

英飞凌 600 V 反向传导驱动器 2 提供具有单片集成二极管的经济高效的 IGBT

**特性**

- $V_{CE} = 600\text{ V}$
- $I_C = 3\text{ A}$
- 参数分布紧密
- 工作频率范围在1 ~ 20 kHz
- 最高结温 150°C
- 短路能力为 3  $\mu\text{s}$
- 防潮设计
- 无铅镀层；符合RoHS标准
- 完整的产品品类和 PSpice 模型: <http://www.infineon.com/rc-d2>



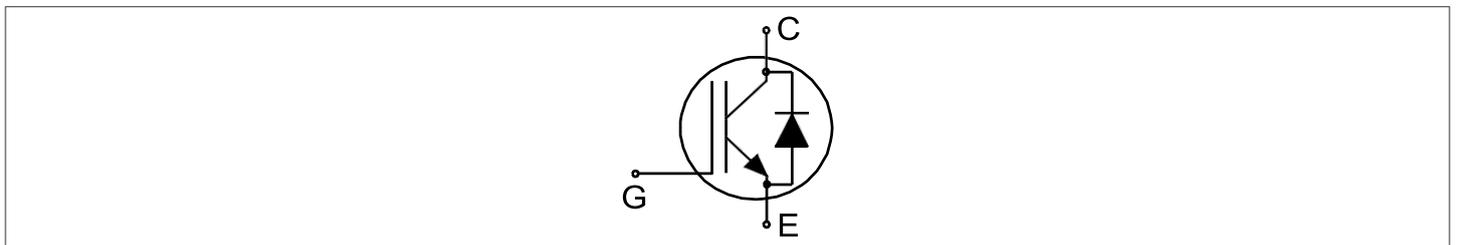
**潜在应用**

- 吊扇
- 台面电器 - 搅拌
- 厨房油烟机
- 冰箱
- 家用空调室内机
- 洗衣机
- 通用驱动器 (GPD)

**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
IKN03N60RC2	PG-SOT223-3	K3DRC2

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）。

## 目录

	描述.....	1
	特性.....	1
	潜在应用 .....	1
	产品验证 .....	1
	目录.....	2
1	封装.....	3
2	IGBT .....	3
3	二极管.....	5
4	特征图 .....	7
5	封装外形 .....	14
6	测试条件 .....	15
	修订记录 .....	16
	免责声明 .....	17

1 封装

**1 封装**

**表 1 特征值**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Storage temperature	$T_{stg}$		-55		150	°C
Soldering temperature	$T_{sold}$	wave soldering / reflow soldering (MSL1 according to JEDEC J-STA-020)			260	°C
Thermal resistance, min. footprint junction-ambient	$R_{th(j-a)}$				160	K/W
Thermal resistance, 6 cm <sup>2</sup> Cu on PCB junction to ambient	$R_{th(j-a)}$				75	K/W
IGBT thermal resistance, junction-case <sup>1)</sup>	$R_{th(j-c)}$				19.7	K/W
Diode thermal resistance, junction-case <sup>1)</sup>	$R_{th(j-c)}$				27	K/W

1)  $R_{th}/Z_{th}$  基于单次冷却脉冲。请注意，使用热电偶无法正确测量二极管的  $R_{th}$ 。

**2 IGBT**

**表 2 最大额定值**

Parameter	Symbol	Note or test condition	Values	Unit
Collector-emitter voltage	$V_{CE}$	$T_{vj} \geq 25\text{ °C}$	600	V
DC collector current, limited by $T_{vjmax}$ <sup>1)</sup>	$I_C$	$T_c = 25\text{ °C}$	5.7	A
		$T_c = 100\text{ °C}$	3	
Pulsed collector current, $t_p$ limited by $T_{vjmax}$	$I_{Cpulse}$		9	A
Turn-off safe operating area		$V_{CE} \leq 600\text{ V}$ , $t_p = 1\ \mu\text{s}$ , $T_{vj} \leq 150\text{ °C}$	9	A
Gate-emitter voltage	$V_{GE}$		$\pm 20$	V
Transient gate-emitter voltage	$V_{GE}$	$t_p \leq 10\ \mu\text{s}$ , $D < 0.01$	$\pm 30$	V
Short-circuit withstand time	$t_{SC}$	$V_{CC} \leq 400\text{ V}$ , $V_{GE} = 15\text{ V}$ , Allowed number of short circuits < 1000, Time between short circuits $\geq 1.0\text{ s}$ , $T_{vj} = 150\text{ °C}$	3	$\mu\text{s}$
Power dissipation	$P_{tot}$	$T_c = 25\text{ °C}$	6.3	W
		$T_c = 100\text{ °C}$	2.5	

1) DPAK当量

**表3 特征值**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CEsat}$	$I_C = 3\text{ A}, V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$	2	2.3	V
			$T_{vj} = 150\text{ °C}$		2.3	
Gate-emitter threshold voltage	$V_{Geth}$	$I_C = 35\text{ }\mu\text{A}, V_{CE} = V_{GE}$	4.3	5	5.7	V
Zero gate-voltage collector current	$I_{CES}$	$V_{CE} = 600\text{ V}, V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$		25	$\mu\text{A}$
			$T_{vj} = 150\text{ °C}$		2500	
Gate-emitter leakage current	$I_{GES}$	$V_{CE} = 0\text{ V}, V_{GE} = 20\text{ V}$			100	nA
Transconductance	$g_{fs}$	$I_C = 3\text{ A}, V_{CE} = 20\text{ V}$		1.7		S
Input capacitance	$C_{ies}$	$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1000\text{ kHz}$		140		pF
Output capacitance	$C_{oes}$	$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1000\text{ kHz}$		7		pF
Reverse transfer capacitance	$C_{res}$	$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1000\text{ kHz}$		6		pF
Gate charge	$Q_G$	$I_C = 3\text{ A}, V_{CC} = 480\text{ V}, V_{GE} = 15\text{ V}$		18		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_{Gon} = 49\text{ }\Omega, R_{Goff} = 49\text{ }\Omega, L_\sigma = 30\text{ nH}, C_\sigma = 32\text{ pF}$	$T_{vj} = 25\text{ °C}, I_C = 3\text{ A}$	7		ns
			$T_{vj} = 150\text{ °C}, I_C = 3\text{ A}$		6.5	
Rise time (inductive load)	$t_r$	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_{Gon} = 49\text{ }\Omega, R_{Goff} = 49\text{ }\Omega, L_\sigma = 30\text{ nH}, C_\sigma = 32\text{ pF}$	$T_{vj} = 25\text{ °C}, I_C = 3\text{ A}$	8		ns
			$T_{vj} = 150\text{ °C}, I_C = 3\text{ A}$		8.5	
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_{Gon} = 49\text{ }\Omega, R_{Goff} = 49\text{ }\Omega, L_\sigma = 30\text{ nH}, C_\sigma = 32\text{ pF}$	$T_{vj} = 25\text{ °C}, I_C = 3\text{ A}$	77.5		ns
			$T_{vj} = 150\text{ °C}, I_C = 3\text{ A}$		113	
Fall time (inductive load)	$t_f$	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_{Gon} = 49\text{ }\Omega, R_{Goff} = 49\text{ }\Omega, L_\sigma = 30\text{ nH}, C_\sigma = 32\text{ pF}$	$T_{vj} = 25\text{ °C}, I_C = 3\text{ A}$	48.5		ns
			$T_{vj} = 150\text{ °C}, I_C = 3\text{ A}$		36.5	
Turn-on energy	$E_{on}$	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_{Gon} = 49\text{ }\Omega, R_{Goff} = 49\text{ }\Omega, L_\sigma = 30\text{ nH}, C_\sigma = 32\text{ pF}$	$T_{vj} = 25\text{ °C}, I_C = 3\text{ A}$	62		$\mu\text{J}$
			$T_{vj} = 150\text{ °C}, I_C = 3\text{ A}$		84	
Turn-off energy	$E_{off}$	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_{Gon} = 49\text{ }\Omega, R_{Goff} = 49\text{ }\Omega, L_\sigma = 30\text{ nH}, C_\sigma = 32\text{ pF}$	$T_{vj} = 25\text{ °C}, I_C = 4\text{ A}$	44		$\mu\text{J}$
			$T_{vj} = 150\text{ °C}, I_C = 3\text{ A}$		75.7	
Total switching energy	$E_{ts}$	$V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_{Gon} = 49\text{ }\Omega, R_{Goff} = 49\text{ }\Omega, L_\sigma = 30\text{ nH}, C_\sigma = 32\text{ pF}$	$T_{vj} = 25\text{ °C}, I_C = 3\text{ A}$	106		$\mu\text{J}$
			$T_{vj} = 150\text{ °C}, I_C = 3\text{ A}$		160	

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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.	
Operating junction temperature	$T_{vj}$		-40		150	°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	
Repetitive peak reverse voltage	$V_{RRM}$	$T_{vj} \geq 25^\circ\text{C}$	600	V	
Diode forward current, limited by $T_{vjmax}$ <sup>1)</sup>	$I_F$		$T_c = 25^\circ\text{C}$	3.9	A
			$T_c = 100^\circ\text{C}$	1.8	
Diode pulsed current, $t_p$ limited by $T_{vjmax}$	$I_{Fpulse}$		9	A	

1) DPAK当量

**表 5 特征值**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Diode forward voltage	$V_F$	$I_F = 3\text{ A}$	$T_{vj} = 25^\circ\text{C}$	1.85	2.2	V
			$T_{vj} = 150^\circ\text{C}$	1.9		
Diode reverse recovery time	$t_{rr}$	$V_R = 400\text{ V}, R_{Gon} = 49\ \Omega$	$T_{vj} = 25^\circ\text{C}, I_F = 3\text{ A}, -di_F/dt = 362\text{ A}/\mu\text{s}$	38		ns
			$T_{vj} = 150^\circ\text{C}, I_F = 3\text{ A}, -di_F/dt = 397\text{ A}/\mu\text{s}$	89.4		
Diode reverse recovery charge	$Q_{rr}$	$V_R = 400\text{ V}, R_{Gon} = 49\ \Omega$	$T_{vj} = 25^\circ\text{C}, I_F = 3\text{ A}, -di_F/dt = 362\text{ A}/\mu\text{s}$	0.085		$\mu\text{C}$
			$T_{vj} = 150^\circ\text{C}, I_F = 3\text{ A}, -di_F/dt = 397\text{ A}/\mu\text{s}$	0.17		
Diode peak reverse recovery current	$I_{rrm}$	$V_R = 400\text{ V}, R_{Gon} = 49\ \Omega$	$T_{vj} = 25^\circ\text{C}, I_F = 3\text{ A}, -di_F/dt = 362\text{ A}/\mu\text{s}$	3.8		A
			$T_{vj} = 150^\circ\text{C}, I_F = 3\text{ A}, -di_F/dt = 397\text{ A}/\mu\text{s}$	4.9		

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表 5 (续) 特征值

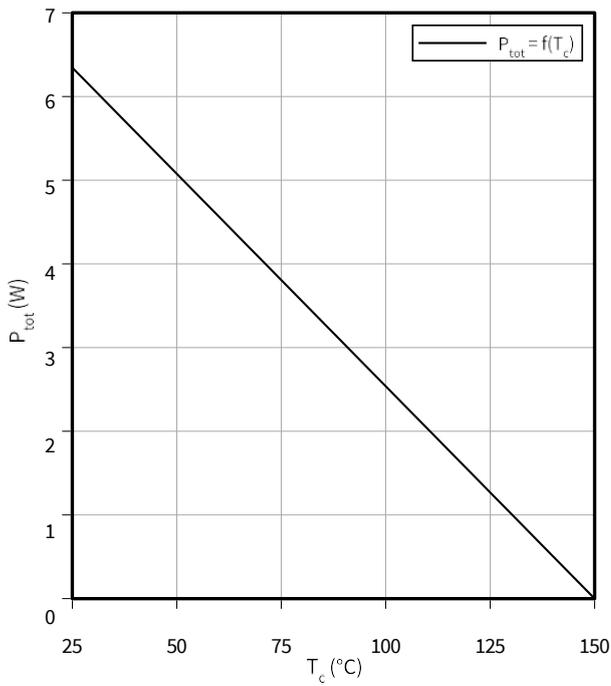
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode peak rate of fall of reverse recovery current	$di_{rr}/dt$	$V_R = 400 \text{ V}, R_{Gon} = 49 \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}, I_F = 3 \text{ A},$ $-di_F/dt = 362 \text{ A}/\mu\text{s}$		129		A/ $\mu\text{s}$
			$T_{vj} = 150 \text{ }^\circ\text{C},$ $I_F = 3 \text{ A},$ $-di_F/dt = 397 \text{ A}/\mu\text{s}$		61		
Operating junction temperature	$T_{vj}$			-40		150	$^\circ\text{C}$

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%。

## 4 特性图

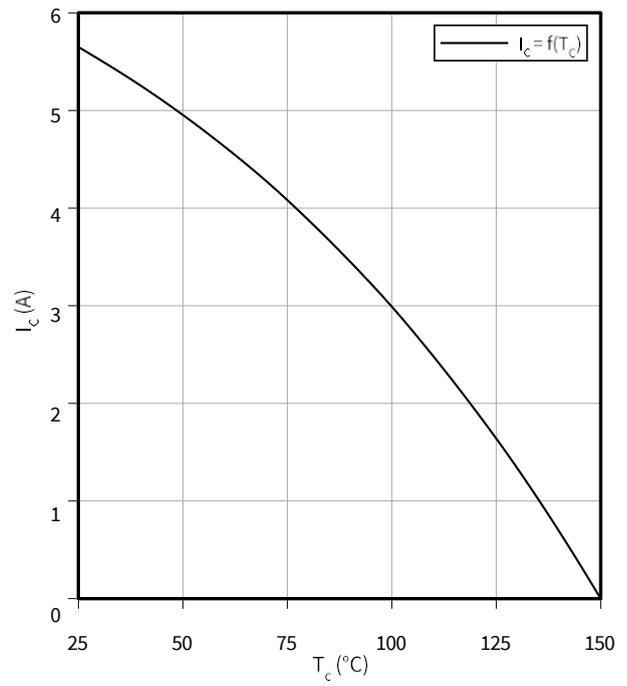
**Power dissipation as a function of heatsink temperature**

$P_{tot} = f(T_c)$   
 $T_{vj} \leq 150\text{ }^\circ\text{C}$



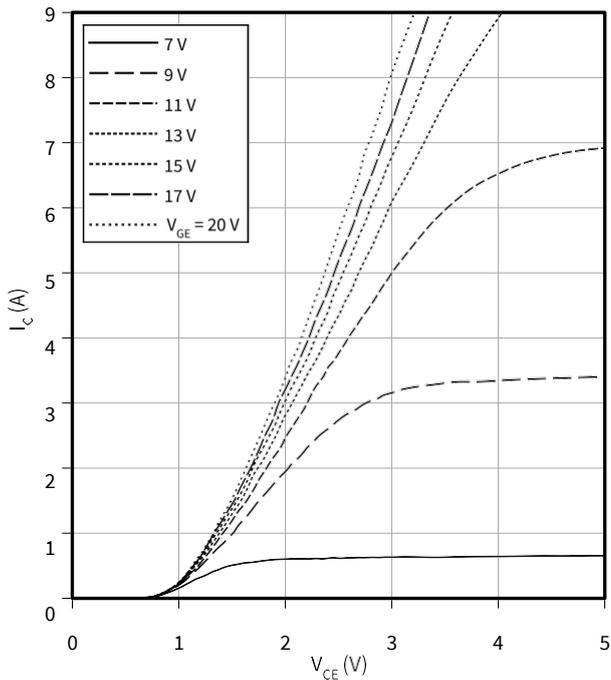
**Collector current as a function of heatsink temperature**

$I_c = f(T_c)$   
 $T_{vj} \leq 150\text{ }^\circ\text{C}, V_{GE} \geq 15\text{ V}$



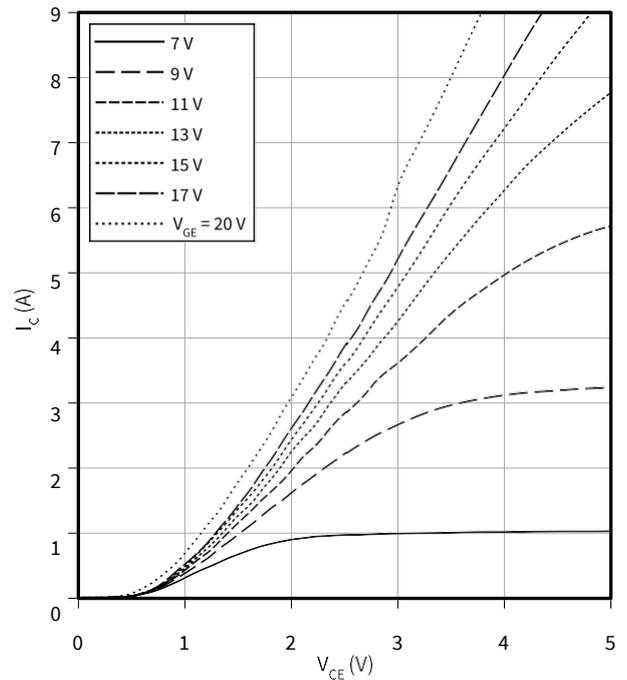
**Typical output characteristic**

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



**Typical output characteristic**

$I_c = f(V_{CE})$   
 $T_{vj} = 150\text{ }^\circ\text{C}$

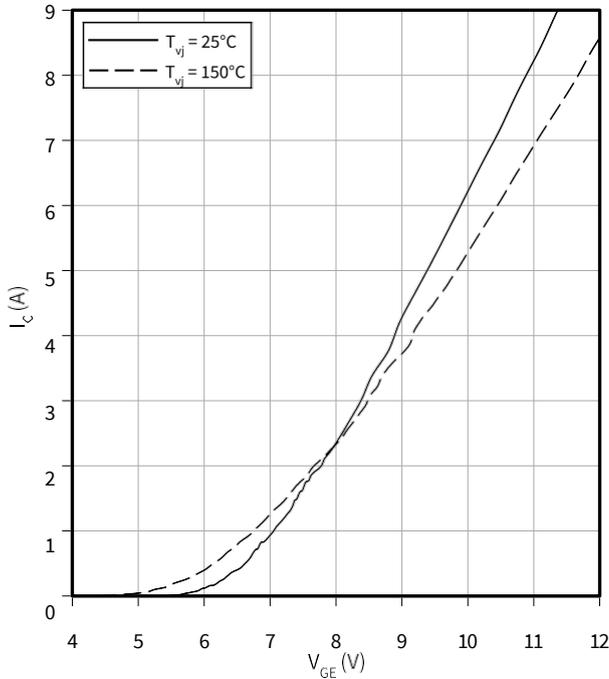


4 特征图

**Typical transfer characteristic**

$I_C = f(V_{GE})$

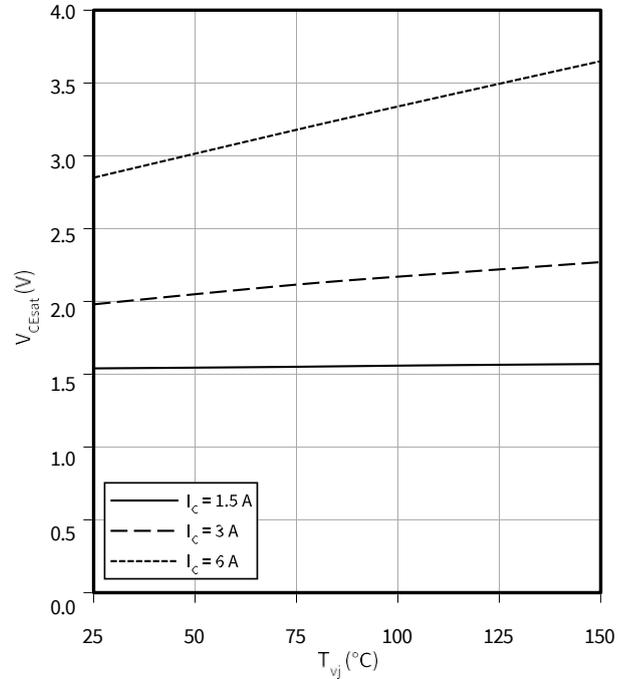
$V_{CE} = 20 \text{ V}$



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

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

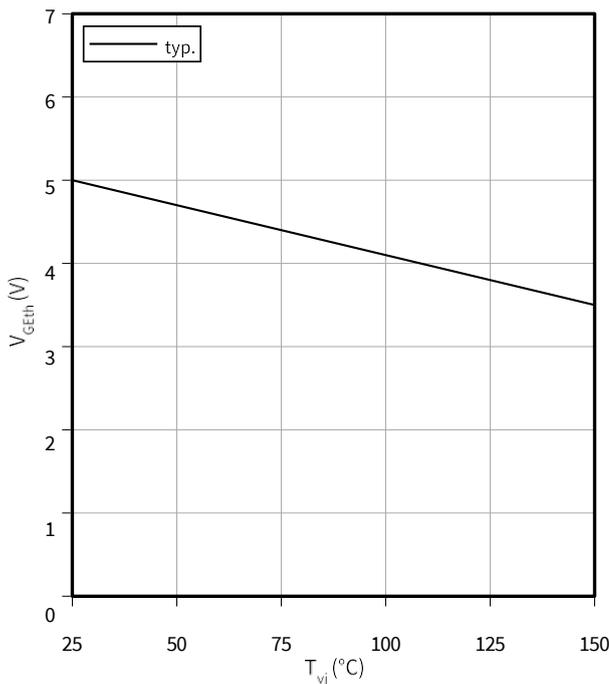
$V_{GE} = 15 \text{ V}$



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

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

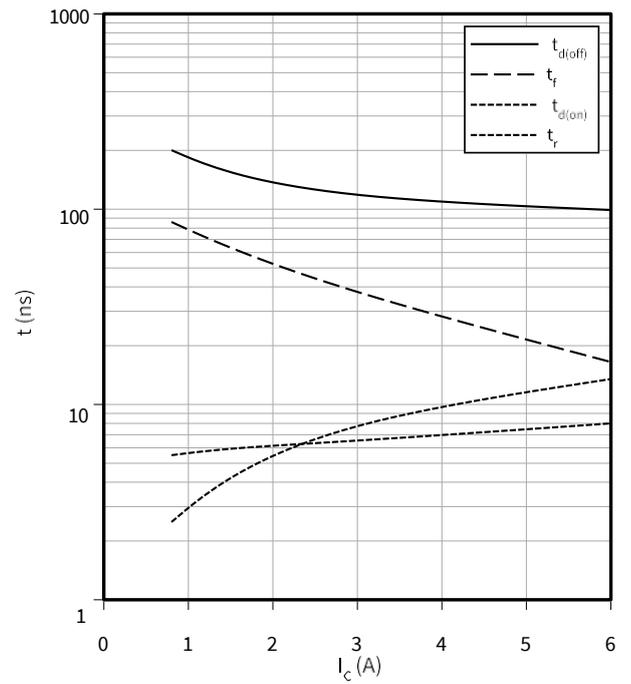
$I_C = 35 \mu\text{A}$



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

$t = f(I_C)$

$V_{CC} = 400 \text{ V}, T_{vj} = 150^\circ\text{C}, V_{GE} = 0/15 \text{ V}, R_G = 49 \Omega$

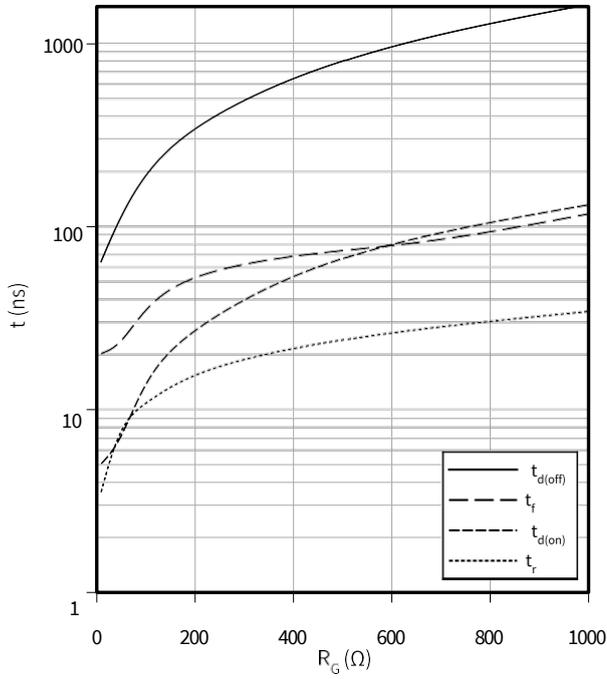


4 特征图

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

$t = f(R_G)$

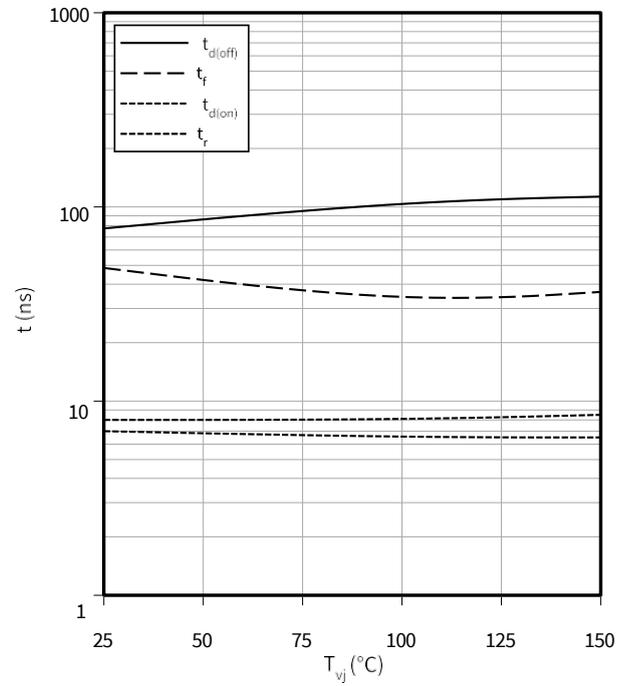
$I_C = 3 \text{ A}$ ,  $V_{CC} = 400 \text{ V}$ ,  $T_{vj} = 150 \text{ }^\circ\text{C}$ ,  $V_{GE} = 0/15 \text{ V}$



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

$t = f(T_{vj})$

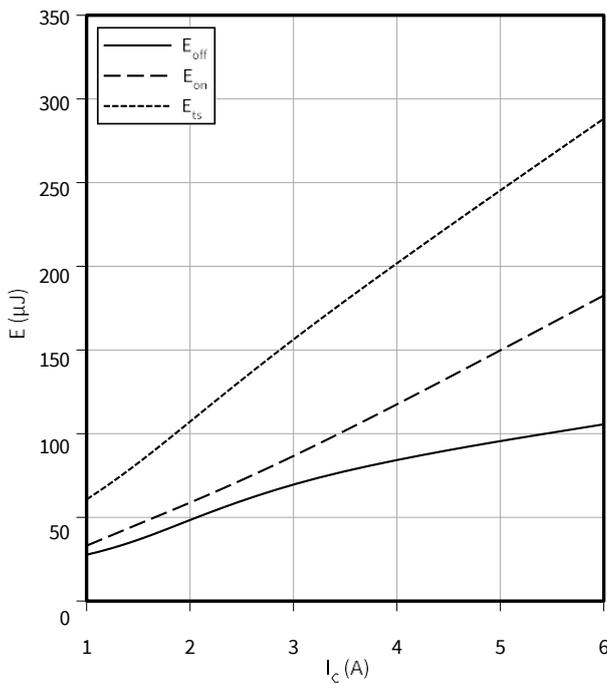
$I_C = 3 \text{ A}$ ,  $V_{CC} = 400 \text{ V}$ ,  $V_{GE} = 0/15 \text{ V}$ ,  $R_G = 49 \text{ } \Omega$



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

$E = f(I_C)$

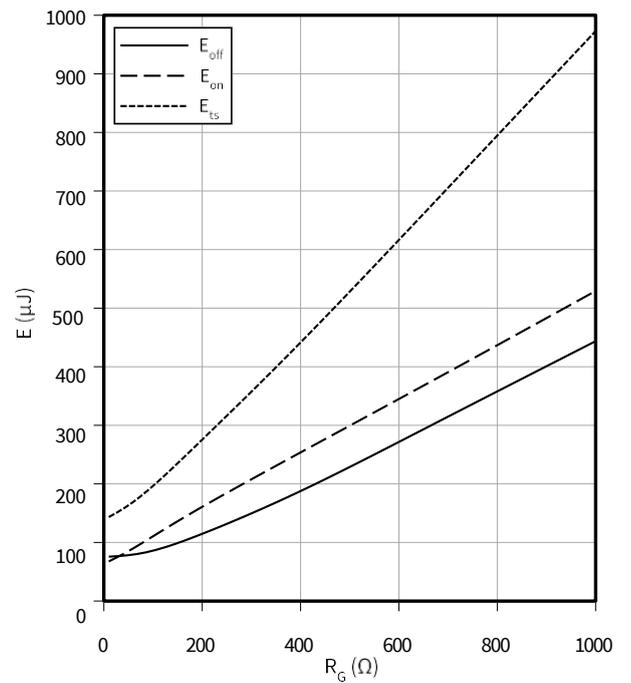
$V_{CC} = 400 \text{ V}$ ,  $T_{vj} = 150 \text{ }^\circ\text{C}$ ,  $V_{GE} = 0/15 \text{ V}$ ,  $R_G = 49 \text{ } \Omega$



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

$E = f(R_G)$

$I_C = 3 \text{ A}$ ,  $V_{CC} = 400 \text{ V}$ ,  $T_{vj} = 150 \text{ }^\circ\text{C}$ ,  $V_{GE} = 0/15 \text{ V}$

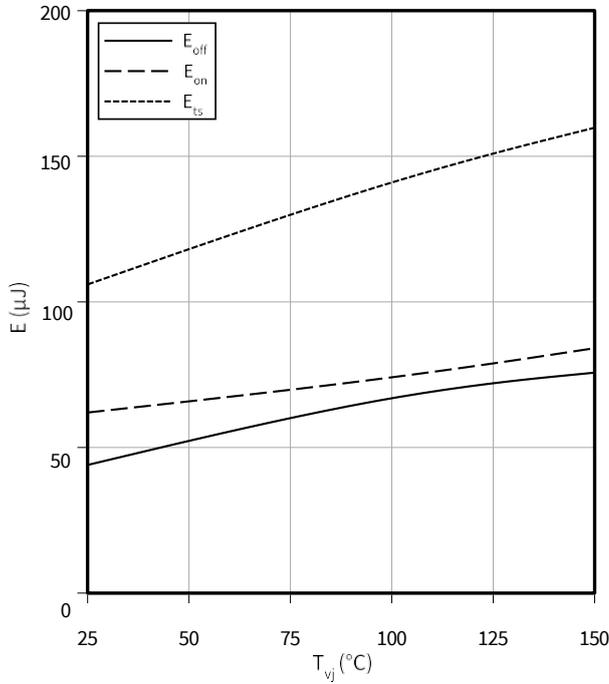


4 特征图

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

$E = f(T_{vj})$

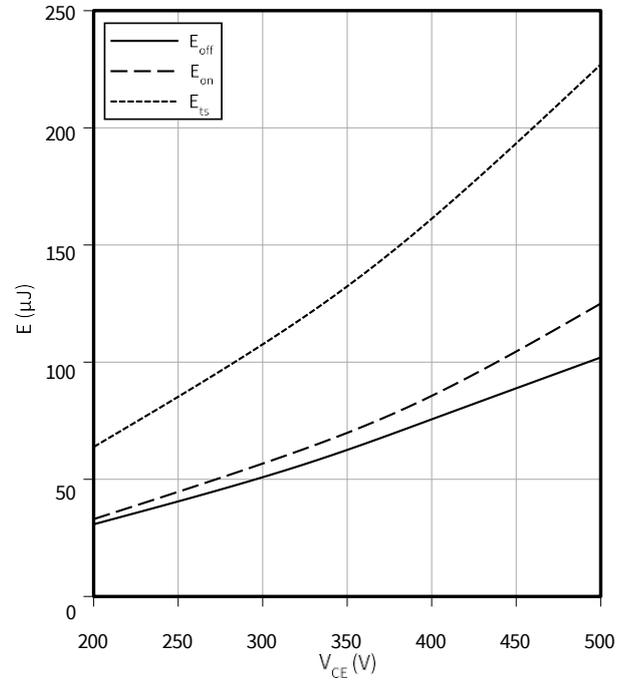
$I_C = 3 \text{ A}$ ,  $V_{CC} = 400 \text{ V}$ ,  $V_{GE} = 15/0 \text{ V}$ ,  $R_G = 49 \ \Omega$



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

$E = f(V_{CE})$

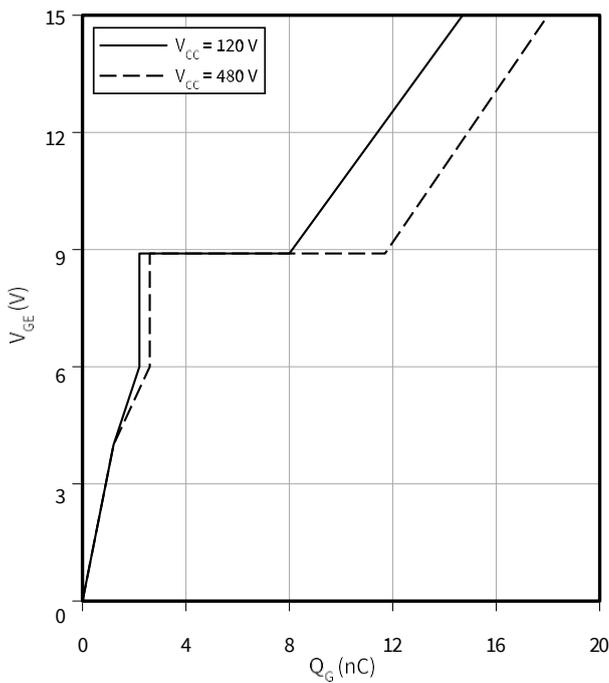
$I_C = 3 \text{ A}$ ,  $T_{vj} = 150 \text{ }^\circ\text{C}$ ,  $V_{GE} = 0/15 \text{ V}$ ,  $R_G = 49 \ \Omega$



**Typical gate charge**

$V_{GE} = f(Q_G)$

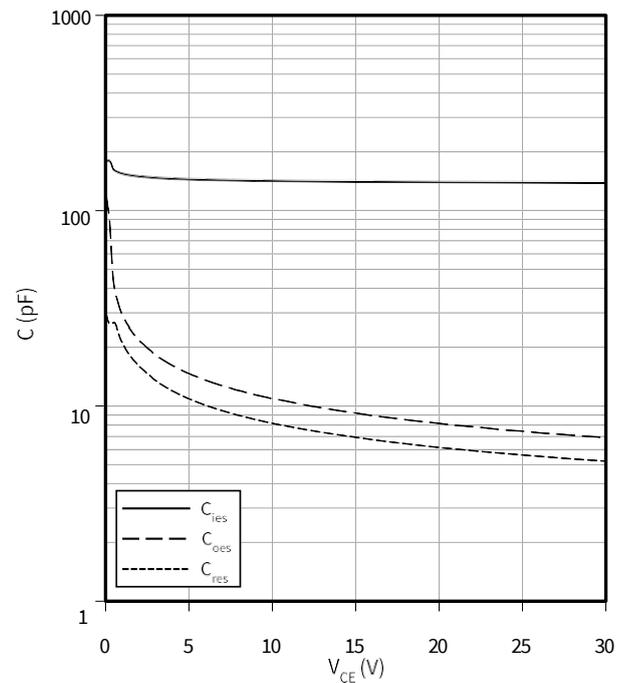
$I_C = 3 \text{ A}$



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

$C = f(V_{CE})$

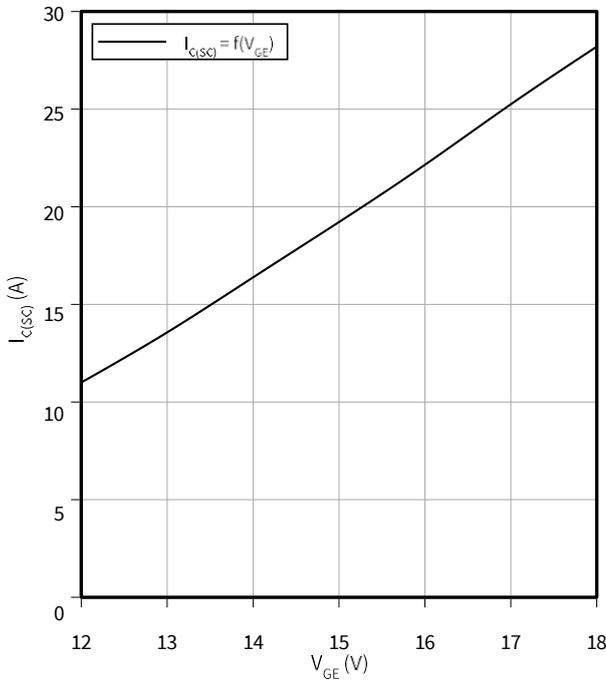
$f = 1000 \text{ kHz}$ ,  $V_{GE} = 0 \text{ V}$



4 特征图

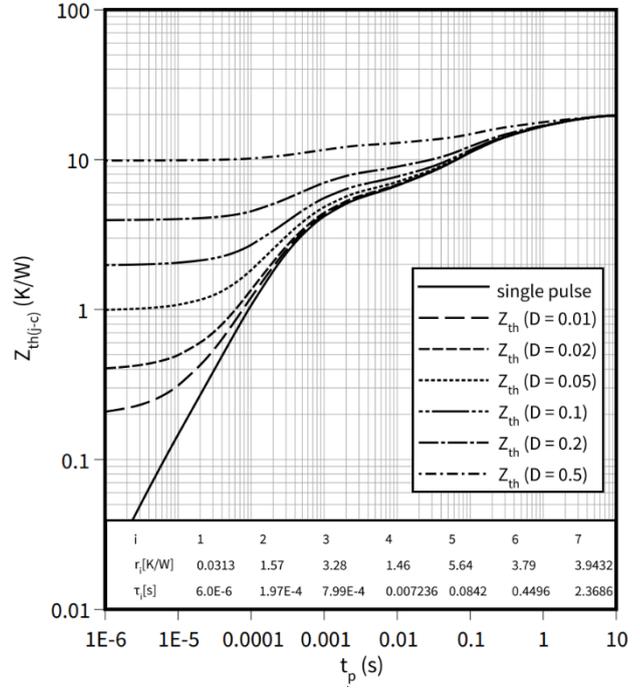
**Typical short circuit collector current as a function of gate-emitter voltage**

$I_{C(SC)} = f(V_{GE})$   
 $T_{vj} \leq 150\text{ }^{\circ}\text{C}$ ,  $V_{CC} \leq 400\text{ V}$



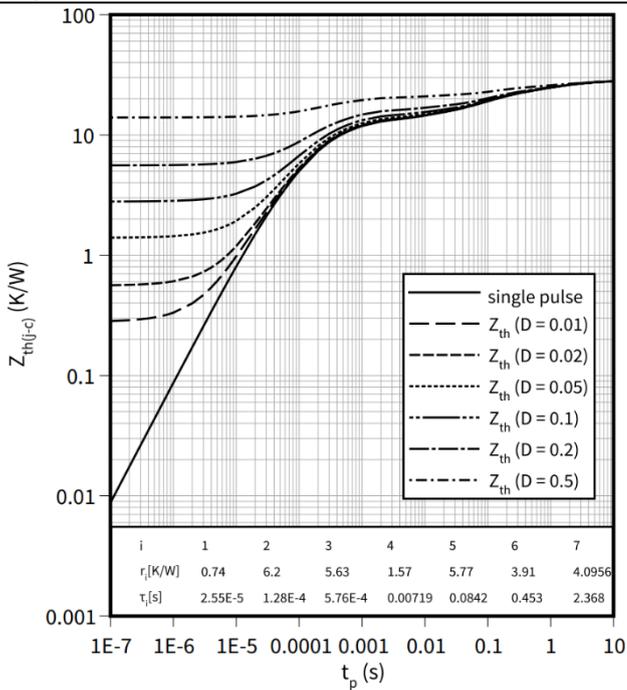
**IGBT transient thermal impedance as a function of pulse width**

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



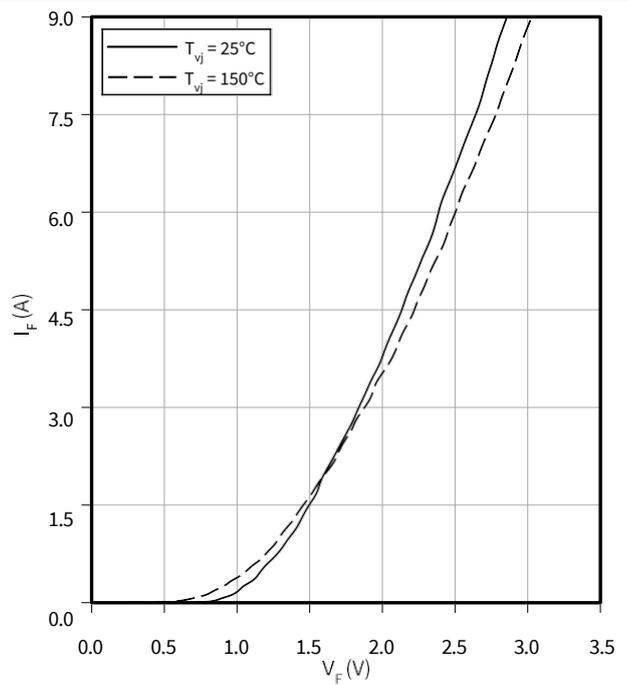
**Diode transient thermal impedance as a function of pulse width**

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



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

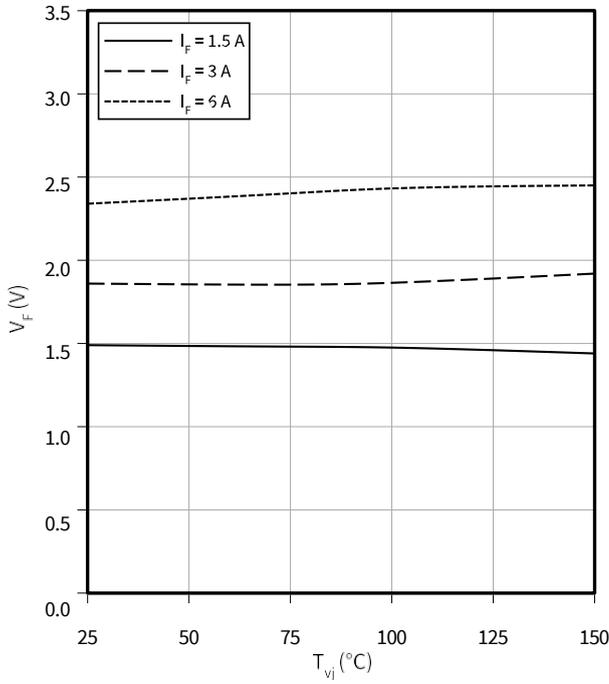
$I_F = f(V_F)$



4 特征图

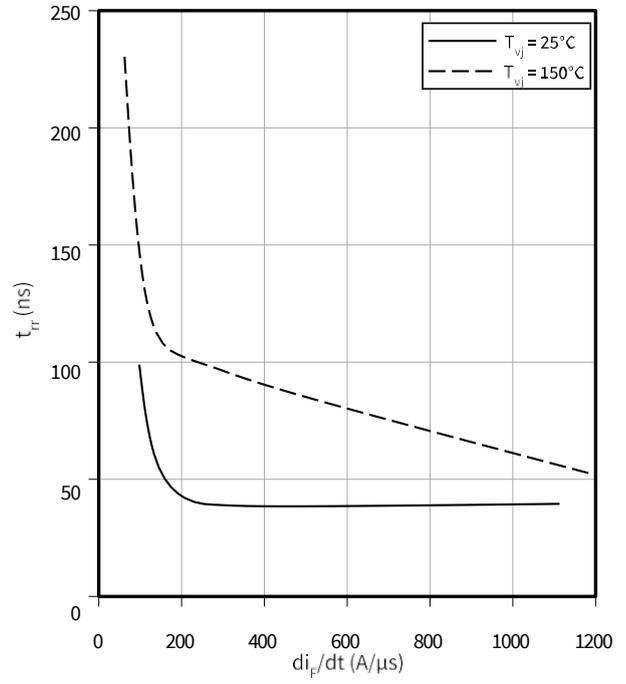
**Typical diode forward voltage as a function of junction temperature**

$V_F = f(T_{vj})$



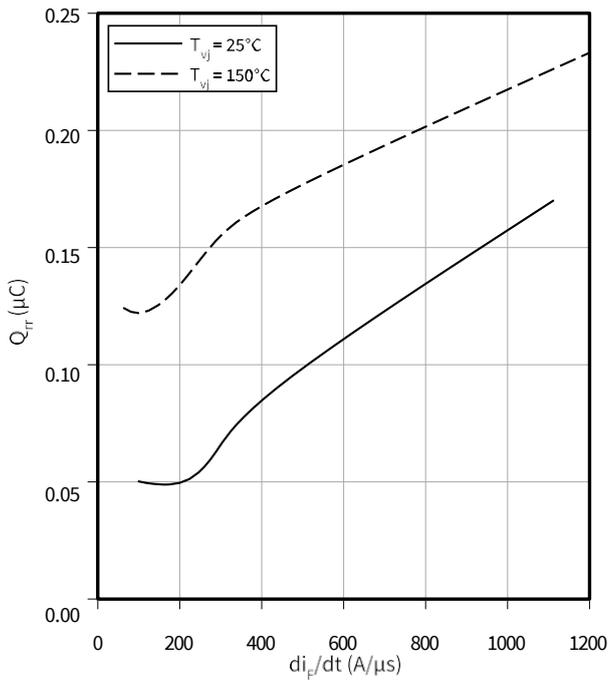
**Typical reverse recovery time as a function of diode current slope**

$t_{rr} = f(di_F/dt)$   
 $V_R = 400$  V,  $I_F = 3$  A



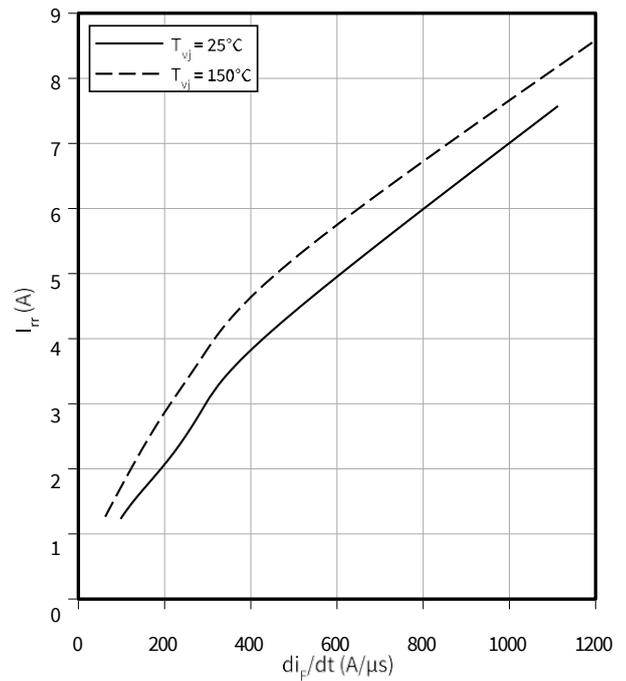
**Typical reverse recovery charge as a function of diode current slope**

$Q_{rr} = f(di_F/dt)$   
 $V_R = 400$  V,  $I_F = 3$  A



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

$I_{rr} = f(di_F/dt)$   
 $V_R = 400$  V,  $I_F = 3$  A

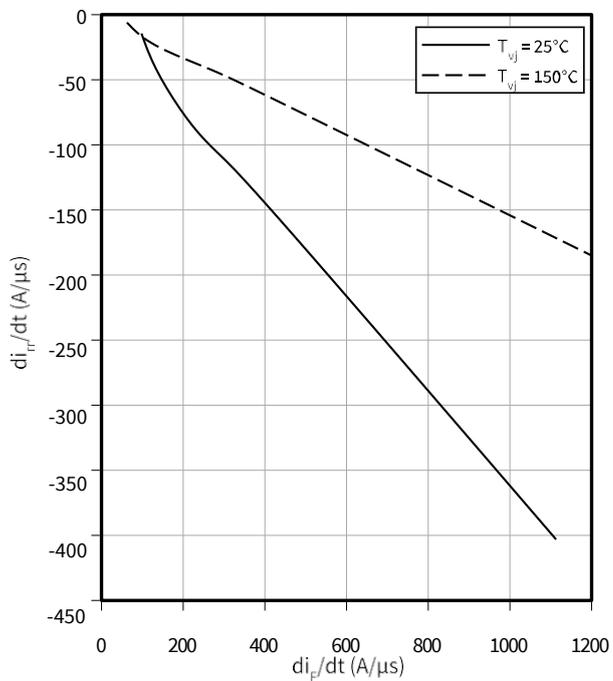


4 特征图

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

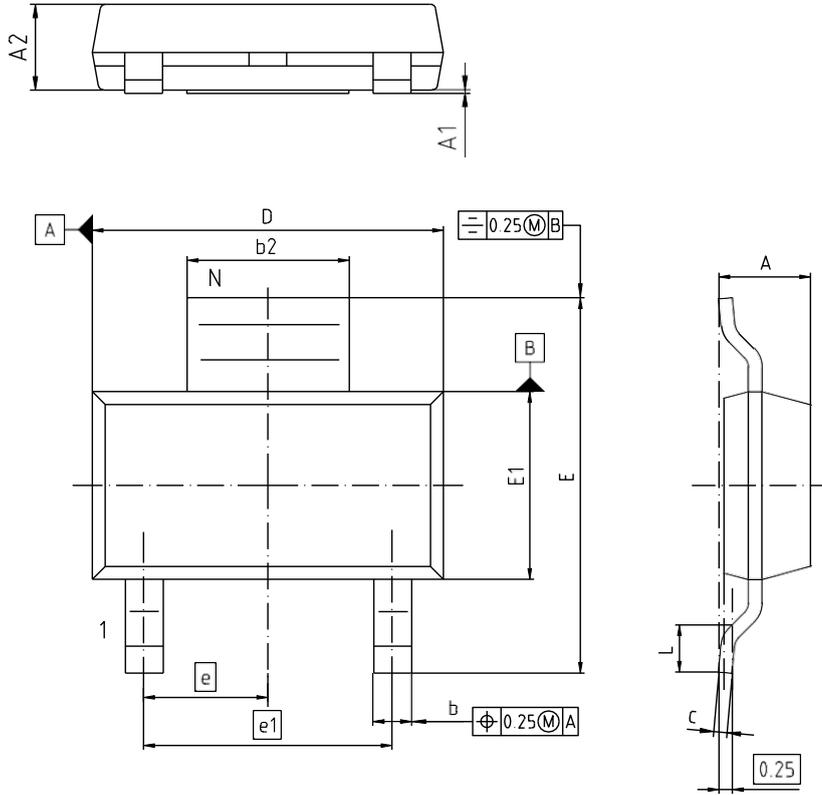
$$di_{rr}/dt = f(di_F/dt)$$

$V_R = 400 \text{ V}$ ,  $I_F = 3 \text{ A}$



5 封装外形

PG-SOT223-3



NOTES:  
1. ALL DIMENSIONS REFER TO JEDEC STANDARD TO-261

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.52	1.80	0.060	0.071
A1	-	0.10	-	0.004
A2	1.50	1.70	0.059	0.067
b	0.60	0.80	0.024	0.031
b2	2.95	3.10	0.116	0.122
c	0.24	0.32	0.009	0.013
D	6.30	6.70	0.248	0.264
E	6.70	7.30	0.264	0.287
E1	3.30	3.70	0.130	0.146
e	2.3 BASIC		0.091 BASIC	
e1	4.6 BASIC		0.181 BASIC	
L	0.75	1.10	0.030	0.043
N	3		3	
O	0°	10°	0°	10°

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SCALE 0 2.5 5mm

EUROPEAN PROJECTION

ISSUE DATE  
24-02-2016

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01

图 1

6 测试条件

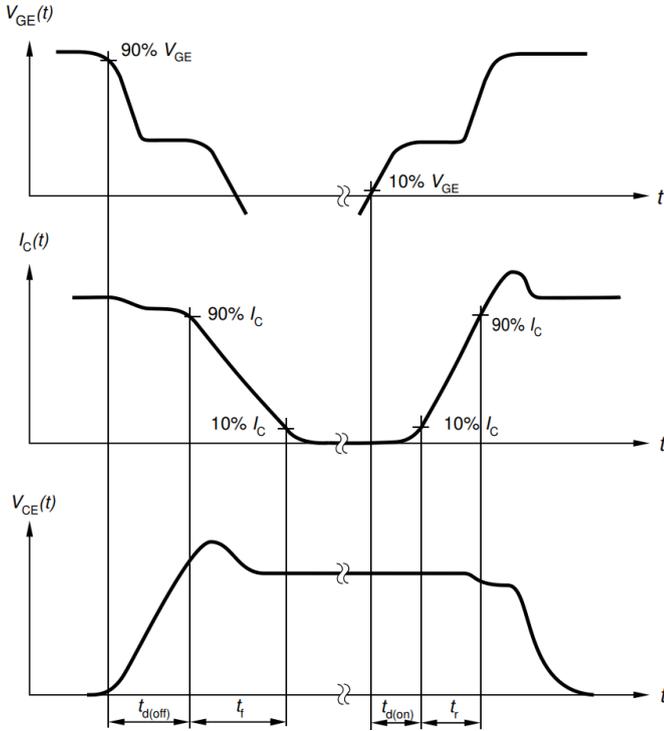


Figure A. Definition of switching times

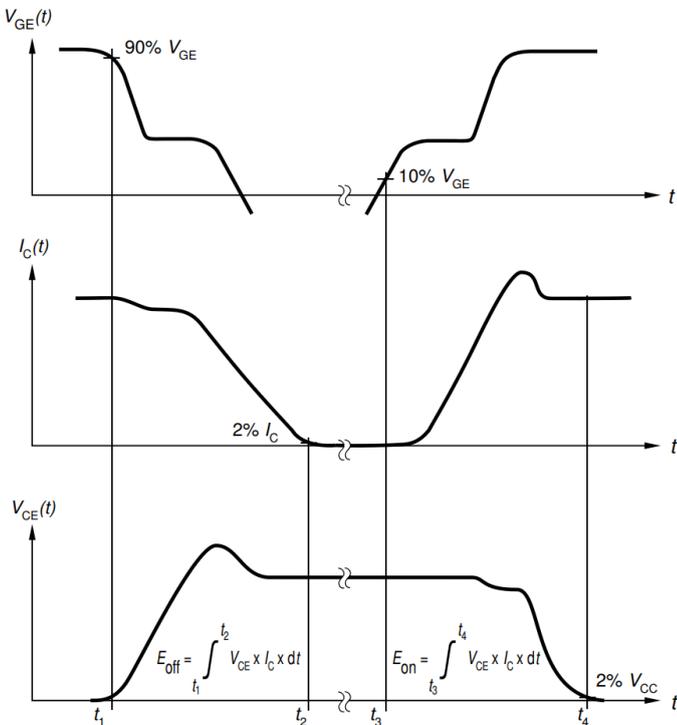


Figure B. Definition of switching losses

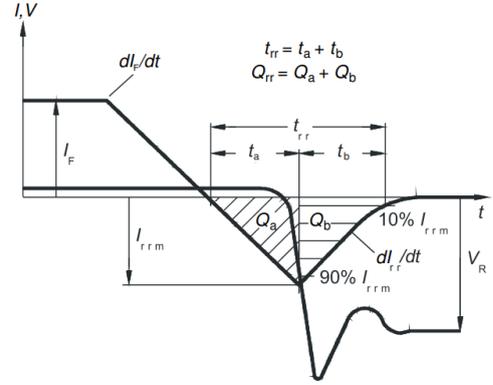


Figure C. Definition of diode switching characteristics

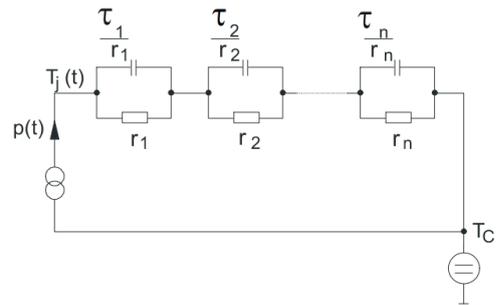


Figure D. Thermal equivalent circuit

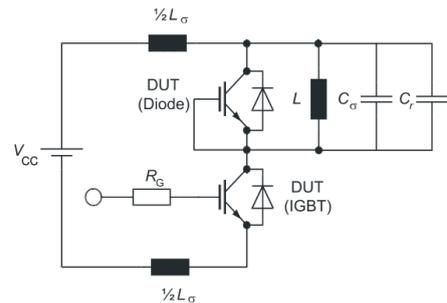


Figure E. Dynamic test circuit  
Parasitic inductance  $L_\sigma$ ,  
parasitic capacitor  $C_\sigma$ ,  
relief capacitor  $C_r$ ,  
(only for ZVT switching)

修订记录

## 修订记录

<b>Document revision</b>	<b>Date of release</b>	<b>Description of changes</b>
1.00	2021-09-28	Final datasheet
1.01	2021-10-15	Change of Potential Applications
1.10	2022-09-21	Add of wave soldering conditions



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