.4		pF
Gate charge	Q_G	$V_{CC} = 520\text{ V}$, $I_C = 50\text{ A}$, $V_{GE} = 15\text{ V}$			103		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 400\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{G(on)} = 10\text{ }\Omega$, $R_{G(off)} = 10\text{ }\Omega$	$T_{vj} = 25\text{ °C}$, $I_C = 50\text{ A}$		15		ns
			$T_{vj} = 175\text{ °C}$, $I_C = 50\text{ A}$		14		
Rise time (inductive load)	t_r	$V_{CC} = 400\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{G(on)} = 10\text{ }\Omega$, $R_{G(off)} = 10\text{ }\Omega$	$T_{vj} = 25\text{ °C}$, $I_C = 50\text{ A}$		9		ns
			$T_{vj} = 175\text{ °C}$, $I_C = 50\text{ A}$		12		
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 400\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{G(on)} = 10\text{ }\Omega$, $R_{G(off)} = 10\text{ }\Omega$	$T_{vj} = 25\text{ °C}$, $I_C = 50\text{ A}$		142		ns
			$T_{vj} = 175\text{ °C}$, $I_C = 50\text{ A}$		175		
Fall time (inductive load)	t_f	$V_{CC} = 400\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{G(on)} = 10\text{ }\Omega$, $R_{G(off)} = 10\text{ }\Omega$	$T_{vj} = 25\text{ °C}$, $I_C = 50\text{ A}$		14		ns
			$T_{vj} = 175\text{ °C}$, $I_C = 50\text{ A}$		18		
Turn-on energy	E_{on}	$V_{CC} = 400\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{G(on)} = 10\text{ }\Omega$, $R_{G(off)} = 10\text{ }\Omega$	$T_{vj} = 25\text{ °C}$, $I_C = 50\text{ A}$		0.44		mJ
			$T_{vj} = 175\text{ °C}$, $I_C = 50\text{ A}$		0.79		

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表 3 (续) 特征值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-off energy	E_{off}	$V_{CC} = 400\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{G(on)} = 10\ \Omega$, $R_{G(off)} = 10\ \Omega$	$T_{vj} = 25\text{ }^{\circ}\text{C}$, $I_C = 50\text{ A}$	0.49		mJ
			$T_{vj} = 175\text{ }^{\circ}\text{C}$, $I_C = 50\text{ A}$	0.97		
Total switching energy	E_{ts}	$V_{CC} = 400\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{G(on)} = 10\ \Omega$, $R_{G(off)} = 10\ \Omega$	$T_{vj} = 25\text{ }^{\circ}\text{C}$, $I_C = 50\text{ A}$	0.93		mJ
			$T_{vj} = 175\text{ }^{\circ}\text{C}$, $I_C = 50\text{ A}$	1.76		
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
Diode forward current, limited by T_{vjmax}	I_F	limited by bondwire	$T_c = 25\text{ }^{\circ}\text{C}$	80	A
			$T_c = 100\text{ }^{\circ}\text{C}$	59	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}			200	A
Power dissipation	P_{tot}		$T_c = 25\text{ }^{\circ}\text{C}$	186	W
			$T_c = 100\text{ }^{\circ}\text{C}$	94	

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
			$T_{vj} = 175\text{ }^{\circ}\text{C}$	1.55		
Diode reverse recovery time	t_{rr}	$V_R = 400\text{ V}$, $R_{G(on)} = 10\ \Omega$	$T_{vj} = 25\text{ }^{\circ}\text{C}$, $I_F = 50\text{ A}$	54.6		ns
			$T_{vj} = 175\text{ }^{\circ}\text{C}$, $I_F = 50\text{ A}$	86.4		
Diode reverse recovery charge	Q_{rr}	$V_R = 400\text{ V}$, $R_{G(on)} = 10\ \Omega$	$T_{vj} = 25\text{ }^{\circ}\text{C}$, $I_F = 50\text{ A}$	1.28		μC
			$T_{vj} = 175\text{ }^{\circ}\text{C}$, $I_F = 50\text{ A}$	3.4		

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表 5 (续) 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode peak reverse recovery current	I_{rrm}	$V_R = 400\text{ V}, R_{G(on)} = 10\ \Omega$	$T_{vj} = 25\text{ °C}, I_F = 50\text{ A}$		43.3		A
			$T_{vj} = 175\text{ °C}, I_F = 50\text{ A}$		75.9		
Diode peak rate of fall of reverse recovery current	di_{rr}/dt	$V_R = 400\text{ V}, R_{G(on)} = 10\ \Omega$	$T_{vj} = 25\text{ °C}, I_F = 50\text{ A}$		-1240		A/ μs
			$T_{vj} = 175\text{ °C}, I_F = 50\text{ A}$		-1670		
Reverse recovery energy	E_{rec}	$V_R = 400\text{ V}, R_{G(on)} = 10\ \Omega$	$T_{vj} = 25\text{ °C}, I_F = 50\text{ A}$		0.36		mJ
			$T_{vj} = 175\text{ °C}, I_F = 50\text{ A}$		0.97		
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 $L_\sigma = 8\text{ nH}$ ，寄生电容 $C_\sigma = 30\text{ pF}$ ，来自图E。能量损耗包括“拖尾”和二极管反向恢复。

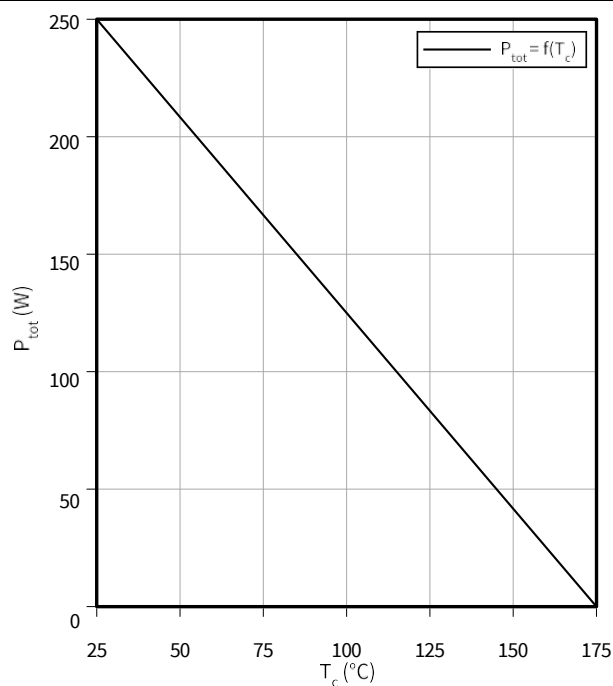
4 特征图

4 特性图

Power dissipation as a function of case temperature

$$P_{\text{tot}} = f(T_c)$$

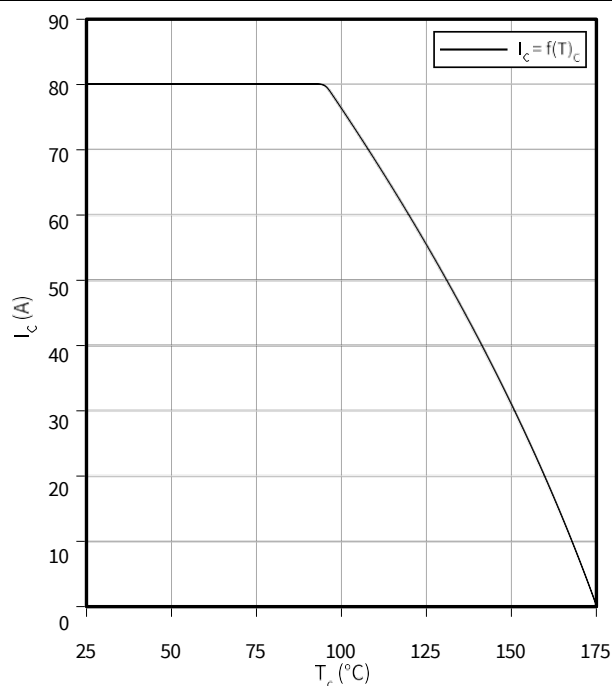
$$T_{vj} \leq 175^\circ\text{C}$$



Collector current as a function of case temperature

$$I_c = f(T_c)$$

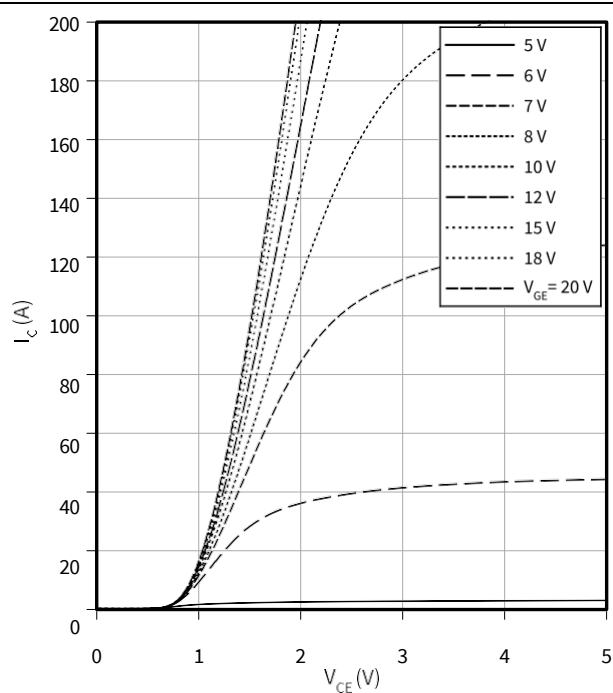
$$T_{vj} \leq 175^\circ\text{C}, V_{GE} \geq 15\text{ V}$$



Typical output characteristic

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

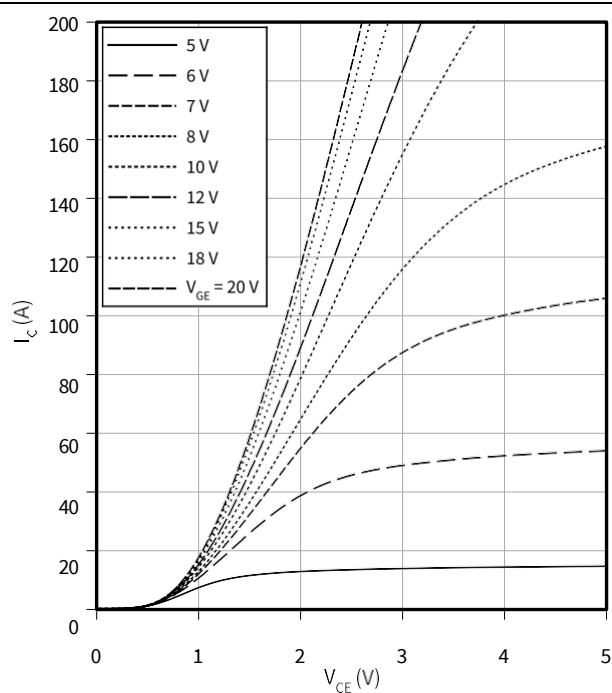
$$T_{vj} = 25^\circ\text{C}$$



Typical output characteristic

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

$$T_{vj} = 175^\circ\text{C}$$

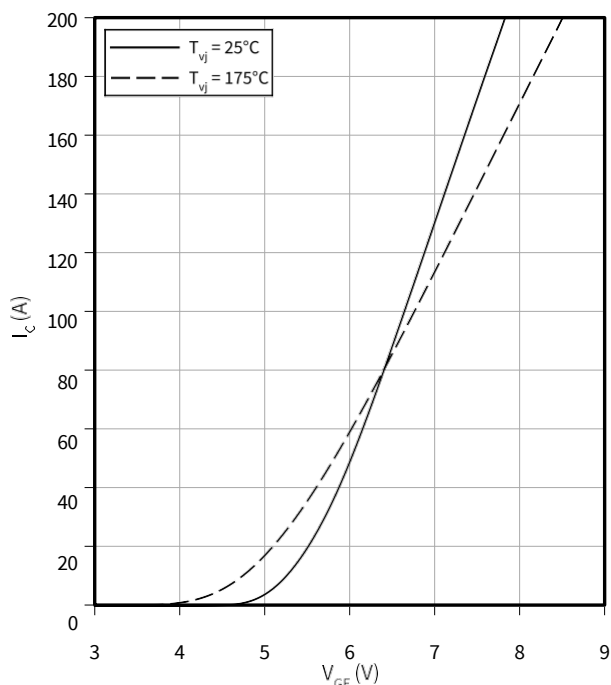


4 特征图

Typical transfer characteristic

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

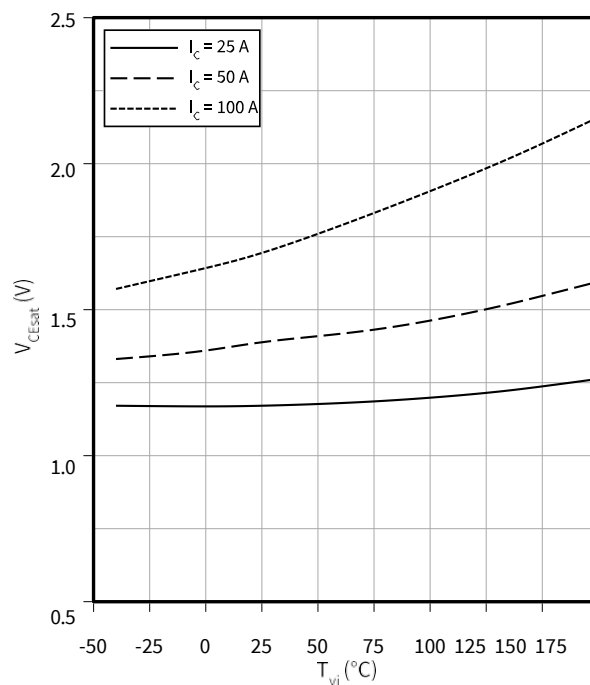
$$V_{CE} = 20 \text{ V}$$



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

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

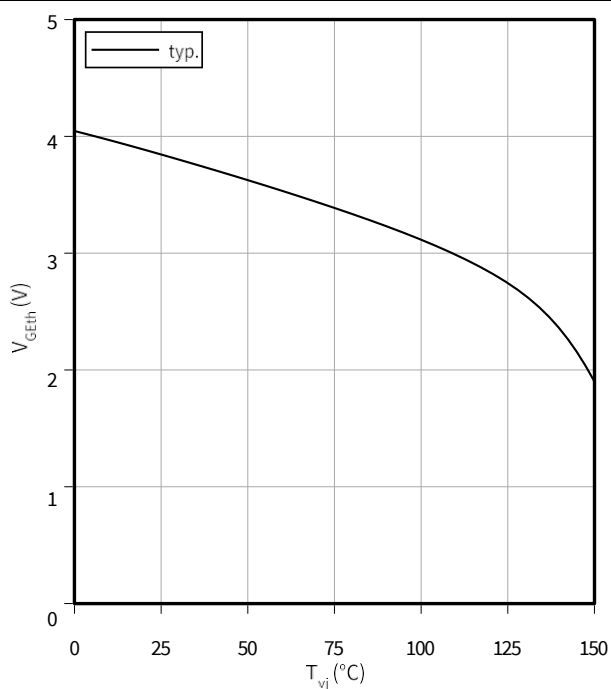
$$V_{GE} = 15 \text{ V}$$



Gate-emitter threshold voltage as a function of junction temperature

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

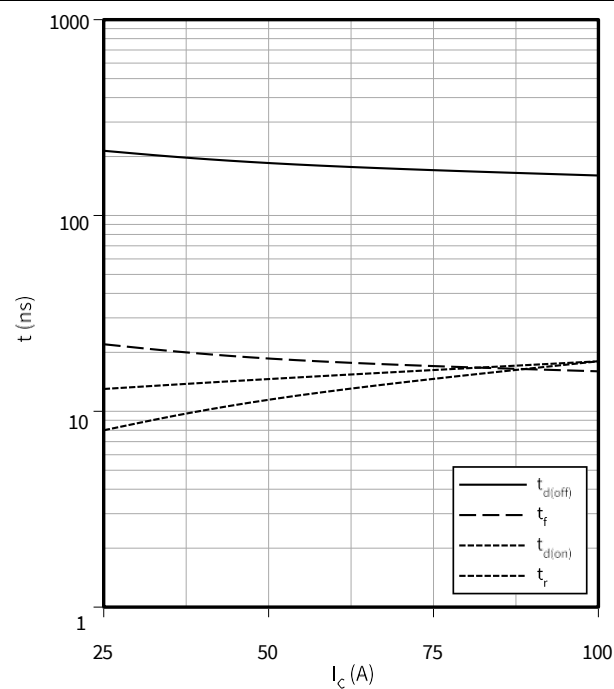
$$I_C = 0.44 \text{ mA}$$



Typical switching times as a function of collector current

$$t = f(I_C)$$

$$V_{CC} = 400 \text{ V}, T_{vj} = 175^\circ\text{C}, V_{GE} = 0/15 \text{ V}, R_G = 10 \Omega$$

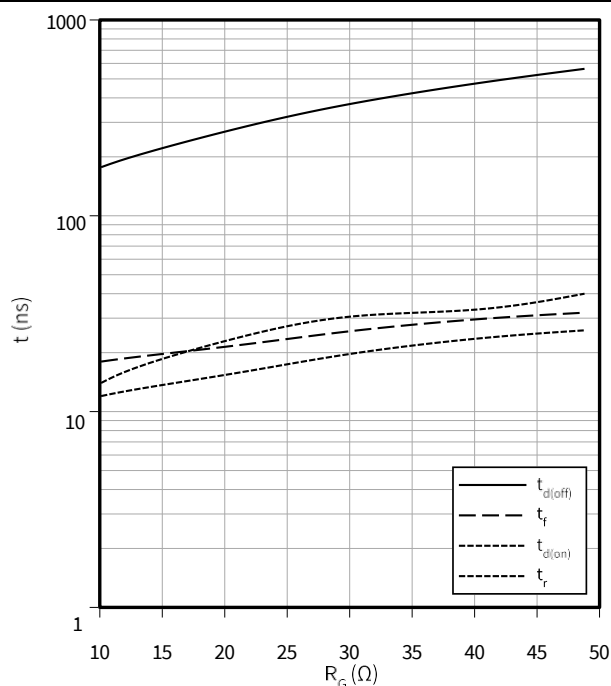


4 特征图

Typical switching times as a function of gate resistor

$$t = f(R_G)$$

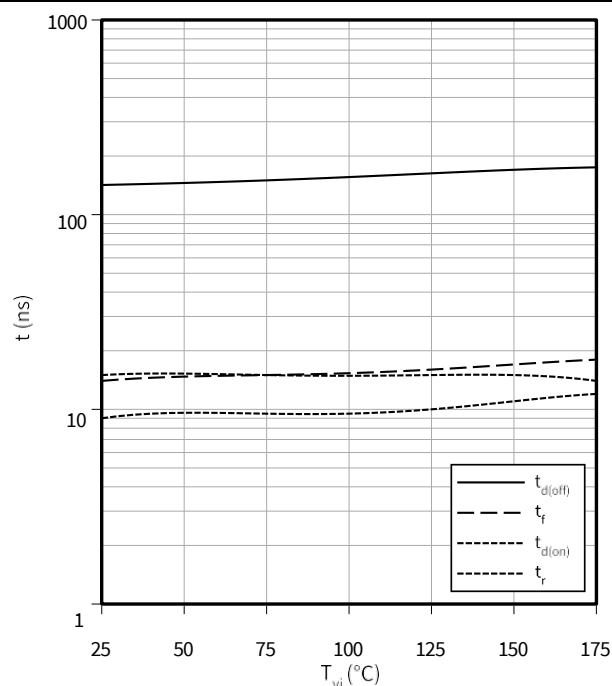
$I_C = 50 \text{ A}$, $V_{CC} = 400 \text{ V}$, $T_{vj} = 175 \text{ °C}$, $V_{GE} = 0/15 \text{ V}$



Typical switching times as a function of junction temperature

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

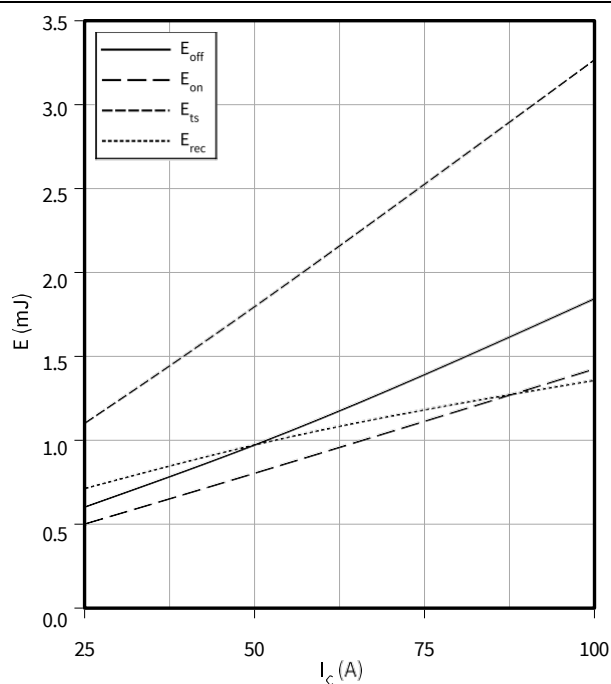
$I_C = 50 \text{ A}$, $V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 10 \text{ Ω}$



Typical switching energy losses as a function of collector current

$$E = f(I_C)$$

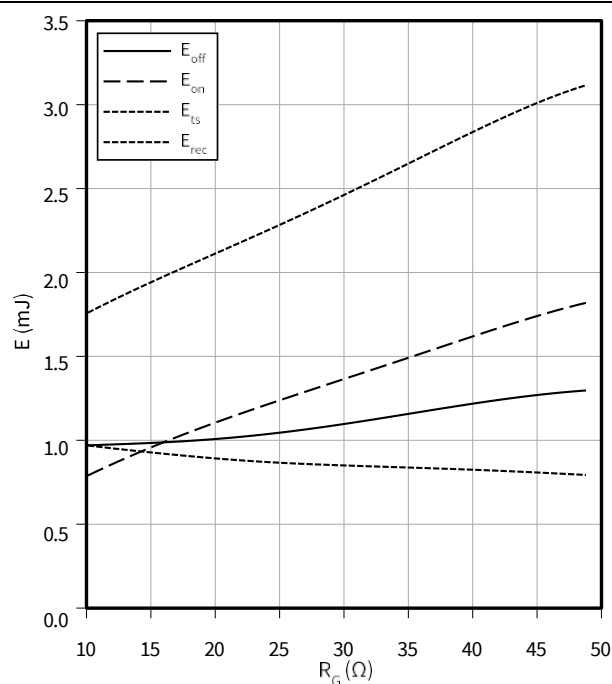
$V_{CC} = 400 \text{ V}$, $T_{vj} = 175 \text{ °C}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 10 \text{ Ω}$



Typical switching energy losses as a function of gate resistor

$$E = f(R_G)$$

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

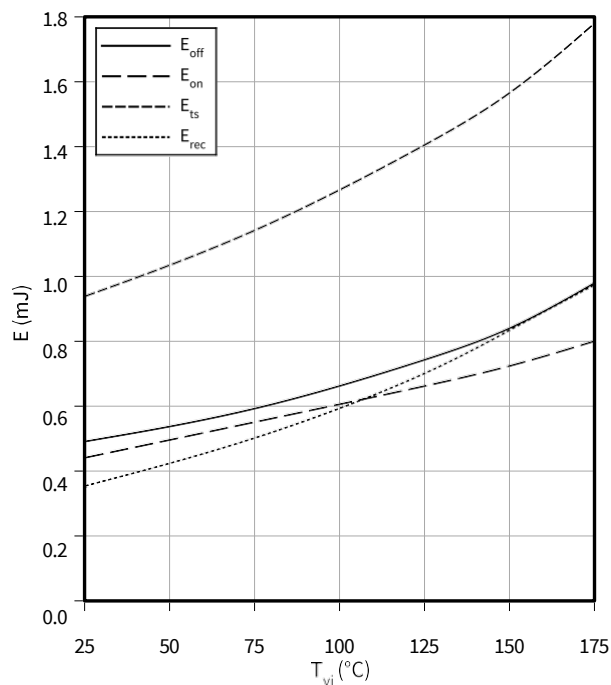


4 特征图

Typical switching energy losses as a function of junction temperature

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

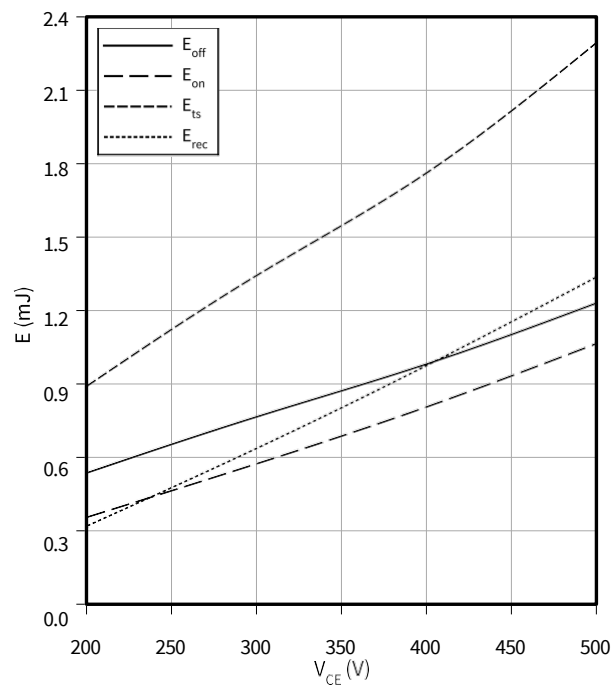
$I_C = 50 \text{ A}$, $V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 10 \Omega$



Typical switching energy losses as a function of collector emitter voltage

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

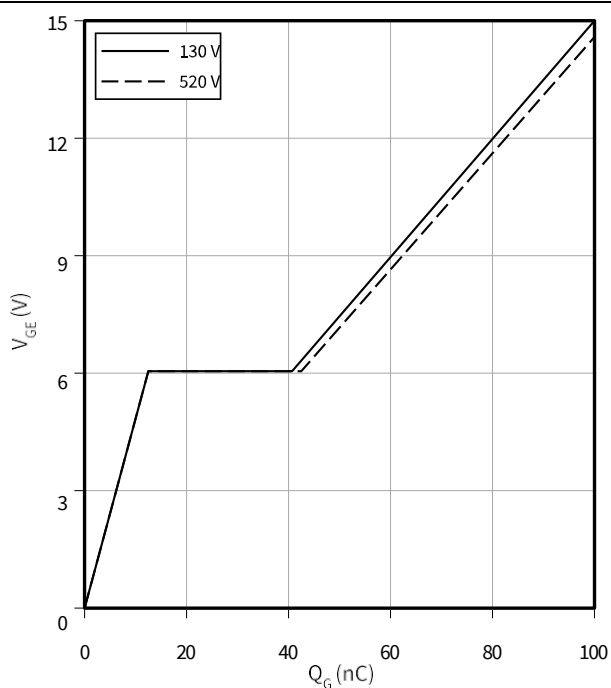
$I_C = 50 \text{ A}$, $T_{vj} = 175 \text{ °C}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 10 \Omega$



Typical gate charge

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

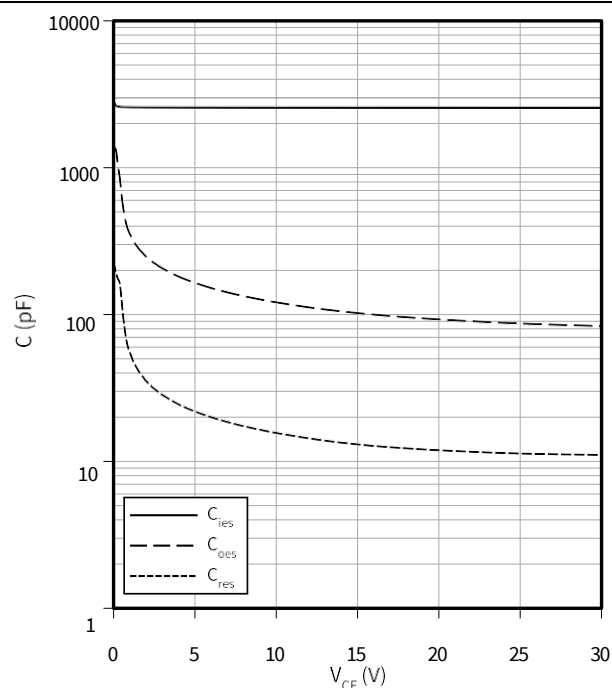
$I_C = 50 \text{ A}$



Typical capacitance as a function of collector-emitter voltage

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

$f = 100 \text{ kHz}$, $V_{GE} = 0 \text{ V}$

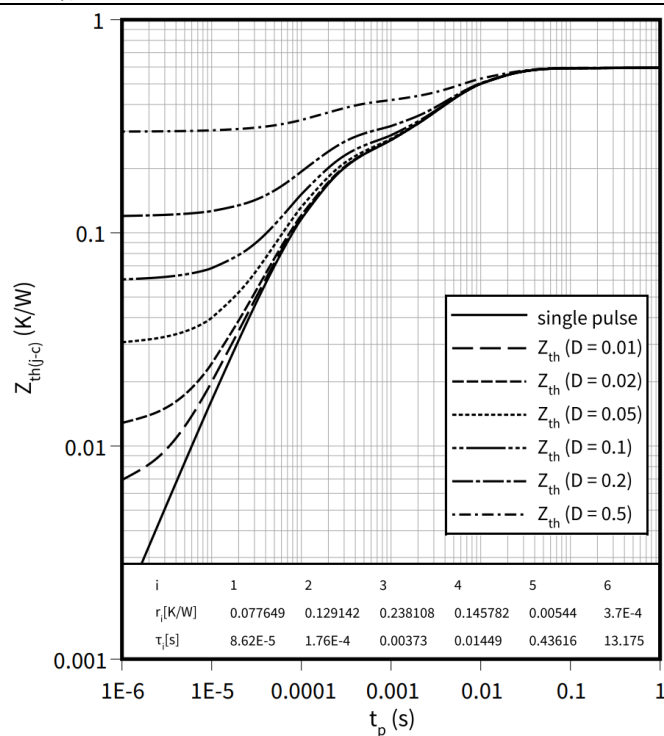


4 特征图

IGBT transient thermal impedance as a function of pulse width

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

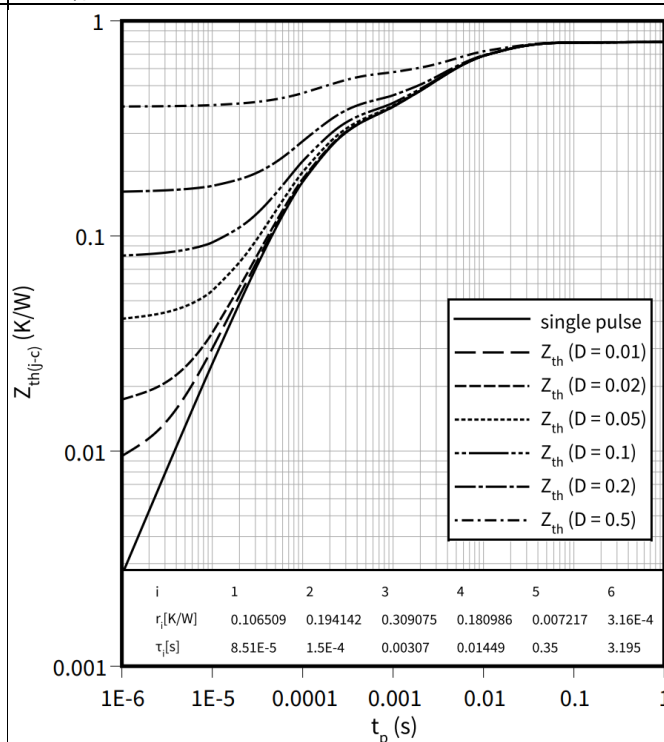
$$D = t_p/T$$



Diode transient thermal impedance as a function of pulse width

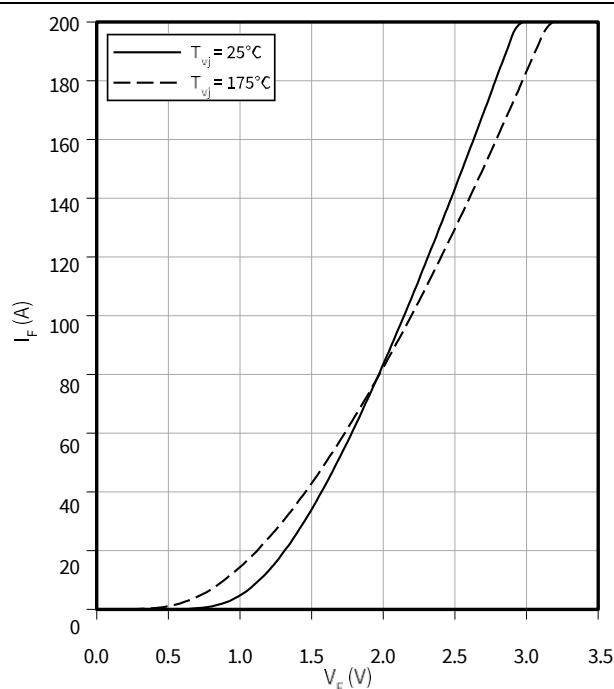
$$Z_{th(j-c)} = f(t_p)$$

$$D = t_p/T$$



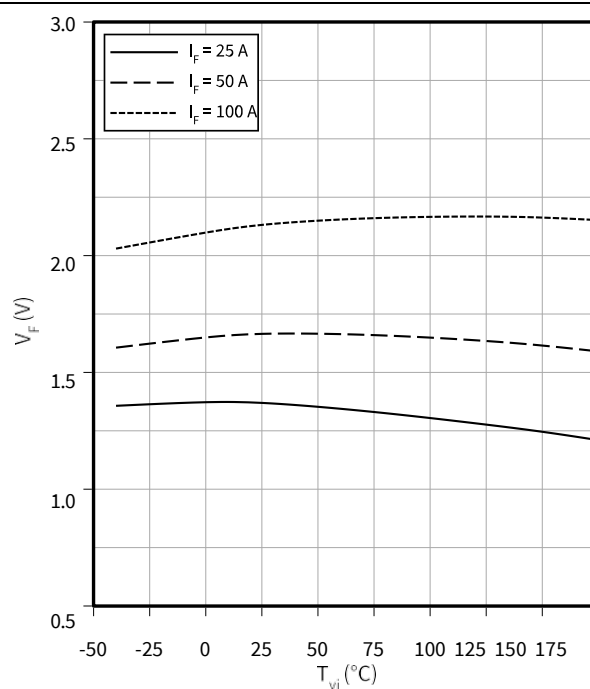
Typical diode forward current as a function of forward voltage

$$I_F = f(V_F)$$



Typical diode forward voltage as a function of junction temperature

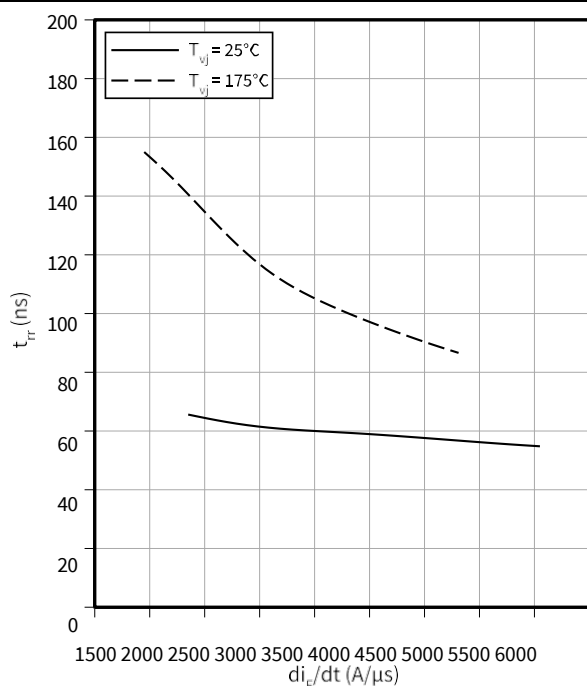
$$V_F = f(T_{vj})$$



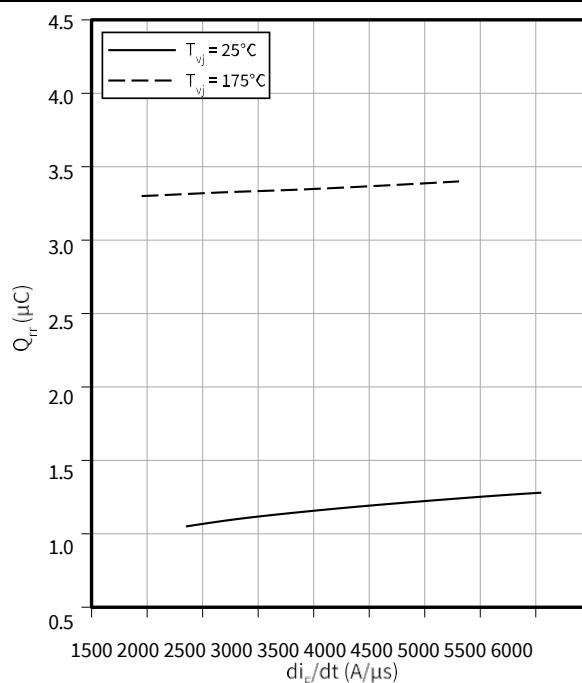
4 特征图

Typical reverse recovery time as a function of diode current slope

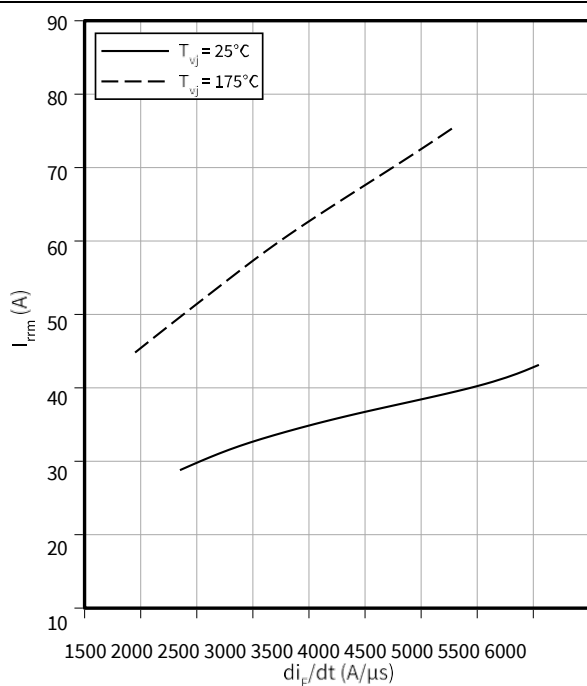
$$t_{rr} = f(di_F/dt)$$

 $V_R = 400 \text{ V}, I_F = 50 \text{ A}$ **Typical reverse recovery charge as a function of diode current slope**

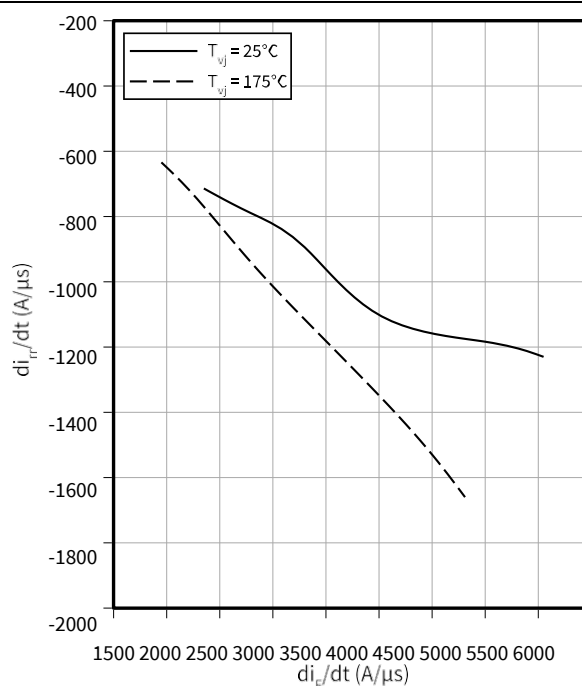
$$Q_{rr} = f(di_F/dt)$$

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

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

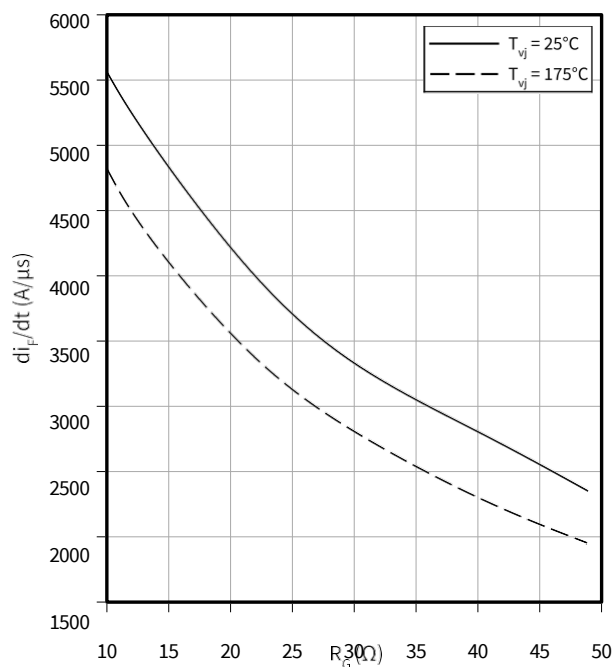
 $V_R = 400 \text{ V}, I_F = 50 \text{ A}$ 

4 特征图

Typical diode current slope as a function of gate resistor

$$di_F/dt = f(R_G)$$

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



5 封装外形

5 封装外形

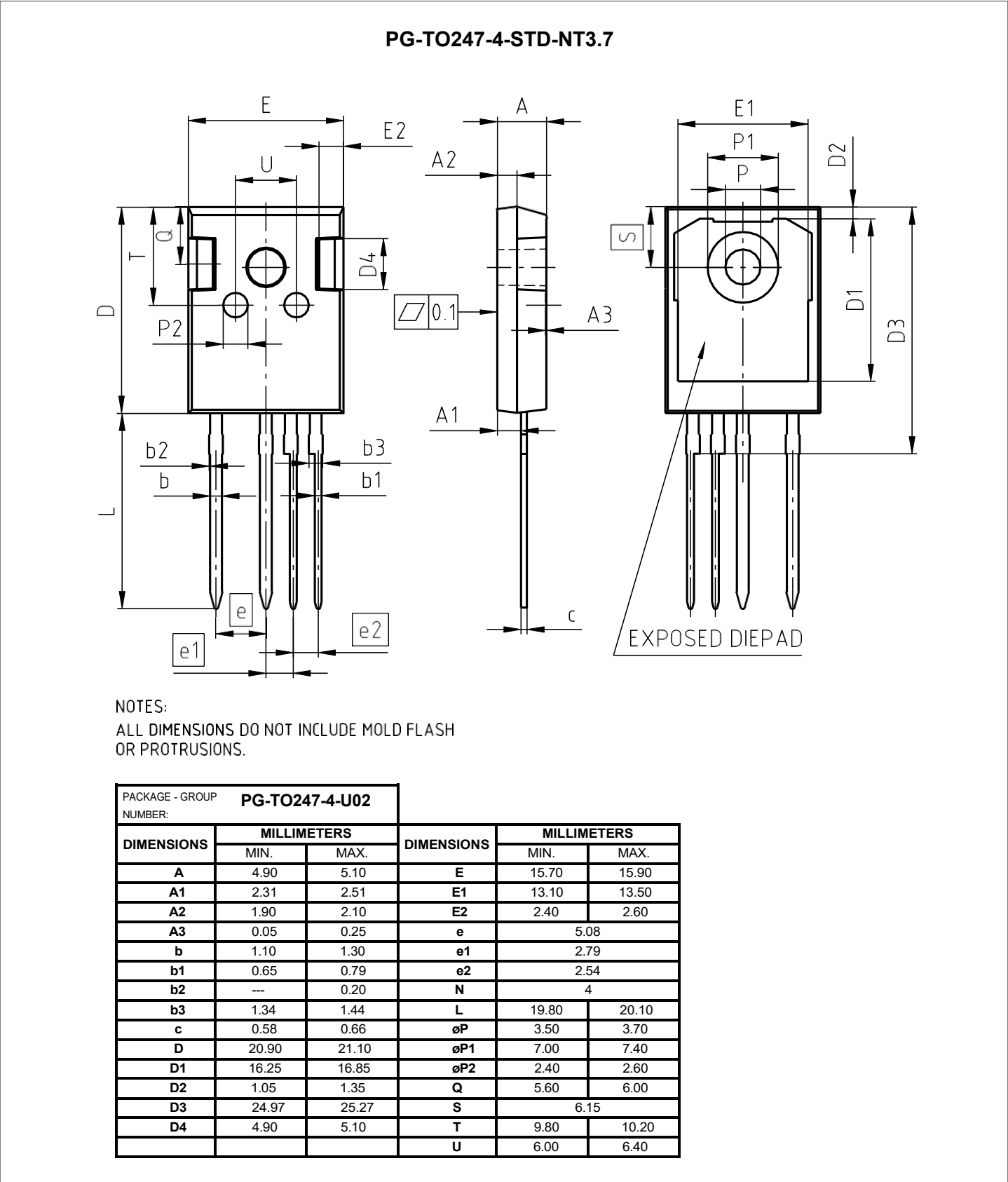


图 1

6 测试条件

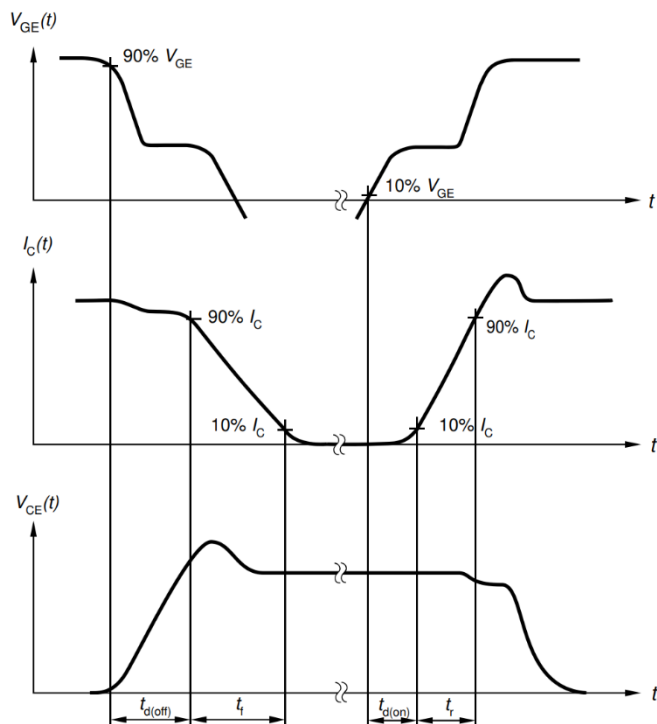


Figure A. Definition of switching times

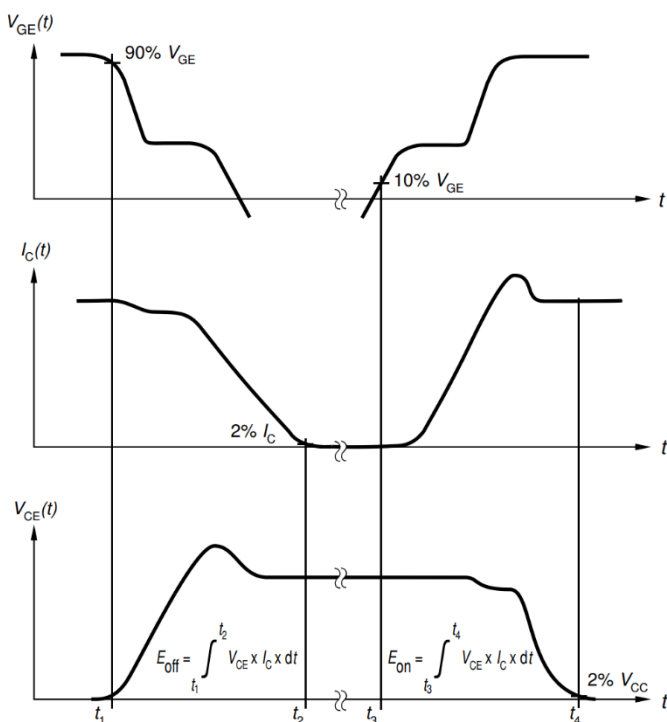


Figure B. Definition of switching losses

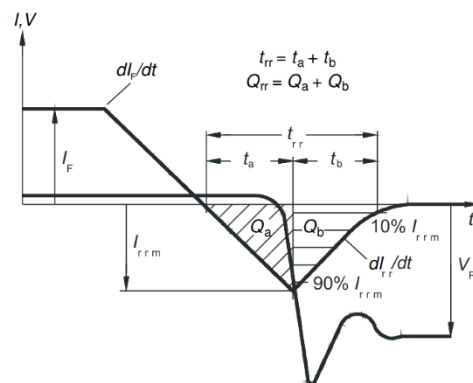


Figure C. Definition of diode switching characteristics

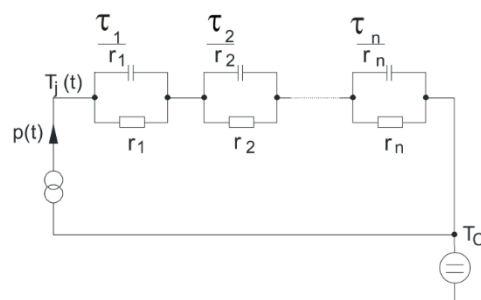


Figure D. Thermal equivalent circuit

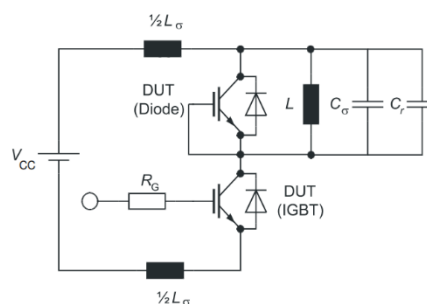


Figure E. Dynamic test circuit
Parasitic inductance L_σ ,
parasitic capacitor C_σ ,
relief capacitor C_r ,
(only for ZVT switching)

修订记录

Document revision	Date of release	Description of changes
1.00	2023-04-27	Final datasheet
1.10	2023-11-15	Update of energy diagrams



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