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 = 40 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

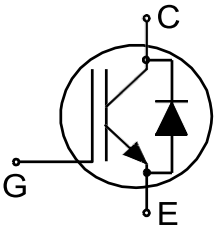
Lead-Free

Green

Halogen-Free

RoHS

描述



Type	Package	Marking
IKW40N120H3	PG-TO247-3	K40H1203

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	80	A
			T_c = 100 °C	40	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}			160	A
Turn-off safe operating area		$V_{CE} \le$ 1200 V, $T_{vj} \le$ 175 °C		160	A
Gate-emitter voltage	V_{GE}			±20	V
Short circuit withstand time	t_{SC}	$V_{CC} \le$ 600 V, V_{GE} = 15 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	483	W
			T_c = 100 °C	220	

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 = 40.0 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 = 1.00 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 = 40.0 A, V_{CE} = 20 V			20.0		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			139		A
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1000 kHz			2330		pF
Output capacitance	C_{oes}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1000 kHz			185		pF
Reverse transfer capacitance	C_{res}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1000 kHz			130		pF
Gate charge	Q_G	I_C = 40.0 A, V_{GE} = 15 V, V_{CE} = 960 V			185		nC
Turn-on delay time	t_{don}	V_{CE} = 600 V, V_{GE} = 15 V, R_{Gon} = 12.0 Ω, R_{Goff} = 12.0 Ω, L_σ = 70 nH, C_σ = 67 pF	T_{vj} = 25 °C, I_C = 40.0 A		30		ns
			T_{vj} = 175 °C, I_C = 40.0 A		29		
Rise time (inductive load)	t_r	V_{CE} = 600 V, V_{GE} = 15 V, R_{Gon} = 12.0 Ω, R_{Goff} = 12.0 Ω, L_σ = 70 nH, C_σ = 67 pF	T_{vj} = 25 °C, I_C = 40.0 A		57		ns
			T_{vj} = 175 °C, I_C = 40.0 A		49		
Turn-off delay time	t_{doff}	V_{CE} = 600 V, V_{GE} = 15 V, R_{Gon} = 12.0 Ω, R_{Goff} = 12.0 Ω, L_σ = 70 nH, C_σ = 67 pF	T_{vj} = 25 °C, I_C = 40.0 A		290		ns
			T_{vj} = 175 °C, I_C = 40.0 A		366		
Fall time (inductive load)	t_f	V_{CE} = 600 V, V_{GE} = 15 V, R_{Gon} = 12.0 Ω, R_{Goff} = 12.0 Ω, L_σ = 70 nH, C_σ = 67 pF	T_{vj} = 25 °C, I_C = 40.0 A		16		ns
			T_{vj} = 175 °C, I_C = 40.0 A		48		
Turn-on energy	E_{on}	V_{CE} = 600 V, V_{GE} = 15 V, R_{Gon} = 12.0 Ω, R_{Goff} = 12.0 Ω, L_σ = 70 nH, C_σ = 67 pF	T_{vj} = 25 °C, I_C = 40.0 A		3.20		mJ
			T_{vj} = 175 °C, I_C = 40.0 A		4.40		

表 3　　特征值（续）

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-off energy	E_{off}	V_{CE} = 600 V, V_{GE} = 15 V, R_{Gon} = 12.0 Ω, R_{Goff} = 12.0 Ω, L_σ = 70 nH, C_σ = 67 pF	T_{vj} = 25 °C, I_C = 40.0 A		1.20		mJ
			T_{vj} = 175 °C, I_C = 40.0 A		2.60		
Total switching energy	E_{ts}	V_{CE} = 600 V, V_{GE} = 15 V, R_{Gon} = 12.0 Ω, R_{Goff} = 12.0 Ω, L_σ = 70 nH, C_σ = 67 pF	T_{vj} = 25 °C, I_C = 40.0 A		4.40		mJ
			T_{vj} = 175 °C, I_C = 40.0 A		7.00		
IGBT thermal resistance, junction-case	R_{thjc}					0.31	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}	T_{vj} ≥ 25 °C		1200	V
Diode forward current, limited by T_{vjmax}	I_F		T_c = 25 °C	40	A
			T_c = 100 °C	20	
Diode pulsed current, limited by T_{vjmax}	I_{Fpuls}			160	A

表 5　　特征值

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	I_F = 20.0 A	T_{vj} = 25 °C		1.80	2.35	V
			T_{vj} = 175 °C		1.85		
Diode forward voltage	V_F	I_F = 40.0 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	

表 5　　特征值（续）

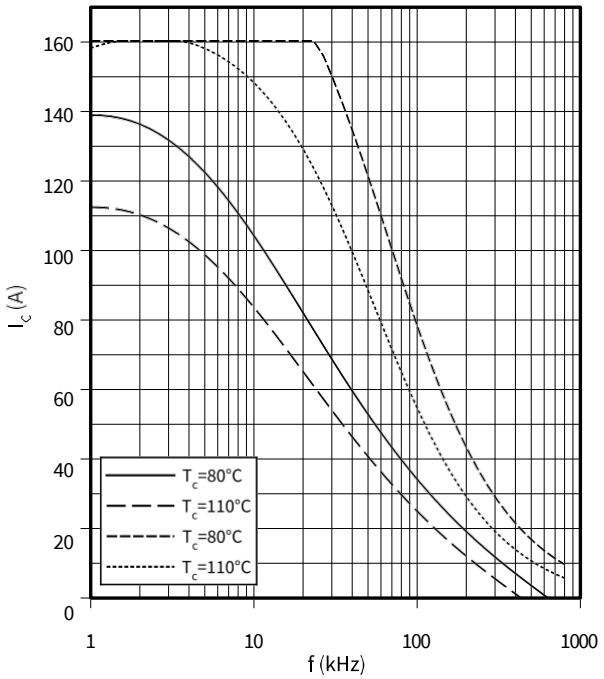
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode reverse recovery time	t_{rr}	V_R = 600 V	T_{vj} = 25 °C, I_F = 40.0 A, $-di_F/dt$ = 500 A/µs		355		ns
			T_{vj} = 175 °C, I_F = 40.0 A, $-di_F/dt$ = 500 A/µs		639		
Diode reverse recovery charge	Q_{rr}	V_R = 600 V	T_{vj} = 25 °C, I_F = 40.0 A, $-di_F/dt$ = 500 A/µs		1.90		µC
			T_{vj} = 175 °C, I_F = 40.0 A, $-di_F/dt$ = 500 A/µs		4.30		
Diode peak reverse recovery current	I_{rrm}	V_R = 600 V	T_{vj} = 25 °C, I_F = 40.0 A, $-di_F/dt$ = 500 A/µs		12.8		A
			T_{vj} = 175 °C, I_F = 40.0 A, $-di_F/dt$ = 500 A/µs		16.0		
Diode peak rate off fall of reverse recovery current	dI_{rr}/dt	V_R = 600 V	T_{vj} = 25 °C, I_F = 40.0 A, $-di_F/dt$ = 500 A/µs		-105		A/µs
			T_{vj} = 175 °C, I_F = 40.0 A, $-di_F/dt$ = 500 A/µs		-84		
Diode thermal resistance, junction-case	R_{thjc}					1.11	K/W
Operating junction temperature	T_{vj}			-40		175	°C

4 特性图

Collector current as a function of switching frequency, IGBT

$I_C = f(f)$

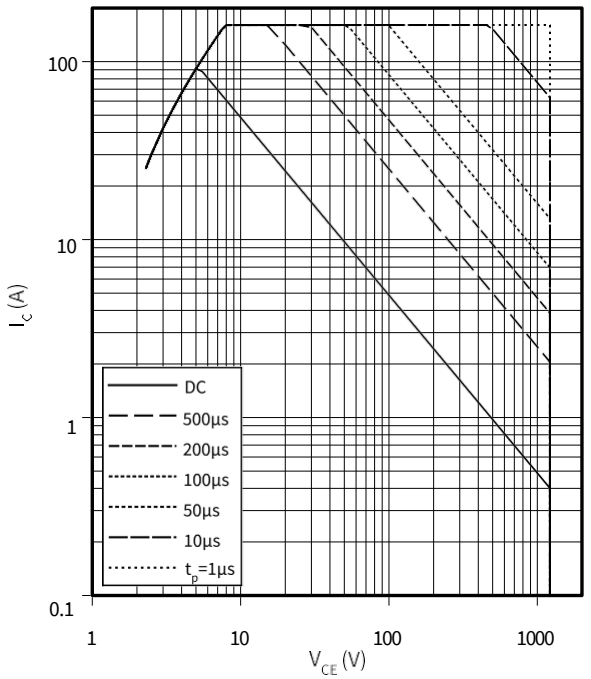
D = 0.5 , V_{CE} = 600 V, $T_{vj} \leq$ 175 °C, V_{GE} = 0/15 V, R_G = 12 Ω



Forward bias safe operating area, IGBT

$I_C = f(V_{CE})$

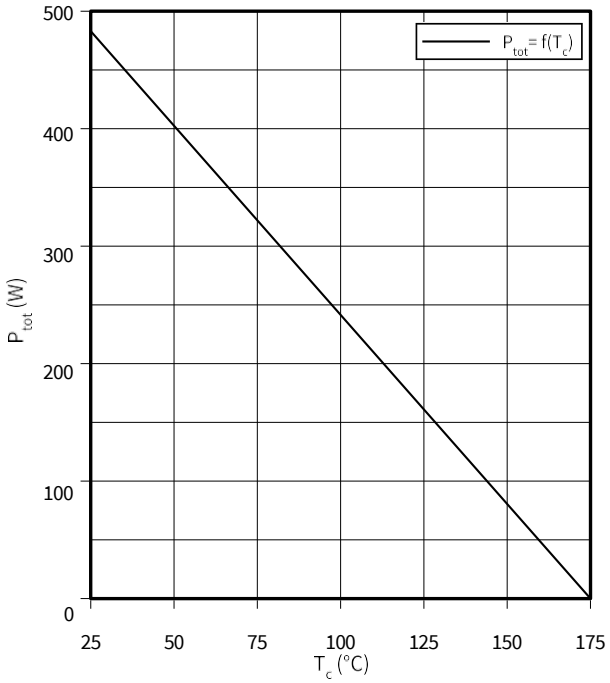
D = 0 , $T_{vj} \leq$ 175 °C, V_{GE} = 15 V, T_c = 25 °C



Power dissipation as a function of case temperature, IGBT

$P_{tot} = f(T_c)$

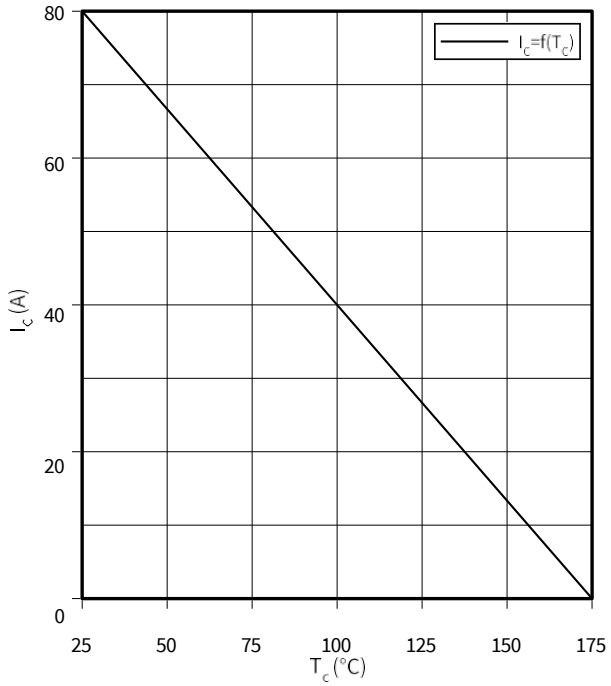
$T_{vj} \leq$ 175 °C



Collector current as a function of case temperature, IGBT

$I_C = f(T_c)$

$T_{vj} \leq$ 175 °C, $V_{GE} \geq$ 15 V

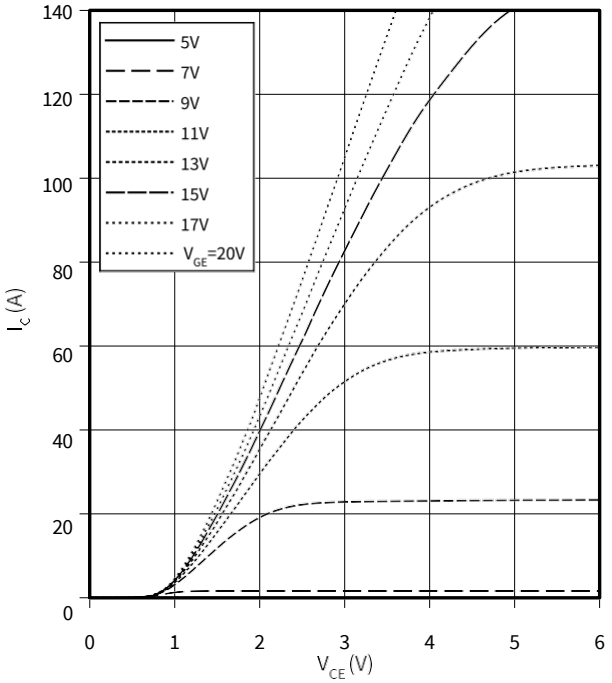


4 特征图

Typical output characteristic, IGBT

$I_C = f(V_{CE})$

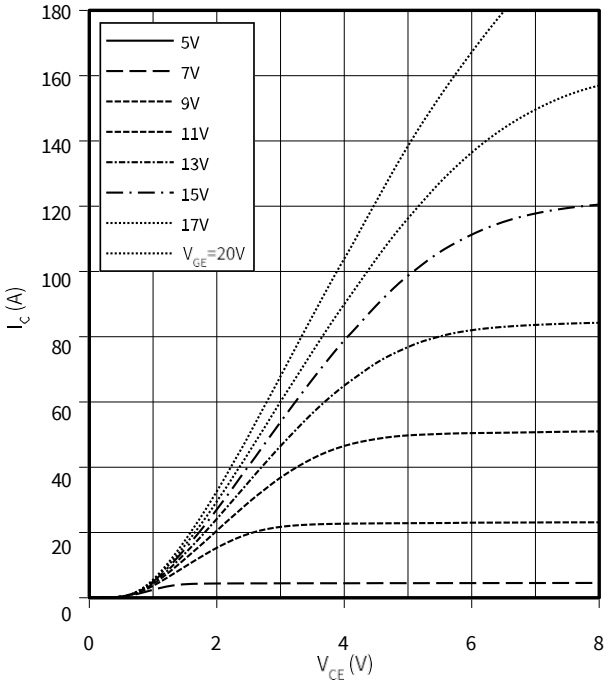
$T_{vj} = 25\ °C$



Typical output characteristic, IGBT

$I_C = f(V_{CE})$

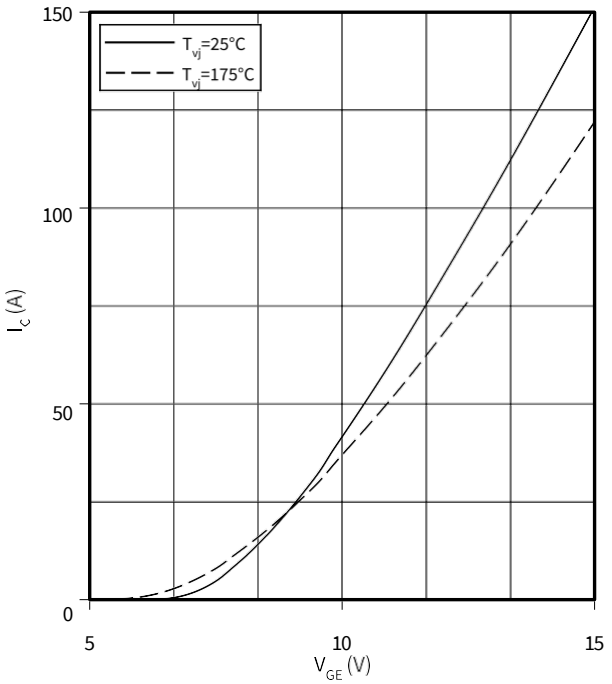
$T_{vj} = 175\ °C$



Typical transfer characteristic, IGBT

$I_C = f(V_{GE})$

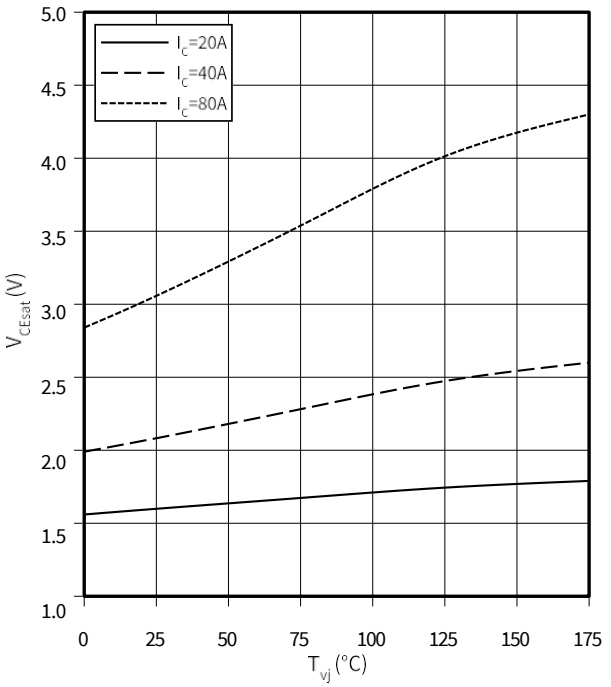
$V_{CE} = 20\ V$



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

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

$V_{GE} = 15\ V$

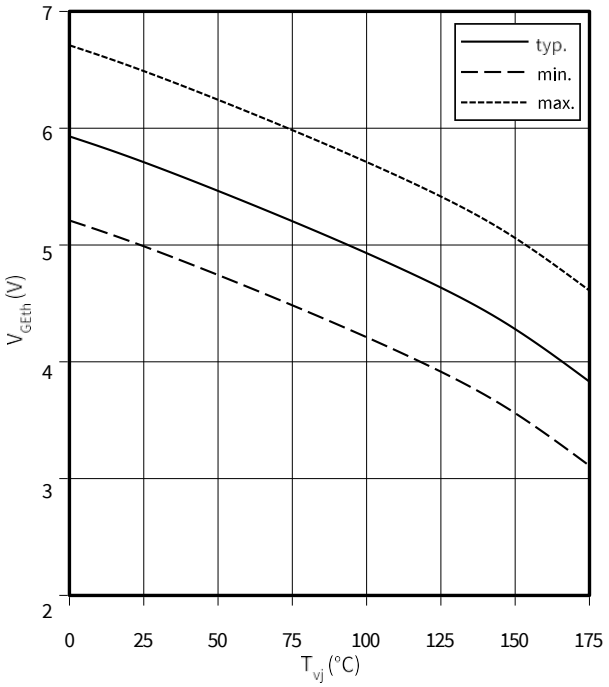


4 特征图

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

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

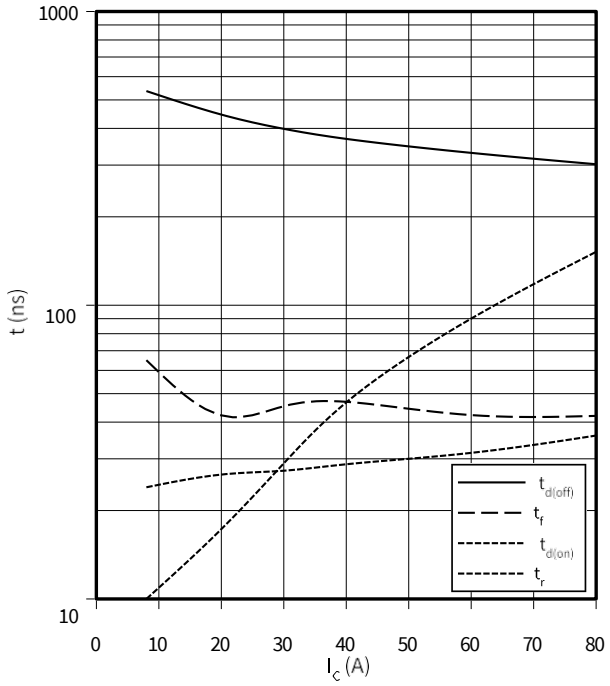
$I_C = 1.00$ mA



Typical switching times as a function of collector current, IGBT

$t = f(I_C)$

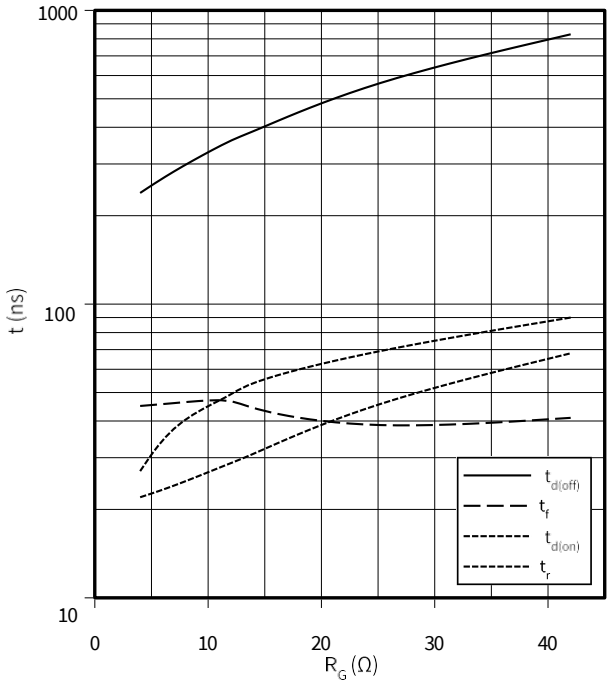
$V_{CE} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 12\ \Omega$



Typical switching times as a function of gate resistance, IGBT

$t = f(R_G)$

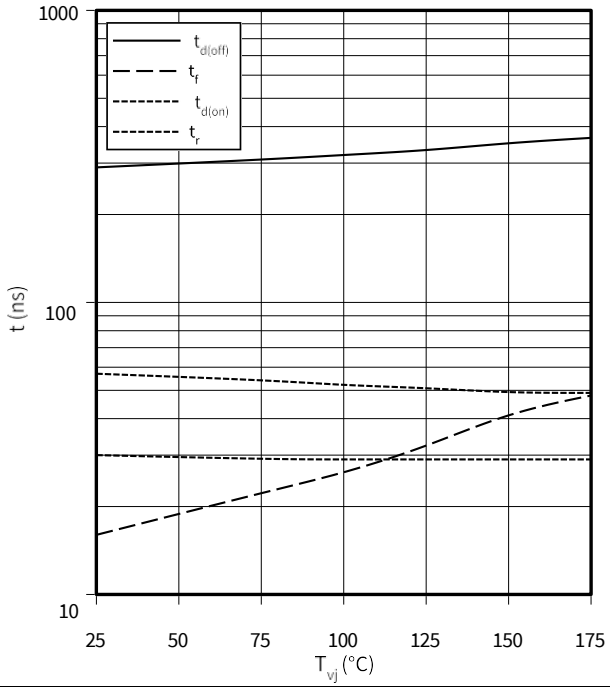
$I_C = 40.0$ A, $V_{CE} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



Typical switching times as a function of junction temperature, IGBT

$t = f(T_{vj})$

$I_C = 40.0$ A, $V_{CE} = 600$ V, $V_{GE} = 0/15$ V, $R_G = 12\ \Omega$

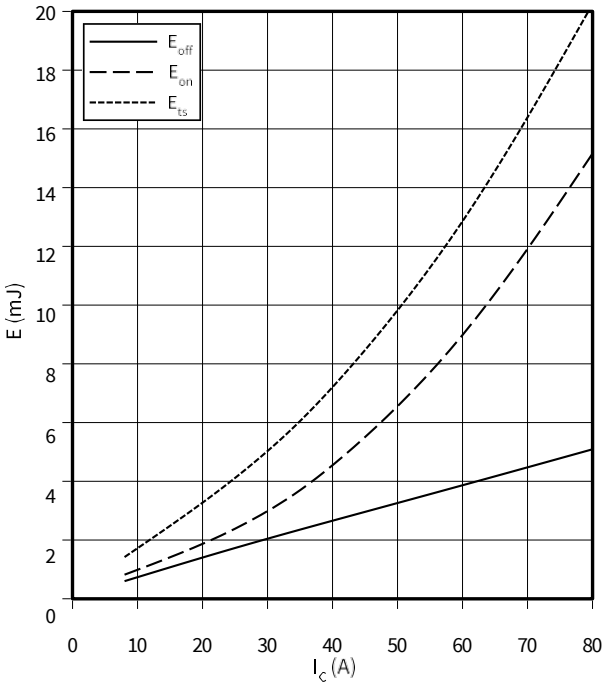


4 特征图

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

$E = f(I_C)$

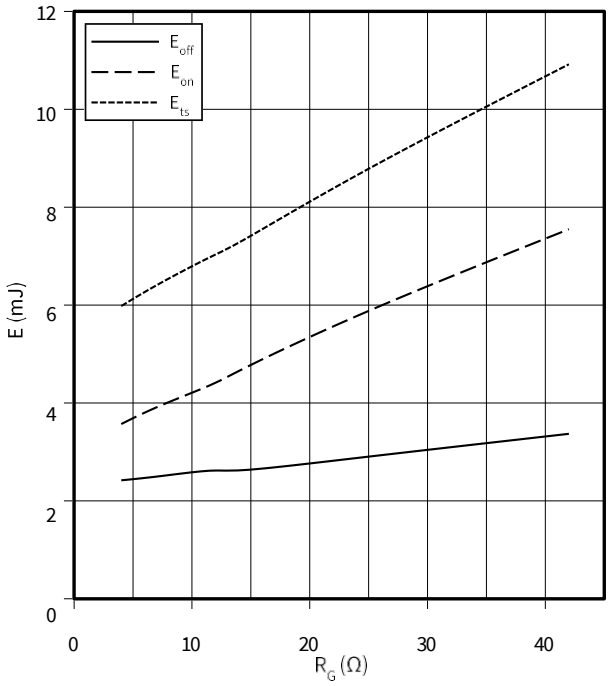
$V_{CE} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 12$ Ω



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

$E = f(R_G)$

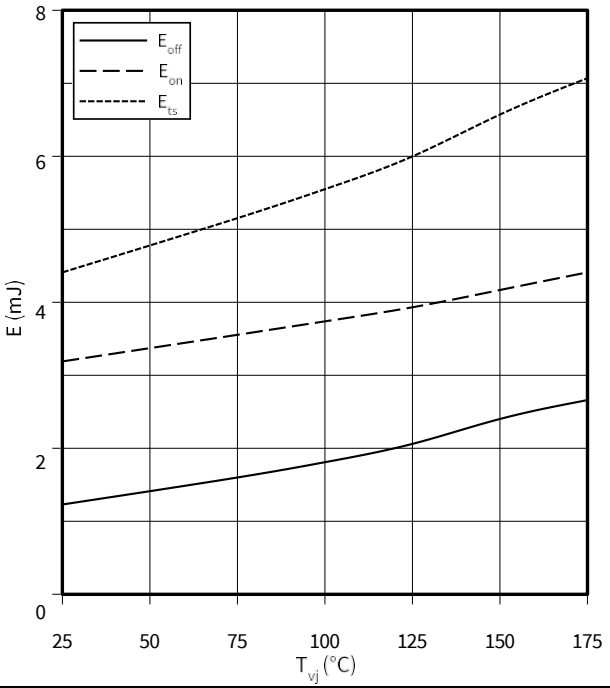
$I_C = 40.0$ A, $V_{CE} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



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

$E = f(T_{vj})$

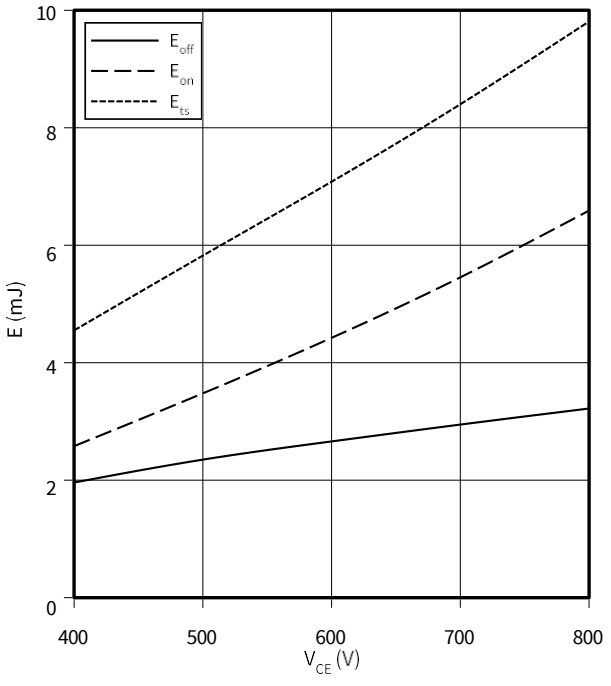
$I_C = 40.0$ A, $V_{CE} = 600$ V, $V_{GE} = 0/15$ V, $R_G = 12$ Ω



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

$E = f(V_{CE})$

$I_C = 40.0$ A, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 12$ Ω

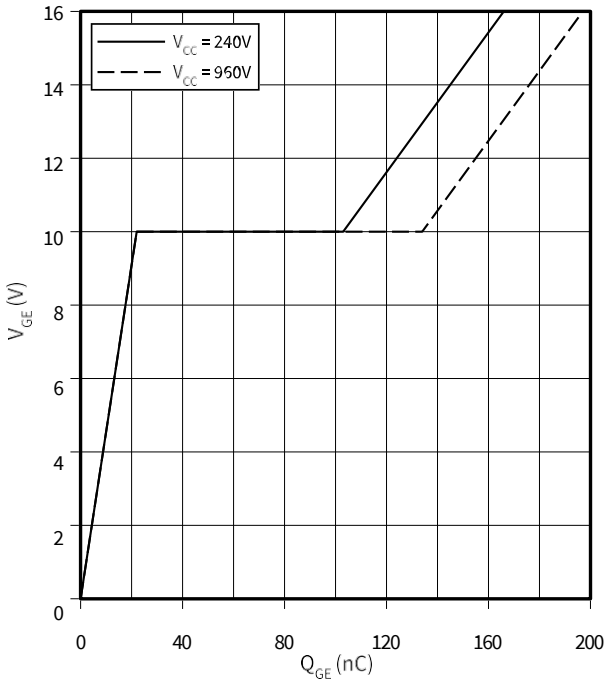


4 特征图

Typical gate charge, IGBT

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

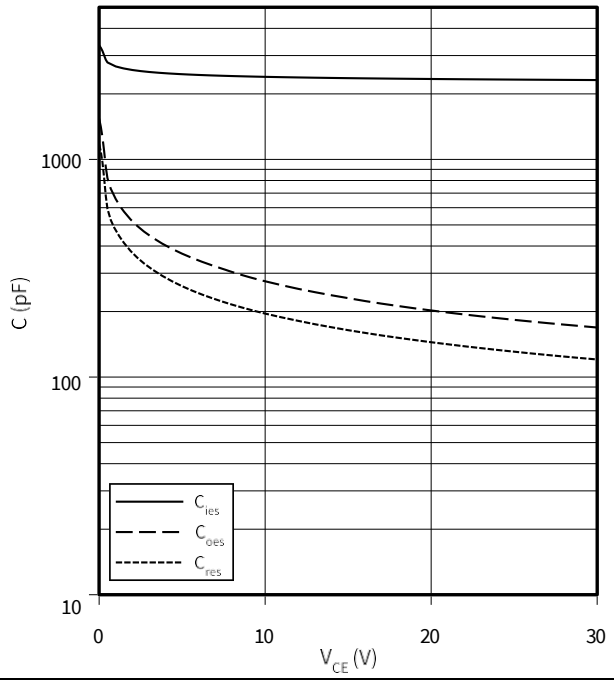
$I_C = 40.0$ A



Typical capacitance as a function of collector-emitter voltage, IGBT

$C = f(V_{CE})$

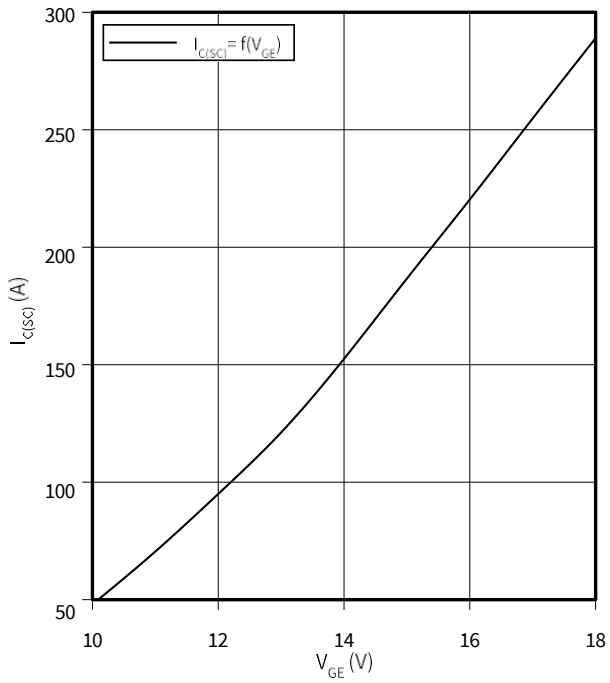
$f = 1000$ kHz, $V_{GE} = 0$ V



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

$I_{C(SC)} = f(V_{GE})$

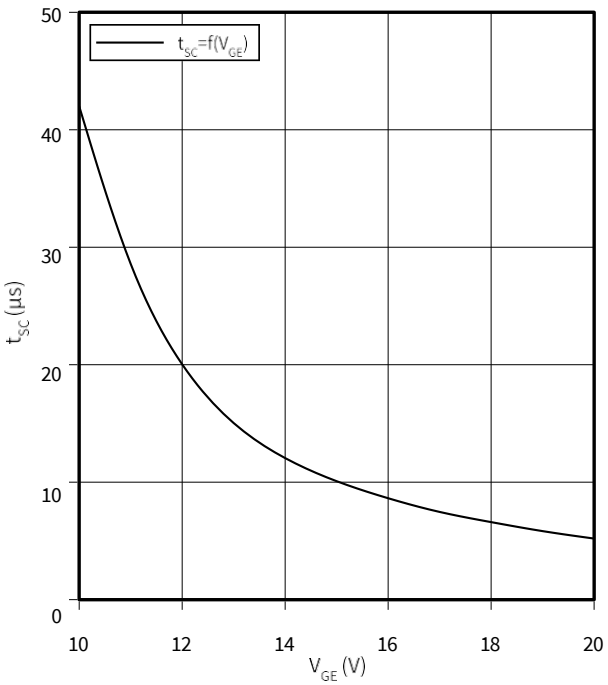
$V_{CE} \leq 600$ V, $T_{vj,\,start} = 25$ °C



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

$t_{SC} = f(V_{GE})$

$T_{vj} \leq 175$ °C, $V_{CC} \leq 600$ V

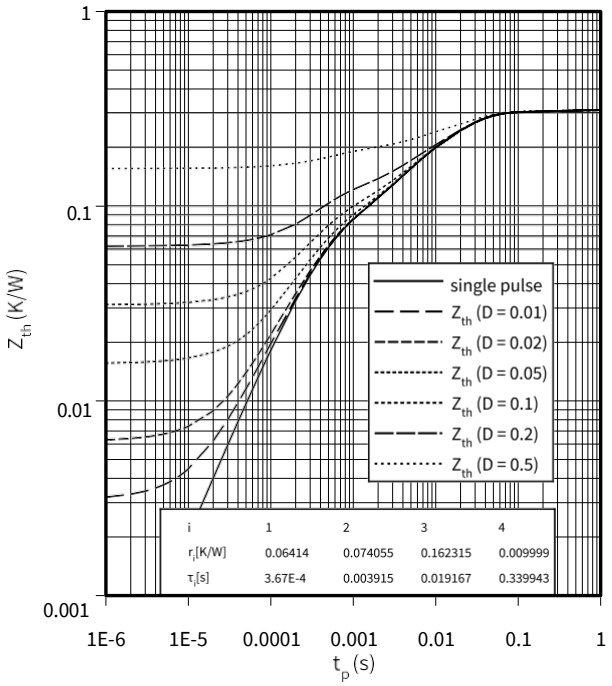


4 特征图

IGBT transient thermal impedance, IGBT

$Z_{th} = f(t_p)$

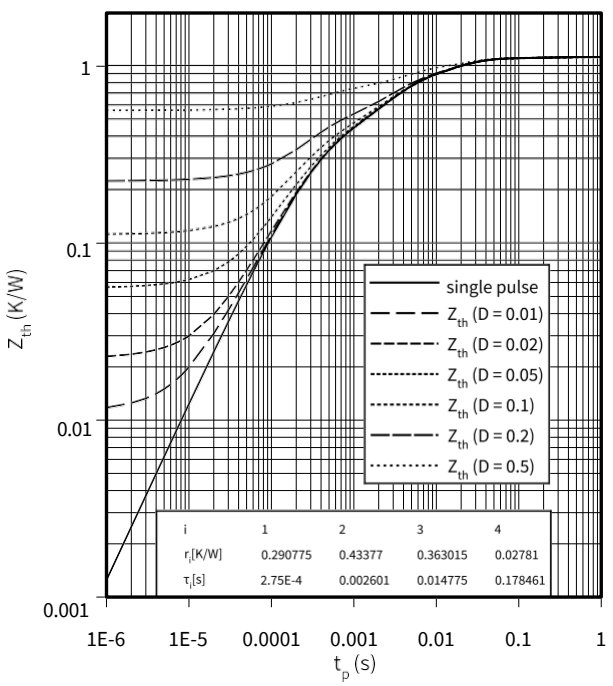
$D = t_p/T$



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

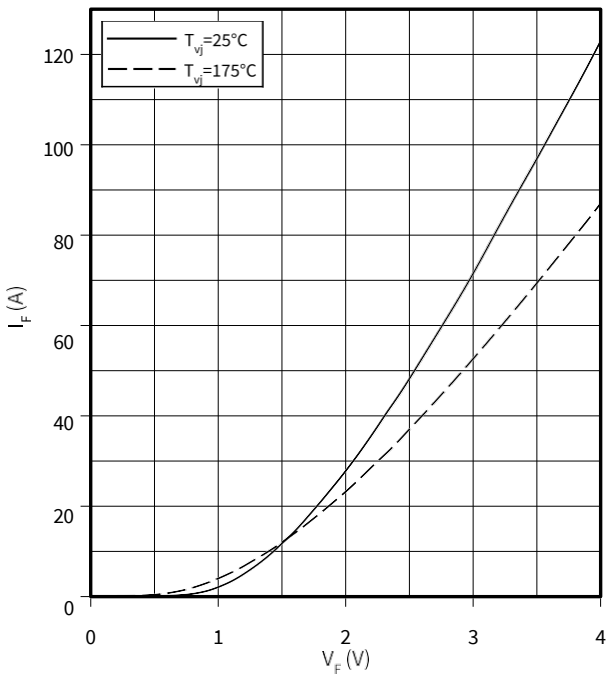
$Z_{th} = f(t_p)$

$D = t_p/T$



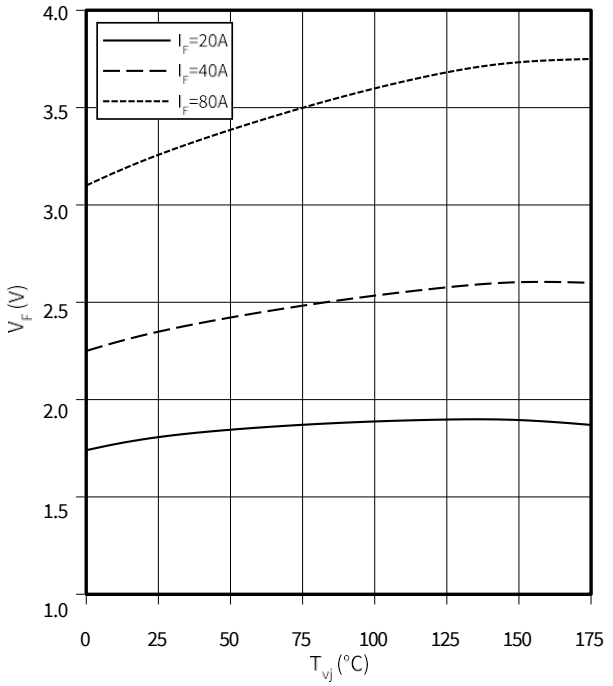
Typical diode forward current as a function of forward voltage, Diode

$I_F = f(V_F)$



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

$V_F = f(T_{vj})$

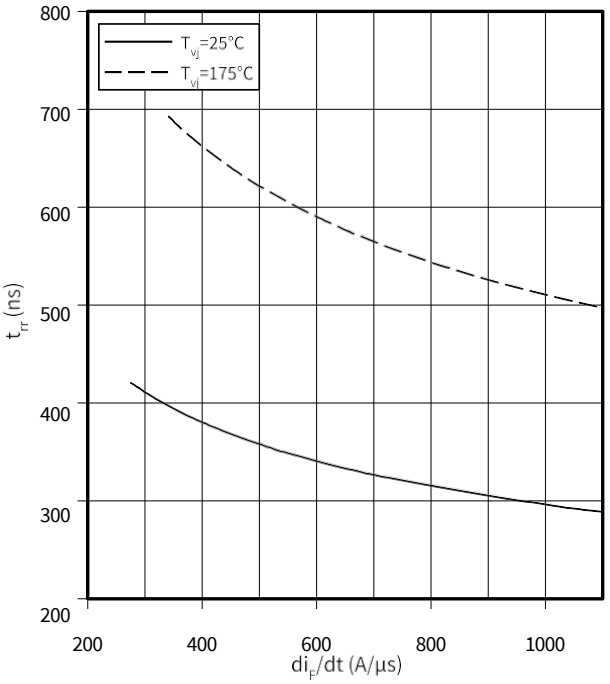


4 特征图

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

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

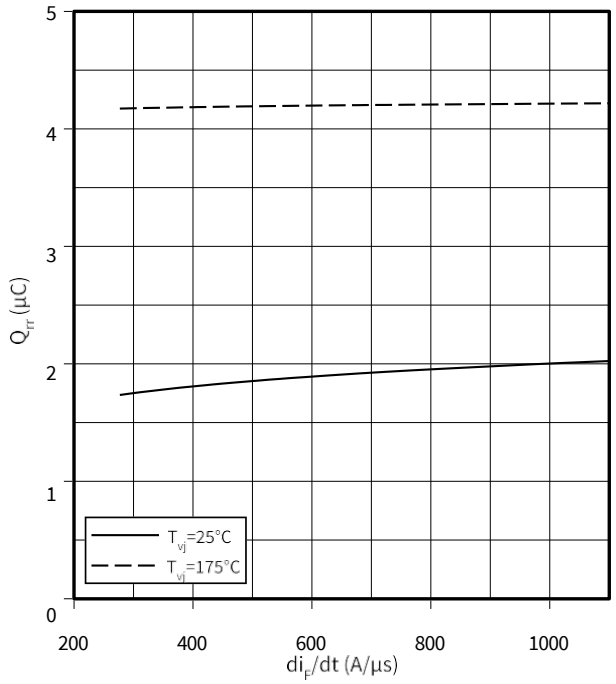
$V_R = 600$ V, $I_F = 40$ A



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

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

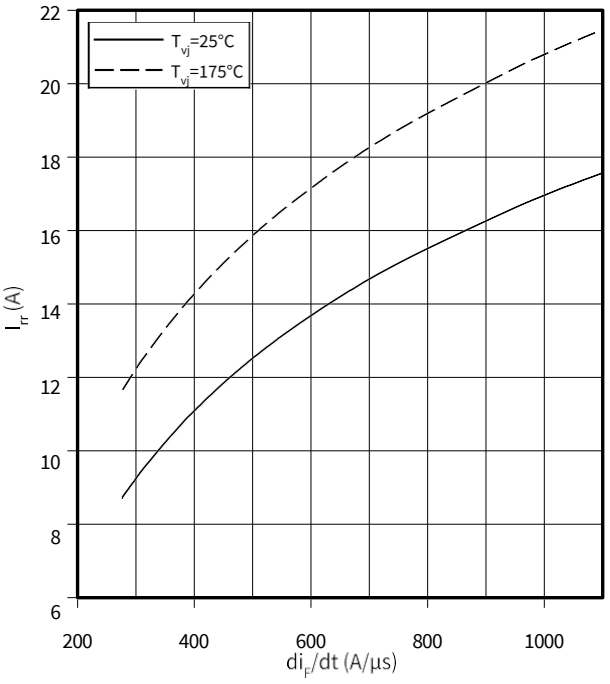
$V_R = 600$ V, $I_F = 40$ A



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

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

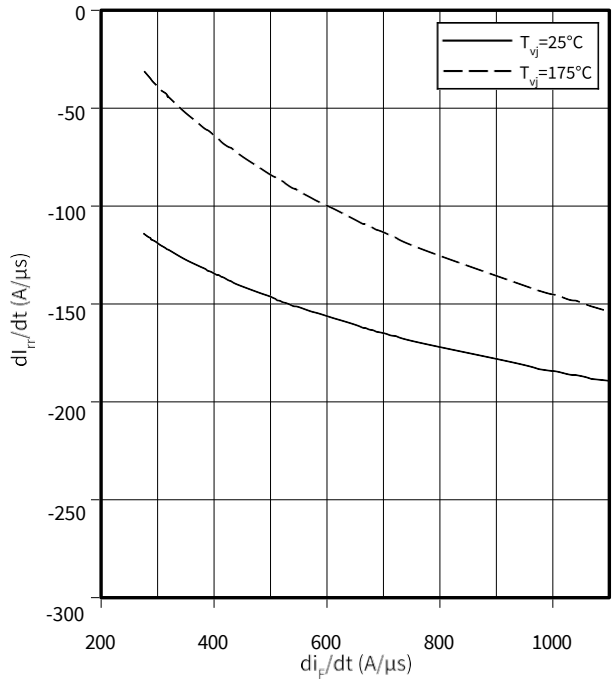
$V_R = 600$ V, $I_F = 40$ A



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

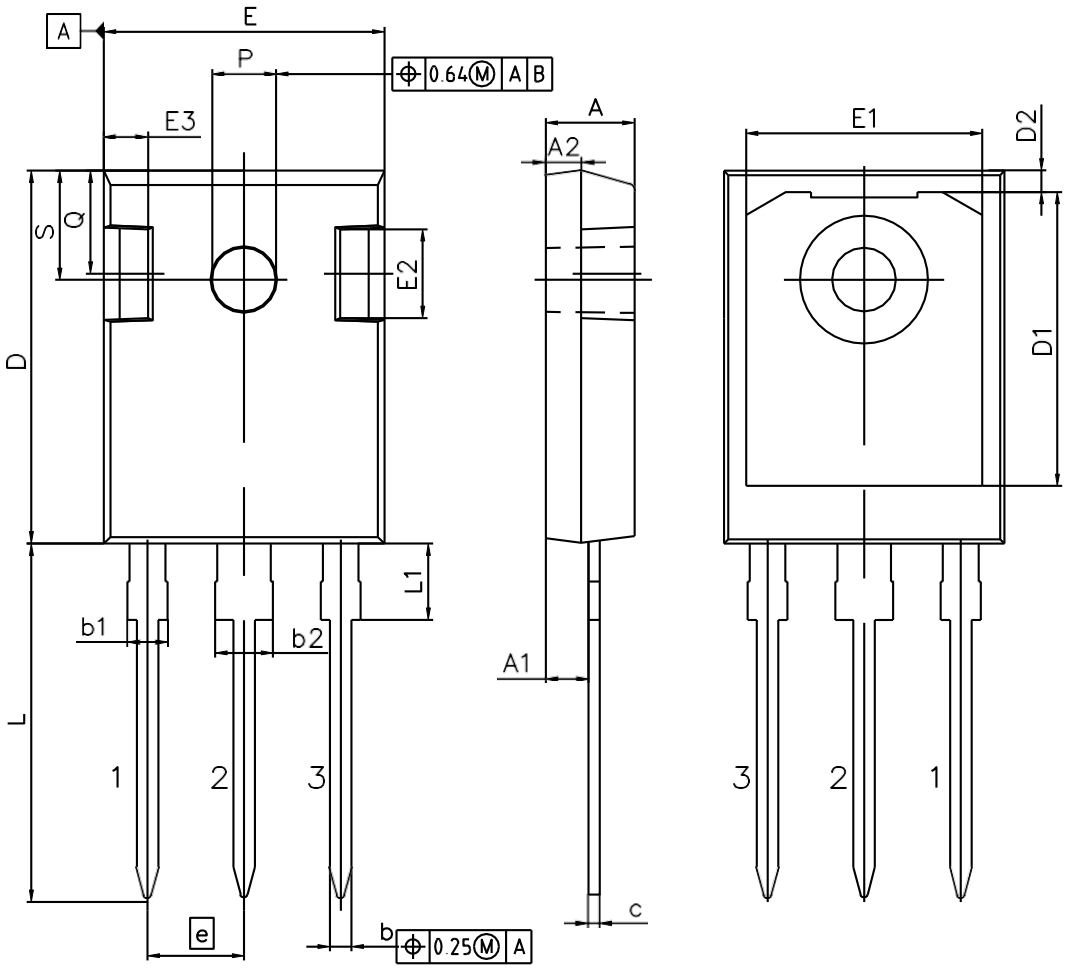
$dI_{rr}/dt = f(di_F/dt)$

$V_R = 600$ V, $I_F = 40$ 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

DOCUMENT NO.
Z8B00003327

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

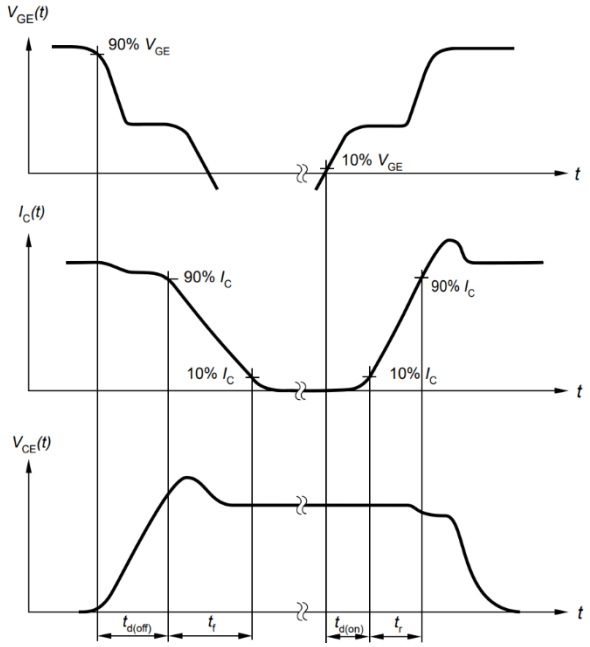


Figure A. **Definition of switching times**

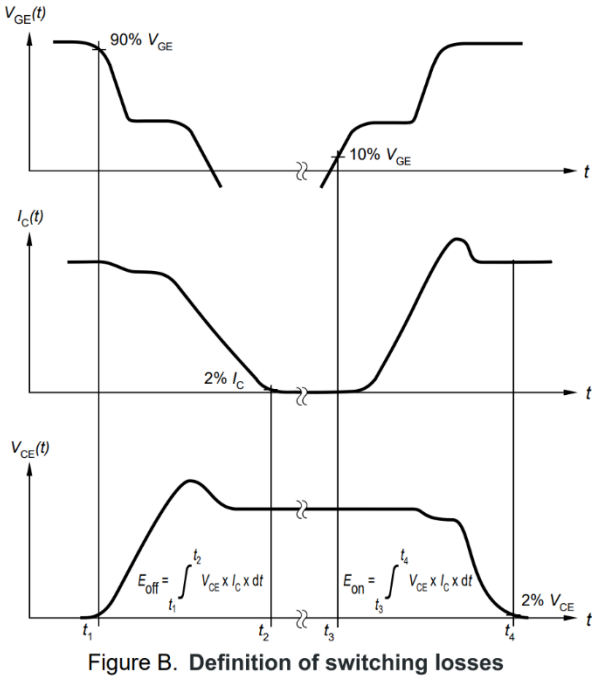


Figure B. **Definition of switching losses**

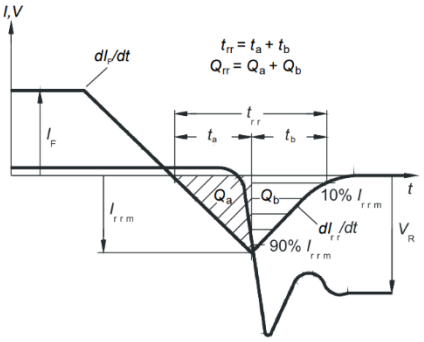


Figure C. **Definition of diode switching characteristics**

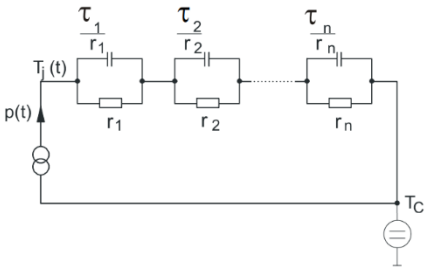


Figure D. **Thermal equivalent circuit**

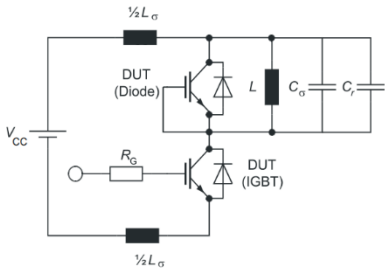


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

图 7

修订记录

Document revision	Date of release	Description of changes
V1.1	2009-12-03	
V1.2	2010-02-10	
V2.1	2014-11-26	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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