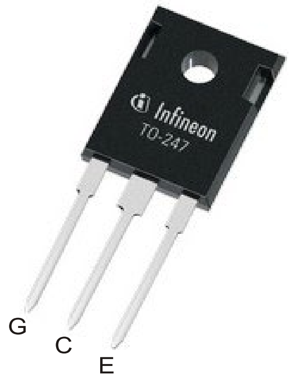
英飞凌高速 DuoPack：采用 Trench 和 Fieldstop 技术的 IGBT，搭配 软、快速恢复反并联二极管



特性

- V_{CE} = 1200 V
- I_C= 15 A
- 非常低的 $V_{CE,sat}$
- 低电磁干扰
- 非常柔软、快速恢复的反并联二极管
- 最高结温 T_{vjmax} = 175°C
- 符合 JEDEC 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

- UPS（不间断电源）
- 焊机
- 高开关频率转换器

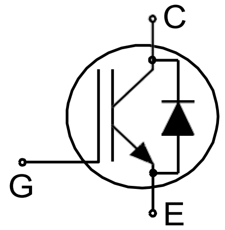
Lead-Free

Green

Halogen-Free

RoHS

描述



Type	Package	Marking
IKW15N120H3	PG-TO247-3	K15H1203

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）。

目录

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, M3 screw Maximum of mounting processes: 3	M				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}			1200	V
DC collector current, limited by T_{vjmax}	I_C		$T_c = 25$ °C	30	A
			$T_c = 100$ °C	15	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}			60	A
Turn-off safe operating area		$V_{CE} \leq 1200$ V, $T_{vj} \leq 175$ °C		60	A
Gate-emitter voltage	V_{GE}			±20	V
Short circuit withstand time	t_{SC}	$V_{CC} \leq 600$ V, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s, $T_{vj} = 175$ °C		10	µs
Power dissipation	P_{tot}		$T_c = 25$ °C	217	W
			$T_c = 100$ °C	105	

表3 特征值

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Collector-emitter breakdown voltage	V_{BRCES}	$I_C = 0.5$ mA, $V_{GE} = 0$ V	1200			V

表 3 特征值（续）

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CE\,sat}$	I_C = 15.0 A, V_{GE} = 15 V	T_{vj} = 25 °C		2.05	2.40	V
			T_{vj} = 125 °C		2.50		
			T_{vj} = 175 °C		2.70		
Gate-emitter threshold voltage	V_{GEth}	I_C = 0.50 mA, V_{CE} = V_{GE}, T_{vj} = 175 °C		5.00	5.80	6.50	V
Zero gate voltage collector current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			250	µA
			T_{vj} = 175 °C			2500	
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V				600	nA
Transconductance	g_{fs}	I_C = 15.0 A, V_{CE} = 20 V			7.5		S
Short circuit collector current	I_{SC}	V_{CC} ≤ 600 V, V_{GE} = 15 V, t_{SC} ≤ 10 µs, Allowed number of short circuits < 1000 , Time between short circuits ≥ 1.0 s, T_{vj} = 175 °C			52		A
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1000 kHz			875		pF
Output capacitance	C_{oes}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1000 kHz			75		pF
Reverse transfer capacitance	C_{res}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1000 kHz			45		pF
Gate charge	Q_G	I_C = 15.0 A, V_{GE} = 15 V, V_{CE} = 960 V			75		nC
Turn-on delay time	t_{don}	V_{CE} = 600 V, V_{GE} = +0/+15 V, R_{Gon} = 35.0 Ω, R_{Goff} = 35.0 Ω, L_σ = 95 nH, C_σ = 67 pF	T_{vj} = 25 °C, I_C = 15.0 A		21		ns
			T_{vj} = 175 °C, I_C = 15.0 A		19		
Rise time (inductive load)	t_r	V_{CE} = 600 V, V_{GE} = +0/+15 V, R_{Gon} = 35.0 Ω, R_{Goff} = 35.0 Ω, L_σ = 95 nH, C_σ = 67 pF	T_{vj} = 25 °C, I_C = 15.0 A		34		ns
			T_{vj} = 175 °C, I_C = 15.0 A		30		
Turn-off delay time	t_{doff}	V_{CE} = 600 V, V_{GE} = +0/+15 V, R_{Gon} = 35.0 Ω, R_{Goff} = 35.0 Ω, L_σ = 95 nH, C_σ = 67 pF	T_{vj} = 25 °C, I_C = 15.0 A		260		ns
			T_{vj} = 175 °C, I_C = 15.0 A		327		
Fall time (inductive load)	t_f	V_{CE} = 600 V, V_{GE} = +0/+15 V, R_{Gon} = 35.0 Ω, R_{Goff} = 35.0 Ω, L_σ = 95 nH, C_σ = 67 pF	T_{vj} = 25 °C, I_C = 15.0 A		14		ns
			T_{vj} = 175 °C, I_C = 15.0 A		43		

表 3 **特征值（续）**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-on energy	E_{on}	V_{CE} = 600 V, V_{GE} = +0/+15 V, R_{Gon} = 35.0 Ω, R_{Goff} = 35.0 Ω, L_{σ} = 95 nH, C_{σ} = 67 pF	T_{vj} = 25 °C, I_C = 15.0 A		1.10		mJ
			T_{vj} = 175 °C, I_C = 15.0 A		1.60		
Turn-off energy	E_{off}	V_{CE} = 600 V, V_{GE} = +0/+15 V, R_{Gon} = 35.0 Ω, R_{Goff} = 35.0 Ω, L_{σ} = 95 nH, C_{σ} = 67 pF	T_{vj} = 25 °C, I_C = 15.0 A		0.45		mJ
			T_{vj} = 175 °C, I_C = 15.0 A		0.90		
Total switching energy	E_{ts}	V_{CE} = 600 V, V_{GE} = +0/+15 V, R_{Gon} = 35.0 Ω, R_{Goff} = 35.0 Ω, L_{σ} = 95 nH, C_{σ} = 67 pF	T_{vj} = 25 °C, I_C = 15.0 A		1.55		mJ
			T_{vj} = 175 °C, I_C = 15.0 A		2.50		
IGBT thermal resistance, junction-case	R_{thjc}					0.70	K/W
Operating junction temperature	T_{vj}			-40		175	°C

注： *电气特性，在 T_{vj} = 25°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}			1200	V
Diode forward current, limited by T_{vjmax}	I_F		T_c = 25 °C	15	A
			T_c = 100 °C	7.5	
Diode pulsed current, limited by T_{vjmax}	I_{Fpuls}			60	A

表5 **特征值**

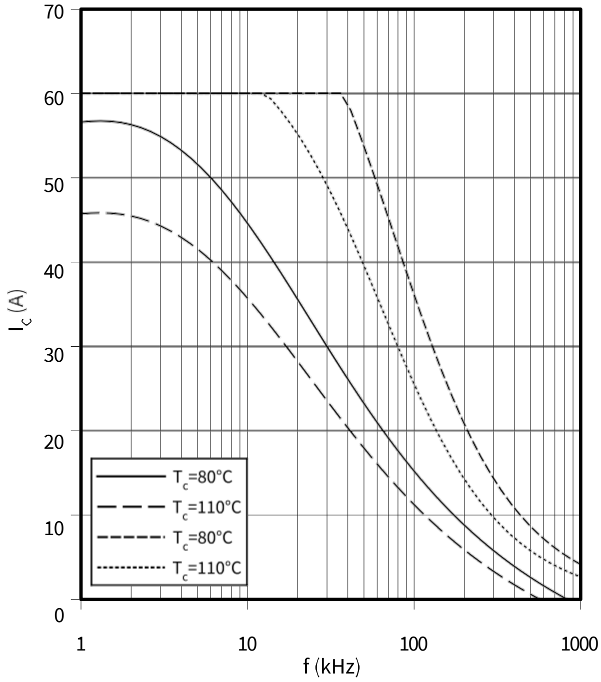
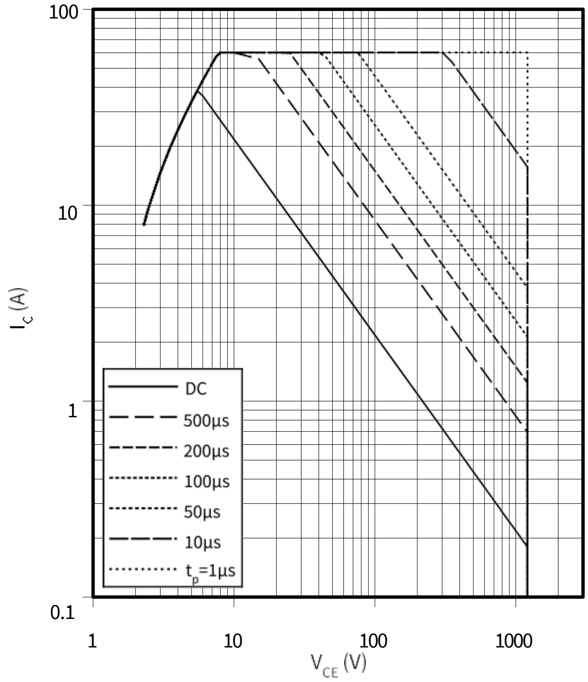
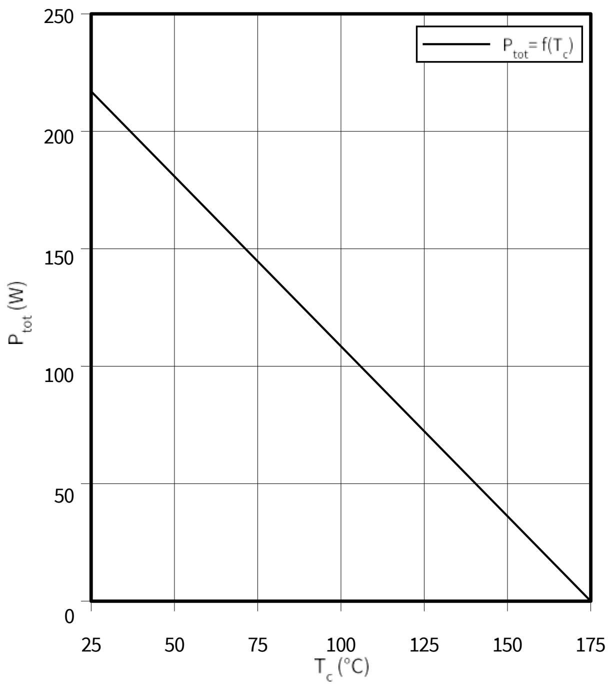
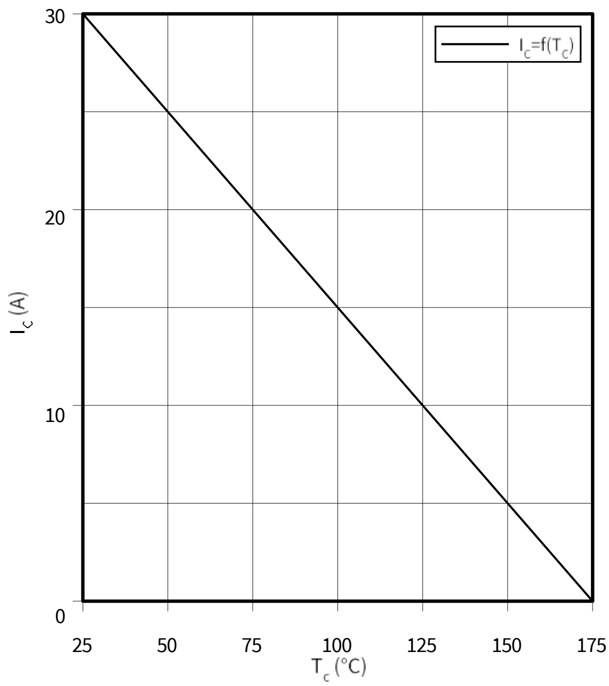
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	I_F = 7.5 A	T_{vj} = 25 °C		1.80	2.35	V
			T_{vj} = 175 °C		1.85		

表 5 特征值（续）

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	I_F = 15.0 A	T_{vj} = 25 °C		2.40	3.05	V
			T_{vj} = 125 °C		2.60		
			T_{vj} = 175 °C		2.60		
Reverse leakage current	I_R	V_R = 1200 V	T_{vj} = 25 °C			250	µA
			T_{vj} = 175 °C			2500	
Diode reverse recovery time	t_{rr}	V_R = 600 V	T_{vj} = 25 °C, I_F = 15.0 A, $-di_F/dt$ = 500 A/µs		260		ns
			T_{vj} = 175 °C, I_F = 15.0 A, $-di_F/dt$ = 500 A/µs		470		
Diode reverse recovery charge	Q_{rr}	V_R = 600 V	T_{vj} = 25 °C, I_F = 15.0 A, $-di_F/dt$ = 500 A/µs		0.80		µC
			T_{vj} = 175 °C, I_F = 15.0 A, $-di_F/dt$ = 500 A/µs		1.70		
Diode peak reverse recovery current	I_{rrm}	V_R = 600 V	T_{vj} = 25 °C, I_F = 15.0 A, $-di_F/dt$ = 500 A/µs		7.7		A
			T_{vj} = 175 °C, I_F = 15.0 A, $-di_F/dt$ = 500 A/µs		9.8		
Diode peak rate off fall of reverse recovery current	dI_{rr}/dt	V_R = 600 V	T_{vj} = 25 °C, I_F = 15.0 A, $-di_F/dt$ = 500 A/µs		-110		A/µs
			T_{vj} = 175 °C, I_F = 15.0 A, $-di_F/dt$ = 500 A/µs		-80		
Diode thermal resistance, junction-case	R_{thjc}					2.12	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 特性图

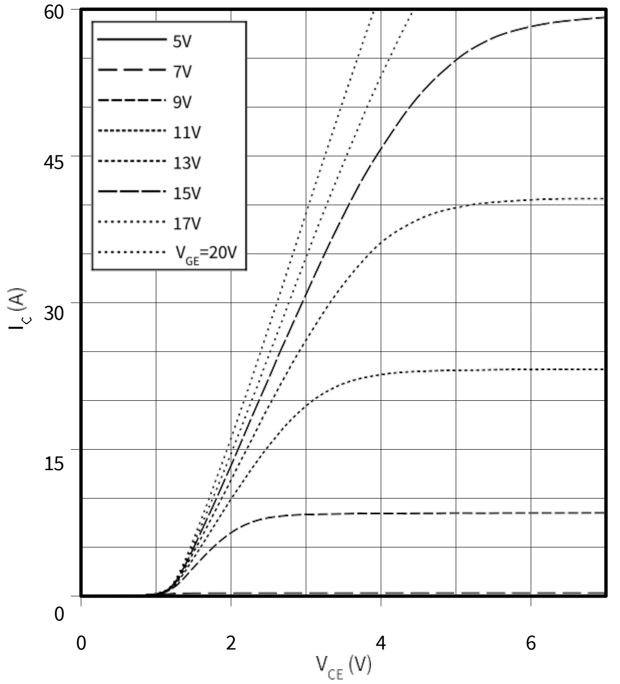
Collector current as a function of switching frequency, IGBT $I_C = f(f)$ $D = 0.5$, $V_{CE} = 600$ V, $T_{vj} \leq 175$ °C, $V_{GE} = 0/15$ V, $R_G = 35\ \Omega$	**Forward bias safe operating area, IGBT** $I_C = f(V_{CE})$ $D = 0$, $T_{vj} \leq 175$ °C, $V_{GE} = 15$ V, $T_c = 25$ °C
 	
Power dissipation as a function of case temperature, IGBT $P_{tot} = f(T_c)$ $T_{vj} \leq 175$ °C	**Collector current as a function of case temperature, IGBT** $I_C = f(T_c)$ $T_{vj} \leq 175$ °C, $V_{GE} \geq 15$ V
 	

4 特性图

Typical output characteristic, IGBT

$I_C = f(V_{CE})$

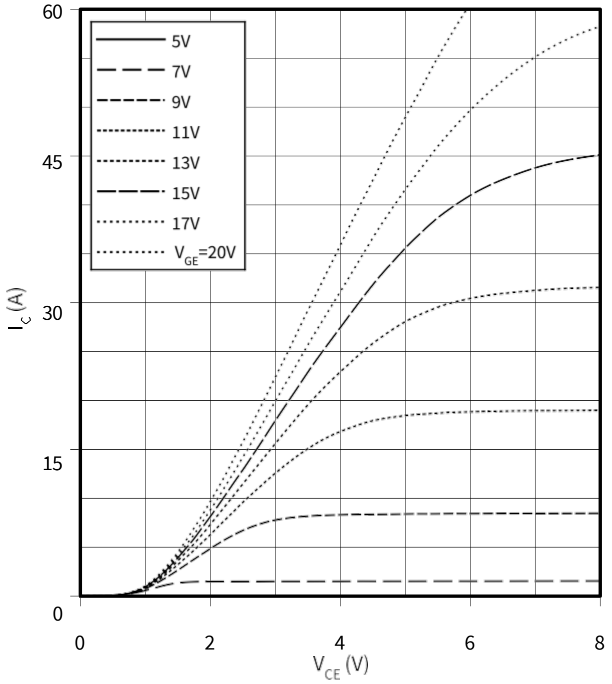
$T_{vj} = 25\ °C$



Typical output characteristic, IGBT

$I_C = f(V_{CE})$

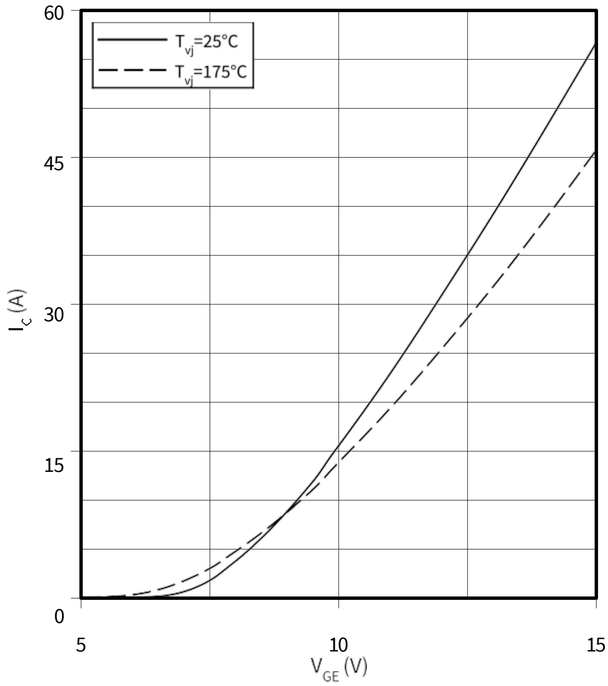
$T_{vj} = 175\ °C$



Typical transfer characteristic, IGBT

$I_C = f(V_{GE})$

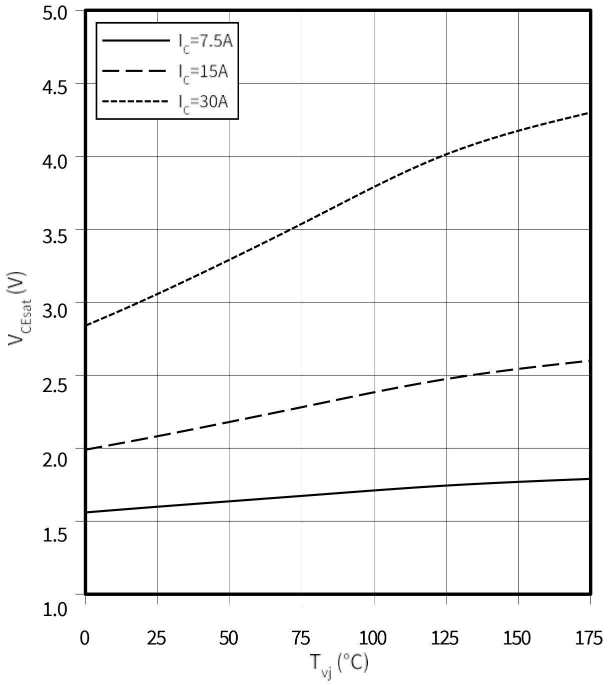
$V_{CE} = 20\ V$



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

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

$V_{GE} = 15\ V$

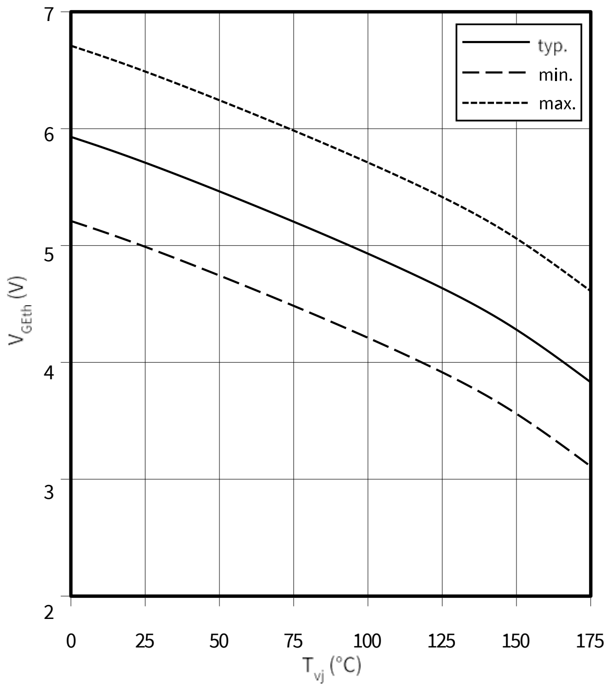


4 特性图

Gate-emitter threshold voltage as a function of junction temperature, IGBT

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

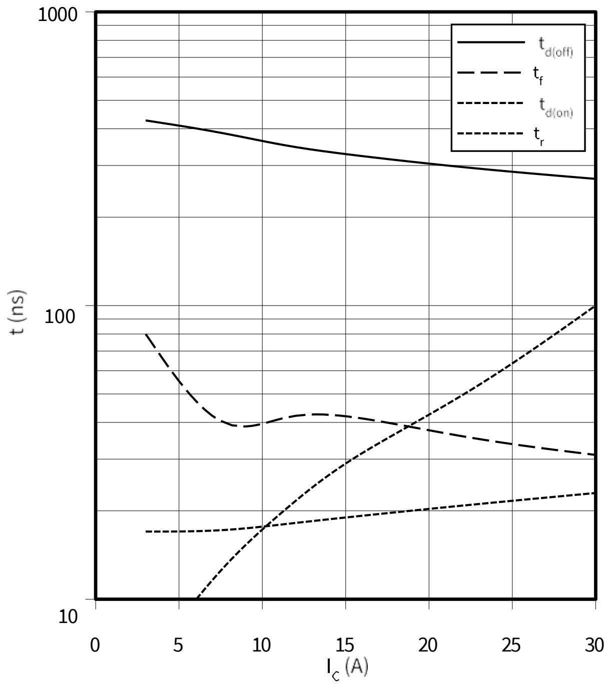
$I_C = 0.50$ mA



Typical switching times as a function of collector current, IGBT

$t = f(I_C)$

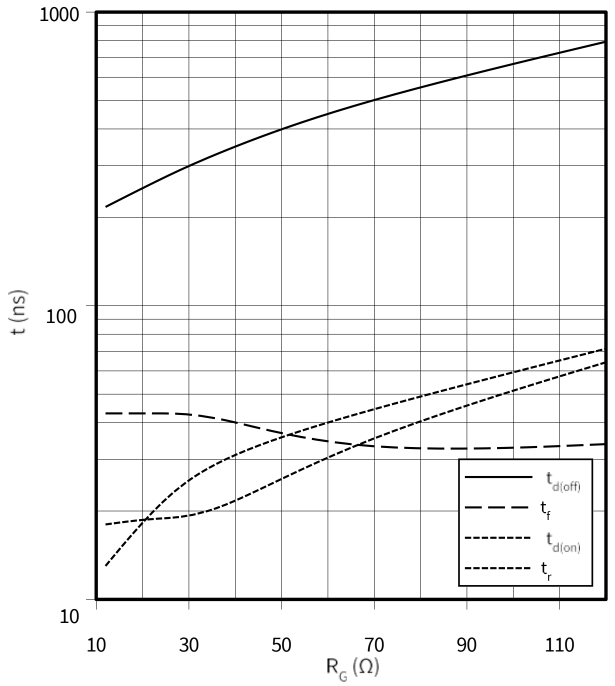
$V_{CE} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 35$ Ω



Typical switching times as a function of gate resistance, IGBT

$t = f(R_G)$

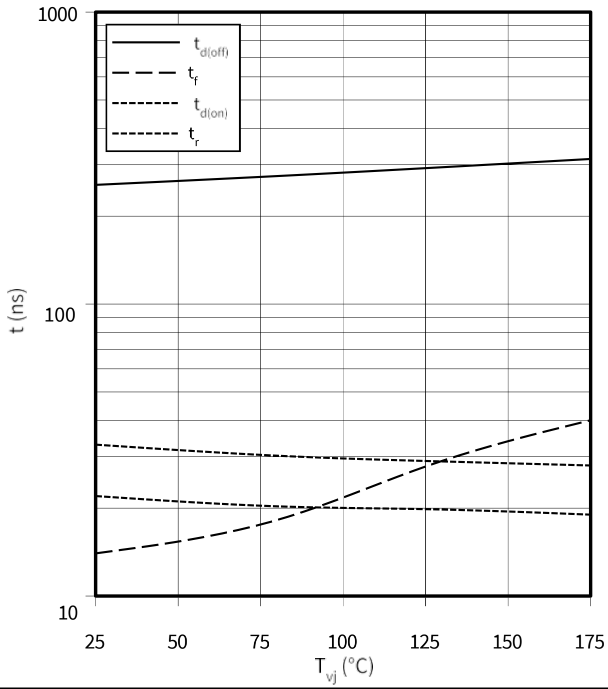
$I_C = 15.0$ A, $V_{CE} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



Typical switching times as a function of junction temperature, IGBT

$t = f(T_{vj})$

$I_C = 15.0$ A, $V_{CE} = 600$ V, $V_{GE} = 0/15$ V, $R_G = 35$ Ω

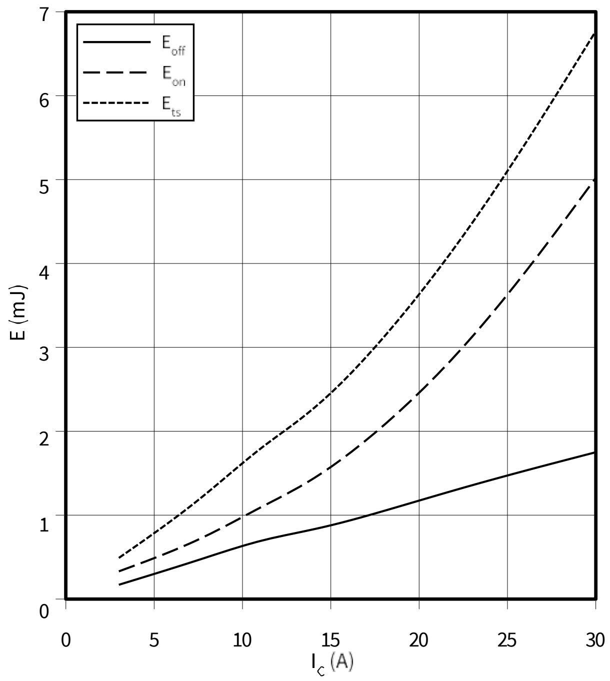


4 特性图

Typical switching energy losses as a function of collector current, IGBT

$E = f(I_C)$

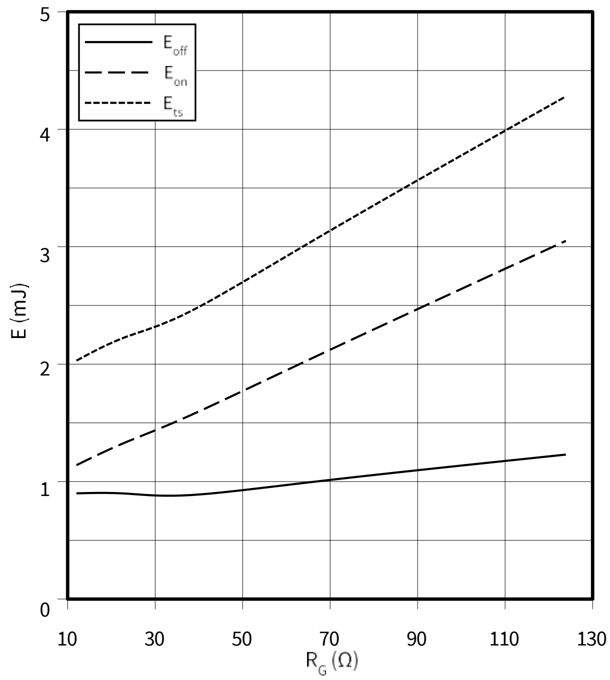
$V_{CE} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 35$ Ω



Typical switching energy losses as a function of gate resistance, IGBT

$E = f(R_G)$

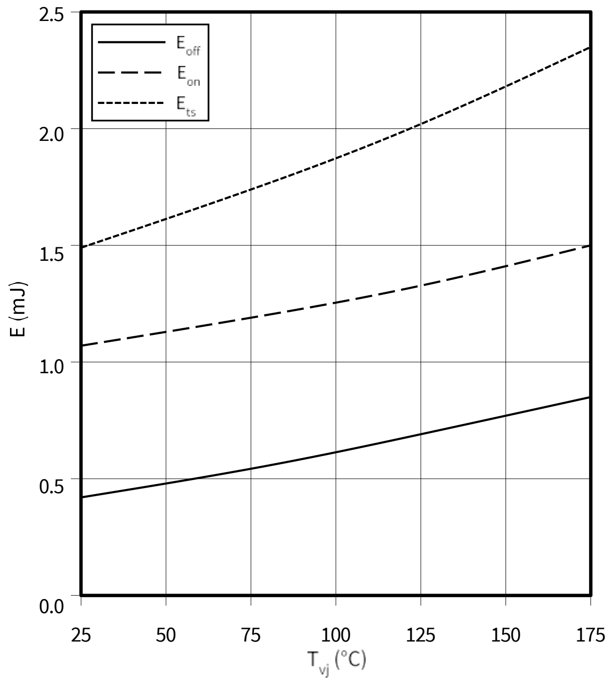
$I_C = 15.0$ A, $V_{CE} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



Typical switching energy losses as a function of junction temperature, IGBT

$E = f(T_{vj})$

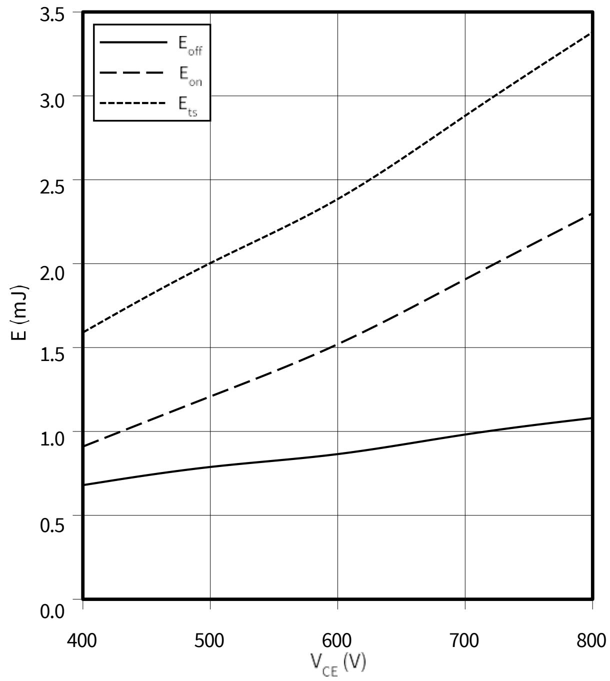
$I_C = 15.0$ A, $V_{CE} = 600$ V, $V_{GE} = 0/15$ V, $R_G = 35$ Ω



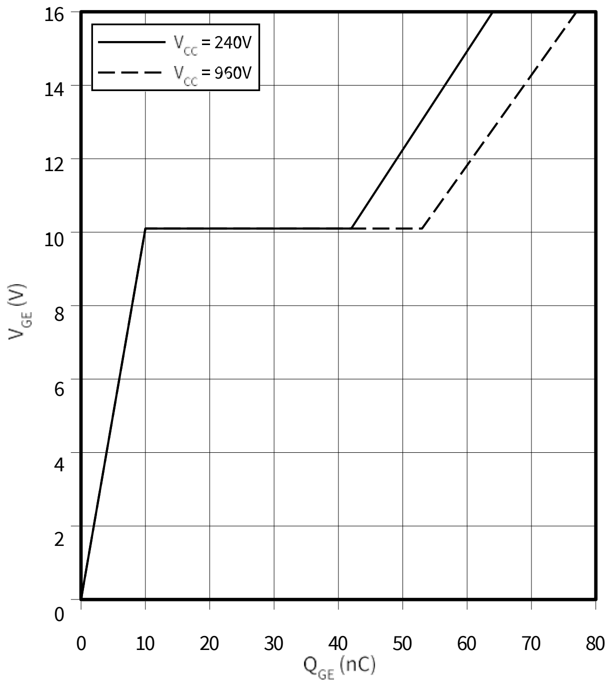
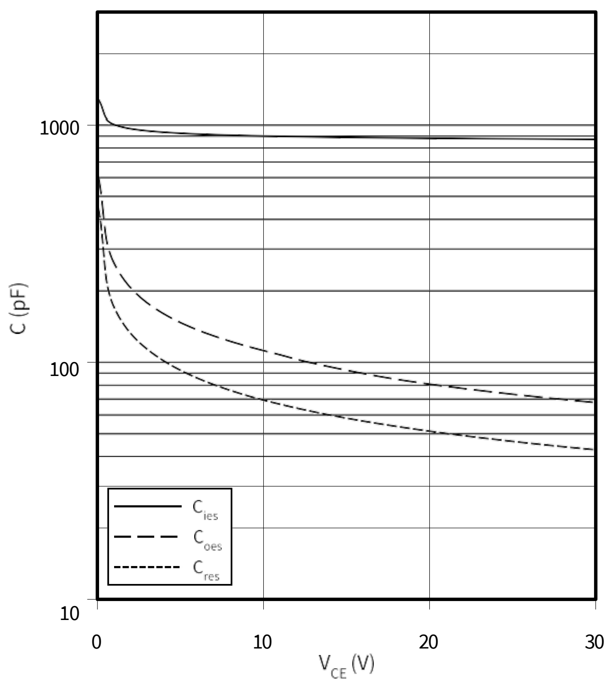
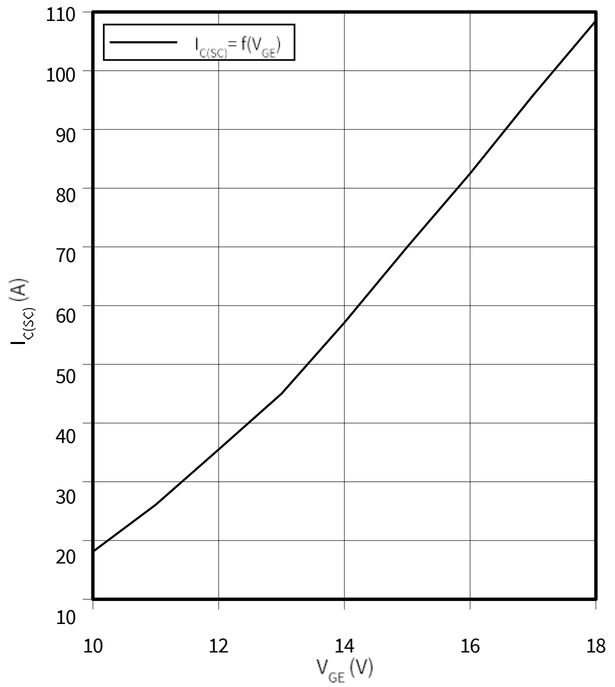
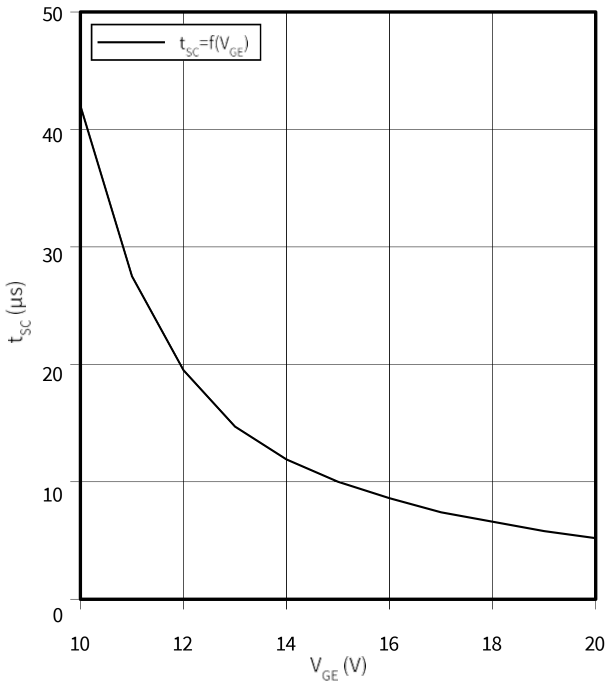
Typical switching energy losses as a function of collector emitter voltage, IGBT

$E = f(V_{CE})$

$I_C = 15.0$ A, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 35$ Ω



4 特性图

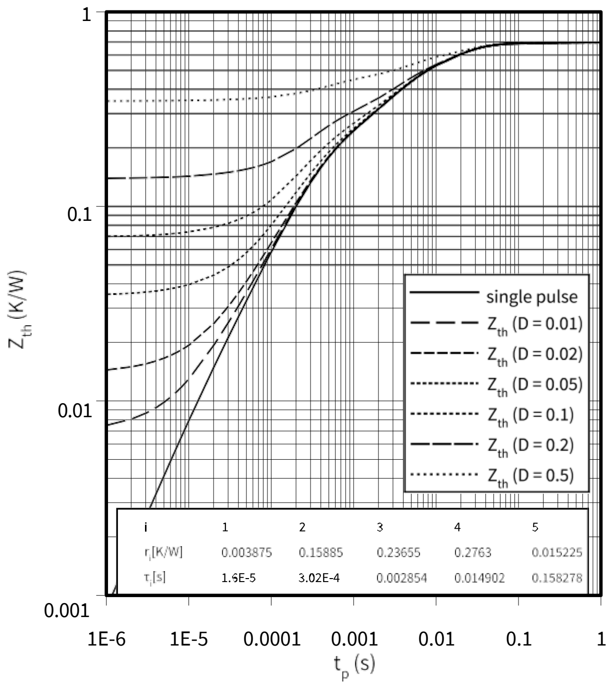
Typical gate charge, IGBT $V_{GE} = f(Q_{GE})$ $I_C = 15.0$ A	**Typical capacitance as a function of collector-emitter voltage, IGBT** $C = f(V_{CE})$ $f = 1000$ kHz, $V_{GE} = 0$ V
	
Typical short circuit collector current as a function of gate-emitter voltage, IGBT $I_{C(SC)} = f(V_{GE})$ $V_{CE} \leq 600$ V, $T_{vj,\,start} = 25$ °C	**Short circuit withstand time as a function of gate-emitter voltage, IGBT** $t_{SC} = f(V_{GE})$ $V_{CE} \leq 600$ V, $T_{vj} \leq 175$ °C
	

4 特性图

IGBT transient thermal impedance, IGBT

$Z_{th} = f(t_p)$

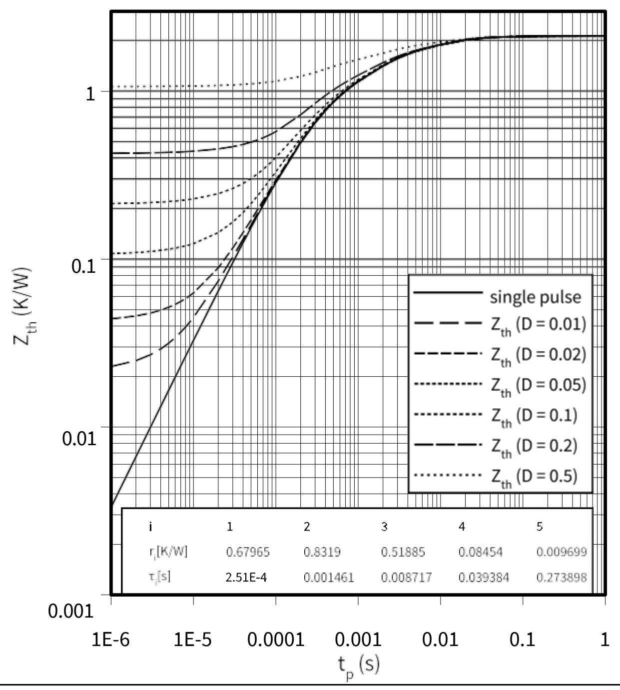
$D = t_p/T$



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

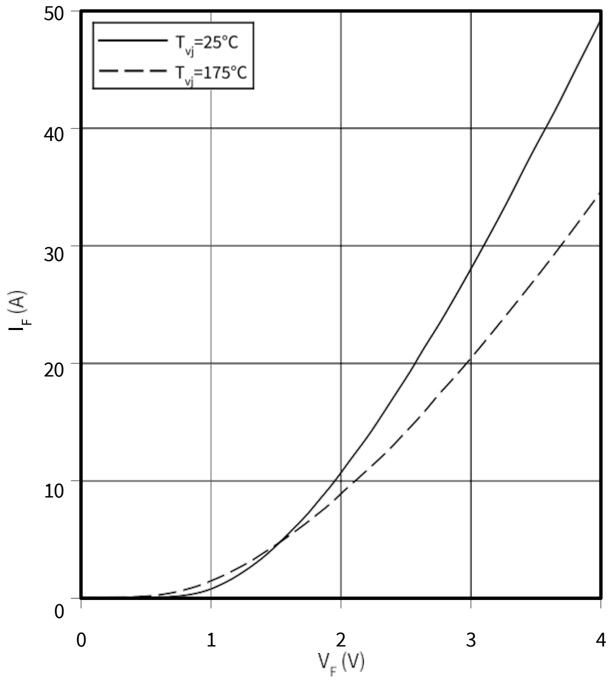
$Z_{th} = f(t_p)$

$D = t_p/T$



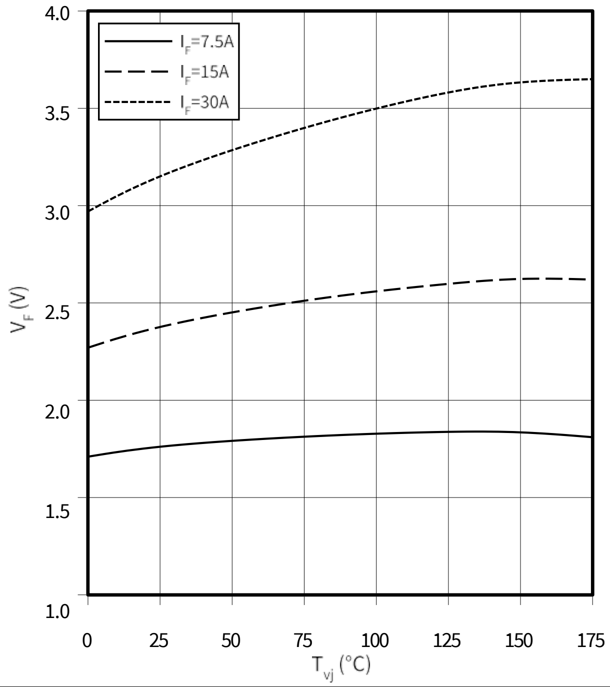
Typical diode forward current as a function of forward voltage, Diode

$I_F = f(V_F)$



Typical diode forward voltage as a function of junction temperature, Diode

$V_F = f(T_{vj})$

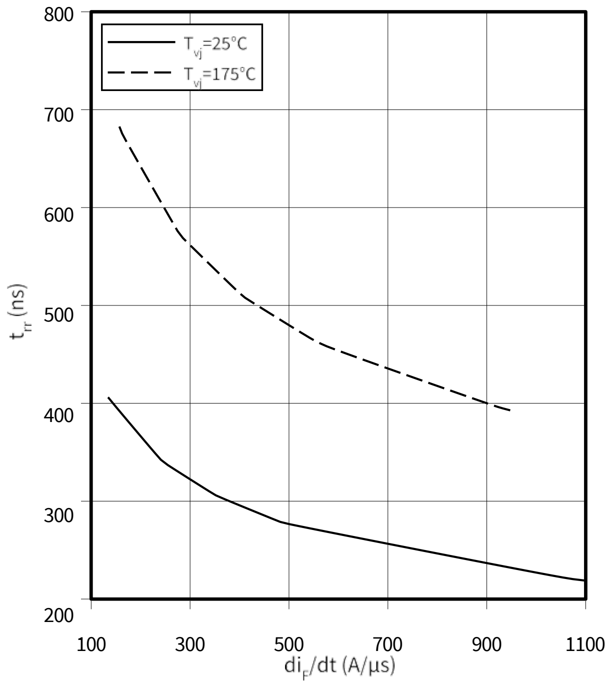


4 特性图

Typical reverse recovery time as a function of diode current slope, Diode

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

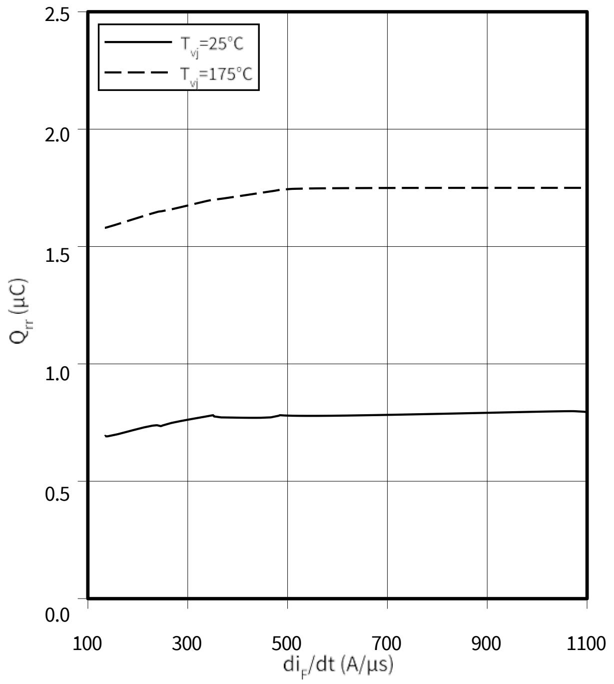
$V_R = 600$ V, $I_F = 15$ A



Typical reverse recovery charge as a function of diode current slope, Diode

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

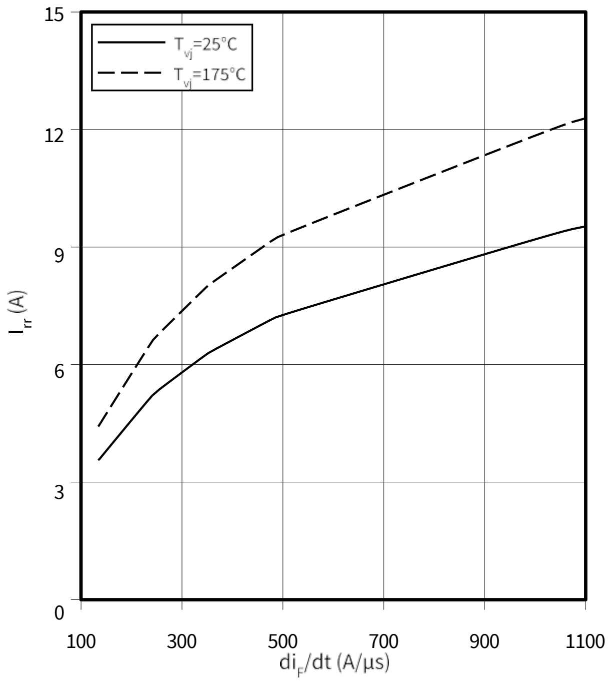
$V_R = 600$ V, $I_F = 15$ A



Typical reverse recovery current as a function of diode current slope, Diode

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

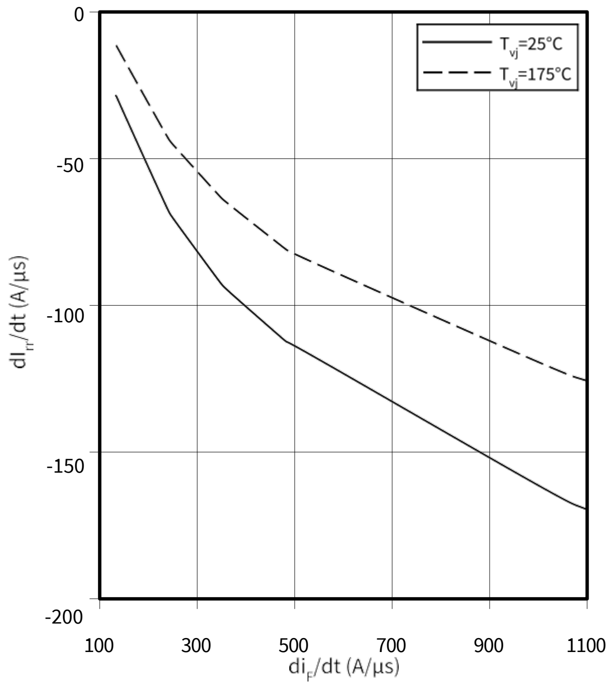
$V_R = 600$ V, $I_F = 15$ A



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

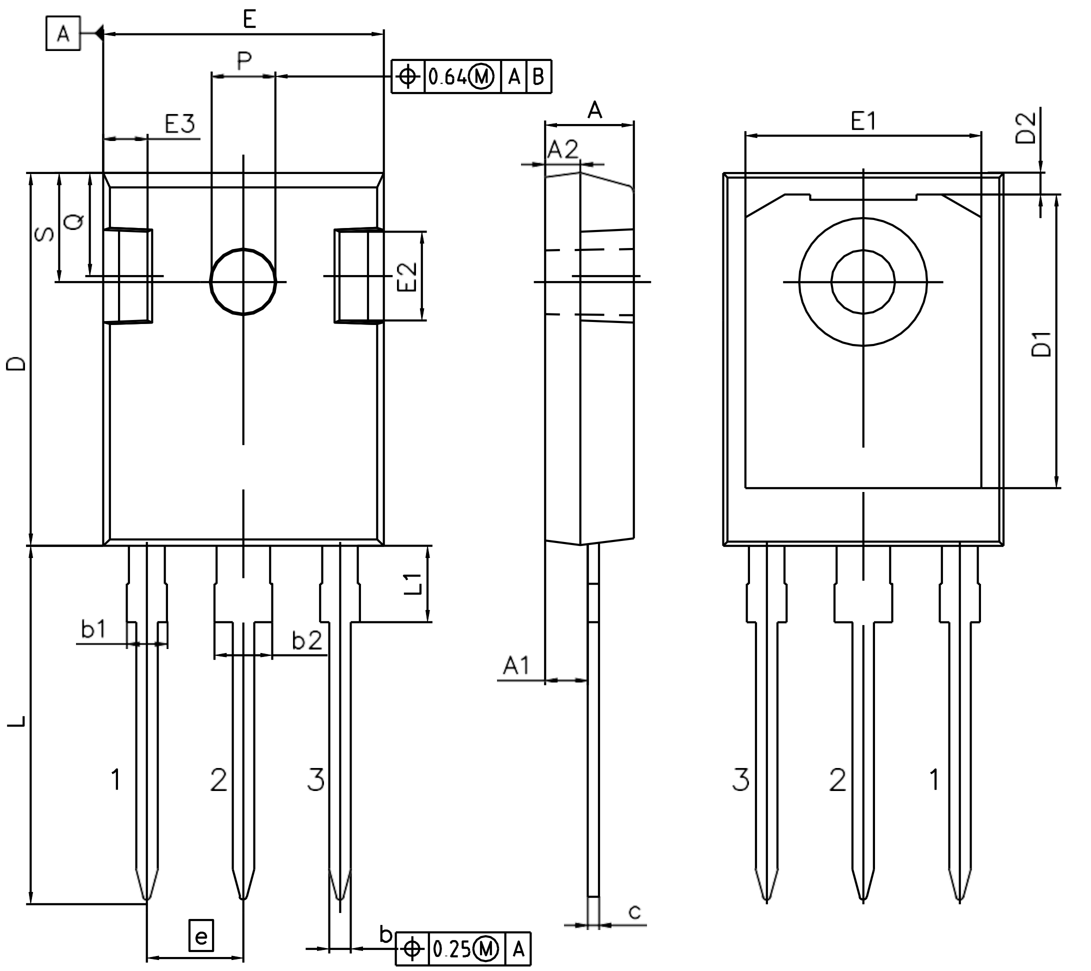
$dI_{rr}/dt = f(di_F/dt)$

$V_R = 600$ V, $I_F = 15$ A



5 封装外形

封装图 PG-TO247-3



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

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REVISION
06

SCALE 3:1
0 1 2 3 4 5mm

EUROPEAN PROJECTION

ISSUE DATE
25.07.2018

图 6.

6 测试条件

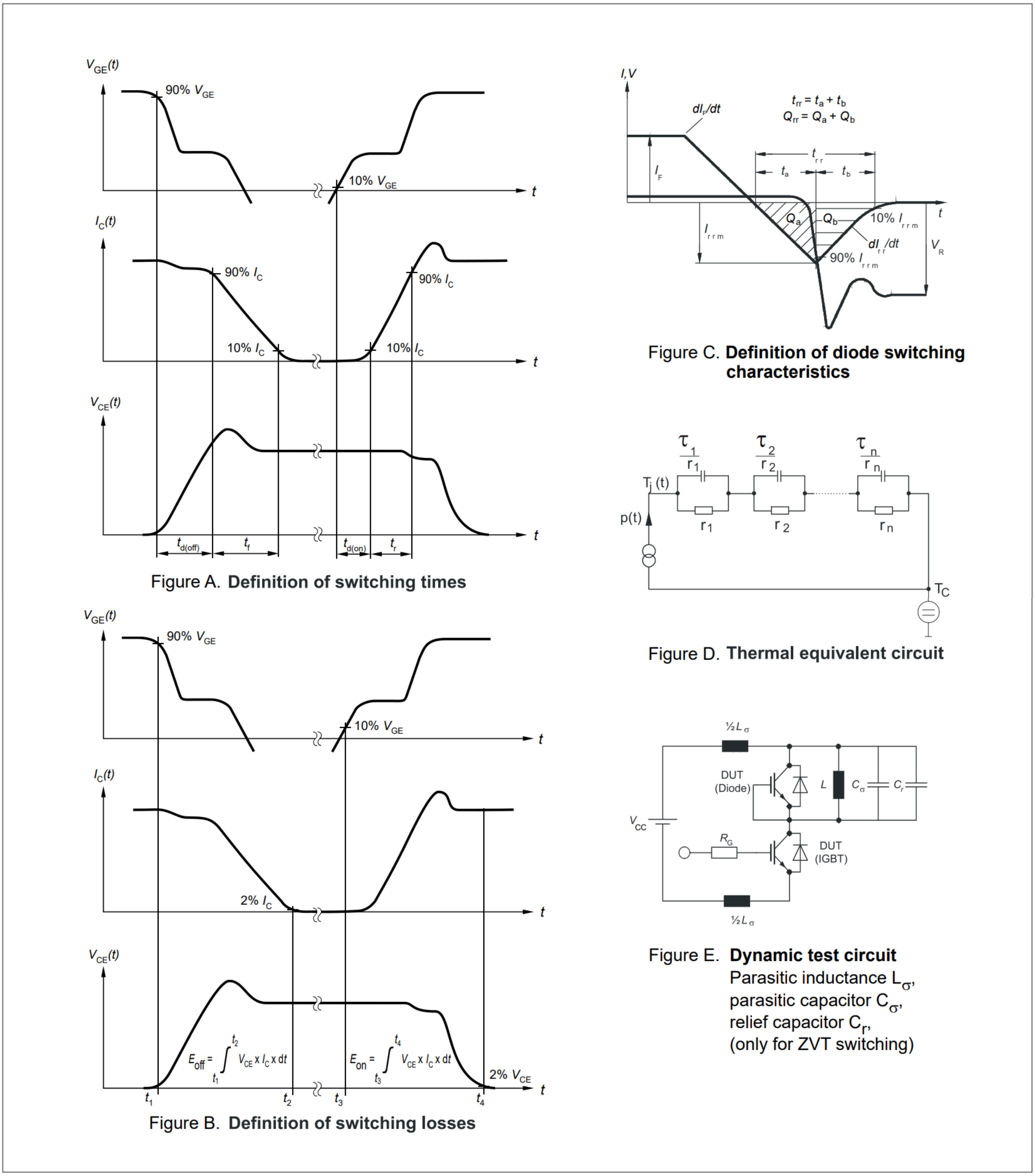
Figure A. Definition of switching times
90% VGE
10% VGE
90% IC
10% IC
td(off)
tf
td(on)
tr
Figure B. Definition of switching losses
2% IC
2% VCE
Eoff
Eon
Figure C. Definition of diode switching characteristics
trr = ta + tb
Qrr = Qa + Qb
10% Irrm
90% Irrm
Figure D. Thermal equivalent circuit
Tj (t)
p(t)
TC
Figure E. Dynamic test circuit
Parasitic inductance Lσ,
parasitic capacitor Cσ,
relief capacitor Cr,
(only for ZVT switching)
DUT (Diode)
DUT (IGBT)
VCC
RG

图 7

修订记录

Document revision	Date of release	Description of changes
V1.1	2009-11-27	
V1.2	2010-02-10	
V2.1	2014-12-01	Final data sheet
V2.2		Minor change figure 28
1.10	2021-09-08	Update of legend at the diagram $V_F = f(T_{vj})$

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