

具有单片体二极管的反向传导 IGBT

特性

- $V_{CE} = 650\text{ V}$
- $I_C = 30\text{ A}$
- 针对 ZCS 应用优化的强大单片二极管
- 高稳健性、温度稳定性
- 极低的 V_{CEsat} 和低的 E_{off}
- 由于 V_{CEsat} 具有正温度系数，因此易于并联
- 低电磁干扰
- 电气参数对温度的依赖性较低
- 符合 JESD-022 目标应用要求
- 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/>

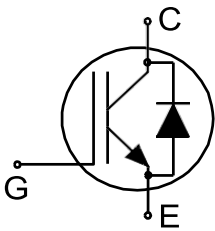


潜在应用

- 焊接
- 功率因数校正
- ZCS - 转换器

- Lead-Free
- Green
- Halogen-Free
- RoHS

描述



Type	Package	Marking
IKW30N65WR5	PG-TO247-3	K30EWR5

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 5 mm (0.197 in.) from case	L_E			13.0		nH
Storage temperature	T_{stg}		-55		150	°C
Soldering temperature		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

2 IGBT

表2 最大额定值

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CE}	$T_{vj} \geq 25\text{ °C}$		650	V
DC collector current, limited by T_{vjmax}	I_C		$T_c = 25\text{ °C}$	60	A
			$T_c = 117\text{ °C}$	30	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			90	A
Turn-off safe operating area		$V_{CE} \leq 650\text{ V}, T_{vj} \leq 175\text{ °C}$		90	A
Gate-emitter voltage	V_{GE}			± 20	V
Transient gate-emitter voltage	V_{GE}	$t_p \leq 10\text{ }\mu\text{s}, D < 0.01$		± 30	V
Power dissipation	P_{tot}		$T_c = 25\text{ °C}$	185	W
			$T_c = 117\text{ °C}$	75	

表3 特征值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Collector-emitter breakdown voltage	V_{BRCES}	$I_C = 0.2\text{ mA}, V_{GE} = 0\text{ V}$	650			V
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 30\text{ A}, V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$	1.4	1.8	V
			$T_{vj} = 175\text{ °C}$	1.65		
Gate-emitter threshold voltage	V_{GETh}	$I_C = 0.3\text{ mA}, V_{CE} = V_{GE}$	3.2	4	4.8	V

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表 3 (续) 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 650 \text{ V}$, $V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$			40	μA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = 20 \text{ V}$				100	nA
Transconductance	g_{fs}	$I_C = 30 \text{ A}$, $V_{CE} = 20 \text{ V}$			35		S
Input capacitance	C_{ies}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 1000 \text{ kHz}$			3700		pF
Output capacitance	C_{oes}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 1000 \text{ kHz}$			35		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 1000 \text{ kHz}$			16		pF
Gate charge	Q_G	$I_C = 30 \text{ A}$, $V_{GE} = 15 \text{ V}$, $V_{CC} = 520 \text{ V}$			155		nC
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{Gon} = 26 \text{ } \Omega$, $R_{Goff} = 26 \text{ } \Omega$, $L_{\sigma} = 45 \text{ nH}$, $C_{\sigma} = 32 \text{ pF}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 15 \text{ A}$		39		ns
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 15 \text{ A}$		35		
Rise time (inductive load)	t_r	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{Gon} = 26 \text{ } \Omega$, $R_{Goff} = 26 \text{ } \Omega$, $L_{\sigma} = 45 \text{ nH}$, $C_{\sigma} = 32 \text{ pF}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 15 \text{ A}$		12		ns
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 15 \text{ A}$		14		
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{Gon} = 26 \text{ } \Omega$, $R_{Goff} = 26 \text{ } \Omega$, $L_{\sigma} = 45 \text{ nH}$, $C_{\sigma} = 32 \text{ pF}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 15 \text{ A}$		367		ns
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 15 \text{ A}$		484		
Fall time (inductive load)	t_f	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{Gon} = 26 \text{ } \Omega$, $R_{Goff} = 26 \text{ } \Omega$, $L_{\sigma} = 45 \text{ nH}$, $C_{\sigma} = 32 \text{ pF}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 15 \text{ A}$		9		ns
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 15 \text{ A}$		9		
Turn-on energy	E_{on}	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{Gon} = 26 \text{ } \Omega$, $R_{Goff} = 26 \text{ } \Omega$, $L_{\sigma} = 45 \text{ nH}$, $C_{\sigma} = 32 \text{ pF}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 15 \text{ A}$		0.47		mJ
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 15 \text{ A}$		0.53		
Turn-off energy	E_{off}	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{Gon} = 26 \text{ } \Omega$, $R_{Goff} = 26 \text{ } \Omega$, $L_{\sigma} = 45 \text{ nH}$, $C_{\sigma} = 32 \text{ pF}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 15 \text{ A}$		0.1		mJ
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 15 \text{ A}$		0.22		
Total switching energy	E_{ts}	$V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_{Gon} = 26 \text{ } \Omega$, $R_{Goff} = 26 \text{ } \Omega$, $L_{\sigma} = 45 \text{ nH}$, $C_{\sigma} = 32 \text{ pF}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$, $I_C = 15 \text{ A}$		0.57		mJ
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$, $I_C = 15 \text{ A}$		0.75		

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表 3 (续) 特征值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
IGBT thermal resistance, junction to case	$R_{th(j-c)}$				0.81	K/W
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
Repetitive peak reverse voltage	V_{RRM}	$T_{vj} = 25^{\circ}\text{C}$		650	V
Diode forward current, limited by T_{vjmax}	I_F		$T_c = 25^{\circ}\text{C}$	24	A
			$T_c = 100^{\circ}\text{C}$	15	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}			45	A

表5 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	$I_F = 15\text{ A}$	$T_{vj} = 25^{\circ}\text{C}$		1.4	1.9	V
			$T_{vj} = 175^{\circ}\text{C}$		1.5		
Diode reverse recovery time	t_{rr}	$V_R = 400\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$, $I_F = 15\text{ A}$, $-di_F/dt = 900\text{ A}/\mu\text{s}$		95		ns
			$T_{vj} = 175^{\circ}\text{C}$, $I_F = 15\text{ A}$, $-di_F/dt = 900\text{ A}/\mu\text{s}$		121		
Diode reverse recovery charge	Q_{rr}	$V_R = 400\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$, $I_F = 15\text{ A}$, $-di_F/dt = 900\text{ A}/\mu\text{s}$		1.25		μC
			$T_{vj} = 175^{\circ}\text{C}$, $I_F = 15\text{ A}$, $-di_F/dt = 900\text{ A}/\mu\text{s}$		2.15		

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表 5 (续) 特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode peak reverse recovery current	I_{rrm}	$V_R = 400\text{ V}$	$T_{vj} = 25\text{ °C}$, $I_F = 15\text{ A}$, $-di_F/dt = 900\text{ A/}\mu\text{s}$		22		A
			$T_{vj} = 175\text{ °C}$, $I_F = 15\text{ A}$, $-di_F/dt = 900\text{ A/}\mu\text{s}$		28		
Diode peak rate of fall of reverse recovery current	di_{rr}/dt	$V_R = 400\text{ V}$	$T_{vj} = 25\text{ °C}$, $I_F = 15\text{ A}$, $-di_F/dt = 900\text{ A/}\mu\text{s}$		590		A/ μs
			$T_{vj} = 175\text{ °C}$, $I_F = 15\text{ A}$, $-di_F/dt = 900\text{ A/}\mu\text{s}$		1100		
Diode thermal resistance, junction to case	$R_{th(j-c)}$					3.4	K/W
Operating junction temperature	T_{vj}			-40		175	°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%。

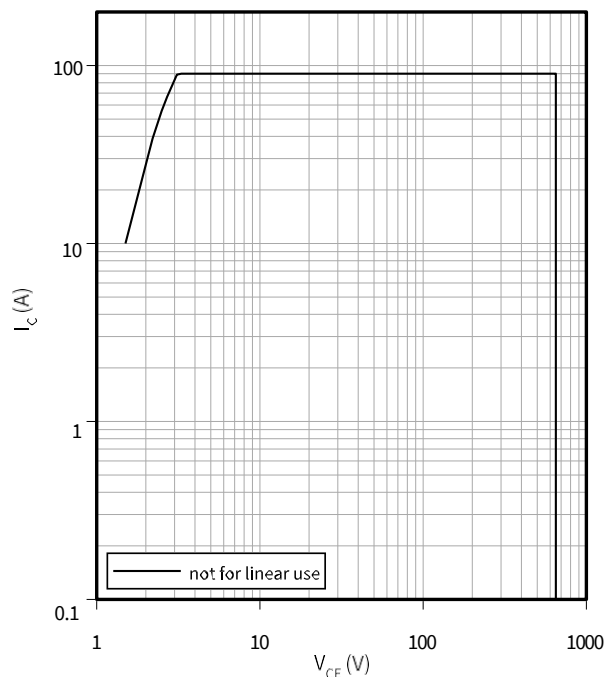
4 特征图

4 特性图

Reverse bias safe operating area

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

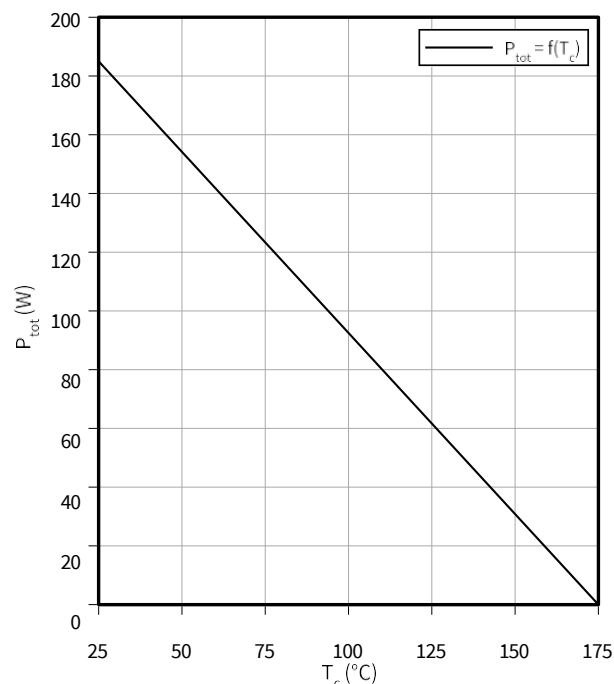
$T_{vj} \leq 175\text{ }^{\circ}\text{C}$, $V_{GE} = 15\text{ V}$, $T_c = 25\text{ }^{\circ}\text{C}$



Power dissipation as a function of case temperature

$$P_{tot} = f(T_c)$$

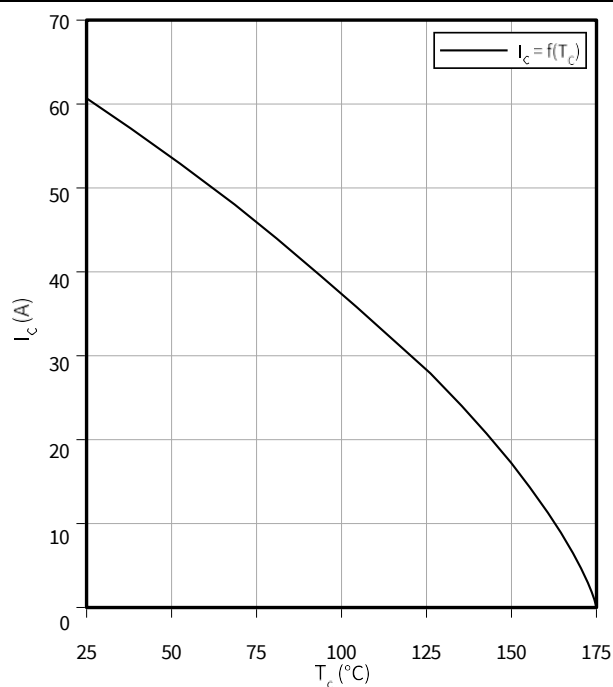
$T_{vj} \leq 175\text{ }^{\circ}\text{C}$



Collector current as a function of case temperature

$$I_C = f(T_c)$$

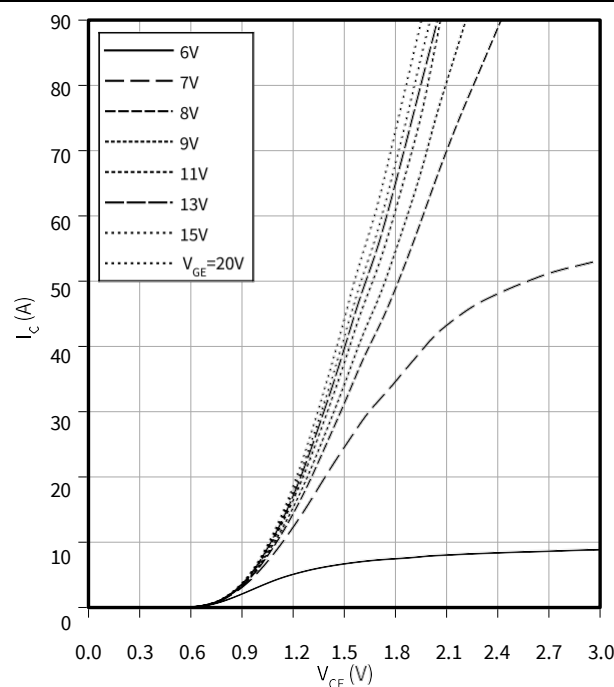
$T_{vj} \leq 175\text{ }^{\circ}\text{C}$, $V_{GE} \geq 15\text{ V}$



Typical output characteristic

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

$T_{vj} = 25\text{ }^{\circ}\text{C}$

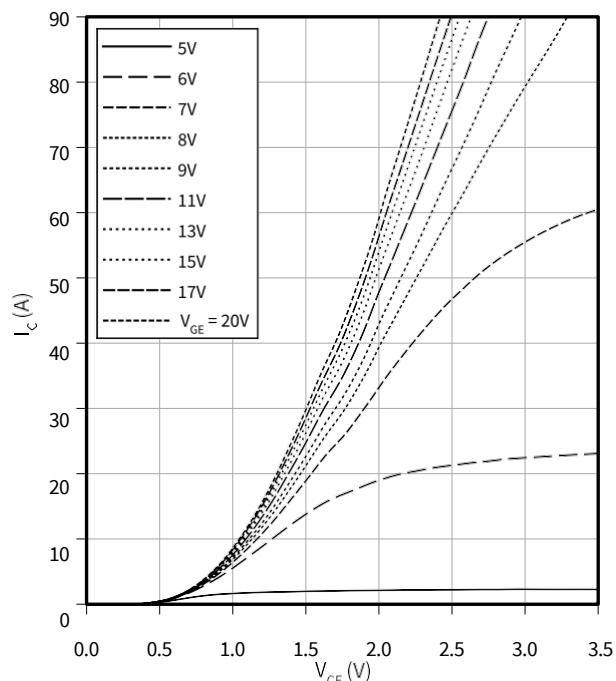


4 特征图

Typical output characteristic

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

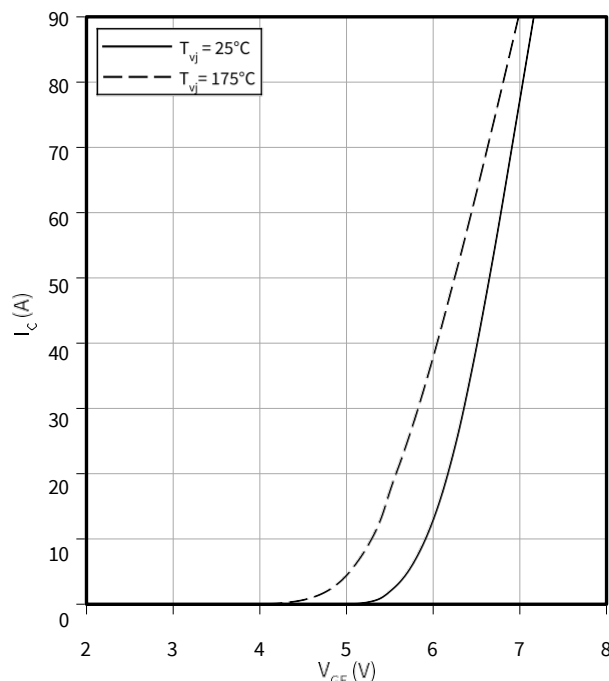
$$T_{vj} = 175^\circ\text{C}$$



Typical transfer characteristic

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

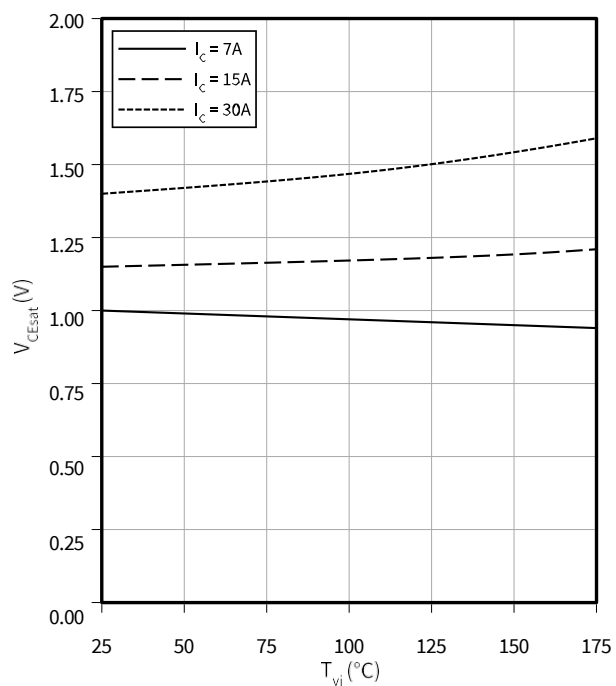
$$V_{CE} = 20\text{ V}$$



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

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

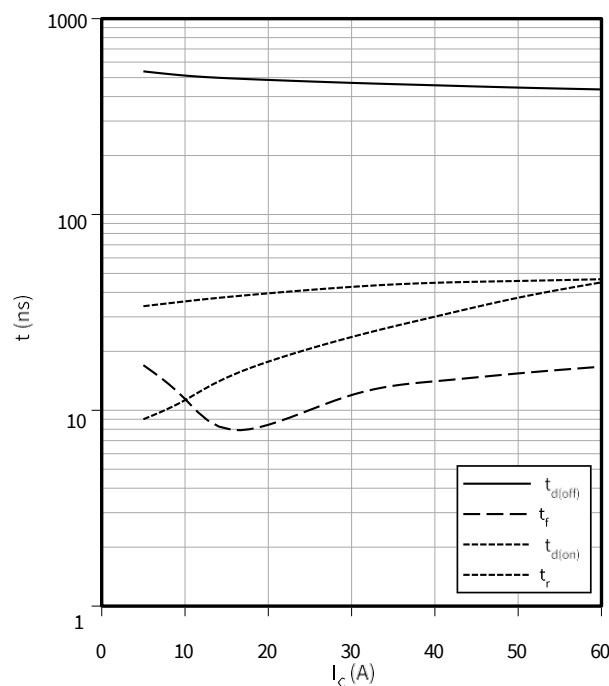
$$V_{GE} = 15\text{ V}$$



Typical switching times as a function of collector current

$$t = f(I_C)$$

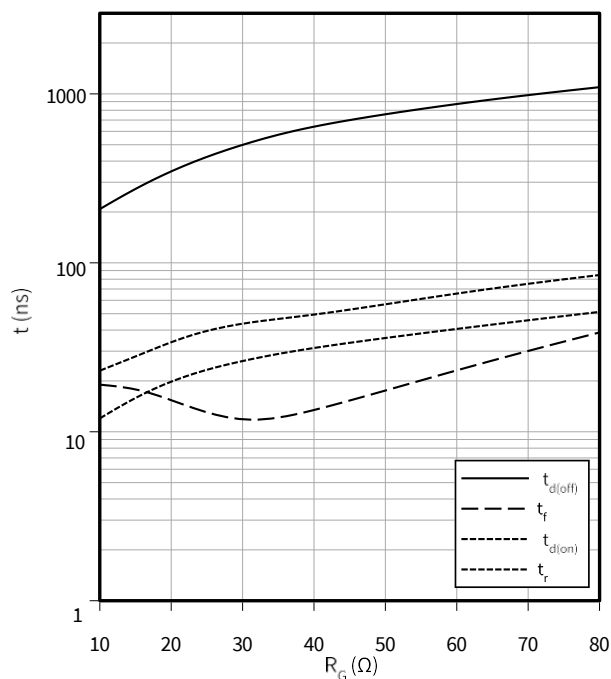
$$V_{CC} = 400\text{ V}, T_{vj} = 175^\circ\text{C}, V_{GE} = 0/15\text{ V}, R_G = 26\ \Omega$$



4 特征图

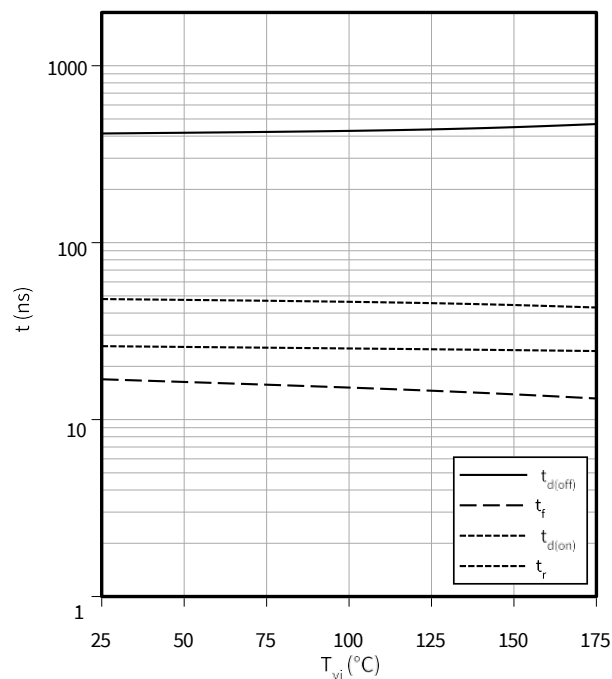
Typical switching times as a function of gate resistor

$$t = f(R_G)$$

 $I_C = 30\text{ A}, V_{CC} = 400\text{ V}, T_{vj} = 175\text{ }^{\circ}\text{C}, V_{GE} = 0/15\text{ V}$


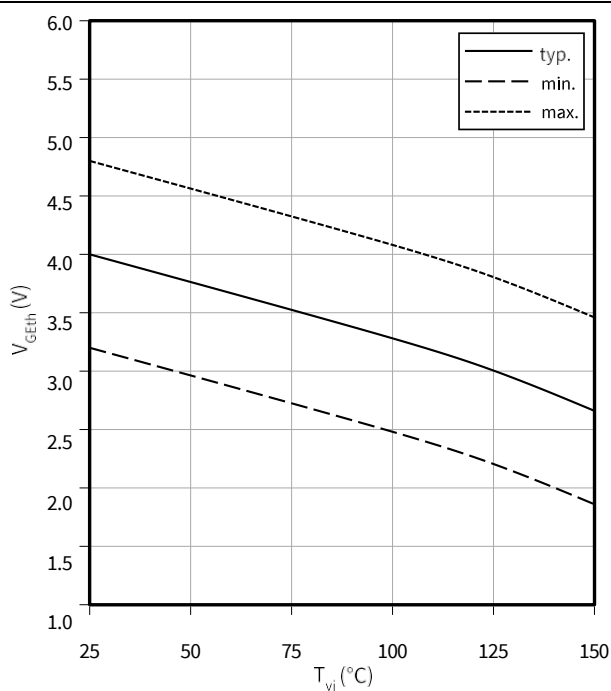
Typical switching times as a function of junction temperature

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

 $I_C = 30\text{ A}, V_{CC} = 400\text{ V}, V_{GE} = 0/15\text{ V}, R_G = 26\text{ }\Omega$


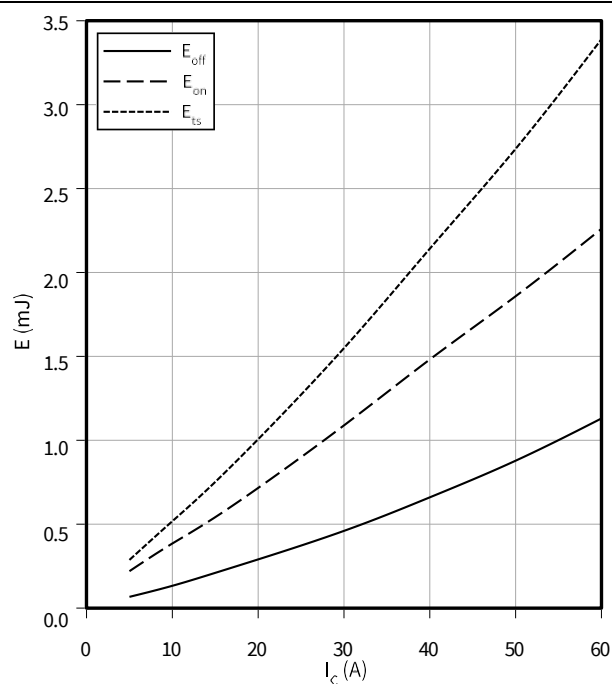
Gate-emitter threshold voltage as a function of junction temperature

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

 $I_C = 0.3\text{ mA}$


Typical switching energy losses as a function of collector current

$$E = f(I_C)$$

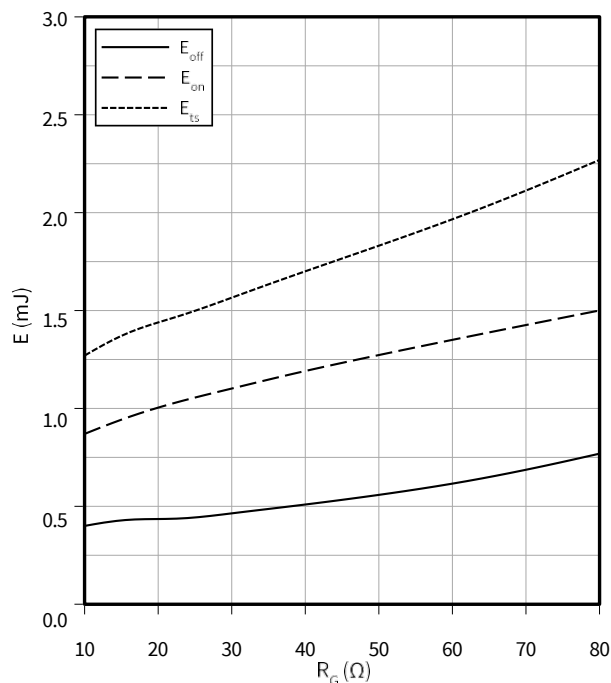
 $V_{CC} = 400\text{ V}, T_{vj} = 175\text{ }^{\circ}\text{C}, V_{GE} = 0/15\text{ V}, R_G = 26\text{ }\Omega$


4 特征图

Typical switching energy losses as a function of gate resistor

$$E = f(R_G)$$

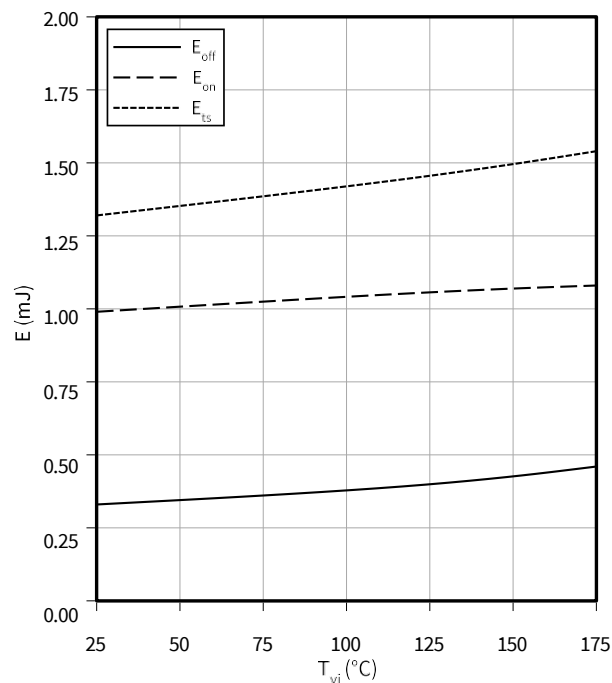
$I_C = 30 \text{ A}$, $V_{CC} = 400 \text{ V}$, $T_{vj} = 175 \text{ }^\circ\text{C}$, $V_{GE} = 0/15 \text{ V}$



Typical switching energy losses as a function of junction temperature

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

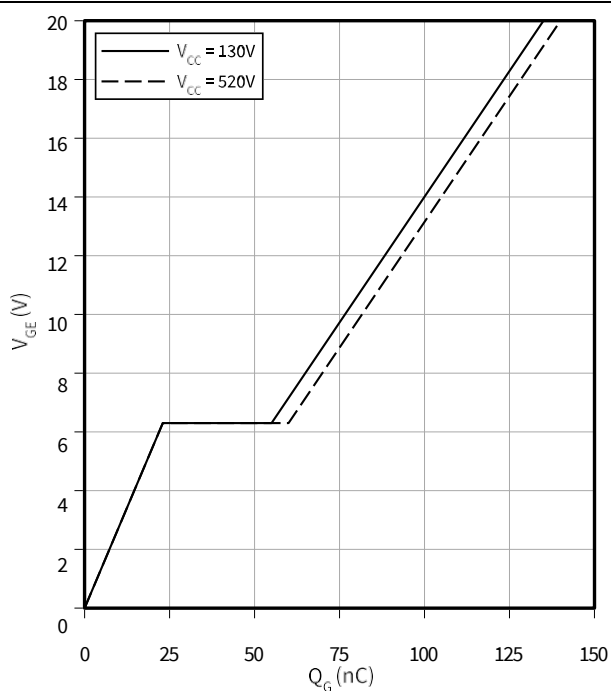
$I_C = 30 \text{ A}$, $V_{CC} = 400 \text{ V}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 26 \text{ } \Omega$



Typical gate charge

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

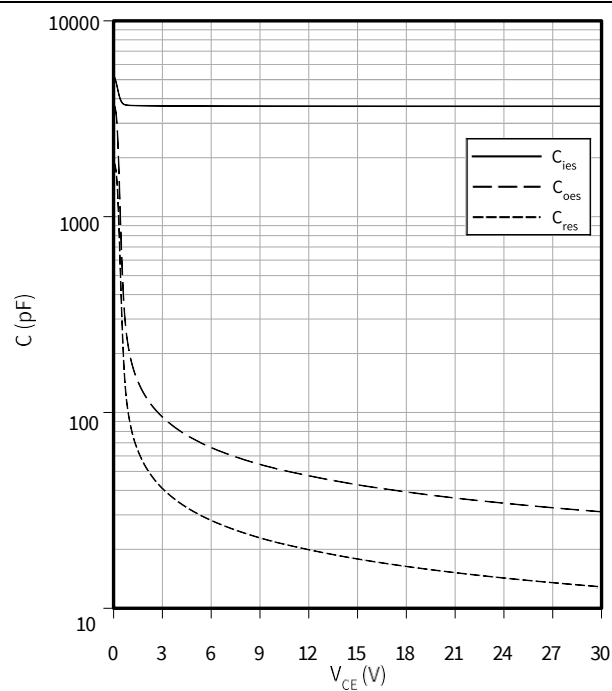
$I_C = 30 \text{ A}$



Typical capacitance as a function of collector-emitter voltage

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

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

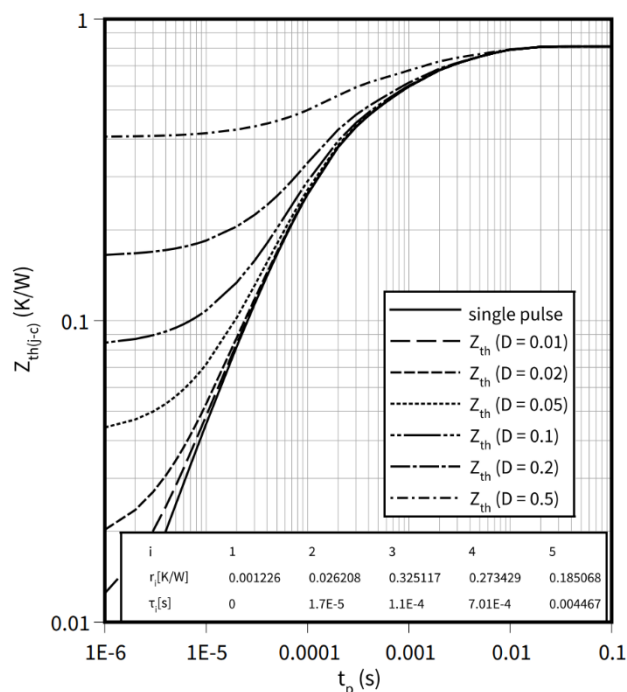


4 特征图

IGBT transient thermal impedance as a function of pulse width

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

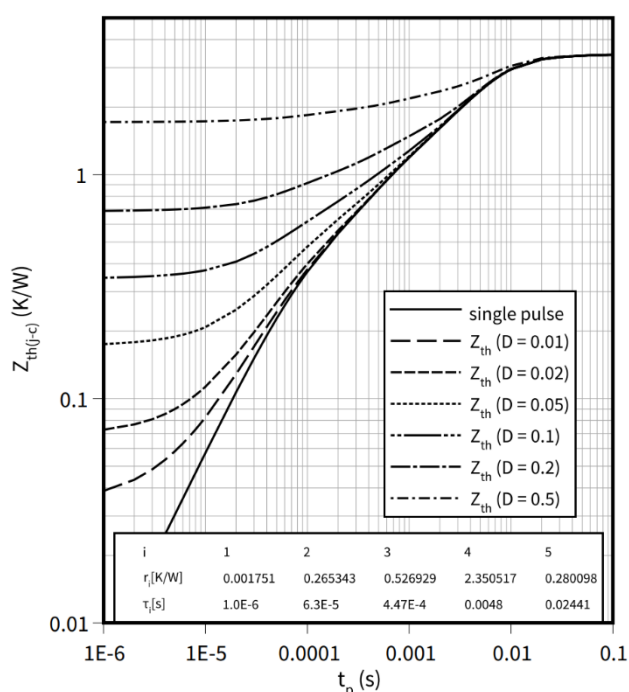
$$D = t_p/T$$



Diode transient thermal impedance as a function of pulse width

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

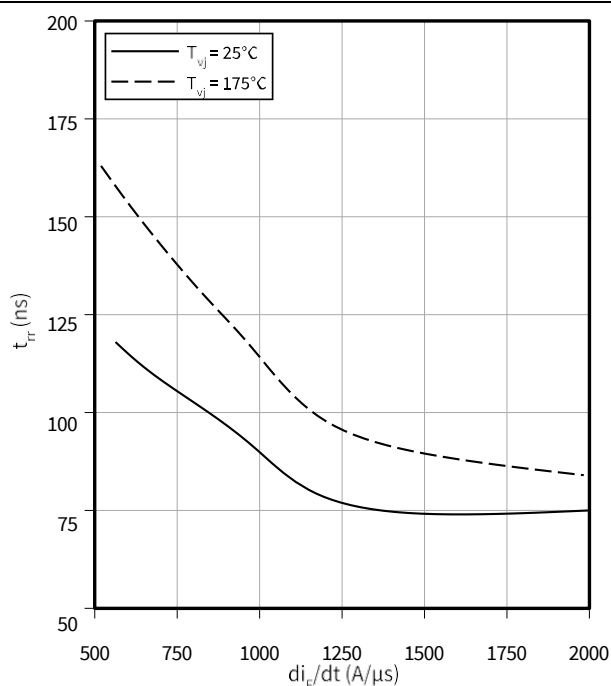
$$D = t_p/T$$



Typical reverse recovery time as a function of diode current slope

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

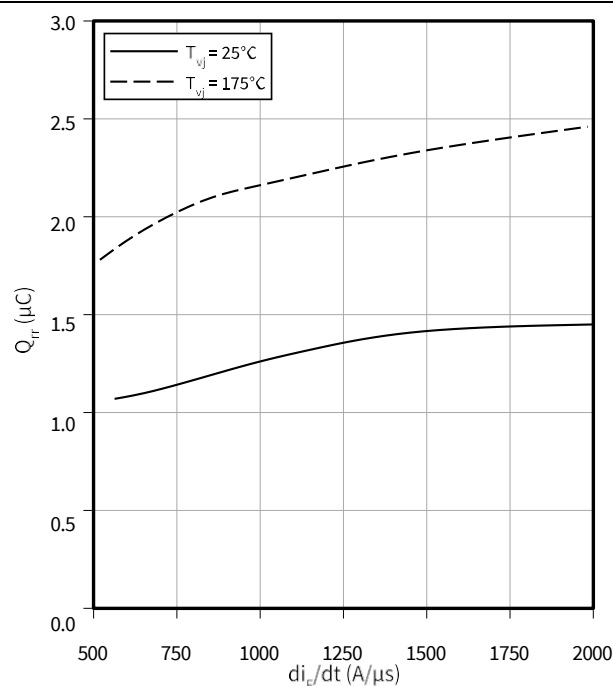
$$V_R = 400 \text{ V}, I_F = 15 \text{ A}$$



Typical reverse recovery charge as a function of diode current slope

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

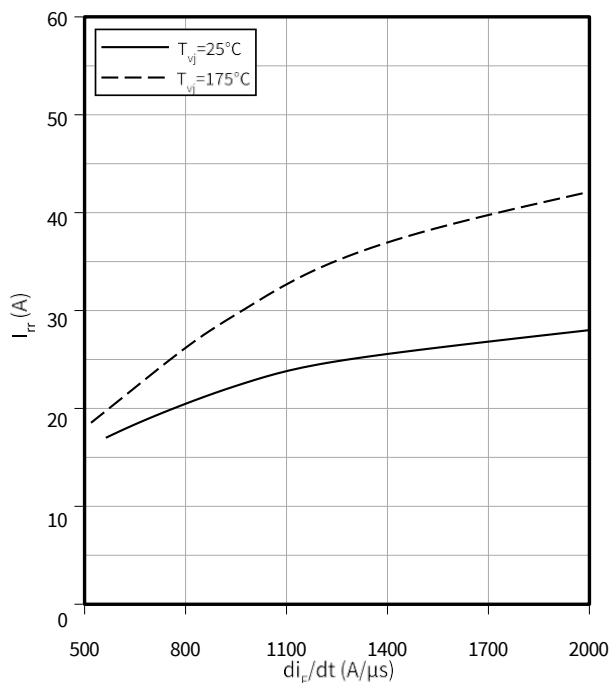
$$V_R = 400 \text{ V}, I_F = 15 \text{ A}$$



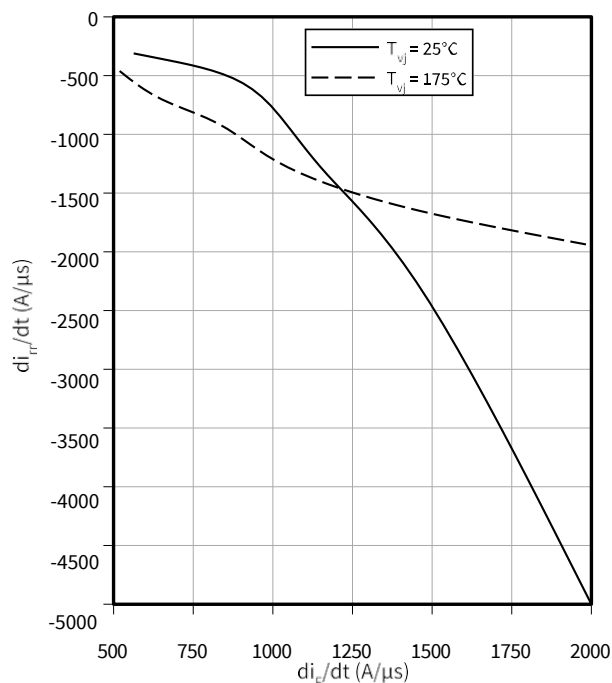
4 特征图

Typical reverse recovery current as a function of diode current slope

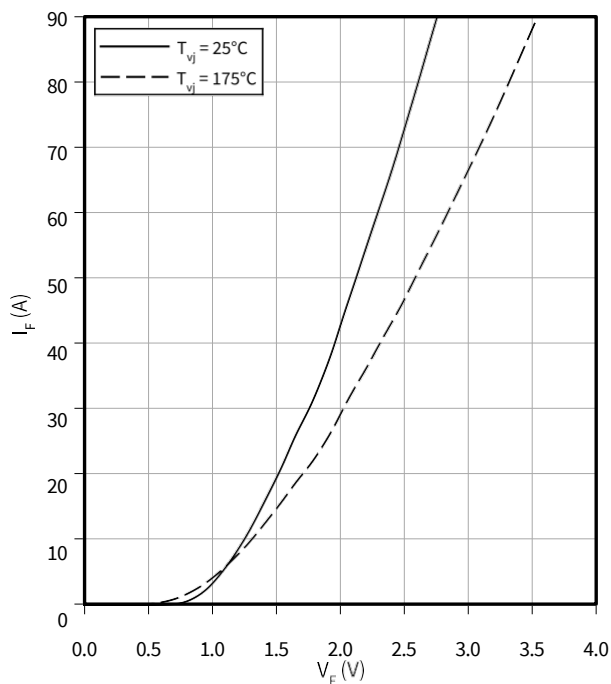
$$I_{rr} = f(di_F/dt)$$

 $V_R = 400 \text{ V}, I_F = 15 \text{ A}$

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

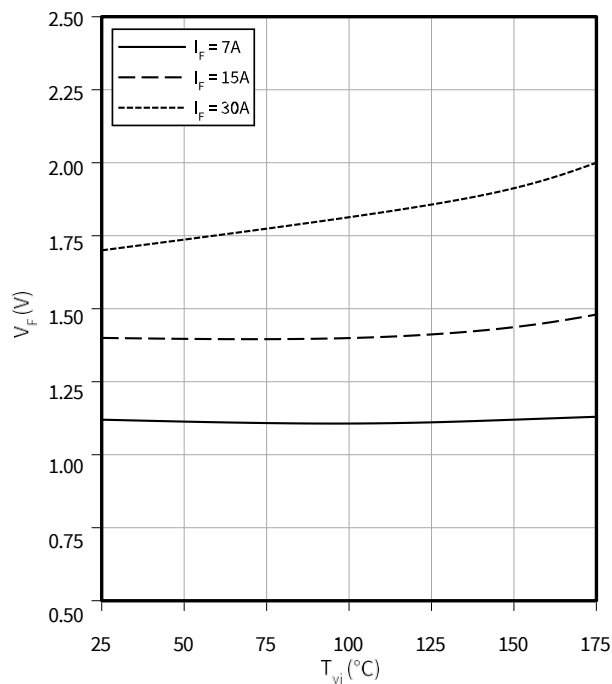
$$di_{rr}/dt = f(di_F/dt)$$

 $V_R = 400 \text{ V}, I_F = 15 \text{ A}$

Typical diode forward current as a function of forward voltage

$$I_F = f(V_F)$$

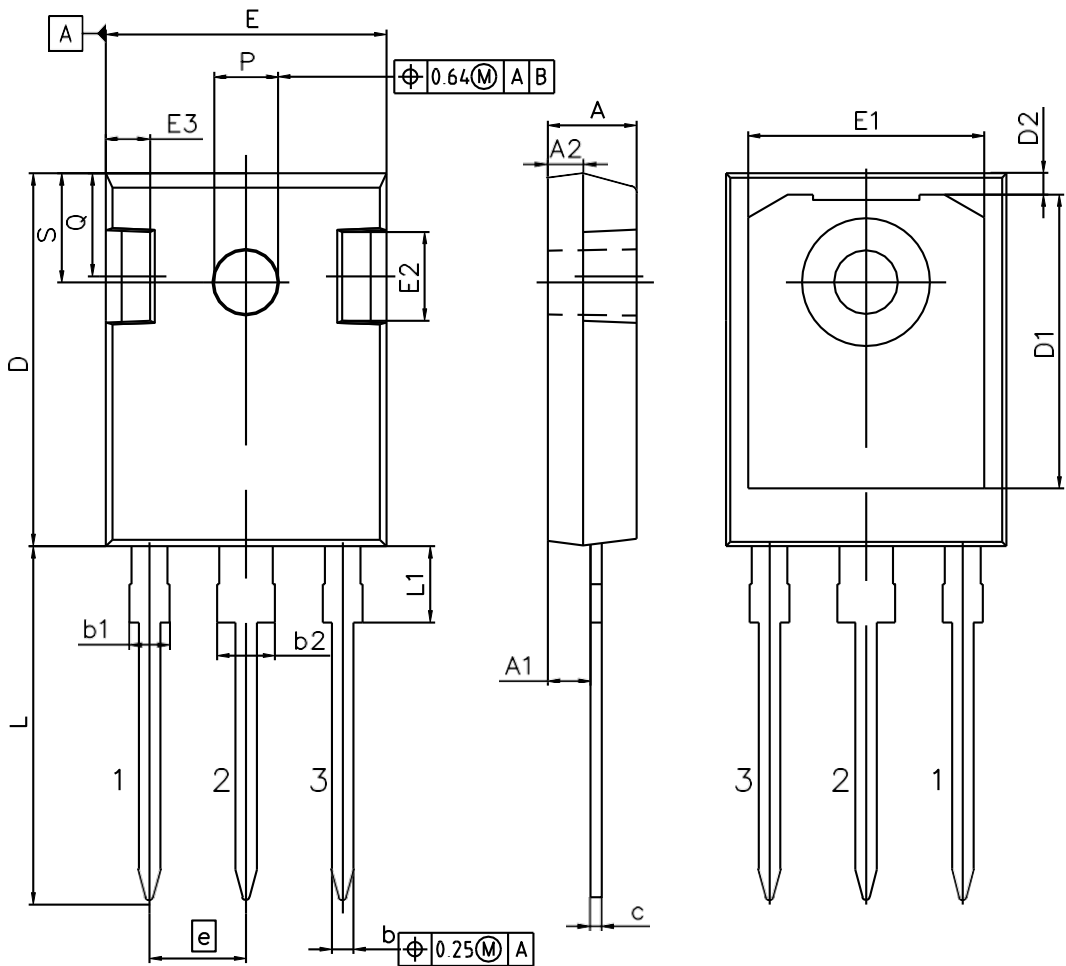

Typical diode forward voltage as a function of junction temperature

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



5 封装外形

封装图 PG-T0247-3



DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.70	5.30
A1	2.20	2.60
A2	1.50	2.50
b	1.00	1.40
b1	1.60	2.41
b2	2.57	3.43
c	0.38	0.89
D	20.70	21.50
D1	13.08	17.65
D2	0.51	1.35
E	15.50	16.30
E1	12.38	14.15
E2	3.40	5.10
E3	1.00	2.60
e	5.44	
L	19.80	20.40
L1	3.85	4.50
P	3.50	3.70
Q	5.35	6.25
S	6.04	6.30

DOCUMENT NO.
Z8B00003327

REVISION
06

SCALE 3:1
0 1 2 3 4 5mm

EUROPEAN PROJECTION

ISSUE DATE
25.07.2018

图 1

6 测试条件

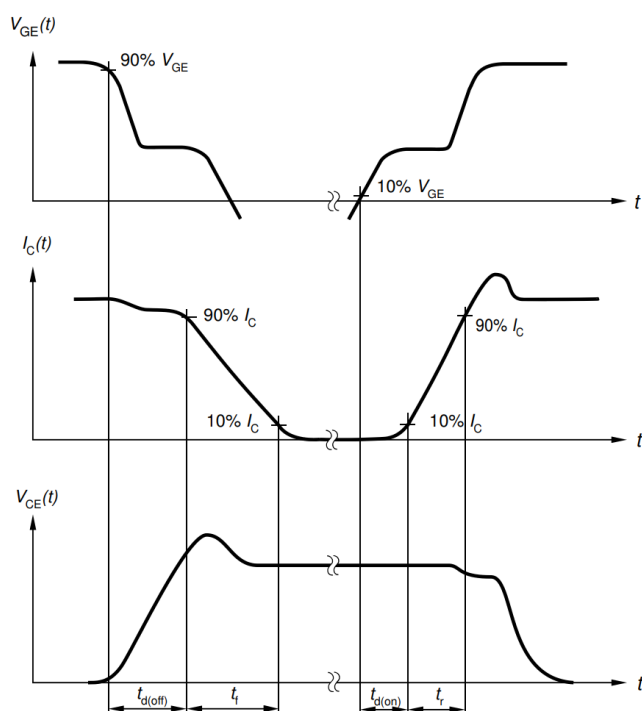


Figure A. Definition of switching times

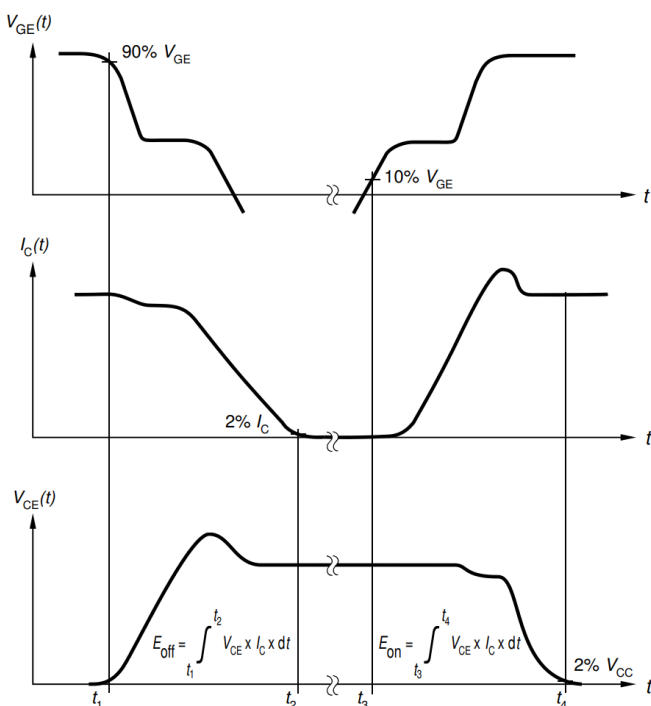


Figure B. Definition of switching losses

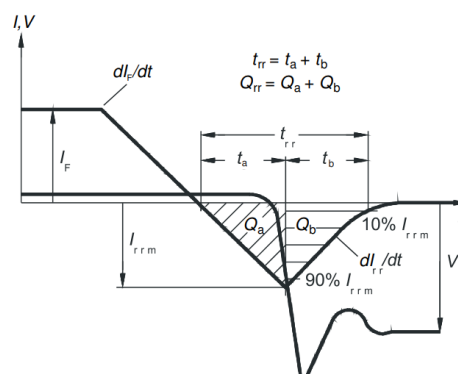


Figure C. Definition of diode switching characteristics

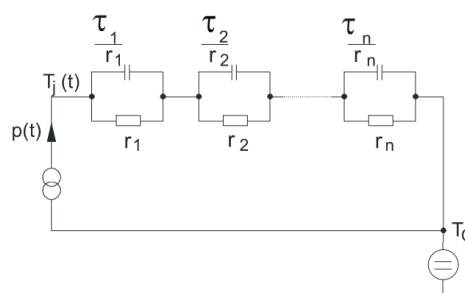


Figure D. Thermal equivalent circuit

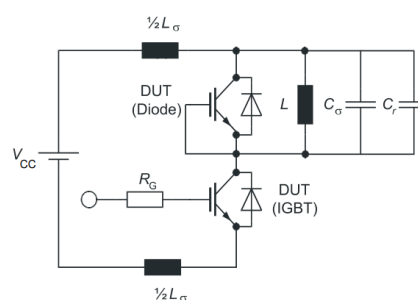


Figure E. Dynamic test circuit
 Parasitic inductance L_σ ,
 parasitic capacitor C_σ ,
 relief capacitor C_r ,
 (only for ZVT switching)

修订记录

Document revision	Date of release	Description of changes
V1.1	2015-04-23	Preliminary data sheet
V1.2	2015-05-12	Minor change Figure 3
V1.3	2015-06-01	Update Figure 14 E(T)
V2.1	2015-12-10	Final data sheet
V2.2	2016-10-14	New switching parameters for IGBT at $I_c=15A$
n/a	2020-11-30	Datasheet migrated to a new system with a new layout and new revision number schema: target or preliminary datasheet = 0.xy; final datasheet = 1.xy
1.10	2022-03-08	Added transient gate-emitter voltage
1.20	2022-05-06	Transient gate-emitter voltage V_{GE} added in table "Maximum rated values" of IGBT Update of switching energy values in table "Characteristic values" "Forward bias safe operating area" diagram renamed to "Reverse bias safe operating area"



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