

英飞凌高速 1200 V TRENCHSTOP™ IGBT 7 技术，集成全额定电流、软换向、

超快速恢复和低 Q_{rr} 发射极控制 7 快速二极管

特性

- $V_{CE} = 1200\text{ V}$
- $I_C = 140\text{ A}$
- 最高结温 $T_{vjmax} = 175^\circ\text{C}$
- 一流的高速 IGBT，集成全额定电流、低 Q_{rr} 和软换向高速二极管
- 低饱和电压 $V_{CEsat} = 1.7\text{ V}$ ，测于 $T_{vj} = 25^\circ\text{C}$ 时
- 针对高速硬开关拓扑（2-L 逆变器、3-L NPC T 型等）进行了优化，提高了效率
- 由于 V_{CEsat} 具有正温度系数，因此易于并联
- 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/>

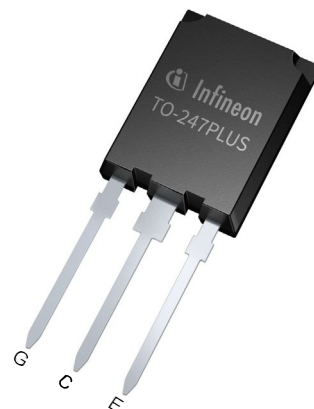
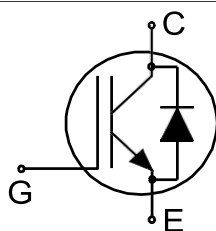
潜在应用

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

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
IKQ140N120CH7	PG-TO247-3-PLUS-NN3.7	K140MCH7



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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_{sld}	wave soldering 1.6 mm (0.063 in.) from case for 10 s			260	°C
Thermal resistance, junction-ambient	$R_{th(j-a)}$				40	K/W
IGBT thermal resistance, junction-case	$R_{th(j-c)}$			0.12	0.16	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$			0.21	0.27	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	$T_c = 25\text{ °C}$	175	A
			$T_c = 100\text{ °C}$	154	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			560	A
Turn-off safe operating area		$V_{CC} \leq 800\text{ V}$, $V_{CE,peak} < 1200\text{ V}$, $V_{GE} = 0/15\text{ V}$, $R_{Goff} \geq 2.9\text{ }\Omega$, $T_{vj} \leq 175\text{ °C}$		560	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
Power dissipation	P_{tot}		$T_c = 25\text{ °C}$	962	W
			$T_c = 100\text{ °C}$	481	

表3 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 140\text{ A}$, $V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$		1.7	2.15	V
			$T_{vj} = 175\text{ °C}$		2		

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表 3 (续) 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Gate-emitter threshold voltage	V_{GEth}	$I_C = 2.24 \text{ mA}$, $V_{CE} = V_{GE}$		4.7	5.5	6.2	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
			$T_{vj} = 175^\circ\text{C}$		17500		
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = 20 \text{ V}$				100	nA
Transconductance	g_{fs}	$I_C = 140 \text{ A}$, $V_{CE} = 20 \text{ V}$			251		S
Input capacitance	C_{ies}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$			18.5		nF
Output capacitance	C_{oes}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$			317		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$			94		pF
Gate charge	Q_G	$V_{CC} = 960 \text{ V}$, $I_C = 140 \text{ A}$, $V_{GE} = 15 \text{ V}$			970		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 4.8 \Omega$, $R_{G(off)} = 4.8 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_C = 140 \text{ A}$		68		ns
			$T_{vj} = 175^\circ\text{C}$, $I_C = 140 \text{ A}$		63		
Rise time (inductive load)	t_r	$V_{CC} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 4.8 \Omega$, $R_{G(off)} = 4.8 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_C = 140 \text{ A}$		55		ns
			$T_{vj} = 175^\circ\text{C}$, $I_C = 140 \text{ A}$		46		
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 4.8 \Omega$, $R_{G(off)} = 4.8 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_C = 140 \text{ A}$		541		ns
			$T_{vj} = 175^\circ\text{C}$, $I_C = 140 \text{ A}$		619		
Fall time (inductive load)	t_f	$V_{CC} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 4.8 \Omega$, $R_{G(off)} = 4.8 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_C = 140 \text{ A}$		21		ns
			$T_{vj} = 175^\circ\text{C}$, $I_C = 140 \text{ A}$		92		
Turn-on energy	E_{on}	$V_{CC} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 4.8 \Omega$, $R_{G(off)} = 4.8 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_C = 140 \text{ A}$		8.84		mJ
			$T_{vj} = 175^\circ\text{C}$, $I_C = 140 \text{ A}$		11.8		
Turn-off energy	E_{off}	$V_{CC} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{G(on)} = 4.8 \Omega$, $R_{G(off)} = 4.8 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_C = 140 \text{ A}$		3.38		mJ
			$T_{vj} = 175^\circ\text{C}$, $I_C = 140 \text{ A}$		6.71		

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3 二极管

表 3 (续) 特征值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Total switching energy	E_{ts}	$V_{CC} = 600 \text{ V}$, $V_{GE} = 15 \text{ V}$, $R_{G(on)} = 4.8 \Omega$, $R_{G(off)} = 4.8 \Omega$		12.2		mJ
				18.5		
Operating junction temperature	T_{vj}		-40		175	°C

注：电气特性，在 $T_{vj} = 25^\circ\text{C}$ 条件下测得，除非另有规定。

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	$T_c = 25^\circ\text{C}$	A
			$T_c = 91^\circ\text{C}$	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}		560	A
Power dissipation	P_{tot}	$T_c = 25^\circ\text{C}$	549	W
		$T_c = 100^\circ\text{C}$	275	

表5 特征值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Diode forward voltage	V_F	$I_F = 140 \text{ A}$		2.5	3	V
				2.3		
Diode reverse recovery time	t_{rr}	$V_R = 600 \text{ V}$, $R_{G(on)} = 4.8 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_F = 140 \text{ A}$	144		ns
			$T_{vj} = 175^\circ\text{C}$, $I_F = 140 \text{ A}$	227		
Diode reverse recovery charge	Q_{rr}	$V_R = 600 \text{ V}$, $R_{G(on)} = 4.8 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_F = 140 \text{ A}$	3.82		μC
			$T_{vj} = 175^\circ\text{C}$, $I_F = 140 \text{ A}$	11.5		
Diode peak reverse recovery current	I_{rrm}	$V_R = 600 \text{ V}$, $R_{G(on)} = 4.8 \Omega$	$T_{vj} = 25^\circ\text{C}$, $I_F = 140 \text{ A}$	53		A
			$T_{vj} = 175^\circ\text{C}$, $I_F = 140 \text{ A}$	101		

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表 5 (续) 特征值

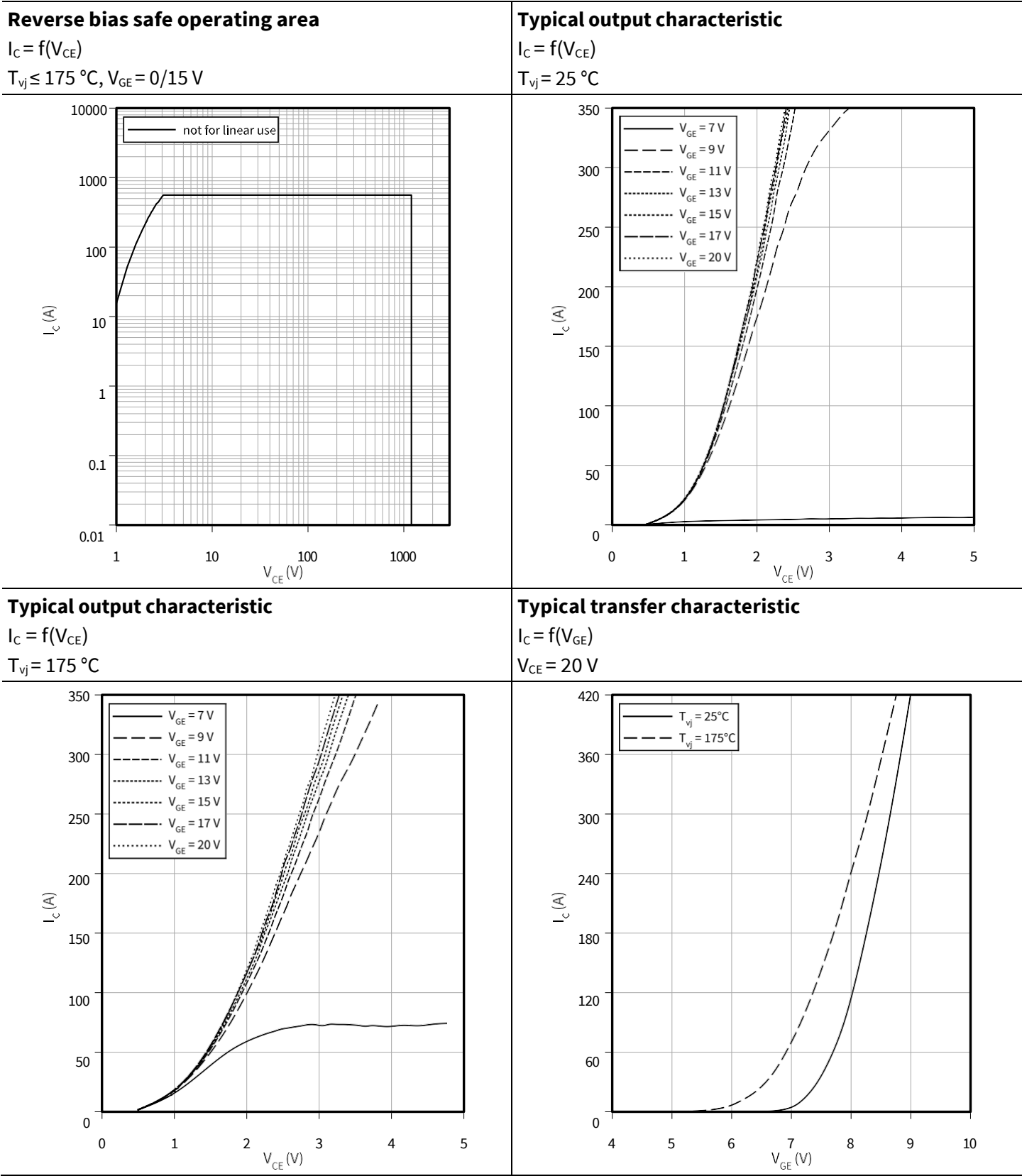
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode peak rate of fall of reverse recovery current	di_{rr}/dt	$V_R = 600 \text{ V}, R_{G(on)} = 4.8 \text{ } \Omega$	$T_{vj} = 25 \text{ } ^\circ\text{C}, I_F = 140 \text{ A}$		-529		A/ μs
			$T_{vj} = 175 \text{ } ^\circ\text{C}, I_F = 140 \text{ A}$		-646		
Reverse recovery energy	E_{rec}	$V_R = 600 \text{ V}, R_{G(on)} = 4.8 \text{ } \Omega$	$T_{vj} = 25 \text{ } ^\circ\text{C}$		1.12		mJ
			$T_{vj} = 175 \text{ } ^\circ\text{C}$		3.81		
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 $L_\sigma = 30 \text{ nH}$, $C_\sigma = 18 \text{ pF}$

4 特性图

4 特性图

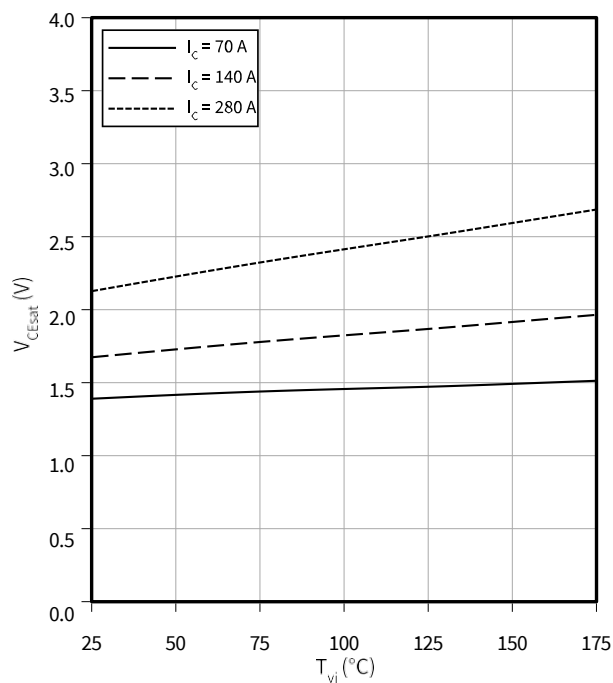


4 特性图

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

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

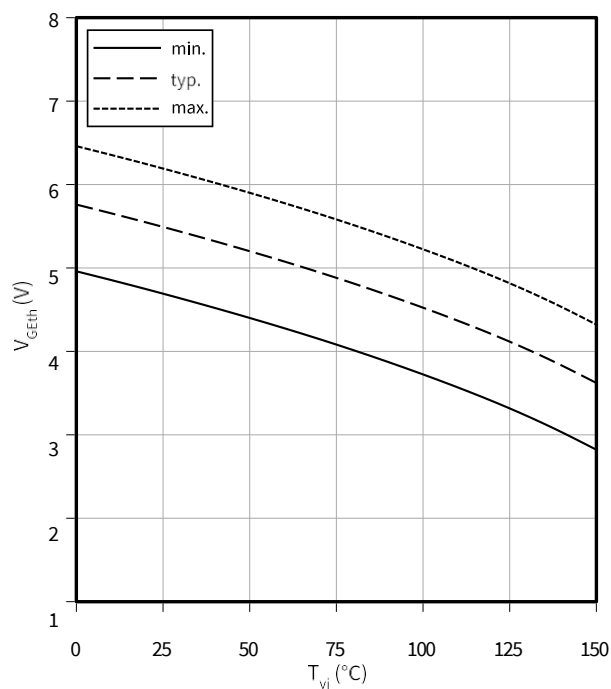
$$V_{GE} = 15 \text{ V}$$



Gate-emitter threshold voltage as a function of junction temperature

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

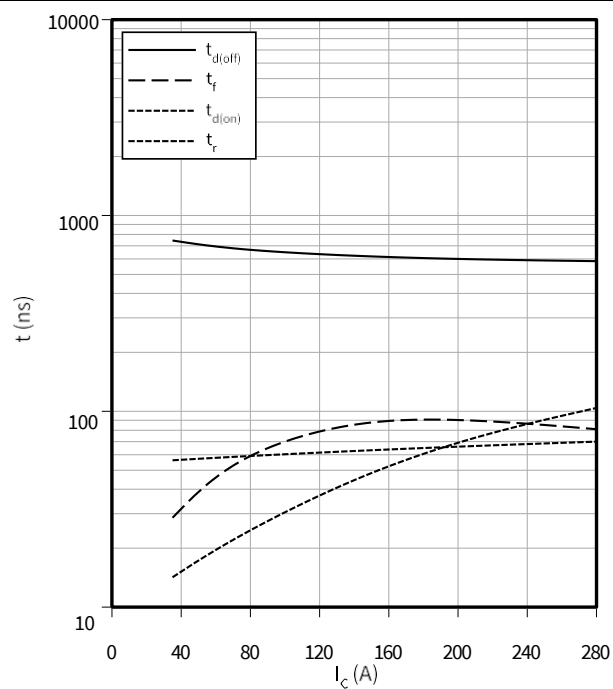
$$I_c = 2.24 \text{ mA}$$



Typical switching times as a function of collector current

$$t = f(I_c)$$

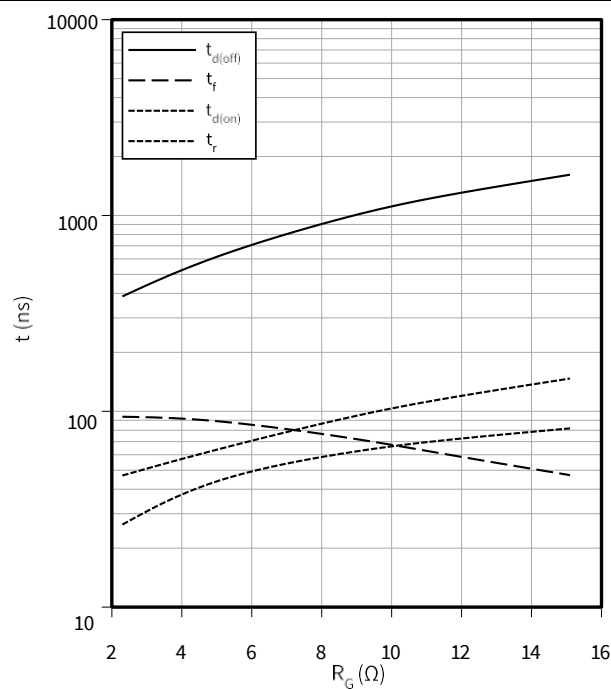
$$V_{CC} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}, R_G = 4.8 \text{ } \Omega$$



Typical switching times as a function of gate resistor

$$t = f(R_G)$$

$$I_c = 140 \text{ A}, V_{CC} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}$$

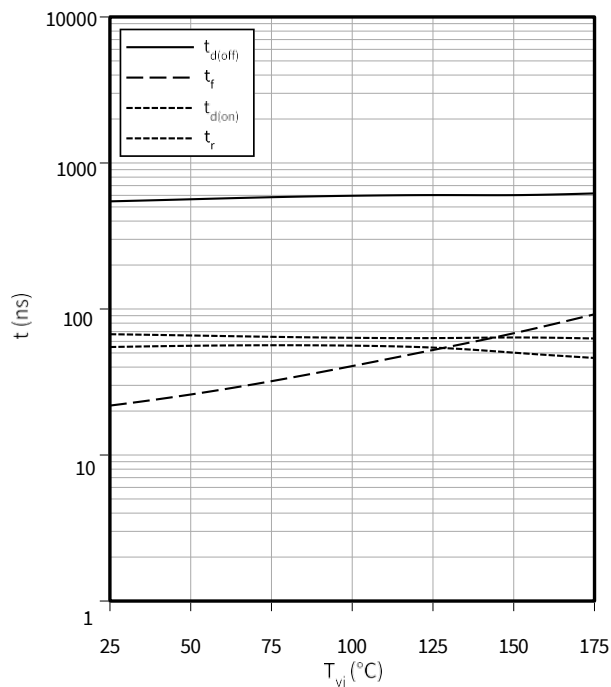


4 特性图

Typical switching times as a function of junction temperature

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

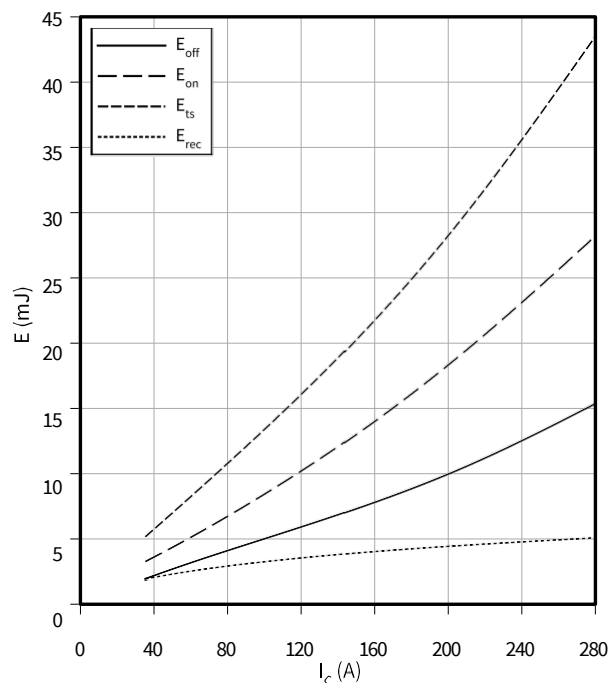
$I_C = 140 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 4.8 \Omega$



Typical switching energy losses as a function of collector current

$$E = f(I_C)$$

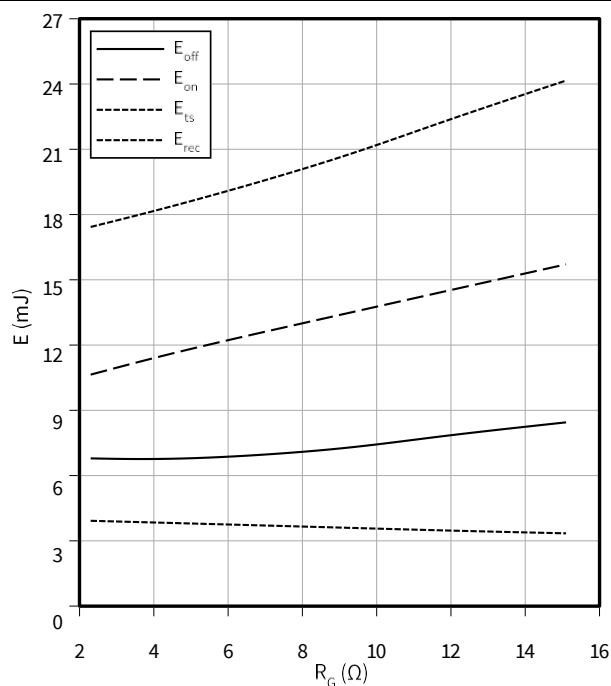
$V_{CC} = 600 \text{ V}$, $T_{vj} = 175 \text{ °C}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 4.8 \Omega$



Typical switching energy losses as a function of gate resistor

$$E = f(R_G)$$

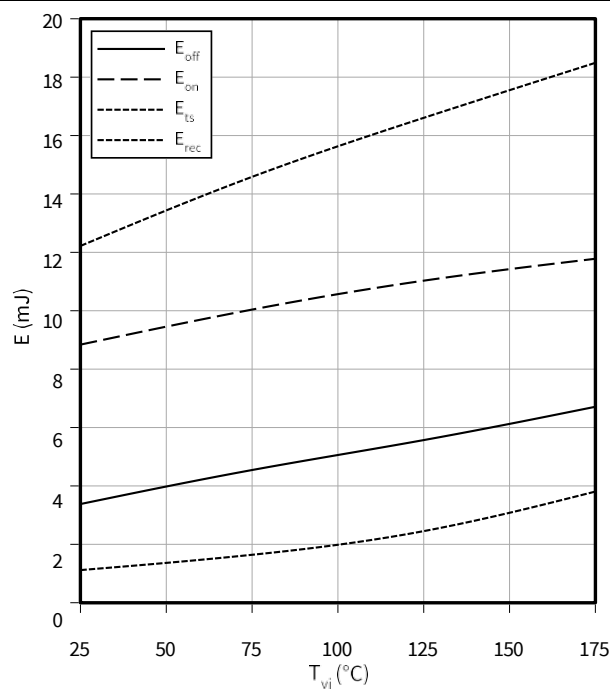
$I_C = 140 \text{ A}$, $V_{CC} = 600 \text{ V}$, $T_{vj} = 175 \text{ °C}$, $V_{GE} = 0/15 \text{ V}$



Typical switching energy losses as a function of junction temperature

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

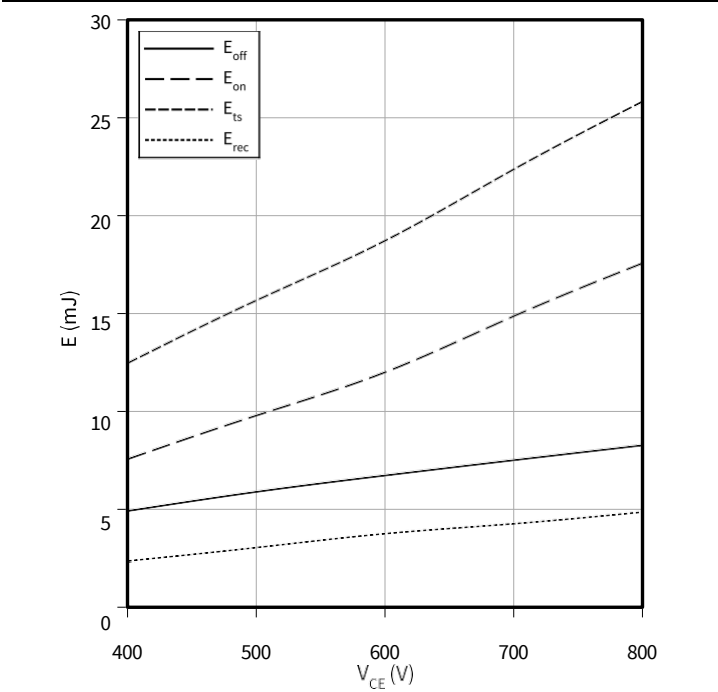
$I_C = 140 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 4.8 \Omega$



4 特性图

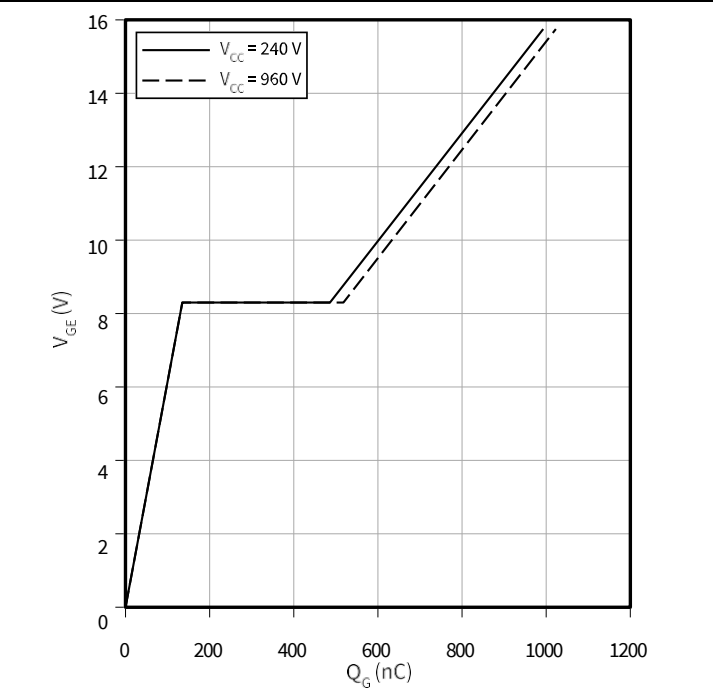
Typical switching energy losses as a function of collector emitter voltage

$E = f(V_{CE})$
 $I_C = 140\text{ A}$, $V_{GE} = 0/15\text{ V}$, $T_{vj} = 175\text{ }^{\circ}\text{C}$, $R_G = 4.8\text{ }\Omega$



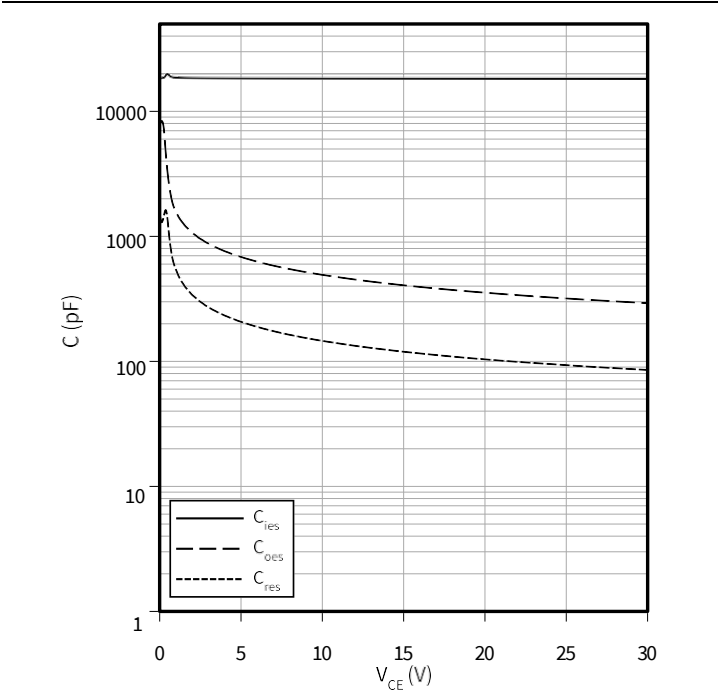
Typical gate charge

$V_{GE} = f(Q_G)$
 $I_C = 140\text{ A}$



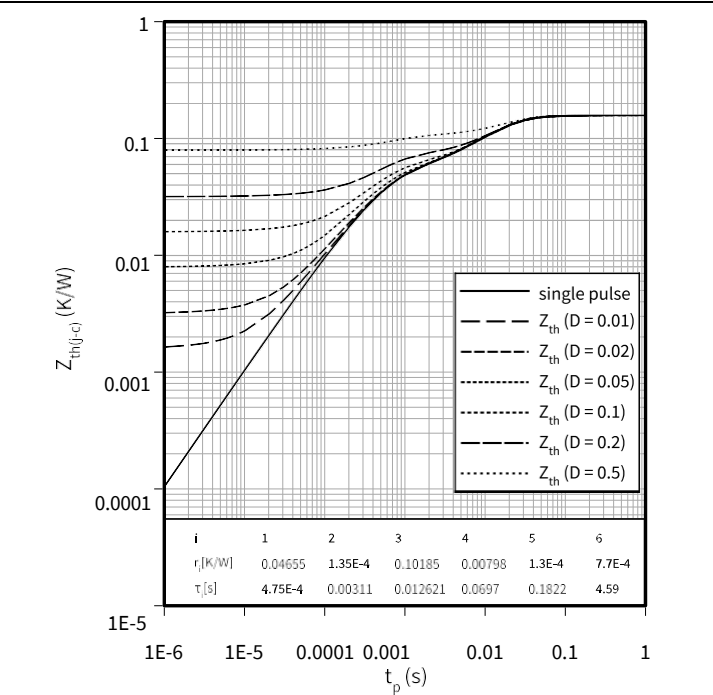
Typical capacitance as a function of collector-emitter voltage

$C = f(V_{CE})$
 $f = 100\text{ kHz}$, $V_{GE} = 0\text{ V}$



IGBT transient thermal impedance as a function of pulse width

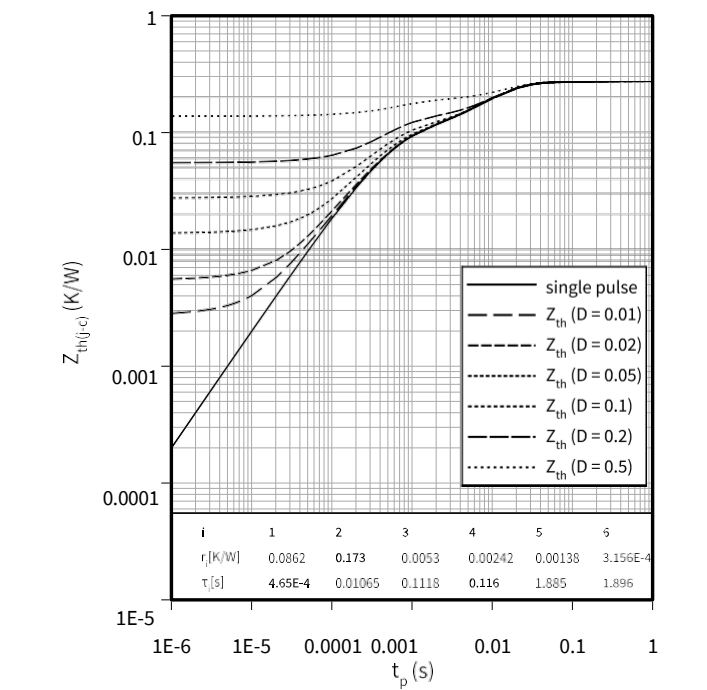
$Z_{th(j-c)} = f(t_p)$
 $D = t_p/T$



4 特性图

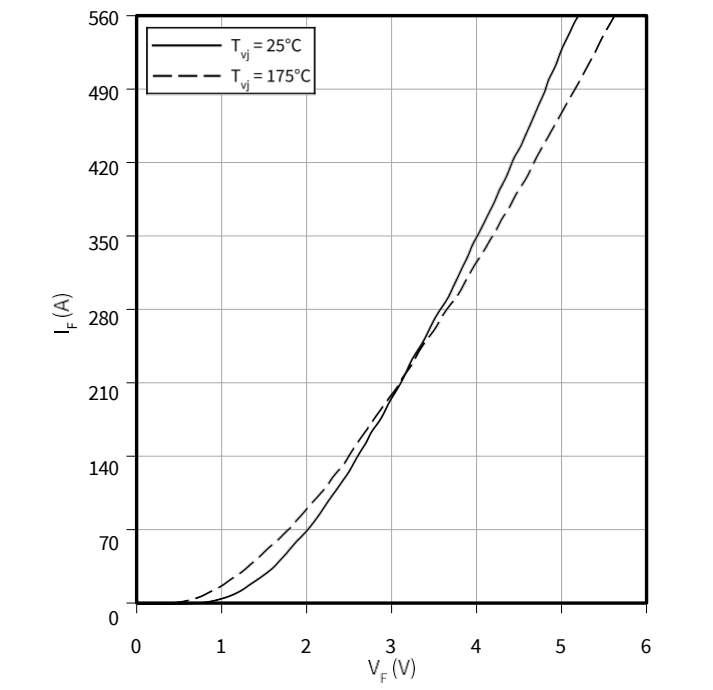
Diode transient thermal impedance as a function of pulse width

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



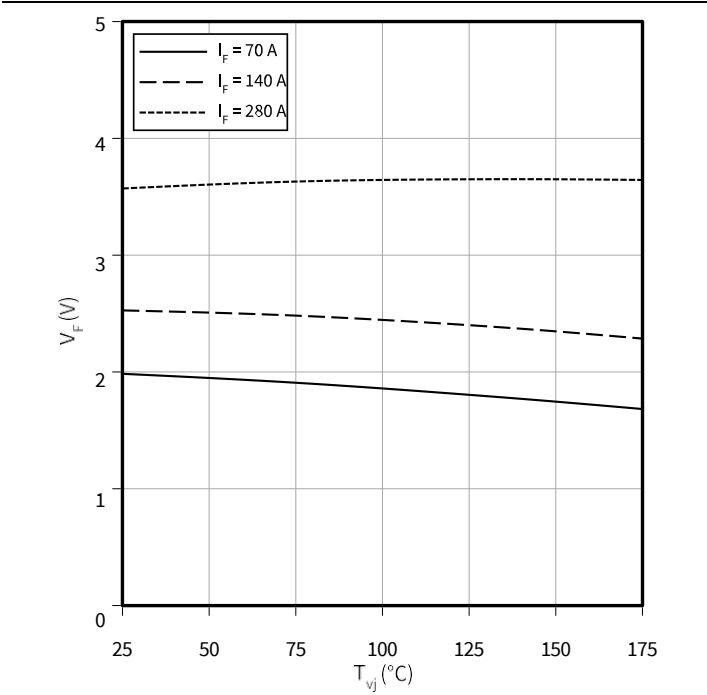
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



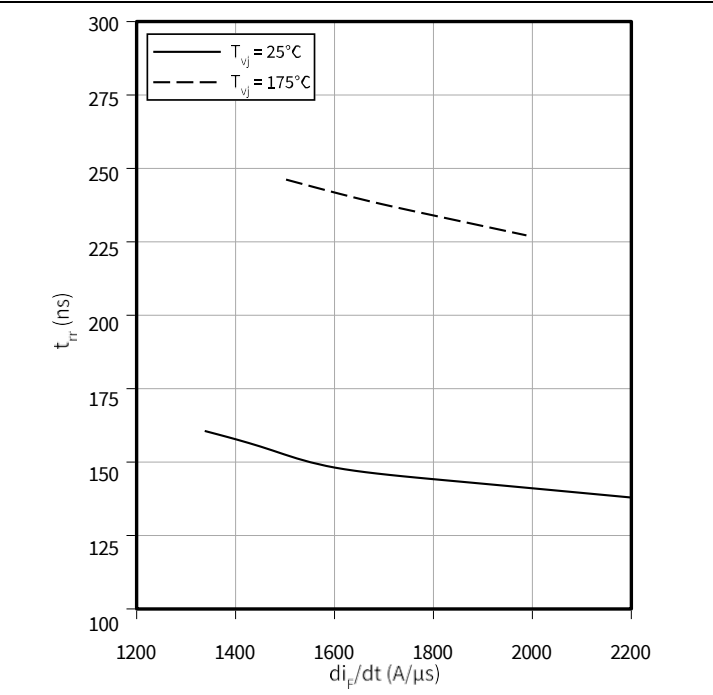
Typical diode forward voltage as a function of junction temperature

$V_F = f(T_{vj})$



Typical reverse recovery time as a function of diode current slope

$t_{rr} = f(di_F/dt)$
 $V_R = 600\text{ V}, I_F = 140\text{ A}$

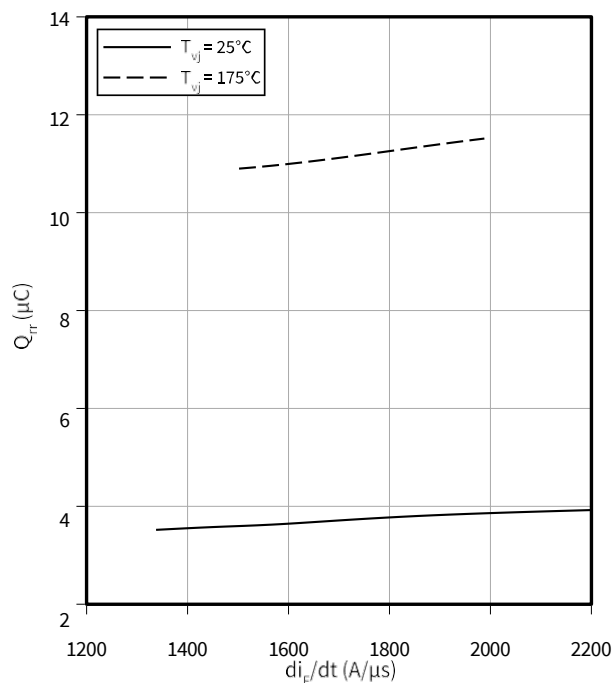


4 特性图

Typical reverse recovery charge as a function of diode current slope

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

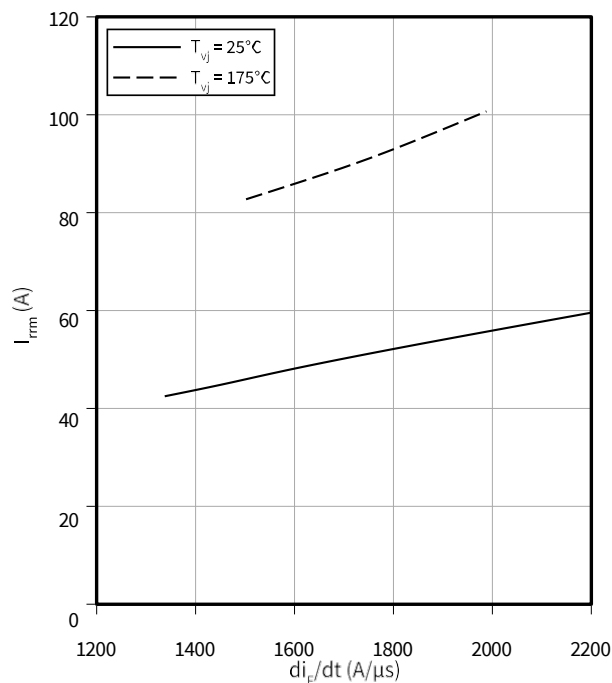
$V_R = 600 \text{ V}$, $I_F = 140 \text{ A}$



Typical reverse recovery current as a function of diode current slope

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

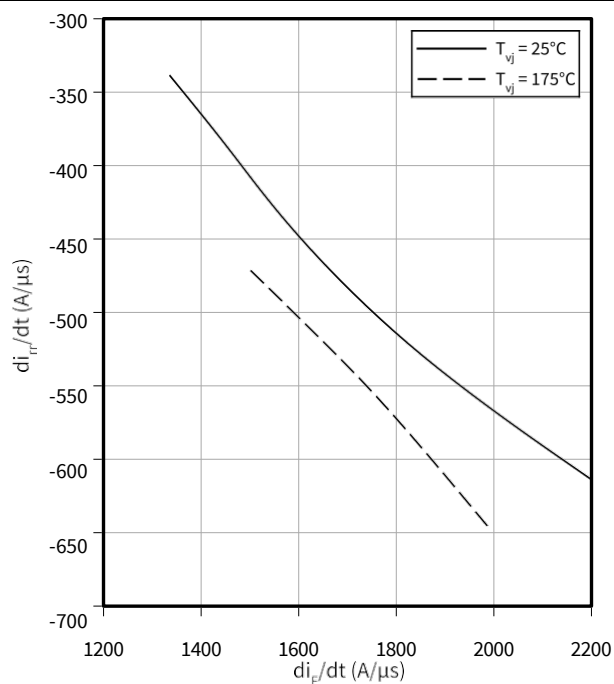
$V_R = 600 \text{ V}$, $I_F = 140 \text{ A}$



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

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

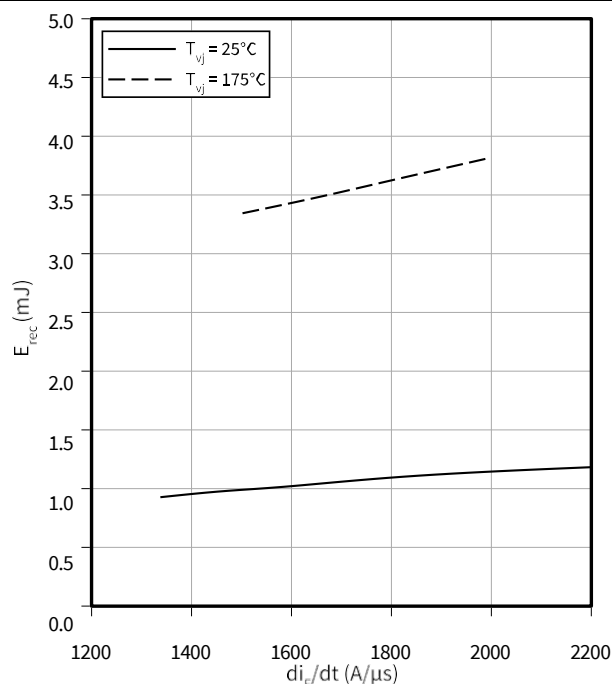
$V_R = 600 \text{ V}$, $I_F = 140 \text{ A}$



Typical reverse energy losses as a function of diode current slope

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

$V_R = 600 \text{ V}$, $I_F = 140 \text{ A}$

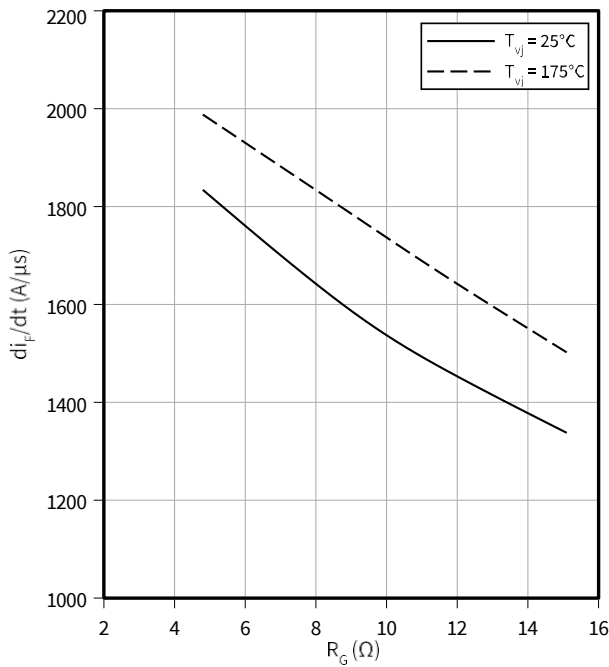


4 特性图

Typical diode current slope as a function of gate resistor

$di_F/dt = f(R_G)$

$V_R = 600\text{ V}$, $I_F = 140\text{ A}$



5 封装外形

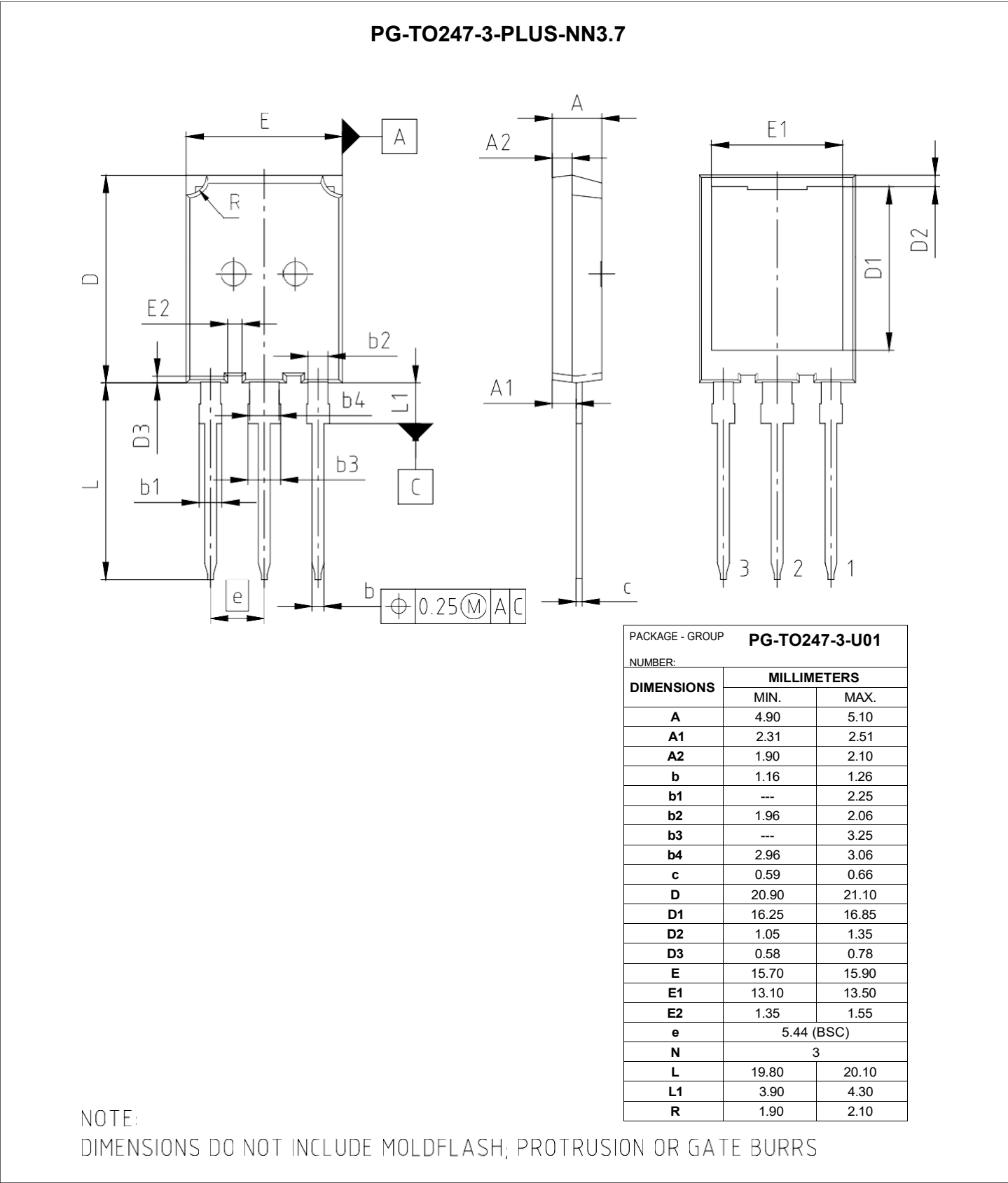


图 1

6 测试条件

6 测试条件

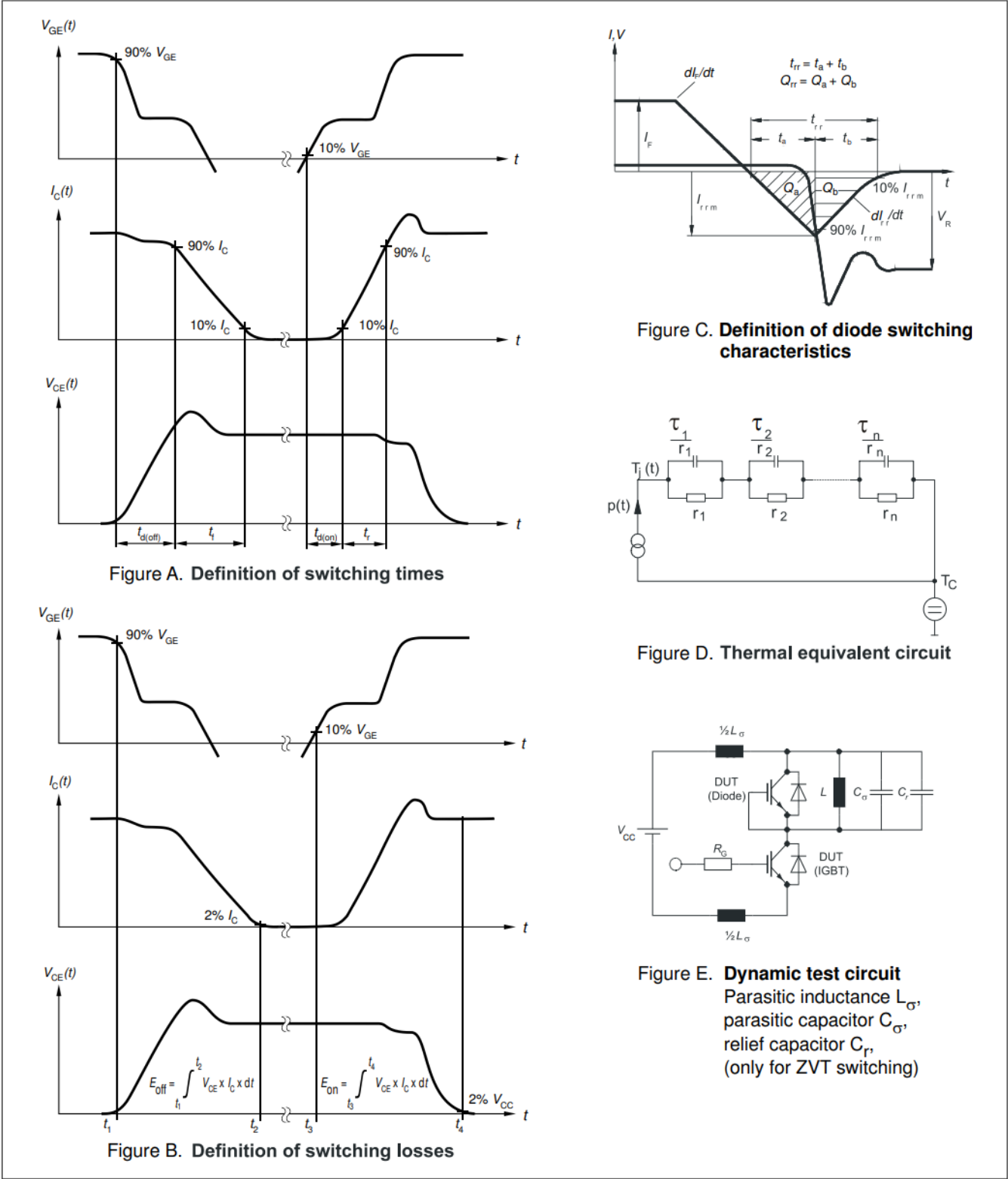


图 2

修订记录

修订记录

Document revision	Date of release	Description of changes
0.10	2022-05-02	Target datasheet
0.20	2022-06-01	Editorial changes
1.00	2022-11-25	Final datasheet
1.10	2023-01-20	Change of product outline drawing on page 14
1.20	2023-07-03	Figure on page 11 updated Editorial changes



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