

最终数据手册

英飞凌 耐短路 750 V EDT2 IGBT，采用可回流焊接的封装，与 软、快速恢复二极管共同封装

特性

- $V_{CE} = 750\text{ V}$
- $I_C = 200\text{ A}$
- 适用于 470 V V_{DC} 系统，并增加了 400 V V_{DC} 系统的过压裕量
- 极低 $V_{CEsat} = 1.4\text{ V}$ (typ.)， $I_{Cnom} = 200\text{ A}$ ， 25°C
- 短路耐受时间 $t_{sc} = 5\ \mu\text{s}$ ($V_{CE} = 470\text{ V}$ 、 $V_{GE} = 15\text{ V}$)
- 由于回流焊能力，系统 R_{th} 可降低至 40%，增加功率输出
- 短路条件下的自限电流
- 正温度系数和非常紧密的参数分布，易于并联
- 由于 $I_{nom} = 200\text{ A}$ ，减少了需要并联的器件数量
- 优异的并联均流能力
- 平滑的开关特性
- 低栅极电荷 Q_G
- 简单的栅极驱动器设计
- 配备快速软恢复发射极控制二极管 (Emcon3)
- 低EMI特征
- TO247PLUS 封装，高爬电距离 6.6 mm， $400 \leq CTI < 600$
- 高可靠性和使用寿命
- 用于直接母线连接的阻性焊接引脚



潜在应用

- 电动汽车牵引逆变器
- DC母线放电开关
- 汽车辅助驱动

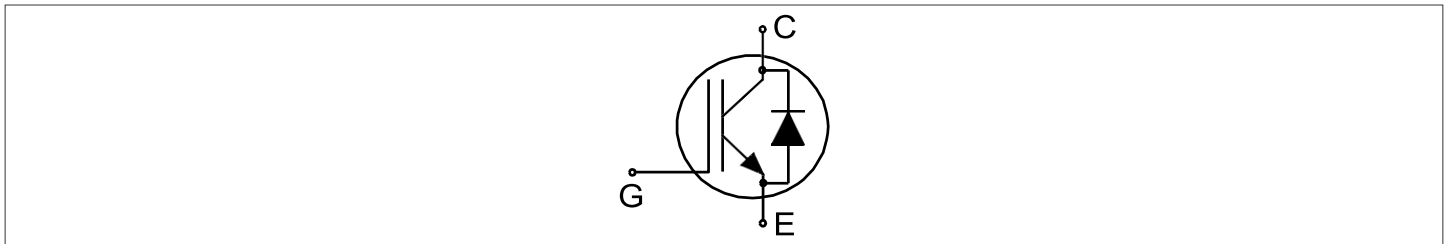
产品验证

- 汽车应用认证。符合AEC-Q101 产品认证
- 符合JEDEC J-STD-020 MSL2 标准的回流焊 260°C

描述

封装引脚定义：

- 引脚 C & 背面 - 集电极
- 引脚 E - 发射极
- 引脚 G - 栅极



Type	Package	Marking
AIKQB200N75CP2	PG-TO247-3-U02	AKQB20FCP

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	L_E	simulated starting from L2 at 1 MHz		4.2		nH
Collector-emitter loop inductance	L_{CE}	simulated starting from L2 at 1 MHz		6		nH
Main emitter pin resistance	R_E	Simulated starting from L2 at 10 kHz		0.43		mΩ
Storage temperature	T_{stg}		-55		150	°C
Soldering temperature	T_{sold}	reflow soldering (MSL2 according to JEDEC J-STD-020)			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 ¹⁾	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$			0.23	0.3 ¹⁾	K/W

1) 通过仿真定义，不进行生产测试

2 IGBT

表 2 最大额定值

Parameter	Symbol	Note or test condition	Values	Unit
Collector-emitter voltage	V_{CE}	$T_{vj} \geq 25 \text{ °C}$	750	V
DC collector current, limited by T_{vjmax}	I_C	$T_c = 25 \text{ °C}$	200	A
		$T_c = 100 \text{ °C}$	200	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}		600	A
Turn-off safe operating area		$V_{CE} \leq 750 \text{ V}, T_{vj} \leq 175 \text{ °C}$	600	A
Gate-emitter voltage	V_{GE}		±20	V
Transient gate-emitter voltage	V_{GE}	$t_p = 10 \text{ μs}, D < 0.01$	±30	V
Short-circuit withstand time	t_{SC}	$V_{CC} \leq 470 \text{ V}, V_{GE} = -8/15 \text{ V}$, Allowed number of short circuits < 1000, Time between short circuits $\geq 1.0 \text{ s}, T_{vj} = 25 \text{ °C}$	5	μs
Power dissipation	P_{tot}	$T_{vj} = 175 \text{ °C}$	$T_c = 25 \text{ °C}$	W
			$T_c = 100 \text{ °C}$	

表3 特征值

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 200\text{ A}, V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	1.2	1.4	1.55	V
			$T_{vj} = 175\text{ }^\circ\text{C}$		1.7		
Gate-emitter threshold voltage	V_{GETh}	$I_C = 2.6\text{ mA}, V_{CE} = V_{GE}$		5.2	5.8	6.4	V
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 750\text{ V}, V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$			200	μA
			$T_{vj} = 175\text{ }^\circ\text{C}$		6000		
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\text{ V}, V_{GE} = 20\text{ V}$				100	nA
Transconductance	g_{fs}	$I_C = 200\text{ A}, V_{CE} = 20\text{ V}$			143		S
Short-circuit collector current	I_{SC}	$V_{CC} \leq 470\text{ V}, V_{GE} = -8/15\text{ V}, t_{SC} \leq 5\text{ }\mu\text{s},$ Allowed number of short circuits < 1000, Time between short circuits $\geq 1.0\text{ s}, T_{vj} = 25\text{ }^\circ\text{C}$	$T_{vj} = 175\text{ }^\circ\text{C}$		1250		A
Input capacitance	C_{ies}	$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 100\text{ kHz}$			20500		pF
Output capacitance	C_{oes}	$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 100\text{ kHz}$			540		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 100\text{ kHz}$			95		pF
Gate charge	Q_G	$V_{CC} = 600\text{ V}, I_C = 200\text{ A}, V_{GE} = -8/15\text{ V}$			1270		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 470\text{ V}, V_{GE} = -8/15\text{ V}, R_{G(on)} = 5\text{ }\Omega, R_{G(off)} = 5\text{ }\Omega$	$T_{vj} = 25\text{ }^\circ\text{C}, I_C = 200\text{ A}$		89		ns
			$T_{vj} = 175\text{ }^\circ\text{C}, I_C = 200\text{ A}$		85		
Rise time (inductive load)	t_r	$V_{CC} = 470\text{ V}, V_{GE} = -8/15\text{ V}, R_{G(on)} = 5\text{ }\Omega, R_{G(off)} = 5\text{ }\Omega$	$T_{vj} = 25\text{ }^\circ\text{C}, I_C = 200\text{ A}$		120		ns
			$T_{vj} = 175\text{ }^\circ\text{C}, I_C = 200\text{ A}$		117		
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 470\text{ V}, V_{GE} = -8/15\text{ V}, R_{G(on)} = 5\text{ }\Omega, R_{G(off)} = 5\text{ }\Omega$	$T_{vj} = 25\text{ }^\circ\text{C}, I_C = 200\text{ A}$		266		ns
			$T_{vj} = 175\text{ }^\circ\text{C}, I_C = 200\text{ A}$		284		
Fall time (inductive load)	t_f	$V_{CC} = 470\text{ V}, V_{GE} = -8/15\text{ V}, R_{G(on)} = 5\text{ }\Omega, R_{G(off)} = 5\text{ }\Omega$	$T_{vj} = 25\text{ }^\circ\text{C}, I_C = 200\text{ A}$		46		ns
			$T_{vj} = 175\text{ }^\circ\text{C}, I_C = 200\text{ A}$		60		

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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.		
Turn-on energy ¹⁾	E_{on}	$V_{CC} = 470 \text{ V}, V_{GE} = -8/15 \text{ V}, R_{G(on)} = 5 \Omega, R_{G(off)} = 5 \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 200 \text{ A}$		15.3		mJ
			$T_{vj} = 175 \text{ }^\circ\text{C}, I_C = 200 \text{ A}$		16.3		
Turn-off energy	E_{off}	$V_{CC} = 470 \text{ V}, V_{GE} = -8/15 \text{ V}, R_{G(on)} = 5 \Omega, R_{G(off)} = 5 \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 200 \text{ A}$		7		mJ
			$T_{vj} = 175 \text{ }^\circ\text{C}, I_C = 200 \text{ A}$		8.1		
Total switching energy	E_{ts}	$V_{CC} = 470 \text{ V}, V_{GE} = -8/15 \text{ V}, R_{G(on)} = 5 \Omega, R_{G(off)} = 5 \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_C = 200 \text{ A}$		22.3		mJ
			$T_{vj} = 175 \text{ }^\circ\text{C}, I_C = 200 \text{ A}$		24.4		
Operating junction temperature	T_{vj}			-40		175	$^\circ\text{C}$

1) 包括反向恢复电流引起的 IGBT 损耗

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		$T_c = 25 \text{ }^\circ\text{C}$	200	A
			$T_c = 100 \text{ }^\circ\text{C}$	200	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}		600	A	
Power dissipation	P_{tot}	$T_{vj} = 175 \text{ }^\circ\text{C}$	$T_c = 25 \text{ }^\circ\text{C}$	500	W
			$T_c = 100 \text{ }^\circ\text{C}$	250	

表 5 特征值

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Diode forward voltage	V_F	$I_F = 200 \text{ A}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	1.6	1.8	2	V
			$T_{vj} = 175 \text{ }^\circ\text{C}$		1.9		

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表 5 (续) 特征值

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Diode reverse recovery charge	Q_{rr}	$V_R = 470 \text{ V}, R_{G(on)} = 5 \text{ } \Omega$	$T_{vj} = 25 \text{ } ^\circ\text{C},$ $I_F = 200 \text{ A},$ $-di_F/dt = 1060 \text{ A}/\mu\text{s}$		4.7		μC
			$T_{vj} = 175 \text{ } ^\circ\text{C},$ $I_F = 200 \text{ A},$ $-di_F/dt = 1067 \text{ A}/\mu\text{s}$		7.5		
Diode peak reverse recovery current	I_{rrm}	$V_R = 470 \text{ V}, R_{G(on)} = 5 \text{ } \Omega$	$T_{vj} = 25 \text{ } ^\circ\text{C},$ $I_F = 200 \text{ A},$ $-di_F/dt = 1060 \text{ A}/\mu\text{s}$		41		A
			$T_{vj} = 175 \text{ } ^\circ\text{C},$ $I_F = 200 \text{ A},$ $-di_F/dt = 1067 \text{ A}/\mu\text{s}$		56		
Reverse recovery energy	E_{rec}	$V_R = 470 \text{ V}, R_{G(on)} = 5 \text{ } \Omega,$ $L_\sigma = 50 \text{ nH}, C_\sigma = 30 \text{ pF}$	$T_{vj} = 25 \text{ } ^\circ\text{C},$ $I_F = 200 \text{ A},$ $-di_F/dt = 1060 \text{ A}/\mu\text{s}$		1.1		mJ
			$T_{vj} = 175 \text{ } ^\circ\text{C},$ $I_F = 200 \text{ A},$ $-di_F/dt = 1067 \text{ A}/\mu\text{s}$		1.9		
Operating junction temperature	T_{vj}			-40		175	$^\circ\text{C}$

注： 为了获得最佳的使用寿命和可靠性，英飞凌建议工作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 $T_{vj} = 25^\circ\text{C}$ 。

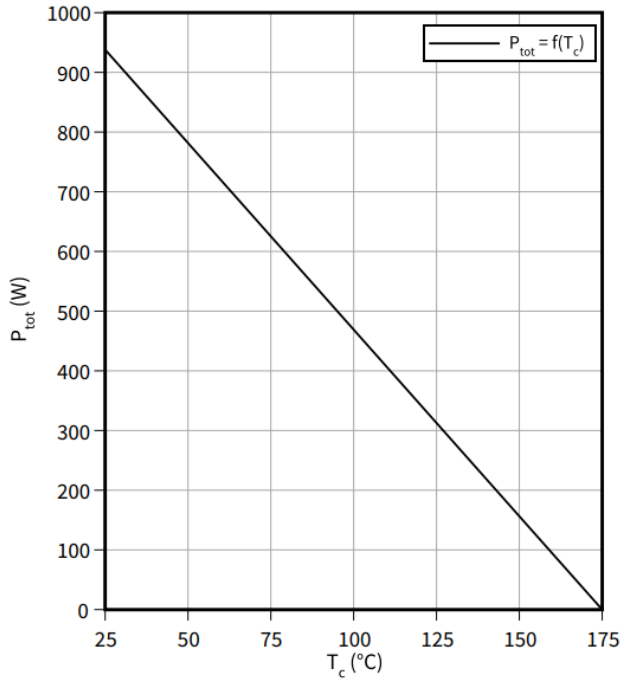
动态测试电路，寄生电感 $L_\sigma = 50 \text{ nH}$ ，寄生电容 $C_\sigma = 30 \text{ pF}$ ，来自图 E。能量损耗包括“拖尾”和二极管反向恢复。

4 特性图

4 特性图

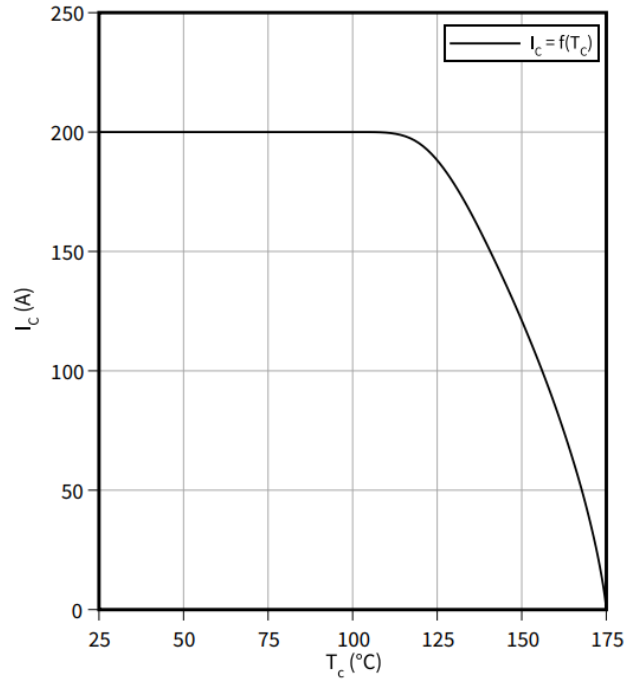
Power dissipation as a function of case temperature

$P_{tot} = f(T_c)$
 $T_{vj} \leq 175\text{ }^\circ\text{C}$



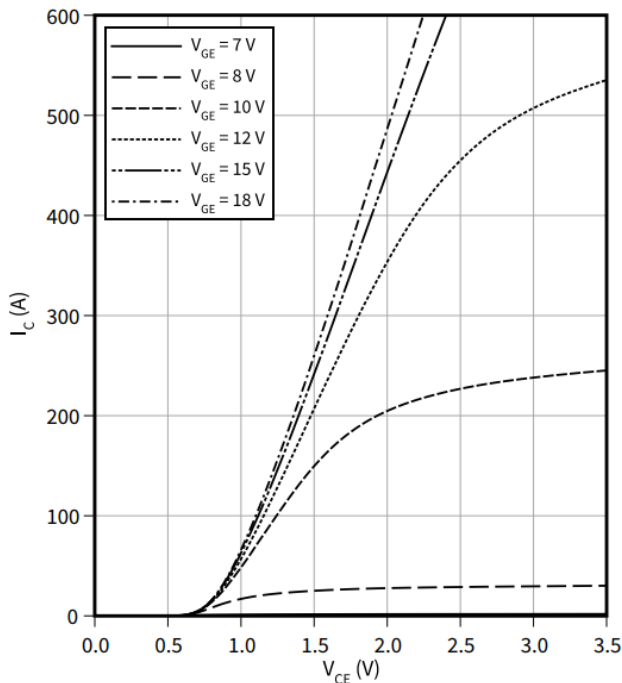
Collector current as a function of case temperature

$I_c = f(T_c)$
 $T_{vj} \leq 175\text{ }^\circ\text{C}, V_{GE} = 15\text{ V}$



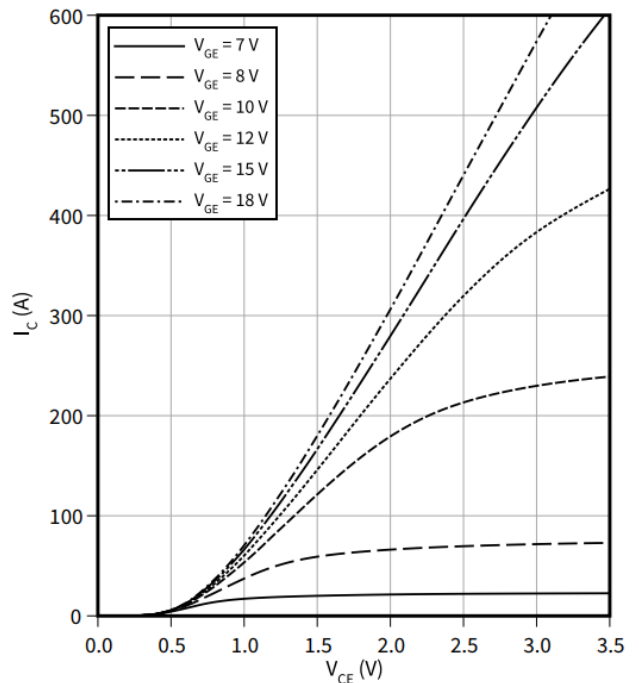
Typical output characteristic

$I_c = f(V_{CE})$
 $T_{vj} = 25\text{ }^\circ\text{C}$



Typical output characteristic

$I_c = f(V_{CE})$
 $T_{vj} = 175\text{ }^\circ\text{C}$

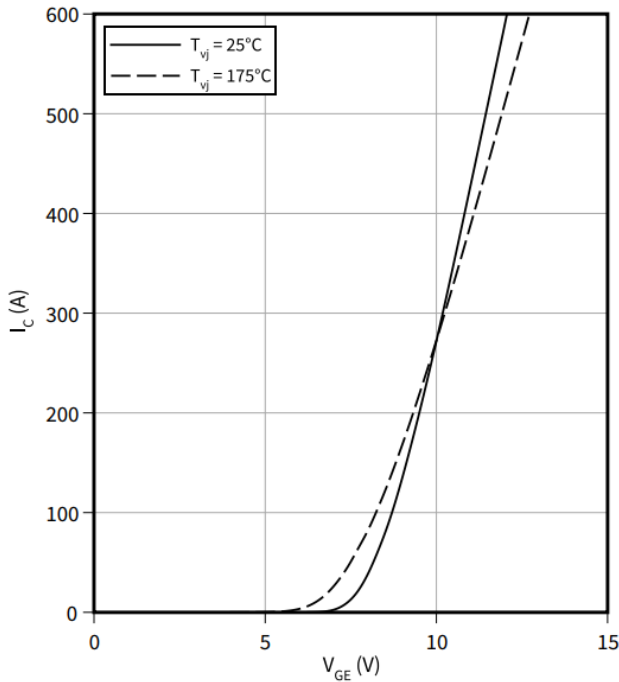


4 特性图

Typical transfer characteristic

$I_C = f(V_{GE})$

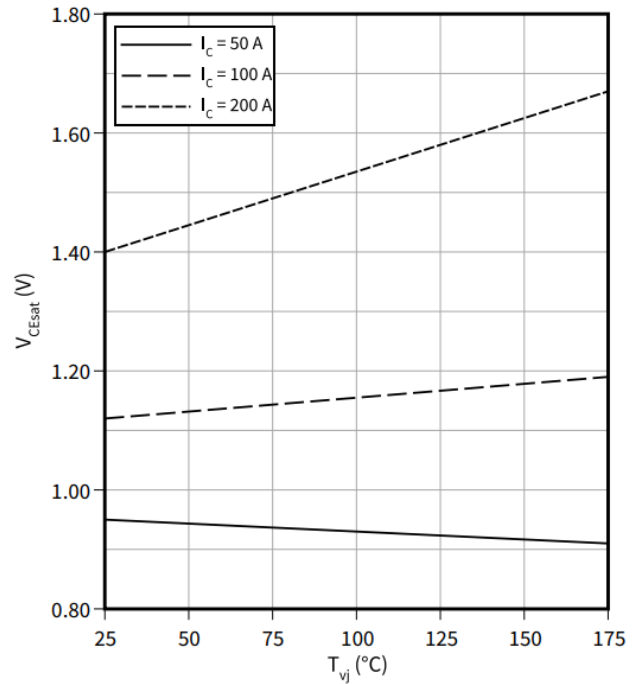
$V_{CE} = 20\text{ V}$



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

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

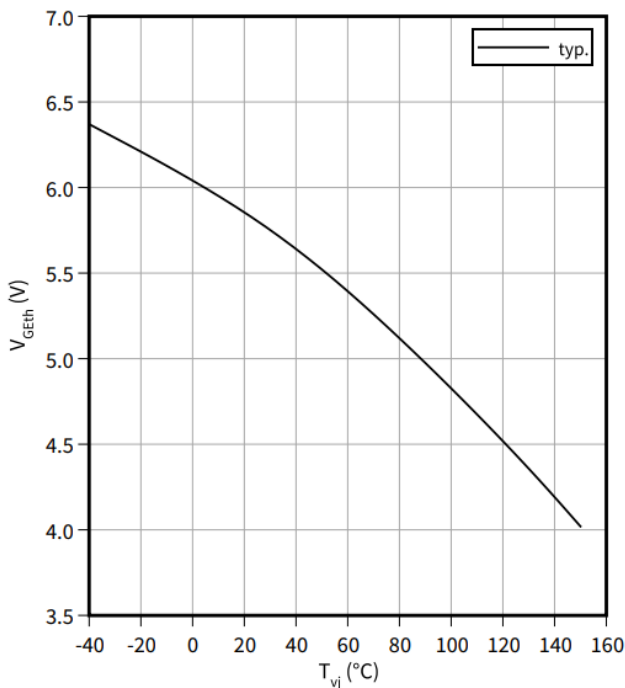
$V_{GE} = 15\text{ V}$



Gate-emitter threshold voltage as a function of junction temperature

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

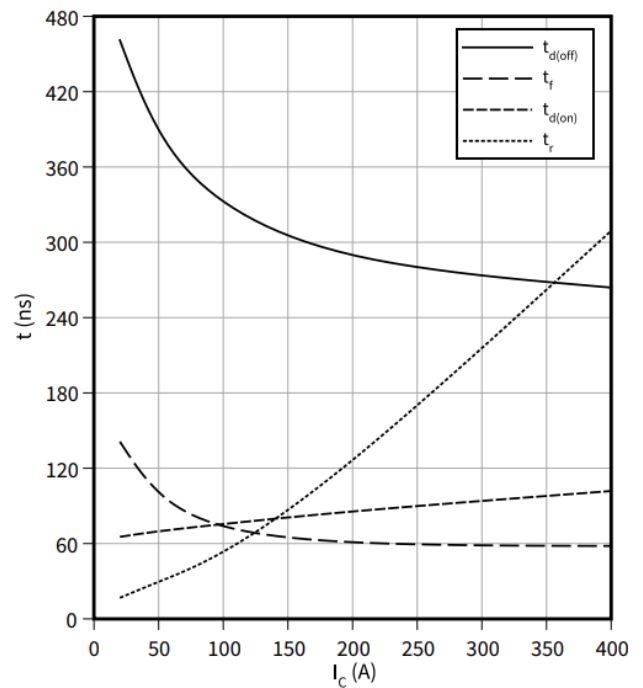
$I_C = 2.6\text{ mA}$



Typical switching times as a function of collector current

$t = f(I_C)$

$V_{CC} = 470\text{ V}, T_{vj} = 175^\circ\text{C}, V_{GE} = -8/15\text{ V}, R_G = 5\ \Omega$

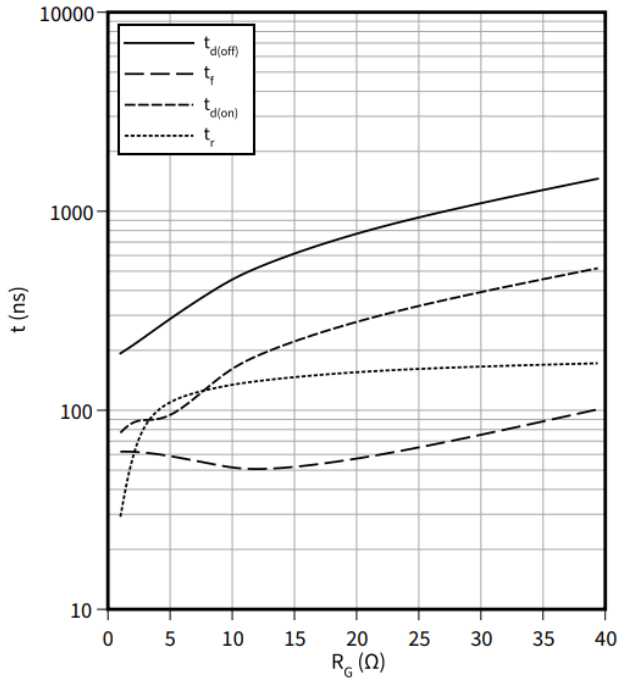


4 特性图

Typical switching times as a function of gate resistor

$t = f(R_G)$

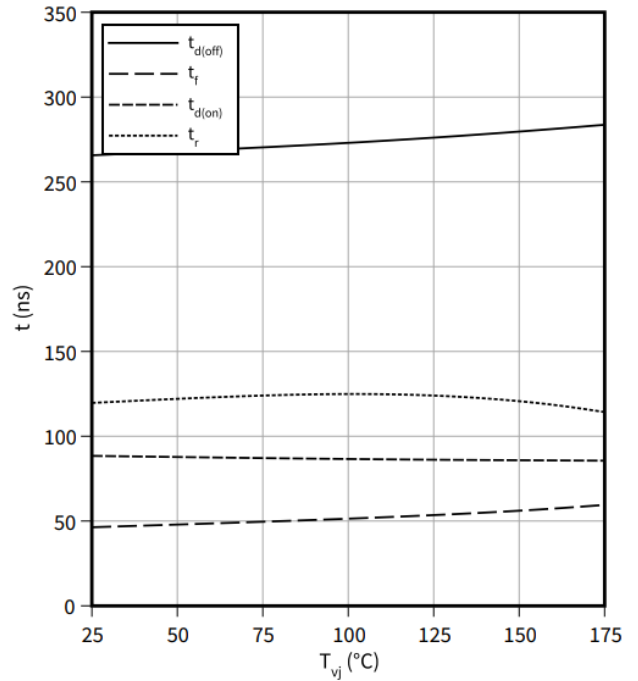
$I_C = 200\text{ A}$, $V_{CC} = 470\text{ V}$, $T_{vj} = 175\text{ }^\circ\text{C}$, $V_{GE} = -8/15\text{ V}$



Typical switching times as a function of junction temperature

$t = f(T_{vj})$

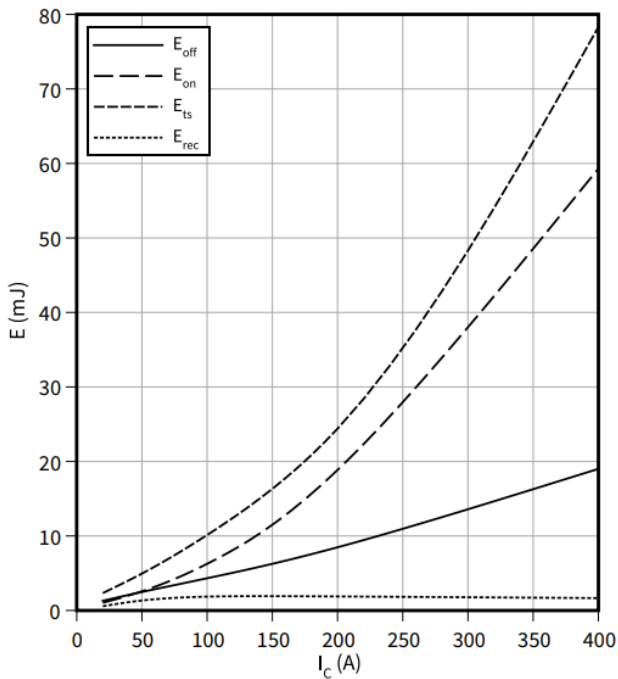
$I_C = 200\text{ A}$, $V_{CC} = 470\text{ V}$, $V_{GE} = -8/15\text{ V}$, $R_G = 5\text{ }\Omega$



Typical switching energy losses as a function of collector current

$E = f(I_C)$

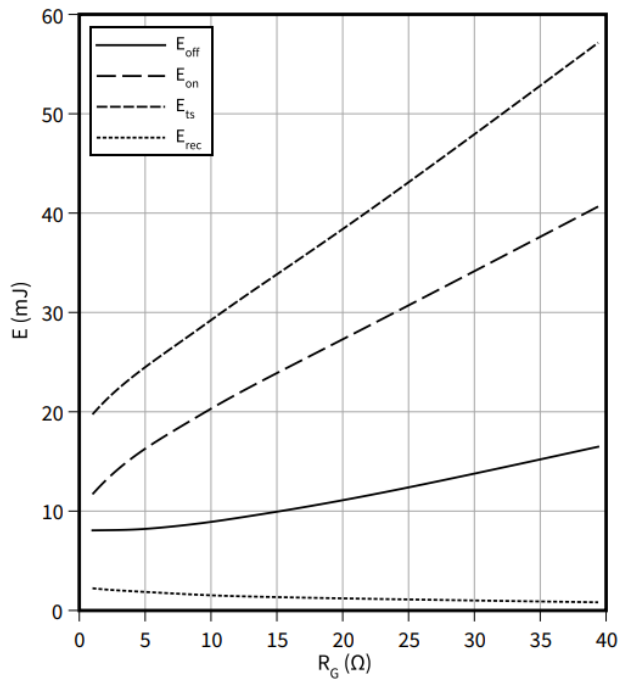
$V_{CC} = 470\text{ V}$, $T_{vj} = 175\text{ }^\circ\text{C}$, $V_{GE} = -8/15\text{ V}$, $R_G = 5\text{ }\Omega$



Typical switching energy losses as a function of gate resistor

$E = f(R_G)$

$I_C = 200\text{ A}$, $V_{CC} = 470\text{ V}$, $T_{vj} = 175\text{ }^\circ\text{C}$, $V_{GE} = -8/15\text{ V}$

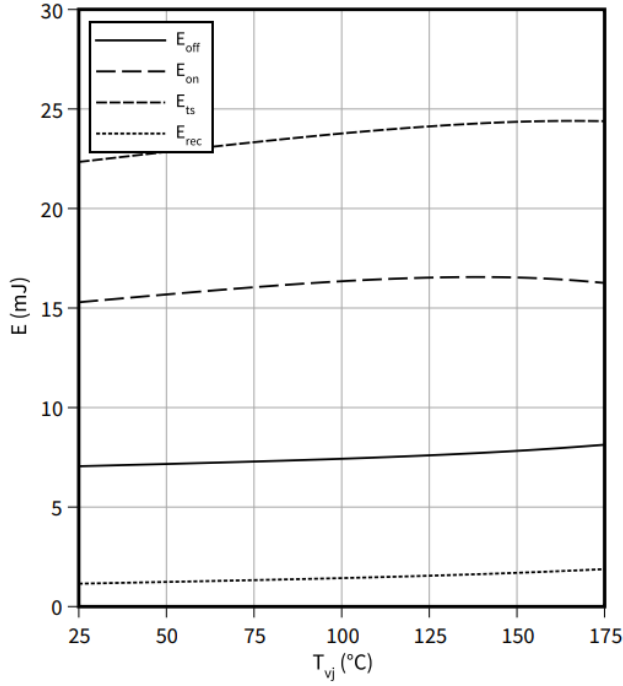


4 特性图

Typical switching energy losses as a function of junction temperature

$E = f(T_{vj})$

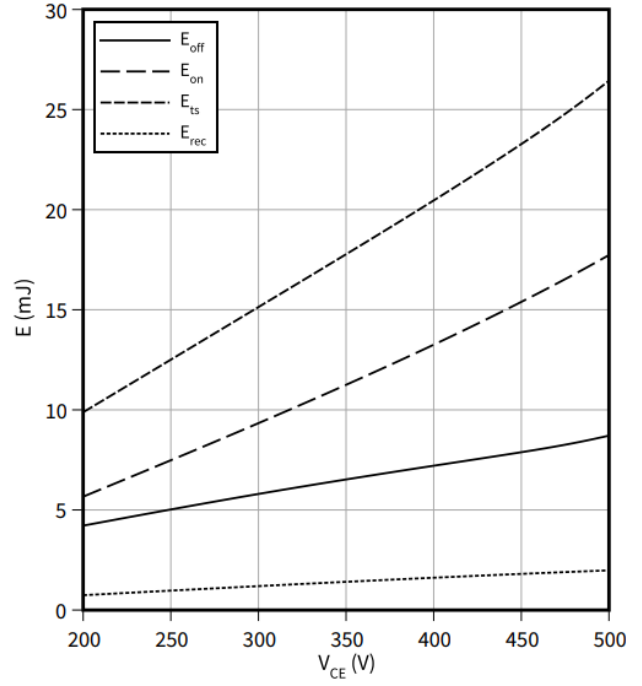
$I_C = 200\text{ A}, V_{CC} = 470\text{ V}, V_{GE} = -8/15\text{ V}, R_G = 5\ \Omega$



Typical switching energy losses as a function of collector emitter voltage

$E = f(V_{CE})$

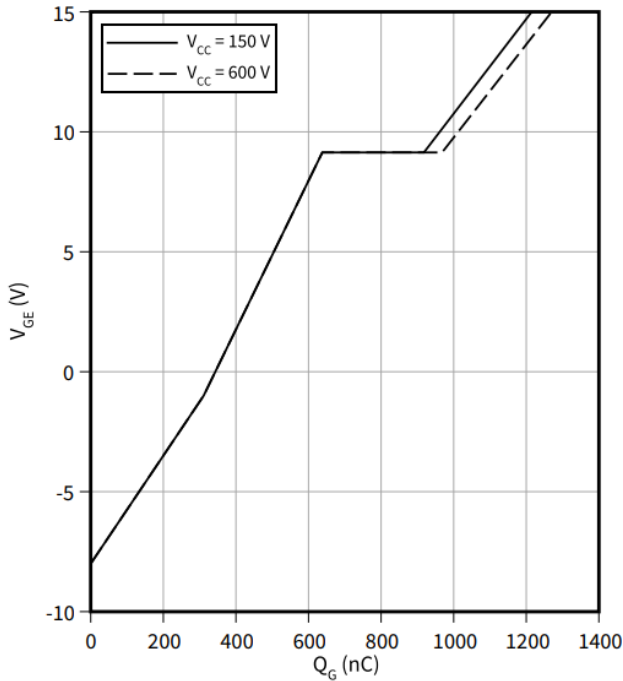
$I_C = 200\text{ A}, V_{GE} = -8/15\text{ V}, T_{vj} = 175\text{ °C}, R_G = 5\ \Omega$



Typical gate charge

$V_{GE} = f(Q_G)$

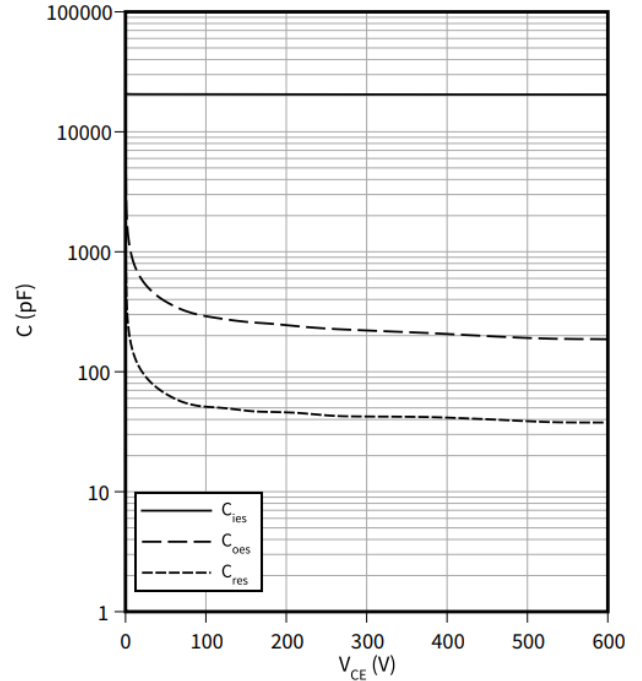
$I_C = 200\text{ A}$



Typical capacitance as a function of collector-emitter voltage

$C = f(V_{CE})$

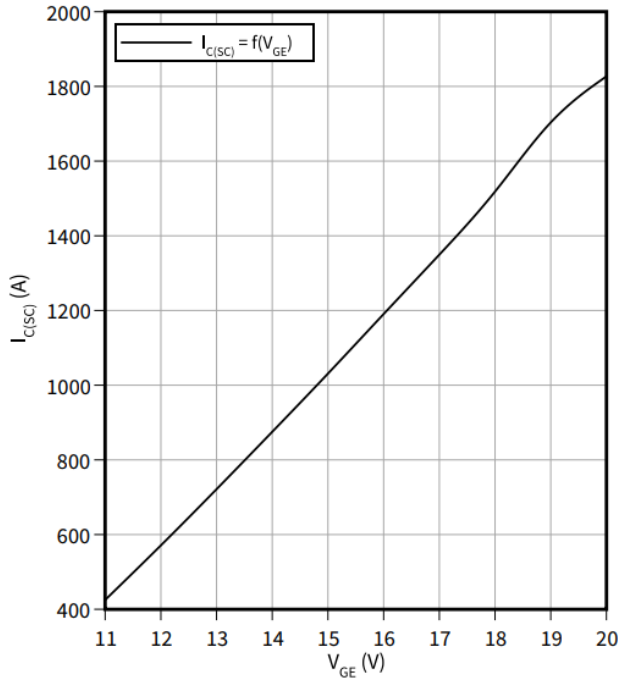
$f = 100\text{ kHz}, V_{GE} = 0\text{ V}$



4 特性图

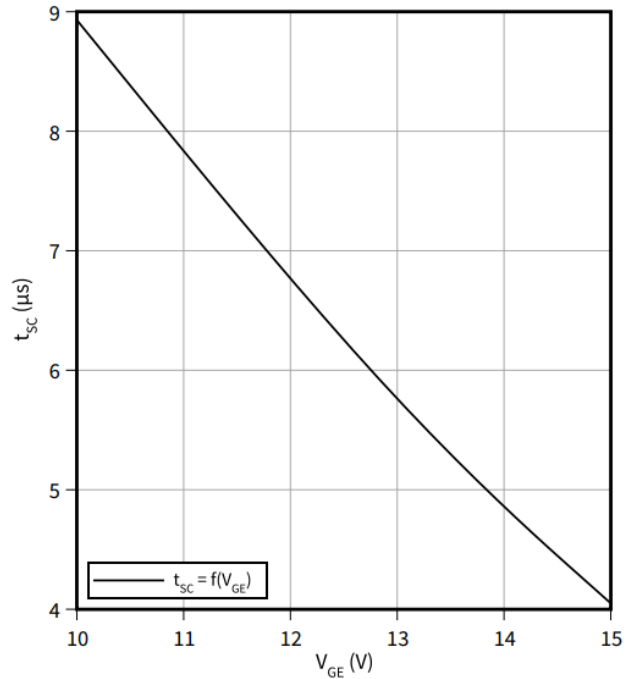
Typical short circuit collector current as a function of gate-emitter voltage

$I_{C(SC)} = f(V_{GE})$
 $T_{vj} \leq 175\text{ }^\circ\text{C}$, $V_{CE} \leq 470\text{ V}$



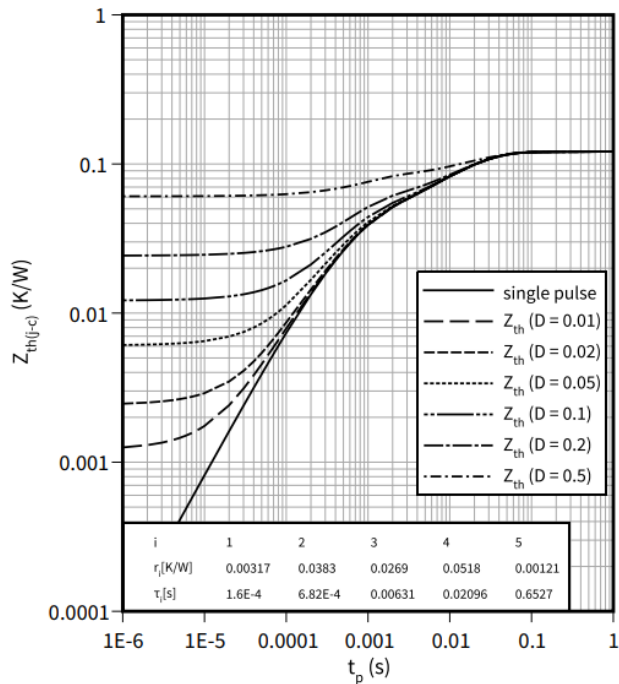
Short circuit withstand time as a function of gate-emitter voltage

$t_{SC} = f(V_{GE})$
 $T_{vj} \leq 175\text{ }^\circ\text{C}$, $V_{CE} \leq 470\text{ V}$



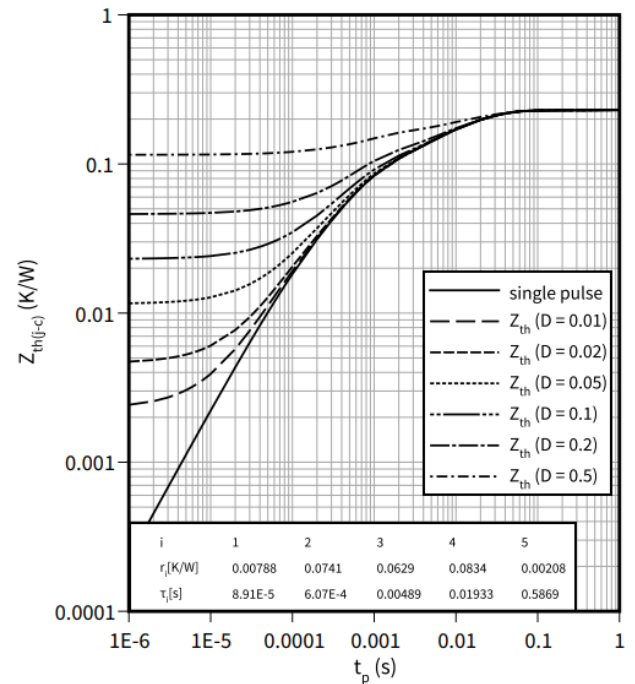
IGBT typical transient thermal impedance as a function of pulse width

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



Diode typical transient thermal impedance as a function of pulse width

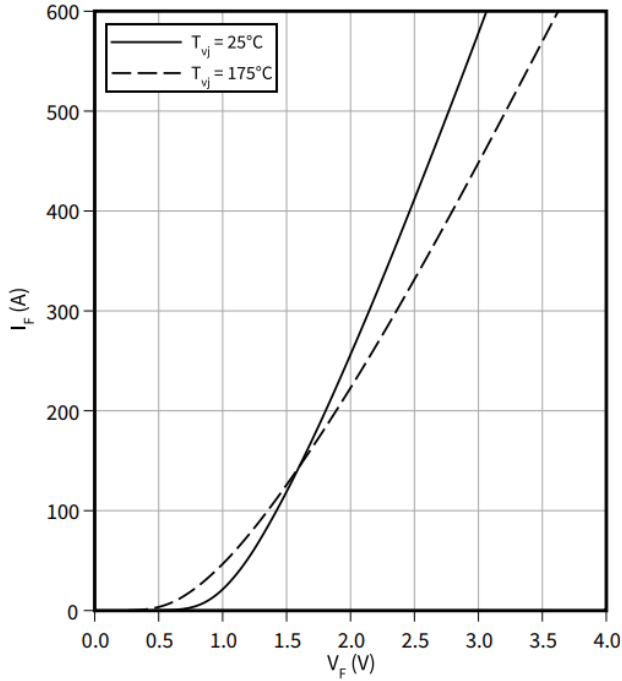
$Z_{th(j-c)} = f(t_p)$
 $D = t_p/T$



4 特性图

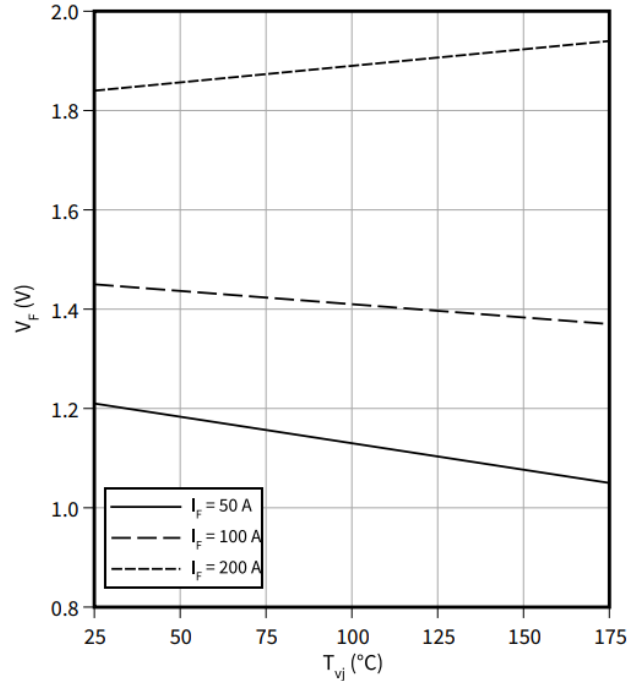
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



Typical diode forward voltage as a function of junction temperature

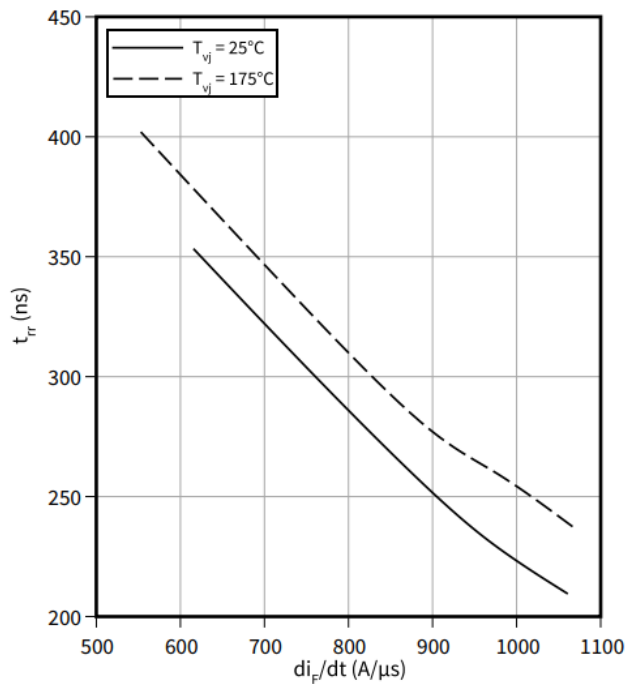
$V_F = f(T_{vj})$



Typical reverse recovery time as a function of diode current slope

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

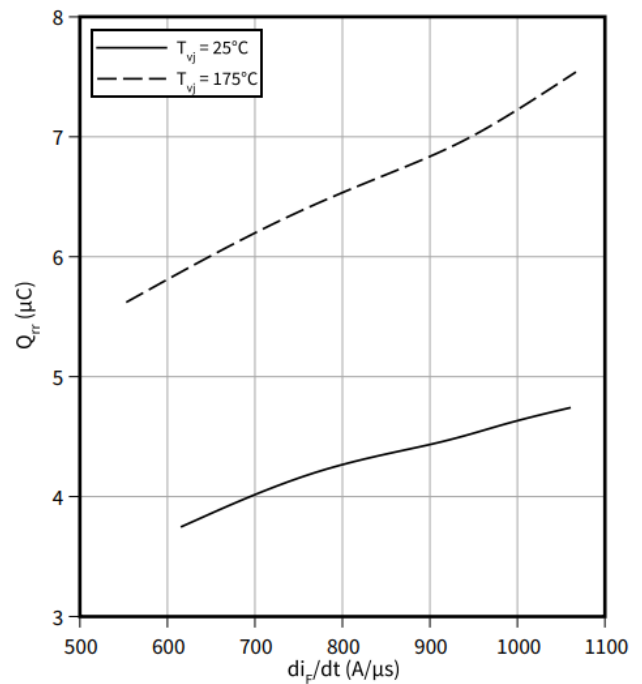
$V_R = 470\text{ V}$, $I_F = 200\text{ A}$



Typical reverse recovery charge as a function of diode current slope

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

$V_R = 470\text{ V}$, $I_F = 200\text{ A}$

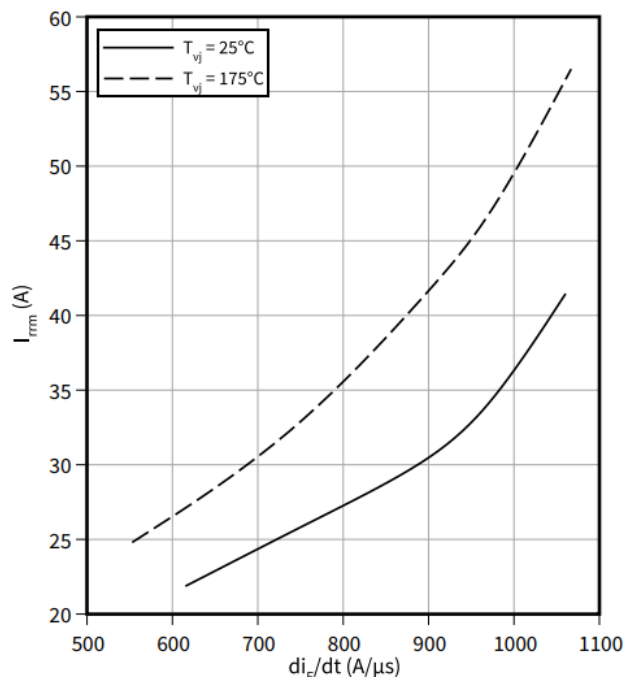


4 特性图

Typical reverse recovery current as a function of diode current slope

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

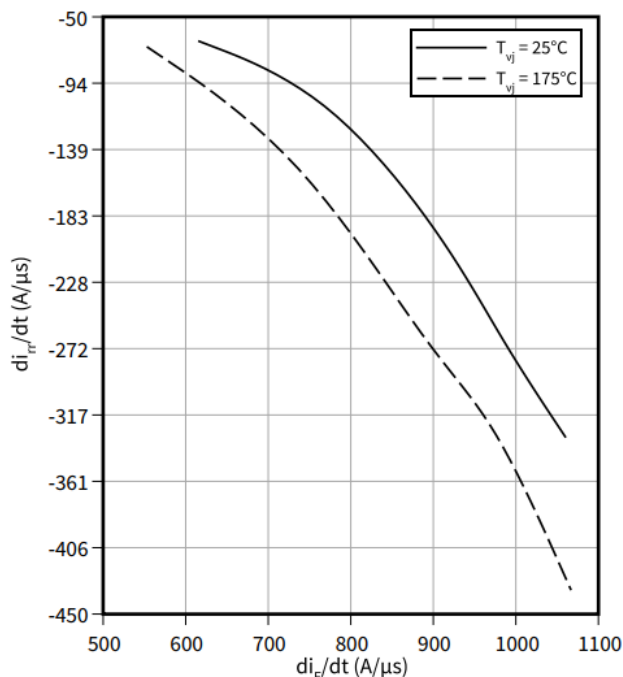
$V_R = 470 \text{ V}, I_F = 200 \text{ A}$



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

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

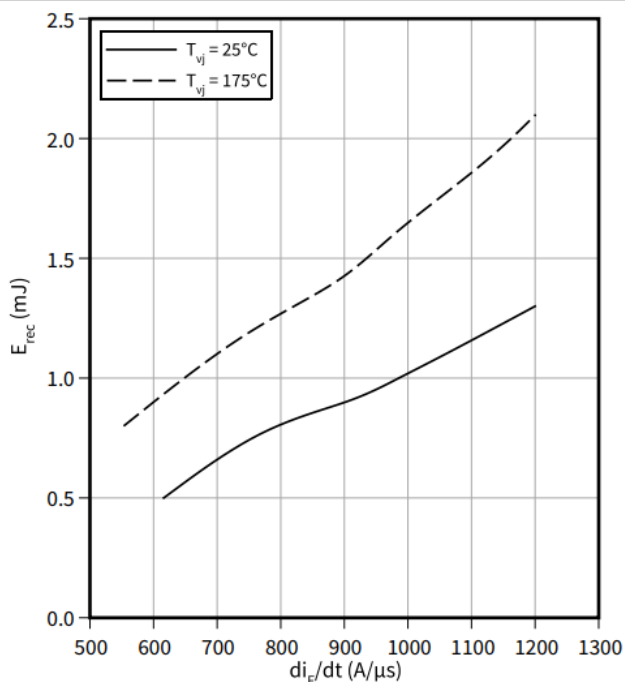
$V_R = 470 \text{ V}, I_F = 200 \text{ A}$



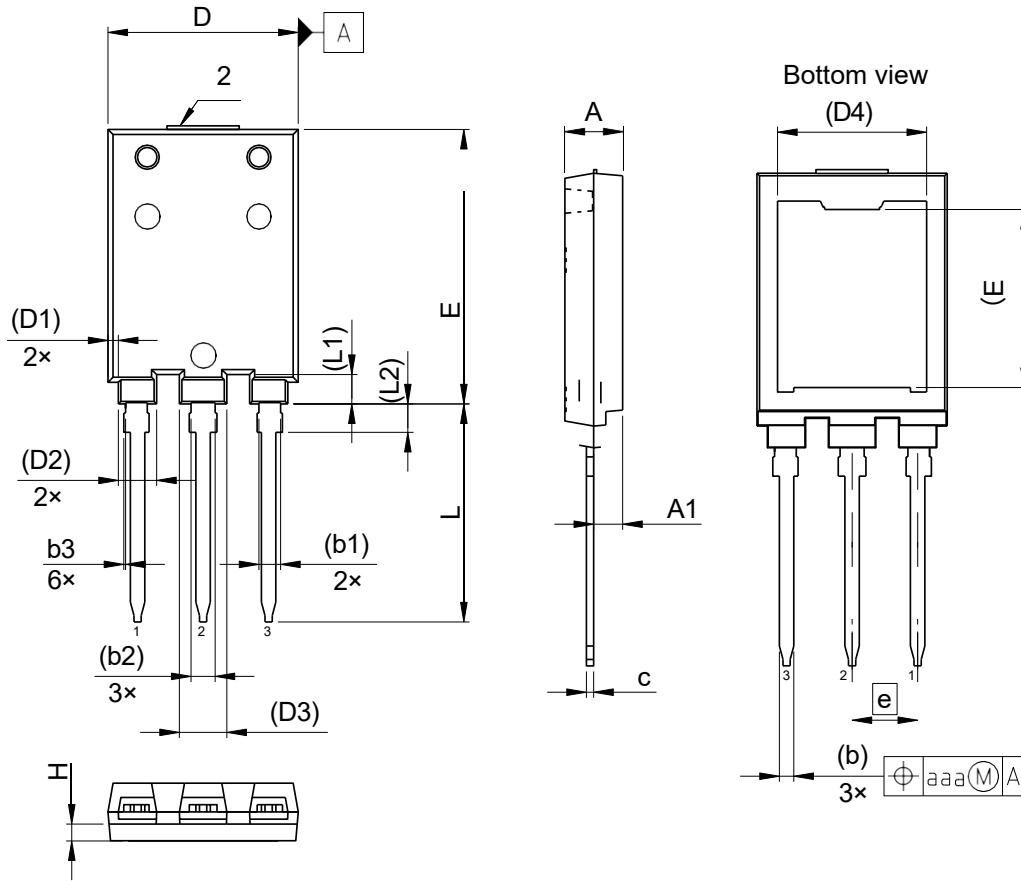
Typical reverse energy losses as a function of diode current slope

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

$V_R = 470 \text{ V}, I_F = 200 \text{ A}$



5 封装外形



PACKAGE - GROUP		
NUMBER: PG-TO247-3-U02		
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.7	4.9
A1	2.16	2.66
b	1.2	
b1	1.8	
b2	2	
b3	0	0.15
c	0.5	0.7
D	15.7	15.9
D1	0.86	
D2	3.18	

DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
D3	3.94	
D4	12.38	
E	22.7	22.9
E1	14.79	
e	5.44	
H	1.3	1.5
L	18.01	18.21
L1	2.44	
L2	2.36	
aaa	0.25	

1) All metal surfaces tin plated except area of cut

2) Mold gate protrusion after degating

All dimensions are in units mm

The drawing is in compliance with ISO 128-30, Projection Method 3 [⊕] [A]

Drawing according to ISO 8015, general tolerances

图 1

6 测试条件

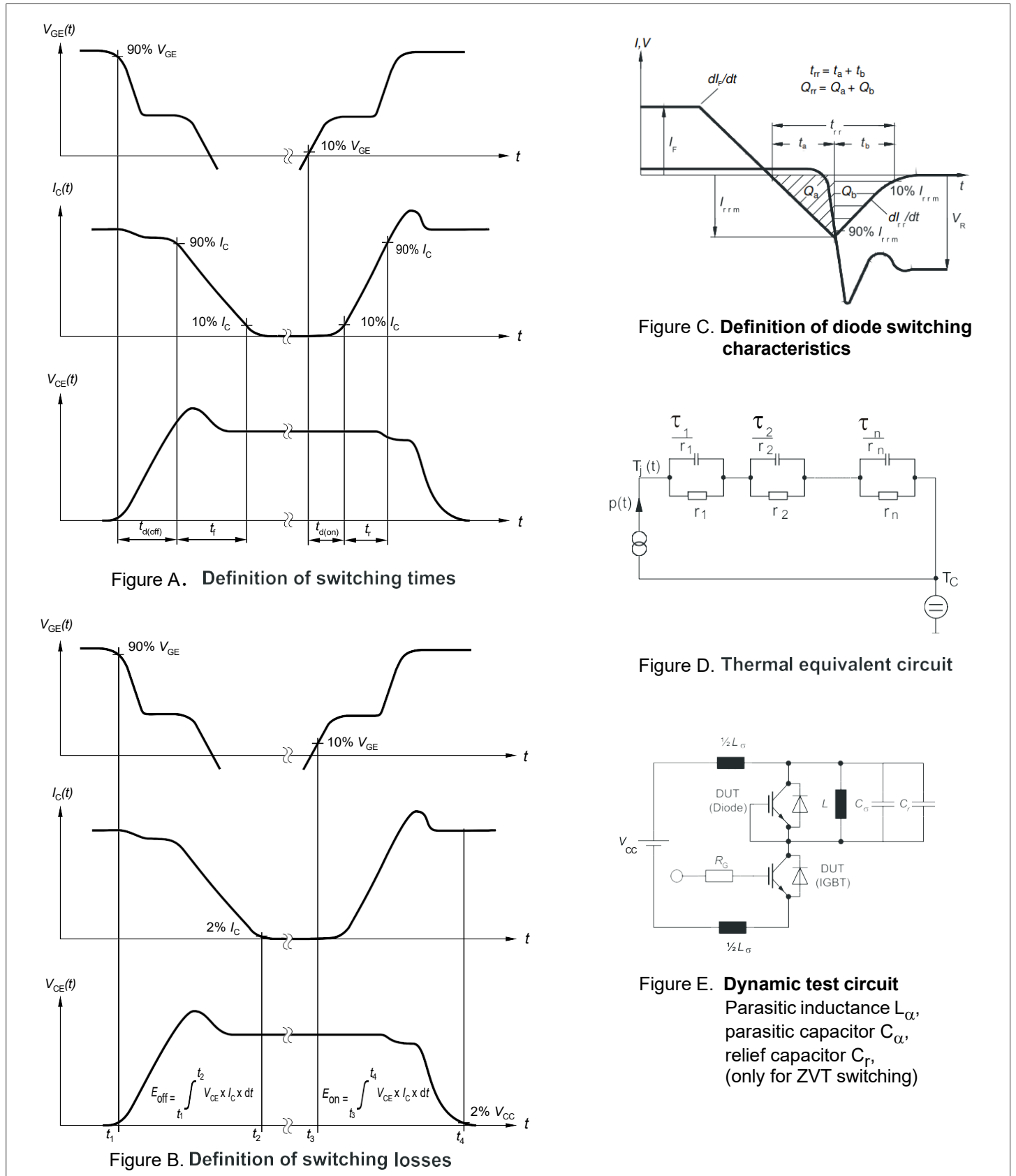


图 2

修订记录

Document revision	Date of release	Description of changes
0.10	2023-02-21	Target datasheet
0.20	2024-02-22	Preliminary datasheet
1.00	2024-07-25	Final datasheet
1.10	2025-06-11	Transient thermal impedance plots, package naming convention, and qualification labels updated according to the latest guidelines



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