

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

- $V_{CE} = 1200\text{ V}$
- $I_C = 40\text{ A}$
- 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/>

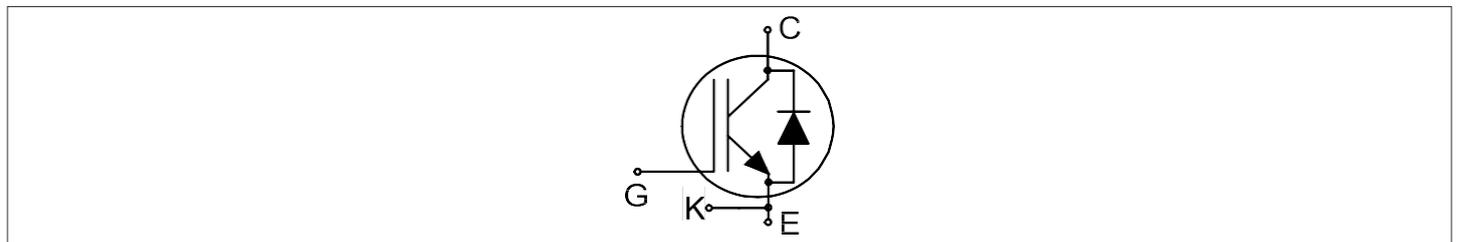
### 潜在应用

- 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
IKZA40N120CH7	PG-TO247-4-STD-NT3.7	K40MCH7

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://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 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 process: 3			0.6	Nm
Thermal resistance, junction-ambient	$R_{th(j-a)}$				40	K/W
IGBT thermal resistance, junction-case	$R_{th(j-c)}$			0.35	0.46	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$			0.6	0.78	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	$T_c = 25\text{ °C}$	95	A
			$T_c = 100\text{ °C}$	70	
Pulsed collector current, $t_p$ limited by $T_{vjmax}$	$I_{Cpulse}$		160	A	
Turn-off safe operating area		$V_{CC} \leq 800\text{ V}$ , $V_{GE} = 0/15\text{ V}$ , $R_{Goff} \geq 27\ \Omega$ , $T_{vj} \leq 175\text{ °C}$	160	A	
Gate-emitter voltage	$V_{GE}$		$\pm 20$	V	
Transient gate-emitter voltage	$V_{GE}$	$t_p \leq 0.5\ \mu\text{s}$ , $D < 0.001$	$\pm 25$	V	
Power dissipation	$P_{tot}$	$T_c = 25\text{ °C}$	330	W	
		$T_c = 100\text{ °C}$	165		

**表 3 特征值**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CEsat}$	$I_C = 40\text{ A}$ , $V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$	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	$V_{GEth}$	$I_C = 0.64 \text{ mA}, V_{CE} = V_{GE}$	4.7	5.5	6.2	V
Zero gate-voltage collector current	$I_{CES}$	$V_{CE} = 1200 \text{ V}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		40	$\mu\text{A}$
			$T_{vj} = 175 \text{ }^\circ\text{C}$		2600	
Gate-emitter leakage current	$I_{GES}$	$V_{CE} = 0 \text{ V}, V_{GE} = 20 \text{ V}$			100	nA
Transconductance	$g_{fs}$	$I_C = 40 \text{ A}, V_{CE} = 20 \text{ V}$		93		S
Input capacitance	$C_{ies}$	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$		5		nF
Output capacitance	$C_{oes}$	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$		108		pF
Reverse transfer capacitance	$C_{res}$	$V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}, f = 100 \text{ kHz}$		30		pF
Gate charge	$Q_G$	$I_C = 40 \text{ A}, V_{GE} = 15 \text{ V}, V_{CC} = 960 \text{ V}$		290		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 600 \text{ V}, V_{GE} = 0/15 \text{ V},$ $R_{G(on)} = 10 \text{ } \Omega,$ $R_{G(off)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$	34		ns
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$		31	
Rise time (inductive load)	$t_r$	$V_{CC} = 600 \text{ V}, V_{GE} = 0/15 \text{ V},$ $R_{G(on)} = 10 \text{ } \Omega,$ $R_{G(off)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$	13		ns
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$		15	
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 600 \text{ V}, V_{GE} = 0/15 \text{ V},$ $R_{G(on)} = 10 \text{ } \Omega,$ $R_{G(off)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$	360		ns
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$		435	
Fall time (inductive load)	$t_f$	$V_{CC} = 600 \text{ V}, V_{GE} = 0/15 \text{ V},$ $R_{G(on)} = 10 \text{ } \Omega,$ $R_{G(off)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$	40		ns
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$		117	
Turn-on energy	$E_{on}$	$V_{CC} = 600 \text{ V}, V_{GE} = 0/15 \text{ V},$ $R_{G(on)} = 10 \text{ } \Omega,$ $R_{G(off)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$	0.97		mJ
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$		1.57	
Turn-off energy	$E_{off}$	$V_{CC} = 600 \text{ V}, V_{GE} = 0/15 \text{ V},$ $R_{G(on)} = 10 \text{ } \Omega,$ $R_{G(off)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$	1.01		mJ
			$T_{vj} = 175 \text{ }^\circ\text{C},$ $I_C = 40 \text{ A}$		2.1	

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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	$E_{ts}$	$V_{CC} = 600\text{ V}, V_{GE} = 0/15\text{ V},$ $R_{G(on)} = 10\ \Omega,$ $R_{G(off)} = 10\ \Omega$	$T_{vj} = 25\ ^\circ\text{C},$ $I_C = 40\text{ A}$		1.98		mJ
			$T_{vj} = 175\ ^\circ\text{C},$ $I_C = 40\text{ A}$		3.67		
Operating junction temperature	$T_{vj}$		-40		175	$^\circ\text{C}$	

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 $T_{vjmax}$	$I_F$		$T_c = 25\ ^\circ\text{C}$	66	A
			$T_c = 100\ ^\circ\text{C}$	42	
Diode pulsed current, $t_p$ limited by $T_{vjmax}$	$I_{Fpulse}$		160	A	
Power dissipation	$P_{tot}$		$T_c = 25\ ^\circ\text{C}$	192	W
			$T_c = 100\ ^\circ\text{C}$	96	

**表 5** 特征值

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Diode forward voltage	$V_F$	$I_F = 40\text{ A}$	$T_{vj} = 25\ ^\circ\text{C}$		2.5	3	V
			$T_{vj} = 175\ ^\circ\text{C}$		2.3		
Diode reverse recovery time	$t_{rr}$	$V_R = 600\text{ V}, R_{G(on)} = 10\ \Omega$	$T_{vj} = 25\ ^\circ\text{C},$ $I_F = 40\text{ A}$		90		ns
			$T_{vj} = 175\ ^\circ\text{C},$ $I_F = 40\text{ A}$		170		
Diode reverse recovery charge	$Q_{rr}$	$V_R = 600\text{ V}, R_{G(on)} = 10\ \Omega$	$T_{vj} = 25\ ^\circ\text{C},$ $I_F = 40\text{ A}$		1.51		$\mu\text{C}$
			$T_{vj} = 175\ ^\circ\text{C},$ $I_F = 40\text{ A}$		4.39		
Diode peak reverse recovery current	$I_{rrm}$	$V_R = 600\text{ V}, R_{G(on)} = 10\ \Omega$	$T_{vj} = 25\ ^\circ\text{C},$ $I_F = 40\text{ A}$		53		A
			$T_{vj} = 175\ ^\circ\text{C},$ $I_F = 40\text{ A}$		84		

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**表 5 (续) 特征值**

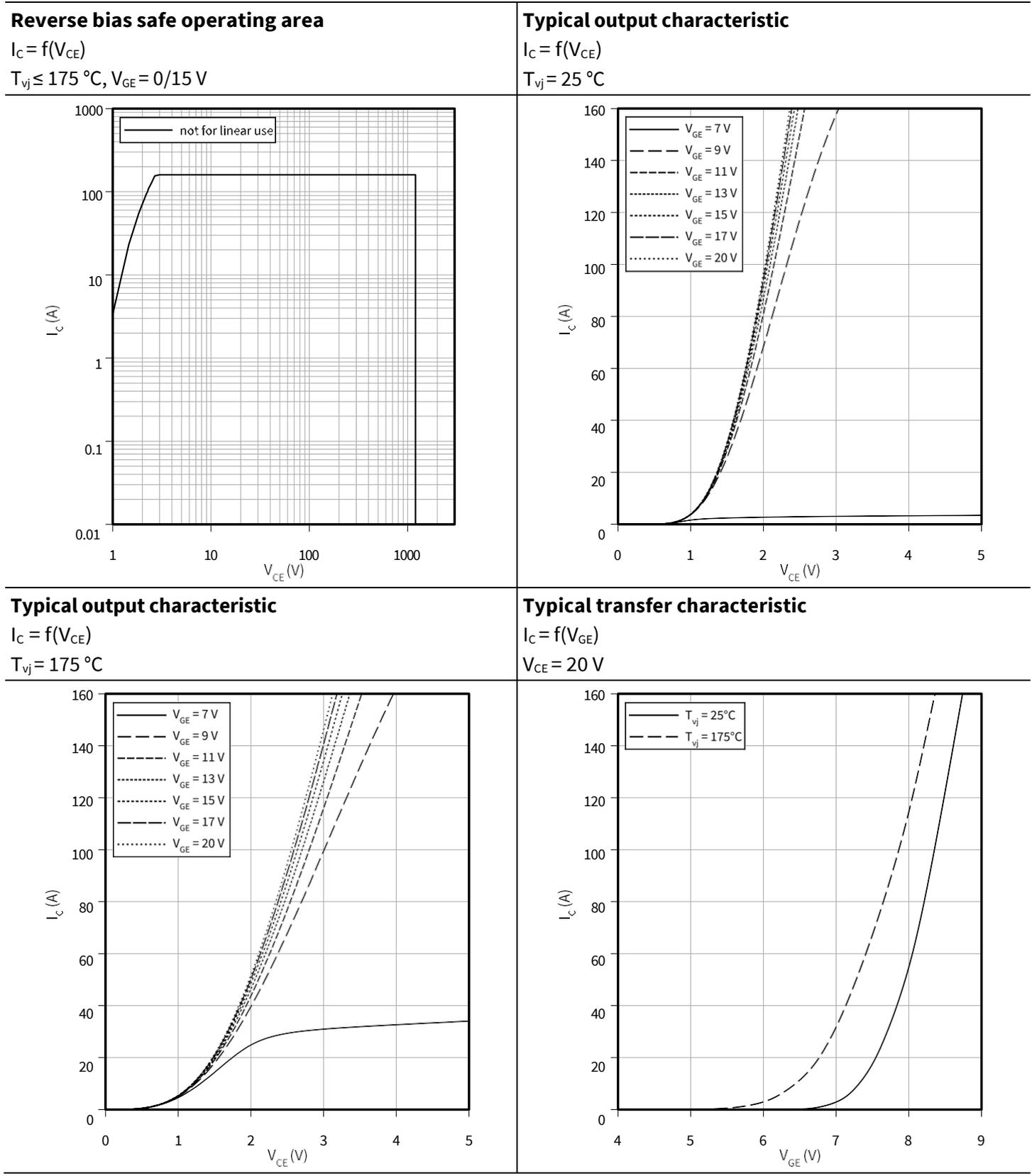
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode peak rate of fall of reverse recovery current	$di_{rr}/dt$	$V_R = 600 \text{ V}, R_{G(on)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ } ^\circ\text{C},$ $I_F = 40 \text{ A}$		-1560		A/ $\mu\text{s}$
			$T_{vj} = 175 \text{ } ^\circ\text{C},$ $I_F = 40 \text{ A}$		-1840		
Reverse recovery energy	$E_{rec}$	$V_R = 600 \text{ V}, R_{G(on)} = 10 \text{ } \Omega$	$T_{vj} = 25 \text{ } ^\circ\text{C},$ $I_F = 40 \text{ A}$		0.54		mJ
			$T_{vj} = 175 \text{ } ^\circ\text{C},$ $I_F = 40 \text{ A}$		1.82		
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

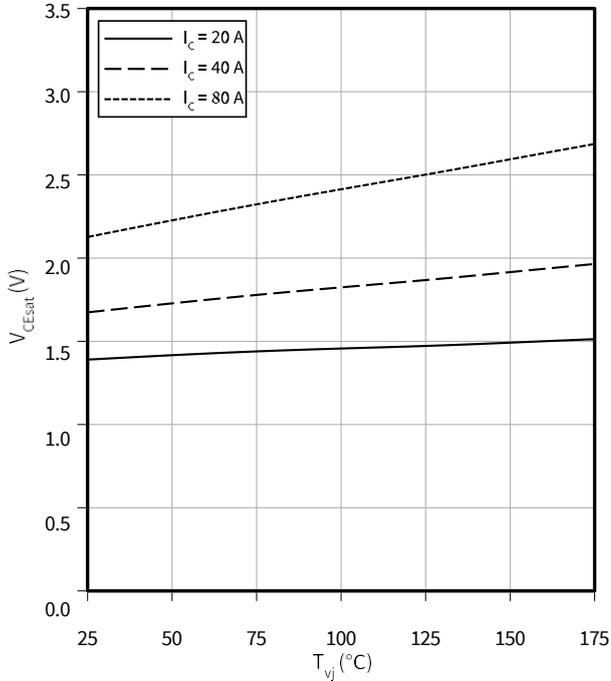
4 特性图



4 特性图

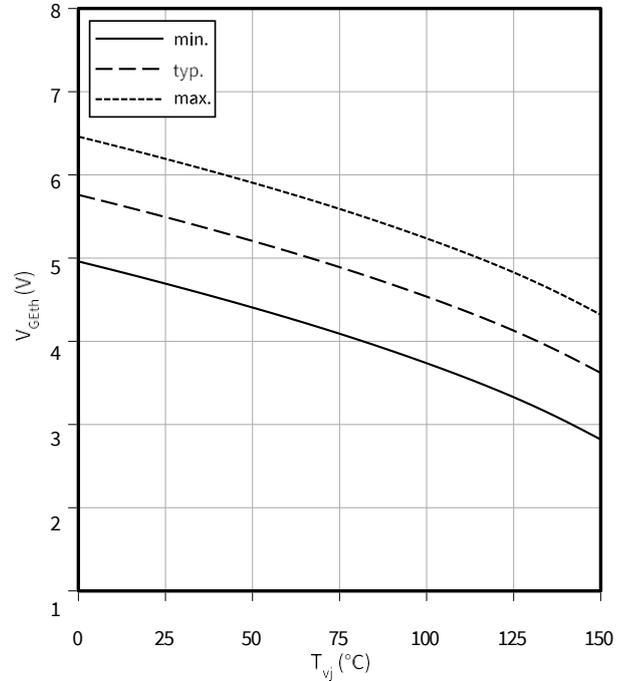
**Typical collector-emitter saturation voltage as a function of junction temperature**

$V_{CEsat} = f(T_{vj})$   
 $V_{GE} = 15 \text{ V}$



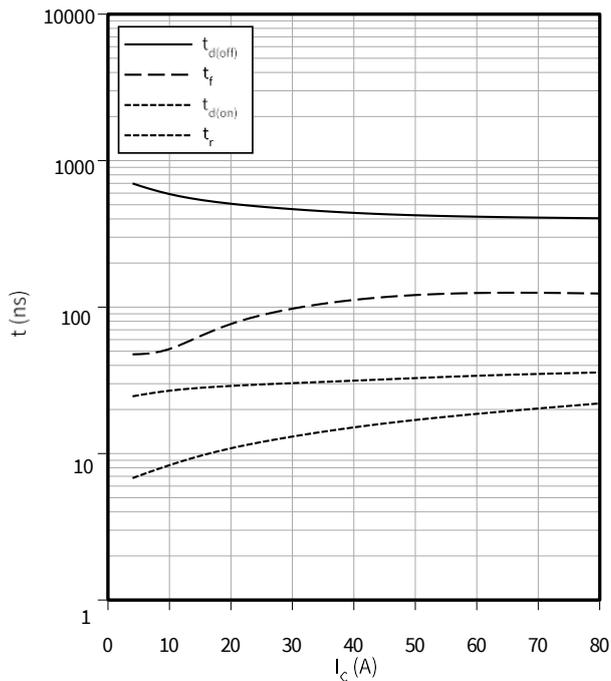
**Gate-emitter threshold voltage as a function of junction temperature**

$V_{GEth} = f(T_{vj})$   
 $I_c = 0.85 \text{ mA}$



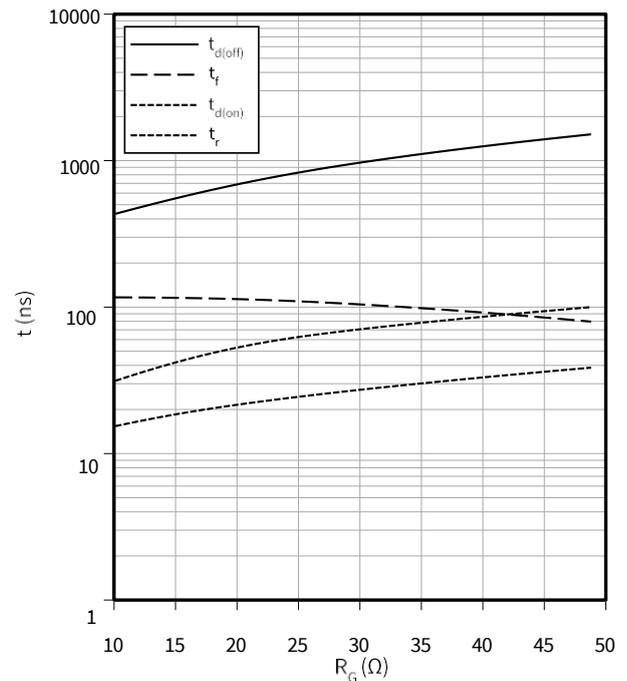
**Typical switching times as a function of collector current**

$t = f(I_c)$   
 $V_{CC} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}, R_G = 10 \text{ } \Omega$



**Typical switching times as a function of gate resistor**

$t = f(R_G)$   
 $I_c = 40 \text{ A}, V_{CC} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}$

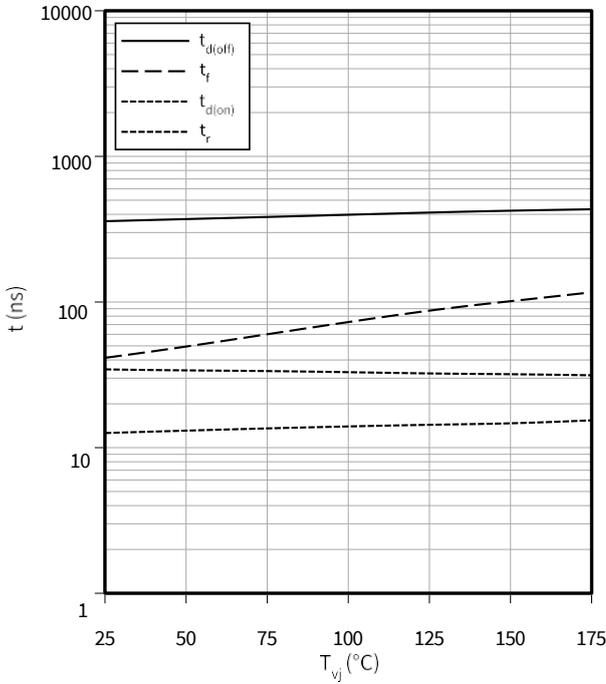


4 特性图

**Typical switching times as a function of junction temperature**

$t = f(T_{vj})$

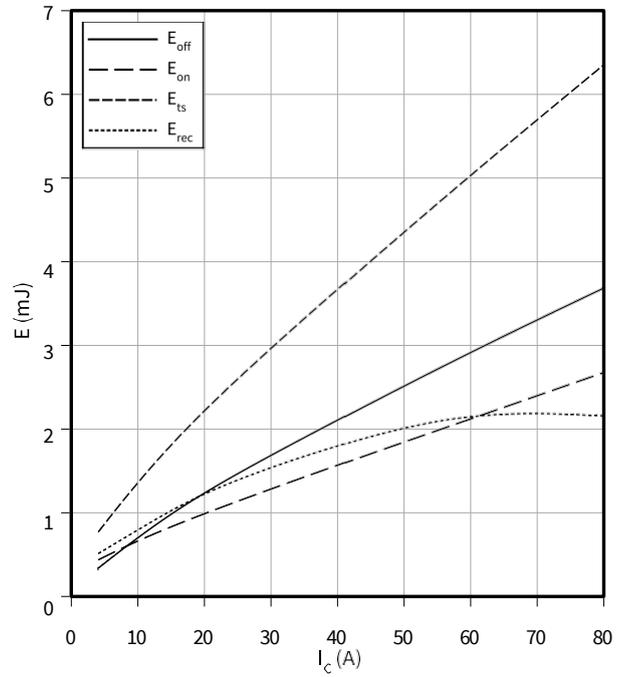
$I_C = 40 \text{ A}, V_{CC} = 600 \text{ V}, V_{GE} = 0/15 \text{ V}, R_G = 10 \Omega$



**Typical switching energy losses as a function of collector current**

$E = f(I_C)$

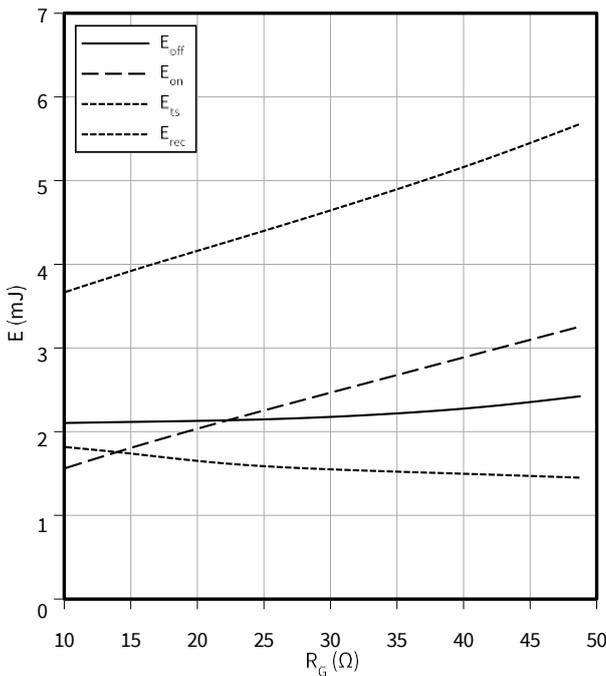
$V_{CC} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}, R_G = 10 \Omega$



**Typical switching energy losses as a function of gate resistor**

$E = f(R_G)$

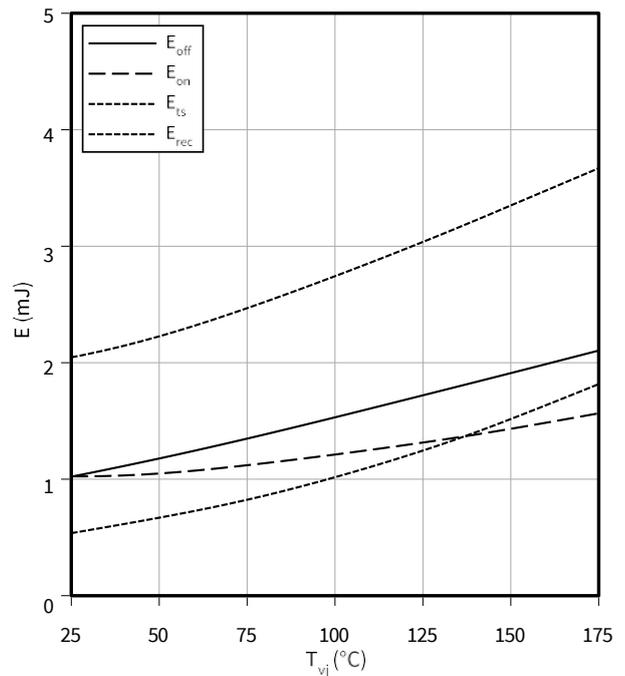
$I_C = 40 \text{ A}, V_{CC} = 600 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GE} = 0/15 \text{ V}$



**Typical switching energy losses as a function of junction temperature**

$E = f(T_{vj})$

$I_C = 40 \text{ A}, V_{CC} = 600 \text{ V}, V_{GE} = 0/15 \text{ V}, R_G = 10 \Omega$

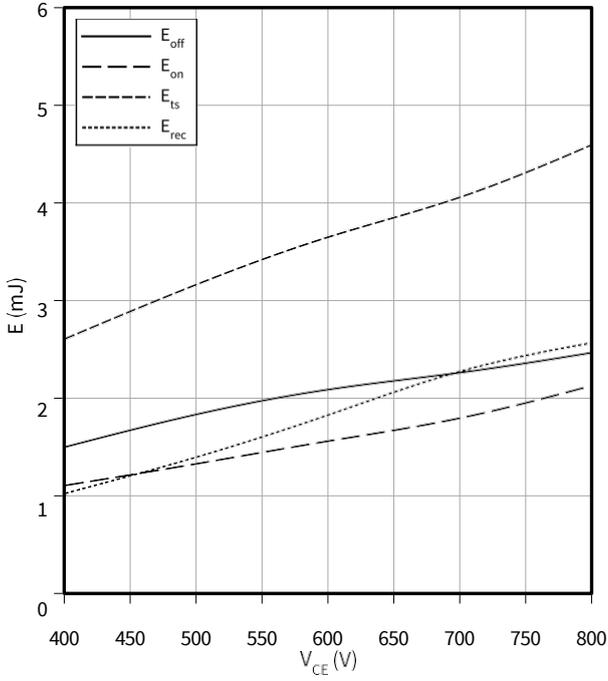


4 特性图

**Typical switching energy losses as a function of collector emitter voltage**

$E = f(V_{CE})$

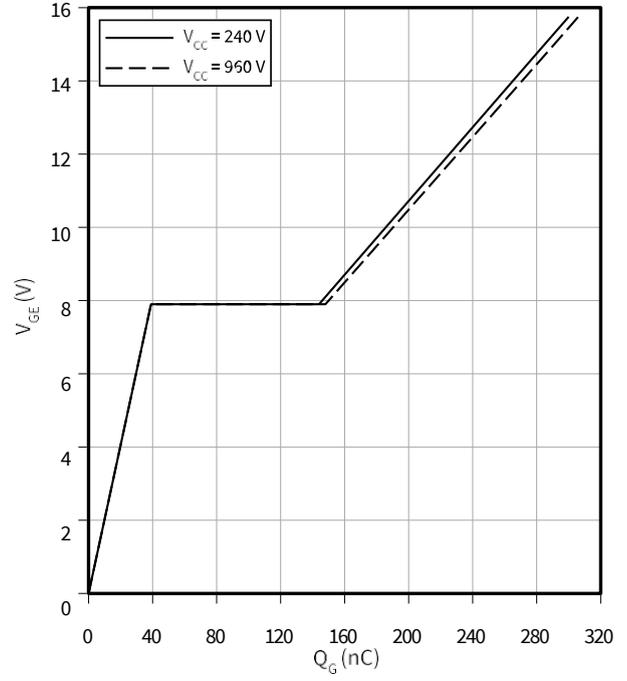
$I_C = 40 \text{ A}$ ,  $T_{vj} = 175 \text{ }^\circ\text{C}$ ,  $V_{GE} = 0/15 \text{ V}$ ,  $R_G = 10 \text{ } \Omega$



**Typical gate charge**

$V_{GE} = f(Q_G)$

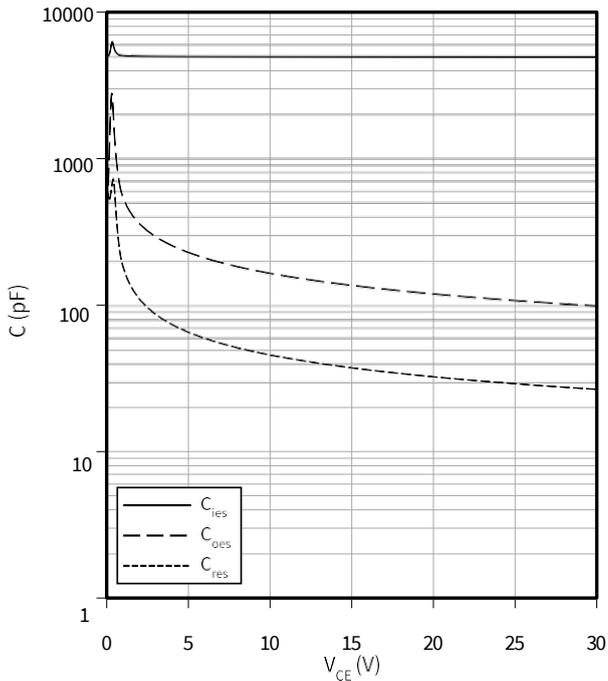
$I_C = 40 \text{ A}$



**Typical capacitance as a function of collector-emitter voltage**

$C = f(V_{CE})$

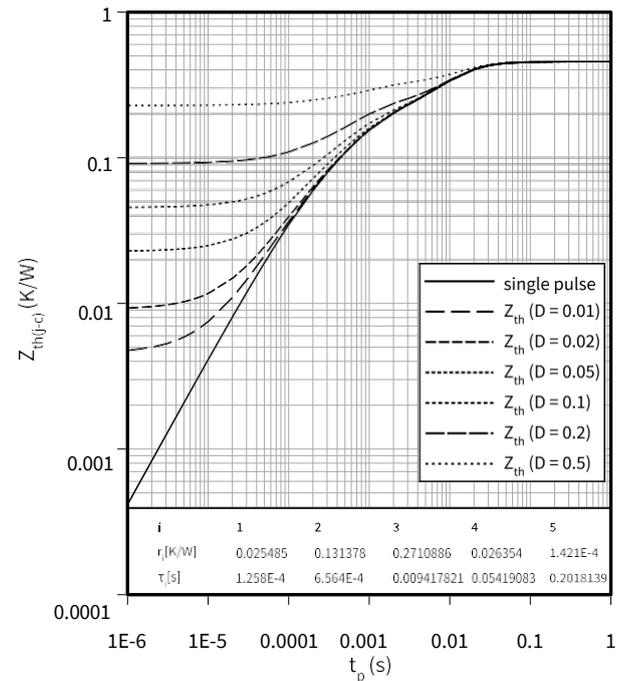
$f = 100 \text{ kHz}$ ,  $V_{GE} = 0 \text{ V}$



**IGBT transient thermal impedance as a function of pulse width**

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

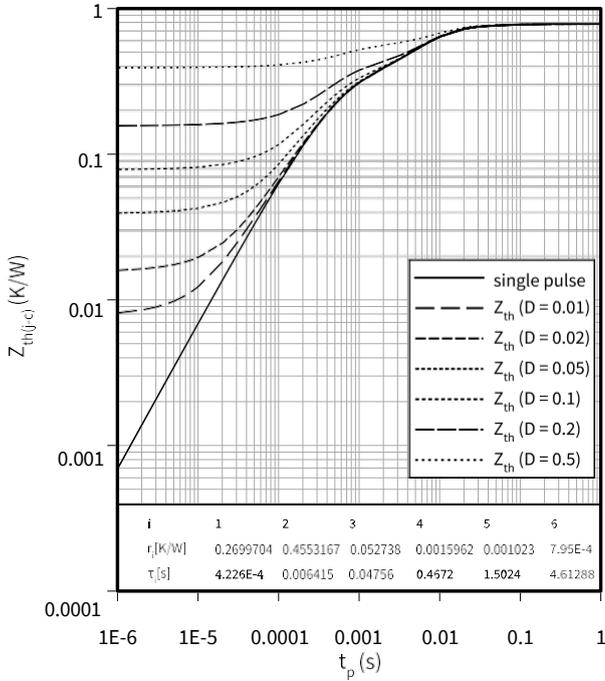
$D = t_p/T$



4 特性图

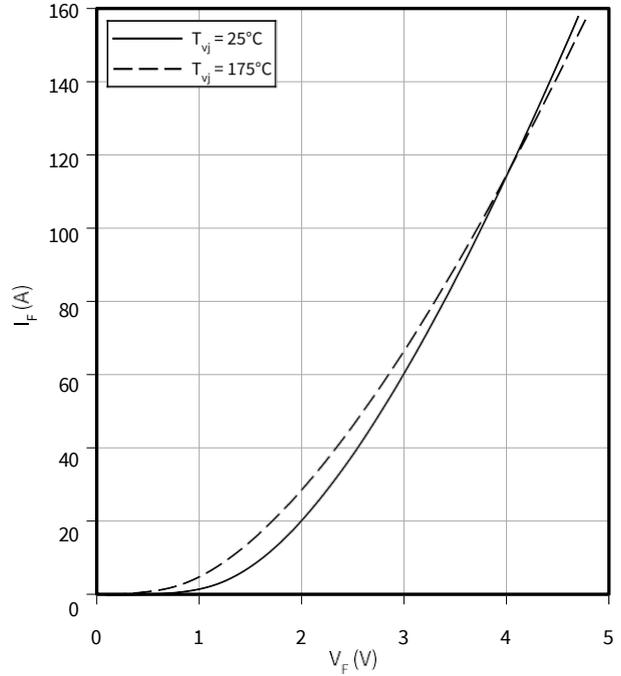
**Diode transient thermal impedance as a function of pulse width**

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



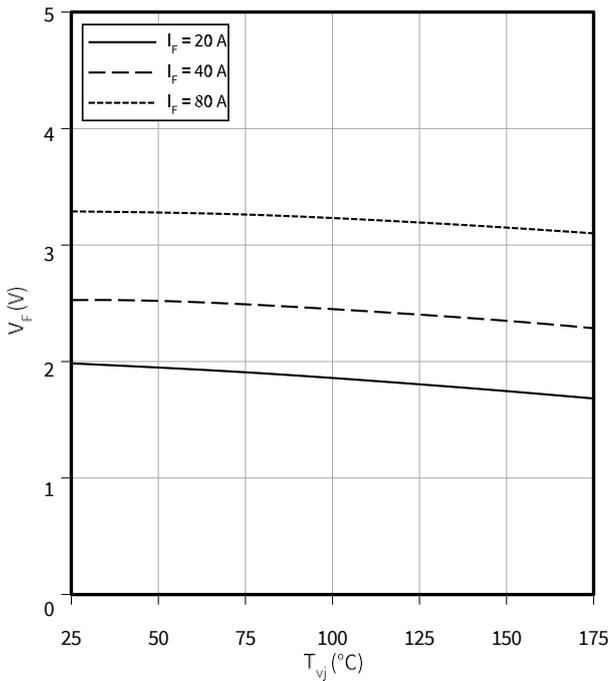
**Typical diode forward current as a function of forward voltage**

$I_F = f(V_F)$



**Typical diode forward voltage as a function of junction temperature**

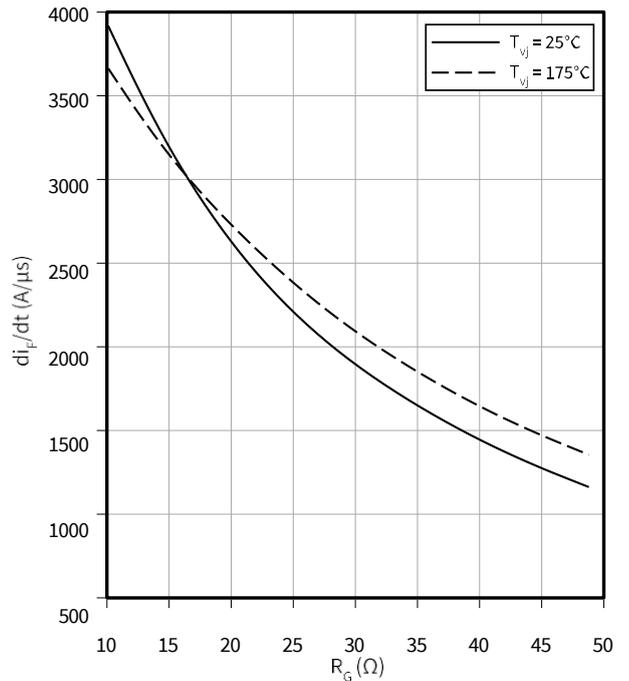
$V_F = f(T_{vj})$



**Typical diode current slope as a function of gate resistor**

$di_F/dt = f(R_G)$

$V_R = 600 \text{ V}, I_F = 40 \text{ A}$

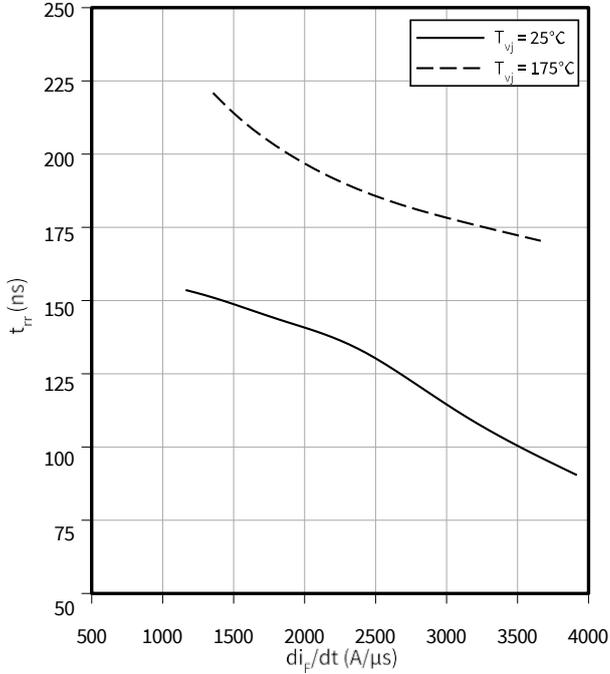


4 特性图

**Typical reverse recovery time as a function of diode current slope**

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

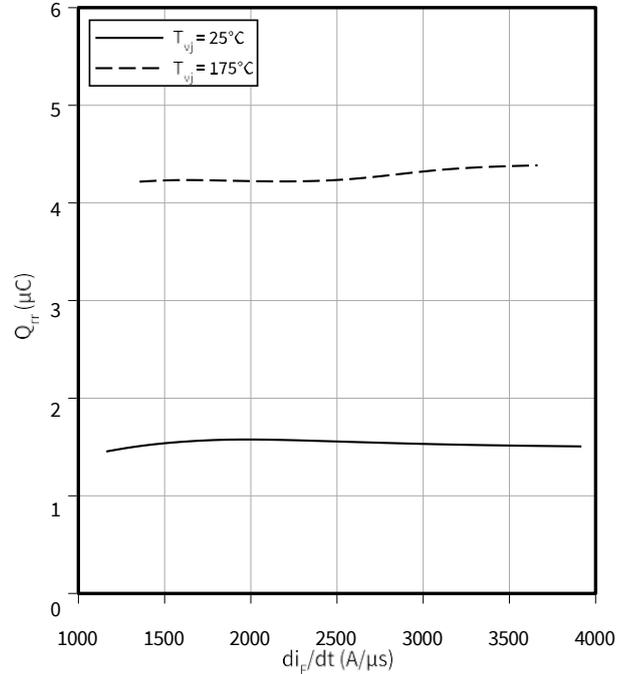
$V_R = 600 \text{ V}, I_F = 40 \text{ A}$



**Typical reverse recovery charge as a function of diode current slope**

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

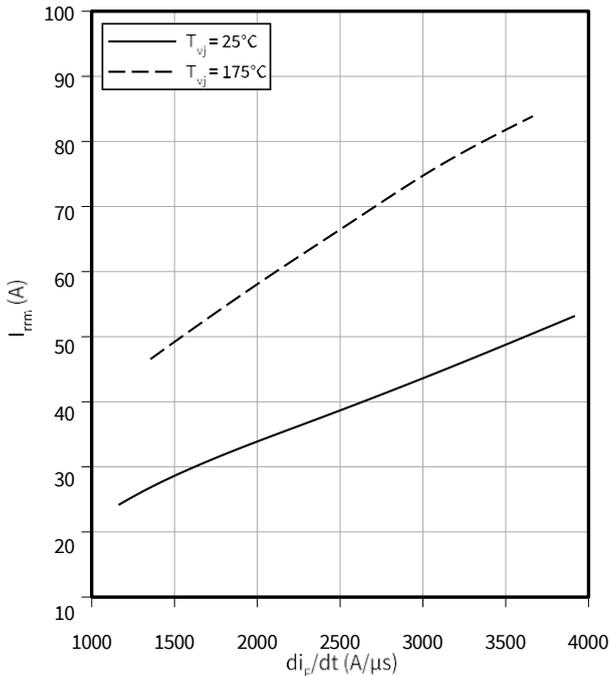
$V_R = 600 \text{ V}, I_F = 40 \text{ A}$



**Typical reverse recovery current as a function of diode current slope**

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

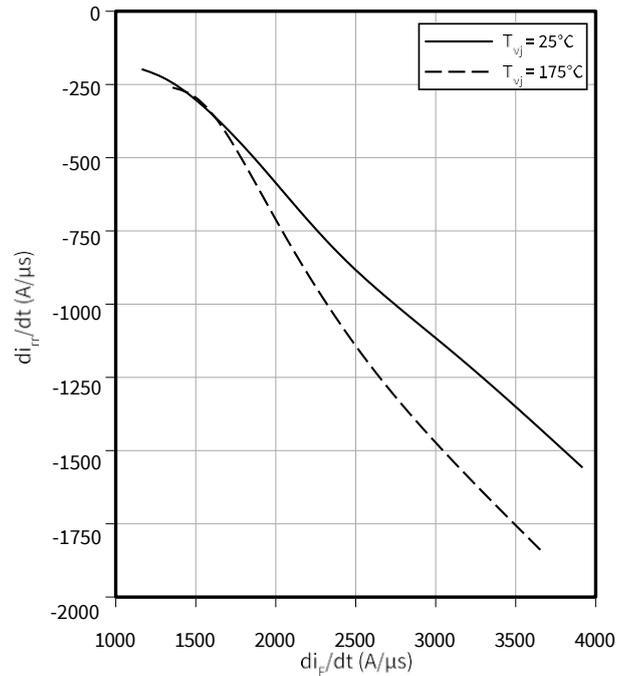
$V_R = 600 \text{ V}, I_F = 40 \text{ A}$



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

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

$V_R = 600 \text{ V}, I_F = 40 \text{ A}$

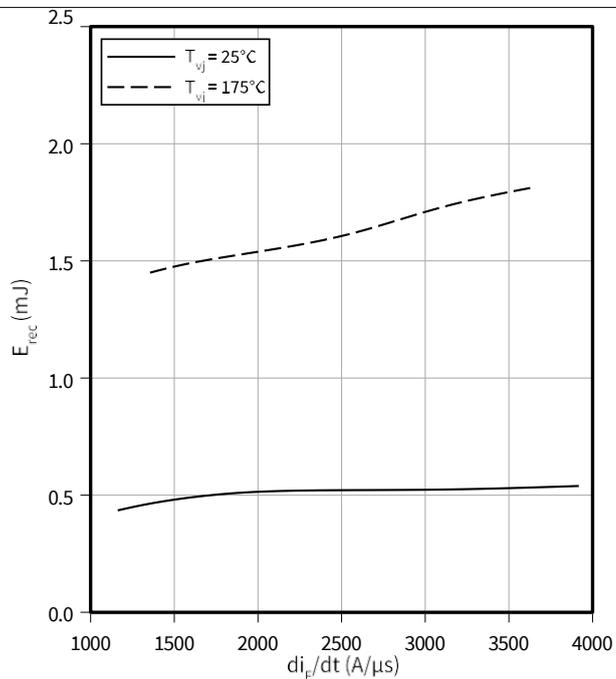


4 特性图

典型反向损耗随二极管电流斜率变化关系

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

$V_R = 600\text{ V}$ ,  $I_F = 40\text{ A}$



5 封装外形

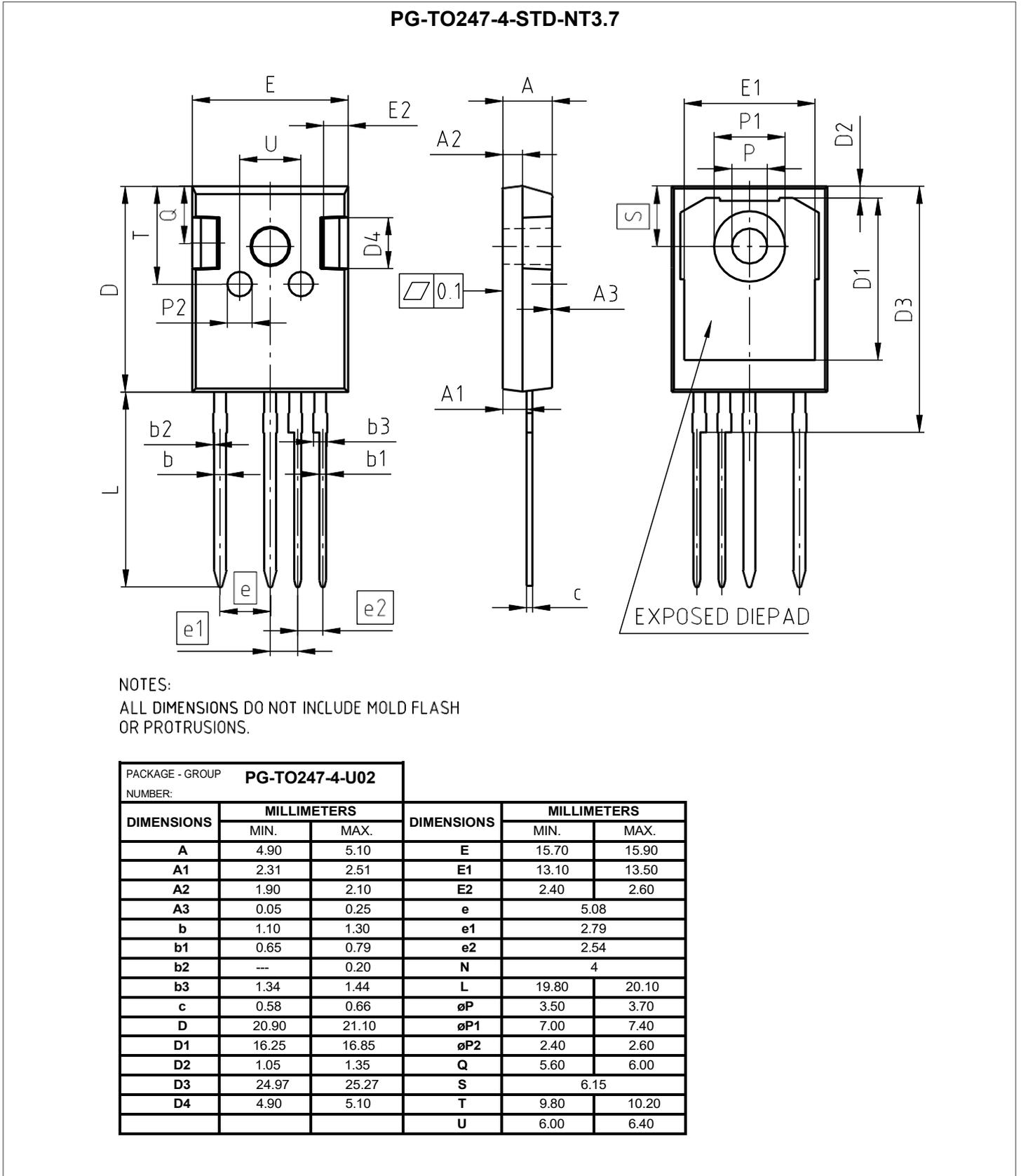


图 1

**6 测试条件**

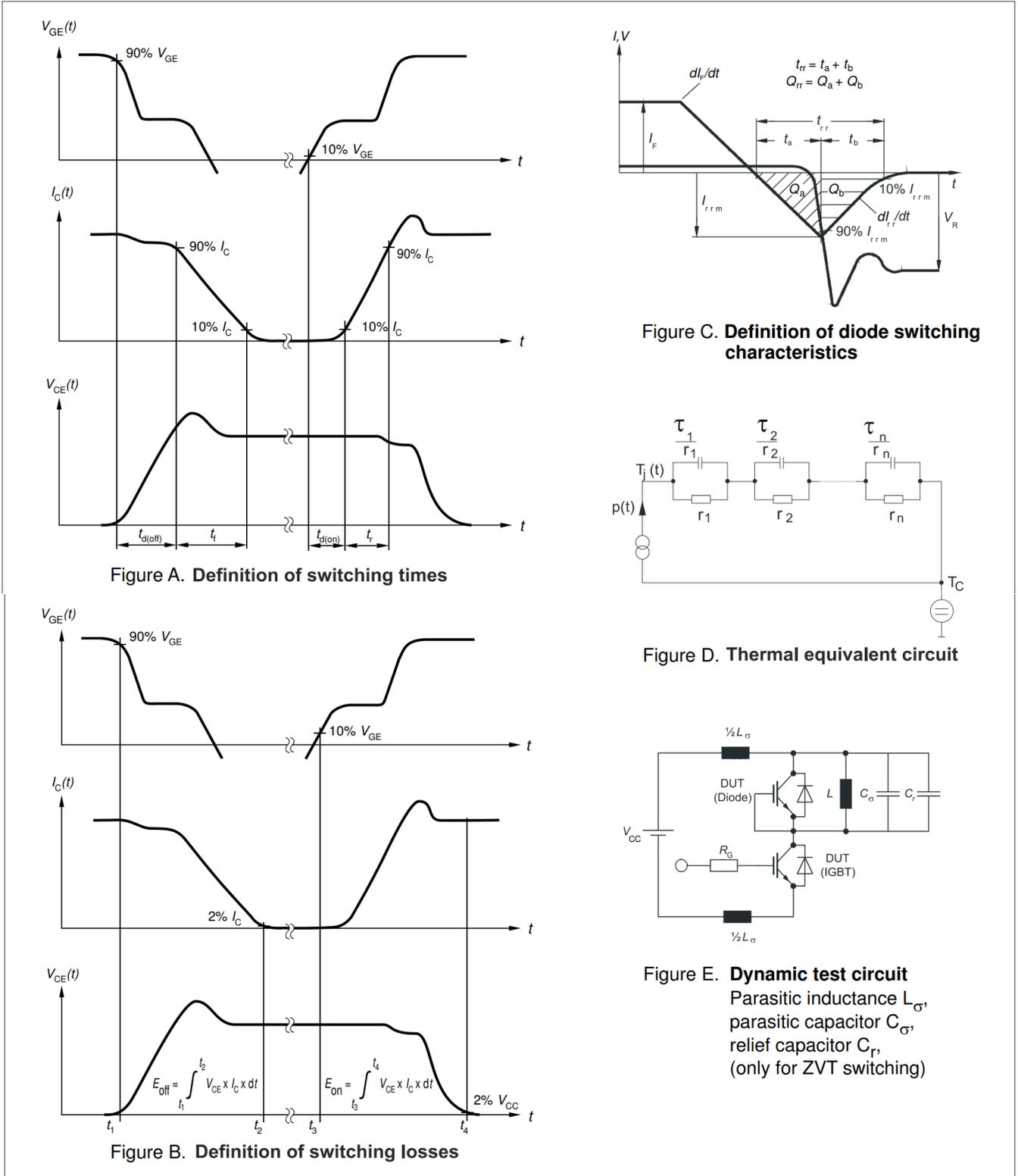


图 2

## 修订记录

<b>Document revision</b>	<b>Date of release</b>	<b>Description of changes</b>
0.10	2022-05-02	Target datasheet
0.20	2022-05-31	Editorial changes
1.00	2022-10-06	Final datasheet
1.10	2022-11-09	Correction of diagrams "Typical output characteristic" Correction of diagram "Typical collector-emitter saturation voltage as a function of junction temperature" Correction of diagram "Typical transfer characteristic" Correction of diagram "IGBT transient thermal impedance as a function of pulse width" Correction of diagram "Diode transient thermal impedance as a function of pulse width" Correction of diagram "Typical diode forward voltage as a function of junction temperature"
1.20	2022-11-23	Update of potential applications



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