

英飞凌短路坚固的 1200 V TRENCHSTOP™ IGBT 7 技术与软和快速恢复发射极控制 7 二极管

特性

- $V_{CE} = 1200\text{ V}$
- $I_C = 50\text{ A}$
- IGBT与全电流，软的及快恢复二极管合封
- 低饱和电压 $V_{CEsat} = 2\text{ V}$ 在 $T_{vj} = 175^\circ\text{C}$
- 针对硬开关拓扑进行了优化（2-L 逆变器、3-L NPC T 型.....）
- 短路耐受性 $8\text{ }\mu\text{sec}$
- 广泛的 dv/dt 可控性
- 完整的产品品类和 PSpice 模型：<http://www.infineon.com/igbt/>



潜在应用

- 工业驱动
- 工业供电
- 太阳能逆变器

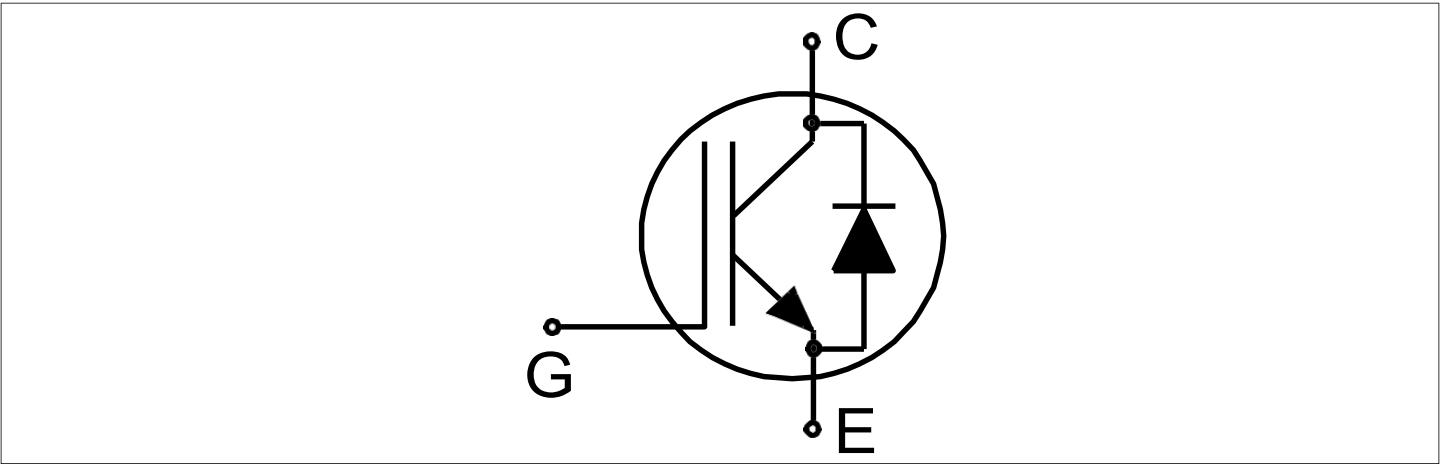


产品验证

- 符合JEDEC47/20/22相关测试的工业应用要求



描述



Type	Package	Marking
IKW50N120CS7	PG-TO247-3	K50MCS7

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 5mm. (0.197in) from case	L_E			13.0		nH
Storage temperature	T_{stg}		-55		150	°C
Soldering temperature		wave soldering 1.6mm (0.063in.) from case for 10s			260	°C
Mounting torque , M3 screw Maximum of mounting process: 3	M				0.6	Nm
Thermal resistance, junction-ambient	$R_{th(j-a)}$				40	K/W

2 IGBT

表2 最大额定值

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CE}	$T_{vj} \geq 25\text{ °C}$		1200	V
DC collector current, limited by T_{vjmax}	I_C	limited by bondwire	$T_C = 25\text{ °C}$	82	A
			$T_C = 100\text{ °C}$	68	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}			150	A
Turn-off safe operating area		$V_{CE} \leq 1200\text{ V}, T_{vj} \leq 175\text{ °C}$		150	A
Gate-emitter voltage	V_{GE}			± 20	V
Transient gate-emitter voltage	V_{GE}	$t_p \leq 0.5\text{ }\mu\text{s}, D < 0.001$		± 25	V
Short circuit withstand time	t_{SC}	$V_{CC} \leq 600\text{ V}, V_{GE} = 15\text{ V}$, Allowed number of short circuits < 1000, Time between short circuits $\geq 1.0\text{ s}, T_{vj} = 150\text{ °C}$		8	μs
Power dissipation	P_{tot}		$T_C = 25\text{ °C}$	428	W
			$T_C = 100\text{ °C}$	215	

表3 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CE\text{ sat}}$	$I_C = 50.0\text{ A}, V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$		1.65	2.00	V
			$T_{vj} = 175\text{ °C}$		2.00		

表 3 特征值 (续)

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Gate-emitter threshold voltage	V_{GEth}	$I_C = 0.98 \text{ mA}$, $V_{CE} = V_{GE}$, $T_{vj} = 25^\circ\text{C}$		5.15	5.70	6.45	V
Zero gate voltage collector current	I_{CES}	$V_{CE} = 1200 \text{ V}$, $V_{GE} = 0 \text{ V}$	$T_{vj} = 25^\circ\text{C}$			40	μA
			$T_{vj} = 175^\circ\text{C}$		4000		
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = 20 \text{ V}$				100	nA
Transconductance	g_{fs}	$I_C = 50.0 \text{ A}$, $V_{CE} = 20 \text{ V}$, $T_{vj} = 175^\circ\text{C}$			21.0		S
Short circuit collector current	I_{SC}	$V_{CE} \leq 600 \text{ V}$, $V_{GE} = 15 \text{ V}$, $t_{SC} \leq 8 \mu\text{s}$, Allowed number of short circuits < 1000 , Time between short circuits $\geq 1.0 \text{ s}$, $T_{vj} = 25^\circ\text{C}$			300		A
Input capacitance	C_{ies}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$			7.2		nF
Output capacitance	C_{oes}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$			140		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$			32		pF
Gate charge	Q_G	$I_C = 50.0 \text{ A}$, $V_{GE} = 15 \text{ V}$, $V_{CE} = 960 \text{ V}$			290		nC
Turn-on delay time	t_{don}	$V_{CE} = 600 \text{ V}$, $V_{GE} = 15 \text{ V}$, $R_{Gon} = 2.3 \Omega$, $R_{Goff} = 2.3 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_C = 50.0 \text{ A}$		29		ns
			$T_{vj} = 175^\circ\text{C}$, $I_C = 50.0 \text{ A}$		26		
Rise time (inductive load)	t_r	$V_{CE} = 600 \text{ V}$, $V_{GE} = 15 \text{ V}$, $R_{Gon} = 2.3 \Omega$, $R_{Goff} = 2.3 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_C = 50.0 \text{ A}$		19		ns
			$T_{vj} = 175^\circ\text{C}$, $I_C = 50.0 \text{ A}$		19		
Turn-off delay time	t_{doff}	$V_{CE} = 600 \text{ V}$, $V_{GE} = 15 \text{ V}$, $R_{Gon} = 2.3 \Omega$, $R_{Goff} = 2.3 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_C = 50.0 \text{ A}$		170		ns
			$T_{vj} = 175^\circ\text{C}$, $I_C = 50.0 \text{ A}$		225		
Fall time (inductive load)	t_f	$V_{CE} = 600 \text{ V}$, $V_{GE} = 15 \text{ V}$, $R_{Gon} = 2.3 \Omega$, $R_{Goff} = 2.3 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_C = 50.0 \text{ A}$		100		ns
			$T_{vj} = 175^\circ\text{C}$, $I_C = 50.0 \text{ A}$		245		
Turn-on energy	E_{on}	$V_{CE} = 600 \text{ V}$, $V_{GE} = 15 \text{ V}$, $R_{Gon} = 2.3 \Omega$, $R_{Goff} = 2.3 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_C = 50.0 \text{ A}$		2.80		mJ
			$T_{vj} = 175^\circ\text{C}$, $I_C = 50.0 \text{ A}$		4.30		
Turn-off energy	E_{off}	$V_{CE} = 600 \text{ V}$, $V_{GE} = 15 \text{ V}$, $R_{Gon} = 2.3 \Omega$, $R_{Goff} = 2.3 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_C = 50.0 \text{ A}$		2.20		mJ
			$T_{vj} = 175^\circ\text{C}$, $I_C = 50.0 \text{ A}$		4.70		

3 二极管

表 3 特征值 (续)

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Total switching energy	E_{ts}	$V_{CE} = 600\text{ V}$, $V_{GE} = 15\text{ V}$, $R_{Gon} = 2.3\ \Omega$, $R_{Goff} = 2.3\ \Omega$	$T_{vj} = 25\text{ }^{\circ}\text{C}$, $I_C = 50.0\text{ A}$	5.00		mJ
			$T_{vj} = 175\text{ }^{\circ}\text{C}$, $I_C = 50.0\text{ A}$	9.00		
IGBT thermal resistance, junction-case	R_{thjc}			0.25	0.35	K/W
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}	$T_{vj} \geq 25\text{ }^{\circ}\text{C}$		1200	V
Diode forward current, limited by T_{vjmax}	I_F	limited by bondwire	$T_c = 25\text{ }^{\circ}\text{C}$	82	A
			$T_c = 100\text{ }^{\circ}\text{C}$	56	
Diode pulsed current, limited by T_{vjmax}	I_{Fpuls}			150	A
Power dissipation	P_{tot}		$T_c = 25\text{ }^{\circ}\text{C}$	250	W
			$T_c = 100\text{ }^{\circ}\text{C}$	125	

表5 特征值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Diode forward voltage	V_F	$I_F = 50.0\text{ A}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$	1.65	2.15	V
			$T_{vj} = 175\text{ }^{\circ}\text{C}$	1.60		
Reverse leakage current	I_R	$V_R = 1200\text{ V}$	$T_{vj} = 25\text{ }^{\circ}\text{C}$		40	μA
			$T_{vj} = 175\text{ }^{\circ}\text{C}$	4000		
Diode reverse recovery time	t_{rr}	$V_R = 600\text{ V}$, $R_{Gon} = 2.3\ \Omega$	$T_{vj} = 25\text{ }^{\circ}\text{C}$, $I_F = 50.0\text{ A}$	165		ns
			$T_{vj} = 175\text{ }^{\circ}\text{C}$, $I_F = 50.0\text{ A}$	305		
Diode reverse recovery charge	Q_{rr}	$V_R = 600\text{ V}$, $R_{Gon} = 2.3\ \Omega$	$T_{vj} = 25\text{ }^{\circ}\text{C}$, $I_F = 50.0\text{ A}$	3.20		μC
			$T_{vj} = 175\text{ }^{\circ}\text{C}$, $I_F = 50.0\text{ A}$	8.25		

表 5 特征值 (续)

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode peak reverse recovery current	I_{rrm}	$V_R = 600\text{ V}, R_{Gon} = 2.3\ \Omega$	$T_{vj} = 25\text{ °C}, I_F = 50.0\text{ A}$		40.0		A
			$T_{vj} = 175\text{ °C}, I_F = 50.0\text{ A}$		54.0		
Diode peak rate off fall of reverse recovery current	dI_{rr}/dt	$V_R = 600\text{ V}, R_{Gon} = 2.3\ \Omega$	$T_{vj} = 25\text{ °C}, I_F = 50.0\text{ A}$		-290		A/ μs
			$T_{vj} = 175\text{ °C}, I_F = 50.0\text{ A}$		-185		
Reverse recovery energy	E_{rec}	$V_R = 600\text{ V}, R_{Gon} = 2.3\ \Omega$	$T_{vj} = 25\text{ °C}, I_F = 50.0\text{ A}$		1.00		mJ
			$T_{vj} = 175\text{ °C}, I_F = 50.0\text{ A}$		3.10		
Diode thermal resistance, junction-case	R_{thjc}				0.45	0.60	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%。

动态测试电路，寄生电感 $L_\sigma = 30\text{ nH}$, $C_\sigma = 28\text{ pF}$

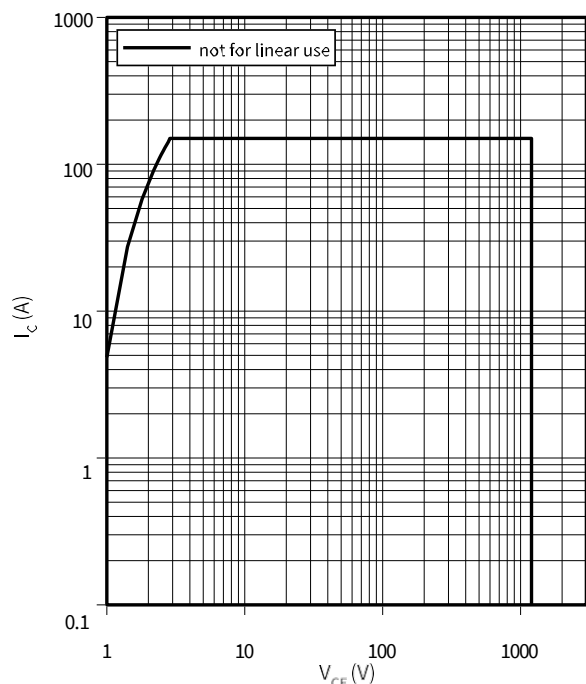
4 特征图

4 特性图

Reverse bias safe operating area, IGBT

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

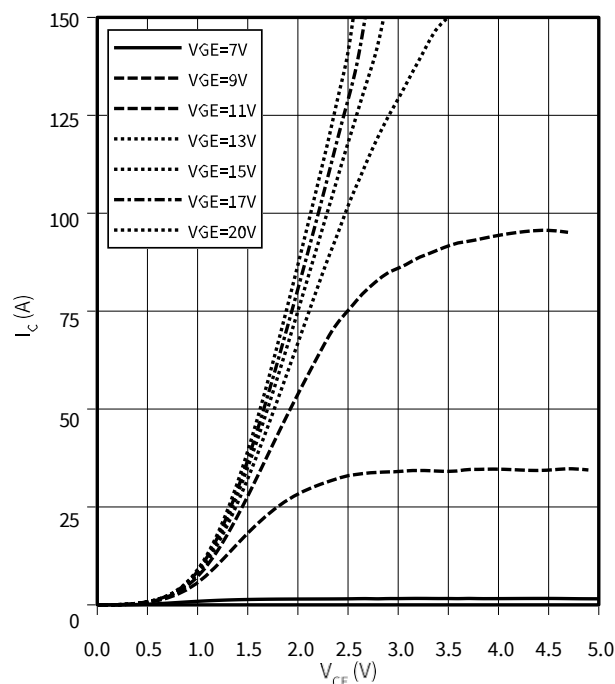
$T_{vj} \leq 175^\circ\text{C}$, $V_{GE} = 15\text{ V}$



Typical output characteristic, IGBT

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

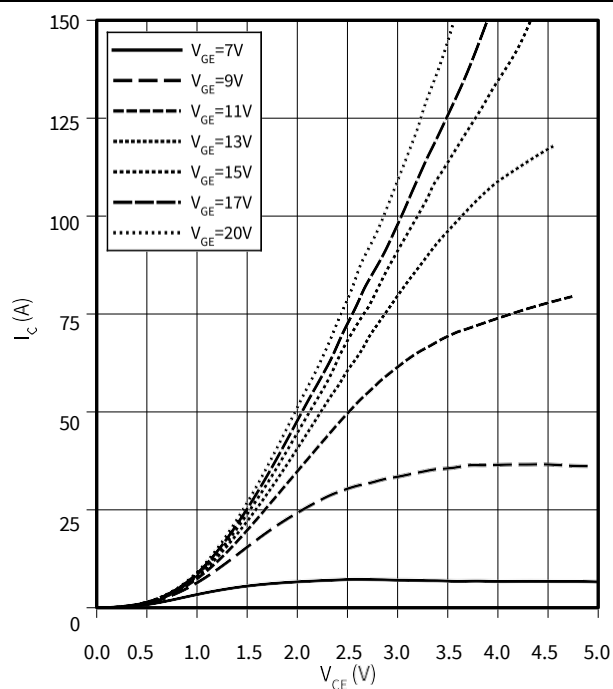
$T_{vj} = 25^\circ\text{C}$



Typical output characteristic, IGBT

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

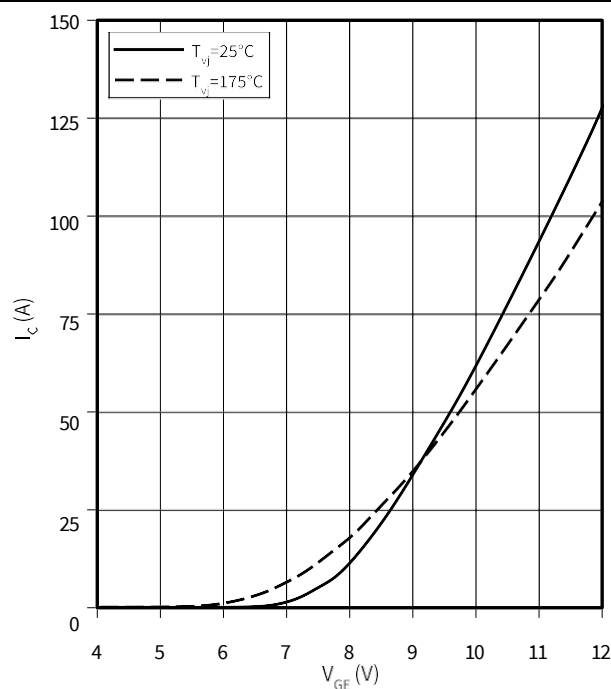
$T_{vj} = 175^\circ\text{C}$



Typical transfer characteristic, IGBT

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

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

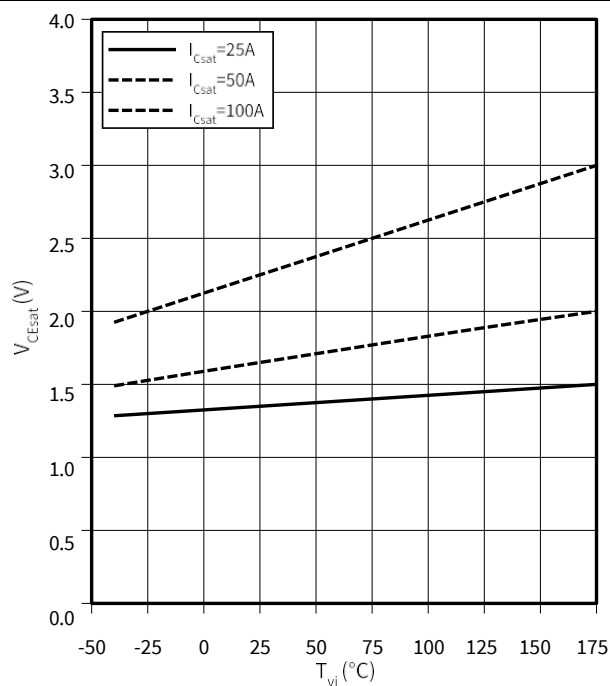


4 特征图

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

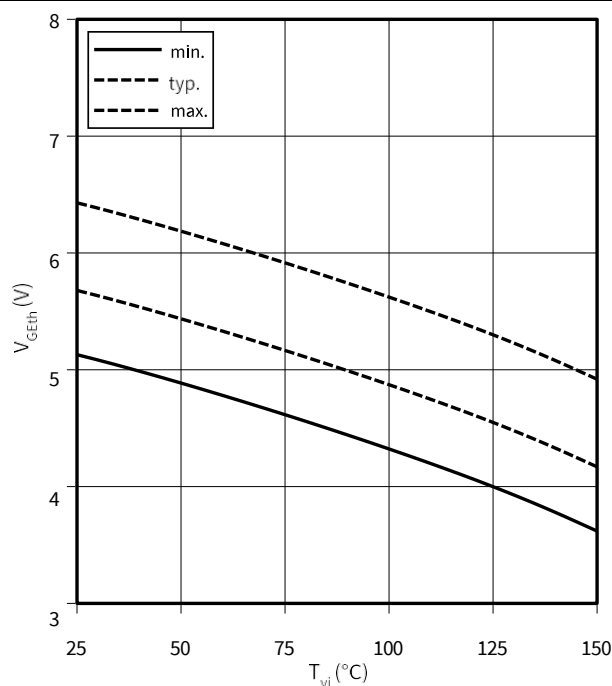
$$V_{CEsat} = f(T_{vj})$$

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


Gate-emitter threshold voltage as a function of junction temperature, IGBT

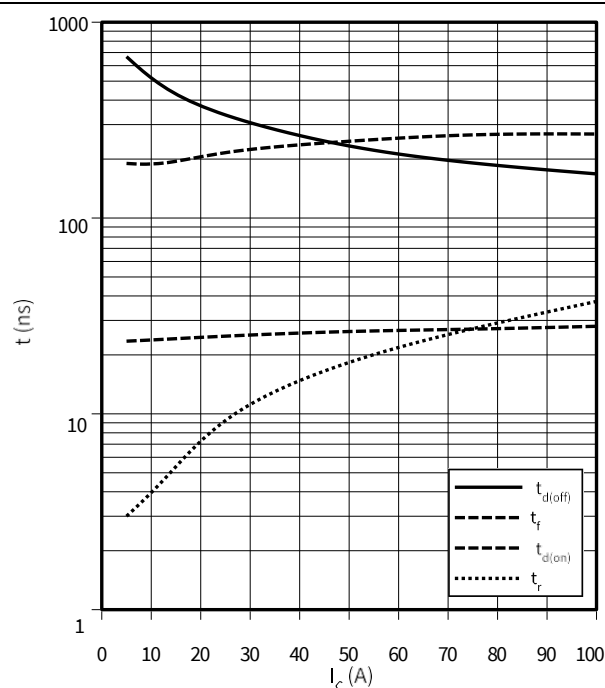
$$V_{GEth} = f(T_{vj})$$

$$I_C = 0.98 \text{ mA}$$


Typical switching times as a function of collector current, IGBT

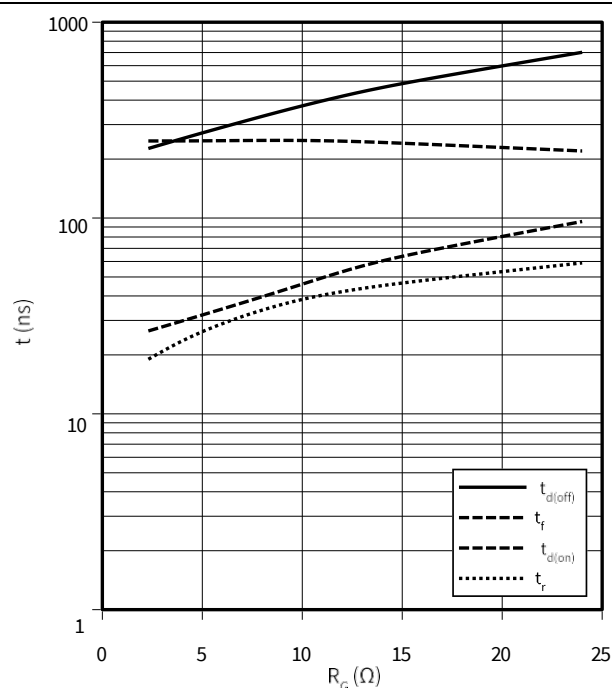
$$t = f(I_C)$$

$$V_{CE} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}, R_G = 2.3 \text{ } \Omega$$


Typical switching times as a function of gate resistor, IGBT

$$t = f(R_G)$$

$$I_C = 50.0 \text{ A}, V_{CE} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}$$

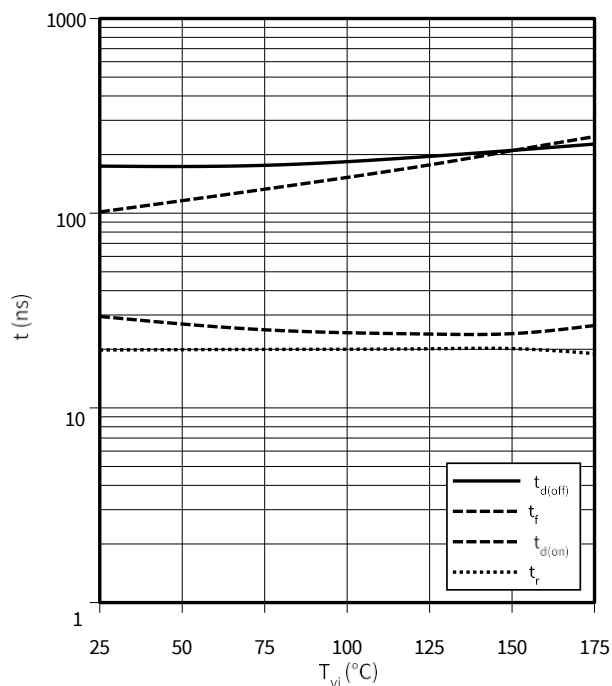


4 特征图

Typical switching times as a function of junction temperature, IGBT

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

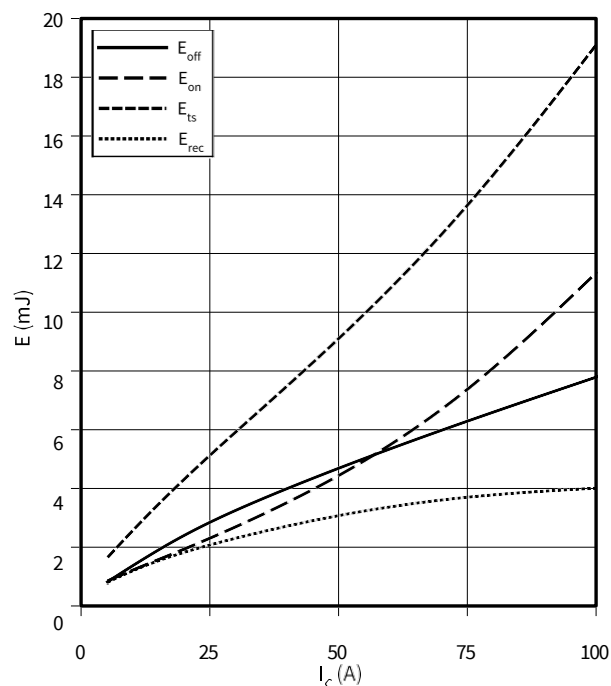
$I_C = 50.0 \text{ A}$, $V_{CE} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 2.3 \Omega$



Typical switching energy losses as a function of collector current, IGBT

$$E = f(I_C)$$

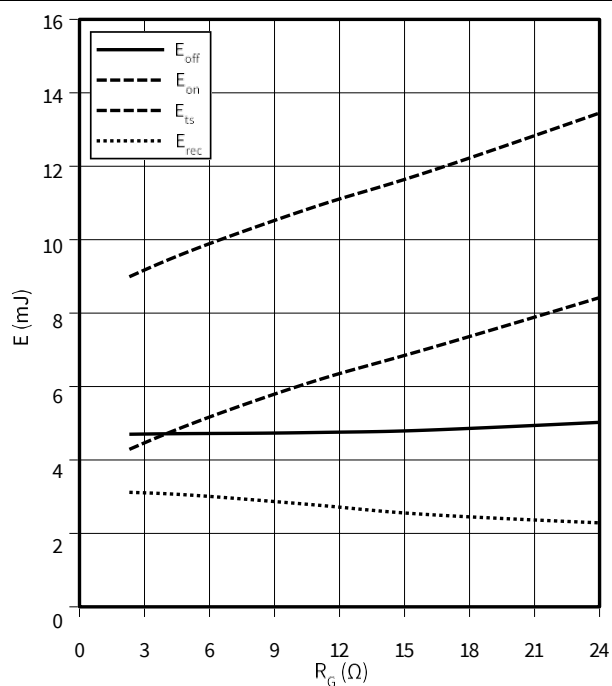
$V_{CE} = 600 \text{ V}$, $T_{vj} = 175 \text{ }^{\circ}\text{C}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 2.3 \Omega$



Typical switching energy losses as a function of gate resistor, IGBT

$$E = f(R_G)$$

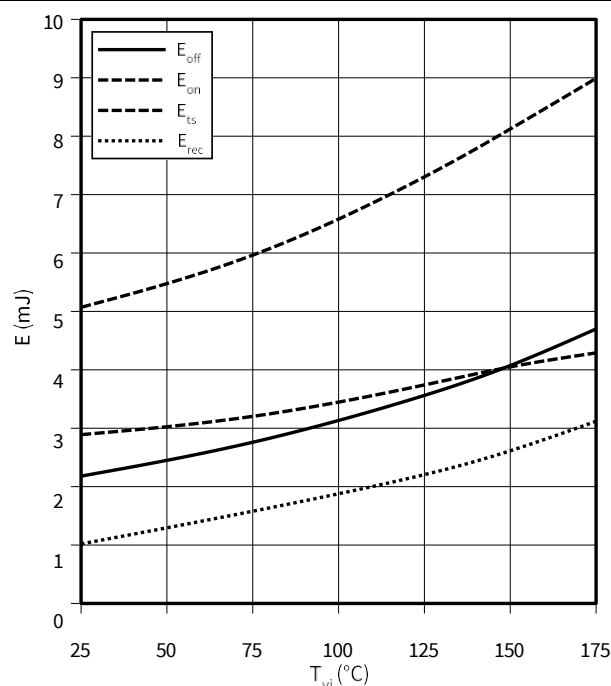
$I_C = 50.0 \text{ A}$, $V_{CE} = 600 \text{ V}$, $T_{vj} = 175 \text{ }^{\circ}\text{C}$, $V_{GE} = 0/15 \text{ V}$



Typical switching energy losses as a function of junction temperature, IGBT

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

$I_C = 50.0 \text{ A}$, $V_{CE} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 2.3 \Omega$

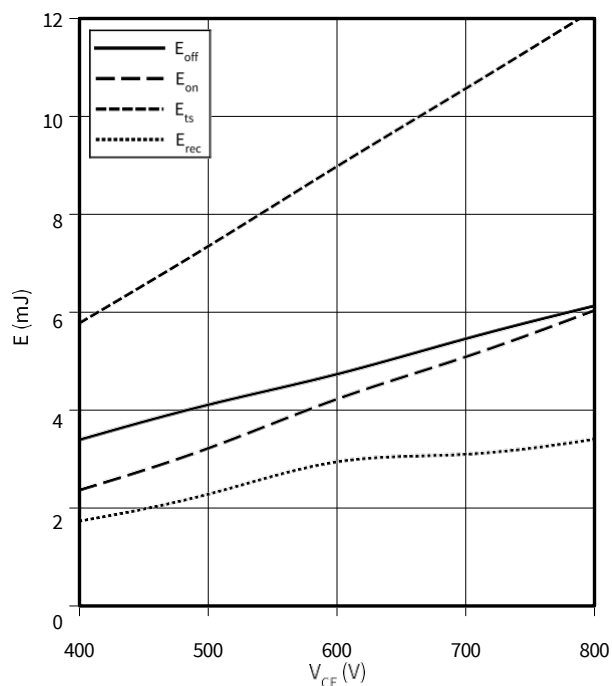


4 特征图

Typical switching energy losses as a function of collector emitter voltage, IGBT

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

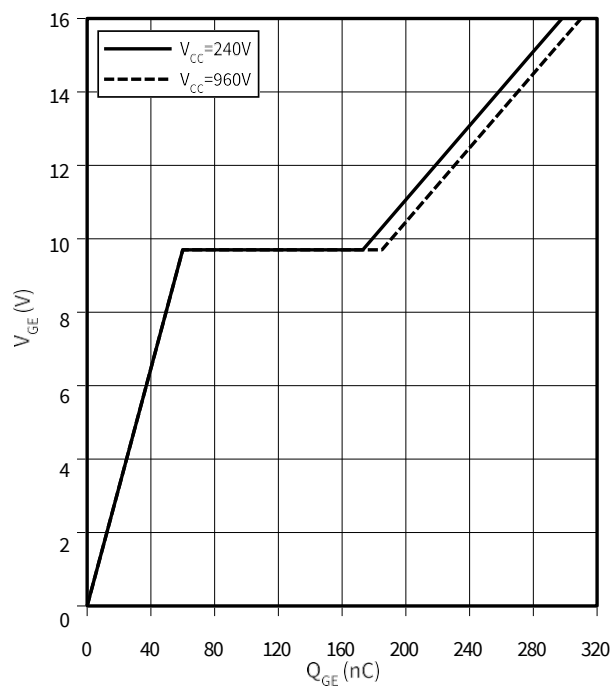
$I_C = 50.0 \text{ A}$, $T_{vj} = 175 \text{ }^\circ\text{C}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 2.3 \text{ } \Omega$



Typical gate charge, IGBT

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

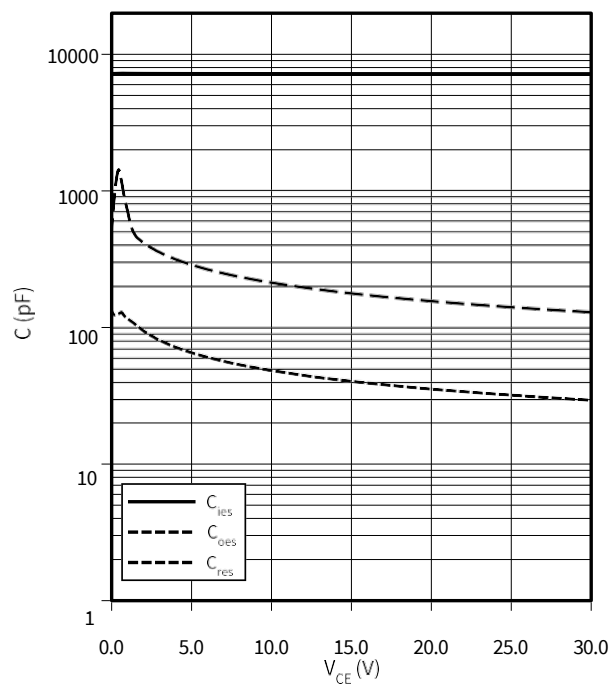
$I_C = 50.0 \text{ A}$



Typical capacitance as a function of collector-emitter voltage, IGBT

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

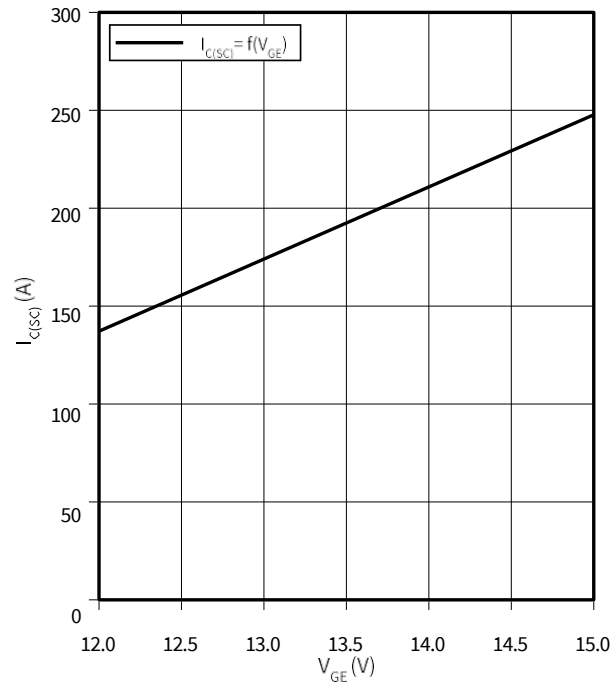
$f = 100 \text{ kHz}$, $V_{GE} = 0 \text{ V}$



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

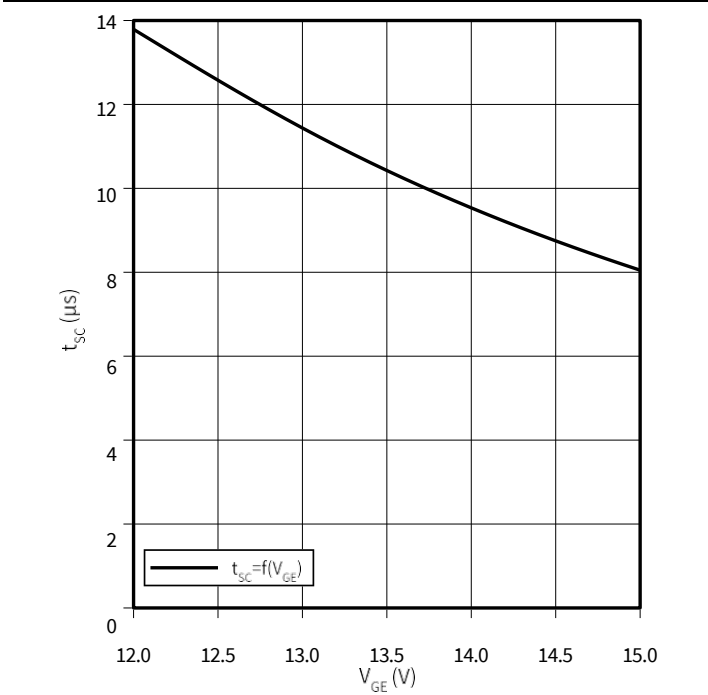
$$I_{C(SC)} = f(V_{GE})$$

$T_{vj} = 150 \text{ }^\circ\text{C}$, $V_{CC} = 600 \text{ V}$

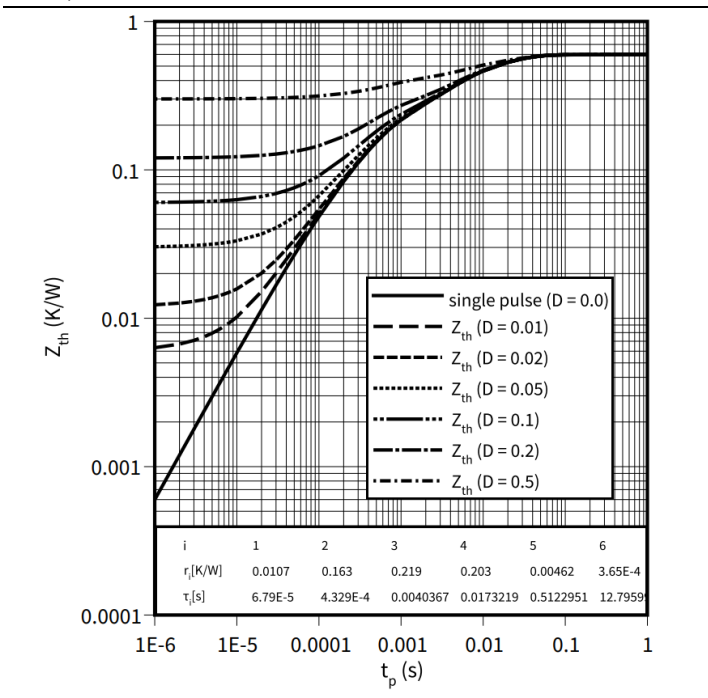


4 特征图

Short circuit withstand time as a function of gate-emitter voltage, IGBT
 $t_{SC} = f(V_{GE})$
 $T_{vj} \leq 150\text{ }^{\circ}\text{C}$, $V_{CC} = 600\text{ V}$



Diode transient thermal impedance as a function of pulse width, Diode
 $Z_{th} = f(t_p)$
 $D = t_p/T$



IGBT transient thermal impedance, IGBT
 $Z_{th} = f(t_p)$
 $D = t_p/T$

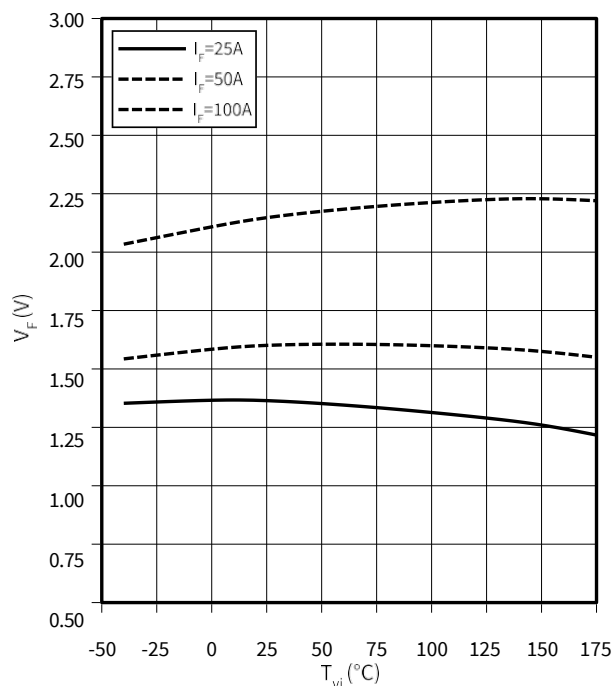


Typical diode forward current as a function of forward voltage, Diode
 $I_F = f(V_F)$

4 特征图

Typical diode forward voltage as a function of junction temperature, Diode

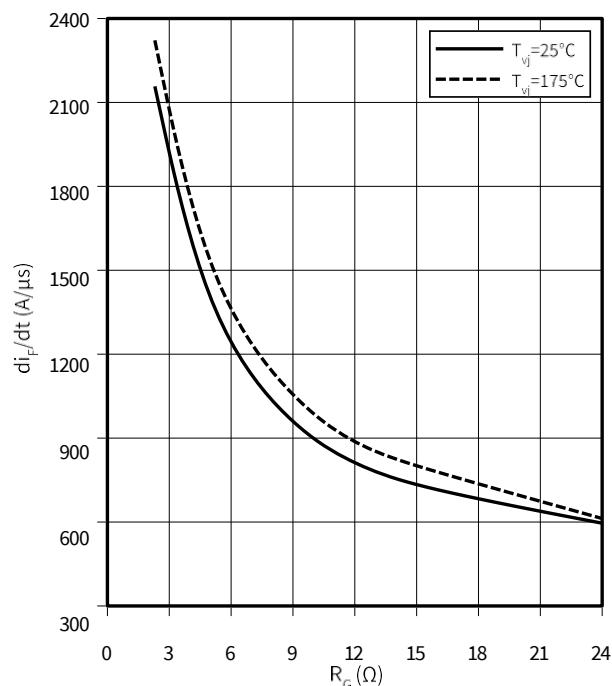
$$V_F = f(T_{vj})$$



Typical diode current slope as a function of gate resistor, Diode

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

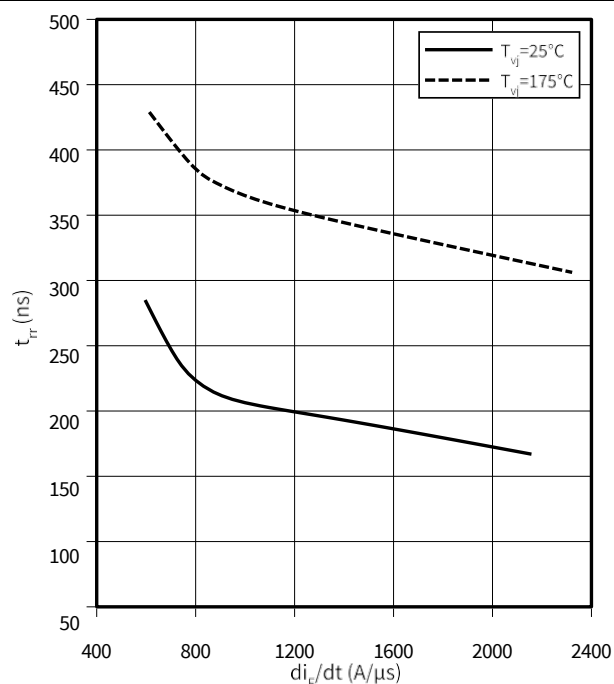
$$I_C = 50.0 A, V_{CE} = 600 V, V_{GE} = 0/15 V$$



Typical reverse recovery time as a function of diode current slope, Diode

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

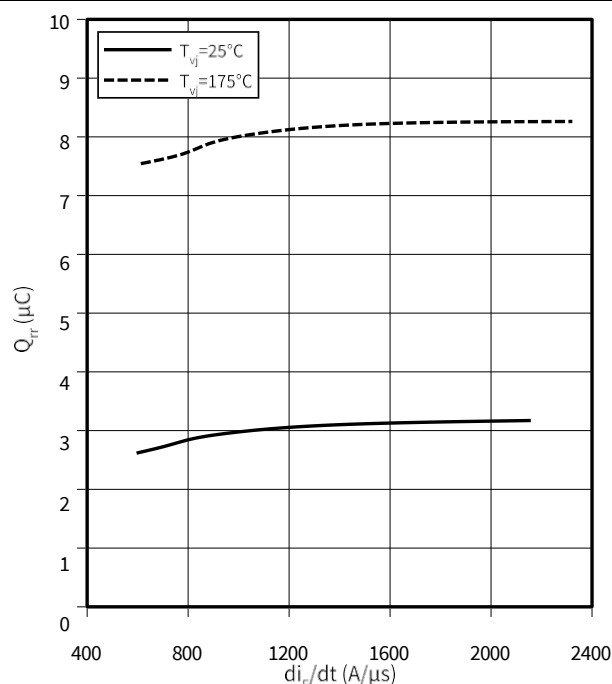
$$V_R = 600 V, I_F = 50.0 A$$



Typical reverse recovery charge as a function of diode current slope, Diode

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

$$V_R = 600 V, I_F = 50.0 A$$

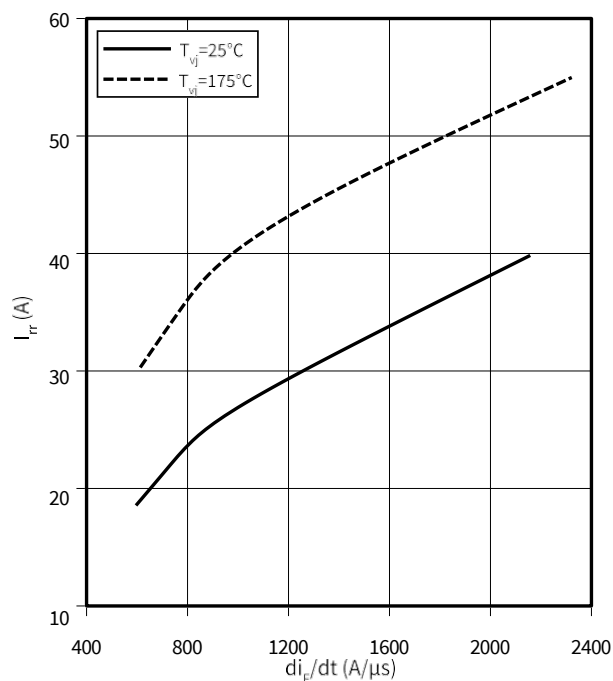


4 特征图

Typical reverse recovery current as a function of diode current slope, Diode

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

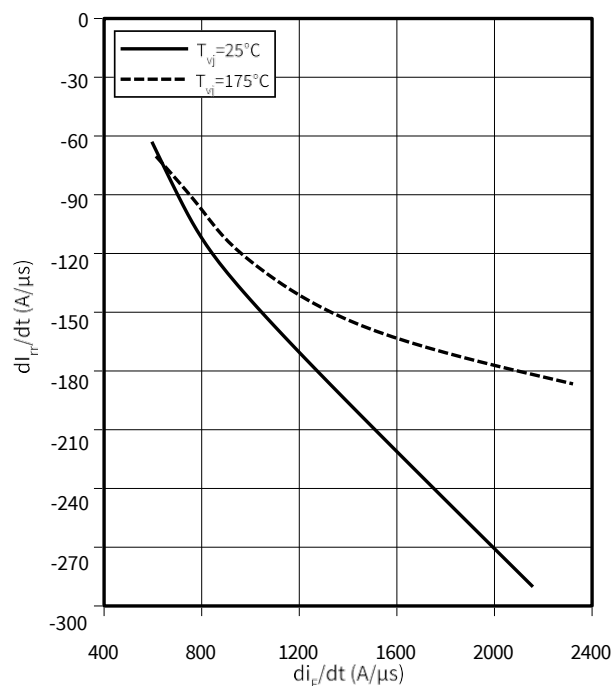
$V_R = 600 \text{ V}$, $I_F = 50.0 \text{ A}$



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

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

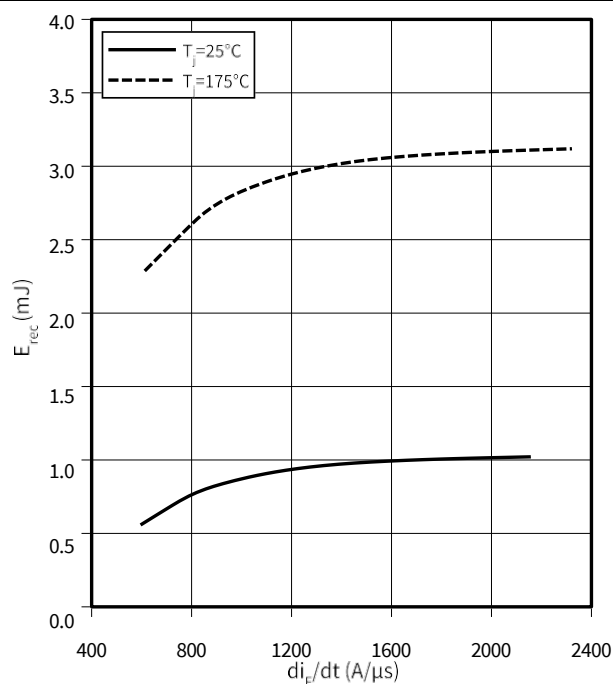
$V_R = 600 \text{ V}$, $I_F = 50.0 \text{ A}$



Typical reverse energy losses as a function of diode current slope, Diode

$$E_{rec} = f(di_F/dt)$$

$V_R = 600 \text{ V}$, $I_F = 50.0 \text{ A}$



5 封装外形

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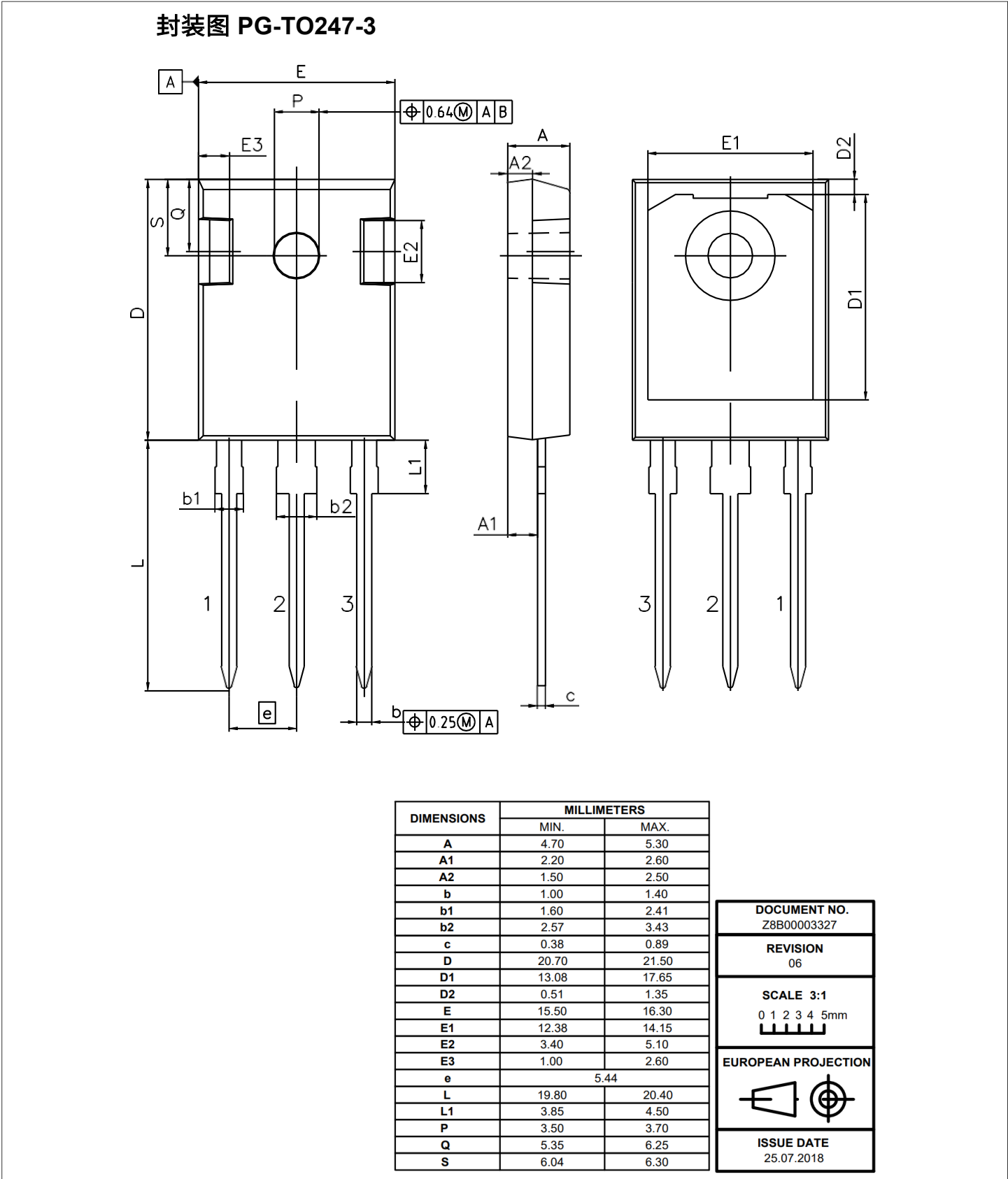


图 6.

6 测试条件

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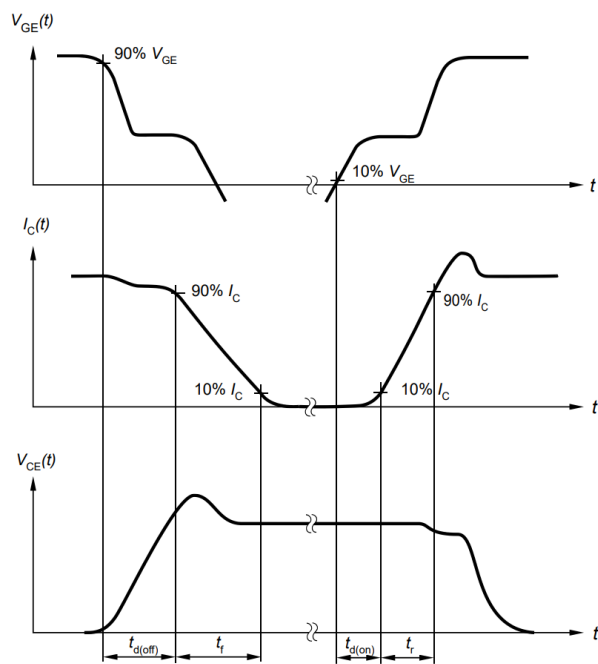


Figure A. Definition of switching times

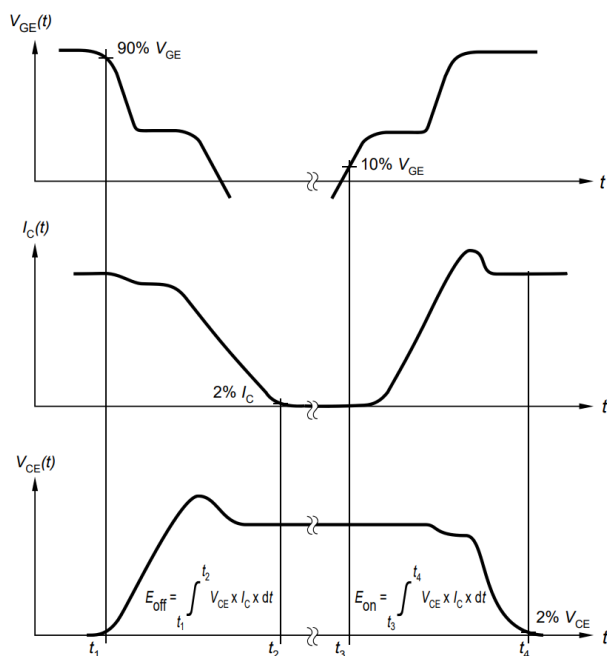


Figure B. Definition of switching losses

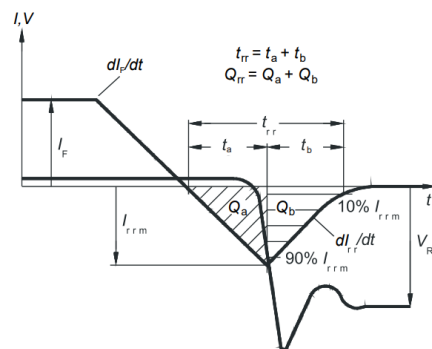


Figure C. Definition of diode switching characteristics

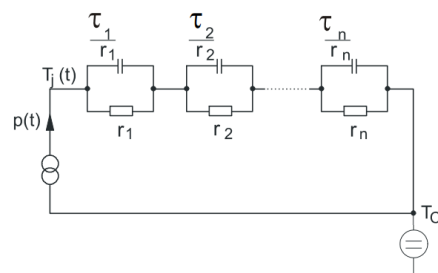


Figure D. Thermal equivalent circuit

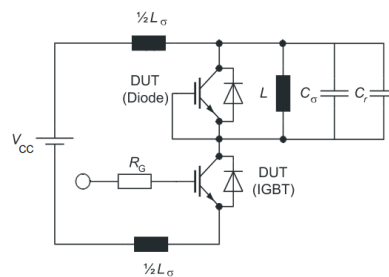


Figure E. Dynamic test circuit
Parasitic inductance L_{σ} ,
parasitic capacitor C_{σ} ,
relief capacitor C_r ,
(only for ZVT switching)



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