

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

- $V_{CE} = 1200\text{ V}$
- $I_C = 15\text{ A}$
- 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

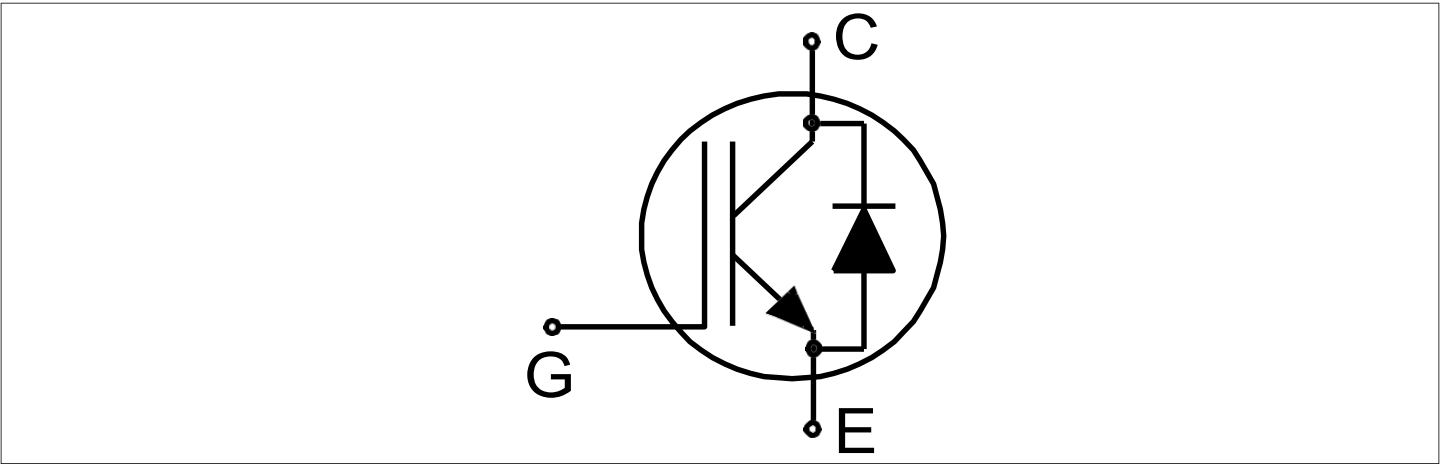


产品验证

- 符合 JEDEC47/20/22 相关测试的工业应用要求



描述



Type	Package	Marking
IKW15N120CS7	PG-TO247-3	K15MCS7

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	$T_C = 25\text{ °C}$	36	A
		$T_C = 100\text{ °C}$	25	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}		45	A
Turn-off safe operating area		$V_{CE} \leq 1200\text{ V}, T_{vj} \leq 175\text{ °C}$	45	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}	$T_C = 25\text{ °C}$	176	W
		$T_C = 100\text{ °C}$	88	

表3 特征值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CE\text{ sat}}$	$I_C = 15.0\text{ A}, V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$	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}	$I_C = 0.30 \text{ mA}$, $V_{CE} = V_{GE}$, $T_{vj} = 25^\circ\text{C}$		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
			$T_{vj} = 175^\circ\text{C}$		1000		
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = 20 \text{ V}$				100	nA
Transconductance	g_{fs}	$I_C = 15.0 \text{ A}$, $V_{CE} = 20 \text{ V}$, $T_{vj} = 175^\circ\text{C}$			6.5		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 $\geq 1.0 \text{ s}$, $T_{vj} = 25^\circ\text{C}$			95		A
Input capacitance	C_{ies}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$			2.2		nF
Output capacitance	C_{oes}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$			55		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$			10		pF
Gate charge	Q_G	$I_C = 15.0 \text{ A}$, $V_{GE} = 15 \text{ V}$, $V_{CE} = 960 \text{ V}$			95		nC
Turn-on delay time	t_{don}	$V_{CE} = 600 \text{ V}$, $V_{GE} = 15 \text{ V}$, $R_{Gon} = 10.0 \Omega$, $R_{Goff} = 10.0 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_C = 15.0 \text{ A}$		23		ns
			$T_{vj} = 175^\circ\text{C}$, $I_C = 15.0 \text{ A}$		20		
Rise time (inductive load)	t_r	$V_{CE} = 600 \text{ V}$, $V_{GE} = 15 \text{ V}$, $R_{Gon} = 10.0 \Omega$, $R_{Goff} = 10.0 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_C = 15.0 \text{ A}$		11		ns
			$T_{vj} = 175^\circ\text{C}$, $I_C = 15.0 \text{ A}$		14		
Turn-off delay time	t_{doff}	$V_{CE} = 600 \text{ V}$, $V_{GE} = 15 \text{ V}$, $R_{Gon} = 10.0 \Omega$, $R_{Goff} = 10.0 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_C = 15.0 \text{ A}$		170		ns
			$T_{vj} = 175^\circ\text{C}$, $I_C = 15.0 \text{ A}$		250		
Fall time (inductive load)	t_f	$V_{CE} = 600 \text{ V}$, $V_{GE} = 15 \text{ V}$, $R_{Gon} = 10.0 \Omega$, $R_{Goff} = 10.0 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_C = 15.0 \text{ A}$		100		ns
			$T_{vj} = 175^\circ\text{C}$, $I_C = 15.0 \text{ A}$		270		
Turn-on energy	E_{on}	$V_{CE} = 600 \text{ V}$, $V_{GE} = 15 \text{ V}$, $R_{Gon} = 10.0 \Omega$, $R_{Goff} = 10.0 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_C = 15.0 \text{ A}$		0.75		mJ
			$T_{vj} = 175^\circ\text{C}$, $I_C = 15.0 \text{ A}$		1.15		
Turn-off energy	E_{off}	$V_{CE} = 600 \text{ V}$, $V_{GE} = 15 \text{ V}$, $R_{Gon} = 10.0 \Omega$, $R_{Goff} = 10.0 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_C = 15.0 \text{ A}$		0.70		mJ
			$T_{vj} = 175^\circ\text{C}$, $I_C = 15.0 \text{ A}$		1.60		

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}	$V_{CE} = 600 \text{ V}$, $V_{GE} = 15 \text{ V}$, $R_{Gon} = 10.0 \Omega$, $R_{Goff} = 10.0 \Omega$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 15.0 \text{ A}$	1.45		mJ
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 15.0 \text{ A}$	2.75		
IGBT thermal resistance, junction-case	R_{thjc}			0.65	0.85	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	$T_C = 25 \text{ }^{\circ}\text{C}$	30	A
		$T_C = 100 \text{ }^{\circ}\text{C}$	20	
Diode pulsed current, limited by T_{vjmax}	I_{Fpuls}		45	A
Power dissipation	P_{tot}	$T_C = 25 \text{ }^{\circ}\text{C}$	100	W
		$T_C = 100 \text{ }^{\circ}\text{C}$	50	

表5 特征值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Diode forward voltage	V_F	$I_F = 15.0 \text{ A}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$	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
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$	1000		
Diode reverse recovery time	t_{rr}	$V_R = 600 \text{ V}$, $R_{Gon} = 10.0 \Omega$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_F = 15.0 \text{ A}$	135		ns
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_F = 15.0 \text{ A}$	265		
Diode reverse recovery charge	Q_{rr}	$V_R = 600 \text{ V}$, $R_{Gon} = 10.0 \Omega$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_F = 15.0 \text{ A}$	0.87		μC
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_F = 15.0 \text{ A}$	2.15		

表 5 特征值 (续)

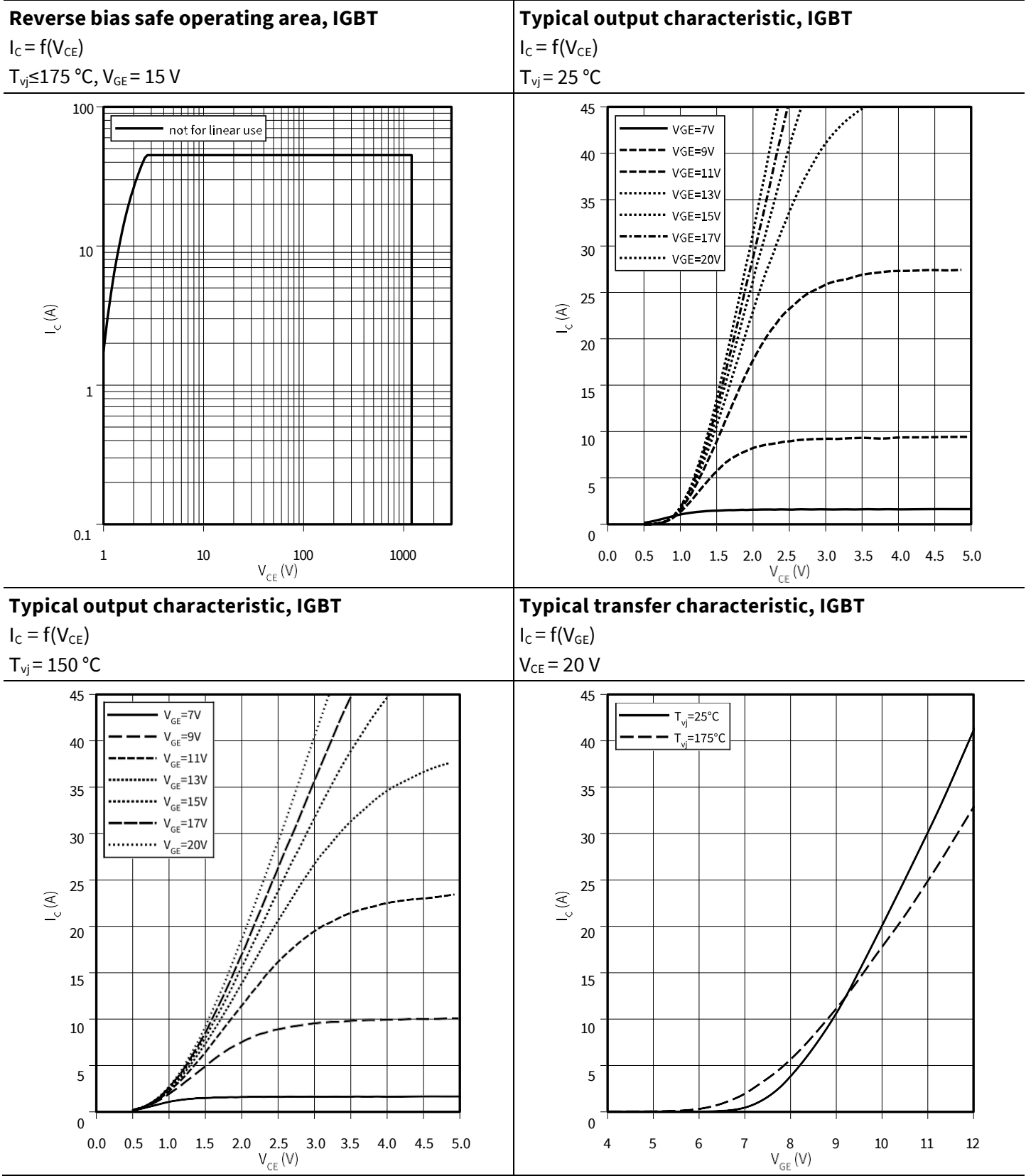
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode peak reverse recovery current	I_{rrm}	$V_R = 600 \text{ V}, R_{Gon} = 10.0 \Omega$	$T_{vj} = 25^\circ\text{C}, I_F = 15.0 \text{ A}$		15.4		A
			$T_{vj} = 175^\circ\text{C}, I_F = 15.0 \text{ A}$		19.7		
Diode peak rate off fall of reverse recovery current	di_{rr}/dt	$V_R = 600 \text{ V}, R_{Gon} = 10.0 \Omega$	$T_{vj} = 25^\circ\text{C}, I_F = 15.0 \text{ A}$		-140		A/ μs
			$T_{vj} = 175^\circ\text{C}, I_F = 15.0 \text{ A}$		-85		
Reverse recovery energy	E_{rec}	$V_R = 600 \text{ V}, R_{Gon} = 10.0 \Omega$	$T_{vj} = 25^\circ\text{C}, I_F = 15.0 \text{ A}$		0.25		mJ
			$T_{vj} = 175^\circ\text{C}, I_F = 15.0 \text{ A}$		0.75		
Diode thermal resistance, junction-case	R_{thjc}				1.10	1.50	K/W
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 $L_\sigma = 30 \text{ nH}$, $C_\sigma = 8 \text{ pF}$

4 特性图

4 特性图

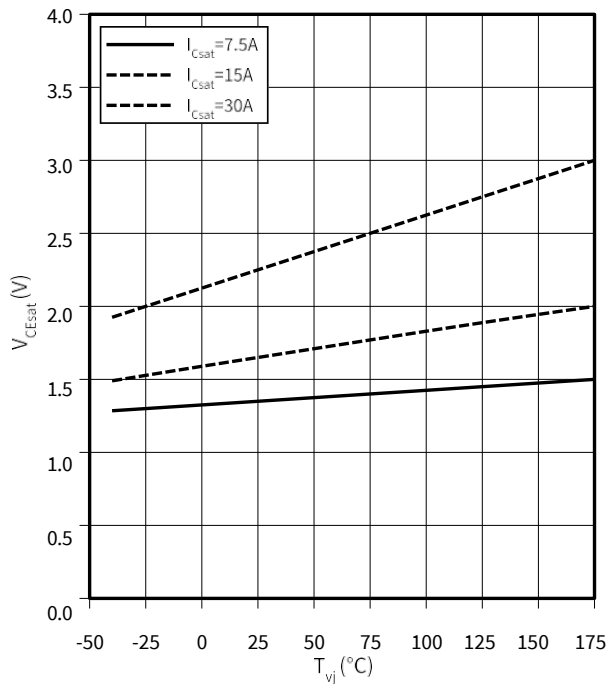


4 特性图

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

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

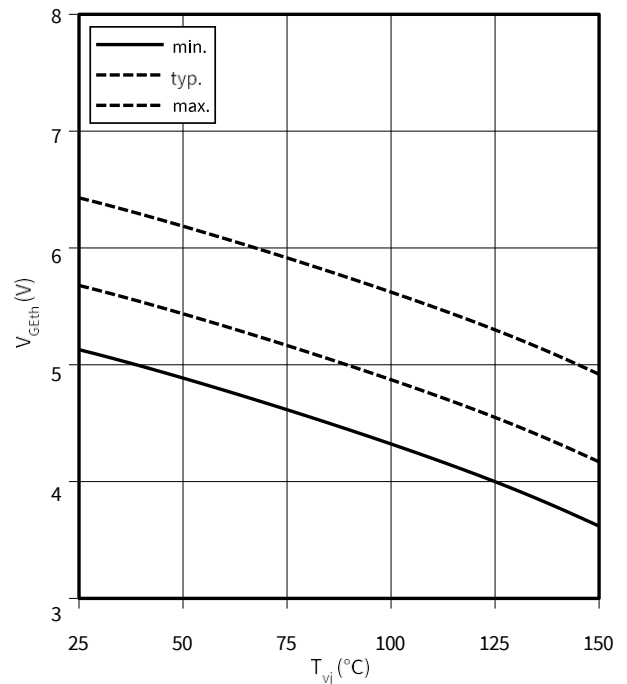
$$V_{GE} = 15 \text{ V}$$



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

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

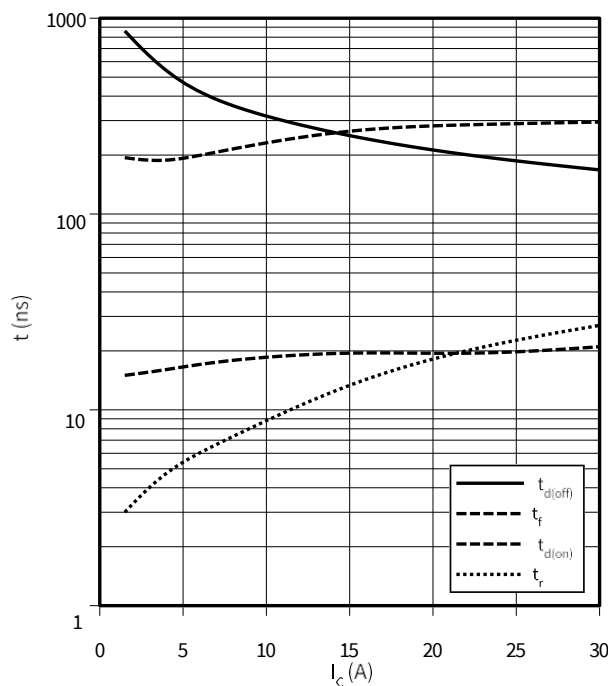
$$I_C = 0.85 \text{ mA}$$



Typical switching times as a function of collector current, IGBT

$$t = f(I_C)$$

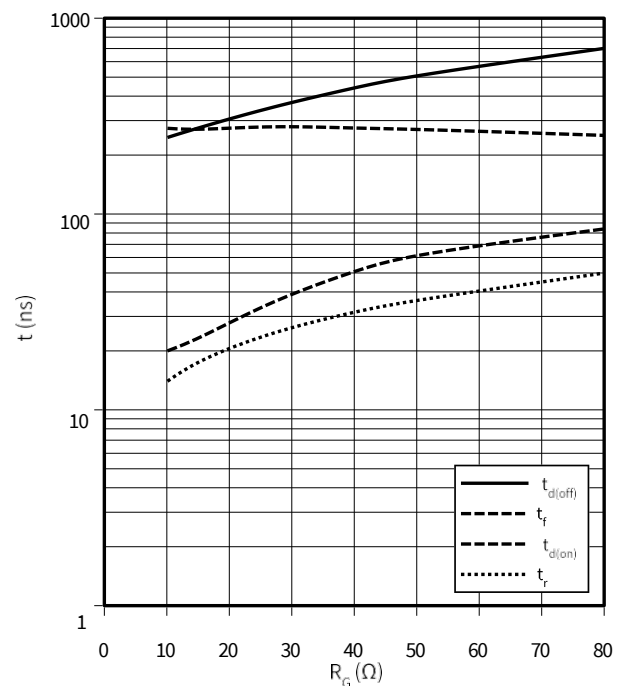
$$V_{CE} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}, R_G = 10.0 \text{ } \Omega$$



Typical switching times as a function of gate resistor, IGBT

$$t = f(R_G)$$

$$I_C = 15.0 \text{ A}, V_{CE} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}$$

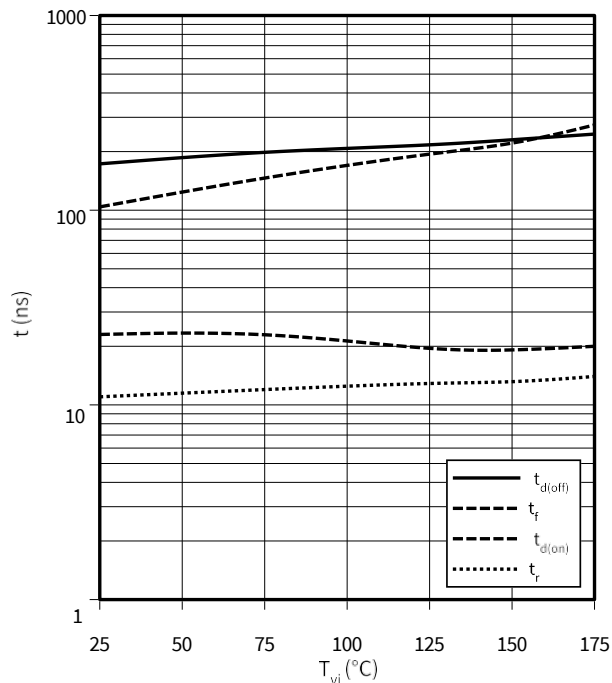


4 特性图

Typical switching times as a function of junction temperature, IGBT

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

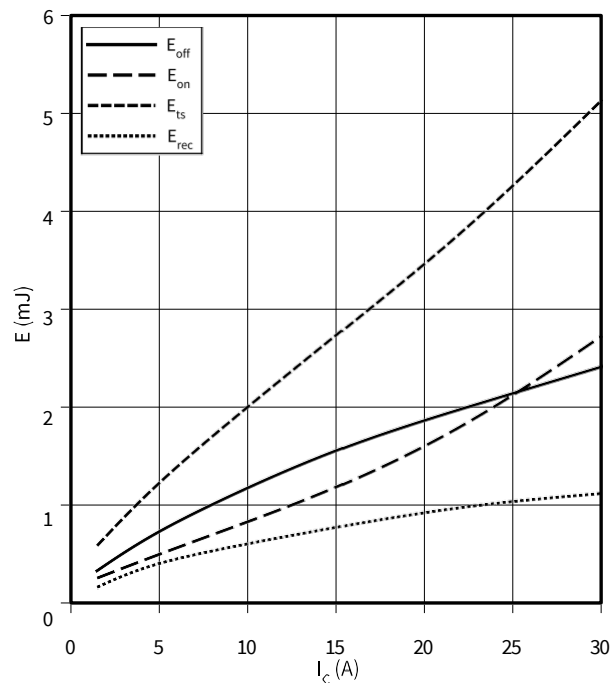
$I_C = 15.0 \text{ A}$, $V_{CE} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 10.0 \Omega$



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

$$E = f(I_C)$$

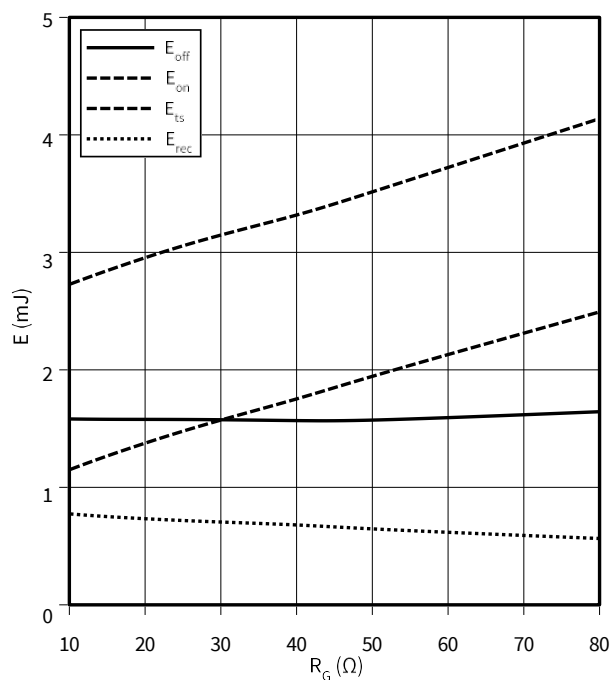
$V_{CE} = 600 \text{ V}$, $T_{vj} = 175 \text{ }^{\circ}\text{C}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 10.0 \Omega$



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

$$E = f(R_G)$$

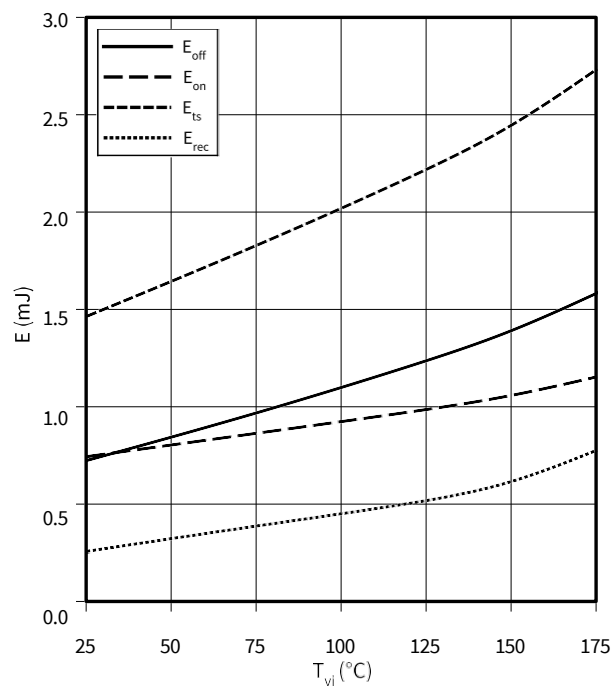
$I_C = 15.0 \text{ A}$, $V_{CE} = 600 \text{ V}$, $T_{vj} = 175 \text{ }^{\circ}\text{C}$, $V_{GE} = 0/15 \text{ V}$



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

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

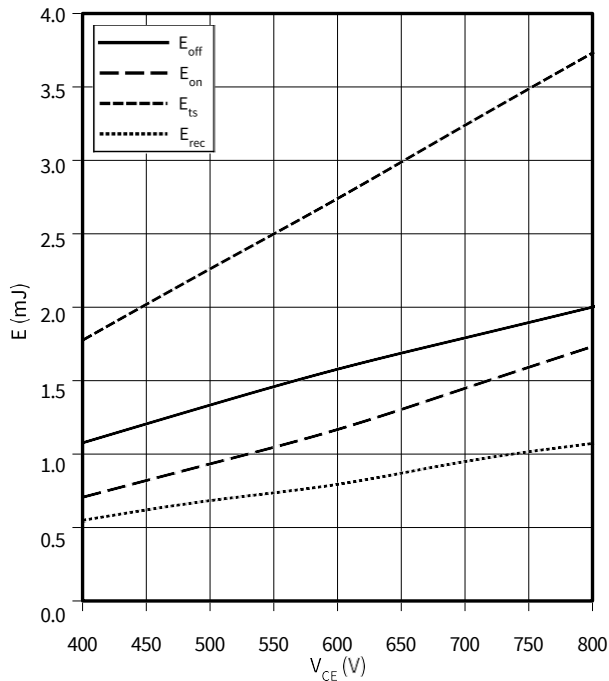
$I_C = 15.0 \text{ A}$, $V_{CE} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 10.0 \Omega$



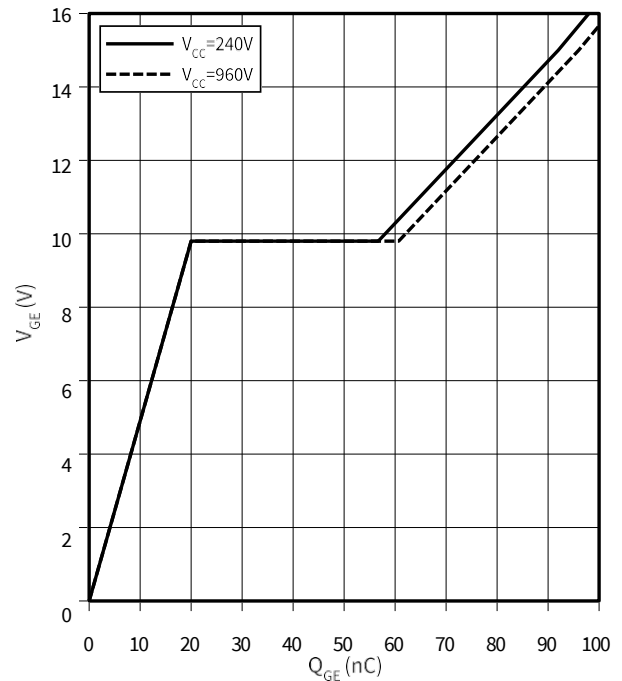
4 特性图

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

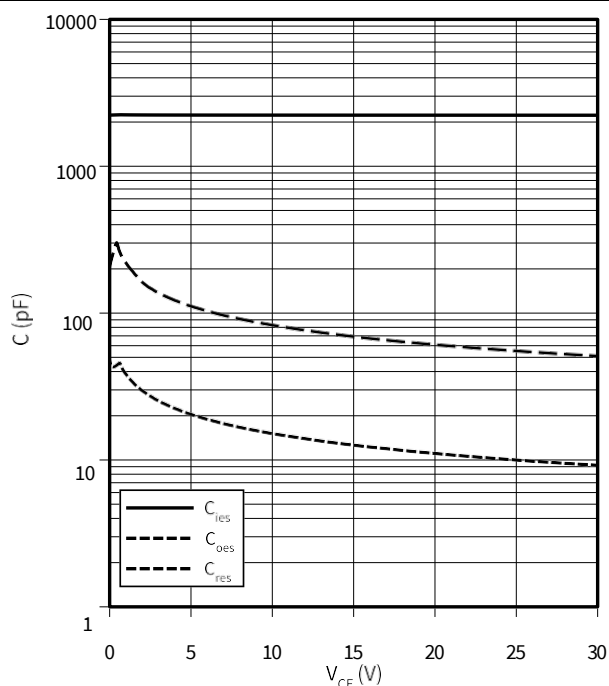
$$E = f(V_{CE})$$

 $I_C = 15.0 \text{ A}, T_{vj} = 175 \text{ }^\circ\text{C}, V_{GE} = 0/15 \text{ V}, R_G = 10.0 \text{ } \Omega$

Typical gate charge, IGBT

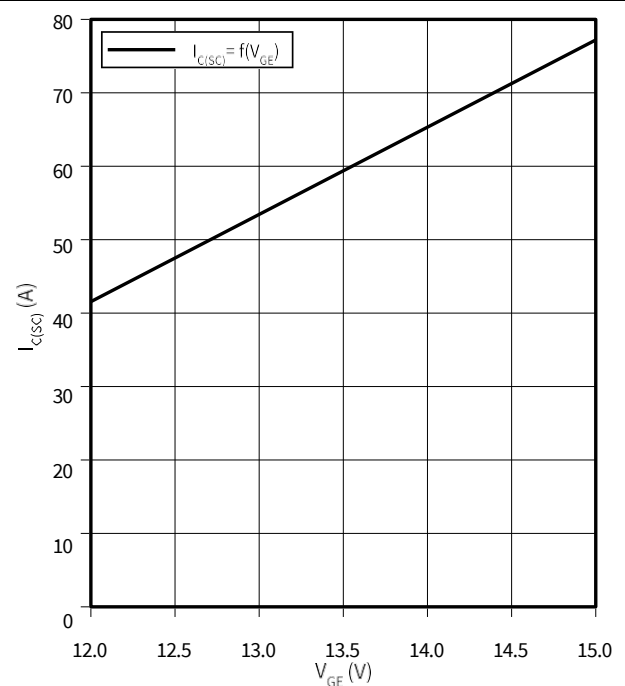
$$V_{GE} = f(Q_{GE})$$

 $I_C = 15.0 \text{ A}$

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

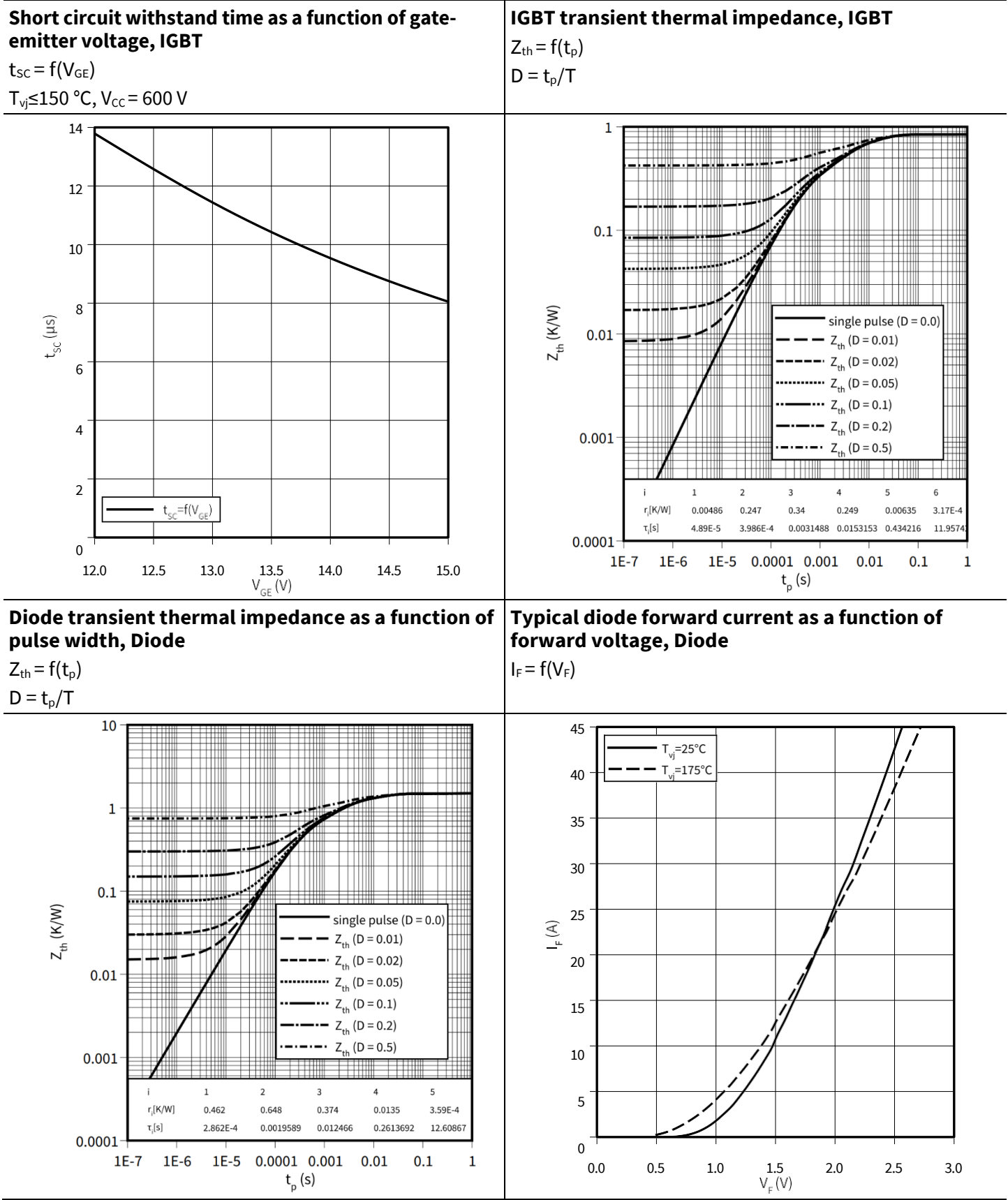
$$C = f(V_{CE})$$

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

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

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

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


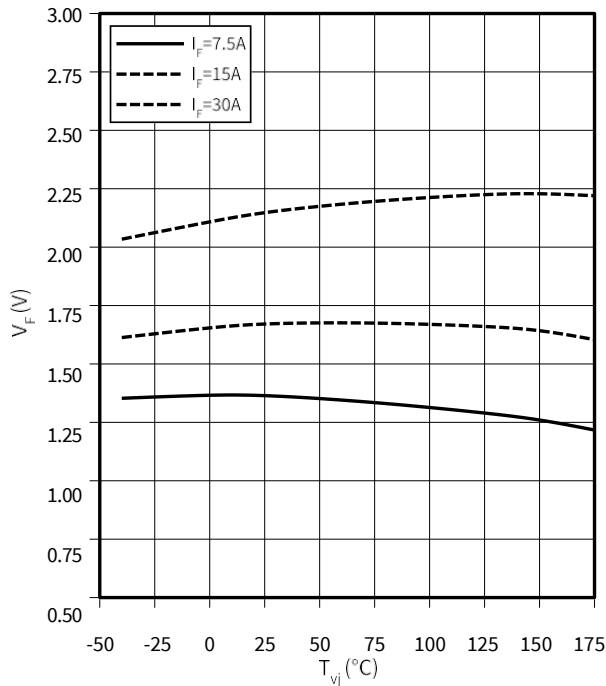
4 特性图



4 特性图

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

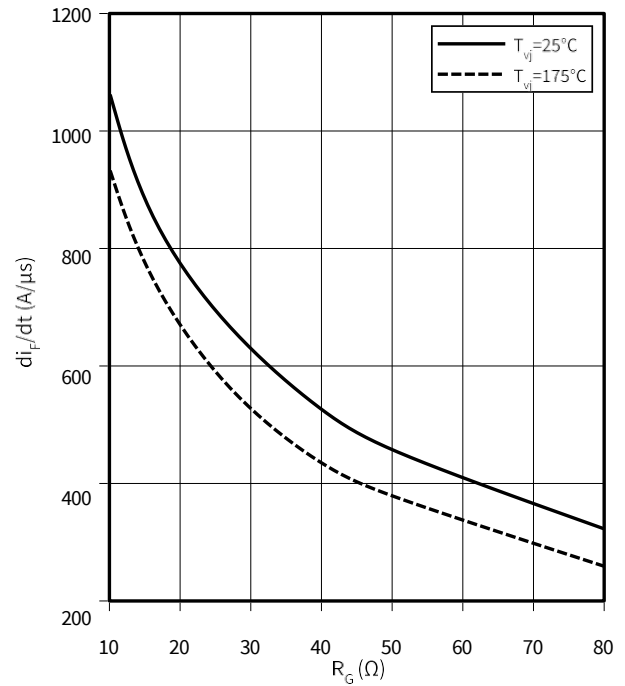
$$V_F = f(T_{vj})$$



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

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

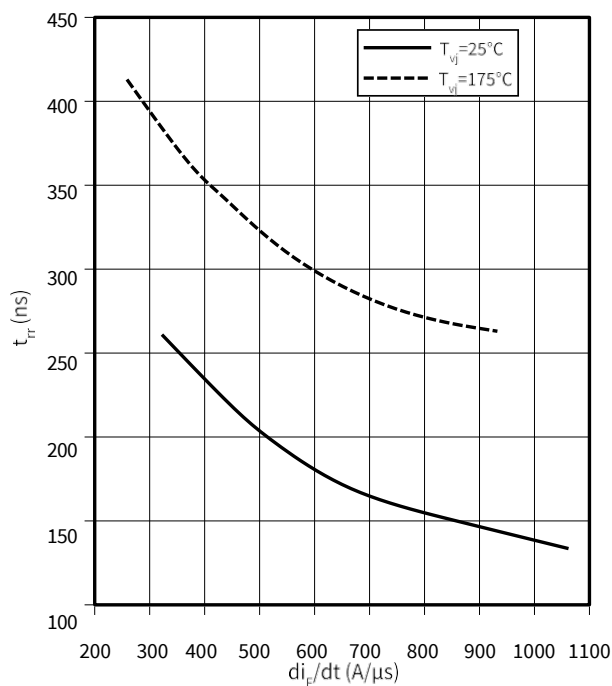
$$I_C = 15.0 A, V_{CE} = 600 V, V_{GE} = 0/15 V$$



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

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

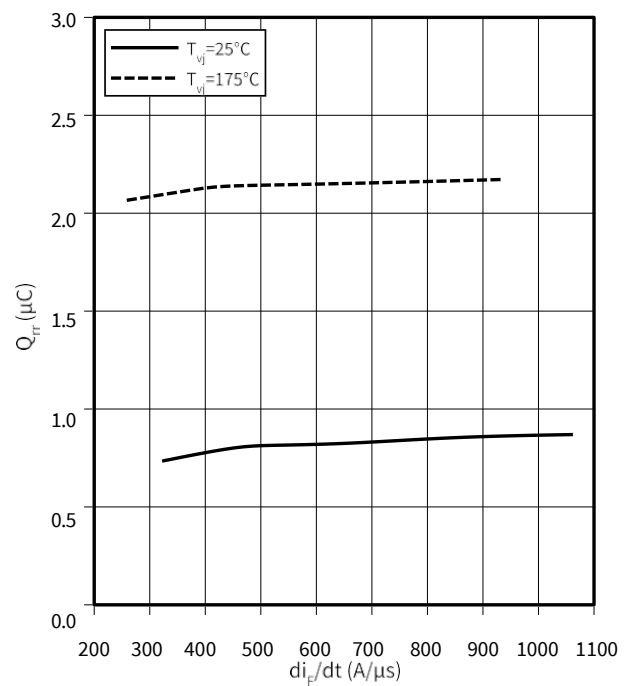
$$V_R = 600 V, I_F = 15.0 A$$



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

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

$$V_R = 600 V, I_F = 15.0 A$$

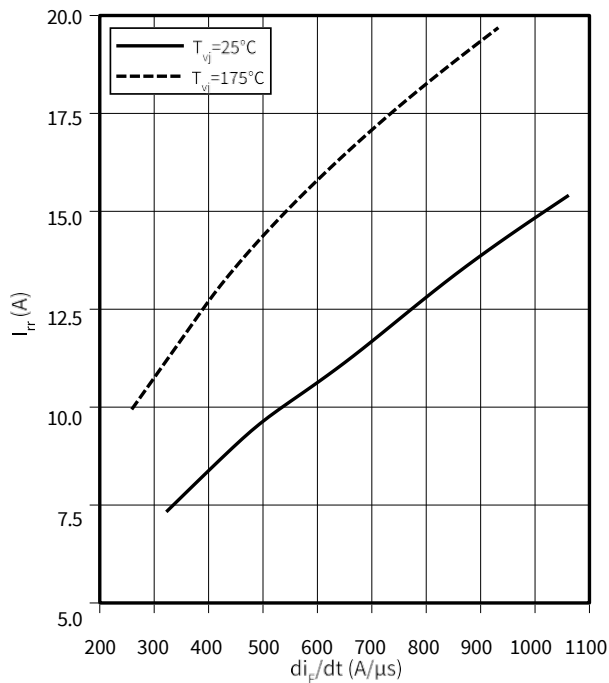


4 特性图

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

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

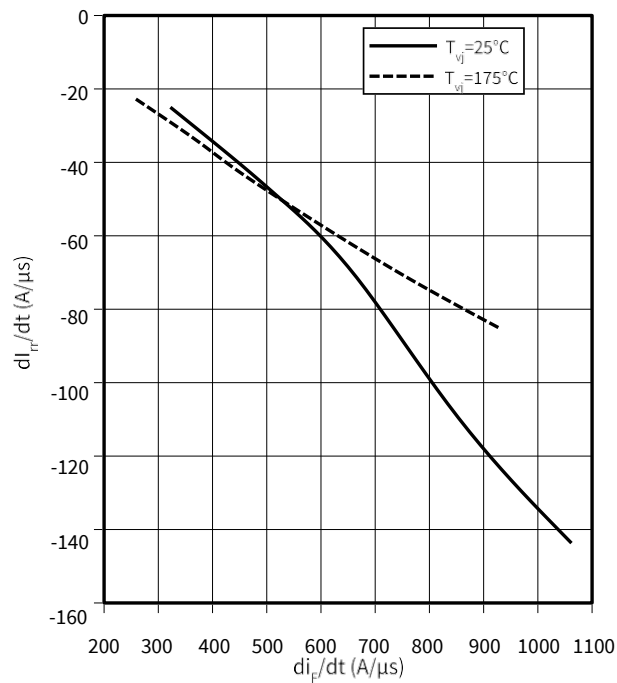
$V_R = 600 \text{ V}$, $I_F = 15.0 \text{ A}$



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

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

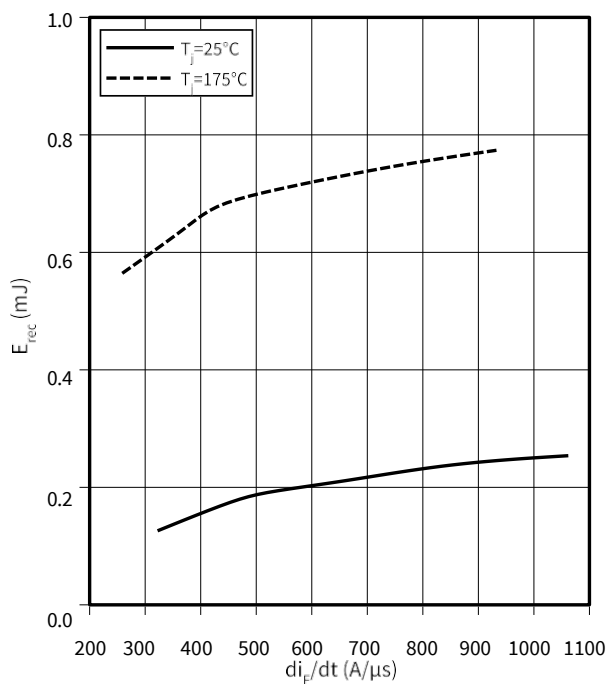
$V_R = 600 \text{ V}$, $I_F = 15.0 \text{ A}$



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

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

$V_R = 600 \text{ V}$, $I_F = 15.0 \text{ A}$



5 封装外形

5 封装外形

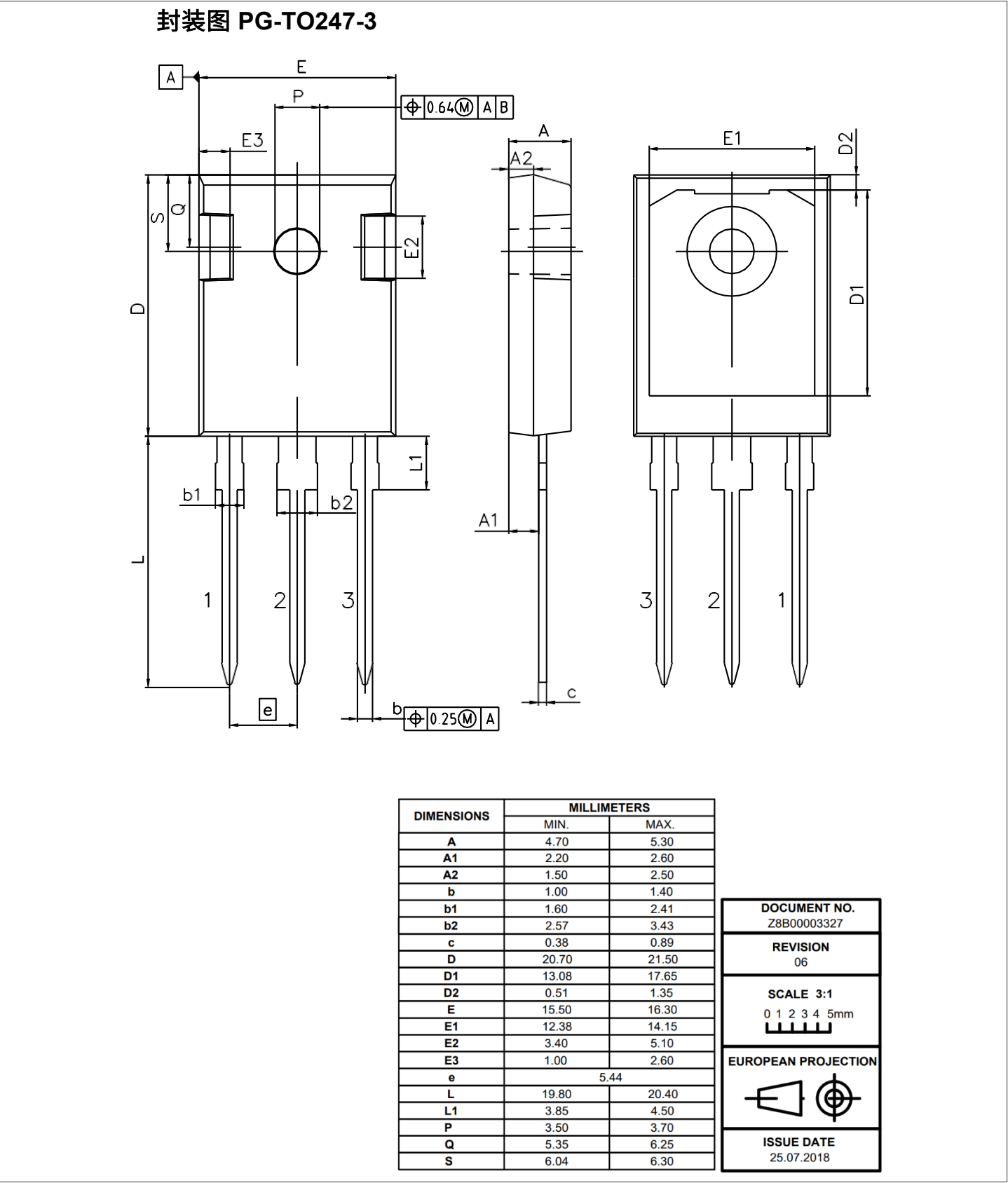


图 6.

6 测试条件

6 测试条件

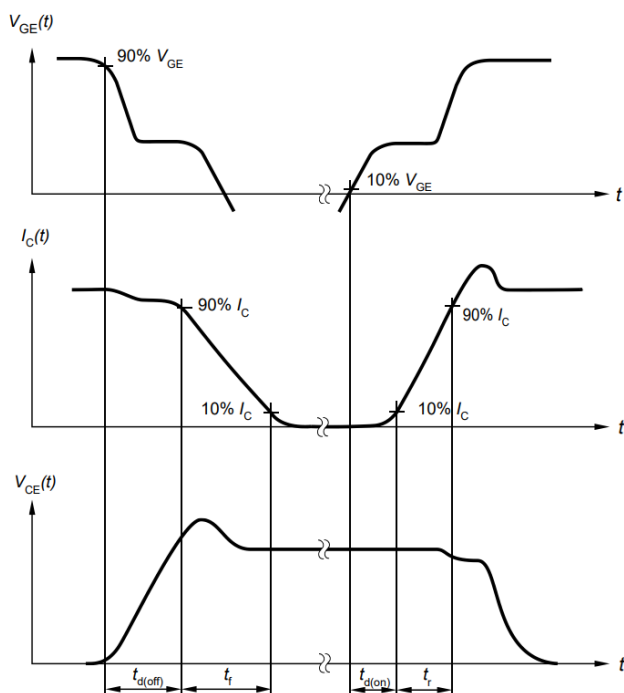


Figure A. Definition of switching times

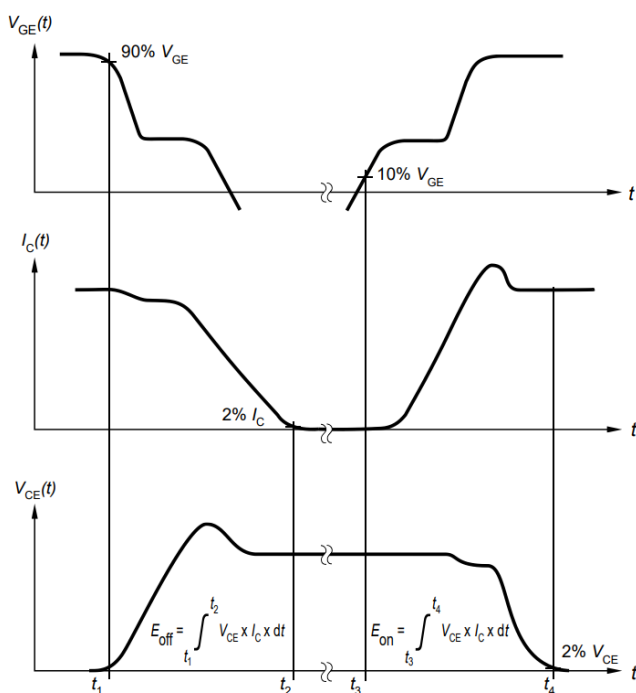


Figure B. Definition of switching losses

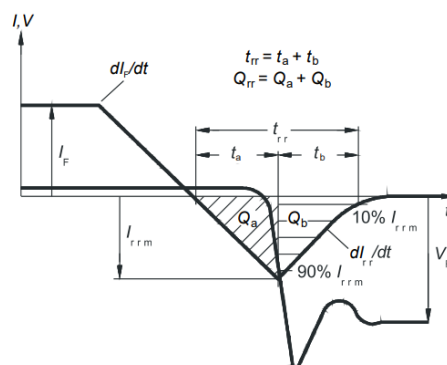


Figure C. Definition of diode switching characteristics

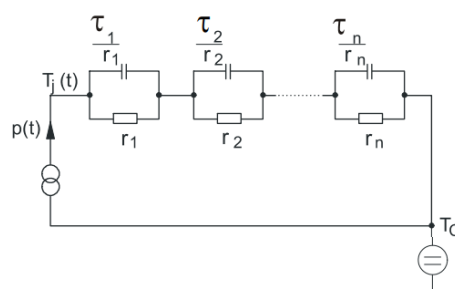


Figure D. Thermal equivalent circuit

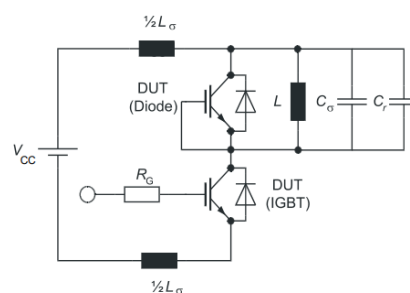


Figure E. **Dynamic test circuit**
Parasitic inductance L_{σ} ,
parasitic capacitor C_{σ} ,
relief capacitor C_r ,
(only for ZVT switching)



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